TUNA TAGGING IN THE PHILIPPINES, THAILAND, AND MALAYSIAN WATERS

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INTRODUCTION

During the past decade, world tuna landings increased markedly; especially active have been the fisheries in the western Pacific Ocean. In 1985, the total world tuna and billfish landings were reported in FAO statistics (FAO 1985) as 3.15 million metric tons (mt), an increase of 63% over landings for 1975. Landings in the Pacific Ocean for 1985 were 2.05 million mt, representing 65% of the world landings. The importance of the western Pacific Ocean is exemplified by the FAO statistical area 71 (Figure 1), in which 29 of the 48 world-recognized scombrid species occur (Collette and Nauen 1983) and catch represents 49% of the Pacific landings for 1985 (FAO 1985).

In an effort to understand more about the tuna resources in the western Pacific Ocean, the Indo-Pacific Tuna Development and Management Programme (IPTP) in 1983-84 cooperatively undertook a tuna tagging study with the Government of Indonesia. The study's results are summarized in Phuket tuna meeting report (FAO 1986). To broaden the tagging program, the IPTP engaged the author of the present report to formulate a plan to conduct tuna tagging in Philippines and Thailand-Malaysian waters.

The terms of reference of this consultancy were as follows:

(1) detail major objectives of tuna tagging in the region,
(2) list target species and number of fish expected to be tagged,
(3) describe the fishing vessel and gear to be used,
(4) develop a time schedule,
(5) calculate budget estimates, and
(6) detail the arrangements to implement the project.

Prior to preparing this report, the author visited the Philippines (Manila and General Santos City), Thailand (Bangkok), and Malaysia (Penang) to consult with fishery officials, tuna scientists, and industry representatives (Appendix Table A). The tour was to include Indonesia; however, time constraints prevented this portion of the consultation to be completed.

REVIEW OF TUNA TAGGING

In developing the strategies for tuna tagging in the Philippines and the Thailand-Malaysia regions, considerable value was gained in reviewing previous tuna tagging efforts. The following sections briefly summarize the results of this review.

Tags

The Atlantic bluefin tuna (Thunnus thynnus) was the first tuna species for which movement was described by tagging information. In 1961, a bluefin tuna landed off Bergen, Norway (Mather 1962) was determined to have originated in the Mediterranean Sea, based on the type of hook found embedded in the tuna's mouth. Although the tagging was inadvertent, the results demonstrated the value of tag placement on pelagic fishes.

Not until the 1950's was a concerted effort made by directed tagging programs to describe the movement of tunas in the eastern Pacific. The California Division of Fish and Game began using plastic loop tags on tunas in 1953 (Wilson 1953). The tag information (tag number and where the tag should be returned) was written directly on the plastic tubing. The tubing was inserted through the upper portion of the fish (posterior of the second dorsal fin) with the aid of a stainless steel tubing. The tag was secured by tying both ends together.

The loop tag was not very satisfactory because it was time consuming to affix the tag and, especially, to secure the ends. Although the latter was resolved by using a "figure eight" knot, tagging time remained a problem until the subsequent development of the dart tag. The dart tag consisted of a length of plastic tubing onto which a solid head with a single barb was affixed at one end. The standard procedure adapted was to secure the tag near the base of the second dorsal fin with the aid of a short length of stainless steel tubing. The tubing was sharpened at one end to permit ease in penetrating the tuna's skin.

The dart tag as described above has been used by research agencies in tagging various species of tunas, including the yellowfin (T. albacares), skipjack (Katsuwonus pelamis), bigeye (T. obesus), albacore (T. alalunga), northern bluefin (T. thynnus), and southern bluefin (T. maccoyi). Additional details of tuna and billfish tagging are reported by Bayliff and Holland (1986). The most extensive use of the dart tag to date has been the skipjack tagging program conducted by the South Pacific Commission (Kearney 1982).

Presently, there are several commercial manufacturers of dart tags: Floy Tag Co. (U.S.A.), Fuyo Sangyo Co. (Japan), and Hallprint, Pty, Co. (Australia). Based on limited interviews with scientists involved in recent tuna tagging experiments, the tags produced by Hallprint are highly recommended. Instead of dart heads that are secured to the tubing by glue, the Hallprint tag heads are molded onto the polyethylene tubing. An additional feature is that the tag consists of two pieces of tubing: An outer tubing protects the writing placed on the inner tubing from abrasion.

Method of Fish Capture for Tagging

Although tuna are taken by a wide range of fishing gear, the suitability of tuna for tagging purposes is limited to a few. The attributes of a good method of capture for tagging purposes include 1) the ability to release tuna in an "undamaged" and unstressed condition, 2) accessibility to a large number of fish, and 3) accessibility to the desired size of fish.

Table 1 provides a rough indication of the suitability of tuna for tagging, based on method of capture. The evaluation is generalized and subjective because some gear types are excellent for some tuna species but not for others; e.g., based on tag recoveries of 5-6% trolling apparently is a satisfactory method of capture for albacore tagging (Laurs and Wetherall 1981). Although not fully tested, it is unlikely that skipjack tuna caught by troll gear can be considered good candidates for tagging because their jaws are easily damaged by the gear. Furthermore, shoreside experiments conducted in Hawaii demonstrated that of the three tuna species (yellowfin, kawakawa, and skipjack) routinely maintained in captivity, skipjack tuna are by far the most susceptible to stress from handling, thus, leading to mortality (Queenth and Brill 1983).

