UNCOMMON and CRYPTIC REEF FISHES: RESULTS OF PILOT SURVEYS ALONG FLEURIEU PENINSULA

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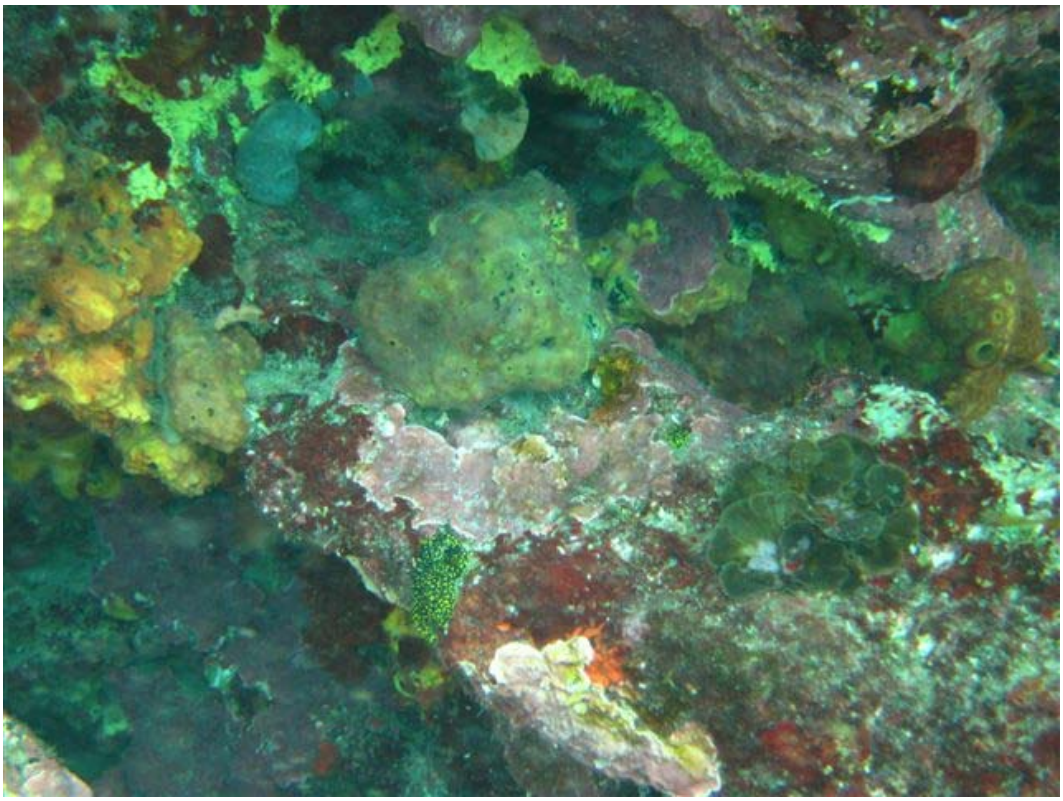

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SUMMARY

Reef locations along the Fleurieu Peninsula were surveyed by diving and snorkelling, from December 2007 to May 2008. During the surveys, we aimed to develop suitable non-destructive techniques to search for various uncommon reef fishes (mostly benthic, and many cryptic). Our target list comprised approximately 50 species from 13 families, for which little information is available on full distribution within South Australia, and habitat. Examples of significant finds during the pilot period included some species in the Syngnathidae (most notable being a range extension and more habitat information for Verco's Pipefish) and Clinidae (some of the uncommonly recorded weedfishes), and several other uncommon reef fishes were recorded by our associates during the survey period. We also utilised the field survey opportunities to collect additional data using standard techniques, such as relative abundance counts for more common reef fishes (to be written up in a separate, statewide report), and fish species lists for several jetties (supplemented by previous validated data from divers and fish experts). We also took approximately 650 photographs of reef fishes, marine invertebrates, and benthic habitats along the Fleurieu Peninsula, many of which can contribute to a marine image database for the Adelaide and Mt Lofty Ranges NRM board.

To date, the surveys from December 2007 to May 2008 have indicated that visual and manual searching through the benthos on SCUBA is the most successful non-destructive method of finding the majority of the small uncommonly-recorded reef fishes that were the targets for this project. Some of these species are crevice dwellers (e.g. the reef pipefishes, and the cardinalfishes); others utilise the cover provided by dense macroalgae (e.g. weedfishes) and detritus (snake-blennies), and some (e.g. anglerfishes) are well camouflaged against various bottom surface covers, such as rocks and rubble, low sponge and ascidian cover, shell rubble, and jetty debris. Slightly different search techniques are required for each group, and over the course of the pilot surveys, knowledge of suitable search strategies developed and improved.

The small number of uncommon fishes observed over more than 30 searches (collectively on SCUBA and snorkel) indicates that further searching is required over time and space to better understand the distribution, relative abundance and habitat of many uncommon reef fishes in South Australia, particularly in areas away from the more easily accessible dive sites in the southern gulfs. The techniques learned and the data gathered during this pilot project, will provide useful background for further searches (e.g. in more remote coastal areas, and on offshore reefs), to help improve knowledge of the distribution, habitat, and conservation requirements of uncommon reef fishes in South Australia.

INTRODUCTION

A number of uncommon, often cryptic reef fishes of potential conservation concern in South Australia include the following:

- some members of the Clinidae (weedfishes) and Ophiclinidae / Ophiclininae (eel-blennies and snake-blennies)
- Apogonidae (cardinalfishes)
- Syngnathidae (e.g. several reef species of pipefish)
- Antennariidae (anglerfishes)
- Aracanidae (temperate boxfishes)
- Pataecidae (prowfishes)
- Aploactinidae (velvetfishes)
- Gobiesocidae (clingfishes) and
- Bythitidae (blindfishes)

A number of larger reef fishes that are also uncommon in South Australia include the Red Velvetfish (single member of the Gnathanacanthidae), the White-nosed Pigfish (single member of Congiopodidae in S.A., and for which for which Gulf St Vincent is the type locality), and several of the less common wrasses (Labridae) and leatherjackets (Monacanthidae). For a number of currently known species in such groups, a detailed, comprehensive search for information, using several thousand sources over a six year period, has shown that

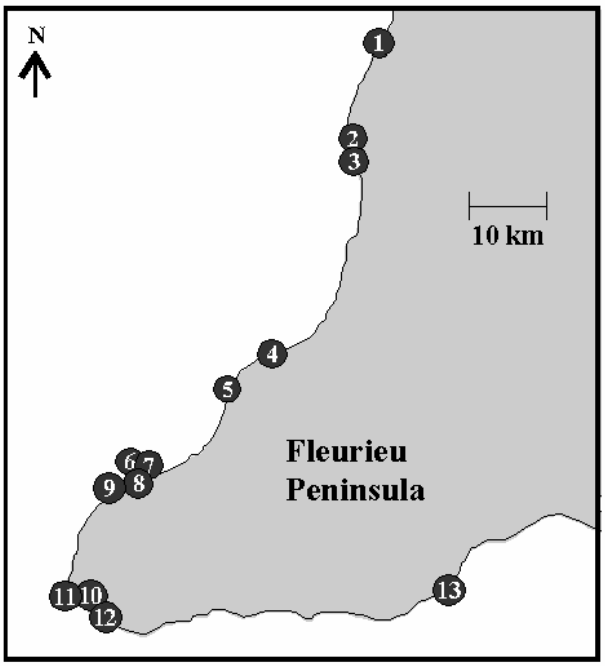
there are there are few existing records in South Australia, and very little is known of the distribution within S.A., habitat requirements, biology, behaviour and ecology (Baker, 2008).

Many of these species could potentially be at risk of localised population decline, due to a combination of factors such as limited geographic range; existence over a narrow depth range; benthic or bentho-pelagic existence and strong habitat association (which makes them susceptible to various threatening processes); localised, benthic reproduction and limited dispersal, and naturally low abundance. A number of nearshore reef fishes also have a limited known presence in S.A., which is at the edge of the geographic range.

The project aims to help improve knowledge of the distribution and habitat of uncommonly recorded (including possibly rare) and often cryptic reef fishes, thereby assisting in the determining the conservation needs of these species. A number of the uncommon reef fishes, particularly those of limited known geographic range, or very narrow depth range, might qualify for protection and listing as "Rare" or possibly "Vulnerable" species, under State legislation, but targeted surveys and analysis of data are required, prior to adequate conservation assessments being made.

With the support of a Wildlife Conservation Fund (DEH) grant in the 2006-07 round, a pilot survey was conducted along the Fleurieu in April 2007, to establish and refine techniques, and during 2007 and early 2008 surveys were also undertaken in other parts of South Australia (Baker et al. 2008). Given the paucity of information about these fishes, in this project we attempted to devise a suitable, non-destructive technique for finding and recording uncommon reef fishes, particularly the small, well camouflaged / cryptic species. We also aimed to learn more about the distribution and habitat of these species, through dive and snorkel searches at various sites along southern Fleurieu Peninsula (**Map 1**). The surveys described here, undertaken at various sites along the Fleurieu Peninsula, also support previous desk-top investigations on the *Marine and Estuarine Fishes of Conservation Concern in the AMLR NRM Region* (Baker, 2007), and further field investigation of these fishes was recommended in the AMLR NRMB *State of the Region Technical Report*.

It is hoped that the techniques learned and the data gathered during this pilot project, will provide useful background for further searches in less accessible and more remote parts of the South Australian coast, from the Victorian border to far western South Australia.



