The Catch Sampling Programme, 1966–73

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Fisheries Research Division Information Leaflet No. 7

Published by the New Zealand Ministry of Agriculture
and Fisheries, Wellington.

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1975
Fisheries Research Division information leaflet no. 7 (1975)

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The Fisheries Research Division's catch sampling programme was started in 1966 to monitor trawl catches of snapper (*Chrysophrys auratus*), tarakihi (*Cheilodactylus macropterus*), elephant fish (*Callorhynchus milii*), red gurnard (*Chelidonichthys kumu*), and sand flounder (*Rhombosolea plebeia*).

Principal aims of the programme were to estimate the abundance and mortality rates of major commercial fish stocks. The mortality rate is usually estimated from the age composition of the catch. However, as there were difficulties in ageing the fish (mainly because ageing techniques had not then been developed), length compositions were recorded to indicate changes in mortality rates. Abundance was estimated from catch rates, and additional information, such as species and quantity discarded, was recorded.

These data are now available in a readily accessible form and are incorporated in studies on major commercial species such as small tarakihi movements or variation in the size composition of snapper catches within different localities. In addition, they have been used to provide information on species not yet exploited by New Zealand fishermen, such as squid (especially *Notodarus sloanii*) and horse mackerel (*Trachurus declivis*).

This leaflet describes the main features of the data and points out some of their uses.

The Sampling Scheme

For this programme the New Zealand coast was divided into 21 areas (fig. 1). Each area was visited every second month by a technician, who worked on board a trawler and sampled its catch. With each trawl shot a sample of each of the species of interest was measured. Sex ratios, total catch, and additional data such as depth, duration of tow, weather, and size of the net were recorded.

Research vessels were occasionally used for this sampling whenever commercial fishing boats were not available.

Length Composition

The average length compositions of the five species are shown in fig. 2. The most frequently occurring, or modal length group, for snapper and tarakihi in most years was greater than the legal minimum length of 25 cm. This is because fishermen avoid those grounds where the small fish predominate. Changes in length composition must therefore be interpreted carefully. For example, the slight decline in the modal length of snapper during 1971–73 could be interpreted either as the result of a large incoming year-class or as an increased fishing effort on small snapper. The former reason, which is discussed below, seems to be more likely.

With the exception of elephant fish there are no striking changes in length compositions. Elephant

