Tuna Resource Exploration with Longline in the South China Sea, Area III: Western Phillipines

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ABSTRACT

An exploratory tuna longline fishing survey was conducted using the research and training vessels of the Southeast Asian Fisheries Development Center, the 1,178 GT MV SEAFDEC and the Bureau of Fisheries and Aquatic Resources, the 165 GT MV MAYA-MAYA in the South China Sea Waters, West of the Philippines from April to May, 1998. A total of 3,796 hooks was set in sixteen (16) fishing stations. There were no tuna caught during the entire survey but only minor and irrelevant species like the Pacific lancetfish, sharks and an opah species, *Lampris guttatus*. The important fishing and oceanographic factors during the survey and other research results on longline are described and analyzed. Additional longline studies within and near the Philippines territorial waters are also presented to substantiate the research results of the joint SEAFDEC/BFAR resource exploratory.

Keywords: tuna longline, tuna survey, South China Sea, Western Philippines.

Introduction

The waters around the Philippines is known to be migratory paths and rich fishing grounds for tunas, traditionally for longline fishing as observed in the reports of foreign vessels poaching in the South China Sea area. The Filipino fishermen, using simple and small scale gears like handline, troll line and gillnets have long been exploiting these species since time immemorial . However, it is only in the 70s that the country's fish production dramatically increased mainly due to the introduction and development of technology to catch tuna notably the introduction of commercial purse seine and ring nets. The payaw, found to be very effective in aggregating the tuna, was readily adopted in commercial fishing and enhanced the increased landings of tuna. Payaw has also been extensively used by small scale fishermen mainly to catch large yellowfin and bigeye tuna using handlines. It has significantly contributed, however, to the increased landings of small size tuna and poses a great impact on the tuna resource.

Long before the introduction of the purse seine and ring net for tuna, efforts have been made to develop tuna industry by using the tuna longline fishery (Martin, 1938; Tapiador, 1951; Fernandez, 1951) but it did not materialize to become a major contributor to the country's tuna production. Marquez (1976) studied the three types of baiting positions for tuna longline fishing and found out that horizontal baiting type showed a higher catch, significantly higher bait loss and lower bait recovery compared to vertical and upside down baiting.

The opening of the export market for the high-priced sashimi and the favorable policy in joint ventures in the late 70s to early 80s again enticed private companies to engage in tuna longline with about 25 tuna longliners in 1982. The joint ventures were not able to sustain operations because of the unstable export market and probably hardships in long operations (Tiongson, 1983).

As of 1997, there are 16 registered tuna longliners in the fishing grounds of Northeastern and Northwestern Luzon waters, the Celebes Sea area and eastern Mindanao. Production and other statistics are however, not being reported. It is admitted that the present sashimi grade market is largely being supplied by medium scale outriggered boats using handlines in the Celebes Sea.

Meanwhile, foreign fishing boats, notably longliners, are allegedly poaching inside the country's territory in the South China Sea and the Pacific Ocean. In fact, the main fishing grounds for the Taiwan fishery are close to both sides of the Philippine archipelago with most fishing done in the western side from January to April and in the eastern side from April to June (Sun and Yang, 1983 cited in Wang, 1991).

Thus, with this situation, longline fishing exploration was conducted during the collaborative oceanographic and resource survey with SEAFDEC and BFAR to determine the catch and composition of longline caught species in the South China Sea: Area III and describe the oceanographic and other factors affecting the fishery.

Materials and Methods

The Tuna longline (Figure 1)

The longline gear of MV SEAFDEC measures 350m long, 7mm dia mainline and the length used per basket depended on the number of branchlines. Polyester (PES) multifilament and nylon monofilament branchlines were used. The PES multifilament branchline, sekiyama and wire leader had a total length of 31m. The Monofilament branchline has no sekiyama and measure 23 m long. The buoy line was made of 7mm dia. Mansen line, 25m long. During the operation, PES branchlines were casted first.

The design and construction of the longline gear on MV MAYA-MAYA is a typical Japanese design. The mainline was made of PES 300 m long and 6 mm diameter. The branchline was also made of PES, 5mm. diameter. The total length of branchline was 27m including the sekiyama and the wire leader.