Map 1: Maps showing sites surveyed along southern Fleurieu Peninsula, December 2007 – May 2008

METHODS

The location of sites surveyed is shown in Figure 1. Dates of field surveys were as follows: (i): 7th – 10th December 2007 (lower Fleurieu Peninsula); (ii) 17th - 19th April 2008 (lower Fleurieu and Encounter Bay) and (iii) 24th – 25th May 2008 (lower Fleurieu). Approximately 12 SCUBA dives and 10 snorkel dives were undertaken during the 6 month period, including 6 single SCUBA dives outside of the main survey periods. Sites for single dives included Carrickalinga (30th December 2007 and 29th January 2008); Rapid Bay (10th February 2008), Port Noarlunga (5th March 2008), and Encounter Bay (20th April and 5th May 2008). Snorkel surveys outside of the main survey periods were undertaken at Cooalinga (February 2007); Rapid Bay (11th December 2007), and Kingston Park – Marino (1st January 2008).

During the main field trips, 2 to 4 divers per site searched for uncommon fishes amongst macroalgae, and also on reef surfaces, under ledges and in crevices, following approximate north-south or east-west lines across reefs at the chosen sites. Concurrently with the searches for uncommon and cryptic fishes, other surveys undertaken during these periods entailed the visual census technique in which divers or snorkellers swim in a given direction, recording the number and size of fishes within a 5 m swathe over a distance of 100 m. The first three authors are all well experienced in the method, and have been trained in estimating fish sizes correctly. Experience with a 100 m line have shown that this takes approximately 10 min swimming time, at the speed at which we normally record number and size of common reef fishes. Therefore, as part of this study, we used 10 min swims as an estimate of a 100 m transect. At each site we used a minimum of 4 replicates, and **Appendix 1** of this report provides example data for groups of 4 replicate 100 m swims, with an estimated total coverage of 2000 m^2.

During the early phase of this project, we also used hand nets of various sizes and meshes, and trialled several techniques, including (i) scooping and sweeping the nets through low macroalgae in the shallow subtidal; (ii) towing larger hand nets behind us whilst swimming through macroalgae on SCUBA, and (iii) scooping and sweeping large nets over subtidal macroalgae, whilst on SCUBA.

At each site, habitat substratum characteristics were noted, major algal canopy species recorded, and an index of exposure estimated subjectively according to the dominant macroalgae canopy species present (see Shepherd & Brook 2007). We estimated rocky bottom relief, according to the average elevation of the reef above the surrounding bottom under the transects.

RESULTS AND DISCUSSION

Techniques

Of the non-destructive techniques discussed in the **Methods** section above, we found that the most effective method of finding uncommon benthic fishes was quiet, patient searching on SCUBA near the bottom. This included searches under ledges, in crevices, and under and in macroalgae (using hands to part the plants). Netting was largely unsuccessful, because the current created by the moving nets (either by standing in the shallows and sweeping; or towing or scooping whilst on SCUBA) served to drive fishes away from the net, rather than catch them. Other issues included dislodgement of macroalgae, which clogged the nets, and entanglement of nets in macroalgae when nets were towed by hand.

Habitats

For the majority of sites visited during the survey period, the type of rocky bottom substrate and the dominant algal canopy species are given in Table 1 below. Other details of sites (relief, visibility, exposure index, canopy cover) and numbers and species of fish encountered (numbers 2000 m^2) are given in Appendix 1.

Table 1. Bottom topography and algal dominants at 12sites, surveyed from December 2007 to May 2008.

Site	Substratum	Main cover / algal canopy species
1. Kingston Park – Marino	Kingston Park: low relief cobble/boulder reef of metamorphic bedrock, and bare sand patches Marino: metamorphic platform reef, breakwater rocks, boulders, and sand; 0.2 - 1m relief.	Kingston Park: bedrock boulders: in shallow subtidal (1 - 2m) 10 - 20% of boulders covered with 50 - 80% dense cover of calcareous tube worms and small mussels, plus 10-20% cover of ulvaceous green algae and small shells (*Diloma*, *Bembicium*) Marino: breakwater rock & boulders partly covered with *Cystophora moniliformis* & *C. monilifera*; sparse *Sargassum* spp. (e.g. *S. lacerifolium*) & *Myriodesma*; understorey of turfing browns (*Cladostephus* & small dictyotaceous & ectocarpaceous browns). *Caulocystis* also forms dense cover in flatter, sandier areas.
2. Noarlunga – inner north **3. Noarlunga – inner south**	High relief (3m); steep sloping reef with boulders at base.	Canopy cover 20% - 25%. *Cystophora* species; some *Ecklonia* and *Sargassum*. High cover of mussels in some areas..
4. Myponga (southern side)	High relief, silty, turf-covered "bommies" (2m) on sand, adjacent to intertidal rocks. Turfing species on "bommies" included *Lobophora variegata*, and a species of *Padina*.	Spindly bases of *Sargassum*, plus mixed *Cystophora* species (such as *C. moniliformis* and *C. monilifera*), plus *Scaberia agardhii*. Also mixed sponges on bommies (three main species, including *Aplysilla rosea*). Patches of compound ascidians (*Clavellina* and other species).
4. Carrickalinga	Schists, 1.5 - 2m relief	*Ecklonia radiata;* mixed species of *Sargassum* and *Cystophora*; abundant sponges and ascidians on ledges and in crevices etc.
6. Lasseters Reef off Second Valley	Schists, 2m relief	Canopy cover approx. 80%. (mixed *Sargassum* species: 40%; mixed *Cystophora* species: 25%; Ecklonia: 15%)
7. Second Valley 1 (caves)	Schists, 1.5 m relief	Canopy cover approx. 70% - 80%. *Ecklonia* 20%, *Cystophora* (mainly *C. subfarcinata*) approximately 60%.
8. Second Valley 2 (islet)	Schists, 1 m relief	Canopy cover approx. 60% . Mixed *Cystophora* and *Sargassum* species; turfing brown and red species of macroalgae in understorey, plus sponges and other sessile invertebrates.
9. Rapid Bay jetty	Bottom under and around jetty piles mainly sand, rubble, small boulders and metal jetty debris.	Mainly *Caulocystis*, *Cystophora*, *Scaberia* and turfing species on bottom adjacent to shallow part of jetty. Patches of *Amphibolis* seagrass off southern side of jetty, less than 3m deep. *Ecklonia* and *Sargassum* on piles, with turfing reds (particularly *Laurencia*), sponges, hydroids, etc. Amongst the brown macroalgae, sponge cover and diversity on piles increases further seaward, and colonial ascidians, including *Clavelina moluccensis* , also occur on piles in deeper water (midway to T section). Also on the mid-section piles are mixed *Caulerpa* species.
10. Fishery Beach 1 (inshore) **11. Fishery Beach 2 (offshore)**	Schists, 0.5 m relief, plus boulders (to 1m)	Canopy cover approx. 70% - %100, interspersed in flatter areas with *Amphibolis* seagrass on sand. Main macroalgae include mixed *Cystophora* species, within understorey of *Plocamium*, coralline reds (including *Haliptilon roseum*) and greens (*Caulerpa* species), plus sessile invertebrates (zooanthid colonies etc).
12. Cooalinga	Schists, 0.5 m relief, plus boulders (to 1m)	Canopy cover approx. 80% . Main macroalgae include mixed *Cystophora* species, within understorey of *Plocamium*, coralline reds (including *Haliptilon roseum*) and greens (*Caulerpa* species).
13. Rosetta Head		Canopy cover approx. 50%, interspersed with *Amphibolis* seagrass (45%), plus some Posidonia (5%). Main macroalgae include mixed *Cystophora* species, and *Scaberia*; minor cover of *Sargassum* species.

Sites varied in terms of exposure to wind waves and swell, from shelter in the inner sides of Noarlunga Reef, moderate exposure at several sites along the Fleurieu (e.g. Cooalinga, and Lasseter's Reef). Bottom relief varied, from relatively flat reefs such as Fishery Beach (offshore) and Marino Rocks, to high relief reefs such as Noarlunga, Lasseter's and the caves at Second Valley. Factors affecting the distribution and abundance of reef fishes are numerous, and include: bottom relief, exposure to swell or waves, algal composition and canopy cover, and preferred food and its availability. Some of the factors affecting distribution and abundance at a given site are explored in a recent report (Shepherd, Baker and Brown, 2008), based on surveys we undertook in late 2007 at north-eastern Kangaroo Island. For many of the slow-moving, site-associated and cryptic benthic fishes, sheltered spaces are important for living and reproduction, and examples include caves, crevices, ledges, spaces in objects (e.g. empty shells, under metal or rock debris, or jetty structures) and proximity to benthos used for camouflage (examples include macroalgae and sponges). We provide below a summary of the less common species recorded during the pilot surveys, with notes on distribution and habitats.

