Seals, salmon and fishermen

Isla Graham, Rob Harris, James Butler & Iain McMyn.
Talk outline

• Introduction
  – Seal & salmon conservation, fisheries & conflict
  – Legislation
  – Moray Firth Seal Management Plan

• Research
  – ‘Rogue’ seals
  – Impact of seal predation
  – Non-lethal methods

• Stakeholder perceptions
Salmon and seals: Moray Firth natural resources

- 18 major rivers, 20 netting stations, 12 DSFBs
- £30 million from rod fisheries 2003
- Grey and harbour seals
- £2.34 million from tourism 1998
Conservation legislation

EU Habitats Directive

• Designation of Special Areas of Conservation (SACs) for species of European importance

• SACs must maintain ‘favourable conservation status’

• 6 rivers SACs for salmon in 1999

• Dornoch Firth SAC for harbour seals in 2000

Protected populations of seals & salmon coincide spatially
Moray Firth spring salmon catch

Salmon

SACs designated
Grey seal pup production at annually monitored UK breeding colonies

- Total production
- Outer Hebrides
- Orkney
- Inner Hebrides
- Isle of May, Fast Castle, Farnes, Donna Nook, Blakeney Pt, Horsey

Estimated pup production

Year
Moray Firth harbour seal decline

*University of Aberdeen and SMRU data*
Seal – salmon fishery conflict

Angus Woodward examines the ramifications of the ever-expanding seal population — probably the greatest predatory threat to the future of our salmon fisheries.

For much of the salmon season two questions are invariably asked as soon as a fish is landed. First, “Is it sea-liced?” And second, “Is it seal-marked?” In recent years an affirmative response to the latter question has become ever more prevalent, thanks to a relentless increase in Britain’s seal population. Numbers of grey seals (the larger species in our waters weighing up to 310 kilos) are expanding by between five and seven per cent per annum, and the latest figures from the Sea Mammal Research Unit estimate that the population reached 124,000 in 2000, with 90 per cent of them resident in Scotland. Counting the smaller common seals, which reach up to 130 kilos, is a much less exact science, but the minimum estimated size of the population in 2000 was 36,500, although it is readily acknowledged that this may be only two-thirds of the true total, 88 per cent of which are in Scottish waters.

Recent studies have indicated that Scotland’s seals consume more fish of all species than the total catch of commercial vessels — a sobering thought. Assuming a daily food intake of four kilos (about 9 lb) and 2.5 kilos (about 5 lb) for grey and common seals respectively, then, even if only one per cent of their diet consists of salmon, this equates to 2,142 tonnes — some 600,000 salmon and grilse. By way of comparison, the official 2000 catch in Scotland, for rods and nets, amounted to just over 100,000 salmon and grilse. And each year the problem is becoming more acute. The powerful sea-lion lobby has consistently used scurrilous data and theories to discount and even deny that seals prey on salmon. Three years ago a qualified marine biologist told an unpublished audience in Dingwall that the 400 or so seals in the Cromarty Firth did not eat salmon; he was adamant that they only rested in the firth, and that their hunting grounds were in open water 50 miles up the coast! He had no answer as to why these same seals frequently ventured into the River Conon, as far as the dam ten miles upstream. Indeed these marine mammals are increasingly common in northern river systems; they are even observed, often devouring salmon, at the mouth of the River Ochil at the southern end of Loch Ness by Fort Augustus, some 30 miles from the sea. So far as scientists are aware, common seals can live indefinitely in freshwater as they have no physiological requirement for saltwater.
Conservation of Seals Act 1970

- Permitted the shooting of seals for the protection of fisheries
- Close seasons for breeding and moulting:
  - Harbours: 1st June – 31st August
  - Greys: 1st September – 31st December
- DSFBs – licences during close seasons
- Section 9 ‘Netsman’s defence’ – shoot seals in the ‘vicinity’ of nets without licence
- Outside close seasons no returns of seals shot
- Conservation Orders – create 12-month close season
Watershed in 2002

• Harbour seal decline threatening SAC status

• **Shooting suspected as one cause** (Thompson et al. (2007) An Cons 10: 48-56)

• Salmon catches poor – DSFB bounty scheme in 1998-2002

• Recognition of economic value of fisheries and tourism

• PDV outbreak in 2002 – Conservation Order for harbour seals introduced

• Moray Firth Partnership and Seals Working Group

• Need for compromise and co-operation between seal, salmon and tourism interests to meet economic, conservation and statutory objectives
Moray Firth Seal Management Plan 2005

AIMS

1. Restore and maintain conservation status for Moray Firth salmon and seal SACs

2. Reduce impact of shooting on harbour seals

3. Reduce impact of seals on salmon stocks

4. Monitor and research seal and salmon interactions

5. Develop and implement non-lethal methods of reducing predation

Butler et al. (2008) Aq Cons 18: 1025-1038
Research
Main aims

To investigate:
1. whether or not ‘rogue’ seals are present in rivers
2. the use of non-lethal acoustic deterrent devices to exclude seals from rivers

Overarching aim:
3. the impact of seal predation on salmon stocks
Do rogue seals exist?

