Factors in the Control of a Sea Fishery

R. M. Cassie

The fundamental equation for the balance between incomings and outgoings of fish stocks in a fishery was first expressed by E. S. Russell in 1930: "stock this year *equals* stock last year *plus* growth during year *plus* recruitment of young fish during year *minus* natural mortality during year *minus* fish caught during year." The last, the fish caught, is the only one of these variables known to us from the start. The others must be determined by sampling.

The principal sampling tool in the hands of the biologist is the same gear used by the commercial fisherman—notably the trawl and other types of net. This gives the basic data required—the size frequency diagram—*provided* always that we are right in assuming that the sample is a representative one. This is often far from certain. Many other techniques may be used for checking and inter-relating the estimates but the commercial fishing gear still always supplies the fundamentals.

Usually the data are so complex that there is great difficulty in co-ordinating them into a convincing picture. Even when an apparently satisfactory result has been obtained it is by no means certain that the control measure deduced from it will "work". Even if it does work it may work for the wrong reason. Some of this uncertainty may be due to large-scale natural fluctuations in stocks, but another factor, so far practically unknown, is suggested. I will call it "*non-catchability*". This is a character which could conceivably be acquired by the fish, or, if already present, could be intensified in the population by natural selection. The effect could be a profound one on the fishing industry. Non-catchability could not be detected by present sampling methods as its effect on the sample would be identical with that of "depletion" or "fishing out". The immediate solution applied by the fisherman would also be the same—more efficient and intensive fishing, though the long-term result would be quite different.

Two approaches to the problem of detecting and evaluating non-catchability are suggested. The first involves the use of entirely new and highly effective methods of sampling such as explosives, poisons, electrical fishing or underwater detection by sonar, photography or television. The second is to set up a model fishery in an aquarium using a small, rapidly reproducing fish such as *Gambusia*.

DISCUSSION

MR. ALLEN said that Mr. Cassie had mentioned a point of major importance. During the last 20-30 years fisheries have developed a number of definite concepts with reference to estimating populations. This has been done entirely on the assumption that the whole of your population was catchable. Once you could accept the possibility of non-catchability by the methods that you are using not only for commercial fishing, but also for estimating populations, the whole problem becomes doubly difficult. There is tremendous need for a new means of approach. In Canada there had been a report on the use of underwater television. The spawning of fish in the Great Lakes in Canada had been described by television. Workers have actually seen the eggs lying among the stones in 100 ft. of water. This is a new tool of tremendous value.

DR. R. G. EVERSON asked a question about the similarity of fisheries and farming, and asked for information about the controlled fish farming which had been initiated by UNESCO in Indonesia, etc. Mr. Cassie said this was more freshwater fishery. The concept of farming as done in enclosed areas of water is rather different from farming the sea. It could produce quite useful information on the cycle of the utilisation of minerals, etc. The main point is that you can put fertiliser into your pond, as on to your land. This will improve your yield from the water. Probably the utilization in water is not so efficient as it is in land. But it is not a paying proposition for sea fisheries.

G. A. KNOX spoke on the economic aspect of the control of fisheries. It was a question of supply and demand. He quoted an investigation which had showed a series of long-term fluctuations in population. No fishery yet has ever been depleted by over-fishing. The prime controlling factor in fisheries is an economic one—supply and demand. When the fishery falls below a certain catch, it is uneconomic to go on fishing, and the fishermen stop fishing.

PROF. V. J. CHAPMAN: Is this question of the character of non-catchabiilty tied up with their possibly getting caught during their first year, or before they are big enough to be kept?

MR. CASSIE: From the point of view of the trawler at any rate, non-catchability is not developed by being caught and being thrown back. They are as good as dead when they are caught. Even if thrown back they do not survive. Fish can see a trawl coming, and see a hook on a line. Some fish are more intelligent than others, and have a better instinctive reaction, simply by being alert to a trawl coming through the water near them. Many more fish swim away than are ever caught.

MISS L. B. MOORE said that Mr. Cassie's slide of the "vacuum-cleaner" fishing device had reminded her of the intake pump in use at Lake Grasmere salt works near Blenheim. This pumped in a considerable amount of sea water, and many other things as well. She wondered whether any modern biologist had thought of using it.

DR. R. M. WILLIAMS asked whether Mr. Cassie had been assuming a stationary population.

MR. CASSIE said he had assumed that it was a stationary population. He had smoothed all natural fluctuations, mortality and so on, so that it was a stationary population.

The Occurrence of Fungal Associations in New Zealand Soils

P. J. Culliford

Within the soil, mould fungi occur as spores and as actively growing mycelium. By plating on nutrient agar identifiable colonies are produced from these true soil organisms, both active and inactive, and also from spores present as chance inclusions from the air. Furthermore, the species so isolated are not the full complement since slow-growing fungi are swamped by others more suited by the culture media. Keeping these facts in mind the species lists secured by plating techniques may be reviewed to see if they provide any evidence that fungi form stable associations in the soil.

Three kinds of tests were applied.

a. Do similar habitats produce similar aggregations of species? The similar habitats chosen were the litter mounds characteristic of rimu (*Dacrydium cupressinum*). Such mounds, each derived largely from the litter of a single tree, display the same pH pattern throughout the profile and yield similar results from organic analysis by Waksman's method of proximate analysis of organic matter. Six litter mounds were studied, at Silverstream, Hunterville, Moawhango, Raurimu, Tokaanu, and Mt. Egmont. Of 37 species of mould fungi isolated eleven appeared to be typically present in rimu litter, the rest being only sporadic. Of the eleven constant species eight belonged to the genus *Penicillium* and one each to *Mucor, Fusarium* and *Trichoderma.* These organisms appear frequently in New Zealand soil, but have not previously been recorded all together. In contrast an adjacent site under beech (*Nothofagus truncata*) at Silverstream provided as dominants a *Trichoderma,* a *Cladosporium* and a different *Penicillium.*

b. Does the same habitat, if it remains unchanged otherwise, yield a similar list of species after a lapse of time?

An initial isolation from field samples from Himatangi sand yielded seventeen species amongst which *Penicillium* (2 spp.), *Stenophyllum, Geomyces,* and *Fusarium* (one sp. each) were numerically dominant. Twelve months later, from an adjacent spot, the same species were obtained in abundance, while two other species had increased in numbers. This flora seemed to have remained fairly stable over this period of time.

c. Does a change in the habitat produce a change in the species content?

Using Himatangi sand, as in the previous test, copper sulphate was applied at rates equivalent to 5 lb. and 25 lb. per acre, the samples and controls being incubated at 22° C. and kept at a constant moisture level for the experimental period of 96 days. The lighter application which about doubles the amount of copper in the soil was regarded as a rather slight change, the heavier dressing as a major change. After the initial period of disturbance due to addition of copper sulphate and transportation and mixing of the soil, the environment remained constant under each treatment. The 5 lb. treatment showed the same general pattern as the control though *Penicillium decumbens* had given way to *P. chrysogenum* as the dominant and some copper-tolerant species had increased in frequency. With more copper about two-thirds of the species disappeared and of the four principal species left two were *Penicillium* species well-known for their ability to