

FORAGING TECHNIQUE AND MOVEMENT STRATEGY OF CYPHOMA GIBBOSUM ON
GORGONIA VENTALINA IN GREATER LAMESHUR BAY.

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ABSTRACT

For the first day of experimentation, I located all Cyphoma gibbosum within thirty feet in every direction of the transect. For the next six days, by means of observation, I discovered their foraging technique and movement strategy. After tracing the outline of the Gorgonia ventalina onto mylar paper I plotted the Cyphoma gibbosum's position and foraged path each day. From this, I calculated the area foraged as well as the distance moved. It was discovered that Cyphoma gibbosum foraged and moved using three basic strategies: straight line movement and simultaneous foraging up and down the Gorgonia ventalina, random movement and simultaneous foraging within the same limited area, movement and foraging along a main vein. I discovered that regardless of which technique utilized, Cyphoma gibbosum foraged an area of approximately 2.2 cm squared ~~per day~~.

INTRODUCTION

Phylum Molluska
Class Gastropoda
Subclass Prosobranchia
Order Mesogastropoda
Family Ovulidae
Genus Cyphoma
Species gibbosum (The original taxonomic key can not be
obtained. This is from Eisenberg 1981)

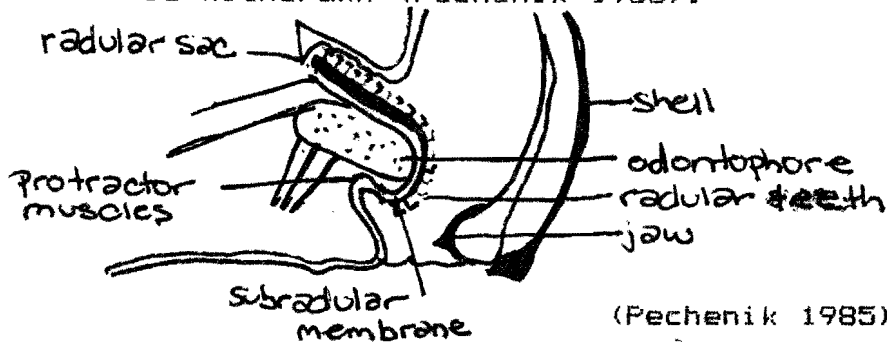
Cyphoma gibbosum is a spindle-shaped gastropod. The mantle is cream-colored with irregular yellow-tan spots outlined in black. When the animal is irritated, this mantle is retracted, exposing a pinkish orange and white shell. It exists in shallow water on fan-shaped and whip-like gorgonians.

Gorgonia ventalina is commonly referred to as sea fan. The colony possesses an axial skeletal structure of either a horny or calcareous central cylinder or a zone of tightly bound spicules. It has an erect skeletal structure attached to a soled substrate by a holdfast. Generally, the plane of the fan is oriented perpendicular to the direction taken by incoming waves (Colin 1978).

The purpose of this research was to study one aspect of the interaction between the Cyphoma gibbosum and the Gorgonia ventalina. The aspect under consideration consisted of studying foraging and migration of the Cyphoma gibbosum, and it therefore proves necessary to read and understand background information on

feeding and movement techniques.

The Cyphoma gibbosum possesses a radula which is the main feeding structure. The radula consists of a firm ribbon, made out of chitin and protein, along which are found rows of sharp teeth. The ribbon is produced from a radular sac, and is underlain by a supportive cartilage-like structure called the odontophore. The buccal mass is a term used to describe the odontophore-radular assembly, together with its complex musculature. For feeding, the buccal mass is protracted so that the odontophore extends just beyond the mouth. The radular ribbon is then moved forward over the tip of the supporting odontophore. As each row of teeth bends at the tip of the odontophore, the teeth automatically stand upright and rotate laterally. The teeth bore into the flesh of the gorgonian and tear pieces loose, bringing the food into the mouth as the radula is withdrawn (Pechenik 1985).



