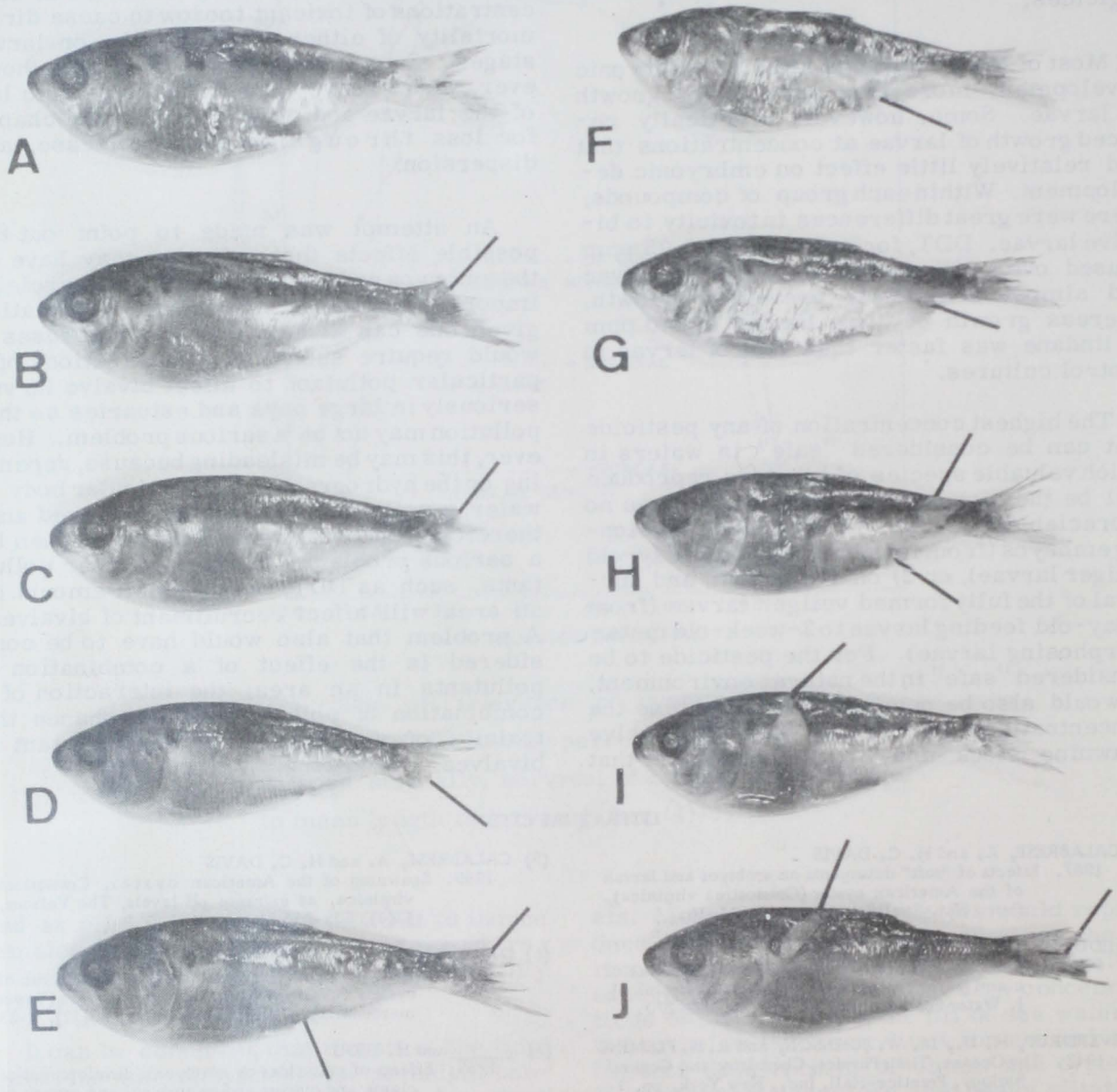


Fig. 1 - Juvenile menhaden injured by predators. Fish A is normal.

# EFFECT OF PREDATORS ON JUVENILE MENHADEN IN CLEAR & TURBID ESTUARIES

Richard L. Kroger and James F. Guthrie

Little is known about the effects of predation on juvenile menhaden during their 6 to 9 months of estuarine life (Reintjes and Pacheco, 1966). Numerous published reports have described the occurrence of juvenile menhaden in stomach samples of other species (Reintjes, Christmas and Collins, 1960). No studies have mentioned scarring rates in populations of juvenile menhaden from different-type estuaries, or the kind of injuries incurred by juveniles that escape after being bitten by predators.

