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Herbivory on Palatable Plants at Different Depths
and in Association with Unpalatable or Poisonous
Marine Animals by John O'Hara

Abstract: This study, performed on a heavily fished reef at Discovery Bay, Jamaica, retested two hypotheses originally tested on a reef in Belize. While work in Belize demonstrated that herbivory decreases with depth and that palatable plants suffer less herbivory when associated with certain animals, this study in Jamaica failed to support these findings. Herbivory did not vary with depth, and associations with Gorgonia or Millepora did not decrease grazing; although there was some indication that association with Tallogorgia may be effective in decreasing herbivory.

Introduction

In order for a marine plant to survive in a coral reef

environment, it must somehow avoid lethal levels of

predation by herbivorous fish. A plant can avoid predation

by producing substances that are distasteful or poisonous to

the predator, or by colonizing areas where the predator is less

abundant or does not feed. Work in Belize demonstrates

that palatable plants suffer less herbivory when associated with

large predation-resistant animals like the sea fan Gorgonia

ventalina or the fire coral Millepora alcicornis (Littler

et al., 1987). Another study in Belize demonstrates that

herbivory pressure also changes with depth, with high

grazing rates in shallow water and lower grazing rates

in deep water (Hay, 1981).

This study attempts to reevaluate the Belize findings

at Discovery Bay in Jamaica, a reef that is recovering

from a severe hurricane in 1980 and is disturbed by

heavy fishing. The study reexamines the Belize findings

and also examines grazing on plants associated with
Nephtheis digitata

another toxic animal, the tube sponge ~~Lissoclinum vaginale~~

(Hendler, 1984). The study tests the following

hypotheses:

① A pollatable plant will suffer less herbivory when associated with a distasteful or poisonous animal.

② Herbivory will decrease with depth.

Methods

The study was conducted at Discovery Bay Marine Laboratory in Jamaica, W.I. for 2 weeks during February and March, 1988. I did four experiments, one to analyze herbivory at different depths on the fore reef and three others to analyze herbivory on plants associated with sea fans, fire coral, and tube sponges. In all ~~the~~ four experiments, cloth pins holding pre-cut *Thalassia testudinum* (a total blade area of 36 cm^2) blades were anchored to the bottom and herbivory was measured by the area of the blade removed in 24 hours.

Thalassia was used because field studies have demonstrated that it is a preferred food of herbivorous reef fish (Ogden, 1976). For the depth study, one pin was anchored every five feet from 20 to 70 feet along the edge of a

large coral buttress. For the other experiments, pins were
as a test,

anchored on the animals and ~~the same number were~~

~~anchored~~ nearby but out of the animal's influence as
individuals

a control. Three to five of each animal type were

studied. The sea fans were all at 50 feet, the fire coral

was at 20 feet, and the tube sponges ranged from 50 to
~~40 to~~
~~40~~ feet.

For the analysis, each animal pin coupled with its

control pin was considered one replicate for each day the

pins were checked. For the depth study, ^{average} area of blades

removed was plotted against depth; and for the animal

studies the data was divided into two groups: less than

13 cm removed and 13 cm or ~~more~~ ^{more} removed.

A chi-square test was used for the Glycophyllum study studies.

and G-tests were used for the Millepora and the sponge were

The data was analyzed in this fashion because the

blades were generally completely grazed or untouched, themselves

so the data did not lend itself to parametric

analyses.

Results

Herbivory did not vary with depth ($r^2 = .001$) and most of the blades were ~~grazed~~ at all depths (Fig. 1).

The average area removed is the average of five replicates at each depth, and in all of the replicates either the entire 26 cm was removed or the blades were untouched. Bites in the blades were small indicating that most of the herbivory was by smaller fish, and parrot fish were the main predators.

Observations revealed that 5cm could be removed in 20 minutes, and on one occasion every pin except for 50' and 30' showed complete blade removal in a 5 hour period.

The 50' pin was located within five feet of a tube sponge ~~and~~ which might explain why it suffered no

herbivory. There was nothing that appeared unusual about the location of the 30' pin that also had no herbivory.

sea fans (*Borgonia*)

Blades located near \downarrow *Borgonians* suffered no less predation than the control blades (table 1).

