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DISTRIBUTION OF LEPTOCEPHALI OF THE TWO SPECIES OF *ANGUILLA* IN THE WESTERN NORTH ATLANTIC, BASED ON COLLECTIONS MADE BETWEEN 1933 AND 1968

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Distribution of lephtocephali of the two species of *Anguilla* in the western North Atlantic based on collections made between 1933 and 1968

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ABSTRACT

Vladykov, V.D. and H. March[1], 1974. Distribution of leptocephali of the two species of *Anguilla* in the western North Atlantic, based on collections made between 1933 and 1968.

For the present study, 790 leptocephali of *Anguilla rostrata*, from 12 mm to 69 mm, and 433 *A. anguilla,* from 14 mm to 79 mm, were available. These specimens were collected in the western North Atlantic between 1933 and 1968. The most extensive collections were made in 1962, 1964, 1965, and 1968. The most numerous collecting stations were established in September, with June and August next in importance. No leptocephali of either species of *Anguilla* were available for April and July. Longitude 50° W was an important dividing line for size distribution of *Anguilla* leptocephali: East of this line 23 of the largest (69 mm - 79 mm) *anguilla* were collected. Contrary to Schmidt's (1925) statement, in our collections 47 *rostrata* were obtained east of this line. Among *rostrata* from both sides of this line, (on the average) somewhat larger specimens were taken east. However, the largest (69 mm) *rostrata* leptocephalus was caught west of this line. The smallest (less than 20 mm) *rostrata* in our collections were obtained in March and June. From published records it is known that leptocephali less than 10 mm were taken in February (Schmidt, 1925) and two specimens 17 mm and 22 mm were caught early in August (Smith, 1968). Therefore, it can be concluded that the American eel can spawn from February to July. In our material, *A. anguilla* from 14 mm to 19 mm were taken in May and June. Apparently these two months are the principal spawning period for the European eel.

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RÉSUMÉ

Vladykov, V.D. et H. March[1] 1974. Distribution of leptocephali of the two species of *Anguilla* in the western North Atlantic, based on collections made between 1933 and 1968.

Ce travail se fonde sur l'étude de 790 leptocéphales d'*Anguilla rostrata* de 12 à 69 mm et de 463 leptocéphales d'*A. anguilla* de 14 à 79 mm. Ces spécimens ont été prélevés dans la partie ouest de l'Atlantique nord entre 1933 et 1968. Les échantillonnages les plus considérables ont été faits en 1962, 1964, 1965 et 1968. C'est en septembre, juin et août qu'on a réussi les plus nombreuses captures. Nous ne possédons pas de leptocéphales d'*Anguilla* pour les mois d'avril et de juillet. Le 50^{e} méridien de longitude O. constitue une ligne de démarcation importante dans la distribution des leptocéphales suivant la taille. Ainsi, à l'est de ce méridien, 23 des plus longs leptocéphales d'*Anguilla anguilla* (de 69 à 79 mm) furent capturés. Contrairement à ce que prétend Schmidt (1925), 47 leptocéphales de l'espèce *rostrata* furent recueillis à l'est du 50^{e} méridien. Les spécimens de *rostrata* pris à l'est de ce même méridien avaient une taille moyenne quelque peu supérieure à celle des spécimens capturés à l'ouest.

Néanmoins, le plus gros leptocéphale de *rostrata* (69 mm) a été capturé à l'ouest du 50^{e} méridien. Les plus petits *rostrata* (moins de 20 mm) que nous ayons collectionnés le furent en mars et en juin. D'après la documentation, les leptocéphales de moins de 10 mm ont été recueillis en février (Schmidt, 1925) et deux spécimens de 17 et 22 mm respectivement le furent en août. On peut donc affirmer que l'anguille américaine peut frayer de février à juillet. D'après nos échantillons, des leptocéphales d'*Anguilla anguilla* mesurant de 14 à 19 mm ont été capturés en mai et juin. Tout indique que ces deux mois constitueraient la principale période de frai de l'anguille européenne.

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INTRODUCTION

Since the extensive study of *Anguilla* larvae in the Atlantic by Schmidt (1923, 1925), only very limited data from new collections have been made available. Taning (1938) described 46 leptocephali of both species of *Anguilla* captured in 1350 hauls by the Bermuda Oceanographic Expeditions, 1929-31. Smith (1968) studied 274 *rostrata* and 15 *anguilla* leptocephali from the Straits of Florida and the Bahamas. Eldred (1968, 1971) gives information for two small samples of two *rostrata* leptocephali each from the Yucatan and Florida Straits. The present study is based on 790 *A. rostrata* and 433 *A. anguilla* leptocephali.

METHODS AND MATERIAL

Collecting Details

The collections of *Anguilla* leptocephali were made over an area from Nova Scotia to the tropical Atlantic, and from Woods Hole (Massachusetts) to the Azores, that is, from 0° to 50° N. latitude and from 25° to 95° W. longitude (Figure 1). *Anguilla* leptocephali were collected during all months of the year except April and July by Canadian and United States research vessels between 1933 and 1968 (Table 1).

Collecting by Canadian research vessels was done under the direction of the senior author, and various types of gear were employed. During the C.S.S. *Hudson* 1965 cruise, one-meter plankton and neuston nets were used. On the C.S.S. *Baffin* in 1966, tows were made with a circular 3-meter net of the type described by J. Schmidt (1929). During the C.S.S. *Hudson* 1968 cruise, collections were obtained with a Marinovich midwater trawl, a modification of the standard Isaac-Kidd trawl. Two models were used: 10-foot (about 3 m) and 6-foot (2 m) frames. The same type of Marinovich trawls were employed regularly by Woods Hole research vessels. The description of this trawl is given by Backus *et al.* (1969).

The Marinovich midwater trawl was used only for oblique tows of variable duration, but most frequently lasting 2-3 hours. Leptocephali of both species of *Anguilla* were more numerous in evening tows, at depths from 50 to 0 m, than during the daytime.

The geographical position of the stations (Table 1) where *rostrata* and *anguilla* leptocephali were collected, refers to the position at which the tow started. These stations are subdivided into two categories. The principal ones refer to serial cruises and carry, in addition to consecutive station numbers, the letters RHB, indicating that the collecting was done under the direction of Dr. Richard H. Backus. The second category consists mostly of incidental collecting stations by various vessels and at different times, hence, they are "Miscellaneous stations". Altogether, *Anguilla* leptocephali were obtained at 99 stations, 75 of which belong to the RHB series, and 24 to the Miscellaneous ones.

Some information on the collecting stations made by C.S.S. *Hudson* in 1965 and 1968 is given by Tibbo (1965) and Marlowe (1968) respectively. Information on collecting stations established by Woods Hole research vessels, such as the *Atlantis* in 1938, is given by Chace (1940) and for the RHB stations 800-813 by R/V *Chain* by Backus *et al.* (1965). Backus *et al.* (1969) gave information on temperature, duration, and depth of RHB stations 1107-1132 including a map showing the position of these and some other stations.

It should be noted that no replicate samples of leptocephali were available to us from the same collecting station, nor were any samples taken during the months of April and July. The number of collecting stations varied considerably from year to year. The most intensive catches were made in 1962, 1964, 1965, and 1968 (Table 2). The collecting stations were most numerous in September (Table 3).

The largest number of *rostrata* leptocephali, 292 (together with two *anguilla*), was taken at RHB station 1109 on June 16, 1965, Lat. 20° 04′ N., Long. 70° 20′ W. RHB station 1316 was next in importance, where on June 26, 1966, Lat. 29° 53′ N., Long. 70° 24′ W., 91 *rostrata* leptocephali were obtained. The largest collections of *anguilla* leptocephali were made in September 1954. At RHB station 1021, Lat. 42° 24′ N., Long. 46° 00′ W., 81 *anguilla* and 25 *rostrata* were taken, and at RHB 1034, Lat. 47° 16′ N., Long. 40° 56′ W., 69 *anguilla* and one *rostrata* were obtained.

Our collection consists of 790 *A. rostrata* leptocephali and 433 *A. anguilla*. The leptocephali were preserved in a 4-5% solution of formalin in sea water neutralized with borax.

Definition of Stages of *Anguilla* Leptocephali

The marine larvae of all species of *Anguilla* are laterally compressed, transparent, and shaped like a willow leaf (Figure 2). In younger stages, they are provided with large grasping teeth, and the anus in larvae of different sizes is located far back, the postanal length being about 30% of the total length. They then are known as "Leptocephali". The larvae of *A. anguilla* were described by Kaup (1856) under the name of *Leptocephalus brevirostris*, while those of *A. rostrata* were named *Leptocephalus grassii* by Eigenmann and Kennedy (1902). An extensive bibliography on leptocephali of the Atlantic and other species of *Anguilla* was given by Castle (1969).

According to Schmidt (1906, 1909), Gilson (1909: 34-35), and Strubberg (1913, 1923), the metamorphosis of eels can be subdivided into six stages. In stage I are included newly hatched larvae and those less than 10 mm in total length. They are called "prelarvae" or "preleptocephali". Jones (1968: 73) called them "protoleptocephali". In stages IV and V, the height of the body is a good deal less than in the

previous stages, but the thickness of the body has increased. These stages may be called "transforming leptocephali". In stage VI the larvae, usually known as "glass eels", already have the cylindrical body of an adult eel, are toothless, and their postanal distance is more than 60% of the total length (Ford, 1931). The length of leptocephali progressively diminishes from stage IV to VI, as it does in elvers.

The present paper will deal only with the distribution and growth of leptocephalus stages II-V. The glass eel (stage VI) is discussed only incidentally.

The size of preserved leptocephali, glass eels, and elvers is expressed as the total length, measured to the nearest millimeter, from the tip of the lower jaw to the posterior end of the middle caudal rays.

Method of Identification of Two Atlantic species of *Anguilla* Leptocephali

Schmidt (1906, 1916) established that the number of myomeres is the principal character by which leptocephali of the two Atlantic species can be identified.

