CHAPTER 8

Fisheries and Water Management

Fishery values, in the Okanagan Basin are dependent on water quantity and water quality within the system. While fish are not consumptive water users, they are demanding in terms of lake level maintenance and tributary and main river flows throughout much of the year. Water quality plays a determining role in the supply of vital life constituents to fish, as do surrounding land use practices. Fish also play a role as indicators of water quality as is outlined in Chapter 6 of this report. Fisheries within the Okanagan system are self supporting with the exception of rainbow trout in the headwater lakes, which are in large part produced in hatcheries and sockeye salmon which spend part of their life at sea. Thus, the future of the fishery, and fishing, in the Okanagan system is closely linked to water management within the basin.

Sport fishing, a significant component of water based recreation, provided approximately 158,000 angler days in the basin in 1971. Over half of this (53.5%) was spent on the main valley lakes and almost half (42%) on the headwater lakes. Stream and river fishing account for the remaining comparatively small amount of time. This recreational pursuit provides a social value to valley residents as well an economic value derived from the tourist sportfishing industry.

A substantial sockeye salmon run (averaging 19,000 spawners annually) use the Okanagan River in Canada for spawning and Osoyoos Lake for rearing. These fish supply a significant portion of the commercial sockeye catch attributed to the Columbia River in the United States and also support a local native Indian ceremonial and food fishery.

The main purpose of fishery investigations under the Okanagan Basin Study has been to determine the existing demand for sport fishing and its value, as well as the capacity of the basin lakes to support sport fisheries so that future management options could be explored. More specifically these fishery studies included the following components:

(a) the role played by each of the four segments of the system; headwater lakes, tributary streams, main valley lakes, the Okanagan River. The inter-relationships of each segment with the whole were also explored,

(b) the effects of water quantity management on fishery resources,

(c) the effects of water quality on mainstem fishery resources,

(d) the determination of fishery capacities in the system,

(e) the social and economic values of the fisheries.

8.1 PRESENT FISHERY RESOURCE (1971) AND UTILIZATION

The four segments - headwater lakes, tributary streams, main valley lakes, and Okanagan River - while generally discrete within the system, do have certain vital inter-relationships that should be noted (Figure 8.1):

(1) Rainbow trout and kokanee from the main valley lakes utilize tributary streams habitats for reproduction.

(2) Streamflows, generated in part by discharge from headwater lakes and reservoirs, are vital to the production of in-channel stream fisheries, and to reproduction by rainbow trout and kokanee from the main valley lakes.

(3) Many of the headwater lake fisheries are vulnerable to lake drawdown for meeting stream discharge requirements including inchannel fishery needs.

(4) The Okanagan River sport fishery is heavily dependent on the migration of fishes from the main valley lakes, particularly Skaha, Vaseux and Osoyoos.

(5) Propagation of sockeye salmon (and other species) in Okanagan Rive-is dependent on water releases from Okanagan Lake. Such releases will in turn draw down the level of Okanagan Lake which may affect shore spawning kokanee, and access to the tributary streams.

(6) Sockeye salmon, propagated in Okanagan River, rear in Osoyoos Lake.

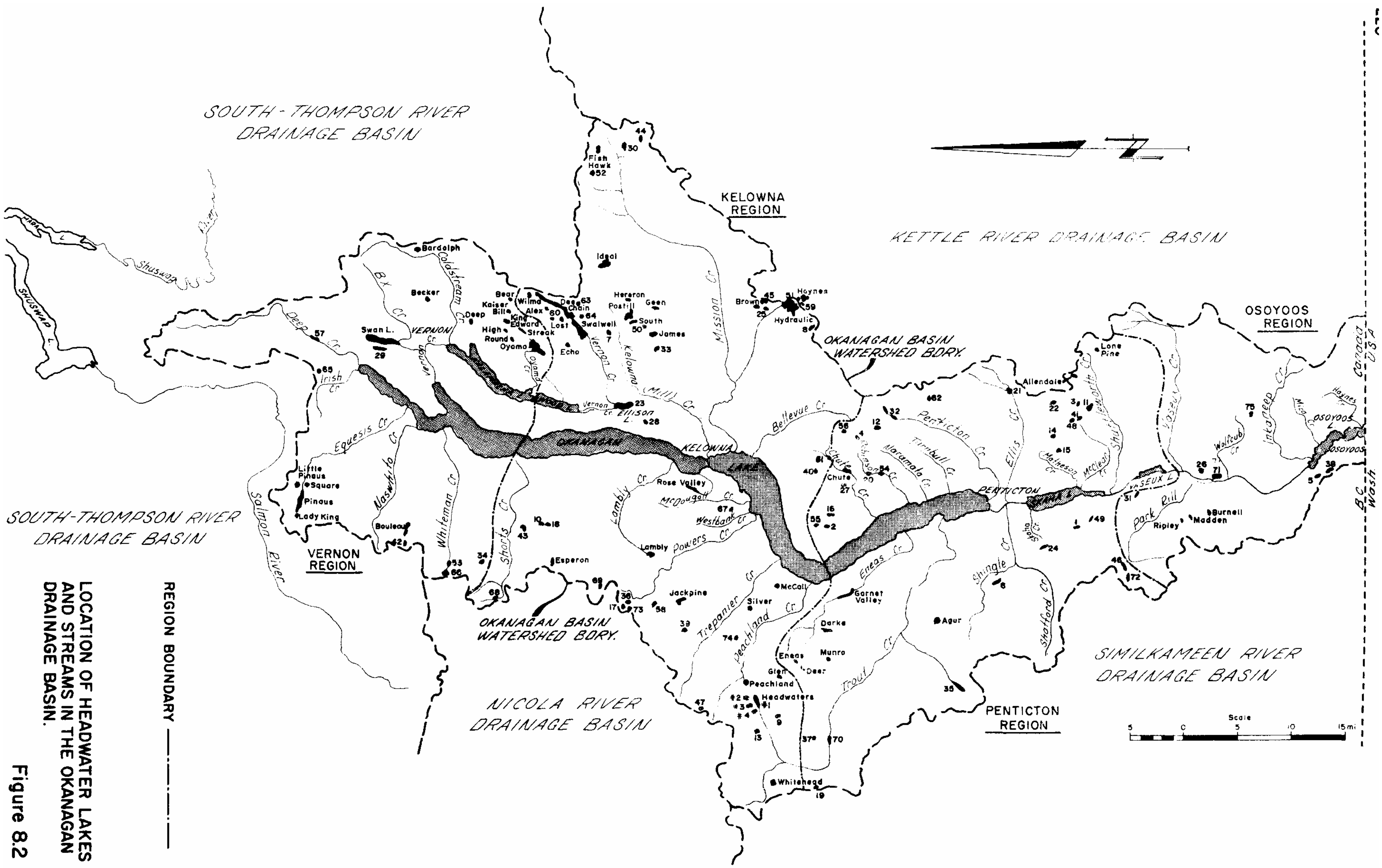
Harvest Capacities of Headwater Lakes and Reservoirs

The headwater lakes support a significant and popular sport fishery primarily for rainbow trout. Headwater lakes for purposes of this study have been defined as all lakes within the basin exclusive of the six main valley lakes.

Analysis of fishery capacities of the headwater lakes was derived on the basis of 57 "key" lakes for which creel census data were obtained and which support the bulk of headwater fishing activity (Fig. 8.2).The analysis was extrapolated to 75 "additional" headwater lakes which have sport fishing potential, but are at present only marginally or not utilized (Figure 8.2a).

Elevation plays a predominant role in fish productivity, and the fisheries of the Okanagan headwater lakes have therefore been analysed according to elevation boundaries. Table 8.1 indicates lake distribution according to elevation, and Table 8.2 the basic carrying capacity of these lakes.

With few exceptions the headwater fisheries are heavily dependent on artificial stocking. The ability of a stocked lake to produce catchable sized trout is dependent primarily upon the basic productive capacity of the lakes and the density of competitor and/or predator species. The carrying capacity of British Columbia



REGION BOUNDARY —·—·—

LOCATION OF HEADWATER LAKES AND STREAMS IN THE OKANAGAN DRAINAGE BASIN.