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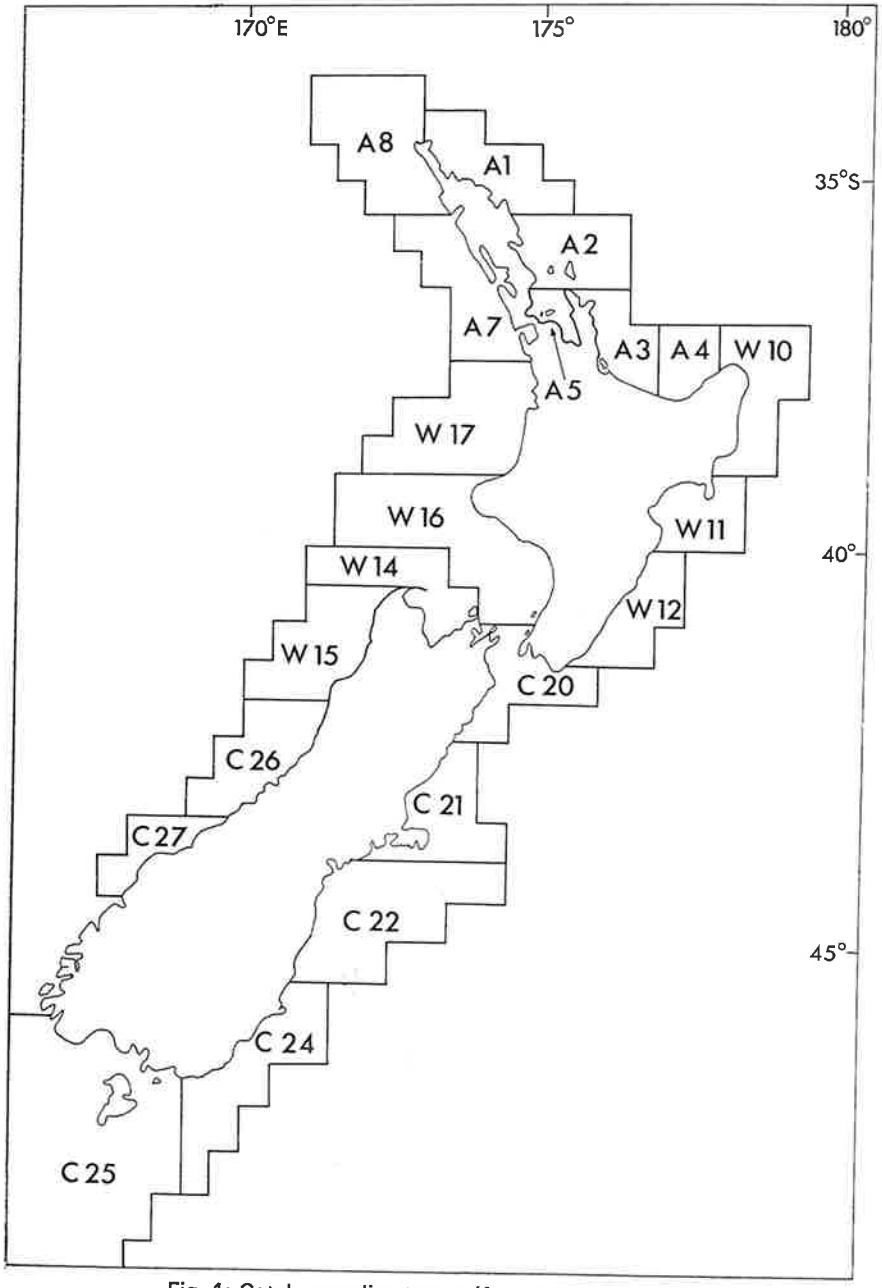

Fig. 1: Catch sampling areas (from 1 January 1968).

