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PROGRESS REPORT ON TUNA TRACKING

by

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This is a brief, informal summary of the results from the first year of our tracking research. We have achieved the two goals we set for the first year, namely to: (1) outfit the vessel with all the equipment and modifications necessary for the programme, and (2) begin collecting data. We are very pleased with the data so far obtained and we anticipate a substantial increase in the number of tracks acquired over the remaining year of the project. Our technique involves placing a depth sensitive ultrasonic transmitter on the back of the fish and then tracking it using a directional hydrophone mounted on our fisheries reseach boat.

So far, we have tracked eight fish: six are from around fish aggregation devices (FADs) and two tracks (one of six days duration) are from non-FAD fish that were caught on the 50 fathom curve inshore from the FAD locations. These non-FAD tracks will be used for comparison with FAD-associated fish. Two tracks are from bigeye tuna (_Thunnus obesus_), an increasingly important species for the fresh market, and six tracks are of yellowfin tuna (_T. albacares_). A full report will be available at the end of the project, but some aspects emerging from our data to date are:

1. The effective range of movement of yellowfin and bigeye tuna of 55-75 cm length around FADs appears to be approximately 6 to 10 miles. We tracked one fish that returned to a FAD after making a 13-mile loop (farthest distance from FAD 6.5 miles) over 24 hours (figure 1). On another occasion, a yellowfin tuna tagged at "S" FAD proceeded directly to "V" FAD about 10 miles away. This track shows that (a) the range of influence of a FAD is at least 10 miles, (b) fish can learn the location of two FADs, and (c) these animals have the navigational capabilities to move from one small area to another (figure 2).

2. Yellowfin tuna have "home ranges" that they retain over at least several days. A fish caught on the 50 fathom contour returned to his area every day following nighttime excursions offshore (figure 3). This track also demonstrates that not all tuna in an area associate regularly with FADs because this animal passed by "V" buoy several times without actually visiting it.

3. One track of a yellowfin tuna arriving at a FAD indicates that 85% of the time spent at the FAD was on the up-current side (figure 4). This behaviour raises some fascinating questions with regard to the underlying mechanisms of fish orientation. This type of information may also prove very useful to fishermen regarding the techniques they use to fish around floating objects. We obviously need to replicate these tracks to be more certain of our conclusions.

4. The vertical movement data are particularly interesting. Among other things, it appears that both yellowfin and bigeye have "travelling depths" that they use when moving from one place to another. Daytime travelling depths for yellowfin appear to be at the bottom of the mixed layer (figure 5) whereas bigeye run much deeper. It is interesting to note the very consistent travelling depths (and temperatures) of the bigeye and also the extremely regular upward excursions (figures 6 and 7). These constant "travelling depths" may be of great value to longline and handline fishermen if additional data can be acquired. Both species swim much closer to the surface at night.

We intend to continue to track fish associated with FADs and a more thorough analysis of their movements will be forthcoming. We hope to acquire funding to expand the project in the future to include larger fish and additional species such as skipjack tuna (*Katsuwonus pelamis*) and mahimahi (*Coryphaena hippurus*). In this way, we will determine if the larger (more valuable) yellowfin and bigeye tuna have the same habits as the small/medium fish that we are now tracking and we will also be able to construct a detailed picture of how the several important pelagic species interact, divide the oceanic food resource, and orient around floating objects such as FADs and logs.

This research is being supported by Hawaii Institute of Marine Biology, University of Hawaii; Sea Grant College, University of Hawaii; National Marine Fisheries Service (Honolulu); and the Federation of Japan Tuna Fisheries Co-operative Association.

Footnote: since this report was prepared, a fisherman caught one of our fish carrying a transmitter three weeks after we abandoned it. The fisherman caught the fish trolling, and said that it was healthy and put up a good fight. This anecdote supports our claim that the transmitter does not seriously impair the animal's behaviour.