Examples of Species Recorded

Syngnathidae (Pipefishes and Pipehorses)

The syngnathid fauna of South Australia is rich, and includes both common and abundant species, and rare and low density species (Baker, 2007, 2008). Generally, many of the life history characteristics of syngnathids make them susceptible to impacts, and vulnerable to population decline. Such characteristics include low population densities (for most species, other than a few of the shallow-water, seagrass-dwelling pipefishes); strong habitat association; small home range sizes and low mobility; possible low rates of natural adult mortality (due to low levels of predation, hence human-induced mortality may disrupt population dynamics); monogamy and localised reproduction; aggregation (in some species) for feeding and/or breeding; small brood sizes, and strong association between adults and young (see Baker, 2008 for summary, and references). Reef syngnathids of interest during the pilot survey period in Gulf St Vincent (GSV) included:

- Red Pipefish *Notiocampus ruber* (Ramsay and Ogilby, 1886)
- Verco's Pipefish *Vanacampus vercoi* (Waite & Hale, 1921)
- Southern Little Pipehorse / Southern Pygmy Pipehorse *Idiotropiscis australis* (Waite and Hale, 1921) = *Acentronura australe* Waite and Hale, 1921
- Javelin Pipefish *Lissocampus runa* (Whitley, 1931)
- Smooth Pipefish *Lissocampus caudalis* Waite and Hale, 1921
- Ring-Back Pipefish / Ring-backed Pipefish *Stipecampus cristatus* (McCulloch and Waite, 1918)
- Western Upside-down Pipefish *Heraldia* sp. 1 (in Kuiter, 2003), southern form of *H. nocturna* Paxton, 1975
- Tiger Pipefish *Filicampus tigris* (Castelnau, 1879)
- Unnamed Pipefish *Stigmatopora* sp. (related to *Stigmatopora narinosa* Browne and Smith, 2007)

Baker (2008) provided detailed synopses on the distribution (including published and unpublished records of these species in South Australia), habitats, biology, vulnerable population characteristics and threatening processes for eight of these species. Main points are summarised in here, for species recorded during 2007 and 2008 (including the AMLRNRM-funded survey period) by the authors, associates, and other divers in South Australia.

Verco's Pipefish

Vanacampus vercoi is known to date only from the central part of the South Australian coast. Previously, the species has been recorded from central Spencer Gulf (including 2 dredged specimens from 1920, collected about 40km seaward of Wardang Island, plus more recent specimens from beam trawl sampling during the early 2000s) and south-eastern Spencer Gulf (Point Turton); south-western GSV / southern Yorke Peninsula (e.g. Edithburgh and Stansbury area) and north-eastern Kangaroo Island (American River and Pelican Lagoon) (Waite and Hale, 1921; Glover, 1979; Paxton et al., 1989; Dawson, in Gomon et al., 1994; Kuiter, 2000; B. McDonald, unpubl. data, 2001; K. Smith, unpubl. data, 2003; Australian Museum record; South Australian Museum records, cited by Baker, 2008).

During the survey period (April 2008), we recorded one large adult specimen of Verco's Pipefish at Rosetta Head in Encounter Bay (**Figure 1**), and a colleague (D. Muirhead) recorded both adult and juvenile Verco's Pipefish at Normanville, on the Fleurieu Peninsula (March 2008). The Encounter Bay specimen represents a south-eastern extension of the known geographic range, and the first record for Encounter Bay. The live specimen at Rosetta Head was positively identified by R. Kuiter, from more detailed photographs of the head (not shown here), which we took *in situ*. Within the currently known geographic range, the species has been recorded in tide pools, tidal channels, shallow subtidal macroalgae and seagrass (*Zostera* and *Posidonia*, with associated epiphytic macroalgae), and rubble bottom habitat. In southern Spencer Gulf, the species has been found in tide pools (e.g. at Point Turton – South Australian Museum record F 03296), but also found in beam trawl samples from *Zostera* seagrass beds further north into the gulf (B. McDonald, unpublished data, 2001). The Normanville specimens were observed at about 2.5m depth, in *Posidonia* habitat, with seagrass detritus. At Encounter Bay, we observed the pipefish at 3 – 4m deep, in the vicinity of a boulder densely covered with mixed *Cystophora* species and *Scaberia agardhii*, surrounded by seagrass. This habitat type has not previously been recorded for Verco's Pipefish. The Encounter Bay specimen sighted during this survey was larger (approximately 15cm) than the published maximum size, and had a bright orange-red abdomen, possibly an indication that the individual was in a reproductive phase. Given the size and colour of the individual, it is possible that *Vanacampus vercoi* breed in the Rosetta Head area.

Figure 1: Verco's Pipefish *Vanacampus vercoi*, observed at Encounter Bay, April 2008. Photo (c) H. Crawford, 2008

Red Pipefish

Notiocampus ruber belongs to a monotypic genus (Dawson, 1979), and has a broad geographic distribution (N.S.W. to W.A., including Tasmania). There are very few records, with less than a dozen specimens of this cryptic species known from across southern Australia (see Baker, 2008, for summary and references). **Figure 2** is a published example (by R. Kuiter) of a specimen recorded at Bicheno in Tasmania, at 20 depth. To date, the species has been found mainly in reef areas, and on other hard substrates, the latter including a shipwreck along the Fleurieu Peninsula in GSV (R. Charles, unpubl. data, 2002, cited by Baker, 2008). During the pilot survey period, we recorded Red Pipefish at 6m deep on a sponge, in a reef crevice under a ledge at Carrickalinga, in April 2007 (**Figure 3**). The specimen was a dusky-pink / light maroon colour, the same colour as the sponge on which it was positioned. The smooth and slender body; short, blunt snout; and large, protruding eyes are characteristic of *N. ruber*. The first author watched the pipefish's movements for several minutes, but unfortunately a camera was not available at the time of the sighting. Following this observation, the pipefish slithered into the reef crevice, and the snake-like movement of the species was observed. The head and upper body move first in one direction, followed by the lower body and prehensile tail. In this case, the tail was gradually unwrapped from the edge of the sponge after the head of the animal had already moved away in another direction. We dived at Carrickalinga several more times during the pilot survey period, in the hope of finding this species again and photographing it, but no specimens were found after the first sighting in Aril 2007. The species apparently occurs within a narrow depth range, often in reef crevice habitats, with the few specimens to date known from 5m to 20m. Given that specific searches in reef habitats are usually required to find this cryptic species, it is likely that the existing records largely reflect commonly dived depths, and if the species occurs in waters deeper than 20m, it is not likely to be found by other search methods (e.g. underwater video etc). However, it is noted that a small number of records have been obtained by other methods e.g. shallow dredging in eastern Australia, and one from a rock lobster pot, the latter being first record of the species in South Australia (S.A. Museum record 1964, cited by Baker, 2008).

Figure 2: A published example of the Red Pipefish *Notiocampus ruber*, one of the syngnathid species observed during the pilot surveys along Fleurieu Peninsula, 2007-08. Photo (c) R. Kuiter

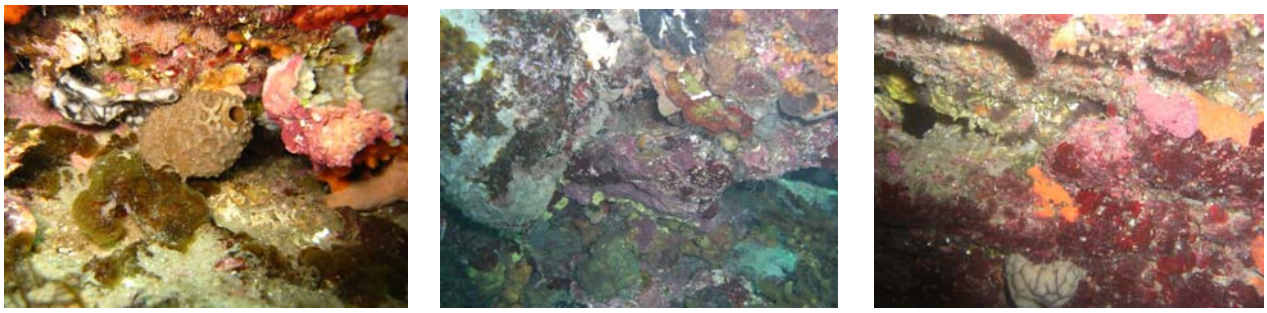


Figure 3: Example of habitat (ledge covered with sponges and other sessile invertebrates, and encrusting algae) in which the behaviour of Red Pipefish was observed at Carrickalinga, April 2007. Photos: H. Crawford (left); J. Baker (middle and right).

Western Upside-down Pipefish

This species, which lives in shallow subtidal caves and may be nocturnally active, is difficult to find and photograph. Western Upside-down Pipefish lives in the same habitat type as Sawtooth Pipefish *Maroubra perserrata*, but the latter species is recorded more commonly (including recent records from various sites along the Fleurieu Peninsula, such as Hallett Cove, Port Noarlunga and Second Valley). Two individuals of *Heraldia* sp. 1 were recorded by an associate of our surveys (D. Muirhead) in February 2008 at Second Valley on the Fleurieu Peninsula, and the species was also recorded recently at this location by another diver (M. Harper), in 2007. The species has also been recorded at Carrickalinga in recent years (K. Smith, unpubl. data, cited by Baker, 2008).

No other syngnathids were observed during the Fleurieu Peninsula surveys, but it is noted here that "Unnamed Pipefish" *Stigmatopora* sp. was observed during a related survey at north-eastern Kangaroo Island, and individuals of Southern Little Pipehorse have been observed by 3 divers along Yorke Peninsula during the past year (see Baker et al., 2008 for details).

