

In search of seal-friendly salmon farming

Seal interactions with salmonid farms: case studies and interim conclusions, October 2009

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Introduction

Over the past 25 years or so, fin fish farms, mainly producing salmon, have become a familiar feature of much of the inshore coastline of Scotland, including the western Highlands and Islands, Orkney and Shetland, and also the west coast of Ireland. In many cases the farms – before the days of planning consent or mandatory environmental impact assessment - were situated within or close to coastal habitat for seals, particularly the common or harbour seal, *Phoca vitulina*, which typically hauls out on inshore tidal ledges or estuarine sandbanks. Colonies of grey seals, *Halichoerus grypus*, typically occur further offshore and may thus be less directly affected by fish farms, but foraging grey seals may discover a farm and be attracted to its fish stock.

This proximity of farms to naturally occurring seal colonies and to seal inshore foraging habitat has, in many cases, resulted in conflict between fish farms and seals. Fish farm stock attracts seals, which may attempt to prey on fish and obtain access through the cage netting. The damage includes stress to the fish, damaged fish attacked through an intact net, holes torn in the net by seals and escaped fish through torn nets. Fish farms have responded to this situation often by attempting to remove seals from their vicinity, by shooting, harassment or other methods. Because of the large numbers of farms involved (around 300, mostly in the west of Scotland, Orkney and Shetland), much of the coastal habitat for common seals is presumed to have been degraded or become uninhabited by common seals, although there is little hard evidence for this.

In recent years a marked decline of common seals counted during the August moulting period was reported for Orkney and Shetland of approximately 42% (CI 10%–62%) between 2001 and 2006 (SCOS, 2008), as well as declines in Strathclyde and the east coast of Scotland. Thus there is considerable concern over the conservation status of common seals in Scotland, as well as public concern over the ethical issues involved in killing seals of either species or displacing them from their habitat. These issues are currently being revisited by the Scottish Parliament in the context of the forthcoming Marine Bill, in which the 1970 Conservation of Seals Act (which permits unlicensed shooting of seals) will be replaced by a more regulated licensing system. In the proposals for the Conservation of Seals section of the Scottish Marine Bill, fish farmers would, for the first time, have to apply for a ‘Seal Management’ licence to shoot seals, demonstrate a need to shoot seals, and record and report the number and species of seals shot. The new licensing system will involve the use of a Permitted/Potential Biological Removal (PBR), which provides a maximum number of seals that can be removed without affecting the wider population. The PBR will take into account differences in the size of the grey and common seal populations and between regional seal populations.¹

The present study is intended to provide some updated information for policy makers in connection with the perceived need of the fish farm industry to kill seals or displace them from inshore habitat. Owing to the past lack of government regulation of this aspect of the industry, there has been little data collected, either qualitatively or quantitatively, on interactions between seals and fish farms.

¹ <http://www.scotland.gov.uk/Topics/Environment/16440/marine-bill-consultation/Seals>

Ross (1988) sent out 121 questionnaires in 1987, and received 51 returns from Scottish marine salmon farms. She found that shooting of seals occurred at 64% of salmon farm sites, and the estimated total number of seals shot at 30 farms in one year was 206 (i.e. an average of 4.4 seals per farm of 47 farms interviewed). Tangling in un-tensioned anti-predator nets was reported at 32 (68%) of 47 sites visited, with an estimate of 113 seals killed in this way (i.e. an average of 2.4 seals per site interviewed). Total annual mortalities by shooting and entanglement for 157 marine farm sites active at the time were therefore estimated at about 1050 seals. In addition, the study found that some operators, particularly the large companies, adopted a seal control policy of 'unsettling' seals in the area (by chasing with a fast boat) with the aim of moving them away. Displacement of seals at farm sites also occurred due to human presence, noise, construction, boat traffic etc.

A more recent study (Quick et al., 2002) involved a questionnaire being sent to 376 recorded marine salmon farm sites in Scotland. Returns were received from 195 sites (52%). These authors found that shooting of predators (including seals) was used as a method of predator control at 49% of sites, with 45 of 73 site managers stating that this was a 'very effective' means of control. The Scottish Salmon Producers' Organisation (SSPO) recently announced a total figure of 489 seals reported to have been shot by their member farms in 2008, i.e. an average of 2.3 seals shot per farm assuming c.214 farm sites currently under the SSPO umbrella. This is about half the shooting rate suggested by the 1988 survey.