Of the several methods of capture evaluated for tuna tagging, the pole-and-line gear has been the most successfully used to date. Large numbers of small to medium sized tunas can be tagged over a short period, and time from capture to release is generally less than 10 seconds. Marr 1963 reported that skipjack tuna were tagged in less than 4 seconds in one tagging experiment; however, the fish were not measured.

The success of fish caught by purse seine for tagging has not been rated high; the problem probably rests with the long period it takes from the time the gear is set until tagging takes place. The tuna probably becomes highly stressed as the "pocket" becomes small enough for the taggers to retrieve the fish. The stress apparently causes physiological changes in the animal that result in delayed mortality. After extensive trials, the Inter-American Tropical Tuna Commission (IATTC) abandoned tagging of tunas caught by purse seine; the recovery rate of yellowfin tuna was judged to be lower than achieved by pole-and-line tagged fish. Also, of 1,363 skipjack tuna caught by purse seine and tagged only 15 (1.1%) were recovered (Bayliff 1973). If fish can be tagged from the early phases of the purse seine operation, the method could result in large numbers of good quality fish being tagged.

With the exception of gill nets, other methods of capture (troll, longline, and handline) can be used for tagging tunas; however, a major shortcoming of these methods is that substantially fewer fish are caught than by the pole-and-line or the purse seine methods. Also, there are some fish size limitations with these gears. The fish caught by gill net generally are landed dead or too badly damaged for tagging.

Recovery Rates

The time between capture and release of the tagged fish is crucial for successful recovery. Data verifying this factor are not abundant; however, it should be noted that the recovery rate in Hawaii of skipjack tuna tagged by loop tags was considerably lower than that of skipjack tuna tagged by dart tags (0.6 vs 9.28%); the dart tag can be applied substantially faster than the loop tag (Marr 1963).

Recovery rates of tagged fish should not be used as the sole criterion to measure success of a tagging project. Low recovery rates may simply reflect a large population base or that the fish migrated from the area and were not available to subsequent fishing effort. Nonbiological factors possibly contributing to low recovery rates include high tagging mortality, tag loss and the nonreturn of tags after capture.

Table 2 provides some tag release and recovery data from previous tagging experiments. As noted above, the tag recovery rates should be viewed with caution.

Tag Rewards

Rewards have been used as a means to encourage the return of tags along with the necessary recovery data. These rewards range from gifts of printed T-shirts and caps to monetary gifts. Table 3 provides some examples of the types of rewards issued by previous tuna tagging programs. To emphasize the need for return of tags, most tagging programs have incorporated a system of annual lotteries, whereby monetary gifts are given to the selection of tag numbers representing tag returns from the previous year.

TUNA TAGGING IN THE PHILIPPINES

The tuna fisheries in the Philippines have shown a remarkable growth since 1971, when the total tuna catch for the Philippines was reported at 9.0 thousand metric tons. By 1985, the catch had risen to 261.6 thousand metric tons, and tuna landings represented 20% of the marine fish production of the Philippines. The principal fishing grounds are the waters off Mindanao Island; about 58% of the total tuna catch for the Philippines comes from this region although tuna are taken throughout the Philippine Archipelago. All tuna species are taken throughout the year; however, there appears to be a peak in August-September for the southern waters of Mindanao Island.

Of the 48 scombroid species recognized by tuna systematists (Collette and Nauen 1983) 29 species are in FAO statistical area 71, which encompasses the Philippines. The major part of the Philippines tuna catch, however, consists of five species: frigate and bullet tunas (36.6%), yellowfin tuna (24.6%), skipjack tuna (23.0%), and kawakawa (16.0%).

The types of gear used to capture tuna vary and include the purse seine (49%), ring net (35%), and bag net (13%). The remaining catch is made by drift gill nets, lift nets, seine nets, longline, handline, and troll gear. It should be noted that several of the gear types use the payaos as part of their fishing operations; e.g., ring-net gear and handline fishing by bancas.

Objectives of Tuna Tagging Program

Development of the tuna fisheries as a major industry in the marine production sector of the Philippine economy has given rise to a number of pertinent questions by the fishing industry and government agencies: 1) Can this catch be sustained? 2) What is the size of the resource base of the several tuna species being harvested? 3) What is the impact on the resource base of the large catches of small sized tunas associated with payaos? 4) Are the small sized tunas present around the payaos products of spawning in Philippine waters? 5) Not all size classes of tunas are present in the fishing grounds; what are their migratory pathways into and out of the region? 6) What are the interactions between gear? Although solutions to some these questions require information beyond that provided by tagging (e.g., detailed catch and effort data for stock assessment studies), a well-designed tagging program can provide a wealth of information regarding the dynamics of the tuna resources and the fisheries.

The objective of the present effort is to develop a tuna tagging technique that can form the basis for later tagging studies designed to address specific questions.

