Fisheries Scientific Committee

Final Determination

Cauliflower Soft Coral
Dendronephthya australis

Listing category: Endangered (EN)
IUCN Category: EN A2ac, B1ab(i,ii,iii,iv)+B2ab(i,ii,iii,iv)

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), has made a final determination to list the **Cauliflower Soft Coral**, ***Dendronephthya australis*** 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) Taxonomy

In 2011, species identification was sought from Dr Leen van Ofwegen, from the National Natural History Museum, The Netherlands, who is considered the world expert in the soft coral family: Nephtheidae. A whole specimen was collected from Port Stephens, New South Wales, and sent to him for examination. The species was identified as *Dendronephthya australis*, a very unique species which he indicated has no known occurrence outside of New South Wales.

Dendronephthya australis, a temperate soft coral species, was first described in 1905 by Kükenthal (Verselveldt & Alderslade 1982), from Port Jackson and Port Hacking, Sydney, and re-described in 1982 in more detail, with material from Fly Point, Port Stephens (Verselveldt & Alderslade 1982).

b) Description of Species

The Family Nephtheidae contains brightly coloured genera, mostly described as bushy, globe-shaped or arborescent in appearance. One genus in the family is Dendronephthya, which is known to have a world-wide distribution and occurs predominantly in tropical waters. The genus Dendronephthya forms colonies which are branched or bushy and usually have a rough or prickly feel from the sclerites. They are usually around 20cm tall (but can grow up to 2 metres high) (Fabricius & Alderslade 2001). Dendronephthya species are common at depths below 20 metres in fast currents and can also grow in muddy estuaries and deep oceanic waters (Fabricius & Alderslade 2001).

The soft coral *Dendronephthya australis* has the following diagnostics (from Verselveldt & Alderslade 1982): The sterile stalk passes into the stem, which distally divides into a few branches. In this part of the colony the groups of polyps are numerous and densely placed, whereas proximally only small groups are found, which stand further apart. There are no foliaceous branches. Proximally the lobes are 'small', distally they are larger and composed of numerous, crowded umbels. The supporting bundle is weak. It consists of some spimy spindles, up to 1 mm long. They are red in colour, as are the basalmost anthocodial sclerites; the other anthocodial sclerites are colourless. In alcohol the sterile stalk and the basal part of the stem are dirty-white. Distally the sclerites become increasingly redder, the twigs and supporting bundles having dark-red spicules. The anthocodiae are white.

There are other soft coral species from the family Nephtheidae that can occur in NSW that look similar to *D. australis*. However, these are tropical species that are found in areas north of Port Stephens and are generally found occurring on rocky reef habitats, not sandy soft bottom habitats where *D. australis* generally occurs.

c) Distribution of species

The only estuaries where *D. australis* is known to occur in abundance are Port Stephens and the Hawkesbury River (Brisbane Water area), New South Wales. They have also been recently (2018) found occurring in Sydney Harbour, Botany Bay and Jervis Bay (John Turnbull, Underwater Research Group, pers. comm, 2018; Andrew Trevor-Jones, Australian Museum, pers. comm, 2018); however, there have only been a few colonies sighted across 8 different sites and their persistence in these areas is uncertain.

In Jervis Bay, a total of 18 colonies were discovered near Bowen Island covering an area of only 25 m^2. In a large scale sub-tidal mapping survey of coastal estuaries, which included the Clyde River, Port Hacking, Port Jackson (Sydney Harbour), Pittwater, and the Hawkesbury River, there was no detection of the occurrence of *D. australis* (Creese et al., 2009).

Soft coral habitats were first mapped in Port Stephens in 2011 using a diver-towed GPS system (Poulos et al. 2015). It was found that *D. australis* only occurs along the southern shoreline of the Port Stephens estuary between Corlette Point and Fly Point (Poulos et al. 2015) and this was confirmed with mapping conducted in 2014 (Davis et al. 2015b). Targeted towed video mapping in 2014 found *D. australis* covering an area of only 30,000m^2 (3 ha) (Davis et al., 2015b) over a mapped area of ~52 km^2. The most recent mapping occurred in August-September 2019 where it showed a large decline in the distribution and abundance across Port Stephens (Meryl Larkin unpublished PhD Data). The 2019 mapping program was more extensive than previous efforts (2011 and 2014) as more areas were searched and more intensive mapping was done when a colony was found. The 2019 mapping found that the soft coral occurred in an area of 9,000 m^2 (0.9 ha) and were found to be smaller and in reduced density.