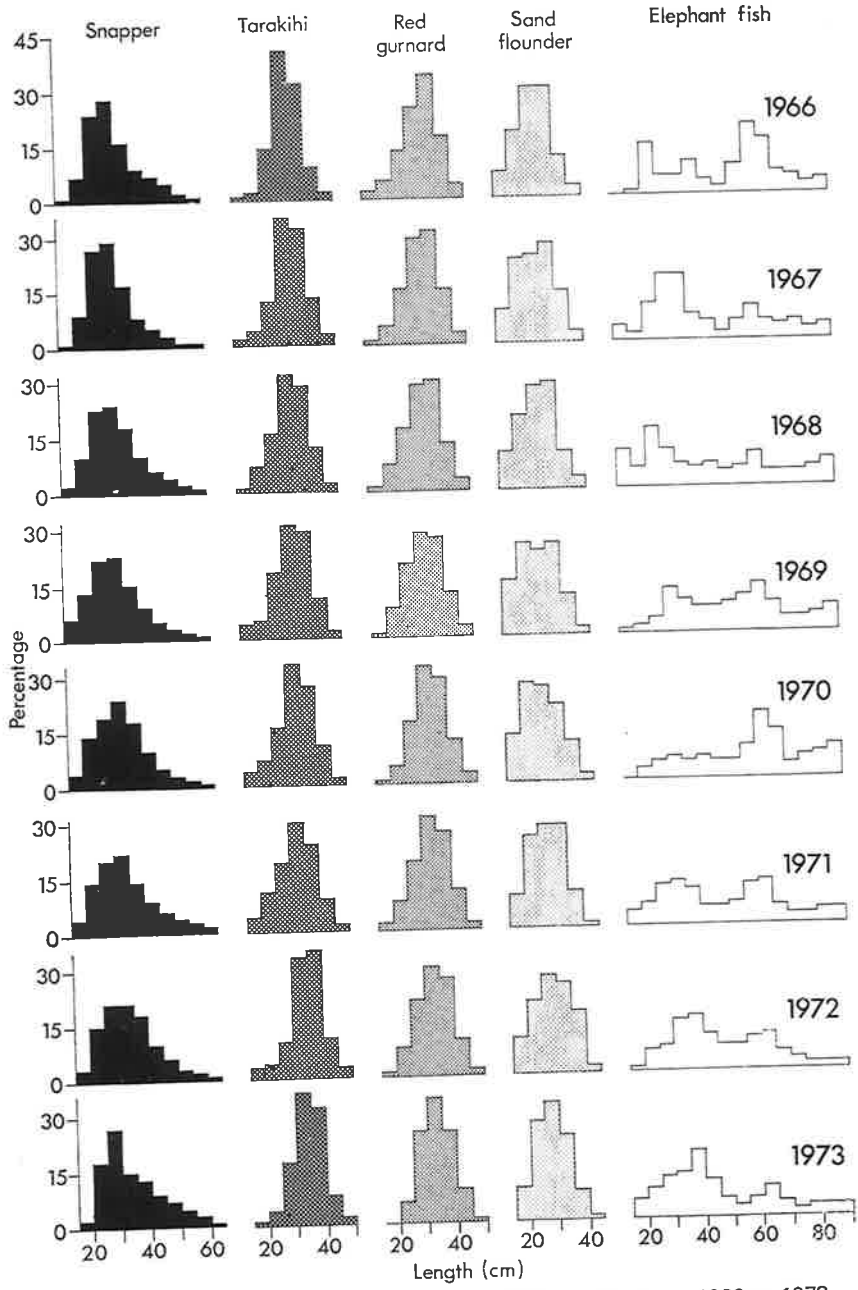

Fig. 2: Average length compositions of the major species from 1966 to 1973.

fish show more variability within the different age groups, as the lengths of these fish do not overlap to the same extent as in the other species. Their length composition is therefore more sensitive to factors such as time of year the fish were caught, different growth rates of the two sexes, and variations in growth rates in different years. Nevertheless, the data do show a shift towards younger fish appearing in catches in recent years, and this results from increased in-shore fishing for elephant fish in winter, when only smaller fish are readily taken.

Fig. 2 shows that on the whole the age compositions of the other species have been fairly stable during the period. However, there is considerable overlap in the ages of fish of a given length, and the length compositions may not have been sufficiently sensitive to show any changes occurring in mortality rates.

The length compositions in fig. 2 include data from all sampling areas in New Zealand and so variation between areas is hidden in the totals. This is illustrated in the following discussion of the two most commercially important species—snapper and tarakihi.

The pattern of snapper size composition is that the smallest fish are in the Hauraki Gulf (area A5) and surrounding areas and that the size of fish increases with distance from the Gulf. This is shown in the following table by the proportion (by numbers*) of fish larger than 50 cm which were caught in areas where snapper was a large part of the catch.

Numbers of Snapper Larger Than 50 cm (Average 1966–73)

Area	Proportion of catch (percent)
W10	9.9
A4	1.6
A3	1.3
A5	0
A2	.4
A1	.5
A8	2.1
A7	7.8
W17	8.5
W16	31.3
W14	41.6

The data support the view that most snapper spawning takes place in the Hauraki Gulf and that the adult fish migrate over a long period. Small fish are not restricted to the north-east of the North Island, though they consistently appear there. For example, the percentage of snapper less than 25 cm in areas A2 and A5 varied between 15 and 33, whereas in area W14 the proportion varied between 0 and 51 percent. The latter suggests sporadic spawning in that area.

Within individual areas there was little variation in length compositions of catches as compared with variation between the areas themselves. However, some changes in size composition were apparent, and the most notable of these was the increase in the proportion of small snapper during the period 1971–73, particularly in areas W16, W14, and W10, as shown in the table on the opposite page.

