COARSE FISH IN SCOTLAND: A THREAT OR A RESOURCE?

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Introduction

Less attention has been given to research on coarse fish (defined as non-salmonid species) in Scotland as most government research has focussed on the economically valuable salmonids. Yet non-salmonid species are widely distributed in Scotland (Maitland 1972; Maitland & Campbell 1992) and play an important ecological role in freshwater ecosystems. The fish fauna of Scotland differs from other parts of the British Isles by being more impoverished following the end of the last Ice Age, ca. 10,000 years ago (Maitland 1977). This brief article summarises the ecological role of of non-salmonid fishes in Scottish fresh waters.

Coarse fish predation on salmonids

Mills (1964) estimated that 10% of the smolt run of salmon *{Salmo salar)* in the River Bran system, Ross-shire, was consumed by pike *(Esox lucius)* in Lochs Luichart, Achanalt, and a'Chuillin, in 1959 and 1961. This was based on population estimates of migrating smolts and adult pike in these lochs, together with the percentage occurrence of smolts in pike stomachs during the smolt run. Damage to trout fisheries is often common and pike are regularly netted or, in extreme cases, the loch is treated with a piscicide such as rotenone (Morrison 1987).

Competition between coarse fish and salmonids for food resources

Competition for food is difficult to validate as an overlap in dietary items does not necessarily imply competition. Campbell (1955) described the food of pike, trout *(Salmo trutta)* and perch *(Perca fluviatilis)* in Loch Tummel and found that common food items were only consumed in late spring. However, Maitland (1965) demonstrated considerable dietary overlap in salmon, trout, stone loach *(Noemacheilus barbatulus),* minnow *(Phoxinus phoxinus)* and three-spined stickleback *(Gasterosteus aculeatus)* in the River Endrick, and concluded that some competition was likely although its level could not be quantified.

Threats posed by introductions of coarse fish

Although only three species were added to the Scottish fish fauna between the end of the last glaciation and 1790, eight additional species were introduced by man in the last two centuries (Maitland 1977). The recent indiscriminate introductions of chub *(Leuciscus cephalus),* dace *(Leuciscus leuciscus)* and ruffe *(Gymnocephalus cernuus)* into Loch Lomond poses a threat to the native fish fauna (Adams et al. 1990; Adams & Maitland 1991; Adams & Tippett 1991; Adams & Mitchell 1992), and particularly threatens a unique population of the river lamprey *{Lampetra fluviatilis)* and powan *(Coregonus lavaretus).* For example, the ruffe population in Loch Lomond has increased and a main food item is the eggs of powan (Adams & Tippett 1991) (Fig.1). Recent introductions of pike, by anglers, may pose a threat to Arctic charr *(Salvelinus alpinus)* in shallow lochs (R. Greer, pers. comm.). It is thought that the two species can co-exist in deep lochs where there is spatial separation of the species, e.g. Loch Insch and Loch Luichart, Inverness-shire.

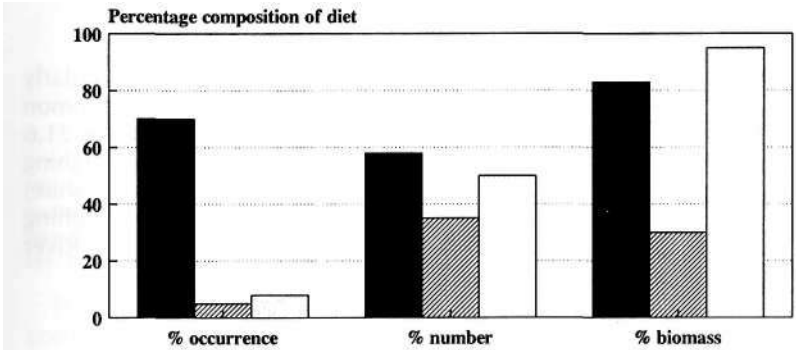

FIG. 1. The contribution of powan eggs to the diet of ruffe (solid bars), brown trout (hatched bars) and powan (stippled bars) in Loch Lomond. The frequency of occurrence, numbers and biomass of eggs are expressed as percentages of the total stomach contents of the three species of fish. Redrawn from Adams & Tippett 1991.

Predation on waterfowl

It has been suggested that the rarity of certain waterfowl in the Scottish Highland lochs is due to predation by pike on ducklings. For example the chicks of mallard *(Anas platyrhynchos),* teal (Anas *crecca)* and great crested grebe *(Podiceps cristatus)* occurred in 7% of the stomachs of pike above 45 cm in length, taken from Lochs Kinord and Davan, north-east Scotland, in June and July (Treasurer 1980).

