TUNA PURSE SEINE OPERATION BY M.V. SEAFDEC IN THE EAST INDIAN OCEAN

Pratakphol Prajakjitt

INTRODUCTION

M.V. SEAFDEC, the Fisheries Training and Research Vessel, has conducted tuna purse seine fishing in the East Indian Ocean from 1994 until today. Because of the situation of declining coastal fishery resources in the Southeast Asia region, oceanic fishery resources are expected to be the new sources of protein in the future. Tuna and tuna-like species are also considered as under exploited oceanic fishery resources. The research objectives are to determine the abundance of tuna species, identify appropriate fishing methods and fishing techniques and also the oceanographic aspects that are related.

Southeast Asian countries, especially Thailand, have an advantage in shorter distances from their base to the fishing grounds. Results of the exploration might be useful for those who would like to establish a tuna purse seiner fleet for operations in the East Indian Ocean, which is considered to be a new fishing ground for tuna purse seine compared with others.

MATERIALS

Purse seiner

Principal particulars of M.V. SEAFDEC

Length over all	65.02 m
Length between perpendiculars	57.00 m
Breadth, molded	12.00 m
Draft, molded	14.658 m
Service speed at 4.50 m draft	14.3 knots
Max.sea trial speed (measured)	16.640 knots
Dead weight	744.42 tons
Gross tonnage	1178 tons
Net tonnage	354 tons
Total complement	63 P
Fish hold capacity (bale)	145.38 m^3
Freezing room capacity	20.48 m^3
Freezing ability (brine)	20t/day
(Air blast)	1.6t/36 hr

Skiff boat (SEAFDEC No.2)

Overall length	9.96 m
Legnth between perpendiculars	9.00 m
Breadth, molded	5.00 m
Draft, molded	1.2 m
Designed weight	7.3 tons

Work boats (SEAFDEC No. 3 and 4)

Overall length	6.26 m
Length between perpendiculars	5.97 m
Breadth, molded	2.79 m
Draft, molded	1.05 m
Designed weight	2.5 tons

Purse seine net

The Tuna and skipjack purse seine net of M.V. SEAFDEC was made by Nichimo Co.,Ltd. With a total net length of 1,155.9 m (contracted), it is composed of 20 portions. The netting yarn is all nylon and the bunt part (portions 1-2) are constructed with 90-160 ply/90 mm mesh size and 40 ply/105 mm mesh size in the body part of the net (portion5-18). The wing attached to the bunt (portion 3-4) is made of 60 ply/90 mm mesh size and the right wing (portion 19-20) is 60 ply/105 mm and 90 ply/105 mm. The upper and lower selvages are constructed of Polyethylene Ultra Cross (PE UC) 320 ply/150 mm 5 meshes depth. The floats are made of Plastic EVA, with dimensions of 160(L) x 190(D) x 33(H.D.) and a buoyancy of 4,000 grams. They are yellow in color. The chain is made of Super Alloy, with a diameter of 11 and 13 mm. It is attached with a bridle chain with single rope 10 pieces and plus bridle chain double 64 pieces. The purse ring is made of Galvanized Iron, 22 mm-diameter x 260 mm.