Number of Myomeres

The most complete information on Atlantic leptocephali is given by Jespersen (1942); however, he used only leptocephali greater than 40 mm in total length.

Jespersen (1942) counted the preanal and postanal myomeres separately, "the distinction between them being given by a vertical line through the anus (Figure 3). If this vertical falls between two myomeres, the division between preanal and postanal myomeres is quite simple, but if it falls upon a segment this is included in the preanal number, and the myomeres situated behind are regarded as postanal."

Even in properly preserved, undistorted leptocephali, the counting of myomeres is not easy, particularly the most anterior and posterior myomeres. In the experience of Jespersen, "as first myomere is reckoned the anterior muscle segment embracing the notochord, and in the posterior part of the caudal portion the segments are, in young individuals, counted according to the number of the spinal ganglia." However, in our material, the spinal ganglia were not clearly visible and hence were not used in counting myomeres.

Our counts of myomeres in both species of *Anguilla* gave lower numbers than those published by Jespersen (1942). This difference could be attributed to several causes: counting technique, different numbers of specimens, variation in size of specimens, and difference in collecting localities. Due to the fact that our counts were lower for both Atlantic species, it does not affect the identification of specimens (Tables 4-5).

We encountered another difficulty familiar to all authors: in repeated counts of myomeres on the same individual, identical numbers were not always obtained. For instance, in the first count we obtained a figure of 104 myomeres, a second count could give 105 or even 106. Nevertheless, the number 104-106 identified specimens as belonging to *A. rostrata*. In the present study, repeated counts of 56 *rostrata* and 48 *anguilla* did not agree, therefore they are not included in Table 5.

Schmidt (1925) noticed that the depth of the body of *rostrata* leptocephali is often greater than that for *anguilla* (Figure 4). This difference could not be observed in all of our samples.

Position of Three Principal Blood Vessels

A long row of blood vessels (arteries) runs from the dorsal aorta vertically down to the intestine and the anterior three of these are generally so conspicuous that they can be easily distinguished from the rest. Jespersen (1942) used the position of these three blood vessels, which is determined by the number of the myomere under which the vessel joins the aorta, to identify leptocephali. In general, the number of myomeres to the first vessel, counting from the head, is about half the number of myomeres to the second or third vessel. Jespersen (1942) also used the sum of the three myomere counts for identification. The difference between the number of myomeres to the second and third blood vessels is equally useful as the sum of myomeres to distinguish between leptocephali of Atlantic *Anguilla* species (Table 6).

Size and Geographical Distribution

Size Schmidt (1923, 1925) observed that fully grown leptocephali of *A. anguilla* are at least 10 mm. longer than those of *A. rostrata*. In our material, the largest *rostrata* leptocephalus measured 69 mm and was taken on September 4, 1964, at RHB station 1006. The longest *anguilla* leptocephalus measured 79 mm and was taken on September 26, 1964, at RHB station 1045. Thus, any *Anguilla* leptocephali taken in the North Atlantic and measuring more than 70 mm in length almost unquestionably belong to *A. anguilla.*

Geographical distribution. Schmidt (1923, 1925) observed that in the western North Atlantic, longitude 50° W. is a dividing line for *Anguilla* larvae. East of it are found almost exclusively *anguilla* leptocephali, which are typically longer that 60 mm. Leptocephali of *A. rostrata* were much more numerous west of longitude 50° W. Our material confirms in broad lines the above observations by Schmidt. Therefore, the geographical position of a collecting station can be a useful but not fool-proof supplementary criterion to separate between *anguilla* and *rostrata* leptocephali.

RESULTS

The present paper is built on the same general lines as those presented by Schmidt (1923, 1925). Some of Schmidt's statements do not coincide with our data. Only the most important differences will be discussed.

Role of 50° Longitude W. as a Dividing Line

Schmidt (1925: 307-308) stated that "East of 50° longitude W. we have not met with larvae of the American eel." However, in our collections made in September 1964 there were seven stations situated between longitude 47° and 40° West, where 47 *rostrata* leptocephali varying in length from 41-67 mm were obtained (Table 9).

It is also of importance to note that in September, 122 *rostrata* leptocephali (Table 13) taken west of the line were 55.6 mm on the average (range 48-69 mm), while 47 from east of the line were larger: 60.5 mm on the average (range 41-67 mm). However the largest *rostrata* leptocephalus, 69 mm, was taken west of the line.

The size of *anguilla* leptocephali were much smaller, 45.2 mm on the average (range 38-68 mm), west of the line and larger, 61.0 mm on the average (range 43-79 mm), east of the line (Table 22). It appears that the large leptocephali of stage V were directed closer to their respective home waters: *anguilla* towards Europe and *rostrata* towards North America.

Geographical Extremes of Collecting Stations for Leptocephali of Two Species of *Anguilla*

Our material of *A. anguilla* was less numerous and collected over a smaller area than that of Schmidt. The comparison of the collecting areas is as follows:

Anguilla anguilla

Geographical position	After Schmidt (1925:307)	Present study
Northernmost find	Lat. 61° 21′ N., long. 10° 59′ W.	Lat. 47° 16′ N., long. 40° 56′ W. (RHB 1034)
Southernmost find	Lat. 20° 14′ N., long. 57° 03′ W.	Lat. 19° 40′ N., long. 82° 56′ W. (RHB 1285)
Westernmost find	Long. 73° 43′ W., lat. 35° 42′ N.	Long. 76° 47′ W., lat. 26° 34′ N. (*Crawford*)
Easternmost find	Long. 15° 35′ E., lat. 38° 07′ N.	Long. 40° 56′ W., lat 47° 16′ N. (RHB 1034)

On the other hand our collecting area for *rostrata* leptocephali differed from that of Schmidt (1925) as follows:

Anguilla rostrata

Geographical position	After Schmidt (1925:307)	Present study
Northernmost find	Lat. 42° 19′ N., long. 50° 22′ W.	Lat. 47° 16′ N., long. 40° 56′ W. (RHB 1034)
Southernmost find	Lat. 17° 55′ N., long. 64° 48′ W.	Lat. 18° 57′ N., long. 78° 47′ W. (*A. Bruun*)
Westernmost find	Long. 82° 59′ W., lat. 20° 08′ N.	Long. 84° 23′ W., lat. 20° 38′ N. (RHB 1287)
Easternmost find	Long. 50° 22′ W., lat. 42° 19′ N.	Long. 40° 56′ W., lat. 47° 16′ N. (RHB 1034)

The principal difference between Schmidt's and our data lies in the fact that we collected *rostrata* leptocephali further north and further east than did Schmidt. We had also a single *anguilla* leptocephalus, taken on May 4, 1961 by the *Crawford*, almost three degrees further west than it was previously known.

NUMBER AND SIZE OF *ANGUILLA* LEPTOCEPHALI COLLECTED IN DIFFERENT MONTHS

The distribution and number of leptocephali collected in different months vary not only with the season but with the species as well. For this reason, each species will be treated separately in text and tables.

Tables 7-10 and 15-18 refer to collecting stations and contain information on the number and range in length of leptocephali at each station. Tables 11-14 and 19-23 contain information on the length of each leptocephalus obtained at the principal collecting stations.

It should be noted that Schmidt (1923, 1925) published details as to the number and length of leptocephali collected by him only at a few selected stations. This omission makes it impossible to properly compare his observations with those discussed in the present paper. Several other inadequacies of Schmidt's work were mentioned by Vladykov (1964).

Anguilla rostrata Leptocephali

The variation in the length of 790 *rostrata* leptocephali depends on the season and collecting locality. In our collections, the smallest and presumably youngest leptocephalus measured 12.3 mm and was taken at RHB Station 1116 on June 19, 1965, and the largest was 69 mm (RHB 1006, September 4, 1964).

January - May

During this period only 15 *rostrata* leptocephali ranging in length from 15 to 49 mm were obtained. No specimens were available for April. The collecting area extended from 19°00′ to 26°22′ N. latitude and from 63°58′ to 77°14′ W. longitude (Table 7). During this period two glass eels, 55 mm and 61 mm, were obtained.

June

The most extensive collections, 474 *rostrata* leptocephali, ranging from 12 to 50 mm, were made during this month. The collecting area extended from 19°40′ to 37°18′ N. latitude and from 70°13′ to 84°12′ W. longitude (Table 7).

July

No leptocephali were available for this month.

August

Ninety-five *rostrata* leptocephali, from 43 to 60 mm were collected during this month. The collecting area extended from 35°39′ to 40°04′ N. latitude and 66°43′ to 70°58′ W. longitude (Table 8).

September

During this month 149 *rostrata* leptocephali were obtained. The larger number, 122 leptocephali (48-69 mm), were taken west of longitude 50° W. and 47 specimens (41-67 mm) were collected east of this longitude (Table 9). The collecting area extended from 32°20′ to 47°16′ N. latitude and 40°56′ to 68°41′ W. longitude.

October - December

During this period 37 *rostrata* leptocephali (38-60 mm) were obtained. The collecting area extended from 18°57′ to 39°36′ N. latitude and 51°55′ to 82°09′ W. longitude (Table 10).

Anguilla anguilla leptocephali

For the present study, 433 *A. anguilla* leptocephali were available. Their lengths ranged from 14.0 (RHB 813; May 10, 1961) to 78.5 mm (in tables given as 79 mm)—(RHB 1045; September 26, 1964).

January - May

During this period only 24 *anguilla* leptocephali ranging from 14 mm to 50 mm were obtained. The collecting area extended from 24°00′ to 40°20′ N. latitude and from 35°12′ to 76°47′ W. longitude (Table 15).

June

Only 9 *anguilla* letpocephali, 20-49 mm in length, were taken. The collecting area extended from 20°04′ to 37°18′ N. latitude and from 70°14′ to 70°22′ W. longitude (Table 15).

