SPECIAL REPORT

RESULTS OF STREAM IMPROVEMENT JOBS by NATIONAL PARK SERVICE C. C. C. CAMPS in NEW ENGLAND

Maynard S. Johnson
Associate Wildlife Technician
Region One

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Work done with the object of stream improvement in New England has been of three principal types: construction of fishways and removal of barriers to migration; construction of check-dams and creation of pools; and arrangement of stone or log "deflectors" modifying the cutting action of the current.

Recreational ponds have been built on several streams, but as their primary purpose was not improvement of streams for fish they will not be discussed here except in their effect on streams. Ponds cause increased summer temperatures - the outlet may be more than ten degrees Fahrenheit warmer than the inlet. However, in the first half-mile below the outlet the temperature is usually lowered several degrees, thus reversing the normal temperature gradient of the stream. Some of the ponds have fishways at their outlets, and some instead have fish screens. Thus fish movements are in some ponds encouraged and in other ponds prevented. In at least five instances pondsite clearing has been done where no dam has been approved - Tyler Pond, Savoy; Halfway Pond, October Mountain; and Mill Pond, Hawley, in Massachusetts; Spring Brook and Sleepy Hollow Brook Ponds, both at Camden Hills, Maine, RDP. Every effort was made, by me and by former Assistant Wildlife Technician Hoover, to emphasize that approval of a dam should precede pondsite clearing. Others thought differently. These cleared areas will be evident for years as "monuments of mistakes". Such ill-advised clearing robs a brook of shade and cover without any of the compensating advantages which a pond might provide.

Chicopee, Mass. SP-3. discontinued.

This camp worked on a municipal watershed area. The principal brook on the area (Cooley Brook) flows into the reservoir and is closed to fishing. Work along the brook was intended to hasten runoff and reduce discoloration from bordering swamp.

Stream improvement for fish would have served no purpose here, and was not attempted.

An older reservoir no longer used for water supply lies near the edge of the watershed reservation and receives the overflow from the reservoir in use. This older reservoir is open to fishing and is stocked with trout for that purpose. I advised against a proposal to construct a fishway over the dam of the old reservoir, and the proposal was dropped. Such a fishway would serve no useful purpose. It would trap any breeding fish which used it, as the reservoir bottom of mud and sand is not suitable for the development of trout eggs. Even if the fishway worked as well as could be hoped, stocking would continue to be necessary to maintain fishing in the reservoir.

This instance is cited to illustrate the point that it is not necessary to construct fishways over all dams, and that the value which any particular fishway would have should be carefully measured against its cost.

Mohawk Trail, Mass. SP-6. discontinued.

Cold River - a series of three dams was made in Cold River, to form pools for recreational use. The work was not done as stream improvement for fish, and is mentioned here only incidentally as an example of the fact that pools formed by damming a swift stream are quickly filled by current-borne sediment.

Pittsfield, Mass. SP-8. discontinued.
Mass. SP-23.

Lulu Brook is a small brook with a steep descent, and also with steep banks. A series of check-dams were constructed in this brook by SP-8 comp, without consultation with wildlife technicians. The pools apparently filled a need, and were occupied by trout even before construction was completed. It has been amply shown, however, that pools formed by check-dams in a swift stream of this sort become quickly filled by sediment, including good-sized rocks as well as gravel. The attached photograph (fig. 1) shows rocks ten inches or more across among deposits above a damplog about twelve inches in diameter.

Check-dams help to stabilize the bottom and reduce the rate of erosion, but they cannot be depended upon to form pools useful to fish.

