The Minister approved this conservation advice on and transferred this species from the Vulnerable to Endangered category, effective from 22 February 2019.

Conservation Advice

Pteropus conspicillatus

spectacled flying-fox

Taxonomy

Conventionally accepted as *Pteropus conspicillatus* (Gould 1850). Known as the spectacled flying-fox, also known as the spectacled fruit bat. Two subspecies are recognised: *P. c. conspicillatus* (Australia and south-eastern New Guinea) and *P. c. chrysauchen* (north-western New Guinea and nearby islands) (Flannery 1995). Within its Australian range, Fox (2011) reported substantial genetic distinction between the Wet Tropics and Iron Range subpopulations; however further analysis in Fox et al. (2012) concluded that there was occasional gene flow between these subpopulations.

Summary of assessment

Conservation status

Endangered: Criterion 1 A4(a)(c)(d)

The spectacled flying-fox was listed as Vulnerable under the EPBC Act in 2002. Following a formal review of the listing status of the species, the Threatened Species Scientific Committee (the Committee) has determined that there is sufficient evidence to support a change of status of the species under the EPBC Act from Vulnerable to Endangered.

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of information provided by a public nomination to change the listing status of *Pteropus conspicillatus*.

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 30 business days between 30 September 2016 and 11 November 2016. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species Information

Description

The spectacled flying-fox is mostly black, with distinctive straw-coloured fur surrounding the eyes and upper muzzle, and a prominent yellow neck-ruff (Richards et al., 2008). Eye-rings of some individuals can be indistinct, making them look similar to black flying-foxes (*Pteropus alecto*) (Hall & Richards 2000), and the ruff and head may be silver-blond in some individuals (Richards et al., 2008). The head and body length is 220-240 mm, while the forearm length is 160-189 mm for males and 149-182 mm for females. Weight ranges are typically 500-1000 g for males and 450-800 g for females (Richards et al., 2008); however males of up to 1011 g and females up to 851 g have been recorded (Westcott pers. comm., 2016).

Distribution

In Australia, the spectacled flying-fox is restricted to north-eastern Queensland, where it occurs in association with extensive areas of rainforest from Cape York along the eastern coast to as far south as Ingham (Churchill 1998), with outlier records at least as far south as Charters Towers and as far west as Chillagoe (Garnett et al., 1999; Qld DERM 2010; Parsons et al., 2006). Within this range, the Wet Tropics region is considered its stronghold (Garnett et al., 1999; Fox 2011; Dennis 2012), with a much smaller population around Iron Range, Cape York (Fox 2011). Richards (1990a) described and mapped all then known camps, and additional camp information is presented in Shilton et al. (2008). Camp locations are also mapped and regularly updated as part of the National Flying-Fox Monitoring Program (DotEE, n.d).

The extent of occurrence of the spectacled flying-fox has probably changed little since European settlement, although extensive clearing of lowland vegetation, particularly rainforests, has likely reduced its area of occupancy substantially. Here, area of occupancy is defined as the area occupied by colonial camps, albeit noting that these may vary within and between years (Shilton et al., 2008).

Clearing continues at a reduced pace (Garnett et al., 1999). There is some anecdotal information of at least local contraction in range, with fewer reports of the species from the Ingham area (Whybird pers. comm., cited in Woinarski et al., 2014). However, despite a steady decline in the maximum number of individuals recorded south of -17.6 degrees latitude since 2004, the species still occupies its southern-most camp and it is unclear whether any significant contraction in range has occurred (Westcott pers. comm., 2016).

Beyond Australia, the species occurs in New Guinea and some surrounding islands (Flannery 1990, 1995), as far west as the Moluccas (Helgen et al., 2008).

Cultural Significance

The spectacled flying-fox was an important traditional food source for the Eastern Kuku Yalanji people (Kuku Yalanji elders [various] pers. comm., cited by Pinson pers. comm., 2015). However, no such use is currently known within the Wet Tropics region (Garnett et al., 1999).

Relevant Biology/Ecology

The spectacled flying-fox is associated mainly with rainforests, with most colonial camps occurring in or near (within several kilometres) of rainforests (Richards 1990a). However, it forages widely away from such camps across a broad range of vegetation types including mangroves, eucalypt forests, *Melaleuca* forests, gardens and orchards (Parsons et al., 2006; Dennis 2012). Individuals may disperse widely from camps to feed, and may move frequently between camps (Westcott et al., 2001). Individuals are known to fly up to 50 km in a single night to feed, and longer-distance movements are predicted (Fox 2011). Following tropical cyclone Larry in March 2006, which had substantial impacts on vegetation at many camps in the Wet Tropics region, spectacled flying-foxes dispersed widely and occupied many new sites, at least temporarily (Shilton et al., 2008).