July

No *anguilla* leptocephali were available for this month.

August - September

In August, only 5 *anguilla* leptocephali were taken: one 63 mm was caught east of longitude 50° W. and four other smaller (37-51 mm) specimens west of this line (Tables 16 and 17). September collections were more numerous, consisting of 318 *anguilla* leptocephali. Their lengths varied according to the locality: west of longitude 50° W. the lengths of 80 leptocephali ranged from 38 to 68 mm with an average of 45.2 mm. (Table 22). East of this line 238 *anguilla* leptocephali from 43 to 79 mm (average 61.0 mm) were obtained. The area of collection extended from 39°19′ to 47°16′ N. latitude and from 29°09′ to 46°29′ W. longitude (Tables 16 and 17).

October - December

During this period 77 *anguilla* leptocephali, ranging in length from 34 to 59 mm, were taken. The collecting area extended from 25°06′ to 39°46′ N. latitude and from 50°15′ to 67°45′ W. longitude. (Table 18).

Length Comparison of Two Species of *Anguilla* Leptocephali

By grouping leptocephali in ten-mm classes, except those smaller than 20 mm, the following observations were made (Tables 24-25). In our collections the longest *rostrata* letocephalus was 69 mm while the maximum length for *anguilla* leptocephali was 79 (78.5) mm. Therefore, the length 70-79 mm characterized the European eel. The next smaller length class, 60-69 mm, was found in 7.6% of *rostrata* (Table 24) and in 28.6% of *anguilla* (Table 25). The occurrence of specimens in the class 50-59 mm was the same (25%) for both species. The length class of 40-49 mm contained 30.5% of *anguilla* leptocephali but only 16.2% of those of *rostrata*. The reverse is true for the class 30-39 mm, *anguilla* 9.2% and *rostrata* 38.3%. The 20-29 mm class was weakly represented (1.2%) by *anguilla* leptocephali but contained 12.4% of *rostrata* specimens. The smallest class, 12-19 mm, was represented by only four individuals of each species.

AGE AND TIME OF SPAWNING

Age of Leptocephali

Our material strongly suggests that leptocephali of both species are represented by specimens of at least two year-classes. Our data support Schmidt's observation (1923, 1925) that *anguilla* leptocephali spend three years at sea, but contradict his conclusion that *rostrata* leptocephali spend only one year at sea. It is the intention of the present authors to prepare another article dealing exclusively with the question of the duration of the leptocephalus stage of *A. rostrata*.

Time of Spawning

In our collection the smallest, and presumably youngest *rostrata* leptocephali, shorter than 20 mm, were taken in March and June (Table 7): on the basis of these data we can conclude that the spawning period for the American eel extends at least from March to June. Moreover, Smith (1968) reported the capture, in the Straits of Florida, of two *rostrata* leptocephali, 17 and 22 mm, on August 9, 1964. Futhermore, Schmidt (1925: 309) wrote that "the early tiny larvae, 7-8 mm long, of *Anguilla rostrata* were taken in February." Therefore, it can be concluded that the American eel has a protracted spawning period, extending from February to July.

In our material four leptocephali of *A. anguilla* ranging from 14 to 19 mm were taken in May and one specimen of 20 mm in June (Table 15). Apparently these two months are the principal spawning time of *A. anguilla*.

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LITURATURE CITED

Backus, R.H., G.W. Mead, R.L. Haedrich, and A.W. Ebeling
(1965) The Mesopelagic fishes collected during cruise 17 of the R/V *Chain*, with a method for analyzing faunal transects. Bull. Mus. Compar. Zool. 134: 139-157, Harvard University.

Backus, R.H., J.E. Craddock, R.L. Haedrich and D.L. Shores
(1969) Mesopelagic fishes and thermal fronts in the western Sargasso Sea. Marine Biology, /: 87-106.

Castle, P.H.J.
(1969) An index and bibliography of eel larvae. J.L.B. Smith Institute of Ichthyology, Spec. Pub. 7.

Chace, F.A., Jr.
(1940) The *Atlantis* expeditions to the West Indies in 1938 and 1939, under the joint auspices of the University of Havana and Harvard University. List of stations. Contr. 274 of the Woods Hole Oceanographic Institution.

Eigenmann, C.H. and C.H. Kennedy
(1902) The leptocephalus of the American eel and other leptocephali. U.S. Fish Comm. Bull. 21: 81-92.

Eldred, B.
(1968) Larvae and glass eels of the American freshwater eel, *Anguilla rostrata* (Lesueur, 1817), in Florida waters. Florida Board of Conservation Marine Research Laboratory, Leaflet Series, 4, Pt. 1: 1-4.

—(1971) First records of *Anguilla rostrata* larvae in the Gulf of Mexico and Yucatan Straits. Florida Department of Natural Resources Marine Research Laboratory, Leaflet Series, 4, Pt. 1: 1-3.

Ford, E.
(1931) Changes in length during the larval life and metamorphosis of the freshwater eel (*Anguilla vulgaris* Turt.). J. Marine Biol. Ass. of the United Kingdom, 17 n.s. 1931: 987-1000.

Gilson, G.
(1909) L'anguille. Sa reproduction, ses migrations et son intérêt économique en Belgique. Annales de la Société Royale Zoologique et Malacologique de Belgique, 1908, 43: 7-58.

Jespersen, P.
(1942) Indo-Pacific leptocephalids of the genus *Anguilla*. Dana-Rep. 22: 1-127.

Jones, F.R.H.
(1968) Fish migration. Edward Arnold Ltd. London. viii.

Kaup. J.J.
(1856) Catalogue of apodal fish in the collection of the British Museum, London.

Marlowe, J.I.
(1968) Cruise Report No. 209, C.S.S. *Hudson*, January 24 - April 11, 1968. Atlantic Oceanographic Laboratory, Bedford Institute.

Schmidt, J.
(1906) Contribution to the life-history of the eel (*Anguilla vulgaris* Flem). Rapp. P. -v. Réun. Cons. Perm. Int. Explor. Mer, 5: 137-274.

—(1909) Remarks on the metamorphosis and distribution of the larvae of the eel (*Anguilla vulgaris* Turt.). Medd. Kommn. Havunders., Fiskeri, 3.

—(1916) On the early larval stages of the fresh-water eels (*Anguilla*) and some other North Atlantic Muraenoids. Medd. Kommn. Havunders, Fiskeri, 5.

—(1923) The breeding places of the eel. Phil. Trans. Roy. Soc. London. Series B, 211: 179-208.

—(1925) The breeding places of the eel. Smithsonian Report for 1924: 279-316.

—(1929) Introduction to the oceanographical reports. Oceanogr. Rep. ''Dana'' Exped., 1.

—(1935) Danish eel investigations during 25 years, 1905-1930. Carlsberg Foundation, Copenhagen.

Smith, D.G.
(1969) The occurence of larvae of the American eel, *Anguilla rostrata*, in the straits of Florida and nearby areas. Bull. Marine Science, 18: 280-293.

Strubberg, A.C.
(1913) The metamorphosis of elvers as influenced by outward conditions. Medd. Kommn. Hav. Fisk., 4.

—(1923) Elvers from north and south Europe. Dana Rep't. 3(4).

Taning, A.V.
(1938) Deep-sea fishes of the Bermuda Oceanographic Expeditions. Family Anguillidae. Zoologica, 23: 313-318.

Tibbo, S.N.
(1965) Cruise Report No. 102. C.S.S. *Hudson* February 1-27, 1965. Bedford Institute of Oceanography.

Vladykov, V.D.
(1964) Quest for the true breeding area of the American eel (*Anguilla rostrata* LeSueur). J. Fish. Res. Board Can. 21:1523-1530.

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Table 1. List of collecting stations in the western North Atlantic where *Anguilla* leptocephali were obtained between 1933 and 1968.

