

(1)

A Conchometric Study of the Genus Campeloma Rafinesque in
Southeastern Michigan

Lawrence Pomeroy

According to Pilsbry (1917) the genus Campeloma Rafinesque is synonymous with and superceded by ~~Ambloxis~~ Ambloxis Rafinesque. Walker (1918) suggests that the name Campeloma be ^eretained, however. Since the majority of workers have since preferred to use the name, Campeloma, it will be used throughout this paper.

Two species of Campeloma occur in Southeastern Michigan, C. rufum and C. decisum. Since the distinction between these two species has been a vexing problem to students of fresh-water molluscs, a conchometric study of them was undertaken in hopes of finding evidence for or against their separate validity. Since the project was undertaken during only a single semester of work, the population samples studied were not large enough to provide any conclusive results. Therefore, the following is in the nature of a preliminary report.

The systematics of Campeloma involve difficulties not encountered in many other groups of the molluscs. There is little size difference among the several species, and with but one exception, there seems to be no significant difference in the height-diameter ratio. There is no ornamentation upon which species might be separated. In fact, the many similarities of the various species are much more striking than are their differences.

The characters which have been used to separate C. rufum and C. decisum, listed in the order of their apparent importance, are the following:

- color
- degree of shouldering
- erosion
- width of median tooth of radula

For separating these from some other species depth of sutures, presence of an umbilical chink, and characters of the protoconch are used in addition to those listed above. From the literature known to the writer, it appears that no attempt has been made to use either the radula or the soft parts for taxonomic purposes. In fact, no thorough anatomical study has been made. Mattox (1938), Call (1888), and Baker (1928) give the general anatomy of some systems and details of a few organs. Apparently not enough has been done along this line to make possible any use of it in taxonomy.

Most writers on *Campeloma* seem to share the opinion that it is a difficult genus taxonomically, both for the lack of good external characters on the species level and because of a great apparent variability.

As an attempt at attacking one aspect of the problem the writer examined the shells and radulae of snails of the two species mentioned above collected in southeastern Michigan. Part of the shells studied were collected by Mr. Leslie Hubricht and are now in the molluscs collection of the University of Michigan Museum of Zoology. The remainder were collected by the writer.

The following characters were examined and recorded for each specimen:

- length of shell
- diameter of shell
- longest dimension of aperture
- opposite (90°) dimension of aperture
- length of operculum
- width of operculum
- color
- erosion
- depth of sutures
- umbilication
- number of whorls
- shouldering
- abnormalities of median tooth of radula

The Natural Populations Sampled

I. Campeloma decisum

Whitmore Lake, Washtenaw Co., Mich., T1s/R6E/S5.

Two collections were made at Whitomre Lake. The first was on March 3, 1948. Although many samples of bottom up to one and one-half meters in depth were taken with the Needham scraper-net, one one specimen was obtained. This was apparently buried in the mud and not active. The second collection was on May 5th. On this occasion there were large numbers of C. decisum, all concentrated within a foot of the water's edge. The spires of most were visible above the sand. They were found in a protected bay sheltered by a long spit of sand.

The Whitmore Lake specimens were typically green in color and quite strongly shouldered, with little erosion and little depth of sutures. There were, however, brown individuals, although the shell color beneath the periostracum was white. Shouldering also varied from the typical shouldered condition to an evenly rounded one.

Island Lake, Livingston Co., Mich., T1N/R6E/S4.

One collection was made here on March 4, 1948. Six specimens were taken. All but one of these was within a foot of the water's edge. The other was in two feet of water, active, and completely above the sand. The water temperature was 8° C.

All specimens were light green in color with a strong shoulder. The spire was always eroded and the sutures moderately impressed. The very small sample was quite uniform.

Round Lake, Lenawee Co, Mich., T1S/R6E/S5.

One collection was made on April 18, 1948. Six specimens were taken. These were in one or two feet of water, at the surface of the sand, and all were dead or dying. They were found on a wave-swept shore and had apparently been caught out of their proper habitat by some set of circumstances.

The specimens were light green, with a narrow shoulder and flat-sided whorls, moderately impressed sutures, and no erosion. Fleming Creek, Washtenaw County, Mich., T2S/R7E/S7.

Although Campeloma is said to be very numerous here, only two specimens were taken on the one visit made. There were in two feet of water in soft mud. Both had spires visible above the mud.

Both specimens have green shells, little shouldering and rounded whorls, moderately impressed sutures, and no erosion. Honey Creek, Washtenaw Co., Mich., T2S/R5E/S14.

Most of the Campeloma found here were in small aggregations in muddy shoals at bends in the creek. It should be noted that the water of Honey Creek is quite highly colored. The date of collection was May 1, 1948.

