Conservation Advice for *Synemon gratiosa* (graceful sun-moth) – January 2011

This Conservation Advice is based on the best information available at the time of preparation and will be revised by November 2011.

Description

Species: *Synemon gratiosa* (Westwood 1877), family Castniidae.

Common name: Graceful sun-moth.

The graceful sun-moth (GSM) is one of about 30 sun-moth species recorded from Western Australia. Sun-moths are strictly diurnal, typically have dark forewings and brightly coloured hind wings, and generally look and behave like butterflies. They are usually inconspicuous when settled, displaying only the dark forewings, but when they fly the hind wings are exposed and they are easily recognised. The GSM has a wingspan of 25–35 mm, with males smaller than females (Figure 1). The upper surface of the forewings is dark grey-black with obscure light grey markings, whereas the upper surface of the hind wings and the undersides of both pairs of wings are bright orange with some darker grey-black bands. The extent of the orange colouration is variable, and specimens become less brightly coloured as they age.

Adults are active only in late summer and autumn, between mid February and late March or early April. The adults have relatively brief lives of approximately one to two weeks. They are active during daylight and may not fly if the weather is cool, overcast or windy. The larvae tunnel within the roots or rhizomes of the host plants (*Lomandra maritima* and *L. hermaphrodita*) on which they feed. It is not yet known how long the GSM takes to complete its life cycle, but, based on similar species it is likely to be one year, with a possibility of two years.

Figure 1. Graceful sun-moth. Left: Preserved specimen (wingspan 33mm). Right: Live adult in typical perching posture.

Conservation Status

The GSM is listed as 'fauna that is rare or likely to become extinct' (generally referred to as threatened fauna) under the Western Australian *Wildlife Conservation Act 1950* Wildlife Conservation (Specially Protected Fauna) Notice 2010(2). It has been given a ranking of Endangered by the Western Australian Threatened Species Scientific Committee. It is also listed as 'Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Listing of the GSM as threatened fauna under the WA *Wildlife Conservation Act 1950* in 1997 was based on expert opinion. It was subsequently assessed to meet IUCN Endangered criteria B1, B2, (a)(b)(i)(ii)(iii)(iv) (as the extent of occurrence is less than 5000 km² (B1), the area of occupancy is less than 500 km² (B2), and it is severely fragmented (a), and has a continuing decline (b) (i)-(v), see below).

In 2009 it was listed as Endangered under the EPBC Act using similar criteria.

The listing (in both cases) was based on the knowledge available at the time, which was that the GSM was known from less than ten extant populations in small remnants of banksia woodland containing the (then) only known food plant *Lomandra hermaphrodita*. These remnants were surrounded by cleared urban or rural lands and subject to a high risk of local extinction. None was in formal conservation estate, although seven areas were in local government recreation reserves and so had some level of protection.

Based on the data then available, listing under IUCN criteria B1, B2, (a)(b) was warranted. Since that time both the knowledge of the species and the processes of conservation listing have improved.

New populations of GSM discovered in 2009 on previously unrecorded habitat (coastal sand and limestone heaths and shrublands), and utilising a different species of food plant (*Lomandra maritima*), prompted the Department of Environment and Conservation (DEC) to carry out additional survey in 2010 of this habitat.

The surveys initially focussed on the Perth and Peel regions but several exploratory surveys were carried out in conservation reserves as far north as Leeman. These brief surveys confirmed that GSM was present in a number of conservation reserves in the DEC Midwest Region.

The 2010 survey confirmed that there were more populations, and has significantly extended the known range of GSM. In addition the GSM appears to be more numerous or dense in this coastal habitat, and coastal dunes appear to be the preferred habitat of the species.

Of the 49 sites with recently recorded (10 years) extant populations, 15 are on land under DEC management and another 11 are also under some form of conservation management as Bush Forever areas.

Assessment of this most recent information against the IUCN criteria indicates that the species – on current information – still meets the endangered criterion B1 and B2 relating to geographic range in that:

B1 - extent of occurrence is less than 5000 km² - for GSM estimated as 2015km²;

B2 - area of occupancy is less than 500 km² - for GSM estimated as from 25km^2 up to 43km².

To meet criterion B the species also has to meet two of (a) severely fragmented, (b) continuing decline, or (c) extreme population fluctuation.