Station No.	Vessel	Date	Year	Position		Number of *Anguilla* leptocephali	
				Lat. N.	Long. W.	*rostrata*	*anguilla*
				RHB stations			
467	*Blue Dolphin*	Aug. 19/20,	53	39° 37′	70° 58′	36	-
484	" "	Aug. 26,	53	39 40′	70° 43′	6	-
555	*Atlantis*	Feb. 10,	54	25 ° 26′	76° 03′	1	-
587	"	Mar. 21,	54	26 ° 22′	76° 10′	2	-
588	"	Mar. 21,	54	26 ° 18′	76 ° 05′	1	-
813	*Chain*	May 10/11	61	27° 30′	54° 05′	-	4
857	"	Sept.14/15,	62	41° 53′	62° 43′	-	1
861	"	Sept. 15,	62	41° 40′	61° 57′	1	-
862	"	Sept. 17,	62	40° 00′	66° 20′	2	-
863	"	Sept. 18,	62	40 ° 03′	66° 40′	27	-
866	"	Sept. 18,	62	39 ° 20′	66° 45′	25	-
867	"	Sept. 19,	62	39 ° 03′	67° 18′	1	-
869	"	Sept.19/20,	62	39° 07′	68° 41′	2	-
1003	*Atlantis II*	Sept. 3,	64	41° 36′	60° 30′	13	-
1004	"	Sept. 4,	64	41° 29′	60° 14′	6	-
1006	"	Sept. 4,	64	41° 16′	57° 37′	12	2
1008	"	Sept. 5,	64	41° 24′	56° 12′	1	-
1010	"	Sept. 5,	64	41° 31′	55° 11′	1	6
1011	"	Sept. 6,	64	41° 33′	54° 55′	16	3
1013	"	Sept. 6,	64	41° 36′	52° 21′	6	2
1014	"	Sept. 7,	64	41° 34′	52° 15′	2	1
1018	"	Sept. 9,	64	41° 27′	47° 13′	1	-
1019	"	Sept. 9,	64	41° 53′	46° 44′	1	-
1020	"	Sept. 9,	64	42° 05′	46° 29′	-	1
1021	"	Sept. 9,	64	42° 24′	46° 11′	25	81
1022	"	Sept. 10,	64	42° 35′	45° 56′	12	17
1023	"	Sept. 10,	64	43° 16′	45° 03′	-	1
1024	"	Sept. 10,	64	44° 07′	44° 09′	-	5
1025	"	Sept. 11,	64	44 ° 13′	44° 11′	-	3
1031	"	Sept. 13,	64	47° 14′	41° 56′	-	1
1034	"	Sept. 13,	64	47° 16′	40° 56′	1	69
1035	"	Sept. 17,	64	46 ° 16′	35° 29′	-	3
1036	"	Sept. 19,	64	42° 20′	29° 09′	-	3
1045	"	Sept. 26,	64	39° 34′	33° 37′	-	6
1046	"	Sept. 27,	64	39 30′	35° 58′	-	2
1047	"	Sept. 27,	64	39 ° 25′	36° 56′	-	2
1050	"	Sept. 29,	64	39° 31′	43° 33′	1	32
1052	"	Sept. 30,	64	39° 19′	47° 45′	6	12
1053	"	Oct. 1,	64	39° 26′	50° 15′	-	2
1054	"	Oct. 1,	64	39 ° 36′	51° 55′	8	1
1055	"	Oct. 2,	64	39 ° 46′	54° 37′	-	2
1109	*Chain*	June 16,	65	20 ° 04′	70° 20′	292	2
1115	"	June 18,	65	24 ° 25′	70° 21′	70	-
1116	"	June 19,	65	24 ° 37′	70° 15′	13	5
1117	"	June 19,	65	25° 18′	70° 14′	-	1
1118	"	June 19,	65	25 ° 29′	70° 13′	1	-
1121	"	June 20,	65	27° 28′	70° 24′	1	-
1123	"	June 20,	65	28 28′	70° 19′	1	-
1129	"	June 22,	65	34° 12′	70° 21′	1	-
1132	"	June 23,	65	37° 18′	70° 22′	1	1
1285	"	June 9,	66	19 ° 40′	82 ° 58′	1	-
1287	"	June 10,	66	20° 13′	84° 12′	1	-
1312	"	June 24,	66	23 ° 53′	83 22′	1	-
1316	"	June 26,	66	29° 53′	79 24′	91	-
1502	"	Aug. 24,	67	40 04′	67 ° 13′	12	-
1503	"	Aug. 24/25,	67	39° 10′	67° 20′	4	-
1505	"	Aug. 25/26,	67	37° 40′	66 50′	3	-
1506	"	Aug. 26,	67	37 ° 37′	66° 43′	19	3
1509	"	Aug. 26/27,	67	35° 39′	67° 17′	1	-
1512	"	Aug. 27,	67	35° 42′	67° 32′	3	-

Station No.	Vessel	Date	Year	Position		Number of *Anguilla* leptocephali	
				Lat. N.	Long W.	*rostrata*	*anguilla*
				RHB stations			
1513	"	Aug. 27/28,	67	35° 47'	67° 33'	6	1
1704	"	Nov. 27/28,	68	30° 30'	67° 27'	5	6
1705	"	Nov. 28,	68	30° 16'	67° 34'	11	1
1712	"	Nov. 30,	68	25° 11'	67° 41'	-	5
1713	"	Dec. 1,	68	25° 06'	67° 45'	-	1
1722	"	Dec. 5,	68	25° 40.5'	67° 35'	1	-
1723	"	Dec. 5/6,	68	25° 39'	67° 43'	2	41
1724	"	Dec. 6,	68	25° 59'	67° 24'	1	-
1725	"	Dec. 6,	68	26° 06'	67° 16'	-	1
1727	"	Dec. 6/7,	68	26° 46'	67° 32'	4	10
1728	"	Dec. 7,	68	26° 53'	67° 33'	1	-
1731	"	Dec. 7,	68	28° 02'	67° 33'	-	1
1737	"	Dec. 8,	68	28° 45'	67° 26'	-	1
1740	"	Dec. 10,	68	31° 31'	67° 31'	1	3
1741	"	Dec. 10/11,	68	31° 39'	67° 34'	1	2
				Miscellaneous stations			
1472	*Atlantis*	Feb. 17,	33	27° 56'	73° 53'	-	1
2945C	"	Jan. 6,	38	35° 50'	67° 30'	-	6
2947A	"	Jan. 30,	38	25° 16'	77° 14'	1	-
	"	Feb. 2,	52	29° 22'	35° 12'	-	1
	Crawford	May 4,	61	26° 34'	76° 47'	-	1
	"	May 7,	61	20° 53'	73° 59'	2	-
	"	May 19,	61	28° 02'	76° 34'	7	-
6314-15	*Atlantis*	Sept. 24,	62	33° 28'	64° 06'	-	1
6316-17	"	Sept. 24/25,	62	32° 50'	64° 04'	2	17
6319-20	"	Sept. 26/27,	62	32° 24'	64° 05'	1	2
6321-22	"	Sept. 27/28,	62	32° 20'	63° 33'	4	45
39	*Hudson*	Feb. 23,	65	34° 53'	75° 23'	1 (G)[1]	-
13	*Baffin*	Mar. 27,	66	24° 00'	63° 45'	-	4
	Hudson	Aug. 4,	66	45° 34'	27° 56'	-	1
824	*Anton Bruun*	Oct. 13,	66	18° 57'	78° 47'	1	-
827	" "	Oct. 13,	66	19° 46'	82° 09'	1	-
	Atlantis II	Jan. 15,	67	28° 50'	62° 26'	-	1
287	*Panulirus I*	Jan. 18,	68	32° 10'	64° 30'	-	1
3	*Hudson*	Jan. 27,	68	40° 20'	59° 37'	1 (G)[1]	2
5	"	Jan. 29,	68	36° 04'	63° 08'	-	2
7	"	Jan. 31,	68	30° 22'	65° 12'	-	1
12	"	Feb. 5,	68	19° 00'	63° 58'	1	-
20	*Crawford*	Aug. 11,	68	39° 10'	69° 44.6'	4	-
21	"	Aug. 11,	68	39° 49.4'	68° 24.1'	1	-

[1]Glass eel stage

Table 2. Number of collecting stations established and number of *Anguilla* leptocephali obtained yearly in the western North Atlantic between 1933 and 1968

Year	Number of Stations	Number of leptocephali *rostrata*	*anguilla*
1933	1	—	1
1938	2	1	6
1952	1	—	1
1953	2	42	—
1954	3	4	—
1961	4	9	5
1962	11	65	66
1964	28	112	257
1965	10	380	9
1966	8	96	5
1967	8	48	5
1968	21	33	78
Total	99	790	433

Table 3. The number of collecting stations for *Anguilla* leptocephali established according to months in the western North Atlantic between 1933 and 1968

MONTH	YEAR and STATIONS (in parentheses)	TOTAL NUMBER Years	Stations
January	1938(2), 1967(1), 1968(4)	3	7
February	1933(1), 1952(1), 1954(1), 1965(1), 1968(1)	5	5
March	1954(2), 1966(1)	2	3
May	1961(4)	1	4
June	1965(9), 1966(4)	2	13
August	1953(2), 1966(1), 1967(7), 1968(2)	4	12
September	1962(11), 1964(25)	2	36
October	1964(3), 1966(2)	2	5
November	1968(3)	1	3
December	1968(11)	1	11

Table 4. Number of preanal and postanal myomeres in leptocephali of two species of *Anguilla* collected from 1938 to 1968.

Species	*A. rostrata*		*A. anguilla*	
Number of specimens	707		379	
Myomeres	Mean	Range	Mean	Range
Preanal	69.45	64–74	70.86	67–75
Postanal	34.72	31–40	40.74	38–48

Table 5. Comparison between the total number of myomeres in leptocephali of two Atlantic species of *Anguilla* in the present study and those given by Jespersen (1942).

Myomeres	*Anguilla rostrata* Number of specimens		*Anguilla anguilla* Number of specimens	
	Present study	Jespersen (1942)	Present study	Jespersen (1942)
101	4	–	–	–
102	11	–	–	–
103	74	–	–	–
104	153	1	–	–
105	205	6	–	–
106	175	18	–	–
107	79	51	–	–
108	29	101	–	–
109	5	68	11	–
110	1	34	55	–
111	–	7	106	–
112	–	–	101	1
113	–	–	79	20
114	–	–	24	65
115	–	–	8	139
116	–	–	1	142
117	–	–	–	77
118	–	–	–	25
119	–	–	–	3
Total	736	286	385	472
Mean	105.13	108.17	111.76	115.58

Table 6. Number of myomeres in leptocephali of two species of *Anguilla* at the levels of the three most distinct anterior vertical blood vessels.

Number of specimens studied: *A. rostrata* - 150; *A. anguilla* - 100

Blood vessels (B.V.)	*Anguilla rostrata*		*Anguilla anguilla*	
	Mean	Range	Mean	Range
I B.V.	17.3	16–20	18.5	17–20
II B.V.	40.0	36–43	41.1	39–43
III B.V.	44.5	42–46	47.1	45–49
III B.V. – II B.V.	4.0	2–7	5.96	5–8
Sum of 3 blood vessels (I + II + III B.Vs.)	102.5	95–108	106.10	102–111

Table 7. List of collecting stations in the western North Atlantic where leptocephali of *Anguilla rostrata* were obtained from January to June, 1938-1968.

