Foraging By Conspecific Individual Sea Urchins, and Conch

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FINAL REPORT

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FORAGING BY CONSPECIFIC INDIVIDUAL SEA URCHINS AND CONCH

by
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NATIONAL UNDERSEA RESEARCH PROGRAM

At West Indies Laboratory
Fairleigh Dickinson University
HYDROLAB PROJECT

St. Croix
U.S. Virgin Islands

REPORT TO NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, DEPARTMENT OF COMMERCE, UNDERSEA RESEARCH PROGRAM

FORAGING BY CONSPECIFIC INDIVIDUAL SEA URCHINS, AND CONCH.

-FROM RESEARCH GRANT TO CHRISTOPHER L. KITTING, Ph.D.*
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ST. CROIX, U.S. VIRGIN ISLANDS

Basic Overview : Field experiments monitored in situ showed that foraging by common, large invertebrate herbivores among tropical seagrasses, Tripneustes ventricosus sea urchins and Strombus gigas conch snails, causes visible damage to food plants normally during rare, often isolated events. Total resource use can appear to be quite broad, although apparent differences in food selection between larger and smaller sea urchins suggest such non-selectivity only when such size-classes are pooled.

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"Quick-look Report' ABSTRACT:

Intensive, repeated monitoring of apparently identical individual animals among their foods can test for interphenotypic (=intraspecific) resource partitioning and it ecological consequences on resources such as foods. Such intraspecific partitioning may become as important in research as the more familiar interspecific resource partitioning has been.

Foraging influences: of two increasingly important fisheries species, Tripneustes ventricosus (sea urchins) and Strombus gigas (conch) were monitored as individuals foraged among designated sets of major available foods. Major foods provided in the experiment were seagrasses (Halophila and Thalassia), large benthic algae (Padina, Dictyota, and Halimeda), and an algal turf growing on coral rubble. Each food type could be used directly or browsed during removal of epiphytes. Initial observations raised the possibility of individually different feeding selectivity within each of these two animal species.

It was necessary to transplant adult Tripneustes temporarily from shallow patch reefs (see Fig. 1 and table 1), along with algae on coral rubble and turtle-grass, to a deeper experimental plot immediately outside the major port-hole of Hydrolab. Although two rare juvenile Tripneustes were found in the adjacent, deep Halophila beds, adult Tripneustes normally does not occur in the vicinity of Hydrolab.. At that experimental depth, environmental conditions (e.g. surg) are more benign, and drifting plants (which would introduce a highly variable food resource) are less common than at shallower depths.

The average diameter of Tripneustes used was 15 cm, ranging from 12 cm to 18 cm. This variation in size (once divided into plots Of five distinct urchins

each) was used to identify individual urchins, along with a code of markings made with fingernail polish on the urchin spines in aboral and equatorial positions.

Six individual plots were constructed with closely spaced monofilament lines strung between wooden stakes. Four plots measured 1 X I m and two plots' measured 2 X 1 m. Similar amounts of transplanted algae and seagrasses were placed in each plot. Five urchins were placed into each of the two 2 X 1 m plots and into two of the 1 X 1 m plots. The remaining two 1 X 1 m plots served as controls. Chicken wire was placed around and over the entire experimental area to deter large sources of disturbances such as stingrays.

A tripod-mounted, time-lapse 35 mm camera with 18 mm lens and flash with battery pack was used to monitor one of the 1 X 1 m plots. Kodachrome 64 was exposed at 16-minute intervals, with breaks of about two hours at various times during the 6 days of observation. These photographs will be used later in the laboratory to analyze foraging behaviors and impacts on foods. To detect hidden feeding noises, contact hydrophones were placed under patches of foods. Reliable taping occurred only when the Life Support Buoy was shut down for its daily check.

During collecting, transplanting, and subsequent experiments, Tripneustes appeared to be very susceptible to a disease, the signs of which include deterioration of the mouth and loss of spines. This disease may be related to that causing the decline of Diadema antillarum, formerly the especially common sea urchin in the Caribbean. We regretted the high mortality despite careful collection, with both densely and sparsely populated containers, for both long and short intervals. Only seven Tripneustes continued to feed throughout the experiment. Following the mission the urchins were returned to patch reefs 2 and 3 in Teague Bay. The other thirteen died (with the above signs) within the first 3 days of the 7-day field experiment.