Clinidae (Weedfishes and Snake-blennies)

The Clinidae family contains the weedfishes (of which there are more than 25 species in southern Australia), and, according to some authors, the snake-blennies and eel-blennies[1]. Most are found over a narrow depth range in nearshore waters. Members of the Clinidae are strongly site-associated in coastal areas of seagrass and macroalgae, and some species are common in such habitats; others are known from very few records. Weedfishes are very well camouflaged benthic fishes, and a single species can be highly variable in colour and patterning according to the habitat. This characteristic makes identification in the field difficult, as does the "skittish" habit of weedfishes, which move quickly for cover when disturbed, and thus provide few photographic opportunities *in situ*. Clinids are viviparous (bear live young) (Gunn and Thresher, 1991, cited by Baker, 2008), and therefore reproduce at a local, site-associated level, and have low dispersive ability,

[1] Some authors assign the Snake-blennies (the genera *Ophiclinus* and *Ophiclinops*), Eel-blennies / Eel Snake Blennies (genus *Peronedys*) and the Crawlers (genus *Stichariu*m), to a separate family, the Ophiclinidae; however it is noted that the Ophiclinidae is not recognised by Nelson (2006) or by the Australian Faunal Directory (Hoese et al, 2006, cited by Baker, 2008).

characteristics that can increase vulnerability to processes causing population decline. Kelleher et al. (1995) mentioned that the live-bearing characteristic of the Clinidae accounts for much of the endemism in this group of fish in southern Australia. These species may be susceptible to population declines from physical disturbance to habitat and siltation from dredging, channel development, boating in shallow waters; also sediment- and effluent-induced dieback of macroalgae and seagrasses etc), but specific data are lacking (Baker, 2008).

Reef-dwelling weedfishes for which few records and little information are available in the survey area, and in South Australia generally, include:

- Kuiter's Weedfish *Heteroclinus kuiteri* Hoese and Rennis, 2006
- Wilson's Weedfish *Heteroclinus wilsoni* (Lucas, 1891)
- Forster's / Long-Snouted / Sharp-Nose / Longnose Weedfish *Heteroclinus tristis* (= *H. forsteri*) (Klunzinger, 1872)
- Rosy Weedfish *Heteroclinus roseus*
- Milward's Weedfish *Heteroclinus* sp. 6 (Hoese et al., in Gomon et al., 1994)
- Whitley's Weedfish *Heteroclinus* sp. 2 (Hoese et al., in Gomon et al., 1994)
- Coleman's Weedfish *Heteroclinus* sp. 4 (Hoese et al., in Gomon et al., 1994)
- Kelp Weedfish *Heteroclinus eckloniae* (McKay, 1970)
- Little Weedfish / The Girls' Weedfish *Heteroclinus puellarum* (Scott, 1955)

Wilson's Weedfish

Although *Heteroclinus wilsoni* is broadly distributed (from southern N.S.W. to Tasmania) (Kuiter, 1993; Australian Museum records, CSIRO Marine Research records, Museum of Victoria records, cited by Baker, 2008), and considered to be common on nearshore reefs in Victoria (Edmunds and Hart, 2003), there are few records in South Australia. Previous records known in this State include Investigator Group islands in the eastern Great Australian Bight (Kuiter, 1983), southern Yorke Peninsula, and Kangaroo Island (Hoese et al., in Gomon et al., 1994; Australian Museum records, cited in Baker, 2008). Wilson's Weedfish is usually found in macroalgae beds (including kelp) in rocky reef areas, to about 20m deep (Hoese et al., in Gomon et al., 1994; Kuiter, 1993). It has also been recorded in rock pools (e.g. Museum of Victoria record 21791, cited by Baker, 2008). During the survey period, an individual of this species was observed (by C. Hall and J. Baker), but not photographed or verified, in the shallow subtidal at Rapid Bay, a habitat dominated by the macroalga *Caulocystis* with lesser cover of *Scaberia agardhii*) (**Figure 4**).

Figure 4: Shallow subtidal habitat (with *Caulocystis* and *Scaberia*) in which a probable specimen of Wilson's Weedfish was recorded at Rapid Bay, December, 2007. Photo: J. Baker

Kuiter's Weedfish
This species, which is associated with rocks and macroalgae in shallow water (to about 15m deep) has been recorded from few localities, in Victoria (e.g. Port Phillip Bay and Westernport Bay), South Australia, and south-western Western Australia (Hoese and Rennis, 2006). There are few records from South Australia, with one of the only published examples being a specimen collected in the Port Lincoln area, in south-western Spencer Gulf, in 1968 (Hoese and Rennis, 2006). During our recent survey on southern Yorke Peninsula, a probable sighting was made at 6m under Stenhouse Bay jetty, in March 2008 (A. Brown, pers. obs.), but no photographic evidence of the specimen is yet available. In 2007, this species was recorded by a colleague (J. Brook) at a reef site between Carrickalinga and Myponga, at 5m deep (**Figure 5**).

Figure 5: *Heteroclinus kuiteri* at a site between Carrickalinga and Myponga, 5m deep. Photo (c) J. Brook

Forster's / Long-Snouted Weedfish and Rosy Weedfish
Heteroclinus tristis (previously known as *H. forsteri*) is found across southern Australia, and is most abundant on reefs in Tasmania and Victoria (Hutchins and Swainston, 1986; Edmunds and Hart, 2003; B. Hutchins, pers. comm., 2006, cited by Baker, 2008). Although the species may not be uncommon, there are few published records in South Australia, possibly due to the cryptic habitats and effective camouflage of this species in macroalgae-rich reef habitats. Examples of records in S.A. these include museum records (*H. forsteri* and *H. tristis*) and survey records collectively from south-western Spencer Gulf (e.g. several specimens from Peake Bay area); Edithburgh and other locations along the "heel" of Yorke Peninsula; the metropolitan coast (Glenelg) (2 old records, from 1905); Fleurieu Peninsula (e.g. Aldinga Reef); northern and north-eastern Kangaroo Island (the latter including the Hog Bay area); Port Elliot; and Goolwa, at the mouth of the River Murray (an old record from 1916) (Hoese et al., in Gomon et al., 1994; K. Smith, unpubl. data, 2002; S.A. Museum records, Museum of Victoria records; Edgar et al., 2006, all cited by Baker, 2008). During the survey period (April 2008), at Rosetta Head in Encounter Bay we observed under red macroalgae (8m) a large (> 10cm), dark maroon-coloured weedfish with many transparent patches in the dorsal fin. This may have been *H. tristis*, or Rosy Weedfish *H. roseus* (see below). A diver from the Flinders University dive club (A. King) also observed *H. tristis* at Rosetta Head, in late 2007 (**Figure 6**). We also observed a specimen matching the description of *H. tristis* at Rapid Bay in March 2008, but no photographic evidence is available.

Like *H. tristis*, the Rosy Weedfish *H. roseus* is also widely distributed across southern Australia, but rarely recorded due to its camouflage in brown and red macroalgae. Examples of localities in S.A. where the species has been recorded include: the Investigator Group islands in the eastern Great Australian Bight; Tiparra Bay area in eastern Spencer Gulf; northern Kangaroo Island / Investigator Strait area; northern and north-eastern Kangaroo I.; southern Kangaroo I.; south-western GSV / "heel" of Yorke Peninsula; southern Fleurieu Peninsula, and Encounter Bay (Australian Museum records, S.A. Museum records, cited in OZCAM database, 2007; S.A. Museum data, 2006; R. Foster, pers. comm., cited by Baker, 2008). Other than a possible sighting at Encounter Bay (see above), no other examples of *R. roseus* were recorded during the survey period.

Figure 6: *Heteroclinus tristis* in Encounter Bay Photo (c) A. King.

Individuals of Milward's Weedfish and Kuiter's Weedfish were observed during related surveys along Yorke Peninsula (Baker et al., 2008). No individuals of Whitley's Weedfish, Coleman's Weedfish, Kelp Weedfish or Little Weedfish were positively identified during the survey period. Several weedfishes that were observed but not identified during our surveys, included at Rapid Bay (April 2007), in shallow subtidal macroalgae (mainly *Caulocystis*): a small (5cm), khaki-green coloured, fusiform-shaped weedfish with 5 white blocks along the side, and a white bar above the eye, below the first dorsal spine. Of the identified species in southern Australia, the closest species matching this visual description would be Coleman's Weedfish; however this species has usually been found in red macroalgae (see Kuiter, in Gomon et al., 1994, and 2000). We returned to Rapid Bay several times during the pilot survey period to photograph this species, but it was not recorded again after the initial sighting. Unidentified weedfishes were also briefly sighted at the northern outer section of the islet at Second Valley (by A. Brown and R. Arnold) in April 2007.

Snake-blennies were not recorded during the Fleurieu Peninsula surveys, but sightings during related surveys along Yorke Peninsula are discussed in a recent report (Baker et al., 2008).

Aploactinidae (Velvetfishes)

There are few members of this largely tropical family of small, cryptic, benthic fishes in South Australia. Most species in the family are known from few specimens, probably due to their small size, cryptic appearance and habitat preferences (e.g. within reef vegetation, under rocks or in rock crevices, or in rubble, coral or coralline algae) (Poss, 1999; Leis, 2005; Imamura, 2006, cited by Baker, 2008). The inshore distribution of aploactinid fishes, their benthic nature, and habitat preferences (e.g. sand and rubble near reef, and possibly other soft bottom habitats) may make localised populations susceptible to decline from habitat impacts in some areas (e.g. sedimentation and pollutants from coastal effluent discharge; or physical loss and sedimentation of habitat from trawling, dredging, channel clearing etc) (Baker, 2008).

