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Report 259

PRELIMINARY REPORT ON THE BEAVER-TROUT INVESTIGATION

By J. C. Salyer

1. ORIGIN OF THE BEAVER-TROUT PROBLEM

The great increase of the Michigan beaver through the years of 1930-1934 returned the problem of beaver occupancy of Michigan trout waters acutely to the angling public's mind. This interval in the life history of the beaver represents a swing toward the high population end of the seven-year cycle which beaver population density strikingly manifests. During this period this most interesting American rodent managed to extend its range in Michigan to some part of the watershed of every Michigan trout stream of any consequence. And this happened in spite of severe environmental handicaps such as the extensive poaching to which the beaver was subjected in the interim.

During the previous high period of the preceding cycle, around 1925-26, this animal had regained much of its old territory only to be sharply reduced by organized poaching in the years immediately following. Yet the dams remained in sufficient numbers and are now of such age that the final effects of the occupation of a trout stream by beaver are plainly discernable to any who would read the story. Seven years then after their first come-back of any consequence in the ninteen hundreds the results of dense beaver activity on our best trout streams had become a source of some apprehension to many anglers.

2. THE BEAVER-TROUT INVESTIGATION

In view of the increasing public interest in the problem, the state conservation officials decided to have a full-time investigation made of the problem. The Institute for Fisheries Research was asked to select the investigator and to assume the major responsibility for the investigation, acting in cooperation with the Game and Fish divisions of the Department of Conservation. Special funds for the work were provided by the Department. The writer was selected to carry out the assignment, and devoted the period from September 1, 1933 to June 30, 1934 to intensive field work on this problem.

Numerous trips were made through the area mutually inhabited by beaver and trout. As this was essentially a field study, more than three-fourths of the investigator's time was spent in the field. Contacts were made with previous investigators of beaver problems, with scores of local conservation officers, interested fishermen, trappers and other residents. Large numbers of affected waters were examined and studied physically, chemically and biologically to determine the effect of the beaver on trout habitat. Experiments were conducted to determine the effects of beaver activity on trout migrations and especially on the success of the natural spawning of trout. Dams were blown to determine the recovery of trout waters, as experiments in beaver-trout management. In short every effort was made to determine just what effects the beaver have on the trout population, for better or for worse, under the different conditions prevailing in different sections of the state.

During the following summer (1934), the Stream Unit of the Institute carried on with the Investigation, checking summer conditions under the writer's directions.

The investigation was presumed to require some three years to complete, but facts essential for setting up a management policy and program were forthcoming at the end of the first year of research. Although the most critical, main aspects of the problem have been determined, it must be emphasized that many interesting and important corollaries of the research have been opened up. These new lines of investigation should be followed through to equally definite conclusions as were achieved in the backbone of the research, namely beaver-trout relationships, speaking in an ecological sense. It would be unfortunate for the cause of wild life research in general if the investigation were terminated without fully exploring the new avenues it has opened in many phases of Michigan wild life existence. As will be demonstrated in the more complete report forthcoming around January of the new year, the beaver is a factor in the life of every Michigan mammal of economic or recreational importance.

Furthermore, the local details of beaver-trout relations need further attention if a management program is to be adopted. Some degree of continued investigation and checking will be called for in effectively carrying out such a program.

3. PUBLIC OPINION DIVIDED IN THE BEAVER QUESTION

When the investigator began work on the problem he found the anglers massed into two definitely divided camps. One faction stoutly maintained their faith in the beaver's ability to provide more and better trout fishing. The other division saw their favored streams ravished by unchecked beaver encroachment. Both were right within certain limitations as to time and place. Both agreed that if any damage to trout waters was outstanding it would be that of killing shade and warming up the streams. Succeeding research, however, has shown that this is one of the minor influences on trout stream welfare.

4. METHOD OF ATTACKING THE PROBLEM

The problem was purely an ecological one. It was a fascinating study from the start. The two main lines of attack were by the observational and the experimental methods. Both gave splendid converging evidence.

√ In the experimental work, hundreds of trout were tagged to check their native ability to surmount (such) obstructions to their spawning runs. Dams of known ages were blasted to determine recovery rates from beaver occupancy of a stream. Temperature studies were made. Food counts were undertaken. Predator sequence was followed up. Beaver were transplanted to observe effects on fishing. These are only a few instances of the experimental approach.