Limited mapping of the soft coral occurrence in Brisbane Water (Northern Hawkesbury River) in 2016 found that it occurred at three out of eight sites searched (Houghton, 2016). Sites selected were based on undertaken assessing areas of potential occurrence, as modelled by Poulos et al (2015). Recent mapping of the occurrence of *D. australis* within Brisbane Water was undertaken in 2019 (Vincent Raoult – University of Newcastle). The soft coral was found to occur at low abundance and a very sparse distribution, with the areal extent of coverage in Brisbane Water mapped as only 30,000 m^2 (3 ha) and limited to the southernmost-extent of the estuary (Vincent Raoult, Unpublished data) (University of Newcastle unpublished data). The area where the soft coral occurs in Brisbane Water is located in an area that has been subject to dredging since 2018.

There were reports of the species allegedly occurring in Wallis Lake at Forster in 2014. The NSW Department of Primary Industries (DPI) Fisheries undertook towed video mapping across Wallis Lake in 2014-2015 and did not find any occurrence of *D. australis* (Davis et al., 2015b).

There have been a few sightings of individual colonies (n=2) occurring along the Swansea Breakwall, Lake Macquarie (Poulos, 2011); however, there have been no confirmed observations of the species occurring in Lake Macquarie since 2012.

Within the Queensland Museum, there are two specimens collected from Queensland that have the same morphometric characteristics as *D. australis* from NSW (based on advice from Dr Merrick Ekins, Collection Manager, Queensland Museum; April 2019). The first is a specimen from Fraser Island collected in 1959 and the other is a specimen from Moreton Island in 1940. Given that these specimens were collected over 60 years ago, and both areas have had extensive marine biodiversity surveys conducted (particular Moreton Bay) over the past 50 years and the species has not been recorded again, there is no evidence to suggest the species currently occurs in abundance within Queensland waters.

d) Relevant biology/ecology of the species

The *Dendronephthya australis* soft coral habitat is known to be an important habitat for a range of diverse marine species (Poulos et al., 2013; Davis et al., 2016b). It has been found to be a preferred habitat for *Hippocampus whitei* (White's Seahorse), an endangered species in NSW, with mature animals found commonly in this habitat (Harasti et al., 2014). It is also important for species such as juvenile Snapper (*Chrysophrys auratus*) (Poulos et al., 2013). Snapper were found to be more abundant and smaller in length in *D. australis* habitats during summer and winter when compared with other adjacent habitats of sponges, seagrass and sand (Poulos et al., 2013). Other fish species that were found to be associated strongly with *D. australis* habitat include the wrasses *Ophthalmolepis lineolatus, Suezichthys devisi, Coris dorsomacula and Psuedolabrus guentheri* (Van Lier et al. 2017), the Bluestriped Goatfish *Upeneichthys lineatus* and the Southern Pygmy Leatherjacket *Brachaluteres jacksonianus* (Davis et al, 2016b).

The species appears to be confined to estuarine environments in NSW where it occurs in depths of 1 to 18 m. The species is yet to be recorded outside estuaries or coastal embayments. It is generally found in sandy bottom areas in regions of high current flow and it can expand and contract in relation to tidal flow cycle (Davis et al., 2015c).

A study was implemented in 2015 assessing the role of *D. australis* in the foodweb, using stable isotopes of carbon δ13C and nitrogen δ15N to identify the trophic structure and flow of energy through the community; and determine the functional role of the soft coral within the community, in comparison to sponges (Corry, 2018). *Dendronephthya australis* and sponges accessed different primary sources for their energy requirements through niche partitioning of the seston. The isotope data provided no evidence that *D. australis* was used as a direct food source by consumers, and therefore does not perform the role of a trophic resource in this

system. However, *D. australis* does provide a habitat for amphipods, major prey components of protected species (pipefish and seahorses), possibly juvenile snapper and other higher consumer diets, suggesting that this soft coral is an important ecosystem engineer within the benthic estuarine environment (Corry, 2015; Corry et al., 2018).

