

■ NEARSHORE FISHERIES DEVELOPMENT AND TRAINING SECTION

Review of the WWF pilot fish aggregating device in the Galapagos Islands

During July 2008, SPC's Fisheries Development Officer, Steve Beverly, conducted a project review in the Galapagos Islands, Ecuador in South America. The two main objectives of the review were to 1) evaluate a pilot fish aggregating device (FAD) project that the World Wildlife Fund (WWF) and Galapagos National Park (GNP) are currently implementing in the archipelago in coordination with the fishing sector, and 2) to work with local technicians to evaluate and improve the performance of the anchored FADs, the fishing techniques used, and the monitoring system in place. The objective of the pilot FAD project, which only allows the use of handlines in fishing, is to provide an economic alternative for artisanal fishermen, allowing them to spend less time and money in catching more valuable species such as bigeye and yellowfin tuna, and to reduce fishing pressure on other resources, such as sea cucumbers and lobsters. The pilot FAD project is a first for the

Galapagos so they called on the expertise of SPC's Nearshore Fisheries Development and Training Section for assistance. The Galapagos Island's fishery was experiencing the same problems that have beset fisheries in many Pacific Island countries. The review was funded by WWF Galapagos.

The Galapagos Islands (Fig. 1) is an archipelago of volcanic islands that straddle the equator in the eastern Pacific Ocean about 1000 km west of continental Ecuador. The archipelago comprises 128 islands and islets, the largest of which are Isabela, Santa Cruz and San Cristobal. The total land area is 7880 km² with a coastline of 1800 km. The archipelago sits on a submarine platform with depths ranging from 1000 m to 3500 m, but the main islands sit on a central platform with depths generally less than 500 m. The islands are affected by three oceanic current systems: the Panama Current from the northeast, which is warm and nutrient

poor; the colder Humboldt Current from Chile and Peru; and the nutrient-rich equatorial Cromwell Counter-current from the west. Because of the upwellings caused by the latter of these currents, the waters around the Galapagos Islands are rich in flora and fauna.

Of the 100 or so marine species caught in the Galapagos artisanal fisheries, only a small number are actually targeted. Among these are sea cucumbers (pepino de mar – *Isostichopus fuscus*), two species of spiny lobsters (*Panilurus pencillatus* and *P. gracilis*), several bottom and demersal fish species (e.g. *Mycteroperca olfax* and *Epinephelus mystacinus*), and pelagic species such as yellowfin and bigeye tuna (*Thunnus albacares* and *T. obesus*) and billfish (*Xiphias gladius*). Recently (2002–2003), the most lucrative of these fisheries has been sea cucumbers (worth USD 3.7 million/year), followed by lobsters (USD 1.1 million/year), and finfishes (about USD 0.7 million/year). Because of the lucra-



regulations and management plan, FAD fishing techniques, and monitoring and data collection.

The Galapagos FADs have very robust cylindrical buoys made from fiberglass and foam with inner steel spars (Fig. 4). They are equipped with lights, batteries, solar panels, radar reflectors, and padeyes for attaching boat mooring lines. Galapagos fishermen refer to FADs as *plantados* (planted), and the FAD buoys with lights and radar reflectors are called *cabezas* (heads). Aggregators are called *pantallas* (screens) or *cuerpos agregadores* (aggregating bodies). The mooring line is called *línea de anclaje* (anchor line) and the anchor block is called *durmiente* (sleeper) or *muerto* (dead).



Steve went on a fishing trip to one of the FADs on a 7-m fiberglass boat powered by a 75 HP outboard motor. As soon as they reached the FAD they began trolling, using handheld 100 m x 3.5 mm braided nylon lines with 10 m x 1.0 mm nylon monofilament sections and 0.5 m wire traces, ending with Rapala Magnum lures. The catch on the trolling lines was 20 small yellowfin tuna (Fig. 5) and 2 small mahi mahi. At dusk, they tied to the FAD and had dinner while waiting for the waning full moon to rise. When the moon came up they started fishing with the same lures they trolled with, jigging these about 15–25 m behind the boat, in the current but not on the surface (sinking them to 15–20 m). The catch was seven larger yellowfin tuna of



Figure 4. Galapagos FAD.

Figure 5. Small yellowfin tuna caught on a Rapala Magnum lure while trolling near the FAD.

