REVIEW OF THE WEAKFISHES (CYNOSCION) OF THE ATLANTIC AND GULF COASTS OF THE UNITED STATES, WITH A DESCRIPTION OF A NEW SPECIES [1]

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The relation of the sand squeteague or, as it is locally called in Texas, sand trout of the Gulf coast to the gray squeteague of the Atlantic coast has been a perplexing problem. Welsh and Breder, who were the first authors of record to examine critically a large series of specimens and who recognized but a single species of sand trout from the Gulf coast, which they identified with *Cynoscion nothus*, state in regard to their species as follows:

> Examination of a large series of specimens taken by the Fisheries schooner *Grampus* in Gulf waters indicates that the species is very close to *Cynoscion regalis*, and that its claim to specific rank is at least doubtful. Although an apparently well-marked variety, further study may show complete intergradation of characters with the latter species. R. J. Coles (1916)[2] considers it simply a color variation of *C. regalis*. (Bulletin, U. S. Bureau of Fisheries, Vol. XXXIX, 1923–1924, p. 169.)

Commercially, the gray trout is a very important species in the fisheries of the Atlantic coast from Cape Cod to the coast of North Carolina. In any study of its migrations and localized races it becomes evident that it is important, first of all, to determine definitely its interrelationship with closely related species. It is especially important to know the exact morphological limits of the species in determining such problems as the age of the fish or its rate of growth. In general, it is axiomatic that in a study of the life history of any species all conclusions must be based on an examination of individuals of the same species, but this has not been the universal rule in the case of the squeteagues. Workers with these fishes, including myself, have not always properly separated their material and frequently have based their identifications on geographical lines. That this is true becomes evident from a study of the published records of these fishes as well as some of the material on which the records are based, after one becomes familiar with the real specific characters, as outlined below. Hitherto young individuals, especially, have been confused because they are almost inseparable in general appearance. The present study was undertaken for the purpose of finding, if possible, usable characters by which the individual fishes may be distinguished and recognized at all stages of growth.

The status of the species of Cynoscion on the Atlantic and Gulf coasts of the United States, as they are generally understood at the present time, may be reviewed and summarized as follows: First of all, we have the spotted squeteague, *Cynoscion nebulosus*. This species is fairly common on the Atlantic and Gulf coasts, and because of its distinctive color and scaleless dorsal and anal fins it is easily recognized and distinguished from the paler weakfishes. It is now generally agreed that there is but one species of spotted weakfish common to the Atlantic and Gulf coasts. This species is not considered in the present paper.

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[1] Submitted for publication Apr. 22, 1929.

[2] Russell J. Coles: Is *Cynoscion nothus* an abnormal *regalis*? Copeia, No. 30, Apr. 24, 1916, pp. 30–31. New York.

The gray weakfish or, as it is commonly called in more southern localities, the gray trout (*Cynoscion regalis*) is the common commercial fish of the Atlantic coast. The individuals comprising the commercial catch, or the vast majority of them, seem to belong to one species; at least now they are generally so regarded. As to the geographic distribution of this species, it is significant that authors generally have failed to record it from the Gulf coast, especially those who reported on extensive collections from that coast. Jordan and Eigenmann (Report, U. S. Fish Commission, 1886, p. 367) record it from Mobile based on material (the number of specimens not stated) in the Museum of Comparative Zoology at Harvard University. This is the only direct record of *regalis* from the Gulf that is known to me. In the literature Cuvier and Valenciennes generally are quoted as authority for including the Gulf coast in the range of *regalis*, but the statement on which this supposed record is based is as follows (Histoire Naturelle des Poissons, Tome 5, quarto ed., 1830, p. 53): "Les colons francais de la Nouvelle-Orleáns le possèdent aussi, et lui ont transféré le nom de *truite*, à cause de ses taches." This statement obviously refers to the spotted weakfish, since this is the only species of Cynoscion on the Gulf coast having well-defined spots.

A third form that is at present recognized is *Cynoscion nothus*. This was described originally from the coast of South Carolina and has since been recorded from Chesapeake Bay to the southwestern coast of Texas. There is difference of opinion as to the status of this species. Welsh and Breder, as quoted above, doubt the real distinctiveness of this form from *regalis*. On the other hand, Hildebrand and Schroeder (Bulletin, U. S. Bureau of Fisheries, Vol. XLIII, Pt. I, p. 300), who had two specimens of this species from Chesapeake Bay, state: "* * * the differences between a true *nothus*, such as we believe to have in hand now, and a *regalis* are so evident and so numerous * * *." Jordan and Gilbert (Proceedings, U. S. National Museum, Vol. V, 1882, p. 607) are the only authors known to me who record this species as being common on the Atlantic coast—namely, at Charleston, S. C. Incidentally, it may be stated that the description of the species given by these authors is probably the best extant, because it is evidently based on abundant material comprising specimens of this species only and not a mixture of individuals of different species. As to the occurrence of this form on the Gulf coast, nearly all authors who have worked over the fishes from that coast, especially those who have studied the fisheries and hence have dealt with masses of individuals, have referred the pale weakfish of the Gulf to *nothus*.

Finally, a fourth species has been described under the name of *thalassinus*. This species was first described by Holbrook (Ichthyology of South Carolina, 1855, p. 132, pl. 18, fig. 2) from a "few specimens" taken off the coast of South Carolina. Gunther (Catalogue of Fishes of the British Museum, vol. 2, 1860, p. 308), who had a single specimen of the pale weakfish from the Gulf coast, doubtfully referred it to *thalassinus*. Jordan and Eigenmann (op. cit.) have picked out three specimens from those studied by them—two from the Gulf and one from the Atlantic coast—and referred them to *thalassinus*. These authors state: "As *C. regalis* is subject to considerable variation, we have regarded *C. thalassinus* as an extreme form or variety rather than a distinct species. It may, perhaps, be found to inhabit a different depth of water than that which the common weakfish frequents." Jordan and Gilbert (Bulletin, U. S. National Museum, No. 16, 1882, p. 582) call it "a doubtful species." Welsh and Breder (op. cit., p. 148) state that "*Cynoscion thalassinus*

(Holbrook), which has not been recognized since the describer's time, seems to be merely nominal, as the description is close to *C. regalis* and *C. nothus.*"

Briefly, then, the consensus of opinion at the present time may be stated as follows: Omitting the spotted squeteague, there are two species of squeteagues common enough to enter into the commercial catch; one, the gray squeteague (*Cynoscion regalis*), is the common market fish of the Atlantic coast, while the other, the bastard trout or sand trout (*Cynoscion nothus*), is the common market fish of the Gulf coast. *C. regalis* does not occur or is very rare on the Gulf coast, and *C. nothus* usually is taken rather sparingly on the Atlantic coast. *C. thalassinus* is a very doubtful species. I had these ideas in mind when I began the study of the sand trout of the Gulf. It soon became evident, however, that such ideas do not fit the actual facts, and a study of considerable available material was undertaken in order to throw more light, if possible, on the subject.

