

PEER REVIEW REPORT

Endangered Species Act Status Review Report for the Dusky Sea Snake, *Aipysurus fuscus*

Peer Reviewers:

- Earl Possardt, U.S. Fish and Wildlife Service, Washington DC
- Michael Guinea, Ph.D., Charles Darwin University, Australia
- John C. Murphy, M.A., Field Museum of Natural History, Chicago, IL
- Harold Heatwole, Ph.D., North Carolina State University, NC

Peer Reviewer Comments (*not associated with order of names as they appear above*):

PEER REVIEWER A:

The document looks fine. I have nothing to add. It was thoroughly done.

PEER REVIEWER B:

The review included the best and most current scientific and commercial information about the species, biology, population structure, habitats, threats and risk of extinction. Very comprehensive and clear what is known and what is not.

Very clearly organized and presented information which supports conclusions.

The data supporting evidence for decline are consistent. The issue and indirect link of healthy coral reef habitat to dusky sea snake populations status is discussed fairly and while it seems logical that the decline of coral reef habitat from climate change will likely affect dusk sea snake populations negatively over the long term in the future the report was very clear that previous coral reef habitat bleaching and recovery did not appear connected to the current decline of this species. Something else seems to have caused the declined and it is not clear what although hybridization is certainly a major threat and factor now.

There is a fair discussion about limitations of the survey methodologies and results but the data are compelling and there is a strong case made that there has been a drastic decline, that the range which was already restricted has been reduced to less than half and where the species still occurs it is in the remaining part of the range where it was historically less abundant and consequently most vulnerable to genetic swamping by a congener, the olive sea snake.

The synthesis and conclusion of this report is right on the mark and cannot be stated more clearly and succinctly. I totally support the findings.

PEER REVIEWER C:

This peer review made comments within the draft report document itself. Below, we indicate the applicable sections of the report, provide the specific portions of text that the reviewer commented on, and the reviewer's comment on the particular portion of text.

Reproduction and growth

Text: While the example of the closely related olive sea snake may serve as a reasonable proxy for the dusky sea snake, it should be noted that breeding cycles of other sea snakes vary widely (Heatwole, 1997).

Comment: Fry et al 2002 pdf attached. It gives a very good review of the reproductive biology of several species of sea snake but unfortunately not *A. fuscus*.

Present or threatened destruction, modification or curtailment of habitat or range

Text: No recovery of hard corals was observed in the first three surveys following the 1998 event, but a significant increase of 6.4% was observed between 2002 and 2004 (Smith et al., 2008) – indicating that recovery was underway and that the 2003 El Nino event had little impact on Scott Reef.

Comment: See Recovery of an Isolated Coral Reef System Following Severe Disturbance, Gilmour, et al. *Science* 5 April 2013: 69-71. [DOI:10.1126/science.1232310]

Text: However, the large gap in these survey data for 1973-2006 could conceal any shorter-term patterns.

Comment: Included in this period is a category 5 cyclone that caused a lot of damage to the reef.

Text: Thus, we conclude it is likely that loss of live coral has contributed to the decline of dusky sea snakes.

Comment: The data and observations do not support this statement.

Text: The reefs where dusky sea snakes are found lie more than several hundred kilometers offshore and thus receive a considerable degree of protection from human activities and land-based sources of pollution.

Comment: Since 1996 Ashmore Reef has been a landing point for suspected illegal entry into Australia. The reef was annexed from Australia's immigration zone along with many other islands and Australia. The response by customs, border protection, navy and federal police was to increase the constabulary with a view to stem the movement of

suspected illegal persons from entry to Australia. This resulted in a great increase in vessel traffic, high speed pursuit vessels and ships. This increase in boats and vessel noise coincided with the decline and eventual loss of all eight species of sea snake from Ashmore Reef. Compare this with the decrease in the numbers of sea snakes and foraging sea turtles at Seringapatam Reef between 2012 and 2013 during the ConocoPhillips seismic survey and drilling near the reef.

Text: Ashmore Reef and Cartier Islands lie about 50-80 km west of the main offshore wells in the Timor Sea, and the closest exploration wells are 36 km away (Russell et al., 2004).

Comment: Scott reef sits directly on top of the Torosa Field that is about to be drilled by Woodside Energy Ltd. The area is expected to experience subsidence or compaction as the gas is removed. This may hasten the apparent sea level rise attributable to global warming. See: www.ga.gov.au/webtemp/1219311/MS10_Kennard_2004_03_14.pdf
http://www.environment.gov.au/cgi-bin/epbc/epbc_ap.pl?name=show_document;document_id=55497;proposal_id=7079.

Text: The necropsy report concluded that the likely cause of death for this specimen was exposure to petroleum hydrocarbons (Gagnon, 2009).

Comment: Sea snakes are the second most vulnerable species after sea birds to the effects of oil slicks see Tawfiq N, Olsen DA (1993) Saudi Arabia's response to the 1991 Gulf oil spill. *Marine Pollution Bulletin* 27, 333-345. And other coastal oil spills in tropical Australia.

Overutilization for commercial, recreational, scientific, or educational purposes

Text: Illegal fishing by Indonesian vessels has occurred at Ashmore Reef; however, this fishing has largely targeted trepang (sea cucumbers), trochus snails, reef fishes, adult sea turtles and bird eggs (Whiting, 2000).

Comment: This fishing continues at Hibernia Reef and Scott Reef.

Inadequacy of existing regulatory mechanisms

Text: Cartier Island was designated as a Marine Reserve in 2000.

Comment: Former British Air Force bombing range nor an exclusion zone and marine reserve.

