CHAPTER 17

Sport Fishery Evaluations

It was pointed out in Chapter 8 that the fishery resource base in the Okanagan Basin consists of four components:

1. Headwater Lakes Sport Fishery
2. Tributary Stream Sport Fishery
3. Main Valley Lakes Sport Fishery
4. Okanagan River - Sport Fishery
   - Salmon Fishery

Although there are several important relationships between these components such as main valley lake fishes spawning in tributary streams, their separation aids the evaluation of management alternatives.

17.1 REVIEW OF EXISTING CONDITIONS

In 1971, an estimated 12,000 anglers spent 157,000 angling days in the Okanagan lakes and streams. Approximately 45% of this fishing effort or 66,000 angling days were recorded in the headwater lakes where 125,000 trout were harvested. This headwater lake harvest is slightly less than one-third of the estimated 474,600 fish that could be caught in these lakes under present water management practices, if stocked to capacity. Because demand was not distributed in proportion to the present harvest potential of each headwater lake, some of the more popular lakes were close to being fully utilized while a large number were under-fished.

Tributary stream fishing accommodated 2300 angling days in 1971 with an estimated harvest of 13,700 trout. This is. less than half of the potential harvest under existing discharge regimes, estimated at 32,200 trout, but the fish only average seven hundredths of a pound and are not generally attractive for anglers.

The sport-fishing effort in the main valley lakes totalled 84,600 angling days in 1971, over 80% of which were recorded on Okanagan Lake. The fish harvest was 262,000 fish; 94% kokanee, 5% Rainbow trout and 1% lake trout and bass. This was less than one-fifth of the potential harvest of kokanee (estimated at 1.3 million) but over half of the potential harvest of Rainbow Trout (estimated at 22,500).

Potential harvest is an estimate of the maximum number of fish that could be removed from the takes or streams without affecting the reproductive viability of the species. Due to the intangible nature of sport fishing which make it more challenging and enjoyable, these potential harvests would probably never be realized because of decreasing angling success rates (frequency of catch designated in terms of the number of fish caught per hour by one angler) as the potential harvest is exhausted. Consequently, the important criterion regarding the viability of the sport fishery is not the ratio between potential and actual harvest but the frequency and size of fish caught. The present (1971) success rate varies ranging from 1.3 kokanee caught per angling hour in Okanagan Lake to 0.5 trout per angling hour in headwater lakes and less than 0.06 trout per angling hour in the main valley lakes. This present success rate is important as it appears to provide a frequency of catch that is socially acceptable to anglers, and has therefore been used as a guide in determining stocking and spawning requirements to meet future angling demands. The one exception to this is the success rate for trout in the main valley lakes which is very low, and should be increased.

Angler participation was valued highly in both economic and social terms. Sport fishermen spent an estimated $1.65 million in 1971, resulting in a net economic benefit to the Okanagan community of $446,000. In addition, resident and non-resident anglers stated that their sport was worth 1.9 million dollars in terms of social values, over and above these expenditures.

In summary, the Okanagan sport fishery offers a variety of angling opportunities to both residents and visitors, providing significant social and economic returns. In view of the increasing consumptive demands for water, especially in the tributary streams, there is a need for careful management of the fishery resource over the next 50 years to ensure its continuing viability and value to both resident and non-resident anglers and the general Okanagan community.

17.2 DISCUSSION OF ASSUMPTIONS

One fundamental assumption underlies all biological analyses and evaluations in future fishery management in the Okanagan. This is that all significant cause and effect phenomena, identified and inferred, are assumed to be related on a simple linear and independent basis. Although this is undoubtedly a gross oversimplification of reality, data were not available to derive a more rigorous set of assumptions. The major assumptions are as follows:

(1) That recruitment from natural reproductive systems will be altered in direct proportion to:

   (a) changed discharge regimes,
   (b) changed quantity and quality of reproductive habitat.

(2) That carrying and productive capacities of lakes and streams will be altered in direct proportion to a complex of positive and negative factors discussed later in this section.

(3) That catch per unit fishing effort and/or available fish harvest will be altered in direct proportion to:

   (a) changed recruitment,

   (b) changed reproductive and carrying capacity.

(4) That distribution of fishing effort will reflect fishing quality measured in terms of success rate and size of catch.

FUTURE ANGLING DEMANDS

The first step in the fishery evaluation process was to estimate potential angling demands in the four components of the sport fishery resource base. These projections were based on anticipated growth of tourist and resident populations, with high and low growth estimates prepared after 1980 in keeping with the concept of providing alternative choices for future growth in the basin. The major assumptions associated with each projection are discussed below.

High Growth Projection

Under the assumption of maximizing economic growth in the valley, it appears that, from a sport fishery viewpoint, net economic benefits could be increased through the attraction of non-resident anglers, whose prime reason for coming to the basin is to fish, and by a continued high rate of resident angler participation. Thus, the basic assumptions underlying the development of a high projection of angling days include an increased rate of non-resident angling participation, accompanied by a continuation of the present rate of resident angler participation associated with the high rate of population growth in Projection II. As both resident and non-resident anglers appear to be attracted to headwater lake fishing, relative rates of headwater angling are expected to increase to the year 2000, followed by a relative decline due to a decrease in angling success rates **as** the limits of the potential harvest are reached. As a result, relatively more pressure will be placed on main valley lake fishing after the year 2000. Projections of angling days in headwater and main valley lakes shown in Table 17.1 indicate that total angler demands will increase almost four-fold from 160,000 in 1971 to 602,000 in 2020.

17.3.2 Low Growth Projection

The basic assumption underlying Projection III was to improve the natural environmental quality of the valley, even if this means sacrificing some proportion of potential economic gains. Sport fishing can contribute to this goal by maintaining high quality fishing opportunities throughout the basin and by placing greater emphasis on resident rather than tourist angling participation. These assumptions are based on the greater recreational (social) values placed on sport fishing by residents compared with non-residents, particularly in headwater lakes.

TABLE 17.1

PROJECTIONS OF ANGLING-DAY DEMANDS

(a) Residents and Non-Residents

	1971	HIGH GROWTH PROJECTION			LOW GROWTH PROJECTION		
		1980	2000	2020	1980	2000	2020
Non-Residents	52,700	82,300	156,900	241,800	74,000	100,800	140,000
Residents	105,300	156,600	234,800	360,600	148,000	217,800	266,500
Total	158,000	238,900	391,700	602,400	222,000	318,600	405,600

(b) Main Valley and Headwater Lakes

	1971	HIGH GROWTH PROJECTION			LOW GROWTH PROJECTION		
		1980	2000	2020	1980	2000	2020
Headwater	65,900	114,300	187,700	246,800	100,000	150,000	191,000
Main Valley	84,600	114,300	190,000	336,700	112,000	155,000	200,000
OK. River & Streams	7,500	10,300	14,000	18,900	10,000	13,000	15,500
Total	158,000	238,900	391,700	602,400	222,000	318,600	406,500

(c) Main Valley Lakes

	1971	HIGH GROWTH PROJECTION			LOW GROWTH PROJECTION		
		1980	2000	2020	1980	2000	2020
Okanagan	70,350	95,000	158,000	281,000	93,200	128,900	166,300
Skaha	6,650	9,000	14,900	26,400	8,800	12,200	15,700
Vaseux	550	700	1,200	1,300	700	1,000	1,300
Osoyoos	1,650	2,200	3,700	6,600	2,200	3,000	3,900
Wood	2,800	3,800	6,300	11,000	3,700	5,100	6,600
Kalamalka	2,600	3,600	5,900	10,300	3,400	4,800	6,200
Total	84,600	114,300	190,000	336,700	112,000	155,000	200,000

Angling demands projected under this low growth policy are based on reduced resident and visitor population growth rates developed under Projection III with the following participation rates:

(1) An increase of 2.5% per decade in resident participation rates. This figure includes both more anglers and more angling days per resident.

