Fisheries Scientific Committee

Final Determination

July 2019

White's seahorse
Hippocampus whitei

Listing Category: Endangered
IUCN Category: EN [A2bc]

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), has made a Final Determination to list the ***Hippocampus whitei*** (**White's Seahorse)** as an **ENDANGERED SPECIES** in Part 1 of Schedule 4 of the Act.

The Fisheries Scientific Committee, with reference to the criteria relevant to this species, prescribed by Part 16 of the *Fisheries Management (General) Regulation 2010* (the Regulation) has assessed and determined that:

- The listing of ENDANGERED is provided for by Part 7A, Division 2 of the Act.
- The assessment has been determined in accordance with the national Common Assessment Method (CAM), which provides a nationally consistent approach to the assessing and listing of threatened species in Australia.

Species information and status

a) Species:

Hippocampus whitei – White's Seahorse, Bleeker, 1855 (family Syngnathidae) is a valid, recognised taxon and is a species as defined in the Act. The species is endemic to NSW and QLD in eastern Australia.

b) Taxonomy

Hippocampus whitei was first discovered in 1789 in Port Jackson (Sydney Harbour) and named after John White, surgeon general to the first fleet and author of *Journal of a Voyage to New South Wales 1789*, in which a portrait of *H. whitei* is published and was described by Bleeker in 1855. *Hippocampus novaehollandiae* Steindachner, 1866 is a synonym.

In 2016, *H. procerus* was determined to be a synonym of *H. whitei* as there were no morphological or genetic differences between individuals of the two species (Lourie et al., 2016; .Short et al., *in press*).

There are 40 genera of Syngnathids (Pipefishes and Seahorses) in Australia and within Hippocampus there are at least eight recognized species in NSW (Kuiter, 2009; Lourie et al., 2016; Australian Museum, 2018); however, only two species are known from Sydney Harbour (Hutchings et al., 2013), the Pot-belly Seahorse *H. abdominalis* Lesson 1927 and *H. whitei*. Other species recently recorded in NSW includes the Thorny Seahorse *H. histrix* Kaup, 1856 (Harasti, 2015) and the Great Seahorse *H. kelloggi* Jordan & Snyder, 1901 (Harasti, 2017).

c) Current conservation status

Jurisdiction	State / Territory in which the species is listed	Date listed or assessed (or N/A)	Listing category
International (IUCN Red List)	**Endangered**	**2017**	**A2bc**
National (EPBC Act)	**Not listed**	**N/A**	**N/A**
State / Territory	**Not listed**	**N/A**	**N/A**

d) Description of species

H. whitei is a small (maximum total length approximately 16 cm (Harasti et al., 2012)), long-snouted seahorse. Morphological characteristics of *H. whitei* are: dorsal-fin rays 16–17, pectoral-fin rays 15–17; tail-rings 33–34; the coronet is high, inclined backwards, and arranged in a five-pointed star at the apex; spines are variable ranging from low to moderately developed and from round to quite sharp and it has a long snout with sharp eye spines (Lourie et al., 1999; Kuiter, 2001). The species is highly variable in colour with their colouration known to change depending on the habitat they are found occurring in. The species is known to live in the wild for up to 5-6 years (Harasti et al., 2012).

e) Distribution of species

H. whitei is known to occur in estuaries from St Georges Basin, NSW to Hervey Bay, QLD (Kuiter, 2009; Harasti et al., 2012). A previous 1903 Australian Museum record from Lake Illawarra cannot be confirmed as the locality information is likely erroneous (Mark McGrouther pers. comm.) And whilst it is possible that *H. whitei* could occur in Lake Illawarra, at this stage there is no definitive evidence and further surveys are required in this region.

From 2005–2009, diving surveys (n=100+) were undertaken across 24 coastal embayments and estuaries along the entire NSW coast, which found *H. whitei* in several locations (Harasti et al., 2012). The only locations where high abundances of *H. whitei* occurred were Sydney Harbour and Port Stephens (Figure 1), with the most found at any of the other locations being eight individuals in Port Hacking. Port Stephens and Sydney Harbour are the only locations where large populations (more than 10 individuals) have been found to occur. Records from the Queensland Museum indicate the species is predominantly found around the Moreton Bay region, but does occur up to Hervey Bay (Jeff Johnson – QLD Museum records) and Mackay (one

specimen in California Academy of Science Museum; collected 1939). Other records from Queensland such as Port Curtis and Burnett River from the 1920s and 1930s were recently confirmed as *H. whitei* (Short et al. in press). Queensland specimens from Burnett River and the Gladstone area are stored at the Australian Museum. There is a single record from the Gulf of Carpentaria, however, this is considered a misidentification or an erroneous recording given the lack of information which accompanies the record (Kuiter, 2001; Jeff Johnson pers. comm. 2018).

Lourie et al. (2016) indicated that the species also occurs in Vanuatu, the Solomon Islands and Papua New Guinea, but this was based on unverified identifications from international museum collections listed in online databases. Recent communications by the FSC with the relevant museum curators, who checked the identities of the specimens in question, confirmed that the specimens reported from these regions are not *H. whitei* (Nalani Schnell and Agnes Dettai, Muséum national d'Histoire naturelle Paris, pers. comms.). Similarly, the species does not occur in South Australia or Victoria as indicated by Lourie et al. (2016), as these museum specimens are in fact *H. breviceps* (confirmed by Karsten Hartel of Museum of Comparative Zoology, Harvard University, and David Cantana and Graham Short of the California Academy of Science). Martin Gomon of Museum Victoria confirmed his museum contains no specimens of *H. whitei* from Victoria.

