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Endemism and Conservation of Sticklebacks in the Queen Charlotte Islands

The Queen Charlotte Islands, located off the coast of northern British Columbia, have long been noted for their endemic biota (Dawson 1880). Recently Foster (1965) has assessed the status of the mammal and bird faunas. He indicates that of the seven mammalian species originally present, four are subspecifically distinct, and one, the extinct caribou deserved specific status. Among the birds there are three endemic subspecies. The invertebrates have not been thoroughly studied; however, Bousfield (1958) has described a new species of amphipod restricted to the islands. Calder and Taylor (1968) note 11 endemic taxa of vascular plants, over 2% of the total. Among the non-vascular plants there is apparently a similar high proportion of endemics (Scholefield, cited *in* Calder and Taylor, 1968). These studies suggest that, as on many islands, isolation and a different selective regime have contributed to divergence of the biota relative to mainland forms.

Studies of the freshwater fishes of the islands reveal atypical forms of the threespine stickleback (*Gasterosteus aculeatus*) as well. The purpose of this note is to outline the degree of differentiation in some of the stickleback populations and to draw attention to trends which could threaten the survival of some of them. Research on the sticklebacks of the Queen Charlotte Islands began in 1966 and the results of a study of sticklebacks in Mayer Lake are described by Moodie (1972a, b). A population in Boulton Lake is the subject of detailed study by one of us (T.E.R.). We and others have sampled over 24 additional lakes and streams and the results of that survey will be published shortly.

Although *G. aculeatus* is a variable species, generally the freshwater form known as *leiurus* (Figure 1A) is a thick bodied fish with three dorsal spines and one pair of ventral spines forming the major part of the pelvic fins. They lack scales but there is a series of lateral bony plates. The number of these plates usually ranges from four to 35 but the average in fresh water is about five to 10. The body color is pale yellow with irregular patches and stripes of olive and brown. For a detailed description of eastern Pacific coast sticklebacks and their variation, papers by Hagen (1967) and Hagen and Gilbertson (1972) should be consulted.

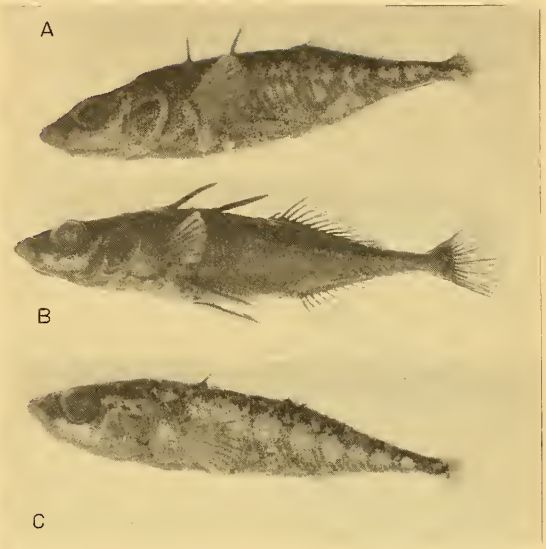

FIGURE 1. *Gasterosteus* from the Queen Charlotte Islands. (A) *Leiurus* from Woodpile Creek, in the Mayer Lake drainage, approximately 55 mm standard length; (B) "Black" specimen from Mayer Lake, approximately 70 mm standard length; (C) specimen from Boulton Lake lacking the second dorsal spine and both pelvic spines, approximately 50 mm standard length.

In the Queen Charlotte Islands many stickleback populations show variations in these characters which well exceed the normal range. In Mayer Lake, on Graham Island (largest of the Queen Charlotte Islands) there are two kinds of sticklebacks. Those inhabiting the three tributary streams of the lake are like the typical *leiurus* described above. In the lake proper there is a different form, termed the "Black" stickleback (Figure 1B). Black sticklebacks are nearly twice the length of *leiurus*, they are very melanistic, much more streamlined, and differ in at least six other morphometric and meristic traits. The Black stickleback appears to meet the criteria of the biologically defined species (Moodie 1972a, b).

There are at least three other lakes on Graham Island containing similar giant, melanistic stickleback populations. Because the typical *leiurus* form in the Queen Charlotte Islands tends to occur in restricted and hard-to-sample environments, we cannot say whether these other populations of

large melanistic sticklebacks exist parapatrically with *leiurus* as in Mayer Lake or not. However, in Drizzle Lake we have taken many large melanistic sticklebacks from the open water and from an inlet stream to the lake a very few smaller fish that may be the *leiurus* form.

