SUMMARY REPORT

OKANAGAN LAKE ACTION PLAN

YEAR 1 (1996-1997) AND YEAR 2 (1997-1998)

INTRODUCTION

Okanagan Lake and its tributaries have long provided aboriginal people, commercial and sportfishers with an abundance of fish, especially kokanee and rainbow trout. Hydro development in the 1940-1950s on the lower Columbia River precluded most salmon stocks from ascending to the Okanagan Lake system although a remnant population of sockeye salmon continue to spawn downstream of Vaseux Lake. Minor commercial fisheries for trout and kokanee existed in the early part of the twentieth century but they were never significant and sportfishing eventually became the dominant method of catch by the early 1960s. The peak of sport fishing effort and harvest occurred in the late 1960s and early 1970s. At that time the public perceived a bright future for a growing recreational fishery. Early in the 1970s and about the time the comprehensive Okanagan Lake Basin Study commenced, Fisheries Managers began to recognize signs that the sport fisheries for kokanee and the priced rainbow were in difficulty.

The most obvious problem was deterioration of spawning and rearing stream habitat due to flood control measures and the high demand of water for irrigation. Many of the streams today are entirely channelized and some are devoid of water during the spawning season. Kokanee shore-spawning habitat has also been negatively impacted by lake drawdown and shoreline development due to high human population growth. A downward spiral in kokanee abundance began in the mid 1970s and has continued through the 1990s.

Local anglers and naturalists have been greatly concerned with the decline of Okanagan Lake fish. Pressure on the provincial government mounted during the 1990s to enact some remedial measures. Closure of the Skaha hatchery in 1990s further aggravated public sentiment and the demand for action accelerated. In 1995, the Ministry of Environment Lands and Parks (MELP) Fisheries Branch responded to public concerns by closing the kokanee sport fishery to conserve the remaining stock. A commitment was also made to involve the public in developing a plan to deal with the tenuous state of Okanagan Lakes' fisheries.

A technical workshop attended by various resource experts and some public members was held June 28-30, 1995, at the Okanagan College campus. The workshop used an Adaptive Environmental Assessment (AEA) format whereby Dr. Carl Walters of the UBC Fisheries Centre led an interdisciplinary group of participants through interpretation of existing data, ideas and policy issues. The workshop reviewed changes to the lakes' nutrients, water quality, plankton, kokanee and rainbow trout populations. A review of the possible reasons for the decline of kokanee was conducted and potential restoration options were discussed.

Based on input from this workshop a working computer simulation model was used for predicting the lakes' production levels including predictive capability for sport fish stocks. **A key finding was that kokanee declines in both stream- and shore-spawning could be attributed to reductions in nutrients and/or due to competition from the introduced mysis shrimp.**

A report documenting the results of the workshop was produced and it included a comprehensive and forward thinking **20-Year Okanagan Lake Action Plan (OLAP).** The OLAP work commenced in 1996 and this report summarizes the progress and findings from 1996 and 1997.

BACKGROUND

It is important to understand that Okanagan Lake is one of several large lake systems in southern British Columbia that has undergone major changes in fish populations. Kootenay, Arrow and Shuswap lakes have also experienced large-scale declines in kokanee and/or trout populations. Reasons for such drastic declines are complex and varied, and solutions will require long-term research and adaptive management experimentation. The workshop participants concluded that no "quick fix" solutions were readily apparent for Okanagan Lake and that a long-term effort was required to resolve the problems. When faced with such large scale problems elsewhere in North America fisheries managers have usually opted for increasing the specie of concern (e.g. kokanee in Okanagan Lake) by means of hatchery introductions. A second strategy has been the introduction of a fish species to deal with the perceived problem - in the case of Okanagan Lake, the introduced shrimp *Mysis* *relicta*.

These two management strategies were rejected at the Okanagan workshop because of the overriding evidence that lake productivity (capacity) had declined so much that fewer fish can be supported today as compared to 20-30 years ago. **It is believed the primary reason for this change is due to a reduction in phosphorus loading and increased competition for food between mysis shrimp and kokanee fry.**

With such a fundamental problem facing Okanagan Lake one may well ask, "What can be done if lake productivity has declined so much?"

