IOTC Tuna Tagging Consultancy
David G. Itano
1 October – 2 November 2002

Note: this report compiled and edited with assistance of Dr. Jean-Pierre Hallier, IRD.

I. Itinerary

Place	Date	Time arrive	Time depart
Honolulu	1 Oct 2002	NA	1120
Osaka/ transit	2 Oct	1530	1655
Singapore / transit	2 - 3 Oct	2215	0035
Seychelles	3 - 31 Oct	0320	2035
Dubai / transit	1 Nov	0110	0330
Singapore / transit	1 - 2 Nov	1645	0730
Tokyo / transit	2 Nov	1455	1930
Honolulu	2 Nov	0715	NA

II. Purpose and background

The Indian Ocean Tuna Commission has proposed to conduct broad scale mark and recapture experiments to provide empirical data to assist management related research on the tuna resources of the Indian Ocean (IO). Information on all three tropical tuna species is urgently required. However, current management concerns dictate a priority to the tagging of bigeye (*Thunnus obesus*) and yellowfin tuna (*T. albacares*) over skipjack (*Katsuwonus pelamis*). The main issue with IO skipjack concerns interaction issues between industrial-scale international purse seine fleets and coastal/artisanal fisheries. A variety of tag types (ie conventional, sonic, archival, pop-up satellite archival tags -PSATs) and methodologies have been proposed from several different types of tagging platforms, both dedicated and opportunistic.

The targeted tagging of bigeye and yellowfin tuna has in the past proved to be a difficult task, particularly for larger sized fish over a broad geographical range. The consultant has had several years of experience in the tagging of tropical tunas and specifically with attempting to maximize the tag releases of yellowfin and bigeye over as wide a size range as possible. The purpose of this consultancy was to examine the possibilities of IOTC using fishing and tagging techniques developed in the Pacific on tagging platforms currently available in the Seychelles.

III. Objectives

The specific objectives of the study mission were to:

- conduct experimental tagging cruises on fishing vessels out of Victoria port, Seychelles to determine suitability as tagging platforms;
- test various fishing gears to target yellowfin and bigeye tunas of various sizes;
- investigate the use of the aggregation behavior of tunas to increase fishing/tagging efficiency, specifically in relation to seamounts and fish aggregation devices (FADs);
- test various devices and methods to transfer large tunas from the water to a tagging surface in good condition,

- demonstrate optimal conventional and archival tagging techniques to designated Seychelles-based personnel, and;

- make field observations useful to baitfish utilization by future tagging cruises.

IV. Activities related to study mission (Appendix I lists tagging cruise personnel while Appendix II indicates daily activities of the consultant during the study period)

3 October – Thursday

I arrived at 0400 without incident, and at 0900 was transported to the IOTC headquarters to discuss the mission with Alejandro Anganuzzi and Alain Fonteneau after which we discussed the mission with Seychelles Fishing Authority (SFA) Managing Director Philip Michaud and Rose-Marie Bargain, head of the SFA Tuna Section. Patrice Dewals, IRD technician showed us the fabricated lifting net and lifting cradle that appeared to be well suited to the job at hand and introduced us to fisheries technician Albert who would help with additional gear requests.

A short meeting was held with Pierre Woodcock who manages the activities of the **R/V l'Amitie** and preliminary plans were made for tagging cruises.

4 October – Friday

Alain Fonteneau and I met with Pierre Woodcock and the captain of **R/V l'Amitie** (Gerard Ernesta) and captain of the **F/V Consolation** (Keith Andre) to discuss the month's activities. It was agreed that the first trip would be made on the **Consolation** to the north to investigate the sites of two FAD deployments and to search and fish in the vicinity of Bird and Denis Islands on the north edge of the Seychelles plateau. During this time, **R/V l'Amitie** crew would prepare and deploy two FADs to the south of the plateau. The second trip would take the **R/V l'Amitie** north to the purse seine grounds and the Coco de Mer seamount followed by a final trip to visit the newly deployed FADs in the southern area. Copies of the month activity plan were distributed to P. Michaud, R-M Bargain, P. Woodcock, G. Ernesta, K. Andre, P. Dewals, A. Fonteneau, A. Anganuzzi, and D. Ardill via N. Ardill.

Gear purchases were made in town with the assistance of Fonteneau and the fabrication of handline leads was completed by Albert of SFA. Captain Andre provided me with an inspection of the F/V **Consolation** which appears to be well fitted and suitable for short to medium range tagging trips of up to a week duration.

5 October – Saturday

Jean-Pierre Hallier, IRD scientist arrived from France to participate in the first two tagging cruises and assist with planning tagging projects for IOTC.

7 October- Monday

Attended meeting with three EU consultants reviewing IOTC plans for tuna tagging work proposed for EU funding. Continued preparations for Cruise 1.

Cruise 1 Summary: FV Consolation – 8 – 13 October 2002

Cruise 1 was conducted on the SFA vessel **Consolation**: a 13.6 m fiberglass Yamaha vessel equipped with a 180 HP diesel main engine, donated to SFA by Japan and equipped for tuna longline fishing (**Figure 1**). The vessel is equipped with a Lindgram- Pitman SuperSpool 2 monofilament longline reel

(32 mile capacity) currently fitted with 20 miles of mainline. The **Consolation** is well fitted with marine electronics, including radar, LCD fish finder, GPS track plotter, VHF radio, HF SSB radiotelephone and autopilot. A 24 ft. parachute sea anchor was rigged to the bow and used successfully during the cruise. One objective of cruise 1 was to search for two FADs set on August 2, 2002 off the north side of the Seychelles Plateau. Details of FADs set in support of the tagging mission are given in **Appendix III**. Details of Cruise 1 and subsequent cruises are given in **Appendix IV**. Details of all pelagic catches made during all three Cruises are given in **Appendix V** with geographical movements illustrated in **Figure 2**[1].

8 October

The **Consolation** loaded ice, food and bait and departed Victoria Port at 1245 with scientific staff J-P Hallier and D. Itano with captain and crew of four (see **Appendix I**). Five trolling lines were rigged to the stern and five *Euthynnus affinis* were taken in transit to the Bird Island area. That evening, made longline set LL-1-1 with 400 hooks baited with squid, setting the gear shallow with five hooks per basket and buoy lines set at 15 and 25 m. All longline and handline set details are listed in **Appendix VI.**

9 October

Hauled longline set LL-1-1 with no tuna taken (see **Appendix V**). A large animal that got caught at the end of the line and later escaped managed to dive down the line up to at least 800 m depth imploding the last plastic buoys and causing the radio buoy to implode with pressure. A search for FAD #1 proved unsuccessful so the vessel trolled east toward Dennis Island arriving in that area past midnight.

10 October

A careful search for FAD #2 was conducted visually and by echo sounder from 0600 to 1115 in a quarter mile grid radiating outward from the FAD deployment position given in **Appendix III** to a radius of 2 miles from the deployment position. Trolled eastward along shelf edge taking miscellaneous pelagics but no target tuna species. Made 200 hook night longline set LL-1-2 at 5 hooks/basket with squid and mackerel bait using 30 and 50 m buoy lines. *Ika shibi* style handlines were set and tended from 2315 – 0315 hours using squid and *Rastrelliger kanagurta* bait resulting in no catch.

11 October

Hauled longline set LL-1-2 from 0700 to 1000 taking two swordfish, one blue marlin and sharks as indicated in **Appendix V**. Trolled northeast all day on shelf edge taking only bycatch species. Set LL-1-3 with approximately 180 hooks in a shallow night-set mode baited with squid and mackerel.

12 October

Retrieved longline set LL-1-3 from 0650 to 0755. No target tuna catch taken. Trolled southeast all day along shelf edge, passing Topaze Bank and finishing at La Junon Bank area on east side of Seychelles plateau at sunset. Trolled six yellowfin 57-76 cm FL, tagging and releasing five as one could not be released due to significant jaw damage. The fish were easily pulled directly through the mid-ships longline landing door of the **Consolation** where they were measured and tagged on a padded mattress kept wetted with the seawater hose (**Figures 3 and 4**). Details of tag releases by species are given in **Appendix VII**. Numerous bycatch species were also taken as listed in **Appendix V**. Four lures were lost due to wahoo cutting nylon leader. Steamed for Mahe that evening.

[1] Chartlet for Figure 1 produced by Bertrand Wendling, SFA.

13 October
Arrived Victoria 0900, unloaded and end of trip.

Cruise 2 Summary: RV l'Amitie – 15 – 22 October 2002

15 October

Depart Victoria 1430 hours steaming north. Cruise 2 was conducted on the SFA vessel **R/V l'Amitie**: a 54 GT, 19.98 m fiberglass multi-purpose research vessel donated to SFA by Japan and equipped for tuna longline fishing (**Figure 5**). The ship has a beam of 5.0 m, 285 HP main engine and a rated operational range of 1500 nm. The vessel is equipped with a modular "mini-longline" system utilizing interchangeable 2500 m monofilament longline reels that are set from the stern and hauled from the bow deck. The vessel is fitted with marine electronics, including radar, fish finder, GPS track plotter, VHF radio, HF SSB radiotelephone and autopilot. Most of these electronics appear to run on the internal 24 volt power system but 110 v and 220 v power is available. The same 24 ft. parachute sea anchor that was used on the **F/V Consolation** was rigged to the bow anchor line and used successfully during the cruise.

16 October

Passed ***F/V Men Gren*** in drifting FAD set at 02° 37'S, 55° 41'E at 0530 hours. Captain R. Bargain contacted **R/V l'Amitie** indicating that their FADs had been holding only skipjack but Asian longline vessels were fishing at 02°S, 62°E. Rigged lines and trolled north all day with no catch.

17 October

Made longline set LL-2-1 at midnight at 0°08' S (33 miles south of seamount) in order to sample longline possibilities in area south of the Coco de Mer Seamount while allowing time to reach the seamount before dark. Hauled longline LL-2-1 between 0716-0900 taking one small swordfish. Steamed directly to Coco de Mer Seamount setting and hauling vertical longline with no catch. Made radio call on VHF 16 to supply vessels anchored on the seamount (***Sea Scout I, Explorer III***), receiving reply only from the ***Explorer III*** operated by the Spanish fishing company Albacora, belonging to the OPAGAC group. We paid a short visit to this vessel being welcomed by Captain Inacio Leniz who invited us to return for lunch on Sunday 20 Oct. He reported that some yellowfin had been around the seamount two weeks prior but currently there was only a small amount of skipjack present. We were unsuccessful in establishing radio contact withy the ***Sea Scout I***, thus were unable to visit the vessel. The ***Sea Scout*** **I** also belongs to the OPAGAC group but works specifically for the Spanish purse seine vessel ***Albacora 4***. Pictures of the two supply vessels as they appear anchored on the Coco de Mer seamount are indicated in **Figures 6 and 7**.

Trolled and tagged two small yellowfin at dusk next to the ***Explorer III***. Set and hauled vertical longline again in the evening, losing most of the line to an underwater snag of some kind, possibly a derelict mooring line. Attempts to chum and jig or bait tuna in the evening in the lights of the moored vessels were unsuccessful, though tuna could be observed feeding on flying fish aggregated to the lights. Made LL-2-2 set at 2106.

18 October

Started trolling 0410 around anchored supply vessels. One 70 cm bigeye was trolled from **R/V l'Amitie** and double tagged at dawn and two *Euthynnus affinis* were boated for tagging practice and demonstration for J-P Valentin. The purse seine vessel **F/V *Txori Toki*** briefly visited the seamount at 0530, made a pass by and steamed south, presumably to Victoria. Retrieved longline LL-2-2 taking three swordfish and miscellaneous bycatch species. No tuna taken.

Made daytime longline set LL-2-3 at 1033 – 1228, resting during heat of early afternoon. Trolling in evening produced response only from dolphinfish that were not boated. Tested underwater light after sunset and captured approximately 25 flying fish with scoop net but no tuna were noted to be attracted to the area. Hauled LL-2-3 set 2045- 0125 (19 Oct) with no tuna taken.

19 October

After LL-2-3 haul, ran back to area of Coco de Mer Seamount, set parachute anchor and four *ika shibi* style handlines baited with flying fish. Ran handlines from 0245 – 0545 with no bites or catch.

At 0600 began trolling around the two anchored supply vessels, taking two skipjack on troll lures and tagging one (59 cm). A 52 cm yellowfin was taken on a dead flying fish slow trolled near the *Ocean Scout I*. A downrigger cannonball was rigged to sub-surface slow-troll a flying fish bait that was taken but no catch resulted.

