

South Dakota
Geological and Natural History Survey

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CIRCULAR 29

A Preliminary Report
of a Biological Survey of the Lakes
of South Dakota

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INTRODUCTION

During the summer of 1926 the South Dakota Game and Fish Commission engaged the following party to make a biological survey of several of the larger lakes of the State: W. H. Over, Director; Dr. E. P. Churchill, Zoologist; G. M. Clement, Field Assistant; O. R. Gleaseman, general camp man; and L. R. Palmerton, Publicity Director for the Commission.

Our instructions were to search out the flora and fauna of each lake, recording each species as far as possible and determining their scarcity or abundance; to ascertain which species were beneficial, and if any were detrimental to game fish or birds.

We were to study the abundance of game fish, the presence or absence of their natural foods, and the species best adapted to each lake.

Fluctuating water levels, their cause and possible remedies were to receive consideration. Minerals in waters and stagnant water conditions were to be observed.

It is apparent that our duties were many and arduous; but there was a thrill of responsibility and pleasure connected with the task always before us that made us feel that in some way we, possibly, could help solve a few of the perplexing problems of fishing conditions in our lakes and streams.

The following lakes were visited: Andes, Madison, Poinsett, Cottonwood (Spink County), Byron, Sand (Brown County), Clear Lake (Marshall County), Pickerel and Oakwood. About one week was spent at each lake. Since our visits were so short and made at different dates, our report can be only tentative.

Maps were made of each lake and the principal bays and other points of interest marked for future reference.

Arrangements have been made whereby in the future a complete report of the results of this survey, including lists of fish, water plants, insects, crustacea, mollusca, reptiles, water birds, food of the important fishes, etc., will be published as a bulletin and distributed by the State Geological and Natural History Survey. Further work will have to be done in fishes, particularly over the western part of the State, before the list is completed.

GENERAL CONDITION OF LAKES

All lakes visited were at a low water level, owing to the fact that South Dakota as well as the whole Northwest had just experienced two years of extremely light precipitation. Some lakes showed a greater loss of water than others; for instance, Andes, Madison, Byron and Poinsett exhibited the greatest loss, while Pickerel and Oakwood showed the least. This inconstant water level in the lakes is a condition of considerable importance, as it affects not only the very existence of fish but also the growth of vegetation necessary for the development of insect life for food as well as protection in spawning beds for most species of fish. The absence of vegetation in a long established spawning bed necessitates the shifting to another field, a disturbance which is not easily adjusted and which often causes the loss of a whole season's production. An ideal condition would be a constant water level.

A careful perusal of the official records of rainfalls (and snowfalls) for the State since 1890, corroborated by the stories of many early settlers, will show that the wet and dry periods run in cycles. The fact that 1893-94-95, 1902-03-04, 1910-11-12 and 1924-25-26 were dry years leads us to expect a dry period about every ten to thirteen years. Fortunately, the wet periods are longer than the dry periods.

The lakes fill up during wet periods, perhaps many times overflowing. If there is a dam at the outlet, some of this flood water will be held back temporarily, but by the time the dry period is here and we need this surplus water it has disappeared by evaporation and seepage. The ratio of loss by evaporation to that by seepage is not known, but may be about seventy-five to twenty-five. The loss by seepage is not the same in all lakes. It is greater in Lake Madison than in Cottonwood Lake, owing to the clay banks of the latter. It is greater when any lake is above normal rather than below. Neither should a lake surrounded by woods show as great a loss by evaporation as one with the shore bare of trees. When the marshes, sloughs and ponds are full, humidity is high and evaporation is less. But the loss by evaporation and seepage cannot be overcome or controlled. Water stored in a lake during a wet period has disappeared before it is needed; hence, the problem is to provide water to keep the lakes up through the dry period. There is no problem during a wet period.

Another element which should not be overlooked in discussing the low water problem is that of the continual drainage of our marshes and sloughs. This has lowered the ground water level over the eastern part of the State and this, of course, affects the water level of the lakes. The drainage is for economic purposes and in some cases is a benefit, but in many instances, when the waste of good land by wide ditches is considered, as well as soil dumps and costs, it is a loss not only to the individual but to the whole State. If drainage is continued

on a large scale it is a factor that must be reckoned with in connection with the problem of a constant water level in the lakes.

