A PRELIMINARY ASSESSMENT OF THE DOWNSTREAM EFFECTS OF THE BENNET DAM ON THE SLAVE AND MACKENZIE RIVER SYSTEMS

CANADIAN WILDLIFE SERVICE

GB
707
C338
1972

A preliminary assessment of the downstream effects of the Bennett Dam on the Slave and Mackenzie River Systems.

A Preliminary Assessment of the Downstream Effects of the Bennett Dam on the Slave and Mackenzie River Systems

J. Bryan Kemper

Canadian Wildlife Service

November, 1972

Introduction

The natural annual spring flood of the Peace-Athabasca Delta area is caused by high water levels in the Peace River attributable to the spring run off. This high water level in the main channel of the Peace is instrumental in preventing the normal drainage of the delta lakes through the Quatre Fourches channel and the Riviere des Roches. Inflow from several rivers, principally the Birch and Athabasca, backs up, thereby flooding temporarily the delta area.

In historical times this has been an annual cycle. The magnitude of the delta flood probably depended upon the height and duration of the spring freshet on the Peace River. As the river subsides the flow pattern northward is resumed and the flooded delta is dewatered leaving the shallow depressions and perched basins full of water. The mosaic of plant communities on the delta has adjusted and is in fact controlled in part by the pattern of seasonal flooding. Concomitantly both mammal and avian inhabitants are dependant upon these annual cycles.

The filling of the impoundment behind the Bennett Dam in 1969, 1970, 1971 and the spring of 1972 reduced the flows downstream on the Peace below those which could be expected to occur under normal operation. The water pattern observed in 1973 should be representative of the pattern to follow in the future although its magnitude will vary.

The construction of the rock weir on the Quatre Fourches has retained delta water levels in 1972 thereby artificially simulating the backing-up effect of the former Peace floodwaters. A similar structure is proposed for the other delta outflow channel, the Riviere des Roches.

The net effect of these two weirs will be to transfer the full downstream effect of the low spring water levels on the Peace River to the Slave River System. It should be realized that from 1969 to 1972 the delta water was in fact buffering the dams effect on the Slave River.

Potential Downstream Problems

An assessment of the possible downstream impact of the reduced flows on the Peace River, downstream from the Bennett Dam was made during an aerial survey conducted by G. H. Staines, G. Townsend and the author on September 13, 14 & 15, 1972. The survey was conducted in a float equipped Cessna 185 over the Peace-Athabasca Delta region, down the Slave River encompassing the Slave River Delta, across Great Slave Lake and down the Mackenzie River to Mills Lake.

Of major importance to the waterfowl resource of this region is the magnitude of the spring flood crest which is responsible for the filling of the many perched basin marshes along the main water channels. Historically a combination of winter river flows and overwinter lake levels has set the stage for the spring flood which fill the perched basins. Reduced overwinter flows, which lower the levels of the large lakes, or small spring runoffs, result in a flood crest which is insufficient to fill some or all of the perched basins. The susceptibility of the areas of the Slave and Mackenzie River systems to damage caused by reduced stream flows will be reflected by the nature of their shoreline slopes and the presence or absence of perched basins.

The Slave River Region

The upper reaches of the Slave River downstream to the Cassette Rapids are characterized by shores with low treed levees (Fig. 1). Associated ponds, marshes and perched basins occur but they are relatively uncommon and not of significant value to the local waterfowl resource. The flows in this portion of the river are likely to reflect the daily cycle of the dam's operation. The variability in flow rates should be sufficient to maintain mud bars and associated features. Should water level or surge control be necessary on this portion of the river, there are several outcrops of the granitic Canadian Shield which would be usable control points upon which weirs etc., could be designed. It is not anticipated that such structures will be deemed necessary in view of the poor quantity and quality of the waterfowl habitat adjacent to this portion of the Slave River above the Cassette Rapids.

The lower reaches of the Slave River downstream from the Cassette Rapids are characterized by high banks and an absence of perched basins (Fig. 2). Reduced stream flows will have little effect in this area. Should the magnitude of the spring flood be reduced for a number of years the possibility exists that some succession of the mud flats by willows may take place.

The Slave River delta is the most important piece of habitat on the Slave River for waterfowl (Fig. 3). Unlike the Peace-Athabasca and Mackenzie River deltas the Slave delta does not have a large number of perched basins. This delta is more heavily treed and the banks of the channel tend to be higher than those of the other delta areas (Fig. 4). The land is more stable and higher above the river water

Figure 1. Tip of island in Slave River above Cassette Rapids. Note low gradually sloping shoreline with conifers on levee, and plant succession on mud spit.

Figure 2. High river banks characteristic of the Slave River below Fort Smith.

Figure 3. Upper reaches of Slave River delta. View shows Great Slave Lake in the background.

