ARCTIC CHARR STREAM ENHANCEMENT IN NUNAVIK: SUMMARY OF ACTIVITIES IN 1989

Presented to:
Kativik Regional Government (Hunter Support Program)
Economic Regional Development Agreement Committee
Makivik Corporation (Economic Development Department)
Seaku Fisheries Incorporated

Makivik Corporation
Renewable Resource Development

Lachine
December 1990

Salvelinus

biologie aquatique

275 Rainville, Beloeil (Québec), J3G 4M4

Beloeil, December 28th 1990

Jackie Koneak
Second Vice-president
Makivik Corporation
650, 32nd avenue
Lachine, Qc
H8T 1Y4

Dear Jackie,

Please find included 10 copies (5 color; 5 black and white) of the final report entitled "Arctic charr stream enhancement in Nunavik: Summary of Activities in 1989." This report reviews the works conducted under the ACSE Program since it started (1986) and includes recommendations for the future.

In spite of its size (100 pages!), the report is straightforward; I think it summarizes well the concepts and the problems behind the ACSE Program. In the past, I have been sending annual progress reports to each communities. After four years of work, it would be appropriate to send them a substantial and illustrated report. I suggest that this report be translated into Inuttitut and forwarded to local organizations. Total costs would be about $6 000 ($3 000 for translation and $3 000 for printing 75 copies) I believe that there are sufficient funds left in the budget (#12-111) to cover these costs.

Finally, I include a tentative distribution list for the English version of the report. I sent the master copy of the report and all related files to Andrée. I hope that you are satisfied with the report and will find it useful.

Sincerely,

Réjean Dumas

RD/rd
encl.

c.c. Stas Olpinski

ARCTIC CHARR STREAM ENHANCEMENT IN NUNAVIK: SUMMARY OF ACTIVITIES IN 1989

Distribution list

Makivik Corporation (Ren. Res. Dev.):	Jackie Koneak (5 copies) Stas Olpinski (5 copies) Willie Adams Tom Boivin Alix H. Gordon Peter May
Makivik Corporation (Econ. Dev.):	Mark T. Gordon Bruno Pilozzi (5 copies)
Seaku Fisheries:	Greg Fisk (5 copies) Marc Allard
Kativik Regional Government:	Jimmy Johannes Sandy Gordon (5 copies)
E.R.D.A. Multipartite Committee:	25 copies (10 color; 15 b&w)
M.P.O.:	Jacque Robichaud Mimi Breton Gilles Chantigny
M.A.P.A.:	Gilles Drolet Fritz Axelsen
M.L.C.P.:	Denis Vandal Louis Roy Carol Rae
Individuals:	Dave Gillis Allen Gordon Goeff Power

ARCTIC CHARR STREAM ENHANCEMENT IN NUNAVIK: SUMMARY OF ACTIVITIES IN 1989

Presented to:
Kativik Regional Government (Hunter Support Program)
Economic Regional Development Agreement Committee
Makivik Corporation (Economic Development Department)
Seaku Fisheries Incorporated

Makivik Corporation
Renewable Resource Development

Lachine
December 1990

Reference: Dumas R. 1990. Arctic Charr Stream Enhancement in Nunavik: Summary of Activities in 1989. Preliminary report presented to: Kativik Regional Government (Hunter Support Program), Economic Regional Development Agreement Committee, Makivik Corporation (Economic Development Department) and Seaku Corporation. Makivik Corporation, Renewable Resource Development. 88 p.

EXECUTIVE SUMMARY

Established by Makivik Corporation in 1986, the Arctic Charr Stream Enhancement Program deals with the difficulties experienced by Arctic charr *Salvelinus alpinus* during their upstream migration in certain river systems. Through various consultations, Inuit hunters have identified 37 river systems in Nunavik where fish migration is believed to be affected by obstacles such as shallow passages, diffused channels, steep climbs, small falls and beaver dams.

During the summer 1989, precipitation levels were much lower than normal in Nunavik. In at least two of the problematic river systems (Tasiujaaluk and Nikuttivik, near Aupaluk), river flow was not sufficient for Arctic charr upstream migration to proceed: large numbers (> 100) of adult fish were trapped in various pools until the flow was restored by abundant rain in mid-September. In spite of these extreme conditions, only one casualty was observed in these two streams. In Tasiujaaluk, the recapture of 8 fish out of 50 tagged while trapped confirmed that Arctic charr had successfully reached at least one wintering lake.

Remedial works were conducted in five problematic streams: Nikuttivik (Aupaluk), Qamanialuk-Tasirjuarusiq (Kangirsuk), as well as Paakittuq, Qallunaartaliviniq and Sapugaarjuit (Akulivik). These works were conducted in August and September by local field workers using manual tools such as steel bars and shovels to build deflection walls and deepen existing channels. The two initial test systems (Tasiujaaluk and Tasikallak) were also inspected to verify the state of previous works. Three other river systems were surveyed.

In light of activities conducted in 1989, 22 of the problematic river systems have been identified as containing obstacles to Arctic charr migration which may be alleviated by remedial works feasible under the ACSE Program. Nine of these systems must be given first priority because the existence of their anadromous Arctic charr populations may be threatened by these obstacles. An evaluation of current stream enhancement techniques must still be completed before remedial works take place in these systems. For the 13 other systems, an approach based on remedial works and periodical maintenance using simple stream enhancement techniques is suggested.

RESUME

Le Programme d'Aménagement des Systèmes Producteurs d'Omble Chevalier a été mis sur pied par la Société Makivik en 1986 afin d'améliorer la qualité des passes migratoires naturelles utilisées par la forme anadrome de cette espèce. En effet, diverses consultations menées auprès des collectivités inuit du Nunavik avaient permis d'identifier 37 systèmes producteurs où l'Omble chevalier pouvait éprouver certaines difficultés lors de sa remontée vers les frayères et les aires d'hivernage. Ces difficultés sont dues à des obstacles physiques tels que les sections peu profondes des rivières, les pentes accentuées, les zones rocheuses, les faibles écoulements d'eau et les barrages de castor.

Au cours de l'été 1989, on a enregistré de très faibles précipitations au Nunavik. Dans deux cours d'eau (Tasiujaaluk et Nikuttivik, près d'Aupaluk), tout au moins, les conditions d'étiage étaient telles que la migration de l'Omble chevalier fût interrompue. Des centaines d'Ombles se retrouvèrent captives entre les seuils. Ce n'est qu'à la mi-septembre que des pluies diluviennes ont permis de rehausser suffisamment les niveaux d'eau pour permettre à ces poissons de reprendre leur migration. En dépit de ces conditions critiques, on a trouvé qu'un seul poisson mort dans ces deux cours d'eau. De plus, au cours de la pêche d'hiver à Aupalajaalik (lac du réseau Tasiujaaluk), on a recapturé 8 des 50 Ombles captives qui avaient été marquées à Tasiujaaluk. Ceci nous porte à croire que ces poissons avaient pu atteindre au moins un lac sans encombre majeur.

En août et septembre, nous avons effectué des travaux correcteurs sur les cours d'eau de 5 systèmes producteurs soit ceux de Nikuttivik (près d'Aupaluk), Qamanialuk-Tasirjuarusiq (près de Kangirsuk), ainsi que Paakittuq, Qallunartaliviniq et Sapugarjuit (dans la région d'Akulivik). Pour ce, chaque collectivité impliquée avait sélectionné une équipe d'ouvriers qui, à l'aide de pelles, de barres de métal et de cordes, ont construit des murs défléchissants et creusé le lit des rivières afin de faciliter la migration de l'Omble chevalier. De plus, nous avons inspecter les cours d'eau de Tasiujaaluk et de Tasikallak afin de vérifier l'état des travaux réalisés lors de la

phase expérimentale. Enfin, nous avons fait l'inventaire des travaux à faire dans 3 autres systèmes.

L'ensemble de ces réalisations nous a permis de réviser la liste priorisée des systèmes à problèmes et d'en identifier 22 qui pourraient demeurer sous la tutelle du Programme d'Aménagement. Parmis ceux-ci, neuf comportent des corridors migratoires en si mauvais état que la survie des populations anadromes qui les empruntent en est compromise. Cependant, avant tout autre aménagement physique, on devra évaluer les techniques présentement utilisées. Les treize autres systèmes comptent des obstacles physiques spécifiques pour lesquels on devra prévoir des travaux correcteurs et un entretien périodique.

Table of Contents

List of Figures

List of Tables

Acknowledgements

First, I would like to acknowledge the financial support of the following organizations:

- Kativik Regional Government (Hunter Support Program);
- Makivik Corporation (Community Development Fund);
- Seaku Fisheries Incorporated;
- Fisheries and Oceans;
- Ministère de l'Agriculture, des Pêcheries et de l'Alimentation.

The latter two organizations made their financial contributions through the Economic Regional Development Agreement (E.R.D.A.).

Numerous individuals participated to the Arctic Charr Stream Enhancement (ACSE) Program in 1989.

Program coordinator:	Réjean Dumas
Community coordinators: (remedial works)	Moses Qumak (Akulivik) Charlie Sequaluk (Aupaluk) Tamisa Thomassie (Kangirsuk)
Field workers: (remedial works)	Johnny Agma (Aupaluk) Simon Aliqu (Akulivik) Peter Grey (Kangirsuk) Aqujaq Igyook (Aupaluk) Sammy Kauki (Aupaluk) Josepie Kudluk (Kangirsuk) Sicaliasie Nappatuk (Akulivik) Matthew Nassak (Kangirsuk) Jimmy Qasaluaq (Akulivik)
Cooks (remedial works):	Maggie Aliqu (Akulivik) Annie Kudluk (Kangirsuk) Suzie Pootoogee (Kangirsuk)
Community representatives: (inspections)	Bobby Baron (Kangiqsualujjuaq) Moses Kritik (Tasiujaq) Mark Kullula (Aupaluk) David Oovvout (Quaqtaq)
Translator (workshop):	Rhoda Kritik (Tasiujaq)

Community workers: (harvest studies)	Christina Aloupa (Quaqtaq) Martha Crow (Umiujaq) Charlie Sequaluk (Aupaluk)
Map Design:	Collin Bird (Makivik) Morrie Portnoff (Makivik)

I would particularly like to thank Carol Rae from Ministère du Loisir, de la Chasse et de la Pêche (M.L.C.P.) for his valuable contribution to the workshop; his expertise in the field of stream engineering was much appreciated. Alix H. Gordon (Kuujjuaq Research Centre) provided great assistance in the field while tagging fish in Tasiujaaluk and during several surveys. Louis Roy (M.L.C.P.) joined the team during surveys in the Kangiqsualujjuaq area. Sandy Gordon (Johnny May's Air Charters Ltd) acted as pilot during the various surveys: I am grateful to him for his good judgment and his enthusiasm.

Marcel Bernard and Louis Roy (M.L.C.P.) as well as Tom Boivin (Makivik) kindly made available raw harvest data from their respective research projects. Stas Olpinski (Kuujjuaq Research Centre) provided continued support and representation at the Multipartite E.R.D.A. Committee. Mae Saunders diligently looked after the secretarial needs of the Program.

Finally, I would like to acknowledge the works of three individuals whose ideas and accomplishments allowed for the institution of the ACSE Program: Goeff Power, Dave Gillis and Allen Gordon.

BACKGROUND INFORMATION

Arctic charr *Salvelinus alpinus* is the most important fish species to the subsistence economy of Québec Inuit. Between 1976 and 1980, they harvested annually close to 200 tons of the anadromous form of the species, nearly 60% of their total fish catch (J.B.N.Q.N.H.R.C. 1982). In many river systems, sustainable limits have been reached. Increasing subsistence needs, renewed interests in developing small-scale commercial fisheries or outfitting camps and, in some areas, the scarcity of Arctic charr have encouraged many communities to seek ways of increasing charr abundance.

In 1984, a project jointly conducted by the University of Waterloo and Makivik Corporation (Power and Barton 1987) revealed that in 18 of 46 river systems surveyed in Ungava, Arctic charr had difficulty in their upstream migration because of physical obstacles and insufficient water flow. These difficulties may become severe, especially during summers of poor precipitations. In Nunavik, anadromous Arctic charr descend to sea around (ice) break-up while river flow is maximal and return to freshwater between mid-August and mid-September. The timing of the upstream run varies mainly in function of latitude and specific hydrographic conditions. During summers of poor precipitation, fish begin moving upstream while river flow is still minimal. In extreme situations, fish will need to wait for abundant autumn rain or even snow falls to restore river flow before reaching their spawning or wintering habitats.

Originally designed to evaluate the possibility of creating new Arctic charr habitats, the 1984 project became the onset of a long-term effort to improve the quality of fish passages in streams of Nunavik. In 1986, Makivik officially initiated the Arctic Charr Stream Enhancement (ACSE) Program to achieve three principal objectives:

A. Identify Nunavik river systems where anadromous Arctic charr experience difficulties in reaching their spawning or wintering habitats because of physical obstacles located in the streams.

B. Evaluate the possibility of increasing Arctic charr abundance by improving the quality of their upstream migration routes.

C. Develop durable stream enhancement techniques adapted to the Arctic.

The program has been divided into two phases:

<u>Phase I - Assessment</u>

- Identification of problem types.
- Evaluation of remedial works required in problematic streams.
- Development of stream enhancement techniques.
- Creation of an Arctic charr harvest and fishing effort data base for each problematic river system.

<u>Phase II - Implementation</u>

- Remedial works and maintenance in problematic streams.
- Monitoring of Arctic charr harvest and fishing effort.
- Evaluation of the long-term benefits of stream enhancement for Arctic charr populations.

Consultation

During Phase I, Nunavik communities participated in documenting the nature of migratory problems through series of community meetings and interviews with Inuit hunters. Among the 157 river systems known to support distinct anadromous Arctic charr populations in Nunavik, community information and surveys have shown that at least 37 contain substantial difficulties for upstream migrating fish (Figure 1).

Surveys

Between 1987 and 1989, 24 problematic river systems (Table 1) were surveyed to document in each the needs for remedial works. Critical passages were photographed and mapped, and, when necessary, the manpower required for stream modifications was estimated. During the surveys, minor corrections were spontaneously made in some streams. According to the field evaluation, remedial works in three quarters of the problematic streams would involve strictly manual labour or less than 50 man-days. In the remaining streams, modifications were believed to necessitate heavy equipment or extensive manpower.

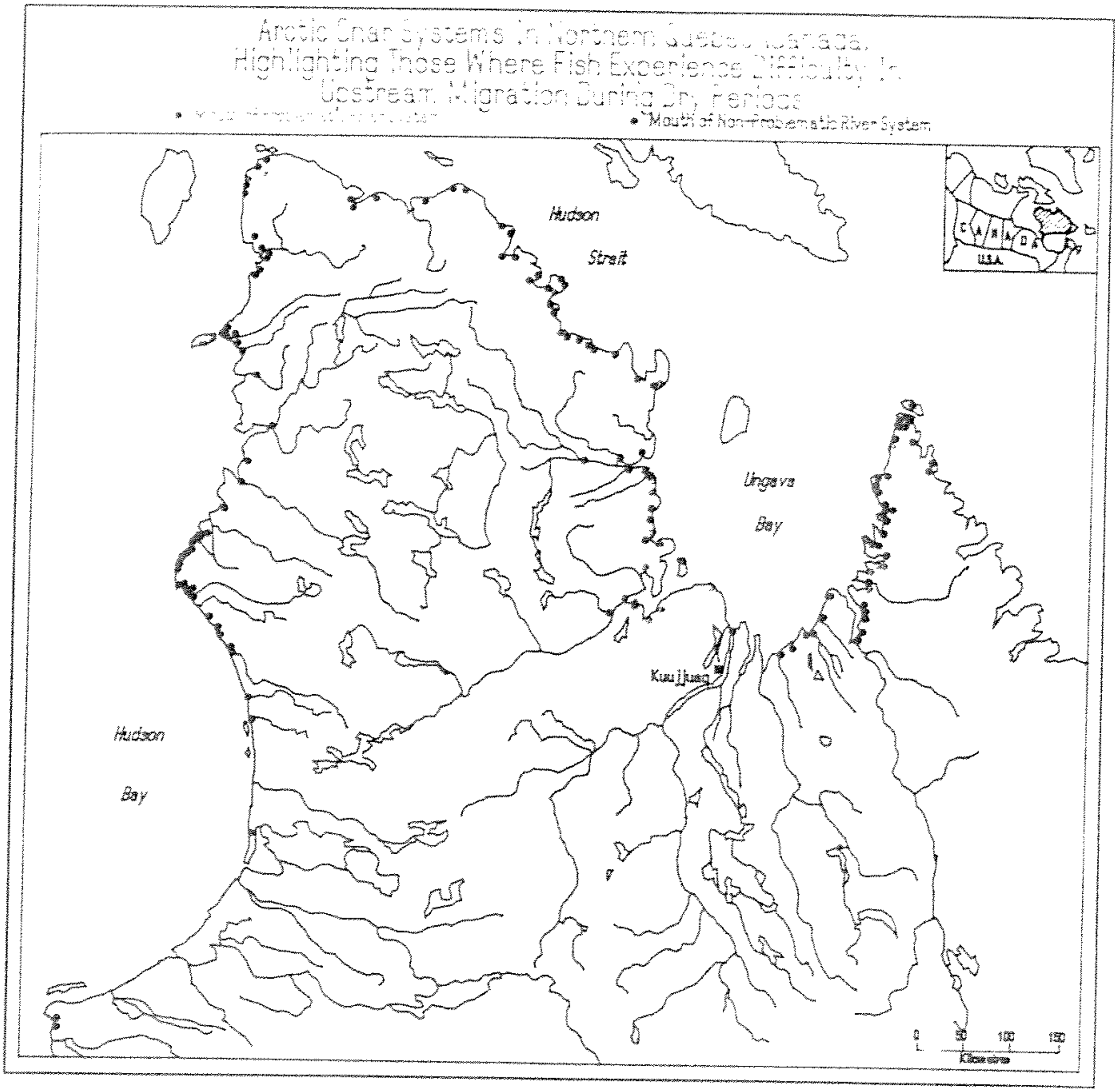


Figure 1. Location of problematic and non-problematic Arctic charr river systems in Nunavik (reproduced from Dumas (1988)).

Table 1. Number of problematic Arctic charr river systems annually surveyed between 1987 and 1989 in each community region.

Community	1987	1988	1989
Tarpangajuk		1	
Kangiqsualujjuaq		2	1
Kuujjuaq			1
Tasiujaq			1
Aupaluk			
Kangirsuk	1		
Quaqtaq			1
Kangiqsujuaq	1	1	
Salluit		1	
Ivujivik		3	
Akulivik		3	
Inukjuaq	6	4*	
Povungnituk			
Umiujaq			
Kuujjuaraapik			
Total	**8**	**15**	**4**

* includes 3 of the river systems surveyed in 1987.

Among these river systems, one is of particular interest: Kuujjuarusiq (Nepihjee River), north of Kuujjuaq consist in a long chain of connecting lakes and rivers of which less than one kilometer is accessible to anadromous Arctic charr because of waterfalls. Suitable wintering habitat for charr is limited to two small, but deep, pools located just below the falls. The Arctic charr population presently using this system is probably very small. Nonetheless, this river system would offer an immense potential if fish were able to migrate beyond the falls. This would necessitate the construction of a fish ladder and would likely require the introduction of juveniles or spawners to accelerate the establishment of the charr population.

Six additional river systems which do not presently support anadromous populations have also been surveyed. At least three of these are known to have had sea-run Arctic charr in the past. In all but one of these streams, physical obstacles to migrating fish and poor water flows were the obvious explanations for fish disappearing. In the Inukjuaq region, one Inuk family has taken the initiative of removing rocks which prevented Arctic charr from entering one of these river systems. The following year (1989), they captured two large sea-run Arctic charr in the stream. The deterioration of fish passages is associated with the isostatic uplift[1]. In the Tasiujaq region, the rate of land lift has been documented to average 4 mm per annum over the past 7 000 years (D. Gillis, pers. comm.).

Remedial Works and Inspections

In 1986, test remedial works began in Tasiujaaluk (between Tasiujaq and Aupaluk). This long and narrow river features various types of obstacles for migrating Arctic charr: shallow passages through gravel beds, steep climbs through boulders and a beaver dam (Gillis and Gordon 1987). The following year, test remedial works continued in Tasikallak (Kangiqsualujjuaq region), a short river characterized with larger rocks and boulders. These river systems have since been annually inspected to assess the state of remedial works and, when required, to carry further modifications. Most of the documentation concerning these remedial works and inspection results remain unpublished, in the form of field notes, detailed maps, sketches of stream sections and photographs.

Under the ACSE program, remedial works involve manual labor using simple tools such as shovels, steel bars, ropes and especially human muscles to deepen existing channels or to reshape others by building deflection walls (Figures 2 and 3). Imagination and common sense are at work as only natural materials from or nearby the stream are used. A typical field crew counts one biologist, four community members (one coordinator and preferably people fishing the concerned system) and one cook.

---

[1] A phenomena by which the land, being relieved from the great weight pressure from former glaciers, is continuously rising.

(Photo: Allen Gordon)

Figure 2. In Tasikallak, fishway enhancement implied moving large boulders.

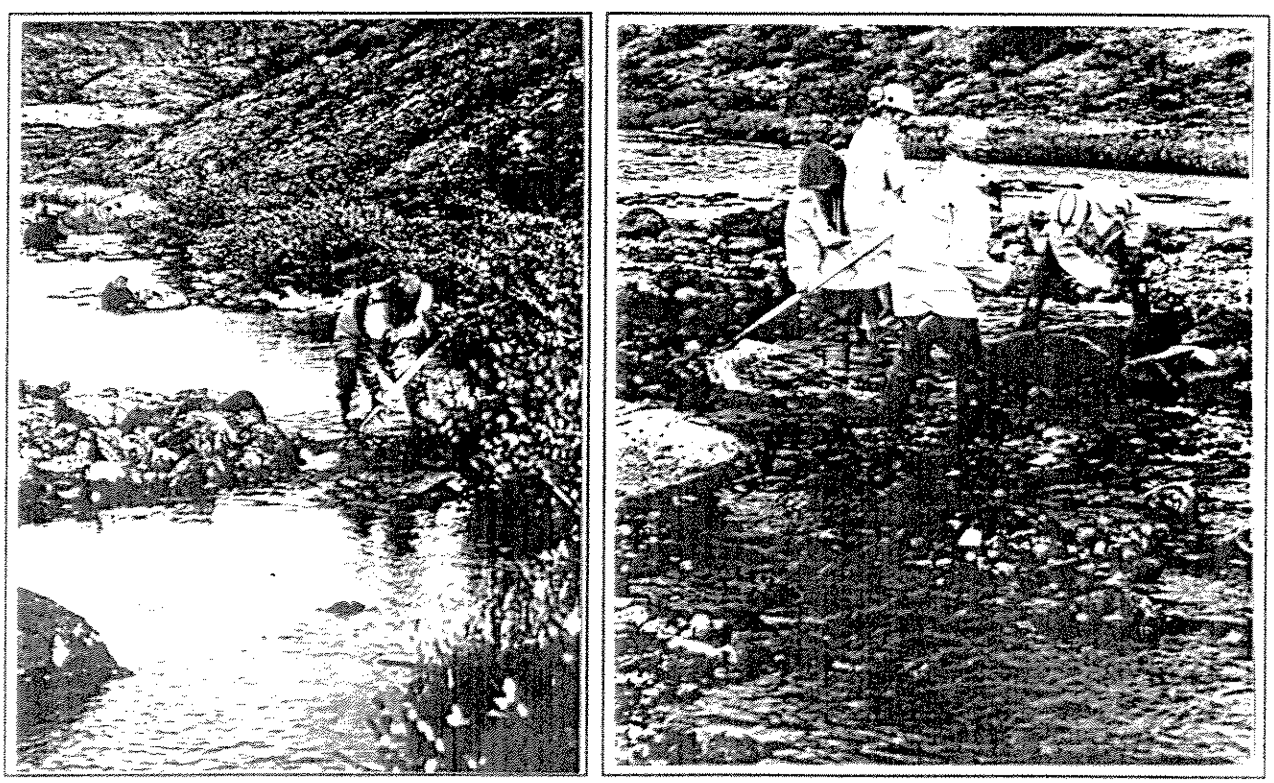


Figure 3. In Tasiujaaluk, shovels and hands were the tools of choice.

Harvest Studies

Among problematic river systems, the size of anadromous Arctic charr populations greatly vary. At one end of the scale: Saputirluit (Inukjuaq area) where Arctic charr are so few that local fishermen disagree about whether or not the species is still present in the system. At the other end of the scale: systems like Sannirarsiq and Sapukkait (Kangiqsualujjuaq area) where the annual upstream migration ranks between 4 000 and 7 000 (Boivin and Vandal 1989).

Except for a few lakes where Arctic charr have virtually disappeared, problematic river systems are fished for subsistence and, in the some cases, have been allocated commercial quotas. Depending on the river system, users may be as few as one or two fishermen, or comprise several families.

Harvest studies constitute an important component of the ACSE Program because fishing success is a simple indicator of fish abundance and such monitoring is less costly than population surveys or juvenile density studies. Along with anecdotal reports from Inuit fishermen, fishing success remains the principal mean by which the benefits of stream enhancement may presently be evaluated.

It is important to limit the collection of harvest data so as to include only fish which have been subject to migration difficulties or, in other words, only anadromous fish. In addition, for our purposes harvest levels must be system-specific and include only captures whose origins (river system) are known. Anadromous Arctic charr are generally harvested year round in Nunavik. However during the summer, fish coming from various river systems mix together at sea and catches can generally not be associated with a given system of origin. For this reason, the harvest study includes only the freshwater catch, usually between September and June. The interpretation of harvest data is further complicated by the possibly high exchange of fish between river systems as documented by Johnson (1980). Due of the lack of relevant data for Nunavik systems, this is not a factor taken into account in our analysis .

In some rivers, Arctic charr are harvested by kakkivak (fish spear) or gaff as soon as they return from the sea when they congregate under rapids or small falls during their upstream migration (mid-August to mid-September). In locations where lakes are reasonably close to the sea, Arctic charr may also be captured by net before lakes freeze. In most systems, serious fishing begins only after freeze-up. October, November and December are major fishing months while the ice is thin, temperatures are not severely cold yet and fish are still moving. During this period, most of the fishing effort is performed by net, though jigging is common and kakkivak are occasionally used. Fishing activities are moderately maintained throughout the winter. In the spring, fishing intensity is revived as jigging through the ice is the method of choice until the ice candles and becomes unsafe. At that point, Arctic charr begin to descend to the sea. At Sapukkait and Sannirarsiq, studies have shown that the majority of fish will spend one entire year in freshwater before spawning (Boivin et al. 1990). Anadromous Arctic charr are therefore susceptible of being caught in freshwater during the summer but the importance of these catches is marginal in most systems.

Harvest studies began in 1986-87 to document the fishing success in lakes of the Tasiujaaluk river system, following the first remedial works. Unfortunately, no pre-works baseline data existed. This highlighted the need to establish a data base for other problematic river systems.

In 1987-88, all but three communities were asked to participate in the harvest study. The three communities excluded were: Kangiqsualujjuaq whose Arctic charr harvest was already monitored, Povungnituk who had not responded to the initial community consultation and Kuujjuaraapik whose only two Arctic charr systems experience difficulties other than migratory in nature. Of 12 communities expected to participate, six provided harvest data, documenting fishing success in 12 problematic systems. Data were available for eight additional systems of the Kangiqsualujjuaq area (Boivin et al. 1988). In 1988-89, harvest data were obtained from nine communities, adding to a total of 25 systems.

1989: AN EXCEPTIONALLY DRY SUMMER

During the summer of 1989, water levels were much lower than usual everywhere in Nunavik due to poor precipitations in July, August and early September (Figure 4 and 5).

Figure 4. Precipitation at Kuujjuaq during the summer 1989. Data source: Ministère de l'Environnement du Québec, Service de la météorologie.

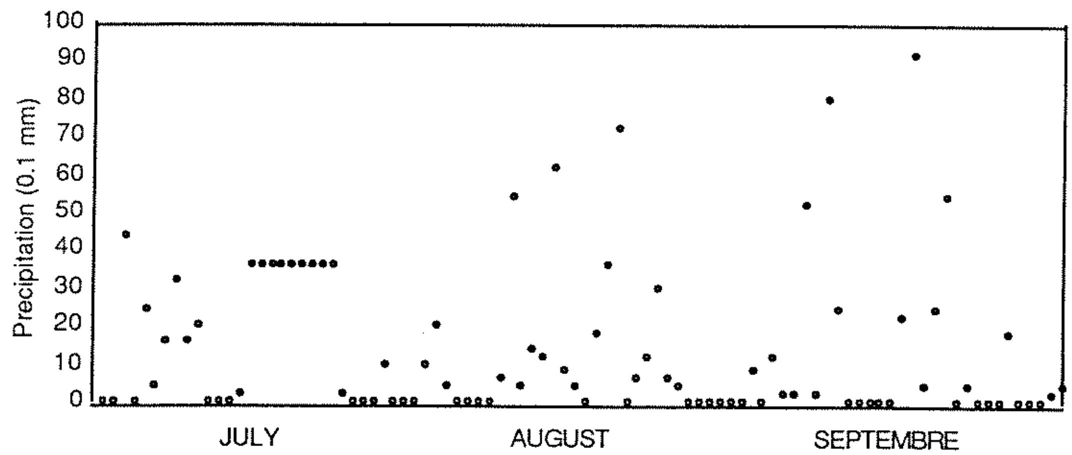
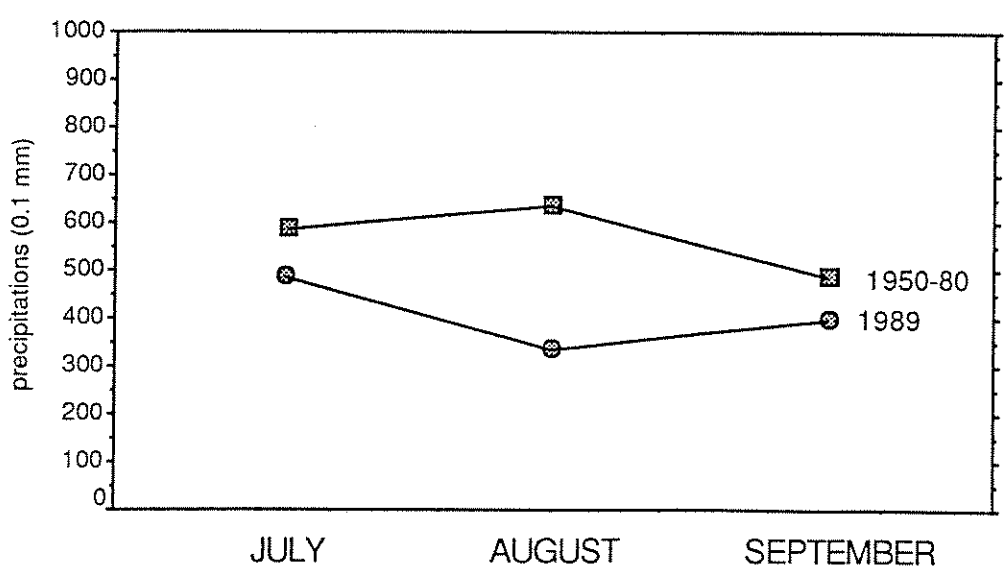


Figure 5. Monthly total precipitation at Kuujjuaq during the summer 1989 as compared to the 1950-80 average. Data source: Ministère de l'Environnement du Québec, Service de la météorologie.