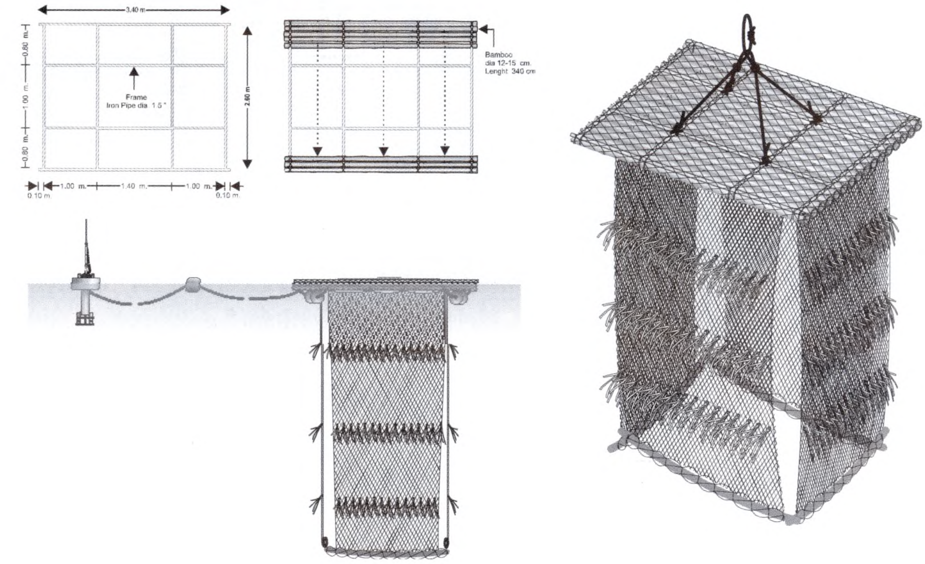

Fig 1. Construction of a FAD (Fish Aggregating Device) of M.V. SEAFDEC

Fig 2. Searching for floating objects

Fish Aggregating Devices (FADs)

The FADs are of the floating type composed of 3.5 m bamboo poles sequentially tied around a 1.5 inch-diameter iron-pipe frame of 3.4 x 2.7 m^2. The FADs are covered by large size twine net to provide more shade and strength. Beneath the FADs, there are four pieces of 7 m net hanging like a 'skirt' and these are decorated with white rope to attract the fish to their shelter. Construction and dimension of the M.V. SEAFDEC FADs are given in Fig 1.

Nautical instruments for fishing

M.V. SEAFDEC has three frequency (28 kHz, 75kHz and 94 kHz) Color Scanning Sonar installed, one 288 kHz Color Echo-sounder, two Wet-paper Echo-sounders with frequencies of 28 and 50 kHz . There are also two sets of Radio direction finder for locating the position of radio buoys. Three Net-Zonde receivers; 40,50 and 60 kHz for detecting net depth while shooting and hauling the purse wire. There are also environment observation instruments related to fishing including a Doppler sonar current indicator and general weather observation systems and a NOAA receiving system.

In the work boats, SEAFDEC No. 3 and 4, a 200 kHz Tele-sounder is installed. These are used for detecting fish schools beneath FADs before and during fishing operations. Echo traces from Tele-sounders are converted and transmitted in the form of radio signals to M.V. SEAFDEC these are converted back to show a trace on the monitor on the bridge.

METHOD

Setting FADs and locating fish and fishing grounds

Determination of environmental information including wind, current direction and speed, the FADs were set in an area of latitude 01°N-06°S longitude 082°-090°E. This position is chosen because of the available information on the FAD's drift rate and direction, this is recorded year by year, to avoid FADs drifting into the Indonesian Exclusive Economic Zone (EEZ) and drifting away eastward which is too far for conducting fishing operations because of the limited time available. Others considerations for the selection of the FAD setting areas relate to the present catch

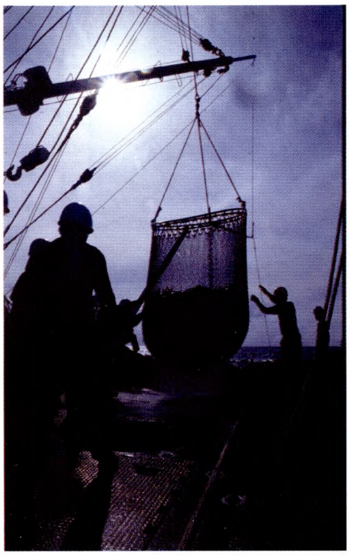

Fig 3. Scooping the fish

information from the Japanese tuna purse seiner fleet. Other indications are the appearances of a front (or frontal zone), drifting garbage or flocks of birds. Setting FADs in such areas may attract tuna schools sooner (Pokapan, 1997).

