BAITFISH RESEARCH

IN NEW IRELAND PROVINCE

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INTRODUCTION

The Papua New Guinea skipjack tuna fishery is the sixth largest in the world in terms of tonnes of fish caught. Almost all of these skipjack are taken using the pole-and-line method as described in HARVEST 5(2): 109-118.

The pole-and-line fishery is totally dependant on supplies of live baitfish. Without these, the fishermen cannot encourage the skipjack into the feeding frenzy in which they swim close enough to the boat to be caught easily.

The baitfishery is therefore very important to the tuna industry in Papua New Guinea and so to the country as a whole.

Since the beginning of 1976, the Fisheries Research Section of the D.P.I. Fisheries Division has been carrying out detailed research into the baitfishery. This research has been based at the Fisheries Research Laboratory in Kavieng and has covered two main topics. These are:

1) methods of improving the handling of the baitfish in order to keep them alive for a longer time after capture, and

2) the workings of the fishery and the biology and population dynamics of baitfish in the Ysabel Passage.

The second of these two research programmes is described in this article.

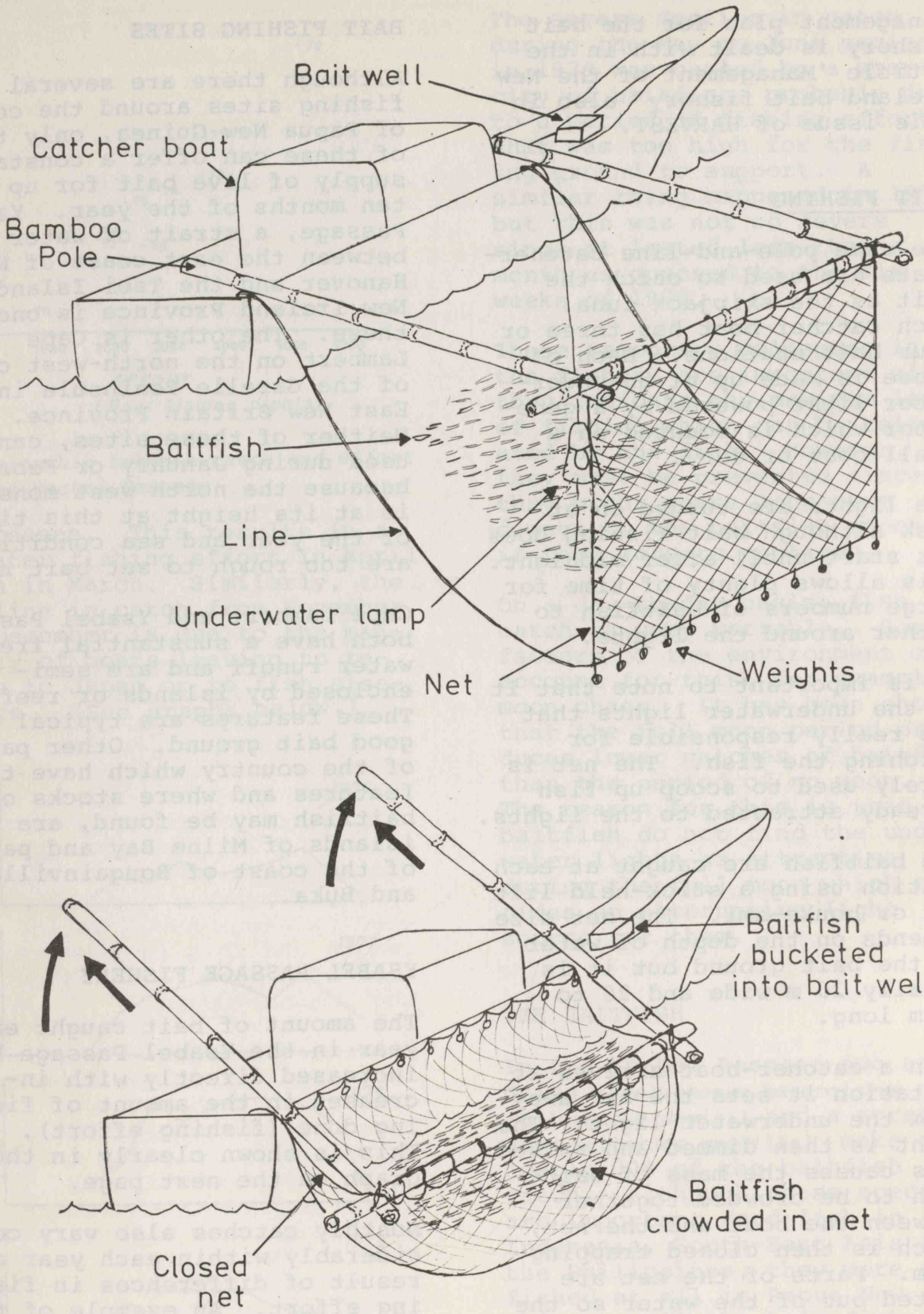
THE PROGRAMME

This research is based on the collection of samples of the bait catch from the Ysabel Passage fishery. Representative samples of fish have been taken from up to three boats every two to ten days (depending on the season) since March 1976. These samples are analysed in the laboratory to find out what species are caught, when they spawn, how quickly they grow, and other necessary information.

At the same time, detailed statistical reports giving information about the catch, the amount of fishing done and the area fished, have been collected from all of the catcher boats. This information is continually being analysed and is used to build up a picture of what is happening on the fishing grounds.