In addition to habitat restoration two options have been identified for increasing the carrying capacity of Okanagan Lake in order to increase kokanee numbers:

1) **increase the lake's productivity by introducing fertilizer similar to the successful experiment on Kootenay Lake;**
2) **reduce the mysis population to ease competition with kokanee.**

The fertilization strategy was rejected due to differing regional interests regarding water quality vs. fish. Consequently, mysis control, habitat protection and stream restoration have become the **focus** of the Okanagan Lake Action Plan.

The Action Plan encompasses a twenty-year period in four blocks of five years duration (detailed in Appendix 1). Initially Phase 1 is directed towards conservation of native stocks, habitat protection and collection of priority information especially on mysis and kokanee. This report summarizes results of the first two years of Phase1 conducted by an impressive number of fisheries biologists, technicians and the public. A list of participants and their primary focus is provided in Appendix 2. Expenditures for fiscal years 1996-97 and 1997-98 are provided in Appendix 3.

RESULTS AND DISCUSSION

Implementation of the various components of Phase 1 of the Action Plan began in 1996 with most field projects well underway by 1997. As with all interdisciplinary studies some work can be conducted in a short time frame and the results quickly evident. Other projects, particularly habitat restoration and research projects, evolve much slower with results evident only after several years. Initial acceptance of the Action Plan by the public and management agencies recognized there were no quick fix solutions to Okanagan Lake kokanee problems and a long-term view was essential. Nevertheless after only two years momentum is building and already there are some positive results and preliminary findings that can and should be acted upon.

Habitat protection and restoration

Habitat protection measures have focused on two specific points. Firstly, the future of wild kokanee stocks is highly dependent upon preservation, protection and conserving stream habitat and specific shorelines. The key to stream protection is informing and educating the public on the value of stream protection, hence the considerable effort to provide the public with several information bulletins and brochures on stream and lakeshore protection. The Lake Care brochure is directed at the public and makes a good case for public stewardship of the resource. The public advisory mail-outs are aimed at water users in the Okanagan Valley, as conservation of water is imperative if stream-spawning fish are to have a future. Shoreline protection is equally important for the shore-spawning component. The study on the relationships between development of shoreline habitat and historic kokanee shore-spawning is expected to provide some key tools for protecting kokanee shore-spawning habitat.

The second broad measure related to habitat protection is recovery or restoration of fish habitat. With respect to shore-spawning kokanee, the review of the operating rule curve for lake levels has significant promise. If it can be demonstrated that the rule curve can be modified to better accommodate shore-spawners without significantly impacting other water users, then this would be a very positive step. The work to date on shore-spawners at Bertram Beach indicates egg loss due to stranding and desiccation. Analysis of the drawdown on Okanagan Lake confirms that high egg/alevin losses will occur with a drop of 0.4 m in the lake level between October and March.

Initial evaluations of stream restoration potential on Trout and Mission creeks also hold promise. Implementation of some or all of the proposed work would be a first good step to kokanee restoration and send a clear signal to the public that the Action Plan is serious about protecting and restoring valuable fish habitat.

Limnology

Routine monthly water sampling of physical, chemical and biological parameters was conducted in 1996 and 1997. Emphasis was placed on standardizing sampling sites and methods (Fig. 1). Kalamalka Lake was added to the sampling program in 1997 for comparison purposes. Both lakes support kokanee and mysids yet Kalamalka kokanee exist in relatively good numbers despite high densities of mysids compared to Okanagan Lake.

Both Okanagan and Kalamalka lakes were thermally stratified from July-October with the thermocline at a depth of 10-20 m. Surface temperatures were often in excess of 20°C in August and September. By late November both lakes had cooled and were well mixed with the upper 45 m isothermal at 11°C. Oxygen levels were routinely above 6 mg/l in both lakes year round. The notable exception was in Armstrong Arm where oxygen depletion was quite evident (<1mg/l) in the hypolimnion. This anomaly is discussed further with regard to mysis distribution.

Water clarity readings were lower at the north end of the lake with the lowest readings in Armstrong Arm. Kalamalka Lake readings were similar to the main basin of Okanagan Lake. Low oxygen, lower water clarity readings and generally higher nutrient levels in Armstrong Arm suggest this portion of the lake is more productive reconfirming previous research. The nitrogen and phosphorus concentrations (total and dissolved) indicates that Okanagan Lake is oligotrophic (fairly unproductive) except Armstrong Arm. **Phosphorus concentrations suggest that it is limiting growth in Okanagan and Kalamalka lakes although dissolved inorganic nitrogen may be seasonally co-limiting in Okanagan Lake.**

Interestingly, the phytoplankton community is dominated by blue-green algae (Cyanobacteria) followed by diatoms. Blue-green algae are usually associated with eutrophic lakes but this is hardly the case for Okanagan Lake, which is oligotrophic except for Armstrong Arm. However, recent work indicates that several other BC lakes that are oligotrophic (unproductive) are also dominated by blue-greens. The species mix of phytoplankton in Okanagan Lake and Kalamalka Lake has not changed over the last three decades.

