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**Using stewardship, long term monitoring and adaptive
management to restore the Atlantic salmon population of the
Northwest River**

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ABSTRACT

The Northwest River is a beautiful rugged river, popular with kayakers and anglers. It flows over 60 kilometres from its headwaters in the Bay du Nord Wilderness Area, through open barren country and cascading falls before emptying into the Atlantic Ocean in Terra Nova National Park on the northeast coast of Newfoundland. For generations, local community residents have enjoyed angling for salmon on the Northwest River and commercial fishing near-shore.

By the early-1990s, both that tradition and the salmon stock in the Northwest River were at risk. Declining numbers of salmon returning to Newfoundland's rivers forced the closing of the commercial salmon fishery in 1992, but stock levels in the Northwest River failed to substantially improve. To protect the remaining salmon, Parks Canada closed the Northwest River to recreational salmon fishing in 1996. A fish-counting fence showed that, despite the cessation of recreational fishing, the number of returning salmon still continued to decline.

Traditional solutions clearly failed to improve returns of salmon to the river, so in 2002 Parks Canada joined with the Department of Fisheries and Oceans and local residents to try a new approach. Together, they formed the Northwest River Atlantic Salmon Conservation Working Group. Led by local citizens, this advisory group of community residents and government agencies created a population recovery and conservation plan. Community stewardship was key to the plan. Recreational fishing could resume *only if* enough fish to ensure the future health of the stock passed through the counting fence. Each salmon caught illegally diminished the likelihood of the river reopening for angling, threatening the aspirations of the community.

The advisory group set short and long-term goals to recover the stock, and determined the minimum number of spawners needed to sustain/rebuild the population. The group then calculated how many salmon could safely be harvested. In the summer of 2003, salmon returns exceeded the targets and Parks Canada reopened the Northwest River to anglers. In subsequent years, this same management process has been applied.

Through their partnership with Parks Canada, Department of Fisheries and Oceans and others, residents now have a meaningful role in managing their local resources. Community pride in this local river system is renewed, and the number of salmon returning to the Northwest River continues to climb.

RÉSUMÉ

La rivière Northwest est une superbe rivière accidentée, populaire auprès des kayakistes et des pêcheurs sportifs. S'étirant sur plus de 60 kilomètres, elle prend sa source dans l'aire de nature sauvage Bay du Nord, traverse de vastes landes désolées et, après une série de cascades, se jette dans l'Atlantique au parc national Terra-Nova, sur la côte nord-est de Terre-Neuve. Des générations de résidents de la région ont pratiqué la pêche sportive du saumon dans la rivière Northwest, et en ont fait la pêche commerciale le long des côtes.

Au début des années 1990, cette tradition et les stocks de saumons de la rivière Northwest étaient menacés : le déclin des remontées de saumon dans les rivières de Terre-Neuve a forcé la fermeture de la pêche commerciale du saumon en 1992, mais le niveau des stocks dans la rivière ne se s'est pas vraiment rétabli. En 1996, dans l'espoir de protéger les saumons restants, Parcs Canada a interdit toute pêche sportive dans la rivière Northwest. Malgré cette mesure, les décomptes aux barrières de dénombrement ont continué de signaler une réduction des remontées de saumons.

Comme les solutions traditionnelles avaient toutes échoué à améliorer la situation des retours dans la rivière, Parcs Canada s'est associé à Pêches et Océans Canada et aux populations locales pour appliquer une nouvelle stratégie en créant le Groupe de travail pour la conservation du saumon de l'Atlantique de la rivière Northwest. Animé par des citoyens du coin, ce groupe consultatif de résidents et d'agences gouvernementales a formulé un plan de rétablissement et de conservation de la population de saumons. L'intendance par la collectivité était à la clé du succès de ce plan : la pêche sportive pourrait reprendre *seulement si* assez de poissons passaient la barrière de dénombrement pour assurer la santé future des stocks. Tout saumon braconné diminuait les chances de rouvrir la rivière aux sportifs, nuisant aux aspirations de toute la collectivité.

Le groupe consultatif s'est donc fixé des objectifs de rétablissement à court et à long terme, et a fixé le nombre minimum de reproducteurs requis pour maintenir et rétablir la population. Puis, le groupe a calculé combien de saumons il serait possible de récolter sans mettre la population en péril. Durant l'été 2003, les remontées de saumon ont excédé les cibles et Parcs Canada a rétabli la pêche sportive dans la rivière Northwest. Dans les années qui ont suivi, le même processus de gestion a été appliqué.

Grâce à ce partenariat avec Parcs Canada, Pêches et Océans Canada et d'autres organismes, les résidents jouent aujourd'hui un rôle significatif dans la gestion de leurs ressources locales. La collectivité éprouve une fierté renouvelée à l'endroit de sa rivière et le nombre de saumons qui en remontent le cours continue d'augmenter.

TABLE OF CONTENTS

Abstract	iv
Résumé.....	v
Table of contents	vi
Background	1
A New Management Approach	5
The formation of the Northwest River Atlantic Salmon Working Group	6
Focus groups – based on Bath (2004).....	7
Providing access to the fishery	11
Population forecasting	13
Results/Discussion	13
The Fishery	13
Education	15
Transparency	15
Fees	16
Special events.....	16
Egg incubation	16
Predators	17
Pollution.....	17
Feedback to the new approach.....	18
Atlantic salmon population recovery	18
Looking to the future... ..	21
Acknowledgments.....	22
Literature cited	22
Appendix 1: Report of the Northwest River Atlantic Salmon Working Group	25
Appendix 2: Forecasting of salmon run strength in Northwest River	40

BACKGROUND

Monitoring of the Atlantic salmon catch in the recreational fishery in Northwest River began as early as 1956 (Porter et al. 1974) when river guardians compiled angling statistics. Management action to improve Atlantic salmon runs was initiated in 1948 (Porter et al. 1974) when a fishway was blasted around Northwest Falls – a barrier to anadromous fish trying to access the relatively expansive habitat available in the upper watershed (Figure 1). When the lower 1.9 km of the river was gazetted into Terra Nova National Park in 1989, relatively little was being done to monitor the health of the salmon population aside from creel surveys. Widespread declines in the size of Atlantic salmon stocks occurred in the late 1980's (Chadwick 1993; Dempson et al. 1998; Hawkins 2000) and coincided with the collapse of Northern Atlantic cod stocks. As a result the Canadian Department of Fisheries and Oceans (DFO) closed the commercial fishery for both species in Newfoundland in the spring of 2002, followed by a closure of the Atlantic cod fishery. As expected, the spawning escapements of salmon to Newfoundland rivers increased; but, over a decade later, the overall population size did not improve to the level expected from closing the commercial fishery (CSAS 2004). On the Northwest River, a fish counting fence installed in 1995 showed that numbers were well below the predicted conservation target (1726 small salmon) recommended by DFO (see Cote et al. 2001). Therefore, Parks Canada, in consultation with DFO, (with whom Parks Canada co-manages the river), decided to temporarily close the river to all angling until the population recovered to the target of 1726 small salmon. Such drastic management action was not well received by many local residents already sensitive to their restricted access of the natural resources within the park. Upon the announcement of the closure, some residents stated that they felt the river never had or never would reach the conservation target and that the Park had no intention to re-open the river. One individual present at the closure announcement meeting threatened that no fish would make it to the counting fence if the river was closed (M. Simpson, Parks Canada, pers. comm.). Despite this response, Parks Canada and DFO followed through with their management decision and continued to monitor the population by means of the Park's counting fence. Even with the cessation of the commercial fishery in 1992 and the recreational fishery in 1996, numbers of salmon on the Northwest River continued a steady decline from nearly 800 salmon in 1996 to only 153, in 2001. An additional year of decline as great as that observed in 2001 would have resulted in no anadromous salmon returns to the river.

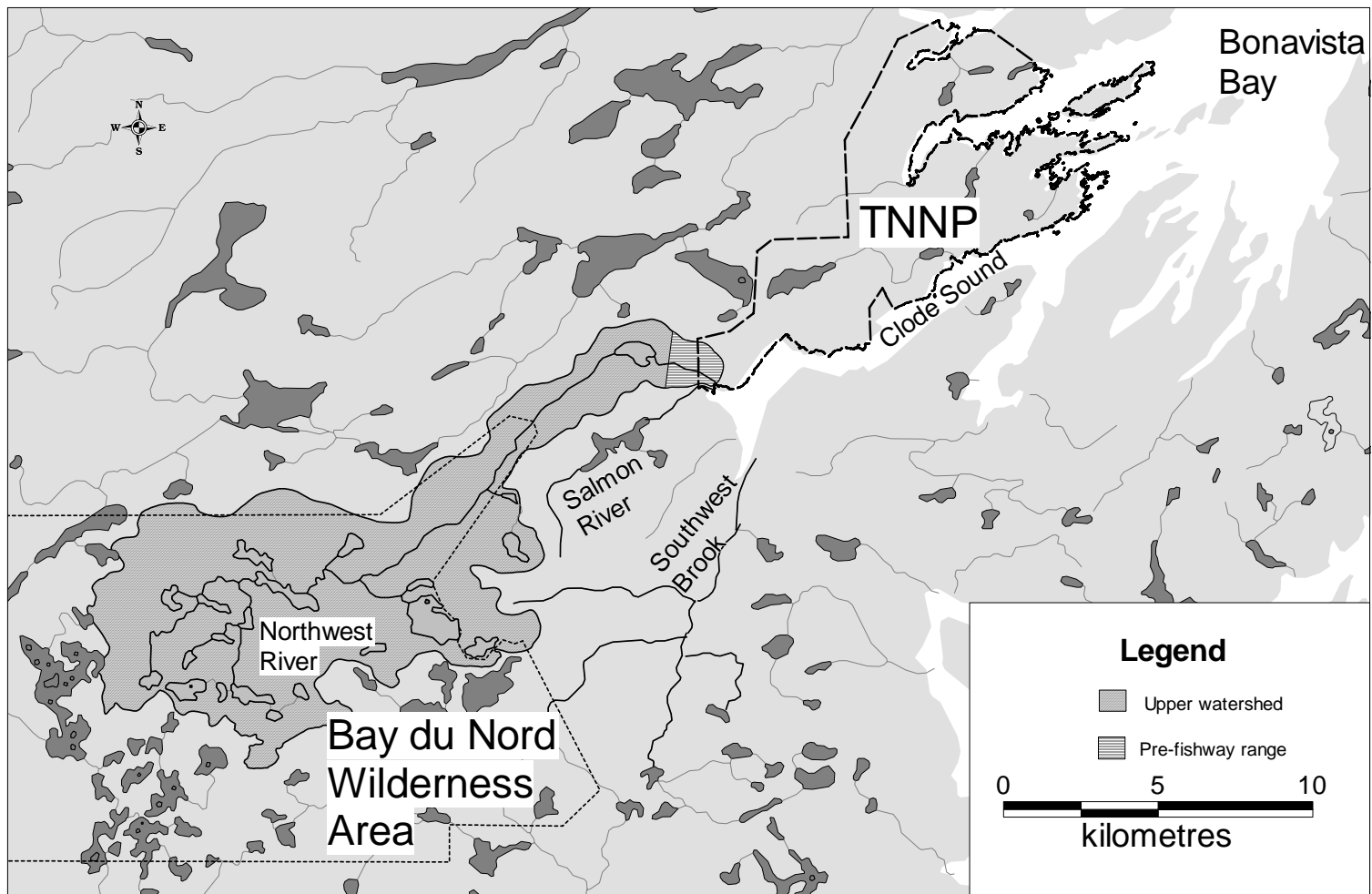


Figure 1: The Northwest River watershed and neighbouring salmon rivers of Clode Sound, Bonavista Bay.

