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HUNGRY HORSE DAM FISHERIES MITIGATION: KOKANEE STOCKING AND MONITORING IN FLATHEAD LAKE

Final Report 1999

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HUNGRY HORSE DAM FISHERIES MITIGATION:

KOKANEE STOCKING AND MONITORING IN FLATHEAD LAKE

FINAL REPORT - 1999

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Foreword

This report summarizes the results and conclusions of a 6-year evaluation of the test of reestablishment of kokanee in Flathead Lake. For complete analysis, study area description, methods and discussion please refer to the annual project reports listed on the headers and in the literature cited.

Acknowledgments

Through the years many people contributed to the completion of this program. The original "founding fathers" of the program in 1991 were John Fraley, Jim Vashro, Larry Lockard, and Joe DosSantos. This group evolved into the current Implementation Group of Brian Marotz, Joe DosSantos, and Wade Fredenberg, who presided over the end of the kokanee test. Fish were reared at Creston National Fish Hatchery under the managerial supervision of Bob Thompson and Mark Maskill. Hatchery workers who supplied their best effort included Dave Bermel, Don Edsall, Gar Holmes, Jon Lane, John Scott, Jim Till, and a host of seasonal personnel. Stew Kienow and Brian Strohschein of Somers Hatchery were always there for assistance and logistic support. Field personnel who persevered in some precarious weather and spent many hours slicing and dicing specimens include Jon Cavigli, Gary Michael, Dean Nyberg, Tim Taylor, and John Wachsmuth from MFWP and Francis Durgeloh, Les Evarts, Clint Folden, and Dane Morigeau from CSKT. Dr. David Beauchamp provided invaluable assistance in the modeling effort. Administrative staff helped process the numerous versions and conversions of text and data; notably Sharon Sarver and Sharon Hooley. Dozens of others contributed as volunteers, seasonals, net pickers, and strategizers and we owe them all a debt of gratitude. Several Flathead Lake and River landowners were generous in providing access and support. The project was guided initially by BPA Project Manager Fred Holm, and in recent years quite ably by Ron Morinaka, who provided logistical support and encouragement.

Executive Summary

Over a 5-year period (1993-1997) about 5.8 million kokanee (total weight approx. 100,000 kg) were planted into Flathead Lake and the Flathead River system upstream of the lake. Following an adaptive management approach, we stocked kokanee over a broad range of sizes, in a variety of locations and habitat types, and in three different seasons. We explored the variety of conditions available and adequately monitored the results to form several solid conclusions.

Returns of adult kokanee did not achieve, nor even approach, numeric target levels. Furthermore, a fishery never developed for the low-density populations of kokanee that were established. Thus, we conclude the project failed to meet pre-determined biological success criteria: 30% survival of kokanee 1 year after stocking, yearling-to-adult survival of 10%, and annual harvest of 50,000 kokanee ($\geq$11 in) with fishing effort $\geq$100,000 angler hours. Due to these failures, the kokanee test was terminated in 1997.

We concluded, from the sample of fish captured in Merwin traps, that growth and condition factor of stocked kokanee surviving to maturity in Flathead Lake were high. Yearling fish that spent two summers in the lake before maturing (Age 2 spawners) were typically 300-400 mm total length at adulthood. These sizes of mature kokanee were similar to those found in wild spawning runs prior to the collapse of the Flathead Lake kokanee population in the mid-1980s. The potential relationship of food supply to growth at higher kokanee densities in Flathead Lake is unknown and cannot be extrapolated from existing information. In addition, we were unable to resolve uncertainty about the relationship between survival of young of year kokanee and the existing Flathead Lake food web through this study.

All direct and indirect evidence indicates that lake trout predation was the overwhelming limiting factor to yearling kokanee survival. Modeling projections, supported by empirical observation, indicate that kokanee are a preferred and highly vulnerable prey species for lake trout in Flathead Lake. None of the various strategies designed to shelter or mask the plants of kokanee (e.g. thermal refuge or turbid water) were successful at providing refuge for kokanee for more than a few months.

