cc to Bradt
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PROGRESS REPORT ON BEAVER-TROUT INVESTIGATIONS

Although beaver-trout relationship studies are still being prosecuted by the Institute, it has been deemed advisable to submit a brief summary of our field observations to date.

Field work was carried on almost continuously from March 29 to May 16. Save for brief reconnaissance trips, little was done on the beaver-trout problem in June. From July 20 to September 1 the Institute's field representative collaborated with Prof. Glen W. Bradt in the Upper Peninsula, the chief objective being the selection of certain streams to serve as beaver refuges. September 23-25, the Director of the Institute and one investigator made a rapid survey of some of the more heavily affected areas, noting the effect of increased fall beaver activity upon trout waters.

Methods of Dam Removal

Since the use of dynamite in removing beaver dams was discouraged, in view of possible fish mortality, attention was given only to the various manual methods by crews of men from the Civilian Conservation Corps, under the general supervision of Mr. Roy Johnstone. Two methods were employed most commonly: (1) lowering the impounded water by making a single breach in the dam; and (2) lowering the impounded water gradually by means of a number of breaches, some in the wings of the dam as well as at the channel of the stream. The latter method came to be more generally favored than the former. It's chief advantages lie in the fact that when the water is drained off slowly, less silt and debris are drawn into the stream, there is less liklihood of fish being stranded in shallow depressions in the pond floor, and possible mechanical damage by flood waters to the stream below the dam is obviated.

Effects of Dam Removal on Stream

As is well known, the release of impounded water from a beaver pond is attended by the disturbance of silt and organic debris from the pond bottom. The fate of this dislodged sediment, and its effect upon the stream, have been subjects of much conjecture. Mr. Salyer, in his report on beaver management says that when a dam is removed by dynamite during high water ".......the great amount of silt incident to these ponds will be spread for miles downstream as a thin, lateral veneer on both banks of the stream". He states further that "if the dam is not blown when the water is rather high, there is danger at times of dumping an immense lot of silt just below the dam which might result in the destruction of an excellent and much-frequented spawning ground or a good spring just below".

The dam removal program was not instituted until after the spring high water stage had passed, nor was dynamite generally employed. It was therefore necessary to obtain direct observations on the disposition of the silt.

This was found to vary greatly, influential factors being size and age of pond, size of breach made in dam, and perhaps most important of all, the character of the stream bed below the dam.

In seeking to determine what became of the silt, it was the investigator's practice to survey the stream for two or three miles below a dam, noting locations and estimating areas of existing silt beds. After the dam had been removed and the water cleared and lowered to its normal level, the stream was again examined, and any newly-formed silt beds noted, as well as any changes in existing ones.

In streams containing large amounts of down timber, stumps, and snags, as for example the upper reaches of the Jordan River in Antrim County and the headwater streams of the Cedar River in Gladwin County, the majority of the silt was seen to be trapped out in the first hundred yards or so. Although the water would remain turbid in appearance for a much longer distance, re-check of bottom conditions showed very little augmentation of pre-existing silt beds beyond that distance. It was found that flocculent silt was the first to be deposited, and that such organic debris as dead leaves and bits of bark, due to their large area in relation to weight, was transported the greatest distances.

In locations where streams run between low, shallow banks and the released waters flooded over them, large amounts of silt and debris were trapped out by grass, shrubs, and other terrestrial vegetation.

When a stream flows through a relatively open channel, with little or no down timber, submerged logs and stumps, etc., sedimentation is not nearly so rapid, and the silt is deposited in the "thin lateral veneer" mentioned by Mr. Salyer. However, in places where the stream flows over shallow, sand and gravel shoals with marked deceleration of current, silt is deposited in the center as well as on the side of the bed, falling into chinks among the gravel, and around similar obstacles.

In all cases observed, after the dam had been out for a few days, the constant action of the current removed excess silt from exposed areas, such as shoals and the center of the bed and deposited it in the eddies and backwaters where silt bars had previously occurred. In no observed instance were spawning grounds permanently obliterated, or springs destroyed.

Particular attention was given to the reactions of aquatic insect larvae in the stream below the dam to the suddenly increased current, raised water level, and silt-laden water. In no instance were they found to be disturbed. This was checked by two tests: in the first, the number of caddis larvae clinging to a certain log in the channel 100 feet below a dam was ascertained. The dam was then removed, and the count repeated as soon as the water had resumed its former level. The number was unchanged. In the second test, the bulk of insect larvae inhabiting a square foot of bottom 100 feet below the dam was taken. A similar sample was collected and measured as soon as the flood waters subsided, and a third sample made four days after the dam removal. Difference in bulk of these three samples was so slight as to indicate that the dam removal had no deleterious effect upon insect larvae below the dam. This is much as would be expected, since these larvae safely weather the annual spring floods.

Although careful watch was kept, no sign of distressed trout was detected. On two occasions, nets were held across the stream, several hundred yards below the removed dam, with a view to catching any trout which might be overcome by the sudden influx of silt. None were taken, nor were any seen to jump, or in any other way manifest distress.

The organisms subject to heavy mortality are those residing in the bottom of the pond and in the dam structure. The dam itself contains large numbers of invertebrates, especially scuds (*Gammarus* and *Hyalella*) and cranefly larvae (Tipulidae). Even though practically all dams were removed by hand, large numbers of these forms were crushed, and many of the remainder destroyed when whirled into the flood. Undoubtedly some escaped and found suitable habitats downstream. No method for determining the percentage of mortality was discovered. The bottom of a pond ordinarily contains large numbers of invertebrates. Notable examples are burrowing mayfly naiads (*Hexagenia* and *Ephemera*), midge larvae (Chironomidae), and caddis larvae, especially those of the families Phryganeidae and Limnophilidae. In many ponds small, soft-shelled snails of the genus *Physa* occur in plentiful quantities. When a dam is removed and the water level drops, these forms are left exposed and soon perish, since but few are able to drag themselves across the mud to the stream.

On several occasions, trout were found stranded in shallow depressions in the pond floor, where they would have died if workmen had not transferred them to the stream. Lampreys, bullheads, sticklebacks, red-bellied minnows and tadpoles were also frequently found stranded.

Recovery of Pond and Stream

When dams are lowered gradually, comparatively little silt is removed from the pond floor save in the actual channel, which is usually swept quite clean. In many cases a small sump remains—that is, a hole deeper than the stream bed, formed when the beaver were excavating mud to chink the dam.

The exposed mud banks which constituted the former pond bottom soon begin to produce vegetation. The first plants to appear are sedges, seeds, and water smartweed. It is too early to forecast the plant succession, but it is to be expected that these mud banks will come to bear plant cover similar to adjoining sections. In the case of seasonal streams, that is, streams whose water supply dwindles to almost nothing during the summer months, vegetation appears in the old channel as well as on the sides.

Summary

1. The method of removing beaver dams gradually has proven satisfactory.

2. Silt and organic debris washed from the pond is trapped in a rather short distance in streams containing large amounts of submerged timbers, but in open streams is carried several miles. In either case the silt eventually accumulates an on pre-existing silt beds, in eddies and backwaters.

3. No evidence could be found to show that either trout or trout food organisms in the stream below a dam are disturbed by this method of removal.

4. There is a heavy mortality among food organisms inhabiting the dam and the pond floor.

5. Fish, including trout, may be stranded in shallow depressions as the water recedes.

6. In streams whose water supply is permanent, the mud banks begin to support vegetation in the first summer of exposure.

7. In streams whose water supply vanishes in summer, vegetation springs up in the stream bed as well as on its banks.

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