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(Noumea, New Caledonia, 5 - 9 August 1991)

TROCHUS RESEEDING EXPERIMENT IN VANUATU

by

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I. INTRODUCTION

The Trochus resource in Vanuatu is relatively small compared to some other Pacific Island Countries. The harvesting of this resource is a small but significant source of revenue and employment in Vanuatu. Scientific assessments of the respective Trochus populations within the fringing reefs of each island in the archipelago as well as the maximum sustainable yields have not been under-taken and hence accurate information on the potential long-term annual harvests are not available.

In recent years the harvesting activity of the Trochus shells in Vanuatu has increased due to the steady increasing demand for the shell of which its market value has increased markedly. This has resulted in the establishment of 3 Shell Processing Factories in Port-Vila and thus increasing the level of exploitation on the resource through out the island regions.

Information obtained from recent Trochus surveys as well as from Processing factories indicate that the level of Trochus harvest in Vanuatu is under-going a steady decline.

Trochus aquaculture has only been recently initiated in Vanuatu. The South Pacific Aquaculture Development Project (SPADP) provided funding to examine the feasibility of setting up a small scale Trochus culture facility in Vanuatu. The long-term objective being to determine whether re-seeding of depleted reefs with hatchery-reared juveniles is a practical tool for management of the wild fishery.

As a means of replenishing exhausted Trochus reefs, re-seeding with hatchery-reared juveniles has not been very successful. In trials carried out in Palau and in Okinawa, high mortality rates have been recorded.

II. METHODS

A. Number of Juvenile *T. niloticus* Released:

Trochus were spawned at the Vanuatu Fisheries Department hatchery in Port-Vila in January, February and March of 1990.

A total of 1400 juvenile *T. niloticus* were tagged and released. 1000 of the released juveniles had maximum basal shell diameter closer and larger than 20 mm, while the additional 400 juveniles had basal shell diameter smaller in size than the first batch.

B. Tagging:

The juvenile *T. niloticus* were segregated into 4 groups, with each group having 350 juveniles and a separate tag colour.

The juveniles in each group were individually marked in three different ways:

- firstly, with small numbered polyethylene Hallprint tags to the shell with cyanocrylate glue (supaglue) (see appendix 1 for a detailed description of the tagging method);
- secondly, with a drop of red-coloured cyanocrylate glue applied to the apex of the shell;
- thirdly, the number on the polyethylene tag was inscribed with pencil on the nacre inside the lip of the shell.

The groups were designated as flows:

GROUP 1	-	PINK TAGS
GROUP 2	-	WHITE TAGS
GROUP 3	-	GREEN TAGS
GROUP 4	-	BLUE TAGS

The juvenile Trochus were then measured with Vernier callipers to the nearest 0.1 mm and returned to a flowing seawater tank, where they were left overnight before transferring to the reef.

Histograms of figure 1, 2, 3 and 4 shows the different basal length measurements of the juveniles in each group. Figure.X shows the length composition of the juvenile trochus *(Trochus niloticus)* used in the seeding trial.

C. Releasing Site:

Patterns of abundance of *Trochus niloticus* on reefs of the Great Barrier Reef have suggested that reefs that are more elevated contain greater numbers of Trochus than low-relief reefs (NASH 1985). Nash (1988) proposed that this difference may be due to higher levels of predation of juveniles on low-relief reefs because they are continuously exposed to predators. Those on high-relief reefs may emerge to feed at low tide when predators (such as crabs and fish) are absent. Consistent with this hypothesis is the observed greater levels of abundance and activity of juvenile *T. niloticus* at low tide than at high tide (NASH 1985).

Due to convenience, a reef flat on the seaward side of Erakor Island was chosen for the releasing site. Since patterns of abundance of natural *Trochus niloticus* populations suggested that juvenile survival is higher on more elevated reefs (NASH 1985, 1988), and seeding trials suggested the same (KUBO 1989), it was intended to locate two sites for releasing the juveniles, one more elevated than the other.

It soon became apparent, however, that the most suitable place for releasing the juveniles was a narrow band of coral rubble immediately shoreward of the elevated reef crest. In this region, the rubble was encrusted with coralline algae, and the spaces between the rubble were considered most appropriate for these juveniles: not so small that the juveniles could not crawl into them, and not so large that larger predators could easily follow.

Since this suitable habitat was located in only a single depth zone, placement of some of the juveniles at a lower elevation elsewhere on the reef would have yield a comparison of mortality rates at both different elevations and different levels of habitat suitability. This confounding of factors was avoided by choosing all sites to be within the suitable habitat zone, and to compare survival rates at different levels of protection from predators.

D. Releasing method:

The tagged juveniles were collected from the tanks at the Fisheries Department and taken in tanks of seawater to Erakor Island, where they were placed in the shade at the top of the beach. Lumps of coral were placed in the tanks, and the juveniles were placed on the coral. These blocks, with the juveniles attached, were to be later transferred to the sites selected for release.

The coral blocks with the juveniles attached were placed at each of the four chosen sites, and the following protection from predators was provided:

- Group 1 (Pink Tags): The coral blocks with the juveniles attached were covered with coral rocks (mainly plate Acropora) as a shelter against both wave action and

Figure 1.