Fishing Operation

Shooting the gear on board MV SEAFDEC occurs at dawn and takes about an hour. The operations were conducted in station numbers 1, 5, 6, 12, 13a, 17, 21, 27, 30-A and 31-A (Figure 2). With an average of 319 hooks set, hauling starts at mid-noon and lasts for about 2 hours. Longer time were experienced when the line kinked and entangled with the lines of the giant squid jig. The number of hooks per basket was 4, 5 or 6 hooks depending on the desired fishing depth (Figure 3.) In general, fishing depth increase with the increase of hooks in a basket. Baits used were milkfish about 20-30 cm long and Indian mackerel about 15-20 cm long. The baits were hooked in the head assuming vertical position. Squids caught by the automatic jigging machine were also used as baits in some of the operations.

On MV MAYA-MAYA, the stations were 8, 9, 16, 17, 23 and 25 (Fig. 4). The number of hooks per basket was fixed at 5 pieces and set 20 baskets (total of 100 hooks) per operation during the entire period of the survey. Milkfish (20-30 cm) and big-eyed scad (15-20 cm) were

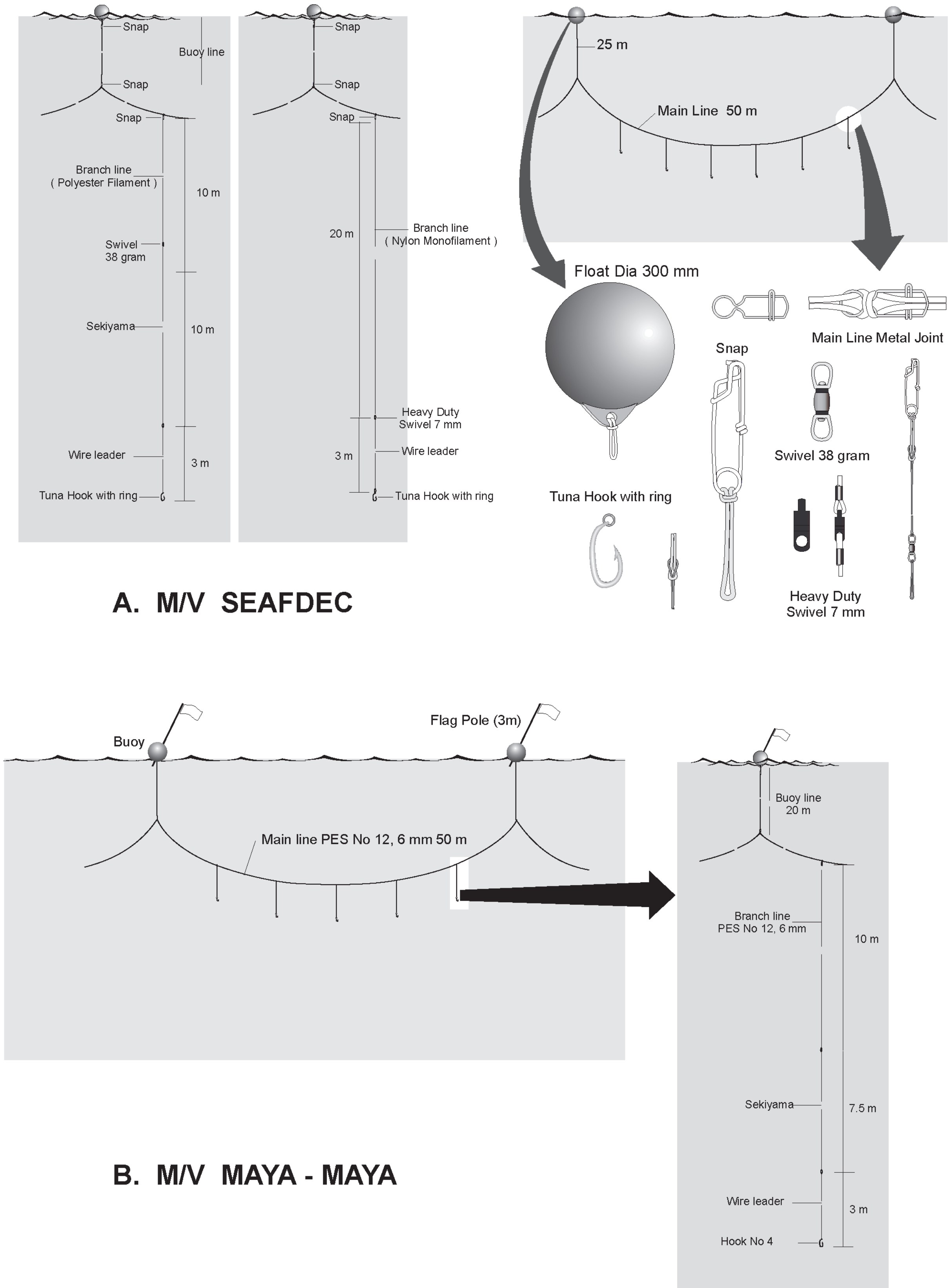
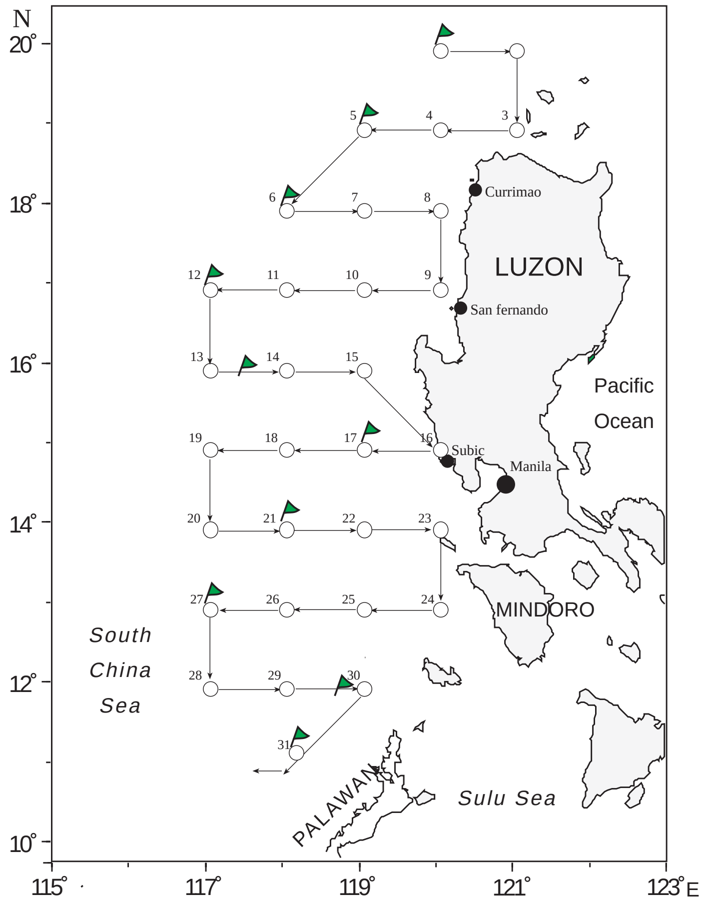


