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AN INVESTIGATION OF THE SPORT FISHERY OF JASPER NATIONAL PARK

by

C. McC. Mottley

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As a result of the recommendations of Mr. A.C. Wright, Superintendent of Jasper National Park, that a scientific investigation be made of the Jasper Park sport fishery with a view to outlining a policy of management, the writer made a survey of the situation this year in the month of July. This survey was intended to obtain some idea of what was involved and to become familiar with the conditions in the various bodies of water in order to be able to formulate a program of investigation and a future management policy.

The sport fishing is confined largely to the lakes, and only in one instance, the Maligne River, is stream fishing of any importance. The lakes may be conveniently divided into three types based on the fish-producing capacity of the spawning beds. This consideration is the primary one in fisheries management and the extent to which artificial aid must be applied depends entirely on this factor.

1. There are those bodies of water which at present contain no fish, such as Brazeau and Twintree Lakes, and which may be stocked. Stocking barren lakes requires a definite policy and this will be outlined below.

2. There are those bodies of water which have poor spawning grounds and the head of fish, whether native or introduced, is too low to provide an inducement for anglers to fish. This type requires a definite annual planting of fish and a definite program of management. Several of the lakes in the immediate vicinity of the town of Jasper fall in this category. Lakes such as Pyramid, Patricia,

Annette and Edith are so accessible for angling that it would seem to be a very desirable asset to have good fishing in them. The plan for these lakes will be treated below.

3. There are those bodies of water which contain a large head of fish and the spawning grounds are so good that there is a tendency for too many fish to survive for the available food in the lake. The lakes in the Maligne area are typical of this class. The problem is not one of the production of young but rather one of stimulating the fishing to cut down the head and also one of increasing the food supplies. These questions will be dealt with in the report.

There is a fourth class of lakes such as Jasper Lake and others in the main valley of the Athabaska which are unsuitable for the more desirable types of game fish and it does not seem to be profitable to include them in the program for the present.

Stocking Barren Lakes

Stocking a barren lake involves a number of important decisions, such as the species of fish most suitable to the water, the best method of introduction and the program to be followed. The majority of barren lakes occur at elevations where they are cut off by falls too high for fish to ascend. Most of these lakes are suitable for game fish. The consensus of opinion seems to favour the rainbow trout as the fish most desirable for the lakes of western North America. It is, therefore, a good policy to encourage the introduction of this species wherever it is possible. Other species might be introduced to advantage in places where there is an abundance of rainbows in nearby lakes in order to lend variety to the fishing, but where fishing alone is the prime consideration then the rainbow would seem to be the first choice. Although barren lakes have seldom

been stocked with more than one species at a time it is worth emphasizing that the introduction of more than one variety is not desirable. Most species of trout and char require the same type of food and it does not increase the total catch materially to try to produce two species in the same body of water.

The method of introduction depends largely on the accessibility of the lake. Since the barren lake contains no fish the chief element of depredation, large fish, is lacking. Under such conditions eyed-eggs, fry and fingerlings would have equally good chances of surviving within certain limits. Eyed-eggs are the easiest to transport and where pack-train methods are involved this method is indicated. It should be determined, however, if suitable streams persisting throughout the year are available for planting the eggs. The planting of fry involves many difficulties. If a definite planting is specified and held in reserve for a certain project and an accident occurs on the trail the program is completely upset. If fry plantings in inaccessible lakes could be made by plane it would greatly enhance the work. What has been said of fry plantings may also be said of fingerlings with the addition of greater hazards.

Before adopting a definite program for a certain barren lake, the probable subsequent history of the fish population should be visualized. Almost invariably in the dozens of such lakes that have been stocked in British Columbia by one or two plantings, the history has been as follows: At first, large numbers of large fish, weighing in some cases up to 30 or more pounds, are caught; then the size begins to fall off and large numbers of smaller fish are taken; at this time the fish of the first generation, now too big for the amount of food available, get thin and many of them are found dead after spawning. The population then goes through a period of adjusting itself to the conditions of the lake and finally settles down to a balance in which the number of fish, resulting from the annual

spawning and reduced by predation and fishing, strikes a certain size relationship with the nutritive capacity of the water. Lakes with good spawning grounds subject to little variation from year to year usually produce large numbers of trout averaging a pound or less. Lakes subject to changes, such as years with extreme drought in the tributary streams, are extremely unstable and may produce a small number of large fish for a period, then suddenly change and produce a large number of small fish. Lakes with poor spawning grounds usually produce a small number of large fish,- one such lake has been credited with a 48-pound Kamloops rainbow.

