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PTEROPOD *CRESEIS ACICULA* RANG

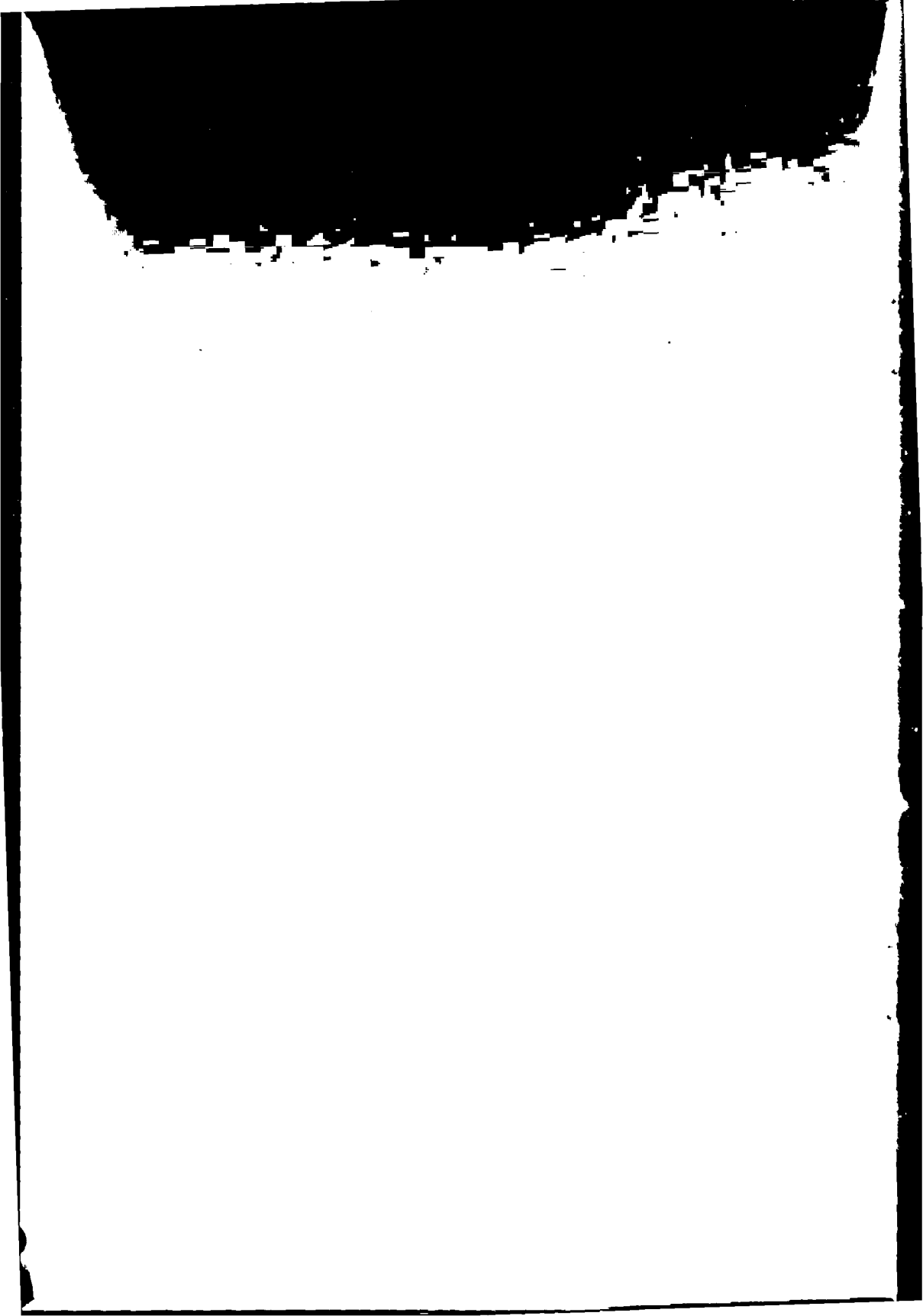
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# OBSERVATIONS ON THE BEHAVIOR OF THE PTEROPOD *CRESEIS ACICULA* RANG

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## ABSTRACT

Descent velocities of anesthetized and non-anesthetized specimens of the pteropod *Creseis acicula* Rang were compared. Anesthetized specimens with wings extended descended in a vertical position at a greater velocity than non-anesthetized specimens which invariably descended in a vertical position. Anesthetized specimens in which the animal was withdrawn into the shell descended in a horizontal position at a slow velocity. Non-anesthetized animals were observed to change their rate of descent. Rate of descent is probably controlled by the angle, pitch and horizontal breadth of the wings.