Figure 8.2

Climate Morphometry

water and habitats

Geology Climate Morphometry

jure 8.1

75 ADDITIONAL HEADWATER LAKES IN THE OKANAGAN BASIN KNOWN TO HARBOUR SPORT-FISHING OPPORTUNITIES - AS SHOWN IN FIGURE 8.2

LAKE	REGION	ELEVATION (in feet)	SURFACE AREA (acres)
1. Aeneas	Penticton	2,400	38
2. Baker	Penticton	4,500	25
3. Big Clarke	Penticton	5,300	13
4. Big Meadow	Penticton	5,400	56
5. Blue	Osoyoos	2,750	5
6. Brent	Penticton	2,700	58
7. Bulman	Kelowna	4,400	62
8. Canyon	Kelowna	5,500	40
9. Chapman	Kelowna	5,600	25
10. Christie	Kelowna	4,400	7
11. Clarke Meadows	Penticton	5,000	19
12. Corporation	Penticton	5,700	12
13. Crescent	Kelowna	4,500	80
14. Culper	Penticton	5,700	8
15. Derenzy	Penticton	5,300	18
16. Divide	Penticton	5,000	14
17. Dobbin	Kelowna	4,800	20
18. Duo Via	Kelowna	4,400	10
19. Eastmere	Penticton	4,700	30
20. Elinor	Penticton	4,100	20
21. Ellis Reservoir 1	Penticton	5,050	45
22. Ellis Reservoir 4	Penticton	4,400	100
23. Ellison	Kelowna	1,400	520
24. Farleigh	Penticton	2,500	35
25. Fish	Kelowna	4,300	35
26. Gallagher	Osoyoos	1,400	17
27. Gemmill	Penticton	4,700	8
28. Glenmore Reservoir	Kelowna	1,200	18
29. Goose	Vernon	1,600	89
30. Graystoke	Kelowna	6,000	89
31. Green	Osoyoos	1,600	44
32. Greyback	Penticton	5,200	307
33. Guest	Kelowna	4,400	28
34. Hudson Bay	Vernon	5,200	15
35. Isintok	Penticton	5,400	97
36. Islaht	Kelowna	4,800	67
37. Kathleen	Penticton	4,500	5
38. Kilpoola	Osoyoos	2,750	42
39. Lacome	Kelowna	3,500	13
40. Lebanon	Kelowna	4,000	3
41. Little Clarke	Penticton	5,100	11
42. Little Bouleau	Vernon	4,600	40
43. Loch Drinkie	Kelowna	4,600	45
44. Loch Katrine	Kelowna	6,400	30
45. Long Meadow	Kelowna	4,300	60
46. Lower Twin	Penticton	2,700	82
47. MacDonald	Kelowna	5,600	12
48. McLean Clan	Penticton	5,300	25
49. Marron	Penticton	2,000	35
50. Meadow	Kelowna	4,500	12
51. Minnow	Kelowna	4,200	35
52. Mission	Kelowna	6,000	133
53. Morrison	Vernon	4,500	5
54. Naramata	Penticton	4,150	35
55. Norman	Penticton	4,600	3
56. Nuttal	Penticton	5,700	13
57. Otter	Vernon	1,150	120
58. Paynter	Kelowna	4,500	57
59. Pear	Kelowna	4,200	35
60. Rankin	Kelowna	4,800	10
61. Ratnip	Kelowna	4,100	5
62. Reed	Penticton	6,000	8
63. Rod	Kelowna	4,600	10
64. Round	Kelowna	-	-
65. Round	Vernon	-	-
66. Seaton	Vernon	4,550	30
67. Shannon	Kelowna	1,700	54
68. Shorts	Kelowna	4,600	20
69. Tadpole	Kelowna	5,300	17
70. Thirsk Reservoir	Penticton	3,400	148
71. Tugulnuit	Osoyoos	1,100	125
72. Upper Twin	Penticton	2,700	79
73. West	Kelowna	4,900	10
74. Wilson	Kelowna	4,300	12
75. Wolf	Osoyoos	2,250	3

Figure 8.2a

TABLE 8.1

DISTRIBUTION BY ELEVATION OF 137 OKANAGAN HEADWATER LAKES WITH SPORT FISHING OPPORTUNITIES OR POTENTIAL

ELEVATION (FEET)	NUMBER OF LAKES	WATER SURFACE AREA (ACRES, AT FULL SUPPLY LEVEL)
Less than 3501 feet	34	3399
3501-4000	8	987
4001-4500	45	4520
4501- 5000	24	806
5001-5500	16	819
Greater than 5500 feet	10	373
TOTALS	137	10904

TABLE 8.2

BASIC CARRYING CAPACITY FOR TROUT FRY, RECENT (1967-1971) AVERAGE TROUT INTRODUCTIONS. AND PERCENT UTILIZATION OF FRY CARRYING CAPACITY BY STOCKING FOR 57 "KEY" OKANAGAN HEADWATER LAKES

ELEVATION, FEET	NO. OF LAKES	BASIC FRY CARRYING CAPACITY AT 2500 FRY PER POUND OR EQUIVALENT		RECENT AVERAGE ANNUAL TROUT INTRODUCTIONS AT 2500 FRY PER POUND OR EQUIVALENT		PERCENT UTILIZATION OF BASIC CARRYING CAPACITY BY RECENT STOCKING
		NO.X1000	NO./ACRE	NO. X 1000	NO./ACRE	
Less than 3501 feet	14	4,225.2	2355	552.5	308	13.1
3501-4000	7	987.5	1004	160.1	163	16.2
4001-4500	22	3,498.8	906	883.1	229	25.2
4501-5000	8	694.7	1447	91.6	191	13.2
5001-5500	5	262.7	1501	41.1	235	15.6
Greater than 5500 feet	1	63.6	1479	0.0	0	0.0
TOTALS	57	9,732.5		1,728.4		17.8%

lakes for stocked rainbow trout is determined by a formula which takes into account littoral area and total dissolved solids. This formula indicates the number of fry (rainbow trout at 2500 fry per pound or equivalent) that the lake can sustain.

Present utilization of fry carrying capacity, on the basis of stocking practices between 1967 and 1971, ranges from 0 to 25 percent and averages 18 percent amongst the 57 "key" headwater lakes.

From determination of headwater lake capacities to accept fry, harvest capacities were estimated for four different sets of conditions assuming sustained harvest and artificial stocking practices.

(1) Present available harvest capacity. Number of trout harvestable annually based on present management and stocking practices.

(2) Primary potential harvest capacity. Number of trout harvestable annually given that:

(a) Recruitment supplied to the full capacity of the lake as per the stocking formula,

(b) Lake conditions at 50% drawdown for active reservoirs apply,

(c) Volumes and depths maintained are adequate to prevent winter kills,

(d) Predation and/or competition are minimal or absent.

(3) Present potential harvest capacity. The primary potential harvest adjusted downward to take into account the existing negative impact of:

(a) Reservoir manipulation

(b) winter kill

(c) Predation and/or competition

(4) Ultimate potential harvest capacity. The primary potential harvest capacity adjusted upward in anticipation of:

(a) Nil drawdown (assuming all water retained for fisheries)

(b) Predation and/or competition minimized or eliminated.

From data collected it was found that the average age of trout caught by anglers, was linked to elevation as was average size. The average size bears an inverse relationship to elevation, while age varies directly (Table 8.3). Survival from the fry stage to catchable age is inversely related to elevation.

TABLE 8.3

AVERAGE SIZE AND AGE OF RAINBOW TROUT CAUGHT IN THE OKANAGAN HEADWATER LAKES AND CORRESPONDING SURVIVAL RATE BETWEEN FRY STAGE AND CATCHABLE AGE.

ELEVATION (FEET)	AVERAGE SIZE AT CATCHING		AVERAGE AGE AT CATCHING-YEARS	AVERAGE SURVIVAL (FRY TO CATCHABLE AGE)
	LB.	GRAMS		
< 3501	0.65	295	2	0.090
3501-4000	0.48	218	2	0.090
4001-4500	0.44	200	3	0.056
4501-5000	0.52	236	4	0.042
5001-5500	0.38	172	4	0.042
> 5500	0.24	109	4	0.042

Knowing stocking requirements, the data presented in Table 8.3, and the degree to which reservoir manipulation, winter kill and predation/competition effect various lakes, trout harvests have been computed for the specific conditions previously outlined. These data are presented in Figure 8.3.