The specimens collected at Honey Creek would, the writer believes, be readily taken as C. rufum. They are very dark brown, have no shouldering, rounded whorls, deeply impressed sutures, and no erosion. The color of the shell below the periostracum is, however, white. The writer believes them to fit more closely into the decisum pattern, although they are by no means typical of either species.

Island Lake, Livingston Co., Mich., T1N/R5E/S21 & 22.

Fourteen Specimens from this lake were brought to me by C. C. Carpenter on May 16, 1948. The only available collecting datum is that they were active at the surface.

The specimens vary from brown to green, some having both. They have no shouldering, rounded whorls, deeply impressed sutures, and very little erosion.

II. Campaloma Rufum

Clark Lake, Jackson Co., Mich., T4S/R1E/S16.

Collections were made at two stations on two different occasions in Clark Lake. The first was on a wave-swept shore, where few were present. The second was in a protected cove, and here they were present in the greatest numbers the writer has yet seen. Nearly all were within the first foot of water from shore. Many were buried in shoreline debris, and some were even above the water level in damp debris. In a single square foot of shore seventy three specimens were taken with one haul of the scraper-net. No effort was made to re-examine this spot to get all that were there. The water of Clark Lake is not noticeable stained, but there are many artesian wells flowing into it bearing dark-staining minerals. Around each specimen was a dark patch of sand. Completely buried specimens could be located by this stained sand.

The majority of the Clark Lake specimens were typical rufum. They had no shouldering, rounded whorls, dark brown periostracum, pink shell, deeply impressed sutures, and no erosion. There were variants all the way to green shells with heavy shouldering and slightly impressed sutures. All possible combinations of characters were found in less than one hundred specimens .

It is immediately evident that the sample taken is inadequate, both from the number of natural populations sampled and total individuals studied. Boycott (1928) states that he thinks an adequate sample of a species would be one hundred specimens from each of one hundred stations throughout the species' range. Actually, this figure would vary greatly according to the extent of the range and the variability of the species. In the case of Campeloma, it would probably not be too great a number.

Even from this small sample ($\Sigma N = 180$) we can obtain a considerable insight into the problem of Campeloma systematics. All those populations from which a considerable number of specimens were taken showed great variability in all the characters now used as species criteria. All possible combinations of characters were present, and although each population showed a dominance of one set of characters it also included individuals which, if taken alone, should surely fall into the other species. It is any wonder that experts cannot always agree on the specific identification of individuals of this genus?

The only character which did not vary in a given population was the color of the shell beneath the periostracum. This was therefore used as the final basis of judgement as to which species made up each population studied. Only one ^{population} was found having the distinctive pink shell which is considered characteristic of rufum. In some populations the shell was so thin and translucent that it was very difficult to decide whether color was due to periostracum or to color in the inner layer of shell. In such cases a part of the periostracum was removed.

Color, when not correlated with other characters, is a notoriously dangerous character on which to base species. This is particularly true in the case of Campeloma, because it is found in such varied environments. Is it not possible that color differences in the calcareous part of the shell as well as in the periostracum, may be due to the presence of some staining mineral in the environment? The literature give no hint that this problem has been investigated or even considered as a possibility.

In hope of finding another character which would be correlated with shell color, the writer examined the radulae of seventy-two specimens. The radulae of the two species were very similar, but in decisum there was a strong tendency toward small accessory cusps on the sides of the median tooth. Rarely did they appear on both sides in any one radula, but they frequently appeared on one side or the other. Studies of thirty-six decisum radulae and thirty-six rufum radulae showed that 75% of the decisum had irregularities of the median teeth. 77.7% of the rufum showed completely regular median teeth. Since all the rufum came from a single station, this may have been a peculiarity of that population. However, the above results indicate that further radula studies might be profitable.

It should be mentioned in passing that the validity of radula characters on the specific and subspecific levels is open to question. Carriker (1943) warns that radulae (in Lymnaea stagnalis) are too variable to be useful for subspecific criteria. Bowell (1933), on the other hand, says that all the species of land snails in the British Isles can be separated on radula characters alone.

The measurements taken on 180 specimens show some interesting results, although the sample was obviously too low to be representative of the two species as a whole. In six of the eight ~~populations~~ measurements in which skewness was computed there was a significant skewness. In one case the skewness was quite extreme, one side of the curve being almost a ^{vertical} straight line. According to Davenport (1904) "skewness is frequently, if not usually, associated with recent or progressing evolutionary change." If later work on larger samples bears out this consistent skewness, it will be a matter of great significance in interpreting the systematics of Campeloma.

Ratios were computed between several pairs of dimensions, such as shell height and shell diameter (see summary of statistical data). In all cases the correlation was high, indicating that the same factors are controlling size of the various shell parts. Thus, shell dimensions are varying as a group, not individually.

Comparison of the statistical data on the two species shows that there is not enough difference ⁱⁿ to size to make it a reliable taxonomic character. It is no more significant that most of the "good" characters in current use for the genus.

