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LOGS AS FISH AGGREGATION DEVICES IN THE EQUATORIAL WESTERN PACIFIC

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Summary

Branches, trunks and entire trees floating in the equatorial western Pacific Ocean attract commercial quantities of tuna and other pelagic fishes. A general description of these "logs" is presented here with information on the species associated with them and the characteristics which attract fish. This paper advocates the use of logs as fish aggregation devices at the village level because of low cost, general availability and robustness as well as their ability to attract fish. Logs can also be used to improve catches, generate revenue through licensing agreements with foreign purse-seine operations, provide access to juvenile tuna of several species for research purposes and monitor local and international pelagic fisheries.

Introduction

1. Distant water fishing fleets, in particular United States and Japanese purse-seiners have in the last decade caught thousands of tonnes of skipjack, yellowfin and bigeye tuna from logs drifting in the equatorial western Pacific. Little is known about the characteristics

of logs which enable them to function as fish aggregation devices (FADs). The aim of this paper is to describe the type of logs that attract fish, and suggest how logs can be used as FADs in artisanal fisheries, especially at the village level where materials and finance are limited.

2. The present information was gathered during 14 months of fishing around logs onboard the U.S. purse-seiner Western Pacific. I wish to thank the captain and crew for their help and cooperation during this period.

Types of logs which attract fish

3. A vertical stratification of fish species is immediately apparent when observing the water surrounding a log. Near the surface and directly under the log is a diverse and abundant community of tropical fishes such as rainbow runners, damselfish, drummers, triggerfish and dolphin. These species, collectively known as "bait" are the prey of the many predators that can be seen below. The log provides the bait shelter and a source of food in the form of encrusting barnacles, crabs and smaller fish. Under the bait are the sharks, most commonly the silky shark and on occasion the oceanic whitetip and blue shark. The tuna occur at greater depths, with mixed schools of skipjack and small yellowfin appearing above the large yellowfin and bigeye. The latter are found at depths of 50m or more during the day but move toward the log at night. Skipjack and small yellowfin may be seen on the surface in daylight as disturbances downwind of the log. Table 1 lists species observed around logs in the western Pacific. In addition to the fish, a number of turtle species, sea-snakes and marine mammals occasionally visit logs.

4. Effective fish aggregating logs vary considerably in shape and size but my observations suggest they must be at least 1.5m long and 0.1m thick before tuna will be attracted. A short, smooth section of trunk, a group of branches or a whole tree can be equally effective as FADs. Submerged branches and roots are often present on logs at sea and appear to attract the most fish. In addition to these minimum dimensions, two further attributes contribute to a logs success as a FAD - the length of time it has been in the water and its distance from other logs.

5. There are several features that identify logs which have been at sea long enough to aggregate fish. These include the presence of seabirds or their guano, a covering of barnacles, the logs generally bleached appearance and low aspect in the water. The last is of primary importance since a log that is floating high offers less underwater surface area for barnacle settlement or shelter. After weeks or months of soaking only a small portion of the log may be showing above the surface but the stability afforded to its associated pelagic community results in an abundance of bait in a region of otherwise low productivity.

6. Trees or tapering trunks often sink at the heaviest end first and gradually move into a vertical position. Such "vertical logs" may stand 5m out of the water and extend 20m below. This extensive underwater section can enhance fish aggregation but unfortunately vertical logs are so near to sinking that few are ever encountered. Their life as FADs can be prolonged if buoys are used to keep them afloat.

7. To be effective in fish aggregation, logs should be at least 5km apart. If they are closer the associated tuna tend to disperse rather than form distinct schools. Current eddies and convergences often concentrate hundreds of logs in relatively small areas (on the order of 200 square km) and although there may be large quantities of tuna present, they are not catchable by purse-seining. In such circumstances they are likely to be vulnerable to longlines, trolling and gillnets.

8. In a 200 square km area containing only one log the catch can often be large. Here the length or girth of a log is not of great importance although a larger log will usually attract more fish. Landings in excess of 150 tonnes have come from logs no more than 2m long and on one occasion a 90m tree yielded 1,500 tonnes over a two week period. Where there are no logs, fish may be attracted to a variety of floating objects such as discarded drums, plastic bags of rubbish, containers and, on rare occasions, dead whales.

9. Another criterion for gauging log suitability is the presence of large numbers of sharks in relation to the visible prey. In my experience abundant sharks often serve as a good indication that tuna are present.

Using logs as FADs

10. For village level and artisanal fisheries present FAD designs are complicated and the material and money needed for construction may not be available. In these situations logs may be of great value and have several advantages over artificial FADs. For one, log-FADs are relatively inexpensive and readily available either on land, at sea as material drifting by or washed ashore. In addition, eddies in the lee of islands may concentrate large numbers of logs that are accessible to

fishermen. Thus available finance can be spent on providing an adequate mooring system. If logs are in plentiful supply they can be fished as they drift past an island, with sea anchors being used to slow their passage.

11. Secondly, logs require little or no modification before deployment, are strong and do not break up in heavy seas. In rough weather, drag on the mooring line can be reduced by deliberately allowing the log to break loose. The anchor line would be attached directly to a buoy so that the mooring could be reused.

