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SOUTH PACIFIC COMMISSION

EIGHTH REGIONAL TECHNICAL MEETING ON FISHERIES
(Noumea, New Caledonia, 20-24 October, 1975)

ACOUSTIC LURES IN NEW ZEALAND

Prepared by:

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Ministry of Agriculture and Fisheries
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New Zealand

SUMMARY

Observations made during tuna fishery advisory services from 1963 to 1971 pointed to the role played by acoustic phenomena in attracting tuna. The principal sounds were those of diving birds, "breezing" (at the surface) schools of anchovy, followed by the sounds of tuna feeding, serving to attract additional tuna.

Using fairly unsophisticated equipment, the acoustic phenomena were recorded in situ. The eight-track tapes obtained were then fitted to a simple transducer system. The first prototype was tested in May 1970 and subsequent models have been sporadically tested between 1971 and 1975. A Commercial firm was licensed to produce and market these "York Acoustolures" (named after the inventor) but the firm was dissolved in 1974.

Though instances of marked success in attracting tuna has occurred, results from tests have been inconclusive, perhaps owing to the fact that hardware, and particularly adequate powering, have been difficult to resolve satisfactorily. A summary of notable results is included in the paper.

A modest testing programme is taking place in New Zealand and the Fisheries Department of Israel is also testing a loaned lure.

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1. Observations between 1963 and 1971 on acoustic phenomena relating to the assembly and feeding of tuna was compiled by A.G. York, Technical Officer of the Fisheries Management Division. The initial work was carried out in the Bay of Islands, New Plymouth, Wellington, Gisborne and Bay of Plenty, New Zealand coastal waters.

2. The principal and most consistent signals noted were: (1) the sounds of diving gannets as they struck the water to prey upon anchovy or similar-sized "baitfish" (the gannets having presumably first located the fish by visual means from the air). Other bird sounds such as the squeaks of shearwaters were also noted; (2) the swimming sounds produced by the schools of anchovy, especially when they "breezed" at the surface.

3. These kinds of primary sounds often resulted in the subsequent appearance of tuna, which would usually promptly begin to feed on the smaller prey fishes. This in turn would generate (3) the sounds of tuna feeding, sometimes working up to a frenzy of activity, itself serving to attract other tuna. Sometimes dolphins would be associated with various stages of the chain of events, and their sounds could be discerned and were possibly a factor. Dolphin frequently travel with tuna.

4. The cause and effect nature of the phenomena described seemed very clear and in fact, logical. Water being in some respects an ideal medium for sound transmission it is only natural to expect fishes, especially predaceous species such as tuna, to use this tool as an aid in securing food (other studies have demonstrated the use of acoustic signals by some fish species in territorial and reproductive behaviour). Indeed, sharks are known to be attracted by the sounds of struggling prey (including man) in the water. Besides their otoliths, structures

somewhat analagous to portions of the mammalian ear, fishes possess lateral lines, sensitive to the passage of sound waves through water. Some fishes also possess air bladders, which in addition to use as a buoyancy regulator, can be used to resonate sound - production or reception.

5. The awareness of the importance of sound to fishes is, therefore, not new to man. Primitive fisheries in south-east Asia use sound to scare or detect fish. Various researchers have studied and recorded sound emissions and that created by swimming schools of fishes. Japanese and Russian scientists, in particular, have studied the responses of fishes, and also of squid, to acoustic signals, with a view toward assisting the capture of food species. In New Zealand it was decided to try to duplicate the sounds leading up to and associated with the feeding of tuna, to ascertain if this synthetic procedure could be used to increase catches.

6. In March 1969, the 9.75 metre vessel TAKAPAU was chartered from Whakatane, Bay of Plenty. Several British Naval sonobuoys (flat frequency response from 50 to 28,000 Hz) were set free up to 4.8 km from the vessel. Signals received were processed with a R-2A/ARR-3 Royal New Zealand Air Force receiver, and the sounds recorded on a Nagra tape recorder with a frequency response of 30 to 20,000 Hz. Sounds could be monitored by an observer using a headset or loudspeaker.

7. On the 4th of March, temperatures in the upper water column were isothermal and salinities (as determined by RS5-3 salinometer) stable. At first a school of dolpins was present - seen visually and recorded. Then, "plopping" noises of diving sea birds were picked up on a sonobuoy approximately 5.6 km east of the drifting vessel. At the same time, five large schools of skipjack tuna surfaced within 1.6 km of the TAKAPAU and swam towards the east. Their swimming sounds and also apparent squeaks they generated could be heard on a hydrophone as they passed. The vessel followed and when within 3.2 km of the sonobuoy, hundreds of gannets (Sula bassana serrator) could be seen diving from low altitudes upon surface schools of anchovy. (Engraulis australis). Fluttering shearwaters (Puffinus gavia gavia) were also present. The arriving skipjack tuna began to feed on the "meat ball" shaped schools of anchovy, attacking from below. Another sonobuoy placed close to the action picked up all the associated sounds clearly. The dominant signals, as noted above, were (1) the diving birds, (2) the anchovy breezing or breaking surface and (3) the ensuing sounds of feeding tuna. All the major and lesser sounds were recorded.

8. A gill net had also been placed near the school of anchovy, and succeeded in catching a number of tuna. As they thrashed and struggled, another sound was generated and recorded, this one likened to a "machine gun rattle". This sound drowned out all others for a

period. Although this capture signal might have been expected to frighten tuna (and in later experiments, did so), such was the frenzy of the feeding that on this occasion the tuna continued their onslaught of the anchovy, a few more being gilled. Eventually the anchovy sounded and the birds and tuna moved off southward to other bait fish on the surface.