On the observational basis, an attempt was made to determine the ancient effects of beaver on trout and trout streams. Early beaver workings were studied and pioneer data were collected and analyzed. Several hundred early settlers, trappers, and lumbermen were interviewed concerning early beaver numbers and locations. Creel census data were secured from an equal number of beaver dam fishermen. Studies were made of timber damage, tree succession, the fate of streams long used by beaver, effects on trout lakes, trout wintering, and numerous other phases of the problem. An exhaustive study of physical chemical changes in the water of beaver dams as contrasted with natural stream conditions gave startling returns. Practically every trout stream of importance in the state was visited and dams of all ages, types and locations were studied. The result was a great mass of harmonious data which verified and supplemented the experimental data. Incidentally an appreciable portion of this material comprised new and pertinent life history information on America's most interesting mammal, the beaver.

5. SUMMARY OF RESEARCH FINDINGS

A. BEAVER DAMS PRODUCE BAD PHYSICAL-CHEMICAL EFFECTS IN TROUT WATERS.

1. All beaver ponds regardless of size or age show a definite biochemical demand on the dissolved oxygen of the water. That is, the organic matter present removes a portion of the oxygen. The effect is sometimes so critical as to kill every living organism in the pond, or again so slight as to be barely detectable.
2. The pH reading of a beaver dam lowers with age, indicating increased acidity. This condition becomes worse four years after the dam was made. This is occasioned by the accumulation of humic acids from flooded submerged timber. In several instances readings so low on the acid side of the scale were found that it is doubtful if trout could tolerate the concentration.
3. As a result of such bad physical-chemical conditions, the trout in a number of streams were rendered unpalatable when eaten.
4. In summer a beaver dam of a half acre or more often causes a rise in the temperature of the stream from one to several degrees. This is not important in the general picture however as the stream generally recovers its original temperature before it has run a quarter mile, even after going through a series of dams. The temperature question is decidedly secondary in the ultimate

e effects of beaver on trout waters.

More serious is the cooling down of spring water in a beaver dam in early winter due to the increased exposure of the water to the air. During the spawning season of the brook and brown trout the water is often cooled down to below the spawning threshold (the temperature at which spawning takes place). Many miles of potential spawning waters have been rendered unproductive in the last five years from this cause alone.

5. Beaver dams are the source of immense quantities of a fine impalpable silt. In high water periods or when a dam is injudiciously blown out by man, this silt is deposited down stream from one-quarter to one-half mile, frequently laying a suffocating deposit over food organisms and over trout eggs previously spawned.
6. For a number of reasons, the physical-chemical conditions in a beaver pond are better when occupied by beaver than when abandoned by them. Removing the beaver without blowing out the dam not only fails to remedy the bad physical-chemical conditions, but may even increase the hazard.

B. BEAVER DAMS INTERFERE VERY SERIOUSLY WITH THE SPAWNING RUNS OF THE TROUT.

1. Tests by tagging fish show that trout do not pass upstream over the ordinary beaver dam.
2. But trout can and frequently do go downstream over a beaver dam to spawn. Unfortunately in most streams the better spawning areas are upstream near headwaters.
3. After lying inactive below an impassible dam for several days, trout spawn just below it. Later silting and the low oxygen content of water from the ice-sealed pond destroys the eggs in the redds from two to four hundred yards downstream below the dam.
4. Trout cannot successfully spawn within beaver ponds due to silt conditions and lack of current. The beds are covered with a black suffocating silt in the first twenty-four hours after spawning. Deprived of an orientating current the male trout do not behave normally during the spawning act in beaver ponds.
5. Freezing of the beaver pond subsequently prevents the stream from warming up during warm weather following a cold snap, sufficiently to permit the trout to resume spawning.
6. As their numbers expand and new colonies are established on a given stream,

beaver progressively reduce the mileage of the stream where trout can spawn, in as much as the trout are unable to negotiate the home dams. On the headwaters region of the river most intensively studied the beaver in three years occupancy reduced the available spawning area to a scant one hundred yards of suitable stream.

C. PERMANENT EFFECTS OF BEAVER ON TROUT STREAM TOPOGRAPHY

1. Sections of the stream repeatedly the site of beaver dams are generally permanently widened and made more shallow with a persistent sandy sump after the dams are out.

2. The shade in the immediate environs of the dam is destroyed. This is, however, of secondary importance in the ultimate welfare of the stream.

