

1371

AGE DISTRIBUTION AND DENSITY PATTERNS OF STROMBUS GIGAS
IN GREATER LAMESHUR BAY, ST. JOHN, U.S.V.I.

Sybil Conway and Tracey Morrow
School for Field Studies
Virgin Islands Ecological Research Station
Box 719, St. John, U.S.V.I. 00803
December 5, 1986

ABSTRACT

In this study the population of S. gigas in Greater Lameshur Bay was surveyed, using band transects in star formations, to determine age-density patterns. We found two distinct size classes of juveniles (3.5 - 6 inches and 6 - 9 inches) which correspond to two year classes. The density of small juveniles was greater at the NW portion of the bed where the sea grass is less dense and there was a concentration of large juveniles at the SE end of the bed which is closer to the shore and where the growth of sea grass is more dense.

INTRODUCTION

The Queen Conch, Strombus gigas, is found from Bermuda and South Florida throughout the Caribbean. For years this large marine gastropod has been prized for its beautiful shell and tasty meat. However, since the 1960's its numbers have been declining due to overfishing. In order to maintain the conch population, in the face of rising demand for its products, management measures, such as size limits, catch quotas, and closed seasons, have been instituted. To make these management techniques more effective in meeting the needs of the conch as well as the people who depend on the income from conch fishing, further research into the population ecology of S. gigas is necessary.

S. gigas can be found at depths ranging from 0 - 120 ft. (Berg). This range may correspond to the depth of the photic zone as S. gigas is an herbivore. Juvenile conch, 3 - 9 inches, are most abundant at shallower depths (30 - 40 ft.) (Randall, 1964). Thalassia testudinum and Syringodium filiforme beds are the favored habitat, but S. gigas is also found on sand flats, gravel, coral rubble, and hard coral rock bottom. (Randall, 1964). S. gigas grazes on epiphytic algae and bacteria found on the sea grass leaves and other substrates. S. gigas spawns once a year, from May to September, and adults migrate to shallow areas to lay eggs, usually between July and October. (Berg)

The S. gigas population in Greater Lameshur Bay was chosen for study because of its location within the Virgin Islands National Park. Although this population had experienced some fishing pressure in the past, it has been virtually untouched for

the past year. The purpose of this study is to determine the location and size of the S. gigas population and to examine density patterns and age distribution.

MATERIALS AND METHODS

To determine the location of the S. gigas population in Greater Lameshur Bay we used a towing method along band transects to cover the bay. (Joyce, P., pers. comm.) On SCUBA we were each towed on a 100 ft. line behind a Boston Whaler at a speed of 2 knots. In this way we were able to sweep large areas of the bay at a depth from which conch could easily be sighted. Weighted bouys were released to mark areas with high concentrations of conch. Once the location of the conch bed was determined a strip census method was used to survey the population. (Hesse) Along 100 ft. transect lines we swam in tandem carrying a 10 ft. rod centered on the transect line. The rod was moved along the line at 2 ft. intervals and all conch encountered in the 10 x 2 ft. quadrats were counted. The length of each conch, from the tip of the siphonal canal to the spire, was measured with a ruler to the nearest 0.5 inch and its location along the transect was noted.

The transects were arranged in a star formation so that from a central point 8 transects radiated in 8 compass directions. After the completion of a star the center was shifted to the end of that transect which showed the highest density of conch, see Fig. 1. (Singer, R., pers. comm.) We continued this process until the density became low enough to determine the boundaries of the bed.

RESULTS

I. Location of Conch Bed in Greater Lameshur Bay.

The results of the towing survey showed a concentration of conch near the Northeast shore of the bay, approximately 30 - 360 ft. off Donkey Bite, at a depth of 16 - 20 ft. (See Fig. 1.)

II. Population Estimate.

The area of the bed as defined in Fig. 1. equals 55,217 ft. The area of the quadrats equals 18,360 ft. , and 670 conch were counted within the quadrats. Therefore by extrapolating from these figures we estimated the population to be 2,015 conch.

III. Distribution of Conch.

We tabulated the number of conch per quadrat and a Poisson distribution test was used to determine if the distribution of conch among the quadrats was random or aggregated. A Chi-Square analysis showed that our results varied significantly from random distribution. (See Table 1.)

Table 1. Poisson Distribution Test for Random Dispersion of S. gigas in Area Mapped Along NE Shore of Greater Lameshur Bay.

# conch/ quadrat	observed frequency	absolute expected frequency	χ^2
0	1236	1164.76	4.357
1	383	481.00	19.96
2	98	99.26	.0159
3>	43	13.66	63.01

$$\sum \chi^2 = 87.34$$

IV. Density of Conch.

On the map of the bed, Fig. 1, we chose four circular areas, counted the number of conch in each area, and determined the density. (See Table 2.)

