PREDATION OF MIGRATORY SALMONIDS

Assessment of a Workshop held in Edinburgh on 11-12 April 2000, made by the Chairman, Professor Fred Last OBE

The Atlantic Salmon Trust
Moulin, Pitlochry
Perthshire
PH16 5JQ

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The Atlantic Salmon Trust
Moulin, Pitlochry
Perthshire
PH16 5JQ
Tel: 01796 473 439
Fax: 01796 473 554
Email: director@atlanticsalmontrust.org
www.atlanticsalmontrust.org

Illustrations by

FOREWORD

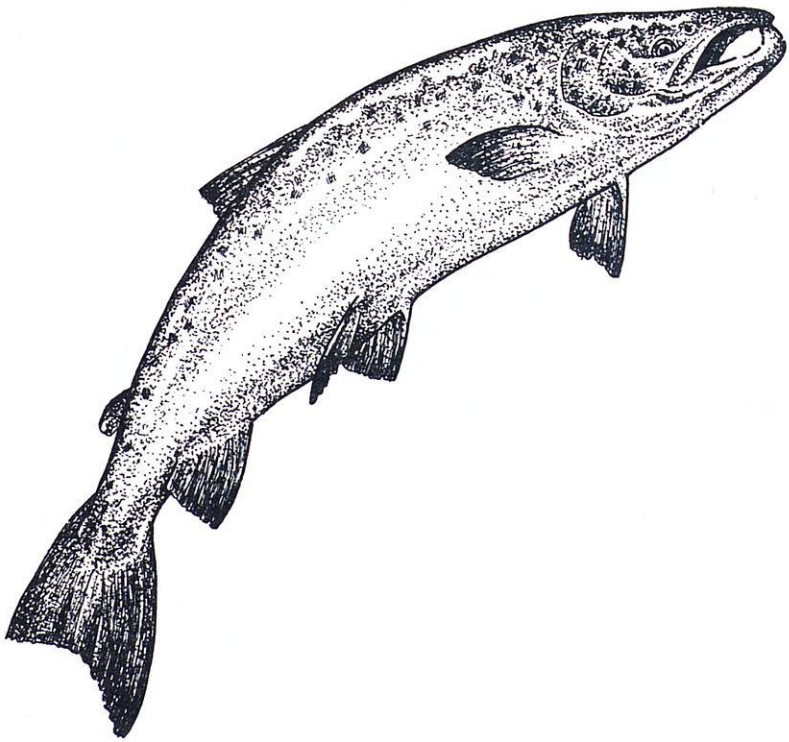
Derek Mills

Chairman, Honorary Scientific Advisory Panel (1991-2002)

The aim of this Workshop, held in the meeting rooms of the Royal Zoological Society of Edinburgh, was to bring together, over two days, representatives from a spectrum of organisations interested in fish predation and predators, with the object of seeking consensus on the scale of associated problems and possible mitigating action. The predators under consideration were the goosander and red-breasted merganser, the grey and common seals, the otter and the mink. Predatory fish were not included in the discussion.

Much of the value of the Workshop lay in facilitating discussion and understanding between the interested groups. The aims of some (e.g. the Royal Society for the Protection of Birds and the Scottish Society for the Prevention of Cruelty to Animals) were to protect some of those predators under discussion, while the chief interest of others (e.g. the Association of Salmon Fishery Boards and the Environment Agency) lay in their control. This meeting offered the prospect of a constructive approach to the problems of predation in the future. A remarkable level of common ground was achieved in informal discussion. Inevitably, there were some dissenting voices over the level of control to impose with respect to certain predators such the sawbill ducks and cormorants, while there was general agreement over the control of others like the mink, an alien to the British Isles. In the case of the otter, there was common assent to the need for its protection, even though it is a salmon predator.

Not all contributors supported their inputs with formal papers, and therefore there can be no Proceedings, as such. This Report consists of an assessment by the independent Chairman. Professor Fred Last, to whom the Trust is most grateful.