Zooplankton is dominated by copepods with cladocerans - which are the preferred food item of kokanee - only present in low densities in the late summer and fall months. They were found in the highest densities in Armstrong Arm in late 1997. Densities of copepods and cladocerans in 1996 and 1997 were comparable to earlier surveys in the 1970s.

Mysis relicta are believed to be one of the primary reasons why Okanagan Lake kokanee have declined since they are competitors with kokanee for the same zooplanktors. Mean seasonal peaks of ~ 450/m^2 of mysids were found in August in Okanagan Lake while the mean in Kalamalka Lake was approximately twice that (~ 1000/m^2). These densities are higher than those found in Kootenay Lake where mysids have declined in recent years. Distribution and abundance of mysids in Okanagan Lake are well documented and this information will be very useful in any mysid harvest strategy being contemplated.

One interesting feature of mysids in Okanagan Lake was their temporal distribution in Armstrong Arm. In September 1997, their density was approximately 1000/m^2. By December 1997, their density had declined to less than 10/m^2. This decrease coincided with decreased oxygen levels in the hypolimnion to less than 1 mg/L and suggests that mysids avoid oxygen-depleted water.

Investigation of the feasibility of large-scale commercial harvest of mysids is a high priority of the Okanagan Lake Action Plan. Contact was made with the Idaho Department of Fish and Game (IDFG) because commercial harvest of mysids had already been attempted on Lake Pend O'Reille. The IDFG confirmed that commercial harvest was viable. Okanagan Regional Fisheries issued two collection permits in 1996 and five in 1997. One permittee harvested over 1,000 kg of mysids in one year and was active in 1997 and 1998. Kokanee by-catch has been acceptable to date.

In 1997, a contract was let to develop a pilot scale beam trawl net which would be just over half the size of a commercial shrimp beam trawl. A 10m-aluminum beam spreads the net that is 26 m long. In March 1998, this net was tested on the south end of Okanagan Lake. **The net appears to work and several kilograms of mysids were captured. This project will be actively pursued in 1998 with the focus on maximizing mysid catch and minimizing kokanee by-catch.**

Preliminary results of the mysid pheromone research also show promise. If male mysids are attracted to females through the release of a sex pheromone then it may be possible to use the attractant to harvest mysids. Sex pheromones have been used as a biological control method for other pests so this mysis project is well worth pursuing at the same time as the harvest project.

Kokanee populations

Hydroacoustic and trawl net surveys were conducted in 1996 and 1997. This work has been on going since 1988 and provides **valuable estimates of in-lake abundance of all ages of kokanee** and provides comparative time series information. Total abundance was estimated at 8.2 million in 1996 and only 5 million in 1997 (Fig. 2). These estimates compare with a range of 5-14 million from 1988-1997 and confirm what the spawning counts have indicated; **a decline in numbers over time**. Fry abundance has declined from 9.0 to 2.9 million over two cycles from 1989 to 1996 (Fig. 3).