Threefin Velvetfish

This small species (to 5cm) is known from a few subtropical locations in Queensland and Western Australia, and also from South Australia. Until recent years, the species' presence in South Australia was known from a single record, collected in Encounter Bay in 1981 (W.A. Museum record, cited by Poss, in Gomon et al., 1994; B. Hutchins, pers. comm., 2006, cited by Baker, 2008). In 2006, during compilation of a chapter on the Aploactinidae in South Australia (Baker, 2008), a request was made to the S.A. museum to determine if further specimens existed in the collection. Presently in South Australia, the species is known from 6 museum specimens in 4 records, plus a photographs from two other localities, but is likely to be more abundant than current records indicate. In addition to the Encounter Bay specimen, other examples include three specimens collected in 1890 near Semaphore in northern metropolitan GSV, and previously misidentified as juvenile *Aploactisoma milesii* (South Australian Museum record F01549; R. Foster, pers. comm., 2006, cited by Baker, 2008); a specimen taken in 2006, from 3-4km off Outer Harbour in metropolitan GSV (SAM specimen, collected by R. Gannon and identified by R. Foster), and a single, undated specimen, from the Franklin Harbour area in Spencer Gulf (South Australian Museum record F10479; R. Foster, pers. comm., 2006, cited by Baker, 2008). In addition, there is a photograph taken by R.

Kuiter, of juvenile *Neoaploactis tridorsalis* under Rapid Bay Jetty, in south-eastern GSV (**Figure 7**). The individuals were recorded under loose rocks, near macroalgae (R. Kuiter, unpubl. data, cited by Baker, 2008). Both larvae (in abundance) and small specimens have been recorded in southern GSV (data by B. Bruce, CSIRO, and R. Kuiter, cited by Baker, 2008). There is also a record of the species from 54m in the central Great Australian Bight, near the W.A. / S.A. border, collected using epibenthic sled, in 1995 (R. Foster, S.A. Museum, pers. comm., 2006, cited by Baker, 2008). Recently, specimens under Edithburgh Jetty have been sighted, photographed (e.g. by J. Lewis), and verified (J. Johnson, Queensland Museum, 2007). This small, well-camouflaged benthic species is easily overlooked amongst the sand, rock and shell rubble in which it resides.

Figure 7: Threefin Velvetfish *Neoaploactis tridorsalis*, recorded under Rapid Bay Jetty. Photo (c) R. Kuiter

Wasp-spine Velvetfish

Acanthosphex leurynnis is a tiny fish (standard length less than 3cm, and specimens smaller than 2cm SL have been recorded (Vidthayanon and Bettencourt, 1988; Johnson, 2004, cited by Baker, 2008). The species appears to be uncommonly recorded, and is known mostly from tropical areas, including South China Sea near Hong Kong, Gulf of Thailand, southeast India, Indonesia, Viet Nam and eastern Papua New Guinea (see reference list in chapter on Aploactinidae, in Baker, 2008). There are few specimens from Australia, with examples including Repulse Bay and Whitsunday I. in Queensland; a site NE of Goulburn I. in the Arafura Sea off Northern Territory; the Perth area in Western Australia (Johnson, 2004), and Spencer Gulf and Gulf St Vincent in South Australia. In this State, examples of specimens that have been identified as *Acanthosphex leurynnis* include 3 museum specimens that were collected from Spencer Gulf in 1898 (South Australian Museum record F10478; R. Foster, pers. comm., 2006, cited by Baker, 2008), and recent shallow trawl survey records in GSV and Spencer Gulf, where the species has been trawled at about 8m, in mixed habitat that includes some seagrass (R. Saunders, SARDI, pers. comm., 2008). Due to its very small size and cryptic appearance, it is presumed that this very small, cryptic fish is usually overlooked in benthic surveys, and no targeted surveys have been undertaken to date. As indicated by recent trawl captures, it may be more abundant in South Australia (and other parts of southern Australia) than previous records suggest.

Acanthoclinidae / Acanthoclininae (Spiny Basslets and Longfins)

The Acanthoclinidae is a small family of fishes (see Hardy, 1985), related to the Pseudochromidae and Plesiopidae. The family is not recognised by all taxonomists, some of whom group these fishes as a subfamily of the Plesiopidae (which contains the blue devil fishes and hulafishes). In Australia, there are only two species in Acanthoclinidae, one in the tropical Pacific, and the other endemic to southern Australia (CSIRO, 2008). The Southern Longfin *Beliops xanthokrossos*, found in southern W.A. and S.A., is of interest here due to its limited known presence and distribution in this State, based on very few records. Also, members of the family are often territorial, have strong site attachment to reefs and produce benthic eggs, characteristics that can make populations vulnerable to localised impacts. Examples of areas in S.A. where the species has been recorded include Kangaroo Island, and Edithburgh on the Yorke Peninsula (Kuiter, in Gomon et al., 1994; Paxton et al., 1989; Australian Museum records, 1978, cited by Baker, 2008). In one of

the dives during the pilot survey period (April 2007), two very small black fishes (about 3cm long), matching the description of Southern Longfin, were observed under two rusted metal plates, under the Rapid Bay jetty. These fishes moved very fast when their cover was disturbed, and swam briefly and quickly in a "figure 8" fashion before burying vertically into the substrate. No photographic evidence is available, but a published example of the species is provided here (**Figure 8**).

Figure 8: A published example of the Southern Longfin, one of the species possibly observed during the pilot surveys along Fleurieu Peninsula, 2007-08. Photo (c) R. Kuiter

Antennariidae (Anglerfishes)

Anglerfishes are mostly tropical, and usually benthic. Of the 12 genera that occur globally, 10 are represented in Australian waters (Pietsch and Grobecker, 1987; Pietsch, in Gomon et al., 1994; CSIRO, 2008), with 6 of those genera occurring in southern Australia. An unnamed species, probably in a new genus, has been recorded recently by R. Harcourt and colleagues in Sydney Harbour, NSW (R. Arnold, University of Washington, pers. comm., April, 2007). Distinctive features of anglerfishes include the short, deep, globose and slightly compressed body; lateral eyes; a large mouth with several rows of small villiform teeth; tube-like gill openings (behind and below the base of each pectoral fin) used for jet propulsion; elongate and leg-like pectoral fin lobes (used for crawling); and the first dorsal spine modified into a freely moving, luring apparatus, consisting of a stalk (illicium) and usually an esca (a terminal "bait") (Pietsch and Grobecker, 1987; Pietsch, in Gomon et al., 1994; Pietsch, 1999; Edgar, 2000, cited by Baker, 2008). The skin of anglerfishes is often spiny, or covered with cutaneous filaments and appendages, which serve as effective camouflage in reef-dwelling species. The colour and pattern of anglerfishes are highly variable, ranging from white, yellow, pink, orange, red, to dark brown and black. Anglerfishes are voracious carnivores that live on the sea floor, and feed on fishes or crustaceans that are attracted to the angler's wriggling esca. However, shallow water coastal species rely less upon this mechanism for prey capture, compared with deep water species. Anglerfish have large, trapdoor-shaped mouths, and are capable of rapidly seizing large fish that fall prey to their feeding approach, which is to "lie in ambush". Some anglerfish species resort to cannibalism, even if the other is a potential mate. The females usually lay eggs that are embedded in a gelatinous mass, and in temperate species, the eggs are attached to the body of a parent (Pietsch and Grobecker, 1980, 1987). In southern Australia, there are observations of anglerfish guarding the egg mass (e.g. photographs by J. Lewis, 2005). The benthic nature, low fecundity, localised reproduction and limited dispersal ability of anglerfishes makes them susceptible to localised impacts, and increase the vulnerability of such fishes to population decline. For anglers that rely upon sponge habitats, any processes that result in removal of sponges (e.g. trawling; coastal dredging; land-based discharges that cause sedimentation and / or eutrophication; benthic damage due to excessive and unregulated diving) might also adversely affect populations. Some temperate anglerfishes are sought after in the specialist aquarium trade (which may cause localised population depletion), but there is no information on the capture of this species in southern Australia for that purpose.

A number of less commonly recorded anglerfishes were of interest during the pilot surveys. Examples include:

- Bougainville's Anglerfish *Histiophryne bougainvilli* (Valenciennes, 1837)
- Glover's Anglerfish *Rhycherus gloveri* Pietsch, 1984
- Sponge Anglerfish *Echinophryne reynoldsi* Pietsch and Kuiter, 1984
- Glauert's Anglerfish *Allenichthys glauerti* (Whitley, 1944)

During April 2007, an anglerfish expert (R. Arnold) from the University of Washington in USA, attended the first of our pilot surveys, along the Fleurieu Peninsula. Unfortunately, no anglerfishes were observed during that survey. Only one anglerfish was observed and photographed along the Fleurieu during the during the NRM-funded survey period, this being the common Tasselled Anglerfish *Rhycherus filamentosus*. Of particular interest during our surveys in GSV was Glover's Anglerfish *Rhycherus gloveri*, the less commonly recorded relative of the widespread south-eastern Tasselled Anglerfish *R. filamentosus*. Glover's Anglerfish is an inshore species, known from south-western Australia and South Australia. Most records in S.A. have come from northern, eastern and western Spencer Gulf, and there is a single record from GSV (early 20th century record from Seacliff). Currently, there are no data to indicate whether or not the species occurs other parts of this State, east or west of the gulfs region. No specimens of Glover's Anglerfish were found during the pilot surveys, but we photographed and filmed a swimming specimen of Tasselled Anglerfish at 8 - 9m depth, in Encounter Bay in April 2008. The visual differences between the common Tasselled Anglerfish and the more limited range Glover's Anglerfish are illustrated in the photos below **(Figure 9**), which show the lure (the illicium and the esca). The two species look very similar, but are distinguished mainly on the esca, which resembles a joined pair of worms in *R. filamentosus*, but is a single tapering, v-shaped appendage with filaments in *R. gloveri*. Illicium length is the other distinguishing feature, and is much longer in *R. filamentosus* - up to 30% of body length.