Date		Station	Position		Leptocephali	
			Lat. N.	Long. W.	N	Range (in mm)
Jan. 30,	38	*Atlantis*	25° 16′	77° 14′	1	49
Feb. 10,	54	555 RHB	25° 26′	76° 03′	1	46
Feb. 5,	68	*Hudson*	19° 00′	63° 58′	1	49
Mar. 21,	54	587 RHB	26° 22′	76° 10′	2	15-17
Mar. 21,	54	588 "	26° 18′	76° 05′	1	48
May 7,	61	*Crawford*	20° 53′	73° 59′	2	29-34
May 19,	61	"	28° 02′	76° 34′	7	26-36
June 16,	65	1109 RHB	20° 04′	70° 20′	292	20-52
June 18,	65	1115 "	24° 25′	70° 21′	70	21-39
June 19,	65	1116 "	24° 37′	70° 15′	13	12-39
June 19,	65	1118 "	25° 29′	70° 13′	1	41
June 20,	65	1121 "	27° 28′	70° 24′	1	43
June 20,	65	1123 "	28° 28′	70° 19′	1	43
June 22,	65	1129 "	34° 12′	70° 21′	1	44
June 23,	65	1132 "	37° 18′	70° 22′	1	44
June 9,	66	1285 "	19° 40′	82° 58′	1	41
June 10,	66	1287 "	20° 13′	84° 12′	1	38
June 24,	66	1312 "	23° 53′	83° 22′	1	43
June 26,	66	1316 "	29° 53′	79° 24′	91	21-50
				Glass eels		
Jan. 27,	68	*Hudson*	40° 20′	59° 37′	1	61
Feb. 23,	65	"	34° 53′	75° 23′	1	55

Table 8. List of collecting stations in the western North Atlantic where leptocephali of *Anguilla rostrata* were obtained in August during 1953-1968.

Date	Station	Position		Leptocephali	
		Lat. N.	Long. W.	N	Range (in mm)
Aug. 19/20 53	467 RHB	39° 37′	70° 58′	36	44-57
Aug. 26, 53	484 RHB	39° 40′	70° 43′	6	43-49
Aug. 24, 67	1502 RHB	40° 04′	67° 13′	12	45-60
Aug. 24/25, 67	1503 RHB	39° 10′	67° 20′	4	49-52
Aug. 25/26, 67	1505 RHB	37° 40′	66° 50′	3	49-54
Aug. 26, 67	1506 RHB	37° 37′	66° 43′	19	43-56
Aug. 26/27, 67	1509 RHB	35° 39′	67° 17′	1	58
Aug. 27, 67	1512 RHB	35° 42′	67° 32′	3	54-59
Aug. 27/28, 67	1513 RHB	35° 47′	67° 33′	6	54-60
Aug. 11, 68	*Crawford*: 20	39° 10′	69° 44.6′	4	48-51
Aug. 11, 68	*Crawford*: 21	39° 49.4′	68° 24.1′	1	48

Table 9. List of collecting stations in the western North Atlantic where leptocephali of *Anguilla rostrata* were obtained during September, 1962 and 1964.

Date	Station	Position		Leptocephali	
		Lat. N.	Long. W.	N	Range (in mm)
Sept. 15, 62	861 RHB	41° 40′	61° 57′	1	58
Sept. 17, 62	862 "	40° 00′	66° 20′	2	59-61
Sept. 18, 62	863 "	40° 03′	66° 40′	27	50-60
Sept. 18, 62	866 "	39° 20′	66° 45′	25	49-64
Sept. 19, 62	867 "	39° 03′	67° 18′	1	58
Sept. 19/20, 62	869 "	39° 07′	68° 41′	2	55-60
Sept. 24/25, 62	*Atlantis* 286-3	32° 50′	64° 04′	2	51-54
Sept. 26/27, 62	" 286-4	32° 24′	64° 05′	1	51
Sept. 27/28, 62	" 286-5	32° 20′	63° 33′	4	51-57
Sept. 3, 64	1003 RHB	41° 36′	60° 30′	13	50-60
Sept. 4, 64	1004 "	41° 29′	60° 14′	6	52-62
Sept. 4, 64	1006 "	41° 16′	57° 37′	12	51-69
Sept. 5, 64	1008 "	41° 24′	56° 12′	1	56
Sept. 5, 64	1010 "	41° 31′	55° 11′	1	54
Sept. 6, 64	1011 "	41° 33′	54° 55′	16	48-60
Sept. 6, 64	1013 "	41° 36′	52° 21′	6	58-63
Sept. 7, 64	1014 "	41° 34′	52° 15′	2	58-61
Sept. 9, 64	1018 "	41° 27′	47° 13′	1	61
Sept. 9, 64	1019 "	41° 53′	46° 44′	1	65
Sept. 9, 64	1021 "	42° 24′	46° 11′	25	53-67
Sept. 10, 64	1022 "	42° 35′	45° 56′	12	55-61
Sept. 13, 64	1034 "	47° 16′	40° 56′	1	55
Sept. 29, 64	1050 "	39° 31′	43° 33′	1	65
Sept. 30, 64	1052 "	39° 19′	47° 45′	6	41-65

Table 10. List of collecting stations in the western North Atlantic where leptocephali of *Anguilla rostrata* were obtained from October to December, 1964-1968.

Date	Station	Position		Leptocephali	
		Lat. N.	Long. W.	N	Range (in mm)
Oct. 1, 64	1054 RHB	39° 36′	51° 55′	8	57-63
Oct. 13, 66	*Anton Bruun*:11	18° 57′	78° 47′	1	38
Oct. 13, 66	*Anton Bruun*:12	19° 46′	82° 09′	1	53
Nov. 27/28, 68	1704 RHB	30° 30′	67° 27′	5	52-60
Nov. 28, 68	1705 "	30° 16′	67° 34′	11	50-55
Dec. 5, 68	1722 "	25° 40.5′	67° 35′	1	42
Dec. 5/6, 68	1723 "	25° 39′	67° 43′	2	40-47
Dec. 6, 68	1724 "	25° 59′	67° 24′	1	49
Dec. 6/7, 68	1727 "	26° 46′	67° 32′	4	52-57
Dec. 7, 68	1728 "	26° 53′	67° 33′	1	55
Dec. 10, 68	1740 "	31° 31′	67° 31′	1	55
Dec. 10/11, 68	1741 "	31° 39′	67° 34′	1	60

Table 11. Number and length of leptocephali of *Anguilla rostrata* obtained at selected RHB stations in the western North Atlantic during June 1965-1966, with totals for all stations for the same month (see Table 7).

Length (mm)	Number of leptocephali collected				
	16-65* 1109	18-65* 1115	19-65* 1116	26-66* 1316	Total for June
12	–	–	1	–	1
18	–	–	1	–	1
20	1	–	–	–	1
1	–	2	–	1	3
2	–	–	–	–	–
3	3	2	1	–	6
4	2	1	1	–	4
5	4	5	–	–	9
6	6	6	1	–	13
7	9	12	1	–	22
8	6	7	–	1	14
9	16	4	1	1	22
30	20	5	–	3	28
1	24	8	–	5	37
2	19	6	1	4	31
3	28	4	1	3	36
4	24	1	–	2	27
5	23	4	–	7	34
6	23	1	1	6	31
7	18	–	1	8	27
8	19	–	1	5	26
9	10	2	1	7	20
40	17	–	–	12	29
1	6	–	–	9	17
2	3	–	–	3	6
3	4	–	–	2	8
4	2	–	–	4	8
5	3	–	–	5	8
6	1	–	–	1	2
7	–	–	–	1	1
8	–	–	–	–	–
9	–	–	–	–	–
50	–	–	–	1	1
1	–	–	–	–	–
2	1	–	–	–	1
Total	292	70	13	91	474

* The first figures refer to the day of the month, and the second, to the year.

Table 12. Number and length of leptocephali of *Anguilla rostrata* obtained at selected stations in the western North Atlantic during August 1953-1968, with totals for all stations for the same month (see Table 8).

Length (mm)	Number of leptocephali collected					
	19/20–53[a] RHB 467	26–53[a] RHB 484	24–67[a] RHB 1502	26–67[a] RHB 1506	11–68[a] *Crawford*[b] 20–21	Total 1953–1968
43	–	1	–	1	–	2
4	1	1	–	–	–	2
5	–	1	1	–	–	2
6	1	–	1	3	–	5
7	1	–	–	1	–	2
8	3	1	–	3	2	9
9	4	2	3	2	1	14
50	6	–	3	5	1	15
1	8	–	1	2	1	12
2	2	–	1	–	–	7
3	6	–	1	1	–	8
4	1	–	–	–	–	5
5	1	–	–	–	–	2
6	–	–	–	1	–	2
7	2	–	–	–	–	4
8	–	–	–	–	–	1
9	–	–	–	–	–	1
60	–	–	1	–	–	2
Total	36	6	12	19	5	95

a The first figures refer to the day of the month, and the second, to the year.

b Collections of leptocephali made at two stations (20 & 21) of *Crawford* cruise 172 are combined.

Table 13. Number and length of leptocephali of *Anguilla rostrata* obtained at selected RHB stations in the western North Atlantic during September 1962 and 1964, with totals for all stations located west or east of longitude 50°W (see Table 9 for complete list of stations).

Length	Number of leptocephali collected						Total		
(mm)	863	866	1003	1006	1011	1021	West	East	Grand total
41	–	–	–	–	–	–	–	1	1
48	–	–	–	–	1	–	1	–	1
49	–	2	–	–	–	–	2	–	2
50	1	1	1	–	–	–	3	–	3
1	4	2	–	1	–	–	10	–	10
2	2	1	2	–	1	–	8	–	8
3	2	5	–	–	2	1	9	1	10
4	8	3	1	1	4	1	19	3	22
5	4	4	1	1	1	–	12	4	16
6	4	3	2	1	3	–	16	2	18
7	–	1	1	–	2	–	5	1	6
8	–	–	2	–	1	2	9	2	11
9	–	1	2	1	–	2	6	4	10
60	2	–	1	3	1	–	10	4	14
1	–	–	–	3	–	–	6	3	9
2	–	1	–	–	–	2	3	3	6
3	–	–	–	–	–	2	1	2	3
4	–	1	–	–	–	4	1	4	5
5	–	–	–	–	–	4	–	7	7
6	–	–	–	–	–	3	–	3	3
7	–	–	–	–	–	3	–	3	3
8	–	–	–	–	–	–	–	–	–
9	–	–	–	1	–	–	1	–	1
Total	27	25	13	12	16	25	122	47	169

Table 14. Number and length of leptocephali of *Anguilla rostrata* obtained in the western North Atlantic during October - December, 1964-1968 (see Table 10).