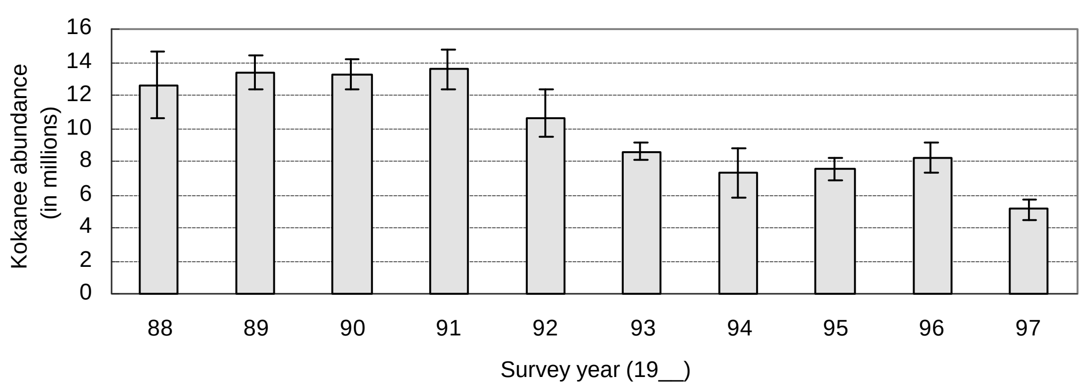

Figure 2. Kokanee abundance in Okanagan Lake based on fall acoustic surveys, 1988-97 Error bars represent 95% confidence limits.

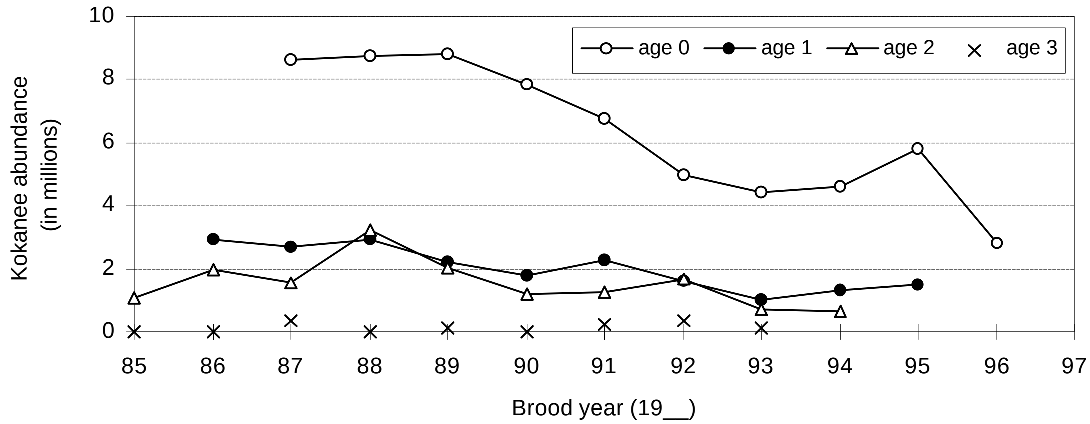

Figure 3. Trends in kokanee abundance by age and brood year based on acoustic and trawl surveys conducted in 1988-97.

The trawl work also provides very good biological data on length-at-age, growth and shore-spawner distribution. Although sample size is small there appears to be a correlation between the distribution and abundance of trawl-caught mature fish and location and possibly abundance of shore-spawners. As well, there appears to be a correlation between shore-spawner counts and subsequent in-lake fry estimates. This correlation requires further examination but if it holds true then it provides another means of corroborating the shore-spawner counts.

A considerable amount of work was conducted on shore-spawning kokanee in 1996 and 1997. The primary focus has been improvement of enumeration methods as well as standardizing method of counting. The prototype remote camera system tested appears to have good potential to assist in determining relative abundance indices at select beach sites. Combined with standard shore counts the camera technique should increase the confidence in shore counts.

The shore count indice in 1996 was only 15,800 and 28,000 in 1997 (Fig. 4). These counts compare with 200,000-730,000 in the 1970s. The 1996 and 1997 counts are some of the lowest in 30 years. Low numbers, patchy distribution and variations in spawn timing all contribute to some questioning of efficacy of the counts. This was especially true for 1997 when the shore-spawners spawned at least one week earlier than usual and the results are considered under estimates. Behavioral studies and biological monitoring of shore spawners at Bertram Beach have provided some useful insights into shore spawning activities. Bertram Beach has been established as an index station for shore counts. Depth of egg deposition relative to water levels suggests that **a high percentage of eggs/alevins are stranded** some years as a result of the current operating regime regulating the lake level.