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1. BACKGROUND

1.1 The International Atlantic Salmon Accord, in advocating concerted action to reverse the current decline in salmon stocks, seeks the optimisation of:

a. Numbers of Atlantic salmon (*Salmo salar L.*) spawning in their native rivers and
b. Survival in both freshwater and marine phases of this species' life cycle.

1.2 When considering the strategy and tactics for the conservation of Atlantic salmon it has to be remembered that this species has many populations and sub-populations, each associated with particular stretches of fresh water. Smolts from these populations and sub populations leave for their marine phase and the survivors return, normally to the same stretches of fresh water, to spawn. These differing populations, which should all be nurtured, contribute greatly to the diversity within Atlantic salmon; in many instances this diversity underpins the range of seasonal fisheries.

1.3 The Accord identifies seven basic issues, each involving a number of contributory factors, which may adversely affect the abundance of salmon:

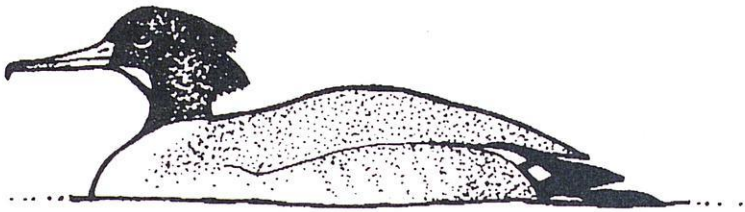
a. Inadequate in-river production,
b. The impact of aquaculture,
c. The impact of fisheries targeted against other species,
d. Low marine survival,
e. The impact of mixed-stock fisheries,
f. In-river exploitation, and
g. Predation, which may occur at different stages of the life cycle.

1.4 All of the issues must be examined because of the wide range of problems facing salmon. To take account of interactions, all of them should ideally be considered both singly and collectively – a holistic approach should be adopted. In examining the particular issue of predation (the subject of the Workshop) due account must be taken of:

a. The significance of losses connected with other issues, and
b. The timing and extent of predation by different predators on stocks of salmon of different sizes and at different stages of the life cycle.

1.5 Both wild salmon and some of their native predators are protected by wildlife legislation, so raising complex issues of conservation management. 'Introduced' predators are not protected.

1.6 The impacts of predation on salmonids, and the benefits of decreasing these impacts, should be considered in the round, with ecological and economic losses and gains being examined locally, nationally and internationally.



2. INFLUENCES OF MERGANSERS AND GOOSANDERS (SAWBILL DUCKS) AND CORMORANTS

2.1 Assessments of predation by mergansers, goosanders and cormorants are based on:

a. Current understanding of the population dynamics of the prey (fish) and predatory birds
b. Analyses of gut contents
c. Studies of bird energetics
d. Assessments of salmon abundance

2.2 Sawbill ducks and cormorants are commonly found in fresh water where salmon occur, but their numbers may vary from year to year and from river to river. Whereas the populations of cormorants in the UK seem to have stabilised or increased locally at 3-5% in recent years, a quantitative survey of the largely freshwater goosander suggests significant increases in some areas. There is no clear trend for the predominantly marine mergansers. The latter have a wide but predominantly northern and western distribution in Great Britain with relatively large numbers in north Wales, the Lake District of England, the Galloway coast and the Northwest of Scotland. In contrast goosanders, which favour rapidly flowing rivers, are in Wales, Northern Ireland, and the Southern Upland, Grampian and Northern regions of Scotland. Goosanders have recently extended their range into several parts of England.

2.3 An examination of the diets of cormorants and sawbill ducks has shown that salmon can form significant elements. In the River Bush, Northern Ireland, it has been estimated that cormorants may take significant proportions (51-66%) of the populations of migrating smolts. In Scotland, during winter and spring, the diets of red-breasted mergansers diet were estimated as averaging about 30% and 56% salmon (by mass) on southern and northern rivers respectively. For goosander, the equivalent figures were 9% in the south and 41% in the north.