Regarding the species biology, there has been no research conducted on the species biology, therefore no information is available on the species reproduction and maturity status. Individual monitoring of some *D. australis* colonies has found that they can survive for up to 12 months (Tom Davis unpublished data), however, their actual longevity is unknown.

e) Habitat requirements of the species

Dendronephthya australis occur in protected estuary environments in areas of high current flow. They are found on sandy substrates in depths of 1 to 18 m. A species distribution model was created to explore the possible occurrence of *D. australis* across the entire Port Stephens estuary, using four environmental parameters: bathymetry, slope of seabed, velocity of tidal currents, and distance from estuary mouth (Poulos et al., 2015). *Dendronephthya australis* colonies occurred along the southern shoreline in the Port Stephens estuary between Fly Point and Corlette Point, but no colonies were found within no-take zones within the marine park. The model illustrated limited habitat suitability for *D. australis* within a larger section of the estuary, suggesting this species has specific environmental requirements for survival. The model indicates that the area highly suitable for the occurrence of *D. australis* is limited to only 730,000 m^2 (73 ha), a mere 1.5% of the east basin of Port Stephens (Poulos et al., 2015).

f) Criteria – threatening processes (Regulation clause 272)

Threats and level of risk to the species

Threats				
Threat	Extent	Impact	Evidence	Time period
Sand inundation	Impact across the entire estuary	High	The movement of sand across the Port Stephens estuary is considered to be magnified by anthropogenic changes to shorelines and marina developments that have altered current dynamics across the Port Stephens estuary (Wainwright, 2011). As a result of a large influx of sand from the western end of Shoal Bay, the *D. australis* colonies that existed at Fly Point and Little Beach from 2006-2010 (Harasti et al., 2014) were inundated from sand movement and as of 2018 have now completely disappeared from	*past, present, future*

			both localities. This sand movement was primarily caused by change in local council's management of sand nourishment within Shoal Bay (Wainwright, 2011).	
Damage from boat anchoring and moorings	Localised impact.	High	Direct damage to *D. australis* from boat anchoring and moorings have been observed occurring at three sites in Port Stephens (Seahorse Gardens, Pipeline and Dutchmans Beach) as reported in Harasti (2016). Boat anchors drag through the *D. australis* colonies ripping them out of the Boat moorings using block and chain were observed to cause large scours remove all the *D. australis* and it has been established that swing mooring can scour out an area of up to 700 m^2 (Glasby and West, 2018).	*past, present, future*
Natural predation by the sea slug	Seasonal impact.	Low	The heterobranch sea slug *Dermatobranchus* sp. is a known predator *of D. australis* with aggregations occurring seasonally (Spring) and they have been shown to impact on the feeding ability *of D. australis* (Davis et al., 2017). As the abundance of *D. australis* has declined in the Port Stephens estuary, it has been observed that the *Dermatobranchus* sp. aggregate in large masses in areas where abundance *of D. australis* is small causing localised depletion in *D. australis* populations (Tom Davis pers comm). In areas where there are a large number of *D. australis* colonies, the impact of the *Dermatobranchus* sp. is minor as the sea slugs are not as concentrated.	*past, present, future*

g) Current conservation status

Jurisdiction	State / Territory in which the species is listed	Date listed or assessed (or N/A)	Listing category i.e. critically endangered or 'none', and criteria if known
International (IUCN Red List)		N/A	N/A
National (EPBC Act)		N/A	N/A