Pools most lastingly useful to fish, in small hillside brooks, have been formed in connection with water-holes built primarily for fire protection. Because filling with sediment is inevitable when water-holes are located in the main channel of a swift-water brook, more recently constructed water-holes have been placed beside the brook where topography permitted. The brook water is held back by a low dam (which need not be more than six inches or a foot in height) and the water-hole is connected with the brook by a short ditch. A water-hole on a brook in the wild-life area of Pittsfield State Forest is a good example of this type. I have attempted to emphasize the potential value to trout of water-holes of this sort, both in discussions with camp personnel of Pittsfield and other camps, and in written comments on water-hole job proposals. In comments of May 15, 1956 (SP-28) and July 8, 1956 (SP-22) I advised against a height of dam which would block the brook channel to fish migration, and suggested placing rocks in the water-holes for fish shelter. It has been gratifying to note that water-holes of this type show no tendency to become silt-filled, and are much frequented by trout. About twenty trout were seen at one time in the water-hole on the Pittsfield wildlife area. There can be no doubt that pools of this sort considerably increase the capacity of small brooks to support trout.

Savoy, Mass. SP-12.

Stream improvement work has been done on two brooks in Savoy State Forest, Tannery Brook and Rose Brook. The earlier work, on Tannery Brook above the pond, consists of a series of one-log dams, notched to provide a spillway. Photograph (fig. 2) is typical of several of these dams. A deposit of sediment has accumulated on the upstream side of the log where a pool was intended to be, and the brook runs under or around the end of the log, instead of over it. A number of these one-log dams are washed away entirely. In no instance did I see the water flowing over the log in the notch provided. Although these logs did not function as was apparently intended, many of them are serving a useful purpose. There is often shelter for fish under such a log or beneath an undercut bank. If a number of logs had been put into the brook at random they would have become lodged at irregular intervals against the bank, and would probably have served the same purpose with a less unnatural appearance.

Work on Ross Brook was done after the work on Tannery Brook, and after it was apparent that use of one-log dams was impracticable under existing conditions. In work on Ross Brook procedure was to arrange rocks as deflectors, taking advantage of existing conditions and locally available materials to direct current to deepen channel, create pools, and undercut banks. Where current was directed into the pools they were kept clear, and did not tend to become filled with sediment. This work was done by Wildlife Foreman Edward Stoehmer, in the summer of 1935, during my first season of employment with the National Park Service. During the following summer the brook became very low, but the pools resulting from the stream improvement work were full of water and contained a goodly number of trout. By the summer of 1937 the brook seemed entirely natural in appearance, and there remained no clear evidence that rocks had been artificially arranged. However, the brook still had numerous pools and plentiful shelter of rocks and undercut banks.

I recommended against attempting stream improvement on Cold River (Savoy Forest) and Roaring Brook (October Mountain Forest). In each of these streams conditions for trout appear rather favorable at present, and the indicated violence of spring floods would speedily destroy any reasonably simple and unpretentious improvements.

Leominster, Mass. SP-13

In the summer of 1936 I examined Steam Mill Brook on this forest with the Superintendent, and recommended that no stream improvement be attempted there. A portion of the brook is now very productive of trout; another part is exposed by clear-cutting and will take some years to recover.

D. A. R. Forest, Mass. SP-14. discontinued.

A "stream improvement" job on Rogers Brook was undertaken by the the camp in 1935 without any previous consultation with wildlife technicians. The improvement took the form of erecting stone barricades at intervals in the brook. These structures did not hold back enough water to form appreciable pools, but constituted insurmountable obstacles to the passage of fish. The most striking deficiency in the brook was lack of shelter. The camp

had removed all shelter from the brook, and most of the vegetation from the banks, the previous season - as is noted in Dr. Agersborg's report of September, 1934. Rogers Brook was said to be an excellent trout stream before the camp began to improve it. Mr. Hoover and I advised doing what was possible to repair the damage - particularly rebuilding the barricades to form deflectors.

Moose Brook, New Hampshire SP-1.

This camp built a series of one-log dams as stream improvement in 1935. The work was done without consultation with wildlife technicians. A job application was submitted for approval after the work was done. All but one of these log dams was washed out before the following summer. The job accomplished nothing.

Bear Brook, New Hampshire SP-2.