Introduction

Kokanee *Oncorhynchus nerka* were introduced into Flathead Lake in 1916. Once established they became the primary sport fish species in the lake and supported an important fishery for over half a century. The kokanee population began to decline in the 1960s, and the kokanee fishery disappeared from Flathead Lake in the late 1980s. The initial decline of kokanee has been attributed to the long-term effects of the construction and operation of Hungry Horse and Kerr dams combined with excessive harvest by anglers. The kokanee population crash of the 1980s was apparently caused by changes in the lake food web induced by the introduction of opossum shrimp *Mysis relicta* (Beattie and Clancey 1991). Attempts to reestablish kokanee in the Flathead Lake ecosystem, by stocking over 11 million kokanee fry and fingerlings between 1988 and 1991, were unsuccessful.

In 1991, Montana Fish, Wildlife and Parks (MFWP) and the Confederated Salish and Kootenai Tribes (CSKT) wrote a mitigation plan to address the impacts of the hydroelectric development of Hungry Horse Dam on the Flathead Lake and Flathead River system fisheries. One objective of the mitigation goal, stated in the <u>Fisheries Mitigation Plan for Losses Attributed to the Construction and Operation of Hungry Horse Dam</u>, was to: "Replace lost annual production of I00,000 kokanee adults, initially through hatchery production and pen rearing in Flathead Lake, partially replacing lost forage for lake trout *Salvelinus namaycush* in Flathead Lake." In 1993, MFWP, CSKT, and the United States Fish and Wildlife Service (USFWS) wrote, and the Northwest Power Planning Council approved, a mitigation implementation plan that initiated a 5-year program to test the use of hatchery-reared fish to restore kokanee to the lake. Stocking of yearling kokanee into Flathead Lake began in 1993. Intense monitoring of the 5-year "kokanee test" started in 1994 and continued through the end of 1998. The annual stocking objective was 1 million yearling kokanee (6-8 in long). Criteria established to evaluate the success of the 5-year kokanee test were: 30% survival of kokanee 1 year after stocking, yearling-to-adult survival of 10%, and annual harvest of 50,000 kokanee ($\geq$11 in) with fishing effort $\geq$100,000 angler hours.

Summary of Significant Results

The following text summarizes the significant results and conclusions, year-by-year, as presented in the annual project reports. The reader should refer to those reports for more extensive information and detailed discussion.

1993 (Refer to: Deleray et. al. 1995)

In June 1993, about 210,000 yearling kokanee were stocked into two bays on the east shore of Flathead Lake (Table 1). Stocking locations were chosen to provide close access to deep water in areas historically used by kokanee. Following stocking, we observed a high incidence of stocked kokanee in stomach samples taken from lake trout captured by gill nets and angling in areas adjacent to the stocking sites. We concluded that excessive lake trout predation precluded significant survival of kokanee stocked in 1993.

TABLE 1. Stocking, marking, and imprinting history of hatchery-reared kokanee released into Flathead Lake (FHL) and the Flathead River (FHR) system, 1993-1997.

Stocking dates	Stocking sites	Number stocked	Total weight stocked (kg)	Mean length (mm)	Mean weight (g)	Mean condition factor (K)	Oxytetracyline marks and imprinting
1993							
Jun 1-2	Woods Bay and Blue Bay FHL	210,769	8,552	170[c]	40.6	0.85	50% one mark 50% two marks
1994							
Jun 6-10	Big Arm Bay FHL	802,174	33,563	163[c]	40.5	0.88	two marks
1995							
May 30-Jun 1	South Bay FHL	501,572	13,250	149[c]	27.2	0.78	two marks
Jun 16	South Bay FHL	408,578	1,120	69[b]	2.7	---	one mark
1996							
Apr 10	Brennemans Slough	187,304	30	---[a]	---	---	no mark
Apr 15-18	South Bay FHL	938,629	17,598	127[c]	17.4	0.80	2-4 marks
Apr 24	Mill Creek	301,553	49	25[a]	0.2	---	no mark; morpholine imprinted
Apr 30	Flathead River at Kokanee Bend	301,553	49	25[a]	0.2	---	no mark; morpholine imprinted
Aug 6	Finley Point FHL	219,627	797	76[b]	3.6	---	one mark

