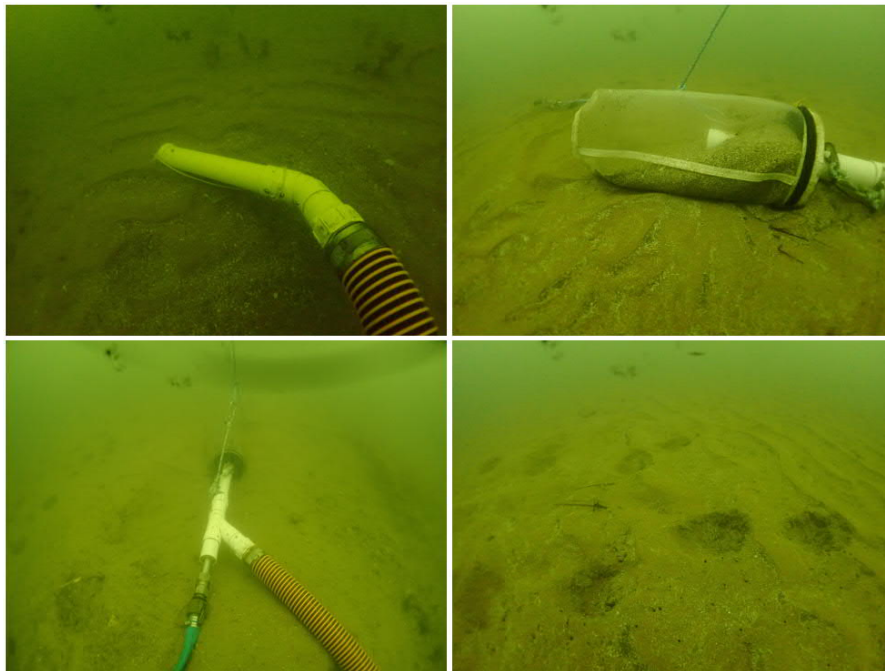


Threatened Ghost Shrimp Survey, Lower North Arm, Western Port 2019

Technical Report A - Annexure F

AGL Gas Import Jetty Project

CEE Technical Report Threatened ghost shrimp survey Lower North Arm, Western Port 2019



December 2019



CEE Technical Report

Threatened ghost shrimp survey

Lower North Arm, Western Port 2019

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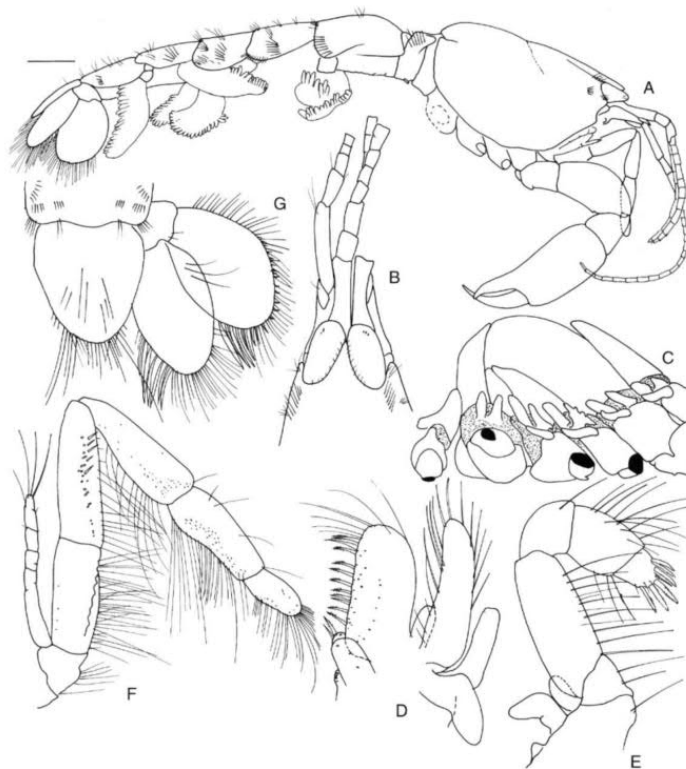


FIG. 20. — *Michelea microphylla* n.sp. A, habitus; B, anterior cephalothorax; C, right side of thorax (carapace removed) to show coxae of maxilliped 3 and pereopods 1-5, epipods and arthrobranchs; D, maxilliped 1; E, maxilliped 2; F, maxilliped 3; G, abdominal somite 6, telson and uropod. All figures from holotype.

Drawings of *Michelea microphylla* from Poore 1997

"Threatened ghost shrimp survey

Lower North Arm Western Port." CEE Report to AECOM.

CEE Pty Ltd (cee.com.au) December 2019. Authors: S Chidgey and P Crockett

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CEE Technical Report

Threatened ghost shrimp survey

Lower North Arm, Western Port 2019

1 Survey Context

AGL Wholesale Gas Limited (AGL) and APA Transmission Pty Limited (APA) propose to establish a gas import facility consisting of a floating storage and regasification unit (FSRU) at Crib Point Jetty and a gas pipeline between Crib Point and Pakenham to connect to the Victorian Transmission System (VTS) east of Pakenham. The regasification process would involve the use of ambient seawater from Lower North Arm of Western Port to heat the cold liquid gas stored on the FSRU and discharge cooled, chlorinated seawater to the waters of Western Port, which has the potential to affect marine biota.

The Project was referred by AGL and APA to the Victorian Government under the *Environment Effects Act 1978* (EE Act) as two separate projects consisting of the Gas Import Jetty Works and Pipeline Works on 13 September 2018. On 8 October 2018, the Minister for Planning issued a decision determining that an Environment Effects Statement (EES) is required for the full Project due to the potential for a range of significant environmental effects.