The present study has shown that instead of one there are two very distinct and easily separable species of sand trout on the Gulf coast. Both are common, although the relative abundance of the two must be left for future determination. One of these species is smaller than the other and, so far as the material at hand discloses, apparently does not enter to any great extent into the commercial catch; the other species is the common market fish. This larger and common species is not *nothus*. It is very close to *regalis*, but evidently is sufficiently distinct to require a separate designation and is here named *Cynoscion arenarius*. The name *thalassinus* is definitely based on specimens from the Atlantic coast and is not applicable to this species, which is confined to the Gulf coast.

The smaller Gulf species evidently is the same as that described by Holbrook under the name of *Otolithus nothus* and is here recognized under that name. Many specimens of this species from both the Atlantic and Gulf coast have been examined. Some of this material has been previously identified by me or by other workers either as *nothus* or *regalis*, depending on whether it came from the Gulf or the Atlantic coast, respectively. This is easily explained by the fact that nearly all of the material consists of small specimens of less than 7 inches, and when of that size the appearance of the fish is such that the species can not be distinguished by a mere visual comparison, even when such comparison is made by an experienced ichthyologist. However, when the distinguishing characters outlined below are examined no trouble will be experienced in identifying even the smallest specimens. When identification is thus definitely made, our material shows that *Cynoscion nothus* is really more common on the Atlantic coast, from North Carolina southward, than most of the discussions in current literature would seem to indicate.

The present study has failed to confirm the distinctness of the form that has been named *thalassinus*. Of the many specimens of gray trout examined from Chesapeake Bay, from the coasts of North and South Carolina, and from the east coast of Florida, I have failed to distinguish more than one species and am therefore forced to the conclusion that *thalassinus* is untenable. It was evidently based on some slender individuals of *regalis*, which manifestly show considerable variation in that character. The coloration shown by Holbrook is essentially that of *regalis*. The number of fin rays is used by the author as one of the chief distinguishing marks, but his counts are obviously unreliable; as, for instance, when he states that *regalis* has only 9 dorsal spines, whereas it nearly always has 10. Besides this, the number of soft dorsal rays given in the original description falls within the range of variation of

regalis, as noted below. The other characters given by him are apparently of no significance.

Instead of being hard to distinguish, as has been asserted, *Cynoscion nothus* is, in fact, readily separable. The present extensive study has revealed three striking characters that prove conclusively that this species is distinct, and by means of which a single individual may be identified readily; namely, (1) the number of vertebræ, (2) the correlation of the numbers of soft dorsal and anal rays, and (3) the absolute number of anal rays.

Counting the vertebræ of many individuals has shown that their number furnishes a valuable and positive character for differentiating this species from the other two. In the specimens of *Cynoscion nothus* counted there were always 27 vertebræ, except in one, which had 26. This was a small specimen from off the coast of North Carolina. Altogether 114 specimens of this species from the Gulf and Atlantic coasts were counted. *Cynoscion regalis* and *C. arenarius* invariably were found to have 25 vertebræ. Fifty-five specimens of these two forms were counted and recorded. The counts were made after the mass of muscles had been removed from one side. The first vertebra, which articulates with the skull and has a different shape than the succeeding vertebræ, and also the hypural were included in the count.

A study of the correlation of the numbers of dorsal and anal soft rays is what first led me to suspect that two distinct species were being confused under the name sand trout on the Texas coast. Table 1 shows this correlation in specimens from various localities on the Gulf coast. A mere glance at the table is sufficient to show that we are dealing here with two distinct forms, one having a shorter anal in combination with a longer dorsal than the other. Table 2 shows the same correlation for specimens from various localities on the Atlantic coast. Those specimens having the short anal in conjunction with a long dorsal also have 27 vertebræ and consequently are *Cynoscion nothus*. Comparing Tables 1 and 2 for *Cynoscion nothus* it may be seen that there is a tendency to an increase in the number of fin rays on the Atlantic coast. However, an increase in the number of rays in northern localities is a common phenomenon occurring among fishes having a wide latitudinal distribution. It may be noted that the increase occurs both in the anal as well as the dorsal, and the differences are not marked enough to be of specific significance.

For practical purposes merely counting the anal rays is sufficient to determine *nothus*. From an examination of Table 1 it will be seen that there is virtually a break in the series of 217 specimens enumerated, as far as the number of anal rays is concerned, except for 12 individuals. Every one of these 12 specimens was dissected and found to have 25 vertebræ, which placed them definitely with *arenarius*. The number of specimens examined is sufficient, for practical purposes, to enable us to make the statement that in Gulf waters *nothus* has 8 or 9 soft anal rays, while *arenarius* has 10 to 12. Similarly, Table 2 shows that for Atlantic coast fish there is a virtual break in the number of anal rays even more pronounced than in Gulf specimens, there being only 5 of 259 Atlantic fish examined that may be said to be intermediate. Of these 5 specimens 4 were found to have 27 vertebræ, which places them unquestionaly with *nothus*, and 1 had 26. This is the only individual of all those examined for vertebræ (169 in all) that had 26, all the others having either 25 or 27. It is a small specimen, having a standard length of 49 millimeters, taken at Beaufort, N. C., on September 29, 1926. Since on the same trip many others of similar size and presumably in company with it were taken, which

unquestionably were *nothus*, it may safely be assumed that this single individual is a *nothus* showing a rare individual variation. On the basis of the material examined, which was manifestly sufficient for all practical purposes in so far as distinguishing species is concerned, it may be stated that on the Atlantic coast *nothus* has 8 to 10 anal rays and *regalis* 11 to 13.

