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Formation of a Mucous Envelope at Night by Parrot Fishes

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(Plate I)

INTRODUCTION

IT is well known that many parrot fishes rest on the bottom at night while leaning against various objects such as rocks, coral or shells. During the summer of 1954 at the Lerner Marine Laboratory, Bimini, B. W. I., several species of these fishes were observed in such positions at night with a large and conspicuous mucous fold around their bodies (Plate I). The formation of this envelope apparently represents a specialized function of the mucus-secreting system. When the parrot fishes, surrounded by mucus, were first observed in an aquarium at night, it was thought that this condition was pathological, but their respiration and reactions appeared normal. After repeated observations of this envelope formation, it became clear that this was normal behavior. Observations were made with a flashlight, and the transparent folds were difficult to see until the light rays were directed at an angle which made them more easily visible.

C. M. Breder, Jr., Priscilla Rasquin, Louise Stoll and Carolyn Winn kindly read and made suggestions on the manuscript, which are gratefully acknowledged.

OBSERVATIONS

Five species of parrot fishes were placed in laboratory aquaria. Four of these, *Scarus croicensis* Bloch, *S. punctulatus* Cuvier & Valenciennes, *Pseudoscarus guacamaia* (Cuvier), and *Sparisoma pachycephalum* Longley,[2] formed conspicuous mucous folds only in the dark, except under certain special conditions. The nomenclature is that used by Longley & Hildebrand (1941). Five individuals of *S. croicensis* were also observed at night in dead finger coral (*Porites* sp.) branches beside the laboratory dock by means of goggles and an underwater flashlight. All were surrounded by a mucous sheath. One species, *Sparisoma chrysopterum* (Bloch & Schneider), did not form such a structure in aquaria or in the water off the dock, where two individuals were observed. The standard length of the various fish studied varied from about 6 to 21 cms. The water temperature in the aquaria was 30 to 32° C.

The structure of the mucous envelope was similar in the four species that produced it. It started as a fold at the mouth and went backward to surround the body of the fish completely. A little flap with a hole in its center covered the open mouth and moved in and out as the fish breathed. Posterior to the caudal fin, an opening of one to several centimeters in diameter was present through which the expired water left. Thus, a flow of water over the gills was insured. As Plate I shows, the folds were complex and extended up to several centimeters away from the body, depending on the size of the individual. The envelope seemingly consisted of a series of layers of mucus and varied in shape to some extent. In a specimen of *S. punctulatus,* about 18 cms. in standard length, the maximum length, width and depth of the envelope was 25 × 13 × 9 cms. In some instances the mucus near the bottom had sand grains attached to it and silt particles often settled on the upper part, which made the envelope more readily observable.

The fish usually leaned against the aquarium wall or drainpipe. However, they swam into conch shells or in among the branches of finger coral which they used for support if available. The mucus was then secreted in these positions.

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[2]The identification of the individual used, which was 6 cms. in standard length, is only tentative.

In one instance, two *S. croicensis* leaned against each other, one being against the aquarium wall, and formed what appeared to be a single fold around both of them.

The mucus was transparent and gelatinous. Large amounts could easily be picked up in the hand. Sometimes when a fish moved out of the fold, the structure partially collapsed into a large ball (Plate I, Fig. 2), but at other times it remained temporarily in the expanded condition.

The exact formation of the envelope was not observed because a light could only be turned on for a few seconds every five minutes or so. If the light was left on, the fish stopped the secretion and soon became active enough to break out of the fold. It appeared to form first around the head region and then pass back over the body, but it was not determined what groups of mucus cells were involved.

The consistency of the formation of the structure was established by nightly observation for the different fish as follows: four individuals of *S. croicensis* and one of *S. punctulatus* from July 19 to 28; five *S. croicensis* from August 17 to 27; one *S. punctulatus* from August 18 to 23; and one *P. guacamaia* from August 21 to 27. Other individuals were watched only occasionally.

Certain differences were noted in the time that some species required to form the completed envelope in the dark and the time required to break out of the folds after the lights were turned on. Although all the species were not studied comparatively, it was demonstrated that *S. croicensis* took longer to form the folds and broke out more quickly than either *S. punctulatus* or *P. guacamaia.* The individuals of *S. croicensis* normally took more than one hour to complete the fold. Under 0.3 footcandles of light, one individual formed it in 80 minutes and another between 75 and 145 minutes. Under these conditions the other two species completed the envelope usually within 30 minutes (*P. guacamaia* in 20 mins., *S. punctulatus* in 25 and 30 mins.). When the lights were turned on, *S. croicensis* usually broke out in less than 30 minutes (5, 10, 25 and 28 mins.), whereas the other two species usually required a longer period (*P. guacamaia* more than 30 mins.). It should be noted, however, that two specimens of *S. punctulatus* and *P. guacamaia* were considerably larger than those of *S. croicensis.*

At night the respiratory rate of the parrot fishes was considerably reduced. One *S. punctulatus* inspired 76 and 73 times per minute during the day and 47 times at night. One *S. croicensis* inspired 100 and 144 times per minute during the day and 56 times at night.

