Notes on the Reproduction of Teleostean Fishes in the South-Western District.

By

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Morone labrax. *Linn.* Bass.

Towards the end of May a large female bass in one of the Aquarium tanks appeared to be approaching ripeness, and constantly swam round the tank followed by one or more of its companions, probably of the opposite sex. A fine-meshed net was accordingly placed over the overflow from the tank in question, and on the morning of the 29th May was found to contain a very large number of eggs, undoubtedly attributable to this species, the only other Teleostean inmates being turbot, congers, pollack, rocklings, and two species of wrasse.

All the eggs proved to be unfertilised, or, at most, showed only an approach to segmentation, which may have been due to the spermatozoa of a rockling. Circumstances seemed strongly to point to the fact that the eggs are not all shed at once, but owing to an unfortunate series of accidents with the net it is impossible to speak on this point with absolute certainty.

Although the bass is a common British fish, its ova find no place in the records of British naturalists, and are only known from the descriptions of Raffaele,* who obtained them both from parents living in the tanks of the Naples Laboratory and from the neighbouring sea.

The eggs observed by us at Plymouth are spherical, and, while living but unfertilised, measure from 1·25 to 1·34 mm. in diameter. Raffaele gives 1·155 to 1·2 mm. as the diameter of Naples examples. The latter have an oil-globule of ·332 to ·366 mm. The Plymouth eggs have often two or more oil-globules, which soon coalesce to form a single globule of ·39 or ·40 mm., pale yellowish to the naked eye, but perfectly colourless by transmitted light under the microscope.

* *Mittheil. Zool. Stat. Neap.*, viii., 1888.

Raffaele's ova are thus smaller than those which we have seen at Plymouth, and have a smaller oil-globule. This difference may perhaps be correlated to the size of the parent fish (as noted by one of us in the case of another species*), but Raffaele does not mention the dimensions of the Naples spawners. The Plymouth female measures about 28 inches, 70·2 cm., so far as we can judge. It is impossible to catch her without emptying the tank, a proceeding at present inconvenient. Bass, according to Risso† and Faber‡, grow, or used to grow, to a larger size than this in the Mediterranean and Adriatic, but Raffaele's examples may have been smaller.

The ova of the bass being easily recognisable, whether from the dimensions and proportionate size of the oil-globule, or from the pigmentation of the embryo, as described by Raffaele, it is somewhat remarkable that they should never have been found in British waters. Raffaele suggests that spawning may take place indifferently in either fresh or salt water, the ova in the former case developing at the bottom. In this district and at Newquay, young bass, from about two inches upwards, are found in the estuaries, and not, so far as we know, in the open sea, and we have taken a large female, with advanced ovaries, in the Tamar estuary. If spawning takes place in the estuary it is not remarkable that the ova should have escaped notice. Those deposited in the Plymouth tanks floated buoyantly in the Aquarium water, which is of somewhat lower specific gravity than that of the open sea, while Raffaele seems to have obtained all his specimens, other than those from the Naples tanks, at the surface. Experiments which he describes suggest that perfectly fresh water is deleterious to the ova (of parents that have been living in sea-water?), while brackish water is rather beneficial than otherwise to the larvæ, and does not injure the ova. As has been indicated by one of us,§ *Motella mustela*, a fish with typically pelagic eggs, almost certainly spawns to some extent in the Plymouth estuary. The local fishermen strenuously assert that the same is true in the case of the flounder, and may be quite correct in their opinion. It is, therefore, by no means impossible that the spawning of the bass takes place, in so far as concerns this district, rather in the estuaries than in the open sea.

Observations of spawning in an Aquarium give no reliable evidence as to the spawning season under natural conditions, since when both periods have been noted they have not been found to coincide. Our

* *Journ. M. B. Assoc.*, N.S., v., 1897, pp. 113 and 117.
† *Ichth. Nice*, p. 300.
‡ *Fisheries of the Adriatic*, p. 71.
§ *Journ. M. B. Assoc.*, N.S., v., No. 2.

large bass are very old members of the Laboratory staff, and, since no reproductive activity has been observed in previous years, it is quite probable that they may have lost count of the seasons.