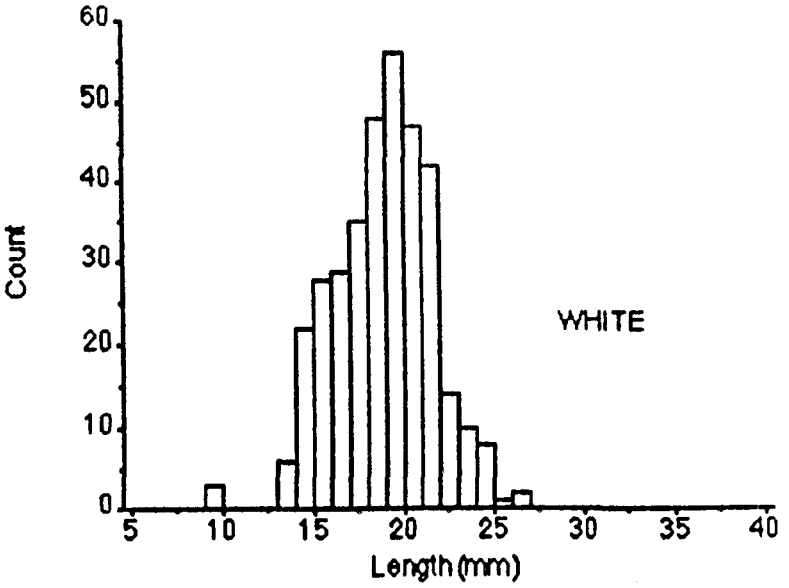

Figure 2.

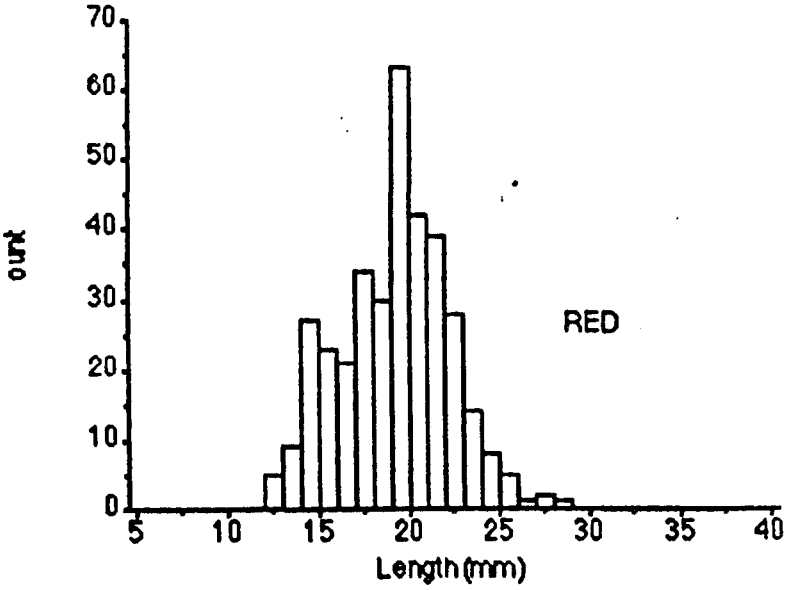

Figure 3.

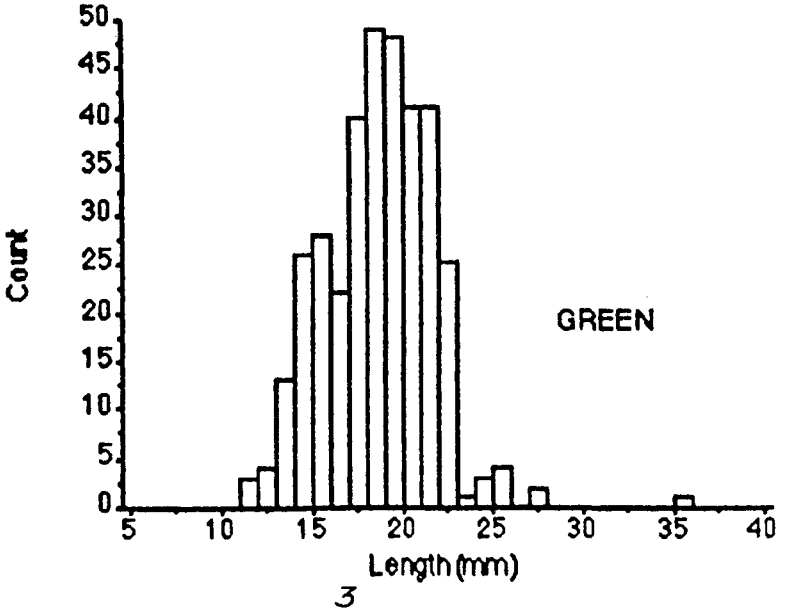

Figure 4.