By combining this statistical information with that obtained from the analysis of the catch samples, the way that the fishery affects the size and composition of the baitfish populations can be seen.

Some of the results of the research programme are described in this article. How they have been used to work out a



Diagrams of bait catching method showing the net at the start of fishing (top) and at the end (bottom). The next stage is to lift the fish on board in buckets and put them in the bait well. This is called bucketing.

management plan for the bait fishery is dealt with in the article 'Management of the New Ireland bait fishery' also in this issue of HARVEST.

BAIT FISHING

The same pole-and-line catcher-boats are used to catch the bait as the skipjack tuna. Each catcher-boat has three or four bait stations. Each of these is made up of an under-water light powered by a gene-rator which is mounted on a small boat or dory.

The lights are turned on at dusk although bait fishing does not start until after midnight. This allows plenty of time for large numbers of baitfish to gather around the lights.

It is important to note that it is the underwater lights that are really responsible for catching the fish. The net is merely used to scoop up fish already attracted to the lights.

The baitfish are caught at each station using a stick-held lift net or bouke-ami. The net size depends on the depth of water at the bait ground but it is usually 20 m wide and 20 to 30 m long.

When a catcher-boat arrives at a station it sets the net away from the underwater light. The light is then dimmed and raised. This causes the mass of bait-fish to be crowded together between the boat and the net, which is then closed trapping them. Parts of the net are lifted out of the water so the baitfish become crowded into a very small volume. This makes it easy for the fishermen to transfer them by bucket to the baitwells in the deck of the catcherboat.

