

TRENDS OF POPULATION DENSITY, MEAN SIZE,
AND DISTRIBUTION OF STROMBUS GIGAS
IN GREATER LAMESHUR BAY, ST JOHN, USVI
PRE AND POST HURRICANE HUGO

K.M.P.B. O'Connell
Nicholas Tolimieri
Matthew D. Wortman

ABSTRACT

This paper is a study of the effects of Hurricane Hugo and a continuation of previous studies on population density, mean size and distribution of Strombus gigas in Greater Lameshur Bay, St. John, USVI. This was accomplished by using transect survey methods. There was found to be a stable population and juvenile bed in the northeast corner of the bay. Mean size was found to have decreased significantly from previous years.

INTRODUCTION

In September 1989 Hurricane Hugo swept through the Caribbean. St. John, USVI, received over 10 hours of sustained winds in excess of 140 mph. This had a severe impact on both terrestrial and marine ecosystems. In particular, large areas of the sea grass beds in Lameshur Bay were gouged out (pers. obs.). This study was done to continue previous studies on Strombus gigas, which inhabit these beds, and to see if there has been a disruption of previous trends since the hurricane. The specific areas compared were: population density, mean size, and distribution of conch.

The Queen Conch, Strombus gigas, is a large herbivorous gastropod of the family Strombidae, which feeds primarily on epiphytic algae on sea grasses (Brownell and Stevely, 1981). Strombus gigas is found in the Caribbean, northern coast of South America, east coast of Central America, and the southern tip of Florida to Bermuda (Colin, 1978, 379). Conch display seasonal migratory and spawning patterns: movement inshore during spring; reproduction in the summer; and movement offshore during fall (Brownell and Stevely, 1981). Ages of conch are determined by length of apex to siphonal aperture and formation of a flared lip. Under one year old, S. gigas live in the substrate. Yearlings range between 7.6-10.8cm; 2 year olds, 12.6-17.0cm; 3 year olds, 18cm and above, are considered adults and begin the formation of a flared lip. Juvenile S. gigas congregate, whereas adults are more mobile (Hesse, 1979 from Boulon, et al, 1986). According to Proft, 1988, the former tend to occur in 8m of water or less, while the latter occur in deeper waters (20-76m).

Culturally, conchs are valued as a food resource. Overharvesting has depleted the population such that a 5 year moratorium was initiated in February of 1988 in St. Thomas and St. John, USVI.

This study was done to determine the effects of Hurricane Hugo on the conch population in Greater Lameshur Bay.

METHODS AND MATERIALS

The S. gigas bed in this survey, located in the northeast part of Greater Lameshur Bay off the sandy halo off Donkey Bight, was identified by Conway and Morrow in 1986. All work was done on SCUBA. A (0,0) point was set up 10° of north from the largest Donkey Bight rock and 14.5m perpendicular to the shore, marked by a automobile tire, which has been left in place. A 200m transect was set up at a heading of 225° and a 150m transect at a heading of 315°. Flags were placed at 10m intervals along each transect. 50X2m subtransects were surveyed from these flags at 315 from the 200m transect and 45° from the 150m one (Fig. 1). Using 50m transect tapes and 1m PVC pipes, a buddy pair swam the length of the subtransect. The size of S. gigas and location along the subtransect were recorded when it fell within 1m on either side of the subtransect.

The data collected were compared to data from previous years (Table 1). The t-test was used to analyze the mean size data.

RESULTS

The population density for the fall of 1989 was found to be 0.039 conch/m. Figure 2 shows that the density of S. gigas dropped off from a high of 0.120 conch/meter² in the fall of 1986 (Conway and Morrow, 1986) and spring of 1987 (Beeh, 1987), to 0.074 in the fall of 1987 (Brickell, 1987). The density decreased to 0.037 in the spring of 1988 (Hicks, 1988) and has remained relatively constant, fluctuating to 0.041 in the summer of 1988 (Gill, 1988) and to 0.039 in the fall of 1989.

The data in Figure 3 show a distinct trend towards the increase of the mean size of S. gigas, from the fall of 1986 until it peaking in the summer of 1988, then decreasing significantly in the fall of 1989. In the fall of 1986 and the spring of 1987, the mean size of S. gigas was 14.6cm (Conway and Morrow, 1986, Beeh, 1987). It continued to increase through the fall of 1987, spring of 1988, and peaked in the summer of 1988, at 16.5cm, 17.1cm, and 18.9cm, respectively (Brickell, 1987, Hicks, 1988, and Harvey, J.I., 1988). It then decreased significantly to 11.7+/-3.3cm in the fall of 1989 (t-test, $p < 0.001$, $t = 61.9$, $df = 372$). The mean size of the fall of 1987 and fall of 1989 were compared. The current mean size was found to be significantly less than that of the fall of 1987 (t-test, $p < 0.001$, $t = 13.9$, $df = 492$).

As shown in Figures 4-9, the overall size distribution shows the same overall trend as mean size. Figure 4, the fall of 1986, displays two consecutive generations; two and three year olds. The spring of 1987 (fig. 5), shows an increase in the size of the younger (formerly the two-year olds) generation and a decrease in the the number of older of the two generations. In the fall of 1987 through the summer of 1988 (Fig. 6-8) the younger generation continued to increase in size. Then in the fall of 1989, the size distribution returned to a largely juvenile population (fig. 9).

The bed of juvenile conch was found on the ends of subtransects 7 - 10 on the 150m transect (Fig. 1). Conch were randomly distributed throughout the rest of the survey area. Figure 11 shows that this coincides with the beds of juveniles identified in previous studies.

DISCUSSION

Although there may have been S. gigas in Greater Lameshur Bay, there was no identified conch bed off Donkey Bight until after 1985 (Hicks, 1988, D. Leritas, pers. comm.). The results suggest that the beds were established then. This may have occurred through recruitment or random settlement. At this time though, the juveniles would not have been evident because they burrow into the sediment.