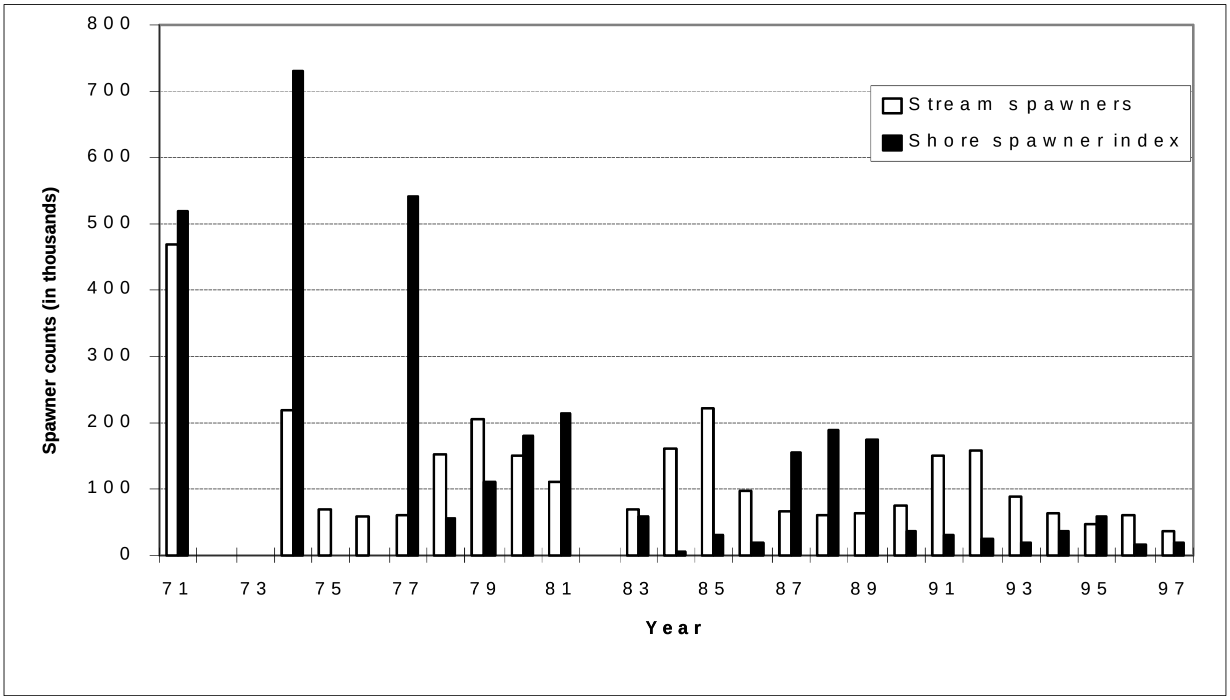

Figure 4. Okanagan Lake kokanee stream escapements and indices of shore spawners.

Stream-spawner estimates were about 61,000 in 1996 and only 35,000 in 1997. Similar to the shore counts, the stream estimates for 1996-97 were some of the lowest on record compared to 200,000-370,000 in the 1970s. Mission Creek had only 34,700 (96) and 18,300 (97) compared to 100,000 recorded in the early 1990s. Clearly **escapements are downward trending** with little reason to think this will change in the near future especially when the trend data from the hydroacoustics surveys are taken into account.

A significant amount of baseline data is being compiled on Okanagan lake kokanee biology. Age at maturation and morphological characteristics are being examined. Differences in molecular genetics between shore-spawners and stream-spawners are being investigated. All of these measures are being undertaken to strengthen the kokanee database and provide the correct information for future rebuilding of the stocks.

PRELIMINARY CONCLUSIONS

The following are some tentative conclusions drawn from the array of work conducted in 1996 and 1997:

- A considerable amount of effort has been expended on informing the public of the value of protecting fish habitat. It is only through public recognition and acceptance of resource ownership (i.e. resource stewardship) that the resource base will be ensured appropriate protection.
- Analysis of the rule curve for lake level regulation may provide some alternatives that could benefit shore-spawning kokanee without impacting on other uses.

- Watershed restoration project proposals on Trout and Mission creeks have potential.
- In-lake acoustic and trawl work provides valuable time series data sets on kokanee.
- Stream-spawning counts are valuable for understanding long term trends.
- Shore-spawner counts can only be used as an indice of abundance and methods require further improvement.
- The kokanee population will not improve significantly in the next 2-3 years.
- Limnology of Okanagan Lake is similar to other large lakes in southern BC including Kalamalka Lake. Differences between Kalamalka and Okanagan lakes are capacity related.
- Phosphorus is limiting in Okanagan Lake.
- Initial mysid pheromone work has potential and could become part of an overall mysid harvest strategy if research demonstrates an attractant is involved in mysis reproduction.
- Mysid harvesting appears feasible and large-scale commercial harvest requires serious consideration.