Searching for floating objects or flotsam like drifting logs and garbage etc. is another way to locate tuna schools. The attraction of fish to floating objects has long been observed. This behavior is explained, both in terms of floating objects serving as a single orientation point in the middle of the ocean and in terms of a gradual build up of a food chain community under and around the floating objects (Ben-yami,1994). Searching for floating objects by the crew of M.V. SEAFDEC, was done after the vessel left the Indonesian EEZ from early morning until twilight. There are three sizes of enlarging power, 7x50, 10x50, and 20x120 binoculars used in the ship for searching from the Compass Deck. After finding interesting flotsam, the vessel is maneuvered dead slow to check for fish schools by the Scanning sonar and Echo sounder. If a few fish are detected a small FAD and radio buoy are attached to attract more fish for operations at the next opportunity. On the other hand, if there are a lot of fish, the radio buoy and light buoy are attached for purse seine fishing operations the next morning.

Fishing operation

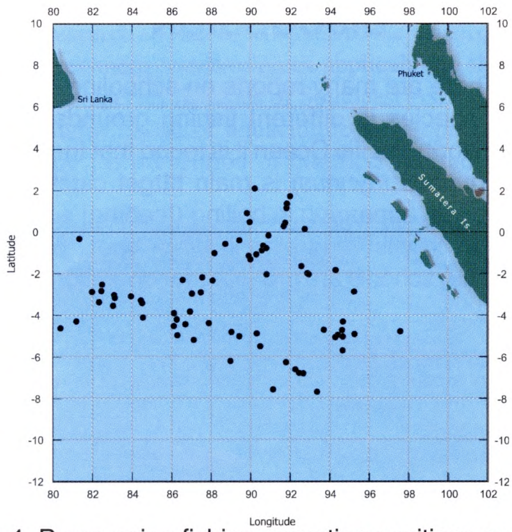

Fig 4. Purse seine fishing operation positions carried out in 1993-1998

On the operating day, the ship will approach the target area and will interrogate the radio buoy and receives both course and distance from the radio direction finder schools and environmental conditions, including wind, current speed and direction, which are considered in the decisions whether to fish or not and for net shooting. There are many times that the operation is canceled because of too few fish detected by the acoustic equipment, too strong a wind, too strong a current or strongly contravening directions among each current layer.

When the proper time arrives, the two work boats-SEAFDEC No.3 and 4 are launched and ordered to go to the FAD. When the crew have made fast to the FAD, a 2 KW underwater lamp is prepared and submerged to a depth of 10 meters beneath the work boat which is tied up nearest to the FAD awaiting the order from the Master fisherman to switch it on. Meanwhile as the preparations and the luring light progress, the Master fisherman and staff observe the Tele-sounder monitor on the bridge to estimate the amount of fish aggregated beneath and around the FAD. As previously mentioned, M.V. SEAFDEC is a starboard side shooting purse seiner, the vessel sets the surrounding net in a clockwise direction at a speed of 10 knots.

Time usage on net hauling depends on the quantity of catch. It may take 4-5 hours if the catch exceeds 70 tons. The skiff is used, during the catch transfer from bunt to fish holds, to keep the bunt float line at a distance from the seiner's side and to help in scooping the catch from the bunt. After all the catch is transferred, the bunt part is pulled out into the water for cleaning then all gear is rearranged for the next fishing operation.

Catch handling

After scooping fish from the bunt part of the net, the catch is passed through the revolving funnel situated at the stern and then to the fish hold. Because the catch of a tuna purse seine is often a large amount, the brine-freezing system is used as the first step to refrigerate the catch rapidly and dry freezing will be used later to maintain the catch in good condition (Munprasit and Chanrachkij, 1993). The brine solution is prepared by dissolving salt in seawater, at a ratio about 1:4, this is pumped into the fish hold and mixed using a submerged pump circulating system. The specific gravity must be checked frequently untill it is 1.17(at 15°C) by Hydrometer or 21.1 in the Baume scale. This is the ideal specific gravity for achieving the lowest freezing point(-21.2°C) of the NaCl solution. The solution is then transferred to another fish hold and refrigerated to -18°C. Excess salt in the fish hold is used for dissolving for the next catch. Brine stock will be transferred to each fish hold to about one-third of its capacity. Catch is transferred into fish hold until