Gobius niger. *Linn.*

In so far as concerns the neighbourhood of Plymouth, this species appears to be chiefly estuarine in distribution, being common throughout the year in the Hamoaze and in the lower reach of the Lynher river. We have little doubt but that spawning takes place to a large extent in the estuary, though, as a matter of fact, we have only found the ova, identified from Petersen's description and figures,* on an old tin trawled in Cawsand Bay on the 14th July.

Gobius paganellus. *Gm. Linn.*

In Plymouth Sound this Goby is common enough, between tide-marks and elsewhere, on rather rough ground, but has not been taken, to our knowledge, in any part of the estuaries. During the present spring a number of specimens were kept in a large table-tank in the Laboratory. In April two males assumed the breeding livery, which may, for the present, be sufficiently described as a deep purplish madder all over the head and body, and nearly black on the anterior parts, while the border of the anterior dorsal fin is cream-colour or orange. Nests were chosen under a flat stone leaning against the side of the tank, and under the convex valve of a scallop, *Pecten maximus*. Ova were deposited, in all probability by several females, but it is not possible to give the size of the parent of the specimens measured. The latter are from 1·84 to 1·90 mm. in length. The shape is rather regularly fusiform, the greatest width, rather less than half the length, occurring about the middle. The base is about one-tenth to one-twelfth of the length; the apex is in all cases somewhat pointed, in most examples most distinctly so, and never broadly rounded as in *G. niger*. The fixing apparatus differs in no important particular from that of *G. niger*. The yolk is opaque, and yellowish in colour.

Petersen (*op. cit.*, p. 7) has criticised a drawing given by one of us, which purports to represent the ova of *G. niger*. As appears from the text, the drawing and identification are those of Professor M'Intosh. In the light of our present observation it becomes evident that the parent species was *G. paganellus*, and not *G. niger*. In future, where the matter is not complicated by the occurrence of other large Gobies, such as *G. Friesii*, it should be easy to distinguish the ova of *G. niger*

* "On the eggs and breeding of our Gobiidæ." From the Danish Biological Station. 1891 (1892), p. 2, Tav. i. b.

and *G. paganellus* by the apex, which is bluntly rounded in the former and more or less acutely pointed in the latter. Spawn, evidently that of *G. paganellus*, has been found on several occasions, at Easter and in the early summer of 1897, attached to various objects between tide-marks on Drake's Island.

Gobius pictus. *Malm.*

The ova of *G. minutus* and *G. Ruthensparri* have been frequently observed at Plymouth, but require no further description than is afforded by the admirable memoirs of Guitel* and Petersen.† It is, perhaps, worthy of remark that males and females of the former species have been taken by one of us in full breeding condition during the first week of September of this year at Newquay, Cornwall. At Plymouth *G. minutus* begins to spawn at least as early as April.

So far as we are aware Mr. A. O. Walker is the only observer who has noticed (in Colwyn Bay) the occurrence of *Gobius pictus* in British waters (*cf.* Day, *Fish. Gt. Brit.*, i., p. 168), although it is quite possible that the species may have been recorded under other names. It is by no means rare on sandy and muddy ground, and among algæ and zostera in Plymouth Sound (Cattewater, Jennycliff Bay, N.E. of Drake's Island), and in Cawsand Bay. A single specimen has been taken in Bigbury Bay, and probably a little attention would show that the species occurs on many parts of our coasts.

We have not observed ova taken directly from the parent, but consider that this species is probably responsible for some spawn attached to a Pecten shell trawled near the Batten Breakwater on the 12th May, 1898. In dimensions and shape the ova approach the condition of *G. microps* (*cf.* Petersen, *op. cit.*, p. 3, tav. i. b., Fig. 11), a form closely allied to *G. pictus*, but unrepresented, so far as we can determine, in our district. The egg measures ·81 mm. in height. As in *G. microps*, it is swollen near the base, the greatest breadth being ·63 mm. Distally the lateral outline is somewhat compressed, while the apex, sometimes rounded, is usually very slightly acuminate. The shape is, therefore, intermediate between that of *G. Ruthensparri* and that of *G. microps*, but nearest to the latter. A newly-hatched larva measured 2·68 mm. in total length. The pigment differs from that of *G. minutus* in that yellow and black chromatophores extend in almost unbroken series along the dorsum and ventrum, to a point near the caudal extremity. Petersen gives no detailed description

* *Arch. Zool. Exper.*, S. II., x., 1892; S. III., iii., 1895.