TABLE 1.—*Correlation of the number of articulate rays of the dorsal and anal fins of Cynoscion arenarius and C. nothus from the coast of the Gulf of Mexico*

[The first short ray of the soft dorsal, which is about one-fourth as long as the anterior fully developed rays and apparently remains unjointed even in the largest specimens, has not been included in the count. The second ray, which is about one-half to two-thirds as long as the anterior fully developed rays and becomes more or less jointed, has been included. The last two rays of both the dorsal and the anal, which apparently are joined at their base, have been counted as one. All specimens having 10 anal rays have been checked by the vertebral count and found to belong to *arenarius*. The numbers in the body of the table represent frequencies]

Anal rays	Dorsal rays							
	24	25	26	27	28	29	30	31
Cynoscion nothus:								
8				5	6	3		
9				11	41	28	3	1
C. arenarius:								
10		9	3					
11	2	22	49	18	1			
12		4	7	4				

TABLE 2.—*Correlation of the number of dorsal and anal articulate rays of Cynoscion regalis and C. nothus from the Atlantic coast. (All specimens having 10 anal rays belong to nothus, as shown by the vertebral count)*

Anal rays	Dorsal rays							
	24	25	26	27	28	29	30	31
Cynoscion nothus:								
8				1	3			
9					19	34	5	3
10				1	1	2	1	
C. regalis:								
11		5	14	21	16	1		
12			12	62	44	9		
13				1	3	1		

It is not deemed necessary for the purpose of the present study to expend more time in working out in detail other structural marks that differentiate *nothus*, since the three characters outlined above convincingly prove its distinctness and constitute usable marks for identifying individual fish. Indeed, according to the standards that some authors use in creating genera, the single character of the vertebral count may be considered to be of generic importance.

Having thus definitely delimited and separated out the smaller *Cynoscion nothus*, there are left the two larger common commercial species—of the Atlantic and Gulf coasts, respectively—and the next matter to settle is the relation between the two. The common commercial fish of the Gulf coast is not *nothus*, as has been generally supposed; it is either *regalis* or something else. In considering the differences between the Gulf fish and the *regalis* of the Atlantic coast it is well to take note of the fact that nearly all previous authors have regarded the common sand trout of the Gulf as different from the gray trout of the Atlantic. The fact that it was generally referred to *nothus* is beside the question. The important fact to remember is that the commercial Gulf fish is apparently of such a different appearance from the Atlantic fish that it was

generally referred to a different species, even by investigators who dealt with the large numbers of individuals handled by fishermen. The Atlantic and Gulf forms, then, apparently are separable when taken in bulk, but when we consider each character separately the matter is not so simple because usually there is considerable intergradation. However, when all the characters are considered together it becomes evident that the two fish are sufficiently different to be regarded as distinct species. The more striking differentiating characters are as follows:

Color.—Apparently color was the chief character on which the distinction rested heretofore. The difference in adult fish is quite striking. The Atlantic coast fish usually has small spots arranged in rather indefinite and irregular streaks, while

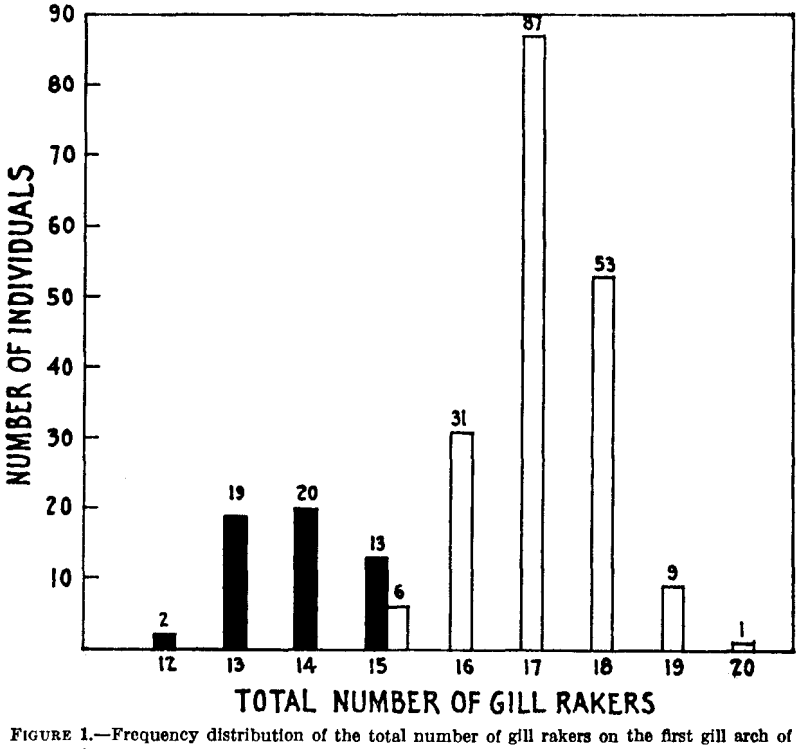

FIGURE 1.—Frequency distribution of the total number of gill rakers on the first gill arch of *Cynoscion arenarius* and *C. regalis*. The solid columns represent specimens from the Gulf of Mexico (*arenarius*) and the blank columns species from the Atlantic coast (*regalis*), in this as well as in the subsequent figures. The numbers at the top of the columns represent the actual number of specimens studied

the Gulf fish is usually pale. There is considerable variation in color. Occasionally there are Atlantic specimens that have the typical coloration faintly developed, while in some Gulf fish there may be faint development of pigmentation. However, taken as a whole, the adults of these two species may be separated nearly always by color alone, especially when in fresh condition. The young of both species are pale and hence can not be separated by color.

Form of the caudal fin.—As in many other sciænids, the caudal fin of the young of Cynoscion is very pointed, the middle rays being considerably prolonged. As the fish grow older the decided prolongation of the middle rays diminishes and the caudal fin becomes somewhat double concave. In *regalis* the transformation of the caudal fin is carried farther, and it becomes distinctly emarginate in large individuals. As may be expected in a case of this kind, there is considerable individual difference

in the size at which this change takes place. An examination of a number of *regalis* from Chesapeake Bay showed that the change to an emarginate condition takes place when the fish reaches a total length between 250 and 300 millimeters. All those below 250 millimeters have the middle rays of the caudal longest, in all those over 300 it is distinctly emarginate, while in those between these lengths both conditions may be found, and some of them have a caudal fin that can best be described as truncate. In *arenarius*, on the other hand, the middle rays of the fin are longest, even in specimens over 300 millimeters long. It may be remarked that the fins of these fishes are rather brittle, and in preserved material they are more or less frayed. This probably explains why this character is not mentioned more often in discussions of the differences between the two forms. However, judging from the condition of our specimens, it is apparent that the difference in the form of the caudal is substantially as described.