Graham et al. (2011) An Cons 14: 587-598
Moray Firth

• Managed as one area (for harbour seals) under new Conservation Order 2004

• Harbour seal Potential Biological Removal of 76

• Grey seals part of North Sea
Management focused on targeting problem individuals in rivers
Management Areas

- Cover all freshwater
- Avoid pupping sites
- Point defence at bottlenecks
- Locally flexible e.g. tourism
‘Problem’ individual removal – a management paradigm

• Linnell et al. (1999) proposed 2 types of problem individual:
  – Type 1: any individual in the wrong place
  – Type 2: an individual that kills more livestock/encounter than others

• Assumes only a small proportion of the individuals in the predator population are responsible

March 2005 – February 2008

- Kyle of Sutherland
- River Conon
- Cromarty Firth
- Findhorn
- River Ness
No shoot policy: 2005 & 2006

Conon

Kyle

Ness

Apr Jun Aug Oct Dec Feb
No shoot policy: 2005 & 2006

Conon

Kyle

Ness

Apr | Jun | Aug | Oct | Dec | Feb
<table>
<thead>
<tr>
<th></th>
<th>Ness</th>
<th>Conon</th>
<th>Kyle</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Harbour Seals</strong></td>
<td>10</td>
<td>8</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td><strong>Grey Seals</strong></td>
<td>8</td>
<td>4</td>
<td>6</td>
<td>18</td>
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On the basis of left-side images
≤ 1 % of local harbour seal population
& ≤ 1 % of the local grey seal population
Do some seals repeatedly use rivers?
Only seen once

40% of harbour seals
6% of grey seals

Seen in 2 or more years

28% of harbour seals

78% of grey seals

Not all seals visit rivers repeatedly
Individual grey seals were re-sighted more often than harbour seals.

Median number of captures per individual seal: harbours=2, greys=7; Wilcoxon’s test: $W=353.5$, $P=0.001$.

Frequency distribution of captures differed between species; Kolmogorov–Smirnov test: $D=0.547$, $P=0.004$. 
Most grey seals were seen in > 2 years. Most harbour seals were seen in only 1.

Longer period of time between the first and last sightings for greys than harbours; Wilcoxon’s test: $W=363.5$, $P<0.001$. Frequency distribution differed between species; Kolmogorov–Smirnov test: $D=0.57$, $P=0.002$. 
Do rogue seals exist?

For both species of seal:

- a small number of individuals, constituting only a small proportion of local population appeared to use rivers.
- More grey seals specialized in using rivers.

Suggests that problem individuals do exist.
Do seals in rivers eat (more) salmon?
Seal diet – for the ‘average seal’

Common and grey seal diet includes more than 50 different prey species. The contribution of each varies seasonally and regionally, although broadly speaking we can say:

<table>
<thead>
<tr>
<th></th>
<th>Scottish west coast</th>
<th>North Sea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey seals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandeels</td>
<td>(21,000)</td>
<td>(69,000)</td>
</tr>
<tr>
<td>Herring</td>
<td>(12,000)</td>
<td>(8,000)</td>
</tr>
<tr>
<td>Cod</td>
<td>(7,000)</td>
<td>(7,000)</td>
</tr>
<tr>
<td>Haddock</td>
<td>(7,000)</td>
<td>(7,000)</td>
</tr>
<tr>
<td>Ling</td>
<td>(4,000)</td>
<td>(5,000)</td>
</tr>
</tbody>
</table>

<p>| Common seals       |                     |           |
| Limited data available thought to be broadly similar to grey seal diet |
| Scottish west coast|                     | North Sea |
| Sandeels           |                     | (Sandeels) |
| Herring            |                     | (Herring) |
| White fish         |                     | (White fish) |
| Flatfish           |                     | (Flatfish) |
| Herring / Sprats   |                     | (Herring / Sprats) |
| Cephalopods        |                     | (Cephalopods) |</p>
<table>
<thead>
<tr>
<th></th>
<th>April-October</th>
<th>November-March</th>
</tr>
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<tbody>
<tr>
<td>Salmonid</td>
<td>5</td>
<td>92</td>
</tr>
<tr>
<td>Eel</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Flounder</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Unidentified</td>
<td>9</td>
<td>5</td>
</tr>
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</table>
### Presence of salmon and trout DNA in seal diet samples

