APPENDIX

B

Biodiversity Technical Report

PART 5 OF 6

Appendix I

NORTH STAR TO NSW/QUEENSLAND BORDER ENVIRONMENTAL IMPACT STATEMENT

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

APPENDIX

B

Biodiversity Technical Report

Appendix I Predictive Habitat Modelling Methodology

NORTH STAR TO NSW/QUEENSLAND BORDER ENVIRONMENTAL IMPACT STATEMENT

Inland Rail North Star to Border EIS

Appendix I – Predictive habitat modelling methodology

Australian Rail Track Corporation

Reference: 2700

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1 Introduction

1.1 Background

The purpose of this document is to present the methodologies associated with the preparation of the predictive habitat models for flora and fauna associated with the Inland Rail Project (North Star to Border) (the Project). These models have been designed to map the potential areas that are likely to be analogous to habitat associated with *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth (Cth)) (EPBC Act) and/or the *Biodiversity Conservation Act 2016* (New South Wales (NSW) (BC Act) conservation significant species. This mapping has the following objective:

- To provide predictive habitat modelling for EPBC Act and BC Act listed flora and/or fauna species to:
  - Identify areas of potential habitat for EPBC Act and BC Act listed species
  - Facilitate the calculation of potential disturbance areas associated the Project and to subsequently inform the adverse impact assessment methodology (AIAMs) model to determine significant residual adverse impacts for matters of national environmental significance (MNES).

This document outlines the methodology used for the development of the predictive habitat models and provides the species/community specific assumptions and mapping requirements required to reproduce the predictive habitat models for each individual species or community. The models have been used to prepare maps indicating the potential extent of each conservation significant species associated with the Project as identified in the Project Environmental Impact Statement (EIS) Terms of Reference (ToR), in addition to those species identified from the desktop review phase of the Project EIS.

1.2 Context

For context with respect to the methodology's compliance with EPBC Act Survey Guidelines for threatened species, the more conservative approach of this methodology surpasses the guidelines expectations. The *'How to use these guidelines'* statement includes:

'…*alternatives to a dedicated survey may also be appropriate. For example, a desktop analysis of historic data may indicate that a significant impact is not likely. Similarly, a regional habitat analysis may be used to determine the importance of a site to the listed birds. Proponents should also consider the proposals impact in the context of the species' national, regional, district and site importance to establish the most effective survey technique(s)…'*

This methodology includes analysis of historic and current data gained from a range of sources (as listed in Table 1.1) with direct and current survey efforts including dedicated ground truthing surveys of the database mapping and follow-up ecological assessments within the project area as part of the projects geotechnical drilling survey program.

1.3 Review of existing databases and literature

Each predictive fauna habitat model has been developed to deliver a process that is robust, transparent and repeatable. The first stage in developing each of the models involved determining the extent of species occurrence and the availability of information pertaining to available species habitat.

Government databases were accessed to identify MNES and BC Act listed species and communities that have potential to occur within the subject land. These data sources are listed in Table 1.1.

Table 1.1 Database and document review summary

Database/data source name	Database search date	Database search areas	Data type
EPBC Act Protected Matters Search Tool (Australian Government)	5/08/2019	10 km buffer from the Proposal	Records of conservation significant flora and fauna species protected under the EPBC Act.
OEH BioNet Wildlife Atlas	7/08/2019	10 km buffer from the Proposal	Records of conservation significant flora and fauna species protected under the BC Act.
Document title			**Reference**
North Star to NSW/QLD Border Project Study Area Selection Report			ARTC 2018
Melbourne to Brisbane Inland Rail, 2016 Phase 1 Continuity Alignment Report, North Star to Yelarbon (01-2700-PD-P00-DE-008)			WSP/PB 2017
Melbourne to Brisbane Inland Rail, 2016 Phase 2 Preparatory Alignment Assessment Report, North Star to Yelarbon (01-2700-PD-P00-DE-011)			WSP/PB 2017a

2 Species and communities included within the predictive habitat mapping model

A total of six conservation significant flora species and 17 conservation significant fauna species listed under the provisions of the EPBC Act were identified as occurring or potentially occurring within the subject land (refer Table 2.1 and Table 2.2).

Table 2.1 EPBC Conservation significant flora species identified from database searches and considered a possible or likely occurrence within the subject land

Family	Species name	Common name	Conservation status		Data source	Likelihood of occurrence^
			BC Act	EPBC Act		
Poaceae	*Dichanthium setosum*	Bluegrass	V	V	BioNet, PMST, SEAR	Likely
Poaceae	*Homopholis belsonii*	Belson's panic	E	V	BioNet, PMST, SEAR	Possible
Surianaceae	*Cadellia pentastylis*	-	V	V	PMST	Possible
Apocynaceae	*Tylophora linearis*	-	V	V	PMST, SEAR	Possible
Fabaceae	*Swainsona murrayana*	Slender Darling-pea	V	V	PMST	Possible
Santalaceae	*Thesium australe*	Austral toadflax	V	V	PMST	Possible

Table notes:

1 Listing under the *Biodiversity Conservation Act 2016* (New South Wales): E = Endangered; V = Vulnerable.
2 Listing under the *Environment Protection and Biodiversity Conservation Act 1999*: CE = Critically Endangered; E = Endangered; V = Vulnerable;

Table 2.2 Conservation significant terrestrial fauna species identified from database searches

Family	Species name	Common name	Conservation status		Data source	Likelihood of occurrence^
			BC Act	EPBC Act		
Accipitridae	*Erythrotriorchis radiatus*	Red goshawk	CE	V	PMST	Possible
Apodidae	*Hirundapus caudacutus*	White-throated needletail	-	V, M	BioNet, PMST	Likely
Ardeidae	*Botaurus poiciloptilus*	Australasian bittern	E	E	PMST	Known
Dasyuridae	*Dasyurus maculatus maculatus*	Spot-tailed quoll (Southeastern mainland population)	V	E	PMST	Possible
Elapidae	*Furina dunmalli*	Dunmall's snake	-	V	PMST, SEAR	Possible
Meliphagidae	*Grantiella picta*	Painted honeyeater	V	V	BioNet, PMST, SEAR	Possible
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	BioNet, PMST, SEAR	Possible
Pteropodidae	*Pteropus poliocephalus*	Grey-headed flying-fox	V	V	PMST	Possible
Rostratulidae	*Rostratula australis*	Australian painted-snipe	E	E	PMST	Possible
Scincidae	*Anomalopus mackayi*	Five-clawed worm-skink	E	V	PMST, SEAR	Possible

Family	Species name	Common name	Conservation status		Data source	Likelihood of occurrence^
			BC Act	EPBC Act		
Scolopacidae	*Calidris ferruginea*	Curlew sandpiper	-	CE, Mi	PMST	Possible
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared pied bat	V	V	PMST, SEAR	Possible
Vespertilionidae	*Nyctophilus corbeni*	Corben's long-eared bat	V	V	PMST, SEAR	Possible
Psittacidae	*Lathamus discolor*	Swift parrot	E	CE	PMST	Possible
Gekkonidae	*Uvidicolus sphyrurus*	Border thick-tailed gecko	V	V	PMST	Possible

Table notes:

1 Listing under the *Biodiversity Conservation Act 2016* (New South Wales): CE = Critically Endangered; E = Endangered; V = Vulnerable.
2 Listing under the *Environment Protection and Biodiversity Conservation Act 1999*: CE = Critically Endangered; E = Endangered; V = Vulnerable; Ma = Marine; Mi = Migratory.

Table 2.3 Threatened ecological communities identified from database searches

Name	Status under the EPBC Act
Brigalow (*Acacia harpophylla* dominant and co-dominant)	E
Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	E
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	CE
Poplar Box Grassy Woodland on Alluvial Plains	E
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	E
Weeping Myall Woodlands	E
White-box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE

3 Predictive habitat modelling input datasets

Predictive habitat modelling was undertaken to identify and map areas that are considered to have the potential to provide habitat for the conservation significant species listed in Table 2.1, Table 2.2 which have potential to occur within the Proposal area. This modelling provides greater certainty in predicting the likelihood of a conservation significant species occurring within the Proposal area and is one of the inputs into the AIAMs model which is used to identified significant residual adverse impacts to MNES.

In addition to species specific vegetation associations that are identified within Table 5.1 and Table 5.2, additional GIS layers and field derived information have been utilised to identify areas of habitat within the Proposal area where applicable to a species. These layers include:

- Ground-verified plant community type (PCT) dataset
- High resolution aerial photography with site derived datasets
- Historic records of conservation significant species (derived from government databases and previous ecological investigations)
- Field derived datasets related to habitat suitability and the presence of micro-habitat features
- Topographic and geological information
- Government derived cadastral datasets
- Drainage feature datasets
- Government predicative habitat mapping datasets.

4 Predictive habitat modelling categories

4.1 Flora and fauna species

4.1.1 General context

Each predictive habitat model allowed partitioning of habitat for flora and fauna species using current scientific knowledge and pre-existing data derived from historic surveys and State based mapping identified above. The specific habitat assumptions for each species that were subject to predictive mapping are provided in Table 5.1 and Table 5.2.

The species-specific assumptions allowed the following areas to be identified for each conservation significant species:

- Unlikely habitat
- General habitat
- Essential habitat
- Core habitat.

The use of these habitat definitions has been accepted by the Commonwealth Department of Environment and Energy for similar linear infrastructure project EISs (e.g. Santos Gas Field Development EIS) and negotiations with the regulators at the inception of the Project EIS has indicated that they are amenable to the use of this modelling for the Project EIS.

An overview of each of these categories is provided in the sections below.

4.1.2 Unlikely habitat

Unlikely habitat consisted of areas that do not contain specimen backed records of the particular species (i.e. no point data derived from the positive identification/confirmation of a species in the field) and contain no evidence of habitat values to support the presence or existence of resident individuals or populations of the species. These areas are located outside of areas identified as potential habitat by OEH.

4.1.3 General habitat

General habitat consisted of areas or locations used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential or core habitat (i.e. records of the species are considered anomalies as general microhabitat features are not considered to be present from a desktop perspective). In addition, areas identified as potential habitat by OEH have been included in the general habitat category. General habitat also includes habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. General habitat may include areas of suboptimal habitat for species. As potential habitat for many species may include most of the REs of the specific bioregion, the general habitat category restricts the habitat to a more limited and realistic set of environmental parameters which are supported by literature and field-based observation. Species specific assumptions that define the general habitat category are identified in Table 5.1 and Table 5.2.

4.1.4 Essential habitat

Essential habitat consists of areas containing resources that are considered essential for the maintenance of populations of the species (e.g. potential habitat for breeding, roosting, foraging, shelter) or areas that have been confirmed as containing suitable habitat as identified by a specimen backed record or indirect evidence of the species (i.e. scat, trace, track, fur/feather, distinctive vocalisation or other site based evidence). Essential habitat has been defined from known records (regardless of currency), generally with a 1 km buffer or site-based observation of the species during site investigations. In addition, if the 1 km buffer from the known record intersects an area identified as general habitat the general habitat rating was elevated to essential habitat. Species specific assumptions associated with the mapping of essential habitat, and instances that deviate from the above criteria are detailed in Table 5.1 and Table 5.2.

4.1.5 Core habitat

Core habitat consists of essential habitat in which the species is known, and the habitat is recognised under relevant recovery plans or other relevant plans, policies and regulations (such as Species Recovery Plans or Approved Conservation Advice for EPBC Act species). Where essential habitat intersects with any identified areas, these areas have been elevated to the core habitat category. Species specific assumptions associated with the mapping of core habitat areas are detailed in Table 5.1 and Table 5.2.

5 Predictive habitat models and general assumptions associated with their development

5.1 Flora, fauna and TEC habitat models

The predictive flora habitat model for each flora and fauna species was designed to provide a dynamic, robust and predictive GIS layer that could incorporate data from scientific literature, verified government datasets, specimen backed datasets (i.e. data derived from a known/confirmed location of an observed specimen) and field identified records into a single layer that could be used to identify areas that are known, or considered to have the potential to support specific conservation significant NC Act and/or EPBC Act listed flora and fauna species. Development of these layers had the ultimate objects to:

- Predict areas that have the potential to support BC Act and/or EPBC Act significant flora species
- Predicted potential areas of conservation significant flora specs habitat to be disturbed, and subsequent assessment of these areas using the AIAMs model to determine significant residual adverse impacts.

The habitat modelling was created using ESRI ArcGIS, specifically the ESRI ArcGIS Model Builder which facilitated the development of scripts that allowed for the species-specific development of queries that utilised a range of GIS input datasets (e.g. REs containing site derived and filed verified information).

The models also incorporated the use of selecting relevant components and performing functions such as buffers and intersects that reflected the preferred habitat of a particular species. As a result of this process output habitat layers were generated for each species according to their individual requirements. The species-specific requirements that were used to generate the species-specific queries used to map potential habitat are identified in Table 5.1 and Table 5.2 . However, it is noted that whilst species that were deemed to have potential to occur within the broader region underwent habitat modelling, the results of the modelling did not necessarily identify habitat within the Proposal area for all of the species modelled. Where this occurred, these species (i.e. without identified habitat within the Proposal area) did not undergo impact assessment as part of the Project EIS. Habitat assumptions were informed by a species profile for each EPBC threatened species and TEC (refer Appendix A1).

As the predictive flora and fauna habitat model mapping has been designed to identify areas of potential habitat for BC Act and/or EPBC Act listed species, several assumptions to the model have been made and derived from scientific literature and expert advice. These assumptions are outlined below.

- Buffers – Buffers have been used when integrating a specimen backed record into the predicted mapping. Generally, a 1 km buffer from the species data point is used when identifying essential habitat derived from a specimen backed record). Deviations from this methodology (where they occur, e.g. 30 m), are identified in Table 5.1 and Table 5.2.
- Essential habitat – The predictive flora and fauna habitat mapping outlined in this document primarily proposes general habitat as the preferred habitat requirements for many of the species mapped. This is as a result of their habitat not being fully understood or cannot be easily extrapolated from available datasets. In most cases, site derived species records were used to extrapolate preferred habitat by correlating with the underlying GIS layer. In these instances, mapped habitat will overlap with the predicted potential general habitat, which has not been elevated to the essential habitat level. For these species, where a species point record and associated buffer (i.e. typically a 1 km, but a reduced buffers of 30 m have been applied to some species) intersect with areas of predicted general habitat, the area of overlap has been elevated to the essential habitat category. In instances where essential habitat is located within an area of protection (excluding areas identified ads predicted habitat by OEH), this is elevated to core habitat. The relationship between general habitat, species records, essential habitat, protected areas and core habitat, is outlined in Figure 5.1.

- Minimum areas of habitat – Mapping has been designed to identify maximum areas of disturbance and therefore no minimum area of habitat has been identified. The methodology was developed to predict areas of potential habitat. However, the resolution of the mapping is constrained by the data inputs (e.g. PCT mapping) and therefore areas that may potentially be identified as habitat will always be contiguous to areas of similar habitat that reflect the minimum resolution for the input dataset (e.g. minimum PCT polygon size, etc.).
- Levels of habitat mapping – General habitat has primarily been indicated on the predictive mapping. However, where known population occur and were confirmed, and these areas overlap with areas of predicted general habitat, these areas have been elevated to essential habitat in accordance line with that used in relation of government mapping associated with the BC Act.

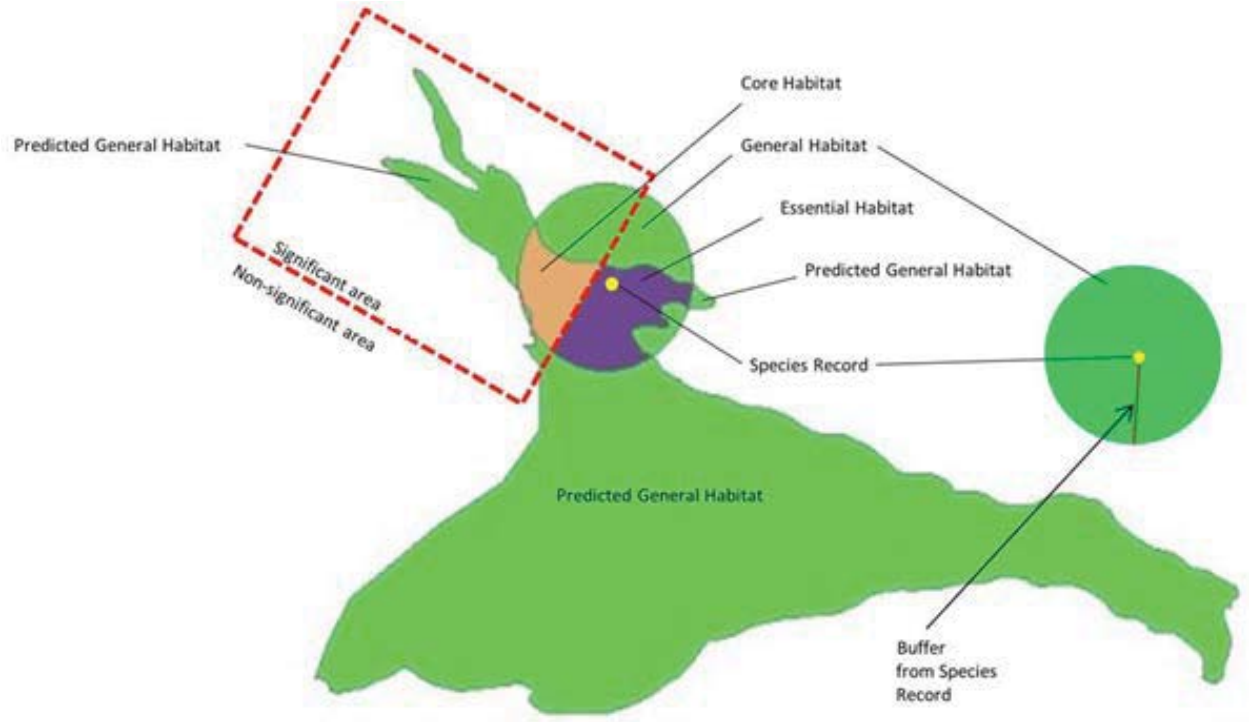


Figure 5.1 **Schematic indicating the relationship between specimen backed records, predicted general habitat, essential habitat and core habitat category designations**

Table 5.1 Listed conservation significant flora species habitat assumptions used to map areas of occurrence within study area

Family	Scientific name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources	Habitat modelling assumptions		
				General Habitat (NSW)	Essential habitat	Core habitat
Poaceae	*Dichanthium setosum*	A Bluegrass	*Dichanthium setosum* is associated with heavy basaltic black soils and stony red-brown hard-setting loam with clay subsoil and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture. The extent to which this species tolerates disturbance is unknown	The following High and Medium condition PCTs are considered to be General habitat: 27;35;43;45;52;55;56;78;81;101;102;201;202;228;250;281;326;367;371;373;381;382;383;393;394;395;403;412;413;418;421;426;429;430;432;433;434;435;437;441;443;444;449;451;460;461;464;481;482;483;484;496;501;504;505;506;508;509;510;511;513;516;517;523;527;528;529;531;534;536;537;538;539;543;549;551;552;556;557;558;562;563;564;566;567;576;577;578;579;580;581;584;585;587;588;589;590;591;592;593;594;595;596;597;598;599;605;618;619;623;628;629;665;704;710;711;734;735;740;796;841;847;921;927;983;986;993;996;998;1076;1099;1104;1118;1162;1164;1167;1169;1171;1174;1179;1306;1307;1313;1315;1316;1317;1324;1329;1331;1332;1333;1354;1361;1364;1370;1373;1382;1383;1394;1512;1608;1691;1693;1695;1748;1761;1766;99997 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat
Poacae	*Homopholis belsonii*	Belson's panic	*Belson's Panic is found on poor soils in dry woodlands at elevations ranging from 342–500 m. Three general types of habitat which support Belson's Panic include:* ■ *Rocky, basaltic hills supporting Eucalyptus albens (White Box)/Geijera parviflora (Wilga) woodland with assorted shrubs and a number of grass species.* ■ *Flat to gently undulating alluvial areas supporting Casuarina cristata (Belah) forest and sometimes Acacia harpophylla (Brigalow) or G.parviflora (Wilga* ■ *Drainage lines supporting C. cristata and sandy country dominated by Cypress Pine-Bloodwood-Ironbark-She-Oak Forest.*	The following High and Medium condition PCTs are considered to be General habitat: 27;35;37;40;43;49;52;55;56;71;81;87;98;101;102;135;145;146;147;202;214;244;367;368;369;370;371;372;373;374;378;421;422;428;433;434;441;442;444;445;448;450;451;452;458;464;484;511;516;544;589;590;593;599;619;710;711;847;998;1076;1179;1324;1383 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Family	Scientific name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources	Habitat modelling assumptions		
				General Habitat (NSW)	**Essential habitat**	**Core habitat**
Asclepiadaceae	*Tylophora linearis*	-	*Tylophora linearis* grows in dry scrub, open forest and woodlands associated with *Melaleuca uncinata, Eucalyptus fibrosa, E. sideroxylon, Eucalyptus albens, Callitris endlicheri, C. glaucophylla, Allocasuarina luehmannii, Acacia hakeoides, A. lineata, Myoporum spp., and Casuarina spp*	The following High and Medium condition PCTs are considered to be General habitat: 54;70;88;141;148;179;202;217;228;235;255;272;321;322;327;330;331;333;341;347;348;354;358;366;367;368;370;371;372;373;374;379;381;389;393;396;397;398;399;401;402;404;405;406;407;408;409;411;412;414;415;417;418;419;421;423;425;426;429;431;432;435;440;441;443;444;449;451;459;461;462;464;467;468;469;470;471;473;477;479;480;506;511;515;516;527;529;531;543;549;555;562;564;573;576;577;581;587;588;589;590;591;592;593;594;595;596;597;598;599;673;676;702;713;714;746;791;955;956;1090;1176;1307;1308;1313;1314;1317;1360;1361;1367;1381;1383;1384;1387;1511 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat
Fabaceae	*Swainsona murrayana*	Slender Darling-pea	The Slender Darling-pea often grows in heavy soils, especially depressions, and is also found on grey and red to brown clay and clay-loam soils in *Atriplex vesicaria* (Bladder Saltbush) herbland, *Eucalyptus largiflorens* (Black Box) woodland and grassland communities and is frequently associated with *Maireana* species	The following High and Medium condition PCTs are considered to be General habitat: 15;16;23;26;27;28;35;37;38;40;43;44;45;46;49;52;55;56;76;77;80;81;82;83;87;101;102;144;155;156;157;158;163;164;165;168;195;197;202;211;212;214;216;222;224;237;242;244;247;248;375;377;421;433;444;454;511;516;628;629;710;711;847;1076;1179;1315;1324;1329;1383 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Family	Scientific name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources	Habitat modelling assumptions		
				General Habitat (NSW)	Essential habitat	Core habitat
Santalaceae	*Thesium australe*	Austral toadflax	Austral toadflax is semi-parasitic on roots of a range of grass species, notably *Themeda triandra* and *Dichanthium* sp. It occurs in shrubland, grassland or woodland, often on damp sites.	The following High and Medium condition PCTs are considered to be General habitat: 23;42;101;116;307;433;434;441;443;444;449;451;453;484;488;489;495;498;502;504;505;507;508;509;510;511;513;516;517;524;526;527;528;529;533;534;536;537;538;539;542;544;552;555;558;559;564;565;566;567;568;577;581;586;588;589;590;593;594;597;599;606;619;650;679;681;687;704;710;711;721;732;734;736;738;740;741;761;763;764;773;784;797;798;800;804;805;806;807;815;829;831;834;846;847;848;849;850;853;854;856;866;874;893;894;895;896;897;898;921;927;931;949;965;970;991;992;993;997;1076;1099;1100;1101;1116;1118;1121;1122;1139;1166;1168;1169;1171;1173;1176;1178;1182;1183;1185;1188;1190;1191;1192;1194;1195;1196;1197;1198;1200;1207;1216;1218;1223;1224;1251;1272;1286;1288;1289;1296;1298;1305;1308;1310;1315;1316;1329;1330;1331;1332;1341;1350;1354;1356;1358;1359;1361;1362;1363;1364;1368;1370;1372;1377;1378;1383;1396;1397;1399;1512;1513;1551;1552;1553;1555;1559;1579;1589;1591;1592;1593;1600;1601;1603;1604;1606;1611;1618;1619;1622;1626;1627;1628;1646;1647;1655;1671;1672;1674;1677;1678;1688;1689;1695;1697;1698;1700;1701 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Family	Scientific name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources	Habitat modelling assumptions		
				General Habitat (NSW)	Essential habitat	Core habitat
Surianaceae	*Cadellia pentastylis*	Ooline	A medium sized tree that grows in semi-evergreen vine thickets and sclerophyll vegetation on sandstone, conglomerate and claystone usually at an altitude 300-460 m asl. Occurs in association with *Eucalyptus albens* (White box), and *Callitris glaucophylla* (White cypress pine) in the canopy. Common understorey species include *Notelaea microcarpa* (Native olive), *Beyeria viscosa* (Pinkwood), Alstonia contricta (Bitterbark), *Geijera parviflora* (Wilga), *Einadia hastate* (Berry saltbush), *Stipa* spp. and *Aristida* spp. Ooline is known to the following vegetation communities in NSW: ■ Semi-evergreen vine thickets with Bitterbark, Hard Alectryon (*Alectryon subdentatus*), Broad-leaved Leopard Tree (*Flindersia collina*), Wilga and Queensland Bottle Tree (*Brachychiton rupestris*) ■ Brigalow-Belah communities with vine thicket species ■ Brigalow-Belah on undulating clay plains and low hills ■ Poplar Box (Eucalyptus populnea) and Bendee (Acacia catenulata) forest	The following High and Medium condition PCTs are considered to be General habitat: 113;114;378;442;445;452 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Table note:

PCT = Plant community types as defined by the NSW State Vegetation Map (SVTM)

Table 5.2 Threatened fauna species habitat assumptions used to map areas of occurrence within the study area

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
Birds	*Erythrotriorchis radiatus*	Red goshawk	The Red goshawk prefers forest and woodland with a mosaic of vegetation types, large prey populations (birds), and permanent water. Habitat must be open enough for fast attack and manoeuvring in flight, but provide cover for ambushing of prey. They avoid very dense and very open habitats. The vegetation types utilised by this species include eucalypt woodland, open forest, tall open forest, gallery rainforest, swamp sclerophyll forest, and rainforest margins. Nests are in tall trees within one km of and often beside permanent water (river, swamp, pool), usually in fairly open, biologically rich forest or woodland. These habitats provide appropriate foraging conditions for the large Red goshawk, and a diversity and abundance of the medium to large birds taken as food.	The following High and Medium condition PCTs are considered to be General habitat when they are contained within 1km of a perennial watercourse: 36;646;647;658;666;668;682;683;685;686;688;690;693;696;697;698;707;723;735;755;761;762;776;780;782;809;811;819;822;837;841;842;843;848;852;855;857;859;861;867;868;872;954;971;974;975;976;977;979;983;986;992;1062;1064;1072;1074;1091;1092;1106;1121;1135;1136;1145;1162;1169;1184;1205;1209;1210;1211;1219;1221;1223;1227;1230;1235;1262;1267;1268;1273;1290;1297;1333 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
Birds	*Botaurus poiciloptilus*	Australasian bittern	The Australasian bittern occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats. It favours wetlands with tall, dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. The species favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and/or reeds (e.g. *Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus*) or cutting grass (Gahnia) growing over muddy or peaty substrate.	The following is considered to constitute General habitat: ■ All areas mapped as perennial waterways, natural drainage (perennial) and waterbodies with a buffer of 100 m applied. ■ Swamp areas mapped as prone to inundation ■ In addition, the following High and Medium condition PCTs (from NSW Veg Mapping) are considered to be General habitat: 8;10;11;12;13;17;24;36;37;39;53;66;160;161;181;182;204;238;240;241;247;249;356;360;361;375;400;410;416;447;465;500;518;630;665;726;779;780;781;782;783;785;798;828;835;920;923;1064;1071;1105;1106;1126;1131;1227;1230;1231;1232;1234;1235;1236;1256;1270;1287;1290;1291;1297;1386;1727;1728;1730;1734;1735;1736;1737;1738;1739;1740;1741;1742;1746;1808;1809;1911;99996;99997 *Note: Any specimen backed records (buffered to a 1 km radius) that fall outside of the areas identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat
Birds	*Grantiella picta*	Painted honeyeater	The Painted honeyeater inhabits mistletoes in eucalypt forests/woodlands, riparian woodlands of black box and River red gum, box-ironbark-Yellow gum woodlands, Acacia-dominated woodlands, paperbarks, casuarinas, Callitris, and trees on farmland or gardens. The species is often associated with following tree species: *Acacia harpophylla, Acacia homalophylla, Acacia pendula, Allocasuarina luehmannii, Eucalyptus largiflorens* and *Eucalyptus camaldulensis.*	The following High and Medium condition PCTs are considered to be General habitat: 2;5;7;8;9;10;11;13;15;16;20;21;23;26;27;28;29;31;35;36;37;38;39;40;41;42;54;55;56;57;58;59;60;67;68;69;70;71;72;74;75;76;77;78;79;80;81;82;83;84;85;86;87;88;98;100;101;103;104;105;106;108;109;110;113;114;116;117;118;119;120;121;122;123;125;127;128;130;131;132;133;134;135;137;139;143;144;147;148;151;179;184;185;186;188;192;193;194;197;200;201;202;206;207;208;213;215;217;220;227;228;229;230;231;232;233;234;237;239;243;244;245;246;248;249;251;255;257;258;264;266;267;268;269;270;272;273;274;275;276;277;278;279;280;281;282;284;286;287;289;290;291;292;293;294;309;312;315;317;318;319;321;322;323;324;325;326;327;328;329;330;331;332;333;337;338;339;340;341;342;343;345;346;347;348;349;350;351;352;353;354;356;357;358;362;363;367;368;369;370;371;372;3	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
			The Painted honeyeater prefers woodlands which contain a higher number of mature trees, as these host more mistletoes. It is more common in wider blocks of remnant woodland than in narrower strips, although it has been observed to breed in relatively narrow roadside strips when ample mistletoe fruit is available.	73;374;376;378;379;380;381;382;383;384;385;386;387;389;390;391;393;394;396;397;398;399;401;402;403;404;405;406;407;408;409;411;412;413;414;417;418;419;420;421;422;423;426;428;429;430;431;432;433;434;435;436;437;438;439;440;441;442;443;444;445;448;449;450;452;453;454;455;456;457;458;459;461;462;463;464;468;469;470;471;472;473;474;477;478;479;480;481;482;483;485;486;488;489;495;496;498;502;503;504;505;506;508;509;510;512;513;514;515;516;517;523;524;526;527;528;529;530;531;532;533;534;536;537;538;539;542;543;544;545;549;550;551;552;555;556;557;558;559;562;564;565;566;567;568;571;572;573;576;577;578;579;580;581;583;584;585;587;588;589;590;591;592;593;594;595;596;597;598;599;600;605;608;609;610;618;621;623;628;629;632;649;651;653;654;671;672;673;674;675;676;681;687;700;701;702;703;704;707;712;713;714;722;723;724;725;727;731;732;733;734;735;736;737;738;740;746;756;760;762;763;764;774;791;792;802;803;804;806;807;808;810;818;822;830;831;832;833;835;840;841;842;843;847;848;849;850;851;852;853;854;855;856;857;859;860;861;863;864;865;866;867;868;872;874;889;890;941;955;956;957;964;965;970;973;977;983;991;992;993;996;997;998;1065;1066;1067;1081;1083;1088;1089;1090;1091;1093;1094;1095;1097;1099;1103;1104;1105;1106;1112;1116;1118;1120;1132;1133;1137;1139;1162;1164;1165;1171;1173;1174;1176;1177;1182;1183;1188;1192;1194;1200;1207;1209;1211;1213;1215;1216;1218;1219;1221;1223;1251;1253;1273;1277;1278;1279;1281;1286;1296;1303;1304;1305;1306;1307;1308;1310;1313;1314;1315;1316;1317;1327;1328;1329;1330;1331;1332;1333;1334;1341;1350;1351;1352;1354;1356;1357;1358;1360;1361;1362;1364;1365;1366;1367;1370;1373;1380;1381;1382;1383;1384;1386;1387;1395;1396;1397;1399;1400;1401;1504;1511;1512;1550;1551;1552;1553;1555;1558;1559;1560;1579;1583;1586;1589;1590;1592;1593;1600;1601;1603;1604;1605;1606;1607;1608;1609;1610;1611;1612;1613;1618;1619;1622;1623;1626;1627;1628;1629;1633;1634;1635;1636;1637;1640;1642;1643;1646;1647;1648;1650;1651;1655;1658;1666		

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	**Essential Habitat**	**Core Habitat**
				;1668;1669;1671;1672;1674;1677;1678;1680;1687;1688;1691;1692;1695;1696;1748;1761;1766;1767;1770;1800;99999 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*		
Birds	*Rostratula australis*	Australian painted snipe	The Australian painted snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and clay pans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia* spp. or cane grass or sometimes *Melaleuca* spp. The Australian Painted Snipe sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up.	The following is considered to constitute General habitat: ■ All areas mapped as perennial waterways, natural drainage (perennial) and waterbodies with a buffer of 100m applied. ■ Swamp areas mapped as prone to inundation ■ In addition, the following High and Medium condition PCTs are considered to be General habitat: 2;5;7;8;9;10;11;12;13;17;24;25;36;37;39;40;43;47;49;50;52;53;66;78;79;115;160;161;181;182;204;205;214;225;226;233;238;240;241;242;247;249;261;271;336;360;361;364;375;400;416;447;465;500;665;780;781;782;783;828;902;1071;1106;1125;1126;1232;1234;1235;1236;1256;1291;1735;1736;1737;1738;1739;1740;1741;1742;1746;1808;1809;1911;99996;99997 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the areas identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
Birds	*Calidris ferruginea*	Curlew sandpiper	The Curlew sandpiper primarily occurs on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters.	The following is considered to constitute General habitat: ▪ All areas mapped as perennial waterbodies with a buffer of 100m applied. ▪ Swamp areas mapped as prone to inundation ▪ In addition, the following High and Medium condition PCTs are considered to be General habitat: 12;18;24;47;53;62;63;189;204;238;242;781;782;783;920;1071;1125;1126;1736;1737;1738;1740;1741;1742;1746;1808;1911;1913;99994;99996;99998 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the areas identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat
Mammals	*Phascolarctos cinereus*	Koala	Koalas naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by *Eucalyptus* species which can be broadly defined as any forest or woodland containing species that are known koala food trees, or shrubland with emergent food trees. Along the Great Dividing Range and the coastal belt throughout the species' range, Koalas inhabit moist forests and woodlands mostly dominated by *Eucalyptus* species.	The following High and Medium condition PCTs are considered to be General habitat: 2;5;7;8;9;10;11;13;15;16;26;35;36;37;38;39;40;41;42;55;56;57;59;67;70;71;72;74;75;76;78;79;80;81;82;83;84;85;87;88;98;101;103;104;105;106;108;109;110;113;114;117;134;135;141;148;173;174;184;185;188;192;200;201;202;206;207;208;217;227;228;230;231;233;234;237;239;243;244;248;249;251;255;257;258;266;267;268;269;270;272;273;274;275;276;277;278;279;280;281;282;283;284;285;286;287;288;289;290;292;293;294;295;296;297;298;299;300;302;304;305;306;307;309;310;311;312;313;314;315;316;318;321;322;323;324;325;326;327;328;329;330;331;332;333;334;337;338;339;340;341;342;343;345;346;347;348;349;350;351;352;353;354;355;356;357;358;362;363;366;367;368;369;370;371;372;373;374;376;378;379;380;381;382;384;385;386;387;389;390;391;392;393;394;395;396;397;398;399;401;402;404;405;406;407;408;409;411;412;413;414;415;417;418;419;420;421;422;423;425;426;428;429;430;431;432;433;434;435;438;439;440;441;442;443;444;445;448;449;450;451;452;453;454;455;456;457;458;459;461;462;463;464;468;469;470;471;472;473;474;477;488;489;495;498;502;503;504;505;506;507;508;5	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
				09;510;511;512;513;514;515;516;517;523;524;525;526;527;528;529;530;531;532;533;534;536;537;538;539;542;543;544;545;549;550;551;552;555;556;557;558;559;562;564;565;566;567;568;572;573;576;577;578;579;580;581;583;584;585;587;588;589;590;591;592;593;594;595;596;597;598;599;600;605;606;608;609;610;611;628;629;632;638;639;649;650;651;652;653;654;655;657;659;661;672;673;674;675;676;684;686;687;688;689;690;691;692;693;694;695;696;697;698;699;700;701;702;703;704;705;706;707;714;716;719;724;725;727;728;729;730;731;732;733;734;735;736;737;738;741;742;743;744;745;746;747;748;749;750;752;754;755;756;760;761;762;763;769;774;777;778;789;792;810;811;812;818;819;822;826;827;829;830;832;833;834;835;836;837;838;839;840;841;842;843;847;848;849;850;852;853;854;855;856;857;858;859;860;861;862;864;865;866;867;868;870;871;872;873;874;875;877;878;879;880;882;883;888;889;890;891;892;904;905;907;911;913;914;921;927;929;931;932;934;935;941;942;943;944;946;947;948;949;950;951;952;953;954;955;956;957;958;963;964;965;967;968;969;970;971;979;980;981;982;983;984;986;988;990;991;992;993;994;995;996;997;998;999;1062;1063;1064;1065;1066;1067;1073;1074;1079;1080;1081;1082;1083;1084;1085;1086;1087;1088;1089;1090;1091;1092;1093;1094;1095;1096;1097;1099;1100;1101;1103;1104;1105;1107;1108;1109;1116;1118;1119;1121;1128;1132;1133;1134;1136;1137;1139;1144;1145;1146;1147;1148;1149;1150;1151;1152;1153;1154;1155;1156;1157;1158;1159;1160;1161;1162;1164;1165;1166;1167;1168;1169;1171;1173;1174;1175;1176;1177;1180;1181;1182;1183;1184;1188;1190;1191;1192;1194;1195;1196;1197;1198;1200;1205;1206;1207;1208;1209;1210;1211;1212;1213;1214;1215;1216;1217;1218;1219;1220;1221;1222;1223;1227;1228;1229;1230;1231;1234;1235;1236;1237;1238;1239;1241;1242;1243;1244;1245;1246;1248;1250;1251;1252;1253;1254;1257;1258;1259;1260;1261;1262;1263;1265;1266;1267;1268;1273;1277;1278;1279;1281;1282;1283;1284;1285;1286;1292;1296;1301;1305;1306;1307;1308;1309;1310;1313;1314;1315;1316;1317;1319		

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
				;1320;1321;1322;1323;1326;1327;1328;1329;1330;1331;1332;1333;1334;1336;1337;1338;1339;1340;1351;1352;1354;1356;1357;1358;1359;1361;1362;1363;1364;1365;1366;1368;1369;1370;1373;1374;1380;1381;1382;1383;1384;1385;1387;1395;1396;1397;1398;1399;1400;1401;1504;1511;1512;1546;1547;1548;1549;1550;1551;1552;1553;1554;1555;1556;1557;1558;1559;1561;1562;1563;1564;1565;1566;1567;1568;1569;1570;1571;1573;1574;1575;1576;1577;1578;1579;1580;1583;1589;1590;1592;1593;1600;1601;1603;1604;1606;1611;1617;1618;1619;1622;1623;1626;1627;1628;1629;1633;1634;1635;1636;1637;1640;1642;1643;1646;1647;1648;1650;1651;1655;1666;1668;1669;1671;1672;1674;1677;1678;1680;1688;1689;1695;1717;1718;1721;1724;1725;1776;1777;1778;1780;1782;1783;1785;1786;1787;1789;1790;1794;1795;1798;1800;1803;1804;1824;1826;1828;1833;1841;1845;1912;1914;1915 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*		

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
Mammals	*Pteropus poliocephalus*	Grey-headed flying-fox	The Grey-headed flying-fox requires foraging resources and roosting sites. It is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps and *Banksia* woodlands. It also feeds on commercial fruit crops and on introduced tree species in urban areas. The primary food source is blossom from *Eucalyptus* and related genera but in some areas it also utilises a wide range of rainforest fruits. None of the vegetation communities used by the Grey-headed Flying-fox produce continuous foraging resources throughout the year. As a result, the species has adopted complex migration traits in response to ephemeral and patchy food resources. The Grey-headed flying-fox roosts in aggregations of various sizes on exposed branches. Roost sites are typically located near water, such as lakes, rivers or the coast. Roost vegetation includes rainforest patches, stands of *Melaleuca*, mangroves and riparian vegetation. Grey-headed flying-foxes commute daily to foraging areas, usually within 15 km of the day roost site. Grey-headed flying-foxes are capable of nightly flights of up to 50 km from their roost to different feeding areas as food resources change. At most times of the year there is a complete exodus from the colony site at dusk.	The following High and Medium condition PCTs are considered to be General habitat: 5;35;36;42;54;55;56;70;76;78;81;83;84;101;102;113;114;147;179;202;217;227;228;244;266;267;269;270;272;273;274;275;276;277;281;282;283;287;290;293;321;322;323;324;325;326;327;330;331;333;345;351;354;356;358;362;363;366;367;368;369;370;371;372;373;374;376;378;379;380;381;382;384;385;386;387;388;389;390;391;393;394;395;396;397;398;399;401;402;404;405;406;407;408;409;411;412;413;414;415;417;418;419;420;421;422;423;425;426;428;429;430;431;432;433;434;435;440;441;442;443;444;445;448;449;450;451;452;453;454;455;456;457;458;459;460;461;462;463;464;468;469;470;471;472;473;477;484;488;489;495;498;499;502;503;504;505;506;507;508;509;510;511;512;513;514;515;516;517;520;521;522;523;524;525;526;527;528;529;530;531;532;533;534;535;536;537;538;539;542;543;544;545;547;548;549;550;551;552;555;556;557;558;559;561;562;564;565;566;567;568;572;573;574;576;577;578;579;580;581;583;584;585;587;588;589;590;591;592;593;594;595;596;597;598;599;600;605;606;608;609;610;611;619;627;628;629;632;636;646;647;649;651;654;657;658;659;661;662;663;664;666;667;668;669;670;672;674;675;676;681;682;683;684;685;686;687;688;689;690;691;692;693;694;695;696;697;698;699;702;703;704;707;708;709;710;711;713;715;721;723;724;725;726;730;731;732;733;734;735;736;737;738;740;741;743;745;746;747;748;749;750;751;752;754;755;756;760;761;762;763;764;767;768;769;770;771;772;773;774;776;777;781;784;785;786;789;790;792;809;810;811;812;814;815;818;819;822;823;824;825;826;827;828;829;830;832;833;834;835;836;837;838;839;840;841;842;843;845;847;848;849;850;852;853;854;855;856;857;858;859;860;861;862;864;865;866;867;868;870;871;872;874;875;877;878;881;882;883;884;885;886;887;889;890;898;904;905;906;907;908;909;910;914;915;916;917;918;919;920;921;923;924;925;926;927;931;934;935;941;942;944;947;948;950;954;956;958;963;964;965;967;968;969;970;971;972;973;974;975;9	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
				76;977;978;979;980;981;982;983;984;986;988;990;991;992;993;994;995;996;997;998;1061;1062;1063;1064;1065;1066;1067;1068;1072;1073;1074;1077;1078;1079;1080;1081;1082;1083;1084;1085;1086;1088;1090;1091;1092;1093;1095;1097;1099;1100;1103;1104;1105;1106;1107;1108;1109;1112;1116;1118;1119;1120;1121;1124;1126;1127;1128;1129;1130;1131;1132;1133;1134;1135;1136;1137;1139;1142;1145;1150;1156;1159;1162;1164;1165;1167;1169;1171;1173;1174;1175;1176;1177;1179;1180;1181;1182;1183;1184;1188;1192;1194;1195;1200;1201;1205;1206;1207;1208;1209;1210;1211;1212;1213;1214;1215;1216;1217;1218;1219;1220;1221;1222;1223;1227;1228;1230;1231;1232;1234;1235;1236;1237;1238;1239;1241;1242;1243;1244;1245;1246;1248;1249;1250;1251;1252;1253;1254;1255;1257;1258;1259;1260;1261;1262;1263;1265;1266;1267;1268;1270;1271;1273;1275;1276;1277;1281;1282;1283;1284;1285;1286;1288;1292;1293;1294;1296;1297;1300;1302;1305;1306;1307;1308;1310;1313;1314;1315;1316;1317;1318;1319;1323;1326;1327;1328;1329;1330;1331;1332;1333;1336;1337;1341;1351;1352;1354;1356;1358;1360;1361;1362;1364;1366;1367;1369;1370;1373;1380;1381;1382;1383;1385;1386;1387;1395;1397;1398;1399;1400;1401;1503;1504;1511;1512;1513;1523;1525;1527;1529;1530;1531;1533;1534;1535;1537;1539;1540;1541;1543;1545;1546;1547;1548;1549;1550;1551;1552;1553;1554;1555;1556;1557;1558;1559;1561;1562;1563;1564;1565;1566;1567;1568;1569;1570;1571;1572;1573;1574;1575;1576;1577;1578;1579;1580;1583;1589;1590;1592;1593;1600;1601;1603;1604;1605;1606;1611;1617;1618;1619;1622;1623;1626;1627;1628;1629;1633;1634;1635;1636;1637;1640;1641;1642;1643;1644;1646;1647;1648;1650;1651;1653;1655;1666;1668;1669;1671;1672;1674;1677;1678;1680;1688;1689;1691;1692;1695;1700;1701;1704;1705;1707;1715;1716;1717;1718;1721;1724;1725;1734;1747;1775;1776;1777;1778;1780;1782;1783;1785;1786;1787;1789;1790;1793;1794;1795;1798;1800;1803;1804;1809;1817;1822;1823;1824;1826;1828;1832;1833;		

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	**Essential Habitat**	**Core Habitat**
				1841;1843;1845;1846;1847;1911;1912;1914;1915;99996;99997 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the areas identified above are considered to constitute General habitat*		
Mammals	*Chalinolobus dwyeri*	Large-eared pied bat	This species has been recorded from a large range of vegetation types including: dry and wet sclerophyll forest; *Callitris glauca* dominated forest; tall open eucalypt forest. Roosting has also been observed in disused mine shafts, caves, overhangs and disused Fairy Martin nests.	The following High and Medium condition PCTs are considered to be General habitat: 42;70;78;88;113;114;147;148;179;184;192;201;202;206;208;217;227;228;255;257;267;270;272;273;274;275;277;281;282;283;321;322;323;325;326;327;328;329;330;331;333;345;351;354;356;357;358;366;367;368;370;371;372;373;374;378;379;380;381;382;384;385;386;387;388;389;390;391;393;394;395;396;397;398;399;401;402;404;405;406;407;408;409;411;412;413;414;415;417;418;419;420;421;422;423;425;426;428;429;430;431;432;433;434;435;439;440;441;443;444;445;448;449;450;451;453;455;456;457;458;459;461;462;463;464;468;471;472;473;477;488;489;495;498;502;503;504;505;506;507;508;509;510;511;512;513;514;515;516;517;523;524;525;526;527;528;529;530;531;532;533;534;536;537;538;539;542;543;544;545;549;550;551;552;556;557;558;559;562;564;565;566;567;568;572;573;576;577;578;579;580;581;583;584;585;587;588;589;590;591;592;593;594;595;596;597;598;599;600;605;606;609;610;611;627;632;636;646;647;649;651;654;657;658;659;661;662;666;668;671;672;673;674;675;676;681;682;683;684;685;686;687;688;691;692;694;695;696;697;702;703;704;706;707;708;709;712;713;714;715;723;724;725;731;732;733;734;735;736;737;738;740;741;743;745;746;747;752;754;756;760;761;762;763;764;769;772;774;776;778;788;789;791;792;809;810;818;819;821;822;826;827;830;832;833;835;836;837;838;840;841;842;843;845;847;848;849;850;851;852;853;854;855;856;857;858;859;860;861;862;863;864;865;866;867;868;870;871;872;873;874;875;877;878;881;882;883;888;889;890;896;904;905;907;910;920;921;924;925;926;927;931;934;935;941;942;944;948;950;956;958;963;964;965;966;967;968;969;970;971;974;975;976;977;978;979;982;983;984;986;988;990;991;992;993;994;	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
				996;997;998;1062;1064;1065;1066;1067;1072;1074;1078;1079;1080;1081;1082;1083;1084;1085;1086;1088;1090;1091;1093;1097;1099;1100;1103;1105;1106;1107;1112;1116;1118;1120;1124;1128;1132;1133;1135;1136;1137;1139;1142;1145;1150;1152;1155;1156;1159;1162;1164;1165;1169;1171;1173;1175;1176;1180;1181;1182;1183;1184;1188;1192;1194;1200;1205;1206;1207;1209;1210;1211;1212;1214;1215;1216;1218;1219;1221;1223;1228;1229;1230;1231;1232;1234;1237;1238;1239;1241;1242;1244;1245;1246;1247;1248;1249;1250;1251;1252;1253;1254;1255;1256;1258;1261;1262;1263;1268;1270;1273;1277;1281;1282;1283;1284;1286;1289;1292;1296;1300;1303;1304;1305;1306;1307;1308;1310;1313;1314;1315;1316;1317;1319;1323;1326;1327;1328;1329;1330;1331;1332;1333;1334;1336;1337;1341;1350;1351;1352;1354;1356;1358;1360;1361;1362;1364;1365;1366;1367;1368;1369;1370;1372;1373;1374;1380;1381;1382;1383;1384;1385;1386;1387;1395;1397;1399;1400;1401;1504;1511;1512;1539;1540;1546;1547;1548;1549;1550;1551;1552;1553;1554;1555;1556;1557;1558;1559;1561;1562;1563;1564;1565;1566;1567;1568;1569;1570;1571;1572;1573;1574;1575;1576;1577;1578;1579;1580;1583;1589;1592;1593;1600;1601;1603;1604;1605;1606;1611;1617;1618;1619;1622;1623;1626;1627;1628;1629;1633;1634;1635;1636;1637;1640;1642;1643;1644;1646;1647;1648;1650;1651;1653;1655;1666;1668;1669;1671;1672;1674;1677;1678;1680;1688;1691;1692;1695;1715;1716;1717;1718;1721;1724;1725;1776;1777;1778;1780;1782;1783;1785;1786;1787;1789;1790;1794;1795;1798;1800;1824;1826;1828;1833;1841;1843;1845;1846;1847;1912;1914;1915;99991;99993 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*		

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
Mammals	*Nyctophilus corbeni*	Corben's long-eared bat	Occurs in a range of inland woodland vegetation types, including box, ironbark and cypress pine woodlands as well as Bull oak woodland, *Acacia harpophylla* woodland, *Casuarina cristata* woodland, *Angophora leiocarpa*, woodland; *Eucalyptus camaldulensis* forests lining watercourses and lakes *Eucalyptus largiflorens*, woodland and dry sclerophyll forest.	The following High and Medium condition PCTs are considered to be General habitat: 2;9;10;20;21;22;23;27;28;29;35;36;37;38;39;40;54;55;56;57;58;59;67;69;70;72;75;78;80;81;82;84;86;87;88;98;101;103;104;105;106;108;109;110;112;113;128;134;135;139;142;147;148;170;171;172;173;174;175;176;177;178;179;180;184;185;186;190;191;192;193;199;200;201;202;207;208;217;218;221;227;228;230;231;235;239;241;243;244;245;246;247;248;249;255;256;257;258;266;267;270;272;273;274;282;321;322;323;324;325;326;327;328;329;330;331;332;333;354;355;356;358;362;367;368;369;370;371;373;374;375;378;379;380;381;382;384;385;387;389;390;393;396;397;398;399;401;402;404;405;406;407;408;409;411;412;413;414;415;417;418;419;420;421;422;423;425;426;428;429;430;431;432;433;434;435;439;440;441;442;443;444;448;449;450;451;454;455;456;457;458;459;461;462;464;468;469;470;471;472;473;474;477;488;489;502;503;504;505;506;508;509;510;511;516;517;526;527;528;529;531;536;537;543;544;549;551;556;562;564;566;567;573;576;577;578;579;580;581;584;587;588;589;590;591;592;593;594;595;596;597;598;599;610;631;671;672;673;674;675;676;687;702;711;713;733;737;746;756;763;764;772;791;810;818;833;847;853;856;864;865;868;890;955;956;965;970;983;998;1065;1066;1083;1090;1112;1118;1120;1124;1132;1133;1137;1162;1165;1171;1173;1176;1177;1182;1183;1194;1218;1251;1255;1270;1273;1277;1279;1305;1306;1307;1308;1310;1313;1314;1315;1316;1317;1327;1328;1329;1350;1351;1357;1360;1361;1362;1367;1370;1372;1380;1381;1383;1384;1387;1397;1399;1400;1511;1539;1540;1543;1550;1551;1552;1553;1555;1558;1559;1579;1583;1606;1611;1618;1619;1623;1626;1627;1628;1629;1633;1634;1635;1636;1637;1640;1642;1643;1644;1646;1647;1648;1650;1651;1653;1655;1660;1661;1666;1668;1669;1671;1672;1674;1675;1676;1677;1678;1680;1688;1695;1770	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	**Essential Habitat**	**Core Habitat**
				Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat		
Reptiles	*Furina dunmalli*	Dunmall's snake	Dunmall's snake has been found in a broad range of habitats, and is most often associated with forests and woodlands containing the following species: *Acacia harpophylla*, *Callitris glaucophylla, Allocasuarina luehmannii* and *Casuarina cristata* on black alluvial cracking clay and clay loams or sandstone derived soils	The following High and Medium condition PCTs are considered to be General habitat: 35;363;367;371;577;581;592;610;791;810;998;1380 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat
Reptiles	*Anomalopus mackayi*	Five-clawed worm-skink	The species shelters at the soil surface where moisture is sufficiently retained under decaying leaf litter, coarse woody debris or artificial debris. The species also lives in cavities in rotting tree bases, logs and in tussock bases. It is known to dig permanent tunnel-like burrows in loose, friable, humic soils in woodlands on slight basalt rises. On the Darling Downs, the species occurs in Bluegrass (*Dichanthium sericeum*) and/or Mitchell Grass dominated grasslands or mixed grasslands dominated by other grass species. In south-east Queensland, the species may occur in *Eucalyptus tereticornis/ Eucalyptus camaldulensis/ Eucalyptus populnea* grassy woodland/ open forests. In addition, the species has been recorded in areas characterised by *Callitris* sp. woodland.	The following High and Medium condition PCTs are considered to be General habitat: 24;27;35;36;37;39;40;43;49;50;52;55;56;71;78;81;83;87;101;115;144;145;146;160;163;168;195;197;211;214;234;241;242;244;247;264;362;376;377;421;433;434;438;441;444;451;454;466;511;516;544;589;590;593;599;619;628;629;710;711;1324;1383 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
			The species is not likely to be found in soils in which deep cracks do not form, such as hard-setting brown clays or sandy soils types).			
Birds	*Apus pacificus* *Hirundapus caudacutus*	Fork-tailed swift White-throated needletail	Aerial insectivores, ubiquitous	All areas	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat
Birds	*Myiagra cyanoleuca*	Forest/woodl and migrants	Fauna within this group are typically found in complex habitats including rainforests, vine thickets and wet sclerophyll forest gullies. However, during migration these species will utilise drier habitats such as riparian forests and woodlands and larger open forest to woodland remnants with a dense understorey (Pizzey and Knight 2007).	The following is considered to constitute General habitat: ALL PCTs (high and medium condition for field work amended layer) that are located within 100m of a perennial watercourse or natural drainage (perennial). *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the areas identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
Mammals	*Dasyurus maculatus maculatus*	Spot-tailed quoll	The Spot-tailed Quoll has a preference for mature wet forest habitat (Belcher 2000b; Green & Scarborough 1990; Watt 1993), especially in areas with rainfall 600 mm/year (Edgar & Belcher 2008; Mansergh 1984). Unlogged forest or forest that has been less disturbed by timber harvesting is also preferable (Catling et al. 1998, 2000). This subspecies has been recorded from a wide range of habitats, including, temperate and subtropical rainforests in mountain areas, wet sclerophyll forest, lowland forests, open and closed eucalypt woodlands, inland riparian and River Red Gum (*Eucalyptus camaldulensis*) forests, dry 'rainshadow' woodland, sub-alpine woodlands, coastal heathlands, occasional sightings from open country, grazing lands, rocky outcrops and other treeless areas (Edgar & Belcher 2008; Green & Scarborough 1990; Jones & Mansergh 1995a; Maxwell et al. 1996; NSW NPWS 1999; Reside 1997 cited in Dawson 2005; Rose 1996 cited in Dawson 2005).	The following is considered to constitute General habitat: All High and Medium condition PCTs that are located within 100m of a perennial watercourse or natural drainage (perennial), also the following High and Medium condition PCTs are considered to be General habitat: 2;5;9;36;42;54;78;79;81;84;85;110;113;114;146;147;186;201;202;217;228;241;249;266;267;268;269;270;272;273;274;275;276;277;278;279;280;281;282;283;284;285;286;287;288;289;290;291;293;294;295;296;297;298;299;300;302;303;304;305;306;307;309;310;311;312;313;314;315;316;317;318;321;322;323;324;325;326;327;328;329;330;331;332;333;334;337;338;339;340;341;342;343;345;346;347;348;349;350;351;352;353;354;356;358;362;363;366;367;368;369;370;371;372;373;374;375;378;379;380;381;382;384;385;386;387;388;389;390;391;392;393;394;395;396;398;399;401;402;404;405;406;407;408;409;412;413;414;415;417;418;419;420;421;422;423;425;426;429;430;431;432;433;434;435;440;441;442;443;444;445;448;449;450;451;452;453;455;456;457;458;459;461;462;463;464;468;469;470;471;472;473;477;488;489;495;498;499;502;503;504;505;506;507;508;509;510;511;512;513;514;515;516;517;519;520;521;522;523;524;525;526;527;528;529;530;531;532;533;534;535;536;537;538;539;542;543;544;545;547;548;549;550;551;552;555;556;557;558;559;561;562;564;565;566;567;568;572;573;574;575;576;577;578;579;580;581;583;584;585;586;587;588;589;590;591;592;593;594;595;596;597;598;599;600;605;606;608;609;610;611;627;628;632;636;638;639;644;646;647;648;649;650;651;652;653;654;655;657;658;659;661;662;663;664;666;667;668;669;670;672;674;675;677;678;679;680;681;682;683;684;685;686;687;688;689;690;691;692;693;694;695;696;697;698;699;701;703;704;705;706;707;708;709;712;715;716;717;718;719;720;722;723;724;725;726;727;728;729;730;731;732;733;734;735;736;737;738;740;741;742;743;744;745;747;748;749;750;751;752;754;755;756;757;760;761;762;763;764;767;768;769;770;771;772;774;775;776;777;778;780;	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
				781;787;788;789;790;792;795;798;800;805;809;810;811;812;814;815;817;818;819;820;821;822;823;824;825;826;827;829;830;831;832;833;834;835;836;837;838;839;840;841;842;843;844;845;847;848;849;850;851;852;853;854;855;856;857;858;859;860;861;862;863;864;865;866;867;868;870;871;872;873;874;875;877;878;879;880;881;882;883;885;886;887;888;889;890;891;892;896;898;899;900;901;904;905;906;907;908;909;910;911;912;913;914;920;921;923;924;927;929;931;932;934;935;939;941;942;943;944;946;947;948;949;950;951;952;953;954;955;957;958;963;964;965;967;968;969;970;971;972;973;974;975;976;977;978;979;980;981;982;983;984;986;988;990;991;992;993;994;995;996;997;998;999;1061;1062;1063;1064;1065;1066;1067;1068;1070;1071;1072;1073;1074;1077;1078;1079;1080;1081;1082;1083;1084;1085;1086;1087;1088;1089;1091;1092;1093;1094;1095;1096;1097;1099;1100;1101;1102;1103;1104;1105;1106;1107;1108;1109;1112;1116;1118;1119;1120;1121;1122;1123;1124;1127;1128;1129;1130;1132;1134;1135;1136;1137;1139;1140;1141;1142;1144;1145;1146;1147;1148;1149;1150;1152;1153;1154;1155;1156;1157;1158;1159;1160;1161;1162;1164;1165;1166;1167;1168;1169;1171;1173;1174;1175;1176;1177;1180;1181;1182;1183;1184;1188;1190;1191;1192;1194;1195;1196;1197;1198;1199;1200;1201;1205;1206;1207;1208;1209;1210;1211;1212;1213;1214;1215;1216;1217;1218;1219;1220;1221;1222;1223;1227;1228;1229;1230;1231;1232;1234;1235;1236;1237;1238;1239;1241;1242;1243;1244;1245;1246;1247;1248;1250;1251;1252;1253;1254;1256;1257;1258;1259;1260;1261;1262;1263;1265;1266;1267;1268;1271;1273;1275;1276;1277;1279;1281;1282;1283;1284;1285;1286;1289;1292;1293;1294;1296;1298;1300;1301;1302;1303;1304;1305;1306;1307;1308;1309;1310;1313;1314;1315;1316;1317;1318;1319;1320;1321;1322;1323;1325;1326;1327;1328;1329;1330;1331;1332;1333;1334;1336;1337;1338;1339;1340;1341;1350;1351;1352;1354;1356;1358;1359;1360;1361;1362;1363;1364;1365;1366;1367;1368;1369;1370;1372;1373;1374;1380;1382;1383;1385;1386;1395;1396;1397;1398;1399;1400;		

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
				1401;1501;1503;1504;1512;1519;1520;1522;1523;1525;1526;1527;1528;1529;1530;1531;1532;1533;1534;1535;1536;1537;1538;1539;1540;1541;1543;1545;1546;1547;1548;1549;1550;1551;1552;1553;1554;1555;1556;1557;1558;1559;1560;1561;1562;1563;1564;1565;1566;1567;1568;1569;1570;1571;1572;1573;1574;1575;1576;1577;1578;1579;1580;1581;1582;1583;1584;1585;1586;1587;1588;1589;1590;1591;1592;1593;1594;1595;1598;1599;1600;1601;1602;1603;1604;1605;1606;1607;1608;1609;1610;1611;1612;1613;1614;1615;1616;1617;1618;1619;1620;1621;1622;1623;1624;1625;1626;1627;1628;1629;1630;1631;1632;1633;1634;1635;1636;1637;1638;1639;1640;1641;1642;1643;1644;1645;1646;1647;1648;1649;1650;1651;1652;1653;1654;1655;1656;1657;1658;1660;1661;1663;1666;1667;1668;1669;1671;1672;1674;1675;1676;1677;1678;1679;1680;1681;1683;1684;1685;1686;1687;1688;1689;1691;1692;1693;1695;1696;1700;1701;1702;1703;1704;1705;1706;1707;1708;1709;1710;1711;1713;1714;1715;1716;1717;1718;1719;1720;1721;1722;1723;1724;1725;1727;1728;1729;1730;1731;1734;1748;1749;1761;1766;1767;1770;1771;1775;1776;1777;1778;1780;1782;1783;1785;1786;1787;1789;1790;1793;1794;1795;1798;1800;1803;1804;1808;1809;1810;1817;1822;1823;1824;1826;1828;1841;1843;1845;1846;1847;1911;1912;1914;1915;99991;99993;99994; *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the areas identified above are considered to constitute General habitat*		

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
Birds	*Lathamus discolor*	Swift parrot	The Swift parrot inhabits dry sclerophyll eucalypt forests and woodlands. It occasionally occurs in wet sclerophyll forests. Breeding occurs in Tasmania. The Swift parrot predominantly forages within habitats that have been so significantly cleared that they are classified as endangered ecological communities. This species primarily feeds on nectar and lerp in the canopy of *Eucalyptus* and *Corymbia* trees, typically *Eucalyptus tereticornis, Eucalyptus robusta* and *Corymbia citriodora/maculata.*	The following High and Medium condition PCTs are considered to be General habitat: 2;5;7;8;9;10;11;36;42;54;74;75;76;78;79;80;81;82;83;86;88;110;201;202;208;217;227;228;237;243;248;249;251;255;266;267;268;269;270;272;273;274;275;276;277;278;279;280;281;282;284;286;287;289;290;291;293;294;302;306;312;315;316;318;321;322;323;324;325;326;327;330;331;333;337;338;339;340;341;342;343;345;346;347;348;349;350;352;353;354;356;358;362;376;379;380;381;382;384;385;386;387;389;390;391;393;394;395;396;397;398;399;401;402;404;405;406;407;408;409;411;412;413;414;415;417;418;419;420;421;423;425;426;428;429;430;431;432;433;434;435;438;440;441;443;444;449;451;453;454;455;456;457;459;461;462;463;464;468;469;470;471;472;473;477;488;489;495;498;502;503;504;505;506;508;509;510;511;512;513;514;515;516;517;523;524;526;527;528;529;530;531;532;533;534;536;537;538;539;542;543;544;545;549;550;551;552;555;556;557;558;559;562;564;565;566;567;568;572;573;576;577;578;579;580;581;583;584;585;587;588;589;590;591;592;593;594;595;596;597;598;599;600;605;609;611;628;649;651;653;654;657;659;661;663;664;673;674;675;676;681;682;683;684;685;687;688;691;694;696;697;700;701;702;703;704;705;713;714;715;724;725;732;733;734;735;736;737;738;740;746;756;760;761;762;763;764;771;772;774;776;777;778;792;818;819;821;822;829;830;832;833;834;835;836;837;838;839;840;841;842;843;847;848;849;850;852;853;854;855;856;857;860;861;862;864;865;866;867;868;870;871;872;874;877;881;883;889;890;904;905;910;914;923;925;926;941;955;956;957;958;963;964;965;968;969;970;971;974;975;976;979;983;984;986;993;994;996;997;1061;1062;1064;1065;1066;1067;1072;1074;1079;1081;1082;1083;1085;1086;1088;1091;1094;1095;1097;1099;1100;1103;1104;1105;1106;1107;1112;1116;1118;1120;1132;1133;1135;1136;1137;1145;1162;1164;1169;1171;1173;1174;1175;1176;1177;1180;1181;1182;1183;1184;1188;1192;1194;1200;1205;1206;1207;1209;1210;1211;1212;1213;1214;1215;1216;1218;	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	Essential Habitat	Core Habitat
				1220;1221;1229;1230;1231;1232;1234;1236;1237;1245;1250;1251;1253;1255;1262;1268;1273;1277;1278;1279;1281;1284;1286;1296;1303;1304;1305;1306;1307;1308;1309;1310;1313;1314;1315;1316;1317;1319;1326;1327;1328;1329;1330;1331;1332;1333;1334;1352;1354;1356;1358;1361;1364;1366;1370;1373;1381;1382;1383;1385;1386;1387;1395;1396;1397;1399;1400;1401;1503;1504;1511;1512;1546;1547;1548;1550;1551;1552;1553;1554;1555;1556;1557;1558;1559;1564;1565;1568;1579;1583;1589;1590;1592;1593;1600;1601;1603;1604;1605;1606;1611;1617;1618;1619;1622;1623;1626;1627;1628;1629;1633;1634;1635;1636;1637;1640;1642;1643;1646;1647;1648;1650;1651;1655;1666;1668;1669;1671;1672;1674;1677;1678;1680;1688;1691;1692;1695;1715;1716;1717;1718;1721;1724;1725;1775;1776;1777;1778;1780;1782;1783;1785;1786;1787;1789;1790;1793;1794;1795;1798;1800;1803;1804;1809;1817;1822;1823;1824;1826;1828;1832;1833;1841;1843;1845;1846;1847;1911;1912;1914;1915;99997 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*		
Reptile	*Uvidicolus sphyrurus*	Border thick-tailed gecko	As implied by another of its common names (Granite Thick-tailed Gecko), this species often occurs on steep rocky or scree slopes, especially granite. Recent records from basalt and metasediment slopes and flats indicate its habitat selection is broader than formerly thought and may have extended into areas that were cleared for agriculture. Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey.	The following High and Medium condition PCTs are considered to be General habitat: 88;148;192;227;228;367;368;369;370;371;372;373;374;379;381;388;393;395;396;397;398;399;401;402;404;405;406;407;408;409;418;419;421;423;429;432;433;434;435;440;441;443;444;448;449;455;456;457;458;459;462;463;488;502;503;504;505;506;508;509;512;514;515;516;517;523;527;528;529;531;532;536;537;538;543;544;545;547;549;551;552;555;556;557;558;562;564;576;577;578;579;580;581;583;584;585;587;588;589;590;591;592;593;594;595;596;597;598;599;600;605;609;627;672;674;675;851;853;856;991;998;1116;1118;1124;1165;1168;1171;1218;1277;1286;1296;1305;1306;1307;1308;1313;1314;1315;1316;1317;1331;1341;1351;1352;1354;1360;1361;1362;1365;1366;1367;1369;1370;1372;1374;1380;1381;1382;1400;1503;1511;1543;1605;1606;1607;1609;1610;1611;1612;1656;1668;	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Class	Scientific Name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources)	GIS Habitat modelling instructions		
				General Habitat (NSW)	**Essential Habitat**	**Core Habitat**
				1687;1691;1693;1695;1696;1761;1766;1767;1770;1771;99993 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*		
Bird	*Pandion haliaetus* (formerly *Pandion cristatus*)	Osprey	The Osprey occurs in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia. The species is commonly recorded in coastal areas but also inland along major rivers. Foraging habitat includes extensive areas of open fresh, brackish or saline wetland habitats, also inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. May occur over atypical habitats such as heath, woodland or forest when travelling to and from foraging sites.	The following is considered to constitute General habitat: the following High and Medium condition PCTs that are located within 100m of a perennial watercourse or waterbody 36;78;238;249;356;361;400;465;646;661;663;682;685;686;689;724;726;751;772;773;774;776;780;781;782;783;784;785;786;815;823;828;835;881;882;883;897;915;916;917;918;919;920;925;926;941;978;1063;1064;1066;1071;1074;1083;1092;1105;1106;1112;1120;1125;1126;1134;1135;1136;1137;1139;1182;1183;1184;1204;1214;1227;1230;1231;1232;1234;1235;1236;1250;1251;1253;1272;1275;1276;1290;1325;1504;1513;1536;1537;1618;1619;1620;1624;1626;1636;1637;1640;1642;1644;1645;1646;1647;1648;1649;1650;1651;1652;1653;1681;1697;1700;1701;1702;1703;1704;1705;1706;1707;1715;1716;1717;1718;1719;1720;1721;1722;1724;1725;1726;1727;1728;1729;1730;1734;1735;1736;1737;1738;1739;1740;1741;1742;1746;1747;1776;1778;1783;1787;1789;1793;1794;1795;1798;1800;1808;1841;1847;1912;1913;99992;99993;99994;99995;99996;99998 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	Any specimen backed records (buffered to a 1km radius) that fall within areas mapped as *General habitat* (refer previous column) constitute *Essential habitat*	In NSW, any areas of essential habitat that overlap with a protected area constitute core habitat

Table note:
PCT = Plant community types as defined by the NSW State Vegetation Map (SVTM)

Table 5.3 TEC habitat assumptions used to map areas of occurrence within the study area

Scientific name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources	Habitat modelling assumptions		
			General habitat (NSW)	Essential habitat	Core habitat
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Brigalow TEC	The Brigalow ecological community occurs roughly within the 500-750 mm annual rainfall belt with a predominance of summer rainfall, although winter rainfall peaks occur in the south of its distribution where the climate in western areas is more arid. In New South Wales, Brigalow occurs on undulating plains or sandplains in the western areas and on flat or gentle rises on alluvial plains or undulating peneplains in eastern areas. Brigalow is associated with red, brown and grey clays, red and grey earths and red-brown earths. The community comprises Brigalow vegetation in the Mulga Land bioregions and the northern floodplains. It includes the following three vegetation communities of: Community 29-Brigalow open woodland on red earth and clay plains mainly in the Mulga Lands Bioregion, Community 31-Brigalow-Gidgee open woodland on clay plains west of the Culgoa River, Mulga Lands Bioregion, and Community 35-Brigalow-Belah woodland on alluvial often gilgaied clay soil mainly in the Brigalow Belt South Bioregion.	The following High and Medium condition PCTs are considered to be General habitat: 35, 445, 629, when ≥0.5 ha *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	n/a	n/a
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Grassland TEC	Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland, once occurred over a large area of Australia. The species composition of tussock grasslands varies throughout its range and is influenced by factors such as rainfall, soil, geology and land use history. These influences may vary the expression of the ecological community over short periods or across small distances. Many grass genera that occur as grassland dominants cover a diversity of habitats. The distribution of the ecological community is strongly reliant on soil type as it is associated with fine textured, often cracking clays derived from either basalt or quaternary alluvium. The ecological community generally occurs on flat to low slopes, of no more than 5 percent (or less than 1 degree) inclination. As slope increases, grassy woodlands dominated by trees such as *Acacia pendula* (Weeping Myall), *Eucalyptus coolabah* (Coolabah), *E. populnea* (Poplar Box) or *E. melliodora* (Yellow Box) occur. The ground layer component of these woodlands may be similar to the grassland but the soils will not be the same cracking clays as on the plains.	The following High and Medium condition PCTs are considered to be General habitat: 52, 102, 250, 320, 460, 484, 619, 633, 710, 795, 796, 799, 800, 1076, 1179, 1324, 1698, when ≥0.5 ha *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	n/a	n/a

Scientific name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources	Habitat modelling assumptions		
			General habitat (NSW)	Essential habitat	Core habitat
		In NSW, the national ecological community is included within two vegetation formations identified by Keith (2004): ■ Western Slopes Grasslands (easternmost occurrences around the Liverpool Plain); and ■ Semi-arid Floodplain Grasslands (westernmost occurrences around the Moree Plain). The ecological community also equates to two communities identified by Benson, which are at a finer scale of vegetation classification: – Community ID 52 Queensland Bluegrass – Cup Grass – Mitchell Grass – Native Millet alluvial plains grassland (Benson et al. 2006); and – Community ID 102 Plains grass grasslands on basaltic black earth soils mainly on the Liverpool Plains in the Brigalow Belt South Bioregion (Benson unpublished).			
Poplar Box Grassy Woodland on Alluvial Plains	Poplar box TEC	The Poplar Box Grassy Woodland is located west of the Great Dividing Range, typically at less than 300 m above sea level (ASL) and between latitudes 20°S to 34°S. The ecological community typically occurs on palaeo and recent depositional soils in flat terrain and occasionally along watercourses in undulating country. The woodland is mainly associated with active and relictual depositional plains and flats including back plains, higher terraces, levees along rivers (particularly in Queensland) and stagnant alluvial plain landscapes. The Poplar Box Grassy Woodland is sometimes found in close proximity to ephemeral watercourses and depressions. The following Plant Community Type (PCT) identification units best correspond to the Poplar Box Grassy Woodland: ■ PCT56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW ■ PCT8716 - Poplar Box - Coolabah floodplain woodland on light clay soil mainly in the Darling Riverine Plains Bioregion ■ PCT101 - Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion ■ PCT244 - Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	The following High and Medium condition PCTs are considered to be General habitat: 56, 87, 101, 244, when ≥ 1 ha *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	n/a	n/a

Scientific name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources	Habitat modelling assumptions		
			General habitat (NSW)	Essential habitat	Core habitat
Weeping Myall Woodlands	Myall TEC	The Weeping Myall Woodlands generally occur on flat areas, shallow depressions or gilgais on raised (relict) alluvial plains. These areas are not associated with active drainage channels and are rarely if ever flooded. The ecological community occurs on black, brown, red-brown or grey clay or clay loam soils. Weeping Myall trees often occur in monotypic stands, however other vegetation may also occur in the ecological community, though not as dominant species. These include: Western Rosewood (*Alectryon oleifolius* subsp. *elongatus*); Poplar box (*Eucalyptus populnea*); or Black box (*Eucalyptus largiflorens*). Weeping Myall Woodlands are analogous to two vegetation communities. These are: Vegetation Community ID 26: Weeping Myall open woodland of the Riverina and NSW South Western Slopes Bioregions; and Vegetation Community ID 27: Weeping Myall open woodland of the Darling Riverine Plains and Brigalow Belt South Bioregions	The following High and Medium condition PCTs are considered to be General habitat: 26, 27, when ≥ 0.5 ha *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	n/a	n/a
Coolibah – Black Box Woodlands of the Darlings Riverine Plains and Brigalow Belt South Bioregions	Coolibah TEC	The Coolibah – Black Box Woodlands are found on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands, and stream levees. The ecological community occurs on a landscape of flat to low relief where small changes in slope and height can influence the species composition. Parts of the ecological community associated with drainage depressions and gilgai. Coolibah – Black Box Woodlands are found in a climatic zone that has summer dominant rainfall with an average annual rainfall ranging from approximately 250 to 700 mm per year. Average minimum monthly temperatures range from -2°C to 5°C and average maximum monthly temperatures range from 23°C to 35°C. NSW Vegetation Classification and Assessment (NSW VCA) vegetation community IDs: ■ ID 37 – Black Box woodland on floodplains of the NSW central and northern wheatbelt including the Darling Riverine Plains Bioregion; ■ ID 39 – Coolibah – River Coobah – Lignum woodland of frequently flooded channels mainly of the Darling Riverine Plains Bioregion; and ■ ID 40 – Coolibah open woodland with chenopod/grassy ground cover on grey and brown clay floodplains.	The following High and Medium condition PCTs are considered to be General habitat: 37, 39, 40, when ≥5 ha *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	n/a	n/a

Scientific name	Common name	Habitat Requirements that are the Basis for the GIS assumptions (derived from SPRATS (Australian Government 2019) and other relevant peer reviewed sources	Habitat modelling assumptions		
			General habitat (NSW)	Essential habitat	Core habitat
White box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	White box TEC	Box – Gum Grassy Woodlands and Derived Grasslands are characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of White Box, Yellow Box or Blakely's Red Gum trees. In the Nandewar Bioregion, Grey Box (*Eucalyptus microcarpa* or *E. moluccana*) may also be dominant or codominant. The tree-cover is generally discontinuous and consists of widely-spaced trees of medium height in which the canopies are clearly separated. This ecological community is listed under New South Wales (NSW) legislation as an endangered ecological community, White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland).	The following High and Medium condition PCTs are considered to be General habitat: 382, 702 when ≥0.1 ha *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	n/a	n/a
Semi-evergreen vine thicket of the Brigalow Belt (North and South) and Nandewar Bioregions	SEVT	Semi-evergreen vine thicket (SEVT) is considered an extreme form of dry seasonal subtropical rainforest. It is generally characterised by the prominence of trees with microphyll sized leaves (i.e. leaves usually 2.5–7.6 cm long), the presence of Bottle Trees (*Brachychiton* spp.) as emergents from the vegetation, and the thickets occurring in areas with a subtropical, seasonally dry climate on soils of high to medium fertility. In New South Wales, the listed SEVT ecological community is equivalent to the *Notelaea microcarpa-Ehretia membranifolia-Geijera parviflora* vine thicket vegetation and the Western Vine Thickets described by Keith (2004). Relative to the small size of the vine thicket patches, the vegetation is floristically rich in shrubs, small trees and vines. The plant species diversity of the vine thickets (< 100 species recorded in the vegetation type; Benson et al. 1996) is, however, much lower than the floristic diversity of the vine thickets in Queensland. Vine thickets in New South Wales are also generally more open than those in Queensland (Floyd 1990), often comprising local thickets of densely spaced trees and shrubs frequently alternating with gaps in which trees and shrubs are absent or sparsely scattered, and in extreme cases occurring just as scattered individuals (Williams 2003). The vine thickets occur mainly on hills on light clay soils derived from basalt also occur in areas with sandy loams derived from sediments. The vine thickets are dominated by a variety of low tree and shrub species, with the species composition varying from north to south, possibly due to rainfall differences. Characteristic canopy species include *Elaeodendron australe* var. *integrifolium* (Red Olive Plum), *Ehretia membranifolia* (Peach Bush), *Geijera parviflora* (Wilga), *Notelaea microcarpa* (Native Olive), *Pouteria cotinifolia* var. *pubescens* (Yellow Lemon) and *Pittosporum spinescens* (Wallaby Apple, Large-fruited Orange Thorn). The trees and tall shrubs are usually 2 to 10 m tall.	The following High and Medium condition PCT is considered to be General habitat: 147 *Note: Any specimen backed records (buffered to a 1km radius) that fall outside of the PCTs identified above are considered to constitute General habitat*	n/a	n/a

6 References

6.1 General references

ARTC 2018. *North Star to NSW/QLD Border Project Study Area Selection Report*

WSP/PB 2017. *Melbourne to Brisbane Inland Rail, 2016 Phase 1 Continuity Alignment Report, North Star to Yelarbon* (01-2700-PD-P00-DE-008)

WSP/PB 2017a. *Melbourne to Brisbane Inland Rail, 2016 Phase 2 Preparatory Alignment Assessment Report, North Star to Yelarbon* (01-2700-PD-P00-DE-011)

6.2 Species specific references:

6.2.1 Flora

Cadellia pentastylis (Ooline)

Atlas of Living Australia (2018). *Cadellia pentastylis*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2912802# [Accessed 28 August 2018].

Benson, J.S. (1993). The biology and management of Ooline (*Cadelia pentastylis*) in NSW. *Species Management Report No. 2*. Hurstville: NSW NPWS.

Harden, G.J. (ed.) (1991*). Flora of New South Wales, Volume Two*. Kensington, NSW: University of NSW Press.

McMaster I. (2008). *Cadellia pentastylis*. (Image) [Online] Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2912802# [Accessed 28 August 2018].

Office of Environment and Heritage (2018). Ooline - Profile. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10118 [Accessed 28 August 2018].

Queensland Department of Natural Resources (2000). *Species Management Manual*. Forest and Fauna Conservation and Ecology Section, Queensland Department of Natural Resources.

Dichanthium setosum (Bluegrass)

Atlas of Living Australia (2018). Distribution of *Dichanthium setosum,* viewed 24 August 2018, available: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2905357.

AusGrass2 (2018). *Dichanthium setosum,* viewed 24 August 2018, available: http://ausgrass2.myspecies.info/content/dichanthium-setosum.

Ayers, D, Nash, S, and Baggett, K (Eds) (1996), Threatened Species of Western New South Wales, New South Wales National Parks and Wildlife Service, Hurstville.

Department of the Environment, Water, Heritage and the Arts (2008). Approved Conservation Advice for *Dichanthium setosum*. Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/14159-conservation-advice.pdf. In effect under the EPBC Act from 26 March 2008.

Department of Environment and Conservation New South Wales (2005), *Dichanthium setosum* – Profile, viewed 11 December 2007, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10221.

Harden, GJ (Ed) 1993, Flora of New South Wales, Volume Four, University of New South Wales Press,

Kensington. Henderson, RJF (1997), Queensland Plants Names and Distribution, Queensland Herbarium: Indooroopilly.

NSW Office of Environment and Heritage (2013). Bluegrass - profile. Available from: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10221.

Yu, P., N. Prakash and R.D.B. Whalley (2000). Comparative reproductive biology of the vulnerable and common grasses in Bothriochloa and Dicanthium. In: Jacobs, S.W.L. and J. Everett, eds. Grasses: systematics and evolution. CSIRO Publishing, Collingwood.

Homopholis belsonii (Belson's panic)

Atlas of Living Australia (1998). Homopholis belsonii. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2912755#overview [Accessed 17 August 2018].

Department of the Environment (2018). Homopholis belsonii in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat. [Accessed 17 August 2018].

Office of Environment and Heritage (2017). Belson's Panic – profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10925 [Accessed 17 August 2018].

Threatened Species Scientific Committee (2008). Commonwealth Conservation Advice on Homopholis belsonii. Available from http://www.environment.gov.au/biodiversity/threatened/species/pubs/2406-conservation-advice.pdf [Accessed 17 August 2018].

Swainsona murrayana (Slender Darling-pea)

Atlas of Living Australia (2018). *Swainsona murrayana*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2888731 [Accessed 30 August 2018].

Department of the Environment (2019). *Swainsona murrayana* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: **http://www.environment.gov.au/sprat**. [Accessed 30 August 2018]

Office of Environment and Heritage, NSW (2018). *Swainsona murrayana*. Available from: https://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=10779 [Accessed 30 August 2018].

Parker D. (2018). *Swainsona murrayana*. (Image) [Online] Available from: https://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=10779 [Accessed 28 August 2018].

Thesium australe (Austral toadflax)

Atlas of Living Australia (2018). *Thesium australe*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2898274#tab_recordsView [Accessed 30 August 2018].

Cohn, J.S. (2004). Effects of slashing and burning on *Thesium australe* R. Brown (Santalaceae) in coastal grasslands of NSW. *Proc. Linn. Soc. NSW*. 125:57-65. Linnean Society of NSW, Kingsford, NSW

Hunter J. (2018). *Thesium australe* (Image) [Online] Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2891975#gallery [Accessed 30 August 2018].

Hunter, J.T., Kingston J. and Croft P. (1999). Vegetation and floristics of Kwiambal National Park and surrounds, Ashford, New South Wales. *Cunninghamia*. 6(2):351-78.

Leigh, J., Boden R. and Briggs J. (1984). *Extinct and Endangered Plants of Australia*. Melbourne, Victoria: Macmillan.

Office of Environment and Heritage, NSW (2018). Austral toadflax. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10802 [Accessed 30 August 2018].

Scarlett, N.H., Branwell M. and Earl G. (2003). *Flora and Fauna Guarantee Action Statement 56-Austral Toad Flax* Thesium australe. [Online]. Victorian Department of Sustainability and Environment (Vic. DSE). Available from: http://www.depi.vic.gov.au/environment-and-wildlife/threatened-species-and-communities/flora-and-fauna-guarantee-act-1988/action-statements.

Tylophora linearis

Atlas of Living Australia (2018). *Tylophora linearis*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2906372# [Accessed 28 August 2018].

Carr G. (n.d.). Flowers, buds and foliage, *Tylophora linearis*. (Image) [Online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10815 [Accessed 28 August 2018].

Office of Environment and Heritage, NSW (2017). *Tylophora linearis*. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10815 [Accessed 28 August 2018].

6.2.2 Fauna

Australasian bittern (*Botaurus poiciloptilus*)

Atlas of Living Australia (2018). Botaurus poiciloptilus. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:47dca80b-ac7c-4130-bef3-4afb4fad35ab [Accessed 22 August 2018].

Birdlife Australia (2018). Australasian Bittern. Available from: http://www.birdlife.org.au/bird-profile/australasian-bittern [Accessed 22 August 2018].

BirdLife International (2016). Botaurus poiciloptilus. The IUCN Red List of Threatened. Available from: http://www.iucnredlist.org/details/22697353/0 [Accessed 22 August 2018].

O'Donnell, Colin. (2011). Breeding of the Australasian Bittern (Botaurus poiciloptilus) in New Zealand. ResearchGate. Available from: https://www.researchgate.net/publication/263002340 [Accessed 22 August 2018].

Office of Environment and Heritage (2017). Australasian Bittern – Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10105 [Accessed 22 August 2018].

State Wide Integrated Flora and Fauna Teams (2018). Australasian Bittern. Available from: http://www.swifft.net.au/cb_pages/australasian_bittern.php [Accessed 22 August 2018].

Threatened Species Scientific Committee (2011). Botaurus poiciloptilus in Species Profile and Threats Database. Department of Environment and Energy. Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/1001-listing-advice.pdf [Accessed 22 August 2018].

Australian painted snipe (*Rostratula australis*)

Aviceda (2002). Photographic image of *Rostratula australis*. [Accessed 22 August 2018]

Barrett, G., Silcocks A., Barry S., Cunningham R. and Poulter R. (2003). *The New Atlas of Australian Birds*. Melbourne, Victoria: Birds Australia.

Blakers, M., Davies S.J.J.F. and Reilly P.N. (1984). *The Atlas of Australian Birds*. Melbourne, Victoria: Melbourne University Press.

del Hoyo, J., Elliott A. and Sargatal J. eds. (1996). *Handbook of the Birds of the World. Volume 3, Hoatzin to Auks*. Barcelona: Lynx Edicions.

Department of the Environment and Energy (2018). *Rostratula australis* in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=77037 [Accessed 22 August 2018].

Garnett, S.T. and Crowley G.M. (2000). *The Action Plan for Australian Birds 2000*. Canberra, ACT: Environment Australia and Birds Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/action/birds2000/index.html [Accessed 22 August 2018]

Marchant, S. and Higgins P.J., eds. (1993). *Handbook of Australian, New Zealand and Antarctic Birds*. Volume 2 - Raptors to Lapwings. Melbourne, Victoria: Oxford University Press.

New South Wales National Parks and Wildlife Service (1999). *Threatened Species Information - Painted Snipe.*

Rogers, D., Hance I., Paton S., Tzaros C., Griffioen P., Herring M., Jaensch R., Oring L., Silcocks A. and Weston M. (2005). The breeding bottleneck: breeding habitat and population decline in the Australian Painted Snipe. In: Straw, P., ed. *Status and Conservation of Seabirds in the East Asian-Australasian Flyway*. Pp. 15-23.

Watkins, D. (1993). A national plan for shorebird conservation in Australia. *RAOU Report Series*. 90.

White, M.E. (1997). *Listen, Our Land Is Crying. Australia's Environment: Problems and Solutions.* Kenthurst, New South Wales: Kangaroo Press.

Curlew sandpiper (*Calidris ferruginea*)

Atlas of Living Australia (2018). *Calidris (Erolia) ferruginea*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:fa188c0e-68ba-4b3f-8e8f-48734608c7d1 [Accessed 23 August 2018].

Birdlife Australia (2018). Curlew Sandpipers. (Image) [Online] Available from: http://birdlife.org.au/bird-profile/curlew-sandpiper [Accessed 22 August 2018].

Dann, P. (1999a). Feeding periods and supratidal feeding of Red-necked Stints and Curlew Sandpipers in Western Port, Victoria. *Emu*. 99:218-222.

Dann, P. (1999b). Foraging behaviour and diets of Red-necked Stints and Curlew Sandpipers in south-eastsoutheastern Australia. *Wildlife Research*. 27:61-68.

Department of the Environment and Energy (2018). *Calidris ferruginea* in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=856 [Accessed 22 August 2018].

Gosbell, K, Collins P. and Christie M. (2002). *Wader Surveys in the Coorong and S.E. Coastal Lakes February 2002*. Australasian Wader Studies Group.

Hayman, P., Marchant J. and Prater T. (1986). *Shorebirds. An identification guide to the waders of the world*. London and Sydney: Croom Helm.

Higgins, P.J. and Davies S.J.J.F. eds (1996). *Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons*. Melbourne, Victoria: Oxford University Press.

Lane, B.A. (1987). *Shorebirds in Australia*. Sydney, NSW: Reed.

Department of Environment and Climate Change, NSW (DECC) (2005). *Taren Point Shorebirds - profile*. NSW DECC. Available from: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10800 [Accessed 22 August 2018].

Dunmall's snake (*Furina dunmalli*)

Atlas of Living Australia (2018). Furina dunmalli. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:9ba2edaa-574b-4c18-8503-d0b658b16cc4 [Accessed 2 September 2018].

Department of Environment and Energy (2018). Furina dunmalli (Dunmall's Snake) in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59254 [Accessed 22 August 2018].

Department of Environment and Science (2017). Dunmall's snake. Queensland Government. Available from: https://www.ehp.qld.gov.au/wildlife/animals-az/dunmalls_snake.html [Accessed 22 August 2018].

Wilson, S (n.d). Dunmall's snake. In. Shy snake is hard to spot. ABC Wide Bay Publication. Available from: http://www.abc.net.au/local/stories/2009/04/21/2548064.htm [Accessed 22 August 2018].

Grey-headed flying-fox (*Pteropus poliocephalus*)

Atlas of Living Australia (2018). *Pteropus poliocephalus*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:a2553aed-383a-4c9b-9534-c6058bcee81b# [Accessed 24 August 2018].

Department of the Environment and Energy (2018). *Pteropus poliocephalus* in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=186 [Accessed 24 August 2018].

Duncan, A., Baker, G.B and Montgomery, N. (1999), *The Action Plan for Australian Bats.* [Online]. Canberra: Environment Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/action/bats/index.html. [Accessed 24 August 2018].

Eby, P. and Lunney, D. (2002), *Managing the Grey-headed flying-fox as a threatened species in NSW*. In: Proceedings of the Royal Zoological Society of New South Wales. Mosman, Sydney: Royal Zoological Society of New South Wales.

Hall, L. and Richards, G. (2000), *Flying Foxes: Fruit and Blossom of Australia*. Sydney: University of New South Wales Press.

Hall, L. (1987), Identification, distribution and taxonomy of Australian flying-foxes (Chiroptera: Pteropodidae). Australian Mammalogy. 10 (2):75-81.

