C.C.C. STREAM IMPROVEMENT WORK IN MICHIGAN

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INTRODUCTION

CARL L. HUBBS

The only time I ever inserted a political remark into a talk was some time ago in Indiana when I was addressing the Annual Meeting of the Izaak Walton League of that state, in which I made the comment that it was a fortunate circumstance that whichever of the two candidates for the presidency at that time were elected, the conservationists of the country would probably be satisfied. I think that remark has been justified by the first act which was taken by the newly elected president in his drive to restore prosperity, which was the inauguration of the so-called C.C.C.—Civilian Conservation Corps. The emergency conservation program was then put in charge of officials in Washington, while the work was undertaken, as you know, by the various conservation officials in the several states.

I think most of us here will look upon this work as one of the wisest of the moves that have been taken for the restoration of prosperity. The "fish men," administrators and investigators, and the fishermen themselves, were rather disappointed that in the drawing up of the activities in connection with this emergency conservation work being carried out by the C.C.C., fish improvement questions were not considered. The improvement of fishing conditions through the C.C.C. labor is such an obvious public benefit, since much of this work does involve chiefly labor, with relatively low cost materials, that it was probably more a matter of oversight than anything else that this fish work was not included in the original program. Despite this fact, a number of the enthusiasts throughout the country submitted proposals for work of this sort—for lake and stream improvements, the construction of hatcheries and rearing ponds, and other work which, by making for an increase in the fish population, would lead toward a betterment of fishing conditions. Any projects of this sort which were approved were approved in a qualified way, always with the restriction that only a very small part of the labor in any one C.C.C. camp should be devoted to this work. Finally, and very fortunately from our standpoint, the Emergency Conservation headquarters in Washington formally approved this type of work as one of the legitimate functions of the C.C.C., and from that time on the work has proceeded a little more above board and on a larger scale; and I think it can be prospected for the future on a still larger scale.

This work is expanding very rapidly. In almost every mail word comes in to us referring to new work along the line of lake and

stream improvements being started, generally in connection with the C.C.C. program, from one end of the country to the other. The states in which this is being done are numerous; I can recall offhand either activity or proposals in Connecticut, New Jersey, West Virginia, Michigan, Iowa, Arizona, Pennsylvania, and a considerable number of other states.

In the work with which we are most familiar, that in our own state, a certain organization was built up. The Department of Conservation of our state naturally had charge of the local work in the state, acting as agent for the Emergency Conservation program in this respect. For the lake and stream improvement work, naturally a number of skilled workers were needed to direct and plan and check on the work as it was done. Several of these skilled workers are now busy in our state, having under them a series of construction foremen, one in each camp, directing the work of these boys. Certain of the better workers among the boys, the more intelligent of them, have been placed in charge of squads, and in that way the organization has been carried down to the laborers themselves. The Institute for Fisheries Research, which since its incorporation has taken a very considerable interest in developing this field of lake and stream improvement, had some men available who had had experience along this line, and these men were, in part, taken over by the organization in our state. Two of these young men will briefly tell you something of the work which has been done in Michigan: one, Mr. Tarzwell, representing the stream work, and the other, Mr. Eschmeyer, representing the lake work.

Stream Improvement

Clarence M. Tarzwell

The organization for trout stream improvement work in Michigan has been partly explained by Dr. Hubbs. At present in the stream improvement work we have three skilled workers: Mr. MacClure in charge of the work in the Upper Peninsula; Mr. Johnston in charge of the work on the Pere Marquette River, and myself, in charge of the work in the Lower Peninsula. In each camp there is a foreman having direct charge of the crew. The crews which have been working vary in number from twelve to forty-four. Before any work is undertaken on the streams a preliminary survey is made, which includes the taking of temperatures, a study of the spring feeders, a study of the food supply, a list of the number of sand banks in which erosion has to be prevented, a study of the present trout population, a study of pools and shelter. Trout stream improvement is needed where shelter and pools are insufficient in number, or where food conditions are poor, and this may require improvement

either on part of the stream or on the whole of it. In former years sufficient studies have been made so that it is known how to produce more food in given areas, and it is also known what each area will do and how certain conditions can be produced.