Table 2. Density of Conch in Four Circular Areas Within the Mapped Conch Bed.

AREA	DENSITY
1	9.42×10^{-3}
2	1.3×10^{-2}
3	2.08×10^{-2}
4	2.06×10^{-2}

V. Size-Frequency Distribution.

The range of conch sizes was from 3.5 inches to 9 inches. We tabulated the number of conch in each size category, in 0.5 inch intervals. (See Fig. 2)

VI. Age Distribution.

We divided the conch into two size classes which we correlated to two age classes: small juveniles 3.5 - 6 inches and large juveniles 6 - 9 inches. We computed a 4×2 contingency table to determine if there was any significant difference in the distribution of the two age classes. (See Table 4.) Along a 300 ft. transect line running NW to SE through the mapped area, we determined the density of each size class at 12 ft. intervals. (See Fig. 3)

Fig. 2

Size frequency of Streblospio rigida surveyed at
Greater Bamesham Bay, St. John, in Nov. 1966.

Curve 1: $3\frac{1}{2}$ to 6 inches, mean size = 4.7 inches

Curve 2: 6 to 7 inches, mean size = 7.1 inches

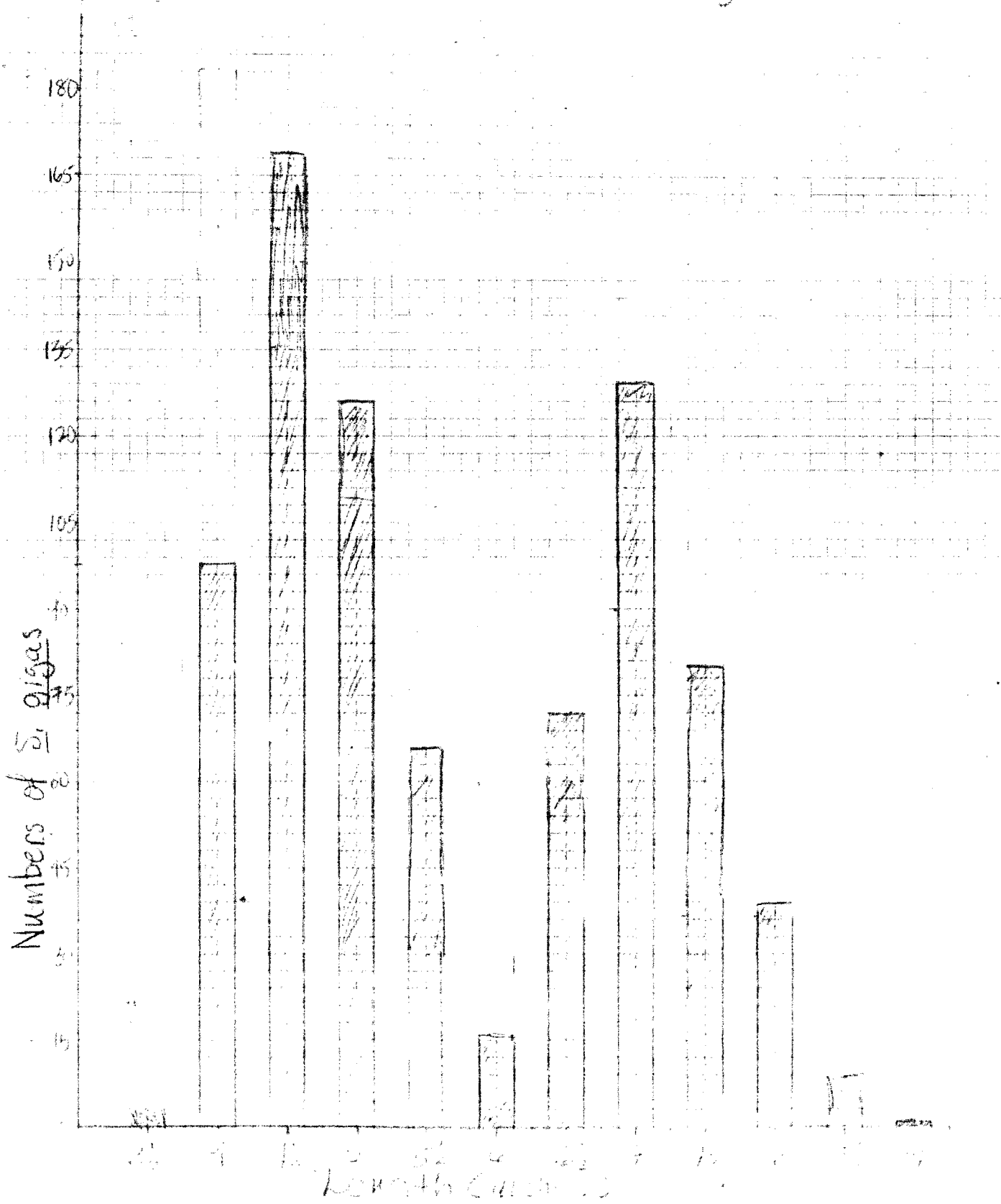


Table 3. 4 x 2 Contingency Table: To determine the distribution of large and small juvenile conch in four circular areas within the mapped conch bed.

