

Abridged Threatened Species Nomination Form

For nominations/assessments under the Common Assessment Method (CAM) where supporting information is available, but not in a format suitable for demonstrating compliance with the CAM, and assessment against the IUCN Red List threat status.

Cover Page *(Office use only for Assessment)*

Species name (scientific and common name):	<i>Croitana aestiva</i> Desert sand skipper
Nomination for (addition, deletion, change):	deletion
Nominated conservation category and criteria:	na

Scientific committee assessment of eligibility against the criteria:		
This assessment is consistent with the standards set out in Schedule 1, item 2.7 (h) and 2.8 of the Common Assessment Method Memorandum of Understanding.		Yes <input type="checkbox"/> No <input type="checkbox"/>
A.	Population size reduction	•
B.	Geographic range	•
C.	Small population size and decline	•
D.	Very small or restricted population	•
E.	Quantitative analysis	•

Outcome:		
<i>Scientific committee Meeting date:</i>		
<i>Scientific committee comments:</i>		
<i>Recommendation:</i>		
<i>Ministerial approval:</i>		<i>Date of Gazettal/ Legislative effect:</i>

Nomination/Proposal summary *(to be completed by nominator)*

Current conservation status				
Scientific name:	<i>Croitana aestiva</i> (E.D. Edwards 1979)			
Common name:	Desert sand skipper			
Family name:	HESPERIIDAE	Fauna <input checked="" type="checkbox"/>	Flora <input type="checkbox"/>	
Nomination for:	Listing <input type="checkbox"/>	Change of status/criteria <input type="checkbox"/>	Delisting <input checked="" type="checkbox"/>	
1. Is the species currently on any conservation list, either in a State or Territory, Australia or Internationally? 2. Is it present in an Australian jurisdiction, but not listed?		Provide details of the occurrence and listing status for each jurisdiction in the following table		
Jurisdiction	State / Territory in which the species occurs	Date listed or assessed (or N/A)	Listing category i.e. critically endangered or 'none'	Listing criteria i.e. B1ab(iii)+2ab(iii)
International (IUCN Red List)				
National (EPBC Act)		18/08/06	Endangered	B1,B2ab(iii,v)
State / Territory	1. Northern Territory	2012	Near Threatened	Approaches B1,B2ab(iii)
	2. Northern Territory	2002	Endangered	B1ab(i,ii,iii,iv)+2ab(i,ii,iii,v)
	3.			
Consistent with Schedule 1, item 2.7 (h) and 2.8 of the Common Assessment Method Memorandum of Understanding, it is confirmed that:				
<ul style="list-style-type: none"> this assessment meets the standard of evidence required by the Common Assessment Method to document the eligibility of the species under the IUCN criteria; 			Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
Comments:				
<ul style="list-style-type: none"> surveys of the species were adequate to inform the assessment; 			Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
Comments:	<p>The distribution of butterflies is determined to a large extent by the distribution of the larval food plant. For the Desert sand-skipper, this is the grass <i>Neurachne tenuifolia</i> (Palmer & Braby 2012), which is restricted to the West MacDonnell Ranges, where it is found in sheltered slopes and gorges as far west as Mt Liebig (260 km West of Alice Springs). As the grass is found fairly continuously through the Chewings and Heavitree Ranges, one can assume that <i>C. aestiva</i> is also fairly continuously distributed through these ranges. Subsequent to the rediscovery of this butterfly species in 2007 and identification of the larval food plant, surveys occurred at 19 sites with potential habitat and located the species at nine of them (NRETA 2010; Palmer and Braby 2012). It is likely that more extensive surveys will locate the species over a larger number of sites and area.</p>			
<ul style="list-style-type: none"> the conclusion of the assessment remains current and that any further information that may have become available since the assessment was completed supports or is consistent with the conclusion of the assessment. 			Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>