These considerations should, therefore, be kept in mind when drawing up the program for stocking a new lake. The most important thing is not to place too many fish in the water for the first generation. This generation will undoubtedly grow to a very large size on the virgin food supply and it is a good plan to capitalize on the excellent fishing which is bound to result. However, the fishing will deteriorate in a few years and this fact should be made clear at the outset to those who may be tempted to commercialize the proposition by catering to the wants of the anglers. The tendency is to expect that such a condition is going to last forever and provide a fisherman's paradise. It seldom does so; either the size remains up and the numbers down or the fish remain small and the numbers are large. Over a long period of time a natural body of water will produce only a certain poundage of fish per acre and under the best conditions it seldom exceeds 10 pounds per acre. The only way to keep up the excellent fishing afforded by barren lakes, recently stocked, is to have a number of such lakes and bring them into "harvest" in succession. In Jasper Park where there are a number of such lakes still unstocked it is strongly recommended that some of them be held in reserve. The Maligne area with the production of phenomenal speckled trout fishing has established the reputation of Jasper Park as a fishing

resort. The Amethyst Lakes are now coming in and should provide exceptionally good fishing for a few years. Steps should now be taken to stock another area and Brazeau Lake will probably serve the purpose. The barren lakes in the northern part of the Park might be held in reserve for about three years, but there is a strong representation from the people who outfit hunting parties to have these lakes stocked in order to provide some sport for their patrons en route to the northern hunting area.

There is practically nothing available to serve as a guide for deciding how many fish should be planted to provide an adequate stocking for a barren lake. It is known that a comparatively few fish will produce the required result on the initial stocking, but subsequently it takes a very large number. Judging from the data that the Biological Board has obtained at Paul Lake, Kamloops, the initial planting should be about 25 fry per acre, or where the lake is over half a mile wide about 3,000 fry per mile of shore-line.

The next generation will suffer from the cannibalism of the first but since the food supply is relatively great it will not be as serious as under balanced conditions. It has been proposed that the second planting should be double the number of the first, or 50 fry per acre. Likewise, the third planting should be double the second. The fourth planting should be made so that the planting itself and the natural seeding would amount to double the third planting. Normally rainbow trout females are ready to spawn at the end of the third year, but the size of the seeding is not as great as that produced by a spawning run made up of the full complement of all year classes, therefore a certain additional number is necessary.

A stocking program carried out in this way should allow good fishing just as soon as the fish are big enough to catch. In other words, the lake should not be closed for a period but thrown open as soon as the fish reach the legal

size and from then on every fish taken out by angling should be regarded as benefitting the lake. Fishing is a thinning process and in barren lakes the only important mortality to the fish over 8 inches is from fishing. Such a lake can be easily overstocked if fishing is curtailed.

After the fish have become established in a barren lake than it falls into either class 2 or class 3. The management policy thenceforth must be based on the fish-producing capacity of the spawning grounds. The subsequent treatment of the lake, therefore, depends on the considerations outlined below.

The Management of Lakes with Poor Spawning Grounds

In a lake system, including the lake proper and its tributaries and outflowing stream, where the spawning beds are poor and the annual production of fry is naturally low, it becomes necessary to resort to artificial methods of propagation.

It has been found at Paul Lake that in order to stock a body of water containing but the one species, rainbow trout, it requires approximately 200 fry per acre. It has also been found that, even under such ideal conditions, the mortality to the stage where fishing becomes operative on the year-class, namely, 8 inches, is greater than 95 per cent of the number of fish planted. It is difficult to apportion the mortality to the various contributing elements but cannibalism, larger fish eating the smaller ones, is probably one of the most important. The yearlings have been found to eat the eggs at spawning, the fry on emerging from the gravel and the fingerlings in the lake. It is almost an invariable rule that where trout of different sizes are associated together the larger will eat the smaller. The failure to recognize this fact by practical fish culturists has often served to throw this phase of fisheries administration

into disrepute. Inadequate plantings have been made year after year and inconclusive results have been obtained. In order to stock any body of water that already contains a head of larger, predatory fish, even though it be of the same species, it requires a planting big enough to allow for a large, expected mortality.

