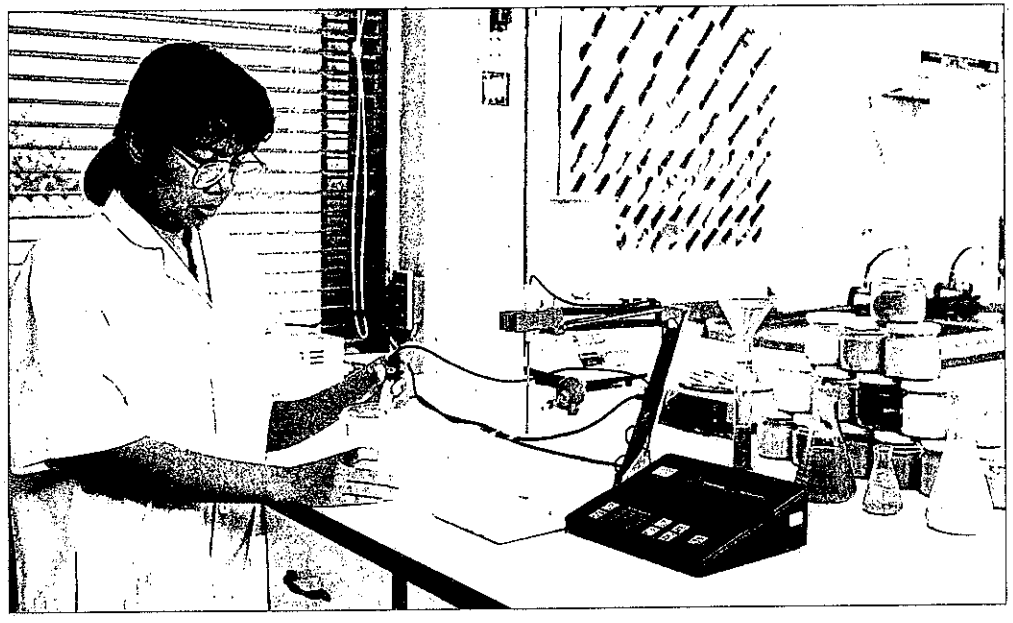

Antibiotic residue monitoring is an integral part of That Seafood Quality Control Programme.

at the detection level of the microbiological method: 0.1, 0.1, 0.01 and 0.2 mg/kg respectively and 0.3 mg/kg for liver and 0.6 mg/kg for kidney in all species. The estimated maximum daily intake of oxytetracycline is 150 *ug* in milk, 30 *ug* in muscle, 0.5 *ug* in fat, 20 *ug* in eggs, 30 *ug* in liver, and 30 *ug* in kidney yielding a total of approximately 260 *ug*, taking account of daily intake values of 300 g of meat as muscle tissue, 100 g of liver, 50 g of kidney, 50 g of tissue fat 100 g of egg and 1.5 l of milk. The Committee concluded that the recommended MRLs are conservative and do not present a risk for the consumer and no further studies on residues of oxytetracycline were required. Thailand needs support from other shrimp producing countries worldwide on the proposal of MRL for oxytetracycline in farmed shrimp. The international acceptable MRL could help a lot in cases of dispute with the importing countries where zero tolerance is applied.

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Tropical tuna fishing with purse seine and log

Fishing for tuna under floating logs is a popular trend. When there is a lack o natural floating logs, fishermen seed artificial logs.

Dr Jean-Pierre Hallier

The association of fish with living and non-living things drifting or swimming in the sea is a well known phenomena.

Tunas especially the three main tropical tuna species (yellowfin, skipjack and bigeye) are directly associated to this behaviour pattern. For these species, fork length between 35-40 cm (juveniles of all species) and 150-180 cm (yellowfin and bigeye adults) are of concern. As tunas smaller than 30 cm are rarely caught, it is not known if the associations do exist for fishes of this size.

The association of tuna with dolphin is best known and well documented. It is apparently restricted mainly to the Eastern Pacific ocean and concerns especially the large yellowfin tuna.

Tunas gather often around whales and whale-sharks. This association occurrs worldwide, more or less according to regions.

Another worldwide association is between tuna and drifting or floating objects. Most of the drifting objects are logs of natural origin. Therefore a log school is often used as a general indicator for tuna schools. However, these objects vary from natural to man-made objects such as plastic refusal, wooden planks, fishing nets, and even buoyant carcasses of whales and other large dead animals. Schools not associated to logs or large animals are often called free-swimming schools or in short, free schools. Following the same idea, denominations such as whale schools, dolphin schools are also commonly used.