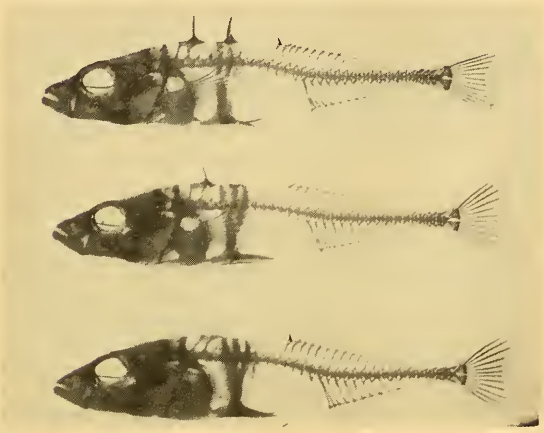

FIGURE 2. *Gasterosteus* from Boulton Lake, cleared and stained with alizarin red S. Upper specimen with all dorsal spines present: center specimen with second and third dorsal spines absent; bottom specimen with first and second dorsal spines absent.

In other lakes we have found unusual variation in spine number (Figure 2). In four lakes, one, two, or all three dorsal spines may be absent in 10 to 90% of the fish. In Boulton Lake the pelvic spines and girdle are polymorphic, so that the spines and virtually all of the girdle are absent in 70% of the individuals collected (Figure 1C). Such spine loss, even of very low percentages, is almost unheard of in extant forms of *Gasterosteus*. No instances are mentioned by Hagen and Gilbertson (1972) in their survey of the species on the west coast. We are unaware of significant loss of spines among the well studied *Gasterosteus* populations of Continental Europe. There is, however, a population in Lough Ree, County Roscommon, Ireland in which some individuals lack the first and second dorsal spine although the frequency is not known (David Marlborough, personal communication). The only comparable population that we know of in North America is on Texada Island, British Columbia, and is under study by J. D. McPhail and others. The lateral plates also show variation beyond the normal range. There are populations in three lakes in which most individuals completely lack plates. In other lakes most fish have only one or two plates per side. The only other localities of which we are aware, where such loss occurs are in southern California, Algeria (Miller and Hubbs 1969) and Texada Island (McPhail, personal communication).

In summary, there are populations of *G. aculeatus* in the Queen Charlotte Islands that show degrees of melanism, gigantism, spine loss, and lateral plate reduction, which are seldom or never exceeded elsewhere in this widely distributed coastal species. Although our investigation is incomplete and the causes of the peculiarities of the sticklebacks are far from understood, there are already some obvious correlations between their morphology and environmental variables. Most of the populations showing lateral plate reduction or spine loss occur in lakes with no outlets and apparently no other species of fish. The absence of both competitors and predators has seemingly allowed the sticklebacks to evolve novel adaptations to their ecologically unusual environments. In contrast, those lakes which contain salmonids and cottids are generally populated by larger sticklebacks with relatively long spines and higher numbers of plates.

This multitude of isolated populations, many of which display morphological variation almost unknown elsewhere, and all within modest distance of one another, offers a rare opportunity to study natural selection, competitive interactions, and predator–prey relationships. Consideration should be given to the maintenance of some of the more extraordinary populations. Fortunately, most lakes are inaccessible and the negative effects of civilization will not reach them for some time. However, this is not the case for a few lakes which also happen to contain the most unusual populations. Boulton Lake is situated within 200 m of the Masset – Port Clements highway. Because the loss of spines and lateral plates in this population appears to be a result of the absence of predators, the introduction of game fish such as trout would probably lead to the elimination of this distinctive population.

At present there is no need for trout introductions because native stocks meet the demands of fishermen. We spent the summers of 1967, 1968, and 1969 on Graham Island and were in the area for 1-month periods in 1970 and 1972. During that interval we saw an increase in trout fishing for sport and subsistence. Although the stickle-

back populations in Mayer Lake may not be adversely affected by such fishing, we fear overfishing in some lakes may lead to pressure to introduce game fish in lakes such as Boulton. Greater angling activity may also lead to introductions for the sake of the simple desire to have more different places to go fishing. The most serious threat to lakes which lack predators, such as Boulton, is that trout will be introduced by the private action of well meaning citizens. If game fish must be introduced we hope the introduction can be restricted to the many suitable lakes and drainages which presently lack fish of any sort.

In California the plateless sticklebacks were granted protection (Miller 1972) only after introductions had considerably altered the gene pool and environment (Miller and Hubbs 1969). In the Queen Charlotte Islands Foster (1965) suggests the extinction of the caribou may have been hastened by the introduction of deer. Surely adequate protection for at least some of the endemic sticklebacks of the Queen Charlotte Islands should be established before irreversible environmental changes occur.

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Is the Grey Squirrel Invading Nova Scotia?

While motoring through the village of Habitant, near Canning (Kings County, Nova Scotia) on the afternoon of November 5, 1972, I saw a Grey Squirrel (*Sciurus carolinensis*) running across the lawn on the property of Roy Hazel. Having no previous record for this species in Nova Scotia, I was greatly interested, and visited the area a few days later to make some enquiries. At the Hazel residence I was informed that the animal had been seen frequently during the previous several weeks and as far as anyone in the community knew, it had arrived there under its own 'steam.' Subsequently I called on others in the neighborhood and two told of having seen it running along an overhead telephone cable.

Still not completely satisfied that the squirrel was not an escaped pet, I enquired over our local radio station (CKEN) asking if anyone had lost