It would be quite possible to stock a lake with larger fish, for instance yearlings 5 or 6 inches long, but unless fry are hard to obtain, such a procedure would be far more expensive. It is probably better and certainly cheaper to plant a large number of fry and take the inevitable loss. If for some reason, such as the magnitude of a certain project or the scarcity of a certain variety, enough fry are not available to make an adequate planting, then it becomes necessary to step up the survival value by rearing the fish to a larger size in ponds.

There are five lakes in the immediate vicinity of Jasper which in past years have received certain plantings of trout fry. These lakes contain native populations of game and coarse fish. Pyramid Lake, for instance, contains lake trout, Rocky Mountain whitefish, suckers, minnows and possibly other species; it may be said, therefore, that it contains a predatory head of fish. The acreage of this body of water is probably about 700 acres (this point is being determined); the planting made in 1934 was 10,000 rainbow trout fry. On the basis of the Paul Lake data it should have been about 140,000 fry or 14 times the number actually planted. The production of fish of a harvestable size (8 inches) from a planting of 10,000 fry would probably amount to 300 to 500 trout or, in this case, less than one rainbow trout per acre. From data in hand it would seem that an abundance of about 6 trout over legal size per acre is necessary before anglers can be induced to take up fishing and get any satisfaction.

The five lakes referred to, Pyramid, Patricia, Lac Beauvert, Annette and Edith, all have very poor spawning grounds. In order to place these lakes on a

producing basis it will be necessary to make a planting every year. For the first three years the stock will have to be brought in from some outside source. After that time it might be possible to collect the required egg supply from the tributaries which enter these lakes early in the spring. In any case it would be quite feasible to construct three or four traps in the Pyramid-Patricia system and obtain enough eggs to run the complete program. Pyramid Lake is very much like Pinantan Lake in the Paul Lake drainage system and the considerations set forth here are based on studies of the latter.

After the fish have become established in a lake of this type, fishing should not be curtailed. By ordinary hook and line methods of angling, it is absolutely impossible to remove all of the fish from a lake and a few will survive to spawn; at Paul Lake the proportion is one in five. In the case of Pyramid and Patricia Lakes it is quite probable that spawning fish can be trapped and stripped. Judging from similar conditions in Pinantan Lake it should be possible to collect over half a million eggs which will be enough to keep up the stock in the five lakes mentioned above. In the case of Lac Beauvert, Lake Annette and Lake Edith where there are practically no spawning grounds, there is absolutely no point in protecting the fish. If heavy fishing is permitted and the head of older, predaceous fish is kept down, it will aid production by keeping a supply of young, vigorously-feeding fish coming on. There is no necessity for a closed season on these lakes because it is normally regulated by the weather. With a supply of young fish there is also no necessity to have protection to allow for spawning or for recuperation after spawning. Some of the best fishing in the Kamloops Lakes is obtained in the spring while the mature fish are in the creeks spawning.

Where a spawning run is being protected for the purpose of egg collections or to help build up a supply of fish, rigid regulations for the preservation of

the run should be adopted. In the majority of cases, fishing in spawning streams should be prohibited. If there are no spawning streams then artificial propagation must be resorted to and the supply of young is automatically ensured.

The Management of Lakes with Good Spawning Grounds

Lakes with good spawning grounds may be subdivided into two types: those where there is only a little drain on the stock from predation, cannibalism and fishing, and those in which there is a heavy drain. Lakes with good spawning grounds have a tendency to become overstocked. The inevitable result of overstocking is to spread the available food in the lake among a larger number of fish and consequently the size diminishes. In order to provide desirable angling the fish should average over one pound in weight at least. It is a fairly safe rule that the larger the fish, the more valuable the angling. This statement must be qualified to a certain extent to include the size of the bag. The majority of anglers will quit fishing if the daily catch falls below two or three fish, regardless of the size. A satisfactory condition which might be said to represent the average is a catch of 6 or 7 fish averaging about two pounds with the possibility of catching in a week's fishing one 5-pound fish. The possibility of catching a large fish must be there regardless of whether it is realized.