Kitting and Dempsey tabulated individual foraging behaviors by observing (at 8-hr intervals 3 times per day) individual feeding occurrences on various foods (summarized in Table 3). At the same times, Odum scored food availability at 10 radial points around each urchin (summarized in Table 2).

Initial assessments of the urchin foraging data suggest that individuals frequently changed their location, food, and algae held on test surfaces (urchin "hat") (summarized in Table-3). No major intraspecific resource partitioning is yet evident under these experimental conditions.

After the 6 days of intensive monitoring during the mission, the seven Tripneustes were. placed on the habitat itself, which is covered predominantly by a red algal turf. Three days later, their foraging trails were photographed to observe grazing rates on such a homogeneous surface. Fecal samples collected at this time reflected the available foods from 3 days earlier, such as sea-grasses, Dictyota fragments, and diatoms rather than the predominantly red algal turf on the habitat.

Because the sea urchins were not as numerous as we had expected, the giant conch, Strombus gigas, was used as the back-up organism we proposed to analyze similarly. Adult conch in their natural habitat of the Halophila seagrass beds were labeled in place then observed repeatedly. Labels included "tie-wrap" tags previously placed on the animals by Dr. M. L. Coulston, numbered reflective tape, and pencil markings on the underside of the animal's shell.

Three times daily (at 8-hr intervals) conch were sought for tabulations of their associated or actively rasped foods (summarized in Table 4). Dirnberger's photographs, anterior and posterior to labeled conch, will enable comparison of plant damage before and after shell and feeding abrasion.

Two conch were tethered to the habitat with 30-m hydrophone cables for audio recordings of their movements and feeding activities. These two conch were also observed three times daily as those sampled above.

Of the 59 conch observed for foraging data, only 30 were found two or more times. Their extreme mobility from day to day precluded extensive re-observation of many individuals. Only 9 were found three or more times, and 4 were found more than four times during the 6 days of observation. Over 30% were actively feeding during these systematic observations. Later, several conch were placed into a spare sea urchin experimental plot for more continous, qualitative observation outside the habitat's large porthole. An initial review of the data suggests the possibility that individual conch tend to forage on a distinct major food quite consistently through time. This would be evidence for intraspecific partitioning. Even for the relatively small numbers of repeated feeding observations, a simple mathematical model with a Markov chain, treating data from a number of individuals together, is being prepared to detect significant partitioning statistically.

Due to the welcome, expert assistance from Hydrolab's staff, particularly to Dr. Coulston, and our back-up research procedures and species, we were able to conduct this unusually detailed research quite successfully. Unusual results undoubtedly will appear further as we conduct follow-up photographic and audio analyses in the laboratory. Discovering the occurrence and extent of such hypothetical individual differences in various populations will have many implications, particularly for fisheries species being influenced by man. Such analyses are expected. to become critical in predicting and managing changes introduced to a population or its various subpopulations (phenotypes) being harvested; only particular phenotypes, if present, may persist and maintain portions of the populations as others are removed by either harvesting, disease, or other modifications of an environment used by a species as a whole.

TABLE 1. NUMBER OF URCHINS COLLECTED FROM PATCH REEFS IN TEAGUE BAY

REEF NUMBER	APPROXIMATE AREA (from WIL aerial photo) (m^2)	NUMBER OF TRIPNEUSTES. COLLECTED
1	1500	0
2	1500	19
3	1500	3
4	300	1
5	400	19
6	4000	4
7	400	0
7.5	1500	0
8	500	0
11	1000	20
13	1500	1
14	1500	4
15	4000	7
16	3000	6

-note that over 1/3 of this number of *Tripneustes* remained. Five others were returned to PR2 and three to PR3 .