Method of Tagging

At the tuna meeting held in Phuket, Thailand, in August 1986, a recommendation was made to undertake tuna tagging in the southern Mindanao Island region (FAO 1986). A review of the fisheries based in General Santos revealed that ring-netting, handlining from bancas, and longlining were the principal methods used in the region. Reportedly, several bancas used a pole-and-line fishing operation with live bait to catch tunas in the region; this has not been confirmed to date.

Two of these three methods--handlining from bancas and longlining--were eliminated as potential sources for capturing tunas for the tagging project, because of the expected small catch and relatively large size of tunas. There are, however, several viable options as sources of tunas for tagging:

(1) If a pole-and-line banca fishery exists, charter one bancas and conduct tagging via surface schools or by fishing around payaos; the latter would require prior arrangements with the payao owner.

(2) Tag tuna caught by the ring-net fishery; tagging should take place after the "pocket" is small enough to catch fish for tagging.

(3) Tag tuna caught by the ring-net fishery; modify tagging operations to reduce stress of tagged fish; several modifications could be included:

(a) operate in conjunction with pole-and-line fishing banca using live bait,

(b) pole-and-line fishing with lures only from a skiff immediately after the ring net has been set, and

(c) divert part of the commercial catch into a small net impoundment placed adjacent to the ring net; tagging can be done after commercial fishing has been completed.

(4) Convert existing fishing vessel (e.g., trawler) to conduct pole-and-line fishing operations.

(5) Charter a pole-and-line vessel from outside the region; e.g., a commercial pole-and-line vessel from Indonesia fishery.

Evaluation of Methods of Capture

The following provides some comments regarding each of the options listed above:

Option 1 is advantageous because the viability of fish caught for tagging by a pole-and-line operation is good. The disadvantages include the possible difficulty in obtaining adequate supplies of baitfish and the expected difficulty of tagging from a banca; e.g., limited space and the presence of two outriggers.

Option 2 would provide a very large supply of tuna, but the bulk of the catch probably would not be suitable for tagging. The latter could be tested by retaining tagged fish for 4-5 days in a small holding pen adjacent to the payao.

Option 3 also would provide a very large supply of tuna. The modifications (Options 3a-c), if successful, should lead to accessibility of good quality fish.

Option 4 has the advantage of a pole-and-line operation; thus, it has the potential of tagging large numbers of viable tuna. The disadvantages include the apparent lack of a steady supply of baitfish and the relative high cost of converting and operating a pole-and-line vessel over a short tagging period. During the South China Sea Programme, the Bureau of Fisheries vessel, Paeneus Monodon was converted into a pole-and-line vessel at a reported cost of about $(US)20-25 thousand (Lee 1978). Operational costs could conceivably amount to $(US)20 thousand per month.

Option 5 has the same advantage as Option 4. The disadvantages include the possible lack of a steady baitfish supply and charter costs could equal about $(US)25 thousand per month.

Projection of Fish to be Tagged

A mission report (FAO 1986) proposed a tagging goal of 20,000 tunas over a 1- to 2-month tagging program in the Philippines. At this time, projecting a meaningful number of fish to be tagged would be difficult because a proven tagging protocol has not been developed for this region. Furthermore, it is unlikely that the conventional pole-and-line method of tagging fish will be the eventual mode of operation for the Philippines; thus, experiences from other areas that use this tagging technique are not applicable to tagged fish projections in the Philippines. It should be noted that the IATTC and the SPC, two research oranizations with extensive experience in tuna tagging, averaged about 250 fish tagged per fishing day. Individual highs exceeded 1,000 tagged fish by the SPC (Kearney 1970).

Rather than focus on a specific number of fish to be tagged, the present project proposed for the Philippines should be directed toward the development of a tagging protocol that could serve future tagging efforts in the region. Future tagging objectives will dictate the number of fish to be tagged and the time and space distribution of tagged fish.

Budget and Projected Time Schedules

Table 4 provides rough budget estimates for the several options noted in this section. Figure 2 gives some indication of the time schedules for these options. Generally, the options involving vessel conversion or charter or both (Options 4 and 5) will involve considerable lead time before field work can be conducted.

TUNA TAGGING IN THAILAND WATERS

During the past decade, Thailand has become the major canned tuna exporting nation in the world. In 1985, the production of canned tuna by Thailand was 10.9 million standard cases; 57% of the canned tuna was shipped to markets in the U.S.A. (Herrick 1986). Although the production sector of the Thailand tuna fishery has shown some growth, the major part of the supply for the canning industry has been through purchases from outside sources. The tuna fishery in Thailand increased steadily from 6.5 thousand mt landed in 1973 to 82.0 thousand mt in 1983; the 1984 landings showed a decline to 69.2 thousand mt (FAO 1986).

Tunas are caught in the Gulf of Thailand and along the west coast of Thailand by several types of gear; the principal gear types include drift gill nets and purse seines (Thai purse seine and the luring purse seine). Catches in 1984 were 26.4% and 70.3% for the two gear types, respectively (FAO 1986). About 85.8% of the Thailand tuna catch was taken from the Gulf of Thailand.

Longtail tuna, kawakawa, and frigate tuna are the principal tuna species taken by the various gear types; all three species are taken throughout the year. In 1979-81, exploratory cruises conducted by an FAO/UNDP project revealed the presence of skipjack tuna in commercial abundance off the west coast of Thailand (Lee 1982). A fishery for this species, however, is yet to be developed.