Figure 6. Large yellowfin tuna caught on the same Rapala Magnum lure while the boat was tied to the FAD.

about 15 to 25 kg each (Fig. 6). Total catch was 29 fish, weighing 170 kg, which were sold the same morning for USD 2.00/lb (USD 4.40/kg). The captain said that they usually get catches like that around the full moon. He also said that his break-even point for a one-day trip was around 182 kg (400 lb) of fish,

Galapagos fishermen use three FAD fishing techniques (*artes de pesca en asociación con plantados*) aimed at capturing pelagic species. These include vertical longlining (*empate oceanico*), handlining (*línea de mano*), and trolling (*línea de arrastre, or troleo*). It has been suggested that the law should be changed to allow alternative fishing techniques, using mechanized reels — either hand reels or electric reels — but use of these devices would require a revision of the Galapagos Special Fishing Law. The Galapagos Special Fishing Law specifies the types of fishing gear that can be used by artisanal fishermen in the Galapagos Marine Reserve, but there are no regulations limiting the number of lines or hooks that each boat can use.

Steve provided a comprehensive report to WWF, making several recommendations to improve the FAD project, including:

- A FAD project manager should be selected to oversee all project activities, including keeping an inventory of FAD materials, coordinating FAD monitoring, catch and effort data collection, data analysis, economic analysis, and ongoing FAD maintenance;
- The FAD design should be reviewed and some changes should be made. Indian Ocean type FADs equipped with radar reflectors and lights would result in a substantial cost savings although they have disadvantages in comparison to a spar buoy design (lower visibility and boats cannot tie to them);
- A FAD maintenance check list should be written and distributed to all the fishing cooperatives. A check list will not only serve as a reminder for all of the components that need to be inspected, cleaned, and repaired, it will serve as a record for the FAD project manager to assist in ordering new materials and conducting more vigorous maintenance visits;
- The FAD project should adopt a simple form to collect data directly from the fishermen — something similar to SPC's Canoe/FAD Monitoring Logsheet — and avoid complicated forms that fishermen are likely to ignore. Logsheets should concentrate on catch and effort, fishing techniques, sea conditions, trip expenses, gross and net revenue, and bycatch;
- A port sampler project should be initiated in order to obtain more detailed data on catch, including species, fork length, weight, deposition, revenue, etc. Port samplers could interview fishermen upon returning to port in each of the three fishing centres in order to collect relevant information. All fish could be measured (fork length) upon unloading and a value could be placed on the catch based on observed sales or based on interviews or market trends;
- WWF should lobby the government to allow small-scale reels into the FAD fishery, such as the FAO wooden hand reel;
- Vertical longlines should be rigged so that there are no hooks in the upper 50–100 m of the water column, circle hooks should be used on longlines, and de-hookers should be carried by all boats; and
- WWF and GNP should initiate more workshops on FAD fishing techniques and proper fish handling for the fishing cooperatives, and include topics such as making your own FAO wooden hand reel, vertical longline fishing, *palu ahi* and other handline fishing methods, on-board handling of sashimi grade tuna, and tuna grading.



Assistance to a domestic longline company in the Cook Islands

In September, Steve went to Rarotonga, Cook Islands to offer assistance to a domestic longline company and to make two presentations to the Cook Islands Tuna Industry Conference, which was organised by the Cook Islands Marine Institutional Strengthening project.

Last year Steve was in the Cook Islands for two months assisting the Rarotonga-based domestic longline fishery (see *Fisheries Newsletter #122*). One of the outcomes of that project was a suggestion that larger boats may do better as they were able to fish more of the EEZ in the southern

Cook Islands. The domestic fleet at the time averaged just 14 m in length, and all were conducting shallow sets without using a line setter. One operator, Land Holdings, purchased a larger (18 m) longline vessel in 2008, but was still experiencing difficulties. They asked the

Ministry of Marine Resources (MMR) to request further assistance from SPC.

Steve went on one longline trip on the new vessel, F/V *Gold Country* (Fig. 1), and determined that the boat was fishing the same way the smaller boats were fishing during his 2007 visit: short trips in close proximity to Rarotonga. Figure 2 shows the Argos track of the fishing trip. Note that the trip was brief — only four sets were made — and that all sets were made within a range of about 75 nm from Rarotonga. Even though F/V *Gold Country* had an operating range greater than the other vessels in the Rarotonga-based fleet, it was not taking advantage of this capability. In addition, the boat was not using a line setter (shooter), even though the company had purchased one when they bought the boat in early 2008. Steve recommended that Land Holdings mount the line setter on F/V *Gold Country* and then begin a campaign of expanding their range so that they could explore the rest of the southern Cooks fishery and better target bigeye and albacore tuna.