In at least two streams (Tasiujaaluk and Nikuttivik, Aupaluk region), rivers were so dry in 1989 that fish were trapped in various pools during the upstream migration; 1989 was an ideal summer to document the difficulties experienced by Arctic charr migrating through critical stream conditions. These difficulties consisted mainly in shallow river sections, interruption of stream flow, rock barriers and sudden drop in streambed. In the latter case, stream features which normally would had been rapids or small falls became impassible jumps for fish. Despite these obvious problems, only three Arctic charr were found dead in nine river systems surveyed, some more than once.

REVIEW OF ACTIVITIES IN 1989

The previously described activities fulfilled almost completely the goals pertaining to Phase I. In 1989, phase II began. Activities were conducted under each of the four main groups and a training workshop was organized.

1. **Stream enhancement workshop** for field coordinators from each community involved in 1989 remedial works.

2. **Inspection** of test remedial works in Tasiujaaluk and Tasikallak.

3. **Survey** of four problematic river systems: Napaartulik (Kangiqsualujjuaq), Kuujjuarusiq (Kuujjuaq), Iqaluliapik (Tasiujaq) and Iqaluppilik (Quaqtaq).

4. **Remedial works** in five river systems from three regions: Aupaluk (Nikuttivik), Kangirsuk (Qamanialuk) and Akulivik (Paakittuq, Qallunaartaliviniq and Sapugaarjuit).

5. **Harvest studies** in problematic river systems not yet included in other studies.

Field Work Schedule

Locations of the river systems involved in the 1989 program activities are presented in Figure 6.

JULY 24-28: Stream enhancement workshop held in Tasiujaaluk for field coordinators from Tasiujaq, Aupaluk, Kangirsuk and Akulivik.

AUGUST 1-5: Remedial works in Qamanialuk (Kangirsuk).

8: Inspection of Iqaluppilik (Quaqtaq).

10-15: Remedial works in Paakittuq, Qallunaartaliviniq and Sapugaarjuit (Akulivik).

22-23: Inspection of Tasiujaaluk (Tasiujaq-Aupaluk).

24: Survey of Iqaluliapik (Tasiujaq).

27: Tagging of 50 Arctic charr trapped at the mouth of Tasiujaaluk.

28: Inspection of Tasikallak (Kangiqsualujjuaq).

28: Survey of Napaartulik (Kangiqsualujjuaq).

SEPTEMBER 14: Survey of Nikuttivik (Aupaluk).

19-20: Remedial works in Nikuttivik.

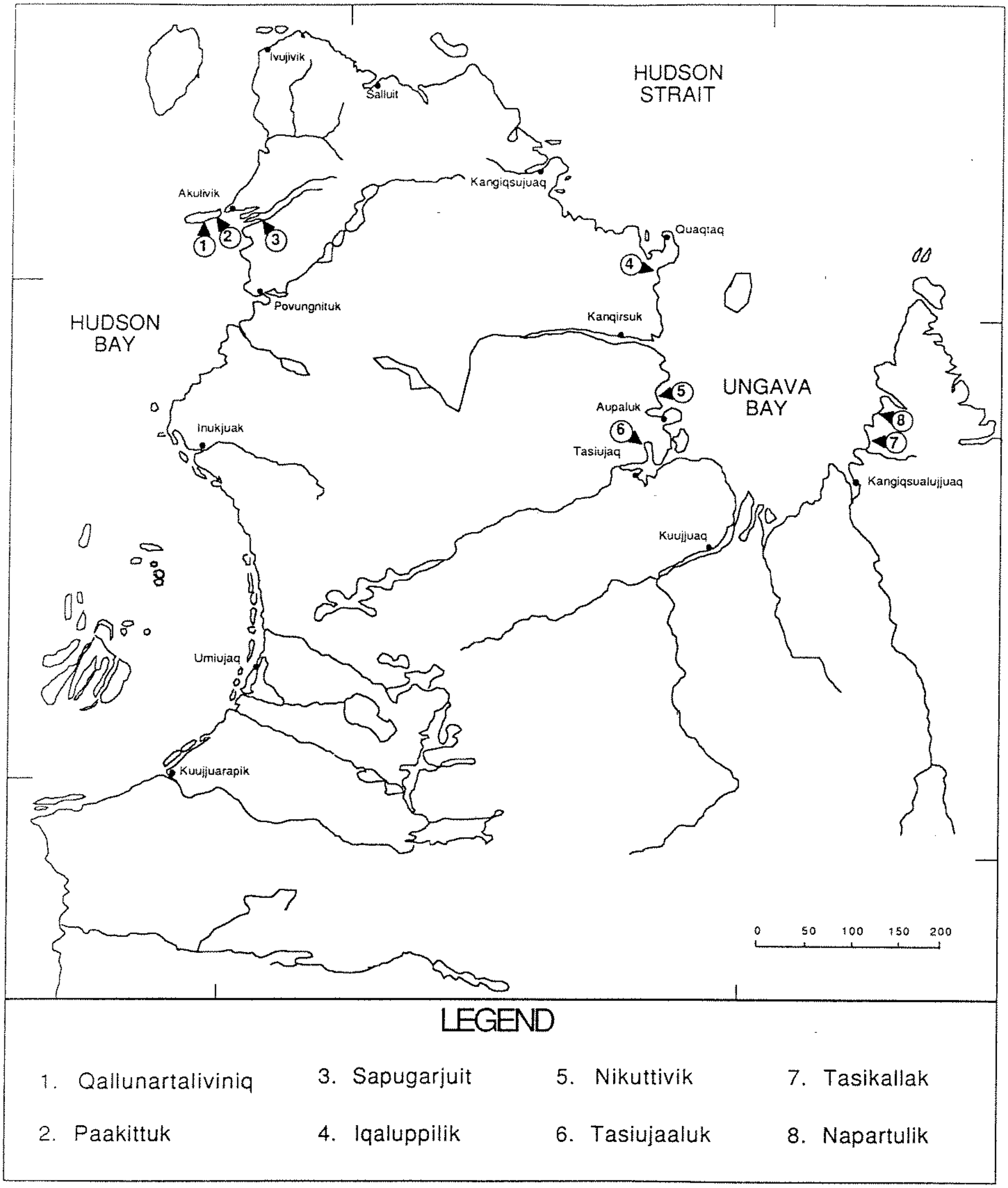


Figure 6. Location of river systems where remedial works and inspections were conducted in 1989.

Stream Enhancement Workshop

The purpose of the stream enhancement workshop was to review our present techniques with the expertise of a specialist in hydrology and stream engineering, and to provide community coordinators with the technical background necessary for them to supervise future remedial works in their own community. Representatives from Tasiujaq, Aupaluk, Kangirsuk and Akulivik participated to the workshop. Carol Rae (Ministère du Loisir, de la Chasse et de la Pêche) acted as technical expert.

The workshop was divided into theory and field sessions respectively held in Tasiujaq and Tasiujaaluk. In the theory session, problems experienced by Arctic charr in various streams of Nunavik were reviewed using photographs from previous surveys, particularly from Tasiujaaluk and river systems where remedial works were to be conducted in 1989. A half-day period concerned more sophisticated structures and fishways used in southern regions of Québec to ease the migration of Atlantic salmon *Salmo salar*. In the field, participants conducted various types of remedial works on river sections of Tasiujaaluk which were diagnosed as problematic for migrating charr.

Annual inspections

Tasiujaaluk
(Tasiujaq-Aupaluk)

A description of this river system as well as a summary of remedial works conducted in 1986 and inspection results from 1987 are presented in a technical report prepared for the communities of Tasiujaq and Aupaluk (Kuujjuaq Research Centre 1988). Tasiujaaluk is a long and narrow river which leads to three lakes used by Arctic charr as spawning and/or wintering habitats; the major obstruction to char migration are located within the first two kilometers of river (Figure 7).

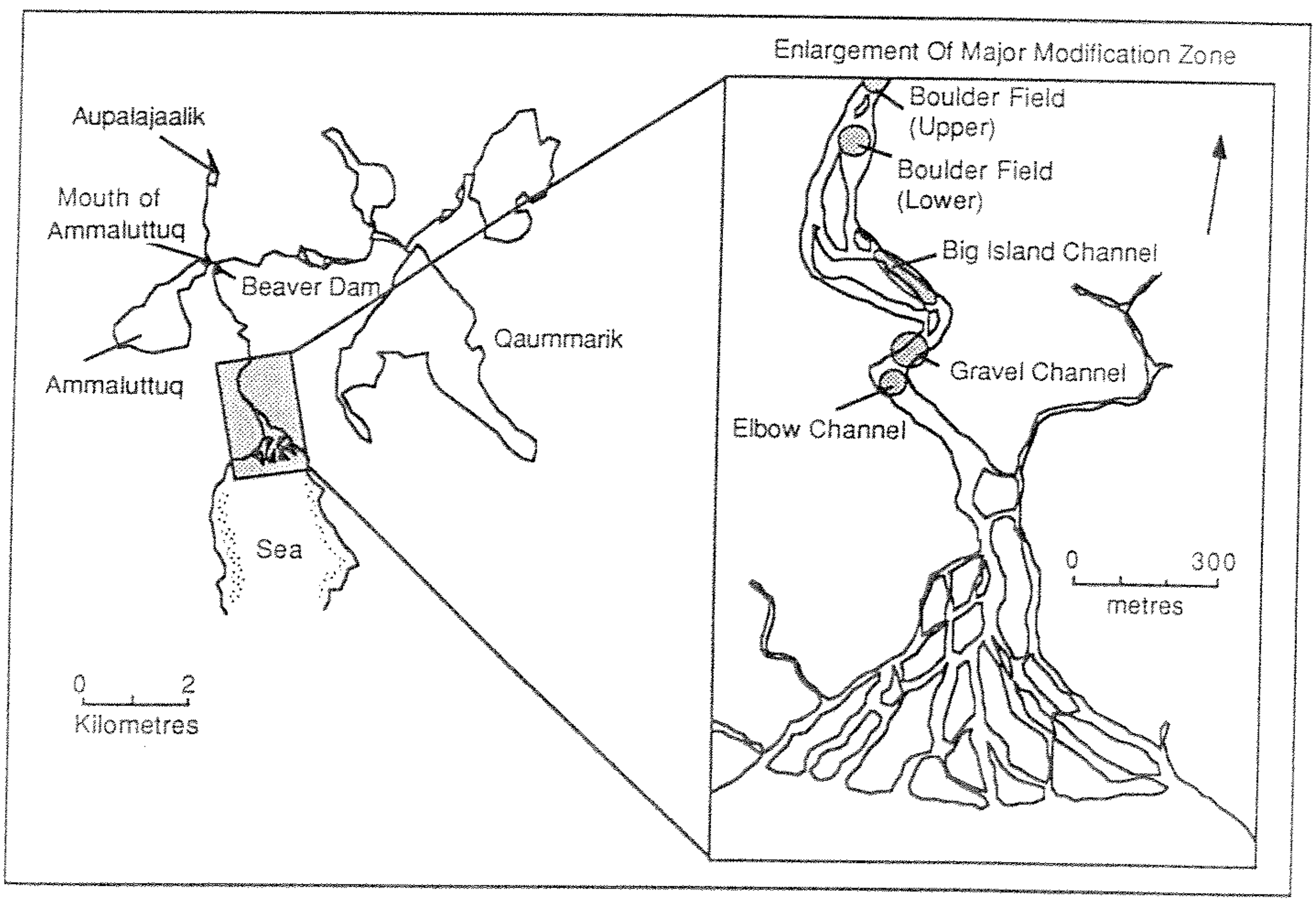


Figure 7. Map of the Tasiujaaluk river system indicating the primary locations of concern for stream enhancement.

In 1989, the lower sections of this river system (approximately two kilometers) had completely dried up by August 22. Water flow was maintained in the first kilometer of river above the estuary, solely by an underground water stream originating from a near-by mountain flowing into the main stream. On August 22, approximately 75 Arctic charr were observed in the stream between the tidal zone and the outlet of the underground water stream. Further upstream, one fish had been found dead in July, most likely trapped between rocks either as an early upstream migrant or a late "downstreamer".

On August 27, fifty of these Arctic charr were tagged with anchor T-type tags and fin clipped. Average fork length was 57.8 cm and ranged between 35 and 80 cm. On September 14, these fish were still present in the stream in similar numbers and resting in the same pools. The number of fish in each pool was similar to what was observed two weeks earlier. The stream was still dry and no charr could have yet reached their spawning and wintering lakes. By the end of September, abundant rain had restored the flow of Ungava streams to normal levels and charr migration most likely proceeded without difficulty. This assumption is supported by the fact that eight of the tagged fish were recaptured in the winter subsistence fishery, all from Aupalajaalik.

Three lakes are used as wintering habitats by anadromous Arctic charr in Tasiujaaluk, two of these are fished by one regular fisherman throughout the winter. Interestingly enough, although fishing effort and number of captures were similar in both lakes (see "Harvest studies" section), all recaptures came from the same lake (Aupalajaalik). This lake is the furthest of the two, meaning that fish had been able to reach the closer lake (Ammaluttuq) as well.

Much of the remedial works conducted in 1986 in Tasiujaaluk are still visible although reshaped or partially washed away. This was easily observed in 1989 since most of these modifications are located within the zone which was completely dry.

As an example, we may examine a boulder field which constitute one of the major obstacles encountered by Arctic charr in Tasiujaaluk. In 1986, a fishway was created through this boulder field to channel the flow into a single path at reduced water levels. Caution was taken to create a winding course allowing the presence of resting pools. Figure 8 illustrates the annual degradation of this channel between 1986 and 1989. We can clearly see that the sinuous path created in 1986 has been simplified into a straighter path which resembles the natural state (before remedial works) except that a deeper channel still exists. In this particular case, this partial return to the natural state is explained by the fact that in the spring the strong current is almost perpendicular to the fishway, which follows rather the slope of the streambed or the direction of flow under reduced water levels. The present path is still partially effective since it receives a greater portion of the flow than would the pre-remedial work's. However, maintaining the original fishway (Figure 8b) would require an annual restoration if the current techniques were used. In 1989, only the entrance to the channel was repaired although this section was completely dry (Figure 9). Every year, small rocks accumulate and obstruct this entrance as illustrated in a 1987 photograph taken while river flow was very high (Figure 10).

Figure 8. Annual photographs of the lower boulder field in Tasiujaaluk, 1986-89.

(Photo: Dave Gillis)

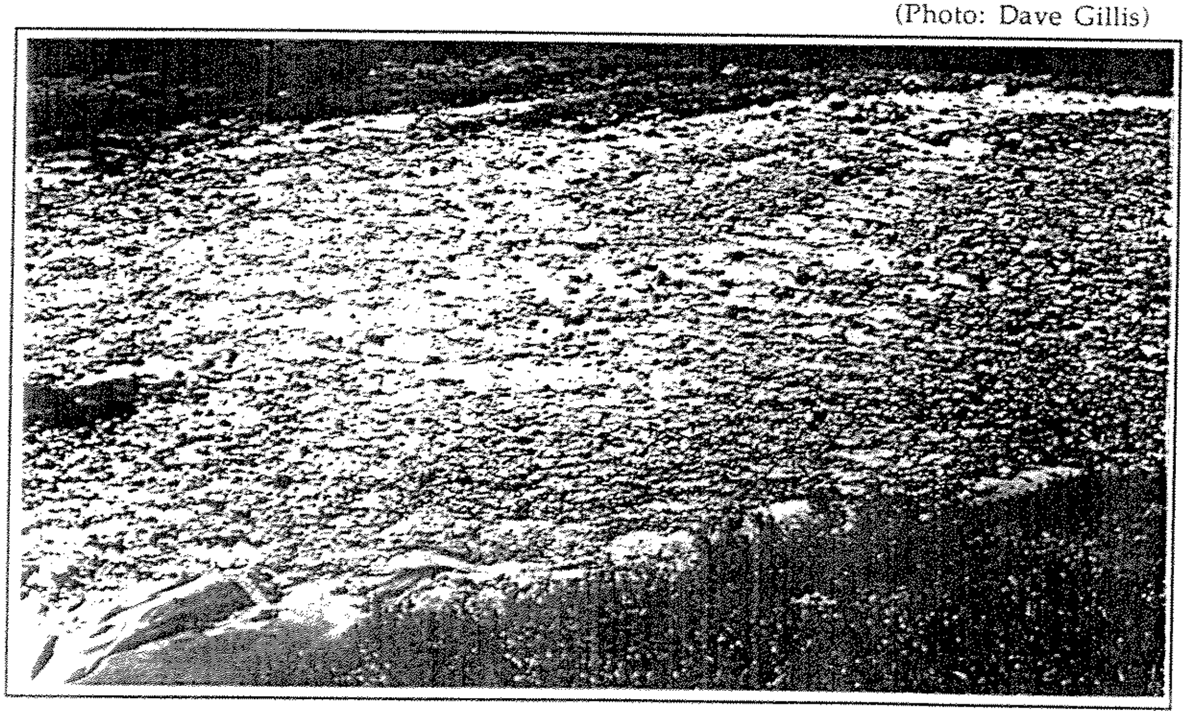


Figure 8a: Lower boulder field before remedial works (August 1986).

(Photo: Dave Gillis)

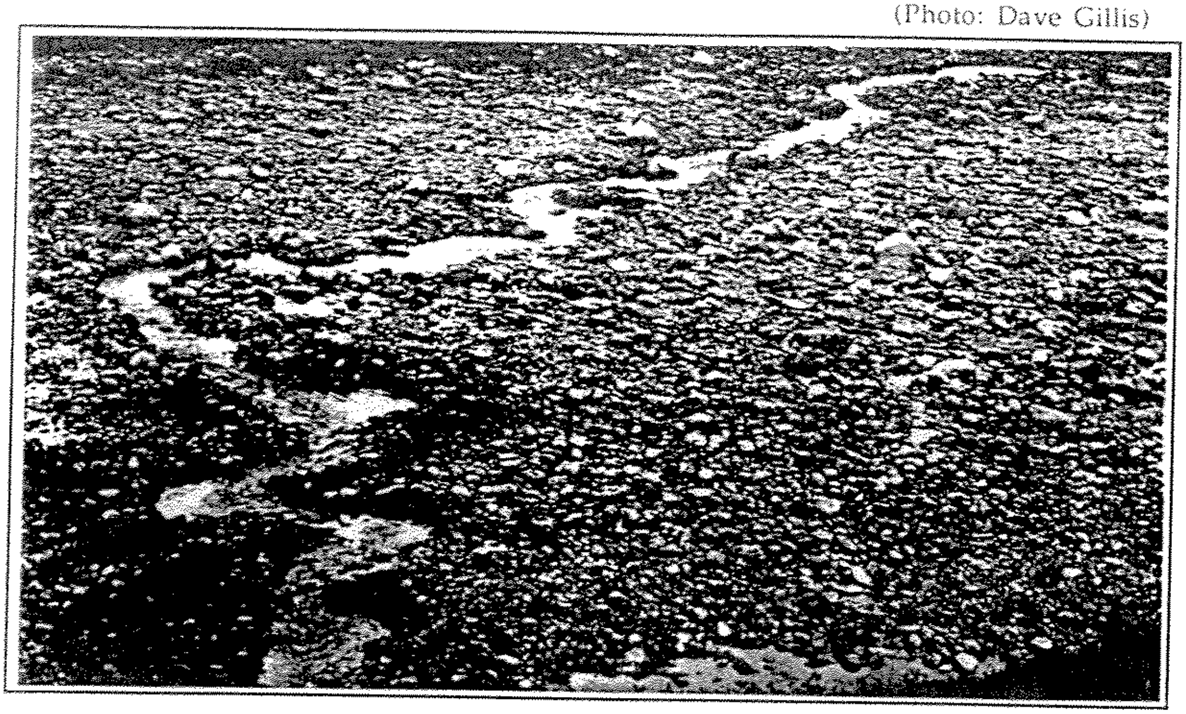


Figure 8b. Lower boulder field after remedial works (August 1986).

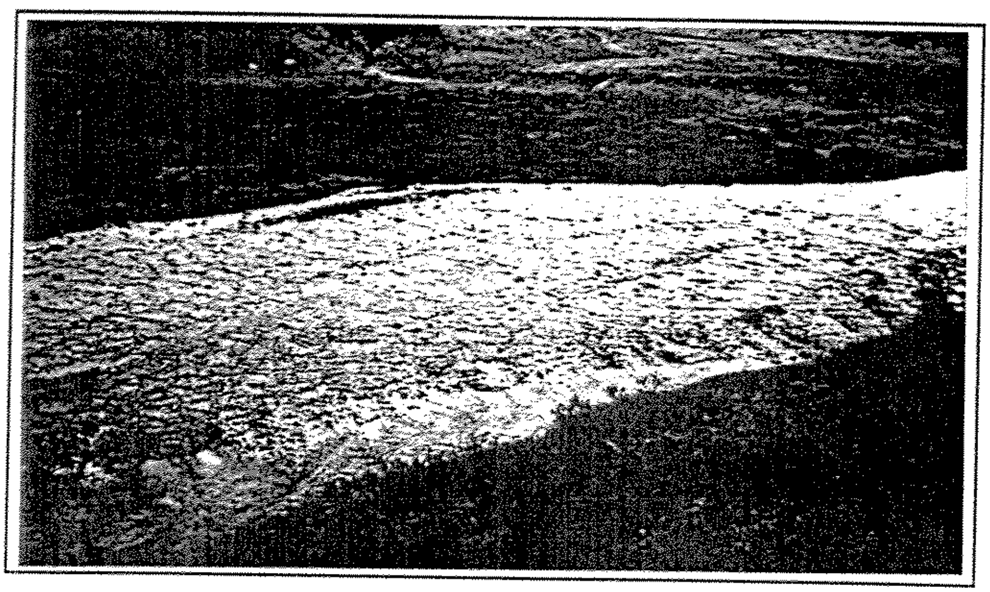


Figure 8c. Lower boulder field (August 1987).

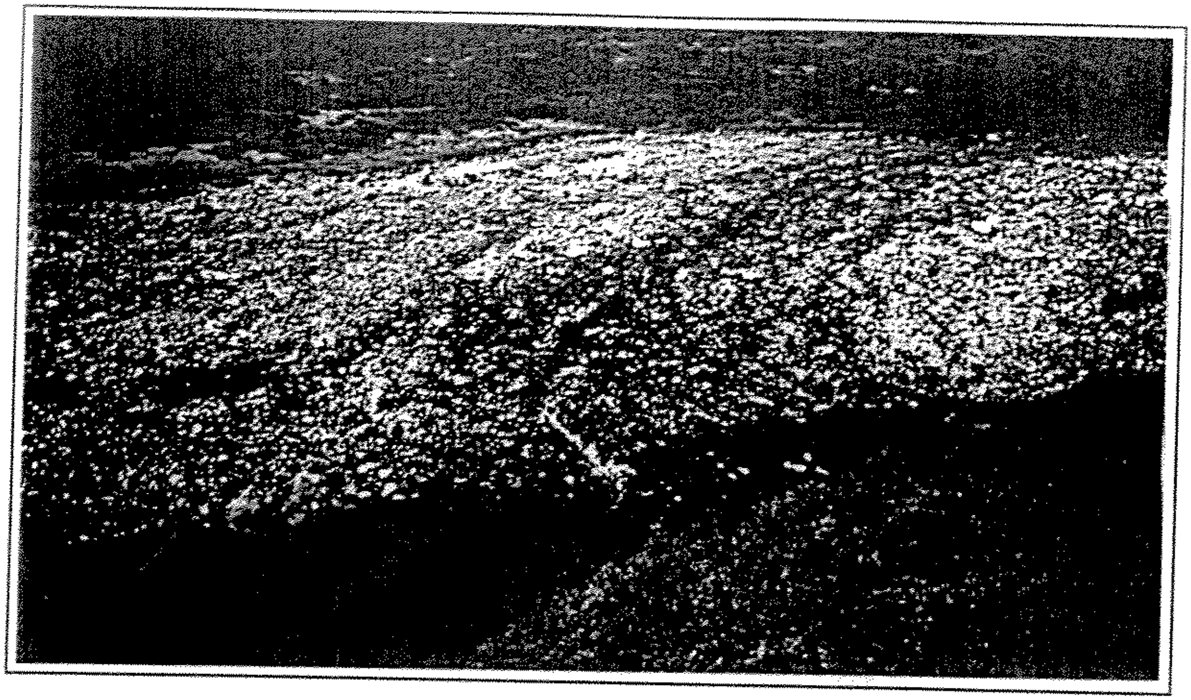


Figure 8d. Lower boulder field (August 1988).

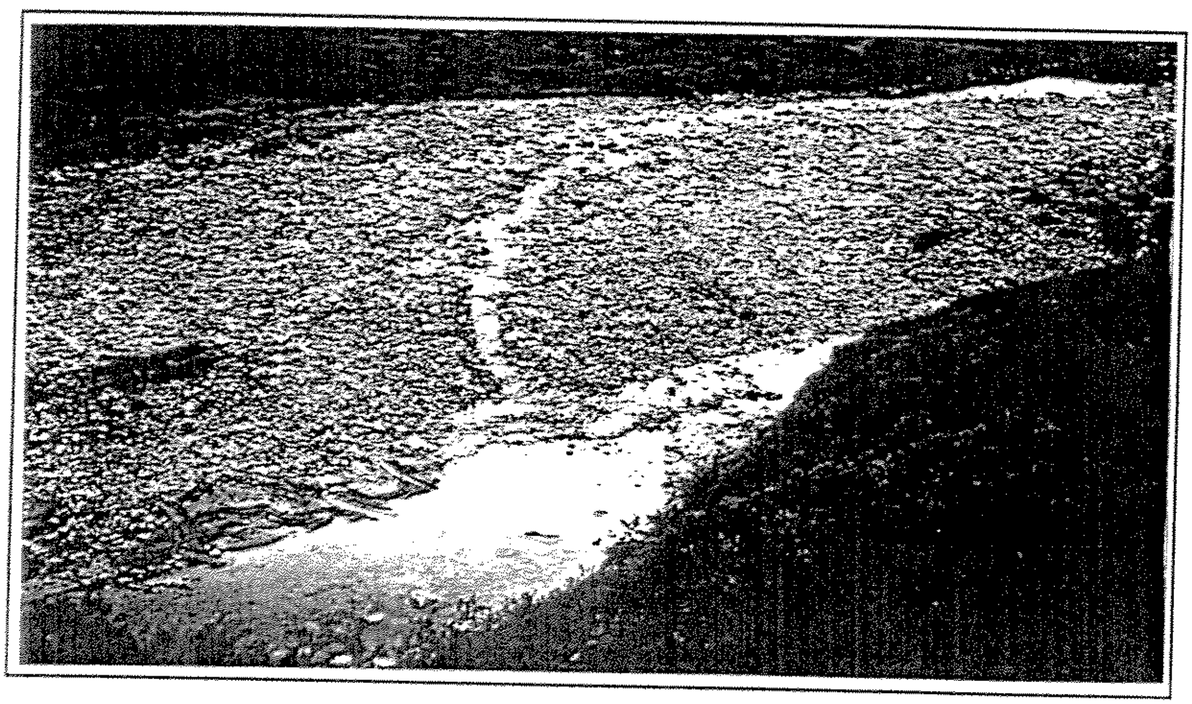


Figure 8e. Lower boulder field (August 1989).

Figure 9. Maintenance at the entrance to the lower boulder field in Tasiujaaluk while this section of the river was completely dry.

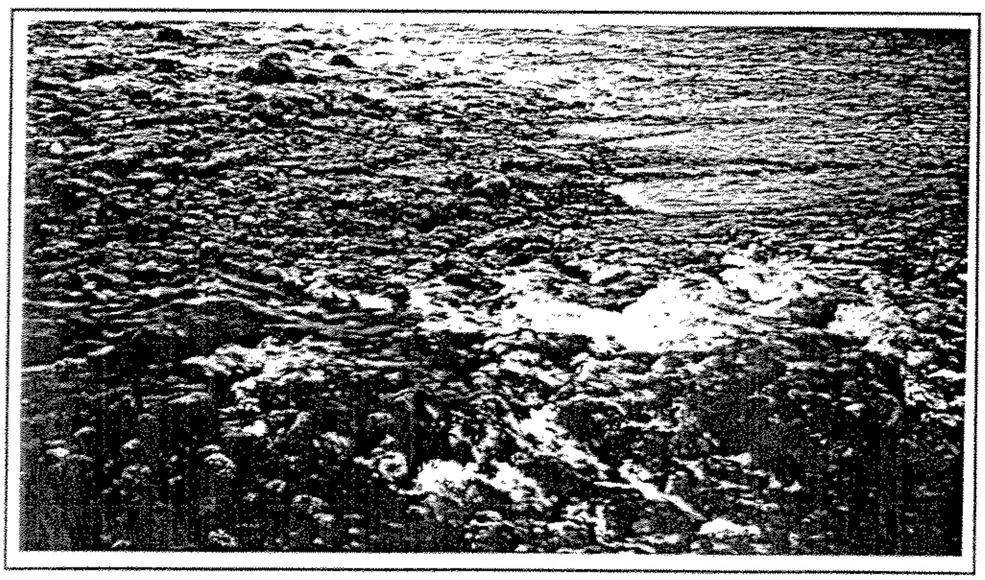


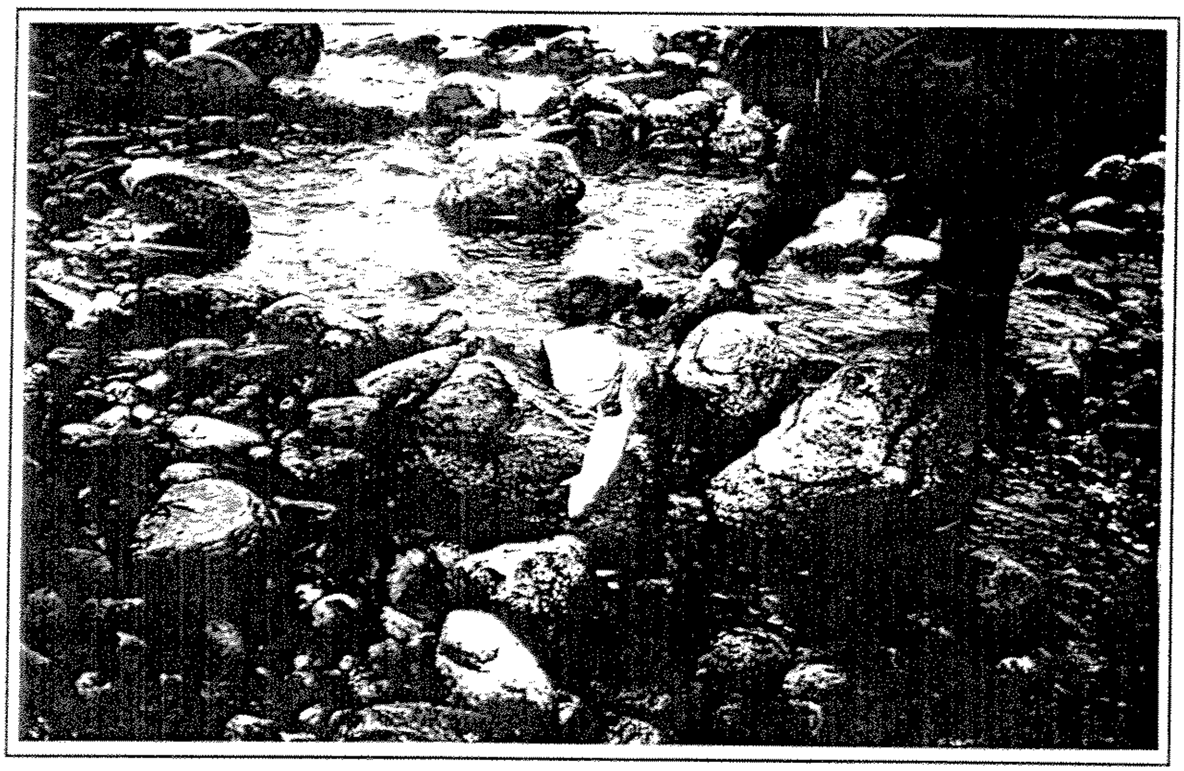
Figure 10. Side view of the entrance to the lower boulder field in Tasiujaaluk in 1987.

