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REPORT OF THE BIOLOGICAL SURVEY OF CERTAIN STREAMS OF
MADAWASKA COUNTY, NEW BRUNSWICK, 1936.

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by

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On August 11, in company with Mr. Jas. Catt, Mr. H. Lynch, and Mr. L. H. Parks, and Acting-Inspector Corbin, the various streams, which had been reported upon in letter dated July 17, addressed to the Deputy Minister of Fisheries, and signed by R.G. McKay, were visited, except those at Trout Brook and the Little Forks of the Iroquois, which were visited on the following day.

On this first visit, only temperatures were taken, with Mr. Catt's thermometer, which by direct comparison was found to read 0.6°C . below the one used in the balance of this survey. These temperatures have been adjusted for the purposes of this report by adding 0.6°C . to these first readings.

On the following days, investigations were made on each of these streams, covering somewhat wider reaches than had been possible with the larger party. In these later studies, samples were collected for oxygen determination, phosphate analyses, and hydrogen-ion (pH) tests. In addition, a small collection of the more representative (more numerous) sedentary fauna of these streams was made.

The results of these studies have been compiled in a table, on page 2. The streams have been arranged approximately in their order of temperature (descending), but since the time of day varied at which these temperatures were taken, and also the condition of the weather, this order must be understood as quite a rough one.

The temperatures in this table were taken in degrees Centigrade, but have been recalculated, and are expressed in degrees Fahrenheit, and placed in columns under the date on which they were secured. In all cases, the phosphate analyses indicated a concentration of less than five milligrams per cubic metre (less than five parts per thousand million), or to all intents and purposes, nil, since no colour could be detected upon the addition of the reagents.

TABLE I.

| Stream | Temperature August | | | | pH | Oxygen. | |
|--|-----------------------|------|------|------|-----|--|------|
| | 11 | 12 | 13 | 14 | | cc. per $\frac{1}{2}$ litre. Sat'n. | |
| Baker Lake - foot of lake | 71.3 | .... | 72.2 | .... | 8.3 | .... | .... |
| Baker lake outlet, at highway bridge | 69.4 | .... | 70.7 | .... | 8.2 | 6.39 | 103 |
| Baker lake outlet, at confluence with Meruimpticook river. | .... | .... | 71.6 | 75.0 | ... | .... | .... |
| Madawaska river, 7 miles above Ed'ton. | .... | .... | ... | 69.8 | 8.0 | 6.34 | 101 |
| Meruimpticook river, at confluence with Baker lake outlet. | .... | .... | 67.3 | 67.7 | 8.3 | .... | .... |
| Little Forks, Iroquois river. | .... | 66.7 | 63.6 | .... | 7.8 | 6.25 | 95 |
| Baker Brook, at mouth. | 65.5 | .... | ... | .... | ... | .... | .... |
| Green river, above dam. | 60.1 | .... | 65.1 | .... | 8.3 | 6.89 | 104 |
| Trout Brook, at third highway bridge. | .... | 58.1 | ... | 64.8 | 8.0 | 6.46 | 100 |
| Blanchette Brook, at highway bridge. | 66.4 | .... | 64.6 | .... | 8.0 | 6.30 | 95 |
| Baker Brook, at bridge 6 miles above mouth. | 64.0 | .... | ... | .... | ... | .... | .... |
| Baker Brook, at end of road. | 63.7 | .... | ... | .... | ... | .... | .... |
| Green River, below dam. | 60.1 | .... | 62.6 | .... | 8.3 | 6.56 | 97 |
| Baker Brook - tributary at forester's cabin. | 61.9 | .... | ... | .... | ... | .... | .... |
| Daigle Brook, at highway bridge. | 61.0 | .... | 60.8 | .... | 8.0 | 6.65 | 96 |

The various values set forth in this table indicate that all of these bodies of water are virtually alike, with the exception of temperature. It is to be noted that the streams are slightly lower in pH (higher hydrogen-ion concentration) than the lakes, or stiller bodies of water, and also that the oxygen concentration is slightly less. These differences have no significance biologically. Similarly, the faunal collections bear remarkable similarity to each other, differing in the amounts available, but having the same organisms, more or less.

This means that so far as the waters are to be considered for fish-cultural purposes, we may confine our attention to the temperatures. As to whether the waters be suitable or not, we have a ready means of comparison in the temperature records which are available for a number of years, for the Maritime hatcheries. Such a comparison can be facilitated by an analysis of these temperature records which has been made by the writer at the Atlantic Biological Station, by which it has been found possible to express these records in the form of mathematical equations, which equations give definite values for the temperature characteristics of each body of water, as used and registered in each of the Maritime hatcheries. It is to be remembered, however, that these analyses have five years of continuous records as their bases, and in the present case we have one or two readings only.

In order to construct such an equation for any body of water, observations taken twice daily are required for three periods separated by three months. The best times for such observations are the end of April, the end of July, and the end of October. It would be best to have the last week of April and the first of May, and

so on - two weeks at each period. In this way the most exact information could be secured regarding the suitability of any waters for fish-cultural purposes. Failing such a record, the next best is a continuous record for four months, extending from before the time of maximum temperature until the middle of November, or just before freeze-up.