For the present study it was decided to begin with a questionnaire survey similar to that used by Ross (1988) and Quick et al. (2002), but to focus specifically on seals.

Methods

The survey was discussed with a senior representative of the Scottish Salmon Producers' Association (SSPO) in late May, who made initial contact with SSPO company managers regarding the survey. During the week beginning 15 June 2009 the questionnaire was sent from Tara Seal Research by 1st class post, with 1st class SAEs, to fish farm companies. Each company belonging to SSPO was first contacted by phone and then sent a package containing a copy of the survey with an SAE for each farm. The Marine Harvest office provided addresses for individual farm managers, who were therefore sent the survey directly. Altogether the survey was distributed to SSPO companies covering 214 farm sites. The survey was also sent to 89 sites in Scotland listed for non-SSPO farms, and to 34 Irish marine salmon farm sites. During July, follow-up phone calls were made, or emails sent, to farms which had not responded to the postal survey. On-site or telephone interviews were made in August with four non-SSPO site managers and one SSPO site manager.

Results

Response to questionnaire

The initial response to the survey was very poor. None of the SSPO companies contacted by Tara Seal Research was willing to participate in the survey. Two postal replies were received from non-SSPO companies and two from Irish farm sites. Follow-up phone calls and emails from Tara Seal Research in July revealed that 15 of the 89 non-SSPO sites were fresh-water hatcheries or smolt sites, and a further 35 had either closed or changed hands. Of the 34 Irish sites contacted, 5 were fresh water sites and 18 had either closed or were unobtainable. Follow-up telephone contact resulted in on-site visits and/or telephone interviews with five farm sites in Scotland, including four from non-SSPO companies and one farm site which was part of an SSPO company.

Summary of feedback from farms

Five of the seven farms responding suffered some degree of attack from seals. None of the seven farms contacted shoot seals.

Both of the two farms (A & D) which did not suffer attacks occurred in the vicinity of seal habitat, both identifying grey seals as being locally present. Both farms have relatively low stocking densities (A - up to 8 kg/cu m and D - 10–12 kg/cu m). A does not use anti-predator nets, but uses an ADD, on intermittently day and night. D uses anti-predator nets, which it considers to be totally effective.

Of the other five farms, one (E) suffered only occasional attacks. E uses neither anti-predator nets nor an ADD, but uses a well tensioned, cone-shaped cage net and low stocking density (10 kg/cu m). Common seals haul out locally and are believed to be the culprits of attacks. The seals take live fish by pushing the net in. They do not take dead fish at the bottom of the cage.

One farm (B) had occasional attacks in the past, but regular and severe attacks in 2009. However, B usually has a high stocking density (21 kg/cu m) and was not using any form of deterrent until installing an AHD early in the summer of 2009, since when this farm has ceased to have any seal problems. The farm is located close to common seal habitat, but the species attacking the farm is not known. The attacking seals did target the 'dead fish' basket at the bottom of the cage.

The other three farms (C, F & G) which suffered frequent or severe attacks are all in the vicinity of seal habitat, although the species attacking was not known in any of the cases. One farm (C) uses a low stocking density (8 kg/cu m) and tensioned anti-predator nets a metre from the sides and 2–3m from the bottom, but the seals are apparently able to bite through these nets and thus reach the cage nets.

Discussion

Despite this small sample of farm managers returning the questionnaire, the overwhelming consensus of the respondents in Scotland is that there is no need to shoot seals as a method of controlling seal attacks on fin fish farms in the marine coastal environment. The environmental awareness and seal-friendly attitude of all interviewees was evident.

The two farms that stated expressly that they did not have a problem (farms A & D) used either an acoustic deterrent (ADD) or a carefully designed and well maintained anti-predator net system. Both of the two farms interviewed that did have problems (B & C) – the problem not yet solved in the case of C – emphasised the futility of shooting seals in the vicinity of a farm in order to dispatch a ‘rogue’ seal, since many seals would have to be shot, and even if the rogue seal was correctly targeted, it would quickly be replaced by another seal. Indeed, this conclusion was reached in the first questionnaire study (Ross, 1988), and a similar conclusion was reached in a study involving experimental shooting of grey seals targeting salmon traps in the Baltic (Sand and Westerberg, 1997).