Fig. 1. Tuna Longline Gears of M/V SEAFDEC and M/V MAYA - MAYA.



Fig, 2 . Tuna Longline Stations of MV SEAFDEC.

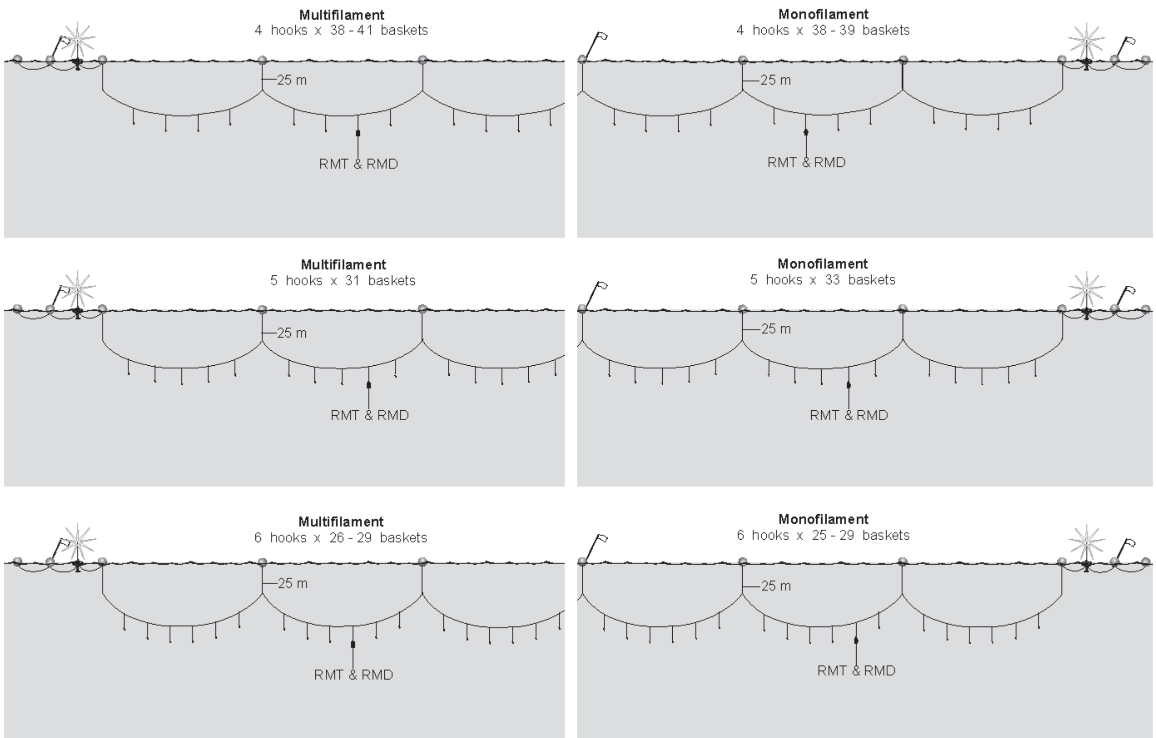
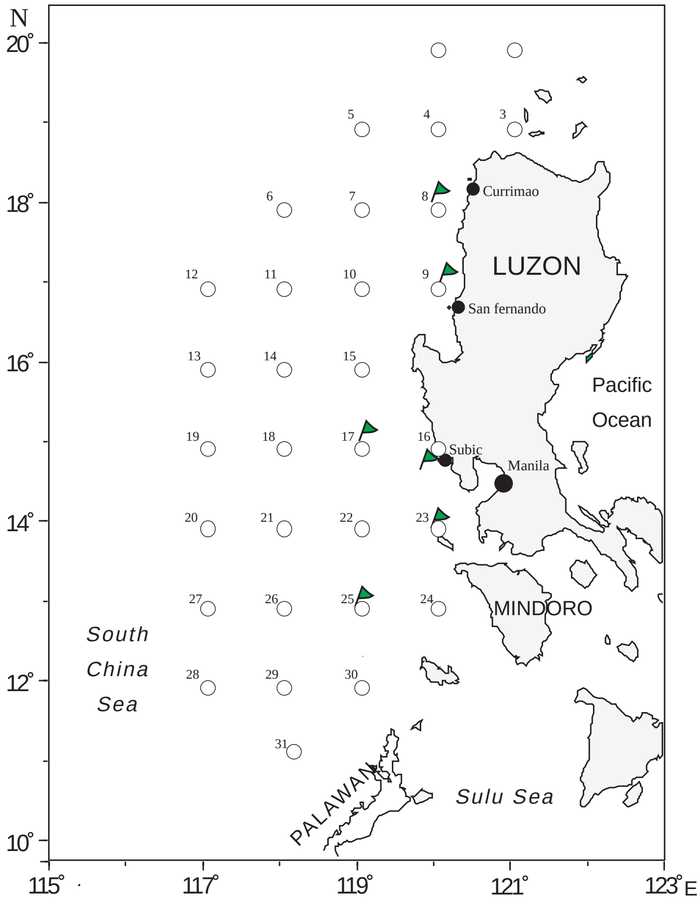


Fig. 3. Tuna longline arrangement with 4, 5 and 6 hooks per basket.



Fig, 4. Tuna Longline Stations of MV MAYAYA.

used as baits and hooked at the region of the first dorsal fin to assume the horizontal baiting position.

