# KALAMALKA LAKE

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## Overview

Kalamalka Lake is located at the northern headwaters of the Okanagan Valley (Fig. 3-1). The lakes' outlet is Lower Vernon Creek which flows for approximately 9 km in a north and west direction before it enters the north-east arm of Okanagan Lake. Water is a limited and valuable resource throughout the Okanagan Valley and especially so for Coldstream Creek, which is the only inflowing stream into Kalamalka Lake. This creek is a key fish bearing stream as well as a vitally important source of water for the valley. Coldstream Creek is the single most important stream for fish production while in contrast, Oyama Creek, is fairly large but devoid of any fish (Halsey 1974). The southern limit of the Kalamalka watershed is Ellison (Duck) Lake that is formed primarily by Upper Vernon Creek. The outlet of Ellison Lake forms Middle Vernon Creek that flows in a northerly direction for about 6 km before entering into Wood Lake. Wood and Kalamalka lakes are virtually connected by this system that is basically void of any suitable fish habitat.

Kalamalka Lake is intensively utilized in the summer months for recreational purposes including boaters, water skiers and other water based activities. While water sports dominate the lake during the summer months, fishing for kokanee, rainbow trout and lake char is also a popular recreational pastime for many of the residents who live on the lake, particularly in the spring, fall and winter months.

## Issues

Primary issues related to Kalamalka Lake fish and their habitat include:

1. Water quality and quantity of the major streams.
2. Protection of riparian habitat along Coldstream Creek that is entirely private land utilized for agriculture and ever increasing urban development.
3. Low flows for fish in all the streams.
4. Human development that encroaches on Middle and Lower Vernon creeks.

## Summary of Work and Reports

In terms of quantitative information useful to Okanagan Valley large lakes fisheries managers, kokanee investigations and subsequent literature increased dramatically with the advent of the *Canada - British Columbia Okanagan Basin Agreement* in 1969. In accordance with that agreement, a series of studies were undertaken to plan the integrated development and management of water resources in the Okanagan Basin. Fisheries studies conducted during this initiative were summarized by Pinsent (1974) and these formed the foundation on which future fisheries-oriented investigations were based. For example, routine monitoring of kokanee annual spawning escapements began in the early 1970s as part of the Okanagan Basin Studies (Northcote et al. 1972). Another of these studies, by Halsey (1974), focused on the Ellison, Wood and Kalamalka lakes fish resources' and this work provided some good insight into species assemblages and some specific aspects of kokanee and rainbow trout biology. Amongst the more important facts identified by Halsey (1974) was the identification of shore spawning kokanee in Kalamalka Lake and that spawning kokanee and rainbow trout move between Wood and Kalamalka lakes.

Due to the urgent problems so evident on Okanagan Lake most fisheries work after the Okanagan Basin Studies focused on that lake with little work directed at the other large lakes in the valley. In the case of Kalamalka Lake, fisheries work consisted of a few periodic checks of the sport fisheries and some estimates of kokanee spawner numbers. Results of this work were summarized in a series of management plans developed in the 1980s (Fisheries Management Plan 1980; Bull 1983; Harper 1985). Other work included the preparation of a management plan by Wildstone Resources in 1992 for the Ministry of Environment because of some critical water quality and quantity issues on Vernon Creek. In 1994, Shepherd (1994) summarized available sport fishery statistics for Kalamalka Lake while Whall and Lasenby (*in* Ashley et al. 1999) compared mysid production in Kalamalka Lake with that in Okanagan Lake as part of the OLAP investigations and Sebastian and Scholten (*in* Andrusak et al. 2000) mention some trawl data from Kalamalka Lake. In the 2000s, there have been surveys conducted on Kalamalka Lake of kokanee shore spawners (Webster 2003; 2004; 2005; 2006) and in 2004 a creel census was carried out on the lake (Webster and Wilson 2005). A number of engineering reports have been written on quantity and quality of water of various streams that flow into the Kalamalka Lake watershed.

**Habitat Issues**

Critical water quality and quantity issues related to the few streams continue to be major concerns for fisheries workers. There have been some efforts in the 2000s to restore fish habitat in Middle Vernon Creek. Protection of Coldstream Creek riparian habitat is a high priority. Also an issue is the protection of key kokanee shore spawning habitat.

**Existing Fishing Regulations**

General regional regulations apply to Kalamalka Lake. Notably, kokanee daily quota is limited to two fish per day. Some boat speed restrictions and or no boating areas also exist on the lake.

