SC/67A/SM/21

Australian Snubfin dolphins Orcaella heinsohni: a review of current knowledge and conservation status

Guido J. Parra and Daniele Cagnazzi

INTERNATIONAL WHALING COMMISSION

Australian Snubfin dolphins *Orcaella heinsohni:* a review of current knowledge and conservation status

Guido J. Parra[1] and Daniele Cagnazzi[2]

[1]Cetacean Ecology, Behaviour and Evolution Lab, School of Biological Sciences, Flinders University, Adelaide, SA, Australia

[2]Marine Ecology Research Centre, School of Environment, Science and Engineering, Southern Cross University, PO Box 157, Lismore, NSW, Australia

Abstract

Australian snubfin dolphins (*Orcaella heinsohni*) were recently described as a new species endemic to northern Australia and potentially southern New Guinea. We review available information on their biology, ecology and threatening processes. Knowledge of population sizes and trends across the species geographical range is lacking. Studied populations are typically less than 100 individuals and no population studied to date is estimated to contain more than 250 mature individuals. Genetic studies indicate Australian snubfin dolphins live in small and relatively isolated populations with limited gene flow among them. Habitat degradation and loss is ongoing and expected to increase across the species range in Australia and a continuing decline in the number of mature individuals is anticipated. Considering the available evidence and following a precautionary approach we considered this species as Vulnerable under IUCN criterion C2a(i) because the total number of mature individuals is plausibly fewer than 10000, an inferred continuing decline due to cumulative impacts; and each of the populations studied to date is estimated to contain fewer than 1,000 mature individuals.

Taxonomy

A recent estimate of the phylogeny of Delphinidae using complete mitogenomes generated using high-throughput sequencing places *Orcaella* within the Globicephalinae subfamily (Vilstrup et al. 2011). Until 2005, the genus *Orcaella* was consider monotypic, with the Irrawaddy dolphin (*Orcaella brevirostris)* being the only species (Rice 1998). In 2005 a study on the external and skull morphology, colour pattern, and mitochondrial DNA control region (Beasley et al. 2005), including samples from much of the genus's range, showed that the dolphins in Australia differ from those elsewhere and they are now regarded as a separate species, the Australian snubfin dolphin (*Orcaella heinsohni*). No subspecies are recognised.

Snubfin dolphins are medium sized delphinids, with males reaching lengths of up to 270 and females to 230 cm (Arnold and Heinsohn 1996, Beasley et al. 2005). They are characterized by a rounded head and blunt rostrum; small dorsal fin situated in posterior portion of the body and a subtle three-tone body coloration pattern consisting of a dark brown dorsal cape, light to brownish grey side, and white abdomen. Distinct neck creases usually bound the head, and the dorsal groove that is present in front of dorsal fin in Irrawaddy dolphin is lacking (Arnold and Heinsohn 1996, Beasley et al. 2005).The flippers are broad, highly mobile and paddle-like shape.

Geographic Range

Australian snubfin dolphins inhabit coastal, shallow waters of the tropical and subtropical zones of Australia, and possibly some parts of New Guinea (Fig. 1). In Australia, snubfin dolphins have been reported from Exmouth Gulf in Western Australia, across the Northern Territory coastline, and along the eastern coast of Queensland as far south as the Brisbane River (Paterson et al. 1998, Parra et al. 2002, Allen et al. 2012, Palmer et al. 2014b) (Fig. 1). Sightings south of Roebuck Bay in Western Australia and south of Keppel Bay in Queensland are rare and considered extralimital. Although snubfin dolphins distribution is considered continuous across its range, the occurrence of the species along the northern Australian coast and southern New Guinea is poorly documented (Parra et al. 2002). There are records attributable to this species from Kikori Delta, Gulf Province, Papua new Guinea but genetic analysis is needed to confirm species (Beasley et al. 2014).

Anecdotal sightings of Snubfin dolphins have been reported from the Solomon Islands (Bass 2010). However, these records were provided during interviews to investigate to status of dugongs in the Solomon Islands, therefore the classification at species and genus levels is highly uncertain.