Comments:	There is no significant new information on the species since the 2012 assessment.				
Nominated national conservation status: category and criteria					
Presumed extinct (EX) <input type="checkbox"/>	Critically endangered (CR) <input type="checkbox"/>	Endangered (EN) <input type="checkbox"/>	Vulnerable (VU) <input type="checkbox"/>		
None (least concern) <input checked="" type="checkbox"/>	Data Deficient <input type="checkbox"/>	Conservation Dependent <input type="checkbox"/>			
What are the IUCN Red List criteria that support the recommended conservation status category?	See species' assessment document for details				
Eligibility against the IUCN Red List criteria (A, B, C, D and E)					
<i>Provide justification for the nominated conservation status; is the species eligible or ineligible for listing against the five criteria. For delisting, provide details for why the species no longer meets the requirements of the current conservation status.</i>					
A.	Population size reduction (evidence of decline)				
B.	Geographic range (EEO and AOO, number of locations and evidence of decline)				
C.	Small population size and decline (population size, distribution and evidence of decline)				
D.	Very small or restricted population (population size)				
E.	Quantitative analysis (statistical probability of extinction)				
Summary of assessment information					
EEO	>1400 km ²	AOO	>48 km ² (using the 2km x 2km grid method)	Generation length	unknown
No. locations	13	Severely fragmented		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/> Unknown <input type="checkbox"/>
No. subpopulations	7	No. mature individuals		unknown	
Percentage global population within Australia				100%	
Percentage population decline over 10 years or 3 generations				No evidence of decline	

Threats (detail how the species is being impacted)		
Threat (describe the threat and how it impacts on the species. Specify if the threat is past, current or potential)	Extent (give details of impact on whole species or specific subpopulations)	Impact (what is the level of threat to the conservation of the species)
The invasive introduced Buffel Grass, <i>Cenchrus ciliaris</i> , forms dense monocultures and competes with native plant species, such as the host plant of the desert sand skipper. Many areas of alluvial soils in the West MacDonnell Ranges are dominated by buffel grass and some areas of potential habitat for the sand-skipper on rocky hill slopes are now being colonised. (current and future)	Areas closer to Alice Springs will be affected sooner.	Medium
Fire: Increased grass biomass also results in high fuel loads, resulting in increases in frequency and intensity of fires. The rocky nature of the sand-skipper's habitat provides some protection from extensive fires. (current and future)	25% of the species' total distribution	Medium
Human interference: Two of the known sites have high visitation rates – Standley Chasm and Ellery Big Hole. (current and future)	15% of the species' total distribution	Low
Management and Recovery		
Is there a Recovery Plan (RP) or Conservation Management Plan operational for the species?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
<p>List all relevant recovery or management plans (including draft, in-preparation, out-of-date, national and State/Territory recovery plans, recovery plans for other species or ecological communities, or other management plans that may benefit or be relevant to the nominated species).</p> <ul style="list-style-type: none"> Palmer, C.M. (2010). National Recovery Plan for the Desert Sand-skipper <i>Croitana aestiva</i>. Department of Natural Resources, Environment, The Arts and Sport, Northern Territory. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/desert-sand-skipper.html. Parks and Wildlife Commission of the Northern Territory (2011) West MacDonnell (Tyurretye) National Park Draft Joint Management Plan 2011 http://www.territorystories.nt.gov.au/bitstream/10070/241354/1/FINAL_Draft_West_Macs_JMP_Word_Master_2011-03-01.pdf 		
<p>List current management or research actions, if any, that are being undertaken that benefit the conservation of the species.</p> <p>Management priorities are to:</p> <ul style="list-style-type: none"> control the spread of Buffel Grass; and maintain appropriate burning practices in locations where populations are found. 		
<p>List further recommended management or research actions, if any, that would benefit the conservation of the species. Please ensure that this section addresses all identified threats.</p>		

Research priorities are to:

- undertake surveys elsewhere in the MacDonnell Ranges to search for additional populations , especially areas occupied by the larval food plant;
- investigate the basic biology and ecology of the species to determine more precisely the habitat requirements; and
- establish a monitoring program to detect possible changes in range or abundance, and to measure the impacts of threatening processes.

Nomination prepared by:

Contact details:

Date submitted:

21 December 2016

If the nomination has been refereed or reviewed by experts, please provide their names and contact details:

Dr Chris Palmer, Department of the Environment and Energy.

Summary of subpopulation information <i>(detailed information to be provided in the relevant sections of the form)</i>						
Location <i>(include coordinates)</i>	Land tenure	Survey information: Date of survey and No. mature individuals	Area of subpopulat ions	Site / habitat Condition	Threats <i>(note if past, present or future)</i>	Specific management actions

Evidence on Listing Eligibility and Conservation Actions 2016

Croitana aestiva (Desert Sand-skipper, Aestiva Skipper)

Priority: 1. Endemic

Action: For delisting under *EPBC Act*

Notes: DoEE to update. Listed near threatened TPWCA (2012) based on recent surveys that the EPBC assessment does not take into account (Endangered 2006).