Objectives of a Tagging Program

A need exists for determining the dynamics of the longtail tuna resource in the Gulf of Thailand; however, tagging as a means to define the migratory pathways of the longtail tuna was not considered as a high priority research objective by Thailand. Instead, high priority was given to identifying the size of the skipjack tuna resource in the waters off the west coast of Thailand. Reference was drawn to the tagging study undertaken in 1977-1980 by the South Pacific Commission, which concluded that a large skipjack tuna resource existed in the central and western Pacific Ocean. The skipjack tuna resource in the SPC region was estimated to exceed 3.0 million metric tons (Kleiber 1983); the tagging data revealed a complex pattern of movement. Conceivably, the skipjack tuna resource in the eastern Indian Ocean is large and undergoes movement through waters of Indonesia, Malaysia, Thailand, and the Nicobar-Andaman Island regions. Although a well-designed, large-scale tagging program could aid materially in understanding this resource, a major drawback in initiating such an extensive tagging program at this time is the lack of wide-ranging fisheries for skipjack tuna in the eastern Indian Ocean. With the exception of coastal fisheries for skipjack tuna in western Indonesia, the only catches of skipjack tuna currently made in the region are from artisanal fisheries operating in near-coastal waters. The lack of extensive surface fisheries for tuna reduces the probability of successful recapture of tagged fish.

Although not covered under the terms of reference for this report, it would seem that some exploratory fishing would be more appropriate for the western Thailand region at this time.

Method of Tagging

The occurrence of adequate supplies of baitfish species suggests that a pole-and-line fishery, although not presently in existence in Thailand, would be the best method for a tagging program in the region for skipjack tuna or longtail tuna. In 1979, an FAO/UNDP project converted a commercial trawler to operate as a pole-and-line vessel (Lee 1982).

If this vessel is still available, the cost of implementing a tagging program will be reduced accordingly.

An alternative source of a fishing platform would be to charter one of the commercial tuna pole-and-line vessels operating in Indonesia. An earlier feasibility study of tuna tagging in the region (Gillett 1981) reported that the cost of chartering a 100-ton, commercial, pole-and-line vessel from the commercial fishery in Indonesia was about $(US)25 thousand per month.

Should a decision be reached to undertake a tagging program restricted to the longtail tuna, an alternative to the pole-and-line method would be to tag fish from a trolling operation.

Number of Fish Expected to be Tagged

It would not be unreasonable to expect to tag 200-400 fish per fishing day if a suitable pole-and-line vessel is used for the tagging program. These estimates are based on the extensive tagging conducted in the eastern Pacific Ocean by IATTC and in the central and western Pacific by the SPC and various Japanese research agencies. Assuming 30 days of pole-and-line fishing during a 2-month tagging program, one can expect about 9,000 fish to be tagged.

If troll vessels are used to tag longtail tuna, the expected number of tuna tagged per day could range up to 100 fish per day. Assuming conditions of 1) 40 fishing days, 2) a daily catch of 75 viable fish for tagging, and 3) engaging three commercial troll vessels for the tagging program, the total number of fish projected for the proposed program is 9,000 longtail tuna.

Budget and Time Table

Table 5 provides an estimated cost of the several options described above, to implement a tagging program in the Thailand region. It should be noted that a tagging program for skipjack tuna or longtail tuna should include Malaysia and Indonesia.

A time table is provided in Figure 3, covering the several options described above.

TUNA TAGGING IN MALAYSIAN WATERS

Presently tuna represents only a small proportion of the total marine fish landings of Malaysia. In 1983, the total tuna landings were reported as about 19,000 mt: 16,000 mt from the fisheries based along the east coast of Peninsular Malaysia and about 3,000 mt from the fisheries based on the west coast (FAO 1986).

The principal methods used in tuna fishing include the drift gill nets and trolling gear; both gear types account for about 90% of the total tuna catch in Malaysia.

Similar to the tuna landings in Thailand, the principal species taken by the tuna fisheries of Malaysia are the longtail tuna and kawakawa. The two species make up about 99% of the tuna landings. Small amounts of frigate, skipjack, bullet, and oriental tunas also are landed.

Objectives of a Tagging Program

A high priority has been placed by Malaysia to define the migratory pathways of the longtail tuna in Malaysian waters and to determine the size of the resource. There is a need to determine whether this species moves into other areas of the Gulf or even into waters outside of the Gulf of Thailand; e.g., Indonesian waters.

Another area identified for a tagging experiment is the region around Sabah and Serawak, where skipjack and yellowfin tuna are taken by commercial fisheries. Until recently, a ring-net fishery using payaos operated off Sabah; however, the present status of this fishery is unknown.

Method of Tagging

Among the existing methods of tuna fishing currently used in Malaysia, trolling appears to be suitable for tagging the longtail tuna. Troll vessels are common along the east coast of Peninsular Malaysia, especially at Terengganu, which is one of the principal tuna landing ports. Troll vessels are reported to average about 500 kg of longtail tuna per trip during the peak season (June-August), each trip lasting about 5 days.