RECOMMENDATIONS

1. Action Plan results should be reported annually.
2. Reports should be provided in a standard format.
3. Public meetings should be conducted in April-May to review progress and results in annual report.
4. Watershed restoration work should be a high priority.
5. Use shore-spawning counts as an indice of abundance; reduce shore-spawning behavioural and fry emergence work for now, and rely on Bertram Beach as an index station.
6. Consider use of “Scotty boxes” or vibbert boxes to determine egg survival rates in beach-spawning locations.
7. Reduce routine limnological sampling by reducing the number of stations sampled; conduct a complete review of lake limnology.
8. Implement mysid harvest strategy and pursue cost recovery to fund further priority work on Okanagan Lake.
9. Pursue mysid pheromone theory.
10. Conduct overall analysis of stream escapement data.
11. Confirm age of spawning for both populations of kokanee using otoliths.
12. Evaluate differences between Okanagan and Kalamalka lakes for kokanee and mysis densities and interactions.
13. Utilize to a much greater extent the information from kokanee research conducted in the Kootenays and Idaho.
14. Correlation between trawl data and shore counts should be investigated further.
15. Continue the examination of kokanee meristics and genetics to better distinguish between shore- and stream-spawners.
16. Conduct another public workshop in 1999 similar to that held in 1995.

APPENDIX 1

1996-2001: *Conserve native stocks, protect habitat and collect priority information*

Priority Remedial Measures	*Sustained Monitoring Program*	*Comparative Analyses Studies*	*Functional Studies*	*Large Scale Experiments*	*Long Term Applied Research*
Develop protection & restoration plans for stream and shore spawning habitats	Maintain annual basic fisheries and limnological monitoring program	Historical review and inventory of changes in kokanee stream/shore spawning habitat	Investigate kokanee shore spawning cues	Conduct bench and pilot scale epilimnetic bubble pump entrainment experiments on mysids	Conduct mysid pheromone and behavioral cues research
Implement stream and shoreline preservation activities	Develop improved shore spawner enumeration methods	Review of kokanee shore spawning habitat requirements	Examine early kokanee lake dispersal and mortality	Examine implications of liberal rainbow trout harvest regulations	Conduct pilot scale harvest tests of mysids
Defer hatchery stocking of kokanee	Expand annual mysid sampling program	Establish limnological monitoring program on Wood and Kalamalka lakes	Examine P budget for specific sources and seasonal dispersion patterns	Defer mass liberations of kokanee fry	Investigate potential new stock ID methods
Examine implications of removal of kokanee angling closure	Determine stock composition of sport catch (when feasible)	Collect and analyze core samples from Okanagan Lake	Resolve age 1 kokanee avoidance of trawl gear		
Implement public consultation, education and working group plans	Mark all enhanced kokanee (if feasible)		Examine lake drawdown timing and kokanee fry emergence		

Phase 1 rationale: Conservation of native stocks and habitat protection to preserve remaining stocks and collection of priority information to improve present management and develop innovative future resource management techniques.

2001-2006: *Rebuild native stocks, restore habitat and collect priority information*

Priority Remedial Measures	*Sustained Monitoring Program*	*Comparative Analyses Studies*	*Functional Studies*	*Large Scale Experiments*	*Long Term Applied Research*
Implement restoration plans for stream and shore spawning habitat	Determine stock composition of sport catch (if feasible)	Incorporate results of historical review in restoration plans	Complete investigation of kokanee shore spawning cues	Conduct full scale bubble pump experiments on mysids if pilot scale is successful	Complete mysid pheromone and behavioral cues research
Minimize hatchery stocking of kokanee	Mark all enhanced kokanee	Incorporate review of shore spawning habitat in restoration plans	Complete examination of early kokanee lake dispersal and mortality	Implement liberal rainbow trout harvest regulations if yields are sustainable	Conduct large scale harvest tests of mysids if pilot scale is successful
Maintain stream and shoreline preservation activities	Implement improved shore spawner enumeration methods	Evaluate findings of lake coring studies on kokanee carrying capacity	Complete P budget for specific sources and seasonal dispersion patterns	Consider potential impacts of mass liberations of kokanee fry	Implement new stock ID methods if successful
Consider removal of kokanee angling closure	Maintain annual basic fisheries and limnological monitoring program	Evaluate findings from Wood/Kal comparative monitoring	Modify trawling methods to capture age 1 kokanee		
	Continue expanded annual mysid sampling program		Implement results of timing lake drawdown timing and kokanee fry emergence study		

Phase 2 rationale: Rebuilding of native stocks and restoration of habitat, continuation of priority information collection to improve present management, initial application of new information and development of innovative resource management techniques.