Stream improvement work on this brook was seriously considered, but has been decided against. This brook has adequate cover and shelter, and plenty of pools. Stream improvement work was considered for demonstration purposes, however, as Mr. Earl Hoover (now of the New Hampshire Fish and Game Department,) wanted an opportunity to demonstrate various types of stream improvement devices. A stream survey was undertaken to get basic data of existing conditions. By the time the survey was completed, Mr. Hoover had changed his mind, and was no longer interested in demonstrating stream improvement devices. It is planned, however, to erect a number of signs indicating the effect of existing obstructions in the brook (stones and logs) on the cutting action of the current.

Fishing is heavy in Bear Brook, as in other accessible brooks, and is maintained by stocking annually or oftener. There are several beaver dams on Bear Brook and its tributaries, constituting habitat for beavers and ducks, and presumably also for muskrats and trout. Beaver dams of course tend to form a barrier to spawning migration of trout. The dam for the recreational pond, to be located near where Bear Brook leaves the project area, will have a fishway.

A weir in Bear Brook, constructed to measure stream flow, constitutes a barrier which trout cannot pass. It will be removed

when it has served its purpose. I had opportunity October 20 to record observations of trout trying to progress against the current below the weir. None were able to get in position to attempt the jump. Data are given with Figure 5.

Mt. Desert Island, Maine, - Acadia National Park Camps.

A larger program of stream improvement work has been done here than by all other National Park Service camps in New England combined. None of the work was on Park waters, as there are no such; the State of Maine claims jurisdiction of all waters even though flowing through Park land. Most of the stream improvement work was done where both water rights and abutting land is private.

In general the work done as stream improvement has been of two types: channel clearing, and construction of dams and fishways. The local game warden, Mr. Smith, tells me that so far as he knows the State Department of Inland Fisheries and Game has made no recommendations for initiating either type of work. The Department has, however, furnished fishway specifications when requested to do so.

The stream improvement work has been initiated by the landscape architect of the Park, at the suggestion of individuals in the local fish and game club. I understand that the members of the club have not always been in agreement as to what should be done

Until within the past year, work of NP camps did not come to the official attention of district or regional technicians. Recent stream improvement work has been carried as a continuation job, held not to require review. Accordingly, I have had no connection with any part of the stream improvement work, except that this fall, jointly with Park Naturalist Sullivan, I made recommendations for modifying fishways already constructed, to make them easier of ascent.

In attempting to evaluate results of stream improvement work it has been difficult to get data, as I did not see the streams before they were improved, and as the present landscape architect (Mr. Breese) is not familiar with work initiated by his predecessor (Mr. Gordon). I talked with Mr. Hadley, Mr. Breese, Park Naturalist Sullivan, Rangers Thompson and Campbell, and Game Warden Smith, and also inspected streams on which work had been done.

Work on Duck Brook (outlet of Eagle Lake)

Stream improvement work on Duck Brook included:

a. baffles where brook passes across concrete slab under bridge on state road #3, near mouth of brook.

b. channel clearing - removal of obstructions from brook; removal of virtually all sticks and logs from brook.

c. dynamiting to make easier grade at falls in brook.

d. arrangement of rocks to form pools.

Stream improvement work similar to the channel clearing on Duck Brook has been done also on the outlet brooks of Bubble Pond, Jordan Pond and Echo Lake.

At New Mill Meadow there was a beaver dam on the course of Duck Brook. The beaver were removed and the beaver dam blown out. A CCC dam was built which did not hold water. The meadow is now without standing water except for the brook meandering through it. Warden Smith says that New Mill Meadow - when there was water there - was excellent for trout. He says that trout were relatively scarce in the rest of the brook. The situation is much the same now, except that New Mill Meadow is now unavailable for trout. Duck Brook is closed to fishing at present, but observation along the brook shows a scarcity of trout.

