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# The conclusion of fieldwork, 1980

The year 1980 was to see the last eight months of fieldwork for the Skipjack Programme. It was an important period for numerous reasons. One was that the remaining countries and territories that had not previously been visited were included in a rather tight schedule. This final cruise also allowed repeat visits to at least some countries. Having some repeat data from the same locations was important for evaluating the variability of skipjack abundance, growth rates and/or behaviour, in time.

We were already aware of the variability across the region of the El Niño–Southern Oscillation (ENSO) – oceanographic events on variability in the distribution of skipjack, but we needed much finer-scale data to help our investigations of variation in skipjack distribution and behaviour within individual countries.

On January 1, the *Hatsutori Maru No. 5* was already in French Polynesia, halfway through a lengthy visit that was jointly funded by the Skipjack Programme and the IATTC. During the total time committed to French Polynesia, the *Hatsutori Maru* took a two-day visit to the Pitcairn Islands. In those two days, 59 skipjack and 290 yellowfin tuna were tagged. The *Hatsutori Maru* then, in turn, visited 17 other countries and territories, namely the Cook Islands, American Samoa, Western Samoa, Niue, Tonga, New Zealand, Norfolk Island (Australia), New Caledonia, Fiji, the Wallis and Futuna Islands, the Solomon Islands, Tuvalu, Kiribati, Nauru, the Federated States of Micronesia and Palau. (The names used for countries and territories are as they were in 1980.)

Completing this ambitious schedule meant that in the last eight months of this final cruise, 65 days were spent travelling between countries and territories. This exceeded, considerably, the amount spent travelling in the full 10 months of cruises in each of the earlier two years: 41 days in 1978 and 47 days in 1979. In the whole of the eight months of the cruise in 1980, only 34 days were spent in port or were lost due to bad weather. On average, less than one day, or part thereof, per week, was spent in port. As in the previous two years, no time at all was lost due to mechanical failure or mismanagement of the vessel's schedule. Both statistics represent confirmation of exceptionally dedicated effort by the vessel's crew and the scientific team.

The only deliberate changes in 1980 to the programme's routine procedures described in earlier reports were in the processing and analysis of data. As the amount of tagging and commercial fishing data inevitably increased, data entry, processing and analysis took up progressively more time than in previous years. Ever since the arrival of the programme's computer, the staff, led by Pierre Kleiber, Sam Bledsoe, Sandy Argue and Clive Maynard, had devised intricate security systems for preventing the accidental or deliberate corruption of data files held on the computer. These systems included the daily creation of magnetic tape copies of the contents of all computer files. A system of storage of these tapes at a secure location outside the SPC, in the safe-storage room at the Australian Consulate in Noumea, prevented the potential loss of data in the event of fire or other serious damage to the computer system.

A total of 49,120 skipjack and other tunas were tagged in the 136 days fishing in 1980. The average of 361 fish tagged per day substantially exceeded the numbers tagged per day in 1978 and 1979 of 244 and 271, respectively. Of considerable interest was that the average number of tuna schools sighted per hour, 0.82, was remarkably similar to that sighted in largely different locations in 1978 (0.83) and 1979 (0.72). This supports the conclusion of a surprisingly uniform distribution of skipjack across the total area of the SPC and over the three years of the Skipjack Programme's fieldwork. This has major implications for the level of confidence that could be placed in the use of tagging data to estimate abundance in the whole area (as discussed in Chapter 19) and for the future management of the distribution of total fishing effort in the region.

Total expenditure of the programme in 1980 was $1,164,547, which was considerably more than in each of the two previous calendar years. The increase was almost entirely due to the higher costs of chartering the bigger research vessel, the *Hatsutori Maru No. 5*, and the timing of when the charter costs were paid. The amount was within the budget. In 1980, the programme's accounts were audited by the New Zealand auditor general, and his approval of the manner in which the accounts were maintained was contained in his report, which was accepted by the Skipjack Programme's Intergovernmental Administrative/Finance Committee at its meeting in Papua New Guinea in October.

One event that occurred in 1980 related to the considerable amount of the programme's work was the evaluation of the stock structure of skipjack. More information on the structuring of schools of skipjack was to come from observation from light aircraft of the behaviour of individual skipjack in large schools. The following six paragraphs are modified slightly from a previously published (Kearney 2022) description of some illuminating observations.

In the summer of 1980, I was tuna spotting from a light plane off the northern tip of the North Island of Aotearoa New Zealand with the country's best fish spotter, Graham Bell. There were five American tuna purse seine boats working the area. Graham was contracted by them to find skipjack schools and direct the boats to the best of them. I was there at the invitation of the New Zealand Ministry of Fisheries as the coordinator of the Skipjack Programme, in which New Zealand had keen interests: firstly, as a supporter and funder of the region-wide programme, and secondly, as a country with its own rapidly expanding skipjack fishery.

