Behaviour of Seals around Fish Farms

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by

John Ace-Hopkins

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Summary

Interaction between seals and marine fish farms is inevitable. Seals are adaptable predators and fish farms represent a captive food source yet it is estimated that less than 1% of seals in Scotland regularly predate on farmed fish. Whatever the number, seal predation is not only financially damaging to this growing industry but is unacceptable from an animal welfare viewpoint. Hence it might be surprising that, as far as the author is aware, no publicly funded research has ever been undertaken into studying the behaviour of seals under these circumstances.

Although there are many anecdotal reports of how seals hunt farmed fish there is only one literature reference to a direct underwater observation of an attack. During its research programmes into better seal scarers Ace Aquatec has indirectly recorded scores of interactions between seals and farmed fish.

The data collected by Ace Aquatec is in accord with eyewitness accounts which gives confidence as to these findings.

Content

1. Introduction

Most pinnepeds – that is seals, sea-lions and walruses - eat fish as part of their natural diet and, when fish farming is locally available, inevitably add farmed fish to their menu. In temperate and sub-arctic latitudes fish farms coexist with pinnepeds and interaction is common-place.

Economically the effects of predation are high. Ross (1988) put the losses of the Scottish salmon industry at between £1.4 and 4.8 million pounds – between 1 and 5% of the (then) total revenue. The costs of sea mammal attacks is higher due to the stress that predator attacks induce in the fish which leads to poorer growth rates, lower immunity to disease and poorer quality fish (Nash *et al* (2000)).

It is the same story in all the major salmon growing regions: Norway, Chile, Canada, USA, Tasmania and New Zealand but, as far as the author knows, no publicly funded research has ever been undertaken to understand how pinnepeds predate on farmed fish. Consequently the secondary question – how best can we deal with the problem – cannot begin to be addressed.

2. Eye-witnesses

2.1 Common seals

Direct observations of seal attacks in the literature are rare. Tillapaugh (1991) reports an account from a diver who witnessed a common seal (*Phoca vitulina*) attacking a pen in Canada. *"The seal circled the netpen until the fish were frightened enough to charge the opposite side of the pen. The seal then dove under the pen and attacked the fish pushing against the side of the netpen. This procedure was repeated several times."*

Common seals rarely damage the growing net but grab a fish between their front paws, bite the abdomen of the fish and suck the guts through the mesh. The fish is then released to die sometime afterwards.

Eyewitnesses in Scotland have corroborated this story, however this is not the only reported method of hunting that common seals employ. When nets are loosely tensioned farm workers have also reported that common seals can manipulate the growing net into a pocket directly, so entrapping a fish that swam too close.

2.2 Grey Seals

Grey seals (*Halichoerus grypus*) are much larger animals (males weigh 250kg), in Scottish waters are more numerous than common seals but are thought to be responsible for less damage. One exception to this rule is in Orkney where greys are vastly in superior numbers. Few eyewitness reports exist as to how Grey seals attack farmed fish but one eyewitness account suggests that the animal has invented at least two other methods.

Orkney waters are characterised by their fast tidal waters that some Grey seals have learned to exploit to their advantage. In strong tides the growing nets become distorted and the fish inevitably swim closer to the nets than they would otherwise do. The Grey seal hooks itself onto the upstream side of the net and waits for a salmon to come too close. When the seal judges the fish is within range he increases his drag by letting go with his back flippers (becoming more upright) and using this impetus coupled with his strength to make the growing net into a pocket to entrap the fish. At one farm the waters are sufficiently clear to regularly witness several animals riding the nets in this fashion.

At least one Grey seal developed another hunting technique. Grey Seals are true seals in that their front flippers are not articulated to raise themselves when on dry land. True seals shuffle along on their stomachs whereas eared seals use all four limbs for locomotion on land. Consequently a true seal cannot raise its upper body to climb over obstacles. Or can it? The basic architecture of a circular growing pen is as follows: the growing net is suspended from the handrail which is held approximately 3 foot above the water by uprights attached to one or more floatation rings. Also attached to the handrail is a top net which prevents diving birds from entering the pen. Apparently one Grey Seal was able to "climb" the 3 feet to the handrail and squeeze between the two nets and thus swim with the fish. No one witnessed his entry but did witness his exit (on three occasions). The animal was seen to swim

at speed to the exit point, use his impetus to leap from the water, rotate and arch its back in the manner of a human high jumper (the Frisbee flop) and landing in the sea in one fluid movement.

2.3 Southern Sea lion

In Chile the main predator is the Southern Sea lion (*Otaria flavescens*). This animal outweighs Common and Grey seals many-fold (a fully grown male reaches 350kg), hunts in groups and is known locally as lobo or the sea-wolf.

They seem to use similar techniques to Common seals (crowding the fish and cupping the nets) but their much greater power means that nets torn by lobos is quite common. Whether this is accidental or deliberate is not known but lobos swimming inside the growing pens is frequently commented upon. These animals could, due to their articulated forearms, easily climb the nets but the author has not heard any report that suggests this to have been "discovered" by lobos.

