Marine Mortality in Atlantic Salmon

Introduction

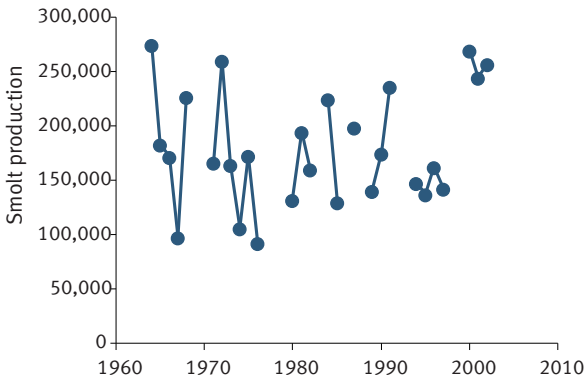
The life cycle of the salmon is unusually complex. Each adult fish that returns to river of origin has overcome all the difficulties associated with the wide range of environments it lives in, or pass through. These difficulties range from the freshwater streams in which the young fish spend the first two or three years of life, through coastal waters teeming with potential predators, to the distant northern oceans of West Greenland. Fish die in all these places, for a variety of reasons that are usually unknown.

In well-stocked streams, the number of smolts produced is limited mainly by the stream's size and habitat quality. These values tend to be constant year-by-year, and smolt production therefore tends to vary within correspondingly close limits. Marine mortality, acting after the smolt stage and before returning adults reach the coast, is observed to be the most important factor governing variation in the number of adult fish that return each year.

Marine Mortality Rates

Although the factors that cause marine mortality are unknown, their effect can be measured. Using purpose-built facilities on the River North Esk, operated by the Montrose Field Station of the FRS Freshwater Laboratory, estimates of mortality rate in the period after smolts leave the river and before they return to homewaters are attempted each year. Emigrating smolts are caught in a trap on Kinnaber lade, an off-take of the main river, and an estimate of the total number of smolts leaving the North Esk is derived from a mark-release-recapture experiment. Figure 1 shows the estimated values for smolt production for the years between 1964 and 2002. Overall, the estimates vary by about a factor of three. In some years, when wet weather and high waters impede the operation of the smolt trap, a reliable estimate of the smolt run cannot be obtained. This leads to the intermittent gaps in the sequence of values shown.

Figure 1



On their return, adult fish ascending the river are counted using the electronic fish-counter which spans the North Esk. Supporting information is obtained from intensive monitoring of the local fisheries in Montrose Bay. In particular, the sea-age composition of the returning adults is determined by reading scales from fish taken by the fisheries. Once this information is combined, the fish are assigned to their smolt year. The percentage marine mortality is then estimated as:

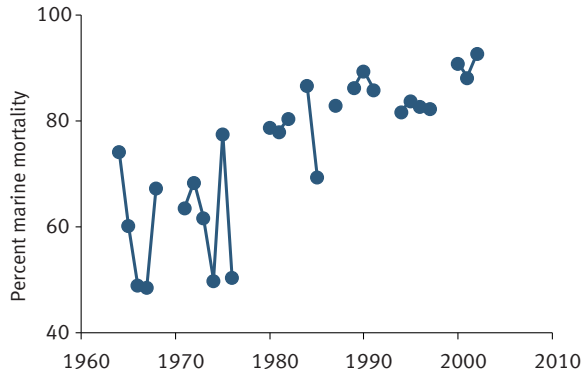
(1- the number of adults returning to the Scottish coast/ the original number of migrating smolts) x 100

This work began in 1964 and the annual estimates of marine mortality are shown in Figure 2.

Fisheries Research Services is an agency of the Scottish Executive
FRS Freshwater Laboratory Faskally Pitlochry Perthshire PH16 5LB UK
tel +44 (0)1796 472060 fax +44 (0)1796 473523
enquiries@marlab.ac.uk http://www.frs-scotland.gov.uk

Overall, the mortality estimates vary by a factor of about two. The most prominent feature of the figure is the marked upward trend in marine mortality rate over the period in which monitoring has been carried out.

Figure 2



The Effects of Rising Marine Mortality Rate

In former times, the overall limit on the size of the North Esk fisheries was probably the river's inherent capacity to produce smolts. In recent years, however, marine mortality has become the main control on the number of returning fish, the productivity of the fisheries and the number of fish that survive to spawn. These changes are not confined to the North Esk. Surveillance from around the North Atlantic indicates that rising marine mortality is a widespread feature of many fisheries in both Europe and North America.

The North Atlantic Salmon Conservation Organisation (NASCO) regulates fishing mortality in those few remote places where ocean fisheries exist. Although the feeding locations and transit routes of salmon are largely unexplored, it is known that the distribution of salmon in the ocean certainly extends far beyond these areas. The factors that affect the survival of salmon in these inaccessible places are a matter only for speculation and they cannot be managed by any practical means.

In order to ensure that the number of spawners remains sufficient to replenish fully the rivers with eggs, the effects of increasing marine mortality must be offset in other ways. It may prove possible to increase the smolt numbers that result from the lower number of eggs carried by the fewer returning fish. Hatchery work, for example, may be used to reduce mortality rates in the early stages of life or habitat improvement may be used to reduce competition and mortality among fry and parr. The main priority, however, must be to ensure that the runs of adults that evade the fisheries to spawn are sufficient to replenish fully the rivers with eggs. Smolt numbers will decline if egg deposition falls below critical levels, and declines in smolt production will lead to further reductions in the number of returning adults. Even now, the most affected locations show signs of approaching this critical situation.

Once they reach homewaters, salmon become relatively accessible and the main mortality factors can be identified and regulated as required. In addition, however, management in homewaters can compensate for the effects of changes in marine mortality rate. Thus, for example, mortality of adults due to fishing pressure can be regulated downwards before it becomes unsustainable by implementing catch-and-release or making other fishery regulations to ensure that sufficient numbers of fish are present at spawning time.

An expanding range of information, including information leaflets, reports and papers, is available from the library at:

FRS Freshwater Laboratory
Faskally, Pitlochry
Perthshire, PH16 5LB
Tel: 01796 472060
Fax: 01674 473523

FW26|02|06

Fisheries Research Services is an agency of the Scottish Executive
FRS Freshwater Laboratory Faskally Pitlochry Perthshire PH16 5LB UK
tel +44 (0)1796 472060 fax +44 (0)1796 473523
enquiries@marlab.ac.uk http://www.frs-scotland.gov.uk

Printed on Greencote Silk, a recycled paper