In Cote et al. (2001), the possible causes of decline of the salmon in Northwest River were overviewed, as were factors that could contribute to population extinction. Poor ocean survival has been cited as the primary cause of widespread decline in Atlantic salmon populations in the Northwest Atlantic (Dempson et al. 1998; Reddin et al. 2000 and Anderson et al. 2000) though there is little definitive knowledge on the specific mechanism. While poor ocean survival has undoubtedly impacted Northwest River, there is no reason to expect that a large-scale problem would impact Northwest River more than other rivers in the region. In a comparison of Northwest River returns to other rivers in the region, it was apparent that Northwest returns were significantly lower in 1999 and 2001. These results suggest that if the extra mortality was caused in the marine phase of the life cycle, it was likely occurring at a local scale as it was not evident in other regional populations. Of factors that could contribute locally, point source pollution (e.g. from town outflows, chemicals from Terra Nova Golf Course) and fishing (whether illegal or by bycatch) could be likely causes.

Given the fact that Northwest River is predominantly pristine, the exception being a golf course situated on the lower 1.5 km of the river, it seemed unlikely that habitat degradation (e.g. Anderson et al. 2000) or freshwater pollution specific to the watershed, was a problem. The great majority of the spawning and rearing habitat is upstream of the golf course, and therefore the only time that it could impact the vast majority of individuals is during migrations through the golf course section as they move to and from the ocean. Furthermore, testing by Parks Canada indicated that river sediments showed no pesticide residues of thiophanate methyl or benomyl (Robinson 1995). Nonetheless, a smolt count, conducted in 2000, indicated relatively poor freshwater survival compared to other Newfoundland rivers (Cote et al. 2001). However, a direct comparison to survival in other rivers was confounded by the presence of land-locked populations of salmon in Northwest River. Intraspecific competition between life history forms could negatively impact the freshwater survival of both the landlocked and the anadromous populations.

Illegal fishing, by its very secretive nature, is more difficult to implicate or exonerate. Law enforcement officials receive reports of illegal fishing in both marine and freshwater environments (M. Simpson pers. comm.). Net scars (Figure 2), on salmon that escaped nets, were also frequently recorded by counting fence staff. In 2000 and 2001, the percent of salmon with scarring in the peak of the run was 15% and 23% respectively (Cote unpublished. data). Unfortunately, net scars have limited use as an index of illegal fishing for several reasons. First, there is no way to determine where scarred fish came in contact with the nets. Adult salmon at sea are wide-ranging (Hansen and Jacobsen 2000)) and Northwest River salmon may come into contact with nets at a considerable distance from NWR as they migrate along the coast. Second, netting is still permitted for some species in the marine environment in Bonavista Bay and therefore there is no way to differentiate between scarred fish from legal nets and those from illegal nets. Anglers have long implicated herring nets as a source of significant bycatch but a study by DFO (CSAS 2002) showed that properly set herring nets have very little salmon bycatch

(though the level of compliance to properly set nets is unknown). Third, the number of individuals that escape nets, and live to be counted at the fence, does not represent the numbers that were killed by nets. Nonetheless, net scarring on fish does implicate illegal fishing as a contributing factor in the observed declines.



Figure 2: Net scars observed on a salmon passing through the Northwest River counting facility.

With the available information, it seemed likely that at least part of the cause of decline was occurring at local scales in the marine environment and that illegal fishing was a contributing factor. At a public meeting, as it was from 1996 – 2001, local residents had little hope that they would ever access the fishery again because they felt that the river could never produce 1726 salmon and the population size was only getting smaller (1996-2001). These beliefs may have created a tolerant environment for illegal fishermen as local residents felt they had little to gain by hindering poaching and much to lose (ranging from lost opportunities to buy illegally caught fish at a good price to possible retribution from poachers). Amidst the decline, appeals for higher levels of enforcement and enhancement (stocking of fry) by angling associations were persistent. Enforcement had limited success in changing the fortunes of the Northwest River salmon population, whether it was due to insufficient resources for patrols, a lack of useful tips from community residents or the intrinsic difficulty of apprehending people involved in secretive activities. The Park, for two reasons, did not embrace enhancement. First, if illegal fishing was the contributing factor, stocking would only add fish to the illegal nets and do little to recover the population. Second, there are many conservation concerns associated with stocking in Northwest River (see Cote et al. 2001) including the weakening and modifying of the genetic structure of the population as well as potentially risking the genetically unique landlocked populations upstream (Cote unpublished data). While Park policy does allow fish stocking when native populations require restoration, there was little will by the stocking proponents to mitigate the conservation concerns. Furthermore, there was no consensus regarding the population level at which stocking would be considered successful and terminated. Clearly the management approach was not working and had to be reconfigured before the population was extirpated. In fact, scientists of DFO, were sufficiently concerned about the risk of extinction of Northwest River salmon to consider submission of the stock for possible listing under the Species At Risk Act if the situation did not improve (R. Porter, DFO pers. comm.).

A NEW MANAGEMENT APPROACH

Options to mitigate impacts of illegal fishing on the Northwest River salmon population were discussed by Cote et al. (2001). Two standard options, increased presence by enforcement officials and improved education were presented. The former, while potentially effective, would require sustained resource allocation to be effective over time while the latter was contingent on shifting attitudes – a lengthy process. Given the declining resources available to enforcement authorities and the precarious situation of the salmon population, neither approach seemed suitable in isolation to solve the problem. One other, non-standard option was proposed; the implementation of “adaptive recreational fisheries management”. This approach would provide incentives, in the form of access to the recreational fishery, to the community to improve the salmon run. In order to ensure conservation was not compromised, minimum thresholds of salmon returns through the fence would be required before a fishery was opened. The thinking behind this approach was that community-sanctioned enforcement, from those supporting a recreational fishery, would be more effective than government-sanctioned enforcement due to the sustained presence of residents in their communities and the importance of social pressure in smaller centres. Such a change in approach would fundamentally shift

the perception of poachers to that of individuals who “take” from their neighbours. One could argue that the management approach during the decline was in fact one that allowed for a recreational fishery - the threshold being 1726 fish. However, the problem with that scenario was that the residents believed the threshold was unrealistic and unattainable (see Cote et al. 2001) and no matter what action was taken (or not taken in the case of illegal fishing) by community residents, there would never be sufficient salmon to allow access to a recreational fishery.

For a new approach to be effective, consensus on the management thresholds were required from government authorities *and* the local residents.

The following summarizes the early stages of community involvement. It outlines the initial community meetings, the formation of the Working Group, as well as the general findings of focus groups (see Bath 2004 for an in-depth analysis) designed to unveil the thinking of Working Group members and determine whether it was consistent with that of local residents.

THE FORMATION OF THE NORTHWEST RIVER ATLANTIC SALMON WORKING GROUP

In the spring of 2002, DFO approached Parks Canada and the local communities in the hopes of developing a Northwest River Working Group. As part of the process of developing the Working Group, the government authorities had community meetings in the towns of Clode Sound (Bunyan’s Cove, Charlottetown, Clarendville and Port Blandford) and Clarendville (the nearest major centre) to get input on their views of Northwest River management and the cause of decline of the Northwest River Atlantic salmon. These meetings were also used as a means to canvass membership for a joint community–government Working Group, which would make recommendations toward the management of the Northwest River and the recovery of its salmon population.

Community views on the management of Northwest River, based on comments made at the meetings, were largely negative – particularly towards Parks Canada, the authority perceived to be responsible for the closure. Opinions on the cause of decline of salmon in Northwest River were varied. Most prevalent, was the view that the river has been in trouble since the park took over the management responsibilities (in fact the park co-manages the river, but almost all fishing takes place within its boundaries) and closing the recreational fishery was a serious mistake. Further, many attendees believed that the park-operated counting fence was an ineffective way to monitor the returns because it inhibited salmon from moving upriver, they could jump the counting fence and that returns were intentionally misreported by Park authorities. Despite these misgivings with previous management, some community residents agreed to serve on a Working Group with the goal of recovering the salmon population.

In the spring of 2002, the Northwest River Atlantic Salmon Conservation Working Group was formed. Local residents, business owners, various government departments and other stakeholders were invited to participate. In the end, the Working Group consisted of local residents and some small business owners from Port Blandford, Charlottetown

and Bunyan's Cove as well as government representatives from the DFO (Enforcement, Management, and Science Branches), Parks Canada (Terra Nova National Park), and the Province of Newfoundland (Department of Tourism). The Group was co-chaired by a local resident and a representative from the enforcement branch of DFO. The mandate of the Working Group was as follows:

“Develop a Conservation Plan for Northwest River, which includes a review of the Conservation Requirements of NWR; options for recovery and conservation of the salmon stock; and recommend a management strategy for angler access to the resource.”

While the number of participants in the Working Group was relatively small, they held frequent meetings, and new members from all stakeholder groups were actively encouraged to participate. Also, the general public were given opportunities for input into recommendations at public meetings.

The initial meeting of the Working Group was on 20 June 2002 and subsequent meetings were held weekly or biweekly. The Working Group held public meetings on November 5 and 6 in Port Blandford and Clarenville to review their Stock Recovery, Conservation Strategy, and fishery management recommendations. The comments provided at the meetings were incorporated into the Working Group's final report (see Appendix I). The Working Group Report was submitted to DFO and Terra Nova Park in December 2002.

FOCUS GROUPS – BASED ON BATH (2004)

In late 2002, the Working Group sanctioned a series of focus groups with the intent of achieving an understanding of broader community views (Bath 2004). The focus groups were to identify key attitudes, beliefs, and issues and possible solutions. Though focus groups are not representative of the entire community, it was a mechanism to identify concerns and possible solutions. In the first phase of this component, a workshop with the Northwest River Working Group facilitated the development of a coherent strategy or approach to the issues facing the river and salmon management. The second phase of the project involved data collection and analysis of local resident viewpoints. Focus groups were held within the communities of Port Blandford and Bunyan's Cove and involved groups of local residents. Local residents were contacted by telephone and asked to participate in a discussion, regarding the Northwest River and salmon management, with an independent facilitator but with the cooperation of Terra Nova National Park. Solicitation for the focus groups was done randomly, though participants tended to be those who were most interested in the issue. Approximately thirty people were invited to the four sessions; two sessions were held in each community. Results from the focus groups were presented back to the Northwest River Salmon Working Group to aid in their decision-making and implementation process regarding future Northwest River salmon management and the stewardship and education plan.

Working Group Views

The Working Group reiterated their view that four potential factors were causing the decline of the Atlantic salmon in Northwest River. These were:

- *Illegal netting,*
- *Predators – e.g. seals, piscivorous birds*
- *Pollution (golf course, town sewage); and*
- *Changes in the ocean environment.*

There was also a general consensus, that there was a sense of apathy in local residents toward the river. This apathy was caused by a lack of access to the river and the perception that they had no ability to change the situation. In recent times, there was a total closure of the river to fishing, but even prior to the closure, complaints of excessive user fees were also voiced. For example, in 2002 to fish for a season on Northwest River a provincial salmon fishing license (\$24) was required, a National Parks angling permit (\$14.25), a National Parks salmon fishing licence (free of charge) and a National Parks personal user pass (\$16.25). The Working Group felt that the relationship between Parks Canada and the communities was poor and that Parks Canada was taking away the rights of local residents and showed communities little respect. Furthermore, the Working Group thought that many residents felt government authorities were deceiving them in order to pursue hidden agendas.

The Working Group indicated that their vision of Northwest River was one with an abundance of salmon that were accessible through a recreational fishery with a simple and inexpensive licensing system. They wished for a healthy environment in their community that was maintained in an economically and socially viable manner. They believed residents should care about the river and look after it and hoped for an atmosphere of mutual respect between government and local communities.

Community resident views

Community residents attending the focus groups had many commonalities with Working Group members. Their associations with Northwest River were largely negative. To them, Northwest River was a place of high user fees, it was polluted from the golf course, and it had few salmon. The Park was also believed to be deceptive with information related to the river. Community members believed that the government's mismanagement was to blame for the salmon population's decline. The counting fence was believed to be a hindrance to returning salmon and the government's actions did little to reduce poaching and maybe made poaching more attractive due to the excessive restrictions. Residents did not believe government institutions had much credibility and thought that officials in Ottawa did little to accommodate the needs of community residents. Perhaps most surprising was the limited awareness that community residents had of the Northwest River Working Group (Bath 2004).