Even vessels, when drifting sea can gather tuna, very similar the gathering of tunas under logs

Long ago, fishermen have use the fish behaviour pattern to the benefit and since industrial pol and-line and purse seine fisheri started, fishing near log schoo have been performed on differe scales according to fisheries ar oceans.

More recently, for differe reasons purse seiners worldwi tend to increase their catch arou log schools. And the advantage log school fishing is that fisherm can seed artificial logs at sea whi act like natural logs. This fishi technique is presented below.

Fishing technique

There is no appreciab difference in the fishing operati

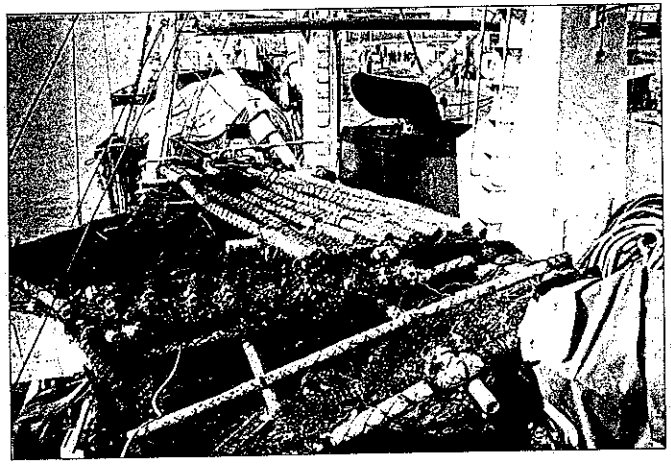
of purse seiners catching tuna schools associated with floating objects and those free swimming schools or schools associated with whale-sharks, whales, *etc...*

Once the object is located, the boat approaches it to find out if tunas are present and if so, evaluate the characteristics of the school (tuna sizes, species composition and school size) by sight, echo-sounder or sonar. The evaluation can also be made from a small boat launched by the purse seiner.

If it is decided that a set should be made, the purse seiner is moved to a certain distance from the object in order to have it in the center of the circle that can be surrounded by the net. From that moment, the traditional fishing operation takes place. The auxiliary skiff is launched, which carries one end of the net, and the purse seiner at full speed circles the object until it reaches the skiff. The end of the net with the skiff is joined with the other net-end on board the purse seiner. The bottom line is drawn for closing the net to be hauled on board until the catch is concentrated in a pocket in order to scoop it. Before that, the small boat ties the object to her side and pulls it out of the net. According to the fishing results, the captain will take one of the following decisions:

- leave the object and resume searching for new schools;
- haul the object on board with the idea of locating it in another appropriate area where tuna can be expected to gather under the object;
- attach a radio beacon to the object with the idea of returning to it at some other time and resume searching;
- remain next to the object so that it cannot be used by other vessels, and proceed to fish again at the right moment generally at dawn.

Objects can also be hauled on board when currents drive them near coasts and especially in shallow waters as purse seiners have nets with a depth up to 200 m and therefore cannot fish in these waters.



Dr Jean-Pierre Hallier

Fish Aggregating Device (FAD) on board a purse seiner.

Log school characteristics

Tuna schools associated with logs and purse seine fishing on log schools worldwide have similar characteristics.

Intensive studies conducted in the Eastern Pacific have clearly demonstrated that neither the size (for logs greater than 1 m.), nor the color, the shape, the nature or the time of the object at the sea has an influence on its attractiveness to tunas. Everywhere, log school tunas are mostly skipjack (on average two thirds) followed by yellowfin and bigeye. Almost everywhere, bigeye is generally more abundant in log schools than in free schools.

Yellowfin and bigeye tuna juveniles are more dominant. On the average, log school catch per set is larger than catch per set from free schools. However, log school tunas generally fetch lower price than that of free schools. Furthermore, the by-catch larger on log schools. This by-catch mostly consist of coastal fish which drift with the log from coastal waters, minor tunas such as frigate tuna and kawakawa, wahoo, rainbow runner, dorado, sharks and rays, trigger-fish, billfish, *etc...* This by-catch involves extra work in cleaning the net and sorting the catch of unwanted species in the limited time available before the catch in the net begins to deteriorate in high sea-temperatures.

Apart from a large catch on the average at log schools, there are other advantages. For instance, hardly 10% of purse seine sets on log schools yield no catch while 50% of sets on free schools are unsuccessful. As tuna biomass under logs is higher at dawn, most sets are conducted early in the morning. Then, by mid-morning, the vessel can load its good catch, more or less saving its fishing day. The rest of the day can then be used to search for free schools and other possible catch or find new logs for fishing, the next morning.