Because pole-and-line fishing is not used in Malaysia, an implementation of this technique for a tagging program will entail converting an existing fishing vessel into pole-and-line fishing or chartering a vessel from outside the region; e.g., Indonesia.

Number of Fish Expected to be Tagged

During a 2-month tagging period, a single tagging operation on a commercial troll vessel should tag about 2,500 fish. This assumes 1) an average catch of 500 kg longtail tuna, 2) an average size of longtail tuna of 1.2 kg, 3) about 75% of the catch being viable for tagging, and 4) making eight fishing trips during the 2-month period. It would not be unreasonable to project a three-vessel tagging operation based in Terengganu, thus, tagging about 7,500 longtail tuna.

Budget and Timetable

Table 6 provides budget estimates for the several options discussed above; Figure 4 provides a general time table for these options. As expected, the time needed to prepare for a tagging program involving a pole-and-line vessel will be considerably longer than making arrangements with commercial troll vessels.

BIBLIOGRAPHY

Bayliff, W. H.
1973. Materials and methods for tagging purse seine-and-baitboat-caught tunas. Inter-Am. Trop. Tuna Comm., Bull. 15(6):463-503.

Bayliff, W. H., and K. N. Holland.
1986. Materials and methods for tagging tuna and billfishes, recovering the tags, and handling the recapture data. FAO Fish. Tech. Pap. 279, 36 p.

Collette, B. B., and C. E. Nauen.
1983. FAO species catalogue of tunas, mackerels, bonitos and related species known to date. FAO Fish. Synop. 125, vol. 2, 137 p.

Food and Agriculture Organization of the United Nations.
1986. Yearbook of fishery statistics, 1985. FAO 60, 462 p.

Gillett, R.
1981. Indonesia/Philippine tuna tagging programme. (FAO draft internal document.)

Herrick, S. F., Jr., and S. J. Koplin.
1986. U.S. tuna trade summary, 1984. Mar. Fish. Rev. 48(3):28-37.

Indo-Pacific Tuna Development and Management Programme.
1986. Report of the Meeting of Tuna Research Groups in the Southeast Asian Region, Phuket, Thailand, 27-29 August 1986. Indo-Pac. Tuna Dev. Manage. Prog., Colombo, Sri Lanka. IPTP/86/Gen/10, 75 p.

Kearney, R. E.
1979. Skipjack survey and assessment programme. Annual report for the year ending 31 December 1978. South Pacific Commission, Noumea, New Caledonia, 15 p.

Kearney, R. E. (editor).
1982. Methods used by the South Pacific Commission for the survey and assessment of skipjack and baitfish resources. Tuna and Billfish Assessment Programme, Tech. Rep. 7, 122 p. South Pacific Commission, Noumea, New Caledonia.

Kleiber, P., A. W. Argue, and R. E. Kearney.
1983. Assessment of skipjack (Katsuwonus pelamis) resources in the central and western Pacific by estimating standing stock and components of population turnover from tagging data. Tuna and Billfish Assessment Program, Tech. Rep. 8. South Pacific Commission, Noumea, New Caledonia.

Laurs, R. M., and J. A. Wetherall.
1981. Growth rates of North Pacific albacore, Thunnus alalunga, based on tag returns. Fish. Bull., U.S. 79(2):293-302.

Lee, R. E. K. D.
1978. Results of small scale live bait pole-and-line fishing explorations for tuna in the Philippines. South China Sea Fisheries Programme, Manila. SCS/78/WP/70, 41 p.

1982. A report prepared for the pole-and-line tuna fishing in southern Thailand Project. Fishing for tuna. FI: DP/THA/77/008, 73 p.

Marr, J. C.
1963. Note on the return rate of tagged skipjack, Katsuwonus pelamis, and the effects of handling. Int. Comm. Northwest Atl. Fish. Spec. Publ. 4:15-16.

Mather, F. J. III.
1962. Transatlantic migration of two large bluefin tuna. J. Cons. Cons. Int. Explor. Mer 27(3):325-327.

Queenth, M. K. K., and R. W. Brill.
1983. Operations and procedures manual for visiting scientists at the Kewalo Research Facility. Natl. Mar. Fish. Ser., NOAA, Honolulu, HI 96822-2396. Southwest Fish. Cent. Admin. Rep. H-83-7, 16 p.

Wilson, R. C.
1953. Tuna marking, a progress report. Calif. Fish Game 39(4): 429-442.

Yonemori, T., J. Uktolseja, and G. S. Merta.
1985. Tuna tagging in eastern Indonesian waters. Indo-Pac. Tuna Dev. Manage. Prog., Colombo, Sri Lanka. IPTP/85/WP/12, 19 p.