2006-2011: *Rebuild native stocks, restore habitat and innovative management*

Priority Remedial Measures	*Sustained Monitoring Program*	*Comparative Analyses Studies*	*Functional Studies*	*Large Scale Experiments*	*Long Term Applied Research*
Complete restoration of stream and shore spawning habitat	Monitor stock composition of sport catch	Review needs	Integrate results of kokanee shore spawning cues	Implement full scale bubble pump for mysid control if experiments are successful	Review needs
Maintain stream and shoreline preservation activities	Mark all enhanced kokanee		Update kokanee model with information on early kokanee lake dispersal and mortality	Maintain liberal rainbow trout harvest regulations if yields are sustainable	
Implement mysid pheromone/ behavioral traps if feasible	Maintain improved shore spawner enumeration methods			Consider impacts of mass liberations of kokanee fry	
Implement large scale harvesting of mysids if harvest tests are successful	Maintain annual basic fisheries and limnological monitoring program				
Modify kokanee angling regulations as required	Continue expanded annual mysid sampling program				

Phase 3 rationale: Rebuilding of native stocks and restoration of habitat, completion of priority information collection to improve present management, further application of new information and implementation of innovative resource management techniques.

2011-2016: *Conserve native stocks, protect habitat and innovative management*

Priority Remedial Measures	*Sustained Monitoring Program*	*Comparative Analyses Studies*	*Functional Studies*	*Large Scale Experiments*	*Long Term Applied Research*
Maintain stream and shoreline preservation activities	Monitor stock composition of sport catch	Review needs	Review needs	Consider effects of mass liberations of kokanee fry	Review needs
Maintain liberal rainbow trout harvest regulations if yields are sustainable	Mark all enhanced kokanee			Review other possibilities	
Maintain full scale bubble pump if cost-effective	Maintain improved shore spawner enumeration methods				
Continue harvesting of mysids if cost-effective	Maintain annual basic fisheries and limnological monitoring program				
Continue mysid pheromone/ behavioral traps if successful	Continue expanded annual mysid sampling program				

Phase 4 rationale: Conservation of native stocks and habitat protection to maintain the biodiversity of kokanee stocks with full implementation of innovative resource management techniques.

APPENDIX 2 Okanagan Lake Action Plan Participants.