The actual construction work is carried on by the C.C.C. boards. Before any work can be done the material must be secured. In the majority of cases where there are not sufficient stones in the bottom of the stream, the material used is wood—tamarack, cedar, pine, jackpine, oak, or hardwoods—whichever is the most readily available and can be secured most easily. Usually the wood is secured from burnt-over areas. In our work on the Sturgeon River the materials were obtained in a hardwood forest on an old burned over area and floated down to the scene of operations.

When sufficient material was cut and piled it was placed in the river and driven down to the scene of operations. Boys were stationed at critical points, such as at turns, to keep the material moving down the stream. When the material arrived at the location of the improvement work, actual construction was begun.

Log drives in Michigan streams widened the streams and made them shallow, therefore there is need for pools and cover. Where a stream section is too wide and it is desirable to make it narrower, this can be done by the introduction of a wing deflector. Food conditions are improved by the wing deflectors, in such rivers as the Sturgeon, a cold stream which is uniformly swift and in which there are very few slow water areas. These slow water areas are produced behind the deflectors and it is here that food production is greatly increased: a muck deposit is produced, and the mayflies become abundant in about a year or two.

The deflectors are built of logs or stones. The current is accelerated on one side and forms a pool, deepening the water and providing places in which the larger trout may stay. Usually they are used at a bend where it is desired to have a pool. In a sand section the deflectors quickly form pools, but in a gravel section the current has to be forced down against the bottom.

The Y-deflector has a double wing, which directs the current downstream for long distances in sand sections, removing the sand and exposing the gravel. This helps food production, as gravel is much more productive than sand. Very few insects live in sand.

In Michigan, many streams are wide, shallow and flat, and have sand bottoms. It is desirable to make such streams narrow, thus accelerating the current, causing the sand to move and exposing the gravel. It is also desirable to confine this sand in a permanent bar so that it does not move about to cover gravel areas and destroy food. This is done by putting brush in behind the deflectors. This brush is fastened down on deadheads already wired. The high water will go over the deflector, but it will be so retarded by the brush that the sand is dropped. Work done in former years has shown

that the bar may be built up above the surface of the water in one year. This has helped to confine the stream to a channel of the type which is most favorable for trout.

It was hoped that plants would grow behind these deflectors, and it has been found that they do grow there. These plant beds greatly increase the food production and give shelter for the young fish. Some plant beds occuping more than two thousand square feet of area have been produced. It is almost unbelievable that such a large bed could be formed by such a small deflector.

In many swift streams there are no suitable places for the young trout. Frequently no side streams enter the main stream to provide the desired nurseries for young trout. These nurseries can be produced by building a wing deflector and chinking it tightly to keep all water from passing through, so that quiet water is produced below, where muck is deposited and food for young trout is produced. Brush fastened along on top of the deflector and allowed to float out on the downstream side provides a real nursery for young trout in places where it did not exist before. Fish have been noted in great numbers around these nurseries.

Cover is also of great importance in many of our streams. Many Michigan streams are so open, although they do possess some pools, that few trout will stay in them. In such streams much can be done by the introduction of cover alone.

An effort is made to make these covers look as natural as possible. It has been difficult to make some of the boys who were brought up in the city and had never seen a trout stream know how to go ahead with the building of a cover which would have the appearance of being natural. Wires are concealed wherever possible, or their use avoided by wedging.

Where the bottom is so hard that pools cannot be formed by other methods, pools can be formed by low dams. Care has been taken to leave a spillway on top of the dam. Each of the rocks is so placed that the current will not wash it over the top. If these dams are of any depth at all, the pool above is greatly improved by additional cover. The trout find refuge here from floods.

In Michigan there are many high sand banks which erode and add sand to our streams. Sand is very unproductive of food and it is one of the evils that needs to be combatted in Michigan. Perhaps it is the most destructive factor in our trout streams. The importance of the sand erosion has been recognized in the state. The Pere Marquette project, carried on from one of the camps, is primarily for the prevention of erosion. Every year immense quantities of sand have been added to the stream, covering up the gravel areas and cutting down the food production; also filling the pools and making wide, flat, shallow areas which are virtually deserts, in which few fish will stay. These sands banks are being controlled in a number of ways. A deflector placed at the upper end draws the

current away from the bank and thus prevents the eroding action of water at the base. On steep banks brush is fastened and allowed to hang down, holding the sand and giving the plants a chance to grow and to recapture the bank. Terracing is also practiced.