Acoustolures

9. Having succeeded in obtaining the acoustic record of a tuna attraction - feeding situation, it remained to devise the equipment and procedure needed to attempt to lure and catch tuna in a completely artificial, i.e. without real prey being present, situation.

10. A.G. York put together an omni-directional magneto-striction transducer which transmitted an amplified tape combining all the attraction signals at an output of 1.5 watts at about 4 to 6 db noise level. In May 1970 this weak signal attracted a small school of skipjack to the big game boat BLUEFIN, at a time when tuna schools were scarce in the Whakatane region.

11. A second prototype was constructed consisting of a DEA-7 directional hydrophone-projector with a -3 db beam width characteristic of 80°. Trials with this model took place in 60 m of water near White Island in the Bay of Plenty in calm weather in January 1971. The projector was lowered 2 m below the keel and a maximum power output of 1.7 watts was transmitted using the combined attractive signals at a noise level of 6-8 db. Within three minutes a school of skipjack surfaced 1.6 km from the vessel, and swam to within 4 m from it. When power was reduced, some of the fish came so close as to strike the transducer. When the signal was changed to the capture sounds, the tuna immediately dispersed and no schools were sighted or detected for 35 minutes.

12. Subsequent to this, the New Zealand electronics firm, the Elsham Group of Christchurch, was given permission by the New Zealand Inventions Development Authority to develop and market "York Acoustolures". The company did this until 1974, distributing an unknown number of lures, but then going into receivership. At present, disposition and further development of the lures is in the hands of the I.D.A.

Effectiveness of the Lures

13. From the beginning, certain problems were encountered in trying to ascertain the effectiveness of the acoustolures for tuna. (The fisheries facility) not being an electronics laboratory, the early prototypes were not ideally engineered, especially for salt water performance. Later it became evident that despite the engineering expertise supposedly available at Elsham, the lures marketed were under-

powered, and the critical aspect of range was neglected; these lures could have projected a weak signal for at the most a few kilometers. A technique for boosting power by moulding lures to fibreglass boat hulls, which act as resonators, has been devised. In addition to the hardware problems, what was needed was further work to identify the conditions of sound transmission at the times of lure experimentation.

14. Although some lures were obtained by the Fisheries Management Division, and distributed to selected fishermen for trials, this programme proved difficult to control. Despite instructions to the contrary, fishermen often admitted to "chumming" with ground bait, to "be sure" of obtaining a catch when tuna appeared near a boat.

15. Following is a listing of major reports pertaining to trials with the Acoustolure.

Date	Place	User	Remarks
1972	Tauranga, N.Z.	Dr Godfrey	Large school of skipjack attracted while lure on. Also attracted dolphin.
1972	Atlantic	Coxwell	"Winning" bluefin caught by vessel using lure during contest.
1972	Haute Bay, South Africa	-	Lured bluefin from 2 km.
1973	Western Australia	Robbins	Lured Southern bluefin to within 3.5 metres of boat, but no closer.
1974	S.E. coast, N.I., N.Z.	Palmer	Lured skipjack toward gill net and caught 300 fish.
1973	Galapagos Isds.	Cawthorn	First attracted from 3 km then, by using repel signal held yellowfin inside purse seine for 18 minutes, during experiments on releasing dolphins from purse seines.

16. At present, several additional lures are on loan. Dr Walter Stark has one in the Solomon Islands region, testing range aspects on dolphin and tuna. His comments to date relate to the need for more power. A loan is in the hands of a former New Zealand fisheries worker in Papua New Guinea. A lure loaned to the Israel Fisheries Division has had partial success both with the attract and repel signals. Interest has also been indicated by fisheries scientists in Malaysia and Indonesia.

17. A visiting American bio-acoustician, Dr William Tavolga, has commented that, although the principle of the lure is sound, more work needs to be done in spectrum analysis of signals. This may be so, but personnel trained in this way are not currently available to the Fisheries Management Division. In any case, the total signal would appear to be the significant one as regards practical applications. It may be noted that this total signal undoubtedly will vary in its individual components in different oceans. Therefore, for an accurate testing of the principle, regional tape recordings of local attraction feeding phenomena should be made and transmitted in fishing trials.

18. Having been provided with several models of the lure from the defunct Elsham Group, by the Inventions Development Authority in late 1974, the Fisheries Management Division attempted additional trials. One difficult aspect of experimentation has always been how to apply suitable controls. A very simple pattern was set up wherein two local boats were chartered to troll for tuna around the southern part of North Island. Each was fitted with a power-boosted Acoustolure. They were to run in parallel courses approximately two miles apart, one with lure on; one with lure off, then alternating. Any differences in catch records would then be analysed for significance. Only a few fish were taken and no conclusive results obtained because of very difficult weather conditions existing during the trials. The division expects to have additional lures power-boosted in time for the beginning of next year's season and to launch bigger and improved experiments with the lure then. The divisional vessel THUNNUS will also be available for liaison work at that time.

19. In summary, acoustolures are not as yet fully proven. The principle appears sound, and some encouraging results obtained. Much more needs to be learned however regarding the conditions under which the device and technique will operate successfully, the responses of the fish, etc. Although its resources are limited, the New Zealand Fisheries Management Division will continue with its experimental programme.

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