2 Need for the study

Potential marine environmental impact pathways of project were reviewed during the referral stage of the project. The referral documents informed the Minister's Scoping requirements for the Gas Import Jetty and Pipeline Project Environmental Effects Statement (EES).

The referral document identified two species listed as threatened on the Flora and Fauna Guarantee Act (FFGA) that may occur in the Crib Point area:

- *Michalea microphylla*: small burrowing shrimp, but only ever found once previously. In 1965 it was collected in one grab sample at 19 m water depth in sand/gravel near Crib Point (O'Hara and Barmby 2000).
- *Pseudocalliax tooradin* (Variously known as *Callianassa tooradin* 1979, *Calliax tooradin* Sakai 1988, *Paraglypturus tooradin* Turkey and Sakai 1995, *Eucalliax tooradin* O'Hara and Barmby 2000 and now *Pseudocalliax tooradin* Sakai 2011): a small burrowing shrimp that is more likely to be found in amongst seagrass in shallower water;

Michelea microphylla was the only listed threatened marine species that possibly occurred in the potential marine impact pathways associated with the discharge of cooler, chlorinated heat exchange seawater. Other species are known from locations remote from the identified impact pathways. The FFGA listed ghost shrimp *Pseudocalliax tooradin* commonly occurs in Western Port and elsewhere (Poore 2019) in shallower water (<10m) than was estimated to be affected by the heat exchange discharge (>10m).

Sampling of the seabed in the area of Crib Point Jetty and other sites in central lower North Arm was planned to determine the present local status of *Michelea microphylla* populations and to inform the assessment risk to the species in the EES.

3 *Michelea microphylla*

3.1 History

The FFGA threatened species *Michelea microphylla* is a very small ghost shrimp (Family Callianassidae). It is known from one individual collected in a sediment grab sample from sand/gravel near Crib Point in 1965.

The individual now known as *Michelia microphylla* was originally collected during the Fisheries and Wildlife Department Crib Point Benthic Survey between 1964 and 1970. The Marine Pollution Studies Group sampled approximately 75 sites over that period and collected and analysed more than 300 sediment samples using a Smith McIntyre grab (Poore 2019). One individual was recognised during sorting of the samples from the study as distinct from known species of ghost shrimp at the time and was catalogued from the collection as an unknown ghost shrimp.

The position of the sample was recorded as 38°19.92'S 145°13.95'E, which corresponds to a distance approximately 2 km north northeast of Crib Point Jetty. The position-fixing in 1965 (radar range from landmarks and plotting on paper chart), would provide a positional accuracy of about 20 m. The 19 m water depth of the sample may have been recorded without reference to tide. The position corresponds to a depth of 16 m relative to Chart Datum (lowest tide) on present-day electronic charts.

The individual was catalogued and stored at the Museums of Victoria (possibly Family Callianassidae at that time) until it was assessed as a new species of ghost shrimp *Michelea microphylla* in the Family Micheleidae during a review of certain ghost shrimp Families in 1997 (Poore 1997). The numerous particular features that separate genera and species of ghost shrimps were sufficiently distinct in the individual examined to separate it from other ghost shrimp families, genera and species and for the individual to be named as a new species *Michelea microphylla*. The original species description continues to validate the identification of this individual as a distinct species (see Sections 3.4 and 6 for further discussion).

3.2 Listing as Threatened in Victoria's Flora and Fauna Guarantee Act

Michelea microphylla was recommended for nomination to be listed as a 'threatened' under Victoria's Flora and Fauna Guarantee Act (1988) in 2000. Justification for the listing by O'Hara and Barmby (2000) was given as:

"Taxonomically distinct. Rare, apparently endemic to Western Port. Only known from one specimen. Most of the 12 known Michelea species are known from relatively few specimens. Burrowing habit may make collection difficult, however, M. microphylla is likely to be rare given the intensity of collection over the past 40 years in Western Port and Port Phillip Bay. Crib Point habitat recorded as sand/gravel. Potential threats possibly include industrial and port development around Crib Point and poor water quality in Western Port. IUCN category: Vulnerable, criteria D2 (global area of occupancy < 100 km², known from less than 5 locations)."

A total of 12 invertebrate marine species were recommended for nomination at that time (O'Hara and Barmby 2000). The species including *Michelea microphylla* were subsequently listed under the provisions of Part 3 of the FFG Act by the Victorian Department of Sustainability and Environment (2009).

3.3 Distribution and habitat

Michelea microphylla is a small ghost shrimp in the family and Infraorder Axiidae. They are related to the larger “Bass yabby” or “ghost nipper” *Trypaea australiensis* (also Infraorder Axiidae). *T. australiensis* is commonly used for bait and is collected by anglers using ‘bait pumps’ in muddy intertidal areas where it may be abundant. In contrast, the much smaller FFG Act listed species *Michelea microphylla* was found in a water depth of about 18 m using a Smith-MacIntyre grab and has not been found anywhere since.

It has been assumed that *Michelea microphylla* lives in burrows in sandy/gravelly seabed habitat in approximately 18 m water depth – a habitat that is widespread in Western Port and at similar depths throughout Bass Strait and South Eastern Australia (O'Hara and Poore 2000, Poore 2019).

3.4 Taxonomy

Ghost shrimps belong to the Infraorder Axiidae of crustaceans, which are commonly known as ghost shrimps, mud shrimps, or burrowing shrimps. There are six families of axiid shrimps (Table 3-1) and hundreds of species. *M. microphylla* belongs to the Genus *Michelea*, within the Family Micheleidae of the Infraorder Axiidae.