Contacted ***Explorer III*** in morning to request permission to board the vessel to attempt fishing and tagging, as all tuna activity on the seamount appeared to be closely associated with the anchored vessels. We were told to stand by for a reply from the captain. After morning trolling, no tuna activity observed and spent the day drifting and running gear for bottom snappers. Several snappers were taken, a mix of *Etelis coruscans* (mostly) of mixed sizes and a few large *E. carbunculus*. At 1600, ***Explorer III*** finally indicated that we could not board at that time, apparently due to their work schedule but confirmed our invitation to board the vessel the following morning 20 October (Sunday) for lunch and fishing/tagging trials.

Decided to steam north of the seamount to try a final longline set in an untried area, setting LL-2-4 from 1710 – 2045.

20 October

Hauled LL-2-4 at 0510 – 0815 with no tuna taken on the longine. Steamed back to seamount to visit ***Explorer III***, with Hallier, Itano and Morgan boarding the vessel at 1130, taking lunch with Captain Inacio Leniz and chief engineer Florencio Garay. The captain was very generous and cooperative, indicating that he would welcome a biologist on board in the future to tag and release tuna from his vessel. He also stated that in July and August 2000, a Spanish biologist from IEO had boarded the vessel for a two-month research mission. It was noted that a cabin on board was labeled “Biologist”.

At 1245, vertical handline jigging was attempted resulting in two small yellowfin taken on chrome jigs fished beneath the vessel at approximately 50 m depth. One fish was retained due to eye damage while the other was tagged and released (**Figure 8**). A decision was made to defer further fishing trials till later in the day when it was cooler and the tuna schools are normally more active. The party returned to the **R/V l’Amitie** for the afternoon.

Hallier, Itano, Valentin and Hoareau returned to the Explorer III at 1645 and attempted handlining with lures and bait until 1815. Mackerel chum was used with dead flying fish and chrome jigs. Unfortunately, the fish schools were not active that afternoon and the ***Explorer III*** crew felt that they were simply not feeding well. No tuna were taken and the boarding party returned to the **R/V l’Amitie** at 1830 and steamed south towards Victoria. During this period, the Iranian tuna purse seine vessel ***F/V Jihad Azadegan*** passed north of the seamount on a westerly course.

21 October

Steamed south all day with trolling lines deployed and no catch taken.

22 October

R/V l'Amitie arrived off Victoria port at 0800, pausing offshore to test the lifting cradle with the bow boom and winch. It appeared that the cradle would be suitable for lifting large tunas through the fish landing door on the bow deck if the boom were properly positioned outboard of the landing door. The vessel entered Victoria port at 0830 to end the cruise.

Cruise 3 Summary: F/V Consolation – 25 – 29 October 2002

25 Oct

Departed Victoria port at 1350 hours trolling south all afternoon with no fish taken. Arrived in area of FAD 3 around 2100 hours (see **Appendix III**) and searched unsuccessfully in the darkness for the FAD with radar. Made LL-3-1 set from 2140 – 2343 northeast of FAD 3 position.

26 Oct

Drifted till dawn, taking one dolphinfish on troll gear on way to FAD 3 position. Located FAD 3 very close to designated position at 5°37.94 S, 55°24.08 (**Figure 9**). Trolling and vertical jigging near the FAD produced no response and the echo sounder did not record the presence of any fish in the area of the FAD. No active bird schools were noted in the vicinity.

Hauled LL-3-1 between 0720 – 1207 taking nine swordfish, one bigeye tuna and two snake mackerel (*Gempylus serpens*). The longline hauling was delayed by 1.25 hours due to tangling of the mainline by a manta ray that escaped close to the vessel.

The bigeye tuna (114 cm FL) was successfully scooped with the one-meter diameter landing net and transferred to a tagging mattress (**Figures 10a – d**). Due to hooking damage to the eye, the fish was not released, but was double tagged and implanted with a dummy archival tag for demonstration purposes on the padded tagging mattress (**Figure 11**). Digital photos and video were taken of the landing and tagging procedures.

Trolled back to FAD 3 with no catch and placed one of the **Consolation** flag buoys with radar reflector on the FAD for easier detection later that night. A large amount of polypropylene line was observed to be floating near the FAD constituting a significant hazard to navigation in the area. Trolled to Plate Island, trolling around the outer drop-off of the island from 1530 to 1825 taking some kawakawa, jobfish and a jack. Although some yellowfin tuna were sighted while jumping just north of Plate Island, none were hooked while trolling. Returned to FAD 3 after sunset, detecting the buoy by radar and tied vessel directly to the FAD.

Set and hauled 18 hook vertical longline twice by 0115 during the night with no catch resulting. The floating FAD line tangled the rudder of the vessel and required the premature hauling of the vertical longline to avoid entanglement.

27 Oct

Hauled 18 hook vertical longline at 0630, taking one small swordfish at a depth of approximately 50 meters. Began trolling towards Fred Seamount at 0700, arriving in the late afternoon, finding FAD 4 very close to deployed position at 6°13.89' S, 54°20.04' E. One wahoo was taken about a mile east of the FAD, but no birds, troll strikes or echo sounder indications were noted of fish in the area. We conducted an echo sounder survey of the charted location of the seamount, noting five areas east and southeast of FAD 4 with strong echo returns at less than 500 meters depth (**Appendix III**). Made LL-3-2 set between 2055 and 2315 hours over the shallow area and to the northeast of the seamount.

28 Oct

Ran back to the shallow area of Fred Seamount, set parachute sea anchor and deployed four *ika shibi* style handlines, fishing them from 0100 to dawn. The underwater light was not set but dim illumination was provided by deck lights that was sufficient to attract squid observed near the boat. One ~40 kg swordfish was taken on handline gear set at 60 m depth using squid and flying fish bait in conjunction with a cyalume light stick attached 3 m above the hook (**Figure 12**). Two wahoo were trolled when the vessel began to run toward the LL-3-2 early in the morning which was hauled from 0750 – 1034. This longline haul produced only three snake mackerels (*Gempylus serpens*).

Trolled back to FAD 4 where no sign of tuna or tuna schools were noted. Trolled the area briefly and started to head directly towards the Seychelles Plateau, arriving just before midnight.

29 Oct

Set parachute sea anchor off the southwest corner of the Seychelles Plateau near the 2000 m contour and set *ika shibi* style handline gear at position 5°10' S, 55° 07' E. One unidentified shark was hooked, escaping by biting through the leader material. Handlines were re-baited and chumming continued till dawn with no catch aside from a dophpinfish taken by surface handline gear.

After dawn, trolled the edge of the Seychelles Plateau, taking three kawakawa and headed directly towards Mahe at 0900. The area of Conception Island next to Mahe was trolled around 1400. An additional kawakawa and two wahoo were taken during the afternoon. Entered Victoria port at 1630 to end the cruise.

V. Fishing gears and techniques

1. Horizontal longline

The **F/V Consolation** was equipped with a Lindgram Pitman SuperSpool II monofilament longline reel and line shooter system with twenty miles of 2.3 mm diameter mainline on the spool which was not filled to capacity. Branchlines consisted of standard longline snaps, 1.8 mm diameter monofilament line, a leaded swivel placed approximately one meter before terminating in a 9/0 stainless steel "J" style hook for a total length of 18 m. Most of the leaders between swivel and hook were made of the same 1.8 mm monofilament but a small number of branchlines were fitted with 0.5 m stainless steel leaders. Buoy drop lines were 30 and 50 meters in length.

The L-P line shooter is rigidly mounted in the center of the stern and configured to only shoot line out. The unit could be easily modified to act as a line hauler. However, the mainline drum can be used as a form of horizontal capstan to haul any manner of line, including vertical longline or jigging lines.

The **R/V l'Amitie** used a modular "mini-longline" system of Japanese manufacture consisting of several interchangeable mainline spools that were filled with 2.3 mm diameter monofilament. Each spool contained fifty stainless swivels separated by 50 m of monofilament for a total length of 2500 meters. Branchlines and drop lines were similar or in some cases the same as those used on the **F/V Consolation**. Mainlines were marked with Ryokuseisha radio buoys flag markers equipped with radar reflectors.

Night sets deployed 5 or 6 hooks between floatlines with the mainline stretched flat with minimal use of the line shooter. Vessel setting speed for the night sets was approximately 6.5 knots with branchlines attached at 15 to 20 second intervals. Daytime sets were attempted with 30 hooks between floats setting at a slower vessel speed and utilizing the line shooter to dump excess line during the set.

The longline pinch hauler of the **R/V l'Amitie** is well suited to haul any diameter line from about 2.1 mm monofilament up to larger diameter mono or braided lines. In addition, there is a side mounted pinch hauler on the aft portion of the longline drum hauler on port side of the bow working deck that could be used to haul additional lines (**Figure 13**).

Longlines were generally baited with whole thawed squid or mackerel (*Scomber* sp.) although fresh Indian mackerel (*Rastrelliger kanagurta*) was also used. Chemical light sticks were sometimes attached to branchlines. Hauling and setting of the line was as normal for monofilament longlining for pelagic species.

2. Vertical longline

Vertical longlines were configured along the lines of those described in detail by publications of the Secretariat of the Pacific Community (Preston, et al, 1998), consisting of mono branchlines snapped to a monofilament or braided nylon mainline, weighted at the bottom and suspended by a buoy and flag marker. Branchlines consisted of standard longline snaps with four to five meters of 1.8 mm diameter monofilament terminating in a 12/0 or 14/0 sized tuna circle hook. Vertical longlines were baited with the same types as those used for horizontal longlining as well as fresh flying fish. Heavy gauge circle hooks should always be used on vertical longline gear due to the short branchlines, as large tuna can straighten weaker hooks.

Vertical longlines were set manually and hauled with the longline pinch puller mounted on the bow of the **R/V l'Amitie** or by wrapping one loop of line around the longline drum of the **F/V Consolation**. **Figures 14 and 15** indicate setting of vertical longlines from vessels tied to a FAD and free drifting on a parachute anchor from Preston, et al (1998). Both methods were tested during Cruises 2 and 3.

3. Troll

Troll gear during the three cruises consisted of nylon handlines of ¼ inch diameter braided line or Casamar 4 or 5 mm diameter net twine attached directly to the overhead canopy frame on the stern of each vessel terminating in a black swivel, 2.0 mm diameter monofilament leader (6 meters) and trolling lure. Braided stainless steel leaders of approximately 30 cm length were used when operating in the vicinity of the Seychelles Plateau or when wahoo were thought to be present. Preferred trolling lures based on past troll tagging projects were inexpensive chrome metal "jet head" type trolling heads skirted with tough PVC material (**Figure 16**). Lure heads were those designed for a standard 7 inch skirt and cost in the range of USD$ 5.25 – 7.50 each. Preferred lure skirt material consists of orange vinyl flag material cut to size, which cost USD$ 1.95 per sheet (12"x12") or PVC strapping material purchased in 50 foot rolls at approximately USD$ 12.00 per roll. Plastic diving lures were also used as the blue/silver model pictured in **Figure 16**.

Slow trolling of fresh/dead bait was also practiced, consisting of hooking a fresh flying fish through the eye sockets with a circle hook and slowly dragging it behind the boat. When a fish took the bait, line was paid out for a short time before hook setting and retrieval.

4. Handline

Three styles of handlining were attempted as follows:

a. Vertical jigging

The simplest handline type consisted of a plastic handreel "caster" filled with heavy monofilament line with braided Dacron backing. The monofilament section consisted of 50 meters of 2.1 mm diameter monofilament attached to 10 meters of 1.8 mm diameter monofilament terminating in a

metal jig of approximately eight to twelve ounces. A typical handreel and a variety of metal jigs in chrome, white and fluorescent finish are shown in **Figure 17**.

This fishing method is regularly practiced by Hawaiian fishermen to target sub-surface bigeye tuna in seamount and FAD associated schools. The method was also used successfully by staff of the Inter-American Tropical Tuna Commission to capture and implant 96 archival tags in bigeye tuna ranging in size from 88 – 134 cm FL.

b. Surface baited handline

Surface handlines have been used successfully to tag and release significant numbers of yellowfin and bigeye in other tagging programs. This is the simplest gear type possible, consisting of braided nylon line, nylon monofilament leader and single baited hook. Chunks of tuna flesh, small baitfish or squid are often used in conjunction with liberal chumming of the water with dead bait. The technique relies on chumming a tuna school to the surface and inciting a feeding frenzy from which fish can be readily hooked and tagged.