TABLE 1. Stocking, marking, and imprinting history of hatchery-reared kokanee released into Flathead Lake (FHL) and the Flathead River (FHR) system, 1993-1997.

Stocking dates	Stocking sites	Number stocked	Total weight stocked (kg)	Mean length (mm)	Mean weight (g)	Mean condition factor (K)	Oxytetracyline marks and imprinting
1997							
May 19- May 21	Northwest Quadrant FHL	708,798	16,239	140[c]	23.0	0.83	one mark
Jun 23	Mill Creek	275,964	166	42[a]	0.6	0.81	not marked
Jun 23	Mill Creek	171,983	482	70[b]	2.8	0.82	not marked
Aug 28 - Sep 4	North End FHL & Mouth FHR	750,000	2,243	71[b]	3.0	0.84	one mark
Sep 15	Mouth FHR	41,951	2,176	184[c]	55.0	0.88	two marks
Oct 1	Mouth FHR	2,347	2,347	361[d]	454.0	0.97	adipose clip
TOTALS		**5,822,802**	**98,661**				

[a]Fry; [b]Fingerlings; [c]Yearlings; [d]Adult

1994 (Refer to: Deleray et. al. 1995)

In June 1994, over 802,000 6-in yearling kokanee were stocked into Big Arm Bay (Table 1, Figure 1). We expected that a strategy of saturation planting in an area believed to have lower lake trout densities would maximize short-term survival of stocked kokanee. This stocking was timed to coincide with near optimum water temperatures and an anticipated spring zooplankton bloom. A net-pen experiment conducted at the time of stocking demonstrated that kokanee reared to yearling size in the hatchery and then transplanted to net pens in the lake, in the absence of predation, adjusted to conditions in Flathead Lake and utilized available zooplankton during June and July without suffering substantial post-stocking mortality. Stocked free-ranging kokanee, captured after several months in the lake, exhibited good growth and condition. We concluded that the food supply in Big Arm Bay did not limit survival of stocked kokanee during summer months.

The 1994 monitoring objective was to quantify lake trout predation of kokanee in Big Arm Bay over the first 8 weeks following stocking. The estimate of kokanee consumption by lake trout was based on a stratified hydroacoustic estimate of lake trout abundance (approx. 7,850 fish over 300 mm in total length), incidence of kokanee per lake trout stomach sample (estimated range 0.22-2.99 kokanee/lake trout stomach depending on stratum), and a calculation of gastric evacuation rate (47 hours for a lake trout to digest a kokanee).

As in 1993, the monitoring results from the 1994 kokanee plant demonstrated that lake trout predation was the primary factor reducing survival of stocked kokanee. We estimated lake trout consumed a minimum of 232,000 kokanee in Big Arm Bay during 8 weeks following stocking. This loss represented 29% of the kokanee stocked. Due to hydroacoustic limitations in identifying bottom-oriented lake trout, we believe we underestimated the true abundance of lake trout, which also led to an underestimate of kokanee mortality.

By the fall of 1994, we estimated that 12.7% of surviving kokanee (up to 72,000 fish) were removed from the population due to early maturation of males (ie. “jacks”). The sum of the two mortality components, loss due to predation in the first 8 weeks (232,000) plus the loss due to early maturation (72,000), accounted for at least 304,000 (38%) of the 802,000 fish planted in 1994. These estimates did not account for documented but unquantified additional losses such as predation outside Big Arm Bay, predation in the months following July, and predation from fish species other than lake trout (such as bull trout *Salvelinus confluentus* and northern pikeminnow *Ptychocheilus oregonensis*).