There are currently no data to support (c) extreme population fluctuations in GSM. There is (b) continuing decline in (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations, and (v) number of mature individuals. Under current knowledge of the species, GSM would still meet (a) severely fragmented criterion.

An estimated 43% of the surveyed area of occupancy (recorded within the past ten years) is on patches of habitat in DEC managed conservation estate, and a further 16% in on Bush Forever areas. An estimated 40% is in areas that have been lost in the last few years, are proposed for clearing in the near future, or are in patches that are considered not viable in the long term.

If additional surveys (proposed for early 2011) significantly increase the number of populations and/or the area of occupied habitat, this last sub-criterion of (a) severely fragmented may no longer be met. If it is demonstrated that other areas of occupied coastal dune habitat exist, it is probable that GSM would not meet the criteria for Endangered.

However currently available data are inadequate to justify a change in the status of GSM at this time.

DEC will consider the outcomes of survey for this species in March 2011, and other research findings, to review the conservation status of GSM. Any proposed changes to its status will be reviewed by the WA Threatened Species Scientific Committee for approval by the Minister for Environment. Approved changes to its conservation status will then be referred to the Commonwealth Threatened Species Scientific Committee for a review of the listing under the EPBC Act.

The newly identified populations on secondary coastal dunes increase the area of known habitat and reduce the amount of fragmentation compared to the understanding prior to 2009 (when GSM was known from less than ten fragmented small remnants of banksia woodland). These facts in themselves lead to reduced concern for the possible risk of extinction of the species.

Distribution and Habitat

The GSM is restricted primarily to the Swan Coastal Plain IBRA (Interim Biogeographic Regionalisation of Australia) region, but extends into the Geraldton Sandplains (Bishop *et al.* 2010b). The GSM occurs within the Swan, South West and Midwest DEC regions, and the Southwest, Swan and Northern Agricultural Natural Resource Management regions.

It is associated with two habitat types: coastal heathland on Quindalup dunes, thought to be the preferred habitat, where it is restricted to secondary sand dunes where the host plant *Lomandra maritima* is locally abundant; and *Banksia* woodland on Spearwood and Bassendean dunes, where the second known host plant *L. hermaphrodita* is widespread. The remaining uncleared habitat is severely fragmented, with most subpopulations disjunct and separated by urban and agricultural areas that limit or prevent dispersal. It has been recorded within the past ten years at 49 sites (see Appendix 1), with a surveyed area of occupancy of 25km^2 and a maximum estimated area of occupancy of 42.6 km^2. The recent (2010) surveys indicate that it is locally extinct at a further 14 sites.

DEC carried out a targeted survey program for GSM in 2010 which resulted in a significant range extension from that known previously. The surveys located a number of large populations as well as populations on conservation estate. It is this new information on habitat and distribution that has led DEC to consider that a re-assessment of the conservation status of the GSM might be warranted after additional survey is carried out to clarify its distribution and the appropriate conservation response.

It is possible to identify on air photographs the coastal dune systems where GSM have been located and therefore to identify areas of similar landform that might also support GSM. The larger reserves in the Midwest Region appear to have extensive areas of these dunes (exceeding 1,500 hectares (15km^2) in total). Further survey of these areas for the food plant and then presence of GSM is required to confirm the assumption that areas of coastal dune GSM habitat can be identified from aerial photography.

If it is shown to be possible to correctly identify the coastal dune habitat of the GSM from aerial photography or other mapping, there are likely to be additional areas of similar

landform in private property and other lands in the DEC Midwest Region (many of which are planned for mining or development, or have owner expectations of such).

The survey to date indicates that GSM is recorded at substantially higher rates on the *Lomandra maritima* habitat and is therefore more numerous/dense in this coastal habitat. Coastal dunes may be the preferred habitat of the species. It also appears that the relative contribution of the banksia woodland (*Lomandra hermaphrodita*) habitat to the total population and area of occupied habitat of the GSM is small.

Threats

The main identified threats to GSM are clearing of habitat for urban, rural and industrial development, and inappropriate management of habitat. Several previously occupied sites are known to have been lost because of land clearing. The largest loss of habitat in the past has been due to urbanisation in the greater Perth urban area (Yanchep to Dawesville). Future land clearing is likely to further reduce the area of remaining habitat and increase fragmentation.

