Stomach Contents of Spawning Quinnat Salmon

QUINNAT salmon (*Oncorhynchus tschawytscha*) normally spend up to a year after hatching in fresh water before migrating to sea as smolt. They stay at sea until mature, in three to four years time, then they usually cease feeding and migrate up the rivers to their spawning grounds. Quinnat salmon are reported to spawn once only, dying without feeding again after spawning.

On May 5, 1957, I assisted in the examination of some spawning quinnat salmon in the Harrison Bight Stream, a tributary of Lake Heron, New Zealand. L. Heron contains 'landlocked' quinnat salmon, but is also accessible to sea-run fish. Forty-three fish were examined, of which only four had anything in their stomachs. Of these four, one had some of the aquatic plant, *Potamogeton*, in its fore-stomach and the other three had each a young quinnat salmon.

The three which contained fish were spent dead males of $9\frac{1}{2}$, 10 and $10\frac{3}{4}$ lb. weight. The lengths of the young quinnat salmon after preservation in formalin were 5·3, 6·3 and 6·9 in. These young fish were all males with hypertrophied testes, as shown in Fig. 1. There was little sign of digestion; two were slightly decomposed or digested in the head region, otherwise the skins were intact.

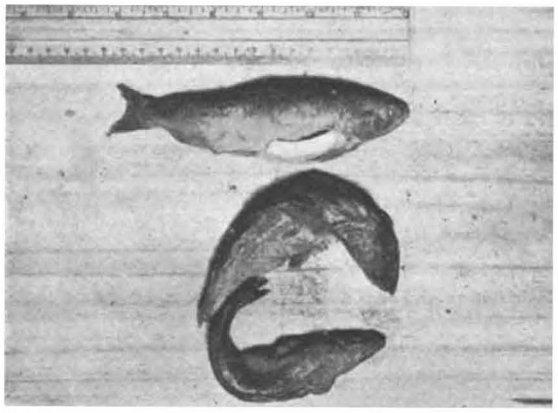

Fig. 1. Young quinnat salmon taken from stomachs of spawning quinnat salmon. Body-wall of top fish removed to show hypertrophied testes

One of the young quinnat salmon contained ten quinnat salmon eggs in its stomach, the others contained insect remains.

Dominance and hierarchy formation have been observed in groups of most salmonids[1]. Movements involved in feeding and in aggressive nipping by quinnat salmon are almost identical[2]. Also it is known that vigorous chasing between quinnat salmon occurs on the spawning redds. Hence, it is suggested that the young quinnat salmon were swallowed while being chased away from the redds by the larger fish.

The fact that the young fish appeared to have been feeding normally suggests that fasting and sexual maturity are not necessarily concomitant in male quinnat salmon.

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[1] Stringer, G. E., and Hoar, W. S., *Canad. J. Zool.*, **33**, 148 (1955).
[2] Bullivant, J. S., thesis, University of Canterbury, N.Z. (1958).

Local Races in Lugworms (*Arenicola marina* (L.))

THE spawning of *Arenicola marina* (L.) on the shores of the British Isles occurs during the last three months of the year, but within these limits there are striking variations of spawning time from place to place. Each local population of lugworms appears to have a characteristic spawning period which occurs at much the same time every year (Duncan, *Proc. Zool. Soc.*, in the press). The differences in the dates of spawning may indicate a tendency towards genetic variation between different populations; they would also encourage such differentiation. There are, of course, environmental differences between beaches which may influence the time of spawning, but it is difficult in this way both to account for the observed similarity of the spawning periods of lugworms at Dale Fort, Wales, and Whitstable, Kent, and for the fortnight's difference in the spawning of worms living as close together as Port St. Mary and Derbyhaven in the Isle of Man.

Lugworms are sedentary animals which spend most of their lives in their burrows. They are capable of swimming, and previous records of lugworms seen or caught in the sea[1] or of beaches emptied of lugworms being re-populated in a short time[2,3] suggest that they carry out migrations, particularly in winter[4], away from the colder, higher-lying parts of the beach and in the spring[5] which may be a dispersal movement. Such journeys are likely to be confined to their own or adjacent beaches unless there are strong tidal currents along the coast flowing close inshore. The fertilized egg sinks in sea water and the larva lives on the surface of the sand attached to sand grains; there are therefore no special provisions for widespread dispersal. Lugworms are not restricted to the littoral, but how far seawards they extend is not known. Often a change from sandy to rocky terrain limits the seaward distribution, but where a sandy bottom links two apparently separated sandy shores, it is possible that a sub-littoral stock may connect the two populations, and it appears likely that the lugworms of the British Isles exist in many nearly isolated populations, with only slight possibilities of interbreeding. Such a situation is clearly conducive to producing differentiated local races. It may therefore be of interest to note the following differences between populations, in characters other than spawning period, which were observed in the course of my work.

The mean sizes of the spawning adults from different populations are given in Table 1 and show a very wide range, that for Llanfairfechan being eight times greater than that for Cullercoats. The spawning samples also showed considerable differences in their colour (Table 1). Apart from a tendency to darken with increase in size and age, the causes of these colour differences, whether environmental, physiological or genetical, are not known. There is a very small difference in the size of ripe cœlomic germ cells from lugworms of different localities (Table 1). The difference appears to be a real one, particularly for the oocytes (90 per cent of the healthy oocytes from ripe females from Port St. Mary were 170μ in diameter and only 5 per cent either 180μ or 190μ). There is no correlation between the mean size of the worms and the size their germ cells usually attain, as one would expect to find if availability of food in different beaches was a determining factor. There appear to be differences in the age and size at which *Arenicola*