Oceanographic Conditions

The ICTD data from the fish sampling were used to infer important oceanographic conditions that may have affected the operations. In addition, the RMT/RMD device were attached to the deepest lines (i.e. center of a basket) in both multifilament and the monofilament branchlines to determine the respective depths and corresponding temperatures. Before any set was made, researchers discussed the results of the previous oceanographic conditions, line depth and catches which affected the operations.

Results

The longline fishing survey was conducted by the two vessels in sixteen (16) fish sampling stations having a combined of 3,796 hooks set. The survey yielded negative results for tuna. Only 34 Pacific lancet fish (*Alopius superciliosus*) 7 sharks and one opah fish *Lampris guttatus* were caught. Bait recovery was very high ranging from 67.9% to 98.08% while bait loss ranged from 1.92% to 32.1%. The average immersion time (i.e. period between setting began and hauling ended) was 9.1 hours for M/V SEAFDEC and 5 hours for M/V Maya-Maya (Table 1). Deeper hooks (i.e. 6 branchlines per basket) caught more fish with hook depth ranging from 80 to 170 meters. Out of 42 pieces, 28 or 66.6% consisted of 22 Pacific lancetfish, 5 sharks (*Alopias* *spp*.) and one (1) opah fish (*Lampris guttatus*). Shallower hooks (i.e. 4-5 branchlines per basket) caught 16 pieces of 12 Pacific lancetfish and 2 sharks. The hook depths ranged from 60m to 150m.

Based on the RMD/RMT, the hook depth of the deepest branchline was 170 m with a corresponding temperature of 17 ^{o}C. The shallowest hook depth is 60m with an average temperature of 20°C. This is located well within the thermocline layer which was determined to be unpronounced in the area. Basing on the research results of this survey, Tiongson (1983) and Tapiador (1952), it appears that the specification of the longline gear as well as temperature and baits were similar (Table 2).

The vertical profile of the fishing stations show a mixed layer of about 20m to 60 m deep after which the temperature starts to decrease gradually. This thermocline layer is evidently not prominent with temperatures of around 15-17 ^{o}C and 12-13^{o}C at 150 m and 250m, respectively. The levels of dissolved oxygen in these layers are about 2.7 –3.3 ml/l and 2.3-2.8 ml/l respectively. Salinity levels are at 33.8 to 34.7 ppt and 34.5 to 34.8 ppt at 40m and 200m respectively. (Table 3).

Discussions

The most important factor in the longline fishery is determining the suitable depths the target species concentrate since the catches are different by hook depth for each species caught (Hanamoto, 1974; Nishi, 1990; Boggs, 1992). Nakano et. al (1997) compared the shallow (< 180m branchlines) and deep longlines (> 180m) and indicated that the albacore, big-eye and lancetfish having catch rates increased with depths while yellowfin, swordfish, mako shark and blue shark had no clear catch rate trend with depth. The catch rate of striped marlin, Pacific blue marlin, sailfish, dolphin fish and snake fish decreased with depths.

Compared to the deep longline, the shallow longline has also been observed to have higher yellowfin tuna (Suzuki et. al., 1977 cited in Nakano et. al, 1997). Other observation showed that yellowfin has high catch rates at 90-100m, 120-150m and even at a range of 40-200m (Hishi, 1990 and Boggs, 1992 cited in Nakano, *et. al*., 1997).

Among the oceanographic parameters, temperature is probably the most important factor being considered in locating fishing grounds. Figure 5 shows sea surface temperature distribution and fishing for tuna species (Uda, 1952 cited in Laevastu and Hayes, 1981). Some studies indicates that albacore spends considerable time in thermocline layers of 10-12^{o}C although the lowest temperature distribution in Figure 3 is 14° C (Laevastu and Hayes, 1981).

Hanamoto (1987 cited in Nakano, et. al., 1997) suggested that water temperature and level of dissolved oxygen could be the limiting factors for the vertical distribution of bigeye tuna which could not live in waters where dissolved oxygen was lower than 1 ml/l and temperature must be between 11°C to 16°C at 250 m depth range.

Table 4 shows comparative temperatures between this survey and other tuna longline areas in the Pacific. Below the temperature turning point is considered as a good capture area (Kurita, 1990 cited in Munprasit et. al., 1991). In this survey, this point occurred at 20-60 m where hook depths of about 60-170m was well below that level.