The goal of a management policy should be to provide fishing to meet the average expectations of the average angler. In lakes with good spawning grounds and only a little drain on the stock there is always a great tendency for the size of the fish to become less and for it to reach a point where the fish are not highly regarded for sport fishing. In this case the fishery manager would recommend cutting down the head. This can be accomplished by stimulating the fishing and removing the restrictions, by collecting the eggs and transferring them to other bodies of water and by killing off the parent fish and only saving

the best of the stock. It may be possible to increase the food supplies in lakes but up to the present large scale experiments have not been attempted and there is little data to go on.

In lakes where there is a heavy drain on the stock of fish and the spawning grounds are extensive enough to provide a self-supporting population, it is possible to draft regulations so that the fishing will exactly balance the nutritive capacity of the water and allow a certain annual catch. Lakes of this type require a careful study of all the environmental conditions and a fairly complete record of the catch from year to year. Fluctuations in the size of the fish from season to season must be investigated in order to be able to forestall any possible depletion or overproduction.

All of the suggestions outlined immediately above apply to lakes where the fishing is sufficiently important to justify the expenditure for such detailed supervision. It would appear from the reports of the Park authorities that the fishing in the Maligne area is becoming so important that some attempt should be made to keep it up to a point where anglers will continue to find an inducement to fish there.

The lakes in the Maligne area were once barren and since stocking have naturally fallen in class 3 of the type in which there is very little drain. The size has been gradually falling since the original introduction. The remedy seems to be to increase the catch. More fishing should be encouraged and restrictions should be removed for a period of four years at least. Although it may seem wasteful to allow an angler to catch more fish than he can transport away from the lake and dispose of, it is the easiest way to control overproduction.

Lake fishing for the speckled trout is not very attractive to the majority of anglers who have fished for rainbows. On the other hand, stream fishing for the speckled trout, especially in the Maligne River, is regarded as magnificent

sport. The Maligne River could therefore be profitably developed to increase fishing. This could be accomplished in several ways. Fishing in the river could be kept open regardless of the fact that many of the fish are ready to spawn. Good fishing pools should be located and well-marked trails might be opened up to them. In favorable places where the pools are now in poor condition a program of improvement could be adopted. A system of boulder or cribbed dams could be installed and the holding capacity of the river could be increased. Increasing the number of pools would not necessarily increase the number of fish but it would probably increase the amount of food.

Maligne Lake is extremely silty for the greater part of the summer. Although the plankton samples have not yet been studied thoroughly, there also appears to be a scarcity of phytoplankton. There are no deep-water aquatic plants and the supply of bottom forms which originally occurred in the lake has been severely depleted by the fish because of the lack of sheltering plants. There are very little data on this phase of fishery management and it would seem to be almost impossible to introduce a plant suitable such as chara, into this type of lake. The heavy deposit of silt and the colloidal suspension of particles in the water seem to be inimical to plant growth, both of the rooted and free-floating. It has been suggested that sunlight is cut off by the extreme turbidity. In spite of the absence of phytoplankton, there seems to be an abundance of Cladocera and Copepods of a very large size. It might be possible to introduce a forage fish such as the landlocked sockeye into Maligne Lake which would feed on the zooplanktonts and make a hitherto limited food supply into one more suitable for the speckled trout. Owing to the lack of data on such introductions in this type of lake and the fact that speckled trout and landlocked sockeye have not been associated in any lake in British Columbia as far as the writer is aware, it does not seem to be a good plan to attempt it on such a large scale

as the area of Maligne Lake would require. In stocking such barren lakes, where it would seem to be a good policy to plant forage fish as well, the forage fish should be introduced prior to the game fish introduction. Although Brazeau Lake falls into the same general type as Maligne Lake, the silt condition is much worse and Cladocera of any size seem to be either lacking or sparsely distributed. A planting of forage fish in Brazeau Lake has therefore not been recommended. If there is some smaller lake in the northern part of the Park it might be a good plan to attempt an experimental introduction of forage fish before making the game fish planting. A minnow, such as the northern dace, might be profitably introduced into the Maligne River. However, the indiscriminate planting of minnows is not desirable and Mr. Wright's recommendation that live minnows for bait be prohibited from any waters in the Park, is a sound one. There is a great danger that many of the parasites that are native to the Athabaska area, such as the tape-worm, might find their way into game fish waters now free of them.