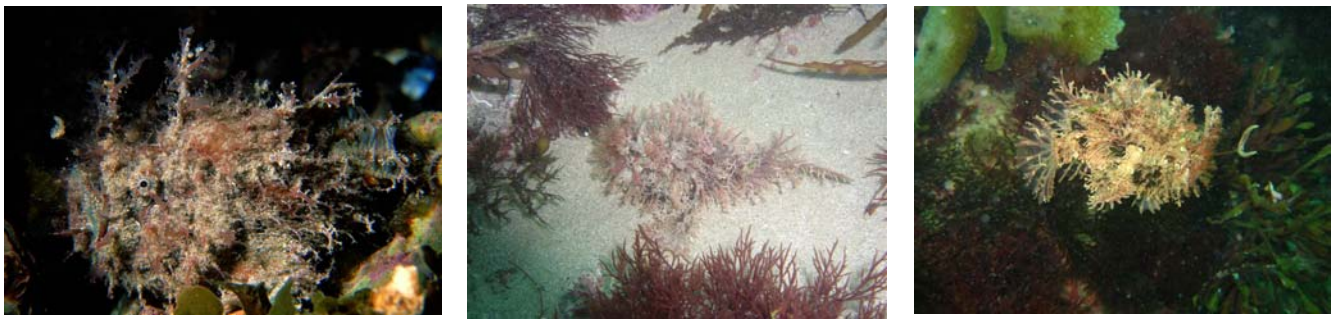


Figure 9: The uncommonly recorded western species Glover's Anglerfish *Rhycherus gloveri* (left), and the more common south-eastern species Tasselled Anglerfish *Rhycherus filamentosus* (middle and right). *R. gloveri* photo (c) J. Lewis; *R. filamentosus* photos (c) J. Baker (middle) and H. Crawford (right).

Other Species

Other fishes of interest during our surveys were the species in Pataecidae (prowfishes) that are uncommonly recorded in South Australia, namely Whiskered Prowfish *Neopataecus waterhousii* (Castelnau, 1872) and Red Indianfish *Pataecus fronto* Richardson 1844. Gulf St Vincent in S.A. is the type locality of the Whiskered Prowfish (Eschmeyer, 2006, cited by Baker, 2008). In the late 1800s, a number of museum specimens were collected in the "Adelaide area" in GSV (Hureau, 1991; Anonymous, 2000, cited by Baker, 2008), and further specimens were also collected from the metropolitan area of during the 1960s and 1970s, with examples including Glenelg, and Port Stanvac (S.A. Museum records, cited in Baker, 2008). Other locations in S.A. from where the species is known to date include the Great Australian Bight; parts of Spencer Gulf (e.g. Port Broughton and Tiparra area); the "heel" of southern Yorke Peninsula; northern and north-eastern Kangaroo Island (e.g. American River); Encounter Bay, and the upper South East (e.g. southern Lacepede Bay area, and Robe area) (Glover, 1979; CSIRO Marine Research data 1967, cited in CSIRO, 2008; S.A. Museum records, cited in Baker, 2008). Whiskered Prowfish occurs in moderately shallow coastal waters, and there is little information about the habitat, other than reports that it is occasionally seen in floating seaweed, such as *Sargassum*, or in lobster pots (Hutchins and Swainston, 1986; Gomon, in Gomon et al., 1994). In S.A., the species has been recorded on "sandy bottom with sparse vegetation" (S.A. Museum record from 1974, cited by Baker, 2008). To date, the species has been recorded mainly in the depth range 20 – 40m (S.A. Museum records; CSIRO data 1973, cited by Baker, 2008), which might explain why it was not recorded during our pilot survey period, given that that we dived from shore, at depths of 5m – 10m. Similarly, the Red Indianfish is very uncommonly recorded in S.A., possibly due to its low densities, cryptic appearance, and habitat association in sponge beds on reefs that may be deeper than commonly dived depths. Although it has been recorded in shallow waters in New South Wales, the species is rarely found in South Australia above 20m, and the depth distribution extends to 80m. Therefore, we were unlikely to find it during the pilot survey period, in which lack of boating facilities restricted our dives to depths of 10m or less.

Examples of locations in S.A. from where the species might have been recorded include the Great Australian Bight; Gulf St Vincent, and Kangaroo Island (Glover, 1979; May and Maxwell, 1986; CSIRO data, cited in CSIRO, 2008; S.A. Museum records, all cited by Baker, 2008). The more common species Warty Prowfish *Aetapcus maculatus*, was not included in our list of target species; however, the vulnerable characteristics of all members of the Pataecidae are noted in the chapter by Baker (2008).

Another site-associated family of reef fishes with limited dispersal ability is the Apogonidae (cardinalfishes). The *Vincentia* cardinalfishes are benthic, mouth-brooding species (Allen, 1999) with localised reproduction, found mainly in shallow subtidal seagrass beds and/or nearshore reefs, and all these characteristics may increase the vulnerability of such species to localised impacts. One of the more common species is the Southern Cardinalfish *Vincentia conspersa*, found in south-eastern Australia States, with the Great Australian Bight being the western limit. It has been recorded throughout South Australia, from the far west to the south-east, on reefs and also in nearshore seagrass beds, and in estuaries (see Baker, 2008 for summary of records). During our surveys, we observed Southern Cardinalfish in a boulder crevice at Rosetta Head (**Figure 10**, left). Less commonly recorded than *Vincentia conspersa* is the Scarlet Cardinalfish *V. badia* (**Figure 10**, right) known from central and southern coastal waters in W.A., and western and central coastal water in South Australia. In this State, *V. badia* has been recorded in GSV (e.g. outer reef at Glenelg), southern Fleurieu / Backstairs Passage area (including a paratype specimen from Cape Jervis), Investigator Strait / northern Kangaroo Island, and parts of northern, central, eastern and southern Spencer Gulf (Paxton et al., 1989; Gomon, in Gomon et al., 1994; unpubl. SARDI data by P. Jennings, 1993; photographs by J. Lewis, 2004; photographs by D. Muirhead, 2004; R. Foster, S.A. Museum, pers. comm., 2006; Australian Museum records, Museum of Victoria records, cited by Baker, 2008). In South Australia, cardinalfishes have been recorded in both the GSV and Spencer Gulf prawn trawl fisheries (Richardson, 1999, and Carrick, 1997, cited by Baker, 2008), and Southern Cardinalfish is a minor part of the bycatch in the Blue Crab Fishery (Svane and Hooper, 2004; Currie and Hooper, 2006, cited by Baker, 2008). Little is known of the relative abundance, biology and population dynamics of cardinalfishes. Taxonomic work is required to determine the number of *Vincentia* taxa in South Australia. It is noted that there are South Australian specimens that are not easily identified as either *V. conspersa* or *V. badia*, using the currently available descriptions and keys. It is not known whether this is due to the inadequacy of the keys, or perhaps indicative of hybridisation or the presence of cryptic taxa (R. Foster, S.A. Museum, pers. comm., 2006, cited by Baker, 2008). For these fishes, more information on the distribution, habitats, biology, vulnerable population characteristics and threatening processes (including trawling), is provided in the chapter on Apogonidae, in Baker (2008).

Figure 10: The south-eastern species Southern Cardinalfish *Vincentia conspersa* (left), recorded in Encounter Bay in May 2008, and the south-western species Scarlet Cardinalfish *V. badia* (right), illustrating mouth-brooding in a male specimen photographed at Edithburgh. Photos (c) H. Crawford (left) and (c) J. Lewis (right).

Species in another benthic, egg-brooding group - the triplefins (Tripterygiidae), are commonly known within S.A., and some are apparently abundant and widely distributed (Baker, 2008). However, the potentially vulnerable population characteristics of the whole group is noted here, such as strong site association; the guarding of benthic eggs in a “nest”; and use of shallow coastal habitats that may be subjected to localised impacts (Baker, 2008).

Of the triplefins, the Crested Threefin *Trinorfolkia cristata* (**Figure 11**) is of particular conservation interest because it may be endemic within this State . However, this reef-associated species has been commonly recorded, and appears not to be rare within the known range, with records from numerous locations in South Australia (Baker, 2008, and references therein). During the survey period, we recorded this species at several locations, including Second Valley (**Appendix 1**), and it has also been reported at Rapid Bay jetty (**Appendix 2**). Processes that impact upon the extent, quality and cover of nearshore reefs may adversely affect populations of site-associated nearshore reef fishes such as Crested Threefin, but there are no specific data.

Figure 11: Examples of the endemic but commonly recorded species Crested Threefin. Photo (c) D. Muirhead

Lastly, several of the reef-dwelling clingfishes, in the family Gobiesocidae, were of interest in our pilot surveys. Most clingfish species are capable of adhering to the substrate, by using their ventral sucking disc, formed in part by the union of the ventral fins. Clingfishes are scaleless, and the body is covered by a thick layer of mucus (Hutchins, in Gomon et al., 1994). There are numerous species of clingfish in S.A., some very common, others rarely recorded, and almost all species are shared with one or more other southern Australian States (see Baker, 2007). Only one endemic clingfish is known to date from S.A., an unnamed species currently known from two photographs and a single specimen (see below). The Gobiesocidae is one of the few families that account for much of the endemism in the southern Australian fish fauna (Kelleher et al., 1995), in this case due to their "nesting" behaviour and thus low dispersal ability.