Taxonomy

Conventionally accepted as *Croitana aestiva* (E.D. Edwards 1979) (HESPERIIDAE)

Nominated Status: not threatened

Current EPBC Act status: Endangered (B1,B2ab(iii,v))

Current TPWC Act status: Near Threatened (B1,B2ab(iii))

Species Information

Description

The Desert Sand-skipper is a small brown and yellow butterfly about 22 mm across the outspread wings. The upper sides of the wings are dark brown with pale yellow markings. There is a central yellow patch, divided by brown veins, on the hind wing. The undersides of the wings are brown suffused with pale yellow, and have yellow spots. The clubs at the end of the antennae are bent near the base. Females can be distinguished from males by the more rounded termen (edge of the wing most distant from the body) (Braby 2000).

Distribution

The Desert Sand-skipper is endemic to the Northern Territory (NT), known only from the MacDonnell Ranges Bioregion. Studies between Feb 2007 and Feb 2010 revealed 13 extant locations, covering at least 1400 km². No desert sand-skipper have been located recently at one of the historic sites (Larapinta Drive, 25 km West of Alice Springs) but the larval food plant does not occur there and it is likely that the species is not permanently at this site. It is likely that the roadside record there from 1966 is a result of a very large emergence of adults from an, as yet undiscovered, patch of habitat in the hills nearby (C. Palmer *pers. comm.*). The distribution of butterflies is determined to a large extent by the distribution of the larval food plant (the grass *Neurachne tenuifolia*) which is restricted to the West MacDonnell Ranges, where it is found in sheltered slopes and gorges as far west as Mt Liebig (260 km West of Alice Springs). As the grass is found fairly continuously through the Chewings and Heavitree Ranges, one can assume that *C. aestiva* is also fairly continuously distributed through these ranges.

Adequacy of Survey

Palmer (NTG unpublished data) did targeted surveys for the species between 2007 and 2010 and found the species at 10 new locations. His studies also identified the larval food plant (Palmer & Braby 2012).

The sporadic appearance of adults (dependent on sufficient rainfall at appropriate times of year) makes the species difficult to survey and monitor. However, there is a clear relationship of the Desert Sand-skipper with its larval food plant (*Neurachne tenuifolia*); that species is only found in the West MacDonnell Ranges (FloraNT 2016), occurring on sheltered slopes and gorges as far west as Mt Liebig (260 km West of Alice Springs). As the grass is found fairly continuously through the Chewings and Heavitree Ranges, one can assume that *C. aestiva* is also fairly

continuously distributed through these ranges. Subsequent to the rediscovery of this butterfly species in 2007 and identification of the larval food plant, surveys occurred at 19 sites with potential habitat and located the species at nine of them (NRETA 2010; Palmer and Braby 2012). It is likely that more extensive surveys will locate the species over a larger number of sites and area.

Relevant Biology/Ecology

Chris Palmer identified the larval food plant; the grass *Neurachne tenuifolia* (Palmer & Braby 2012). This grass is generally found in sheltered rocky gullies and gorges and on steep, south-facing, rocky slopes. It tends to be locally dominant in the habitats most favoured by the Desert Sand-skipper.

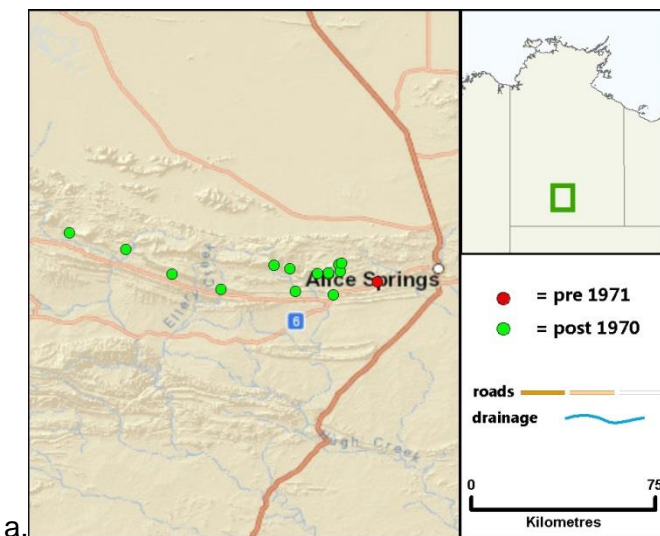
Adult emergence and abundance are entirely dependent on rainfall, such that adults will not emerge without adequate rain, and larger numbers of adults are seen following wetter periods (Palmer & Braby 2012). There is a prolonged flight period following sufficient rain, indicating an adaptation to these sporadic events. Upon emergence, adult males and females feed opportunistically on many species of nectar-producing plants, representing several families, such as the Asteraceae, Amaranthaceae and Nyctaginaceae. Mating and oviposition have not been observed, although males have been observed exhibiting territorial behaviour leading to fighting with other males and interacting with females.