(2) Continuation of existing rates of tourist participation.

(3) Relatively greater emphasis on headwater lake angling throughout the 50-year planning period.

The results presented in Table 17.1 indicate that total angling-day demands could increase almost three-fold over the planning period, totaling 406,500 by 2020. Over 74% of this fishing effort could be enjoyed by residents compared with 60% at present and 64% in the high growth projection.

HEADWATER LAKES

Harvest Capacities

Headwater lakes are defined as all lakes and reservoirs in the basin excluding the six main valley lakes. There are some 137 of these lakes with present or potential fishing opportunities and having a combined surface area of 10,900 acres at full supply level. Although there is some natural reproduction of trout in the higher elevation lakes, almost all the present harvest is obtained from Rainbow trout stocking programs. During the period 1967-71, an annual average of 1.7 million trout at 2500 per pound equivalent weight were introduced into the 57 'key' headwater lakes where most of the headwater fishing was recorded. This stocking program provided an annual harvest of 119,400 trout and was supplemented from natural reproduction by 6,100 trout.

Among the many factors which influence trout productivity in the headwater lakes, four are of particular importance. These are (1) elevation (influencing temperature, length of growing season and drainage), (2) total dissolved solids (an index of nutrient availability), (3) water level fluctuation (influencing bottom fauna production, available habitat area, over-wintering depth and oxygen parameters) and (4) presence or absence of predator and competitor fish species. Because elevation is the major factor of the four mentioned above, productivity estimates have been prepared for 500-foot elevation increments.

Estimated potential harvest capacities of the 137 headwater lakes are presented in Table 17.2 assuming continuation of existing water management practices, such as lake drawdowns. This harvest potential is estimated at 474,600 trout compared to the estimated harvest of 125,500 trout taken in 1971. Increased stocking programs required to realize this potential harvest were extrapolated linearly from data derived from the 1971 stocking program and estimated harvest.

On this basis, realization of potential harvest capacities would require an annual stocking rate of some 5.4 million trout at 2500 per pound equivalent weight.

TABLE 17.2

DISTRIBUTION BY ELEVATION OF POTENTIAL INCREASES IN AVAILABLE TROUT HARVEST AND CONSEQUENT STOCKING PROGRAMS FOR 137 HEADWATER LAKES

ELEVATION FEET	1971 AVAILABLE HARVEST CAPACITY NO.X 1000	1971 REALIZED HARVEST NO.X 1000	1971 UTILIZATION OF AVAILABLE HARVEST(%)	POTENTIAL AVAILABLE HARVEST* CAPACITY No.x 1000	POTENTIAL INCREASE IN 1971 AVAILABLE HARVEST NO.X 1000	RECENT(1969-71) STOCKING RATE AT 2500/lb. EQUIVALENT NO. X 1000	RATES OF STOCKING TO AVAILABLE HARVEST	POTENTIAL INCREASE IN STOCKING PROGRAM NO. X 1000
3500	57.8	33.7	58.3	126.6	68.8	552.5	11.12	935.2
3500-4000	14.4	10.3	71.5	32.9	18.5	160.1	11.12	313.6
4001-4500	53.6	65.8	100+	168.9	115.3	883.1	17.80	1764.0
4501-5000	5.2	12.5	100+	48.2	43.0	91.6	23.49	808.0
5001-5500	6.4	2.9	45.3	49.6	43.2	41.1	24.18	1015.6
over 5500	1.5	0.3	20.0	23.4	21.9	00.0	25.00	540.0
TOTALS	138.9	125.5	90.3	449.6	310.7	1728.4	---	5376.4

Higher estimates of harvest potential were also made on the basis of improved water management (decreased lake drawdowns) resulting in an 'ultimate' potential harvest capacity of 1.3 million trout or some 2.8 times the estimate based on present conditions. Stocking programs would have to be increased from the present 1.7 to 5.4 million trout per year as part of this improved management proposal for this harvest to be realized.

Fishery Management Alternatives (Headwater Lakes)

Because of the limited availability of natural spawning habitat, the only real sport fishery management alternatives to meet projected angler demands in addition to continuing existing programs are to increase the stocking rate and/ or to improve water management practices including increasing reservoir capacities. Due to the limited availability of increased storage (see Chapter 14) and the small impacts of water management practices on headwater fisheries (see Technical Supplement IX), only an increased stocking program was evaluated in detail.

Based on responses from the questionnaire survey of headwater anglers, it was assumed that the existing success rate (measured as the number of trout caught per hour) was the minimum required to maintain a reasonable quality of sport fishing in the headwater lakes. If the annual rate of stocking headwater lakes remained the same over the next 50 years, the average annual success rate would be expected to decrease after 1980 under both Projections, resulting in declines in angler satisfaction and participation as shown in Table 17.3.

TABLE 17.3

PROJECTED ANGLER SUCCESS RATE UNDER EXISTING STOCKING PROGRAM

	PROJECTED DEMAND		SUCCESS RATE	
	HIGH	LOW	HIGH	LOW
	ANGLING DAYS		TROUT PER ANGLING HOUR	
1971	67,900	67,900	0.57	0.57
1980	114,300	100,000	0.42	0.49
2000	187,700	150,000	0.24	0.30
2020	246,800	191,000	0.19	0.24

To maintain present success rates of catch throughout the headwater lakes, the stocking program would have to be increased up to four times present levels (Table 17.4). By the year 2020, the number of trout introductions required to satisfy high and low projections of angling demands is estimated at 4.7 and 3.6 million respectively at an equivalent size of 2500 fry per pound. The upper figure is close to the'best' estimate of the resource capability of all 137 lakes, placed at 5.4 million fish.

TABLE 17.4

ESTIMATED BENEFITS AND COSTS OF STOCKING PROGRAM IN HEADWATER LAKES TO MEET PROJECTED ANGLING DEMANDS, 1970-2020

YEAR	PROJECTED DEMAND		TROUT HARVEST REQUIRED		TROUT INTRODUCTIONS REQUIRED AT 2500 FRY PER POUND		TOTAL COSTS (1970 DOLLARS) INCREMENTAL		TOTAL BENEFITS			
									ECONOMIC		SOCIAL	
	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW
	ANGLING DAYS		NO. X 1000		No. x 1000		$1000		$1000		$1000	
1970	65,900	65,900	125.5	125.5	1728.4	1728.4	0	0	0	0	0	0
1980	114,300	100,000	217.2	190.0	2382.9	2085.7	31.4	21.0	22.5	19.7	56.6	49.6
2000	187,700	150,000	356.6	285.0	3629.3	2900.4	1110.0	772.0	768.6	655.6	1509.5	1252.4
2020	246,800	191,000	469.9	362.9	4678.3	3619.9	2160.0	1362.0	1559.2	1256.5	2626.6	2130.5

It is evident that 1971 success rates can only be maintained in headwater lakes if both increased stocking programs are undertaken and fishing is encouraged on all 137 lakes rather than the 57 lakes that are presently utilized. On an individual basis, it is probably that some lakes, especially those with good access, may become over-fished white others will not be utilized to their full potential. In order to make provision for the range of fishing experience demanded by anglers - fly fishing only, no access for power boats, low-density 'wilderness' angling, etc. it may be necessary to establish or extend zoning regulations over the next 10-20 years.