This preliminary human dimensions study, to understand and address issues facing salmon and the Northwest River, illustrated the commonality between local communities and the views of the Northwest River Salmon Working Group. For example, all groups shared concerns about poaching, wanted to build stronger communication between groups (e.g. local residents and Parks Canada), held similar visions of a sustainable fishery with community ownership, and believed in similar measures to address the concerns.

From the focus groups, the following ideas from communities were put forth to the Working Group:

- Continue working with the Working Group, build upon the positive working relationship and develop respect, trust and credibility,
- Allow fishermen access to the river so as to encourage interest and stewardship
- Inform the public how salmon abundance has changed and what has caused it,
- Let local community residents know how many salmon are going up the river and when the river could be opened (increase transparency),
- Set up a river watch program of interested residents
- Develop community pride and “acceptable” behaviours.
- Promotion of stewardship and education

These ideas were consistent with the recommendations put forth by the Working Group in the initial Salmon Stock Recovery and Conservation Strategy. The focus groups also allowed the Working Group to develop a vision for the future...

To instil community pride and stewardship in the river as a place to enjoy both recreational fishing and nature while maintaining a tourist attraction and a symbol of a thriving environment.

WORKING GROUP RECOMMENDATIONS

The Salmon Stock Recovery and Conservation Strategy was developed from ideas brought forward in the initial community meetings, and information provided by DFO and Parks Canada. Issues were identified, options considered and recommendations put forward (see Appendix 1 for the Working Group's recommendations). A schematic of the general approach proposed is provided in Figure 3.

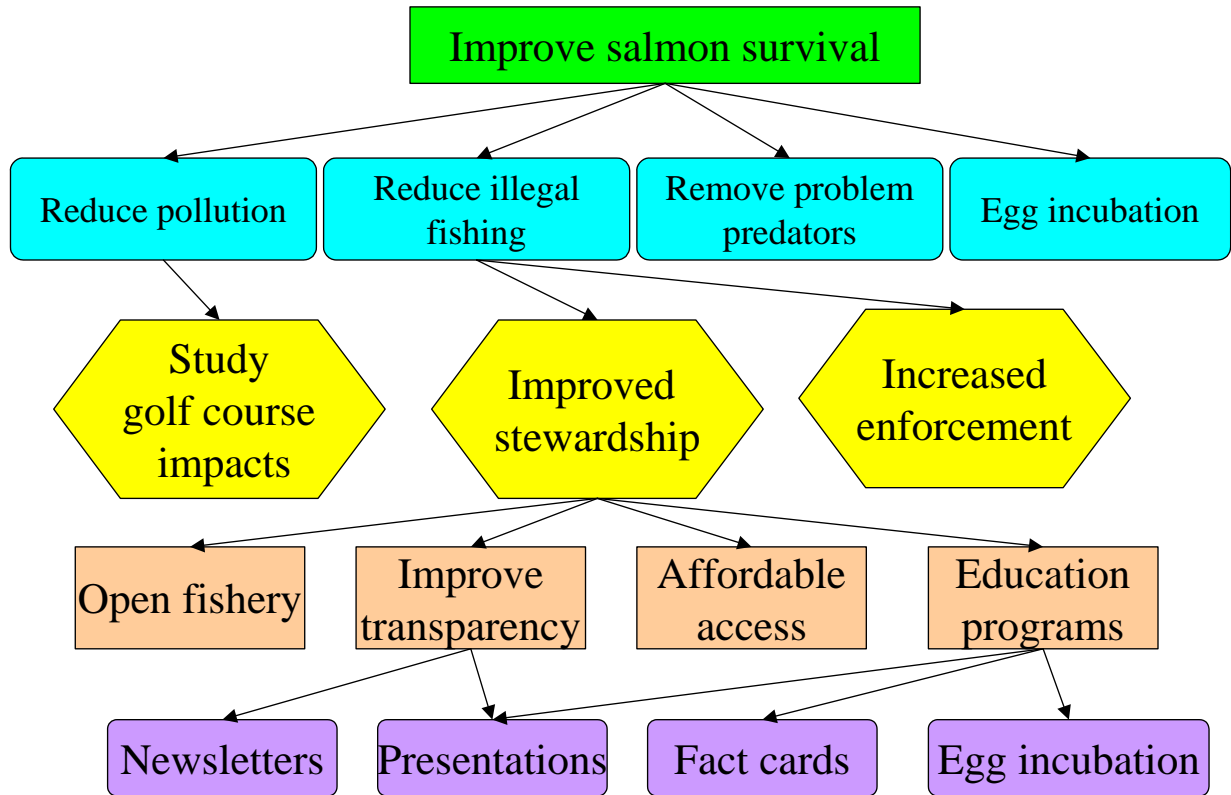


Figure 3: An overview of the recommendations put forward by the Northwest River Atlantic Salmon Working Group for the management of Northwest River.

The cornerstones of the Working Group's recommendations to rebuild the salmon population were to provide access to a recreational salmon fishery and a education and awareness program. Access to the resource would be the "carrot" that would demonstrate that governments were sincere in allowing a fishery as salmon stocks improved, and that there were benefits to be obtained from the resource if illegal fishing was reduced. The following section outlines the discussions on the feasibility of allowing a recreational fishery on a vulnerable fish population.

PROVIDING ACCESS TO THE FISHERY – COULD WE SIMULTANEOUSLY ENSURE CONSERVATION AND PROVIDE REASONABLE HOPE FOR A FISHERY?

Setting management goals for the Northwest River Atlantic salmon population was a challenging task. Several competing management goals and opinions were put forward for managing the population (Table 1). First, the traditional habitat based approach used by DFO across the province indicated that 1726 small salmon were required to maintain "characteristic" levels of smolt production (O'Connell et al. 1991; O'Connell and Dempson 1995). When egg deposition by large salmon was included, this number could be reduced to 1470 fish because large salmon carry more eggs per individual. Though these targets are science-based, several questions regarding its applicability to Northwest River were stated – namely its relevance to a system that has land-locked populations of salmon and that the production potential of the watershed was enhanced with the construction of the fishway around Northwest Falls (Cote et al. 2001).

The removal of the barrier at Northwest Falls in 1948 opened up the vast majority of the river's available habitat though land-locked salmon already occupied it. The true availability of this habitat was not known but anadromous smolt production in a nearby Newfoundland system with ouananiche (Hutchings 1985) was less than half the "characteristic" value used by DFO for conservation target calculation and it seemed reasonable that intraspecific competition between life history forms would reduce production (Cote et al. 2001). Local residents, whose buy-in was vital to the success of the management strategy, thought the targets unreasonable based on their own experience with the river. Indeed, historical estimates, based on creel surveys indicated that the Northwest River salmon population was able to persist with mean returns of 675 salmon, had never surpassed the conservation target and rarely surpassed 50% of it (the accuracy of this value is unknown however, because a fixed parameter was used to estimate escapement and the creel census data may be of questionable reliability (Cote et al. 2001)). Policy direction of Parks Canada also was in conflict with applying this conservation target for two reasons. First, achieving characteristic densities of anadromous salmon in the previously isolated upper watershed could come at the cost of the genetically unique land-locked populations. Second, the value of 1726 salmon far exceeded the historical abundance of fish in the river prior to the construction of the fishway (estimated at 70 fish). The historical estimate of 70 fish, based on availability of habitat downstream of Northwest Falls was also unappealing to DFO and Parks Canada. For one, achieving a threshold of 70 fish did little to protect the health of an Atlantic salmon population given the "enhanced" state of the river and it would also reduce the protection of one of many wild populations that were declining in the Northwest Atlantic.

Hutchings (1994) put forth thresholds based on population requirements to maintain genetic diversity. In his report he estimated safe population levels at which the population's gene bank would be unlikely to suffer losses. Assuming a range of population-mixing rates he estimated 300 to 630 adult spawners were needed. DFO scientists agreed that in principle the conservation egg deposition requirements per unit of habitat for anadromous salmon in rivers such as the Northwest, where new habitat was made available through barrier removal, could be lower than for similar habitat in rivers with no landlocked salmon present. However, there was insufficient data available to calculate a lower conservation level. Therefore they advised that the management target should not be less than the maximum egg deposition achieved in past years; and it should not be less than 50% of the conservation level calculated using methods without landlocked salmon (Appendix 1).

Table 1: Science-based thresholds to maintain persistence of Atlantic salmon in Northwest River.

Origin	Threshold
Habitat based conservation target of the watershed before the fishway	70
Maintenance of genetic structure (mean straying rates)	300
1995-2001 mean of returns through fence	504
Historical mean (based on creel census)	564
Maintenance of genetic structure (conservative straying rates)	630
Habitat based conservation target	1470
DFO habitat-based conservation target of enhanced watershed with large salmon safety factor	1726

Based on the available information, the Working Group put forth recommendations to set a long term management target of 700 salmon and a 3-year interim target of 500 fish (spawning escapement). Terra Nova National Park supported these thresholds based on the following justification:

- *It is estimated that 300-600 salmon are required to maintain genetic diversity in the river; 500 salmon approaches the more conservative estimate*
- *The average number of salmon through the counting fence (1995-2001) was 505 fish*
- *The average historical number of salmon returns estimated from angling (1958-2000) was 534 fish*
- *Prior to the blasting of the fishway, salmon in Northwest River would have existed at much lower levels than 500*

Subsequent to ensuring the interim thresholds were met, the Working Group recommended that access to a modest recreational fishery would be allowed. Only 50 fish or 10% of the minimum requirement would be allowed in a retention fishery. Both Parks Canada and the DFO accepted these recommendations.

POPULATION FORECASTING

Population forecasting was considered a key aspect to successfully implementing the incentive-based fishery for Northwest River. The incentive-based approach, as put forward for Northwest River, required a minimum escapement of 550 salmon to achieve the 3-year management target. The dilemma for managers was to provide meaningful access to anglers while ensuring management goals were met. Anglers desired access in the early part of the season, when water temperatures are cool and salmon are more likely to be hooked (late season access is less desirable because there is a higher probability of closures related to low water or high temperatures and fish are less likely to take a fly in the warm water). Unfortunately, allowing fishing early in the season before the strength of run was known seemed foolhardy. Previous runs indicated that the 550 fish threshold (recommended by the Working Group) had only been surpassed in the mid to late part of the season (17 July – 6 August) – a time when angling conditions are generally poor. As a result, to meet both management objectives, a population forecasting approach was explored (details of the approach are listed in Appendix 2).

RESULTS/DISCUSSION

Based on the information gained in consultation with community residents and the management recommendations, Parks Canada and DFO responded to the issues brought forward by the Working Group for the management plan. Though recommendations were not universally accepted, the plan was generally sound and very helpful. The following outlines the response of management authorities to the recommendations and the preliminary results of the management action.

THE FISHERY

Terra Nova National Park and DFO agreed to a 3-year Conservation Strategy that allowed for a small incentive-based recreational fishery with a interim management target of 500 spawners. The opening of the fishery would be based on in-season reviews. Three triggers were put forward to open the fishery – two early season triggers and a mid-season review. The first opportunity to open the fishery would occur if 75 fish passed through the counting fence by 30 June. If that threshold was reached a small quota of 20 fish would be allocated, with an additional 30 fish allocated if returns increased as expected. If that threshold was not achieved, a second early season threshold of 200 fish by 5 July would allow opening of the fishery for 50 fish. In the event that both early season thresholds were not reached, a mid-season review could allow the fishery to open. The mid-season review was based on the projections outlined in Appendix 2. If the river was not opened with any of these mechanisms it would remain closed for the year.

