

is 92.4 per cent. This large increase, as already indicated, resulted from the catches of the last three years of the period, and especially from the banner year 1921, when the catch was more than twice as large as for any other year for which records are available.

Other species taken in the pound nets in Lynnhaven Roads are bluefish, sheepshead, pompano, sturgeon, and sand perch. All of these were of minor importance in the fishery during the period covered by the records under consideration. Occasionally, also, small catches of mullets, pigfish, Spanish mackerel, and bonito are made. The last-named species are taken in such small quantities, however, that their value in the fishery does not justify any discussion. The decline in the bluefish

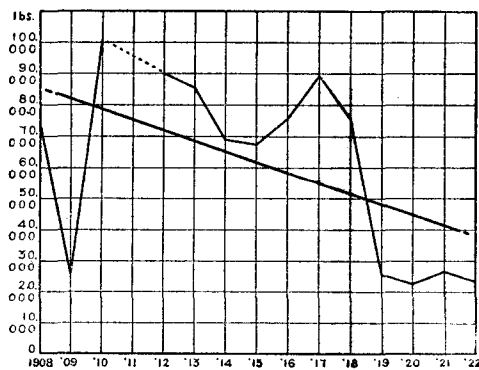


FIG. 22.—Graphic representation of the number of pounds of squeteague (*Cynoscion regalis*) taken from 1908 to 1922 at the Buchanan Bros. fishery, arranged by years. It is problematical whether the species will recover from the decline since 1918. The straight, heavy line shows the general trend in the quantities caught.

in Chesapeake Bay, according to all accounts, is quite general, and the catch unmistakably has declined at this fishery for the entire period (1908 to 1922) under consideration. A sharp drop occurred in 1916, and since that time a partial recovery is indicated. The sheepshead, too, is said formerly to have been much more numerous

in Chesapeake Bay. The table presented herewith shows that at no time during the years covered by the records was this species of much importance in this fishery, and during recent years the catch has been negligible. The catch of pompano at this fishery warrants brief mention only because it is a highly prized food fish and because the small quantities taken bring a good price. Except for fairly large catches in 1913 and 1914, the species appears to have been rather stationary and uniformly scarce. The decline of the sturgeon is so well known that it does not require discussion. The catch at the Buchanan brothers' fishery was quite consistently low from 1916 to 1922, except in 1918, when it was more than twice as large as during any other year covered by the records. The sand perch is often taken in large numbers, and usually only the very largest individuals are retained

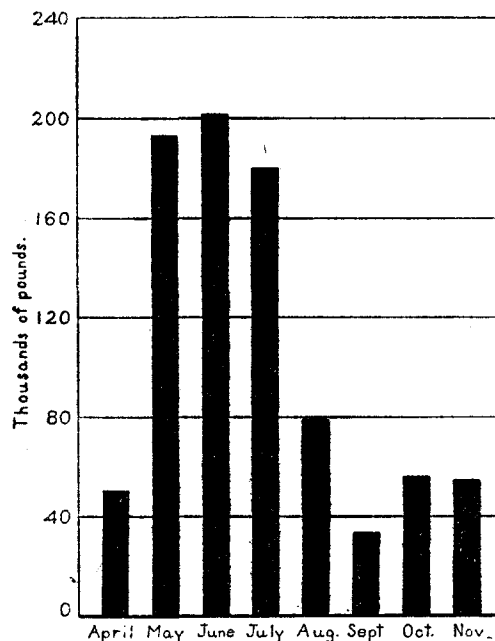


FIG. 23.—Graphic representation of the number of pounds of squeteague (*Cynoscion regalis*) taken from 1908 to 1922 at the Buchanan Bros. fishery, arranged by months. The species is not taken in commercial numbers during March.

for the market. The number retained, however, depends somewhat upon the abundance of more desirable species and market conditions.

#### CONCLUSION

It is evident from the foregoing discussion and the tables presented herewith that a number of important species in the fishery under discussion have declined during the period covered by the records at hand; one, at least, appears to have remained nearly stationary, and for two the catch has increased. It must be borne in mind, however, that a change in the gear used took place during the earlier years for which records of catches are at hand. The extent to which this change affected the trend, exclusive of the catch of shad and herrings (which was not influenced), is not known. Moreover, it has been shown that the change in the gear undoubtedly resulted in a somewhat larger catch, at least from 1912 to 1917. The calculated trend shown on the graphs, as well as the percentages of increase and decrease given in the preceding section, therefore, is subject to an error of unknown significance. Yet, it seems certain that for most of the species considered the decline was less rapid or the increase more pronounced than indicated, according to whether an increase or a decrease in the catch took place.

It is very interesting, and possibly significant, that the majority of the species discussed suffered a serious decline during about the middle of the period for which records are available, and that several species (shad, herrings, butterfish, starfish, spot, and flounder) during the last several years, when a set of two pound nets only was operated, showed a tendency to recover. The increase in the catches is regarded by the writers as a hopeful sign.

It is impossible to estimate the exact significance of these statistics in relation to the fisheries for the rest of the bay, as few records for the entire bay are available for comparison. Limited evidence has been produced to show that the records of this fishery of the catch of shad and herrings does reflect the status of these species for the entire bay, and the writers know of no reason why the same should not be true of the other important commercial species of this pound-net fishery. Inasmuch as no more reliable statistics are available, the present ones are offered for what they may be worth in this connection. Certainly, they are of interest as a local study and in showing when the species appear in the mouth of the bay in commercial numbers, the month or months during which they are the most abundant, and when they again become scarce.