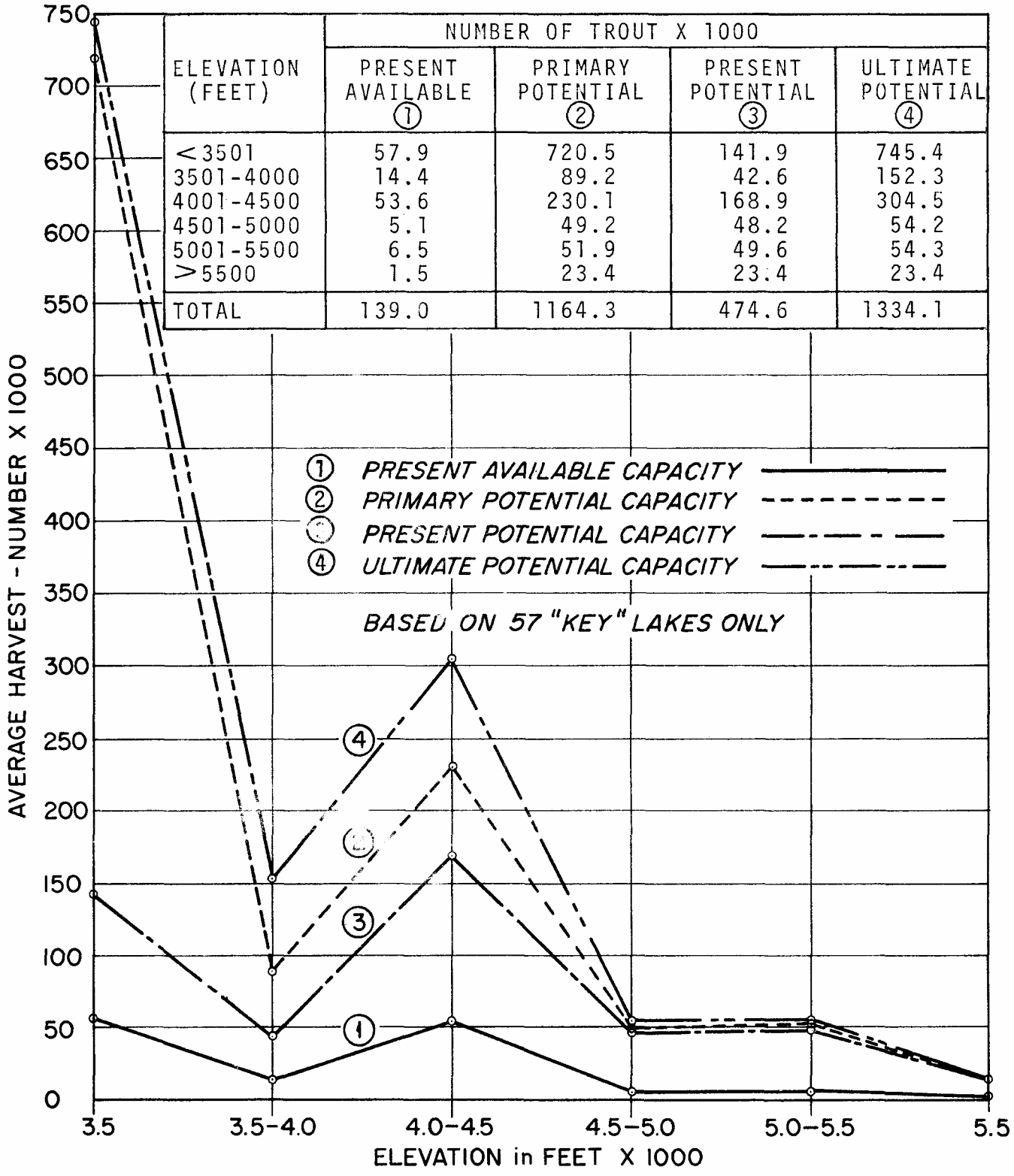
This analysis of trout harvest potentials in the headwater lakes has proceeded from an essentially assumed set of parameters and relationships which are generally true, but have not been proven in detail in this instance. Elevation is the key influence on trout productivity in this situation and has been linked to carrying capacity, harvest potential, special negative influences (drawdown, winter kill, predation) and present realized harvest.

The present potential harvest, based on saturation stocking, is 3.7 times the 1971 realized harvest. Ultimate potential harvest - the lakes abilities to produce without the constraints of limited stocking, reservoir manipulation and predator/competition interaction - is 10.6 times the 1971 realized harvest. Thus the ability of the headwater lakes to produce trout for anglers is only partially being used. Saturation stocking alone could increase yields almost four fold over present success rates, while the lakes could ultimately produce over ten times that which is presently being extracted.

8.1.2 Harvest Capacities of Tributary Streams

Sections of at least 21 tributary streams in the Okanagan Basin support viable rainbow and/or brook trout populations or did so historically. These stocks are entirely supported by natural reproduction. Most of these streams are also utilized for the reproduction, incubation and rearing of salmonid species from the main valley lakes.

ELEVATION (FEET)	NUMBER OF TROUT X 1000			
	PRESENT AVAILABLE ①	PRIMARY POTENTIAL ②	PRESENT POTENTIAL ③	ULTIMATE POTENTIAL ④
<3501	57.9	720.5	141.9	745.4
3501-4000	14.4	89.2	42.6	152.3
4001-4500	53.6	230.1	168.9	304.5
4501-5000	5.1	49.2	48.2	54.2
5001-5500	6.5	51.9	49.6	54.3
>5500	1.5	23.4	23.4	23.4
TOTAL	139.0	1164.3	474.6	1334.1



DISTRIBUTION BY ELEVATION OF TROUT HARVEST CAPACITIES FOR 57 KEY OKANAGAN HEADWATER LAKES. Figure 8.3

Two types of trout harvest capacity estimates were derived for the Okanagan tributary streams, both reflecting an annual sustainable harvest equilibrium;

(1) Primary potential harvest capacity - the number of trout harvest-able annually given a "minimal optimum" discharge regime consistent with average annual discharge volume and present physical stream habitat.

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

Estimates for the above are based on reference to published accounts of trout stream yields in other locales and a creel census and trout population sampling program on Trout Creek in 1971.

On the basis of other studies and data derived from the Trout Creek investigation, it was concluded that 12 pounds of trout per acre is a reasonable estimate of the primary potential sustained harvest for Trout Creek. At the small average size of stream resident rainbow trout this amounts to 178 trout per acre or 323 trout per mile. A total of 6132 trout would be available annually from the entire fishable reach of Trout Creek (from Thirsk Reservoir to the Summerland irrigation intake).

Extrapolation of the above data to the other streams was carried out and is presented in Column (2), Table 8.4. Column (3) of the same table indicates available harvest of the 21 streams under present discharge management.

TABLE 8.4

PRIMARY POTENTIAL HARVEST CAPACITIES AND PRESENT AVAILABLE HARVEST CAPACITIES OF 21 OKANAGAN TRIBUTARY STREAMS

COLUMN 1 STREAM & REACH	COLUMN 2 PRIMARY POTENTIAL HARVEST NO. OF TROUT	COLUMN 3 PRESENT AVAILABLE HARVEST NO. OF TROUT	COLUMN 1 STREAM & REACH	COLUMN 2 PRIMARY POTENTIAL HARVEST NO. OF TROUT	COLUMN 3 PRESENT AVAILABLE HARVEST NO. OF TROUT
B-X, Upper	147	32	Powers	889	711
B-X, Lower	135	82	Shingle, A	454	759
Coldstream	307	206	Shingle, B	386	301
Deep	110	76	Shorts	2545	1909
Equesis	736	729	Shuttleworth	196	139
Ellis	546	475	Trepanier	1637	1326
Inkaneep	129	74	Trout, A	711	611
Kelowna	208	183	Trout, B & C	6132	5457
Lambly	2533	1570	Vaseux	1165	1165
Mission,A	1913	1779	Vernon, A	368	320
Mission,B	6169	5552	Vernon, B	1202	829
Mission,C	5690	4893	Whiteman, A	662	629
Peachland	938	816	Whiteman, B	724	695
Penticton	1778	1405	TOTAL	38,410	32,223

Trout fishing in the tributary streams while providing a different type of recreational experience produces much smaller sportfish than any other angling in the basin.

It is noted that the present available harvest of 32,223 trout is only 16% less than the primary potential harvest of 38,410 trout. In general then, water which might be diverted for the particular benefit of resident stream trout will tend to yield greater fishery benefits if applied to maintaining levels of headwater reservoirs or more particularly if applied to propagation of salmonids from the main valley lakes (see next section).