The first presentation that Steve gave to the Cook Islands Tuna Industry Conference was titled “Improving fishing performance in the domestic longline fishery”. The presentation outlined three themes: increasing fishing effort, improving CPUE, and increasing revenue. The second presentation was given jointly with Pam Maru of MMR and Dr Yonat Swimmer of the US National Marine Fisheries Service in Hawaii, and introduced a planned hook exchange programme that will likely take



Figure 1 (top). F/V *Gold Country*.

Figure 2 (bottom). Argos track of F/V *Gold Country*'s longline fishing trip from 8–13 September 2008.

place in the Cook Islands during 2009. The plan is to replace all of the longline hooks currently being used by the domestic fishery, with standardised stainless steel tuna circle hooks, probably 16/0 hooks without the ring. These hooks have been found to help mitigate the capture of some

bycatch species, especially sea turtles, and to help with post-release survival if these species are hooked. Data will be recorded on all fishing trips, and results will be compared with past data from trips where hooks were not standardised.



FAD fishing methods and small boat safety workshop in Suva, Fiji Islands

BACKGROUND

Fiji's Department of Fisheries' Capture and Development Section are tasked with maintaining the development of safe and sustainable small fishing boat operations to ease the burdens of operational costs on artisanal and small-scale commercial fishermen throughout Fiji. Rising fuel costs and declining catch rates have significant adverse effects on the fishermen's capabilities to return home with a profitable catch; therefore, any intervention by Fiji's Department of Fisheries to alleviate these burdens are very much welcomed by the fishermen.

The fishermen are categorised into four groups:

- Fishermen who troll for pelagic species around FADs and running schools.
- Inshore and offshore fringing reef slope fishermen using hand-lines and nets.
- Night divers for reef fish.
- And fishermen who carry out a combination of these fishing activities.

While contemplating assistance to these fishermen, the Fiji Department of Fisheries had to keep in mind the declining inshore reef stocks that are evident in areas adjacent to most of the heavily populated urban coastlines.

The current preliminary solution is to implement FAD programmes in strategic areas to encourage fishermen to fish for pelagic species — as an alternative to reef fish — so that reef species are given an opportunity to recover. Fishermen will need to be taught several basic, but effective, FAD fishing methods that will enable them to use

FADs fully and enhance their chances of returning with a payload catch. Most FAD fishermen only troll around FADs, which consumes considerable amounts of fuel.

The FADs are not being used to their full capacity, as very few fishermen went midwater fishing for the larger yellowfin tuna that can be found at deeper depths than the one's caught during trolling. Midwater jigging for skipjack tuna and other pelagic fish can also result in big catches if it is done right. The fuel consumption will be an affordable fraction compared to trolling, because midwater jigging requires long periods of drifting with periodical use of the engine to return to the vicinity of the FAD.

In support of this, the Fiji Department of Fisheries requested SPC's assistance with implementing a FAD fishing methods workshop targeted at training select fishermen from the Suva–Nausori area as well as Department of Fisheries officers, to acquire the skills to replicate this training in other centres around Fiji.

SPC's Fisheries Development Officer, William Sokimi, was assigned to conduct the FAD fishing methods and small boat safety workshop in Suva from 12 July–2 August, focusing on safe and sustainable fishing operations for small boat, off-shore fishermen.

While fishing methods application was an important part of this workshop, equally important was:

- dissemination of information on the safety aspects of handling small boats and conducting small-scale fishing operations;

- care and handling of fish onboard as well as during processing;
- processing the catch for local and export markets;
- keeping records of all aspects of the fishing operations; and
- basic financial management of small-scale commercial fishing operations.

William worked with and advised the selected Fiji Department of Fisheries Capture and Development Section staff in all aspects of conducting the workshop, including planning, preparation, briefing on safety and small boat operations, briefings on fishing methods, constructing fishing gear, implementing Safe Operation Plans (SOPs), pre-fishing trip procedures, practical fishing trips, anchoring procedures (using grapnel anchor and sea anchor), post fishing trip procedures, care and handling of the catch, fish processing, stowing fishing gear and equipment, record keeping using logbooks, and basic small fishing operations financial management.