#### *Buchanan brothers' fishery*

#### ACIPENSER OXYRHYNCHUS (STURGEON)

[Amounts given show the number of pounds of sturgeon taken at the Buchanan brothers' fishery from 1916 to 1922. It is evident that the sturgeon is of small importance in this pound-net fishery]

	1916	1917	1918	1919	1920	1921	1922	Average
April.....		285	150	150			175	109
May.....	40	185	275	100	100	100	240	148
June.....	100		230	25		125		68
July.....			260					37
August.....		40				50		13
September.....			50					7
October.....	50		290	40		100		68
November.....			50					7
Total.....	190	510	1,305	315	100	375	415	

## BULLETIN OF THE BUREAU OF FISHERIES

*Buchanan brothers' fishery—Continued*

## POMOLOBUS PSEUDOHARENGUS AND POMOLOBUS FESTIVALIS (HERRINGS)

[These species are not separated for the market and therefore are combined in the records under the name "herring." The entire catch (listed by pounds) for the period covered was taken in pound nets. Note that when a small catch was made in April it generally was followed by a larger catch than usual in May]

	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Average
March.....	9,380	12,950	10,250	1,575	2,725	3,500	3,750	850	1,065	1,000	3,165	1,190	1,815	4,750	1,950	3,994
April.....	26,850	36,850	10,400	6,950	4,110	8,100	16,885	5,345	1,885	6,135	13,390	6,525	1,565	2,810	4,600	10,160
May.....	1,550	1,100	815	3,625	4,190	5,225	1,025	660	850	2,485	3,365	200	1,435	450	1,600	1,698
June.....						275	325	100		75	100				300	78
Total.....	37,780	50,900	21,465	12,050	11,025	17,100	21,985	6,955	3,800	9,695	20,020	7,915	4,815	8,010	8,450	

## ALOSA SAPIDISSIMA (SHAD)

[The entire catch of shad for the period covered was taken in pound nets and is listed by pounds. A few shad are caught early in March, as soon as the nets are set, and usually not many are caught after May 15. The largest single day's catch for the period covered was made on March 25, 1910, when 3,900 pounds were taken]

	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	Average
March.....	2,650	5,000	10,585	3,800	5,195	2,520	2,060	1,535	4,680	625	5,665	2,230	2,570	6,580	1,245	1,815	3,679
April.....	2,710	11,025	2,280	4,580	4,565	5,405	1,670	1,270	2,210	900	1,400	1,420	330	4,725	3,005	2,150	3,101
May.....	2,050	1,000	290	1,240	2,215	4,010	490	625	420	700	290	365	655	1,155	1,075	1,585	1,135
Total.....	7,410	17,025	13,135	9,620	11,975	11,935	4,220	3,430	7,310	2,225	7,355	4,015	3,555	12,460	5,325	5,550	

## PARALICHTHYS DENTATUS (SUMMER FLOUNDER)

[Amounts are listed in pounds; those marked "b" were taken in part in a seine and in part in pound nets; all other amounts were taken in pound nets. The small catches during midsummer should not be interpreted to mean that this fish is scarce in the bay at that time, for it is taken in considerable numbers with hook and line. A seasonal change in habits is suggested]

	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Average
April.....	1,785	740	1,275	400	520	840	150	165	215	1,730	620	767
May.....	1,625	450	2,520	1,440	1,970	875	2,155	790	1,865	1,790	1,035	1,501
June.....	365	210	635	610	725	395	150	320	670	530	230	440
July.....	80b	75b	235b	100b	165b	60b	80	140	135	185	180	130
August.....	50b	50b	140b	75b	55b	60b	100	50	100	175	185	94
September.....	50b	135b	85b	75b	110b	45b	100	115	200	435	200	141
October.....	1,510b	3,000b	590b	1,275b	1,025b	1,390b	1,745	200	850	4,010	1,800	1,531
November.....	960	2,585	3,435	4,300	2,475	2,250	3,480	2,160	8,400	25,605	10,150	5,982
Total.....	6,425	7,245	8,915	8,275	7,045	5,915	7,960	3,940	12,435	34,460	14,400	

## MUGIL CEPHALUS AND M. OUREMA (MULLET)

[Mullet are not regularly caught in pound nets. The table, with amounts given in pounds, shows that only occasionally a school is trapped]

	1916	1917	1918	1919	1920	1921	Average
August.....	300					150	75
September.....	2,640				550	175	561
October.....	375	50	350		50	1,900	454
November.....					100		17
Total.....	3,315	50	350		750	2,225	

FISHES OF CHESAPEAKE BAY

Buchanan Brothers' fishery—Continued

SCOMBEROMORUS MACULATUS (SPANISH MACKEREL)

[Amounts given show the number of pounds of Spanish mackerel taken by a set of two pound nets from 1918 to 1922. Blank spaces do not necessarily indicate that no fish of this species were taken, for daily catches of less than 10 pounds were not listed separately]

	1918	1919	1920	1921	1922	Average
May.....					100	20
June.....	375	680	105	1,125	205	498
July.....		1,400	175	1,005		518
August.....	125	1,150		50		285
September.....		550	300	100	300	250
October.....					40	8
Total.....	500	3,780	580	2,280	645	

SARDA SARDA (BONITO)

[Amounts given show the number of pounds of bonito taken from 1916 to 1922 at the Buchanan brothers' fishery. Blank spaces do not signify that no bonito were taken, as daily catches amounting to less than 10 pounds were not listed separately]

	1916	1917	1918	1919	1920	1921	1922	Average
May.....						15		2
June.....	30	25	25	20	140	20	25	40
July.....	25	20	30	55	55	30	35	36
August.....	20	85	20	105	25	30	30	45
September.....	15	10	15	15	55	10	25	21
Total.....	90	140	90	195	275	105	115	

PEPRILUS ALEPIDOTUS (STARFISH)

[Amounts are given in pounds; those marked "b" were taken in part in a seine, but mainly in pound nets; all other amounts were taken in pound nets. The first catches of the season generally are made from about May 10 to 25, the species apparently arriving about a month later than its relative, the butterfish]

	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Average
May.....	25,225	3,965	8,815	5,800	7,635	4,940	9,670	9,645	150	4,085	7,065	7,909
June.....	35,350	18,200	15,285	14,885	11,765	21,030	16,490	5,550	9,175	16,880	12,270	16,080
July.....	9,685b	11,185b	16,275b	20,000b	2,475b	6,855b	3,465	6,490	10,250	5,990	6,380	9,014
August.....	2,565b	1,390b	265b	13,120b	645b	2,920b	815	6,990	2,100	7,790	28,100	6,063
September.....	1,640b	185b	115b	745b	790b	1,080b	2,725	5,850	7,100	19,200	5,190	4,056
October.....	125b	145b	125b	115b	35b	425b	895	1,160		210	735	401
November.....									1,100			100
Total.....	74,590	35,060	40,880	54,665	23,345	37,250	33,970	35,685	30,085	54,480	59,740	