AREA		SMALL	LARGE	TOTAL
1	obs.	85	2	87
	exp.	47.35	39.64	
	χ^2	29.94	35.74	65.68
2	obs.	35.5	9.5	45
	exp.	24.49	20.50	
	χ^2	4.95	5.90	10.85
3	obs.	108	75	183
	exp.	99.60	83.39	
	χ^2	0.7084	0.8441	1.552
4	obs.	42	140	182
	exp.	99.05	82.94	
	χ^2	32.85	39.25	72.1
total		270.5	226.5	497

DISCUSSION

The area in which we found conch consisted of a Thalassia testudinum and Syringodium filiforme grass bed which became progressively more dense as we moved SE. The conchs were located to within 10 - 20 ft. of the sandy halo, marking the Eastern most boundary of the bed. To the South, SW, and West there was an abrupt decrease in S. gigas density beyond which many milk conch, S. costatus, were found. The substrate on which S. costatus were found was more sandy than the S. gigas bed. These two populations were distinctly separated, only a few S. gigas individuals were found among the S. costatus population. (See Fig. 1) This division may indicate competition between the two populations which has lead to niche separation. Also we observed S. costatus spawning and it may be that this population migrated to the sand flat to lay their eggs. To the North the population density slowly decreased although there was no obvious change in substrate. This may indicate a minimum critical population density of the colony because the habitat beyond the North boundary appeared to be suitable for S. gigas yet they were not found there.

As shown by the Poisson distribution test (Table 1), S. gigas were not randomly dispersed. The density measurements calculated in Table 2 show that the conch bed was more densely populated in the SE portion than in the NW. The size - frequency distribution showed two groupings of conch in distinct size

classes (See Fig. 2) The means of the two curves were found to be 4.7 and 7.1 . The difference between these two means, 2.4, corresponds to the average growth of juvenile conchs per year as found by the Hydrolab hatcheries in St. Croix, USVI. (Iversen and Jong, 1985). From this correlation we determined that the two groupings represent two year classes. In the four areas examined for the contingency analysis, a significantly greater amount of small juveniles were found in the NW portion and a greater amount of large juveniles in the SE. There was not a sharp division between the two age classes from one end of the bed to the other, rather a gradual change. Although there was a mixture of the two size classes in the SE, the larger juveniles were dominate in number. However, the NW portion was inhabited almost exclusively by the smaller juveniles (See Fig. 3). This distribution may be due to the activity of predators from the reef, like octopus, preying on the smaller juveniles in the SE area. It is also possible that the smaller juveniles prefer the sandier area to the NW because it allows more space for them to bury themselves. Burial provides protection from predators and reduces the water flow which increases their ability to lay down a new layer of shell (Randall, 1964).

No adult conch, i.e. those having a flaring lip, were found. This may be due to recent overfishing, despite National Park regulations, which removed virtually all adults and the population has not had time to recover its full complement of age classes. Another explanation could be that this area is serving as a nursery ground. The adults may have migrated to deeper water after their spawning season.

This study showed age distribution patterns which may be related to habitat preference or predation pressure. Further investigation into the relationship between sea grass bed density and S. gigas age distribution, as well as predator - prey interactions, may aid in determining the reasons for the observed distribution. Also this study may be used as a basis for study of time-related changes in age densities and population size in Greater Lameshur Bay.

REFERENCES

- Berg, Carl J. Jr., Conch biology.
- Herkes, James Burnett. Management and replenishment of conch.
- Hesse, K.O. 1979. Movement and migration of the queen conch Strombus gigas in the Turks and Caicos Islands. Bull. Mar. Sci. 29:303-311.
- Jory, D. and E. Iversen. 1985. Queen conch at the crossroads. Sea Frontiers. 31:150-159.
- Randall, J.E. 1964. Contributions to the biology of the queen conch, S. gigas. Bull. Mar. Sci. 14:246.

Fig. 3 Distribution of Size Classes along a 300ft. transect running NW to SE through the conch population surveyed in Great James Bay, St. John, in Nov. 1986.