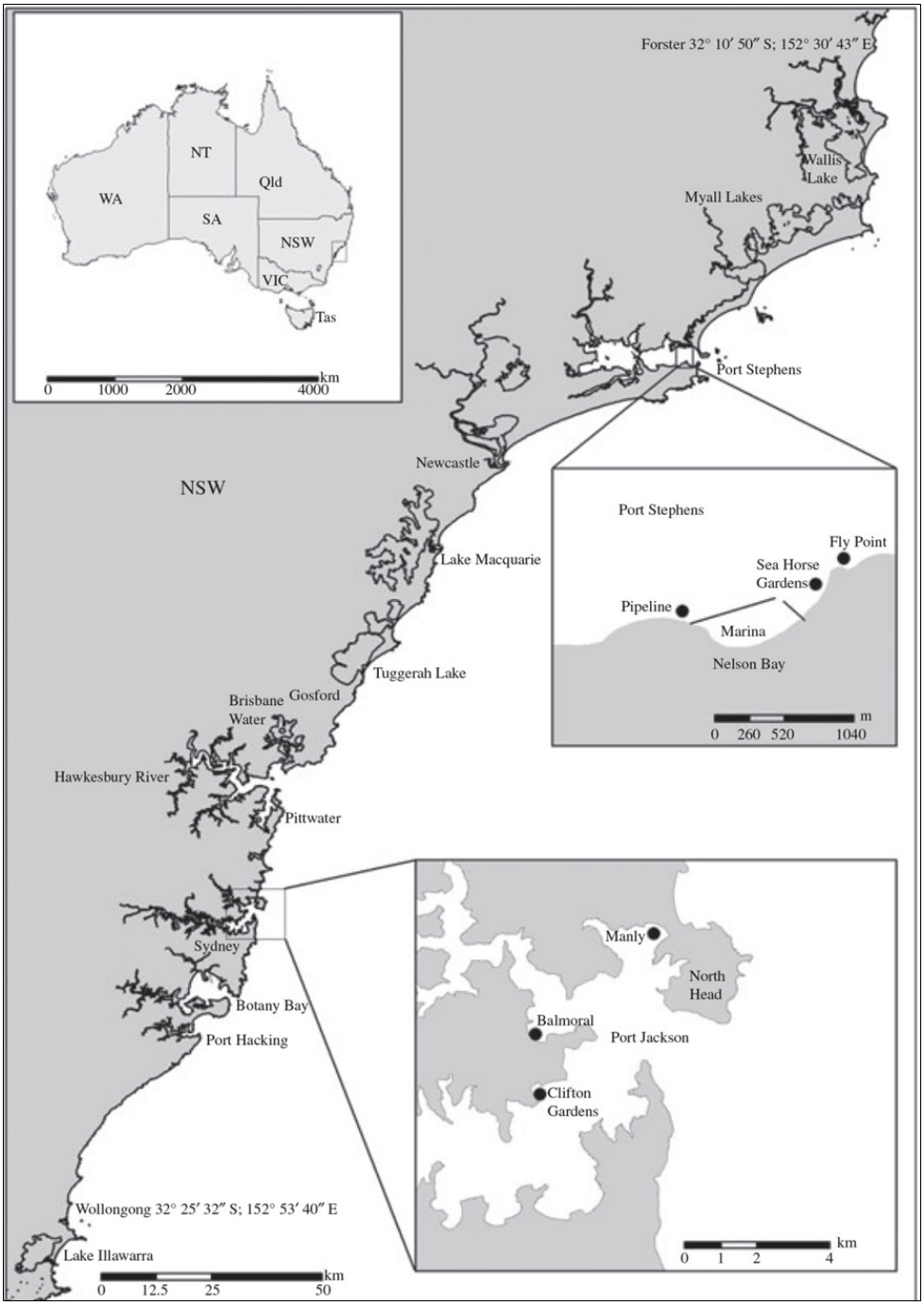

Figure 1. Known distribution of *H. whitei* in estuaries in NSW (not including Tweed River), Australia, with insert boxes showing Port Stephens and Sydney Harbour study sites. Source: Harasti et al. (2012).

In NSW, the species is currently confirmed to occur in eight estuaries between Forster and Port Hacking (Sydney) and in the Tweed River (previously identified as *H. procerus*). These estuaries are Wallis Lake (Forster), Port Stephens, Lake Macquarie, Tuggerah Lake, Hawkesbury River (including locations such as Brisbane Water and Pittwater), Port Jackson (Sydney Harbour), Botany Bay and Port Hacking. There is a single photographic record (January 2018) of a juvenile *H. whitei* from St Georges Basin that was logged through REDMAP (www.redmap.org.au); however, there is no further evidence to suggest that a resident

population exists in St Georges Basin, as this is the only confirmed sighting from this location and the individual is probably a vagrant.

To determine the current Area of Occupancy (AOO) for *H. whitei*, all observational and museum data from iNaturalist (unfiltered iNaturalist location data was provided by Mark McGrouther) and the Atlas of Living Australia were used. In addition, confirmed sightings from other locations based on surveys or confirmed photos were also included (David Harasti unpubl. data). These positions were plotted and then the AOO calculated using a 2 x 2 km grid over each point. The current AOO across Australia for *H. whitei* is estimated to be 460 km^2 (NSW is 332 km^2 ; QLD is 128 km^2).

To determine Extent of Occurrence (EOO), a polygon was drawn around all the points used to determine AOO with the polygon also encompassing large sections of mainland. The size of the EOO is estimated to be 380,000 km^2. To provide an estimate of the marine area covered within this EOO (Figure 2), a polygon was drawn around the coastal region for the known distribution of the species, based on museum and observational records. The estimated marine area that *H. whitei* occurs in is represented by this polygon is 34,234 km^2 (Figure 2).