PORONOTUS TRIACANTHUS (BUTTERFISH)

[Amounts are given in pounds; those marked "b" were taken in part in a seine, but mainly in pound nets; all other amounts were taken in pound nets. The first catches of the season usually are made during the first half of April, or about a month before its relative, the starfish, is taken]

	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Average
April.....	15,435	210	160	4,000	570	70	290	5,275	315	605	2,400	2,666
May.....	100,910	1,805	36,260	24,215	9,080	3,920	14,600	15,770	600	15,890	4,410	20,678
June.....	132,600	28,750	44,190	8,425	23,120	18,095	17,810	21,990	9,850	13,520	12,630	29,907
July.....	35,840b	36,265b	64,050b	12,405b	7,800b	19,935b	7,000	16,860	17,000	5,830	5,790	20,798
August.....	10,075b	2,240b	1,070b	8,670b	1,115b	11,295b	2,645	23,480	4,200	5,200	10,010	7,273
September.....	415b	430b	475b	475b	215b	385b	990	13,300	6,500	4,840	3,950	2,907
October.....	510b	415b	515b	175b	125b	1,690b	2,020	1,935	240	1,120	585	848
November.....	125	665	635	2,020	1,705	1,455	2,460	250	850	1,445	910	1,138
Total.....	295,910	68,780	147,355	60,385	43,730	56,845	47,815	98,860	39,555	48,450	40,685	

*Buchanan Brothers' fishery*—Continued

## TEACHNOTUS CAROLINUS (POMPANO)

[Amounts are given in pounds; those marked "a" were caught in a seine; those marked "b" were taken partly in a seine and partly in pound nets. All other amounts were taken in pound nets. The blank spaces signify that if any pompanoes were taken, the daily catches amounted to less than 10 pounds. This species is not taken in commercial quantities earlier than June.]

	1908	1909	1910	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Average
June.....		50			300				50		20		100	80	43
July.....		210b		40b	65b	25b	125b	475b	115b		390		225	55	123
August.....	460a	100a			50b	30b	165b	150b			125		50	115	108
September.....					60b	630b	35b						100		59
October.....	40a		50a		650b	1,805b	65b			50	25		35	25	196
Total.....	500	360	50	40	1,125	2,490	390	625	440	50	560	0	510	275	

## POMATOMUS SALTATRIX (BLUEFISH)

Amounts are given in pounds; those marked "a" were caught in a seine; those marked "b" were taken partly in a seine and partly in pound nets; all other amounts were taken in pound nets. The blank spaces signify either that no fish at all or that less than 10 pounds were taken on any one day.]

	1908	1909	1910	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Average
April.....		125		100			1,300			25				20	112
May.....	515	530	1,150	1,450	460	310	3,160	30	745	200	50	25	365	185	662
June.....	150	4,175	1,350	735	1,935	3,460	315	75	25	35	40	220	265	25	914
July.....	810b	1,975b	125b	910b	2,375b	2,340b	515b	50b	48b	25	180	35	100	200	690
August.....	2,490a	375a	75a	310b	680b	440b	1,635b	25b	40b	75	60	60	25	150	459
September.....	1,740a	325a	8,250a	2,430b	285b	375b	125b	20b	495b	130	150	625	50	350	1,103
October.....	740a	925a	7,850a	3,450b	1,435b	5,540b	635b	125b	400b	735	1,160	400	700	1,475	1,833
November.....		50a		135	560	3,925	175			100		50		275	283
Total.....	6,445	8,500	18,800	9,520	7,830	16,890	7,960	325	1,790	1,325	1,610	1,405	1,595	2,780	

## ORTHOPISTIS CHRYSOPTERUS (PIGFISH)

Amounts given show the number of pounds of pigfish taken from 1916 to 1922 at the Buchanan brothers' fishery. Blank spaces simply indicate that the daily catches amounted to less than 10 pounds during the periods covered.]

	1916	1917	1918	1919	1920	1921	1922	Average
April.....	50	180	75					36
May.....	2,800	1,420	2,775					969
June.....	735	630	100					268
July.....								
August.....								
September.....		408						58
October.....	55	850	50					136
Total.....	3,640	3,635	3,000					

## ARCHOSARGUS PROBATOCEPHALUS (SHEEPSHEAD)

[Amounts are listed in pounds; those marked "a" were taken in a seine; those marked "b" were taken in part in a seine and in part in pound nets; all other amounts were taken in pound nets. Blank spaces do not always signify that no sheepheads were taken, as daily catches of less than 10 pounds were not listed separately. According to the fishermen, the sheephead was an abundant fish "years ago" and was taken in large numbers. Its abundance must have diminished prior to 1908.]

	1908	1909	1910	1912	1913	1914	1915	1916	1917	1918	1919-22	Average
April.....			100									7
May.....	65	350	850	2,660	325	100			25	140		287
June.....	25	50	50	400	25	60						48
July.....												
August.....												
September.....												
October.....		150a		220b								26
November.....							25					2
Total.....	90	550	500	3,280	350	160	25		25	140		

FISHES OF CHESAPEAKE BAY

Buchanan Brothers' fishery—Continued

LEIOSTOMUS XANTHURUS (SPOT)

[Amounts are given in pounds; those marked "b" were taken in part with a seine and in part with pound nets; all other catches were made with pound nets]