Of the 49 sites with recently recorded (10 years) extant populations throughout the range of GSM, 17 have development proposals over them. Of these, 16 are within the Perth Metropolitan and Peel regions, and the sites proposed for development include some of the largest populations (based on high transect counts of GSM and large area of habitat) such as at Alkimos – Yanchep, and the Lake Clifton – Yalgorup areas. These areas had the greatest numbers/density of GSM recorded during the 2010 survey season.

These 17 sites have a smaller total area of projected habitat (from mapping approximately 900ha) than the 26 sites under some form of conservation management (DEC managed lands and Bush Forever areas). These sites were surveyed by consultants as part of the environmental assessment of specific developments and so only the development area boundaries were surveyed. This does not give information on populations that may occur in adjoining private land and underestimates the future area of clearing that will take place.

Other threats are habitat degradation caused by Phytophthora dieback, grazing, inappropriate fire regimes, recreational use of off-road vehicles, and lack of weed control (Threatened Species Scientific Committee 2008b). These have the potential to reduce the number and density of food plants for egg laying and larvae, or change the structure of vegetation reducing the breeding success of adult moths. Several large, uncleared sites where the GSM has been recorded in the past are no longer occupied, and it is thought that past management practices have contributed to these local extinctions.

Conservation objectives for graceful sun-moth

- Clarify the conservation status of GSM.
- Ensure that development (individually and cumulatively) does not impact on the species to such an extent so as to cause it to meet the criteria for listing as endangered (noting DEC is currently of the view that if it is demonstrated that other areas of occupied coastal dune habitat exist, it is probable that GSM would not meet the criteria for Endangered). This is of most relevance within the Perth Metropolitan and Peel regions where several known populations are within areas subject to development proposals.
- Continue management of existing populations and habitat on DEC managed lands and other land under conservation management.

Research priorities

Based on the new distribution information from the 2010 survey season, DEC considers that the most urgent conservation action for the GSM is for further survey and research to resolve gaps in knowledge of the distribution, biology, and habitat requirements with an aim to clarify the conservation status of the species.

- The primary research priority is for additional surveys to determine the extent of occurrence and area of occupancy, and to determine the number and size of populations protected in formal conservation estate or under threat.
- Assessment of habitat characteristics, including the abundance and density of host plants, minimum patch size and minimum viable population size, is needed to determine the features required to support GSM populations.
- Critical life history information should be determined to enable transect counts to be converted to population estimates and to determine dispersal distances, both of which will influence future survey methodology, and inform conservation planning;
- Genetic studies are required to assess levels of gene flow and genetic differentiation between populations breeding on different host plants or at the extremes of the species range, and to identify potential inbreeding populations;
- Ascertain fire intensity and interval to promote suitable vegetation condition and protect the GSM in all life stages;
- Before-and-after impact studies to be conducted to assess the effects of land clearing and other disturbance on remnant GSM populations.

Based on the outcomes of survey in March 2011 and other research findings, DEC will review the conservation status of the GSM during 2011, and refer any proposed amendment to its conservation status to the WA Threatened Species Scientific Committee.

Management actions identified

This list does not encompass all actions that may benefit GSM, but highlights those considered to be of highest priority at the time of preparing this conservation advice.

Habitat Loss, Disturbance and Modification

- Identify populations of high conservation priority.
- Investigate protection options such as formal conservation arrangements, management agreements and covenants on private land, and for Crown and private land investigate inclusion in formal conservation reserve tenure where possible.
- Manage threats to areas of vegetation that contain populations of GSM.
- Control access routes to suitably constrain public access to known sites on public land.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
- Implement an appropriate fire management regime for each (important) population.

Invasive Weeds

- There should be identification and removal of invasive weeds which could become a threat to GSM, and management of sites to prevent weed introduction.
- Ensure chemicals or other mechanisms used to control or eradicate weeds do not have a significant adverse impact on GSM.

Trampling, Browsing or Grazing

- Develop and implement a management plan for the control or eradication of herbivores that may impact the host plants of GSM.
- Minimise the use and maintenance of firebreaks and other tracks in known habitat during March when males are likely to have established territories on tracks.
- Prevent grazing pressure at known sites through exclusion fencing or other barriers.