Though simple in concept, the technique was used successfully by the South Pacific Commission to tag and release thousands of yellowfin and bigeye during the Regional Tuna Tagging Project while fishing on tuna aggregations in the Coral Sea. The Hawaii Tuna Tagging Project also used this fishing method successfully to tag and release yellowfin and bigeye on anchored FADs and seamounts.

c. *Ika* shibi or *palu* ahi style handline

The *ika shibi* fishery of Hawaii evolved from a night handline fishery for squid into a significant small scale fishery for large yellowfin and bigeye (Yuen, 1979). The technique uses baited handlines from small drifting vessels at night in conjunction with a small underwater light used to attract squid and bait. Tuna are attracted to the aggregated bait and chummed close to the baited handlines. The drift of the vessel should be slowed and controlled by the use of a parachute sea anchor so that handlines fish nearly vertical in the water column.

The ancient Polynesian method used to handline large tunas during the daytime used a line weighted with a stone wrapped in a leaf that also enclosed the leader, baited hook and chum. This form of fishing which is commonly referred to as “drop stone” fishing in the Pacific has developed into a method called *palu ahi* fishing, or “chum tuna” fishing, where a canvas cloth and lead weight have replaced the leaf and stone. *Drop stone* fishing was generally practiced in areas where subsurface tuna concentrations were known to aggregate close to islands or atolls. In the modern context, *palu ahi* fishing is often carried out near FADs or banks. During the tagging cruises, a combination of *ika shibi* and *palu ahi* style handlining was carried out near FADs and seamounts. **Figures 18a – c** illustrate the technique of wrapping a baited handline with chum in *palu* ahi style handlining. A thorough and well illustrated description of both handline techniques is given in Preston et al (1998).

During the three cruises, a 24 foot nylon parachute anchor was successfully deployed from both the **R/V l’Amitie** and **F/V Consolation**. Four handlines were fished at night from the drifting vessels using squid, *Scomber* mackerel, Indian mackerel (*Rastrelliger kanagurta*) or flying fish for bait. Handlines consisted of 150 m of 4 mm diameter braided nylon backing, 100 m of 400 lb test hard Dacron bottomfish line marked every ten meters. Leaders consisted of 6 – 8 meters of 1.8 mm diameter nylon monofilament crimped directly to heavy duty 12/0 to 14/0 sized tuna circle hooks.

Two *ika* shibi style bow lines were normally set on the surface without any additional weight. Two weighted *palu ahi* style stern lines were set at depths ranging from 40 to 70 meters. These lines were set using a heavy cloth chum bag that holds the weight, chum and baited leader that is allowed to sink to the desired depth before the contents are released, as described by Preston, et al (1998). This technique allows fisherman to target sub-surface tuna and feed concentrations with baited hooks and

is used successfully in Hawaii to take tuna up to 80 kgs in size. Once set, the lines are attached to the vessel with heavy elastic bands or thin cotton string that serves to set the hook and eventually breaks when a fish takes the bait.

d. Other gears

Additional handline and troll gear from Hawaii was brought to the Seychelles for testing. Whole body plastic imitation squid lures and large barb-less pole and line type lures are used in the Hawaiian bigeye handline fishery. The plastic squid lures are rigged with stout single or double hooks to 800 – 1000 lb test monofilament line and suspended from steel davits mounted along both sides of the vessel. Both lure types are trolled beside or directly behind the vessels within one meter of the vessel and chummed profusely over surface concentrations of bigeye and yellowfin tuna. The technique appears to be unique to the Hawaiian offshore handline fishery and can produce very high catch rates of medium sized tuna, primarily bigeye of 65 to 115 cm FL. The Hawaii Tuna Tagging Project used this fishing method to tag and release thousands of yellowfin and bigeye on offshore FADs and seamounts. A barb-less type pole and line lure is pictured in the center of the handline spool in **Figure 17** and plastic squid lures rigged to heavy line are shown in **Figure 19**.

e. Notes on Hooks

For the purposes of tagging, the barbs of conventional “J” hooks should be bent down to speed the unhooking process and to lessen hooking damage. Only the tip of the barb should be rounded over rather than flattening the entire barb which allows too many fish to escape.

Past experience with trolling hooks suggest that only stainless steel hooks with a maximum size of 9/0 should be used. Galvanized single hooks do not have the tensile strength necessary to withstand the strike and pull on the heavy handline gear used for tagging. The hooks should also be rigged mid-way in the lure skirt which reduces the number of fish hooked deep in the gills, rear or the oral cavity or through the rear of the eye orbits making them unsuitable for tag and release.

Blunting barbs on “J” style longline hooks is not practical as the fish will easily escape during the longline soak period, suggesting the utility of using tuna circle hooks. The use of circle hooks also increases the likelihood of a clean hookup in the corner of the mouth rather than a gut hooking as is often the case when using “J” style hooks. Unfortunately, deeply set circle hooks are difficult and time consuming to extract. It is suggested that circle hooks be cut at the hook eye and left in the fish or extracted from the outside, pulling the leader all the way through the hook wound and cutting the leader. This technique has been successfully used to land and release giant bluefin tuna in the Atlantic during archival tagging and tagging with PSATs.

VI. Tagging gears and methods

1. Conventional tagging

Conventional plastic dart tags used during the study mission were manufactured by Hallprint Pty. of Australia. The tags have a white vinyl single bard point joined to a 13 cm yellow streamer for a total length of 14.8 cm. The tag legend bore a sequential four digit number in the AA series (ie AA 0142) near the tag head and tag end with the legend "IOTC VICTORIA SEYCHELLES – REWARD" in black lettering.

Unfortunately, stainless steel tag applicators purchased by the same manufacturer measured 14.1 cm, leaving about one cm sticking out of the end of the applicator. When applicators loaded with tags were placed in the vinyl tag magazines, the excess tag material caused the tag to be pushed out of the front of the applicator. While not a significant problem when tagging small numbers of fish, this would not be acceptable for rapid tagging operations or if tags were to be placed upright in tag blocks as is often the case on dedicated tagging platforms.

Fish were measured and tagged on a vinyl mattress measuring approximately 112 x 72 x 5 cm, filled with a foam pad and marked in whole cm for measurement purposes (see **Figure 8**). The mattress is constructed of tough but smooth vinyl material with a nylon zipper in one side to allow removal and cleaning of the foam pad. Six sturdy nylon straps are sewn into the corners and midway along the long axis to allow the unit to be easily secured to the vessel during heavy seas or to tie the unit up to drain and dry between uses. Ideally, close cell foam is used inside which does not soak up blood or odors, but regular cushion foam can be used if the volume of tagging is not high. A tape measure should be used periodically to check that the measurements on the mattress are correct, or if not, that proper correction factors are applied to release data.

During this study mission, tags were stored in flat vinyl tag magazines. These were borrowed from the Hawaii Tuna Tagging Project that had adapted them for use on small fishing vessels in cramped conditions. The tags are stored in paired vinyl magazines measuring 40 x 89 cm, each one having fifty slots for loaded applicators in two rows (**Figure 20**). The first magazine is numbered 01 – 50 while the second is numbered 51 – 00. During tagging operations, the entire tag number is noted periodically, but only the last two digits need be recorded most of the time to allow faster operations.

Tags were placed below the second dorsal fin so that the tag head and barb passed transversely through the dorsal musculature to anchor securely behind the second dorsal fin pterygiophores (fin ray supports). A properly placed conventional tag should feel very secure in place and should not be able to be pulled free without a great deal of force. Normally, a well placed tag can support the weight of small tuna and will stretch or break before being pulled free from a larger fish.

Double tagging is accomplished by placing tags on different sides of the fish, one in front of the other so there is no danger of severing the first tag when the second applicator and tag is inserted (**Figure 21**). Serially numbered tags should be used and it is best to adopt a convention where even numbered tags are placed first and one one side and the odd numbered tag is opposite, or vice versa. The idea is that subsequent analysis may wish to examine differential tag shedding by placement order or side of fish by tagger. Individual taggers should be required to release a minimum number of double tagged fish by species and size range as determined by those conducting the tag recapture analysis to examine differential tag shedding effects.

2. Data recording

Data was recorded manually by pencil on plastic data boards during the three cruises. Data recorded included the date, tag number, fish species, fork length to the nearest cm, time of capture, location in latitude and longitude, tagger and fish condition. The convention in database recording used by the

South Pacific Commission was to designate each tagger by three initials, ie Kevin N. Bailey = KNB. Manual data recording was possible due to the small number of fish tagged on these cruises and available personnel to record data. During tagging cruises when the fish are being landed at a high rate or the tagger is working independently, a mechanized means to record data is desirable.

Recent tagging programs have adopted the use of mini-cassette tape recorders to record tag release data, such as the one shown in **Figure 22**. For maximum efficiency and to minimize the chances of data loss, the following criteria should be followed. Tape recorders should be simple "one touch recording" type and as sturdy as possible, lacking added features such as integrated AM/FM radios, voice activated recording systems or other extraneous features that may interfere with voice recording. Units with large, clear front windows that allow the viewing of the tape in motion during recording and a clearly visible tape counter are preferred. Pause buttons should be deactivated with vinyl tape so the unit can not be paused accidentally and the volume control should be taped to maximum. Tapes should be pre-recorded with music or some sound other than tag data which will alert the tagger if his unit accidentally switches from the "Record" mode to "Play" mode. Audio tapes should be normal bias, 90 minute tapes clearly labeled with an "A" side and "B" side and an individual identifying number.

Each tagger should have two tape recorder units with fresh AA alkaline batteries ready for use in Ziploc plastic bags taped shut and rigged for wearing around the neck. Sound will easily pass through the plastic bag while protecting the unit from water damage. A third unit should be available as a backup and all three recorders clearly marked with the tagger name and in some way to differentiate one unit from the other, ie KNB #1, KNB #2, KNB #3.

Most importantly, a standardized criteria for tag releases should be adopted throughout the tag release phase. There is no doubt that tuna can survive serious injury, but not all will and it is necessary to set some minimum criteria for fish condition. Each release should be as similar to the next as possible, although basic differences may be noted due to different capture gear types, tagger effects, etc.

During these tagging cruises, the fish condition criteria would reject any fish for tagging that had hooking damage to the eye, gills, or showed significant arterial bleeding or significant jaw damage. The term "significant" is admittedly subjective so some means to better define these categories may be necessary. However, some tag releases are "better" than others, and the condition of fish on release should be noted and recorded in the database. During these cruises, a condition factor of "0" was assigned for a good/normal condition fish while a condition factor of "1" indicates some problem that is not so serious as to reject the fish for tagging but notes the fish is not perfect.

3. Archival and sonic tagging

Tagging from smaller vessels may not produce large numbers of releases, but small boats and crews can be a cost effective means to target larger fish for implantation with internal or externally anchored electronic tags. The consultant has been involved in archival tagging cruises of the National Marine Fisheries Service that have successfully implanted internal archival tags in bigeye and yellowfin tunas and external PSAT tags on swordfish, yellowfin tuna, blue shark and pelagic white tip shark. Currently the consultant is involved in a project to implant internal sonic tags in yellowfin and bigeye tunas in Hawaii. The procedures and equipment are essentially the same for either archival or sonic tags. **Figure 23** shows a padded cradle fitted to the stern of a 9 meter vessel for archival tagging experiments in Hawaii.

Fish are preferably places upside down in a padded cradle and with gills irrigated with seawater if possible. The eyes should be covered with a wetted cloth. The preferred material is a synthetic chamois typically used in car cleaning and drying (**Figure 24**). Ideally, persons involved in the procedure should be gloved in *Nitrile* or latex sterile gloves. A short incision is made with a sterile scalpel in the belly wall off-center of the midline, forward of the vent but posterior to the main area of

vital organs. The scalpel incision should not be made entirely into the gut cavity, leaving a thin membrane that should be penetrated with the tip of the index finger. It is believed that a torn wound in the peritoneal cavity will heal faster than a straight cut. This opening should be only as large as necessary to admit the body of the tag which is quickly inserted while any external light stalk or sensor is positioned (**Figures 25 – 26**).

Tags may be coated with a mixture of wax or bathed in an antibiotic solution to reduce bio-rejection by the fish. The wound should be quickly sutured using forceps, needle and sterile suture material (**Figure 27**). The minimum size for yellowfin to accept an internal archival type tag appears to be 55 – 60 cm FL. For tuna in the size range to accept internal archival tags, we have found a 3/8-Circle, #6 needle with braided silk or cat gut suture #2 or #3 is suitable for fish up to approximately 85 cm. Larger fish are more efficiently sutured with #4 or #2 needles. Before drawing the first knot to close the wound, a few drops of commercial cyanoacrilate bonding material can be applied to the inside edges of the incision. A standard surgeons knot is used (**Figure 28**). We have used a product *VETBOND* that is used in the veterinary field during small animal operations. While being eventually water soluble, this product can help in the initial healing process. If the opening is not too large, a single suture with glue is sufficient. However, if the animal shows no signs of distress and time allows, a second suture can be applied (**Figure 29**). After the operation, the fish is measured, marked with an external dart tag, assessed to condition and released if judged to be in good condition. Fish should be gently cradled with both hands and ejected head first into the water (**Figure 30**). The investigators may wish to time each operation and reject any animals for release if they are held out of water for periods longer than some minimum threshold. Further experimentation and work is required along these lines.