Hall, L.S. (2002), *Management of flying fox camps: what have we learnt in the last twenty five years?* In: Eby, P. and D. Lunney, eds. Managing the Grey-headed flying-fox as a Threatened Species in NSW. Page(s) 215-224. Mosman, NSW; Royal Zoological Society of NSW.

Hariono, B., Ng J. and Sutton R.H. (1992). Lead concentrations in tissues of fruit bats (*Pteropus* sp.) in urban and non-urban areas. *Wildlife Research*. 20.

Leo (2010). *Pteropus poliocephalus*. (Image) [Online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:a2553aed-383a-4c9b-9534-c6058bcee81b [Accessed 24 August 2018].

Martin, L. (2000), Aspects of the Reproductive Biology of the Grey-headed flying-foxes that explain documented population declines, and support a threatened status. In: Proceedings of a Workshop to Assess the Status of the Grey-headed flying-fox in New South Wales. Unpublished report to the NSW Threatened Scientific Committee.

Nelson, J.E. (1965), Movements of Australian flying foxes (Pteropodidae: Megachiroptera). Australian Journal of Zoology. 13:53-73.

Pallin, N. (2000), Ku-ring-gai Flying-fox Reserve: habitat restoration project, 15 years on. Ecological Management and Restoration. 1:10-20.

Ratcliffe, F.N. (1931), *The flying fox (Pteropus) in Australia*. CSIRO Bulletin. 52:1-133.

State of the Environment Advisory Council (1996). *Australia: State of the Environment, 1996.*

Teagle, S. (2002). Flying fox Consultative Committee - Formation, Outcomes and Future Strategies. In: Eby, P. and D. Lunney, eds. *Managing the Grey-headed Flying-fox as a Threatened Species in NSW*. Page(s) 109-116. Mosman, NSW: Royal Zoological Society of NSW.

Tidemann, C. and Vardon, M. (1997), *Pests, pestilence, pollen and pot-roasts: the need for community-based management of flying foxes in Australia*. Australian Biologist. 10(1):77-83. hs Forest: New Holland Publishers Pty Ltd.

Tidemann, C.R. (1998), *Grey-headed flying-fox, Pteropus poliocephalus,* Temminck, 1824. In: Strahan, R., ed. The Mammals of Australia. Frenc.

van der Ree, R., McDonnell, J. Temby, I. Nelson, J. and Whittingham, E. (2005), The establishment and dynamics of a recently established urban camp of flying foxes (*Pteropus poliocephalus*) outside their geographic range. Journal of Zoology. 268:177-185. The Zoological Society of London.

van der Ree, R., McDonnell, M.J. Temby, I. Nelson, J. and Whittingham, E. (2006), The establishment and dynamics of a recently established urban camp of Pteropus ploiocephalus outside their geographic range. Journal of Zoology London. 268:177-185.

Koala (*Phascolarctos cinereus*)

Atlas of Living Australia. (2018). Phascolarctos cinereus. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:e9d6fbbd-1505-4073-990a-dc66c930dad6 [Accessed 22 August 2018].

Crowther, M., D. Lunney, J. Lemon, E. Stalenberg, R. Wheeler, G. Madani, K. Ross and M. Ellis. (2013). Climate-mediated habitat selection in an arboreal folivore. Ecography. 36:001-008.

Department of Environment and Energy (2018). Phascolarctos cinereus (Koala) Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=85104 [Accessed 22 August 2018].

Department of Environment and Science (2017). Koala facts. Queensland Government. Available from: https://www.ehp.qld.gov.au/wildlife/koalas/koala-ecology.html [Accessed 22 August 2018].

Martin, R. and K. Handasyde. (1999). The Koala: Natural history, conservation and management. Sydney, NSW: UNSW Press.

Moore, B.D. and W.J. Foley. (2000). A review of feeding and diet selection in koalas (Phascolarctos cinereus). Australian Journal of Zoology. 48:317-333.

Office of Environment and Heritage (2018). Koala - Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10616 [Accessed 22 August 2018].

Large-eared pied bat (*Chalinolobus dwyeri*)

Atlas of Living Australia (2018). *Chalinolobus dwyeri*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:cddd224d-40ed-49d9-bb88-dcbfe064a35e#gallery [Accessed 24 August 2018].

Curtis, L.K., Dennis, A.J., McDonald, K.R., Kyne, P.M. and Debus, S.J.S. (2012). *Queensland's Threatened Animals* CSIRO Publishing, Collingwood, Victoria, Australia

Department of Environment and Resource Management (2011). National recovery plan for the Large-eared pied bat *Chalinolobus dwyeri*. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Department of the Environment and Energy (2011). *Chalinolobus dwyeri* in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=183 [Accessed 24 August 2018].

Duncan, A., Baker, G.B and Montgomery, N. 1999, *The Action Plan for Australian Bats.* [Online]. Canberra: Environment Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/action/bats/index.html. [Accessed 24 August 2018].

Dwyer, P.D. (1966). Observations on Chalinolobus dwyeri (Chiroptera: Vespertilionidae) Australia. Journal of Mammalogy. 47:716-718.

Hoye, G.A. and Dwyer P.D. (1995). Large-eared pied bat *Chalinolobus dwyeri*. **In:** Stahan, R, ed. *The Mammals of Australia*. Page(s) 510-511. Chatswood, NSW: Reed Books.

Hoye, G.A. (2005). *Recovery plan for the large-eared pied bat Chalinolobus dwyeri*. Fly By Night Bat Surveys Pty Ltd. Brisbane: Queensland Parks and Wildlife Service.

Ryan, R.M. (1966). A new and imperfectly known Australian Chalinolobus and the taxonomic status of African Glauconycteris. *Journal of Mammalogy*. 47:86-91.

Schulz, M. (1998). Bats and other fauna in disused Fairy Martin Hirundo arial nests. *Emu*. 98:184-191.

Threatened Species Scientific Committee (2012). *Commonwealth Listing Advice on* Chalinolobus dwyeri *(Large-eared Pied Bat)*. Department of Sustainability, Environment, Water, Population and Communities. Canberra, ACT: Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/183-listing-advice.pdf. In effect under the EPBC Act from 29 June 2012.

Five-clawed worm-skink (*Anomalopus mackayi*)

Atlas of Living Australia (2018). *Anomalopus mackayi*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:bcbb3f69-0f90-4b6d-a062-218439a61a51 [Accessed 23 August 2018].

Brigalow Belt Reptiles Workshop (2010). Proceedings from the workshop for the nine listed reptiles of the Brigalow Belt bioregions. 18-19 August. Brisbane: Queensland Herbarium.

Cogger H.G. (2000). *Reptiles and Amphibians of Australia*, (6th edition) Ralph Curtis Books, NSW

Department of the Environment and Energy (2018). *Anomalopus mackayi* in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25934 [Accessed 23 August 2018].

Dolley, C (n.d.). Photograph: Long-legged worm-skink, Department of National Parks, Sport and Racing, (Image) [Online] Available from: https://www.ehp.qld.gov.au/wildlife/animals-az/longlegged_wormskink.html [Accessed 23 August 2018].

Ehmann, H. (1992). Encyclopaedia of Australian Animals: Reptiles. Angus and Robertson: Sydney

NSW National Parks and Wildlife Service (1999). *Five-clawed Worm-skink - Threatened Species Information*. Available from: http://www.environment.nsw.gov.au/resources/nature/tsprofileFiveclawedWormskink.pdf

Shea, G.M., Millgate M. and Peck S. (1987). A range extension for the rare skink *Anomalopus mackayi. Herpetofauna.* 17 (2):16-19.

Wilson, S.K. and Knowles, D.G. (1988). Australia's Reptiles A Photographic Reference to the Terrestrial Reptiles of Australia. Collins: Sydney.

Painted honeyeater (*Grantiella picta*)

Atlas of Living Australia (2018), *Grantiella picta.* Viewed 17 August 2018, Available: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:de126daa-e11d-42e0-ace6-7873abe6c96b#.

Barea, L. P. (2008). Nest-site selection by the Painted Honeyeater (Grantiella picta), a mistletoe specialist. Emu, 108, 213-220.

BirdLife International (2018) Species factsheet: Grantiella picta. Downloaded from http://www.birdlife.org on 17/08/2018.

Chapman A (2017), *Grantiella picta*, viewed 17 August 2018, Available: https://images.ala.org.au/store/2/0/a/1/e183a4e1-b111-444b-b39d-59fd62b01a02/original

Cooney, S. J., Watson, D. M., and Young, J. (2006). Mistletoe nesting in Australian birds: A review. Emu, 106, 1-12.

Department of the Environment (2015). Conservation Advice Grantiella picta painted honeyeater. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/470-conservation-advice.pdf. In effect under the EPBC Act from 08 July 2015.

Garnett, S., J. Szabo and G. Dutson (2011). *The Action Plan for Australian Birds 2010*. CSIRO Publishing. Available from: http://birdsindanger.net/taxatable.

Higgins, P. J., Peter, J. M., and Steele, W. K. (Eds.). (2001). Handbook of Australian, New Zealand and Antarctic birds: Vol. 5. Tyrant-flycatchers to Chats. Oxford University Press: Melbourne. ISBN 0195532589. http://eol.org/pages/919405/details#cite_note-Higgins.2CPeter.2CSteele-2.

Keast, A. (1968). Seasonal movements in the Australian honeyeaters (Meliphagidae) and their ecological significance. Emu, 67, 159-209. http://eol.org/pages/919405/details#cite_note-Keast-12.

Nature Conservation Act 1992 (Queensland): September 2017 list)

Oliver, D. L., Chambers, M. A., Parker, D. G. (2003). Habitat and resource selection of the Painted Honeyeater (Grantiella picta) on the northern floodplains regions of New South Wales. Emu, 103, 171-176. http://eol.org/pages/919405/details#cite_note-OliverChambers-13.

Department of Environment and Science (DES), Painted honeyeater – *Grantiella picta*, Wetland*Info*, Queensland, viewed 17 August 2018, https://wetlandinfo.des.qld.gov.au/wetlands/ecology/components/species/?grantiella-picta.

Pizzey, G., and Knight, G. (2012). The field guide to the birds of Australia (9th ed.). HarperCollins: Sydney. ISBN 978-0-7322-9193-8. http://eol.org/pages/919405/details#cite_note-Higgins.2CPeter.2CSteele-2.

Simpson, K., and Day, N. (2004), *Field Guide to the Birds of Australia*, 7th ed. Australia: Penguin, 210.

Whitmore, M. J., and Eller, C. M. (1983). Observations at a nest of Painted Honeyeaters. Emu, 83(3) 199-202

Red goshawk (*Erythrotriorchis radiatus*)

Atlas of Living Australia (2016). Erythrotriorchis radiatus. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:1405a1d4-557c-40ac-9f44-a6d41e9136cd#overview [Accessed 22 August 2018].

Debus, S.J.S. (1991). An annotated list of NSW records of the Red goshawk. Australian Birds. 24:72- 89

Debus, S.J.S. (1993). The status of the Red goshawk (Erythrotriorchis radiatus) in New South Wales. Olsen, P., ed. Australasian Raptor Studies. Page(s) 182-191. ARA-RAOU, Melbourne

Department of Environment and Energy (2018). Erythrotriorchis radiatus (Red Goshawk) in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=942 [Accessed 22 August 2018].

Department of Environment and Science (2017). Red Goshawk. Queensland Government. Available from: https://www.ehp.qld.gov.au/wildlife/threatened-species/endangered/endangered-animals/red_goshawk.html [Accessed 22 August 2018].

Marchant, S. and P.J. Higgins, eds. (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2 - Raptors to Lapwings. Melbourne, Victoria: Oxford University Press.

Office of Environment and Heritage (2017). Red Goshawk – Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10279 [Accessed 22 August 2018].

Spot-tailed quoll (*Dasyurus maculatus maculatus*)

Atlas of Living Australia (2019) *Dasyurus maculatus maculatus.* Available from: **https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:673abc94-f59b-4840-86e7-4053538f6d07** [Accessed 25 July 2019].

Department of the Environment (2019). *Dasyurus maculatus maculatus* (SE mainland population) in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: **http://www.environment.gov.au/sprat**. [Accessed 25 Jul 2019].

Edgar, R. and Belcher, C. (1995) Spotted-tailed Quoll Dasyurus maculatus. Pp. 67-9 in Strahan, R. (ed.) The Mammals of Australia. Reed Books, Sydney.

Menkhorst, P. and Knight, F. (2001) A Field Guide to the Mammals of Australia. Oxford Uni Press, Melbourne.

Office of Environment and Heritage (2019) Spotted-tailed Quoll – profile. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10207 [Accessed 25 July 2019].

Corben's long-eared bat (*Nyctophilus corbeni*)

Atlas of Living Australia (2018) *Nyctophilus corbeni.* Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:8a111847-ee8b-4739-935f-248d37eb63ae [Accessed 22 August 2018].

Department of Environment and Energy (2018). *Nyctophilus corbeni* (Corben's Long-eared Bat) Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=83395 [Accessed 22 August 2018].

Department of Environment and Science (2017). Eastern long-eared bat. Queensland Government. Available from: https://www.ehp.qld.gov.au/wildlife/animals-az/micro-bats/eastern_longeared_bat.html [Accessed 22 August 2018].

Murphy (2005). Photograph: Southeast long-eared bat.

Office of Environment and Heritage (2017). Corben's Long-eared Bat - Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10568 [Accessed 22 August 2018].

Schulz, M. and Lumsden, L. (2010). (Draft) National Recovery Plan for the Southeastern long-eared bat *Nyctophilus corbeni*, Victorian Department of Sustainability and Environment

White-throated needletail (*Hirundapus caudacutus*)

Atlas of Living Australia (2018). *Hirundapus caudacutus*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:21205690-54fd-452a-9772-d3e1f8780dff# [Accessed 24 August 2018].

Barrett, G., Silcocks A., Barry S., Cunningham R. and Poulter R. (2003). *The New Atlas of Australian Birds*. Melbourne, Victoria: Birds Australia.

Burrows S. (2017). *Hirundapus caudacutus* (Image) [Online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:21205690-54fd-452a-9772-d3e1f8780dff# [Accessed 24 August 2018].

Cooper, R.P. (1971). High flying swifts. *Australian Bird Watcher*. 4:79-80.

Department of the Environment and Energy (2018). *Hirundapus caudacutus* in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=682 [Accessed 24 August 2018].

Higgins, P.J. (ed.) (1999). Handbook of Australian, New Zealand and Antarctic Birds. Volume Four - Parrots to Dollarbird. Melbourne: Oxford University Press.

6.2.3 Threatened Ecological Communities

Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC

Department of the Environment and Energy (2019). Brigalow (*Acacia harpophylla* dominant and co-dominant) in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=28 [Accessed 24 August 2019].

Myall Weeping Woodlands TEC

Department of the Environment and Energy (2019). Weeping Myall Woodland in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=98 [Accessed 25 August 2019].

White box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC

White box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland in Species Profile and Threats Database, Department of Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=43 [Accessed 25 July 2019].

Poplar Box Grassy Woodland on Alluvial Plains TEC

Poplar Box Grassy Woodland on Alluvial Plains in Species Profile and Threats Database, Department of Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=141&status=Endangered [Accessed 25 July 2019].

Coolibah-Black Box Woodland of the darling Riverine Plains and the Brigalow Belt South Bioregions TEC

Coolibah-Black Box Woodland of the darling Riverine Plains and the Brigalow Belt South Bioregions in Species Profile and Threats Database, Department of Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=66 [Accessed 25 July 2019]

Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC

Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland in Species Profile and Threats Database, Department of Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=88 [Accessed 25 July 2019].

Keith, D. (2004). Ocean shores to desert dunes: The native vegetation of New South Wales and the ACT, Department of Environment and Conservation, NSW

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions TEC

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions in Species Profile and Threats Database, Department of Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=24 [Accessed 25 July 2019]

Keith, D. (2004). Ocean shores to desert dunes: The native vegetation of New South Wales and the ACT, Department of Environment and Conservation, NSW.

Appendix A
Species profiles

Inland Rail NSW/QLD North Star to Border EIS

Species and Community Profiles

Australian Rail Track Corporation

Reference: 2700

Contents

Figures

1 Flora species

1.1 *Homopholis belsonii* (Belson's panic)

1.1.1 Status

Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) – Vulnerable

Biodiversity Conservation Act 2016 (NSW) (BC Act) – Endangered

1.1.2 Biology and ecology

1.1.2.1 Characteristics

Homopholis belsonii (Belson's panic) is a perennial grass capable of growing up to 0.5 m high, with leaf ligule at 0.8 to 1.5 mm and long leaf blades spanning between 2 to 4.5 mm in width (refer Photograph 1.1). The leaves of the plant are often glabrous however can also be found with ciliates at the base (Threatened Species Scientific Committee (TSSC) 2008; Office of Environment and Heritage (NSW) (OEH) 2019).

Along the lowermost branch two to three laterally compressed 4.8 to 8 mm spikelet feature whilst the common axis of the inflorescence and the primary branches both reach a length of 8 to 15 cm. The primary branches however contain hairy axils (OEH 2019).

Photograph 1.1 Homopholis belsonii

Source: Queensland Herbarium (2018)

1.1.2.2 Known distribution

Homopholis belsonii is known to occur along the northwest slopes and plains of New South Wales, near Goondwindi, and in Queensland along the southern Brigalow Belt near the Darling Downs area west of Toowoomba, Oakey and Millmerran. In Queensland, Belson's panic has been identified to cover an area of over 80,000 km^2 (Department of the Environment and Energy (DotEE) 2019, OEH 2019) (refer Figure 1.1).

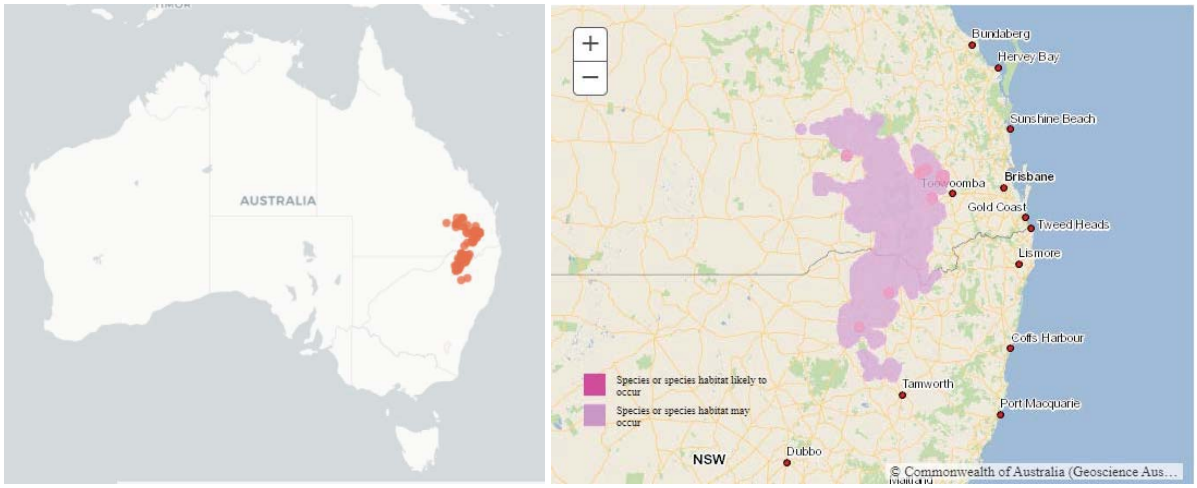


Figure 1.1 Distribution range of Belson's panic

Source: ALA (2019), DotEE (2019)

1.1.2.3 Biology and reproduction

Homopholis belsonii is known to occur in isolated areas of remnant vegetation with an ability to recolonise cleared or highly disturbed environments. The species is often found in regenerating vegetation along roadsides in sufficiently large populations producing seeds, despite viability time not known (DotEE 2019).

Flowering of the species usually occurs between February to May and possibly in November to December as fruiting has been recorded in February. Belson's panic has indicated the ability to germinate readily without the need for a dormancy period and dispersal through wind occurs when panicles dry after seed formation (DotEE 2019).

1.1.3 Habitat

Homopholis belsonii has been known to grow often in poor soils in dry woodlands specially in New South Wales as well as in areas which receive irregular or intermittent flooding, where *Homopholis belsonii* can be found on higher, well-drained rises. An elevation level of 200 to 520 m is required for the species in New South Wales whilst in Queensland, the species range from 342 to 500 m elevation (DotEE 2019).

The species can be classified to grow in three specific habitats which include:

- Rocky and basaltic hills featuring *Eucaluptus albens* (White box) and *Geijera parviflora* (Wilga) woodlands with various shrub and grass species
- Flat to gently undulating alluvial areas featuring *Casuarina cristata* (Belah) forests and occasionally *Acacia harpophylla* (Brigalow) forests
- Drainage lines featuring *C. cristata* and sandy country dominated by Cypress Pine-Bloodwood-Ironbark-She-Oak Forest (TSSC 2008).

1.1.4 Threatening processes

The following have been identified as potentially threatening processes to *Homopholis belsonii*:

- Habitat clearing for agriculture, development and/or pasture improvement
- Overgrazing by domestic stock

- Invasion of habitat by introduced species
- Encroachment of native vegetation impacting survival and reproduction in locations (OEH 2019).

1.1.5 Threat abatement/recovery plans

The following threat abatement plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). *Saving Our Species: Help save the Belson's panic*. NSW. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=1055&ReportProfileID=10925. In effect under the BC Act 2016.

1.1.6 References

Atlas of Living Australia (1998). Homopholis belsonii. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2912755#overview [Accessed 17 September 2019].

Department of the Environment (2019). Homopholis belsonii in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat. [Accessed 17 September 2019].

Office of Environment and Heritage (2019). Belson's Panic – profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10925 [Accessed 18 September 2019].

Queensland Herbarium. (2018). Belson's panic (Homopholis belsonii). [Image] [Online] Available from: https://images.ala.org.au/image/details?imageId=b5335e13-c937-4b4c-a7c0-5e725c5ee083. [19 September 2019].

Threatened Species Scientific Committee (2008). Commonwealth Conservation Advice on Homopholis belsonii. Available from http://www.environment.gov.au/biodiversity/threatened/species/pubs/2406-conservation-advice.pdf [Accessed 18 September 2019].

1.2 *Dichanthium setosum* (Bluegrass)

1.2.1 Status

EPBC Act – Vulnerable

BC Act – Vulnerable

1.2.2 Biology and ecology

1.2.2.1 Characteristics

Dichanthium setosum (Bluegrass) is an upright perennial grass less than 1 m tall. It has mostly hairless leaves about 2 to 3 mm wide. The flowers are densely hairy and clustered together along a stalk in a cylinder shape (refer Photograph 1.2) and appear mostly during summer. The species can form pure swards or occur as scattered clumps (Ayers et al. 1996; DEC 2005 as in DEWHA 2008; Harden 1993).

Photograph 1.2 Bluegrass (Dichanthium setosum)

Source: Rose (2013)

1.2.2.2 Known distribution

Dicanthium setosum occurs on the northern tablelands in the Saumarez area, west of Armidale, and 18 to 30 km east of Guyra. It has been found sparsely on the north-western slopes, central western slopes and north-western plains of New South Wales, extending west to Narrabri. In Queensland, it has been documented to occur from the Leichhardt, Morton, North Kennedy and Port Curtis regions (refer Figure 1.2). This species occurs in the Mistake Range, in Main Range National Park, and possibly in Glen Rock Regional Park, adjacent to the Main Range National Park (Ayers et al. 199; Henderson 1997).

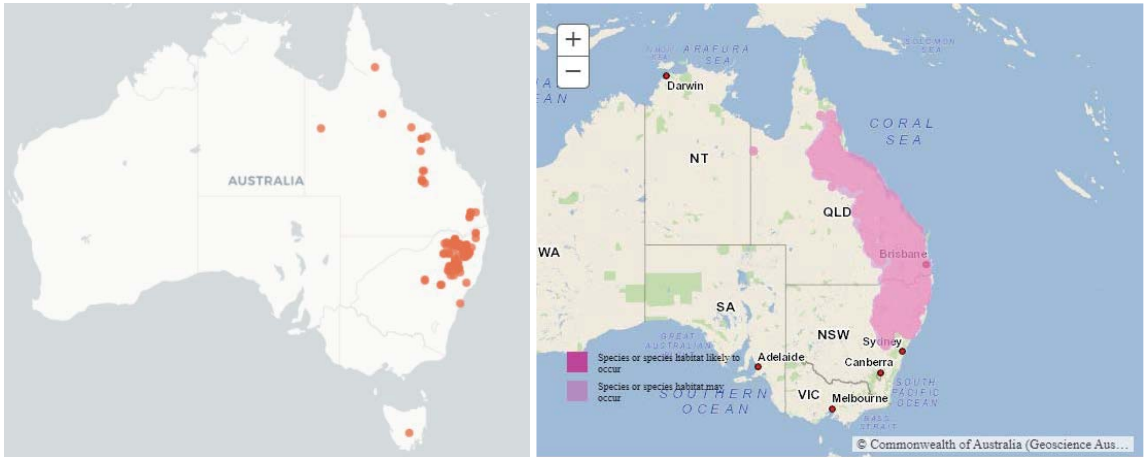


Figure 1.2 Distribution range of Dicanthium setosum

Source: ALA (2019), DotEE (2019)

1.2.2.3 Biology and reproduction

Dicanthium setosum is a warm season perennial grass, that commences growing in springs, flowers in summer and becomes dormant in late autumn. A fire frequency of greater than five years has been recommended for the species (OEH 2013; Yu et al. 2000).

1.2.3 Habitat

Dicanthium setosum is associated with heavy basaltic black soils and stony red-brown hardsetting loam with clay subsoil and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture. The extent to which this species tolerates disturbance is unknown. The species occurs within the Border Rivers−Gwydir, Central West, Namoi, Northern Rivers (New South Wales), South East and Fitzroy (Queensland) Natural Resources Management regions (Ayers et al. 1996; DEC 2005).

1.2.4 Threatening processes

The following have been identified as potentially threatening processes to *Dicanthium setosum*:

- Heavy grazing by agricultural animals
- Clearing of habitat for pasture and cropping
- Frequent irregular fires for agricultural purposes
- Road widening
- Invasion by introduced grasses (OEH 2013).

1.2.5 Threat abatement/recovery plans

The following threat abatement plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). *Saving Our Species: Help save the Bluegrass*. NSW. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=1192&ReportProfileID=10221. In effect under the BC Act 2016.

1.2.6 References

Atlas of Living Australia (2019). Distribution of Dichanthium setosum, viewed 13 September 2019, available: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2905357.

AusGrass2 (2019). Dichanthium setosum, viewed 13 September 2019, available: http://ausgrass2.myspecies.info/content/dichanthium-setosum.

Ayers, D, Nash, S, and Baggett, K (Eds) (1996), Threatened Species of Western New South Wales, New South Wales National Parks and Wildlife Service, Hurstville.

Department of the Environment and Energy – Species Profile and Threats Database – Dichanthium setosum — bluegrass. viewed online at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=14159. [Viewed 18 September 2019]

Department of the Environment, Water, Heritage and the Arts (2008). Approved Conservation Advice for Dichanthium setosum. Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/14159-conservation-advice.pdf. In effect under the EPBC Act from 26 March 2008.

Harden, GJ (Ed) 1993, Flora of New South Wales, Volume Four, University of New South Wales Press,

Kensington. Henderson, RJF (1997), Queensland Plants Names and Distribution, Queensland Herbarium: Indooroopilly.

Office of Environment and Heritage (2019), Dichanthium setosum – Profile, viewed 13 September 2019,at: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10221.

Rose, H. (2013). *Dichanthium setosum*. [image] [online] Available at: https://www.flickr.com/photos/73840284@N04/8675273472. [13 September 2019].

Yu, P., N. Prakash and R.D.B. Whalley (2000). Comparative reproductive biology of the vulnerable and common grasses in Bothriochloa and Dicanthium. In: Jacobs, S.W.L. and J. Everett, eds. Grasses: systematics and evolution. CSIRO Publishing, Collingwood

1.3 *Tylophora linearis*

1.3.1 Status

EPBC Act – Endangered

BCA Act – Vulnerable

1.3.2 Biology and ecology

1.3.2.1 Characteristics

Tylophora linearis is a slender, almost hairless twiner with a clear sap. Its leaves are dark green, linear and 1-5 cm x 0.5 to 3 mm. The flowers are purplish, 3 to 6 mm in diameter, hairy and in radiating groups of 3 to 8 (refer Photograph 1.3). The fruit is cigar shaped, hairless, up to 100 mm long and has a diameter of approximately 5 mm (OEH 2019).

Photograph 1.3 Tylophora linearis

Source: Carr (n.d.)

1.3.2.2 Known distribution

There are records of *T. linearis* from Goonoo, Pillaga West, Pillaga East, Bibblewindi, Cumbil and Eura State Forests, Coolbaggie Nature Reserve, Goobang National Park and Beni Strategic Cropping Area. There have also been records near Glenmorgan in the western Darling Downs, Queensland (OEH 2019) (refer Figure 1.3).

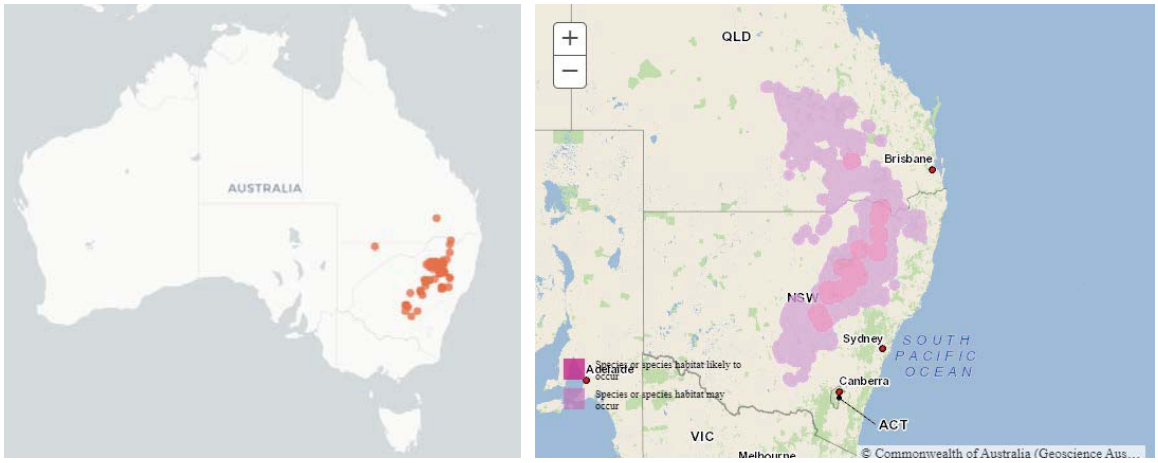


Figure 1.3 Distribution range of T. linearis

Source: ALA (2019), DotEE (2019)

1.3.2.3 Biology and reproduction

Tylophora linearis flowers in spring, with flowers recorded in November or May with fruiting probably 2 to 3 months later (OEH 2019).

1.3.3 Habitat

Tylophora linearis grows in dry scrub and open forest. It has been recorded in low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla* and *Allocasuarina luehmannii*. It also grows in association with *Acacia hakeoides, Acacia lineata, Melaleuca uncinata, Myoporum* species and *Casuarina* species (OEH 2019).

1.3.4 Threatening processes

The following have been identified as potentially threatening processes to *T. linearis*:

- Track maintenance
- Forestry activities
- Inappropriate disturbance regimes (OEH 2019).

1.3.5 Threat abatement/recovery plans

The following threat abatement plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). *Saving Our Species*. NSW. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10815. In effect under the BC Act 2016.

1.3.6 References

Atlas of Living Australia (2019). Tylophora linearis. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2906372# [Accessed 17 September 2019].

Carr G. (n.d.). Flowers, buds and foliage, Tylophora linearis. (Image) [Online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10815 [Accessed 17 September 2019].

Department of the Environment and Energy – Species Profile and Threats Database – Tylophora linearis. viewed online at: https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=55231. [Viewed 18 September 2019]

Office of Environment and Heritage, NSW (2019). Tylophora linearis. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10815 [Accessed 17 September 2019].

1.4 *Cadellia pentastylis* (Ooline)

1.4.1 Status

EPBC Act – Vulnerable

BC Act – Vulnerable

1.4.2 Biology and Ecology

Characteristics

Ooline is a medium-sized spreading tree usually about 10 m tall, and rarely to 25 m. It is very slow-growing. The glossy green leaves are 2 to 4 cm long and 15 to 20 mm wide, with broadly rounded tips. The upper sides of the leaves are darker and glossier than the undersides. Leaf venation is prominent on both leaf surfaces when dry. The white flowers are small and usually single. Each flower produces a cluster of up to five rounded, brown berries, 3 to 5 mm wide. Cadellia pentastylis is of considerable biogeographic interest as it is a relic of an extensive rainforest vegetation that covered much of Australia in the past. The species appears to flower spasmodically, during a general flowering period of October to January. Dispersal of fruit and seed is probably by “passive fall” or by birds. Seeds showed a high rate of infertility at all sites, although they have been successfully germinated and established after heat application. The species has the capacity to resprout from rootstock and coppice vigorously from stumps, a feature which may be critical for the species survival in a fire-prone environment (OEH 2019).

Photograph 1.4 Ooline (Cadellia pentastylis)

Source: McMaster (2008)

1.4.2.1 Known distribution

Ooline occurs on the western edge of the New South Wales north-west slopes, from Mt Black Jack near Gunnadah to west of Tenterfield and extends into Queensland to Carnarvon Range and Callide Valley, south-west of Rockhampton (Harden et al. 2006). This species is conserved within the Tregole National Park (NP), Sundown NP, Carnarvon Gorge NP, Mt Kaputar NP, Gamilaroi Nature Reserve (NR), Gibraltar NR, Bunal Flora Reserve (FR), Mehi FR, Campbell State Forest (SF) and Deriah SF (Briggs & Leigh, 1996; Curran & Curran 2005). Both Sundown NP and Carnarvon Gorge NP have more than 1,000 individuals (Briggs & Leigh, 1996). Some existing stands are on private property (Fletcher 2002). This species occurs within the Border River–Gwydir, Namoi (New South Wales), Burdekin, Burnett Mary and South West Queensland Natural Resource Management Regions. The natural range of Ooline is from 24ºS to 30ºS in the 500 to 750 mm per annum rainfall belt. (DotEE 2019, OEH 2019)

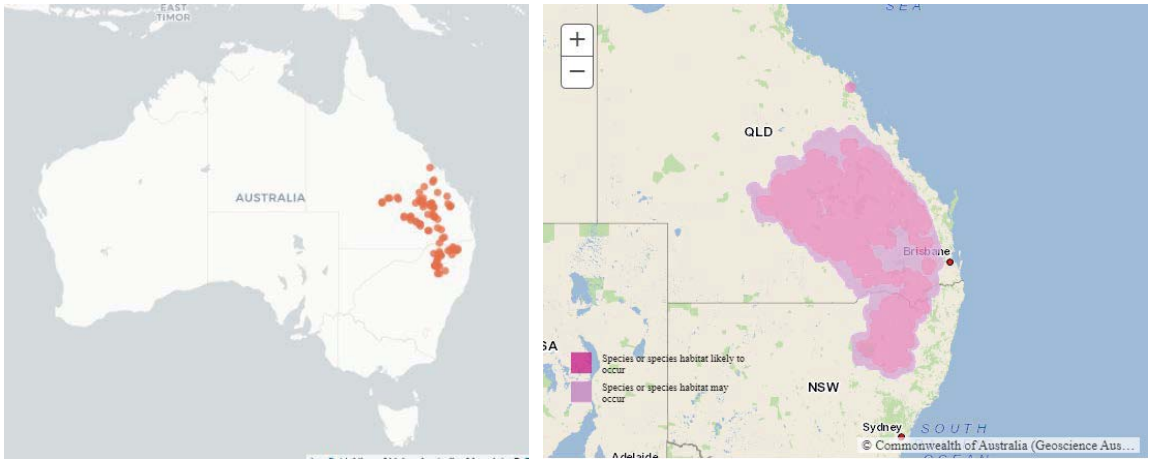


Figure 1.4 **Distribution range of Ooline**

Source: ALA (2019), DotEE (2019)

1.4.3 Habitat

Ooline grows in dry rainforest, semi-evergreen vine thickets and sclerophyll ecological communities, often locally dominant or as an emergent. Plants have been reported to be growing in cultivation at the Australian National Botanic Gardens, Canberra and Royal Botanic Gardens, Sydney (CHABG, 1994).

The distribution of this species overlaps with the following EPBC Act-listed threatened ecological communities:

- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions,
- Brigalow (Acacia harpophylla dominant and co-dominant), and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

There appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth (OEH 2019).

1.4.4 Threatening processes

The main threats listed for the species are:

- Localised extinction due to small scattered populations
- Inbreeding which threatens genetic diversity
- Low seed viability
- Logging
- Clearing for agriculture

- Grazing and soil compaction by domestic stock, feral goats and pigs
- Invasion of habitat by weeds
- Frequent fires
- Tunnel and sheet erosions
- Damage to roadside populations during roadworks
- High insect attacks.

1.4.5 Threat abatement/recovery plans

The following threat abatement plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). *Saving Our Species*. NSW. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10118. In effect under the BC Act 2016.

1.4.6 References

Atlas of Living Australia. (2019). Cadellia pentastylis – Available online at: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2912802 [Viewed 18 September 2019]

Department of the Environment and Energy – Species Profile and Threats Database – Cadellia pentastylis – Ooline viewed online at: https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=9828 [Viewed 18 September 2019]

Eddie,C. 2012. SANTOS Field Guide to the Trees and Shrubs of Eastern Queensland Oil and Gas Fields. Finsbury Green Printing

Office of Environment and Heritage – Threatened Species Profiles – Ooline (Cadellia pentastylis) Available online at: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10118 [Viewed 18 September 2019]

McMaster, I. (2008). Cadellia pentastylis. [image] [online] Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2912802# [28 August 2018].

1.5 *Lepidium aschersonii* (Spiny peppercress)

1.5.1 Status

EPBC Act – Endangered

BCA Act – Endangered

1.5.2 Biology and ecology

1.5.2.1 Characteristics

Spiny peppercress (*Lepidium aschersonii*) is an erect perennial herb up to 30 cm high, hairy and intricately branched, with smaller branches that are spinescent. The leaves are lobed, up to 12 cm long at the base and reduce in size up the stem. The flowers are small and borne in elongated clusters terminating in a spine. The fruit is a 2-celled, flattened circular pod on a spreading stalk, 4 mm long and 2.5 mm wide, with slight wings in the upper half forming a small notch at the apex (OEH 2018).

No image available.

1.5.2.2 Known distribution

Spiny peppercress occurs in the marginal central western slopes and northwestern plains regions of New South Wales from the Victorian border north to the Queensland border around North Star and Yetman (refer Figure 1.5). It is also found in southwest Victoria (OEH 2018).

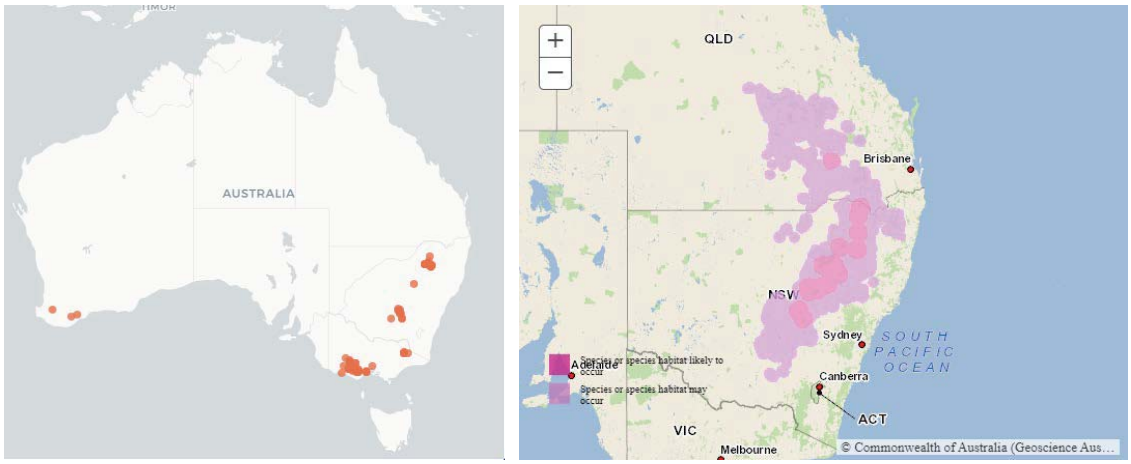


Figure 1.5 **Distribution range of Lepidium aschersonii**

Source: ALA (2019), DotEE (2019)

1.5.2.3 Biology and reproduction

Spiny peppercress flowers from spring to autumn. It is believed to be short-lived and populations have been known to immediately disappear following inundation by flooding, reappearing several seasons later. An apparent increase in numbers during drought conditions has also been observed. The species is reported to be salt tolerant and grows well under dry conditions. The species is most abundant where the understorey is sparser or non-existent and is often described as a “weed” where it dominates paddocks (OEH 2018).

1.5.3 Habitat

Spiny peppercress is found on ridges of gilgai clays dominated by Brigalow, Belah, Buloke and Grey box. Often the understorey is dominated by introduced plants. Vegetation structure varies from open to dense, with sparse grassy understorey and occasional heavy litter (OEH 2018).

1.5.4 Threatening processes

The following have been identified as potentially threatening processes to Spiny peppercress:

- Weed invasion
- Grazing
- Land development (tree clearing, levelling and crop establishment)
- Trampling and soil compaction
- Roadworks and rubbish dumping
- Roadworks (OEH 2018).

1.5.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Carter, O. (2010). *National Recovery Plan for the Spiny Peppercress* Lepidium aschersonii. Department of Sustainability and Environment, Melbourne. Available from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-spiny-peppercress-lepidium-aschersonii. In effect under the EPBC Act from 13-Aug-2010.
- Department of the Environment and Energy (2016). *Threat abatement plan for competition and land degradation by rabbits*. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-rabbits-2016. In effect under the EPBC Act from 07-Jan-2017.
- Department of the Environment and Energy (2017). *Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (Sus scrofa) (2017)*. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/feral-pig-2017. In effect under the EPBC Act from 18-Mar-2017.

1.5.6 References

Atlas of Living Australia (2018). Spiny Peppercress. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2919081# [Accessed 25 October 2018].

Department of the Environment and Energy (2018). *Lepidium ascheronii* in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/spratlookupspecies.pl?name=lepidium&searchtype=Wildcard [Accessed 12 August 2019].

Office of Environment and Heritage, NSW (2018). Spiny Peppercress - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10461 [Accessed 25 October 2018].

1.6 *Lepidium monoplocoides* (Winged peppercress)

1.6.1 Status

EPBC Act – Endangered

BCA Act – Vulnerable

1.6.2 Biology and ecology

1.6.2.1 Characteristics

Winged pepper-cress (*Lepidium monoplocoides*) is an erect annual herb or perennial forb, 15 to 20 cm high, with angular and striped stems roughened with small warts. Leaves are narrow and linear and usually 2 to 7 cm long (refer Photograph 1.5). Flowers are small, borne in elongated clusters and the petals are minute or absent. Fruit are 2-celled, flattened circular pods on a spreading stalk, 5 mm long and about 4 mm wide, with pointed wings extending to a narrow notch at the tip (OEH 2017).

Photograph 1.5 Lepidium monoplocoides

Source: Copeland (n.d.)

1.6.2.2 Known distribution

Widespread in the semi-arid western plains regions of New South Wales. Collected from widely scattered localities, with large numbers of historical records but few recent collections. There is a single collection from Broken Hill and only two collections since 1915, the most recent being 1950. Also previously recorded from Bourke, Cobar, Urana, Lake Cargelligo, Balranald, Wanganella and Deniliquin. Recorded more recently from the Hay Plain, south-eastern Riverina, and from near Pooncarie. (OEH 2019) (refer Figure 1.6).

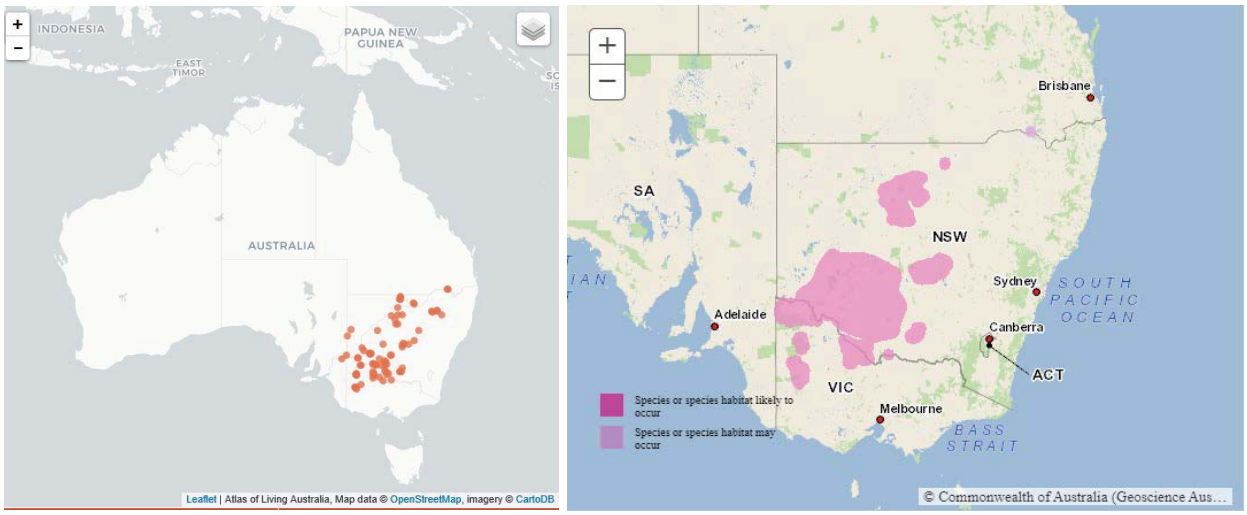


Figure 1.6 Distribution range of Winged peppercress

Source: ALA (2019), DotEE (2019)

1.6.2.3 Biology and reproduction

Winged peppercress flowers from late winter to spring, or August to October. The species is highly dependent on seasonal conditions. Occurs in periodically flooded and waterlogged habitats and does not tolerate grazing disturbance.

The number of plants at each site varies greatly with seasonal conditions, but sites tend to be small in area with local concentrations of the plant. Has been recorded as uncommon to locally common with hundreds of plants at sites (OEH 2019).

1.6.3 Habitat

The species occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of around 300-500 mm. Predominant vegetation is usually an open woodland dominated by Allocasuarina luehmannii (Bulloak) and/or eucalypts, particularly Eucalyptus largiflorens (Black Box) or Eucalyptus populnea (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses. It has been recorded in a wetland-grassland community comprising Eragrostis australasicus, Agrostis avenacea, Austrodanthonia duttoniana, Homopholis proluta, Myriophyllum crispatum, Utricularia dichotoma and Pycnosorus globosus, on waterlogged grey-brown clay. Also recorded from a Maireana pyramidata shrubland (OEH 2019).

1.6.4 Threatening processes

The following have been identified as potentially threatening processes to Winged peppercress:

- Agricultural development (most of the former range of the species has been extensively used for agriculture, cropping and improved pasture).
- Habitat removal (small depressions that were former principal habitat eliminated by ploughing).
- Grazing (the species is highly palatable to rabbits and kangaroos).
- Disturbances associated with a Navy-owned communications tower, service roads and fire-breaks.
- Pugging and trampling by stock.
- Recreational 4WD vehicles churn up solid surface and significantly disturb habitat structure. (OEH 2019).

1.6.5 Threat abatement/recovery plans

The following threat abatement plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). *Saving Our Species*. NSW. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10463. In effect under the BC Act 2016.

1.6.6 References

Atlas of Living Australia (2019). *Lepidium monoplocoides*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2898274 [Accessed 19 September 2019].

Copeland, L. (n.d.). *Lepidium monoplocoides* (Image) [Online] Available from: https://www.nationalparks.nsw.gov.au/conservation-programs/winged-peppercress-conservation-program [18 September 2019].

Office of Environment and Heritage, NSW (2019). Winged Peppercress - profile. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10463 [Accessed 19 September 2019].

1.7 *Swainsona murrayana* (Slender Darling-pea)

1.7.1 Status

EPBC Act – Vulnerable

BC Act – Vulnerable

1.7.2 Biology and ecology

1.7.2.1 Characteristics

Slender Darling-pea (Swainsona murrayana) is a prostrate, somewhat erect perennial herb growing up to 25 cm tall with densely pubescent stems. The leaves are about 5 to 10 cm long, with 3 to 11 leaflets that are 5 to 30 mm long and 1 to 2 mm wide. The flowers are up to 10 mm long and pea-like with the keel a solid pink and the standard petals typically striped pink and white (refer Photograph 1.6). It is distinguished by the strongly twisted hypanthium and keel with retracted tip (DSE 2007; Harden 1991; Jeanes 1996; OEH 2019).

Photograph 1.6 Slender Darling-pea (*Swainsona murrayana*)

Source: Queensland Herbarium (2018)

1.7.2.2 Known distribution

In Queensland the Slender darling pea can be found around Roma and possibly further west and near the New South Wales border. In New South Wales it has been recorded from just north of Moree southwest across to Mildura and the Victorian border (refer Figure 1.7). It has been recorded in northwestern Victoria as well as the southeastern corner of South Australia (OEH 2017). Refer Figure 1.7.

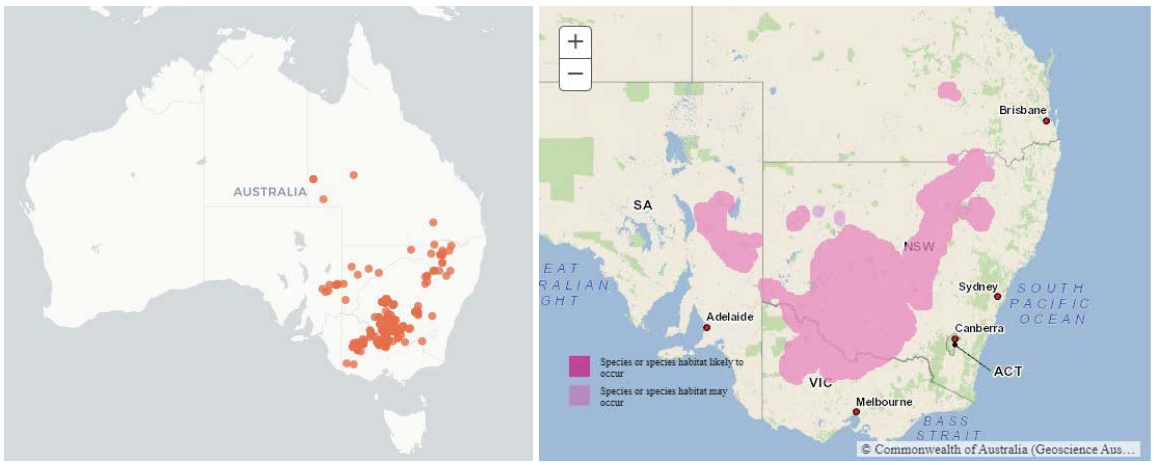


Figure 1.7 Distribution range of the Slender darling pea

Source: ALA (2019), DotEE (2019)

1.7.2.3 Biology and reproduction

Slender darling pea produces winter-spring growth, flowering in spring to early summer and then dying back after flowering. They re-shoot readily and often carpet the landscape after cool season rains. This species has been known to occur in paddocks that have been moderately grazed or occasionally cultivated. Swainsona species contain swainsonine, which affects the nervous system and is toxic to livestock (OEH 2017).

1.7.3 Habitat

The Slender darling pea has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. It grows in a variety of vegetation types including Bladder saltbush, Black box and grassland communities on level plains, floodplains and depressions and is often found with *Maireana* species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated (OEH 2017).

1.7.4 Threatening processes

The following have been identified as potentially threatening processes to Slender darling pea:

- Heavy grazing by domestic stock and pest species
- Loss of grassland habitat to cultivation
- Invasion of grassland habitat by weeds
- Increased salinization
- Frequent fires may directly affect plants or alter the habitat in which it grows
- Urban developments and the expansion of townships (OEH 2017).

1.7.5 Threat abatement/recovery plans

The following threat abatement plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). *Saving Our Species*. NSW. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10779. In effect under the BC Act 2016.

1.7.6 References

Atlas of Living Australia (2019). *Swainsona murrayana*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2888731#overview [Accessed 13 September 2019].

Department of Sustainability and Environment, Victoria (2007). A Nationally Threatened Species of the Grassland Community. Slender Darling-pea (*Swainsona murrayana*). Victorian Government Department of Sustainability and Environment. Melbourne, Department of Sustainability and Environment. Available from: http://www.northernplainscmn.com.au/uploads/flora_fauna/fact_sheets/slender-darling-pea.pdf.

Harden, G.J. (ed.) (1991). *Flora of New South Wales, Volume Two*. Kensington, NSW: University of NSW Press.

Jeanes, J.A. (1996). Fabaceae. In: Walsh, N.G. & T.J. Entwisle, eds. *Flora of Victoria*. 3:663-829. Inkata Press, Melbourne.

Office of Environment and Heritage, NSW (2017). Slender darling pea - Profile. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10779 [Accessed 13 September 2019].

Queensland Herbarium (2018). Slender Darling-pea (*Swainsona murrayana*). (Image) [Online] Available from: https://images.ala.org.au/image/details?imageId=49d0d1b9-bc50-4516-a3bc-3045a585e809. [20 September 2019].

Schmidt-Lebhun, A.N. (n.d.). Swainsona murrayana (Image) [Online] Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2888731#gallery [Accessed 13 September 2019

1.8 *Thesium australe* (Austral toadflax)

1.8.1 Status

EPBC Act – Vulnerable

BC Act – Vulnerable

1.8.2 Biology and ecology

1.8.2.1 Characteristics

Austral toadflax is a small, straggling herb growing to 40 cm tall. Leaves are pale green to yellow-green, somewhat succulent, 1 to 4 cm long and 0.5 to 1.5 mm wide (refer Photograph 1.7). Flowers are minute and white, emerging where the leaves meet the stems and appearing in spring. The fruit is small and nut-like, developing in summer. This species is often hidden amongst grasses and herbs (OEH 2017).

Photograph 1.7 Austral toadflax (*Thesium australe*)

Source: Hunter (2018)

1.8.2.2 Known distribution

Austral toadflax occurs in New South Wales, the Australian Capital Territory (ACT), Queensland and Victoria (refer Figure 1.8). It is also known from eastern Asia. Its current distribution is sporadic but widespread, occurring between the Bunya Mountains in southeast Queensland to northeast Victoria and as far inland as the southern, central and northern tablelands in New South Wales and the Toowoomba region (ALA 2019; OEH 2019; Scarlett et al. 2003).

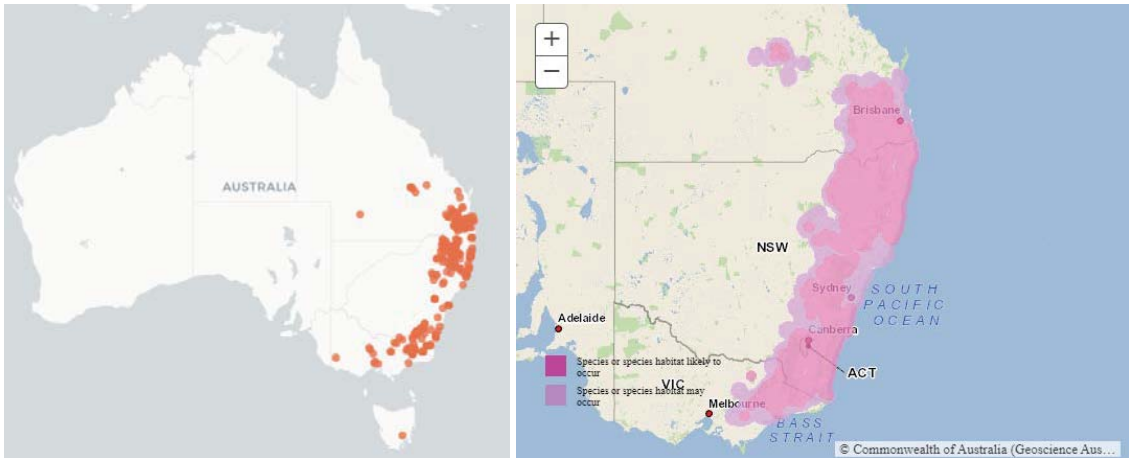


Figure 1.8 **Distribution range of the Austral toadflax**

Source: ALA (2019), DotEE (2019)

1.8.2.3 Biology and reproduction

Austral toadflax flowers and fruits throughout the year on the coast, and during summer at higher altitudes. In subalpine and tableland climates, the species dies back to rootstock during winter and resprouts in spring. In coastal areas, the species persists all year round and may live for longer than two years. The existence of buds near the soil surface allows the species to resprout after disturbance. It is observed to germinate well after fire; however, fire is not essential for germination (Cohn 2004; Scarlett et al. 1994).

1.8.3 Habitat

It is semi-parasitic on the roots of certain grass species; occurring in shrubland, grassland or woodland, often on damp sites. It occurs in subtropical, temperate and subalpine climates over a wide range of altitudes. It occurs on soils derived from sedimentary, igneous and metamorphic geology on a range of soils, including black clay loams to yellow podzolics and peaty loams (Leigh et al.1984; Hunter et al. 1999; Cohn 2004).

Vegetation types include open grassy heath dominated by Swamp myrtle (*Leptospermum myrtifolium*), Small-fruit hakea (*Hakea microcarpa*), Alpine bottlebrush (*Callistemon sieberi*), Woolly grevillea (*Grevillea lanigera*), Coral heath (*Epacris microphylla*) and *Poa* spp.; Kangaroo grass grassland surrounded by Eucalypt woodland; and grassland dominated by Barbed-wire grass (*Cymbopogon refractus*) (Leigh et al. 1984; Hunter et al. 1999).

1.8.4 Threatening processes

The following have been identified as potentially threatening processes to the Austral toadflax:

- Lack of fire/disturbance
- Existing and intensified grazing by livestock, native herbivores and feral herbivores
- Residential, infrastructure and agricultural development
- Weed invasion
- Infrastructure (road and rail) maintenance (DotEE 2018; OEH 2018).

1.8.5 Threat abatement/recovery plans

The following threat abatement plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). *Saving Our Species*. NSW. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10802. In effect under the BC Act 2016.

1.8.6 References

Atlas of Living Australia (2019). *Thesium australe*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2898274#tab_recordsView [Accessed 19 September 2019].

Cohn, J.S. (2004). Effects of slashing and burning on *Thesium australe* R. Brown (Santalaceae) in coastal grasslands of NSW. *Proc. Linn. Soc. NSW*. 125:57-65. Linnean Society of NSW, Kingsford, NSW

Hunter J. (2019). *Thesium australe* (Image) [Online] Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2891975#gallery [Accessed 19 September 2019].

Hunter, J.T., Kingston J. and Croft P. (1999). Vegetation and floristics of Kwiambal National Park and surrounds, Ashford, New South Wales. *Cunninghamia*. 6(2):351-78.

Leigh, J., Boden R. and Briggs J. (1984). *Extinct and Endangered Plants of Australia*. Melbourne, Victoria: Macmillan.

Office of Environment and Heritage, NSW (2019). Austral toadflax. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10802 [Accessed 19 September 2019].

Scarlett, N.H., Branwell M. and Earl G. (2003). *Flora and Fauna Guarantee Action Statement 56-Austral Toad Flax* Thesium australe. [Online]. Victorian Department of Sustainability and Environment (Vic. DSE). Available from: http://www.depi.vic.gov.au/environment-and-wildlife/threatened-species-and-communities/flora-and-fauna-guarantee-act-1988/action-statements.

1.9 *Cyperus conicus*

1.9.1 Status

EPBC Act – Not listed

BC Act – Endangered

1.9.2 Biology and ecology

1.9.2.1 Characteristics

Cyperus conicus is a tufted, greyish perennial sedge with a short thick underground stem. The leaves are rough and about 3 to 5 mm wide. The flowerhead is simple or compound with 4 to 10 branches that are up to 8 cm long. The flowerheads are comprised of numerous spikelets that are 2.5 to 3 mm long and about 0.8 mm wide (refer Photograph 1.8). These spikelets are pale brown tinged yellow or red-brown. The fruit is a triangular black nut about 1.8 mm long and 0.8 mm in diameter (OEH 2018).

Photograph 1.8 ***Cyperus conicus***

Source: Wood (2004)

1.9.2.2 Known distribution

C. conicus is found across the tropics in Queensland, Western Australia and the Northern Territory, including north of Alice Springs. In New South Wales it is mainly restricted to areas surrounding the Piliga region and north towards the Queensland border (refer Figure 1.9) (OEH 2019).

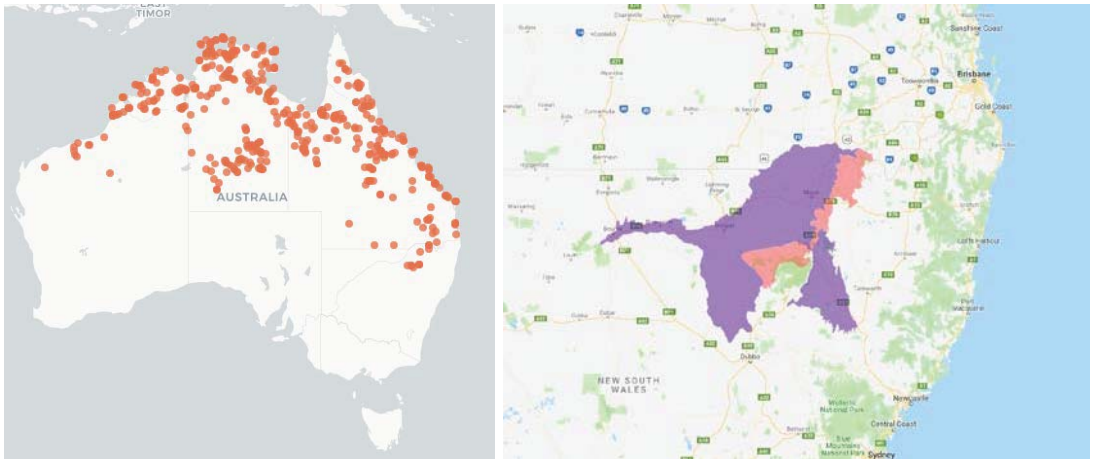


Figure 1.9 **Distribution range of *Cyperus conicus***

Source: ALA (2019), OEH (2019)

1.9.2.3 Biology and reproduction

Cyperus conicus is rhizomatous, growing in sandy soils and flowering from spring to summer (Wilson 2008).

1.9.3 Habitat

Cyperus conicus is associated with vegetation communities including *Melaleuca* swamps, open Box woodland and sedgelands. Habitat features include floodplains, creed beds and banks, swamps, run-on areas and various watercourses along with bores and dams. This species is also associated with *C. victoriensis, C. difformis, C. iria, C. compressus, C. nervulosus, C. dactylotes, Fimbristylis* and *C. fulvus*. The population status of *Cyperus conicus* ranges from very rare and occasional, to common and abundant in some populations (OEH 2019).

1.9.4 Threatening processes

The following have been identified as potentially threatening processes to *C. conicus*:

- Clearing such as drainage, irrigation and dredging practices used in cropping and horticulture
- Changed flooding patterns
- Grazing
- Logging
- Disturbance to the sandy habitat by rabbits (OEH 2018).

1.9.5 Threat abatement/recovery plans

The following threat abatement/recovery plans have been identified as relevant for this species

- Office of Environment and Heritage (2016), *Saving our Species Programme*. Available from https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=507&ReportProfileID=10198. In effect under the BC Act 2016.

1.9.6 References

Atlas of Living Australia (2018). *Cyperus conicus*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2889591#tab_recordsView [Accessed 25 October 2018].

Office of Environment and Heritage (2018). *Cyperus conicus* - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10198 [Accessed 25 October 2018].

Wilson K.L. (2008). *Cyperus conicus*, in PlantNet: New South Wales Flora Online. National Herbarium of New South Wales. Available from http://plantnet.rbgsyd.nsw.gov.au/ [Accessed 25 October 2018].

Wood D. & B. (2004). *Cyperus conicus.* (Image) [Online] Available from: https://biocache.ala.org.au/occurrences/7b2f14df-9811-4e8a-ba72-cc135cacad88. [20 September 2019].

1.10 *Desmodium campylocaulon* (Creeping tick-trefoil)

1.10.1 Status

EPBC Act – Not listed

BC Act – Endangered

1.10.2 Biology and ecology

1.10.2.1 Characteristics

Creeping tick-trefoil (*Desmodium campylocaulon*) is a prostrate twining herb that grows up to 1 m high. The stems are covered with hooked hairs. The leaves have three leaflets, each lance-shaped, 2 to10 cm long and 5 to 20 mm wide. The pea-like flowers are numerous, pink or bluish and about 6 mm long. The pods are saw-like, 15 to 20 mm long and composed of 3 to 6 segments. The pods are membranous and slightly net-veined, swollen when ripe but not splitting at maturity (OEH 2019).

No image available.

1.10.2.2 Known distribution

The Creeping tick-trefoil occurs chiefly in the Collarenebri and Moree districts in the northwestern plains of New South Wales. It also occurs in the Northern Territory and Darling Downs district of southeastern Queensland (OEH 2019) (refer Figure 1.10).

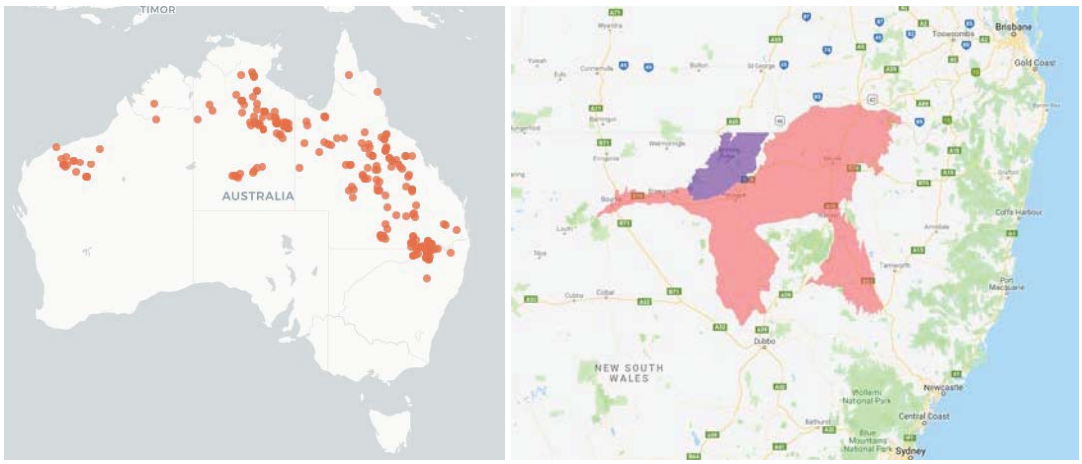


Figure 1.10 **Distribution range of Creeping tick-trefoil**

Source: ALA (2019), OEH (2019)

1.10.2.3 Biology and reproduction

Creeping tick-trefoil flowers in summer and autumn and is said to be strongly stoloniferous and well cropped by cattle. (OEH 2019).

1.10.3 Habitat

The Creeping tick-trefoil is usually found in clay soils with *Astrebla* and *Iseilema* species. In New South Wales it grows on cracking black soils in the Narrabri, Moree and Walgett regions. Other associated species include *Acacia harpophylla*, *Astrebla pectinata* and *Sorghum, Dichanthium* and *Panicum* species (OEH 2019).

1.10.4 Threatening processes

The following have been identified as potentially threatening processes to the Creeping tick-trefoil:

- Grazing
- Habitat depletion (OEH 2019).

1.10.5 Threat abatement/recovery plans

The following threat abatement/recovery plans have been identified as relevant for this species

- Office of Environment and Heritage (2016), *Saving our Species Programme*. Available from https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=520&ReportProfileID=10219. In effect under the BC Act 2016.

1.10.6 References

Atlas of Living Australia (2019). *Desmodium campylocaulon*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2903014#overview [Accessed 19 September 2019].

Canberra NautreMap (2019). Thesium australe. Available from: https://canberra.naturemapr.org/Community/Sightings/Details/4185770 [Accessed 19 September 2019]

Office of Environment and Heritage (2019). Creeping Tick-trefoil - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10219 [Accessed 19 September 2019].

1.11 *Digitaria porrecta* (Finger panic grass)

1.11.1 Status

EPBC Act – Not Listed

NC Act – Near threatened

BC Act – Endangered

1.11.2 Biology and ecology

1.11.2.1 Characteristics

Finger panic (*Digitaria porrecta*) is a perennial, loosely tufted, erect or ascending grass up to 60 cm tall. The nodes are pubescent and culms are branched. The leaf sheaths are smooth, or with a few hairs towards the base; the ligules are membranous, 2 to 3 mm long; the leaf blades are linear, the apex reinforced, 5 to 15 cm x 0.3 to 0.4 cm, pubescent or smooth. The Finger panic has a loose branching cluster of several racemes up to 25 cm long. The lower racemes are mostly convoluted, branched divaricately 3 to 10 cm long. The upper racemes are individual with spikelet's in pairs, 5 to 7 mm long. The lower glume is approximately 1 to 1.5 mm long and the upper glume is known to be shorter than spikelet, covered with short soft hair between the outer nerves. Lower florets are known to be as long as the spikelet's, and smooth between the outer nerves but fibres at first appressed. When at length the Finger panic is woolly and upper florets are shorter than the spikelet's. The Finger panic has a similar appearance to the Hairy panic *(Panicum effusum)* and Queensland panic *(Panicum queenslandicum),* both of which are found in Queensland (DES 2018).

No image available

1.11.2.2 Known distribution

The Finger panic is endemic to eastern Australia in Queensland and New South Wales (refer Figure 1.11). The species has been recorded in Queensland within the Brigalow Belt bioregion, Nebo district, southwest of Mackay, central highlands between Springsure and Rolleston, and from Jandowae south to Warwick. In Queensland, Finger panic occurs in communities dominated by Eucalyptus orgadophila on hills and slopes and and E. tereticornis and E. populnea in drainage lines (Halford 1995).

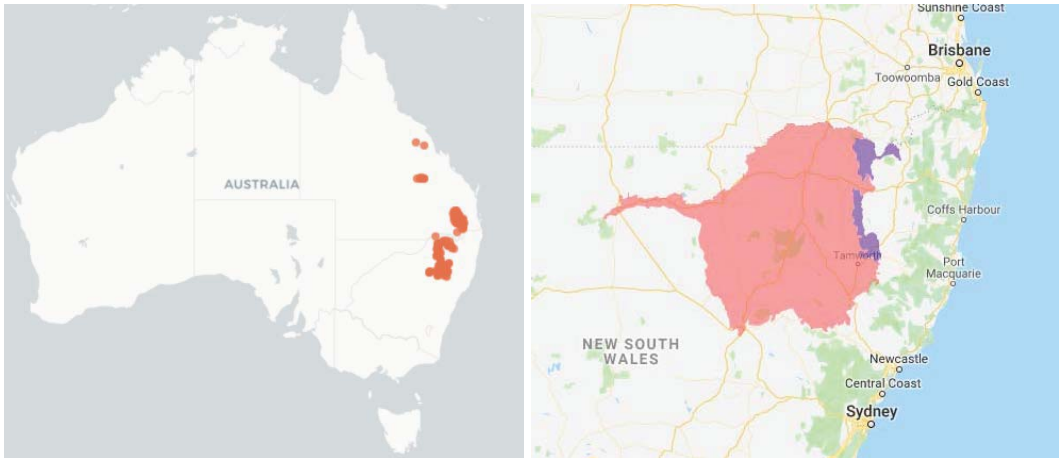


Figure 1.11 Distribution range of Finger panic

Source: ALA (2019), OEH (2019)

1.11.2.3 Biology and reproduction

The species flowers in late summer in a cylindrical cluster along a stalk and spread stiffly from the flowering stem, with the lower clusters arranged in a whorl of four to six, each up to 30 cm long. Finger panic seeds from March to April but also reproduces vegetative by dying back to the tussock base, from which it re-sprouts in summer. The species thrives in highly disturbed areas that have been cleared, including road reserves (Halford 1995, per sobs; Schell and Stark 2017).

1.11.3 Habitat

Finger panic is known to occupy dark and fine textured soils with some seasonal cracking and often persists in disturbed habitats, such as fallow paddocks, but its capability to maintain a viable population is unknown. The species is generally found in open woodland, tussock grasslands, box or forest red gum, alluvial plains and in areas with heavy cracking clays (DES 2018; Halford 1995).

1.11.4 Threatening processes

The following have been identified as potentially threatening processes to the Finger panic:

- Habitat loss from clearing and habitat fragmentation, disturbance and modification
- Invasive weeds compete with Finger panic for habitat resource
- Agriculture in terms of grazing impacts from livestock and physical disturbance from machinery are an identified threat (NSW DEC 2008).

1.11.5 Threat abatement/recovery plans

The following threat abatement/recovery plans have been identified as relevant for this species

- Office of Environment and Heritage (2019), *Saving our Species Programme*. Available from https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10222. In effect under the BC Act 2016.

1.11.6 References

Atlas of Living Australia (2019).

Department of the Environment and Energy (2019)

Office of Environment and Heritage, NSW (2019).

1.12 *Diuris tricolor* (Pine donkey orchid)

1.12.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

1.12.2 Biology and ecology

1.12.2.1 Characteristics

Pine donkey orchid (Diuris tricolor) is a terrestrial species growing on the ground. It has one to three leaves, that are up to 30 cm long and 4 mm wide. The flower stalk is 20 to 40cm high and has two to six flowers, which are bright yellow to orange and speckled with red to purple and white markings (refer Photograph 1.9). The sepals are very long and often crossed (OEH 2017).

Photograph 1.9 Pine donkey orchid (*Diuris tricolor*)

Source: Richter (2012)

1.12.2.2 Known distribution

Pine donkey orchid is found from south of Narrandera to the Darling Downs in Queensland (refer Figure 1.12). It is sporadically distributed on the western slopes of New South Wales, and in the north is found around Pilliga National Park and Bibblewindi State Forest (OEH 2017).

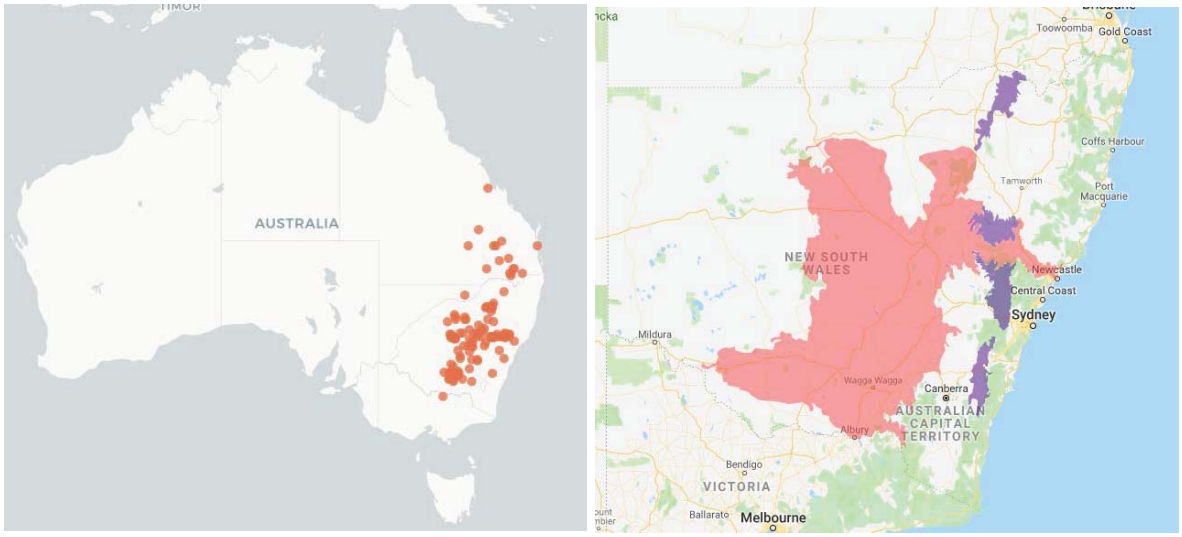


Figure 1.12 **Distribution range of the Pine donkey orchid**

Source: ALA (2019), OEH (2019)

1.12.2.3 Biology and reproduction

Pine donkey orchid is a tuberous, deciduous, terrestrial orchid and usually flowers between early September to late October. It has been recorded as individuals or in small groups as well as in large colonies (OEH 2017).

1.12.3 Habitat

Pine donkey orchid is usually recorded in disturbed habitats. It is associated with species such as *Callitris glaucophylla, Eucalyptus populnea, E. intertexta* as well as Ironbark and *Acacia* shrubland. The understorey is often grassy with herbaceous plants such as *Bulbine* species. It is found in sandy soils, either on flats or small rises (OEH 2017).

1.12.4 Threatening processes

The following have been identified as potentially threatening processes to Pine donkey orchid:

- Habitat clearing and modification (loss of ground layer protection and moisture-retaining litter)
- The short duration of its flowering and therefore cryptic nature
- Feral animal impacts (e.g. rabbits and goats)
- Weed competition (OEH 2017).

1.12.5 Threat abatement/recovery plans

No threat abatement/recovery plans identified as relevant for this species.

1.12.6 References

Atlas of Living Australia (2019).

Atlas of Living Australia (2018). Pine donkey orchid. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2903119 [Accessed 25 October 2018].

Office of Environment and Heritage, NSW (2018). Pine donkey orchid - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10243 [Accessed 25 October 2018].

Richter, R. (2017). Pine donkey orchid (Diuris tricolor). (Image) [Online] Available from: https://images.ala.org.au/image/details?imageId=c5b49eb1-69de-4a3f-86b9-53032ba951b9. [20 September 2019].

1.13 *Phyllanthus maderaspatensis*

1.13.1 Status

EPBC Act – Not listed

BCA Act – Endangered

1.13.2 Biology and ecology

1.13.2.1 Characteristics

Phyllanthus maderaspatensis is a rigid forb up to 30 to 50 cm high, with slender angular branches. The leaves are arranged in two regular rows on opposite sides of the branches. They are oblong-linear or wedge shaped, 10 to 25 mm long, rounded or with a short point at the tip, with white-rimmed stipules at the base (refer Photograph 1.10). The flowers are very small and have no petals. The male and female flowers are found on the one plant, borne in clusters in the leaf axils. The fruit is a slightly flattened 3-lobed capsule about 3 mm in diameter, containing seeds covered with 10 to 12 rows of minute warts (OEH 2017).

Photograph 1.10 ***Phyllanthus maderaspatensis***

Source: Townsend (2017)

1.13.2.2 Known distribution

Phyllanthus maderaspatensis has been recorded very widely across northern Australia (refer Figure 1.13. In New South Wales it has been found in the Brewarrina and Collarenebri districts in the north-western plains of New South Wales (OEH 2017).

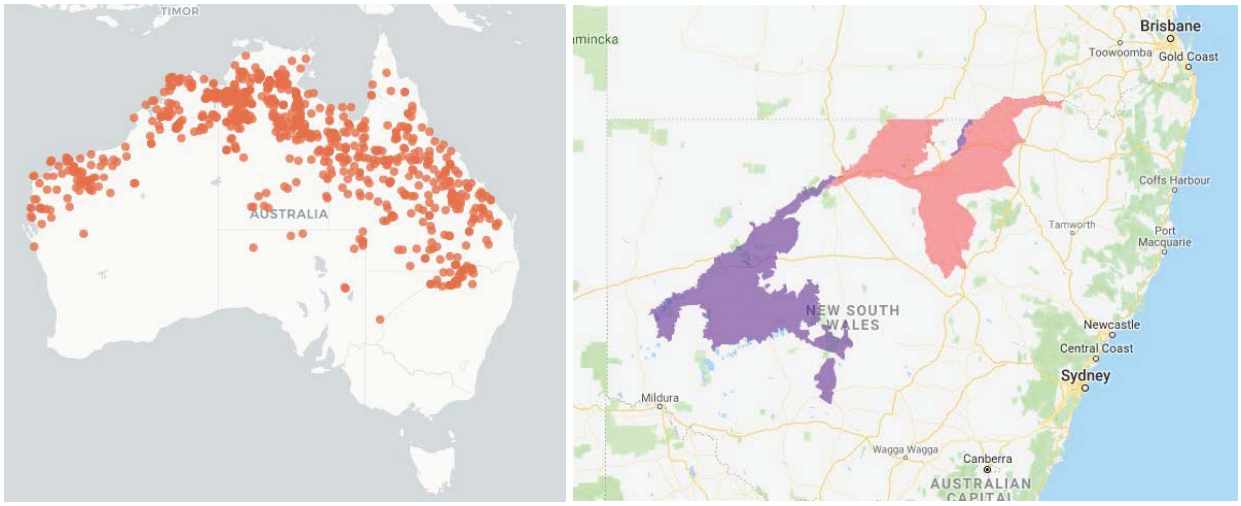


Figure 1.13 **Distribution range of P. maderaspatensis**

Source: ALA (2019), OEH (2019)

1.13.2.3 Biology and reproduction

Phyllanthus maderaspatensis flowers from spring to summer and is a summer growing annual. Seeding has been recorded in March. It occurs after summer rains and readily drops its leaves as it dries off. It has been recorded as common in disturbed areas (OEH 2017).

1.13.3 Habitat

Phyllanthus maderaspatensis occurs in floodplain areas on heavy soils and may rely on appropriate and intermittent rainfall and flooding events. It is often associated with open grasslands and eucalypt woodlands in or near creek beds, and grassy flats and levees near watercourses (OEH 2017).

1.13.1 Threatening processes

The following have been identified as potentially threatening processes to *P. maderaspatensis*:

- Clearing of floodplain habitat (for irrigation and cropping)
- Roadside clearing
- May be limited by competition from other summer-growing annuals (OEH 2017).

1.13.2 Threat abatement/recovery plans

No threat abatement/recovery plans identified as relevant for this species.

1.13.3 References

Atlas of Living Australia (2018). *Phyllanthus maderaspatensis*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2919355#overview [Accessed 26 October 2018].

Townsend, K. (2017). Phyllanthus maderaspatensis. (Image) [Online] Available from: https://images.ala.org.au/image/details?imageId=2567625a-9750-4f58-8aa3-637df65ffa5e. [20 September 2019].

Office of Environment and Heritage, NSW (2017). *Phyllanthus maderaspatensis* - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10623 [Accessed 26 October 2018].

1.14 *Platyzoma microphyllum* (Braid fern)

1.14.1 Status

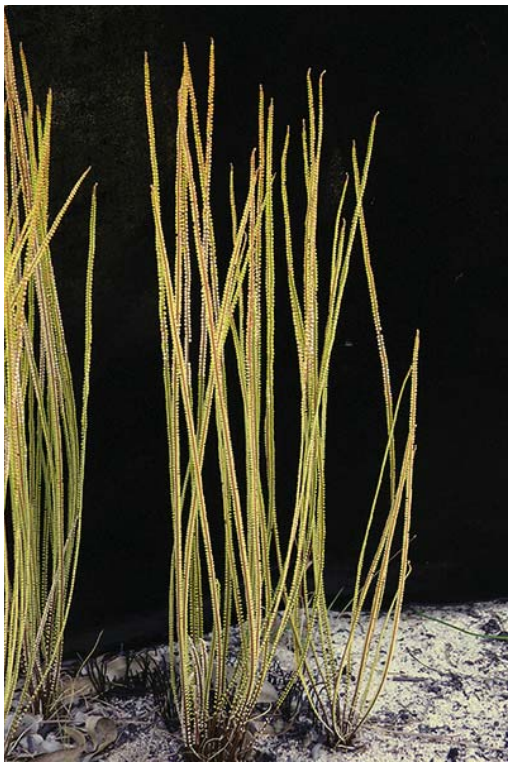
EPBC Act – Not listed

BC Act – Endangered

1.14.2 Biology and ecology

1.14.2.1 Characteristics

Braid fern (*Platyzoma microphyllum*) is a clumping fern covered with copper coloured hairs. The simple fronds are linear, green and 3 to 7 cm long whilst the pinnate fronds are typically 20 to 35 cm long with numerous pouch-like segments on each side of the stem (refer Photograph 1.11) (OEH 2018).



Photograph 1.11 Braid fern *(Platyzoma microphyllum)*

Source: Wood (2004)

1.14.2.2 Known distribution

Braid fern is widespread across northern Australia and down the east coast of Queensland. It has been recorded in New South Wales but only in the Yetman district (refer Figure 1.14) (OEH 2018).

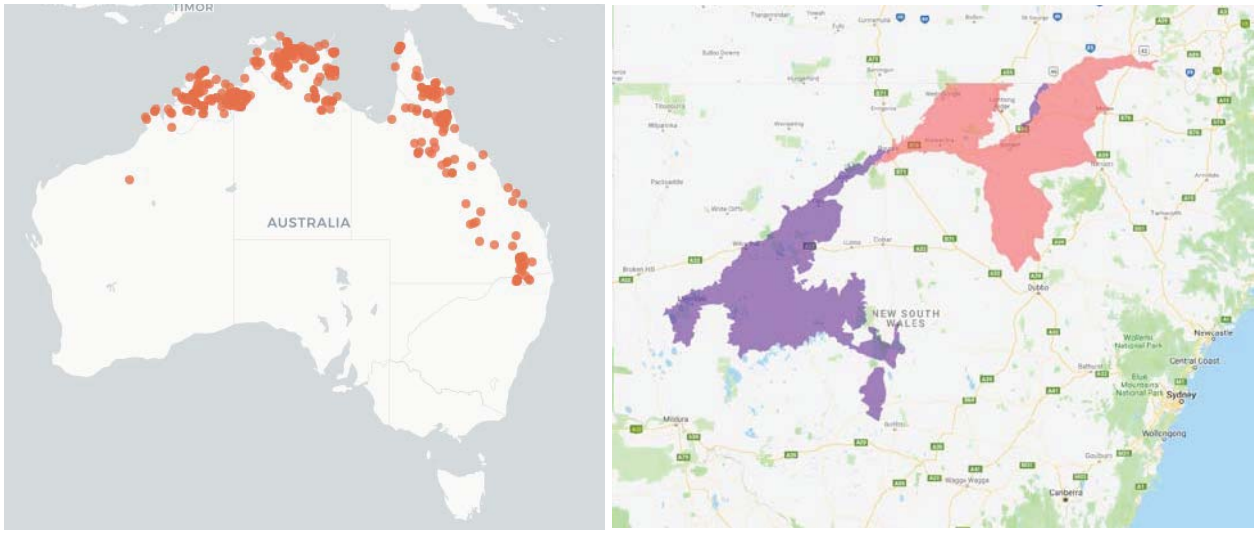


Figure 1.14 **Distribution range of the Braid fern**

Source: ALA (2019), OEH (2019)

1.14.2.3 Biology and reproduction

Braid fern reproduces by spores borne on the under surface of the fronds along the veins. Fertile individuals have been recorded throughout most of the year. Populations can form tussocks or colonies up to several metres across (OEH 2018).

1.14.3 Habitat

Braid fern grows in sandy or swampy soils, or in clay soils adjacent to water where it is subject to periodic flooding. Associated species include *Hakea dactyloides, Brachyloma daphnoides, Jacksonia scoparia, Xylomelum cunninghamii, Calytrix tetragona, Leptospermum species, Brachyloma daphnoides* and *Lomandra* species. It has also been found in *Callitris* woodland in sandy soil (OEH 2018).

1.14.4 Threatening processes

The following have been identified as potentially threatening processes to Braid fern:

- Habitat depletion and degradation
- Grazing, trampling and pugging of the soil
- Availability of moist habitats (depressions and swamps are often temporary and ephemeral) (OEH 2018).

1.14.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as relevant for the species.

- Office of Environment and Heritage (2016), *Saving our Species Programme*. Available from https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=752&ReportProfileID=10636. In effect under the BC Act 2016.

1.14.6 References

Atlas of Living Australia (2018). *Platyzoma microphyllum*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2916514# [Accessed 26 October 2018].

Office of Environment and Heritage, NSW (2018). Braid fern - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10636 [Accessed 26 October 2018].

Wood D. & B. (2004). Braid fern (Platyzoma microphyllum). (Image) [Online] Available from: https://biocache.ala.org.au/occurrences/ad5eb2f0-9335-4932-a156-ecf2f9d8b5c8. [20 September 2019].

1.15 *Polygala linariifolia* (Native milkwort)

1.15.1 Status

EPBC Act – Not listed

BCA Act – Endangered

1.15.2 Biology and ecology

1.15.2.1 Characteristics

Polygala linariifolia is an annual or perennial herb that grows to around 20 cm in height with branches presented as mostly upright and a woody taproot. Leaves of this herb grow to 3.5 cm in length, are variable in shape but are usually oval and broader towards the tips. The tip of the leaves displays a short point and are dull in texture due to the short hairs that sparely cover them. Flowering in spring and summer small groups of flowers appear during this time showing bluish purple, yellowing and occasionally white blooms. The fruit capsule is broad oblong flattened shape with a narrow wing and seeds that are black with white hairs (OEH 2019).

No image available.

1.15.2.2 Known distribution

In New South Wales Polygala linariifolia is found north from Copeton Dam and the Warialda are to Southern Queensland and to the northern New South Wales coast near Casino and Kyogle. There are also isolated populations in far western New South Wales near Weebah Gate, west of Hungerford (refer Figure 1.15). Records also exist for this species in Western Australia (OEH 2019).

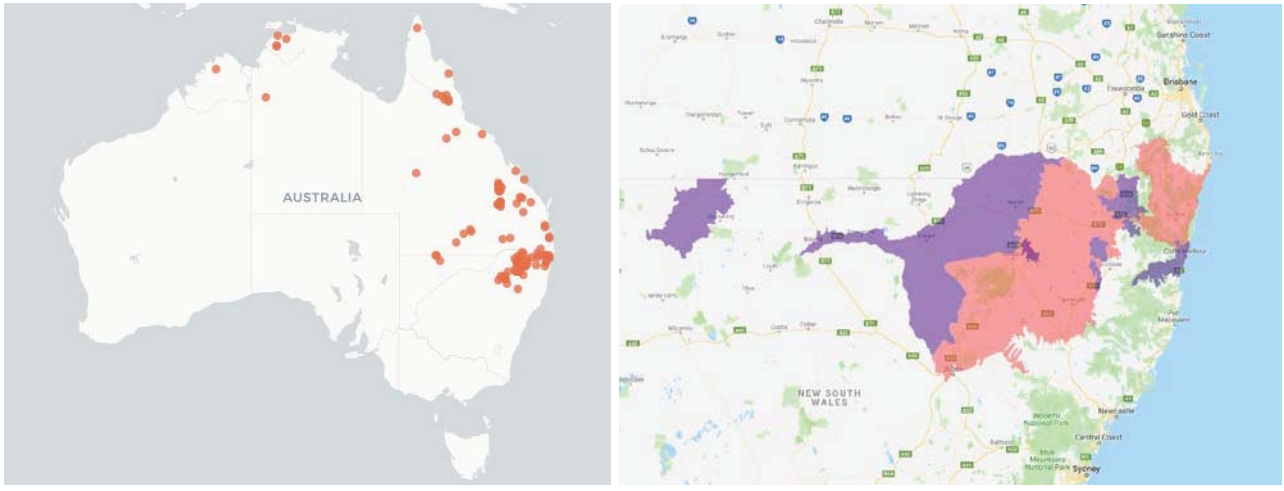


Figure 1.15 **Distribution range of *Polygala linariifolia***

Source: ALA (2019), OEH (2019)

1.15.2.3 Biology and reproduction

Polygala linariifolia flowers from spring to summer

1.15.3 Habitat

Polygala linariifolia grows in sandy soils in dry eucalypt forest and woodland with a sparse understorey. It has also been recorded growing in dark sandy loam on grite at Inverell and Torrington districts in shrubby for of *Eucalyptus caleyi*, *Eucalyptus dealbata* and *Callitris*, along with yellow podsolic soil on granite in layered open forest (OEH 2019).

1.15.4 Threatening processes

The following have been identified as potentially threatening processes to *Polygala linariifolia*:

- Land clearing for agriculture
- Grazing and tramping by domestic stock
- Browsing by feral goats and rabbits
- Competition from invasive grasses including Coolatai grass and African lovegrass
- Roadworks and roadside maintenance
- Frequent fires
- Timber extraction
- Small populations resulting in local extinctions (OEH 2019).

1.15.5 Threat abatement/recovery plans

No threat abatement/recovery plan has been identified as being relevant for this species.

1.15.6 References

Atlas of Living Australia (2019). Polygala linariifolia. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2905798#literature. [Accessed: 25 September 2019].