Pteropods have wing-like appendages, which are modifications of lateral lobes of the foot, on either side of the head. The manner in which these wings are flapped during forward movement has given the common name sea-butterflies to these minute pelagic gastropods (Fig. 1). In some pteropods the wing-like extensions also form an



FIGURE 1. Photomicrograph of ventral end of *Creseis acicula* Rang in horizontal position on glass slide with wings in swimming attitude. Magnification x 42. Photograph taken with polaroid type 46 projection film and phase microscope.

important part of the feeding mechanism (Hardy, 1956; Morton, 1954). This paper reports another usage of the wings, the control of the rate at which the pteropod descends through water. Knowledge of the mechanisms by which zooplankton ascend and descend might aid in determining the relative importance of the complex environmental factors such as temperature, light and pressure which seem to control the vertical distribution and diurnal migration of zooplankton (Moore and O'Berry, 1957).

During the early mornings of July 15-18, 1958, the pteropod *Creseis acicula* Rang, which bears a narrow cone-shaped shell, occurred in abundance in plankton flowing into Corpus Christi Bay through Aransas Pass, Texas. Living specimens were placed for observation in a glass cylinder having an inside diameter of 14 centimeters and containing a column of water 45 centimeters in height. Individuals were observed to swim from the bottom of the vessel to the surface of the water by rapidly flapping their wings while maintaining the long axis of the shell in a vertical position. Whenever wing motion ceased the specimens would slowly descend through the water with outstretched wings seemingly checking the velocity at which the animals descended (Fig. 2). In order to determine if the outstretched wings were actually slowing the rate of descent, the following experiments were performed:

1. The velocity at which 24 living specimens with their wings outstretched and the long axis of the shell in a vertical position descended through the lower 20 centimeters of water in the cylinder was measured using the sweep-second hand of a wrist-watch for timing (Table 1).

2. The velocity at which 15 specimens anesthetized with a 0.5% solution of chloretone descended through the same water column was measured (Table 1). These specimens became anesthetized with the wings projecting from the shell in a seemingly relaxed position. The shells descended in a vertical position.

3. The velocity of descent of 18 anesthetized specimens was measured in the same manner as above (Table 1). These specimens, by chance, had become anesthetized with their bodies withdrawn into the shell and descended through the water with the long axis of the shell in a horizontal position.

All the non-anesthetized animals and the animals anesthetized with wings extended descended with the shell vertical. All animals anesthetized with body withdrawn descended with the shell horizontal. One

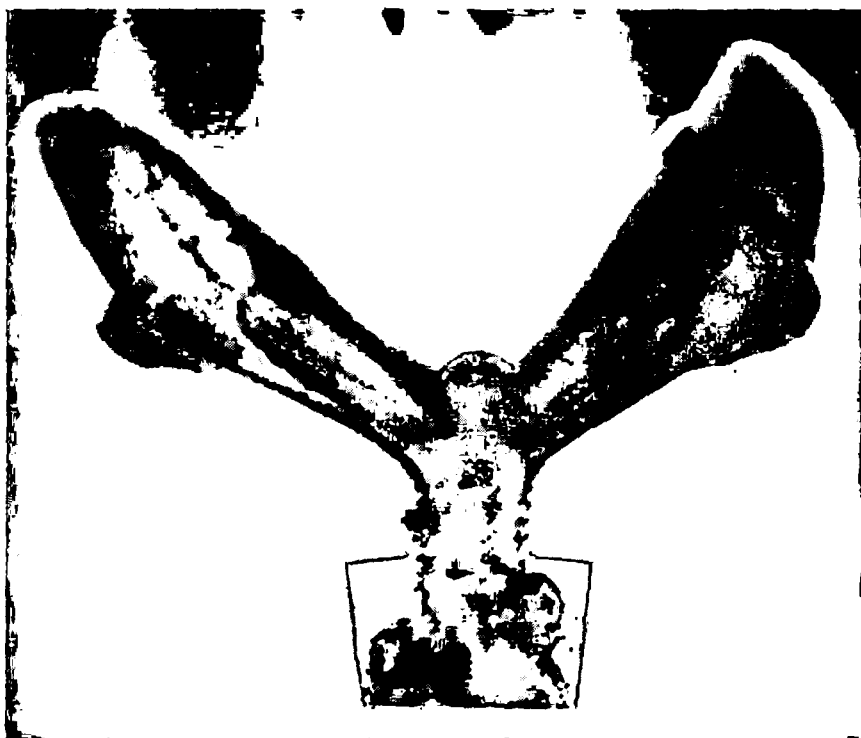


FIGURE 2. Photomicrograph of ventral end of *Creseis acicula* Rang in horizontal position on glass slide with wings outstretched as when descending through water. During descent the wings are pitched in the same direction. Magnification x 42. Photograph taken with polaroid type 46 projection film and phase microscope.

specimen anesthetized with body withdrawn recovered and extended its body during descent. The shell at this time immediately went from a horizontal to vertical attitude.

