

Drizzle Lake

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Drizzle Lake Ecological Reserve  
Queen Charlotte Islands, B.C.

Interim Research Report

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The biological research undertaken on the Drizzle Lake Ecological Reserve, Queen Charlotte Islands, beginning in the summer of 1975, has involved three principle areas of study:

- 1- the examination of the selective agents and life history in the unique population of Gasterosteus aculeatus present in this lake. For comparative information, other populations from the islands have been sampled.
- 2- the establishment of a species inventory of the reserve including principally birds, mammals, and common flora. Natural history observations on the feeding behaviour in each of the sexes of various bird species have been made in an attempt to interpret the adaptive significance of plumage colouration between species and sexes.
- 3- the examination of the colour variation in the giant Pacific Land Slug in the forest and mus-keg regions surrounding Drizzle Lake. As in the stickleback, other areas of the islands have been sampled for comparison.

1- Gasterosteus research

These studies have involved a number of different aspects of the interactions between the cutthroat and the stickleback. For the last 50 years, various workers in Europe and North America (Heuts, Munzing, Hagen, Moodie, McPhail) have been analyzing the morphological variation in the lateral armour of the 3-spined stickleback. They have found that different populations have predictable armour counts depending upon the salinity, temperature, and amount of trout predation. Each of these workers have stressed the importance of subtle selective differences between the populations and have all concluded that selection is acting on physiological characters linked or correlated with the lateral armour. They each have felt that the lateral armour is in itself a neutral character. The studies begun at Drizzle Lake have been carried out in order to determine the multiple selective interactions that may be acting directly on the visible phenotype and attempt to understand the geographical variation in the lateral armour. One advantage of the Drizzle Lake locality for this type of research is that the habitat is as yet undisturbed and the interactions between predator and prey represent a natural situation. This is unlike the majority of localities in Europe and North America where the introduction of popular game species have altered the aquatic ecosystems to such an extent that correct interpretation of species interactions is virtually impossible.

Some of the methods and results obtained from the Drizzle Lake Reserve are as following:

- a) examination of 758 specimens for stomach contents, lateral scute numbers and position, length, depth, colour patterns and sex. Comparisons have been made between food types(i.e. benthic vs pelagic) and the remaining variables. Although only basic statistics have been performed, there are significant trends present in an association between lateral scute number and food contents. These differences are in the direction expected assuming different types of predation(fish vs bird).
- b) Examination of another population of stickleback where spines have been lost in the majority of individuals has led to the suggestion that the dragonfly larvae, Aeschna, is an important predator on the juvenile stickleback. This suggestion has many applications in understanding the morphological variation in the stickleback, as the actual capture strategy of the larvae is quite different from that of the cutthroat or the bird method. It would appear, from aquarium observations, that spines and lateral scutes are themselves disadvantageous to the stickleback in that they allow the dragonfly larvae to grasp the body of the fish. Those individuals showing a reduction in spine or scute number would in theory be at a selective advantage under this selective regime. This would account for the partial reduction in lateral armour in the Drizzle Lake forms, a reduction which was inexplicable in a recent paper on the Charlotte Stickleback(Moodie and Reimchen, 1976).

(4)

c) observations on the feeding behavior of the common and arctic loon, the common, red-breasted, and hooded merganser, the red-necked grebe, and the belted kingfisher. Each of these species have been observed to prey extensively on the juvenile stickleback though with consistent differences in the time of day and in the distance from the lake shore. The methods which each species use in breaking the spines suggest a number of adaptive uses for the lateral scute numbers and morphology and in turn provide an answer to the differences observed with extensive cutthroat predation. Although these observations require experimental verification, they suggest that the lateral scutes and their numbers have at least two different functions. The posterior scutes seem to serve as a structural support for the dorsal and pelvic spines while the anterior scutes, much smaller and not associated with the spines, provide protection to the pericardial region when the stickleback is seized by a cutthroat just anterior to the dorsal and pelvic spines. These functions will be explained in greater detail when the diagrams have been completed for publication (mid-summer).

In Drizzle Lake, different predators are each contributing to part of the survivorship curve of the stickleback. The evidence which is accumulating suggests that predator diversity is maintaining considerable variation in the lateral scute numbers since numerous phenotypes are optimal depending upon the predator involved..

There are various ways to test the hypothesis of multiple optimal phenotypes.

One would be to show selective predation by each predator in the populations.

This could be done for cutthroat by an examination of stomach contents but it would be very difficult for bird predators and for dragonfly larvae. In the former it would require sacrificing a large number of birds, but even with this, numbers of consumed fish would scarcely be large enough to detect selective differences. For the dragonfly larvae, stomach contents provide no information as only muscle tissue is eaten. There is another method for testing the theory, and that is the comparison of a large number of populations which differ in the amount of predation by the various predators. For example, a population undergoing predation predominantly by cutthroat should have a reduced variance since only a small number of optimal phenotypes are required. Some data of this sort are available from sampling on the islands and it does appear to support the predictions (Moodie and Reimchen, 1976). In this paper we note a reduced variance in populations with heavy cutthroat predation compared to those where cutthroats were rare or absent

We assumed that the reduction in variance was owing to the stronger selection and conversely, the increased variance owing to a relaxation of selection. I feel now that we were incorrect in these assumptions and that the reduced variance was owing to selection for fewer phenotypes while those showing increased variance were owing to selection for a greater number of modes. Our former assumptions were based upon a single optimal phenotype for each population, an assumption which has become tacitly accepted in most of the evolutionary and genetically orientated papers.