In 2003, the 30 June threshold was reached by 22 June and, by the time the fishery opened, the 5 July threshold was passed allowing the fishery to open for the entire 50 fish quota. The fishery ran for 8 days and was closed the evening that the 50 fish quota had been reached. Total retention in 2003 was 51 fish (Table 3), slightly above the quota. In 2004, the management plan was similar to 2003, except that if mid-season projections allowed for an escapement of 700 fish (the long term management goal), an additional 25

fish would be allocated to the quota. Run timing was later in 2004 and the river did not open in either of the early season triggers. A mid-season projection, however, allowed the fishery to open for 50 fish and an additional 25 fish when projections indicated the long-term target of 700 fish would be exceeded. After 8 days of fishing, warm water temperatures caused the closure of the fishery with 10 fish remaining on the quota. Success rates of anglers were high in both years and several fishermen caught their quota of two fish (Table 3).

Table 3: Fishery statistics for 2003 and 2004 on Northwest River.

Year	Quota	Licenses issued	Days of fishing	Total Catch	Fishermen with at least 1 salmon	Fishermen with 2 salmon	Escapement target	Achieved escapement
2003	50	45	8	51	69%	45%	500	1232
2004	75	61	8	65	79%	28%	500	1427

CHRONOLOGY OF THE 2004 FISHERY

Trigger 1: 75 fish by 30 June required to open fishery.

30 June run total = 21 salmon

Management action: fishery remained closed.

Trigger 2: 200 fish by 5 July to open fishery.

5 July total: 109 salmon

Management action: fishery remained closed.

Trigger 3: mid-season review

8 July total: 253 salmon, projected >629 salmon (required 550).

Management action: open fishery for 50 fish starting 8 July.

15 July: 50 fish quota reached.

Management action: fishery closed.

18 July: 942 salmon through fence exceeding long term management target of 700 fish.

Management action: fishery re-opened for the remainder of 75 fish.

25 July: only 65 salmon retained but high water temperatures.

Management action: river closed for rest of season.

EDUCATION

One of the key recommendations put forward by the Working Group to develop stewardship was to initiate an education program. A subcommittee of the Working Group was set up to define the education program. To develop and facilitate the program, DFO made money available to hire a stewardship coordinator for the Working Group in the spring of 2004. The coordinator, along with an intern from Parks Canada, developed presentations to be given by Working Group members, arranged for special events and drafted the Working Group's newsletters. Presentations have been done at local schools (21), as well as for the Volunteer Fire Department (1), the Port Blandford Town Council (1), Girl Guides (2), Cadets (1) and Federal and Provincial political representatives (1). Over 700 individuals have attended presentations. Biannual newsletters have also been developed by the coordinator, and were circulated to the Clode Sound communities and the nearest major population centre, Clarenville. Finally the Working Group developed a Northwest River Atlantic Salmon Fact Card, distributed by general mail out, and as a handout item that outlines the basic facts about Northwest River's salmon stock and the role the Working Group plays in the management of Northwest River. In addition to presentations done on the behalf of the Working Group, interpretation staff of Terra Nova National Park have included the Atlantic salmon of Northwest River in their school programs. Twenty-two classroom presentations have been done for school groups since 2003. A second, innovative initiative, called Ecopal, was also developed by Terra Nova National Park. The Ecopal program connects school children that reside near National Parks over the internet to learn about resource issues in their own region as well as that as those in the region of their partner school. In this application, children from Alma, New Brunswick (adjacent to Fundy National Park) and Glovertown, Newfoundland learned about the Northwest River Atlantic salmon and the endangered Inner Bay of Fundy salmon stock.

TRANSPARENCY

Prior to the development of the Working Group, Terra Nova National Park made efforts to increase transparency in the management of Northwest River. Since the operation and proper reporting at the counting fence appeared to be a source of concern to residents, the Park developed an agreement with the Town of Port Blandford to staff some of its Northwest River monitoring team from the communities of Clode Sound through the Town Office. This action has allowed some community residents to participate in the monitoring, learn the operations, and provide credibility to the numbers being reported by the Park to the public. The Working Group viewed this action as a positive change and the Park has maintained these staffing practices. Further to ensuring involvement of local residents in monitoring, it was suggested by the Working Group to make up-to-date counts available to the community. Previously, fence counts were not made available in real-time as it was thought that the information would be used by those involved in illegal activities. After discussion amongst Working Group members it was decided that the benefits of transparency would outweigh the potential losses associated with facilitating poaching. Since most illegal fishing was believed to be occurring in the marine environment, most believed illegal fishermen would know of peaks in the run before fence staff would. Based on these discussions, TNNP mounted a sign indicating real-

time salmon returns in a place that was visible from the Trans-Canada Highway. The response to the sign has been very positive, as many residents actively follow the returns. For those audiences less closely involved in the operations of the river, the Working Group publishes a biannual newsletter regarding Northwest River. The newsletter contains information regarding the status of the salmon run, the management of the fishery, fishery statistics and the activities of the Working Group.

The formation of the Working Group has also allowed a forum in which transparency of management decisions can be achieved. The regular meetings held by the Working Group allow for frequent updates on the river and for discussions on the reasons behind management decisions. It also provides park managers with opportunities to learn from local residents, gauge community opinion and seek alternative measures and ideas through discussion. Community residents, either on the Working Group or through communication with Working Group members have access to government biologists, enforcement officials and policy makers to question current management practice and provide suggestions. Three key benefits have materialized from such an approach – a mutual understanding between government and community residents, improved community ownership in management actions, and management that better suits the needs of all parties.

FEES

Local residents expressed concern with respect to the license fees associated with fishing for salmon in Terra Nova National Park. In addition to the requirement to have a provincial salmon fishing license there exists the requirement for user fees and licenses associated with fishing for salmon or trout. The Working Group believes that the reduction/removal of some of these fees would assist in fostering stewardship, as the cost associated with salmon fishing may be prohibitive to many residents, who if barred from the river, may resort to illegal fishing. Additionally, to foster stewardship and protection of the resource, the presence of anglers on the river must be viewed as a positive step. As Parks Canada's fees are structured nationally there is little leeway for fee reduction, however, given the requirements for licenses from other jurisdictions to fish in Northwest River, perhaps progress can be made in this area.

SPECIAL EVENTS

The organization of special events was an idea brought forward by the Working Group as a means to increase the profile of Northwest River and re-establish it as a source of community pride. The Northwest River Working Group will play a key role in the Port Blandford town celebrations – an event that coincides with the salmon fishing season. Further involvement from local youth will be solicited for a competition to develop a poster and logo for the Northwest River Working Group. It is anticipated that on-site interpretive programs will augment these events.

EGG INCUBATION

The recommendations of the Working Group suggested use of egg incubation as a means to restore the Atlantic salmon population and improve community stewardship. While egg incubation is a popular activity that is supported by angling groups there are many

disadvantages with the approach (discussed in Cote et al. (2001)). Among these include the potential to further deteriorate the health of the population. In addition to the potential risks associated with stocking, there has been little evidence that stocking is an effective technique to restore declining populations, much less do it in a cost-effective manner. Due to the aforementioned reasons, Parks Canada has clear policy regarding stocking - to be allowed when it is “*the only possible alternative available*” to population recovery. This option, with many associated mitigating measures (see Cote et al. 2001), was being considered as a last resort when returns dropped to 153 salmon in 2001. However, the modest recovery of the salmon in the 2002 season prompted Park managers to await the results of the other initiatives recommended by the Working Group before attempting egg incubation. Under any conditions, however, enhancing a healthy salmon population through stocking, for the benefit of a recreational fishery, goes against National Parks policy and cannot be condoned in Northwest River. That said, the use of very small incubators for demonstration purposes has been widely used as an educational tool in classrooms. Though schoolchildren often release artificially reared juveniles back into the river, the releases occur at such small scales that they likely have negligible impact on the natural population. The Working Group is currently pursuing this idea as a means to educate local school children on salmon conservation issues.

PREDATORS

It is the belief of the Working Group that predators are having impacts on salmon returns. Atlantic salmon are an important part of the ecosystem as they are a food source for many of Newfoundland’s native species. Salmon predators target salmon in freshwater, estuarine and marine environments and include piscivorous birds (e.g. mergansers, eagles, kingfishers), aquatic mammals (e.g. seals, river otters), and fish (e.g. cod). From a Parks Canada viewpoint, active reductions of native wildlife species is not a desirable means for improving salmon returns in Northwest River; particularly since the abundance of predators in the Northwest River area do not seem to be obviously higher than in other systems around Newfoundland. Furthermore, Parks Canada values all native species regardless of commercial importance. That said, the management recommendation put forward by the Working Group was to remove problem seals from Clode Sound and do further study on predation issues. Management of seals in Clode Sound falls beyond Terra Nova National Park’s jurisdiction, but the Park would not support hunting activities conducted from Park lands. However, the Park does support the idea of additional research on predation if funds become available to do so.

POLLUTION

Pollution from two sources was of concern to the Working Group – pesticides from the Terra Nova Golf Course, and sewage from the Town of Port Blandford. Since other rivers in the area do not seem to be impacted from sewage outflows, the Working Group recommended that a study be conducted examining whether pesticides are leaching into the river. While the Working Group is aware of the study conducted in 1994 by Parks Canada, which showed no impacts, they believed that the study is out of date. Parks Canada supports this recommendation and is in the process of establishing water quality monitoring protocols for all waterbodies within the Park. To date, preliminary analysis of benthic invertebrate communities above and below the golf course show no evidence

of damage to invertebrate communities from the golf course (Cote unpublished data). Furthermore, the Park has worked with the management of the golf course to pursue Audobon Certification – a program that certifies a golf course operates in an environmentally friendly way.

FEEDBACK TO THE NEW APPROACH

Initially the proposed recommendations of the Working Group were assessed with the focus groups. Those results suggested that the Working Group's views represented those of the community. Since then response to the management plan by stakeholders was gauged by feedback at community meetings in 2003, 2004 as well as comments made to counting fence staff during the 2003 and 2004 seasons. For the most part feedback has been very positive and most individuals feel that management of the Northwest River has improved; many even seeing it as a model for other rivers. The most widespread complaint has been related to the fees and the amount of permits required to fish on the Northwest. Other less frequent complaints brought forward were directed at the relatively short fishing season, the need to improve fishing trails, the impacts of the golf course and the lack of catch and release fishing. These issues will be brought before the Working Group to look for possible solutions.

ATLANTIC SALMON POPULATION RECOVERY

The expectation of the Working Group was that returns would gradually build to the threshold where a recreational fishery would be possible. Surprisingly, in the summer following the formation of the Working Group, the returns rose to 552 salmon prior to any management recommendations being accepted (Figure 5). In 2003, the first season that the recreational fishery recommendations were incorporated, salmon returns increased dramatically to 1272 – the highest ever observed at the counting fence and sufficient to allow for a modest recreational fishery of 50 fish. In 2004, a new record of 1472 fish was set and the fishery was opened for the second consecutive year.

The run projection approach used to manage the fishery successfully allowed for early opening of the fishery during prime fishing conditions while simultaneously maintaining a high probability of acquiring the required salmon numbers for conservation purposes. In 2003 (Figure 6), early projections would have enabled the river to open 12 days before conservation targets were hit and in 2004, four days before. In both years, runs went on to far exceed minimum management targets necessary for a fishery.

Improvements to the run do not necessarily equate to effective management action. It has long been put forth that salmon returns across Newfoundland would improve substantially if natural sea survival improved (CSAS 2002). Could it be that natural sea survival has caused the surprising turn around in Northwest River? The answer is yes. When the returns of 1999 to 2004 are expressed as a percentage of the 1995 to 1998 mean (Figure 7), the values in Northwest River are below 100% and continue to drop until 2001 – the year the Working Group was formed. In 2002, the run was still below the 1995-1998 mean but improved somewhat, while in 2003 and 2004 the run was over 200% of the 1995-1998 mean. When similar examinations are done on the neighbouring rivers in Salmon Fishing Areas 4 and 5 an interesting trend emerges. One sample t-tests

indicate that Northwest River returns (as a percentage of the 1995-1998 mean) differed from neighbouring rivers in each year but one (2000). In two of three pre-Working Group years, returns were significantly lower than in other rivers in the region (1999: $t_{d.f=5} = 3.93$, $p = 0.011$; 2001: $t_{d.f=5} = 4.15$, $p = 0.009$), while in all three post Working Group years returns were significantly higher (2002: $t_{d.f=5} = -3.87$, $p = 0.012$; 2003: $t_{d.f=5} = -4.35$, $p = 0.007$; 2004: $t_{d.f=5} = -4.53$, $p = 0.006$) (Figure 7). These results suggest that there was a general regional improvement in runs from 2002 onward but the magnitude of improvements in Northwest River did not extend to other rivers in the region. Such a conclusion implies that natural sea survival may have improved but the success is a result to improvement of local conditions.

