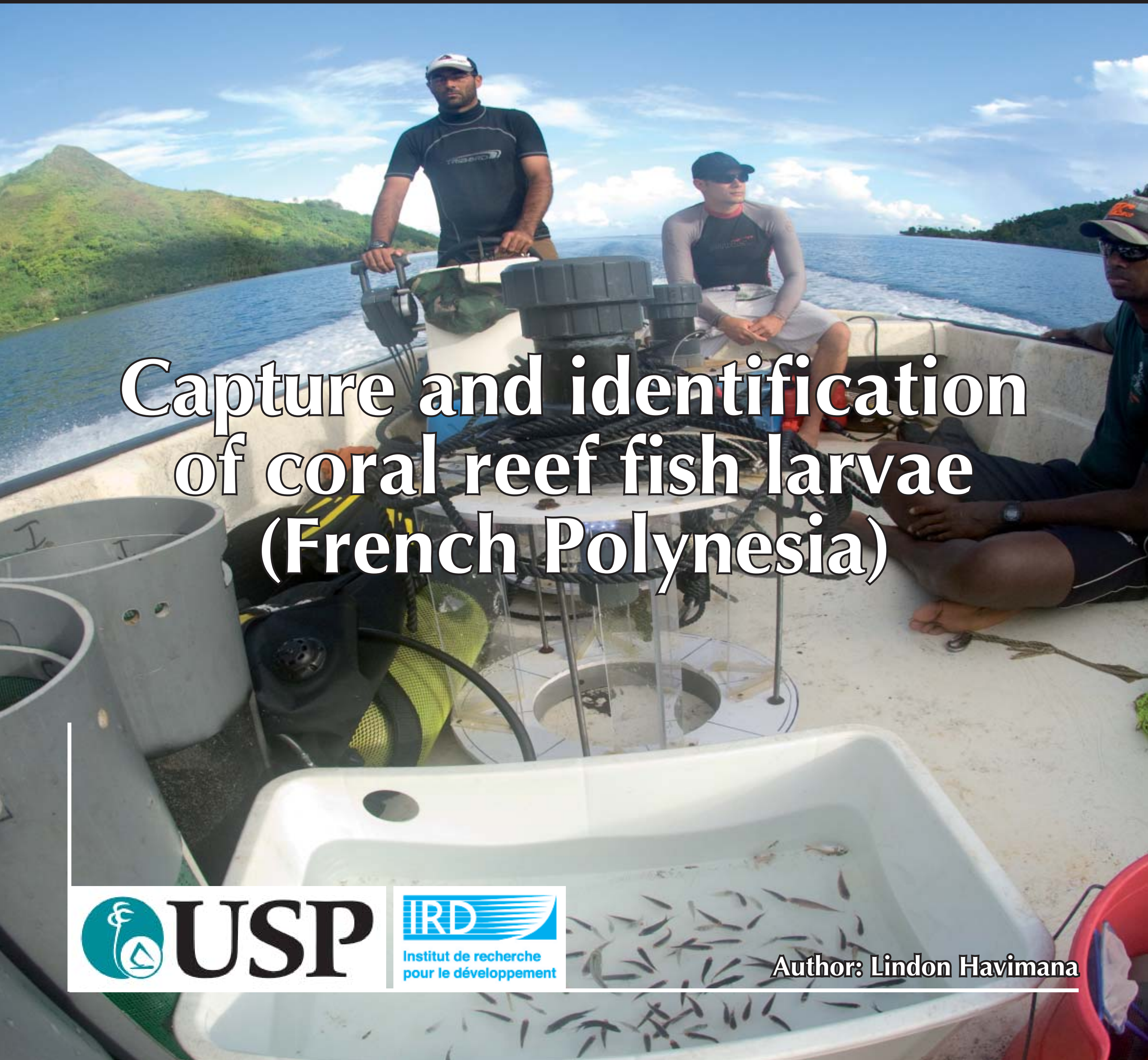
COMPONENT 3C - Project 3C8
New techniques of reef fish postlarvae capture

March 2010

Coral Reef InitiativeS for the Pacific
Initiatives Corail pour le Pacifique

TRAINING COURSE REPORT

Capture and identification of coral reef fish larvae (French Polynesia)



Institut de recherche pour le développement

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CRISP

Coral Reef InitiativeS for the Pacific
Initiatives Corail pour le Pacifique

SPREP/PROE

The CRISP Coordinating Unit (CCU) was integrated into the Secretariat of the Pacific Community in April 2008 to insure maximum coordination and synergy in work relating to coral reef management in the region.

The CRISP Programme is implemented as part of the policy developed by the Secretariat of the Pacific Regional Environment Programme to contribute to the conservation and sustainable development of coral reefs in the Pacific.

The Initiative for the Protection and Management of Coral Reefs in the Pacific (CRISP), sponsored by France and established by the French Development Agency (AFD), is part of an inter-ministerial project that began in 2002. CRISP aims to develop a vision for the future of these unique ecosystems and the communities that depend on them and to introduce strategies and projects to conserve their biodiversity, while developing the economic and environmental services that they provide both locally and globally. CRISP also, has a role in fostering greater integration in this area between developed countries (Australia, New Zealand, Japan, USA), French overseas territories and Pacific Island developing countries.

The initiative follows a specific approach designed to:

- associate networking activities and fieldwork projects;
- bring together research, management and development endeavours;
- combine the contributions of a range of scientific disciplines, including biology, ecology, economics, law and social sciences;
- address the various land and marine factors affecting coral reefs (including watershed rehabilitation and management);
- avoid setting up any new body but supply financial resources to already operational partners wishing to develop their activities in a spirit of regional cooperation. This is why the initiative was established on the basis of a call for proposals to all institutions and networks.

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This approach is articulated through a series of thematic objectives:

Objective 1: Improved knowledge of the biodiversity, status and functioning of coral ecosystems.

Objective 2: Protection and management of coral ecosystems on a significant scale.

Objective 3: Development of the economic potential represented by the use values and biodiversity of coral ecosystems.

Objective 4: Dissemination of information and know-ledge; and capacitybuilding and leadership with local, national and international networks.