Office of Environment and Heritage, NSW (2019). Polygala linariifolia. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10643. [Accessed: 25 September 2019]

1.16 *Pomaderris queenslandica* (Scant pomaderris)

1.16.1 Status

EPBC Act – Not listed

BCA Act – Endangered

1.16.2 Biology and ecology

1.16.2.1 Characteristics

Pomaderris queenslandica is a medium sized shrub ranging from 2 – 3 m in height. Stems are whitish with tiny star shaped hair clusters. Leaves are 2.5 – 7 cm long with oval, narrow elliptical shape. The leaves are shiny at the top and woolly underneath. Flowers are small and creamy yellow in colour (OEH 2019).

No image available.

1.16.2.2 Known distribution

The distribution of Pomaderris queenslandica is widely scattered but not common in north-east New South Wales and in Queensland. There are several records of this species from the New South Wales north coast and a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolata (refer Figure 1.16) (OEH 2019).

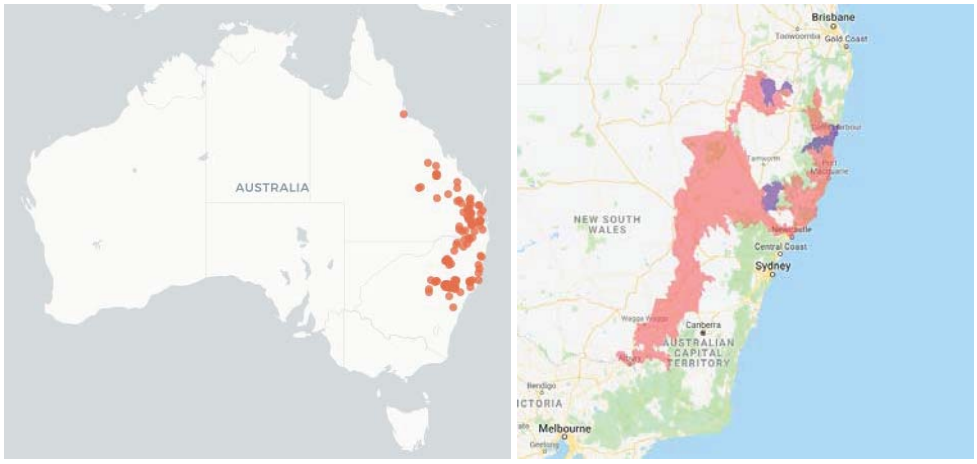


Figure 1.16 **Distribution range of *Pomaderris queenslandica***

Source: ALA (2019), OEH (2019)

1.16.2.3 Biology and reproduction

The species flowers during spring and summer (OEH 2019).

1.16.3 Habitat

Pomaderris queenslandica is mostly found in moist eucalypt forest or sheltered woodlands with a shrubby understory, and occasionally along creeks (OEH 2019).

1.16.4 Threatening processes

The following have been identified as potentially threatening processes to *Pomaderris queenslandica*:

- Land clearing for agriculture
- Timber harvesting causing disturbance
- Invasive exotic plant species
- Inappropriate fire regimes
- Isolation causing localised extinction
- Electricity infrastructure driving habitat loss
- Continued grading of roads and roadsides causing disturbance
- Domestic livestock causing disturbance (OEH 2017).

1.16.5 Threat abatement/recovery plans

No threat abatement/recovery plan has been identified as being relevant for this species.

1.16.6 References

Atlas of Living Australia (2019). Pomaderris queenslandica (Scant pomaderris). Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2905791#overview [Accessed: 25 September 2019]

Department of the Environment and Energy (2019)

Office of Environment and Heritage (2017). Pomaderris queenslandica (Scant pomaderris). Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10656 [Accessed 25 September 2019].

1.17 *Swainsona sericea* (Silky swainson-pea)

1.17.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

1.17.2 Biology and ecology

1.17.2.1 Characteristics

Silky swainson-pea (Swainsona sericea) is a prostrate or erect perennial, growing to 10 cm tall. The stems and leaves are densely hairy. The leaves are up to 7 cm long, composed of 5 to 13 narrow, pointed leaflets, each up to 15 mm long. The purple pea-shaped flowers are to 11 mm long and there is up to 8 flowers on a single stem which can be up to 10 cm long (refer Photograph 1.12). They have hairy pods up to 17 mm long (OEH 2018).

Photograph 1.12 ***Swainsona sericea*** **(Silky swainson-pea)**

Source: Wood (2002)

1.17.2.2 Known distribution

The Silky swainson-pea has been recorded from the northern tablelands to the southern tablelands and further inland on the slopes and plains in New South Wales (refer Figure 1.17). Also found in South Australia, Victoria and Queensland (OEH 2019).

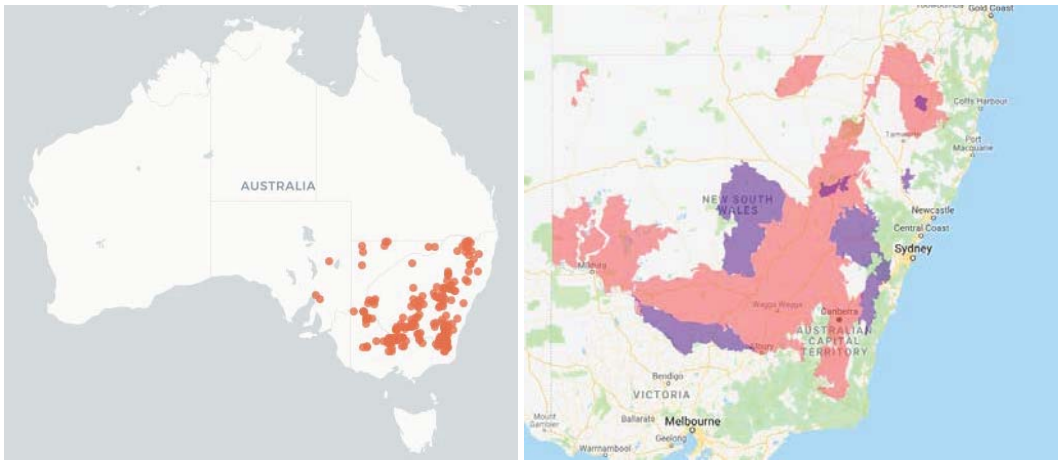


Figure 1.17 **Distribution range of *Swainsona sericea* (Silky swainson-pea)**

Source: ALA (2019)

1.17.2.3 Biology and reproduction

Swawinsona sericea regenerates from seed after fire. Swainsona species contain swainsonine, which affects the nervous system and is toxic to livestock (OEH 2019).

1.17.3 Habitat

Swawinsona sericea is found in natural temperate grassland and Snow gum woodland. It is also found in Box-gum woodland in the southern tablelands and south west slopes. It is sometimes found in association with cypress-pines *Callitris* spp. (OEH 2018).

1.17.4 Threatening processes

The following have been identified as potentially threatening processes to Silky swainson-pea:

- Loss and degradation of habitat for residential, infrastructure and agricultural developments
- Populations exhibit variations in ploidy level indicating that they are separate taxa
- Invasion of weeds
- Intensification of grazing regimes (OEH 2018).

1.17.5 Threat abatement/recovery plans

No threat abatement/recovery plan has been identified as relevant for this species.

1.17.6 References

Atlas of Living Australia (2018). *Swainsona sericea*. Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2906530#overview [Accessed 26 October 2018].

Canberra Nature Map (2010). *Swainsona sericea* (Image) [Online] Available from: https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2906530#gallery [Accessed 26 October 2018].

Office of Environment and Heritage, NSW (2017). Silky swainson-pea - Profile. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10783 [Accessed 26 October 2018].

Wood D. & B. (2002). Braid fern (Platyzoma microphyllum). (Image) [Online] Available from: https://biocache.ala.org.au/occurrences/ad5eb2f0-9335-4932-a156-ecf2f9d8b5c8. [20 September 2019].

2 Fauna species – Conservation significant species (Aquatic)

2.1 Murray cod (*Maccullochella peelii*)

2.1.1 Status

EPBC Act – Vulnerable

BC Act – Not listed

2.1.2 Biology and ecology

2.1.2.1 Characteristics

The Murray cod (Maccullochella peelii) is the largest freshwater species of fish in Australia, measuring up to 1.8 m in length and weighing about 10 kg although some records indicate the species may reach over 100 kg in weight. The Murray cod has a broad head, rounded snout, equal length jaws and has a concaved facial profile. The light olive to dark green scales of the fish has mottled pattern, with a white ventral colouration. The pectoral fins of the fish are rounded and large with soft dorsal, anal and caudal fins with distinctive red or white edging (DotEE 2019) (refer Photograph 2.1).

Photograph 2.1 Murray cod (*Maccullochella peelii*)

Source: flagstaffotos (2006)

2.1.2.2 Known distribution

The Murray cod was once a widespread species and abundant in the lower and mid reaches of the Murray-Darling Basin between Queensland and South Australia (refer Figure 2.1). However, the distribution of the species has now reduced to several bioregions between Queensland and Victoria, including the Brigalow Belt South Bioregion (National Murray Cod Recovery Team 2010, DotEE 2019).

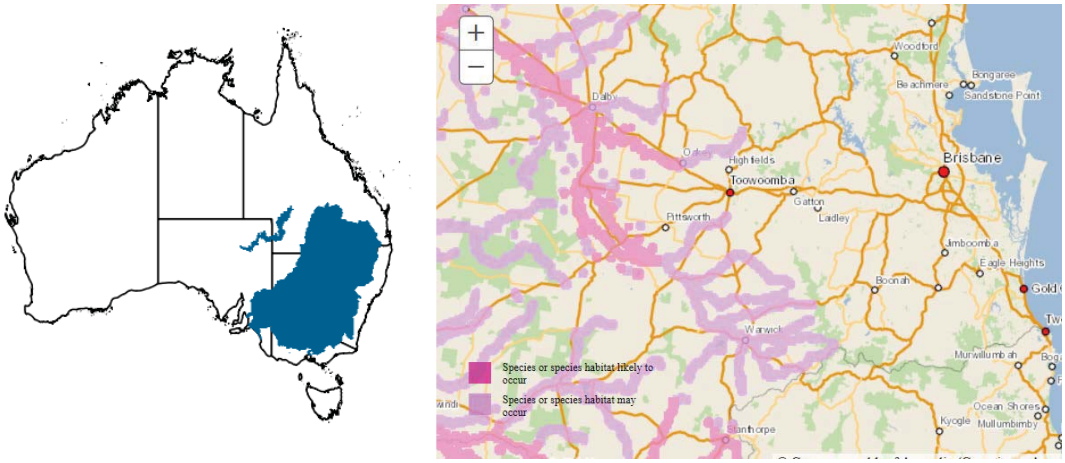


Figure 2.1 **Distribution range of Murray cod**

Source: ALA (2019), DotEE (2018)

2.1.2.3 Biology and reproduction

Due to the size of the Murray cod, it is considered the apex predator of the Murray-Darling river system and known to ambush its prey. The demersal species is known to hunt from sunset to sunrise, feeding on spiny crayfish and shrimp as well as reptiles and other fish species including cod (DotEE 2019).

The Murray cod has relatively low fertility compared to many other freshwater fish with the species generally reaching sexual maturity, which is heavily dependent on size, at 5 years of age. Male Murray cod, who are known to guard and fan the eggs during incubation, mature at a larger size than females with the species breeding as a pair. A female cod weighing 3 kg can produce up to 10,000 eggs often laid in logs or snags after developing them through winter until spawning, which is triggered by an increase in temperature and day length (DotEE 2019).

Upon hatching larvae tend to remain clustered in their nest for up to 11 days with the male continually providing protection before the larvae leave the nest to drift downstream and feed on zooplankton as well as aquatic insects (DotEE 2019).

2.1.3 Habitat

The habitat of the species is diverse, ranging from clear rocky streams to slow-flowing, turbid lowland rivers or billabongs where the fish is found frequently in the main channel. Due to the species preferred breeding environment, it is often found in streams containing large rock, snags, overhanging vegetation, stumps or other woody structures (DotEE 2019).

The species is known to take long distance journeys prior to spawning travelling up to several hundred kilometres upstream despite their naturally sedentary nature (Koehn et al. 2009).

2.1.4 Threatening processes

The following have been identified as potentially threatening processes to the Murray cod:

- Impoundment of streams and altered water flow
- Loss of riparian vegetation
- Habitat removal, modification and degradation (DotEE 2018).

2.1.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- National Murray Cod Recovery Team (2010). *National Recovery Plan for the Murray Cod* Maccullochella peelii peelii. Department of Sustainability and Environment, Melbourne. Available from: http://www.environment.gov.au/resource/national-recovery-plan-murray-cod-maccullochella-peelii-peelii. In effect under the EPBC Act from 16-Dec-2010 as *Maccullochella peelii*.

2.1.6 References

Atlas of Living Australia. (2019). Maccullochella peelii. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:54e10f17-f08c-4f93-b576-681f361ffe56 [Accessed 17 September 2019].

Department of Environment and Energy. (2019). Maccullochella peelii (Murray Cod) Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66633 [Accessed 17 September 2019].

Flagstaffotos. (2006). Maccullochella peelii - Murray Cod. [image] [online] Available from: https://commons.wikimedia.org/wiki/File:Murray_cod_melb_aquarium.jpg. [16 September 2019].

Koehn J.D., J.A. McKenzie, D.J. O'Mahony, S.J. Nicol, J.P. O'Connor and W.G. O'Connor. (2009). Movements of Murray cod (Maccullochella peelii peelii) in a large Australian lowland river. Ecology of Freshwater Fish. 18:594-602. John Wiley and Sons A/S.

Murray Darling Basin Authority. (2007). Native Species – Murray Cod (Maccullochella peelii peelii). Available from: https://www.mdba.gov.au/sites/default/files/archived/mdbc-NFS-reports/2202_factsheet_native_murray_cod.pdf [Accessed 18 September 2019].

National Murray Cod Recovery Team (2010). National Recovery Plan for the Murray Cod Maccullochella peelii peelii. Department of Sustainability and Environment, Melbourne. Available from: http://www.environment.gov.au/resource/national-recovery-plan-murray-cod-maccullochella-peelii-peelii [Accessed 18 September 2019].

2.2 Silver perch (*Bidyanus bidyanus*)

2.2.1 Status

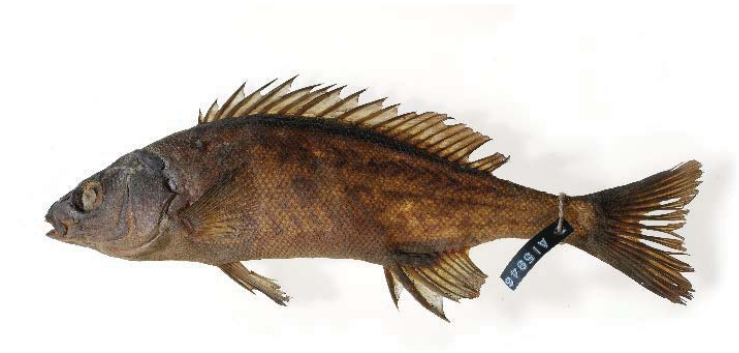
EPBC Act – Critically Endangered

BC Act – Vulnerable

2.2.2 Biology and ecology

2.2.2.1 Characteristics

A medium to large, fish with a body that becomes deeper and more laterally compressed with age. Maximum length ~500 mm and maximum weight 8 kg; usually 350 mm and 2 kg. The single dorsal fin has a higher, spinous anterior section and a lower, rayed section at the rear. They have a pointed head and snout and a relatively small mouth with equal jaws and narrow bands of very fine villiform (needle-like) teeth. The body colour is grey to grey-brown or dusky bronze with a lighter belly. The scales are much smaller than those on Golden or Macquarie perch. The tail is weakly forked. Very large specimens assume a slightly disproportionate appearance with a strongly humped forehead, strong lateral compression and a more distinctly pointed, almost beak-like head and snout (Lintermans 2007, OEH 2019).



Photograph 2.2 Silver Perch (Bidyanus bidyanus)

Source: Michelle (2017)

2.2.2.2 Known distribution

Formerly widespread over much of the Murray-Darling Basin excluding the most upper reaches, Silver perch has declined over most of its range. Numbers moving through a fishway at Euston Weir on the Murray River declined by 93 per cent between 1940 and 1990. Only nine Silver perch were recorded in a two-year survey of 40 randomly selected sites in the New South Wales portion of the Basin in the mid 1990s. The species is still patchily abundant in the mid-Murray. The ACT probably represented the upstream limit of distribution in the Murrumbidgee catchment, although the large spawning run of fish that occurred in summer from Lake Burrinjuck is unfortunately a thing of the past (Lintermands 2007,OEH 219).

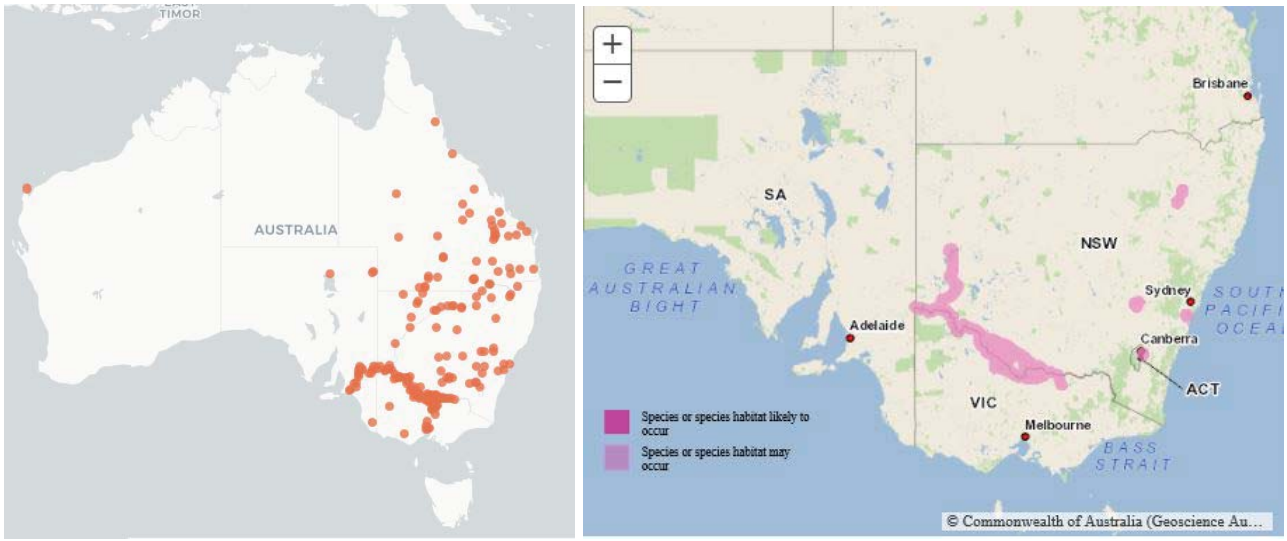


Figure 2.2 Distribution range of Silver Perch

Source: ALA (2019), DotEE (2019)

2.2.2.3 Biology and reproduction

Silver perch display sexual dimorphism, with females growing to a larger size. Growth varies between individual fish and is affected by the productivity of environments. Male fish reach sexual maturity at three years of age, and female fish reach sexual maturity at four to five years of age. Growth slows dramatically in both sexes after sexual maturity. Mallen-Cooper and Stuart (2003) estimated a mean maximum size for Murray River silver perch of 422 mm for female fish and 377 mm for male fish.

They spawn in spring and summer after an upstream migration, when large schools often form. Spawning occurs in late afternoon, dusk or just after nightfall. Spawning occurs in shoals at or near the surface, involves simultaneous release of milt (sperm) and eggs by male and female fish respectively, and is often accompanied by thrashing at the surface (Lake, 1967a; Merrick and Schmida, 1984; Clunie and Koehn 2001). Merrick and Schmida (1984) reported that spawning occurs where water flows over a gravel or rock rubble substrate. Whilst spawning can occur during non-flood conditions, spawning activity was significantly increased during a flood and environmental water release in 2005 in the mid-Murray River. Lake (1967b) found that fertilised, water-hardened eggs were 2.7 to 2.8 mm in diameter and hatched in 30 to 31 hours at temperatures of 26 to 27°C. Silver perch eggs spawned at cooler temperatures had longer hatching times. Importantly, Lake (1967b) noted that silver perch eggs are semi-pelagic and will sink to the bottom in the absence of current; he also noted the propensity for the chorion ('outer covering') of silver perch eggs to adsorb very fine suspended sediment. The cumulative evidence indicates that silver perch reproduction is flexible in terms of flow conditions and temperature; reproduction can occur in both within-channel flows and floods and at relatively cool water temperatures. Surveys found that silver perch across the Murray-Darling Basin failed to recruit during 2008 to 2010 drought conditions and that its current low densities may heighten the risk from extended recruitment failure in the future (Davies et al. 2012).

Silver perch are omnivorous. The diet contains aquatic plants, snails, shrimps, zooplankton and aquatic insect larvae.

This species is bred artificially in a number of government and commercial hatcheries and widely stocked into farm dams and reservoirs. While significant numbers of silver perch are bred and grown in aquaculture facilities for human consumption in Australia and Asia, these aquacultured fish are not considered meaningful to the long-term survival of silver perch in the wild, as they are highly domesticated both in the behavioural and the genetic sense (Rowland 2009). Similarly, large numbers of hatchery-bred silver perch are stocked, usually in impoundments, but these stocked silver perch appear to make little improvement to the conservation situation of wild silver perch (Davies et al. 2008; Rowland 2009; Davies et al. 2012).

2.2.3 Habitat

Silver perch are found in similar habitats to Murray cod and Golden perch, i.e. lowland, turbid and slow-flowing rivers. However, numerous reliable accounts exist of silver perch penetrating to Cooma (~ 800 metres ASL) on the Murrumbidgee River in large-scale upstream migrations in summer in the early and mid 1900s. Silver perch are consistently reported by anglers and researchers to show a general preference for faster-flowing water, including rapids and races, and more open sections of river, throughout the Murray-Darling Basin (Clunie and Koehn 2001). In the upper Murrumbidgee River during the 1960s and 1970s, the species was renowned for migrating into clear fast-flowing rapids in summer, in which anglers observed and targeted them (Pratt, 1979). Silver perch are a highly migratory freshwater fish. The extensive migration of adults, particularly during flooding, has long been recognised and is considered to be part of their spawning behaviour, likely a strategy to offset the downstream drift of eggs and larvae (Cadwallader, 1977; Reynolds, 1983; Mallen-Cooper et al., 1995). Reynolds (1983) tagged and then recovered a small number of tagged adult silver perch in the lower Murray River; most moved about 40 km upstream, while one fish moved 110 km and another 570 km upstream in 19 months.

2.2.4 Threatening processes

River regulation has severely affected this species through disruption of migration and reproductive behaviour. It is estimated there are 4000 barriers to fish movement in the Murray-Darling Basin in the form of dams, weirs and other structures (Lintermans 2007), the vast majority of which do not have fishways. Between 2001 and 2013, the Sea to Hume Dam Fish Passage Program provided purpose-built fishways to give native fish passage past 15 weirs and barrages on the Murray River between the river's mouth and Hume Dam at Albury (Lintermans, in prep. 2013), thereby ameliorating the impacts of weirs on the movement of juvenile and adult native fish, including silver perch in the middle and lower Murray River (but not necessarily native fish eggs and larvae).

Thermal pollution In the upper Murray system, large dams release cold water from their base, below the lower thermal limits for hatching and growth of native fish eggs and larvae, and disrupting cues for movement by juvenile and adult fish (e.g. Astles et al. 2003). Thermal pollution typically takes several hundred kilometres for water temperatures to be restored to normal (summarised in Clunie and Koehn 2001).

Blackwater events - Blackwater is water containing high levels of dissolved organic carbon which gives it a characteristic dark colour. Blackwater results from flood waters inundating floodplains or dry river channels, in the process leaching carbon compounds from inundated plant material. The dissolved organic carbon in blackwater encourages rapid bacterial growth which consumes dissolved oxygen and can reduce dissolved oxygen levels to very low levels that are fatal to fish and other aquatic organisms. While the extraction of dissolved organic carbon by floodwaters is a natural phenomenon, severe blackwater events are at least partially a result of river regulation, which has reduced the frequency and extent of floodplain inundation, and thus increased stores of dissolved organic carbon yielding plant material (Gerkhe et al., 1993; King et al. 2012).

Habitat degradation - It is widely recognised that Murray-Darling habitats have been degraded by desnagging, increased turbidity and salinity, loss of submergent macrophytes ('water weed'), and loss of riparian vegetation and associated siltation due to land clearing and a variety of poor farming practices including cattle grazing and trampling river banks (summarised in Clunie and Koehn 2001). While all of these forms of habitat degradation have affected silver perch, key impacts are likely to be (1) loss of submergent macrophytes, which may be important nursery areas for juvenile silver perch and important sites for feeding for all life stages, and (2) siltation, which can smother silver perch eggs that sink to the substratum in the absence of current.

Alien pathogens - There are many pathogens and parasites present in Murray-Darling waterways capable of affecting silver perch. Almost all are introduced ('alien'), having been brought into Australia with imports of live alien fish. Diverse evidence suggests alien pathogens and parasites may have had greater impacts on native fish species than realised in the past, and ongoing impacts in the present. The key alien pathogens and parasites are of concern are EHNV, Saprolegnia and Aphanomyces, Chilodonella, Ichthyophthirius, Lernaea and Asian fish tapeworm.

Interactions with alien species (Carp, Brown and Rainbow trout, *Gamubzia holbrooki* and Redfin perch) are also suspected to be a threat.

2.2.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Threatened Species Recovery Planning Program (2006). Silver perch *Bidyanun bidyanus* NSW Recovery Plan. NSW Department of Primary Industries. Available from: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/636388/NSW-Silver-Perch-Recovery-Plan.pdf. In effect under the New South Wales Fisheries Management Act 1994.

2.2.6 References

Astles KL, Winstanley RK, Harris JH and Gehrke PC (2003). Experimental study of the effects of cold water pollution on native fish. A final report for the Regulated Rivers and Fisheries Restoration Project. NSW Fisheries Final Report Series No. 44.

Cadwallader PL (ed.) (1977). J.O. Langtry's 1949–1950 Murray River Investigations. Fisheries and Wildlife Paper, Number 13. Fisheries and Wildlife Division, Ministry for Conservation, Melbourne.

Clunie P and Koehn J (2001). Silver Perch — A Resource Document. Volume 2. Murray Darling Basin Commission, Canberra. Available online at: http://www.dse.vic.gov.au/__data/assets/pdf_file/0019/112483/SilverPerchResourceDocument2001.pdf

Davies PE, Harris JH, Hillman TJ and Walker KF (2008). Sustainable Rivers Audit Report 1: A Report on the Ecological Health of Rivers in the Murray–Darling Basin, 2004–2007. Prepared by the Independent Sustainable Rivers Audit Group for the Murray-Darling Basin Ministerial Council. Murray-Darling Basin Commission, Canberra.

Davies PE, Stewardson MJ, Hillman TJ, Roberts JR and Thoms MC (2012). Sustainable Rivers Audit Report 2: The ecological health of rivers in the Murray–Darling Basin at the end of the Millennium Drought, 2008–2010. Volume 1. Prepared by the Independent Sustainable Rivers Audit Group for the Murray-Darling Basin Ministerial Council. Murray-Darling Basin Commission, Canberra.

Department of the Environment (2019). *Bidyanus bidyanus* - Silver perch in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed Tue, 17 Sep 2019

Department of Environment (2013). Conservation Advice Bidyanus bidyanus (Silver perch) available online at: http://www.environment.gov.au/biodiversity/threatened/species/pubs/76155-conservation-advice.pdf

Department of Primary Industries (2019). Threatened species lists – Silver Perch Bidyanus bidyanus. Viewed online at: https://www.dpi.nsw.gov.au/fishing/threatened-species/what-current/vulnerable-species/silver-perch

Gehrke PC, Revel MB and Philbey AW (1993). Effects of river red gum, Eucalyptus camaldulensis, litter on Golden perch, Macquaria ambigua. Journal of Fish Biology 43: 265–279.

King AJ, Tonkin Z and Lieshcke J (2012). Short-term effects of a prolonged blackwater event on aquatic fauna in the Murray River, Australia: considerations for future events. Marine and Freshwater Research 63: 576–586.

Lintermands, M. (2007). *Fishes of the Murray Darling Basin: An introductory guide*. Murray Darling Basing Commission.

Mallen-Cooper M, Stuart IG, Hides-Pearson F and Harris J (1995) Fish migration in the Murray River and assessment of the Torrumbarry fishway. Final report for Natural Resource Management Strategy Project N002. NSW Fisheries Research Institute and the Cooperative Research Centre for Freshwater Ecology. Cited in: Clunie and Koehn (2001).

Merrick JR and Schmida GE (1984). Australian Freshwater Fishes — Biology and Management. Griffin Press Ltd. South Australia.

Michelle, M. (2017). Silver perch (Bidyanus bidyanus). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=4d93d98a-ede5-4ad8-bd8e-40cc74a1c861. [19 September 2019].

Reynolds LF (1983). Migration patterns of five fish species in the Murray-Darling River system. Australian Journal of Marine and Freshwater Research 34: 857–871

Threatened Species Recovery Planning Program (2006). Silver perch Bidyanun bidyanus NSW Recovery Plan. NSW Department of Primary Industries. Available from: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/636388/NSW-Silver-Perch-Recovery-Plan.pdf [Accessed: 25 September 2019].

2.3 Darling river snail (*Notopala sublineata*)

2.3.1 Status

EPBC Act – Not listed

BC Act – Not listed

FM Act - Endangered

2.3.2 Biology and ecology

2.3.2.1 Characteristics

The Darling river snail is a medium sized freshwater snail with a rounded shell that ends in a conical spire. Shell colouration ranges from dark green to greenish brown without banding. Like other snails in its body shape it can be further characterised by its prominent snout and short eye stalks on the outside of the tentacles (DPI 2007).

No image available.

2.3.2.2 Known distribution

The Darling river snail was once widely distributed along most large rivers with a high presence of woody debris, particularly from the Murray-Darling river system (refer Figure 2.3). Each sub-species is restricted in its distribution as follows; N. sublineata hanleyi is restricted to the Murray and Murrumbidgee drainages, N. sublineata sublineata is restricted to the Darling River and its tributaries whilst N. sublineata alisoni has a wide distribution in more norther inland and coastal drainages outside of New South Wales (DPI 2007).

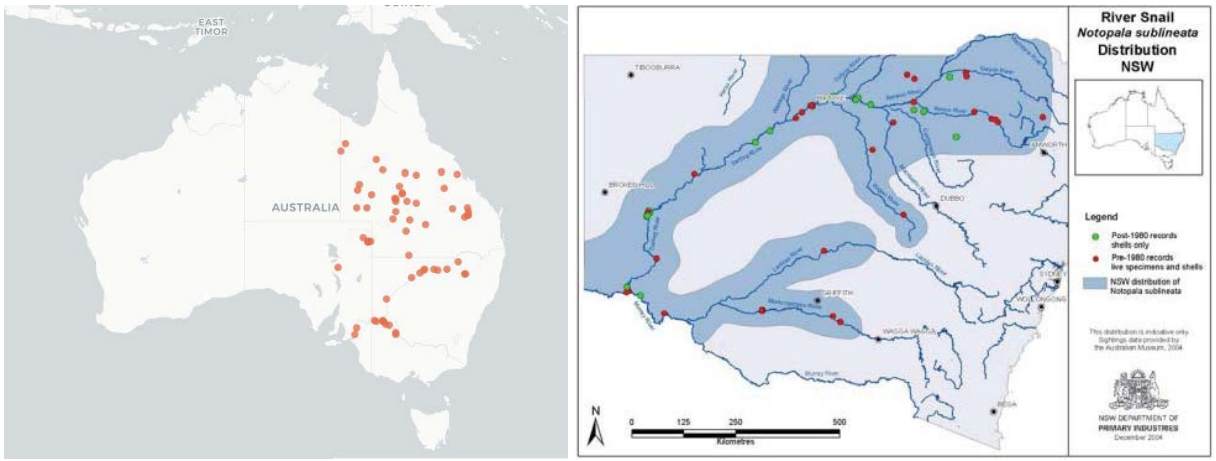


Figure 2.3 **Distribution range of the Darling river snail**

Source: ALA (2019), DPI (2007)

2.3.2.3 Biology and reproduction

Whilst there is very little information that exists about the reproduction of Darling river snails other members of the Viviparidae family are characterised by the females giving birth to live young, rather than the more common method of laying eggs. Fertilisation is internal and the embryos are retained within the pallial oviduct. Young remain with the female until they reach a size that is large enough for them to survive independently. The energetic cost of vivparity means the fecundity of viviparous snails is low compared to other freshwater gastropods. Biotic and abiotic factors such as periphyton quantity and quality, population density, water temperature, dissolved oxygen, calcium concentrations and current velocity also drive fecundity of freshwater vivparids (DPI 2019).

2.3.3 Habitat

The Darling river snail once inhabited flowing rivers across the Murray-Darling system and could be found on logs and rocks along the river banks or crawling in the mud. The remaining suitable habitat consists of irrigation pipelines throughout the Murray and Darling systems. This artificial environment provides the suitable conditions to promote microbial production and organic accumulation which the snails rely on as a food source (DPI 2007).

2.3.4 Threatening processes

The following have been identified as potentially threatening processes to Darling river snails:

- River regulation and changes to natural river flows
- Removal of large woody debris 'snags' through de-snagging programs and clearing of riparian vegetation
- Chemical treatment of snails in artificial habitat (pipelines)
- Sedimentation
- The introduction of carp to the Murray-Darling Basin
- A lack of knowledge and understanding
- Low community awareness and support for the species.

2.3.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- NSW Department of Primary Industries (2007) Recovery plan for the endangered river snail (*Notopala* sublineata). Available at: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/635470/Recovery-plan-for-the-endangered-river-snail-Notopala-sublineata-June-2007.pdf. In effect under the Fisheries Management Act 1994.

2.3.6 References

Atlas of Living Australia (2019). Murray river snail, *Notopala sublineata*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:c77bc925-6cd1-49ce-9cb3-b0e1ab5dbf35. [25 September 2019].

Department of the Environment and Energy (2019). Murray river snail, Notopala sublineata. Available from: http://www.environment.gov.au/biodiversity/threatened/nominations/ineligible-species/notopala-sublineata. [25 September 2019].

NSW Department of Primary Industries (2007 Recovery plan for the endangered river snail (Notopala sublineata). Available at: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/635470/Recovery-plan-for-the-endangered-river-snail-Notopala-sublineata-June-2007.pdf. [Accessed: 25 September 2019]

Office of Environment and Heritage, NSW (2019).

2.4 Eel-tailed catfish (Murray – Darling population) (*Tandanus tandanus*)

2.4.1 Status

EPBC Act – Not listed

BC Act – Endangered

2.4.2 Biology and ecology

2.4.2.1 Characteristics

Eel-tailed catfish have a large head, tough smooth skin and range in colour from olive-green to brown or black with a whitish underside. Larger specimens can reach almost 7 kg in weight but are rarely more than 2 kg. Their fleshy lips are surrounded by numerous barbels that aid in feeding. Their short dorsal fin located just behind the head has a serrated spine at the front (refer Photograph 2.3) (MDBC 2007).

Photograph 2.3 Eel-tailed catfish (Tandanus tandanus)

Source: McGrouther (2016)

2.4.2.2 Known distribution

Eel-tailed catfish historically inhabited slow-flowing rivers throughout the Murray-Darling Basin and coastal rivers from southern New South Wales to northern Queensland however these riverine populations have largely declined since the 1970's/early 1980's and is no longer common in its historical range (refer Figure 2.4) (MDBC 2007).

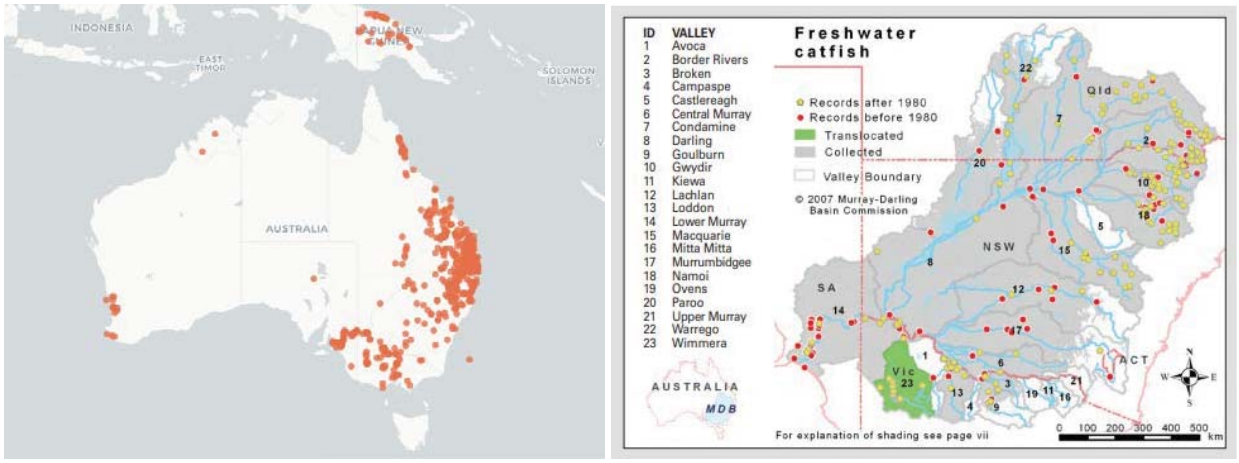


Figure 2.4 Distribution range of Eel-tailed catfish, *Tandanus tandanus*

Source: ALA (2019), Murray-Darling Basin Commission (2007)

2.4.2.3 Biology and reproduction

Eel-tailed catfish are a sedentary species preferring to remain in an area moving less than 5 km. Their carnivorous diet consists of crustaceans, molluscs, aquatic insects and small fish (DPI 2008) and will also consume aquatic insects, snails and small fishes. Juveniles rely more so on aquatic insects for their diet. Eel-tailed catfish are mostly active at dusk and in the early evening (MDBA 2007). This species is somewhat solitary however juveniles will sometimes form loose aggregations (Fishes of Australia 2019).

Eel-tailed catfish reach sexual maturity at 3 to 5 years of age spawning in spring and summer when water temperatures reach 20 to 24°C. Males guard the nest, a circular or oval shaped depression, 0.6 to 2.0 m in diameter that is made from the pebbles and gravel of the benthos with coarser material in the centre. Males will also fan and clean the non-adhesive eggs which settle into the coarse substrate taking approximately seven days to hatch. It is thought that several spawning events may occur at each nest within a season either sequentially or concurrently (MDBA 2007).

2.4.3 Habitat

Eel-tailed catfish are a large bodied non-migratory catfish species that inhabits a range of aquatic ecosystems including rivers, creeks, lakes, billabongs and lagoons preferring slower moving water bodies. As a benthic species it lives, feeds, and breeds near the bottom of the water bodies it inhabits. It can be found in both clear and turbid with substrates ranging from mud to gravel and rock. Whilst now rare in natural river ecosystems it can be found in artificial dams and waterways.

2.4.4 Threatening processes

The following have been identified as potentially threatening processes to the Eel-tailed catfish:

- Historic commercial fisheries
- Loss of habitat (lakes, billabong, lagoons) through river regulation
- Barriers to movement or natural flow of rivers
- Competition with introduced species, such as carp (*Cyprinus carpio*) and Redfin perch (*Perca fluviatilis*) (MBDA 2007)
- Loss of spawning sites and suitable habitat as a result of siltation
- Change in river flow patterns and flooding regimes causing habitat loss
- Chemical pollution from agricultural runoff
- Temperature spawning cues effected by cold-water discharge from dams and weirs
- Loss of aquatic plants (DPI 2008).

2.4.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- NSW Department of Primary Industries (2015) Eel-tailed catfish population in the Murray-Darling Basin, *Tandanus tandanus* see section: *Conservation and recovery actions*. Available at: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/635918/primefact-eel-tailed-catfish-population-in-the-murray-darling-basin.pdf. In effect under the Fisheries Management Act 1994.

2.4.6 References

Atlas of Living Australia (2019). Freshwater catfish, *Tandanus tandanus*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:f4138d26-9594-49ed-b3a5-b1851a634108. [Accessed: 26 September 2019].

Department of Primary Industries (2015). Eel-tailed catfish population in the Murray-Darling Basin, Tandanus tandanus. [onine] Available at: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/635918/primefact-eel-tailed-catfish-population-in-the-murray-darling-basin.pdf. [Accessed: 26 September 2019].

McGrouther, M. (2016). Eel-tailed catfish (Tandanus tandanus). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=9928dd92-dd90-43e6-bd0f-e2818ef51d21. [19 September 2019].

Murray-Darling Basin Commission (2007). Factsheet native freshwater catfish. Available at: https://www.mdba.gov.au/sites/default/files/archived/mdbc-NFS-reports/2202_factsheet_native_freshwater_catfish.pdf. [Accessed: 25 September 2019].

2.5 Southern purple spotted gudgeon (*Mogurnda adspersa*)

2.5.1 Status

EPBC Act – Not listed

BC Act – Endangered

2.5.2 Biology and ecology

2.5.2.1 Characteristics

The Southern purple spotted gudgeon can be characterised by its rounded head and small mouth and rounded tail. Their colouration includes dark brown along the dorsal, fading to pale brown and whitish-cream colour on the belly. Distinguishing markings are present along the body with white, red and blue spots that become more apparent during breeding, at which time yellow bars become visible along the dorsal and anal fins. This species of gudgeon can be distinguished from others by the presence of three red-maroon bars along its cheek (refer Photograph 2.4). Other species found within the same distribution are of similar size and shape looking similar to this species (DPI 2015).

Photograph 2.4 Southern purple spotted gudgeon *(Mogurnda adspersa)*

Source: Schmida (2015)

2.5.2.2 Known distribution

The Southern purple spotted gudgeon is endemic to southeastern Australia, particularly the Murray-Darling Basin (ALA 2019). This species occurs in coastal drainages from the Pascoe River, Queensland to the Clarence River in New South Wales along with Inland Murray-Darling drainages from the Macquarie River, New South Wales to the Onkaparinga River, South Australia. In New South Wales the species is confined to small remnant populations in the Macquarie, Gwydir and Border Rivers catchments along with a self-sustaining population from captive-bred fish in the Castlereagh Catchment. The Richmond and Hunter valley are the sites of the only existing population in eastern New South Wales (Fishes of Australia 2018) (refer Figure 2.5).

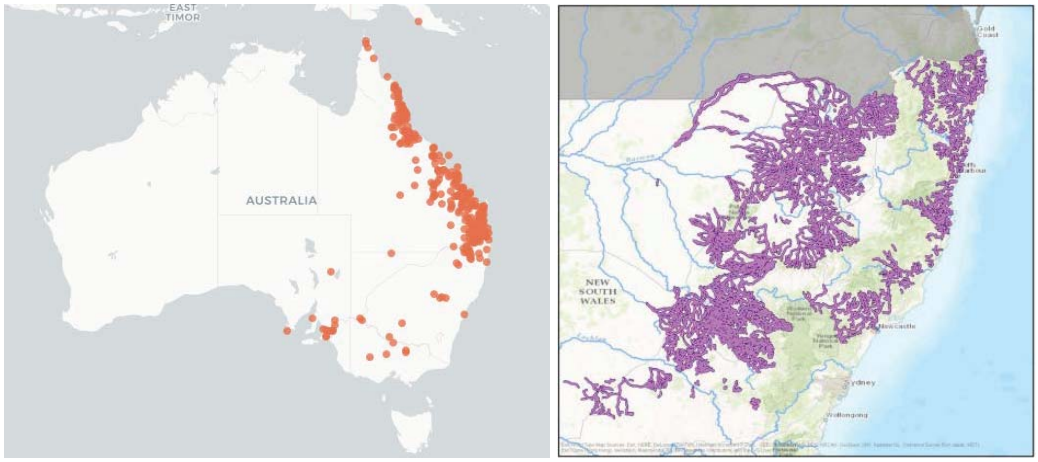


Figure 2.5 **Distribution range of the Southern purple spotted gudgeon *(Mogurnda adspersa)***

Source: ALA (2019), (DPI 2017)

2.5.2.3 Biology and reproduction

Southern purple spotted gudgeons rely primarily on terrestrial insects and their larvae as their source of food however will also feed on worms, small fish, tadpoles and plant material. For males of this species sexual maturity is reached once they grow to around 4.5 cm whilst females reach sexual maturity when 5 cm in length. Courtship occurs during the spring and summer months when water temperatures are warmer (20^{o}C) when males begin to demonstrate elaborate courting displays. Females can lay between 30 and 1,300 eggs per batch during the mating season, which are deposited in clusters on rocks, wood or broad-leafed plants. The eggs take 3 to 8 days to hatch, during which time the males will guard and fan them. The new larvae are around 4 mm in length (DPI 2015).

2.5.3 Habitat

The Southern purple spotted gudgeon prefers calm rivers and creeks sheltering amongst underwater plants, wooden debris and rocks along the benthos (ALA 2019). Other important habitat features include low turbidity, cover from overhanging vegetation from river banks and leaf litter (DPI 2015).

2.5.4 Threatening processes

The following have been identified as potentially threatening processes to the Southern purple spotted gudgeon:

- Introduced species including Eastern gambusia (*Gambusia holbrooki*), common carp (*Cyprinus carpio*) and Redfin perch (*Perca fluviatilis*)
- Habitat disturbance cause by invasive species
- Reduction in aquatic plants resulting in loss of suitable habitat
- River regulation impacting the flow and water level of rivers and wetlands particularly in Southern purple spotted gudgeon breeding and recruitment habitat
- Temperature spawning cues effected by cold-water discharge from dams and weirs
- Livestock causing damage to river banks and increasing turbidity
- Agricultural runoff and siltation impacting water quality
- Small populations and inability to disperse long distances resulting in localised extinctions from severe events.

2.5.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- NSW Department of Primary Industries (2015). Southern purple spotted gudgeon see section: *Conservation and recovery actions*. Available at: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/635290/Primefact-1275-Southern-Purple-Spotted-Gudgeon-Mogurnda-adspersa.pdf. In effect under the Fisheries Management Act 1994.
- Murray-Darling Basin Authority (2012). Reintroduction plan for the Purple spotted gudgeon in the southern Murray-Darling Basin. Available at: https://www.mdba.gov.au/sites/default/files/pubs/PSG-final-corporate-style_v2.pdf.

2.5.6 References

Atlas of Living Australia (2019). Southern purple spotted gudgeon (*Mogurnda adspersa*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:fd34c28a-56cf-43cc-9e15-5a121f664c72. [26 September 2019].

Department of Primary Industries (2015). Southern purple spotted gudgeon (*Mogurnda adspersa*). [onine] Available at: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/635290/Primefact-1275-Southern-Purple-Spotted-Gudgeon-Mogurnda-adspersa.pdf. [Accessed: 26 September 2019].

Department of Primary Industries (2015). Southern purple spotted gudgeon (Mogurnda adspersa). [onine] Available at: https://www.mdba.gov.au/sites/default/files/pubs/PSG-final-corporate-style_v2.pdf. [Accessed: 26 September 2019].

Fishes of Australia (2018). Southern purple spotted gudgeon (Mogurnda adspersa). [onine] Available from: http://fishesofaustralia.net.au/home/species/4148. [26 September 2019].

Murray-Darling Basin Authority (2012). Reintroduction plan for the Purple spotted gudgeon in the southern Murray-Darling Basin. Available at: https://www.mdba.gov.au/sites/default/files/pubs/PSG-final-corporate-style_v2.pdf. [Accessed: 26 September 2019].

Schmida, G. (2015). Southern purple spotted gudgeon (Mogurnda adspersa). [image] [online] Available from: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/635290/Primefact-1275-Southern-Purple-Spotted-Gudgeon-Mogurnda-adspersa.pdf. [Accessed: 26 September 2019].

2.6 Western olive perchlet (Western population) (*Ambassis agassizii*)

2.6.1 Status

EPBC Act – Not listed

BC Act – Not listed

FM Act – Endangered

2.6.2 Biology and ecology

2.6.2.1 Characteristics

The Western olive perchlet, also known at the Agassiz's glassfish is an oval shaped fish with a moderately large mouth, very large eyes and a forked tail. Their translucent scales have dark edging which forms a distinct pattern. The fins are clear however the dorsal and anal fins will usually have a broad dark streak along the edges (refer Photograph 2.5). Large individuals can reach 80 mm in length however most are less than 40 mm (DPI 2013)

Photograph 2.5 **Western olive perchlet *(Ambassis agassizii)***

Source: DPI (2013)

2.6.2.2 Known distribution

Historically the Western olive perchlet had a broad distribution from northern New South Wales to north Queensland and across much of the Murray-Darling Basin to South Australia and Victoria. This population has suffered a serious decline and is now extinct in South Australia except for a single translocate population in Swan Reach (Fishes of Australia 2019) and extinct in Victoria. This species was last recorded in South Australia from the Basin drainage was 1983. In New South Wales it is known from only a few populations in the Darling drainage upstream of Bourke, however is more abundant locally in the Border Rivers and Condamine-Balonne system (MDBA 2007) (refer Figure 2.6).

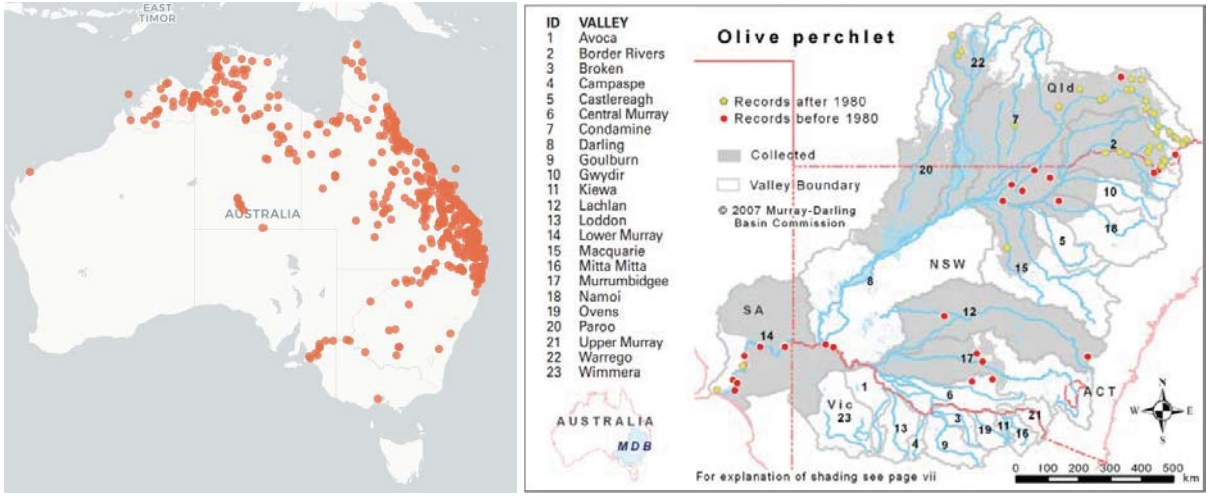


Figure 2.6 **Distribution range of Western olive perchlet *(Ambassis agassizii)***

Source: ALA (2019), MBDA (2007)

2.6.2.3 Biology and reproduction

Olive perchlets primarily carnivorous feeding on zooplankton such as Copepods and cladocera, along with aquatic and terrestrial insects. They will also eat mosquito wrigglers, small arachnids and occasionally small wish and feed primarily during daylight hours (MBDA 2007). Both males and female Olive perchlets reach sexual maturity after one year and live only for 2-4 years. Once water temperatures reach 23^{o}C, during the warmer months from October to December, spawning will occur. Utilising aquatic plants and rocks along the streambed females will lay 200 to 700 eggs (DPI 2019). A larger female specimen (49 mm long) was recorded carrying 2,350 eggs. Eggs will hatch after 5 to 7 days at 22^{o}C with 3 mm sized larvae once hatched (MBDA 2007).

2.6.3 Habitat

Preferring backwards with little to no water movement and a strong association with woody habitat and aquatic vegetation the Western olive perchlet inhabits the vegetated edges of lakes, creeks, swamps, wetlands and rivers (MBDA 2007). During the day they are usually found in sheltered areas with overhanging vegetation, aquatic macrophyte beds, logs, dead branches and boulders dispersing in the evening to feed (DPI 2014).

2.6.4 Threatening processes

The following have been identified as potentially threatening processes to Western olive perchlet populations:

- Introduced species including Eastern gambusia (*Gambusia holbrooki*) and Redfin perch (*Perca fluviatilis*)
- Cold water pollution restricting breeding and spawning success
- Habitat disturbance and degradation
- River regulation and loss of wetlands (MDBA 2007)
- Loss of instream aquatic vegetation through river regulation and introduced species (carp *Cyprinus carpio*) (DPI 2014).

2.6.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- NSW Department of Primary Industries (2015). Olive Perchlet (western population) - *Ambassis agassizii*. Available at: under *Conservation and recovery actions* https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/635876/PUB12-10-Primefact-176-Western-Olive-Perchlet-Ambassis-agassizii.pdf. In effect under the Fisheries Management Act 1994.

2.6.6 References

Atlas of Living Australia (2019) Olive perchlet (western population) - *Ambassis agassizii*. [online] Available from https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:b0ff773c-19a9-4a1c-88cd-65fb4351276b. [26 September 2019].

Department of Primary Industries (2014) Prime fact: Olive perchlet (western population) - Ambassis agassizii. [onine] Available at: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/635876/PUB12-10-Primefact-176-Western-Olive-Perchlet-Ambassis-agassizii.pdf. [Accessed: 26 September 2019].

Department of Primary Industries (2014) Prime fact: Olive perchlet (western population) - Ambassis agassizii. [photo] [onine] Available from: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/635876/PUB12-10-Primefact-176-Western-Olive-Perchlet-Ambassis-agassizii.pdf. [Accessed: 26 September 2019].

Fishes of Australia (2019) Agassiz's Glassfish, Ambassis agassizii. [onine] http://fishesofaustralia.net.au/home/species/1581#moreinfo. [26 September 2019].

Murray-Darling Basin Authority (2012). Reintroduction plan for the Purple spotted gudgeon in the southern Murray-Darling Basin. Available at: https://www.mdba.gov.au/sites/default/files/archived/mdbc-NFS-reports/2203_factsheet_native_olive_perchlet.pdf. [Accessed: 26 September 2019].

3 Fauna species – Conservation significant species (Terrestrial)

3.1 Dunmall's snake (*Furina dunmalli*)

3.1.1 Status

EPBC Act – Vulnerable

BC Act – Not listed

3.1.2 Biology and ecology

3.1.2.1 Characteristics

Dunmall's snake (*Furina dunmalli*) is a small to medium-sized, venomous (family Elapidae), snake that typically grows to a length of up to 75 cm. It has a uniform dark grey-brown colour on the top of the body, which fades to white at its lower flanks and has 21 rows on the mid-section). Most of the scales near the upper lip exhibit pale blotches. The head is large and distinct from the neck (DES 2019).

No image available.

3.1.2.2 Known distribution

Dunmall's snake is endemic to Australia and inhabits areas near the Queensland border within the Brigalow Belt South bioregion to the Nandewar bioregion in New South Wales (refer Figure 3.1). In Queensland, the snake is often found in areas 200 to 500 m above sea level with recorded sightings in Oakey and Inglewood. In New South Wales, the species is predominantly found in the northeast inland region (DotEE 2019).

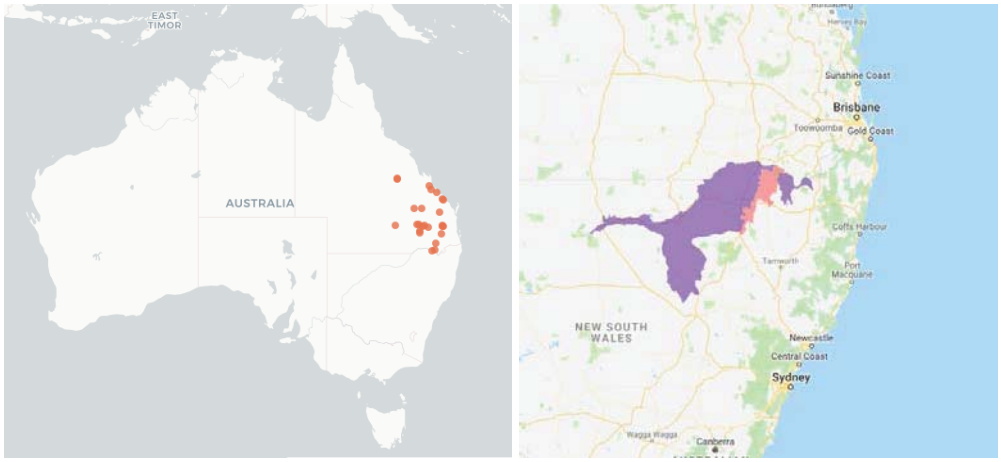


Figure 3.1 **Distribution range of the Dunmall's snake**

Source: ALA (2019), OEH (2019)

3.1.2.3 Biology and reproduction

Dunmall's snake are known to eat small lizards such as skinks and geckos. Analysis of the gut contents of this species yielded the remains of Tree skink (*Egernia striolata*). Limited knowledge is available on the snake's life cycle or reproductive behaviour; however, it is known that the species lays eggs rather than live young (DotEE 2019).

3.1.3 Habitat

Given the rarity, and difficulty of detecting Dunmall's snake, all suitable habitats (remnant or non-remnant vegetation) that are coincident with the known locations of the species are considered important habitats. Dunmall's snake has been found in a broad range of habitats, including:

- Forests and woodlands on black alluvial cracking clay and clay loams dominated by *Acacia harpophylla* (Brigalow), other Wattles (*A. burowii, A. deanii, A. leioclyx*), *Callitris* spp. (native cypress) or *Allocasuarina luehmannii* (Bull-oak).
- Various *Corymbia citriodora* (Spotted gum), *Eucalyptus crebra* (Ironbark) and *E. melanophloia* (Silver-leaved ironbark), *Callitris glaucophylla* (White cypress pine) and *Allocasuarina leuhmanii* (Bull-oak) open forest and woodland associations on sandstone derived soils
- The edge of dry vine scrub near Tarong Power Station, Queensland, and hard ironstone country (Queensland RE Land Zone 7) at Lake Broadwater near Dalby, Queensland.

There is a paucity of information related to ecological requirements of this species, however it has been observed sheltering under fallen timber and ground debris and is known to utilise cracks in alluvial clay soils (DES 2019; DotEE 2019).

3.1.4 Threatening processes

The following have been identified as potentially threatening processes to Dunmall's snake:

- Habitat loss and fragmentation due to land clearing in core areas of the Darling Downs
- Predation by feral animals such as foxes, cats and pigs
- Inappropriate road side management (DES 2019).

3.1.5 Threat abatement/recovery plans

No threat abatement/recovery plan has been identified as being relevant for this species.

3.1.6 References

Atlas of Living Australia (2019). Furina dunmalli. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:9ba2edaa-574b-4c18-8503-d0b658b16cc4 [Accessed 2 September 2019].

Department of Environment and Energy (2019). Furina dunmalli (Dunmall's Snake) in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59254 [Accessed 2 September 2019].

Department of Environment and Science (2019). Dunmall's snake. Queensland Government. Available from: https://www.ehp.qld.gov.au/wildlife/animals-az/dunmalls_snake.html [Accessed 2 September 2019].

Wilson, S (n.d). Dunmall's snake. In. Shy snake is hard to spot. ABC Wide Bay Publication. Available from: http://www.abc.net.au/local/stories/2009/04/21/2548064.htm [Accessed 12 September 2019].

3.2 Five-clawed worm-skink (*Anomalopus mackayi*)

3.2.1 Status

EPBC Act – Vulnerable

BC Act – Endangered

3.2.2 Biology and ecology

3.2.2.1 Characteristics

The Five-clawed worm skink (*Anomalopus mackayi*), also called the Long-legged worm-skink is a burrowing skink, which is characterised by three fingers and two toes. This species typically grows to 27 cm long. It has smooth scales with an overall greyish-brown upper body, with dark spots in longitudinal rows. Its ventral surface is yellow-green with dark flecking. In the southern region of its range, this species has no pattern, while in the north, it has longitudinal rows of dark spots on the dorsal and lateral surfaces (Cogger 2000; DotEE 2019).

3.2.2.2 Known distribution

The known distribution of the Five-clawed worm-skink is patchy in the North West Sloped and Plains of north-east New South Wales and southeastern Queensland (refer Figure 3.2). In southeastern Queensland, the species' known distribution is on the upper Condamine River floodplain, from Warwick in the south, to the Jimbour region in the north, and bordered by the western edge of the granite belt (Brigalow Belt Reptiles Workshop 2010; DotEE 2019, OEH 2019).

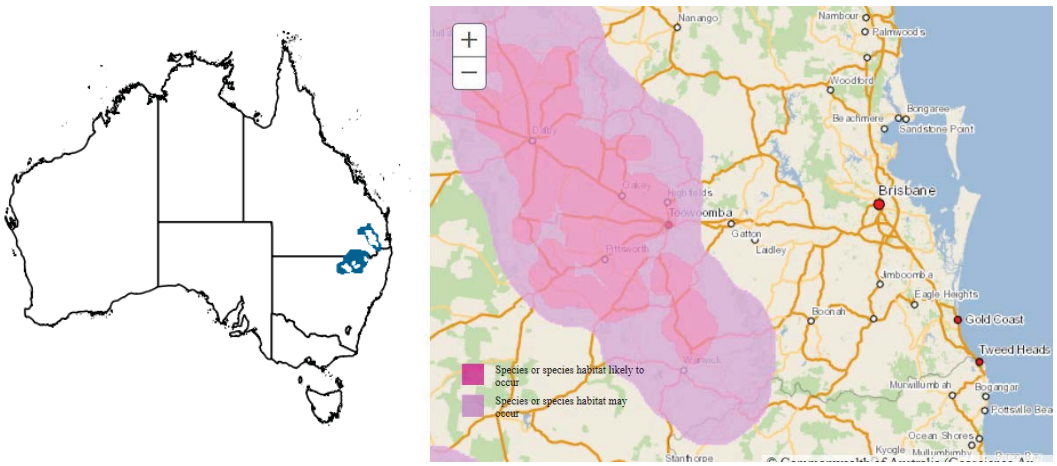


Figure 3.2 **Distribution range of the long-legged worm-skink**

Source: ALA (2019), DotEE (2018)

3.2.2.3 Biology and reproduction

Very little is known about the Five-clawed worm-skink's reproduction and diet. However, it is believed to feed on arthropods, such as white ants and captive specimens have been recorded eating mealworms (Cogger et al. 1983; Shea et al. 1987).

Five-clawed worm-skinks lay up to three eggs per clutch during Spring (Shea et al. 1987; Wilson and Knowles 1988; Ehmann 1992).

3.2.3 Habitat

The Five-clawed worm-skink is known to occur in both remnant and non-remnant woodlands and grasslands, and in areas modified by agriculture and other human activities. It is typically found under timber, leaf litter and other debris. It is also known to inhabit rotting tree base cavities, logs and tussock bases. This species has been found sheltering under artificial materials lying flat on the ground, such as discarded railway sleepers, sheet metal and hay bales. On the Darling Downs, the species occurs in *Dichanthium sericeum* (Bluegrass) and/or *Astrebla* spp. (Mitchell grass) dominated grasslands, or mixed grasslands dominated by other grass species (Brigalow Belt Reptiles Workshop 2010; DotEE 2019, OEH 2019).

3.2.4 Threatening processes

The following have been identified as potentially threatening processes to the Five-clawed worm-skink:

- Land clearing for agriculture has been particularly severe within the Five-clawed worm-skink's range
- Overgrazing compacts soil making it difficult for the species to find suitable shelter
- Removal of logs and timber also reduces soil humidity and the amount of shelter available for the species. Agricultural chemicals may poison and pollute the soil which may adversely affect the species
- Predation by feral species, such as cats and foxes, is another threat facing much of Australia's native wildlife including the Five-clawed worm-skink (Brigalow Belt Reptiles Workshop 2010; NSW NPWS 1999).

3.2.5 Threat abatement/recovery plans

No recovery plan has been identified as being relevant for this species. The following threat abatement plan is relevant to this species:

- Department of the Environment (2015). Threat abatement plan for predation by feral cats. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats. In effect under the EPBC Act from 23 July 2015

3.2.6 References

Atlas of Living Australia (2019). Anomalopus mackayi. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:bcbb3f69-0f90-4b6d-a062-218439a61a51 [Accessed 13 September 2019].

Brigalow Belt Reptiles Workshop (2010). Proceedings from the workshop for the nine listed reptiles of the Brigalow Belt bioregions. 18-19 August. Brisbane: Queensland Herbarium.

Cogger H.G. (2000). Reptiles and Amphibians of Australia, (6th edition) Ralph Curtis Books, NSW

Department of the Environment and Energy (2019). Anomalopus mackayi in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25934 [Accessed 13 September 2019].

Dolley, C (n.d.). Photograph: Long-legged worm-skink, Department of National Parks, Sport and Racing, (Image) [Online] Available from: https://www.ehp.qld.gov.au/wildlife/animals-az/longlegged_wormskink.html [Accessed 12 September 2019].

Ehmann, H. (1992). Encyclopaedia of Australian Animals: Reptiles. Angus and Robertson: Sydney

Office of Environment and Heritage (2019). Threatened biodiversity profile search - Five-clawed Worm-skink – profile. Available at: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10055 [Viewed on 18 September 2019]

NSW National Parks and Wildlife Service (1999). Five-clawed Worm-skink - Threatened Species Information. Available from: http://www.environment.nsw.gov.au/resources/nature/tsprofileFiveclawedWormskink.pdf

Shea, G.M., Millgate M. and Peck S. (1987). A range extension for the rare skink Anomalopus mackayi. Herpetofauna. 17 (2):16-19.

Wilson, S.K. and Knowles, D.G. (1988). Australia's Reptiles A Photographic Reference to the Terrestrial Reptiles of Australia. Collins: Sydney

3.3 Grey-headed flying-fox (*Pteropus poliocephalus*)

3.3.1 Status

EPBC Act – Vulnerable

BC Act – Vulnerable

3.3.2 Biology and ecology

3.3.2.1 Characteristic

The Grey-headed flying-fox (*Pteropus poliocephalus*) weighs approximately 600 g to 1 kg, and typically measures 23 cm to 28 cm from head to body. The grey-headed flying fox exhibits a collar of orange/brown around its neck, whilst its head is covered in light grey. The fur on the body is grey, often with flecks of white and ginger (refer Photograph 3.1). The fur on the back exhibits two morphs, which are possibly related to age, moult, or sub-population. Winter fur is typically darker than summer fur, and pronounced moulting is known to occur in June (DotEE 2019; Eby and Lunney 2002; Hall 1987; Hall and Richards 2000; Tidemann 1998).

Photograph 3.1 Grey-headed flying-fox (Pteropus poliocephalus)

Source: Leo (2010)

3.3.2.2 Known distribution

The Grey-headed flying-fox occurs in the coastal belt of Eastern Australia, typically ranging from Rockhampton in central Queensland to Melbourne in Victoria (refer Figure 3.3). It is noted that only a small portion of this range is used at any one time, as the species selectively forages where resources are available (DotEE 2019; Tidemann 1998).

The availability of food resources has a direct influence on the occurrence and relative abundance within the Grey-headed flying foxes distribution in various seasons and years (Pallin 2000; Hall 2002; van der Ree et al. 2006).

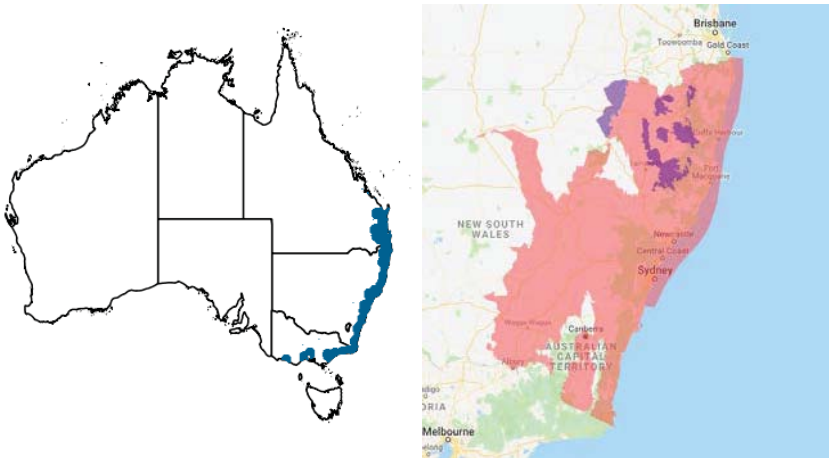


Figure 3.3 **Distribution range of the Grey-headed flying-fox**

Source: ALA (2019), OEH (2019)

3.3.2.3 Biology and reproduction

Nectar and pollen from *Eucalyptus*, *Corymbia, Angophora, Melaleuca*, and *Banksia* species are considered the primary food source for grey-headed flying foxes. This species is known to supplement its diet with a wide range of rainforest fruits and introduced species (Duncan et al. 1999; Eby 1995; 1998; Hall and Richards 2000; Parry-Jones and Augee 1991).

Mating is known to occur in the early autumn months, after which time the larger camps begin to separate, reforming in late spring/early summer when food resources become more abundant. Males and females typically separate in October, when the young are born. Each year, following six months of gestation, females bear a single young. For one month after giving birth, the mother carries her offspring on her ventral surface to feeding sites. When completely furred, the young are left in maternal camps, and are nursed until they are independent, at approximately 12 weeks of age. Sexual maturity typically occurs at about three years of age (DotEE 2019; Hall and Richards 2000; Martin 2000; Nelson 1965; Tidemann 1998).

3.3.3 Habitat

The Grey-headed flying-fox is a canopy-feeding species that eats fruit and nectar. This species utilises a range of vegetated habitats, including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps and *Banksia* woodlands. In an urban setting, this species is known to feed on commercial fruit crops, and on introduced tree species (DotEE 2019).

Roost sites are generally located near water bodies. This species is known to roost in vegetation ranging from rainforest, *Melaleuca* stands, mangroves and riparian vegetation. The species has a high level of roost site fidelity, although new sites have been known to be colonised (Lunney and Moon 1997; Nelson 1965; Ratcliffe 1931; Tidemann and Vardon 1997; van der Ree et al 2005).

3.3.4 Threatening processes

The following have been identified as potentially threatening processes to the Grey-headed flying-fox:

- Clearing of native vegetation for agriculture and forestry operations has accelerated the destruction and disturbance of roosting and foraging habitats of the species in eastern Australia (DotEE 2019; Duncan et al. 1999; SEAC 1996; Teagle 2002)
- Lack of foraging resources can also force Grey-headed flying-foxes into commercial fruit crops, increasing conflict with growers and subsequent culling of individuals (DotEE 2019)
- Urban-dwelling Grey-headed flying-foxes can accumulate lethal levels of lead from the environment and are prone to electrocution on powerlines (DotEE 2019; Hariono et al. 1992)

- Displacement leading to competition and hybridisation with the Black flying-fox (*P. alecto*) is also a known threat (DotEE 2019; Duncan et al. 1999; SEAC 1996; Teagle 2002).

3.3.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2016), *Saving our Species Programme*. Available from https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=785&ReportProfileID=10697. In effect under the BC Act 2016.

3.3.6 References

Atlas of Living Australia (2019). Pteropus poliocephalus. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:a2553aed-383a-4c9b-9534-c6058bcee81b# [Accessed 11 September 2019].

Department of the Environment and Energy (2019). Pteropus poliocephalus in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=186 [Accessed 11 September 2019].

Duncan, A., Baker, G.B and Montgomery, N. (1999), The Action Plan for Australian Bats. [Online]. Canberra: Environment Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/action/bats/index.html. [Accessed 13 September 2019].

Eby, P. and Lunney, D. (2002), Managing the Grey-headed flying-fox as a threatened species in NSW. In: Proceedings of the Royal Zoological Society of New South Wales. Mosman, Sydney: Royal Zoological Society of New South Wales.

Hall, L. and Richards, G. (2000), Flying Foxes: Fruit and Blossom of Australia. Sydney: University of New South Wales Press.

Hall, L. (1987), Identification, distribution and taxonomy of Australian flying-foxes (Chiroptera: Pteropodidae). Australian Mammalogy. 10 (2):75-81.

Hall, L.S. (2002), Management of flying fox camps: what have we learnt in the last twenty five years? In: Eby, P. and D. Lunney, eds. Managing the Grey-headed flying-fox as a Threatened Species in NSW. Page(s) 215-224. Mosman, NSW; Royal Zoological Society of NSW.

Hariono, B., Ng J. and Sutton R.H. (1992). Lead concentrations in tissues of fruit bats (Pteropus sp.) in urban and non-urban areas. Wildlife Research. 20.

Leo (2010). Pteropus poliocephalus. (Image) [Online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:a2553aed-383a-4c9b-9534-c6058bcee81b [Accessed 11 September 2019].

Martin, L. (2000), Aspects of the Reproductive Biology of the Grey-headed flying-foxes that explain documented population declines and support a threatened status. In: Proceedings of a Workshop to Assess the Status of the Grey-headed flying-fox in New South Wales. Unpublished report to the NSW Threatened Scientific Committee.

Nelson, J.E. (1965), Movements of Australian flying foxes (Pteropodidae: Megachiroptera). Australian Journal of Zoology. 13:53-73.

Pallin, N. (2000), Ku-ring-gai Flying-fox Reserve: habitat restoration project, 15 years on. Ecological Management and Restoration. 1:10-20.

Office of Environment & Heritage (2019). Saving our species: help save the Grey-headed flying fox. [online] Available at: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=785&ReportProfileID=10697. [Accessed 26 September 2019].

Ratcliffe, F.N. (1931), The flying fox (Pteropus) in Australia. CSIRO Bulletin. 52:1-133.

State of the Environment Advisory Council (1996). Australia: State of the Environment, 1996.

Teagle, S. (2002). Flying fox Consultative Committee - Formation, Outcomes and Future Strategies. In: Eby, P. and D. Lunney, eds. Managing the Grey-headed Flying-fox as a Threatened Species in NSW. Page(s) 109-116. Mosman, NSW: Royal Zoological Society of NSW.

Tidemann, C. and Vardon, M. (1997), Pests, pestilence, pollen and pot-roasts: the need for community-based management of flying foxes in Australia. Australian Biologist. 10(1):77-83. hs Forest: New Holland Publishers Pty Ltd.

Tidemann, C.R. (1998), Grey-headed flying-fox, Pteropus poliocephalus, Temminck, 1824. In: Strahan, R., ed. The Mammals of Australia. Frenc.

van der Ree, R., McDonnell, J. Temby, I. Nelson, J. and Whittingham, E. (2005), The establishment and dynamics of a recently established urban camp of flying foxes (Pteropus poliocephalus) outside their geographic range. Journal of Zoology. 268:177-185. The Zoological Society of London.

van der Ree, R., McDonnell, M.J. Temby, I. Nelson, J. and Whittingham, E. (2006), The establishment and dynamics of a recently established urban camp of Pteropus ploiocephalus outside their geographic range. Journal of Zoology London. 268:177-185.

3.4 Koala (*Phascolarctos cinereus*)

3.4.1 Status

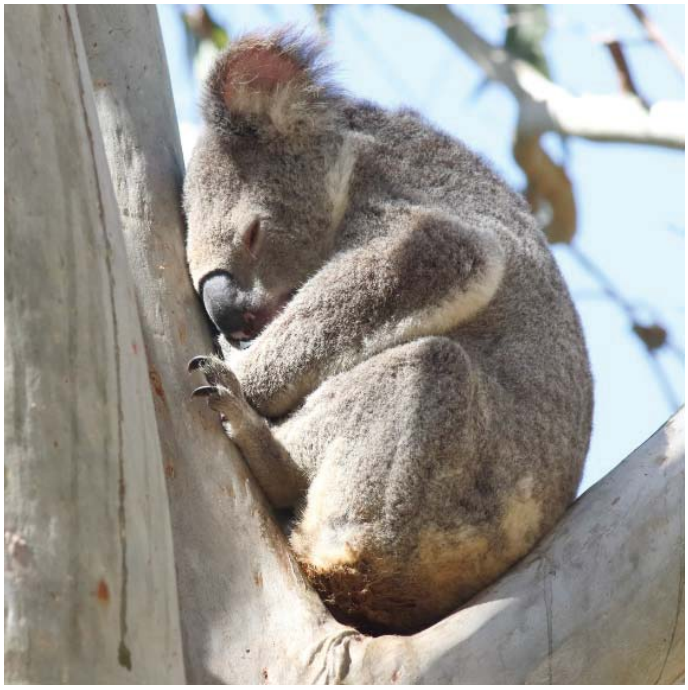
EPBC Act – Vulnerable

BC Act – Vulnerable

3.4.2 Biology and ecology

3.4.2.1 Characteristics

The Koala (*Phascolarctos cinereus*) is an arboreal marsupial, with a stocky body, large rounded ears, sharp claws and has grey-coloured fur (refer Photograph 3.2). This species displays sexual dimorphism (males generally are larger than females), with male koalas weighing approximately 6.5 kg (DotEE 2019).



Photograph 3.2 Koala (Phascolarctos cinereus)

Source: Walker (2017)

3.4.2.2 Known distribution

The Koala is distributed along the east coast of Australia extending from Queensland to New South Wales (refer Figure 3.4). In Queensland, the koala's distribution extends across several bioregions, encompassing a great diversity of habitats with the greatest concentration being in southeast Queensland. In New South Wales, the species occurs mostly in central and north coasts with populations known to inhabit the area west of the Great Dividing Range (DES 2019; OEH 2019).

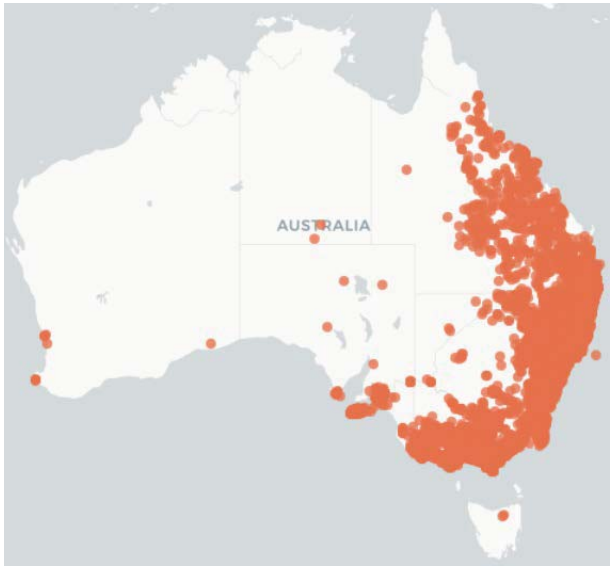


Figure 3.4 Distribution range of Koala

Source: ALA (2019)

3.4.2.3 Biology and reproduction

The Koala is a leaf-eating specialist feeding primarily during dawn, dusk or during the night. Its diet is restricted mainly to foliage of Eucalyptus spp.; however, it may also consume foliage of related genera, including *Corymbia* spp.*, Angophora* spp. and *Lophostemon* spp. The Koala may, at times, supplement its diet with other species, including *Leptospermum* spp. and *Melaleuca* spp. (Crowther et al. 2013, Martin and Handasyde 1999; Moore and Foley 2000).

Female Koalas can potentially produce one offspring each year with births occurring between October and May. The newly-born Koala lives in its mother's pouch for six to eight months and, after leaving the pouch, remain dependent on the mother, riding on her back. Young Koalas are independent from about 12 months of age (DotEE 2019).

3.4.3 Habitat

Koala habitat can be broadly defined as any environment containing Koala food tree species (*Eucalyptus* spp., *Corymbia* spp., *Angophora* spp. and *Lophostemon* spp.) or shelter trees. Preferred food and shelter trees are naturally abundant on fertile clayey soils (DotEE 2019).

Along the Great Dividing Range and the coastal belt throughout the species' range, Koalas inhabit moist forests and woodlands mostly dominated by Eucalypt species. Koalas are also known to occur in highly modified (e.g. urbanised) or regenerating native vegetation communities (DotEE 2019).

3.4.4 Threatening processes

The following have been identified as potentially threatening processes to the Koala:

- Habitat loss, modification or fragmentation as a result of urbanisation
- Secondary threats such as predation by domestic dogs, vehicle strikes and stress
- *Chlamydia* which reduces the life expectancy of the species (OEH 2019; DES 2019).

3.4.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2008), Recovery plan for the koala (Phascolarctos cinereus). Available from: https://www.environment.nsw.gov.au/research-and-publications/publications-search/recovery-plan-for-the-koala-phascolarctos-cinereus. In effect under the BC Act 2016.
- Office of Environment and Heritage (2018), Recovery plan for the koala *(Phascolarctos cinereus)*. Available from: https://www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-koala-strategy. In effect under the BC Act 2016.

3.4.6 References

Atlas of Living Australia. (2019). Phascolarctos cinereus. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:e9d6fbbd-1505-4073-990a-dc66c930dad6 [Accessed 18 September 2019].

Crowther, M., D. Lunney, J. Lemon, E. Stalenberg, R. Wheeler, G. Madani, K. Ross and M. Ellis. (2013). Climate-mediated habitat selection in an arboreal folivore. Ecography. 36:001-008.

Department of Environment and Energy (2019). Phascolarctos cinereus (Koala) Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=85104 [Accessed 18 September 2019].

Department of Environment and Science (2019). Koala facts. Queensland Government. Available from: https://www.ehp.qld.gov.au/wildlife/koalas/koala-ecology.html [Accessed 13 September 2019].

Martin, R. and K. Handasyde. (1999). The Koala: Natural history, conservation and management. Sydney, NSW: UNSW Press.

Moore, B.D. and W.J. Foley. (2000). A review of feeding and diet selection in koalas (Phascolarctos cinereus). Australian Journal of Zoology. 48:317-333.

Office of Environment and Heritage (2019). Koala - Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10616 [Accessed 18 September 2019].

Walker, B. (2017). Phascolarctos cinereus - Koala. [image] [online] Available from: https://images.ala.org.au/image/details?imageId=72044d32-05fc-47ef-96fd-cd5968d0ed03 [16 September 2019].

3.5 Large-eared pied bat (*Chalinolobus dwyeri*)

3.5.1 Status

EPBC Act – Vulnerable

BC Act – Vulnerable

3.5.2 Biology and ecology

3.5.2.1 Characteristics

The Large-eared pied bat (*Chalinolobus dwyeri*) is a medium-sized insectivorous bat measuring approximately 100 mm in length, and weighing 7 to 12 g. This species exhibits a shiny black coat, with a white stripe on the flank (underside) of each wing. The ears are large and the facial lobes are located on the lower lip, between the corner of the mouth and the bottom of the ear (refer Photograph 3.3). Its short, broad wings suggest that this species flies slowly, and with considerable manoeuvrability (DERM 2011; DotEE 2019; Hoye and Dwyer 1995; Ryan 1966).

Photograph 3.3 Large-eared pied bat (Chalinolobus dwyeri)

Source: Musser (2017)

3.5.2.2 Known distribution

The former and current distribution of the large-eared pied bat is poorly known. Records for current distribution exist from Shoalwater Bay and inland to Carnarvon in Queensland, through to Ulladulla, in New South Wales (refer Figure 3.5). It is thought that this species is uncommon and has a patchy distribution (DotEE 2019).

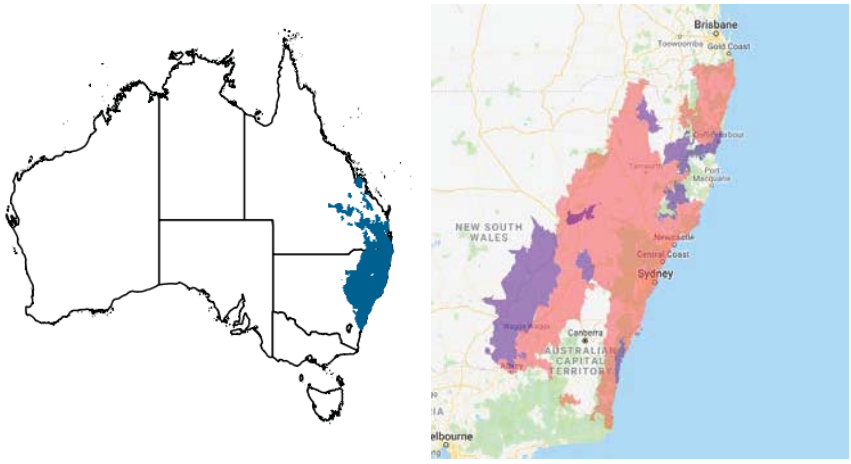


Figure 3.5 **Distribution range of the Large-eared pied bat**

Source: ALA (2019), OEH (2019)

3.5.2.3 Biology and reproduction

The large-eared pied bat feeds on insects flying at 6 to 10 m off the ground and along creek lines. It is unknown if it targets particular groups of insects (Curtis et al. 2012; DERM 2011).

Females can give birth at one year of age, and males also appear capable of breeding at this age. Mating appears to occur in early winter. A nursery colony is typically established in September by both adult females and males, with the majority of adult males leaving by the time the young are born in early summer. Females are known to give birth to one or two young per year. By the end of March the juveniles have left the roost. The adult females leave the roost after the juveniles, and the site is abandoned during the winter months. Life expectancy and natural mortality have not been determined (DotEE 2019; Dwyer 1966; Hoye and Dwyer 1995).

3.5.3 Habitat

Available roosts are unevenly distributed throughout the landscape. Large-eared pied bats require a combination of sandstone cliffs/escarpments to provide roosting habitat that is adjacent to higher fertility sites (particularly box gum woodlands or river/rainforest corridors which are used for foraging) (DotEE 2019).

Large-eared pied bats have been observed in disused mine shafts, caves, overhangs and disused Fairy martin (*Hirundo ariel*) nests for shelter and to raise young. This species possibly also roosts in tree hollows, within dry and wet sclerophyll forest, Cyprus-pine dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland, Brigalow and sandstone outcrop country. In southeast Queensland, the species has primarily been recorded from higher altitude, among moist tall open forest adjacent to rainforest (DotEE 2019; Hoye and Dwyer 1995; Schulz 1998).

3.5.4 Threatening processes

The following have been identified as potentially threatening processes to the Large-eared pied bat:

- Disturbance and damage to primary nursery sites by animals (particularly goats) and humans (Hoye 2005; Duncan et al. 1999; TSSC 2012)

- Populations can be easily displaced as they roost in disused mines which often become active if commodity prices make them economical or they can be filled for safety reasons (Hoye 2005; Duncan et al. 1999; TSSC 2012).
- Habitat loss and isolation of woodland habitat near cliffs, caves and old mines for agriculture or development
- Too-frequent fire regimes
- Use of pesticides (OEH 2019)

3.5.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Large-eared pied bat *(Chaminolobus dwyeri)*. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10157. In effect under the BC Act 2016.

3.5.6 References

Atlas of Living Australia (2019). Chalinolobus dwyeri. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:cddd224d-40ed-49d9-bb88-dcbfe064a35e#gallery [Accessed 17 September 2019].

Curtis, L.K., Dennis, A.J., McDonald, K.R., Kyne, P.M. and Debus, S.J.S. (2012). Queensland's Threatened Animals CSIRO Publishing, Collingwood, Victoria, Australia

Department of Environment and Resource Management (2011). National recovery plan for the Large-eared pied bat Chalinolobus dwyeri. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Department of the Environment and Energy (2019). Chalinolobus dwyeri in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=183 [Accessed 17 September 2019].

Duncan, A., Baker, G.B and Montgomery, N. 1999, The Action Plan for Australian Bats. [Online]. Canberra: Environment Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/action/bats/index.html. [Accessed 17 September 2019].

Dwyer, P.D. (1966). Observations on Chalinolobus dwyeri (Chiroptera: Vespertilionidae) Australia. Journal of Mammalogy. 47:716-718.

Hoye, G.A. and Dwyer P.D. (1995). Large-eared pied bat Chalinolobus dwyeri. In: Stahan, R, ed. The Mammals of Australia. Page(s) 510-511. Chatswood, NSW: Reed Books.

Hoye, G.A. (2005). Recovery plan for the large-eared pied bat Chalinolobus dwyeri. Fly By Night Bat Surveys Pty Ltd. Brisbane: Queensland Parks and Wildlife Service.

Musser, A. (2017). Large-eared pied bat (Chalinolobus dwyeri). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=d05ddeaf-7807-489b-9269-50f79951560d. [16 September 2019].

Ryan, R.M. (1966). A new and imperfectly known Australian Chalinolobus and the taxonomic status of African Glauconycteris. Journal of Mammalogy. 47:86-91.

Schulz, M. (1998). Bats and other fauna in disused Fairy Martin Hirundo arial nests. Emu. 98:184-191.

Threatened Species Scientific Committee (2012). Commonwealth Listing Advice on Chalinolobus dwyeri (Large-eared Pied Bat). Department of Sustainability, Environment, Water, Population and Communities. Canberra, ACT: Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/183-listing-advice.pdf. In effect under the EPBC Act from 29 June 2012.

3.6 Corben's long-eared bat (*Nyctophilus corbeni*)

3.6.1 Status

EPBC Act – Vulnerable

BC Act – Vulnerable

3.6.2 Biology and ecology

3.6.2.1 Characteristics

The Corben's long-eared bat (*Nyctophilus corbeni*) is a relatively large microchiropteran bat species with a head and body length approximating 50 to 75 mm in length and tail length of approximately 35 to 50 mm. The bat has long ears and a shallow muzzle ridge groove with dark-grey brown fur and slightly lighter tips (refer Photograph 3.4). The weight varies between genders with females weighing 14 to 21 g and being heavier than males who weigh 11 to 15 g. The body of the bat is covered with light brown fur (DES 2019; DotEE 2019).

Photograph 3.4 Corben's long-eared bat (Nyctophilus corbeni)

Source: Murphy (2005)

3.6.2.2 Known distribution

The Corben's long-eared bat has a limited distribution restricted to the Murray-Darling Basin in southeastern Australia (DotEE 2019) (refer Figure 3.6).

In Queensland, the majority of records for this species are from the Brigalow Belt South Bioregion, with the most easterly record from the Bunya Mountains National Park. The most northerly records are from the Expedition Range and Dawson River areas with the most westerly records from west of Bollon in the Mulga lands Bioregion. In New South Wales, the species is often found in northeastern New South Wales (DES 2019; DotEE 2019; OEH 2019; Schulz and Lumdsen 2010).

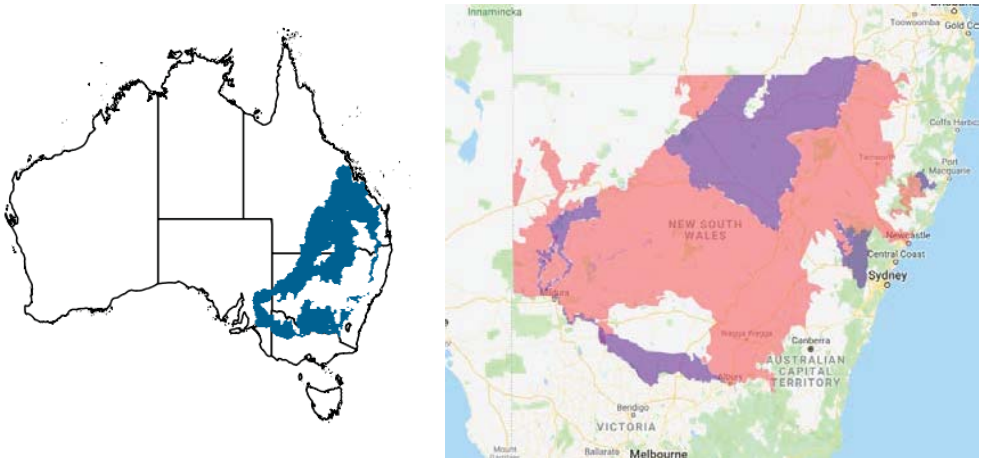


Figure 3.6 **Distribution range of Corben's long-eared bat**

Source: ALA (2019), OEH (2019)

3.6.2.3 Biology and reproduction

This bat species feeds on insects from foliage and on the ground, eating beetles, bugs, moths, grasshoppers and crickets (DES 2019).

There is little information currently available on this species reproductive biology, although it is thought that mating takes place during autumn and winter. Females are thought to store sperm until spring, when fertilisation and gestation occurs. Up to two young are born during late spring/early summer with young not fully weaned until mid-summer (OEH 2097; Curtis et al. 2012).

3.6.3 Habitat

This species is known to inhabit a range of inland woodland vegetation types including box, ironbark, cypress pine, mallee, bull-oak, brigalow and belah woodlands/forests. The species will roost in tree hollows, crevices and under loose bark within these communities (OEH 2019).

Essential habitat for the species is generally associated with large tracts of vegetation (100s to 1,000s of ha), including open forest with open to dense understorey Semi Evergreen Vine Thicket/Brigalow/Belah communities and mixed *Eucalyptus*/*Corymbia*/*Angophora* communities. The species is known to fly large distances (>7 km in a night) from roosts to foraging areas (DES 2019; DotEE 2019).