2.4 The variability of the data for the diets of predatory birds affects the validity of possible generalisations. Without continuous sampling it is difficult to make due allowance for day-to-day, season-to-season and yearly local variations, nor is it feasible to make adjustments for differences attributable to the changing availability of potential prey species (salmon and other fish).

2.5 Despite reservations about such generalisations, local impacts should not be ignored. These may be especially significant where individual salmonid populations are small, or at life-history stages (larger parr and smolts) where there is little potential for any compensatory mechanism to operate. It is a truism that if fewer fish survive to migrate as smolts to the North Atlantic it is likely that fewer will return as adults. Where salmon stocks are at risk, it may be essential to exercise the precautionary principle in acting to reduce the impact of predation, recognising that legislation, when protected predator species are involved, requires that a licence be obtained before lethal control measures may be used even where the conservation status of the predators in question is favourable.

2.6 Extensive (widespread) culling of avian predators is neither necessary nor (see 2.5) an option under current UK and European legislation – cormorants and sawbills are afforded both domestic and international legislative protection. Shooting under licence to prevent serious damage to fisheries is allowed under a derogation to EU legislation, but this cannot be used during breeding seasons, when even disturbance, in so far as it would be significant, is prohibited.

2.7 Many methods of decreasing the effect of local numbers of predatory birds have been investigated, with due regard for effectiveness, practicability, acceptability and cost. Interest has focused on a diverse array of deterrents (e.g. acoustic and visual scarers, ultrasonics, increasing water turbidity, conditioned taste aversion) and on methods of modifying sites with the aim of making them less attractive to cormorants and sawbills (e.g. roost modification). However, few of the techniques appear to be suitable for use on rivers, and the most effective deterrents in these localities appear to be human disturbance and shooting to scare (or to kill as an aid to scaring). Resource limitations are likely to dictate that these techniques should be targeted on areas and times of greatest salmonid vulnerability, as described in 2.5 above. It is also recognised that shooting may be prohibited or impractical at sites of conservation importance or in the vicinity of human habitation.

2.8 In Scotland, licences to shoot piscivorous birds are granted by the Executive to Salmon Fishery Boards, on a catchment basis. There are no equivalent salmon management bodies in England and Wales, and individual proprietors must seek licences from the Department for the Environment, Food and Rural Affairs (DEFRA) or the National Assembly for Wales, although the Environment Agency is frequently involved. Some members of the Workshop suggested that a catchment-wide approach was important in addressing the impact of predators on particular salmon stocks, and considered that the procedure for the granting of licences should be optimised, particularly in view of the targeted approach postulated in 2.5 above. [*Post Workshop Note: Revised guidance was issued in September 2000*].

2.9 **Summary**. Piscivorous birds may eat large numbers of juvenile salmon at certain times and places, but the effects on fish populations and fisheries have not been quantified. In this regard it should be remembered that streams have their own distinctive sub-populations of salmon. Much needs to be done fully to understand the impacts of avian predators, the ability of salmon populations to respond to losses, and the effects of control measures. However, appropriately regulated action aimed at reducing significant local predation accords with the precautionary approach. Despite many investigations of other options, it is currently estimated that, in the context of rivers, human disturbance and shooting (both aimed at reducing local numbers of feeding cormorants and sawbills) are the most practical measures for providing focused defence for the critical life stages of threatened fish populations. Further work is required to quantify the effects.

3. PREDATION BY SEALS (GREY AND COMMON)

3.1 Estimates suggest that the UK populations of grey seals and common seals number at least 120,000 and 33,000 respectively. Although there have been considerable differences between grey seal colonies, the numbers of these animals have steadily increased since 1960 by 6.5% annually. More than 50% of the world's population of grey seals breeds in British waters. Common seal numbers declined at the end of the 1980's because of phocine distemper, but have since recovered to pre-epidemic levels.

3.2 Two major studies have been made of the diet of grey seals. One study was made by the Sea Mammal Research Unit (SMRU) and the other by the Marine Laboratory, Aberdeen. It is thought that there is little difference in the diets of grey and common seals feeding in the same area at the same time.