12. Logs have large surface areas for the settlement of animals, especially if branches and roots are included. Submerged branches eliminate the need for streams of net and rope and, at the same time reduce the chance of entanglement in propellors and fishing gear. Logs are also a natural surface for colonization and probably act as a source of food for some inhabitants. They can also be modified by the inhabitants to provide shelter.

13. Finally as a log becomes saturated and begins to sink it will often move into a vertical position and therefore enhance fish aggregation.

14. As can be seen from Table 1 many of the small bait species are reef inhabitants. This suggests that the period of log colonization might be shortened by first anchoring the log close to a reef. Once a community of reef fishes has accumulated the log can be slowly towed to the desired position.

15. Although this paper is aimed specifically at artisanal fisheries, logs can of course be used in commercial operations as evidenced by the purse-seine industry.

Research implications

16. Logs can also play a part in the monitoring and improving of catches, and in generating revenue. The logs fished by the U.S. and Japanese purse-seine fleets probably originate from the larger islands in the equatorial region, in particular Papua New Guinea, the Solomon Islands and the Philippines. Transport from PNG and the Solomon Islands is usually northwesterly via the South Equatorial Current. Logs carried to about 5 N can be entrained in the Equatorial Countercurrent along with material originating from the Philippines and transported eastward. The irregularity of the countercurrent west of 160 E may also result in many of these logs returning to the west. It is interesting to note that few logs are encountered in the area governed by the North Equatorial Current (Bailey and Souter, 1982). This suggests that terrigenous material gathered in these currents are trapped within the region bounded by the Federated States of Micronesia in the north, Kiribati in the east and the Solomon Islands and PNG in the south.

17. A programme of deliberate launchings of tagged logs from the source islands could be part of a licensing agreement with foreign vessels, with additional fees being levied if tagged logs are fished. An observer programme running concurrently would ensure accurate catch returns and provide a detailed data base for managing local and international fisheries. The logs can be anchored or floating freely. The former option will be expensive to initiate while the latter, although considerably cheaper will eventually result in the logs drifting beyond an islands 200 mile exclusive economic zone. This could be offset to some degree through inter-island agreements as with the Nauru Group (Doulman and Wright, 1983).

18. Log-FADs may also provide opportunities for assessing the stock sizes of juvenile tunas since logs attract large numbers of small skipjack and yellowfin. During purse-seine operations such fish, although caught are usually discarded because they are too small to can economically. These small fish would therefore be readily available for sampling and tagging in conjunction with log fishing. At present the lack of attention to the current use and potential for log-FADs not only deprive fisheries biologists of necessary information but deprive many Pacific island nations of an inexpensive and effective aid to fishing.

Literature cited

Bailey,K., and D.Souter 1982. Tuna purse-seine cruise report, June 2 - August 10, 1982 M/V Western Pacific final report. Pacific Tuna Development Foundation, Honolulu. 37pp.

Doulman,D.J. and A.Wright 1983. Recent developments in Papua New Guinea's tuna fishery. Marine Fisheries Review 45(10-12): 47-59.

Table 1: A list of species found around logs in the western Pacific.

Species name	Common name	Abundance (mean no./log)
FISH		
Prionace glauca	Blue shark	1
Pterolamiops longimanus	Oceanic whitetip	1-10
Carcharhinus falciformis	Silky shark	10-100
Rhincodon typus	Whale shark	1
Dasyatis sp.	Stingray	1
Mobula japanica	Manta ray	1
Stolephorus spp.	Anchovies	>100
Cypselurus and Exocoetus spp.	Flyingfish	1-10
Hippocampus sp.	Seahorse	1
Sphyraena barracuda	Barracuda	1-10
Elagatis bipinnulatus	Rainbow runner	>100
Naucrates ductor	Pilotfish	1-10
Seriola sp.	Yellowtail	1-10
Decapturus sp.	Mackerel scad	>100
Trachurus sp.	Jack mackerel	>100
Caranx spp.	Jacks	1-10
Coryphaena hippurus	Dolphin	10-100
Lobotes surinamensis	Tripletail	1-10
Kyphosus sp.	Drummer	10-100
unidentified pomacentrid	Damselfish	1-10
Acanthocybium solandri	Wahoo	1-10
Scomber japonicus	Japanese mackerel	10-100
Auxis thazard	Frigate tuna	1-10
Euthynnus affinis	Kawakawa	1
Katsuwonus pelamis	Skipjack	>100
Thunnus albacares	Yellowfin tuna	>100
Thunnus alalunga	Albacore	1-10
Thunnus obesus	Bigeye tuna	10-100
Makaira nigricans	Blue marlin	1
Makaira indica	Black marlin	1
Tetrapturus audax	Striped marlin	1
Xiphias gladius	Broadbill swordfish	1
Remora spp.	Sharksuckers	1-10
Canthidermis spp.	Triggerfish	>100
Alutera spp.	Filefish	10-100
Diodon hystrix	Porcupinefish	1
REPTILES		
Eretmochelys imbricata squamata	Pacific hawksbill turtle	1
Caretta caretta gigas	Pacific loggerhead	1
Chelonia mydas japonica	Green turtle	1
Laticauda spp.	Banded sea-snakes	1
MAMMALS		
Globicephala sp.	Pilot whale	1-10
Tursiops truncatus	Bottlenosed dolphin	1-10
Orcinus orca	Killer whale	1