Conservation Information

- Raise awareness of GSM within the local community and with decision makers by preparing documents on the species and its conservation (for example a Science Division Information Sheet);
- Conduct field days in conjunction with environmental consultants and community (Friends) groups.

Enable Recovery of Additional Sites and/or Populations

- Investigate methods to rehabilitate and improve GSM habitat, including options to increase numbers of food plants.
- Investigate methods of translocation of larvae or adult GSM to supplement existing populations, re-establishing locally extinct populations or establishing new populations.
- Implement translocation protocols if supplementing, re-establishing or establishing populations is considered necessary and feasible.

Proposed response to development impacting on graceful sun-moth

The newly identified populations on secondary coastal dunes increase the area of known habitat of GSM and reduce the amount of fragmentation compared to the understanding prior to 2009. If it is demonstrated that other areas of occupied coastal dune habitat exist, it is probable that GSM does not meet the Endangered criteria and that it either meets Vulnerable criteria or is not threatened.

Considering this, impact on some populations of GSM will not cause extinction of the species and DEC considers that, if such decisions do not result in significant loss of habitat, this would not substantially increase the level of endangerment.

However, if the view that additional areas of habitat exist is shown to be incorrect, decisions to clear known GSM habitat would further endanger the species.

Therefore, until the status of GSM is clarified later in 2011, the DEC response to development proposals that will impact on populations of GSM will be to seek to protect as much habitat as possible, in the best condition and arrangement possible (best shape, including other conservation values) within the bounds of normal or reasonable outcomes from statutory planning and environmental assessment processes (including allocation of open space, and meeting other requirements such as retention of Carnaby's black cockatoo feeding habitat).

Advice for Decision Makers

- Significant impact guidelines and other documentation written for the related species, the golden sun-moth, *Synemon plana* (found in Victoria, NSW and the ACT), can provide some guidance on conservation approaches that would also be relevant to GSM (Department of Sustainability and Environment 2004; Department of the Environment, Water, Heritage and the Arts 2009). These guidelines should be adapted for the different biology and ecology of the GSM, but the basic approach and requirements apply.

- Significant impact guidelines for GSM will be prepared by DEC during 2011.
- The primary objective for decision makers should be *in situ* retention and protection of as much known habitat as possible, in the best condition and arrangement possible.
- Decisions to protect habitat should be made as early in the planning process as possible and should avoid intensifying land use on known habitat or otherwise making decisions that result in increased threat to habitat. For example areas of possible habitat should be assessed as early as possible and known GSM habitat should not be rezoned to higher use.
- Where past planning decisions have already been made in support of development of an area in a strategic context (for example zoning or structure plans), subsequent decisions should still seek to ensure *in situ* retention and protection of as much habitat as possible, in the best condition and arrangement possible (best shape, including other conservation values) within the bounds of "normal" statutory planning and environmental assessment processes;
- The coastal dune *Lomandra maritima* habitat appears to support larger and denser populations of GSM, and so is likely to provide a greater contribution to the total population and area of occupied habitat. Therefore protection of areas of this habitat provides more opportunity to contribute to the continued persistence of the species.
- Decisions on proposals should seek to avoid and mitigate impacts on GSM or its habitat, however some proposals may still have residual impacts on the species. Impact may include the clearing of known habitat, and subsequent taking of individuals of GSM.
- The taking of threatened fauna as a consequence of approved clearing must be authorised by a licence issued under the *Wildlife Conservation Act 1950*.
- DEC advises that where a development proposal involves clearing that is unavoidable due to provision of infrastructure of State significance; or where statutory land use planning and environmental impact assessment decisions in support of development have already been made ; and the proponent has:

  (i) adequately assessed the size and distribution of the local population of GSM;

  (ii) made reasonable efforts to avoid and minimise impact on GSM; and

  (iii) clearly identified the relative magnitude of any residual impact on the local population;