1995 (Refer to: Hansen et. al. 1996)

We modified the stocking plan again in 1995 by changing the release site to South Bay (Figure 1). We assumed that the relatively warm and shallow waters of South Bay would support fewer lake trout than other parts of Flathead Lake during summer and anticipated that spatial isolation would result in a reduction in immediate post-stocking losses from lake trout predation. On May 30 and June 1, 1995, we stocked 502,000 yearling kokanee, and subsequently released 409,000 young-of-year kokanee on June 16 into South Bay (Table 1).

We regularly sampled fish in South Bay with gill nets in 1995, but only began to consistently capture kokanee about 1 month after stocking. The delay was attributed to the fact that minimum capture size of the gill nets exceeded the length of most of the kokanee at

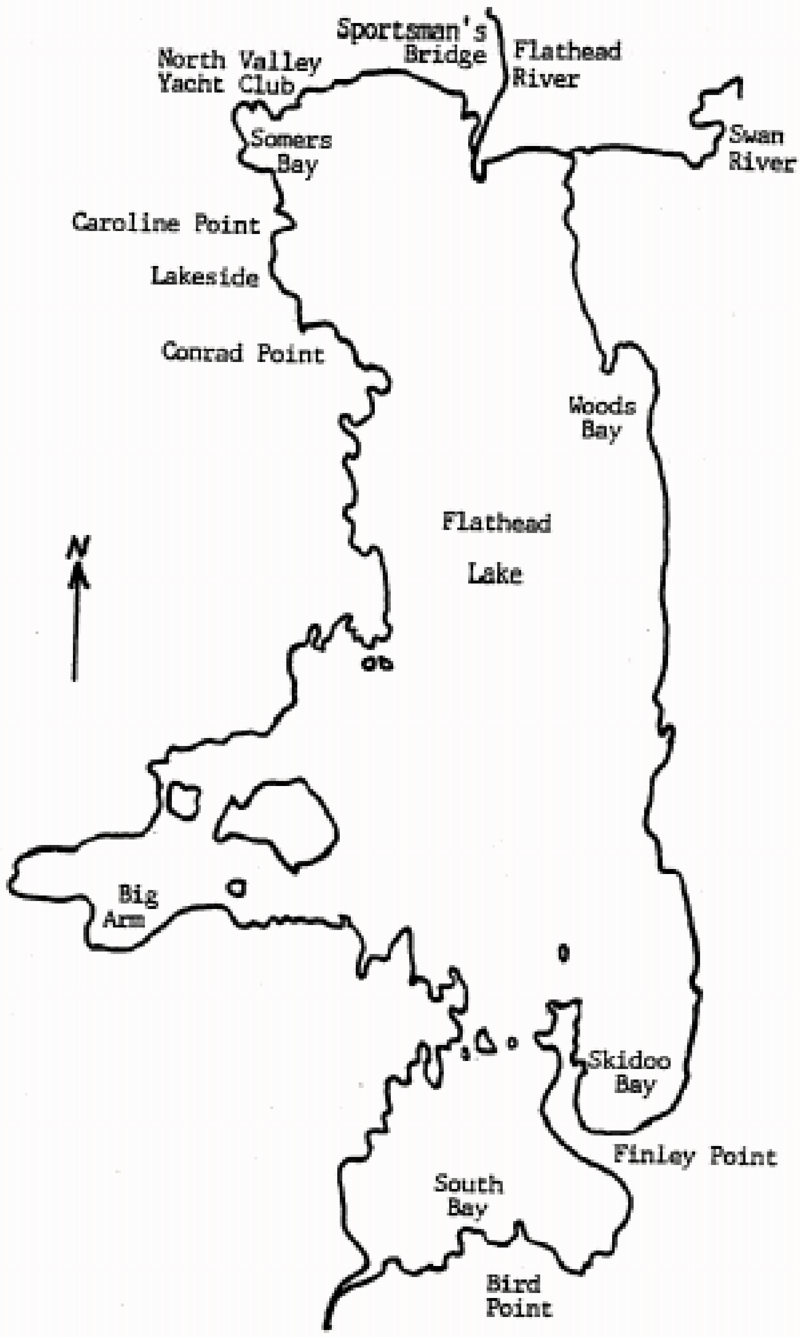

FIGURE 1. Flathead Lake and Flathead River showing general location of bays, sampling sites, and fish stocking locations.

the time the kokanee were released. The kokanee that we did capture during the summer of 1995 had relatively high condition factors (K), and condition factors increased progressively from the time of release to the time of the last measurements in August.

The abundance of alternative prey for lake trout in South Bay in 1995 may have also reduced predation on kokanee. Lake trout captured in South Bay during the study period preyed primarily on lake whitefish, followed by kokanee and yellow perch. Kokanee accounted for only 12% of the prey fish of lake trout captured in South Bay in 1995, whereas in Big Arm Bay in 1994 kokanee were 81% of the fish diet (numerically). Thirty-seven percent of lake trout captured in Big Arm Bay during the first 8 weeks following the release of kokanee in 1994 contained kokanee in their stomachs. During the same 8-week period in 1995, only 14% of lake trout captured in South Bay contained kokanee.

The largest number of kokanee found in a single lake trout stomach in South Bay in 1995 was four, and the average was 0.3 kokanee per lake trout. During 1994 in Big Arm Bay, the largest number of kokanee we found in a single lake trout stomach was 21, and the average was 0.9 kokanee per lake trout. Lake trout were also present in higher densities (indicated by gill-net catch rates) in Big Arm Bay in 1994 than in South Bay in 1995.

