

**CRUSTACEA:** *Eurydice pulchra*?: 7(100); *Ampelisca brevicornis*: 7(199); *Bathyporeia pelagica*: 2(199); *Urothoe grimaldi*: 2(pr.); *Talitrus saltator*(?): 6(20); *Callinassa laticauda*: 6(20); *Upogebia stellata*: 7(100), 8(100), 10(100); *Macropodia longirostris*: 5(pr.); *Eupagurus prideauxi*: 5(pr.), 6(pr.), 7(100); *Eupagurus bernhardus*: 6(pr.), 8(100), 10(pr.); *Atelecyclus rotundatus*: 8(100); *Goneplax angulata*: 10(pr.).

**ECHINODERMATA:** *Marthasterias glacialis*: 5(pr.), 6(pr.); *Astropecten irregularis*: 5(pr.); *Amphiura filiformis*: 5(125), 6(300); *Ophiura texturata*: 5(pr.); *Echinocardium cordatum*: 2(pr.), 6(pr.), 10(pr.); *Leptosynapta decaria*: 6(20); *Asterias rubens*: 6(pr.).

**COELENTERATA:** *Corymorpha nutans*: 5(pr.), 6(pr.); *Cerianthus lloydii*: 5(25), 6(20); *Cerianthus membranaceus*: 5(pr.); *Peachia hastata*: 5(25), 6(pr.); *Adamsia palliata*: 5(pr.), 6(pr.).

**SIPUNCULOIDEA:** *Golfingia elongata*: 7(100).

**NUMBER OF SPECIES AT EACH SITE:** 1(1), 2(17), 3(8), 4(4), 5(31), 6(37), 7(14), 8(23), 9(9), 10(9), 11(3). **TOTAL NUMBER OF SPECIES:** 81.

#### THE RED BAND-FISH, *CEPOLA RUBESCENS* L. AT LUNDY

R. J. A. ATKINSON

*University Marine Biological Station, Millport, Isle of Cumbrae, Scotland*

and

R. S. V. PULLIN

*Department of Marine Biology, University of Liverpool, Port Erin, Isle of Man*

#### INTRODUCTION

The red band fish, *Cepola rubescens* L. is a long eel-like fish (see Fig. 2) with very striking orange-red colouration. According to Wheeler (1969), it is trawled most commonly on mud grounds at depths of 70 to 200 m off South and South-West Britain. There is very little published information on this species other than an analysis of length and weight relationships for Mediterranean specimens (Vives, Suau, and Planas, 1959) and some brief observations on captive fish (Wilson, 1953, 1963). The latter suggests that this fish makes burrows. *Cepola* was first found in Lundy waters by Atkinson in 1974 when diving in Quarry Bay and has been intensively studied since then at other sites in Halfway Wall Bay and Gannets Bay. These studies have been reported by Atkinson (1976) and Atkinson, Pullin, and Dipper (in press).

#### 1974 STUDIES

These studies, reported by Atkinson (1976) were restricted to preliminary observations on burrow and fish size and distribution. They confirmed that large *Cepola*, 60–70 cm, standard length were present in Quarry Bay. The area studied was 17 m below Chart Datum. The burrowing habit of *Cepola* was confirmed, the burrows being massive structures 60–70 cm deep and having the appearance of a vertical shaft with a slightly enlarged basal chamber in the shell gravel layer underlying the mud. The burrowing crab *Goneplax rhomboides* was also present in large numbers. Along a 48 × 2 m belt transect, *Goneplax* burrows occurred at about 1 per sq. m, and 6–7 *Cepola* burrows were present.

## 1975 STUDIES

These studies were made on a different site, in Gannets Bay only 12 m below Chart Datum, following difficulties in relocating the Quarry Bay site because of rough weather and poor visibility. Field observations were made of fish behaviour, burrow size and burrow distribution. Burrow casts were made by pouring down a liquid polyester resin (AP101PA with liquid catalyst, Trylon Ltd.) and raising the solid resin 24 hours later. These revealed a complex of burrowing species around the large vertical *Cepola* shaft (Fig. 1). The horizontal burrows near the surface are those of the crab, *Goneplax rhomboides* and the deeper lattice-like arrangement is probably the work of the burrowing shrimp *Upogebia stellata*. Plate 1 shows a *Cepola* in the entrance of its burrow. Ten fish were collected for an analysis of age, growth, feeding and sexual organisation. These produced very interesting results some of which are in conflict with the findings of Vives *et al.*, 1959. The Lundy *Cepola* were all very large old fish. The males were 65–70 cm standard length, 190–240 gm body weight and 4–5 years old. The females were 45–50 cm standard length, 135–150 gm body weight and 4–8 years old. These figures approach, and for some individuals slightly exceed, the upper length limits given by Wheeler (1969). A striking sexual dimorphism was observed in fin coloration. The males (Fig. 2) had a blue/mauve margin running almost the entire length of the dorsal, anal and caudal fins and this coloration was very reduced in extent or absent in females. The males also appeared to have longer free fin-rays than females at the termination of the tail, giving it a divided appearance. Both sexes were very close to spawning and had full ripe gonads. Analysis of stomach contents revealed an opportunistic zooplankton diet; mainly copepods and decapod crustacean larvae. The stomach contents of some fish included *Cepola* eggs which indicated a spawning population nearby. Histological studies on the gonads showed no evidence of the sex-change postulated for this species by Vives *et al.* (1959), and suggested instead a normal gonochorist sexual organisation. The 1975 studies therefore produced the first detailed analysis of burrow structure, new information on sexual dimorphism, and the beginnings of a complete analysis of age, growth, feeding and maturation.