3.3 From analyses of faecal remains the report of the SMRU study suggested that species other than salmon formed the diet of the seals under investigation. In contrast the Marine Laboratory study of 368 seal stomachs recorded remains of salmonids in 28%. The results need to be interpreted with caution because a prey species can occur in a high percentage of stomachs, but only make a small contribution to the diet of the predator. The absence of salmonid remains in seal faeces studied by SMRU could be explained by:

a. the progressive digestion of bones during their passage in the gut of seals and/or
b. the fact that seals only eat part of the salmon that they catch: fishermen commonly find the heads and backbones of salmon in their nets.

[*Post meeting note: Work sponsored by the Atlantic Salmon Trust and carried out by Fisheries Research Services and Aberdeen University has validated the use of DNA analysis to determine the presence of salmonid tissue in seal faeces*]

3.4 The Scottish Salmon Strategy Task Force estimated that, even if (presumably adult) salmon were to form only 1% of the diet of all seals, current numbers of grey seals could annually consume about 400,000 salmon, that is about 2.5 times as many as the total annual catch of wild salmon and grilse taken by United Kingdom homewater fisheries. To this total could be added an estimate of a further 70,000 salmon taken by Scotland's common seals, which enter rivers more frequently than grey seals. There are no quantitative estimates of predation on smolts.

3.5 Recent behavioural studies have suggested that seals in the open sea tend not to feed at depths near the surface, and are more likely to prey on slower moving species. It has also been suggested that some of the injuries previously thought to have been inflicted on salmon by seals may be attributable to bottlenose dolphins and harbour porpoises. With the availability of a range of sophisticated techniques (antisera, molecular, DNA), further examination of the diets of seals should be made, taking account of spatial and temporal differences in the availability of their prey.

3.6 Despite the uncertainties attached to estimates of overall annual salmon consumption by seals, there is little doubt that salmon are a very significant part of the diet of some seals, particularly those that enter salmon rivers or frequent bays and haul-out sites in, or near, rivers. These seals can take fish trapped in nets, in addition to free-swimming fish.

3.7 While it is essential to enhance our understanding of the impacts of seals on the population dynamics of salmon and other fish, it is also necessary to take steps to lessen damage. As with fish-eating birds, widespread culling would be neither justifiable nor acceptable, but there can be local grounds for appropriate action to be taken to protect salmon stocks.

3.8 Under the Conservation of Seals Act 1970, licences may be granted to kill or take seals (grey and common) during their close (breeding) seasons for a number of purposes, including the prevention of damage to fisheries. Outwith the close season, no licence is required for such action. In 1998 the Conservation of Seals (Common

Seals) (Shetland Islands Area) Order 1991, which prohibited the wilful killing, injuring or taking of common seals within the seaward limits of the territorial waters of the Shetland Islands Areas, was revoked. The Conservation of Seals Act prohibits the use at any time of poisonous substances and, in respect of firearms, specifies the requirement to employ a rifle using ammunition with a muzzle energy of not less than 600ft/lb (813.5J) and a bullet weight of not less than 45 grains (15.4g). However, since the tightening of the gun laws in Scotland during the 1990s, it has become difficult to obtain a suitably endorsed firearm certificate in a number of police regions.

3.9 Assessments of the scope for local action and of potential efficacy in safeguarding fish populations could be facilitated by consultation between Fishery Boards and the Sea Mammals Research Unit – the effects of such local actions need to be assessed.