Although many roost sites have been used for long periods, genetic studies show that there is little genetic differentiation between groups of individuals at different camps in the Wet Tropics region, indicating that there is substantial movement of individuals between colonies (Fox 2011; Fox et al., 2012). The spectacled flying-fox will often share camps with other *Pteropus* species, including the little red, and black, flying-foxes (Qld DERM 2010).

Diet includes fruits of many tree species, pollen, nectar and leaves (Richards 1990b; Parsons et al., 2006; Richards et al., 2008; Qld DERM 2010). Telemetry data suggest that much of the foraging is undertaken in open forests (on mass flowering events) rather than on the dispersed fruit and flower resources in rainforests (Shilton et al., 2008; Westcott pers. comm., cited in Woinarski et al., 2014).

Breeding is highly seasonal and synchronised, with births occurring between October and December (Shilton et al., 2008). Females produce one young per year. Longevity in the wild may be up to 13 years, although only a small proportion of individuals live that long (Fox et al., 2008). Some females produce young at two years, but the majority first breed at three years (Fox et al., 2008). Generation length, determined by life table analysis, is five years (Fox et al., 2008); however, this assessment may not be representative as it relates to a colony (and a period) with a high rate of mortality associated with tick infection (Fox pers. comm., cited in Woinarski et al., 2014). Generation length is therefore taken as the midpoint of longevity and age at sexual maturity, i.e. 7‑8 years (Woinarski et al., 2014).

Threats

Historic decline was associated particularly with habitat loss and persecution. These impacts have now lessened, in part because of protection afforded due to national threatened species listing. However, although much of the species' range occurs within the Wet Tropics World Heritage Area where it is protected from many threats, key foraging resources are found outside the World Heritage Area in agricultural land where clearing and persecution at orchards still occur (Woinarski et al., 2014). Monitoring by Westcott and McKeown (2014) from 2004 to 2014 showed an increasing population shift towards urban areas, which may result in a future increase in human and flying-fox conflicts. A subsequent publication (Tait et al., 2014) showed that there has been an increase in the proportion of urban camps and an increase in the proportion of the population using urban camps over this time period. This increase is not associated with the loss of non-urban camps or habitat.

Table 1 – Threats impacting the spectacled flying-fox in approximate order of severity of risk, based on available evidence.

Threat factor	Threat type	Threat status	Evidence base
Climatic factors			
Cyclones	known	current	Analysis of monthly monitoring data from the Wet Tropics over 2004−2014 identified significant declines of the population associated with cyclones (Westcott et al., 2015). Both severe and moderate cyclones were identified as having a significant effect when they result in widespread damage to tree canopies resulting in long term loss of flower and fruit resources (Wescott et al., 2015).
Climate change	potential	future	An increased incidence of extreme cyclones and extreme hot days could affect this species (Welbergen et al., 2007). Considered a significant threat by Qld DERM (2010).
Habitat loss and fragmentation			
Land clearing	known	current	Much of the species' habitat has been cleared and there is ongoing clearing, particularly of foraging (non-rainforest) habitat. Habitat losses are associated with development impacts in coastal and near-coastal areas and plateaus, and agriculture intensification on the dry western margins of the species' range (Queensland Herbarium 2014). There may also be some continuing fragmentation impacts.

			Habitat loss and fragmentation is considered a significant threat by Qld DERM (2010).
Culling and persecution			
Persecution at orchards	known	current	Culling was previously allowed under permit, but this ceased when the species was listed as Vulnerable under Queensland legislation. However, some illegal culling continues (Westcott pers. comm., 2016). Although electrocution grids have been prohibited in Queensland since 2001, they are not required to be dismantled, resulting in continued illegal electrocution (Booth 2006). Persecution by orchardists is considered a significant threat by Qld DERM (2010).
Persecution at camps (especially in and near towns)	known	current	Persecution at camps is rarely lethal; however, disturbance during early gestation can lead to some young falling or being abandoned, with animals moving to other camps. Given the high levels of natural movement between camps by individuals and extreme natural fluctuations in camp size, little long-term impact is likely (Woinarski et al., 2014) unless roosting habitat is removed altogether. However, while individual disturbance events have limited impact, their cumulative effect is significant − e.g. interference at critical periods in the breeding cycle across a number of key camps could result in the loss of many young (Westcott pers. comm., 2016).
Disease and abnormalities			
Tick paralysis	known	current	Many individuals have been reported to die due to tick paralysis, with this incidence probably increasing, possibly due to spread of the introduced shrub wild tobacco (*Solanum mauritanium*) (Garnett et al., 1999; Fox 2011; Dennis 2012; Buettner et al., 2013). Spectacled flying-foxes eat the fruits of this shrub, perhaps due to lower food availability resulting from land clearing or periods of low rainfall, which might expose them to ticks as they forage closer to the ground (Buettner et al., 2013). Some incidences of tick paralysis occur throughout the Cairns district, but the majority are found on the Southern Atherton Tablelands where it is a significant threat during October−December each year. Up to 700 adults and 500 orphans per year come into the Tolga Bat Hopital due to this disease (Mclean pers. comm., 2016). Analysis indicates fluctuating trends between years associated with rainfall patterning (Buettner et al., 2013). Tick