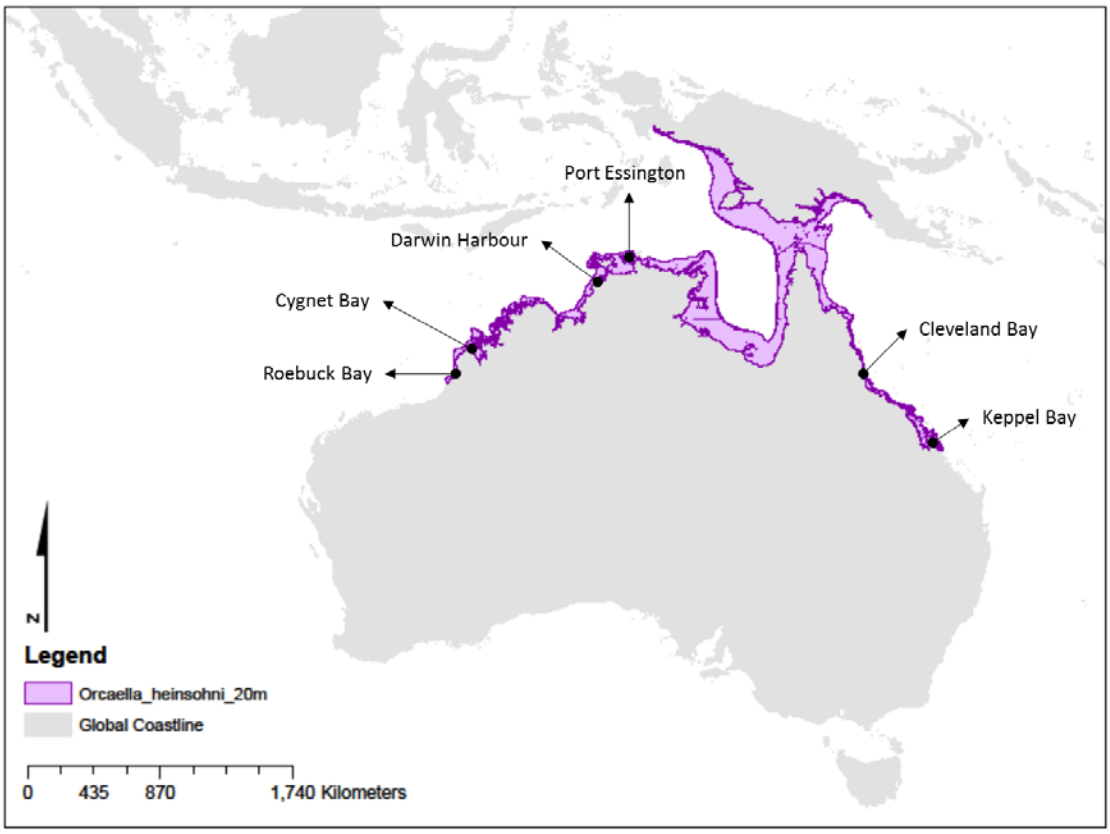

Figure 1. Suggested geographical range of Australian snubfin dolphins (*Orcaella heisohni*) and locations where population studies have occurred within their range (see also Table 1).

Population

Abundance

At present, there is no range-wide estimate of the abundance of Australian snubfin dolphins. Estimates of abundance are only available for a few selected populations across Australia (Table 1, see Fig. 1 for locations). Available abundance estimates indicate that Australian snubfin dolphins occur in small populations of typically less than 100 individuals (Table 1).

If we assume that the proportion of mature individuals (Nm) is similar to that estimated for the Indo-Pacific humpback dolphin (*Sousa chinensis*), which is 50% (Taylor et al., 2007), all populations studied to date (Table 1) number < 250 mature individuals. Considering that all available abundance estimates for Australian snubfin dolphins are low (typically less than 100 individuals, Table 1), the total number of mature individuals across their range is unlikely to exceed 10000 individuals.