The CRISP Programme comprises three major components:

Component 1A: Integrated coastal management and watershed management

- 1A1: Marine biodiversity conservation planning
- 1A2: Marine Protected Areas
- 1A3: Institutional strengthening and networking
- 1A4: Integrated coastal reef zone and watershed management

Component 2: Development of coral ecosystems

- 2A: Knowledge, beneficial use and management of coral ecosytems
- 2B: Reef rehabilitation
- 2C: Development of active marine substances
- 2D: Development of regional data base (ReefBase Pacific)

Component 3: Programme coordination and development

- 3A: Capitalisation, value-adding and extension of CRISP programme activities
- 3B: Coordination, promotion and development of the CRISP programme
- 3C: Support to alternative livelihoods
- 3D: Vulnerability of ecosystems and species
- 3E: Economic task force

CRISP is funded by the following partners:

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UNIVERSITY OF THE SOUTH PACIFIC

School of Marine Studies, Laucala Campus, Fiji

Capture and Identification of coral reef fish larvae (French Polynesia)

By Lindon Havimana

Training course conducted from the 24th January to 27th February 2010

Supervisors: David LECCHINI (IRD - UR 227 CoReUs)

Edward LOVELL, Milika SOBEY & Joeli VEITAYAKI (USP)

Bernard MAIZERET (French Embassy at Fiji Islands)

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Abstract

Coral reef fish larvae were sampled daily over 13 days using the crest net method on Moorea Island (French Polynesia). A total of 75 species were captured and identified with a total abundance of 2313 larvae. The most abundant were *Stegastus fasciolatus* (504), *Chrysiptera Leucopoma* (218), *Apogon yellow head* (172), and *Scorpaenopsis diabollus* (143). Environmental factors as such hydrodynamic features of the water mass above and in front of the reef crest could have also influence the colonisation. The supply of coral reef fish was modulated by the lunar phase, which is significantly more larvae being caught during the third quarter and the new moon. This tendency for the larvae to colonize the reefs during dark nights would be related to ecological factors such as predation.

1. Introduction

Today, coral reef ecosystems are under threat as a result of direct and indirect effects of overfishing and pollution from agriculture and land activities (Hughes et al. 2003). These are responsible for the major drivers of massive and accelerating reduction in coral species abundance that has caused wide spread changes in reef ecosystems over the past two centuries. Increased human population and improved storage and transportation have exponentially increased the scale of impacts on the reefs as well. For instance marketing of fishes and other natural resources have become global, supplying demand for reef resources have extend beyond their tropical sources (Hughes et al. 2003). These factors affect the well being of coral reefs and the associate reef fish result in reduction of biodiversity (e.g. Graham et al. 2006; Wilson et al. 2006) where in much severer cases leads into ecological shift (Hughes et.al, 2003).

In coral reef ecosystem, majority of the coral reef fish have a life cycle that includes pelagic phase lasted for three to six months, and sedentary reef phase (for review, see Werner 1988 – Fig. 1). At the pelagic phase, the larvae entre the pelagic region as a result of current and their swimming abilities which move them away from the reef. They undergo metamorphosis and swim back towards the reef using visual or sound cue to continue into juvenile development stage. Usually arrived over the reef crest at nights to avoid the predation pressure on them which this process is term as colonization (colonisation phase, Dufour and Galzin 1993). Upon colonizing the reef the predation is thought to be intense thus all marine larvae that arrived have been said to make ‘a suicide drop on the reef’ and face a ‘wall of mouths’ (Kaufman et al., 1992). Hours after the colonization, the fish larvae metamorphosed into juvenile stage and choose a suitable habitat base on coral habitat characteristics, and presence of conspecifics as well as the other species (for review, see Doherty 2002).

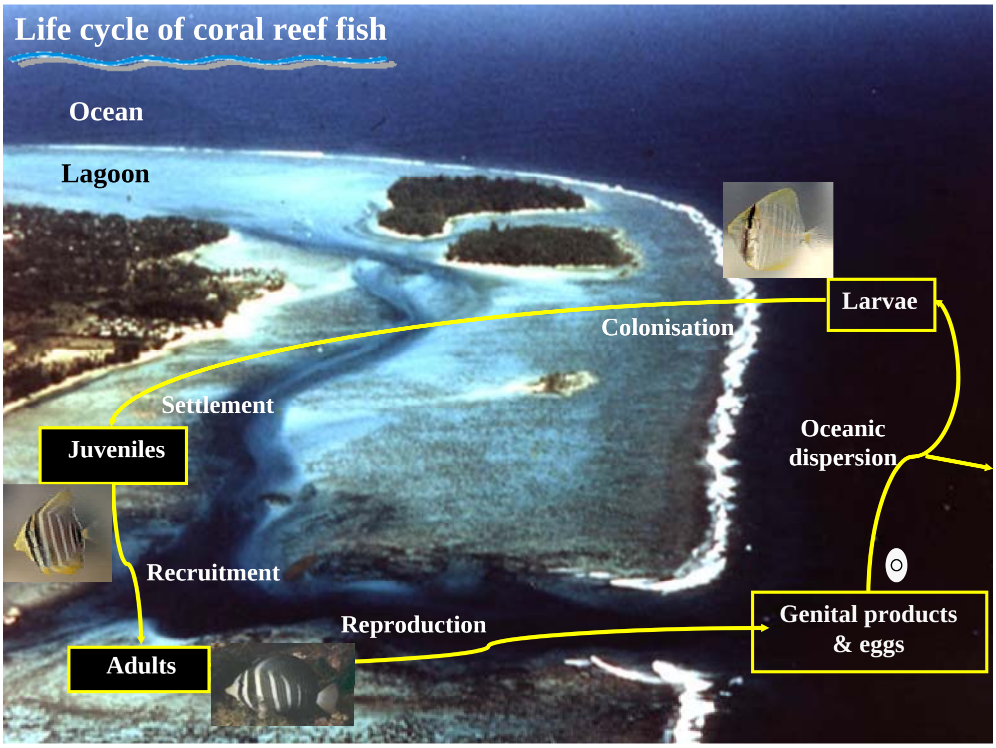

Figure 1: Description of life cycle of coral reef fish

The colonization process was observed to usually occur at night and in higher species numbers during new moon periods than in full moon periods (Lecchini et al. 2004) and this process concerns mainly post-flexion larval stage and juvenile stage (Dufour and Galzin 1993) since they can drift easily and passively over the reef crest (Sale 1991). Thus, crest net was the most suitable method that can be utilized to capture these larvae which actively filter larva from the incoming water from the ocean into the lagoon. Crest nets have a number of advantages over other methods (light trap, net either towed or dropped in the water column): (1) fish larvae are caught just before settlement, which would give a suitable measure of larval flux and supply; (2) the high energy and turbulence of the reef crest minimizes net avoidance by larvae; (3) since the net is put up for the night, the larvae cannot see the net thus it is a passive gear for easy larval capture (Dufour et al. 1996). On the other hand, light traps are used to sample reef fish larvae in their last few days before settlement, and they have been to a limited extent to investigate the vertical distribution of reef fish larvae in the field (Doherty and Carleton, 1997; Hendriks et al., 2001).