4. Lifting scoops and cradles

Three lifting devices were tested during the tagging cruises. Unfortunately, there were so few tuna taken during the cruises that adequate testing of the various devices was not possible. However, experiences of the consultant on similar vessels can assist in the evaluation of the various devices and vessels.

a. Direct lift

The simplest method to bring taggable fish to the tagging mattress that requires no device at all was to pull hooked fish directly through the landing door of the **F/V Consolation** onto the padded tagging mattress. The door of the **Consolation** is only 50 cm from the waterline allowing small and medium sized fish to be pulled directly onto the mattress for tagging, measurement and release. The consultant has used this method to tag large numbers of bigeye and yellowfin to about 110 cm in Hawaii. However, a stern mounted door is better as the momentum of the fish and the motion of the boat can be used to assist in the maneuver (**Figure 31**).

b. Scoop net (60 cm)

On **R/V l'Amitie** this option was not possible as the bow fish door is too high off the water and there is no stern door or low access to land fish. A simple scoop net with 60 cm diameter stainless steel hoop covered in small mesh was used to lift troll caught fish from the stern to a tagging mattress (**Figure 32**).

c. Brailer (100 cm)

A larger round scoop brailer of 100 cm diameter was constructed to assist in the lifting of larger fish and was used to lift a bigeye taken during Cruise 3 (**Figures 10a – d**). This net was constructed of 30 mm diameter stainless steel tubing welded into a 100 cm diameter circle to a 3.5 meter handle of the same material. A knotless nylon webbing (70 mm stretched mesh) was sewn into the hoop with a drop

of approximately 70 cm. This device was suitable for use on either the **Consolation** or the **R/V l'Amitie**.

d. Stretcher (190 cm)

A larger lifting cradle, or stretcher was designed to lift large tunas to the deck of the **R/V l'Amitie** assisted by a bow boom and winch. This idea for this device evolved from the simple stretcher used by personnel of the NMFS to lift large tunas and sharks to the deck of the ***R/V Townsend Cromwell*** for archival and PSAT tag implantation (**Figures 33 – 35**). This device is literally an emergency medical stretcher for human use adapted to lift large pelagics from the water using a manual block and tackle attached to four ropes that attach at the four corners of the stretcher. A hooked fish must be maneuvered over the device which is hauled up and lowered onto a padded mattress, or the fish is transferred to the mattress later.

For the purposes of this consultancy, a purpose built stretcher was constructed for use on the **R/V l'Amitie**. This stretcher was relatively narrow to allow it to fit inside the narrow fish door on **R/V l'Amitie**, being 73 cm X 190 cm x 15 cm deep. The double frame construction was necessary to give the 30 mm diameter stainless steel adequate rigidity. Attachment points for the lifting ropes were moved back 42 cm from the front of the device and separated by a lifting pipe to assist in guiding the fish onto the front of the cradle. The entire frame was meshed with the same knotless webbing used on the 100 cm circular lifting brailer (**Figures 36a – e**).

The **R/V l'Amitie** is well suited to use such a device as she is equipped with a long boom on a bow mounted mast that can extend outboard of the fish door. The end of the boom was positioned over and slightly behind the door to allow the stretcher to be lowered into the water next to the vessel. Lowering and lifting of the stretcher was controlled by a hydraulic winch controlled at the base of the mast. Two small guide ropes were attached to the stretcher to control it's shearing when lowered into the water.

VII. Field results and observations

1. Vessels and crew

a. F/V Consolation

The crews of the **F/V Consolation** and **R/V l'Amitie** were easy to work with, cooperative and keen to do whatever the consultant deemed necessary, including working long hours or attempting new fishing techniques. The **Consolation** is well equipped with longline gear and marine electronics, fishing efficiently with a total crew of four, leaving room for two scientists. Crew quarters are cramped, but very liveable and the vessel is well suited for short to medium range trips up to one week duration. The L-P longline reel, low fish door and adequate working deck space make her a good tagging platform for specific objectives around the Seychelles plateau. Also, the small size and maneuverability of the vessel make her well suited for deploying the smaller-scale gear types such as vertical longline, handline and troll.

b. R/V l'Amitie

The main advantage of **R/V l'Amitie** is having an expanded operational range, as her longline system is inferior to that of the **F/V Consolation** and her high deck makes tagging fish very difficult. However, the lifting stretcher should be effective to raise large tunas for tagging while the smaller scoop net can be used for smaller fish. However, the stretcher needs further evaluation and testing. The larger size allows more scientists or tagging technicians on the vessel although living quarters can be difficult due to the lack of an operational air conditioner. In regard to basic shipboard equipment, the echo sounder on board is ineffective for detecting fish schools or depths beyond 200 m, which it

currently marks with difficulty. For handlining and jigging, the vessel is a bit large and cumbersome to work effectively close to anchored FADs, although it could be an effective platform for working near drifting high seas FADs. A significant plus of the vessel is the availability of AC 110 and 240 current and 24 volt power, and the space to house a portable generator for additional power needs.

c. Supply vessels

The anchored supply vessel ***Explorer III*** was well fitted to house a tagging technician in comfort with the added plus that the captain and managing company have been very cooperative and agreeable to collaborating with tagging research. Indeed, one of the vessel staterooms was labeled for a "Biologist", as the vessel had hosted a biologist a few years ago. These matters were discussed over a Sunday lunch that was generously hosted by the captain of the ***Explorer III*** (see **Figure 37**), which was a good indication of their interest in cooperating with IOTC.

Unfortunately, the general structure and layout of the vessel is not well suited for tagging. There is no access for fish capture and tagging from the stern and the bow deck is high off the water making it difficult to land larger fish. However, there is a covered area on the bow deck from which many small to medium sized fish could be tagged (**Figure 38**). This area is also on the forward work deck with scuppers to the sea, which means that it can be easily hosed down and cleaned and a saltwater hose can be left running without causing any problems.

The ***Ocean Scout I*** appears well suited for tagging operations, being an ex-ocean going tugboat constructed low to the water with a large, open aft deck. However, we were unsuccessful in establishing any contact with the vessel and it is uncertain whether the owners would be interested in cooperating with a tagging project.

One general constraint common to both vessels is the strong current that is often present on the Coco de Mer Seamount which would make handline operations difficult from an anchored vessel. However, there are undoubtedly times when the current slacks and the vessel crew indicated that there would be ample opportunities to tag large numbers of tuna from the vessels. In addition, the anchored vessels provide a perfect opportunity from which to base residence time and local movement studies of tuna aggregated to the seamount using sonic tags and listening stations. The electronic listening devices could be simply lowered over the side of the anchored supply vessel and retrieved at any time to download data.

2. Fishing gears
a. Horizontal longline

The longline gear on the **Consolation** is new and very efficient, being a single spool Lindgram Pitman system reel with integrated line shooter and timer. The system on the **R/V l'Amitie** is somewhat cumbersome and slow to set due to the need to switch out spools every 2500 meters, which means the operation must come to a halt at every spool switch. Hauling is also slowed during spool switches. However, the system works adequately for the purposes of research longlining.

One of the main considerations in using longline gears for tagging is the ability to modify the crew's normal routines to maximize the capture of tunas in a taggable condition. Once a concentration of fish is located, short, shallow sets in the early morning hours will probably work best, but experimentation will be necessary to determine the best time, depth and procedures for different species. The most significant problem noted was the use of swordfish style, 9/0 "J" style hooks. While these are effective for commercial fishing, the fish have a tendency to swallow these hooks which are also prone to injuring the back of the eye orbit when taken deeply.

The availability and choice of longline bait in Victoria seems to be restricted to frozen squid, which is presumably supplied for the swordfish targeted fishery. A variety of other baits attractive to tuna may have to be sourced for tagging cruises.

b. Vertical longline

Vertical longline gear was tested on Cruise 2 and 3, and appears a viable gear type to target large tuna in areas where fish are aggregated, ie seamounts, FADs, offshore banks. Obviously, further testing and training will be required as there were not enough tuna found to adequately test the gear. For this gear to be used effectively, the lines must be deployed either free drifting, from an anchored FAD or directly from the vessel depending on existing current and sea conditions. However, the consultant has used the gear type successfully in other areas and found it to be an efficient gear type in certain situations. A significant advantage of vertical longline gear is that it provides direct information on the depth of aggregated tuna that can be targeted by other gears. Also, fish in good condition can be landed as the line can be hauled as soon as a fish is hooked as its presence can be easily noted by the action of the surface float.

c. Troll

Trolling is considered to be a relatively poor gear type for tagging studies due to the higher rate of rejection for tagging caused by hooking damage and trauma. Fixed handlines like those used during this study are particularly damaging as they have no means to slack line or cushion the pull of the vessel on the strike. However, the condition of tuna trolled on the **Consolation** was quite good with only one yellowfin in six rejected for tagging (jaw damage) with the rest appearing to be in good condition. One mitigating factor here may have been the use of braided nylon lines that offer considerable stretch on the strike and tying the ends of the line high on the overhead canopy. The line sag due to gravity provided some additional cushioning effect on the strike. The use of large trolling reels or commercial handline reels with a drag system would reduce hooking injury and provide a more efficient means to tag troll caught individuals.

One problem encountered when trolling tuna on or near the Seychelles Plateau or near Plate Island had to do with the large number of bycatch species encountered. Kawakawa, wahoo, sailfish, jobfish, dogtooth tuna and other species can arrive in such numbers as to interfere with the catch of taggable tuna and damage the gear. The crew's tendency to troll too shallow or in areas other than prime tuna grounds should be discouraged.

Slow trolling with dead bait appeared to be a promising technique to use from the anchored supply vessels, with the strong current supplying the water speed to simulate movement of the dead bait. A shear board or boom could be used to carry the bait away from the hull while the circle hooks would allow the line(s) to be set and left to fish unattended.

d. Handline

a. Vertical jigging

Few opportunities arose to test vertical jigging during the cruise, but the technique was successfully demonstrated on the anchored supply vessel ***Explorer III*** for subsurface yellowfin tuna. The fishing method has been particularly successful in targeting medium sized bigeye in Hawaii and the Eastern Pacific Ocean, and the consultant has no reason to doubt that it will be effective in the Indian Ocean. The advantages of the technique are that very small vessels can be used and the fish condition is generally good as each fish is individually hooked and landed immediately, in contrast to longline caught fish. In areas of subsurface tuna aggregations, deep jigging should be strongly considered, such as over seamounts or near FADs.

b. Surface baited handline

Unfortunately, the proper conditions to test surface handlines also did not occur during any of the three cruises due to a lack of fish. However, this should be another technique to tag and release fish without the need for live bait. However, better sources and quality of frozen bait needs to be secured to support this fishing method, that relies heavily on chumming and the use of oily, fatty baitfish such as temperate water sardines, anchovies or herring. To repeat the methods section of this report: The technique relies on chumming a tuna school to the surface and inciting a feeding frenzy from which fish can be readily hooked and tagged.

c. *Ika shibi* and *palu ahi* style handline

Once again, sufficient quantities of medium and large tunas were not encountered during the consultancy to properly test i*ka shibi* and *palu ahi* style handline gear. However, the techniques should be useful to take subsurface tuna from aggregations for specific purposes. In particular, the gear is capable of quickly landing large fish as demonstrated by the landing of a swordfish in taggable condition during Cruise 3. Therefore, the gear should be suitable to land large tunas for archival tagging or PSAT deployments.

From an operational standpoint, the parachute sea anchor worked well on both vessels, slowing and controlling the drift of the boats so the lines were fishing effectively (vertically). However, the underwater light used during Cruise 2 was actually a baitfish attraction light of very high output and too bright for *ika shibi* fishing. A smaller light or light rigged to a rheostat for dimming should be used in the future.

One aspect of *ika shibi* fishing that was not tested was the use of fresh or live squid for bait. Further attempts should make sure that a light tackle fishing pole be available to cast and retrieve small squid jigs. Fresh bait in this fishery can dramatically improve catch rates.