Figure 4. Slave River delta looking upstream. Corifers are slow to colonize delta area due to fluctuating water table. Note that perched and open basins are not abundant.

levels. The production capabilities of the area are difficult to estimate, but they are certainly lower than the Peace-Athabasca or Mackenzie delta on a square mile basis. The outlying islands of the delta serve as a staging area for ducks, geese and particularly swans (Fig. 5).

Figure 5. Outer edge of Slave River delta. The shallow littoral regions are used by staging swans and geese. Logs in photograph mark edge of shallow deltaic deposits.

Reduced flow levels on the Slave River should not have a significant effect on the Slave delta due to the deeply incised river channels. The flood crest should be sufficient to duplicate the spring flood. Tree and ice jams in the river at the time of the flood may be responsible for the flooding of many of the terminal edges of the delta. Reduced

lake levels on Great Slave Lake will be of the magnitude of two to three inches. This effect will be overcome by the windthrow (windpile) which can raise the lake level at the Slave delta by as much as 12" in as many hours (Law 1950) during NW storms.

Great Slave Lake

The projections of the water levels of Great Slave Lake supplied by the Water Planning and Operations Branch (see Appendix A) suggest that very little change can be expected. The lower levels which occurred on the lake previously were due to the filling of the Bennett Dam. This condition should not reoccur under normal operations for the production of hydroelectric power.

The anticipated effect of the Bennett Dam and the two rock weirs will be to decrease the level of Great Slave Lake about 3 or 4 inches. Peak lake levels will be reached earlier, however this is due only to a reduction in later season levels. The lake levels will not rise above their end of June stage, whereas previously they peaked in late July. This reduction will remain in effect through most of the ice free period.

This stage regime should not affect the waterfowl populations of the Great Slave Lake area significantly. Windthrow and annual variations in flows will overcome the effects of the dam operations.

Mackenzie River

The source of the Mackenzie River is a wide shallow depression at the western edge of Great Slave Lake. Thus the volume of low in the upper reaches of the river are determined by the level of the lake.

The entire length of that portion of the river from Big Island to Mills Lake is very wide and shallow, with gradually sloping shorelines which have been colonized by emergent and subaquatic vegetation. The sloping shoreline and successional nature of the vegetation make this area sensitive to change in river stage and alterations of the spring flood crest. The buffering effect of the large volume of water in Great Slave Lake is expected to prevent any major changes in river stage in this region attributable to the Bennett Dam.

Two areas on the portion of the river surveyed had major concentrations of waterfowl. The groups of islands west of Big Island at the source of the river is a nesting area for migratory swans. Several hundred birds observed in the area were occupying habitat similar to that being used by the swans off the mouth of the Slave delta.

Mills Lake is the most important waterfowl staging area examined on the Mackenzie River. Actually a shallow widening of the river channel rather than a true lake, the area is extensively used by swans, ducks, Canada, white-front and snow geese. No estimation of numbers was attempted however, over the areas surveyed Mills Lake ranks second in importance being exceeded only by the Peace-Athabasca Delta.

The beds of emergent vegetation in Mills Lake and the mud flats on the northern shore, make this area very susceptable to change in river stage. The buffering effect of Great Slave Lake should prevent major changes from taking place at the present time. However, if additional change in the upper Mackenzie River basin occur in the future, Mills Lake may be adversely affected.

Discussion

The stage regime anticipated from the normal operation of the Bennett Dam for the production of hydroelectric power should not adversely affect the waterfowl habitat over the region surveyed. Three important staging areas have been identified:

1. The Slave River delta
2. Big Island chain
3. Mills Lake

These areas are significantly important to the waterfowl resource to warrant occasional spot checks during the next few years.

Three additional dams on the Peace River are now contemplated, two in British Columbia and one in Alberta at Dunvegan. The downstream effects of the filling of the reservoirs behind these dams, should they be built, would be severe. Reduced flow levels would alter the levels of the major lakes more dramatically than occurred in 1969 through 1971. The first notable change in permanent stage levels will be a shifting of the plant communities adjacent to the gradually sloping shorelines. Therefore a baseline survey of the present communities of these areas will be most useful to the future assessment of environmental changes.

Recommendations

1. A series of false color, modified I. R. aerial photographs be taken over each of the three important areas denoted above. Both high and low level flight lines should be included. This information would prove a baseline for future environmental "impact type"

studies which will be needed to assess future development within the watershed. The photography can be worked into the Airborne Program of the Canada Centre for Remote Sensing. Cost would not exceed $1,000.00.

2. Further efforts should be made to determine the mechanism of flooding during the spring on areas such as the Slave River Delta. If insufficient information is available from Northern CWS personnel, a technician should observe the breakup for about 2 weeks.
3. The large open prairies near Hook Lake on the Slave River should be monitored for vegetation changes associated with changes in spring and summer water levels.