3. If there is not sufficient current to wash out a dam on a lowland stream, the vegetation creeps out over the dam from both sides and the dam is finally sodded in. It will not wash out after this condition is once reached. After years of beaver occupancy in a stream of this type, the end result is a succession of marshy terraces where once were dams, then a series of hummocky, wet meadows, and finally the complete extinction of the stream itself. Many fine springfed tributaries of our better trout streams have been lost in this manner. This whole history can transpire in the relatively short interval of from twenty to forty years.

4. Even more hopeless is the fate of a trout stream which, when dammed by beaver, goes into an acid-heath-bog type of succession which culminates in a peat bog. This is not infrequent in the Upper Peninsula streams, but rather rare below the Straits.

5. Selective cutting of stream-side forest trees for food by beaver results in scattered shade removed to some distance from the stream banks. The banks lose their dark, moist condition and finally dry up and begin eroding. Streamside erosion is a major factor in limiting trout production.

D. BEAVER PONDS GREATLY INCREASE PREDATOR PRESSURE ON TROUT STREAMS

1. By damming and opening up broad water areas previously shielded by overhanging shrubbery, beaver open long stretches of virgin water to fishing by herons,

kingfishers, and bitterns.

2. Turtles and water snakes move into the more favorable beaver pond habitat.

3. In the first two years of pond existence, trout have a tendency to drop down into the pond from considerable distances upstream. Thus concentrated, their loss to predators is greater than when the fish population is diluted by the more extensive natural stream area.

E. PARASITES INCREASE AS BEAVER BECOME PREVALENT ON A TROUT STREAM

1. Michigan trout waters showing heavy strigeid infestation (black spot disease) of their trout almost invariably have had a recent history of beaver activity.

2. Gill lice are most prevalent in beaver ponds, especially ponds over five years old.

3. Round stomach worm infestation of trout in the old ponds of the Upper Peninsula is becoming yearly more common.

F. BEAVER POND FIRST INCREASE, LATER DECREASE THE TROUT CATCH

1. The environment for trout in a newly created pond is so excellent that trout concentrate there from several miles upstream. In typical beaver-trout streams, having a beaver density of two active colonies per mile, the fishing history is about as follows:

   a. The legal limit is often caught in from one to ~~four~~ two hours effort the first year.

   b. Fishing remains good here the second year but the fishing effort runs from two to four hours for the limit catch.

   c. In the third year, the end is approaching, for one legal fish on the average is caught in about four to six hours.

   d. In the fourth year, the fishing is practically terminated, for a scant dozen legal fish is the typical catch for the entire summer. The beaver themselves have most often exhausted their food supply locally and have moved up or downstream.

G. BEAVER DESTROY TROUT CONDITIONS IN TROUT LAKES

1. Damming of a trout lake's outlet and raising of the water level by beaver means the extinction of the lake as a trout lake.
2. The whole ecology of the lake changes: (a) it becomes warmer, (b) warm water pond weeds come in, (c) perch and pickerel quickly become the dominant fish.
3. This transition is well initiated at the end of the first five years after the dam is made and is finally complete in the tenth year.

(Space does not permit a detailed account of the factors responsible for such ecological reversal. The formal report will deal with this subject extensively. But it should be repeated again—the presence of a beaver dam on trout lakes spells the doom of its trout population.)

H. BEAVER PONDS ALSO HAVE BENEFICIAL EFFECTS ON TROUT.

1. A beaver pond during its first year supplies food, shade, and cover decidedly superior to that of the natural stream.
2. The beaver pond supplies at least two years of good fishing and more if it is not blocked in by another dam immediately upstream (which unfortunately is generally the rule).
3. The beaver pond, before the onset of severe stagnation is an effective winter abode for trout on certain shallow streams.
4. The innate fertility of a beaver pond increases food production for some distance downstream in impoverished, especially sandy streams.
5. The beaver pond is indispensable in maintaining continuous trout fishing in the rocky, short, down-plunging streams which flow into Lake Superior, because:
   a. These streams are much subject to local drouth.
   b. The excessive exposed rock surface warms up the water dangerously in summer unless covered by water backed up by a dam.
   c. Wintering pools, such as are furnished by beaver dams are needed here.
6. Beaver create fishing where there was none before. Tiny spring trickles when dammed by beaver often become a trout ponds as large as two to thirty acres.

