BROODSTOCK AND RESEARCH LAKE
OPPORTUNITIES IN SOUTHERN INTERIOR B.C.

by

Kenneth I. Ashley
Eric Parkinson
Arthur F. Tautz

Fisheries Project Report No. RD7
May 1, 1986
Province of British Columbia
Ministry of Environment
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Kenneth I. Ashley
Eric Parkinson
Arthur F. Tautz

Fisheries Research and Development Section, Fisheries Branch, Ministry of Environment, Province of British Columbia, 2204 Main Mall, University of British Columbia, Vancouver, B.C. V6T 1W5

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ABSTRACT


The broodstock lakes program was initiated by the Fisheries Branch in the spring of 1984 for the purpose of identifying privately-owned lakes in southern B.C. for potential broodstock and research opportunities. The program has been coordinated by the Fisheries Research and Development Section, and has focused on lakes in the Thompson-Nicola and Okanagan areas with an initial examination of southern Cariboo area lakes. The actual surveys were conducted in three phases: Merritt area (Phase One), Douglas Lake ranch area (Phase Two), and southern interior region (Phase Three). A number of lakes were identified in each phase and at least six lakes are suitable for broodstock purposes and eleven lakes suitable for research purposes. The six broodstock lakes could produce a total of 2.9 million eggs per year. Future efforts on the broodstock/research lake program should focus on program direction and field surveys.
LIST OF TABLES

Table 1. Location and morphometric details of selected broodstock and research lakes.

Table 2. Production estimates and constraints of selected broodstock and research lakes.
INTRODUCTION

The broodstock lakes program was initiated by the Fisheries Branch in the spring of 1984 for the purpose of identifying privately-owned lakes in southern British Columbia for potential broodstock and research opportunities. The program has been coordinated by the Fisheries Research and Development Section, and has focused on lakes in the Thompson-Nicola and Okanagan areas with an initial examination of southern Cariboo area lakes.

The rationale for the broodstock lakes program is twofold, (1) development of secure sources for wild egg production, (2) obtaining closed lakes for research purposes. Most of the Fisheries Branch's egg production originates from wild stocks on lakes open to public fishing. The establishment of broodstock lake which are closed to angling offers a number of advantages including security from overfishing and the elimination of angling selection pressure for early maturation. Some of the special stocks we propose to culture in these lakes include stream resident rainbow, late maturing lake rainbow, piscivorous rainbow or cutthroat, hormonally masculinized female rainbow and late maturing kokanee. Broodstock lakes can be fairly small since a productive 20 ha lake could yield over 500,000 eggs/year. However, the summerkill/winterkill risk must be almost zero in order to protect these valuable stocks. Good access is also a priority to facilitate spring egg collections.

The second major use of closed lakes is for research purposes. Recent experience by the Research Section has pointed out the difficulty of conducting experiments on closed public and controlled harvest lakes due to poaching problems (e.g. Harper Lake). An additional difficulty is the reluctance of regional managers to close lakes at a time when effort is increasing and catches are declining.

The Research Section has little information on the relationship between production, survival, harvest rates and stocking rates. In open lakes these experiments require expensive creel census data collection. These lakes can again be fairly small (5-10 ha) and definitely < 20 ha. The risk of summerkill/winterkill can be somewhat higher and ease of access lower than for broodstock lakes. A closed drainage system to eliminate natural recruitment is a definite advantage.

Some additional research uses for closed lakes includes:

1. developing systems of managing lakes with a minimal amount of data acquisition (e.g. C.P.U.E. and age distribution of catch);

2. comparison of the survival and growth of various wild stocks;
3. experiments on the control of coarse fish populations by piscivorous stock;

4. long-term hooking mortality studies;

5. examining the effects of various stocking and harvest strategies on the abundance of food items;

6. comparison of the growth and survival of precocious and nonprecocious individuals.

Ideal lakes for all of these uses are small, accessible, and productive. In some cases winterkill lakes can be used.

There are three steps in the acquisition of private lakes:

1. initial identification and listing of private ownership lakes.

2. performing a file search and site survey of candidate lakes.

3. negotiating for the use of selected lakes with the landowners.

This report outlines the progress to date (May 1, 1986) on the broodstock lakes program, including the completion of Steps 1 and 2, and the initial negotiations in Step 3.