Threats

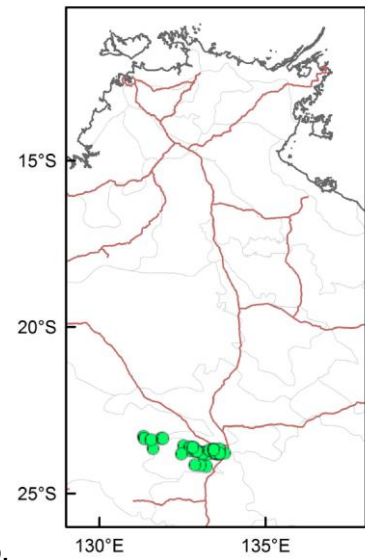
The larval food plant of this butterfly species is probably intolerant of fire (Prendergast and Hattersley, 1985), and the habitats in which it occurs are surrounded by open plain areas very exposed to bushfires. Consequently, the threats of invasive grass species and altered fire regimes are of most importance to the species because they interact, resulting in the current fire regimes in central Australia, which are characterised by large pulses of intense, uncontrolled fires (Edwards *et al.* 2008).

Buffel Grass, *Cenchrus ciliaris*, is a very invasive species in Central Australia that forms dense monocultures and competes with, eventually displacing, native plant species, particularly grasses (Clarke *et al.* 2005). The increased biomass in the high density monocultures results in high fuel loads, resulting in increases in the frequency and intensity of fire. Relatively large areas of buffel grass now occur particularly on alluvial soils throughout central Australia and also on rocky hill slopes of the MacDonnell Ranges west of Alice Springs. The steep slopes, gullies and gorges favoured by the Desert Sand-skipper and its host-plant for breeding provide some protection from invasion by buffel grass, but there is potential at all known Desert Sand-skipper locations for some level of invasion and greater exposure to fires around the margins.

There are potential impacts from tourism in several popular destinations such as Standley Chasm as important habitat may be exposed to visitor impacts such as trampling, rubbish and the spread of weeds. Illegal collection is also a possible problem as the re-discovery of the Desert Sand-skipper in February 2007 attracted widespread media interest, as well as interest by amateur butterfly enthusiasts (Palmer 2010).



a.



b.

Distribution of a. *Croitana aestiva* and b. its larval food plant *Neurachne tenuifolia*

Assessment of available information in relation to the listing Criteria

Criterion A. Population size reduction (reduction in total numbers)				
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4				
	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction	
A1	≥ 90%	≥ 70%	≥ 50%	
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%	
A1	<p><i>based on any of the following</i></p> <ul style="list-style-type: none"> (a) direct observation [except A3] (b) an index of abundance appropriate to the taxon (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat (d) actual or potential levels of exploitation (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites 			
A1				Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.
A2				Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.
A3				Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3]
A4	An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.			

Evidence:

Systematic and comprehensive counts of adults following rain were conducted at Standley Chasm following re-discovery of the species in 2007 until 2010, and up to 80 adults have been observed at that site at any one time. The species is now known from 13 locations, but due to the challenges of locating small, mobile individuals in rugged terrain, counts of adult individuals for six of these are low, with between one and twelve adults seen at each location. Although these data demonstrate the presence of this species, the counts probably underestimate the population size at these six locations.

Although most of the known localities show evidence of some disturbance (Palmer 2010), this has apparently had only little or no impact on the numbers of butterflies at locations. There is currently no evidence that numbers or range has declined. However, the larval food plant is probably intolerant of fire (Prendergast and Hattersley, 1985), and the habitats in which it occurs are surrounded by open plain areas very exposed to bushfires.