The same log can be fished around for several days in a row but of course catch per set tends to decrease but it is not rare that such logs would yield several hundred mt of tuna.

This fishing technique has undergone several improvments as some purse seiners rely more and more on log schools for their catch.

In the early eighties, fishermen started to attach buoys with radio beacon to logs. A log found during the day or fished early morning which seems promising for future catches is then radio located by the vessel. In the early stages these radio beacons were designed to emit signals continuously which made them too easy to be found by foreign purse seiners. Consequently, they made sleepers that is, a radio signal from the tuna boat to emit signals for only a short time. This made it more difficult to be located by other purse seiners. However, in most fisheries, radio beacon and log stealing among vessels is common practice. In practice, some purse seiners work with more than twenty of these buoys.

As natural logs are limited, artificial logs are made and seeded in areas where the current is known which is heading more or less in the same direction for a lengthy period. Obviously for a given vessel to manage several logs at the same time, it is most advisable to have all logs drifting more or less in the same direction, at the same speed.

Log school fishing around the world

The development of purse seine fishing on log schools was different among fisheries and oceans. Catches on log schools are significant in all oceans but are particularly important in the western part of the three main oceans (Indian, Pacific and Atlantic) where they account for more or less 50% of the total purse seine catch.

Eastern Pacific

In the Eastern Pacific ocean, log school catches have fluctuated over the years. During the period 1980-90, catches reached a maximum of 32% of the total catch in 1982 and a minimum of 8% in 1985 (based on data from the IATTC observer programme). These fluctuations are mostly related to prices paid by canneries and to the supply situation of yellowfin. When canneries pay a much higher price for large yellowfin than for small yellowfin or skipjack, the fishermen have an incentive to fish on tuna schools associated with dolphins where large yellowfin tuna are predominant instead of fishing on log schools.

However, since the beginning of the eighties the fishery is under constant pressure by environmental groups in order to decrease dolphin mortality associated with sets on large yellowfin schools. Despite considerable progress by fishermen their target is for zero, mortality level. As it becomes more and more difficult for purse seiners to set on dolphin schools to meet the low mortality target for dolphins, they started to leave the area since the beginning of the eighties while for those who remained, they tend to set more often on log schools. As a result, log school catches in this fishery are on the increase in recent years and this trend is expected to continue in the future.

Western Pacific

Western Pacific tuna fishery by far the largest, was dominated for many years by the Japanese pole-and-line fishery whose operations extented from the South of Japan to the waters of Indonesia and Fiji. Japanese purse seiners started to operate in the early seventies but their number remained low until 1980, when they replaced pole-and-line vessels with purse seiners. At the same time, US purse seiners started to move in from the Eastern Pacific as they were forced to leave because of the dolphin issue there. These vessels started to fish mainly in the north of Papua New Guinea and Solomon Islands where natural logs are abundant and thus fishing there became common practice. The log school

Table: Average Log School Catch by Purse Seiners, Other Types of Catch by the Same Gear and Total Catch

		East Atlantic 88-90	West Atlantic Venezuela	East Pacific 88-90	West Pacific SPC area	Indian Ocean 84-90
YELLOWFIN	Log school catch by P.S.	6.3	15.9	30.0	80	16.0
	Other type of P.S. catch	70.3	16.9	259.0	68	62.0
	Total species catch	118.7	-	-	-	122.0
SKIPJACK	Log school catch by P.S.	23.8	3.7	44.7	198	61.0
	Other type of P.S. catch	43.5	1.9	35.6	183	23.0
	Total species catch	93.0	-	--	153.0	
BIGEYE	Log school catch by P.S.	2.0	-	2.3	9.0	4.7
	Other type of P.S. catch	4.4	-	1.4	1.0	2.1
	Total species catch	62.8	-	82.0	73.0	38.9
TOTAL	Log school catch by P.S.	30.0	19.6	74.7	288.0	81.7
	Other type of P.S. catch	170.0	18.8	296.0	290.0	87.1
	Total species catch	274.5	-	-	-	314.8