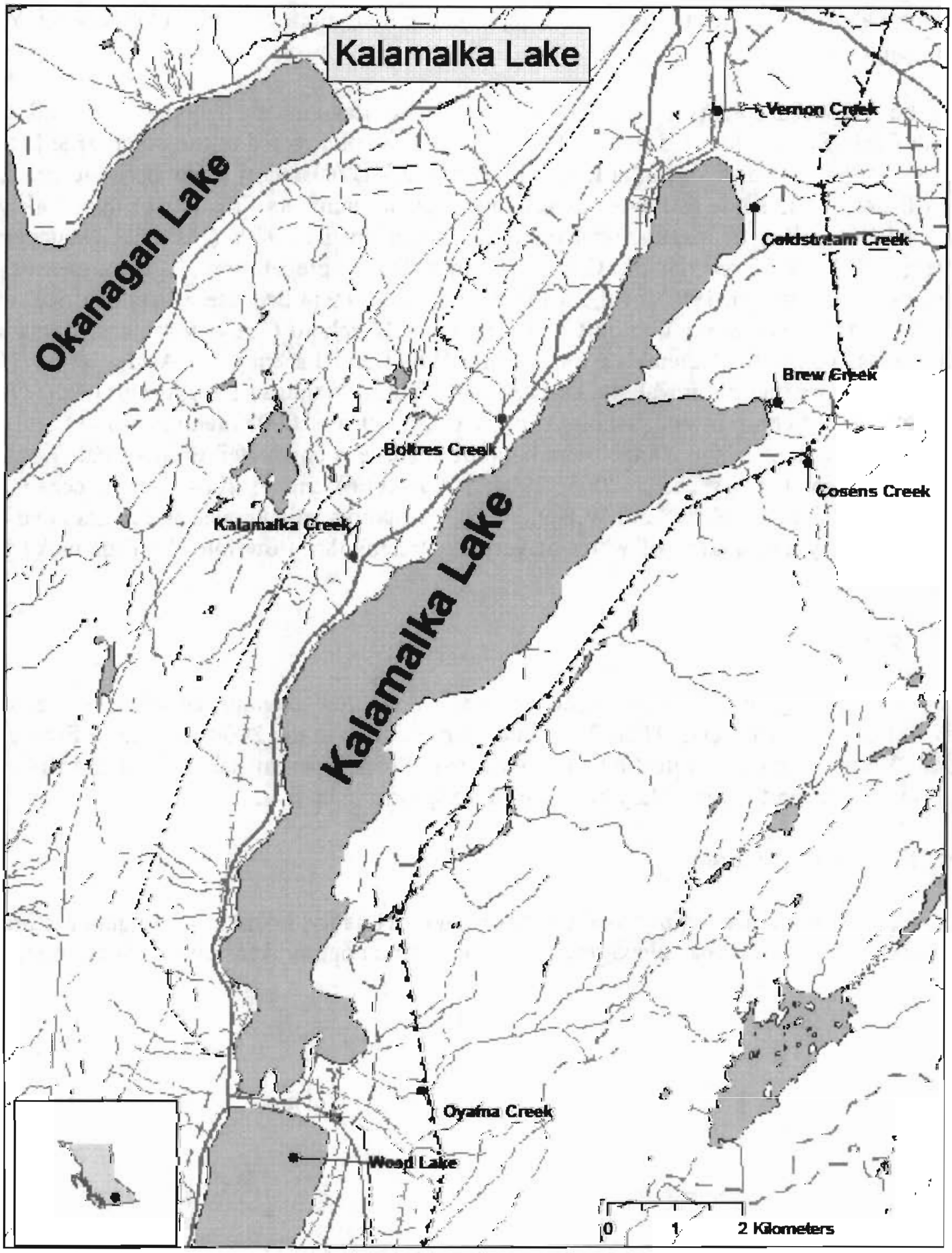



**Figure 3-1.** Map of Kalamalka Lake.

### Current Management Objectives

The last management plan for large lakes was written by Bull (1983). An extensive analysis of large lakes supply of sport fish and expected demand was conducted to outline where future angling can be accommodated and what management strategies should be implemented. Habitat protection, especially of stream habitat was paramount. Enhancement of stream habitat in Coldstream Creek was identified as a priority. One objective worth noting was cessation of stocking rainbow trout into the large lakes due to concern over genetic integrity of wild trout. Kokanee were identified as having potential for increased catch and harvest. Lake trout were introduced into Kalamalka Lake in the early 1970s but stocking was halted in 1978. Rainbow trout stocking also occurred over several decades but was halted in 1964. Kokanee from Meadow Creek were also introduced in the late 1940s and early 1950s. Today no stocking of any species occurs.

### Creel Census Data

Angler effort and catch statistics were collected on Kalamalka Lake in the late 1970s and Houston (1985) summarized this data. Webster and Wilson (2005) provide some comparative annual effort data based on SLIM data while the MOE SLAM files provide some additional effort data (opportunistic) that are also summarized. Despite differences in data and methods used to estimate effort it is quite clear that angler effort is low today compared to the 1990s and that total effort in the best years hardly exceeded 10,000 angler days. This estimate of effort is low considering easy access and relatively safe waters that result in many anglers using car top boats and some float tubes.

Rainbow trout, kokanee and lake trout are the three sport fish species of interest to Kalamalka Lake anglers. Webster and Wilson (2005) found that rainbow trout were the most sought fish followed by lake trout and kokanee. Little comparable data is available for catch estimates for any of the primary sport fish species except some crude estimates of summer catch (Table 3-1).

**Table 3-1.** Estimates of effort (angler days) on Kalamalka Lake from Shepherd (1994) and Wilson and Webster (2005).

| Year | SLIM | Angler Days | |
|---|---|---|---|
| | | SLAM (opportunistic) | Wilson and Webster (2005) |
| 1971 | | | 2,148 |
| 1988 | 4,700 | 4,051 | 4,051 |
| 1989 | 11,002 | | |
| 1990 | 5,954 | | |
| 1991 | 10,237 | 4,578 | |
| 2001 | 7,928 | | |
| 2004 | | 2,251 | 2,251[2] |

[1] Data shown in Appendix V of Shepherd (1994 has been converted to angler days using 4.5 hours per day.
[2] Estimated by aerial boat counts (SLAM).

Houston (1985) provided some comparable success rates for the three sought after sport fish as well as estimates of catch. This data is reproduced in Table 3-2 as well as some data from Webster and Wilson (2004). By any standard angler success rates on this lake are low, especially for kokanee that often exceed one fish hour. Rainbow trout fishing success on large lakes such as Shuswap Lake (Andrusak 2007) typically ranges between 0.15-0.3 fish per hour which is more than double the rates recorded on Kalamalka Lake.