The following methods have been suggested for keeping the lakes up to normal, or nearly so, during the dry periods; first, artesian wells; second, dams at the outlets; third, diverting small streams or new drainage into the lakes.

By normal is meant a water level at or within a few inches of flowing out at the natural outlet, and we assume that eight out of eleven years the lakes are near enough this stage for all practical purposes and no assistance is needed, the problem being to provide a supply of water for the other three years.

It seems impractical to consider artesian wells at all, as the supply is diminishing and we should be reserving rather than drawing further from that source. Furthermore, the quantity is inadequate, as it would take many wells to affect the water level during a dry period of any one of our larger lakes. It is not enough to say that "every little helps," for artesian wells are expensive and need to be kept in order. It is reported that two have already stopped flowing at Lake Andes for lack of attention. The quality of the water in many wells is not suitable for the propagation of fish; besides, we would be adding further to the mineral contents of the lake.

In regard to the second method: The erection of a dam at the outlet of a lake will not accomplish the purpose, that is, keep the lake up to normal through a dry period. This is contrary to public opinion, for people are continually clamoring for dams, but dams for storage purposes in a lake will not solve the problem.

Our lakes are of glacial origin, most of them being formed by the ice unloading soil at the lower end of a valley, thereby damming it up. They are old and established; the inlet and outlet were formed thousands of years ago, the latter to take care of the natural inflow of the former; and the water level of the lake conforms to them except for seepage and evaporation. Our whole drainage system was naturally (not artificially) established and adjusted at the time the lakes were formed and, generally speaking, is perfect. Hence, damming the outlet of a lake will not create more water for a dry period.

But, you will say, if you dam the outlet of a lake and raise it two feet above normal, are you not storing water that will keep the lake up through a dry period? You are not, because you cannot, by damming the outlet, raise the lake two feet, at the beginning of a dry period, from your old natural inlet. The lake may and often does rise two feet above normal during an extremely wet period, but this is three or four years before the dry period and the storage water has disappeared by evaporation and seepage before you really need it. This very condition happened at Lake Madison. The dam at the outlet on the east end has been constructed several years. In 1922 or 1923 the lake was

full, even higher than the top of the dam, but during the dry period of 1925-26 this was one of the lowest lakes in the State. There is a small stream flowing continually into the lake at the inlet, but this is not sufficient to afford any relief. This offers a good illustration of what we are contending, that the dam did not accomplish the purpose for which it was intended.

Another case in which a dam answered no useful purpose was that of Pickerel Lake. A dam had been erected at the outlet on the west side several years ago and later was crushed or pushed out by the ice, yet in August, 1926, we found this lake nearly normal or within fourteen inches of running over at the outlet in spite of the fact that there was no dam.

Of the lakes visited the only one at which a dam will accomplish a purpose was Sand Lake, Brown County, and this is not a lake proper but a wide channel in the James River. The dam here will hold back the continuous flood water and really create a new lake.

If it is necessary and practical to raise a lake and keep it above normal, then with a sufficient inflow a dam, of course, is necessary.

The third method and the most practical one in keeping the lakes high enough to carry them through a dry period is to conserve the spring flood waters, mostly melted snow, by diverting new drainage and filling the lakes every spring. We need more water at the inlet in the spring rather than more dams at the outlet.

This method has been adopted at Lake Byron, where a stream was dammed up about one mile from the lake. This raised the water high enough to carry it through a new ditch into the lake. If this has been properly planned it should produce results. This plan could be worked out in a practical way, for example, by erecting a controlled dam in the Big Sioux River and diverting enough flood water every spring, or as found necessary, into Dry Lake to fill Lake Poinsett; or by a dam and canal from Choteau Creek to fill Lake Andes. Lake Madison is at the head of a small drainage system and apparently it may be difficult to find new flood waters.

Owing to the fluctuation in the amount of snowfall from year to year it is possible that occasionally this method will not give relief, but the chances will always be much greater with a larger area to draw from.

We certainly do not recommend that one lake be filled at the expense of another, but always that the spring flood waters be reserved. Flood water is one of our largest assets, yet we seem glad to see it go down to the Gulf of Mexico every spring.

Furthermore, we do not recommend the building of ditches or dams unless the plans are carefully worked out by a capable engineer as to results and costs and found to be practical.

Dams should be controlled and only enough water turned in to fill the lake, with no surplus to overflow the surrounding territory; this is usually not serious but causes considerable consternation among the land owners.