			paralysis is considered a moderate threat by Qld DERM (2010).
Birth abnormalities (cleft palate syndrome)	known	current	There is possibly an increasing incidence of cleft palate syndrome (30 - 40 cases reported from 1998 - 2001), with unknown cause (Woinarski et al., 2014). The syndrome is characterised by a number of features including the cleft palate. It is considered a minor threat by Qld DERM (2010). The true incidence of cleft palate syndrome in the Wet Tropics is unknown. Juveniles with the syndrome fall off their mothers away from the camps, and there is a consistent search effort at birthing time at only 3 spectacled flying-fox camps: Tolga and Malaan on the Atherton Tablelands (for tick paralysis adults) and Cairns City (for abandoned young) (Mclean pers. comm., 2016). Some young with the syndrome are found every year but numbers spike occasionally; at Tolga in 2001 from a camp of 4500 individuals (census figures from O. Whybird, cited Mclean pers. comm., 2016), 224 young came into care and 50 of these had cleft palate syndrome (Mclean pers. comm., 2016). 2015 was another year with a severe spike in numbers for cleft palate young at Tolga, Cairns and other camps on the coast (Mclean pers. comm., 2016).
Other mortalities			
Mortality associated with barbed wire, powerlines and fruitnetting	known	current	Considered a minor threat by Qld DERM (2010).
Secondary poisoning through chemicals used in agriculture	suspected	current	Considered a likely threat by Qld DERM (2010). Banana growers have reported deaths of spectacled flying-foxes after the bats have come into contact with organophosphate poisons that are used to control insect damage in developing fruits; the number of deaths are unknown (Qld DERM 2010).
Food availability			
Habitat degradation (and resource depletion) due to myrtle rust	suspected	future	Spread of the fungus myrtle rust (*Uredo rangelii*) in the Wet Tropics (Metcalfe et al., 2014) may affect recruitment of many of the tree species important in the flying-fox's diet, which may have an impact in the long term (Woinarski et al., 2014).
Habitat degradation (and resource	suspected	current	Changed fire regimes, predominantly fire exclusion due to the absence of burning by Indigenous people, have resulted in major change to the vegetation composition and

depletion) due to fire exclusion			structure in the Wet Tropics Bioregion since the 1950s, accelerating since the 1980s (Stanton et al., 2014a, 2014b). 25−79% of sclerophyll woodland and forest are in an irreversible stage of rainforest transition (Stanton et al., 2014a). It is possible that this may affect food availability for the spectacled flying-fox, however, the impact is unclear. Loss of sclerophyll and grassland habitats transitioning to closed forests through rainforest irruption has been documented at Iron Range (Russell-Smith et al., 2004a, 2004b).
Fire			
Habitat degradation and disturbance due to wildfire or prescribed burning	suspected	current	Fire can destroy food resources for the spectacled flying-fox and force them to vacate roosts. Smoke is a known deterrent to flying foxes and is used as a dispersal mechanism. A large fire near the Cairns roosting site forced the bats to vacate the site for 3−4 weeks during the birthing season in 2015 (Pergolotti pers. comm., 2016). Fire can also lead to the rapid infestation of guinea grass (*Panicum maxium*) through the understory of forests, which blocks out other plant species and can increase the intensity of subsequent fires (Northern Land Manager 2011).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. 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 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.

based on any of the

(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

Evidence:

Eligible under Criterion 1 A4(a)(c)(d) for listing as Endangered

The spectacled flying-fox is undergoing a continuing decline in population size due to a range of threats, with impacts exacerbated due to its low reproductive output. It (and other pteropodids) has a 'slow' life history, and modelling has shown that relatively small increases in mortality rate may precipitate substantial population decline (McIlwee & Martin 2002; Fox et al., 2008).