Number of gill rakers.—This character has been mentioned by previous writers as differentiating the Gulf and Atlantic forms, and the present study has shown it to be usable, but there is considerable overlapping. The modal number for *regalis* in specimens of over 70 millimeters, standard length, is 5+12, while in *arenarius* it is 3+10 or 4+10. In the study of this character the size of the fish must be taken into consideration, since it has been found that the number varies with the size, especially in *arenarius*. In the young fish the gill rakers are comparatively longer and more slender. As the fish grow older they become shorter and stouter, and the foremost one on the lower limb of the first arch and one or two uppermost ones on the upper limb tend to become absorbed and disappear. Moreover, this disappearance is more marked in *arenarius*, and consequently when larger specimens are compared the difference is more pronounced.

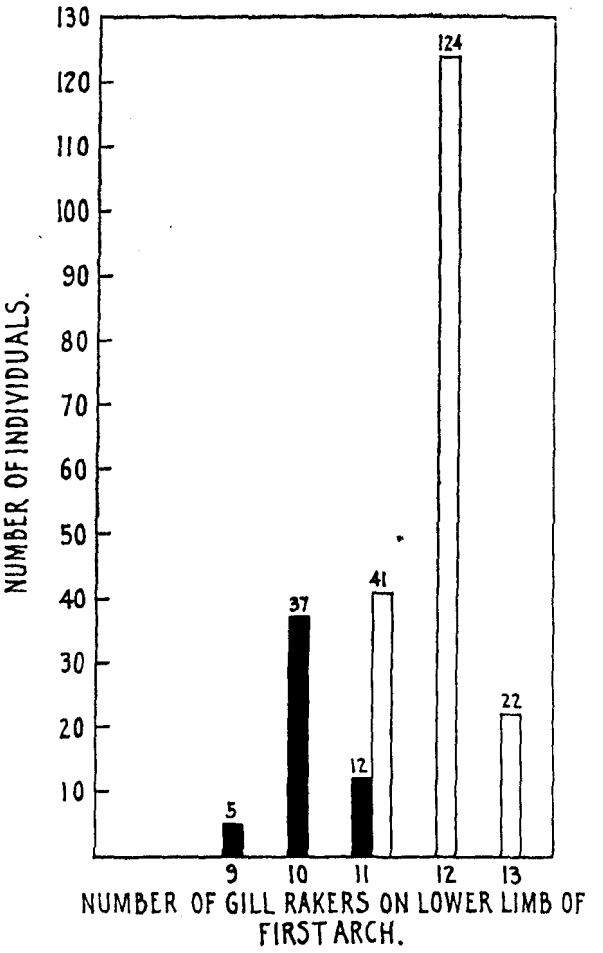

FIGURE 2.—Frequency distribution of the number of gill rakers on the lower limb of the first arch of *Cynoscion arenarius* and *C. regalis*. The one gill raker that stands at the angle of the arch and has one root on the lower limb and one on the upper limb has been included uniformly in this count

For the purposes of the present study all specimens have been divided into two groups, those of 70 millimeters or less and those over 70 millimeters standard length, and like groups have been compared. It might have been desirable to make a finer division of groups, but there was not enough material of all sizes in both forms. However, this division seems sufficient to bring out the essential facts. Figures 1 and

2 are graphic representations of the frequency distribution of the gill rakers in the group of larger specimens. In 69 smaller specimens of *arenarius* of 30 to 60 millimeters the mode for the total number of gill rakers falls at 15, with the class 16 a very close second. Comparing these smaller specimens of *arenarius* with the larger *regalis*, it may be seen that the modes are even then distinct, although the overlapping is quite considerable. I do not have a sufficient number of smaller *regalis* to establish the frequency distribution, but from the few specimens counted it seems evident that the difference between the larger and smaller members of this species is not so marked as it is in *arenarius*.

A precaution to be taken when the number of gill rakers is used as a distinguishing character may be mentioned. As may be conjectured, it is sometimes difficult to

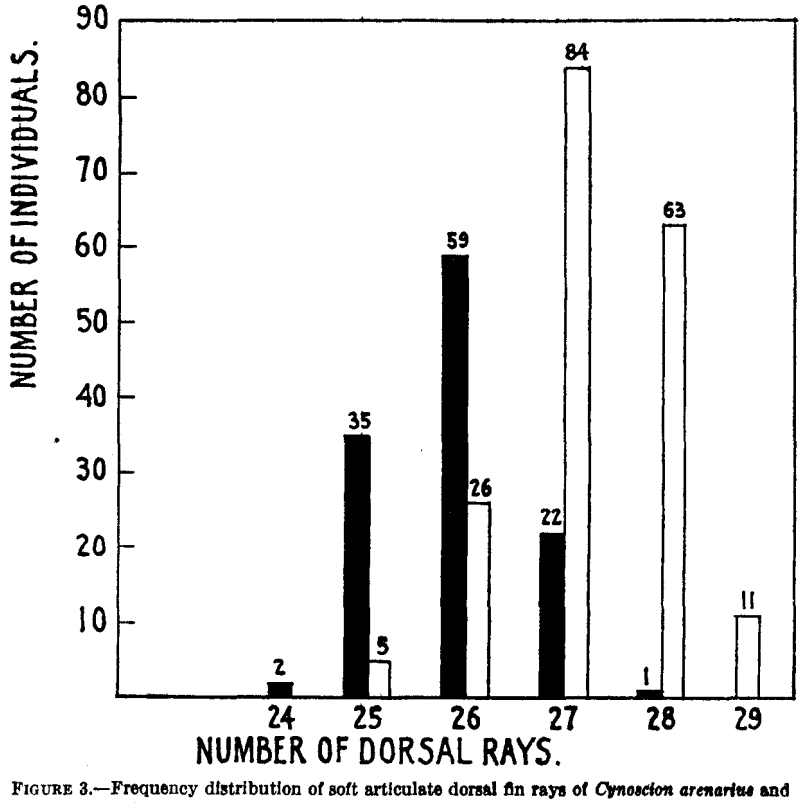

FIGURE 3.—Frequency distribution of soft articulate dorsal fin rays of *Cynoscion arenarius* and *C. regalis*. The first short ray, which remains unjointed in the largest specimens, was not included in the count, and the last two rays, which are apparently united at their base, have been counted as one

decide as to what constitutes a gill raker and what is a mere tubercle at each end of the gill arch. It is hard to describe in so many words where a line may be drawn. The number counted will vary somewhat with the observer, but when the same investigator makes the counts in both species the numbers are comparable. In the present study all gill rakers were included that were big enough to be manipulated with a dissecting needle, or about 1 millimeter long as a rough estimate. If the gill rakers on the lower limb only are counted, the number of doubtful cases will be surprisingly small. When the total number of gill rakers is enumerated, the divergence in the two species is emphasized because there is usually a difference of one or two gill rakers also on the upper limb. However, there is greater chance for error

due to the personal equation of the observer, because it is harder to draw a line between gill rakers and tubercles at the uppermost part of the gill arch. In the present study, therefore, the number of gill rakers on the lower limb (fig. 2) and also the total number (fig. 1) have been enumerated separately, the first because of the greater accuracy possible and the second because of the greater divergence shown.