	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Average
March									1,300			118
April		2,360	1,100	310	500	90		980	540	300	330	591
May	1,320	7,250	12,050	3,085	5,605	1,950	5,360	2,040	1,615	980	7,560	4,438
June	6,700	5,500	8,820	4,586	14,080	6,015	6,815	2,860	4,580	1,530	3,585	5,778
July	18,400b	39,200b	7,960b	8,820b	18,025b	10,395b	3,960	4,310	3,745	9,615	2,985	11,689
August	45,075b	42,225b	16,175b	17,150b	4,400b	11,660b	6,370	3,485	6,200	17,800	3,130	16,698
September	62,950b	96,235b	28,915b	78,575b	57,860b	12,400b	3,420	7,515	4,750	25,065	5,200	34,898
October	41,400b	30,990b	27,410b	92,325b	26,700b	7,375b	30,815	26,970	23,400	37,000	36,250	38,678
November	1,425	285	1,735	8,165	785	1,540	2,095	16,175	5,200	6,185	1,045	3,967
Total	177,870	217,045	104,165	213,015	127,965	51,415	54,855	61,825	61,320	100,615	60,085	

BAIRDIELLA CHRYSURA (SAND PERCH)

[Amounts given show number of pounds of sand perch marketed. This species is taken in large numbers, particularly in the spring and summer, but the individuals generally are too small to market]

	1918	1919	1920	1921	1922	Average
April	175	570	85	175	205	242
May	565	110	210	750	260	379
June	215	110	130	165	110	156
July	110	70	85	65	120	90
August	130	50	130	475	50	171
September	275	150	200	745	270	328
October	2,485	3,655	660	3,540	3,755	2,307
November	1,055	300	1,300	1,085	935	971
Total	4,960	5,015	3,060	7,000	5,705	

MICROPOGON UNDULATUS (CROAKER)

[Amounts are given in pounds; those marked "a" were caught with a seine; those marked "b" probably were caught partly with a seine and partly with pound nets; amounts unmarked were caught in pound nets. The first catch of croakers usually is made sometime during the last half of March, when the fish arrive in large schools, the very first catches sometimes consisting of several thousand pounds]

	1908	1909	1910	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Average
March	1,975		8,750	3,750	175		20			24,100	4,100	12,725	23,370	80,075	11,750
April	2,895	140	27,175	151,320	675	116,010	100,200	288,285	56,100	171,180	24,825	23,870	12,950	22,035	71,281
May	460		11,150	4,430	4,360	14,380	35,200	45,565	7,825	34,970	34,780	5,900	4,385	11,130	16,467
June	780	108	34,300	12,900	6,580	1,580	10,535	7,460	4,960	1,595	2,720	4,745	1,400	2,095	6,552
July	640b	390b	96,400b	12,745b	915b	6,180b	1,300b	4,645b	13,265b	170	270	2,866	1,400	450	11,800
August	510a	3,000a	510a	670b	260b	220b	1,080b	485b	5,665b	430	705	1,850	1,920	255	1,261
September	80a	570a	360a	18,430b	420b	470b	550b	210b	220b	140	400	300	3,330	3,855	2,127
October	20a	30a	80a	20b	210b	270b	1,440b	180b	220b	320	150	200	825	270	307
November	75a	55a			50b	1,180b	585b	200b	175b	485	310	350	130	535	288
Total	7,552	3,906	172,725	208,505	18,645	140,260	180,870	347,030	88,430	233,090	67,120	52,300	65,490	123,790	

## Buchanan Brothers' fishery—Continued

## MENTICIRRHUS AMERICANUS, M. SAXATALIS, AND M. LITTORALIS (KINGFISH)

[The three species of kingfish that occur in Chesapeake Bay are not separated in the market and therefore all were listed as kingfish in the records from which this table was compiled. However, *americanus* is the predominating species, and the quantities listed are chiefly of it. Amounts are given in pounds; those marked "a" were taken with a seine; those marked "b" were taken partly with a seine and partly with pound nets; all other amounts were taken in pound nets]

	1908	1909	1910	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Average
April.....	4,855	4,050	5,115	12,575	1,500	2,700	775	425	1,025	115	50	80	250	125	2,403
May.....	10,825	5,925	13,800	22,075	2,200	21,275	6,375	7,240	5,975	3,600	560	430	240	460	7,213
June.....	1,025	3,050	5,625	2,715	1,050	1,850	575	1,790	2,745	950	640	465	215	115	1,629
July.....	2,500b	2,300b	2,525b	5,075b	1,850b	5,575b	950b	780b	6,235b	210	140	80	120	150	2,019
August.....	400a	550a	1,900a	1,100b	1,325b	1,200b	1,275b	300b	1,380b	150	200	250	70	100	728
September.....	100a	175a	100a	320b	475b	400b	150b	50b	105b	70	40	50	50	50	152
October.....	450a	1,700a	200a	1,405b	1,250b	1,875b	4,350b	1,250b	1,000b	345	170	100	115	410	1,044
November.....	325a	100a	-----	375	225	1,500	1,875	70	90	135	280	400	80	240	405
Total.....	20,480	17,850	29,265	45,640	9,675	36,375	16,325	11,905	18,555	5,575	2,060	1,835	1,140	1,650	-----

## CYNOSCION REGALIS (SQUETEAGUE)

[Amounts are given in pounds; those marked "a" were taken in a seine; those marked "b" were taken partly in seines and partly in pound nets; all other amounts were taken in pound nets. The first catches in commercial quantities usually are made early in April]

	1908	1909	1910	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Average
April.....	7,775	2,800	11,785	3,440	8,450	1,175	5,250	675	360	245	175	120	1,650	1,125	3,216
May.....	37,450	5,300	23,060	18,140	7,800	10,755	17,350	14,695	19,515	12,420	7,475	3,660	6,630	8,585	13,774
June.....	5,200	7,650	45,700	12,200	28,310	13,825	5,100	27,135	30,055	20,780	6,400	4,160	2,955	2,100	15,112
July.....	14,450b	5,925b	17,560b	28,550b	27,215b	20,025b	17,950b	8,175b	25,215b	13,840	1,580	3,370	2,520	1,195	12,861
August.....	2,365a	2,365a	10,960b	4,400b	5,350b	8,000b	12,305b	4,400b	8,910	1,510	1,000	1,555	870	569	5,609
September.....	1,110a	935a	185a	5,920b	2,975b	1,950b	3,725b	5,170b	1,355b	5,130	1,000	600	1,545	1,235	2,345
October.....	100a	235a	200a	7,485b	4,400b	5,125b	3,225b	5,560b	7,375b	10,590	630	3,600	3,895	2,380	3,914
November.....	565a	265a	-----	3,500	1,925	10,725	6,975	1,795	925	4,075	6,575	6,000	5,770	5,585	3,905
Total.....	74,175	25,495	100,845	90,195	85,475	68,930	67,575	75,510	89,200	75,490	25,345	22,510	26,520	23,075	-----

