D R A F T

PRELIM superseded.

Section 10 Effects of sub-minimal flows on Kokanee and rainbow trout, Okanagan Lake, 1970/71 and 2020.

Procedure

From projections by B.C.W.I.B.[a] of the discharge at mouths of 6 streams for the years 1970 and 1980, under conditions of a) "historic" and b) "modified" operations of water management, the deficiency of flow in each month, as compared with the stated fishery requirement[b], was determined as a percentage value for both kokanee and rainbow trout. The greatest percentage deficiency in any one month[c] was taken to be representative of the "worst" survival conditions for each species separately over any one year. The deficiencies so determined were averaged for one "dry" and one "average" year, and were then converted to "least monthly flow available"

(= 100 — % deficiency; Table 10.1).

The B.C.W.I.B. projections as stated for 1980 ~~are~~ were considered to be more properly applicable to the year 2020, and ~~are~~ were so assumed in this analysis[d]. Realistic values applicable to the development level projected for 1980 will not be made available within the study framework.

The spawning populations of kokanee enumerated in 1971 in each of the six streams[e] were semi-arbitrarily assumed to demonstrate the effects of a flow regime approximated by the above "least monthly flow available" for the 1970 level of development under "historic" operations. This combination was adopted as an individual "null"condition for each of the six streams. Accordingly, the "relative flow available" in each of the six streams, as projected for (1980 (=2020) "historic"operations , and for 1970 and

1980 (=2020) modified operations, was established by direct proportion relative to the "null" condition (Table 10.2).

A further assumption was made that at any value of stream flow less than the stated requirements, the deleterious effect on the fishery resource is in direct proportion to the relative flow reduction at ~~all~~ any stage of biological development. Hence by applying the relative values (Table 10.2) to the 1971 recorded and estimated spawning populations of "effective" kokanee and rainbow trout in each stream, revised values of spawning populations were derived for 1970 and 2020 under historical and modified operational sequences (Table 10.3).

An effective kokanee female spawner was defined as being productive of 38 fry, and capable of spawning at full efficiency on 2.53 sq.ft. of gravel of 100% quality rating (i.e. 150 eggs/sq.ft.). ~~Estimate of effective spawning population~~ An exception to this general assumption was that effective females in Mission Creek ~~are~~ were assumed to be each productive of 76 fry.

Findings

It was estimated that if all the reservoirs on five streams tributary to Okanagan Lake continue to be operated according to historical practice, the effected kokanee stream spawning population is likely to increase by about ~~24%~~ 16% by ~~1980~~ 2020. If a modified sequence of operations is adopted, an increase of up to ~~49%~~ 28% within the decade may be anticipated, increasing to about ~~44%~~ 30% by 2020.

Likewise the rainbow trout spawning population is projected

to decline by about 11% by 2020 under historical operations, whereas under a modified sequence an increase of some 11% may be expected within about ten years, but an increase of less than 6% by 2020.

These figures were extended to apply to all other stream spawning populations of Okanagan Lake kokanee and rainbow trout.

It is noted that the modified operations referred to above are only preliminary hypothetical modifications of day-to-day reservoir operations. It may be feasible to readjust these with relative ease, in order to better accommodate fishery requirements without further disbenefit to consumptive water uses, but all such modifications must depend on future cooperation between the Water Resources Service, the Fish and Wildlife Branch, and specific irrigation districts in the development of alternative management guidelines, including the formulation of appropriate reservoir operating rule curves.

a Data from K. Smyth, Tasks 35 and 36, Part I

b Stated by G.D. Koshinsky in memo dated June 20, 1972 to A.M. Thomson.

c One month during incubation periods, or the greatest mean value of any two consecutive months during spawning or rearing periods.

d Trout, Peachland, Powers, Equesis, Vernon, Mission, which provided spawning habitat for 97% of all stream spawning kokanee enumerated in 1971

e T.A.J. Leach to T.J. Willcocks at meetings on 2nd & 19th.Feb.1973.

e quality rating as estimated by Galbraith & Taylor ( ).

TABLE 10.1 Least monthly flows available at the mouths of six tributaries to Okanagan Lake, 1970/71 and 2020.

a) Historic operations

Stream	Least monthly flow available %			
	1970/71		2020	
	Kokanee	Rainbow	Kokanee	Rainbow
Trout	51	22	55	24
Peachland	40	8	33	1
Powers	60	25	48	7
Equesis	45	70	80	70
Vernon	70	80	75	100
Mission	29	36[a]	44	42[a]

b) Modified operations

Stream	Least monthly flow available %			
	1970/71		2020	
	Kokanee	Rainbow	Kokanee	Rainbow
Trout	75	75	65	65
Peachland	100	100	100	100
Powers	60	50	92	50
Equesis	100	100	93	75
Vernon	100	100	100	100
Mission	26	36[a]	51	42[a]

[a] 70% of maximum deficiency taken, to allow for flow above Black Mt. 1D

TABLE 10.2 Relative flow available at the mouths of six tributaries to Okanagan Lake, 1970/71 and 2020.

a) Historic operations

Stream	Flow available, relative to 1970/71 historic, %			
	1970/71		2020	
	Kokanee	Rainbow	Kokanee	Rainbow
Trout	100	100	108	109
Peachland	100	100	83	13
Powers	100	100	80	28
Equesis	100	100	178	100
Vernon	100	100	107	125
Mission	100	100	152	117

b) Modified operations

Stream	Flow available, relative to 1970/71 historic, %			
	1970/71		2020	
	Kokanee	Rainbow	Kokanee	Rainbow
Trout	147	341	127	295
Peachland	250	1250	250	1250
Powers	100	200	192	200
Equesis	222	143	207	107
Vernon	143	125	143	125
Mission	100	100	176	117

TABLE 10.3 Recorded and projected effective spawning populations of kokanee and rainbow trout in six tributaries to Okanagan Lake, 1970/71 and 2020.

Stream	Spawning populations under historic water regulations operations			
	1970/71		2020	
	kokanee	rainbow	kokanee	rainbow
Trout	300[e]	33[e]	324	36
Peachland	6,526[a]	2,157[a]	6,526[a]	523
Powers	7,300	811	5,840	227
Equesis	27,600	3,067	49,128	3,067
Vernon	1,000	111	1,070	139
Mission	81,000[b]	13,384[b]	81,000[b]	13,384[b]
Total	~~83,226~~ 123,726	19,563	~~103,388~~ 143,888	17,376

Stream	Spawning populations under ~~historic~~ modified water ~~regulations~~ operations			
	1970/71		2020	
	kokanee	rainbow	kokanee	rainbow
Trout	441[e]	113[e]	381	97
Peachland	6,526[a]	2,157[a]	6,526[a]	2,157[a]
Powers	7,300	1,622	14,016	1,622
Equesis	61,272	4,386	57,132	3,282
Vernon	1,430	139	1,430	139
Mission	81,000[b]	13,384[b]	81,000[b]	13,384[b]
Total	157,969	21,801	160,485	20,681

[a] population derived from potential accommodable fry production at 380 eggs per female and 10% egg to fry survival.

[b] population derived from 1969 accommodable fry production at 380 eggs per female and 20% egg to fry survival.

[e] estimated.