## 1976 STUDIES

These studies were concentrated on a new site 13 m below Chart Datum at Halfway Wall Bay. The most important discovery made during 1976 was the presence of large numbers of young *Cepola* in small burrows both at this site and at the Gannets Bay site. The fact that these were not recorded in 1974 and 1975 does not mean that they were not there! They are easily overlooked as the small burrows, although distinct in aperture shape and size, tend to merge into the general background of mud and *Goneplax* burrows so that one's eye is drawn only to the burrows of larger fish. Young fish (0-group or 1-group) were collected for further study to complete the work on age, growth, feeding and maturation. This work is still in progress but it is already apparent that a sex-change in young fish is unlikely, and that sexual dimorphism in size and fin coloration occur early in life. Resin casts of the small burrows of young fish were extremely interesting. Some had side-shafts, presumably for escape and/or respiration. Fifteen young *Cepola* were successfully transported to Port Erin, Isle of Man for further study. Some of these constructed burrows in captivity and are currently the subject of studies on respiration and sensory perception. Field observations were made on a mapped site at 2-hour intervals round-the-clock to look for patterns of activity. The results of these are still being analysed, but indicate resting periods when the fish is curled up in gravel in the basal chamber, alternating with visits to the burrow aperture to observe surroundings, clean the burrow and feed. The presence of divers and lights probably distorted the normal behaviour patterns which would be better observed using underwater television. It appears that there is constant recruitment of young *Cepola* into the Lundy stock, which is not solely composed of old fish as appeared likely from the 1974 and 1975 studies. The 1976 studies produced specimens for completion of age, growth, feeding and maturation work and some very valuable behavioural

observations both in the field and in the laboratory. They confirmed that Lundy mud grounds afford an ideal habitat for *Cepola rubescens* and a unique shallow water location for its study.

## DISCUSSION

The studies described here have added much information on *Cepola rubescens* to the published literature and the authors plan to continue this work in the future. Visiting divers, whether marine biologists or not, will probably wish to observe this spectacular fish in what may be the only location affording good visibility over mud at modest depths. The authors urge divers to treat this species with respect and to refrain from collecting specimens or displacing fish from their burrows. Field and laboratory studies suggest that groups of *Cepola* may have a social structure. The burrows are clumped and burrow-sharing by different sexes has been observed together with indications of reduced aggression between individuals in certain circumstances. Despite the discovery of young fish and liberated eggs (ingested by '1975' fish), the status of the Lundy stock of *Cepola* is not known and requires a complete survey. For the record, the authors sampled cooked *Cepola* while conducting post-mortems on the 10 1975 specimens and the results were most unimpressive. The successful capture and transportation of live *Cepola* requires decompression stops to allow the swim-bladder to compensate, a supply of oxygen *en route* and the provision of the correct substratum in captivity. This obviously requires extensive research vessel facilities and should not be attempted other than for specific research projects.