## SYSTEMATIC CATALOGUE OF THE FISHES OF CHESAPEAKE BAY

## INTERPRETATION OF DESCRIPTIONS

Abbreviations used by many writers of ichthyological descriptions have been adopted. For example, the expression "head 3 to 3.5" signifies that the length of the head, measured from the tip of the upper jaw to the bony margin of the opercle (unless otherwise stated), is contained 3 to 3.5 times in the "standard length"—that is, in the distance from the end of the snout to the base of the caudal fin. Similarly, the expression "depth 2.5 to 3" signifies that the greatest depth of the body is contained 2.5 to 3 times in the standard length. Roman numerals are used for indicating spines and Arabic numerals for soft rays in giving fin-ray formulæ. For example, "D. VII-I, 15; A. III, 12" signifies that the dorsal fins are two in number, and that the first one consists of 7 spines and the second of 1 spine and 15 soft rays, and that the anal fin consists of 3 spines and 12 soft rays. If the dorsal fin had been single and had contained the same number of rays, the formula would have been written thus: D. VIII, 15. The number of scales given (unless otherwise stated) is the number of oblique rows that occur just above the lateral line from the upper angle of the gill opening to the base of the caudal. The terms used in the descriptions and keys in describing the external structure of a fish are largely indicated in the accompanying outline of the croaker.

## USE OF KEYS

The keys have not been made with the view of showing natural relationships, but they are intended purely for the purpose of ready identification, and in preparing them only the characters applicable to the fishes of Chesapeake Bay have been taken into consideration. In using the keys, first determine to which of the major groups

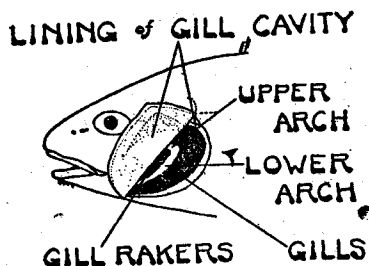
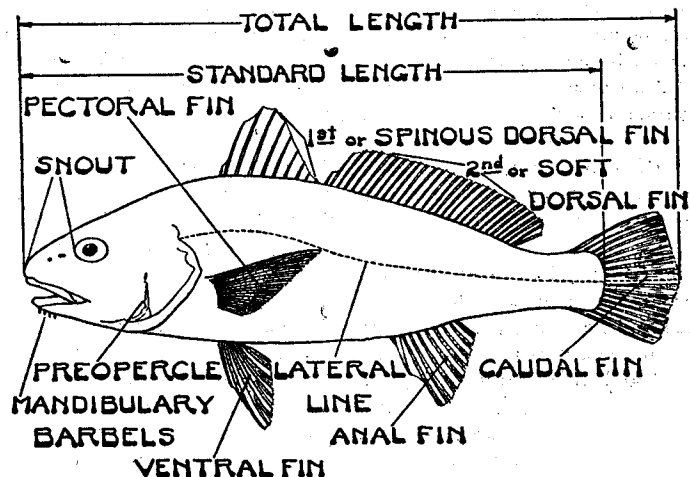


FIG. 24.—Diagram of a sciaenid, explaining terms used in keys and descriptions

the specimen in hand belongs; then take up the regular order of letters under that group. If the characters of the specimen do not agree with those under the single letters, look under the double letters (occasionally triple letters are used), ignoring all intervening matter. By means of indentations, the order of subordination of the minor groups to the major groups is shown.

## KEY TO THE FAMILIES

- I. LEPTOCARDII: AMPHIOXI (the lancelets).—Skeleton a cartilaginous rod; brain and skull wanting; body elongate, compressed, translucent; mouth a longitudinal slit, surrounded by cirri; eyes and fins rudimentary..... *Branchiostomidae* (lancelets), p. 42
- II. MARSIPOBRANCHII: HYPEROARTIA (the lampreys).—Skeleton cartilaginous; brain and skull present; body eel-shaped; head not differentiated from the body; mouth circular, suctorial; seven small, round gill openings on each side..... *Petromyzonidae* (lampreys), p. 43



III. ELASMOBRANCHII (Sharks, skates, and rays).—Skeleton cartilaginous; skull imperfectly developed; brain present; gill openings slitlike, five to seven on each side; skin with small, rough scales, spines, or tubercles, or naked; air bladder absent; jaws separable from the skull.

1. Body elongate, usually more or less rounded, not greatly depressed and not forming a disk; gill openings all or partly lateral; pectoral fins not attached to the head.

**EUSCELACHII** (the typical sharks).

- a. Body typically fishlike; one or two dorsal fins present; anal fin present.
- b. Head normally shaped, not broad and expanded across the eyes.
- c. Nictitating membrane absent; each nostril with a cirrus or barbel; two or three gill slits over base of pectoral.....*Orectolobidæ* (nurse sharks), p. 44
- cc. Nictitating membrane absent; nostrils without a cirrus or barbel; gill slits all in advance of pectorals; mouth broad, mainly transverse  
.....*Lamnidæ* (man-eater sharks), p. 45
- ccc. Nictitating membrane present, nostrils without a cirrus or barbel; last gill slit above base of pectoral; mouth narrow, crescent-shaped.....*Galeidæ* (gray sharks), p. 46
- bb. Head greatly expanded across the orbital region, more or less hammer-shaped  
.....*Sphyrinidæ* (hammerhead sharks), p. 49

**TECTOSPONDYLI** (the dogfishes and angel sharks).

- aa. Body more or less depressed; two dorsal fins present; anal fin absent.
- d. Head and body not greatly depressed; each dorsal fin preceded by a spine; pectoral fins not greatly expanded.....*Squalidæ* (dogfishes), p. 51
- dd. Head and body notably depressed and expanded; dorsal fins without spines; pectoral fins large, greatly expanded.....*Squatidæ* (angel sharks), p. 54
2. Head and body much depressed; gill openings all inferior; pectoral fins greatly expanded, attached to the head; anal fin absent.