Population Trend

Estimates of population size trends across the species' range are unknown. Most population studies of Australian snubfin dolphins have been conducted over a three-year period. Studies in Cleveland Bay indicated that even with relatively unbiased and precise abundance estimates, population trends will be extremely difficult to detect in less than three years unless changes in population size were greater than 20% p.a. (Parra et al. 2006a). A multiyear study (2006-ongoing) in Keppel Bay, Central Queensland, showed that between 2006-2010 abundance estimates of snubfin dolphins remained stable around 74 (65-84) individuals, before starting to decline slightly in 2011 to about 68 (64-72) individuals in 2013 (Cagnazzi 2013). The decline in abundance estimates was associated with a period of extensive summer flooding that has been impacting this region every summer since 2010. Even though the negative trend is small and the 95%CI of the estimates still overlaps, the decline has been consistent since 2011. Based on the accuracy of the estimates about 8 years of surveys are required to statistically detect the observed trend (Cagnazzi 2013). Population estimates from recent surveys (2014-2016) in the same area showed a variation in the trend but also a substantial variation across years with the lower estimates being 87 (54-121) in 2014, 140 (113-168.) in 2015 and 97 (62-132) in 2016 (Cagnazzi personal communication).

Population Structure

Genetic analysis conducted on biopsy samples collected across two nearby populations (Roebuck Bay and Cygnet Bay ~ 250km apart) in the Kimberly, Western Australia showed significant levels of population structure at both mitochondrial and nuclear markers (Brown et al. 2014). Contemporary migration rates between these two sampling locations were low (< 10%, m < 0.1). Similar results were obtained for populations of the east coast of Queensland (Parra et. al. unpublished data). No genetic information is available from the Northern Territory and Papua New Guinea. Overall, the genetic data available suggest that Australian snubfin dolphins may exist as metapopulations of small, largely isolated population fragments with limited gene flow.

A case of inter-generic hybridisation between a snubfin dolphin female and a male humpback dolphin was documented at Cygnet Bay, north Western Australia. The hybrid individuals is an adult female which associates primarily with other snubfin dolphins (Brown et al. 2014).

Table 1. Abundance estimates of Australian snubfin dolphins (*Orcaella heinsohni*) in Queensland (QLD), Northern Territory (NT) and Western Australia (WA).

State	Study Site (~Area km^2)	Study Period	Population Estimate (95%CI) [a]	Approximate Density	Number of mature Individuals[b]	Reference
QLD	Cleveland Bay(310 km^2)	1999-2002	64 (51–80)–76 (65–88)	0.21–0.25	32 (26-40) -38 (33-44)	(Parra et al. 2006a)
	Keppel Bay (980km^2)	2006-2011	71 (61–80)–80 (68–93)	0.07–0.08	36 (31-40) -40 (34-47)	(Cagnazzi et al. 2013b)
NT	Darwin region (1086 km^2)	2011-2015	19 (18-20) -70 (49-90)	0.017-0.064	9.5 (9-10)-35(25-45)	(Brooks et al. 2017)
	Port Essington (325 km^2)	2008-2010	136 (58–317)–222 (146–336)	0.42–0.68	68 (29-159)-111 (73-168)	(Palmer et al. 2014a)
WA	Roebuck Bay (~100km^2)	2013-2014	133 (127-148)	1.33	67 (64-74)	(Brown et al. 2016)
	Cygnet Bay (130 km^2)	2012-2013	48 (41–58)–54 (51–60)	0.37–0.42	44 (21-29)-27(26-30)	(Brown et al. 2016)

[a] Population estimates are provided as minimum and maximum values obtained across the different years of study.

[b] Estimated at 50% of the total population size as estimated for Indo-Pacific humpback dolphins (*S. chinensis*)(Taylor et al. 2007)

Habitat and Ecology

Habitat

Studies to date indicate that Australian snubfin dolphins occur mainly within shallow, protected coastal and estuarine habitats (Parra et al. 2002, Parra 2006, Parra et al. 2006b, Allen et al. 2012, Palmer et al. 2014b, Brown et al. 2016). A study conducted in far northern Queensland indicated that snubfin dolphins occurred mostly in waters less than 15 m deep, within 10 km of the coast and in waters no more than 20 km from the nearest river mouth (Parra et al. 2006c). In Cleveland Bay snubfin dolphins preferred shallow water, < 2 m deep, and shallow areas with seagrass beds (Parra 2006).Similarly, in Keppel Bay, snubfin dolphins core area of use coincided with the Fitzroy River estuary (Cagnazzi et al. 2013b). Within this range, snubfin dolphins used shallow (2–5 m), shallow subtidal (5–10 m) and moderate depth (10–15 m) habitat more frequently than expected by chance. In contrast, intertidal (0–2 m) and deeper water (15–20 m) were used less frequently than expected by chance (Cagnazzi et al. 2013b).