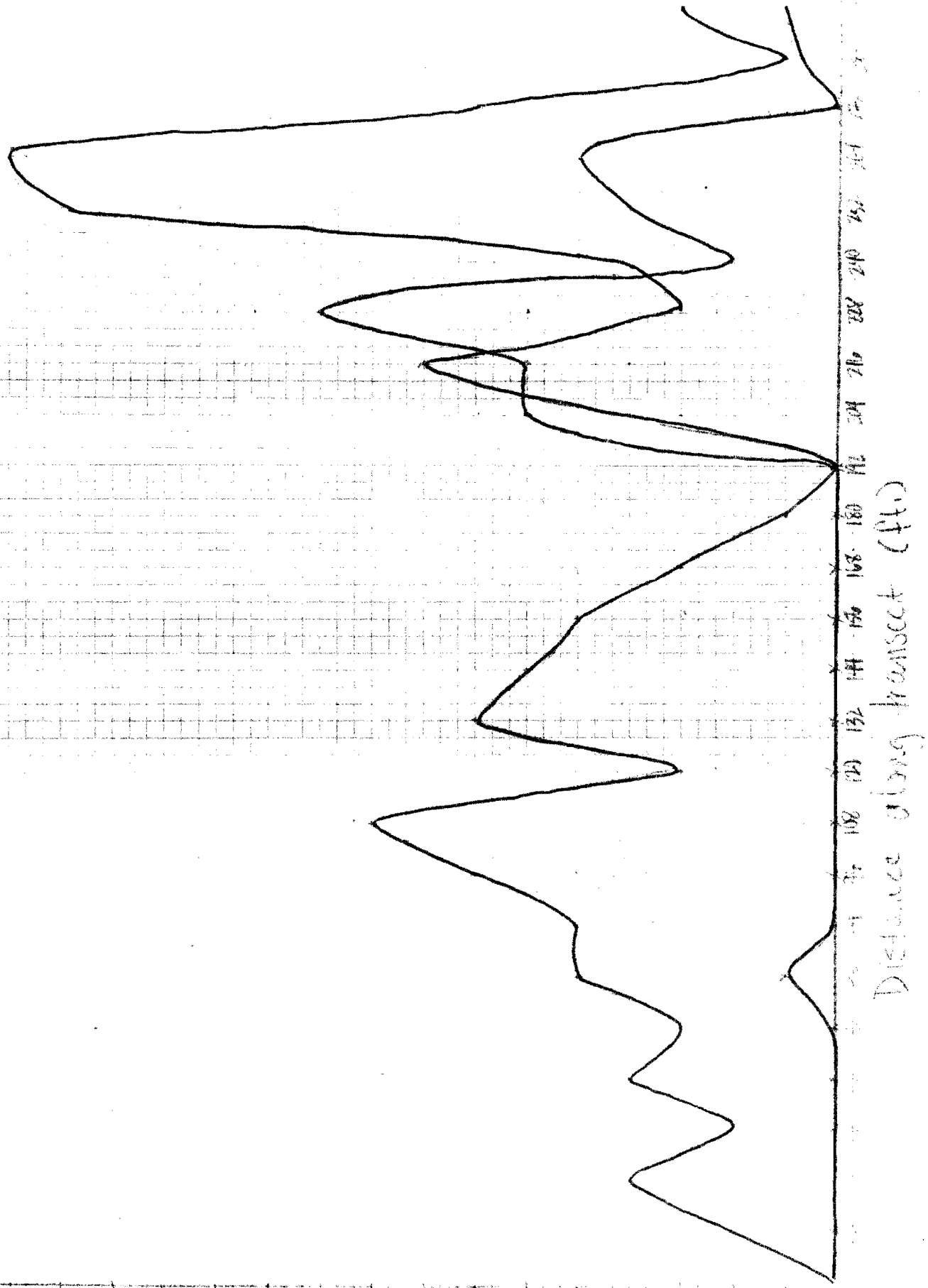
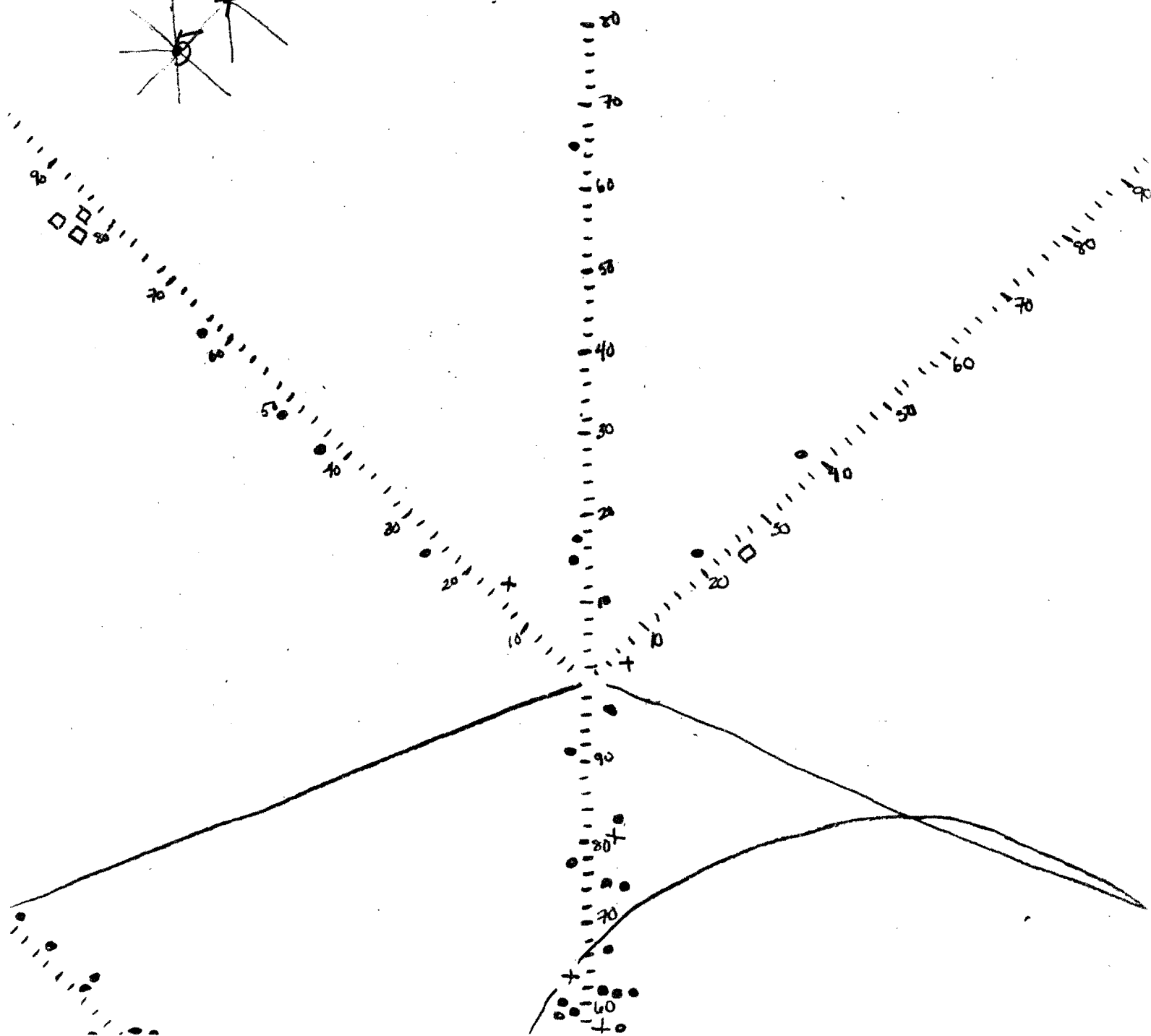
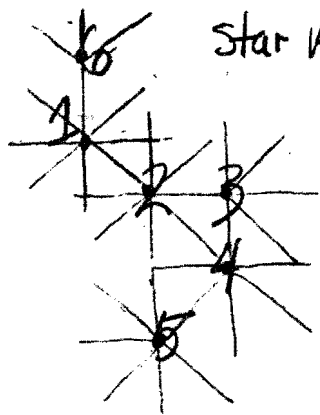