The work this summer (1933) has been limited by the fact that the Michigan Emergency Conservation Work was an immense undertaking, and the tools and materials could not be secured as promptly as was wished. The work was late in getting underway, but it did get underway and much has been accomplished. However, it is hoped that much more will be accomplished next year, since the work has been officially recognized. Plans are being made for work this winter, and also for next year. Plans for the work in the winter camps include the placing of material at suitable locations along the banks before the ground freezes. When the snow comes it is hoped that men will be able to go into the swamps and cut dead timber for the deflectors, cedar for the covers and tamarack for the stakes. Then when the frost comes out of the ground in the spring it is hoped that crews will be put on these large sand banks to do work to prevent erosion. This program will be carried on until June. After June the actual summer work can begin, as the streams will then become warm enough so that the men can work in them during the day. The work of installing cover and deflectors to bring about improved food conditions and more pools and afford cover for fish can be undertaken with material brought out and piled along the stream bank during the winter.

Lake Improvement

R. W. Eschmeyer

After a rather brief experimental period in lake improvement, the Institute for Fisheries Research was given an opportunity to put into practice some of the improvements with which it had been experimenting. This opportunity came through the establishing, by the President, of the Civilian Conservation Corps.

Since our improvement experiments had been in progress for only three years, no improvements were attempted except those which had given definite indication of being beneficial to fish life or to fishing. The work was limited to those environmental changes which called for a minimum amount of equipment and a maximum amount of labor.

Personnel

Two types of men were included in the camps: two of the crews were composed entirely of veterans; the other four included boys (18 to 25 years of age), together with a small number of local woodsmen.

The boys were, for the most part, from the cities and had had no previous training in any phase of the work, not even in such simple matters as cutting brush. They exhibited a desire to learn, however, and with a little patience on the part of the foremen, the crews soon developed into rather efficient units. In almost all camps volunteers were called for and, as a result, the boys in the crew were those who had expressed a desire to work in the water.

The veterans were more experienced, were more steady workers, and were able to accomplish more than the boys, each using the same amount of energy. Almost all of the veterans were past the age, however, when being in the water has a strong appeal, and their work had to be done chiefly from boats. This proved to be somewhat of a handicap.

All things considered, it appears that boys are preferable to older men in work of this kind during the summer. The older men would probably accomplish more when working through the ice in winter.

Types of Improvements Installed

1. Brush shelters.—A large percentage of the time was spent in making and installing various types of brush shelters. These were intended primarily for the protection of young fish. Previous experimental work had indicated that they serve the purpose well. Incidentally, adult fish are also concentrated and better fishing results. If a fairly large number of shelters are installed in a lake, there appears to be relatively little danger of removing too many adult fish, in spite of the tendency to concentrate them around the shelters. The increased protection of young fish is regarded as balancing the increased crop of fish harvested.

2. Gravel for spawning.—Where smallmouth bass occur, and where there is little or no gravel, spawning conditions for this species (and to a lesser degree other species) were improved by providing gravel at proper depth. On hard bottoms the gravel was placed on the bottom in heaps of about a bushel each. In soft-bottomed lakes the gravel was placed in boxes made of old lumber. These boxes were made about three feet square and six inches high, were filled with gravel and then placed on the bottom at proper depth.

3. Slabs for minnow spawning.—In lakes which showed a food deficiency, efforts were made to increase the minnow supply, both by introducing more minnows and by providing slabs for their spawning. The slabs were provided primarily for the blunt-nosed minnows, a species which is excellent as a forage fish, and which spawns on the under surface of objects lying on or near the bottom. Several types of slab devices were used.

4. Aquatic vegetation.—Vegetation, including pond-lilies, muskgrass and several species of pond-weeds, was transferred from lakes containing an abundance of weeds to lakes in which a definite lack of vegetation was in evidence.

5. Minnows and young bass.—Both minnows and bass were planted in several lakes. These were taken from lakes containing an abundance of minnows or bass and were transported in regular hatchery cans to other lakes. They were planted only in lakes where few or none occurred previously.

Since it is probable that a bulletin on lake improvement may be forthcoming in the near future, methods of installing the several improvements need not be discussed here.

Blanks were filled out by the foremen each day indicating the man-hours worked, the number and kind of improvement structures completed, the kind of material used, and certain other significant items. Charts were made to indicate the location of the improvements. The sheets showed the amount of time required to make the several improvement devices, while the charts made it possible to revisit the improvement areas to determine the stability of the several structures, as well as to determine their effect on their environment and on the fish production.