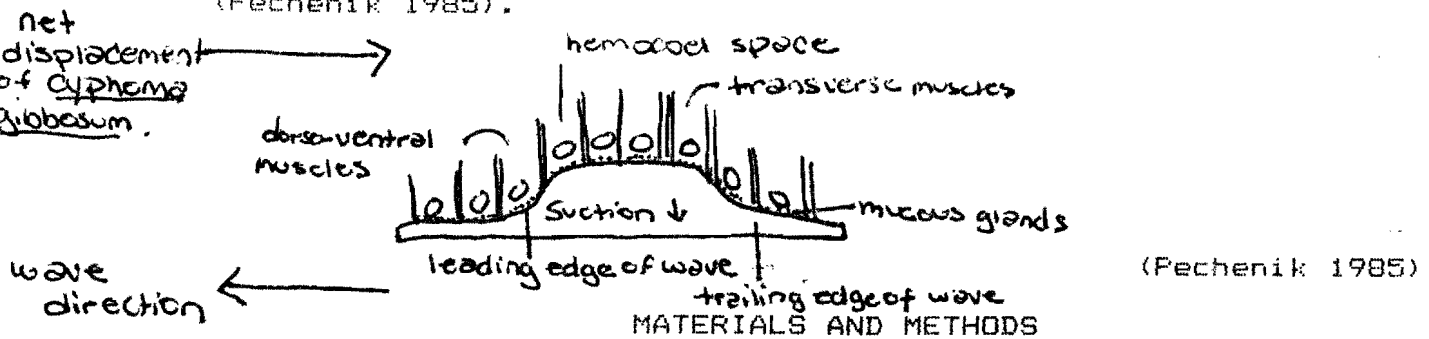
(Pechenik 1985)



(Kaether 1967)

The Cyphoma gibbosum move by means of pedal waves of small muscle contraction. The foot is a muscular mass that forms the ventral part of the body. The musculature is mostly vertical; no circular muscles are involved. Hemocoelic spaces are interspersed between regions of vertical musculature. At the start of a pedal wave, the dorso-ventral musculature contracts at the anterior portion of the foot. Apparently, the transverse muscles do not relax, preventing the increased hemocoelic pressure from causing the foot to widen. Instead, the foot is extended forward by the increased hydrostatic pressure in the hemocoel. A wave of contraction of the dorso-ventral musculature then follows, moving posteriorly. The edges of the foot are temporarily sealed against the substrate with mucus secreted by glands on the foot, so that a small suction is generated between the substrate and the raised portion of the foot. If the hemocoelic spaces at the leading edge of the wave are closed off from the general circulation, they become squeezed up against the overlying musculature. This increase in pressure helps bring about the re-extension of the dorso-ventral musculature at the trailing edge of the wave, by exerting downward force when the dorso-ventral muscles relax. The re-extension of the dorso-ventral musculature is also aided by the suction created beneath the raised portion of the foot; this space thus acts as a hydrostatic skeleton, allowing the musculature at the forward edge of the wave to antagonize that at the trailing edge. The hydrostatic skeleton operates through a temporary pressure decrease; essentially sucking the raised portion of the foot

downward, rather than through a temporary pressure increase (Pechenik 1985).



MATERIALS AND METHODS

MATERIALS

calculator
mylar sheets

pencils
notebook

ruler
SCUBA equipment

METHODS

I used the first day of the experiment to comb an area of thirty feet out in every direction from the transect. Once discovery was complete, experimentation began. I used mylar sheets onto which I traced the outline of Gorgonia ventalina. For each of the six remaining days, I wrote on this map the position of the Cyphoma gibbosum and the foraged path (which could easily be distinguished by a change in color from purple to black of the gorgonian's flesh). I also made notes on its orientation in relation to weather and currents. Each day, after this process was completed I again combed the area in order that I may discover new Cyphoma gibbosum in the area. If I did, I began the process again.

At the end of each dive, I transferred my data onto paper. I then measured how large an area it foraged and how far it moved.

At the end of the seven days of experimentation, I began the analysis of the information.

RESULTS

Table 1. Area Foraged and Distance Traveled of Cyphoma gibbosum on Gorgonia ventalina in Greater Lameshur Bay.