In recognition that some lakes will experience high density angling in the near future, a general shift in the stocking program has been built into the cost estimates. This includes stocking a greater proportion of larger fish (e.g. 50 fry per pound and 10 per pound) in these lakes. The stocking of catch-able-sized trout in heavily utilized lakes is a possible management alternative which was not evaluated in this Study because of the lack of immediate requirements for fish larger than 10 per pound.

Benefits and costs associated with an increased stocking program were evaluated. After 1980, the existing hatchery capacity in the Okanagan will not be able to support the Okanagan stocking requirements and also meet commitments in other areas in the interior of the Province. New hatchery facilities would have to be constructed by 1985, resulting in a four-fold increase of annual costs from $53,000 in 1970 to $216,000 by 2020 (in 1970 dollars, not discounted). Net economic benefits (Table 17.4) were valued at $1.73 and $4.90 per resident and visitor angler-day respectively, with social (consumer surplus) benefits valued at $13.50 and $2.50 per resident and visitor angler-day respectively, as obtained from the sport fishermen survey.

The appropriate economic benefits associated with the stocking program involve an estimate of the number of potential angling days that would not occur due to decreasing success rates in absence of increased stocking. There are many problems associated with determining this figure. First, there is little understanding of the relationship between angler participation and success rate. Presumably this would vary among anglers, some persevering longer than others, content with other factors such as low angling densities, aesthetics and lack of power boats. In addition, the 'social value' of an angling day might decline with reduced success rates but this relationship is completely unknown. Second, it is not known how many anglers would simply transfer their participation to the main valley lakes rather than not fish in the basin altogether. A transfer of fishing activity would not incur any net losses to the basin as a whole. Third, it is not certain that angling success rates would fall in a linear manner as noted on Table 17.3. Some type of curvilinear relationship could affect the rate of angler participation foregone,

In the absence of any better data, it was assumed that 10%, 30% and 50% of potential headwater angling effort for 1980, 2000 and 2020 respectively would be foregone if present rates of stocking are not increased. Total benefits and costs are compared in Table 17.4 and indicate that a new hatchery would not be warranted based on net economic benefits only but could be justified if social benefits are included. If resident and non-resident anglers are actually willing to pay all or part of these social benefits in the form of increased licence fees then the costs of constructing and operating a new fish hatchery could be supported. Because of the high potential demand for headwater fishing in both projections, increased investment in stocking programs would appear to be justified regardless of the type of future the Okanagan Valley may experience.

17.5 TRIBUTARY STREAMS

The basic capacities for streams tributary to the Okanagan to produce in-channel trout were estimated by reference to literature and an examination of Trout Creek as an example of Okanagan Basin conditions. Minimal discharge regimes to support the trout fishery were established and adjustments made for regimes that did not maintain such flows. No attempt was made to evaluate disbenefits due to cultural modifications nor to evaluate fish introductions. These factors are not expected to play a major influencing role in this component of the Okanagan fishery resource.

Twenty-one tributary streams support trout fisheries. Fish stocks, maintained entirely by natural reproduction accommodated about 2000 angler-days in 1971. Most of these tributaries are also utilized for reproduction and rearing by salmonids from the main valley lakes.

17.5.1 Harvest Capacities

Two types of harvest capacity estimates which provide an annual sustained harvest were obtained for Okanagan tributary streams;

(1) Primary potential harvest capacity; the estimated number of trout given an 'adequate' discharge regime, consistent with overall average annual discharge volume and present stream habitat.

(2) Present potential harvest capacity; the primary harvest capacity adjusted downward to account for the present discharge regime.

A primary potential harvest capacity of 38,410 trout is available annually if adequate flow discharges are instituted to support fisheries while a present potential harvest capacity of 32,220 trout is available annually. An increase of only 16% is thus possible assuming improved flows.

While stream fishing provides a different form of angling recreation, the size of fish is small, averaging about 0.07 pounds in Trout Creek. There is little potential, aside from expensive management techniques to improve the average fish size in the tributaries.

17.5.2 Management Alternatives (Tributary Streams)

No formal projections have been made for future angling demands in tributary streams. While there is a potential demand for stream fishing which will likely increase, anglers are generally aware of the limited capacity of Okanagan streams.

It is apparent that storage reservoirs on tributary systems expand opportunities to meet residual flow requirements. However, these opportunities have not received much priority in Okanagan reservoir operations. Since only a 16% overall increase in in-channel trout productivity is predicted from minimal acceptable discharge regimes, it may well be that in most creeks, this water would yield greater overall fishery benefits if applied to reservoir level maintenance, or more likely the spawning and rearing needs of salmonids (trout and kokanee) from the main valley lakes.

MAIN VALLEY LAKES

The six main valley lakes presently harbour extensive kokanee fish stocks, but relatively small populations of Rainbow and take trout. In addition, there are compliment stocks of coarse fish and miscellaneous sport fish which are not extensively utilized and thus not included in this evaluation section.

6.1 Harvest Capacities

Harvest capacities of kokanee and Rainbow trout in the main valley lakes were derived from data on total dissolved solids, mean lake depth and nutrient concentrations which appear to affect fish populations (Chapter 8). Improvements in reproductive environments in tributary streams, where main lake kokanee and Rainbow trout spawn, were also taken into account.

Independent estimates of potential harvest capacities in the main lakes were obtained from present catch data and knowledge of Zooplankton standing crop and "competitor or niche group" relationships. Both approaches indicate that all main lakes have far greater capacities to support kokanee and Rainbow trout than the tributary streams are capable of rearing. Thus, even if minimum flows for fish were assured in tributaries, lack of sufficient reproductive habitat would remain the limiting factor of main lake fish populations.

Tables 17.5 and 17.6 present a range of estimates of potential harvest capacities for kokanee and Rainbow trout respectively in all main valley lakes. These estimates are based on (1) present tributary discharge regimes and spawning habitat, (2) modified regimes which would reduce water deficits for sport fish in most creeks and, (3) modified regimes plus improved habitats. It can be seen that provision of water supplies alone would not greatly increase harvest.