<table>
<thead>
<tr>
<th></th>
<th>Riverine</th>
<th>Salmon</th>
<th>Trout</th>
</tr>
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<tbody>
<tr>
<td>Grey</td>
<td>Feb-Mar (2)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Feb-Mar (2)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Harbour</td>
<td>Apr-Sep (5)</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Total (%)</td>
<td>2 (22%)</td>
<td>4 (44%)</td>
<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th></th>
<th>Coastal</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Total (%)</td>
<td>12 (6.6%)</td>
<td>14 (7.7%)</td>
<td></td>
</tr>
</tbody>
</table>

**Riverine**: Feb-March (2) and April-September (5). **Coastal**: (182)
Do seals in rivers eat (more) salmon?

- Limited data but…
- Suggests that there are problem individuals that are more likely to consume salmonids
The problem with problem individual management

• Dependent on being able to define & identify problem individuals
• Dependent on having suitable, selective control methods

MFSMP defined problem individuals as any individuals using rivers, but

• Extent of river-use varied individually
• Conservation benefits of removing grey vs harbour seals
Impact of seal predation on salmon stocks
Potential Impact of Removing Seals

Estimated assuming that:

- Only harbour seals
- Eat nothing but adult salmon
- Not replaced by other seals
- All fish ‘saved’ are available to the fishery
- Exploitation rate of 15%

Impact of seals is greatest on small rivers

Modelled Impact of Removing One Harbour Seal
Potential increase in rod catch/stock caused by the removal of seals
Management Implications

Relieving seal predation may have greatest impact on:

• Spring salmon sub-stocks & fisheries.
• Small populations of salmon.

But….  Many assumptions & predictions are not quantitative.
Impact of seal predation on salmon stocks

Indirect impact (on fish stocks):

- Both species of seal in rivers (↑ impact)
- Winter peak in seal numbers suggests seals are targeting spawned adults salmonids (↓ impact)
- But in some rivers, winter peak coincides with spring salmon run

Direct impact (interference with fisheries):

- Impact of harbour seal peak in summer greater (than winter peak) as most fisheries are closed during winter
Grey seal – Hg011 back in the R.Conon on 24th November

Common seal – Pv009 back in the R.Conon 16th February
Harbour seal telemetry locations (Feb)

♀ caught in river

1♀ & 2♂ caught in firth
Management Implications

• Full understanding is rarely available
• Pragmatic approach based on best information available
• Diet & telemetry data insufficient for robust conclusion re: collective impact of problem seals in rivers
Management Implications

But, minimising the cost for seal conservation dictates that control should be targeted at individuals with greatest per capita impact.

Photo-id data provide strong evidence that controlling seals in rivers provides best per capita protection for salmon conservation & fisheries.
Non-lethal Methods
Acoustic Deterrent Device trials

- Lofitech Seal Scarer (approx 189dB/μP/m)
- North Esk: Jan-May 2006 (57 surveys)
- River Conon: Oct 2007-Feb 2008 (62 surveys)
- ADD switched on & off alternately
ADD had no effect on the abundance of seals in the survey area.
ADD reduced movement of seals upstream of ADD

Proportion of surveys with seals upstream of ADD

Management Implications

• ADDs may be partially effective as a barrier to seal movement upstream in some situations.
• Cost-benefit analysis is required
Fishery stakeholder perceptions

Questionnaire survey in 2006

‘Are seals impacting on salmon and sea trout stocks and catches…?’
‘Are a few ‘problem’ seals responsible…, or is it all seals?’
‘How should seal predation be controlled?’

- No control
- Non-lethal methods
- Shoot problem seals
- Population reduction

- Angler
- Ghillie
- Owners
Stakeholder perceptions

• Stakeholders estimated the direct cost of seal interference:
  – only 0.2% of total reported annual angler days were lost
  – an estimated cost of £14,960 annum\(^{-1}\)

• Research suggests little indirect impact of seal predation

• Yet, stakeholders’ perceive indirect impact of seal predation to be significant
Some things to think about...

• The place of lethal control in conflict management
• Stakeholder inclusion
• Managing predators & prey when both are of conservation concern
• Wider legal & management framework (eg potential impact of marine renewables on seals and salmon)
“To some extent conservation conflicts are unavoidable and our ambition should be to ensure that decisions are well informed, and made through transparent and participatory processes with acceptable compromise as much a goal as consensus.”

Linnell (2011) An Cons 14: 602-603
Harbour seals shot

Year

Conservation Orders

Unidentified
Grey
Harbour

Seals shot
0 100 200 300 400 500

Conservation Orders

Year

Unidentified
Grey
Harbour

Seals shot
0 100 200 300 400 500