Characteristics of the clingfishes that make them vulnerable to impact include strong site association; habitat specificity; parental care of eggs and young at the "nesting" site; poor swimming ability, and low dispersal ability. Clingfishes are strongly site-associated with nearshore seagrass beds (and, in some cases, macroalgae-covered reefs), and therefore any processes which degrade the quality of coastal seagrass beds and reefs may have an impact on these species. Of the less common reef-dwelling species of interest in our survey, most are not exclusively found on reefs, but also dwell in seagrass beds. These include Long-snout Clingfish *Parvicrepis* sp. 1, Obscure (Little) Clingfish *Parvicrepis* sp. 2, Brown-spotted Spiny (= Kelp) Clingfish Genus A, sp. 2, Rat Clingfish Genus B sp., and "South Australian Spiny Clingfish" (Genus A sp. 4: B. Hutchins. pers. comm., 2007). Of these, the latter is of particular interest, because there are so few specimens known. These include one that was collected by N. Holmes in the Nuyts Archipelago, eastern Great Australian Bight, and the other from Seacliff in metropolitan GSV (B. Hutchins, ex-W.A. Museum, pers. comm., 2007, cited by Baker, 2008). It is likely that the species may have a broader distribution in S.A., but has not been documented due to the small size, cryptic nature, and also due to the lack of targeted sampling. Habitat details are not known, other than for the few examples listed above, which were found in shallow subtidal vegetation. The Seacliff specimen of South Australian Spiny Clingfish was recorded from the green macroalga *Caulerpa cactoides* (B. Hutchins, pers. comm., 2007, cited by Baker, 2008).

During the pilot survey period, we did not record any of the reef-dwelling clingfishes listed above. These species are very small and cryptic, and seldom seen by dive survey. One of the most effective methods of finding and extracting clingfishes is to uproot large quantities of shallow subtidal marine vegetation and rinse it in a large bucket of fresh water, during which process clingfishes drop off the plants, into the bucket. However, we chose not to use any destructive methods during the pilot surveys, hence did not attempt this method. We found hand netting to be ineffective in finding reef-dwelling clingfishes, and will continue to

use visual search techniques in suitable habitats. In seagrass beds along the Fleurieu, there are recent examples of other less commonly recorded clingfish species, in Genus C (a genus that includes Grass Clingfish and Slender Clingfish), photographed by D. Muirhead. Grass Clingfish species are commonly found in shallow seagrass beds (including the larger seagrasses *Amphibolis* and *Posidonia*), and on flat-bladed macroalgae (e.g. *Ecklonia radiata, Scaberia agardhii* and others), on reef patches adjacent to seagrass beds (Hutchins, in Gomon et al., 1994; Kuiter, 1996; Hyndes et al., 2003; D. Muirhead, unpubl. data 2004-2007, cited by Baker, 2008).

Other Data (e.g. Species Richness)

During some of the surveys over this pilot period, we also utilised time underwater to record other (i.e. more common and more mobile) reef fish species observed during the searches for less common and cryptic benthic species (e.g. **Appendix 1**). Some of these data will contribute to a report on visual surveys of common fishes at over 200 shallow reefs in S.A. (Shepherd, Baker and Brook, in prep.). We have collated species lists for a number of sites visited during the pilot survey period, such as Rapid Jetty, where we recorded 66 of the total number (111) of bony fish species known to date from Rapid Bay Jetty (**Appendix 2**).Differences in species richness and composition between various jetties in S.A. will be discussed further in a forthcoming publication (Baker and Shepherd, in prep.).

During this project, we took ~ 650 photographs of reef fishes, marine invertebrates, and benthic habitats along Fleurieu Peninsula, many of which can contribute to a marine image database for the AMLRNRM Board.

Conclusions, and Further Work

To date, the surveys from December 2007 to May 2008 have indicated that visual and manual searching through the benthos on SCUBA is the most successful non-destructive method of finding the majority of the small uncommonly-recorded reef fishes that were the targets for this project. Given the conservation-based objectives of our work, we did not wish to use rotenone, a fish ichthyocide that is commonly used by researchers to find small cryptic fishes. Some of the target species are crevice-dwellers (e.g. the reef pipefishes); others utilise the cover provided by dense macroalgae (e.g. weedfishes), and some (e.g. anglerfishes) are well camouflaged against various bottom surface covers, such as rocks and rubble, low sponge and ascidian cover, shell rubble, and jetty debris (decaying wood, rusty metal etc). In that regard, slightly different search techniques are required for each group, and over the course of the pilot surveys, knowledge of suitable search strategies developed and improved.

The small number of uncommon fishes observed over more than 30 searches (collectively on SCUBA and snorkel) indicates that further searching is required over time and space to better understand the distribution, relative abundance and habitat of many uncommon reef fishes in S.A., particularly in areas away from the more easily accessible dive sites in the southern gulfs. The lack of boat facilities during the survey period restricted our dives to depths of 5m – 10m, hence it was not possible to search for some of the deeper-dwelling reef fish species, as discussed above. In 2009, we hope to survey a number of less accessible reef sites (by boat, rather than shore diving), and to expand the survey program to include the nearshore reefs of upper and lower south-eastern South Australia, and the western Eyre Peninsula and eastern Great Australian Bight, which, to date, have been very inadequately and infrequently surveyed, even for common reef fishes. To date, no surveys for uncommon and cryptic fishes in have been undertaken in such areas.

The first author is now developing a network of contacts within the South Australian diving community to assist with the searching and recording of uncommon benthic fishes, and staff from museums and independent consultancies across Australia have been helpful in verifying species identifications during the pilot survey period. Marine divers and photographers with an interest in the less common and cryptic benthic fishes should continue to be encouraged to search for such fishes, and provide their photographs (with date, and location) to museums or independent fish experts in southern Australia, for positive identification. Recreational divers can make a significant contribution to knowledge of the distribution, depth range, habitat and even the biology of less commonly recorded fishes. It is hoped that this process can become more formalised in future, and we plan to engage dive clubs (both university-based and independent) in future surveys to help us contribute to knowledge of distribution and habitats of uncommon fishes in South Australia, and to assist in community education about the existence of such fishes, and the potential threats they face.

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Appendix 1. Examples of sites surveyed along southern Fleurieu Peninsula, including numbers of species and averaged densities (per 2000 m^2) of more common reef-associated fishes recorded during the surveys, with data on relief, visibility, and exposure. Group 1 = pelagic species found throughout water column; Group 2 = species associated with sand or seagrass that wander into reef areas; Group 3 = benthic omnivores or carnivores; Group 4 = species which live and move about under the algal canopy or rest in shelter; Group 5 = cave-dwelling or cryptic species. **A**: CO = Cooalinga; FI = Fishery Beach inshore; FO = Fishery Beach offshore; FN = Fishery Beach north; RB = Rapid Bay Jetty; SV1 = Second Valley (caves at southern end); SV2 = Second Valley (islet with boat sheds); LA = Lasseter's Reef; CK = Carrickalinga; NS = Pt Noarlunga (south inner); NN = Pt Noarlunga (north inner); MR = Marino Rocks. Data for these and sites along Fleurieu Peninsula & Encounter Bay will be listed and analysed, in a forthcoming publication on shallow reef surveys using timed swims to visually record relative densities (Shepherd, Baker, and Brook, in prep.).

Sites	**CO**	**FI**	**FO**	**FN**	**RB**	**SV1**	**SV2**	**LA**	**CK**	**NS**	**NN**	**MR**
Replicates x 100 m	4	4	4	4	4	4	4	4	4	4	4	4
Depth	4	5	5	5	8	5	5	5	6	4	4	4
Rocky bottom relief (m)	0.4	0.8	0.5	2	1	1.5	1.5	2	1.5	3	3	0.2
Visibility (m)	9	9	7	20	8	15	9	12	10	8	10	8
Exposure index (0-4)	2.5	2	2	2	1.5	2	2	2.5	2	1	1	1.5
% algal canopy cover	80	70	70	100	5	70	60	80	80	25	20	50
Fishes Density/2000m2												
Group 1												
Sphyraena novaehollandiae Snook					4							
Dinolestes lewini Long-finned pike					16			63	20		1	4
Trachurus novaezelandiae Yellowtail scad					50							200
Scorpis aequipinnis sea sweep	17	34	1	12		32	18	10	1	41		53
Scorpis georgiana banded sweep											144	
Caesioperca rasor barber perch									4			
Enoplosus armatus old wife				51	25			49	5	8	7	
Arripis georgianus Australian herring / tommy ruff							45	560				
Group 2												
Sillaginodes punctata King George whiting					23						2	1
Sillago schomburgkii yellow-fin whiting									24		17	
Hyporhamphus melanochir sea garfish												
Neoodax balteatus little weed whiting / little rock whiting												
Haletta semifasciata blue weed whiting / blue rock whiting												
Phycodurus eques leafy sea dragon					2							
Upeneichthys vlamingii blue-spotted goatfish / red mullet				8	45	10		1	2	9		
Parequula melbournensis silverbelly					29							
Group 3												
Achoerodus gouldii western blue groper				1								
Dactylophora nigricans dusky morwong	4	12	7	7	3	2	3	1		8	4	8
Kyphosus sydneyanus silver drummer	1	5	8	15		1	2	2	14	8	5	
Pentaceropsis recurvirostris long-snouted boarfish					18							
Cheilodactylus nigripes magpie perch	10	7	6	7	31	4	14	7	5	63	43	3
Girella zebra zebra fish	49	33	1	11	63	52	43	12	20	4	4	201