Population trends for the species have been difficult to detect due to the large intra-annual fluctuations of animals in and out of the counted population (Westcott et al., 2012). A decline has previously been suspected, but not demonstrated, due to threats such as habitat loss and the observance of many abandoned or destroyed colonies (Garnett et al., 1999; Dennis 2012). Large fluctuations in the number of individuals in colonies were previously interpreted as short-term re-locations following cyclonic events (Shilton et al. 2008; Westcott pers. comm., cited in Woinarski et al., 2014). However, more recent data analysis indicates that many bats die in the months following the loss of food resources due to cyclones (Westcott et al., 2015).

Monthly monitoring undertaken in the Wet Tropics from 2005 to 2014, based on daytime counts at roost sites, indicated that the population declined at a rate of 47−62% over the 10 year period. Fitting of Bayesian state-space models to November data for each year (which best estimates the size of the breeding population as most adults are in camps), and excluding data from the November 2006 count, immediately post-Cyclone Larry which caused a very large drop in population size and could be considered an outlier, demonstrated a decline in both the maximum and average size of roosting camps (Westcott et al., 2015). The trend was statistically significant despite high inter-annual variability in abundance (maximum yearly population estimates fluctuated between 203 722 and 125 000 over a 10 year period). Projecting this decline forward suggests that 70−90 percent of the population may be lost over a three generation period.

Although there were significant changes in camp use and 12 new camps were discovered between 2005 and 2014, the number of camps occupied at any given time remained constant.

This suggests that although the movement of individuals away from known camps or to outside the study region may contribute to the observed population trend and variability, it does not explain the full extent of the decline. Analysis of the data revealed that large reductions in population size coincided with (i.e. followed) cyclones, which were the likely cause of much of the population decline (Westcott et al., 2015). However, the decline has also occurred at the same time as the species has shown a shift towards urban areas, increasing conflict with humans (Westcott et al., 2015). Annual monitoring data over the period 1998-2005 for the Wet Tropics, notwithstanding some methodological constraints and inconsistencies, showed no general pattern of decline (Fox 2011).

Fox et al. (2008) developed life history tables for one colony site (Tolga Scrub on the Atherton Tablelands), derived from a large sample size of individuals killed by paralysis ticks *Ixodes holocyclus*, and reported that this subpopulation declined by 16 percent over the two year study (2001-2002). However they cautioned that this rate of decline may not be representative of other years at this site, or of other sites; in particular lowland sites which have far lower tick incidence (Fox pers. comm., cited in Woinarski et al., 2014). Furthermore, it is unlikely that this colony represents a closed subpopulation, so the 16 percent decline may not have been due to mortality alone (Westcott pers. comm., cited in Woinarski et al., 2014).

The Committee considers that the species has undergone a decline of around 50 percent over 2005-2014, and that this rate of decline may be projected to continue in the near future as threats to the species are ongoing and not fully understood. The species is projected to undergo a severe reduction in numbers over three generation lengths (21−24 years for this assessment), equivalent to at least 50 percent (and possibly more than 80 percent), over a time period that includes both the past and the future. Therefore, the species has met the relevant elements of Criterion 1 to make it eligible for listing as Endangered.

Criterion 2.	**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 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:			
(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:

Not eligible

The extent of occurrence is estimated at 10 124 km^2, and the area of occupancy estimated at 124 km^2. These figures are based on the mapping of all known roost site locations obtained from state governments, museums and the CSIRO. The EOO was calculated using a minimum convex hull, and the AOO calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines 2014 (DotEE 2016). Woinarski et al. (2014) estimated the AOO at 148 km^2, and considered this to be a significant underestimate due to limited sampling across the occupied range, but thought that the AOO was still likely to be less than 2000 km^2 .

The species occurs at more than 10 locations, and is not severely fragmented. There is a continuing decline in population size (see Criterion 1). Despite large fluctuations in the number of individuals between years, these are not considered exteme.

Following assessment of the data the Committee has determined that the area of occupancy is likely to be limited, however the species only satisfies 1 of the 3 conditions under Critierion B2. Therefore, the species has not met the required elements of this criterion.