  DEC may determine that the project is acceptable and is likely to support an application to take a proportion of a GSM population caused by the clearing of habitat.
- In the short-term (1-2 years) the most appropriate compensation or 'offset' for any residual impact would be in the form of assistance with priority survey and research activities to hasten collection of data and enable review of the conservation status of the species.
- Other mitigation or offset actions, such as contribution to management of other protected populations, including investigations of translocation of food plants and GSM to nearby sites with suitable habitat, would also be supported as these activities enhance or augment other sites that contain viable populations.
- DEC considers at this time it is unnecessary to seek purchase of areas of unprotected habitat as offsets.
- Judgements on impacts may differ between State, Commonwealth and local decision making processes. Regardless of any WA planning and environmental approvals for the taking of GSM, any person undertaking an action that may affect GSM should consider their obligations under all other relevant processes. In particular action that significantly impact GSM may also require approval under the Commonwealth EPBC Act.

Existing Plans/Management prescriptions that are relevant to the species

- Survey methods and additional information on the distribution of GSM have been prepared by DEC (Bishop *et al.* 2010a; Bishop *et al.* 2010b).
- Conservation and Listing advices have been prepared by DEWHA (Threatened Species Scientific Committee 2008a; b)
- Significant impact guidelines and other documentation written for the related species, the golden sun-moth, *Synemon plana* (found in Victoria, NSW and the ACT), can provide additional guidance on conservation approaches for GSM (Department of Sustainability and Environment 2004; Department of the Environment, Water, Heritage and the Arts 2009).

These prescriptions were current at the time of publishing (January 2011). Please refer to the relevant agency websites for any updated versions.

Information Sources

Bishop C., Williams M., Mitchell D. & Gamblin T. (2010a) Guidelines for graceful sun-moth (*Synemon gratiosa*) surveys & site habitat assessments, version 1.1. Department of Environment and Conservation.

Bishop C., Williams M., Mitchell D., Williams A., Fissioli J. & Gamblin T. (2010b) Conservation of the Graceful Sun-moth: Findings from the 2010 Graceful Sun-moth surveys and habitat assessments across the Swan, South West and southern Midwest Regions. Interim report, Department of Environment and Conservation, Kensington WA.

Department of Sustainability and Environment. (2004) Golden Sun Moth *Synemon plana*, Action Statement No. 106.

Department of the Environment Water Heritage and the Arts. (2009) Background paper to EPBC Act Policy Statement 3.12 - Nationally Threatened Species and Ecological Communities: Significant impact guidelines for the Critically Endangered Golden Sun Moth *Synemon plana*. Department of the Environment, Water, Heritage and the Arts, Canberra.

Threatened Species Scientific Committee. (2008a) Commonwealth Conservation Advice on *Synemon gratiosa*. Department of the Environment, Water, Heritage and the Arts, Canberra.

Threatened Species Scientific Committee. (2008b) Commonwealth Listing Advice on *Synemon gratiosa*. Department of Environment, Water, Heritage and the Arts, Australia.

Westwood J. O. (1877) A monograph of the Lepidopterous genus Castnia and some allied groups. *Transactions of the Linnean Society* **1**, 155-207.

APPENDIX 1 – HISTORIC AND CURRENT POPULATIONS OF GRACEFUL SUN MOTH - *SYNEMON GRATIOSA*

(information current as at 13 August 2010)

Site No.	Location	First Record	Year and No. seen	status of population	Habitat type	Area of Known Habitat	Conservation Status of Land: (Reserve, Bush Forever, etc	Local Authority
1	"Perth"	1915	1915-1	presumed to be extinct	unknown	unknown	unknown	
2	"Swan River" (exact location unknown)	Pre 1950	Pre 1950 - 10	presumed to be extinct	unknown	unknown	unknown	
3	Kings Park	1935	1935-2	presumed to be extinct	*L. hermaphrodita*	Area of habitat unknown, (bushland - 320ha)	Crown reserve vested with Botanic Parks and Gardens Authority. Bush Forever site 317	
4	"Crawley" (exact location unknown)	1935	1935 - 1	presumed to be extinct	unknown	unknown	unknown	
5	"Fremantle" (exact location unknown)	1935	1935 - 2	presumed to be extinct	unknown	unknown	unknown	
6	"Naval Base"	Pre 1970?	Pre 1970?-1	Unknown, but probably extinct	*L. maritima*	unknown	unknown	
7	"Applecross"	1951	1951-1	Unknown, but probably extinct	*L. hermaphrodita*	unknown	unknown	
8	"Jandakot"	1969	1969-2	Unknown, but probably extinct	*L. hermaphrodita*	unknown	unknown	
9	"Sorrento"	1971	1971-1	Unknown, but probably extinct	*L. maritima*	unknown	unknown	
10	"Swanbourne"	1976	1976-2 2010-0	presumed to be extinct	*L. maritima*	unknown	unknown	
11	"Mandurah" (exact location unknown)	1984	1984 - 1	Unknown, but probably extinct	unknown	unknown	unknown	
12	Wanneroo (exact location unknown)	1984	1984 - 16 1985 - 3	Marangaroo golf course, presumed to be extinct	*L. hermaphrodita*	unknown	unknown	Wanneroo
13	Neerabup	1996	1996 - 21 2008 - 0 2010 - 0	Unknown, not recently relocated presumed to be extinct	*L. hermaphrodita*	Area of habitat unknown, (bushland – > 200ha)	Private Property zoned Industrial, part Bush Forever site 295	Wanneroo