TABLE 17.5

ESTIMATED PRESENT AND POTENTIAL SUSTAINABLE KOKANEE HARVEST CAPACITIES IN MAIN VALLEY LAKES, 1970 LEVEL OF DEVELOPMENT

TRIBUTARY STREAMS		NUMBER OF KOKANEE HARVESTABLE ANNUALLY X 1000						
DISCHARGE REGIME	REPRODUCTIVE HABITAT	WOOD	KALAMALKA	OKANAGAN	SKAHA	VASEUX	OSOYOOS	TOTAL
Present	Present	7.1	25.7	1128.7	95.8	0.5	25.5	1283.3
Modified	Present	8.6	37.3	1207.7	132.2	0.8	40.7	1426.8
Modified	Enhanced	13.2	37.3	2347.7	209.8	0.8	40.2	2649.0
		POUNDS OF KOKANEE HARVESTABLE PER ACRE						
Present	Present	0.49	0.75	3.65	10.12	0.23	1.79	
Modified	Present	0.60	1.09	3.90	13.97	0.34	2.83	
Modified	Enhanced	0.91	1.09	7.59	22.17	0.34	2.83	

TABLE 17.6

ESTIMATED PRESENT AND POTENTIAL ANNUAL SUSTAINABLE HARVEST OF RAINBOW TROUT. OKANAGAN MAIN VALLEY LAKES, 1970 LEVEL OF DEVELOPMENT

TRIBUTARY STREAMS		NUMBER OF TROUT HARVESTABLE X 1000						
DISCHARGE REGIME	REPRODUCTIVE HABITAT	WOOD	KALAMALKA	OKANAGAN	SKAHA	VASEUX	OSOYOOS	TOTAL
Present	Present	0.15	2.79	17.86	1.45	0.05	0.23	22.53
Modified	Present	0.35	6.50	31.97	1.52	0.05	0.24	40.63
Modified	Enhanced	1.40	6.50	197.00	2.35	0.05	0.24	207.54
		POUNDS OF RAINBOW TROUT HARVESTABLE PER ACRE						
Present	Present	0.09	0.60	0.26	0.20	0.05	0.10	
Modified	Present	0.21	1.40	0.46	0.21	0.05	0.11	
Modified	Enhanced	0.84	1.40	2.86	0.33	0.05	0.11	

capacities for kokanee but in combination with improvements to reproductive habitat, total harvest could be doubled. Harvest potential for Rainbow trout could be significantly increased with modified discharge and greatly increased (almost ten-fold) by enhanced habitat and modified regime (Table 17.6).

Modified operation of headwater storage reservoirs would not have a major impact on increasing sport fishery populations in some creeks, because in certain critical months, zero or near zero flows would continue to prevail. However, changes in the pattern of storage releases could significantly reduce the amount of additional water required to maintain minimum flows in all months. Such assured flows are absolutely essential in at least average and wet years before any investment in restoring reproductive habitat in tributary creeks is worthwhile.

17.6.2 Management Alternatives (Main Valley Lakes)

Due to lack of data and time, detailed evaluation of fishery management alternatives to satisfy projected angling demands in the main valley lakes were restricted to Okanagan and Skaha Lakes. Observations pertinent to fishery management in Wood, Kalamalka, Vaseux and Osoyoos Lakes are as follows:

(a) Wood Lake

According to limnological evaluations detailed in Section 8, Wood Lake water quality may slowly improve as nutrient loadings are reduced. Under these circumstances, Wood Lake might return to its 1930 condition when it harboured an important kokanee and trout fishery.

The re-establishment of Wood Lake as a productive sport fishery is dependent upon such a chain of variables that it is difficult to make any firm projections of sport fishery potential at this time. It is simply worth noting that there is considerable potential should water quality conditions improve.

(b) Kalamalka Lake

Lake trout, introduced in 1967, contributed the largest proportion by weight of all angled species in 1971. Although this species will likely have considerable impact on the population dynamics of other sport fisheries in Kalamalka Lake in the future, such changes "cannot be predicted without improved data. Provision of additional reproductive habitat is expected to enhance the kokanee population of this lake.

(c) Vaseux Lake

This lake is highly eutrophic and completely dependent on Skaha Lake and Okanagan River water quality. It is not presently a significant producer of desirable sport fish, a condition which is expected to continue over the next 50 years.

(d) Osoyoos Lake

Due to high surface water temperatures, low summer oxygen concentrations in the bottom waters of the lake, and abundance of predatory species, this lake is far from ideal as rainbow trout habitat. Enhancement of kokanee stock would probably result from improvements in reproductive habitats, notably Okanagan River discharge regimes. Recommendations concerning the bass fishery are not possible with presently available data.

17.6.3 Management Alternatives (Okanagan Lake)

Okanagan Lake supports over 80% of all main lake angling and this proportion is expected to be maintained or possibly increased over the next 50 years. Consequently, present (1971) demands of 70,350 angling days may be expected to increase between two and four-fold depending on the growth of tourist and resident populations and the extent of the counter-attraction of headwater lakes.

Assuming that no additional action is taken to manage the resource over the next 50 years, sport fishery populations in the lake may be expected to decline due to increased water consumptive use requirements in tributary creeks, although these withdrawals would be partially compensated by an increased storage in headwater reservoirs. Projected angling day demands would not over-fish the present (1971) harvest potential of the lake, but success ratios would be expected to drop significantly below present levels for both angling day projections resulting in declines in angler satisfaction and potential participation (Table 17.7).

TABLE 17.7

CHANGE IN ANGLING SUCCESS RATES FOR KOKANEE AND RAINBOW TROUT IN OKANAGAN LAKE ASSUMING NO FISHERY ENHANCEMENT

YEAR	POTENTIAL HARVEST	PROJECTED ANGLING DAY DEMANDS		KOKANEE AVAILABLE PER ANG. DAY		CATCH PER UNIT EFFORT NO.PER HOUR	
	No.X 1000	HIGH	LOW	HIGH	LOW	HIGH	LOW
(a) Kokanee							
1970	1128.7	70,300	70,300	15.46	15.46	1.264	1.264
1980	1365.1	95,000	93,200	14.37	14.65	1.164	1.198
2000	1212.4	158,000	128,900	7.67	9.40	0.627	0.769
2020	1054.1	281,000	281,000	3.75	6.34	0.307	0.518
(b) Trout							
1970	17.86	70,300	70,300	0.245	0.245	0.022	0.022
1980	17.95	95,000	93,200	0.189	0.193	0.017	0.017
2000	17.90	158,000	128,900	0.113	0.139	0.010	0.012
2020	17.82	281,000	166,300	0.063	0.107	0.006	0.010

A number of alternatives were examined to maintain current success rates for kokanee and to improve success rates for Rainbow trout, in view of the preferences of the latter fishery. These included:

(a) Tributary Management and Enhancement of Spawning Areas in Selected Streams.

(b) Artificial Reproductive Habitat.

(c) Enhancement of Shore Spawning Kokanee Habitat.

(a) Tributary Management and Enhancement of Spawning Areas in Selected Streams

As discussed in Chapter 14, tributary streams are presently managed primarily for the purpose of providing water for irrigation and domestic purposes. Consequently, fishery flows are met only incidentally and not at all in Trout, Peachland and Powers Creeks during dry years (Table 17.8). Even under average run-off conditions, minimum flow requirements in the later summer months may not be met resulting in considerable loss of fishery potential in all six creeks for which discharge data are available.