The density was constant in the fall of 1986 and spring of 1987. It then decreased until the spring of 1988 where it has remained relatively constant. There are two possible reasons for this change in density. The first explanation for the initial decrease in density is that the bay was overpopulated in the fall of 1986 and spring of 1987, but then dropped and stabilized at the bed's carrying capacity.

A second possibility involves the spatial relationships between both juveniles and adults. The adult population present in the fall of 1986 decreased in number in the spring of 1987 (Fig. 4 and 5), yet the density remained the same. This means that more juveniles were present in the spring of 1987. It is possible that these new juveniles had not yet exposed themselves, or that more of them had come into the study area from areas just outside it. The latter reasoning being that juveniles tend to congregate. This could also account for the decrease in density over the next two years. As the S. gigas get older, they tend to spread out. As they spread out, the distribution becomes more random, resulting in a lower survey density. The reason that the density remained relatively constant is related to mean size.

The mean size of S. gigas increased steadily from the fall of 1986 to the summer of 1988. During this period, there was no seasonal fluctuation. From the summer of 1988 to the fall of 1989 the mean size dropped significantly to 11.7cm. This change in size would correlate with the adult tendency to migrate offshore in the fall. However, the S. gigas in Greater Lameshur have not shown a decrease in mean size in the fall, which would indicate an absence of larger conch due to migration. The mean size of the fall of 1989 was found to be significantly less than that of the fall of 1987. This significant drop in mean size in the same season leads us to believe that the decrease in mean size cannot be attributed to regular seasonal migration alone. This is because the mean size is significantly less than that of previous falls as well as previous springs.

The decrease in mean size along with an initial decrease, then leveling off of density suggests a colonization of this section of the bay. Our explanation is as follows. Settlement into the Donkey Bight grassbed occurred in the summer of 1985, where they remained buried until 1986 (which is when the bed was discovered). They increased in size, but were not reproductively mature until the summer of 1988. This is corroborated by the increase in mean size up to 18.9cm in summer 1988. At this time, they would have been able to reproduce for the first time, after which they would have migrated to deeper waters (Proft, 1988). In the fall of 1989, their offspring would be greater than a year old, with a length of approximately 12cm. The current mean size of 11.7cm supports this theory. As stated above, the density would have remained constant, until the fall of 1989. At this point one would expect to see an increase in density due to congregation of new juveniles that were spawned in the summer of 1988. The lack of an expected increase in density is due to a less successful recruitment.

Now that there is an established bed, we expect to see regular seasonal fluctuations in mean size and density due to migration. This is because previously there had been only one generation, which as juveniles, did not migrate.

A second explanation would be the effects of hurricane Hugo. It is possible that the high wave action of the hurricane may have removed some of the conch. It is also possible that the more mobile adults moved to deep, calmer waters when the water activity increased. Another explanation is that the adults migrated out of the bed area after the hurricane because of unfavorable conditions. The lack of and expected increase in density could be an effect of the Hurricane.

At this point it is impossible to determine the severity of the effects of Hurricane Hugo. This study needs to be continued over the next several years to determine if trends of seasonal variations in mean size and density develop and if Hugo had an effect on Strombus gigas in Greater Lameshur Bay.

ACKNOWLEDGEMENTS

We would like to thank our parents for making us possible; Mary, Heinz, and Danl for their help; Jacques Costeau for inventing SCUBA and making the study have less ups and downs, those big snails and their entrails just for being there, and the dolphins for making the boat rides back soooo exciting. We'd also like to thank Hans and Gary for reviewing our dater. Remember: time is dater, when you're diving, time is air, time is money, so air is money and so is dater. The End.

REFERENCES

- Beeh, J., 1987. Size Distribution and Density of Strombus gigas in Greater Lameshur bay, St. John, USVI. The School For Field Studies (Unpublished).
- Boulon, R.H. Jr, Beets, J. and Zullo, E.S., 1986. Long-term monitoring methods for fisheries resources of the Virgin Islands Biosphere Reserve. Biosphere Reserve Research Reports. 13:12-17.
- Brickell, J., 1987. Size distribution and Density of Strombus gigas in Greater Lameshur Bay, St. John USVI. The School For Field Studies (Unpublished)
- Brownell, W.N. and J.M. Stevely, 1981. The Biology, Fisheries, and Management of the Queen Conch, Strombus gigas. Mar. Fish. Rev. 43:1-12.
- Colin, P.L., 1978. Marine Invertebrates and Plants of the Living Reef. TFH Publications, 379.
- Conway, S and Morrow, T., 1986. Age distribution and density patterns of Strombus gigas in Greater Lameshur Bay, St. John. The School for Field Studies (Unpublished)
- Gill, K.M., 1988. Density and Distribution of Strombus gigas in Greater Lameshur Bay, St. John, USVI. The School For Field Studies (Unpublished)
- Harvey, J., 1988. Size Distribution of Strombus gigas in Greater Lameshur Bay, St. John, USVI. The School For Field Studies (Unpublished)
- Hicks, L.J., 1988. Population Density and Distribution of Strombus gigas in

Greater Lameshur Bay. The School For Field Studies (Unpublished)

Proft, H.M., 1988. Migration patterns of juvenile Strombus gigas in Greater Lameshur Bay, St. John USVI. The School for Field Studies (Unpublished).