LAKE SURVEY PROCEDURE

The broodstock lakes survey started in the spring of 1984 and was conducted in three phases. The first phase examined the Merritt area for candidate lakes. The second phase examined the Douglas Lake Ranch area using aerial reconnaissance with follow-up summer and winter ground surveys. The third phase covering the southern interior region was conducted via a two-part private contract, with a follow-up winter survey by Fisheries Branch personnel. In addition, individual lakes suggested by regional staff were surveyed as time permitted.

Personnel involved in the broodstock lake surveys were as follows:

Phase One : Merritt Area – Ken Ashley and Kanji Tsumura

Phase Two : Douglas Lake Ranch Area

- Aerial survey – Ken Ashley and Eric Parkinson
- Summer survey – Ken Ashley and Eric Parkinson
- Winter survey – Ken Ashley and Bruce White
Phase Three: Private Contract - Southern Interior Region

Part One - George Stringer
Part Two - George Stringer
Winter survey - Ken Ashley

The survey procedure for each lake was as follows:

1. a file search was conducted to determine what information was currently available.

2. the landowner was contacted concerning access, drainage system, level fluctuations and type of fish species present in each lake.

3. each lake was visited and sounded for maximum depth, and oxygen-temperature, Secchi depth, and water chemistry (major ions, nutrients and metals) samples were collected.

RESULTS

Phase One: Three potential broodstock lakes were identified in the Merritt area: Garcia, Mathew and Menzies lake. All three are completely surrounded by private land; Garcia and Mathew are controlled by a single owner. Garcia Lake was previously used by the Fish and Wildlife Branch in the development of the trout stocking formula (Stringer et al. 1980).

Negotiations with the landowner for the use of Garcia and Mathew lakes (Alan Collett) started on March 23, 1984 and verbal approval to use Garcia Lake as a research site was obtained on May 1, 1984. Garcia was originally planned as a coho salmon-redside shiner study. However, a spring survey (May 10, 1984) revealed an intermittent outflow creek (Godey Creek) was flooded and provided a meandering but complete connection between Garcia Lake and the Coldwater River. As a result the transplant application was withdrawn and replaced on May 14, 1984 with an application for 1550 Premier Lake rainbow and 1550 Gerrard Lake stock rainbow. Transplant approval (No. 1461) was obtained on May 17, 1984 and the trout were stocked in Garcia Lake on June 5, 1984. On November 15, 1984 Garcia was closed to angling (Fisheries Public Notice No. 84-41) until further notice.

The agreement allows Fisheries Branch to use Garcia Lake as a research site and obtain access across Mr. Collett's property to carry out the required sampling program. The term of the agreement is for three years: May 1, 1984 to May 1, 1987. A formal contract written by R.J. Walker (Wildlife Branch) was delivered to Mr. Collett on December 19, 1985. However, it has yet to be signed.

Verbal approval for the use of Mathew Lake was obtained from Mr. Collett on February 20, 1985. The conditions are similar to the Garcia agreement, allowing access to Fisheries
Branch personnel for the purpose of trout stocking and required sampling. The duration of the agreement is for two years: March 14, 1985 to March 14, 1987. No fish have been stocked in Mathew to date (May 1, 1986); however, some rainbow from Garcia have moved upstream into Mathew Lake. The initial 1986 plans for Mathew Lake include examining the growth and survival of stocked immature and mature age 2+ rainbow trout. A formal contract for Mathew Lake has not been drawn up as the Garcia contract has not been signed.

Verbal approval for the use of Menzies Lake was obtained from the landowners (Nettie and Tibbie Menzies) on February 20, 1985. Menzies Lake was subsequently stocked with 368 rainbow trout on May 16 – June 20, 1985. A formal contract agreement for Menzies Lake was signed by the landowners on December 20, 1985. The agreement is for three years, commencing January 1, 1986 and ending December 31, 1989 (Appendix 1), with an option for a three year extension.

An experimental solar-powered aeration system was installed in Menzies Lake on February 11, 1986, and future plans include continued testing of the solar aerator and development of a river broodstock from Blackwater rainbow trout. Selected morphometric details are listed in Table 1.

Phase Two: The Douglas Lake Ranch property was surveyed for potential broodstock and research lakes in the summer of 1984. Ranch lakes were first identified on 1:100,000 scale topographic maps, then photographed during an aerial survey on July 25, 1984. A ground survey was conducted on August 20-24, 1984 to collect limnological data from the most promising lakes. A follow-up winter survey (February 18-22, 1985) was conducted to estimate winterkill risk in selected lakes.