Table 3-1. *Michelea microphylla* taxonomy

Taxon	Name
Phylum	Arthropoda
Subphylum	Crustacea
Class	Malacostraca
Subclass	Eumalacostraca
Superorder	Eucarida
Order	Decapoda
Suborder	Pleocyemata
Infraorder	Axiidea (Ghost, Mud or Burrowing shrimps)
Family*	Micheleidae
Genus	<i>Michelea</i>
Species	<i>microphylla</i> <i>Michelea microphylla</i>
Family*	Eucalliidae
Genus	<i>Pseudocalliax</i>
Species	<i>tooradin</i> <i>Pseudocalliax tooradin</i>
Family*	Callianassidae
Genus	<i>Trypaea</i>
Species	<i>australiensis</i> <i>Trypaea australiensis</i>

* There are six families in the Infraorder Axiidae, many genera and hundreds of species.

The three colour coded species listed here are examples that are mentioned in this report

There are fifteen species in the genus *Michelea*. Most of the *Michelea* species are:

“from tropical waters, most from shallow water a few metres deep. Species descriptions are generally based on one, rarely 2–6 specimens. One species, *M. leura* (Poore & Griffin, 1979), has been reported twice in northern Australia since its first discovery, *Michelea vandoverae* (Gore, 1987) once since in the Gulf of Mexico, and the others never.” (Poore 2019)

While only one individual of *Michelea microphylla* has ever been found, the numbers of records of the Western Port ghost shrimp *Pseudocalliax tooradin* are increasing as sampling in suitable habitat in Victoria spreads (Poore 2019). Although *P. tooradin* is a ghost shrimp it belongs to a different genus and family from *Michelea microphylla* (Table 3-1).

The Australian ghost shrimp *Trypaea australiensis* has a variety of common names including, locally, the Bass yabby. It is common in Western Port and is abundant from southern Queensland to eastern Victoria on intertidal sandflats and mudflats. It is frequently collected for bait by fishers using a 'bait pump' on the intertidal mud and sand flats and was collected subtidally during this investigation (Figure 8). Although it is a ghost shrimp it belongs to a different genus and family from *Michelea microphylla* (Table 3-1).

4 Sampling plan and design

The collection of only one individual of *Michelea microphylla* since 1965 indicates that they are exceptionally sparsely distributed and may be out of reach of the sampling devices commonly used by scientists to collect small invertebrates in subtidal habitats. Grab samplers (Smith MacIntyre and Ponar grabs) generally collect samples to 100 mm sediment depth, which is sufficient to collect most burrowing invertebrates but may not reach ghost shrimps in deeper burrows.

Burrowing shrimps can create burrows that are deeper than 120 mm (Butler et al 2007, Butler and Bird 2009) and require collection by pushing a tube to depths of 250 mm to 400 mm (or more) into the sediments and extracting a sample under vacuum – such as the commercially available 'yabby pumps' used by recreational fishers to burrowing invertebrates for bait and by scientists working on mudflats. Numerous small samples can be collected quickly and efficiently over an area of seabed to maximise the likelihood of collecting burrowing shrimps in intertidal habitats many species occur.

4.1 Sampling method

Scientist-divers sampled sediments in Lower North Arm of western Port for ghost shrimp using a water-lift device that is often used to sample subtidal sediments for burrowing invertebrates including worms, clams and crustaceans such as burrowing shrimps (Figure 4-1). The sampler comprises a pipe that is open at one end and is fitted with a mesh bag at the other end. Seawater (or air) is pumped through the pipe via a hose from a pump operating on the survey vessel. The passage of the water through the pipe creates venturi suction at the open end and draws sediments and biota into the pipe as it is slowly pushed into the seabed.

A mesh bag is fitted to the other end of the pipe. The water and fine sediments pass through the mesh bag, but objects and biota less than 1 mm are retained in the bag. This method is used widely for collecting infauna samples in sediments with high shell content or where biota burrow deeper into sediments or in seagrass and around cobbles and rocks.

The 75 mm diameter pipe was pushed up to 300 mm into the sediments at each site sampled. This process was repeated at 20 to 30 positions at each site, depending on the amount of material that accumulated in the mesh bag. Hence, the accumulated material in the bag represents a composite of numerous smaller cores. The composite sample in the mesh bag at each site was returned to the surface where it was transferred to a sorting tray.