**Table 3-2.** Angler success rates (CPUE) and estimates of catch for the three preferred sport fish species in Kalamalka Lake 1971, 1980 and 2004.

| | Catch Success (fish/hr) | | | Estimated Harvest | | |
|---|---|---|---|---|---|---|
| **Year** | **Rainbow Trout** | **Lake Trout** | **Kokanee** | **Rainbow Trout** | **Lake Trout** | **Kokanee** |
| 1971 | 0.02 | 0.01 | 0.19 | 102 | 70 | 1235 |
| 1980 | 0.04 | 0.04 | 0.08 | 791 | 791 | 1582 |
| 2004 | 0.07 | 0.002 | 0.08 | | | 0 |

**Summary of Relevant Biological Data**

Rainbow Trout

A comprehensive file search revealed that very little data exists for Kalamalka Lake rainbow trout. Northcote et al. (1972) provide some good data on Kalamalka Lake rainbow trout and noted that they were much smaller than Okanagan Lake rainbows. They reported that age's 3-5 fish were < 400 mm. The summers of 1950 and 2006 were the only other years when rainbow trout data was even collected with the latter year the most complete. Although sample sizes were small the length frequency plots for these two years show that most angler caught rainbows are small with no fish > 600 mm (Fig. 3-2). Ages of fish in 1955 were predominately 2-4+ years. Webster and Wilson (2004) noted the condition factor for the few rainbows sampled was poor (0.89).

The only study directed at Kalamalka Lake rainbow trout spawning and rearing habitat appears to be Halsey (1974) although he does refer to some earlier ministry work that could not be found. He identified Coldstream Creek as the most important stream followed by Lower Vernon Creek, the outlet that flows into Okanagan Lake. It is also possible that Kalamalka Lake rainbows migrate through Wood Lake to spawn in Middle Vernon Creek.

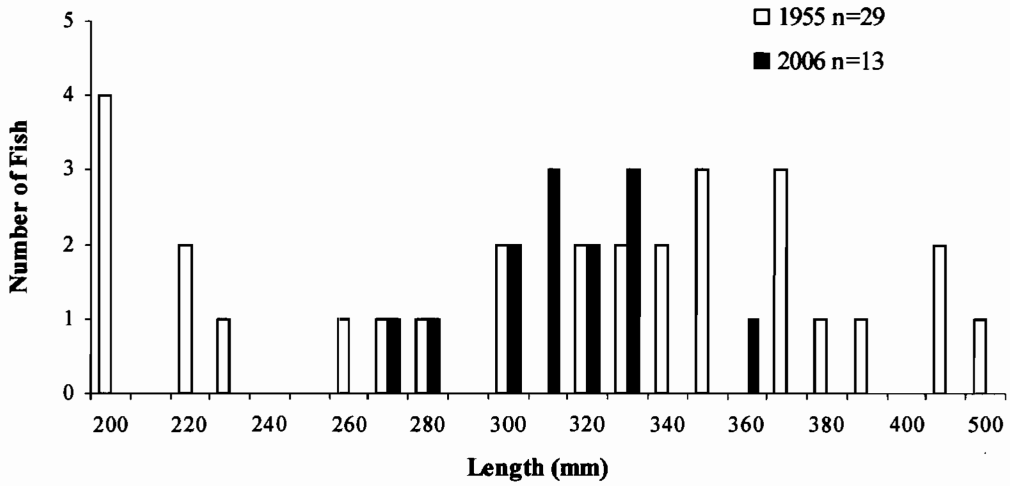



**Figure 3-2.** Length-frequency distribution of Kalamalka Lake rainbow trout caught during the summer 1955 and 2006.

Lake Trout

The ministry stocked lake trout into Kalamalka Lake starting in 1970 through to 1978. Historically, there was an attempt in 1909 to introduce lake trout by means of an eyed egg plant but this was unlikely to have been successful, hence, the various transplants in the 1970s. Northcote et al. (1972) did capture 91 trout during gill netting in 1971 and these were from the first group stocked in 1970 as age 3 fish. Experimental gill netting was undertaken in 1977 and 1978 to determine the success of the introductions from 1970-1977. Lake trout were captured in both years (Fig. 3-3) ranging in size from 420-770 mm. These fish were aged as 4 and 5 years and which was considered fairly reliable data since stocking only began in 1970 meaning the oldest fish could only age 7 or 8 years.

Unfortunately, lake trout do compete with rainbow trout and kokanee for food as well as they are known to be predators of whitefish, sculpins, kokanee and kokanee eggs based on stomach content analysis of the 1978 fish. The three lake trout checked by the survey crew in 2004 were quite large (mean = 743 mm) and all had a high condition factor (1.6). There is no file data that mentions any possible spawning sites for lake trout.