Length (mm)	Months			
	October 3 stations	November 2 stations	December 7 stations	Total 12 stations
38	1	–	–	1
40	–	–	1	1
1	–	–	–	–
2	–	–	1	1
3	–	–	–	–
4	–	–	–	–
5	–	–	–	–
6	–	–	–	–
7	–	–	1	1
8	–	–	–	–
9	–	–	1	1
50	–	1	–	1
1	–	3	–	3
2	–	1	1	2
3	1	–	–	1
4	–	6	1	7
5	–	3	3	6
6	–	–	–	–
7	1	–	1	2
8	–	1	–	1
9	2	–	–	2
60	1	1	1	3
1	2	–	–	2
2	1	–	–	1
3	1	–	–	1
Total	10	16	11	37

Table 15. List of collecting stations in the western North Atlantic where leptocephali of *Anguilla anguilla* were obtained from January to June, 1933-1968.

Date	Station	Position		Leptocephali	
		Lat. N.	Long. W.	N	Range (in mm)
Jan. 6, 38	*Atlantis*	35° 50′	67° 30′	6	39-46
Jan. 15, 67	*Atlantis II*	28° 50′	62° 26′	1	46
Jan. 18, 68	*Panulirus I*	32° 10′	64° 30′	1	45
Jan. 27, 68	*Hudson*	40° 20′	59° 37′	2	46-50
Jan. 29, 68	"	36° 04′	63° 08′	2	47-48
Jan. 31, 68	"	30° 22′	65° 12′	1	42
Feb. 17, 33	*Atlantis*	27° 56′	73° 53′	1	37
Feb. 2, 52	"	29° 22′	35° 12′	1	39
Mar. 27, 66	*Baffin*	24° 00′	63° 45′	4	37-41
May 4, 61	*Crawford*	26° 34′	76° 47′	1	46
May 10/11, 61	813 RHB	27° 30′	54° 05′	4	14-19
June 16, 65	1109 "	20° 04′	70° 20′	2	28-32
June 19, 65	1116 "	24° 37′	70° 15′	5	20-30
June 19, 65	1117 "	25° 18′	70° 14′	1	33
June 23, 65	1132 "	37° 18′	70° 22′	1	49

Table 16. List of collecting stations in the western North Atlantic, west of longitude 50 W, where leptocephali of *Anguilla anguilla* were obtained during August and Setpember, 1962-1967.

Date	Station	Position		Leptocephali	
		Lat. N.	Long. W.	N	Range (in mm)
Aug. 26, 67	1506 RHB	37° 37′	66° 43′	3	37-47
Aug. 27/28, 67	1513 "	35° 47′	67° 33′	1	51
Sept. 14/15, 62	857 "	41° 53′	62° 43′	1	68
Sept. 24, 62	*Atlantis*	33° 28′	64° 06′	1	40
Sept. 24/25, 62	"	32° 50′	64° 04′	17	40-48
Sept. 26/27, 62	"	32° 24′	64° 05′	2	38-40
Sept. 27/28, 62	"	32° 20′	63° 33′	45	41-51
Sept. 4, 64	1006 RHB	41° 16′	57° 37′	2	59-66
Sept. 5, 64	1010 RHB	41° 31′	55° 11′	6	41-49
Sept. 6, 64	1011 RHB	41° 33′	54° 55′	3	41-57
Sept. 6, 64	1013 RHB	41° 36′	52° 21′	2	44-47
Sept. 7, 64	1014 RHB	41° 34′	52° 15′	1	61

Table 17. List of collecting stations in the western North Atlantic, east of longitude 50° W, where leptocephali of *Anguilla anguilla* were obtained during August and September, 1964 and 1966.

Date	Station	Position		Leptocephali	
		Lat. N.	Long. W.	N	Range (in mm)
Aug. 4, 66	*Hudson*	45° 34′	27° 56′	1	63
Sept. 9, 64	1020 RHB	42° 05′	46° 29′	1	58
Sept. 9, 64	1021 "	42° 24′	46° 11′	81	52-70
Sept. 10, 64	1022 "	42° 35′	45° 56′	17	43-62
Sept. 10, 64	1023 "	43° 16′	45° 03′	1	58
Sept. 10, 64	1024 "	44° 07′	44° 09′	5	58-72
Sept. 11, 64	1025 "	44° 13′	44° 11′	3	52-57
Sept. 13, 64	1031 "	47° 14′	41° 56′	1	73
Sept. 13, 64	1034 "	47° 16′	40° 56′	69	56-77
Sept. 17, 64	1035 "	46° 16′	35° 29′	3	65-75
Sept. 19, 64	1036 "	42° 20′	29° 09′	3	69-76
Sept. 26, 64	1045 "	39° 34′	33° 37′	6	57-79
Sept. 27, 64	1046 "	39° 30′	35° 58′	2	70-72
Sept. 27, 64	1047 "	39° 25′	36° 56′	2	57
Sept. 29, 64	1050 "	39° 31′	43° 33′	32	52-75
Sept. 30, 64	1052 "	39° 19′	47° 45′	12	43-56

Table 18. List of collecting stations in the western North Atlantic where leptocephali of *Anguilla anguilla* were obtained from October to December, 1964 and 1968.

Date	Station	Position		Leptocephali	
		Lat. N.	Long. W.	N	Range (in mm)
Oct. 1, 64	1053 RHB	39° 26′	50° 15′	2	51-53
Oct. 1, 64	1054 "	39° 36′	51° 55′	1	59
Oct. 2, 64	1055 "	39° 46′	54° 37′	2	51-55
Nov. 27/28, 68	1704 "	30° 30′	67° 27′	6	41-45
Nov. 28, 68	1705 "	30° 16′	67° 34′	1	45
Nov. 30, 68	1712 "	25° 11′	67° 41′	5	37-41
Nov. 30/ Dec. 1, 68	1713 "	25° 06′	67° 45′	1	36
Dec. 5/6, 68	1723 "	25° 39′	67° 43′	41	34-45
Dec. 6, 68	1725 "	26° 06′	67° 16′	1	43
Dec. 6/7, 68	1727 "	26° 46′	67° 32′	10	40-45
Dec. 7, 68	1731 "	28° 02′	67° 33′	1	44
Dec. 8, 68	1737 "	28° 45′	67° 26′	1	44
Dec. 10, 68	1740 "	31° 31′	67° 31′	3	40-45
Dec. 10/11, 68	1741 "	31° 39′	67° 34′	2	45-47

Table 19. Number and length of leptocephali of *Anguilla anguilla* obtained in the western North Atlantic during January-March, 1933-1968 (see Table 15 for complete list of stations).

Length (mm)	Number of leptocephali collected			
	January[a] 1938 & 1968	February[b] 1933 & 1952	March[c] 1966	Total 1933-1968
37	–	1	1	2
39	1	1	1	3
40	1	–	1	2
1	1	–	1	2
2	1	–	–	1
3	1	–	–	1
4	1	–	–	1
5	1	–	–	1
6	3	–	–	3
7	1	–	–	1
8	1	–	–	1
50	1	–	–	–
Total	13	2	4	19

a 5 stations
b 2 stations
c a single station

Table 20. Number and length of leptocephali of *Anguilla anguilla* obtained in the western North Atlantic during May-June, 1961 and 1965 (see Table 15 for complete list of stations).

Length (mm)	Number of leptocephali collected		
	May[a] 1961	June[b] 1965	Total 1961-1965
14	1	—	1
18	1	—	1
19	2	—	2
20	—	1	1
21	—	1	1
25	—	1	1
28	—	2	2
30	—	1	1
32	—	1	1
33	—	1	1
46	1	—	1
49	—	1	1
Total	5	9	14

a 2 stations
b 4 stations

Table 21 Number and length of leptocephali of *Anguilla anguilla* obtained at selected stations in the western North Atlantic during September 1962 and 1964, with totals for all stations located west or east of longitude 50° W (see Tables 16 and 17 for complete list of stations).

Length (mm)	Number of leptocephali collected				Total		
	Atlantis 286–5	RHB 1021	RHB 1034	RHB 1050	West	East	Grand total
38	–	–	–	–	1	–	1
40	–	–	–	–	3	–	3
1	2	–	–	–	8	–	8
2	9	–	–	–	14	–	14
3	5	–	–	–	7	2	9
4	10	–	–	–	13	–	13
5	8	–	–	–	12	–	12
6	3	–	–	–	4	–	4
7	5	–	–	–	7	–	7
8	–	–	–	–	1	–	1
9	1	–	–	–	2	–	2
50	–	–	–	–	–	–	–
1	2	–	–	–	2	3	5
2	–	1	–	2	–	5	5
3	–	–	–	1	–	2	2
4	–	4	–	4	1	13	14
5	–	2	–	2	–	6	6
6	–	5	1	6	–	16	16
7	–	5	3	2	1	14	15
8	–	5	1	3	–	14	14
9	–	11	6	2	1	23	24
60	–	9	6	3	–	20	20
1	–	10	7	2	1	22	23
2	–	7	7	1	–	19	19
3	–	3	6	1	–	10	10
4	–	4	6	2	–	13	13
5	–	5	6	–	–	12	12
6	–	6	3	–	1	12	13
7	–	3	5	–	–	8	8
8	–	–	1	–	1	1	2
9	–	–	2	–	–	3	3
70	–	1	3	–	–	5	5
1	–	–	2	–	–	2	2
2	–	–	–	–	–	3	3
3	–	–	2	–	–	4	4
4	–	–	–	–	–	–	–
5	–	–	1	1	–	3	3
6	–	–	–	–	–	1	1
7	–	–	1	–	–	1	1
8	–	–	–	–	–	–	–
9	–	–	–	–	–	1	1
Total	45	81	69	32	80	238	318

Table 22. Number and length of leptocephali of *Anguilla anguilla* collected at different stations during September 1962 and 1964, east and west of longitude 50°W (see Tables 16 and 17 for complete list of stations).