BAIT FISHING SITES

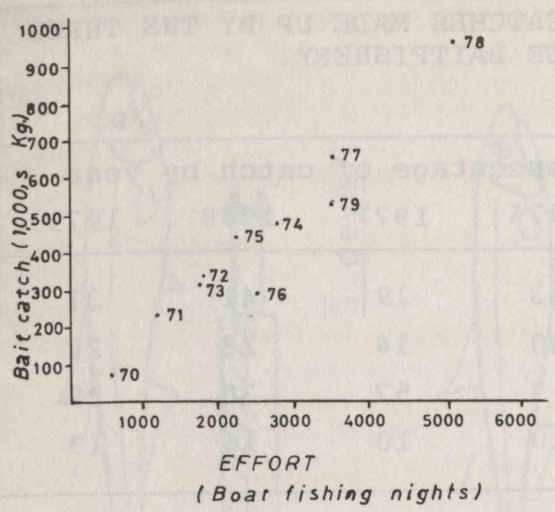
Although there are several bait fishing sites around the coast of Papua New Guinea, only two of these can offer a constant supply of live bait for up to ten months of the year. Ysabel Passage, a strait of water between the east coast of New Hanover and the Tsoi Islands in New Ireland Province is one of these. The other is Cape Lambert on the north-west coast of the Gazelle Peninsula in East New Britain Province. Neither of these sites, can be used during January or February because the north west monsoon is at its height at this time of the year and sea conditions are too rough to set bait nets.

Cape Lambert and Ysabel Passage both have a substantial fresh-water runoff and are semi-enclosed by islands or reef. These features are typical of a good bait ground. Other parts of the country which have these features and where stocks of baitfish may be found, are the islands of Milne Bay and parts of the coast of Bougainville and Buka.

YSABEL PASSAGE FISHERY

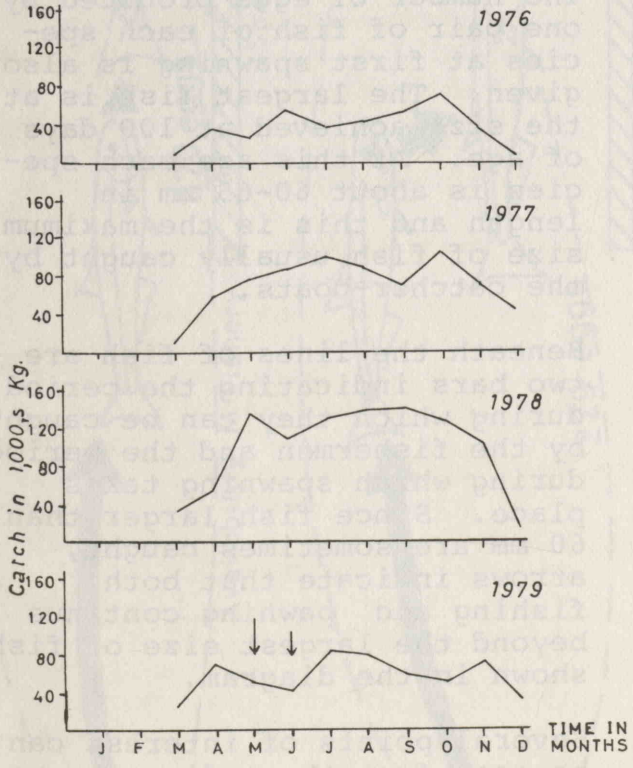
The amount of bait caught each year in the Ysabel Passage has increased directly with in-creases in the amount of fish-ing done (fishing effort). This is shown clearly in the graph on the next page.

Monthly catches also vary con-siderably within each year as a result of differences in fish-ing effort. An example of this is the increase in catch from March to April in each year. During these two months at the start of the fishing season, the number of boats operating in the Ysabel Passage steadily



Relationship between catch and effort in the Ysabel Passage

increases. This results in a greater fishing effort in April than in March. Similarly, the decline in catch from November to December is due to the majority of boats leaving to return to Japan or to fish elsewhere. (See graphs below.)



Bait catch by month for the years 1976-1979 in the Ysabel Passage, New Ireland.

The severe decline in catch during the May to June period in 1979 was caused by a scarcity of baitfish, probably due to a period of fishing effort that was too high for the fishing ground to support. A similar thing happened in 1978 but this was not so severe since it lasted less than a month as opposed to the six weeks of 1979.

These temporary collapses in the fishery are important since they indicate the maximum level of fishing which can be tolerated by the fish. However, they must be prevented since they might cause long-term damage to the baitfish stocks if they were to continue.