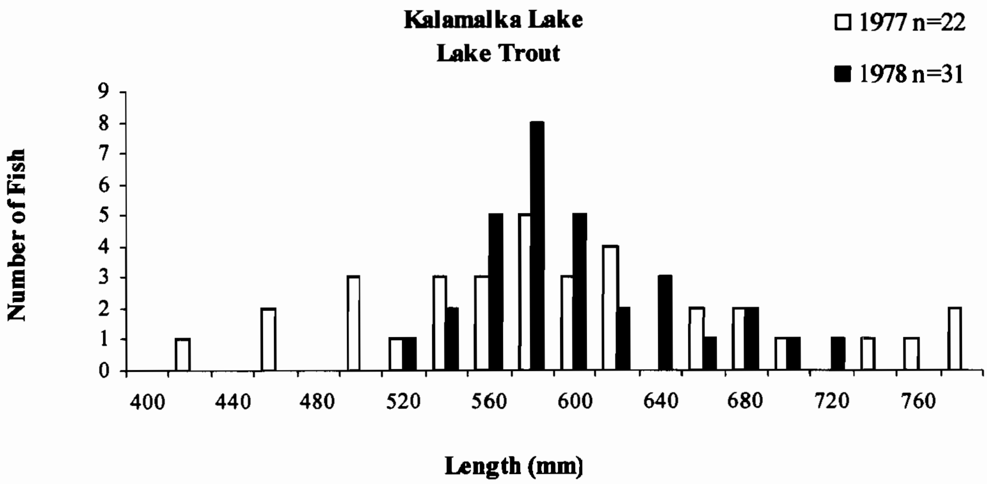



**Figure 3-3.** Length-frequency distribution of gill net caught lake trout in Kalamalka Lake 1977 and 1978; 1977 samples were obtained in May and October; 1978 samples in May.

Kokanee

There is a reasonable amount of data for Kalamalka Lake kokanee. Similar to Okanagan Lake there are two kokanee spawning populations with stream spawners present in Coldstream Creek and shore spawners found mostly on the west and east shorelines.

Halsey (1974) reported a total of 8,000 spawners in Coldstream Creek in 1972 one year after Northcote et al. (1972) estimated 60,000. For this report these numbers have been adjusted to reflect peak count x 1.5 so that these estimates are comparable with the contemporary estimates (Fig. 3-4). Estimates during the 2000s have ranged from ~ 4,000-19,000 with the average for all counts ~ 20,000. Since the mid 1990s the estimates appear to be trending downward.

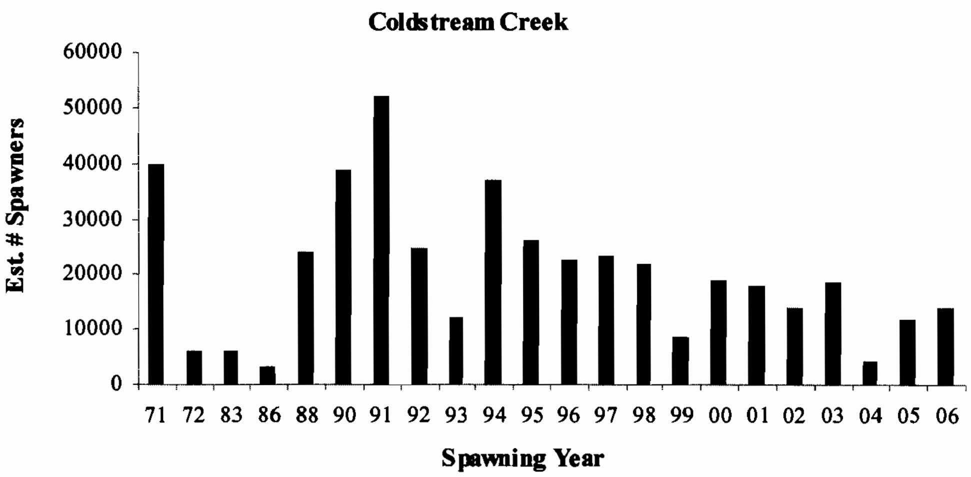



**Figure 3-4.** Estimates of kokanee spawners in Coldstream Creek. All peak counts adjusted by 1.5.

Estimates of shore spawner abundance commenced in 2001 as reported by Webster (2006). Small numbers were estimated from 2001-2004 that were all < 4,000 per year but in 2005 the estimate numbers jumped to ~19,000 (Fig. 3-5). Preliminary total lake abundance estimates have been made (D. Sebastian, MOE stock assessment biologist, Victoria, BC, pers. comm.) for 1997 and 2004 that ranged from ~1.8-0.8 million respectively (Fig. 3-6). The ages 1-2 estimates are low suggesting adult numbers would be likely be < 100,000 which is consistent with the escapement data. It should also be noted that abundance in 2004 was only about 50% of the 1997 estimate.

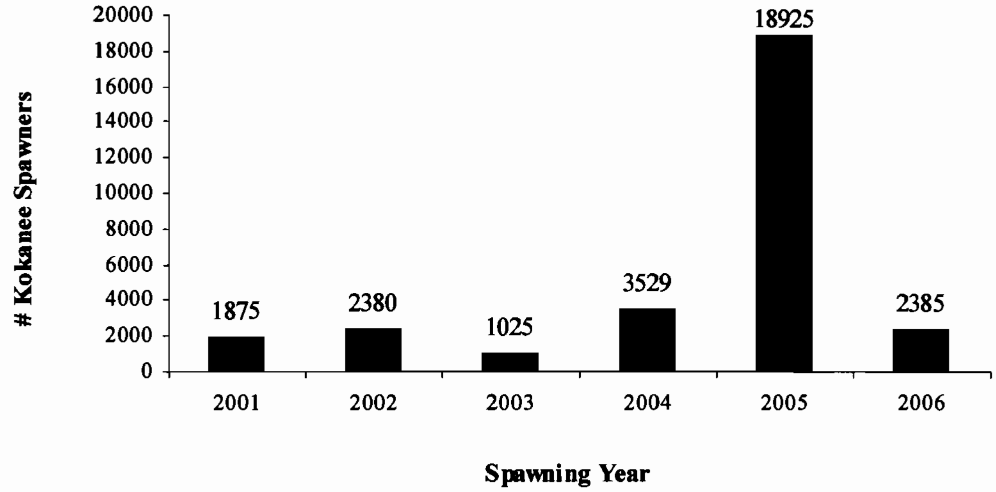



**Figure 3-5.** Estimates of relative abundance (peak count) of shore spawning kokanee in Kalamalka Lake 2001-2006 by Webster (2006).