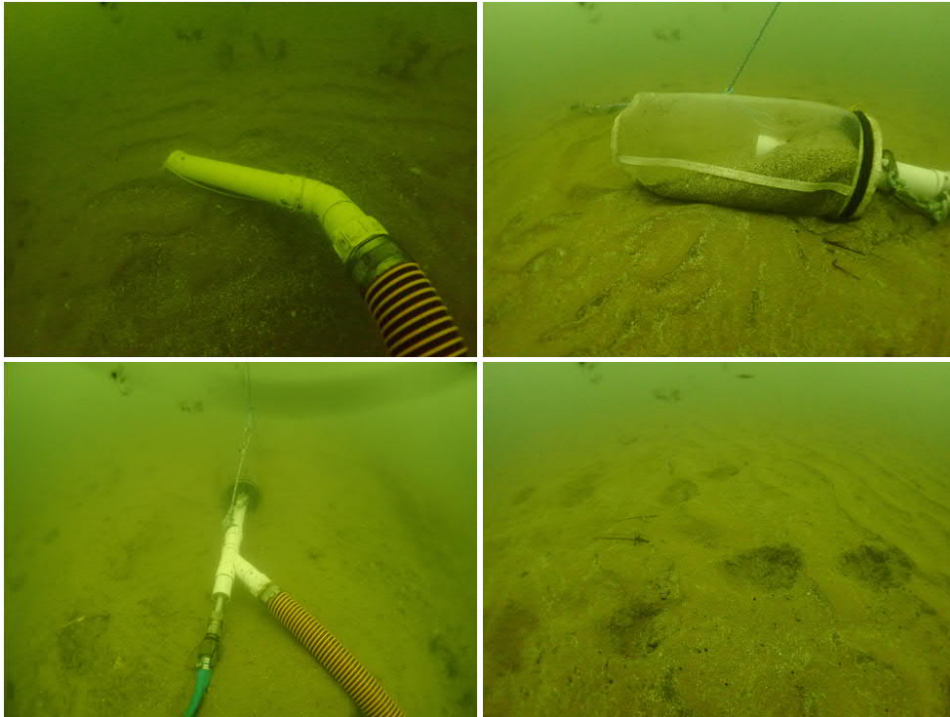


Figure 4-1. Diver operated suction sampler for subtidal ghost shrimps in Western Port

4.2 Sample sorting

The high proportion of shell in the seabed at many sites resulted in relatively large quantities of material retained in the mesh bag that required further rinsing and sieving to detect small biota such as ghost shrimps by a specialist taxonomist familiar with the species (Figure 4-2, Dr G Poore, Museums of Victoria).



Figure 4-2. Sample sorting for ghost shrimp onboard vessel

4.3 Sample sites and dates

The sites sampled, dates samples and position of the sites sampled are listed in Table 4-1. The locations of the sites are shown in Figure 4-3.

Table 4-1. Survey dates and site coordinates

Site	Date	East	Northing	Latitude	Longitude
Mm Berth 2a	13 Jul 2018	345099	5753516	S38.35313	E145.22723
Mm Berth 2b	13 Jul 2018	345075	5753446	S38.35376	E145.22694
Mm Berth 2c	13 Jul 2018	345102	5753340	S38.35472	E145.22723
Mm Berth 2d	13 Jul 2018	345149	5753246	S38.35557	E145.22775
Mm found 1965	25 Sep 2019	345513	5755822	S38.33243	E145.23247
Mm N1	25 Sep 2019	345069	5754478	S38.34446	E145.22709
Mm N2	13 Jul 2018	344809	5755365	S38.33642	E145.22432
Mm N3	04 Oct 2019	344982	5756157	S38.32932	E145.22648
Mm NE	04 Oct 2019	346061	5755833	S38.33242	E145.23875
Mm NW1	13 Jul 2018	344676	5754289	S38.34610	E145.22256
Mm W10m	25 Sep 2019	344717	5753590	S38.35240	E145.22288
Mm E	25 Sep 2019	346317	5753885	S38.35001	E145.24125
Mm NE	25 Sep 2019	346317	5753885	S38.35001	E145.24125
Mm S1	25 Sep 2019	345220	5753036	S38.35748	E145.22851
Mm S2	04 Oct 2019	345552	5752246	S38.36465	E145.23213