WORKSHOP BRIEF

Classroom sessions were carried out over two days to brief participants on:

- Safety aspects of handling small boats at sea. Emphasis was placed on this topic to highlight the importance of implementing SOPs and basic safety awareness when fishing or operating boats.
- Fishing methods that would be used during the workshop.
- FADs: what they are and how they function.
- Fishing gear components and tools.

- Fishing gear for various types of midwater fishing methods.
- Care of fishing gear, unused components and tools.
- Basic onboard hygiene.
- Care and maintenance of fishing boats.
- Proper onboard handling of fish and icing the catch.
- Handling and processing of fish for local and overseas fish markets.
- Maintaining catch records.
- Maintaining operations records and financial records for small commercial fishing operations.



A four-part PowerPoint presentation was given, covering all of the workshop topics. Notes on the PowerPoint presentation, handbooks and pamphlets were issued to participants to encourage them to keep up with the presentation. A display of the tools and several fishing gears were presented for the participants' perusal (Figs. 1 and 2).



DVDs were used to illustrate safety, fish handling, fish markets, hygiene and small commercial fishing business requirements.

Two days were dedicated to constructing fishing gear and setting up the boats for fishing trips (Fig. 3).



Figure 1 (top). Fishing gear used during the workshop.

Figure 2 (middle). Manuals and DVDs used during the workshop.

Figure 3 (bottom). Participants constructing fishing gear.

Gear for six types of fishing methods were constructed for the practical fishing sessions; however, other FAD fishing methods were discussed and notes were delivered on the construction methods for these.

The six methods focussed on were:

- Chum bag scatter bait weighted jigging rod
- Bait jigging
- Live bait fishing
- Mahi mahi line, and
- Trolling (with multiple lures on one mainline to maximise catch effort).

Four days of the workshop were spent in practical fishing operations, using the six fishing methods. On the last day, certificates were issued.

SUBSURFACE FISH AGGREGATING DEVICES AND FISHING GROUNDS USED DURING THE WORKSHOP

In late 2007, two subsurface FADs were deployed off Suva as part of the Japan International Cooperation Agency (JICA) course on community-based fisheries diversification in Pacific small island states (Fiji study). One subsurface FAD was deployed off Nukubutho sandbank in position 18°13.49'S; 178°27.13'E, while the other subsurface FAD was deployed off Naqara Island in position 18°13.47'S; 178°18.52'E.

Although the subsurface FADs could not be seen, large schools were sighted in the vicinity and so these FADs were used as the primary fishing grounds during the workshop. Additionally, a surface FAD, which was deployed three weeks prior to the commencement of the workshop, 2 nm east of Suva Harbour passage, had drifted to

only 0.5 nm from the passage, and about the same distance offshore. This FAD was used during bad weather but, because it had drifted close to the passage, the Harbour Master requested that the surface bamboo aggregator be removed to prevent merchant ship captains from mistaking it for a manned small craft..

FISHING METHODS USED DURING THE PROJECT

Chum bag scatter bait method.

This method is an advanced modification of the drop stone method that was traditionally used in the Pacific region in earlier years. Although some Pacific Islanders still use the drop stone method in its basic form, its capabilities are limited for small-scale commercial use.

With the drop stone method, fishing duration is dependent on the amount of stones a fisherman takes with him. Once the line is sunk, frees the chum and baited branchline, the stone and wrapping leaf drop free and the baited branchline is allowed to drift with the current while the chum attracts fish. Once he runs out of stones, the fisherman

must switch methods, usually to either rod and sinker jigging, live bait fishing or trolling.

With the chum bag method (Fig. 4), the full gear is permanently attached to the mainline. The chum bag replaces the leaf that wraps the chum, and the 1-kg sinker replaces the stone. A winding board is included to make it easier to coil the 20-m branchline. The whole parcel is packed into the bag and secured by a flexible wire that is worked loose when the required depth is achieved. The fisherman can fish for as long as he has bait to do so.

Weighted jigging rod method.

This method requires a weighted jigging rod attached to the end of a mainline and a branchline of 2–10 m attached to the other end of the rod. It can be used with either a baited hook or with a hook and feather lure (Fig. 5).