The dam at the outlet of Eagle Lake has a fishway closed by flashboards. This is shown in attached photograph (fig. 4.). On inquiry from Warden Smith, I was informed that one law required that the fishway be built, and another law gave the Bar Harbor Water Co. control of flowage from the Lake. No water, except insignificant leakage around flashboards, was passing through the fishway.

Estimates of effect of Duck Brook work

The work done on Duck Brook, including blowing of beaver dam at New Mill Meadow, was intended to afford unimpeded access for fish. It is not clear that there are advantages from doing this sufficient to balance the disadvantages.

As has just been noted, access from Duck Brook to Eagle Lake is blocked by flashboards across the dam and fishway. There is no sufficient evidence to show that there would be an advantage if the fishway were open. Warden Smith tells me that there are supposed to be sea-run trout which having gone to the ocean might wish to return to the lake. I have not been able to get a record of any observations that such trout, trying to get back into Eagle Lake, concentrated below Eagle Lake dam or other obstacles formerly in the brook.

I am informed that 130,000 young brook trout from a federal hatchery were put in the brooks of Mt. Desert Island last summer (some in lakes and ponds); and that heavy plantings of trout are made every year. Where waters are regularly and heavily stocked the principal requirement for a good crop of fish is not so much unobstructed access as good living and growing conditions.

Much of Duck Brook is deficient in shelter and food for fish, and these deficiencies seem likely to prevent any benefit being realised from the stream improvement work which has been done there.

Work on outlet stream of Great Pond

Distance from Great Pond to Somes Sound, by water, is about one and one-half miles, of which a mile or more is occupied by Somes and Ripple Ponds. The objective of the stream improvement work has been to remove obstacles and to permit unobstructed movement of fish from the ocean to Great Pond. The main consideration has been salmon. Other anadromous fish - eels and alewives - are known to ascend this brook.

As stream improvement work the CCC has constructed dams and fishways - or in some cases reconstructed on the sites of old dams:

at outlet of brook into Somes Sound
in the village of Somesville
at outlet of Somes Pond
at outlet of Great Pond

Certain additional work will be necessary, and will be proposed to make the fishways more easily ascended.

Somes Pond contains pickerel, which are not native to Mt. Desert Island, but have been introduced. Great Pond is stocked with about ten thousand young salmon a year. These are lake salmon, or so-called landlocked salmon. Most of the other ponds on the island, as well as the brooks, are stocked with trout. In addition to the regular plantings of salmon in Great Pond, there is apparently some natural reproduction. Warden Smith reports observations of salmon spawning both on shoals in the pond and in the outlet brook.

I have not been able to get satisfactory data on whether there ever were runs of Atlantic salmon into this brook. Important runs of Atlantic salmon have always been into bays and mouths of larger river systems (as for example the Penobscot River), drawing from many miles of river and tributaries. Not much can be expected from a brook one-half mile long, interrupted by ponds in which pickerel predominate. It is clear that if any appreciable number of Atlantic salmon are to be raised in the water of Great Pond they must be raised in the pond itself rather than in the short outlet brook.

There is a question whether the so-called landlocked salmon are a variety distinct from Atlantic salmon. The important differences are not in structure but in life-history. The lake salmon or so-called landlocked salmon are not landlocked in the sense of any physical barriers which prevent their descent to the ocean. The temperature and other environmental factors of certain lakes, and the reaction of lake salmon to these factors, are such that the young salmon remain and mature in the lakes instead of descending to the ocean. Atlantic salmon descend from rivers (sometimes from lakes) in which they were reared, and spend a varying length of time in the ocean before they again seek fresh water as mature fish. It is understood that Atlantic salmon returning from the sea ordinarily do not feed in fresh water. Those taken by angling are usually caught near the mouths of rivers as they start to make their way upstream.