Each relevant stream feature was photographed during the multiple surveys and detailed field notes were taken; this information remains available for future reference but will not be extensively described in this report as this should be included in an eventual synthesis review of Phase I.

The apparent cause of flow interruption in this system is a deep enlargement (pool) of the river located further upstream (before the lakes) and which acts as a reservoir: when water levels drop below that of the outlet of that pool, flow is interrupted and the river dries up (Figure 11). This has occurred during two of the past four summers: 1986 and 1989. The construction of a water retention system which could be manually operated seems to be the only solution to this problem (C. Rae, pers. comm.). However the logistics of building and operating retention structures make this alternative less practical.

Figure 11. Downstream view of a deep pool located approximately 3 km from the mouth of Tasiujaaluk. Acting as a reservoir, it caused the complete interruption of flow in 1989 as seen here.

Remedial works such as diversion walls and deepened fishways remain partially effective during the normal low water periods but definitely need an annual maintenance because they are damaged by strong spring currents. This river system must be closely monitored.



By August 22 1989, Tasiujaaluk had completely dried up over a 2-kilometer river section. In July, one fish had been found dead, either as an early upstream migrant or as a late "downstreamer".

Tasikallak
(Kangiqsualujjuaq)

Tasikallak is one of the best Arctic charr fishing lakes in Nunavik and one of the key systems fished for subsistence in Kangiqsualujjuaq. It (Figure 12) benefits from a good water flow. However, during summers of poor precipitations, many of the possible routes for upstream migrating charr result in dead-ends among boulders. A well defined and durable fishway was created in this river in 1987 by moving large boulders. Unfortunately, in some river sections the path runs almost crosswise to the river bed and where smaller rocks were used, water spillage occurs. This spillage may create sufficient flow to attract fish towards the outside of the fishway's wall where they may be trapped. Two fish were found dead in such situation. A crew of four would need two working days to better "seal" the downstream-side wall of the fishway by widening the entrance in order to reduce the likeness of fish getting trapped.

Figure 12. Low oblique aerial view of Tasikallak.

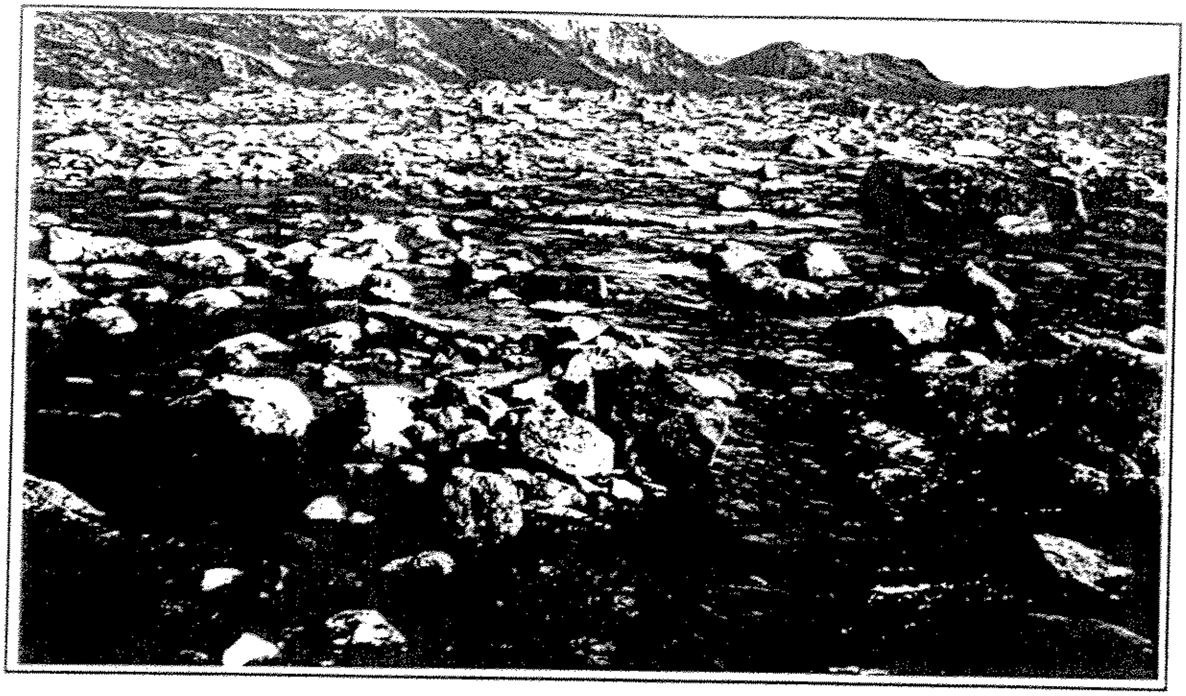


Figure 13. View of the lower section of the fishway in Tasikallak: smaller rocks present and used in this section have been moved by the the river flow which, during high water levels, runs perpendicular to the fishway.

Figure 14. Detailed upstream view of the fishway showing the seepage.

Napaartulik
(Kangiqsualujjuaq)

This river (Figure 15) maintains a good water flow throughout the summer but migrating charr may have difficulty in swimming through certain passages just before reaching the lake because the outlet is extremely wide. The river branches into many steep channels (Figures 16 and 17) before the lake, this greatly diffuses water flow into smaller streams, many of which are obstructed by willow bushes. The required remedial works are light; 2 days would suffice for four men to complete the remedial works.

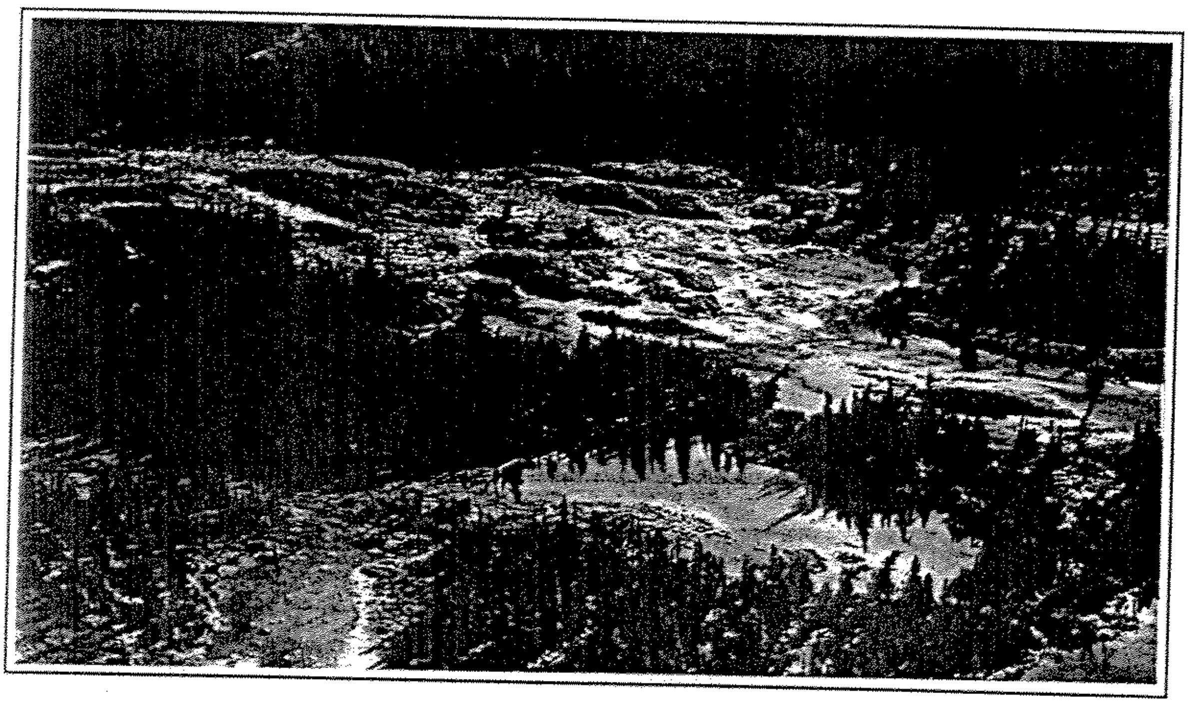


Figure 15. Low oblique aerial photograph showing a section of Napaartulik where the river branches into several channels.

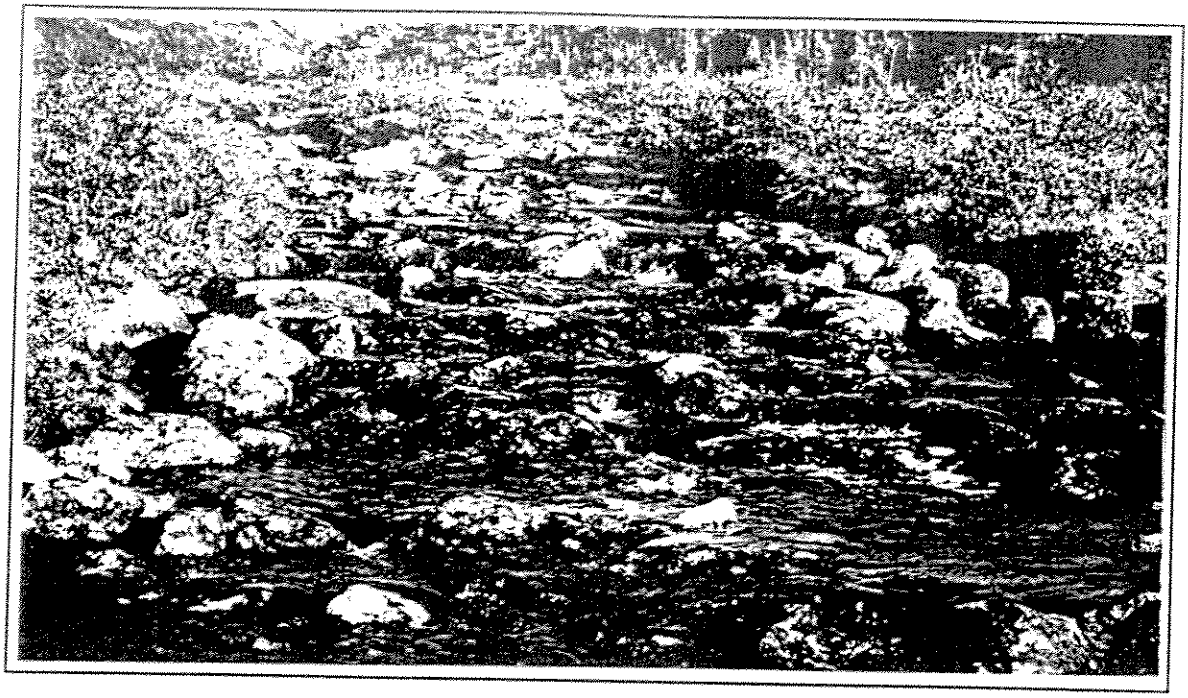


Figure 16. Upstream view of a main branch of Napaartulik river.

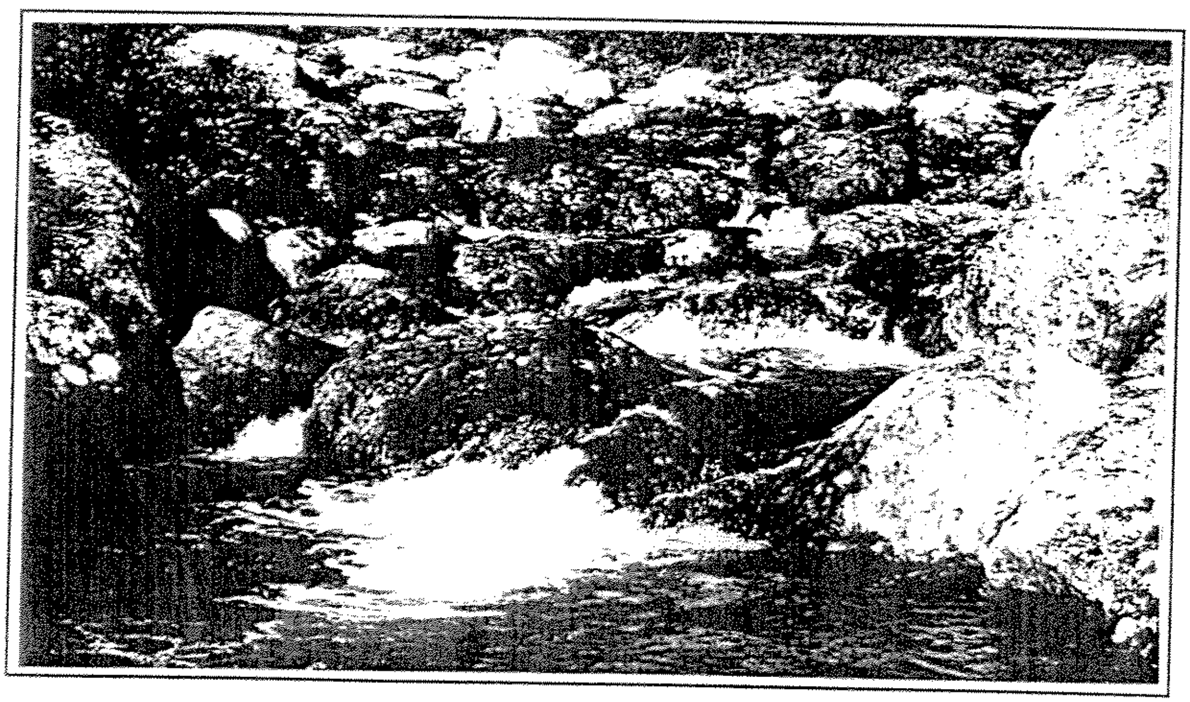


Figure 17. Napaartulik contains steep stream segments not believed to be problematic for Arctic charr.

Kuujjuarusiq
(Kuujjuaq)

This river system was surveyed under a contract from Kuujjuamiut Inc. to evaluate the possibility of increasing the size of anadromous Arctic charr wintering and spawning habitats (Barton et al. 1985, Dumas 1990). A fish ladder would allow fish above twin falls (Figure 18), the only obstacle preventing Arctic charr from reaching a long chain of lakes (Figure 19). As explained in the background section, this river presently offers very limited habitat for Arctic charr to spawn and winter (Figure 20). They have occasionally been caught in the autumn below the falls.

On August 30, a team of divers inspected the falls to verify a legendary belief (among certain residents of Kuujjuaq) concerning the existence of a passage or cave (under the falls) where fish could overwinter. The existence of such features was denied by the underwater survey.

This river system represents a great potential for increasing the availability of Arctic charr in the vicinity of Kuujjuaq. The project is currently evaluated by Kuujjuamiut Inc.; it remains independent of the ACSE Program.

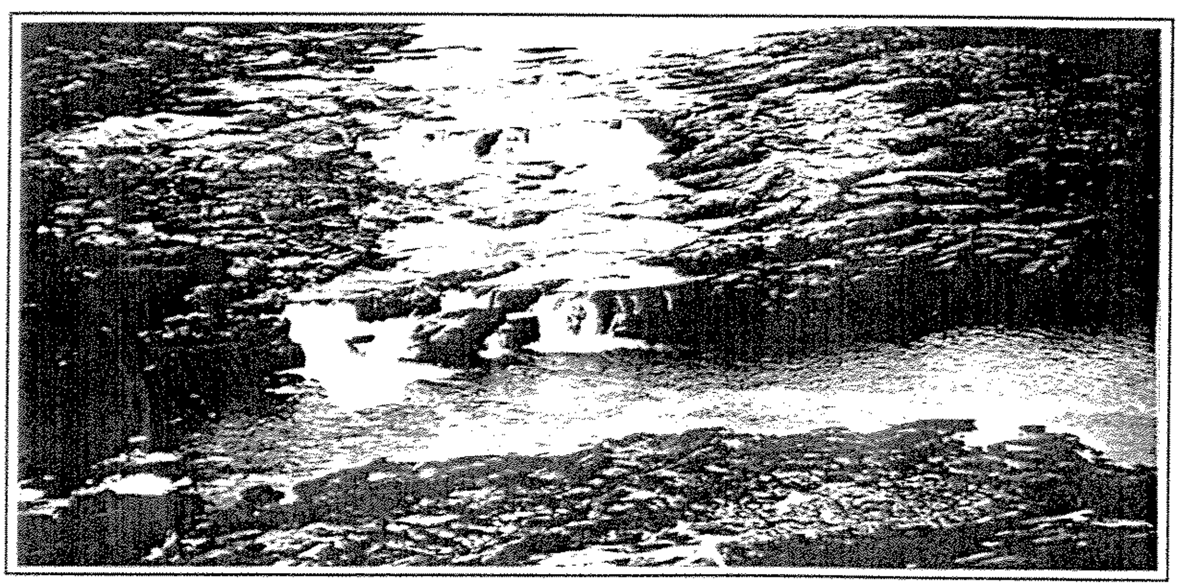


Figure 18. In Kuujjuarusiq, these falls located close to the sea are the only obstacles preventing Arctic charr from reaching the lakes above.

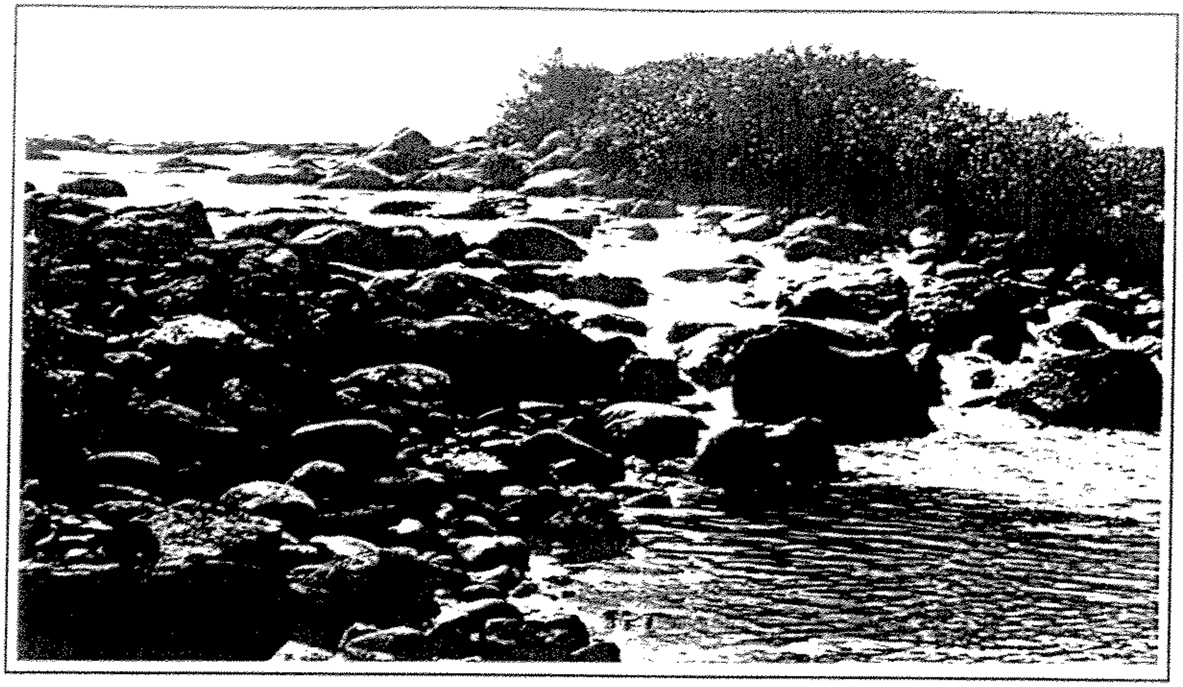


Figure 19. Although certain parts of the river are shallow above the falls, survey results have shown that this would be a problem for Arctic charr migration.

Figure 20. In Kuujjuarusiq, Arctic charr spawning and wintering habitat is limited to a large and a smaller pool respectively located below and East of the falls.

Iqaluliapik
(Tasiujaq)

This river contains sections unusually steep for a system used by anadromous Arctic charr. However, these are not problematic for migrating fish because they consist in multiple steps easily passed by Arctic charr (Figure 21). The only river section where Arctic charr may experience some difficulties is located just above the tide line where the stream is divided into two branches: it consists in a short shallow climb through medium-size rocks. Although not of severe concern, some light remedial works could improve the migration path. This would require no more than two days of work for a three-men crew. This system remains a low priority.

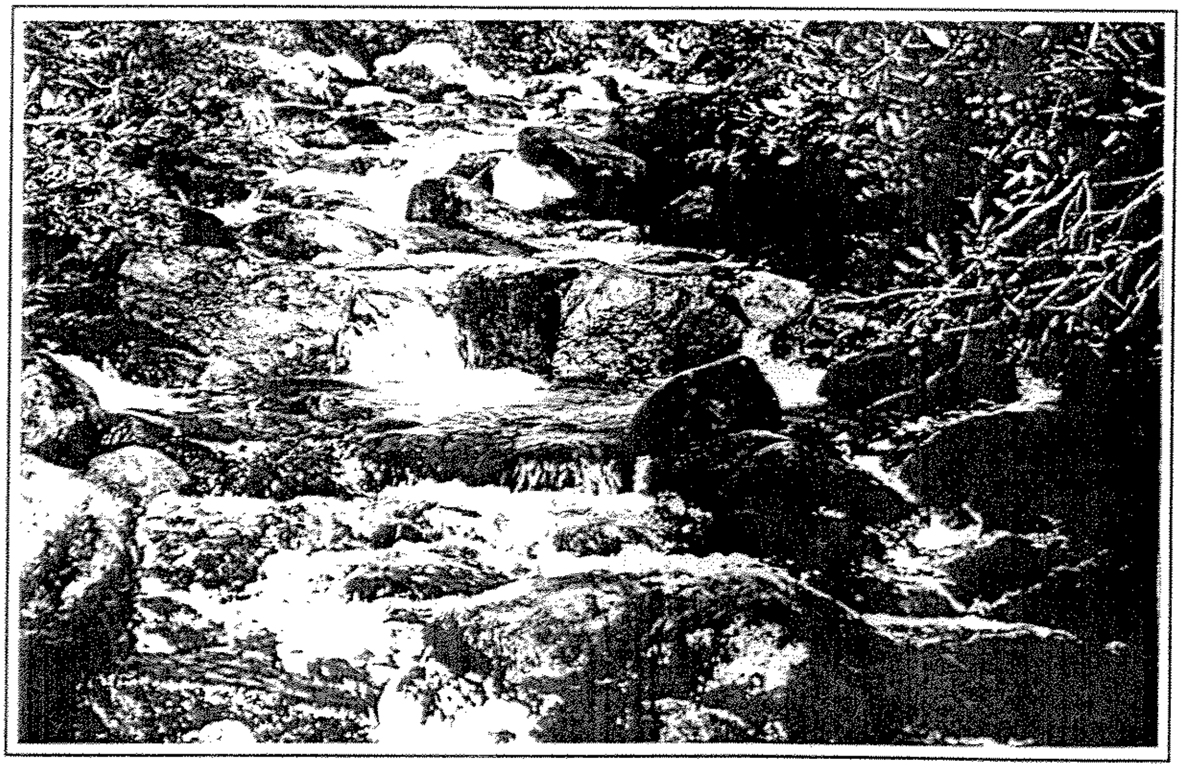


Figure 21. Iqaluliapik: a steep climb through large boulder which do not represent a difficulty for Arctic charr migrating upstream.

Iqaluppilik
(Quaqtaq)

This river (Figure 22) contains very difficult passages for upstream migrating charr and should be considered as a high priority. A traditional fishing weir (saputiit) located close to the sea was known to affect the migration of Arctic charr in this river (D. Oovvout, pers. comm.). Now it is vestigial but has left very shallow passages in its surroundings. Further upstream, water flow gets diffused into smaller channels whose largest could not be used by charr without difficulty. These channels consist in larger rocks through which a fishway must be opened; such eventual remedial works would be durable (Figure 23). An other traditional fishing weir is located at the outlet of the lake. Although the access to the lake is shallow it is not of great concern for Arctic charr migration (Figure 24).

Great care must be taken when working on this stream in order not to drain critical pools or create dead-ends into which migrating fish may get trapped. Four men would require five days to complete the necessary remedial works.

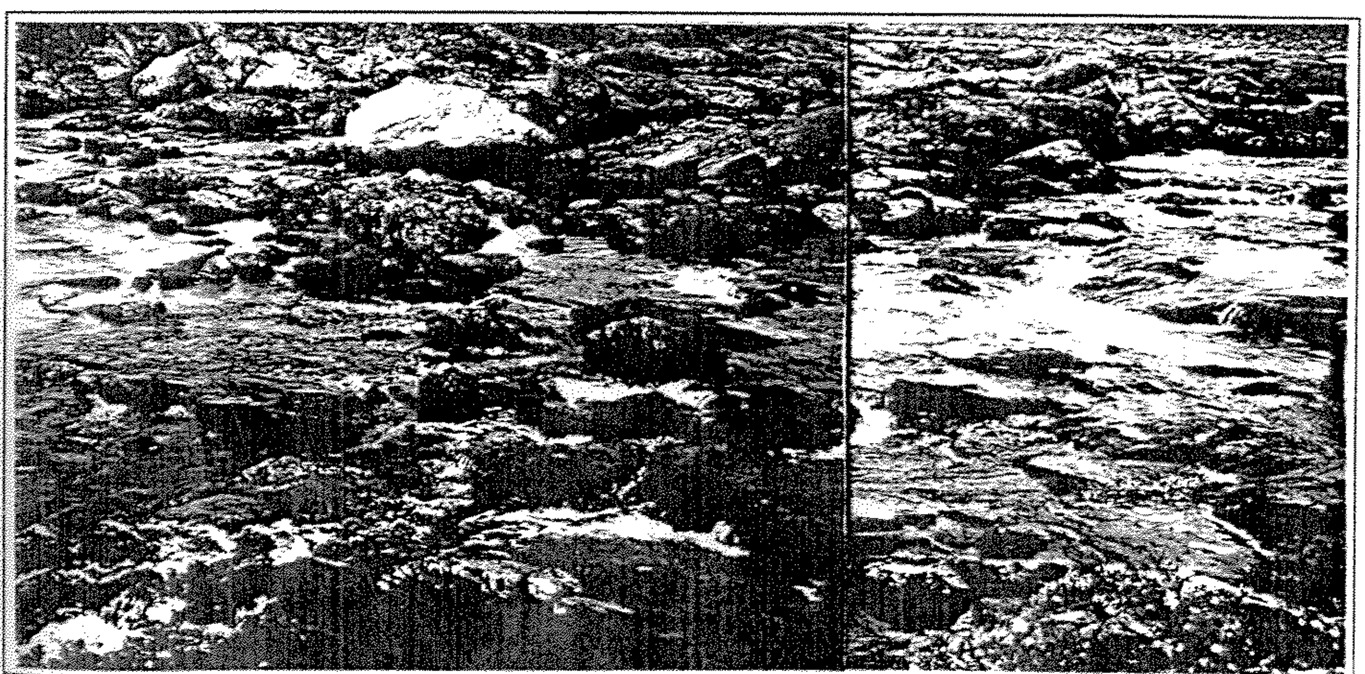


Figure 22. Most of the riverbed in Iqaluppilik consists in larger rocks.

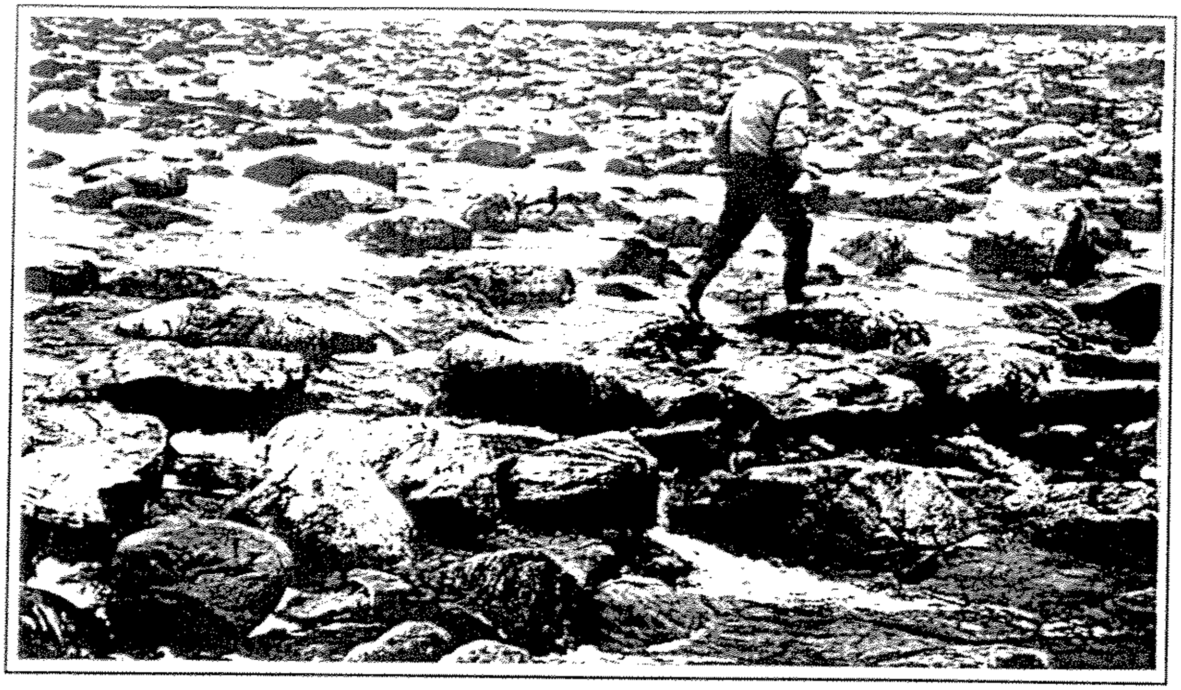


Figure 23. Upstream view showing part of the boulder field which represents the most problematic section in Iqaluppilik.

Figure 24. Lake outflow in Iqaluppilik showing vestigial Saputiit.

Nikuttivik
(Aupaluk)
[September 19 -20: 5 men X 2 days]

This river was previously inspected on September 14, while approximately 300 charr were trapped below a steep rapid near the first lake. Many of the fish trapped in the stream had part of their belly skin worn to the flesh; one fish had had his back skin obviously dried up in the recent days. Unfortunately, the main camera used during the surveys was stolen and there are no photographs available to illustrate this exceptional situation.