Work Accomplished

The following summary indicates the amount of work which was accomplished during the summer of 1933:

Total number of crews—6.

Total man hours—10,302.

Total lakes improved—28.

Total brush shelters (various types)—1,084.

Total bass nests (boxes)—50.

Total bass nests without boxes—198 (plus 11 cubic yards of gravel).

Total minnow slab devices—233.

Total vegetation planted—55 cans plus 5 truck loads.

Total minnows and yearling bass planted—37 10-gallon cans.

Plans are now in progress for a continuation and expansion of this lake improvement work in Michigan over the winter and next year.

Discussion

Mr. Wickliff: Have you determined the maximum velocity of the current in your best trout waters? How great a velocity of water can a trout stand?

Mr. Tarzwell: I cannot say we know the maximum velocity, but it is my experience that food production is increased as velocity is increased in gravel areas. While trout feed in swift water, they prefer the quieter sections in which to stay, so that they do not have to be continually battling the current in order to maintain their position. Covers are built to give these resting places, while deflectors are used to produce swift water and make food channels. The fish lie in the quiet shelter under the cover,

moving out a short distance to feed in the channel which flows by the cover from the deflector. Trout do not generally rest in water of a velocity greater than two feet per second, but will feed in water having a velocity as great as five feet per second.

MR. ADAMS: Do you believe the stream improvements you have put in will stand the action of the ice next winter?

MR. TARZWELL: This is really not a new thing; we have been doing work in stream improvement for the past four years. The first structures were installed in 1930, the work being under the direction of the Institute of Fisheries Research, which is carrying on scientific research for the Department of Conservation. The Department of Conservation made a special appropriation in 1930 to do some work on the Little Manistee River. As this was really an experimental project, and was the first work of the kind we had done, we knew very little about how to proceed, or how the work was going to stand up. But we built several different types of barriers, and they have been tested. The next year the work was undertaken more in earnest. Many of the first year's installations were lost. In 1931 four or five were lost—one of them was made of stumps, which are very hard to hold. In the winter of 1931 the weather was mild, and there was very little ice. Last year there was much ice, and the deflectors stood very well, but the ice pulled the stakes on some of the covers, which were large,—in fact, too large. In the work on the Sturgeon this year the covers were placed entirely under water, the stakes being sawed off under water; so that in the winter the ice will have no chance to damage it. On the Pigeon River the losses have been small; out of five or six hundred actually built in the seasons of 1931 and 1932, only about a dozen have been lost. These streams are, you might say, warm in summer and cold in winter; the Pigeon freezes so hard you can skate on it, but on the whole the structures remained in place very well. Some of them have been in place for three years, but they were not all built by the C.C.C.

MR. ADAMS: Is this improvement work done on streams the land on either side of which is owned by the state?

MR. TARZWELL: Improvements have been largely confined to state-owned lands, except where, in some cases, work has been done for private people at their own expense; they paid the Institute for the services of the man who was directing the work. The C.C.C. work has been conducted on state-owned streams except where, as along the Sturgeon River, the owners petitioned the Department to do the work. Mr. Westerman can explain that to you more fully.

MR. WESTERMAN: With regard to the employment of E.C.W. workers on privately owned land, the Department has prepared a petition form which is made available to owners who desire to avail themselves of that type of work. This, of course, is relatively new as yet; as Mr. Tarzwell has explained, most of the work this summer has been on state-owned land, but in the hope and expectation that E.C.W. labor will be available for the next twelve months—we do not know definitely yet—we have set up this machinery—a petition form and a letter to accompany it to all inquiring

parties. I have one in my room—I will bring it down so that you may see it later. We expect to consider these in the order in which they are presented, in planning future work.