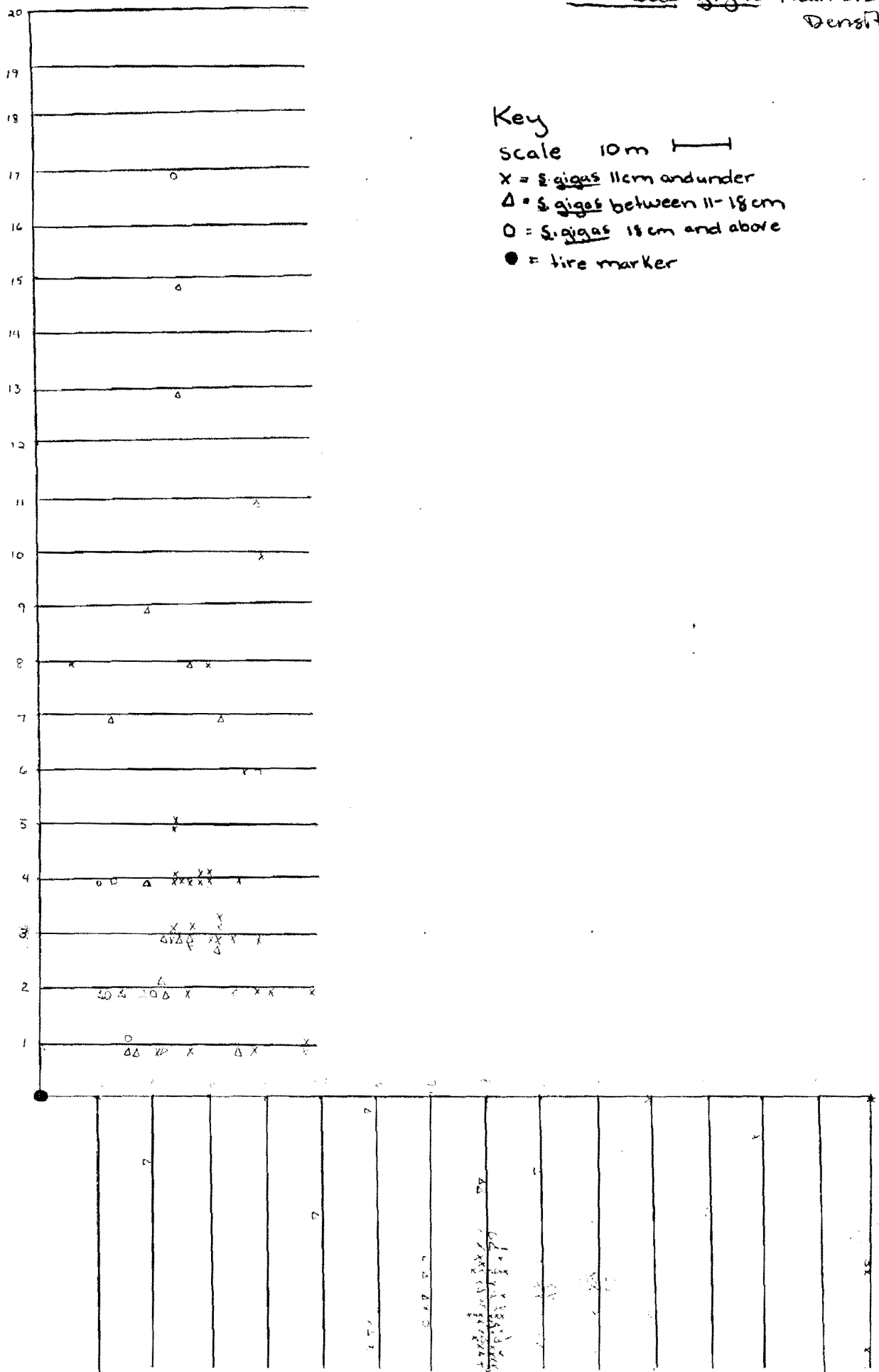


Figure 1. Map of transects and S. gigas size and distribution in Greater Lameshur Bay, St John, USVI.