State / Territory	New South Wales	Under assessment	

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

Assessment against IUCN Redlist Categories and Criteria (Version 3.1)*		
A.	Population size reduction	Assessment Outcome: Endangered A2ac Justification: Population reduction in *Dendronephthya australis* has been observed to have occurred over the past two decades making it eligible for criterion A2. Whilst the generation time for *D. australis* is not known, evidence from surveys in the wild indicate that the species only lives for a maximum of approximately 2 years (Tom Davis pers comm; D Harasti personal observation); however, further work on life expectancy of *D. australis* is required. Generation time is therefore considered short for this species; therefore the minimum 10 year interval is considered the appropriate measurement timeframe for the assessment. In Port Stephens, large declines in abundance of *D. australis* have been recorded over the past 10 years. Recent surveys completed in 2019 using towed video allowed direct comparison with towed video data collected in 2014 (Davis et al. 2015b). In 2014, *D. australis* covered an area of 30,000 m^2 (3 ha) whilst in 2019 it was only 9,000 m^2 (0.9 ha); a reduction of 71%. At two locations (Seahorse Gardens and Pipeline), the *D. australis* population declined by 95% and 73% across the two sites, respectively, from 2008 - 2016 (Harasti, 2016) based on the initial habitat mapping in 2008 that was conducted in a study on the seahorse *Hippocampus whitei* (Harasti et al., 2014). Surveys of the Pipeline site in September 2019 found only 26 remaining colonies of *D. australis* over an area of approximately 100 m^2 (Harasti unpublished data), compared with a mapped area of 3864 m^2 in 2011 and 690 m^2 in 2015 (Harasti, 2016). The decline in *D. australis* coverage from 2011 to 2018 at the Pipeline location is estimated to be 97%. Similarly, the decline in coverage of *D. australis* between 2011 and 2015 at the Seahorse Gardens sites was 98% (Harasti, 2016) and surveys of this site in October 2018 and April 2019 found no recovery of the species. At two other locations in Port Stephens (Fly Point and Little Beach), there were previously two large *D. australis* populations covering areas of approximately 500 m^2 (Harasti et al., 2014). At both sites, population declines of 100% were observed to have occurred between 2009 and 2010, and it is not known what caused the entire *D. australis* subpopulation to disappear from these two localities. It is considered that the main contribution to the declines within Port Stephens are ongoing, with the main threats being inundation from sand movement and damage from boat anchoring. However, the

<table>
<tr><td></td><td></td><td>causes of the reduction in D. australis abundance within Port Stephens are not well understood and may not be reversible. As such, a population decline over the past 20 years of over 70% is inferred for the Port Stephens estuary based on the mapping data as described above.

Documented declines in other locations where D. australis occurs are not as detailed as those recorded in Port Stephens, as targeted mapping and abundance surveys have not been conducted. In Sydney Harbour, sightings of D. australis covering large areas were recorded in around Balmoral and near Watson's Bay in the 1970s (R. Kuiter, pers. comm in Poulos et al., 2015). The occurrence of this species in Sydney Harbour (particularly large, mature colonies) is rare (John Turnbull, Underwater Research Group, pers. comm, 2018). A population decline over the past 30 years of >50% is inferred for the Sydney region based on the small abundance currently found compared with anecdotal information from the 1970s.

Whilst the abundance of D. australis in the vicinity of Brisbane Water in the Hawkesbury River is very low (30,000 m^2 or 3 ha), there is no evidence to suggest the species has declined, as surveys in the area only commenced in 2015. Similarly, in Jervis Bay, there is only a very small population (20 colonies) which has been seen to fluctuate significantly over the past 2 years. As such, estimating population declines in this locality is not feasible as no historic data exists.</td></tr>
<tr><td>B.</td><td>Geographic range</td><td>Assessment Outcome: Endangered. B1ab(i,ii,iii,iv) +B2ab(i,ii,iii,iv)

Justification: The extent of occurrence (EOO) for D. australis is estimated to be 4,970 km^2. A species with an EOO of less than 5,000 km^2 qualifies as Endangered. Note: This EOO covers large deep-water offshore habitats where the species does not occur.

The area of occupancy (AOO) was estimated to be 80 km^2 (Table 1), based on 2 x 2 km grids for each location where the species has been found to occur using the recommended method by the IUCN, 2018. A species with an AOO of less than 500 km^2 qualifies under the Endangered threshold (if it also meets at least two of Criterion Ba-c).

Table 1. Estuaries where D. australis is known to currently occur within New South Wales based on mapping, underwater survey data and confirmed diver sightings.