*Unless otherwise stated, all proportions are in terms of weight of fish.

Numbers of Snapper Smaller Than 25 cm in Areas W16, W14, and W10

Year	Proportion of catch (percent)
1966	0
1967	5
1968	1
1969	3
1970	5
1971	8
1972	25
1973	11

Because this change in size composition was not apparent in the northern areas, where large quantities of small snapper were sought for export, this increase in the number of small fish probably indicates a strong incoming year-class.

The areas from which samples of tarakihi were regularly obtained fall into three groups: East coast, North Island (W10, W12), west coast, South Island (C26, C27), and east coast, South Island (C20, C21, C22, C24). The west coast of the South Island and east coast of the North Island gave fairly stable unimodal size compositions which had similarly shaped graphs but a different average length. The modal group from the west coast of the South Island was 35–40 cm and that from the east coast of the North Island was 30–35 cm. These data did not show any strong or consistent variation that could be attributed to the variation in year-class strength or to changes in mortality.

The tarakihi from the east coast of the South Island were considerably smaller than those from the other two regions, and their length compositions were frequently bimodal and showed large variations for which as yet there is no obvious explanation.

Catch Per Unit of Effort

Catch per unit of fishing effort is often used to measure the abundance of fish. In this study the standard unit of effort is measured from the estimated distance that the net travelled over the bottom after allowing for correction for the boat size. Fig. 3 shows the average catch per unit of effort for each species during the period. Again these data are for the country as a whole, and therefore large local variations are not shown. In contrast to the almost stable length distributions, the catch per unit of effort shows marked fluctuations. For example, snapper abundance almost doubled between 1966 and 1971, but fell to near the 1966 level by 1973. This pattern is typical of the effect of strong year-classes, and fig. 3 shows the probable result of the strong year-classes spawned in the early 1960s.

The overall catch per unit effort for tarakihi showed minor variations between 1966 and 1971 and a more evident decline between 1972 and 1973, which reflects the current decline in tarakihi landings. The data for individual areas show a more consistent decline in areas W10, W12, C26, and C27 (fig. 4), and fluctuations in the other major areas are so large that they obscure any trends. The figures for catch per unit of effort alone do not indicate a cause for the decline in abundance, though stability of the length compositions in the four areas does suggest that the decline was not caused by excessive fishing.