The longlines used in this survey are also basically of the shallow Japanese design and fishing depths within the distribution of most of the target species like yellowfin, marlin and sailfish. Deeper areas which are still within the fishing range of most of the longline target species and where echos indicated presence of fish were however not tried during the exploration. In fact, more catch (regardless of species) were observed when the hook depth was made deeper.

Table 1 : Particulars of longline operations onboard M.V. SEAFDEC and M.V. MAYA-MAYA

1. M.V SEAFDEC

Station	Basket set			Total hooks	Immersion	Bait Recovery		Bait Loss		Catch
	Mono	Multi	Hools/basket	set	Time(hrs)	Number	Percentage	Number	Percentage	
1	25	28	6	318	9	216	67.9	67.9	32.1	4 Lancet fish
5	37	38	4	300	9	248	82.7	52	17.3	5 Lancet fish
										1 shark
7	38	40	4	312	9	306	98.08	6	1.92	1 Lancet fish
										1 shark
12	39	40	4	316	9	276	87.4	40	12.6	3 Lancet fish
14	38	41	4	316	9	285	90.2	31	9.8	1 Lancet fish
17	25	28	6	318	9	274	66.2	44	13.8	5 Lancet fish
										1 shark
21	28	29	6	342	9.3	281	82.2	61	17.8	5 Lancet fish
27	33	31	5	320	9.3	239	74.7	81	25.3	5 Lancet fish
31-A	27	26	6	318	9.3	223	70.1	95	29.9	2 Lancet fish
30-A	29	27	6	336	9.3	261	77.7	76	22.3	6 Lancet fish
										3 sharks
										6 L. guttatus

2. MV MAYA-MAYA

Station	Basket set		Hooks/basket	Total hooks	Immersion	Catch
	Mono	Multi		set	Time (hrs)	
8		20	5	100	6	2 Lancet fish
9		20	5	100	6	1 Lancet fish
16		20	5	100	5	
17		20	5	100	4.75	
23		20	5	100	3.42	
25		20	5	100	5	

Table 2 Fishing Indicators of Other Research Results on Tuna Longline Operations

Factor	This survey, 1998	Tiongson, 1983	Tapiador, 1952
Float line (m)	25	25	13
Mainline (m)	50	24	36-72
Branchline (m)	23-31	22	31
Total	98-106	71	80-116
Branchlines/basket	4-Jun	9	6
Total hooks covered	3796	11, 174	27,900
Bait	milkfish, Indian mackerel, squid	horse mackerel (saury)	milkfish
Fishing ground	South China Sea	Sulu Sea	South China Sea, Sulu/Celebes Seas
Approx. surface temp.(°C)	28-31		27-30
Approx. temp. at 50m(°C)	22-28		25-29
CPUE, all species(per 100 hooks)	1.1*	0.44**	3.4**
CPUE for tuna (per 100 hooks)	0	0.2	2.5

* 80% lancet fish
** Only valuable species, shark included

Table 3 Fishing Station Profile from M.V. SEAFDEC South China Sea : Weatern Philippines April-May 1998

Station	Hook Depth Range		Thermocline		Temperature (°C)					D.O (ml/l)		Salinity	(%)
No.	m	°C	start (m)	°C	Surface	50m	150m	250m	300m	150m	250m	40m	200m
1	141-170	18-17	60	25.7	28	27	17	13	12	3.3	2.8	33.8	34.8
5	60-120	22-17	25	25.5	28	23	15	12	11	3	2.3	34.1	34.6
7	60-95	21-18	25	26.5	28	-	15	12	11	3	2.3	33.7	34.5
12	70-120	24-18	40	27.3	30	27	17	13	12	3	2.3	33.7	34.6
14	70-100	26-22	60	27	30	28	17	14	12	2.7	2.5	33.9	34.6
17	80-150	25-17	25	32	30	28	17	13	12	2.7	2.4	34.7	34.7
21	60-140	17-16	20	30.3	31	27	16	13	12	3	2.5	33.9	34.6
27	90-150	21-16	30	30.4	31	28	16	13	12	3	2.5	33.8	34.6
31	100-150	18-16	20	30	30	24	17	13	12	2.9	2.5	34.2	34.6
30	95-165	20-17	20	30.6	31	26	16	13	11	3	2.5	33.9	34.6