MR. HIGGINS (Washington, D. C.): This is a different type of lake improvement from the type of work carried out by the Conservation Board under the direction of one of the investigators of the Bureau of Fisheries in South Carolina. At the request of the Governor's office, one of the Bureau investigators, Dr. Ellis, made a study of a lake about eighteen miles from Columbia. It is a hydro-electric reservoir created about 1929, which is about thirty-five miles long, with a tortuous shore line comprising some five hundred miles. Fishing in such a reservoir, as in most artificial reservoirs, rises to a very high level in the first two or three years, due, of course, to an abundance of food supply in the newly flooded area. But the fishing in this lake began to fall off very seriously last year, and this year it is still worse. The lake drains from its northern side a great area of clay hills in South Carolina, and the water entering the lake is extremely acid. The lake on the north side is very turbid and the water very acid, with a high carbon dioxide content. The southern shore of the lake, however, is sandy; the fish conditions are more favorable along the southern shore. The improvement project, then, is limited to the southern shore of the lake. In addition to the acid condition of the water, a significant factor in the fish production is the extreme fluctuation in water level. As is common with reservoirs, peak power demand brings down the water level, in this case very severely—it fluctuates as much as sixty-five feet, which of course, is a very extreme condition. The improvement, then, consists in establishing along the southern shore, where water conditions are favorable, a number of sill dams just below the maximum level of the lake, that will retain the water level at a certain minimum as the lake falls. In these areas, which in some cases are as much as a mile long and a quarter of a mile wide, aquatic vegetation will be planted in the narrow fingers or bays; the shore line will be improved by methods such as Dr. Hubbs has described, and it is anticipated that in these bays or impounded areas fishing conditions can be very materially improved. It is excellent water for bass and other warm water fishes, and by stocking these impounded areas with brood fish—and if necessary, by the way, gizzard shad—excellent fishing should be established. A camp has been established on the southern shore of the lake, and under the direction of Dr. Ellis from the biological side, and a skilled engineer, these sill dams will be built. The largest ones will be perhaps three hundred yards long and as much as twelve feet high, but most of them will be smaller and can be handled with trucks from the highway department. It is another case of lake improvement which is of particular significance in connection with the many hydro-electric reservoirs throughout the country in the south.

DR. HUBBS: I call to mind another type of lake improvement which is of tremendous importance. Throughout the prairie regions of our country the best type of lake improvement is the making of lakes where they

do not already exist. In the Iowa work, with which we have been connected in a consulting way, the construction of artificial lakes takes a very prominent part. It is hoped that the game and fish production of that state can be very materially increased by the construction of a considerable number of large artificial lakes. The wonderful fishing in some of these lakes is an indication of what may be expected there. Before a large lake was artificially constructed, survey lines were run around the shore to show how deep the water would be at each spot, and improvements of various sorts were placed while the men worked on dry land. The material used was cut from the land which was acquired for the purposes of the lake. Along the shores long rows of submarine bulkheads were constructed, about which vegetation could be planted if it would not naturally produce itself there; the wind exposure might be so great that weed beds would not become established without some such protection.

MR. FARLEY: You may be interested in a different variety of this same general program. The streams of California come dashing down from ten or twelve thousand feet, and in the course of two or three hundred miles reach their level, so that stream improvement in that state is not the same problem that you have in the Middle West. Back in the high Sierras, in our granite country, we have many small lakes that come out through very narrow niches in the rocks, and frequently a dam no longer than fifteen feet can be built up and thus raise a considerable body of water with very little effort. Some of these areas are utterly devoid of trees, so it is impossible to build a log type dam; the work has to be done with cement and other supplies brought in by pack animals. Work of this kind was done three years ago, first as a cooperative project with the State Fish and Game Commission, the city of San Francisco, on whose watershed we were working, and the county which was involved. Five dams were originally built; they were checked the two years following and were found so satisfactory that this year surveys have already been made for future work. Incidentally, California water supplies and watersheds are so carefully guarded that no work can be done unless a very thorough survey has first been made, and frequently there are insurmountable objections to impounding any water on the watersheds used exclusively for irrigation purposes. But this year an extension camp has been established; just before I left they had completed one additional camp and were starting on the second, and unless they get snowed out, before I get back they will have work proceeding on three during this season. It is an entirely different type of work, adaptable only to mountain country; it is really a variation of the kind of thing in stream improvement that has been spoken of here.

DR. VAN OOSTEN: I do not know very much about planting brush in the lakes, but the question has occurred to me whether ultimately the predators will find these places of refuge for the small fish, gather around these brush heaps, and deplete the fish supply of the lake perhaps more rapidly than if

the brush heap were not there. Is there any possibility of such a good beginning ending ultimately in disaster from this cause?