Range	10 western stations		15 eastern stations		Total (25 stations)	
(mm)	N	%	N	%	N	%
40–4	46*	57.4	2	0.8	48*	15.1
45–9	26	32.5	–	–	26	8.2
50–4	3	3.8	23	9.7	26	8.2
55–9	2	2.5	73	30.7	75	23.6
60–4	1	1.3	84	35.3	85	26.7
65–9	2	2.5	36	15.1	38	11.9
70–4	–	–	14	5.9	14	4.4
75–9	–	–	6	2.5	6	1.9
Total	80		238		318	
Mean		45.16		61.02		57.03
Range		38–68		43–79		38–79

* including one – 38 mm long

Table 23. Number and length of leptocephali of *Anguilla anguilla* obtained in the western North Atlantic from October to December, 1964-1968 (see Table 17 for complete list of stations).

Length (mm)	October, 1964 3 stations	November, 1968 3 stations	December, 1968			Grand total October–December
			RHB 1723	RHB 1727	Total (8 stations)	
34	–	–	1	–	1	1
5	–	–	2	–	2	2
6	–	–	2	–	3	3
7	–	1	5	–	5	6
8	–	1	8	–	8	9
9	–	–	8	–	8	8
40	–	2	5	2	8	10
1	–	2	5	–	5	7
2	–	3	3	2	5	8
3	–	–	1	1	3	3
4	–	1	–	2	5	6
5	–	2	1	3	6	8
6	–	–	–	–	–	–
7	–	–	–	–	1	1
51	2	–	–	–	–	2
53	1	–	–	–	–	1
55	1	–	–	–	–	1
59	1	–	–	–	–	1
Total	5	12	41	10	60	77

Table 24 Number and length of *Anguilla rostrata* leptocephali collected monthly in the western North Atlantic between 1933-1968.

Month	Length in mm													
	12-19		20-29		30-39		40-49		50-59		60-69		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
January	-	-	-	-	-	-	1	100	-	-	-	-	1	0.1
February	-	-	-	-	-	-	2	100	-	-	-	-	2	0.2
March	2	66.7	-	-	-	-	1	33.3	-	-	-	-	3	0.3
May	-	-	4	44.4	5	55.6	-	-	-	-	-	-	9	1.1
June	2	0.4	94	19.8	297	62.7	79	16.7	2	0.4	-	-	474	60.0
August	-	-	-	-	-	-	36	37.9	57	60.0	2	2.1	95	12.0
September	-	-	-	-	-	-	4	2.4	114	67.5	51	30.2	169	21.4
October	-	-	-	-	1	10.0	-	-	4	40.0	5	50.0	10	1.3
November	-	-	-	-	-	-	-	-	15	93.7	1	6.3	16	2.2
December	-	-	-	-	-	-	4	36.4	6	54.5	1	9.1	11	1.4
Grand total	4	0.5	98	12.4	303	38.3	127	16.2	198	25.0	60	7.6	790	100.0

Table 25. Number and length of leptocephali of *Anguilla anguilla* collected monthly in the western North Atlantic between 1933 and 1968.

Month	Length in mm															
	14-19		20-29		30-39		40-49		50-59		60-69		70-79		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
January	-	-	-	-	1	7.7	11	84.6	1	7.7	-	-	-	-	13	3.0
February	-	-	-	-	2	100.0	-	-	-	-	-	-	-	-	2	0.5
March	-	-	-	-	2	50.0	2	50.0	-	-	-	-	-	-	4	0.9
May	4	80.0	-	-	-	-	1	20.0	-	-	-	-	-	-	5	1.2
June	-	-	5	55.6	3	33.3	1	11.1	-	-	-	-	-	-	9	2.1
August	-	-	-	-	2	40.0	1	20.0	1	20.0	1	20.0	-	-	5	1.2
September	-	-	-	-	1	0.3	73	23.0	101	31.8	123	38.7	20	6.2	318	73.2
October	-	-	-	-	-	-	-	-	5	100.0	-	-	-	-	5	1.2
November	-	-	-	-	2	16.7	10	83.3	-	-	-	-	-	-	12	2.8
December	-	-	-	-	27	45.0	33	55.0	-	-	-	-	-	-	60	13.9
Grand total	4	0.9	5	1.2	40	9.2	132	30.5	108	25.0	124	28.6	20	4.6	433	100.0

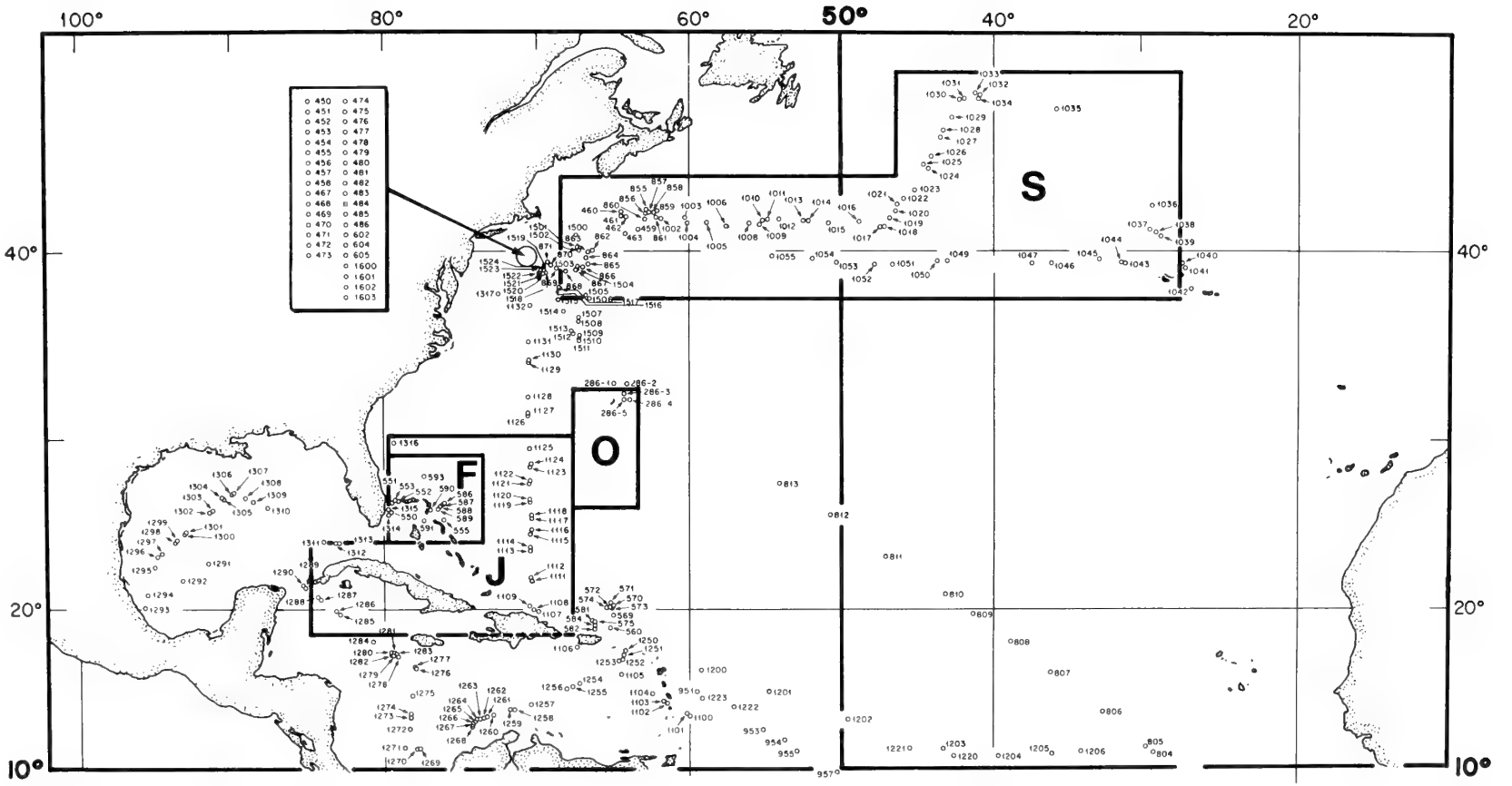

Figure 1. Position of the Atlantic RHB collecting stations, at some of which *Anguilla* leptocephali were obtained for the present study. The principal collecting areas for the different months are designated as follows: F - February and March; J - June; S - September; O - October - December. (Modified after Backus *et al.*, 1969)