Number of fin rays.—Figures 3 and 4 represent the number of articulate fin rays in the dorsal and anal, respectively. It may be seen at a glance that while there is considerable overlapping, each form shows a strongly marked mode. Furthermore, the mode is markedly conspicuous in both characters. While, because of the large number of overlapping individuals, these characters by themselves do not prove the distinctness of the two species very convincingly, yet they furnish additional proof when considered in conjunction with the other characters. The advantage in the use of the fin rays lies in that their numbers can be determined accurately in terms of exact figures and are not subject to variation with the personal idiosyncracies of the observer or with the size of the fish.

Using the following standard formulæ:

$$\text{Standard deviation} = \sigma = \sqrt{\frac{\Sigma f x^2}{n}}$$

Probable error of arithmetic mean $= E =$

$$\pm 0.6745 \frac{\sigma}{\sqrt{n}}$$

and probable difference $= \sqrt{E_1^2 + E_2^2}$

some statistical constants have been worked out for the numerically variable characters of gill raker and fin-ray counts. These constants are shown in Table 3. The numerical values of the ratios of the actual differences of the arithmetic means to the probable differences are high in every case and serve to emphasize the distinctness of the two species.

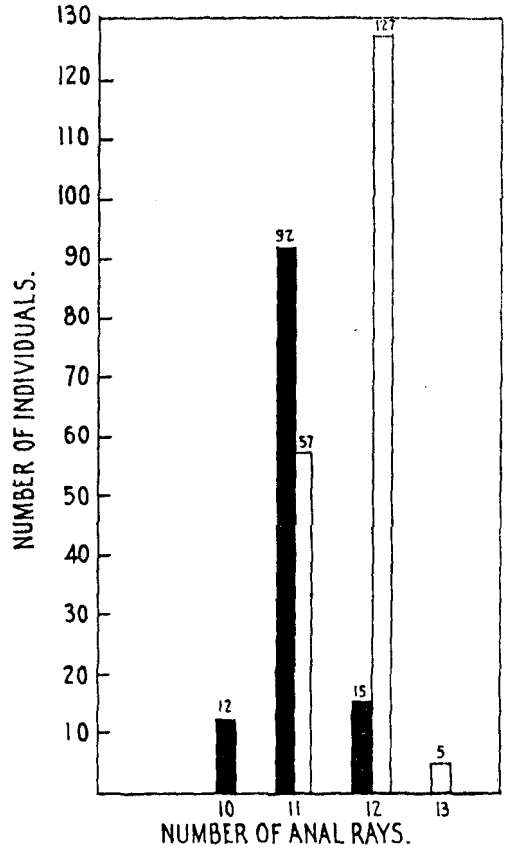

FIGURE 4.—Frequency distribution of soft articulate anal fin rays of *Cynoscion arenarius* and *C. regalis*. The last two rays, which apparently are united at the base, have been counted as one.

TABLE 3.—*Some statistical constants showing the divergence between Cynoscion regalis from the Atlantic coast and C. arenarius from the Gulf coast*

	Gill rakers, entire first arch		Gill rakers, lower limb only		Dorsal rays		Anal rays	
	C. regalis	C. arenarius	C. regalis	C. arenarius	C. regalis	C. arenarius	C. regalis	C. arenarius
Mean	17.26	13.81	11.90	10.13	27.26	25.87	11.72	11.03
Standard deviation of mean	.894	.829	.570	.546	.862	.751	.502	.476
Probable error of mean	.044	.076	.028	.050	.042	.046	.025	.029
Probable difference of means	.088		.057		.063		.038	
Actual difference	3.45		1.77		1.39		.69	
Actual difference divided by probable difference	39		31		22		18	

Proportional measurements.—In addition to the characters discussed above there are also some significant proportional measurements. A number of measurements expressed as percentages of the standard length are given in Table 4. Of course, the measurements are too few to warrant drawing any general conclusions. They were intended merely as a test to show whether such characters will separate the two forms more convincingly. Of the various measurements taken it may be seen that those that show the greatest divergence are the length of the maxillary, the length of the snout, and the depth of the caudal peduncle. However, a close examination of the figures seems to show that if a long series of measurements be taken, most likely the results will not be more convincing than are the characters already mentioned. They will probably only duplicate the previous results and emphasize the fundamental differences between the two forms while at the same time showing their close relationship. It is, therefore, not deemed necessary for our purpose to undertake the extra labor of a long series of measurements. The magnitude of the test is also increased by the fact that the proportional measurements vary greatly with the size of the fish and hence are not comparable when taken from fish of widely different sizes.

Table 4 shows that the length of the snout and of the maxillary and the depth of the caudal peduncle vary in the two species in different directions—in *regalis* the snout and maxillary are shorter while the peduncle is deeper than in *arenarius*. Hence, the divergence in the two species may be shown more clearly when these measurements are compared. This is done in Table 5, the figures representing the number of times the depth of the caudal peduncle goes into the length of the snout and the maxillary, respectively.

TABLE 4.—*Some proportional measurements of Cynoscion regalis and C. arenarius*

[The numbers represent percentages of the standard length; that is, the distance from the tip of the snout to the base of the caudal]

Standard length	Snout	Maxillary	Least depth of caudal peduncle	End of insertion of dorsal to base of caudal on mid line	Vent to end of insertion of anal	Head	Depth	Eye
Cynoscion regalis:								
275	8.25	13.31	8.84	13.71	14.22	30.76	23.64	5.13
247	8.14	13.52	8.71	12.35	14.94	30.04	24.66	5.26
236	8.09	14.07	9.36	13.77	15.21	30.59	23.31	5.89
208	9.04	14.86	9.47	13.56	14.42	32.46	27.98	6.59
200	7.75	13.85	9.30	13.35	14.65	30.70	24.60	6.35
197	8.32	13.96	9.34	12.28	16.55	31.22	23.60	6.40
178	8.99	14.66	9.38	11.69	14.61	32.64	24.04	6.69
167	8.62	14.19	9.76	12.40	16.53	32.22	25.39	6.77
162	7.90	13.70	9.88	13.83	16.54	30.93	25.08	7.00
102	8.92	15.29	9.22	12.66	18.18	34.61	27.16	8.53
C. arenarius:								
268	9.70	14.55	8.43	12.31	15.41	31.23	25.00	5.11
242	8.88	14.50	8.68	12.56	14.79	31.49	25.08	5.37
228	9.00	14.43	8.46	14.17	14.03	31.27	24.30	5.61
213	9.15	15.12	8.31	13.80	12.63	32.30	25.82	5.87
203	8.97	15.00	8.33	13.35	14.53	32.02	23.30	5.86
184	9.18	14.95	8.59	13.48	13.91	32.60	23.70	6.30
178	9.44	14.78	8.31	13.60	15.17	32.58	24.49	6.40
173	9.31	14.80	9.13	12.83	16.18	32.89	26.82	6.53
169	9.35	14.50	9.23	13.07	14.79	31.36	27.22	6.45
110	8.91	15.00	8.36	12.45	15.64	33.82	24.18	7.91