Screens should be included to prevent the introduction of rough fish. Ditches must be kept free of rubbish to protect the banks.

Let us suggest here that this conserving of the spring flood waters by damming up small streams and draws should be practiced by our farmers over the entire State. Nearly every quarter section of the western two-thirds of the State has a draw or valley that could be dammed up to create a fair sized pond. The Milwaukee railroad has done this at several places along its line from Chamberlain to Rapid City. Thousands of these small lakes would benefit the whole State by raising the humidity, thereby preventing hot, dry winds, besides keeping the ground water level up, all of which would mean better crops.

PROPAGATION OF GAME FISH

One of the important problems confronting the State Game and Fish Commission is that of keeping the lakes stocked with game fish; or to provide fair fishing for those who buy a license.

Of the nine lakes visited only two afforded fairly good game fishing and two good bullhead fishing. That our lakes have been depleted of fish is admitted by everyone and all kinds of reasons have been advanced to explain the present condition. It is our opinion that an excessive bag limit, better highways and the automobile have been the chief causes. Fish have decreased as fishermen have increased, with no practical provision for keeping the lakes stocked.

Minnesota with her "ten thousand lakes" has a bag limit of eight black bass and the season does not open in the northern zone until June 21, while South Dakota with her very few lakes has a bag limit of twenty-five and the season opens May 30. We have hauled the black bass off the spawning beds in Lake Andes at the rate of twenty-five a day, often sadly disregarding the limit, and then we wonder why the supply is not kept up. What would you think of a farmer who kills eight of his ten brood sows just before farrowing time and expects the remaining two to keep the farm stocked with seventy-five or ninety feeders for the next season? This is just what we have done in Lake Andes (and other lakes of the State), and we expect the fast diminishing numbers of fish to keep up the supply. The practical farmer has his breeding pens filled with his best sows, which are separated from the balance of his stock pigs. We must adopt the same method by setting aside fish refuges for spawning beds and strictly prohibiting fishing therein. The natural spawning or breeding beds of the sunfish family, which includes bass, crappies and bluegills, are the shallow

bays more or less filled with rushes and pond weeds. One or two of these should be set aside in each lake. If the lake should become overstocked, one of the bays may be released for a season or two. As a last resort the whole lake may be closed for fishing for a year or two. If a rule of this kind will work with deer, pheasants or wild ducks, it will work with fish.

We can expect better results from natural spawning beds than from artificial ponds and the former will be many times cheaper for the State. While we would not discourage the experimenting with artificial propagating ponds for black bass, especially where already constructed, we are of the opinion that they will not produce the results expected, and that the number of fish produced from these ponds that reach maturity or lawful size will indeed be small in comparison with the cost of keeping them up. To illustrate, assuming that each female of the thirty-two pairs of black bass in the small ponds at Lake Andes deposited her full limit of eggs and seventy-five per cent attained the size of fry and were put into the lake annually, the number would not go far toward stocking the lake. It would not be a "drop in the bucket." But, instead of seventy-five per cent reaching lawful size we have no reason to expect that more than fifteen to twenty-five per cent will attain that size. Then, too, it is doubtful if one-half of the females in this pond deposited anywhere like their full quota of eggs, or up to 5,000 each, as most of them were caught during the spring with hooks and more or less injured, making it doubtful that they would deposit eggs at all the first season. Fish are not unlike other creatures in this respect.

It will take at least 1,000 pairs of black bass, breeding in their natural spawning beds, to stock Lake Andes and afford fair fishing; that is with a big limit of eight or ten fish a day. Under present conditions, and when co-operation is necessary to bring about a better state of affairs, we think that eight black bass a day should satisfy any good sportsman.

Black bass are monogamous in their mating habits and their domestic relations are such that to obtain the maximum results it is absolutely necessary that both male and female be protected during their breeding season. Large-mouthed black bass do not begin to spawn until the water reaches a temperature of about 60 degrees F., which in South Dakota cannot take place until after the fishing season opens for this species, or until the latter part of June or often well into July. On June 20 at Lake Andes we examined the reproductive organs of twenty-three bass that had been caught in a weedy bay, their natural spawning bed. Twelve were females that had not spawned and most of them would not have done so for several days. Nearly all of the others were males.

