

— DRAFT —

RECOVERY OF BLEACHED SCLERACTINIAN CORALS IN
VIRGIN ISLANDS NATIONAL PARK
ST. JOHN, U.S. VIRGIN ISLANDS

Larry N. McLain
Caroline S. Rogers
Sean W. Baker

Virgin Islands National Park
P.O. Box 7789
St. Thomas, USVI 00801

March 23, 1989

Hi —

Good talking to you today —
This is for you and Tom R. only —

Please do not pass it along
to anyone else — your comments
would be helpful —

Cheers —

Caroline

Abstract. The coral bleaching phenomenon appeared throughout the Caribbean and western Atlantic in the summer and fall of 1987. General observations around St. John, U.S.V.I., showed that at least 16 species of hard corals growing near the surface down to a depth of 25 m lost their zooxanthellae. The following species exhibited the most bleaching: D. labyrinthiformis, D. strigosa, M. annularis, and A. agaricites. A total of 45 colonies of 5 species were tagged at 2 sites within Virgin Islands National Park. These corals were photographed and categorized as bleached, pale or normal periodically throughout 1988 and in January 1989. Some recovery of the bleached corals was noticed early in 1988. However, by the end of 1988, approximately 83% of the corals that were originally categorized as bleached or pale had not regained their normal color. Sixty percent of bleached corals and 21% of pale corals exhibited partial mortality 9 months after the beginning of the study.

Introduction

The coral bleaching phenomenon appeared throughout the Caribbean and South Atlantic in the summer and fall of 1987 (Williams et al. 1987). Here we report on bleaching observed on the coral reefs within Virgin Islands National Park (VINP), St. John, U. S. Virgin Islands (Fig. 1). Pale colonies of Millepora spp. were first noted in July of 1987. By October, hard corals of 16 species, from the surface to about 20 m, were exhibiting loss of zooxanthellae, with the following species apparently the most affected: Diploria labyrinthiformis, D. strigosa, Agaricia agaricites, and Montastrea annularis. Frequently, bleached corals were growing near normal colonies of the same species.

Around St. John, bleaching was most conspicuous in the hard corals, although some bleaching of the zoanthid Palythoa caribbea, the encrusting gorgonian Erythropodium, a few other species of gorgonians and at least one species of sponges was also seen.

General observations around the island were supplemented with more detailed studies at two sites within the park. In November of 1987, during the peak of the bleaching, we began a small pilot study to get preliminary information on the coral responses to bleaching and to develop effective methods for following these responses over time. A more extensive study was begun in March 1988.

Materials and methods

General observations

Between October 1987 and September 1988, 23 dives were made at 14 locations around St. John to record the hard coral species affected by bleaching from the surface to a depth of 25 m. More than one dive was made at Haulover Bay, Steven Cay, and off Reef Bay to allow for comparisons over time at these sites (Fig. 1).

Coral tagging studies

The pilot study was carried out at Henley Cay, a small island located in the northwest corner of the Virgin Islands National Park (Fig. 1). Current velocity and direction are quite variable in this portion of the sound. The exposure to open water and moderate wave energy yield a high coral cover with healthy conditions around the island. The study site was located on the southwest side of Henley Cay at a depth of 5 m.

Eleven corals of five different species (D. strigosa, D. labyrinthiformis, M. annularis, Montastrea cavernosa, and Agaricia agaricites) were selected, including nine bleached and two pale colonies. The corals that we chose to study were not the only species affected by bleaching. However, they are some of the most predominant hard coral species found in this region.

An aluminum tag was attached with wire to a nail driven into the pavement near each coral colony. A slate with an identification number and metric scale was placed near the coral.