The results of the survey were disappointing. Although many lakes are located on the Douglas Lake Ranch property, most are shallow, eutrophic, difficult to access in winter months, and subject to high winterkill risk. None are well suited for broodstock use; however, several may be useful for research purposes. Potential research lakes are: Beautiful, Old Car, Pikes, Pikehead, Sabin and Rush. Selected morphometric details are listed in Table 1.

Negotiations for the use of Pikes Lake for a research site started on February 25, 1986, and written approval was obtained from the ranch manager (Joe Gardner) on March 25, 1986. The experiment involves stocking two groups of rainbow trout in Pikes Lake in late May, 1986 and harvesting them in late September or October 1986 to examine relative growth and survival.
Phase Three (Part One): Part One of the private broodstock lakes contract involved an examination of the entire southern interior region. Mr. George Stringer was awarded the contract based on his experience and local knowledge of southern interior lakes. In compiling the list of potential broodstock/research lakes, Mr. Stringer visited the following district and sub-regional offices:

1. Vernon - discussed lakes with Don Stewart and Al Frisby
2. Penticton - contacted Chris Bull by phone to review and confirm lake use
3. Princeton - discussed lakes with Fred Reheis
4. Merritt - discussed lakes with Bud Ward
5. Kamloops - discussed lakes with regional staff and reviewed files
6. Williams Lake - discussed lakes with Jack Leggett and regional staff
7. Lillooet - discussed area potential with T. McGunigle and J. Miller. T. McGunigle also provided information on Clinton and 70 Mile House lakes.

Some general conclusions were reached by the contract after discussions with Ministry personnel. There is little potential in the Lillooet area because of the mountainous terrain, paucity of lakes and low ratio of private to public land. A similar situation applies for the area east of Salmon Arm.

The Cariboo region has a large number of small lakes, many of which are not well known. However, it is unlikely that many high quality lakes exist. Many of the Cariboo plateau lakes are shallow, alkaline or remote and, therefore provide little security. Nevertheless, there are many lakes in the 5-10 acre (2-4 ha) size range.

The net result of the Part One private contract was a ranked list of 31 lakes in the southern interior region that may have broodstock/research potential. Two lakes, Campbell at Little Fort and Menzies at Merritt, were not included as both lakes were being examined by Ministry staff. In addition, most lakes on the Douglas Lake Ranch property were excluded as they
had been previously surveyed. The 31 lakes, listed in order of
decreasing priority, are:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Lake</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Salmon</td>
<td>Douglas Lake</td>
</tr>
<tr>
<td>2.</td>
<td>Genier</td>
<td>Barriere</td>
</tr>
<tr>
<td>3.</td>
<td>Richter</td>
<td>Osoyoos</td>
</tr>
<tr>
<td>4.</td>
<td>Crater</td>
<td>Merritt</td>
</tr>
<tr>
<td>5.</td>
<td>Sleeping Waters</td>
<td>Okanagan Falls</td>
</tr>
<tr>
<td>6.</td>
<td>Garcia</td>
<td>Merritt</td>
</tr>
<tr>
<td>7.</td>
<td>Kennedy</td>
<td>Princeton</td>
</tr>
<tr>
<td>8.</td>
<td>Pothole</td>
<td>Merritt</td>
</tr>
<tr>
<td>9.</td>
<td>Mathew</td>
<td>Merritt</td>
</tr>
<tr>
<td>10.</td>
<td>Dale</td>
<td>Quesnel</td>
</tr>
<tr>
<td>11.</td>
<td>Brent</td>
<td>Penticton</td>
</tr>
<tr>
<td>12.</td>
<td>Huff</td>
<td>Vinsulla</td>
</tr>
<tr>
<td>13.</td>
<td>Hull</td>
<td>Kamloops</td>
</tr>
<tr>
<td>14.</td>
<td>Round</td>
<td>Vernon</td>
</tr>
<tr>
<td>15.</td>
<td>Hallis</td>
<td>Quesnel</td>
</tr>
<tr>
<td>16.</td>
<td>Goose</td>
<td>Vernon</td>
</tr>
<tr>
<td>17.</td>
<td>Mellin</td>
<td>Douglas Lake</td>
</tr>
<tr>
<td>18.</td>
<td>Wawn</td>
<td>Horseyfly</td>
</tr>
<tr>
<td>19.</td>
<td>Hastings</td>
<td>Princeton</td>
</tr>
<tr>
<td>20.</td>
<td>Abel</td>
<td>100 Mile House</td>
</tr>
<tr>
<td>21.</td>
<td>Tad</td>
<td>100 Mile House</td>
</tr>
<tr>
<td>22.</td>
<td>Liza</td>
<td>Goldbridge</td>
</tr>
<tr>
<td>23.</td>
<td>Devils</td>
<td>Hope</td>
</tr>
<tr>
<td>24.</td>
<td>Ketchan</td>
<td>Princeton</td>
</tr>
<tr>
<td>25.</td>
<td>Schiedam</td>
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</tr>
<tr>
<td>26.</td>
<td>Separation</td>
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<td>27.</td>
<td>Brown</td>
<td>Clinton</td>
</tr>
<tr>
<td>28.</td>
<td>Larkin</td>
<td>Princeton</td>
</tr>
<tr>
<td>29.</td>
<td>Smith</td>
<td>Osoyoos</td>
</tr>
<tr>
<td>30.</td>
<td>Lot 3906</td>
<td>Narcosli Creek</td>
</tr>
<tr>
<td>31.</td>
<td>Lot 842</td>
<td>Penticton</td>
</tr>
</tbody>
</table>