On a day-to-day basis, fish catch is very variable. Some factors of the environment can account for this, for example moon phase. It has been shown that the full moon period produces lower catches of baitfish than the period of no moon. The reason for this is that the baitfish do not find the underwater lights as attractive during the full moon which provides an alternative light source for them.

THE BAITFISH

In the Ysabel Passage two anchovies *(Stolephorus heterolobus* and *Stolephorus devisi)* and a sprat-*(Spratelloides gracilis)* make up nearly 90% of the baitfish catch. Although these species are important food fish in Indonesia, South-East Asia and the Philippines, they were not fished at all in Papua New Guinea until the bait fishery started in 1970.

The relative amounts of the different bait species caught varies greatly between boats on

TABLE I. PERCENTAGE OF TOTAL ANNUAL CATCHES MADE UP BY THE THREE DOMINANT SPECIES OF THE YSABEL PASSAGE BAITFISHERY.

Species	Percentage of catch by year			
	1976	1977	1978	1979
S. heterolobus	53	19	41	37
S. devisi	30	14	13	28
S. gracilis	7	57	30	22
Other species	10	10	16	13

the same night. Even the same boat fishing in the same place can expect quite different percentages of the three dominant bait species on following nights. An especially large amount of one of the three dominant baitfish species usually means that a group of fish of that species has just moved into that particular area.

From Table 1 we can see that, together, the two anchovies dominate the fishery, and that *S. heterolobus* is the most common of these. The sprat, *S. gracilis*, does however make a valuable contribution to bait catches and its importance to the success of the Ysabel fishery should not be understated.

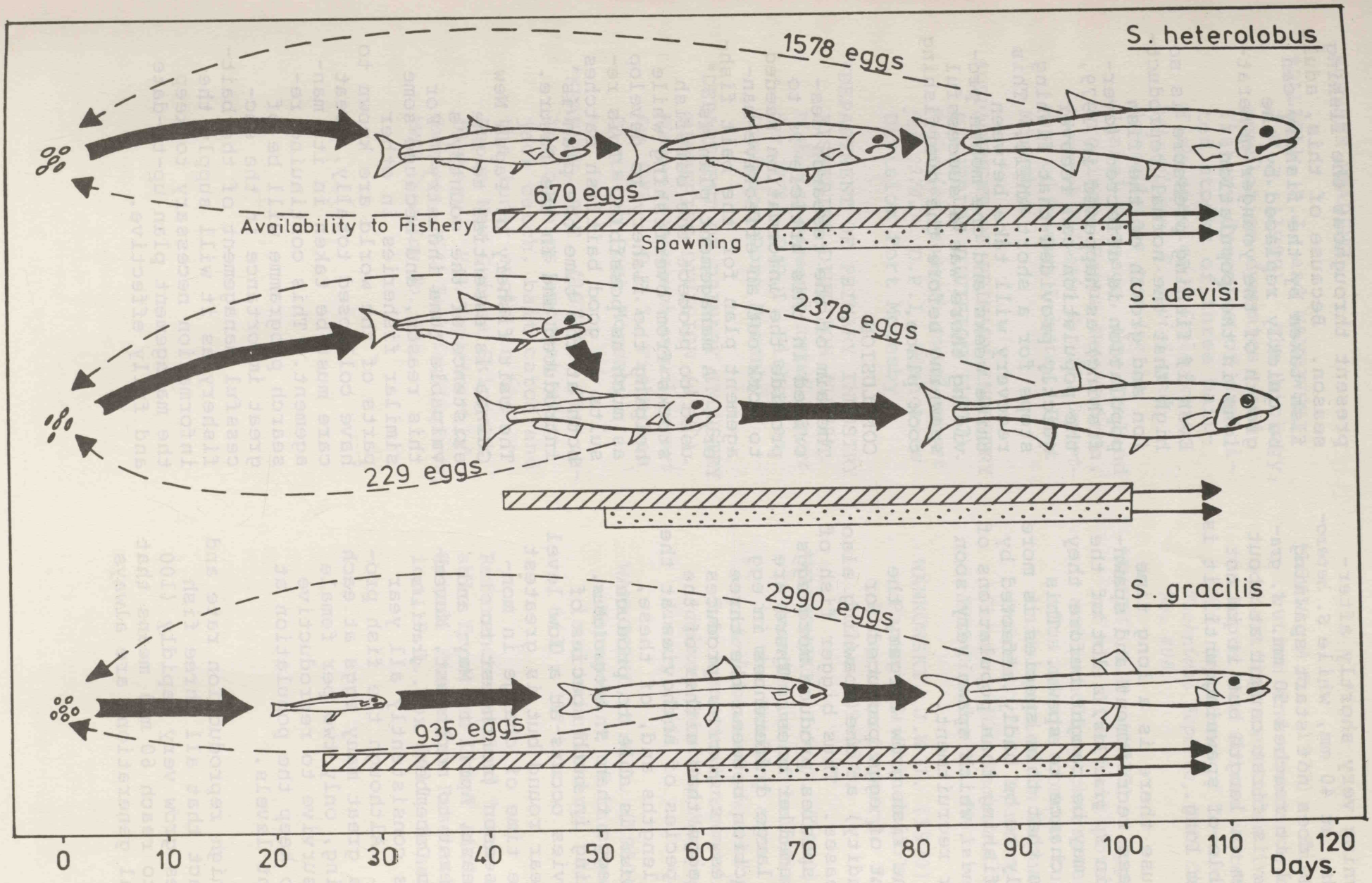
The 'other species' classification includes all the other fish species caught in bait hauls. The number of different fish in this group is very large but only some of them are useful as bait. These include talai *(Herklosicthys punctatus)*, fusiliers (*Caesio* spp.) and mangrove sardine *(Thrissina balaema)*. Large quantities of one or other of these types of fish are occasionally taken in the bait hauls, and they may dominate bait catches in some cases. Generally, however, they are much less common than either of the two anchovies or the sprat.