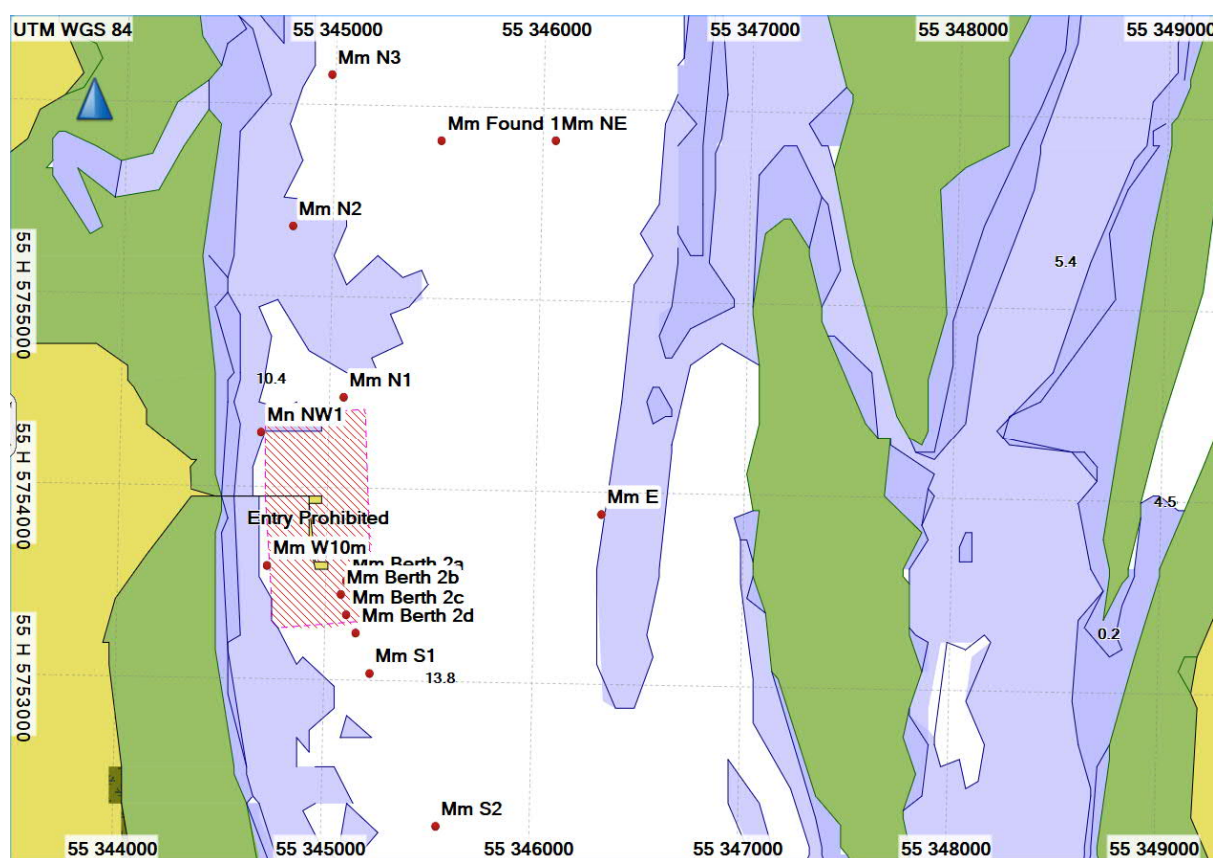


Figure 4-3. Location of sites sampled for *Michelea microphylla*

Sampling sites were arranged to include:

- Sites at Berth 2 (four sites surveyed for VRCA in July 2018)
- The position where *Michelea microphylla* was originally collected and sites adjacent to that position (Surveyed for CPGIJP Sep 2019)
- Information from prior towed video surveys was used to select sites with predominantly soft seabed along the potential dispersion pathway from Berth 2 and at other reference sites.

Tidal currents in North Arm of Western Port restrict diving to periods of slack water (low tidal currents) that occur around high and low tides. Sampling by diver in the main channel is possible for a period of approximately 45 to 90 minutes either side of high or low tide, depending on the tidal range on the day. Sampling at a total of 14 sites was achieved on three separate days.

4.4 Permits

Permits for collection of threatened species were obtained from the Department of Environment, Land, Water and Planning and the Victorian Fisheries Authority.

5 Outcomes sampling

No FFGA listed ghost shrimps *Michelea microphylla* or *Pseudocalliax tooradin* were collected from any site, including the site where the only individual of *Michelea microphylla* was previous collected in 1965.

The nature of the seabed at all sites comprised sand, shellgrit and empty shell with a small proportion of fine material. The proportion of coarser material (shell and shellgrit) and surface features of the seabed varied across the range of sites, except for the four Berth 2 sites, which were relatively similar to each other in character.



Figure 5-1. Sieved subtidal sediment sample from Lower North Arm

5.1 Berth 2 sites

The seabed at the Berth 2 sites was similar flat, compacted sediment with shell and shellgrit across the surface. The sediments below the surface comprised a high proportion of large shell pieces. The unconsolidated shellgrit and fine material was underlain by stiff grey clay that was less than 150 m from the seabed surface at most points sampled. The area was dredged during the construction of the jetty in about 1965. No threatened species of ghost shrimp were found at any of the Berth 2 sites. Another species of ghost shrimp, *Biffarius limosus* (Family Callianassidae), was found at Sites a and b at Berth 2, and two reference sites north of the jetty. *Biffarius limosus* is widespread and common in the deeper waters of Port Phillip Bay and is known also from muddy sediments to 100 m depth in NSW and Tasmania. One specimen of *Leonardaxius werribee* - a related group of small 'mud lobsters' (Family Axiidae) - was also collected. This species is widespread in muddy sediments from Victoria and Tasmania at 10 to 25 m water depth.



Figure 2. Range of seabed types sampled at Berth 2 (images from towed video)

5.2 Site where *Michelea microphylla* was previously found

The site where *Michelea microphylla* was previously found is located near the main North Arm shipping channel. The water depth was 18 m. The seabed comprised medium sand and shell with sand waves of various size.

No *Michelea microphylla* were present in the sample, but other common ghost shrimps (*Typaea australiensis*) were present.

The large erect tubes of tube worms, probably the genus *Eunice* (R Wilson Museums of Victoria, *pers comm*), were common across the seabed with cunjevoi also present. A slipper lobster or Balmain Bug *Ibacus peronii* was also observed at this site (Figure 4-3).