3.6.4 Threatening processes

The following have been identified as potentially threatening processes to the Southeastern long-eared bat:

- Habitat loss and/or fragmentation
- Destruction of roosting sites and foraging habitat through fire
- Overgrazing and forestry activity
- Predation by feral species and competition for tree hollows
- Exposure to agrichemicals (DES 2019).
- Reduction in hollow-bearing trees
- Disturbance to winter roosts and breeding sites (OEH 2019).

3.6.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Corben's Long-eared Bat (*Nyctophilus corbeni*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10568. In effect under the BC Act 2016.

3.6.6 References

Atlas of Living Australia (2019) Nyctophilus corbeni. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:8a111847-ee8b-4739-935f-248d37eb63ae [Accessed 11 September 2019].

Department of Environment and Energy (2019). Nyctophilus corbeni (Corben's Long-eared Bat) Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=83395 [Accessed 11 September 2019].

Department of Environment and Science (2019). Eastern long-eared bat. Queensland Government. Available from: https://www.ehp.qld.gov.au/wildlife/animals-az/micro-bats/eastern_longeared_bat.html [Accessed 11 September 2019].

Murphy (2005). Photograph: Southeast long-eared bat.

Office of Environment and Heritage (2019). Corben's Long-eared Bat - Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10568 [Accessed 12 September 2019].

Schulz, M. and Lumsden, L. (2010). (Draft) National Recovery Plan for the Southeastern long-eared bat Nyctophilus corbeni, Victorian Department of Sustainability and Environment

Zell, M. (2019). Southeastern long-eared bat (Nyctophilus corbeni). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=2c438bfa-583a-4585-846c-135199ce39d6. [19 September 2019].

3.7 Spotted-tailed quoll (southeastern mainland population) (*Dasyurus maculatus maculatus*)

3.7.1 Status

EPBC Act – Endangered

BC Act – Vulnerable

3.7.2 Biology and ecology

3.7.2.1 Characteristics

Male Spotted-tailed quolls (southeastern mainland population) (*Dasyurus maculatus maculatus*) have a head-body length of 380 to 759 mm, with females being 350 to 450 mm. Male tail lengths are between 370 to 550 mm and 340 to 420 mm for females. The average male Spotted-tailed quoll weighs between 2.8 to 4.6 kg, whilst females average a weight of 1.5 to 2 kg. The fur on its back ranges in colour from rich red-brown to dark brown with white spots (refer Photograph 3.5). The Spotted-tailed quoll is distinguished from other quolls by the spots running along the length of its tail. The fur on the underside is cream or white. They also have short, round ears which extend just above the outline of the head. Female Spot-tailed quolls have a poorly developed pouch (Belcher 2003; DotEE 2019; Green and Scarborough 1990; Jones 1997; Körtner et al. 2004; Queensland Museum 2015).

Photograph 3.5 Spotted-tailed quoll (Dasyurus maculatus maculatus)

Source: Bennett (2012)

3.7.2.2 Known distribution

The Spotted-tailed quoll (southern subspecies) was previously widely distributed from southeast Queensland, eastern New South Wales, Victoria, southeast South Australia and Tasmania (refer Figure 3.7), however, it is estimated that the range has reduced by 50 to 90 per cent. Detailed distribution records and abundance estimates are lacking, due to the scale and intensity of survey effort that is required to detect the species across its entire range (Jones et al. 2001; Long and Nelson 2004).

In Queensland, the spotted-tailed quoll occurs in the southeast, coastally from Bundaberg to the New South Wales border, and inland to Monto and Stanthorpe. Spot-tailed quolls are known from five broad geographic regions: four from coastal ranges and the Great Dividing Range from the New South Wales border to Gladstone. The fifth is centred on the eastern Darling Downs-Inglewood Sandstone provinces of the Brigalow Belt South Bioregion. Unconfirmed reports suggest the subspecies may occur in the Clarke and Conway Range areas, eastern Queensland (Long and Nelson 2004; Van Dyck and Longmore 1991).

Figure 3.7 **Distribution range of the Spotted-tailed quoll (southern subspecies)**

Source: DotEE (2019)

3.7.2.3 Biology and reproduction

Spotted-tailed quolls are predominantly nocturnal and typically prey on medium-sized mammals. Typically, prey includes Ringtail possum (*Pseudocheirus pererinus*), Common brushtail possum (*Trichosurus vulpecula*), Mountain brushtail possum (*Trichosurus caninus*), Greater gilder (*Petauroides volans*) and Rabbit. Additionally, this species consumes insects, lizards, crayfish, poultry, birds, small mammals, frogs, fish, plant material and refuse that has been discarded by humans (Belcher 1995; 2000; Dawson 2005; Edgar and Belcher 2008; Jones et al. 2001).

Mating and births for the Spotted-tailed quoll occur over the winter months (June to August). It is possible for roaming males to mate with more than one female per year (Belcher and Darrant 2004; Dawson 2005; Fleay 1940).

After a gestation period of 21 days, litters of between four and six are born, in late-July to mid-August. Young are attached to the teat for about eight weeks from birth. Subsequently, young may be left in the maternal den while the mother is hunting for food to provide to her young. At 18 to 21 weeks the young are fully independent and 33 per cent of the body size of the mother (Belcher 2003; DotEE 2019; Edgar and Belcher 2008; Fleay 1940; Green and Scarborough 1990; Jones et al. 2001).

3.7.3 Habitat

Spot-tailed quolls have been recorded from a wide range of habitats, including temperate and subtropical rainforests in mountain areas, wet sclerophyll forest, lowland forests, open and closed eucalypt woodlands, inland riparian and *Eucalyptus camaldulensis* (River red gum) forests, dry 'rainshadow' woodland, sub-alpine woodlands, coastal heathlands and occasionally in open country/other treeless areas. Habitat requirements include suitable den sites such as hollow logs, tree hollows, rock outcrops or caves. From a study in Kosciuszko National Park, home range estimates were 620 to 2560 ha for males, and 90 to 650 ha for females (Edgar and Belcher 2008; Green and Scarborough 1990; Maxwell et al. 1996; NPWS 1999).

The Spotted-tailed quoll is known to prefer mature wet forest habitat especially areas with rainfall 600 mm/year. Unlogged forest or forest that has had limited disturbance by timber harvesting is also preferable (Belcher 2000; Catling et al. 1998; 2000; Edgar and Belcher 2008; Green and Scarborough 1990; Mansergh 1984; Watt 1993).

3.7.4 Threatening processes

The following have been identified as potentially threatening processes to the Spotted-tailed quoll:

- The loss, fragmentation, disturbance and degradation of habitat through clearing of native vegetation, timber harvesting and other forest management practices (ACT Government 2005; Belcher et al. 2007; Catling and Burt 1995; Catling et al. 1998; Long and Nelson 2004)

- Predation from Red foxes (*Vulpes vulpes*), Dingos (*Canis lupus dingo*) and Domestic dogs (*Canis lupus domesticus*). Dietary and habitat overlap with these species may also be leading to competitive effects (Körtner and Gresser 2002; Long and Nelson 2004; Murray and Poore 2004)
- Spotted-tailed quolls have been killed by landholders in response to poultry coop raids. The large home ranges of the spotted-tailed quoll, particularly males, also makes them susceptible to road mortality in forested areas fragmented by roads, and a tendency to scavenge carrion may increase this threat (Dawson 2005; Green and Scarborough 1990; Nelson 2004; Jones 2000 cited in Long and Nelson 2004; Jones et al. 2003; Long and Nelson 2004).
- Following various baiting programs using 1080 baits for invasive predators, the dosage for foxes and dogs is potentially fatal to the spotted-tailed quoll, particularly for smaller individuals, such as females and juveniles (Körtner and Watson 2005).

3.7.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Spotted-tailed quoll (*Dasyurus maculatus*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10207. In effect under the BC Act 2016.

3.7.6 References

ACT Government (2019). Spotted-tailed Quoll (Dasyurus maculatus) - a vulnerable species, Action Plan No. 30. Canberra: Environment ACT. Available from: http://www.environment.act.gov.au/cpr/conservation_and_ecological_communities/threatened_species_action_plans. [Accessed 12 September 2019]

Belcher, C.A. (1995). Diet of the tiger quoll (Dasyurus maculatus) in East Gippsland, Victoria. Wildlife Research. 22:341-357.

Belcher, C.A. (2000). The Ecology of the Tiger Quoll, Dasyurus maculatus, in southeastern Australia. Ph.D. Thesis. Melbourne, Victoria: Deakin University.

Belcher, C.A. (2003). Demographics of tiger quoll (Dasyurus maculatus maculatus) populations in southeastern Australia. Australian Journal of Zoology. 51:611-626.

Belcher, C.A. and Darrant J.P. (2004). Home range and spatial organization of the marsupial carnivore, Dasyurus maculatus maculatus (Marsupialia: Dasyuridae) in southeastern Australia. Journal of Zoology. 262:271-280.

Belcher, C., Nelson J. and Darrant J. (2007). Diet of the tiger quoll (Dasyurus maculatus) in southeastern Australia. Australian Journal of Zoology. 55:117-122.

Bennett, S. J. (2012). Spotted-tail quoll (southeastern mainland population) (Dasyurus maculatus maculatus). [image] [online] Available from: https://www.flickr.com/photos/quollism/8470326020/in/photolist-otMpsh-dUuCPN-8i5qZD-8FyqvQ-8Fyrj9-8i5v82-8i5fv2-8i5dAx-8i8tbh-dUuJyw-3ibXyv-6ohk1i-6ohoxX-dUp7A8-6ompZ1-6omrpj-a9ZctU-9agNYm-28zD4py-MzPVJP-2bkFCPX. [17 September 2019].

Catling, P.C., Burt R.J. and Forrester R.I. (1998). Models of the distribution and abundance of ground-dwelling mammals in the eucalypt forests of southeastern New South Wales. Wildlife Research. 25(5):449-466.

Catling, P.C., Burt R.J. and Forrester R.I. (2000). Models of the distribution and abundance of ground-dwelling mammals in the eucalypt forests of north-eastern New South Wales in relation to habitat variables. Wildlife Research. 27:639-654.

Claridge, A.W., Paull D., Dawson J., Mifsud G., Murray A.J, Poore R. and Saxon M.J. (2005). Home range of the spotted-tailed quoll (Dasyurus maculatus), a marsupial carnivore, in a rainshadow woodland. Wildlife Research. 32(1):7-14.

Dawson, J.P. (2005). Impact of wildfire on the Spotted-tail quoll Dasyurus maculatus in Kosciuszko National Park. M.Sc. Thesis. University College (Australian Defence Force Academy), University of New South Wales.

Department of the Environment and Energy (2019). Dasyurus maculatus maculatus (SE mainland population) in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=75184. [Accessed 12 September 2019]

Edgar, R. and Belcher C. (2008). Spotted-tail quoll, Dasyurus maculatus (Kerr, 1792). In: Strahan, R., ed. The Mammals of Australia. Page(s) 61-62. Carlton, Victoria: Reed New Holland.

Fleay, D. (1940). Breeding of the Tiger Cat. Victorian Naturalist. 56:159-163.

Green, R.H. and Scarborough T.J. (1990). The Spotted-tail quoll Dasyurus maculatus (Dasyuridae, Marsupialia) in Tasmania. The Tasmanian Naturalist. 100:1-15.

Jones, M.E., Oakwood M., Belcher C.A., Morris K., Murray A.J., Woolley P.A., Firestone K.B., Johnson B. and Burnett S. (2003). Carnivore Concerns: Problems, issues and solutions for conserving Australasia's marsupial carnivores. In: Jones, M., Dickman C. and Archer M., eds. Predators with Pouches: The biology of carnivorous marsupials. Page(s) 422-434. Collingwood, Victoria: CSIRO Publishing.

Jones, M.E., Rose R.K. and Burnett S. (2001). Dasyurus maculatus. Mammalian Species. 676:1-9. American Society of Mammalogists.

Körtner, G. and Gresser S. (2002). Impact of fox baiting on quoll populations. Final Report to Environment Australia and the New South Wales National Parks and Wildlife Service.

Long, K.I. and Nelson J.L. (2004). (Draft) Recovery Plan for Dasyurus maculatus (Spotted-tail quoll) 2005-2009. Canberra: Department of the Environment.

Mansergh, I.M. (1984). The status, distribution and abundance of Dasyurus maculatus (Tiger Quoll) in Australia with particular reference to Victoria. Australian Zoologist. 21:109-122.

Maxwell, S., Burbidge A.A. and Morris K. (1996). The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia, Environment Australia.

Murray, A.J. and Poore R.N. (2004). Potential impact of aerial baiting for wild dogs on a population of spotted-tailed quolls (Dasyurus maculatus). Wildlife Research. 31:639-644.

National Parks and Wildlife Service (NPWS) (1999). Spotted-tail quoll, Dasyurus maculatus (Kerr 1792). Hurstville, New South Wales: National Parks and Wildlife Service.

Office of Environment and Heritage (2019). Spotted-tailed quoll - Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10207 [Accessed 12 September 2019].

Threatened Species Scientific Committee (2004). Commonwealth Listing Advice on Dasyurus maculatus maculatus (Spotted-tail quoll, Spotted-tail quoll, Tiger Quoll). [Online].

Van Dyck, S.M. and Longmore, N.W. (1991). The mammal records. In: Ingram, G.J. and Raven, R.J., eds. Atlas of Queensland's Frogs, Reptiles, Birds and Mammals. Page(s) 284-336. Brisbane: Queensland Museum.

Watt, A. (1993). Conservation status and draft management plan for Dasyurus maculatus and D. hallucatus in southern Queensland. Queensland: Department of Environment.

3.8 Border thick-tailed gecko (*Uvidicolus sphyrurus*)

3.8.1 Status

EPBC Act – Vulnerable

BC Act – Vulnerable

3.8.2 Biology and ecology

3.8.2.1 Characteristics

The Border thick-tailed gecko is a small lizard up to 10 cm long (average 7 cm). It is fawn to brown above with faint darker brown flecks and many small white spots arranged in rows across the head, back and sides and on the legs. The gecko looks 'knobbly' due to numerous conical tubercles, especially on the tail. The tail is fat and rectangular with a thin tapering tip, and typically has four pale rings. The species has recently been re-assigned to the genus Uvidicolous. These Geckos are active at night and shelter by day under rock slabs, in or under logs, and under the bark of standing trees (DotEE 2019, OEH 2019)

Photograph 3.6 Border thick-tailed gecko (*Uvidicolus sphyrurus*)

Source: Fordyce & White (2018)

3.8.2.2 Known distribution

Found only on the tablelands and slopes of northern New South Wales and southern Queensland, reaching south to Tamworth and west to Moree. Most common in the granite country of the New England Tablelands. Occurs at sites ranging from 500 to 1,100 m elevation. Populations are mostly fragmented, with over 50 discrete sites currently known that are separated by at least 2 km (DotEE 2019, OEH 2019).

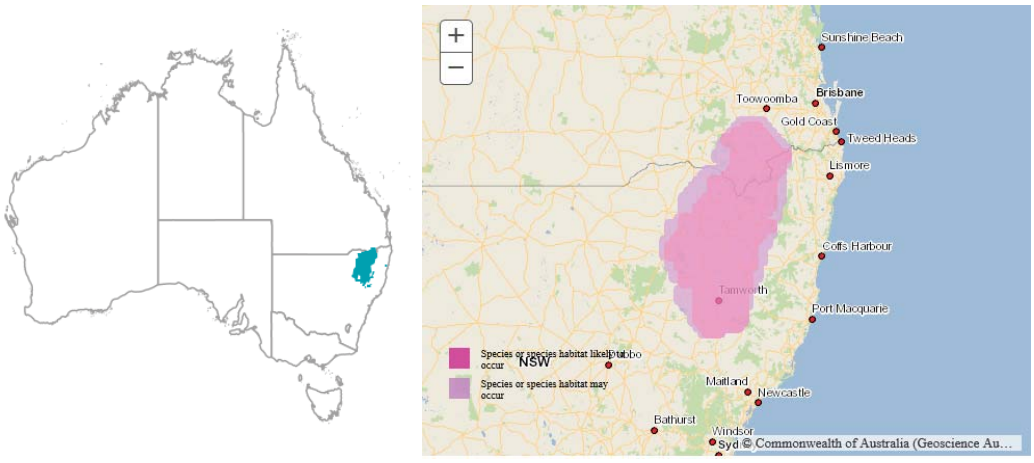


Figure 3.8 Distribution range of the Border thick-tailed gecko (*Uvidicolus sphyrurus*)

Source: ALA (2019), DotEE (2019)

3.8.3 Habitat

As implied by another of its common names (Granite thick-tailed gecko), the species often occurs on steep rocky or scree slopes, especially granite in dry eucalypt forest or woodland. Records from basalt and metasediment slopes and flats indicate its habitat selection is broader than formerly thought and may have extended into areas that were cleared for agriculture.

Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey.

3.8.4 Threatening processes

The following have been identified as potentially threatening processes to the Border thick-tailed gecko:

- Rocky dry open forest clearing and fragmentation for agriculture and development
- Bushrock harvesting
- Over burning of rocky dry open forest
- Harvesting fallen timber for firewood
- Trampling and grazing from livestock and feral goats
- Predation by introduced species (foxes and cats)
- Lack of knowledge and understanding of this species ecology and biology
- Impacts from exotic flora infestation, particularly coolatai grass and garden escapees (OEH 2019).

3.8.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Border Thick-tailed Gecko (*Uvidicolus sphyrurus*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10823. In effect under the BC Act 2016.

3.8.6 References

Atlas of Living Australia. 2019. Uvidicolus sphyrurus – Border Thick-Tailed Gecko. Available online at: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:7a6bad30-8da4-4fb4-b0e9-c8a01a95d11d [Viewed 18 September 2019]

Department of the Environment and Energy 2019 Threatened species and ecological communities – SPRAT - Uvidicolus sphyrurus — Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko available online at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=84578 [Viewed 18 September 2019]

Fordyce, N. and White, J. (2018). Border thick-tailed gecko (Uvidicolus sphyrurus). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=7be19574-e16a-4847-b5b2-43a3ce231789. [19 September 2019].

Office of Environment and Heritage 2019 Threatened Species - Border Thick-tailed Gecko – profile. Available online at: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10823 [Viewed 18 September 2019]

3.9 Bristle-faced free-tailed bat (*Mormopterus eleryi*)

3.9.1 Status

EPBC Act – Not listed

BC Act – Endangered

3.9.2 Biology and ecology

3.9.2.1 Characteristics

Bristle-faced free-tailed bats are small insectivorous bats that are light sandy brown in colour along the back and lighter in colour below (refer Photograph 3.7). With individuals reaching a weight of 6 grams, the Hairy-nosed free-tailed bat differs from members of the Mormopterus genus due to their light build, long thin muzzle and distinct genetics (OEH 2019). Furthermore, they differ in their unique echolocation call structure (iNaturalist 2019). Other unique features include stout bristles on the nose and distinctive large fleshy projections present on the genitals of both males and females (OEH 2019).

Photograph 3.7 Bristle-faced free-tailed bat (Mormopterus eleryi)

Source: Thompson (2014)

3.9.2.2 Known distribution

The Bristle-face free-tailed bat is distributed across the southern half of the Northern Territory to central Queensland and north-western New South Wales (refer Figure 3.9). There are only three disjunct locations where this species occurs within New South Wales. These sightings include 13 individuals recorded at Gundabooka National Park, south of Bourke; one individual from Dhinnia Dthinawa Nature Reserve and two from Bonshaw (OEH 2019).

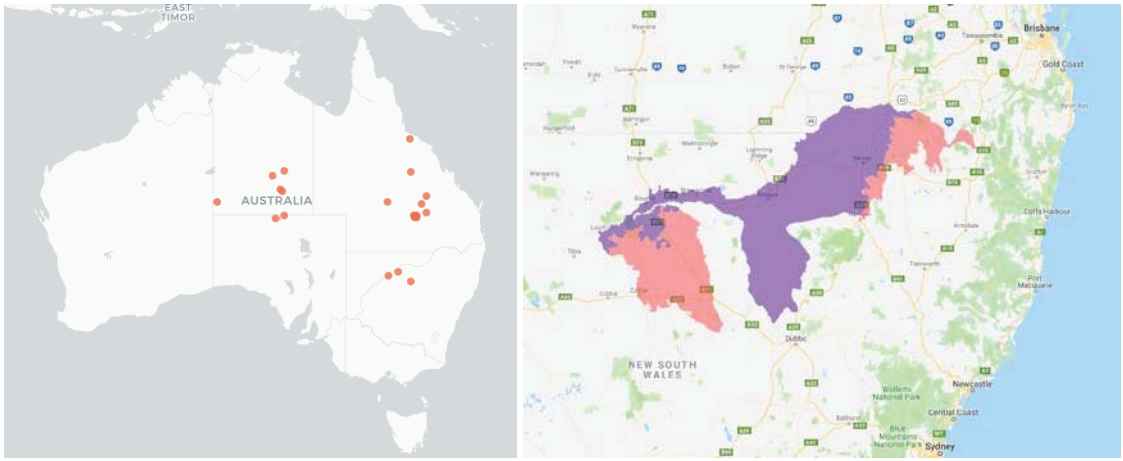


Figure 3.9 **Distribution range of Bristle-faced free-tailed bat (Mormopterus eleryi)**

Source: ALA (2019), OEH (2019)

3.9.2.3 Biology and reproduction

Bristle-face free-tailed bats have unique echolocation calls contrasting with other species of Australian molossid bats in that it displays a strongly frequency-modulated search phase pulse. Of all Australian *Mormopterus* they exhibit the highest mean characteristic frequency at 36 kHz (iNaturalist 2019).

Very little is known about the biology and reproduction of Bristle-faced free-tailed bats due to a lack of knowledge on the species. A maternity roost was located at Gundabooka National Park with a total of 15 lactating female bats (iNaturalist 2019). With its presence recorded at only 15 locations this species appears to be extremely rare. Other Australian species from the same family rely upon hollow-bearing limbs and fissures in the trees for roosting indicating that this species has similar habitat requirements (OEH 2019).

3.9.3 Habitat

Whilst little is known about the habitat requirements of Bristle-faced free-tailed bats other members of their family generally rely on hollow bearing trees and fissures for roosting sites. This species is predicted to occur in the following ecological communities; Brigalow belt south, Cobar peneplain, Darling riverine plains and Nandewar (OEH 2019).

3.9.4 Threatening processes

The following have been identified as potentially threatening processes to Bristle-faced free-tailed bats:

- Removal of essential roosting habitat – trees bearing hollows and fissures
- Low population numbers make them more susceptible to impacts of habitat loss
- Lack of scientific knowledge on the species
- Direct mortality and habitat modification from fire
- Prey availability impacted from the use of pesticides and herbicides and bioaccumulation from associated toxins
- Changes to foraging and roosting habitat as a result of invasive flora through altered vegetation structure
- Feral animal herbivory degrading habitat.

3.9.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Bristle-faced free-tailed bat (Mormopterus eleryi). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10923. In effect under the BC Act 2016.

3.9.6 References

Atlas of Living Australia (2019). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:26daebea-5fc7-4433-93b9-8fbf6265aa1c#overview. [Accessed 26 September 2019].

iNaturalist (2019). [online] Available from: https://www.inaturalist.org/taxa/207687-Mormopterus-eleryi. [Accessed 26 September 2019].

Office of Environment and Heritage (2019). Bristle-faced Free-tailed Bat - profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10923 [Accessed 12 September 2019].

Thompson, B. (2015). Bristle-faced free-tailed bat (*Mormopterus eleryi*). [image] [online] Available from: https://commons.wikimedia.org/wiki/File:Mormopterus_eleryi_Mount_Isa.png. [20 September 2019].

3.10 Black-striped wallaby (*Macropus dorsalis*)

3.10.1 Status

EPBC Act – Not listed

BC Act – Endangered

3.10.2 Biology and ecology

3.10.2.1 Characteristics

The Black-striped wallaby is a medium-sized macropod that is grey-brown in colour with rufous forequarters, pale ventral fur and a distinctive black dorsal stripe running from the forehead down the back. Whilst similar in appearance to the Red-necked wallaby the Black-striped is smaller and more colourful, particularly the rust-red patches on the shoulders, arms and upper legs along with prominent white cheeks and hip-stripes (refer Photograph 3.8). They also hop with a hunches or crouched stance giving them a distinctive gait (OEH 2019).

Photograph 3.8 Black-striped wallaby (Macropus dorsalis)

Source: McMaster (2017)

3.10.2.2 Known distribution

The Black-striped wallaby is distributed between Townsville in Queensland to norther New South Wales occurring on both sides of the Great Dividing Range. West of the Great Divide it can be found in brigalow remnants south of Narabri. Along the north coast this species is restricted to the upper catchments of the Clarence and Richmond rivers (refer Figure 3.10) (OEH 2019).

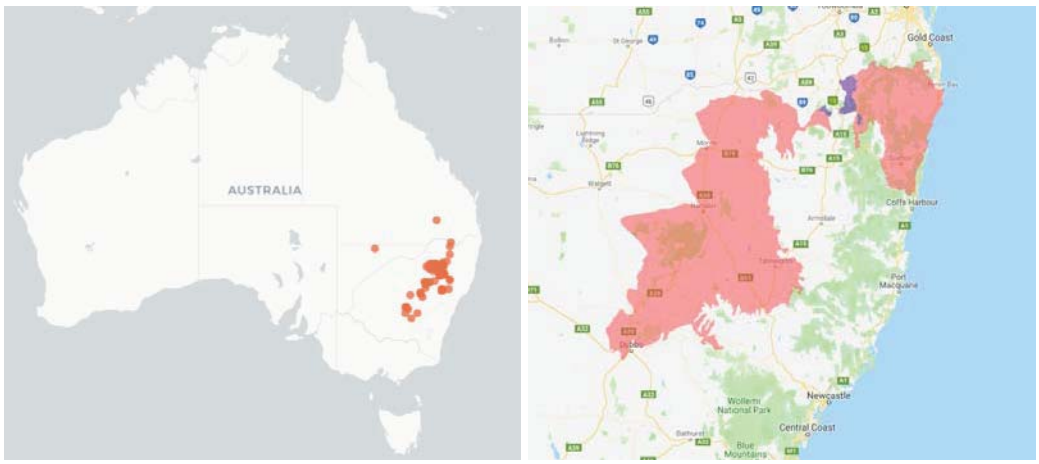


Figure 3.10 Distribution range of Black-striped wallaby (Macropus dorsalis)

Source: ALA (2019), OEH (2019)

3.10.2.3 Biology and reproduction

The species is largely nocturnal, foraging at night and sheltering during the day within thick vegetation (OEH 2019). The species breeds year-round. Gestation ranges between 33-36 days, pouch life ranges between 192-225 days and weaning occurs between 81-159 days following pouch emergence (Van Dyck & Strahan 2008).

3.10.3 Habitat

Black-striped wallaby habitat consists of dense woody or shrubby vegetation that sits low to the ground and must occur near open grassy areas consisting of suitable browsing habitat. Where it occurs on the north west slopes of the Great Divide the dense vegetation it is associated with includes brigalow, ooline and semi-evergreen vine thicket. Where it occurs on the north coast it has a strong association with dry rainforest but will also utilise wet eucalypt forest with a rainforest understorey or dense shrub layer present (OEH 2019).

3.10.4 Threatening processes

The following have been identified as potentially threatening processes to Bristle-faced free-tailed bats:

- Reduction of critical habitat for the species due to agriculture and forestry
- Predation by feral cats, wild dogs and foxes
- Domestic stock overgrazing and changing habitat structure
- Grazing associated with feral species such as goats and rabbits
- Habitat quality reduced as a result of invasive weeds (lantana and prickly pear)
- Illegal hunting and poisoning
- Small isolated populations experiencing genetic bottlenecks
- Frequent fire regimes where they occur in small reserves
- Knowledge gaps on the ecology of this species in New South Wales limiting the ability to ensure viable populations
- Vehicle strike where habitat fragments occur near roads
- Climate change causing more frequent fires and less rainfall resulting in a change of habitat quality, particularly in fragmented landscapes.

3.10.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Black-striped wallaby (*Macropus* dorsalis). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10500. In effect under the BC Act 2016.

3.10.6 References

Atlas of Living Australia (2019). Black-striped wallaby (Macropus dorsalis). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:7ac48b20-fc54-4e5c-a05d-29f6122d4f49. [26 September 2019].

Office of Environment and Heritage, NSW (2019). Black-striped wallaby (Macropus dorsalis). [online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10500. [26 September 2019].

McMaster, I. (2017). Black-striped wallaby (Macropus dorsalis). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=a6df4694-f239-4daa-9c20-b2e83f6e49b4. [20 September 2019].

Van Dyck, S. & Strahan, R. (2008) The mammals of Australia, Third edition. Reed New Holland, Sydney.

3.11 Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)

3.11.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

3.11.2 Biology and ecology

3.11.2.1 Characteristics

The Eastern bentwing-bat has dark brown to reddish- brown fur on its back with slightly lighter coloured fur on its belly. Its high domed head has a short snout and short ears (refer Photograph 3.9). The wing membrane in this species is attached to the ankle rather than the base of the toe. The ‘bent wing’ appearance is due to the fact that the third finger bone is much longer than other finger-bones. Weighing only 20 grams, the head and body length is approximately 6 cm with a wingspan of 30-35 cm (OEH 2019).

Photograph 3.9 **Eastern bentwing-bat *(Miniopterus schreibersii oceanensis)***

Source: Bush (2019)

3.11.2.2 Known distribution

Eastern bentwing-bats occur predominantly along the east coast of Australia from Victoria to norther Queensland. They also occur on north-western coast of Western Australia (ALA 2019, OEH 2019) (refer Figure 3.11).

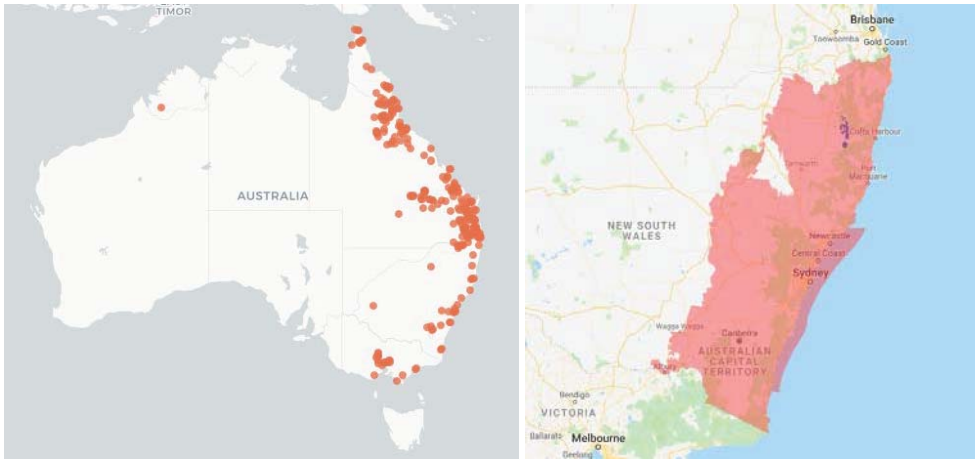


Figure 3.11 **Distribution range of the Eastern bentwing-bat**

Source: ALA (2019), OEH (2019)

3.11.2.3 Biology and reproduction

Eastern bentwing-bats will for discrete populations that are central to a maternity cave, which they will utilise annually during the breeding months in spring and summer. This is where mothers will give birth and rear their young. For maternity caves to be deemed suitable they must provide specific temperature and humidity regimes. Outside of the breeding season bats will disperse no more than 300 km from the maternity cave (OEH 2019).

3.11.3 Habitat

Eastern bentwing-bats utilise caves as their primary choice for roosting habitat but will also utilise man-made structures that include disused mines, storm-water drainage pipes and buildings. This species is also known to utilise the following habitat types; Australian Alps, Brigalow Belt south, Nandewar, New England Tablelands, New South Wales north coast, New South Wales south western slopes, south east corner, south east highlands and south eastern Queensland (OEH 2019).

3.11.4 Threatening processes

The following have been identified as potentially threatening processes to Eastern bentwing bats:

- Recreation use of essential cave habitat causing disturbance to bat populations
- Loss of high value foraging habitat
- Introduced exotic pathogens, such as white-nose fungus
- Invasive flora species (particularly blackberries) blocking cave entrances or intentional blocking for human health and safety reasons
- Fires during breeding season
- Feral cat predation (OEH 2019).

3.11.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Eastern bentwing-bat (Miniopterus schreibersii oceanensis). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10534. In effect under the BC Act 2016.

3.11.6 References

Atlas of Living Australia (2019). Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:abc00f63-254a-47d9-b1ed-b859a172915c. [27 September 2019].

Bush, T. (2019). Eastern bentwing-bat (Miniopterus schreibersii oceanensis). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=aa98e344-176c-4321-8897-3ba6e256697e. [20 September 2019].

Office of Environment and Heritage, NSW (2019). Eastern bentwing-bat (Miniopterus schreibersii oceanensis). [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10534. [27 September 2019].

3.12 Eastern cave bat (*Vespadelus troughtoni*)

3.12.1 Status

EPBC Act – Not listed

BCA Act – Vulnerable

3.12.2 Biology and ecology

3.12.2.1 Characteristics

The Eastern cave bat is a small chestnut-brown bat with reddish tinges on the head and much darker wings. The ears are small and conical shaped, and their nose is short and up-tipped (refer Photograph 3.10). They are very similar in appearance to other closely related species and can be very difficult to differentiate. The most reliable distinguishable feature is the shape of the male's penis (OEH 2019).

Photograph 3.10 Eastern cave bat *(Vespadelus troughtoni)*

Source: Armstrong (2019

3.12.2.2 Known distribution

The distribution of Eastern cave bats occurs across a long band on either side of the Great Dividing Range from Cape York in the north to Kempsey in the south. Records also exists for this species in the New England Tablelands and the upper north coast of New South Wales. They have been recorded as far west as the Warrumbungle Range (refer Figure 3.12) (OEH 2019).

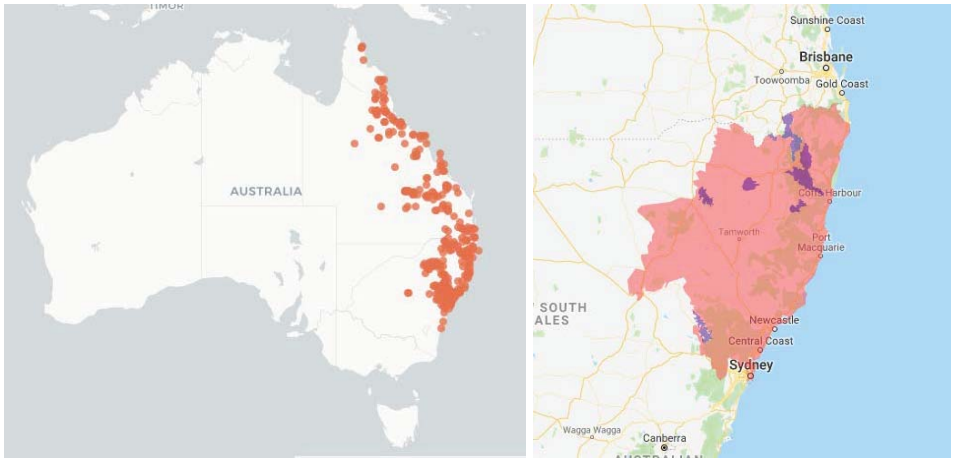


Figure 3.12 Distribution range of the Eastern cave bat

Source: ALA (2019), OEH (2019)

3.12.2.3 Biology and reproduction

As the Eastern cave bat is uncommon little is known about their biology and reproduction (OEH 2019).

3.12.3 Habitat

Like other similar species they are cave-roosting and are associated with dry open forest and woodlands that are close to cliffs and rocky overhangs. Colonies consisting of up to 500 individuals have been found in disused mines (OEH 2019).

3.12.4 Threatening processes

The following have been identified as potentially threatening processes to Eastern bentwing bats:

- Loss of woodland habitat adjacent to cliffs and suitable roosting sites
- Loss of feeding habitat due to timber harvesting, inappropriate fire regimes and agriculture
- Herbicides and pesticides reducing populations of invertebrate prey and causing accumulation of toxins in the fat stores of the bats
- Undetected populations being adversely impacted by poor land management practices
- Likely they are predated upon by feral animals such as cats and foxes
- A lack of knowledge around the ecology, behaviour and habitat requirements of the species.

3.12.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Eastern bentwing-bat (Miniopterus schreibersii oceanensis). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10829. In effect under the BC Act 2016.

3.12.6 References

Armstrong, G. (2019). Eastern cave bat (*Vespadelus troughtoni*). [image] [online] Available from: https://biocache.ala.org.au/occurrences/348036ac-010f-4a23-a607-3223cbe13105. [20 September 2019].

Atlas of Living Australia (2019). Eastern cave bat (Vespadelus troughtoni). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:8548a762-086e-4307-a5dc-99db098139af. [27 September 2019].

Office of Environment and Heritage, NSW (2019). Eastern cave bat (Vespadelus troughtoni). [online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10829. [27 September 2019].

3.13 Eastern pygmy-possum (*Cercartetus nanus*)

3.13.1 Status

EPBC Act – Not listed

BCA Act – Vulnerable

3.13.2 Biology and ecology

3.13.2.1 Characteristics

Eastern pygmy-possums are a tiny marsupial weighing only 15 to 43 grams. Their almost bare hands and prehensile tails aid in their arboreal nature. They have big ears that point forward, their fur is light brown on top and white below (refer Photograph 3.11) As adults their head and body length ranges between 70 to 110 mm with a tail length ranging between 75 to 105 mm (OEH 2019).

Photograph 3.11 Eastern pygmy-possum *(Cercartetus nanus)*

Source: Mahogany (2014)

3.13.2.2 Known distribution

The Eastern Pygmy-possum is confined to Australia's south-eastern corner occurring in southern Queensland, eastern South Australia and in Tasmania. In New South Wales it can be found along the coast and inland to the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes of the Great Dividing Range (OEH 2019) (refer Figure 3.13).

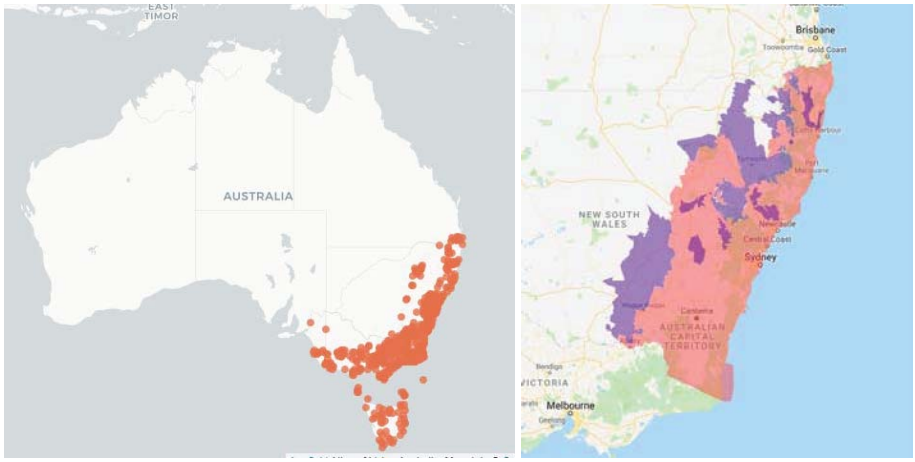


Figure 3.13 **Distribution range of the Eastern pygmy-possum**

Source: ALA (2019), OEH (2019)

3.13.2.3 Biology and reproduction

The Eastern pygmy-possum feeds from banksias, eucalypts and bottlebrushes feasting on nectar and pollen and is an important pollinator of these species, especially in heathland vegetation. In habitats where flowers are less abundant or outside of flowering this species relies on insects. Like many of Australia's mammals they prefer to shelter in tree hollows, they have however also been recorded utilising rotten stumps, holes in the ground, abandoned bird nests, possum dreys and thickets of vegetation. Breeding females solely build nests constructing them in tree hollows, under bark of eucalypts and in shredded bark of tree forks (OEH 2019).

This species of possum tends to be solitary with individuals using multiple nests. Males have a non-exclusive home range consisting of an area of around 0.68 hectares whilst female ranges are around 0.35 hectares. Whilst most births occur during late spring and early autumn this species will give birth whenever food is available. Will frequently spend time in a state of torpor, particularly during winter where internal body temperature will be similar to that of their surroundings (OEH 2019).

3.13.3 Habitat

Eastern pygmy-possums can be found in a range of habitats including rainforest, dry sclerophyll (including Box-ironbark) forest and woodlands to heath. There does however seem to be a preference for woodland and heath apart from where it occurs in north-eastern New South Wales where it is encountered more frequently in rainforest (OEH 2019).

3.13.4 Threatening processes

The following have been identified as potentially threatening processes to Eastern bentwing bats:

- Habitat loss and fragmentation due to land-clearing for agriculture and development
- Changed fire regimes impacting the abundance of their preferred food source
- Loss of shrub diversity due to overgrazing by livestock and rabbits
- Predation from feral animals; wild dogs, foxes and cats
- Reduced availability of nesting sites from fire wood collection
- Vehicle strike where roads occur near suitable habitat (OEH 2019).

3.13.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Eastern pygmy-possum (*Cercartetus nanus*). Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:1cb198f0-1ec4-450c-9af3-6fa4066099cb. In effect under the BC Act 2016.

3.13.6 References

Atlas of Living Australia (2019). Eastern pygmy-possum (*Cercartetus nanus*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10155. [27 September 2019].

Mahogany, S. (2014). Eastern pygmy-possum (Cercartetus nanus). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=31117a3a-3929-4d70-960e-9b31e6a58a35. [20 September 2019].

Office of Environment and Heritage, NSW (2019). Eastern pygmy-possum (Cercartetus nanus). [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10155. [27 September 2019].

3.14 Kultarr (*Antechinomys laniger*)

3.14.1 Status

EPBC Act – Not listed

BC Act – Endangered

3.14.2 Biology and ecology

3.14.2.1 Characteristics

Kultarrs are a small mouse sized marsupial that are fawn coloured with a white underbelly. Their protruding eyes and large ears are distinctive of this species along with their long, delicate legs and elongated toes. Their tail is thin and tipped with a dark tuft of fur (refer Photograph 3.12). Sexual dimorphism occurs within the species with males (80 to 100 mm) being larger than the females (70 to 95 mm). They weigh between 17 to 30 g and 14 to 29 g respectfully (OEH 2019).

Photograph 3.12 Kultarr (*Antechinomys laniger)*

Source: Bawden (2018)

3.14.2.2 Known distribution

Occurring in the semi-arid and arid zones of Australia Kultarrs presented in only small numbers. In New South Wales most records come from the Cobar and Brewarrina region (OEH 2019) (refer Figure 3.14).

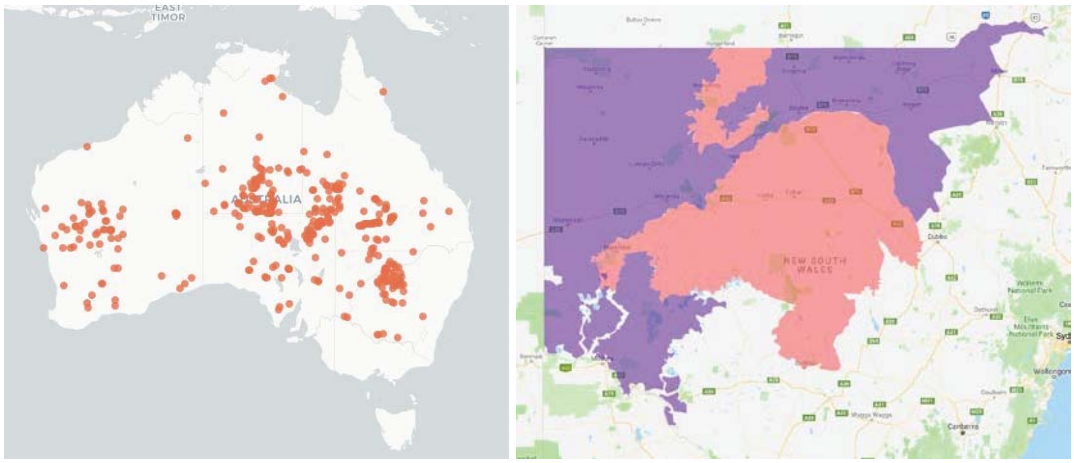


Figure 3.14 **Distribution range of the Kultarr**

Source: ALA (2019), OEH (2019)

3.14.2.3 Biology and reproduction

The lifespan of Kultarrs in the wild is unknown, however captive specimens have shown to live up to 5 and a half years. Kultarrs tend to encounter population fluctuations according to the season and environmental conditions. Populations experience significant declines following droughts and severe flooding events (OEH 2019).

3.14.3 Habitat

The Kultarr is nocturnal and known to use hollow logs, stumps, spinifex tussocks, in deep soil cracks, beneath saltbush and burrow of other nesting animals as shelter whilst they sleep. They are terrestrial in their nature and inhabit open country, especially claypans among *Acacia* woodlands (OEH 2019).

3.14.4 Threatening processes

The following have been identified as potentially threatening processes to Eastern bentwing bats:

- Predation from feral animals including foxes and cats
- Habitat disturbance from livestock grazing, even at low-intensity
- Extreme weather events such as drought and flood
- Crop production and cultivation eliminating shelter and reducing foraging success
- Fire impacting refuge sites and abundance of prey
- Lack of information to inform conservation strategies (OEH 2019).

3.14.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Kultarr (Antechinomys laniger). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10057. In effect under the BC Act 2016.

3.14.6 References

Atlas of Living Australia (2019). Kultarr (Antechinomys laniger). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:f26069f0-f03b-4383-819a-94c3f5852adc. [27 September 2019].

Bawden, T. (2018). Kultarr (Antechinomys laniger). [image] [online] Available from: https://biocache.ala.org.au/occurrences/b17d5e17-a0fd-4098-a282-45c424df03b6. [20 September 2019].

Office of Environment and Heritage, NSW (2019). Kultarr (Antechinomys laniger). [online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10057. [27 September 2019].

3.15 Little pied bat (*Chalinolobus picatus*)

3.15.1 Status

EPBC Act – Not listed

BCA Act – Vulnerable

3.15.2 Biology and ecology

3.15.2.1 Characteristics

Little pied bats are distinctively black and white weighing 4 to 8 grams. Their head and body measures 4.5 cm whilst their tails measure 3.5 cm (refer Photograph 3.13. Their glossy fur is black along the back and grey on the belly. A distinctive 'V' shape is outline in white fur across the pubic area (OEH 2019).

Photograph 3.13 Little pied bat (Chalinolobus picatus)

Source: Robertson (2017)

3.15.2.2 Known distribution

Little pied bats are distributed across much of inland New South Wales and Queensland. In New South Wales they are predominantly around the Western Plains and slopes. Their distribution extends slightly into South Australia and Victoria (refer Figure 3.15) (OEH 2019). Specific locations where this species include Willandra lakes – New South Wales, Idalia National Park – Queensland and Sturt National Park – New South Wales (ALA 2019).

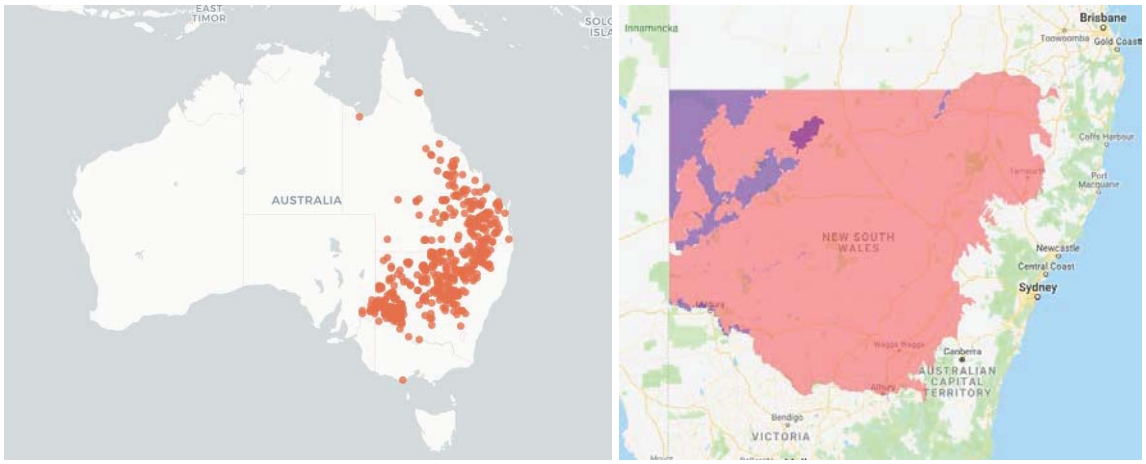


Figure 3.15 Distribution range of the Little pied bat

Source: ALA (2019), OEH (2019)

3.15.2.3 Biology and reproduction

The Little pied bat occurs in small colonies consisting of a few individuals to 50 bats (ALA 2015). They can tolerate high temperatures and dry conditions as long as they have access to open water close to their habitat. Their diets consist of moths and other flying insects (OEH 2019) along with wingless ants, cockroaches, spiders, termites and grasshoppers. They hunt predominantly in the low and mid layer the canopy (ALA 2019). No information is available on the reproduction of this species.

3.15.3 Habitat

Little pied bats are known to roost in hollow bearing bushland trees of the semi-arid tall shrublands and vine forests but can also be found in eucalypt and open acacia woodland. They can also be found in abandoned buildings that occur near these habitat types (ALA 2019).

3.15.4 Threatening processes

The following have been identified as potentially threatening processes to Eastern bentwing bats:

- Loss of habitat and degradation of existing habitat
- Predation by feral animals such as cats
- Pesticide use reducing prey availability adjacent to foraging sites
- Inappropriate fire regimes
- Removal of hollow bearing trees required for nesting including trees that occur in paddocks
- Lack of knowledge on key breeding sites and reproductive biology (OEH 2019).

3.15.5 Threat abatement/recovery plans

No threat abatement or recover plan exists for this species however feral cat management plans may be applicable to the recovery of this species.

3.15.6 References

Atlas of Living Australia (2019). Little pied bat (*Chalinolobus picatus*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:b2a4f584-e14a-4fa6-a7e0-5fd91263d110. [27 September 2019].

Office of Environment and Heritage, NSW (2019). Little pied bat (Chalinolobus picatus). [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10159. [27 September 2019].

Robertson, S. (2017). Little pied bat (Chalinolobus picatus). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=0a6b9bcd-78ae-4b4b-ac14-deba0ffbceb1. [20 September 2019].

3.16 Northern free-tailed bat (*Mormopterus lumsdenae*)

3.16.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

3.16.2 Biology and ecology

3.16.2.1 Characteristics

Not unlike other free-tailed bat species the Norther free-tailed bat has a thick, wrinkled upper lip and grooved cheeks, giving the hear a mastiff-like appearance and a long tail that extends beyond the membrane. They have a muscular build, their ears are triangular shaped, and wing membrane are thick and flexible. Although it usually flies high it can descend low over water and can crawl over tree trunks on the ground (OEH 2019).

No images available.

3.16.2.2 Known distribution

Northern free-tailed bats are distributed across northern Australia from Western Australia to Queensland and south to the north-east corner of New South Wales. They are mostly absent from the arid zone of Australia (refer Figure 3.16). The only confirmed sighting from New South Wales was from Murwillumbah where a colony was found in the roof of a house, otherwise only calls have been detected from a few other locations in the same region (OEH 2019).

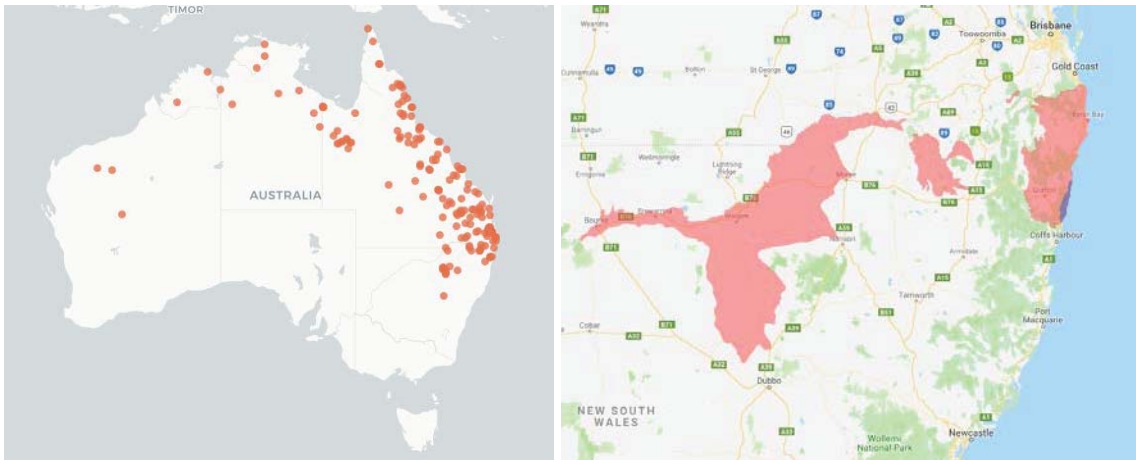


Figure 3.16 **Distribution range of Northern free-tailed bat *(Mormopterus lumsdenae)***

Source: ALA (2019), OEH (2019)

3.16.2.3 Biology and reproduction

There is very little recorded information available about their biology and reproduction, although it is though that hollow-bearing trees are important roosting sites (OEH 2019).

3.16.3 Habitat

In the wild Northern free-tailed bats are known to utilise tree hollows in habitat such as rainforest, open forest and woodlands where there are water courses nearby. They are also found in towns and cities inhabiting roofs of houses in urban areas (OEH 2019).

3.16.4 Threatening processes

The following have been identified as potentially threatening processes to Northern free-tailed bats:

- Loss of habitat and degradation of existing habitat from agriculture, residential and infrastructure development
- Reduction of hollow-bearing trees in their preferred habitat as a result of dieback, improper fire regimes and lack of old growth forest
- Pesticide use reducing prey availability (OEH 2019).

3.16.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Kultarr (Antechinomys laniger). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10057. In effect under the BC Act 2016.

3.16.6 References

Atlas of Living Australia (2019). Northern free-tailed bat (Mormopterus lumsdenae). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:d2ecff89-8872-4c92-a552-c63dd07f65de#literature [27 September 2019].

Office of Environment and Heritage, NSW (2019). Northern free-tailed bat (Mormopterus lumsdenae). [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10159. [27 September 2019].

3.17 Pale imperial hairstreak (*Jalmenus eubulus*)

3.17.1 Status

EPBC Act – Not listed

BC Act – Critically endangered

3.17.2 Biology and ecology

3.17.2.1 Characteristics

The Pale imperial hairstreak is a stunning medium-sized butterfly, the upperside of the wing have iridescent central areas that are mostly white with a very faint tint of green (more evident in males) or blue (more apparent in female). The hind wing is more iridescent where the colouration extends close to the outer margins. Males and females have a wingspan of 32 and 37 mm respectively. Compared to similar species the black marking on the underside of the wing are narrower along with the short black bar at the end of the cell on the upperside of the forewing. Other differences include a generally paler underside, a chestnut-brown subterminal band on the underside of both wings which is stronger in colour and more pronounced. Also, the white iridescent area of the top of the wings is unique to *Jalmenus eubulus* (OEH 2019).

No image available.

3.17.2.2 Known distribution

The Pale imperial hairstreak is found in both Queensland and New South Wales. It can be found in the seasonally sun-humid central and southern areas of Queensland whilst in New South Wales it is restricted to Brigalow-dominated open forests and woodlands where it occurs in the north of the state (refer Figure 3.17). (OEH 2019).

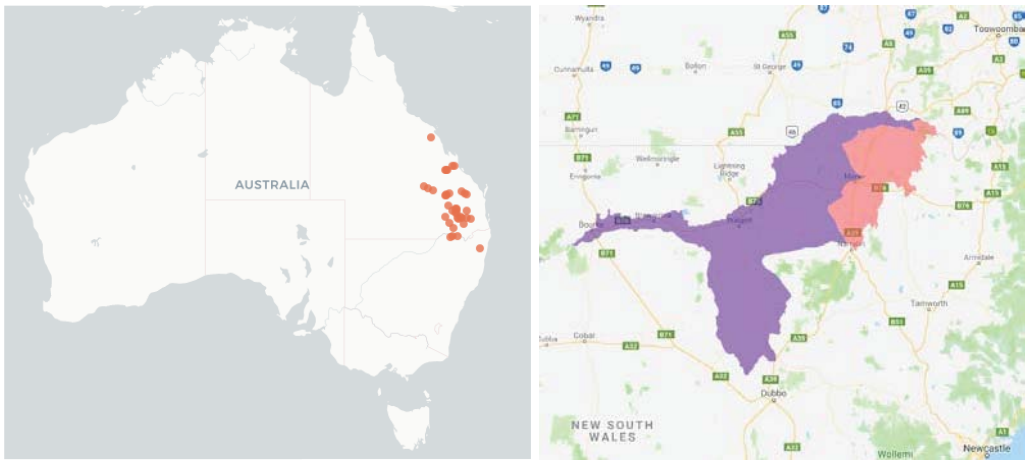


Figure 3.17 **Distribution range of Pale imperial hairstreak *(Jalmenus eubulus*)**

Source: ALA (2019)

3.17.2.3 Biology and reproduction

Pale imperial hairstreaks are dependent on old-growth forest or woodlands that have not been impacted by major disturbances such as clearing. They have not been observed in regrowth. In New South Wales it is only found in brigalow woodland. This species has a unique obligate relationship with a specific species of ant (*Iridomyrmex* group of ants) that attend to the larvae. The larvae are monophagous feeding solely on the leaves of brigalow *Acacia harpophylla* (OEH 2019).

3.17.3 Habitat

Suitable Pale imperial hairstreak habitat consists of brigalow species including *Acacia harpophylla* and Buloke, *Casuarina cristata* on clay soils where the landscape is gently undulating or flat. Habitat also consists of emergent eucalypts including Poplar box and Wilga (OEH 2019).

3.17.4 Threatening processes

The following have been identified as potentially threatening processes to Pale imperial hairstreak:

- Loss of old growth brigalow (*Acacia harpophylla*) dominated woodlands and degradation to existing habitat
- The obligate relationship with other species makes the Pale imperial hairstreak particularly susceptible to extinction in New South Wales
- Lack of information of the species distribution
- Lack of understanding of threats to the species (OEH 2019).

3.17.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2018), Saving our species: Pale imperial hairstreak (*Jalmenus* eubulus). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=20123. In effect under the BC Act 2016.

3.17.6 References

Atlas of Living Australia (2019). Pale imperial hairstreak (*Jalmenus eubulus*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:2da9c823-15f0-43de-8ebc-0f20dacbfa61. [27 September 2019].

Office of Environment and Heritage, NSW (2019). Pale imperial hairstreak (Jalmenus eubulus). [online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10057. [27 September 2019].

3.18 Pale-headed snake (*Hoplocephalus bitorquatus*)

3.18.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

3.18.2 Biology and ecology

3.18.2.1 Characteristics

The Pale-headed snake (Hoplocephalus bitorquatus) is up to 90 cm long and is a largely tree dwelling snake. Its body is a uniform light brown or grey with a cream belly and nape, separated from the head by a narrow blackish bar (refer Photograph 3.14). The top of the head is grey and may have a series of black spots, which are most prominent along the edge of the white nape. The lips may have black vertical bars (OEH 2017).

Photograph 3.14 Pale-headed snake *(Hoplocephalus bitorquatus*)

Source: Stock (2017)

3.18.2.2 Known distribution

The Pale-headed snake has a patchy distribution from northeast Queensland to the northeastern quarter of New South Wales (refer Figure 3.18). In New South Wales it has been recorded from as far west as Mungindi and Quambone on the Darling Riverine Plains, across the north west slopes (OEH 2017).

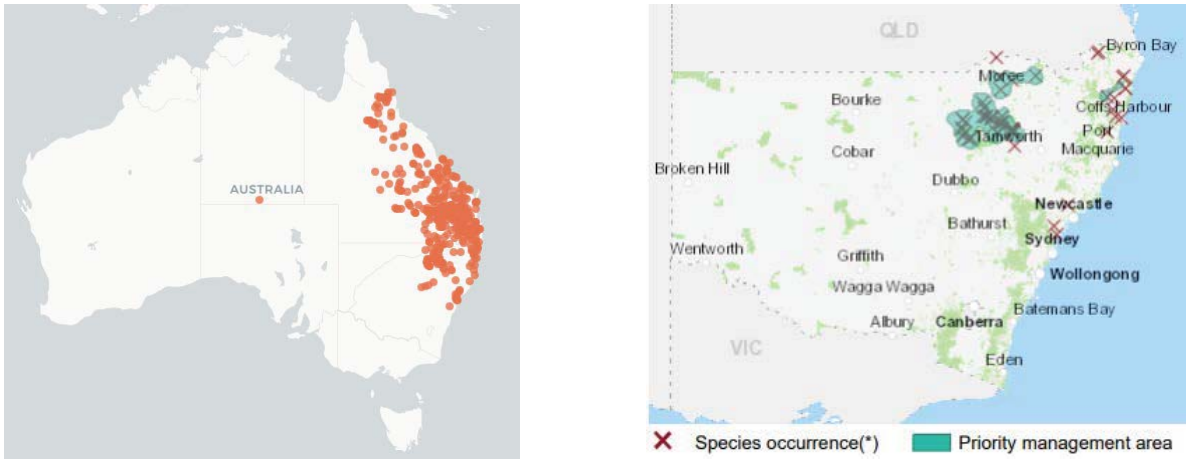


Figure 3.18 Distribution range of Pale-headed snake *(Hoplocephalus bitorquatus*)

Source: ALA (2019), OES (n.d.)

3.18.2.3 Biology and reproduction

The Pale-headed snake is arboreal, and its main prey is tree frogs although they will also hunt lizards and small mammals (OEH 2017).

It is a highly cryptic species that can spend weeks at a time hidden. They are known to breed from September to May and give birth to 2 to 11 live young. Captive individuals have been observed only breeding every second year (Australian Museum 2017).

3.18.3 Habitat

The Pale-headed snake can be found in wet and dry sclerophyll forest and open woodlands (especially *Callitris*) on floodplains and near watercourses. They rely heavily on old and dead standing trees with hollows and exfoliating bark for shelter (Australian Museum 2017).

3.18.4 Threatening processes

The following have been identified as potentially threatening processes to the Pale-headed snake:

- Clearing and fragmentation of habitat
- Forestry practices which result in loss of old or dead trees
- Too frequent burning for fuel reduction or grazing management
- Illegal collection of snakes from the wild
- Disturbance to riparian habitat from the installation and maintenance of easements (OEH 2017).

3.18.5 Threat abatement/recovery plans

The following recovery plan is applicable to this species:

- Office of Environment and Heritage (2016), *Saving our Species Programme*. Available from https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=619&ReportProfileID=10412. In effect under the BC Act 2016.

3.18.6 References

Atlas of Living Australia (2018). *Hoplocephalus bitorquatus*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:99435ae1-52be-463c-921b-22acc20658c7 [Accessed 24 October 2018].

Australian Museum (2017). Pale-headed Snake - *Hoplocephalus bitorquatus*. Available from: https://australianmuseum.net.au/pale-headed-snake. [Accessed 24 October 2018].

Office of Environment and Heritage, NSW (2018). Pale-headed snake - profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10412 [Accessed 24 October 2018].

Office of Environment and Heritage (n.d.). Saving our species: Help save the Pale-headed Snake. Available from https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=619&ReportProfileID=10412 [Accessed 13 August 2019].

Stock, N. (2017). Pale-headed snake (Hoplocephalus bitorquatus). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=3b1c67e0-3361-46ce-9b8a-7735923dac4f. [19 September 2019].

3.19 Rufous bettong (*Aepyprymnus rufescens*)

3.19.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

3.19.2 Biology and ecology

3.19.2.1 Characteristics

The Rufous bettong (*Aepyprymnus rufescens*) is a small marsupial that is 70 to 80 cm long from nose to tail, weighing 2.5 to 3.5 kg. The fur on the upperparts is shaggy grey with a rufous tinge on the tips and pale grey on the underparts. The tail sometimes has a white tip (refer Photograph 3.15). They also tend to have fur between the nostrils and bare pink skin around the eyes. They normally move around by first placing the forelegs on the ground and bringing the hindlegs forward however they can also hop (Frankham 2014; Menkhorst and Knight 2011; OEH 2018).

Photograph 3.15 Rufous bettong (Aepyprymnus rufescens)

Source: Bawden (2018)

3.19.2.2 Known distribution

Rufous bettongs have a patchy distribution from Cooktown, Queensland, to north-eastern New South Wales as far south as Mt Royal National Park (refer Figure 3.19). They are found on both sides of the Great Dividing Range from 100 m to 700 m in elevation (Frankham 2014; OEH 2018).

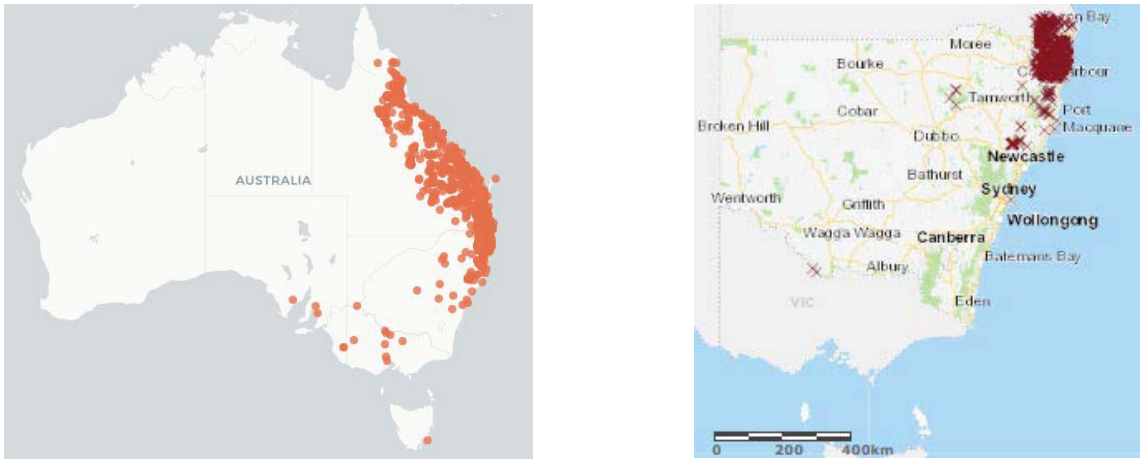


Figure 3.19 Distribution range of Rufous bettong

Source: ALA (2019), OEH (n.d.)

3.19.2.3 Biology and reproduction

During the night Rufous bettongs feed on grasses, herbs, seeds, flowers, roots, tubers, fungi and occasionally insects. They can cover 2 to 4.5 km when foraging (Menkhorst and Knight 2011; OEH 2018).

Rufous bettongs breed year-round usually raising two or three young per year. They are a solitary and nocturnal species which creates 'nests' or shallow depressions lined with fibrous vegetation. Multiple nests are often used by the same individual. Sexual maturity in females is reached at around 11 months (Frankham 2014).

3.19.3 Habitat

They are common in coastal eucalypt forest, tall wet sclerophyll forest and dry open woodlands. A tall native grassy understorey is important for shelter (Frankham 2014).

3.19.4 Threatening processes

The following have been identified as potentially threatening processes to the Rufous bettong:

- Changes to the grassy understorey by inappropriate burning and grazing
- Competition from rabbits
- Predation by feral cats and foxes
- Loss of habitat through clearing, logging and collection of fallen timber
- Poor knowledge of the species' abundance and distribution in the western parts of its range (OEH 2018).

3.19.5 Threat abatement/recovery plans

No threat abatement/recovery plans have been identified as being relevant for this species.

3.19.6 References

Atlas of Living Australia (2018), *Aepyprymnus rufescens.* Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:7a7a2817-26e7-44bd-bb34-1dc9c1ed4d38 [Accessed 23 October 2018].

Bawden, T. (2018). Rufous bettong (Aepyprymnus rufescens). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=c79ea2ba-bb24-401e-a709-6fe54f7604bb. [23 September 2019].

Frankham, G. (2014) Aepyprymnus rufescens Rufous Bettong in Museums Victoria Collections https://collections.museumvictoria.com.au/species/15119 [Accessed 23 October 2018].

Menkhorst P. and Knight F. (2011). A Field Guide to the Mammals of Australia, 3rd Edition. Oxford University Press.

Office of Environment and Heritage (2018). Rufous Bettong - Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10033 [Accessed 23 October 2018].

3.20 Squirrel glider (*Petaurus norfolcensis*)

3.20.1 Status

EPBC Act – Not listed

BCA Act – Vulnerable

3.20.2 Biology and ecology

3.20.2.1 Characteristics

Squirrel gliders (*Petaurus norfolcensis*) have a head and body length of about 20 cm and weigh about 190 to 300 gm. On the upperparts they have blue-grey to brown-grey fur while their belly is cream and the last third of the tail is black (refer Photograph 3.16). There is a dark stripe from between the eyes to the mid-back and there tends to be dark markings around the ears. The tail is quite bushy averaging about 27 cm in length (OEH 2017).

Photograph 3.16 Squirrel glider (Petaurus norfolcensis)

Source: Bawden (2018)

3.20.2.2 Known distribution

The Squirrel glider is found across eastern Australia, from northern Queensland to western Victoria (refer Figure 3.20).

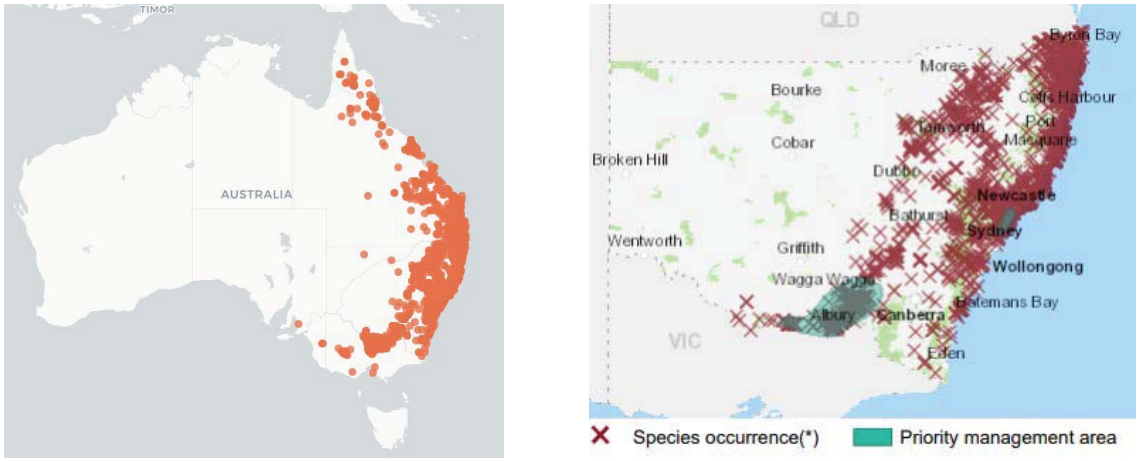


Figure 3.20 Distribution range of the Squirrel glider

Source: ALA (2019), OEH (2018)

3.20.2.3 Biology and reproduction

The Squirrel glider diet varies seasonally and consists of *Acacia* gum, eucalypt sap, nectar, honeydew, manna, invertebrates and pollen (OEH 2017).

They live in family groups consisting of a single adult male and one or more adult females and offspring. They require abundant tree hollows for refuge and their bowl-shaped, leaf lined nests. Typically, two young are born to a single female from May to December (Menkhorst and Knight 2011; OEH 2017).

3.20.3 Habitat

Squirrel gliders inhabit mature or old growth Box/Box-ironbark woodlands and River red gum forest west of the Great Dividing Range and Blackbutt/Bloodwood forest with a heath understorey in coastal areas. They prefer mixed species stands with a shrub or *Acacia* midstorey (OEH 2017).

3.20.4 Threatening processes

The following have been identified as potentially threatening processes to the Squirrel glider:

- Habitat loss, fragmentation and degradation
- Loss of hollow-bearing trees
- Loss of understorey food resources
- Inappropriate fire regimes
- Mortality due to entanglement on barbed wire
- Occupation of hollows by exotic species
- Mortality due to collision with vehicles
- Predation by exotic predators
- Changes in spatial and temporal distribution of habitat due to climate change (OEH 2017).

3.20.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Help save the Squirrel Glider. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=733&ReportProfileID=10604. In effect under the BC Act 2016.

3.20.6 References

Atlas of Living Australia (2018) *Petaurus norfolcensis.* Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:24dc4182-07a2-431a-a310-a9f3f80530e0#overview [Accessed 25 October 2018].

Bawden, T. (2015). *Petaurus norfolcensis* (Squirrel Glider). (Image) [Online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:24dc4182-07a2-431a-a310-a9f3f80530e0#gallery [Accessed 25 October 2018].

Menkhorst P. and Knight F. (2011). *A Field Guide to the Mammals of Australia, 3rd Edition*. Oxford University Press.

Office of Environment and Heritage (2018). Squirrel Glider - Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10604 [Accessed 25 October 2018].

Office of Environment and Heritage (2018). Saving our Species: Help save the Squirrel Glider. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=733&ReportProfileID=10604 [Accessed 16 August 2019].

3.21 Stripe-faced dunnart (*Sminthopsis macroura*)

3.21.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

3.21.2 Biology and ecology

3.21.2.1 Characteristics

Strip-faced dunnarts are a pale green-brown marsupial that is roughly the size of a mouse. Its underside and feet are white and a distinct black stripe that runs from the middle the eyes to the ears. The muzzle is slender and pointed and the tail is longer than the head and the body combined (refer Photograph 3.17) (OEH 2019).

Photograph 3.17 Stripe-faced dunnart (Sminthopsis macroura)

Source: Benton (2016)

3.21.2.2 Known distribution

Stripe-faced dunnarts occur throughout much of inland central and northern Australia including the central and norther regions of New South Wales. Western Queensland, Northern Territory, South Australia and Western Australia. They are rarely encountered on the New South Wales Central West Slopes and North West Slopes with the most easterly records derived from Dunno, Coonabarabran, Warialda and Ashford (OEH 2019) (refer Figure 3.21).

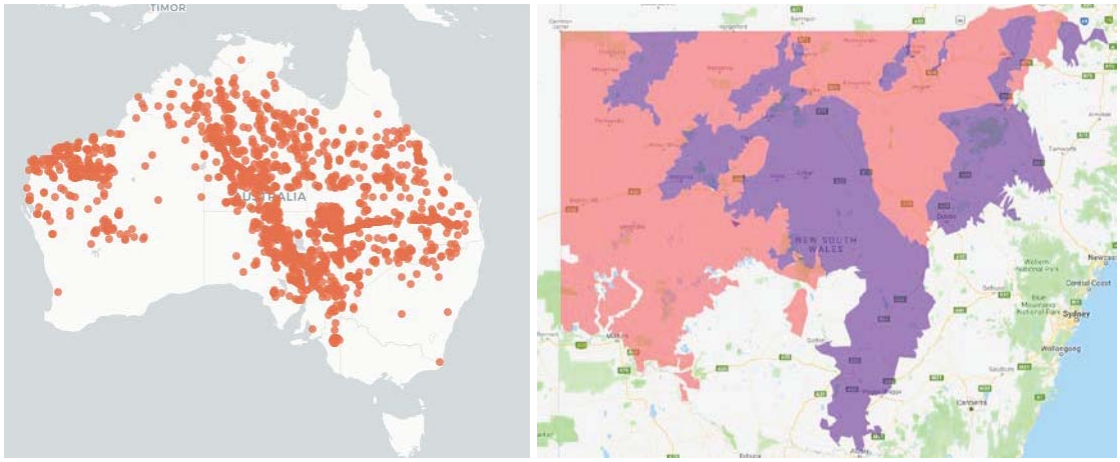


Figure 3.21 **Distribution range of Stripe-faced dunnart**

Source: ALA (2019), OEH (2019)

3.21.2.3 Biology and reproduction

The Strip-faced dunnart breeds between July and February with a gestation period of about 11 days, the shortest of any mammal. This species is polyoestrous with females producing multiple litters in a season. Males can breed throughout the season and for up to three seasons. Litter size is equal to the number of teats but usually consists of no more than eight joeys (ALA 2019).

3.21.3 Habitat

Preferring ungrazed habitat Stripe-faced dunnarts are in habitat consisting of native dry grasslands and low dry shrublands. They will shelter in cracks in the ground and drainage lines providing options for food and shelter. They prefer habitat with greater diversity and healthier understorey vegetation (OEH 2019).

3.21.4 Threatening processes

The following have been identified as potentially threatening processes to the Stripe-faced dunnart:

- Loss of dry grassland and shrubland habitat
- Heavy grazing or trampling by livestock
- Frequent fire regimes in their preferred habitat
- Predation by feral animals including foxes and cats
- Dunnarts are extremely sensitive to organophosphorus pesticide commonly used to control locusts. If not lethal it can result in lethargy making individuals more susceptible to predation.

3.21.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Help save the Stripe-faced Dunnart (Sminthopsis macroura). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10759. In effect under the BC Act 2016.

3.21.6 References

Atlas of Living Australia (2019). Stripe-faced Dunnart (*Sminthopsis macroura*). Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:87bffd05-f107-42f4-bf63-427e76a053c4. [27 September 2019].

Benton, J. (2018). Stripe-faced dunnart (Sminthopsis macroura). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=bb416150-115d-420c-8a74-b61c5d715bcf. [23 September 2019].

Office of Environment and Heritage, NSW (2019). Species profile: Stripe-faced Dunnart (Sminthopsis macroura). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10759. [27 September 2019].

3.22 Woma (Aspidites ramsayi)

3.22.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

3.22.2 Biology and ecology

3.22.2.1 Characteristics

The Woma is a large bodied python that measures 1.5 m long on average, but large specimens can reach 2.7 m. The body of Womas is an olive-brown or reddish-brown consisting of darker cross-bands across the dorsal surface of the body from the neck down. The ventral surface is a cream colour with pink or brown blotches whilst the head is a yellowing colour distinct from the rest of the body (refer Photograph 3.18) (OEH 2019). Woma pythons are absent of the heat sensing pits that are typical of most other Australian python species (ALA 2019).

Photograph 3.18 Woma (Aspidites ramsayi)

Source: Gorta (2019)

3.22.2.2 Known distribution

The Woma is distributed throughout the arid and semi-arid regions of Australia. It occurs in the north-west of New South Wales and east to about Louth and Bourke (refer Figure 3.22). Its range and abundance in the south-eastern region of Australia seems to be undergoing serious decline (OEH 2019).

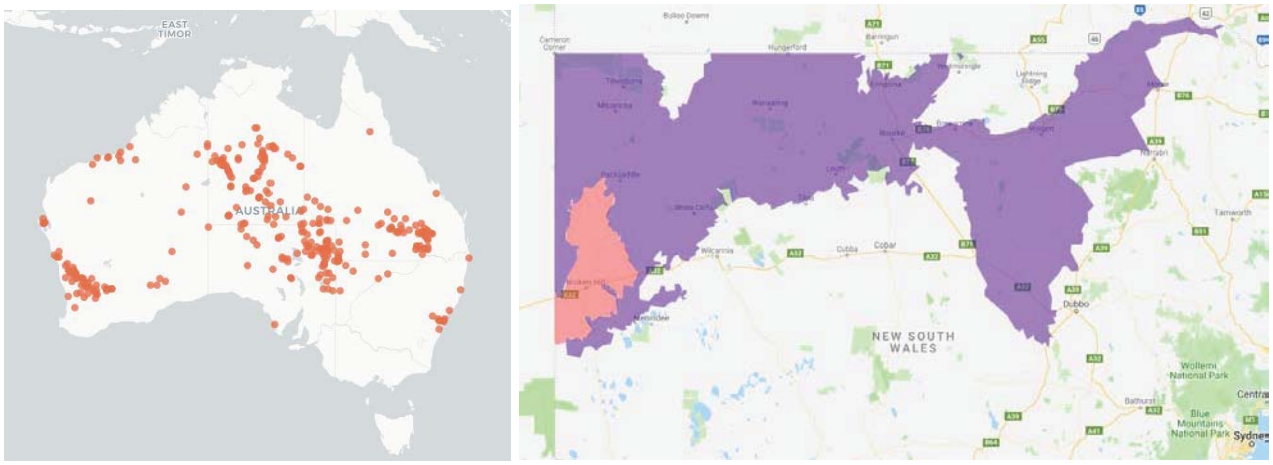


Figure 3.22 **Distribution range of Woma (Aspidites ramsayi)**

Source: ALA (2019), OEH (2019)

3.22.2.3 Biology and reproduction

Woma pythons are a desert species that are mostly associated with sandy terrain however they also inhabit stony environments that are adjacent to sandy country. As a python they are non-venomous and prey predominantly on larger reptiles actively hunting at night when their diurnal prey is sleeping. Prey species include Bearded dragons and goannas. Whilst they are placid when approached they possess long sharp teeth and have powerful jaws. Womas have the ability to lure prey with their tail ambushing their prey in a similarly method to death adders (*Acanthophis spp.*) and will actively forage for prey searching burrows and trees (OEH 2019).

During the mating season in autumn males become more active during the day in search for females. Females lay eggs and will coil around the clutch to guard them during the incubation period (ALA 2019).

3.22.3 Habitat

With their range covering most of Australia, except for the south Woma pythongs inhabit subtropical to temperate desert and sandy plains, including dunefields and deep cracking black soil plains for the semi-arid zone. Womas will shelter in disused burrows, hollow logs and under grass hummocks.

3.22.4 Threatening processes

The following have been identified as potentially threatening processes to the Woma python:

- Loss of essential habitat including dry grasslands and shrublands
- Habitat fragmentation exacerbating the isolation of small populations resulting in localised extinctions and reduced genetic diversity
- Grazing activities and poorly managed fire regimes changing the physical and biological features of their habitat
- Fire causing direct mortality
- Small populations are particularly susceptible to localised extinction as a result of predation by cats and foxes
- Catastrophic natural disasters including drought or extensive wildfire
- Illegal poaching of Woma pythons from the wild, particularly where their population numbers are already low

- Human-induced climate change further changing the structure and functionality of their preferred habitat reducing the capacity to support viable
- Disturbance to terrestrial habitat (OEH 2020).

3.22.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Help save the Woma (*Aspidites* ramsayi). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10069. In effect under the BC Act 2016.

3.22.6 References

Atlas of Living Australia (2019). Woma (*Aspidites ramsayi*). Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:87bffd05-f107-42f4-bf63-427e76a053c4. [27 September 2019].

Gorta, S. (2019). Woma (Aspidites ramsayi). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=62dd04ec-41f8-4800-8699-f56ab95252d6. [23 September 2019].

Office of Environment and Heritage, NSW (2019). Species profile: Woma (Aspidites ramsayi). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10759. [27 September 2019].

3.23 Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)

3.23.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

3.23.2 Biology and ecology

3.23.2.1 Characteristics

The Yellow-bellied sheathtail-bat is a large member of the sheathtail-bat family growing to 87mm in length. It possesses long, narrow wings, a glossy, jet-black back and a yellowish-white belling. The white colouration extends to the shoulders and just behind the ears. Their sharp pointed muzzle and flattened head is indicative of the species. An incredibly elastic sheath covers the tail allowing for variation in the tail-membrane area. Males possess a throat pouch, whilst females instead have a patch of bare skin in the same place (refer Photograph 3.19) (OEH 2019).

Photograph 3.19 Yellow-bellied sheathtail-bat (Saccolaimus flaviventris)

Source: OEH (2015)

3.23.2.2 Known distribution

The Yellow-bellied sheathtail-bat's distribution covers a wide area of Australia found across the northern and eastern part of the country. Its distribution extends as far south as Victoria and to south-western New South Wale and South Australia where it is a late summer and autumn visitor. Records of this species include the New England Tablelands and North West Slopes (refer Figure 3.23) (OEH 2019).

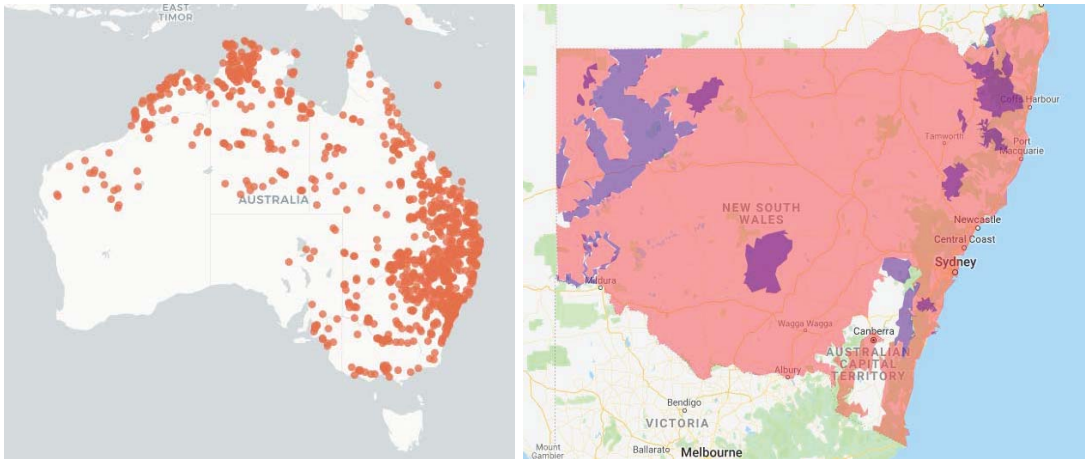


Figure 3.23 Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris)*

Source: ALA (2019)

3.23.2.3 Biology and reproduction

Yellow-bellied sheathtail-bats fly high and fast during hunting over the forest canopy or lower where country is more open. They will forage in most habitat types across their wide distribution and seem to defend their aerial territory (OEH 2019).

The species roosts in small colonies of up to 30 individuals (Australian Museum 2019). Yellow-bellied sheathtail-bats have been recorded breeding from December to mid-March giving birth to a single young (OEH 2019).

3.23.3 Habitat

Roosting sites include tree hollows and building, where trees are absent they have been reportedly found in mammal burrows (OEH 2019). Foraging habitat includes woodlands, forests and open areas, in tropical to semi-arid environments (ALA 2019). Specific habitat associations for this species are unknown, due to a lack of studies.

3.23.4 Threatening processes

The following have been identified as potentially threatening processes to Yellow-bellied sheath-tail bats:

- Roosting and breeding sites becoming disturbed
- Clearing for residential and rural subdivisions fragmenting and degrading foraging habitat
- Reduced availability of hollow-bearing trees from land clearing
- Insect availability being impacted by the use of herbicides and pesticides along with accumulation of toxic residues in the bats fat stores (OEH 2019).

3.23.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Yellow-bellied Sheathtail-bat (Saccolaimus flaviventris). Available from: https://webcache.googleusercontent.com/search?q=cache:D9rD-7ZQcl8J:https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx%3FProfileID%3D10741+&cd=1&hl=en&ct=clnk&gl=au. In effect under the BC Act 2016.

3.23.6 References

Australian Museum 2019, Yellow-bellied Sheathtail Bat. Available from: https://australianmuseum.net.au/learn/animals/bats/yellow-bellied-sheathtail-bat/. [27 September 2019].

Atlas of Living Australia 2019, Saccolaimus falviventris: Yellow-Bellied Sheathtail-Bat. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:cdb0482f-2292-4c84-a66d-d19ff52fe263. [27 September].

Office of Environment and Heritage 2017, Yellow-bellied Sheathtail-bat – profile. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10741. [27 September 2019].

Office of Environment and Heritage. (2015). Yellow-bellied sheathtail-bat (Saccolaimus flaviventris). [image] [online] Available from: https://images.ala.org.au/image/details/faa15974-c7f9-4b44-9c77-8fbd9430df5b. [23 September 2019].

3.24 Zigzag velvet gecko (*Amalosia rhombifer*)

3.24.1 Status

EPBC Act – Not listed

BC Act – Endangered

3.24.2 Biology and ecology

3.24.2.1 Characteristics

The Zigzag velvet gecko grows to a total length of around 16 cm with a cream ‘zigzag’ pattern along their dorsal surface. A rich brown colouration flanks the zigzag pattern above whilst its sides and limbs are a speckled darker or paler brown (refer Photograph 3.20) (OEH 2019).

Photograph 3.20 Zigzag velvet gecko (*Amalosia rhombifer)*

Source: Black (2017)

3.24.2.2 Known distribution

Zigzag velvet geckos are distributed across northern Australia from the Kimberley’s in Western Australia to northern Queensland and south to Alice Springs in central Australia (ALA 2019). In New South Wales this species has only a small distribution on the north western slopes near the New South Wales-Queensland border. Reserves they have been recorded in include Dthinna Dthinnawan National Park and Arakoola Nature Reserve (refer Figure 3.24) (OEH 2019).

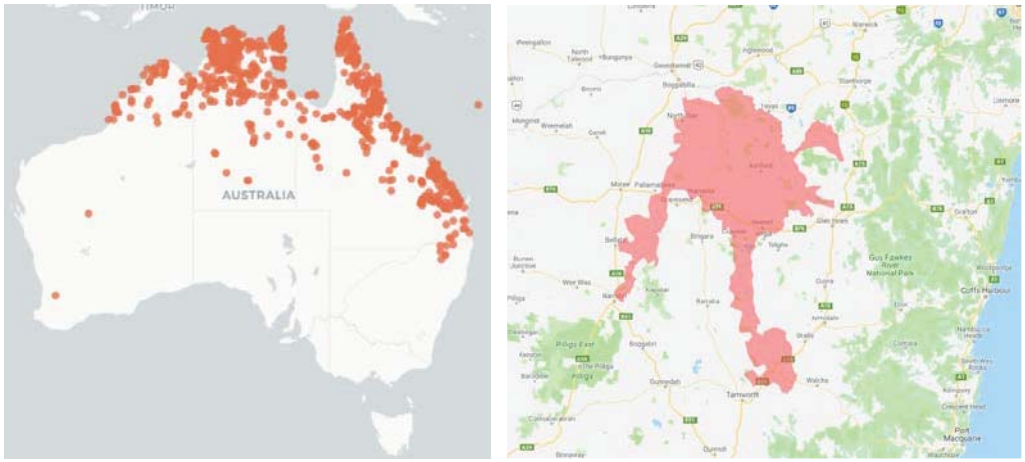


Figure 3.24 Distribution range of Zigzag velvet gecko

Source: ALA (2019)

3.24.2.3 Biology and reproduction

Very little is known about the reproductive habits of Zigzag velvet geckos, the species was first recorded in 2001 in New South Wales. In Queensland it has occasionally been found in urban dwellings. As an arboreal species they spend most of their lives in trees and utilise tree fissures and decorticating bark as micro habitat (OEH 2019).

3.24.3 Habitat

The species is confined to woodland habitats that are dominated by eucalypt species including *Eucalyptus sideroxylon, E. moluccana, E. blakelyi, Callitris* species. The species has regional distribution in the Brigalow Belt South, Nandewar and New England Tablelands (OEH 2019).

3.24.4 Threatening processes

The following have been identified as potentially threatening processes to Zigzag velvet gecko (OEH 2019):

- Reduced habitat availability as a result of land clearing and fragmentation from agriculture and forestry
- Altered fire regimes reducing availability of suitable micro habitat
- Isolated populations becoming vulnerable to localised extinction and loss of genetic diversity
- Predation by feral animals, particularly foxes and cats
- Lack of knowledge and understanding of the species from a taxonomic perspective.

3.24.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Yellow-bellied Sheathtail-bat (Saccolaimus flaviventris). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10871. In effect under the BC Act 2016.

3.24.6 References

Atlas of Living Australia (2019). Zigzag velvet gecko (*Amalosia rhombifer*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:91f62d14-91ff-4471-b50d-622b42e13558#overview. [30 September 2019].

Black, D. (2017). Zigzag velvet gecko (Amalosia rhombifer). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=85c51a48-0f09-4141-9552-c5920001d645. [27 September 2019].

Office of Environment and Heritage, NSW (2019). Zigzag velvet gecko (Amalosia rhombifer). [online] Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10871. [30 September 2019].

4 Fauna species – Conservation significant species – Birds

4.1 Australasian bittern (*Botaurus poiciloptilus*)

4.1.1 Status

EPBC Act – Endangered

BC Act – Endangered

4.1.2 Biology and ecology

4.1.2.1 Characteristics

The Australasian bittern (*Botaurus poiciloptilus*) is a large stocky, partially nocturnal heron which can reach up to a total body length of 75 cm with a wingspan just over 1 m. The species has a long narrow neck, a straight brownish-yellow bill which transitions into a dark brown feathering on the side of its neck and becomes pale at the throat. The mottled brown upper surface of the bittern is supported by a buff dark brown striped under surface and pale green legs (refer Photograph 4.1). Bittern juveniles differ from adults due to their paler feathering and heavier buff flecking on the back. Sexes can be differentiated through size as female bittern weigh about 900 g compared to male bittern, who are significantly heavier weighing up to 1,400 g. The physical appearance of the bittern makes it very well camouflaged within its natural habitat and often go unspotted (Birdlife 2019; SWIFFT 2019; TSSC 2011).