SUGGESTIONS FOR BEAVER-TROUT MANAGEMENT

Michigan is long since past the "let alone" policy in its wild life management. It has in the last decade become a leader in wild life research and management. Its deer, grouse, and trout management programs among others seem highly successful. There is no reason why the beaver-trout complex cannot be equally well managed.

The beaver should not be permitted to continue occupying our trout streams without control. Unless a sound beaver-trout management program is adopted and carried out, a choice will need be made between beaver and trout. On the other hand, this investigation has indicated that, under proper management, beaver can readily be made an aid in maintaining trout fishing, rather than a menace as at present. Under the system of management to be proposed, it is believed that, as a minimum result, the present beaver population can be maintained without material damage to the trout fishing.

Both beaver and trout are exceedingly desirable natural resources. It is not needful to point out the source of revenue trout fishing is to the state and individual in Michigan. Moreover, the presence of the right number of beaver on our streams guarantees more otter, muskrats, and even deer in the country. The life cycles of beaver and otter are so interlinked that it is doubtful if the latter could maintain itself in Michigan without the former.

Therefore the situation calls for the definite institution of strict and scientific beaver management on Michigan streams. This cannot be too strongly emphasized. The future of trout fishing in Michigan in the writer's opinion is in real jeopardy if the crisis is ignored. Yet control or management of the beaver seems relatively simple. The essential points, here mentioned, will be enlarged upon in the more extensive report being prepared.

1. A partial control of the beaver can be afforded by trapping, regulated with due consideration to the welfare of the beaver and to the economic interests of the trapper. Evidence on the proper season for trapping was obtained during the investigation, and will be given in the fuller report.

2. Excessive trapping, however, does not seem to be a reasonable solution. In

the high years of their cycle, beaver have increased despite this check.

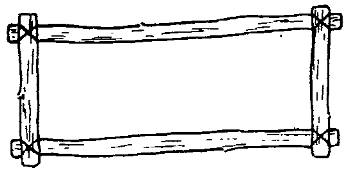
3. The vital point of the problem is that the pernicious effects of beaver on trout continue, even become accentuated, after beaver have become completely trapped out from a region, or for other reasons have abandoned the area.

4. Effective MANAGEMENT is only to be obtained by a systematized and routine blowing out of dams after they have fulfilled their greatest mutual service to both beaver and trout. The age of the dam at which it should be blown out depends on the main features in the natural history of both beaver and trout. The investigation has largely been pointed toward the determination of the proper time for destroying the dams. It is believed that this point has been satisfactorily determined for different types of trout streams, which will be classified in the further report. It was found that the speed and completeness of stream recovery as well as the efficiency of operation vary with the method used in blowing out the dams. In the experimental blowing of dams there was developed an improved technic, which will be described in the next report.

5. The recovery of a stream, that is its transformation from a semistagnant beaver pond into good trout water, can be hastened by stream improvement operations. Experimentally, fine spawning beds have been uncovered by the use of deflectors placed on a bottom of deep silt formerly laid down by a beaver pond, and these beds have been extensively used.

The opinion should be repeated that, although the main features of the beaver-trout problem have apparently been solved by this investigation, a continuation of the research is most distinctly called for. New lines of inquiry have been opened up that need further study. Further study and probably continuous observation of beaver-trout relations throughout the state will be needed to determine the finer details of the beaver-trout management program and activities.

Finally it may be pointed out that the urgency of the need for beaver-trout management is evident from our estimate that 25% of the mileage of Michigan trout streams becomes the bottom of a beaver pond every ten years.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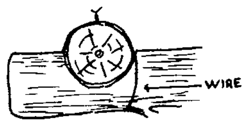