**BATOIDEI** (skates and rays).

- a. Tail comparatively thick, bearing two dorsal fins and no caudal spine.
- b. Body elongate, depressed, but not forming a disk; snout produced into a long, thin, saw-like process, armed on each side with a series of large, strong teeth  
.....*Pristidæ* (sawfishes), p. 55
- bb. Body broad, forming with the pectorals a rhomboidal or subcircular disk; snout more or less produced, not sawlike, and never armed with teeth.
- c. Disk rhomboidal; skin usually rough, bearing spines, prickles, or tubercles; no electric organs present.....*Rajidæ* (skates), p. 56
- cc. Disk subcircular; skin smooth, unarmed; an electric organ on each side of median line on head.....*Torpedinidæ* (electric rays), p. 61
- aa. Tail usually very slender; bearing one or no dorsal fins and usually one or more strong, serrated spines.
- d. Disk subcircular or rhomboidal; pectoral fins uninterrupted confluent around the snout  
.....*Dasyatidæ* (sting rays), p. 63
- dd. Disk broad and angular; pectoral fins not confluent around the snout; head bearing one or a pair of rostral processes or cephalic fins.
- e. Head bearing one or a pair of rostral processes; teeth large, flat, largely hexagonal.
- f. Snout with a pair of rostral fins, joined together and forming a single rostral process.....*Myliobatidæ* (eagle rays), p. 68
- ff. Snout with two separate lobes, making the anterior margin of the snout concave  
.....*Rhinopteridæ* (cow-nosed rays), p. 70
- ee. Head with a pair of cephalic fins, developed as two hornlike appendages; teeth small, numerous, in pavement.....*Mobulidæ* (sea devils), p. 71

IV. PISCES (The true fishes).—Skeleton usually bony, sometimes cartilaginous; skull with a well-developed system of bones; a single gill opening on each side; skin commonly with normally developed scales, sometimes with variously shaped bony plates and occasionally naked.

1. **GANOIDEI** (ganoid fishes): Tail strongly heterocercal; arterial bulb muscular, with numerous valves.

## GLANOSTOMI (the sturgeons).

- a. Skeleton cartilaginous; snout produced, with four flexible barbels; mouth underneath; teeth wanting; skin imperfectly covered with bony plates..... *Acipenseridæ* (sturgeons), p. 72

## HOLOSTEI (the gar pikes).

- aa. Skeleton bony; both jaws greatly produced, armed with sharp teeth; no barbels; skin completely covered with rhombic plates..... *Lepisosteidæ* (gar pikes), p. 77

## 2. TELEOSTEI (nonganoid fishes): Tail homocercal or isocercal (not heterocercal); arterial bulb thin, with a pair of opposite valves.

## A. Ventral fins present, abdominal.

- a. Dorsal fin single; adipose fin present or wanting.

## b. Adipose fin wanting.

- c. Pectoral fins inserted low on side, below axis of body; lateral line, when present, normally placed; lower pharyngeal bones separate.

- d. Gill openings restricted, the membranes attached to the isthmus; jaws without teeth.

## EVENTOGNATHI (suckers, carps, and carplike minnows).

- e. Maxillaries forming sides of margin of upper jaw; lower pharyngeal bones armed with a single row of comblike teeth..... *Catostomidæ* (suckers), p. 117

- ee. Premaxillaries alone forming margin of upper jaw; lower pharyngeal bones supporting one to three series of teeth, the teeth few in number

..... *Cyprinidæ* (carps and minnows), p. 120

- dd. Gill openings not restricted, the membranes free from the isthmus; teeth in jaws present or absent.

- f. Head naked; dorsal fin more or less over the middle of the body; upper jaw not protractile; color silvery.

## ISOSPONDYLI (the clupeoid and salmonoid fishes).

- g. An external bony plate present between the arms of the lower jaw; lateral line present.

- h. Scales comparatively small; pseudobranchiæ present, large; the last ray of dorsal not produced..... *Elopidæ* (10-pounders), p. 78

- hh. Scales very large, pseudobranchiæ absent; last ray of dorsal greatly produced, filamentous..... *Megalopidæ* (tarpons), p. 79

- gg. No bony plate between the arms of the lower jaw; lateral line absent.

- i. Body oblong or elongate; mouth small to moderate, terminal or slightly superior, oblique; stomach not gizzardlike. *Clupeidæ* (herrings), p. 81

- ii. Body rather short and deep; mouth small, inferior, terminal; stomach gizzardlike..... *Dorosomidæ* (gizzard shad), p. 106

- iii. Body elongate; mouth large; snout pointed, usually projecting far beyond mandible; stomach not gizzardlike

..... *Engraulidæ* (anchovies), p. 108

- ff. Head scaly; dorsal fin commonly posterior in position; upper jaw protractile or not; color not silvery.

## HAPLOMI (the pikelike fishes).

- j. Body very elongate; snout considerably produced, depressed; mouth large; maxillaries forming sides of upper jaw; size moderate to large..... *Esocidæ* (pikes and pickerels), p. 132

## CYPRINODONTES (the killifishes and top minnows).

- jj. Body oblong or moderately elongate; snout not produced; mouth small; premaxillaries forming entire margin of upper jaw; size small.