The contractor's general conclusion is that it would be unlikely that many private and suitable lakes in the 25-50 acre (10-20 ha) size range exist that have not been considered. The exceptions would be in the Cariboo; however, these lakes would be somewhat remote and difficult to access and control. Part One was completed on August 22, 1985.

**Phase Three (Part Two):** Part Two of the private broodstock lakes contract involved a detailed examination of 9 lakes selected from the original 31 lakes identified in Part One. The 9 best lakes were selected based on recommendations from Part One and discussions with regional staff (Williams Lake, Kamloops and Penticton). The contract provides a detailed description of each lake including access, drainage basin charac-
teristics, morphometry, land status, land ownership spawning and growth potential, security, fish species and final evaluation.

The result of the Part Two private contract is a final report listing nine lakes in the southern interior region that should have broodstock/research potential. The 9 lakes, listed in order of decreasing potential, are:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Lake</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Richter</td>
<td>Osoyoos</td>
</tr>
<tr>
<td>2.</td>
<td>Genier</td>
<td>Barrier</td>
</tr>
<tr>
<td>3.</td>
<td>Brent</td>
<td>Penticton</td>
</tr>
<tr>
<td>4.</td>
<td>Huff</td>
<td>Kamloops</td>
</tr>
<tr>
<td>5.</td>
<td>Lot 842</td>
<td>Princeton</td>
</tr>
<tr>
<td>6.</td>
<td>Hull</td>
<td>Kamloops</td>
</tr>
<tr>
<td>7.</td>
<td>Tad</td>
<td>100 Mile House</td>
</tr>
<tr>
<td>8.</td>
<td>Sleeping Waters</td>
<td>Penticton</td>
</tr>
<tr>
<td>9.</td>
<td>Ketchan</td>
<td>Princeton</td>
</tr>
</tbody>
</table>

Selected morphometric details are listed in Table 1. Part Two was completed on November 26, 1985.

Phase Three (Winter Survey): The purpose of the winter survey was threefold: measure mid-winter oxygen-temperature values and estimate winterkill risk; examine access during winter months; contact landowners and discuss possibilities of using their lakes for broodstock/research purposes. Two lakes were removed from the original list of 9 lakes; Ketchan Lake (too shallow and remote) and Tad Lake (too many landowners and major Ducks Unlimited project site). The remaining seven lakes were visited between January 22-March 26, 1986.

Winterkill Risk

None of the lakes would be classified as having a high winterkill risk. A ranked list of winterkill risk (%) is:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Lake</th>
<th>Winterkill Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Richter</td>
<td>0 - 5%</td>
</tr>
<tr>
<td>2.</td>
<td>Genier</td>
<td>0 - 5%</td>
</tr>
<tr>
<td>3.</td>
<td>Hull</td>
<td>15 - 20%</td>
</tr>
<tr>
<td>4.</td>
<td>Brent</td>
<td>15 - 20%</td>
</tr>
<tr>
<td>5.</td>
<td>Sleeping Waters</td>
<td>20 - 25%</td>
</tr>
<tr>
<td>6.</td>
<td>Lot 842</td>
<td>25 - 30%</td>
</tr>
<tr>
<td>7.</td>
<td>Huff</td>
<td>25 - 30%</td>
</tr>
</tbody>
</table>
Access