A number of feeding experiments will be carried out this year to test whether the dragon fly larvae and the cutthroat differ in their success at capturing given phenotypes. The experiments will include representatives of different size cohorts for both predator and prey in order to check for age and size-dependent selective differences. In addition, more observational data will be collected to test some of the various conclusions reached to date. It is apparent that the conclusions reached by the previous workers on the "neutral significance" of the lateral scutes and their numbers has been based primarily on an insufficient understanding of the life history and predator-prey interactions of this species.

If each population maintains a number of optimal phenotypes owing to predator diversity, it is of interest to speculate on the diversity of stickleback forms on the Charlottes and the possibility of a glacial refugium. The endemic nature of certain mammals, birds, and plants has led other workers to suggest a refugium for the islands during the Wisconsin glaciation. At first sight, the data on the stickleback would support these suggestions, since the radiation of forms is apparently much higher than anywhere else in the circumboreal distribution of the species. However, it seems probable that this diversity of forms is the result of slight differences in the predator pressure among populations and not the result of 30,000+ years of isolation. That is to say, a refugium may indeed have occurred on these islands but the data from the stickleback can be used neither to accept nor reject the possibility. The time required for the radiation is potentially as low as a few hundred years in view of the intensity of natural selection that has been observed in natural situations. All that is required to generate the differences in the sticklebacks are shifts in the abundance of the various predators.



## 2- Species Inventory in Drizzle Lake Reserve

Mammals: Euarctos americanus(6)  
Odocoileus hemionus(35)  
Lutra canadensis(1)  
Martes americana(1)  
Procyon lotor(18)  
Castor canadensis(3)  
Ondatra zibethica(4)  
Tamiasciurus sp(?) (100+)  
Peromyscus maniculatus  
Sorex obscurus  
Mustela erminea(1)

(x) numbers designate individuals seen

Birds: Grus canadensis(2 breeding pairs with young)  
Olor buccinator(6 adults + 1 young)  
Gavia immer(19)  
G. arctica(3)  
G. stellata(3)  
Podiceps grisegena(2)  
Branta canadensis(100+)  
Anas platyrhynchos(500+)  
A. acuta(35)  
Aythya sp(?) (12)  
Bucephala clangula(24)  
B. albeola(2)  
Histrionicus histrionicus(5)  
Clangula hyemalis(6)  
Mergus merganser(15)  
M. serrator(2)  
Lophodytes cucullatus(2)

- Megasceryle alcyon(20)
- Buteo jamaicensis(3)
- Haliaeetus leucocephalus(20)
- grouse sp(?)
- Larus argentatus(10)
- Colaptes cafer(5)
- Sphyrapicus varius(red race)(3)
- Cyanocitta stelleri(2)
- Corvus corax(25+)
- Parus rufescens(many)
- Sitta canadensis(1)
- Troglodytes troglodytes(many)
- Ixoreus naevius(many)
- Regulus satrapa(3)
- Vermivora celata(flock)
- Dendrica townsendi(flock)
- Pinicola enucleator(40-50)
- Spinus pinus(many)
- Loxia curvirostris(many)
- Junco oreganus(many)
- Passerella iliaco(10)

(x) the numbers provided are estimates of the maximum number seen on any single day

Plants: This inventory will be completed after this years flowering season.

Observations on the adaptive significance of the various plumages of the piscivorous birds will continue on this lake as well as others. These natural history observations have provided some interesting ideas on the significance of color patterns and stand in contrast to the present ideas involving species and sex recognition. At present, it is too early to attempt a review of these ideas and a report will be presented in the coming year.

3- Studies on the colour variation on the Pacific Land Slug.

In an attempt to understand the selective agents responsible for this colour variation, numerous observations and collections have been made from different areas around Drizzle Lake and around the islands. Large differences in phenotype frequencies have been observed over short distances without "obvious" changes in the background. This pattern is typical for most studies of this nature and thus a search has been made of the potential predators which may show discontinuous distributions which correlate with the changes in phenotype frequencies. To the present, no success has been achieved although some observations have been made on the common toad (Bufo boreas) which does occasionally feed on the slugs. The most important component to this study is the microdistribution of the juveniles, and at present, the search for these has been a failure. Although some have been found, these are so uncommon that their distributions provide little information on the different backgrounds occupied by the various age cohorts. Work on this subject will be carried out in more detail this year.

The Drizzle Reserve has been used increasingly in the last 4 months for camping, fishing, and hiking. Most of the hikers are members of the Armed Forces Base from Nassau and to the present have shown care in their usage of the area. It is probable that this usage will continue and escalate with the growing numbers of visitors and residents to the islands.

A recent letter from the Junior Chamber of Commerce to the business community in Nassau is attempting to generate support for a land based runway at the edges of the Reserve. Although this plan had been previously rejected by the government owing to the potential damage to the watershed area of the Drizzle Reserve, the business community in addition to the Armed Forces Base, are pushing with new vigour. To the majority of island residents, excluding those who would profit by increased accessibility, the presence of yet another jet runway would result in more cultural and ecological damage and for this reason should be rejected. Unfortunately, it is the profit orientated few who are the most vocal and active.

Other Ecological Reserves

Attempts are under way with Islands Protection and myself to introduce sea otters back onto the west coast of the Charlottes, perhaps in the Port Chanal Reserve Area. The sea otter transplant will cost about 15,000 dollars and will hopefully be federally or provincially funded. The important ecological role of this species is well known and is considered a keystone species. The disappearance of the many kelp beds which harbour many species of fish as

well as providing a substrate for eggs must have had a considerable effect on the close intertidal ecosystem. Since the marine intertidal region cannot be isolated ecologically from the supratidal region, owing to numerous species of birds and mammals which utilize both, it would seem biologically sound to recreate in the Ecological Reserve the conditions which have existed previously.