2.4 Common strategy

Fish respond to stress by losing their appetite, become easier to panic but slower to respond. Therefore it is not surprising that all predating seals and sea lions target only one or two pens on a farm and by continually stressing the fish the seal reduces its effort to get the same food-reward.

It would appear that this wasteful, unnatural behaviour is learned by very few individuals. In 1999 it was estimated that the Scottish Grey seal population was 125,000 and the common seal population 29,000. Scotland produces some 40 million farmed salmon annually. Between 2 and 10%[♦] are lost to seals which represents between 1 and 4 million individuals. Tillapaugh (1991) estimates that the common seal would have to eat 45 fish per night from which we can calculate that this loss can be attributed to between 50 and 250 seals should they feed exclusively on farmed salmon. Predation is more pronounced in the winter than in the summer but even if we were to multiply the number of seals by five-fold **less than 1 in every 100 seals regularly predate on farmed salmon**.

3. Ace Aquatec's research

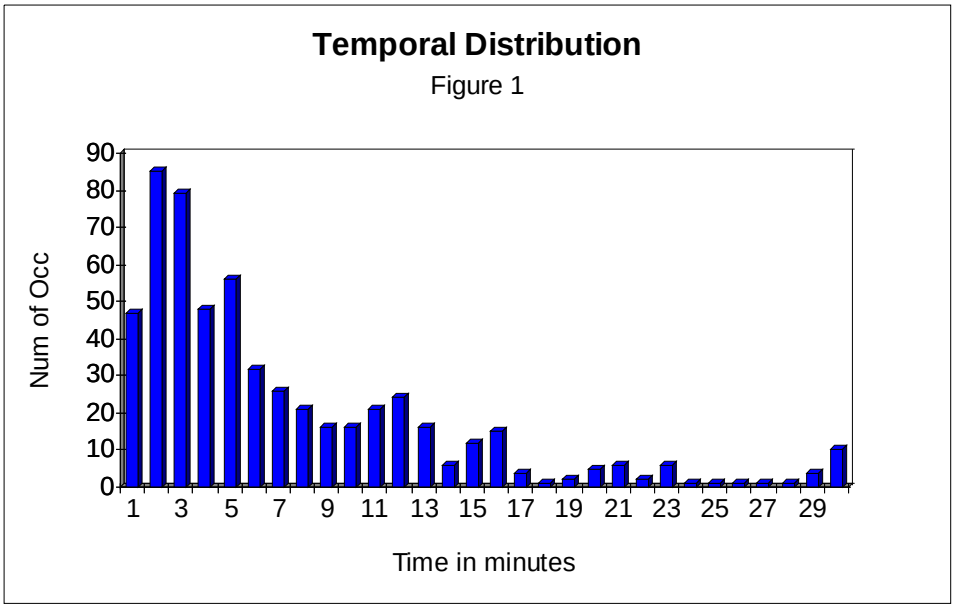
Since December 2000 Ace Aquatec has been conducting proving trials of triggered seal scares. One of the spin-offs of this research is that it offers us some insights into the behaviour of predating seals. Ace Aquatec Silent Scrammers rely on information collected from the fish themselves. The Trigger Device sits within the growing pen with the fish, which normally swim around it. When panicked however they collide with the Trigger Device which detects and telemeters this information to the scrammer. The proving trials are so designed as to collect the time and location of these events. Analysis of this information means that we can plot the time and position of panicking fish. Assuming that these triggering events relate to the predating seal means that we can begin to look at their behaviour and start to correlate this information with eyewitness accounts.

3.1 Clustering

Figure 1 is an example of the way detections are clustered in time. If detections were random, we would expect the graph to have a bell shaped distribution with a mean (in this case) of 8.24 minutes. Instead we see a shape that is more of a Poisson distribution indicating that detections are not random but have a relationship to one another. In other words detections are clustered in time because the predating seal is present and frightening the fish repeatedly. He then departs to forage elsewhere and subsequently returns. Although the statistics vary between trials predating seals spend between 5 and 10 minutes harassing the fish and return to the cages at intervals of between 20 and 30 minutes.

Predating seals constantly re-visit the site during the night, their peak activity varies from day to day but seems to only rarely coincide with dawn and dusk. It is probable that the seal attacks the fish when they are most lethargic and is less hampered by low light levels than one might expect of a visual hunter.

[♦] Seals will predate on fish of most sizes so the fish predated would be worth approximately half the harvest value.



3.2 Spatial Patterns of attack

There appears to be a difference between how seals attack small (12 to 15m cages) pens compared to large (20m+) pens. In small pens the seal appears to "tour" the farm. Figure 2 and 3 are examples of two successive tours separated by just under an hour. The arrows indicate the direction of the seal which starts at the top left in Figure 2 and departs in the same direction. The seal again re-appears from the top left in Figure 3 but subsequently departs from the centre right. In both cases the seal favours certain pens but the pattern is not identical. With such small pens it is feasible that the fish are panicked by the seal in more than one pen even though the seal is concentrating on one, however this would not explain the differences observed.