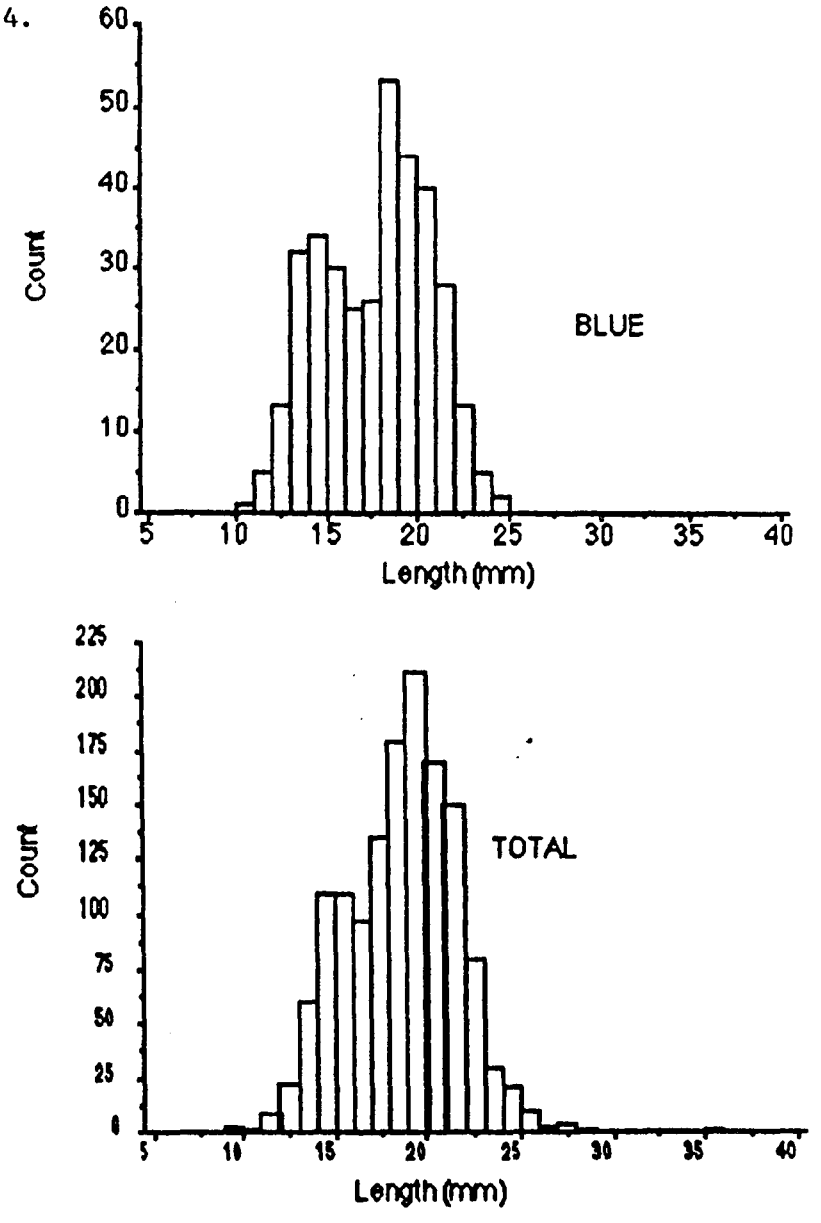

Figure x. Length composition of the juvenile trochus (*Trochus niloticus*) used in the seeding trial.

predation.

- Group 2 (White Tags): Plastic mesh with 1*1 cm holes was placed over the blocks. The mesh was anchored in place with coral blocks placed around its edge while steel rods were used to firmly hold the corners of the mesh in place by hammering the steel rods through the mesh into the substrate.

- Group 3 (Green Tags): As for Group 1, but looser (more open) coral covering the blocks to which the released juveniles were originally attached.

- Group 4 (Blue Tags): As for Group 2.

The juveniles were released on the reef between 4:30 pm and 5:30 pm. This time was chosen because it was two hours before low tide, so that the juveniles would have had several hours to adjust to their new surrounding before the reef was fully covered. In addition, releasing in the early evening was likely to minimise exposure to predation immediately after release, since most predators are active in daylight hours.

E. Recapture Surveys:

The purpose of the recapture surveys is to assess rates of recovery, mortality and movement of the juveniles with minimal disturbance of the substrate.

Each of the four sites are searched thoroughly for juveniles, both live and dead. The area around each of the four sites is searched carefully for juveniles which may have moved out from the shelter of the site, and the distance that these juveniles may have moved is also noted. The site is then dismantled (mesh removed, all shelter boulders removed and placed to one side after carefully searching for attached juveniles) and all juveniles removed, tag number recorded, then placed on coral lumps for the juveniles to attach which will be later replaced in each site again. Crushed shell fragments are collected, and tag number (if still attached to the shell fragment) recorded.

After surveying each site the juveniles are replaced into each site, and the shelter reconstructed as described above.

Figures 1, 2, 3, and 4 shows the number of tagged juvenile Trochus recaptured during 4 separate recapture surveys.

F. Juvenile Measurements:

About 50 juvenile T. niloticus from each Group are measured roughly every forth-night, using a Vernier callipers. So far only 2 measurements have been done for each Group.

Figure 5 shows the comparison of the mean daily growth rates of the juveniles in each Group between the 2 measurements.

Growth rate appears to be fast, since the number inscribed with pencil on the shell lip has moved inside the shell aperture, indicating that growth of the shell is rapid.