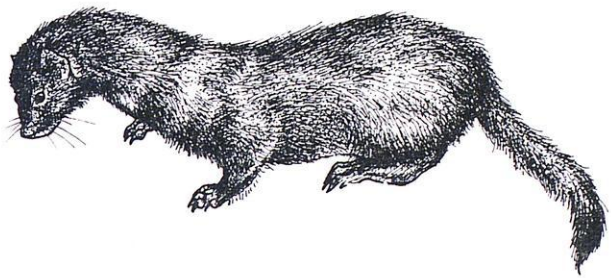
3.10 Reference was made at the workshop to other methods of lessening or controlling the impact of seals:

a. Note was taken of the progress being made in Canada with contraceptive vaccines and their application. Although it was assessed that the operational difficulty of administering the vaccine (even in an as yet undeveloped "bio-bullet" form) would currently preclude its practical use, work on this technique should be kept under continuous surveillance. It has been suggested that lower seal birth rates might result in higher pup survival rates, with an overall neutral effect on numbers of seals.
b. Recent experiments with scarers, including acoustic deterrents, suggest that if further developed, they might be of use in discouraging seals from taking fish in nets or from moving upstream in rivers.

3.11 **Summary.** It is essential to understand exactly how seals affect the dynamics of populations of salmon and other fishes. It is recommended that an objective long-term holistic study is put in place to observe how the presence of seals, and their exclusion, affect the emigration and immigration of salmon, particularly in dry years when low water delays salmon immigration or movement upstream. In the meantime, existing powers are available locally for action to prevent damage to salmonid fisheries. Advice on targeting this action should be made available to District Salmon Fishery Boards. Exploration of alternative techniques should continue.

4. PREDATION BY MUSTELIDS

4.1 Two species are of significance, the native otter (*Lutra lutra L.*) and the introduced North American mink (*Mustela vison Schreber*). Feral populations of the latter, a pest, are widespread in Great Britain: they are associated with a variety of freshwater and coastal habitats and have linear home ranges extending 1-6 km. Since the 1970s populations of otters have spread from their strongholds in Scotland, Wales and the West of England: they are of international conservation importance. The home ranges of otters are larger than those of mink – they extend from 12-78 km.



4.2 Mink are generalist predators: they take rabbits, water voles, waterfowl, ground nesting birds, amphibians and invertebrates, also fish. Their choice of prey is strongly habitat-dependent. In a body of standing water cyprinids (eg roach) were observed to be the main (fish) prey, whereas in a nearby river salmon were the more important element of diet. In some rivers in Scotland eels form a greater proportion of the diet of mink than salmon, whereas in others the situation is reversed.

4.3 Otters, unlike mink, are predominantly fish-eating, taking eels and cyprinids in standing waters, and variable proportions of salmon and eels in riverine habitats. In north east Scotland and possibly elsewhere the use made of riverine habitats by otters was inversely related to the width of those habitats, that is otters spent most time foraging in narrow tributaries or narrow stretches of river. Observations of salmon at the time of spawning have indicated that otters could take considerable numbers of adult fish (a daily intake of up to 1.5kg has been quoted), preferring healthy specimens to diseased and males to females. If this latter preference is general, it could have a significant impact on breeding success where salmon runs have been greatly reduced.

4.4 As mink are classified as non-native pests direct action can be taken to control them. In contrast otters are protected under domestic and European legislation. Under the Wildlife and Countryside Act otters are afforded full protection: it is illegal to kill, injure, take, possess, disturb or damage their places of shelter or to sell otters, although translocation has been carried out with the aim of re-introducing populations.

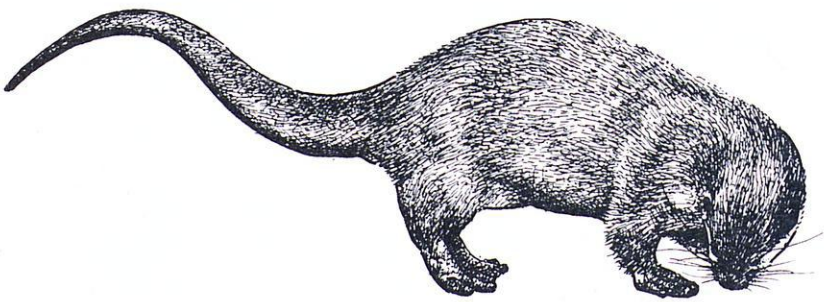
4.5 In relation to control, there would be no conflict of interest in relation to mink, but the same is not true of otters. At the national scale it is the intent of the Joint Nature Conservation Committee to maintain existing otter populations, encourage natural recolonisation, and effectively safeguard viable populations of otters and their habitats throughout their natural range. However, the Workshop upheld the very strong statement made in the Salmon Strategy Task Force Report: *From a fisheries perspective there is no justification for the deliberate introduction of otters to salmon rivers or to parts of salmon rivers from which they are currently absent.* There may be a local conflict when a site is at the same time a candidate Special Area of Conservation for otters and for salmon.