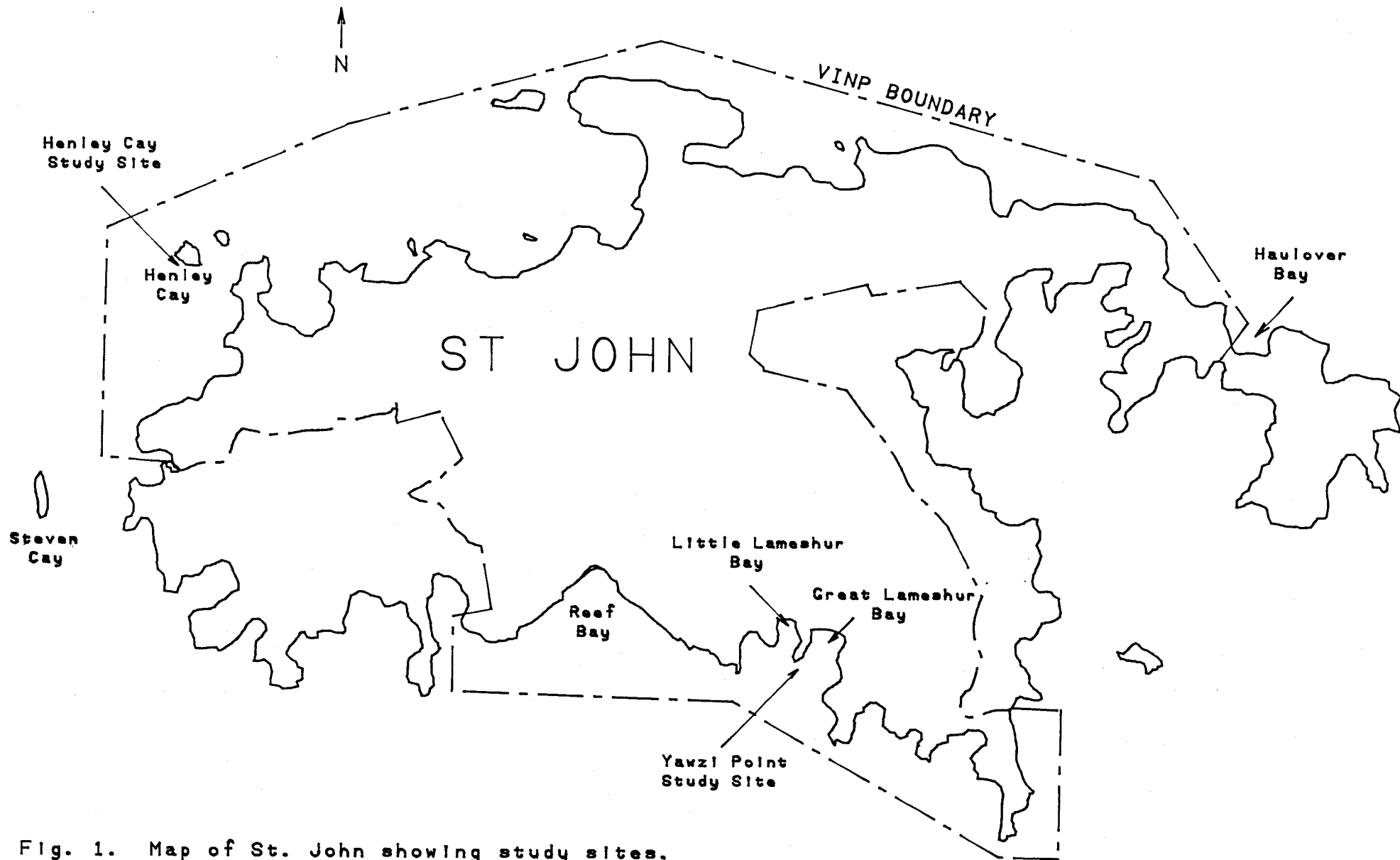


Fig. 1. Map of St. John showing study sites.

The coral and slate were then photographed from an angle that would best represent the entire colony using a Nikonos 5 camera with a 35mm lens and 64 ASA print film. When each successive colony was tagged, a compass bearing and distance from the previous colony was recorded.