One potential, and so far untested problem is that handlined tuna can overheat from within, causing the burnt tuna syndrome, which can contribute to post release mortality. The use of heavier line and mechanical line haulers are thought to reduce this problem due to shortened fighting time, but further research along these lines is required. However, for classic *ika shibi*, night handlining, the thin red line used during the consultancy should be changed to braided nylon, which is easier to handle, safer on the hands and allows faster landing of large fish. The thin red line supplied by the consultant is necessary for *palu ahi* style handlining where the “no stretch” qualities of the line allow the chum bag to be released and fished effectively for medium sized tuna.

d. Other gears

From observations made during the three cruises, the use of surface trolled plastic squid lures as pictured in **Figure 19** for bigeye probably will not be a viable option for tagging in the equatorial Indian Ocean. In Hawaii, this technique is used on local seamounts and deep-water moorings to land large quantities of bigeye that are chummed to the surface. These aggregations are chummed into a frenzy and can be fished throughout the day. Many of the tag releases of bigeye made during the Hawaii Tuna Tagging Project were caught in this manner. However, the sea surface and vertical thermal structure of the water column is much cooler in Hawaii compared to the areas visited during the consultancy. It may be possible that this technique could be adapted to very early morning hours or to areas to the south of the Seychelles, but this remains to be seen. Presently, there appear to be no likely areas in the western Indian Ocean where this technique can be applied.

3. Tagging / lifting devices

a. Tagging gear

In regard to basic tagging equipment, the most important item was the tagging mattress, which replaced the tagging cradle normally used by large-scale tagging programs. While a raised tagging cradle is well suited for small to medium sized fish taken by pole and line, it is less suited for small vessels or large fish. The tagging mattress constructed for these cruises performed very well on both vessels and should be considered for further use IN CONJUNCTION with a proper tagging cradle(s) if a dedicated tagging vessel is utilized. The mattress was easily stored and moved to various locations on the vessels and adequately cushioned the fish while allowing an easy surface upon which to measure the fish. However, a tagging mattress is completely unsuitable for use when implanting internal archival or sonic tags. For sonic tagging, some sort of cradle should be constructed that can house the tagging mattress, similar to the archival tagging cradle shown in **Figure 23**.

The vinyl tag magazines worked very well during the cruises to securely hold and organize tags and applicators ready for tagging in a safe, secure pouch. The consultant has found this style of tag holder to be the best when many different, small vessels are utilized. The magazines can be kept to the side during tagging and are not as dangerous as tag blocks where loaded applicators are exposed in an upright position. Also, the tag magazines can be secured to a vertical surface for rapid access.

Longer tag applicators need to be purchased to accommodate the 14.8 cm tags purchased by IOTC. A more important consideration is whether the program should purchase smaller tags for smaller fish, as these tags are large for tuna of less than 60 cm FL.

For data recording, the simple data boards were adequate for the cruises due to the lack of fish and slow rate of tagging. However, for a regular tagging program, tape recorders as detailed previously should be used. For situations where the rate of tagging does not warrant tape recorders, data recording forms should be designed and printed on water resistant paper with columns for all appropriate data.

Details of the construction of suitable tagging cradles, tag applicator blocks and associated technical gear can be found in Kearney (ed) 1982.

b. Lifting devices

The ability of this consultancy to evaluate lifting devices must be considered incomplete due to the scarcity of tuna of various size classes with which to test the nets and cradles. However, the experience of the consultant using similar devices can assist in the evaluation of the devices where empirical data is lacking.

The 60 cm scoop net was surprisingly efficient at scooping and lifting small troll caught fish to the deck of the **R/V l'Amitie**, and similar nets could be made for future tagging trips using troll gear. Nets should be customized to suit particular vessels as far as handle length and weight.

The 100 cm brailer scoop net seems to be well suited for lifting intermediate sized fish and can be adapted to any type of vessel. It was very easy to leader the fish inside the net but a bit harder to lift it manually to deck level. The addition of a snatch block above the landing door to pull the lifting line would make this task much easier and more efficient. However, the webbing of the net should be reduced as the depth of the net was excessive. However, with these minor modifications, the net should be well suited for lifting fish up to approximately 140 cm FL. The long handle on the net provided stability of the device in the water and the ability to quickly maneuver the ring to scoop fish.

The utility of the 190 cm tagging stretcher is still undetermined due to a lack of large tuna during Cruise 2. However, this system has been used with some success by other researchers (see **Figures 33 – 35**) and the consultant feels that the stretcher constructed for the IOTC has some important improvements that should improve performance considerably. In particular, moving the forward lifting points back and spreading the lifting lines with a pipe should make leadering fish over the

stretcher much easier. However, controlling the shearing of the device in the water with guy lines will need to be tested and can only be mastered with time and experience. Similar to the 100 m brailer, the mesh on the stretcher can probably be shallowed, but only experience will tell if this is desirable. Additional weighting of the stretcher may also be necessary.

4. Gut contents / baitfish

The gut contents of finfish captured during the three cruises was examined and is noted in **Appendix V**. The dominant forage species in almost all pelagic species sampled was the pelagic stomatopod *Natosquilla investigatoris*. Mesopelagic octopods, decapod shrimp, squids and pelagic crabs were also noted from swordfish and bycatch species. One objective of gut sampling was to determine if any of these fish had been feeding on forage species that would make suitable baitfish for pole and line tagging operations. Unfortunately no *Decapterus* sp. were found in any fish stomachs and no tuna baitfish species were noted aside from some fusiliers (CAESIONIDAE) found in the stomach of a kawakawa (*E. affinis*). Therefore, the cruises did not provide any promising data on baitfish resources in the area of the Seychelles plateau.

VII. Discussion and recommendations

Recommendations and discussion follows each bulleted point (in bold face) which represent objectives of this consultancy.

- **conduct experimental tagging cruises on fishing vessels out of Victoria port, Seychelles to determine suitability as tagging platforms;**

The **Consolation** should be a more efficient and cost effective vessel compared to **l'Amitie** within her operational range due to the lower landing door, lower gunnels, more efficient longline system and better maneuverability near FADs. The smaller size also makes her easier and quicker to stop and start when troll tagging.

The **R/V l'Amitie** is a good vessel for longer range trips, but needs upgrading in marine electronics and some means to better cool or ventilate the crew quarters for equatorial work. In particular, the vessel should be equipped with a high grade echo sounder capable of distinguishing fish and bait and possibly a sonar unit for evaluating aggregations on seamounts and FADs. The addition of a scientific grade echo sounder with integrated GPS and computer storage capability would greatly enhance the value of the vessel for scientific survey and research. The vessel has the range and autonomy to survey and operate on high seas drifting FADs of the purse seine fishery or her own drifting FADs, which holds great promise for future tagging work.

The captains and crews of both vessels, many of whom were the same individuals, offer a big plus to the potential utilization of these boats for tagging. They are obviously accustomed to working with scientists and were very cooperative. However, regular habits, accustomed work hours and regularly used gear are difficult to modify for a short consultancy or a charter. These factors reinforce the difficulty in conducting tagging operations on an ad hoc basis and the desirability of having longer term charters or a dedicated tagging vessel.

- **test various fishing gears to target yellowfin and bigeye tunas of various sizes;**

Traditional longline gear is clearly a difficult gear type from which to tag tuna due to the characteristically low catch rates, poor fish condition and amount of time needed for the setting and hauling operations. The real problem with the long hours is that it takes the energy and interest of the crew away from conducting other fishing and tagging activities. In addition, the gear and setting practices may need to be significantly modified to target tuna for tagging, such as changing all the hooks to circle hooks, which may not be practical for a short contract or charter. However, anything can be done if it is paid for, but changing all the gear would entail significant manpower and added charter costs. Nevertheless, longline gear can be one means to target very large tunas for specific tagging purposes, such as the implantation of archival tags or sonic tags on the high seas.

Vertical longline may be a better option, as theoretically the fish should be in better condition as the line can be hauled as soon as a fish is detected by movements of the surface float. However, the branchline lengths may have to be lengthened to land more fish in taggable condition. Vertical longlines may be more useful to determine the depth at which fish are biting by species and then target those depths with single hook handline gear.

Trolling tends to damage fish due to the shock of the strike against a moving vessel. However, if troll gear is to be used, damage to the fish can be mitigated by using some sort of reel with a drag system. The large Alvey brand hand reels, such as the Reef King or some commercial hydraulic reels with a drag system are very efficient and can be used to enhance a tagging platform. However, trolling should not be considered as a primary means to tag fish, but more of a way to locate schools for intensive chumming and handlining. Also, trolling will seldom catch bigeye, but can be a good way to locate yellowfin schools.

Various styles of handlining may offer the best option for tuna tagging by non pole and line gears in the Indian Ocean. For archival tagging, *ika shibi* or *palu ahi* style handlining or vertical jigging can capture large tuna in a taggable condition and far larger fish than are normally possible with conventional pole and line gear. Several squid were observed around the vessel at night. Gear and techniques to land these wild baits should be explored which may enhance catch rates. The subsurface nature of these gears are also useful to target bigeye tuna and larger yellowfin.

The short surface handline gear can also be very effective in tagging large numbers of smaller tuna. However, all of these techniques rely on targeting aggregated and feeding schools. Some seamounts and drifting FADs appear to hold the best chance for tagging significant numbers of bigeye and yellowfin tuna with handline gear. However, it would be best to assess post-release mortality of large tuna taken by handline or longline by some fishery independent means, such as the use of PSATs or sonic tracking.

- **investigate the use of the aggregation behavior of tunas to increase fishing/tagging efficiency, specifically in relation to seamounts and fish aggregation devices (FADs);**

The anchored FADs available during the consultancy were either ‘not available’ due to their being subsurface or simply lost, or had not sufficient time to aggregate any tuna. Therefore, the utility of anchored FADs to support tagging operations around the Seychelles plateau could not be properly evaluated. However, in the absence of an established FAD program, it seems unlikely that anchored FADs will be a viable option to support future tagging operations. A few strategically placed FADs could assist tagging efforts, but the cost of these FADs and their maintenance would have to be borne completely by the program. It is unlikely that local Seychellois fishermen or fishery programs will support them due to the long distance from Victoria to the outer plateau shelf and relative abundance of bottomfish for small boat fisheries.

Drifting FADs were not tested during the consultancy, but their efficacy in aggregating all three tropical tuna species in the Indian Ocean has been well demonstrated by the purse seine fishery. Tagging on drifting FADs has a number of advantages to a tagging program, such as concentrating and increasing tuna vulnerability in remote and high seas areas and allowing the situation to be controlled by the tagging scientists. For example, a drifting FAD can be easily removed from the water after releasing tuna on it, forcing them to disassociate at a known date. This type of manipulation is not possible on other types of aggregation, such as anchored FADs, seamounts or reefs.

Positive contacts made on the Coco de Mer seamount with the anchored supply vessel ***Explorer III*** were a very positive outcome of Cruise 2, and should be expanded via further dialogue with the OPAGAC group. However, the ***Ocean Scout I*** appears to be a better tagging platform so direct contact with this vessel's company should be investigated.

The Coco de Mer seamount represents a reliable tag release location in the center of the purse seine fishery if an efficient collaboration can be established with the anchored vessels. It was clear from our Cruise 2 that the best tagging locations were on the vessels themselves due to the strong FAD effect of the anchored boats. Given that OPAGAC seems conducive to hosting a tagging technician/biologist on board, this is one positive point for a regional tagging program. The logistical setup is also ideally conducive to the use of sonic tags and listening station technology that could be deployed and retrieved on a line from each vessel. This form of electronic fish monitoring would yield important data on the residence times and diurnal habits by season for tuna associated to the seamount; information necessary to estimate species-specific vulnerability to the seamount fishery. However, one should bear in mind that tunas on this seamount are regularly fished by purse seiners, therefore residence times might not be easy to estimate with sonic tags.

However, from a practical standpoint, a single technician will not be a safe or effective tagging operation on board the anchored supply vessels. It is not satisfactory to assume that he will be assisted by off duty workers on their free time after the novelty of the tagging wears off. Tagging tuna on the equator can be hot, tedious and difficult work. It will be critical to secure the services of off duty crewmen so the tagger is assisted most of the time. This could be achieved either through delegation of duty by the managing company or some pay arrangement from the tagging program to supplement crewmen's wages during off duty hours. Of course, these duties must not interfere with their ability to perform regular duties. Some ground rules could be established to avoid problems, such as limiting a crewman to one hour of tagging and then rotating to another crewman. Another option would be to place two technicians on board the vessel so as to be completely independent of the crew and their work load.

- **test various devices and methods to transfer large tunas from the water to a tagging surface in good condition,**

The 100 cm round brailer scoop net seemed to be an effective means to raise large tuna from the water for tagging. The net is easily adapted to any vessel, can be operated manually and quickly deployed. The larger 190 cm stretcher device is much more cumbersome to manipulate, requiring a boom and mechanical winch and is more strongly influenced by drift and shear in the water. However, neither device was properly tested during the consultancy due to a lack of fish and trials.