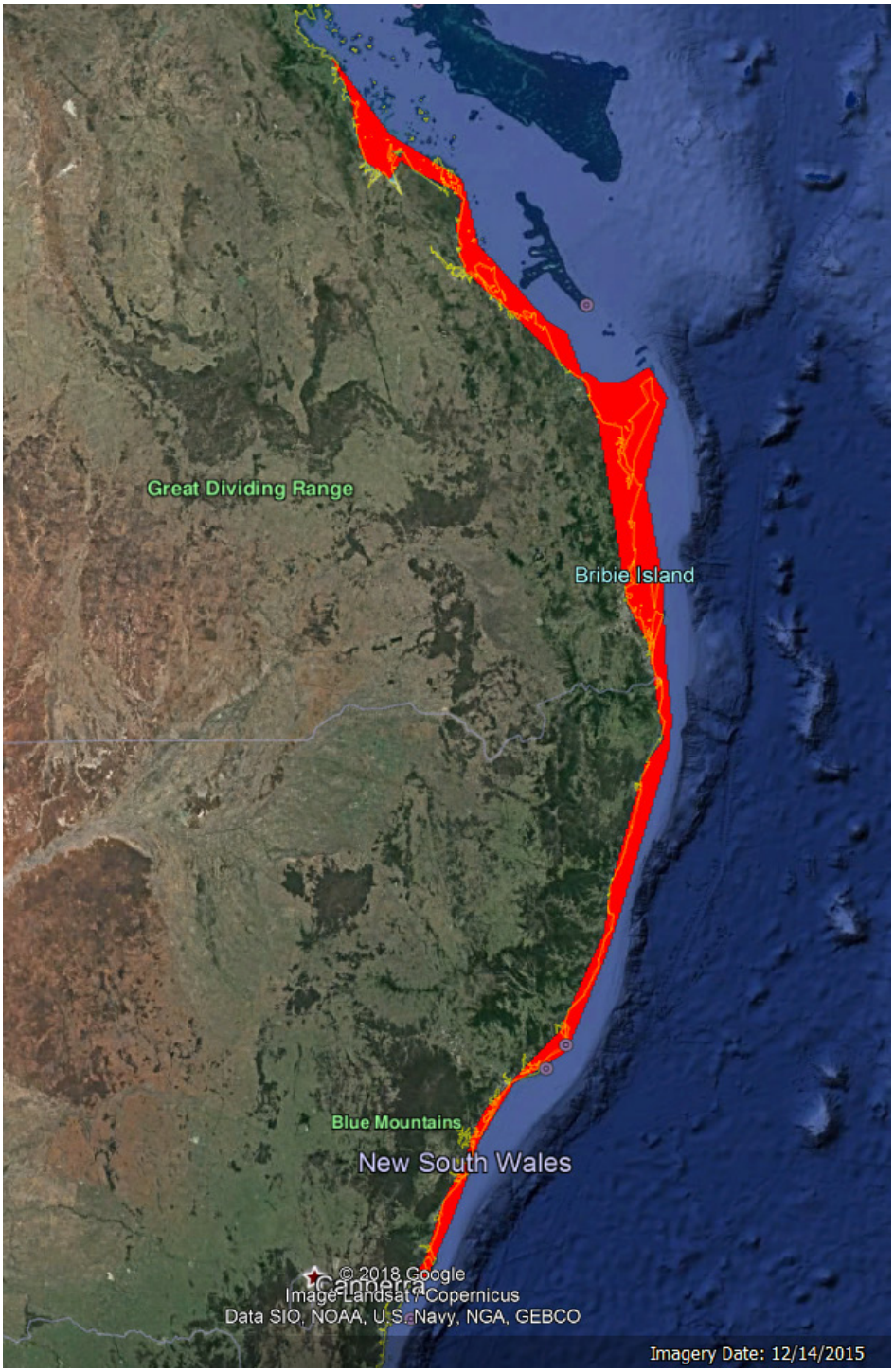

Figure 2: Suggested distribution of *H. whitei* based on observational and museum records as indicated by red polygon.

f) Relevant biology/ecology of the species

H. whitei displays rapid growth, early maturity and reproduction; age at sexual maturity is 210 days old (Mean total length = 106.7 mm) and life expectancy is 5–6 years (Harasti et al., 2012); the generation length is estimated at 3 years. Litter size is ~ 150 (Vincent & Giles, 2003); in a breeding season a large male can reproduce up to 8 times, as in the Syngnathid family the males

give birth (Harasti et al., 2012). However, litter size is considered to decrease following each reproduction (Vincent & Giles, 2003).

The survival rate for juvenile *H. whitei* is unknown; however it is considered to be very low (< 5% per annum) (D. Harasti unpub. data). These growth and reproductive traits indicate that the species has the ability to develop large populations if conditions are appropriate, such as the availability of suitable habitat and few predators (Harasti et al., 2015). However, the species has very limited dispersal ability given that there is no pelagic stage for juveniles (Kuiter, 2009), with newborns generally settling in the area of birth and not travelling far (Harasti et al., 2014b). *H. whitei* is not associated with 'rafting' (whereby juvenile seahorses attach themselves to floating debris to disperse and recruit to new areas) as observed in other seahorse species.

Von Bertalanffy growth parameters for Port Stephens were: females $L\infty = 149.2$ mm and K= 2.034 per year and males $L\infty = 147.9$ mm and K=2.520 per year compared to estimates from Sydney Harbour: females $L\infty = 139.8$ mm and K= 1.285 per year and males $L\infty = 141.6$ mm and K=1.223 per year (Harasti et al., 2012).

g) Habitat requirements of the species

H. whitei is known to occur at depths between 1-15 metres and is found utilising a wide range of habitat types (both natural and artificial). In Port Stephens, juveniles prefer gorgonian habitats (*Euplexaura* sp.) whilst adults had a preference for both sponges and soft coral (*Dendronephthya australis*) habitats. They were also found occurring in *Posidonia australis* seagrass and juveniles also used *Sargassum* sp. macroalgal and soft coral habitats (*Carijoa* sp. and *D. australis*) (Harasti et al., 2014b). They prefer more complex habitats, believed to provide better protection and more available food resources (Hellyer et al., 2011; Harasti et al., 2010); however, their habitat selection can also be influenced by prey type and occurrence of predators (Manning et al., 2018) .

The species displays strong site fidelity, with tagged males occurring on the same site (6000 m^2) for up to 56 months and females 49 months, with no seahorse ever recorded moving between sites. Individuals are not known to move far, as the largest distance a tagged animal (n = 948) was found to travel was only 70 m (Harasti et al. 2014b). Individuals show strong fidelity to holdfasts (the holdfast is the habitat that the seahorse holds onto with its prehensile tail) such as sponges, with some individuals being recorded on the same holdfast for up to 17 months (Harasti et al. 2014b).

Within Sydney Harbour, seahorses are generally found on artificial habitats such as the protective swimming net enclosures and also on jetty pylons. Their use of artificial habitats in the harbour appears to be most common in areas where natural habitat (such as seagrass, sponges and soft corals) has been lost. While seagrass decline and loss has been quantified for the harbour (West et al., 2004), there are no quantitative estimates for the loss of other natural habitat such as sponges and soft corals. The soft coral *Dendronephthya australis* and sponges are a preferred habitat for *H. whitei* (Harasti et al., 2014) and both are declining in distribution and abundance within Port Stephens (Harasti, 2016). *Dendronephthya australis* has previously been recorded in areas closer to, and within, Sydney, NSW, such as Sydney Harbour (Balmoral and near Watson's Bay) during the 1970s (R. Kuiter, pers. comm. in Poulos et al., 2015), but, now the species occurrence (particularly large, mature colonies) within and around Sydney is rare (John Turnbull, Underwater Research Group, pers. comm.).

h) Criteria – reduction in abundance, geographic distribution or genetic diversity (Regulation clause 271)

Background

Information is available on population status of *H. whitei* from two estuaries where populations were previously most abundant, Port Stephens and Port Jackson (Sydney Harbour) (Harasti et al., 2012). Resurveys of population abundance at both Port Stephens and Sydney Harbour have found declines in population abundance over the past decade (Harasti, 2016). There have been large population declines in Port Stephens (+90% decline from 2006 – 2015) and in Sydney Harbour (Manly) (+40% decline 2007 – 2015) (D. Harasti unpubl. data). Declines in Sydney Harbour have also been observed at Clifton Gardens (Chowder Bay) (Harasti et al., 2010) and Balmoral (D. Harasti unpub. data). No population abundance surveys have been undertaken for these two locations over past 8 years. However, populations of the swimming nets are known to be greatly affected by council cleaning of the nets and populations undergo severe fluctuations in response to net cleaning (Harasti et al., 2010).