Figure 1. FAO statistical areas for the Pacific Ocean

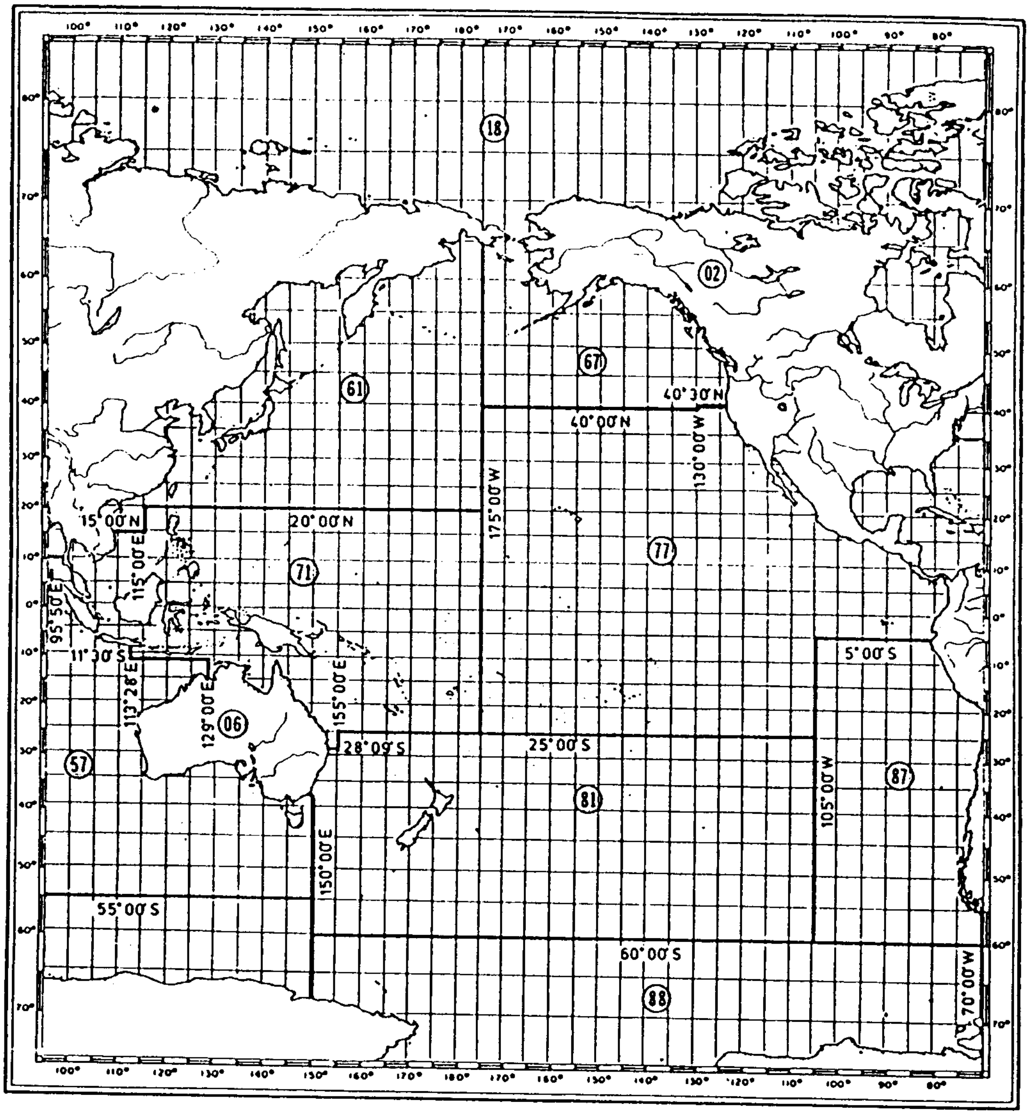

Table 1.—General evaluation of method of capture for tagging purposes.

Method	Potential large catch	Quality of fish	Size of fish
Pole-and-line	High	Good	Small-medium
Purse seine	Very high	Poor-medium	Small-large
Troll	Low-medium	Medium-good	Small-large
Gill net	Low-medium	Poor	Small-large
Longline	Low	Poor-Medium	Medium-large
Handline	Low	Good	Small-large

Table 2.—Recovery rates of tuna tagging experiments.

Area	Date	Agency	Type of tag	Method capture	Number tagged	Number recaptured	Recovery (%)
				SKIPJACK TUNA			
HAWAII	1954-56	POFI	LOOP	P&L	742		0.6
HAWAII	1957	POFI	DART	P&L	8,161		9.2
PALAU	1968	POFI	DART	P&L	265	5	1.9
E.PAC.	1969(?)	IATTC	DART	PS	1,363	15	1.1
E.PAC.	1952-64	IATTC	DART	P&L	90,412	4,381	4.8
PNG		PNG	DART	P&L			14.0
FR. POL.	?	IATTC(?)	DART	P&L			0.3
CWPAC	19__-82	SPC	DART	P&L	ca.140,000		4.3
INDON	1983/84	I/IPTP	DART	P&L	378	1	0.3
INDO	1984	I/IPTP	DART	P&L	5,361	18	0.3
WPAC		JAPAN	DART	P&L			
ATLAN	1987	ICCAT	DART	?	2,264	125	5.5
				YELLOWFIN TUNA			
E.PAC.	1969	IATTC	DART	PS	8,000		ca. 6.0
E.PAC.	1952-64	IATTC	DART	P&L	59,547	8,397	14.1
CWPAC	19__-82	SPC	DART	P&L			
INDO	1983	I/IPTP	DART	P&L	134	1	0.7
INDO	1984	I/IPTP	DART	P&L	575	1	0.2
WPAC	?	JAPAN	DART	P&L			
				SOUTHERN BLUEFIN TUNA			
AUST	1983-84	AUST	DART	P&L(?)	ca.10,000	4,000	40.0
				ALBACORE TUNA			
NPAC		NMFS	DART	TROLL			
NPAC		JAPAN	DART	P&L(?)			
SPAC		NMFS	DART	TROLL		2	
SPAC		ORSTOM	DART	TROLL			
SPAC		NZ	DART	TROLL			

Table 3.—Rewards for return of tuna tags.