All of the lakes are accessible by road. However, during winter months snow depth is the main factor controlling access. A ranked list of accessibility during winter months is:

Good - Richter, Genier
Fair - Brent, Huff, Sleeping Waters
Poor - Hull, Lot 842

Landowner Cooperation

All of the landowners contacted were interested in the idea of using their lake for broodstock or research purposes. In fact, other than Richter, none of the lakes received more than a few days angling pressure per year. Most of the lakes are used for irrigation and cattle ranching (Brent, Huff and Hull) or recreational property (Genier, Lot 842, and Sleeping Waters). Richter is currently managed as a private trophy fishery, and experiences approximately 200 angler days per year paying $20/day to fish the lake. Implicit in each conversation was an expectation of financial compensation and detailed guidelines for the use of their lakes.

Classification

After reviewing the available data we believe the lakes can be grouped into 4 general classifications: broodstock, research/broodstock, research, and miscellaneous.

1. Broodstock

Lakes in this category are well suited for broodstock purposes, and require little if any habitat modification and improvement: Campbell, Garcia, and Genier.

2. Research/Broodstock

Lakes in this category are well suited for research purposes, and may be easily upgraded to broodstock sites with minor habitat improvement: Menzies (aeration), Richter (stabilize levels), Sleeping Waters (aeration).

3. Research

Lakes in this category are suitable for research purposes. Some lakes could be upgraded to broodstock status; however, major habitat improvements would be required. Fish stocked in these lakes would be subject to a 15-30% winterkill risk: Beautiful, Brent, Huff, Hull, Lot 842, Mathew, Old Car, Pikes, Pikehead, Rush and Sabin.
4. Miscellaneous

This category contains several bodies of water that were briefly encountered during the broodstock survey, which may have some fisheries potential:

A. Crater Potholes - a group of 4-5 small lakes north of Crater Lake (Merritt) which may have some use in replicated research experiments.

B. Gleneden Trout Farm - an 11 ha site near Salmon Arm with three 46 m earthen ponds that may be used for early rearing and production.

C. Kamloops Lagoon - the fourth "cell" in the Kamloops sewage treatment plant is a 36 ha pond with a maximum depth of 5 m that could be used as an experimental site.

D. Minnie/Stoney lakes - two private fishing lakes on the Douglas Lake Ranch which may be suitable as broodstock lakes.

E. Mission Creek - small holding pond near Mission Creek (Kelowna).

F. Salter's Pond/Skaha Hatchery - a small lake near Kaleden which could be used as a broodstock or experimental lake, possibly in combination with the existing Skaha Hatchery.

Production Estimates

The potential egg production from the surveyed broodstock lakes was calculated using the following procedure:

\[
\text{Egg Production} = \frac{Y \times A \times F \times E}{W}
\]

where:
- \(Y\) = estimated yield (kg/ha)
- \(A\) = lake area (ha)
- \(F\) = proportion of females (0.5)
- \(E\) = number of eggs per female (1300; Murray, 1980)
- \(W\) = weight per female (0.75 kg)

The main problem with this procedure is estimating the potential fish yield from each lake. Estimates of fish yield from interior B.C. lakes are available from experimental studies (Stringer et al. 1980) and creel census programs (unpub. data), and range from 10-60 kg/ha. These yields are generally higher than the < 10 kg/ha predicted by the morphoedaphic index (MEI) regression equation (Ryder et al. 1974).

We have assumed that potential yields on these broodstock lakes varies with MEI in the manner described by Ryder et al. (1974), but are higher by a factor of six in monoculture lakes and three in lakes containing coarse fish. This formula
predicts yields of 20 kg/ha from Garcia Lake and 46 kg/ha from Crater Lake. These are similar to the yields of 16.5 kg/ha and 55 kg/ha calculated for the same two lakes by Stringer et al. (1980). On Pennask Lake, this procedure predicts a potential annual egg take of 5.3 million eggs. The current yield from Pennask consists of an angler yield of 10,000 kg (equivalent to about 9 million eggs) and an egg take of approximately 1.5 million eggs, plus natural escapement (Brian Chan, pers. comm.).