90 percent of the capacity is reached, This allows space for fish body expansion after freezing, the full fishhold is treated with brine solution and wooden screens are used to cover the hatch to press all fish under the brine. The catch is submerged in brine solution for at least 12 hours or until the temperature is -15°C, afterwards, the solution can be discharged and kept in other fish holds. The catch might then be transferred to dry freezing room or kept in the fish hold at a temperature of -40°C until it is unloaded ashore.

RESULT

Position of the fishing operations & Quantity of catch

There were 73 fishing operations conducted by M.V. SEAFDEC from 1993-1998. The total catch was 1955.4 tons and the average catch per unit effort (CPUE) was 26.79 tons. Fishing operations were carried out in the area of latitude 02° N-08° S, longitude 080°-098° E, radiating around The Ninety East Ridge. Fishing operations in 1993-1994 were carried out mostly to the northward and eastward of the Ninety East Ridge. The five operations of 1993 were carried out in November and the total catch was 39 tons. In 1994, there were 7 operations in February-March and 6 in October-November. The total catch was 354 tons with an average catch per operation of 27.23 tons. In 1995, there were 20 operations, 11 in February-March and 9 in October-November. In the early period of 1995, M.V. SEAFDEC operated above latitude 03° S in between longitude 088° -096° E and had a total catch of 376.4 tons. In the late period, operations took place under latitude 03° S longitude 084° - 094° E, with a total catch of 156 tons. Total average catch per operation in 1995 was 26.62 tons.

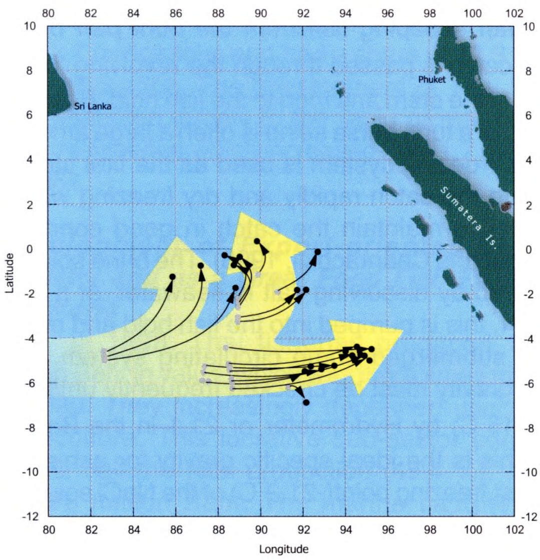

Fig 5. Overlaid drifting routes of FADs and model of surface current during Feb.-Mar. in 1994-96 and 1998

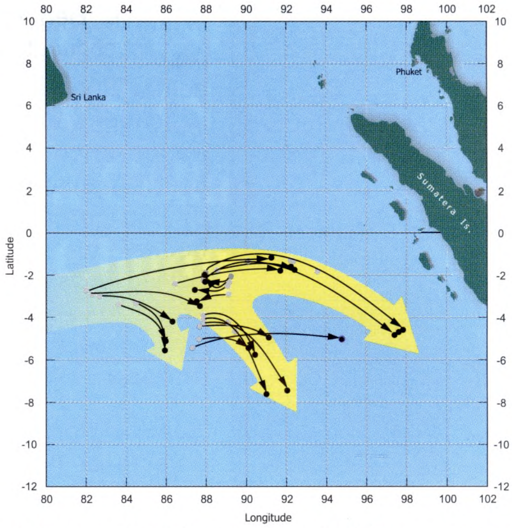

Fig 6.Overlaid drifting routes of FADs and model of surface current during Oct.-Nov. in 1994-96 and 1998