8.1.3 Harvest Capacities of the Main Valley Lakes

(a) General Capacities

The 27 fish species inhabiting the main valley lakes of the Okanagan support a substantial sport fishery (84,600 angler days between June 1971 and May 1972). Gross sustainable fish harvest capacities of the main valley lakes were estimated on the basis of mean depth and total dissolved solid concentration according to Ryder's model (23), developed for north-temperate lakes of comparable latitude.

These gross sustainable fish harvest estimates were further refined by taking into account total phosphorus concentration relative to that of Okanagan Lake. The rationale for this assumption is completely outlined in technical supplement IX. Table 8.5 indicates these primary sustainable (based on Ryder's model) and secondary sustainable harvest capacities (Based on refinement of Ryder's model by accounting for phosphorus concentrations).

TABLE 8.5

ESTIMATES OF PRIMARY AND SECONDARY GROSS SUSTAINABLE FISH HARVEST CAPACITIES OF OKANAGAN MAIN VALLEY LAKES UNDER PRESENT (1971) CONDITIONS

LAKE	ESTIMATED PRIMARY SUSTAINABLE HARVEST CAPACITY POUNDS/ACRE/YR.	AVERAGE PHOSPHORUS CONCENTRATION OF LAKE MICROGRAMS PER LITER	RELATIVE* PHOSPHORUS CONCENTRATION COMPARED TO OKANAGAN LAKE	ESTIMATED SECONDARY SUSTAINABLE HARVEST CAPACITY POUNDS/ACRE/YEAR
Wood	3.0	219	7.30	21.7
Kalamalka	1.9	14	0.47	0.9
Okanagan	1.5	30	1.00	1.5
Skaha	2.5	77	2.57	6.5
Vaseux	5.1	77	2.57	13.2
Osoyoos	3.1	73	2.43	7.6

* Concentration in Comparison to Okanagan Lake, i.e. 7.30 means 7.30 x the concentration shown for Okanagan Lake.

Further refinement of these gross estimates may also be made by relating them to species proportion composition of sampling catches. This was done with the gill net sample data collected during 1971 on the Okanagan main valley lakes. The proportion of the secondary gross annual fish harvest attributable to various species groups in each lake is presented in Table 8.6.

TABLE 8.6
SECONDARY ESTIMATES OF GROSS ANNUAL FISH HARVEST CAPACITIES BY SPECIES GROUPS FOR THE MAIN VALLEY LAKES UNDER PRESENT (1971) CONDITIONS. BREAKDOWNS' ARE ACCORDING TO PROPORTIONS BY WEIGHT OF FISH IN GILLNET (SAMPLING) CATCHES

	TOTAL ALL SPECIES	PREFERRED SPORT FISH (TROUT & KOKANEE)	MARGINAL SPORT FISH (MOUNTAIN WHITE-FISH, BASS, ETC.)	LAKE WHITE-FISH	PREFERRED COARSE FISH	MARGINAL COARSE FISH
1. Pounds per acre:						
Wood	21.7	0.93	0.00	0.00	12.59	8.18
Kalamalka	0.9	0.51	0.00	0.00	0.19	0.20
Okanagan	1.5	0.39	0.15	0.22	0.33	0.41
Skaha	6.5	0.76	0.03	2.67	1.40	1.64
Vaseux	13.2	0.34	0.40	4.84	2.02	5.60
Osoyoos	7.6	0.90	0.07	1.05	4.20	1.38
2. Pounds per lake, X 1000:						
Wood	49.9	2.2	0.0	0.0	28.9	18.8
Kalamalka	5.8	3.3	0.0	0.0	1.2	1.3
Okanagan	129.0	33.5	12.9	18.9	28.4	35.3
Skaha	32.3	3.8	0.1	13.3	7.0	8.1
Vaseux	9.0	0.2	0.3	3.3	1.4	3.8
Osoyoos	28.3	3.4	0.3	3.9	15.6	5.1

In view of the particular importance of kokanee and rainbow trout to Okanagan fisheries and also in consideration of their special habitat requirements and vulnerabilities more refined estimates were attempted for productive capacities and sustainable harvests of these two species.

(b) Salmonid Sport Fish Capacities

Anglers are currently attracted to the Okanagan main valley lakes because of their endemic stocks of salmonid species. Kokanee and rainbow trout accounted for 94% and 5% respectively, of the fish harvested by boat anglers in 1971. Not all the main valley lakes are equally suited to salmonid productions. Kalamalka Lake at one extreme, is too oligotrophic for good sustained salmonid production. Conversely, advanced eutrophy has made Wood and Vaseux Lakes poor salmonid habitat due to unfavorable temperatures, low dissolved oxygen content and other conditions acting in concert. The American portion of Osoyoos Lake is also considered to have a poor salmonid habitat.

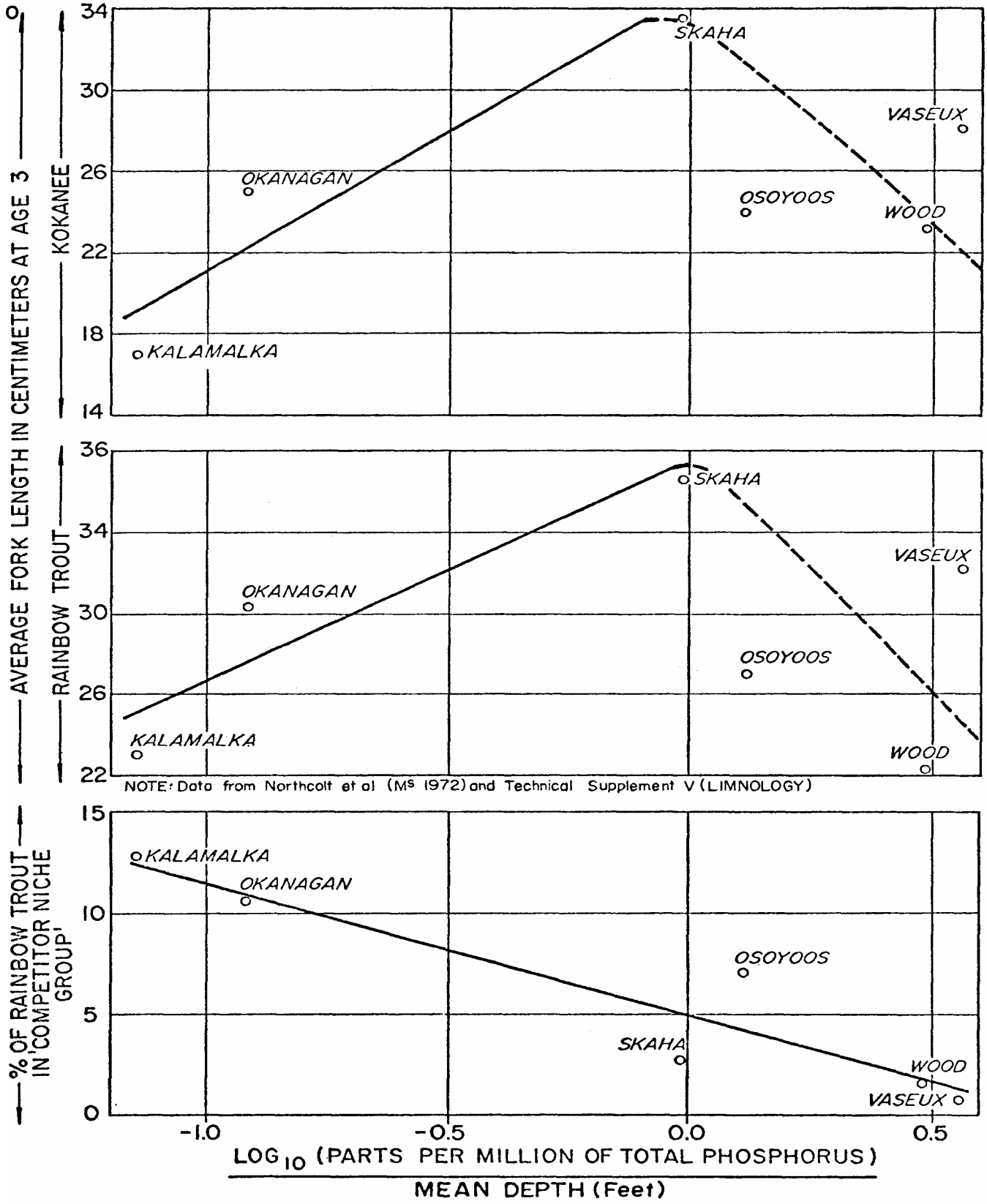
It was found that nutrient availability, (as determined by phosphorus loading) was directly correlated to salmonid growth to a point at which the reverse became the case. The peak point was found to be at about the present Skaha Lake level (Figure 8.4), thus it was assumed that present conditions in Skaha Lake are near optimal for salmonid growth and production. Enrichment beyond this point would probably be detrimental. The bulk of kokanee on these lakes spawn at the same age so their fecundity (egg production) is also linked to trophic conditions by virtue of the dependence of reproduction on fish size. That is, the number of eggs per female varies directly with the size of the fish which is, in turn, dependent on "P" concentration.