Recommendations Now Under Advisement

In his report under date of October 16, 1934, Mr. Wright made several suggestions with regard to control of the Jasper Park sport fishery. Some of these suggestions have already been put into effect and it would seem to be a profitable undertaking to consider the suggestions in the light of some of the general considerations outlined above. Taking up the suggestions on page 3 of his report:

1. This recommendation refers to an advance in the season of the speckled trout fishing in the Maligne area. The purpose of the proposed advance is to give greater protection to the spawning fish. This will lead to a still greater

production of fry. From the data collected by the writer it would seem that the watershed is now producing too many fry for the food supply and in order to keep the size up production should be curtailed somewhat. However, this is a matter for those most interested in the quality of the fishing to decide. If the anglers and those catering to anglers wish to have the stock reach a larger size on the average than it now does, then fishing should be increased. The wastage of eggs would therefore be a benefit rather than a detriment to the watershed. In this case it would probably be easier to let the weather conditions control the fishing and have no specific closed season. It is in the best interest of those catering to the anglers, however, to advertise when the fishing is at its best rather than when the season opens.

2. With regard to the seasons for rainbow trout, the regulations should also be drafted to meet the requirements of each body of water. Closed seasons should only be imposed if the lake comes in the self-supporting category. If it is not self-supporting and artificial stocking is being carried on, a head of spawning fish is not required and there is no purpose in the measure. If, on the other hand, the lake has sufficient spawning grounds to carry on unaided, then the regulations should be drafted to meet the requirements of the situation. Each body of water should be studied and the average fishing effort determined in order to arrive at some idea of the drain. If the drain is high then some measure of curtailment should be adopted; if the drain is low then longer seasons and possibly higher limits could be allowed.

3. It is probably a good move to allow only fly fishing in certain lakes. Fly fishing develops a more thoughtful attitude on the part of the angler and this phase of the sport should not be overlooked. However, what has been said above with regard to the drain also applies to the lakes mentioned in this section. Trefoil Lakes have no spawning grounds of importance and it may be

necessary to stock them each year. In that case, limitations to the drain are not necessary. Mona Lake, on the other hand, has excellent spawning grounds and is very seldom fished on account of its inaccessibility. In that case the size will remain below that desired by fishermen and the drain will be slight.

4. With regard to the use of boats or rafts, the question of the drain comes in again. If heavier fishing is desired, then the use of boats is recommended. A boat allotment of about one boat per 20 acres of lake might be adopted as working arrangement. This number has been found to work satisfactorily on Paul Lake.

5. The question of the use of live minnows was treated above.

6. This seems to be a highly desirable measure.

7. This suggestion falls in line with the general idea of having all the regulations meet the requirement of a definite plan. Specific regulations covering individual lakes, rather than a blanket policy, are absolutely essential if the production of sport fish is to be managed.

8. This suggestion is covered by the idea of scientific management for the sport fishery of the Park. This will be treated in the following section.

The Management Policy

The management of a sport fishery requires three definite steps:

1. The collection of information pertaining to each body of water. This work is what is becoming known as a biological survey.

2. The drafting of a working plan. This includes the formulation of regulations and the fish cultural requirements.

3. The checking of results. Fishery management is still in the experimental stage and in order to adapt the technique and methods to new waters, it is essential to treat each body of water as an individual experiment. The work

should be carried on in four-year periods and at the end of that time a complete stock-taking should be made and methods should be revised if necessary.

The Collection of Information:

Before a fishery manager can advise as to the best method of propagation to be followed or the best regulations to be adopted, certain fundamental data must be in hand. The following points must be determined:

1. The location and accessibility of the body of water. The location of a lake includes the altitude, geogrephical position and the drainage basin in which it occurs. The accessibility must be known in order to determine the extent to which it will be exposed to fishing and, in case plantings are to be made, whether eggs, fry or fingerlings can be transported to it.

2. The area and configuration. All plantings and the yield therefrom should be placed on a unit basis. If plantings are made on the basis of so many eggs or fry per acre, then results are much easier to check; otherwise, the plantings would revert to the old haphazard method of propagation. The configuration of the lake should be known since the amount of shore-line is probably the most important consideration in the production of young fish. The shore zone is several times richer than the deep water in fish food. The shore development or area-shore-line ratio is therefore an important consideration in outlining a stocking program.