<table>
<tr><th>Area of Occurrence</th><th>AOO (km^2)</th></tr>
<tr><td>Port Stephens</td><td>24</td></tr>
<tr><td>Brisbane Water</td><td>16</td></tr>
<tr><td>Sydney (Botany Bay, Port Jackson)</td><td>32</td></tr>
<tr><td>Jervis Bay</td><td>4</td></tr>
<tr><td>TOTAL</td><td>80 km^2</td></tr>
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In addition to the geographic range thresholds, at least two of three other conditions must be met. These conditions are:</td></tr>
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		(a) The population or habitat is observed or inferred to be severely fragmented or there are five or less locations where it occurs. Assessment outcome: Endangered. Justification: The species is currently only confirmed to be occurring in abundance in four locations (See Table 1 above for locations). Therefore, it meets this criterion as it occurs within five or less locations. Port Stephens is the only location where the species has been observed occurring in large abundance. In the Sydney region, *D. australis* has been observed in small numbers occurring within Botany Bay (Bare Island and Kurnell) and Port Jackson (Sydney Harbour). Due to their close proximity, these are considered as one locality as they would all be impacted by a single threatening event. A single threatening event that could cause a subpopulation to disappear from a location would be a change in water quality as increased turbidity and sedimentation (such as caused by dredging operations) would pose significant harm to the species. The Jervis Bay location is considered to be a vagrancy location as only a small number of colonies have been recorded within the embayment. These colonies experience extreme fluctuations and declines (see c below). *(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 outcome: Endangered Justification: A study by Harasti (2016) found significant declines in the coverage of *D. australis* at two locations (Seahorse Gardens and Pipeline) between 2009 and 2015 (Harasti, 2016). At the Seahorse Gardens, the *D. australis* habitat area declined by 95% during this period, whilst at the Pipeline the decline was 73% in area of *D. australis*. These declines were attributed to three factors: 1) damage from incorrectly installed moorings, 2) boat anchor damage, and 3) sand inundation. Recent mapping in Port Stephens found a 71% decline in coverage of *D. australis* from 2014 to 2019 with the main cause for the decline thought to be inundation from sand (Meryl Larkin, unpublished PhD data). Sightings of *D. australis* covering large areas were recorded in areas within Sydney Harbour (Balmoral and near Watson's Bay) in the 1970s (R. Kuiter, pers. comm in Poulos et al., 2015); however, the species occurrence (particularly large, mature colonies) within and around Sydney Harbour is rare (John Turnbull, URG, pers. comm). From 2005 to 2009, Harasti et al. (2012) undertook extensive diving surveys of 24 estuaries along the NSW coast to search for the presence of the seahorse *Hippocampus whitei.* The only location where *D. australis* was found to occur in these surveys was along the southern shoreline of Port Stephens.

		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 outcome: Insufficient data Justification: (i) This species has been observed to experience fluctuations across its range (see below), however, these fluctuations are variable and inconsistent as they have not always recovered. At Fly Point site in Port Stephens, a large colony of *D. australis* occurred from 2005-2008 covering an area of 500 m^2 (Harasti, unpublished data). Similarly, *D. australis* covered an area of 400 m^2 at Little Beach from 2006-2008. The *D. australis* soft corals were found to disappear completely from both sites between 2009 and 2010 and it is believed sand inundation was the cause; however, the cause was never quantified. The species was found to reoccur in 2012 at the Little Beach location covering an area of approximately of 400 m^2; however, these colonies all disappeared within 12 months with the reason for decline unknown. As of 2018, *D. australis* has not been found to reoccur at either the Fly Point or Little Beach sites. In Jervis Bay, a small population of < 20 colonies was found occurring on the NW corner of Bowen Island in August 2017, however, when divers went back to sample the colonies in February 2018 they had all disappeared. A survey in October 2018 found 10 small colonies had reappeared at the same location.
C.	Small population size and decline	Assessment Outcome: Insufficient data to assess Justification: An actual assessment of the total number of mature individuals has never been undertaken across its range. Therefore, there is insufficient data to assess the species against this criterion.
D.	Very small or restricted population	Assessment Outcome: Insufficient data to assess Justification: Assessment of mature individuals has not been undertaken for *D. australis*. As there is no information available on the species reproduction and maturity status, it is not possible to assess number of 'mature' individuals. Therefore, there is insufficient data to assess the species against this criterion.
E.	Quantitative analysis	Assessment Outcome: Insufficient data to assess Justification: Currently, there are not enough data to undertake a quantitative analysis to determine the extinction probability of *Dendronephthya australis*.

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

It is the opinion of the Fisheries Scientific Committee that *Dendronephthya australis* 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, *D. australis* is eligible to be listed as an endangered species.

j) Assessment under the Common Assessment Method (CAM)

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

k) Fisheries Scientific Committee Management Recommendations for *D. australis*

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

- Implement research regarding the biology of the species to assess reproduction, generation time, survival and longevity (High priority).
- Reduce the impact of public and private boat moorings that impact on *D. australis* habitats within NSW including replacement of block and chain moorings with non-scouring environmentally friendly mooring systems (High priority).
- Negotiate with relevant authorities to encourage the identification, assessment and modification of natural resource management plans and policies to minimise impacts on *D. australis* habitats (Medium priority).
- Consider information on *D. australis* distribution, abundance and habitat preferences during development and review of Marine Park Zoning Plans (High priority).
- Continue to monitor the distribution and abundance of *D. australis* at important sites (Port Stephens and Brisbane Water) to inform population status and to assist in determining the effectiveness of recovery actions (High priority).