No attempt was made to investigate anatomical characters, but this may prove the most fruitful field for finding good characters for the species of Campeloma. Certainly, the shell characters are inadequate as they are now used, and the writer looks with suspicion on almost all of the species of Campeloma thus far erected.

In the short time allotted to this problem it was impossible to make a study of the literature on the paleontology of Campeloma, if any. A knowledge of the paleontology would undoubtedly help in answering some of the questions which arise from a statistical

study. The skewed distribution curves and complete lack of discreet differences in the two species makes one wonder if this is not a group in which the differentiation of species is just beginning but is not yet far enough advanced to produce many clear-cut species. If this is the case, a valid taxonomic interpretation of it will be difficult. Added to the difficulties is the large probability that some of the characters are subject to environmental modification.

A proper study of this problem should include the breeding of several generations of snails, both in the laboratory and in the natural environment, using both bi-sexual and parthenogenetic populations and as many character combinations as possible. The anatomy and histology of the entire genus must be studied in greater detail than heretofore in the search for anatomical distinctions. It would be dangerous to limit the study to only two species or to a portion of the whole natural range. Such a study will not be completed overnight.

SUMMARY

1. 182 specimens of Campeloma decisum and C. Rufum were studied from populations in southeastern Michigan.
2. The dimensions and external characters of the shell and operculum were recorded and treated statistically.
3. Of the characters in current use, only color of the shell below the periostracum was found not to vary in any given population.
4. Shell dimensions of the two species are not significantly different.
5. 36 radulae of each species were examined.
6. The median tooth of 75% of the decisum had accessory lateral cusps, while 77.7% of the rufum had none.

7. In six of the eight measurements for which it was computed there was a significant skewness.
8. It is proposed that Campeloma may be a genus in which species are undergoing differentiation.
9. It is further proposed that many of the characters now used for species in this genus are subject to wide environmental variation and are thus invalid.
10. Shell characters seem inadequate for separating the species studied.

Synopsis of the Statistical Data.

I. Campeloma rufum.

N = 68

Shell height:

M = 23.44 ± .339

σ = 2.799

V = 11.96

Skewness = .034

Shell diameter:

M = 15.44 ± .204

σ = 1.684

V = 10.94

Skewness = .24

Aperture height:

M = 13.7 ± .157

σ = 1.295

V = 9.452

Aperture width:

M = 8.868 ± .0869

σ = .938

V = 10.54

Operculum length:

M = 10.769 ± .164

σ = 1.322

V = 12.24

Skewness = ~~7.17~~ +2.69

Operculum width:

$$M = 6.23 \pm .0623$$

$$\sigma = .5024$$

$$V = 8.064$$

$$\text{Skewness} = -34.69$$

II. Campeloma decisum.

$$N = 118$$

Shell height:

$$M = 25.314 \pm .456$$

$$\sigma = 4.952$$

$$V = 19.573$$

$$\text{Skewness} = -.99$$

Shell diameter:

$$M = 17.26 \pm .294$$

$$\sigma = 3.19$$

$$V = 18.439$$

$$\text{Skewness} = .005$$

Aperture height:

$$M = 14.59 \pm .234$$

$$\sigma = 2.542$$

$$V = 17.4$$

Aperture width:

$$M = 9.46 \pm .132$$

$$\sigma = 1.558$$

$$V = 16.4$$

Operculum length:

$$M = 11.543 \pm .206$$

$$\sigma = 2.113$$

$$V = 18.37$$

$$\text{Skewness} = -.7$$

Operculum width:

$$M = 6.495 \pm .119$$

$$\sigma = 1.28$$

$$V = 19.077$$

$$\text{Skewness} = .135$$

Correlations of two variables.