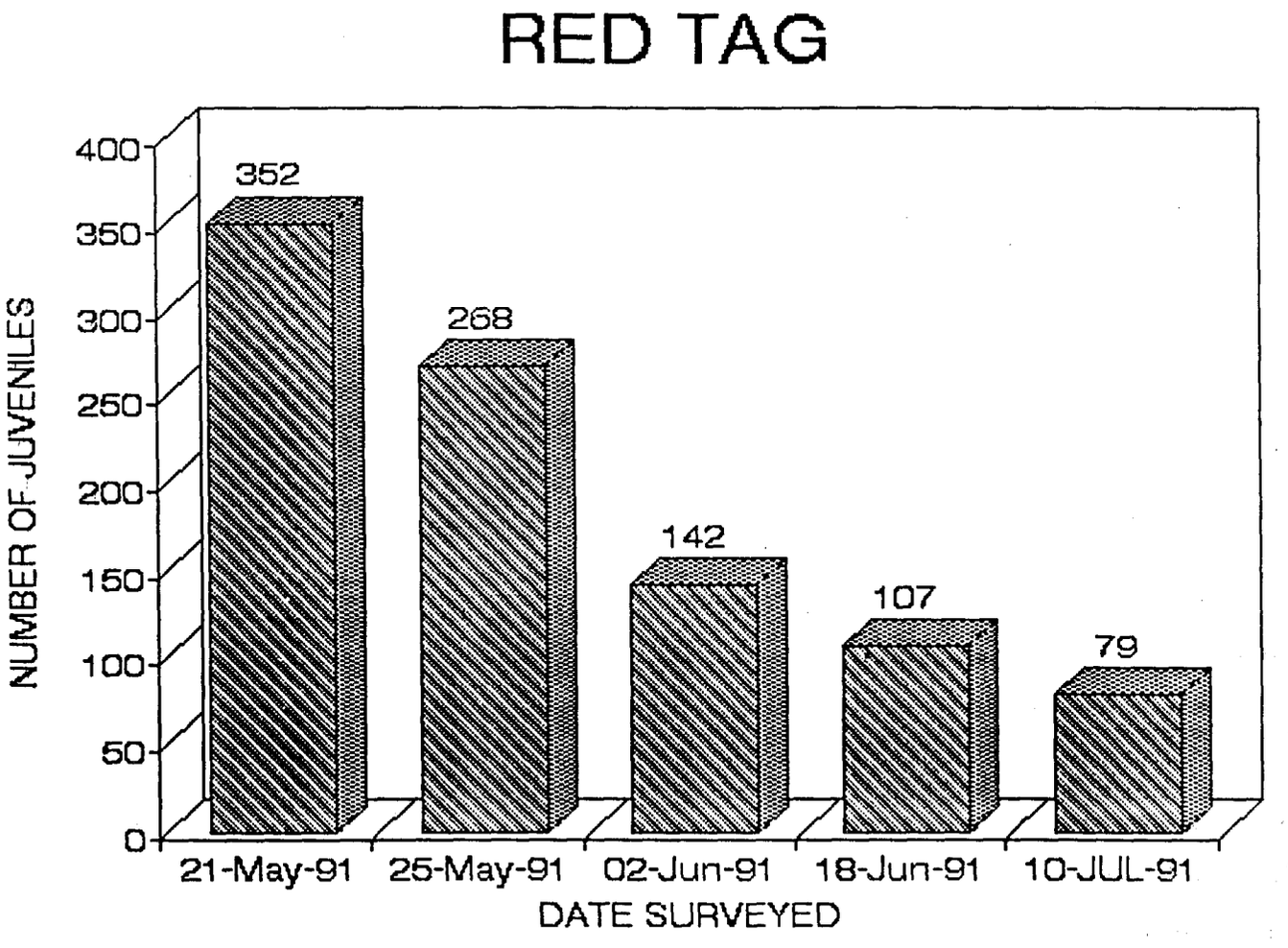

Figure 1. Number of Group 1 Juvenile Trochus recaptured.