DENSITY OF STROMBUS GIGAS VERSUS TIME

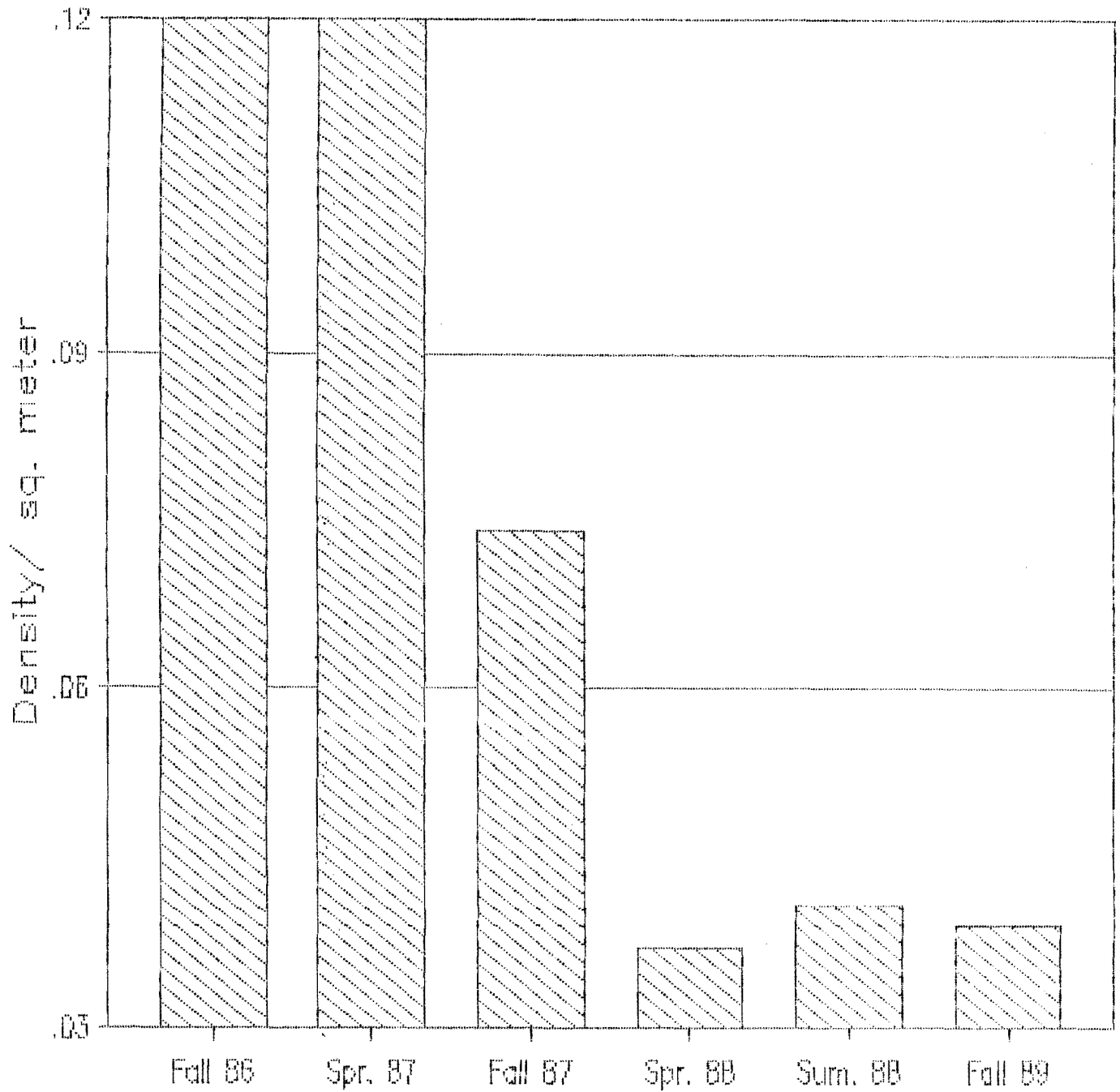


Figure 2. Density of S. gigas from Fall 1986 to Fall 1989

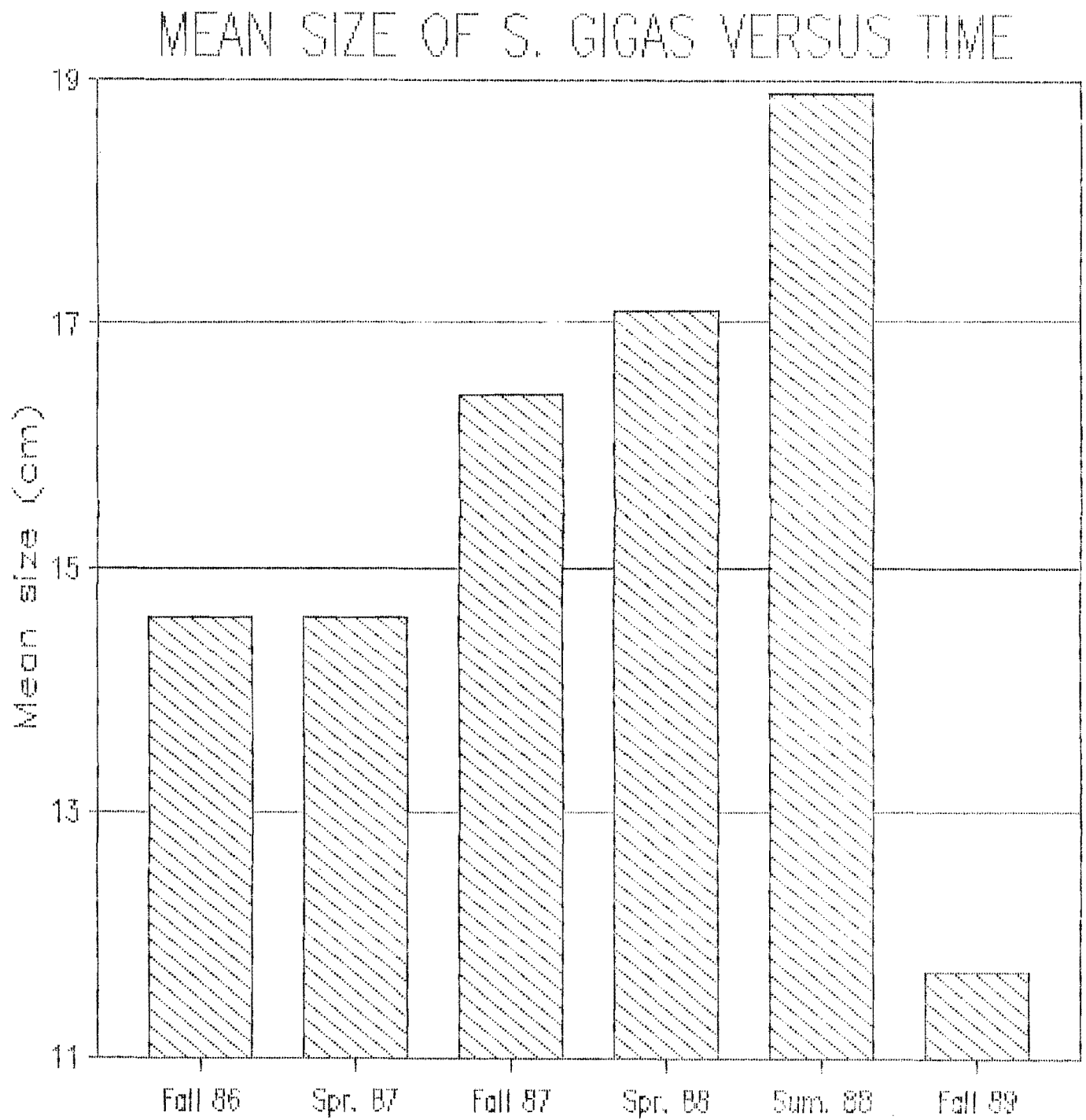