From these data, we concluded that higher short-term (post-stocking) survival of planted kokanee occurred in South Bay than in Big Arm Bay, although we were not able to develop quantitative estimates. The comparative survival advantage was attributed primarily to the existence of a thermal refuge for kokanee from lake trout in South Bay during the summer months. Lake trout abundance in South Bay declined in spring with increasing water temperatures, then increased in fall as water temperatures declined. Avoidance of warmer water appears to be the best explanation for the movement of lake trout out of South Bay.

Through analysis of Merwin trap results from Flathead Lake and in-hatchery studies we concluded that regardless of whether they were held at the hatchery for broodstock or planted as yearlings into the lake, when kokanee were hatched and reared in confinement for 18 months about 13% matured as "jack" males at age 1, about 81% matured at age 2 and the remaining 6% matured at age 3. Based on growth rates documented in 1994 and 1995, the largest stocked yearling kokanee were expected to enter the fishery (minimum 11 inches total length) after about 4 months in the lake. This maturity schedule would make most stocked yearling kokanee available in Flathead Lake for anglers to harvest for about a 1-year period (fall to fall) prior to spawning and dying.

In 1995, we also monitored the kokanee cohort that was stocked in Big Arm Bay in 1994 in order to evaluate success criteria for yearling to adult survival. We conducted a basin-wide search for mature kokanee during October and November 1995, and set Merwin traps near the 1994 and 1995 release sites. In the Merwin traps we captured 122 kokanee in Big Arm Bay and 223 kokanee in South Bay. We concluded, based on examination of oxytetracycline marks, that 65 kokanee caught in Big Arm Bay (53%) and 1 kokanee caught at the South Bay site (0.4%) were planted in 1994. These results indicated a strong tendency toward homing of adult spawners to the stocking locations. We observed no staging or evidence of spawning at any of the other historically used Flathead Lake and Flathead River sites and considered it unlikely that large concentrations of spawning kokanee went unnoticed by agency personnel and the public. Consequently, we concluded success criteria for spawning escapement were not met for the 1994 cohort. Success criteria for establishment of a fishery was not evaluated between 1993 and 1995 because fishing for kokanee on Flathead Lake had been closed by regulation.