Photograph 4.1 Australasian bittern (Botaurus poiciloptilus)

Source: Brown (2014)

4.1.2.2 Known distribution

The Australasian bittern is known to occur in southeastern Australia, extending from Bundaberg through to northern Tasmania (refer Figure 4.1). In New South Wales, the species is predominantly found in the Murray-Darling basin which once formed a stronghold for the birds (Birdlife 2019; Birdlife International 2016).

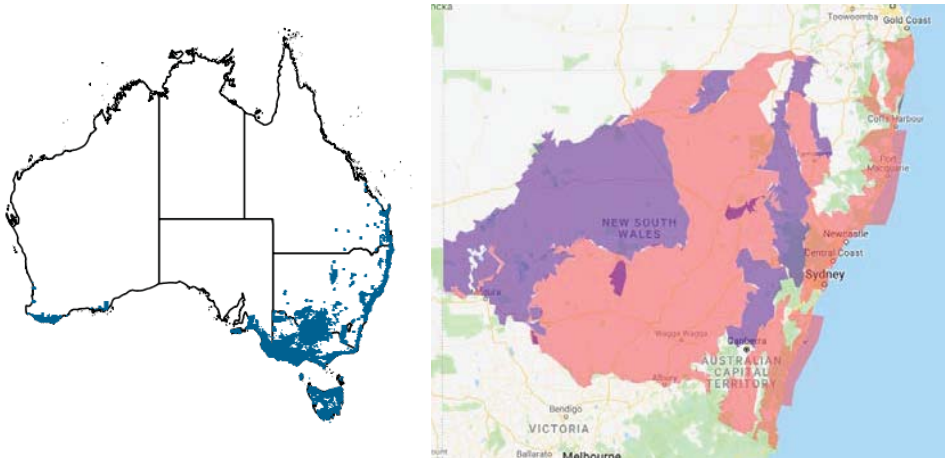


Figure 4.1 **Distribution range of the Australasian bittern**

Source: ALA (2019), OEH (2019)

4.1.2.3 Biology and reproduction

The Australasian bittern is crepuscular and known to hide during day time and come out after sun down. It feeds mainly on frogs, fish, crayfish, spiders, insects and snails. The species constructs a feeding platform over deeper water using reeds trampled by the bird and uses multiple hunting techniques to capture prey (Birdlife 2019; OEH 2019).

The species breed around summer, between October and January, as solitary pairs and begin building nests in secluded, densely vegetated wetlands on platforms of reeds approximately 30 cm above water level. The female Australasian bittern will lay six eggs of olive to brown colour to a clutch and are known to have a short incubation period (Birdlife 2019; O'Donnell 2011; TSSC 2011).

4.1.3 Habitat

Preferred habitat for the Australasian bittern consists of permanent freshwater wetlands with tall dense vegetation including bulrushes (*Tyhpa* spp.), spikerushes (*Eleocharis* spp.) and tall emergent sedges. Rice paddies within the Murray-Darling basin are a known habitat for the species who disperse widely during periods of droughts to coastal wetlands and to ephemeral wetlands (Birdlife International 2016; OEH 2019).

4.1.4 Threatening processes

The following have been identified as potentially threatening processes to the Australasian bittern:

- Wetland drainage for agriculture
- Changes brought on by high levels of grazing, drought and salinisation of swamps
- Long term habitat destruction exposing species to predation
- Abandoning nests due to slight disturbances as a result of their sensitive nature (Birdlife International 2016)
- Water quality reduced as a result of silation, pollution and salinity
- Predation from feral animal including pigs, foxes and cats
- Herbicides and pesticides deducing the health of wetland areas
- Changes in water management and cropping practices
- Climate change impacting seasonal rainfall and associated environmental water allocations (OEH 2019)

4.1.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Australasian bittern (*Botaurus poiciloptilus*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10105. In effect under the BC Act 2016.

4.1.6 References

Atlas of Living Australia (2019). Botaurus poiciloptilus. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:47dca80b-ac7c-4130-bef3-4afb4fad35ab [Accessed 2 September 2019].

Birdlife Australia (2019). Australasian Bittern. Available from: http://www.birdlife.org.au/bird-profile/australasian-bittern [Accessed 2 September 2019].

BirdLife International (2016). Botaurus poiciloptilus. The IUCN Red List of Threatened. Available from: http://www.iucnredlist.org/details/22697353/0 [Accessed 2 September 2019].

Brown, C. (2014). Australasian bittern (Botaurus poiciloptilus). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=540dc629-3998-48c0-848a-18e1514a39c5. [17 September 2019].

O'Donnell, Colin. (2011). Breeding of the Australasian Bittern (Botaurus poiciloptilus) in New Zealand. ResearchGate. Available from: https://www.researchgate.net/publication/263002340 [Accessed 2 September 2019].

Office of Environment and Heritage (2019). Australasian Bittern – Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10105. [Accessed 2 September 2019].

State Wide Integrated Flora and Fauna Teams (2019). Australasian Bittern. Available from: http://www.swifft.net.au/cb_pages/australasian_bittern.php [Accessed 2 September 2019].

Threatened Species Scientific Committee (2011). Botaurus poiciloptilus in Species Profile and Threats Database. Department of Environment and Energy. Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/1001-listing-advice.pdf [Accessed 2 September 2019].

4.2 Australian painted snipe (*Rostratula australis*)

4.2.1 Status

EPBC Act – Endangered Marine (CAMBA)

BC Act – Endangered

4.2.2 Biology and ecology

4.2.2.1 Characteristic

The Australian painted snipe (*Rostratula australis*) is a stocky wading bird approximately 220 to 250 mm in length. It has a long pinkish bill and chestnut-coloured head, with a white ring around the eye and a crown stripe. The back and wings are metallic green and barred with black and chestnut. There is a pale stripe extending from the shoulder into a V down the individuals upper back (refer Photograph 4.2). The adult female is slightly larger and more brightly coloured than the male (DotEE 2019).

Photograph 4.2 Australian painted snipe male (Rostratula australis)

Source: eBird Australia (2015)

4.2.2.2 Known distribution

The Australian painted snipe has been recorded at wetlands in all states and territories of Australia but is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, New South Wales, Victoria and southeastern South Australia (refer Figure 4.2). Known distribution has likely declined by approximately 50 per cent in Australia since European settlement (Barrett et al. 2003; Blakers et al. 1984; DotEE 2019; Environment Australia 1997).

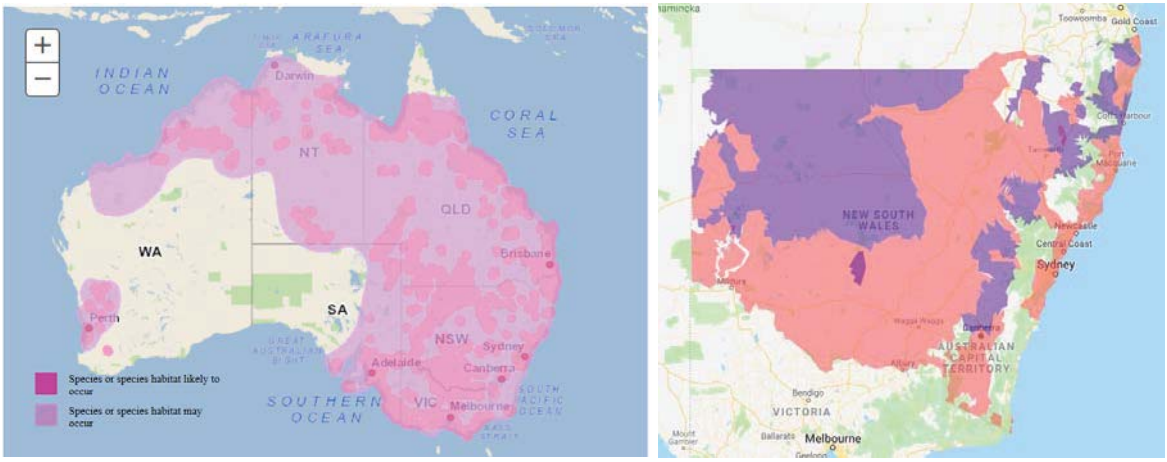


Figure 4.2 Distribution range of the Australian painted snipe

Source: DotEE (2019), OEH (2019)

4.2.2.3 Biology and reproduction

The Australian painted snipe eats vegetation, worms, seeds, insects, molluscs, crustaceans and other invertebrates. They are mainly crepuscular and generally remain in dense cover when feeding, although they may forage over nearby mudflats and other open areas such as agricultural land or grassland (Marchant and Higgins 1993).

The Australian painted snipe may breed in response to wetland conditions rather than during a particular season. The species has been recorded breeding in all months in Australia. Their breeding habitat requires shallow wetlands with areas of bare wet mud and with canopy cover nearby. The species' nests usually occur on or near small islands in freshwater habitats. Females are known to lay two to six (typically three or four) eggs and may lay up to four clutches in a year and incubation takes 15 to 21 days. The females usually breed every two years (DotEE 2019; Marchant and Higgins 1993).

This species is generally seen alone or in pairs or occasionally in small flocks. Flocking occurs during the breeding season but are also known to form after the breeding season and at some locations where small groups regularly occur (DotEE 2019; Marchant and Higgins 1993).

4.2.3 Habitat

The Australian painted snipe generally inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans. The species has also been observed to use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. The Australian painted snipe has been recorded nesting in and near swamps, canegrass swamps, flooded areas, including samphire, grazing land, among cumbungi, sedges, grasses, salt water couch, saltbush (*Halosarcia* sp.) and grass, in ground cover of water-buttons and grasses, at the base of tussocks and under low saltbush (DotEE 2019; Marchant and Higgins 1993).

The Australian painted snipe requires suitable wetland areas even in drought conditions, but the species can move to suitable habitat if necessary (Marchant and Higgins 1993).

4.2.4 Threatening processes

The following have been identified as potentially threatening processes to the Australian painted snipe:

- The loss and alteration of wetland habitat, particularly the drainage of wetlands and diversion of water to agriculture and reservoirs therefore reducing flooding and precluding the formation of temporary shallow wetlands (NSW NPWS 1999; Watkins 1993; White 1997)
- Grazing and trampling of wetland vegetation by livestock (NSW NPWS 1999)
- The colonisation of invasive, noxious weeds could render habitats less suitable for the snipe and changes to fire regimes might be affecting savannah vegetation around wetlands in northern Australia (del Hoyo et al. 1996; Garnett and Crowley 2000; NSW NPWS 1999; Rogers et al. 2005; Watkins 1993; White 1997)
- Australian painted snipe nesting sites may also be vulnerable to introduced terrestrial predators such as the European red fox or feral cat (DotEE 2019).
- Lack of knowledge on the breeding ecology of this species (OEH 2019).

4.2.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Australian painted snipe male (Rostratula australis). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10734. In effect under the BC Act 2016.

4.2.6 References

Aviceda (2002). Photographic image of Rostratula australis. [Accessed 10 September 2019]

Barrett, G., Silcocks A., Barry S., Cunningham R. and Poulter R. (2003). The New Atlas of Australian Birds. Melbourne, Victoria: Birds Australia.

Blakers, M., Davies S.J.J.F. and Reilly P.N. (1984). The Atlas of Australian Birds. Melbourne, Victoria: Melbourne University Press.

del Hoyo, J., Elliott A. and Sargatal J. eds. (1996). Handbook of the Birds of the World. Volume 3, Hoatzin to Auks. Barcelona: Lynx Edicions.

Department of the Environment and Energy (2019). Rostratula australis in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=77037 [Accessed 12 September 2019].

eBird Australia. (2015). Australian painted snipe male (Rostratula australis). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=80919ccc-36ac-463a-9bd9-1462b7a05d1d. [17 September 2019].

Garnett, S.T. and Crowley G.M. (2000). The Action Plan for Australian Birds 2000. Canberra, ACT: Environment Australia and Birds Australia.

Marchant, S. and Higgins P.J., eds. (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2 - Raptors to Lapwings. Melbourne, Victoria: Oxford University Press.

New South Wales National Parks and Wildlife Service (1999). Threatened Species Information - Painted Snipe.

Office of Environment and Heritage (2019). Australian painted snipe male (*Rostratula australis*) – Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10734. [30 September 2019].

Rogers, D., Hance I., Paton S., Tzaros C., Griffioen P., Herring M., Jaensch R., Oring L., Silcocks A. and Weston M. (2005). The breeding bottleneck: breeding habitat and population decline in the Australian Painted Snipe. In: Straw, P., ed. Status and Conservation of Seabirds in the East Asian-Australasian Flyway. Pp. 15-23.

Watkins, D. (1993). A national plan for shorebird conservation in Australia. RAOU Report Series. 90.

White, M.E. (1997). Listen, Our Land Is Crying. Australia's Environment: Problems and Solutions. Kenthurst, New South Wales: Kangaroo Press

4.3 Curlew sandpiper (*Calidris ferruginea*)

4.3.1 Status

EPBC Act – Critically endangered

BC Act – Endangered

4.3.2 Biology and ecology

4.3.2.1 Characteristics

The Curlew sandpiper (*Calidris ferruginea*) is a small, slim sandpiper 18 to 23 cm long and weighing 57 g, with a wingspan of 38 to 41 cm. The legs and neck are long. The bill is also long and is decurved with a slender tip. The bill is black, sometimes with a brown or green tinge at the base. The head is small and round, and the iris is dark brown. The legs and feet are black or black-grey. When at rest, the wing-tips project beyond the tip of the tail. The sexes are similar, but females have a slightly larger and longer bills and a slightly paler underbelly in breeding plumage (Higgins & Davies 1996).

In breeding plumage, the head, neck and underbody to rear belly are a rich chestnut-red with narrow black bars on the belly and flanks. There are black streaks on the crown, a dusky loral stripe, and white around the base of the bill. The head, neck and underbody have a pale-streaked appearance due to white tips on the feathers. The feathers on the mantle and scapulars are black with large chestnut spots and grayish-white tips. The back and upper rump are dark brown, with a prominent square white patch across the lower rump and uppertail-covert (Higgins & Davies 1996).

The non-breeding plumage is similar to the breeding plumage. Differences are that the cap, ear-coverts, hindneck and sides of neck are pale brownish-grey with fine dark streaks, grading to off-white on the lower face, with white on the chin and throat. There is a narrow dark loral stripe and white supercilium from the bill to above the rear ear-coverts. The mantle, back, scapulars, tertials and innerwing-covert are pale brownish-grey with fine dark streaks. The underbody is white with a brownish-grey wash and fine dark streaks on the foreneck and breast (refer Photograph 4.3) (Higgins & Davies 1996).

Photograph 4.3 Curlew sandpiper (Calidris ferruginea)

Source: Emilio (2014)

4.3.2.2 Known distribution

In Australia, curlew sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers (refer Figure 4.3). Records occur in all states during the non-breeding period, and also during the breeding season when many non-breeding one-year old birds remain in Australia rather than migrating north.

In Queensland, scattered records occur in the Gulf of Carpentaria, with widespread records along the coast south of Cairns. There are sparsely scattered records inland. In New South Wales, they are widespread east of the Great Divide, especially in coastal regions. They are occasionally recorded in the Tablelands and are widespread in the Riverina and south-west New South Wales, with scattered records elsewhere. In Victoria, they are widespread and common in coastal bays and inlets and are widespread in near-coastal wetlands, and inland in suitable habitats such as the Kerang area, Mildura, and western districts. In Tasmania, they are recorded on King Island and the Furneaux Group. They mostly occur in eastern Tasmania, but also at several sites in north-west Tasmania, with occasional records on the west coast. In South Australia, curlew sandpipers occur in widespread coastal and subcoastal areas east of Streaky Bay. Important sites include ICI and Price Saltfields, and The Coorong. Occasionally they occur in inland areas south of the Murray River and elsewhere. In Western Australia, they are widespread around coastal and subcoastal plains from Cape Arid to south-west Kimberley Division, but are more sparsely distributed between Carnarvon and Dampier Archipelago. They occur in large numbers, in thousands to tens of thousands, at Port Hedland Saltworks, 80 Mile Beach, Roebuck Bay and Lake Macleod. They are rarely recorded in the north-west Kimberley, around Wyndham and Lake Argyle, and occasionally they occur inland, in areas south of 26° S. In the Northern Territory, they mostly occur around Darwin, north to Melville Island and Cobourg Peninsula, and east and south-east to Gove Peninsula, Groote Eylandt and Sir Edward Pellew Island. They are recorded inland from Victoria River Downs and around Alice Springs (Higgins & Davies 1996).

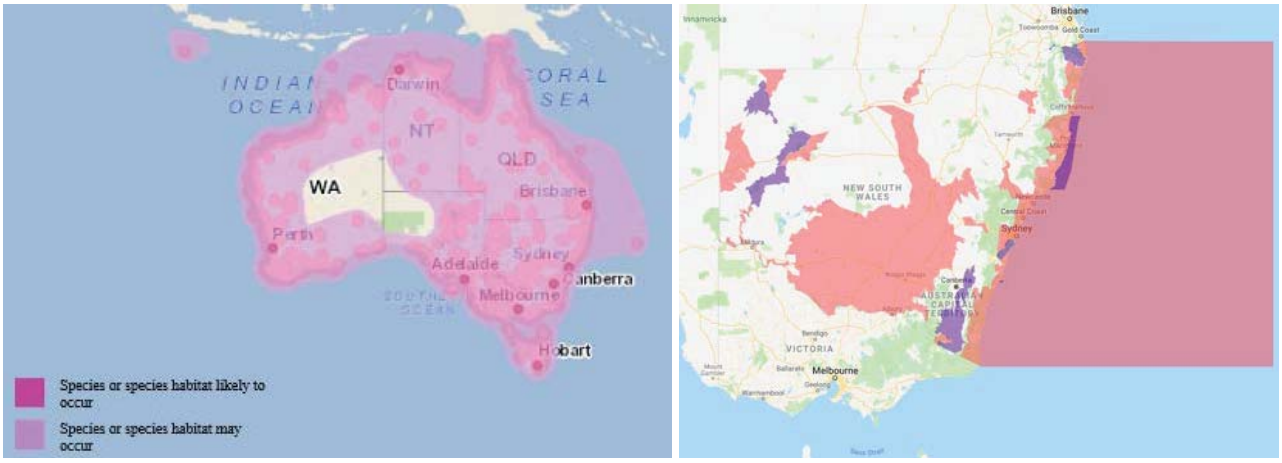


Figure 4.3 **Distribution range of the Curlew sandpiper (Calidris ferruginea)**

Source: DotEE (2019), OEH (2019)

4.3.2.3 Biology and reproduction

This species is distinct, with its combination of small size, slim build, long decurved black bill, and long black legs. However, it may be confused with the Dunlin (*Calidris alpina*) as they are very similar in size and shape. They may also be confused, but less so, with the Sharp-tailed sandpiper (*Calidris acuminata*) as they are also similar in size, and breeding plumage, and the adult is similar to the breeding Red knot (*Calidris canutus*). In non-breeding and juvenile plumages, they can also be confused with non-breeding and juvenile White-rumped sandpiper (*Calidris fuscicollis*), and in non-breeding plumages can be confused with non-breeding Dunlin (Higgins & Davies 1996).

This species is gregarious, often occurring in large flocks. They mix freely with other small waders when feeding and roosting (Higgins & Davies 1996).

This species does not breed in Australia. The oldest recorded bird was over 19 years old (Leishman 2008). Other records of longevity include a bird banded at Werribee Sewerage Farm, Victoria, which was recaptured at this site over 18 years and one month after being banded (EA 1999e) and three birds recaptured in Victoria which were at least 16 years old (Minton et al. 2001a).

4.3.3 Habitat

This species is migratory. Overlapping breeding grounds occur in Siberia, and populations move south to widely different non-breeding areas which generally occur south of 35° N. Most birds migrate south via the western route, probably overland across Siberia and China, and south Asia. The northern migration occurs much further east, mainly along the south-east and east coasts of China, where staging occurs, then continue overland to breeding areas (Higgins & Davies 1996).

Curlew sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (Higgins & Davies 1996).

Curlew sandpipers forage on mudflats and nearby shallow water. In non-tidal wetlands, they usually wade, mostly in water 15 to 30 mm, but up to 60 mm, deep. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores. At high tide, they forage among low sparse emergent vegetation, such as saltmarsh, and sometimes forage in flooded paddocks or inundated saltflats. Occasionally they forage on wet mats of algae or waterweed, or on banks of beachcast seagrass or seaweed.

Curlew sandpipers generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh (Higgins & Davies 1996).

4.3.4 Threatening processes

There has been a very widespread and large population decline in southern Australia since the 1980s, probably due to threats in breeding areas that are outside Australia. In non-breeding grounds in Australia, this species mostly occurs in highly populated areas and is therefore vulnerable to possible habitat alteration. It is necessary to maintain undisturbed feeding and roosting habitat along the south-east coast and at sites on the north-west coasts used during migration for the species to survive at current population levels (Lane 1987; Gosbell et al. 2002).

Iwamura and colleagues (2013) found that rises in sea level could cause a dramatic collapse of population flow of this species caused by intertidal habitat loss. Taking into account upshore movements of intertidal habitat, their modelling indicates that this species population flow could reduce by 15 per cent with a 200 cm sea level rise (Iwamura et al. 2013).

"The Shorebird Community occurring on the relict tidal delta sands at Taren Point", listed as an endangered ecological community in New South Wales (NSW DECC 2005d), is threatened by the following processes:

- Loss of feeding and roosting habitat
- Fragmentation or isolation of sites within feeding areas resulting in decreasing abundance
- Human disturbance at roost and feeding sites
- Disturbance by dogs at roost and feeding sites
- Pollution
- Human disturbance from recreational activities
- Reduction in flow rates to the floodplain wetlands in the Murray-Darling Basin
- Mangrove invasion in saltmarsh habitat
- Major development for coastal infrastructure (OEH 2019).

4.3.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Curlew sandpiper (*Calidris ferruginea*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=20166. In effect under the BC Act 2016.

4.3.6 References

Birdlife Australia (2019). *Curlew Sandpiper*. Available from: https://birdlife.org.au/bird-profile/curlew-sandpiper [Accessed 25 July 2019].

BirdLife International (2008). *Curlew Sandpiper - species factsheet*. BirdLife International. Available from: http://www.birdlife.org/datazone/species/index.html?action=SpcHTMDetails.asp&sid=3057&m=0.

Department of the Environment and Energy (2019). *Calidris ferruginea – Curlew Sandpiper* in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=856. [Accessed 25 July 2019]

Environment Australia (EA) (1999e). *Australia's national report for the tenth JAMBA and fourth CAMBA consultative meetings, 1999*. Environment Australia. Available from: http://www.environment.gov.au/biodiversity/migratory/waterbirds/nationalreport.html.

Gosbell, K, P. Collins & M. Christie (2002). *Wader Surveys in the Coorong & S.E. Coastal Lakes February* 2002. Australasian Wader Studies Group.

Emilio, J. (2014). Curlew sandpiper (Calidris ferruginea). [image] [online] Available from: https://www.flickr.com/photos/juan_e/14189744097/in/photolist-3Dg6vj-XhMbXb-rEiyqF-XnhsNC-rssdoW-AUdiMa-pdsrhP-dhR1NF-XPhgeP-MPQ8zZ-q6ScfT-3fHmMC-PrPzBY-c2Wp1A-qadmL4-dMuRJe-MPQ8s4-224r7hp-YNVDc5-rA499X-dMuRA8-d9oHrS-J5pVor-Dnv4mM-nBU9yi-4nUe3Y-3ZKHWu-rA9TAR-fUJf3r-DAhXUZ-3ZFvdM-21Wxs4h-CCLU2s-Ds1PXx-D2MNA2-6eZssG-4FMQa8-DnvAzZ-6eVizr-vYK8Ps-J5q4k8-2327Qcz-21Fxk46. [18 September 2019].

Hayman, P., J. Marchant & T. Prater (1986). Shorebirds. An identification *guide to the waders of the world*. London & Sydney: Croom Helm.

Higgins, P.J. & S.J.J.F. Davies, eds (1996). *Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons*. Melbourne, Victoria: Oxford University Press.

Iwamura, T., H.P. Possingham, I. Chades, C. Minton, N.J. Murray, D.I. Rogers, E.A. Treml & R.A. Fuller (2013). Migratory connectivity magnifies the consequences of habitat loss from sea-level rise for shorebird populations. *Proceedings of the Royal Society B: Biological Sciences*.

Johnsgard, P.A. (1981). *The Plovers, Sandpipers and Snipes of the World*. Lincoln: Nebraska Press.

Lane, B.A. (1987). *Shorebirds in Australia*. Sydney, NSW: Reed.

Leishman, A. (2008). *Elapsed Time and Distance Records*. Australian Bird Study Association. Available from: http://www.absa.asn.au/recoveries/ar4.html.

Minton, C., & J. Whitelaw (2000). Waders roosting on mangroves. *Stilt*. 37:23-24.

Minton, C., R. Jessop, D. Graham & P. Collins (2001a). Recoveries of waders banded in Victoria 1999/2000. Victorian Wader Study Group Bulletin. 24:22-29.

NSW Department of Environment and Climate Change (DECC) (2005d). Taren Point Shorebirds - profile. NSW DECC. Available from: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10800.

Office of Environment and Heritage (2019). Australian painted snipe male (Rostratula australis) – Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20166. [30 September 2019].

Tulp, I., & P. de Goeij (1994). Evaluating wader habitat in Roebuck Bay (north-western Australia) as a springboard for northbound migration in waders, with a focus on Great Knots. Emu. 94:78-95.

4.4 Australian bustard (*Ardeotis australis*)

4.4.1 Status

EPBC Act – Not listed

BC Act – Endangered

4.4.2 Biology and ecology

4.4.2.1 Characteristics

The Australian bustard is a heavy-bodied bird that spends the majority of its time on the ground. These large birds stand to one m tall and the larger males reach a wingspan of up to 2.3 m. Distinguishing features include the black cap on top of the hear, erect posture and long legs. The head, neck and breast are white with flecks of dark grey. The top of the wings are brown with a distinguished black patch on the lower edge of the wing (refer Photograph 4.4) (OEH 2019).

Photograph 4.4 **Australian bustard *(Ardeotis australis)***

Source: Sutton (2012)

4.4.2.2 Known distribution

The Australian bustard is and inland species of Australia but is now scares or locally extinct in southern and south-eastern Australia. Populations still occur in the north-west corner of New South Wales with occasional migrants seen as far east as western slopes and Riverine plain. This species breeds exclusively in the north-west region of the state (refer Figure 4.4) (OEH 2019).

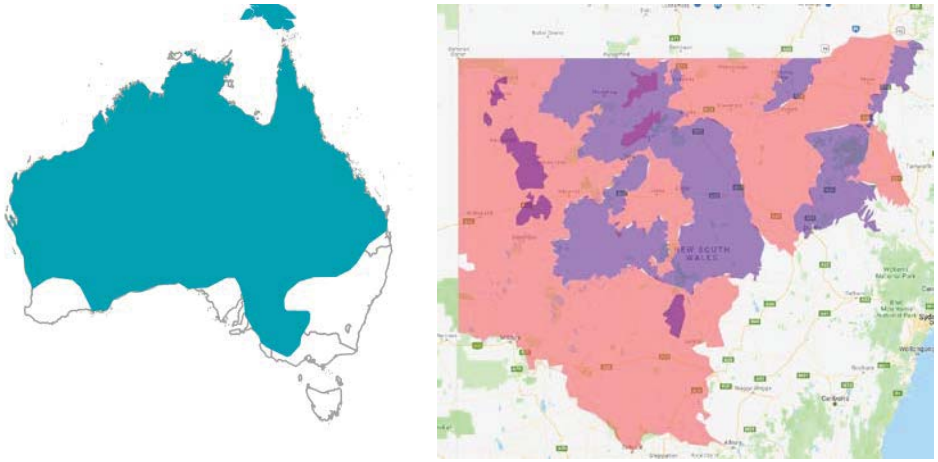


Figure 4.4 **Distribution range of Australian bustard**

Source: ALA (2019), OEH (2019)

4.4.2.3 Biology and reproduction

Australian bustards feeds mostly on insects, and will hunt young birds and small vertebrates such as lizards and mice. They will also consume leaves, seeds and fruit. They utilise ecotones between grassland and protective shrublands to nest on bare ground on low sandy ridges and stony rises. Shrubs and long grasses provides shelter in their breeding areas (OEH 2019).

4.4.3 Habitat

The Australian bustard is an inhabitant of tussock and hummock grasslands with a preference to tussock grasses. They are also associated with low shrublands or low open grassy woodlands. The dispersive nature of this bird species sees them move across long distances with irregular widespread movement. These movements seem to be determined by climatic conditions and prey availability, particularly where mice numbers are high and in recently burnt areas. Australian bustards are associated with the following habitat types in New South Wales:

- Brigalow Belt South
- Broken Hill Complex
- Channel Country
- Cobar Peneplain
- Darling Riverine Plains
- Mulga Lands
- Murray Darling Depression
- Riverina
- Simpson Strezelecki Dunefields (OEH 2019).

4.4.4 Threatening processes

The following have been identified as potentially threatening processes to Australian bustard:

- Overgrazing from livestock in tussock grasslands
- Predation by foxes and cats
- Illegal hunting
- The loss, fragmentation and degradation of semi-arid open grassy woodlands
- Secondary poisoning from rabbit baiting (OEH 2019).

4.4.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Australian bustard *(Ardeotis australis).* Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10063. In effect under the BC Act 2016.

4.4.6 References

Atlas of Living Australia (2019). Australian bustard (*Ardeotis australis*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:3a0e99fe-fe4d-4be0-a748-8d09e4bcdb98. [30 September 2019].

Office of Environment and Heritage, NSW (2019). Species Profile: Australian bustard (Ardeotis australis). [online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10063. [30 September 2019].

Sutton, I. (2012). Australian bustard (Ardeotis australis). [image] [online] Available from: https://commons.wikimedia.org/w/index.php?sort=relevance&search=Ardeotis+australis&title=Special:Search&profile=advanced&fulltext=1&advancedSearch-current=%7B%7D&ns0=1&ns6=1&ns12=1&ns14=1&ns100=1&ns106=1&searchToken=crdshf60hciy5pk2825izxiyv#%2Fmedia%2FFile%3AArdeotis_australis_Birralee.jpg. [23 September 2019].

4.5 Barking owl (*Ninox connivens*)

4.5.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.5.2 Biology and ecology

4.5.2.1 Characteristics

The Barking owl is a medium sized owl weighing 650 g and measuring 42 cm in height. Similar to the Powerful owl it is somewhat smaller and larger than the Southern boobook. The owl's eyes are bright yellow and absent of the facial disk associated with other own species. The upperparts of the body are brown to greyish-brown whilst the breast is white with brown streaks (refer Photograph 4.5). The talons of this species is yellow. Differences between males and females include their size, crown and call. Males are often larger with a square crown and a deeper tone in their call. Their 'wook wook' call is typical of the species with pairs of birds performing the call-and-answer duet. They will occasionally use a high-pitched scream that sounds like a screaming woman (OEH 2019).

Photograph 4.5 **Barking owl *(Ninox connivens)***

Source: Edgley (2010)

4.5.2.2 Known distribution

Barking owls are distributed across mainland Australia with the exception of the central arid zones and is more common in the north of the country. It is less common in the south having undergone large declines now occurring in a wide but sparse distribution across New South Wales (refer Figure 4.5). Clearing of woodland and areas with fertile soil have lead to a crash in numbers with the largest populations now restricted to the western slopes and plains along with some northeast coastal and escarpment forests. Linear riparian strips serve as remaining inhabitable areas where populations once flourished. A survey conducted in 2001 determined that the Pilliga Forest is home to the largest population of Barking owls in southern Australia. They will occasionally extend their home ranges into urban areas hunting prey attracted to street lights (OEH 2019).

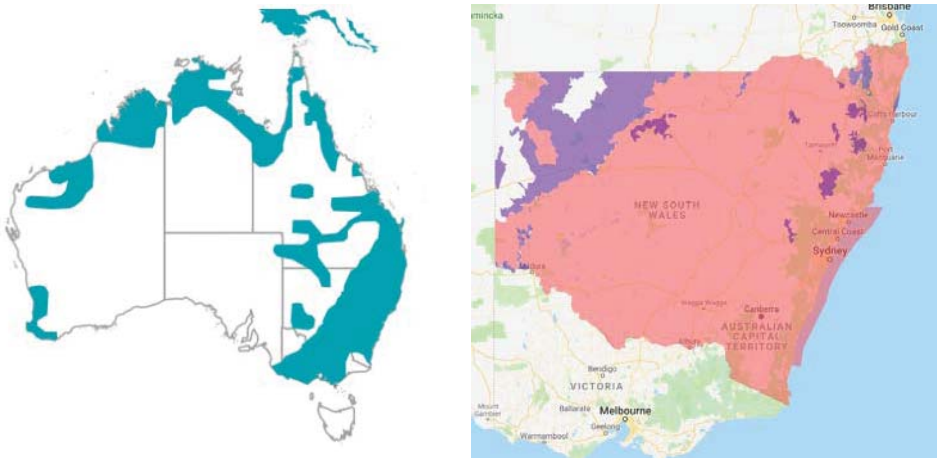


Figure 4.5 **Distribution range of Barking owl**

Source: ALA (2019), OEH (2019)

4.5.2.3 Biology and reproduction

Barking owls will prey upon small arboreal mammals including Squirrel gliders and Common ringtail possums in areas where hollow bearing trees can support these species. Where hollow trees are absent they rely more heavily on birds, invertebrate and terrestrial mammals as prey. Pairs of this species are monogamous requiring very large permanent territories due to sparse prey densities. Their territories can be as large as 6,000 hectares. Barking owls nest in very old trees with large hollows where two or three eggs will be laid. They have a preference for nesting in living eucalypts but will also nesting in dead trees. During the breeding season, the male of the pair will perch nearby to overlook the hollow entrance. Pairs will return to the same hollow to breed unless they have been disturbed by a predator, in which case they will change nesting sites. Pairs will begin nesting in mid-winter or spring with variability between pairs and among years. Most frequently eggs will be laid in August with fledging occurring in November. The female will incubate the eggs for 5 weeks roosting outside the hollow once the chicks are 4 weeks old, fledging will occur 2 to 3 weeks after this. The young will still be dependent for several months (OEH 2019).

4.5.3 Habitat

Barking owls inhabit woodland and open forest utilising fragmented remnants and partially cleared farmland. They demonstrate flexibility in habitat use as they can hunt in both open and closed forest. In areas that have been heavily cleared adjacent to timbered riparian areas they have sometime be found breeding. This is thought to be due to the fact that fertility of riparian areas is able to support higher densities of pre. Preferring shaded portions of the tree canopy for roosting they have a preference for dense foliage in trees such as *Acacia* and *Casuarina* species (OEH 2019).

4.5.4 Threatening processes

The following have been identified as potentially threatening processes to Barking owls:

- Loss of habitat through clearing, cultivation, intense grazing and replacement with exotic pastures
- Tree harvesting that removes old growth hollow-bearing trees which changes the forest structure to dense regrowth
- Removing fallen logs and large dead trees for fire wood
- Frequent fires causing the loss or degradation of important habitat for prey species such as understory vegetation
- Disturbance of nesting and foraging sites
- Feral predators competing for the same prey (foxes)

- Lack of knowledge and poor organisation of data on the species
- Nest predation reducing breeding success (OEH 2019)

4.5.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Barking owl (Ninox connivens). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10561. In effect under the BC Act 2016.

4.5.6 References

Atlas of Living Australia (2019). Barking owl (*Ninox connivens*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:a64b3461-23eb-47fe-9cf1-5d639ea47670. [30 September 2019].

Edgley, J. (2010). Barking owl (Ninox connivens). [image] [online] Available from: https://commons.wikimedia.org/wiki/File:Barking_Owl_(Ninox_connivens).jpg. [23 September 2019].

Office of Environment and Heritage, NSW (2019). Barking owl (Ninox connivens). [online] Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10561. [30 September 2019].

4.6 Black-breasted buzzard (*Hamirostra melanosternon*)

4.6.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.6.2 Biology and ecology

4.6.2.1 Characteristics

As one of the largest birds of prey in Australia the Black-breasted buzzard can total a wingspan of 1.5 m. Relative to the body and short square tail the wings are noticeably long. During flight the distinctive black breast and white patches at the base of the black ‘fingered’ primary feathers of the wings can be seen. Its nape is reddish standing out against the black face and back (refer Photograph 4.6) (OEH 2019).

Photograph 4.6 **Black-breasted buzzard *(Hamirostra melanosternon)***

Source: Nicolson (2017)

4.6.2.2 Known distribution

The Black-breasted buzzard is restricted to areas that receive less than 500 mm of rainfall from north-western New South Wales and north-eastern South Australia to the east coast near Rockhampton, then across the north of Australia to Perth absent only from the Western Australian deserts (refer Figure 4.6) (OEH 2019).

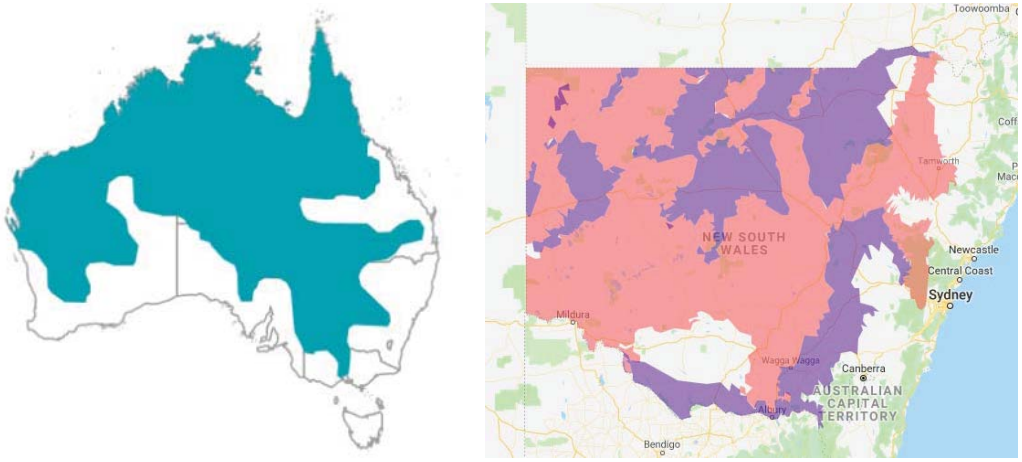


Figure 4.6 **Distribution range of Black-breasted buzzard**

Source: ALA (2019)

4.6.2.3 Biology and reproduction

Black-breasted buzzards are not particularly powerful hunters regardless of their size and prey upon smaller vertebrates such as reptiles, small mammals and birds, including nestlings. They will also scavenge feeding on carrion. These buzzards are also adapted to feeding on large eggs, such as emus, utilising rocks to crack the eggs. Breeding occurs between August and October nesting in tall trees near water. They will lay two eggs in their flat nests which are made with sticks and are lined with green leaves (OEH 2019).

4.6.3 Habitat

The Black-breasted buzzard inhabitants a vast range of habitats across its range where it prefers timbered watercourses as breeding habitat. They hunt primarily in grasslands and sparsely timbered areas. In New South Wales they are associated with the following habitat types:

- Brigalow Belt South

- Broken Hill Complex
- Channel Country
- Cobar Peneplains
- Darling Riverine Plains
- Mulga Lands
- Murray Darling Depression
- Nandewar
- New South Wales South Western Slopes
- Riverina
- Simpson Strzelecki Dunefields
- South Eastern Highlands
- Sydney Basin (OEH 2019).

4.6.4 Threatening processes

The following have been identified as potentially threatening processes to Black-breasted buzzards:

- Loss of habitat particularly trees along inland watercourses
- Reduced suitability of foraging habitat as a result of overgrazing and tree clearing
- Illegal egg collecting and shooting.

4.6.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Black-breasted buzzard (*Hamirostra* melanosternon). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10395. In effect under the BC Act 2016.

4.6.6 References

Atlas of Living Australia (2019). Black-breasted buzzard (*Hamirostra melanosternon*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:c89b8b74-f2bb-4a39-a6a9-e6573d36d557. [30 September 2019].

Nicolson, K. (2017). Black-breasted buzzard (Hamirostra melanosternon). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=261167ba-e0d4-4274-8df6-473c127e6390. [23 September 2019].

Office of Environment and Heritage, NSW (2019).

4.7 Black-necked stork (*Ephippiorhynchus asiaticus*)

4.7.1 Status

EPBC Act – Not listed

BC Act – Endangered

4.7.2 Biology and ecology

4.7.2.1 Characteristics

Black-necked storks are the only type of stork that are found in Australia. Key characteristics include the distinctive black and white waterbird stand at an enormous 1.3 m tall with an impressive 2 m wingspan. The head and neck are covered in an iridescent green and purple sheen whilst the huge bill, part of the wings and the short tail are all black. The legs are orange -red to bright red whilst the remainder of their body is white (refer Photograph 4.7). It is only the females that have a bright yellow eye, whilst the males have dark-brown eyes. Juveniles are brown before they come into their full colours. They can be seen singularly, in pairs or small family groups (OEH 2019).

Photograph 4.7 Black-necked stork (Ephippiorhynchus asiaticus)

Source: eBirdlife (2015)

4.7.2.2 Known distribution

In Australia the sub-species of Black-necked storks (*E. a. australis*) are widespread in coastal and wetland areas including New Guinea. Their range extends to central New South Wales on the east coast, across the north of Australia and into Western Australia following the coast and inland water courses (refer Figure 4.7) (OEH 2019).

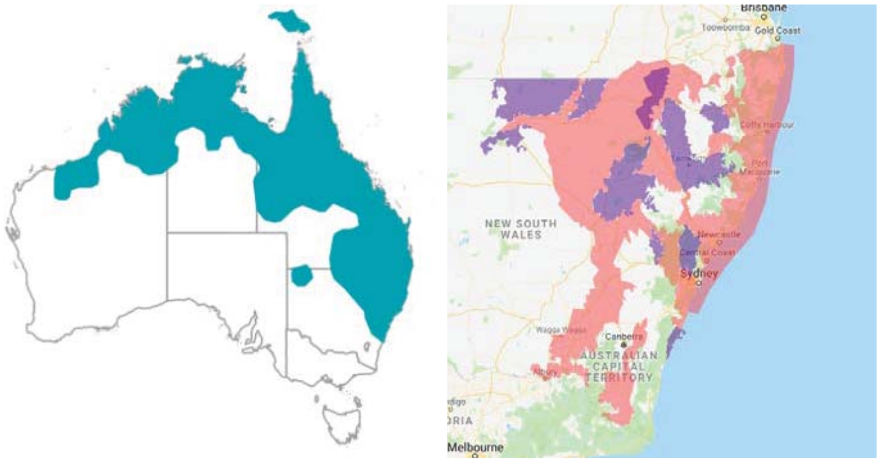


Figure 4.7 Distribution range of Black-necked stork

Source: ALA (2019)

4.7.2.3 Biology and reproduction

Black-necked storks commonly forage in water ranging in depth from 5 to 30 cm searching for their prey. Feeding mostly on eels their diet also consists of fish, frogs, freshwater invertebrates such as crayfish and insects. Selecting trees that are close to water these storks will build their large nests high up in the trees. This high vantage point provides a clear view of the surrounding area of the floodplain environment. In New South Wales they will breed from May to January, with incubation occurring between May to October and nestlings from July to January. The young will begin fledging by September and the parents share the nesting duties. It is estimated that there are 75 established breeding pairs of Black-necked storks in New South Wales. Their territories are enormous and highly variable depending on the quality of the surrounding wetland habitat. Home ranges average about 9,000 ha range from 3,000 to 6,000 ha in high quality habitat and 10,000 to 15,000 ha where habitat is of a lower quality of highly dispersed (OEH 2019).

4.7.3 Habitat

Key habitat for the Black-necked stork includes floodplain wetlands, swamps, billabongs, watercourses and dams within their distribution range. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries (OEH 2019).

4.7.4 Threatening processes

The following have been identified as potentially threatening processes to Black-necked storks:

- Powerlines that are close to wetlands and floodplains, powerlines have been identified as one of the most critical threats to the species in New South Wales
- Changes to natural water flow impacting the health of wetland ecosystems as they rely on these systems for much of their prey items
- Wetland ecosystems being cleared or drained for development
- Loss of mature paddock trees for nesting
- Salinity impacting the health of wetlands
- People disturbing foraging and roosting sites.

4.7.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Black-necked stork (*Ephippiorhynchus asiaticus*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10275. In effect under the BC Act 2016.

4.7.6 References

Atlas of Living Australia (2019). Black-necked stork (*Ephippiorhynchus asiaticus*). [image] [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:e7552037-18c6-494b-8ad3-10bc996e68bd#overview. [30 September 2019].

Nicolson, K. (2017). Black-necked stork (Ephippiorhynchus asiaticus). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=261167ba-e0d4-4274-8df6-473c127e6390. [23 September 2019].

Office of Environment and Heritage, NSW (2019). Black-necked stork (Ephippiorhynchus asiaticus). [image] [online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10275. [30 September 2019].

4.8 Blue-billed duck (*Oxyura australis*)

4.8.1 Status

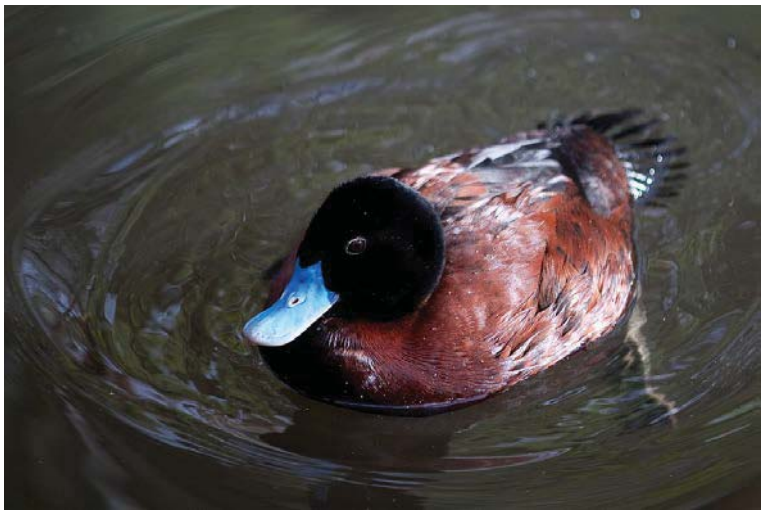
EPBC Act – Not listed

BC Act – Vulnerable

4.8.2 Biology and ecology

4.8.2.1 Characteristics

Blue-billed ducks are one of only two species of stiff-tailed ducks in Australia. A small and compact duck they grow to a total length of 40 cm. During the breeding season the males of this species is distinguished by their bright blue bill, the blue colouration is only present during breeding. Their head and neck is black whilst their body is a rich chestnut brown (refer Photograph 4.8). Females are brownish-black above and have narrow bands of light, mottled brown and black below. Females have a dark grey-green bill, which is similar to the males outside of the breeding season. (OEH 2019).



Photograph 4.8 Blue-billed duck (Oxyura australis)

Source: Ashburst (2010)

4.8.2.2 Known distribution

Blue-billed ducks are endemic to south-eastern and south-western Australia (refer Figure 4.8). Whilst they are widespread across New South Wales they occur mostly in the southern Murray-Darling Basin area. Travelling some 300 km these ducks disperse during the breeding season in search for deep swamps. In general they are only seen in coastal areas during the summer or drier years (OEH 2019).

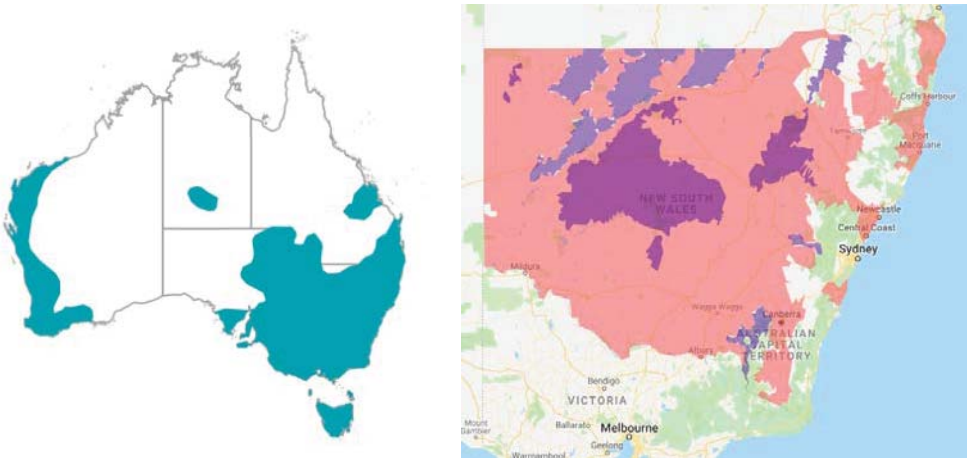


Figure 4.8 **Distribution range of Blue-billed duck (Oxyura australis)**

Source: ALA (2019)

4.8.2.3 Biology and reproduction

Scouring the bottom of the water bodies they inhabit Blue-billed ducks will feed on seeds, buds, stems, leaves, fruit and small aquatic insects larvae from midges, caddisflies and dragonflies. Blue-billed ducks partially migrate between breeding swamps and overwintering lakes sometimes dispersing further to breed during spring and early summer. From the months between September and February they will nest in Cumbungi solitarily over deep water. Nests are constructed in a bowl shape and can be found in Lignum, sedges or Spike-rushes. A clutch will usually consist of five or six eggs. Males do not assist with nest building or incubation. By April/May young birds disperse o inland New South Wales to non-breeding sites along the Murray River system and coastal lakes (OEH 2019).

4.8.3 Habitat

Blue-billed ducks are completely aquatic and are associated with deep water, permanent wetland or swamps with dense aquatic vegetation. They will fly if disturbed but prefer to dive to avoid detection. Swimming low in the water along dense cover, particularly in the central part of wetlands provides the best setting for feeding. (OEH 2019).

4.8.4 Threatening processes

The following have been identified as potentially threatening processes to Blue-billed ducks:

- Degradation of breeding habitat through water regulation activities including drainage, flood mitigation, ground water extraction and water harvesting
- Rubbish dumping
- Increased fire frequency changing the species composition of flora simplifying breeding and foraging habitat
- Clearing and overgrazing of water vegetation
- Salinity impacting essential nesting habitat
- Illegal hunting
- Water pollution as a result of herbicides and pesticides (OEH 2019)

4.8.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Blue-billed duck (*Oxyura australis*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10580. In effect under the BC Act 2016.

4.8.6 References

Ashburst, R. (2010). Blue-billed duck (Oxyura australis). [image] [online] Available from: https://commons.wikimedia.org/wiki/File:Oxyura_australis_1.jpg. [23 September 2019].

Atlas of Living Australia (2019). Blue-billed duck (Oxyura australis). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:cfcc7058-47fa-4407-b0a0-e4246bea0368. [30 September 2019].

Office of Environment and Heritage, NSW (2019). Blue-billed duck (Oxyura australis). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:cfcc7058-47fa-4407-b0a0-e4246bea0368. [30 September 2019].

4.9 Brolga (*Grus rubicunda*)

4.9.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.9.2 Biology and ecology

4.9.2.1 Characteristics

As one of Australia's largest flying birds the Brolga is and unmistakable bird across its range. They stand at 1.3 m tall and have a wingspan close to 2.5 m. The feathers along the body and neck are pale bright great with a distinct band of red bare skin across the back of the neck to the beak and a black dewlap under the chin. Their long legs are black (refer Photograph 4.9). Young birds are darker and are absent of the red band and dewlap. Their call is a brassy trumpeting that carries long distances (OEH 2019).

Photograph 4.9 Brolga *(Grus rubicunda)*

Source: eBird Australia (2015)

4.9.2.2 Known distribution

Historically Brolgas were found right across Australia except for Tasmania, the south-eat corner and the south-western third of the continent. Whilst still common in the north of its range southern populations have experienced declines (refer Figure 4.9) (OEH 2019).

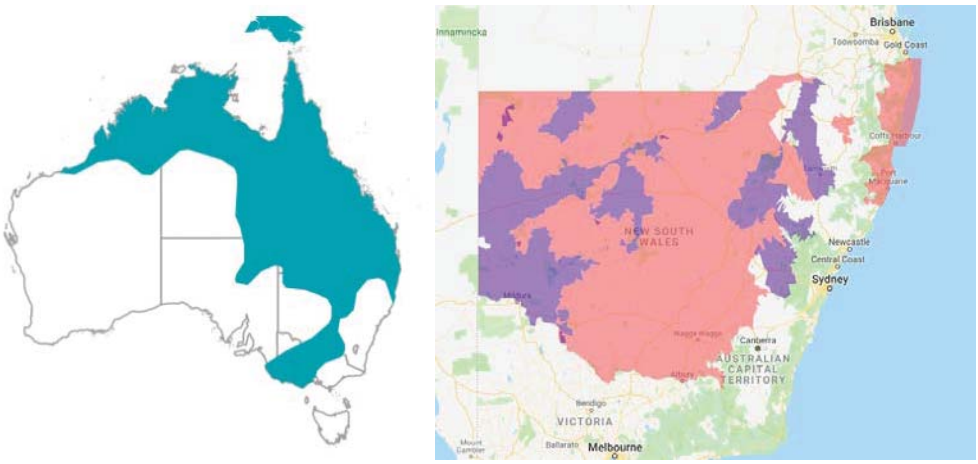


Figure 4.9 **Distribution range of the Brolga**

Source: ALA (2019)

4.9.2.3 Biology and reproduction

Brolgas can be found usually in flocks, sometimes numbering the thousands through the dry season congregating around the remaining shrinking wetlands (Morcombe 2010). Pairs will begin to move inland once the wet season rains arrive. They feed with their heads fully submerged using their 'crowbar' like bill to probe and turnover the ground, feeding primarily on sedge roots and tubers. They will also eat insects, crustaceans, molluscs and frogs. Brolgas perform a 'dance' in courtship or bonding where the pair face each other, crouch down and stretch upwards, trumpet, leap and toss grass and sticks into the air. The nest is made up of grasses and sticks, enlarged with mud, on an island or in the water. The female will lay two eggs from winter to autumn (OEH 2019).

4.9.3 Habitat

Brolgas utilise habitats including freshwater swamps, flooded grasslands, floodplains, billabongs, lagoons, dry grasslands, irrigated pastures and occasionally estuarine mangroves (Morcombe 2010). They are associated with the following habitat types in New South Wales:

- Brigalow Belt South
- Broken Hill Complex
- Channel Country
- Cobar Peneplain
- Darling Riverine Plains
- Mulga Lands
- Murray Darling Depression
- Nandewar
- New England Tablelands
- New South Wales North Coast
- New South Wales South Western Slopes
- Ocean

- Riverina
- Simpson Strzelecki Dunefields
- South Eastern Highlands
- South Eastern Queensland
- Sydney Basin (OEH 2019).

4.9.4 Threatening processes

The following have been identified as potentially threatening processes to Black-necked storks:

- Drainage of swamps
- Poisoning or shot as crop pests
- Loss of wetland habitat (OEH 2019).

4.9.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Brolga (Grus rubicunda). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10382. In effect under the BC Act 2016.

4.9.6 References

Atlas of Living Australia (2019). Brolga (*Grus rubicunda*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:4e1415c7-9e9c-4c63-9256-d637eec3644a. [30 September 2019].

eBird Australia. (2015). Brolga (Grus rubicunda). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=aa94c2a1-2fd6-46b0-913c-50c0c6bfd651. [23 September 2019].

Morcombe, M. 2010. Aus. Birds, App.

Office of Environment and Heritage (2019). Brolga (Grus rubicunda). [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10382. [30 September 2019].

4.10 Black-tailed godwit (*Limosa limosa*)

4.10.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.10.2 Biology and ecology

4.10.2.1 Characteristics

Black-tailed godwits are a larger species of sandpiper reaching 44 cm in length with a wingspan of 63 to 75 cm. Their long pink bill with its black tip is quite distinctive of this species. There is a white bar across the dark flight feathers of the wing whilst the underside coverts are white along with a broad white strip under the wing. There is a sharp demarcation between the white rump and the black tail. Their long trailing legs are greenish-black (refer Photograph 4.10). Non-breeding plumage is greyish-brown above and white below, and a grey breast. Distinguishing features of the Black-tailed godwit includes black tail in flight; longer, more pink, non-upturned bill; non-streaked breast when compared to the similar looking Bar-tailed godwits (OEH 2019).

Photograph 4.10 Black-tailed godwit *(Limosa limosa)*

Source: Edmonds (2013)

4.10.2.2 Known distribution

Black-tailed godwits migrate from their breeding grounds in Mongolia and Eastern Siberia to Australia for the southern summer and are most frequently observed at Kootangan Island (Hunter River estuary), occasionally being seen elsewhere along the coast and inland. The large lakes in the western area of New South Wales is utilised by the species along with the Murray-Darling system, the western slopes of the Northern Tablelands and the far north-western corner of the state (refer Figure 4.10) (OEH 2019).

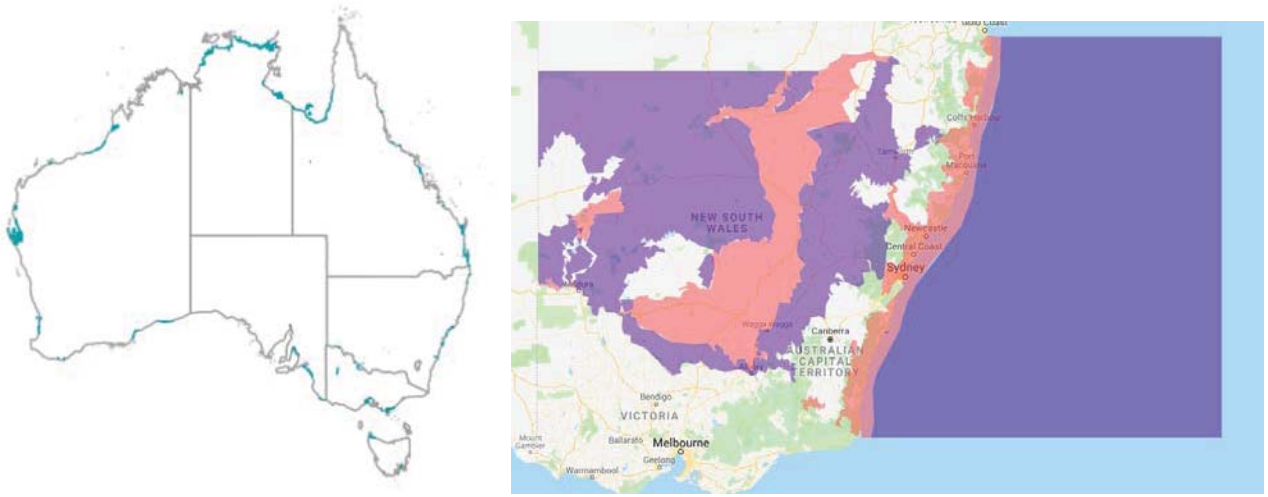


Figure 4.10 Distribution range of Black-tailed godwit

Source: ALA (2019)

4.10.2.3 Biology and reproduction

Black-tailed godwits forage for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs and tadpoles in soft mud or shallow waters. This species will roost and loaf around mud banks, shell bars and sandy uprises. As a migratory species they do not breed in Australia (OEH 2019).

4.10.3 Habitat

Black-tailed godwits primarily use coastal regions within their range consisting of sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats. Where they occur inland they prefer water less than 10 cm in depth, around muddy lakes and swamps. Some individuals have been found in wet fields and at sewage treatment plants. (OEH 2019).

4.10.4 Threatening processes

The following have been identified as potentially threatening processes to the Black-tailed godwit (Limosa limosa):

- Changes to the hydrology of inland lakes and water bodies which may modify or remove suitable habitat
- Human disturbance of roosting sites from recreational activities
- Mangrove incursion in saltwater habitat
- Coastal industrial development impacting important feeding grounds
- Groundwater pollution impacting foraging habitat
- Erosion, climate change inundation and sea-level rise impacting foraging habitat (OEH 2019).

4.10.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Black-tailed godwit (*Limosa limosa*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10479. In effect under the BC Act 2016.

4.10.6 References

Atlas of Living Australia (2019). Black-tailed godwit (*Limosa limosa*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:ba17b534-ec3d-4ec3-8f9a-6c2c79ad4459. [30 September 2019].

Edmonds, J. (2013). Black-tailed godwit (Limosa limosa). [image] [online] Available from: https://www.flickr.com/photos/30107812@N05/8603014935/in/photolist-e7dGBH-fTF1dy-yZeH13-SHvSZs-Tq185N-oKyx5Y-SgwNjy-cYjnad-eBVC7U-bVSw7h-8qVYAL-qmodGt-cJuk9Q-nC4ZfS-yQ3GAf-nhGisv-U2gvo2-7T1HQk-V63pJN-9ywJev-2fizLui-CpCYdg-doPETp-7T4YcG-2fizLGT-TMzYRK-qmypBZ-asEsnD-kJpvZ2-6ejh2Y-Rzvf9q-U6Sx88-cZBvtL-fY2Hby-okXXAh-cYjmEL-6rP7ZL-dhQSyv-71mQWh-dhQY4q-ssNKTC-2fAdXcv-q51LC1-S4Dr77-25Uef9C-TMzYux-bPz6b8-bSmP6g-9NsDQi-6R96Js. [17 September 2019].

Office of Environment and Heritage, NSW (2019). Species Profile: Black-tailed godwit (Limosa limosa). [online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10479. [30 September 2019].

4.11 Brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)

4.11.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.11.2 Biology and ecology

4.11.2.1 Characteristics

The Brown treecreeper is a grey-brown bird with black barring that can be seen on the lower chest and under the tail. When in flight there are pale buff bands that run across the understand. A dark line can be observed across the eye and the head is a pale grey (refer Photograph 4.11). This species happens to be Australia's largest species of treecreeper. There are some minor differences between the sexes with males showing small patches of black and white streaking at the central top of the breast whilst females have rufous and white streaking. The most notable differences with juveniles is the patterning on the underside of the body and their paler bill and gape. This subspecies is distinguishable to the similar picumnus by the colouration of the face, body and tail markings. There is some overlap with the two subspecies in central New South Wales. Their call is a noisy and conspicuous loud 'pink' call which is repeated in contact given in a series of 5 to10 descending notes (OEH 2019).

Photograph 4.11 Brown treecreeper (eastern subspecies) *(Climacteris picumnus victoriae)*

Source: NatureShare (2015)

4.11.2.2 Known distribution

This eastern subspecies of Brown treecreeper is endemic to eastern Australia, as the name suggests. It is associated with eucalypt forests and woodland of the inland plains and slopes of the Great Diving Range and is less common in the coastal plains and ranges. The western boundary of their range occurs near Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell at which point C. picumnus victoiriae begins to overlap with the arid zone subspecies C. picumnus picumnus (refer Figure 4.11). Throughout their range in eastern New South Wales the eastern subspecies of Brown treecreeper inhabits eucalypt woodlands in the central region of the state and coastal areas with drier open woodlands that includes the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys (OEH 2019).

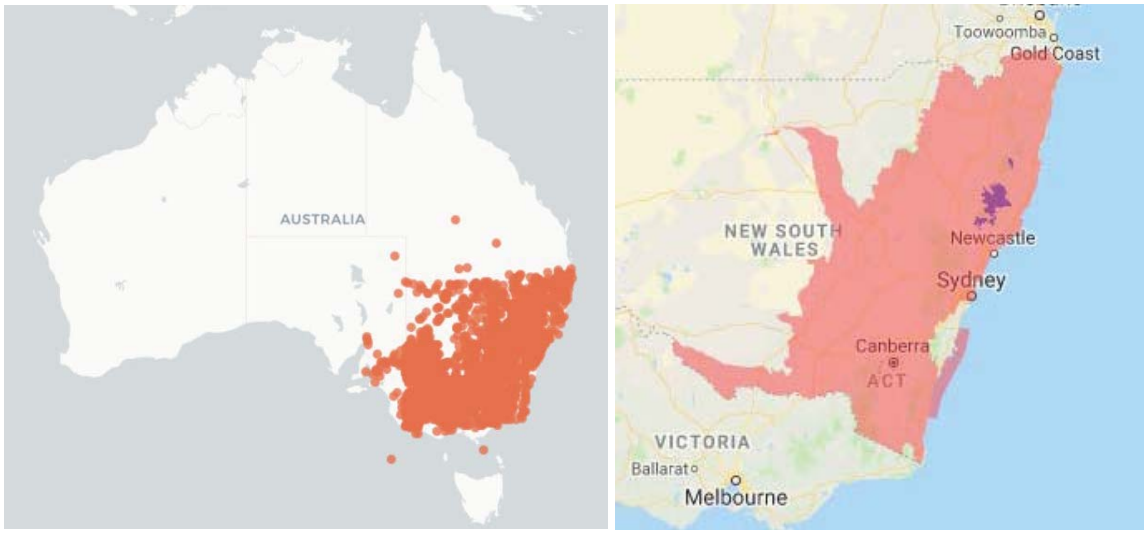


Figure 4.11 **Distribution range of Brown treecreeper (eastern subspecies)**

Source: ALA (2019)

4.11.2.3 Biology and reproduction

This subspecies of Brown treecreeper is sedentary and is a resident in all seasons, year-round where it occurs, though some individuals may disperse locally after breeding. When foraging amongst fallen timber and along tree trunks or branches this species has been observed to be noisy and conspicuous. The species tends to spend equal time feeding on the ground and in trees spending much more time foraging on the ground than other treecreeper species. Prey items mostly consist of ants and other insects found by poking and probing timber, tussocks, tree trunks and lateral branches. Eighty per cent of their diet is comprised of ants whilst spiders, insect larvae, moths, beetles, flies, hemipteran bugs, cockroaches, termites and lacewings make up the remaining percentage of prey items. They will also consume the sap of Mugga ironbark, paperbark and other eucalypts along with lizards and food scraps. This species depends on hollows of live or standing dead trees and tree stumps. Breeding co-operatively or in pairs groups will occupy an area of 1.1 to 10.7 ha. Groups are comprised of a breeding pair, with retained male offspring and, rarely retained female offspring. Cooperative breeding groups can consist of two to five birds (OEH 2019).

4.11.3 Habitat

Where it occurs inland of the Great Dividing Range the eastern subspecies of Brown treecreeper inhabits eucalypt woodlands that includes Box-gum woodlands and woodland dominated by stringybarks or other rough-barked eucalypts accompanied by an open grassy understorey. Understorey usually consists of shrub species found in mallee and River red gum forests that borders wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses. Fallen timber is an important habitat feature for foraging. Usually absent from woodlands that have a dense shrub layer (OEH 2019).

4.11.4 Threatening processes

The following have been identified as potentially threatening processes to Brown treecreepers:

- Loss of woodland habitats and mallee as a result of agriculture, forestry, mining and residential development
- Isolated populations in fragmented forest resulting in localised extinction of the species
- Loss of hollow bearing trees reducing availability of essential breeding habitat
- Overgrazing and increased fire frequency impacting ability of eucalypt overstory to regenerate
- Compaction and overgrazing reducing leaf litter availability
- Poor forest management practices
- Change in habitat structure i.e. loss of understorey
- Invasive weeds competitive with native vegetation
- An overabundance of Noisy minors (OEH 2019).

4.11.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Brown treecreeper (eastern subspecies) (Climacteris picumnus victoriae). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10171. In effect under the BC Act 2016.

4.11.6 References

Atlas of Living Australia (2019). Brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:f86b3932-9e3f-4655-9035-ce49c3261415. [1 October 2019].

NatureShare. (2015). Brown treecreeper (eastern subspecies) (Climacteris picumnus victoriae). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=3bf43bc4-e14b-4227-acec-ab8fa7e1b419. [23 September 2019].

Office of Environment and Heritage, NSW (2019). Brown treecreeper (eastern subspecies) (Climacteris picumnus victoriae). [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10171. [1 October 2019].

4.12 Bush stone-curlew (*Burhinus grallarius*)

4.12.1 Status

EPBC Act – Not listed

BC Act – Endangered

4.12.2 Biology and ecology

4.12.2.1 Characteristics

The Bush stone-curlew is a medium sized bird with a height of 55 cm. Plumage is grey to light brown with black blotches (refer Photograph 4.12). This species is often seen standing still during the day and has conspicuous long legs and bright yellow eyes, when disturbed they often lie flat on the ground. (OEH 2019).

Photograph 4.12 Bush stone-curlew *(Burhinus grallarius)*

Source: Bechly (2009)

4.12.2.2 Known distribution

The Bush stone-curlew currently occurs throughout most of the continent except the arid centre, southern coastline and Tasmania. The species is most common in the north of the country and relatively rare in the southeast of its range. In New South Wales the species is absent from the southern highlands and far northwest (OEH 2019) (refer Figure 1.3).

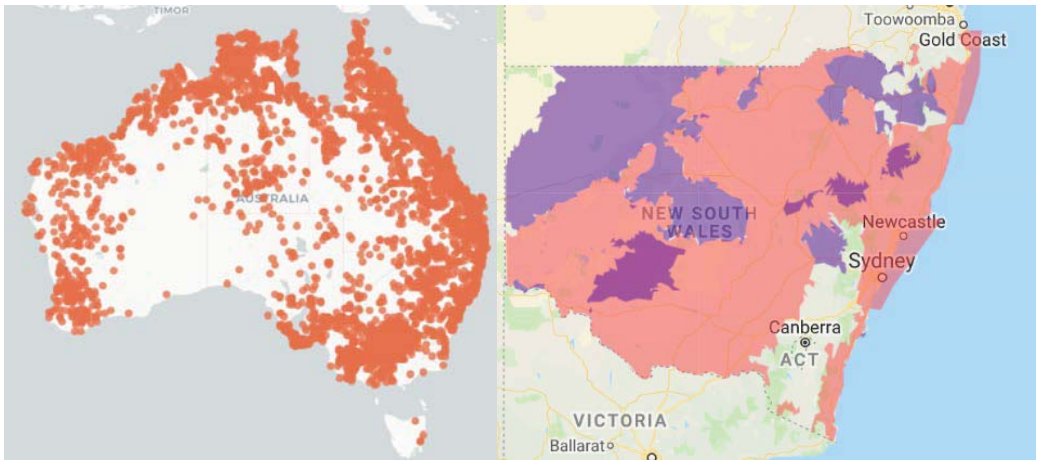


Figure 4.12 Distribution range of Bush stone-curlew

Source: ALA (2019)

4.12.2.3 Biology and reproduction

The Bush stone-curlew is terrestrial, remaining at ground level to shelter, forage and breed. The species is nocturnal, foraging at night by stalking and running for a range of prey such as insects and small vertebrates including frogs, lizards, snakes and rodents. Breeding occurs in spring to early summer. Nests consist of a shallow scrape in the ground or simply a bare patch of ground, with two eggs laid (OEH 2019).

4.12.3 Habitat

Suitable habitat for the Bush stone-curlew includes a wide range of vegetation communities, typically with an open structure, sparse ground layer and abundant woody debris. Preferred habitat types include open forests and grassy woodlands, grasslands, and mangroves. The species is also common is some cities and towns on the east coast (OEH 2019).

4.12.4 Threatening processes

The following have been identified as potentially threatening processes to the Bush stone-curlew:

- Predation by foxes and cats
- Trampling of eggs by cattle
- Clearance of woodland habitat for agricultural and residential development
- Modification and destruction of ground habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, grazing and frequent fires
- Disturbance in the vicinity of nest sites
- Negative impacts of pesticides on wildlife when used around nesting sites and habitat (OEH 2019).

4.12.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Bush stone-curlew (Burhinus grallarius) Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10113. In effect under the BC Act 2016.

4.12.6 References

Atlas of Living Australia (2019). Bush stone-curlew (Burhinus grallarius). [online] Availale from : https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:9e797cd8-e8a0-40ed-a2a6-6abecff8e21f. [1 October 2019].

Bechly, Gunter. (2009). Bush stone-curlew (Burhinus grallarius). [image] [online] Available from: https://commons.wikimedia.org/wiki/File:Burhinus_grallarius_Wilhelma.JPG. [23 September 2019].

Department of the Environment and Energy (2019)

Office of Environment and Heritage, NSW (2019).

4.13 Cotton pygmy-goose (*Nettapus coromandelianus*)

4.13.1 Status

EPBC Act – Not listed

BC Act – Endangered

4.13.2 Biology and ecology

4.13.2.1 Characteristics

The Cotton pygmy-goose is a relatively small duck with a bill similar to that of a goose (refer Photograph 4.13). Males are mostly white with glossy green wings and a dark breast band. Females are generally darker with a dark eye stripe and white eyebrow. The species is most commonly observed on the surface of water (OEH 2019).

Photograph 4.13 Cotton pygmy-goose *(Nettapus coromandelianus)*

Source: eBird Australia (2015)

4.13.2.2 Known distribution

The Cotton pygmy-goose occurs across eastern Queensland coastal and sub-coastal environments and is currently considered a rare visitor to New South Wales. The species is most common in the coastal regions of central Queensland between Rockhampton and Ingham (OEH 2019) (refer Figure 4.13).

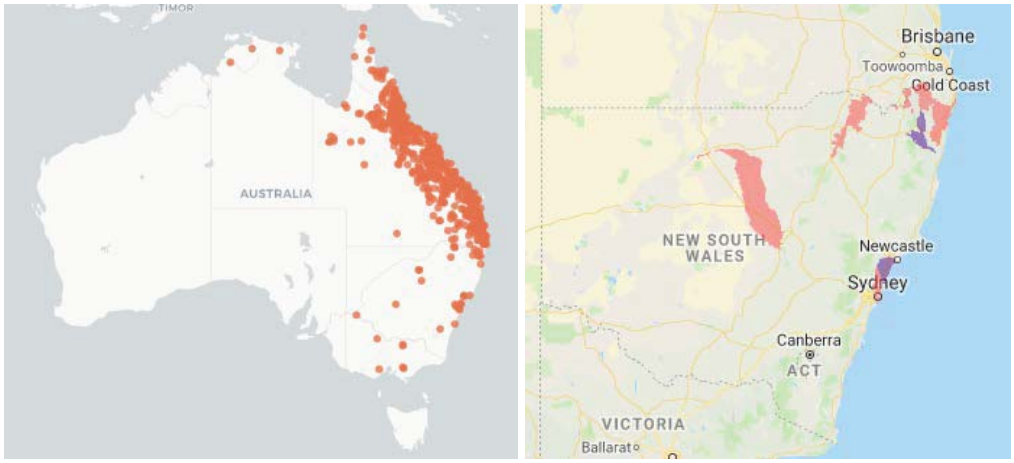


Figure 4.13 Distribution range of Cotton pygmy-goose

Source: ALA (2019)

4.13.2.3 Biology and reproduction

The Cotton pygmy-goose forages primarily on aquatic plants in freshwater wetlands, including seeds, pond weed, sedges and water grasses. Insects are occasionally included in the diet. The species roosts in nearby dead standing trees with hollows, which are also used for breeding. The species does not make nests within the hollows but sometimes utilises existing nests. Breeding occurs between the months of November and April with 6 to 9 eggs laid. Goslings become independent at 6 months (OEH 2019).

4.13.3 Habitat

Suitable habitat for the Cotton pygmy-goose includes freshwater lakes, lagoons, swamps and dams that are vegetated with waterlilies and other aquatic plants. Preferred wetlands are typically deep and include large freshwater lakes and the edges of quiet creeks and rivers, always with waterlilies. Shallow wetlands are not used (OEH 2019).

4.13.4 Threatening processes

The following have been identified as potentially threatening processes to the Cotton pygmy-goose:

- Clearing and draining of lakes and wetlands for agriculture and development
- Invasion of wetland habitat by introduced weeds such as Water hyacinth
- Heavy grazing of wetlands areas by domestic stock, and associated frequent burning
- Removal of standing dead trees containing nest hollows and hollow bearing live trees near lakes and wetlands
- Use of herbicides, insecticides and other chemicals near wetlands
- Potential impacts on water quality and habitat availability as a result of mining activities
- The introduction of exotic grasses such as *Echinochloa polystachya* and *Hymenachne anplexiaulis* for ponded pastures choking waterbodies
- Feral cats and foxes (OEH 2019).

4.13.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Cotton pygmy-goose (*Nettapus coromandelianus*) Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10557https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10113. In effect under the BC Act 2016

4.13.6 References

Atlas of Living Australia (2019) Nettapus (Cheniscus) coromandelianus. [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:03229bdf-31a4-4ada-aeb8-076e461fd602. [1 October 2019]

eBird Australia. (2015). Cotton pygmy-goose (Nettapus coromandelianu). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=a7da8bbf-042a-4b59-9e84-348579bc9786. [23 September 2019].

Office of Environment and Heritage, NSW (2019) Cotton pygmy-goose - profile. [online] Available from https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10557. [1 October 2019]

4.14 Diamond firetail (*Stagonopleura guttata*)

4.14.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.14.2 Biology and ecology

4.14.2.1 Characteristics

The Diamond firetail is a relatively large finch at 17g. The bills, eyes and rump are red (refer Photograph 4.14). The breast and throat are white and separated by a black breast band. Flanks are black with white spots. (OEH 2019).

Photograph 4.14 Diamond firetail (Stagonopleura guttata)

Source: Peters (2014)

4.14.2.2 Known distribution

The Diamond firetail occurs across southeastern Australia and is most common in the highland and western slopes, being absent from the far west and uncommon in coastal districts. In New South Wales the species is rarely observed west of the Darling River (OEH 2019) (refer Figure 4.14).

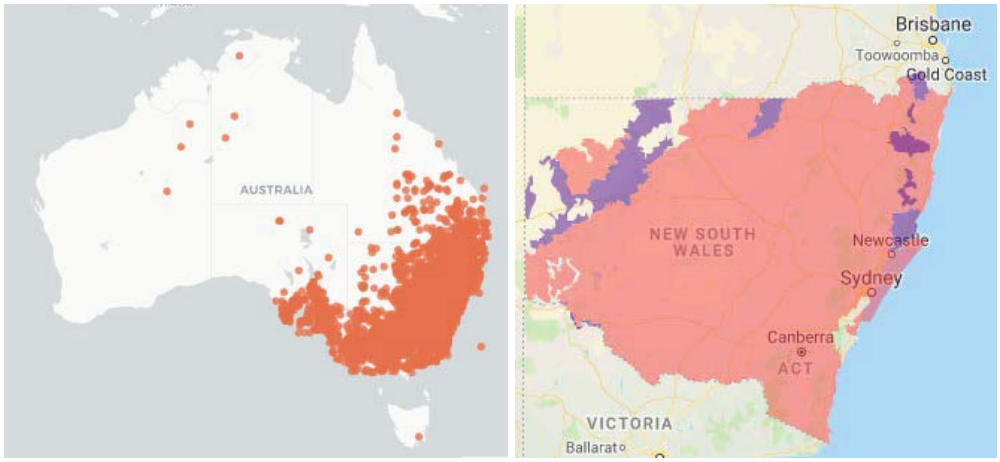


Figure 4.14 Distribution range of Diamond firetail

Source: ALA (2019)

4.14.2.3 Biology and reproduction

The Diamond firetail is primarily a granivore, but also preys on insects during the breeding season. The species forages on the ground in groups of up to 40 individuals. Roosting takes place in dense shrubs with or without small nests build specifically for nesting. Breeding occurs during August to January in small colonies. Nests are globular in shape and typically located in a dense shrub or alternatively below a raven or raptor nest (OEH 2019).

4.14.3 Habitat

Suitable habitat for the Diamond firetail included open forest, grassy woodland, mallee, grassland and derived grasslands. Box-gum woodlands and Snow gum woodlands are preferred habitats. In landscapes modified by agriculture, riparian zones provide habitat (OEH 2019).

4.14.4 Threatening processes

The following have been identified as potentially threatening processes to the Diamond firetail:

- Clearing and fragmentation of woodland, open forest, grassland and mallee habitat for agriculture and residential development, and firewood collection
- Poor regeneration of open forest and woodland habitats
- Invasion of weeds, resulting in the loss of important food plants
- Modification and destruction of ground- and shrub layers within habitat through: removal of native plants, litter and fallen timber; introduction of exotic pasture grasses; heavy grazing and compaction by stock; and frequent fire
- Predation of eggs and nestlings by increased populations of native predators such as the Pied currawong (*Strepera graculina*)
- Risk of local extinction due to small, isolated populations
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy miners (OEH 2019).

4.14.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Diamond firetail (*Stagonopleura guttata*) Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10768. In effect under the BC Act 2016

4.14.6 References

Atlas of Living Australia (2019). Stagonopleura (Stagonopleura) guttata: Diamond firetail. [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10768. [1 October 2019].

Peters, N. (2014). Diamond firetail (Stagonopleura guttata). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=d4505d35-89e7-495a-912a-71a7523ed29f. [23 September 2019].

Office of Environment and Heritage, NSW (2019) Diamond Firetail – profile [online]. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10768 [1 October 2019].

4.15 Dusky woodswallow (*Artamus cyanopterus cyanopterus*)

4.15.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.15.2 Biology and ecology

4.15.2.1 Characteristics

The Dusky woodswallow is a small-medium sized passerine with an average mass of 35 g. The species is chocolate brown tending to grey on the wings. The bill is blue with a black tip. The tail is black with white corners (refer Photograph 4.15) (OEH 2019).

Photograph 4.15 Dusky woodswallow *(Artamus cyanopterus cyanopterus)*

Source: Peters (2014)

4.15.2.2 Known distribution

The Dusky woodswallow is widespread across the east and south of the country, including Tasmania. The species occurs across most of New South Wales but is absent from the far north west (OEH 2019) (refer Figure 4.15).

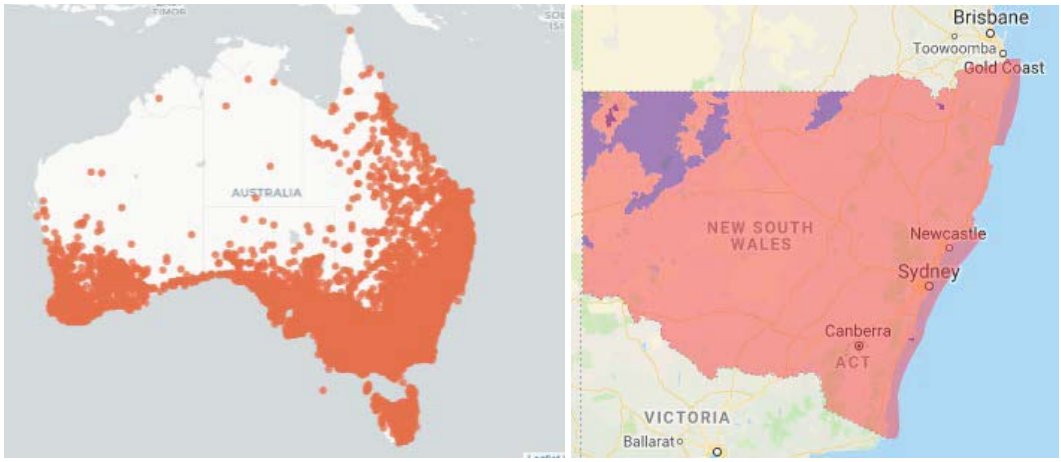


Figure 4.15 **Distribution range of Dusky woodswallow**

Source: ALA (2019)

4.15.2.3 Biology and reproduction

The Dusky woodswallow is primarily an aerial insectivore. Foraging occurs above the canopy, often at heights of several hundred metres, and also above water. The species also hovers over leaf litter and woody debris beneath the canopy during foraging. The species is partly migratory depending on geographic location. Following breeding, Dusky woodswallows in New South Wales migrate north to Queensland. Breeding as solitary pairs or small flocks occurs in spring and summer. The nest consists of an open cup-shape, positioned in a shrub or low tree, sometimes in hollows and fence posts (OEH 2019).

4.15.3 Habitat

The Dusky woodswallow inhabits open eucalypt forests and woodlands, including mallee. Suitable habitat is typically open with a sparse understory of eucalypt saplings, acacias and other shrubs, and a ground layer of grasses, sedges and woody debris. Other known habitats include heathlands, shrublands and sometimes rainforest. The species is also commonly recorded in farmland close to forest or woodland (OEH 2019).

4.15.4 Threatening processes

The following have been identified as potentially threatening processes to Dusky woodswallow:

- Historical and ongoing loss of woodlands and dry open sclerophyll forests, including mallee because of agriculture, mining, forestry and residential development
- Reduction in area, and increased isolation of patches of remnant woodlands and open forest
- Ongoing degradation of habitat through the loss of dead timber, removal of coarse woody debris and other disturbances of the ground layer
- Aggressive exclusion by over abundant noisy miners
- Reduction in the availability of food resources due to overgrazing and loss of leaf litter
- Lack of knowledge with the community regarding the species and its habitat requirements
- Habitat degradation from invasion by weeds including exotic grasses and woody weeds, and inappropriate land uses (OEH 2019).

4.15.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Dusky woodswallow (*Artamus cyanopterus cyanopterus*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=20303. In effect under the BC Act 2016.

4.15.6 References

Atlas of Living Australia (2019).

Department of the Environment and Energy (2019)

Peters, N. (2014). Dusky woodswallow (*Artamus cyanopterus cyanopterus*). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=518b054e-49de-4c36-8c01-cf3279a5059e. [23 September 2019].

Office of Environment and Heritage, NSW (2019).

4.16 Eastern grass owl (*Tyto longimembris*)

4.16.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.16.2 Biology and ecology

4.16.2.1 Characteristics

The Eastern grass owl is a ground-dwelling owl of medium size (35 cm) with the typical facial disc indicative of Tyto owls. The upper most part of the body is dark brown, buff and yellow-orange, accompanied by silvery spots. In males the underparts are white whilst females are buffy with sparse dark spots. Their legs are long extending well beyond the tail during flight and are mostly absent of feathers (refer Photograph 4.16). This also distinguishes them from the similar barn owl however their main call is similar for both species. When they roost, their posture is tall and upright (OEH 2019).

Photograph 4.16 Eastern grass owl *(Tyto longimembris)*

Source: eBird Australia (2015)

4.16.2.2 Known distribution

There are records of Eastern grass owls from each state across mainland Australia with most records in the northern and north-eastern part of the country. In New South Wales their distribution is most dense in the north-east of the state (refer Figure 4.16) (OEH 2019).

Figure 4.16 **Distribution range of Eastern grass owl**

Source: ALA (2019)

4.16.2.3 Biology and reproduction

Population numbers of Eastern grass owls fluctuate greatly depending on resource availability with rodent plagues resulting in an increase in numbers. Resting during the day on a trampled platform known as a 'form' in large tussock or other heavy vegetation growth. When disturbed they will fly at a short burst from their cover, flying low and slowly, dropping into vegetation cover nearby. This species will always nest on the ground with nests consisting of trodden grass, which can be accessed by tunnels in vegetation. Environmental conditions heavily influence the breeding season, which is highly variable with nesting in New South Wales occurring during autumn and winter (OEH 2019). Females will lay between three to eight eggs which are dull white in colour and tapered oval shaped. The incubation period lasts for 35 to 40 days (Morcombe 2010).

4.16.3 Habitat

Eastern grass owls are associated with swampy areas, grassy plains, swampy heath and cane grass or sedges on floodplains. They have a preference for areas of tall grass including tussock grass. They are associated with the following habitat types in New South Wales:

- Brigalow Belt South
- Darling Riverine Plains
- Ocean
- South Eastern Queensland
- Sydney Basin (OEH 2019).

4.16.4 Threatening processes

The following have been identified as potentially threatening processes to Eastern grass owl (*Tyto longimembris*):

- Habitat destruction and degradation by grazing cattle and agriculture
- Control and baiting of rodents limiting seasonal food supply and potentially reducing breeding success and poisoning owls

- Frequent fires reducing ground cover this species depends on for nesting and roosting
- Lack of knowledge of the ecology of the species
- Cumulative effects of habitat destruction and introduced species abundance (OEH 2019).

4.16.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Eastern grass owl (*Tyto longimembris*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10819. In effect under the BC Act 2016.

4.16.6 References

Atlas of Living Australia (2019). Eastern grass owl (*Tyto longimembris*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:12d6e000-f7c5-457b-b8dd-9e0d57c2aa25#overview. [2 October 2019].

eBird Australia. (2015). Eastern grass owl (Tyto longimembris). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=42893e99-a833-46e5-be7c-7dc225f85f94. [23 September 2019].

Morcombe, M. 2010. Aus. Birds, App.

Office of Environment and Heritage, NSW (2019). Eastern grass owl (Tyto longimembris). [online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10819. [2 October 2019].

4.17 Flame robin (*Petroica phoenicea*)

4.17.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.17.2 Biology and ecology

4.17.2.1 Characteristics

The Flame robin is a small bird reaching 14 cm in length. The striking colouration of males includes a bright orange-red throat, breast and upper-belly, dark grey head and upperparts, a small white patch on the forehead and white striped on the wings and edges of the tail. The rump is white (refer Photograph 4.17). Females of this species are brown, darker above with a whitish throat, belly and rump. The white mark on the forehead is less conspicuous and have white-buffish marks on the wings and tail. Young males tend to resemble the females of the species (OEH 2019).

Photograph 4.17 Flame robin *(Petroica phoenicea)*

Source: Hayson (2014)

4.17.2.2 Known distribution

Flame robins are endemic to south eastern Australia and are distributed from the Queensland border in the east to south eastern South Australia. They also occur in Tasmania (refer Figure 4.17). In New South Wales the Flame robin inhabits upland areas during the breeding season and the inland slopes and plains. It is thought that there are two separate populations in the state occurring at the Northern Tablelands and the Central to Southern Tablelands (OEH 2019).

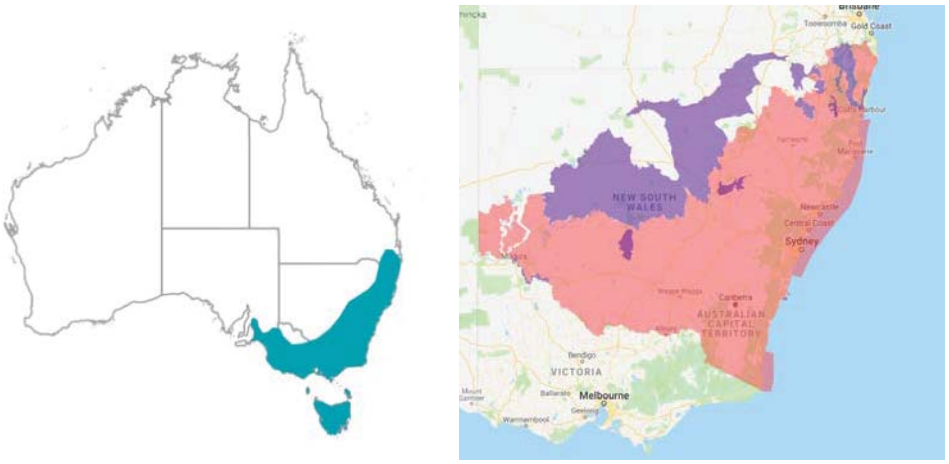


Figure 4.17 Distribution range of Flame robin

Source: ALA (2019), OEH 92019)

4.17.2.3 Biology and reproduction

Flame robins will forage from a low perch where they will search for invertebrate prey on the ground, amongst woody debris and off tree trunks. They will also take insects during flight and glean foliage in search of prey. In open habitat they will utilise fence posts, thistles and other prominent perches to hunt from. They occur singularly, in pairs and sometimes in flocks with up to 40 individuals. Outside of breeding season they will join mixed feeding flocks. Flame robins breed from spring to late summer building nests in sheltered sites close to the ground in shallow cavities in trees, stumps or banks. Nests are in the shape of an open cup consisting of spider webs and plant material (OEH 2019).

4.17.3 Habitat

Flame robin breeding habitat consists of moisty eucalypt forest and woodland in upland regions, particularly on ridges and slopes. They prefer areas with clearings or with an open understorey. Breeding habitat consists of a ground layer that is dominated by native grass layer with a shrub layer that is either sparse or dense. The sometimes occur in temperate rainforest and at higher altitudes can be found in herbfields, heathlands, shrublands and sedgelands. During winter the species will utilise drier more open habitats associated with lowlands and valleys below the ranges and to the western slopes and plains. They will occupy areas that have undergone recent burns however these areas become unsuitable once the vegetation structure begins to close during regeneration (OEH 2019).