TABLE 17.8

DISCHARGE DEFICIENCIES FOR KOKANEE AND RAINBOW TROUT IN SIX STREAMS TRIBUTARY TO OKANAGAN LAKE FOR 1971 LEVEL OF DEVELOPMENT

STREAM	WATER MGT.	HYDROLOGICAL TYPE YEAR	MOST LIMITING MONTHLY DISCHARGE DEFICIENCY(%)		AVERAGE MOST LIMITING DISCHARGE DEFICIENCY (%)	
			KOKANEE	TROUT	KOKANEE	TROUT
Trout	historic	dry avg.	91 6	100 50	49	75
	modified	dry avg.	55 0	60 0	28	30
Peachland	historic	dry avg.	75 46	100 50	61	75
	modified	dry avg.	0 0	0 0	0	0
Powers	historic	dry avg.	68 14	100 50	41	75
	modified	dry avg.	79 0	63 0	40	32
Equesis	historic	dry avg.	49 20	27 9	35	17
	modified	dry avg.	0 0	0 0	0	0
Vernon (Lower)	historic	dry avg.	50 10	50 10	30	30
	modified	dry avg.	0 0	0 0	0	0
Mission	historic	dry avg.	82 64	78 46	73	62
	modified	dry avg.	80 66	43 24	73	33

Because the tributaries are generally managed for irrigation, in most years residual storage is reserved in headwater reservoirs to protect licenced water users against possible shortages in the following year should runoff be small. Under modified operation of these streams, it was assumed that some of this residual storage could be released during kokanee spawning and incubation to meet minimum desirable fishery flows. Table 17.8 shows that such an alternative would considerably reduce water deficiencies in all six tributaries for fisheries, effectively eliminating deficiencies in Vernon, Peachland and Equesis Creeks.

This alternative has a number of potential drawbacks. First, in all but Mission and Kelowna Creeks, carry-over storage is necessary to ensure adequate irrigation supplies from year to year and this storage will become more important as consumptive water requirements increase in tributary streams in the future. Second, winter drawdowns of headwater reservoirs may have a detrimental effect 0,n headwater fisheries creating winter-kill conditions through lack of water, or oxygen under the ice. Third, due to freezing conditions throughout the winter at higher elevations, it may not be possible to provide fishery flows at the mouths of creeks as the water might freeze enroute.

The harvest potential of both kokanee andRainbow trout from tributary creek spawning, assuming adequate flows, is shown in Table 17.9 and 17.10. Under assured flows for fisheries. Mission Creek could increase its annual harvest capacity from 84,000 to almost 400,000 kokanee, accounting for over 90% of all tributary stream spawning potential under present development of reproductive habitat. The only other creek exhibiting a significant increase in harvest potential under assured flows is Equesis, which could deliver 54,000 harvestable kokanee. A similar pattern holds for Rainbow trout. Mission Creek has a potential harvest capacity of 26,000 trout under assured flows compared to 9,000 at present.

Once minimum flow requirements have been met either through modified flows or increased storage, it would then be feasible to improve spawning habitats in the lower reaches of selected tributaries. This action would not be justified at present due to the high frequency of flow deficits during the summer months. Tables 17.9 and 17.10 show that habitat improvement would generally increase potential harvest capacities for both trout and kokanee in Mission, Trepanier and Equesis Creeks. Indeed, these three creeks would account for almost alt potential harvest available from tributary spawning kokanee and trout.

The potential harvests discussed above are based on maximum harvests allowable to maintain a sustained fishery population. Fisheries evaluations for Okanagan (and Skaha) Lake were actually done on a two level frequency. Firstly, the ability of the lakes to produce at a maximum sustained yield was evaluated. While this is a biologically feasible alternative, it would mean a greater harvest from the same fish population, and thus a lower rate of angler success

TABLE 17.9

KOKANEE HARVESTS IN OKANAGAN LAKE

1970-2020 UNDER VARIOUS FISHERY MANAGEMENT ALTERNATIVES

CREEK	PRESENT HARVEST 1970 STORAGE HISTORIC DISCHARGE	ABILITY OF LAKES TO PRODUCE AT A MAXIMUM SUSTAINED YIELD		HARVEST POTENTIAL - 2020 MAINTAINING 1970 ANGLER SUCCESS RATES			
		1970 LEVEL POTENTIAL HARVEST AVAILABLE ASSURED FLOWS NO ENHANCED HABITAT	1970 MAXIMUM POTENTIAL HARVEST FULL ENHANCEMENT OF REPRODUCTIVE HABITAT & ASSURED FLOWS	HISTORIC OPERATION INCREASED STORAGE NO ENHANCEMENT		MODIFIED OPERATION INCREASED STORAGE NO ENHANCEMENT	
				HIGH IRRIGATION DEVELOPMENT	LOW IRRIGATION DEVELOPMENT	HIGH IRRIGATION DEVELOPMENT	LOW IRRIGATION DEVELOPMENT
COLUMN	X 1000 (1)	X 1000 (2)	X 1000 (3)	X 1000 (4)	X 1000 (5)	X 1000 (6)	X 1000 (7)
Mission	84.3	399.4	953.5	90.75	108.8	163	326.7
Trepanier	2.8	19.8	394.4		No Hydrological Data		
Trout	0.1	0.8	4.5	0	0.1	0.1	0.14
Vernon (lower)	.3	1.8	39.8	1.8	1.8	1.8	1.8
Equesis	7.5	54.0	205.8	6.1	6.9	7.0	11.40
Whiteman	0.2	1.2	2.4		No Hydrological Data		
B-X Creek	0	0.8	1.4		No Hydrological Data		
Powers	2.0	9.6	14.5	.91	1.8	1.75	2.1
Peachland	1.3	6.0	18.3	1.02	1.07	2.4	3.3
Lambly	5.1	0.8	1.8		No Hydrological Projections		

TABLE 17.10

RAINBOW TROUT HARVESTS IN OKANAGAN LAKE

1970-2020 UNDER VARIOUS FISHERY MANAGEMENT ALTERNATIVES

CREEK	PRESENT HARVEST 1970 STORAGE HISTORIC DISCHARGE	ABILITY OF LAKES TO PRODUCE AT A MAXIMUM SUSTAINED YIELD		HARVEST POTENTIAL - 2020 MAINTAINING 1970 ANGLER SUCCESS RATES			
		1970 LEVEL POTENTIAL HARVEST AVAILABLE ASSURED FLOWS NO ENHANCED HABITAT	1970 MAXIMUM POTENTIAL HARVEST ASSURED FLOWS FULL ENHANCEMENT	HISTORIC OPERATION INCREASED STORAGE NO ENHANCEMENT		MODIFIED OPERATION INCREASED STORAGE NO ENHANCEMENT	
				HIGH IRRIGATION DEVELOPMENT	LOW IRRIGATION DEVELOPMENT	HIGH IRRIGATION DEVELOPMENT	LOW IRRIGATION DEVELOPMENT
COLUMN	X 1000 (1)	X 1000 (2)	X 1000 (3)	X 1000 (4)	X 1000 (5)	X 1000 (6)	X 1000 (7)
Mission	9.2	26.44	157.56	3.27	6.98	34.2	41.19
Trepanier	0.31	1.17	2.05	-	No Hydrological Data		-
Trout	0.02	0.05	0.28	0.0	0.01	0.05	0.07
Vernon (Lower)	0.03	0.04	0.95	0.04	0.04	0.04	0.04
Equesis	0.81	1.60	6.12	0.55	0.62	0.78	0.98
Whiteman	0.02	0.05	0.10	-	No Hydrological Data		-
B-X Creek	0.02	0.05	0.07	-	No Hydrological Data		-
Powers	0.21	0.97	1.44	0.14	0.36	0.63	0.71
Peachland	0.14	0.92	2.05	0.08	0.17	0.48	0.56
Lambly	0.02	0.05	0.09	-	No Hydrological Data		-

(number of fish caught per angler per hour). It was decided that maintenance of angler success levels at present or improved catch rates is also a desired criteria. Therefore, in the latter part of the evaluation, the economic and social costs and benefits of maintaining 1970 levels of angler success rates are evaluated to the year 2020. Tables 17.9 and 17.10 show the projected harvests for kokanee and Rainbow trout under varying fishery management alternatives.