- k. Anal fin similar to the dorsal and not modified in the male; species oviparous..... *Cyprinodontidæ* (killifishes), p. 134

- kk. Anal fin in the male modified, some of the rays produced, others short and more or less coalesced, the fin serving as an intromittent organ; species viviparous... *Pæciliidæ* (top minnows) p. 145

## SYNENTOGNATHI (the gars, halfbeaks, and flying fishes).

cc. Pectoral fins inserted rather high on sides, on or near the axis of the body; lateral line usually placed abnormally low on the sides, frequently along the edge of the abdomen; body very elongate; vertebræ numerous (45 to 70).

l. Snout not in the shape of a tube; body covered with scales.

mm. Both jaws produced, forming a beak, each jaw with a band of sharply pointed teeth; pectoral fins normal.

n. Dorsal and anal fins single, not followed by detached finlets.....*Belonidæ*, p. 147

nn. Dorsal and anal fins followed by a series of four to six detached finlets.....*Scomberesocidæ*, p. 151

mm. Upper jaw short, the lower much produced (in Chesapeake specimens); pectoral fins normal.....*Hemiramphidæ*, p. 152

mmm. Jaws normal, neither produced (in adult); pectoral fins greatly enlarged, used as organs of flight

.....*Exocetidæ*, p. 154

u. Snout greatly produced, forming a long tube, terminating in a small mouth; scales wanting; bony plates on various parts of the body; caudal fin forked, the middle ray produced into a long filament.....*Fistulariidæ* (cornet fishes), p. 186

bb. Adipose fin present.

## NEMATOGNATHI (the catfishes).

o. Body without true scales (naked in Chesapeake specimens); anterior part of head with one or more pairs of whiskers; dorsal and pectoral fins each with a strong spine.

p. Nostrils close together, neither with a barbel; ventral fins with 6 rays.....*Aridæ* (sea catfishes), p. 127

pp. Nostrils far apart, the posterior one with a barbel; ventral fins with eight or nine rays

.....*Ameiuridæ* (horned pouts), p. 129

## INTOMI (the lantern fishes).

oo. Body with cycloid scales; head without whiskers; head and snout depressed; mouth very large; premaxillaries alone forming margin of upper jaw; fins without spines; caudal forked.....*Synodontidæ* (lizard fishes), p. 130

aa. Two dorsal fins, the anterior with spines only, the posterior chiefly of soft rays; no adipose.

q. Pectoral fins entire, no free rays.

r. Head not pikelike; the jaws not produced; teeth small or wanting; lateral line obsolete.

s. First dorsal with three to nine flexible spines; anal fin with a single weak spine

.....*Atherinidæ* (silversides), p. 187

ss. First dorsal with four stiff spines; anal fin with three stiff spines (two in very young)

.....*Mugilidæ* (mulletts), p. 192

rr. Head pikelike; the jaws produced; teeth strong; lateral line present

.....*Sphyrænidæ* (barracudas), p. 197

qq. The lowermost rays of pectorals free and feelerlike or barbellike.....*Polynemidæ* (threadfins), p. 199

- AA. Ventral fins present, attached to the thorax or throat, under, anterior to, or slightly behind base of pectorals.
- a. Gill openings moderate or large, situated anterior to pectoral fins; carpal bones normally developed; the pectoral fins without a "wrist."
- b. Ventral fins always with I, 5 rays.
- c. Ventral fins separate and distinct, never united and never forming a part of a sucking disk.
- d. Suborbital without a bony stay; cheeks not mailed; pectoral fins entire, without detached rays.
- e. Anterior dorsal fin converted into a sucking apparatus, forming a disk at nape, consisting of several crosswise partitions and a single lengthwise septum  
-----*Echeneididæ* (remoras), p. 328
- ee. Anterior dorsal fin normal, not converted into a sucking disk.
- f. Dorsal and anal fins followed by a series of detached finlets; anal fin not preceded by free spines; caudal fin broadly forked  
-----*Scombridæ* (mackerels), p. 200
- ff. Dorsal and anal fins not followed by several detached finlets.
- g. Body elongate, spindle-shaped; head strongly depressed; snout broad; first dorsal with eight or nine free spines...*Rachycentridæ* (crab eaters), p. 234
- gg. Body not spindle-shaped; head never greatly depressed; snout not expanded.
- h. Anal fin preceded by two free spines (sometimes obsolete in very old, joined by membrane in very young); ventral fins present at all ages; oesophagus without teeth.
- i. Preopercle entire; caudal peduncle slender, frequently with lateral bony scutes; teeth, if present, small to moderate  
-----*Carangidæ* (crevallies, pompanos, etc.), p. 216
- ii. Preopercle serrate; caudal peduncle rather stout, never with bony scutes; teeth unequal, some of them enlarged  
-----*Pomatomidæ* (bluefishes), p. 231
- hh. Anal fin not preceded by free spines.
- j. Oesophagus provided with lateral sacs containing teeth; anal fin long, similar to dorsal; ventral fins normal in young, sometimes reduced or wanting in adults...*Stromateidæ* (butterfishes), p. 210
- jj. Oesophagus not provided with teeth.
- k. Lateral line extending to end of caudal fin; anal fin with one or two spines.
- l. Backbone typically with 10+14 vertebræ  
-----*Sciaenidæ* (croakers and drums), p. 271
- ll. Backbone typically with 14+10 vertebræ  
-----*Otolithidæ* (weakfishes), p. 296
- kk. Lateral line ending at base of caudal.
- m. Nape with a fleshy flap resembling an adipose fin; similar but smaller fleshy flaps on sides of lower jaw near angle of mouth; dorsal fin continuous...*Branchiostegidæ* (tilefishes), p. 305
- mm. No fleshy flap at nape or on lower jaw.
- n. Gills 4, a slit behind the fourth.
- o. Premaxillaries excessively protractile, their basal processes very long, entering a groove at top of cranium just underneath the skin; scales large; fin spines strong; color silvery...*Gerridæ* (mojarras), p. 369
- oo. Premaxillaries only moderately protractile, or not protractile.
- p. Anal fin with one or two spines; dorsal fins separate, with about 8 to 16 spines; form elongate; fresh-water fishes.