FIGURE 1.
PATCH REEF NUMBERS
AFTER OGDEN, W/L

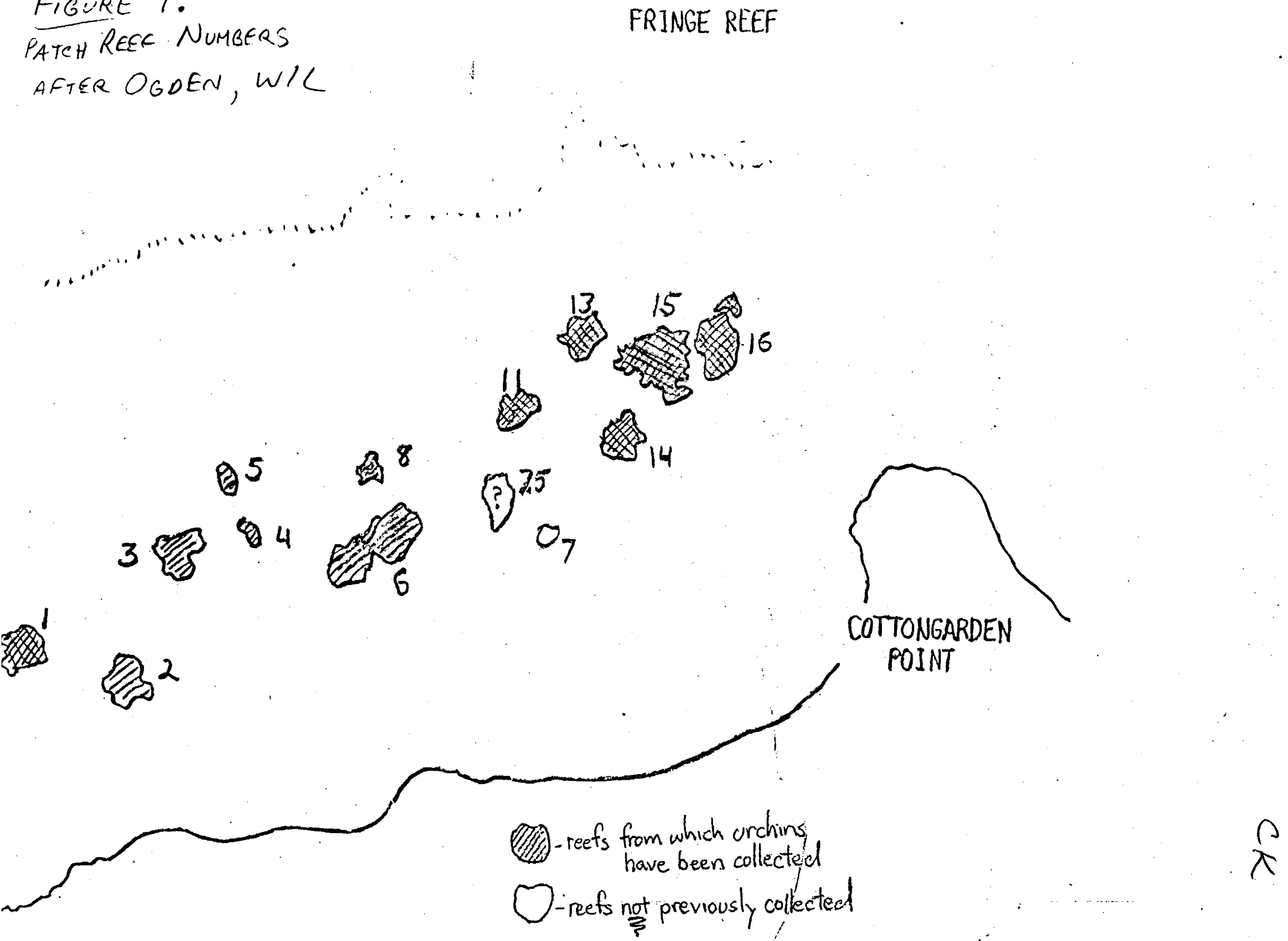

TABLE 2. SUMMARY OF ACCESSIBILITY OF MAJOR FOODS TO URCHINS IN EXPERIMENTS

FOOD	*PERCENTAGE
Halimeda	7.3
Padina	3.0
Dictyota	9.2
Thalassia	10.0
Sand	62.8
Coral rubble (with crustose coralline and small turf algae)	7.7

*Data consists of percentage of sample times that food was found adjacent to urchins. 10 points around each urchin were sampled each time.

TABLE 3. SUMMARY OF URCHIN FORAGING IN EXPERIMENT

FOOD	PERCENTAGE IN DIET
Thalassia	23
red algal turf	23
coral rubble	13
Padina	8
Halimeda	6
Dictyota	6
Caulerpa	6

TABLE 4. SUMMARY OF CONCH FORAGING, FOR THE MOST FREQUENTLY OBSERVED INDIVIDUALS

FOOD	NUMBER OF INDIVIDUALS OBSERVED FEEDING	TIMES FEEDING ON THIS FOOD *
Halophila	3	≥3
Caulerpa	1	≥3
Halimeda	1	≥3
all three	1	≥3

*out of 4 observations throughout several days

Two other conch tethered with hydrophones and several in time-lapse photo's are yet to be analyzed.