There were 14 fishing operations in 1996, 8 times in March and 6 in October-November. All fishing operations in this year took place under latitude 01°S. The average catch per operation was comparatively high at 36.71 tons, and the total catch was 514 tons. In the following year, 1997, the total catch decreased to 142 tons in 13 operations which were carried out to the eastward of latitude 088° E in between latitude 02° - 05° S. The average catch per fishing operation in 1997 was 10.92 tons. In 1998, there were 8 fishing operations, 5 in February-March and the rest in November-December. The operation positions were below latitude 02° - 08° S in between longitude 087° - 098° E. The total catch during the year was 374 tons in which 340 tons were caught in the early period. There was a big haul of 200 tons, at latitude 04°53'.3S longitude 095°14'.9 on 13 March which increased the average catch per operation of this year to 46.75 tons.

DISCUSSION

There are many reports on schooling patterns of tuna species in different fishing grounds. In the eastern North Pacific Ocean it is found that the Bluefin tuna (*Thunnus thynnus*) is main target catch of the purse seiner, appearing in boiling (feeding) schools[1], breezing schools[2] and also in black spot[3] patterns. The feeding schools are preferred for operations rather

[1] *Boiling school, Feeding school, Boilers* : Fish feeding intensively, and often in conjunction with marine birds, crowding upon the prey and creating an impression of the top of boiling pot.
[2] *Breezing school, Breezers* : Fish swimming very close to the surface of the water, usually in the single direction, creating ripples which resemble those created by a light breeze.
[3] *Black spots* : Subsurface schools appearing to the ship borne observer as black or dark spots.

than the other two mentioned patterns. Ben-Yami (1994) explained that it might be the fact of directional motion of the feeding tuna school is slower, less prudent and swimming more shallowly. In the eastern tropical Pacific Ocean, American tuna fishermen depend on porpoises for locating Yellowfin and Skipjack tuna schools (Green, Perrin and Petrich, 1971). About half the seine-caught Yellowfin tuna from the eastern Pacific are captured from schools associated with porpoises, spotted dolphins (*Stenella graffmani*), spinners (*S. longirostris*) and common dolphins (*Delphinus delphis*). Therefore, fishermen in these fishing grounds use binoculars to search for the spouting of porpoises at the sea surface. Tuna purse seine fishing in the Pacific Ocean also use aircraft, both fixed-wing and helicopters, for scouting fish schools, porpoises, birds or flotsam in the wider areas. Similarly, Japanese tuna purse seiner fleets operating off the West Coast of Africa also search for signs of birds, whales or porpoises for locating tunas schools. However, schooling patterns like boilers, breezers or black spots are rarely seen in the east Indian Ocean. Schools of tuna in these fishing grounds are frequently found aggregating under flotsam and drifting garbage. Therefore, drifting FADs are widely used for aggregate tuna in the area. From the study of the relationship between days of FAD's drifting and quantity of catch (correlation and regression analysis) by Pokapan (1997) found that there is a significant relationship between them (correlation coefficient = 0.5214). Japanese purse seiners operating in the East Indian Ocean have 28-46 FADs (Chantawong *et.al*, 1995) for alternating use in fishing operations throughout the season. When they find their FADs drifting too far or nearly inside the Indonesian EEZ, the FADs are picked up and reset again in the selected area. M.V. SEAFDEC, as mentioned previously, is operating in only two periods of the year in February-March and October-November. Thus, during such long time intervals between the working periods, at the end of each period, all FADs must be picked up. This results in a lower number of drifting days for the FADs in the fishing grounds. Anyway, a good relationship between SEAFDEC's Japanese Master fisherman and other Japanese purse seiners', like the Nipponn Maru, Fuguichi Maru, could relieve this trouble by exchanging, setting and resetting FADs between them. Furthermore, fishing ground information is exchanged to determine the best fishing spot for that period. Obviously, there is great advantage in fleet fishing operation over single-seiner operation.

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