South Pacific Commission	
Tag return—	$2.00 (local currency) or one T-shirt with tagging logo paid for each tag returned to SPC
Lottery——	annual lottery held with monetary prizes given for top 3 tag numbers randomly selected; prizes totaled $2.0 thousand dollars (US)
AUSTRALIA	
Tag return--	$5.00 (A) paid for each tag returned
Lottery——	annual lottery held; prizes of $400, $600 and $1,000 given to first three numbers randomly selected
ATLANTIC	
Tag return—	$5.00 (US) paid for each tag returned
Lottery——	annual lottery held; $500 (US) for tropical tunas (yellowfin, bigeye and skipjack); $500 (US) for temperate tunas (albacore and bluefin) and billfishes
U.S.A. (ALBACORE TUNA)	
Tag return—	baseball cap with logo and $2.00 (US) paid for each "standard"tag recovery; $50.00 (US) paid for tag and fish (tetracycline injected fish); additionally, cannery price paid for fish
Lottery——	3-5 drawings; cash awards ($150-$300 US) for first two winners; cases of tuna given to other winners

Table 4.—Budget estimate for tuna tagging in Philippine waters.

Object class	Estimated cost (thousand US dollars)	Options 1	2	3A	3B	3C	4	5
PERSONNEL								
Project Leader (8months)	1.0	X	X	X	X	X	X	X
Bio-tech (4mo)	0.8	X	X	X	X	X	X	X
Bio-tech (4mo)	0.8	X	X	X	X	X	X	X
Consultant (3 weeks)	4.2	X	X	X	X	X	X	X
Admin. support	(host country)	X	X	X	X	X	X	X
Sea Duty stipend	3.2	X	X	X	X	X	X	X
TRAVEL								
Consultant	4.0	X	X	X	X	X	X	X
PL(domestic travel)	1.0	X	X	X	X	X	X	X
TAGGING PLATFORM								
Banca charter	?	X	0	X	0	0	0	0
P&L								
conversion	25.0	0	0	0	0	0	X	0
operating (3 mo)	45.0	0	0	0	0	0	X	0
charter	75.0	0	0	0	0	0	0	X
Ring-net owner	?	0	X	X	X	X	0	0
EQUIPMENT/SUPPLIES								
Tags (10,000)	5.0	X	X	X	X	X	X	X
Tagging needles (600)	1.2	X	X	X	X	X	X	X
Cradles (3)	0.3	X	X	X	X	X	X	X
Tape recorders(3)	0.3	X	X	X	X	X	X	X
Calipers(3)	0.3	X	X	X	X	X	X	X
Micro-computer	5.0	X	X	X	X	X	X	X
Holding pen	1.0	0	X	X	X	X	0	0
OTHERS								
Posters	0.2	X	X	X	X	X	X	X
Printed T-shirts	2.0	X	X	X	X	X	X	X
Lottery awards (3 yrs)	3.0	X	X	X	X	X	X	X
Data mgt	1.0	X	X	X	X	X	X	X
MISCELLANEOUS	4.0	X	X	X	X	X	X	X
TOTAL	-							

1/ X denotes item to be included in the option
O denotes item not to be included in the option

Figure 2.—Projected timetable for tuna tagging program in Philippine waters.

Activity	1 2 3 4 5 6 7 8 9 10 11 12 (months)
1. Selection/appointment of Consultant and Project Leader (1 mo)	/—/
2. Work out arrangements/ agreement with government (2 mo)	/——/
3. Project preparation (includes arrangement for tagging platform, purchase equipment/supplies, posters, logbooks, develop data mgt system) (2 mo)	/——/
4. Implementation of field work (2 mo)	/——/
5. Analysis/write up of report (2 mo)	/——/
6. Present results to Government and fishing industry (2 wks)	/—/

Table 5.—Budget estimate for tuna tagging in Thailand waters.

Object class	Estimated cost (US dollars)	Pole-and-line convert	Pole-and-line charter	Troll	Purse seine
PERSONNEL					
Project Leader (8 mo)	2.9	X	X	X	X
Bio-tech (4mo)	1.0	X	X	X	X
Bio-tech (4mo)	1.0	X	X	X	X
Consultant	4.2	X	X	X	X
Admin. support	Host Country	X	X	X	X
Sea duty stipend (240 sea-days)	1.9	X	X	X	X
TRAVEL					
Consultant	4.0	X	X	X	X
Proj.Leader (domestic)	0.5	X	X	X	X
TAGGING PLATFORM					
Conversion	25.0	X	0	0	0
Operation (3mo)	45.0	X	0	0	0
Charter P&L(3mo)	75.0	0	X	0	0
Charter Troll(3vess.)	?	0	0	X	0
Purse seiner (RV CHULABORN 3mo)	60.0				
EQUIPMENT/SUPPLIES					
Tags (10,000)	5.0	X	X	X	X
Tagging needles (600)	1.2	X	X	X	X
Tagging cradles (3)	0.3	X	X	X	X
Calipers (3)	0.3	X	X	X	X
Micro-computer(1)	5.0	X	X	X	X
OTHERS					
Posters	0.2	X	X	X	X
Printed T-shirts(800)	2.0	X	X	X	X
Lottery awards (3yrs)	3.0	X	X	X	X
Data mgt	1.0	X	X	X	X
MISCELLANEOUS	4.0	X	X	X	X
TOTAL	-				

1/ X denotes item to be included in the option
O denotes item not to be included in the option

Figure 3.—Projected timetable for tuna tagging program in Thailand waters.