Moreover, in marine organisms that have a relatively sedentary stage and dispersive propagules, the size of adult stocks is set by a dynamic balance between input of propagules (larval colonisation) and their subsequent loss via death. Some studies demonstrated that predation may eliminate colonized larvae up to 30% to 90% during the first week of settlement, and the losses in some species possibly being as high as 60% on the first night of the arrival (see review by Doherty 2002). The larval supply at colonisation represents a real natural ichthyologic production of a fish adult stock, in number of individuals. As fish larvae stock is numerically more important than adult stock and the catches of aquarium fish are based upon a number of individuals (and less on biomass or size), it is preferable to encourage fishing pressure on larvae stock and rear them with aquaculture methods to increase their survival. Effectively, in the wild, 90% of larvae disappear before adult age. The adult breeding stock would be thus preserved and the colonisation rate would be the exploitable theoretical limit not to be exceeded (over-fishing).

This study aims to answer two questions: [1] To estimate the effectiveness of crest net in capturing of coral reef fish larvae. [2] How to identify post-flexion fish larvae to the lowest possible taxonomic classification.

2 Method and materials

2.1 Study area

This study was conducted at Moorea (17 30’S, 149 5’W), a high volcanic island in the society archipelago of French Polynesia (Galzin and Pointer, 1985). The island is16 km west of Tahiti Island and is encircled by a barrier reef which delimits the lagoon 800 to 1300 m in width and 2 m in depth with fringing reef lies adjacently to the land. The reef crest which separates the lagoon from the open ocean is almost permanently at sea level as a result of narrowly tidal range (annual maximum 0.3 m) that occurs around the islands (Dufour and Galzin 1993). The reef is intersected by Cook’s bay, Opunohu bay and the deep passages that cut through from the lagoon to the open ocean at the northern end of the island. According to previous oceanographic studies, the circulation of the water on the reef is portrayed as; wave breaking constantly occurring creates flux of fresh oceanic water over the reef crest into the lagoon. The water then remains there for 6 hours before channeling back into the open ocean as currents (Dufour and Galzin 1993).

Best site selection is one of the fundamental aspects that lead into informative report. The location for the crest net on the reef crest was (17°31’7.38”S, 149°55’20.89”W) at the western side of the islands between two marine protected area of Tetaiuo and Taotaha. The site was favoured because of the weak wave energy and narrow reef crest with lagoon lies next. These are important factors must be accounted for when setting up the crest nets.

Figure. 2. Moorea Island. French Polynesia, showing the sampling locations (source: Google earth).

2.2 Sampling methods

Capture of fish larvae for this study was done by crest net. The crest net was used to collect the larvae during the colonisation period. The net was fixed on the highest peak of the substrate of reef crest directly facing the open ocean. The codend was then allowed to extend into the lagoon and attached firmly by nylon strings bolted on the substrate to avoid being washed away by currents. The net was setup in the late afternoon for the whole night and was putted down in the morning. The larvae collected in the collector then transferred into the esky/bucket and transported to the aquaria room at CRIOBE by outboard motor engine for sorting and culturing. This method was done from 25 January to 25 February expect on moonlight nights and unfavourable weather conditions.

Crest net used in this study has three main parts, the entrance where the fish larvae enter, the separator designed to decrease mortality from desiccation and low oxygen concentration, and the collector where fish larvae trapped and collected. The size of the net was 1.5 m in width, 0.75 m in height, and 5 m in length with the mesh size of 1 mm. The entrance of the net was supported by nylon strings bolted as well on the substrate as illustrated by figure (b), and they must form letter (M) when erecting the entrance.

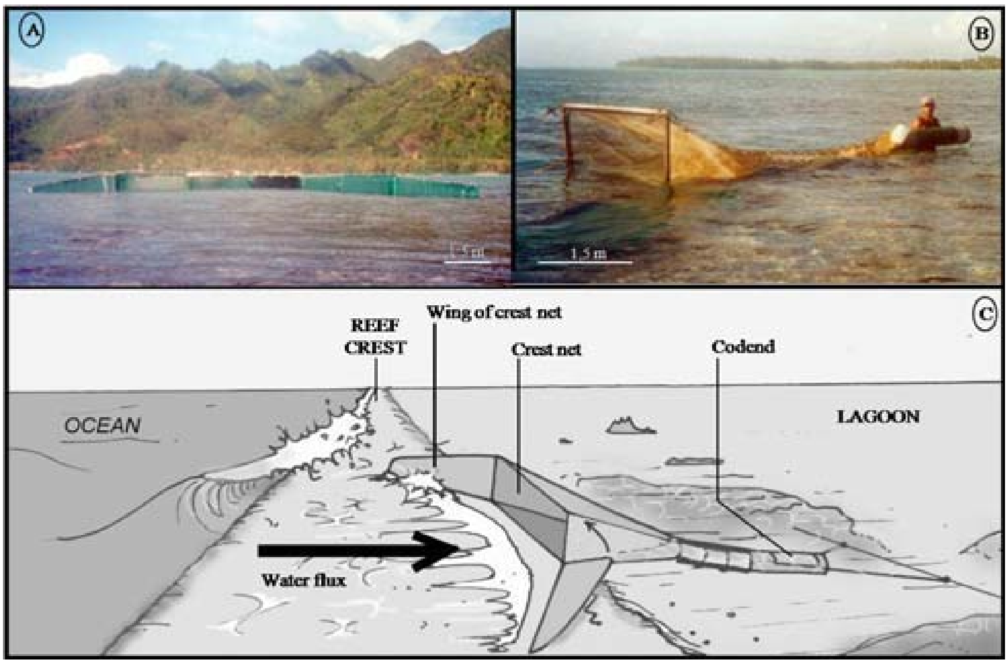

Figure 3. Illustration of crest net on the reef crest in Moorea. (A) is one method of setting up the crest net, the extending wings are meant to reduce biasness in the data collected. B is the method used in this study, however the sampling area is only 1.5 m in width thus chances of getting bias data is quite high. Finally C is the demonstration of how fluxes water bringing in fish larvae into the net.