Mission, Trepanier and Equesis Creeks continue to provide most of the fishery potential. In view of the potential importance of these creeks, detailed evaluations of water management alternatives required to assure minimum flows were assessed.

(i) Mission Creek

By 2020, if the present operation and storage capacities in Mission Creek watershed remain unchanged, only about 10% and 4% of potential harvests of kokanee and trout respectively would be available. Modified operation of existing storages, would significantly decrease water deficiencies for fisheries from 11,100 acre feet to 8,000 acre feet in dry years (Table 17.11). By itself, this management alternative would not improve kokanee harvest capacities as zero flows would still occur in September during dry and average runoff years. Trout harvest capacities would be increased by about 25% by this modified operation.

TABLE 17.11

WATER DEFICITS FOR FISHERIES IN MISSION CREEK BY 2020 ASSUMING EXISTING STORAGE AND ALTERNATIVE OPERATING RULES

OPERATING RULE	HIGH LEVEL OF IRRIGATION DEVELOPMENT		LOW LEVEL OF IRRIGATION DEVELOPMENT	
	DRY YEAR DEFICITS	AVERAGE YEAR (acre feet)	DRY YEAR DEFICITS	AVERAGE YEAR (acre feet)
Present Operation	14,800	9,800	11,100	5,700
Modified Operation	11,300	5,400	8,000	500
Reduction in Deficits	3,500	4,400	3,100	5,200

To improve kokanee and trout harvest capacities to desirable levels in Mission Creek an additional 3,000 to 4,000 acre feet of storage would be required over and above that available under the modified operation of existing storages. This would assure full fishery flows in approximately 8 years out of 10. Preliminary hydrologic investigations indicate that approximately 3,600 acre feet of additional storage are available for development in the upper reaches of Mission Creek. Development of this storage would cost approximately $900,000 and would support an additional 78,700 and 28,100 harvestable kokanee and trout respectively (Table 17.12).

TABLE 17.12

OKANAGAN SPORT FISHERY MANAGEMENT EVALUATION MATRIX

IN MISSION, TREPANIER AND EQUESIS CREEKS

ALTERNATIVE	POTENTIAL KOKANEE HARVEST		POTENTIAL TROUT HARVEST		COSTS		CAPITALIZED BENEFITS	
	INCREMENTAL HARVEST	TOTAL HARVEST	INCREMENTAL HARVEST	TOTAL HARVEST	CAPITAL $1000	ANNUAL $1000	ECONOMIC $1000	SOCIAL $1000
	NO. X 1000		NO. X 1000					
Mission Creek								
1. modified discharge	-	1212.7	6.9	24.8	-	-		
2. increased storage	78.7	1291.4	28.1	52.9	$ 900.0	$ 99.0		
3. streambed improvement	120.8	1412.2	89.0	141.0	440.0	44.4		
TOTAL	199.5		114.0		$1,340.0	$143.4	$1191.9	$1991.7
Equesis Creek								
1. increased storage	43.0	1418.1	6.0	141.5	$ 175.0	$ 18.0		
2. streambed improvement					28.5	2.5		
TOTAL	43.0		6.0		$ 202.5	$ 20.5	$ 254.0	$ 423.8
Trepanier Creek								
1. pumping	83.5	1499.6	4.7	145.2	$ 173.0	$ 55.0		
2. streambed improvement					100.0	10.5		
TOTAL	83.5		4.7		$ 273.0	$ 65.5	$ 508.2	$ 850.1
TOTALS	326.0		131.7		$1,816.5	$240.5	$1,954.1	$3,265.6

When minimum flows can be assured in all but drought years, rehabilitation of the spawning beds, costing approximately $440,000 would support an additional 120,800 harvestable kokanee and 89,000 harvestable trout. Total costs of these fishery enhancement measures on Mission Creek are estimated at $1,340,000, but would be justified by total net economic benefits of $1,192,000 and social benefits of $1,992,000 over the next 50 years.

(ii) Equesis Creek

Due to limited developed headwater storage in Equesis Creek, modified operation of this storage would not be feasible without significantly reducing carry over storage in drought years. Present water deficits to support fisheries in average-dry runoff conditions total 700 acre feet. Preliminary hydrologic studies indicate that 550 acre feet of storage could be developed on Pinaus Lake. The additional 150 acre feet required to support the fishery might be obtained from some modification of headwater storage operation, or, if necessary, some water could be bought from the irrigation district. Total costs of developing or purchasing water rights for 700 acre feet are estimated at $175,000. Since the above would deplete headwater storage opportunities, no expansion of existing agricultural acreage, based on headwater storages, is recommended for this tributary basin. Total benefits associated with the enhanced fishery are estimated at $254,000 in economic terms and $423,000 in social terms over the next 50 years (Table 17.12).

(iii) Trepanier Creek

As no storage sites were identified on the headwaters of Trepanier Creek, the current fishery deficit of 2200 acre feet would have to be pumped from Okanagan Lake. This alternative is relatively inexpensive as the spawning beds lie within one mile of the Creek mouth. Total costs (1970 dollars) are estimated at $173,000 with annual costs (amortization, operation and maintenance) of $55,000. Improvement to natural reproductive habitat would also be required to realize maximum harvest potential, at a cost of approximately $100,000. These measures would support an additional 83,500 harvestable kokanee and 4,700 harvestable trout annually worth a total of $508,000 and $850,000 in economic and social benefits respectively.

(iv) Summary

The estimated costs of enhancement of natural reproductive habitat for kokanee and Rainbow trout in Mission, Equesis and Trepanier Creeks are compared in Table 17.12. It is anticipated that management of these three basins towards the goal of realizing their maximum potential harvest capacities, together with protection and enhancement of shore spawning habitats, could satisfy potential angling demands to about the year 2000 under the high growth projection and to 2020 under the low growth projection. Harvest potentials may be expected to decline after these dates as successively less water may be available in the tributaries for spawning purposes. Additional fishery production to meet expanding angler demands would then have to be obtained from artificial spawning facilities or from enhancement of shore-spawning habitats.