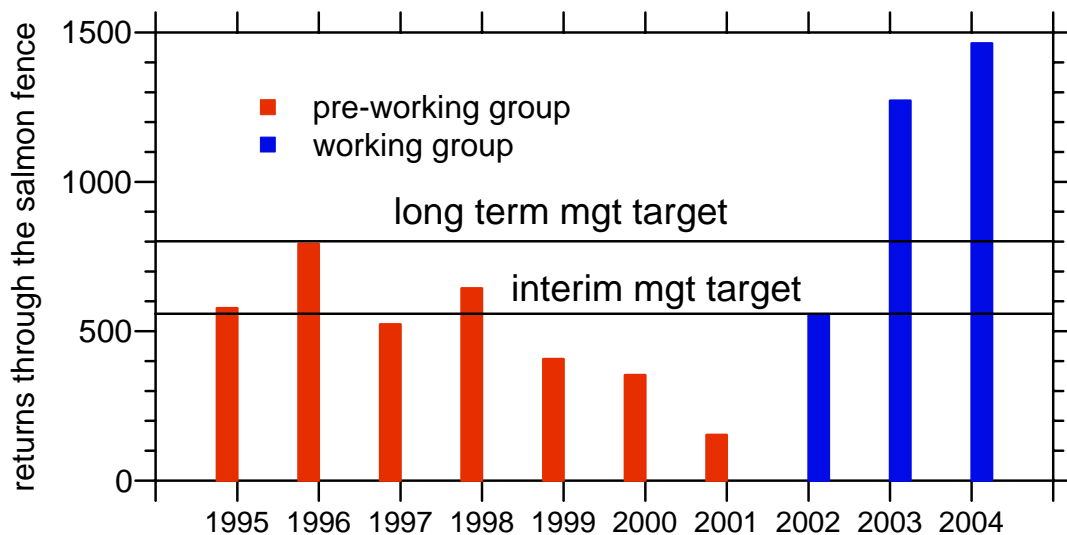


Figure 5: Returns of Atlantic salmon through the Northwest River counting fence before and after the formation of the Northwest River Atlantic Salmon Working Group. Note: only years 2003 and 2004 had potential for the recreational fishery.

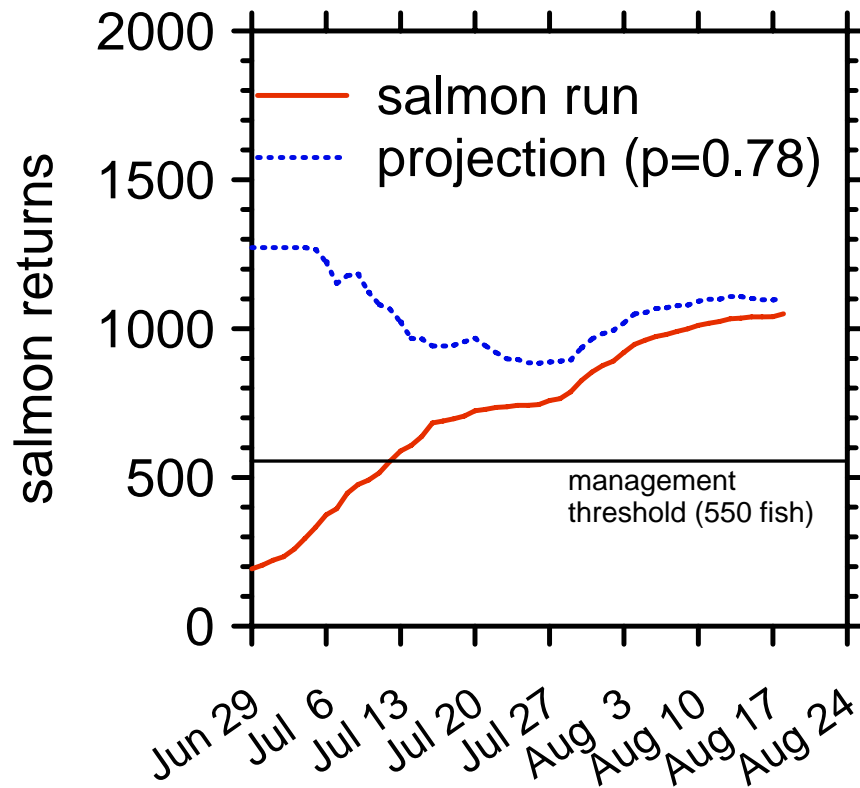


Figure 6: Actual salmon returns (solid line) and projected year-end returns (dashed line) for Northwest River, 2003. The probability of achieving the projected salmon returns or greater ($p = 0.78$) was estimated by reporting the second lowest projection from the eight previous modelling years.

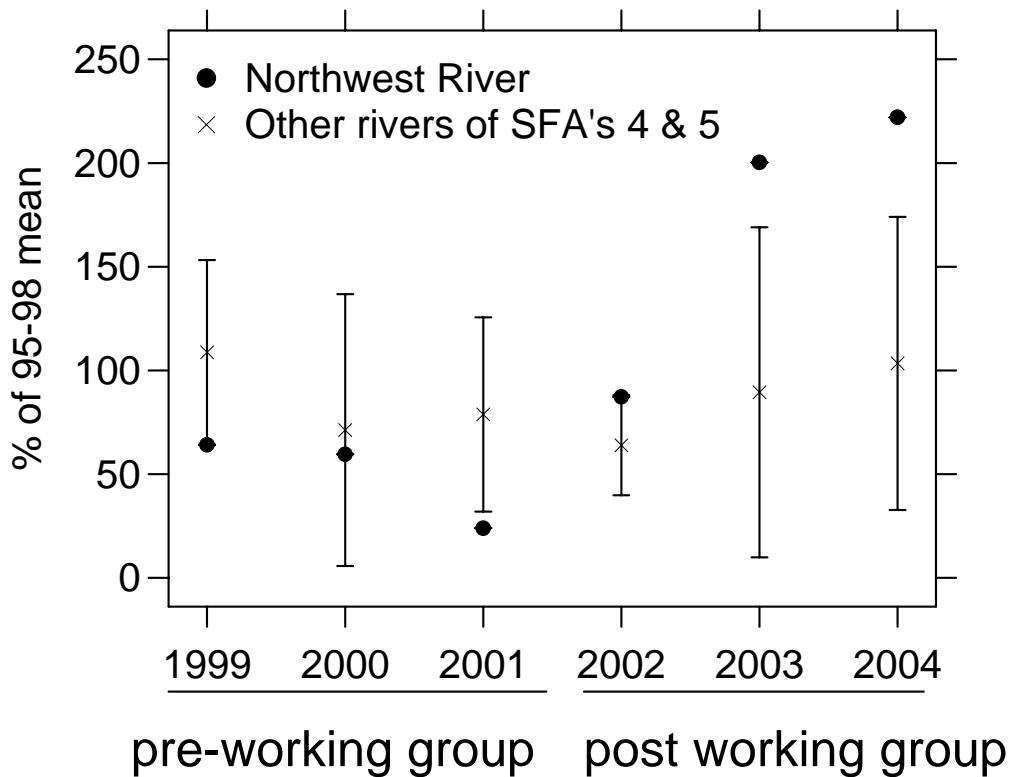


Figure 7: Salmon runs in Northwest River (dark circles) compared to runs in neighbouring rivers (Exploits, Salmon, Campbellton, Middle Brook, and the Terra Nova) for 1999-2004. Runs are expressed as a percent of the 1995 – 1998 mean. Error bars represent 1.96SD.

LOOKING TO THE FUTURE...

Following the collapse of the commercial salmon fishery in 1991, Chadwick (1993) predicted a new era of river specific management. At least in the case of Northwest River, management consideration of river specific factors has lead to a plan that had improved the health of the salmon population and enhanced stewardship and support from local residents. Furthermore, real time management has improved response time of managers thus allowing for more responsible management and improved access to anglers.

However, the recent successes in the past three years do not warrant complacency. The salmon lifecycle is typically 5 years (e.g. the majority of returns expected in 2005 will have been spawned in 2000) and egg deposition in 2000 and 2001 were lowest since the counting fence was installed. Unless improvements in survival occur, whether in the river or at sea, returns in the near future (2005 and 2006) may not be sufficient for a recreational fishery. Since survival is density dependent (Jonsson et al. 1998), it is hoped that compensatory mechanisms may dampen the effect of low egg deposition to some

extent. Nonetheless, managing expectations of anglers who are becoming accustomed to a fishery is a key issue for managers and the Working Group to deal with.

The great improvement to Atlantic salmon returns in Northwest River has prompted the Working Group to recommend reopening of Southwest Brook and Salmon Brook (Figure 2) in 2005 if salmon returns in the neighbouring Northwest River appear favourable. The Southwest and Salmon brooks were closed in 1996 based on the poor returns to Northwest River because no information was available for those rivers. Under the recommendations, all three brooks would remain closed until Northwest River achieved its management targets at which point all would open. This strategy allows fisheries managers to maintain confidence that fishing will not occur if stocks are at low levels, while maintaining an economical option for anglers not able to afford the fees associated with angling in the park. It also maintains the incentive for individuals to forsake illegal fishing since partaking in that activity would decrease the chances of a legal fishery in all rivers of Clode Sound.

When reporting on the Northwest River focus groups, Bath (2004) indicated, “*Terra Nova National Park has a long way to go to earn respect from the communities, but on a positive note the communities appreciated this initial listening exercise. T.N.N.P. needs to be seen in the communities continuing to listen.*” Tremendous improvements to the numbers of salmon returning to the Northwest River have been realized but equally important are the improvements to the relationship between government authorities and local communities. Improvements notwithstanding, both the salmon stock and the relationship with the communities are in a fragile state and require continued attention to maintain this positive momentum.

DFO are now applying this model, used to engage communities in conservation of the salmon resource, to nine other rivers in Newfoundland.

ACKNOWLEDGMENTS

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APPENDIX 1: REPORT OF THE NORTHWEST RIVER ATLANTIC SALMON WORKING GROUP

Preamble: The Northwest River Atlantic Salmon Working Group consists of community residents and government representatives. The views presented in the report are not necessarily those of any one member of the Working Group or those of the various government agencies involved. The government representatives on the Working Group were primarily resource persons.”

Background:

Upstream migration of sea-run Atlantic in Northwest River, Code Sound, (Fig 1) was restricted to the lower 3.6 kilometers of the river due to a natural water falls until 1948 when the falls was modified to allow fish passage. Sea-run Atlantic salmon was historically harvested by both commercial and recreational fisheries until 1992 when a moratorium was placed on the commercial fishery in insular Newfoundland in response to a general decline in abundance of salmon. The recreational fishery in Northwest River was closed in 1996 due to a continued decline in population size. Recreational catch statistics available from the Department of Fisheries and Oceans (DFO) and Parks Canada from 1974 to 1996 indicate considerable annual variation in the number of salmon angled. The largest recorded catch was 340 salmon in 1978, and the lowest was 30 salmon in 1991 (data for 1989 excluded because it is viewed to be incomplete) (Table 1).