Criterion 3. 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**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Not eligible

The population size of the spectacled flying-fox (and other *Pteropus* species) is difficult to estimate because of imprecision in counting large numbers of bats at colonial camps, and because numbers may vary substantially across time at camps, and not all camp sites are known (Garnett et al., 1999; Westcott & McKeown 2004; Westcott et al., 2012). Approximately 50 roost sites have been identifed in the Wet Tropics, but only 10 are usually occupied at any point in time (Tait et al., 2014). Only small, irregular numbers (less than 1000) and no identififed permanent roosts have been recorded in the Iron Range National Park and McIllwraith Ranges (Fox 2011).

Notwithstanding these recognised problems, based on near-simultaneous counts at all then known camps in the Wet Tropics Garnett et al. (1999) estimated the Wet Tropics population size at about 153 000 individuals, and considered that the total (Australian) population ‘may reach’ 200 000. More or less analogous counts have been conducted annually since (and, from 2004, at monthly intervals) for the Wet Tropics region (Shilton et al., 2008; Fox 2011; Westcott & McKeown 2014). Monthly monitoring at all known camps (roost sites) from 2004 to 2006 indicated a counted population fluctuating at around 200 000 animals (Westcott et al., 2001; Shilton et al., 2008; Westcott pers. comm., cited in Woinarski et al., 2014), with the counted population estimated to be about 80% of the entire population (i.e. around 250 000 individuals) in the Wet Tropics. However, as of November 2015, the number of mature individuals is estimated at 100 000 (Westcott pers. comm., 2016).

There have been no such robust estimates for subpopulations on Cape York Peninsula, but Fox (2011) considered the Iron Range colony to be 'very small … at most comprising several hundred individuals. It is unknown whether the small subpopulations in the Iron Range and McIllwraith Ranges still exist, due to inadequate survey effort in these regions (Fox pers. comm., 2016).

The total number of mature individuals is likely to be around 100 000, which is above the threshold to be considered. Therefore, the species has not met this required element of this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

As of November 2015, the number of mature individuals is estimated to be around 100 000 (Westcott pers. comm., 2016), which is not low. Therefore, the species has not met this required element of this criterion.

Criterion 5. 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:

Insufficient data to determine eligibility

Population viability analysis has not been undertaken.

Conservation Actions

In 2016 the House of Representatives conducted an inquiry into flying-fox management in the eastern states (Parliament of the Commonwealth of Australia 2017). The conservation and management actions outlined in this Conservation Advice are consistent with the recommendations from the inquiry.

Recovery Plan

A recovery plan for the spectacled flying-fox (Qld DERM 2010) was developed by the Queensland government and adopted as a national recovery plan under the EPBC Act in 2011. The plan is scheduled to expire in 2021 and has not yet been reviewed. The Committee recommends that the current recovery plan be retained, and the decision whether to continue to have a recovery plan be considered prior to the plan expiring.

The recovery plan includes the following objectives:

- research practicable and cost-effective flying-fox deterrent systems for commercial fruit growers;
- identify and protect native foraging habitat critical to survival;
- accurately assess the short and long term population size and population trends;
- improve the public perception of the spectacled flying-fox and the standard of information available to guide recovery;
- increase knowledge of roosting requirements and protect important camps;
- improve understanding of the incidence of tick paralysis and actions to minimise paralysis mortality;
- implement strategies to reduce incidence of electrocution and entanglement; and
- investigate the causes of birth abnormalities such as cleft palate syndrome.

Some of the actions under these objectives have been implemented, but the extent to which they have contributed to recovery is unclear.

Primary Conservation Actions

1. Protect habitat − including important roost and foraging sites (particularly winter foraging habitat), and native non-rainforest vegetation on the western margins of the species' range − from clearing and fragmentation.
2. Engage with the public to resolve conflicts between humans and flying-foxes in ways which do not harm the species.

Further habitat clearing and fragmentation in areas containing important roosting and foraging habitat is likely to have a significant impact on the species.

The species requires a continuous temporal sequence of productive foraging habitats and suitable roosting habitat (Westcott et al., 2001). Habitat and associated seasonal resources critical to the survival of this species have not been mapped.

Conservation and Management Priorities

The spectacled flying-fox has been subject to appreciable research, monitoring and management over the last 20 years. It is a high priority species under Queensland's Back on Track program, which outlines management measures to be undertaken for threatened species (Queensland Government 2010a,b). Development activities which may significantly impact the species are regulated under the EPBC Act, with additional information on camp management activities provided in a referral guideline (DoE 2015).

Habitat loss and fragmentation

- Prevent vegetation clearing at important roost and foraging sites.
- Undertake weed control and revegetation at flying-fox camps where required.