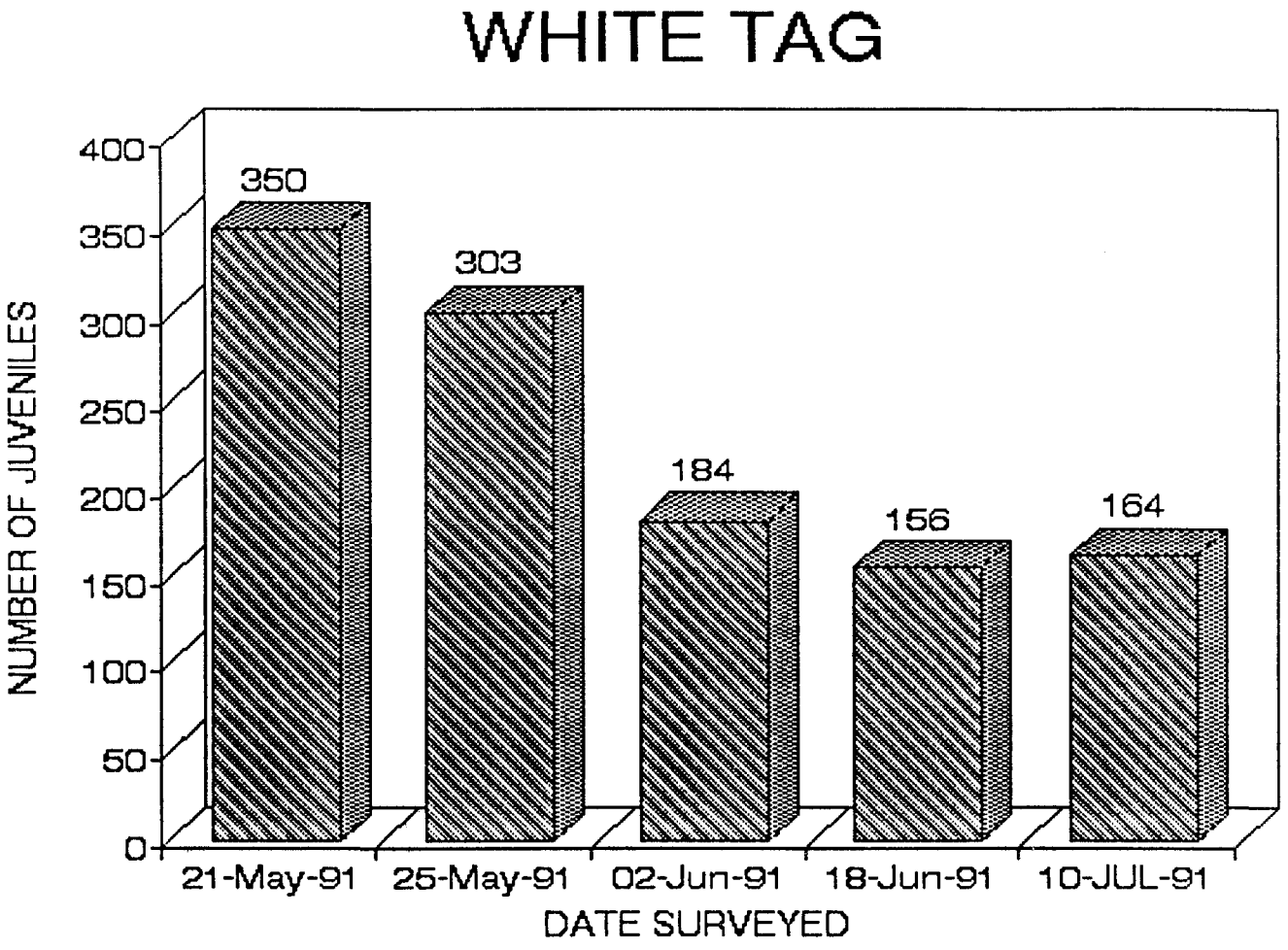

Figure 2. Number of Group 2 Juvenile Trochus recaptured.