Emergency remedial works were conducted on September 19 and 20; these involved reducing the fall-like rapids (one-meter vertical drop) into smaller steps using steel bars to separate rocks from the bedrock (Figures 25 and 26). Such work and abundant rain (just before the works) allowed fish to move up freely. This very clearly demonstrated the benefits of such work, especially when assisted by "mother nature". Additional works may be required in the lower section of the stream near the sea.

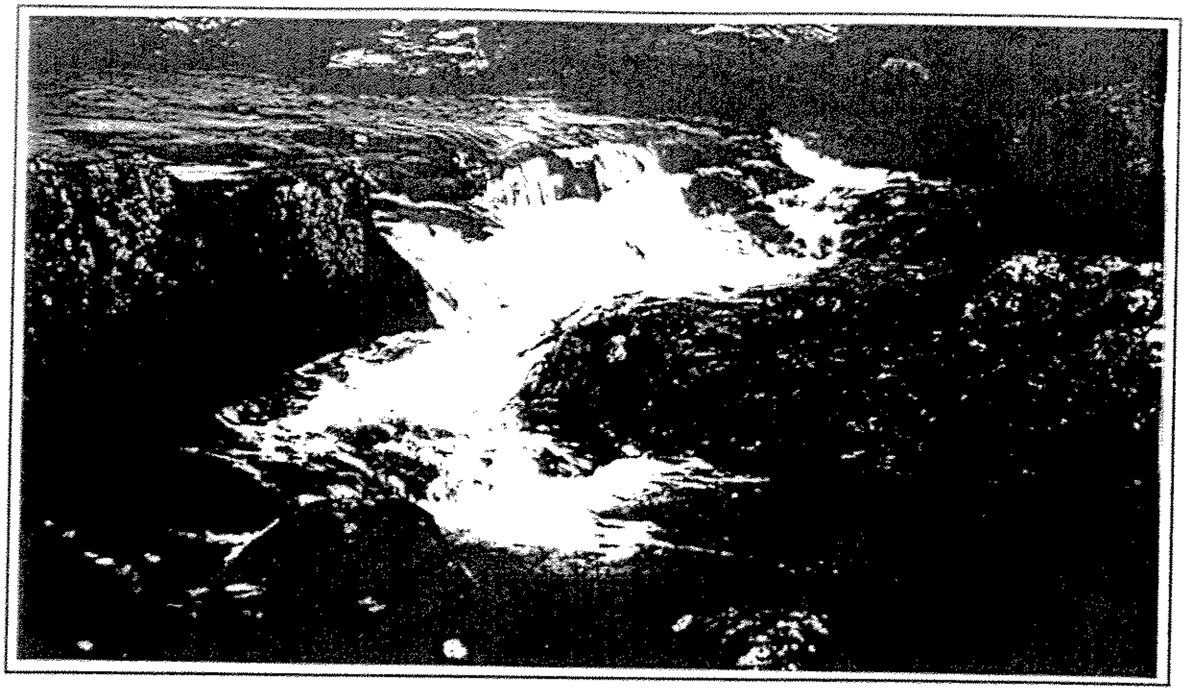


Figure 25. North branch of the problematic rapid in Nikuttivik after the remedial works and the abundant rain.

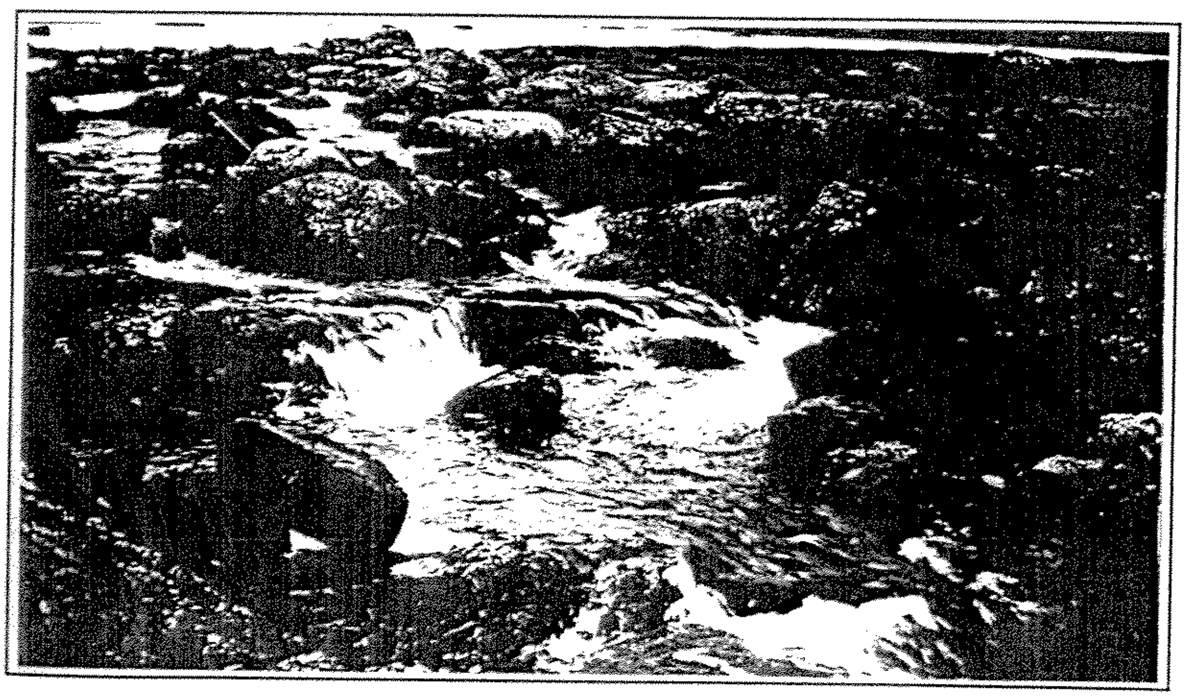


Figure 26. South branch of the problematic rapid in Nikuttivik after the remedial works and the abundant rain.

Qamanialuk and Tasirjuarusik
(Kangirsuk)
[August 1 - 6: 5 men X 5 days]

The main lake of this system (Tasirjuarusik) is filled with small islands where common eider nest in large numbers in June and July. Residents from Kangirsuk then regularly visit the lake for collecting eiderdown as well as jigging for Arctic charr and ,in their opinion, "the best-tasting lake trout in Nunavik".

Below Tasirjuarusik is a smaller shallow lake (Qamanialuk), the two lakes are connected by a deep stream named Aariaq. Qamanialuk has two outlets to the sea; two parallel streams of which only one (West side) is used by Arctic charr (T.Thomassie, pers. comm.). Before reaching the sea, this branch divides into two streams whose main one (used by Arctic charr) contains an important two-step fall. This water fall nearly maintains a 2 meter vertical drop when reached by the high tide (Figure 28 and 29).

From August 1 to 6, remedial works were conducted along the two problematic areas: the Western branch (Figure 27) of Qamanialuk's outflow and the stream flowing from Aariaq into the East side of Qamanialuk.

The Western branch of Qamanialuk's outflow maintains a good flow throughout the summer but in many places, the river is so wide that some sections become very shallow. This branch is characterized by alternating large pools and moderate climbs through wide boulder fields. Remedial works mainly involved the creation of a fishway simply by moving rocks onto the side of the main channel (Figures 30 and 31) and the removal of sill between pools (Figures 32 and 33). Similar works were also conducted below Aariaq (where Tasirjuarusik flows into Qamanialuk) on the eastern-most branch of the outflow (Figure 34).

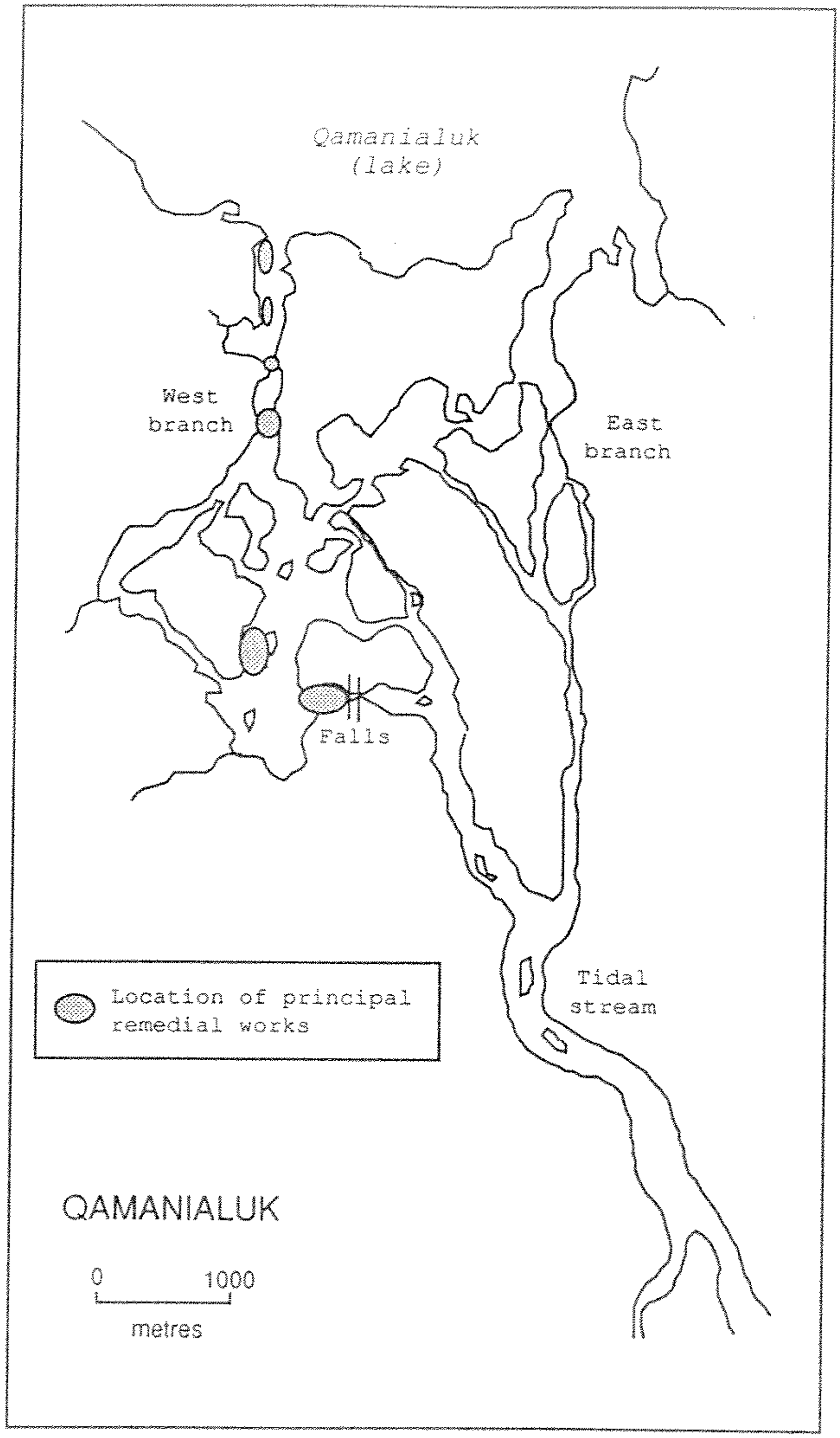


Figure 27. Approximate map of Qamanialuk indicating the location of the principal remedial works conducted in 1989.

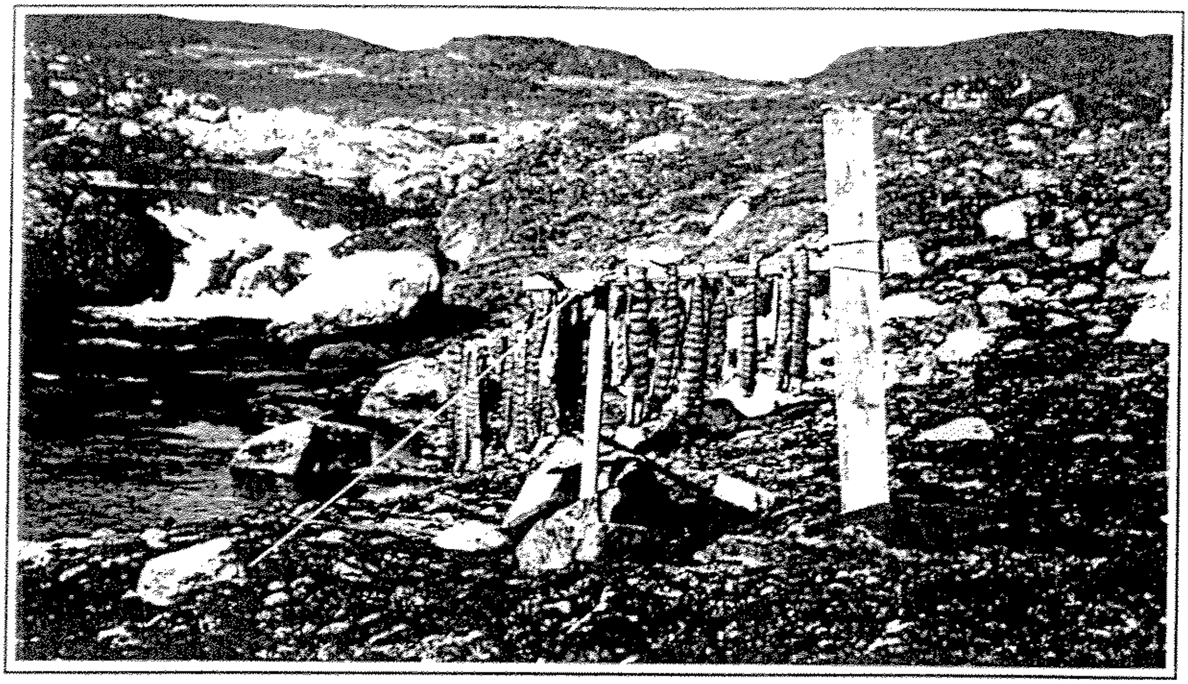


Figure 28. The mouth of Qamanialuk was an important traditional fishing area during the upstream Arctic charr migration as indicates the presence of old saputiit and numerous fish caches.

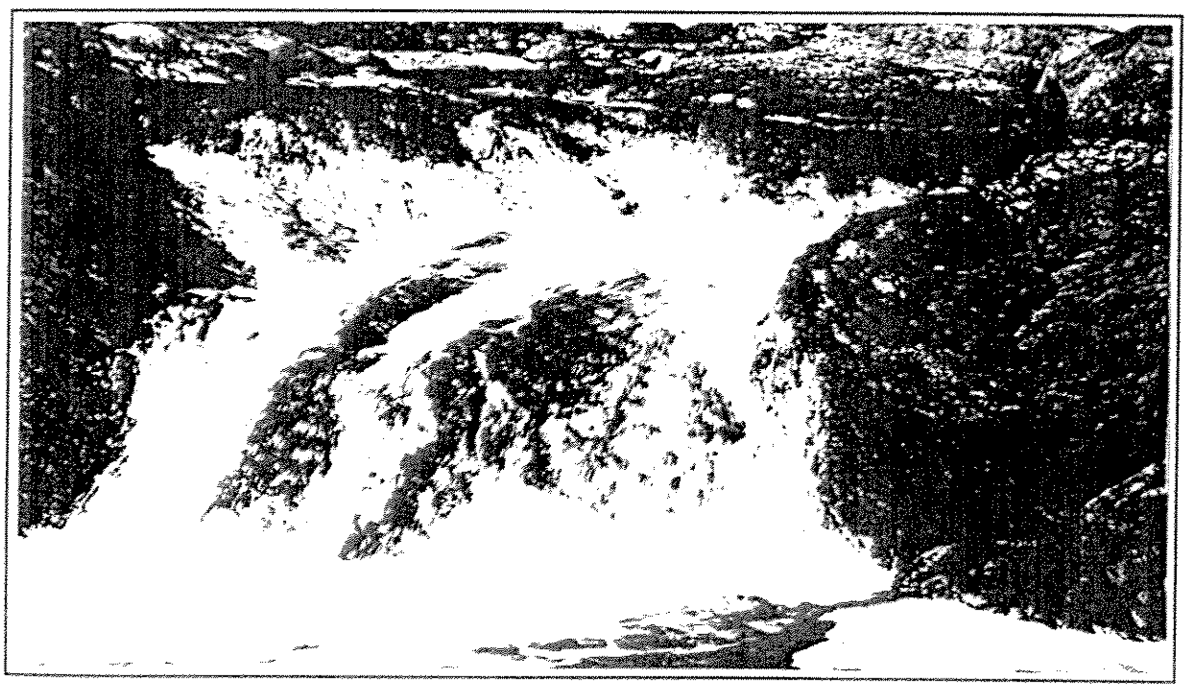


Figure 29. Close-up of the two-step fall reached by the tide at Qamanialuk.

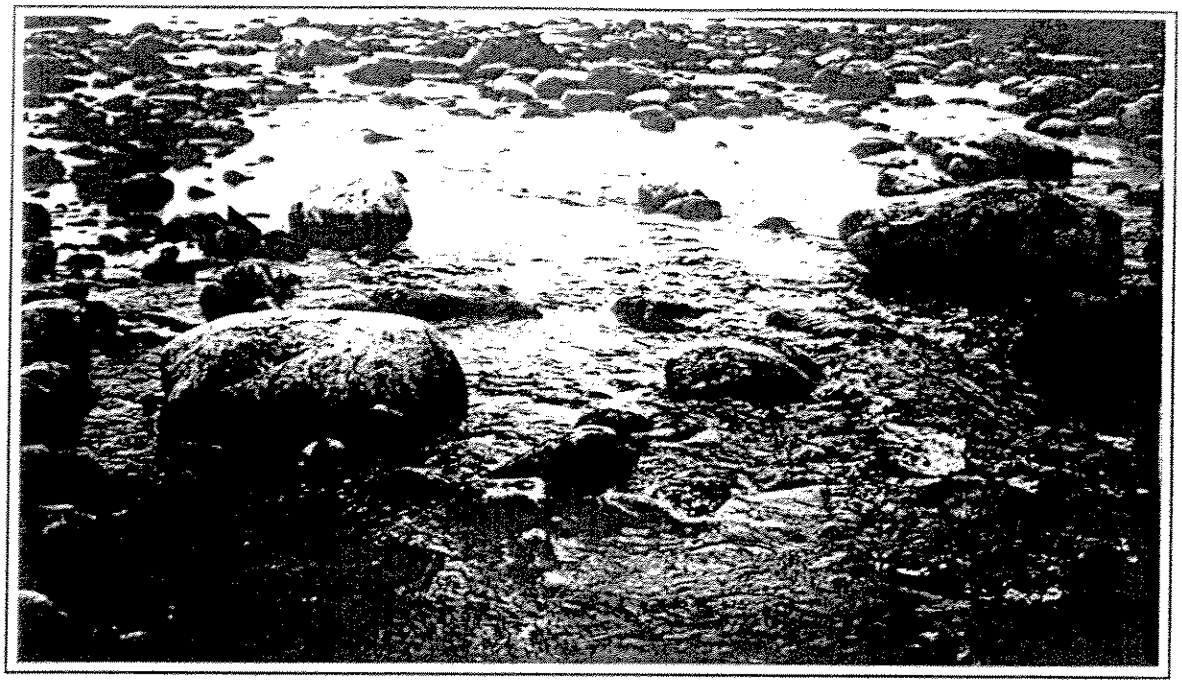


Figure 30. Main channel in a boulder field of the West branch of Qamanialuk's outflow, before the remedial works.

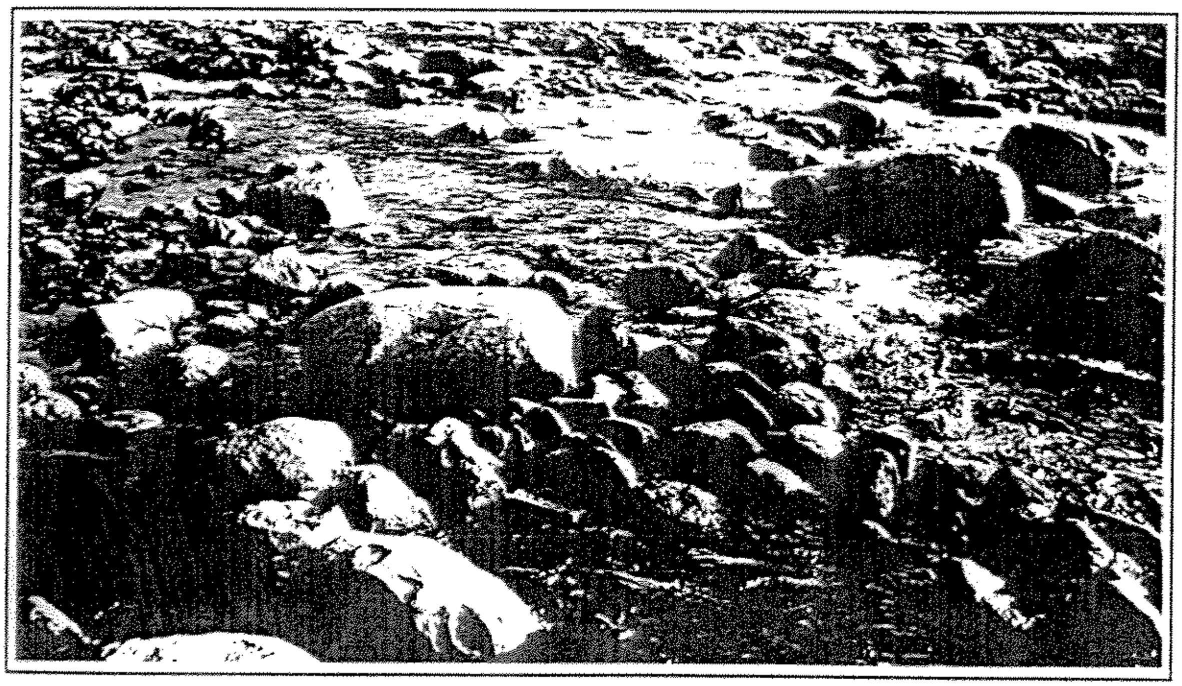


Figure 31. Same as Figure 30, after the remedial works.

Figure 32. Example of a sill between two pools below Aariaq.

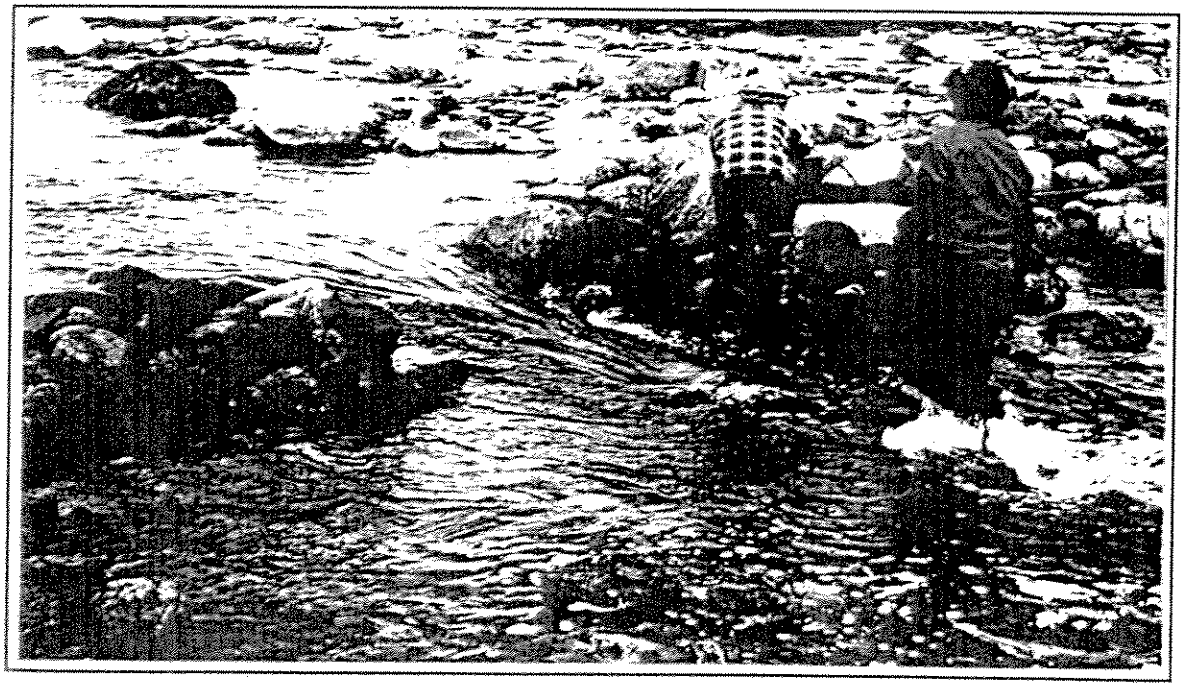


Figure 33. Same as Figure 32, after removal of the sill.

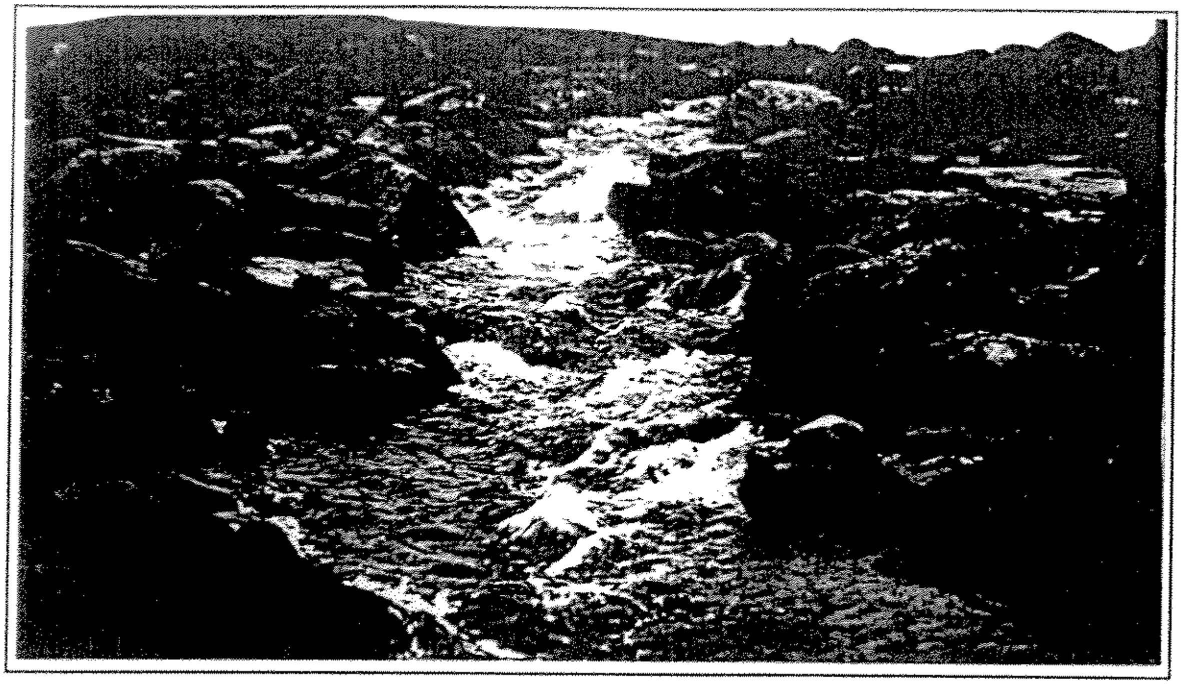


Figure 34. Fishway resulting from remedial works just below Aariaq.

As this was the case in other remedial works, field workers sometimes have a tendency to do more work than required and remove too many rocks from the stream. This causes an increase in the flow rate of the various segments of the river. As a result, the access to each of the pools located above the modified channels as well as the access to Qamanialuk (the first lake) have become shallower. An example of this situation is illustrated in Figures 35. The solution to this problem is the assembly of deflection walls at the outlet of the pool below which channel improvements take place: A narrower outlet will help to stabilize the water level in the pool.

Most of the remedial works conducted in Qamanialuk are believed to be durable because the rocks forming the channels are generally large. On the other hand, new sills may result from these modifications for the reasons described above; it is highly recommended that this river system be inspected during the next dry summer.

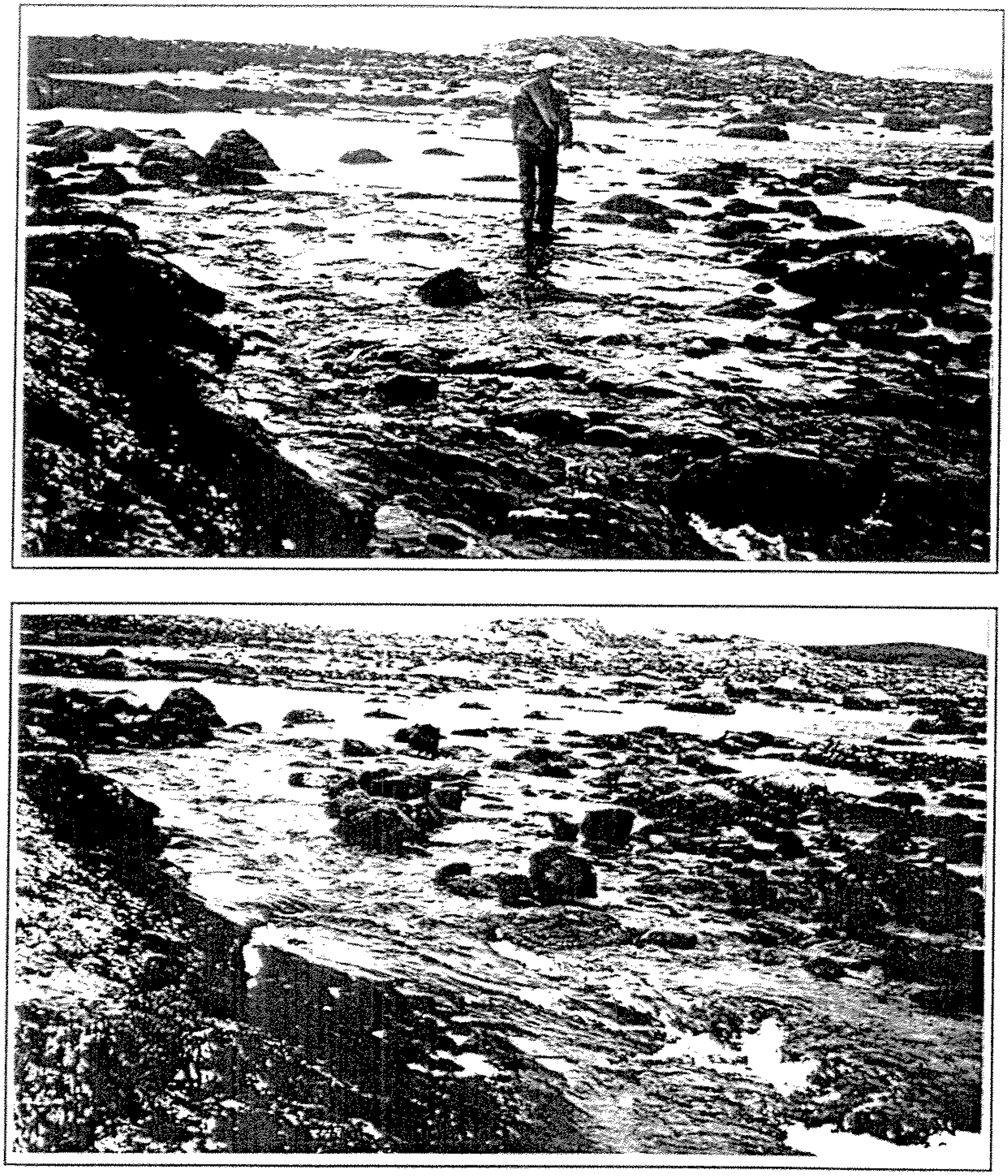


Figure 35. Although the need was questionable, remedial works were conducted in the situation illustrated above by moving rocks onto the right side of the channel. The **top photograph** was taken before the remedial works. The **bottom photograph** shows the channel immediately after the remedial works. In spite of a deflection wall (upper left corner) which partially retain the flow, the water level in the pool had already dropped by about 10 cm.

