A LOWER JAW DEFORMITY IN JUVENILE AND ADULT ATLANTIC SALMON (SALMO SALAR L.)

BY D.T.G. Quicke

Introduction
Various types of jaw deformity have previously been described in several species of fish (Bruno, 1990; Crouch et al., 1973; Dawson, 1964, 1966 and 1971; Dawson and Heal, 1976; Treasurer, 1994). The current note reports on the incidence of a lower jaw deformity in both juvenile and adult reared-ranched Atlantic salmon (Salmo salar L.).

The condition was similar to a lower jaw deformity described in post-smolt farmed Atlantic salmon in the Shetland Isles during 1987 and 1988 (Bruno, 1990).

Materials and Methods
The Salmon Research Agency (formerly the Salmon Research Trust of Ireland) has been rearing and releasing Atlantic salmon smolts in the Burnsthistle River system in western Ireland since 1957 as part of on-going experimental ocean ranching programmes (Piggins, 1979; Piggins and Mills, 1985). The vast majority of smolts (including 1+ and 2+ year old) are derived from a line-bred 1-sea-winter (1SW) grilse stock which was originally selected from wild grilse parents in the Burnsthistle system (Cross and King, 1983). A small number of smolts derived from 2-sea-winter (2SW) River Corrib stock have also been released on occasions. All returning adult salmon and grilse are monitored by traps and from angling returns within the Burnsthistle system (Mills and Piggins, 1983; Piggins and Mills, 1985).

During 1984 a small number of reared grilse was observed with an unusual deformity of the lower jaw (Figure 1). Although the incidence of the deformity appeared to be low, it was decided to examine all returning adult fish (both wild and reared) during subsequent years. Parr were also routinely examined in the hatchery during micro-tagging operations and wild smolts were examined in the downstream traps during the normal smolt migration in order to determine whether or not the deformity occurred during the freshwater phase. During the winter of 1985, an attempt was made to examine the hypothesis that the deformity might have a genetic basis by mating deformed male and female grilse with normal grilse and monitoring the development of the resultant progeny in the hatchery.

Results
A total of 121,443 reared smolts was released into the Burnsthistle system between 1980 and 1985 (Anon., 1980-85). Details on the annual numbers of smolts released, together with the resultant return rates of 1SW maiden grilse, and the incidence of observed jaw deformities are summarised in Table 1. Grilse return rates varied between 0.5 and 3.7%, with an average return rate of 2.3% over the 6-year period. A total of 17 maiden grilse was observed with a deformed lower jaw. Ten were derived from 1+ grilse smolts, two from 2+ grilse smolts, and one from 2+ 2SW smolts. The parentage of four grilse could not be determined due to tag loss. The incidence of the jaw deformity amongst the various smolt age/parentage groups broadly reflected the relative proportion of the smolt groups released. The ratio of affected female to male grilse was 8:5. However, the sex of four fish could not be determined due to the severity of the deformity. The annual incidence of the jaw deformity was low and varied from 0-1.4%, with an average incidence of 0.6% over the 6-year period. There was no indication that the level of incidence was increasing (or decreasing) over time.

Apart from the obvious jaw deformity, the affected grilse appeared to be in a relatively healthy state. However, their average size and condition was substantially lower than normal grilse (Table 2), probably because their ability to feed was somehow impaired by the jaw deformity. Nevertheless, it is interesting to note that two deformed grilse were captured on rod and line by anglers during 1985. Indeed, two more specimens were recorded as kelts in the downstream trap and one of these survived to return again as a short absence (54 months) previously spawned grilse in 1982 having increased in length from 61.8cm to 63.0cm during the intervening period.

Severely deformed grilse were used in the general broodstock programme during the winter of 1985. One deformed male was mated with a normal female, and one deformed female was mated with a normal male. Unfortunately, it was not possible to raise a deformed male with a deformed female. The resultant ova were...
incubated separately, and fly development was monitored closely throughout the first summer. No deformed jaws were observed in a sample of 309 0+ parr examined in September 1986. However, the condition was observed, albeit at a very low incidence (<0.001%), in the normal 1+ parr population during the winter of 1986 (Figure 2). The condition has not been observed in the reared stocks since 1987 and has never been noted in any of the wild stocks (Rogan pers. Comm.).

Discussion
Although the incidence of the lower jaw deformity in the present study was relatively low in both juvenile (<0.01%) and adult (0.1-1.5%) reared-raised Atlantic salmon, Bruno (1990) noted a much higher incidence (c.30%) of a similar condition in post-smolt farmed Atlantic salmon in the Shetland Isles. This may be explained by the fact that the survival rate of farmed salmon is significantly lower than farmed salmon which are held in the protective environment of a cage. Although it was clear that the deformed farmed salmon were able to feed and reproduce, their average size and condition was substantially lower than normal fish. Bruno (1990) noted that while farmed farmed salmon were able to feed and swim normally and appeared to be in good condition, there was some reduction in mean weight compared with normal fish. The farmed stock had to be harvested early which represented a significant financial loss to the farmer. It is also possible that the deformed fish may have been downgraded due to their appearance. A high incidence of deformed fish in farmed stocks is unlikely to be popular with anglers and traditional net fishermen and could significantly impact on the potential biomass yield from a commercial ranching programme. Although the condition was observed, albeit at a very low incidence in the general population of 1+ hatchery parr, specific attempts to reproduce the condition in the hatchery by mating deformed grilse with normal grilse proved negative. However, the possibility of a genetic basis for the deformity cannot be completely ruled out. The condition may be due to a recessive gene which occurs at a very low incidence in the reared stocks, and it highlights the importance of properly managed breeding programmes for both farmed and farmed-raised stocks (Gjedrem, 1986). Cross and King (1983) found an erosion of genetic variability in hatchery stocks compared with wild stocks in the Barrisheugh system. Piggott and Mills (1985) reported on the occurrence of deformed grilse with compacted vertebrae which were derived from 24 Barrisheugh smolt between 1972 and 1978. The jaw deformity could be caused by several other factors, for example, mechanical injury, nutritional deficiencies, parasitism, teratogenic substances, and adverse environmental conditions. However, taking into consideration the low incidence of the deformity and the fact that all of the fish in the hatchery were exposed to the same conditions, it seems more likely that the deformity may have been caused by mechanical injury or a genetic aberration.

Summary
The incidence and possible causes of a lower jaw deformity in juvenile and adult reared-raised Atlantic salmon (Salmo salar L.) is reported from the Barrisheugh River system in western Ireland.

Authors’ address
ESI Fisheries Conservation, Hydro Group, Athlone, Co. Clare, Ireland.

Acknowledgements
I am grateful to Gar Rogan (RRA), the late David Piggott (SWT), and David Bruno (SIOAIRD, Scotland) for their comments.

References