It is understood that plantings of young Atlantic salmon will be made in Great Pond. It is considered possible that the young fish will leave the pond when they are partly grown, but before they are large enough to afford fishing. If any of them attempt to return to spawn when about four years old, it is probable that they would afford fishing only as they attempted to enter the brook from Somes Sound. Any salmon which used the fishways successfully and returned to Great Pond presumably would not afford any angling. If Atlantic salmon with this type of life history should be substituted in Great Pond, wholly or partly, for the present strain of lake salmon, it is not evident that the change could in any way improve the fishing in Great Pond. The present salmon fishing in Great Pond is maintained by annual stocking of young lake salmon, in greater numbers than are caught. It is not easy to suppose that a self-maintaining stock of Atlantic salmon (which presumably cannot be caught in the lake) can be established there without interference with the crop of propagated lake salmon.

Whether the series of dams with fishways which have been erected between Great Pond and Somes Sound, as stream improvement, will result in establishing a run of Atlantic salmon into Great Pond is a question which cannot be answered for some years. It is another question, and an equally dubious one, whether the establishment of an Atlantic salmon run into Great Pond if accomplished would in any way benefit the salmon fishing in Great Pond. The justification and value of this stream improvement work, so far as it concerns fish, will depend on the eventual answers to these yet unanswered questions. I will not attempt any discussion of the relation of this work to landscape values or property values.

Interpretations and Conclusions

The general conclusion from consideration of various jobs of stream improvement by SP and NP camps in New England is that too many things have been attempted with too little analysis of what each particular job is intended to do and is likely to accomplish.

Fishways and Obstructions

Not every condition which interferes with unhindered movement of fish in a stream requires building of fishways or removal of obstructions.

Construction of fishways, and especially construction of dams and fishways as stream improvement, would seem to be justified only when there is reason to believe that economically useful fish will ascend the fishway in significant numbers, and when it can be shown that some definite advantage will result from that ascent.

Fish movements upstream are important principally in connection with spawning migrations. Where regular planting of young fish is depended on to maintain fishing, conditions favorable to growth and survival of young fish become much more important than unimpeded access from all parts of the stream to suitable spawning grounds. In any proposals for channel clearing, or removal of beaver dams or other barriers, serious consideration must be given to the possibility that any advantage of uninterrupted access will be more than offset by reduction of shelter and of feeding areas. It seems doubtful if that serious consideration has been given in channel clearing jobs undertaken without biological advice.

Checkdams and pools

Construction of check-dams in rapid streams is not a satisfactory method of stream improvement for fish. Under some conditions a series of check-dams may form terraces and help to stabilize a stream-bed. Check-dams in streams on steep slopes cannot be depended upon to form pools. The pools first formed are very soon obliterated by sediment and even by rocks of considerable size. Except in the smallest of swift streams check-dams of reasonably simple size and construction are subject to being torn out bodily by the power of the torrent in flood-time.

Where topography permits, excavation at one side of a stream-bed may be a practical way to form pools not subject to silting. Such a pool can be connected to the brook by a few feet of ditch. Pool excavation is best justified beside brooks which become very low in summer, where the stored water in the pools has

special importance as a retreat for fish, and as a reserve supply available for emergency use in case of fire.

Deflectors and relation of current to fish habitat in streams

In general logs in a stream, or rocks large enough so they cannot be moved by the current, add greatly to the carrying capacity of a brook for trout. Assuming that the brook is otherwise suitable for trout, with adequate year-round flow and suitable temperatures, logs or large rocks modify the uniformity of the current and in various ways make a more diversified and more favorable habitat, promoting a more abundant life for fish. The current is here and there directed against the bottom or against the bank by one of these obstructions, and by its cutting action digs out a pool behind or below some shelter. In other places quiet eddies may be formed, or gravel bars or silt deposits. As has been mentioned, at Bear Brook, N. H. logs and rocks fortuitously arranged seem to have afforded as favorable a physical habitat for trout as could have been created by a planned program of stream improvement. When logs and rocks are intentionally arranged in a stream as deflectors, they soon come to appear and to have much the same effect as if arranged by chance. Stream improvement work can hope to do no more than to supplement deficiencies and simulate favorable conditions occurring naturally elsewhere.