In the present case, neither such record is available. For only one of these streams, namely the Little Forks of the Iroquois river is there a minimum temperature, and this was taken on the fourteenth. All that can be done therefore, is to take the temperatures which were registered on this day at the various Maritime hatcheries, using the maximum, minimum and the diurnal range. A further point must come into this discussion, namely the deviation of any of these hatcheries from their mean. In Table II each hatchery is listed in order of its average temperature as determined from the equations already referred to. The line between the second and third indicates the upper level of suitable temperature as determined by various physiological and other means, and the line between the fourth and third last indicates the lower level of suitable temperatures, determined similarly. The maximum and minimum temperatures for August fourteenth are then listed, and then the diurnal range for the same day. In the next two columns, the temperature adjusted with respect to the deviation of the averages from the mean is listed, and the temperatures for Little Forks of the Iroquois river, are treated similarly, in the last line. Since no other minimum temperatures values are available, no attempt is made to treat the other bodies of water studied in this manner. They may be compared with

the maximum values of the various hatcheries. The weekly (average) maximum and minimum for the week ending August 15th. are also given, and the weekly (average) range.

The deviations from the averages for both maximum (figure 1) and minimum (figure 2) throughout the Maritimes, may be determined from the accompanying figures, which are a sort of "weather-map". These figures indicate that the region of Madawaska county was probably about 2°F. below the usual or average maximum temperature during the week of August 15th., and about 3°F. below the average for the same week for the minimum, and similarly for other regions. It is the adding of these deviations to the values listed under "observed temperatures" which gives the values listed under "adjusted temperatures".

It will be obvious that the adjustment on the basis of the deviation of the maximum and the minimum from their means is not altogether satisfactory method of determining the true relationship of these waters with known waters, yet it does reveal certain characteristics upon which we may perhaps pass judgment.

The most striking thing, in the Little Forks of the Iroquois river, is the low minimum as compared with other bodies of water

(HATCHERIES)

TABLE II.

| Hatchery. | Observed Diurnal | | Range | Adjusted | | Aver. Weekly | | Average Weekly Range |
|------------------------------|------------------|-------------|-------|-------------|-------------|------------------|------------------|----------------------|
| | Temp's Max. | Temp's Min. | | Temp's Max. | Temp's Min. | Temperature Max. | Temperature Min. | |
| (All in degrees, Fahrenheit) | | | | | | | | |
| Yarmouth | 72 | 70 | 2 | 71 | 70 | 74.9 | 65.5 | 9.4 |
| Middleton | 57 | 54 | 3 | 64 | 60 | 66.7 | 59.8 | 6.9 |
| Antigonish | 71 | 66 | 5 | 70 | 66 | 66.7 | 62.4 | 7.3 |
| Bedford | 75 | 70 | 5 | 73 | 67 | 73.5 | 65.5 | 8.0 |
| Kellys Pond | 68 | 66 | 2 | 67 | 64 | 69.5 | 62.5 | 7.0 |
| Miramichi | 64 | 58 | 6 | 64 | 57 | 66.2 | 53.0 | 13.2 |
| Saint John | 68 | 64 | 4 | 67 | 66 | 67.5 | 65.5 | 2.0 |
| Margaree | 54 | 52 | 2 | 53 | 57 | 61.8 | 56.3 | 5.5 |
| Grand Falls | 54 | 51 | 3 | 56 | 54 | 58.2 | 50.5 | 7.7 |
| Florenceville | 59 | 55 | 4 | 60 | 54 | 60.7 | 51.3 | 9.4 |
| Restigouche | 47 | 44 | 3 | 48 | 47 | 49.3 | 46.5 | 2.8 |
| Little Forks | 63 | 50 | 13 | 65 | 53 | .... | .... | ... |

for the same day - there is only one other lower, namely the coldest of our hatcheries, Restigouche. The next most striking thing is the tremendous diurnal range indicated by this one value. It is as great as the greatest weekly variation (average) namely that of Miramichi, and is more than double any other diurnal range.

Both of these points indicate that this water will not be suitable for fish-cultural purposes. Even the maximum, while definitely in the suitable range, does not put this water very high in the scale of more suitable waters, even when adjusted for the deviation from the anticipated normal.

If one considers only the maximum temperatures, with the foregoing discussion in mind, it would appear that the confluence of the Meruimpticook river, with the Baker lake outlet offers the best waters of those studied for fish-cultural purposes in this region. The indications seem to be that the Baker outlet is too warm. However, the colder waters of the Meruimpticook are warmer than those of the Little Forks, of the Iroquois, and the combination of the waters seems ideally suitable for fish-cultural purposes, for the mixture of these in varying proportions offers a readily controlled means of temperature control, which is not usually available in most fish-cultural establishments. This view might be considerably modified, were longer temperature records available, from which the temperature characteristics could be more accurately ascertained.

It would appear that all other waters examined would be less suitable than these two discussed more fully above.

CONCLUSIONS.

1. All of the streams are sufficiently alike so far as most of the environmental characters are concerned, that all but temperature may be ignored.

2. The confluence of the Meruimpticook river, with the Baker lake outlet presents a unique combination of characteristics, in that two different temperatures are available. This appears to offer the best waters of the region, in so far as the present investigation was able to ascertain.

3. The Little Forks of the Iroquois river has a satisfactory maximum temperature for fish-cultural purposes, but the low minimum with the great daily range seem to indicate that these waters would not be suitable for fish-cultural purposes, so far as the limited data available reveal.

4. Much more temperature data, as indicated above on page 3, are necessary before satisfactory, or conclusive opinions can be expressed.