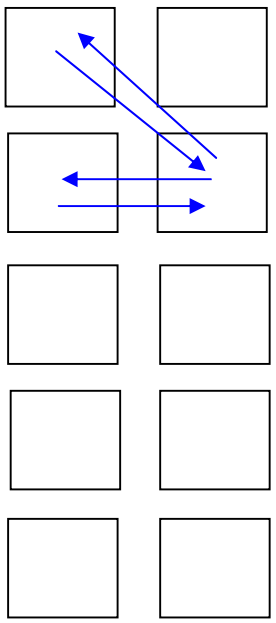


Figure 2

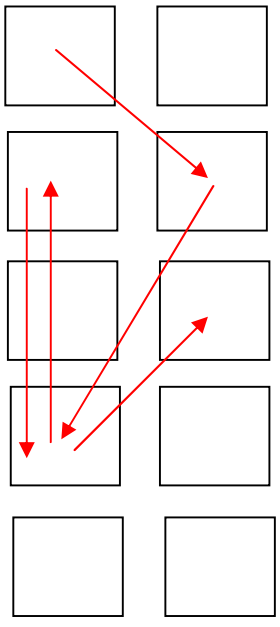
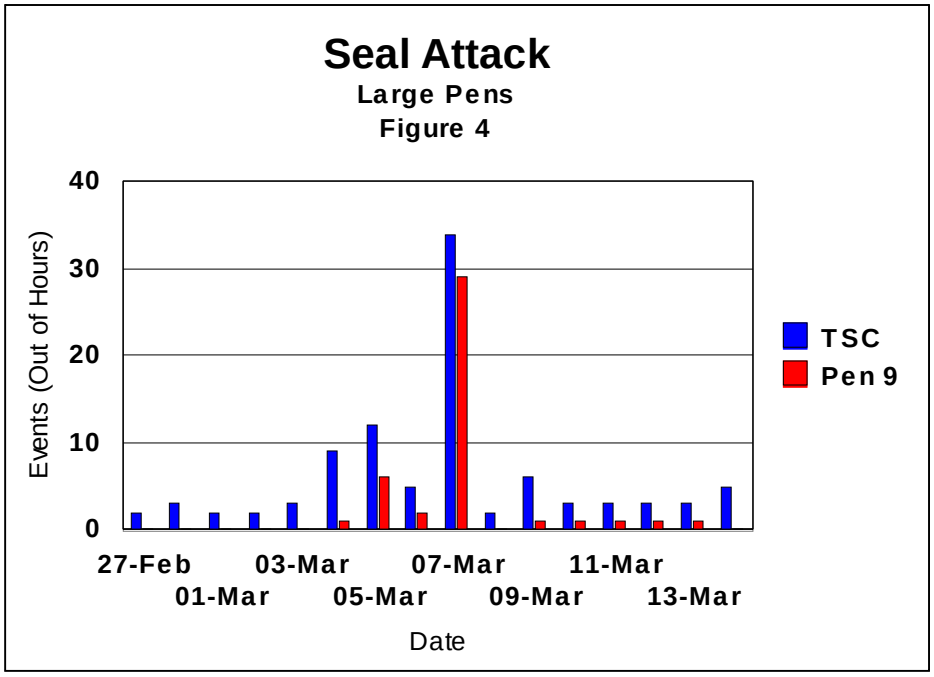


Figure 3

When cages are large the seal seems to concentrate on a single pen. An example of the is given in Figure 4. Prior to the 4th March Pen 9 had not had a detection. From that date to the 7th March Pen 9 was responsible for an increasing number of detections reaching a peak of some 90%. We can see in this case that the seal initially hunted around the farm and after 3 days zeroed into Pen 9. Fortunately he was unsuccessful which might explain the return of triggering events to their previous low level.



4. Hunting Success

Using Tillapaugh's figure of the dietary requirement of a common seal as 45 fish per night it would seem that the seal is not rewarded each time he scares the fish. Assuming that the seal hunts around the farm for 12 hours and visits the farm between 2 and 3 times an hour then each visit would have to yield 1 to 2 fish. Each visit however yields approximately 5 detections indicating several attempts for each food reward.

5. Conclusions

Our knowledge of how pinnepeds attack farmed fish is patchy relying on eyewitness accounts and indirect observations. It is therefore probable that we know only a fraction of behaviours indulged in by these adaptive creatures and so any conclusions are, at best, tentative.

The research results collected by Ace Aquatec would seem to be consistent with eyewitness accounts and so gives us confidence in the observations.

One consistent thread would seem to be that predating seals spend considerable time around the farm frightening the fish and that only repeated failure to obtain a food reward deters these animals.

Seals are adaptive creatures and seem to have evolved several methods of hunting depending on their attributes and the physical layout of the farm. How they evolved these methods is currently a mystery but, given their social nature, it is probable that seals copy successful strategies from others.

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