After the eggs are deposited and fertilized the male takes charge of the "nest" or mass of spawn, protects it until the eggs hatch, and continues to care for the young until they are an inch or more in length, or about the last of August. The pair retire to their spawning beds several days before the eggs are to be deposited and from that time on until the males leave the young either sex will fight and strike at any disturbance to protect their eggs or young, which is their "home." This is the reason that the largest "catches" are made in June and July in weedy bays, and also the reason why we have depleted our lakes of game fish.

We strongly urge the setting aside of one or more bays in each lake as a natural spawning field for the sunfish family, as bass, crappies, bluegills and sunfish. These bays can be separated from the main waters by a line of floating buoys. They will have to be guarded to protect the breeding fish, but if it resolves itself into a commercial proposition it can be made to pay in dollars, for the public is willing to pay for licenses if there are fish to catch.

VEGETATION

We are apt to deplore the presence of weeds in the lakes, yet it is necessary that there be a fair growth in every lake to insure a balanced condition, or to develop a supply of aquatic insects, which make up a very large part of the food, not only of young, but of many of the adult game fish, and also, to afford the necessary protection for the young from larger fish, which are cannibalistic in their feeding habits. Hence, no weeds, fewer fish (or poorer) and fewer ducks. Several species of pondweeds, wild celery and wild rice provide feed for the latter.

The abundance or scarcity of vegetation in the lakes is controlled from year to year by some agency; it may be caused by the over-abundance of carp that are continually rooting along the bottom, or by the fluctuation of the water level. In 1923 we saw Lake Byron so full of weeds that a motor boat could not run; this last summer (1926) we would estimate that there was only ten per cent of the growth of three years ago. There was no vegetation in Cottonwood Lake in 1926, yet we were told that "some years the lake was full of weeds." With only ten per cent of the amount of vegetation in Lake Byron that there was three years ago, there was still enough to encourage the presence of an abundance of insect life. However, there were no fish to consume them, which was perhaps the reason that the insects appeared so numerous.

It is possible that a too luxuriant growth of weeds in a lake can be detrimental, in that it produces an over-abundance of decaying matter, which develops too much carbon and causes the death of fish while the lake is frozen over.

During our visit at Lake Andes thousands of fish lined the shores that had died during the winter of 1925-26, and it is hardly conceivable that they smothered in such a large body of water. We have seen a photograph taken along the shore of Lake Campbell showing tons of dead perch, pickerel, suckers, carp and buffalo that had died late in the summer of 1925. As far as we know the cause of their death has not been determined.

For all practical purposes most of our lakes are well supplied with an abundance of vegetation that is adapted to this climate. There are about fifty species of aquatic plants growing in the different lakes of the State. In addition to the above there are nearly that number of grasses, reeds, rushes and sedges to be found in or around the different lakes. Then if we go further and consider the algae and other minute forms that belong to the vegetable family and inhabit the different lakes we could add another fifty species. It is this latter that forms the scum and develops the stagnant appearance in some of the lakes. At this time we cannot speak as to its economic importance. It is part of the food of young fish as well as that of carp and suckers. A small amount was also found in the stomachs of crappies, bluegills and perch, but this may have been taken incidentally with the larvae of insects.

All of our aquatic plants except the rushes and sedges are annuals and all perish at the end of the season, hence seining under the ice will not affect the growth of the next season.

It is worth while to experiment with wild rice (it is now growing in at least a dozen places in the State) and wild celery; also water lilies, preferably the form with white blossom, as they offer protection to young fish and are attractive. Wild celery has been introduced in many places over the State but very little was found growing during our survey trip. It is doubtful if this plant will thrive to any extent in South Dakota. Some seasons it is fairly abundant in Big Stone Lake and is found occasionally in the deeper lakes of the northeastern corner of the State. Wild rice should be gathered the first week of September and planted immediately in shallow, slow running water. It thrives well in lakes in northern Minnesota.