Figure 3. mean size of S. gigas from Fall 1986 to Fall 1989

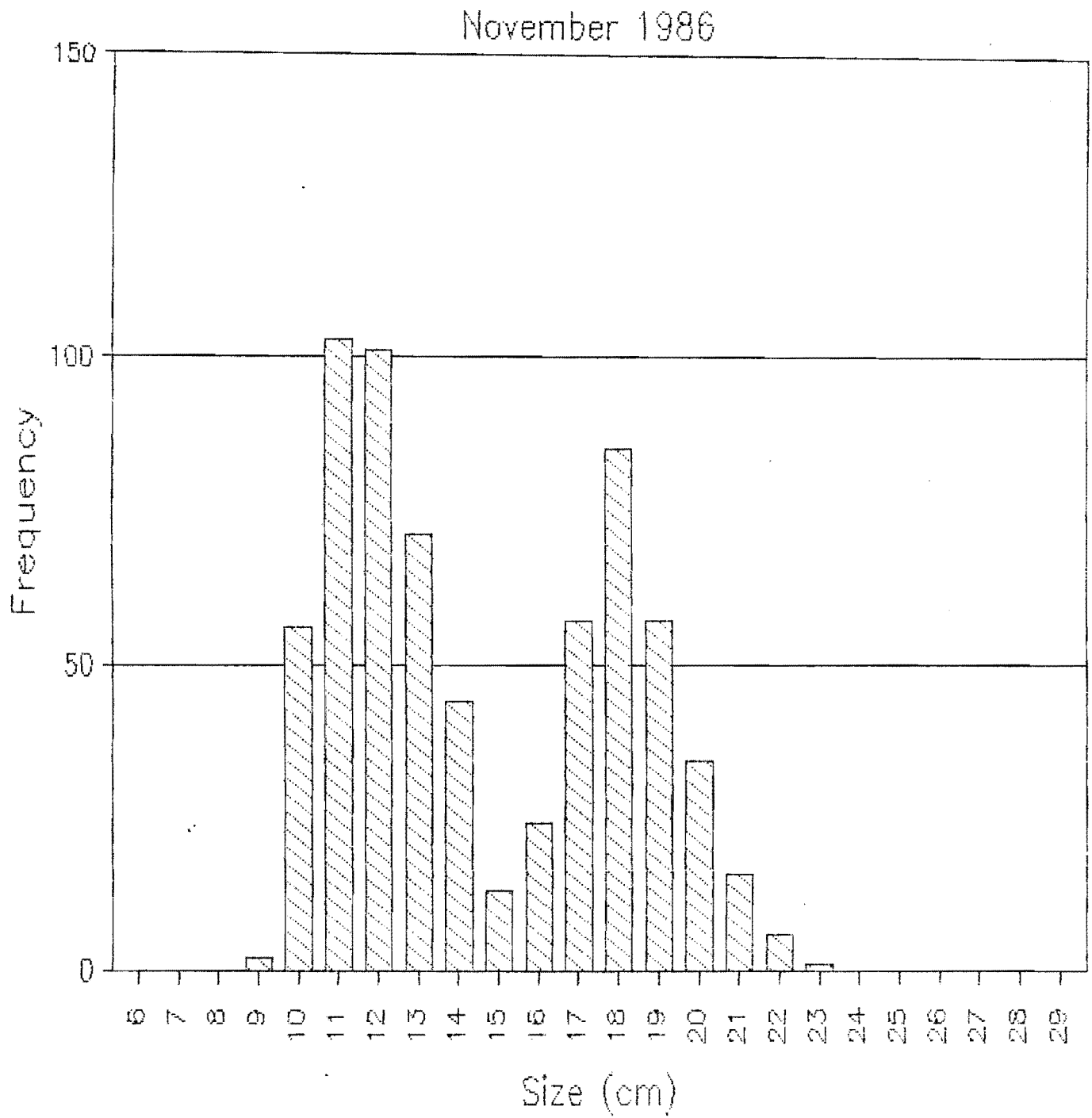


Figure 4 : SIZE Distribution S. gigas for November 1986