A great advantage of the 100 cm brailer was the long handle that provides positive control of the net hoop. Similar devices with an oblong or oval net ring could be made to handle large fish with an overhead pulley for lifting. However, these devices should be viewed as a means to bring small numbers of large fish to the deck for specific purposes, such as archival tagging, not for mass tagging experients.

- **demonstrate optimal conventional and archival tagging techniques to designated Seychelles-based personnel, and;**

All the techniques and technical aspects of tagging and a large scale tagging program were clearly NOT demonstrated during the consultancy or transferred to local counterparts due to the lack of tuna during all three cruises. Specific, at-sea and in port training will be necessary in the future when serious tagging operations begin. In the meantime, suitable forms and a comprehensive tag release and recapture database should be designed and debugged as much as possible. Bailey, et al (1993) describes the tuna tagging database developed by the South Pacific Commission to handle data from a large-scale tuna tagging program that may be useful in guiding the development of an IOTC database.

- **make field observations useful to baitfish utilization by future tagging cruises.**

Stomach analysis of the tuna and bycatch species taken during the three cruises did not reveal any *Decapterus* sp. or any common tuna baitfish species, such as anchovies, sardines or sprats. However, a few fusiliers were noted in an *E. affinis* captured on the eastern edge of the Seychelles plateau. Fusiliers (CAESIONIDAE) make up a significant component of the tuna baitfish used by the Solomon Islands pole and line fishery and are a hardy, high quality baitfish group. However the Solomon Islands baitgrounds where fusiliers are common are enclosed, coral rich lagoons of the type that are not present on the Seychelles plateau. Fusiliers may be taken in quantity in some of the outer atolls of the Seychelles, but their harvest may be counter to the desires of the sport diving and tourism industries. However, the limited gut sampling carried out on these cruises is clearly inadequate to assess what may actually be present on the Seychelles plateau. A better and more comprehensive means to sample baitfish populations should be attempted.

VIII. SUMMARY

The scarcity of tuna during all three cruises hindered the ability to properly address all project objectives. However, several useful observations and recommendations can be made in relation to fielding a large-scale tagging program for the Indian Ocean. It should be noted that the lack of tuna encountered during the consultancy was considered anomalous, and not a fair demonstration of tagging prospects where the area and time of cruises can be adjusted to more efficiently target yellowfin and bigeye. The timing of the consultancy was set during a period when weather and fishing conditions should have been favorable and when the consultant was available. However, inter-annual variations in weather and local fish abundance conspired with unfortunate result.

Developing a working relationship with the companies with anchored supply vessels on the Coco de Mer Seamount should be a priority, as this site represents a cost effective opportunity to seed tags out in the midst of the purse seine fishery throughout the year. An average of 15000 MT of tuna are caught annually on this seamount (Chart 1) distributed at 53 % skipjack, 38 % yellowfin and 9 % bigeye. Monthly catches peak from July to November (Chart 2). October shows the highest catch for each of the three species for the period 1984-2001. The situation encountered during cruise 2, with almost no tuna around, appears to be very unusual.

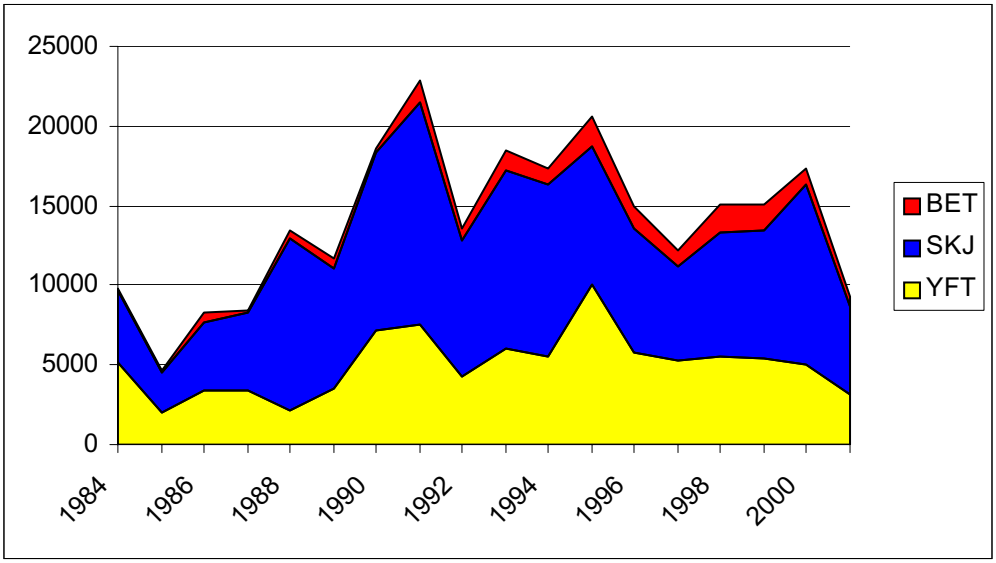

Chart 1 : Yearly purse seine catch by species on Coco de Mer seamount (1984-2001)

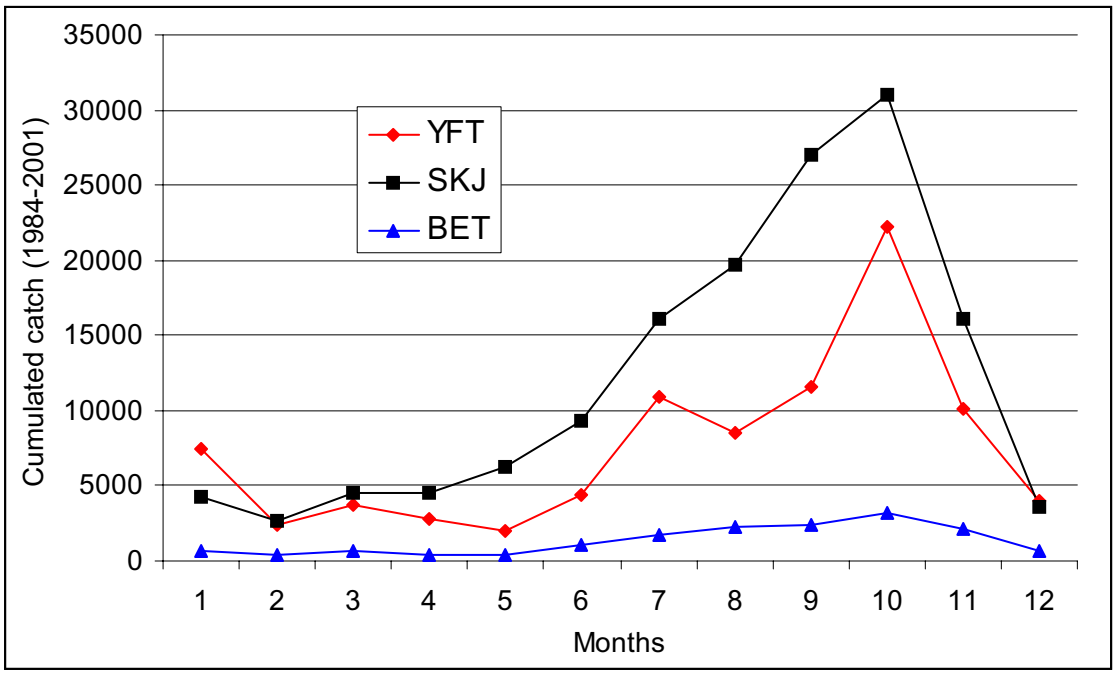

Chart 2 : Monthly purse seine catch by species on Coco de Mer seamount (cumulative catch 1984-2001)

The catch distribution by size (Chart 3) is characterised by two size classes of yellowfin: one group of 44-76 cm FL and a larger group ranging from 100-150 cm FL, while bigeye is represented by juveniles from 44 to 100 cm FL and in smaller numbers than yellowfin. Therefore, it should be possible to tag a wide range of yellowfin on the seamount while only juvenile bigeye appear available. Although purse seine statistics indicate 9% bigeye in the catch, it may be possible to increase bigeye tag releases by targeting them with subsurface handlines or early in the morning hours. Also, the proportion of bigeye and yellowfin on the seamount may actually be higher due to mixing of small bigeye/yellowfin tuna with skipjack in the landings.

Another consideration is that tagging on the seamount need not occur during times of very high

abundance of fish, as there should be ample supplies of fish for tagging available throughout the year. Releases during times of lower abundance may actually be preferable as purse seine activity will be reduced and the incidence of short term recaptures of fish released and recaptured on the seamount will also be minimized.

The small vessels and crews evaluated during the consultancy appear well suited for short to medium range tagging operations, but the main use of the **F/V Consolation** will likely be restricted to small - scale archival or anchored FAD related tagging missions. Fishing in proximity to the Seychelles plateau is difficult due to the large troll bycatch issue. However, by targeting particular seasons and offshore small island areas when surface yellowfin are abundant, the **F/V Consolation** should be capable of releasing in the range of 30 to 70 yellowfin tuna per day using a mix of troll and handline gears. Higher release numbers may be possible, but concentrated feeding aggregations of tuna need to be located and targeted. It is likely that a small number of larger bigeye and yellowfin could be taken with subsurface gears at night and landed with the 100 cm scoop brailer.

The **R/V l'Amitie** is actually less efficient for troll tagging than the smaller boat and landing large fish is more difficult due to the higher work deck. The main advantage of this vessel would be her ability to work more distant areas and to tend and work on drifting high seas FADs. However, to work effectively on drifting FADs, the vessel electronics need to be upgraded.

While tagging troll caught tuna on the edge of the Seychelles Plateau will be quite seasonal, purse seine catch statistics in this region suggest year long availability of yellowfin and bigeye tuna. From 1995 to 2001, bigeye catch in the area around Seychelles Plateau (3°S-7°S/53°E-58°E) fluctuated from 8000 to 22000 MT comprised of 48 % yellowfin, 42 % skipjack and 10 % bigeye (Chart 4). The high catch rate of yellowfin is particularly encouraging. Monthly catch rates (Chart 5) indicate a marked peak for yellowfin in July and an October peak for skipjack. Bigeye do not show any particular abundance throughout the year. The scarcity of tuna encountered during cruises 1 and 3 may not be expected from these monthly catch distributions, although targeting areas and seasons further off the Plateau where the purse seine vessels operate may be more productive.

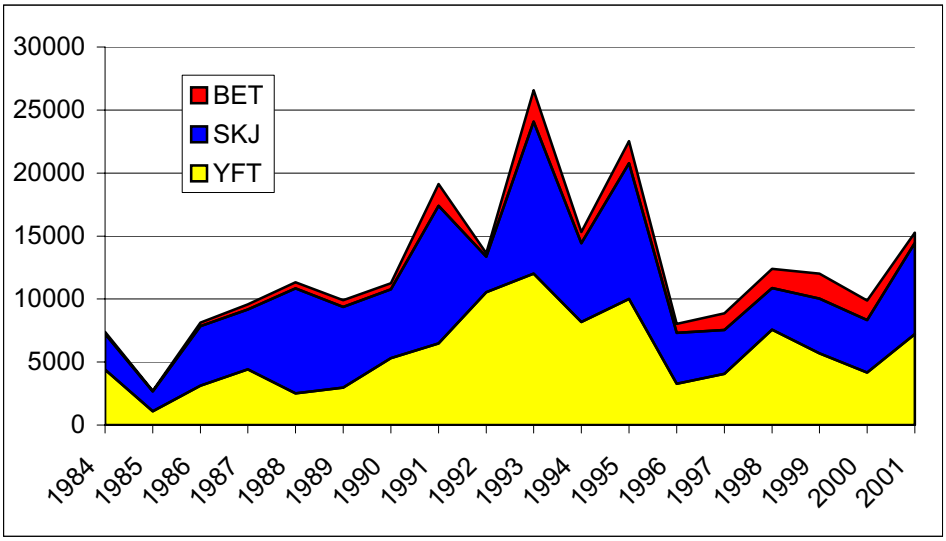

Chart 4 : Yearly purse seine catch by species in the area 3°S-7°S / 53°E-58°E – around Seychelles Plateau – (1984-2001)

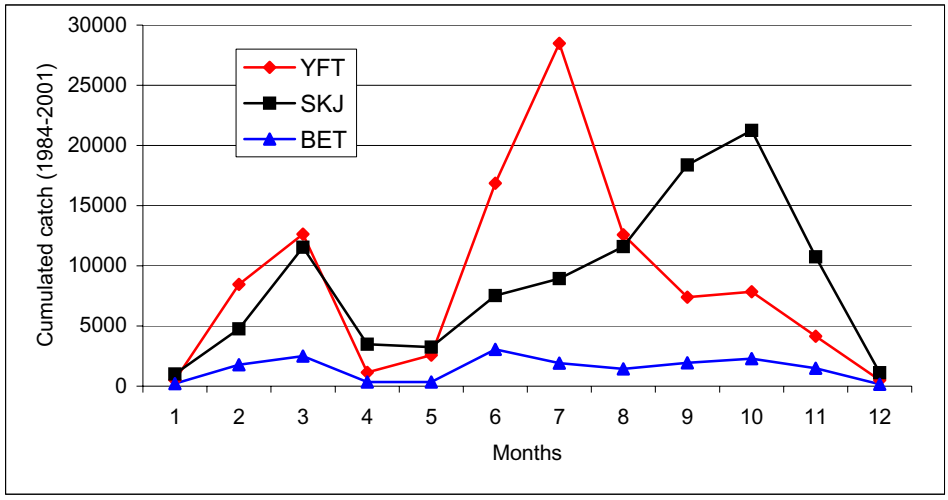

Chart 5 : Monthly purse seine catch by species in the area 3°S-7°S / 53°E-58°E – around Seychelles Plateau – (cumulative catch 1984-2001)

In this area, yellowfin catch is mostly adult fish (105 to 145 cm FL), although small size fish (between 42 and 60 cm FL) are also available. Bigeye from 42 to 150 cm FL are available but always in small quantities (Chart 6).

