Herring in the North Sea, Exploitation and Conservation

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Geographic Distribution of Atlantic and Pacific herring
Herring reproduction

Herring use external fertilization to produce masses of adhesive, benthic (bottom-oriented) eggs that develop on the ocean floor and then hatch into transparent larvae which join the plankton drifting on ocean currents and eddies.
Spawning grounds of autumn and spring spawning herring in the North Sea and adjacent waters. Circles denote location of spring spawning in fjords.
Schematic map of main hatching sites (dark shaded) and nursery areas (cross hatched) of NSAS herring. Spawning activity ranges from Aug/Sept to Jan/Feb and progresses from north to south.
North Sea herring. Contribution of each spawning component to the total stock, estimated from the SCAI index.
Schematic of assumed generalised migration patterns of North Sea herring, taken from Cushing and Bridger (1966) and Burd (1978).
The herring that return to inshore waters each spring to spawn also attract birds, whales and seals that feast on the energy-rich fish or their eggs.
Simplified food chain

- Shark (fish-eating fish)
- Cod (fish-eating fish)
- Herring (plankton-eating fish)
- Squid
- Anchovy (plankton-eating fish)
- Fish larvae (zooplankton)
- Conchs (zooplankton)
- Copepods (zooplankton)
- Diatoms (phytoplankton)
- Dinoflagellates (phytoplankton)
North Sea Autumn Spawners are exploited by a variety of fleets, ranging from small purse seiners to large freezer trawlers, of different nations (Norway, Denmark, Sweden, Germany, The Netherlands, Belgium, France, UK, Faroe Islands).
The majority of the fishery takes place in the Orkney-Shetland area and northern North Sea in the 2\textsuperscript{nd} and 3\textsuperscript{rd} quarters of the year, and in the English Channel in the 4\textsuperscript{th} quarter.
North Sea herring catches (landings + discards) from 1947 to 2016
The herring fishing ban 1977 - 1981

• 1970s collapse of the herring stock
  • High fishing pressure
  • Recruitment failure

• Management action not implemented in time
  • The stock exploited by at least 14 different nations
  • Necessary substantial catch reductions were not agreed.

• 1 January 1977 exclusive economic zones (EEZ) extended to 200 miles
  • British government was the first to declare a total ban on all directed herring catches.

• End of June 1977, all directed herring catches in the North Sea came to a halt.
• 1981 and 1982 a small TAC set for Southern North Sea and Channel.
• 1983 ban lifted in other areas of the North Sea

• Consequences of the ban
  • A large number of ship-owners went bankrupt
  • The lack of supply resulted in a change in consumer behaviour, the kipper became less popular.
  • Some vessels turned to mackerel and horse mackerel
  • the way was paved for a contemporary pelagic fishing fleet.
Economic effect of the ban on directed fishing for herring in the UK:
(a) value of the UK herring landings, exports, and imports (1976–1983; Wood and Hopper, 1984);
(b) kipper processing in Scotland (1965–1985; source: Scottish Sea fisheries statistics).
How is the fishery controlled?

**Total Allowable Commercial Catch (TACC)**
- the total amount of fish the commercial sector is allowed to catch each year

**Total Fish Stock**
- determined through stock assessment

**Total Allowable Catch (TAC)**
- the total quantity that can be sustainably taken each year

**Individual Quotas**
- individual commercial fishing enterprises purchase quota, which is the right to harvest for sale a proportion of the TACC

**Allowance for recreational and customary fishing**
Areas closed to fishing on herring and sprat
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How is the herring TAC determined?
Mathematical models require fish data

Sustainable Yield Curve

- When $E$ increases, sustainable yield increases because growth increases with decreases in stock size.
- Further increase of $E$ decreases yield because further decrease of stock size causes growth to fall.

Catch/Harvest

Low level of effort

Effort
Herring Acoustic surveys
2016 Heras Survey

Norway
Denmark
Germany
Netherlands
Ireland
Scotland

Last week of June
to
Third week of July
North Sea Autumn Spawners, age composition (1 to 8) based on the herring acoustic survey (HERAS).
We age herring by counting the number of rings in the fish otoliths.
Time series of landings (000 t), recruitment (billions of 1-year-olds), spawning stock biomass (000 t) and fishing mortality (percentage per year of ages 2 - 6) of herring in the North Sea.
Fisheries Management

Fisheries data
- Data poor: Catch and effort data over a number of years (10 or more)
- Data rich: age-structured catch and abundance

Stock Assessment
Fit models to data
Determine the state of the stock
Predict future stock trends for a range of management options
Scientific Advice
The Thames herring: a UK managed small stock
How the MSC works with fisheries, suppliers and retailers to encourage a more sustainable seafood market:

- Fisheries which meet the MSC standard are independently certified as sustainable.
- Retailers and restaurants choose MSC certified sustainable seafood.
- A traceable supply chain assures consumers that only seafood from an MSC certified fishery is sold with the MSC ecolabel.
- Consumers preferentially purchase seafood with the MSC ecolabel.
- Market demand for MSC certified seafood increases.
- More fisheries choose to improve their practices and volunteer to be assessed against the MSC standard.
Thames Estuary. Drift net area where the Thames herring TAC applies.
Thames herring, possible reasons for the collapse:

• The TAC (total allowable catch) could only be enforced in the driftnet area
  – While trawlers in the rest of the Thames Estuary could potentially exceed the TAC.

• Increased human activities in the Thames Estuary such as:
  • DREDGING
  • WIND FARMS
  • NUCLEAR POWER STATIONS

• Climate change?
Thank you!
• 2000 the fishery was MSC certified.
• 2005 the certification was renewed subject to annual audits.
• since 2002 drift net fishery landings < 2 tons.
• 2009 Scientific surveys were stopped.
• Fishery subsequently managed on the basis of the results from a sentinel fishery.
• 2010 MSC certificate withdrawn.
• Estimated stock biomass is well below precautionary limits.
• Thames Estuary closed for herring fishing since 2016.