Annual benefits associated with the rehabilitation of natural spawning in the three creeks are also shown on Table 17.12. These benefits include net economic values derived from tourist expenditures as well as social values based on anglers' expression of the value of an angler day. It was assumed that the existing standing stock would satisfy angler demands to 1975, but there would be a 10% decline in potential angling demands by 1980 if no management measures were implemented. After 1980 it was assumed that 50% of potential demand would not occur due to declining success rates. Under these assumptions, the total economic benefits for Okanagan Lake fishery enhancement accumulated over the next 50 years would total over 1.9 million dollars compared with a total capital investment (not discounted) of 1.8 million dollars. There are additional social benefits of 3.2 million dollars which would justify such an investment provided social values are considered in the evaluation of alternatives.

(b) Artificial Reproductive Habitat

Discussion in the preceding section indicated that the important creeks with fishery spawning potential are all situated in the central or northern part of Okanagan Lake. The creel census survey showed that angler success for both kokanee and trout were very much lower in the southern portion of Okanagan Lake than elsewhere. In lieu of good natural spawning habitat in the southern tributaries to Okanagan Lake, a number of artificial facilities were examined to increase harvest potential in this part of the lake.

The relative productivity and costs of (1) a spawning channel, (2) incubation channel, (3) incubation boxes and (4) hatchery were investigated for development on the lower reaches of Trout Creek. The ratio of costs for these four facilities, including providing water, to deliver 500,000 to 4 million kokanee and Rainbow trout was 8:1:1:5. An incubation channel was selected as the most feasible alternative for Trout Creek on the basis of costs of production per harvestable fish.

Although Trout Creek could supply the additional 1000 acre feet a year required for an incubation channel, siltation, resulting from a natural slide in Trout Creek canyon may present a major problem in operating this facility. The costs of containing the slide or constructing a settling basin to remove the silt would make any fishery enhancement program in Trout Creek uneconomic.

As an incubation channel requires a relatively small amount of water, it appears that a number of options for enhancing the sport fishery in the south basin of Okanagan Lake should be examined before final decisions are made. These include locating the channel in another basin such as Penticton Creek, or pumping water from Okanagan Lake to the lower delta of Trout Creek. If fishery management measures are undertaken in the other creeks as discussed above, there will be no real need to develop such an artificial facility until the year 1990.

(c) Enhancement of Shore Spawning Kokanee Habitat

In the case of kokanee, additional harvest potential is available from shore spawning habitats, which presently (1971) deliver an estimated 140,000 harvestable fish. Of the present escapement, about 663,000 could be removed from this population and still maintain a sustained yield, though it is assumed that this extraction would involve a drastic reduction in catch per unit effort.

Harvest potential from shore-spawning kokanee could be increased through better controls on Okanagan Lake levels. Preliminary studies have indicated that all spawning takes place within a depth of 5.5 feet of water along the shoreline of the lake and that kokanee production would be maximized if lake levels were to fluctuate less than 6 inches between October 1 and February 28. Obviously, lake levels cannot be controlled only for protecting shore-spawning kokanee, but if other factors are taken into consideration, it would appear that more careful management in dry and average runoff years could enhance this component of the Okanagan fishery. Improvements to the shore spawning habitat could potentially increase harvest yields, but this alternative could only be evaluated with more study on this aspect of kokanee life history.

(d) Summary of Okanagan Lake Fishery Management

In order to maintain available fish harvest production in step with angling demands from 1970 to 2020, major emphasis has been placed on rehabilitating natural spawning habitats in creeks offering the greatest benefit-cost advantages. Consideration was also given to providing additional fish harvests in the southern basin of Okanagan Lake through provision of artificial spawning facilities. A suggested sequential fisheries enhancement program for both kokanee and Rainbow trout is presented in Table 17.13. It should be noted that angler success rates for kokanee may marginally decrease from present rates over the next 50 years, and rates for Rainbow trout should increase two-fold. By implementing this program, the stated objective of maintaining or enhancing angling success with justified investments can be essentially achieved.

17.6.4 Management Alternatives (Skaha Lake)

The level of water quality in Skaha Lake has reached optimum conditions for the production of sport fish stocks. Any further enrichment of the lake would likely create environmental conditions unsuitable for sport fish and result in a rapid reduction of trout and kokanee stocks. Even assuming that water quality will be maintained or improved, angler success levels may be expected to fall

TABLE 17.13

SPORT FISHERY MANAGEMENT PROGRAM FOR

KOKANEE AND RAINBOW TROUT IN OKANAGAN LAKE, 1970-2020

IMPROVEMENT	DATE	POTENTIAL INCREASED HARVEST		ANNUAL COSTS $1000	ANNUAL COST PER HARVESTABLE FISH
		KOKANEE NO. X 1000	TROUT		
1. Implement Okanagan Lake operation improvements	1974	47.2	0	nil	nil
2. Initiate modified operations on Mission Creek	1975	0	6.9	nil	nil
3. Development of Storage on Mission Creek	1976	78.7	28.1	99.0	0.93
4. Pumping and Streambed improvement on Trepanier	1980	83.5	4.7	65.0	$0.74
5. Incubation Channel in Trout Creek	1980	25.4	4.8	17.2	$0.57
6. Rehabilitate Mission Creek spawning area	1990	120.8	89.0	44.4	$0.21
7. Rehabilitation and Storage on Equesis Creek	1990	43.0	6.0	20.5	$0.42
8. Enhancement of shore-spawning kokanee habitats	2000+		To be determined		
9. Establishment of incubation boxes as required	2000+		To be determined		

TABLE 17.14

CHANGE IN ANGLER SUCCESS RATES FOR KOKANEE AND RAINBOW TROUT

IN SKAHA LAKE-NO FISHERY ENHANCEMENT

YEAR	POTENTIAL[1] HARVEST	PROJECTED ANGLING DAY DEMANDS		KOKANEE AVAILABLE PER ANG. DAY		CATCH PER UNIT EFFORT NO. PER HOUR	
	NO.X 1000	HIGH	LOW	HIGH	LOW	HIGH	LOW
(a) Kokanee							
1970	95.8	6,650	6,650	14.4	14.4	0.048	0.048
1980	78.1	9,000	8,800	8.7	9.8	0.029	0.032
2000	76.4	14,900	12,200	5.1	6.3	0.017	0.021
2020	82.2	26,500	15,700	3.1	5.9	0.010	0.019
(b) Rainbow Trout							
1970	1.45	6,650	6,650	0.22	0.22	0.022	0.022
1980	1.98	9,000	8,800	0.22	0.22	0.022	0.022
2000	1.81	14,900	12,200	0.12	0.15	0.012	0.015
2020	1.73	26,500	15,700	0.06	0.11	0.006	0.011

[1] Assumes present water quality is maintained or improved.

significantly if no fishery enhancement program is undertaken (Table 17.14).

Due to limited natural stream spawning habitat around Skaha Lake, any significant increase in kokanee and Rainbow Trout harvest capacities will be dependent on artificial propagation. Since Rainbow trout and kokanee are subject to excessive predation in the lake, the natural or artificial stocking of fry at 2500 fry per pound would not result in any significant increase in harvest capacities. This predation problem could be overcome by stocking trout and kokanee at sizes of 50 and 10 fry per pound.

