MARINE SKILL REPORT SUBMITTED TO THE
UNIVERSITY OF HAWAII MARINE OPTION PROGRAM

Report on Research:
Selected Aspects of the Reproductive Biology of *Glyphidodontops biocellatus* from Enewetak Atoll

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ABSTRACT

Standard length, total weight and gonad weight were examined in the damselfish Glyphidodontops biocellatus. Specimens were collected at seasonal intervals from 1972 through 1974 at Enewetak Atoll, Marshall Islands. Size frequency distribution, population size structure, size at reproductive maturity and length-weight relationship were determined. Males are significantly larger in standard length than females and dominated the large size classes. Males and females, however, are equally abundant overall. Reproductive maturity is attained at about the same standard length in both sexes. There is no obvious difference in the length-weight relationship of males and females.

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# INTRODUCTION

Glyphidodontops biocellatus (Perciformes, Pomacentridae) is a drab brown or gray damselfish with a pale bar on its sides (Figure 1). It achieves a maximum of 75-80 mm standard length and is a benthically oriented herbivore inhabiting patch reefs and coral rubble outcrops in lagoons adjacent to shore and in depths from 0.5 to 5 meters. Its range is from the tropical Indo-West-Pacific to the Samoan, Marshall and Gilbert Islands (Allen, 1975).

First described by Quoy and Gaimard in 1824, there has been some question whether G. biocellatus is a color variant of or is a distinct species from Abudefduf zonatus (Cuvier). Randall (1955) and Keenleyside (1972) conclude that the species are distinct based upon habitat differences. Hiatt and Strasburg (1960) conclude that food and feeding habits are identical for both fish. Allen (1975a) used taxonomic characteristics to conclude that these fishes constitute a single species whose slightly different habitats may account for the differences in coloration. Glyphidodontops biocellatus occupies the inner patch reefs whereas Abudefduf zonatus occupies the reef flat.

The reproductive behavior of G.biocellatus was documented by Keenleyside (1972). Food habits and general ecology were examined by Hiatt and Strasburg (1960). There is no information that pertains to the basic population biology of this species. Such information is crucially important in fisheries management. Since G. biocellatus has some potential for exploitation as an aquarium fish, this study was undertaken to investigate certain selected aspects of this species' population and reproductive biology.