Acknowledgements

I would like to thank G. Townsend, Dr. W.E. Stevens and G.H. Staines for their background information on the hydrological history of the areas discussed in this report.

References

Law, C.E. 1950. An initial study of the ecology of the muskrat (Ondatra zibethica spatulata osgood) of the Slave River Delta with particular reference to the physical environment. Cdn. Wildl. Service Rept. 96 pp. maps pls.

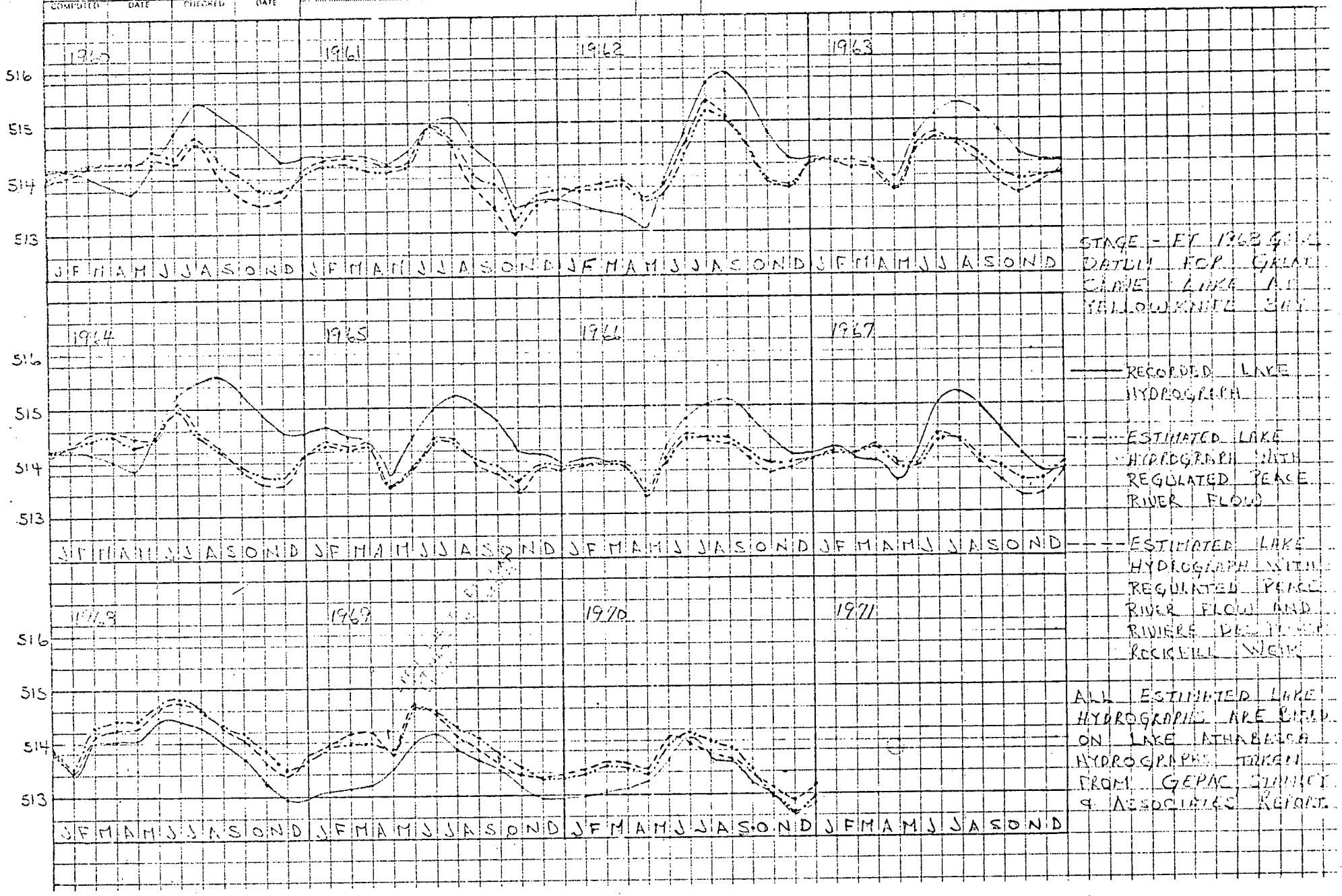
Stevens, W.E. 1971. Ecological effects of diverting water from the Mackenzie River Basin to the Saskatchewan-Nelson Basin. Cdn. Wildl. Service Rept. 64 pp. maps.

Appendix A

Hydrographic predictions

ENERGY, MINES AND RESOURCES
INLAND WATERS BRANCH

COMPUTED DATE CHECKED DATE DETAIL FILE NO.



DOWNSTREAM EFFECTS OF P.A.D.P. PROPOSAL

GREAT SLAVE LAKE

5

AL. COULGEN Oct 11, 1972