Parks Canada has operated a fish counting fence on Northwest River since 1995. The numbers of salmon counted at the counting facility ranged from a high of 787 salmon in 1996 to a low of 152 salmon in 2001 (Table 2). DFO and Parks Canada biologists estimated the historical (1985 – 1995) annual number of salmon that entered Northwest River by applying an exploitation rate (0.20), which approximated the exploitation rate calculated for 1995, to the annual angling catches (Table 3). The maximum estimate of number of salmon returning to Northwest River was 1600 in 1985. The salmon population appeared to decline from 1985 to 1991, improve from 1992-94, but continued to decline after 1996, a period when all fisheries were closed.

It is apparent that the fisheries management strategies put in place, which included closing the commercial and recreational fisheries, were not successful in restoring the salmon population in Northwest River. The Salmon Association of Eastern Newfoundland (SAEN) approached DFO in 1998 to implement a salmon enhancement program on Northwest River as a means to rebuild the salmon population. A Working Group, under the chair of SAEN, was established by DFO in 1999 to look at the causes of the decline in salmon population in Northwest River and recommend options for stock rebuilding. That Working Group concluded that illegal fishing in freshwater and at sea was the primary cause for the stock decline. They proposed to implement a stewardship program and increased enforcement to address the problem. An integral component of the stewardship program was a small-scale salmon fry-stocking program. SAEN took the

lead in writing the proposal and soliciting resources, in 2001. However, disagreements, among the Working Group members, in wording of the proposal resulted in SAEN withdrawing from the Working Group and the total initiative was terminated.

The continued decline in numbers of salmon passing through the Northwest River counting fence coupled with the very low number (152) counted in 2001 continued to raise very serious concerns regarding the long-term viability of the Northwest River salmon population.

In spring of 2002, DFO approached community residents, Parks Canada and Provincial government departments to form a Northwest River Atlantic Salmon Recovery/Conservation Working Group. Four public meetings were held that resulted in the formation of the Working Group. The Terms of Reference of the Working Group is in Appendix 1 and the composition of the Working Group is in Appendix 2. The primary tasks of the Working Group were to develop a stock Recovery/Conservation Plan for Northwest River and recommend a management strategy for an angling fishery.

The initial meeting of the Working Group was on 20 June 2002 and subsequent meetings were held weekly or biweekly. The Working Group held public meetings on November 5 and 6 in Port Blandford and Clarendville to review the recommendations of the Working Group. The comments provided at the meetings have been incorporated into this report.

RECOVERY/CONSERVATION PLAN

THE WORKING GROUP WAS TASKED WITH DEVELOPING A CONSERVATION PLAN THAT WOULD INCLUDE THE FOLLOWING ELEMENTS:

1. A review of the spawner conservation requirements for Northwest River
2. Options for recovery and long term conservation of Atlantic salmon in Northwest River (identifying most probable causes of decline and recommend preferred option for recovery)
3. Recommend a management strategy for anglers to access the resource (i.e. stock size before fishery would open, duration of the fishery, and level of harvest)

1. Conservation Requirements:

The numbers of Atlantic salmon spawners required to meet the conservation requirements for Northwest River was calculated by Linehan and O'Connell (1996) to be 1726 small (<63 cm) salmon. Their calculations were based on an egg deposition requirement of 2.4 eggs per m² for stream habitat and 368 eggs per hectare for pond habitat, which is similar methodology used for other rivers in Newfoundland. O'Connell

et al (1997) re-calculated the number of spawners required for conservation in terms of numbers of small and large salmon combined. They assumed that large salmon should comprise 22% of the spawners similar to percentage of large salmon in the returns to the river in 1995. Their calculations indicated that conservation egg deposition requirements would be met with 1148 small salmon and 324 large salmon, for a total of 1471 fish.

Scientists have raised concern about the appropriateness of applying the above referenced methodology for calculating spawner requirements for Northwest River. Landlocked salmon are indigenous to the watershed upstream from the falls at km 3.6. Thus, when the falls was made accessible to sea-run salmon in 1948, the sea-run salmon colonizing the river have to compete with the landlocked salmon for rearing habitat, probably resulting in a lower productivity of sea-run salmon than would be expected if landlocked salmon were not present. Scientist reviewed this issue during the DFO Regional Stock Assessment Process in March 2001, and provided the following advice to the Newfoundland Salmon Advisory meeting in November 2001.

“Scientists agreed that in principle the conservation egg deposition requirements per unit of habitat for anadromous salmon in these enhanced rivers (Northwest, Rocky, Terra Nova and Exploits rivers) would be lower than for similar habitat in rivers with no landlocked salmon present. However, at this time, there is insufficient data available to calculate a lower conservation level. It is therefore advised that the management target should not be less than the maximum egg deposition achieved in past years; and it should not be less than 50% of the conservation level calculated using methods without landlocked salmon.”

The Working Group agrees that a management target of 50% of the conservation requirements, as calculated for habitat not containing landlocked salmon, is realistic for a long-term target. The management target should be in terms of large and small salmon and the proportion large would be based on the average proportion observed from 1995 to 2002. Using these values, the long-term management target would be 700 salmon spawners (large and small). However, the Working Group feels that in the short-term, a management target that is less than 700 salmon should be used. The Working Group, therefore, recommends that for the next three years a management target of 500 salmon (small + large) spawners be used, after which it would be review. The intent would be that, over time the management target would be increased to 700 salmon. The reason for the lower management target is to allow anglers to have access to the resource at as early a date as possible. The Working Group feels that access to the resource is an important part of a stewardship program, which is necessary for recovery of the salmon population.

2. Causes of Decline and Options for Stock Recovery:

Potential causes for the decline in the Atlantic salmon population in Northwest River were identified and discussed at public meetings and during meetings of the Northwest River Atlantic Salmon Recovery/Conservation Working Group. These causes are

outlined below (not prioritized), along with options considered, and recommendations by the Working Group.

2.1 Low Natural Survival at Sea

The Working Group reviewed information from other Newfoundland rivers, and noted that the survival rates (smolt-to-adult) of salmon at sea have been much lower since the late 1980's than they were in the 1970's and early 1980's. These low natural survival rates are believed to be the primary cause for the overall low production of salmon in Newfoundland, contributed to the decline in salmon stock in Northwest River and has hampered its recovery. However, unlike other rivers on the northeast coast of Newfoundland where salmon populations remained relatively stable at low levels, the salmon population in Northwest River continued to decline. There is insufficient information to determine the natural survival rate of the Northwest River salmon stock at sea. A preliminary study conducted in 2000 suggested that the survival rate of salmon back to the Northwest River fish counting fence was lower than 1%. This low survival rate is believed to be related to both natural mortality and illegal removals. The Working Group is concerned that the lack of information on the sea survival makes it difficult to determine the extent of illegal removals at sea and difficult to adequately develop management strategies for stock recovery.

Options Considered

1. Initiate a smolt monitoring program on Northwest River in addition to continuing the adult salmon monitoring, so that sea survival rates can be estimated.
2. Examine additional ways to increase smolt production, either through increasing spawning escapement (egg deposition) and hence smolt production.

Recommendations

1. Conduct the necessary smolt and adult salmon monitoring necessary to estimate at sea survival rates.
2. Increase smolt production by reducing illegal removals in freshwater.
3. Initiate a small-scale fry-stocking program to supplement smolt production.

2.2 PREDATION

Community residents have observed the presence of several known predators on Atlantic salmon in coastal/inland waters of Northwest River, namely: birds such as eagles, loons, osprey, kingfishers, gulls and mergansers, seals, otters, rock cod, and Atlantic cod. Many of these predators appear to have increased in abundance in recent years. The restricted season for hunting/trapping these animals (where seasons are allowed) allow their numbers to increase, which results in a potential for greater impact on the salmon, resource.

The Working Group believes that predation could have a serious negative impact on the salmon population, particularly when salmon are highly concentrated in the estuary during the smolt out-migration and up-stream adult salmon migration. There is no scientific information to quantify the extent that predation may be contributing to the decline of salmon in Northwest River. However, intuitively it seems logical that predation could be extensive since all salmon stage in the estuary during the short period of time that they adapt osmoregulatory changes.

OPTIONS CONSIDERED

1. Conduct scientific investigations on the extent of predation during the smolt and adult salmon runs (May – July)
2. Selective removal of predators that presently have regulated hunting seasons.

Recommendations:

The Working Group recognizes that all of the predators identified are probably not contributing significantly to the decline in the Northwest River salmon population. Also, it is not feasible or desirable to selectively remove most bird species, such as eagles, ospreys, loons, kingfishers, and mergansers.

1. Conduct scientific investigations on the extent of predation by cod and seals during the smolt and adult salmon runs (May – July).
2. Selectively remove seals present in the estuary during the period May 1 to July 31.

2.3 Pollution from domestic sewage and pesticide use on the Golf course

It was identified that poor water quality may be impacting on the survival of salmon in Northwest River and Clode Sound. Community residents expressed concern that the lack of sewage treatment may be impacting water quality. Additional concern was expressed over the use of pesticides on the Terra Nova Golf Course. While Parks Canada did conduct a study that found there was no evidence of pesticide pollution, it was conducted several years ago (1994). Pollution can negatively affect the rate of returns to the river in a number of ways. i) directly kill fish; ii) affect osmoregulation of smolts as they enter the marine environment, reducing survival at sea; iii) potential to impact the homing mechanism of returning adult salmon; iv) potential to impact the reproductive process.

The Working Group discussed the potential for the domestic sewage effluent to negatively impact on salmon production of Northwest River. The sewage outflow is directly in the marine environment at Port Blandford. A number of fish species, including sea-run brook trout, are known to be present in proximity to the outflows, thus it is unlikely that the sewage is negatively impacting on the salmon survival. Also, the

Working Group is aware that domestic sewage is or has been dumped directly into major salmon rivers, such as the Gander and Exploits Rivers without any apparent negative affect on the salmon populations.

The Working Group was not able to discount the potential for negative impact of chemicals used on the Terra Nova Golf Course on the salmon population in Northwest River. Even though there is a high level of public concern on this issue, there is insufficient information to determine the extent, if any, of effects of the chemicals on salmon survival.

Options considered:

1. Discontinue the use of chemicals on the golf course.
2. Conduct research to determine:
 - if domestic sewage is a cause for concern
 - if chemicals are leaching into the river;
 - if chemicals are leaching into the river, are there lethal or sub-lethal effects on the salmon population. *In-situ* fish toxicity studies could be conducted followed by salinity challenge experiments.

Recommendations:

1. Conduct research to determine:
 - i) if chemicals are leaching into the river;
 - ii) if chemicals are leaching into the river, determine if there are lethal or sub-lethal effects on the salmon population. *In-situ* fish toxicity studies should be conducted followed by salinity challenge experiments.

2.4 *The Fish Counting Fence*

Some residents perceive that the fish counting fence operated on Northwest River, near the Trans Canada Highway, obstructs fish passage to the upper watershed. It was felt that the rattling of the conduit in the fence frightens salmon and they will not enter the trap in the fence. There has also been concerns expressed regarding misreporting of salmon abundance by Parks Canada staff.

The Working Group reviewed information on run timing and found no evidence that the fish counting fence was preventing salmon from migrating upstream; although there may be delays in the migration due to environmental conditions. However the perception by the public is real and if there are alternate means of counting salmon, they should be considered. The Working Group found no reason to believe that Parks Canada was misreporting salmon numbers.

It was also noted that the counting fence is the best source of data, for opening the recreational fishery, with respect to conducting in-season forecasts of abundance.

Options considered:

1. Installation of electronic fish counter.
2. Move the counting trap to the “run-around” in the falls upstream from the present site. This would eliminate any effects (other than obstruction and noise) the counting fence may have on upstream migration and would have the added benefit of reducing any poaching currently occurring at the falls. If the fence is moved then there would be a requirement to operate both sites for at least two years to refine forecasting at the upper site.
3. Keep the counting fence at the present location for one more year and reconsider moving it to the fall in 2004. There may be a discontinuity of run-timing data by moving the counting fence, and all salmon passing through the counting fence at the present location may remain downstream from the fall.