† *Op. cit.* The ova and larva of *G. minutus* have also been described by one of us in *Ann. Mag. Nat. Hist.*, S. VI., 1890, p. 30.

of the larva of *G. microps;* but his drawing of the embryo indicates that the pigmentation of the two forms must be rather similar at the time of hatching.

Gobius Jeffreysii. *Günther.*

An old oyster shell, presumably dumped down with other rubbish by a harbour mud-hopper, was dredged on the 3rd July, 1898, about two miles S. by E. of the Plymouth Mewstone in about twenty-three fathoms of water. It was found to be coated on one side by the eggs of a Goby. The shell did not appear to be a recent contribution to the Mewstone ground, while the spawn was in an early stage of development, and may be supposed to have been deposited where found. No Goby was found in the net, but *G. Jeffreysii* is commonly taken on the same ground, where it is the only representative of its genus. In shape the ova differ from those attributed to *G. pictus,* chiefly in that the apex is always rounded and never acuminate. The height varies from ·72 to ·78 mm., the greatest breadth from ·55 to ·58 mm. The yolk is practically colourless. We have no observations of more advanced stages.

Gobius scorpioides. *Collett.*

According to Smitt (*Hist. Scand. Fish.*, Ed. II., i., p. 260) this Goby has hitherto been known from three specimens, of which two, 28 and 37 mm. long, were taken by G. O. Sars at twenty to sixty fathoms outside Stavanger and Hardanger fjords, while the third, 18·5 mm. long, was found by Winther at six fathoms in the S.W. of the Cattegat.

We are able to extend the range of the species to the British area, having taken a specimen on the 13th July, 1897, in the mouth of Falmouth Harbour at about eighteen fathoms, N. by W. of Anthony point, in a dredge full of dead shells, etc. It is a female measuring 21 mm. in total length. The ovaries are much distended, and contain apparently ripe ova loose in the lumen, with the outer layer of the zona everted.

The ova are mostly oval or ovoid in shape, but some show an approach to the shouldered condition common to other small species of the genus. Two measure ·52 and ·60 mm. in height by ·42 and ·39 mm. in greatest breadth, but these measurements do not allow for the expansion which probably takes place when the spawn is deposited in the ordinary way in sea-water, the specimen having been preserved in weak formol before its viscera were examined. The everted outer layer of the zona is similar to that of other Gobies, except that it shows

hardly any perforations near the micropylar region, the numerous recticulo-radiate ridges being mostly united by a thin membrane.

G. scorpioides is certainly the smallest British Goby so far recorded. If common it is not likely to be often retained in the meshes of an ordinary net.

Aphia pellucida. *Nardo.*

We cannot find a description of the ova of this fish, though in other respects, thanks to Collett,* the cycle of its life-history is fairly well known. In the early part of July of the present year, adults of both sexes were rather numerous on the zostera and weed beds of the inner part of Cawsand Bay, the females being full of roe. They became scarce towards the end of the month, and none have been since taken. The abundance of this species in the estuary of the Lynher in April has already been noticed by one of us. (*Journ. M. B. A.*, vol. i., p. 89.)

None could be found there on the 21st July of the present year. If the fish is a permanent inhabitant of the estuary this would seem to indicate that the brood of last year, offspring of the half-grown examples met with in April, had already died off, having fulfilled the life-span of a single year allotted to them by Collett.† It is, however, possible that individuals move seawards from the estuary at the approach of maturity, while the larvæ in turn migrate to the estuary.

Though breeding adults were numerous, we failed to find the spawn attached to any object trawled or dredged in Cawsand Bay. Examination of the ovary of a female, 1¾ inches long, taken in the Bay on the 14th July, indicates that the ova are certainly demersal. The yolk, probably not quite mature, was transparent, colourless, and almost free from granulations. It consisted at this stage of an outer layer, enclosing an inner and more refractive part. After 15 hours in sea-water the ovum was evidently dead. It had become opaque and yellowish, the refractive part having been apparently broken up into a number of globules, bearing a general resemblance to those of Gobius. Under natural conditions it is probable that the yolk is not essentially different from that of Gobius, but less opaque and without conspicuous colouration. The zona is thin and without special markings. As in Gobius, it is enveloped in the ovarian condition by an outer membrane, which is everted when the follicle is ruptured, and forms the fixing apparatus. This outer membrane is, however, divided into a number of

* *Proc. Zool. Soc.*, 1878, i., p. 318.