While there are no individual age data available for the 1997 fish for analysis Northcote (1972) determined mean size of age 2+ summer caught (gill net) fish were < 200 mm while age 3+ fish were slightly > 200 mm and the overall mean age was age 3+, which is assumed to be age-at-maturity. Sebastian and Scholten (*in* Andrusak et al. 1999) conducted a hydro acoustic and trawl survey in early October 1997. They caught four age groups that included some spawners that were almost certain to have been shore spawners. The mean size of age 0+ was 53 mm, age 1+ (98 mm), age 2+ (193 mm) and age 3+ (208 mm). Their data supports the notion that most mature kokanee are age 3+. They noted that mean size of all age groups were smaller than Okanagan Lake kokanee. A second acoustics and trawl survey was conducted in September 2004 and the size-frequency distribution again suggested four age groups (Fig. 3-6) but a distinct mode at 370 mm suggests some very large fish that could be the stream spawners while the mode at 223 mm most likely represents the shore spawners. Based on available data it is clear that these kokanee are small compared to other Okanagan Region large lake kokanee, a conclusion originally made in a comparable study by Northcote et al. (1972).

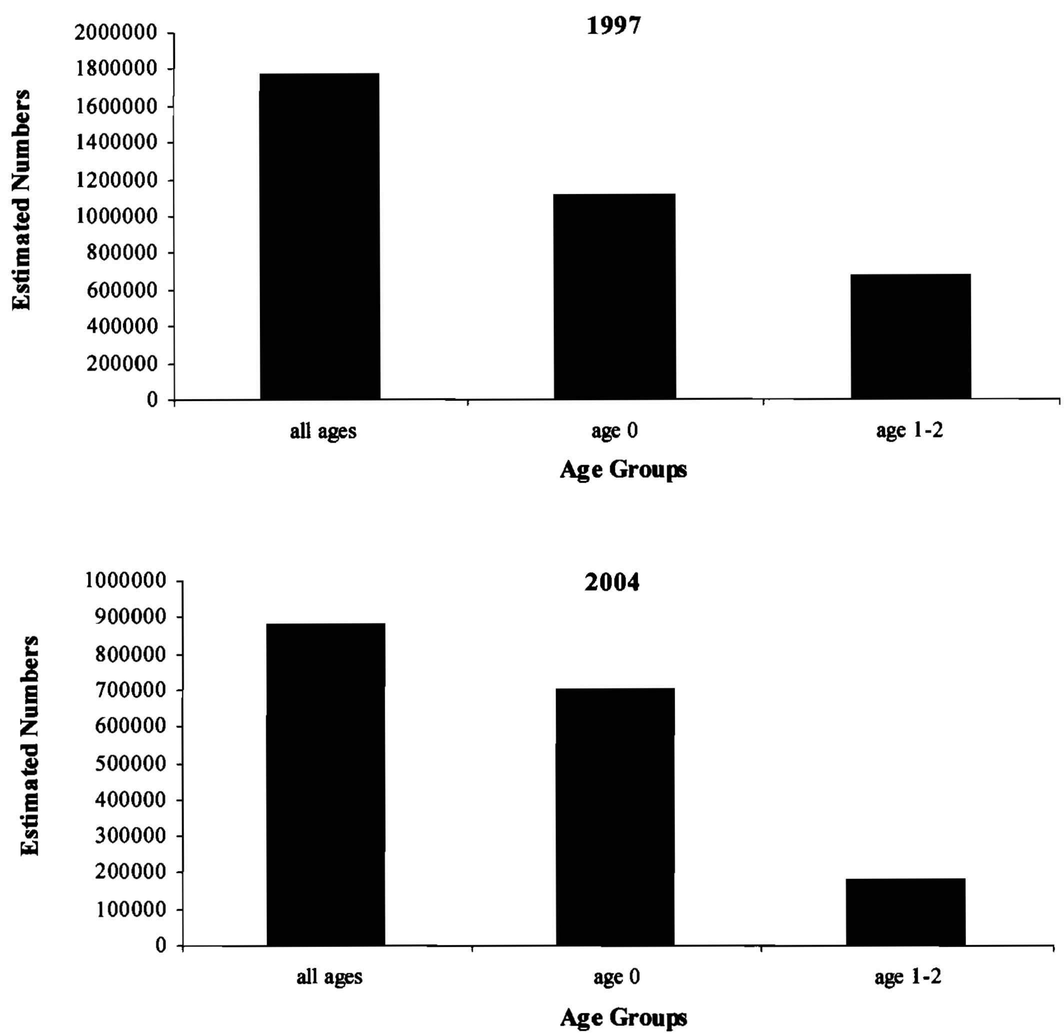



**Figure 3-6.** Total kokanee abundance estimates based on hydro acoustic surveys on Kalamalka Lake 1997 and 2004 (data from D. Sebastian).

Length-frequency analysis of Kalamalka Lake kokanee also indicates a single age-at-maturity, most likely age 3+ although a few fish < 200 mm could be age 2+. These fish are small and at least for the years 2004 and 2005, they would be barely recruitable in the 2004 fishery since even in late summer, most would be < 200 mm given the mean size in mid October was only 217 mm. The mean size in 2005 was slightly larger at 225 mm but even for this year these fish would barely be of catchable size in late summer (Fig. 3-7). Northcote et al (1972) provided summary data for 1971 Coldstream Creek spawners with mean lengths of only 215 mm, mean weights 100 gm and fecundity of 240. These values were considerably lower than those of seven spawning populations measured in seven Okanagan Lake tributaries (Appendix 1, *in* Northcote et al. 1972).