Potential egg yields from the surveyed lakes range from 86,000 from Lot 842 to 3.8 million from Rush Lake (Table 2). These yields are preliminary estimates and must be validated in actual operations. The yields on controlled broodstock lakes may be improved by optimizing stocking rates, increasing the proportion of repeat spawners, and skewing the sex ratio to females by removing some mature males.

DISCUSSION

The requirements of the broodstock program are 6-8 lakes producing a maximum total of 6 million eggs/year in packages ranging between 300,000 and 1.5 million eggs per year. The approximate breakdown is as follows: 2-3 million production eggs, 2-3 million lake special stocks and 800,000 stream stocks. The required size of the lake is estimated to range from 5 ha for a high productivity lake with a small egg take to 100 ha for a low productivity lake with a large egg take. In addition to lakes, private production facilities capable of producing > 300,000 egg/yr in isolation from other fish would be considered.

The requirements of the research program are more variable and depend on the nature of the experiments. However, 4-6 lakes of varying size and productivity should be adequate.

RECOMMENDED LAKES

The recommended lakes for the broodstock program are:

1. Genier    -  609,000 eggs annually
2. Campbell  -  159,000 eggs annually
3. Garcia    -  297,000 eggs annually

The following lakes are classified as broodstock/research and should be upgraded to broodstock status. Menzies and Sleeping Waters both require small surface aerators as insurance against winterkill. Both lakes already have single phase power, and installation of aeration equipment would be
straightforward and relatively inexpensive ($4000). Richter Lake requires an investigation into its water level fluctuations.

1. Menzies - 159,000 eggs annually
2. Sleeping Waters - 280,000 eggs annually
3. Richter - 1,406,000 eggs annually

The recommended lakes for the research program depend on the type of experiments planned. At least 11 lakes are potentially available: Beautiful, Brent, Huff, Hull, Lot 842, Mathew, Old Car, Pikes, Pikehead, Rush, and Sabin. It is difficult to rank these lakes when the experiments are not formalized. However, a tentative grouping in order of decreasing potential for research purposes is:

Good - Huff, Hull, Pikes, Pikehead, Mathew
Fair - Beautiful, Lot 842, Old Car, Rush
Poor - Brent, Sabin

As mentioned earlier, these lakes are subject to a 15-30% winterkill risk and are not easily upgraded. Research experiments should be designed with this constraint in mind, and none of these lakes are suitable for long term (> 5 years) experiments.

HABITAT IMPROVEMENTS

A variety of habitat improvement techniques are currently available to increase the suitability of certain lakes for broodstock or research purposes. For example, aeration has been recommended to upgrade Menzies and Sleeping Waters to broodstock status. A word of caution, however, in that aeration is not a panacea for all lakes. Depending on the size, trophic level and distance from power lines, aeration may not be suitable for certain lakes. In fact, because of the inherent genetic value of fish in a broodstock lake, high winterkill risk lakes should not be used for broodstock purposes. Aeration should be used as insurance on low winterkill risk lakes, not as a program mainstay on high winterkill risk lakes.

Several lakes would benefit from increased depth of water storage (e.g. Pikes, Pikehead and Rush). An engineering feasibility study on the cost and reliability of low level dams would be a useful exercise. In addition, stream diversion may be possible in certain lakes to increase flushing rates.

A number of chemical treatments exist which may improve water quality for research purposes. These include alum treatment (Cooke and Kennedy 1981), liming (Murphy et al. 1985), and nitrate addition (Barica et al. 1980). These experiments would initially be limnologically oriented. However, if successful, they could be used to upgrade research lakes to research/broodstock or broodstock status.
ALTERNATE OPTIONS

At least two alternate options exist for broodstock lakes. The first option is to negotiate for the use of private fishing lakes that produce "muddy" tasting fish. Minnie and Stoney lakes fit this category, as they are located on Douglas Lake Ranch property and are used by guests of the Corbett Lake Inn. Most of the anglers using these lakes are experienced fly fishermen, and few of the fish are killed, especially during summer months when the "muddy" taste is most noticeable. Under these circumstances it may be possible to operate a "controlled harvest" broodstock lake in which accurate catch records are maintained.

The second option is to use Crown lakes, either as restricted harvest or complete closures. After reviewing the information collected on the broodstock lake surveys, our conclusion is that the majority of high quality lakes in British Columbia are owned by the Crown. If the required number of eggs cannot be obtained from private sources, then Crown lakes should be considered. One or two appropriately sized lakes could supply most of the production stock eggs, and considering the reduction in legal negotiations and rental/lease fees over private sources, this could be of significant value. Regional staff and local anglers may be reluctant to support this approach. However, given its importance to the overall fisheries program, this avenue should not be overlooked.