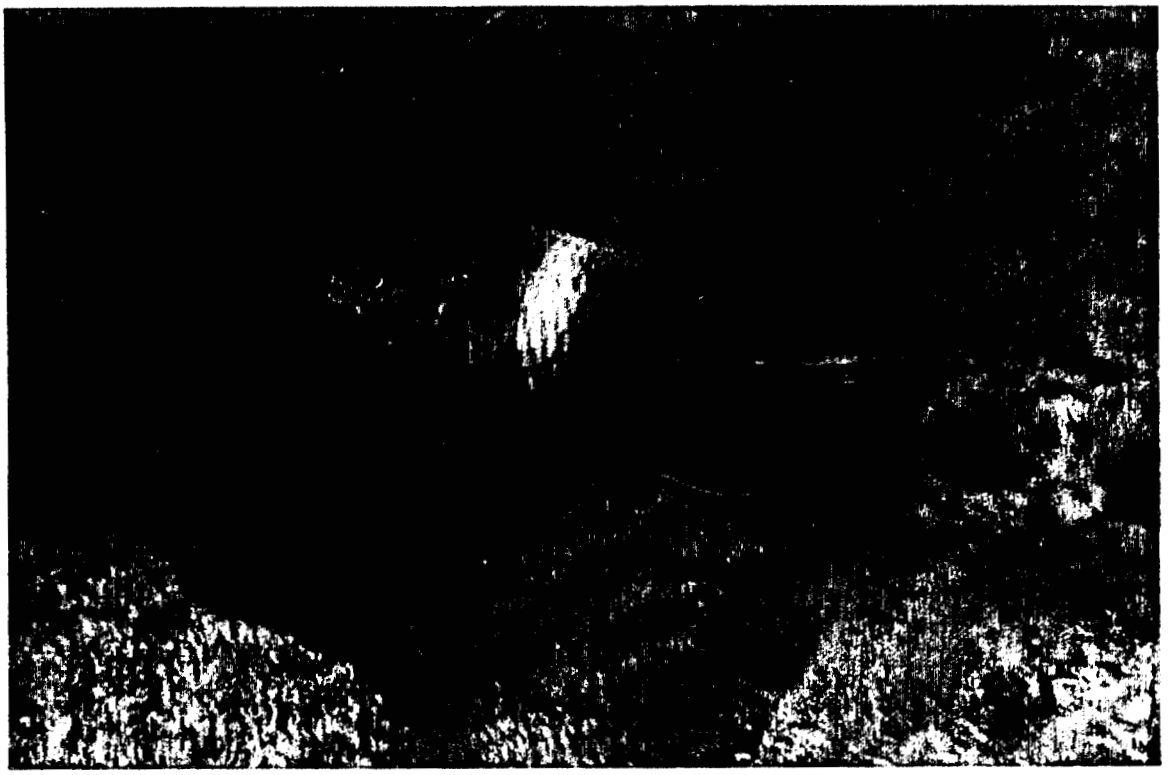


Figure 1. - Glyphidodontops biocellatus (about 75 mm TL), One Tree Island, Great Barrier Reef in two meters. (Figure from Allen, 1975a).

## MATERIALS AND METHODS

### Field Sampling

The specimens of G. biocellatus examined in this study were collected at Enewetak Atoll in the Marshall Islands (Figure 2). Collections were made 1-29-72, 9-18-72, 12-6-72 and 2-23-74 by Ronald S. Nolan. A description of the study site is provided in Nolan (1975). The capture method involved applying rotenone to isolated patch reefs entirely covered by a $\frac{1}{4}$" mesh nylon bag. This prevented the larger specimens from escaping and yielded a reliably unbiased sample. Collected fish were placed on ice within thirty minutes of death. They were fixed in 10% formalin-seawater and upon return to the laboratory were eventually preserved in 40% isopropanol.

### Laboratory Examination

Standrd length was measured to the nearest 0.1 mm using dial calipers. All weights were measured to the nearest 0.0001 g on an analytical electro-balance after fish and gonads were towelled dry. Gonads were then sexed and staged by examining histological smears. Ovarian staging followed the method of Helfrich (1958) where development is determined by the size and appearence of ova and their position in the ovary. This method was also used by Swerdloff (1970). Testes were categorized as unripe, nearly ripe, or ripe according to the fullness of seminal vesicles. In all, 136 fish were examined from the four collections.

### Quantitative Analysis

Quantitative analysis was performed on the IBM/370 computer. The Biomedical Computer Programs P-series (Dixon and Brown,1977) were used for all analyses.