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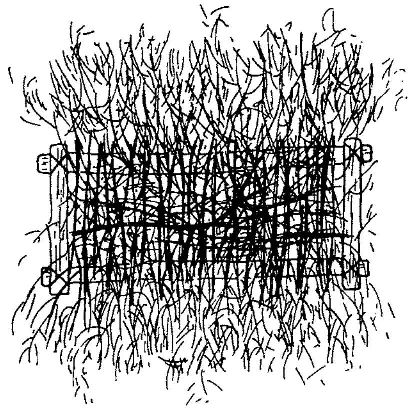
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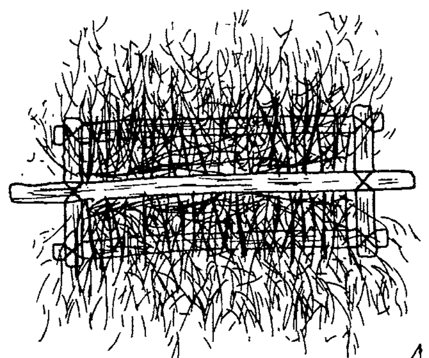
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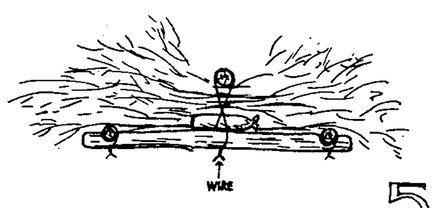

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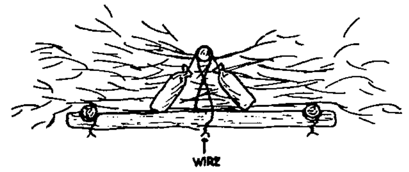

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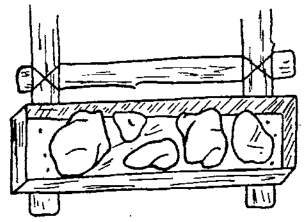
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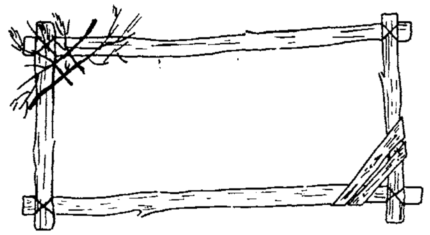
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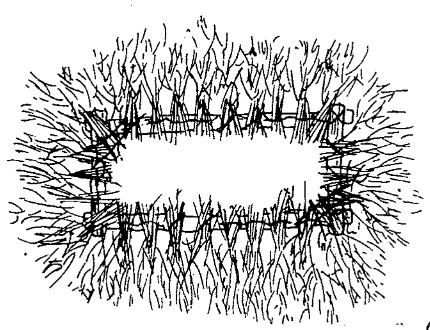
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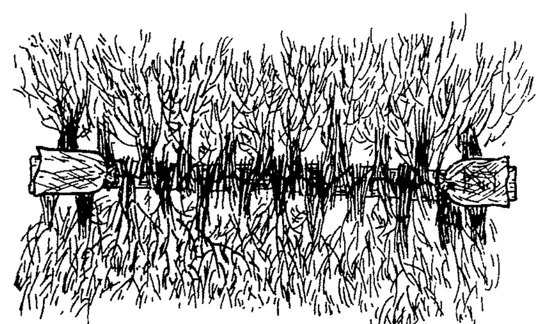
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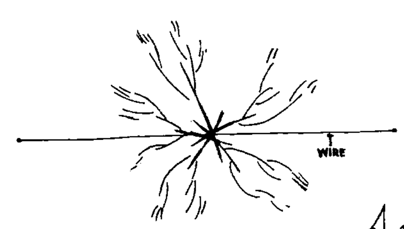

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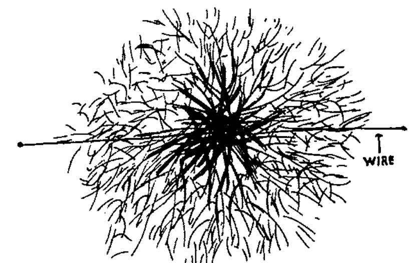

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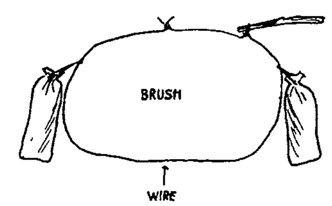

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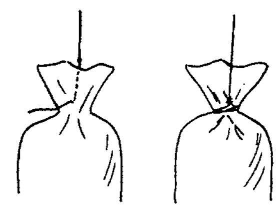
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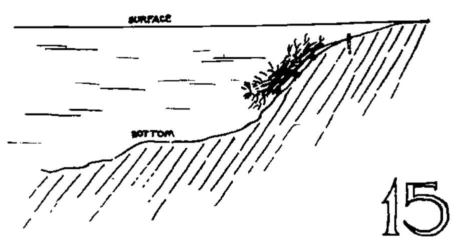