Kokanee released in 1994 and 1995 maintained desirable growth rates and condition factors during the monitoring periods. We concluded in 1995, as we had in 1994, that lake trout predation was the primary factor limiting the success of kokanee restoration in Flathead Lake. Releasing kokanee in South Bay in 1995 resulted in substantial reductions in immediate post-stocking mortality of kokanee relative to earlier release sites.

From 1993 through 1995, numbers of kokanee released annually into Flathead Lake were less than specified by the stocking objective. Complications at the hatchery included insufficient egg supplies and chronic losses due to furunculosis (a bacterial disease).

1996 (Refer to: Carty, Fredenberg et. al. 1997)

In April 1996, we stocked 939,000 marked kokanee yearlings into South Bay and 790,000 unmarked kokanee fry at three sites in the Flathead River system. In August, 220,000 marked kokanee fingerlings were boat-planted into Flathead Lake off Finley Point (Table 1). The egg supply problem of earlier years was solved by successful development of a hatchery broodstock and resultant egg production from that broodstock in 1994 and 1995.

In 1996, we conducted system-wide monitoring and used bioenergetics modeling to evaluate success criteria for survival and spawning escapement. Monitoring in 1996 was also designed to determine if improved post-stocking survival of yearlings planted in 1995 resulted in greater adult survival and escapement in 1996. Kokanee fishing on Flathead Lake was open in 1996 from May 18 through September 15, and we conducted a limited creel survey to begin evaluating success criteria for establishment of a fishery.

Spring and early summer monitoring (gill netting, angling, Merwin trapping, electrofishing, and visual surveys) of fish stocked in 1996 revealed considerable mortality of yearling kokanee from lake trout predation during the first month after stocking. Additionally, we documented the loss of yearling kokanee from downstream movement out of Flathead Lake and migration of some yearling kokanee north from South Bay into the main body of Flathead Lake. We concluded that the mid-April release date (dictated by fish health concerns at the hatchery) resulted in post-stocking losses of a higher magnitude than those experienced in 1995 when kokanee were stocked at this site around June 1.

Drift netting in Mill Creek revealed that some of the kokanee fry released directly from Creston Hatchery emigrated rapidly to the Flathead River. However, we did not track their movements beyond that point. We did not track movements of kokanee fry released into the Flathead River system at Brenneman's Slough or Kokanee Bend.

An August hydroacoustic survey, combined with gill netting, located kokanee only in the northwest part of Flathead Lake. The hydroacoustic estimate (47,700 kokanee) was based, in part, on 13 unmarked kokanee (length range, 170-195 mm) caught in gill nets set near Caroline and Conrad points; the origin of these 13 fish was not determined.

Monitoring in the fall (Merwin trapping, gill netting, and visual surveys), designed primarily to measure returns from the 1995 cohort, indicated that few kokanee stocked in spring 1995 and few “jack” males from the spring 1996 plant survived to maturity. A few kokanee fingerlings stocked in 1996 off Finley Point were captured in Merwin traps in South Bay and Gravel Bay on the east lakeshore.

The creel survey showed no evidence that a kokanee sport fishery developed in 1996. Although 77% of anglers interviewed (58 of 75 responses) knew about the program to reintroduce kokanee to Flathead Lake, only 45% (115 of 254 responses) knew that kokanee fishing was open on Flathead Lake. Few (<2%) anglers interviewed had fished for kokanee in 1996, and none of the anglers interviewed had caught kokanee in Flathead Lake in 1996.

Bioenergetics modeling predicted that nearly all yearling kokanee stocked into Flathead Lake would be eaten by lake trout within 1 year after stocking. Model simulations and monitoring data from 1993-1996 revealed that much of this predation occurred within the first month after stocking. The 1993-1996 monitoring data also showed that lake trout (when their movements are not limited by water temperatures >15^{o}C) moved into areas where kokanee were stocked and selectively fed on kokanee.