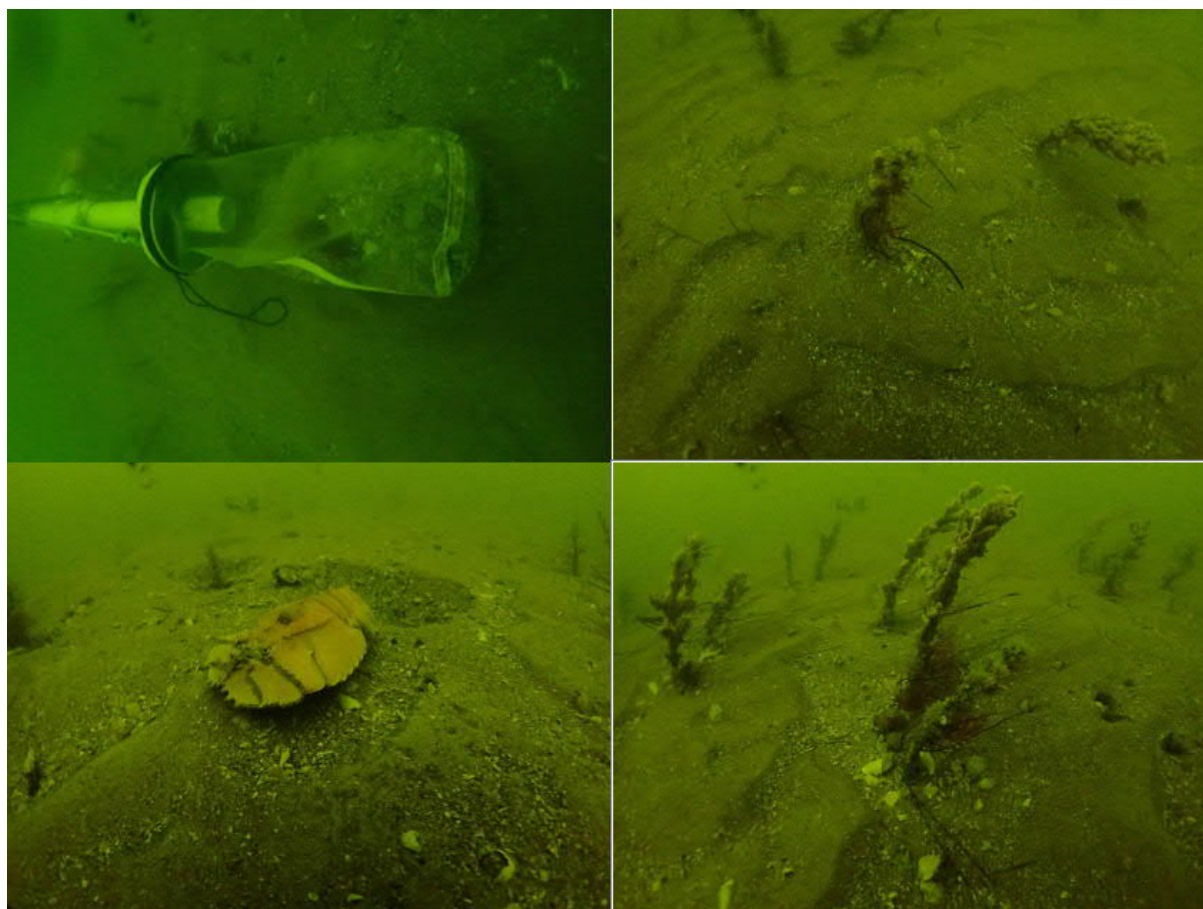


Figure 5-3. Seabed features in 2019 where *M microphylla* was collected in 1965

5.3 Other sites

The seabed surface features and sediment composition at the remaining sites varied substantially visually from site to site and even within individual sites (Figure 4).

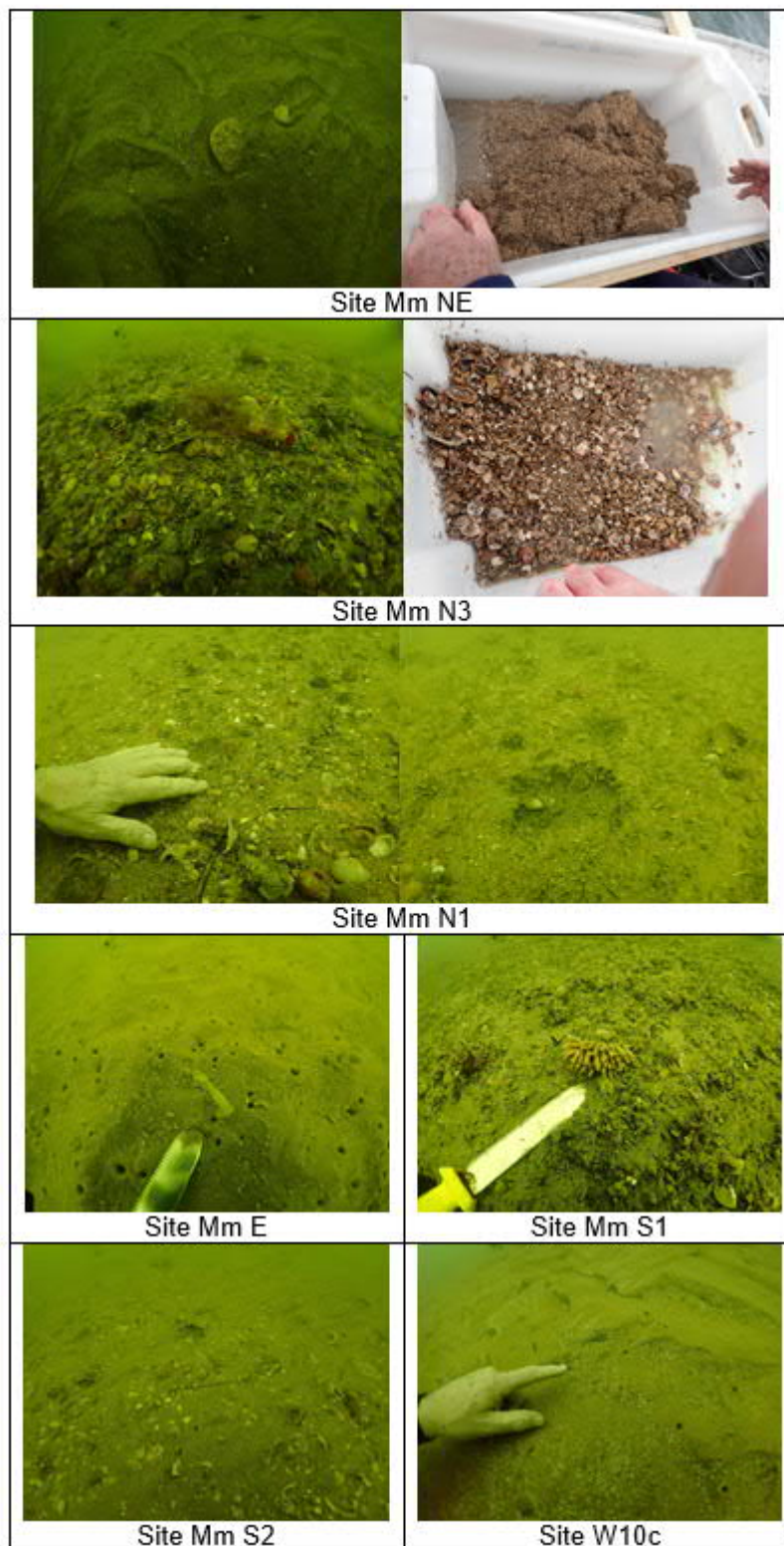


Figure 4. Seabed at Ghost Shrimp sampling sites
(Diver photos)