Initial population declines were first noticed between 2010 and 2013 (Harasti, 2014) in Port Stephens. Populations at the two largest known aggregation sites, the Pipeline and Seahorse Gardens, were found to decline in abundance from 2006 to 2015. The Seahorse Gardens had a population estimate of ~600 mature animals in 2006, while resurveys of the site in 2015 provided a population estimate of only 10 animals (Harasti, 2016); a 98% decline if over 10 years (IUCN Criterion A2b) (Harasti 2016). In April 2018, population surveys were repeated at the Seahorse Gardens site, however, only one individual (juvenile) was found over three consecutive daily surveys (D. Harasti unpub. data).

Similarly, the Pipeline site also experienced a large decline: population estimate of ~200 animals was indicated in 2006, compared to only 45 animals in 2015; a 95% decline if extrapolated over 10 years (IUCN Criterion A2b; see Figure 2 below from Harasti (2016)). The population declines in Port Stephens were correlated with statistically significant declines in the preferred habitats of seahorses. Both soft coral and sponge habitats were found to decline significantly ($F_{1,76} = 7.801$, $p < 0.001$) at both these sites from 2009 to 2015 (Harasti, 2016).

Populations in Sydney Harbour (Manly Harbour) on the protective swimming enclosure (referred to as the Manly Net) also declined at the one location where population abundance data had been collected. The adult population size on the Manly Net from May 2007 to February 2008 was estimated at 315 (95% CI 304–326). This net was resurveyed from November 2014 to April 2015, and it was found that the population had declined by approximately 40% with a population abundance estimate of 176 (165–189); or 56% if this decline rate is extrapolated over 10 years (D. Harasti unpub. data).

Anecdotal information and diving surveys on *H. whitei* populations in Sydney Harbour indicates that there have been declines at various other locations within the harbour. Surveys of the Clifton Gardens net in February 2015 recorded only seven mature animals, compared to 70 animals on the previous survey of the net in 2008; a 98% decline if extrapolated to 10 years (D. Harasti unpub. data).

In Nov 2005 and May 2006, 146 and 206 individuals, respectively, were tagged on the Balmoral net (K. Martin-Smith unpub. data), but in February 2015 a survey of the net found only three seahorses (D. Harasti, unpub. data).

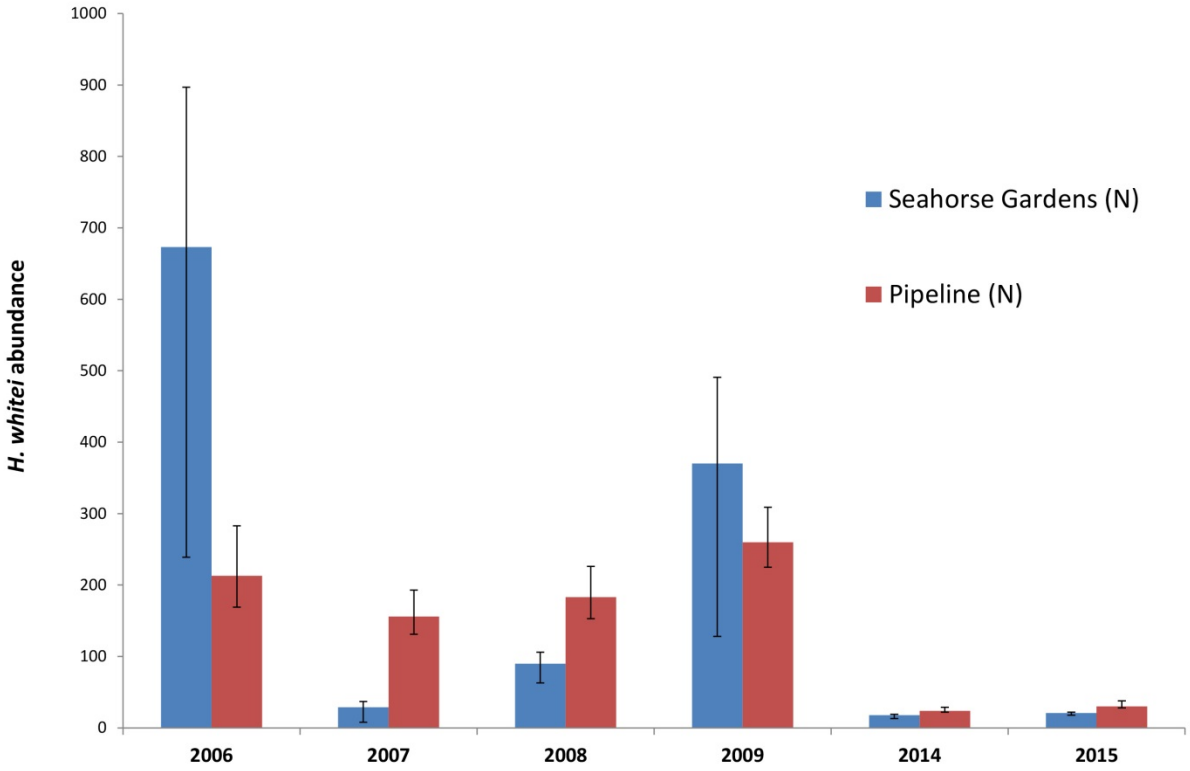

Figure 2 Changes in *H. whitei* population abundance estimates (with 95% confidence interval [CI]) at 2 sites in Port Stephens (2006−09 and 2014−15) using closed population model with JH Estimator in the program NOREMARK (source: Harasti, 2016).