A sample of 682 juvenile Gulf menhaden, Brevoortia patronus (mean fork length 62 mm), a spotted sea trout, Cynoscion nebulosus, and a blue runner, Caranx crysos, were collected in Steinhatchee River, Florida, on July 13, 1971, with a cast net. We examined the menhaden immediately and determined that 19% had been injured by predators. Injuries ranged from single tooth slashes to missing fins and chunks of flesh (Figure 1). It can be assumed that most injuries occurred recently if rapid regeneration and healing obscures injuries in this river, as observed for fin-clipped and tagged juvenile menhaden in other estuaries and in the laboratory (Kroger and Dryfoos, 1972), or if injured menhaden in schools are preyed upon at a greater rate than noninjured menhaden (Gunter and Ward, 1961).

Most injuries were probably caused by trout and other sight-feeding predatory fish, such as blue runners (Simmons and Breuer, 1950 and Reintjes, 1969). We saw these species make 20 predatory attacks in 1 hour on menhaden schools at the surface in a small cove. Water clarity, as indicated by secchi disk readings, registered greater than 100 cm (the length of our secchi stick). We consider this very clear and ideal for sight-feeding predators.

## Predators Reduce Schools

Observations by fishermen and rate of scarring suggest that the number of juveniles in Steinhatchee River decreases steadily as a result of predation. Fishermen who live by the river reported that schools of juvenile menhaden are usually 20 to 30 feet in diameter in April. But, by July of each year, the schools which are about the same in number are reduced by the abundant predator population to the 5- to 10-feet-diameter schools we saw. These observations are supported by calculations--based on the fact that 19% of the fish were injured, and the assumption that one of 10 bitten juveniles survives. These indicate that our sample of 682 fish was the remains of an original group of 1,852 juveniles ($682 \times .19 \div .1 + 552 = 1852$). This estimate should be greater if scars disappear, or if rate of predation increases on injured menhaden.

The precise number of injured juvenile menhaden in samples from other clear-water and turbid estuaries was not obtained because we did not immediately examine each fish when fresh. After the samples were preserved, only major injuries were discernible. Based on field calculations, however, we know that at least 10% of the juvenile Atlantic menhaden, B. tyrannus, were injured in samples collected from two Rhode Island and Massachusetts clear-water estuaries in 1969-71. Water clarity in these estuaries was such that the bottom was visible in over 2 m of water. Typical abundant predatory fish captured in the haul seine with the injured menhaden, and whose stomachs contained menhaden, included chub mackerel, Scomber colias, and bluefish, Pomatomus saltatrix. Other probable menhaden predators were caught, but their stomachs were not examined; these included crevalle jack, Caranx hippos, and northern sennet, Sphyraena borealis.

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Contrast of Turbid Estuaries

In contrast, while capturing juvenile menhaden for tagging and yearly abundance studies from 1956 to 1971 on the Atlantic and Gulf coasts, we have never observed more than one or two injured juvenile menhaden in any of several thousand samples collected in over 50 turbid estuaries where secchi readings ranged from 10 to 50 cm. Stomachs of ladyfish, Elops saurus, captured in these samples have been examined and shown to contain a high percentage of juvenile menhaden (Sekavec, 1971). The only other typical predatory fish captured with the juveniles in these turbid estuaries, and which stomach analysis showed they fed on menhaden, included longnose and alligator gars, Lepisosteus osseus and L. spatula. These turbid-water predators usually were absent from the samples, or were present only in small numbers.

The high rate of scarring we observed in populations of juvenile menhaden in clear water, relative to turbid water, indicates either a different rate of escapement when juveniles are bitten by the resident predators--or a different rate of predation on the juveniles in the two types of estuaries. We believe the great amount of scarring indicates a higher rate of predation on the menhaden. In our opinion, abundant predators severely reduce the number of juvenile menhaden in some clear-water estuaries, whereas in turbid estuaries rates of predation on menhaden are much lower (Kroger and Guthrie, 1973). Additional studies of the interaction of menhaden and predator populations in clear and turbid estuaries are needed.

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