Culling and persecution

- Increase compliance efforts to reduce illegal shooting and culling.
- Prevent all electrocution at orchards and camps.
- Develop and maintain non-destructive protocols for resolving conflicts between humans and flying-foxes, including alternatives to dispersal.

- Establish a management zone around camps (which should be defined as an area large enough to accommodate seasonal influxes of individuals), where human habitation is prohibited.

Stakeholder engagement

- Develop conservation covenants on lands with high value for this species.
- Develop effective processes for community and industry engagement in the management of flying-fox camps and orchards.
- Involve Indigenous ranger groups in survey, monitoring and management activities.
- Educate the public, particularly urban residents, about the spectacled flying-fox (e.g. through ecotourism).

Disease and abnormalities

- Control the incidence and spread of wild tobacco in order to limit exposure to paralysis ticks.

Other mortalities

- Replace drape nets on backyard fruit trees with taut nets, in accordance with Queensland Department of Environment and Heritage Protection guidelines, to minimise entanglements.
- Encourage electricity utility companies to increase spacing between electrical cables when replacing crosspieces as part of their continual upgrade program.
- Replace the top strands of barbed wire in fences within the foraging range with plain wire.

Survey and Monitoring priorities

- Maintain the existing monitoring program within the Wet Tropics area, and establish a monitoring program for camps outside the Wet Tropics.
- Undertake a targeted survey of all suitable habitat for roost sites within the species' range, particularly in Cape York Peninsula, and identify important roost sites.
- Identify important foraging habitat and its distribution, particularly outside the Wet Tropics World Heritage area, and particularly on Cape York Peninsula.
- Enhance monitoring for disease, tick paralysis, and other potential causes of population-level decline.
- Monitor the incidence and spread of myrtle rust.

Information and Research priorities

- Continue to assess the effectiveness of a range of deterrents for use in horticulture that do not kill flying-foxes.
- Increase understanding of the relative causes of mortality, and incorporate into life history and population viability modelling.
- Identify effective options for reducing the impacts of camps on people that have the least impact on the species.
- Understand the factors which lead to successful low-conflict urban flying-fox camps.
- Identify factors underlying the species' selection of camp sites, and the extent to which the availability of sites may be limiting.
- Assess pathways for contacts with paralysis ticks, and factors involved in inter-year variation in the incidence of tick paralysis.

- Identify 'hotspots' for barbed-wire entanglements.
- Identify whether the incidence of cleft palate syndrome is increasing, the causes of the increase, and options for reducing the incidence.
- Identify the incidence and impact of any secondary poisoning from chemicals used in agriculture.
- Assess the likely impact of myrtle rust on key food plants.
- Investigate appropriate fire management regimes which will maintain adequate food resources for the species.

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **transferring** from the Vulnerable category to the Endangered category:

Pteropus conspicillatus

(ii) The Committee recommends that there should be a recovery plan for the species.

Threatened Species Scientific Committee

7 March 2017

References cited in the advice

Booth, C. (2006). Shocking Queensland: an electric grids update. In *The Australasian Bat Society Newsletter 26*, pp. 54-56. Australasian Bat Society.

Buettner, P. G., Westcott, D. A., Maclean, J., Brown, L., McKeown, A., Johnson, A., Wilson, K., Blair, D., Luly, J., Skerratt, L., Muller, R., & Speare, R. (2013). Tick Paralysis in Spectacled Flying-Foxes (*Pteropus conspicillatus*) in North Queensland, Australia: impact of a ground-dwelling ectoparasite finding an arboreal host. *PLoS One*, 8, e73078.

Churchill, S. (1998). *Australian Bats.* Reed New Holland, Sydney.

Dennis, A. J. (2012). Spectacled Flying-fox *Pteropus conspicillatus*. In *Queensland's threatened animals* (eds L. K. Curtis, A. J. Dennis, K. R. McDonald, P. M. Kyne & S. J. S. Debus.), pp. 388-389. CSIRO Publishing, Collingwood.

Department of the Environment and Energy (DotEE) (2015). *Referral guideline for management actions in Grey-headed and Spectacled flying-fox camps.* Australian Government Department of the Environment and Energy, Canberra. Available on the internet at: http://www.environment.gov.au/biodiversity/threatened/publications/referral-guideline-management-actions-flying-fox-camps

Department of the Environment (DotE) (2016). *Area of Occupancy and Extent of Occurrence for Pteropus conspicillatus*. Unpublished report, Australian Government Department of the Environment, Canberra.

Flannery, T. F. (1990). *Mammals of New Guinea*. Robert Brown and Associates, Carina.