Fluctuations in the number of mature individuals (>7 cm total length) have been observed occurring in both Sydney Harbour and Port Stephens. Fluctuations in Sydney Harbour have occurred on the protective swimming nets and have been observed for both Chowder Bay (Figure 3) and Manly (Figure 4). These fluctuations are most likely driven by the impact of the nets being cleaned which generally leads to seahorse populations declining to very low abundance. A fluctuation in mature animals has also been observed occurring across various locations in Port Stephens from 2006 – 2016. Large changes in mature animal abundance have been observed at the both the Pipeline site (Figure 2) and the Seahorse Garden site (Figure 5).

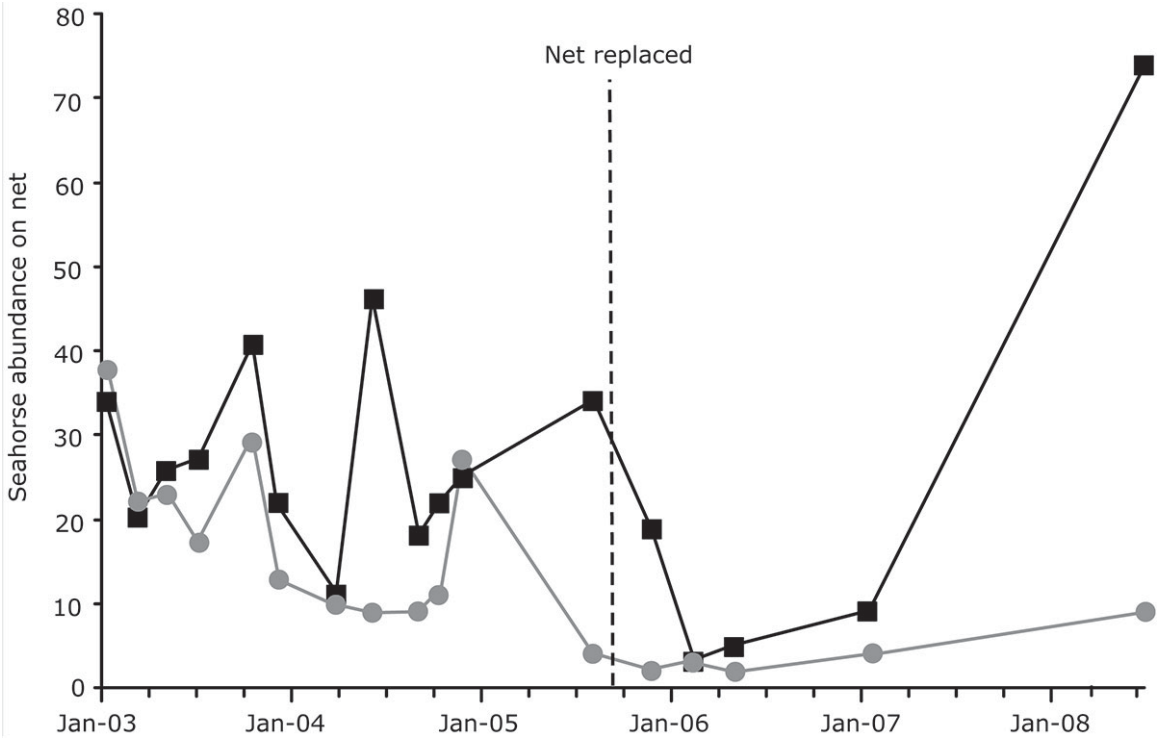

Figure 3. Total abundance of mature seahorses on swimming enclosure net at Clifton Gardens, Sydney Harbour, over the period 2003-2008. ■ = *Hippocampus whitei*; ● = *Hippocampus abdominalis*. (Source: Harasti et al., 2010).

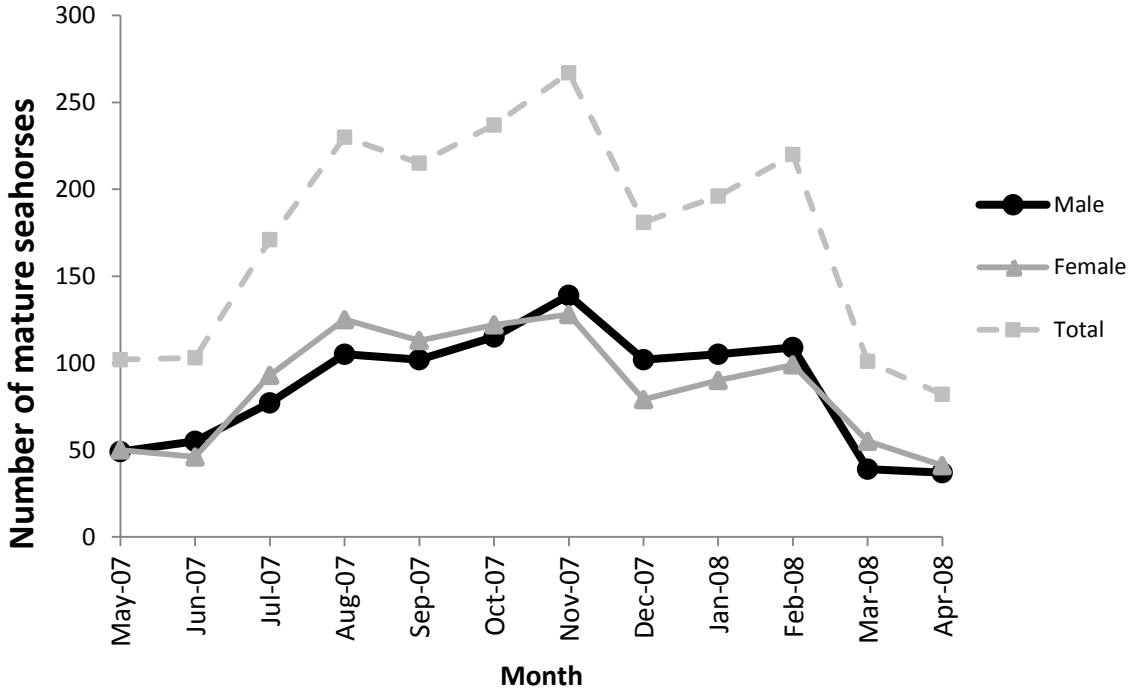

Figure 4: Total abundance of mature seahorses on swimming enclosure net at Manly, Sydney Harbour, over 12 month period (May 2007 – April 2008) (Source: Harasti et al., 2010).