Increased nutrient loading may also effect salmonids by enhancing conditions for competition and predator species. In fact, it was found that the percentage of rainbow trout in its "competitor or niche group" was inversely related to phosphorus concentration throughout the Okanagan main valley lakes. (Figure 8.4). It is thus assumed that such interactions contribute substantially to reduced growth and population densities of salmonids in the more eutrophic main valley lakes.

The Okanagan main lake salmonid populations are heavily dependent on in-flowing streams for reproduction. Discharge requirements for kokanee and rainbow trout in streams differ seasonally, but are generally the same in terms of spawning areas. Reservoirs on streams tributary to the Okanagan main valley lakes, are presently operated without particular regard to the migration, spawning, incubation and rearing requirements of salmonids, which causes a considerable loss of reproduction capacity. In addition to stream spawning, kokanee have been found to spawn extensively along the shoreline of some of the main valley lakes. Shore spawners accounted for about 57% of the estimated total kokanee spawning population in 1971. Approximately half of the egg deposition in these shoreline areas during the fall, occurs at lake depths of 1.5 feet or less. Essentially all kokanee shore spawn is deposited in water five feet deep or less.

A survey of the natural reproductive habitat in the accessible lower reaches of streams tributary to Wood, Kalamalka, Okanagan and Skaha Lakes indicates that over 80% of the reproductive capacity of Okanagan streams has been lost due to cultural modifications. These include alterations to access, streambeds, configuration, silt load, stream bank cover, pollution and discharge regimes.

Estimated present (1971) escapement of rainbow trout and kokanee are presented in Table 8.7. It is noted that only in Peachland Creek was there a greater escapement than could be accommodated with existing reproductive habitat. One stream, Coldstream Creek supports essentially the entire salmonid population of Kalamalka Lake. Mission, Equesis and Trepanier Creeks are the principal salmonid producing streams for Okanagan Lake where shore spawning is a major kokanee producing factor. The Okanagan River provides spawning for essentially all the salmonids of Skaha, Vaseux and Osoyoos Lakes.



NOTE: Data from Northcott et al (Ms 1972) and Technical Supplement V (LIMNOLOGY)

EFFECT OF TOTAL PHOSPHORUS CONCENTRATION IN CONJUNCTION WITH MEAN DEPTH ON GROWTH OF KOKANEE AND RAINBOW TROUT, AND ON CONTRIBUTION BY RAINBOW TROUT TO ITS COMPETITOR NICHE GROUP IN THE OKANAGAN MAIN VALLEY LAKES. Figure 8.4

TABLE 8.7
ESTIMATED 1971 SPAWNING ESCAPEMENT OF KOKANEE AND RAINBOW TROUT POPULATIONS OF OKANAGAN MAIN VALLEY LAKES

LOCATION	KOKANEE ESCAPEMENT X 100	RAINBOW TROUT ESCAPEMENT X 100
OKANAGAN LAKE		
Trout Cr.	5	.5
Eneas Cr.	5	.5
Peachland Cr.*	47(362)*	4.2
Trepanier Cr.	104	9.3
Powers Cr.	73	6.5
McDougall Cr.	0	.4
Lambly	5	.5
Shorts Cr.	5	.5
Whiteman Cr.	6	.5
Naswhito Cr.	5	.5
Equesis Cr.	276	24.6
Deep Cr.	5	.5
B-X Cr.	0	.5
Vernon Cr.,Lower	10	.9
Mission Cr.	3121	278.2
Bellevue Cr.	0	.4
Penticton Cr.	5	.5
Shore Spawners	5180	-
Okanagan Lk. Sub-Total	8817	328.6

* 36,200 Kokanee spawners ascended Peachland Creek, However, based on reproductive habitat available, it was found only 4,700 could effectively spawn.

LOCATION	KOKANEE ESCAPEMENT X 100	RAINBOW TROUT ESCAPEMENT X 100
WOOD LAKE		
Vernon Cr.,Upper	5	1.2
Wood Lake Shore Spawners	33	-
Wood Lake Sub-Total	33+	1.2
KALAMALKA LAKE		
Coldstream Cr.	597	105.6
Kalamalka Lake Shore Spawners	55	-
Kalamalka Lake Sub-Total	652	105.6
SKAHA LAKE		
Ellis Cr.	5	.2
McLean Cr.	5	.2
Shingle Cr.	5	.2
Okanagan River	401	14.9
Skaha Lake Sub-Total	401+	15.5
VASEUX LAKE		
Okanagan River	4	.5
Vaseux Lake Sub-Total	4	.5
OSOYOOS LAKE		
Inkaneep Cr.	5	0
Okanagan River	369	2.9
Osoyoos Lake Sub-Total	369+	2.9
TOTALS	10,276+	454.3

The ability of lakes to support a given number of kokanee spawners was determined on the basis of lake productivity (Table 8.8). It is noted that in all cases this ability to support spawners (and by inference harvestable fish) is not currently a limiting factor. Stream habitat or other factors must therefore be the present major limitation to kokanee populations in the main valley lakes.

TABLE 8.8

ESTIMATES OF KOKANEE SPAWNING ESCAPEMENTS SUPPORTABLE ANNUALLY BY OKANAGAN MAIN VALLEY LAKES BASED ON LAKE CARRYING CAPACITY. FOR COMPARISON ACTUAL SPAWNING ESCAPEMENTS ARE INCLUDED

LAKE	NUMBER OF SPAWNERS X 1000		
	SUPPORTABLE BY LAKE	PRESENT ESCAPEMENT	% UTILIZATION OF CARRYING CAPACITY
Wood	802.0	3.3	0.4
Kalamalka	1,139.6	65.2	5.7
Okanagan	7,592.0	881.7	11.7
Skaha	466.6	40.1	8.6
Vaseux	96.8	0.4	0.4
Osoyoos	636.2	36.9	5.8

Minimum and maximum annual sustainable harvests of kokanee were derived for the main valley lakes (Table 8.9). The minimum annual sustainable harvest was deemed to be the present (1971) harvest. The maximum annual sustainable harvest is based on data from the West Arm of Kootenay Lake taking into account different fecundities (rates of egg production) and merely indicates the levels to which Kokanee harvests could be carried on a sustained yield basis. While this maximum sustainable harvest approach is biologically sound from a management point of view, it would undoubtedly result in a decrease in angling success rates (number of fish caught per hour), which may be unacceptable to anglers.

TABLE 8.9

ESTIMATED MAXIMUM AND MINIMUM ANNUAL SUSTAINABLE KOKANEE HARVESTS FROM OKANAGAN MAIN VALLEY LAKES

	NUMBER OF KOKANEE HARVESTABLE ANNUALLY X 1000						
	WOOD	KALAMALKA	OKANAGAN	SKAHA	VASEUX	OSOYOOS	TOTAL
Minimum	1.82	1.24	237.5	5.91	0.01	0.99	247.47
Maximum	5 47	73.02	2,019.9	185.66	1.36	69.13	2,354.54

A key to rainbow trout productivity is the capacity of a lake for fry. These values were arrived at for main valley lakes using (1) the stocking formula developed for headwater lakes and adjusting it to phosphorus concentrations relative to Okanagan Lake, and (2) the amount of competition and/or predation in each of the lakes. The annual carrying capacity for rainbow trout fry based on the above procedure, and the present fry production based on 1971

escapement are compared in Table 8.10. It is noted that in all cases but Kalamalka Lake, only about 5% or less of a lake's capacity to accept rainbow trout fry is presently being utilized. This is evidence in part of the limitations stream spawning habitat is presently placing on these trout populations.