Recommendations:

1. *Keep the counting fence at the present location for two more years and reconsider moving it to the fall in 2004. There may be a discontinuity of run-timing data by moving the counting fence, and all salmon passing through the counting fence at the present location may remain downstream from the falls.*

2.5 ILLEGAL FISHING IN COASTAL AND INLAND AREAS

Mortalities from illegal fishing have also been implicated in the decline of Atlantic salmon observed on Northwest River. Several people at the public meetings indicated that they felt that illegal fishing in coastal areas and in-rivers was a major cause of the decline in salmon returns. It is also thought that there is a “door-to-door” market for illegally caught fish. It is believed that much of this action is a response to the closure of the recreational fishery. The primary reason given for the high level of illegal fishing, was that residents in the area do not have access to salmon angling in any nearby river. Also they resented closure of the river to angling, since they believed that the stock was not as low as indicated; and the closure was a ploy by Parks Canada to stop people from fishing.

The Working Group supports the view that illegal fishing in both coastal and inland waters is a significant factor contributing to the decline in the salmon population.

Options considered:

1. Allow a retention-angling fishery at the earliest possible date, so those local residents have a legal opportunity to access the resource. This would require establishing a realistic management target for the number of spawners, above which a fishery could be opened. (See Section on Management Strategy)

Rationale: provision of access to the resource would instill a greater level of trust in governments, and enhance stewardship of the resource; thus reduce illegal activities.

2. Allow a marine retention salmon angling fishery at the same time as an in-river-angling fishery is permitted.

Rationale: Cabin owners who do not traditionally angle in rivers would have a legal access to the resource and may then reduce illegal activities. It would instill stewardship of the resource.

3. Implement a stewardship program (See Section 2.7).
4. Increase the level of enforcement and supporting resources dedicated to Northwest River.

Recommendations:

1. Allow an in-river retention-angling fishery at the earliest possible date, so those local residents have a legal opportunity to access the resource. This would require establishing a management target for the number of spawners, above which a fishery could be opened. (See Section 3, Management Strategy)
2. Implement a stewardship program with direct involvement of the local people (See Section 2.7).
3. Increase the level of enforcement and supporting resources dedicated to Northwest River, such that there are two dedicated officers during the period of 24 May to 30 August. Periodically use special response teams and undercover fisheries officers.
4. Establish an effective “River Watch” group in the Port Blandford area to conduct monitoring and encourage the effective use of Crime Stoppers.
5. Move the fishing counting trap upstream to the falls in 2004. The presence of trap attendants will deter poaching at the falls.

2.6 By-catch in commercial fishing gear.

The Working Group reviewed information available on “by-catch” of salmon in legal fishing gear and concluded that by-catch could potentially have a serious impact on the numbers of salmon returning to Northwest River. However there is no information available to quantify the level of by-catch in fishing gear in the Clode Sound area.

Options considered:

1. Remove commercial bait nets from locations of high salmon by-catch or potential high salmon by-catch; such as, at traditional commercial salmon berths.
2. Require fishermen to set their bait nets parallel to shore with the headropes sunk one fathom.

Recommendations:

The Working Group was not able to determine the how serious an impact by-catch has been having on the Northwest River salmon population due to the lack of specific information on by-catch in the area. It is therefore recommended that:

1. A study should be conducted to determine the level of by-catch in bait nets.
2. DFO should take action to minimize salmon by-catch. Where feasible fishermen should be required to set bait nets parallel to shore and sink them one fathom.

2.7 Stewardship

Stewardship is a key component of the Northwest River Atlantic salmon Conservation/Recovery Program. In order for the salmon resource to recovery the local communities need to take responsibility as stewards of the resource. The provision of angling opportunities at the earliest possible date is an incentive for the community not to condone abuses of the salmon resource and its habitat. However, access to the resource, by itself, is not sufficient to develop and maintain a sense of responsibility and stewardship within the local communities. A long-term, well-designed, visual program of education and awareness is required to instill a sense of stewardship. Such a Program requires a highly visible focus (focal activity), reach all age groups within the communities, and provide an opportunity for individuals from the community to be involved throughout the year.

Recommendation:

1. A stewardship program be initiated and consisting of four major initiatives: 1) access to the resource at the earliest possible date, 2) education/awareness, 3) salmon egg incubation and fry stocking, and 4) Improve relationship with Parks Canada.

2.7.1 Access to the resource at the earliest possible date

Residents in nearby communities feel that the salmon stock size in Northwest River was not sufficiently low in 1996 to have warranted it to be closed to angling. They feel that government agencies, particularly Parks Canada, was using the low stock size as a ploy to exclude local residents from using the salmon resource in the Park, similar to the denial of access to other resources. In order to gain trust in governments and to believe that there are benefits to them from having a healthy salmon stock in Northwest River, they must have a reasonable expectation of being able to angle for salmon in the near future. It is, therefore, important that a realistic management strategy be developed, such that access to the resource would occur at the earliest possible date. The Management Strategy outlined in Section 3 is considered an integral part of a stewardship program.

2.7.2 EDUCATION AND AWARENESS

Education and awareness is an important aspect of any stewardship program. The public needs to become aware of the specific conservation requirements of the salmon stock in Northwest River; as well, as the benefits that can be derived from a healthy stock. An education and awareness program would identify those human activities that can negatively impact on salmon production, those activities that would benefit the resource, and how the people can become stewards of the resource.

A committee, under the direction of the Northwest River Atlantic salmon Conservation Working Group, would be formed to advise on material that should be included in an education and awareness program. The committee would consist of community residents, stakeholders, and government agencies.

Audio-visual material specifically related to the salmon resource in Northwest River and its interrelationship with the local community would be prepared in the form of presentations and displays. Possible elements of the material would be: history of salmon on the Northwest River, life history of salmon and its habitat requirements, conservation and protection of the resource, fisheries, and management strategies.

Interested community residents and stakeholders would be trained to present the education and awareness material to community organizations, schools and visitors to the area.

The estimated cost of preparing the education and awareness material and conducting the training is \$60,000.

2.7.3 Salmon egg incubation and fry stocking

The third component of the stewardship program would be a small-scale Atlantic salmon egg incubation and fry stocking project. This project would compliment the education and awareness component, provide a focus for community participation, and be a visible activity year around. The adult salmon produced would, to some degree, off set the impact that an angling fishery would have on the spawning escapement as well as, to a limited degree, increase the number of spawners and thus improve the rate of recovery of the salmon population.

The concept of an egg incubation and fry-stocking project is as follows:

- Approximately 150,000 salmon eggs would be taken from about 100 salmon captured at the fish counting fence, and placed in a re-circulating egg incubator, which would be located in the Town of Port Blandford.
- These eggs should produce approximately 125,000 fry, which would be stocked in a tributary of Northwest River.

- A portable egg incubator is presently available from DFO, and can be hooked up to the community water supply in Port Blandford. One trained operator is required to operate and provide security for the incubator throughout the winter. Additional personnel are requirements for broodstock security.
- The project should run for at least six years; but could be a long-term component of the education and awareness project if funds were available. This operator of the incubator, who would be a full time person, could lead and conduct most of the delivery of the education/awareness initiative.
- The project would require the Working Group to develop a partnership with stakeholders, local communities, DFO, and Parks Canada.
- The cost of the project, excluding cost of operating the fish counting fence would be about \$100,000 per year
- The Working Group would solicit funds from corporate sponsors and government agencies.

2.7.4 Community Relationship with Parks Canada

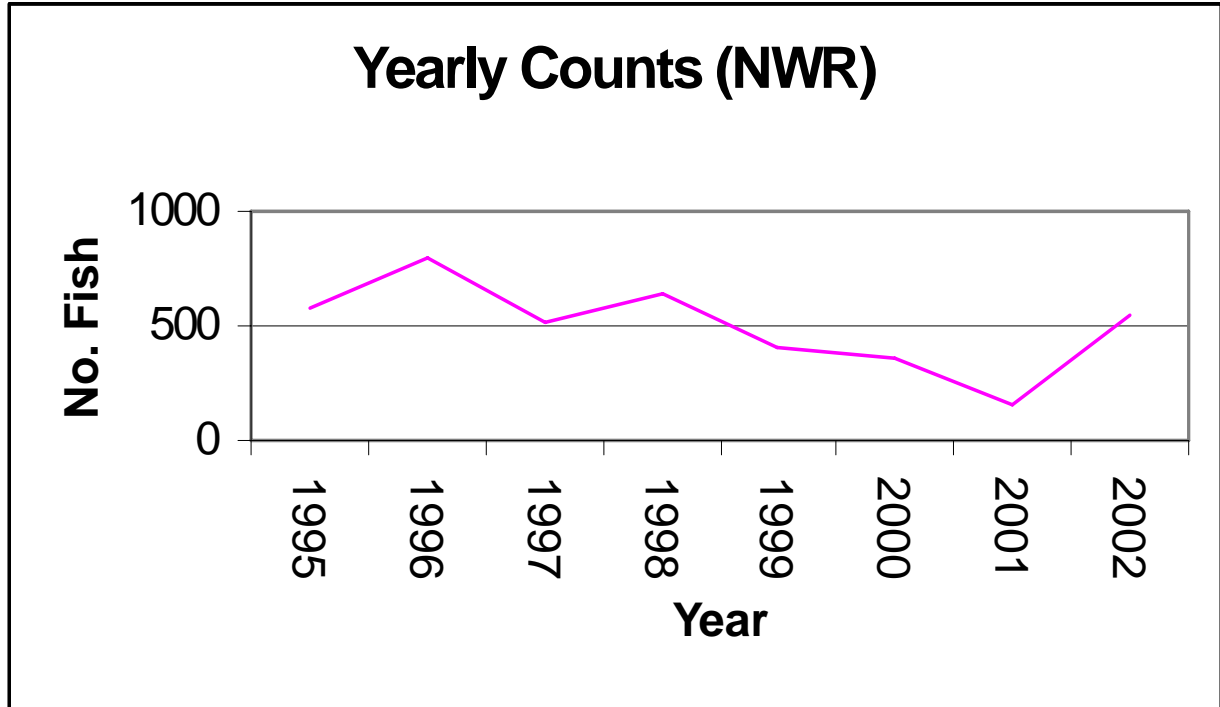
The relationship between local residents and Parks Canada is strained. Some participants at public meetings expressed a lack of trust for the integrity of Parks Canada. It was their view that Park was selective in the information that it released to the public and was not receptive to suggestions from local community residents. Directed efforts should be made to improve this relationship, as part of the stewardship program. The committee established under the Education and Awareness component (Section 2.7.2) would be tasked with developing means to improve the relationship. Some suggestions to consider would include:

- Increase communication between Park staff and community residents
- Involve community volunteers during water quality testing and salmon monitoring
- Continue involvement of Port Blandford Town Council while staffing the counting fence
- Implementation of an Atlantic salmon interpretation program at Northwest River