Based on the above evidence, there are few quantitative data available to assess the size of the species' population but there is no evidence observed, estimated, inferred, projected or suspected that the species' population, distribution or quality of habitat has, is or is likely to suffer decline above the threshold level for Vulnerable. Consequently, *Croitana aestiva* is not eligible for listing under this criterion.

Criterion B. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1. Extent of occurrence (EOO)	< 100 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
AND at least 2 of the following 3 conditions indicating distribution is precarious for survival:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Previous assessment of the conservation status of this species was based on a very small number of records and the species not having been observed for more than 30 years. Now, the species is known from at least 13 locations and much more is known of the species' ecology (Palmer 2010).

Based on these 13 locations, the EOO is approximately 1400 km². The EOO is likely to increase with more surveys of appropriate habitat under the correct conditions (Palmer, *pers. comm.*). The AOO is similarly small, but its distribution is not severely fragmented and does not experience extreme fluctuations in numbers or distribution.

Although the butterfly has a limited spatial distribution and is ecologically specialised, there is no evidence of decline, either observed or inferred. Most of the known localities show evidence of some disturbance (Palmer 2010) but this has apparently had only little or no impact on butterfly populations. There is currently no evidence that numbers or range has declined.

The larval food plant of this butterfly species is probably intolerant of fire (Prendergast and Hattersley, 1985), and the habitats in which it occurs are surrounded by open plain areas very exposed to bushfires. Consequently, the interrelated threats of invasive grass species and altered fire regimes are of most importance to the species. Buffel Grass, *Cenchrus ciliaris*, is a very invasive species in Central Australia, forms dense monocultures and competes with, eventually displacing, native plant species, particularly grasses (Clarke *et al.* 2005). The increased biomass in the high density monocultures results in high fuel loads, resulting in increases in the frequency and intensity of fire. The steep slopes, gullies and gorges favoured by the Desert Sand-skipper, and its host-plant, for breeding provide some protection from invasion by buffel grass, but there is potential at all known Desert Sand-skipper locations for some level of invasion and greater exposure to fires around the margins.

Based on the above evidence, *Croitana aestiva* is not eligible for listing as nationally threatened under this criterion. However, the conservation status of this species approaches Vulnerable based on small EOO and AOO. There are also potential threats to the species. The species will remain listed in the non-CAM category of Near Threatened in the Northern Territory (approaching B1,B2ab(iii)).

Criterion C. Population size and decline			
	Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals	< 250	< 2,500	< 10,000
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	Very high rate 25% in 3 years or 1 generation (whichever is longer)	High rate 20% in 5 years or 2 generation (whichever is longer)	Substantial rate 10% in 10 years or 3 generations (whichever is longer)
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(a) (ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b) Extreme fluctuations in the number of mature individuals			

Evidence:

Systematic and comprehensive counts of adults following rain were conducted at Standley Chasm following re-discovery of the species in 2007 until 2010, and up to 80 adults were observed at that site at any one time. Larger numbers of individuals at juvenile and immature stages presumably occur in each subpopulation. The species is now known from 13 locations, but due to the challenges of locating small, mobile individuals in rugged terrain, counts of butterflies for six of these are low, with between one and twelve adults seen at any one time at each location. Although these data demonstrate the presence of this species, the counts are considered to underestimate the number of adult individuals at these six locations.

Although most of the known locations show evidence of some disturbance (Palmer 2010), this has apparently had only little or no impact on butterfly populations. There is currently no evidence that numbers or range has declined. However, the larval food plant is probably intolerant of fire (Prendergast and Hattersley, 1985), and the habitats in which it occurs are surrounded by open plain areas very exposed to bushfires.

Based on the evidence above, there are few quantitative data available to assess the size of the species' population and there is no evidence observed, estimated, inferred, projected or suspected that the species' population, distribution or quality of habitat has, is or is likely to decline. Consequently, *Croitana aestiva* is not eligible for listing under this criterion.

Criterion D. Number of mature individuals			
	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
D. Number of mature individuals	< 50	< 250	< 1,000
D2. <i>Only applies to the VU category</i> Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	D2. Typically: AOO < 20 km ² or number of locations ≤ 5

Evidence:

Systematic and comprehensive counts of adults following rain were conducted at Standley Chasm following re-discovery of the species in 2007 until 2010, and up to 80 adults were observed at that site at any one time. Larger numbers of individuals at juvenile and immature stages presumably occur in each subpopulation. The species is now known from 13 locations, but due to the challenges of locating small, mobile individuals in rugged terrain, counts of butterflies at six of these are low, with between one and twelve adults seen at any one time at each location. These counts are considered to underestimate the numbers of individuals at these six locations.