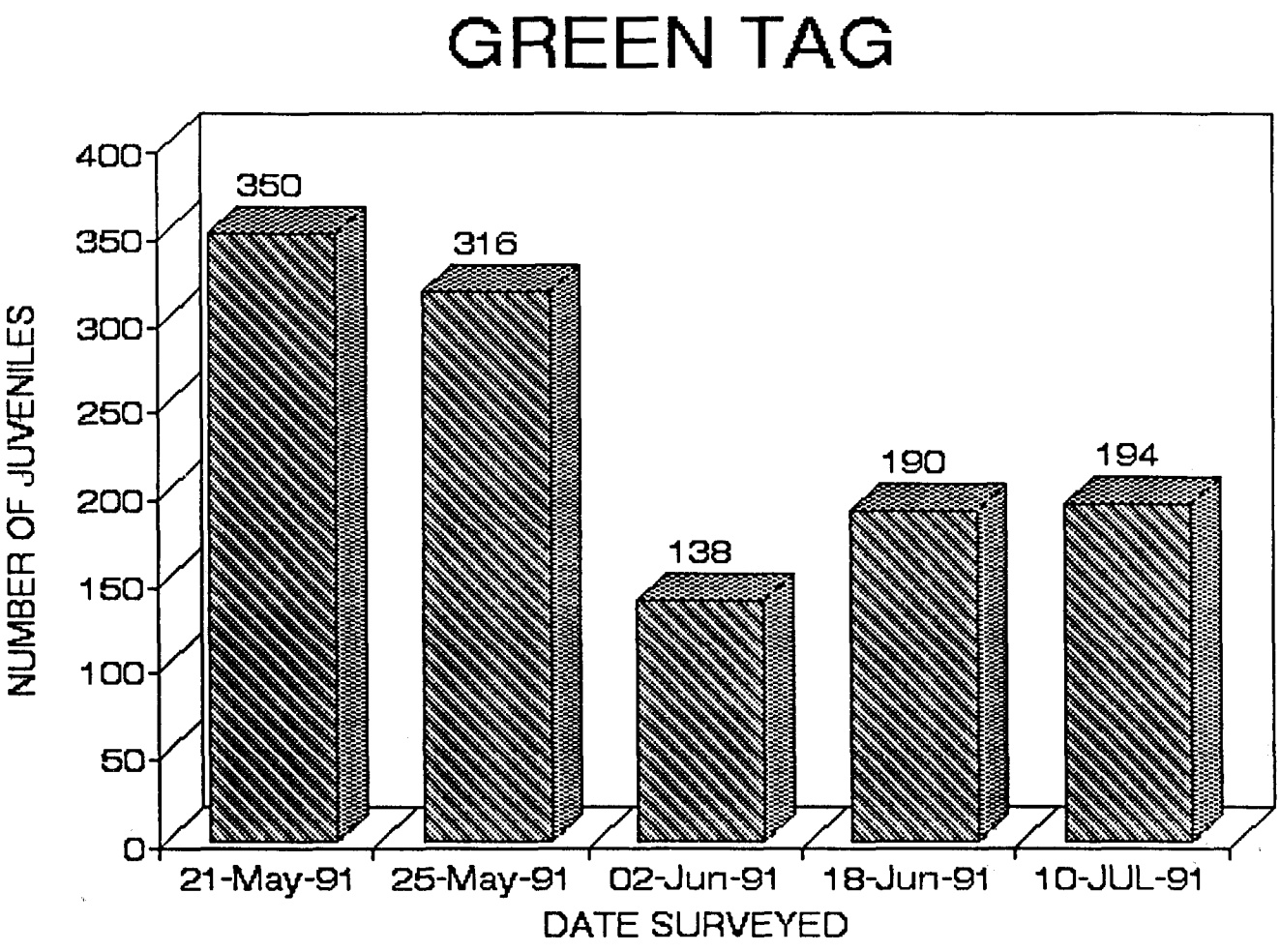

Figure 3. Number of Group 3 Juvenile Trochus recaptured.

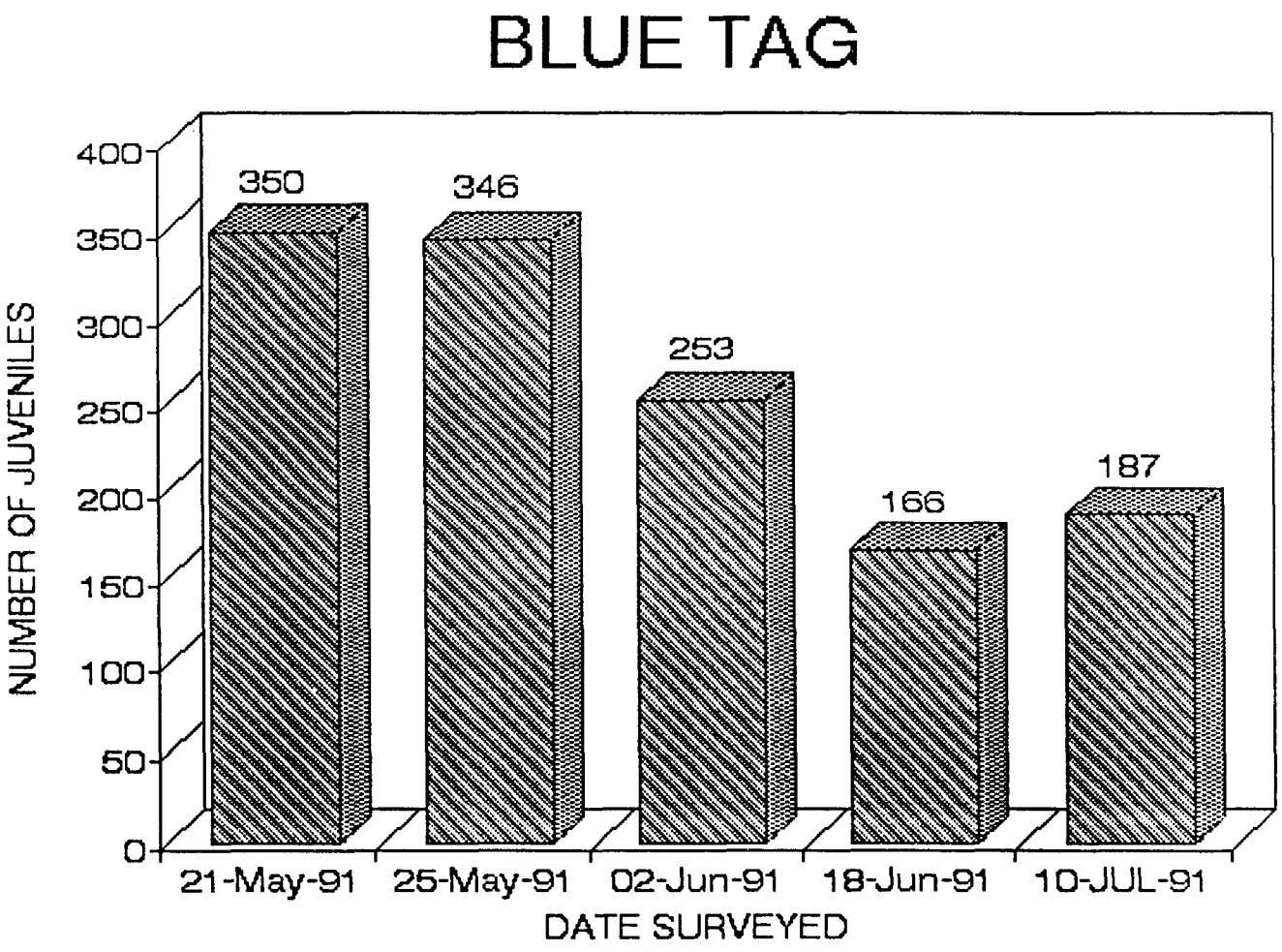

Figure 4. Number of Group 4 Juvenile Trochus recaptured.