Paakittuq
(Akulivik)
[August 10-12: 5 men X 2 days]

This river is very small. It is less than 5 m wide on average and approximately 200 m long (Figure 37). The shallow reefs situated just off the outlet of this river are popular fishing sites in the summer, but the anadromous population using this system is probably small. The upper part of the stream consists in gravel mixed with small boulders. In some segments water depth was under 10 cm (Figure 36).

Remedial works mainly involve the construction of deflection walls using rocks from the land to reduce the width of the stream and increase water depth (Figures 38 to 43).

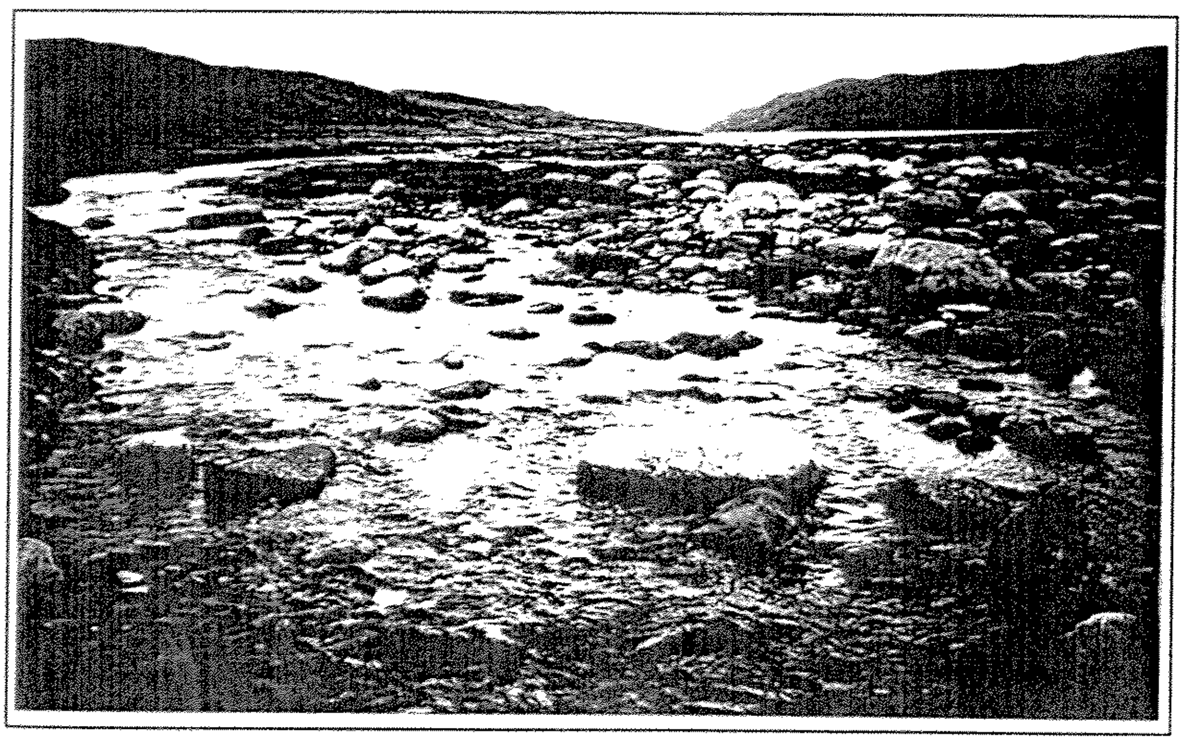


Figure 36. Paakittuq (before remedial works): upstream view taken just above the lower broad section and showing the lake in the background.

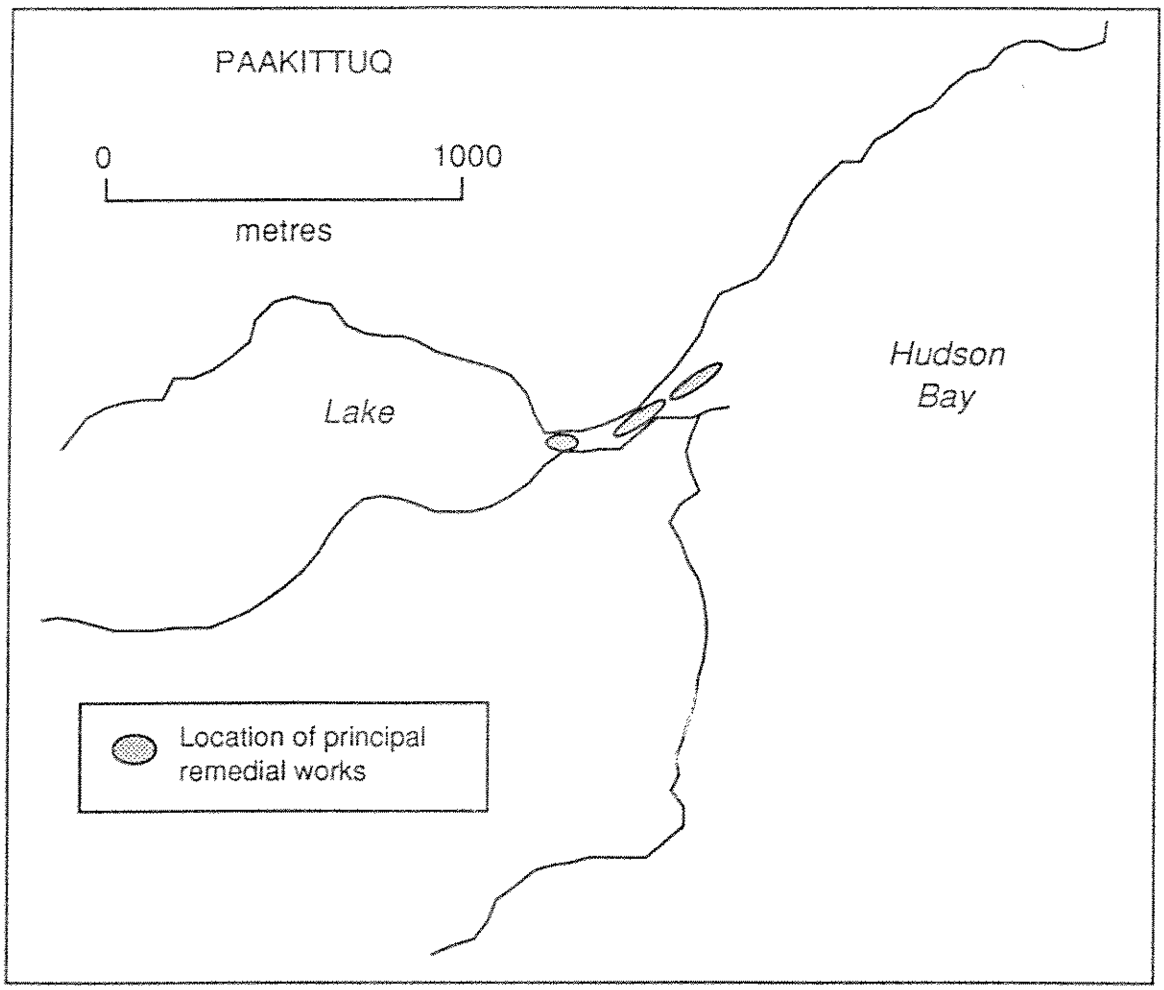


Figure 37. Approximate map of Paakittuq and location of principal remedial works conducted in 1989.

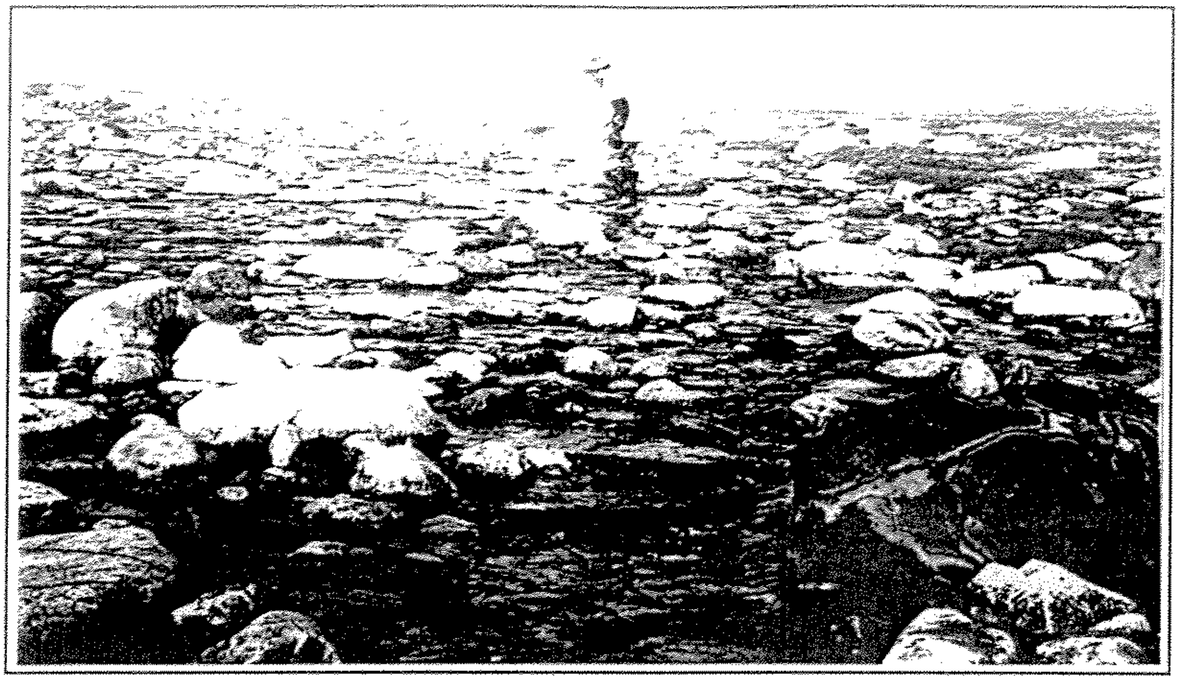


Figure 38. Paakittuq (before remedial works): upstream view of the river as it becomes narrow above the fishway (Figure 44).

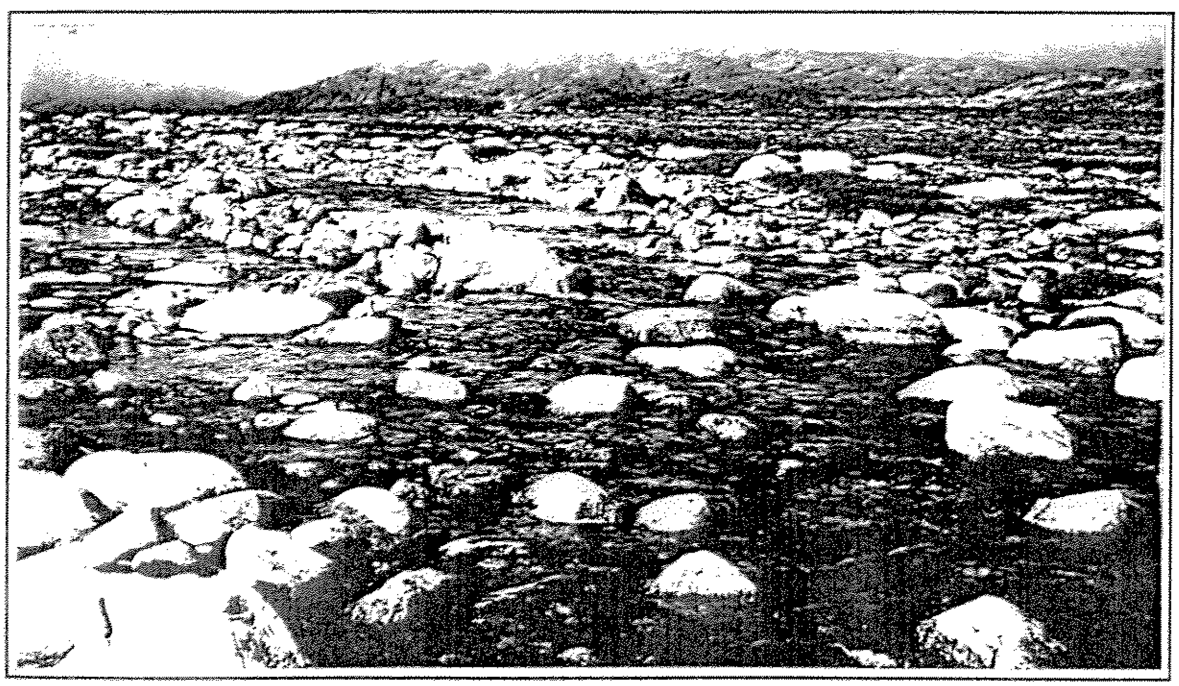


Figure 39. Paakittuq (after remedial works). Same view Figure 38. Notice the deflection wall which reduces water loss through the left side and allows more water into the fishway (Figure 44).

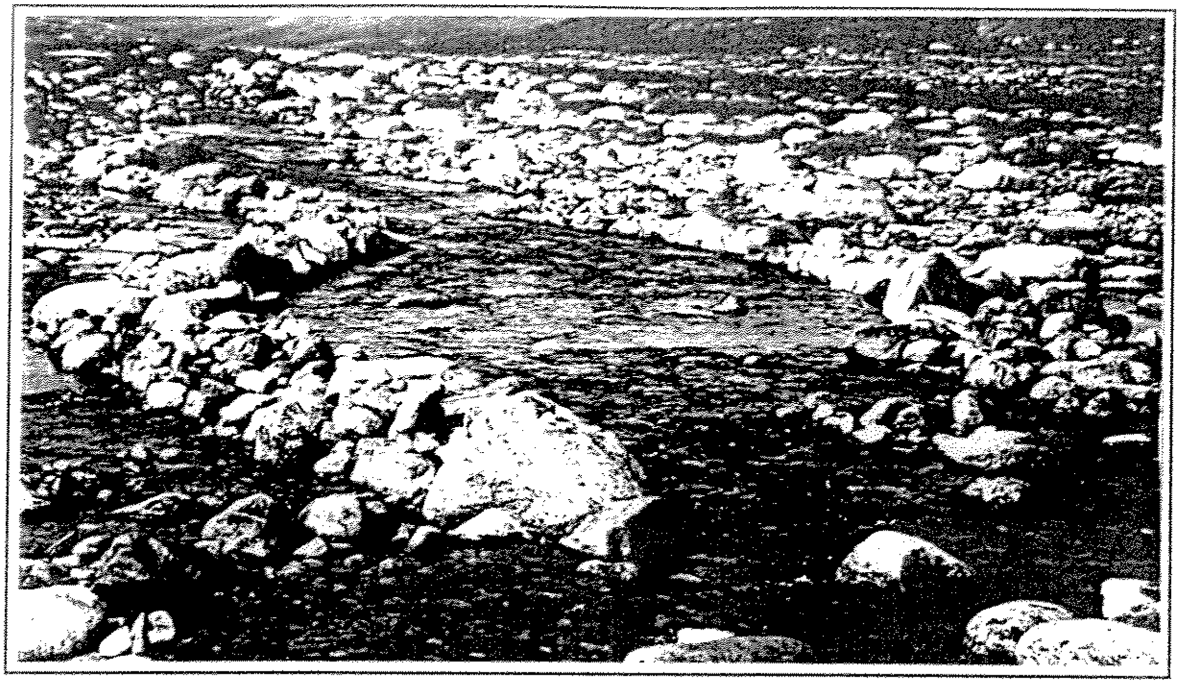


Figure 40. Paakittuq (after remedial works): close-up of the deflection wall illustrated in Figure 39.

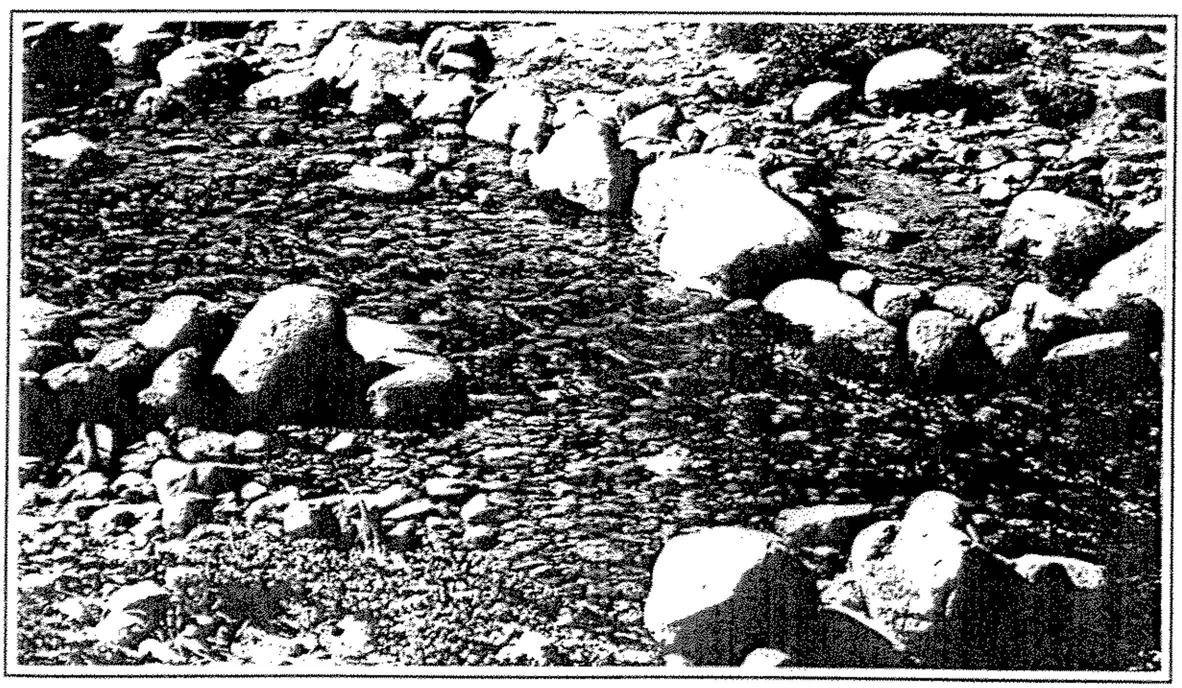


Figure 41. Paakittuq (after remedial works): deflection walls in the narrow section of the stream.

Figure 42. Paakittuq (after remedial works): a deflection wall built at the entrance to the lake (outflow) reduces water lost through a secondary channel.

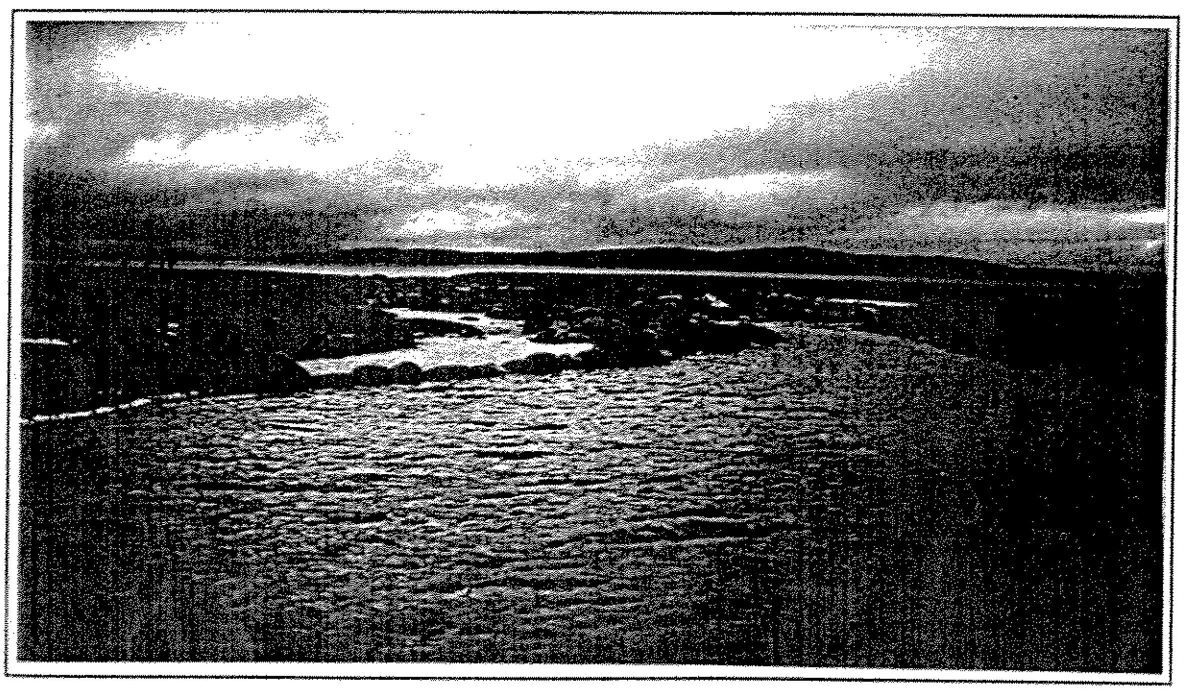


Figure 43. Paakittuq (after remedial works): downstream view of the lake outflow.

In the lower segment, the stream becomes wider and flow was lost through multiple channels among larger boulders. A narrow single channel was created among these boulders, channelling most of the stream flow into a winding fishway offering a few small resting pools (Figure 44). This river system must be inspected next summer as an annual maintenance may be required.

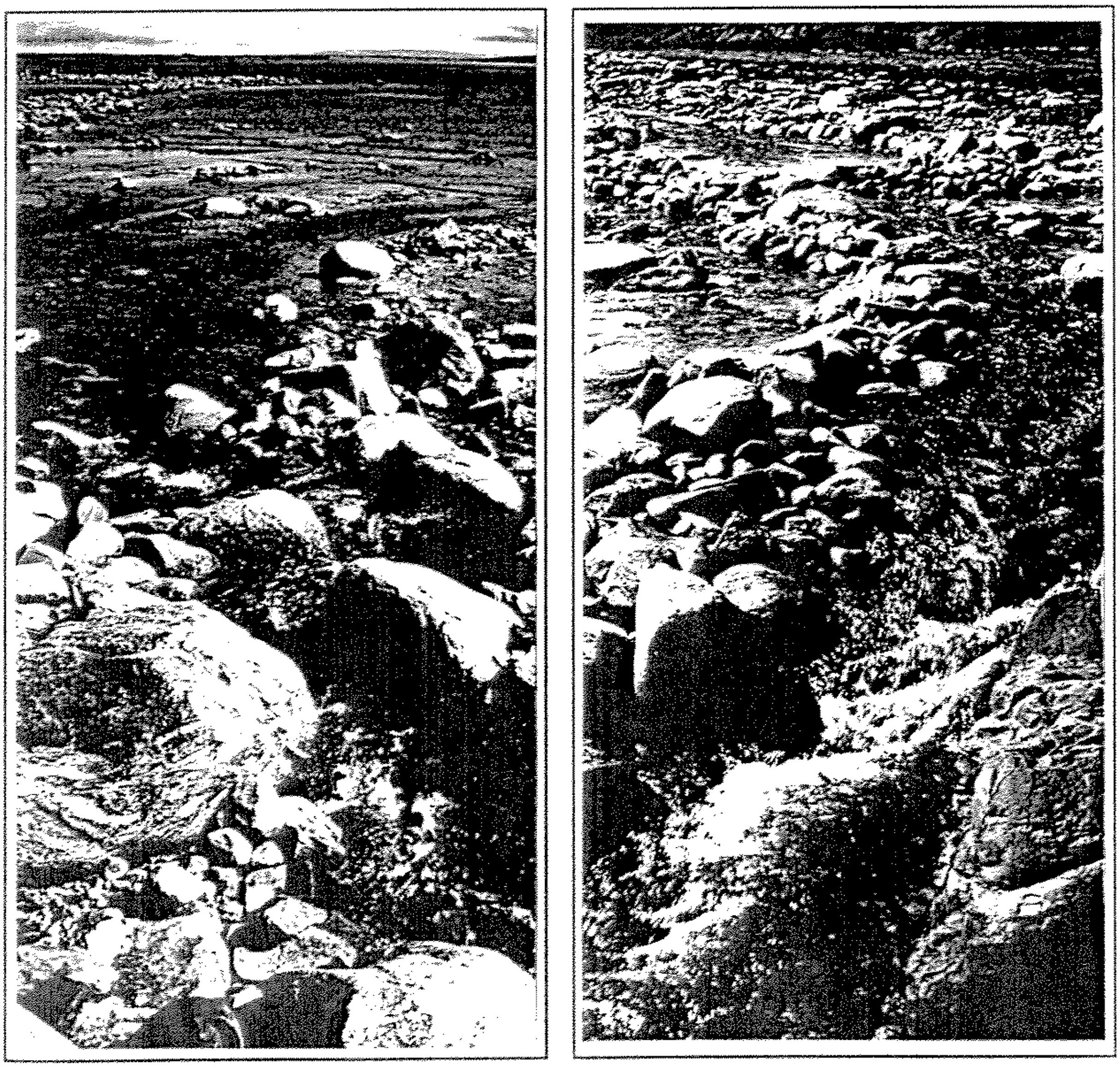


Figure 44. Paakittuq (after remedial works): downstream (left) and upstream view (right) of the raceway built to channel most of the water flowing through the broad lower section of the stream.

Qallunaartaliviniq

(Akulivik)

[August 12-14: 5 men X 2 days]

Due to the small size of its drainage basin, the summer water flow is greatly reduced in this river system. Close to the lake, the stream is wide, rocky and very shallow. About halfway between the lake and the sea, the stream splits into two branches (Figure 45). As the Southern branch becomes almost completely dry, solely the Northern one is used by upstream migrating fish. Below the fork, the Southern branch contains one steep climb through a boulder field (Figure 46) and very shallow gravel sections (Figure 50).

The upper part of the boulder field was partially blocked by a deflection wall (Figure 48) in order to increase water flow in the main channel (Figure 47). The depth of fish passages was increased by building deflection walls (Figure 51 and 52). In the most problematic section, close to the sea, the passage was reduced to about 20 % of the streambed width (Figure 51). Although large rocks were used, these walls will be exposed to ice movements and strong currents in the spring; their durability must be verified. It is essential to inspect this river system next year and an annual maintenance should be provided for.

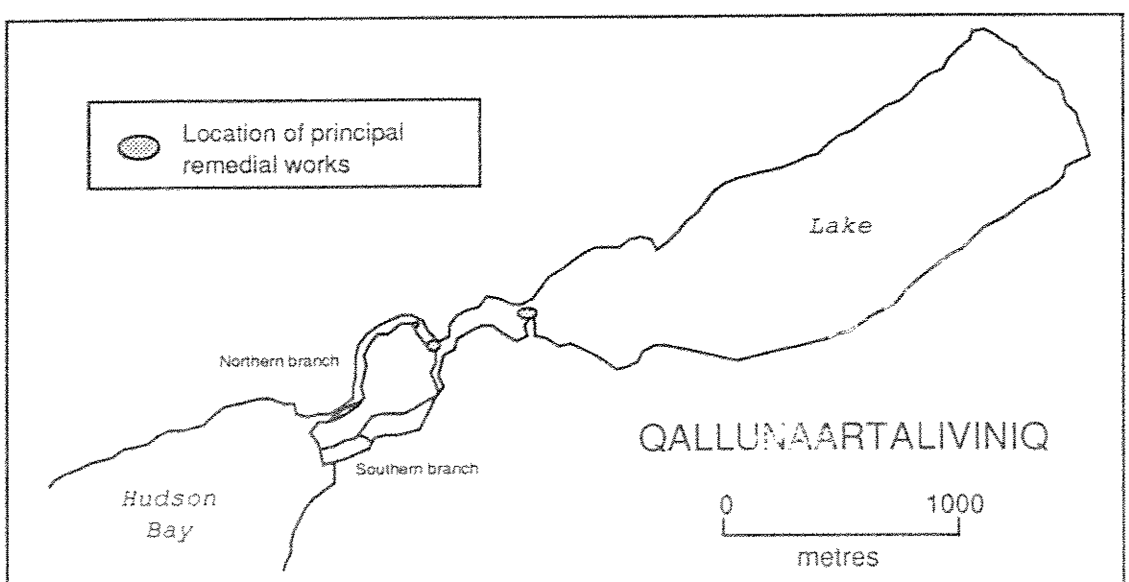


Figure 45. Approximate map of Qallunaartaliviniq indicating the location of the principal remedial works.

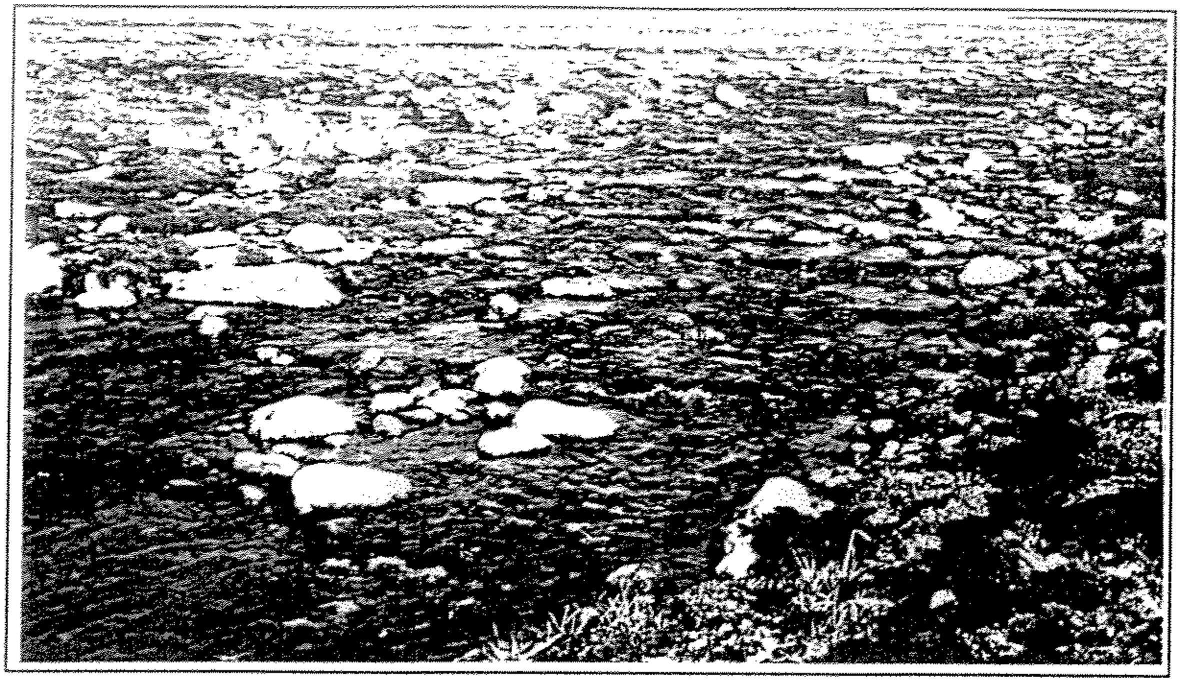


Figure 46, Upstream view of the main channel in the boulder field (before remedial works) in Qallunaartaliviniq.