In several instances, under apparently anoxic conditions, some of the parrot fish formed the mucous envelope around their bodies in daylight. One specimen of *S. pachycephalum* and three of *S. croicensis* were observed to do this in aquaria where the running water supply had shut off. The water had been turned off about an hour and the temperature of the water had increased in two tanks each containing two fish. One specimen of *P. guacamaia* (about 21 cms. st. l.), presumably in a state of anoxia in a bucket, formed the envelope. In at least one instance, three individuals of *S. croicensis,* not under anoxic conditions but wedged in finger coral, formed the structure in daylight. It was also usually produced in tanks darkened during the day, although the formation time was about doubled.

When a light is turned on after the slime covering is formed, the fish breaks out in such a manner as to indicate that the envelope is sufficiently resistant to modify the first swimming movements. In 4 out of 7 instances, parrot fishes moved backwards out of the mucous fold. Twice they wiggled out sideways and once one swam forward out of it.

In one instance, the mucus at the front of a parrot fish was separated from the mouth. The fish then moved forward slightly so that the mucus again came in contact with the mouth and a new hole was made for breathing.

Discussion and Summary

The formation by parrot fishes of a large mucous envelope after dark is a remarkable behavioral trait that evidently has not been previously recorded. It has been observed both in aquaria and in the field. Four species apparently do this normally every night, whereas *Scarus brachiale* does not form the envelope. Most fishes are covered with a thin coat of mucus and its secretion is a slow, possibly continuous process. The behavior recorded here is a divergence from this pattern and seems to represent a rare specialization of the mucus-secreting system. More refined chemical differences may be present, but these have not been adequately investigated.

The structure has been described in the previous section. The fish utilize any object to swim into or lean against at night before the mucus is secreted. Precisely how the envelope is formed has not been determined. At the resumption of daytime activities the fish's behavior is modified in that the fish has to back out or wiggle vigorously forward to rid itself of the mucous coat. Preliminary data show that *S. croicensis* takes longer to form the structure and takes less time to break out than either *S. punctulatus*

or *Pseudoscarus guacamaia*. This seems to indicate that the latter two species have a higher threshold of reactivity to light stimuli under these conditions. The ecological significance of these differences is unknown. Two questions that arise are the nature of the physiological mechanisms involved and the function of this conspicuous mucous envelope.

Reid (1894) and Uhlich (1937) indicated that there is a direct reaction to touch or chemical stimulation of the mucus cells and possibly a nervous control. However, as they indicate, their experiments of direct stimulation of intact and excized skin do not seem to present critical evidence bearing on the latter conclusion. The reactions of parrot fishes to light and anoxia strongly suggest that there is a nervous control, at least in these fishes, although the possibility of hormonal influence cannot be eliminated. The lack of light, which is usually necessary for the formation of the envelope, leads one to believe that the stimulus is mediated through the eyes to the nervous system and finally to the mucus cells. However, it appears that anoxic conditions produce the same effect and presumably stimulate the respiratory system which relays to the nervous system. When in the dark, the fish's respiration is considerably lowered so that there may not be transmission through the optic system to the mucus cells, but instead the stimulus may be mediated by the respiratory system because of the reduced oxygen supply as under anoxic conditions.

The function of the mucous envelope is not clear and can only be speculated upon at this time. The envelope may protect the fish from nocturnal predators, since it would be particularly vulnerable when lying on the bottom. Protection against the settling of silt is one of several other possibilities. The nature of the mucous secretion in the parrot fishes may make it possible to test some of these supposed functions in future experiments.

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EXPLANATION OF THE PLATE

FIG. 1. Large mucous envelope around a rainbow parrot fish (*Pseudoscarus guacamaia*), standard length, 21 cms.

FIG. 2. On the left, mucous fold around a parrot fish, *Scarus croicensis*. On the right, another individual has freed itself from the mucous fold, which remains as a nearby oval mass of slime.

