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RH: Okanagan Lake kokanee · Shepherd

A CASE HISTORY: THE KOKANEE STOCKS OF OKANAGAN LAKE

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Abstract: Within one decade, Okanagan Lake kokanee went from being managed for sport fishery purposes to a major concern from the perspective of conservation biology. Both shore-spawning and stream-spawning runs have declined dramatically, despite a fishery closure since 1995. Shore spawners are genetically different from stream spawners, and are quite unique in spawning behavior. The 1998 returns of both stocks were about 1% of the levels of the 1970s, when routine monitoring of spawning began. While the introduction of an exotic species, *Mysis relicta*, is likely the driving force behind the decline, there are a variety of other forces that may have initially masked and more recently aggravated the situation. A long-term (20 yr) Action Plan for the recovery

of the kokanee stocks was formulated in 1995. Phase I (1996-2000) of the Plan stands on two legs: (1) developing a practical means of *Mysis* control; and (2) conserving key habitats. The results of the first three years of work on the Plan are reviewed, and options for the future discussed. Given intensifying human development pressures in the Okanagan, can we save habitats that are currently empty for future fish?

Key Words: behavior, British Columbia, habitat, kokanee, limnology, *Mysis relicta*, Okanagan, *Oncorhynchus nerka*, spawning, planning

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In the Okanagan, early settlers took an abundance of kokanee (*Oncorhynchus nerka*) for granted. Rakes and washtubs were used to take kokanee home by the wagon load from the beaches and tributaries of Okanagan Lake (Figure 1). Even into the late 1960s, kokanee remained so numerous that no need was seen for an angling bag limit province-wide. By the late 1970s, concern for Okanagan Lake kokanee stocks began to build as angler catches climbed and spawner numbers shrank. In the mid-1980s, the BC Environment Ministry began to allocate additional resources to improving the management of the

Okanagan Lake kokanee sport fishery, which had an estimated net worth of about $1,000,000 annually (Shepherd 1990 MS).

By 1995, stock conservation concerns had replaced those of fishery management, and Okanagan Lake was closed to fishing for kokanee effective 15 March 1995. That closure is unlikely to be rescinded in the near future, given the bleak population monitoring results to date. Both stream- and shore-spawner numbers have continued to decline since annual escapement counts began in the early 1970s. In 1998, spawner numbers were down to disastrously low levels of less than 13,000 adults in total, just 1% of the numbers seen 25-30 years ago (Figure 2). Annual hydroacoustic (Figure 3) and trawling (Figure 4) abundance estimates for younger age classes indicate that, rather than recovery, further declines are likely in the coming years without some significant changes.

Both stream-spawning and shore-spawning strains of kokanee occurred naturally in the Okanagan Lake system, probably due to glacial wanderings some 10,000 years ago (McPhail and Carveth 1992). Despite this relatively recent arrival in the Okanagan, the two strains differ markedly from each other in terms of spawning and incubation lifestyles (Table 1). The stream-spawning kokanee runs are similar to the "standard" sockeye in spawning morphology and behaviour,

and can be quite variable in size- and age-at-maturity. In contrast, shore spawners show very little variation in size (Figure 4) and are much less pronounced with regard to spawning coloration (Dill 1996 MS) and other secondary sexual maturation features (eg, dorsal hump, hooked jaws, compression of body).

Okanagan Lake shore spawners are unique among salmon in their spawning behaviour. Rather than rounded gravel, they choose large angular rocks (Figure in shallow (15-100 cm water depth) shoreline areas, presumably to allow water circulation to the eggs via wave action without shifting the substrate. Shore spawners have abandoned the standard salmon strategy of an approximate two-week period of spawner pairing, male defense of the female against other males, and female defense of her redd until death. Instead, schools of adults move onto the shoreline in the morning, and females will drop out of the schools to investigate the substrate. Once a female finds a suitable spot, she will circle and clean the selected area using the typical salmonid tail-digging action. This behaviour draws males to the site, and they press into a "cluster" (Dill 1996 MS) over the crevice that has been cleaned by the female. The female then passes through the cluster of males, and the combined group releases eggs and

sperm to settle into the crevices. Spawner numbers peak around noon, and the spawning sites are generally abandoned by evening (Dill 1996 MS).

Recent genetic studies using a variety of methods (Taylor and Pollard 1998 MS) suggest that the stream- and shore-spawning ecotypes of Okanagan Lake kokanee are closely related to each other and have a common ancestry. However, the results to date also indicate that gene flow is restricted between these two ecotypes, and improved microsatellite-assay techniques may allow strain identification and separation.

In the simpler days of dealing with just fisheries management concerns, stream-spawning stocks received the most attention, as it appeared that shore spawners contributed less to angler catches due to their smaller size at maturity (Shepherd 1990 MS). Times of course have changed, and the first priority of the BC Fisheries Program is now "*...the protection, maintenance and rehabilitation of native fish and their habitat to ensure ecosystem sustainability and biodiversity*" (Fisheries Branch 1996). The unique biology of the shore-spawning kokanee of Okanagan Lake only adds to the argument for its protection and preservation along with the stream spawners.