The sea was glassy calm; there were lots of skipjack about, and the visibility from our high-wing Cessna was excellent. We had found nine or 10 schools of between 35 and 45 tonnes each. Following Graham's direction, all the boats were at the same time 'in set', about to set their net, or approaching a school that had been agreed by the captain of the boat, on Graham's recommendation, to be a priority target. As all boats were occupied, we had time to have a look around while listening on the radio to the progress of each set, the completion of which would take several hours.

As we circled a school of about 40 tonnes, I saw six or seven skipjack swim out one side of the school heading almost due north. I was most surprised that a small number of fish would just leave a school like this out in the middle of nowhere. Didn't the axiom of safety in numbers for schooling

fish apply to skipjack? Graham and I discussed what we had just seen. He hadn't noted it before. We began a search for similar pods of skipjack. It was only when we looked closely that we realised there were lots of them. We hadn't noticed these small groups before because we had been looking for big schools, not individual fish. We quickly realised that the pods were headed to all points of the compass. We could not detect any pattern or obvious preference in direction. If it had not been such a fabulous day for fish spotting and had there not been more than enough schools to keep all the boats busy, we probably would never have noticed this phenomenon. From different perspectives, we both had a great interest in finding out more about the behaviour of skipjack schools.

We watched one group of eight skipjack swim up to our school from the west. These eight fish swam right into the middle of the school. Seconds later, five swam out the other side on the same trajectory as those that had entered the school. We observed about 10 interactions in the next half hour or so. We kept looking for this phenomenon when we had spare time throughout the afternoon. Sometimes more came out of the schools than had gone in. Sometimes less. Occasionally, none came out. The fact that we could not detect a pattern in the directions they were going or coming intrigued me. As far as we could see, the directions of their movements appeared completely random. But for reasons we did not really understand, we suspected that it was not. To us, it was unexpected behaviour. But it was so common it was clearly not occurring accidentally: there had to be some predetermined purpose to it!

We flew around the general area, and now that we were looking for them, we found small groups of skipjack everywhere. Never individual fish; not even two, but three was not uncommon. Twelve was the maximum we saw in a group. We felt that we could be forgiven for thinking that they must be able to count! The moving pods tended to go in 'gun-barrel' straight lines. They did not even seem to change direction much when a big school of skipjack was nearby. If a school was in their path, they would collide with it and apparently 'test it out'. They did occasionally deviate a little to do so. If, when they were out in the open, their paths crossed with another small pod, they may or may not link up with it.

The big schools remained relatively stationary, with fish moving about within them. Individual schools remained about the same size as the day went on. None was bigger than 45 tonnes or smaller than 35 tonnes at any stage. The degree of movement within schools was difficult to assess, as the

density of similar-sized individuals was high and they were stacked on top of each other to a depth of several fathoms. There were 10,000 to 15,000 fish in a school. The range in the size of the schools, which Graham was proven by purse seine catches to be able to estimate with an accuracy of better than approximately 10 per cent, was such that no two schools could coalesce without exceeding the maximum school size in the area on that day.

What was the reason behind this behaviour by small pods of fish? The obvious suggestion was that individual fish of a different size than the average in the school felt out of place. The need to be with others of their same size compelled them to leave the school. But leaving it on your own was likely too dangerous; pursuit of 'safety in numbers' was assumed to be why fish schooled in the first place! If you felt compelled to leave a school, best to find a few mates of about your size to go with you?

What was the significance of the 45-tonne maximum and 35-tonne minimum school size?

Some quantification of the school restructuring we had observed in New Zealand was provided a few years later. From the results of the recoveries of Skipjack Programme tags, we were able to prove that skipjack schools did indeed restructure throughout the day. One of the programme's scientists, Dr Ray Hilborn, published an estimate of the half-life of a school as almost exactly one day. In layperson's terms, a 40-tonne school of skipjack at the beginning of the day could well be the same size at the end of the day, but only half of the individual fish in it at the end of the day would be the same ones that were there at the beginning of the day.

Preliminary results of much of the work of the Skipjack Programme were presented to the fisheries officers of the region and other interested parties at the Twelfth Regional Technical Meeting on Fisheries in Noumea in November 1980. Presentations on the updated methods and activities were given, and individual documents on the results of the analyses of baitfish catches and effectiveness of that bait, skipjack migrations, growth, blood genetics, parasites, cannibalism and length frequency distributions throughout the region were distributed and discussed. Background documents available at this meeting included the series of preliminary country reports, which by the end of 1980 had been completed for every country and territory in the SPC, plus New Zealand and Australia. These country reports were very popular with the fisheries officers of all countries and territories (see Chapter 15).

The final analyses of the skipjack population assessments could not be completed until at least the great majority of anticipated tag recoveries had been documented and included in the analyses. The meeting was advised that the almost final results of the programme would be presented at the Thirteenth Regional Technical Meeting on Fisheries in Noumea in August 1981. We had set ourselves a very tight deadline, as some tag returns would still be outstanding at that time; however, by the end of 1980, we had seen enough of the incoming tag returns and fishing effort data to be confident that another year would be adequate for the total skipjack population size to be determined within acceptable confidence limits. The last of the final country reports would likely still be outstanding at that time and would be concluded under the Tuna and Billfish Assessment Programme.

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