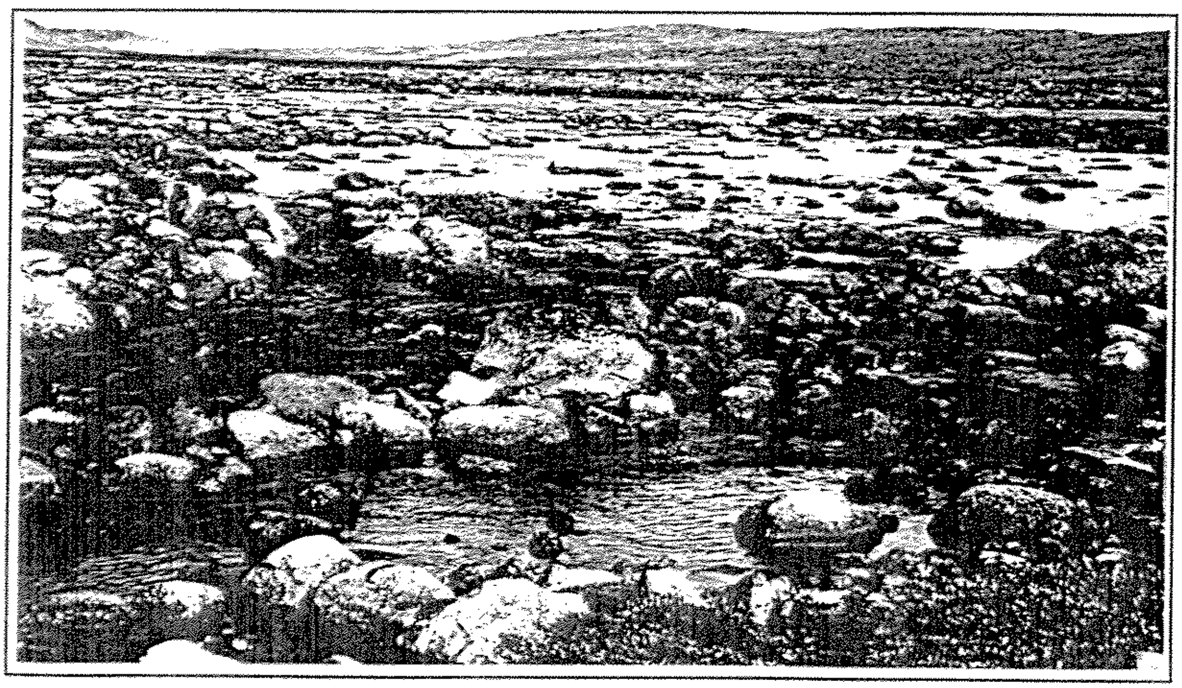


Figure 47. Close-up of the upper part of the boulder field (after remedial works) in Qallunaartaliviniq. Notice the deflection wall in the upper left corner which channels the flow into the fishway.

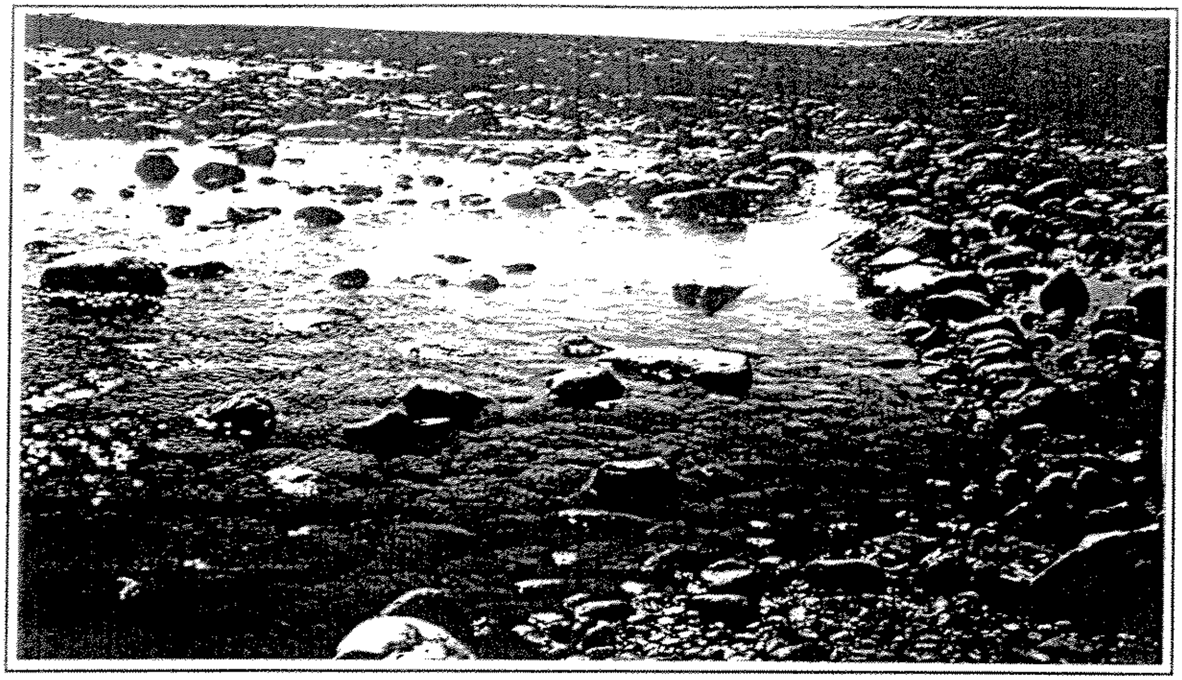


Figure 48. Side view of the stream just above the boulder field (Figure 47) showing the deflection wall and looking into part of the dried up Southern branch.

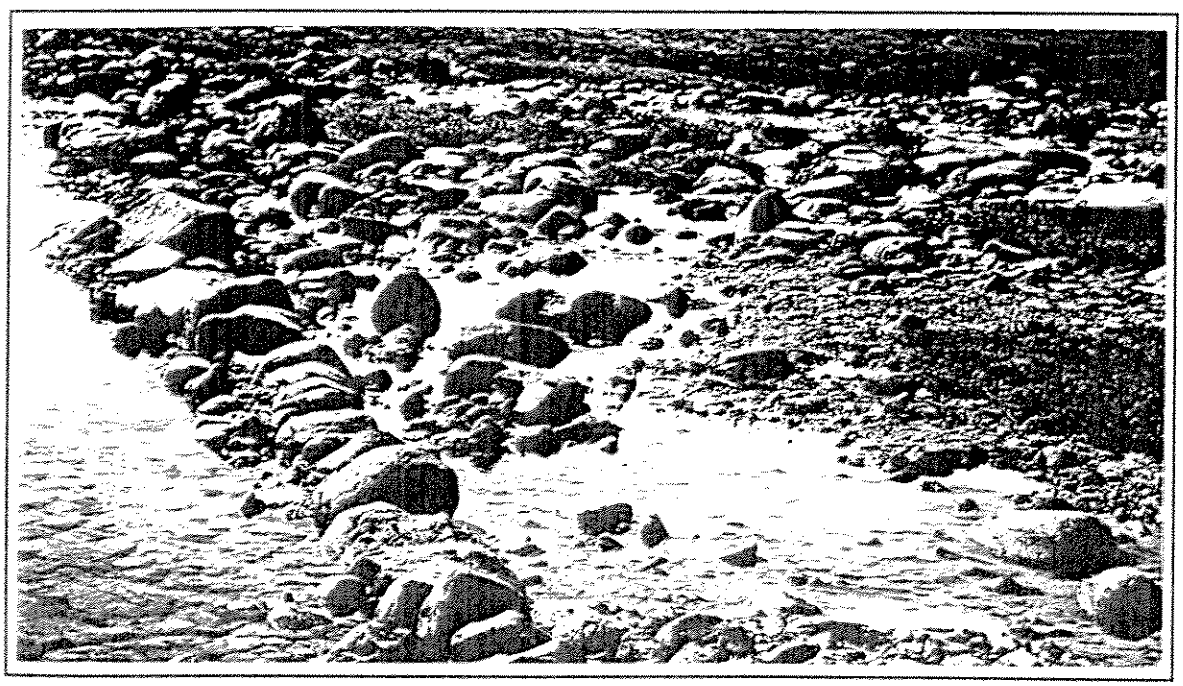


Figure 49. [View with Figure 48]. Side view of the stream just above the boulder field, showing how the deflection wall diverted the flow into the main channel.

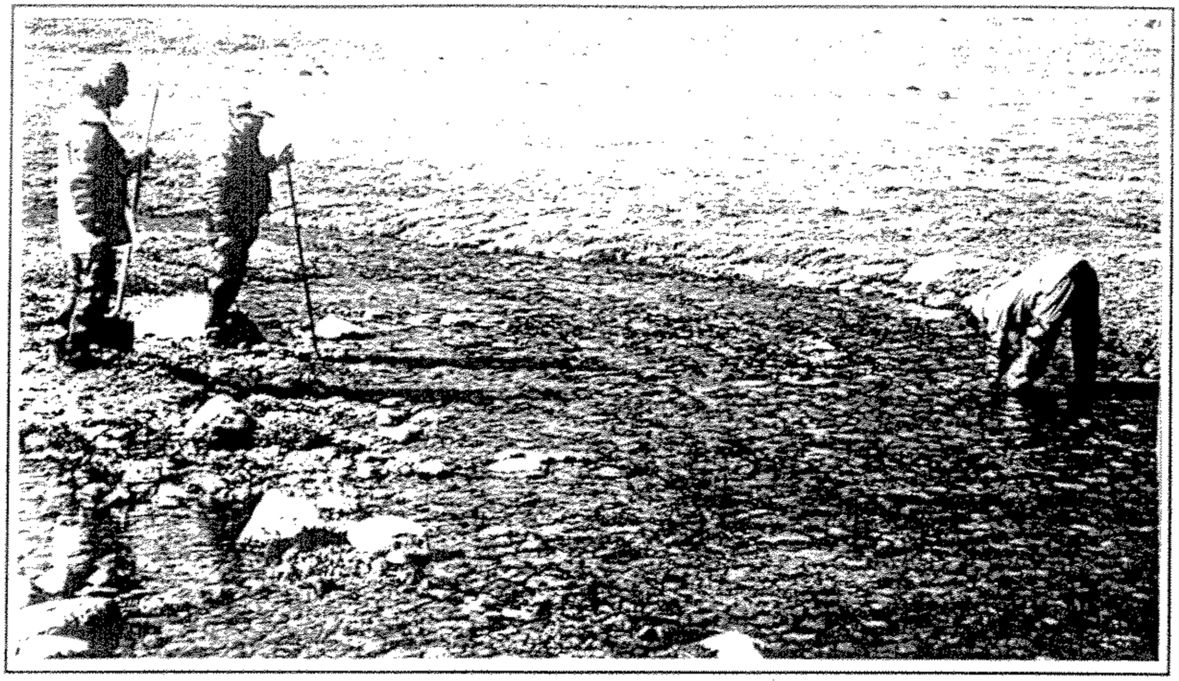


Figure 50. Shallow gravel (or small rock) section in Qallunaartaliviniq (before remedial works).

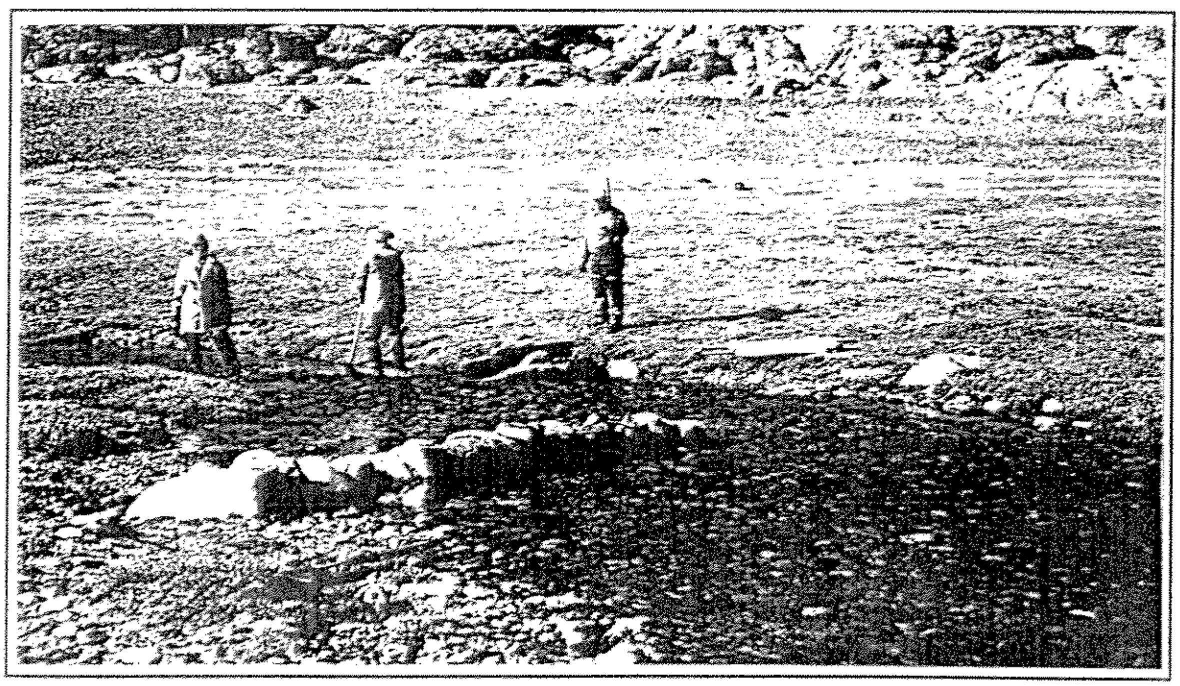


Figure 51. [Same as Figure 50]. Deflection walls used to increase water depth in a shallow passage.

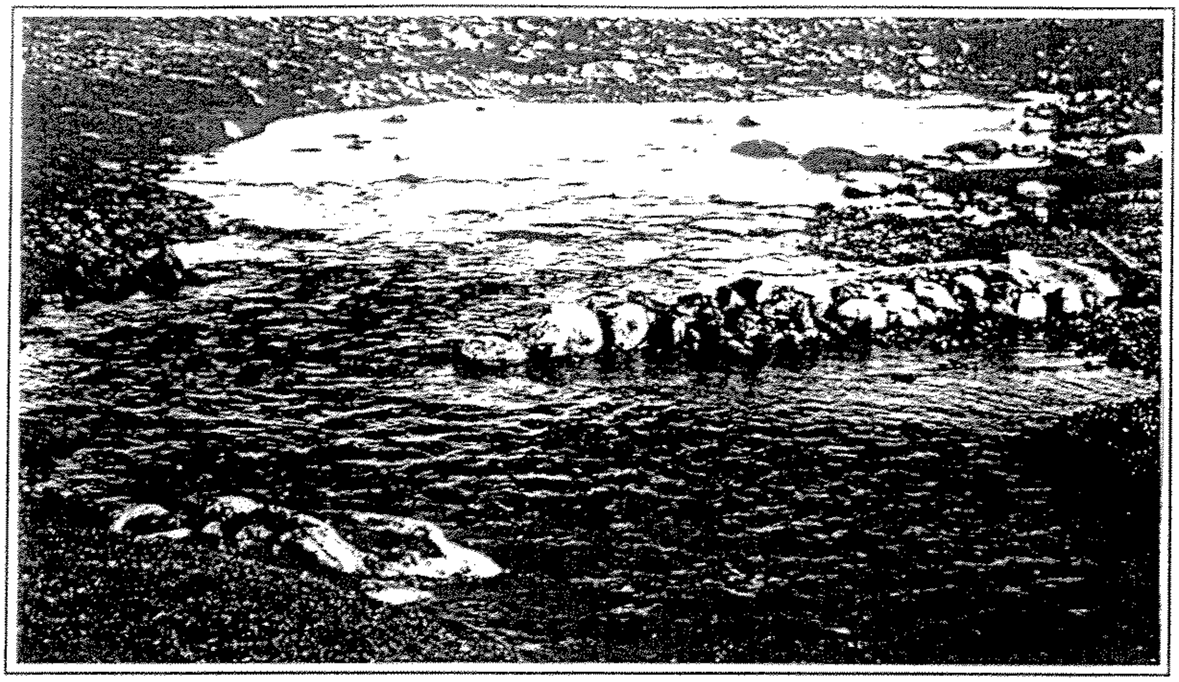


Figure 52. Upstream view of the deflection walls (main one on the left and a smaller one on the right in the foreground) shown in Figure 51.

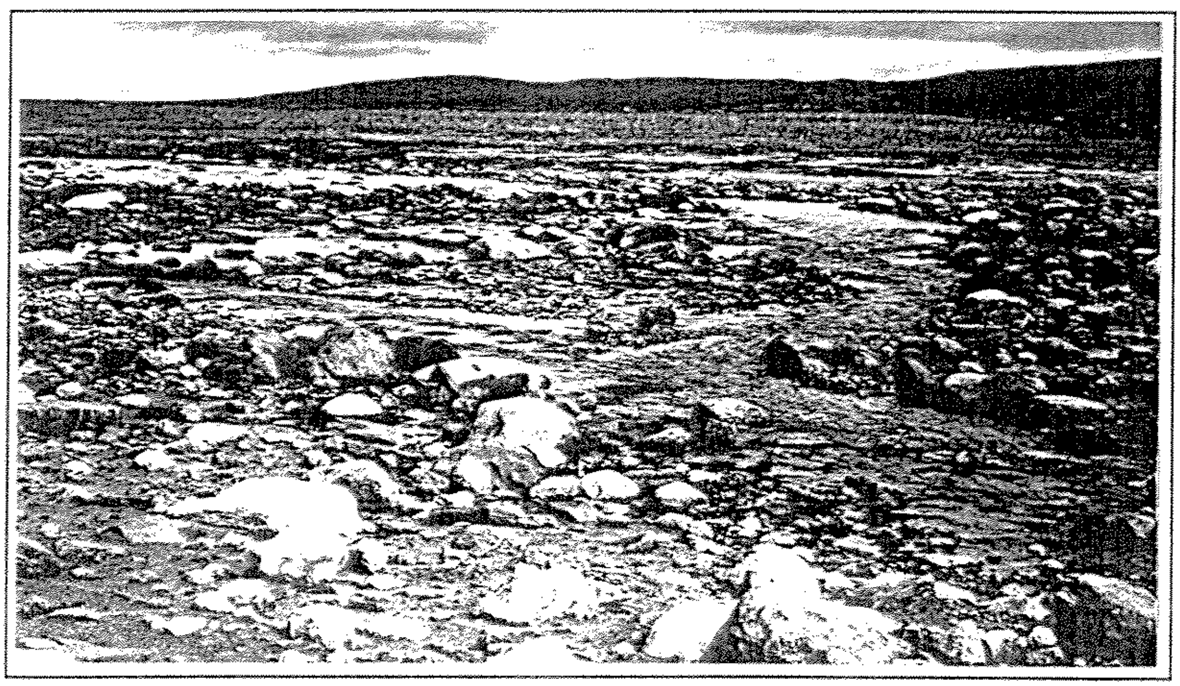


Figure 53. The most problematic section in Qallunaartaliviniq, located just above the high tide mark was corrected by constructing a long deflection wall with large rocks and small boulders(left), and deepening a fishway.

Sapugaarjuit
(Akulivik)
[August 15: 5 men X 1 day]

This river maintains a good flow rate and did not require extensive works. The river bed consists mainly in large boulders (Figure 55). An old traditional fishing weir is located just before the lake (Figure 54); it had already been modified in the past to allow charr to reach the lake without difficulty (Figure 56). The shallower rapid sections of the main channel were improved and the work will be durable. There are no foreseeable problems for future migrating charr in this system. No further maintenance is required.

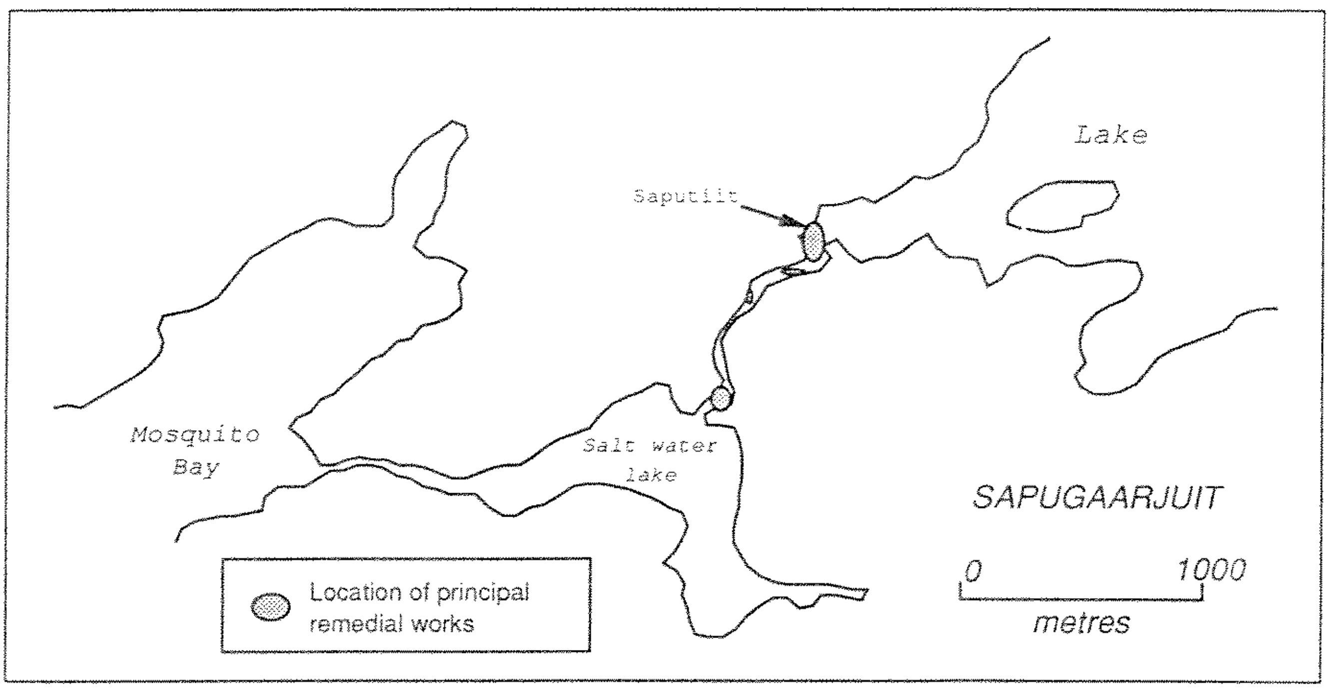


Figure 54. Approximate map of Sapugaarjuit indicating the location of the principal remedial works.

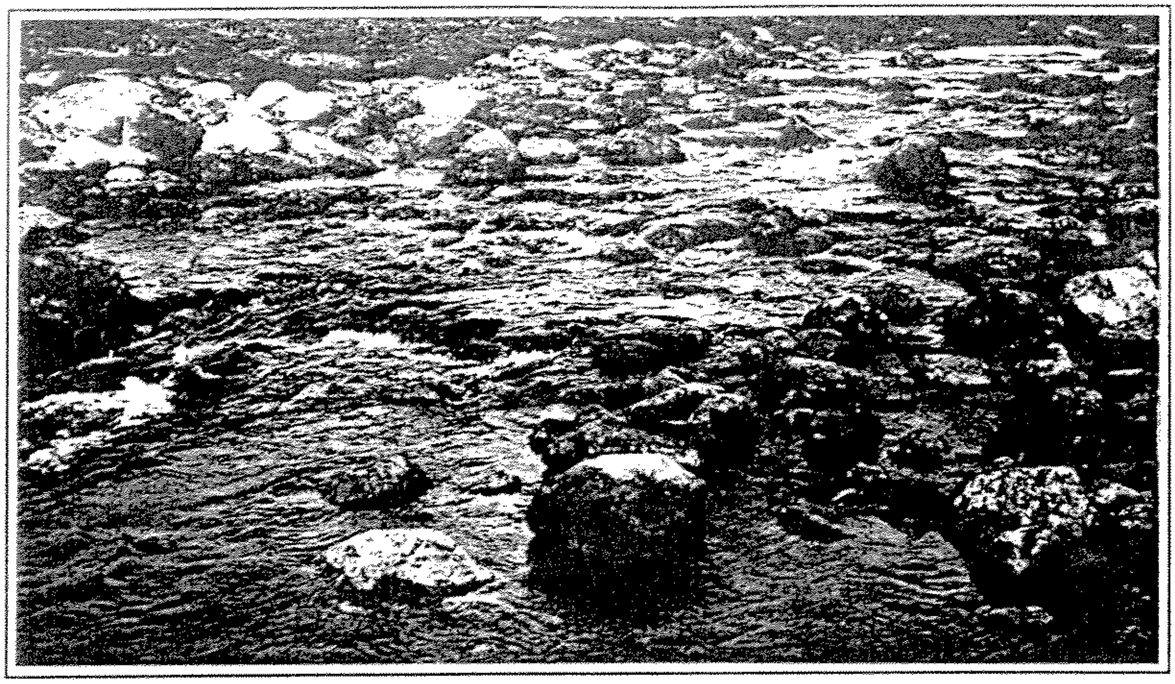


Figure 55. Sapugaarjuit, which river bed consists mainly of large boulders, maintains a good water flow throughout the summer .

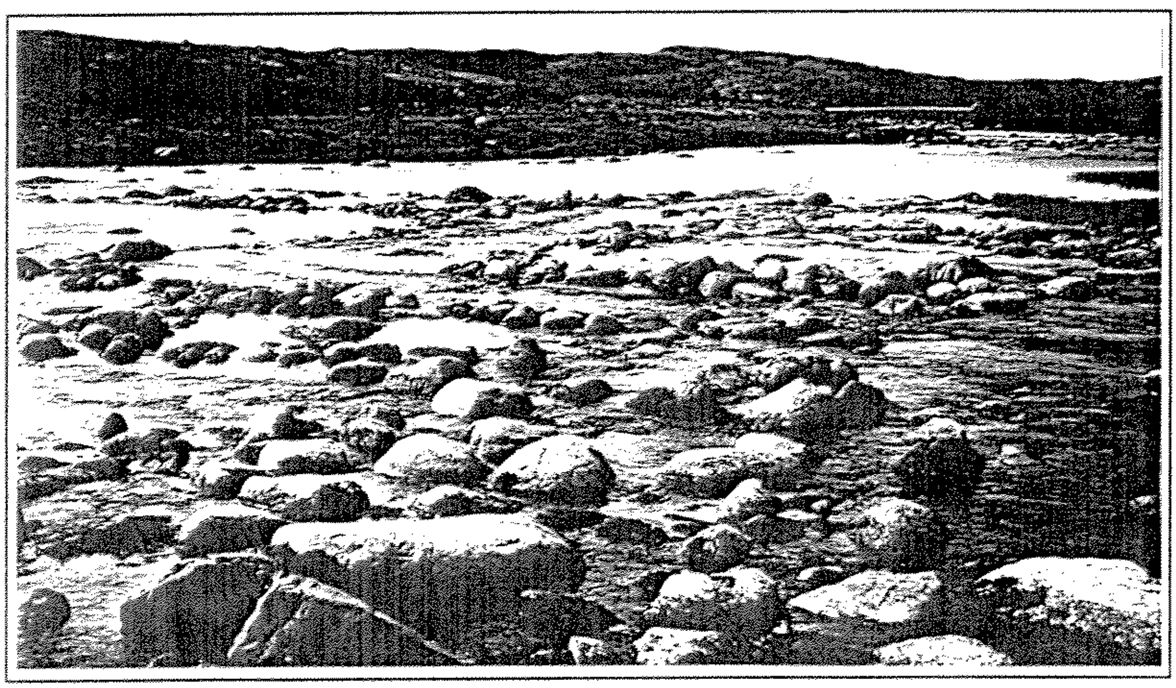


Figure 56. A traditional fishing weir located close to the lake had been modified in previous years in order to ease Arctic charr migration.

Harvest Studies

Methodology

During the 1989-90 fishing season, four Arctic charr harvest studies were conducted in Nunavik independently of this project:

- Monitoring of Annanack and Sons' experimental commercial fishery.
  Organization: Makivik Corporation, Kuujjuaq Research Centre.
  Community: Kangiqsualujjuaq (all Arctic charr systems).
  Method used: booklets.
  Status: results presented in Boivin (1990).

- Iqalukkait experimental commercial fishery.
  Organization: Makivik Corporation, Kuujjuaq Research Centre.
  Community: Kangiqsujuaq (all Arctic charr systems).
  Method used: booklets and questionnaires.
  Status: partial data from April to November 1989 (Olpinski 1990).

- Data base collection for outfitting development.
  Organization: Ministère de Loisir, de la Chasse et de la Pêche.
  Communities: Tasiujaq and Kangirsuk.
  Method used: questionnaires.
  Status: raw data have been received; report in preparation.

- Hudson Bay commercial fishery development.
  Organization: Kativik Regional Government,
  Ministère du Loisir, de la Chasse et de la Pêche.
  Communities: Salluit, Ivujivik, Akulivik, Povungnituk and Inukjuaq
  Method used: questionnaires.
  Status: all communities except Inukjuaq participated in the survey; raw data have been received and compiled; report in preparation.

In order not to duplicate studies, arrangements were made with coordinators of these projects for accessing and citing their results. Harvest studies conducted under this project in 1989-90 were aimed at documenting

Arctic charr fishing success in the problematic river systems which were not included in the above studies.

The period covered by the harvest study is from September 1989 to June 1990. In June 1990, harvest study materials were forwarded to the four communities which had not been included in the other current studies: Aupaluk, Quaqtaq, Inukjuaq and Umiujaq. Each of these communities were asked to hire a field worker whose tasks were to prepare a list of potential fishermen for each problematic river systems identified under the ACSE program and assist them in filling a harvest questionnaire (Appendix 1). In these questionnaires fishermen were asked to provide the following information for each river system: total Arctic charr catch by net, rod, kakkivak or gaff (estimated within set categories: 1-5, 5-10, 10-20, etc.); number of nets used at once and number of netting days per month. Summer (1989) catches of anadromous Arctic charr in freshwater were occasionally included when specified by the fisherman during the interview.

In Aupaluk, booklets (Appendix 2) were used instead of questionnaires for fishermen to keep harvest records from Tasiujaaluk. Booklets provide more accurate data when properly used since catches of all species and fishing effort are recorded daily. Tasiujaaluk being the first site of remedial works and likely being the most problematic of all systems, it was considered important to have good harvest records for this system Usually only one fisherman fishes this system; he has been involved in the annual inspection and keeps very good records of his catches. Harvest booklets and tag return sheets were forwarded to him in November and returned in June. A $10 reward was offered for each returned tag (Appendix 3). Booklets were assumed to have been distributed to all fishermen using problematic systems of the Aupaluk region, however they were used only by the two fishermen who fished in lakes of the Tasiujaaluk system in 1989-90. The questionnaires forwarded to Aupaluk in June were intended to gather harvest data from river systems other than Tasiujaaluk.