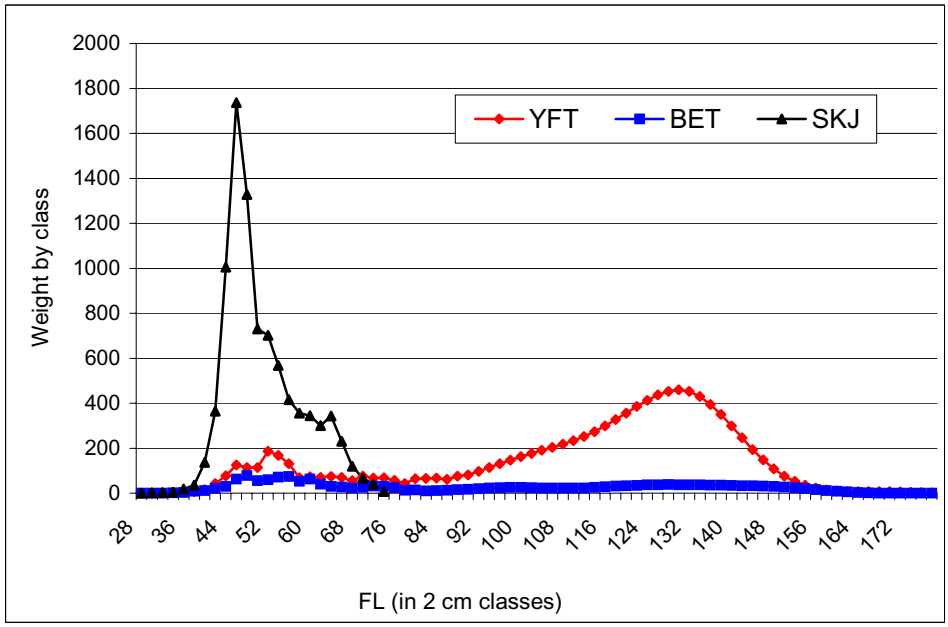

Chart 6 : Catch distribution by size, species and FL classes for purse seiner in the area 3°S-7°S / 53°E-58°E – around Seychelles Plateau – (average 1991-2001)

Time and expense in training new crews, modifying gear, modifying commercial habits and other considerations make it impractical to base a large tagging program on opportunistic or part-time tagging platforms. A dedicated tagging platform or platforms will be necessary to achieve program continuity and a standardized quality of releases. HOWEVER, such a vessel should not be limited to the pole and line technique, but prepared to apply a variety of gear types to target different species and sizes of tuna.

A key issue here is the need to focus on aggregated tuna schools and the ability to incite them into

active feeding frenzies which will require large quantities of bait. Aside from the difficulties in obtaining live bait in the Seychelles, it was clear that stores of suitable frozen bait are not currently available in the Seychelles. Successful tagging operations of the South Pacific Commission while fishing on tuna aggregations in the Coral Sea and bigeye tagging in Hawaii depended entirely on intensive chumming with oily, high fat fish such as temperate water anchovy, sardine and mackerel. The advantage with frozen bait is that it can simply be purchased and brought in, perhaps on cooperating supply vessels or purse seiners transiting from Europe, while wild bait can be impossible or very difficult to obtain.

A dedicated tagging platform, equipped to conduct a mixture of live bait, dead bait and lure fishing on drifting FADs and free schools appears to be the best option for realizing tagging in the western Indian Ocean and for targeting bigeye and yellowfin tuna. It is recommended that trial tagging be carried out on the high seas on drifting FADs, perhaps in conjunction with the activities of the EU funded FADIO project. Other aspects and objectives of FADIO may serve to assist the tagging program objectives, such as residence time and vulnerability issues related to the Coco de Mer Seamount and drifting FADs.

References

Bailey, K., P. Williams, and R. Price. 1993. A manual for the tagging database system of the Regional Tuna Tagging Project. Tuna and Billfish Assessment Programme. Noumea, New Caledonia. Technical Report No. 30. 49 pp.

Kearney, R.E. {ed} 1982. Methods used by the South Pacific Commission for the survey and assessment of skipjack and baitfish resources. Tuna and Billfish Assessment Programme. Noumea, New Caledonia. Technical Report No. 7. 120 pp.

Preston, G.L., L.B. Chapman, and P.G. Watt. 1998. Vertical longlining and other methods of fishing around Fish Aggregating devices (FADs): a manual for fishermen. Secretariat of the Pacific Community, Coastal Fisheries Programme, Capture Section. Noumea, New Caledonia. 64 pp.

Yuen, H. S. H. 1979. A night handline fishery for tunas in Hawaii. *Mar. Fish. Rev.* 41:7-14.

Appendix I. Personnel and contacts during tagging cruises

Cruise 1	**title/affiliation**
Hallier, Jean-Pierre	scientist, IRD
Itano, David	scientist, UH
Andre, Keith	Captain, F/V Consolation
Hoareau, Daniel	Captain, R/V l'Amitie
Camille, Stephen	crew, SFA
Souffe, Jean	crew, SFA
Cruise 2	
Hallier, Jean-Pierre	scientist, IRD
Itano, David	scientist, UH
Valentin, Jean-Paul	biologist/technician SFA
Hoareau, Daniel	Captain, R/V l'Amitie
Collen Lavigne	engineer
Camille, Stephen	crew, SFA
Souffe, Jean	crew, SFA
Morgan, Stephen	crew, SFA
Gerald Pierre	cook
Explorer III	
Leniz, Inacio	Captain
Garay, Florencio	Chief Engineer
Randriamanantena, Alexandre	Cook
Cruise 3	
Itano, David	scientist, UH
Dewals, Patrice	biologist/technician IRD
Hoareau, Daniel	Captain, F/V Consolation
Camille, Stephen	crew, SFA
Morgan, Stephen	crew, SFA
Gerald Pierre	cook

Appendix II. Consultant daily activities

Date October	Location	Activity
1	In transit	Depart Honolulu 1120, transit via Kansai/Singapore
2	In transit	In transit, cross International Dateline
3	Victoria	Arrive Victoria 0330.
4	Victoria	Cruise planning, gear purchases, fabrication.
5	Victoria	Cruise planning
6	Victoria	Cruise planning
7	Victoria	Cruise planning, meet with EU consultants
8	At sea	Cruise 1 begins – F/V Consolation to north and east Seychelles plateau
9	At sea	Cruise 1 – F/V Consolation to north and east Seychelles plateau
10	At sea	Cruise 1 – F/V Consolation to north and east Seychelles plateau
11	At sea	Cruise 1 – F/V Consolation to north and east Seychelles plateau
12	At sea	Cruise 1 – F/V Consolation to north and east Seychelles plateau
13	At sea	Cruise 1 ends, return to Victoria port
14	Victoria	In port, report writing
15	At sea	Cruise 2 begins– R/V l'Amitie to Coco de Mer Seamount
16	At sea	Cruise 2 – R/V l'Amitie to Coco de Mer Seamount
17	At sea	Cruise 2 – R/V l'Amitie to Coco de Mer Seamount
18	At sea	Cruise 2 – R/V l'Amitie to Coco de Mer Seamount
19	At sea	Cruise 2 – R/V l'Amitie to Coco de Mer Seamount

20	At sea	Cruise 2 – R/V l'Amitie to Coco de Mer Seamount
21	Victoria	Cruise 2 – R/V l'Amitie to Coco de Mer Seamount
22	Victoria	Cruise 2 ends, return to Victoria port
23	Victoria	In port, report writing
24	Victoria	In port, report writing
25	At sea	Cruise 3 begins – F/V Consolation to Plate Island and Fred Seamount
26	At sea	Cruise 3 – F/V Consolation to Plate Island and Fred Seamount
27	At sea	Cruise 3 – F/V Consolation to Plate Island and Fred Seamount
28	At sea	Cruise 3 – F/V Consolation to Plate Island and Fred Seamount
29	At sea	Cruise 3 ends – return to Victoria port
30	Victoria	In port, report writing
31	Victoria	In port, report writing, depart Victoria 2035.

Appendix III. FAD positions and Fred Seamount soundings

Fad #	Area	Lat	Long	Depth	Date set	Comments
1	Bird Island	3° 43.7' S	54° 53.3' E	1400 m	2 Aug 02	Searched 9 Oct 02, presumed lost, subsurface
2	Dennis Island	3° 46.5' S	55° 59.8' E	1100 m	2 Aug 02	Searched 10 Oct 02, presumed lost, subsurface
3	Plate Island	5° 37.8' S	55° 24.0' E	1900 m	2 Oct 02	
4	Fred Seamount	6° 13.8' S	54° 20.1' E	1100 m	2 Oct 02	
NA	Fred Smt	6°13.1' S	54°22.1' E	~500 m	Recorded during echo sounder survey of Fred Seamount summit area by F/V Consolation on 27-10-02.	
NA	Fred Smt	6°12.7' S	54°23.1' E	~450 m		
NA	Fred Smt	6°13.54' S	54°22.69' E	~380 m		
NA	Fred Smt	6°14.01' S	54°22.89' E	~425 m		
NA	Fred Smt	6°14.91' S	54°22.87' E	~550 m		

Appendix IV. Tagging cruise daily activities

Date	Area	Fish tagged				Activity
		YFT	BET	SJK	Total	
Cruise 1						
8 Oct	Victoria	-	-	-	-	Depart Victoria 1245, trolling north toward Bird Island 2230 arrive area of FAD 1, set longline
9 Oct	Bird I	0	0	0	0	Haul LL, no target catch, unsuccessful search for FAD 1, trolling
10 Oct	Dennis I	0	0	0	0	Unsuccessful search for FAD 2. Trolling, no target catch. Set longline 2100
11 Oct	NE shelf	0	0	0	0	Haul LL, no target catch. Trolling, no target catch. Set LL.
12 Oct	NE shelf to E side	5	0	0	5	Haul LL, no target catch. Trolling. YF located near La Junon Bank. Six trolled, five tagged and released. One YF not tagged – jaw damage.
13 Oct	Victoria	-	-	-	-	Return to Victoria 0900, end of trip.
Total		***5***	***0***	***0***	***5***	
Cruise 2						
15 Oct	Victoria	-	-	-	-	Depart Victoria 1430, trolling north.
16 Oct	North of plateau	0	0	0	0	Trolling north, pass F/V Men Gren, no catch
17 Oct	South of Coco de Mer	2	0	0	2	Longline set 33 miles south of seamount, no tuna. Proceed to Coco de Mer. Trolled YFT.
18 Oct	Coco de Mer	0	1	0	1	Trolled one bigeye. No catch on longline
19 Oct	Coco de Mer	1	0	1	2	Handline, longline no tuna catch. Trolled YFT, SJK. Bottomfished
20 Oct	Coco de Mer	1	0	0	1	Longline,\troll no tuna catch. Two YFT jigged from Explorer III
21 Oct	North of plateau	0	0	0	0	Trolling south towards Victoria
22 Oct	Victoria	-	-	-	-	Return to Victoria 0830, end of trip.
Total		***4***	***1***	***1***	***6***	
Cruise 3						
25 Oct	Victoria, south plateau	0	0	0	0	Depart Victoria 1350, trolling south to FAD 3, set LL-3-1
26 Oct	FAD 3, Plate Is.	0	0	0	0	Survey FAD 3, haul LL-3-1, demo tag bigeye tuna, troll Plate Island, fish vertical LL-3-1
27 Oct	FAD 3, FAD 4, Fred Seamount	0	0	0	0	Fish VLL-3-1, survey FAD 3, FAD 4, set LL-3-2