I. Campeloma rufum.

x = shell height

y = shell diameter

$$r_{xy} = .91$$

x = shell height

y = aperture height

$$r_{xy} = .93$$

II. Campeloma decisum.

x = shell height

y = shell diameter

$$r_{xy} = .97$$

x = shell height

y = ~~shell~~ aperture height

$$r_{xy} = .88$$

BIBLIOGRAPHY

- Allison, L. N. 1942. Trapping snails of the genus Campeloma.
Science, 95(2457): ~~131~~ 131-132.
- Baker, F. C. 1928. The Fresh-water Mollusca of Wisconsin.
Madison: Wisc. Acad. Sci., Arts, and Letters. Part I.
- Bowell, E. W. 1933. Radulae. Jl. Conchology, 17(9): 287-293.
- Boycott, A. E. 1928. Conchometry. Proc. Mal. Soc. London
28: 8-31.
- Call, R. E. 1883. Note on the Genus Campeloma of Rafinesque.
Washburne Coll. Bull. 1: 49-168.
- Call, R. E. 1888. On the gross anatomy of Campeloma. American
Naturalist, 22: 491-497.
- Call, R. E. 1894. On the geographic and Hypsometric distribution
of North American Viviparidae. Am. Jl. Sci. 48: 132-140.
- Carriker, M. R. 1943. Variability, Developmental changes, and
denticle replacement in the radula of Lymnaea stagnalis
appressa Say. Nautilus 52(2): 52-59.
- Davenport, C. B. 1903. A comparison of some Pectens from the
East and West Coasts of the United States. Mark Anniversary
Volume. New York: Henry Holt and Co.
- Davenport, C. B. 1903a. Quantitative studies in the evolution of
Pecten-III. Proc. Am. Acad. Arts and Sci. 39(6): 123-159.
- Davenport, C. B. and Hubbard, M. E. 1904. Studies in the
evolution of Pecten-IV. Jl. Exp. Zool. 1(4): 608-616.
- Mattox, N. T. 1935. Abnormalities in the uterine young of
Campeloma rufum, a fresh-water snail. Am. Midland Naturalist,
16(2): 144-153.
- Mattox, N. T. 1937. Oogenesis of Campeloma rufum, a
parthenogenetic snail. Zeits. fur Zellforsch. und microscop.
Anat. 27(4): 456-465.
- Mattox, N. T. 1938. Morphology of Campeloma rufum, a
parthenogenetic snail. Jl. Morph. 62(2): 243-261.
- Medcof, J. C. 1940. On the life cycle and other aspects of the
snail, Campeloma, in the Speed River. Canadian Jl. of Res.
18: 165-172.
- Pilsbry, H. A. 1916. New subspecies of Viviparus and Campeloma.
Nautilus, 30: 41-43.
- Pilsbry, H. A. 1917. Rafinesque's genera of fresh-water snails.
Nautilus, 30(10): 109-114.

Simpson, G. G. and Roe, A. . Quantitative Zoology.
New York: McGraw-Hill Book Co.

Van Cleave, H. J. 1936. Reversal of symmetry in Campeloma rufum,
a fresh-water snail. The American Naturalist, 70: 567-573.

Van Cleave, H. J. and Altringer, D. A. 1937. Studies on the life
cycle of Campeloma rufum, a fresh-water snail. The American
Naturalist, 71: 167-184.

Van Cleave, H. J. and Richey, E. M. 1936. Studies on the radial
in snails of the genus Viviparus. Trans. Am. Micros. Soc.,
55(2): 223-229.

Walker, Bryant. 1918. A synopsis of the classification of the
fresh-water Mollusca of North America north of Mexico.
U. Mich. Mus. Zool. Misc. Pub. #6.