TABLE 5.—*Relation between the least depth of the caudal peduncle and the lengths of the snout and the maxillary* [1]

Species	Standard length	Least depth of caudal peduncle in snout	Least depth of caudal peduncle in maxillary	Species	Standard length	Least depth of caudal peduncle in snout	Least depth of caudal peduncle in maxillary
Cynoscion regalis	275	0.93	1.51	C. arenarius	268	1.15	1.73
	247	.93	1.55		242	1.02	1.67
	236	.86	1.50		228	1.06	1.70
	208	.95	1.57		213	1.10	1.82
	200	.83	1.49		203	1.08	1.80
	197	.89	1.49		184	1.07	1.74
	178	.96	1.56		178	1.14	1.78
	167	.88	1.45		173	1.02	1.62
	162	.80	1.39		169	1.01	1.57
	102	.97	1.66		110	1.07	1.79

[1] The figures represent the number of times the former is contained in the latter, respectively. Note that in the few specimens measured, which were taken at random except that specimens of approximately like size were taken for the purpose of comparison, there are no overlapping individuals for one ratio and a significant divergence for the other.

The data and conclusions presented above may now be summarized in the conventional form used in descriptive works.

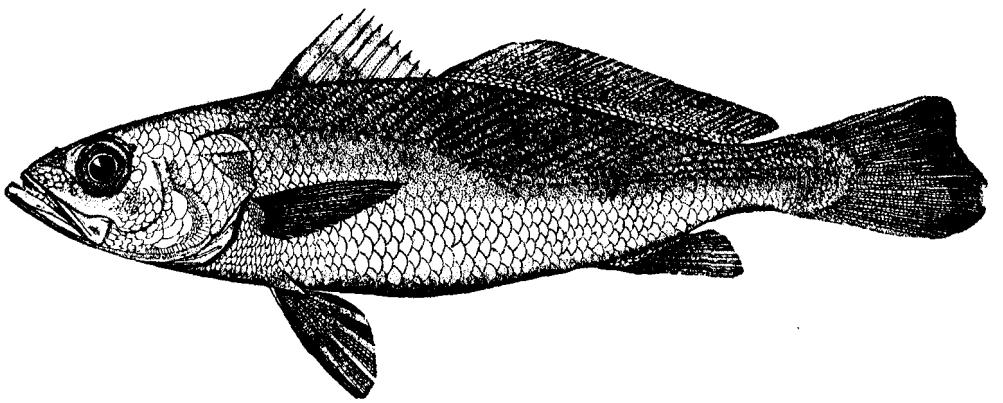

FIGURE 5.—*Cynoscion nothus* (Holbrook). Silver squeteague. Drawn by Louella E. Cable from a specimen taken off North Carolina

Cynoscion nothus (Holbrook)

Common name.—Silver squeteague.

Other common names.—Bastard trout (Chespeake Bay and coasts of North and South Carolina); sand trout (Texas coast, where it is not distinguished from *Cynoscion arenarius*).

Otolithus nothus Holbrook, Ichthyology of South Carolina, 1855, p. 134, pl. 19, fig. 1. (Type locality, coast of South Carolina.)

Cynoscion nothus Jordan and Gilbert, Proc., U. S. Nat. Mus., vol. 5, 1882, p. 607.

Cynoscion nothus Welsh and Breder (in part), Bull., U. S. Bureau of Fisheries, Vol. XXXIX, 1924, p. 169.

Cynoscion nothus Hildebrand and Schroeder, loc. cit., Vol. XLIII, 1928, Pt. I, p. 299.

Diagnosis.—Vertebræ nearly always 27 (113),[3] rarely 26 (1). Anal soft rays predominantly 9 (145), sometimes 8 (18), and infrequently 10 (5) in specimens from the Atlantic coast. Total number of gill rakers on the first arch in individuals of

[3] The number in parentheses refers to the actual number of specimens, on an examination of which the statement is based.

30 to 130 millimeters, enumerated together, have a mode of 13 (87), frequently 12 (33) or 14 (28), rarely 15 (3). Most common number of gill rakers on the first arch 3 + 10. There is somewhat of a tendency to a decrease in the number of gill rakers as the fish increases in size, but the mode remains the same in the smaller and larger specimens examined (30 to 130 millimeters standard length), the decrease not being as pronounced as in the following species. Snout rather short, shorter than the least depth of caudal peduncle. Caudal peduncle short, the length of the rather short maxillary greater than the distance from posterior end of insertion of dorsal to base of caudal on mid line. Eye conspicuously larger than in the two other species. Dorsal rather long, the usual number of soft rays 28 (71) or 29 (67), frequently 27 (18), less frequently 30 (9), rarely 31 (4); the number of rays increasing in more northern latitudes, the mode being at 28 in Gulf specimens, in those from Fernandina and Cape Canaveral, Fla., the numbers 28 and 29 are about equally distributed, while in North Carolina specimens the mode falls at 29. Color pale, without conspicuous pigmentation, the upper part usually straw or walnut, the lower part lighter silvery; sometimes an indication of irregular rows of faint spots. Small individuals, up to about 85 millimeters standard length, have the upper part more or less faintly clouded, the cloudy areas tending somewhat to form broad transverse bands.

Geographical distribution.—Occurs from Chesapeake Bay to the southwestern coast of Texas. The material at hand indicates that it is fairly common or abundant on the Gulf coast of the United States and the east coast of Florida. Recorded as being common on the coast of South Carolina. Probably common on the coast of North Carolina.[4] Not now recorded as being common in Chesapeake Bay.

Cynoscion regalis (Bloch and Schneider)

Common name.—Gray squeteague.

Other common names.—Weakfish (coasts of New England, New York, and New Jersey); gray trout, trout, and sea trout (Chesapeake Bay and southward).