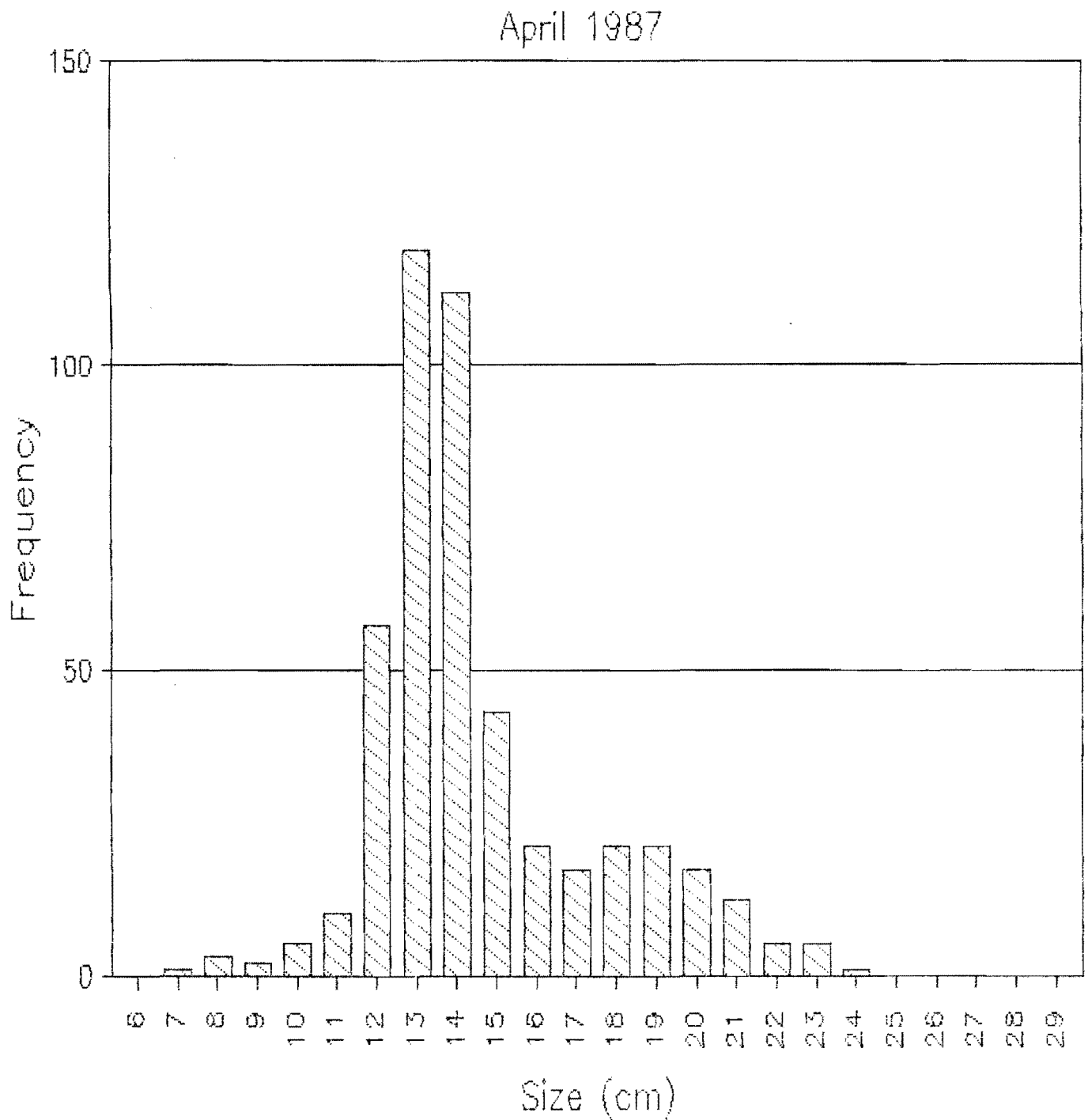


Figure 5. Size distribution S. gigas for April 1987

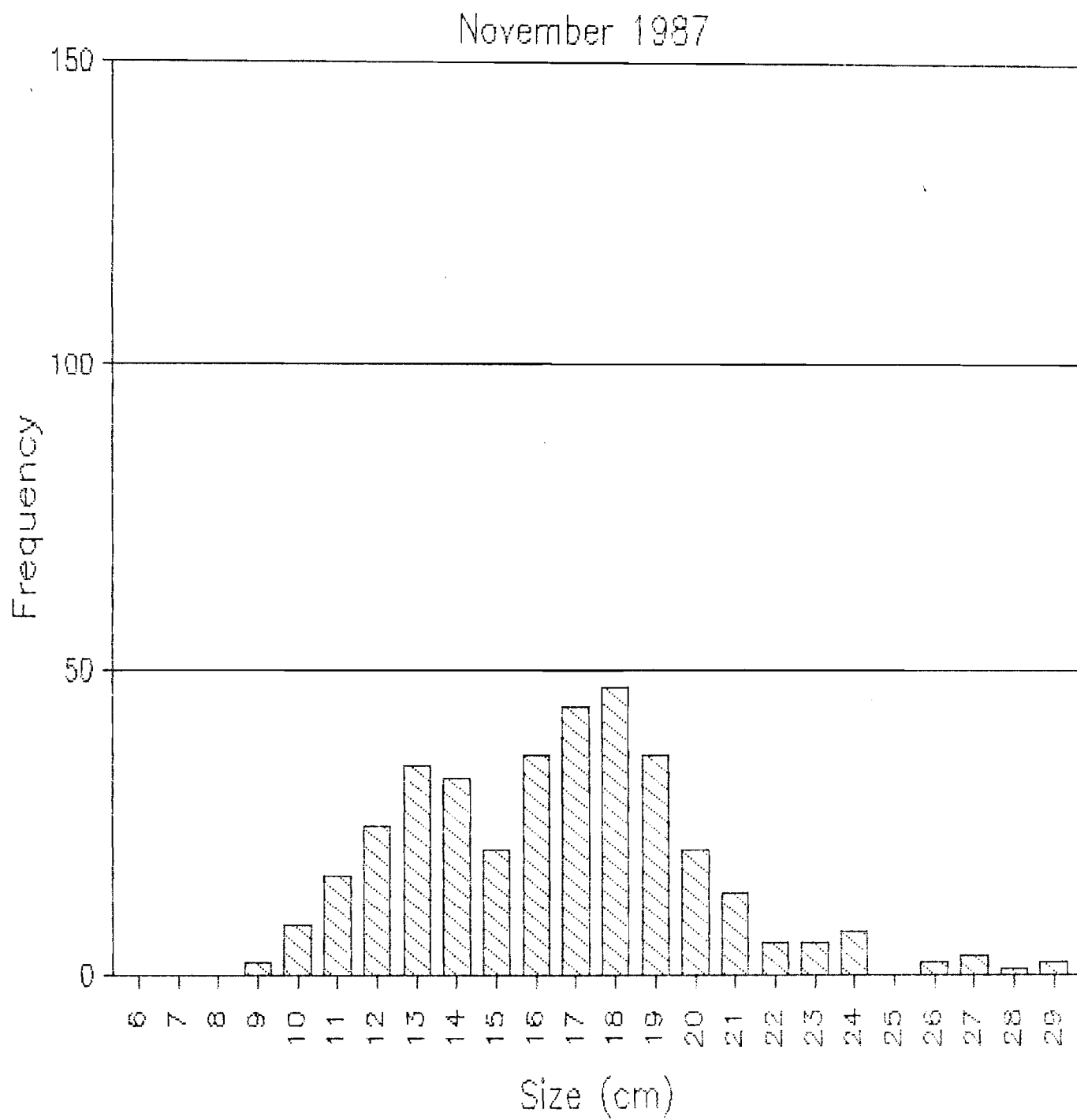