FUTURE WORK

Future work on the broodstock/research lakes should be directed in two general areas: program direction and field surveys. Within program direction, three general tasks are envisioned:

1. Formal directive. At this stage of the program it is appropriate to write a formal statement of goals, objectives and timetable of the broodstock/research program. Most of the preliminary work has been done and this is an appropriate time to realistically assess whether there are sufficient private lakes to supply the programs needs.

2. Research/Fish Culture Liaison. As the program progresses from the initial survey phase to the planning stage, increased contact and cooperation is required between Research Section and Fish Culture Section. This is an appropriate time to appoint specific individuals from each section (and possibly regions?) to a broodstock lakes working committee.

3. Legal Negotiations. One of the primary goals of the broodstock program is the establishment of secure egg sources. If private lakes are to be used as brood lakes, then expert legal assistance is required in negotiating for their use. This would
involve developing secure long-term lease plans (e.g. 20 years) and/or purchasing outright some of the lake properties.

Specific guidelines should be developed for calculating rental or lease payments to the lake owners. This could be done on an areal basis using assessed property values, or involve direct payments for caretaker services and use of storage facilities. We believe adequate financial compensation is a very important step in the establishment of a successful private broodstock lakes program.

In terms of field surveys, three general tasks are required:

1. A spring survey should be conducted to examine the existing broodstock in each lake, as well as survey the lakes for fish capture sites and required capture gear.

2. The bodies of water listed in the "miscellaneous" category should be examined to determine if there are any good broodstock or research sites.

3. Any "new" lakes that may be suggested by regional staff or private citizens should be investigated.
LITERATURE CITED


<table>
<thead>
<tr>
<th>Lake</th>
<th>Location</th>
<th>Area (ha)</th>
<th>Mean Depth (m)</th>
<th>TDS (gm/l)</th>
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<sup>a</sup> = estimated parameters in brackets
Table 2. Potential egg production from surveyed lakes estimated by the method detailed in the text. The effects of winterkill and drawdown as possible constraints on production have been ignored.

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<td>17. Sleeping Water</td>
<td>90</td>
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</table>
APPENDIX

1. Example of Menzies Lake contract agreement
THIS AGREEMENT dated for reference the 23 day of April, 1986.

BETWEEN:

J. A. MENZIES LIMITED (Inc. No. 1915)
c/o Menzies Ranch
Kane Valley Road
Box 58
Merritt, British Columbia

(herein called the "Owner")

OF THE FIRST PART

AND:

HER MAJESTY THE QUEEN IN RIGHT OF
THE PROVINCE OF BRITISH COLUMBIA,
represented by the Minister of
Environment, Parliament Buildings,
Victoria, British Columbia

(herein called the "Province")

OF THE SECOND PART

WHEREAS:

A. The Owner is the registered owner in fee simple of the
land described in Schedule "A" hereto (herein called the
"Land"); and

B. The Province wishes to enter onto the Land to construct,
operate and maintain certain works thereon for the
purpose of culturing fish and the Owner has agreed to
permit the Province to enter the Land for such purposes.

NOW THEREFORE this agreement witnesses that in consideration of
the premises and other good and valuable consideration (the
receipt and sufficiency of which is hereby acknowledged), the
parties agree as follows:

1. The Owner on the terms set forth below, hereby grants to
the Province, its servants, agents, employees, and
contractors, a license to enter on the Land for the
following purposes:
(a) to gain access to and from Menzies Lake over a road on the Land extending from Kane Valley Road to Menzies Lake as shown by a red line on the plan annexed as Schedule "B" hereto;

(b) to erect, construct, install, operate and maintain the works described in Schedule "C" hereto (herein called the "Works");

(c) to conduct and monitor fish transplants in Menzies Lake;

(d) to carry out such other activities which are necessarily incidental and appurtenant to the aforesaid.

2. The duration of this license and the rights herein granted shall be for a term of three years commencing on January 1, 1986 and ending on December 31, 1989 unless cancelled or renewed in accordance with the terms hereof.