It is possible that the combined number of mature individuals from the 13 known locations is less than 1000. However, the larval food plant occurs fairly continuously through a much wider area of the Chewings and Heavitree Ranges, and it is likely this butterfly species is more widespread than currently known. Consequently, it is likely that both the number of mature individuals and the AOO are larger than the thresholds for Vulnerable, and *Croitana aestiva* is not eligible for listing under this criterion.

Criterion E. Quantitative Analysis			
	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Evidence:

There are insufficient quantitative data available to model extinction risk for the species with any confidence.

Summary

The distribution of butterflies is determined to a large extent by the distribution of the larval food plant. For the Desert sand-skipper, this is the grass *Neurachne tenuifolia* (Palmer & Braby 2012), which is restricted to the West MacDonnell Ranges, where it is found in sheltered slopes and gorges as far west as Mt Liebig (260 km West of Alice Springs). As the grass is found fairly continuously through the Chewings and Heavitree Ranges, one can assume that *C. aestiva* is also fairly continuously distributed through these ranges. Consequently, it is likely that more extensive surveys will locate the species over a larger number of sites and area.

The conservation status of this species approaches Vulnerable based on small EOO (1400 km²) and AOO. However, this species does not meet the criteria for listing as nationally threatened. The species will remain listed in the non-CAM category of Near Threatened in the Northern Territory (approaching B1,B2ab(iii)). There are also potential threats to the species, mostly indirectly via its larval food plant.

Conservation Actions

Conservation and Management Priorities

Management priorities are to:

- i. control the spread of Buffel Grass; and
- ii. maintain appropriate burning practices around locations where populations are found.

Survey and Monitoring priorities

Establish a monitoring program to detect possible changes in range or abundance, and to measure the impacts of threatening processes (DLRM 2012).

Information and research priorities

Research priorities are to:

- i. undertake surveys elsewhere in the MacDonnell Ranges to search for additional populations, especially areas occupied by the larval food plant;
- ii. investigate the basic biology and ecology of the species to determine more precisely the habitat requirements.

References cited in the advice

Braby M. F. 2000. Butterflies of Australia: their identification, biology and distribution. CSIRO Publishing, Melbourne.

Clarke, P.J., Latz, P.K., and Albrecht, D.E. (2005). Long term changes in semi-arid vegetation: invasion of an exotic perennial grass has larger effects than rainfall variability. *Journal of Vegetation Science* 16, 237-248.

Department of Land Resource Management, 2012. Threatened Species of the Northern Territory: DESERT SAND-SKIPPER *Croitana aestiva*. [Online]. Darwin: Department of Natural Resources, Environment and the Arts. Available from: http://www.lrm.nt.gov.au/__data/assets/pdf_file/0008/349379/desert_sand_skipper_nt.pdf

Edwards, E. D. 1979. Two new species of *Croitana* Waterhouse (Lepidoptera: Hesperidae) from central Australia. *Australian Entomological Magazine* 6(2): 29-38.

Edwards, G. P., Allan G. E., Brock C., Duguid A., Gabrys K. and Vaarzon-Morel P. 2008. Fire and its management in central Australia. *The Rangeland Journal* 30:109-121.

FloraNT 2016 Factsheet *Neurachne tenuifolia* S.T.Blake. Northern Territory Government website <http://eflora.nt.gov.au/factsheet?id=4641>

NRETA 2010. FINAL REPORT – ‘Conservation management and recovery of the Desert sand-skipper *Croitana aestiva*’. Final report to DEWHA. NT Department of Natural Resources, Environment and the Arts, May 2010.

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Palmer C.M. and Braby, M.F. 2012 Rediscovery of the Desert Sand-skipper *Croitana aestiva* Edwards (Lepidoptera: Hesperidae): morphology, life history and behaviour. *Australian Journal of Entomology* 51,47-59.

Prendergast, H.D.V. and Hattersley 1985. Distribution and cytology of Australian *Neurachne* and its allies (Poaceae), a group containing C3, C4 and C3-C4 intermediate species. *Australian Journal of Botany* 33, 317-336.

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