Activity	1 2 3 4 5 6 7 8 9 10 11 12 (months)
1. Selection/appointment of Consultant and Project Leader (1 mo)	/.../
2. Work out arrangement/ agreement with Government (1.5 mo)	/....../
3. Arrangement for tagging platform	
a. Convert vessel (3 mo)	/.........../
b. Charter (2.5 mo)	/........./
c. Engage troll vessels (1 mo)	/........../
4. Preparation (purchase of equipment/supplies) (2 mo)	/......./
5. Conduct field work (2 mo)	/......./
6. Analysis/write-up of results (2 mo)	/......./
7. Present results to Government and fishing industry (2 wks)	/.../

Table 6.—Budget estimate for tuna tagging in Malaysian waters.

Object class	Troll operation (Thousand US dollars)
PERSONNEL	
Project Leader (8 mo)	4.8
Bio-tech (4 mo)	1.4
Bio-tech (4 mo)	1.4
Bio-tech (4 mo)	1.4
Consultant (3 weeks)	4.2
Admin. support	Host country
Sea duty stipend	2.4
TRAVEL & PER DIEM	
Consultant	4.0
Project Leader (domestic travel)	0.5
TAGGING PLATFORM	
Usage costs (3 vessels)	9.6
Payment tagged fish (7,500)	6.0
EQUIPMENT/SUPPLIES	
Tags (10,000)	5.0
Tagging needles (600)	1.2
Tagging cradles (3)	0.3
Calipers (5)	0.5
Micro-computer (1)	5.0
OTHERS	
Posters	0.2
Printed T-shirts (800)	2.0
Lottery awards (3years)	3.0
Data mgt	1.0
MISCELLANEOUS	4.0
TOTAL	57.9

Figure 3.—Projected timetable for tuna tagging program in Malaysian waters.

Activity	1	2	3	4	5	6	7	8	9	10	11	12
	(months)											
1. Selection/appointment of Consultant and Project Leader (1 mo)	/../											
2.Work out arrangements/ agreement with government (1.5 mo)	/..../											
3. Work out arrangement for tagging platform (1 mo)		/../										
4. Preparation-purchase of equipment/supplies (2 mo)			/...../									
5. Conduct field work (2 mo)					/...../							
6. Analysis/write-up of results (2 mo)						/...../						
7. Present results to Government and fishing industry (2 wks)								/../				

Appendix Table A.--Meetings and consultations.

Several meetings and consultations were held during the consultant's visit of the Philippines, Thailand, and Malaysia. Individuals met included the following:

Philippines

Manila--(meeting in the conference room of BFAR on 10 August 1987)

Dr. Virginia Aprieto, College of Fisheries, Univ. Philippines
Mrs. Aurora Reyes, BFAR
Ms. Filomena Gande, Planning Officer, BFAR
Mr. Reuben Ganaden,Chief, Fisheries Biology Section, BFAR
Mr. Noel Barut, Biologist, BFAR

Note--also met briefly with Director Juanito Malig to inform him of the overall objectives of the project

General Santos--(meeting in BFAR regional office on 11 August 1987)

Mr. Expidito Respicia, SAFI
Mr. Mario Mallorca, RS Albina Fishing Co.
Ms. Minda L. Regidor, DFE Co.
Mr. Eliseo Aguinaldo, Dela Pena Fishing Co.
Mr. Rudy Rivera, RD Fishing Industry, Inc.
Mr. Rene Kintanar, QBRO Fishing Co.
Ms. K.L. Yamanaka, Univ. of British Columbia, Canada
Mr. Eliseo Depra, Jr., Provincial Fisheries Officer, BFAR, General Santos Office
Mr. Reuben Ganaden, BFAR
Mr. Noel Barut, BFAR

Thailand (Bangkok)

Met with Mr. Boonlert Phasuk (Director, Marine Fisheries Division for the Government of Thailand) and Dr. Veravat Hongskul (Secretary-General, SEAFDEC) on 17 August 1987.

Malaysia (Penang)

Met with the following individuals at the Fisheries Research Institute:

Mr. ONG Kah Sin, Acting Director of Research (Fisheries Research Institute)
Mr. LUI Yean Pong, Senior Fisheries Officer (Acting Head of Resources Section, Fisheries Research Institute)
Mr. Abdul Hamid Yasin, Fisheries Officer, Branch of the Fisheries Research Institute, Kuala Terengguanu
Ms. CHEE, Phaik Ean, Fisheries Officer, Fisheries Research Institute