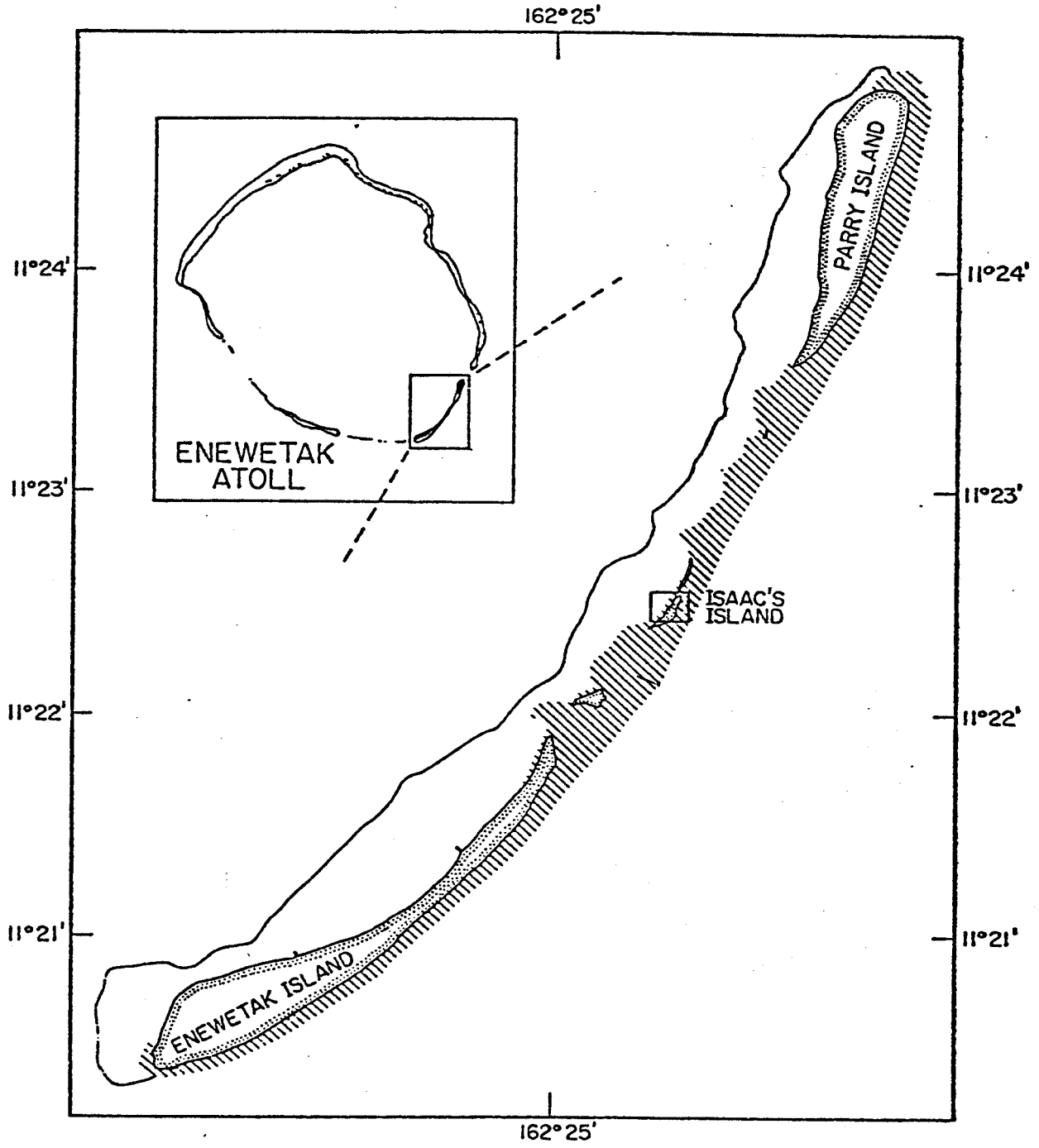



Figure 2. - Map of Enewetak Atoll, Marshall Islands showing the study region along the windward side of the atoll. The hatching indicates the limits of the seaward reef. (Figure from Nolan, 1975).

## RESULTS AND DISCUSSION

### Population Size Structure

Glyphidodontops biocellatus is sexually dimorphic. Males are significantly larger in standard length than females (Figure 3). There was no difference in the variances of the sexes but the means differed greatly (Table 1).

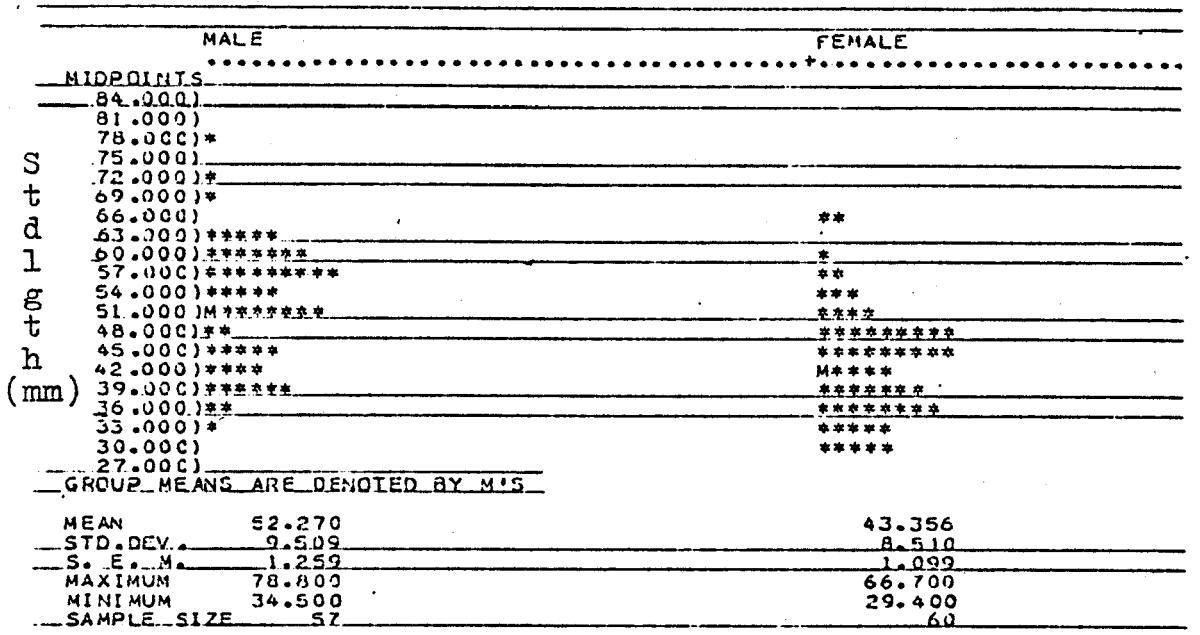
Males were significantly more abundant in the larger size classes (Table 2). Females predominated at intermediate and very small sizes. Both sexes were equally abundant overall. The differences between the sexes at lengths greater than 33 mm are probably the result of different growth rates between the sexes upon their attaining reproductive maturity and the genetic predisposition for males to grow larger than females as a result of sexual selection. The predominance of females in the smallest size class is thought to be biased due to the greater likelihood of detecting an ovary than a testes at these very small standard lengths.