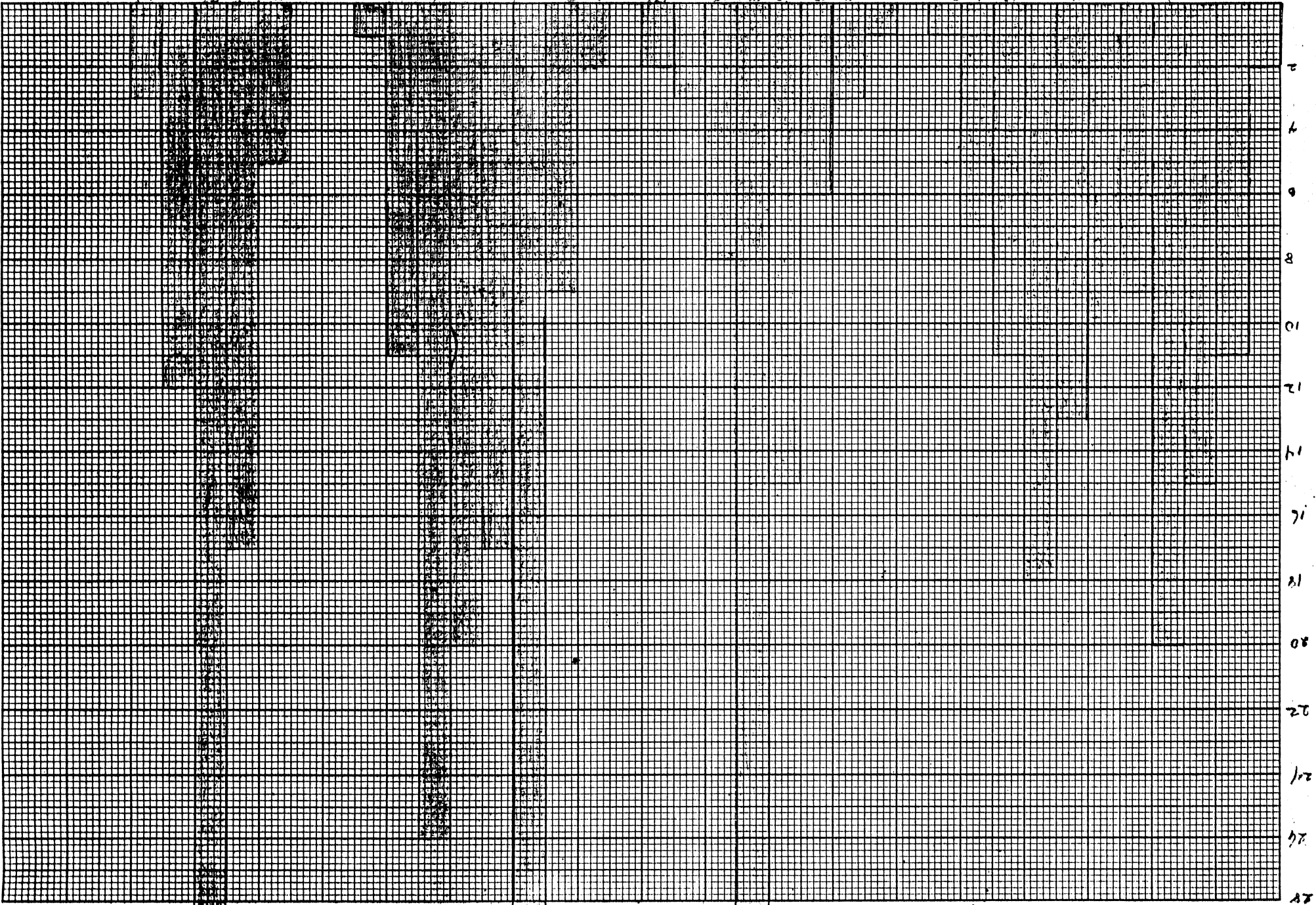
C. decision - aperture height

C. rufum - ap. ht.

C. decision - aperture width

C. rufum - aperture width

10 11 12 13 14 15 16 17 18 19 20 10 11 12 13 14 15 16 17 18 19 20 10 11 12 13 14 15 16 17 18 19 20