BIOLOGY AND POPULATION DYNAMICS

The diagrams opposite show the growth of the three dominant bait species from the egg up to one hundred days of age. The first fish in each diagram is shown at the commonest size at which the species is first caught (enters the fishery). The next fish is shown at the size at which it is first capable of spawning (laying eggs). The number of eggs produced by one pair of fish of each species at first spawning is also given. The largest fish is at the size achieved at 100 days of age. At this age each species is about 60-65 mm in length and this is the maximum size of fish usually caught by the catcher-boats.

Beneath the lines of fish are two bars indicating the period during which they can be caught by the fishermen and the period during which spawning takes place. Since fish larger than 60 mm are sometimes caught, arrows indicate that both fishing and spawning continue beyond the largest size of fish shown in the diagram.

Several points of interest can be seen from these diagrams. Both of the anchovies enter the fishery (recruit) at about the same length (37-38 mm). However, *S. devisi* is capable of



The life cycles of the three dominant bait species caught in the Ysabel Passage. The diagram shows how the fish grow over the first 120 days of their life; the age and size at which they are available to the fishery; the age at which they start to spawn and the numbers of eggs produced. The fish are shown life-size in this diagram.

spawning very shortly afterwards, at 40 mm, while *S. heterolobus* does not start spawning until it reaches 50 mm. *S. gracilis* is first caught at about 27 mm in length but it is not capable of spawning until it is 44 mm long.

Because there is a long time between recruitment and spawning in *S. gracilis*, a lot of the fish may be caught before they have chance to spawn. This means that this species is more likely to be badly affected by overfishing than populations of *S. devisi* which spawn very soon after recruitment.