Results

The 1989-90 harvest studies provided fishing activity reports from 23 problematic river systems. Altogether, there are 26 systems for which we have at least one year of harvest data between 1985 and 1990. Core data on individual systems consisted in:

- number of fishermen reporting having fished;
- number of Arctic charr caught by gill net;
- number of Arctic charr caught by other means (jig, kakkivak, hook or rod);
- fishing effort (gill net only) = [number of nets] x [number of days].

From this data, the catch per unit of effort (C.P.U.E.), or average number of Arctic charr caught per day in one net, may be calculated. This calculation does not take into account the length of the net used or its mesh size : any net set for one day counts as one net-day. A summary of harvest data available per river system and grouped per community is presented in Table 2.

On the basis of harvest data and empirical information collected during the course of the Program, problematic systems may be grouped into 3 categories:

1. Systems supporting substantial harvests. These tend to be larger river systems where fish are abundant but where a particular obstacle can be problematic for migrating fish under severe low water levels. Systems which are distant from communities (e.g. Sapukkait) are fished irregularly whereas those closer to communities (e.g. Tasikallak) annually provide an important part of the subsistence catch.
2. Systems supporting moderate harvests. These are systems of various sizes which have small to moderate Arctic charr populations able to support a sustained harvest.
3. Systems supporting little or no harvest. These systems are usually connected to the sea by small streams up which Arctic charr have great difficulty swimming because of insufficient water flow. They seem to support very small anadromous populations and contribute little to the communities' Arctic charr harvest.

In Table 3, the problematic river systems identified under the ACSE Program have been classified according to the three categories described above. This classification is a subjective assay meant only to provide the reader with a global perspective on the relative importance of these systems.

Table 2. Anadromous Arctic charr catch (by net and other means), fishing effort and C.P.U.E. available for problematic river systems included in the ACSE Program.

2a. River systems of the Kangiqsualujjuaq region. Data source: Boivin (1987), Boivin et al. (1988), Boivin and Vandal (1989), Boivin et al. (1989), Boivin (1990a), Boivin (1990b), Boivin et al. (1990), and unpublished data provided by T.Boivin from Makivik Corporation.

SAPUKKAIT	1985-86	1987-88	1988-89	1989-90
# of fishermen	0	0	*	**
AC catch - net	0	0	0	99
AC catch - others	0	0	101	728
Effort (net-days)	0	0	0	28
C.P.U.E.	0	0	-	3.5

* Subsistence harvest from counting fence during a scientific project.
** Combined subsistence, commercial an scientific catches.

SANNIRARSIQ	1985-86	1987-88	1988-89	1989-90
# of fishermen	0	*	-	***
AC catch - net	0	273 **	276	0
AC catch - others	0	9	9	919
Effort (net-days)	0	**	44 (249 fish)	0
C.P.U.E.	0	-	5.7	-

* Except for 4 fish, all catches came form a scientific fishery.
** Scientific fishery using gang-mesh nets.
*** Commercial fishery using a counting fence.

2a.River systems of the Kangiqsualujjuaq region (continued).

NAPAARTULIK	1985-86	1987-88	1988-89	1989-90
# of fishermen	n.a.	n.a.	n.a.	n.a.
AC catch - net	325	0	124	0
AC catch - others	<100	0	0	0
Effort (net-days)	67	0	12 (35 fish)	0
C.P.U.E.	4.9	0	2.9	0

QARLIIK	1985-86	1987-88	1988-89	1989-90
# of fishermen	n.a.	n.a.	n.a.	n.a.
AC catch - net	100	256	164	0
AC catch - others	0	0	0	0
Effort (net-days)	n.a.	12 (118 fish)	13 (110 fish)	0
C.P.U.E.	n.a.	9.8	8.5	0

TASIKALLAK	1985-86	1987-88	1988-89	1989-90
# of fishermen	n.a.	n.a.	n.a.	n.a.
AC catch - net	1 930	899	1 137	1 100
AC catch - others	<145	15	91	29
Effort (net-days)	185	62	53 (760 fish)	17 (227 fish)**
C.P.U.E.	10.4	14.5*	14.3	13.4

* It is interesting to note that the C.P.U.E. of the subsistence fishery only were respectively 10.8 and 9.3 in 1987-88 and 1988-89.

** Commercial fishery only.

2a.River systems of the Kangiqsualujjuaq region (continued).

AKILASAALUK	1985-86	1987-88	1988-89	1989-90
# of fishermen	n.a.	n.a.	n.a.	n.a.
AC catch - net	61	0	0	0
AC catch - others	0	0	0	0
Effort (net-days)	12	0	0	0
C.P.U.E.	5.1	0	0	0

2b. Problematic River systems of the Kuujjuaq region. Data source: ACSE Program.

QASIGIARSIUVIK	1987-88	1988-89	1989-90
# of fishermen	7	3	n.a.
AC catch - net	65 - 75	51 - 76	n.a.
AC catch - others	248	36 - 51	n.a.
Effort (net-days)	248	22	n.a.
C.P.U.E.	0.3	2.3 - 3.5	n.a.

2c. Problematic River systems of the Tasiujaq region. Data source: 1987-88-89 - ACSE Program; 1989-90 - M.L.C.P. (en rédaction).

UNGAVATUAQ	1987-88	1988-89	1989-90
# of fishermen	1	n.a.	0
AC catch - net	80	n.a.	0
AC catch - others	20	n.a.	0
Effort (net-days)	14	n.a.	0
C.P.U.E.	5.7	n.a.	-

TASIUJATUQAIT	1987-88	1988-89	1989-90
# of fishermen	2	1	0
AC catch - net	130	0	0
AC catch - others	35	1	0
Effort (net-days)	150	0	0
C.P.U.E.	0.9	-	0

2d. Problematic River systems of the Aupaluk region. Data source: ACSE Program.

TASIUJAALUK (Aupalajaalik)	1986-87	1987-88	1988-89	1989-90
# of fishermen	1	1	1	1
AC catch - net	40	201	40	305
AC catch - others	0	0	0	0
Effort (net-days)	>18	143	23	173
C.P.U.E.	<2.2	1.4	1.7	1.8

TASIUJAALUK (Ammaluttuq)	1986-87	1987-88	1988-89	1989-90
# of fishermen	1	1	1	2
AC catch - net	179	253	210	190
AC catch - others	0	0	0	0
Effort (net-days)	>113	143	149	58 (84 fish)
C.P.U.E.	<1.6	1.8	1.4	1.5

TASIUJAALUK (Qaummarik)	1986-87	1987-88	1988-89	1989-90
# of fishermen	2	0	0	0
AC catch - net	10	0	0	0
AC catch - others	10	0	0	0
Effort (net-days)	>2	0	0	0
C.P.U.E.	<5.0	-	-	-

2d. Problematic river systems of the Aupaluk region (continued).

QINGAUJAQ	1987-88	1988-89	1989-90
# of fishermen	1	n.a.	n.a.
AC catch - net	15	n.a.	n.a.
AC catch - others	20	n.a.	n.a.
Effort (net-days)	n.a.	n.a.	n.a.
C.P.U.E.	n.a.	n.a.	n.a.

NIKUTTIVIK	1987-88	1988-89	1989-90
# of fishermen	3	n.a.	n.a.
AC catch - net	69	n.a.	n.a.
AC catch - others	14	n.a.	n.a.
Effort (net-days)	n.a.	n.a.	n.a.
C.P.U.E.	n.a.	n.a.	n.a.

2e. Problematic river systems of the Kangirsuk region. Data source: 1987-88-89 - ACSE Program; 1989-90 - M.L.C.P. (en rédaction).

TASIRJUARUSIQ (QAMANIALUK)	1987-88*	1988-89	1989-90
# of fishermen	8	20	12
AC catch - net	50	340	10
AC catch - others	60	92	86
Effort (net-days)	46	274	2
C.P.U.E.	1.09	1.24	5.0

* Probably only partially reported.

2f. Problematic River systems of the Quaqtaq region. Data source: ACSE Program.

IQALUPPILIK	1987-88	1988-89	1989-90
# of fishermen	3	n.a.	3
AC catch - net	0	n.a.	0
AC catch - others	7 -20	n.a.	17 - 40
Effort (net-days)	0	n.a.	0
C.P.U.E.	-	n.a.	-

SIAQITUQ	1987-88	1988-89	1989-90
# of fishermen	3	n.a.	4
AC catch - net	1 - 5	n.a.	100 - 150
AC catch - others	6 - 15	n.a.	97 - 155
Effort (net-days)	14	n.a.	28
C.P.U.E.	0.1 - 0.4	n.a.	3.6 - 5.4

2f. Problematic River systems of the Quaqtaq region (continued).

INNANGAJUIT	1987-88	1988-89	1989-90
# of fishermen	n.a.	n.a.	2
AC catch - net	n.a.	n.a.	150 - 200
AC catch - others	n.a.	n.a.	200 - 275
Effort (net-days)	n.a.	n.a.	5
C.P.U.E.	n.a.	n.a.	30 - 40

2g. Problematic River systems of the Kangiqsujuaq region. Data source: 1988-89 ACSE Program; 1989-90 - Olpinski (1990).

IQALUKKAIT	1987-88	1988-89	1989-90
# of fishermen	n.a.	16	6
AC catch - net	n.a.	286 - 290	671 *
AC catch - others	n.a.	705	(included above)
Effort (net-days)	n.a.	11	12 (112 fish)
C.P.U.E.	n.a.	26.0 - 26.4	9.3 **

* Partial data from April to November 1989 including subsistence and scientific captures.
** Effort data available only from the scientific gill net fishery.

2g. Problematic River systems of the Kangiqsujuaq region (continued).

TASIQAJUIRUTIQ	1987-88	1988-89	1989-90
# of fishermen	n.a.	0	1 *
AC catch - net	n.a.	0	0
AC catch - others	n.a.	0	1 *
Effort (net-days)	n.a.	0	n.a.
C.P.U.E.	n.a.	0	n.a.

* Partial data available only from August to November 1989.

2h. Problematic River systems of the Salluit region. Data source: 1987-88 ACSE Program; 1989-90 M.L.C.P. (en rédaction).

TASIALURJUAQ	1987-88	1988-89	1989-90
# of fishermen	28	n.a.	4
AC catch - net	0	n.a.	0
AC catch - others	402	n.a.	66
Effort (net-days)	2	n.a.	0
C.P.U.E.	0	n.a.	-

2i. Problematic river systems of the Ivujivik region. Data source: M.L.C.P. (en rédaction).

KANGITUUQ	1987-88	1988-89	1989-90
# of fishermen	n.a.	n.a.	0
AC catch - net	n.a.	n.a.	0
AC catch - others	n.a.	n.a.	0
Effort (net-days)	n.a.	n.a.	0
C.P.U.E.	n.a.	n.a.	-

IQALUIT	1987-88	1988-89	1989-90
# of fishermen	n.a.	n.a.	3
AC catch - net	n.a.	n.a.	160
AC catch - others	n.a.	n.a.	0
Effort (net-days)	n.a.	n.a.	300
C.P.U.E.	n.a.	n.a.	0.5

KUUGAQ	1987-88	1988-89	1989-90
# of fishermen	n.a.	n.a.	0
AC catch - net	n.a.	n.a.	0
AC catch - others	n.a.	n.a.	0
Effort (net-days)	n.a.	n.a.	0
C.P.U.E.	n.a.	n.a.	-

2j. Problematic river systems of the Akulivik region. Data source: M.L.C.P. (en rédaction).

PAAKITTUQ	1987-88	1988-89	1989-90
# of fishermen	n.a.	0	1
AC catch - net	n.a.	0	0
AC catch - others	n.a.	0	5
Effort (net-days)	n.a.	0	0
C.P.U.E.	n.a.	-	-

QALLUNAARTALIVINIQ	1987-88	1988-89	1989-90
# of fishermen	n.a.	0	0
AC catch - net	n.a.	0	0
AC catch - others	n.a.	0	0
Effort (net-days)	n.a.	0	0
C.P.U.E.	n.a.	-	-

SAPUGAARJUIT	1987-88	1988-89	1989-90
# of fishermen	n.a.	4	0
AC catch - net	n.a.	>417	0
AC catch - others	n.a.	52 - 80	0
Effort (net-days)	n.a.	66	0
C.P.U.E.	n.a.	>6.3	-

2k. Problematic river systems of the Umiujaq region. Data source: ACSE Program).

TASIUJAQ	1987-88	1988-89	1989-90
# of fishermen	5	26	19
AC catch - net	8	410 - 445	>871
AC catch - others	69	702 - 772	150 - 240
Effort (net-days)	16	467	146
C.P.U.E.	0.5	0.9 - 1.0	5.97

Table 3. Relative classification of problematic river systems according to the Arctic charr subsistence harvest and the importance of the anadromous population.

Community	Important population	Moderate population	Relict population	Unclassified
Tarpangajuk				Tarpangajuk Uugalik
Kangiqsualujjuaq	Ippigittuq Sapukkait Sannirarsiq Napaartulik Tasikallak	Angusik Qarliik	Akilasaaluk	
Kuujjuaq	Qasigiarsiuvik		Kuujjuarusiq	
Tasiujaq			Majuagaq	Tasiujatuqait Iqaluliapik
Aupaluk	Tasiujaaluk	Nikuttivik		Qingaujaq Nuluarniavik
Kangirsuk	Tasirjuarusik			Isurtuq
Quaqtaq		Iqaluppilik		Siaqituq Innangajuit
Kangiqsujuaq	Iqalukkait		Tasiqajuirutiq	
Salluit	Tasialurjuaq			
Ivujivik		Kuugaq Iqaluit		Kangituuq
Akulivik	Sapugaarjuit	Qallunaartaliviniq	Paakittuq	
Povungnituk				Kangirsuruaq
Inukjuaq	Ippigittuq Saputiapiit Tasiujaapik	Kuugajaaraaluk Siukkakallait	Saputirluit Tikiraaluk	Iqaluppilik
Umiujaq	Tasiujaq			
Kuujjuaraapik			Iqaluppiit	

DISCUSSION

Although widely recognized as a weaker swimmer than Atlantic salmon, Arctic charr is able to pass various obstacles. Sannirarsiq (Figure 57) and Qamanialuk -.Tasirjuarusik (Figure 28 and 29) are clear examples of its ability to swim up falls approaching two meters. In Tasiujaaluk, we were able to observe fish easily crossing several meters of gravel bed with less than half their body depth of water. These performances nevertheless require the presence of deeper pools where charr may pick up swimming speed in preparation for the obstacle or simply rest between obstacles. As confirmed in 1989 by observations in Tasiujaaluk and Nikuttivik, Arctic charr are able to survive in such pools during several weeks while waiting for precipitations to improve stream conditions. Even when very small (surface area < 1 m^2), these pools constitute effective "fish shelters" as long as the water remains well oxygenated and cool; fish observed in such pools were strong and alert. On the other hand, fish resting in heavily-sedimented pools with poorer water flow were more lethargic.

Figure 57. In Sannirarsiq, Arctic charr pass falls which may very well define the limit of their capabilities.

These observations confirm the great ability of Arctic charr to adapt to variability of physical conditions found in Nunavik streams. Throughout four years of stream surveys (n=40) conducted between 1986 and 1989, less than 10 adult Arctic charr were found dead as a result of stream condition. Throughout numerous informal discussions, formal interviews with hunters and presentations in all communities, there are only few cases of large numbers of fish found dead in Nunavik streams. Examples of known casualties related to poor migration conditions in various Nunavik streams are presented below in Table 4. This is not an exhaustive report of events since there has been no systematic inventory of the various sources of anecdotal reports. Observations from Tasiujaaluk still give us an idea of the periodicity of the problem

Table 4. Casualties related to poor migration conditions in Nunavik streams.

Community	River system	Year	Event
Kangiqsualujjuaq	Tasikallak	~1980	~100 fish trapped and dead
		1989	2 fish found dead in stream
Tasiujaq-Aupaluk	Tasiujaaluk	1979	~50 fish dead in a dried-up pool
	Tasiujaaluk	1982	several fish dead eaten by fox
	Tasiujaaluk	1986	~100 fish trapped in pools
			numerous dead juveniles in stream
	Tasiujaaluk	1989	~100 fish trapped in pools
			1 fish found dead
Aupaluk	Nikuttivik	1989	~300 fish trapped in various pools

This leads us to reflect about the main objective of stream enhancement to increase Arctic charr abundance either by attracting more fish into a particular system or, preferably, by reducing mortalities associated with upstream migration. So far, major remedial works have been conducted in seven problematic river systems; minor stream modifications were done in four additional systems (Table 5). In all but one case (Sapugaarjuit), the stream work is believed to ease the upstream migration of individual fish, at least during periods of low water level. So far, there has been no systematic evaluation of the benefits of stream enhancement for the Arctic charr populations. Expected benefits may either be directly noticeable in the short term or only be the result of long-term improvements:

Noticeable in the	Direct benefit	Resulting benefit	Mechanism	Monitoring method
Short term	Increased number of migrants		Increased flow rate	Counting fence & tagging
Short term	Reduced casualties (juvenile & adult)		Improved channel & pools	Visual inspection
Short term	Improved physiology		Increased survival and fecundity	Physiological condition
Long term		Increased juvenile density	Increased number of spawners	Juvenile density studies
Long term		Increased population	Factors above combined	All methods combined
Short or long term		Increased fishing success	Increased recruit density	Harvest studies

The ACSE program is currently using two of the above methods to collect data which would be used in the eventual evaluation of the Program: visual inspection of the streams (Table 4) and harvest studies (Table 5). The other methods presented in the table above may be more effective means of understanding the impacts of dry summers on Arctic charr populations and especially of segregating these from other causes of natural fluctuations. However, these methods are very costly and, at least in the early years of the Program, preference is given to a more global approach of monitoring stream conditions and charr populations in as many systems as possible.

At this point in the Program, it is early to evaluate its eventual benefits as some may take more than one Arctic charr generation (4-10 years) before being noticeable. On the other hand, it is important to set the pace and the approach by identifying the main aspects of the upstream migration problematic and updating the prioritized river system list.

Table 5. Summary of stream enhancement works completed to date in Nunavik and system-specific harvest and effort data available before and after the works.

Community	Stream enhancement Major	Minor	Year	Harvest data (# years) Before	After
Kangiqsualujjuaq	*Tasikallak*		1987	1	3
Tasiujaq-Aupaluk	*Tasiujaaluk*		1986	0	4
Aupaluk	*Nikuttivik*		1989	2	0
Kangirsuk	*Qamanialuk*		1989	1	1
Kangiqsujuaq		*Tasiqajuirutiq*	1988	0	1
Akulivik	*Paakittuq*		1989	1	1
	Qallunaartaliviniq		1989	1	1
	Sapugaarjuit		1989	1	1
Inukjuaq		*Saputirluit*	1988	0	0
		Saputiapiit	1988	0	0
		Siukkakallait	1988	0	0

According to the information cumulated to date, there are three main levels in the upstream migration problematic:

1. Preventing the elimination of relict anadromous populations;
2. Stopping the severe deterioration of migration conditions which healthy populations are subjected to;
3. Alleviate the possible limitation caused by substantial obstacles (falls, rapids, etc.) in large river systems.

A fourth level (not necessarily last in priority) concern river systems which do not presently support anadromous Arctic charr populations:

4. Establish anadromous populations in new river systems or expand the available habitat in small river systems already used.

In discussing each of these priority levels it is important to realize that over and above the natural fluctuations, there is a definite trend due to the isostatic uplift causing streams to "dry up". The ACSE Program must therefore be set up to provide a long-term effort to correct and maintain migration passages.

1. Relict anadromous populations

In Nunavik, there are several examples of river systems where Arctic charr have recently disappeared:

Community	River system	Illustration	Hypothesis for disappearance
Tarpangajuk*	60° 02 lat. N 65° 02 long. W	Fig. 58-59	Fall > 1m with insufficient flow for fish to jump.
Akulivik	Isurqutuuq		Lake pH= 4
Inukjuaq	Kitturiartuuq		Insufficient water flow
Inukjuaq	Kangirsukallak	Fig. 60-61	Insufficient water flow

* The anterior presence of Arctic charr in this system was suggested by some residents of Kangiqsualujjuaq because of the existence of vestigial saputiit near the lake but this could not be confirmed by residents of Tarpangajuk.

This list is not exhaustive: it only includes river systems which were visited during ACSE surveys (Dumas 1989). We know of Arctic charr populations which are close to extinction because of over-fishing and inter-specific competition (e.g. Kuujjuaq River). However, to our knowledge, inadequate migrating conditions is probably the single most important cause of anadromy extinction among Nunavik river systems

River systems classified under "relict population" in Table 3 include at least three river systems (Tasirajuirutik, Paakittuq and Saputirluit) whose anadromous Arctic charr population may be endangered because of substantial difficulties for fish returning from the sea. These systems may very well be next on the list of disappearing populations and must be given priority. The current stream enhancement techniques may unfortunately not be adequate to improve stream conditions in the long term. These river systems will gradually suffer more and more from insufficient water flow. Current techniques aim at concentrating water flow in narrow sections when required but do not manage water regimes.

In terms of Arctic charr numbers, these river systems may not represent a great loss because they support very small populations but, in terms of numbers that could be reached if streams were properly restored, they are certainly worth saving. Once a population decreases below a certain number of spawners then the introduction of new individuals (juveniles or adult) would be required in conjunction with the stream work. Additionally, given the small populations involved, it is in these river systems that the benefits of stream enhancement will be most noticeable.

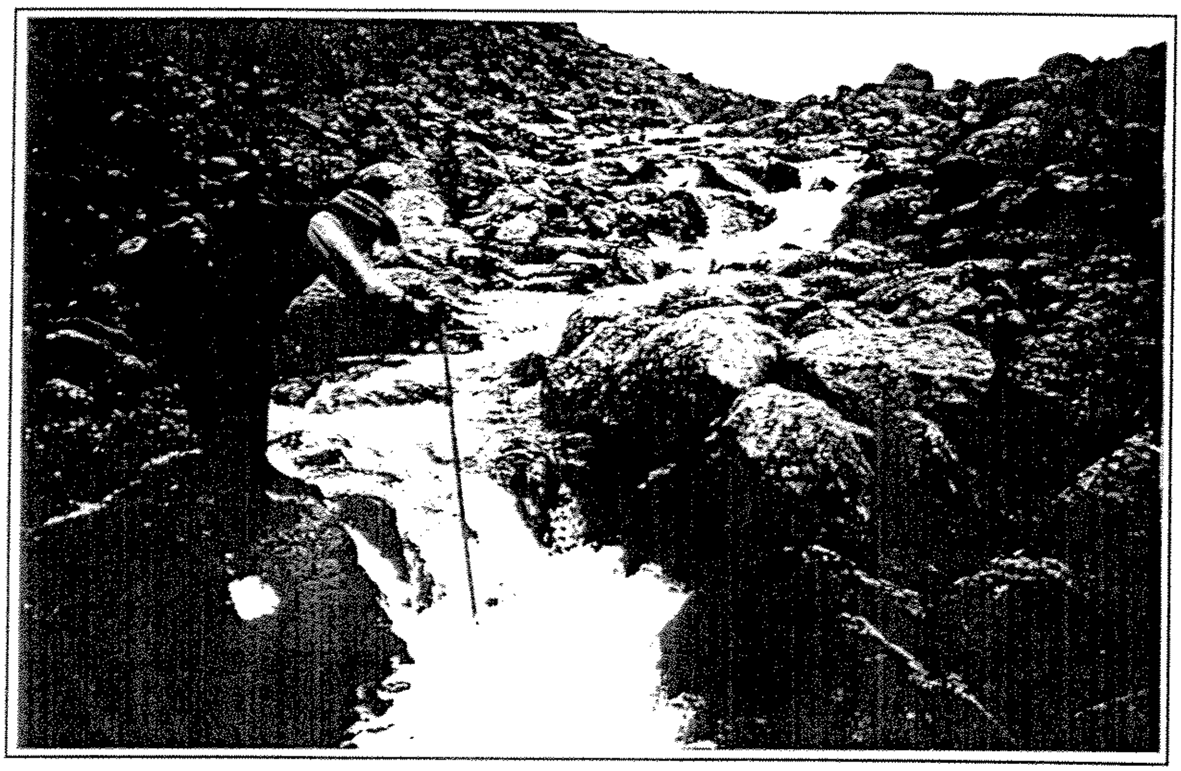


Figure 58. In Tarpangajuk, this small fall is likely to be responsible for anadromous Arctic charr disappearing from this river system (see Figure 59).

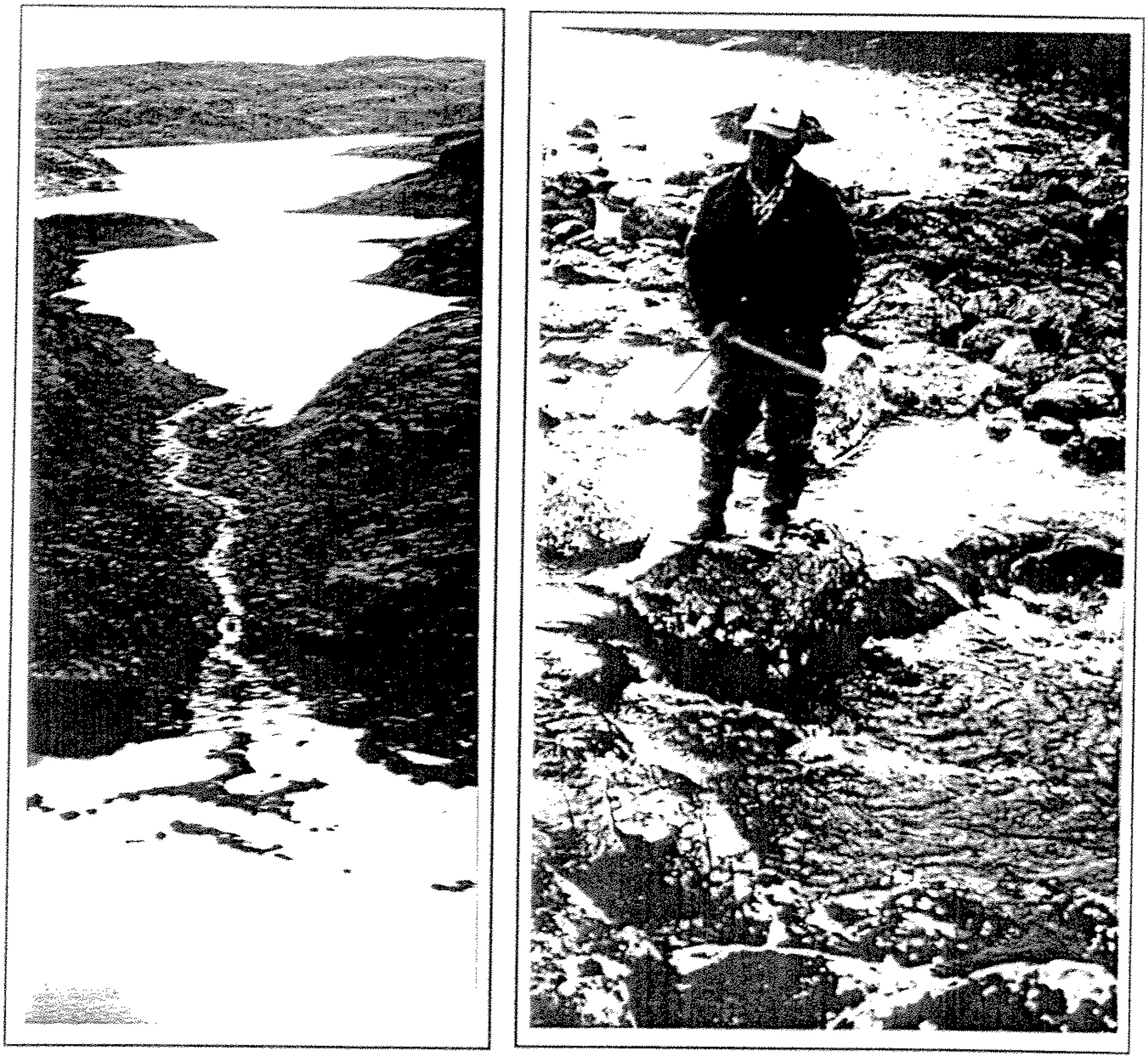


Figure 59. In Tarpangajuk, a large lake connected to the sea by a small stream (low oblique aerial photograph on the left) probably supported an anadromous Arctic charr population in the past as demonstrated by a vestigial saputiit (right).

Figure 60. Kangirsukallak (Inukjuaq region) is located close to an important summer camp. In 1989, two sea-run Arctic charr were captured in the stream (which no longer accommodated anadromous fish) as a result of remedial works (Figure 61) recently conducted by local residents .

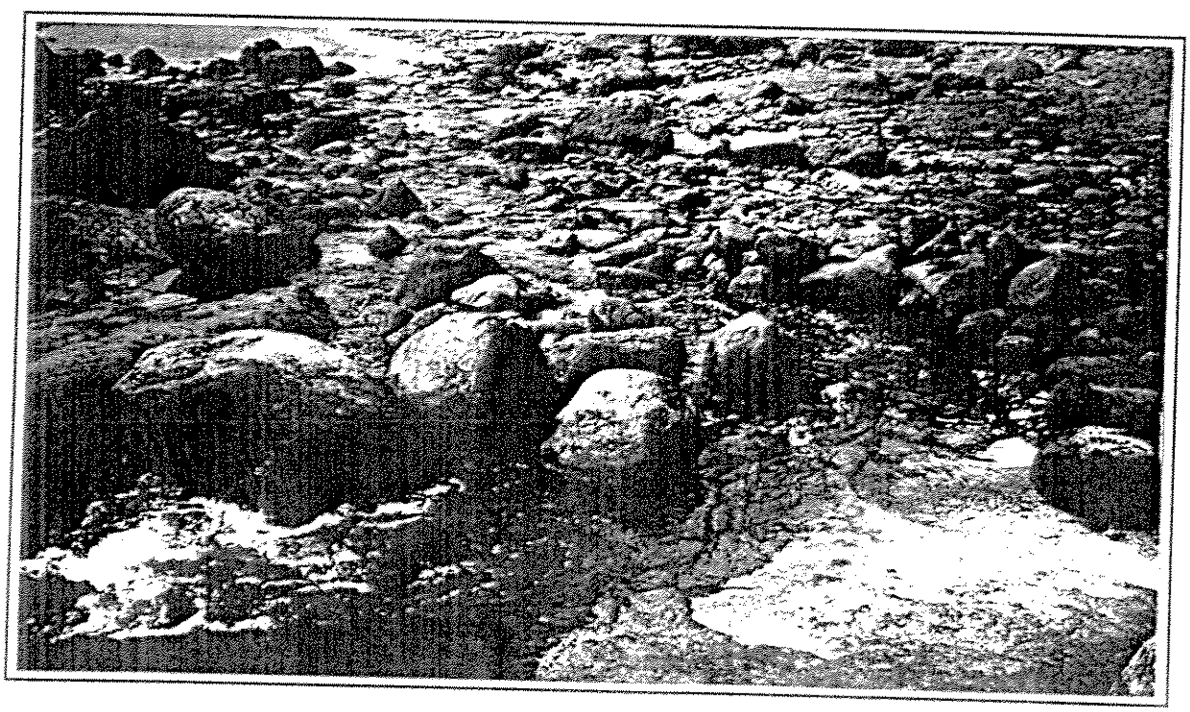


Figure 61. In Kangirsukallak, local residents restored an old fishway by moving boulders which were obstructing the mouth of the stream.