Site No.	Location	First Record	Year and No. seen	status of population	Habitat type	Area of Known Habitat	Conservation Status of Land: (Reserve, Bush Forever, etc	Local Authority
14	Whiteman Park, Whiteman	1997	1997 – 2 2006 – 0 2010 - 0	Unknown, not recently relocated presumed to be extinct	*L. hermaphrodita*	Area of habitat unknown, (bushland – 367ha)	Freehold land WAPC – Whiteman Park, Bush Forever site 304	Swan
15	Koondoola Regional Bushland, Koondoola	2002	2002 - 4 2004 – 1 2006 – 1 2008 - 1 2010 - 2	Extant	*L. hermaphrodita*	Area of habitat ~80ha, (bushland – 123ha)	Crown Reserve A 48449, Management Order with City of Wanneroo, Purpose: Conservation and Recreation, Bush Forever site 201	Wanneroo
16	Warwick Conservation Area, Warwick	2003	2003 - 13 2004 - 14 2005 - 4 2006 - 3 2008 - 15 2009 - 9 2010 – 4	Extant	*L. hermaphrodita*	Area of habitat ~58ha	Freehold land, City of Joondalup Bush Forever site 202	Joondalup
17	Errina Rd bushland, Alexander Heights	2004	2004 - 1 2010 – 7	Extant	*L. hermaphrodita*	Area of habitat ~8.5ha	Freehold land WAPC, Bush Forever site 493	Wanneroo
18	Landsdale Road Bushland, Landsdale	2004	2004 – 1 2010 – 0	Unknown, not recently relocated.	*L. hermaphrodita*	Area of habitat ~15ha	Crown Reserve C 24794, Shire of Wanneroo, Purpose: Public Recreation, Bush Forever site 199	Wanneroo
19	Decourcey Way Bushland, Marangaroo	2004	2004 – 3 2010 – 0	Unknown, not recently relocated.	*L. hermaphrodita*	Area of habitat ~32ha,	Crown Reserve A 20091, City of Wanneroo, Purpose: Recreation and Parklands Act 103-1978 Bush Forever site 328	Wanneroo
20	Shenton bushland, Shenton Park	2004	2004 – 1 2005 – 0 2006 – 0 2009 - 0 2010 - 1	Extant	*L. hermaphrodita*	Area of habitat unknown (bushland – 20ha)	Crown Reserve A 43161, City of Nedlands, Purpose: Recreation and Conservation Bush Forever site 218	Nedlands
21	Gumblossom Park, Quinns Rocks	2005	2005 – 1 2010 – 0	Unknown, not recently relocated.	*L. maritima*	Area of habitat ~4ha	Crown Reserve C 28376, City of Wanneroo, Purpose: Recreation Subject to partial clearing application	Wanneroo
22	Porteous Park, Sorrento	2008	2008 – 1 2009 – 1 2010 – 1	Extant	*L. maritima*	Area of habitat ~1.3ha	Crown Reserve C 30149, City of Joondalup, Purpose: Public Recreation	Joondalup
23	Maritana Park, Kallaroo	2009	2009 – 3 2010 – 6	Extant	*L. maritima*	Area of habitat ~2.3ha	Crown Reserve C 32039, City of Joondalup, Purpose: Public Recreation	Joondalup