NO.	TYPE	AV AREA Per-day	AV DIS Per-day	1	2	3	4	5	6	7
1	A	2.1	9.6		1.7	1.8	2.4	2.3	2.2	2.1
					10.3	7.1	14.0	9.2	8.6	8.4
2	A	2.2	10.1		2.0	2.6	2.1	2.0	2.3	2.1
					7.8	15.0	8.3	12.0	9.1	8.4
3	A	1.9	8.8		1.6	2.0	2.0	2.1	1.9	2.0
					6.5	8.0	14.0	8.4	7.6	8.0
4	A	2.0	8.7				2.3	1.8	1.6	2.4
							11.0	7.3	6.7	9.7
5	A	2.3	9.1		2.0	2.6				
					8.0	10.3				
6	B	2.0	2.0		1.5	2.0	2.2	2.4	1.6	2.2
					1.5	2.0	2.2	2.4	1.6	2.2
7	B	2.2	3.3		2.0	0.9	3.0	1.6	3.2	2.3
					2.0	8.0	3.0	1.6	3.2	2.3
8	B	1.9	6.1		2.1	1.5	2.0	1.2	2.5	2.0
					2.1	5.5	3.0	15.0	2.5	9.0
9	B	2.5	1.2		2.3	3.2	2.1	3.2	2.5	1.4
					2.3	3.2	2.1	3.2	2.5	1.4
10	B	2.3	4.7		2.4	1.4	1.7			
					2.4	16.0	1.7			
11	B	2.6	2.6				2.3	2.7	2.3	3.0
							2.3	2.7	2.3	3.0
12	C	0.45	0.50		0.5	0.0	0.7	1.2	0.3	0.0
					0.5	0.0	0.5	1.4	0.3	0.0
13	C	0.53	0.60		0.3	0.0	0.0	0.8	0.5	0.0
					2.0	0.0	0.0	0.8	0.8	0.0

The first number in each column is area foraged a day
The second number in each column is distance foraged a day

Figure 1. Area Foraged vs. distance travelled of Cyphoma gibbosum on Gorgonia ventalina.

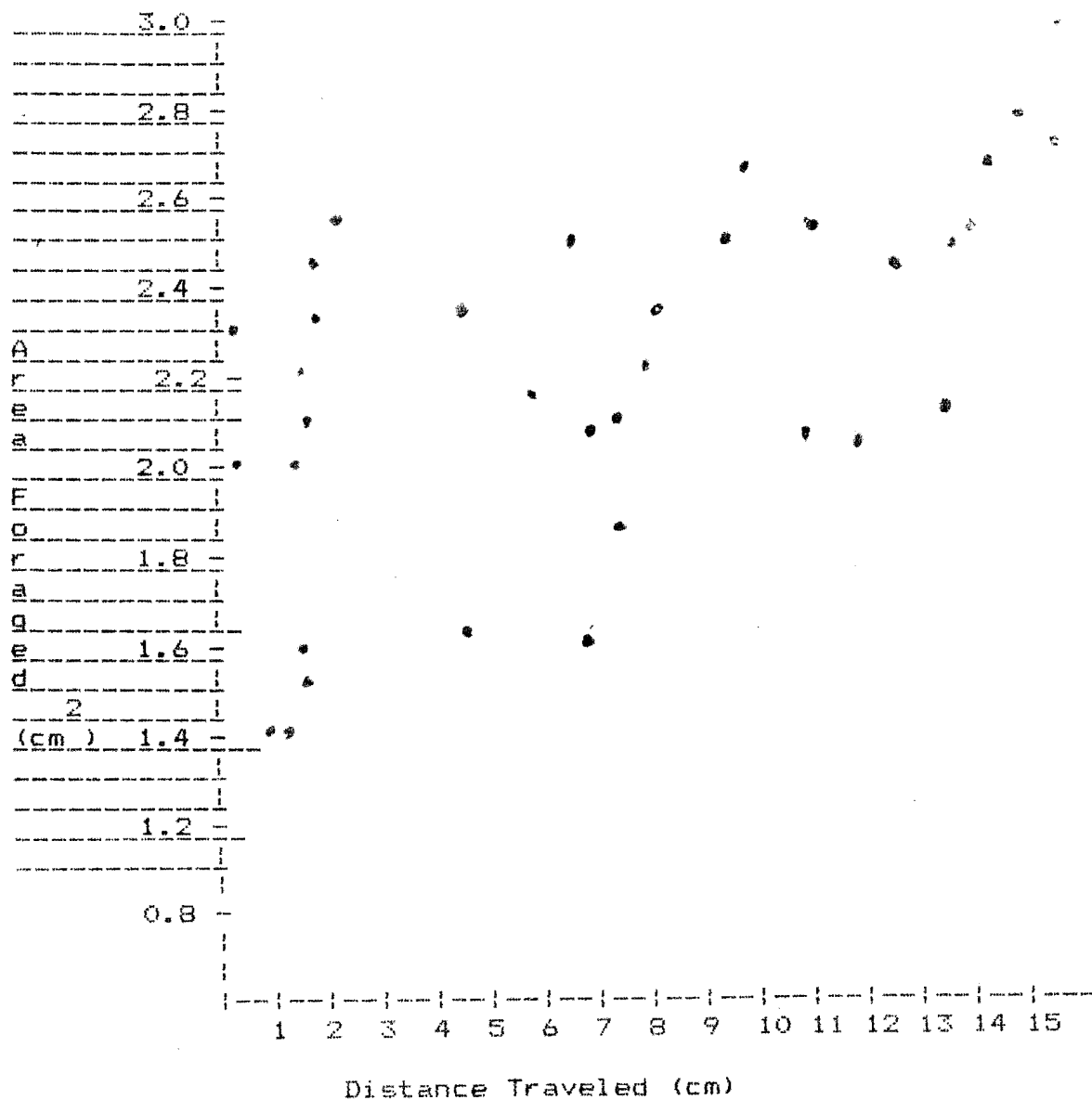


Figure 2. Probability of Cyphoma gibbosum being on the leeward side of Gorgonia ventalina