2. <u>Severe deterioration of migration conditions for healthy populations</u>

This concerns systems which support healthy populations but where in some years stream conditions are severe and may result in some casualties. The gradual deterioration of upstream migrating conditions for Arctic charr in these streams is definitively a problem in need of solutions. We know that this deterioration process is noticeable within one generation time as confirmed by numerous observations from older Inuit hunters.

These systems need initial remedial works followed by a periodical monitoring and maintenance program. In this perspective, the effectiveness of current techniques for stream maintenance must be evaluated in light of inspection results from test systems and projects conducted elsewhere for other salmonid species. The choice or proper techniques requires that problem types and their incidence in problematic Arctic charr rivers are well documented. The review of problem types presented in Dumas (1989) has been revised according to the 1989 survey results and summarized in Table 6. The evaluation of stream enhancement techniques should include a review of the relative importance of each problem type in each system, the implied difficulty (if any) for charr migration and the effectiveness of current stream enhancement techniques at reducing the difficulty rating associated with each problem.

As stated earlier, at this point, it remains unclear if stream maintenance would result in increased numbers of charr reaching spawning and wintering habitats, in improved ability to reproduce, in increased winter survival or simply in enhanced physiological condition.

Some of the most unusual problem types, not yet been illustrated in this report, are shown in the following photographs: beaver dam (Figure 62), road culverts (Figure 63) and traditional fishing weir or saputiit (Figure 64).

Table 6. Summary of the types of obstacles to migration identified in problematic systems and their incidence as primary obstacle.

Code	main obstacle to charr migration	# of rivers*
Bo	Steep climb through boulders/rocks	7
Fa	Severe rapids/small falls (steep water drop)	7
Ch	Poor water flow due to diffused channels	5
In	Insufficient water flow	4
Sa	Old traditional fishing weirs (saputiit)	3
Gr	Shallow gravel/small rock passages	3
La	Shallow access to lake	1
Be	Solid bed rock	1
Bv	Beaver dam	1
Cu	Road culvert	1
Un	Nature of obstacles unknown	3

*Includes results from the 1984 Ungava survey (Barton et al. 1985).

(Photo: Dave Gillis)

Figure 62. In Tasiujaaluk (Tasiujaq-Aupaluk region), a beaver dam had completely obstructed the stream used used by anadromous Arctic charr.

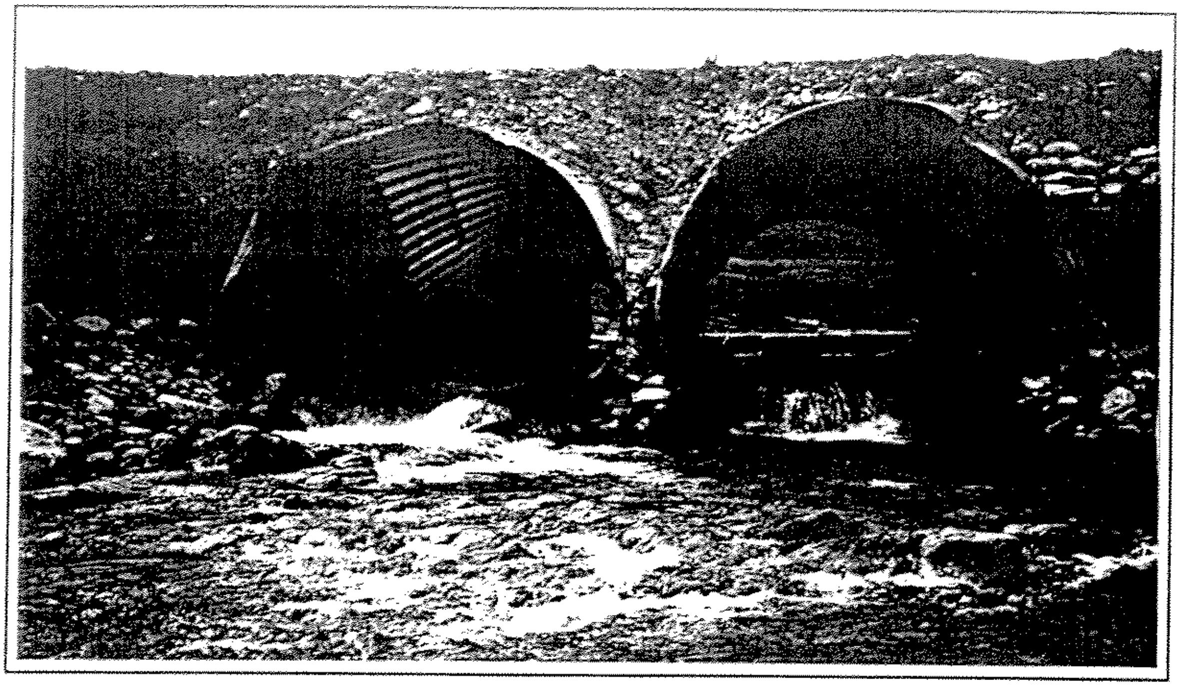


Figure 63. In Tasialurjuaq (Salluit region), the migration of anadromous Arctic charr is affected by damaged and improperly installed road culverts.

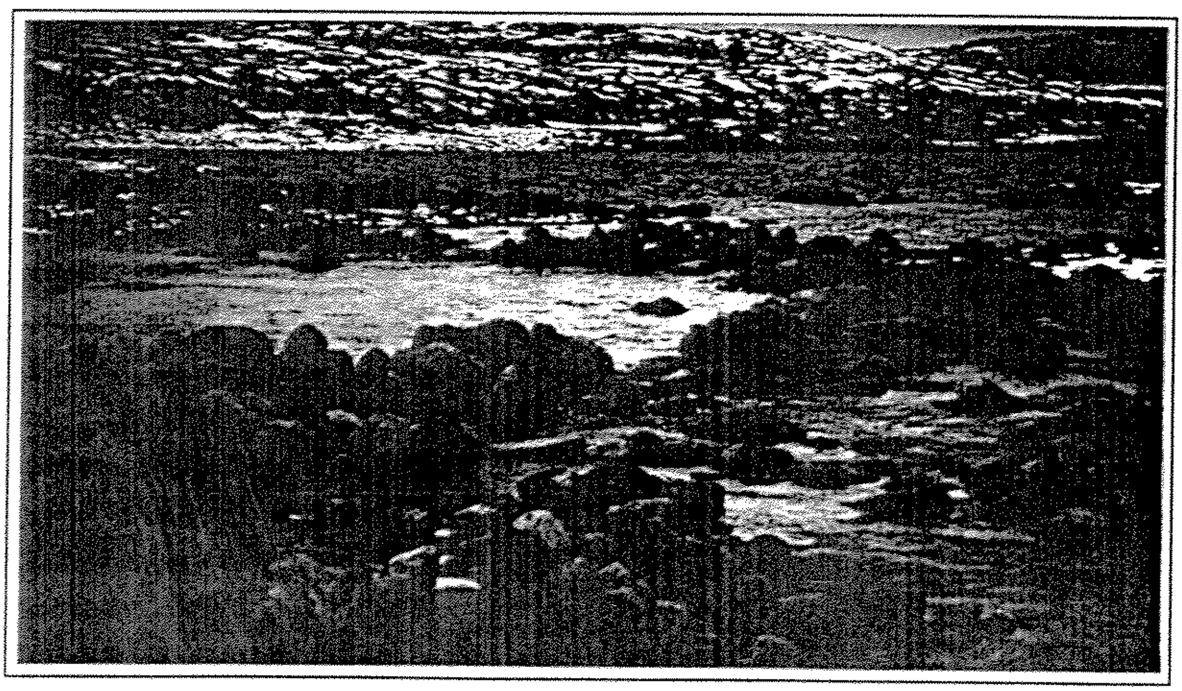


Figure 64. Saputiit were traditionally constructed to congregate Arctic charr during the upstream migration. In certain locations like Saputiapiit (Inukjuaq), the weir must be inspected to insure that it does not cause any obstruction.

3. Substantial obstacles in larger river systems

Certain river systems contain large-scale obstacles such as falls (e.g. Sannirarsiq. Figure 57), important rapids or long river sections which would require extensive remedial works (exceeding 50 men-days). The impact of falls and large rapids on Arctic charr migration is probably lesser than what their physical appearance would suggest since most river system where they are found support important anadromous populations. We need to gain a much more precise understanding of the limiting effect of these features before contemplating the possibility of modifying their structure. Such work would be costly and would not necessarily benefit the Arctic charr population. Rivers containing long problematic sections, on the other hand, potentially have a greater impact on the populations. Remedial works in these systems would involve extensive and expensive operations but uncertain success. It is preferable to leave these systems on hold until the benefits of stream enhancement are demonstrated in simpler systems. Inspection of these complex river sections are nonetheless recommended during dry summers to document the importance of casualties.

4. New river systems or expanded habitat.

An older Inuk hunter was once describing Arctic charr systems as any river accessible (for fish) from the sea and containing suitable wintering and spawning habitats. From the point of view of stream enhancement, this is the best definition one can find. During ACSE Program surveys, six river systems presently unused by anadromous Arctic charr were visited; in all but one the absence of the species was explained by the inaccessibility from the sea due to an impassible jump, a shallow and steep section or simply an insufficient water flow. As previously described, Kuujjuarusiq is a unique case where the possibilities for expanding the freshwater habitat available to Arctic charr are immense. Several other systems without anadromous Arctic charr were visited in 1984 (Barton et al. 1985).

We will not further expand on these systems as they have not been the focus of the ACSE Program to this date. We must simply stress that these systems represent a great potential for increasing Arctic charr abundance in

Nunavik. The feasibility study jointly conducted by the University of Waterloo and Makivik in 1984 was a first step in that direction. We now have sufficient information at hand to select a test site; a pilot project is the logical next step.

The prioritized problematic river system list has been revised according to items discussed above and information collected in 1989; it is presented in Table 7.

Table 7. Prioritized list and status of problematic Arctic charr river systems in Nunavik by community, indicating in each the main obstacle to migration (according to codes presented in Table 5).
Priority level #1: relict population, high priority.
Priority level #2: stream maintenance required.
Priority level #3: remedial works involve heavy equipment or over 50 men-days.
Priority level #4: river system needing habitat expansion.
River systems where remedial works have been completed are highlighted in bold.

Community	River system	Status	Main obstacle
Tarpangajuk (3)	Uugalik	not surveyed	-
	Tarpangajuk	not surveyed	Fa
	Ippigittuq	no migration problem	-
Kangiqsualujjuaq (8)	Sapukkait	priority level #3	Sa
	Sannirarsiq	priority level #3	Fa
	Napaartulik	priority level #2	Ch
	Angusik	priority level #3	Ch
	Qarliik	priority level #1	Ch
	Tasikallak	priority level #2	Ch
	Ujarasujjulik	priority level #3 (or #4?)	-
	Akilasaaluk	priority level #2	Bo
Kuujjuaq (2)	Kuujjuarusiq	priority level #4	Fa
	Qasigiarsiuvik	priority level #3	-
Tasiujaq (2)	Tasiujatuqait	priority level #3	Bo
	Ungavatuaq	priority level #3	-
	Iqaluliapik	priority level #2	Bo
(and Aupaluk) (1)	**Tasiujaaluk**	priority level #2	In
(2)	Majuagaq	priority level #1	In

Table 7. (continued)

Community	river system	status	main obstacle
Aupaluk (3)	Qingaujaq	priority level #1	Gr
	Nikuttivik	priority level #2	Fa
(and Kangirsuk) (1)	Nuluarniavik	priority level #3	Fa
Kangirsuk (2)	Isurtuq	priority level #3	Fa
	Qamanialuk	priority level #2	Fa
Quaqtaq (3)	Iqaluppilik	priority level #1	Ch
	Siaqituq	priority level #3	Bo
	Innangajuit	not surveyed	no lake
Kangiqsujuaq (2)	**Iqalukkait**	priority level #2	Bo
	Tasiqajuirutiq	priority level #1	Fa
Salluit (1)	Tasialurjuaq	culvert problem in debate between M.L.C.P. and Transport Québec	Cu
Ivujivik (3)	Kangituuq	priority level #2	Bo
	Iqaluit	no migration problem	-
	Kuugaq	priority level #2	Gr
Akulivik (4)	**Paakittuq**	priority level #1	In
	Qallunaartaliviniq	priority level #1	Gr
	Isurqutuuq	problem other than migratory (lake pH = 4)	
	Sapugaarjuit	remedial works completed	Sa
Povungnituk (1)	Kangirsuruaq	not surveyed	-
Inukjuaq (8)	Iqaluppilik	priority level #3	Be
	Kuugajaaraaluk	priority level #2	Bo
	Ippigittuq	no migration problem	-
	Saputirluit	priority level #1	In
	Saputiapiit	priority level #2	Sa
	Tasiujaapik	no migration problem	-
	Tikiraaluk	priority level #1	In
	Siukkakallait	priority level #2	Bo
Umiujaq (1)	Tasiujaq	beaver dam problem	Bv
Kuujjuaraapik (1)	Iqaluppiit	problem other than migratory	-

RECOMMENDATIONS

Considering that remedial works were conducted in five new river systems in 1989 and that the harvest data base is still incomplete for many problematic systems, it is recommended that:

1. Remedial works conducted in Tasiujaaluk, Nikuttivik, Qamanialuk, Paakittuq, Qallunaartaliviniq and Sapugaarjuit be inspected in 1991 during the anadromous Arctic charr upstream run.

2. Harvest and fishing effort data collection be continued in cooperation with other ongoing studies to insure that fishing success is documented, in all problematic systems.

Given that the direct resulting benefits of stream enhancement remain to be evaluated and that the effectiveness of techniques presently used needs to be assessed, it is further recommended that:

3. A review of current techniques used under the ACSE Program in Nunavik and those used in other regions for salmonid habitat enhancement, as well as their respective effectiveness for anadromous Arctic charr, is completed.

4. Following the completion of this review, the ACSE Program operations be planned in order to address the problematic aspects of priority #1 and priority #2 river systems.

Finally, because of the scarcity of anadromous Arctic charr systems in the vicinity of certain communities (especially Kuujjuaq, Quaqtaq, Umiujaq and Kuujjuaraapik), and their need to increase Arctic charr abundance, it is recommended that:

5. A pilot project, aiming at establishing a new anadromous Arctic charr population or expanding the range of an existing one, is undertaken.

LITERATURE CITED

Barton D., T. Boivin, M. Lefebvre, P. Lemieux, G. Power and B. de Schiffart. 1985. A feasibility study of the potential for increasing the abundance of anadromous Arctic charr in northern Québec.. Makivik Corporation, Research Department. 5 volumes.

Boivin T. 1987. The winter fishery of Kangiqsualujjuaq, Québec and winter physiology of arctic char. M. Sc. thesis, U. of Waterloo. 170 p. + app.

Boivin T. 1990a. The Arctic charr (*Salvelinus alpinus*) experiemental-commercial fishery in Kangiqsualujjuaq, Québec, November 1989 - April 1990. Scientific report submitted to: Department of Fisheries and Oceans, Ministère de l'Agriculture, des Pêcheries et de l'Alimentation and Ministère du Loisir, de la Chasse et de la Pêche. Makivik Corporation. 24 p.

Boivin T. 1990b. Arctic charr (*Salvelinus alpinus*) Research during the winter of 1990 at Lake Sapukkait, eastern Ungava Bay, northern Québec. Preliminary report submitted to: Economic Development Agreement Committee. Kuujjuaq Research Centre, Makivik Corporation. 11 p.

Boivin T., F. Axelsen and L. Roy. 1990. Project report of the research on Arctic charr experimental systems in eastern Ungava Bay, northern Québec, 1989. Report submitted to: Economic Regional Development Agreement Committee. 17 p.

Boivin T., S. Olpinski and P. May. 1988. The Arctic charr (*Salvelinus alpinus*) experimental fishery in Kangiqsualujjuaq, Québec, 1987-88. Scientific report submitted to: Ministère de l'Agriculture, des Pêcheries et de l'Alimentation and Ministère du Loisir, de la Chasse et de la Pêche. Kuujjuaq Research Centre, Makivik Corporation. 35 p.

Boivin T., S. Olpinski and P. May. 1989. The Arctic charr (*Salvelinus alpinus*) experiemental-commercial fishery in Kangiqsualujjuaq, Québec, November 1988 - April 1989. Scientific report submitted to: Ministère de l'Agriculture, des Pêcheries et de l'Alimentation and Ministère du Loisir, de la Chasse et de la Pêche. Kuujjuaq Research Centre, Makivik Corporation. 30 p.

Boivin T.G. and D. Vandal. 1989. Arctic charr research using counting fences in eastern Ungava Bay, northern Québec 1988. Scientific report submitted to: Ministère de l'Agriculture, Pêcheries et Alimentation, Québec. 29 p.

Dumas R. 1988. Stream enhancement in northern Québec (Canada): a test project to improve the quality of Arctic charr (*Salvelinus alpinus*) migratory passages. Poster presented at the International Symposium on Charrs and Masu Salmon, Sapporo, Japan, October 3-9, 1988.

Dumas R. 1989 Arctic Charr Stream Enhancement in Nunavik: Summary of Activities in 1989. Presented to Makivik Corporation, Seaku Corporation, Kativik Regional Government (Hunter Support Program) and Economic Regional Development Agreement Committee. Kuujjuaq Research Centre, 13 p.

Dumas R. 1990. Feasibility to establish anadromous Arctic charr above the Nepihjee River falls (Dry Bay): survey results and recommendations. Renewable Resource Development, Makivik Corporation. 23 p.

Gillis D. and A. Gordon. 1987. Arctic Charr Enhancement Test Project: Interim Report. Makivik Research Department. 6 p.

James Bay and Northern Québec Native Harvesting Research Committee. 1982. Research to establish present levels of native harvesting: harvests by the Inuit of northern Québec (Phase II yrs. 1979 and 1980). Prepared for the Coordinating Committee on Hunting, Fishing and Trapping. Montréal 1982.

Johnson L. 1980. The arctic charr, *Salvelinus alpinus*. In: E. K. Balon [ed.]. Charrs, Salmonid Fishes of the Genus Salvelinus. Perspective in Vertebrate Science. Vol. 1. p. 15-98.

Kuujjuaq Research Centre. 1988. Arctic Char Stream Enhancement: Tasiujaaluk inspection 1987. Makivik Corporation. 8 p.

Ministère du Loisir, de la Chasse et de la Pêche (en rédaction). Enquête sur la récolte d'Omble chevalier au Nunavik, 1989-1990.

Olpinski S, 1990. Monitoring of the 1989 experiemental-commercial Arctic charr (*Salvelinus alpinus*) weir fishery at Lake Iqalukkait, and the March 1990 scientific fisheries at Lakes Iqalukkait and Iqalujjuaq northern Ungava Bay, Québec. Prepared for: The Canada-Québec subsidiary agreement on fisheries development; section 111: northern Québec (E.R.D.A.). 47 p.

Power G. and D. Barton. 1987. Some effects of physiographic and biotic factors on the distribution of anadromous arctic charr *Salvelinus alpinus* in Ungava Bay, Canada. Arctic (40) 3: 198-203.

Appendix 1:
Harvest questionnaire

ᐃᖃᓗᒃᐱᒃ ᒪᔪᖅᐱᒥᓯᕐᒥᒃ ᐊᕐᑭᓯᖅᑕᐅᒥᐊᖃᕐᓂᕐᒥᒃ

Arctic Char Stream Enhancement

ARCTIC CHAR HARVEST STUDY
FALL 1989 - WINTER 1990

Community:	River system:	Fisherman:
______	______	______

Did you fish in this river system this year?
(Between September 1989 and May 1990) (OR JUNE)

No [ ] Yes [ ] If yes: [ ] By Net [ ] By Kakivak [ ] By jigging [ ] By Nitsik

Please estimate your fish catch within the limits defined below
(Put an "X" in the appropriate box)

Number of fish caught	Fish caught by Net	Fish caught by Jigging/Rod	Fish caught by Kakivak	Fish caught by Nitsik
None				
1 - 5				
5 -10				
10 - 20				
20 - 30				
30 - 40				
40 - 50				
50 - 75				
75 - 100				
100 - 150				
150 - 200				
If more than 200 give approximate Number				

How many nets were you using and how many days were they set, for each month?

	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Number of nets									
Number of days									

ᐃᖃᓗᒃᐱᑦ ᒪᔪᖅᐱᒋᓱᖕᒋᑦ ᐊᖏᓱᖅᑕᐅᒥᐊᖅᑲᓂᖕᒋᑦ

Arctic Char Stream Enhancement

ᐃᖃᓗᒃᐱᑦ ᖃᐅᔨᓴᖅᑕᐅᓂᖕᒋᑦ
ᐅᑭᐊᒃᓴᖅ 1989 - ᐅᑭᐅᖅ 1990

ᓄᓇᓕᖕᒐ: ______________

ᑰᑦ ᐊᑎᖓ: ______________

ᐃᖃᓗᖕᓂᐊᑎ: ______________

ᑕᒫᓂ ᑰᒥ ᐃᖃᓗᖕᓂᐊᓚᐅᖅᐱᑦ?
(ᓯᑎᒻᐱᕆ 1989 ᐊᒻᒪᓗ ᒪᐃ 1990 ᐊᑯᓐᓂᖓᓂ)
(ᖁᓂᑐᓂ)

ᐊᐅᒃ ☐ ᐋᖅ ☐ ᐊᖏᕈᐱᑦ: ☐ ᓄᓗᐊᓄᑦ ☐ ᑲᑭᕙᖅᑐᑦ ☐ ᐊᐅᓚᓴᐅᑎᑐᑦ ☐ ᓂᖅᓯᑐᑦ

ᐊᑏ ᐊᖏᓯᓚᐅᖅᐳᑦ ᐃᖃᓗᒃᑕᐱᓂᕐᐱᑦ ᖃᓯᐅᓂᖕᒋᑦ ᐊᑕᓂᒃᑐᓄᑦ ᓯᕿᑖᐱᖕᓄᑦ
(ᐃᒪᐃᓕᖕᒐᔪᒥᑦ X ᐊᖅᓚᓗᑎᑦ ᖃᓯᖏᓂᐱᓂᕐᐱᑦ ᐃᓂᖕᒪᓄᑦ ᐃᓯᕙᐊᐱᖕᓄᑦ ᐊᑖᓄᑦ)

ᖃᓯᐅᓂᖕᒋ ᐃᖃᓗᐃᑦ	ᐃᖃᓗᒃᑕᐱᓂᑦ ᓄᓗᐊᓄᑦ	ᐃᖃᓗᒃᑕᐱᓂᑦ ᐊᐅᓚᓴᐅᑎᑐᑦ ᐃᖃᓴᐅᑎᑐᑦ	ᐃᖃᓗᒃᑕᐱᓃᑦ ᑲᑭᕙᖅᑐᑦ	ᐃᖃᓗᒃᑕᐱᓃᑦ ᓂᖅᓯᑐᑦ
ᐱᑕᖃᖏᑐᖅ				
1 - 5				
5 - 10				
10 - 20				
20 - 30				
30 - 40				
40 - 50				
50 - 75				
75 - 100				
100 - 150				
150 - 200				
200 ᐅᖓᑖᓂᒃᓴᑕ ᖃᓯᐅᓂᖕᒋᑦ ᐊᖅᓚᓗᒋᑦ				

ᖃᓯᓂᑦ ᓄᓗᐊᓂᑦ ᐊᑐᖅᑕᓚᐅᖅᐱᑦ ᐊᒻᒪᓗ
ᖃᓯᓂᑦ ᐅᖓᓂᑦ ᐃᓕᓯᒪᖅᑕᓚᐅᖅᐸ ᑕᒡᕗᒥ ᐊᑕᐅᓯᕐᒥ

	ᓯᑎᐱᕆ	ᐅᑐᐱᕆ	ᓄᕕᐱᕆ	ᑎᓯᐱᕆ	ᔭᓄᐊᕆ	ᕕᕝᕗᐊᕆ	ᒫᑦᓯ	ᐊᐃᕆᓕ	ᒪᐃ
ᓄᓗᐊᑦ ᖃᓯᐅᓂᖕᒋᑦ									
ᐅᖓᐃᑦ ᖃᓯᐅᓂᖕᒋᑦ									

Appendix 2:
Harvest booklet

ᐅᓪᓗᖓ
Date

ᓇᓂ ᐃᖃᓗᑦᓯᐅᕆᑦ ᐅᓪᓗᒥ
Where did you fish today? ____________

ᖃᑦᓯᓂᒃ ᓄᓗᐊᓂᒃ ᐊᑐᕆᑦ ᐅᓪᓗᒥ?
How many nets did you use today? [ ]

ᐃᖃᓗᐃᑦ ᖃᓄᐃᑦᑐᓂᖏᑦ Fish Species	ᐃᖃᓗᑦᑕᑎᑦ ᐅᓪᓗᒥ Your fish catch today		
	ᓄᓗᐊᓄᑦ By Net	ᐊᐅᓚᓴᐅ ᑎᒍᑦ By Jigging	ᑲᑭᕙᒍᑦ ᓂᑦᓯᒍᑦᑐᓂ By Kakivak or Nitsik
ᐃᖃᓗᒃᐱᐃᑦ Sea run Arctic Char			
ᐊᐅᐸᓚᔦᑦ Spawning char			
ᓄᑎᓪᓖᑦ Land locked char			
ᑲᕕᓯᓖᑦ ᓴᑦᑐᔦᑦ Lake Whitefish			
ᑲᕕᓯᓖᑦ ᐊᒻᒪᓗᑯᑖᑦ Round Whitefish			
ᐃᓯᐅᕋᓕᑦᑖᑦ Lake trout			
ᐋᓇᐃᑦ Brook trout			

ᐃᖃᓗᖕᓂᕈᕕᑦ ᓇᓗᓇᐃᒃᑯᑕᓕᒻᒥᒃ ᐊᓪᓚᓗᒍ ᕿᓯᑦᓯᒍᑎᖓ
If you caught a tagged charr, write the tag number ____________

ᐅᓪᓗᖓ
Date

ᓇᓂ ᐃᖃᓗᑦᓯᐅᕆᑦ ᐅᓪᓗᒥ
Where did you fish today? ____________

ᖃᑦᓯᓂᒃ ᓄᓗᐊᓂᒃ ᐊᑐᕆᑦ ᐅᓪᓗᒥ?
How many nets did you use today? [ ]

ᐃᖃᓗᐃᑦ ᖃᓄᐃᑦᑐᓂᖏᑦ Fish Species	ᐃᖃᓗᑦᑕᑎᑦ ᐅᓪᓗᒥ Your fish catch today		
	ᓄᓗᐊᓄᑦ By Net	ᐊᐅᓚᓴᐅ ᑎᒍᑦ By Jigging	ᑲᑭᕙᒍᑦ ᓂᑦᓯᒍᑦᑐᓂ By Kakivak or Nitsik
ᐃᖃᓗᒃᐱᐃᑦ Sea run Arctic Char			
ᐊᐅᐸᓚᔦᑦ Spawning char			
ᓄᑎᓪᓖᑦ Land locked char			
ᑲᕕᓯᓖᑦ ᓴᑦᑐᔦᑦ Lake Whitefish			
ᑲᕕᓯᓖᑦ ᐊᒻᒪᓗᑯᑖᑦ Round Whitefish			
ᐃᓯᐅᕋᓕᑦᑖᑦ Lake trout			
ᐋᓇᐃᑦ Brook trout			

ᐃᖃᓗᖕᓂᕈᕕᑦ ᓇᓗᓇᐃᒃᑯᑕᓕᒻᒥᒃ ᐊᓪᓚᓗᒍ ᕿᓯᑦᓯᒍᑎᖓ
If you caught a tagged charr, write the tag number ____________

Appendix 3:
Tag return notice

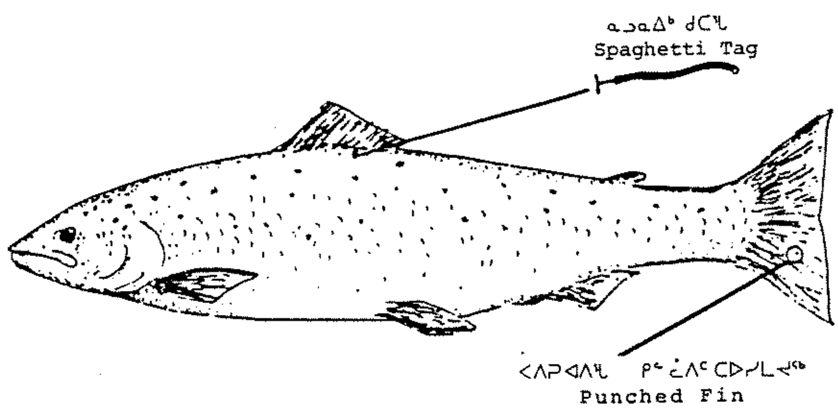
ᐱᔭᐅᒍᒪᔪᑦ

ᐊᐅᒡᒍᓯᐅᑎᓪᓗᒍ 1989-ᒥ ᓇᓗᓇᐃᒃᑯᓯᖅᑐᐃᓚᐅᔪᒍᑦ 51-ᓂᒃ ᐃᖃᓗᑉᐱᓂᒃ ᑕᓯᐅᔮᓗᒻᒥ. ᐃᖃᓗᖕᓂᕈᕕᑦ ᓇᓗᓇᐃᒃᑯᓯᖅᓯᒪᔪᒥᒃ ᐅᐸᖅᑎᓂ ᖃᐅᔨᑎᖅᓯᓚᐅᕆᑦ.

ᖃᐅᔨᒍᒪᕗᒍᑦ:

- ᐃᖃᓗᑉᐱᐱᓂᖅᐱᑦ ᓇᓂᒃᓂᖓᓂ
- ᐅᓪᓗᖓᓂᓗ
- ᐊᒻᒪᓗ ᓇᓗᓇᐃᒃᑯᑕᖓᑕ ᑭᓯᖅᓯᒍᑎᖓᓂᒃ

ᐅᖃᓚᒍᑦᓇᖅᑯᑎᑦ ᓄᓇᓕᖅᓯ ᐊᓪᓚᕕᖓᓄᑦ ᐅᑉᐹᓅᓐᓃᑦ ᐅᐸᖅᑎᓗᑦ 964-2951-ᒧᑦ ᑲᓕᐊᒃ ᑳᓗᑎᑦ ᐅᖃᓚᖃᑎᖃᕈᒪᓗᑎᑦ ᐋᓕ ᑯᐊᑕᒥᒃ ᐅᑉᐹᓅᓐᓃᑦ 1-800-361-7052-ᒧᑦ ᕆᔮ ᑐᒫᒧᑦ ᐅᖃᓚᒍᒪᓗᑎᑦ. $10-ᒥᒃ ᐊᐃᖅᑐᑕᐅᓛᖅᑯᑎᑦ ᐃᖃᓗᑉᐱᓂᕈᕕᑦ ᓇᓗᓇᐃᒃᑯᓯᖅᓯᒪᔪᒥᒃ.



WANTED

In August 1989 we tagged 51 Arctic char in Tasiujaaluk. If you catch one of these fish, tell us about it.

We need to know the:

- location
- date
- tag number
- length of fish

Please contact your municipality office or contact us at 964-2951 (call collect and ask for Alix Gordon) or 1-800-361-7052 (ask for Réjean Dumas). We will forward you a $10 reward.