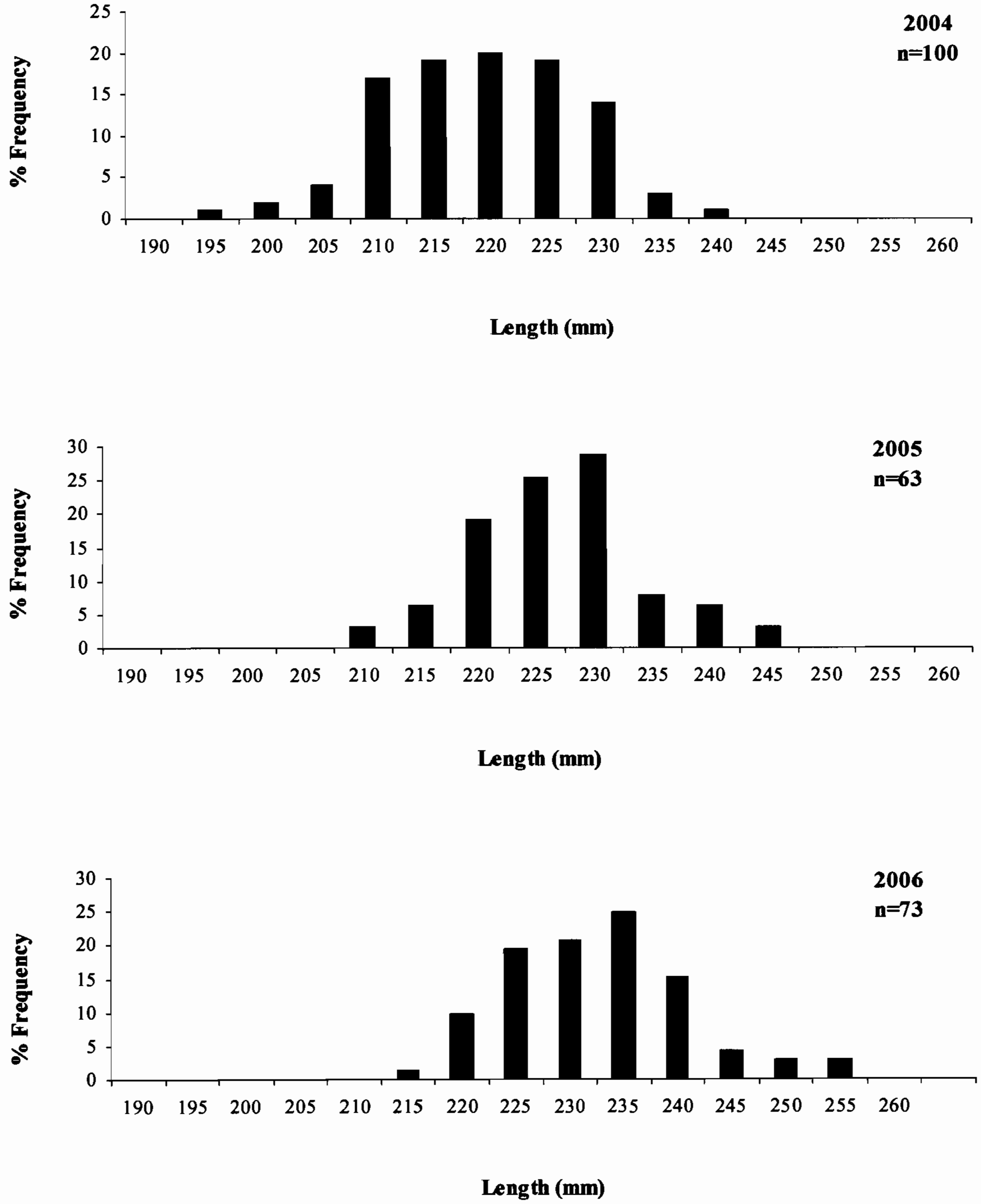
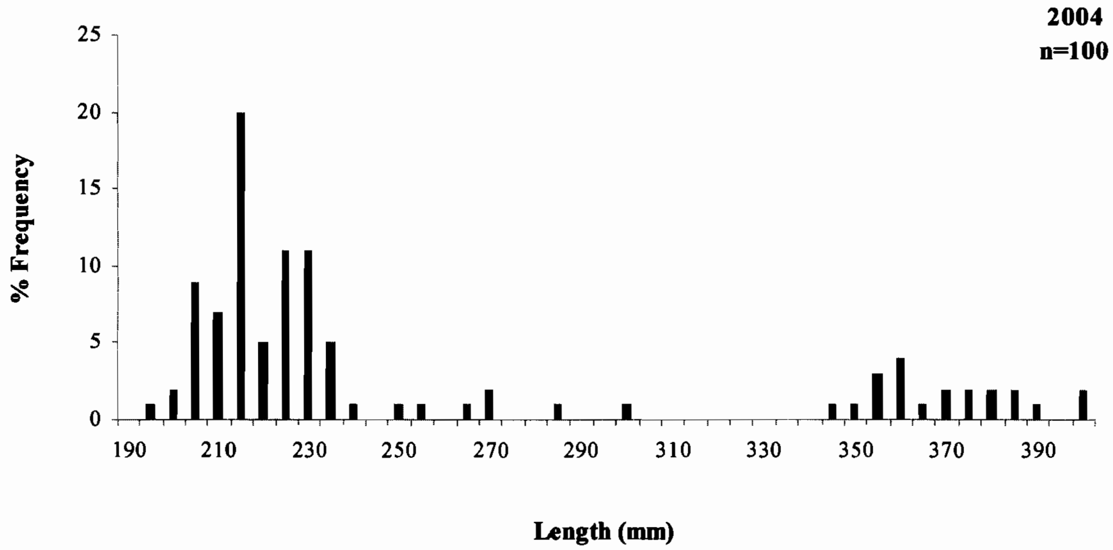