$$= \frac{1}{13} = \frac{1}{8192} = 1.22 \times 10^{-4}$$

DISCUSSION

Although I could not see much detail, after careful observation, I was able to see how Cyphoma gibbosum forage and move.

Antennae protruded and felt the area in front of the Cyphoma gibbosum. Afterwards, the radula projected onto the Gorgonia ventalina and wrapped itself three-quarters of the way around the sea fan's skeleton. I saw the radula's slight movement as it ate. At times the radula would let go of its grip as the antennae sensed the situation. It would then resume eating again.

In order to grip onto the sea fan as well as move along it, Cyphoma gibbosum extended its foot which appeared as a large muscular mass at the ventral part of the body. The edges sealed against the skeleton. It would then pull the Cyphoma gibbosum towards the direction of extension. This process would continue for the duration of the migration.

Many conclusions can be drawn from the observations and calculations of foraging and movement of Cyphoma gibbosum.

Three types of foraging and traveling strategies are used:

Type A straight line movement and simultaneous foraging up and down the sea fan.

Type B random movement and simultaneous foraging within the same limited area.

Type C movement and foraging along a main vein.

Type A

Although all traveled and ate in basically a straight line, the specific technique of type A varied. Some traveled far, up to 14 cm, and created a very narrow path of foraged gorgonian. Others traveled a shorter distance, as small as 7.1 cm, and created a thicker path of foraged gorgonian. Regardless of which system, the area of foraging was basically the same ranging from 1.6 cm to 2.6 cm. Some chose to travel in a certain path one day and then to repeat this same path the next day, making it thicker and longer and continuing this up and down foraging for some days. Others never repeated their path but continued in a one directional straight line.

Type B

Foraged area appeared random as the Cyphoma gibbosum moved up and down, side to side in the same basic area. All movement was to forage, and when the Cyphoma gibbosum traveled it did so only to relocate itself on another part of the fan to begin the same type of foraging strategy. A good example of this is number 7, who foraged an area using type B, moved 8 cm to another part of the fan, and resumed type B again. For the 8 cm of movement, no gorgonian was eaten.

Type C

Cyphoma gibbosum of Type C moved extremely little as they traveled up and down the main vein of the gorgonian. Although it appears from Table 1 that they foraged a smaller amount than those of Type A and Type B, this is not true. They actually ate

the same amount, yet it was not in distance but in depth. Being located on the vein provided them with a thicker substrate to eat. Thus they traveled up and down randomly, eating a greater depth of the vein.

Regardless of the type of movement and foraging technique, all Cyphoma gibbosum ate somewhere between .9 cm and 3.2 cm of Gorgonia ventalina. If they traveled fast and far, then the foraged path was long and narrow. If they traveled slow and short, their path was small and deep. The lack of correlation between distance and area foraged is proven in Figure 1.

A correlation can be made, however, between the orientation of the Cyphoma gibbosum on the Gorgonia ventalina. It was observed that all the Cyphoma gibbosum were located on the leeward side of the fan. The probability of this happening non randomly is a 1.22×10 percent chance as shown in Figure 2. Thus, Cyphoma gibbosum have a way of choosing which side of the Gorgonia ventalina to exist on. It makes sense for them to choose the leeward side, in order that they may avoid the possibility of being knocked off of their substrate.

Cyphoma gibbosum's orientation also depends on the weather. I observed that during high energy days, the Cyphoma gibbosum oriented itself on or near a vein, or near the center part of the Gorgonia ventalina. Ones that were not at these locations were found missing after a high energy interval as seen with number 5. Some Cyphoma gibbosum (numbers 3 and 10) traveled a far distance (8 cm and 16 cm respectively) in order to orient themselves in a more favorable position during a high energy time.. IN two other cases (numbers 4 and 11) new cyphoma were found after the rough day. They could possibly be other Cyphoma gibbosum that were removed from their original substrate.

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