Group 3 (continued) **Sites**	**CO**	**FI**	**FO**	**FN**	**RB**	**SV1**	**SV2**	**LA**	**CK**	**NS**	**NN**	**MR**
Notolabrus tetricus blue-throated wrasse	29	40	65	88	54	15	16	48	14	3		18
Notolabrus parilus brown-spotted wrasse		1			21	5			4	10		4
Dotalabrus aurantiacus Castelnau's wrasse				5				1	2			6
Austrolabrus maculatus black-spotted wrasse					26			1	4		2	
Meuschenia flavolineata yellow-striped leatherjacket				12	2			1	3	10	11	
Meuschenia freycineti 6-spined leatherjacket								3		57	55	
Meuschenia galii Blue-lined leatherjacket					4			2	31	1	3	
Meuschenia hippocrepis horseshoe leatherjacket	7	3	3	11	21	9	4	35	22	4	9	4
Acanthaluteres brownii spiny-tailed leatherjacket								4	1			
Eubalichthys cyanoura blue-tailed leatherjacket					2							
Eubalichthys gunnii Gunn's leatherjacket				3								
Scobinichthys granulatus rough leatherjacket					35			7				
Meuschenia scaber velvet leatherjacket					24							
Brachaluteres jacksonianus pygmy leatherjacket					3	3						
Chelmonops curiosus western talma					10	1		10	7	20	3	
Group 4												
Aplodactylus arctidens southern sea carp			1	1			1				1	
Aplodactylus westralis western sea carp				1								
Odax acroptilus rainbow cale					1	2			2			1
Odax cyanomelas herring cale	6	1	2	16	15	10	3	18	8	14		
Pictilabrus laticlavius senator wrasse	1	7	10	7			5	4	5			
Eupetrichthys angustipes snakeskin wrasse						1			1			
Siphonognathus beddomei pencil weed whiting						1		8		1		
Siphonognathus caninus sharp-nosed weed whiting				4	4							
Parma victoriae Victorian Scaly fin	3	1	1	7	16	5	4	9	3	3	8	
Tilodon sexfasciatus 6-banded coral fish	1	3		2	18	6	3	31	6	23	19	5
Diodon nichthemerus globefish										2		
Tetractenos glaber smooth toadfish		3					1			2		1
Contusus richei barred toadfish											10	
Aracana ornata ornate cowfish		2										
Parapercis haackei wavy grubfish												

Group 5												
Paraplesiops meleagris western (or southern) blue devil								6				
Pempheris multiradiata common bullseye				4	81	40	6	125	88	15	2	20
Pempheris klunzingeri rough bullseye					6	40		475	10			
Parapriacanthus elongatus slender bullseye					9			30				
Pempheris ornata orange-lined bullseye					4							
Trachinops noarlungae yellow-headed hulafish					75	120		980	670	570	597	
Cochleoceps bicolor western cleaner clingfish					6							
Helcogramma decurrens black-throated threefin					1	3			1			
Trinorfolkia cristata crested threefin / triplefin						2						
Trinorfolkia clarkei Common threefin / triplefin												
Number of species	11	14	11	21	35	22	15	29	28	22	21	15
Number of individuals	128	152	106	273	637	364	168	2503	977	876	946	529

Appendix 2: Bony fish species list for Rapid Bay Jetty. Sixty species listed below were recorded during the surveys described in this report, and are not coded numerically. Species recorded at other times, by other sources, are coded as: (1) Marine Life Society of South Australia: Reynolds (2002) and D. Muirhead, pers. comm., 2008; (2) R. Kuiter, pers. comm., 2008; (3) CERF Reef Life Survey training records, February 2008; (4) Baker (2008), and references therein, including K. Smith, unpubl. data, 2003, 2004, (5) Australian Anglers Association (2005) (national fishing records), and (6) K. Smith, pers. comm. 2008. Species for which identity is unverified are marked #.

Acanthaluteres brownii spiny-tail leatherjacket
Achoerodus gouldii western blue groper
Anoplocapros lenticularis white-barred boxfish (6)
Aracana aurita Shaw's cowfish (3)
Aracana ornata ornate cowfish (1)
Arripis georgianus Australian herring / tommy ruff (6)
Aspasmogaster tasmaniensis Tasmanian clingfish
Austrolabrus maculatus black-spotted wrasse
Beliops xanthokrossos southern longfin
Brachaluteres jacksonianus southern pygmy leatherjacket
Caesioperca rasor barber perch
Callogobius mucosus sculptured goby (1) #
Cheilodactylus nigripes magpie perch
Chelmonops curiosus western talma
Cnidoglanis macrocephalus estuary catfish
Cochleoceps bicolour western cleaner clingfish
Dactylophora nigricans dusky morwong
Dinolestes lewini Long-finned pike
Diodon nicthemerus globefish (1)
Dotalabrus aurantiacus Castelnau's wrasse / pretty polly
Echinophryne crassispina prickly anglerfish (4)
Enoplosus armatus old wife
Eocallionymus papilio painted dragonet / painted stinkfish (1)
Eubalichthys cyanoura blue-tailed leatherjacket
Eubalichthys gunnii Gunn's leatherjacket
Eubalichthys mosaicus mosaic leatherjacket
Eupetrichthys angustipes snakeskin wrasse
Foetorepus calauropomus common stinkfish
Genypterus tigerinus rock ling (1)
Girella zebra zebra fish
Haletta semifasciata blue rock whiting / blue weed whiting
Helcogramma decurrens black-throated threefin
Heteroclinus tristis Forster's weedfish / long-snouted weedfish #
Heteroclinus wilsoni Wilson's weedfish
Histiogamphelus cristatus rhino pipefish (4)
Hypoplectrodes nigroruber / nigrorubrum black-banded sea perch (1)
Hyporhamphus melanochir southern sea garfish (6)
Kathetostoma nigrofasciatum deepwater stargazer (5) #
Kyphosus sydneyanus silver drummer (1)
Lepidotrigla vanessa butterfly gurnard (5)
Leptatherina presbyteroides silver fish (1)
Leptoichthys fistularius brush-tail pipefish (4)
Leviprora inops longhead flathead (1)
Lotella rhacina largetooth beardie (1)
Maroubra perserrata sawtooth pipefish (6)
Maxillicosta meridianus southern gurnard perch (1)
Maxillicosta scabriceps little gurnard perch (4)
Meuschenia flavolineata yellow-striped leatherjacket
Meuschenia freycineti six-spined leatherjacket (3)
Meuschenia galii blue-lined leatherjacket
Meuschenia hippocrepis horseshoe leatherjacket
Meuschenia scaber velvet leatherjacket
Nemadactylus valenciennesi southern blue morwong / queen snapper
Nesogobius sp. 4 groove-cheeked goby (4)
Nesogobius sp. (unidentified sand goby)
Neoodax balteatus little weed whiting (1)
Neoaploactis tridorsalis threefin velvetfish (2)
Neosebastes bougainvillii gulf gurnard perch (3)
Neosebastes pandus bighead gurnard perch (1)
Neosebastes scorpaenoides common gurnard perch (1)
Neosebastes thetidis thetis fish (4)
Notolabrus parilus brown-spotted wrasse
Notolabrus tetricus blue-throated wrasse
Odax acroptilus rainbow cale
Odax cyanomelas herring cale
Othos dentex harlequin fish (1)
Omegophora armilla ringed toadfish
Ophiclinus antarcticus Adelaide snake-blenny (4)
Parablennius tasmanianus Tasmanian blenny
Parapercis haackei wavy grubfish
Paraplesiops meleagris southern blue devil (1)
Parapriacanthus elongatus slender bullseye
Parazanclistius hutchinsi short boarfish (4)
Parequula melbournensis silverbelly / southern silverbelly
Parma victoriae Victorian scalyfin
Pelates octolineatus western striped trumpeter
Pempheris multiradiata common bullseye
Pempheris klunzingeri rough bullseye
Pempheris ornata orange-lined bullseye
Pentaceropsis recurvirostris long-snouted boarfish
Phycodurus eques leafy sea dragon
Phyllophryne scortea smooth anglerfish / white-spotted anglerfish (4)
Phyllopteryx taeniolatus weedy seadragon (1)
Pictilabrus laticlavius senator wrasse
Platycephalus aurimaculatus toothy flathead (5)
Platycephalus laevigatus rock flathead / grass flathead (1)
Platycephalus speculator southern blue-spotted flathead (1)
Pseudocaranx georgianus silver trevally (1)
Pseudophycis bachus red cod (3)
Rhycherus filamentosus tasselled anglerfish (1)
Scobinichthys granulatus rough leatherjacket
Scorpis aequipinnis sea sweep (6)
Seriola lalandi yellowtail kingfish (1)
Seriolella punctata silver warehou (5) #
Sillaginodes punctatus / punctata King George whiting
Siphamia cephalotes Wood's siphonfish (3)
Siphonognathus caninus sharp-nosed weed whiting
Siphonognathus argyrophanes tubemouth
Siphonognathus attenuatus slender weed whiting (6)
Siphonognathus beddomei pencil weed whiting
Siphonognathus radiatus long-rayed weed whiting
Sphyraena novaehollandiae snook or short-finned pike
Stigmatopora argus spotted pipefish (4)
Threpterius maculosus silver spot #
Tilodon sexfasciatus six-banded coralfish / moonlighter
Trachinops noarlungae yellow-headed hulafish
Trachurus novaezelandiae yellowtail scad
Trinorfolkia clarkei common threefin
Trinorfolkia cristata crested threefin / crested triplefin (1) #
Upeneichthys vlamingii red mullet / blue-spotted goatfsh
Vincentia conspersa southern cardinalfish / southern gobbleguts (1)