Site No.	Location	First Record	Year and No. seen	status of population	Habitat type	Area of Known Habitat	Conservation Status of Land: (Reserve, Bush Forever, etc	Local Authority
24	Coastal bushland, Burns Beach to Ocean Reef Marina	2010	2010-1	Extant	*L. maritima*	Area of habitat ~1ha	Crown Reserve, City of Joondalup, Purpose: Public Recreation, Subject to partial clearing application Bush Forever site 325	Joondalup
25	Ocean Reef marina, Ocean Reef	2009	2009 – 14	Extant	*L. maritima*	Area of habitat ~21ha	Freehold, proposed for recreation development Bush Forever site 325	Joondalup
26	Cawarra Cr bushland, Craigie	2009	2009 – 8 2010 – 32	Extant	*L. maritima*	Area of habitat ~1.8ha	Crown Reserve C 35310, City of Joondalup, Purpose: High School site Proposed for rehabilitation following demolition of school	Joondalup
27	Craigie open space, Craigie	2009	2009 – 2 2010 – 5	Extant	*L. maritima*	Area of habitat ~110ha	Crown Reserve C 32858, City of Joondalup, Purpose: Recreation, Bush Forever site 303	Joondalup
28	Madana Park, Craigie	2009	2009 – 4 2010 – 1	Extant	*L. maritima*	Area of habitat ~1.2ha	Crown Reserve C 32653, City of Joondalup, Purpose: Public Recreation	Joondalup
29	Burns Beach bushland Burns Beach	2009	2009 – 12	Extant	*L. maritima*	Area of habitat ~16ha (Possible habitat – 400ha)	Private property - proposed for development, and Bush Forever site 322	Joondalup
30	Preston Beach reserve 22091	2010	2010 – 53	Extant	*L. maritima*	Area of habitat ~85ha	Crown Reserve 22091, Shire of Waroona, Purpose: Camping and Recreation	Waroona
31	Nambung National Park, Kangaroo Point	2010	2010 – 2	Extant	*L. maritima*	Area of habitat ~95ha	DEC managed National Park	Dandaragan
32	Nilgen Nature Reserve, Lancelin	2010	2010 – 7	Extant	*L. maritima*	Area of habitat ~ 40ha, (Possible habitat ~490ha)	DEC managed Nature Reserve	Gingin
33	Beekeepers Nature Reserve, East Jurien	2010	2010 – 1	Extant	*L. maritima*	Area of habitat ~ 20ha	DEC managed Nature Reserve	Coorow
34	Southern Beekeepers Nature Reserve - East Cervantes	2010	2010 – 5	Extant	*L. maritima*	Area of habitat ~ 40ha, (Possible habitat ~250ha)	DEC managed Nature Reserve	Dandaragan
35	Wanagarran Nature Reserve	2010	2010 – 4	Extant	*L. maritima*	Area of habitat ~40ha, (Possible habitat ~719ha)	DEC managed Nature Reserve	Dandaragan
36	Wilbinga Conservation Park, north coast	2010	2010 – 18	Extant	*L. maritima*	Area of habitat ~119ha	DEC managed Conservation Park	Gingin

