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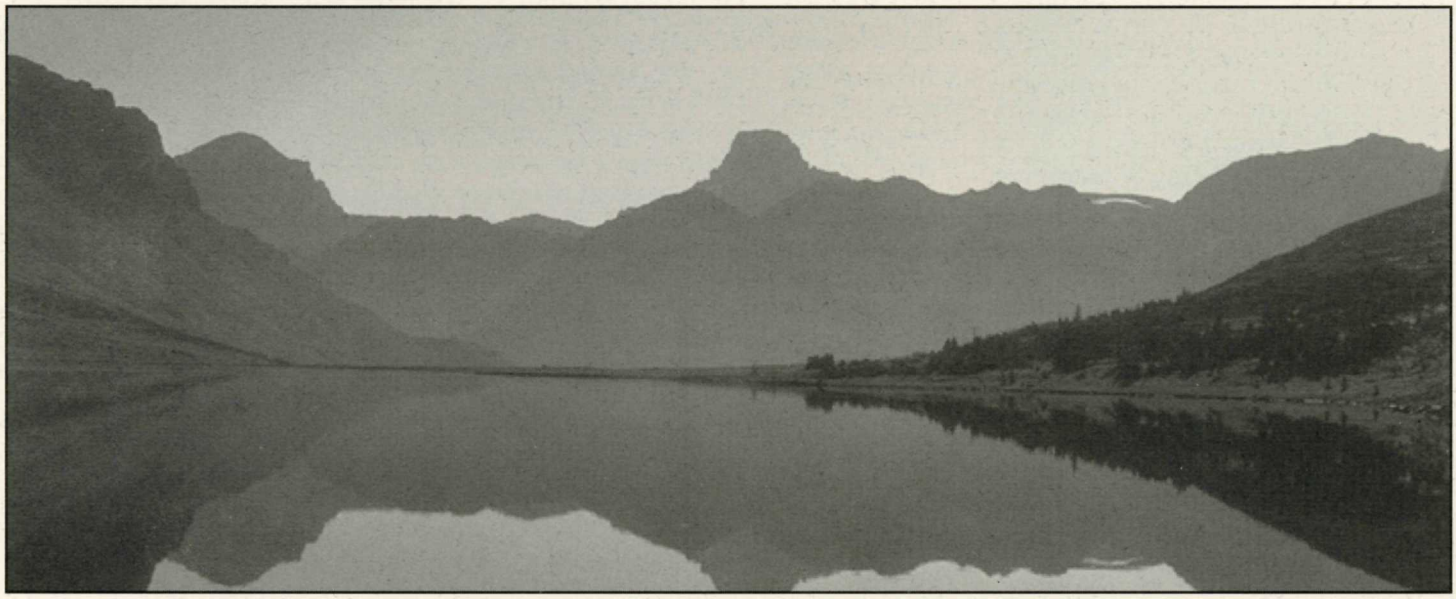
BIOTIC IMPOVERISHMENT

The results of sport fish stocking during Banff's early years are still with us today



Fiddling with nature: Sport fish, such as trout, were stocked into many of Banff National Park's naturally fishless lakes

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INTRODUCTION

Canadian national parks, now protected and preserved in as "natural" a state as possible, were once developed to encourage recreational and tourism activities. In order to increase the appeal of mountain parks for angling, sport fish were stocked into about 20 per cent of the national park's lakes. Stocked species usually were rainbow, cutthroat, and brook trout *(Oncorhynchus mykiss, O. clarkii, and Salvelinus fontinalis)*, but the list also included Atlantic salmon *(Salmo salar)*, lake trout *(Salvelinus namaycush)*, and several hybrids. Introduced fish, particularly the trout, had an enormous impact on the naturally fishless lakes into which they were stocked. Through predation on aquatic invertebrates and release of nutrients in their waste, stocked fish fundamentally changed the character of aquatic ecosystems in the affected waterbodies. We have been studying the effects of fish stocking in several small alpine lakes in Banff National Park. In this article, we will describe some of the impacts stocked fish had, and continue to have, long after the discontinuation of stocking.

IMPACT OF FISH STOCKING

Snowflake, Pipit and Bighorn Lakes, three small alpine lakes in the front ranges of Banff National Park, were stocked with trout and/or char in the early '60s. The introduced fish quickly eliminated the natural top predator, the large calanoid copepod *Hesperodiaptomus arcticus* (see *Figure 1*), and large herbivorous cladocerans (*Daphnia* spp.) from the lakes (Anderson 1972, Anderson and Donald 1978). These invertebrates were important in structuring the aquatic communities through predation on other organisms and their loss had cascading effects on the abundance of organisms in lower trophic levels.

Daphnia exert a strong negative influence on the planktonic algal communities through their ability to filter large volumes of lakewater for algae, which they use as a food source. In combination with the addition of phosphorus to the lakes through fish waste, which fertilized algae in these phosphorus-limited lakes, the loss of *Daphnia* resulted in large increases in algal biomass. Fossil chlorophylls and other photosynthetic pigments preserved in the sediments of Snowflake and Pipit Lakes indicate that algal biomass increased eight to 23 times over pre-stocking levels (Leavitt *et al.* 1994).

Hesperodiaptomus is a predator of small copepods and rotifers (microscopic planktonic algal grazers). In lakes where it is abundant, it keeps populations of these organisms at low levels. After *H. arcticus* was eliminated by stocked fish, other smaller species of copepods, including *Diacyclops* and *Acanthocyclops*, genera too small to be attractive to fish as a food source, increased in abundance and eventually dominated all three lakes. These copepods were not effec-

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