Figure 6. Size distribution for S. gigas, November 1987

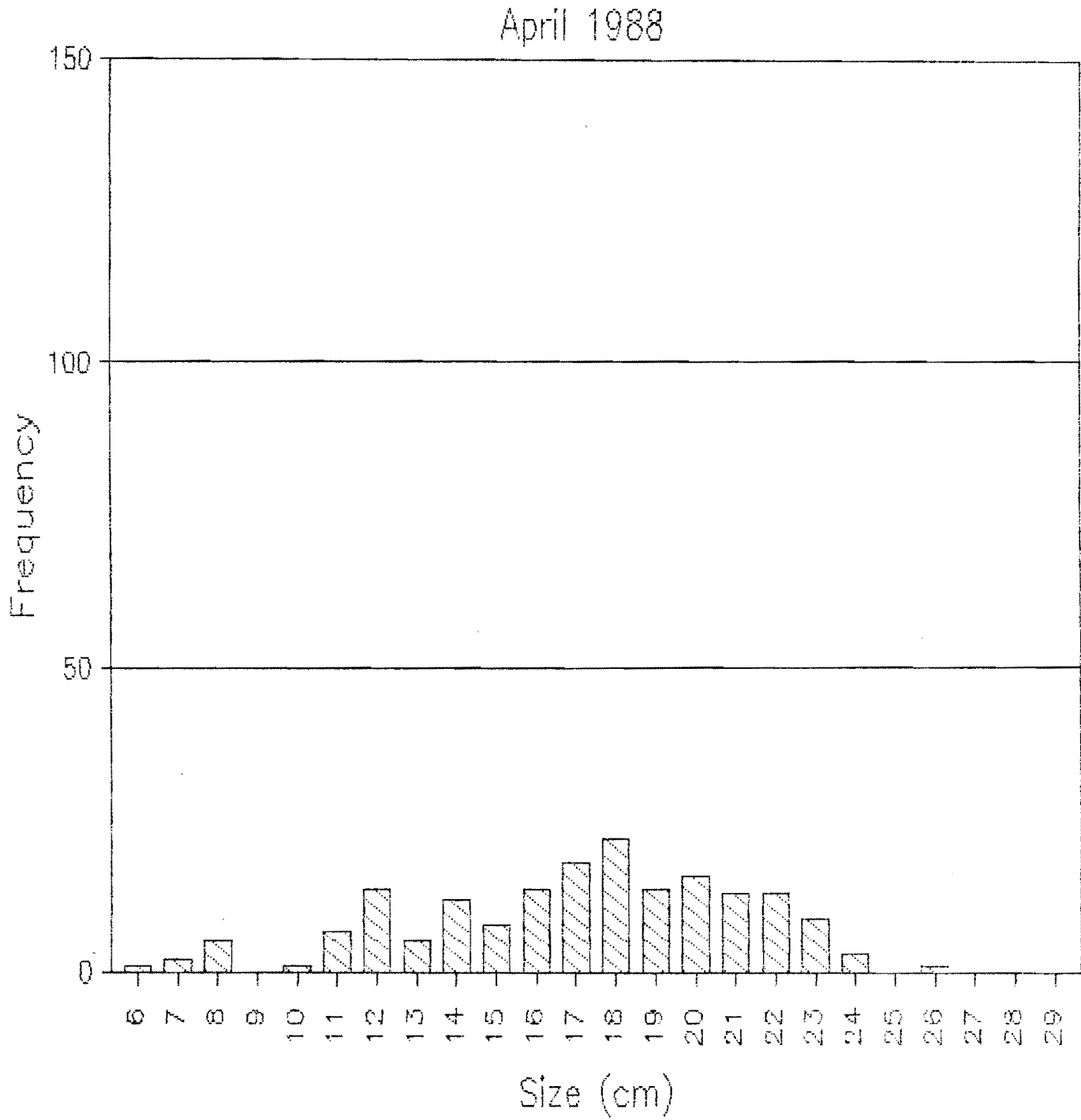


Figure 7 . Size distribution of S. gigas For April 1988

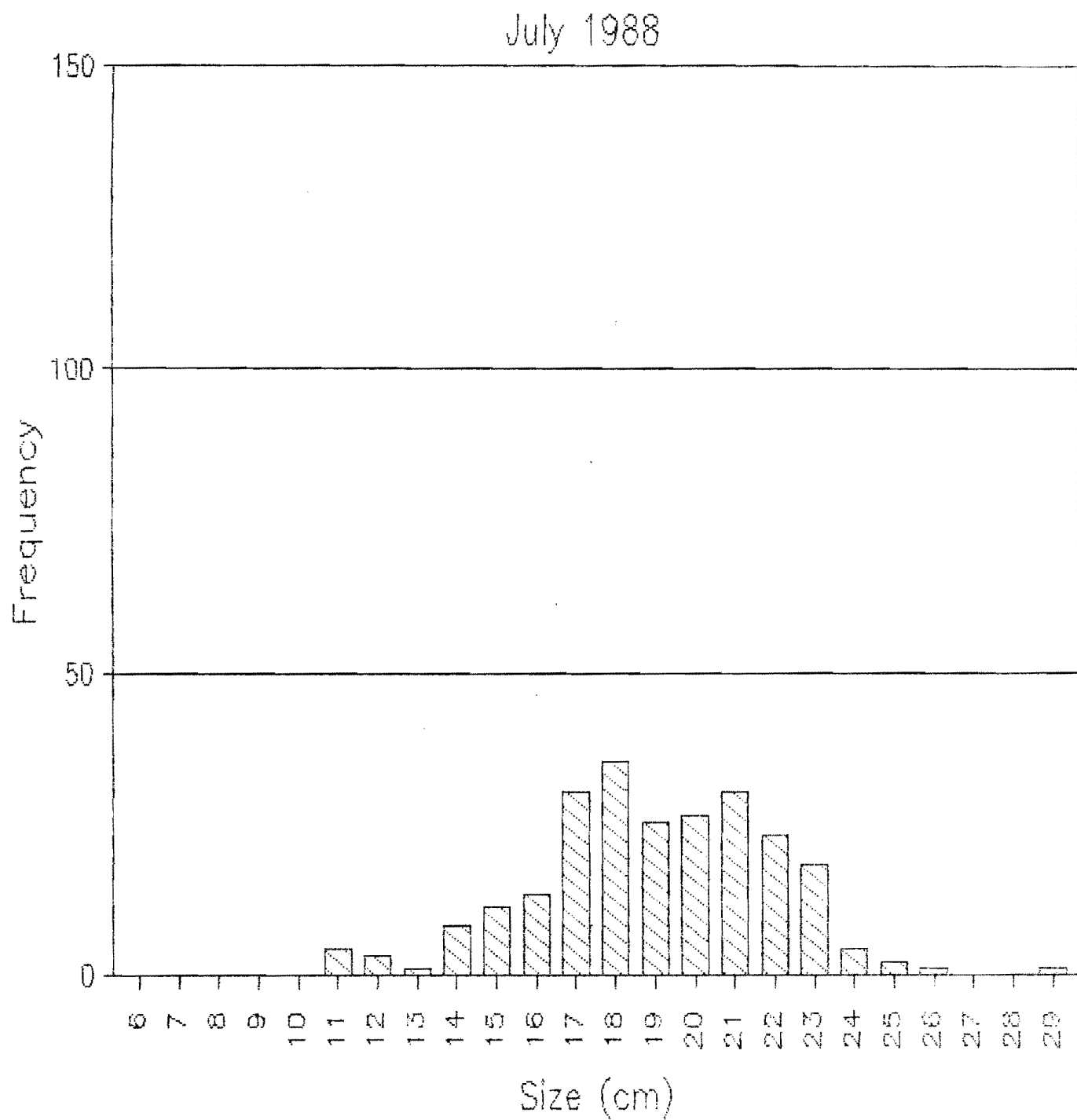