4.6 The piecemeal direct control of mobile predatory species such as mink and otter is, even if it were allowed, unlikely to prove successful because the resulting voids would probably be re-occupied within a short period of time.

4.7 As far as otters are concerned the use of other methods such as habitat modification is, like that of direct action, precluded by existing legislation and to a considerable extent the presence of both otters and salmon is regarded as being indicative of healthy waterways - measures to make aquatic habitats less suitable for otters may have adverse affects on salmon and other species of fish. As yet, supplementary feeding with other fish species and/or crayfish, as in the Donana National Park, Spain, has not found favour, in part because it might upset the balance of species which it is intended to conserve.

4.8 The Workshop commended the initiative taken by Scottish Natural Heritage and the Scottish Executive to investigate the practicalities of trapping mink in the Western Isles, by examining the relative benefits of trapping throughout the Isles vis-à-vis trapping at favoured locations to which other mink might be attracted as previously resident mink are eliminated. The outcome of this study was being awaited with interest. [*Post Workshop note: a mink eradication project has been approved and is being implemented*]

4.9 **Summary**. Both otters and mink may prey on salmon. Given the imperative to conserve otters, some damage by them has to be accepted. However, they should not be actively introduced into salmon rivers. Investigations into the most effective means of reducing the numbers of mink should continue.



5. DISCUSSION AND KEY CONSIDERATIONS

5.1 Stocks of wild Atlantic salmon are assessed as being lower now than at any remembered time.

5.2 Action should be taken, wherever it is feasible, to prevent further deterioration and, more positively, to enhance the conservation status of the stocks.

5.3 This enhancement is a necessity because:

a. Salmon are a major element in many freshwater and marine ecosystems.
b. There are obligations to conserve salmon in British laws and European directives.
c. Wild Atlantic salmon fisheries contribute significantly to rural economies

5.4 Predation is one of the factors affecting stocks of salmon. Of the others (see 1.3) it is essential to identify the causes of *low marine survival* – the percentage of smolts returning to fresh water as adults is decreasing.

Key Consideration 1: Extensive and sophisticated studies of marine survival should be in place.

[*Post Workshop Note: This requirement had been identified in November 1998 at the Atlantic Salmon Trust Workshop on Problems Facing Salmon in the Sea. The North Atlantic Salmon Conservation Organisation (NASCO), at its Council meeting in June 2000, agreed to set up a Working Group to develop ideas for a five year international programme to identify and explain the causes of the increased marine mortality of Atlantic salmon and to examine means to counteract this mortality. This work is being directed by an International Co-operative Research Board*].

[*Additional Note, added in 2005.*
NASCO has begun a major research programme entitled "Salmon at Sea" or SALSEA. The aim of this programme is to identify and explain the causes of increased marine mortality of Atlantic salmon and to examine the possibilities of counteracting this mortality with the aim of restoring the wild salmon to its historical level of abundance. In 2005, in co-operation with the Fisheries Research Services, Aberdeen, and the Institute of Marine Research, Bergen, the AST initiated research cruises in the North Atlantic as a precursor to the main SALSEA Programme].

5.5 For a species as important as salmon surprisingly little is known of:

a. Its interrelation with other species of fish and
b. The impacts of predators, singly and in combination, on single or multi species fish communities.

Key Consideration 2: One or more holistic studies should be made of the immediate, mid and long term effects of predation in one or more river systems.