## ACKNOWLEDGEMENTS

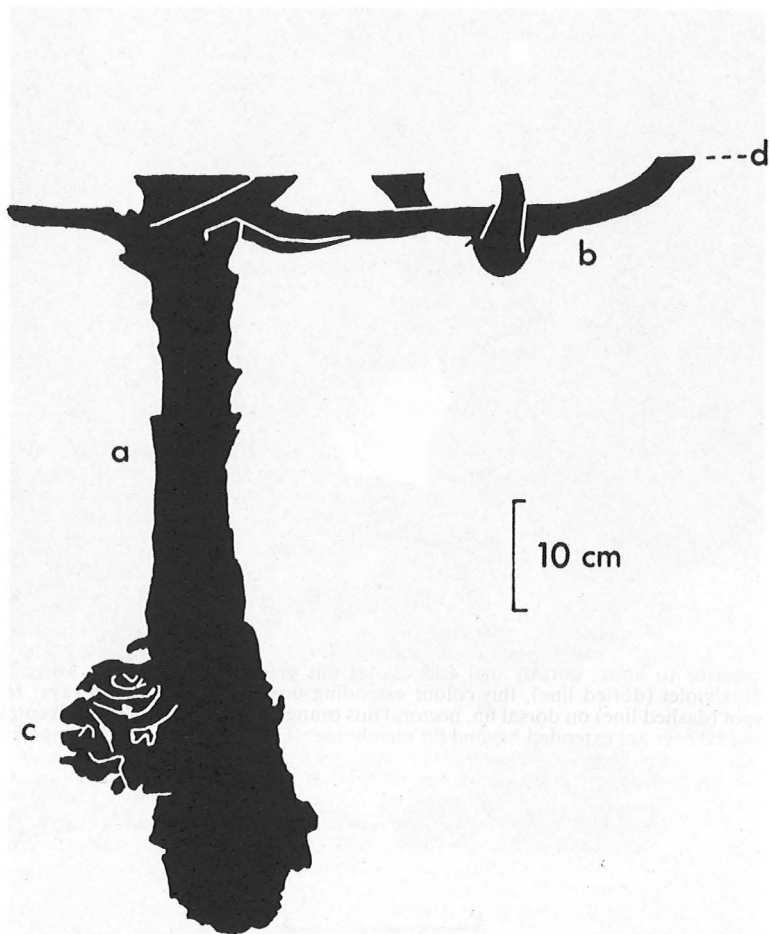
The authors acknowledge the support of the Lundy Field Society for much of this work. Thanks are also due to Bristol Channel Divers Ltd., for invaluable help and provision of facilities; to M. Bates and N. Bowden for diving services; to the Zoology Department, University College of Swansea for the loan of diving equipment; and to the Lundy Island authorities for the supply of oxygen for fish transportation.

## REFERENCES

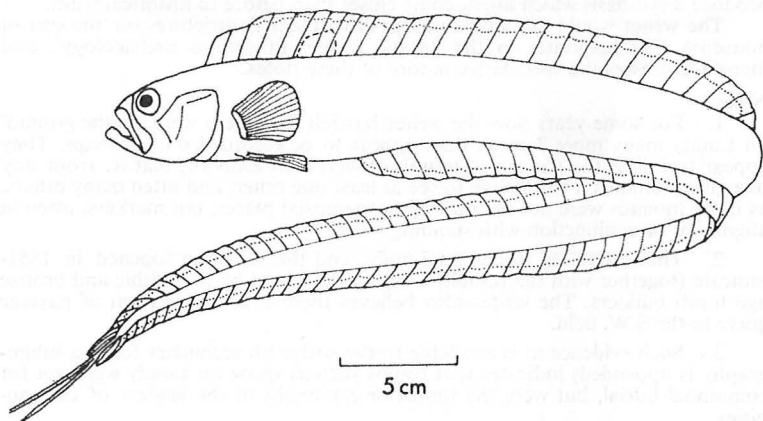
- Atkinson, R. J. A. (1976). Some preliminary observations of the burrows of the Red Band fish, *Cepola rubescens* L., *J. Fish. Biol.*, **9**, 181-183.
- Atkinson, R. J. A., Pullin, R. S. V., and Dipper, F. A. Studies on the red band fish, *Cepola rubescens* L. (in press. *J. Zool.*).
- Vives, F., Suau, P., and Planas, A. (1959). Sobre la biología de la cinta (*Cepola rubescens*) *Investigación pesq.*, **14**, 3-23.
- Wheeler, A. (1969). *The fishes of the British Isles and North-West Europe*. London: Macmillan, 613 pp.
- Wilson, D. P. (1953). Notes from the Plymouth Aquarium II. *J. mar. biol. Ass. U.K.*, **32**, 199-208.
- Wilson, D. P. (1963). *Zeus faber* and *Cepola rubescens* in captivity. *Bull. Inst. oceanogr. Monaco* (no. spec.) **1A**, 35-40.



Plate. 1. Large female *Cepola rubescens* in burrow entrance.



**Fig. 1.** *Cepola rubescens* burrow—side view drawn from resin cast: (a) the vertical, club-shaped fish burrow with adjoining horizontal *Goneplax rhomboides* burrows (b) and lattice-like shrimp burrows, probably of *Upogebia stellata* (c). (d) indicates plane of mud surface.



**Fig. 2.** Male *Cepola rubescens*: coloration—body pinky orange, paler ventrally anterior to anus; dorsal, anal and caudal fins yellow/brown fringed with pale blue/violet (dotted line), this colour extending down some of the fin rays; red spot (dashed line) on dorsal fin, pectoral fins orange, pelvics violet. Tips of central caudal rays are extended beyond fin membrane. (Females have pinky orange fins similar to the body colour except for the pelvics which are pale, almost colourless; there is a red spot on the dorsal fin but there is little or no projection of caudal (rays)).