SUPERVISION OF THE LAKES

Under the present method of policing the State as it applies to game and fish, our corps of wardens is as efficient as could be expected. Most of the wardens have an honest desire to see the game and fish protected according to the law and are interested in their further propagation. However, as each one is required to cover more territory than any one can properly handle, their time is taken up with protection rather than propagation. There is not a warden nearer than twenty-five miles from Lake Poinsett, one of the finest lakes in the

State and one with unusual fishing possibilities. We think that most of our lakes are not properly supervised. The following plan suggested itself to us many times during our summer's work: That a capable and trained fish culturist be put in charge of the larger lakes, (Lake Poinsett would be a good place to start), with the understanding that here is a manufacturing plant that in pioneer days was a paying proposition; the plant is as good as new, but times have changed; the old, out-of-date management fails to turn out the finished product in quantities sufficient to meet the demand; the profits (partly from licenses sold and partly in recreation) have decreased enormously; the owners (the public) have faith in the old plant and believe that it can be made to pay, for they now realize that the people will not buy licenses to fish in South Dakota if there are no fish.

We do not recommend a fish hatchery for the new superintendent of Lake Poinsett but rather that he be permitted to set aside bays as natural spawning beds for bass, crappies and bluegills. It is a large lake and will take several spawning fields and time to restock a lake from its present run-down condition. If the new superintendent decides to keep the lake stocked with pickerel (northern pike) he will probably wish to use Dry Lake as their breeding ground. It will be necessary to divert flood water from the Big Sioux River through a controlled sluice gate into Dry Lake to keep Lake Poinsett filled up to normal water level. It may be necessary to have a deeper waterway between the two lakes. He may wish to seine out some of the bullheads. Much educational and publicity work will need to be done. If we mistake not the new superintendent will in time suggest that there should be a driveway along the east shore of the lake. He will encourage the planting of shade trees everywhere. He will be interested in attracting wild life and it may be necessary to have both lakes with their shores proclaimed a bird refuge. We saw more species of water birds here than at any other lake. Cormorants were trying to nest on Rocky Island in Dry Lake but did not succeed because of too much publicity. About seventy-five white pelicans were living on the two lakes. We were aware of the fact that these birds live chiefly on small fish, but most of these are minnows with no economic value, besides it takes pelicans, cormorants, gulls, wild ducks and other wild life to make a well rounded-out lake proposition.

We recommend a trained fish culturalist for Lake Poinsett as a purely practical undertaking, and that in time it will apply in a similar way to several of the larger lakes, for some such drastic measure should be taken to make our lakes what they should be. At best it will take three or four years to get results.

We can further see the need of having trained fish culturists in guiding the activities of fish propagation in the State. There are questions relative to present conditions that apparently cannot be in-

telligently answered, yet are important, and if these activities are to be carried forward and at cost to the public they should be done only with the definite knowledge that we are obtaining results that are permanent.

A trained fish culturist would want to know what effect the seining of rough fish will have on the game fish that are repeatedly caught and returned to the lake, and to what extent it affects their breeding, etc. If this handling is injurious to game fish then he would try to provide some device whereby small rough fish can also be taken and the lake cleared of them without repeating the operation every three or four years. Will rough fish eventually crowd out game fish? Under what condition would game fish hold their own? Do carp or turtles eat the eggs of game fish? (Of all the stomachs of carp and turtles examined on our trip none showed the presence of fish eggs.) Does the presence of a great number of carp rooting and feeding over the bottom of lakes interfere with the natural growth of vegetation? Should commercial bullhead fishing be encouraged and continued? Should commercial bullhead fishermen pay a license to fish? Is it true that black bass will eat young bullheads, to the extent that they will finally clear them out of the lake? (We heard this at Lake Andes.)

It must be realized that with a fluctuating climate, it will be impossible to obtain a balanced condition continually in the different lakes. They will be as difficult to regulate as a farm; but one farmer is successful while his neighbor with the same soil is a failure; or the merchant or manufacturer; one is successful and another not. The successful man is trained for his work and directs it along practical methods. This is the plan we would like to see applied to our lakes. A dozen fine fishing lakes will be an asset to South Dakota.

The fact that bullheads are at present commercially important is no valid reason why we should continue to propagate them if the majority of our people wish them replaced with game fish. It is our opinion, however, that they are worth while and that some of the lakes should be made to provide bullhead fishing. The whole family, including the wife and children, can catch bullheads and they afford fish to eat when perhaps game fish are not available. While stationed at a certain lake this last summer a man drove thirteen miles with his family to "take a day off and fish." After three hours of fishing and not a bite the father begged us to tell him where in the lake he could "catch a mess of bullheads." We were compelled to tell him there were none in the lake, and our eyes wandered off toward a row of fishing huts, rotting nets and old tar vats which were relics of the days when there were plenty of bullheads there.