- Implement aquaria studies to develop techniques for *D. australis* cultivation (High priority)

- Initiate research that examines the feasibility of transplanting aquaria grown *D. australis* for transplant into the wild for rehabilitation (High priority)

- Implement the feasibility of using eDNA to investigate the occurrence of *D. australis* in estuaries and embayments across and outside its range (Medium priority).

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

- Encourage the reporting of sightings of *D. australis* along the east coast of Australia through DPI or iNaturalist (Medium priority).

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

This 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 assessment 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

Corry, M. (2015). The functional role of the soft coral *Dendronephthya australis* in the benthic food web of temperate estuaries. *Honours thesis, Newcastle University.* Newcastle, Australia.

Corry, M., Harasti, D., Gaston, T, Mazumder, D and Moltschaniwskyj, N. (2018). The functional role of the soft coral *Dendronephthya australis* in the benthic food web of temperate estuaries. Marine Ecology Progress Series. DOI10.3354/meps12498.

Creese, R. G., Glasby, T. M., West, G. & Gallen, C. (2009). *Mapping the habitats of NSW estuaries*. Industry & Investment NSW. p. 95.

Davis, T., Harasti, D., Smith, S. (in review). Responses of *Dendronephthya australis* soft corals to predation by sea slugs. *Submitted January 2017 to Marine and Freshwater Research*.

Davis, T., Harasti, D., Kelaher, B., and Smith, S.D.A. (2016). Diversity surrogates for estuarine fish assemblages in a temperate estuary in New South Wales, Australia. *Journal of Regional Marine Studies*. doi:10.1016/j.rsma.2016.05.009.

Davis, T., Harasti, D., Smith, S. (2015a) Developing a classification typology for subtidal habitats in a temperate estuary in New South Wales, Australia. *Marine and Freshwater Research*. doi.org/10.1071/MF15123.

Davis, T., Gallen, C., Laird, R. and Harasti, D. (2015b). Mapping sub-tidal habitats in the Eastern Port of Port Stephens. *Final Report to Hunter Local Land Services*. 44 pp.

Davis, T., Harasti, D., Smith, S. (2015c) Extension and feeding of *Dendronephthya australis* soft corals in tidal current flows. *Marine Biology*. 162 (10), 2155-2159.

Glasby, T. M., & West, G. (2018). Dragging the chain: Quantifying continued losses of seagrasses from boat moorings. Aquatic Conservation: Marine and Freshwater Ecosystems, 28(2), 383-394.

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

Harasti, D., Martin-Smith, K. & Gladstone, W. (2014). 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.

Houghton, J. (2016). Mapping new populations and evaluating the biological value of a estuarine soft coral in NSW. Honours Thesis. Estuarine Science and Management, University of Newcastle.

Poulos D. 2011. Unique soft coral habitat in a temperate estuary: significance to biodiversity and marine park management. *Honours thesis, University of Technology*: Sydney, Australia.

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*. doi.org/10.1071/MF14059.

Poulos, D. E., Harasti, D., Gallen, C., & Booth, D. J. (2013). Biodiversity value of a geographically restricted soft coral species within a temperate estuary. *Aquatic Conservation: Marine and Freshwater Ecosystems* 23(6), 838-849.

Smith SDA, Edgar RJ (2014) Documenting the density of subtidal marine debris across multiple marine and coastal habitats. PLoSONE 9:e94593

Val Lier, J., Harasti, D., Laird, R., Noble, M and Fulton, C.J. (2017). Soft canopy structure provides key predictors for estuarine fish community composition across multiple mesohabitat types. *Marine Biology*.
DOI 10.1007/s00227-017-3068-2

Wainwright D (2011) Halifax Park/Fly Point sand accumulation study. Report prepared for Port Stephens−Great Lakes Marine Park. BMT WBM, Newcastle.
www.mpa.nsw.gov.au/pdf/Halifax%20-%20Study.pdf