The population size structure of G. biocellatus is similar to that of almost all other damselfish species studied (MacDonald, 1979). The exceptions are the anemone fishes which are monogamous. In anemone fishes, the females grow to larger sizes than the males (Allen, 1975b).

### Reproductive Patterns and the Length-weight Relationship

Reproductive maturity is attained at about 35-40 mm in both sexes (Figure 4). However, there is some tendency for females to become reproductively mature at a slightly smaller length than males.

There is no obvious difference in the length-weight relationship of males and females (male: $y = -12.24 + 0.35x$ ; female: $y = -8.14 + 0.27x$)(Figure 5). This indicates that at any given length, males and females make comparable investments in somatic tissue. Re-examination of Figure 4 reveals that the weight of ovaries is consistently greater than that of testes across the entire range of standard lengths examined. From this it is apparent that females make a greater investment in gonadal tissue than do males. These differences tend to support the contention made earlier that males probably grow at a faster rate than females subsequent to attaining reproductive maturity.




| | MALE | FEMALE |
|---|---|---|
| MEAN | 52.270 | 43.356 |
| STD. DEV. | 9.509 | 8.510 |
| S. E. M. | 1.259 | 1.099 |
| MAXIMUM | 78.800 | 66.700 |
| MINIMUM | 34.500 | 29.400 |
| SAMPLE SIZE | 57 | 60 |

Figure 3. - Standard length frequency distribution for Glyphidodontops biocellatus. Descriptive statistics are summarized beneath the histogram for each sex respectively.

| SOURCE | SUM OF SQUARES | DF | MEAN SQUARE | F VALUE | TAIL PROBABILITY |
|---|---|---|---|---|---|
| BETWEEN GROUPS | 2322.4128 | 1 | 2322.4128 | 28.61 | 0.0000 |
| WITHIN GROUPS | 9336.5586 | 115 | 81.1875 | | |
| TOTAL | 11658.9688 | 116 | | | |
| LEVENE'S TEST FOR EQUAL VARIANCES | | 1, 115 | | 0.74 | 0.3921 |

Table 1. - One-way analysis of variance of the standard length of male and female Glyphidodontops biocellatus.

| | STANDARD LENGTH (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ≤33 | 36 | 41 | 46 | 51 | 56 | 61 | ≥66 | Total |
| % Male | 9.1 | 26.7 | 47.1 | 26.1 | 62.5 | 76.5* | 91.7* | 66.7 | 48.7 |
| % Female | 90.9* | 73.3 | 52.9 | 73.9* | 37.5 | 23.5 | 8.3 | 33.3 | 51.3 |

Table 2. - Population characterization of Glyphidodontops biocellatus. * = significant difference (using $\chi^2$ analysis, $p \leq .05$).