PROJECT FOCUS	PERSONNEL	AFFILIATION
Project coordination and scientific liaison	Ken Ashley	Research Section, Ministry of Fisheries, UBC
	Ian McGregor	Regional Fisheries, Kamloops
	Dale Sebastian	Conservation Section, Ministry of Fisheries, Victoria
	Lisa Thompson	Fisheries Centre, UBC
	Bruce Shepherd	Regional Fisheries Penticton
Regional support and logistics	Ian McGregor	Regional Fisheries Kamloops
	Bruce Shepherd	Regional Fisheries Penticton
	Dave Smith	Regional Fisheries Penticton
	Brian Jantz	Regional Fisheries Penticton
	Steve Matthews	Regional Fisheries Penticton
	Graham Young	Penticton contractor
Habitat restoration	Jan den Dulk	Watershed Restoration Program contractor Kamloops
Okanagan Lake rule curve	Dr. Peter Ward	Engineering Consultant Vancouver
Water licence mail-outs	Bruce Shepherd	Regional Fisheries Penticton
	Cathy Irvine	Penticton contractor
Limnology	Laurie McEachern	Biological contractor, Penticton
Water quality	Vic Jensen	MELP Environmental Protection
Phytoplankton	Rick Nordin	MELP Water Management Branch Victoria
Zooplankton	Laurie McEachern	
Mysid biology	Dr. Dave Lasenby	Biology Department, Trent University, Ontario
	Janice Quirt	Grad Student, Trent University
	J.D. Whall	Grad student, Trent University
	Ken Ashley	
Mysid harvest techniques	Bruce Shepherd	
	Dave Smith	
	Graham Young	
	Bob McIlwaine	Cantrawl Richmond BC
	Bob Bowker	Tofino BC
Kokanee enumerations	Brian Jantz	Regional Fisheries Penticton
	Steve Matthews	Regional Fisheries Penticton
	Bruce Shepherd	
	Dave Smith	
	Lisa Thompson	
	Dr. Peter Dill	Okanagan College, Penticton
	Jason Webster	Sedge Consulting, Vernon
	Brian Levitt	Sedge Consulting, Vernon
	Michelle Trumbley	Trumbley Environmental Consulting Ltd. Vernon
	Debbie Pollen	
	Liz Murphy	
Kokanee biology	Dr. Peter Dill	Okanagan College, Kelowna
	Lisa Thompson	Fisheries Centre, UBC
	Bruce Shepherd	Regional Fisheries Penticton
Kokanee genetics	Dr. Eric Taylor	Dept Zoology UBC
	Susan Pollard	Conservation Section, Ministry of Fisheries, Victoria
	Gary Winans	NMFS Seattle, Washington
Kokanee stock identification	Gordon Haas	Research Section, Ministry of Fisheries, UBC
Kokanee trawl and acoustics	Dale Sebastian	Conservation Section, Ministry of Fisheries, Victoria
	George Scholten	Conservation Section, Ministry of Fisheries, Victoria
	Bruce Shepherd	
	Dave Smith	
	Tom Dolynuk	Penticton contractor
	Michael Ellis	Penticton contractor
	Graham Young	Penticton contractor
	Howie Richardson	Penticton contractor
Shore habitat classification	Dr. Hans Shreier UBC	Resource Management Dept UBC
	Cecilia Wong	Resource Management Grad student
Westland video	Ken Ashley	
Paleolimnology	Ken Ashley	
	Dr. Lidija Vidmanic	Contract scientist, UBC

APPENDIX 3

Budget for years 1 (1996/97) and 2 (1997/98) of Okanagan Lake Action Plan.

The annual expenditure for implementing the Action Plan is provided in Tables 2 and 3. Approximately two thirds of the money has been provided by the Habitat Conservation Trust Fund (HCTF) with lesser amounts secured from BC Gas, City of Kelowna, Forest Renewal BC and the Ministry of Environment, Lands and Parks. The Federal Department of Fisheries and Oceans (DFO) provided some funding for the habitat protection brochures.

Okanagan University College has provided invaluable student assistance and waived substantial administration fees. Okanagan Carp Co. has provided equipment and labour in mysid harvest work. The US National Marine Fisheries Service provided assistance and support for genetic analysis. The Canadian Coast Guard assisted in angler monitoring and the BC Corrections Branch provided volunteer labour.

Table 2. Estimated cost of Okanagan Lake Action Plan by fiscal year.

Year	Amount requested of HCTF	Amount approved by HCTF	Expended	Funding additional to HCTF
1996/97	$ 200,000	$ 200,000	$ 200,000	$ 159,000[1]
1997/98	$ 268,600	$ 268,600	$ 268,600	$ 110,000[2]
1998/99	$ 285,000			$ 220,000[3]

[1] Comprised of $15,000 from BC Gas, $20,000 in kind from Okanagan University College, $30,000 in equipment and labour from Okanagan Carp Co., $40,000 in computer analysis from Utah State University and the balance from MELP.

[2] Comprised of $25,000 from FRBC, $5,000 from National marine Fisheries Service, $2,000 from the Canadian Coast Guard, $18,000 waived administration fees from Okanagan University College and the balance from MELP.

[3] Funding includes $60,000 from MELP, $130,000 FRBC/City of Kelowna, $18,000 from US National Marine Service and $2,000 from BC Corrections Branch. Additional funding has been requested from BC Gas and others.

Table 3. Approximate HCTF expenditure in 1997/98 by major components of Phase 1 of Okanagan Lake Action Plan.

ACTIVITY	EXPENDITURE	
YEAR	1996/97	1997/98
Monitoring	$ 94,500	$ 96,200
Comparative analyses	$ 46,000	$ 41,000
Large scale experiments	$ 0	$ 0
Priority remedial measures	$ (15,000)[1]	$ 48,400
Applied research	$ 6,000	$ 49,000
Functional studies	$ 16,500	$ 19,500
Communication	$ 37,000	$ 14,500
Total	$ 200,000	$ 268,600

[1] BC Gas contributed $15,000 to HCTF for priority remedial activities.