Some intractable problems were noted in the questionnaires and interviews, particularly in the case of farm C, which has tried anti-predator nets to no avail. This farm has not as yet tried ADD, however, and might perhaps consider doing so if the problem persists. The current possible development of a species-specific ADD (which should not have an adverse effect on cetaceans; A. Knight, pers. comm.) could be a major step in the solution to continuing problems of seal predation.

It was apparent from some interviews that the species of attacking seal was not known. Some inconsistency in reporting of the behaviour of attacking seals may be attributable to different behaviour of grey and common seals. For example, the reported behaviour of the attacking seals in B and C (seals unafraid of man, persistent attacks and biting through nets, targeting dead fish at bottom of cage) differed from the behaviour described by farm E of seals believed to be local common seals (targeting live fish by pushing through the cage net, not tearing holes in the mesh, not targeting dead fish at the bottom of the cage).

Grey seals appear to be the more opportunistic of the two species and will adapt their foraging behaviour very rapidly to avail of new opportunities, including ready acceptance of dead fish or scraps discarded by fishing boats, etc. Seals seen in harbours foraging on fishing boat discards are almost always grey seals *Halichoerus grypus*². Grey seals, particularly adult males, are also larger, stronger animals than common seals and appear to be less deterred by human presence. Studies of grey seals attacking salmon traps in the Swedish Baltic sea suggested that adult male grey seals are less shy of humans and expose themselves more than female and juvenile grey seals (Sand and Westerberg, 1997), and may be the most bold and persistent fish farm offenders.

² Although these seals are sometimes called ‘harbour seals’ because they hang around harbours, they are a different species from the true harbour (common) seal *Phoca vitulina*.

Common seals, so far as is known, are much less likely to acquire foraging strategies which involve them eating prey they have not caught and killed themselves. This would be consistent with the report from farm E that the common seals occasionally raiding their farm do not target dead fish at the bottom of the cage net and may be less persistent or successful in tearing holes in the nets – although common seals in the Baltic may tear holes in fyke nets to reach live eels in the traps (Konigson, 2007).

Two farms (D & E) emphasised that fish (especially pollack and mackerel) abound in the sheltered area between the cage moorings and the cage itself, and that in some cases seals are attracted to this source of fish rather than the caged fish. Some farms (A, D & E) were of the opinion that low stocking density helps to make the caged stock less attractive to seals. Farm A has a stocking density of only 8 kg/cu m, and thinks that because the fish are not crowded against the sides of the cage, they cannot be reached by seals pushing at the cage sides. Another farm (not participating in the present study), recently reduced its stocking density to 15 kg/cu m to achieve the RSPCA Freedom Food standard, and also felt that the lower stocking density made the fish stock less attractive to seals (A. Knight, personal communication).

The results of this very limited study were very encouraging for the future of the fin fish aquaculture industry in that it seems feasible for fin fish farms to co-exist harmoniously with seals where the will to take appropriate measures is present. These measures seem to include, either singly or in combination, (1) reducing stocking density, (2) using well designed and maintained anti-predator nets, and (3) using ADDs. One very clear problem of the law in Scotland continuing to permit shooting as a method of controlling seal predation at fish farms is the difficulty experienced by some farms in identifying the species of seal attacking the cages. A fish farmer permitted by law to shoot a quota of seals hauling out nearby in the hope of eliminating the culprit attacking his farm might target local common seal haul-out groups, even if the actual attacker was a grey seal. Since some common seal populations in Scotland, particularly in Orkney and Shetland, are undergoing serious declines, it is essential that such lethal measures would be curbed under new legislation.

We realise that this result may be an over-simplification, due to the small sample of farm respondents to the survey and we look forward in the immediate future to obtaining more interviews and opinions from fish farms not yet participating, and working with the industry to address the more difficult problems. The search for non-lethal and environmentally friendly predator control systems at marine fish farms requires cooperation, trust and transparency between the fish farm industry, scientists and animal protection interests. We hope this study may contribute a small step in this direction, and that this report will be considered as an interim report of an ongoing study.