Predation by salmonids, waterfowl and mammals

Small coarse fish such as minnows and sticklebacks are eaten by salmonids and piscivorous birds, for example cormorants *(Phalacrocorax carbo),* grebes (family Podicipitidae) and mergansers *(Mergus senator)* (Mills 1962, 1965). These and other coarse fish, particularly eels *(Anguilla anguilla),* are also important as food for otters *(Lutra lutra)* and mink *(Mustela vison)* (Jenkins & Harper 1980).

Fish as indicators of changing water qualify

As lakes become progressively eutrophic, fish faunas change from coregonid and salmonid species to percids and ultimately cyprinids (Hartmann & Numann 1977). An example is Loch Leven, Kinross. This originally held Arctic charr but the population became extinct in the 19th century and the famous brown trout fishery of Loch Leven is now threatened by eutrophication (Maitland 1992). Eventually only a coarse fishery may be viable unless attempts are made to improve water quality.

Coarse sport fisheries

There is a potential for developing coarse fisheries for sport, particularly as angling pressure mounts on salmonid stocks. Large pike are common in Loch Lomond, where a fish weighing 47 pounds 11 ounces (ca. 21.6 kg) was caught in the island area due west of Balloch. A chub weighing 10 lbs 8 oz (ca. 4.8 kg) was taken from the River Annan, Dumfriess-shire, and a disputed record grayling *(Thymallus thymallus)* weighing 7 lbs 2 oz (ca. 3.2 kg) was taken from the Melgum tributary of the River Isla, Tayside (Dyson 1985).

Commercial coarse fisheries

Commercial, largely occasional, fisheries for eels exist throughout Scotland, and fisheries for pike and other species are expanding, particularly in the Highlands.

Opportunities for further research

The low species diversity in fish communities in Scotland presents opportunities to examine the population dynamics of non-salmonid species in relatively simple communities or assemblages of fish (e.g. Treasurer et al. 1992). As some species are near the northern limit of their distribution, there may be differences in life history strategies. For example, Mann et al. (1984) presented data showing that there may be

reduced reproductive investment by gudgeon *{Gobio gobio)* in the River Don, Aberdeenshire, compared with populations of gudgeon in the River Frome, Dorset. On maturation the maximum weight of pike ovaries (expressed as the gonadosomatic index: gonad weight as a percentage of body weight) in three lochs in north-east Scotland was only 7-9% of body weight (Fig. 2) (Treasurer 1990). This is approximately half the values obtained from pike in southern waters, e.g. Slapton Ley (Bregazzi & Kennedy 1980), the River Stour, Dorset (Mann 1976) and Windermere (Kipling & Frost 1969). Relative fecundity, i.e. the number of eggs per gram body weight, was also low, as was testes weight, half that of pike in England.

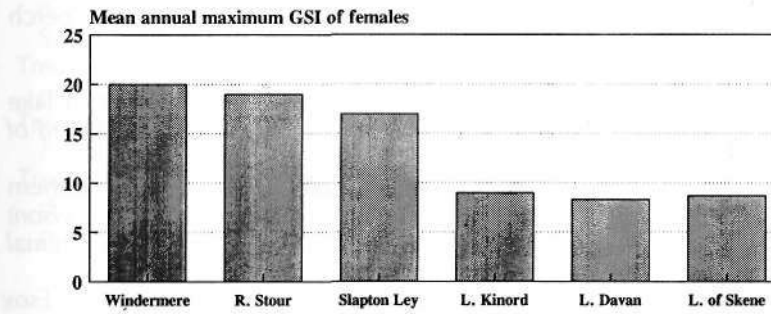

FIG. 2. Mean annual maximum values for the gonadosomatic index (GSI, %) of pike in northeast Scotland (L. Kinord, L. Davan, L. of Skene; Treasurer 1990) compared with pike from more southern waters in Cumbria (Windermere; Kipling & Frost 1969), Devon (Slapton Ley; Bregazzi & Kennedy 1980) and Dorset (R. Stour; Mann 1976).

The impact of introduced species and their interaction with native fish communities is being studied in Loch Lomond (Adams et al. 1990; Adams & Tippett 1991) and potential means of protecting endangered species have been suggested (Maitland & Campbell 1992).

An annotated bibliography of research on non-salmonid freshwater fish in Scotland has been prepared in collaboration with Dr Derek Mills of the Institute of Ecology and Resource Management, University of Edinburgh. A copy of this bibliography may be obtained on request from the authors.

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