Flannery, T. F. (1995). *Mammals of the South-west Pacific and Moluccan islands*. Reed New Holland, Sydney.

Fox, S. (2011). The Spectacled Flying Fox – a review of past and present knowledge. In *The biology and conservation of Australasian bats* (eds B. Law, P. Eby, D. Lunney & L. Lumsden), pp. 136-145. Royal Zoological Society of New South Wales, Mosman.

Fox, S., Luly, B., Mitchell, C., Maclean, J., & Westcott, D. A. (2008). Demographic indications of decline in the spectacled flying fox (*Pteropus conspicillatus*) on the Atherton Tablelands of northern Queensland. *Wildlife Research 35*, 417-424.

Fox, S., Waycott, M., Blair, D., & Luly, J. (2012). An assessment of regional genetic differentiation in the spectacled flying fox (*Pteropus conspicillatus*, Gould). In *People landscapes: archaeological and biogeographic approaches to landscapes* (eds S. G. Haberle & B. David), pp. 459-471. ANU e-press, Canberra.

Garnett, S. T., Whybird, O., & Spencer, H. (1999). The conservation status of the Spectacled Flying Fox *Pteropus conspicillatus* in Australia. *Australian Zoologist 31*, 38-54.

Hall, L., & Richards, R. (2000). *Flying foxes and fruit and blossom bats of Australia.* Australian Natural History Series. UNSW Press.

McIlwee, A., & Martin, L. (2002). On the intrinsic capacity for increase of Australian flying-foxes (*Pteropus* spp. Megachiroptera). *Australian Zoologist 32*, 76-100.

Metcalfe, D., Liddell, M., Bradford, M., & Green, P. (2014). Tropical rainforests of Eastern Australia. In: *Biodiversity and Environmental Change: Monitoring, Challenges and Direction* (eds Lowe, A., Burns, E, Lindenmayer, D., & Thurgate, N), pp. 153-224. CSIRO Publishing.

Parliament of the Commonwealth of Australia (2017). Living with fruit bats: Inquiry into flying-fox management in the eastern states. House of Representatives Standing Committee on the Environment and Energy, Canberra. Available in the Internet at: http://www.aph.gov.au/Parliamentary_Business/Committees/House/Environment_and_Energy/Flyingfoxmanagement/Report_1.

Parsons, J., Cairns, A., Johnson, C., Robson, S., Shilton, L. A., & Westcott, D. A. (2006). Dietary variation in Spectacled Flying Foxes (*Pteropus conspicillatus*) in the Wet Tropics of Australia. *Australian Journal of Zoology 54*, 417-428.

Parsons, J. G., van der Wal, J., Robson, S. K. A., & Shilton, L. A. (2010). The implications of sympatry in the Spectacled and Grey-headed Flying-fox, *Pteropus conspicillatus* and *P. poliocephalus* (Chiroptera: Pteropodidae). *Acta Chiropterologica 12*, 301-309.

Queensland Department of Environment and Resource Management (DERM) (2010). National recovery plan for the spectacled flying-fox *Pteropus conspicillatus*. Queensland Department of Environment and Resource Management, Brisbane. Available on the internet at: http://www.environment.gov.au/resource/national-recovery-plan-spectacled-flying-fox-pteropus-conspicillatus

Queensland Government (2010a). Wet Tropics Natural Resource Management Region - Back on track actions for biodiversity. Available on the internet at: http://www.qld.gov.au/environment/library/.

Queensland Government (2010b). Cape York Peninsula Natural Resource Management Region - Back on track actions for biodiversity. Available on the internet at: http://www.qld.gov.au/environment/library/.

Queensland Herbarium (2014). *Regional Ecosystem Description Database. Version 8.1*. Department of Science, Information Technology, Innovation and the Arts. Brisbane.

Richards, G. C. (1990a). The Spectacled Flying Fox *Pteropus conspicillatus* (Chiroptera: Pteropodidae), in north Queensland. 1. Roost sites and distribution patterns. *Australian Mammalogy 13*, 1-24.

Richards, G. C. (1990b). The Spectacled Flying Fox *Pteropus conspicillatus* (Chiroptera: Pteropodidae), in north Queensland. 2. Diet, seed dispersal and feeding ecology. *Australian Mammalogy 13*, 25-31.

Richards, G. C., Spencer, H. J, & Fox, S. (2008). Spectacled Flying-fox *Pteropus conspicillatus*. In *The mammals of Australia*. Third edition (eds S. Van Dyck & R. Strahan), pp. 438-440. Reed New Holland, Sydney.