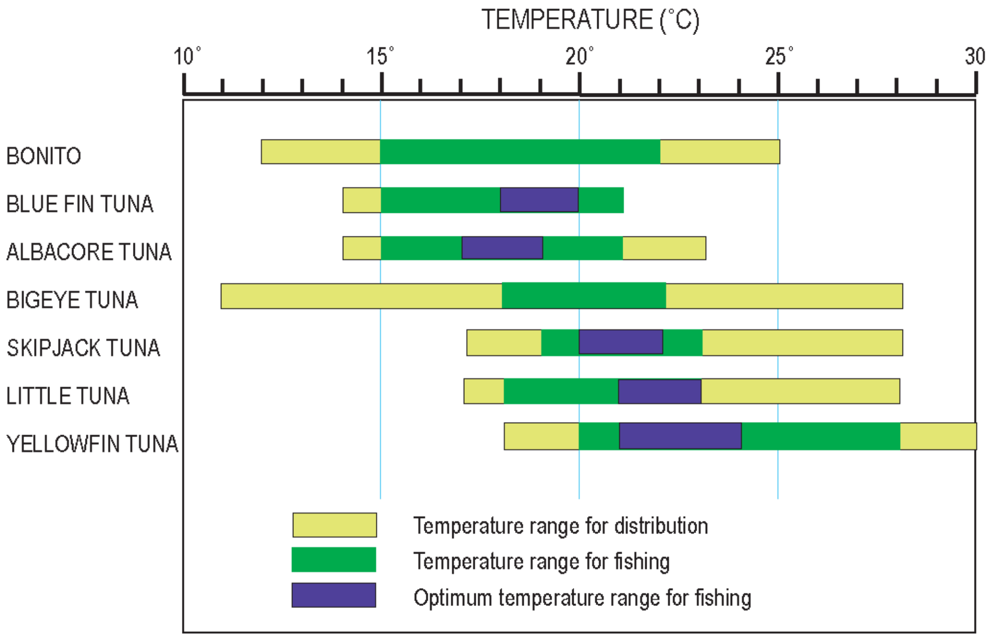


Fig. 5. Sea surface temperature distribution and fishing for tuna species.

Table 4. Oceanographic indicators of other studies on tuna longline operations.

Area	*Temperature (°C)*		*D.O (ml/l)*	
	150m	*250m*	*150m*	*250m*
SCS (This survey)	*15-17*	*12-14*	*2.5-3.5*	*2.3-2.5*
*Equator**	*18-23*	*11-14*	*3.0-4.5*	*1.5-3.5*
*East of Hawaii**	*16-20*	*11-13*	*4.5-5.5*	*3.5-4.5*
*Tropical Eastern Pacific**	*13-21*	*12-16*	*0.5-4.0*	*0.5-3.0*

** After Nakano, 1997*

Depth and temperature are however, not only the factors that affect fishing. It has been a fact that Taiwanese longline vessels prefer the use of live baits than frozen fish to increase catches.

It is important to note that longline catches may have significantly declined in the area. In the 1950s, it was indicated that the catch rate was around 3.4 fish/100 hooks (Tapiador, 1952) and may already have significantly declined in the 1980s (Tiongson, 1983). In a survey in 1981-82, the main fishing grounds for the Taiwan fishery were close to both sides of the Philippine archipelago but in 1985 the inshore longliners began to use Singapore, Palau and Indonesia as base ports. Although the reason for the shift is not clear, it may reflect exhaustion of the traditional fishing grounds or may be a result of rapid growth in power and capacity of the fishing vessels (Wang, 1994).

Nonetheless, longliners apparently Taiwanese types, were spotted several times within the Philippines EEZ during the survey. Since the last observation on board a Taiwanese tuna longline was done in the early 1980s, it is important to determine the present techniques employed in these fishing vessels to ascertain the potential/status of the fishery in the western part of the Philippines. Likewise, the survey was only done in 2 months time, hence, longer operations maybe needed to further validate the results. Continuous monitoring by long term effort is recommended. An Observers Program will be implemented to collect the fisheries data necessary for assessing the viability of various fishery and their effective management.

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