Site No.	Location	First Record	Year and No. seen	status of population	Habitat type	Area of Known Habitat	Conservation Status of Land: (Reserve, Bush Forever, etc	Local Authority
37	Wilbinga Conservation Park, north east	2010	2010 – 12	Extant	*L. maritima*	Area of habitat ~40ha	DEC managed Conservation Park	Gingin
38	Wilbinga Conservation Park, South coast	2010	2010 – 9	Extant	*L. maritima*	Area of habitat ~48ha	DEC managed Conservation Park	Gingin
39	Yalgorup National Park, central	2010	2010 – 62	Extant	*L. maritima*	Area of habitat ~140ha	DEC managed National Park	Waroona
40	Yalgorup National Park, White Hill Rd	2010	2010 – 56	Extant	*L. maritima*	Area of habitat ~164ha	DEC managed National Park	Mandurah
41	Yanchep National Park, Pipidinny Rd	2010	2010 – 46	Extant	*L. maritima*	Area of habitat ~96ha	DEC managed National Park	Wanneroo
42	Yanchep National Park, Water Block	2010	2010 – 21	Extant	*L. maritima*	Area of habitat ~54ha	DEC managed National Park	Wanneroo
43	Coolimba Rd, Leeman	2010	2010 – 7	Extant	*L. maritima*	Area of habitat ~131ha	Road reserve with adjacent Private property	Carnamah
44	Alkimos 1	2010	2010 – >100	Extant	*L. maritima*	Area of habitat ~137ha	Private property with proposed urban development	Wanneroo
45	Binningup	2010	2010 – 39	Extant	*L. maritima*	Area of habitat ~148ha	Private property with proposed urban development	Harvey
46	Golden Bay	2010	2010 – 3	Extant	*L. maritima*	Area of habitat ~47ha	Private property with proposed urban development	Rockingham
47	Point Peron, within Regional Park	2010	2010 – 3	Extant	*L. maritima*	Area of habitat ~31ha	DEC managed Regional Park, proposed marina and urban development Bush Forever site 355	Rockingham
48	Moore River	2010	2010 – 22	Extant	*L. maritima*	Area of habitat ~22ha	Private property	Gingin
49	Preston Beach, adjacent to reserve 22091 (S)	2010	2010 – 92	Extant	*L. maritima*	Area of habitat ~10ha, (bushland – 95ha)	Private property with proposed urban development	Waroona
50	Preston Beach, adjacent to reserve 22091 (N)	2010	2010 – 30	Extant	*L. maritima*	Area of habitat ~5ha, (bushland – 50ha)	Private property with proposed urban development	Waroona
51	Lake Clifton, adjacent to Yalgorup National Park	2010	2010 – 112	Extant	*L. maritima*	Area of habitat ~150ha	Private property with proposed lifestyle rural development	Mandurah

Site No.	Location	First Record	Year and No. seen	status of population	Habitat type	Area of Known Habitat	Conservation Status of Land: (Reserve, Bush Forever, etc	Local Authority
52	South Yanchep, adjacent to Yanchep National Park	2010	2010 – 2	Extant	*L. maritima*	Area of habitat ~10ha	Private property	Wanneroo
53	Tamala Park, Mindarie	2010	2010 – 3	Extant	*L. maritima*	Area of habitat ~65ha	Private property with proposed urban development	Wanneroo
54	Alkimos 2	2010	2010 – 14	Extant	*L. maritima*	Area of habitat ~12ha	Private property with proposed urban development	Wanneroo
55	Jindee	2010	2010 – 35	Extant	*L. maritima*	Area of habitat ~12ha	Private property with proposed urban development	Wanneroo
56	Brighton	2010	2010 - 15	Extant	*L. maritima*	Area of habitat ~12ha	Private property with proposed urban development	Wanneroo
57	Jandakot Regional Park, Wandi	2010	2010 – 3	Extant	*L. hermaphrodita*	Area of habitat ~93ha	DEC managed Regional Park Bush Forever site 347	Kwinana
58	Sir Frederick Samson Park, Samson	2010	2010 – 1	Extant	*L. hermaphrodita*	Area of habitat ~13ha	Crown Reserve 34233, City of Fremantle Purpose: Recreation Bush Forever site 59.	Fremantle
59	East Landsdale, Landsdale	2010	2010 – 3	Extant	*L. hermaphrodita*	Area of habitat ~40ha	Private property with current subdivision application	Wanneroo
60	Anketell Rd, Anketell	2010	2010 – 2	Extant	*L. hermaphrodita*	Area of habitat ~89ha	DEC managed Regional Park - Western Power transmission line easement Bush Forever site 347	Serpentine-Jarrahdale
61	Reid Highway bushland, Mirrabooka	2010	2010 – 1	Extant	*L. hermaphrodita*	Area of habitat ~48ha	WAPC owned and proposed for transfer to DEC. Bush Forever site 385	Stirling
62	Roe Highway Extension	2010	2010 – 6	Extant	*L. hermaphrodita*	Area of habitat ~55ha	Roe Highway extension currently being prepared for EIA.	Cockburn
63	Erindale Rd Bushland, Hamersley	2010	2010 – 17	Extant	*L. hermaphrodita*	Area of habitat ~37ha	Private property	Stirling