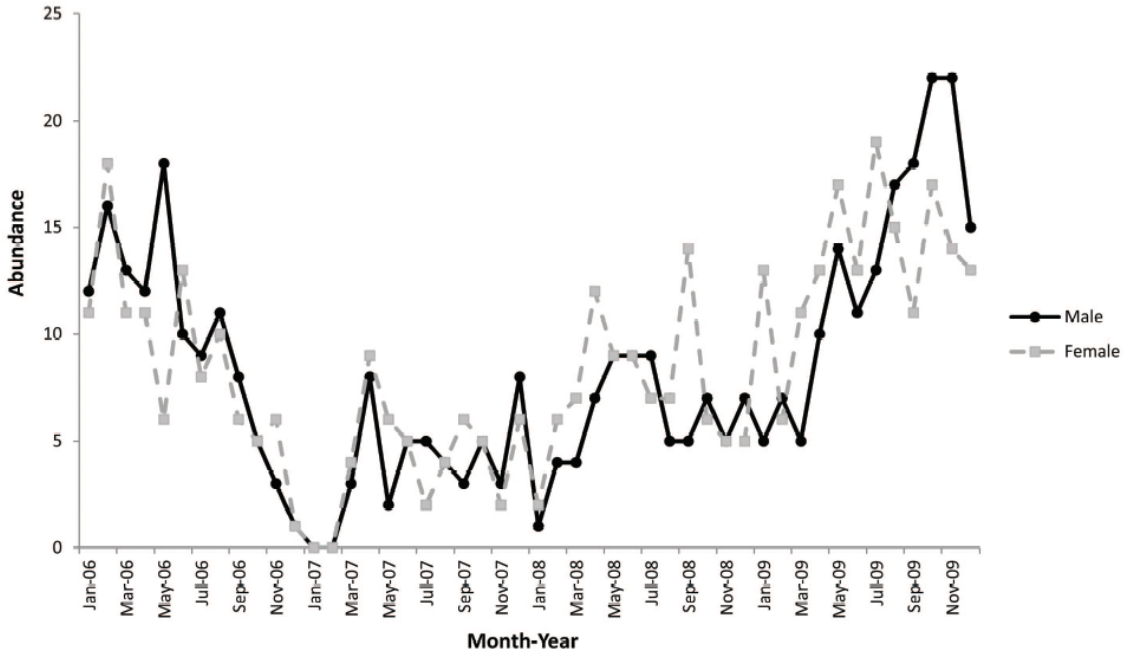

Figure 5: Monthly abundance of adult *H. whitei* recorded in 60 min dive surveys from (2006-2009 at the Seahorse Gardens site, Port Stephens (Source: Harasti et al., 2014a).

Populations of *H. whitei*

The current status of *H. whitei* populations in estuaries other than Port Stephens and Sydney Harbour is unknown, but there are no indications or evidence to suggest that large populations exist outside of Port Stephens or Sydney Harbour. Even though the species is totally protected in NSW, essential habitats continue to be threatened from anthropogenic inputs and as such it is likely that the decreasing population trend will continue in the future. Loss of essential habitats such as the seagrass *P. australis*, soft coral *D. australis* and sponge gardens have been found to be in decline in both Port Stephens and Sydney Harbour over the past two decades (West et al., 2004; Glasby & West, 2015; Harasti, 2016).

In Queensland, there has been no assessment of its population status and it's not possible to determine if *H. whitei* has declined in Qld waters (Col Limpus pers. comm.). The occurrence of *H. whitei* in Queensland waters is considered rare, as individuals are seldom encountered. Extensive surveys in seagrass habitats in Moreton Bay and the Gold Coast seaway for *H. procerus* (*whitei*) using net and snorkel surveys in 2014 & 2016 recorded only four individuals (Graham Short, California Academy of Science unpub. data). Extensive seagrass surveys between 2017 and 2018 in Moreton Bay using six replicate 50m beam trawls at four locations, sampling every six weeks in areas that are at least 75% *Zostera*, only recorded six individual *H. whitei* (Dana Burfeind, University of Queensland unpub. data).

The species is not confirmed to occur in Victorian or South Australian waters.

Assessment against IUCN Redlist Categories and Criteria (Version 3.1)*		
A.	Population size reduction (evidence of decline)	**Assessment: Endangered [A2bc]** **Justification:** State-wide NSW surveys for occurrence of *H. whitei* found that they only occurred in abundance in two locations: Port Stephens and Sydney Harbour. There is no evidence to suggest that large populations occur outside these two locations in NSW. Initial population declines were first noticed between 2010 and 2013 in

		Port Stephens (Harasti, 2014). The population declines observed in two of the largest known concentrations of the species over a six-year study (2009-2015) in Port Stephens are reported as over 90% with some fluctuation (Harasti, 2016). If extrapolated over 10 years, the Port Stephens population declines are estimated to be over 95%. Population trends varied in other areas, ranging from stability at one location in Nelson Bay to declines of 40% at one site in Sydney Harbour (Manly Harbour). Although the numbers in the main population survey sites (Harasti et al., 2012; Harasti et al., 2014a; Harasti, 2016) indicate that the species may reach thresholds for a Critically Endangered listing, the species is not likely declining as quickly in less populated parts of its range where habitats are not as threatened, including in Queensland. It is inferred that across the species' range, declines of 50-70% have occurred in the past 10 years (being the longer of 10 years or three generations, as relevant to this criterion). It is not possible to assess if declines have occurred in Queensland as the species is seldom seen and there is no evidence to suggest that large populations occur within QLD. There has been a decline in habitat quality available for *H. whitei*. Large declines (>90%) in essential habitats for the species (soft corals, sponges and seagrass) have been documented over the past few decades in both Sydney Harbour and Port Stephens (West et al., 2004; Glasby & West, 2015; Harasti, 2016) which is likely causing a decline in *H. whitei* populations. The overall decline may not have ceased, is not fully understood and may not be reversible. **Therefore, *H. whitei* is eligible to be listed as Endangered under Criterion A2bc.**
B.	Geographic range (EOO and AOO, number of locations and evidence of decline)	Assessment: Does not meet this criterion Justification: Based on observational records, diving surveys and museum records, the current Area of Occupancy (AOO) is estimated to be 460 km^2. A species with an AOO of less than 500 km^2 meets the first spatial threshold of 'endangered'. The Extent of Occurrence (EOO) is estimated to be 380,000 km^2 based on the minimum convex hull polygon (no inward curves) as recommended by the IUCN Guidelines using the GEOCAT spatial tool. However, this estimate covers ~90% of terrestrial land where the species does not occur. To provide an estimate of the marine area covered within this EOO, a polygon was drawn around the coastal region across the known distribution of the species, based on museum and observational records (Figure 2). The estimated marine area represented by this polygon is 34,234 km^2 In addition to these distribution thresholds, at least two of three other conditions must be met. These conditions are: a) Severely fragmented or number of locations. Assessment: Although the historical distribution is unknown, in New South Wales (NSW) *H. whitei* is now known to occur in only eight estuaries from Forster (Wallis Lake) to Port Hacking (Sydney) and in the Tweed River. In Queensland, *H. whitei* has