2.3 Sorting and identification of fish larvae

Upon arrival at the aquaria laboratory aerators were added into the esky/ bucket to supply sufficient oxygen for the fish larvae. The larvae then sorted accordingly into their genera. Meristic and morphology characters of fish larvae were used to identify and differentiate them from other species. Guide to identification of fish larvae of French Polynesia was used as reference and confirmation purposes (Galzin et al. 2006). When sorting in each species was confirmed to be correct by the supervisor, the fish in each species were then counted and recorded and this was repeated in each day. Species that were not discovered from previous studies (Waqalevu study, 2009) were then transferred into larval rearing tanks to culture and taken their images. Ethanol was used as well for preserving the dead larvae that are important for later study. Images of all the identified fish species were taken as well as this would become an important future aid in identifying larvae and juvenile.

3. Result

Fish larvae captured with crest net - A total of 2313 larvae belonging to 75 species were collected over four sampling weeks. However, this number accounted only for 13 days of the whole study period due to cyclones badly hit French Polynesia, thus crest net was not set up. The average count for the 13 sampling days was 178 larval fish per day.

Below is the total count recorded in each day of the sampling period. The most abundant species were *Stegastus fasciolatus* (total abundance = 504), *Chrysiptera Leucopoma* (218), *Apogon yellow head* (172) and *Scorpaenopsis diabollus* (143). It was noted that the highest count was recorded during the new moon phase, thus it confirmed that colonisation depends on lunar cycle.

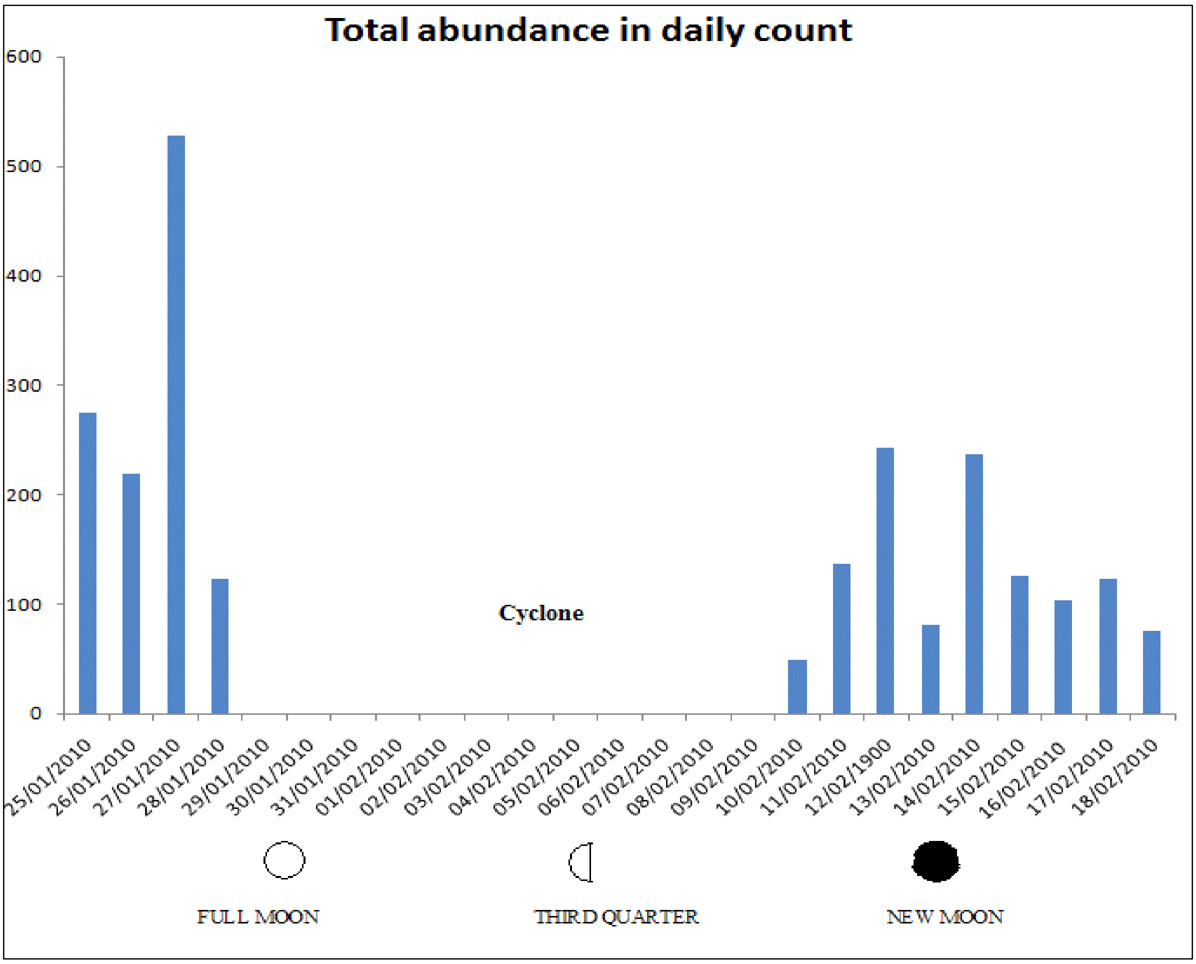

Figure 4: Illustration of how lunar cycle affects the colonisation.

Species richness is the number of species counted in each day. It was noted that diversity of species are also influenced by lunar cycle as well. It increased during new moon and decreased during full moon. The fish families that have many species counted were Acanthuridae (10), Pomacentridae (9), Apogonidae (7), and Holocentridae (7).