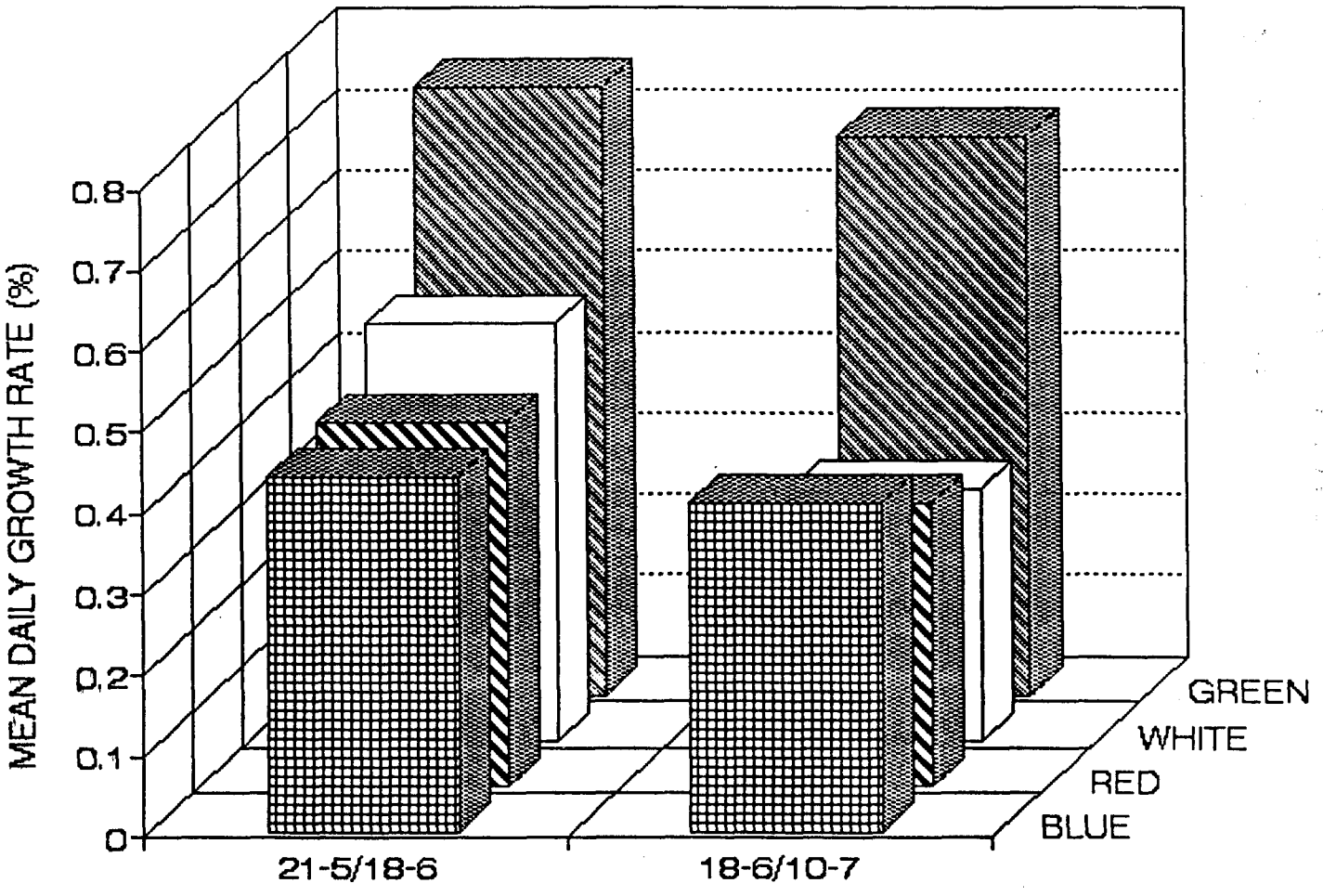

Figure 5. Histogram showing Mean Daily Growth Rate (%) of the Juveniles Trochus of each Group.

III. SURVIVAL, MORTALITY, AND MISSING RATES

Table 1. Percentage of juveniles in each Group that had survived after 49 days of releasing.

GROUP	%SUR.AFTER 4 DAYS	%SUR.AFTER 12 DAYS	%SUR.AFTER 27 DAYS	%SUR.AFTER 49 DAYS
G1	76.0	40.0	30.0	22.0
G2	86.0	53.0	46.0	47.0
G3	90.0	39.0	54.0	55.0
G4	98.0	72.0	47.0	53.0

Table 2. Mortality rates of juveniles from each Group after 49 days of releasing.