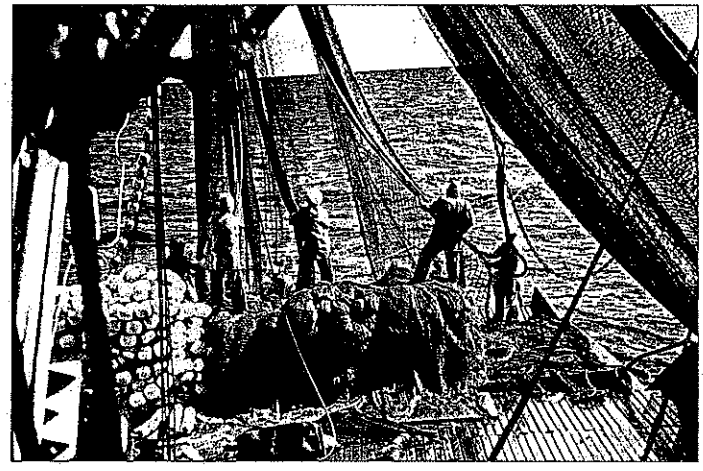
In Fonteneau (1992) P.S. = Purse seine

catch largely dominated the total catch. A striking difference between the Japanese and the US fisheries was that it was almost exclusively log school fishing by the Japanese while the US vessels concentrated on log and free school fishing. In order to secure their annual catch exclusively with log school fishing, the Japanese soon, started to develop artificial logs.

In the second half of the eighties, though the total log school catch continued to increase by weight, it decreased as a percentage of the total catch. Several factors were attributed: purse seiners of different flags other than US and Japan, entered the fishery; the fishing zone was extended eastwards to areas where natural logs were less abundant; sets on free-swimming schools became more successful due to improvments in gear and setting techniques.

Eastern Atlantic

In the Eastern Atlantic ocean, purse seine fishing started in 1964. Yellowfin was the target species. Although fishing on logs probably took place in the late sixties this



Dr Jean-Pierre Hallier

Hauling the net.

mode of fishing was rather incidental, and remained poorly reported in log books until 1987.

In 1983 and 1984, low catch rates of yellowfin were responsible for the departure of a large part of the fleet for the Western Indian Ocean. Vessels that remained in the Eastern Atlantic tended to set more often on log schools. During the period 1988-1990, an average of 18% of the French and Spanish total catch was made on logs. In the nineties, this proportion increased for several reasons:

- Many fishermen on board purse seiners fishing in the Atlantic, have spent some time fishing in the Indian Ocean where log fishing was very common. Therefore they are not reluctant to set on logs.
- Artificial logs are easy to build and at low cost, they are commonly used today to increase log school catches. Futhermore, in most fishing areas, association between tunas and logs (natural or artificial) is significant. In some areas, logs can even increase the tuna biomass which otherwise will remain dispersed. This situation is noticed in the Eastern Atlantic ocean south of the equator where new and large catches of skipjack are made by using artificial logs while this species was not caught previously in this area.
- The increase in the size of the boats and gears used is the most striking characteristic of the development of purse seine fishery, though the running cost of these large vessels is very high. Thus, it is inevitable for them to secure stable catches. Yellowfin stock fluctuates with seasons and from year to year. Most yellowfin stocks are fully exploited if not overexploited. Fishing on natural and artificial logs ensures regular catches and profits even if the price per mt is somewhat lower as catches mostly consist of skipjack and small yellowfin and bigeye.
- Small size tunas were not much appreciated by canneries in the past, but are now regularly processed.

Most of these reasons also apply to other purse seine fisheries and log school catches are expected to continue to increase worldwide.

Log school fishing and stock management

This technique has several drawbacks, some of which have already been mentioned above.

In fisheries, indices of abundance is expressed as catch per unit effort which is commonly used to explain the exploitation status of a given stock. In purse seine fisheries, units of effort are usually the fishing day or the searching day. But what is the meaning of these units for a fleet that fishes most exclusively on logs. If logs (natural or artificial) are all set with radio beacons, there is no searching time and the fishing time is not related to the stock abundance. Logically, catch per set would seem to better represent the biomass. Scientists have found some difficulties to deal with this fishery especially when it comes to estimate indices of abundance for the exploited stocks.

This fishing technique concerns mainly small size tuna sold at a cheaper price. To obtain the same turnover, a purse seiner fishing on log schools will need to achieve a bigger catch than it would have needed to fish on free schools. By-catch is known to be more extensive for log sets than for the other types of sets, but information on by-catch is sparse. In addition this larger by-catch will not improve the turnover.