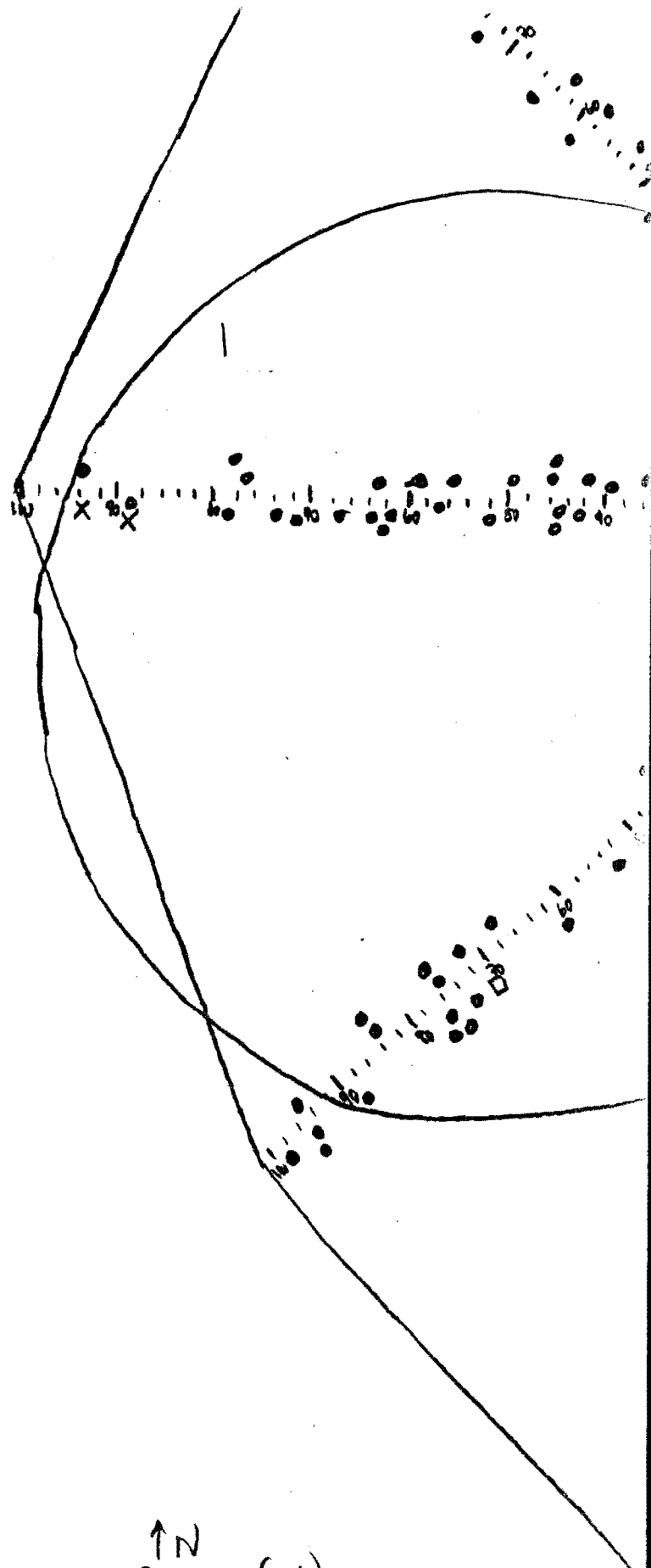
Fig. 1 Map of *S. gigas* population surveyed in
Greater Lameshur Bay, St. John, U.S.V.I.,
showing age distribution and density patterns.