The specimens which became anesthetized with wings extended descended more rapidly than did the non-anesthetized specimens even though the position of the shell was the same under each condition. The mean descent velocities were different at the 5% probability level. This is interpreted as indicating that living specimens are able to retard their rate of descent probably by manipulating the angle, pitch, and horizontal breadth of the wings. This interpretation was supported by the behavior of individual organisms which were observed to first descend rapidly, then more slowly, and then again rapidly.

The anesthetized specimens with body withdrawn descended more slowly than the anesthetized specimens which descended with the shell in a vertical position. This is very likely because the shell presents poor streamlining when descending in a horizontal position. The mean velocity of descent of non-anesthetized forms were not statistically different at the five per cent probability level from the mean velocity of descent of the anesthetized shells which descended with the shell axis horizontal.

TABLE 1  
VELOCITY OF DESCENT OF *Creseis acicula* RANG (CM/SEC.)<sup>1,2</sup>

Item	Non-anesthetized Specimens		Anesthetized Specimens	
			Long axis vertical during descent	Long axis horizontal during descent
Number of specimens		24	15	18
Mean descent velocity		1.15 cm/sec.	1.55 cm/sec.	1.05 cm/sec.
Standard deviation		0.31 cm/sec.	0.36 cm/sec.	0.19 cm/sec.
Variability		27	23	18
Observed range	0.72-1.80 cm/sec.		1.11-2.50 cm/sec.	0.83-1.34 cm/sec.
2 standard errors of the mean		0.13 cm/sec.	0.18 cm/sec.	0.09 cm/sec.

<sup>1</sup>Temperature and salinity of the water was 31 deg. C. and 33.9 parts per thousand, respectively.

<sup>2</sup>Specimens varied in length from 3.5-6.5 mm. Length of specimen did not seem to affect velocity of descent.

It is interesting to speculate concerning reasons for the behavior of this terpod. *Creseis* has two ways in which to try to escape from its enemies. It may retract its body inside of the shell or it may flee. Although retraction of the body inside the shell might be able to protect the soft body of *Creseis* from small predators, it affords no protection from those animals which swallow the animal whole. In order to escape large animals, *Creseis* must flee. The velocity at which three specimens of *Creseis acicula* ascended through 45 centimeters of water at a more or less steady pace was measured to be 1.28, 2.5, and 3.0 centimeters per second, respectively. These animals were able to ascend more rapidly by swimming than they were able to descend through the water by gravitational pull. It would seem therefore that *Creseis*

could escape its enemies more readily by swimming than by any other means. However, observations in the laboratory indicate that the shell of these animals maintains a vertical position during swimming and the principal direction of movement is upward and there is relatively little lateral change of position by swimming. Also descent was always by the parachute-like action described above. Occasionally an individual near the water surface would perform a loop after which it would descend, but, otherwise, all swimming motion was confined to the animal remaining stationary in the water column or ascending. In order to test the reaction of *Creseis* when disturbed, several specimens, which were maintaining themselves near the surface, were tapped lightly with a pencil. They momentarily retracted their bodies inside the shell but then extended their wings and "parachuted" to the bottom. As most pteropod predators probably live near the surface, the principal direction of escape for the pteropod is down. Therefore, the method by which the descent is made assumes importance as a possible escape mechanism. The animal is able to maintain the shell in a vertical position by extending the body outside of the shell. This permits more rapid descent than if the body were withdrawn and the shell allowed to descend in a horizontal position. In nature, the animal was not observed to make use of the additional velocity made available by descending in a vertical position, but, on the contrary, slowed down its rate of descent by wing manipulation.

Oppenheimer (personal communication, 1958) has observed that cilia around the mouthparts of *Creseis a.* continue to operate even though the wings are not in motion. Perhaps pteropods slow their descent when passing through a particular nutritious stratum of water. However, this could not have been the reason for the variation in descent velocities observed in the laboratory in essentially homogeneous water.

In conclusion, it appears that when the wings of *Creseis acicula* Rang are extended the shell of this organism is able to maintain a vertical position during descent. The rapidity at which the descent is made seems to be controlled by the attitude of the wings. Faster descent is possible with the shell vertical than horizontal with the animal withdrawn into the shell. Horizontal descent does not seem to take place in nature. It has been postulated in this note that the behavior of *Creseis acicula* during descent might be an escape mechanism or related to feeding habit.

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