TABLE 8.10

ESTIMATED CARRYING CAPACITY FOR RAINBOW TROUT FRY AND PRESENT UTILIZATION OF CARRYING CAPACITY IN OKANAGAN MAIN VALLEY LAKES

	WOOD	KALAMALKA	OKANAGAN	SKAHA	VASEUX	OSOYOOS
Present Carrying Capacity Fry X1000	756	956	23,377	1,732	501	1,857
Present Fry Production Fry X1000	3.6	297.9	1,197.9	62.3	1.9	11.1
Present Utilization of Carrying Capacity, %	0.5	32.1	5.1	3.6	0.4	0.6

As with kokanee populations, minimum and maximum annual sustainable rainbow trout harvest capacities were determined. The minimum estimate was assumed to be the actual 1971 catch as recorded by creel census (12,800 rainbow trout from all lakes). Maximum sustainable harvest capacity estimates were based on population-age structures, average age at catching and estimated survival rates. (Table 8.11)

TABLE 8.11

ESTIMATED MAXIMUM AND MINIMUM ANNUAL SUSTAINABLE RAINBOW TROUT HARVESTS FOR OKANAGAN MAIN VALLEY LAKES

	NUMBER OF RAINBOW TROUT HARVESTABLE ANNUALLY X1000						
	WOOD	KALAMALKA	OKANAGAN	SKAHA	VASEUX	OSOYOOS	TOTAL
Minimum	0	0.1	11.08	1.35	0	0.25	12.78
Maximum	0.09	7.92	24.65	1.55	0.05	0.22	34.48

The comments with regard to lower angler success and maximum sustainable harvest that were discussed with regard to kokanee also apply to the trout species.

In summary only a small portion of the main valley lakes capacity to grow sport fish is presently being utilized, such production being limited by the ability of the tributary streams and shoreline spawning areas to produce fry. While the maximum sustainable harvest has not been fully exploited to

date, any further demand on this resource would undoubtedly result in a decrease in angler success rates which may be unacceptable from a social viewpoint. Enhancement of the main valley lake fisheries to maintain present angler success rates, must therefore be based on the alteration of stream characteristics for improved sport fish fry production.

8.1.4 Harvest Capacity of the Okanagan River

(a) Sockeye Salmon

The Okanagan River between Vaseux and Osoyoos Lake serves as the major reproductive habitat for sockeye salmon ascending the Columbia River. The progeny also spend one year rearing in Osoyoos Lake. The total Columbia sockeye escapement is about 95,000 fish annually of which about 19,000 spawn in the Okanagan River in Canada.

Commercial fishermen in the lower Columbia River (United States portion of River) take an average of 21,600 sockeye annually, of which 70% (15,120 fish) are of Okanagan River origin. An additional 3,100 sockeye (annual average) are taken by Canadian and American Indians for subsistence and ceremonial purposes. The present catch to escapement ratio at the river mouth is 0.3:1. It is suggested this could be safely altered 0.5:1 under present conditions.

(b) Sport Fishery

Because of its use as a flood control channel, the Okanagan River cannot be optimally managed for its indigenous fish fauna. As it is heavily channelized, it lacks the meanders, pool and riffle development and shading characteristics of unaltered streams. Higher temperatures coincident with these modifications may drive salmonids out of the river during the summer months.

The availability of fish in the river appears to be heavily dependent on migration from the mainstem lakes. Thus the population status of lake sport fish populations to a large degree determines the fishery opportunities in the river.

It was estimated that the existing "unimproved" section of the river could support a sustained annual yield of about 500 fish, about 87% of the present harvest. Rather than over exploitation, these values are taken as a reflection of the role played by sport fishes migrating into the river from the mainstem lakes.

8.2 ANGLER USE AND SOCIO-ECONOMIC ASPECTS OF THE SPORT FISHERY

The fishery studies described above indicate that the Okanagan Valley harbours a significant sport fishery resource. This resource has considerable value as an attraction for tourist anglers, as an important recreational pursuit for residents and as an indicator of the environmental health of the basin. However, this fishing resource is dependent on water for spawning, rearing and migration, and consequently must compete with other water uses, such as for irrigation, and domestic purposes.

This information was the objective of a socio-economic survey of sport fishermen, undertaken throughout the summer of 1971. The survey was closely tied to aerial and ground boat-count surveys so that the total population of anglers could be estimated.

2.1 Angler Participation

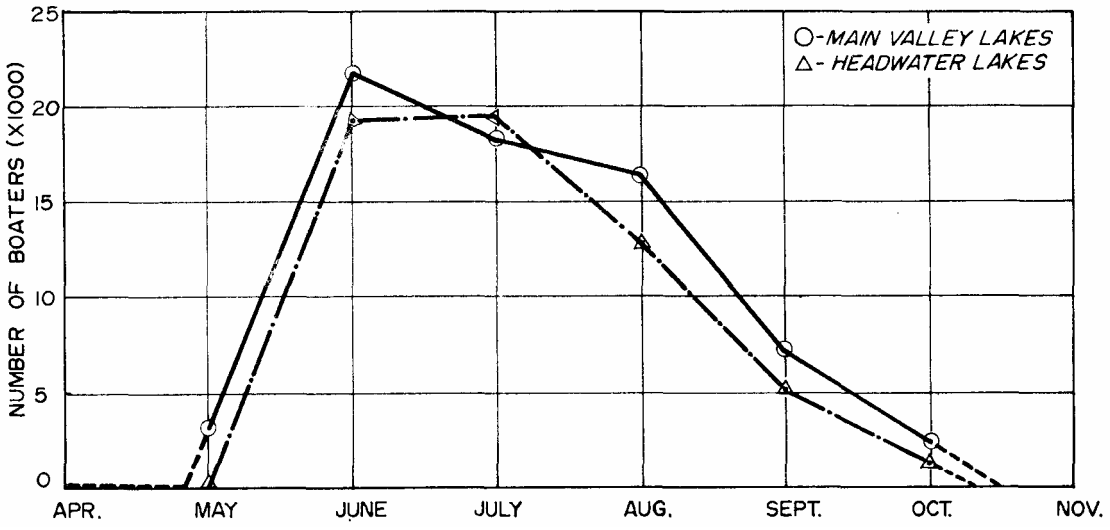
About 157,700 angling days of sport fishing activity were recorded on all surface waters of the Okanagan Basin during the period May 1971 to April, 1972 (Table 8.12). Of this total, an estimated 127,260 angling days were experienced by boaters, almost 27,000 angling days by shore fishermen and 3,460 angling days by ice-fishermen. Slightly more than half the total fishing effort occurred on the main valley lakes, mostly on Okanagan Lake. Similarly, most of the fishing in the headwater lakes was concentrated in relatively few of the 98 lakes surveyed, the most popular lakes being Pinaus, Beaver(Swalwell), Dee-Chain, Lambly, Jackpine and Oyama, which together attracted over 70% of the 65,880 headwater angling days.

TABLE 8.12

SUMMARY OF ANGLER DAYS IN THE OKANAGAN BASIN, 1971

LOCATION	BOAT FISHERMEN	SHORE FISHERMEN	ICE FISHERMEN	TOTAL
Wood	2,300	450	50	2,800
Kalamalka	2,150	450	0	2,600
Okanagan	58,450	11,700	200	70,350
Skaha	5,450	1,100	100	6,650
Vaseux	450	100	0	550
Osoyoos	1,350	250	50	1,650
Total Main Valley Lakes	70,150	14,050	400	84,600
Headwater Lakes	57,111	5,711	3,060	65,882
Tributary Streams	-	2,325	-	2,325
Okanagan River	-	4,900	-	4,900
TOTALS	127,261	26,986	3,460	157,907

Seasonal patterns of participation are similar for both main valley and headwater lakes (Figure 8.5). Little fishing was recorded until mid-May, when there was a surge of participation which was maintained until late July. Fishing activity gradually dropped off throughout the rest of the summer. There was however, significant shore fishing around the main valley lakes in November for both kokanee and whitefish.