4.17.4 Threatening processes

The following have been identified as potentially threatening processes to Flame robin:

- Breeding and wintering sites being impacted by clearing and habitat degradation
- Loss of micro habitat essential for nesting as a result of 'tidying up' of rough pasture and grazing land
- An over-abundance of Pied currawongs (*Strepera gracculina*) resulting in increased predation, particularly during breeding season
- Dense regeneration after fire resulting in habitat becoming unsuitable for the species
- Competitive exclusion from an over-abundance of Noisy miners (*Manorina melanocephala*) within habitat range
- Patches of habitat becoming more isolated or fragmented as a result of clearing and agricultural land use
- Exotic grasses and other exotic weeds changing vegetation composition resulting in a loss of native ground cover, canopy cover, shrub cover, logs, fallen branches and leaf litter (OEH 2019).

4.17.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Yellow-bellied Sheathtail-bat (Saccolaimus flaviventris). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=20129In effect under the BC Act 2016.

4.17.6 References

Atlas of Living Australia (2019). Flame robin (Petroica phoenicea). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:9fa9eadf-5d8f-4f79-9ee3-44191be8330c. [2 October 2019].

Hayson, A. (2014). Flame robin (Petroica phoenicea). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=e01010c5-f3a2-46a1-a311-178cfadfa66e. [23 September 2019].

Office of Environment and Heritage, NSW (2019). Flame robin (Petroica phoenicea). [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20129. [2 October 2019].

4.18 Freckled duck (Stictonetta naevosa)

4.18.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.18.2 Biology and ecology

4.18.2.1 Characteristics

The Freckled duck is dark brown with white to buff freckles (refer Photograph 4.18). The bill is narrow and slightly up-turned. During the breeding season, the base of the bill of male Freckled ducks becomes crimson red. The rear of the head is peaked (OEH 2019).

Photograph 4.18 Freckled duck *(Stictonetta naevosa)*

Source: Leo (2016)

4.18.2.2 Known distribution

The Freckled duck occur in southeastern and southwestern Australia. In New South Wales the species is most common in the Murray-Darling basin system, particularly the Riverina and Bulloo basins (OEH 2019) (refer Figure 4.18). During dry conditions inland, the species disperses to coastal wetlands.

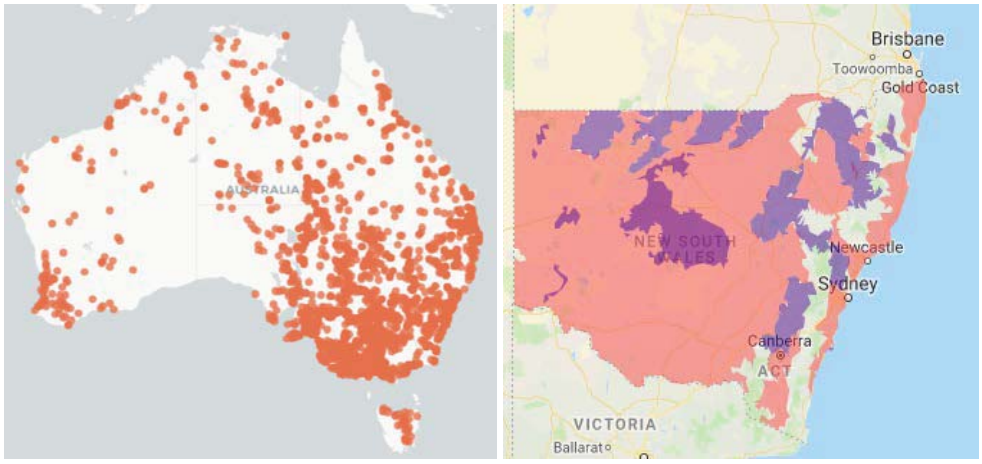


Figure 4.18 Distribution range of Freckled duck

Source: ALA (2019)

4.18.2.3 Biology and reproduction

The Freckled duck inhabits freshwater swamps, where it rests during the day amongst dense aquatic vegetation. During daw, dusk and night the species forages on algae, seeds, vegetative parts of aquatic grasses, sedges and small invertebrates. Breeding occurs between October and December, or when conditions are favourable. Nests are built in dense vegetation at water level. Breeding typically occurs in ephemeral freshwater swamps with dense vegetation (OEH 2019).

4.18.3 Habitat

Suitable habitat for the Freckled duck includes ephemeral and permanent freshwater wetlands and small waterways with dense vegetation such as Cumbungi, Lignum or Tea-tree. Ephemeral wetlands are preferred for breeding. During drought in the Murray-Darling the species disperses to deeper permanent lakes on the coast and is also utilises artificial impoundments, including reservoirs, dams and sewage ponds (OEH 2019).

4.18.4 Threatening processes

The following have been identified as potentially threatening processes to Freckled duck:

- Draining and clearing of wetland and swamp habitat
- Changes to natural river flows and flood patterns as a result of dams, weirs and irrigation
- Grazing and trampling of wetland habitat by grazing stock or vertebrate pests
- Illegal shooting
- Lack of knowledge about the distribution of breeding activity
- Too frequent or intense burning reduces habitat quality (OEH 2019).

4.18.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Freckled duck (*Stictonetta naevosa*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10771. [2 October 2019] In effect under the BC Act 2016.

4.18.6 References

Atlas of Living Australia (2019) Stictonetta naevosa: Freckled duck [online]. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:cca72699-7f7e-4bdc-a915-8f39a20e9145 [2 October 2019].

Leo. (2016). Freckled duck (Stictonetta naevosa). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=53570098-6af5-402a-87a9-12a6f51966d8. [23 September 2019].

Office of Environment and Heritage, NSW (2019) Freckled duck – profile [online]. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10771 [2 October 2019].

4.19 Flock bronzewing (*Phaps histronica*)

4.19.1 Status

EPBC Act – Not listed

BC Act – Endangered

4.19.2 Biology and ecology

4.19.2.1 Characteristics

The Flock pigeon is relatively large pigeon (refer Photograph 4.19). Plumage is sandy colour. Males have a black head with a white forehead. Females have a brown head (OEH 2019).

Photograph 4.19 Flock pigeon

Source: Dunis (2017)

4.19.2.2 Known distribution

The Flock pigeon is distributed from arid central Australia to the north west coast (refer Figure 4.19). The species occurs in a patchy distribution across the north west of New South Wales (OEH 2019).

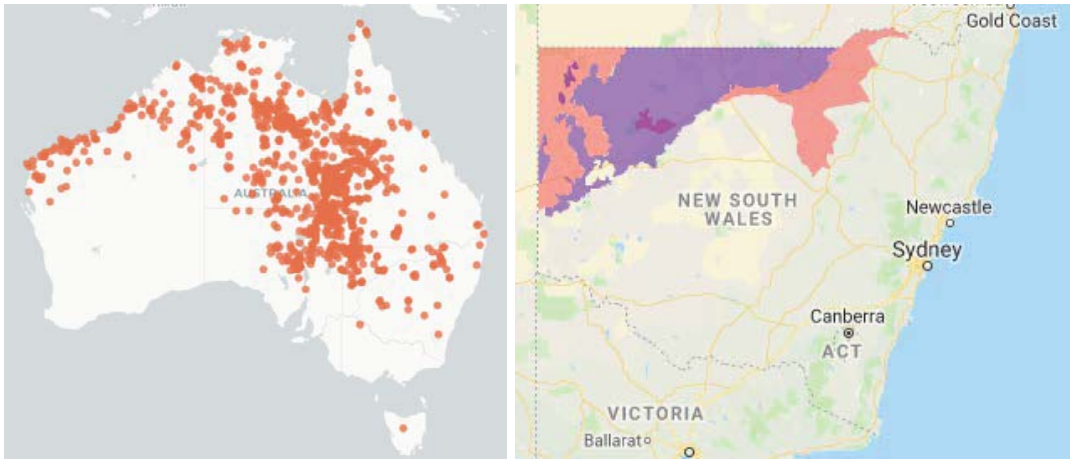


Figure 4.19 Distribution range of Flock pigeon

Source: ALA (2019)

4.19.2.3 Biology and reproduction

The Flock pigeon is a granivore, feeding on the seeds of grasses and herbaceous plants. The species is required to drink daily and is therefore dependent on available water. The species forages on the ground in large flocks, which historically numbered up to 100,000 (OEH 2019).

4.19.3 Habitat

The Flock pigeon occurs in open habitat including grasslands, saltbush, spinifex and open mulga. Preferred habitat is tussock grasslands, particularly Mitchell grassland (OEH 2019).

4.19.4 Threatening processes

The following have been identified as potentially threatening processes to Flock pigeon:

- Grazing, by sheep in particular, removes the grass bulk which provides habitat (cover) and potential food sources. It also allows herbaceous prickly weeds to dominate. Trampling of nests by stock when the species is nesting near watering points can be a problem
- Cultivation removes tussock grasses thus destroying any potential habitat of this species
- Predation by cats and foxes is likely at all times, particularly when nesting (OEH 2019).

4.19.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save the Flock Bronzewing. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=737&ReportProfileID=10612 [4 October 2019]. In effect under the BC Act 2016.

4.19.6 References

Atlas of Living Australia (2019) Phaps (Histriophaps) histronica: Flock Bronzewing [online]. Available at: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:6a686033-0629-4fa6-ac84-5e3f7cd2c2b9 [4 October].

Dunis, V. (2017). Flock bronzewing (Phaps histronica). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=8de53662-4efb-4d34-9a4a-cf40635a7590. [23 September 2019].

Office of Environment and Heritage, NSW (2019) Flock Bronzewing – profile [online]. Available at: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10612 [4 October].

4.20 Glossy black-cockatoo (*Calyptorhynchus lathami*)

4.20.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.20.2 Biology and ecology

4.20.2.1 Characteristics

The Glossy black-cockatoo is a small black cockatoo species that has a massive, rounded bill and short crest. The tail panel on males is red whilst the females is yellow and orange-red. In juveniles the tail panel is barred black, a feature which changes with the birds ages gradually decreasing. Females will have pale-yellow marking on the head and neck that are rather irregular along with the underside of the wing. The will feed inconspicuously on Sheoaks in pairs or small groups (refer Photograph 4.20) (OEH 2019).

Photograph 4.20 Glossy black-cockatoo *(Calyptorhynchus lathami)*

Source: McGrath (2018)

4.20.2.2 Known distribution

Glossy black-cockatoos are an uncommon species, however where suitable habitat occurs they are widespread from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of New South Wales. A small population also occurs in Riverina and an isolated population on Kangaroo Island off South Australia (refer Figure 4.20) (OEH 2019).

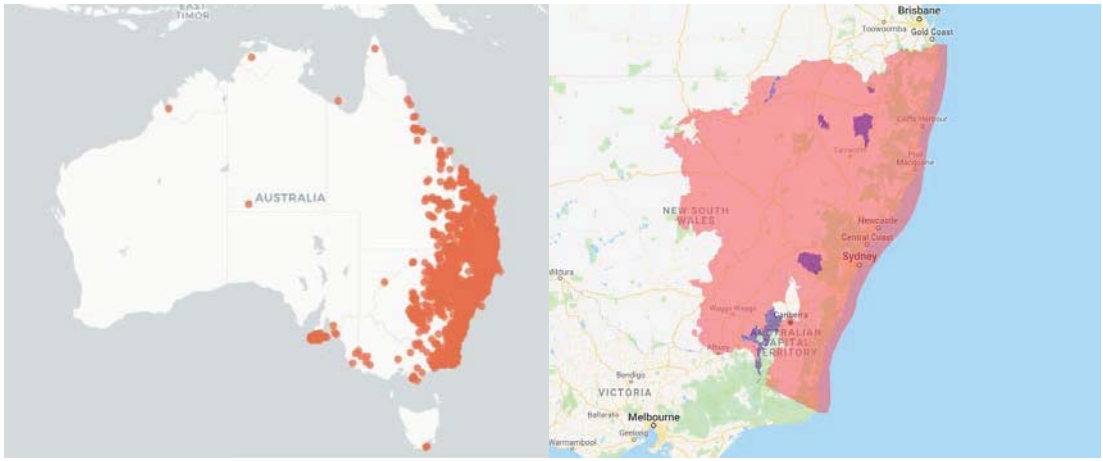


Figure 4.20 Distribution range of Glossy black-cockatoo

Source: ALA (2019), OEH (2019)

4.20.2.3 Biology and reproduction

Glossy black-cockatoos are obligate feeders on Sheoaks making them a critical food source for the species. They shred the cones using their big bill to feed on the seeds. They depend on large hollows in trees for breeding with a single egg being laid in March and May (OEH 2019).

4.20.3 Habitat

Glossy black-cockatoos occupy open forest and woodlands of the coast and the Great Dividing Range where there are stands of sheoak present. Black sheoak (*Allocasuarina littoralis*) and Forest sheoak (*A. torulosa*) are critical food trees for the species (OEH 2019).

4.20.4 Threatening processes

The following have been identified as potentially threatening processes to Glossy black-cockatoos:

- Habitat loss from clearing for development
- Land management activities reducing the availability of hollow bearing trees
- Decline of sheoak foraging habitat from land clearing and feral herbivores
- Limited information regarding sites important to the breeding habits of this species
- Reduced access to surface water near foraging and nesting sites
- Coal seam gas and open cut coal mining causing loss of foraging and breeding sites along with disruptions to breeding attempts
- Altered reproductive success of sheoaks due to water stress and climate change
- Illegal bird smuggling and egg collecting
- Invasive flora altering natural habitat (OEH 2019).

4.20.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Glossy black-cockatoo (Calyptorhynchus lathami). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10140. In effect under the BC Act 2016.

4.20.6 References

Atlas of Living Australia (2019). Glossy black-cockatoo (*Calyptorhynchus lathami*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:db6c2bba-e721-407d-bb54-7e5b0ade3376. [3 October 2019].

McGrath, F. (2018). Glossy black-cockatoo (Calyptorhynchus lathami). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=d8f30702-b765-440e-b1b4-908bb7806cab. [23 September 2019].

Office of Environment and Heritage, NSW (2019). Glossy black-cockatoo (Calyptorhynchus lathami). [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10140. [3 October 2019].

4.21 Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)

4.21.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.21.2 Biology and ecology

4.21.2.1 Characteristics

The Grey-crowned babbler is a medium sized passerine with a length of 30 cm. The species is grey-brown with a grey crown and a white throat and breast, separated by a dark eye band. The bill is long and curved downwards (refer Photograph 4.21) (OEH 2019).

Photograph 4.21 **Grey-crowned babbler (eastern subspecies) *(Pomatostomus temporalis temporalis)***

Source: Dew (2017)

4.21.2.2 Known distribution

The Grey-crowned babbler occurs through Victoria, New South Wales and Queensland including coastal areas and the Murray-Darling basin. Within New South Wales the species inhabit the western slopes of the Great Dividing Range and the western plains. Coastal populations also occur in the northern rivers region and the Hunter region (refer Figure 4.21). The species appears to be absent from the southern highlands and the far north west of the state (OEH 2019).

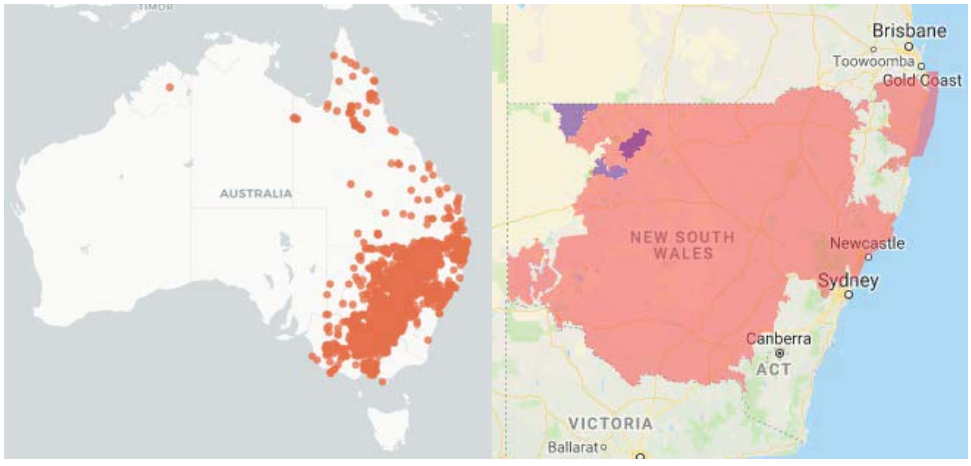


Figure 4.21 **Distribution range of Grey-crowned babbler**

Source: ALA (2019)

4.21.2.3 Biology and reproduction

The Grey-crowned babbler forages at ground level or in the shrub layer in family groups of up to 15 individuals. The species is insectivorous, using its long bill to probe the soil and loose bark. Dome-shaped roosting nests are used for shelter at night time, with the entire family group roosting together during non-breeding. Breeding occurs during July to February, when two to three eggs are laid. The dominant female broods the eggs and is fed by the dominant male and family helpers. Fledglings are defended and fed by all members of the group (OEH 2019).

4.21.3 Habitat

The Grey-crowned babbler inhabits woodlands. Preferred woodland types include open Box-Gum woodlands on the slopes, Box-Cypress-pine and open Box woodlands on alluvial plains. The species also occurs in Brigalow woodlands, and partially cleared farmland adjacent to woodland (OEH 2019). Coastal woodlands on fertile soils also provide suitable habitat.

4.21.4 Threatening processes

The following have been identified as potentially threatening processes to Grey-crowned babbler:

- Loss, degradation and fragmentation of woodland habitat on high fertility soils
- Excessive total grazing pressure and loss of coarse woody debris is resulting in degradation and loss of important habitat components
- Infestation of habitat by invasive weeds including exotic perennial grasses. These weeds are very aggressive and form dense grass swards covering inner-tussock spaces preventing access to leaf and stick litter were babblers commonly forage for invertebrates
- Inappropriate fire regimes – excessive fires lead to loss of tree and shrub regeneration and absence of fire may lead to the grass sward being too dense and therefore unsuitable for foraging babblers
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy miners
- Climate change impacts including reduction in resources due to drought
- Nest predation by species such as ravens and butcherbirds may be an issue in some region where populations are small and fragmented (OEH 2019).

4.21.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Grey-crowned Babbler (eastern subspecies) (Pomatostomus temporalis temporalis) [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10660. In effect under the BC Act 2016.

4.21.6 References

Atlas of Living Australia (2019) Pomatostomus (Pomatostomus) temporalis temporalis: Grey-Crowned Babbler [online]. Available at: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:abc0cd69-503a-44f2-aa52-3a69805c598f [2 October 2019].

Dew, S. (2017). Grey-crowned babbler (eastern subspecies) (Pomatostomus temporalis temporalis). [image] [online] Available from: https://images.ala.org.au/image/8df56d18-a950-4725-9f5c-ba7df6cf354e. [23 September 2019].

Office of Environment and Heritage, NSW (2019) Grey-crowned Babbler (eastern subspecies) - profile.

4.22 Grey falcon (*Falco hypoleucos*)

4.22.1 Status

EPBC Act – Not listed

BC Act – Endangered

4.22.2 Biology and ecology

4.22.2.1 Characteristics

Grey Falcons are a medium sized bird of prey that is pale in colour with a heavy, thick-set, deep chest appearance. It shares many similarities with the Peregrine falcon in shape and flight but has slightly longer wings. The upper most part of the body is uniformly light grey, shading to blackish on the primaries to form conspicuous dark wing tips (refer Photograph 4.22). Narrow blackish bars flash across the tail. The chin, throat and cheeks are white, whilst the remainder of the underside of the body is pale grey. The eye-ring, cere and base of the bill are bright orange and yellow, with the tip of the bill being black (OEH 2019).

Photograph 4.22 **Grey falcon *(Falco hypoleucos)***

Source: Nicholas (2018)

4.22.2.2 Known distribution

In New South Wales Grey falcons are sparsely distributed predominantly through the Murray-Darling Basin. The also occasionally occur in the state east of the Great Dividing Range. Historically the species was much broader than previously as it is now confined to the arid parts of the range. It is estimated that there are less than 5,000 individuals remaining (refer Figure 4.22) (OEH 2019).

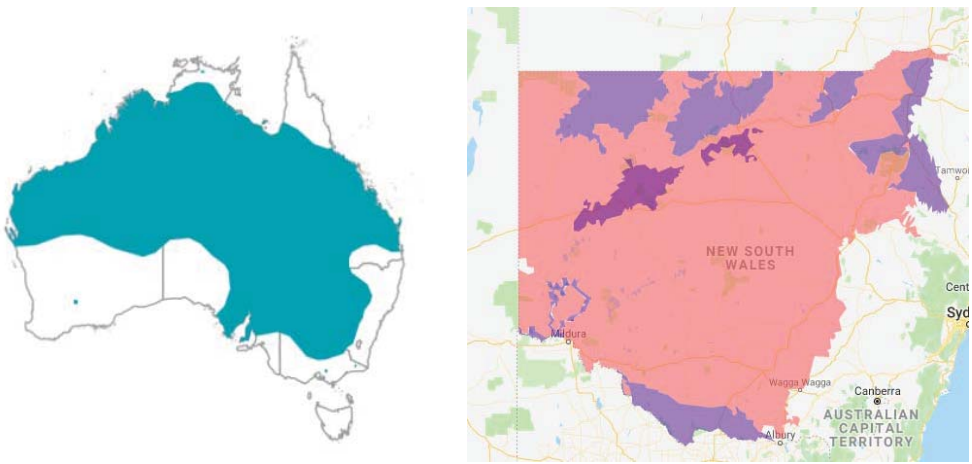


Figure 4.22 **Distribution range of Grey falcon**

Source: ALA (2019), OEH (2019)

4.22.2.3 Biology and reproduction

The majority of a Grey falcon's diet consists of bird species, particularly parrots and pigeons. Their high speed and manoeuvrability gives them the ability to chase and swoop aerial prey. They will also feed on reptiles and mammals given the opportunity. Similar to other falcons in their breeding behaviours they will readily occupy the old nests of other raptors and ravens preferring nests that are high in a living eucalyptus near water or a watercourse. The height of the laying season occurs between late winter and early spring. Typically the female will lay two or three eggs (OEH 2019).

4.22.3 Habitat

Grey falcons are mostly restricted to shrubland, grassland and wooded watercourses of arid and semi-arid locations, however they are sometimes associated with open woodlands coastal regions of their range. They have been known to inhabit wetland areas due to the availability of prey that is attracted by surface waters (OEH 2019).

4.22.4 Threatening processes

The following have been identified as potentially threatening processes to Grey falcon (*Falco hypoleucos*):

- The greatest cause of their decline is habitat loss as a result of grazing and clearing in the arid and semi-arid zones of their distribution
- Chemical control programs for mice and locusts can cause secondary poisoning
- Eggs or young that are taken for falconry and captivity has had an impact on the species
- A lack of knowledge on their distribution and ecology (OEH 2019)

4.22.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Grey falcon (*Falco hypoleucos)*. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10330. In effect under the BC Act 2016.

4.22.6 References

Atlas of Living Australia (2019). Grey falcon (Falco hypoleucos). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:5c4c5947-83a6-4a42-b861-8c408cfed4e7. [2 October 2019]. [17 September 2019].

Nicholas, K. (2018). Grey falcon (Falco hypoleucos). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=569ffdf5-5560-454d-9dd0-f1d9e40a3c04. [17 September 2019].

Office of Environment and Heritage, NSW (2019). Grey falcon (Falco hypoleucos). [online] Available from: https://images.ala.org.au/image/details?imageId=569ffdf5-5560-454d-9dd0-f1d9e40a3c04. [2 October 2019]. [17 September 2019].

4.23 Hooded robin (south—eastern form) (*Melanodryas cucullata cucullata*)

4.23.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.23.2 Biology and ecology

4.23.2.1 Characteristics

The Hooded robin is one of Australia's larger species of robins measuring 17 cm in length. Males of this species have striking black and white markings with a bold black hood that stands out against the white breast. The black back in flanked with bold white shoulder and wing bars (refer Photograph 4.23). Females and immature males are much less intense showing light brownish grey on their upperparts, however the wings share the same black and white markings. These robins are distinguished by their larger size and distinctive white wing bars and different shaped tail markings (OEH 2019).

Photograph 4.23 Hooded robin (south—eastern form) *(Melanodryas cucullata cucullata*

Source: Dew (2017)

4.23.2.2 Known distribution

The Hooded robin is widespread across Australia; although the south-eastern form is mostly restricted to the south east of South Australia, across Victoria and to the north of New South Wales. It is mostly absent from the wet coastal regions and drier deserts of its distribution (refer Figure 4.23) (OEH 2019).

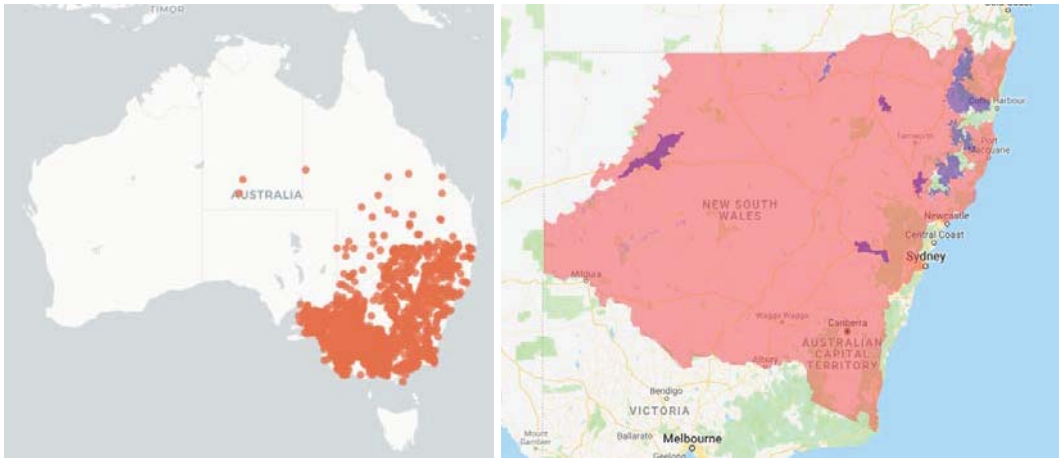


Figure 4.23 **Distribution range of Hooded robin (south—eastern form)**

Source: ALA (2019), OEH (2019)

4.23.2.3 Biology and reproduction

Hooded robins, like other robins use a perch and pounce method to catch their prey. Perching on a low dead stump, fallen timber or low hanging branch they will pounce on their insect prey. Home range sizes depend on whether the species is breeding or not, 10 ha during breeding and 30 ha outside of breeding season. Hooded robins breed at any time during winter and spring and are capable of rearing several broods. The cup shaped nests are small consisting of bark and grass that has been bound by spiderweb. Nests are usually found in the fork of a tree from around 1 to 5 m above the ground. Both sexes will defend the nest displaying behaviour consistent with an injury tumbling across the ground to draw potential predators away from the nest. Females will lay two or three eggs with an incubation period of 14 days. Females off this species sometimes demonstrate cooperative brooding (OEH 2019).

4.23.3 Habitat

The Hooded robin prefers open woodland habitat consisting of eucalypt species, acacia scrub and mallee usually with clearings or open areas. This species requires structural diversity of micro habitat consisting of mature eucalypts, saplings, small shrubs and somewhat tall native grasses (OEH 2019).

4.23.4 Threatening processes

The following have been identified as potentially threatening processes to Hooded robins:

- Land clearing impacting habitat quality and fragmenting existing habitat in woodlands
- Heavy grazing from stock, trampling, removal of litter and timber simplifying habitat structure reducing availability of microhabitat
- An over abundance of Noisy miners in woodland habitat resulting in exclusion of Hooded robins
- Drought stressing resource availability
- Forestry activities causing disturbance and changes to vegetation communities where the species occurs (OEH 2019).

4.23.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Hooded robin (south—eastern form) (Melanodryas cucullata cucullata). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10519. In effect under the BC Act 2016.

4.23.6 References

Atlas of Living Australia (2019). Hooded robin (south—eastern form) (Melanodryas cucullata cucullata). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:bfde5e0f-82f9-4090-bd0e-1b1600f428f2#overview. [3 October 2019].

Dew, S. (2017). Hooded robin (south—eastern form) (Melanodryas cucullata cucullata). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=d48d2325-d602-4b53-a4ff-754bf264a5c6. [23 September 2019].

Office of Environment and Heritage, NSW (2019). Hooded robin (south—eastern form) (Melanodryas cucullata cucullata). [online] Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10519. [3 October 2019].

4.24 Little eagle (Hieraaetus morphnoides)

4.24.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.24.2 Biology and ecology

4.24.2.1 Characteristics

The Little eagle is a small raptor that occurs in two colour forms: either pale brown with vague underwing markings otherwise dark brown across the upper parts of the body and pale below, with a rusty head and a distinctive rufous patterning under the wing that extends to the wing edge. The underside of the wing shows a pale 'M' marking whilst in flight with the wings tipped with black (refer Photograph 4.24). Both colour morphs have a black-streaked head with a slight crest, a band across the upper shoulder that is pale in colour, the tail is square shaped and their legs are feathered (OEH 2019).

Photograph 4.24 Little eagle *(Hieraaetus morphnoides)*

Source: Burrows (2018)

4.24.2.2 Known distribution

The Little eagle is distributed across much of mainland Australia including the most densely forested parts of the Great Diving Range escarpment (refer Figure 4.24). In New South Wales it occurs as a single population (OEH 2019).

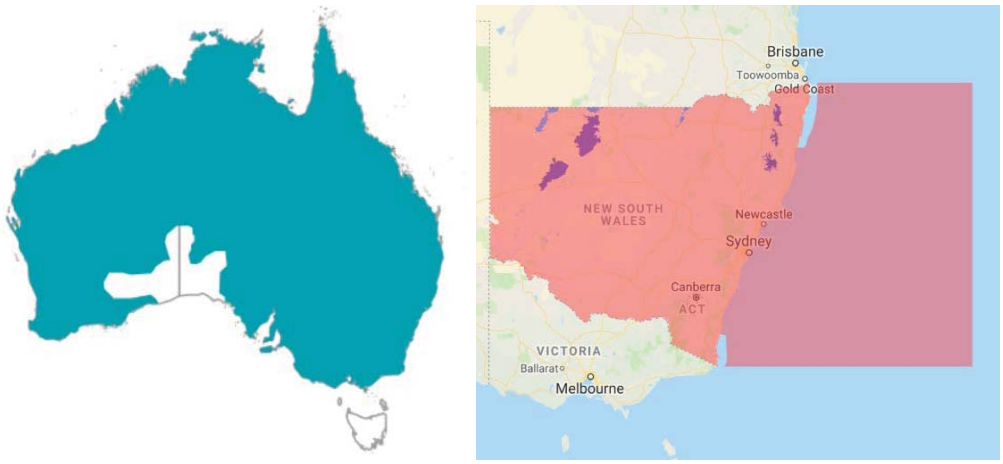


Figure 4.24 **Distribution range of the Little eagle**

Source: ALA (2019), OEH (2019)

4.24.2.3 Biology and reproduction

Little eagles nest in tall living trees within remnant forest patches where pairs will build large stick nests during the winter months. The female will lay two or three eggs during spring and the young will fledge in early summer. Prey items predominantly include birds, reptiles and mammals however they will also scavenge on carrion and take large insects (OEH 2019).

4.24.3 Habitat

Little eagles will utilise eucalypt forest, woodlands or open woodlands consisting of She-oak and *Acacia* along with riparian woodlands along interior New South Wales rivers. Regional habitats in New South Wales for this species includes the following:

- Australian Alps
- Brigalow Belt South
- Broken Hill Complex
- Channel Country
- Bobar Peneplain
- Darling Riverine Plains
- Mulga Lands
- Murray Darling Depression
- Nandewar
- New England Tablelands
- New South Wales North Coast
- New South Wales South Western Slopes
- Ocean
- Riverina
- Simpson Strzelecki Dunefields

- South East Corner
- South Eastern Highlands
- South Eastern Queensland
- Sydney Basin (OEH 2019).

4.24.4 Threatening processes

The following have been identified as potentially threatening processes to Little eagles:

- Secondary poisoning from feral baiting programs
- Degradation and clearing of foraging and breeding habitat (OEH 2019).

4.24.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Little eagle (*Hieraaetus morphnoides*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=20131. In effect under the BC Act 2016.

4.24.6 References

Atlas of Living Australia (2019). Little eagle (Hieraaetus morphnoides). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:e3a02fd4-abea-49d9-82d5-98208455ecd3. [3 October 2019].

Burrows, S. (2018). Little eagle (Hieraaetus morphnoides). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=1c4687b5-de72-455b-9829-5be9fa83555c. [23 September 2019].

Office of Environment and Heritage, NSW (2019). Little eagle (Hieraaetus morphnoides). [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20131. [3 October 2019].

4.25 Little lorikeet (*Glossopsitta pusilla*)

4.25.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.25.2 Biology and ecology

4.25.2.1 Characteristics

The Little lorikeet is a relatively small parrot with bright green plumage and a red face (refer Photograph 4.25). The underparts are pale olive-yellow, and the mantle is brown. The bill is black (OEH 2019).

Photograph 4.25 Little lorikeet *(Glossopsitta pusilla)*

Source: Fordyce (2017)

4.25.2.2 Known distribution

The Little lorikeet occurs across the east coast of Australia and the Great Dividing Range, from Victoria to north Queensland. The species also occurs on the east coast of Tasmania. The species is absent from the western plains of New South Wales (OEH 2019) (refer Figure 4.25).

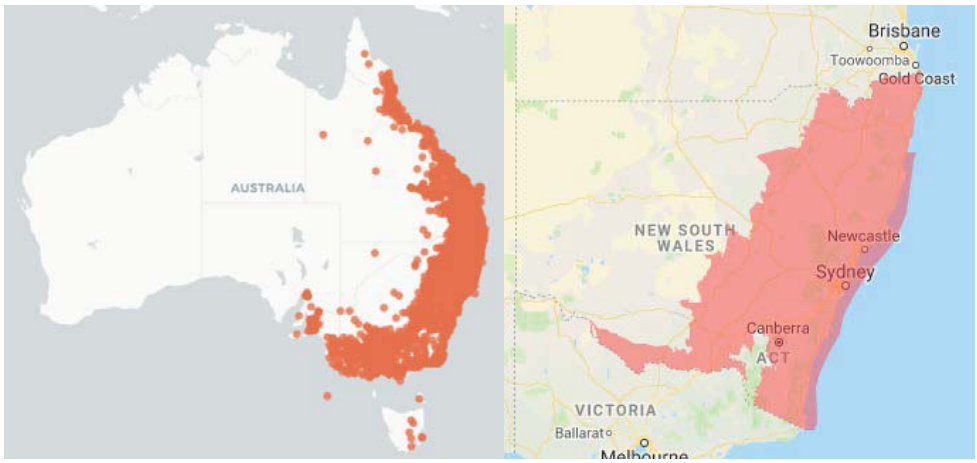


Figure 4.25 Distribution range of Little lorikeet

Source: ALA (2019)

4.25.2.3 Biology and reproduction

The Little lorikeet is primarily a nectarivore, foraging for nectar and pollen in the canopy of *Eucalyptus* trees. Some fruits such as mistletoe are also taken. The species is a gregarious forager, feeding in groups up to 10 individuals, often with other species of lorikeets. Roosting occurs in a dense canopy trees. Breeding occurs in May to September, with three to four eggs laid when nectar is highly abundant. Nests are located in the hollows of smooth-barked eucalypt trees, with a small entrance (3 cm) and at a height of 2 to 15 m, often in close vicinity to foraging areas. The species exhibits strong nest site fidelity (OEH 2019).

4.25.3 Habitat

The Little lorikeet inhabits *Eucalyptus*, *Angophora* and *Melaleuca* forest and woodland. Preferred habitat includes forests and woodlands with higher soil fertility, such as riparian forests, with greater nectar productivity (OEH 2019).

4.25.4 Threatening processes

The following have been identified as potentially threatening processes to Little lorikeet:

- Given that large old *Eucalyptus* trees on fertile soils produce more nectar, the extensive clearing of woodlands for agriculture has significantly decreased food for the lorikeet, thus reducing survival and reproduction. Small scale clearing, such as during roadworks and fence construction, continues to destroy habitat and it will be decades before revegetated areas supply adequate forage sites
- The loss of old hollow bearing trees has reduced nest sites, and increased competition with other native and exotic species that need large hollows with small entrances to avoid predation. Felling of hollow trees for firewood collection or other human demands increases this competition
- Competition with the introduced Honeybee for both nectar and hollows exacerbates these resource limitations
- Infestations of habitat by invasive weeds
- Inappropriate fire regimes
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy miners
- Climate change impacts including reduction in resources due to drought
- Degradation of woodland habitat and vegetation structure due to overgrazing (OEH 2019).

4.25.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save the Little Lorikeet *Glossopsitta pusilla* [online. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=929&ReportProfileID=20111 [2 October 2019]. In effect under the BC Act 2016.

4.25.6 References

Atlas of Living Australia (2019) Parvipsitta pusilla: Little Lorikeet [online]. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:7613c3e0-edf7-4326-98fe-d6c342bcdb88 [2 October 2019].

Fordyce, N. (2017). Little lorikeet (Glossopsitta pusilla). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=c048b941-a49b-4344-8b1a-bab1864d5e72 [23 September 2019].

Office of Environment and Heritage, NSW (2019) Little lorikeet – profile [online]. Available at: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20111 [2 October 2019].

4.26 Magpie goose (*Anseranas semipalmata*)

4.26.1 Status

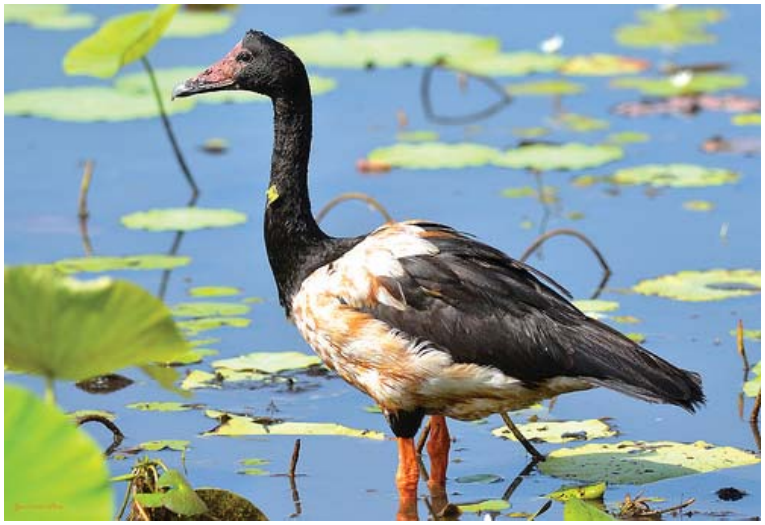
EPBC Act – Not listed

BC Act – Vulnerable

4.26.2 Biology and ecology

4.26.2.1 Characteristics

The Magpie goose is a large bodied, distinctively black and white water bird (70 to 90 cm) with a large knobbed head and orange legs (refer Photograph 4.26). The rear of the body is black on the upper side along with the upper chest, neck and head. The body and wings are white with immature birds displaying grey or brown. Whilst neither a duck or a goose they are regarded as a primitive relative (OEH 2019).



Photograph 4.26 Magpie goose *(Anseranas semipalmata)*

Source: eBird Australia (2015)

4.26.2.2 Known distribution

The Magpie goose occurs throughout the norther tropics where it is most commonly encountered. Historically its range extended into south-east Australia however has seen a sharp decline in the region since the 1920's due to reed swaps, their breeding habitat, being drained and overgrazed by livestock. In central and northern New South Wales there has been a slight increase in sightings since the 1980's. Vagrants follow food sources to south-eastern New South Wales (refer Figure 4.26) (OEH 2019).

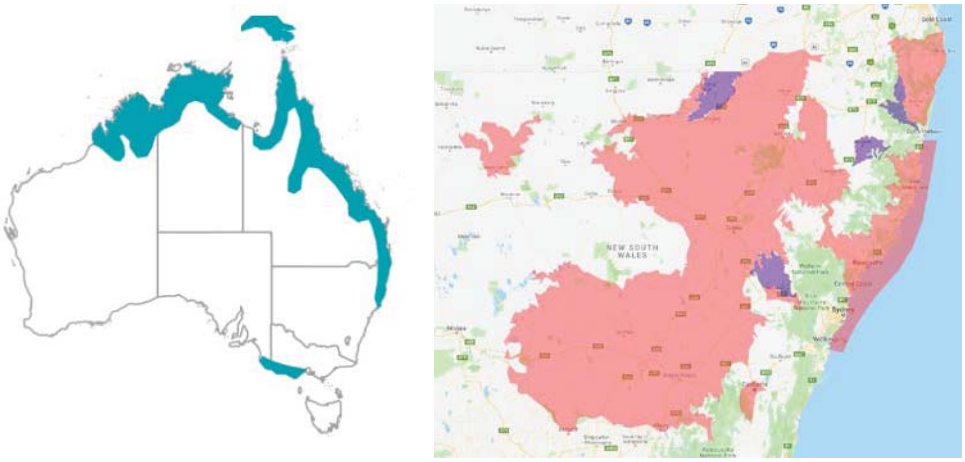


Figure 4.26 **Distribution range of Magpie goose**

Source: ALA (2019), OEH (2019)

4.26.2.3 Biology and reproduction

Breeding occurs during February to June. Magpie geese will breed in areas that experience high rainfall in both summer and winter with breeding behaviour strongly influenced by water level of the wetlands they utilise. Breeding largely occurs in monsoonal areas with the adults building nests in tall trees over deep water or on a floating platform of reeds (Australian Museum 2020). Clutch size is up to 8 eggs. Breeding is unlikely to occur in south-eastern New South Wales (OEH 2019).

4.26.3 Habitat

Suitable habitat for the species includes shallow wetlands, dry ephemeral swamps, wet grasslands and floodplains. Preferred habitat is describes as wetlands less than 1 m deep with dense vegetation including rushes and/or sedges (OEH 2020).

4.26.4 Threatening processes

The following have been identified as potentially threatening processes to Magpie geese:

- Wetland habitat impacted by changes of hydrological regimes through drainage of swamps, ponds, dams and other wetlands for agriculture and other human uses
- Water pollution such as salinity, chemical runoff and eutrophication impacting the health of wetland habitat
- Trampling and overgrazing from livestock causing changes to habitat and loss of nests
- Foxes predating upon eggs and goslings
- Feral pigs potentially reducing food availability
- Lack of knowledge and understanding of threats
- Monitoring is required to understand longer term trends in population dynamics
- Monitoring required to quantify severity of threats
- Commercial activities disturbing essential habitat (OEH 2019).

4.26.5 Threat abatement/recovery plans

There is no threat abatement recovery plan currently available for this species.

4.26.6 References

Atlas of Living Australia (2019). Magpie goose (Anseranas semipalmata). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:e6c44fa1-6428-42b4-a5f3-1315783484b0. [3 October 2019].

Australian Museum (2020) Magpie Goose. [online] Available from: https://australianmuseum.net.au/learn/animals/birds/magpie-goose/ [17 March 2020].

eBird Australia. (2015). Magpie goose (Anseranas semipalmata). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=b752ac15-4ffb-4770-8fb0-72aacaa1da7e. [23 September 2019].

Office of Environment and Heritage, NSW (2019). Magpie goose (Anseranas semipalmata). [online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10056. [3 October 2019].

4.27 Major Mitchell's cockatoo (*Lophochroa leadbeateri*)

4.27.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.27.2 Biology and ecology

4.27.2.1 Characteristics

The Major Mitchell's cockatoo is a unique cockatoo of Australia's dry inland. The species is the only one to display their characteristic salmon-pink colouration and are also known as the Pink cockatoo. The upper part of the body is white, and the most prominent feature is their white crest that is banded with red and gold (refer Photograph 4.27). Compared to other cockatoos they are smaller than a Sulphur-crested cockatoo (*C. galerita*), but larger than a Galah (*Eolophus roseicapullus*). They have a distinctive whinny stammering call (OEH 2019).

Photograph 4.27 Major Mitchell's cockatoo *(Lophochroa leadbeateri)*

Source: Nicolson (2019)

4.27.2.2 Known distribution

Major Mitchell's cockatoos are associated with the inland arid and semi-arid interior of Australia occurring from south-western Queensland, south to norther Victoria and across through much of South Australia and the southern Northern Territory. In Western Australia their range extends to the coast between Shark Bay and Jurien. In New South Wales they are found as far east as Griffith and Bourke, sometimes occurring further east (refer Figure 4.27) (OEH 2019).

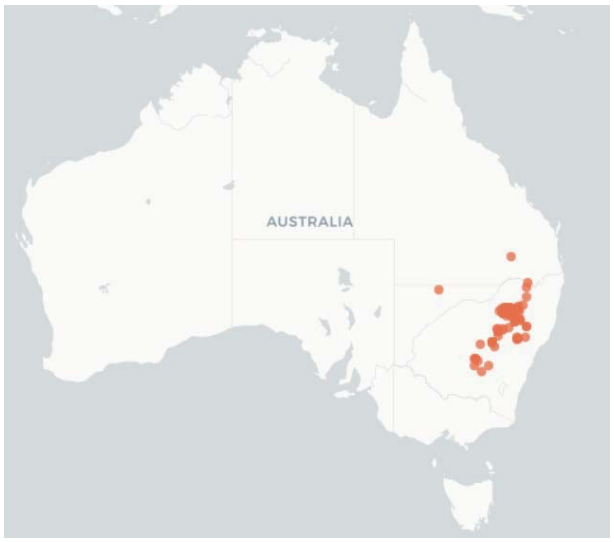


Figure 4.27 Distribution range of Major Mitchell's cockatoo

Source: ALA (2019), OEH (2019)

4.27.2.3 Biology and reproduction

Major Mitchell's cockatoo forages primarily on the ground, feeding on the seeds of native and exotic melons, saltbush, wattles and cypress pines (OEH 2017).

Major Mitchell's cockatoo typically breeds from May to August in Queensland. The nest is located within a tree hollow and is made of decayed debris, bark fragments and pebbles. On average, a clutch size is 2 to 4 eggs (Pizzey and Knight 2007).

4.27.3 Habitat

Major Mitchell's cockatoos are commonly encountered in small pairs and groups but can be found in large flocks where there is an abundance of food. They feed on the ground most of the time selecting seeds from both native and exotic melons. Native seeds are also derived from saltbush, wattles and cypress pines. Nesting pairs are sparsely distributed with no more than a single pair within 30 square kilometres. This species nests in tree hollows (OEH 2019).

4.27.4 Threatening processes

The following have been identified as potentially threatening processes to Major Mitchell's cockatoos:

- Clearing of woodland habitat
- Overgrazing in foraging areas resulting in a loss of seeding grasses and prevention of food plant regeneration
- Loss of essential nesting hollow
- Illegal nest-robbing and trapping (OEH 2019).

4.27.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Major Mitchell's cockatoo (*Lophochroa leadbeateri*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10116. In effect under the BC Act 2016.

4.27.6 References

Atlas of Living Australia (2019). Major Mitchell's cockatoo (Lophochroa leadbeateri). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:0217f06f-664c-4c64-bc59-1b54650fa23d. [3 October 2019].

Nicolson, K. (2019). Major Mitchell's cockatoo (Lophochroa leadbeateri). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=554a7090-343a-4556-8a24-4b40811196fd. [23 September 2019].

Office of Environment and Heritage, NSW (2019). Major Mitchell's cockatoo (Lophochroa leadbeateri). [online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10116. [3 October 2019].

Pizzey, G. and Knight, F. (2007). *The Field Guide to the Birds of Australia*. Harper Collins publishing, Sydney.

4.28 Masked owl (*Tyto novaehollandiae*)

4.28.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.28.2 Biology and ecology

4.28.2.1 Characteristics

Marked owls are a medium-sized owl measuring 40 to 50 cm in length. Their dark eyes are set against their prominent flat, hearth shaped facial discs which is encircled by a dark border. Their large powerful feet are feathered down to the toes and are powerful. Several colour morphs exist for this species along with huge variation in plumage. The uppermost part of the body is grey to dark brown with buff to rufous mottling and fine, pale spots (refer Photograph 4.28). Extensive barring occurs across the tail and wings. The underside of the wings is white to rufous-brown with variable dark spotting. Birds exhibiting paler colouration have a white face with a brown patch around each eye, whilst darker birds have a chestnut face. Compared to the sooty owl the darker form of Marked owl is much browner (OEH 2019).

Photograph 4.28 Masked owl *(Tyto novaehollandiae)*

Source: Harrison (2013)

4.28.2.2 Known distribution

Marked owls have a limited distribution occurring in pockets across south-eastern Australia, southern South Australia and south-western Western Australia. Most records for this species occur within New South Wales where they occur from the coast to the western plains (refer Figure 4.28). This species is most abundant in the coastal regions of its distribution and does not encounter seasonal changes in its distribution (OEH 2019).

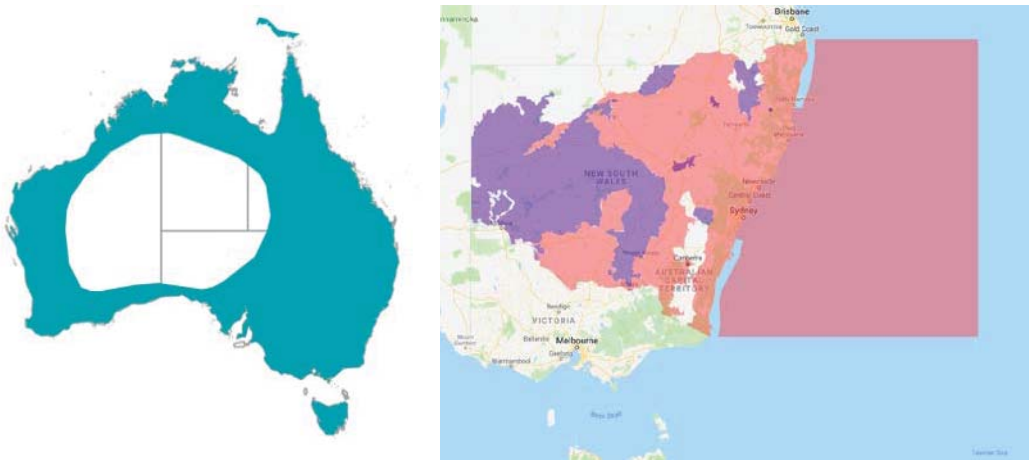


Figure 4.28 Distribution range of Masked owl

Source: ALA (2019), OEH (2019)

4.28.2.3 Biology and reproduction

Masked owls will usually breed between March and July but will usually breed during times with an abundance of prey (OEH 2019). They nest in large cavernous hollows in tree trunks or the main limb of a branch in heavily timbered forest or next to open spaces, which they will utilise for hunting. Females lay between two and four eggs in a clutch which she will incubate for 38 to 42 days. Nestlings will initially be covered in white down, which will later be replaced with creamy buff. Fledglings will first leave the nest after around 10 to 12 weeks staying nearby the nest to be fed for several months (Morcombe 2010).

4.28.3 Habitat

Marked owls utilise habitat consisting of dry eucalypt forests and woodlands from sea level to 1100 m. An adult pair will occupy a large home range of 500 to 1,000 ha (OEH 2019).

4.28.4 Threatening processes

The following have been identified as potentially threatening processes to Masked owls:

- Loss of large hollow bearing trees and changes in forest structure resulting in a lack of mature trees with hollow features in the future
- Habitat loss as a result of grazing, agriculture, forestry and other development
- Grazing and regular burns can impact the habitat requirements of prey species indirectly impacting food availability of the owls
- Secondary poisoning from rodent baiting
- Vehicle strike (OEH 2019).

4.28.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Masked owl (*Tyto novaehollandiae*). [online] Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10820. In effect under the BC Act 2016.

4.28.6 References

Atlas of Living Australia (2019). Masked owl (Tyto novaehollandiae). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:32b5f516-e4bc-4e81-b98a-c44c6dc84159. [3 October 2019].

Harrison, J.J. (2013). Masked owl (Tyto novaehollandiae). [image] [online] Available from: https://commons.wikimedia.org/wiki/File:Tyto_novaehollandiae_castanops_male_1_-_Port_Arthur.jpg. [23 September 2019].

Morcombe, M. 2010. Aus. Birds, App.

Office of Environment and Heritage, NSW (2019). Masked owl (Tyto novaehollandiae). [online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10820. [3 October 2019].

4.29 Painted honeyeater (*Grantiella picta*)

4.29.1 Status

EPBC Act – Vulnerable

BC Act – Vulnerable

4.29.2 Biology and ecology

4.29.2.1 Characteristics

Painted honeyeater (Grantiella picta) is a medium honeyeater, growing to a length of 14 to 15 cm in size. The Painted honeyeater weights around 20 to 25 g and has a black head and back, and bright yellow on the wings and upper tail and a bright pink bill (refer Photograph 4.29). The male is distinguished by white underparts with black streaks on flanks (above legs). The females are slightly smaller than the males and identified by brownish-black colouring with white underparts. Juveniles are browner and have a greyish coloured bill. The Painted honeyeater is known to use the same nest sites each season and are generally seen in pairs or singles, rarely in small flocks of up to six birds (DES 2019; Higgins et al. 2001; Simpson and Day 2004).

Photograph 4.29 Painted honeyeater (*Grantiella picta*)

Source: Knight (2009)

4.29.2.2 Known distribution

The Painted honeyeater is endemic to Australia and its distribution over summer and spring stretches from inland central Victoria through scattered parts of New South Wales, the ACT and southern Queensland (refer Figure 4.29). During winter the Painted honeyeater is known to migrate further to North Queensland, around Cape York Peninsula, and eastern areas of the Northern Territory. Opportunistic sightings have been recorded in far eastern parts of South Australia (Garnett et al. 2011; Higgins et al. 2001; Pizzey and Knight 2012).

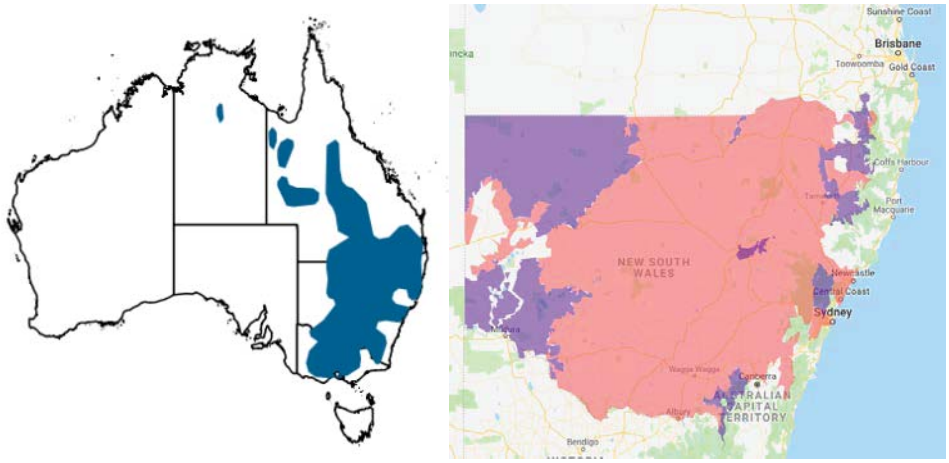


Figure 4.29 Distribution range of the Painted honeyeater

Source: ALA (2019)

4.29.2.3 Biology and reproduction

The Painted honeyeater is typically seen individually or in pairs, less frequently seen in small flocks of up to six birds. This species is known to consume fruit. The species is predominantly observed in areas where mistletoe is abundant. The species is known to have a mixed diet consisting of nectar, berries and insects, defining them an omnivorous and an obligate nectarivore (Oliver et al. 2003).

The species nests in a variety of trees and have been documented to favour mistletoe as a nesting site. The foliage of mistletoe helps with concealment of the nest to protect from predators and subsequent nest failure (Barea 2008; Cooney et al. 2006).

The breeding season generally takes place between October through to March and can be influenced by environmental conditions and the availability of food resources. Generally, the male Painted honeyeater will arrive at a nesting site several weeks before the female.

Both the male and female Painted honeyeaters maintain the nest, incubate the eggs, brood and feed the young. Nests are generally found approximately 15 m from the ground where the typical clutch consists of two eggs, but not uncommonly one to three eggs can be found. The species are known to raise one to two broods per season, where eggs are incubated for 13 to 15 days, and young fledge in 14 to 20 days. Box the female and male leave the nest at approximately the same time, generally 5 months after fledglings leave the nest and food resources decline (DES 2019; Garnett et al. 2011; Whitmore and Eller 1983).

4.29.3 Habitat

The Painted honeyeater is predominantly found in open forest, box-open woodland, eucalypt forest/woodlands, riparian woodlands and acacia woodlands. The Painted honeyeater inhabits environments that have a high prevalence of mistletoe which provides both nesting and food resources. Favourable species including needle-leaved mistletoe *(Amyema cabagei)* and grey mistletoe *(A. quandang)*. An identified key association between the Painted honeyeaters migration south-north is believed to be a result of mistletoe fruit availability and general mistletoe distribution and abundance (DotEE 2015; Keast 1968; Simpson and Day 2004).

4.29.4 Threatening processes

The following have been identified as potentially threatening processes to the Painted honeyeater:

- Clearing of woodland and open forests
- Removal of large, old trees with heavy mistletoe infestations
- Degradation of open forest and woodland remnants, including thinning of trees bearing mistletoe
- Heavy grazing of grassy woodlands
- Habitat infestation by weeds such as African boxthorn, Gazania and invasive grasses
- Inappropriate fire regimes
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy miners
- Degradation and simplification of habitat due to overgrazing (OEH 2019).

4.29.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Department of the Environment, Australian Government (2015). Conservation Advice: *Grantiella picta* painted honeyeater [online]. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/470-conservation-advice.pdf [October 2019].

4.29.6 References

Atlas of Living Australia (2019), *Grantiella picta.* Viewed 17 September 2019, Available: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:de126daa-e11d-42e0-ace6-7873abe6c96b#.

Barea, L. P. (2008). Nest-site selection by the Painted Honeyeater (Grantiella picta), a mistletoe specialist. Emu, 108, 213-220.

BirdLife International (2019) Species factsheet: Grantiella picta. Downloaded from http://www.birdlife.org on 17/09/2019.

Cooney, S. J., Watson, D. M., and Young, J. (2006). Mistletoe nesting in Australian birds: A review. Emu, 106, 1-12.

Department of the Environment and Energy (2015). Conservation Advice Grantiella picta painted honeyeater. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/470-conservation-advice.pdf. In effect under the EPBC Act from 08 July 2015.

Garnett, S., J. Szabo and G. Dutson (2011). *The Action Plan for Australian Birds 2010*. CSIRO Publishing. Available from: http://birdsindanger.net/taxatable.

Higgins, P. J., Peter, J. M., and Steele, W. K. (Eds.). (2001). Handbook of Australian, New Zealand and Antarctic birds: Vol. 5. Tyrant-flycatchers to Chats. Oxford University Press: Melbourne. ISBN 0195532589. http://eol.org/pages/919405/details#cite_note-Higgins.2CPeter.2CSteele-2.

Keast, A. (1968). Seasonal movements in the Australian honeyeaters (Meliphagidae) and their ecological significance. Emu, 67, 159-209. http://eol.org/pages/919405/details#cite_note-Keast-12.

Knight, R. (2009). Painted honeyeater (Grantiella picta). [image] [online] Available from: https://www.flickr.com/photos/sussexbirder/8079677675/in/photolist-8Fw6ib-diYsFv-LDPPEM. [17 September 2019].

Nature Conservation Act 1992 (Queensland): September 2017 list)

Oliver, D. L., Chambers, M. A., Parker, D. G. (2003). Habitat and resource selection of the Painted Honeyeater (Grantiella picta) on the northern floodplains regions of New South Wales. Emu, 103, 171-176. http://eol.org/pages/919405/details#cite_note-OliverChambers-13.

Department of Environment and Science (DES), Painted honeyeater – *Grantiella picta*, Wetland*Info*, Queensland, viewed 17 September 2019, https://wetlandinfo.des.qld.gov.au/wetlands/ecology/components/species/?grantiella-picta.

Pizzey, G., and Knight, G. (2012). The field guide to the birds of Australia (9th ed.). HarperCollins: Sydney. ISBN 978-0-7322-9193-8. http://eol.org/pages/919405/details#cite_note-Higgins.2CPeter.2CSteele-2.

Simpson, K., and Day, N. (2004), *Field Guide to the Birds of Australia*, 7th ed. Australia: Penguin, 210.

Whitmore, M. J., and Eller, C. M. (1983). Observations at a nest of Painted Honeyeaters. Emu, 83(3) 199-202

4.30 Pied honeyeater (*Certhionyx variegatus*)

4.30.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.30.2 Biology and ecology

4.30.2.1 Characteristics

The Pied honeyeater is sexually dimorphic, small passerine. The male is black and white with a white wing bar and a blue wattle beneath the eye (refer Figure 4.30). The female is grey-brown with a white wing bar. For both sexes the bill is down curved (OEH 2019).

Photograph 4.30 **Pied honeyeater *(Certhionyx variegatus)***

Source: Dunis (2017)

4.30.2.2 Known distribution

The Pied honeyeater occurs throughout the arid and semi-arid regions of Australia. In New South Wales the species is largely absent from coastal areas, with the exception of occasional records in the Hunter region during inland drought (OEH 2019) (refer Figure 4.30).

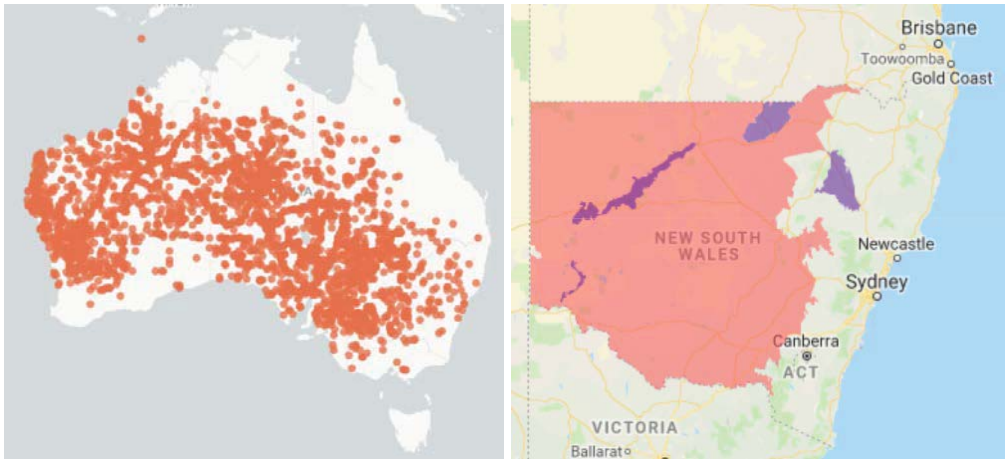


Figure 4.30 **Distribution range of Pied honeyeater**

Source: ALA (2019)

4.30.2.3 Biology and reproduction

The Pied honeyeater is primarily nectarivorous, but occasionally feeds on fruit, seeds and arthropods. The species is highly nomadic within its' range, following flowering events in response to rain. Foraging groups consist of pairs to small flocks, sometimes mixed with other species of honeyeaters. Breeding occurs during June to November. Nests are shallow and cup-shaped, constructed from twigs, leaves and grass, lined with spider web and placed low in a shrub or small tree. Between one and three eggs are laid, with both sexes incubating the eggs (OEH 2019).

4.30.3 Habitat

The Pied honeyeater occurs in Acacia woodlands and shrublands, malee and spinifex scrubs across the arid and semi-arid regions of Australia. Preferred habitats include Mulga shrublands, mallee woodlands, spinifex and eucalypt woodlands, and any habitat with *Eremophila* spp., a primary nectar source for the species (OEH 2019).

4.30.4 Threatening processes

The following have been identified as potentially threatening processes to Pied honeyeater:

- The clearing of nectar-producing shrubs (such as *Eremophila* and *Grevillea* spp.) reduces food supplies and may interrupt broadscale nomadic movements
- Grazing has a similar but less immediate impact compared to clearing, although many of the preferred food shrubs appear immune to grazing effects
- Infestation of habitat by boxthorn in some areas
- Loss of woodland habitat, including large old trees
- Fragmentation of woodland habitat
- Inappropriate fire regimes
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy miners
- Reduction in resources due to drought conditions, increasing due to climate change (OEH 2019).

4.30.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save the Pied Honeyeater *Certhionyx* variegatus [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=476&ReportProfileID=10156 [2 October 2019]. In effect under the BC Act 2016.

4.30.6 References

Atlas of Living Australia (2019) Certhionyx (Certhionyx) variegatus: Pied Honeyeater [online]. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:31f17bad-c9bd-485e-8d5c-a8d4aaf865dd [2 October 2019].

Dunis, V. (2017). Pied honeyeater (Certhionyx variegatus). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=f0f6496a-e461-413c-9b09-2d54deec2969 [23 September 2019].

Office of Environment and Heritage, NSW (2019) Pied Honeyeater – profile [online]. Availabe from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10156 [2 October 2019].

4.31 Red-tailed black-cockatoo (inland subspecies) (*Calyptorhynchus banksii samueli*)

4.31.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.31.2 Biology and ecology

4.31.2.1 Characteristics

The Red-tailed black-cockatoo is a large black cockatoo with a length of 50-64 cm that is sexually dimorphic. Males exhibit red panels on the tail. Females show yellow scalloping on the breast and shoulders and back bars across red tail panels (refer Photograph 4.31). Both sexes have a stout bill and a large crest (OEH 2019).

Photograph 4.31 Red-tailed black-cockatoo (inland subspecies) (*Calyptorhynchus banksii samueli*)

Source: Browne-Cooper (2019)

4.31.2.2 Known distribution

The Red-tailed black-cockatoo occurs in association with watercourses and overflows of the Paroo, Darling, Bogan, Macquarie and Barwon Rivers (OEH 2019) (refer Figure 4.31). This population is considered genetically distinct from the northeastern New South Wales subspecies population.

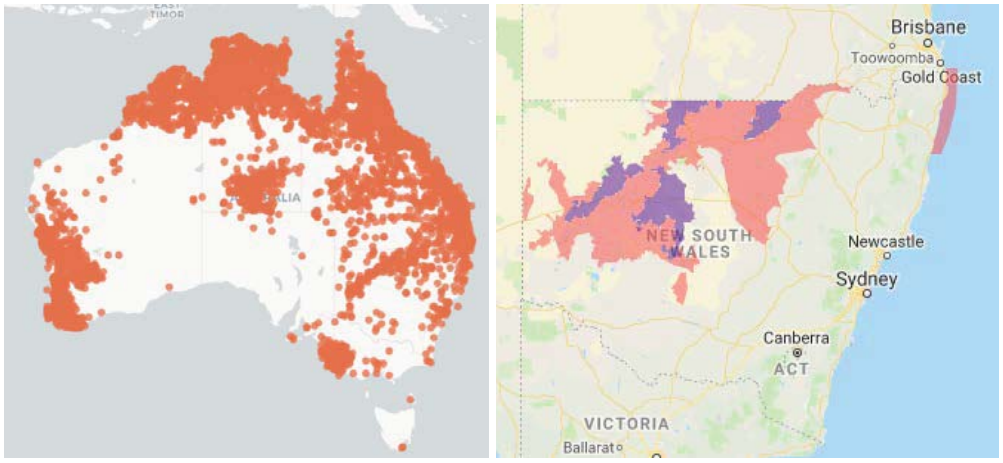


Figure 4.31 Distribution range of Red-tailed black-cockatoo (inland subspecies)

Source: ALA (2019)

4.31.2.3 Biology and reproduction

The Red-tailed black-cockatoo forages in flocks ranging from a few individuals to several hundred birds. The species feeds in the seeds of *Acacia*, *Eucalyptus*, *Casuarina*, *Hakea* and *Grevilliea*. Boring insects form a small part of the diet. The species forms life-long breeding pairs. Nesting occurs in tree hollows, at the base of a deep hollow, usually in the main trunk. One to two eggs are laid. The hollow is lined with wood chips. The female incubates the eggs and is fed by the male (OEH 2019).

4.31.3 Habitat

The Red-tailed black-cockatoo occurs in *Eucalyptus* forest and woodlands, *Acacia* woodlands and *Casuarina* woodlands. Preferred habitat includes River red gum and Coolibah riparian forests and woodlands along major watercourses. Other habitats include grasslands, scrublands, wetlands and floodplain vegetation (OEH 2019).

4.31.4 Threatening processes

The following have been identified as potentially threatening processes to Red-tailed black-cockatoo:

- Loss of native forest and riparian vegetation for agriculture and development
- Removal of large trees containing large hollows needed for nesting, including dead trees and paddock trees
- Too frequent burning of areas of habitat
- Inappropriate grazing regimes which prevents regeneration of food resources and leads to loss of habitat trees through erosion of riverbanks
- Illegal removal of eggs and chicks for the aviculture trade, as these birds do not breed well in captivity (OEH 2019).

4.31.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Available from: Saving our species: Help save the Red-tailed Black-Cockatoo (inland subspecies) Calyptorhynchus banksia samueli [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=464&ReportProfileID=10138 [3 October 2019]. In effect under the BC Act 2016.

4.31.6 References

Atlas of Living Australia (2019) Calyptorhynchus (Calyptorhynchus) banksia [online]. Available: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:e9cc6e53-1f30-469a-b563-1b525bb9c41b [3 October 2019].

Browne-Cooper, R. (2019). Red-tailed black-cockatoo (inland subspecies) (Calyptorhynchus banksii samueli). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=18a521dc-aa32-4f40-ba3c-b7b6c00facb5. [23 September 2019].

Office of Environment and Heritage, NSW (2019) Red-tailed Black-Cockatoo (inland subspecies) – profile [online]. Available: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10138 [3 October 2019].

4.32 Red goshawk (*Erythrotriorchis radiatus*)

4.32.1 Status

EPBC Act – Vulnerable

BC Act – Critically Endangered

4.32.2 Biology and ecology

4.32.2.1 Characteristics

The Red goshawk (*Erythrotriorchis radiatus*) is a large, swift and powerful rufous-brown goshawk. This species of raptor is estimated to be of 45 to 58 cm in total body length with a wingspan of 110 to 135 cm. The red goshawk is boldly mottled and streaked, with rufous scalloping on the back and upper wings, and massive yellowish legs and feet. The head of the bird is pale and streaked with darker feathers (refer Photograph 4.32). Females are typically larger than males, more powerfully built, paler and more heavily streaked below, showing some white on the under body. Red goshawk juveniles are distinguished from adults due to their rufous head (DES 2019; DotEE 2019).

Photograph 4.32 Red goshawk (Erythrotriorchis radiatus)

Source: ALA (2016)

4.32.2.2 Known distribution

The Red goshawk is distributed along the east coast of Queensland, Cape York Peninsula and across into northern regions of Australia (refer Figure 4.32). In Queensland, is it estimated that the species population is limited to the bioregions of the Wet Tropics, Cape York Peninsula and Mount Isa Inlier. However, surveying of the species in another three bioregions has yet to occur. Some adults of red goshawk in southeast Australia have been known to migrate annually from the ranges down into the lowlands during winter period. The species is thought to be extinct in southeast Queensland as well as being very rare in New South Wales extending south to about 30˚S (DES 2019; OEH 2019).

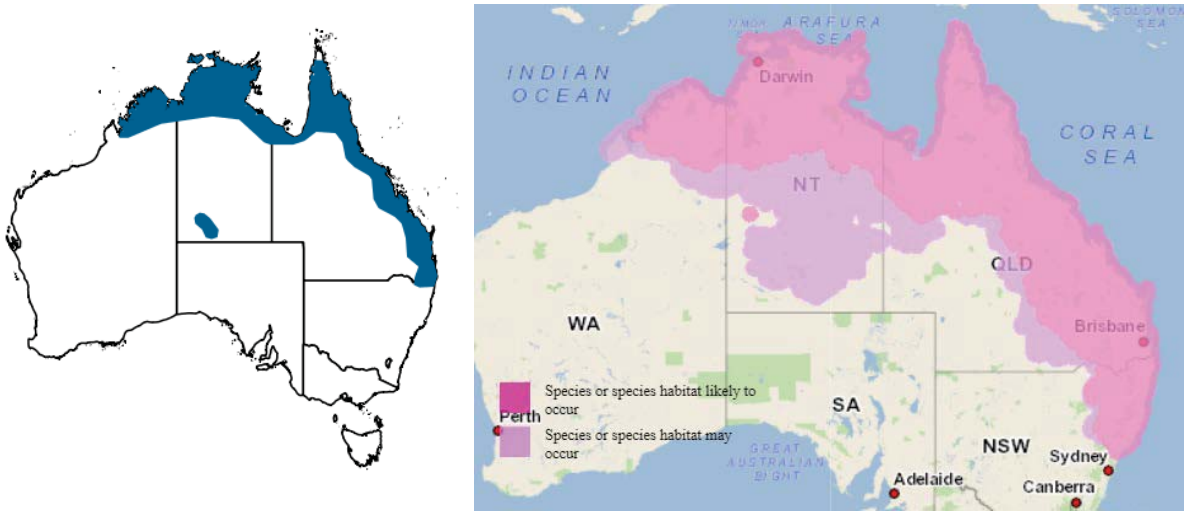


Figure 4.32 **Distribution range of Red goshawk**

Source: ALA (2016)/Geoscience Australia (2015)

4.32.2.3 Biology and reproduction

The solitary Red goshawk is known to prey on birds such as Australian brush-turkeys, Kookaburras and Rainbow lorikeets as well as small mammals, reptiles and insects. The species is known to attack its prey from the air, gliding straight down or chasing it down. The male of the species will build nests using dead sticks lined with twigs and green leaves within an exposed fork in the upper quarter of a tree between 10 to 20 m above ground and used each year (DES 2019; OEH 2019).

The breeding season for Red goshawk occurs from September to December with one to two eggs being laid by the females between August and October in the southeast regions. Females will incubate eggs for a period of 39 to 43 days with the young being fully fledged after eight weeks despite not being independent for at least another ten weeks (DES 2019).

4.32.3 Habitat

The red goshawk typically occurs in both coastal and sub-coastal areas, in wooded and forested lands of tropical and warm-temperate Australia. Riverine forests are also used frequently. The red goshawk nests in large trees, frequently the tallest and largest in a stand, which are typically within 1 km of a permanent water source. This species typically avoids very dense, and very open habitats (Debus 1991; 1993; OEH 2019; Marchant and Higgins 1993).

In Queensland the species is known to inhabit cleared parts of eastern Queensland associated gorges and escarpment country whilst in New South Wales the preferred habitat includes mixed subtropical rainforest such as *Melaleuca* swamp forest as well as riparian *Eucalyptus* forest of coastal rivers (DES 2019; OEH 2019).

4.32.4 Threatening processes

The following have been identified as potentially threatening processes to the Red goshawk:

- Clearing and fragmentation of riparian forests and woodlands. Nests are particularly vulnerable to clearing of habitat, and even where riparian strips are not cleared, Red goshawks usually nest in the tallest trees, which are exposed to storm damage and other disturbance when surrounding vegetation removed
- Clearing and fragmentation of habitat for rural and residential development
- Disturbance of habitat, particularly breeding habitat resulting in breeding failure, from forestry activities
- Loss or degradation of sources of permanent water through draining of wetlands

- Use of persistent pesticides may result in pesticide contamination of prey species and cause secondary poisoning of the Red goshawk
- Intentional shooting by pigeon and poultry owners
- Reduction in available prey as a result of clearing, the use of fire and changing land use from forest to agricultural land
- Disturbance of nesting sites and breeding failure from illegal egg-collecting
- Stochastic events, such as drought and fire, or occurrence of disease, that may have exaggerated impacts upon an already depleted population
- Genetic bottlenecks may restrict gene flow affecting an already small population.
- Inappropriate fire regime changing habitat structure and impacting on prey availability
- Lack of information on the species in New South Wales to inform a conservation management strategy (OEH 2019).

4.32.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save the Red Goshawk *Erythrotriorchi*s [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=1199&ReportProfileID=10279 [3 October 2019]. In effect under the BC Act 2016.

4.32.6 References

Atlas of Living Australia (2019). Erythrotriorchis radiatus. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:1405a1d4-557c-40ac-9f44-a6d41e9136cd#overview [Accessed 12 September 2019].

Debus, S.J.S. (1991). An annotated list of NSW records of the Red goshawk. Australian Birds. 24:72- 89

Debus, S.J.S. (1993). The status of the Red goshawk (Erythrotriorchis radiatus) in New South Wales. Olsen, P., ed. Australasian Raptor Studies. Page(s) 182-191. ARA-RAOU, Melbourne

Department of Environment and Energy (2019). Erythrotriorchis radiatus (Red Goshawk) in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=942 [Accessed 12 September 2019].

Department of Environment and Science (2019). Red Goshawk. Queensland Government. Available from: https://www.ehp.qld.gov.au/wildlife/threatened-species/endangered/endangered-animals/red_goshawk.html [Accessed 12 September 2019].

Marchant, S. and P.J. Higgins, eds. (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2 - Raptors to Lapwings. Melbourne, Victoria: Oxford University Press.

Office of Environment and Heritage (2019). Red Goshawk – Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10279 [Accessed 12 September 2019].

4.33 Regent honeyeater (*Anthochaera phrygia*)

4.33.1 Status

EPBC Act – Critically Endangered

BC Act – Critically Endangered

4.33.2 Biology and ecology

4.33.2.1 Characteristics

The Regent honeyeater is a medium sized honeyeater with an average mass of 35 to 50 g and an average length of 20 to 24 cm. The plumage is black with pale yellow scalloping, a black head and bright yellow wings and tail (refer Photograph 4.33). A patch of dark pink or cream coloured skin surrounds the eye (OEH 2019).

Photograph 4.33 Regent honeyeater (Anthochaera phrygia)

Source: eBird Australia (2015)

4.33.2.2 Known distribution

The Regent honeyeater occurs in a patchy distribution across south eastern Australia from south east Queensland to central Victoria. The species inhabits the western slopes of the Great Dividing Range as well as coastal areas (refer Figure 4.33) (OEH 2019).

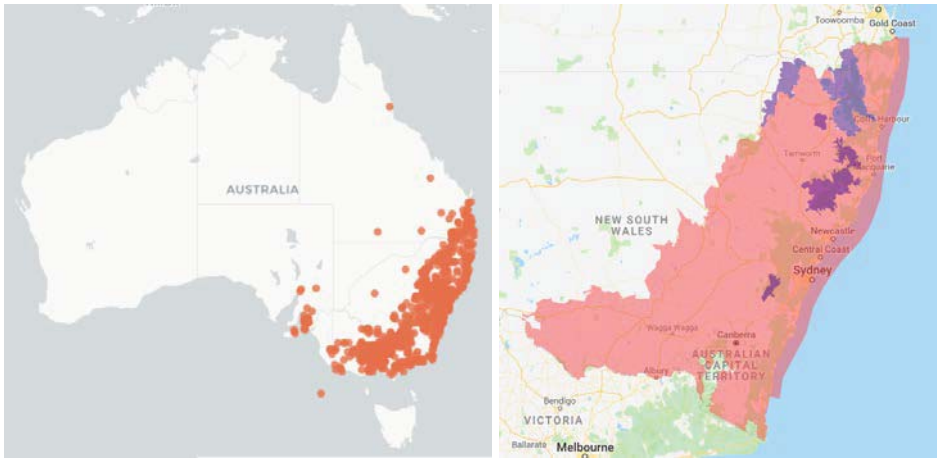


Figure 4.33 Distribution range of Regent honeyeater

Source: ALA (2019)

4.33.2.3 Biology and reproduction

The Regent honeyeater is primarily a nectarivore, but also feeds on insects and their exudates. The species is nomadic and partly migratory, following seasonal flowering events. Breeding occurs in two known areas in New South Wales, Capertree Valley and Bundarra-Barraba regions during July-April. The nest consists of an open cup shape made from bark, grass, twigs and wool, located in a horizontal branches or forks in a tall mature eucalypt or Sheoak (OEH 2019).

4.33.3 Habitat

The preferred habitat of the regent honeyeater is wet areas containing fertile soils that provide reliable nectar seasonally in areas of creek flats, river valleys and lower slopes. They are also found in dry eucalypt woodland and open forest in both rural and urban environments with mature eucalypts (DES 2019).

Other habitats of the species include E. *robusta* (Swamp mahogany), *Corymbia maculata* (Spotted gum) and *Casuarina cunninghamiana* (River she-oak) with associated *Amyena cambagei* (Mistletoe) (DES 2019).

4.33.4 Threatening processes

The following have been identified as potentially threatening processes to the Regent honeyeater:

- Historical loss, fragmentation and degradation of habitat from clearing for agricultural and residential development, particularly fertile Yellow Box-White Box-Blakely's Red Gum Woodlands
- Continuing loss of key habitat tree species and remnant woodlands from major developments (mining and agricultural), timber gathering and residential developments
- Key habitats continue to degrade from lack of recruitment of key forage species and loss of paddock trees and small remnants increasingly fragmenting the available habitat
- Suppression of natural regeneration of overstorey tree species and shrub species from overgrazing. Riparian gallery forests have been particularly impacted by overgrazing
- Competition from larger aggressive honeyeaters, particularly noisy miners, noisy friarbirds and red wattlebirds
- The small population size and restricted habitat availability make the species highly vulnerable to extinction via stochastic processes and loss of genetic diversity, and reduced ability to compete, increased predation and reduced fledging rates
- Egg and nest predation by native birds and mammals
- Inappropriate forestry management practices that remove large mature resource-abundant trees. Firewood collection and harvesting in Box-Ironbark woodlands can also remove important habitat components
- Disturbance at nesting sites leading to reduced nesting success by recreational users
- Loss of key foraging resources as a result of inappropriate fire regimes (OEH 2019).

4.33.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save the Regent Honeyeater *Anthochaera Phrygia* [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10871 [3 October 2019]. In effect under the BC Act 2016.

4.33.6 References

Atlas of Living Australia (2019). *Anthochaera (Xanthomyza) phrygia*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:af9380ee-2f65-4213-bb6f-ea6baf92ad3e#overview [Accessed 18 September 2019].

Birdlife Australia (2019). Regent Honeyeater. Available from: http://www.birdlife.org.au/bird-profile/regent-honeyeater [Accessed 18 September 2019].

BirdLife International (2019). Anthochaera phrygia. The IUCN Red List of Threatened. Available from: http://www.iucnredlist.org/details/full/22704415/0 [Accessed 18 September 2019].

Curtis, Lee K. Dennis, Andrew J. McDonald, Keith R. Kyne, Peter M. Debus, Stephen J.S (2012). Queensland's Threatened Animals. CSIRO.

Department of Environment and Science (2019). Regent Honeyeater. Queensland Government. Available from: https://www.ehp.qld.gov.au/wildlife/animals-az/regent_honeyeater.html [Accessed 18 September 2019].

eBird Australia. (2015). Regent honeyeater (Anthochaera phrygia). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=ad1bf8a3-56b4-4f31-ab23-4e19388eeeac. [17 September 2019].

4.34 Scarlet robin (*Petroica boodang*)

4.34.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.34.2 Biology and ecology

4.34.2.1 Characteristics

Scarlet robins are a smaller species of the robin family measuring 13 cm in length. In males the uppermost part of the body is black, including the head which includes a noticeable white patch on the forehead. The wings include white stripes and the tail has white tail-edges. The chest is a bright scarlet-red in males with a white belly (refer Photograph 4.34). Females of the species are brow, darker above, and have a dull reddish breast and whitish throat. The white forehead marking is smaller in the female and they share the similar white markings on the wings and tail. Juvenile males will resemble the female (OEH 2019).

Photograph 4.34 Scarlet robin *(Petroica boodang)*

4.34.2.2 Known distribution

Scarlet robins occur from south east Queensland to south east South Australia with populations in Tasmania and south west Western Australia. They are restricted to the eastern part of New South Wales from the coast to inland slopes (refer Figure 4.34) (OEH 2019).

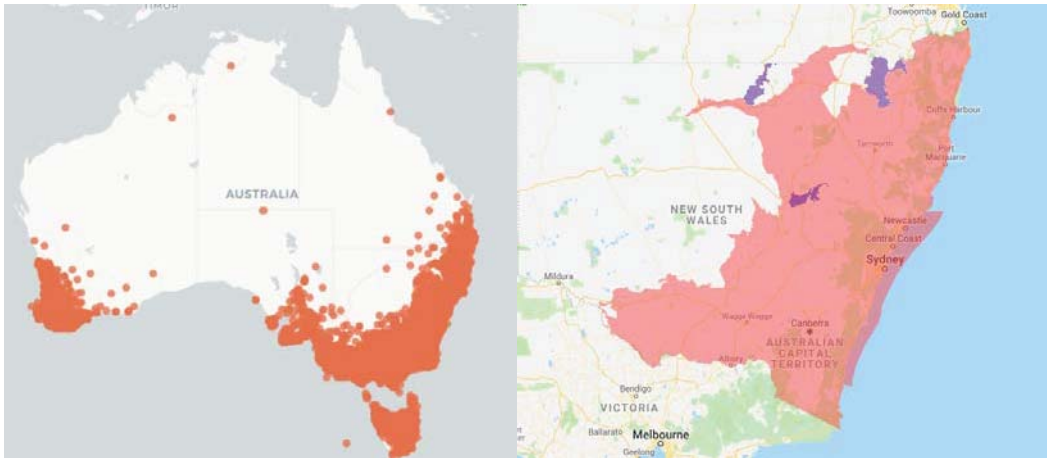


Figure 4.34 Distribution range of Scarlet robin

Source: ALA (2019), OEH (2019)

4.34.2.3 Biology and reproduction

The Scarlet robin hunts from the perch of a low branch, tree stump of fence post pouncing on small insects and other invertebrates which are taken from the ground, tree trunks, stumps and logs. They will also occasionally hunt in the shrub and canopy layer. During autumn and winter these robins will join mixed feeding flocks with other small insectivorous birds associated with dry forest and woodlands. They will most commonly breed on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions and can sometimes be found at 1,000 m above sea level. Breeding usually occurs between July and January during which time they will defend a breeding territory raising two to three broods in a season. The small, cup shaped nest is made from plant fibres and cobwebs built in the fork of a tree about 2 m above the ground. Pairs will stay together year-round, otherwise birds are solitary or sometimes in small family parties (OEH 2019).

4.34.3 Habitat

The Scarlet robin lives in dry eucalypt forests and woodlands with an understorey structure that is typically open and grassy with some shrubs in the area. They will utilise both old growth or regrowth vegetation and occasionally mallee or wet forest communities. They also occur is wetlands and tea-tree swamps. One of the most important habitat features for the species is an abundance of fallen logs and timber (OEH 2019).

4.34.4 Threatening processes

The following have been identified as potentially threatening processes to Scarlet robins:

- Clearing, degradation and overgrazing of the species' habitat
- Reduction in the size of remnant patches
- Changes to the structural complexity and simplification of habitat, particularly the loss of shrub cover, ground cover, logs, fallen branches and leaf litter
- Exotic grasses and woody weeds replacing native shrubs and ground covers
- Loss of habitat essential for breeding and feeding through the removal of standing dead timber, logs and coarse woody debris as a result of grazing, fire wood collection and 'tidying up' of rough pasture
- An over abundance of Pied currawongs increasing nest predation rates reducing breeding success of the robins and competitive exclusion from Noisy miners within their habitat
- Predation by feral cats
- Regeneration after disturbance altering habitat suitability if regeneration is dense (OEH 2019).

4.34.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: Scarlet robin (*Petroica boodang*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=20133. In effect under the BC Act 2016.

4.34.6 References

Atlas of Living Australia (2019). Scarlet robin (Petroica boodang). Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:557046f1-5345-44e4-b08b-a1a55cacefa6. [3 October 2019].

Office of Environment and Heritage, NSW (2019). Scarlet robin (Petroica boodang)– Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20133. [Accessed 12 September 2019].

4.35 Speckled warbler (*Chthonicola sagittata*)

4.35.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.35.2 Biology and ecology

4.35.2.1 Characteristics

The Speckled warbler is a small ground dwelling passerine with a length of 13 cm. The species has a black crown streaked with buff. The underparts are pale and distinctively streaked (refer Photograph 4.35). The wings and tail are grey-brown (OEH 2019).

Photograph 4.35 Speckled warbler *(Chthonicola sagittata)*

Source: fladstaffotos (2007)

4.35.2.2 Known distribution

The Speckled warbler occurs from central Queensland to western Victoria. In New South Wales it inhabits the eastern half of the state. It is most common along the Great Dividing Range and is rarely observed in coastal environments. The species is absent of semi-arid regions of western New South Wales (refer Figure 4.35) (OEH 2019).

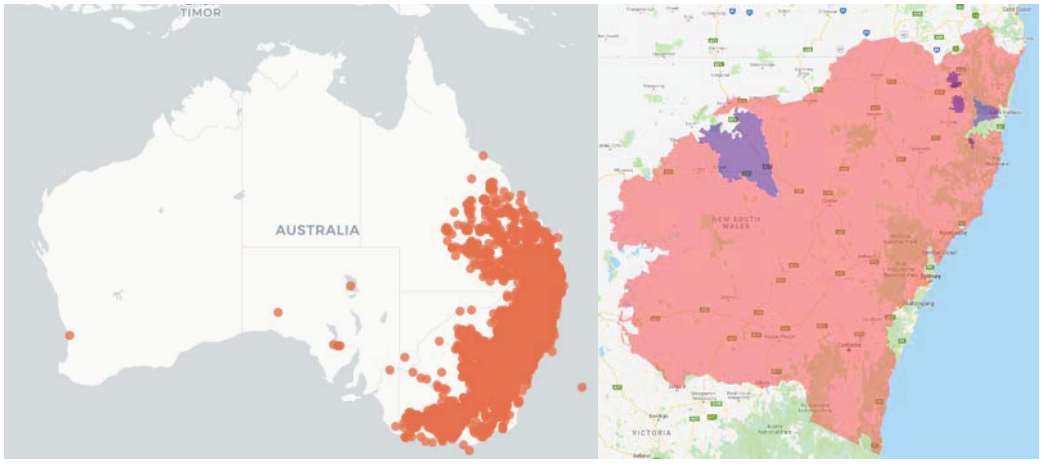


Figure 4.35 **Distribution range of Speckled warbler**

Source: ALA (2019)

4.35.2.3 Biology and reproduction

The Speckled warbler is primarily insectivorous but also eats seeds, usually foraging at ground level. The species is sedentary, and pairs defend breeding territories averaging 10 ha. Breeding occurs during August to January, when three to four eggs are laid. The nest consists of a roughly built dome, comprised of grass and strips of bark. The nest is located on the ground amongst grass tussocks and woody debris, or at the base of a dense shrub. Cooperative breeding with a third male sometimes occurs (OEH 2019).

4.35.3 Habitat

The Speckled warbler inhabits *Eucalyptus* dominated forests and woodlands with a grassy understorey. Preferred habitat includes rocky ridges and gullies with scattered native tussock grassed and a sparse shrub layer. Large areas of remnant vegetation are required for population viability. Other habitats may include travelling stock routes with low grazing disturbance and woodlands with high structural complexity at the shrub and ground level (OEH 2019).

4.35.4 Threatening processes

The following have been identified as potentially threatening processes to Speckled warbler:

- Due to the fragmented nature of the populations and their small size the species is susceptible to catastrophic events and localised extinction
- Clearance of remnant grassy woodland habitat for paddock management reasons and for firewood.
- Poor regeneration of grassy woodland habitats
- Modification and destruction of ground habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, heavy grazing and compaction by stock and frequent fire
- Habitat is lost and further fragmented as land is being cleared for residential and agricultural developments. In particular, nest predation increases significantly, to nest failure rates of over 80 per cent, in isolated fragments
- Nest failure due to predation by native and non-native birds, cats, dogs and foxes particularly in fragmented and degraded habitats

- Infestation of habitat by invasive weeds
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy miners
- Climate change impacts including reduction in resources due to drought (OEH 2019).

4.35.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save the Speckled warbler Chthonicola sagittata [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=799&ReportProfileID=10722 [3 October 2019]. In effect under the BC Act 2016.

4.35.6 References

Atlas of Living Australia (2019) Chthonicola sagittata: Speckled warbler [online]. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:f911a1e3-46e0-47ff-941f-fdb649d78754 [3 October 2019].

Office of Environment and Heritage, NSW (2019) Speckled Warbler – profile [online]. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10722 [3 October 2019].

Flagstaffotos (2007). Speckled warbler (Chthonicola sagittata). [image] [online] Available from: https://commons.wikimedia.org/wiki/File:Speckeld_warbler.jpg. [23 September 2019].

4.36 Spotted harrier (*Circus assimilis*)

4.36.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.36.2 Biology and ecology

4.36.2.1 Characteristics

The Spotted harrier is a large bird of prey, often seen gliding very low over grasslands and cropping areas. The face and underparts are chestnut (refer Photograph 4.36). The wingtips are conspicuously tipped black. The tail is long and banded (OEH 2019).