Recommendations

1. Continue and expand the present study with modified questionnaire and interviews. Develop a database, frequently updated, to store and collate data obtained. Individual companies and farm sites would remain anonymous unless they wish to be identified.

2. Set up a study watch with photography at some farms (such as C) suffering repeated attacks in order to identify the species of attacker, number of animals involved, and any individually identifying features. Such studies could be ideal for short student projects, and, if coordinated, could make a significant contribution to clarifying issues and problems and developing creative and non-lethal solutions.
3. Set up trials of low stocking densities (c. 8 kg/cu m) at farms currently subject to repeated seal attacks. The trials would require a good quantitative baseline data of types and severity of seal attacks and seal species involved. Low stocking densities could be trialled with cages with no anti-predator nets and no ADDs, or with one or other additional deterrent.

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Case studies

Farms in Scotland (A–E)

- A. (Questionnaire returned and telephone interview) Lewis Salmon Ltd., Stornoway, Isle of Lewis. Organic farm.
1. **Seal problems:** No.
 2. **Seals haul-out site locally?** There are a few grey seals hauled out locally
 3. **Anti-predator nets?** Not used. They used to use them when they used old wooden cages, but stopped when they went over to circular plastic cages. The cage nets are tensioned – 16 weights on nets. Divers check nets every two months.
 4. **Mesh size:** Cage net mesh is 15mm.
 5. **Other deterrents tried?** Terrecos seal scarer, on hire; on intermittently day & night; one covers all 6 cages of farm. Seems to be successful. Has been in for about 5 years.
 6. **Stocking density:** Maximum is 8kg/cu.m. Fish grow better at low stocking density, and less attractive to seals – fish not up against the sides of cage, so seals can't get at them.
 7. **Thoughts on seal shooting:** Should not be necessary and should not occur: fish farms should co-exist harmoniously with wildlife, including predators.
- B. (On-site interview)
1. **Seal problems:** Yes. Seals attack nets, bite holes in net and bite fish through net. Also take dead fish from collection basket at bottom of cage. Seal attack problem especially bad in 2009, with seals attacking one after another, even during harvesting. In 2006, 17% of fish losses were attributable to seals. In 2008, the figure was 5%, and in 2009 figure rose to 58%. Normally seals attack only one of group of cages, but this year attacked all cages in group. Seals would attack one after the other, especially during harvesting. Species of seal attacking not known. Seal problem usually (except this year) negligible compared with other problems. Lice is worst problem; also algal blooms.
 2. **Seals haul-out site locally?** Small inshore common seal haul-out site locally, c. 3 miles away. C. 12 seals noted at site on day of farm visit.
 3. **Anti-predator nets?** Used formerly, made from old salmon nets, but not successful. Seals made holes in nets and moved through to fish cages. Do use top net, but sometimes, if this is not fixed securely to cage, leaving gap, seals may leap into cage, feed and then leap out again.
 4. **Mesh size:** Cage net: 25mm

5. **Other deterrents tried?** Tried other scarers, such as orca sounds, with no success (or only very short-term). AHD installed in June (c. 5 weeks before interview); appears to have solved problem – no attack since AHD.
6. **Stocking density:** Usually 21kg/cu.m., but lower this year due to low oxygen levels and ISA.
7. **Thoughts on seal shooting:** ‘No decent salmon farmer wants to shoot seals’. No long-term benefit from shooting seals, since new individual would keep appearing. No way of identifying repeat ‘rogue’ seal offender – though formerly seal would brush against red anti-foulant paint and therefore be identifiable. In old days response to seal attack would have been to go and shoot 10-15 seals locally, but not in recent times.

C. (Questionnaire returned and on-site interview)

1. **Seal problems:** Yes, seal makes hole in predator net then goes in and out through the net to the cage, and bites or slashes fish through the cage net. In April/May lost 1,500 fish out of 6,000 in a cage, probably to one seal. Seal may make hole in cage as well. Estimated 30% of stock lost this year. Species of seal not known – both present. Sea lice remain a far bigger problem than seals.
2. **Seals haul-out site locally?** Not known.
3. **Anti-predator nets?** Use tensioned nets across top and anti-predator nets on all sides and at bottom. One metre from sides and 2-3 metres from bottom. Heavy fine mesh net doublers to the bottom panels of cages can help to deter seals.
4. **Mesh size:** Anti-predator nets: 50mm
5. **Other deterrents tried?** No
6. **Stocking density:** 7-8kg/cu metre each fish approximately 1 kg i.e. 8 fish/cu metre.
7. **Thoughts on seal shooting:** If it is unclear which seal is doing the damage, then it would be irresponsible of me to shoot those in the vicinity indiscriminately