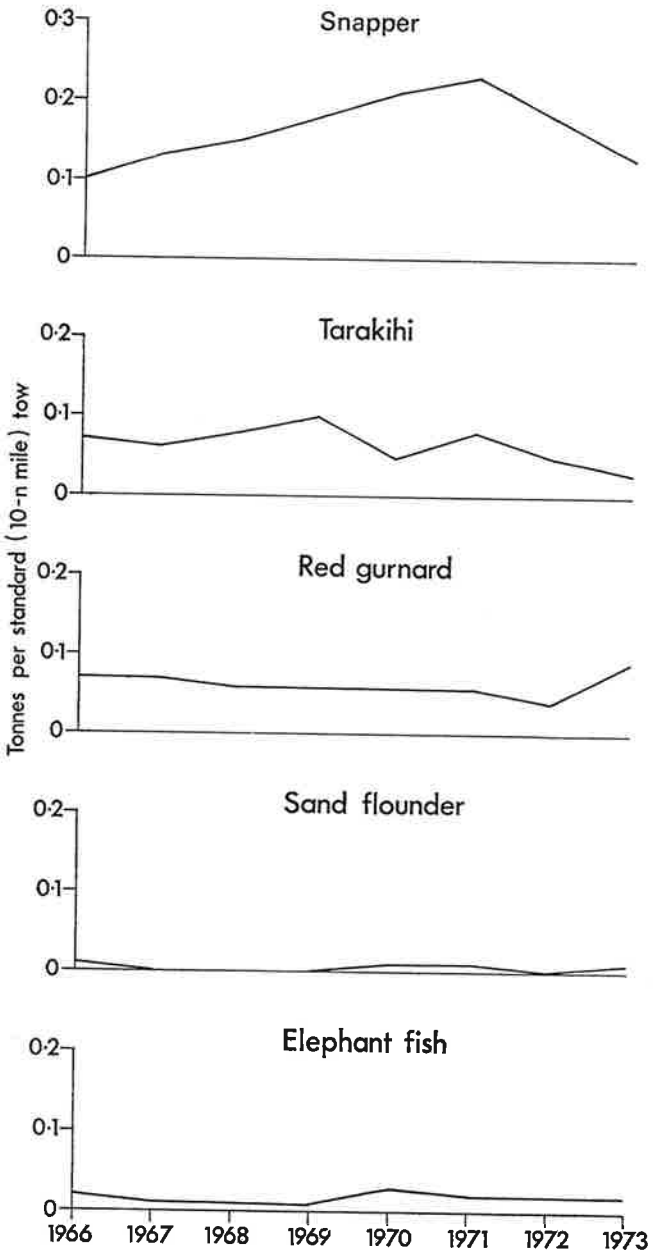

Fig. 3: Average catch per unit of effort between 1966 and 1973.

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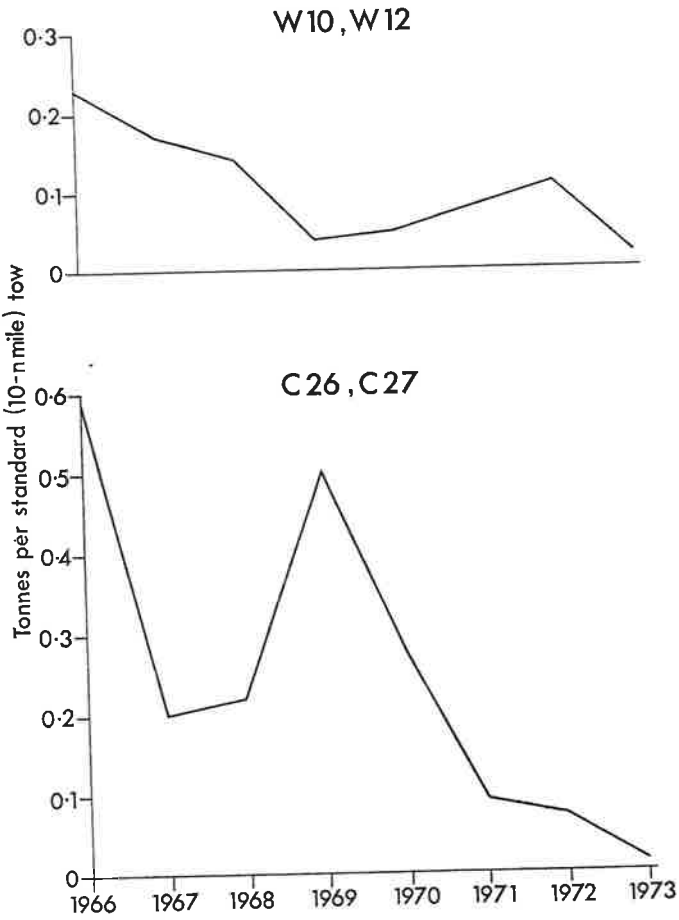

Fig. 4: Tarakihi catch per unit of effort for east coast, North Island (W10, W12), and west coast, South Island (C26, C27), between 1966 and 1973.

The catch per unit of effort for red gurnard, elephant fish, and sand flounder fluctuated without any apparent major trends. This suggests that there have not been any serious changes in red gurnard and sand flounder populations. (Fluctuations in the yields of the latter species have been discussed in Fisheries Research Division Information Leaflet No. 5.) Because of the change in the age composition of elephant fish catches in recent years the lack of trend in catch per unit of effort data cannot be taken as an assurance of stability in this species and changes in its abundance can be expected in future.