Key Consideration 3: A **specific study of seal predation should investigate the impact of seals that enter rivers and frequent bays and haul-out sites near salmon rivers.**

5.6 Discussion of predation should recognise the necessity to ensure the appropriate protection not only of salmon, the prey, but also of its native British predators. This consideration does not apply to mink, which was introduced into the British Isles, and, rightly regarded as a pest, is not accorded protection.

5.7 Locally, severe predation may jeopardise key populations and sub-populations, and as a result risk the depletion of diversity, which is a consideration of national and international importance.

5.8 In the absence of firm information, and accepting the need for balance (see 5.6 above), it is sometimes necessary to invoke the precautionary principle to ensure the survival of salmon populations or sub-populations.

Key Consideration 4: Local action to limit predation by piscivorous birds should be targeted on areas and periods of greatest salmonid vulnerability. The procedures for obtaining authorisation of local action should be enhanced

Key Consideration 5: Salmon Fishery Boards planning local action to reduce the impact of seal predation should consider consulting the Sea Mammal Research Unit.

5.9 Because many avian and mammalian predators are highly mobile, measures to offset or minimise salmon predation in rivers should be undertaken in a catchment context.

5.10 Research into non-lethal methods to mitigate serious predation by piscivorous birds should be pursued. In the interim, techniques of continuous human disturbance and deterrent shooting should remain available to provide point defence for critical life stages of threatened salmonid populations.

5.11 Non-lethal methods of mitigating seal predation should continue to be explored.

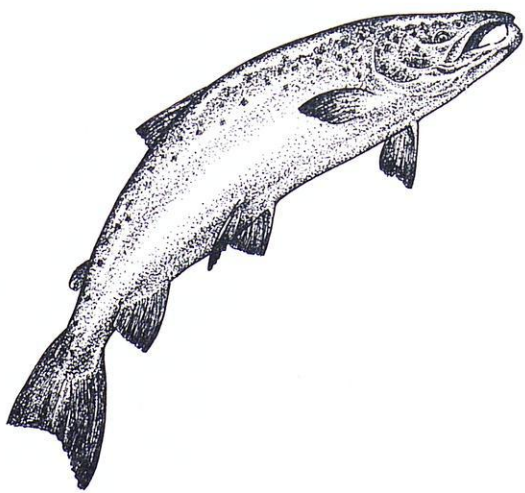
Key Consideration 6: Awareness of the research being done on immuno-contraceptive vaccines at Dalhousie University, Canada, should be sustained.

Key Consideration 7: Different types of scarers should be examined and, if necessary modified to enhance their efficacy against seals.

5.12 The Workshop discussed the merits of habitat restoration and concluded that measures to improve habitat for salmon were also likely to benefit its predators. However, this outcome was not seen as a reason for withholding improvements.

6. CONCLUSION

6.1 The Workshop acted as a catalyst, bringing together ornithologists, fishermen, fish biologists, zoologists, members of policy directorates etc. In doing so it enhanced mutual understanding and facilitated the exchange of information. It will have helped to trigger a desire to ensure that the demography of salmon stocks and the behaviour of predators are observed concurrently, and more comprehensively than in the past.



WORKSHOP PARTICIPANTS

Chairman:

Professor Fred Last OBE

Delegates:

Association of Salmon Fishery Boards/Association of West Coast Fishery Trusts	Mr Andrew Wallace
Atlantic Salmon Trust	Dr Derek Mills
Centre for Fisheries and Aquaculture Science	Mr Ian Russell
Countryside Council for Wales	Dr Siân Whitehead
Department of Agriculture, Northern Ireland	Dr Gersham Kennedy
English Nature/Joint Nature Conservation Cttee	Mr John Holmes
Environment Agency	Dr Mark Diamond
Fisheries Research Services	Dr John Armstrong
Institute for Terrestrial Ecology	Dr Dave Carss
Marine Institute (Ireland)	Mr Ger Rogan
North Atlantic Salmon Conservation Organisation	Dr Peter Hutchinson
Royal Society for the Protection of Birds	Dr Andy Tharme
Scottish Agricultural Science Agency	Dr Gill Hartley
Salmon Net Fishing Association of Scotland	Mr Robert Ritchie
Scottish Natural Heritage	Dr Colin Galbraith
	Dr Willie Duncan
Scottish Executive Rural Affairs Department	Mr George Thomson
	Mr David Dunkley
	Ms Diane McLafferty
Scottish SPCA	Mr Michael Flynn
Scottish Wildlife Trust	Mr Peter Pollard
Sea Mammal Research Unit	Mr Callan Duck