Johnius regalis Bloch and Schneider, Systema Ichthyologia, 1801, p. 75.

Otolithus regalis Cuvier and Valenciennes, Hist. Nat. Pois. (quarto ed.), tome 5, 1830, p. 50 (in part; includes also the spotted squeteague, as shown by the statement "Il y en a une variété plus belle, à taches noires mieux terminées et s'étendant même sur la seconde dorsale et sur la caudale.").

Otolitus thalassinus Holbrook, Ichthyology of South Carolina, 1855, p. 132, pl. 18, fig. 2.

Cestreus regalis Jordan and Eigenmann, Rept., U. S. Commissioner of Fisheries, 1886, p. 366 (in part; excepting specimens from Gulf of Mexico).

Diagnosis.[5]—Vertebræ 25 (8). Anal soft rays with a modal number of 12 (127), commonly also 11 (57), infrequently 13 (5). Total number of gill rakers in individuals of 71 to 180 millimeters, standard length, with the mode at 17 (87), frequently 18 (53) or 16 (31), infrequently 19 (9) or 15 (6), rarely 20 (1), the modal number for the two

[4] After the above was written I received a letter from Dr. S. F. Hildebrand (Aug. 8, 1928), in which he said: "Yesterday I picked up in the local market a *Cynoscion nothus* and I obtained the interesting information that this fish has been taken in considerable numbers during the past few months in a pound net operated in the sea off Bogue Banks. I saw only 1 specimen in the catch of yesterday, but the manager informed me that 'a lot of them' had been taken and that during May they frequently obtained as many as 100 pounds per day. This is very interesting information, inasmuch as it was supposed that the species was quite rare in this vicinity. To date I do not know of a single specimen that has been taken within the harbor. I do not know of any fishing, exclusive of hook and line work and seining within the bight of Cape Lookout, that is done in offshore waters other than with this particular pound net. It may be, therefore, that this species is much more common in our offshore waters than was supposed."

[5] The diagnosis is based on specimens from Chesapeake Bay; Beaufort, N. C.; Winyah Bay, S. C.; and Fernandina and Cape Canaveral, Fla. In more northern localities the number of fin rays probably increases somewhat.

limbs of the first arch enumerated separately being 5+12. The tendency to fewer gill rakers with increase in the size of the fish is not as marked as in the following species. The caudal is emarginate in specimens over 300 millimeters total length, the change from a biconcave to an emarginate condition taking place when the fish reaches a total length of approximately 250 to 300 millimeters. Least depth of caudal peduncle in grown individuals usually greater than length of snout, 1.39 to 1.66 in maxillary. Dorsal soft rays have a modal number of 27 (84), the next highest class being 28 (63), frequently 26 (26) or 29 (11), infrequently 25 (5). Color, upper two thirds of body with rather small irregular pigment spots without sharply defined borders, many of the spots contiguous or coalescent, forming irregular oblique or longitudinal streaks. This typical coloration frequently faint in preserved specimens, especially in the smaller individuals. Lower third of body plain silvery gray, sometimes somewhat irridescent. Fins usually pale, without well defined spots, sometimes a few faint spots on caudal, near its base only.

Geographical distribution.—Atlantic coast of the United States from Massachusetts Bay to the east coast of Florida. Occurs also occasionally in the Gulf of Maine.

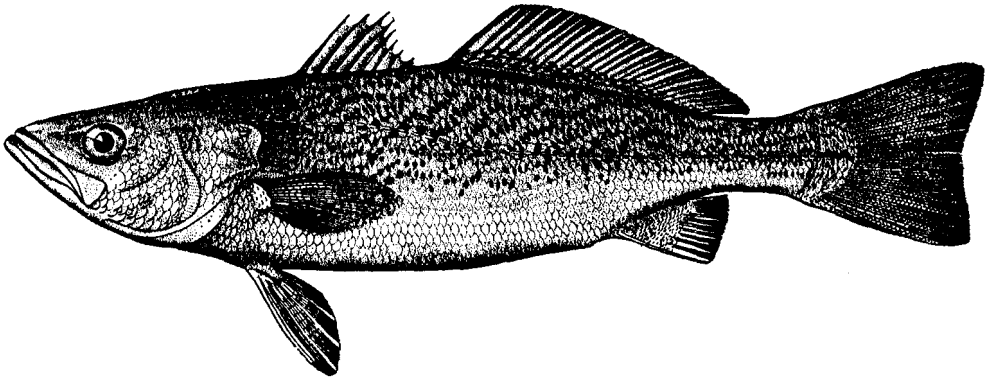

FIGURE 6.—*Cynoscion regalis* (Bloch and Schneider). Gray squeteague. Drawn by Louelle E. Cable from a specimen taken off North Carolina

Specimens studied from Chesapeake Bay, the Carolinas, and Florida. This species is evidently confined to the Atlantic coast, the Gulf form being sufficiently distinguished to be regarded as a distinct species or at least subspecies.

Cynoscion arenarius[6] sp. nov.

Common name.—Sand squeteague.

Other common names.—Sand trout (Texas); white trout (Pensacola).

Otholitus thalassinus Gunther (not Holbrook), Cat. Fish. Brit. Mus., vol. 2, 1860, p. 308.

Cynoscion nothus Goode and Bean (not Holbrook), Proc., U. S. Nat. Mus., vol. 2, 1879, p. 131.

[6] An unbiased study of the data here presented shows, I believe, that there is room for difference of opinion as to the degree of difference between this form and *regalis* from the Atlantic coast—whether they should be regarded as species or as subspecies. I am personally averse to the use of trinomials because, first, for practical reasons such names are clumsy, and, second, even on theoretical grounds, in a consideration of the larger problems of descent, the use of trinomials is not of great help, since our understanding of the mechanism and methods of descent are too hazy, uncertain, and controversial at the present time, and the mere bestowal of a trinomial on any taxonomic unit does not help to elucidate these problems. Under the circumstances, therefore, it seems that the matter of expediency should be given consideration and the name be merely regarded as a convenient handle in discussing the particular form, in which case simplicity is desirable.

Cestreus regalis var. *thalassinus* Jordan and Eigenmann (not Holbrook), Rept., U. S. Commission of Fisheries, 1886, p. 366 (in part; specimens from Pensacola and Pass Christian only).

? *Cestreus regalis* var. *regalis* Jordan and Eigenmann (not Bloch and Schneider), loc. cit. (in part; specimens from Gulf of Mexico not being described, it is not possible to state with certainty whether they belong here or under *nothus*).

Cynoscion nothus Welsh and Breder (in part), Bull., U. S. Bureau of Fisheries, Vol. XXXIX, 1924, p. 169.

