

Drizzle Lake E.R.52

Drizzle Lake

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ECOLOGICAL RESERVES COLLECTION
GOVERNMENT OF BRITISH COLUMBIA
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Research Program 1976-1985

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A. Boulton Lake: an evolutionary examination of spine loss in Gasterosteus: *stickle-back fish*

1. "Spine deficiency and polymorphism in a population of Gasterosteus aculeatus: an adaptation to predators?". Reimchen 1980, Can. J. Zool. 58:1232-1244.
2. "Seasonal and age-related differences in the infection of Gasterosteus aculeatus with Cyathocephalus truncatus and Schistocephalus solidus." Reimchen 1981, Can. J. Zool., accepted for publication
3. "Differential cestode infection among sex and spine phenotypes in Gasterosteus and the implications to a balanced polymorphism." Reimchen, in preparation.
4. A long term monitoring(1976-1985) of spine-phenotype frequencies and cestode infections to determine the importance of endocyclic selection(alternating fitness of the phenotypes within each generation). Samples are being obtained every 4 months.

B. Drizzle Lake: an examination of a giant form of Gasterosteus with the purpose of testing the "niche-width" hypothesis(Van Valen 1965, Am. Nat.) as it relates to meristic variation within the population. This hypothesis, although having significant implications for evolutionary theory, has not been rigorously tested in any natural population, but rather, has been discussed largely from a theoretical basis. The necessary data for such

test requires an exceptionally detailed examination of the population dynamics and selective pressures within the different microhabitats occupied by the population.

1. Estimate the total population size of Gasterosteus from mark/release/recapture data and determination of the survivorship curve from egg to adult.
2. Determine the sources of mortality for each age class of fish. Eighteen species of piscivores, representing 15 bird, 1 mammal and 2 fish species, have been observed on the lake; stickleback are the predominant prey of 16 of these species.
3. Record the foraging positions on the lake for each predator and the size and number of Gasterosteus consumed. This data is being collected by video-taping the fish captures of avian piscivores, and by examination of spraints of river otter and stomach contents of predatory fish. Total numbers of fish will be independently estimated from caloric requirements of the predators. The data, as yet incomplete, shows that greater than 1,000,000 stickleback are consumed each year by these predators, with common loon, red-necked grebe and cutthroat trout the major sources of mortality. This data will be integrated into the survivorship curve to identify the critical periods in the life history of the fish where selection on defensive traits may be operating.

Some of this data, dealing with foraging distribution of loons, has been completed ("Observations of loons (Gavia immer and G. stellata) at a bog lake on the Queen Charlotte Islands." Reimchen and Douglas, Can. Field Nat. 94:398-404).

4. Collecting transects were begun in 1980 to assess phenotypic variability in the stickleback population. 105 collecting sites were chosen to provide a profile of the stickleback throughout the lake. Fish from each site are scored for body length, sex, spine and scute morphology, lacerations and other predator-induced injuries, and then fin-clipped and released. These transects are being carried out every 8 weeks throughout the year and will continue until the summer of 1983.

The data from 1980 indicates that there is a non-random distribution of phenotypes. It is necessary to distinguish whether these differences are the end result of selection by predators or phenotypic preferences for characteristic microhabitats. Large experimental tanks (400 l) will be constructed or purchased so that light intensity, wavelength, depth and substrate can experimentally altered for behavioural comparisons among the phenotypes.

5. Prey manipulation by piscivores: This is currently being recorded on videotape to determine how predators manipulate the stickleback before swallowing. Specifically, I am interested in where on the body (head region, trunk, caudal peduncle, pelvic or dorsal spine) the stickleback is grasped

by avian piscivores, in contrast to salmonids, as well as the frequency with which fish escape after initial capture.

C. Structure, position and function of lateral plates: Gasterosteus has a series of lateral bony plates on the body surface which show wide-spread geographical variation in position and number. Marine populations are fully plated, with about 35 plates, while freshwater populations have approximately 7 anterior plates. Although this species has been widely studied, no functional interpretation has yet been offered for this trend. Arising from an earlier investigation of spine morphology (Reimchen 1980) and more recent detailed examination of the structure of lateral plates, a functional interpretation for both position of plates and geographical variability in number of plates has been developed. In brief, anterior plates function primarily as structural support for dorsal and pelvic spines, while posterior plates provide physical protection to the body. Several lines of experimental evidence are required for further development of the model. One prediction is that reduction in the numbers of anterior scutes will lead to a corresponding reduction in rigidity and strength of the dorsal and pelvic spines. Accordingly, an instrument has been constructed which is capable of measuring lateral deflection of spines per unit of force. A second prediction is that an increase in numbers of lateral plates reduces body flexibility and, therefore, maximum swimming speed. A velocity chamber

usi photo-electric cells is being constructed to measure acceleration and maximum velocity. This experimental work will be carried out at Drizzle Lake during 1982 using phenotypes with scutes ranging from 0 - 9. In 1983, the work will be expanded to other populations, including low, partial and fully plated forms.

D. Geographical distribution of Gasterosteus and other freshwater fish in the Queen Charlotte Archipelago: Since 1976, I have allotted 8 weeks per year for this part of the research and, to the present, have sampled about 50% of the Islands' lakes (148 localities). Due to the remoteness of many of these watersheds, it has been feasible to visit only 5 to 15 new systems each year. As well as collecting data on the distribution of freshwater fish on the Islands, I have measured physical parameters (pH and spectral absorption curves for the water) for most lakes. Several exceptionally divergent stickleback populations have been found, some of which lack all lateral armour and virtually all spines. As well, resident fish populations have been discovered in exceptionally acidic waters (pH 3.9). In two localities with divergent fish, R. Matthews (Simon Fraser University) has recently obtained peat and lake bottom cores from which pollen profiles and Carbon-14 dates will be determined. Stickleback collected during these geographical surveys are scored for some 10 morphological traits and parasite fauna; the data, when complete, will be analyzed with multivariate statistics. A major manuscript (perhaps a monograph) on Morphology and

Adaptive Radiation of Gasterosteus on the Queen Charlotte Islands is planned. Such a contribution will be of value for a number of reasons. Firstly, the morphological diversity of the stickleback on the Charlotte Archipelago equals or exceeds that found throughout its circumboreal distribution. Secondly, if the radiation has been entirely post-glacial (although Carbon-14 dates may indicate otherwise), it implies very rapid evolutionary change in the fish. This is directly relevant to present concepts of speciation rates. Thirdly, the discovery of extremely acid-tolerant fish populations has a number of physiological and applied implications. Since many ponds and lakes lack fish, it will be possible in the future, with consultation of government agencies, to establish experimental populations in which the predatory regime can be controlled. The rate and direction of change, if any, would provide a useful comparison with natural populations.

E. Courtship behaviour and chick ontogeny of the red throated loon (Gavia stellata): On Drizzle Lake in 1979, a complete developmental sequence was obtained on the courtship, incubation and chick development of the red throated loon. This work was done primarily to determine the numbers and species of fish used in the parental feeding of the chick. The recent acquisition of a VTR has allowed more detailed data collection than was obtained with spotting scope coverage. There has been no published data on G. stellata in North America and only a small amount in Europe, since the species is very restricted in distribution and sensitive to any disturbance.