

other factors alone are not usually competent to arrest increase of population earlier. The general conclusion is reached that populations of trout in New Zealand waters commonly produce more eggs than are necessary to effect the maintenance of the stock at the same numerical strength and destroy by superimposition of spawning-redds the excess over what are required for such maintenance.

It follows that, where this is so, reduction (within limits) of a population increases the average efficiency of reproductive units. Conversely, increase of population by means other than artificial extension of spawning-areas will decrease the average efficiency of spawning. It also follows, as a point of importance in connection with practical policies, that attention should be given to the protection of stream-beds capable of providing spawning-places for trout from the effects of pollution and from deterioration caused by other preventable agencies. Those in control of trout waters, many of which are good in every respect save for deficiency of spawning-ground, might also very well make tentative efforts towards the artificial provision of stream-bed suitable for the nesting operations of trout. Study of fisheries bulletins should give one a sufficient understanding of fundamental principles to afford a basis for at least some promising experiments.

Mr. K. R. Allen's work has been devoted to the investigation of a trout population from another important aspect, and during the past year he has made good progress with the programme outlined in last year's report. This has as its object an attempt to gather information concerning the relationship between the food-supply in a stream and the quantity of trout which it supports. For this purpose it was necessary to concentrate the work on some small stream with a good stock of trout situated reasonably close to the laboratory in Wellington. The Horokiwi Stream flowing into Porirua Harbour has been selected as suitable in most respects for the work planned.

In order to determine the quantity of food present in the stream it is necessary to measure the area of each type of water (pool, rapid, &c.) and to find out the average number of each of the principal animals per square foot in each of them. In this way the total number of each animal in this whole stream can be estimated approximately. The greater part of that portion of the system which carries trout has been surveyed during the year; this comprises approximately 8 miles of stream covering over 10½ acres. Quantitative collections of the fauna are also being made in various parts of the stream at regular intervals throughout the year. It appears that the average number of animals to the square foot is approximately 290, and thus there are very roughly 14,000,000 animals in the part of the stream so far surveyed. A proportion of these animals (possibly about 10 per cent.) belong to types which are rarely or never eaten by trout.

It is also necessary for the purpose of this work to know the life-history of the typical fish of the Horokiwi and find out what quantity and kind of food they eat at different stages of their life and to what extent they move about the stream or out to the sea. In order to do this the fish which hatched in the spring of the past year are being followed throughout their life. It has been found that in this stream the fish grow remarkably fast during their first year, and at the end of March, when five months old, are about 5 in. in length. The food of the trout in the Horokiwi shows very little change during the first year, and is composed very largely of mayfly nymphs of the genera *Deleatidium* and *Atalophlebia*; these together usually make up 80 per cent. to 90 per cent. of the food. In addition to these principal lines of investigation, data are also being obtained concerning the spawning habits of the trout in the Horokiwi, and the number and size of fish caught by anglers there. A start has also been made with a programme of tagging trout in order to obtain further information concerning the migration and rate of growth of the fish.

In January, 1940, a visit was made by Mr. Allen to the Waiau River system in Southland in order to observe the Atlantic salmon there and obtain data concerning the distribution of the immature stages of these fish. It was found that at the time of the visit salmon in their first year were abundant in the lower part of the Upukerora River and occurred in smaller numbers in the upper part of this and the Eglinton River. Second-year salmon were also found in small numbers in the upper parts of the river.

At the request of local acclimatization societies Mr. Hobbs made an examination of waters in the Palmerston North - Marton area, of the Wellington District, and in portions of the Waimarino District. A brief survey of streams in the Tongariro National Park was made for the Tourist Department. The North Canterbury, Waitaki, Otago, and South acclimatization districts were also visited.

Sea Fisheries.

The Marine Biologist, Mr. A. M. Rapson, has completed a report which is now in the press, for publication as Fisheries Bulletin No. 7, on "The Growth, Reproduction, and Distribution of the Lemon Sole in Tasman Bay and Marlborough Sounds." This is based on observations made and material collected from fishing-boats in recent years which constitute a portion of the whole data collected with regard to the distribution and spawning of the flat fish of these areas. Mr. Rapson used a tow-net of 3 ft. diameter, with a hinged ring of his own design for its mouth, for the collection of planktonic eggs. The eggs and larvae of the lemon sole have been described as to their specific characters, the stages of larval development have been worked out, and the location of spawning-grounds has been determined. Measurements of lemon soles in commercial catches were made, and from consideration of length-frequencies the local character of stocks and their movements throughout the year were elucidated. An estimate of growth-rate has been made from the examination of otoliths (ear-bones), which shows that the species first appears in commercial hauls at the age of two years when males have reached an average length of 23 cm. (9 in.) and females 25 cm. (9·8 in.). At this age these fish become mature. By the analysis of length-frequency data from commercial catches in Danish-seine vessels it was found that the percentage of fish under 23 cm. in length decreased from 6·1 to 1·3 after the minimum legal size of the mesh of the cod end of the net had been increased from 4½ in. to 5 in.