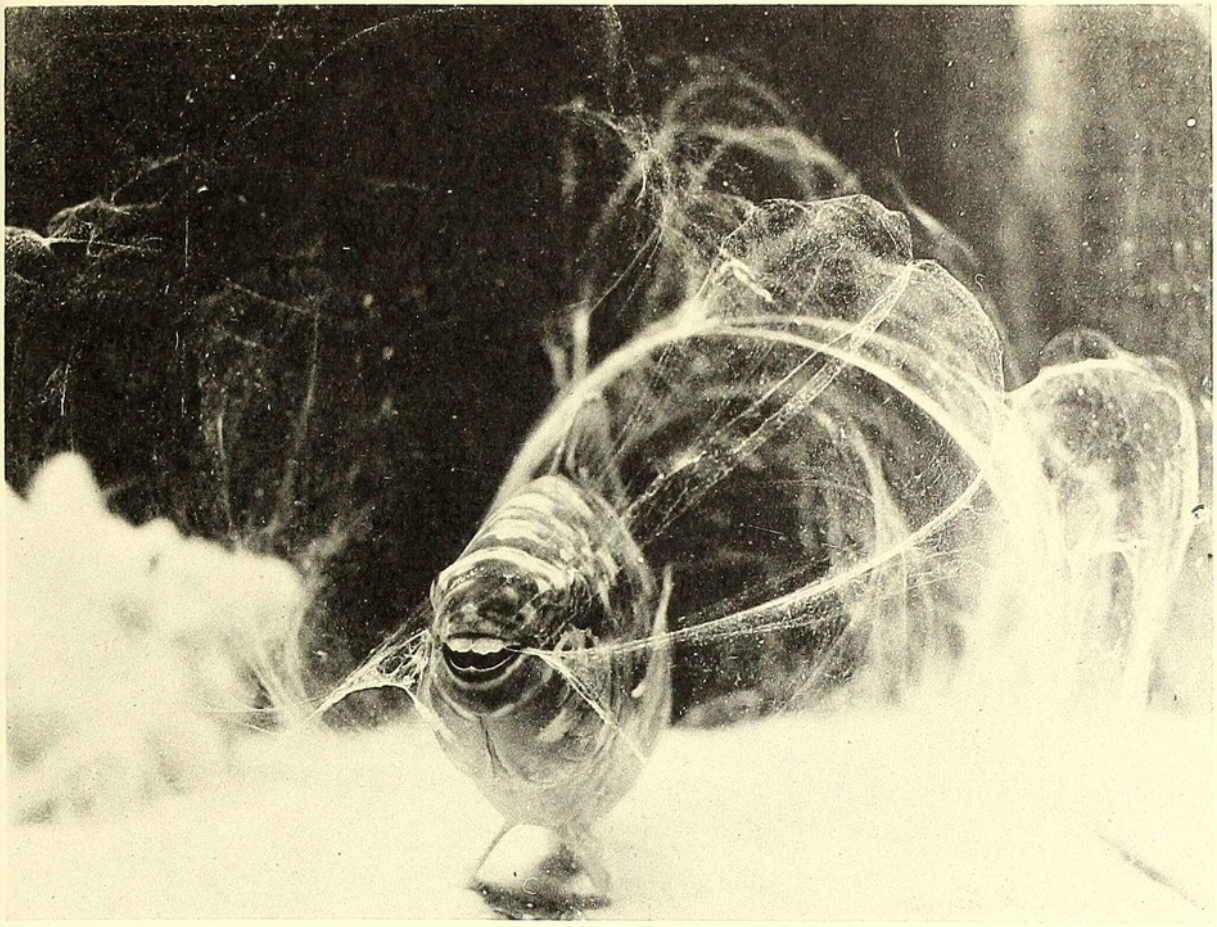

FIG. 1

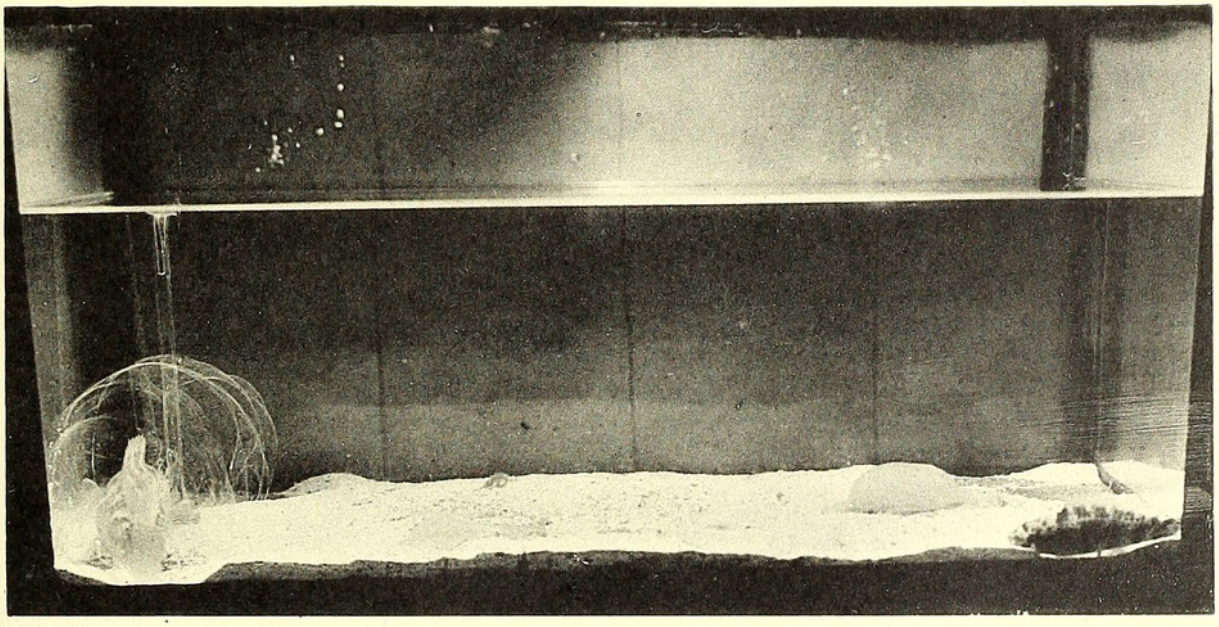

FIG. 2

FORMATION OF A MUCOUS ENVELOPE AT NIGHT BY PARROT FISHES