Large numbers of the common ghost shrimp *Typaea australiensis* were found at sites characterised by smooth to undulating sand with visible burrow openings (Sites Mm W10, MmE) and relatively little shell in sediment (Figure 8).



Figure 8. The Bass Yabbie, *Typaea australiensis*, was common on seabed smooth sandy seabed marked with burrow entrances

6 Rareness of marine species

Many species of invertebrate are collected in very low numbers or only on rare occasions by scientists using standard sampling equipment that sample a limited number of invertebrate habitats. Depending on the context, they may be considered sparse, scarce or rare. Targeted surveys by researchers may provide greater insight to the extent of a rare species if the habitat characteristics are identified and if the species has particular interest. If a particular species is sparsely distributed over a large area or depth range or habitat or any combination of these factors that is infrequently sampled, then that species will remain rare.

Large commercial species, such as prawns or lobsters, have very specific habitats and distributions that are well-known from hundreds of years of exploitation. Their behaviour is well known and techniques to collect individual species have been and continue to be refined. Collection is aided by fast vessels equipped with increasing levels of technology to efficiently catch quantities of a particular species. In some areas even these species may but may be described as sparse or scarce at times (seasons or years). As conditions for those species change (overfishing or habitat change), commercial species may become scarce or populations listed as threatened. The commercial fish species, Southern Bluefin tuna is listed on the FFGA list of threatened species, but it is still caught recreationally in Victoria.

The collection of only one individual of *Michelea microphylla*, ever, results in this species to be considered as 'rare' (O'Hara and Barmby 2000) or 'rarest' (Poore 2019). However, it is not unusual for species to be rare. Rare species are those that aren't often seen or caught by commercial methods or collected during scientific surveys. Most species of rare invertebrate are rare due to the small size and number of samples collected relative to the area that a species may occupy and the limited number of habitats that are sampled by the techniques commonly available to scientists.

It is common for most of the species collected during an infaunal sampling program to be represented by a single or small number of individuals from tens or even hundreds of samples (Poore 2019, Poore et al 2014). Some populations of certain rare species may actually be small. Hence, O'Hara and Barmby's (2000) listing of *Michelea microphylla* as rare (Section 3.2) is appropriate as a reminder to consider the range of common to rare species as indicators of the condition of the marine ecosystem in an impact assessment study.

7 Conclusions to investigation

This targeted survey of deeper, bare sediment seabed habitat in Lower North Arm comprising mixed habitats of medium to coarse sand and areas with substantial quantities of shell found no individuals of either FFGA listed ghost shrimp species *Michelea microphylla* and *Pseudocalliax tooradin*. The survey did collect ghost shrimps from three more common species (*Biffarius limosos*, *Leonardaxius werribee* and *Trypaea australiensis*), which indicates the methods were appropriate for collecting subtidal ghost shrimps with burrowing habits in general.

- *Pseudocalliax tooradin* populations are associated with seagrass habitats in shallower water (<10 m deep) in Western Port and Port Phillip, so it is not surprising it was not found in this survey of deeper bare sediments.
- *Michelea microphylla* has only been recorded once, ever, in spite of the intensity of previous sampling in Western Port and Port Phillip including targeted sampling in Lower North Arm in this program. While it is considered rare, it is likely that individuals in Western Port are part of a population or populations that are distributed at similar depth (≥ 20 m) and habitats as Lower North Arm that are found elsewhere in Southeastern Australian coastal waters (Poore 2019).

The outcomes of this investigation inform the effects or risk assessment component of the AGL Gas Import Jetty Project EES.

8 References

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9 Acknowledgement

The authors thank Dr G C B Poore of Museums Victoria for assisting with identifications directly in the field, for his thoughtful report and his advice during field work and subsequent discussions.

Appendix : “Looking for Michelea” G C B Poore 2019

Looking for *Michelea microphylla*

Report to Consulting Environmental Engineers, Unit 4, 150 Chesterville Road, Cheltenham,
Vic., 3192

By

Gary C. B. Poore, Curator Emeritus, Museums Victoria, Melbourne

7 October 2019

The ghost shrimp, *Michelea microphylla* Poore, 1997, is a decapod crustacean belonging to the family Callinidae. Callinids are related to callinassoid ghost shrimps, a more abundant and diverse group, and are assumed to have similar ecology. Callinassoids are burrowers in soft sandy and muddy sediments and it is assumed that *Michelea* is too, although it is possible that it lives cryptically near the sediment surface.

Between 1964 and 1970 the Crib Point Benthic Survey (CPBS), undertaken off Crib Point, Western Port, had three phases: a preliminary survey, an intensive sampling effort, and seasonal sampling of a limited number of stations (Poore, 1986). The sampling was undertaken by the Marine Pollution Studies Group (Fisheries and Wildlife Department). During the preliminary survey 20 stations near Crib Point were sampled once with a single grab sample between July and October 1964. During the period of intensive sampling 51 stations were occupied. Five grab samples were taken at each station. Between late 1963 and 1970 five stations were sampled at irregular intervals to investigate seasonal changes – 53 samples in all.