Russell-Smith, J., Stanton, J. P., Whitehead, P. J. & Edwards, A. (2004a). Rain forest invasion of eucalpyt-dominated woodland savanna, Iron Range, north-eastern Australia: I. Successional processes. *Journal of Biogeography 31*, 1293-1303.

Russell-Smith, J., Stanton, J. P., Edwards, A., & Whitehead, P. J. (2004b). Rain forest invasion of eucalpyt-dominated woodland savanna, Iron Range, north-eastern Australia: II. Rates of landscape change. *Journal of Biogeography 31*, 1305-1316.

Shilton, L. A., Latch, P. J., McKeown, A., Pert, P., & Westcott, D. A. (2008). Landscape-scale redistribution of a highly mobile threatened species, *Pteropus conspicillatus* (Chiroptera, Pteropodidae), in response to Tropical Cyclone Larry. *Austral Ecology 33*, 549-561.

Stanton, P., Stanton, D., Stott, M., & Parsons, M. (2014a). Fire exclusion and the changing landscape of Queensland's Wet Tropics Bioregion 1. The extent and pattern of transition. *Australian Forestry* 77(1): 51-57.

Stanton, P., Parsons, M., Stanton, D. & Stott, M. (2014b). Fire exclusion and the changing landscape of Queensland's Wet Tropics Bioregion 2. The dynamis of transition forests and implications for management. *Australian Forestry* 77(1): 58-68.

Tait J., Perotto-Baldivieso H.L., McKeown A. & Westcott D.A. (2014). Are Flying-Foxes Coming to Town? Urbanisation of the Spectacled Flying-Fox (*Pteropus conspicillatus*) in Australia. *PLoS One*, 9, e109810.

Welbergen, J. A., Klose, S. M., Markus, N., & Eby, P. (2007). Climate change and the effects of temperature extremes on Australian flying-foxes. *Proceedings of the Royal Society B 275*, 419-425.

Westcott, D. A., Dennis, A. J. , McKeown, A., Bradford, M., & Margules, C. (2001). The spectacled flying fox, *Pteropus conspicillatus*, in the context of the world heritage values of the Wet Tropics World Heritage Area. CSIRO, Atherton.

Westcott, D. A., Fletcher, C. S., McKeown, A., & Murphy, H. T. (2012). Assessment of monitoring power for highly mobile vertebrates. *Ecological Applications 22*, 374-383.

Westcott, D. A., & McKeown, A. (2004). Observer error in exit counts of flying-foxes (*Pteropus* spp.). *Wildlife Research 31*, 551-558.

Westcott, D. A., & McKeown, A. (2014). *Spectacled flying-fox monitoring in the Wet Tropics Region.* Report to the National Environmental Research Program. Reef and Rainforest Research Centre Limited, Cairns (13pp.).

Westcott, D. A., McKeown, A., Parry, H., Parsons, J., Jurdak, R., Kusy, B., Sommer, P., Zhao, K., Dobbie, M., Heersink, D., & Caley, P. (2015). *Implementation of the national Flying-Fox monitoring program*. Rural Industries Research and Development Corporation, Canberra.

Woinarski, J. C. Z., Burbidge, A. A., & Harrison, P. L. (2014). *The Action Plan for Australian Mammals 2012*. CSIRO Publishing, Collingwood.

Other sources cited in the advice

Department of the Environment and Energy (DotEE) (n.d). Monitoring Flying-Fox Populations web page. Available on the internat at: https://www.environment.gov.au/biodiversity/threatened/species/flying-fox-monitoring.

Fox, S. (2016). Personal communication by email, 7 November 2016.

Helgen, K., Salas, L., & Bonaccorso, F. (2008). *Pteropus conspicillatus*. In *The IUCN Red List of Threatened Species*. Version 2012.1. Accessed 4 July 2012. Available on the internet at: http://www.iucnredlist.org.

Mclean, J. (2016). Personal communication by email, 7 November 2016. Director, Tolga Bat Rescue and Research Inc. (Tolga Bat Hospital).

Northern Land Manager (2011). Managing Weeds for Wildlife Conservation: Guinea Grass. Available on the internet at: http://www.landmanager.org.au/#sort=sort_title%20asc&nid=522529

Pergolotti, D. (2016). Personal communication by email, 24 November 2016.

Pinson, D. C. (2015). Personal communication by email, 22 March 2015.

Westcott, D. (2016). Personal communication by email, 19 June 2016. CSIRO Land and Water.