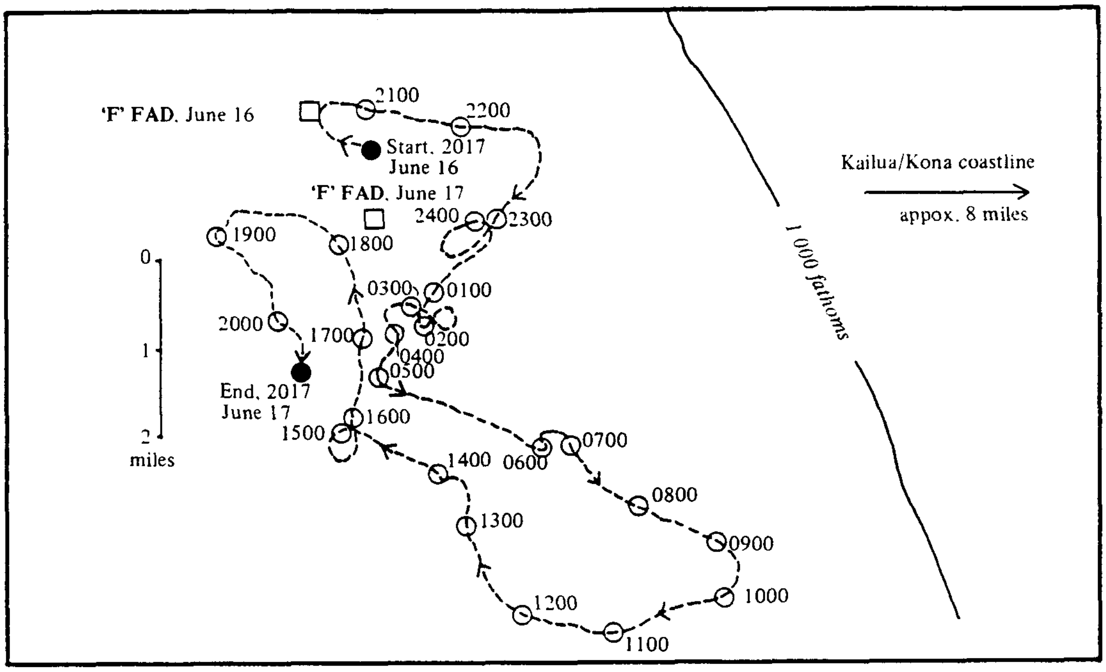

Figure 1: Track of a bigeye tuna returning to FAD 'F' after a 13-mile loop. This animal (57 cm) was caught just after sunset near 'F' buoy and returned to the FAD at dusk the next day. Furthest distance from the buoy was about 6 miles.

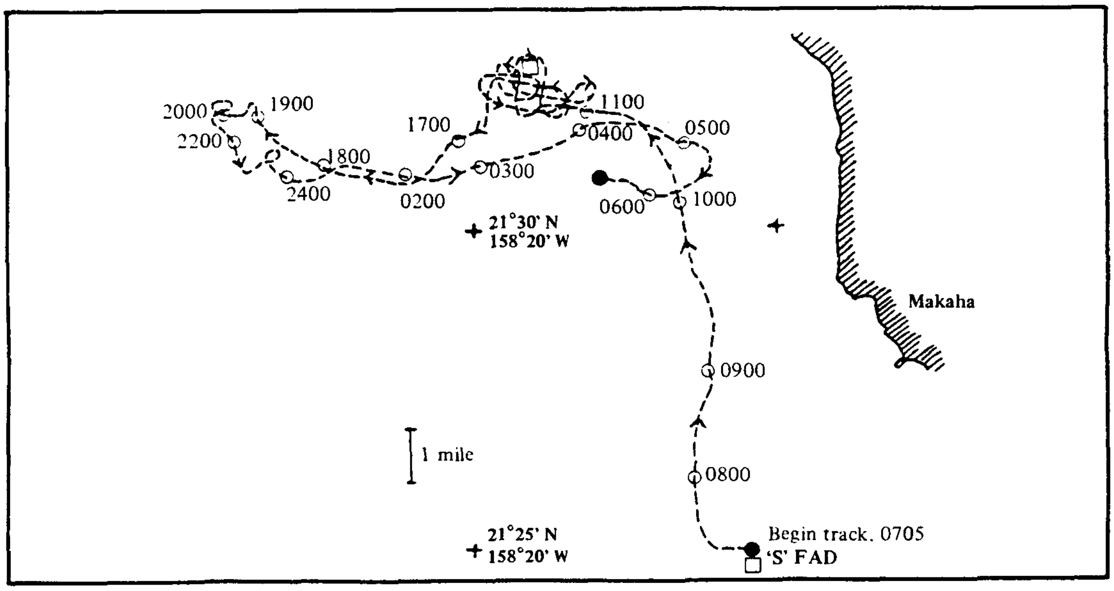

Figure 2: A 55 cm yellowfin tuna caught at 'S' buoy was released after having an ultrasound transmitter placed on its back. The released fish moved in a very direct course to the next nearest FAD 'V' which was located about 9 miles away. After spending several hours near 'V' buoy, the fish moved offshore at night before returning the next morning.