**Figure 3-7.** Length-frequency distribution of Kalamalka Lake shore spawning kokanee 2004-2006.

Size-frequency histograms of the Coldstream Creek spawners illustrated in Figure 3-8 suggest a very different frequency distribution and probable age composition compared to the shore spawners. While the primary modes of the stream spawners are nearly identical to the shore spawners at ~ 230 mm there were no shore spawners exceeding 255 mm while 26% of the stream spawners were > 255 mm in 2004 and 10% in 2006.



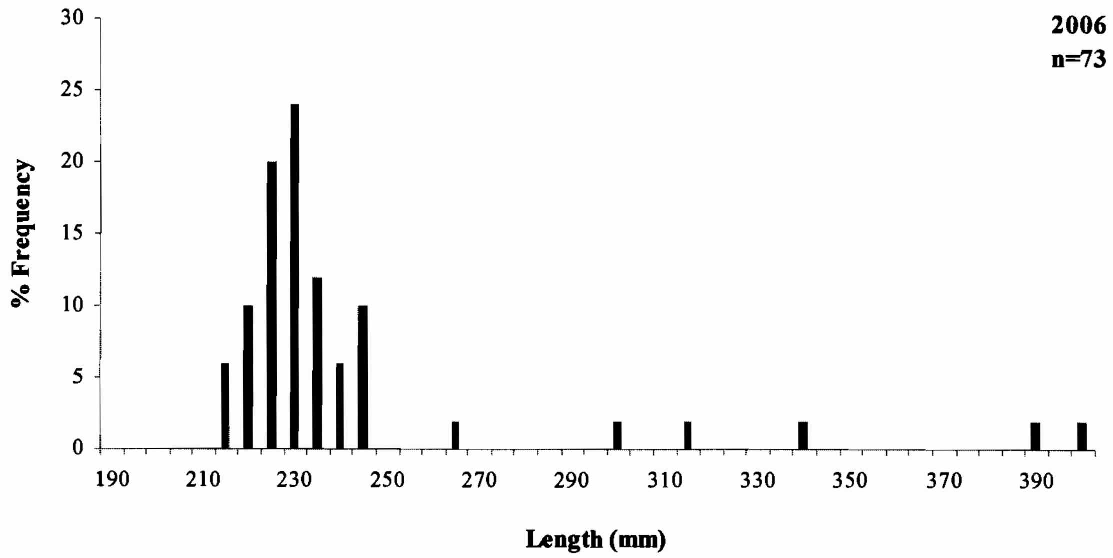




**Figure 3-8**. Length-frequency histograms for Coldstream Creek kokanee spawners in 2004, 2006.

Length-frequency distributions of the 2004 trawl caught kokanee have been superimposed on the graph in Figure 3-9 with the lengths of the 2004 Coldstream Creek spawners. At least four modes are evident with some very large kokanee caught ranging in size from 360-420 mm. On a number of occasions in several reports there has been speculation that Coldstream Creek kokanee may in fact be from Wood Lake. The mode shown in Figure 3-9 at ~ 370—420 mm is nearly identical to the Middle Vernon Creek spawners (see Wood Lake section). Also, the fact that no kokanee were caught in the 2004 fishery despite the size of these spawners lends some credence to this possibility. Halsey (1974) trapped kokanee moving between the two lakes in late October thus the question about which stock spawns where.

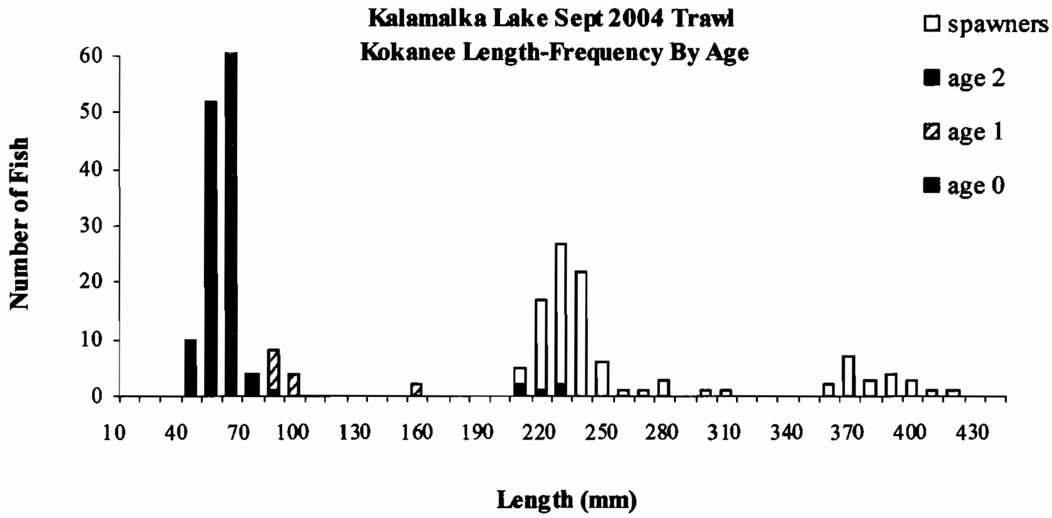



**Figure 3-9** Length-frequency distribution of 2004 trawl caught kokanee from Kalamalka Lake (data from D. Sebastian).

**Population Data**

There are no contemporary estimates of population size for the rainbow or lake trout. Pinsent et al. (1974) estimated the lake could support ~ 65,000 spawners and the abundance estimates for kokanee in 1997 and 2004 suggest the adult population is probably < 100,000.