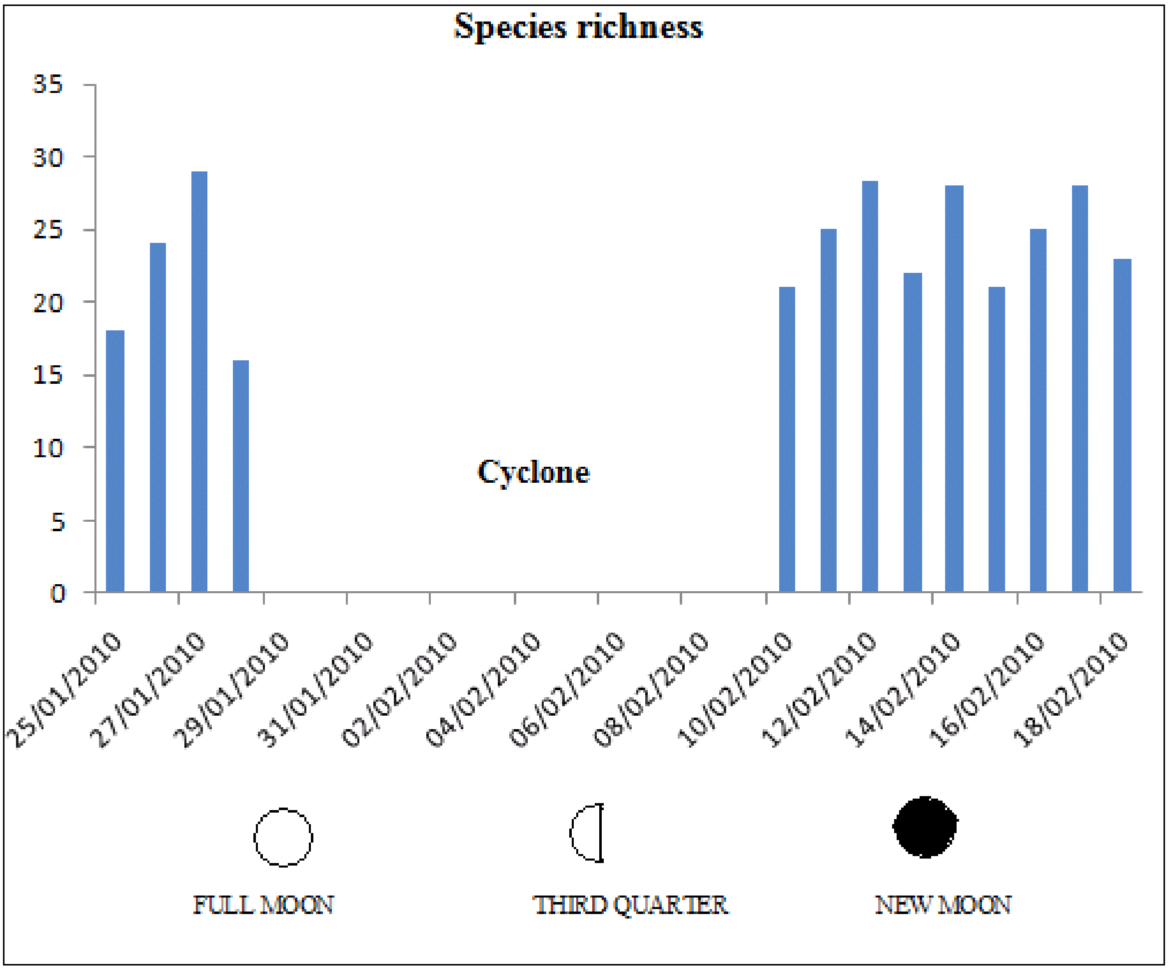

Figure 5: Number of species captured in each sampling nights.

The table summarised the total counts of fish larvae, total number of species counted in 2009 and 2010 sampling period. Numbers of sampling days are given to determine the catch per unit effort of the crest net in total count and species in two different years.

Year	**Total count**	**Total species**	**Sampling days**	**Counts/day**	**no of species/day**
2009	1208	71	18	67.1	3.94
2010	2313	75	13	178	5.77

Table 1. Statistical analysis of crest net in its catch per unit effort in two years. Last year the CPUE was 67.1; however this it increased to 178 catch per day.

Sample calculation

CPUE (total count) = 1208/18 = 67.1

CPUE (species) = 75/13 = 5.77

The graph illustrates that daily total abundance in 2009 is less than what it is in 2010. Despite the difference, both are influenced by lunar cycle.

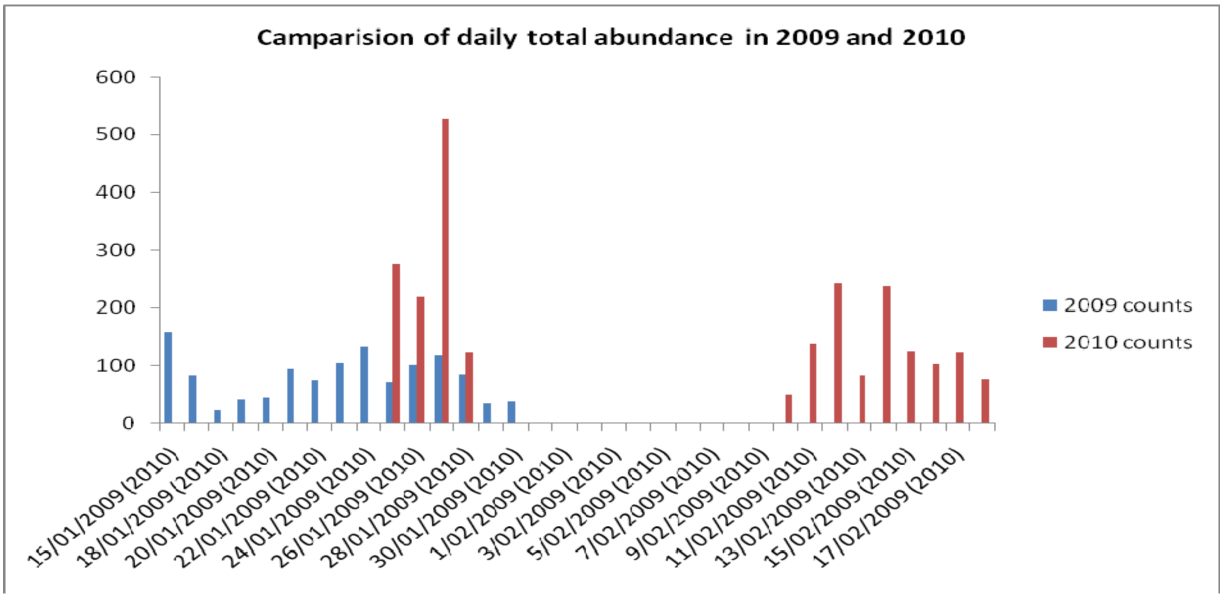

Figure 6. Comparison of daily counts in 2009 and 2010.