Text: Table 2. Summary of possible threats to A. fuscus and relative strength of the evidence indicating these may be operative threats on A. fuscus. Threats are organized by their appropriate ESA section 4(a)(1) category. Characterizations of the relative likelihood (very low, low, medium, high) that a particular threat is contributing or will contribute to the observed

decline in abundance of A. fuscus are explained further in the text above. (Table 2 is not reprinted here but is available in the report.)

Comment: I would nominate “medium” for the “oil and gas” threat. [Regarding hybridization,] we have no information on the rate of hybridization from just one trip. It could be balanced. More work is needed! I agree with your interpretation in that the results from this one trip indicated introgression. The specimens we sampled in the 2012 and 2013 surveys were no different in appearance and relative numbers for previous surveys. The Seringapatam specimens always looked different from those at Scott Reef which I have mentioned in the past as support for the lack of gene flow between reefs. I suspect if introgression is seen as the chief cause of the decline of dusky sea snakes it may then be another case of monitoring their eventual disappearance when there could be other causes for the decline. I prefer to acknowledge introgression as a cause of apparent decreases, but other factors may be also operating. I prefer to examine all the evidence that we have available.

PEER REVIEWER D:

This peer review made comments within the draft report document itself. Below, we indicate the applicable sections of the report, provide the specific portions of text that the reviewer commented on, and the reviewer’s comment on the particular portion of text.

Taxonomy and Distinctive Characteristics

Text: *Regarding the subsection of the report entitled **Taxonomy and Distinctive Characteristics**, this reviewer made several comments.*

Comments: This is a bit misleading. The phylogenetic position of the sea snakes is pretty well known, what is “unresolved” is the name that should be applied to them and to a degree is whether or not the clade gets full family status or subfamily status. The clade Hydrophiinae includes both terrestrial and marine snakes and the same clade could also be called Hydrophiidae. In any case they are all Elapids or Elapoids.

You should have a nomenclatural history, discussion of the holotype, the type locality, etc.

Consider inserting the following comment here: Tschudi (1837:335) originally described *Stephanohydra fusca* based upon ZMB 2824, with the type locality as "Asia." Fisher (1856) moved the species to Lacépède's genus *Aipysurus* recognizing its similarity to *Aipysurus laevis* described by Lacépède in 1804. Smith (1926) noted the literature suggested the type specimen came from the Celebes and reported that it had been confused with *Aipysurus laevis*, but that the two species could be easily separated by ventral counts that did not overlap. Smith (1926) further confused the type locality by reporting a BMNH specimen from Ashmore Reef as the type specimen. In fact given the

known distribution of this snake, it is unlikely it occurs in Sulawesi (Celebes) and should have the type locality restricted to Ashmore Reef.

Text: Like all sea snakes, it has a paddle-like tail for swimming; and, like all marine reptiles, it has a salt gland, which allows it to secrete salt and thereby maintain its osmotic balance (Dunson, 1975).

Comment: Recent research suggest this is not completely correct, see Lillywhite, H. B., Sheehy, C. M., Brischoux, F., & Grech, A. (2014). Pelagic sea snakes dehydrate at sea. *Proceedings of the Royal Society B: Biological Sciences*, 281(1782), 20140119. Sea snakes depend much more on freshwater than previously thought and often drink rainwater from the surface of the ocean. The salt glands are not particularly effective at removing salt.

Text: They are capable of cutaneous respiration whereby oxygen diffuses from sea water across the skin into the blood and carbon dioxide is diffused across the skin into the water.

Comment: The degree to which they can do this varies with species and temperature.

Text: ...maximum total length is about 0.9 m (Rasmussen, 2000).

Comment: You give maximum size as 0.98 m below.

Range and Habitat Use

Text: Figure 1. Reefs within the historical range of A. fuscus include Ashmore, Hibernia, Scott (North and South) and Seringapatam Reefs.

Comment: This map should be modified to show the range of *A. fuscus*. Shade the area the snake is known from or use bright colored markers to show specific locations the snake is known from. As it stands the reader might think the snake is found throughout the entire area on the map

Abundance and Population Structure

Text: There are no historical or current population estimates for the dusky sea snake.

Comment: But there is a comment in Smith, 1926:17 where he states he had 27 specimens from Ashmore Reef collected by Malayan collectors and that he could have

had many more specimens – suggesting the snake was common. In fact, suggesting it was much more common than it was in 1973 in [your] Figure 3.

Text: Table 1. Survey information and relative abundance data for A. fuscus by reef. Survey methodologies and measurement of relative abundance varied across surveys. Data are reported as the number of dusky sea snakes counted and their percentage of the total number of snakes captured during the particular reef survey. (Note: Some authors/ references consider Seringapatam Reef to be a part of Scott Reef; and although the precise location is unclear, the Minton and Heatwole (1975) survey at Scott Reef is considered here under “Scott Reef.”)

Comment: If you use Smith’s 1926 numbers in this table it could add to your case. Although the data is not as refined as the other reports.

This reviewer also added the following papers and book to the list of references:

Fischer, J.G. 1856. Die Familie der Seeschlangen. Abhandl. Nat. Ver. Hamburg 3: 1-78

Lacépède, B. G. E. L. 1804. Mémoire sur plusieurs animaux de la Nouvelle- Hollande dont la description n’a pas encore été publiée. Annales du Muséum National d’Histoire Naturelle, Paris, 4:184-211

McCosker, J.E. 1975. Feeding behavior of Indo-Australian Hydrophiidae. Pages 217-232 In: Dunson W.A. (ed) The biology of sea snakes. University Park Press, Baltimore, pp 217-232.

Smith, M. A. 1926. Monograph on the Sea Snakes. (Hydrophiidae). British Museum of Natural History, London 130 pp.

Tschudi, J.J. 1837. Neues Genus von Wasserschlangen. Archiv für Naturgeschichte 3: 331-335