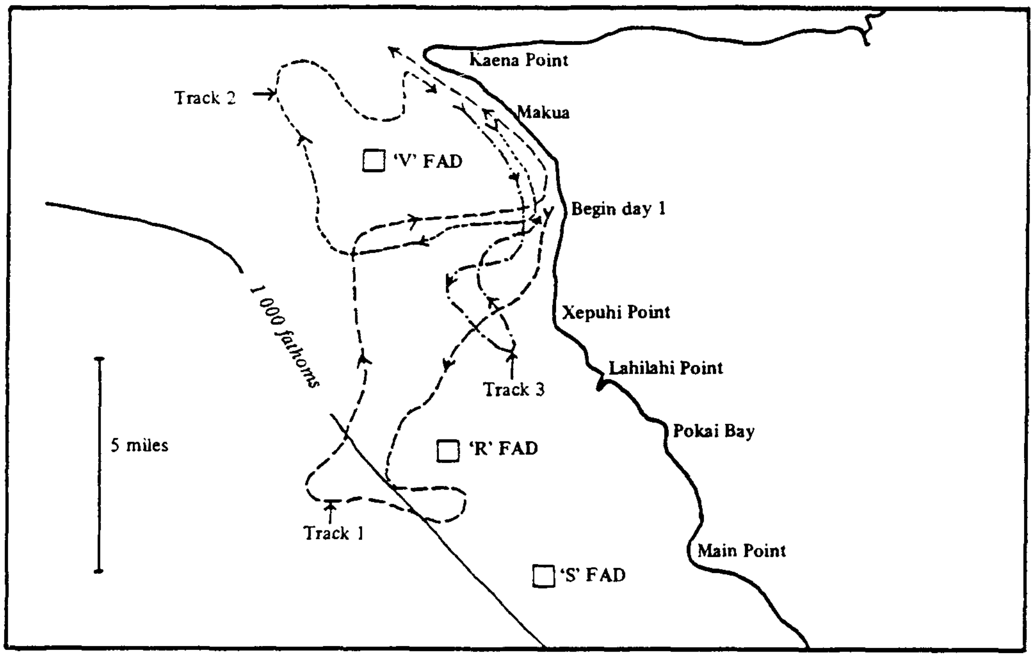

Figure 3: Repetitive movements of a 70 cm yellowfin tuna during a six-day period. Three tracks of approximately 24 hours were made spanning a period of six days. During daylight hours, the fish patrolled the 50 fathom ledge between Kena Point and Makaha and made extensive excursions offshore after sunset. The path of its night-time movements took it beyond the location of the adjacent FADs. FAD 'R' was not on station at the time of these tracks.

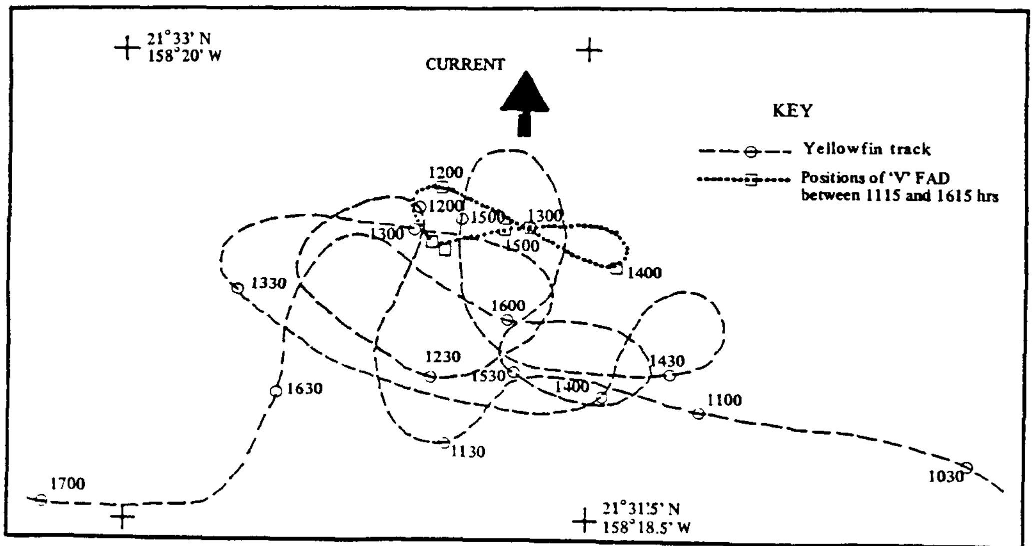

Figure 4: After arriving at FAD 'V', a 55 cm yellowfin tuna spent about 85 per cent of the next 5 hours on the up-current side of the buoy. The movements of the buoy were also recorded using Loran-C and radar data.