D. (Questionnaire returned and on-site interview) Partly organic

1. **Seal problems:** Negligible since introduction of anti-predator nets. One site was targeted by greys before barrier net was installed and was very effective. Site close to harbour where grey seals are fed at factory site. Over Christmas period when factories shut down there is an increased risk from seal attack. Extra vigilance is carried during this period including increasing the distance between cage net and barrier net.

Seals may be seen in vicinity of sites because of richer fishing – Pollock and saithe around cages. Increased biodiversity around cage attracts seals

2. **Seals haul-out site locally?**

3. **Anti-predator nets?** Company policy is to carry out risk assessment of each site with the potential of seal attack/interaction. If there is an increased risk they will deploy secondary barrier nets (non-lethal predator nets). These nets are high visibility tensioned nets designed to create a barrier between stock and seals. Staff are also encouraged to identify and record seal movements around sites. Barrier nets cost £5,000 per cage. High visibility heavy duty polypropylene. Seal could chew through them but not in a short time. Distance from side of cage – 0.5 – 1metres from sides, 2 – 4 metres from bottom. Distance from side of cage may be increased when there is an increased risk from seal attacks.
4. **Mesh size:**
5. **Other deterrents tried?** Neither ADD nor other deterrents needed
6. **Stocking density:** 10–12 kg/cu.m.
7. **Thoughts on seal shooting:** Should not occur.

E. (Telephone interview) Organic farm

1. **Seal problems:** Farm occasionally suffers seal attacks. Seals actually bite fish through the net –push the net in. Seals do not make holes in the net, although if there is an existing tear, they may make the tear worse. Seals are more ‘aggressive’ in spring, but not especially worse this year. Seals just take live fish. They do not take dead fish collected at bottom of cage, Financial losses not really significant, but fish worth about £7-8 each, and if they take 5-10 fish a week, losses could run into thousands of ££. Seals attacking are common seals hauling out locally.
2. **Seals haul-out site locally?** Yes, common seals.
3. **Anti-predator nets?** Anti-predator nets not used, due to organic growth on the nets, and also cannot use anti-foulants. There is no top net either. The nets are about 1m from the surface, so seals can not leap in. However, otters can get in – they climb in, take one fish, then climb out with it and eat fish on the walkway!

The cage net is tensioned, so seal has to work hard to push it in. The net is cone-shaped. This means the surface area of the cage is much reduced.
4. **Mesh size:** 12-16mm
5. **Other deterrents tried?**
6. **Stocking density:** 10 kg/cu.m.
7. **Thoughts on seal shooting:** He has the impression that a seal in the vicinity of a farm maintains a feeding territory in that area. If you were to shoot one, another would appear. There are plenty of pollack and mackerel in the water around the fish cages – probably they are going more for that than the content of the cages. The only time they

have had to shoot a seal in the past is if it actually got into the cage. They have not shot any seal at the present farm.

Farms in Ireland (F–G)

F. (Questionnaire return) Organic farm

1. **Seal problems:** Yes. Consider 30 fish per pen to be an 'attack'. Can occur at any time, but especially during winter. Cost of seal attacks c. £50-70K per year, but £100K with labour included. Does not know species causing problem.
2. **Seals haul-out site locally?** Does not know.
3. **Anti-predator nets?** Yes. A few feet from cage sides and 1m from cage bottom.
4. **Mesh size:** 28mm
5. **Other deterrents tried?** ADDs, go off when seal attack occurs.
6. **Stocking density:**
7. **Thoughts on seal shooting:** Seals are not shot.

G. (Questionnaire return)

1. **Seal problems:** Yes, frequent attacks.
2. **Seals haul-out site locally?** Yes, c. 400m away. Common seals.
3. **Anti-predator nets?** No
4. **Mesh size:**
5. **Other deterrents tried?** New Iofitech ADD just installed. No results of success yet.
6. **Stocking density:**
7. **Thoughts on seal shooting:** Seals are not shot.