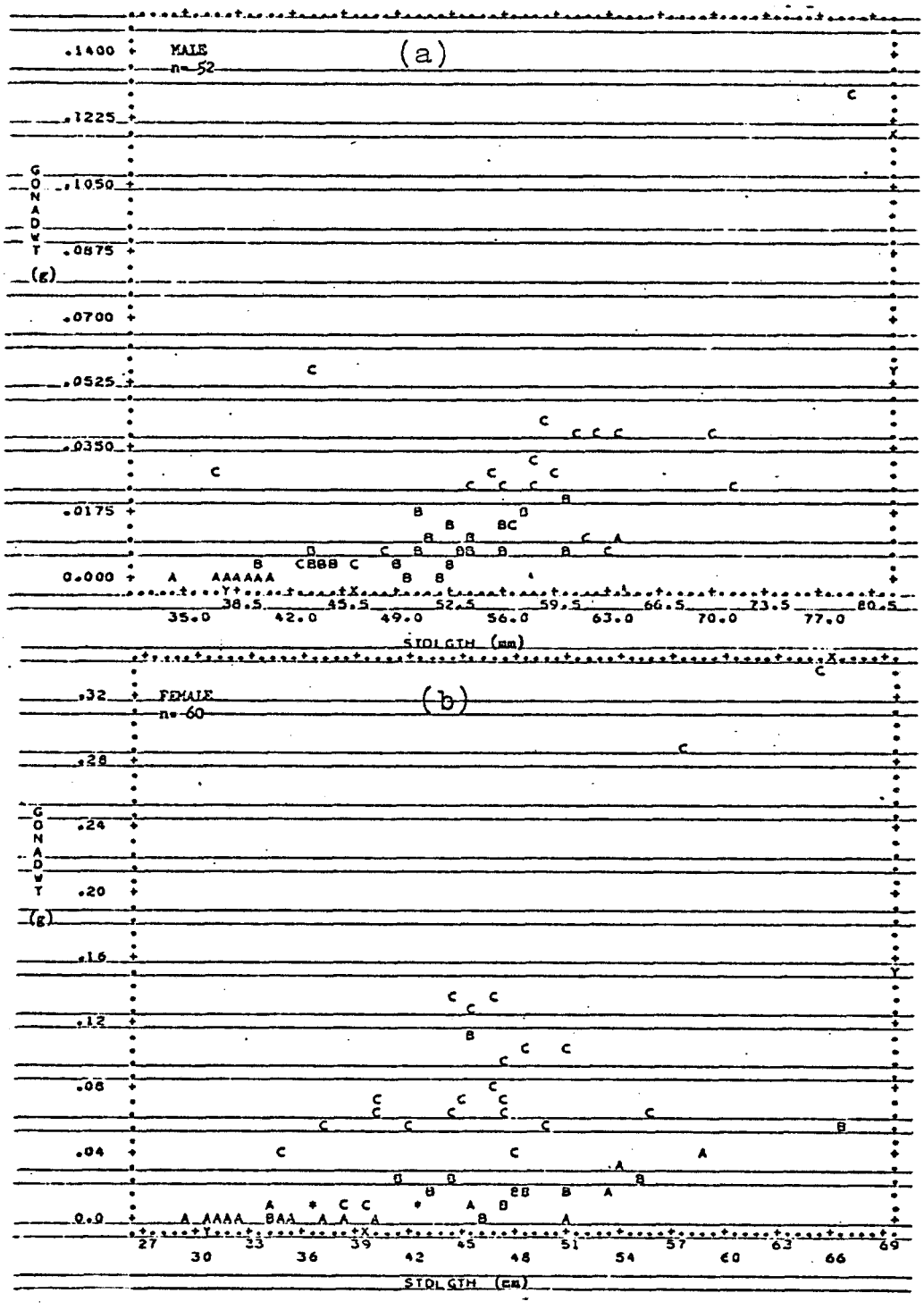



Figure 4. - Relationship of standard length and gonadal weight for Glyphidodontops biocellatus. (a) Males: A= unripe testes, B= nearly ripe testes, C= ripe testes. (b) Females: A= resting ovaries, B= developing ovaries, C= ripe ovaries. *= multiple individuals of different gonadal stages.

