FISH

The Disappearing Goby

from our Marine Vertebrate Correspondent

GIVEN a river estuary in which population of fishes is extremely large from July to January when the fishes' gonads are reaching maturity and then almost disappears, which explanation is most likely to explain the disappearance of the fish—offshore migration to breed; low temperatures; lowered salinity; lack of food; or predation? In a study on the distribution and abundance of the sand goby (*Gobius minutus*, better known in recent literature as *Pomatoschistus minutus*) in the estuary of the Ythan, just north of Aberdeen, M. C. Healey (*J. Zool.*, **163**, 177; 1971) attempts to answer these questions.

Sand goby

In the Ythan estuary the sand goby is abundant from July when the young of the year enter the estuary for the first time and the class of the previous year return to the river. After recruitment stops, losses are gradual until January or February when about 85 per cent of the first year fish disappear. A second decline in the population occurs the following November when the fish are in their second year and the year class is almost extinguished. Because the January–February decline occurred when the gonads of both sexes were mature or close to maturity it seemed quite natural to assume that the disappearance was connected with breeding behaviour, and this seemed to be confirmed by the sex-ratio which changed from unity during the period of abundance to about one male to five females after February.

Healey has attempted to explain these observations by a series of alternative hypotheses. First, he considers the possibility that the gobies cannot obtain sufficient food in the spring months, hence they migrate or die off. His observations show that the most important item in their diet is the amphipod crustacean, *Corophium volutator*, and taking into account the daily requirements of the goby population, he demonstrates that there can be no shortage of food.

Another possible explanation is that the sand goby migrates from shallow inshore waters to escape low winter temperatures, and this has been suggested by other workers. Healey, however, dismisses this on the grounds that in the Ythan temperatures are rising by February when the migration begins. Similarly, lowered salinity is

ruled out as a causative factor because Healey could find no regular seasonal change in salinity in the area.

The possibility that the gobies were simply migrating offshore to breed is also considered. *Gobius minutus* is territorial in its breeding season; the males build and guard "nests" under empty bivalve shells. Consequently the population tends to spread out over the sea bed to a random pattern in response to the availability of suitable ground. The fact that males seem to decline in the catches in February could well be associated with their spreading out and becoming harder to catch in their shell "nests".

Although other workers have found that the scarcity of the sand goby in inshore waters is matched by an increase offshore, Healey's attempt to catch them offshore was not successful. It is curious, however, that in contrast to the wealth of data on density, fishing effort, and net efficiency for the estuary work, Healey is remarkably coy about details of the offshore fishing effort. It is said that offshore fishing was not intensive, but the only data given seem to amount to a total of four hours and forty minutes trawling on six separate days, nothing about the size of the net, its mesh, or the speed at which it was hauled. On this evidence Healey concludes that the sand gobies had not moved offshore to spawn, and he therefore advances another hypothesis that the activities associated with breeding

expose the fish to a high level of predation. As he observes, there are a number of fish and fish-eating birds in the estuary which might prey on gobies if their behaviour made them available. It seems remarkable that after two useful years' work on the biology of the sand goby Healey, in an article of more than fifty pages containing twenty-one tables and fourteen text figures, can write in support of this predator hypothesis "since I know nothing about the diets of various predators at the important time of the year, it is a completely speculative hypothesis".

PHOTOSYNTHESIS

Break in the Chain

from our Photosynthesis Correspondent

IT seems likely that the b-type cytochrome (cyt b_{559}) found in the chloroplasts of green leaves is not located on the principal electron transport pathway linking photosystem two (S2) with photosystem one (S1). The occurrence of cyt b_{559} in chloroplasts is well known but its place in the photosynthetic electron transport chain is far from certain. In fact, at room temperature there is no observable photo-oxidation or photo-reduction of this cytochrome *in vivo*. Recently, however, Boardman and his colleagues in Canberra have presented evidence which indicates a possible site

Measuring Coronal Line Profiles

IN the forthcoming issue of *Nature Physical Science*, G. Henderson, A. Larsen and P. M. Marshall of Heriot-Watt University describe the latest stage of the development of the Fabry-Perot method for the investigation of solar coronal line profiles.

Henderson and his colleagues have used their Fabry-Perot spectrometer in conjunction with the coronagraphs at the Pic du Midi Observatory in the Hautes Pyrénées and at Wendelstein, Ober Bayern. The essential features of any coronagraph resemble those of an astronomical telescope except that the glass of the objective lens must be absolutely flawless and completely clean so that there is as little scattering of the sunlight as possible. In essence, most coronagraphs produce an artificial solar eclipse by the introduction of an occulting disk in an appropriate position so that only the corona itself is observed.

The Heriot-Watt team have made line profile measurements on the 5303 Å (FeXIV) and 6374 Å (FeX) lines of the solar corona by focusing the coronal region of interest onto the entrance aperture of the Fabry-Perot spectrometer. The coronagraph telescope al-

ways points at the centre of the Sun and so a pair of gimbaled mirrors had to be positioned between the final lens of the coronagraph and the entrance aperture of the spectrometer. In order to scan through the wavelength range of interest, the separation of the Fabry-Perot reflecting plates is modulated by means of piezoelectric crystals. Finally, the light emerging from the reflecting plates is passed through a narrow band interference filter and onto a photomultiplier tube which records the variation of intensity with wavelength.

During a four week period in October 1970, successful observations were made at the Pic du Midi and a total of 1,200 line profiles of the red and green lines were collected from the coronal region as far out as $1.6 R_{\odot}$ from the solar limb. Weather conditions at Wendelstein were unfortunately not very good during this period and only ten profile measurements of the green line at $1.1 R_{\odot}$ were possible. The large amount of potential data now available on coronal line profiles should enhance knowledge of the environment and energy distribution of the highly ionized atoms which populate the corona.