3. The depth and bottom contour. The depth of the lake is a very important point; most species of salmonoid game fishes require cooler water than is normally found at the surface of lakes in the summer time. There should be an area deep enough to provide water below 12°C. during the summer for the bigger fish to retire to. The bottom contour of the lake is an important factor in determining the amount of food available. A gradually sloping bottom is more desirable than one which shelves off steeply or a bottom which forms large, shallow shoals.

4. The nature of the bottom. The nature of the bottom is an important factor in determining the type of vegetation and the quantity and quality of the food supply. The type of vegetation present in the lake should also be known.

5. The nature of the drainage system. The drainage system includes the tributaries of the lake and the outflowing stream. It is also important to know the source from which the tributaries draw their supply of water. These considerations are important in any study of the production of young fish.

6. The spawning beds. Most salmonoid game fish require water flowing over a gravelly bottom for spawning. The quality and quantity of the gravel in the drainage system should be known before attempting the management program.

7. The temperature of the lake and its tributaries. The temperature relations of the water and particularly the formation of thermoclines, should be known.

8. The nature of the food supply. This includes qualitative and quantitative estimations of the bottom organisms and the plankton.

9. The species of fish present and the extent to which stocking may have been carried on. In order to estimate the effect of predators and cannibalism on the fish, the species of fish native to the lake and the kinds of fish introduced should be known. It should also be determined to what extent previous stocking has been successful.

10. The fishing effort in lakes already containing fish. The yield of fish per person per day is an important factor in determining the amount of stocking necessary.

Drafting a Working Plan:

After the data from the biological survey have been obtained, the fishery manager is then in a position to work out the details of the regulations and fish cultural operations. Owing to the lack of personnel and funds for this type of work, the Biological Board has adopted a scheme known as the area method of investigation and management. This merely means the concentration of the investigation for a specific length of time in a restricted area, then when the production of fish reaches a satisfactory point, attention is turned to the next most pressing problem. From the preliminary investigation this summer, it would seem that the lakes in the immediate vicinity of Jasper require first attention. The complete data are not in hand for outlining the whole program for these lakes but the writer has obtained enough information to recommend an intensive stocking program. It is, therefore, suggested that annual plantings of rainbow trout fry be made as follows. The actual number for each lake may be revised somewhat when the complete data with regard to area are obtained, but the figures given below will give a general idea of the size of the planting and the number of eggs required.

Pyramid Lake	150,000
Patricia Lake	125,000
Lac Beauvert	75,000
Lake Annette	75,000
Lake Edith	75,000
	500,000

It is also recommended that an initial planting of about 20,000 rainbow trout fry be made in Brazeau Lake.

The two projects outlined above should constitute the main fish cultural program for the next four years. A supply of approximately 600,000 eyed rainbow trout eggs should be obtained. It is recommended that this supply be secured from a source in Canada if possible. Owing to the presence of the disease known as furunculosis, which is present in American trout farms and hatcheries, it does not seem to be a desirable practice to bring in eggs from sources over which the purchaser has no control. In the majority of cases, this disease breaks out after the fish have become free-swimming and once they have been planted, there is absolutely no check on the results. The plantings specified above do not take into account any mortality due to unusual causes, such as epidemic diseases.

The drafting of regulations may be carried out as more of the essential data concerning the lakes is gathered and as the plan develops. Other lakes in the Park will also be placed under definite regulations as the necessary information comes to hand.

Checking of Results:

As the program proceeds, definite checks will be made of the progress of this work. This will include:

1. A determination of the yield in certain typical lakes by a determination of the number of fish in the fishing drain and the spawning runs. The permit system of fishing now in vogue in the Park will lend itself to this phase of the work.

2. An annual determination of the growth rates in the various lakes for signs of fluctuations in size for age in order to be able to forestall depletion or overproduction.

3. Studies of the main food types for correlative fluctuations.

4. A complete check-up of the productive capacity of the lake at definite intervals.

Specific Recommendations

1. That a competent biologist be appointed to be responsible for the various details of the program.

2. That a fishery warden be detailed to carry out the collection of samples and to assist in the routine investigations.

3. That a hatchery be constructed in the Park to handle about one million eyed-eggs. Cottonwood creek has been under observation for this purpose for several years and it seems to be satisfactory for the hatching of eyed-eggs.