Boat based surveys conducted between Keppel Bay and Cleveland Bay further strengthen the importance or rivers to snubfin dolphin in Queensland. The only resident population of snubfin dolphin along 800 km of coastline between Cleveland Bay and Keppel Bay was found at the mouth of the Proserpine River in the Whitsundays (Cagnazzi and Parra unpublished data).

In the Northern Territory, most records of snubfin dolphins are from estuaries, tidal rivers and coastal areas within 20 km of river mouths. Some individuals have been recorded up to 30 – 50 km upstream in larger tidal river and at least as far as 10 km offshore (Palmer et al. 2014a, Palmer et al. 2014c). Studies in Western Australia also indicate snubfin dolphins manly occur in shallow coastal areas (Brown et al. 2016).

Food and Feeding

Analysis of the stomach contents of 13 snubfin dolphins indicated that snubfin dolphins are opportunistic generalist feeders, preying upon bottom-dwelling and pelagic fish and cephalopods associated with coastal and estuarine waters (Parra and Jedensjö 2014). Overall, the cardinal fish (*Apogon* sp.) was the most important prey in numerical terms (Ni = 23.4%) followed by the cuttlefish (*Sepia* sp., Ni = 16.6%), the squid (*Uroteuthis (Photololigo)* sp., Ni = 15.3%), and the toothpony fish (Gazza sp., Ni = 9.6%). The most frequently encountered fish families were the Sciaenidae (69.2%), Leiognathidae (61.5%), Apogonidae, Haemulidae, Sillaginidae, and Synodontidae (53.8%). Cephalopods were represented by at least two families: Sepiidae (cuttlefish, 76.9%) and Loliginidae (squid, 53.8%). The few decapoda identified, the prawn *Metapenaeopsis* sp. and the Indian prawn (*Penaeus indicus*), belong to the family Penaeidae (Parra and Jedensjö 2014).

Reproduction

Life history data for Australian snubfin dolphins are lacking. Life history of this species is thought to be similar to that of their close relative the Irrawaddy dolphin, with an estimated age of first reproduction as nine years and an approximate generation length of 15.6 years (Taylor et al. 2007). Near adult size (2.1 m) was reached in 4-6 years. Base on dentinal layers

of 18 snubfin dolphins from north Queensland waters, it was suggested that snubfin dolphins may live for at least 30 years(Marsh et al. 1989),

Migrations and Movements

Australian snubfin dolphins are listed on Appendix I and Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) and as migratory under the Environment Protection and Biodiversity Conservation Act 1999. Such designation is primarily because populations of this species occur across international waters. However, Australian snubfin dolphins do not appear to undergo large-scale seasonal migrations, although seasonal shifts in abundance have been observed.

In Cleveland Bay Australian snubfin dolphins do not reside in the study area permanently, but use the study area regularly from year to year (Parra et al. 2006a) following a movement pattern of emigration and re-immigration into the study area. Based on studies along the Queensland coast, the representative ranges and core areas of space use by snubfin dolphins have been estimated to range between 197- 349 km^2 16-231 km^2, respectively (Parra 2006, Cagnazzi et al. 2013b). A study in Darwin Harbor and two neighboring sites (1086 km^2) in the Northern Territory, showed?? highly variable population-size estimates, high rates of temporary emigration and a permanent emigration rate of around 10% indicated that snubfin dolphins may move at scales larger than the study area.

Social structure

Schools of snubfin dolphins vary in size from one to 22 animals, with an average of 3 to 5 animals per school (Cagnazzi 2010, Parra et al. 2011, Brown 2016). Association patterns among individuals in Cleveland Bay, Queensland, were non-random and highly structured, with social networks characterized by numerous strong associations among specific clusters of individuals. Modelling of temporal patterns of association indicated long-lasting associations were an important feature of snubfin dolphins' fission-fusion dynamics. (Parra et al. 2011). In Cygnet Bay, Western Australia, individuals of all sex classes showed preferred associations. Males were generally more gregarious and formed stronger and longer-term associations than females. Associations were not correlated with genetic relatedness for any sex class (Brown 2016).

Use and Trade

There is no evidence of traditional use/trade for consumption or medicinal use across the Australian snubfin dolphin's geographical range.