We concluded that none of the success criteria were met in 1996, and bioenergetics modeling indicated that these criteria could not be met under current stocking levels (up to 1 million yearling kokanee) using existing stocking strategies (large numbers of kokanee released at one or two sites).

1997 (Refer to: Carty, Deleray et. al. 1997)

In May 1997, we stocked about 709,000 yearling kokanee at four sites in the northwest part of Flathead Lake (Table 1). Stocking coincided with turbid inflows from a near-record high spring runoff in the Flathead River. We also stocked about 276,000 kokanee fry and 172,000 fingerlings directly into Mill Creek at the hatchery and another 750,000 fingerling kokanee into the north end of the lake and mouth of the Flathead River (Sportsmans Bridge) in late August and early September. Another 42,000 yearling kokanee and 2,347 adult males (excess brood) were stocked at the mouth of the Flathead River in mid-September and the first of October, respectively. This concluded the stocking phase of the kokanee test, with 1.95 million fish planted in 1997.

From mid-May through late September 1997, we monitored water temperature and transparency and sampled crustacean zooplankton in Somers Bay and off Conrad Point. Surface waters warmed from 10-14°C in mid-May to a peak of 22°C in late August, then declined to about 16°C by late September. Due to exceptionally high runoff during 1997, water clarity was lower than normal, with Secchi disk readings of only 0.5 m in mid-May gradually increasing to as high as 7.9 m by late September.

Copepods (*Diaptomus spp.,* with lower numbers of *Cyclops spp.*) were generally more abundant than cladocerans (*Daphnia spp.,* with lower numbers of *Bosmina spp.*) during summer 1997 at sample sites in Somers Bay and off Conrad Point. Similar patterns of abundance were observed at both sample sites, although zooplankton levels at the Somers Bay site were slightly higher. Peak levels of the four genera observed at Somers were: *Diaptomus* = 8.1 / L on June 25; *Cyclops* = 5.1 / L on July 11; *Daphnia* = 2.8 / L on June 25; and *Bosmina* = 1.9 / L on May 15. The same site was sampled monthly from June 1980 through November 1981 by Leathe and Graham (1982) and comparable peak levels of these four genera occurred during that period. However, larger predatory zooplanktors such as *Leptodora kindti* and *Epischura spp.* that were common in 1980-81 (and an important component of the kokanee diet at that time) were absent from 1997 samples. Further evaluation of the zooplankton food web and its relationship to kokanee diet is needed.

A vertical gill-net survey and hydroacoustic survey of Flathead Lake was conducted in August 1997. A total of 33 kokanee were captured in gill nets in the north half of the lake, 31 of which had oxytetracycline marks characteristic of the May plant of yearling fish. The other two fish were unmarked. Hydroacoustic data have not been summarized and correlated with the gill net catch data to produce population estimates, but kokanee were the second most abundant species sampled after lake whitefish.

Fall Merwin trapping at two of the four yearling stocking locations (North Valley Yacht Club near Somers, Caroline Point Marina south of Lakeside) captured 510 kokanee, the highest number to date. Nearly 99% of the captured fish were males, indicating a strong return of “jacks” from the spring 1997 yearling plant. Oxytetracycline mark analysis verified this origin for 92% of the samples.

A single brook stickleback *Culaea inconstans,* captured in the Caroline Point trap on December 9, was apparently the first verified occurrence of this species in Flathead Lake. Merwin traps operated in the Flathead River sloughs (Fennon and Half Moon), under a separate project, incidentally captured 31 kokanee during spring and fall operations. Most were from the spring yearling plant in the lake, indicating straying from the lake into the river.