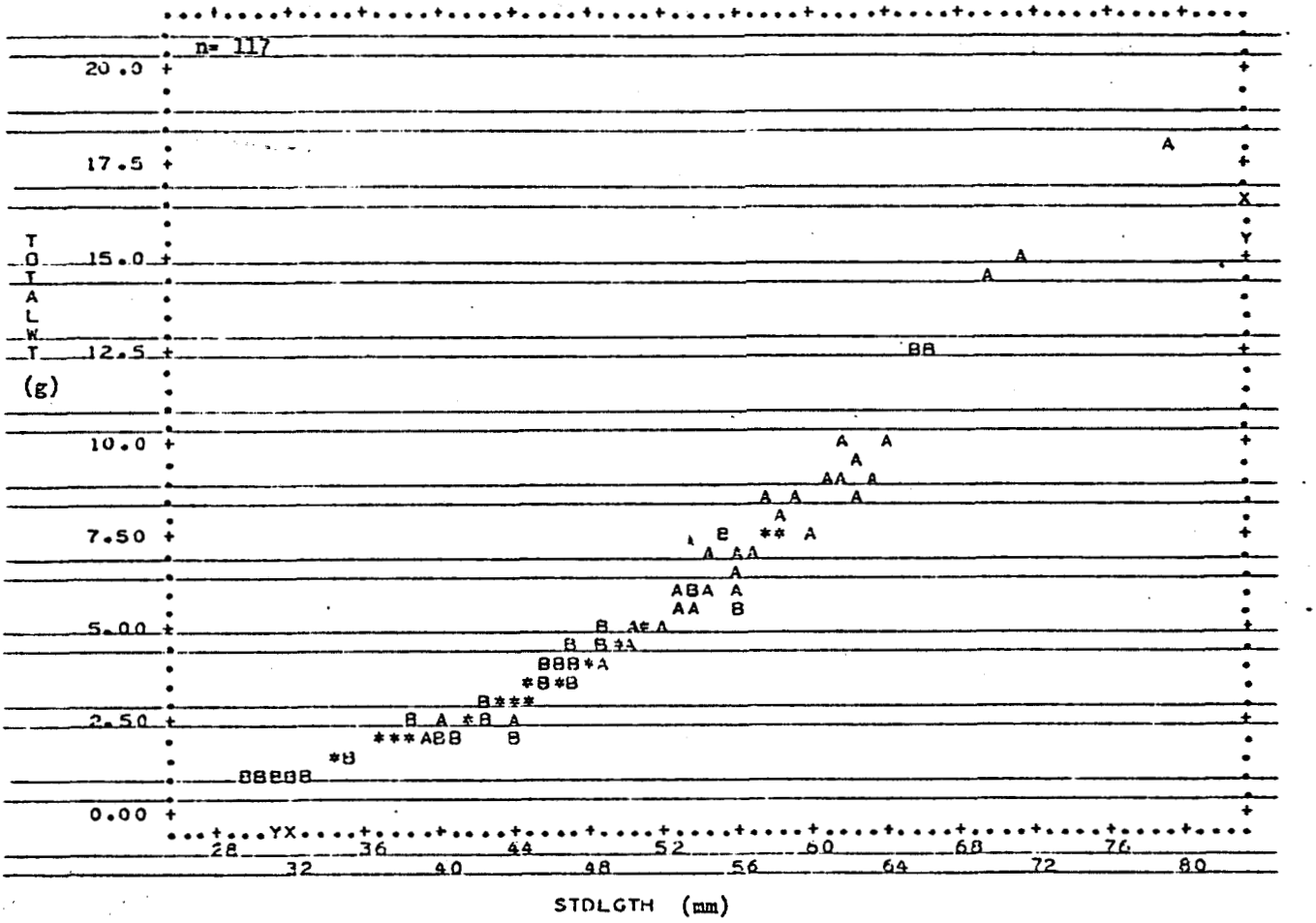



Figure 5. - Relationship of standard length and total body weight for Glyphidodontops biocellatus. A= males, B= females, *= multiple individuals of both sexes.

Overall, the reproductive patterns and length-weight relationship are similar to all other species of damselfishes studied (MacDonald, 1979). Although an analysis of this species' mating systems was not considered, it is very likely that this species is polygynous. The sexual dimorphism, population size structure, and reproductive pattern lend credence to this possibility (MacDonald, 1979).

ACKNOWLEDGEMENTS

The collections of Glyphidodontops biocellatus were provided by Dr. Ronald S. Nolan and were acquired during his doctoral research at Enewetak. Intramural funds to Dr. Nolan were provided by Scripps Institute of Oceanography. I am grateful to the University of Hawaii Zoology Department for providing funds for computer usage. The University of Hawaii Marine Option Program provided the funds necessary to purchase the supplies used in this study. A special thanks to Craig MacDonald for many hours of instruction in experimental design, methodology and analysis, and for the reviewing of this report.

## EVALUATION

I am confident that the project I have participated in will prove extremely valuable as a foundation for all future research I undertake. The skills I have acquired in the handling of biological research materials, in statistical analysis and computer formatting, in the use of library materials and in the drafting of project proposals and preparation of research reports, are an integral part of my undergraduate education at the University of Hawaii. The experience has significantly increased my understanding of the scientific research process.

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