Some of us may not like bullheads but they provide sport and meat for a class of people who, too, are worth while.

CONDITION OF WATER FROM MINERAL STANDPOINT

Many of our lakes contain more or less mineral matter as alkaline content but none to the extent that it is a detriment to fish. Cottonwood Lake is perhaps the most strongly impregnated of any visited and we found wall-eyed pike thriving and fat. Perch, their first cousins, were poor, due to the lack of vegetation to develop insect food in sufficient quantities. The pike were feeding on the perch. This lake also contained rough fish as suckers, buffalo and carp. We think the lack of vegetation was due to the abundance of carp rooting over the bottom of the lake rather than to the presence of minerals.

We are of the opinion that every lake visited will sustain most species of game fish if properly handled, and that the light mineral content is in no way an excuse for the absence of fish. (There are probably only two lakes in the State that contain minerals to the extent that fish cannot live in them. One is Medicine Lake, Codington County, in which there is no life whatever; the other is Bitter Lake, south of Waubay which contains several forms of minute insect life as well as two or three species of vegetation, but no fish to our knowledge.)

The raising of the lakes every spring by flood water, as we have suggested elsewhere in this report, will tend to keep the water fresh and in a more salubrious condition, not only for fish but also for bathing.

LAKE ANDES—CHARLES MIX COUNTY

Lake Andes is a fine body of water but now too low for the successful propagation of fish.

There is a fair supply of bluegills and crappies; wall-eyed pike are rare; black bass are scarce and no adequate provision is being made to restock the lake. A few sunfish were present but carp and bullheads were scarce.

We are convinced that the presence of bluegills is not responsible for the diminution of black bass. There is sufficient growth of vegetation for all practical purposes. The temperature of the water is such that probably in no season will black bass begin to spawn before the latter part of June. Conditions are apparently very favorably adapted to the welfare of the sunfish family and we suggest that the propagation of black bass, bluegills and crappies be encouraged to the exclusion of other species; that Johnson's bay and one other (perhaps Owen's) be set aside as breeding beds.

The local residents and Izaak Walton League should encourage the planting of shade trees along the shore, which would add much to the attractiveness of the lake and decrease evaporation.

LAKE MADISON—LAKE COUNTY

We found Lake Madison about three and one-half feet below normal water level and so shallow that there was danger of fish suffocating in the coming winter. The dam erected at the outlet on the east side many years ago did not accomplish the purpose, for which it was erected because there was no new flood-water diverted into the lake. See discussion under "General Condition of Lakes."

Black bass have been practically fished out; there are a few wall-eyed pike in the lake, as well as a fair supply of crappies, and northern pike, with an abundance of yellow perch. Carp, buffalo, black suckers and bullheads are numerous. Of the stomachs of carp examined here none contained food of any kind, as they were spawning at this date and not feeding. All stomachs of perch and crappies examined showed an abundance of aquatic insect food present in the lake. There is an ample supply of vegetation in the lake to develop aquatic insects, as well as food for ducks.

This should make an ideal black bass lake and at least two weedy bays should be set aside for spawning beds. If the lake could be raised to normal water level the bay at the extreme west end of the lake and west of the old railway grade would provide every environment as a spawning bed for bass and crappies. It perhaps would be necessary to dig a deeper channel connecting this bay with the main lake.

The lake should be cleared of rough fish.

LAKE POINSETT—HAMLIN COUNTY

Water, four feet below normal. This condition had left summer cottages at the north end several rods from the water with rushes and weeds intervening. For this reason most of the cottages were vacant.

One of the finest lakes in the State if properly handled.

Yellow perch and pickerel or northern pike are fairly common. Bullheads are abundant and offer the best sport. It was reported that in 1924 bluegills, crappies and silver bass were introduced into the lake; also that in seining for rough fish a few black bass were seen, but it is evident that none of the last four mentioned are common.

The lake is well adapted to bass but they will have to be introduced and catching them off the spawning beds prohibited for a number of years to afford fair fishing.

Dry Lake will afford a spawning bed for pickerel or northern pike. Lake Poinsett is large and deep enough to support a variety of game fish. It is centrally located and therefore should be one of the best fishing places in the State. Because it is not located near a large town "with a pull", it is sadly neglected.

There is a sufficient quantity of vegetation in the lake for all practical purposes. Wild rice and wild celery have been introduced at the outlet but none were found growing.