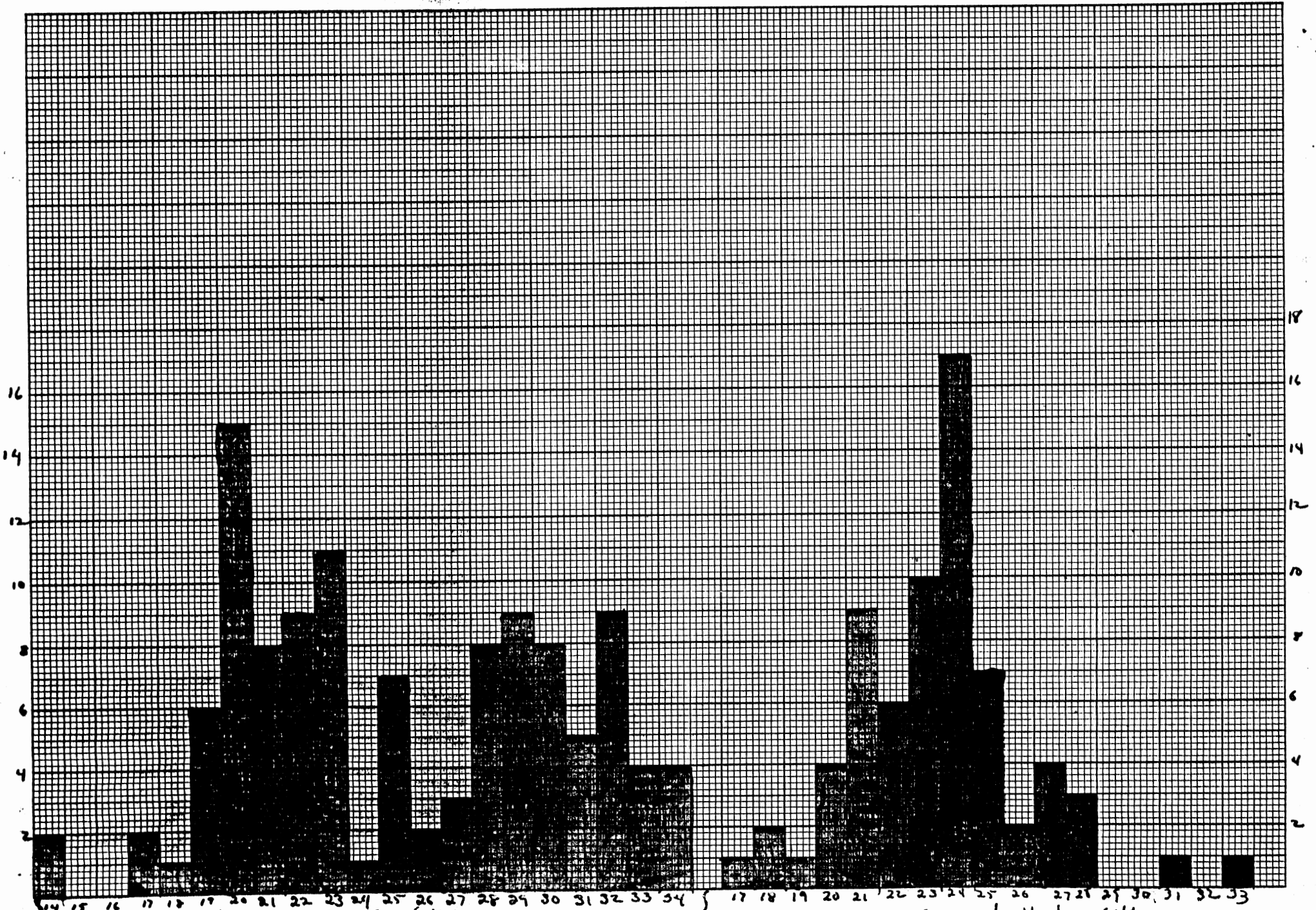


2
4
6
8
10
12
14
16
18
20
22
24
26
28

15

15

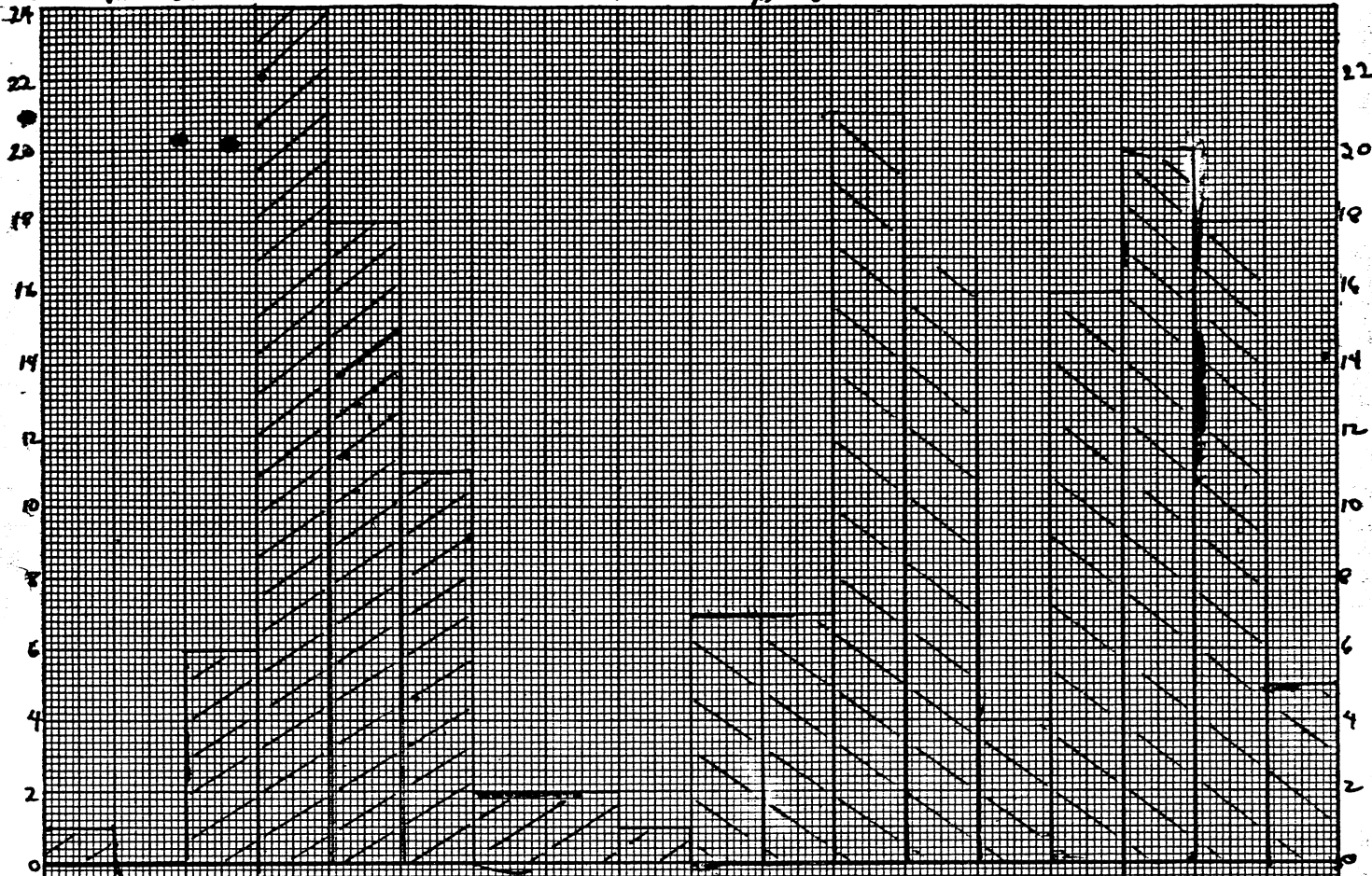
30



C. rufum - operculum length

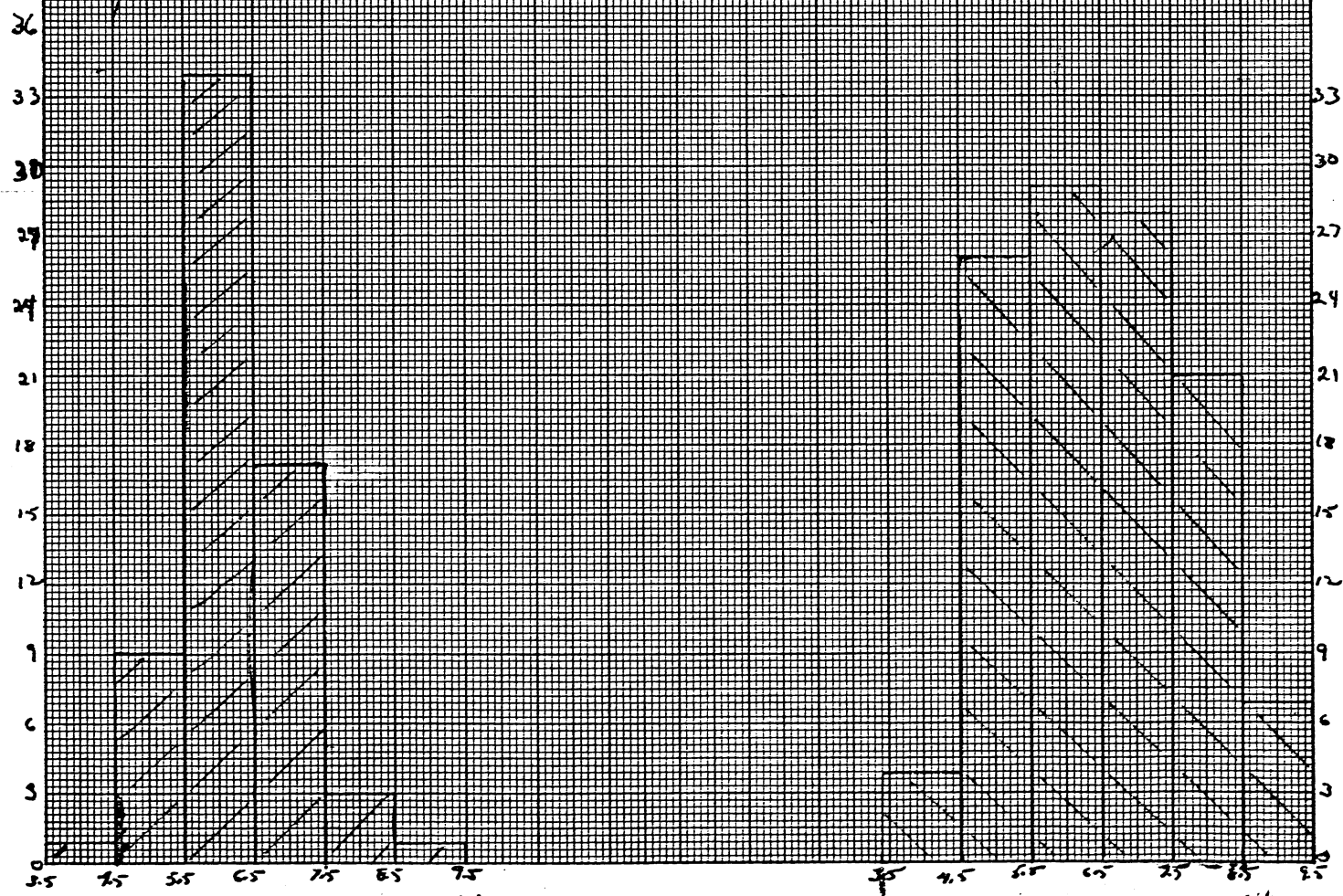
C. decisum - operculum length