28 Oct	FAD 4, Fred Seamount	0	0	0	0	Fish night handline gear, haul LL-3-2, troll towards Seychelles Plateau
29 Oct	SW Seychelles Plateau to Mahe	0	0	0	0	Fish night handline gear, troll towards Mahe, return to Victoria 1630, end of trip
Total		***0***	***0***	***0***	***0***	

Appendix V. Tagging cruise catch summaries[2]

Date October	Species	Qty	Gear	Tagged	Fate	Comments
Cruise 1						
8	Euthynnus affinis	5	Tr		Chum	In transit to shelf
9 Oct LL1-1	Gempylus serpens	1	LL		Discarded	
"	Cubiceps baxteri	1	LL		Discarded	74 cm FL. Photo taken
"	Carcharhinus falciformis	1	LL		Finned	Gut empty
"	C. longimanus	1	LL		Finned	
"	E. affinis	2	Tr		Chum	
10 Oct	E. affinis	2	Tr		chum	
"	Istiophorus platypertus	2	Tr		Retained	
"	Aprion virescens	1	Tr		Retained	
11 Oct LL-1-2	Xiphias gladius	2	LL		Retained	
"	Makaira mazara	1	LL		Retained	Lower jaw to fork length 160 m, photo taken
"	C. falcifomis	3	LL		Finned	1 male, 2 females, one with pups, photo taken
"	C. longimanus	2	LL		Finned	
"	Sphyrna lewini	9	LL		Finned	All males
"	E. affinis	5	Tr		Chum	
	Acanthocybium solandri	1	Tr		Retained	
"	Coryphaena hippurus	1	Tr		Retained	
"	Ablennes hians	1	Tr		Discarded	
12 Oct LL-1-3	S. lewini	1	LL		Finned	Male
"	Sphyraena barracuda	1	LL		Retained	
"	X. gladius	1	LL		Retained	
"	Thunnus albacares	6	Tr	5	released/retained	Gut- squilla
"	E. affinis	15	Tr		Chum	Gut- squilla, Caesionidae
"	Gymnosarda unicolor	2	Tr		Retained	Gut empty
"	A. solandri	3	Tr		Retained	Gut – fish remains, digested items
"	C. hippurus	5	Tr		Retained	Gut- squilla
"	Elagatis bipinnulata	6	Tr		Retained	Gut- squilla
"	A. virescens	1	Tr		Retained	
"	Carangoides fulvoguttatus	1	Tr		Retained	
Cruise 2						
17 Oct LL-2-1	X. gladius	1	LL		Retained	Gut-Small fish, squilla
VLL-1	No catch					Vertical longline set
VLL-2	No catch					Vertical longline. Snagged line, lost most hooks
"	T. albacares	2	Tr	2	Released	Trolled small YF next to bow of Explorer III late afternoon
18 Oct	T. obesus	1	Tr	1	Released	Trolled BE next to bow of Sea Scout I early morning
"	E. affinis	2	Tr		Chum	Trolled next to bow of Sea Scout I
LL-2-2	X. gladius	3	LL		Retained	Gut- small fish, Cubiceps?
"	Ruvettus pretiosus	7	LL		Discarded	Similar size, apprix 130 cm
"	G. serpens	2	LL		Discarded	Gut- pelagic octopod, squilla
18-19 Oct LL-2-3	X. gladius	4 + 1 esc	LL		Retained/ escaped	10 barracudinas, digested fish remains, squilla

[2] Squilla refers to *Natosquilla investigatoris*

"	Prionace glauca	1	LL		Escaped	Cut line at boat, escaped
"	G. serpens	1	LL		Discarded	Gut- 10 crabs, octopus, squilla
	Taractichthys stendachneri	1	LL		Retained	Gut- empty
19 – 20 Oct LL-2-4	X. gladius	3	LL		Retained	Gut- Balistidae, barracudinas, squid, fish remains, decapod shrimp
"	C. falciformis	1	LL		Finned	
"	C. longimanus	1	LL		Finned	
"	S. lewini	1	LL		Finned	
"	G. serpens	1	LL		Discarded	Gut- squilla
19 Oct	Katsuwonus pelamis	2	TR	1	Released/ retained	34 cm retained, 59 cm tagged
	T. albacares	1	HL/TR	1	Released	Caught on slow trolled flying fish
20 Oct	T. albacares	2	HL jig	1	Released/ retained	Jigged from deck of Explorer III
Cruise 3						
25 Oct						No catch on troll gear
26 Oct	C. hippurus	1	TR		Retained	Trolled when vessel started up
LL-3-1	X. gladius	1	LL		Retained	86 cm LJ-Fl. Gut- Oplophoridae shrimp, fish remains, squilla, squid bait
"	X. gladius	1	LL		Retained	155 cm LJ-FL. Gut- fish remains, squid beak, mackerel bait
"	X. gladius	1	LL		Retained	164 cm LJ-FL,.Gut- squid bait.
"	G. serpens	1	LL		Discarded	Gut- full of squilla
"	Thunnus obesus	1	LL	Demo	Retained	114 cm male, double tag and archival tag demonstration
"	X. gladius	1	LL		Discarded	Only head, large, shark damage
"	X. gladius	1	LL		Retained	188 cm LJ-FL. Gut- empty
"	X. gladius	1	LL		Retained	142 cm LJ-FL. Gut- fish remains
"	G. serpens	1	LL		Discarded	Gut- 8 squilla
"	X. gladius	1	LL		Discarded	Only head, med, shark damage
"	X. gladius	1	LL		Retained	104 cm LJ-FL. Gut- Oplophorid shrimp, squid bait.
"	X. gladius	1	LL		Retained	129 cm LJ-FL. Gut- fish remains, Oplophorid shrimp, mackerel bait
26 Oct	A. virescens	3	TR		Retained	Trolled near Plate Island
"	E. affinis	1	TR		Retained	Trolled near Plate Island
"	C. fulvoguttatus	1	TR		Retained	Trolled near Plate Island
27 Oct VLL-3-1	X. gladius	1	VLL		Retained	Taken on vertical longline at night, 50 m.
27 Oct	A. solandri	1	TR		Retained	Trolled one mile from FAD 4
28 Oct	X. gladius	1	HL		Retained	Taken on ika shibi style handline at night, 60 m.
"	A. solandri	2	TR		Retained	Trolled at dawn near Fred Smt
28 Oct LL-3-2	G. serpens	3	LL		Discarded	On second longline set near Fred Seamount
29 Oct	C. hippurus	1	HL		Retained	Taken on surface handline at night
"	E. affinis	3	TR		Retained	Trolled on SW edge of plateau
"	A. solandri	2	TR		Retained	Trolled sw of Mahe
"	E. affinis	1	TR		Retained	Trolled next to Conception Island

Appendix VI. Longline and handline set details

Date	Set #	Set		Haul		# of hooks	Hooks/ bsk	Float line (m)	Bait	Area/Comment
		Start position	En d position	Start position	End position					
Cruise 1										
8-10 to 9-10	LL-1-1	2230	0130	0649 03°28'S 54°59'E	0950 03°37'S 54°52'E	400	6	30 m	Squid	North of FAD 1 position
10-10 to 11-10	LL-1-2	2100	2230	0700 03°52'S 56°17'E	1000 03°48'S 56°11'E	200	5	15 m	Squid, mackerel	Northeast of Denis I
11-10 to 12-10	LL-1-3	1900	2100	0650 04°46'S 56°45'E	0755 04°44'S 56°42'E	180	6	15 m	Squid, mackerel	East of Seychelles plateau
Cruise 2										
17-10	LL-2-1	0000 0°08S 55°55E	0140 0°16S 55°56E	0716 0°17S 55°59E	0900 0°13S 55°59E	180	6	30 m	Squid, mackerel	Night set 33 miles south of Coco de Mer seamount
17-10	VLL-2-1	1520 0°25'N 56°01'E	Same	1740 0°25'N 56°02'E	Same	15	NA		Mackerel	210 m depth on seamount
17-10	VLL-2-2	1852 0°24'N 56°01'E	Same	2015 0°25'N 56°02'E	Same	20	NA		Mackerel	South of high spot on seamount
17-10 to 18-10	LL-2-2	2106 0°25'N 56°02'E	2212 0°30'N 55°59E	0712 0°25'N 56°04'E	0908 0°19'N 56°06'E	220	6	30 m	Squid, mackerel	Night set south of high spot of seamount
18-10	LL-2-3	1033 0°24'N 56°02'E	1228 0°29'N 56°01'E	2045 0°27'N 56°05'E	0125 21°22N 56°08'E	370	30	50 m	Squid, mackerel	Daytime set south and east of seamount
19-10	Ika shibi HL	0245 0°25'N 56°02'E				4	NA	NA	Flying fish, mackerel	Night handline with uw light
19-10 to 20-10	LL-2-4	1710 0°46'N 56°03'E	2045 0°54'N 56°07'E	0510 0°51'N 56°12'E	0815 0°43'N 56°13'E	220	10 6	50m 30m	Squid, mackerel	Night set north of seamount
Cruise 3										
25-10 to 26-10	LL-3-1	2140 5°28'S 55°30'E	2343 5°38'S 55°23'E	0720 5°38'S 55°27'E	1207 5°29'S 55°33'E	280	6	30m	Squid, mackerel	Night set near FAD 3
26-10	VLL-3-1	2210 5°37'S 55°25'E	Same	Same	same	18	NA	10 m apart	Squid, mackerel	Night set tied up to FAD 3
"	VLL-3-2	0200 5°37'S 55°24'E	Same	Same	same	18	NA	10 m apart	Squid mackerel	Night set tied up to FAD 3, one swordfish
27-10 to 28-10	LL-3-2	2055 6°15'S 54°23'E	2315 6°07'S 54°32'E	0750 6°12'S 54°21'E	1034 6°07'S 54°31'E	340	6	30 m	Squid, mackerel	Nigh set on Fred Seamount
28-10	Ika shibi HL	0100 6°14'S 54°22'E	NA	NA	0700 6°11'S 54°19'E	4	NA	NA	Squid, mackerel, flying fish	Night handline on Fred Seamount
29-10	Ika shibi HL	0030 5°10'S 55°07'E	NA	NA	0700 5°04'S 55°03'E	4	NA	NA	Squid, mackerel	Night handline at SW of Seychelles Plateau

Appendix VII. Tag release details

Date	Tag #	Sp	FL	Gear	Tagger	Cond	Lat	Long	Time	Comments
12-Oct-02	AA 0133	YFT	76	TR	JPH	0	4.46 S	56.37 E	0905	35 m depth
12-Oct-02	AA 0134	YFT	70	TR	DGI	0	5.04 S	56.54 E	1355	57 m depth
12-Oct-02	AA 0135	YFT	69	TR	JPH	0	5.17 S	57.05 E	1750	La Junon Bank
12-Oct-02	AA 0136	YFT	57	TR	DGI	0	5.17 S	57.05 E	1750	La Junon Bank
12-Oct-02	AA 0137	YFT	57	TR	DGI	0	5.17 S	57.05 E	1750	La Junon Bank
17-Oct-02	AA 0138	YFT	49	TR	DGI	0	0-25'N	56-01'E	1815	near Explorer III Coco de Mer
17-Oct-02	AA 0139	YFT	53	TR	JPH	1	0-25'N	56-01'E	1825	near Explorer III Coco de Mer
18-Oct-02	AA 0140	BET	70	TR	JPV	0	0-25'N	56-01'E	0545	near Sea Scout I Coco de Mer
"	AA 0141	"	"	"	JPH	0	"	"	"	double tagged with AA 0140
19-Oct-02	AA 0142	SKJ	59	TR	DGI	1	0-25'N	56-01'E	0630	Near Sea Scout I Coco de Mer
19-Oct-02	AA 0143	YFT	52	HL/TR	JPV	1	0-25'N	56-01'E	0710	near Sea Scout I Coco de Mer on dead flying fish bait
20-Oct-02	AA 0144	YFT	50	HL	JPH	0	0-25'N	56-01'E	1300	from Explorer III on metal jig

DGI = David George Itano, JPH = Jean-Pierre Hallier, JPV = Jean-Paul Valentin