Bait jigging method. The bait jigging rig is a simple 20-kg test line with four to six hooks on the branchline (Fig. 6). The lures on these hooks were white drinking straws cut to the length of the hook shank. While this rig is effective in jigging for



Figure 4. Tekata Toaisi preparing to deploy a chum bag.

bait, it is also effective in jigging for frigate mackerel and other small pelagic fish species.

Live bait fishing method. This method is straight forward and involves hooking fresh-caught live bait onto a mainline, and slacking it to a depth where large pelagic fish can find it.

Trolling lines with two lures. These trolling lines are constructed as is normally done for conventional single hook trolling

lines, using red and white squid skirt lures with double hooks. The only difference is the addition of a second, shorter branchline at the swivel end. The length of the shorter branchline can be anything from 1–3 m or more depending on the fisherman’s preference. Some fishermen prefer to have short second branchlines to make it easier to remove fish when the line is hauled in; others prefer longer second branchlines because they feel this is more effective

than shorter ones. During the workshop both the short and long second branchlines proved equally effective.

FISHING TRIPS

Participants were divided into three teams of five and tagged according to the colour of the reels they used (yellow team, blue team and red team). This encouraged a coordinated effort in constructing fishing gear and setting up individual boats for fishing. It also inspired the mood for friendly competition to see which group would do well during the fishing trips.

The two final days of fishing resulted in good catch rates. The improvement in weather conditions allowed the boats to fish the subsurface FAD at Nukubuco and troll the fringing reefs towards Beqa, Nukulau and Makuluva Islands. Fishing had to be limited in accordance to the ice that was carried on board. The Nukubuco subsurface FAD area was packed with a large Frigate Mackerel school that took anything that went overboard (Fig. 7). It took very little effort to catch this fish as the school was very slow moving and rotated in the same area. Either the yellowfin and skipjack tuna never had a chance to get the hooks, or they were not in the area. However, this was good practise for the fishermen and it was decided not to risk further scouting for yellowfin tuna in case there wouldn’t be another good opportunity to practise the fishing methods. The main thing was to demonstrate how the methods worked so that the fishermen could have confidence to use them later during their fishing operations.

A surface FAD marker would have greatly facilitated effective implementation of the bait jigging and scatter bait method; however, the practise undertak-

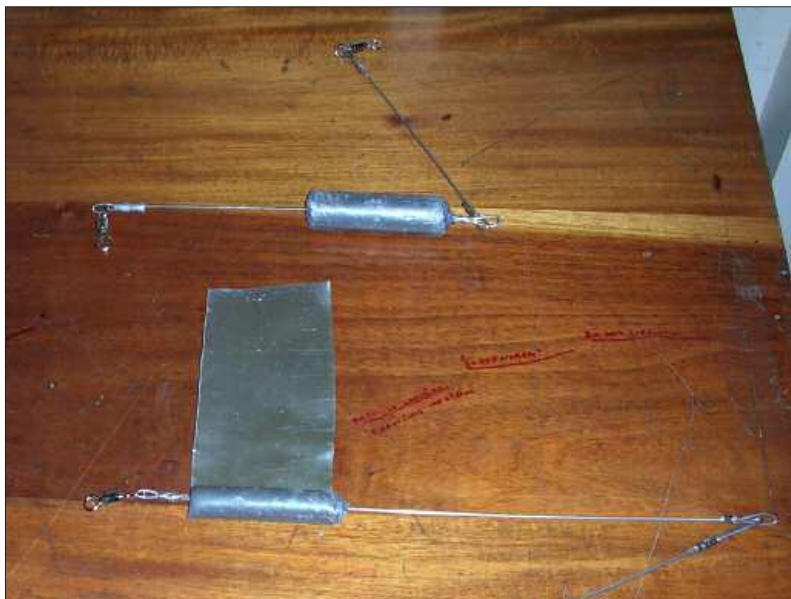


Figure 5. Jigging rods under construction.

Figure 6. Bait jigging rigs coiled on wooden slats.

en was sufficient to demonstrate the potentials of the methods for future development.

A total of 74 fish were caught over the two days, comprising 68 frigate mackerel, 1 skipjack tuna, 1 mahi mahi, 1 dogtooth tuna, 1 trevally, 1 barracuda, and 1 wahoo.