Figure 8. Size distribution of S. gigas for July 1988

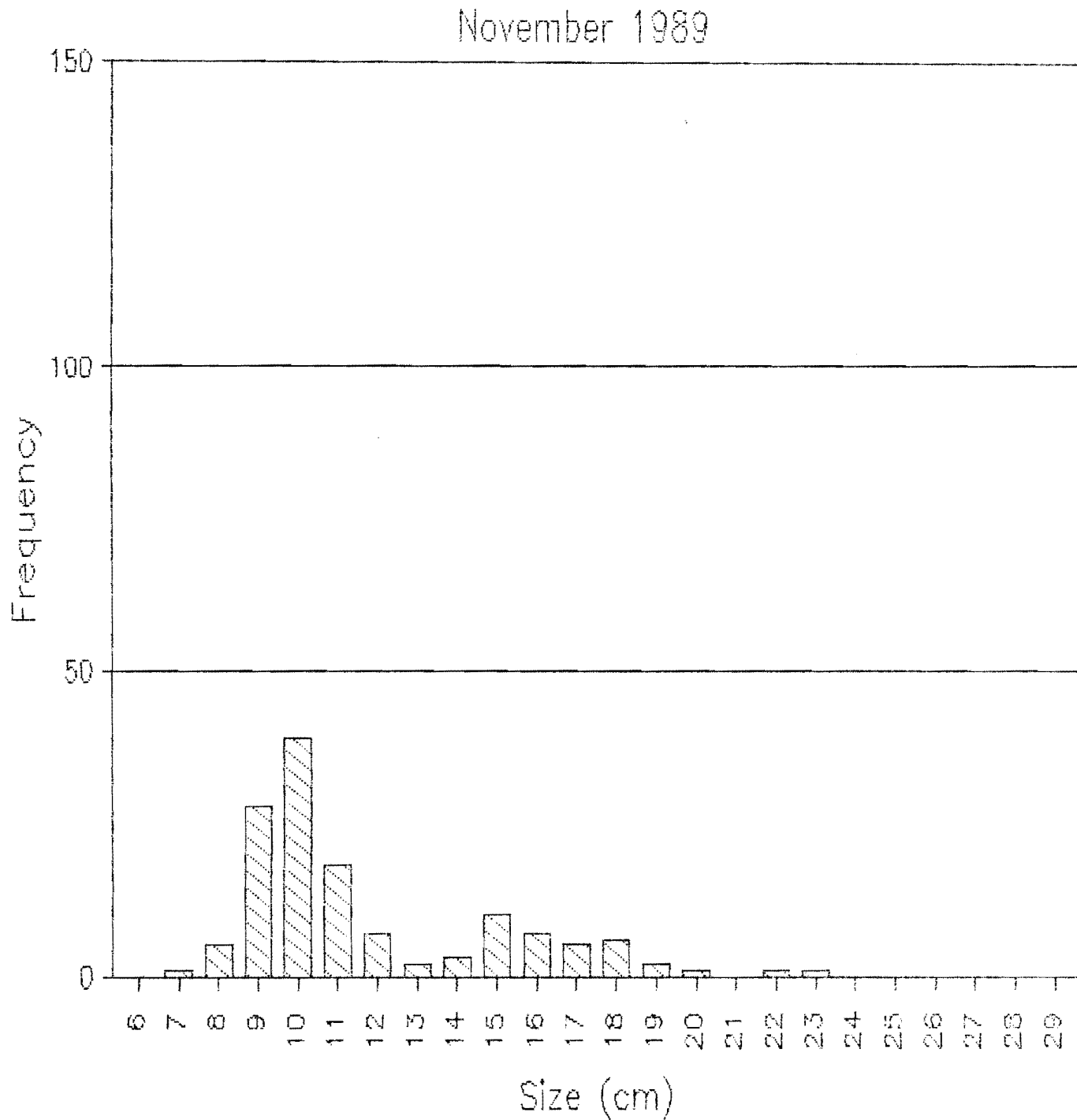


Figure 9. Size distribution of S. gigas for November 1989