GROUP	M.RATE AFTER 4 DAYS	M.RATE AFTER 12 DAYS	M.RATE AFTER 27 DAYS	M.RATE AFTER 49 DAYS
G1	0.6	0.6	2.3	6.4
G2	1.7	2.0	3.7	5.7
G3	1.1	2.0	6.3	7.7
G4	1.1	2.8	4.5	8.5

Table 3. Percentage of juveniles missing from each Group after 49 days of releasing.

GROUP	%MISS. AFTER 4 DAYS	%MISS.AFTER 12 DAYS	%MISS.AFTER 27 DAYS	%MISS.AFTER 49 DAYS
G1	23.4	59.4	67.7	71.7
G2	12.3	44.9	50.3	47.3
G3	8.9	59.0	39.7	37.3
G4	0.9	25.2	48.5	38.5

Table 4. Total Survival, Mortality, and Missing rates of juveniles after 49 days of releasing.

TOTAL	AFTER 49 DAYS (%)
SURVIVAL RATE	44.2
MORTALITY RATE	7.1
MISSING RATE	48.7

Table 5. Percentage of dead juveniles from each Group that are being crushed and those being preyed on by hermit crabs after 49 days of release.

GROUP	%CRUSHED AFTER 49 DAYS	%BY HERMITS AFTER 49 DAYS
G1	5.0	95.0
G2	85.0	15.0
G3	43.0	57.0
G4	38.0	62.0

Table 6. Total percentage of dead juveniles being crushed and those being attacked by hermit crabs after 49 days of release.

DEAD JUVENILES	AFTER 49 DAYS (%)
CRUSHED	43
HERMIT CRABS	57

VI. GENERAL REMARKS

A. Movement of Juveniles:

Movement of the juveniles out from under the shelters (more are found outside the shelters than in them). The shelters seem too dark, and the darkness is likely to inhibit algal growth. The juveniles moved different distances at the four sites, with movement being most at the site with Group 1 juvenile *T. niloticus*, somewhat less at the site with Group 2 juveniles, and not very much at the sites with group 3 and 4 juveniles (but still most moved

out from under the shelter).

A strong net direction movement toward the sea (movement onto the reef crest) is recorded at the site with Group 1 juvenile *T. niloticus*. The juveniles are being found up to twenty-five metres from the shelter. Searching showed there is less movement in other directions.

The juveniles had moved into spaces between the coral rubble. Some could be seen well sheltered within the rubble matrix a few centimetres below the surface. Others had sought shelter under larger pieces of dead coral, while others were relatively exposed, that is being partially hidden under a boulder but with most of the shell exposed.

B. Rock Shelters:

It seems clear that, as mentioned earlier, the rock shelters serve as shelter to organisms larger than the juvenile *T. niloticus*. The original purposes of the rock shelters were:

- to provide shelter from predation,
- to lessen the impact of strong wave action or tidal current in the days following release of the juveniles, inorder to allow them time to adjust to conditions in the sea.

It is clear that neither purpose is any longer served, since:

- the shelters provide suitable hiding places for predatory species (octopus, porcupine fish, hermit crabs and crabs),
- the juveniles mostly moved out from under the shelters into spaces within the surrounding reef matrix.

The larger rocks are therefore removed from the sites.

APPENDIX I: TAGGING PROCEDURES USING SMALL POLYETHYLENE TAGS

Hallprint[1] manufactures small numbered tags made of polyethylene. Hallprint has provided the following advice for storage and handling of tags and glue, as well as the method to follow for best adhesion.

Care and storage of tags

1 Keep the tags away from heat, or expose to strong sunlight for any length of time.

2 If the tags become contaminated with oil, grease or dust they will not stick.

3 It is essential that the person handling the tags have clean dry hands. Do not use cosmetic or barrier creams or sunburn cream on the hands while tagging.

Adhesive

1 Use cyanocrylate glue ('Supaglue') (widely available from hardware stores, etc.). Those for household use have been found superior to special purpose grades.

2 It seems that the quality of this glue depends on age and conditions under which it is kept. Store the glue in the refrigerator when not in use, to extend its usable life.

Tagging procedures

1 DO NOT dry the shells thoroughly, or rinse it with fresh water before attaching the tag. This is because the adhesion process is activated by moisture, and by salt. So the shell should be slightly damp with salt water.

2 Put the glue on the tag, not on the shell. The glue starts to set as soon as it comes in contact with salt water, so will have gone off by the time the tag is put onto the shell if the glue is put on the shell instead of the tag.

3 A good means of applying the glue is to use a sharp pin to pierce the tag to hold it, apply the glue to the back of the tag, then place it on the shell.

Use a pair of fine forceps (preferably with curved tips) to press the tag onto the shell, to ensure that the tag follows the curvature of the shell. As much as possible, ensure that there is no space between the edge of the tag and the shell, since a free edge is likely to catch on something and pull the tag off.

5 There is a secondary curing process, which is completed within a few minutes of exposure to air.

6 The back of the polyethylene tag has a polarised layer, which should not be removed with solvents, etc. This layer is crucial for good adhesion.

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[1]Hallprint Pty Ltd, 27 Jacobsen Crescent, Holden Hill, South Australia 5088, Australia. Telephone (08) 261 0312