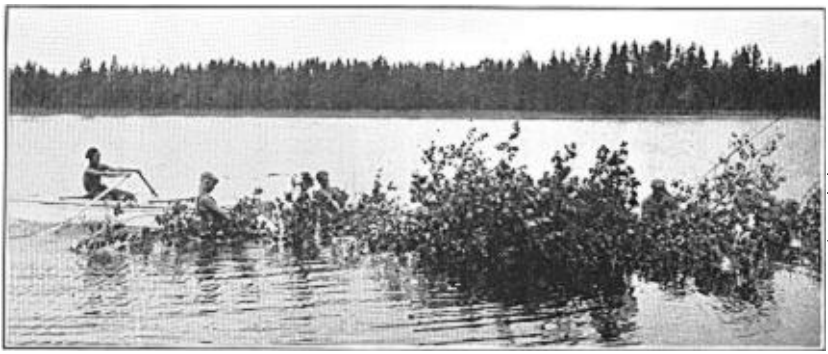
MR. ESCHMEYER: Following upon the work we have done this summer, we have been told by some of the old timers that fishing was better than it ever had been. I do not know anything better that could happen to an adult fish than for it to be caught. I do not think it will end in disaster; we have put in so many shelters that I am sure there will be enough surviving for another year.

MR. MARKUS: With reefrence to the improvement in streams along private properties, I would like to ask Mr. Westerman if he had any difficulty with some of these people who might not have wanted the stream improvement to be made; and also if there was any chance, in the construction of these improvements, of raising the water to a higher stage and causing complaint on the part of those opposed to the work.

MR. WESTERMAN: Answering the first part of your question, I may say that no attempt has been made to do work unless there has been a request for it; the department simply provides the machinery so that those who wish to have work done may request the department to do it, the purpose being to have a uniform method of getting the information assembled.

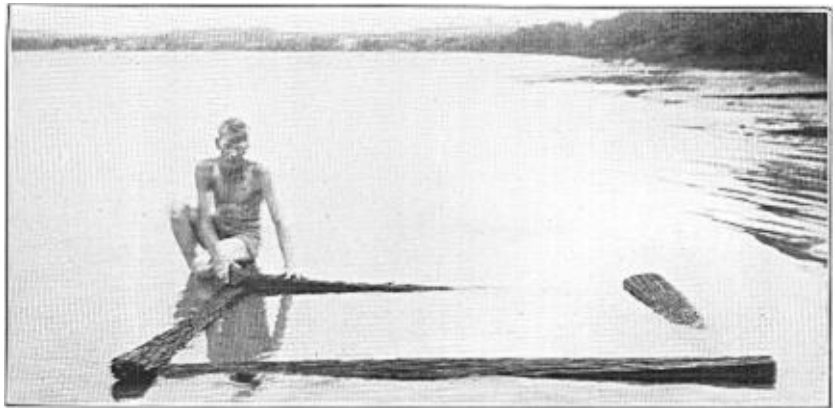
To answer the second part of your question, I would say that the mechanics of stream improvement, as we understand it in Michigan, does not involve the building of dams in the ordinary sense of the term; they are rather low head dams in stretches of swift water, and the effect of their construction is not to overflow the land. In fact, our problem is more with dams created through other causes, such as the operations of beaver. The beaver problem is quite an important one on many of the Michigan streams. Beaver have been protected for a good many years; only in the last two or three years has there been any open season on them, and that was a short one. Of course, in many cases there have been reports of nuisance beaver and these have been live trapped and removed to other areas where there may have been requests for beaver and where the Game Commission believe the beaver may be an advantage. The operations of the beaver have brought about what we consider a rather serious problem in relation to the trout in such streams. We hope in a year or two to have more definite information on that question for the Society through the Institute for Fisheries Research, which is tackling the problem for us.

THE PRESIDENT: It is evident that this subject of lake and stream improvement is a very complicated one, and an immense amount of experimental work will be required before we shall be in a position to determine the most efficient methods to use under various sets of conditions. It is very evident that the methods which under one set of conditions may be very satisfactory, under a different set of conditions might easily do more harm than good. The whole subject should be investigated at the first opportunity.



1. Towing brush shelter to deeper water. Shelters are usually towed with outboard motor and submerged in water about 10 feet deep.

2. Minnow spawning device. This type made of boards.



3. Minnow spawning device. This type is made of slabs.

4. Placing gravel on firm bottom for bass spawning.

5. Box of old boards filled with gravel. Used where bottom is soft.