Diagnosis.—Vertebræ 25 (47). Soft anal rays with the modal number very decisively at 11 (92), sometimes 10 (12) or 12 (15). Total number of gill rakers in specimens of 71 to 266 millimeters, standard length, usually 14 (20) or 13 (19), frequently 15 (13), infrequently 12 (2). Enumerating separately the gill rakers on the two limbs of the first arch the most usual numbers are 4 + 10 or 3 + 10. The

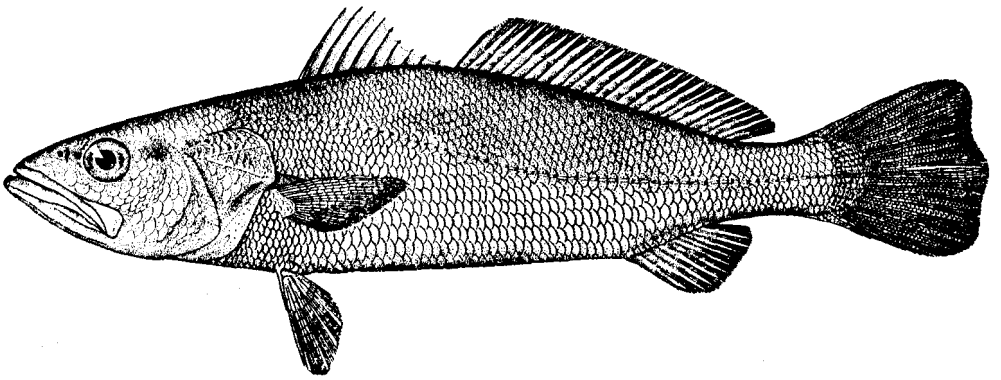

FIGURE 7.—*Cynoscion arenarius* sp. nov. Sand squeteague. Drawn by Louella E. Cable from a specimen taken off Galveston, Tex.

tendency to a decrease in the number of gill rakers with an increase in the size of the fish is quite marked; in specimens of 31 to 70 millimeters standard length the frequency distribution is as follows: 14 (6), 15 (31), 16 (24), 17 (7), 18 (1). Caudal not emarginate in individuals over 300 millimeters, the middle rays being somewhat longer (specimens up to 315 millimeters total length examined). Least depth of caudal peduncle usually shorter than snout; 1.57 to 1.82 in maxillary. Dorsal soft rays have a modal number of 26 (59), quite commonly 25 (35) or 27 (22), rarely 24 (2) or 28 (1). Color pale, without well defined spots, yellowish above, silvery below, the centers of the scales above level of gill opening sometimes forming faint oblique rows of cloudy areas. The back in young cloudy, the cloudy areas tending to form indefinite broad cross bands.

Description of type specimen.—Total length 290, standard length 245, greatest depth (60.1) [7] near tip of ventrals, 4.08 times; head (77.4 measured to posterior membranous edge of opercle) 3.17 in standard length. Snout (22.3 measured to edge of membranous border of eye) 3.47; eye (13.3 measured between membranous borders) 5.82; interorbital (16.5 measured on a level through middle of eye) 4.69; maxillary (36.2) 2.14; postorbital part of head (44.8) 1.73; least depth of caudal peduncle (21) 3.69; distance from posterior end of dorsal insertion to base of caudal on mid line (33.8) 2.29; and distance from anal opening to posterior end of insertion of anal (35) 2.21 in length of head.

[7] The number in parentheses in every case gives the actual length in millimeters.

Snout rather long, considerably longer than eye and slightly more than least depth of caudal peduncle; eye 1.68 and least depth of peduncle 1.06 in snout. Maxillary rather long, distance from posterior end of dorsal insertion to base of caudal on midline 1.07 and distance from vent to posterior end of insertion of anal 1.03 in maxillary, which extends to a vertical about midway between pupil and posterior margin of eye. Articulation of mandible on a vertical behind posterior margin of eye at a distance about equal to diameter of pupil. Outer angle of insertion of ventral on a vertical through the lower angle of insertion of pectoral. Length of ventral (about 38) less than length of pectoral (about 43). Distance from tip of snout to origin of spinous dorsal (86) 2.85 and base of entire dorsal (127) 1.93 in standard length. Origin of anal on a vertical through base of fifteenth articulate dorsal ray, its base (26.8) 9.14 in standard length, ending on a vertical through the space between the third and fourth dorsal rays from its end. First dorsal with 10 flexible spines, last one very short and almost entirely embedded in skin. Second dorsal with 1 short simple and 26 articulate rays, the last one being divided to its base. Anal with 2 short, rather feeble spines, covered with thick skin, and 11 articulate rays, the last one being divided to its base. Gill rakers 3+9 and 3+10 on right side. Vertebræ 25. Scales approximately 60 in lateral line (most of the scales of the specimen in hand have fallen off, and an accurate count is not possible). Color nearly uniform, without conspicuous spots, yellowish above, silvery below. Centers of scales on back somewhat dusky, due to concentration of minute pigment specks. Tips of lower jaw and snout blackish.

Holotype.—Cat. No. 89395, U. S. N. M. Female with developing ovaries in granular condition, February 26, 1917, Galveston, Tex., off entrance to harbor. Taken by Schooner *Grampus*, W. W. Welsh in charge.

KEY TO THE SPECIES

a. Vertebræ nearly always 27, rarely 26. Anal rays usually 9, sometimes 8, infrequently 10 in individuals from Atlantic coast only. Atlantic coast and coast of Gulf of Mexico, from Chesapeake Bay to Texas ..... *Cynoscion nothus*

aa. Vertebræ 25. Anal rays at least 10 in Gulf of Mexico individuals and at least 11 in Atlantic coast examples.

b. Grown specimens colored more or less with blackish spots, which frequently form oblique or longitudinal streaks. Caudal emarginate in individuals of over 300 mm. total length. Gill rakers usually 5+12. Snout usually shorter than least depth of caudal peduncle, which is contained 1.39 to 1.66 in maxillary. Modal numbers of soft articulate rays of dorsal and anal 27 and 12, respectively. Atlantic coast of United States. *Cynoscion regalis*

bb. Color pale without definite spots. Caudal not emarginate in largest examples. Gill rakers usually 3+10 or 4+10 in specimens over 70 millimeters standard length. Snout usually longer than least depth of caudal peduncle, which is contained 1.57 to 1.82 in maxillary. Modal numbers of soft articulate rays of dorsal and anal 26 and 11, respectively. Gulf coast of the United States ..... *Cynoscion arenarius*