Photograph 4.36 Spotted harrier (Circus assimilis)

Source: Sando (2018)

4.36.2.2 Known distribution

The Spotted harrier occurs across entire continent, except densely wooded areas along the Main Range and coast (OEH 2019) (refer Figure 4.36).

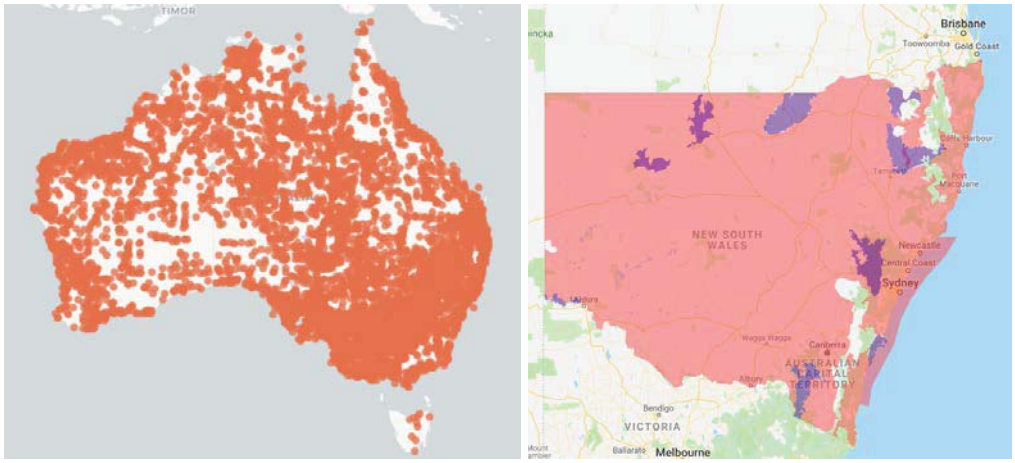


Figure 4.36 Distribution range of Spotted harrier

Source: ALA (2019)

4.36.2.3 Biology and reproduction

The Spotted harrier is carnivorous, preying on terrestrial mammals, birds, reptiles and insects. The species hunts by flying low and ambushing prey on the ground. The main prey species include Bandicoots, Bettongs and rodents. Where these species have declined, terrestrial grassland birds form an important component of the species diet. Breeding occurs in spring and sometimes autumn, when two to four eggs are laid. The nest consists of a stick platform and is located high in a tree. Nestlings fledge after several months (OEH 2019).

4.36.3 Habitat

The Spotted harrier inhabits grasslands, grassy open woodlands, inland riparian woodlands and shrublands. Remnant *Acacia* open woodland and mallee is also considered habitat. Agricultural lands, including introduced grasslands, cereal crops, stubble and fallow fields provide suitable foraging habitat (OEH 2019).

4.36.4 Threatening processes

The following have been identified as potentially threatening processes to Spotted harrier:

- Loss of foraging and breeding habitat, particularly that which affects prey densities
- Loss of mature trees from rural landscapes
- Secondary poisoning from the use of pindone in rabbit control
- Secondary poisoning from rodenticides
- Lack of knowledge of locations of key breeding habitat and breeding ecology and success (OEH 2019).

4.36.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save the Spotted Harrier *Circus assimilis* [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=937&ReportProfileID=20134 [3 October]. In effect under the BC Act 2016.

4.36.6 References

Atlas of Living Australia (2019) Circus assimilis: Spotted harrier [online]. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:75801261-975f-436f-b1c7-d395a06dc067 [3 October 2019].

Office of Environment and Heritage, NSW (2019) Spotted harrier – profile [online]. Available form: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20134 [3 October 2019].

Sando, D. (2018). Spotted harrier (Circus assimilis). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=8ba225ed-3cdb-42f1-b0b3-facb9a6b4106. [23 September 2019].

4.37 Squatter pigeon (*Geophaps scripta scripta*)

4.37.1 Status

EPBC Act – Vulnerable

BC Act – Critically endangered

4.37.2 Biology and ecology

4.37.2.1 Characteristics

The Squatter pigeon (Geophaps scripta scripta) (southern sub-species) is a heavily built, medium sized ground dwelling pigeon, measuring approximately 26 to 32 cm in total length with a wing span of 45 cm. Adults are generally grey-brown in colour, with black and white stripes on the face and throat, blue-grey skin around the eyes, dark brown (with some patches iridescent green or violet) wings, a blue-grey lower breast, and white flanks and lower belly (refer Photograph 4.37). Both sexes are of similar appearance, whilst juveniles are duller in colour, with patchy and less distinctive black and white facial stripes and paler facial skin (DotEE 2018; OEH 2017; NPWS 1999).

Photograph 4.37 Squatter pigeon southern sub-species (*Geophaps scripta scripta*)

Source: ALA (2016)

4.37.2.2 Known distribution

The Squatter pigeon (southern sub-species) was once found widespread nationally extending from southern New South Wales to the Burdekin River in northern Queensland (refer Figure 4.37). However, the species is now limited to an area from north Queensland to the northwest slopes of New South Wales, including southeast Queensland, the western slopes of the Great Diving Range, the Gwydir River region and the Liverpool Plains (Cooper et al. 2014; OEH 2017).

Figure 4.37 Distribution range of the southern Squatter pigeon

Source: DotEE (2019)

4.37.2.3 Biology and reproduction

The Squatter pigeon (southern sub-species) forages on the ground for grass seeds, herbs, shrubs and insects. The Squatter pigeon is typically seen in pairs, or in small groups of up to 20 or more individuals and breed throughout the year. Breeding however is influenced by heavy rainfall which most commonly occurs during the dry season between May and June (DotEE 2018; OEH 2017; Pizzey and Knight 2007).

Squatter pigeon nests are depressions scraped into the ground beneath a tussock of grass, bush, fallen tree or log and sparsely lined with grass. The female lays two eggs which are smooth, lustrous, pale cream and oval with an incubation period of approximately 17 days by both parents. Southern Squatter pigeon chicks will remain in the nest for a further 2 to 3 weeks after hatching (Australian Bush Birds 2018; AWC 2017; DotEE 2018).

4.37.3 Habitat

The Squatter pigeon (southern sub-species) is known to inhabit grassy understorey of open eucalypt woodlands and plains featuring sandy areas within close proximity to water. Areas of semi-arid or arid landscape with sandy, open and short grass cover dissected by gravel ridges is the preferred habitat for the species. The ground cover in foraging and breeding habitat is typically patchy, consisting of native, perennial tussock grasses or a mix of perennial tussock grasses and low shrubs or forbs. This vegetated ground layer rarely exceeds 33 per cent of the ground area. The remaining ground surface typically consists of bare patches of gravelly or dusty soil, and areas lightly covered in leaf litter and coarse, woody debris (e.g. fallen trees, logs and smaller debris). The species is also often found alongside tracks and roadsides (DotEE 2018; OEH 2017).

4.37.4 Threatening processes

The following have been identified as potentially threatening processes to the southern Squatter pigeon:

- Fragmentation and/or clearing of grassy woodland habitats for agriculture and development
- Overgrazing by domestic stock and feral rabbits of habitat
- Predation by feral cats and foxes
- Illegal shooting (OEH 2017).

4.37.5 Threat abatement/recovery plans

No recovery plan has been identified as being relevant to this species.

The following threat abatement plans have been identified as being relevant for this species:

- Department of the Environment (2015). Threat abatement plan for predation by feral cats. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats. In effect under the EPBC Act from 23-Jul-2015.
- Department of the Environment and Energy (2016). Threat abatement plan for competition and land degradation by rabbits. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-rabbits-2016. In effect under the EPBC Act from 07-Jan-2017.
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). Threat abatement plan for predation by the European red fox. DEWHA, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/predation-european-red-fox. In effect under the EPBC Act from 01-Oct-2008.

4.37.6 References

Atlas of Living Australia (2016). *Geophaps (Geophaps) scripta scripta*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:d5c52cd0-6d21-4322-a5c5-bc11a94d8c3a#overview [Accessed 22 August 2018].

Australian Bush Birds (2018). Squatter Pigeon - *Geophaps scripta*. Available from: http://www.australianwildlife.org/wildlife/squatter-pigeon.aspx [Accessed 22 August 2018].

Australian Wildlife Conservancy (2017). Species profile - Squatter Pigeon. Available from: http://www.australianwildlife.org/wildlife/squatter-pigeon.aspx [Accessed 22 August 2018].

Department of Environment and Energy (2018). *Geophaps scripta scripta* (Squatter Pigeon) in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64440 [Accessed 22 August 2018].

National Parks and Wildlife Service (1999). Threatened Species Information – Squatter Pigeon. New South Wales Government. Available from: https://www.environment.nsw.gov.au/resources/nature/tsprofileSquatterPigeon.pdf [Accessed 22 August 2018].

Office of Environment and Heritage (2017). Squatter Pigeon (southern) - Profile. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10350# [Accessed 22 August 2018].

Pizzey, G. and Knight, F. 2007, The Field Guide to the Birds of Australia (8th edition) Harper Collins Publishers, NSW, Australia.

4.38 Square-tailed kite (*Lophoictinia isura*)

4.38.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.38.2 Biology and ecology

4.38.2.1 Characteristics

The Square-tailed kite is a medium-sized raptor with generally reddish plumage (refer Photograph 4.38). The face is white and the tail and wings and tipped black. During flight the tail is squared (OEH 2019).

Photograph 4.38 Square-tailed kite (Lophoictinia isura)

Source: Winterflood (2018)

4.38.2.2 Known distribution

The Square-tailed kite occur across coastal and sub-coastal Australia and is largely absent from the arid zone (OEH 2019) (refer Figure 4.38). It is most common along the coast and major inland rivers. Many individuals migrate to the south east of New South Wales during summer for breeding.

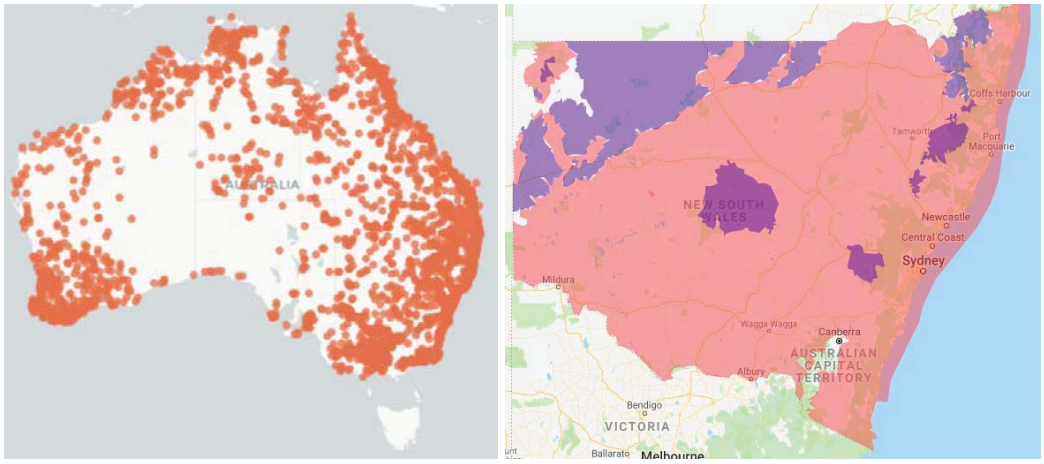


Figure 4.38 Distribution range of Square-tailed kite

Source: ALA (2019)

4.38.2.3 Biology and reproduction

The Square-tailed kite is primarily carnivorous, preying on birds but also insects. The species hunts by flying low over the canopy, ambushing prey. The species is specialised in hunting honeyeaters and their nestlings. Square-tailed kites forage within large hunting ranges greater than 100 km^2. Breeding occurs during July to February, when one to two eggs are laid. The nest consists of sticks and is either bowl or platform shaped. The nest is typically located in a tall tree close to a watercourse. Incubation takes 40 days, followed by a nestling stage of 8 weeks. Fledglings are dependent for 2 months (OEH 2019).

4.38.3 Habitat

Habitat for the Square-tailed kite includes open forest, woodland, low open eucalypt woodland, *Acacia* shrubland, grassland and herbfields. Preferred habitats occur along watercourses (OEH 2019).

4.38.4 Threatening processes

The following have been identified as potentially threatening processes to Square-tailed kite:

- Clearing, logging, burning, and grazing of habitats resulting in a reduction in nesting and feeding resources
- Disturbance to or removal of potential nest trees near watercourses
- Illegal egg collection and shooting (OEH 2019).

4.38.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save the Square-tailed Kite *Lophoictinia isura* [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=674&ReportProfileID=10495 [3 October 2019]. In effect under the BC Act 2016.

4.38.6 References

Atlas of Living Australia (2019) Lophoictinia isura: Square-tailed Kite [online]. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:f6edc452-91de-4ab0-9cf6-49ca23b82995 [3 October 2019].

Office of Environment and Heritage, NSW (2019) Square-tailed Kite – profile [online]. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10495 [3 October 2019].

Winterflood, G. (2018). Square-tailed kite (Lophoictinia isura). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=8ba225ed-3cdb-42f1-b0b3-facb9a6b4106. [23 September 2019].

4.39 Turquoise parrot (*Neophema pulchella*)

4.39.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.39.2 Biology and ecology

4.39.2.1 Characteristics

The Turquoise parrot is a relatively small and slender parrot with an average length of 21 cm and an average weight of 40 g. The male is bright green on top, with a turquoise face and crown. The shoulders are red. The female is less bright and has a white face (refer Photograph 4.39) (OEH 2019).

Photograph 4.39 **Turquoise parrot *(Neophema pulchella)***

Source: Kee (2008)

4.39.2.2 Known distribution

The Turquoise parrot occurs from southern Queensland to central Victoria. The species inhabits coastal lowlands, the Main Range and western slopes. The species is absent from the arid and semi-arid zones of New South Wales (refer Figure 4.39) (OEH 2019).

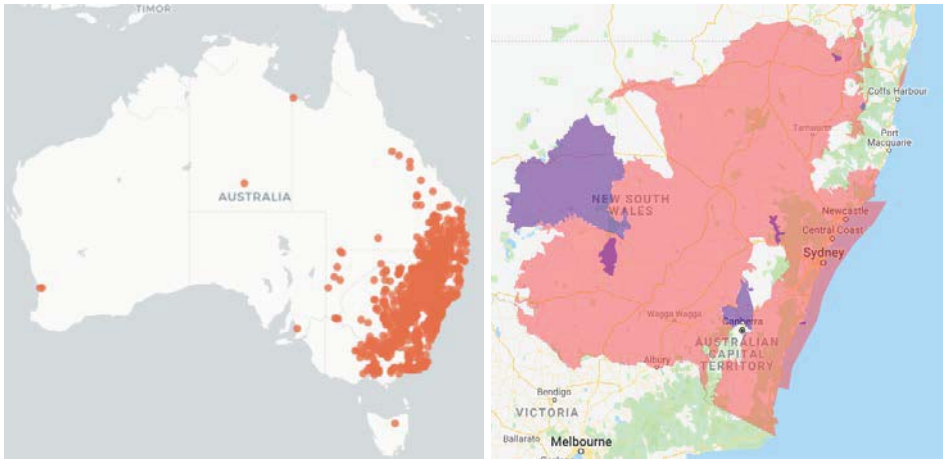


Figure 4.39 **Distribution range of Turquoise parrot**

Source: ALA (2019)

4.39.2.3 Biology and reproduction

The Turquoise parrot is primarily insectivorous but also consumes vegetable matter. The species forages on the ground in pairs or groups of up to 30 birds, feeding on the seeds of grasses and herbs. Breeding occurs in August to December. The nest is located in the hollow of a tree, log or post, and is composed of wood dust. Four to five eggs are laid (OEH 2019).

4.39.3 Habitat

The Turquoise parrot occurs where eucalypt woodland habitat for nesting and shelter is adjacent to open grassy foraging habitat. Suitable habitat includes timbered ridges, riparian woodlands and agricultural land with remnant woodland (OEH 2019).

4.39.4 Threatening processes

The following have been identified as potentially threatening processes to Turquoise parrot:

- Clearing of grassy-woodland and open forest habitat
- Loss of hollow-bearing trees and critical habitat feature degradation
- Degradation of habitat through heavy grazing, firewood collection and establishment of exotic pastures
- Predation by foxes and cats
- Illegal trapping of birds and collection of eggs which also often results in the destruction of hollows
- Inappropriate fire regimes
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy miners
- Climate change impacts including reduction in resources due to drought (OEH 2019).

4.39.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save the Turquoise Parrot *Neochema pulchella*. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=706&ReportProfileID=10555 [3 October 2019]. In effect under the BC Act 2016.

4.39.6 References

Atlas of Living Australia (2019) Neophema (Neophema) pulchella: Turquoise Parrot [online]. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:18a3adb5-3ffd-4396-a0f5-0f6b3edd75cf [4 October 2019].

Kee, L. (2008). Turquoise parrot (Neophema pulchella). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=8ba225ed-3cdb-42f1-b0b3-facb9a6b4106. [23 September 2019].

Office of Environment and Heritage, NSW (2019) Turquoise Parrot – profile [online]. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10555 [4 October].

4.40 Varied sittella (*Daphoenositta chrysoptera*)

4.40.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.40.2 Biology and ecology

4.40.2.1 Characteristics

The Varied sittella is a small bird with a length of 10 cm (refer Photograph 4.40). The species has a sharp bill and a short tail, with yellow eyes and feet. The orange wing bar is prominent during flight. Head colour is variable across the state, including white, grey and black (OEH 2019).

Photograph 4.40 Varied sittella *(Daphoenositta chrysoptera)*

Source: Aviceda (2008)

4.40.2.2 Known distribution

The Varied sittella occur most regions of Australia except the arid zones without trees and Tasmania. In New South Wales it is largely absent from the far northwest (OEH 2019) (refer Figure 4.40).

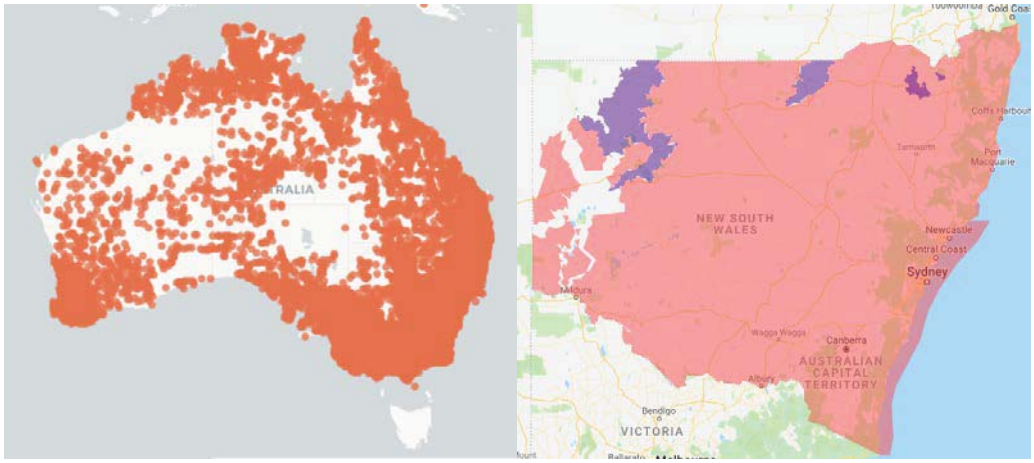


Figure 4.40 Distribution range of Varied sittella

Source: ALA (2019)

4.40.2.3 Biology and reproduction

The Varied sittella is an arboreal insectivore, feeding on ants and termites from the branches and trunks of trees with rough bark or smooth barked gums with dead branches. The species flies to the top of trees and forages in a downward direction. Breeding occurs in during September to February, when a deep cup shapes nest is built in the fork of a tree branch and camouflaged with leaves and strips of bark, held together with spider web (OEH 2019).

4.40.3 Habitat

Varied sittella habitat includes eucalypt forest and woodlands, mallee and *Acacia* woodlands. Preferred habitat includes rough-barked eucalypt species such as stringybarks and ironbarks (OEH 2019).

4.40.4 Threatening processes

The following have been identified as potentially threatening processes to Varied sittella:

- Apparent decline has been attributed to declining habitat. The sedentary nature of the Varied Sittella makes cleared land a potential barrier to movement
- The Varied sittella is also adversely affected by the dominance of Noisy miners in woodland patches
- Threats include habitat degradation through small-scale clearing for fence lines and road verges, rural tree decline, loss of paddock trees and connectivity, 'tidying up' on farms, and firewood collection
- Infestation of habitat by invasive weeds
- Inappropriate fire regimes
- Climate change impacts including reduction in resources due to drought
- Overgrazing by stock impacting on leaf litter and shrub layer (OEH 2019).

4.40.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save the Varied Sittella Daphoenositta chrysoptera [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=938&ReportProfileID=20135 [4 October 2019]. In effect under the BC Act 2016.

4.40.6 References

Atlas of Living Australia (2019) Daphoensitta (Neositta) chrysoptera: Varied Sittella [online]. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:01f22981-27bd-41aa-a0df-8df28f48d88a [4 October 2019].

Aviceda. (2008). Varied sittella (Daphoenositta chrysoptera). [image] [online] Available from: https://commons.wikimedia.org/w/index.php?curid=3720610. [23 September 2019].

Office of Environment and Heritage, NSW (2019) Varied Sittella – profile [online]. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20135 [4 October].

4.41 White-bellied sea eagle (*Haliaeetus leucogaster*)

4.41.1 Status

EPBC Act – Marine

BC Act – Vulnerable

4.41.2 Biology and ecology

4.41.2.1 Characteristics

White-bellied sea eagles are a large raptor that have a broad wing span and a short, wedge shaped tail. Measuring 75 to 85 cm in length and 180 to 220 cm across the wings they are a sizeable bird. As adults they are mostly white on the head, belly, breast and feathers across the front underside of the wings. The remainder of the underside of the wings and upper surface is grey in colour along with the base of the tail. The tail also has a white tip. The hooked bill is grey with a darker tip and the eye is dark brown. Their cream-white legs are accompanied by long black talons (refer Photograph 4.41) (OEH 2019).

Photograph 4.41 White-bellied sea eagle (*Haliaeetus leucogaster*)

Source: Kee (2007)

4.41.2.2 Known distribution

White-bellied sea eagles are distributed right around Australia's coastline including in Tasmania. Their range also extends inland along rivers and wetlands, in New South Wales they occupy these habitats throughout the Murray-Darling Basin (refer Figure 4.41) (OEH 2019).

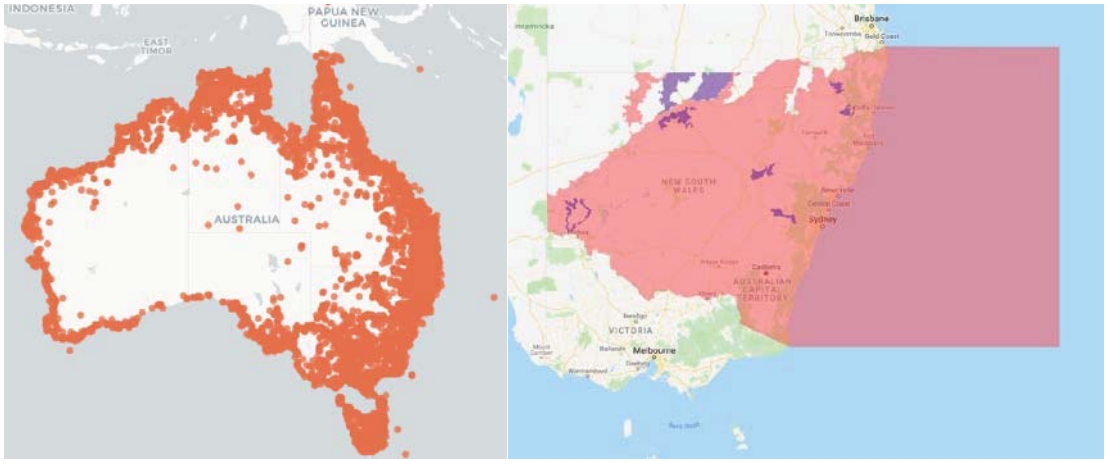


Figure 4.41 Distribution range of White-bellied sea eagle

Source: ALA (2019)

4.41.2.3 Biology and reproduction

White-bellied sea eagles feed primarily on fish and freshwater turtles but will also take water birds, reptiles, mammals and carrion. They will hunt prey from a perch or whilst in flight circling around their hunting grounds at a height of 10 to 20 m. Small prey will sometimes be eaten on the wing, otherwise carried to a feeding platform or occasionally consumed on the ground. Females will typically lay two eggs between June and September with young staying in the nest for 65 to 70 days before fledging. This species can be solitary, live in pairs or small family units consisting of the parents and dependent young (OEH 2019).

4.41.3 Habitat

White-bellied sea eagles will occupy areas that are characterised by the presence of large open water bodies including rivers, swamps, lakes and the ocean. In coastal regions they occur in areas around bays, inlets, beaches, reefs, lagoons, estuaries and mangroves. Inland they will occupy areas within the vicinity of lakes, reservoirs, billabongs and saltmarshes. They will utilise terrestrial habitats that include coastal dunes, tidal flats, grasslands, heathlands, woodlands, and even rainforest. They will use emergent and dead trees as 'guard roosts' creating large nests from sticks lining the nest with leaves (OEH 2019).

4.41.4 Threatening processes

The following have been identified as potentially threatening processes to White-bellied sea eagle (*Haliaeetus leucogaster*):

- Land clearing reducing the amount of suitable habitat forcing birds to nest in sub-optimal habitat which reduces breeding success, a persistent threat given the increase in coastal development
- As they are sensitive to disturbance nest young may be deserted as a result of exposure to human activity, residential developments, coastal tourism and coastal land sub-divisions
- Entanglement in recreational and commercial fishing gear, particularly fish farms
- Fatalities and reduced breeding success as a result of non-target poisoning during vertebrate pest control and exposure to chemicals both directly and indirectly through prey along with deliberate poisoning
- Potential impacts from climate change as inland habitats become effected by increased drought frequency reducing the availability of suitable nesting habitat (OEH 2019)

4.41.5 Threat abatement/recovery plans

No threat abatement or recovery plan exists for this species.

4.41.6 References

Atlas of Living Australia (2019). White-bellied sea eagle (*Haliaeetus leucogaster*). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:cdaae4b5-4a09-4986-8f7b-7cfdddbfc723. [2 October 2019].

Kee, L. (2007). White-bellied sea eagle (Haliaeetus leucogaster). [image] [online] Available from: https://www.flickr.com/photos/lipkee/2084118558/in/photolist-4baDQA-4vyDwp-8SdXxX-2e5XNuT-eSraCt-62BgN5-diLHbi-diXYYz-pLc9Nw-diwQYt-q3EpUL-q1qWCU-Uw592F-Yigxyg-6S5Qtb-bLjnVD-PHug8d-nhx2aP-8ASbPH-8AVkYm-4gHjnj-6S5QMA-7rXW2t-bLjqbc-eSCAVN-kgnRaz-bxuwvF-26VSBis-25WC63V-6h8yCA-tbzQ37-25WC6jr-25WC5Ng-jSSnZa-e6GddH-8AUF8K-8AXHKJ-8AUDV8-8AUCGF-5KgdKe-8AVkej-7FFNFd-7FBTx4-7FFPqq-6h4oh6-7FFP3U-6h4oic-Vy9MGR-rHHBjP-RdpCtP. [23 September 2019].

Office of Environment and Heritage, NSW (2019). White-bellied sea eagle (Haliaeetus leucogaster). [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20322. [2 October 2019].

4.42 White-fronted chat (*Epthianura albifrons*)

4.42.1 Status

EPBC Act – Not listed

BC Act – Vulnerable

4.42.2 Biology and ecology

4.42.2.1 Characteristics

The White-fronted chat is an Australian endemic passerine measuring approximately 12 cm in length and weighing 13 g. Defining features include the short slender bill, long spindly legs, a short square tipped tail and rounded wings (refer Photograph 4.42). Whilst it is classified as a honey eater it is closer in appearance to its close relative the Orange chat and Crimson chat with the most notable difference being its black and white colouration. Males of the species have more striking colouration than females and juveniles which look much the same (OEH 2019).

Photograph 4.42 White-fronted chat *(Epthianura albifrons)*

Source: Harris (2016)

4.42.2.2 Known distribution

Distributed across the southern half of Australia the White-fronted chat can be found from southernmost Queensland to southern Tasmania and across to Western Australia as far north as Carnarvon. They mostly occur in temperate to arid climates and are sometimes found in sub-tropical areas. Occupying foothills and lowlands up to 1,000 m above sea level. In New South Wales it can be found more commonly in the southern part of the state where it prefers damp open habitats (refer Figure 4.42). Along the coastline in saltmarsh vegetation but will also occupy open grasslands and sometime in low shrubs on the fringes of wetland habitat (OEH 2019).

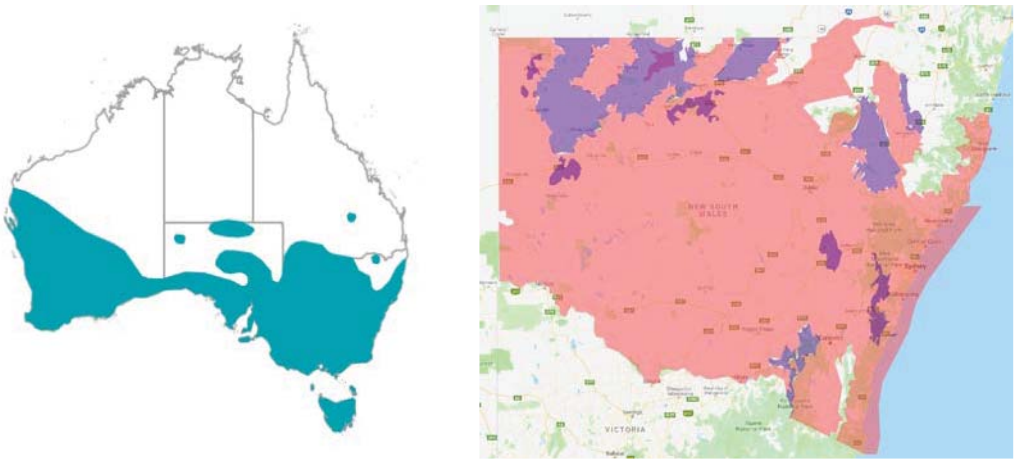


Figure 4.42 Distribution range of White-fronted chat

Source: ALA (2019)

4.42.2.3 Biology and reproduction

White-fronted chats are a gregarious species that can be found feeding either singularly or in pairs foraging on bare ground or grassy wetland areas. They are insectivorous birds consuming mostly flies and beetles they catch close to bare or grassy ground in wetland areas. These birds will live to an estimated 5 years of age reaching sexual maturing after one year old. Observations have been made of White-fronted chats breeding late July through to early March. Their nest is an 'open-cup' design that is built in low vegetation, sometimes in low isolated mangroves. The nests are anywhere between 23 cm and 2.5 m off the ground. A clutch will consist of two to three eggs with the complete nesting cycle (including nest building) finished in 50 days (OEH 2019).

4.42.3 Habitat

White-fronted chats prefer open country including inland salt lakes, estuaries, salt marshes that are accompanied by low, sparse samphire, swamp margins, open low heath and remnant low vegetation on farms (Morcombe 2010).

4.42.4 Threatening processes

The following have been identified as potentially threatening processes to White-fronted chat (*Epthianura albifrons)*:

- Reduction in habitat quality and extent
- Human disturbance in residential areas and increased nest predation
- Natural habitat is highly prone to change through modification of river flows and floodplains
- At high risk for predation from native and introduced species
- Sea-level rise and mangrove encroachment presenting threats to essential habitat (OEH 2019).

4.42.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2018). Saving our Species: White-fronted chat (*Epthianura albifrons*). Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=20143. In effect under the BC Act 2016. (OEH 2019).

4.42.6 References

Atlas of Living Australia (2019). White-fronted chat (Epthianura albifrons). [online] Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:ad93518c-5763-4f8f-8759-e31b36216e0c. [1 October 2019].

Harris, K. (2016). White-fronted chat (Epthianura albifrons). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=45008a22-91c3-4c82-b069-86c1ca8d8e71. [23 September 2019].

Morcombe, M. 2010. Aus. Birds, App.

Office of Environment and Heritage, NSW (2019). White-fronted chat (Epthianura albifrons). [online] Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20143. [1 October 2019].

4.43 White-throated needletail (*Hirundapus caudacutus*)

4.43.1 Status

EPBC Act – Vulnerable

BC Act – Not listed

4.43.2 Biology and ecology

4.43.2.1 Characteristic

The White-throated needletail (*Hirundapus caudacutus*) is a large (20 cm in length and approximately 115 to 120 g in weight) swift with a thickset, cigar-shaped body, stubby tail and long pointed wings. Sexes are alike, with no seasonal variation, and juveniles are separable with good visibility. The adults have a dark-olive head and neck, with an iridescent gloss on the crown; the mantle and the back are paler, greyish; and the upper wings are blackish, sometimes with a greenish gloss, with a contrasting white patch at the base of the trailing edge; the upper tail is black with a greenish gloss. The face is dark-olive with a narrow, white band across the forehead and lores and a white patch on the chin and throat. The underparts are generally dark-olive except for a U-shaped band across the rear flanks, the vent and the undertail coverts, and the undertail is black with a greenish gloss. The underwing is black brown with glossy grey-brown flight feathers. The bill is black, the eyes black-brown and the legs and feet are dark grey, sometimes with a pinkish tinge.

Juveniles are generally similar to adults, but in good views can be separated by being generally duller, with little gloss to the plumage; the pale saddle is duller, contrasting less with the head, neck and uppertail; and the white band across the forehead and white patches on the upperwings and the vent and undertail coverts are all less prominent and duller (Higgins 1999).

The White-throated needletail is generally gregarious when in Australia, sometimes occurring in large flocks, comprising hundreds or thousands of birds, though they are occasionally seen singly, and occasionally occur in mixed flocks with other aerial insectivores, including Fork-tailed Swifts (*Apus pacificus*) and Fairy martins (*Hirundo ariel*) (Learmonth 1950, 1951; McMicking 1925; Wheeler 1959).

Photograph 4.43 White-throated needletail (Hirundapus caudacutus)

Source: Knight (2007)

4.43.2.2 Known distribution

The White-throated needletail is widespread in eastern and south-eastern Australia (Barrett et al. 2003; Blakers et al. 1984; Higgins 1999). In eastern Australia, it is recorded in all coastal regions of Queensland and New South Wales, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains (refer Figure 4.43). Further south on the mainland, it is widespread in Victoria, though more so on the southern side of the Great Divide, and there are few records in western Victoria outside the Grampians and the South West. The species occurs in adjacent areas of south-eastern South Australia, where it extends west to the Yorke Peninsula and the Mount Lofty Ranges. It is widespread in Tasmania (Barrett et al. 2003; Blakers et al. 1984; Higgins 1999). White-throated needletails only occur as vagrants in the Northern Territory (recorded in the Top End, including around Darwin, Katherine and Mataranka and Tennant Creek; and further south around Alice Springs) and in Western Australia (at disparate sites from the Mitchell Plateau in the Kimberley, south to the Nullarbor Plain and Augusta in the South West, and west to Barrow Island, the Houman Abrolhos and the Swan River Plain) (Barrett et al. 2003; Blakers et al. 1984; Brooker et al. 1979; Sedgwick 1978; Slater 1964; Storr 1987; Storr et al. 1986; Wheeler 1959). The species is also a vagrant to various outlying islands, including Norfolk, Lord Howe, Macquarie, Christmas and Cocos-Keeling Islands (Barrand 2005; Green 1989; McAllan et al. 2004; Schodde et al. 1983; Stokes et al. 1984; Warham 1961a).

The species occurs at numerous and widespread sites in eastern Australia. There are no current captive populations of this species and none have been reintroduced into the wild.

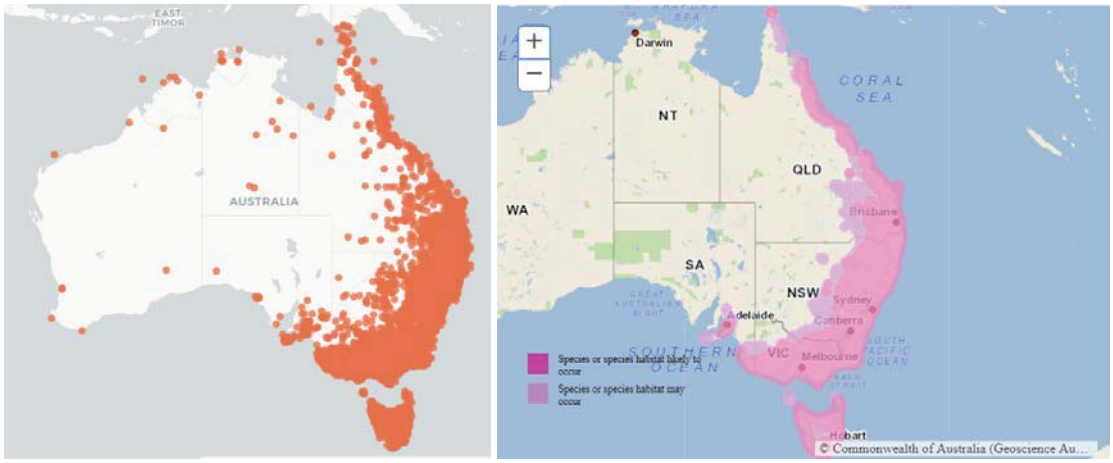


Figure 4.43 **Distribution range of the White-throated needletail (Hirundapus caudacutus)**

Source: ALA (2019)/Geoscience Australia

4.43.2.3 Biology and reproduction

The species is quite distinct, as it is larger than other swifts that occur in Australia, such as the Fork-tailed Swift, and its blunt tail instantly distinguishes it from that species. Needletails may occur at great elevations, where they are visible only as 'specks in the sky' (Cooper 1971) and only visible with the aid of binoculars, but when flying at lower altitudes are readily detectable.

The nominate subspecies *caudacutus* of the White-throated needletail is a trans-equatorial migrant, breeding in the Northern Hemisphere and flying south for the boreal winter (Chan 2001; Chantler 1999; Dingle 2004; Higgins 1999).

There are no published details of the ages of sexual maturity or life expectancy of the white-throated needletail. When in Australia, needletails are sometimes eaten by raptors, such as the Swamp Harrier (*Circus approximans*), Australian hobby (*Falco longipennis*), Peregrine falcon (*Falco peregrinus*) and Barking Owl (*Ninox connivens*) (Barnes et al. 2005; Czechura 1984; Hollands 2003; Mooney 1983; Olsen et al. 2006), and an injured needletail was killed and eaten by a Laughing Kookaburra (*Dacelo novaeguineae*) (Wheeler 1952).

This species does not breed in Australia (Higgins 1999). The White-throated needletail lays eggs from late May to early June (Chantler 1999). The nest is placed in a vertical hollow in a tall coniferous tree or on a vertical rock-face, either comprising a small bracket or half-cup of thin twigs and straw cemented together by the bird's saliva and glued to the side of the hollow or rock (Roberts 1991), or a shallow scrape among debris accumulated at the bottom of a tree hollow (Chantler 1999). Clutches usually comprise two eggs (Dement'ev & Gladkov 1951; Yamashina 1962) but some may be as large as seven eggs (Chantler 1999), and these are incubated by both sexes for 21 days (Roberts 1991) or 40 days (Chantler 1999). The chicks, which are blind and naked when they hatch, fledge after 40 to 42 days (Chantler 1999; Dement'ev & Gladkov 1951; Yamashina 1962).

4.43.3 Habitat

In Australia, the White-throated needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1,000 m above the ground (Coventry 1989; Tarburton 1993; Watson 1955). Because they are aerial, it has been stated that conventional habitat descriptions are inapplicable (Cramp 1985), but there are, nevertheless, certain preferences exhibited by the species. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland (Higgins 1999). They also commonly occur over heathland (Cooper 1971; Learmonth 1951; McFarland 1988), but less often over treeless areas, such as grassland or swamps (Cooper 1971; Gosper 1981; Learmonth 1951). When flying above farmland, they are more often recorded above partly cleared pasture, plantations or remnant vegetation at the edge of paddocks (Emison & Porter 1978; Friend 1982; Tarburton 1993).

4.43.3.1 Feeding habitat

In Australia, White-throated needletails almost always forage aerially, at heights up to 'cloud level', above a wide variety of habitats ranging from heavily treed forests to open habitats, such as farmland, heathland or mudflats (Learmonth 1951; McDonald 1938; Tarburton 1993; Templeton 1991), though they sometimes forage much closer to the ground in open habitats, once as low as about 15 cm in a coastal saltworks (Watson 1955). They sometimes forage over recently disturbed areas, such as forest that has been recently cleared or burnt, or above paddocks as they are being ploughed or slashed (Blakers et al. 1984; Bravery 1971). They often forage in areas of updraughts, such as ridges, cliffs or sand-dunes (Legge 1927; Loyn 1985a; Mitchell et al. 1996), or in the smoke of bushfires (McCulloch 1966), or in whirlwinds (Le Souëf & Campbell 1902). They often forage along the edges of low pressure systems, which both lift their food sources and assist with their flight, and it is said that they follow these systems across Australia (Boehm 1939). They seldom alight on the ground or vertical substrates to catch insects (Carlyle 1982; McCaskill 1943; Quested 1980).

4.43.3.2 Roosting habitat

The species has been recorded roosting in trees in forests and woodlands, both among dense foliage in the canopy or in hollows (Corben et al. 1982; Day 1993; Quested 1982; Tarburton 1993), though the number of references to needletails roosting in trees possibly over-emphasizes such occurrences (Higgins 1999). It has been suggested that they also sometimes roost aerially (Currie 1928; Dove 1919; Schulz & Kristensen 1994), and it was formerly erroneously thought that the species did not alight while in Australia (Pescott 1983).

4.43.3.3 Breeding habitat

The species breeds in wooded lowlands and sparsely vegetated hills, as well as mountains covered with coniferous forests (Chantler 1999; Dement'ev & Gladkov 1951).

White-throated needletails may take refuge during extreme conditions. Many birds were seen perching on the trunks of trees during a bushfire (Currie 1916; Currie 1928); during cold weather, one was found roosting during the day in the hollow branch of a eucalypt (Pettigrew & Wilson 1985) and some were seen sheltering in stunted scrub during bad weather on the high plains (Paterson 1930). They may also alight on the trunks or branches of trees during hot or inclement weather (Davies 1982; Littler 1910a; Loyn 1980; Whackett 1989; Wheeler 1959); and there is a record of needletails resting on a lawn under sprinklers during hot weather (Davies 1982).

The species does not rely on a listed threatened ecological community.

4.43.4 Threatening processes

There appear to be few threats to the populations of White-throated needletails in Australia. When in Australia, there is the constant threat of collision with overhead wires (Cameron & Hinchey 1981; Campbell 1930; Le Souëf 1917; Wheeler 1965a), windows (Slater 1964) and lighthouses (Draffan et al. 1983; Stokes 1983), though, as this affects only a few individuals, it is not a threat to the species overall.

4.43.5 Threat abatement/recovery plans

No threat abatement or recovery plan exists for this species.

4.43.6 References

Atlas of Living Australia, (2019). White-throated Needletail - *Hirundapus caudacutus*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:21205690-54fd-452a-9772-d3e1f8780dff. [1 October 2019].

Barnes, C.P., A.B. Rose & S.J.S. Debus (2005). Breeding behaviour and diet of a family of Barking Owls *Ninox connivens* in south-eastern Queensland. *Australian Field Ornithology*. 22:182-195.

Barrand, P.D. (2005). White-throated Needletail *Hirundapus caudacutus*: a new bird for Christmas Island. *Australian Field Ornithology*. 22:104-105.

Barrett, G., A. Silcocks, S. Barry, R. Cunningham & R. Poulter (2003). *The New Atlas of Australian Birds*. Melbourne, Victoria: Birds Australia.

Blakers, M., S.J.J.F. Davies & P.N. Reilly (1984). *The Atlas of Australian Birds*. Melbourne, Victoria: Melbourne University Press.

Boehm, E.F. (1939). The Fork-tailed Swift *(Micropus pacificus*, Latham 1801): with special reference to its occurrence in South Australia. *South Australian Ornithologist*. 15:54-58.

Brandis, C.C.P., C.J. Chafer, & L.E. Smith (1992). Seabirds recorded off Wollongong, New South Wales 1984-1990. *Australian Bird Watcher*. 14:165-179.

Bravery, J.A. (1971). Sight record of Uniform Swiftlet at Atherton, Qld. *Emu*. 71:182.

Brooker, M.G., M.G. Ridpath, A.J. Estbergs, J. Bywater, D.S. Hart & M.S. Jones (1979). Bird observations on the north-western Nullarbor Plain and neighbouring regions, 1967-1978. *Emu*. 79:176-190.

Cameron, R. & M. Hinchey (1981). An apparently immature White-throated Needletail in Australia. *Australian Bird Watcher*. 9:68.

Campbell, A.G. (1930). Notes on swifts. *Emu*. 29:308.

Carlyle, J. (1982). More on landings of White-throated Needletails. *Bird Observer*. 611:97.

Carter, L. (2018). *White-throated Needletail*. Available from: https://australianmuseum.net.au/learn/animals/birds/white-throated-needletail/ [Accessed 25 July 2019].

Chan, K. (2001). Partial migration in Australian landbirds: a review. *Emu*. 101:281-292.

Chantler, P. (1999). Apodidae (swifts) species accounts. **In:** del Hoyo, J., A. Elliott & J. Sargatal, eds. *Handbook of the Birds of the World. Volume 5. Barn-owls to Hummingbirds*. Page(s) 419-457. Barcelona: Lynx Edicions.

Cooper, R.P. (1971). High flying swifts. *Australian Bird Watcher*. 4:79-80.

Corben, C., G. Roberts & A. Smyth (1982). Roosting of a White-throated Needletail. *Sunbird*. 12:47-48.

Coventry, P. (1989). Comments on airborne sightings of White-throated Needletails *Hirundapus caudacutus*. *Australian Bird Watcher*. 13:36-37.

Cramp, S. (1985). *Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. Volume 4*. Oxford: Oxford University Press.

Crompton, A. (1936). Spine-tailed Swift *Hirundapus caudacutus*. *South Australian Ornithologist*. 13:183-184.

Currie, C.C. (1928). Spine-tailed Swifts perching in Victoria. *Emu*. 28:76.

Currie, K. (1916). Swifts resting on trees. *Emu*. 16:108.

Czechura, G.V. (1984). Peregrines in Queensland. *Journal of Raptor Research*. 18:81-91.

Davies, J. (1982). Daylight landings of White Throated Needletails. *Bird Observer*. 609:76.

Davis, W.A. (1965). Field notes from South Gippsland. *Australian Bird Watcher*. 2:134-138.

Dawson, P., D. Dawson, I. Reynolds & S. Reynolds (1991). Notes on the birds of Logan Reserve, southeast Queensland, 1967-1990. *Sunbird*. 21:93--111.

Day, N. (1993). Tree perching and presumed roosting of White-throated Needletails *Hirundapus caudacutus*. *Australian Bird Watcher*. 15:43-44.

Dement'ev, G.P. & N.A. Gladkov (1951). *Birds of the Soviet Union. Volume 1*. Jerusalem: Israel Program for Scientific Translations (1969).

Dingle, H. (2004). The Australo-Papuan bird migration system: another consequence of Wallace's Line. *Emu*. 104:95-108.

Dove, H.S. (1919). Migration of swifts. *Emu*. 19:53-55.

Draffan, R.D.W., S.T. Garnett & G.J. Malone (1983). Birds of the Torres Strait: an annotated list and biogeographic analysis. *Emu*. 83:207-234.

Emison, W.B. & J.W. Porter (1978). Summer surveys of birds in the Mt Cobberas - Snowy River area of Victoria, Australia. *Emu*. 78:126-136.

Friend, G.R. (1982). Bird populations in exotic pine plantations and indigenous eucalypt forests in Gippsland, Victoria. *Emu*. 82:80-91.

Gosper, D.G. (1981). Survey of birds on floodplain-estuarine wetlands on the Hunter and Richmond Rivers in northern NSW. *Corella*. 5:1-18.

Green, R.H. (1989). *Birds of Tasmania*. Launceston, Tasmania: Potoroo Publishing

Higgins, P.J. (ed.) (1999). *Handbook of Australian, New Zealand and Antarctic Birds. Volume Four - Parrots to Dollarbird*. Melbourne: Oxford University Press.

Hollands, D. (2003). Eagles, Hawks and Falcons of Australia. Second Edition. Melbourne: Bloomings Books.

Knight, R. (2007). White-throated needletail (Hirundapus caudacutus). [image] [online] Available from: https://www.flickr.com/photos/sussexbirder/8077024804/in/photolist-dCzG2D-diJS5m-diJRGS-s1aH3F. [17 September 2019].

Le Souëf, D. & A.G. Campbell (1902). Migration of swifts. Emu. 1:149.

Le Souëf, D. (1917). Spine-tailed Swift. *Emu*. 16:190-191.

Learmonth, N.F. (1950). Observations on swifts near Portland, Vic., during summer, 1949-1950. *Emu*. 50:56-58.

Learmonth, N.F. (1951). More observations on swifts. *Emu*. 51:151-152.

Legge, R.W. (1927). Birds of Sandy Cape, Tasmania. *Emu*. 27:19-23.

Littler, F.M. (1910a). *A Handbook of the Birds of Tasmania and its Dependencies*. Launceston: Published privately.

Loyn, R.H. (1980). Bird populations in a mixed eucalypt forest used for production of wood in Gippsland, Victoria. *Emu*. 80:145-156.

Loyn, R.H. (1980). Bird populations in a mixed eucalypt forest used for production of wood in Gippsland, Victoria. *Emu*. 80:145-156.

Loyn, R.H. (1985a). Bird populations in successional forests of Mountain Ash, *Eucalyptus regnans*, in central Victoria. *Emu*. 85:213-230.

McAllan, I.A.W., B.R. Curtis, I. Hutton & R.M. Cooper (2004). The birds of the Lord Howe Island Group: a review of records. *Australian Field Ornithology*. 21:1-82.

McCaskill, L.W. (1943). The invasion of New Zealand by Spine-tailed Swifts in the summer of 1942-43. *New Zealand Bird Notes*. 1:38-40.

McCulloch, E.M. (1966). Swifts and bushfires. *Emu*. 65:290.

McDonald, N.H.E. (1938). Notes on swifts. *Emu*. 38:339.

McFarland, D. (1988). The composition, microhabitat use and response to fire of the avifauna of subtropical heathlands in Cooloola National Park, Queensland. *Emu*. 88:249-257.

McMicking, F.V. (1925). Spine-tailed Swifts *(Hirundapus caudacutus)* feeding on grasshoppers. *Emu*. 25:41.

Mitchell, A., J. Peter & G. McCarthy (1996). Birds of the Ironbark Basin. *Geelong Bird Report*. 1995:29-40.

Mooney, N. (1983). Food of Swamp Harriers in Tasmania. *Australasian Raptor Association Newsletter*. 4(3):12-13.

Olsen, J., E. Fuentes, A.B. Rose & S. Trost (2006). Food and hunting of eight breeding raptors near Canberra, 1990-1994. *Australian Field Ornithology*. 23:77-95.

Paterson, A. (1930). A swift weatherbound. *Emu*. 30:147.

Pescott, T. (1983). *Birds of Geelong*. Geelong: Neptune Press.

Pettigrew, J.D. & P. Wilson (1985). Nocturnal hypothermia in the White-throated Needletail, *Hirundapus cautacutus*. *Emu*. 85:200-201.

Quested, T. (1980). Spine-tailed Swift perching on tree. *Australian Birds*. 14:52.

Quested, T. (1982). Spine-tailed Swift landing in tree. *Australian Birds*. 16:64.

Roberts, T.J. (1991). *The Birds of Pakistan. Volume 1, Non-passeriformes*. Karachi, Pakistan: Oxford University Press.

Schodde, R., P. Fullagar & N. Hermes (1983). A review of Norfolk Island birds: past and present. *Australian National Parks and Wildlife Service Special Publication*. 8.

Schulz, M. & K. Kristensen (1994). Notes on selected bird species on the south-western coast of Tasmania, between Port Davey and Cape Sorell. *Australian Bird Watcher*. 15:265-272.

Sedgwick, E.H. (1978). A population study of Barrow Island avifauna. *West Australian Naturalist*. 14:85-108.

Slater, K.R. (1964). Spine-tailed Swift in central Australia. *Emu*. 64:72.

Slater, K.R. (1964). Spine-tailed Swift in central Australia. *Emu*. 64:72.

Stokes, T. (1983). Bird casualties in 1975-76 at the Booby Island Lightstation, Torres Strait. *Sunbird*. 13:53-58.

Stokes, T., W. Sheils & K. Dunn (1984). Birds of the Cocos - Keeling Islands, Indian Ocean. *Emu*. 84:23-28.

Storr, G.M. (1987). Birds of the Eucla Division of Western Australia. *Records of the Western Australian Museum*. Suppl. 27.

Storr, G.M., R.E. Johnstone & P. Griffin (1986). Birds of the Houtman Abrolhos, Western Australia. *Records of the Western Australian Museum Supplement*. 24.

Tarburton, M.K. (1993). Radiotracking a White-throated Needletail to roost. *Emu*. 93:121--124.

Templeton, M.T. (1991). Birds of scientific area S.A.16, Marbletop, Nanango, Queensland. *Sunbird*. 21:19-25.

Warham, J. (1957). A possible record of the Spine-tailed Swift. *Western Australian Naturalist*. 5:232-233.

Warham, J. (1961a). A Spine-tailed Swift at Macquarie Island. *Emu*. 61:189-190.

Watson, I.M. (1955). Some Species Seen at the Laverton Saltworks, Victoria, 1950-1953, with Notes on Seasonal Changes. *Emu*. 55:224-48.

Whackett, M. (1989). White-throated Needletails. *Western Australian Bird Notes*. 50:1.

Wheeler, J. (1965a). A boy's care of an injured bird. *Australian Bird Watcher*. 2:152-153.

Wheeler, W.R. (1952). Some Victorian swift records. *Bird Observer*. 249:2-3.

Wheeler, W.R. (1959). Notes on Swifts, 1958-59. *Bird Observer*. 334:2-5.

Yamashina, Y. (1962). *Birds of Japan - A Field Guide*. Tokyo: Tokyo News Service.

5 Threatened ecological communities

5.1 Brigalow (*Acacia harpophylla* dominant and co dominant)

5.1.1 Status

EPBC Act – Endangered

BC Act - Endangered

5.1.2 Ecology

5.1.2.1 Characteristics and defining features

Brigalow Threatened Ecological Community (TEC) is a low woodlands or forest communities dominated by *Acacia harpophylla* (Brigalow), with pockets of *Casuarina cristata* (Belah) and *Eucalyptus populnea* subsp. *bimbil* (Poplar box). The canopy tends to be quite dense and the understorey and ground cover are only sparse (refer Photograph 5.1). The height of the tree layer varies from about 9 m in low rainfall areas (averaging around 500 mm per annum) to around 25 m in higher rainfall areas (averaging around 750 mm per annum). This community has been extensively cleared for agriculture, with most surviving remnants along roadsides and paddock edges (Butler 2007; OEH 2019).

Photograph 5.1 Brigalow TEC

5.1.2.2 Known distribution

Brigalow TEC extends from south of Charters Towers in Queensland, in a broad swathe east of Blackall, Charleville and Cunnamulla, south to northern New South Wales near Narrabri and Bourke (refer Figure 5.1). In Queensland, it occurs predominantly within the Brigalow Belt North, Brigalow Belt South, Darling Riverine Plains and Southeast Queensland bioregions. In New South Wales, remnants of Brigalow TEC mostly occur north of Burke, west of Narrabri and north of Moree (Butler 2007).

Figure 5.1 **Distribution range of Brigalow TEC**

Source: DotEE (2019)

5.1.3 Threatening processes

The following have been identified as potentially threatening processes to Brigalow TEC:

- Land clearing and fragmentation
- Invasion and establishment of weed species
- Overgrazing by domestic stock
- Changes in hydrological regimes
- Spray drift of herbicides and pesticides
- Fragmentation resulting in edge effects and risk of loss of small, scattered remnants
- Clearing and damage from road and rail maintenance activities
- Lack of viability of seed set
- Lack of pollinators
- Logging for fence posts (OEH 2019).

5.1.4 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=368&ReportProfileID=10109 [4 October 2019]. In effect under the BC Act 2016.

5.1.5 References

Butler, D.W. (2007). Recovery plan for the "Brigalow (*Acacia harpophylla* dominant and co-dominant" endangered ecological community (draft of 1 May 2007). Report to the Department of the Environment and Water Resources, Canberra. Queensland National Parks and Wildlife Service, Brisbane.

Department of the Environment and Energy (2019). Brigalow (Acacia harpophylla dominant and co-dominant) in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=28 [Accessed 31 August 2019].

Office of Environment and Heritage, NSW (2019). Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10109 [Accessed 31 August 2019].

Threatened Species Scientific Committee (2001). Brigalow (Acacia harpophylla dominant and co-dominant), advice to the Minister for the Environment and Water Resources from the Threatened Species Scientific Committee on a public nomination for an ecological community listing on the Environment Protection and Biodiversity Conservation Act 1999 [Accessed 31 August 2019].

5.2 Coolibah – Black box Woodlands of the Darling Riverine Plains and the Brigalow Belt South bioregions

5.2.1 Status

EPBC Act – Endangered

BC Act - Endangered

5.2.2 Ecology

5.2.2.1 Characteristics and defining features

Coolibah – Black Box woodland TEC is associated with floodplains and drainage areas. This TEC is defined as woodlands dominated by Eucalyptus coolabah subsp. coolabah and/or Eucalyptus largiflorens (Black box) with a grassy understory. Suitable soil for this TEC is grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands and stream banks (NSW Scientific Committee 2009). The TEC occurs a climatic zone with a summer dominated rainfall averaging 250 to 700 mm per year. The vegetative community provides characteristic habitat features of value to particular fauna, including a grassy understorey with scattered fallen logs, areas of deep-cracking clay soils, patches of thick regenerating Eucalyptus saplings, and large trees containing a diverse bark and foliage foraging resource and an abundance of small and large hollows. The fertile and relatively mesic environment of these woodlands provides essential resources for the persistence of fauna in the semi-arid region, supports a wide range of declining woodland birds and provides important nesting sites for colonial breeding waterbirds. (OEH 2019).

Photograph 5.2 Coolibah TEC

Source: Elliot (2015)

In Queensland, Coolibah TEC occur within the following REs:

- 11.3.3 - *Eucalyptus coolabah* woodland on alluvial plains
- 11.3.16 - *Eucalyptus largiflorens, ± Acacia cambagei ± A. harpophylla* woodland to low open woodland on alluvial plains

- 11.3.28 - *Eucalyptus coolabah* ± *Casuarina cristata* open woodland on alluvial plains
- 11.3.37 - *Eucalyptus coolabah* fringing woodland on alluvial plains (DSEWPC 2011).

5.2.2.2 Known distribution

Coolibah TEC are situated within the upper reaches of the Murray-Darling Basin and southern part of the Fitzroy River system and are limited to the Darling Riverine Plains and Brigalow Belt South bioregions, situated in northern New South Wales and southern Queensland (DotEE 2019) (refer Figure 5.2).

Figure 5.2 **Distribution range of Coolibah TEC**

Source: DotEE (2019)

5.2.3 Threatening processes

The following have been identified as potentially threatening processes Coolibah TEC:

- Grazing, cropping and pasture improvement
- Weeds and pest animals
- Mining activities and construction of roads and other infrastructure
- Hydrological changes
- Changes in fire regime (DotEE 2019).

5.2.4 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=376&ReportProfileID=10175 [4 October 2019]. In effect under the BC Act 2016.

5.2.5 References

Benson J. (n.d.). Coolibah woodland (Image) [Online] Available from: https://www.hsi.org.au/go/to/94/threatened-ecological-communities.html#.W4ichUxuJ9A [Accessed 19 August 2019].

Department of the Environment (2019). Coolibah – Black Box Woodlands of the darling Riverine Plains and the Brigalow Belt South Bioregions in Community and Species Profile and Threats Database. Department of the Environment. Canberra. Available from: http://www.environment.gov.au/sprat [Accessed 19 August 2019].

Elliot, D. (2015). Coolibah – Black box woodlands of the Darling Riverine Plains and the Brigalow belt south bioregions [image] [online] Available from: https://www.flickr.com/photos/drelliott0net/20918518819/in/photolist-8Hc8kk-8Hfaqb-8Hfe4L-dhXpRE-8Hc4Dr-Nr4bvD-2KjDHt-8uYQhD-8v2SEu-8uYQca-NzJdL-xSuSRz/. [18 September 2019].

NSW Scientific Committee (New South Wales Scientific Committee) (2009). Coolibah – Black Box Woodland of the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South Bioregions – reject delisting of ecological community [Accessed 19 August 2019].

Office of Environment and Heritage (2019). Threatened biodiversity profile search - Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions – profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10175 [18 September 2019].

5.3 Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland

5.3.1 Status

EPBC Act – Critically endangered

BC Act – Not listed

5.3.2 Ecology

5.3.2.1 Characteristics and defining features

The Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC occurs on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland. Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC change with seasonal conditions and are dominated by perennial tussock grasses such as *Astrebla* spp.(Mitchell grasses), *Austrostipa aristiglumis* (Plains grass), *Dichanthium sericeum* (Queensland blue grass, *Themeda australis* (Kangaroo grass), *Panicum queenslandicum* (Yadbila) or one of 13 other indicator grass species (refer Photograph 5.3). The composition of the grassland will change according to seasonal rainfall, temperature, fire and management. The TEC occurs on plains with a slope less than 5 degrees. The communities have very few trees or shrubs, but will have a diversity of herb species including legumes, orchids, daisies and lilies (OEH 2014).

Photograph 5.3 **Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC**

Source: Aurecon (2019)

In Queensland, this TEC is considered to be analogous to the following regional ecosystems REs:

- 11.3.21 *Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains (cracking clay soils)
- 11.3.24 *Themeda avenacea* grassland on alluvial plains (basalt derived soils) (TSSC 2010).

5.3.2.2 Known distribution

The natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC can be found on the Liverpool Plains and the Moree Plains of New South Wales and the Darling Downs of Queensland (OEH 2014) (refer Figure 5.3).

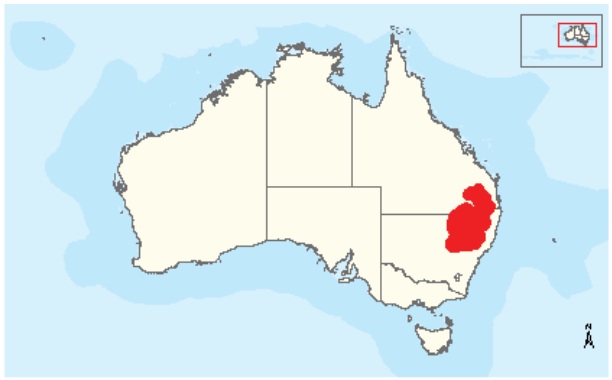


Figure 5.3 **Distribution range of natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC**

Source: DotEE (2019)

5.3.3 Threatening processes

The following have been identified as potentially threatening processes to natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC:

- Clearing for cropping and mining
- Grazing by introduced livestock
- Weed invasion
- Changed flood regimes

- Changed fire regimes
- Feral animals such as pigs (OEH 2014).

5.3.4 Conservation advice

The following conservation advice has been identified as being relevant for this species:

- Department of the Environment and Energy (2008). Approved conservation advice for Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland [online]. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/88-conservation-advice.pdf [4 October 2019]. In effect under the BC Act 2016.

5.3.5 References

Department of the Environment and Energy (2019). *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland*, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=88 [Accessed 3 September 2019].

Office of Environment and Heritage, NSW (2014). *Natural Grasslands on Alluvial Plains*. Available from: https://northerntablelands.lls.nsw.gov.au/__data/assets/pdf_file/0003/542559/TECfact-NaturalGrassland-LLS.pdf [Accessed 3 September 2019].

Threatened Species Scientific Committee (2010). Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on an Amendment to the list of Threatened Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* [Accessed 3 September 2019].

5.4 Weeping Myall Woodlands

5.4.1 Status

EPBC Act – Endangered

BC Act - Endangered

5.4.2 Ecology

5.4.2.1 Characteristics and defining features

Weeping Myall woodland TEC are predominantly underlain by red-brown earths and heavy textured grey and brown alluvial soils in areas receiving 375 mm to 500 mm of mean annual rainfall. *Acacia pendula* (Weeping Myall) is the dominant overstory flora species due to its ability to undergo regular cycles of senescence and regeneration, making it often the only tree species in a Weeping Myall woodland TEC (OEH 2017b; DEWHA 2009) (refer Photograph 5.4).

The structure of the community varies between low to open woodland and open shrubland. Understorey structure and composition is affected by latitude with areas south of the Lachlan River district featuring a dominant open layer of chenopod shrubs including saltbushes, native cotton bushes and bluebushes. More woody species and summer grasses including *Astrebla* spp. (Mitchell grass), *Dichanthium sericeum* (Queensland blue grass) as well as *Austrodanthonia* (Wallaby grass) species feature in the northern part of the TEC (DEWHA 2009).

Photograph 5.4 Weeping Myall woodland TEC

Source: Aurecon (2019)

Weeping Myall Woodland TEC are typically restricted to small patches and occur within two REs in Queensland, which are:

- 11.3.2 *Eucalyptus populnea* woodland on alluvial plains
- 11.3.28 *Casuarina cristata* ± *Eucalyptus coolabah* open woodland on alluvial plains (DEWHA 2009).

5.4.2.2 Known distribution

The TEC is found inland along alluvial plains west of the Great Diving Range in New South Wales and Queensland. Weeping Myall woodland is found in natural resource management and catchment management authority regions (refer Figure 5.4), including the:

- Border-Rivers-Gwydir catchment management authority region, New South Wales
- Border Rivers and Maranoa Balonne natural resource management region, QLD
- Condamine natural resource management region, QLD (DEWHA 2009).

Figure 5.4 Distribution range of Weeping Myall woodland TEC

Source: DotEE (2019)

5.4.3 Threatening processes

The following have been identified as potentially threatening processes to weeping Myall woodland TEC:

- Land clearing due to cropping or agriculture
- Land degradation
- Weed invasion and herbivory by caterpillars (DotEE 2019).

5.4.4 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregions [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=999&ReportProfileID=10973 [4 October 2019]. In effect under the BC Act 2016.

5.4.5 Reference

Department of the Environment (2019). *Weeping Myall Woodlands in Community and Species Profile and Threats Database*. Department of the Environment. Canberra. Available from: http://www.environment.gov.au/sprat [Accessed 17 September 2019].

Department of the Environment, Water, Heritage and the Arts (2009). *Weeping Myall Woodlands. Australian Government*. Available from: http://www.environment.gov.au/system/files/resources/a887e6ec-f4db-4476-8e72-977085028dbd/files/weeping-myall-woodlands.pdf [Accessed 17 September 2019].

Office of Environment and Heritage (2019). *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions - profile*. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10973 [Accessed 17 September 2019].

5.5 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

5.5.1 Status

EPBC Act – Critically endangered

BC Act - Endangered

5.5.2 Ecology

5.5.2.1 Characteristics and defining features

White box-Yellow box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC is an open woodland community, which have a tussock grass layer, patchy shrub layer and tree layer predominantly made up of *Eucalyptus albens*, *E. melliodora* and *E. blakelyi*. Intact sites contain a high diversity of trees, shrubs, climbing plants, grasses and especially herbs. Tree cover is generally discontinuous and consists of widely-spaced trees of medium height (refer Photograph 5.5). This ecological community occurs on moderate to highly fertile soils at altitudes of 170 m to 1,200 m (NSWSC 2002; OEH 2019; Yates and Hobbs 1997).

Photograph 5.5 **White box-yellow box-Blakely's red gum grassy woodland and derived native grassland TEC**

Source: Aurecon (2019)

5.5.2.2 Known distribution

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC occur in an arc along the western slopes and tablelands of the Great Dividing Range from southern Queensland through New South Wales to central Victoria (Beadle 1981) (refer Figure 5.5).

Figure 5.5 **Distribution range of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC**

Source: DotEE (2019)

5.5.3 Threatening processes

The following have been identified as potentially threatening processes to White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC:

- Habitat loss, degradation and fragmentation from agricultural, forestry, mining, infrastructure and residential development
- Degradation by over grazing and trampling
- Degradation of remnants by non-native plant species
- Increased nutrient status due to application of fertilisers to native groundcover
- Altered fire regimes.
- Lack of community knowledge
- Human disturbance by off road vehicles, camping, other recreational activities (OEH 2019).

5.5.4 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Office of Environment and Heritage (2019). Saving our Species: Help save the White Box Yellow Box Blakely's Red Gum Woodland [online]. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=988&ReportProfileID=10837 [4 October 2019]. In effect under the BC Act 2016.

5.5.5 References

Department of the Environment and Energy (2019). *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=43 [Accessed 4 September 2019].

Office of Environment and Heritage, NSW (2019). *White Box Yellow Box Blakely's Red Gum Woodland*. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10837 [Accessed 4 September 2019].

Threatened Species Scientific Committee (2006). Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on Amendments to the List of Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* [Accessed 4 September 2019].

Beadle, N.C.W. (1981). The Vegetation of Australia. Cambridge University Press, Cambridge.

Yates, C.J. and R.J. Hobbs (1997). Temperate Eucalypt Woodlands: a review of their status, processes threatening their persistence and techniques for restoration in Australian Journal of Botany 45: 949-973

NSW Scientific Committee (2002). *White Box Yellow Box Blakely's Red Gum Woodland – endangered ecological community listing*. Final Determination. Available from: https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2000-2003/white-box-yellow-box-blakelys-red-gum-woodland-endangered-ecological-community-listing [Accessed 4 September 2019].

Oliver, O. (n.d.). *Yellow Box grassy woodland* (Image) [Online] Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10837 [Accessed 4 September 2019].

5.6 Poplar Box Grassy Woodland on Alluvial Plains

5.6.1 Status

EPBC Act – Endangered

BC Act – Not listed

5.6.2 Ecology

5.6.2.1 Characteristics and defining features

The nominated "Poplar Box Grassy Woodland on Alluvial Plains" covers native grassy eucalypt woodland where poplar/bimble box is the main tree canopy species present. Other tree species may occasionally occur depending on the characteristics of the site, these include *Callitris glaucophylla* (White cypress pine), *Casuarina cristata* (Belah), *Eucalyptus coolabah* (Coolibah), *Eucalyptus largiflorens* (Black box), *Eucalyptus melanophloia* (Silver-leaved ironbark), *Eucalyptus microcarpa* (Inland grey box) and *Eucalyptus pilligaensis* (Narrow-leaved grey box).

The mostly grassy understorey of the poplar box grassy woodland can vary in composition depending on local hydrological conditions, rainfall, landscape position, soil type and season. It will also vary depending on fire, grazing and other management regimes. Parts of the ecological community may occasionally have patchy or scattered shrubs, particularly during droughts when hardy plants such as chenopods (saltbush) become more prevalent (DotEE 2019a).

Photograph 5.6 Poplar box grassy woodland on alluvial plains

Source: Aurecon (2019)

5.6.2.2 Known distribution

Grassy woodlands are widely distributed throughout the 'sheep-wheat belt', running from southern Queensland to central Victoria. They are characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance of openly spaced trees, such as *Eucalyptus populnea* (Poplar box). The drought tolerant grassy woodlands typically occur on fertile clay or loamy soils on alluvial plains, lower slopes, creek flats and drainage lines. But due to the productive nature of the landscape in which they occur, most have been modified or degraded. Remnant patches that retain mature trees and an intact native grassy groundlayer or a variety of wildflowers have very high conservation value and are 'rare jewels' within the now fragmented rural landscape. These patches not only provide habitat for many flora and fauna species, they provide vital reference areas for restoration of degraded woodlands. Remnant grassy woodlands provide increasingly rare natural connections with rural identity in the productive landscape (DotEE 2019a).

The ecological community mostly now occurs as scattered remnant patches inland of the Great Dividing Range in New South Wales and Queensland, within the Brigalow Belt North, Brigalow Belt South, Cobar Peneplain, Darling Riverine Plains, New South Wales South Western Slopes and Riverina IBRA bioregions.

Figure 5.6 Distribution range of Poplar Box Grassy Woodland on Alluvial Plains TEC

Source: DotEE (2019b)

5.6.3 Threatening processes

The following have been identified as potentially threatening processes to poplar box grassy woodland on alluvial plains:

- Land clearing due to agricultural, pastoral, mining and peri-urban activities
- Weed invasion and feral animals
- Inappropriate fire regimes
- Dieback and potential climate change impacts (DotEE 2019a).

5.6.4 Threat abatement/recovery plans

The following conservation advice has been identified as being relevant for this species:

- Department of the Environment and Energy (2019) Conservation Advice (including listing advice) for the Poplar Box Grassy Woodland on Alluvial Plains [online]. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/141pb-conservation-advice.pdf [4 October 2019]. In effect under the BC Act 2016.

5.6.5 Reference

Department of the Environment and Energy (DotEE) (2019a). *Conservation Advice (including listing advice) for the Poplar Box Grassy Woodland on Alluvial Plains*. Australian Government. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/141pb-conservation-advice.pdf [Accessed on 25 July 2019].

Department of the Environment and Energy (DotEE) (2019b). *Poplar Box Grassy Woodland on Alluvial Plains* in Species Profile and Threats Database. Australian Government, Canberra. Available from: https://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=141 [Accessed 25 July 2019].

5.7 Semi-evergreen Vine Thickets of the Brigalow Belts (North and South) and the Nandewar Bioregions

5.7.1 Status

EPBC Act – Endangered

BC Act - Endangered

5.7.2 Ecology

5.7.2.1 Characteristic and defining features

Semi-evergreen vine thicket TEC is considered an extreme form of dry seasonal subtropical rainforest. It is generally characterised by the prominence of trees with microphyll sized leaves and the presence of Bottle trees (*Brachychiton* spp.) as emergent. Semi-evergreen vine thicket TEC are generally less than 10 m high, made up of vines and rainforest trees as well as some shrubs (refer Photograph 5.7). The main canopy is dominated by rainforest species such as Red olive plum (*Cassine australis var. angustifolia*), Wilga (*Geijera parvifolia*), Native olive (*Notelaea microcarpa var. microcarpa*) and Peach bush (*Ehretia membranifolia*). Currant bush (*Carissa ovata*) is often present and typical vines include Gargaloo (*Parsonsia eucalytophylla*) and Wonga vine (*Pandorea pandorana*). The thickets occur in areas with a subtropical, seasonally dry climate on soils of high to medium fertility. It is common on undulating plains on fine grained sedimentary rocks (frequently shale) and on basalt hills and plains (DotEE 2019; OEH 2019; McDonald 1996).

Photograph 5.7 Semi-evergreen vine thicket TEC

Source: Aurecon (2019)

5.7.2.2 Known distribution

Semi-evergreen vine thicket TEC extend from the Townsville area in Queensland to northern New South Wales. It is mostly located within the Brigalow Belt bioregion (refer Figure 5.7). In Queensland, the remnant patches are mostly scattered from coastal dunes and river deltas through the northern and central parts of the Brigalow Belt Bioregion to its southeastern parts between Jandowae and Killarney on the Queensland/New South Wales border (Queensland Herbarium 2002). Within New South Wales it is found in small patches from south east of Boggabilla to south west of Scone (OEH 2019).

Figure 5.7 Distribution range of Semi-evergreen vine thicket TEC

Source: DotEE (2019)

5.7.3 Threatening processes

The following have been identified as potentially threatening processes to Semi-evergreen vine thicket TEC:

- Fragmentation
- Land clearing
- Inappropriate fire regimes
- Invasion by introduced pasture species and increased grazing (TSSC 2001).

5.7.4 Threat abatement/recovery plans

The following recovery plan has been identified as being relevant for this community:

- McDonald, W.J.F (2010). National recovery plan for the "Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions" ecological community. Report to Department of the Environment, Water, Heritage and the Arts, Canberra. Queensland Department of Environment and Resource Management, Brisbane. Available from: http://www.environment.gov.au/resource/national-recovery-plan-semi-evergreen-vine-thickets-brigalow-belt-north-and-south-and. In effect under the EPBC Act from 12-Mar-2010.

The following threat abatement plans have been identified as being relevant for this community:

- Department of Sustainability, Environment, Water, Population and Communities (2011). Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/resource/threat-abatement-plan-biological-effects-including-lethal-toxic-ingestion-caused-cane-toads. In effect under the EPBC Act from 06-Jul-2011.
- Department of the Environment and Energy (2017). Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (Sus scrofa) (2017). Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/feral-pig-2017. In effect under the EPBC Act from 18-Mar-2017.

5.7.5 Reference

Department of the Environment and Energy (2019). Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions in Species Profile and Threats Database, Department of the Environment and Energy, Canberra. Available from: www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=24 [Accessed 17 September 2019].

Queensland Herbarium (2002). Environment Protection and Biodiversity Conservation Act Threatened ecological communities 1997 remnant. Unpublished map, Queensland Herbarium, Brisbane.

Threatened Species Scientific Committee (2001). Commonwealth Listing Advice on Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions. Available from: www.ea.gov.au/biodiversity/threatened/communities/sevt.html [Accessed 18 September 2019].

McDonald, W.J.F. (1996). *Spatial and temporal patterns in the dry season subtropical rainforests of eastern Australia, with particular reference to the vine thickets of central and southern Queensland*. PhD thesis, B

Office of Environment and Heritage, NSW (2019). Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions - profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10749 [Accessed 17 September 2019].

5.8 Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions

5.8.1 Status

EPBC Act – Not Listed

BC Act - Endangered

5.8.2 Ecology

Carbeen open forest communities exist in areas associated with siliceous sand, earthy sands and clayey sands. This forest community can be found in flat areas with gentle rises and well draining sandy soils derived from ancient water courses, such as alluvial or aeolian sandy soils. Sometimes found on clay alluvial soils but is mostly restricted to well-drained sandy sites. Areas consisting of gentle rises or lenses are indictions of historical streams that are now some distance from existing water courses.

5.8.2.1 Characteristics and defining features

These woodland ecosystems are charachterised by the presence of Carbeen (*Corymbia tessellaris*) and White Cypress Pine (*Callitris glaucophylla*) that had been an open forest community of flora and fauna in the past, however are now present as woodland or remnant trees. Other trees associated with this forest community include *Corymbia dolichocarpa, Eucalyptus populnea, E. camaldulensis, Casuarina cristata* and *Allocasuarina leuhmannii* (OEH 2019).

Photograph 5.8 Carbeen open forest community endangered ecosystem

Source: Aurecon (2019)

5.8.2.2 Known distribution

Carbeen Open Forest Community is a distinctive plant community on the riverine plains of the Meehi, Gwydir, MacIntyre and Barwon Rivers and in small remnants farther south (OEH 2019).

Figure 5.8 Distribution range of Carbeen Open Forest Community TEC

Source: OEH 2019

5.8.3 Threatening processes

The following have been identified as potentially threatening processes to Carbeen Open Forest Community TEC:

- Fragmentation and land clearing
- Competition from invasive weed species resulting in a change of community structure and composition of flora
- Overgrazing by domestic stock
- Hydrological regimes changing due to pumping groundwater for irrigation along with artificial changes to surface water flows through drains and levees
- Impacts from agricultural run of from pesticides and herbicides
- Edge effect from fragmentation resulting in loss of small, scattered remnants
- TEC Landholders and managers lacking knowledge in the value of the TEC
- Quarry activities
- Road maintenance activities causing damage to TEC
- Inappropriate fire regimes
- Lack of pollinators.

5.8.4 Threat abatement/recovery plans

The following recovery plan has been identified as being relevant for this community:

- Office of Environment & Heritage (2019). Saving Our Species: Help save Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=373&ReportProfileID=10145.

5.8.5 Reference

Wikimedia Commons. Corymbia tessellaris (image) [online] Available from: https://commons.wikimedia.org/wiki/File:Corymbia_tessellaris.jpg [Accessed 13 September 2019].

Office of Environment and Heritage (2019). Threatened biodiversity species profiles - Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions – profile. Available online at: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10145 [Viewed 18 September 2019]

5.9 The Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River

5.9.1 Status

EPBC Act – Not Listed

BC Act - Endangered

5.9.2 Ecology

Carbeen open forest communities exist in areas associated with siliceous sand, earthy sands and clayey sands. This forest community can be found in flat areas with gentle rises and well draining sandy soils derived from ancient water courses, such as alluvial or aeolian sandy soils. Sometimes found on clay alluvial soils but is mostly restricted to well-drained sandy sites. Areas consisting of gentle rises or lenses are indications of historical streams that are now some distance from existing water courses.

5.9.2.1 Characteristics and defining features

These woodland ecosystems are characterised by the presence of Carbeen (*Corymbia tessellaris*) and White Cypress Pine (*Callitris glaucophylla*) that had been an open forest community of flora and fauna in the past, however are now present as woodland or remnant trees. Other trees associated with this forest community include *Corymbia dolichocarpa, Eucalyptus populnea, E. camaldulensis, Casuarina cristata* and *Allocasuarina leuhmannii* (OEH 2019).

Photograph 5.9 Carbeen open forest community endangered ecosystem

Source: Mark Marathon [CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0)]

5.9.2.2 Known distribution

Carbeen Open Forest Community is a distinctive plant community on the riverine plains of the Meehi, Gwydir, MacIntyre and Barwon Rivers and in small remnants farther south (OEH 2019).

Figure 5.9 **Distribution range of Carbeen Open Forest Community TEC**

Source: OEH 2019

5.9.3 Threatening processes

The following have been identified as potentially threatening processes to Carbeen Open Forest Community TEC:

- Fragmentation and land clearing
- Competition from invasive weed species resulting in a change of community structure and composition of flora
- Overgrazing by domestic stock
- Hydrological regimes changing due to pumping groundwater for irrigation along with artificial changes to surface water flows through drains and levees
- Impacts from agricultural run of from pesticides and herbicides
- Edge effect from fragmentation resulting in loss of small, scattered remnants
- TEC Landholders and managers lacking knowledge in the value of the TEC
- Quarry activities
- Road maintenance activities causing damage to TEC
- Inappropriate fire regimes
- Lack of pollinators.

5.9.4 Threat abatement/recovery plans

The following recovery plan has been identified as being relevant for this community:

- Office of Environment and Heritage (2019). Saving Our Species: Help save Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=373&ReportProfileID=10145.

5.9.5 Reference

Wikimedia Commons. Corymbia tessellaris (image) [online] Available from: https://commons.wikimedia.org/wiki/File:Corymbia_tessellaris.jpg [Accessed 13 September 2019].

Office of Environment and Heritage (2019). Threatened biodiversity species profiles - Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions – profile. Available online at: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10145 [Viewed 18 September 2019]

6 Fauna species – Migratory

6.1 Common sandpiper (*Actitis hypoleucos*)

6.1.1 Status

EPBC Act – migratory

BC Act – Not listed

6.1.2 Biology and ecology

6.1.2.1 Characteristics

The Common sandpiper (*Actitis hypoleucos*) is a small sandpiper of 19 to 21 cm in length with a wingspan of 32 to 35 cm (refer Photograph 6.1). Breeding plumage of the species is dark brown above, with a greenish gloss to feathers of cap, hindneck and mantle. Brown colouring is interspersed with irregular barring. Feathers are white underneath. The species has a prominent white eye-ring and indistinct dark eye-stripe from the bill to the rear of the ear coverts. White patches amongst darker feathers on the sides of the breast area are also notable. The species has a long tail that extends behind the wings when at rest, short legs, and a medium length bill (Higgins & Davies 1996).

Non-breeding plumage of the species is duller and more uniform in coloration. The sexes are similar and juveniles are distinguishable only when close enough to identify faint buff-spotted fringes to the feathers of head, neck, breast, mantle and scapulars (Hayman et al. 1986; Higgins & Davies 1996).

Photograph 6.1 Australasian common sandpiper (Actitis hypoleucos)

Source: Shah (2018)

6.1.2.2 Known distribution

Found along all coastlines of Australia and in many inland areas, the Common sandpiper is widespread in small numbers (refer Figure 6.1). The population when in Australia is concentrated in northern and western Australia (Blakers et al. 1984; Higgins & Davies 1996). Areas of national importance and maximum counts (Watkins 1993) include:

- Northern Territory
  - Kakadu National Park, Northern Territory (300)
  - Darwin area, Northern Territory (52)
- Western Australia
  - Nuytsland Nature Reserve, Western Australia (52)
  - Roebuck Bay, Western Australia (40)
- Queensland
  - South-eastern Gulf of Carpentaria, Queensland (235)
  - Cairns Foreshore, Queensland (42).

Bamford and colleagues (2008) claim there are few important sites within Australia due to the amount of suitable habitat for this species, and that sites in the Philippines, Myanmar, China, Russia and south-east Asia are increasingly important for migration.

In surveys of 197 wetlands in south-western Western Australia between 1981 and 1985, the species was recorded at 29 sites (Jaensch et al. 1988).

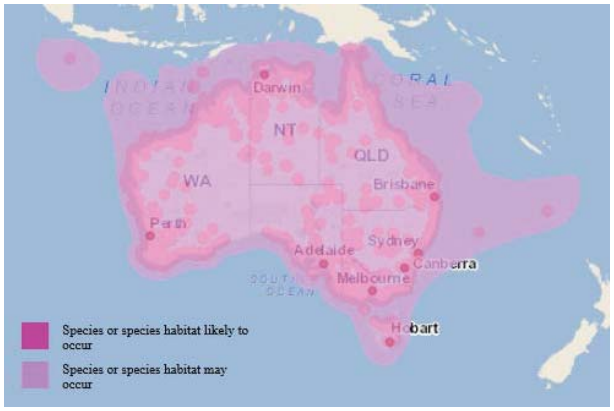


Figure 6.1 **Distribution range of the Australasian common sandpiper**

Source: DotEE (2019)

6.1.2.3 Biology and reproduction

Birds have been recorded surviving up to twelve years in banding studies to assess lifetime reproductive success in the species (Holland & Yalden 1994). Within Australia the common sandpiper is recorded either singularly or in loose groups of less than five birds (Blakers et al. 1984). Flocks are formed for migration, though even in migration individuals separate widely to feed at staging sites. The species has been known to roost with other waders (Cramp & Simmons 1983; Higgins & Davies 1996).

The Common sandpiper breeds in Europe and Asia within the period April to August (Cramp & Simmons 1983; Higgins & Davies 1996). Approximately four eggs are laid, though three to five eggs per clutch can occur. The nest is usually close to water, though not always on flat ground or the slope of banks, concealed by vegetation or overhangs. Occasionally nests are on more open, bare ground or on artificial ledges. Incubation takes approximately 21 to 22 days, and chicks fledge in 26 to 28 days (Hayman et al. 1986; Snow & Perrins 1998).

6.1.3 Habitat

6.1.3.1 Salt-water and fresh-water ecosystems

The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (Geering et al. 2007; Higgins & Davies 1996).

6.1.3.2 Foraging environments

Generally the species forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots. Birds sometimes venture into grassy areas adjoining wetlands (Higgins & Davies 1996).

6.1.3.3 Roost sites

Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks (Higgins & Davies 1996).

6.1.4 Threatening processes

6.1.4.1 Human activities

It is thought that human activities are the cause of the population decline of Common sandpipers in Europe. Such activities include:

- Habitat changes
- Regulation of rivers
- Pollution
- Use of pesticides (reducing prey abundance, especially in breeding periods) (Cramp & Simmons 1983).

6.1.4.2 Habitat loss

There are a number of threats that affect all migratory waders, including the common sandpiper, that occur in the East Asian-Australasian Flyway. The greatest threat facing waders is habitat loss, both direct and indirect (Melville 1997). Staging areas used during migration through eastern Asia are being lost and degraded by activities which are reclaiming the mudflats for future development (e.g. Barter 2002, 2005b, 2005c; Ge et al. 2007; Moores 2006; Rogers et al. 2006; Round 2006). In many suitable staging areas along the East Asia Flyway many intertidal areas have been reclaimed, and the process is continuing at a rapid rate and may accelerate in the near future (Barter 2002, 2005b, 2005c).

6.1.4.3 Reduction of quality and quantity of water

In addition, water regulation and diversion infrastructure in the major tributaries have resulted in the reduction of water and sediment flows which compound the problem (Barter 2002, 2005b; Barter et al. 1998; Melville 1997). Migratory shorebirds are also adversely affected by pollution, such as organochlorines or heavy metals discharged into the sea from industrial or urban sources, both on passage and in non-breeding areas (Barter 2005b; Blomqvist et al. 1987; Harding et al. 2007; Huettmann & Gerasimov 2006; Melville 1997; Schick et al. 1987).

6.1.4.4 Global warming

Global warming and associated changes in sea level are likely to have a long-term impact on the breeding, staging and non-breeding grounds of migratory waders (Harding et al. 2007; Melville 1997).

6.1.4.5 Potential threats

Disturbance from human activities, including shellfish harvesting, fishing and aquaculture, is likely to increase significantly in the future (Barter 2005b; Barter et al. 2005; Davidson & Rothwell 1993).

6.1.5 Threat abatement/recovery plans

There is currently no threat abatement plan or recovery plan for this species. There is a general conservation plan for migratory shorebirds:

- Department of the Environment and Energy (2015) Wildlife Conservation Plan for Migratory Shorebirds – 2015 [online]. Available at: http://www.environment.gov.au/system/files/resources/9995c620-45c9-4574-af8e-a7cfb9571deb/files/widlife-conservation-plan-migratory-shorebirds.pdf [4 October 2019].

6.1.6 References

Bamford M., D. Watkins, W. Bancroft, G. Tischler & J. Wahl (2008). *Migratory Shorebirds of the East Asian - Australasian Flyway: Population estimates and internationally important sites*. Canberra, ACT: Department of the Environment, Water, Heritage and the Arts, Wetlands International-Oceania. Available from: http://www.environment.gov.au/biodiversity/migratory/publications/shorebirds-east-asia.html.

Barter, M.A. (2002). Shorebirds of the Yellow Sea: Importance, Threats and Conservation Status. Wetlands International Global Series No. 8, International Wader Studies 12. Canberra, ACT: Wetlands International.

Barter, M.A. (2005b). Keeping the common shorebirds common: Action planning to save the Dunlin. **In:** Straw, P, ed. Status and Conservation of Shorebirds in the East Asian-Australasian Flyway. Proceedings of the Australasian Shorebirds Conference 13-15 December 2003, Canberra, Australia. Page(s) 183-187. Sydney: Wetlands International Global Series 18, International Wader Studies 17.

Barter, M.A. (2005c). Yellow Sea-driven priorities for Australian shorebird researchers. **In:** Straw, P., ed. Status and Conservation of Shorebirds in the East Asian-Australasian Flyway. Proceedings of the Australasian Shorebirds Conference 13-15 December 2003, Canberra, Australia. Sydney, NSW: Wetlands International Global Series 18, International Wader Studies 17.

Barter, M.A., D. Tonkinson, J.Z. Lu, S.Y. Zhu, Y. Kong, T.H. Wang, Z.W. Li & X.M. Meng (1998). Shorebird numbers in the Huang He (Yellow River) Delta during the 1997 northward migration. *Stilt*. 33:15-26.

Barter, M.A., K. Gosbell, L. Cao & Q. Xu (2005). Northward shorebird migration surveys in 2005 at four new Yellow Sea sites in Jiangsu and Liaoning Provinces. *Stilt*. 48:13-17.

Blakers, M., S.J.J.F. Davies & P.N. Reilly (1984). *The Atlas of Australian Birds*. Melbourne, Victoria: Melbourne University Press.

Blomqvist, S., A. Frank & L.R. Petersson (1987). Metals in liver and kidney tissues of autumn-migrating Dunlin *Calidris alpina* and Curlew Sandpiper *Calidris ferruginea* staging at the Baltic Sea. *Marine Ecology Progress Series*. 35:1-13.

Cork, J. (2019). *Common Sandpiper*. Australian Museum. Available from: https://australianmuseum.net.au/learn/animals/birds/common-sandpiper/ [Accessed 30 July 2019].

Cramp, S. & K.E.L. Simmons, eds. (1983). *Handbook of the Birds of Europe, the Middle East and North Africa. The Birds of the Western Palearctic. Volume 3, Waders to Gulls*. Oxford: Oxford University Press.

Davidson, N. & P. Rothwell (1993). Disturbance to waterfowl on estuaries. *Wader Study Group Bulletin*. 68.

Department of the Environment and Energy (2019). *Actitis hypoleucos – Common Sandpiper* in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59309 [Accessed 30 July 2019].

Ge, Z.-M., T-H. Wang, X. Zhou, K.-Y. Wang & W.-Y. Shi (2007). Changes in the spatial distribution of migratory shorebirds along the Shanghai shoreline, China, between 1984 and 2004. *Emu*. 107:19-27.