		been confirmed to occur from Mackay to the Gold Coast Seaway (Queensland Museum and Australian Museum records); however, there are no recent records (past 80 years) of the specimen occurring north of Bundaberg. *H. whitei* populations are not considered to be severely fragmented and are found in more than 10 locations; therefore, this sub-criterion is not met. 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 Assessment: Populations in both Port Stephens and Sydney Harbour are continuing to decline over the past two decades (Harasti, 2016) as a result of ongoing habitat loss (iii) (as stated in criteria A above and in 'background'). This has result in a continuing decline in the number of mature individuals (v). *H. whitei* is considered endangered under this sub-criterion based on (iii and v). 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. Assessment: Fluctuations in number of mature individuals have been observed at several long term monitoring sites in Port Stephens and Sydney Harbour, as shown in Harasti et al. (2010, 2012) for Sydney Harbour and Harasti et al. (2014a) and Harasti (2016) for Port Stephens. See figures and details above in 'background'. However, these fluctuations do not meet the IUCN definition of 'extreme fluctuations', therefore the species does not meet this criterion.
C.	Small population size and decline (population size, distribution and evidence of decline)	Assessment: The total number of mature animals found across both NSW and QLD has not been documented and is considered data deficient. Therefore, there are insufficient data to demonstrate if *H. whitei* is eligible for listing in any category under this criterion.
D.	Very small or restricted population (population size)	Assessment: The number of mature animals found across both NSW and QLD has not been documented but it is highly likely to be greater than 1000, making the species ineligible for listing in any category under Criterion D1 or D2 (based on AOO or number of locations).
E.	Quantitative analysis (statistical probability of extinction)	Assessment: A quantitative analysis has not been undertaken for the species. Therefore, there are insufficient data to demonstrate if *H. whitei* is eligible for listing in any category under this criterion.

* In 2015 the NSW Government signed an Intergovernmental Memorandum of Understanding on the Agreement on a Common Assessment Method for listing of threatened species and threatened ecological communities (the CAM). The CAM provides a nationally consistent approach to assessing and listing threatened species in Australia, using the IUCN Redlist Categories and Criteria (Version 3.1). To ensure that this Proposed Final Determination meets the requirements under the CAM, an assessment against the IUCN Redlist Categories and Criteria (Version 3.1) has been included. This assessment also reflects the requirements for listing species provided under clause 271 of the *Fisheries Management (General) Regulation 2010*.

For more information on the CAM please visit
http://www.environment.gov.au/biodiversity/threatened/cam

i) Criteria – threatening processes (Regulation clause 272)

Threat	Extent	Impact
Natural Habitat Loss	The major threat to *H. whitei* is loss of essential marine habitats across its range. Habitats that are known to be important for *H. whitei* such as soft corals, sponges and seagrass have all been shown to decline in various locations throughout NSW and QLD (West et al., 2004; Harasti, 2016). *H. whitei* is known to occur along some of the most heavily populated estuaries in Australia. As the species displays strong site fidelity and has specific habitat preferences, the further loss of key habitats through anthropogenic effects would result in a negative effect on the species' abundance and distribution; as has occurred in Port Stephens (Harasti, 2016) and Sydney Harbour. See Harasti (2016) for the impact of habitat loss on population abundance. As the species is known to use artificial habitats (swimming nets and jetty pylons), there is potential for habitat rehabilitation to be used to assist with the species recovery. Experiments with artificial seahorse habitats (referred to as Seahorse Hotels) are currently being trialled in Port Stephens and initial results are encouraging.	The level of threat of habitat loss is considered HIGH. Whilst the Port Stephens estuary was previously considered a 'stronghold' for populations of *H. whitei*, the recent population declines as a result of habitat loss indicates that its long-term conservation within the Port Stephens waterway is at risk if essential marine habitats continue to be lost. The main impacts known to threaten *H. whitei* habitats in Port Stephens include anchor damage, sand inundation and damage from moorings (Glasby and West, 2015; Harasti, 2016). Similarly, the populations in Sydney Harbour face the same threats, however, artificial structures (swimming nets) have provided temporary habitat, although this artificial habitat is also at risk (see below).

Threat	Extent	Impact
Cleaning of artificial habitats (protective swimming nets) in Sydney region	Within Sydney Harbour, it has been shown that *H. whitei* are very susceptible to councils cleaning the nets as removal of epibiota caused a decrease in *H. whitei* abundance and that *H. whitei* showed significant avoidance to areas devoid of epibiotic growth (Harasti et al., 2010). Guidelines for cleaning of the nets to minimise harm to the seahorses were developed and provided to councils in 2009 (Harasti et al., 2010); however, councils rarely implement these guidelines (David Harasti pers. comm).	The level of threat from the cleaning of the protective swimming nets is considered moderate. Research has shown that populations of *H. whitei* on swimming nets can significantly decline following council cleaning of the nets and can take years to recover. See Harasti et al. (2010) that documents the impact of cleaning of swimming nets by councils on local population abundance.

j) Conclusion pursuant to Section 220F of the Act:

It is the opinion of the Fisheries Scientific Committee that *Hippocampus whitei* is:

a) facing a very high extinction risk in New South Wales in the near future, as determined in accordance with criteria prescribed by the regulations, and

b) is not eligible to be listed as a critically endangered species.