A map of the area showing the relative positions of the sample colonies was made using the information on bearing and distances. The corals could be located and identified using the map with bearing and distances, the identification tags on each colony and the photographs. The photographic prints were copied on to mylar sheets which were then taken under water. Often, the photos were essential for positive identification of the coral colonies. Tags frequently disappear or become covered with algae making them hard to see. The coral colony or the surrounding area generally has some unique characteristic which appears in the photo and assists in identification. The photo was also used as a guide to estimate the proper distance and angle from which the coral should be rephotographed. Print film was used at the beginning of the study with 200 ASA Ektachrome slide film used thereafter. Slides when projected could be more easily compared from one sample day to another.

The main study site at Yawzi Point between Greater Lameshur Bay and Little Lameshur Bay is on the south side of St. John. Current velocities are low, with moderate to heavy wave energy from the east and southeast. The coral cover is moderately high (c. 25%). We used the same techniques at Yawzi Point as at Henley Cay with minor modifications. We decided to tag approximately equal numbers of bleached, pale and normal corals. Before entering the water, we decided to swim a set course around Yawzi Point. Following the course, we chose bleached, pale or normal corals as they appeared. Thirty-four corals were tagged of which eleven were bleached, twelve were pale and eleven were normal. There were 14 colonies of D. strigosa, 7 of D. labyrinthiformis, 10 of M. annularis, and 3 of A. agaricites, over a depth range from 3.7 to 8.5 m. Bearing and distances were taken between corals. The corals were tagged with prestamped hard aluminum tags which were attached with nails or nylon wire ties, and as before the corals were photographed with 64 ASA print film. The photo prints were laminated between two sheets of plastic and bound in a spiral notebook. The notebook could be taken underwater and the original color photos could be used for identification.

A bleached coral was defined as one with an area which was totally white but still alive. This could include the whole colony or only a small part of a colony. Colonies which included both pale and bleached areas were considered "bleached". Pale corals could range from almost normal in color to very pale. A very pale coral is almost white but has a slight yellowish or greenish color. Often many of the bleached and pale corals would only be affected on top of the colony while the sides would be normal.

When a tagged coral was relocated it was recorded as bleached, pale or normal, and then rephotographed. After the film was developed the slides were projected and again the corals

were categorized as bleached, pale or normal. The results from the field observations and the slide observations were then compared. In most cases the results were identical. Categorizing these corals (as normal, pale or bleached) is somewhat subjective; however, there has been only one observer throughout the studies. Also, the field observations were reconfirmed by the slide analysis.

The percent of mortality of each coral colony surface was estimated by comparing the original photographs of the tagged corals to those taken on the last sampling day. Any dead areas (no matter what size) that appeared after the beginning of the study were noted. Dead portions ranged from one or two square centimeters to much larger areas in a few cases.

Results

General observations

The extent of bleaching, in terms of number of colonies affected, varied around the island. In general, by February 1988, it appeared that many of the corals were beginning to regain their normal coloration, although portions of some had died and were colonized by algae. In spite of the signs of improvement, bleaching was still widespread in March. By May, there appeared to have been further recovery. In a few bays, shallower areas appeared to have been hit harder by the bleaching and were taking longer to recover. In July, very little bleaching was evident, although we saw some pale D. labyrinthiformis colonies which seemed to have been survivors from the previous fall rather than victims of a new bleaching episode.

A dive to 20 m on the reef south of Reef Bay in November 1987 revealed bleached colonies of the following species: D. labyrinthiformis, M. annularis, M. cavernosa, Helioseris cucullata, Siderastrea siderea, Porites astreoides, A. agaricites, Mycetophyllia aliciae, M. alcicornis, and M. squarrosa. By June 1988, very little bleaching was still conspicuous at this site, although some Agaricia agaricites colonies at 14 m were still pale. Some of the D. labyrinthiformis colonies had pale areas, dead areas with algal growth, and areas which either never bleached or had regained their normal color.

In October 1987, dives in Haulover Bay in depths under 10 m indicated that numerous colonies of D. labyrinthiformis were bleached, with fewer colonies of M. annularis, and D. strigosa, C. natans. By February, there was no doubt that there was less bleaching in this bay.