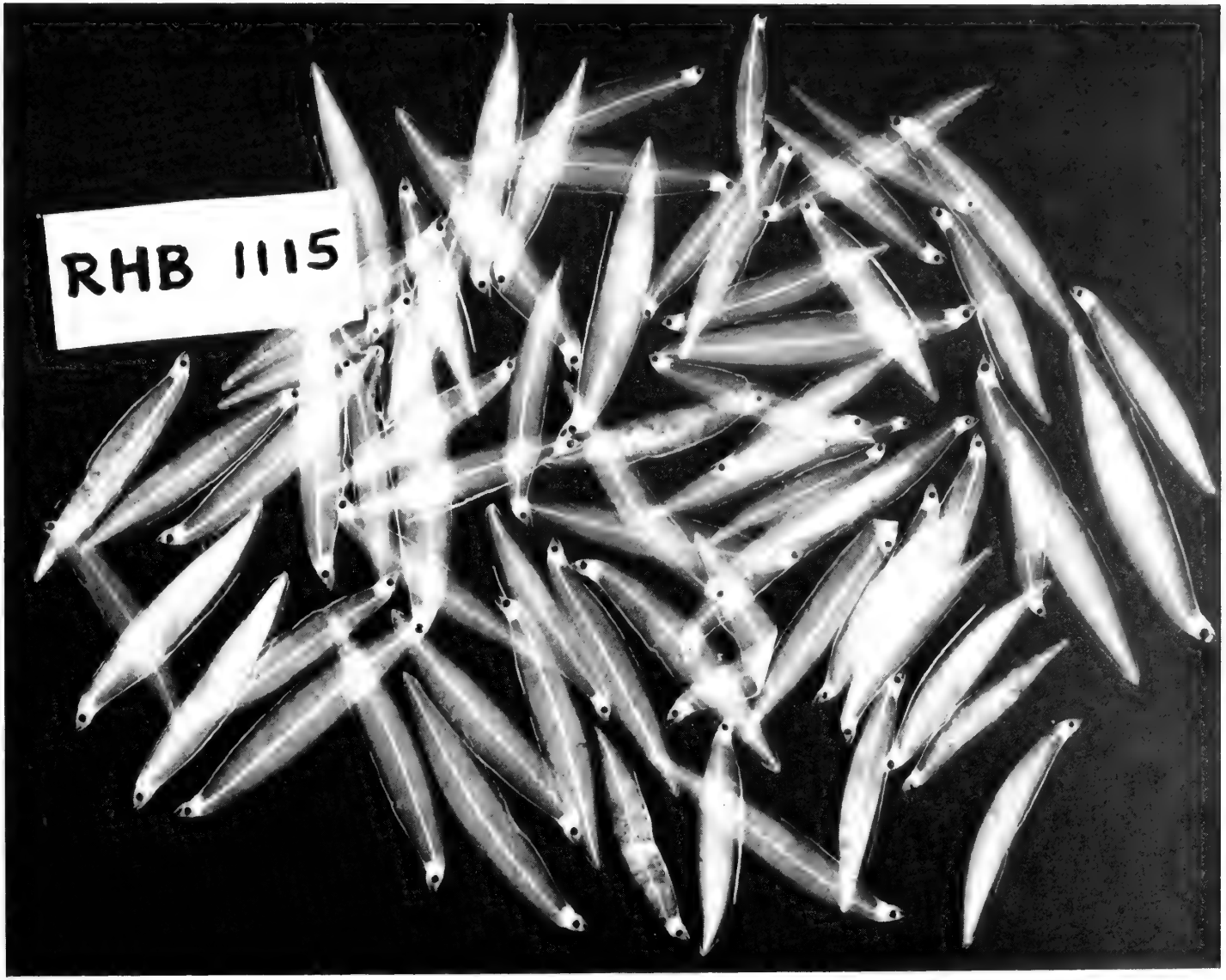

Figure 2. A haul consisting of 70 leptocephali of *Anguilla rostrata* ranging in length from 21 mm to 39 mm, taken at RHB station 1115 in the western North Atlantic on June 18, 1965. N.B. All leptocephali have a rather similar, narrow body shape.

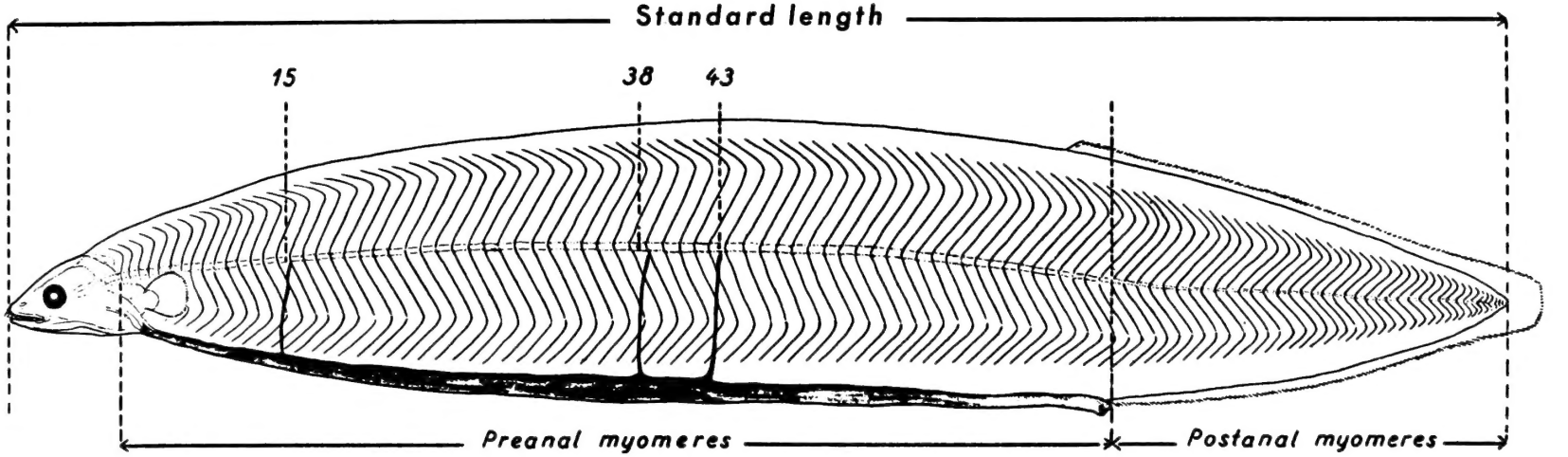

Figure 3. A schematic drawing of an *Anguilla* leptocephalus showing the separation between the pre- and postanal myomeres and the position of three vertical blood vessels (after Jespersen, 1942)

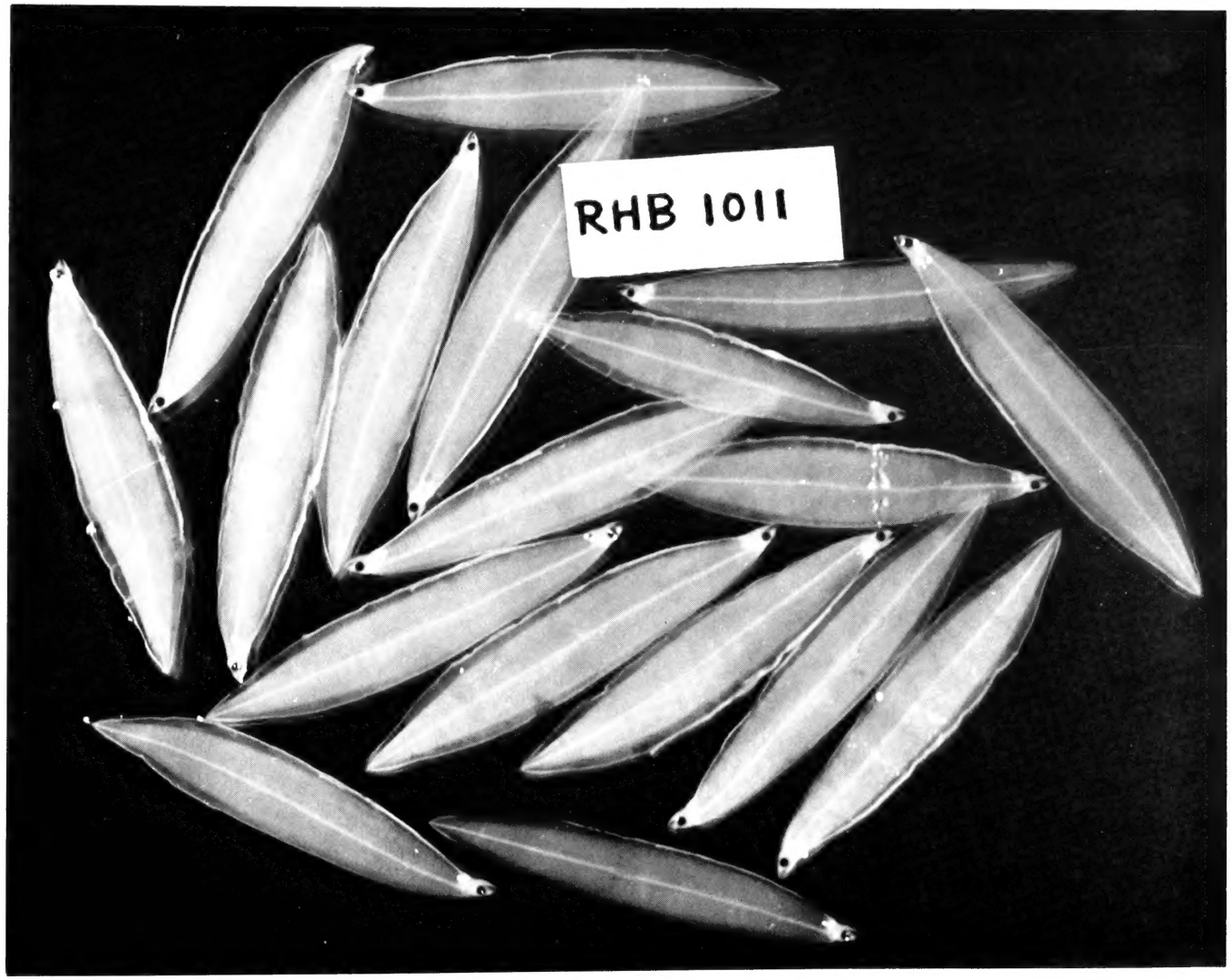

Figure 4. A haul consisting of 16 lepotcephali of *Anguilla rostrata* ranging in length from 44 mm to 60 mm and 3 leptocephali of *A. anguilla* ranging from 41 mm to 57 mm taken at RHB station 1011 in the western North Atlantic on September 6, 1964. N.B. The body shape of *rostrata* is rather deep while *anguilla* are rather narrow in shape, particularly the specimen at the bottom of the photograph.

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