Threats

The biological features discussed above render the snubfin dolphin particularly vulnerable to anthropogenic threatening processes. Recognized threats to snubfin dolphins are summarized in Table 2.

Table 2. Recognised threats to tropical inshore dolphins (adapted from The Action Plan for Australian Mammals 2012(Woinarski et al. 2014) and The Coordinated National Research Framework to Inform the Conservation and Management of Australia's Tropical Inshore Dolphins (DOE 2015).

Threat - Type	Likely Consequence	Threat - Extent (geographic)	Likely Impact
Habitat Degradation & Modification (including coastal development, port expansion, dredging, catchment run-off and aquaculture)	minor- moderate- severe (depending on location)	localised (potential to moderate)	Several regions across humpback dolphins' range in Australia have been substantially modified both inland, to allow mining, agricultural and grazing activities and along the coast to allow industrial ports; marinas, aquaculture and residential developments (Allen et al. 2012, Bejder et al. 2012, Grech et al. 2013, Grech et al. 2015, Parra and Cagnazzi 2016). Results in habitat loss, decreased water & habitat quality, and increased vessel movement, potentially leading to disturbance, stress, recruitment failure and/or displacement. Effects may be short or long-term. (Cagnazzi et al. 2013b, Pirotta et al. 2013, Todd et al. 2015).
Accidental Capture (from fisheries activities including entanglement and bycatch)	moderate- severe	moderate	A known cause of mortality with potential to locally deplete populations and cause local extinctions (Paterson 1990, Hale 1997, Parra et al. 2002, Berg Soto et al. 2013, Meager and Sumpton 2016).
Shark Exclusion Devices (nets and drum lines set at popular coastal beaches)	moderate-severe	localised	A known cause of mortality with potential to locally deplete populations and cause local

Threat - Type	Likely Consequence	Threat - Extent (geographic)	Likely Impact
			extinctions (Paterson 1990, Hale 1997, Gribble et al. 1998, Parra et al. 2002, Berg Soto et al. 2013, Meager and Sumpton 2016).
Vessel Strike	moderate	minor (localised)	A known cause of injury (or mortality) globally in busy waterways (Bechdel et al. 2009, Dwyer et al. 2014, Christiansen et al. 2016) e.g. vessel strike injuries reported for significant proportion of dolphins in Roebuck Bay, WA (Thiele 2010).
Noise Pollution (i.e. anthropogenic noise & acoustic disturbance such as from vessels, seismic activity or marine construction)	minor	moderate	Can cause disturbance, stress, or result in avoidance behaviour and interfere with acoustic communication (McCauley and Cato 2003, Nowacek et al. 2007).
Pollution (chemical, debris, plastic, etc.)	minor	moderate	Elevated levels of toxic chemicals leading to impaired immune, endocrine and reproduction systems (Evans 2003, Cagnazzi et al. 2013a). Plastic debris may lead to physical injury or starvation from ingestion.
Prey Depletion (potential threat due to fisheries)	minor (+potential)	minor- moderate	Potential for increased fishing pressure to deplete food resources of dolphins. This may exacerbate other threat impacts (e.g. habitat degradation).
Climate (variability & Climate Change impacts a potential threat)	minor- moderate (+potential)	minor- moderate	Altered coastal conditions and projected increases in cyclone severity, floods, storm surge, and sea surface temperature could affect dolphin habitat and food resources (Lawler et al. 2007, Meager and Limpus 2014).
Disease	minor	minor- moderate	Potential to cause local population

Threat - Type	Likely Consequence	Threat - Extent (geographic)	Likely Impact
		(localised)	depletion.

Conservation status and actions

The conservation status of Australian snubfin dolphins at national and international level are summarized in Table 3. Globally, snubfin dolphins are listed as 'Near Threatened' by the International Union for Conservation of Nature (IUCN), listed in Appendix I of the Convention on International Trade in Endangered Species (CITES), and listed on Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS). In Australia, Snubfin dolphins are included on the list of migratory species under the EPBC Act and are listed as Near Threatened in The action plan for Australian mammals 2012 (Woinarski et al. 2014).

Table 3. Conservation status of Australian snubfin dolphins (*Orcaella heinsohni*).