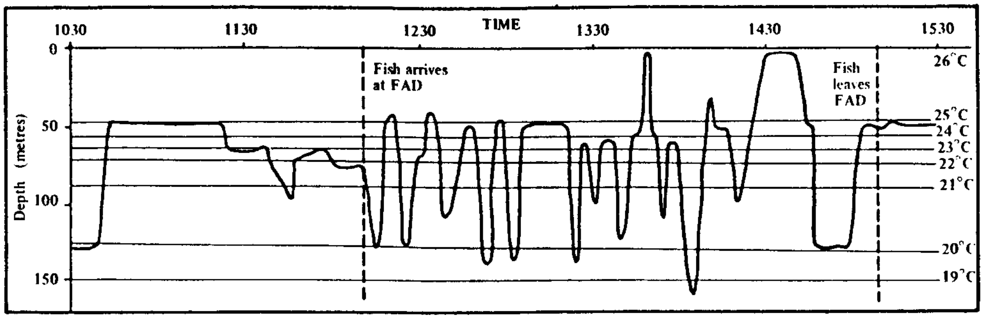

Figure 5: Vertical movements of a yellowfin tuna approaching and staying at a FAD. When moving from one location to another, yellowfin tuna appear to utilise 'travelling depths' at which they spend extended periods of time. A frequently observed travelling depth appears to be the boundary between the bottom of the mixed layer and the top of the thermocline (in this case 25°C at about 50 metres). This fish exhibits a travelling depth while approaching the buoy and then displays quite regular vertical movements when in the immediate vicinity of the FAD. Again, these vertical excursions are frequently limited by the mixed layer boundary and the 20°C isotherm.

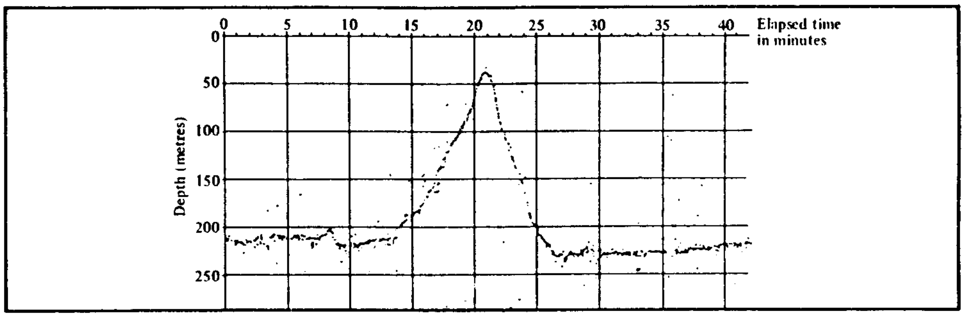

Figure 6: The swimming depth of this 54 cm bigeye tuna was constant around 200 metres during the daytime. However, the fish also displayed dramatic upward excursions which occurred at very regular hourly intervals during daytime. This figure also displays the fine detail our system allows.

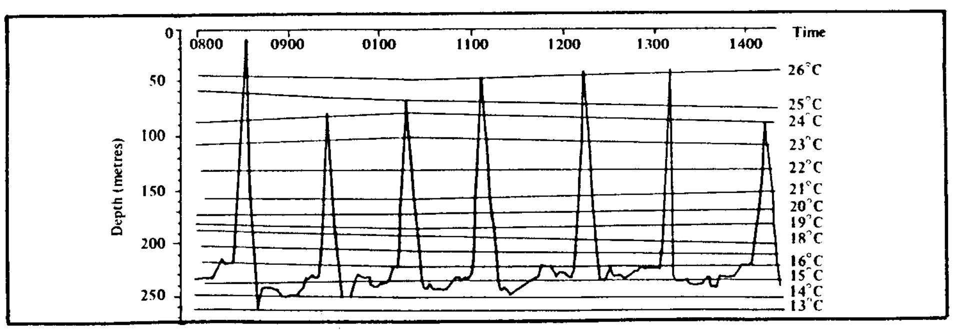

Figure 7: Predominant daytime travelling depth of a 57 cm bigeye tuna. The travelling depth is almost completely restricted to the 14-16°C stratum at 230-250 metres. This plot also shows the very regular upward excursions that seem to be characteristic of this species and size.