Geering, A., L. Agnew & S. Harding, eds. (2007). *Shorebirds of Australia*. Melbourne: CSIRO Publishing.

Harding, S.B., J.R. Wilson & D.W. Geering (2007). Threats to shorebirds and conservation actions. **In:** Geering, A., L. Agnew & S. Harding, eds. *Shorebirds of Australia*. Page(s) 197-213. Melbourne, Victoria: CSIRO Publishing.

Hayman, P., J. Marchant & T. Prater (1986). *Shorebirds. An identification guide to the waders of the world*. London & Sydney: Croom Helm.

Higgins, P.J. & S.J.J.F. Davies, eds (1996). *Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons*. Melbourne, Victoria: Oxford University Press.

Holland, P.K. & D.W. Yalden (1994). An estimate of lifetime reproductive success for the Common Sandpiper Actitis hypoleucos. *Bird Study*. 41:110-119.

Huettmann, F. & Y.N. Gerasimov (2006). Conservation of migratory shorebirds and their habitats in the Sea of Okhotsk, Russian Far East, in the year 2006: state-of-the-art and an outlook. *Stilt*. 50:23-33.

Jaensch, R.P., R.M. Vervest & M.J. Hewish (1988). Waterbirds in nature reserves of south-western Australia 1981-1985: reserve accounts. *RAOU Report Series*. 30.

Melville, D.S. (1997). Threats to waders along the East Asian-Australasian Flyway. **In:** Straw, P., ed. *Shorebird conservation in the Asia-Pacific region*. Page(s) 15-34. Melbourne, Victoria: Birds Australia.

Moores, N. (2006). South Korea's shorebirds: a review of abundance, distribution, threats and conservation status. *Stilt*. 50:62-72.

Rogers, D.I., N. Moores & P.F. Battley (2006). Northwards migration of shorebirds through Saemangeum, The Geum estuary and Gomso Bay, South Korea in 2006. *Stilt*. 50:73-89.

Round, P.D. (2006). Shorebirds in the Inner Gulf of Thailand. Stilt. 50:96-102.

Schick, C.T., L.A. Brennan, J.B. Buchanan, M.A. Finger, T.M. Johnson & S.G. Herman (1987). Organochlorine contamination in shorebirds from Washington state and the significance for their falcon predators. Environmental Monitoring and Assessment. 9:115-131.

Shah, I. (2018). Common sandpiper (Actitis hypoleucos). [image] [online] Available from: https://www.flickr.com/photos/gilgit2/44427278065/in/photolist-2aFTpWR-S9gWPs-2aSZEhq-2eKVLL5-85TnUf-RfxdTs-YpXXvf-SLFbCB-QcrBtn-bm2SeN-28JMeEo-To7Lst-2cJqu5M-GvCTMA-QutaHL-Hy1FDZ-pW5YFs-2d8KdLY-NoZnXa-pW6tZg-22EbXfG-DEzSa6-S6Uk1M-29Nd1Mq-3QaZXx-RW7xjq-2746P1J-pgZU8n-2aD4XR5-22nLAZA-22uEGMr-2dRNodA-JysctG-S3vetQ-ER6wWe-JmtKc2-J8ivDE-HnPo1u-22K5cBK-aBkJUf-29FQYN1-3Qf9yq-bEpLdv-qXHuc5-4F82Ew-dnX7JA-dJT6hG-JSqDBp-8CYi8j-i861hQ. [17 September 2019].

Snow, D.W. & C.M. Perrins (1998). The birds of the western Palearctic. Consise Edition. Oxford, England: Oxford University Press.

Watkins, D. (1993). A national plan for shorebird conservation in Australia. *RAOU Report Series*. 90.

6.2 Forked-tailed swift (*Apus pacificus*)

6.2.1 Status

EPBC Act – migratory

BC Act – N/A

6.2.2 Biology and ecology

6.2.2.1 Characteristics

The Fork-tailed swift (*Apus pacificus*) is a medium to large member of the Apodidae Family. It has a length of 18 to 21 cm, a wingspan of 40 to 42 cm and weighs around 30 to 40 g. It is a medium-sized swift, with a slim body with long scythe-shaped wings that taper to finely pointed tips. It is characterized by a long and deeply forked tail. It is smaller and slimmer than the White-throated needletail (*Hirundapus caudacutus*) with much narrower wings and a longer, more deeply forked tail. It is much bigger than swiftlets with much longer wings and a lower forked tail. The fork-tailed swift is mainly blackish with a white band across the rump. There is also a white patch on the chin and throat. The body, tail and upperwings are black-brown and they have a faint pale scaling to the saddle and white scalloping to the underbody. The sexes are alike with no seasonal variation, juveniles are also indistinguishable in the field (Higgins 1999).

Photograph 6.2 Australasian forked-tailed swift (Apus pacificus)

Source: Nicolson (2018)

6.2.2.2 Known distribution

Queensland

There are scattered records of the fork-tailed swift in the Gulf Country, and a few records on Cape York Peninsula (refer Figure 6.2). In the north-east region there are many records east of the Great Divide from near Cooktown and south to Townsville. They are also widespread but scattered in coastal areas from 20° S, south to Brisbane and in much of the south south-eastern region. They are more widespread west of the Great Divide, and are commonly found west of the line joining Chinchilla and Hughenden. They are found to the west between Richmond and Winton, Longreach, Gowan Range, Maraila National Park and Dirranbandi. They are rarely found further west to Windorah and Thargomindah (Higgins 1999).

New South Wales

In New South Wales, the Fork-tailed swift is recorded in all regions. Many records occur east of the Great Divide, however, a few populations have been found west of the Great Divide. These are widespread but scattered further west of the line joining Bourke and Dareton. Sightings have been recorded at Milparinka, the Bulloo River and Thurloo Downs (Higgins 1999).

Victoria

The Fork-tailed swift is widespread but sparsely scattered in all regions of Victoria (Higgins 1999).

Tasmania

There are several records of the fork-tailed swift in Tasmania. They occur on the islands of the Bass Strait, especially King Island but also on Cape Barren Island, and the Furneaux Group. There are some mainland records, mostly in the north, from Stanley East, to Cullenswood and Break O'Day Valley. Further sightings have been recorded at the Horton River, Blackburn Creek, Maria Island, Roseberry, Waddamana, Oakwood Hill, and the Henty Bridge (Higgins 1999).

South Australia

In South Australia the fork-tailed swift is widespread from the Victorian border west to the Spencer Gulf. It is also common in coastal parts of Eyre Peninsula as far west as Franklin Island, off Streaky Bay and north to 32° S. There have been a few recently published records beyond these bounds, such as in Flinders Ranges and the Lake Eyre Drainage Basin from Billa Kallina Station, Lake Eyre South and Marree. Sightings have also been recorded north to Moorayepe and east to Innamincka and Moomba (Higgins 1999).

Western Australia

In Western Australia, there are sparsely scattered records of the fork-tailed swift along the south coast, ranging from near the Eyre Bird Observatory and west to Denmark. They are widespread in coastal and subcoastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands. They are scattered along the coast from south-west Pilbara to the north and east Kimberley region, near Wyndham. There are sparsely scattered inland records, especially in the Wheatbelt, from Lake Annean and Wittenoom. They are found in the north and north-west Gascoyne Region, north through much of the Pilbara Region, and the south and east Kimberley. They are also recorded in the Timor Sea, both at sea and around islands such as the Ashmore Reef. Isolated records occur at Neale Junction in the Great Victoria Desert and on the Nullarbor Plain (Higgins 1999).

Northern Territory

In the Northern Territory, there are widespread but scattered records in the north. These include some offshore islands, mostly south to Victoria River Downs. Scattered records occur further south to Attack Creek, north of Tennant Creek. Further south, isolated records occur in the Tanami Desert, Avon Downs in the south, Barkly Tableland and, also in far south, at the Hay River. They have also been recorded in the north Simpson Desert and west near Alice Springs (Higgins 1999).

Offshore islands

Small numbers have occasionally been recorded at Lord Howe Island, Norfolk Island, Christmas Island, Macquarie Island and Chatham Island (Higgins 1999).

Figure 6.2 **Distribution range of the Australasian Fork-tailed swift**

Source: DotEE (2019)

6.2.2.3 Biology and reproduction

The Fork-tailed swift does not breed in Australia. In their breeding range, they nest on mountain cliffs or island rock caves, inside narrow crevices or in cracks on vertical cliff faces. They are also known to nest in houses and occasionally in holes in trees (Chantler & Driessens 1995; De Schauensee 1984; Grimmett et al. 1999b; O.S.J. 1974; Roberts 1991). They breed from April to July, usually in small colonies, producing two or three eggs per brood (Chantler & Driessens 1995; Grimmett et al. 1999b; Roberts 1991; Robson 2000).

6.2.3 Habitat

The Fork-tailed swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.

In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. They sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines (Higgins 1999). They forage aerially, up to hundreds of metres above ground, but also less than 1 m above open areas or over water. They often occur in areas of updraughts, especially around cliffs. They are said to search along edges of low-pressure systems, which assist flight. Low-flying swifts are said to be precursors of unsettled weather, possibly because insect prey fly at a lower altitude when the air is humid and when the air density is low (Cameron 1952). They sometimes feed aerially among tree-tops in open forest (Higgins 1999). They probably roost aerially but are occasionally observed to land (Higgins 1999). They were once recorded roosting in trees, using a bare exposed branch emergent above the foliage (Newell 1930). Sometimes they loaf in the air, by allowing strong winds to support them (Boehm 1939). There have been rare records of loafing elsewhere including swifts briefly resting on ground (Campbell 1900) and alighting on wire netting of a tennis court (Wheeler 1959).

6.2.4 Threatening processes

There are no significant threats to the Fork-tailed swift in Australia. Potential threats include habitat destruction and predation by feral animals. Due to the wide range of the species the potential impacts are thought to be negligible (Birdlife International 2009b).

6.2.5 Threat abatement/recovery plans

The following threat abatement/recovery plan has been identified as being relevant for this species:

- Department of the Environment (2015) Threat abatement plan for predation by feral cats [online]. Available at: http://www.environment.gov.au/system/files/resources/78f3dea5-c278-4273-8923-fa0de27aacfb/files/tap-predation-feral-cats-2015.pdf [4 October 2019].

6.2.6 References

Atlas of Living Australia (2019). *Apus (Apus) pacificus (Latham, 1801)*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:698f5cfc-4b81-4ed3-aebd-750d1f86a573# [Accessed 30 July 2019].

BirdLife International (2009b). Apus pacificus In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.2. *Apus pacificus*. IUCN Red List.

Boehm, E.F. (1939). The Fork-tailed Swift *(Micropus pacificus*, Latham 1801): with special reference to its occurrence in South Australia. *South Australian Ornithologist*. 15:54-58.

Cameron, A.C. (1952). At what height do birds fly?. *Emu*. 52:86-88.

Campbell, A.J. (1900). *Nests and Eggs of Australian Birds*. Sheffield, Private.

de Schauensee, R.M. (1984). *The Birds of China*. Oxford, UK: Oxford University Press.

Department of the Environment and Energy (2019). *Apus pacificus – Fork-tailed Swift* in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=678 [Accessed 30 July 2019].

Grimmett, R., C. Inskipp & T. Inskipp (1999b). *A Guide to the Birds of India, Pakistan, Nepal, Bangladesh, Bhutan, Sri Lanka, and the Maldives*. Princeton, New Jersey: Princeton University Press.

Higgins, P.J. (ed.) (1999). *Handbook of Australian, New Zealand and Antarctic Birds. Volume Four - Parrots to Dollarbird*. Melbourne: Oxford University Press.

Newell, H.H. (1930). Fork-tailed Swifts. Emu. 29:277.

Nicolson, K. (2018). Fork-tailed swift (Apus pacificus). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=64c6d1c6-cbac-456e-9566-fd84d70cfa2b. [17 September 2019].

Ornithological Society of Japan (O.S.J.) (1974). *Check-list of Japanese Birds*. Gakken Co., Tokyo.

Roberts, T.J. (1991). *The Birds of Pakistan. Volume 1, Non-passeriformes*. Karachi, Pakistan: Oxford University Press.

Robson, C. (2000). *A field guide to the birds of Thailand and South-East Asia*. Bangkok, Thailand & New Holland, London, Asia Books.

Scarff, A. (1990). Fork-tailed Swifts: Geraldton. *Western Australian Bird Notes*. 54:7.

Wheeler, W.R. (1959). Notes on Swifts, 1958-59. *Bird Observer*. 334:2-5.

6.3 Sharp-tailed sandpiper (*Calidris acuminata*)

6.3.1 Status

EPBC Act – migratory

BC Act – N/A

6.3.2 Biology and ecology

6.3.2.1 Characteristics

The Sharp-tailed sandpiper (*Calidris acuminata*) is a small-medium wader. The bird has a length of 17 to 22 cm, a wingspan of 36 to 43 cm and a weight of 65 g. It is a portly sandpiper with a flat back, pot belly and somewhat drawn-out rear end. It has a small flat head on a short neck with a short and slightly decurved bill. The species has medium length legs. At rest, the primaries are level with or slightly short of the tip of the tail. The primary projection is short in adults and moderately long in juveniles. The sexes are similar and there is marked seasonal variation (Higgins & Davies 1996).

Photograph 6.3 Australasian sharp-tailed sandpiper (Calidris acuminata)

Source: Kavanagh (2019)

6.3.2.2 Known distribution

Sharp-tailed sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage (Cramp 1985; Higgins & Davies 1996).

In Queensland, they are recorded in most regions, being widespread along much of the coast and are very sparsely scattered inland, particularly in central and south-western regions (Higgins & Davies 1996). They are widespread in most regions of New South Wales and Victoria, especially in coastal areas, but they are sparse in the south-central Western Plain and east Lower Western Regions of New South Wales, and north-east and north-central Victoria (Higgins & Davies 1996). In Tasmania, they mostly occur in coastal areas in the east from George Town to Hobart, with scattered records on the north-west coast, and west coast from Henty River and Port Davey. They also occur occasionally inland and on Bass Strait islands (Higgins & Davies 1996).

In South Australia, they are widespread in the eastern half, east of a line from Streaky Bay, north-east to Pandiburra Bore and Coonchera Waterhole. They may also be found north of Lake Eyre, north-west to Oolgawa Waterhole, south-west to Mintabie and south-east to Nunn's Bore. Further west, they are recorded at Twin Rocks and Cook, east Nullarbor Plain (Higgins & Davies 1996).

In Western Australia, scattered records occur along the Nullarbor Plain and the southern areas of the Great Victoria Desert. They are widespread from Cape Arid to Carnarvon, around coastal and subcoastal plains of Pilbara Region to south-west and east Kimberley Division. Inland records indicate the species is widespread and scattered from Newman, east to Lake Cohen, south to Boulder and west to Meekatharra (Higgins & Davies 1996).

In the Northern Territory they mostly occur in the north coastal regions, generally east to Groote Eylandt and Gove Peninsula, but also around McArthur River and east of Borroloola. Widely but sparsely scattered inland records occur south to northern Tanami Desert, and in south Northern Territory, from Alice Springs, north to Napabie Lakes and south to Uluru National Park (Higgins & Davies 1996).

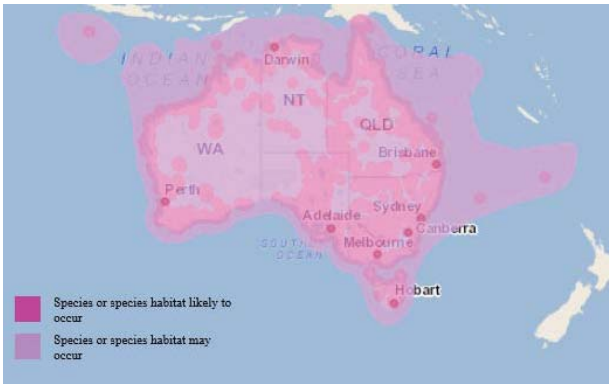


Figure 6.3 Distribution range of the sharp-tailed sandpiper

Source: DotEE (2019)

6.3.2.3 Biology and reproduction

The Sharp-tailed sandpiper forages on seeds, worms, molluscs, crustaceans and insects (Higgins & Davies 1996). The species is recorded to eat the following plant seeds: *Paspalum* spp.; *Trifolium* spp (Clover).; *Medicago* sp., *M. sativa* (Lucerne); *Ruppia* spp.; *Chenopodium* spp. (Goosefoot) and *Polygonum* spp. (Knotweed) (Higgins & Davies 1996). The species is also recorded to eat various insects, including the larvae, and molluscs and crustaceans. They also ingest grit, sand and charcoal. They are also reported to eat arachnids and dead fish (Barker & Vestjens 1989; Higgins & Davies 1996).

The Sharp-tailed sandpiper is migratory, breeding in northern Siberia and moving in flocks of less than a thousand, to non-breeding areas south of the Equator (Higgins & Davies 1996). The species departs the breeding grounds from late June, with most leaving during July.

6.3.3 Habitat

In Australasia, the Sharp-tailed sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season. They may be attracted to mats of algae and water weed either floating or washed up around terrestrial wetlands, and coastal areas with much beachcast seaweed. Sometimes they occur on rocky shores and rarely on exposed reefs (Higgins & Davies 1996).

They forage at the edge of the water of wetlands or intertidal mudflats, either on bare wet mud or sand, or in shallow water. They also forage among inundated vegetation of saltmarsh, grass or sedges. They forage in sewage ponds, and often in hypersaline environments. After rain, they may forage in paddocks of short grass, well away from water. They may forage on coastal mudflats at low tide and move to freshwater wetlands near the coast to feed at high tide. Occasionally they forage on wet or dry mats of algae and among rotting beachcast seagrass or seaweed, and sometimes they are recorded foraging around the edges of stony wetlands or among rocks in water, and rarely on exposed reef (Higgins & Davies 1996).

Roosting occurs at the edges of wetlands, on wet open mud or sand, in shallow water, or in short sparse vegetation, such as grass or saltmarsh. Occasionally, they roost on sandy beaches, stony shores or on rocks in water (Higgins & Davies 1996). They have also been recorded roosting in mangroves (Minton & Whitelaw 2000).

6.3.4 Threatening processes

The loss of important habitat reduces the availability of foraging and roosting sites. This affects the ability of the birds to build up the energy stores required for successful migration and breeding. Some sites are important all year round for juveniles who may stay in Australia throughout the breeding season until they reach maturity. A variety of activities may cause habitat loss. These include direct losses through land clearing, inundation, infilling or draining. Indirect loss may occur due to changes in water quality, hydrology or structural changes near roosting sites (DEWHA 2009).

As most migratory shorebirds have specialised feeding techniques, they are particularly susceptible to slight changes in prey sources and foraging environments. Activities that cause habitat degradation include (but are not restricted to):

- Loss of marine or estuarine vegetation, which is likely to alter the dynamic equilibrium of sediment banks and mudflats
- Invasion of intertidal mudflats by weeds such as cord grass
- Water pollution and changes to the surface water regime
- Changes to the hydrological regime
- Exposure of acid sulphate soils, hence changing the chemical balance at the site (DEWHA 2009).

Direct mortality is a result of human activities around the migration pathways of shorebirds and at roosting and foraging sites. Examples include the construction of wind farms in migration or movement pathways, bird strike due to aircraft, hunting, chemical and oil spills (DEWHA 2009).

6.3.5 Threat abatement/recovery plans

There is currently no threat abatement plan or recovery plan for this species. There is a general conservation plan for migratory shorebirds:

- Department of the Environment and Energy (2015) Wildlife Conservation Plan for Migratory Shorebirds – 2015 [online]. Available at: http://www.environment.gov.au/system/files/resources/9995c620-45c9-4574-af8e-a7cfb9571deb/files/widlife-conservation-plan-migratory-shorebirds.pdf [4 October 2019].

6.3.6 References

Barker, R.D. & W.J.M. Vestjens (1989). *The Food of Australian Birds. 1 Non-Passerines*. Lyneham, ACT: CSIRO.

Cramp, S. (1985). *Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. Volume 4*. Oxford: Oxford University Press.

Department of the Environment and Energy (2019). *Calidris acuminata – Sharp-tailed Sandpiper* in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=874 [Accessed 30 July 2019].

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009). *Draft Significant impact guidelines for 36 migratory shorebirds Draft EPBC Act Policy Statement 3.21*. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/epbc/publications/migratory-shorebirds.html.

Higgins, P.J. & S.J.J.F. Davies, eds (1996). *Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons*. Melbourne, Victoria: Oxford University Press.

Kavanagh, P. (2019). Sharp-tailed sandpiper (*Calidris acuminata*). [image] [online] Available from: https://www.flickr.com/photos/patrick_k59/46301707304/in/photolist-2dxwmsm-2f7Wpc2-2cRpB6V-2fzddoG-254uhk9-21RS3AD-J5pVor-Dnv4mM-RPUPCq-21Wxs4h-DnvAzZ-J5q4k8-2327Qcz-21xdmw8-XKp6ZK-DpvVqo-21usDbS-XFVjNK-DTHCUp-bDBKME-21xeaer-Zs78j9-21usx2Y-21xdLZX-21si5af-21Fxk46-2ghF6bq-RGryGt-23uUAdu-21usrf7-21xd7sg. [17 September 2019].

Minton, C., & J. Whitelaw (2000). Waders roosting on mangroves. Stilt. 37:23-24.

Museums Victoria (2019). *Calidris acuminata, Sharp-tailed Sandpiper*. Available from: https://collections.museumvictoria.com.au/species/8200 [Accessed 30 July 2019].

6.4 Curlew sandpiper (*Calidris ferruginea*)

Refer to Section 4.3 for details.

6.5 Pectoral sandpiper (*Calidris melanotos*)

6.5.1 Status

EPBC Act – migratory

BC Act – N/A

6.5.2 Biology and ecology

6.5.2.1 Characteristics

The Pectoral sandpiper (*Calidris melanotos*) is a small-medium sandpiper and member of the Scolopacidae family. The species has a length of 19 to 24 cm, a wingspan of 37 to 45 cm and a weight of 85 g for males and 60 g for females. The species is characterised by a flat back and a plumpish body that tapers to a drawn out rear end. The head is small and rounded, situated on a long neck. The legs are short and the bill varies from short and straight, to medium-length and gently decurved. When at rest the folded primaries (flight feathers) are level with, just short of, or slightly longer than the tip of the tail. Also, the folded primaries are short in breeding adults and long in juveniles (Higgins & Davies 1996).

Photograph 6.4 Pectoral sandpiper (Calidris melanotos)

Source: Cannizzaro (2016)

6.5.2.2 Known distribution

Queensland, New South Wales and Victorian distribution

In Queensland, most records for the pectoral sandpiper occur around Cairns. There are scattered records elsewhere, mainly from east of the Great Divide between Townsville and Yeppoon. Records also exist in the south-east of the state as well as a few inland records at Mount Isa, Longreach and Oakley. In New South Wales, the pectoral sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. West of the Great Divide, the species is widespread in the Riverina and Lower Western regions. In Victoria the pectoral sandpiper is mainly found from Port Phillip Bay and the valley of the Murray River between Kerang and Piangil. It has also been recorded at Coronet Bay (in Westernport Bay), Wimmera and Mallee (Higgins & Davies 1996).

Tasmania, South Australia and Northern Territory distribution

In Tasmania the pectoral sandpiper is very rare, however records exist for Cape Portland, Orielton Lagoon-Sorell, Barilla Bay, Clear Lagoon, Cameron Inlet and Flinders Island. In South Australia, the pectoral sandpiper is found mostly in the south-east, from north to the Murray River and west to Yorke Peninsula. Outside of this region the species is occasionally recorded in Innamincka, Welcome Bore and Mintabie. In the Northern Territory, the pectoral sandpiper is found at Darwin and Alice Springs (Higgins & Davies 1996).

Western Australian distribution

In Western Australia, the species is rarely recorded. It has been observed at the Nullarbor Plain, Reid, Stoke's Inlet, Grassmere Lake, Warden Lake, Dalyup and Yellilup Swamp, Swan River, Benger Swamp, Guraga Lake, Wittecarra, Harding River, coastal Gascoyne, the Pilbara and the Kimberley (Higgins & Davies 1996).

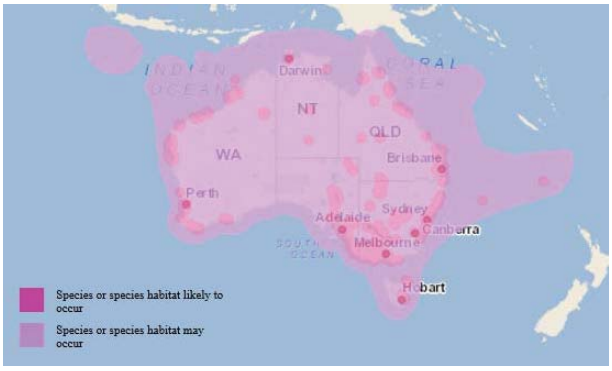


Figure 6.4 **Distribution range of the pectoral sandpiper**

Source: DotEE (2019)

6.5.2.3 Biology and reproduction

The Pectoral sandpiper is omnivorous, consuming algae, seeds, crustaceans, arachnids and insects. While feeding, they move slowly, probing with rapid strokes. They walk slowly on grass fringing water (Higgins & Davies 1996). The species is very similar in shape to the Sharp-tailed sandpiper (*Calidris acuminata*) but with a slightly slimmer, longer neck, more rounded crown, a lower more sloping forehead, slightly shorter legs and a slightly longer and more strongly decurved bill (Higgins & Davies 1996). The Pectoral sandpiper breeds in northern Russia and North America.

6.5.3 Habitat

In Australasia, the Pectoral sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.

The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands (Higgins & Davies 1996).

6.5.4 Threatening processes

The following identifies threats relevant to the Pectoral sandpiper, and migratory shorebirds in general:

- Habitat loss: The loss of important habitat reduces the availability of foraging and roosting sites. This affects the ability of the birds to build up the energy stores required for successful migration and breeding. Some sites are important all year round for juveniles who may stay in Australia throughout the breeding season until they reach maturity. A variety of activities may cause habitat loss. These include direct losses through land clearing, inundation, infilling or draining. Indirect loss may occur due to changes in water quality, hydrology or structural changes near roosting sites (DEWHA 2009).
- Habit degradation: As most migratory shorebirds have specialised feeding techniques, they are particularly susceptible to slight changes in prey sources and foraging environments. Activities that cause habitat degradation include (but are not restricted to):
  - Loss of marine or estuarine vegetation, which is likely to alter the dynamic equilibrium of sediment banks and mudflats
  - Invasion of intertidal mudflats by weeds such as cord grass
  - Water pollution and changes to the hydrological regime
  - Exposure of acid sulphate soils, hence changing the chemical balance at the site (DEWHA 2009).
- Disturbance: Disturbance can result from residential and recreational activities including; fishing, power boating, four wheel driving, walking dogs, noise and night lighting. While some disturbances may have only a low impact it is important to consider the combined effect of disturbances with other threats. Roosting and foraging birds are sensitive to discrete, unpredictable disturbances such as loud noises (i.e. construction sites) and approaching objects (i.e. boats). Sustained disturbances can prevent shorebirds from using parts of the habitat (DEWHA 2009).
- Direct mortality: Direct mortality is a result of human activities around the migration pathways of shorebirds and at roosting and foraging sites. Examples include the construction of wind farms in migration or movement pathways, bird strike due to aircraft, chemical and oil spills (DEWHA 2009).

6.5.5 Threat abatement/recovery plans

There is currently no threat abatement plan or recovery plan for this species. There is a general conservation plan for migratory shorebirds:

- Department of the Environment and Energy (2015) Wildlife Conservation Plan for Migratory Shorebirds – 2015 [online]. Available at: http://www.environment.gov.au/system/files/resources/9995c620-45c9-4574-af8e-a7cfb9571deb/files/widlife-conservation-plan-migratory-shorebirds.pdf [4 October 2019].

6.5.6 References

Atlas of Living Australia (2019). *Calidirs (Erolia) melanotos (Vieillot, 1819)*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:186ec2cd-8267-4162-8c0a-7c6bc51262c2#overview [Accessed 30 July 2019].

Cannizzaro, A. (2016). Pectoral sandpiper (Calidris melanotos). [image] [online] Available from: https://www.flickr.com/photos/acryptozoo/29119997223/in/photolist-qSpBqG-BhZinu-cRHTMG-pHjnZN-g1AAkj-g1APDA-oL5iJU-oNv7pC-LneADD-au69FW-eUyr8Q-UTHojX-cXywrQ-Uxjt8E-rDgqWE-bBcp48-VH3Z3A-p84mDi-vYJU2Y. [17 September 2019].

Department of the Environment and Energy (2019). Calidris melanotos – Pectoral Sandpiper in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=858 [Accessed 30 July 2019].

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009). *Draft Significant impact guidelines for 36 migratory shorebirds Draft EPBC Act Policy Statement 3.21*. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/epbc/publications/migratory-shorebirds.html.

Higgins, P.J. & S.J.J.F. Davies, eds (1996). *Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons*. Melbourne, Victoria: Oxford University Press.

6.6 Latham's snipe (*Gallinago hardwickii*)

6.6.1 Status

EPBC Act – migratory

BC Act – N/A

6.6.2 Biology and ecology

6.6.2.1 Characteristics

Latham's snipe (*Gallinago hardwickii*) is a medium sized wader, and the largest snipe in Australia, with a length of 29 to 33 cm, a wingspan of 50 to 54 cm and a mass of 150 to 230 g. It has a long straight bill, rather short broad pointed wings, a long tail and short legs (Higgins & Davies 1996). The cryptic plumage is intricately marked with barring and chevrons of buff, black and various shades of brown, with blackish-brown stripes across the crown and cream streaks down the back. The belly and parts of the head are white, and the tail is rufous with a white tip. The eyes are large and blackish-brown in colour (Higgins & Davies 1996; Pizzey & Knight 1997). The colour of the bill varies from pale-brown to olive, becoming blackish at the distal third and olive-yellow at the base. The legs and feet are olive-grey to olive in colour. The sexes are similar in appearance, and there is no seasonal variation in the plumage. Juveniles in fresh plumage differ only slightly from adults, but can be distinguished by slight differences in the patterning on the upperwing. Adults and juveniles are indistinguishable after early November (Higgins & Davies 1996). In non-breeding areas, snipe that are flushed from cover flee with a distinctive and rapid 'zig-zagging' flight (Weston 2006, pers. comm.).

Latham's snipe usually occurs singly or in small, loose groups of less than a dozen birds (Driscoll 1993; Higgins & Davies 1996; Naarding 1983). It is occasionally observed in larger groups of several dozen birds (Higgins & Davies 1996; Naarding 1983) or more (e.g. migrating flocks may contain up to 200 birds when they arrive in Australia) (Frith et al. 1977; Naarding 1981, 1982).

Photograph 6.5 Latham's snipe (Gallinago hardwickii)

Source: Dunens (2018)

6.6.2.2 Known distribution

Latham's snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia (i.e. it travels through northern Australia to reach non-breeding areas located further south) (Higgins & Davies 1996). The species has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia (including the Adelaide plains and Mount Lofty Ranges, and the Eyre Peninsula). The range extends inland over the eastern tablelands in south-eastern Queensland (and occasionally from Rockhampton in the north), and to west of the Great Dividing Range in New South Wales (Barrett et al. 2003; Blakers et al. 1984; Frith et al. 1977). The species is widespread in Tasmania (Barrett et al. 2003; Naarding 1983; Thomas 1979) and is found in all regions of Victoria except for the north-west (Barrett et al. 2003; Blakers et al. 1984; Emison et al. 1987). Most birds spend the non-breeding period at sites located south of the Richmond River in New South Wales (Frith et al. 1977).

The species is occasionally recorded at sites located to the west of the core range (e.g. in north-western and south-western Queensland, north-western New South Wales, mid-northern South Australia, the Northern Territory and Western Australia) (Barrett et al. 2003; Blakers et al. 1984; Bywater & McKean 1987; Frith et al. 1977; Hunt 1993). It is also an irregular visitor to Norfolk Island and Lord Howe Island, and possibly to Macquarie Island (records are unconfirmed) (Higgins & Davies 1996).

The extent of occurrence is estimated at 3,000,000 km². This estimate, which is based on published maps, is considered to be of high reliability (Garnett & Crowley 2000). There are no historical records of any changes in the extent of occurrence, but it is thought to be stable at present (Garnett & Crowley 2000; Higgins & Davies 1996).

It is difficult to predict future trends in the extent of occurrence, but they will likely be determined by the suitability of habitat throughout the range of the snipe. The use (to some extent) of some modified habitats in Australia suggests that the extent of occurrence will probably remain relatively stable (Weston 2006, pers. comm.).

The area of occupancy is estimated at 3000 km². This estimate is based on the number of 1 km² grid squares that the species is thought to occur in at the time when its population is most constrained. However, this estimate is considered to be of low reliability (Garnett & Crowley 2000).

The area of occupancy is presumed to have declined since the arrival of Europeans. No quantitative data are available to illustrate this decrease, but there is evidence of population declines having occurred during the 20th century in New South Wales (Frith et al. 1977), Victoria (Humphreys 1986; Naarding 1983), Tasmania (Legge 1932; Littler 1910) and South Australia (Naarding 1983) and, together with the widespread loss of habitat due to the drainage and clearance of wetlands, and the impact of hunting, it is highly likely that there has been a historical decline in the area of occupancy. This decline is likely to be ongoing (Garnett & Crowley 2000), but may be partially mitigated by the limited use of some modified habitats in Australia (Weston 2006, pers. comm.).

There have been no estimates of the number of locations in which Latham's snipe occurs in Australia. Estimates of the number of locations are problematic, given that the species is highly mobile, will readily move between locations as conditions become more or less favourable, has a widespread distribution and, in wet years (when potentially many wetland areas are available), can have a widely dispersed population (Naarding 1986).

The distribution of Latham's snipe is naturally fragmented (although, because of the mobility of the species, this is unlikely to have any affect on survival). The distribution is fragmented because the preferred habitat (i.e. freshwater wetlands) occurs in patches throughout the non-breeding grounds (Weston 2006, pers. comm.).

Figure 6.5 Distribution range of Latham's snipe

Source: DotEE (2019)

6.6.2.3 Biology and reproduction

Latham's snipe is an omnivorous species that feeds on seeds and other plant material (mainly from species in families such as Cyperaceae, Poaceae, Juncaceae, Polygonaceae, Ranunculaceae and Fabaceae), and on invertebrates including insects (mainly flies and beetles), earthworms and spiders and occasionally molluscs, isopods and centipedes (Frith et al. 1977; Todd 2000).

The composition of the diet can vary somewhat over the duration of the species' stay in Australia, but no clear patterns have been determined. Latham's snipe forage during the day or at night. They use their bills to jab and probe into mud that may be exposed or covered by very shallow water (Frith et al. 1977; Todd 2000).

No precise information is available on the life expectancy, although banding data indicates that birds are capable of surviving for more than four years (Driscoll 1993). The age of sexual maturity is unknown, but birds probably breed for the first time at one or two years of age (Frith et al. 1977; Naarding 1982).

Latham's snipe does not breed within Australian jurisdiction. The breeding range is confined to Japan and far eastern Russia (Higgins & Davies 1996; Naarding 1986). For summaries of the breeding biology of this species, see del Hoyo et al. (1996) or Driscoll (1993).

6.6.3 Habitat

In Australia, Latham's snipe occurs in permanent and ephemeral wetlands up to 2,000 m above sea-level (Chapman 1969; Naarding 1981). They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977; Naarding 1983; Weston 2006, pers. comm.). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith et al. 1977; Naarding 1983).

Latham's snipe occurs in temperate and tropical regions of Australia (Driscoll 1993). Its altitudinal range extends from sea-level (i.e. the coast) or possibly below. For example, there are records from near Lake Eyre (Higgins & Davies 1996) to approximately 2,000 m above sea-level (Chapman 1969; Driscoll 1993).

In Australia, Latham's snipe occurs in a wide variety of permanent and ephemeral wetlands (Naarding 1981). They usually occur in open, freshwater wetlands that have some form of shelter (usually low and dense vegetation) nearby (Frith et al. 1977; Naarding 1983; Weston 2006, pers. comm.). They generally occupy flooded meadows, seasonal or semi-permanent swamps, or open waters (Frith et al. 1977; Naarding 1983), but various other freshwater habitats can be used including bogs, waterholes, billabongs, lagoons, lakes, creek or river margins, river pools and floodplains (Frith et al. 1977; Naarding 1981, 1983). The structure and composition of the vegetation that occurs around these wetlands is not important in determining the suitability of habitat (Naarding 1983). As such, snipe may be found in a variety of vegetation types or communities including tussock grasslands with rushes, reeds and sedges, coastal and alpine heathlands, lignum or tea-tree scrub, button-grass plains, alpine herbfields and open forest (Chapman 1969; Frith 1970; Frith et al. 1977; Naarding 1983; Wall 1990).

Latham's snipe sometimes occur in habitats that have saline or brackish water, such as saltmarsh, mangrove creeks, around bays and beaches, and at tidal rivers (Frith et al. 1977; Naarding 1983; Patterson 1991). These habitats are most commonly used when the birds are on migration (Frith et al. 1977). They are regularly recorded in or around modified or artificial habitats including pasture, ploughed paddocks, irrigation channels and drainage ditches, ricefields, orchards, saltworks, and sewage and dairy farms (Fielding 1979; Frith et al. 1977; Lane & Jessop 1985; Naarding 1982, 1983). They can also occur in various sites close to humans or human activity (e.g. near roads, railways, airfields, commercial or industrial complexes) (Frith et al. 1977; Naarding 1983).

The foraging habitats of Latham's snipe are characterized by areas of mud (either exposed or beneath a very shallow covering of water) and some form of cover (e.g. low, dense vegetation) (Frith et al. 1977; Todd 2000). The snipe roost on the ground near (or sometimes in) their foraging areas, usually in sites that provide some degree of shelter, e.g. beside or under clumps of vegetation, among dense tea-tree, in forests, in drainage ditches or plough marks, among boulders, or in shallow water if cover is unavailable (Frith et al. 1977; Naarding 1982, 1983).

Latham's snipe can occur coincidentally with the painted snipe (*Rostratula benghalensis*) (i.e. both species occupy similar habitats and may sometimes come into close proximity with one another) (Weston 2006, pers. comm.).

Latham's snipe is known to occur in the upland wetlands of the New England Tablelands and Monaro Plateau, which is listed as an Endangered Threatened Ecological Community under the EPBC Act (DEH 2006). Based on the snipe's distribution and habitat preferences, it could also occur in swamps of the Fleurieu Peninsula (which are listed as Critically Endangered under the EPBC Act), temperate highland peat swamps on sandstone (which are listed as Endangered under the EPBC Act), and in the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin (which is listed as Endangered under the EPBC Act). They could also potentially occur in bluegrass (*Dichanthium*) dominant grasslands of the Brigalow Belt Bioregions (North and South) and in natural temperate grasslands of the Southern Tablelands of New South Wales and the Australian Capital Territory (both of which are listed as Endangered under the EPBC Act) if either of these communities are subject to flooding.

6.6.4 Threatening processes

Historically, the greatest threats to Latham's snipe in Australia have been a loss of habitat caused by the drainage and modification of wetlands, and excessive mortality due to hunting (Frith et al. 1977; Littler 1910; Naarding 1985). The loss of habitat in Australia has been extensive, with many of the wetlands traditionally occupied by snipe having been drained or modified (Frith et al. 1977; Naarding 1983). The impact of habitat loss upon the species is largely unknown, although it has been implicated as a likely cause of some population declines (Littler 1910), and has probably been a factor in others (M.A. Weston 2006, pers. comm.).

The past impacts of shooting are better known. The species was formerly hunted, legally, in all states in eastern Australia. It has been estimated that up to 10 000 birds (including 6000 birds in Victoria and 1,000 birds in Tasmania) were killed annually by hunters before bans on shooting were introduced in 1976 (in New South Wales), 1983 (in Tasmania) and 1984 (in Victoria) (shooting is also banned in Queensland and South Australia, but the dates at which bans were introduced are unknown) (Naarding 1981, 1983, 1985, 1986; M.A. Weston February 2006, pers. comm.).

The current major threat to the species appears to be the ongoing loss of habitat. The wetland habitats occupied by Latham's snipe are threatened by a variety of processes including drainage, diversion of water for storage or agriculture, development of land for urban or other purposes, and land management practices such as mowing of habitat during summer can render it unsuitable for several months (Frith et al. 1977; Garnett & Crowley 2000; Naarding 1981, 1985; Weston 1995). The habitat is also potentially threatened by vegetational replacement: on Cape York Peninsula, grasslands occupied by snipe on migration are being replaced by broad-leaved tea-tree (*Melaleuca viridiflora*) woodland, although the current rate of replacement (5 per cent per decade) is not sufficient to threaten the species at present (Crowley & Garnett 1998; Garnett & Shephard 1997; Garnett & Crowley 2000).

There do not appear to be any other major threats to the species at present. The birds are said to be easily disturbed by the intrusion of humans or cattle into their habitats (Naarding 1983), but some populations occupy wetlands that are prone to disturbance, e.g. near industrial complexes, roads or railways, airfields, within school grounds (Higgins & Davies 1996; Naarding 1982, 1983). The pollution of wetlands (via nutrient enrichment, industrial discharge or inappropriate land management practices) and the salinization of wetlands are potential threats to the snipe (Melville 1997; M.A. Weston February 2006, pers. comm.), but no information is available on the impact of pollution or salinization upon snipe populations. Collisions with vehicles could be a potential minor threat to some snipe, as birds are known to roost at times beside roadside puddles (M.A. Weston February 2006, pers. comm.).

6.6.5 Threat abatement/recovery plans

There is currently no threat abatement plan or recovery plan for this species. There is a general conservation plan for migratory shorebirds:

- Department of the Environment and Energy (2015) Wildlife Conservation Plan for Migratory Shorebirds – 2015 [online]. Available at: http://www.environment.gov.au/system/files/resources/9995c620-45c9-4574-af8e-a7cfb9571deb/files/widlife-conservation-plan-migratory-shorebirds.pdf [4 October 2019].

6.6.6 References

Barrett, G., A. Silcocks, S. Barry, R. Cunningham & R. Poulter (2003). *The New Atlas of Australian Birds*. Melbourne, Victoria: Birds Australia.

Birdlife Australia (2019). *Latham's Snipe*. Available from: http://www.birdlife.org.au/bird-profile/lathams-snipe [Accessed 30 July 2019].

Blakers, M., S.J.J.F. Davies & P.N. Reilly (1984). *The Atlas of Australian Birds*. Melbourne, Victoria: Melbourne University Press.

Bywater, J., & J.L. McKean (1987). A record of Lathams Snipe *Gallinago hardwickii* in the Northern Territory. *Australian Bird Watcher*. 12:65.

Chapman, G. (1969). Notes on birds of the Kosciusko high country. *Canberra Bird Notes*. 1(4):2-6.

Crowley, G.M. & S.T. Garnett (1998). Vegetation change in the grasslands and grassy woodlands of central Cape York Peninsula. *Pacific Conservation Biology*. 4:132-148.

del Hoyo, J., A. Elliott & J. Sargatal, eds. (1996). *Handbook of the Birds of the World. Volume 3, Hoatzin to Auks*. Barcelona: Lynx Edicions.

Department of the Environment and Energy (2019). *Gallinago hardwickii – Latham's Snipe, Japanese Snipe* in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=863 [Accessed 30 July 2019].

Department of the Environment and Heritage (2006a). *Upland wetlands of the New England Tablelands and the Monaro Plateau information sheet*. www.deh.gov.au.

Driscoll, P.V. (1993). Summary of Banding Data and a Literature Review for Five Species of Migratory Bird: Red-necked Stint (Calidus ruficollis), Little Tern (Sterna albifrons sinensis), Eastern Curlew (Numenius madagascariensis), Great Knot (Calidris tenuirostris) and Latham's. Report for the Australian National Parks and Wildlife Service, Canberra.

Dunens, E. (2018). Latham's snipe (Gallinago hardwickii). [image] [online] Available from: https://www.flickr.com/photos/blachswan/39986095442/in/photolist-jyK8z1-pBrUzW-bmFekY-JANDUp-qDak1C-iN5xUh-22AL3MQ-22bh6fR-Dq3z2q-JPsxEc-23At3Sg-K2mF9F-RpTFBC-22Tvciu-22sZ8Qm-21si5jo-22bh5Y8-28Fqu4J-FQkbtL-FGpjt2-23Vrc5E. [17 September 2019].

Emison,W.B., C.M. Beardsell, F.I. Norman, R.H. Loyn & S.C. Bennett (1987). Atlas of Victorian Birds. Melbourne: Department of Conservation (Forest & Lands) & Royal Australian Ornithological Union.

Fielding, P. (1979). Avifauna of Tasmanian orchards. *Tasmanian Naturalist*. 56:7-8.

Frith, H.J. (1970). The Japanese Snipe *Gallinago hardwickii* - a preliminary report. *CSIRO Division of Wildlife Research Technical Memorandum 6*.

Frith, H.J., F.H.J. Crome & B.K. Brown (1977). Aspects of the Biology of the Japanese Snipe *Gallinago hardwickii*. *Australian Journal of Ecology*. 2:341-368.

Garnett, S.T. & G.M. Crowley (2000). *The Action Plan for Australian Birds 2000*. Canberra, ACT: Environment Australia and Birds Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/action/birds2000/index.html.

Garnett, S.T., & S. Shephard (1997). Cape York Peninsula, Australia, as a stopover site for Latham's Snipe *Gallinago hardwickii*. *Stilt*. 30:54-55.

Higgins, P.J. & S.J.J.F. Davies, eds (1996). *Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons*. Melbourne, Victoria: Oxford University Press.

Humphreys, J.S. (1986). Birds of Cherry Lake, Altona, Victoria - annotated comments on species and seasonal movements. *Australian Bird Watcher*. 11:153-166.

Hunt, J. (1993). Latham's Snipe confirmed in South-West. *Western Australian Bird Notes*. 65:1-2.

Lane, B.A. & A.E. Jessop (1985). National Wader Count - Report to Participants. *Unpublished report for Royal Australasian Ornithologists Union, Melbourne*.

Legge, R.W. (1932). Australian Snipe. *Emu*. 31:308.

Littler, F.M. (1910a). *A Handbook of the Birds of Tasmania and its Dependencies*. Launceston: Published privately.

Melville, D.S. (1997). Threats to waders along the East Asian-Australasian Flyway. **In:** Straw, P., ed. *Shorebird conservation in the Asia-Pacific region*. Page(s) 15-34. Melbourne, Victoria: Birds Australia.

Naarding, J.A. (1981). Latham's Snipe *(Gallinago hardwickii)* in Tasmania. *Wildlife Division Technical Report*. 81/2. Tasmania: National Parks and Wildlife Service.

Naarding, J.A. (1982). Latham's Snipe *(Gallinago hardwickii)* in Tasmania. *Wildlife Division Technical Report*. 82/1. Tasmania: National Parks and Wildlife Service.

Naarding, J.A. (1983). Latham's Snipe *(Gallinago hardwickii)* in Southern Australia. *Wildlife Division Technical Report*. 83/01. Tasmania: National Parks and Wildlife Service.

Naarding, J.A. (1985). Latham's Snipe *(Gallinago hardwickii)* in Australia and Japan. *Wildlife Division Technical Report*. 85/2. Tasmania: National Parks and Wildlife Service.

Naarding, J.A. (1986). Lathams Snipe, *Gallinago hardwickii*, in Australia and Japan. *RAOU Report Series*. 24:1-74.

Patterson, R.M. (1991). Bird observations 1990 - systematic list. *Tasmanian Bird Report*. 20:32-52.

Pizzey, G. & F. Knight (1997). *The Graham Pizzey and Frank Knight Field Guide to the Birds of Australia*. Sydney: Angus & Robertson.

Todd, M.K. (2000). Feeding ecology of Latham?s Snipe *Gallinago hardwickii* in the Lower Hunter Valley. *Emu*. 100:133-138.

Wall, L. (1990). Letter to the editor. *Stilt*. 17:77.

Weston, M.A. (1995b). Snipers band together in the suburbs. *Geo*. 17:18-19.

Weston, M.A. (2006). *Personal communication, February 2006*.

6.7 White-throated needletail (*Hirundapus caudacutus*)

Refer to Section 4.42.2.2 for details.

6.8 Yellow wagtail (*Motacilla flava*)

6.8.1 Status

EPBC Act – migratory

BC Act – N/A

6.8.2 Biology and ecology

6.8.2.1 Habitat and known distribution

The Yellow wagtail (*Motacilla flava*) is an extremely uncommon, non-breeding migrant species. The numbers of individuals at any one site are so small relative to their global populations that no small group of individuals is likely to be significant for either the species in Australia or the ecological attributes of a site. For these taxa lodgement of records to the Commonwealth is the only recommendation to proponents.

Photograph 6.6 Yellow wagtail (Motacilla flava)

Source: Pestana (2011)

Habitat that is important to the species consists of non-breeding habitat only. This includes mostly well-watered open grasslands and the fringes of wetlands. Roosts in mangroves and other dense vegetation are also considered important habitats.

Figure 6.6 **Distribution range of the Yellow wagtail**

Source: DotEE (2019)

6.8.3 Threatening processes

No threats have been identified for this species.

6.8.4 Threat abatement/recovery plans

There is currently no threat abatement plan or recovery plan for this species. There is a general conservation plan for migratory shorebirds:

- Department of the Environment and Energy (2015) Wildlife Conservation Plan for Migratory Shorebirds – 2015 [online]. Available at: http://www.environment.gov.au/system/files/resources/9995c620-45c9-4574-af8e-a7cfb9571deb/files/widlife-conservation-plan-migratory-shorebirds.pdf [4 October 2019].

6.8.5 References

Atlas of Living Australia (2019). *Motacilla (Budytes) flava Linnaeus, 1758*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:5b193d88-79d6-4a38-9c11-1385bace84c8#overview [Accessed 30 July 2019].

Department of the Environment (2015). *Referral guideline fore 14 birds listed as migratory species under the EPBC Act*. Australian Government. Available from: http://www.environment.gov.au/system/files/resources/c05f5b87-0a99-4998-897e-7072c236cf83/files/migratory-birds-draft-referral-guideline.pdf [Accessed 30 July 2019].

Department of the Environment and Energy (2019). *Motacilla flava – Yellow Wagtail* in Species Profile and Threats Database. Australian Government. Available from: http://155.187.2.69/cgi-bin/sprat/public/publicspecies.pl?taxon_id=644 [Accessed 30 July 2019].

Pestana, F. (2011). Yellow wagtail (Motacilla flava). [image] [online] Available from: https://www.flickr.com/photos/ferranp/5652899418/in/photolist-9BwA45-HRgKqh-gR7PEB-fqKQ16-o1PHy5-fqKQjV-gR7PRD-fqKQdF-nmAZEj-QJYupF-o1PHxd-nsA7DR-nYSZa3-29bQGXw-QPEsnm-RkvQME-J6aFCJ-4Gy77j-k732Zo-RxsJbL-eKmW48-nuDpMn-nqQ8ZW-2dXB6Bd-s7mLvg-9T9Y7S-9T7afH-2nhuTx-9JQHoM-o1PHD5-cSUaUY-9T9ZRQ-aLjuZe-9Ec8xC-o1CfSD-qbdtXd-nhXMG3-gR6SDW-gUkByF-o1PHKC-aD92DN-o1CfKK-nJr6Eq-DRXEbo-9T9Z4W-p9jAnR-nYSZqy-9E3tPb-eujvUb-dJQUtZ. [17 September 2019].

6.9 Satin flycatcher (*Myiagra cyanoleuca*)

6.9.1 Status

EPBC Act – migratory

BC Act – N/A

6.9.2 Biology and ecology

6.9.2.1 Characteristics

The Satin flycatcher (*Myiagra cyanoleuca*) is a member of the Dicruridae family. They have a length around 17.5 cm, a wingspan of 23 cm and a weight of 17 g. The species is characterised by an upright posture, short erectile crest, and a distinctive habit of quivering the tail when perched. Males are glossy blue-black above, with a blue-black chest and white below, while females are duskier blue-black above, with a orange-red chin, throat and breast, and white underparts and pale-edged wing and tail feathers. Young birds are dark brown-grey above, with pale streaks and buff edges to the wing feathers, and a mottled brown-orange throat and chest (Higgins et al. 2006).

Photograph 6.7 Satin flycatcher (Myiagra cyanoleuca)

Source: Musser (2014), Harris (2016)

6.9.2.2 Known distribution

The Satin flycatcher is widespread in eastern Australia and vagrant to New Zealand (Blakers et al. 1984; Coates 1990a). In Queensland, it is widespread but scattered in the east, being recorded on passage on a few islands in the western Torres Strait (refer Figure 6.7). It is patchily recorded on Cape York Peninsula, from the Cape south to a line between Aurukun and Coen. The species is more widespread farther south, though still scattered, from Musgrave Station south to c. 24° S, mostly in coastal areas, but also on the Great Divide, and occasionally further west (Blakers et al. 1984). Satin flycatchers are widespread in south-eastern Queensland, in the area from Fraser Island, west to Goombi and south to the New South Wales border (Blakers et al. 1984). In New South Wales, they are widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains (Blakers et al. 1984; Cooper & McAllan 1995; Morris et al. 1981).

In Victoria, the species is widespread in the south and east, in the area south of a line joining Numurkah, Maldon, the northern Grampians, Balmoral and Nelson (Blakers et al. 1984; Emison et al. 1987). They are sparsely scattered on the western plains and very occasionally further north (e.g. a few scattered sites in the Little Desert) (Emison et al. 1987).

In Tasmania, they are widespread in the east, mostly west to a line joining Ulverstone and South Cape, though they are recorded farther west along the northern coast and in the north-west, and are very occasionally recorded at scattered sites near the western coast (e.g. Temma, Strahan and Port Davey) (Blakers et al. 1984; Green & McGarvie 1971). They regularly occur on islands in the Bass Strait (e.g. Albatross Island, King Island and the Furneaux Group) (Blakers et al. 1984).

In South Australia, they are occasionally recorded, mostly in the lower south-east, occasionally as far north as Naracoorte (Blakers et al. 1984). There have been six records at scattered sites in the area from Langhorne Creek, west to eastern Kangaroo Island and north to Sandy Creek (Blakers et al. 1984). There are records from farther west (e.g. 13 km east of Kimba on the Eyre Peninsula, and at Marree and Billa Kalina Bore) (Carpenter 1985; Eckert 1987).

In Western Australia, there is a single vagrant record from Twilight Cove and in the Northern Territory (Brooker 1974a), there is an unconfirmed report from Bang Bang Billabong in Kakadu National Park (Andrew & Eades 1991).The satin flycatcher occurs at many scattered sites in New Guinea and offshore islands, including Bismarck, D'Entrecasteaux and Louisiade Archipelagos.

Figure 6.7 **Distribution range of Satin flycatcher**

Source: Atlas of Australia (2019)

6.9.2.3 Biology and reproduction

Satin flycatchers are mainly insectivorous, preying on arthropods, mostly insects, although very occasionally they will also eat seeds. They are arboreal foragers, feeding high in the canopy and subcanopy of trees, usually sallying for prey in the air or picking prey from foliage and branches of trees, flitting from one perch to another, constantly wagging their tail (Frith 1969; Green 1995; Loyn 1980, 1985a; Officer 1969; Taylor et al. 1997b). On Kangaroo Island, South Australia, they have been recorded sallying for flying insects in the middle and upper layers of 5 m tall eucalypt mallee.

The birds breed throughout Australia. They prefer to nest in a fork of outer branches of trees, such as paperbarks, eucalypts, and banksias (Gilbert 1935; BA NRS 2002). From 83 records in the Birds Australia Nest Record Scheme 2002, 78 (94 per cent) were in eucalypts, including Tasmanian blue gum, manna gum, broad-leaved peppermint, mountain grey gum, narrow-leaved peppermint, messmate, mountain gum, snow gum, broad-leaved stringybark, Sydney peppermint and yellow box. Two (2.4 per cent) nests were in blackwood, two (2.4 per cent) in broad-leafed paperbark, and one (1.2 per cent) in an unidentified tree (BA NRS 2002). Satin flycatchers usually nest in a high, exposed position in a slender fork on an outer branch, also on dead horizontal branches and once on a branch which curved upwards in a shallow bow, with the nest at the highest part of the curve (BA NRS 2002). They nest in the same locality each year, and sometimes in the same tree (BA NRS 2002; Howe 1928; Napier 1969). The average height of the nest is 12.3 m (BA NRS 2002; Gilbert 1935; Howe 1928). Where satin flycatchers breed at elevations of more than 600 m above sea level in south-eastern Australia, they breed from November to early January (Frith 1969). In Queensland, eggs have been recorded in December (BA NRS 2002). In New South Wales, eggs have been recorded between November and January (BA NRS 2002; Gilbert 1935; Morris et al. 1981). In Victoria, satin flycatchers breed between November and March, with 84 per cent of records (49 breeding records) from between November and January (BA NRS 2002; Emison et al. 1987).

6.9.3 Habitat

Satin flycatchers generally inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests (Blakers et al. 1984; Emison et al. 1987; Officer 1969).

The birds mainly inhabit eucalypt forests, often near wetlands or watercourses. They generally occur in moister, taller forests than the leaden flycatcher (*Myiagra rebecula*) often occurring in gullies (Blakers et al. 1984; Emison et al. 1987; Officer 1969). They also occur in eucalypt woodlands with open understorey and grass ground cover, and are generally absent from rainforest (Emison et al. 1987; Officer 1969). In south-eastern Australia, they occur at elevations of up to 1400 m above sea level, and in the ACT, they occur mainly between 800 m above sea level and the treeline (Emison et al. 1987; Taylor & COG 1992).

Satin flycatchers are mainly recorded in eucalypt forests, especially wet sclerophyll forest, often dominated by eucalypts such as *Eucalypt fastigata* (Brown barrel), *E. dalrympleana* (Mountain gum), Mountain grey gum, Narrow-leaved peppermint, Messmate or Manna gum, or occasionally *E. regnans* (Mountain ash). Such forests usually have a tall shrubby understorey of tall acacias, for example *Acacia melanoxylon* (Blackwood). In higher altitude *E. stellulata* (Black sallee), woodlands, they are often associated with tea-trees and tree-ferns (Emison et al. 1987; Loyn 1985a; Mac Nally 1997). They sometimes also occur in dry sclerophyll forests and woodlands, usually dominated by eucalypts such as *E. blakelyi* (Blakely's red gum), *E. sideroxylon* (Mugga ironbark), Yellow box, *E. albens* (White box), Manna gum or stringybarks, including *E. macrorhyncha* (Red stringybark) and Broad-leaved stringybark, usually with open understorey (Ford & Bell 1981; Traill et al. 1996). In the uplands of East Gippsland, they occur in pasture with scattered eucalypts (Emison & Porter 1978). On passage, they sometimes occur in riparian river red gums (*E. camaldulensis*) (Emison et al. 1987). The few records in South Australia have mostly been from eucalypt mallee woodland or mixed eucalypt-moonah (*Melaleuca lanceolata*), mallee shrubland with an understorey of heathy shrubs. They have also been seen in tall, open stringybark forest with scattered *Pinus radiata* saplings (pine), a lower tree stratum of blackwood and ground cover of dense bracken and some flowering tea-trees up to 1.5 m tall (Carpenter 1985). In far south-eastern South Australia, satin flycatchers breed in open forest of Manna gum and *Eucalyptus baxteri* (Brown stringybark), with understorey of Blackwood and *Pteridium esculentum* (Austral bracken). They have only been recorded in other habitats as a non-breeding visitor (Carpenter 1985). They are occasionally recorded in thickets of paperbarks, Brigalow shrubland, coastal thickets, heathland and mangroves (Storr 1984c).

6.9.4 Threatening processes

Populations of the satin flycatcher are said to have been reduced by clearing and logging of forests in south-eastern Australia, mainly the loss of mature forests (Blakers et al. 1984). Satin flycatchers are largely absent from regrowth forests (Loyn 1980; Loyn 1985a; Smith 1984; Taylor et al. 1997b).

6.9.5 Threat abatement/recovery plans

There is no threat abatement plan or recovery plan for this species.

6.9.6 References

Andrew, D.G., & D.W. Eades (1991). Twitchers' Corner. *Wingspan*. 3:9.

Atlas of Living Australia (2019). *Myiagra (Myiagra) cyanoleuca (Vieillot, 1818)*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:77929aae-e7de-48dd-aac9-ba1080d28783 [Accessed 30 July 2019].

BA NRS (2002). *Birds Australia Nest Record Scheme*.

Birdlife Australia (2019). *Satin Flycatcher*. Available from: http://www.birdlife.org.au/bird-profile/satin-flycatcher [Accessed 30 July 2019].

Blakers, M., S.J.J.F. Davies & P.N. Reilly (1984). *The Atlas of Australian Birds*. Melbourne, Victoria: Melbourne University Press.

Brooker, M.G. (1974a). The Satin Flycatcher-a new record for Western Australia. *Western Australian Naturalist*. 12:181.

Carpenter, G. (1985). Bird Notes. *South Australian Ornithological Association Incorporated Newsletter*. 113:8-11.

Coates, B.J. (1990a). *The Birds of Papua New Guinea Including the Bismarck Archipelago and Bougainville. Volume 2 Passerines*. Alderley, Queensland: Dove Publications.

Cooper, R.M. & I.A.W. McAllan (1995). *The Birds of Western New South Wales. Preliminary Atlas*. Albury, NSW: NSW Bird Atlassers.

Department of the Environment and Energy (2019). *Myiagra cyanoleuca – Satin Flycatcher* in Species Profile and Threats Database. Australian Government. Available from: https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=612 [Accessed 30 July 2019].

Eckert, H.J. (1987). Satin Flycatcher at Maree. *South Australian Ornithologist*. 30:82.

Emison, W.B. & J.W. Porter (1978). Summer surveys of birds in the Mt Cobberas - Snowy River area of Victoria, Australia. *Emu*. 78:126-136.

Emison,W.B., C.M. Beardsell, F.I. Norman, R.H. Loyn & S.C. Bennett (1987). *Atlas of Victorian Birds*. Melbourne: Department of Conservation (Forest & Lands) & Royal Australian Ornithological Union.

Ford, H.A. & H. Bell (1981). Density of birds in eucalypt woodland affected to varying degrees by dieback. *Emu*. 81:202-208.

Frith, H.J. (1969). Birds in the Australian High Country. Sydney: Reed.

Gilbert, P.A. (1935). The seasonal movements and migrations of birds in eastern New South Wales. *Emu*. 35:17?27.

Green, R.H. & A.M. McGarvie (1971). The birds of King Island. Records of the Queen Victoria Museum. 40

Green, R.H. (1995). The Fauna of Tasmania: Birds. Launceston, Tasmania: Potoroo Publishing.

Harris, K. (2016). Satin flycatcher (Myiagra cyanoleuca). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=e294aee2-7cf5-4d47-af1d-0e8740369565. [17 September 2019].

Higgins, P.J., J.M. Peter and S.J. Cowling (2006). Boatbill to Starlings. In: The Handbook of Australian, New Zealand and Antarctic Birds. 7. Melbourne: Oxford Press.

Howe, F.E. (1928). Notes on some Victorian birds. *Emu*. 27:252--265.

Loyn, R.H. (1980). Bird populations in a mixed eucalypt forest used for production of wood in Gippsland, Victoria. Emu. 80:145-156.

Loyn, R.H. (1985a). Bird populations in successional forests of Mountain Ash, Eucalyptus regnans, in central Victoria. Emu. 85:213-230.

Mac Nally, R. (1997). Population densities in a bird community of a wet sclerophyllous Victorian forest. *Emu*. 97:253-258.

Morris, A.K., A.R. McGill & G. Holmes (1981). *Handlist of Birds in New South Wales*. Sydney: NSW Field Ornithologists Club.

Morris, A.K., A.R. McGill & G. Holmes (1981). Handlist of Birds in New South Wales. Sydney: NSW Field Ornithologists Club.

Musser, A. (2017). Satin flycatcher (Myiagra cyanoleuca). [image] [online] Available from: https://images.ala.org.au/image/details?imageId=c6460cde-1d8a-4cca-95de-f0450bf2963d. [17 September 2019].

Napier, J.R. (1969). Birds of the Break O'Day Valley, Tasmania. *Australian Bird Watcher*. 3:179-192.

Officer, H.R. (1969). *Australian Flycatchers and Their Allies*. Melbourne: The Bird Observers Club.

Smith, P. (1984). The forest avifauna near Bega, New South Wales I. Differences between forest types. *Emu*. 84:200-210.

Storr, G.M. (1984c). Revised list of Queensland birds. *Records of the Western Australian Museum Supplement*. 19:1-189.

Taylor, M. & Canberra Ornithologists Group (COG) (1992). *Birds of the Australian Capital Territory. An Atlas*. Canberra: Canberra Ornithologists Group and National Capital Planning Authority.

Taylor, R., P. Duckworth, T. Johns & B. Warren (1997b). Succession in bird assemblages over a seven-year period in regrowth dry sclerophyll forest in south-eastern Tasmania. *Emu*. 97:220-230.

Traill, B.J., E. Collins, P. Peake & S. Jessup (1996). Current and past status of the birds of Chiltern- a Box-Ironbark forest in north-eastern Victoria. *Australian Bird Watcher*. 16:309-326.

6.10 Glossy ibis (*Plegadis falcinellus*)

6.10.1 Status

EPBC Act – migratory

BC Act – N/A

6.10.2 Biology and ecology

6.10.2.1 Characteristics

The Glossy ibis (*Plegadis falcinellus*) is the smallest ibis known in Australia. The neck is reddish-brown and the body is a bronze-brown with a metallic iridescent sheen on the wings. The glossy ibis has a distinctive long, downwards curved bill that is olive-brown in colour. The facial skin is blue-grey with a white line that extends around the eyes. The eyes, legs and feet are brown (Birds Australia 2010b). Sexes are similar in plumage, but the male is larger in size. The average length of a glossy ibis is 55 to 65 cm, with a wingspan of 80 to 95 cm, and weight of approximately 500 to 800 grams (Hancock et al. 1992; Marchant & Higgins 1990).

During the breeding season, plumage colour intensifies to a rich chestnut on the neck, mantle, shoulders and under parts. A purple-green sheen occurs on the head, upperparts, tail and wings. The facial skin turns pale blue with courtship, and fades to dark purple after the courting period (Hancock et al. 1992).

Juveniles have similar dark plumage to adults. Nestlings have a pink bill which gradually turns olive-brown starting from the tip (Hancock et al. 1992).

The glossy ibis is found singularly, in pairs or in small flocks. Large flocks are also occasionally large, for example the largest was about 60 000 birds in the Alligator Rivers region, Northern Territory (Morton et al. 1989). The glossy ibis is found in the company of other ibis such as the Straw-necked ibis (*threskiornis spinicollis*) or Australian White ibis (*threskiornis molucca*). Breeding is colonial and often with or near other ibis, herons and egrets (Marchant & Higgins 1990).

Photograph 6.8 Glossy ibis (Plegadis falcinellus)

Source: Keats (2013)

6.10.2.2 Known distribution

Within Australia, the Glossy ibis is generally located east of the Kimberley in Western Australia and Eyre Peninsula in South Australia. The species is also known to be patchily distributed in the rest of Western Australia. The species is rare or a vagrant in Tasmania (Beehler et al. 1986; Coates & Bishop 1997; Marchant & Higgins 1990).

Figure 6.8 Distribution range of the Glossy ibis

Source: Atlas of Living Australia (2019)

6.10.2.3 Biology and reproduction

Glossy ibis feed mainly on aquatic invertebrates/insects such as freshwater snails, mussels, crabs and crayfish. The species will also, however, eat fish, frogs and tadpoles, dryland invertebrates (such as beetles and grasshoppers), lizards, small snakes and nestling birds (del Hoyo et al. 1992; Gowland 1988; Marchant & Higgins 1990; Vestjens 1977).

Seeds of aquatic plants may also be eaten, including commercial rice which is recorded as a major diet item in parts of northern Australia (del Hoyo et al. 1992; Gowland 1988; Marchant & Higgins 1990; Vestjens 1977). The species feeds in very shallow water (Hancock et al. 1992), probing the water and mud with their long, curved bill, walking slowly and sedately (Birds Australia 2010b; Marchant & Higgins 1990).

Glossy ibis are known to live for approximately eight years (Scott 1997), though the oldest record of the species is 14 years and 3 months (Clapp et al. 1982). Like other waterbirds, the species is likely to be sexually mature by one or two years of age (Scott 1997). They breed from mid spring to the end of summer. Reproduction may extend to September to April if there is persistent food resources at breeding sites (Birds Australia 2010b; Chatto 2000; Jaensch & Bellchambers 1997; Marchant & Higgins 1990). In some areas, breeding is said to coincide with annual rains (del Hoyo et al. 1992). Three to six eggs are laid. Both adults care for young who fledge in approximately 25 to 28 days (Hancock et al 1992). Chicks will interact with chicks from nearby nests from approximately ten days of age. Once fledged, adults remain feeding young for several weeks (Marchant & Higgins 1990).

The species nests in mixed species colonies, either in small groups (from 5–100 pairs in Africa) (Brown et al. 1982) or in large aggregations of thousands of pairs (del Hoyo et al. 1992). The Glossy ibis has low breeding site fidelity and will inhabit new habitat if it becomes available (Melvin et al 1999). The nest is a platform of twigs and vegetation usually positioned less than one metre above water (occasionally up to 7 m) in tall dense stands of emergent vegetation (e.g. reeds or rushes), low trees or bushes (del Hoyo et al. 1992). The nest is often lined with aquatic vegetation (Birds Australia 2010b).

Australian breeding habitat types include wooded and shrubby swamps in the semi-arid and arid regions of the Northern Territory and Queensland. This includes *Acacia stenophylla* (Cooba), *Eucalyptus*/*Muehlenbeckia florulenta* swamps (lignum) of the Murray-Darling Basin and in *Melaleuca*/reed swamps at near-coastal breeding colonies in the south. Breeding has once been recorded in mangroves in the Northern Territory (Marchant & Higgins 1990).

The glossy ibis breeds at only a limited number of locations within Australia. Most records are from the following areas:

- Murray Darling Basin in northern New South Wales
- Western Riverina of New South Wales/Victoria
- From wider south-east South Australia
- Channel Country of Queensland/South Australia (wetlands of the Bulloo, Diamantina and Georgina River systems, occasionally also Cooper Creek)
- Lower Ord/Keep Rivers of Western Australia and the Northern Territory (Beehler et al. 1986; Chatto 2000; Coates & Bishop 1997; Jaensch & Bellchambers 1997; Marchant & Higgins 1990).

There are also isolated records of small breeding colonies elsewhere in eastern Australia and in the south-west of Western Australia. Breeding within Australia is outside tropical areas, except for several records in the wetlands of the Northern Territory and the lower Ord/Keep Rivers of Western Australia and Northern territory (Beehler et al. 1986; Chatto 2000; Coates & Bishop 1997; Jaensch & Bellchambers 1997; Marchant & Higgins 1990).

6.10.3 Habitat

The Glossy ibis preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons (del Hoyo et al. 1992; Hancock et al. 1992; Marchant & Higgins 1990).

Within Australia, the largest contiguous areas of prime habitat is inland and northern floodplains. The glossy ibis is commonly in largest numbers in drying Top End grass/sedge swamps and Channel Country grass/forb meadows. The species is sometimes recorded in wooded swamps, artificial wetlands (such as irrigated fields), and in mangroves for breeding (Chatto 2000; Marchant & Higgins 1990). The species may retreat to permanent wetlands and/or coastal areas (including tidal wetlands) during drought (Marchant & Higgins 1990).

Glossy ibis roost in trees or shrubs usually near, but sometimes far, from water bodies (Brown et al. 1982; Marchant & Higgins 1990).

6.10.4 Threatening processes

Wetland destruction or degradation is the major threat to the glossy ibis. Activities including water diversion and drainage (restricting areas of shallow water), irrigation, and hydroelectric power production damage suitable habitat for foraging and breeding. Such alterations of the Macquarie Marshes resulted in a failure of glossy ibis to nest there (Balian et al. 2002; Birds Australia 2010b; del Hoyo et al. 1992; Hancock et al. 1992; Marchant and Higgins 1990; Snow & Perrins 1998).

Clearing, grazing, burning, increased salinity, groundwater extraction and invasion by exotic plants and fish species are also threats to the species through habitat modification. The bird is also threatened locally in some areas by hunting and pesticides (del Hoyo et al. 1992; Marchant and Higgins 1990; Snow & Perrins 1998).

Human disturbance of waterbirds is a possible threat. A study by Burger & Gochfeld (1998) identified disturbance in foraging patterns of glossy ibis and four other waterbirds in a well frequented wildlife refuge in the United States of America. The species is susceptible to avian influenza so may be threatened by future outbreaks of the virus (Melville & Shortridge 2006).

6.10.5 Threat abatement/recovery plans

There is currently no threat abatement plan or recovery plan for this species. There is a general conservation plan for migratory shorebirds:

- Department of the Environment and Energy (2015) Wildlife Conservation Plan for Migratory Shorebirds – 2015 [online]. Available at: http://www.environment.gov.au/system/files/resources/9995c620-45c9-4574-af8e-a7cfb9571deb/files/widlife-conservation-plan-migratory-shorebirds.pdf [4 October 2019].

6.10.6 References

Atlas of Living Australia (2019). *Plegadis falcinellus (Linnaeus, 1766)*. Available from: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:fd74a66c-2566-4a49-b46a-8a2a1699f594 [Accessed 30 July 2019].

Balian, L.V., M.G. Ghasabian, M.S. Adamian & D. Klem, Jr (2002). Changes in the waterbird community of the Lake Sevan-Lake Gilli area, Republic of Armenia: a case for restoration. *Biological Conservation*. 106:157-163.

Beehler, B.M., T.K. Pratt & D.A. Zimmerman (1986). *Field guide to the birds of New Guinea*. Princeton, USA: Princeton University Press.

Birdlife Australia (2019). *Glossy Ibis*. Available from: http://www.birdlife.org.au/bird-profile/glossy-ibis [Accessed 30 July 2019].

Birds Australia (2010b). *Birds in Backyards- Glossy Ibis factsheet*. Available from: http://birdsinbackyards.net/species/Plegadis-falcinellus. [Accessed 30 July 2019].

Brown, L., E.K. Urban & K. Newman (1982). *The Birds of Africa. Volume 1*. London, Academic Press.

Burger, J. & M. Gochfeld (1998). Effects of ecotourists on bird behaviour at Loxahatchee National Wildlife Refuge, Florida. *Environmental Conservation*. 25(1):13-21.

Chatto, R. (2000). Waterbird breeding colonies in the Top End of the Northern Territory. *Parks & Wildlife Commission of the Northern Territory Technical Report*. 69.

Clapp, R.B., M.K. Klimkiewicz & J.H. Kennard (1982). Longevity records of North American birds: Gaviidae through Alcidae. *Journal of Field Ornithology*. 53:81-124.

Coates, B.J. & K.D. Bishop (1997). *A Guide to the Birds of Wallacea Sulawesi, The Moluccas and Lesser Sunda Islands, Indonesia*. Alderley, Queensland: Dove Publications.

del Hoyo, J., A. Elliot & J. Sargatal (1992). Ostrich to Ducks. **In:** *Handbook of the Birds of the World*. 1. Spain: Lynx Edicions.

Department of the Environment and Energy (2019). *Plegadis falcinellus – Glossy Ibis* in Species Profile and Threats Database. Australian Government. Available from: https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=991 [Accessed 30 July 2019].

Gowland, P.N. (1988). *RAOU Microfiche*. Moonee Ponds, RAOU.

Hancock, J.A., J.A. Kushlan & M.P. Kahl (1992). *Storks, Ibises and Spoonbills of the world*. London, Academic Press.

Jaensch, R. & K. Bellchambers (1997). *Waterbird conservation values of ephemeral wetlands of the Barkly Tablelands, Northern Territory*. Report to Australian Heritage Commission and Parks & Wildlife Commission of the Northern Territory.

Keats, D. (2013). Glossy ibis (Plegadis falcinellus). [image] [online] Available from: https://www.flickr.com/photos/dkeats/9720123258/in/photolist-fNWb13-ebrqMa-mGjEjT-bB1XN7-ebrqvr-mGjNHB-dqTHsD-bPVAZR-dhuXNM-9LWLFP-ebrsvZ-cWQy7N-FWHBQw-BTiGgV-s2bYDZ-redkpM-PUrHsP-cWQzDo-cWQA1s-bPVB46-ebrqt4-qjG5h-9sc2Eu-9d32Y5-6Xf9C3-ebx4gE-mGkHBy-cWQhwS-pSxcVc-ebx3Ys-mGjvUr-dhuXvb-cWQgVw-9LWLaz-21sj6PA-ebrr1a-mGhB5x-cWQz53-mGhLJx-S46UqS-ebrr3g-7Vr7TN-9KhdHp-EFLoL-sCtBB-ebrqAc-9o4X41-Y63kfc-ebrqCr-FHfZvC. [17 September 2019].

Marchant, S. & P.J. Higgins (1990). *Handbook of Australian, New Zealand and Antarctic Birds. Volume One - Ratites to Ducks*. Melbourne, Victoria: Oxford University Press.

Melville, D.S. & K.F. Shortridge (2006). Migratory waterbirds and avian influenza in the East Asian-Australasian Flyway with particular reference to the 2003-2004 H5N1 outbreak. **In:** Boere, G & C. Galbraith & D. Stroud, eds. *Waterbirds around the world*. Page(s) 432-438. Edinburgh, UK: The Stationary Office.

Melvin, S.L., D.E. Gawlik & T. Scharff (1999). Long-term movement patterns for seven species of wading birds. *Waterbirds. The International Journal of Waterbird Biology*. 22(3):411-416.

Morton, S.R., K.G. Brennan & M.D. Armstrong (1989). *Distribution and Abundance of Waterbirds in the Alligator Rivers Region, Northern Territory. Volume 1*.

Scott, A. (1997). *Relationships between waterbird ecology and river flows in the Murray-Darling Basin. CSIRO Technical report No. 5/97*. Available from: http://www.clw.csiro.au/publications/technical97/tr5-97.pdf. [Accessed 30 July 2019].

Snow, D.W. & C.M. Perrins (1998). *The birds of the western Palearctic. Consise Edition*. Oxford, England: Oxford University Press.

Vestjens, W.J.M. (1977). *Technical Memorandum Division of Wildlife Research CSIRO Australia*. 12.

6.11 Common greenshank (*Tringa nebularia*)

6.11.1 Status

EPBC Act – migratory

BC Act – N/A

6.11.2 Biology and ecology

6.11.2.1 Characteristics

The Common greenshank (*Tringa nebularia*) is a heavily built, elegant wader, 30 to 35 cm in length, with a wingspan of 55 to 65 cm and weight up to 190 g for both males and females. The bill is long and slightly upturned and the legs are long and yellowish-green. In flight, all plumages show uniformly dark upperwing and contrasting white rump extending in a white wedge up the back, whitish tail and tips of toes projecting slightly beyond the tip of the tail. The sexes are alike (Higgins & Davies 1996).

The species is seen singly or in small to large flocks (sometimes hundreds) in a variety of coastal and inland wetlands. Wary, noisy and excitable, the common greenshank bobs its head in alarm and flushes with ringing calls, often long before other species. Flight is rapid and often zigzagging. The usual flight call is a distinctive, quick ringing whistle of two, three or four syllables (Higgins & Davies 1996).

Photograph 6.9 Common greenshank (Tringa nebularia)

Source: Matos (2017)

6.11.2.2 Known distribution

The species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia (refer Figure 6.9) (Higgins & Davies 1996). The following outlines where the birds are distributed.

Queensland

The species is widespread in the Gulf country and eastern Gulf of Carpentaria. It has been recorded in most coastal regions, possibly with a gap between north Cape York Peninsula and Cooktown. Inland, there have been a few records south of a line from near Dalby to Mt Guide, and sparsely scattered records elsewhere (Higgins & Davies 1996).

New South Wales

The species has been recorded in most coastal regions. It is widespread west of the Great Dividing Range, especially between the Lachlan and Murray Rivers and the Darling River drainage basin, including the Macquarie Marshes, and north-west regions (Higgins & Davies 1996).

Victoria

Widespread in coastal regions, mainly between Gippsland Lakes and Port Phillip Bay. Inland the species is known mostly in the west and in the Murray River Valley (Higgins & Davies 1996).

Tasmania

The Common greenshank is mainly found along the coast, from around Temma in the north-west to Hobart in the south-east (Higgins & Davies 1996).

South Australia

The species is found throughout the area east of 145° E, but there are a few records from the Flinders Ranges. It is also occasionally seen inland west of 145° E. It is found in all coastal regions west to, at least, Streaky Bay, with scattered records elsewhere along the coast (Higgins & Davies 1996).

Western Australia

The Common greenshank is generally absent from the Western Deserts although there are a few records from the Great Sandy Desert and the Nullarbor Plain. It occurs around most of the coast from Cape Arid in the south to Carnarvon in the north-west. In the Kimberley region it is recorded in the south-west and the north-east, with isolated records from the Bonaparte Archipelago (Higgins & Davies 1996).

Northern Territory

The species is sparsely scattered through most of the Northern Territory, including occasional records in the Tanami Desert and records from Birrindudu Waterhole in the north-east to Lake Woods, Lake Sylvester and the Barkly Tableland in central Northern Territory (Higgins & Davies 1996).

Sites of international importance in Australia and maximum, or average, counts from summer and winter surveys around Australia (Watkins 1993) include:

- Eighty Mile Beach, Western Australia, 2240
- Wilson Inlet, Western Australia, 568
- Roebuck Bay, Western Australia, 560
- The Coorong, South Australia, 720
- Penrice Saltworks, South Australia, 450
- Clinton Conservation Park, South Australia, 460
- South-east Gulf of Carpentaria, Queensland, 1240
- Great Sandy Strait, Queensland, 1069
- Hunter R. estuary, New South Wales, 561
- Westernport Bay, Victoria, 492.

High counts have also been recorded (Watkins 1993) for:

- Gulf of St Vincent, South Australia, 1130
- West coast of the Eyre Peninsula, South Australia, 580
- Port Phillip Bay, Victoria, 460 (Lane 1987).

The Common greenshank has also been recorded from Lord Howe Island, Norfolk Island, Macquarie Island, Heard Island, Chatham Island, Snares Island, Prince Edward Island, Iles Kerguelen, Iles Crozet, Ile de la Possession and Ile de l'Est. Small numbers regularly visit New Zealand (Higgins & Davies 1996).

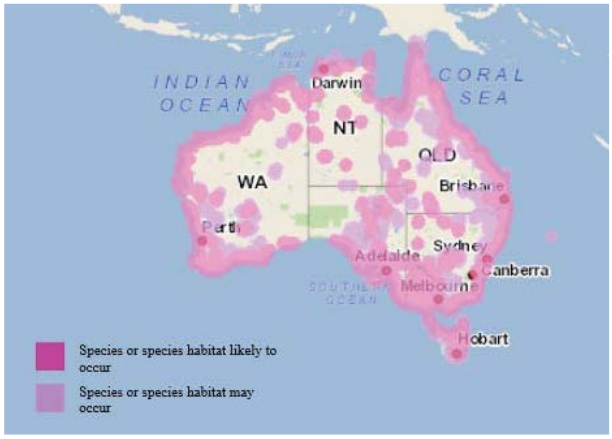


Figure 6.9 **Distribution range of common greenshank**

Source: DotEE (2019)

6.11.2.3 Biology and reproduction

The Common greenshank is carnivorous. In Australia is has been recorded eating molluscs, crustaceans, insects, and occasionally fish and frogs. Elsewhere, it has also been recorded eating annelids, lizards, and rodents (Higgins & Davies 1996). The species feeds during both day and night time. It is active and agile, finding prey by sight or, occasionally, by touch. The birds wade in shallow water along edge of water in tidal estuaries, muddy claypans, saltworks and saltpans (Higgins & Davies 1996). They glean from the surface of mud, vegetation or water and pursue insects on the surface of the water and in the air. Prey is occasionally manipulated, crushed and washed before being swallowed whole, especially large items such as eels (Higgins & Davies 1996).

The Common greenshank does not breed in Australia. The birds nest on the ground in the open, but usually next to a piece of dead wood or beside rocks, trees, fences or sticks, which act as nest markers (Snow & Perrins 1998). The nest is a shallow scrape lined with some plant material (del Hoyo et al. 1996). Three to five (mostly four) eggs are laid in late April to June (del Hoyo et al. 1996, Robinson 2005). Incubation lasts for 22 to 26 days (del Hoyo et al. 1996; Robinson 2005) and chicks fledge approximately 25 to 31 days after hatching. Around 74 per cent of eggs hatch and 32 per cent of hatchlings fledge (del Hoyo et al. 1996). Age of first breeding is thought to be two years (Robinson 2005), but some return to breeding grounds when only one year old (del Hoyo et al. 1996). The oldest ringed bird was 15 years and 10 months (Robinson 2005).

6.11.3 Habitat

The Common greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees. It was once recorded with Black-winged stilts (*Himantopus himantopus*) in pasture, but are generally not found in dry grassland (Higgins & Davies 1996).

The species is known to forage at edges of wetlands, in soft mud on mudflats, in channels, or in shallows around the edges of water often among pneumatophores of mangroves or other sparse, emergent or fringing vegetation, such as sedges or saltmarsh. It will occasionally feed on exposed seagrass beds (Higgins & Davies 1996).

The common greenshank roosts and loafs round wetlands, in shallow pools and puddles, or slightly elevated on rocks, sandbanks or small muddy islets. Occasionally the species will perch and roost on stakes (Higgins & Davies 1996). The species is known to have roosted on an inland claypan near Roebuck Bay, Western Australia; this site may be an important roost site for this species at least during the non-breeding season (Collins et al. 2001).

6.11.4 Threatening processes

Within Australia, there are a number of threats common to most migratory shorebirds, including the Common greenshank.

6.11.4.1 Loss/modification of habitat

The demands of long flights make migratory shorebirds particularly susceptible to loss of, or changes to, the habitat of resting or foraging grounds along their route (DEH 2005c). Site fidelity is another feature of migratory shorebird behaviour which can compound the risk that habitat modification or loss can represent. Residential, farming, industrial and aquaculture/fishing activities represent the major cause of habitat loss or modification in Australia. Residential or other development of saltworks or land adjacent to mudflats near the outskirts of built-up areas can reduce suitable habitat for the species and increase levels of disturbance (Straw 1992a).

6.11.4.2 Silt, pollution, weeds or pest invasion

Increased silt in the water, pollution and weed or pest invasion of habitats can change the quality or quantity of food available from the sites or modify important biophysical aspects. Pollution is a particular threat as pollutants tend to accumulate and concentrate in wetlands (DEH 2005c). Excess nutrients, including from offsite, diffuse sources, can lead to eutrophication which in turn can impact on the availability of benthic prey species (Harding et al. 2007; Straw 1992a). Industrial pollution, such as in the case of accidental release, can lead to the build up of heavy metals or toxic elements in the substrate of wetlands which, in turn, can affect benthic prey fauna (DEH 2005).

6.11.4.3 Disturbance

With increasing tourist visitation and development along the Queensland coast and around Broome, Western Australia, increasing levels of disturbance from human recreational activity are likely. Recreational fishing, four-wheel driving, unleashed dogs and jet-skiing may disturb the foraging or roosting behaviour of migratory shorebirds. Migratory shorebirds are most susceptible to disturbance during daytime roosting and foraging periods. Disturbance can lead to reduced energy reserves required by the birds prior to migration (DEH 2005c).

6.11.4.4 Introduced species

Introduced plants, such as *Eichhornia crassipes* (Water hyacinth) can lead to long-term changes to the nature and biodiversity of wetlands which in turn can affect their suitability for use by migratory shorebirds (DEH 2005c). Introduced plants, such as S*partinia* spp. (Cord grass), can invade intertidal mudflats and reduce the amount of suitable foraging areas, as has already occurred in other countries (Goss-Custard & Moser 1988). Exotic marine pests may also result in the loss of benthic food sources (DEH 2005c).

The biological characteristic of the species which poses a key threat to its survival is that it regularly flies for thousands of kilometres over some of the most densely populated areas of the world. The huge human population in east Asia places enormous pressure on natural resources and manifests itself in activities such as the reclamation of mudflats (Barter 2002, 2005).

6.11.5 Threat abatement/recovery plans

There is currently no threat abatement plan or recovery plan for this species. There is a general conservation plan for migratory shorebirds:

- Department of the Environment and Energy (2015) Wildlife Conservation Plan for Migratory Shorebirds – 2015 [online]. Available at: http://www.environment.gov.au/system/files/resources/9995c620-45c9-4574-af8e-a7cfb9571deb/files/widlife-conservation-plan-migratory-shorebirds.pdf [4 October 2019].

6.11.6 References

Department of the Environment and Heritage (2005c). *Background Paper to the Wildlife Conservation Plan for Migratory Shorebirds*. Canberra, ACT: Department of the Environment and Heritage. Available from: http://www.environment.gov.au/biodiversity/migratory/publications/pubs/shorebird-plan-background.pdf.

Barter, M.A. (2002). Shorebirds of the Yellow Sea: Importance, Threats and Conservation Status. Wetlands International Global Series No. 8, International Wader Studies 12. Canberra, ACT: Wetlands International.

Barter, M.A. (2005c). Yellow Sea-driven priorities for Australian shorebird researchers. **In:** Straw, P., ed. Status and Conservation of Shorebirds in the East Asian-Australasian Flyway. Proceedings of the Australasian Shorebirds Conference 13-15 December 2003, Canberra, Australia. Sydney, NSW: Wetlands International Global Series 18, International Wader Studies 17.

Birdlife Australia (2019). *Common Greenshank*. Available from: http://www.birdlife.org.au/bird-profile/common-greenshank [Accessed 30 July 2019].

Collins, P., A. Boyle, C. Minton & R. Jessop (2001). The importance of inland claypans for waders in Roebuck Bay, Broome, NW Australia. *Stilt*. 38:4--8.

del Hoyo, J., A. Elliott, D.A. Christie & J. Sargatal (1996). *Handbook of the Birds of the World: Hoatzin to Auks*. Barcelona: Lynx Edicions.

Department of the Environment and Energy (2019). *Tringa nebularia – Common Greenshank, Greenshank* in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=832 [Accessed 30 July 2019].

Goss-Custard, J.D. & M.E. Moser (1988). Rates of change in the numbers of Dunlin, *Calidris alpina*, wintering in British estuaries in relation to the spread of *Spartina anglica*. *Journal of Applied Ecology*. 25:95-109.

Harding, S.B., J.R. Wilson & D.W. Geering (2007). Threats to shorebirds and conservation actions. **In:** Geering, A., L. Agnew & S. Harding, eds. *Shorebirds of Australia*. Page(s) 197-213. Melbourne, Victoria: CSIRO Publishing.

Higgins, P.J. & S.J.J.F. Davies, eds (1996). *Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons*. Melbourne, Victoria: Oxford University Press.

Lane, B.A. (1987). *Shorebirds in Australia*. Sydney, NSW: Reed.

Robinson, R.A. (2005). *BirdFacts: profiles of birds occurring in Britain & Ireland. BTO Research Report 407*. Available from: http://blx1.bto.org/birdfacts/results/bob5480.htm.

Matos, H. (2017). Common greenshank (Tringa nebularia). [image] [online] Available from: https://www.flickr.com/photos/145880133@N04/33210877622/in/photolist-SAJqSj-dJUAsX-7QBXDR-dJUDfp-qmyqQv-ExLPX6-EfWAAv-dJRkeU-278Vob5-V6GR9D-RVaMiZ-dJKUP2-dJRgfb-dJRmcC-dK14DE-dJRhj9-dJRj6Q-9H13Mz-U4MNNi-3ZFrhe-dJKTYn-oTCiPi-fY2cd4-3c7eCV-7dr6zo-oTmA5x-neQUm-4nUdQ1-Eubada-L7xRE8-q59v8z-f5vPxs-6x9orw-TTHgv9-ababct-6x5cXZ-rdQnrz-6x5dbM-222u7Q4-5Ks4m7-5wdtPT-EDeVEK-rhBHGt-rAQvwC-3cbEsE-dK15UC-dJUCE4-dhQSMh-g5RCgS-ayGuF4. [17 September 2019].

Snow, D.W. & C.M. Perrins (1998). *The birds of the western Palearctic. Consise Edition*. Oxford, England: Oxford University Press.

Straw, P. (1992a). *Relocation of Shorebirds. A Feasibility Study and Management Options*. Sydney, NSW: Unpublished report by the Royal Australasian Ornithologists Union for the Federal Airports Corporation.

Watkins, D. (1993). A national plan for shorebird conservation in Australia. *RAOU Report Series*. 90.