Flood water from the Big Sioux River should be diverted into this lake but carefully regulated as well as screened to prevent the immigration of carp and other species of suckers.

COTTONWOOD LAKE—SPINK COUNTY

About fourteen inches below normal; water now averages up to twelve feet deep in a few places. It is reported as being dry in 1883, 1902-03 and again about 1914.

Almost entirely surrounded by a well defined clay bank which is instrumental here in reducing seepage. Since the establishment of the State Park here it must be made a success. There are also splendid opportunities for experimenting with the breeding of black bass.

The following fish were found living in the lake: wall-eyed pike, yellow perch, white crappies, northern pike or pickerel, bullheads, orange-spotted sunfish, bluegills, suckers, redhorse, buffalo, carp and several species of minnows.

There was no vegetation in the lake, consequently but little aquatic insect life and the perch were small and poor. The absence of vegetation is probably due to the abundance of carp. Much of the bottom of the lake is gravelly and offers a fine spawning bed for wall-eyed pike. The absence of weedy bays will tend to discourage the breeding of the sunfish family.

On July 13th the lake was covered with a scum of algae—a minute form of vegetation—which later massed toward the east side and carp were feeding on it at the surface. Most of the stomachs of carp examined showed that their chief food was vegetation.

Owing to the absence of vegetation to encourage insect life for food, there are too many fish as well as too many species of fish in the lake. (There is no doubt that conditions will again exist whereby vegetation will thrive in this lake in the future.) All game fish were poor except the wall-eyed pike, which were feeding on the small perch.

The bass ponds in the State Park contained an abundance of vegetation.

LAKE BYRON—BEADLE COUNTY

Lake Byron is a small, shallow lake sixteen miles northeast of Huron. It was about three feet lower than in August, 1923. The deepest place during our visit in 1926 was four and one-half feet. There were no fish in the lake, all having smothered the previous winter. In places the shores were lined with dead pickerel, carp and perch. The drag of a large seine over a considerable area brought up only four small bullheads.

If this lake could be raised and kept to a constant level, most species of game fish should do well but not more than two species should be introduced; pickerel and perch, or perch with crappies or bluegills. The entire east bay should be set aside for spawning beds and fishing prohibited therein, which is the natural and economic method of keeping this lake stocked with game fish.

If properly located the dam and ditch constructed to run flood water into the lake in the spring should bring results. The ditch is small and will have to be kept free from rubbish, also screened to prevent carp and other rough fish from entering the lake again.

SAND LAKE—BROWN COUNTY

Sand Lake is a wide channel in the James River about twenty-five miles northeast of Aberdeen. With normal rainfall and the new dam erected at the lower end a fine body of water will be created.

There are no fish in the lake except small bullheads and carp, the larger fish having been cleaned out by commercial fishermen two years ago. Two hundred and fifty thousand young pickerel were put into the lake in the spring of 1926. Pickerel and bullheads should thrive there and provide fine sport for the general public rather than for commercial fishermen.

It is doubtful if the lake will be attractive as a summer resort.

CLEAR LAKE—MARSHALL COUNTY

Clear Lake is located in Township 126, Range 52, 53 and covers an area of about two sections.

The water level was two and one-half feet below normal. Soundings were made over the entire lake and the deepest place was fifteen feet. The fine, wooded shores offer attractive sites for summer cottages.

There are many fine bathing beaches.

The following fish were found in its waters: black bass, black crappies, wall-eyed pike and green sunfish. No species was abundant and, as at all other lakes, restocking or a closed season is necessary to afford fair fishing in the future.

Commercial fishermen were depleting the lake of bullheads. There are no minnows at present in the lake, but plenty of vegetation to support insect life.

This fine lake is accessible to the public, as a highway runs along the north shore. A good driveway around the lake would be an added attraction and this suggestion could be emphasized in regard to most of our lakes.

As at most of the other lakes, more water is needed at the inlet in the spring rather than more dams at the outlet.

PICKEREL LAKE—DAY COUNTY

Pickerel Lake is in Township 123, Range 53. It is three and one-half miles long and from one-half to one mile wide. The greatest depth found by sounding was thirty feet. The water was at nearly normal level, usually clear and free from algae. Several fine springs are flowing into the lake. The wooded shores abound with elm, oak, basswood and willows. Chokecherry, June-berry, thorn-apple and ironwood make up the list of shrubs. There are many fine bathing beaches.