The predominantly small size catch has another consequence: same weights from log and free schools will be made up of a very different number of fish. If one takes an average weight of 20 kg, for free school fish (the average weight commonly observed for this type of fishing) a 1 mt. catch will on average number 50 fishes. While the same weight of a log school catch with a 2.5 kg. average weight will number 400 fishes: eight times more than for free school catch. This has direct and important implications in terms of stock management, while catches of small size fish do not pose a potential biological problem for skipjack, the situation is very different for yellowfin and bigeye tuna especially when stocks are heavily exploited. In this kind of fishery, an increase of log school catch will induce a lower yield per recruit: the stock will then be not only heavily exploited but also badly exploited. This applied to yellowfin and bigeye stocks while, for the time being, there is no alarm of any sort for skipjack.

This technique increases the efficiency of purse seiners but may be less efficient in terms of stock exploitation. Fishermen are well informed of this situation and whatever the fishery or the ocean, everytime yellowfin, especially large fish are available the purse seiners go for them. One possible exception could be the Japanese purse seiners, whose operations depend most heavily on log school catches in the Western Pacific and Indian Oceans.

Today, purse seine fisheries around the world cannot make it without log school fishing however closely the development of this type of fishing is monitored by scientists.

Dr Jean-Pierre Hallier is attached to ORSTOM, Dakar, Senegal.

Crocodiles hamper technology development

The proposal to reintroduce crocodile culling, could find the aggressive salties looking down the barrel of hunters rifles while paving the way for safer experiments on gear technology developments.

by Richard Mounsey

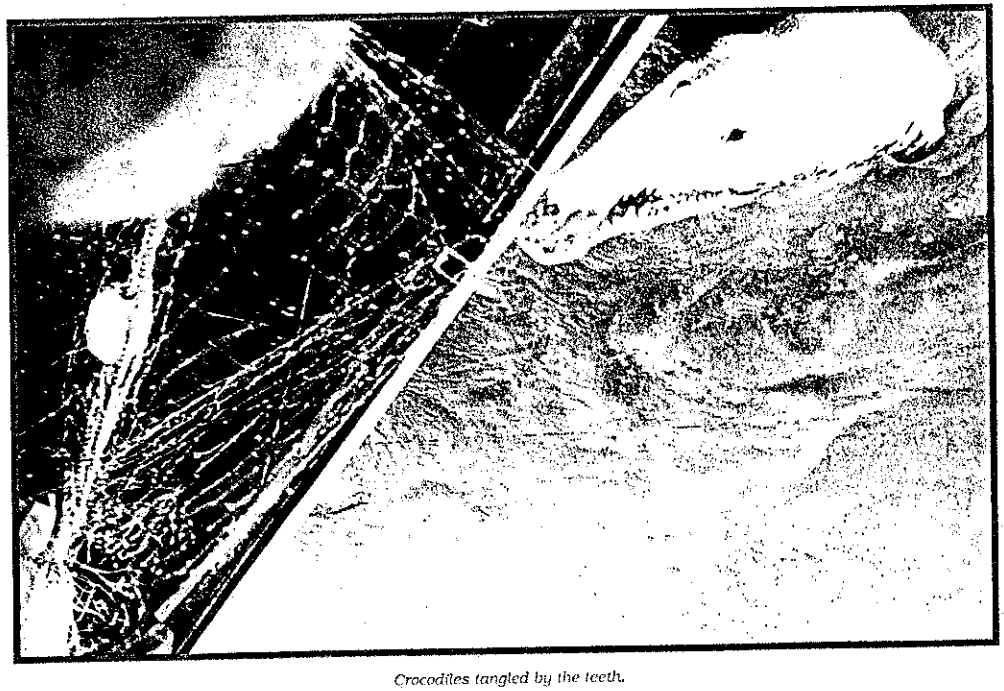
Isolation, insects, muddy waters, huge tides and blistering hot sun are not the only things fishing gear technologists have to contend with in coastal regions of the Northern Territory. Huge crocodiles frequently disrupt inshore gear development trials and it is likely this problem will only get worse if the Government's attempts to re-introduce culling are not successful.

The giant saltwater crocodiles of the Northern Territory were approaching extinction in the early 1970s but due to strict management controls the population has dramatically increased. Today their numbers are believed to exceed 60 000 and are increasing at a steady rate.

These frightening creatures from a bygone era, inhabit coastal fringes, large river systems and many offshore islands of the Northern Territory. During the mating season, October/November, trawler skippers commonly report sightings of the salties 50 to 100 nautical miles out in the sea.

Damages to vessels and gears

Coastal crab pot and gillnet fishers encounter crocodiles on a daily basis and must remain always alert. Apart from posing personal danger to fishers, the salties are notorious for destroying fishing gear



Richard Mounsey

Crocodiles tangled by the teeth.