In December, little bleaching was evident at Steven Cay at depths less than 10 m except for several colonies of D. labyrinthiformis and fewer colonies of D. strigosa. By September 1988, no conspicuous bleaching was apparent at this site.

Coral tagging studies

The corals from both Henley Cay and Yawzi Point have recovered

slowly since the beginning of the studies (Tables 1, 2; Fig. 2), with bleached corals still apparent in March (at Henley) and in May (at Yawzi Point). None of the corals at Yawzi which were considered normal at the beginning of the study turned pale or bleached subsequently. The corals at Henley Cay regained their normal color somewhat faster than those at Yawzi Point, although we were only monitoring 11 colonies at Henley.

At Yawzi Point the bleached and pale corals have improved very slowly. Approximately 83% of the coral colonies that were originally categorized as bleached or pale still had pale areas nine months after the beginning of the study. While there certainly has been some improvement, these corals still do not appear normal.

None of the eleven normal corals that were tagged at Yawzi Point exhibited any mortality. Twenty one percent (3 colonies) of the pale corals tagged at Henley and Yawzi had some dead areas along with sixty percent (12 colonies) of the bleached colonies at both sites. Generally the area of the colony surface which died was located at the site of original bleaching. Most of the corals which exhibited mortality lost less than 20% of their surface area (Fig. 3).

Discussion

Observations around St. John and the results of the coral tagging studies indicate that recovery of hard corals from loss of their zooxanthellae has been a slow process. Rogers (1979) showed that corals of several species which bleached as a response to total shading exhibited little recovery and in some cases had algal overgrowth 15 weeks after shading ceased.

The results suggest that corals at Henley Cay recovered a little sooner than those off Yawzi Point, although a smaller number of colonies was monitored at Henley. It is possible that bleached or pale corals located in high current areas recovered more quickly than those in other areas. Recovery appeared to be rapid at Steven Cay where currents are usually strong.

The tagging studies and observations at many locations around the island suggest that D. labyrinthiformis was the species most affected by bleaching. Sixty-three percent (5) of the bleached or pale D. labyrinthiformis colonies which were tagged exhibited some death of coral polyps. Fifty-five percent (6) of the D. strigosa colonies had some mortality whereas less than 30% (3) of the colonies of M. annularis and 25% (1) of the colonies of A. agaricites had dead portions. These percentages are based on a small number of samples. However, the trends they suggest agree with observations at other sites.

It is impossible to calculate the actual amount of mortality that was caused by the bleaching phenomenon. However, considering that 44% of the pale and bleached corals had some death of coral polyps, and assuming that what we saw at the two study sites around St. John was representative of other locations, there may have been a substantial loss to Caribbean coral reefs. It is obvious that the bleached and pale corals were weakened. What long term effects will this have? Over 80%

Table 1

Bleached Coral Summary for Henley Cay

CORAL SPECIES	NOV/14/87			JAN/20/88			MAR/16/88			MAY/25/88			SEP/07/88		
	NORMAL	PALE	BLEACHED	NORMAL	PALE	BLEACHED	NORMAL	PALE	BLEACHED	NORMAL	PALE	BLEACHED	NORMAL	PALE	BLEACHED
<i>D. strigosa</i>	0	0	2	0	1	1	0	2	0	1	1	0	2	0	0
<i>D. labyrinthiformis</i>	0	0	3	0	0	3	0	2	1	1	2	0	2	1	0
<i>M. annularis</i>	0	1	1	0	1	1	0	2	0	0	2	0	1	1	0
<i>M. cavernosa</i>	0	1	0	1	0	0	1	0	0	1	0	0	1	0	0
<i>A. agaricites</i>	0	0	3	0	0	3	0	2	0	2	0	0	1	0	0
TOTAL *	0	2	9	1	2	8	1	8	1	5	5	0	7	2	0