Vegetation was abundant and nearly every aquatic plant indigenous in South Dakota was growing here. Wild rice was plentiful for several rods up Chekpa Creek and a few plants of wild celery were growing where the creek emptied into the lake.

Wall-eyed pike, pickerel or northern pike, yellow perch, black crappies, black bass, bluegills, silver bass and black suckers are found in the lake. Cray fish were numerous, affording food for two or three species of fish.

As we judge lakes this is perhaps the nearest an ideal lake of any in the State.

At the time of our visit (August 7) the temperature of the water in the reservoir at the fish hatchery was 46.4 degrees F.; at the mouth of the tile near the hatchery, 51.8; where it empties into the lake 61; out in the lake about 77 degrees.

A dam had been erected at the outlet on the west side, but it was located too near the margin of the lake and was pushed out by the ice some years ago. A dam here is a waste of funds.

The bay at the extreme north end of the lake, a portion of Chekpa Creek and perhaps another bay should be set aside as spawning beds for the purpose of keeping Pickerel Lake stocked with game fish.

OAKWOOD, TETONKAHA—BROOKINGS COUNTY

Oakwood, Tetonkaha and Round Lakes are located in Township 111, Range 51, except a small portion at the northwest corner, which is Range 52.

With normal water level these lakes are connected; at present the water is twelve inches below normal. The average depth is from four to eight feet. A small area in Tetonkaha Lake is nine feet deep.

Fish in the lakes are black bass, bluegills, crappies, wall-eyed pike, pickerel and perch. Bullheads, carp and suckers are abundant.

There is but little vegetation in any of the lakes, consequently a scarcity of insect life and perch and bullheads are poor. The rough fish should be removed from these lakes and a screen put in at the outlet to prevent them coming in again during high water.

Black bass, bluegills and crappies should do well in these lakes, and the setting aside of Mortimers' Slough at the north end of Te-

tonkaha Lake and a large bay in Oakwood Lake as spawning beds would keep these lakes stocked and afford good fishing after a year or two.

Here are many fine sites for summer attractions and every effort should be made to keep the lakes normal in every respect.

The wooded island where the Goodfellow resort is now located should in some way be definitely preserved for the benefit of the public. Here are many fine trees of hackberry, elm and oak, as well as two large Indian mounds with a historical value that should never be destroyed.

SUMMARY

Where lakes show a decided low water level as Andes, Poinsett, Madison and Byron did in 1926 and probably will in every dry period, means should be provided to divert a larger flow of the spring water to fill them every spring.

Dams at the outlet of a lake will seldom accomplish the purpose for which they are intended.

Where new dams are erected for the purpose of diverting streams into lakes they should be controlled and screens included to prevent the introduction of rough fish.

The natural rather than the artificial methods of keeping the lakes stocked with black bass, bluegills and crappies will produce better results and at less cost to the State; therefore we recommend that weedy bays be set apart as their natural spawning beds; these to be separated by a line of floating buoys and all fishing therein prohibited.

Most of the lakes for all practical purposes are well supplied with aquatic vegetation adapted to this climate.

Any experiment with new plants that the public wishes to undertake should be encouraged.

We recommend that commercial bullhead fishermen be compelled to pay a special license, and also that commercial bullhead fishing to the point of depletion in any lake be discouraged, or until such a lake can be stocked with game fish.

No lake visited in 1926 is so strongly impregnated with minerals as to be detrimental to fish.

Conditions existed in all the lakes visited to warrant the recommendation that the bag limit of black bass be reduced to eight per day and that of bluegills and crappies be reduced to fifteen per day. To meet the exigencies of good roads, the automobile and present methods of fish propagation, we are forced to accept the greatly reduced bag limit, or no fish.

Present methods of fish propagation as it applies to the lakes is not, and will not be productive and yield the necessary increase of game fish; therefore we recommend that a thoroughly trained and

capable fish culturist be put in charge for the State; and further that a trained fish culturist be located at Lake Poinsett to work out such a method as outlined in the discussion.

That too many of our citizens disregard our fish and game laws.

We do not recommend the building of any dams, ditches or hatcheries unless the plans are carefully worked out by a capable engineer as to results and costs and found to be practical.

Any recommendation suggested by this survey does not imply an increased expenditure of funds; it implies a diversion of funds.