The graph illustrates that daily number of species counted is 2010 is more than in 2009. But species abundance is depends on the lunar cycle as well. Higher during new moon and less in full moon nights.

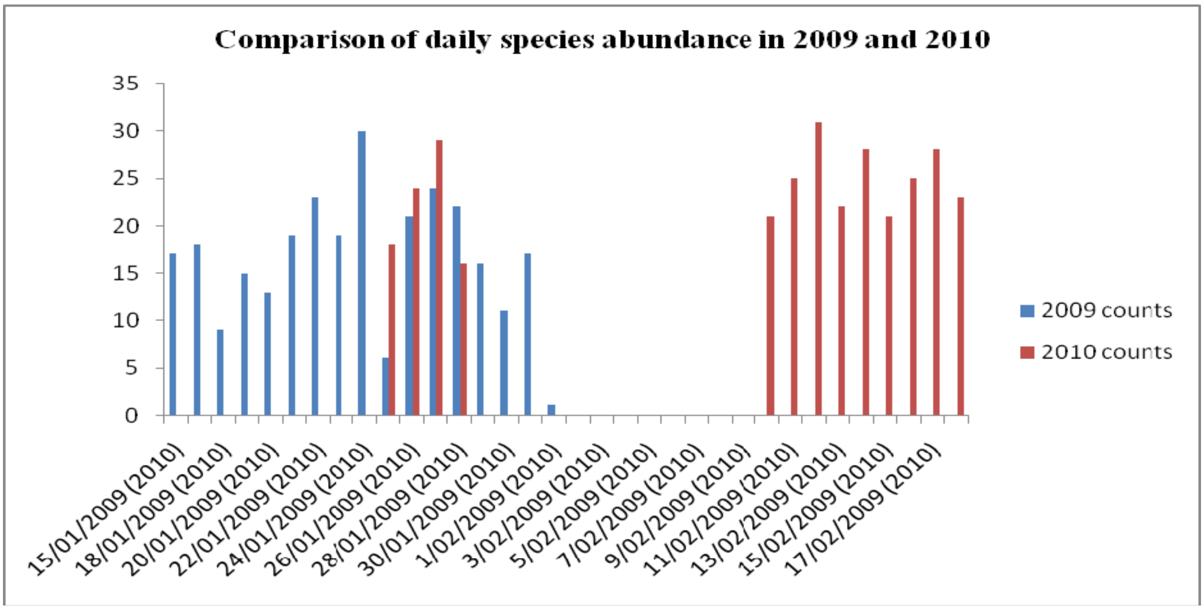

Figure 7. Comparison of daily counts in 2009 and 2010.

4. Discussion and Conclusion

Crest net has been used to sample coral reef fish larvae since 1988 (Dufour and Galzin 1993) and has been proved a successful method to capture larvae at the end of their pelagic life stage. It was noted that colonization pattern of larvae are dependent on the lunar cycle, as it is observed in the results. This pattern also varies at species level, where different species prefer to colonize at different times; this could be due to certain ecological processes (e.g. presence of predator, food, strength of waves, etc). Peaks of larval flux occurred during moonless periods of the nights (Dufour and Galzin 1993), being evident during new moon and first quarter of the lunar cycle.

In this comparative study (compare to Waqalevu report in 2009), the catch per unit effort of this year total abundance was really higher (178 vs 67.1), except for species diversity which is much closer (5.77 vs 3.94) even though the study was conducted only for 13 days, while Waqalevu study was 18 days. According to Jenkins and Black (1994), the supply of larvae from offshore regions to nursery areas may be controlled by the circulation through tidal inlets and the retention within nursery region. However, Dufour and Galzin (1993) further argued that the correlation between larval flux and water flow (current) is not constant, except for wave’s height. This study proves that Dufour and Galzin (1993) argument seems to be right, despite the shorter sampling period compared to Waqalevu sampling period, since total abundance were higher and wave heights were higher as well as a result of three cyclones badly hit French Polynesia.

In terms of the species diversity in daily counts, this year accounts higher number (5.77 vs 3.94). This signifies that species diversity of French Polynesia is still in a sustainable condition. This could be right because coral over on the reefs are in good health, thus, diverse species of associated coral reef fish are well supported (Syms and Jones, 2000).

During identification of fish larvae it is important not to rely so much on meristic character of the fish. Some fish may become stressed and change colour during sorting. For instance, *Chenochaetus striatus* orange horizontal bands become more pronounced when they are stressed thus making it more like *Acanthurus lineatus.* To avoid that, this study based the identification of fish larvae on their meristic, morphology characters and their length. In addition, sources of stresses were limited by supplying sufficient oxygen, avoiding touching them frequently, and changing the water quality continuously.

To conclude, colonisation of fish larvae is influenced by the lunar cycle, and it seen to be higher during moonless night, as this is due to ecological factors (predation, temperature, ocean circulation, etc). The efficiency of the crest net in filtering fish larvae in the incoming water depends on the wave height. Current and wind may also contributed, but their influence is not constant (Dufour and Galzin 1993), these may be due to shearing force exerted by water against wind actions resulting in change of direction from that of wind. It is now understood that fishing pressure should be emphasised on post-larval stock and rear them with aquaculture techniques to increase their survival, since 90% of larvae disappear before adult age (Doherty 2002). The adult breeding stock then would be preserved, and the colonization rate would be the exploitable theoretical limit not to exceed.

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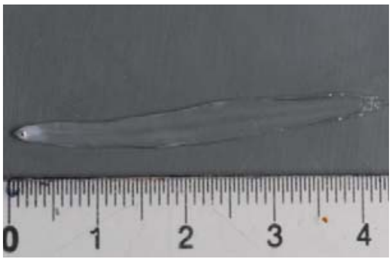
ANNEX 1: CAPTURE OF FISH LARVAE WITH CREST NET.