Table 1

	Near Gor.	Control	
area removed:	$\geq 13\text{ cm}$	29	31
	< 13cm	6	4

$\chi^2 = .46$
 $p > .1$

There were 35 replicates consisting of five animals observed over seven days. Again most of the herbivory was either complete, or the blades had only a few small bites.

Avg. Blade Area Removed per
Day vs. Depth

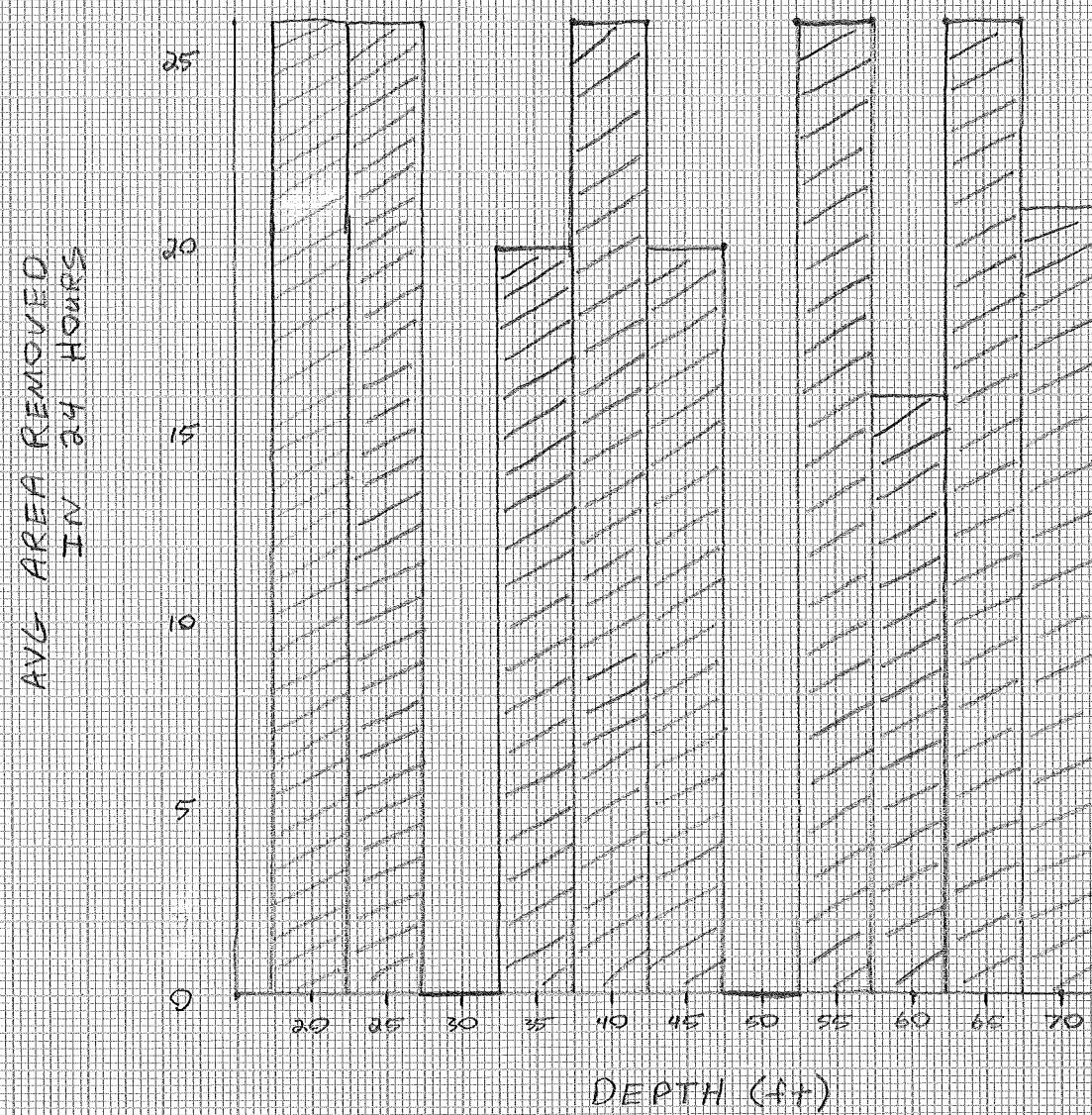


FIG. 1

The blades located near Millepora suffered no less predation than their control blades (table 2).