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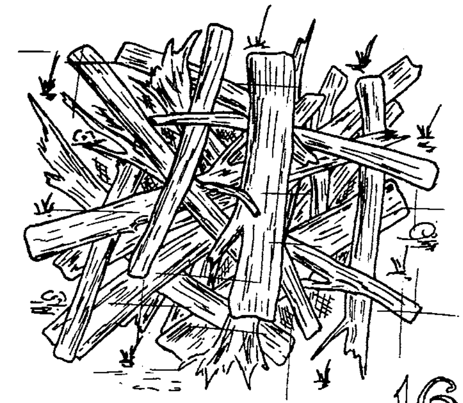
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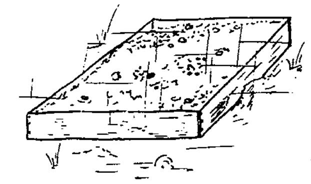
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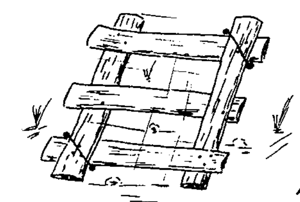
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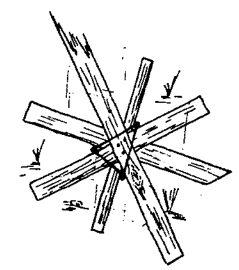
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For Explanation See Other Side

DIAGRAMS

Fig. 1. Frame for ladder shelter.
A cross-member in the middle is desirable if the frame is over 10 or 12 feet long. Frames can be made any length. A width equal to about one half the average length of the brush is desirable. If built too narrow the shelter is apt to turn over when being submerged.

Fig. 2. A method of fastening the several pieces of the frame.
By notching and wiring as shown, spikes or nails are not needed.

Fig. 3. Shelter practically completed.
Brush is more loosely packed by placing some brush lengthwise to the frame as shown.

Fig. 4. Shelter completed.
The pole is wired to the two cross-members at the ends of the frame and holds the brush in place. Size of shelter depends upon the size of material available and on the particular taste of the individual making them as well as on means of moving the shelter if not built where it is to be submerged. Brush is generally piled to a height of 3 to 5 or 6 feet. The wire holding down the upper timber should be stapled to the timber.

Fig. 5. Method of weighting shelter.
Bag of sand (or rocks) placed in shelter after a supporting layer of brush has been put on the frame. This method serves where shelters are built on rafts or on the ice where they will not submerge prematurely by adding the weight.

Fig. 6. Method of weighting shelter.
This is considered superior to placing the weight on top since the shelter has no tendency to be top-heavy or to turn over while being submerged. One bag at each end may be sufficient, the number depending on the size of the shelter.

Fig. 7. Method of weighting shelter.
Suitable especially where rocks are used. An extension of the two members of the frame at each end of the shelter, covered by a box-like structure as shown, serves the purpose well. Rocks must be placed at both ends simultaneously. This method, by using boards or a layer of brush, also works well where bags of sand are used.

Fig. 8. Frame for square type shelter.
This shows two ways of building up ends to support sandbags or rocks.

DIAGRAMS

Fig. 9. Square type completed.
Ready to be submerged.

Fig. 10. I-type.
Weighted. Ready to be submerged.

Fig. 11. Circular shelter, starting construction.
Wire is temporarily fastened down to prevent its being moved.

Fig. 12. Circular shelter, partially completed.
Showing method of placing brush.

Fig. 13. Circular shelter. Method of wiring, drawing wire tight, and attaching weights.

Fig. 14. Wiring bag.
If wire is placed through bag and then twisted around bag there will be less tendency of the sack slipping out of the wire.

Fig. 15. Method of placing shelter on slope.
If the water is too shallow above the drop-off and if the slope is sharp and extends into deep water, the shelter can be held on the slope by use of a stake and wire as shown. Once it has settled down the shelter will stay on a slope of considerable angle if currents are not strong.

Fig. 16. Water-logged shelter.
Water-logged material placed in heap at proper depth.

Fig. 17. Small-mouth bass spawning box.
Made of boards and filled with gravel and sand.

Fig. 18. Slab device.
Staked to bottom in water ½ to 1½ feet deep. Used by minnows for spawning.

Fig. 19. Board device.
Used in place of slabs.

Fig. 20. One method of arranging improvements.