3. The Province covenants with the Owner:

(a) to construct the Works using good quality materials and good workmanship;

(b) not to commit or suffer any willful or voluntary waste, spoil or destruction on the Land or do or suffer to be done thereon anything that may be or become a nuisance to owners or occupiers of adjoining land;

(c) to repair all damage to the Land caused by the erection, construction or installation of the Works;

(d) upon the expiration of the term of this license, to remove the Works from the Land and leave the Land in a clean and sanitary condition;

(e) to exercise its rights under this license in a reasonable manner;

(f) to use and occupy the Land solely for the purposes described herein;

(g) to permit the Owner or its authorized representative to enter upon the site of the Works at all reasonable times to examine its condition and to inspect the Works;
(h) to peaceably quit and deliver possession of the Land to the Owner on the expiration or earlier cancellation of this licence;

(i) to do all acts which are reasonably necessary to ensure that the Owner's present restrictions on access by the general public to the Land and other lands owned by the Owner are not compromised or lessened by virtue of the exercise by the Province of its rights under this licence and for the purpose of this covenant the Province acknowledges that the Owner has prohibited and intends to prohibit access by the general public to the Land; and

(j) to indemnify and save the Owner harmless from any loss or damage arising out of any injury or death in any way attributable to the operation of the Works.

4. The Owner covenants with the Province:

(a) that notwithstanding any rule of law to the contrary, title to and ownership of the Works shall at all times remain vested in the Province;

(b) not to interfere with or permit any interference with the erection, construction, installation, operation or maintenance of the Works by the Province;

(c) to use its best efforts to ensure that its successor in title to the Land and any person, firm or corporation now or hereafter holding a charge or encumbrance against the Land are bound by the terms and conditions of this licence; and

(d) to renew this licence for a further term of 3 years upon written request of the Province provided that the Province is not in default hereunder at the time of such request.

5. In the event that the Province fails to observe or perform any of the covenants, agreements, provisions or conditions contained herein and such failure continues for a period of 60 days following the giving of written notice by the Owner to the Province of the nature of such failure, the Owner may cancel this license and the Province shall upon the written request of the Owner forthwith remove the Works from the Land.
6. All notices required or permitted to be given hereunder shall be in writing and shall be properly given if given by hand or mailed by prepaid registered mail addressed in the case of the Province to:

Fisheries Branch
Ministry of Environment
c/o 2204 Main Mall
University of British Columbia
Vancouver, British Columbia
V6T 1W5

Attention: Ken Ashley
Fisheries Biologist

and in the case of the Owner to:

J. A. Menzies Limited
c/o Menzies Ranch
Kane Valley Road
Box 58
Merritt, British Columbia

7. This license shall not entitle the Province to exclusive possession of the Land and nothing in this license shall be interpreted to restrict or prevent the Owner from using the Land in any manner which does not interfere with the rights herein granted to the Province.

8. The terms and provisions of this license shall extend to and be binding upon and enure to the benefit of the parties hereto and their successors and assigns.

9. Time is of the essence in this agreement.

10. In this license, unless the context otherwise requires the singular includes the plural and the masculine includes the feminine and the body corporate or politic.

IN WITNESS WHEREOF the parties have executed this license as of the day and year first above written.

The Corporate seal of 
J. A. MENZIES LIMITED was hereunto affixed in the presence of:

Authorized Signatory

/Authorized Signatory/
c/s

- 4 -
SIGNED, SEALED AND DELIVERED )
by the Minister of Environment )
or his duly authorized )
representative on behalf of )
Her Majesty the Queen in Right )
of the Province of British )
Columbia in the presence of: )

[Signature]

(Signature of Witness)

EARLE PEELE

(Name of Witness)

810 BLENHEIM ST.

(Address of Witness)

VICTORIA, B.C.

Minister of Environment or
his duly authorized
representative
SCHEDULE "A"

All those lands lying and being within the Nicola Assessment District and more particularly known and described as:

Lot 4401,
Group 1,
Kamloops Division Yale District
The "Works" mean and include a solar powered water pump/aeration system, fish stocking equipment and fishing nets.
DATED for reference, 1985

BETWEEN:

J. A. MENZIES LIMITED

AND:

HER MAJESTY THE QUEEN IN RIGHT
OF THE PROVINCE OF BRITISH
COLUMBIA, represented by the
Minister of Environment

LICENCE

Ministry of Attorney General
6th Floor
1019 Wharf Street
Victoria, British Columbia
V8W 2Y9   (387-1067)

Jim R. Yardley
Barrister and Solicitor