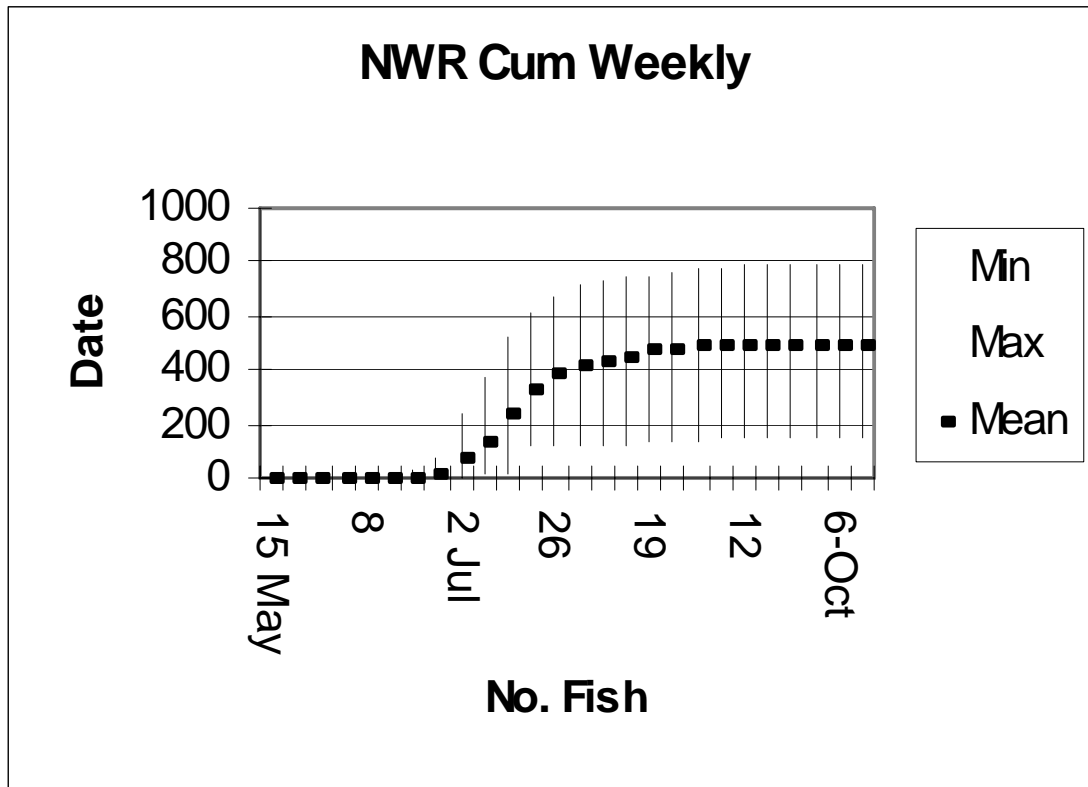
3. Management Strategy

Upstream migrating Atlantic salmon have been monitored at Stick Pool (near TCH) for the past eight (8) years, 1995 - 2002. Counts have ranged from a low of 153 salmon in 2001 to a high of 793 salmon in 1996 (Table 2). The average number of returns was 537 fish, of which with 24% were large salmon (>63 cm). The following Figure shows annual fluctuations in returns but with a declining trend. The returns in 2002 was the

highest recorded since 1998, which the Working Group feels is related to a decrease in illegal fishing. The high profile given, this year, to the serious state of the salmon stock in Northwest River likely increased awareness of the conservation issue resulting in less poaching.



Daily run timing data are available for each year, 1995 to 2002. The upstream migration is highly influenced by water levels in the River. The following Figure summarizes the cumulative numbers of salmon in the River each week. The dot is the average or mean number of salmon in the river for the date shown, and the vertical line shows the maximum and minimum number of salmon.



The Working Group supports a long-term management target of 700 salmon (small + large) spawners (small + large) for Northwest River;

RECOMMENDATIONS

1. An interim management target of 500 salmon spawners be used for a three-year period, after which the interim target would be reviewed (See Conservation Requirements, Section 1). The intent would be that, over time the management target would be increased to 700 salmon. The reason for a lower management target is to allow anglers to have access to the resource at as early a date as possible. The Working Group feels that access to the resource is an important part of a stewardship program, which is necessary for recovery of the salmon population.
2. Working Group recommends a pilot angling fishery in 2003 that would be permitted if an in-season forecast projects that the total salmon returns to the fish counting fence will be in excess of 550 salmon. The Working Group believes that an early opening of the recreational fishery will provide an incentive to reduce illegal, which will result in an increase the spawning escapement. The pilot fishery would have the following elements:

- Northwest River would be opened as a Class III river.
- Angling would be permitted only in that portion of Northwest River that lies within the Terra National Park except for the section from Stick Pool to Cliff Pool, inclusive.
- The angling fishery have a quota up to 50 small salmon, but would close at any time it appeared that the interim management target would not be met.
- Anglers would be permitted one salmon per day and requested to take their salmon to the counting fence attendant for biological sampling.
- The Working Group reviewed 2 scenarios for an early recreational fishery and one scenario for a late opening fishery;

Early Scenarios

- i) If the total number of salmon counted through the fish counting fence by June 30 is 75 or more salmon, the angling season would open on July 1 for 3 days with a quota of 20 small salmon. If less than 75 salmon are counted by June 30 the season would not open on July 1.
- ii) If the number of salmon counted through the fish counting fence by July 5 is 200 or more salmon, the angling season would open for a total retention of 50 small salmon (includes salmon retained July 1-3). If the number of salmon is less than 200 salmon the season would not open on July 6.

Late Scenario

- i) If a midseason review, conducted in mid to late July, predicted a river escapement of over 550 fish the angling season would open for a total retention of 50 small salmon (includes salmon previously). If the predicted number of salmon is less than 550 salmon the season would not open. In this scenario environmental conditions (such as timing of fish entry into the river, water discharge and temperature, comparisons of run timing data with other Newfoundland rivers) could be taken into account, as well as, run timing information for other rivers in Bonavista Bay.
- Historical data for the returns to the river indicated that for all years that the “trigger” numbers of fish had passed through the counting fence by June 30 or July 5, the returns to the River exceeded 550 salmon. Thus the Working Group has a reasonable level of confidence that the interim management target would be met.
 - It is anticipated that no more than 50 salmon would be angled during the periods selected.

- Opening a fishery on July 1 would provide an incentive not to poach salmon. Also, the presence of anglers on the lower river would be a deterrent to poaching at least during the daytime.

License Fees: Local residents have expressed concern with respect to the license fees associated with fishing for salmon in Parks Canada. In addition to the requirement to have a provincial salmon fishing license there exists the requirement for user fees and licenses associated with fishing for salmon or trout. The Working Group believes that the reduction/removal of some of these fees would assist in fostering stewardship, as the cost associated with salmon fishing may be prohibitive. Additionally to foster stewardship and protection of the resource the presence of anglers on the river must be viewed as a positive step.

APPENDIX 2: FORECASTING OF SALMON RUN STRENGTH IN NORTHWEST RIVER

An examination of previous salmon runs in Northwest River indicated that they were quite variable in size - the largest run at that time being five times greater than the smallest (Figure 4). However, the run timing, or the way the run was spread across the season, was fairly consistent. If it was assumed that future runs would have similar timing to previous years we could predict or scale the size of future runs based on early season returns.

For example, on 8 July 1996, 319 salmon had passed through the counting fence equalling 40% of the year-end total of 793 fish (Table 2). On 8 July 2004, we could estimate that the 253 fish that had been counted at the trap would again represent 40% of the run that year (thus predicting a total run of 633 fish). In reality, the proportion of the year's run that has gone through the trap on a given day varies from year to year.

Therefore, we proposed to predict the run based on each year of past data and use this distribution of predictions to estimate the probability of achieving our management target. The predictions of the 2004 run for 8 July 2004 ranged from 429 to 12650 salmon and 8 of 9 projections predicted numbers greater than 550 salmon. It was determined a-priori that a >80% certainty of achieving our targets by year-end was desired. Since 8 of 9 predictions exceeded the target threshold, the river was opened to angling. Such an approach has several assumptions. First, it assumes that the timing of the salmon run is not changing over time. Second, it assumes that run timing and run size are independent variables. While there is no obvious reason to disbelieve the former assumption, there is statistical evidence that indicates the latter assumption is valid. There is no relationship between run size and the day in which half the run has past the fence ($F_{d.f.=1,8}=0.045$; $p=0.837$). Intuitively, achieving a run of 12650 salmon in Northwest River seems far less likely than a 1 in 9 chance as some natural limiting factor would come into play well before that number was reached. This large run size is an artefact of the unusually late run in 1997 scaled up to the relatively large run-to-date on 8 July 2004. Fortunately, in this application where there is concern about maintaining a minimum number of fish, extrinsic factors to the model from resource limitation should have little impact on the utility of this model for management purposes.

Table 2: Example calculations used to predict run size at year-end from previous fence counts and run magnitude on 8 July, 2004.

Year	<i>a</i> Run size on July 8	<i>b</i> Year end run size	<i>c</i> Proportion of run through on July 8 (<i>a/b</i>)	<i>d</i> Predicted run for 2004 (253/ <i>c</i>)
1995	46	577	0.08	3163
1996	319	793	0.40	633
1997	8	523	0.02	12650
1998	378	644	0.59	429
1999	125	407	0.31	816
2000	59	353	0.17	1488
2001	35	153	0.23	1100
2002	71	557	0.13	1946
2003	476	1272	0.37	684

* based on 253 fish through the trap on July 8, 2004

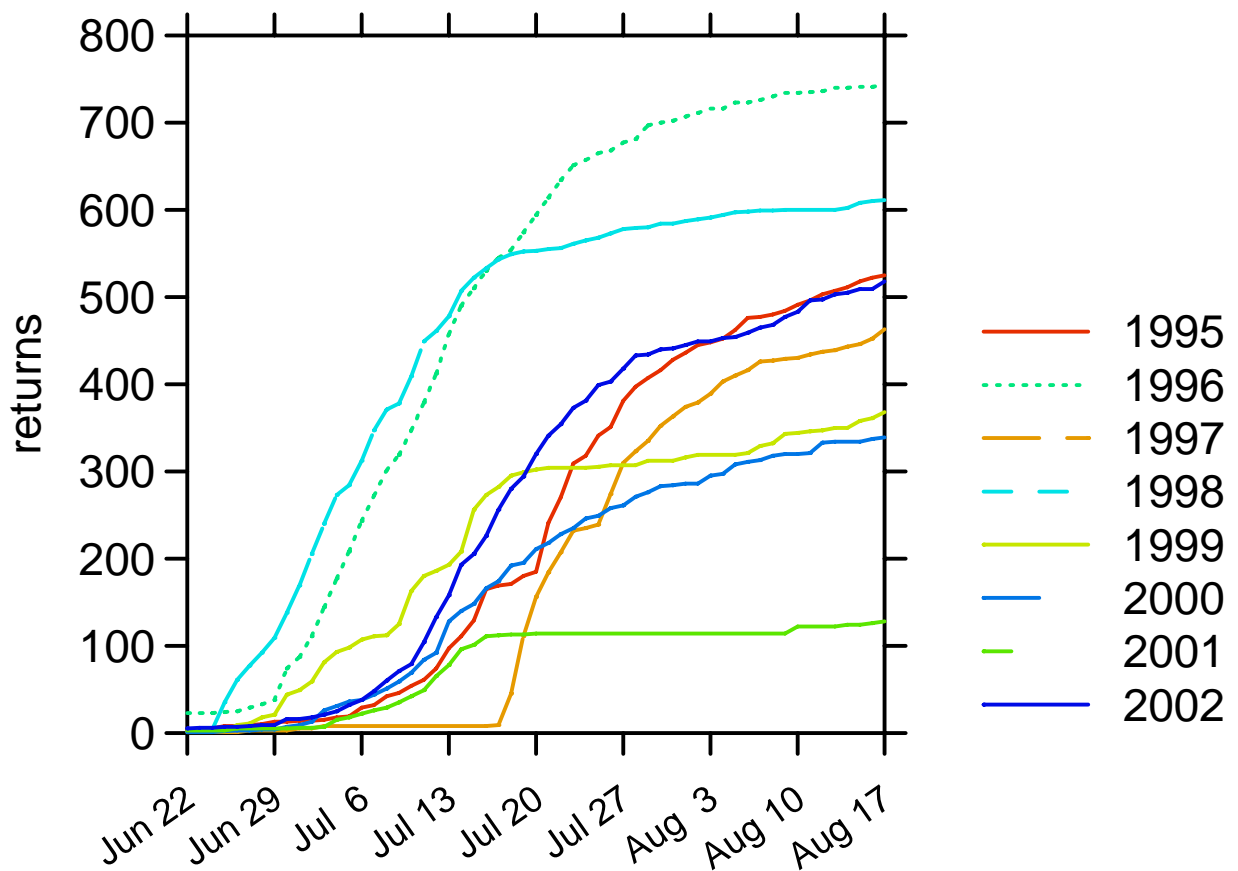


Figure 4: Run timing of Atlantic salmon in Northwest River from 1995 to 2002.