table 2

	Near Mill.	Control	
area removed: $\geq 13 \text{ cm}$	11	12	$G = 1.44$
$< 13 \text{ cm}$	1	0	$p > .1$

This study had 12 replicates consisting of 3 Millepora stands observed over 4 days.

The blades located near tube sponges showed statistically no less herbivory than the control, although as the data indicates, there were fewer blades removed near the sponges (table 3).

table 3

	Near Sponge	Control	
area removed: $\geq 13 \text{ cm}$	4	7	$G = 2.74$
$< 13 \text{ cm}$	4	1	$p > .1$

It is important to note that one test blade near a

Sponge ~~xx~~ had exactly 13 cm removed. Of this

data point is considered in the <13 group, thus $t = 4.44$

and $p < 0.05$, which is significant with $p < 0.05$. As

with the other experiments, the other blades were completely

taken or left ~~xx~~ untouched. There were 8 replicates

consisting of two sponges observed over four days.

Discussion

The results from this study in Jamaica do not support the results of earlier work in Belize. In Jamaica, herbivory did not decrease with depth and herbivory on T. thalassia was not reduced by association with G. dugonina or M. nigrolineata. The different finding could be explained by disturbances on the Jamaican reef. Heavy fishing that has gone on for many years and continues at present has resulted in the removal of most of the large fish from the reef. Without these large fish, many of which may feed on smaller herbivorous fish, the smaller fish increase in numbers and herbivory pressure increases greatly. The result would be smaller fish feeding ^{are} As a result, the smaller fish ~~would be~~ forced to feed on

plants

less preferred slope as their natural food supply is

grazed away. Grouped with these less preferred

plants

slope would be palatable species in association with

distasteful or poisonous animals and deeper species.

It is possible that deeper plants are less preferred because

they are further from shallow nests or territories. On the

other hand, deeper plants may no longer be less preferred

because the predation risk has been removed. The end

result is that less predators and more small herbivorous

fish lead to herbivory on low preference plants that

would be left ungrazed on an undisturbed reef.

This argument could explain the finding and

it gains additional support from observations that

most of the herbivory on the Thalassia was by smaller fish. The herbivory also took place very quickly, as observed in the depth study, which supports the idea that grazing pressure is very high on the reef.

The experiment with the tube sponge was initiated because of observations from depth study indicating that the sponges might decrease herbivory. Because the experiment was started late, sample size was low and this could explain why the findings were not significant. Trends in the data do indicate that the sponges inhibit the grazers more than Gorgonia or Millepora, and I feel that further work would demonstrate this even on Jamaica's ~~to~~ ~~to~~ less herbivory near the sponges.

Experimental factors explaining the results could

be the amount of *T. ballastia* offered and the interval

at which the pens were observed. It is possible that

while herbivory pressure is great, if enough food is offered
grazing is monitored

or if the food is checked at a short enough interval, difference

in herbivory might be observed. From a biological
though,

standpoint ~~this~~, this difference ~~even if it existed~~ would

not be important because it is evident that a palatable

plant would not survive in any of the locations tested.

Complete grazing just once a week would prevent the

survival of the plant. It becomes evident ~~that~~ that

simple associations are not sufficient protection on a reef ~~to~~

with severe grazing pressure, and perhaps only by producing

its own defenses can a plant survive in this environment.

This study raises two questions that I feel deserve further research. Additional work with the sponge I feel will bear out significant results. This work could be continued by looking at the sponges to determine why they prevent herbivory. The high rate of herbivory on the reef also makes this site an excellent place to examine algal preferences. Once a preference hierarchy is established, further work might reveal why certain algal species are preferred less than others.

1981

Preferences

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