- = small juveniles (3½" - 6")
- X = large juveniles (6" - 9")
- = *Strombus costatus*

Star 6 N ↑

Star Arrangement



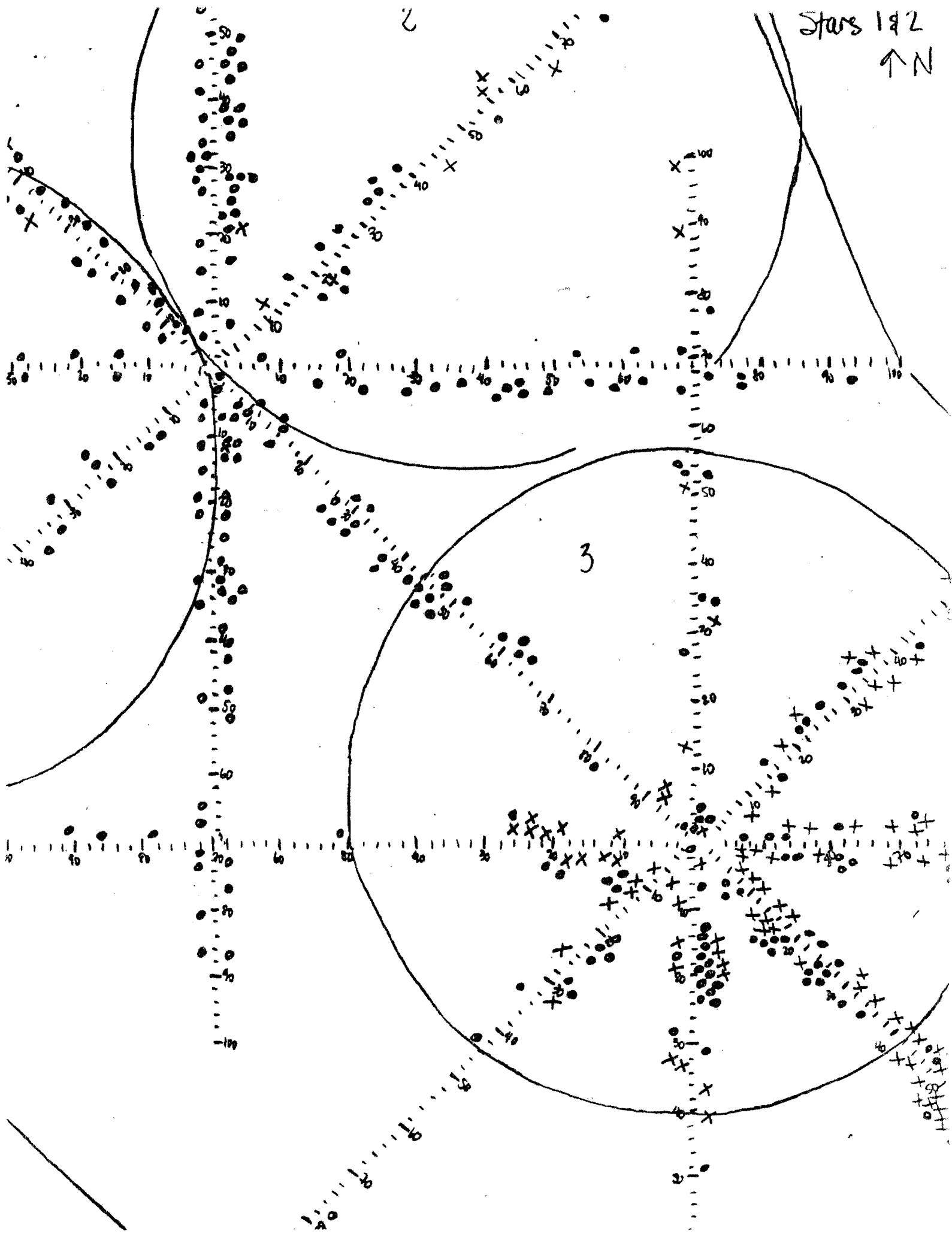


↑N
STAR 1 (W)