Michelea microphylla was described from a single 13-mm long individual collected by grab sampler during the CPBS at station 52N (38°19.92'S, 145°3.95'E), on sand-gravel sediments at 19 m depth.

O'Hara and Barmby (2000) recommended that the species be nominated for listing as 'threatened' under Victoria's FFG Act. Details for this reasoning were as follows:

“Taxonomically distinct. Rare, apparently endemic to Western Port. Only known from one specimen. Most of the 12 known *Michelea* species are known from relatively few specimens. Burrowing habit may make collection difficult, however, *M. microphylla* is likely to be rare given the intensity of collection over the past 40 years in Western Port and Port Phillip Bay. Crib Point habitat recorded as sand/gravel. Potential threats possibly include industrial and port development around Crib Point and poor water quality in Western Port. IUCN category:

Vulnerable, criteria D2 (global area of occupancy $< 100 \text{ km}^2$, known from less than 5 locations)."

The species was listed under the provisions of Part 3 of the Flora and Fauna Guarantee Act 1988 by the Victorian Department of Sustainability and Environment (2009).

Despite several attempts to collect this species in this area it has not be rediscovered. This report addresses the apparent rarity of this species.

Rarity of marine invertebrates in general

Most species of marine invertebrates are rare. It is a simple fact of sampling demonstrated time and again (Poore et al., 2014). This phenomenon can be shown in Western Port, one of most intensively sampled areas anywhere for marine benthic invertebrates. Amphipods are smaller and more abundant crustaceans than ghost shrimps and good data exist for several families. Phoxocephalidae are one of the best studied and richest families in Australia. Barnard and Drummond (1978) described numerous species from southern Australia, discovering 49 species of Phoxocephalidae at the CPBS stations. All were described as new species of which four (8%) were found at only one CPBS station, and six (12%) at two or three stations. Most of the remainder were confined to Western Port and/or Port Phillip Bay.

Rarity such as this has been quantified in intensive surveys over compact areas of the shelf and deep sea elsewhere (Gray et al., 1997). An extensive study of invertebrates off the WA coast found three-quarters of 805 species to occur in just one of 135 samples, a result that might be expected over such a wide area (Poore et al., 2014). Even well known and relatively easily collected larger animals like decapod crustaceans show the same phenomenon (Poore et al., 2008). Forty percent of 191 species of decapods collected in the Great Australian Bight were represented by a single specimen (Farrelly and Ahyong, 2019).

It is not unexpected, therefore, that *Michelea microphylla*, one of the hundreds of species collected in Western Port appears to be rare, as are many others.

Rarity of ghost shrimps

A few species of ghost shrimps, particularly of the families Callichiridae and Callianassidae, are extremely abundant on intertidal marine and estuarine beaches throughout the world. In Australia, *Trypaea australiensis* Dana, 1852, is abundant from southern Qld to eastern Vic. on intertidal sandflats and mudflats and is often estuarine. It is the target of bait fishers using a yabby pump.

Ghost shrimps of the genus *Michelea*, on the other hand, are always rare. Fifteen species are known, most from tropical waters, most from shallow water a few metres deep. Species descriptions are generally based on one, rarely 2–6 specimens. One species, *M. leura* (Poore & Griffin, 1979), has been reported twice in northern Australia since its first discovery, *Michelea vandoverae* (Gore, 1987) once since in the Gulf of Mexico, and the others never.

Species of *Michelea*, on this evidence, could be assumed to be generally rare.

Rarity of this species

Of a total of 225 grab samples in the area taken between 1964 and 1970, *Michelea microphylla* was found in only one sample (stn CPBS 52N). Nor was the species taken at any of the 150 grab samples taken during the 1973–1974 Westernport Environmental Study. Some WPES samples were close to Crib Point or on similar sediments. The species was not caught during a survey in eastern Bass Strait (Coleman et al., 1997). We have not been able to find specimens of this species during targeted diving sampling in 2018 and 2019. However, the sand-gravel habitat at Crib Point near the entrance to Western Port does occur at similar depths throughout Bass Strait and the species could exist outside the entrance.

Michelea microphylla can be considered the rarest of all ghost shrimps in Victoria. *Pseudocalliax tooradin* (Poore & Griffin, 1979) was also described from specimens taken at Crib Point but has since been captured elsewhere in Western Port and Port Phillip Bay. It too was listed as vulnerable by O'Hara and Barmby (2000). Others species are more common in Western Port (Coleman and Poore, 1980), such as *Trypaea australiensis* mentioned above. *Arenallianassa arenosa* (Poore, 1975) occurs commonly from southern Qld to Tas., in intertidal to shallow subtidal sandflats, often estuarine. *Filhollianassa ceramica* (Fulton & Grant, 1906) occurs commonly from Tas. to southern WA in intertidal and shallow subtidal mudflats and sandy beaches. *Biffarius limosus* (Poore, 1975) is extremely abundant from NSW to Tas. on subtidal muddy sediments to 100 m depth and is the only species recorded in deep water in Bass Strait.

Conclusion

Michelea microphylla is a “short-range endemic” using the criteria of O'Hara (2002). The species occupies a small area and is probably highly habitat-specific as are other ghost shrimps. *Michelea microphylla* is not alone in this – many species, including many in the Crib Point area, meet the same criteria on the basis of existing evidence.

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