**Limits to Production**

Kalamalka Lake is the most productive of all the large lakes in the Okanagan Region with a TDS of 290. This would suggest that fish production should be comparatively high but the fish data indicates that production is, if anything, low given the small size of the rainbow trout and kokanee. Spawning habitat for rainbow trout is limited to only one or possibly two inflowing streams while the out flowing stream (Lower Vernon Creek) has a barrier at the outlet. Kokanee are similarly constrained by available stream habitat although there appears to be large areas of suitable shore spawning habitat. Lake trout are shore spawners and probably are not constrained by spawning habitat. If anything, they may be limited by available forage species such as kokanee.

*Mysis relicta* probably constrains kokanee production as high densities have been measured in the lake and this lake has been considered as a candidate for mysid harvest (Andrusak et al. *in*

Andrusak et al. 2005). Mysids on the other hand may serve as a good intermediary food for lake trout.

Water shortage and low flows are the greatest constraints on fish production. All streams are heavily utilized by the agricultural industry and low flow concerns are evident in the file data.

**Theoretical Estimates of Populations Using Biostandards**

The following estimates of potential numbers of catchable fish are clearly "best guesses" in the absence of real fisheries exploitation data. They are intended to place some bounds on possible population sizes and available fish numbers but certainly should not be considered as empirical. There is more reliability placed on the kokanee estimates based on actual data and the biostandard (5 fish/kg) that has been determined through kg/ha/yr estimates on a number of large lakes. This lake can probably support an annual harvest of 6-8,000 kokanee based on the escapement and estimates of yield shown in Table 3-3. Estimates of catch for rainbow trout and lake trout have been used as an estimator until further research is conducted on lake biostandards. It is unlikely that exploitation rates for rainbow and lake trout on Kalamalka Lake are more than 10% and the only catch estimates are from the 2004 census that were less than 200. Lake trout catch was also very low (<100), therefore, potential harvest numbers are also very low.

**Table 3-3.** Estimations of potential numbers of recruitable size fish based on biostandards. Note: 5 kg/ha/yr was used for kokanee based on high TDS.

| Species | # Kokanee @ 5kg/ha/yr | Recruitable Fish Based on Estimated Exploitation Rate | | ~ Potential Allowable Harvest |
|---|---|---|---|---|
| | | 5% | 10% | |
| Kokanee | 64,225 | 3,200 | 6,400 | 6,400 |
| Rainbow Trout | | < 1,000 | < 500 | 500 |
| Lake Trout | | 1,000 | 500 | 1,000 |

**New Management Objectives**

Kalamalka Lake will be managed to meet angler demand for reasonable numbers of smaller trout and kokanee. Large size lake trout will continue to be an attraction for a few serious anglers but no active management of this introduced species is contemplated. Size of kokanee is problematic and this could possibly be improved by increasing the daily catch limit, which is currently two per day, as there is reasonable certainty that annual harvest could be increased. Recovery of water for fish flows and protection of riparian habitat, especially on Coldstream Creek, are key and continuing strategies for this lake. Kokanee will continue to be viewed primarily as forage for the piscivores, especially lake trout.

**Recreational Fishing**

Kalamalka Lake has some limited potential for increased harvest of kokanee, rainbow trout and lake trout. Increasing the size of kokanee would attract more interest and permitting the harvest of more lake trout may provide anglers with more incentive to fish for this introduced species.

**Data Gap Analysis**

A number of data gaps have been identified for rainbow trout and kokanee that inhabit Kalamalka Lake. Priority data requirements are as follows:

1. A biostandard for yield estimates for rainbow trout is critical information gaps that need to be addressed for all the lakes in this plan. Such information would at least allow for some bounds to be established for potential population size.

2. Data most lacking on Kalamalka Lake is for rainbow trout. Estimates of spawner numbers should be attempted on Coldstream Creek.

3. Middle Vernon Creek is currently being investigated for improvements for kokanee production. This work should be expanded to determine if any Kalamalka Lake rainbows utilize this system.

4. Rainbow trout growth data is required to determine if these trout are piscivores or non-piscivores.

5. Annual harvest of rainbow trout needs to be estimated. Basic biological data such as age-at-maturity, size, fecundity and growth need to be determined.

**Priority Tasks for Kalamalka Lake**

1. Estimate current allowable harvest for kokanee.
2. Protect Coldstream Creek; encourage stream stewardship through local conservation groups.
3. Assess all streams to determine extent of adfluvial rainbow trout production.
4. Conduct a random stratified creel census to determine current harvest levels of kokanee and rainbow trout.
5. Obtain specific rainbow trout biological data from the sport fishery during creel census to determine rainbow trout size, age, growth and fecundity.
6. Determine total lake abundance of kokanee through a trawl and acoustic survey.
7. Continue to conduct shore spawner estimates and ground counts of kokanee spawners in Coldstream Creek.
8. Updated heavy metal analysis of lake trout may assist in greater harvest of this introduced species, i.e., presumably lower levels may encourage anglers to fish for them.