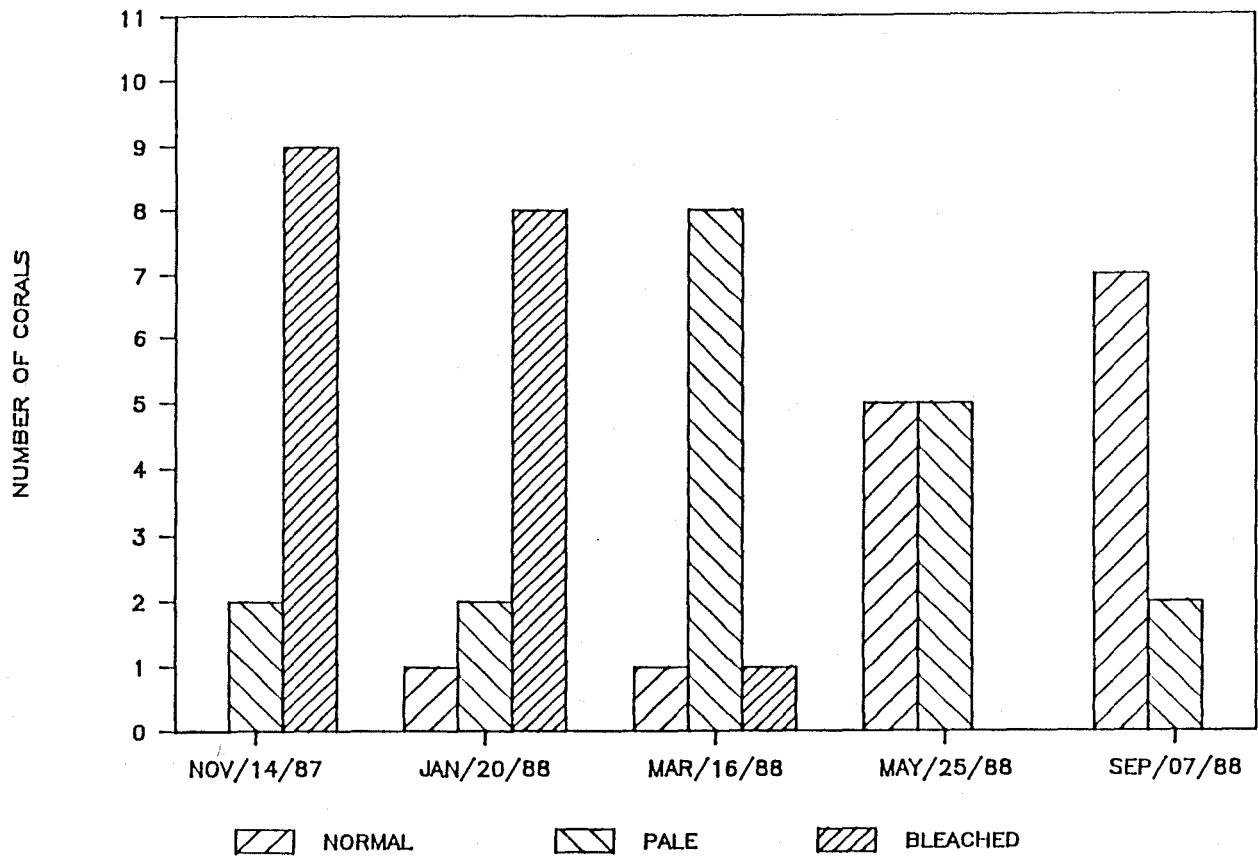
Table 2

Bleached Coral Summary for Yawzi Point

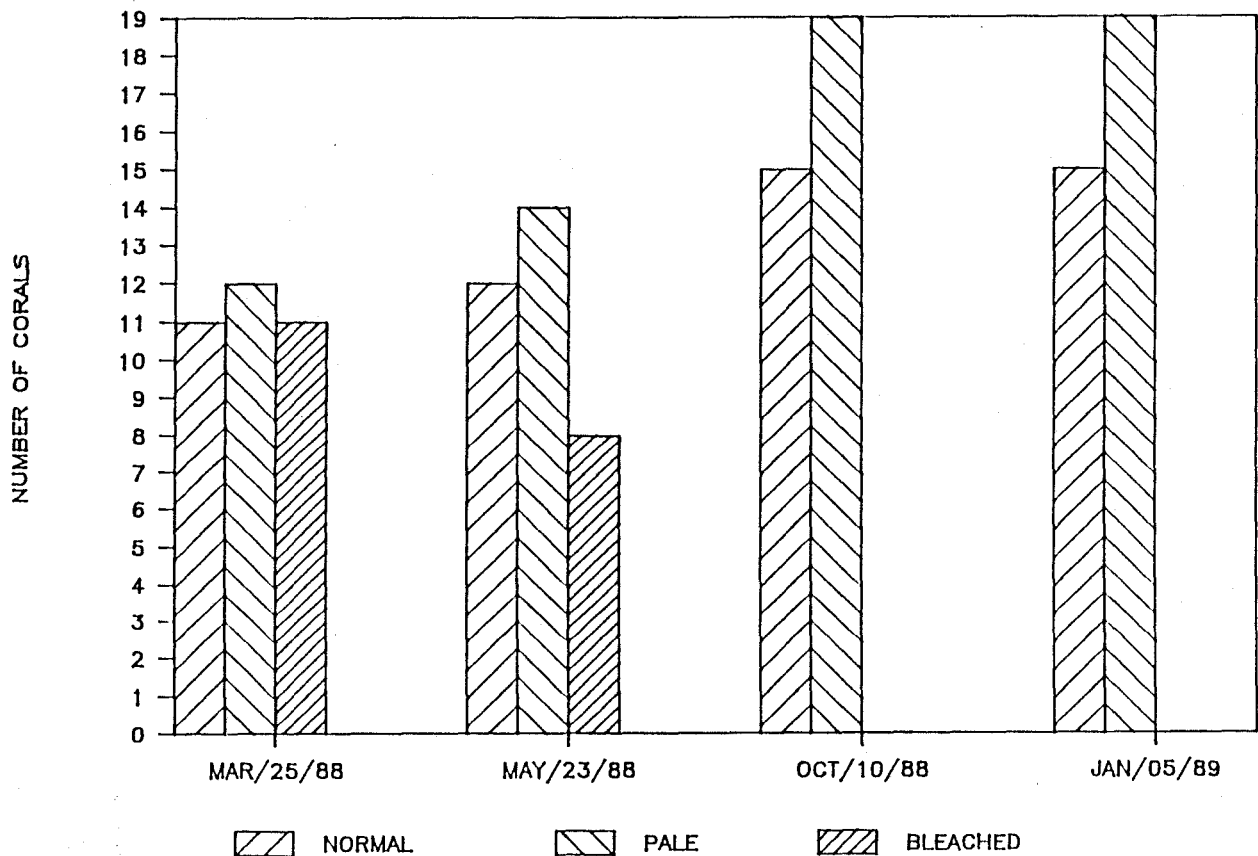
CORAL SPECIES	MAR/25/88			MAY/23/88			OCT/10/88			JAN/05/89		
	NORMAL	PALE	BLEACHED	NORMAL	PALE	BLEACHED	NORMAL	PALE	BLEACHED	NORMAL	PALE	BLEACHED
<i>D. strigosa</i>	5	3	6	5	4	5	6	8	0	6	8	0
<i>D. labyrinthiformis</i>	2	2	3	2	3	2	3	4	0	3	4	0
<i>M. annularis</i>	2	6	2	2	7	1	3	7	0	3	7	0
<i>A. agaricites</i>	2	1	0	3	0	0	3	0	0	3	0	0
TOTAL	11	12	11	12	14	8	15	19	0	15	19	0

* One *A. agaricites* colony could not be relocated in 3/88; an additional one could not be relocated in 9/88.