WORKSHOP CLOSING

The workshop was closed by the Fiji’s Director of Fisheries, Sanaila Naqali, and laminated certificates were issued to participants to acknowledge their attendance. A buffet lunch, hosted by the Coastal, Extension and Development Section, followed and consisted entirely of the fish caught during the workshop.

DISCUSSION AND CONCLUSION

The organising and implementation of this workshop went very well despite discouraging weather conditions at the start of the practical fishing sessions.

Interviews with small-scale commercial fishermen who attended the workshop, and with those who couldn’t attend, revealed that most fishermen knew only a few basic methods

of offshore commercial fishing and almost all offshore FAD fishermen only ever engaged in trolling. Only a few had tried drop stone fishing or midwater jigging (with limited success). It seems that this generation of fishermen have fully customised themselves to fishing from fibreglass banana boats. Trolling is their main offshore fishing method. Very few know what a sea anchor is or its potential to offshore and FAD fishing so the Fiji Fisheries Department’s timing to revive assistance to small scale commercial fishing operations is opportune and should be encouraged.

Subsurface FADs. The two subsurface FADs have large schools in the surrounding vicinity. On the first day of fishing a big school of large yellowfin tuna was engaged at the Nukubuco subsurface FAD area but the three large yellowfin tuna that was caught all escaped due to the inexperience of the fishermen in handling big fish. Other schools of skipjack tuna and frigate mackerel were in the area. The subsurface FAD off Naqara Island also had large

schools but these were slightly away from the initial deployment position leading to suspicion that the subsurface FAD had shifted position.

Observations of these subsurface FADs suggest that:

- subsurface FADs are very effective at aggregating large schools of fish;
- if there are no surface markers, subsurface FADs are only good for trolling in the early morning hours, until the schools start forming and begin to run, and in the late afternoon;
- in order for other fishing methods to be used effectively at subsurface FADs, a surface marker should be included at each FAD so that the fisherman can drift close to the subsurface FAD to jig for baitfish and tuna. The surface marker would enable fisherman to maintain an effective fishing distance from the subsurface FAD; and
- if the surface marker is connected to the subsurface FAD by a strong rope, then the fishermen can tie their vessel to this and jig at this spot to save fuel. It is possible to attach a 12–22mm rope to the subsurface FAD for the surface marker. This modification would allow fishermen to fish the subsurface FADs to their full potential.

In all, the workshop was a huge success and the results from this will be indicators for the Fiji Department of Fisheries to restructure their assistance and training programs for small-scale commercial fishing operations.



Figure 7: Fish caught during the double lure trolling exercise.

Second Pacific Island fisheries evidence training and investigation course

Following the inaugural course in 2007, this is the second time SPC has co-sponsored this Pacific Island Fisheries Evidence Training and Investigation Course (FETIC) with the Pacific Islands Forum Fisheries Agency (FFA).

From 13–29 August 2008, a group of fisheries officers (1 female and 14 males) from 14 Pacific Island countries and territories attended this training programme, which was run at the National Fisheries College in Kavieng, Papua New Guinea. The three course facilitators were from the Primary Industries and Resources South Australia (PIRSA).

The FETIC programme is adapted from the Australian Basic Evidence Training and Investigation Course (BETIC) programme, which is a major component of the nationally accredited Certificate III in the Seafood Industry (Fisheries Compliance). FETIC was developed by PIRSA on behalf of the Australian Fisheries Academy, FFA and SPC in 2007.

The course objective was to enhance Pacific Island fisheries officers' skills in:

- fisheries management principles and legislation;
- monitoring fish catches;
- patrol operations, including methods and resources;
- investigation techniques, including evidence gathering, note taking, chain of evidence, interviewing; and
- statement taking, brief preparation, and court procedures.

The course facilitators made the following recommendations to both FFA and SPC:

- Course sponsors continue to give consideration to supporting the annual facilitation of the Pacific Island Fisheries Evidence Training & Investigation Course.
- Future courses continue to be delivered and assessed

against a Competency Based Training methodology.

- Consideration of any future course venues be based on the capacity to facilitate a marine platform to facilitate practical exercises with a marine component.
- Prior to any future course being facilitated a Training Needs Analysis and review of past course evaluations be conducted to ensure the relevancy and appropriateness of the course content, venue and delivery.
- Course Sponsors give consideration to developing a recognised process and pathway to support participants to achieve full accreditation of the Certificate III Seafood Industry (Fisheries Compliance) or Higher through the approved Recognition Process.