† The brood of 1898, if present, would be too small to be retained in the net employed. It is possible that some larvæ, taken at the mouth of the Lynher in 1897, may have belonged to these species ; they were not preserved.

fine threads which may spring directly in a single series from around the micropyle, or may be united for a very short distance proximally. In this respect the condition of Blennius is approached rather than that of Gobius, but the divergence from the latter type is only one of degree.

When freshly removed from the ovary the zona was spherical, and about ·44 mm. in diameter, the perivitelline space being small, but soon expanding in sea-water. About 15 hours after extension, such ova as were at all regular in outline had acquired a broadly oval shape, the yolk mass remaining round. One example measured 1·06 mm. by ·78 mm.; another, 1·25 mm. by ·95 mm. We cannot say how far either dimensions or shape conformed to the natural condition, as we were unable to effect fertilisation.

Crystallogobius Nilssonii. *Düb and Kor.*

This fish is exceedingly abundant on the Eddystone grounds and in the deeper part of Falmouth Bay, forming in these localities, as probably on all offshore grounds in the district, the chief food of half-grown dories (*Zeus faber*) and large scald-fish (*Arnoglossus laterna*). The latter is essentially a bottom fish, and all records with which we are acquainted tend to confirm Collett's opinion that Crystallogobius is an inhabitant of the lower strata of the water, if not actually a bottom fish to the same extent as the Gobies. However, on the 8th of May of last year a female was taken in a surface net near the Eddystone. It measures 22 mm. in total length. The ovaries contain eggs (transparent, like the rest of the animal, in the fresh condition) of which the largest measure about ·12 mm. in diameter. They are spherical, and not sufficiently mature to justify any conclusion as to their appearance in the ripe condition.

CORRIGENDA.

Capros aper (vol. v., pp. 44, 121). Advanced larvæ of about 5 to 6·5 mm., taken off Fowey, have been referred in my previous papers to Capros, chiefly on account of the pigmentation, since the specimens were not in the best state of preservation. This year I have had several opportunities of observing in the living condition a larva which certainly belongs to the same species, and is without doubt a young *Ctenolabrus rupestris*. It would be difficult to find a better illustration of the difficulty of determining a Teleostean larva at a stage when the skeletal characters are insufficiently developed for exact diagnosis, and especially when the conformation has been more

or less obscured by post-mortem distortion, since it would appear that the larvæ of Capros, Crenilabrus, and several species of Lepadogaster all pass through phases characterised by one and the same pigmentation pattern. The identity of the pattern seems to be explicable neither by the taxonomic propinquity of the genera nor by protective adaptation.

Caranx trachurus. My attention has been drawn to several errors in my notes on this species (vol. v., p. 116). The yolk in *Temnodon saltator* is actually described by Agassiz and Whitman as having only cortical segments, instead of becoming segmented throughout as in the ova which I attribute to Caranx. The difference is one of degree, since yolk segments when present in ripe eggs seem to be the survivors of the yolk spherules of ovarian stages (*cf.* Raffaele, *Mitth. Zool. Stat. Neap.*, viii., 1888, p. 21), although it is only in the supposed Caranx eggs that these segments have been seen to divide and to encroach upon, and finally occupy all parts of the yolk after deposition. I have also spoken of Raffaele's species, No. 3 (*loc. cit.*, p. 64) as doubtfully assigned by its discoverer to Coryphæna, whereas Raffaele really says that, while recognising the resemblance to Coryphæna, he considers that No. 3 probably belongs to a family nearly related to the Clupeidæ. If this view were correct one would expect to see at the larval stage, depicted in Tav. iv., Fig. 9, some trace of transverse folds in the lining membrane of the intestine.

The young Caranx, mentioned in vol. v., p. 119, were taken between Puffin Island and Bray Head, Co. Kerry. In recording them from the Irish Sea I was misled by a similarity of names in the two localities.

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