Fish Discarded at Sea

The average percentage of each species discarded at sea between 1966 and 1973 was: Snapper 3, tarakihi 3, sand flounder 2, gurnard 5, elephant fish 9, and all species 13.

The average discard rates for snapper, tarakihi, sand flounder, and red gurnard were fairly low. However, as most of the discards were small fish, even a low rate can represent a large number of fish. For example, between the years 1966 and 1973, 15 percent (by numbers) of the snapper caught were smaller than the legal minimum size and therefore became the bulk of the discards.

Discards were mainly from areas A1, A2, A3, A4, and A5, all of which are the major fishing areas for snapper.

Tarakihi showed a different pattern, with very few discards from W10, the most heavily exploited area. However, they were discarded more regularly from the east coast of the South Island, as well as from area W14. The latter includes a known nursery area from which more than 60 percent of the fish taken in 1970, 1971, and 1972 were discarded. This pattern is consistent with the length differences between the areas discussed previously.

Discard rates for elephant fish were variable compared with those for the other major commercial species, and because of increasing exploitation of immature elephant fish, large quantities (nearly 30 percent in 1973) which were too small to market have been discarded.

The discard rate of all species was contributed to mainly by species which were unmarketable at the time. The variety of species in this category was large, the two most important being spiny dogfish (mostly *Squalus acanthias*) and barracouta (*Thyrsites atun*). Together they accounted for about 25 percent of all rejects between 1966 and 1972.

These species, particularly the latter, are being processed in increasing quantities, and by 1973 they had formed only 9 percent of all discards for the country. However, there is still considerable variation in the wastage between areas, depending on local consumer resistance to particular species and the availability of processing facilities. For this reason discards were much higher on the east coast of the South Island, and between 1970 and 1973 just over 50 percent of the fish caught by trawling in areas C22 and C24 were discarded. Discard rates in neighbouring areas were not as high as this, but they were still above the average rate.

Conclusions

The main problem with interpretation of the catch sampling data is that length is not an adequate measure of age for long-lived New Zealand species, and length compositions have not proved to be sensitive enough indicators of changes in mortality rates. Moreover, the logistic problems of sending technicians to sea limit the number of boats sampled to one or sometimes two in each area. This in turn restricts the representativeness of the sample. Nevertheless, there is sufficient information from the

programme to allow for some generalisations about the state of some of our major commercial stocks.

The data for snapper, red gurnard, and sand flounder show fluctuations in abundance, though the lack of a consistent trend in either the catch per unit of effort or the change in size composition indicates that stocks of these species are fairly stable. In some areas the catch per unit of effort for tarakihi is declining though the length-frequency data do not suggest this is the result of excessive fishing.

Elephant fish are of more serious concern. Though the catch sampling catch per unit of effort data do not yet show a diminishing abundance, stocks are likely to decline unless the increased exploitation of small fish is checked. Recently the regulations concerning this species were amended to provide a minimum catch size of about 51 cm, but it remains to be seen whether this will stabilise the fishery.

Future Monitoring of the Stock

The new fishing return system, which was introduced last year, will provide the data on fishing effort and discards, and it is therefore not necessary to continue collecting this information in the sampling programme. This new system has made it possible for more effort to be used in collecting information on age structure of stocks, which are of primary importance in estimating mortalities.

Instead of measuring lengths, which indicate the age only approximately, the fish will be directly aged by the studying of zones in their ear bones or otoliths. As it is more convenient to remove the otoliths when on shore, in future, sampling will be done in fish sheds rather than on the fishing boats. Sampling ashore will have the added advantage of enabling data from several boats in each port to be accumulated and thus of ensuring a more representative sample.

Acknowledgment

Sincere thanks are expressed to all those skippers and crews who made the catch sampling programme possible by permitting sampling technicians to accompany them on their boats.

A. R. SHEARER, GOVERNMENT PRINTER, WELLINGTON, NEW ZEALAND—1975
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Fisheries Research Division information leaflet no. 7 (1975)