Family	Species List	ABD
Acanthuridae	*Acanthurus lineatus*	2
	Acanthurus olivaceus	1
	Acanthurus triostegus	118
	Acanthurus xanthopterus	2
	Ctenochaetus striatus	50
	Naso brevirostris	2
	Naso lituratus	0
	Naso uniconis	2
	Naso vlamingii	5
	Zebresoma scapas	1
Albulidae	*Albula glossodonta*	9
Apogonidae	*Apogon fraenatus*	109
	Apogon exostigma	7
	Apogonichthys ocellatus	40
??	*(Apogon yellow head)*	172
??	*(Apogon black head)*	32
	Ostorhinchus angustatus	1
??	*(Apogon longfin)*	6
Aulostomidae	*Aulostomus chinenesis*	2
Balistidae	*Rhinecanthus aculeatus*	7
Blennidae	*sp1 (small)*	7
	sp2 (longest)	4
	sp3 (medium)	4
Bothidae	*Bothus mancus*	13
Carapidae	*carapus spp*	2
Chaetodontidae	*Chaetodon auriga*	5

	Chaetodon citrinellus	3
	Chaetodon ephippium	4
	Chaetodon qudrimaculatus	1
	Chaetodon trifascialis	1
Fistulariidae	*Fistularia commersoni*	3
Gobiidae	*Valenciennea strigata*	9
	Gobiidae spp	72
Holocentridae	*Myripristis berndti*	3
	Myripristis kuntee	12
	Myripristis pralinia	38
	Neoniphon argenteus	51
	Neoniphon sammara	7
	Sargocentron microstoma	141
	Sargocentron spiniferum	15
Kuhllidae	*Kuhlia mugil*	2
Labridae	*Thalassoma hardwicke*	20
Lathrinidae	*Monotaxi grandoculis*	12
Lutjanidae	*Lutjanus fulvus*	0
	Lutjanus Kasmira	4
Microdesmidae	*Ptereleotris micropelis*	1
Miranidae	*Miranidae spp*	9
Mullidae	*Parupeneus barberinus*	11
	Parupeneus multifasciatus	16
Mugilidae	*Mugil*	2
Pomacentridae	*Abudefduf sexfasciatus*	1
	Stegastes fasciolatus	504
	Stegastes lividus	2
	Stegastes nigricans	25

	Chromis viridis	107
	Dascyllus aruanus	21
	Chrysiptera glauca	4
	Chrysiptera leucopoma	218
	Pomacentrus pavo	17
Ptereleotridae	*Ptereleotris spp*	8
	Chaetodon lunulatus	1
	Scorpaenodes gaumensis	129
	Scorpaenopsis diabolus	143
Scaridae	*Scaridae spp*	8
Serranidae	*Epinephelus merra*	3
	Grammistes sexlineatus	2
Siganidae	*Siganus spinus*	1
Soleidae	*Soleidae spp*	2
Sphuraenidae	*Sphyraena barracuda*	1
Syngnathidae	*Corythoichthys flavofasciatus*	1
Synodontidae	*Saurida gracilis*	39
Synodontidae	*Synodontidae spp*	1
Tetraodontidae	*Canthigaster bennetti*	3
Zanclidae	*Zanclus cornutus*	5
Muranidae	sp???	27

Annex 2: Coral reef fish larvae photographs.



Albula glossodonta -45mm

Abudefduf sexfasciatus-14mm

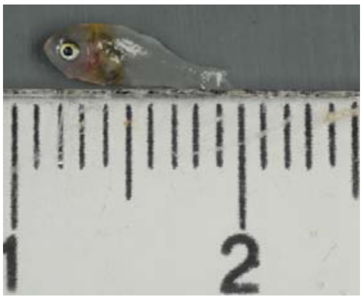
Acanthurus lineatus-33mm

Acanthurus olivaceous-31mm

Acanthurus triostegus-25mm

Acanthurus xanthopterus-28mm

Apogon exotigma-30mm

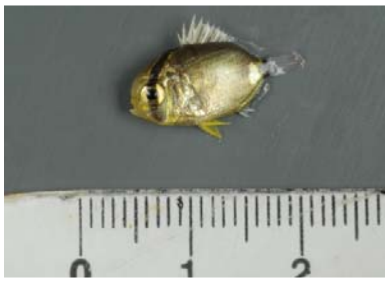


Apogon Yellowhead-7mm

Apogon longfin-23mm

Aulostomus chinensis-150mm

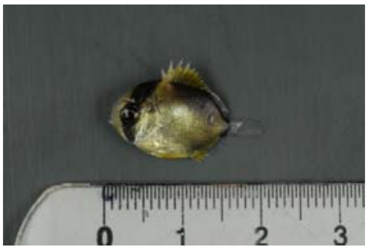
Blennidae spp longest-19mm



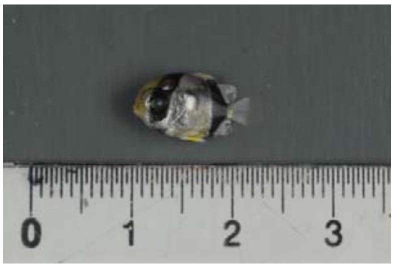
Chaetodon lunulatus-14mm

Chaetodon auriga-20mm

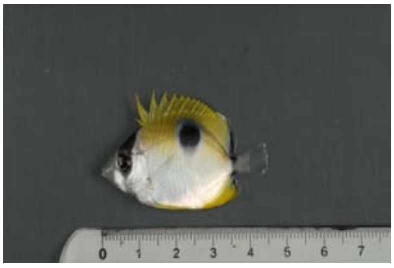
Chaetodon cirinelus-30mm.



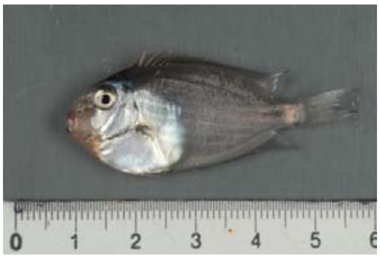
Chaetodon ephippium-16mm.



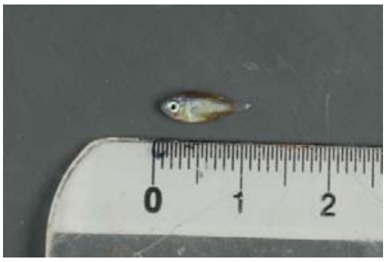
Chaetodon trifascialis-10mm.



Chaetodon unimaculatus-40mm.

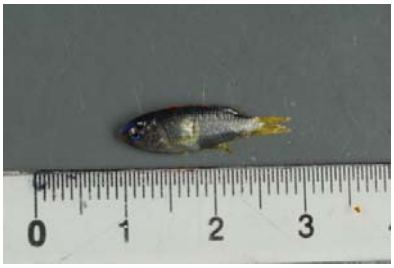


Chetochaetus striatus-39mm.



Chromis viridis-9mm.

Chrysiptera. glauca-15mm.