As the fish grow larger, the amount of eggs produced (or fecundity) at one spawning also increases. Thus bigger fish of each species produce more eggs than smaller ones. There are also large differences in egg production between the three species. *S. gracilis* produces more eggs than either of the two species of anchovies at the same lengths and, of these, *S. devisi* is able to produce more eggs than *S. heterolobus*. Spawning in both species of anchovies occurs at a low level all year round but is greatest at the time of change in monsoon season (northwest to southeast, April to May; and southeast to northwest, November to December). *S. gracilis* spawns consistently all year round. Although the fish produce a great many eggs at each spawning, only two per female need survive to reproductive age to keep the population at present levels.

This high reproduction rate and the fact that all three fish species grow very rapidly (100 days to reach 60 mm) means that several generations are always present throughout the fishing season. Because of this, adult fish taken by the fishery can be quickly replaced by the growth of the younger generations in the population.

Even if fishing pressure is so high that the normal reproduction and growth of the fish population is affected (overfishing) as happened in 1979, the population can recover quickly provided that fishing stops for a short while. This recovery will take between three weeks and one month providing there was a successful spawning before the overfishing took place.

CONCLUSION

The aim of the research described in this article is to provide the information needed to work out an effective management plan for the bait fishery. A management plan is used to protect the baitfish stocks from overfishing while helping the fishery to develop as much as possible. This results in good baitfish catches both at the time the plan is introduced and in the future.

The bait fishery of Papua New Guinea is essential to the existence of the country's valuable tuna industry. For this reason, and because some similar fisheries in other parts of the world are known to have collapsed totally, great care must be taken in its management. This continuing research programme will be of great importance in the successful management of the baitfishery as it will supply the information necessary to keep the management plan up-to-date and fully effective.

FURTHER READING

*DALZELL, P.J. and WANKOWSKI, J.W.J. (1980). The biology, population dynamics, and fishery dynamics of exploited stocks of three baitfish species. *Stolephorus heterolobus, S. devisi* and *Spratelloides gracilis* in Ysabel Passage, New Ireland Province, Papua New Guinea. *Research Bulletin No. 22, Department of Primary Industry,* Port Moresby.

*DEPARTMENT OF PRIMARY INDUSTRY FISHERIES DIVISION (1977). *Fisheries research annual report for 1976.* D.P.I. Fisheries Division Port Moresby.

*DEPARTMENT OF PRIMARY INDUSTRY FISHERIES DIVISION (1979). *Fisheries research annual report for 1978.* D.P.I. Fisheries Division Port Moresby.

*DEPARTMENT OF PRIMARY INDUSTRY FISHERIES DIVISION (1980). *Fisheries research annual report for 1979.* D.P.I. Fisheries Division Port Moresby.

*KEARNEY, R.E. (1977). The relationships amongst skipjack catch, bait catch and the lunar cycle in the Papua New Guinea Skipjack fishery. *U.S. Department of Commerce, NOAA Technical Reports, NMFS Circular No. 408.*

*LEWIS, A.D. (1977). Distribution and abundance of baitfish resources in Papua New Guinea waters. *U.S. Department of Commerce, NOAA Technical Reports, NMFS Circular No. 408.*

*SMITH, B.R. (1977). Appraisal of the live-bait potential and handling characteristics of the common tuna bait species in Papua New Guinea. *U.S. Department of Commerce, NOAA Technical Reports, NMFS Circular No. 408.*

WANKOWSKI, J.W.J. (1979). Papua New Guinea pole-and-line tuna fishery. *Harvest* 5(2): 109-118.

*WANKOWSKI, J.W.J. (1980). Management of baitfishing in the Kavieng area. *Background document prepared for the Tuna Resources Management and Advisory Committee Meeting, 24th January, 1980.*

WANKOWSKI, J.W.J. (1980). Management of the New Ireland baitfishery. *Harvest* 6(3): 117-123.

References marked * are available from the Chief Biologist, Kanudi Fisheries Research Station, P.O. Box 2417, Konedobu.