Costs and benefits of a proposed fish hatchery for Skaha Lake are presented in Table 17.15. It was assumed that prior to hatchery construction, certain other less costly improvements would be undertaken including enhancement of the natural spawning habitat in Okanagan River. The stocking program would likely increase angling success rates substantially, particularly for Rainbow Trout, but would cost some $228,000 annually by 2020.

TABLE 17.15

APPROXIMATE COSTS AND BENEFITS OF HATCHERY RAISED KOKANEE AND RAINBOW TROUT FOR THE SATISFACTION OF ANGLING DEMAND IN SKAHA LAKE, 1980 TO 2020

YEAR	ADDITIONAL HARVEST REQ'D NUMBER X 1000	CORRESPONDING NUMBER X 1000 @ 2500/lb.	CORRESPONDING NUMBERS X 1000 AT WEIGHTS INDICATED		ANNUAL COST,		ANNUAL BENEFITS	
			50/lb	10/lb	TOTAL X$1000	PER HARVEST-ABLE FISH, $	ECONOMIC $1000	SOCIAL
KOKANEE								
1980	23	383	43.5	12.6	29.4	1.28		
2000	55	917	104.2	33.0	70.4	1.28		
2020	178	2,967	337.2	97.5	227.9	1.28	19.0	58.4
							27.2	84.5
RAINBOW TROUT							48.4	169.1
1980	0	0	0	0	0			
2000	0.48	8.0	0.91	0.26	0.61	1.28		
2020	2.60	43.3	4.92	1.42	3.33	1.28		

Annual benefits associated with the enhancement of Skaha Lake sport fishery were estimated on the basis that 65% of the projected angling day demands (high estimate) above the 1970 level would be due to improved Rainbow trout fishing. This assumption is based on the finding that 65% of main valley lake fishermen preferred catching trout to kokanee.

Under this assumption, anticipated increases in net expenditures by nonresident anglers would not pay for full hatchery program. However, stocking of Skaha Lake would certainly enhance the Rainbow trout fishery and could be provided from the hatchery recommended to support the headwater lake fishery. Consequently, Skaha Lake should be considered when establishing the stocking capability of the new hatchery for the Okanagan Basin.

17.7 OKANAGAN RIVER FISHERY MANAGEMENT

The Okanagan River system serves the Okanagan primarily as a flood control and water conservation channel and it produces only a limited number of sport fishes. The sport fish capability is heavily dependent on movement of fishes from the main valley lakes and is most realistically evaluated on this basis. In-channel sport fishes could not be shown to be particularly sensitive to the discharge alternatives considered. The "unimproved" section of the river, (S.O. L.I.D. dam to just north of Oliver) serves as a spawning bed for the major Columbia River sockeye salmon run which is extremely sensitive to river discharges.

17.7.1 Sport Fishes

About 4,900 days were spent in 1971 angling for Rainbow trout and Whitefish in the Okanagan River resulting in a harvest of 700 pounds of preferred sport fishes. However, no angler demand projections for the river were made, because Okanagan River is not considered to be of major importance to Okanagan anglers.

The availability of fish in the river is dependent to such a large degree on the fish populations of the main valley lakes, particularly Skaha and Osoyoos, that the future fisheries potentials are inexorably linked to management of these lakes. The detailed projections in the main valley lakes section can therefore be used as a basis for estimating the harvest potential of the Okanagan River sport fishery.

17.7.2 Sockeye Salmon

Of an annual average escapement of 85,000 Sockeye salmon to the Columbia River 19,000 spawn in the Okanagan River. The annual Sockeye catch at the mouth of the Columbia River for the period of 1961 to 1971 was 21,600 fish, of which 15,120 (70%) originate in the Okanagan River. An additional 3,100 fish are taken by the Indian fishery.

This catch to escapement ratio is considered as extremely low due to below average environmental conditions, and because the results were recorded during a period when fishery managers were attempting to re-build the run. Based on average environmental conditions and the maintenance of existing spawning habitat the future annual catch may be in the order of 40,000 sockeye per year.

Alternatives for protecting the salmon run over the next 50 years were described in Chapter 14 and will only be summarized here. Continuation of present operating rules for releasing water into Okanagan River could threaten the viability of the run by 2000 as withdrawals for consumptive uses increase. The water conservation alternative involving lowering intakes along Okanagan River to reduce minimum flows to 100 cfs at Oliver during the irrigation season would guarantee fishery requirements in all but a period of consecutive drought years when fishery flows would have to be reduced. The amount of reduction would depend on the size of the salmon run and the magnitude of drought. Implementation of this water conservation alternative would at least maintain the salmon run at current levels over the next 50 years.

Construction of an artificial spawning channel adjacent to Okanagan River to maintain the present run would cost over $500,000 with an annual cost, including amortizated capital, operation and maintenance of $54,500. Such a facility could conserve about 30,000 acre feet in a drought year assuming minimum flow requirements for fisheries were met at all times. These costs could not be justified on the basis of any economic or social benefits that might occur to the Okanagan Basin itself.

17.8 SUMMARY

It appears that an increase of over three times the current stocking program in the headwater lakes will be required over the next 50 years to maintain existing success rates. Due to the high economic and social values placed on headwater angling, such a program could be justified for both of the growth projections considered.

In addition, management measures on Mission, Equesis and Trepanier Creeks which are tributary to Okanagan Lake, plus protection of shore-spawning habitats will be necessary to maintain an adequate stock of kokanee and trout to meet potential angling demands. Preliminary evaluations indicate that the economic benefits resulting from these improvements would exceed implementation costs.

Enhancement of kokanee and Rainbow trout in Skaha lake is dependent on artificial propagation. This may not be economically justified alone, but could be if programmed in conjunction with headwater fishery management.

Total costs of the entire sport fishery management program for the Okanagan could exceed 3 million dollars over the next 50 years. In the past, the costs of such fishery enhancement programs have been borne by the Province and recovered in part from annual licence fees paid by anglers. Alternatively, as the benefit is expressed by angler's satisfaction gained through sport fishing and from expenditures of non-resident anglers appear to exceed costs of enhancement, part or all of these costs could be borne by anglers within the Okanagan. Both these management approaches have implications that can only be discussed briefly in this report.

If the costs are borne by the entire Province, then the program described above should be evaluated in a provincial perspective. The Okanagan basin is only one sport fishery management area in British Columbia and thus the benefits of a 3 million dollar investment may be better obtained by allocating some or all of this amount to other regions. Such decisions will depend upon knowledge of fishery resource capability and potential angling demands in all major fishery areas in the Province.

If the costs are borne by resident and non-resident anglers in the Okanagan, then a system of user charges would have to be instituted. From an administrative point of view, such charges would be best levied on annual licences, though in theory, they should be applied to each angling day. Higher costs of angling in the Okanagan, either through increased licence fees or daily charges would have policy implications in the Province and could also upset the estimation of future demands. If licences cost more in the Okanagan than in neighbouring regions, some anglers might avoid the Okanagan completely, thus reducing potential demands and the subsequent costs of fishery enhancement.

Any financial arrangement for managing the sport-fishery program will have to be carefully evaluated before recommendations can be made. Such evaluations have not been undertaken within the scope of this draft report.