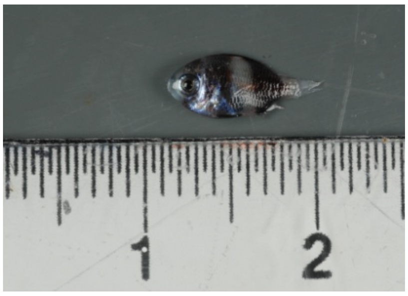


Chrysiptera. glauca-16mm.

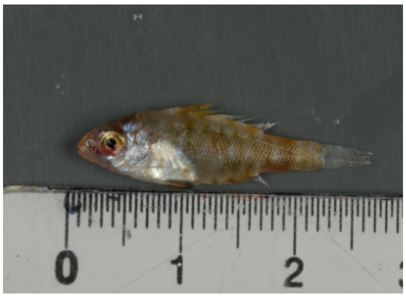
Chrysiptera leucopoma-16mm.

Clupidae spp-31mm.

Ctenochaetus striatus-43mm.

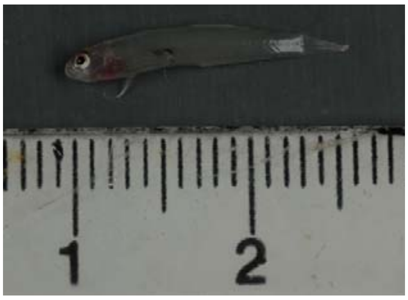


Dascllus aruanus-8mm.



Gnathodontex aureolineatus-22mm.

Gobi spp2-13mm.



Gobiidae spp.-15mm.

Grammistus sexlineatus-11mm.

Kuhlia mugil-27mm.

Lutjanus kasmira-27mm.

Monotaxis grandoculis-39mm.

Mugil mugil-30mm

Mulloidichtgys flavolineatus-85mm

Myripristis pralina-40mm

Myripristus kantee-37mm

Naso lituratus-61mm

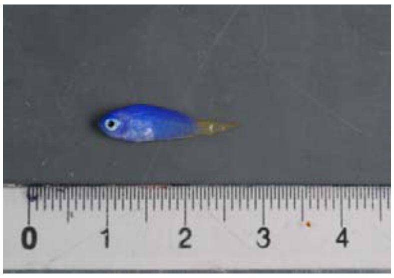
Naso vlamingii-45mm

Neoniphon argenteus-34mm

Sargocentron microstoma-50mm

Parupeneus barberinu-42mm

Parupeneus mutifasciatus-59mm

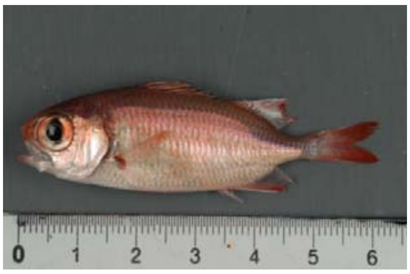


Pomacentrus pavo-14mm

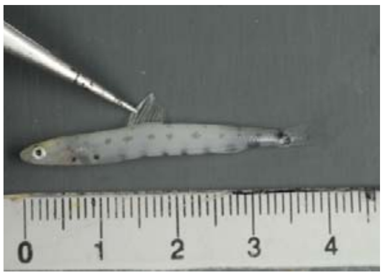
Ptereleotris microlepis-25mm

Rhinecanthus aculeatus-21mm

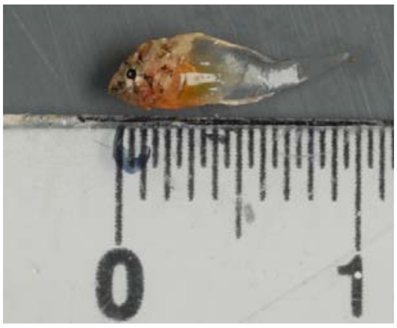
Sargocentron microstoma-50mm



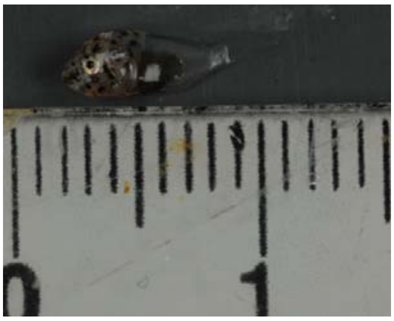
Sargocentron spiniferum-51mm



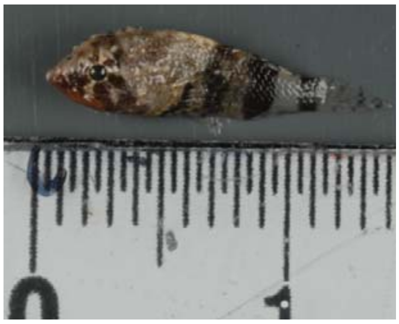
Saurida gracilis-36mm



Scopaenopsis diabollus-8mm

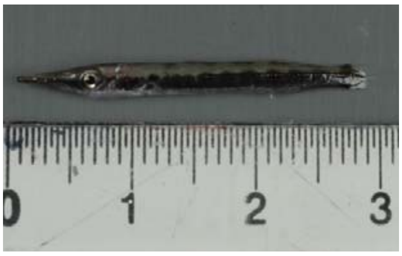


Scorpaenopsis diabolus-7mm



Sebastapistes strongia-11mm

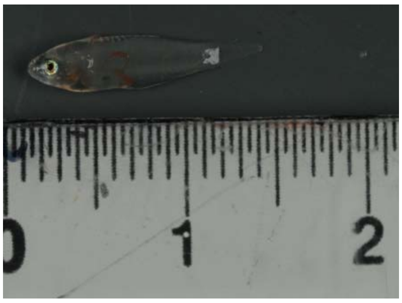
Siganus spinus-38mm



Sphyraena barracuda-23mm

Stegastes. lividus-16mm

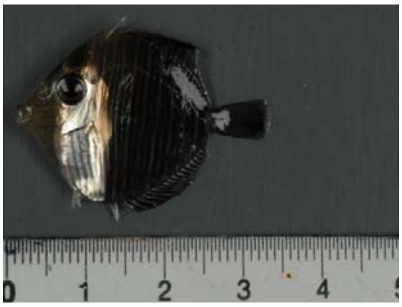
Stegastes fasciolatus-13mm



Thalassoma hardwicke-11mm

Valencienna strigata-39mm

Zandus cornutus-53mm



Zebrasoma scopas -26mm