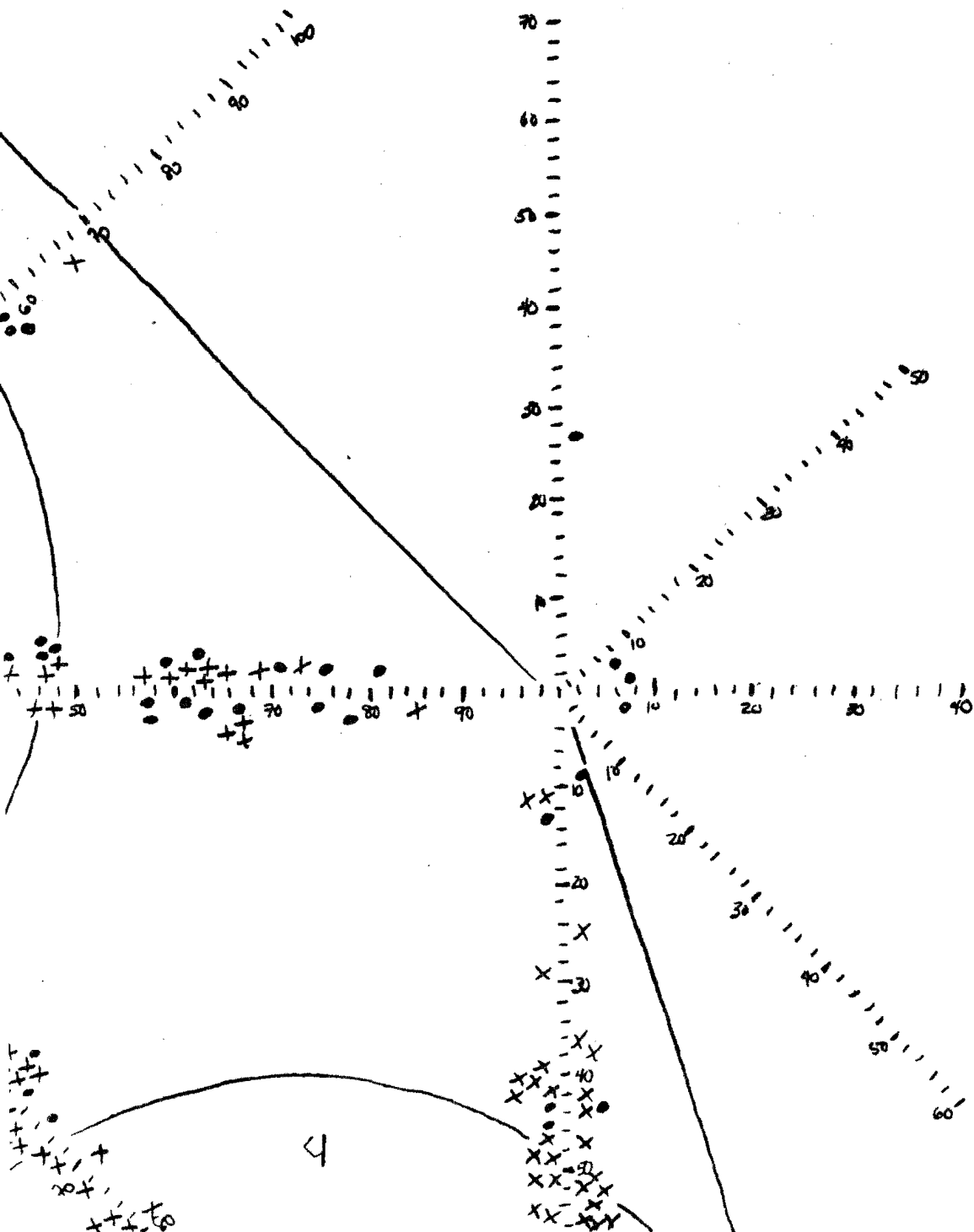
Stars 192
↑ N

2

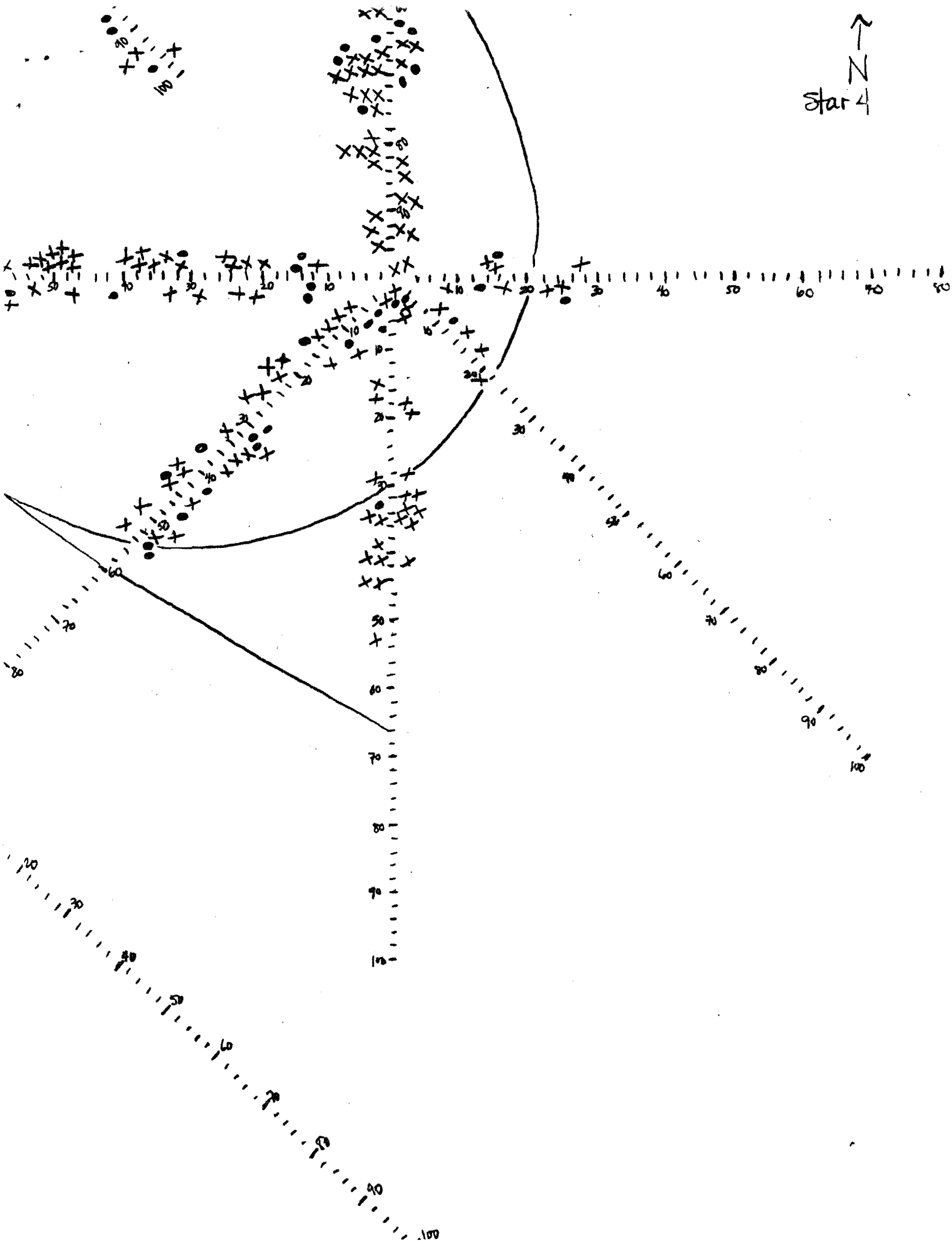
3



Star 3 ↑ N



Star 4
N



↑
N
STAR 5 (W)