Staging and spawning surveys, conducted in the lake and river system during the fall of 1997, found 15 fish along the west shore (Hatchery Bay and Stoner Creek) that were similar in size and appearance to the “jacks” from the yearling plant. An October 27 snorkel survey in the Swan River below Bigfork Dam located 40-50 adult males that were visually recognizable as surplus adult males that were stocked at the mouth of the Flathead River on October 1. Six adult kokanee were collected from Mill Creek (near the hatchery) by electrofishing during fall 1997. All but one were determined to be hatchery brood fish and were either returns from the October 1 plant or escapees. The sixth was an extremely large (508 mm), bright red male of undetermined origin. No other concentrations of spawners were identified in the lake or river during 1997.

One unmarked kokanee was caught by an angler on July 19 near Woods Bay. Thirty-nine kokanee were also recovered from lake trout stomachs (volunteer angler returns) between the summer of 1997 and the end of February 1998. Oxytetracycline mark analysis of these fish indicated 59% originated from the spring yearling plant, 10% from the fall fingerling plant, and 31% were unmarked. The persistent appearance of unmarked kokanee in the population may indicate that some natural reproduction (or emigration from upstream waters) is occurring.

In summary, the fall 1997 monitoring results indicated that the over-summer survival of spring-stocked yearling kokanee may have been substantially enhanced by the visual isolation provided by the turbid water. The fish appeared to have dispersed throughout the north end of the lake (and lower river system) and evidence indicated they were being preyed on by lake trout. The initial “jack” return was the highest to date. Growth and condition were consistent with past values from other stocking locations, and zooplankton monitoring indicated peak levels of crustacean zooplankton were similar to that recorded in 1980-81 at the same monitoring sites.

A Merwin trap set in South Bay off Bird Point (the 1995 and 1996 stocking location), captured 29 kokanee. Low returns to the South Bay trap reinforced our conclusion made in 1996 that the strategy of stocking in South Bay in 1995 and 1996 provided only a temporary thermal refuge from lake trout.

None of the success criteria: 30% survival of kokanee 1 year after stocking, yearling-to-adult survival of 10%, and annual harvest of 50,000 kokanee (≥11 in) with fishing effort ≥100,000 angler hours were met in 1997. As a result, the Hungry Horse Implementation Group elected to terminate all further stocking of kokanee in Flathead Lake. The monitoring phase continued.

1998 (Refer to: Fredenberg 1998)

No fish were stocked in Flathead Lake in 1998. Kokanee monitoring activities were considerably reduced from levels of the previous several years. A comprehensive lakewide creel survey, using the same methodology as the 1992-93 survey, was begun in July and was scheduled to run for one full year. During the summer of 1998, creel clerks received only one report of an angler-caught kokanee; a fish captured on July 2 at West Shore State Park. The catch was not visually verified by the clerk.

Fall Merwin trapping at the two north lake sites (Yacht Club and Caroline Point) was repeated in order to assess adult returns from the spring 1997 yearling plant. Seventy-nine mature kokanee were captured; 59% were males and 41% were females. Based on oxytetracycline mark analysis about 93% of returns were from the 1997 yearling spring plant, 4% were unmarked, and 3% were from the fall yearling plant. No searches for redds or spawning fish were conducted in 1998. A few incidental reports of angler-caught kokanee or lake trout with kokanee in their stomachs were received, but not generally verified.

The low return rate of adult kokanee to the stocking locations in 1998, despite relatively high returns of “jacks” in 1997, corroborates previous years observations that kokanee survival to adulthood is largely precluded, apparently due to lake trout predation. Despite stocking of nearly 1.7 million kokanee fingerlings and yearlings into Flathead Lake in 1997, under conditions we viewed as favorable for survival, losses to predation and other factors again precluded the establishment of a fishery in 1998.

This report completes our targeted efforts to monitor the kokanee test. Unmarked kokanee fry and fingerlings distributed from the hatchery in 1997 may continue to show up in the system through the fall of the year 2000. After that time, any kokanee observed in Flathead Lake will likely be naturally produced and/or the result of drift from upstream waters.

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