SEASONAL PATTERNS OF BOAT ANGLING EFFORT IN THE OKANAGAN BASIN. Figure 8.5

Approximately two-thirds of the angling days (105,860) were recorded by residents and one-third (51,840) by visitors. Over 40% of visiting anglers came from the Lower Mainland. Only 20% of the visiting anglers came from Alberta, relatively lower than the proportion of Albertans in the general population of Okanagan tourists. American anglers represent a higher proportion of visiting anglers than in the general tourist population (Table 8.13).

TABLE 8.13

HOME LOCATION OF NON-RESIDENT ANGLERS AND GENERAL TOURISTS IN 1971

LOCATION	ANGLERS	ALL VISITORS
Lower Mainland	42.1%	35.0%
Rest of B.C.	15.7	13.1
Alberta	19.9	37.5
Sask.-Manitoba	2.6	3.5
Rest of Canada	2.6	1.9
Western U.S.	16.6	8.0
Rest of U.S.	0.5	1.0

As expected, residents fished more frequently than visitors (Table 8,14). The median number of angling days per year for residents and visitors were estimated to be 16, and 7 respectively though some residents (mostly retired) fished over 100 days in 1971. Using these median values, a total of 6,680 residents and 7,620 visitors fished during the census period, May 1971 to June 1972.

Just under one-third (32%) of visitor anglers indicated that fishing was the main and only reason for coming to the Okanagan. This .proportion may be an underestimate, as the socio-economic survey was undertaken during the summer months when many tourists enjoy fishing as part of a package of recreational experiences available in the Okanagan.

TABLE 8.14
FREQUENCY OF RESIDENT AND VISITORS
PARTICIPATION (ANGLING DAYS) IN 1971

DAYS PER YEAR	RESIDENTS (PERCENT)	VISITORS (PERCENT)
1-5	9	40
6-10	25	50
11-15	14	8
16-20	17	1
21-30	16	1
31-60	12	
61-100	5	
over 100	2	

It is also somewhat lower than that reported in other regions of the Province, suggesting that the Okanagan Lakes do not presently have the quality fishing required to attract the angling tourist.

The fishing survey also compared a number of socio-economic characteristics of resident and non-resident anglers. For both groups, fishing tended to be a family experience, over 76% of visitors and 46% of residents fishing in family groups. Non-resident anglers tended to be younger, better educated and had higher household incomes than their resident counterparts. Resident anglers had more fishing experience in the valley, averaging 8 years compared with only 1.3 years for non-residents. In fact, over 40% of visiting anglers were fishing for the first time in 1971.

8.2.2 Sport Fish Harvest

Fish catch is one of the primary motivations for fishing and a major criterion for assessing the value of the sport fishery in various locations in the valley. Fish harvest in the headwater and main valley lakes were

tabulated during the creel census. Results are summarized in Table 8.15. The headwater lakes, on an average tend to provide better quality fishing with high elevations, though data on catch per angling hour for lakes above 5,000 feet are misleading because of the small number of fishing hours censused. It is interesting to note that the more inaccessible headwater lakes tend to offer better fishing than the ones with easy access and high angling pressures.

In the main valley lakes, kokanee represented 80% of total harvest by weight and 94% by number. Despite their small size, an average of more than one was taken each angling hour on Okanagan Lake. This catch per unit effort varied between the north and south portions of Okanagan Lake, however, averaging 1.8 fish per angling hour north of Kelowna bridge and only 0.7 fish per angling hour south of the bridge. This feature, due to the limited spawning habitat in the south, is recognized by anglers judging from the much smaller angling effort observed in the extreme south basin of Okanagan Lake. Larger kokanee, averaging over half-a-pound each were caught in Skaha Lake, though not as frequently as on Okanagan Lake.

Angling success for rainbow trout on the main valley lakes was extremely low (less than one per 16 angling hours), but this is partially compensated by the large size of fish, especially those caught during the winter months (median weight of over 4 pounds).

Newly established lake trout stocks are starting to be exploited in Kalamalka Lake, while bass, yellow perch and crappie constitute the bulk of the game fish caught in Osoyoos and Vaseux Lake.

8.2.3 Angler Behaviour and Preferences

Effective management of the sport fishery resource in the Okanagan should be responsive to the needs and desires of participating anglers. Consequently, part of the socio-economic survey attempted to determine anglers' attitudes and preferences for fishery management in the valley. The major reasons for choosing a fishing site appear to be: (1) ease of access, (2) proximity to place of residence and (3) chance of success. Over 34% of anglers camped at their fishing site and a further 33% spent less than 30 minutes to reach their site. These percentages varied between headwater and main valley lake anglers, however, over 80% of the latter reaching their site within half-an-hour compared to 14% of headwater anglers. Apparently, the higher success ratios, especially for the highly prized rainbow trout in headwater lakes more than compensates for additional travel time. It is worth emphasising that the vast majority of resident anglers preferred fishing in their region of residence both in headwater and main lakes and expressed a strong desire to see this dispersed opportunity maintained in the future.

TABLE 8.15

FISH HARVESTS AND ANGLER SUCCESS RATES IN OKANAGAN BASIN LAKES DURING 1971

(a) Fish Harvest and Success Rates Headwater Lakes

ELEVATION (FEET)	TOTAL AREA AT FULL SUPPLY (ACRES)	TOTAL EFFORT ANGLING-DAYS	PER ACRE ANGLING-HOURS	TOTAL HARVEST	TOTAL WT. (POUNDS)	NUMBER PER ACRE	CATCH PER ANGLING HOUR	POUNDS PER ACRE
Less than 3500	3,399	8.1	32.9	33,686	21,896	9.9	0.30	6.4
3501-4000	987	4.8	19.5	10,264	4,927	10.4	0.53	5.0
4001-4500	4,520	6.4	26.0	65,807	28,955	14.6	0.56	6.4
4501-5000	806	5.0	20.3	12,487	6,493	15.5	0.76	8.1
5001-5500	819	0.7	2.8	2,932	1,114	3.6	1.29	1.4
Greater than 5501	373	0.1	0.4	288	69	0.8	2.00	0.2
TOTALS	10,904			125,465	63,454			

(b) Fish Harvest and Success Rates in Main Valley Lakes

	WOOD	KALAMALKA	OKANAGAN	SKAHA	VASEUX	OSOYOOS	TOTAL
Surface Area (Acres)	2298	6400	84,990	4967	680	3719	104,054
Angling Hours per Acre	2.96	1.00	2.18	3.78	0.96	1.14	
Total Harvest	1817	1409	248,777	7258	270	2516	262,047
Kokanee	1817	1237	237,512	5905	10	991	247,472
Rainbow Trout	0	100	11,083	1353	0	246	12,782
Other	0	72	182	0	260	1279	1,793
Total Harvest lb./acre	0.13	0.10	0.93	0.81	0.19	0.60	
Kokanee	0.13	0.04	0.77	0.62	0.00	0.07	
Rainbow Trout	0.00	0.02	0.16	0.19	0.00	0.11	
Other	0.00	0.04	+	0.00	0.19	0.42	
Catch Per Angling Hour	0.268	0.220	1.325	0.386	0.411	0.590	
Kokanee	0.268	0.193	1.265	0.314	0.015	0.232	
Rainbow Trout	0.000	0.016	0.059	0.072	0.000	0.058	
Other	0.000	0.011	0.001	0.000	0.396	0.300	
Average size of Fish in Angling Catch, lb.							
Kokanee	0.159	0.187	0.278	0.525	0.300	0.262	
Rainbow Trout	-	1.380	1.248	0.696	-	1.616	
Lake Trout	-	3.686	-	-	-	-	

Over 80% of all anglers questioned preferred catching rainbow trout and although kokanee represent 94% of all fish caught in the main valley lakes, almost half (48%) of the main valley anglers stated a preference for trout. Most anglers appeared satisfied with the present availability and harvest of salmonids, though a significant minority did desire to see increased trout harvests in the main valley lakes.