As such, *H. whitei* is eligible to be listed as an endangered species.

k) Assessment under the Common Assessment Method (CAM)

It is the opinion of the Fisheries Scientific Committee that *Hippocampus whitei* is eligible to be listed nationally as an endangered species under the Common Assessment Method.

l) Additional information

Fisheries Scientific Committee Management Recommendations for *H. whitei*

Current and recommended management and research actions that will benefit the conservation of the species:

- Collate and synthesise data collected to quantify the significance of high and moderate risk threat interactions with *H.whitei* (Medium priority).
- Reduce the impact of public and private boat moorings that impact on *H. whitei* habitats (High priority).
- Council to maintain best practice management of protective swimming nets by using the suggested NSW DPI seahorse friendly cleaning methods (High Priority).
- Consider information on *H. whitei* distribution, abundance and habitat preferences during development and review of Marine Park Zoning Plans (Medium priority).
- Negotiate with relevant authorities to encourage the identification, assessment and modification of natural resource management plans and policies to minimise impacts on *H. whitei* habitats (Medium priority).
- Continue to monitor the distribution and abundance of *H. whitei* at important sites (Port Stephens and Sydney Harbour) to inform population status and to assist in determining the effectiveness of recovery actions (High priority).
- Develop and trial artificial habitats to promote recovery of *H. whitei* populations (High priority).
- Implement research using eDNA to investigate the occurrence of *H. whitei* in estuaries and embayments across its range (High priority).

- Implement genetics research to investigate population structure of *H. whitei* across its entire range (NSW and QLD) (Medium priority).

- Encourage the reporting of sightings of seahorses along the east coast of Australia to iSeahorse and iNaturalist (Medium priority).

m) Statement on the standard of scientific evidence and adequacy of survey:

This assessment and determination has been prepared by the Fisheries Scientific Committee in good faith using the highest possible standard of scientific evidence and adequacy of survey.

As prescribed under Section 4 of the Intergovernmental MOU on the CAM, in preparing this documentation the Committee gave consideration to:

(i) the nature of the data, including adequacy of survey (occurrences) and monitoring (to detect change), including factors such as sampling design, effort applied, number of variables considered, proportion of a species' range covered, time period covered etc.;

(ii) the number of data sets relevant to the conclusion;

(iii) the range of uncertainty in the data and degree of consistency between different data sets;

(iv) the source of the data and its credibility; and

(v) the relevance of the data to the particular assessment criterion.

References

Australian Museum (2018). Seahorses and pipefishes. https://australianmuseum.net.au/seahorses-and-pipefishes (accessed 16 July 2018)

Glasby T.M. & West G. (2015). Estimating losses of *Posidonia australis* due to boat moorings in Lake Macquarie, Port Stephens and Wallis Lake. Fisheries Final Report Series. Port Stephens Fisheries Institute, Port Stephens

Harasti, D. (2014). The biology, ecology and conservation of White's seahorse *Hippocampus whitei*. PhD thesis, School of the Environment. Sydney: University of Technology - Sydney. 211pp.

Harasti, D. (2016). Declining seahorse populations linked to loss of essential marine habitats. *Marine Ecology Progress Series*, 546:173–181.

Harasti, D (2017). Southwards range extension of the great seahorse *Hippocampus kelloggi* in Australia. *Journal of Applied Ichthyology*. doi/10.1111/jai.13414

Harasti, D. (2015). Range extension and first occurrence of the thorny seahorse *Hippocampus histrix* in New South Wales, Australia. *Marine Biodiversity Records*, 8(E49): 3.

Harasti, D., Martin-Smith, K., & Gladstone, W. (2014a). Does a no-take marine protected area benefit seahorses? *PloS One*, 9(8): e105462.

Harasti, D., Martin-Smith, K. & Gladstone, W. (2014b). Ontogenetic and sex-based differences in habitat preferences and site fidelity of the White's seahorse *Hippocampus whitei*. *Journal of Fish Biology*, 85: 1413–1428.

Harasti, D., Glasby, T.M. & Martin-Smith, K.M. (2010). Striking a balance between retaining populations of protected seahorses and maintaining swimming nets. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 20:159–166.

Hellyer, C.B., Harasti, D. & Poore, A.G.B. (2011). Manipulating artificial habitats to benefit seahorses in Sydney Harbour. *Aquatic Conservation: Marine and Freshwater Ecosystems* , 21:582-–589.

Hutchings, P.A., Ahyong, S.T., Ashcroft, M.B., McGrouther, M.A. & Reid, A.L. (2013) Sydney Harbour: its diverse biodiversity. *Australian Zoologist*, 36(3): 255–320.

Kuiter, R.H. (2001). Revision of the Australian seahorses of the genus *Hippocampus* (Syngnathiformes: Syngnathidae) with descriptions of nine new species. *Records of the Australian Museum,* 53: 293–340.

Kuiter, R.H. (2009). *Seahorses and their relatives*. Seaford: Aquatic Photographics.

Lourie, S.A., Vincent, A.C.J. & Hall, H.J. (1999). *Seahorses: An Identification Guide to the World's Species and their Conservation*. London: Project Seahorse.

Lourie, S. A., Pollom, R. A., & Foster, S. J. (2016). A global revision of the Seahorses *Hippocampus* Rafinesque 1810 (Actinopterygii: Syngnathiformes): Taxonomy and biogeography with recommendations for further research. *Zootaxa*, 4146(1): 1–66.

Manning, C., Forster, S., Harasti, D., Vincent, A. (2018). A holistic investigation of the ecological correlates of abundance and body size for the endangered White's seahorse *Hippocampus whitei*. Journal of Fish Biology. https://doi.org/10.1111/jfb.13745

Poulos, D.E., Harasti, D., Gallen, C., Davis, T., & Booth, D.J. (2015). Distribution and spatial modelling of a soft coral habitat in the Port Stephens-Great Lakes Marine Park: implications for management. *Marine and Freshwater Research*, 67(2): 256–265.

Short, G., Harasti, D., and Hamilton, H. (in press) *Hippocampus whitei* Bleeker, 1855, a senior synonym of the southern Queensland seahorse *H. procerus* Kuiter, 2001 (Teleostei: Syngnathidae): molecular and morphological evidence. Zootaxa.

Vincent, A.C.J. & Giles, B.G. (2003). Correlates of reproductive success in a wild population of *Hippocampus whitei*. *Journal of Fish Biology*, 63: 344–355.

West, G., Williams, R.J. & Laird, R. (2004). Distribution of Estuarine Vegetation in the Parramatta River and Sydney Harbour, 2000. NSW Fisheries Final Report Series No. 70.

Associate Professor Mark Lintermans
Chairperson
Fisheries Scientific Committee