Listing	Status
International	
International Union for the Conservation of Nature (IUCN)	Near Threatened
Convention on Migratory Species	Appendix II
Convention on International Trade in Endangered Species (CITES)	Appendix I
Australia	
Australian Mammal Action Plan 2012	Near Threatened
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Migratory
Marine Bioregional Plan	Conservation Value
Queensland Government (Nature Conservation Act 1992)	Near Threatened
Northern Territory Government (Northern Territory Threatened Species List)	Data Deficient
Western Australian Government (Western Australian Wildlife Conservation Act)	Protected, Priority 4[1]
Australian Action Plan for Cetaceans (Bannister et al. 1996)	Insufficiently known - K
Review of Conservation of Australia's Smaller Whales and Dolphins (Ross 2006)	Priority Species (Insufficiently known)
Great Barrier Reef Marine Park Authority	High priority for management

[1.] Non-legislative management category Priority 4 – taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are not considered currently threatened or in need of special protection, but could be if present circumstances change.

The Australian Government invested $2 million over three years (2014-15 to 2016-17) for the implementation of a Whale and Dolphin Protection Plan. The National Dolphin Conservation Plan will promote the conservation of dolphins in Australian waters by supporting research into dolphin conservation, including investigating key threats and determining the conservation status of priority species such as the Australian Snubfin dolphin and the Australian humpback dolphin. To identify the primary research objectives to inform the conservation and management of Australia's Tropical Inshore Dolphins an expert workshop was held on April 9 and 10 2015 in Canberra. The resulting research strategy (DOE 2015) identified the following research objectives applicable to Australian snubfin and humpback dolphins: 1) provide for access to and analysis of standardised national tropical dolphin data to assess distribution and underpin management and conservation, 2) conduct long-term monitoring project to determine trends, mitigate impacts from threats, and support adaptive management and conservation of tropical inshore dolphins, 3) identify, map and assess threats

to tropical inshore dolphins, understand related impacts, and mitigate risks, 4) improve knowledge of genetic connectivity dispersal and movement at national, regional and local scales, 5) foster collaborative and national approaches to effectively gather mortality, life history and dietary information from stranded and by-caught specimens, 6) foster community participation in data collection on tropical inshore dolphins and develop a continuous-improvement approach to methods and related programs. Guidelines on sampling and statistical methods to achieve some of these objectives have been recently described in Brooks et al. (2014).

Multiple-use marine protected areas in Western Australia (e.g. Shark Bay and Ningaloo Reef Marine Park) and Queensland (Great Barrier Reef Marine Park, Dugong Protected Areas; Moreton Bay Marine Park) cover a substantial portion of Australian snubfin dolphins known and presumed habitat and may provide some protection for this species.

Snubfin dolphins were identified as a conservation value in Commonwealth waters around Australia in the North, North-west and Temperate East Marine bioregional plans (DSEWPaC 2012c, b, a). These plans were developed under section 176 of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and are aimed at improving management and decision making in relation to Australian marine biodiversity and resources.

National Guidelines for Whale and Dolphin Watching and for interaction with seismic explorations provide some protection for inshore dolphins (DOE 2005, 2008). Strategies to reduce the entanglement and death of Australian snubfin dolphins in nets set by The Queensland Shark Control Program for protection of bathers include the use of acoustic alarms, mixed use of nets and drumlines, overall reduction in the number of nets, and establishment of mammal rescue squads (Gribble et al. 1998, DPI 2001).

IUCN Red List Recommendation

Considering the available evidence and following a precautionary approach we considered this species as Vulnerable under IUCN criterion C2a(i) because the total number of mature individuals is plausibly fewer than 10,000, an inferred continuing decline due to cumulative impacts; and each of the defined subpopulations studied to date is estimated to contain fewer than 1,000 mature individuals. Although the species may not meet any of the criteria for Endangered at this time, it is likely to do so in the near future considering it is possible that: 1) number of mature individuals is less than 2,500, 2) the reductions in population size have been larger and pervasive enough to cause a net reduction for the entire species of at least 20% over a period of 2 generations, and 3) that the number of mature individuals in each subpopulation across their range is ≤ 250 individuals. Confirmation of species presence and distribution extent in southern New Guinea is urgently needed as this area may potentially hold large numbers of animals.

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