HENLEY CAY BLEACHED CORALS



YAWZI POINT BLEACHED CORALS



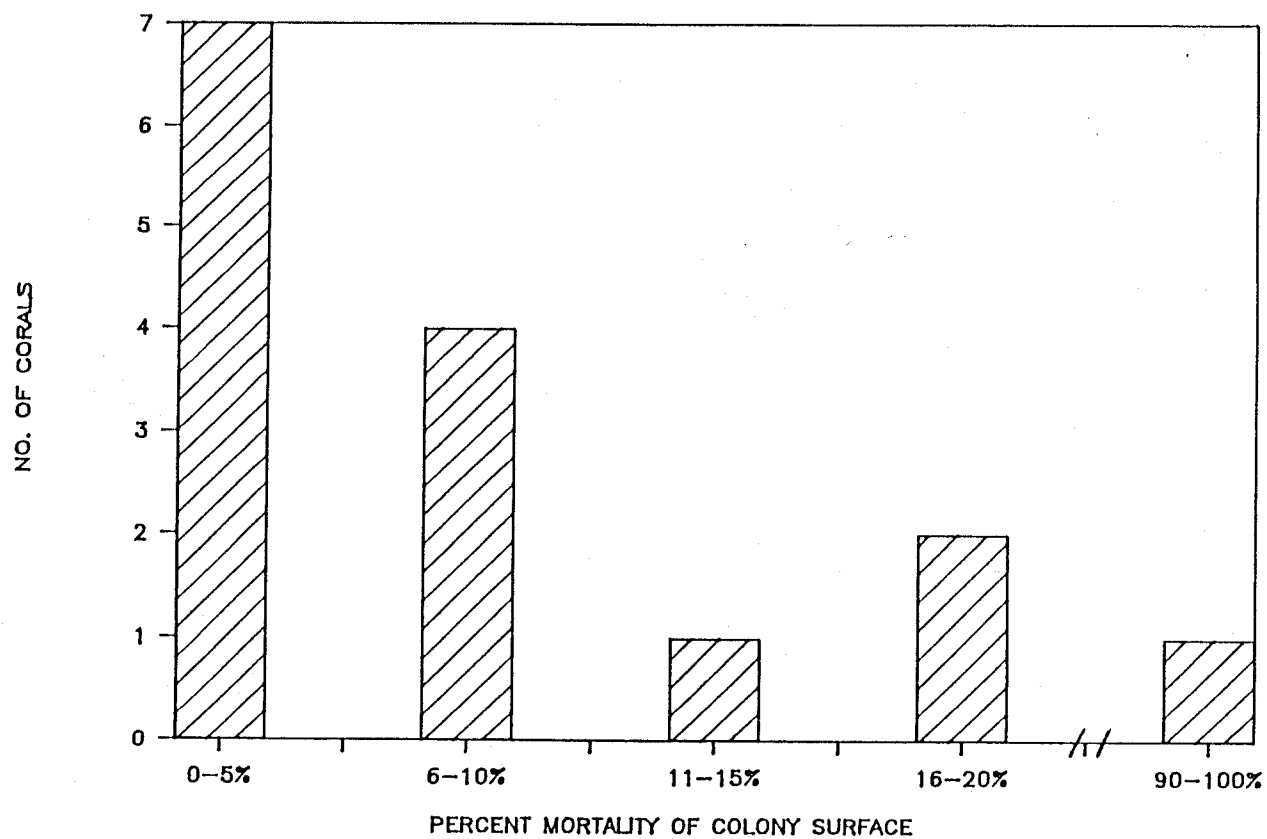


Fig. 3:

percent of the bleached and pale corals that were tagged at Yawzi Point are still pale after a year. The stress caused by the bleaching could effect reproduction. It could also allow the entrance of secondary infections such as blackband disease or weaken the ability of the coral to compete with other reef organisms. Some of the sublethal effects might not show up for years or may be so subtle that they could go unnoticed. Total recovery of corals affected by bleaching will be hindered if additional bleaching events occur. In March 1989, we observed what could be the beginning of another episode of bleaching around St. John.

Acknowledgements. We were very fortunate to be able to drag the following busy people into the water with us to assist with coral tagging, relocation, and photography: Joseph Luttman, Biological Technician (VINP); Chuck Weikert, Chief, Division of Interpretation (VINP). Thanks to both of them!

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