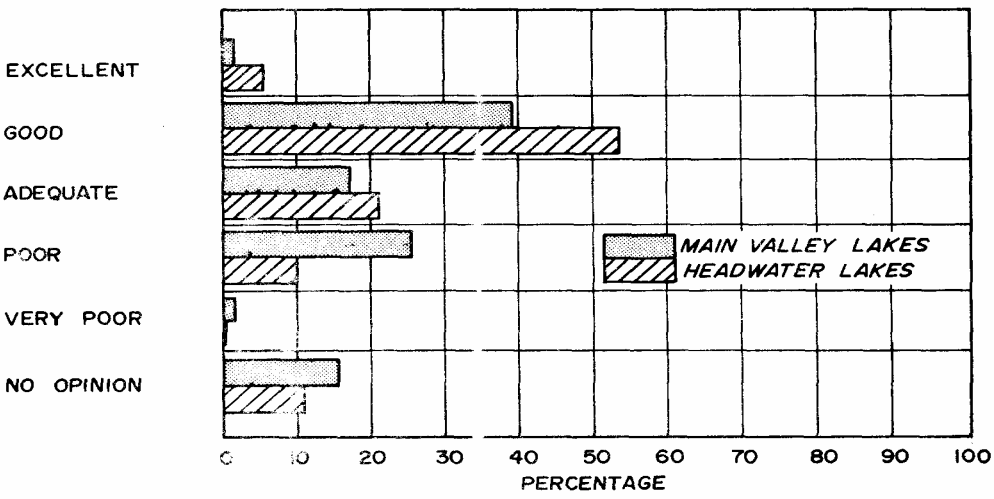
To obtain some idea of the future demand for sport fishing in the Okanagan, anglers were asked if they were generally satisfied with present conditions, and their preferences for angling experience. Sixty percent stated their general satisfaction. Thirty-six percent of the sample had no particular preferences, and 35% stated a preference for headwater angling (Table 8.16). A significant minority (23%) desired more stream fishing. When these responses are compared with the minority of anglers who stated their general dissatisfaction, their main concerns appear to be lack of stream fishing and lakes exclusively reserved for fly fishing. It should be emphasized that few anglers appeared to be particularly concerned about lack of stream fishing, realizing that the Okanagan was not a suitable location for this activity.

TABLE 8.16

PREFERENCES OF ANGLERS FISHING OKANAGAN LAKES AND STREAMS

TYPE OF FISHING	GENERAL SAMPLE %	"UNSATISFIED" SAMPLE %
No Particular Preferences	36.4	-
Headwater Fishing	35.0	48.2
- General	20.4	22.2
- Fly Fishing	10.7	20.4
- Lakes with no Motor Boats	3.9	3.6
Stream Fishing	22.8	51.8
Main Lake Fishing	5.3	1.8

The Okanagan sport fisherman is offered a range of facilities, some public-such as boat ramps and boat docks, and some private-such as marinas, rentals and equipment purchases. Figure 8.6 indicates that while the majority of anglers were satisfied with the services, there was a tendency for main valley fishermen to be less satisfied than those on the headwaters. Most of this dissatisfaction was levelled at poor or inadequate public boat launching facilities, especially around Okanagan and Osoyoos Lakes. A number of anglers also noted problems of launching their boats during the spring of 1971 when Okanagan Lake was drawn down to its minimum operating elevation of 1119.8 feet.



OKANAGAN BASIN ANGLER COMMENTS WITH REGARD TO QUALITY OF EXISTING FACILITIES.

Figure 8.6

8.2.4 Value of Sport Fishing

(a) Economic Values

The approach used to place economic and social values on the Okanagan sport fishery is similar to that described for water based recreation in Chapter 7, In summary, economic values are assumed to equal the net expenditures of visitor anglers while in the Okanagan, plus a portion of net resident fishermen expenditures, under the assumption that some residents would fish outside the Okanagan in the absence of sport fishing in the basin. As many non-resident anglers stated they would have come to the Okanagan even if fishing were not available, only the portion of their total expenditures associated with their fishing activities in the Valley was accounted in the economic analysis.

Table 8.17 shows the breakdown of average expenditures by non-resident anglers during 1971, both for those primarily motivated toward fishing in the valley and for those to whom fishing was part of a recreation "package". Total gross expenditures by the entire population of non-resident anglers amounted to over $500,000, an average of over $65 per angler. Slightly more than half of these revenues were obtained from food and accommodation expenses, about 25% from travel expenses and the rest from equipment purchase, boat rentals, etc. Subtracting the costs to supply the goods and services demanded by non-resident anglers, net expenditures amounted to approximately $260,000, for an average of $34 per angler.

TABLE 8.17
NON-RESIDENT ANGLERS' EXPENDITURES
IN THE OKANAGAN IN 1971

	TRAVEL EXPENSES	FOOD & LODGING	EQUIPMENT	RENTALS	TOTAL
Primary-Motivated Anglers					
Total Expenditures	$ 90,170	$191,770	$30,480	$50,800	$363,220
Expenditures per Angler	35.50	75.50	12.00	20.00	143.00
Expenditures per Angler Day					24.00
Other Anglers					
Total Expenditures	$ 38,100	$ 60,930	$12,700	$25,400	$137,160
Expenditures per Angler	7.50	12.00	2.50	5.00	27.00
Expenditures per Angler Day					5.50
TOTAL EXPENDITURES	$128,370	$252,730	$43,180	$76,200	$500,380

Resident anglers spent an estimated $1,150,000 in 1971 on sport-fishing, mainly equipment. Of this total expenditure, $400,000 remained as net gain to the Okanagan economy. Assuming that in the absence of a fishery, 50% of this revenue would be lost to the Okanagan as a result of fishermen travelling outside the basin, net income accruing to the Okanagan from resident angler expenditures was estimated at $200,000 in 1971.

Net costs of managing the Okanagan sport fishery should also be subtracted from the total net income estimate to obtain a true measure of net economic benefits. From the viewpoint of the Okanagan economy, these net costs amounted to $15,000 thus net economic benefits associated with resident angler participation totalled some $185,000 in 1971.

In summary, sport fishermen spent $1,650,000 in the Okanagan during the 1971 fishing season. The net economic benefit to the Okanagan resulting from this expenditure amounted to some $445,000, representing $4.90 per nonresident angling-day and $1.75 per resident angling day. These values will be used in Part IV of this report in which sport-fishery management alternatives are evaluated.

Non-Economic Values

Under a zero pricing policy, net economic benefits derived from angler expenditures may not be equated with total value of the sport. Both resident and non-resident fishermen were asked how much a day's fishing was worth over and above their estimated expenditures. In view of the real difficulties of determining these values, the following results should be interpreted as being very approximate estimates of the social value of sport fishing.

The median value for resident ang1e»s was $310 per year or $13.50 per angler day, while the median value for non-resident anglers was $19.00 per year or $2.50 per angler day. The large difference between these two values appeared to be due to the fact that visitors were more immediately aware of their daily expenditures than residents, who tend to make large single payments for boat or other equipment and whose daily costs are small. Applying these daily values to the total angling population the social value of sport fishing was estimated at $1,888,000 in 1971, approximately $1,830,000 associated with resident angling and $58,000 with non-resident angling. As was the case with shoreline recreation, this figure represents a very rough estimate of the additional value anglers placed on their activities over and above their direct expenditures in 1971. Acknowledging the difficulties associated with evaluating sport fisheries, there is little doubt that this resource contributes significantly to the economic and social life style of Okanagan residents and tourists.

8.3 SUMMARY

Present fish harvest capacities in the Okanagan Basin are based primarily in the headwater and main valley lakes. Opportunities in the streams and rivers are limited. The headwater lakes can be far more heavily stocked than is presently the case as they have an inherent capacity to provide up to 10 times the present harvest of rainbow trout. The ability of the main valley lakes to produce sport fishes is limited by the capacity of the tributary streams and rivers to accept spawners. Man induced changes have destroyed approximately 80% of the original spawning capability of these streams. Phosphorus levels in the lakes were found to be linked to kokanee growth rate and productivity. Phosphorus also has an effect on rainbow trout and the resulting percentage in a "competitor niche group".

Anglers spent 157,700 days fishing in the Okanagan Basin in 1971. Two thirds of the fishing was done by valley residents, one third by non-residents. Eighty percent of the main valley lakes' harvest was kokanee although most anglers stated a definite preference for rainbow trout. Sixty percent of the anglers interviewed were satisfied with present conditions. Thirty-six per-cent stated no particular preferences.

Sport fishermen spent $1,650,000 in the Okanagan during the 1971 fishing season. The net economic benefit to the Okanagan resulting from this ex-penditure amounts to some $445,000, representing $4.90 per non-resident angling day and $1.75 per resident angling day. The non-economic social values of sport fishing in the Okanagan amount to $13.50 per angling day for residents and $2.50 per angling day for non-residents. Therefore, the annual social values of sport fishing was estimated at $1,888,000 in 1971.