6.5 7.5 8.5 9.5 10.5 11.5 12.5 13.5 14.5 15.5



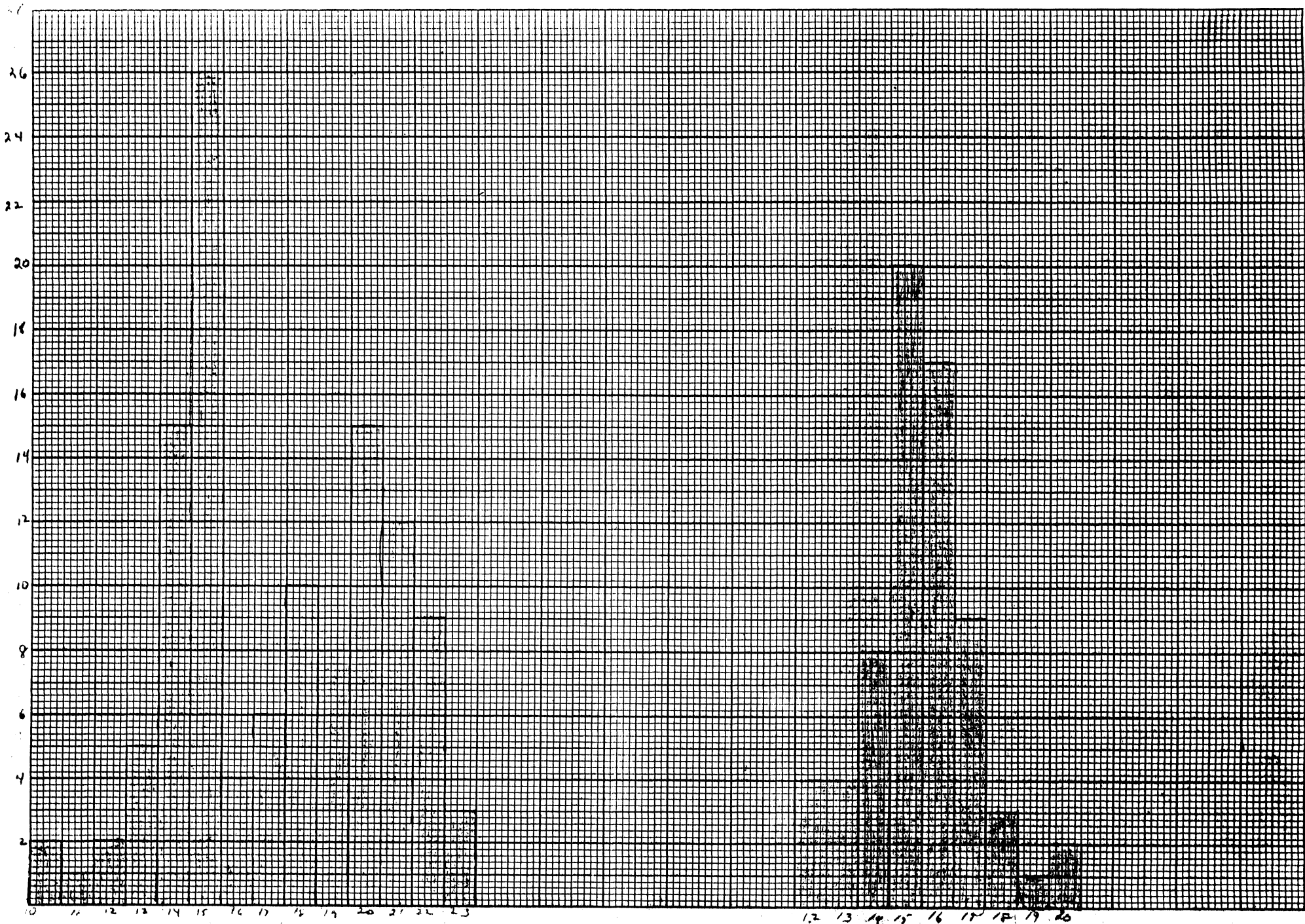
10 Millimeters to the Centimeter
MADE IN U.S.A.

NO. 6788



C. rufum - operculum width

C. decisum - operc. width



C. decisum - shell diameter -

C. rufum - shell diameter -

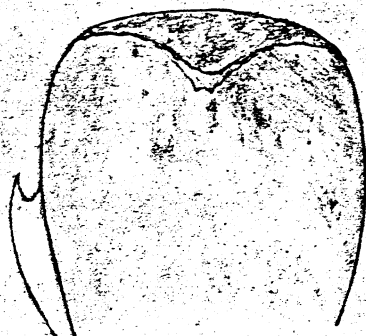


Fig. 1. Typical median tooth of Campeloma decisum.

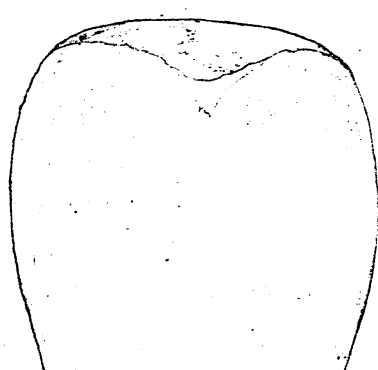


Fig. 2. Typical median tooth of Campeloma tufoni.