Other Invited Participants:

Dr Paul Thompson (Aberdeen University – Cromarty Field Station)
Mr William Shearer (Consultant – Salmon Net Fishing Association)

Rapporteur:

Mr Tim Hoggarth (Deputy Director, Atlantic Salmon Trust)

Atlantic Salmon Trust Members in attendance:

Colonel Bill Bewsher (Chairman)
Mr Jeremy Read (Director)
Mr John Webb (Field and Research Biologist)

ATLANTIC SALMON TRUST PUBLICATIONS

The Biology of the Sea Trout (Summary of a Symposium held at Plas Menai, 24-26 October 1984)	E.D. Le Cren
Salmon Stocks: A Genetic Perspective	N.P. Wilkins
Salmonid Enhancement in North America	D.J. Solomon
Salmon in Iceland	Thor Gudjonsson & D. Mills
Atlantic Salmon Facts *(Revised May 2003 by R.G.J. Shelton & J.B.D. Read)*	D. Mills, G. Hadoke
The Atlantic Salmon in Spain	C.G. de Leaniz, A.D. Hawkins, D. Hay & J.J. Martinez
Salmon in Norway	L. Hansen & G. Bielby
The Automatic Counter – a Tool for the Management of Salmon Fisheries (Report of a Workshop held at Montrose, 15-16 September 1987)	A. Holden
A Review of Irish Salmon and Salmon Fisheries	K. Vickers
Water Schemes – Safeguarding of Fisheries (Report of Lancaster Workshop)	J. Gregory
Genetics and the Management of the Atlantic Salmon	T. Cross
Fish Movement in Relation to Freshwater Flow and Quality	N.J. Milner
Acidification of Freshwaters: The Threat and its Mitigation	R. North
Strategies for the Rehabilitation of Salmon Rivers (Proceedings of a joint Conference held at the Linnean Society in November 1990)	D. H. Mills
Salmon Fisheries in Scotland	R. Williamson
The Measurement and Evaluation of the Exploitation of Atlantic Salmon	D.J. Solomon & E.C.E. Potter

Surveying and Tracking Salmon in the Sea	E.C.E. Potter & A. Moore	
Automatic Salmon Counting Technologies - a Contemporary Review	G.A. Fewings	
Salmon in the Dee Catchment: The Scientific Basis forManagement (Proceedings of a one day meeting held at_ Glen Tanar House, 13 October 1994)	A. Youngson	
Spring Salmon	A. Youngson	
Enhancement of Spring Salmon (Proceedings of a one day Conference held at the Linnean Society of London 26 January 1996)	edited by D. H. Mills	
Water Quality for Salmon and Trout (second, revised edition)	J. Solbé	
Salmon Fisheries in England & Wales	W. Ayton	
The Industrial Fishery for Sandeels	A.D. Hawkins J. Christie & K. Coull	
Habitat Restoration for Atlantic Salmon	D.W.J. Smart	
The Interpretation of Rod & Net Catch Data (Proceedings of a Workshop held at the Centre for Environment, Fisheries & Aquaculture Science, Lowestoft November 2001)	edited by R.G.J. Shelton	
Predation of Migratory Salmonids (Assessment of a Workshop held in Edinburgh on 11-12 April 2000, made by the Chairman, Professor Fred Last OBE)		
Hardback: **Salmon in the Sea and New Enhancement Strategies** (Proceedings of the 4th International Atlantic Salmon Symposium, St. Andrews, New Brunswick, June 1992)	edited by D. Mills	£30.00

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