- q. Branchiostegals 7; preopercle serrate; air bladder present; fishes of moderate size  
 ----- *Percidæ* (perches), p. 236
- qq. Branchiostegals 6; preopercle entire; air bladder obsolete or nearly so; fishes of small size, the majority of the species not exceeding a length of 3 or 4 inches ----- *Etheostomidæ* (darters), p. 237
- pp. Anal fin with three to eight spines; dorsal fins separate or continuous; form various.
- r. Teeth more or less bristlelike, or at least slender and close-set, movable; gill membranes attached to the isthmus; soft part of vertical fins completely covered with small scales; form short and deep.
- s. Dorsal fins nearly or quite separate; teeth slender but scarcely bristlelike  
 ----- *Ephippidæ* (spade fishes), p. 306
- ss. Dorsal fin continuous; teeth numerous, very slender, bristlelike; color usually brilliant  
 ----- *Chætodontidæ* (butterfly fishes), p. 308
- rr. Teeth not bristlelike, usually firmly attached to the jaws, not movable; gill membranes free from the isthmus; form usually elongate.
- t. Pseudobranchiæ very small; anal fin with three to eight spines; dorsal fin continuous or notched, with 6 to 13 spines; form moderately short and deep to elongate, compressed; fresh-water fishes ----- *Centrarchidæ* (fresh-water basses and sunfishes), p. 238
- tt. Pseudobranchiæ well developed; anal fin definitely with three spines; form elongate, generally more or less compressed; marine fishes.
- u. Teeth on anterior part of jaws broad, incisorlike; form oblong or elongate, always notably compressed.
- v. Teeth on sides of jaws molarlike; no teeth on vomer or palatines; vertical fins not densely covered with scales; intestinal canal of moderate length  
 ----- *Sparidæ* (porgies), p. 261
- vv. Jaws without molar teeth; teeth present on vomer and palatines; vertical fins densely scaled; intestinal canal very long; species herbivorous  
 ----- *Kyphosidæ* (rudderfishes), p. 269
- uu. Teeth in jaws all pointed, not broad and incisorlike.
- w. Vomer and palatines without teeth.
- x. Body deep, strongly compressed; the back strongly elevated; preopercle with large serrations at angle; caudal fin round  
 ----- *Lobotidæ* (triple-tails), p. 255

- xx. Body elongate, only moderately compressed; the back not greatly elevated; preopercle entire or with fine serrations; caudal fin forked. *Pomadasidæ* (grunts), p. 257
- ww. Vomer and palatines with teeth.
- y. Head and body much compressed; mouth very oblique to nearly vertical; eye very large; post-orbital part of head short; scales small, very rough  
 -- *Priacanthidæ* (catalufas), p. 253
- yy. Head and body only moderately compressed; mouth moderately oblique to nearly horizontal; eye small to moderate; post-orbital part of head not shortened; scales not excessively rough.
- z. Maxillary for the most part slipping under preorbital; opercle without a spine; teeth in the jaws rather strong, unequal, some of them usually enlarged  
 -- *Lutianidæ* (snappers), p. 256
- zz. Maxillary not, or only partly, concealed by the preorbital; opercle ending in a spine.
- (a) Body elongate, compressed; maxillary without a supplemental bone; teeth pointed, fixed; two dorsal fins; scales of moderate size..... *Moronidæ* (white basses), p. 244
- (aa) Body oblong, somewhat compressed; maxillary with a supplemental bone; dorsal fin continuous; scales quite small..... *Epinephelidæ* (groupers), p. 250  
 nn. Gills  $3\frac{1}{2}$ , the slit behind the last small or wanting.
- (aaa) Body rather robust; maxillary without a supplemental bone; teeth pointed, fixed; dorsal fin continuous; scales moderate or large..... *Serranidæ* (sea basses), p. 251
- (b) Head and body more or less compressed; eyes lateral, moderately large; scales large; mouth horizontal to more or less oblique.
- (c) Teeth in the jaws large, separate..... *Labridæ* (lipped fishes), p. 317
- (cc) Teeth in the jaws coalesced, forming a continuous cutting edge  
 ..... *Scaridæ* (parrot fishes), p. 321
- (bb) Head broader than deep, partly covered with bony plates; eyes very small, on top of head; mouth vertical, surrounded by fleshy fringes  
 ..... *Uranoscopidæ* (star-gazers), p. 329
- dd. Suborbital with a bony stay; head inclosed in bony plates, bearing spines; pectoral fins long, winglike, with the three lowermost rays detached and free from each other, developed as feelers..... *Triglidæ* (sea robins), p. 312
- cc. Ventral fins close together forming a sucking disk, or separate, with a sucking disk between them of which they form a part.
- (d) Body short and thick, more or less triangular in cross section; skin with bony tubercles; suborbital stay present; opercles normally developed; gills  $3\frac{1}{2}$ ; ventral fins forming the bony center of a sucking disk  
 ..... *Cyclopteridæ* (lumpfishes), p. 311
- (dd) Body oblong or elongate, roundish or more or less compressed; body with or without scales; no suborbital stay; opercle normally developed; gills 4; ventral fins close together, forming a sucking disk..... *Gobiidæ* (gobies), p. 322

- (ddd) Body oblong, broad, and depressed anteriorly; skin naked; no suborbital stay; opercle reduced to a concealed spinelike projection; gills  $2\frac{1}{2}$  or 3; ventral fins far apart, with a sucking disk between them, of which they form a part  
-----*Gobiesocidæ* (clingfishes), p. 339
- aa. Gill openings reduced to small foramen, situated near the axils of pectorals; carpal bones greatly elongated, forming a "wrist."
- (e) Mouth large, superior, very oblique to vertical; gill openings in or near lower axil of pectoral; oblique to vertical; two dorsal fins, the first dorsal with one to three detached tentacle-like spines on the head, the first spine expanded at tip, forming a lure or bait.
- (f) Head and body very broad, depressed anteriorly; pseudobranchiæ present; mouth excessively large and broad; skin naked; head and sides with dermal flaps; size large-----*Lophiidæ* (anglers), p. 351
- (ff) Head and body compressed; pseudobranchiæ absent; mouth moderately large, not excessively broad; skin naked or with minute tubercles and dermal tentacles; size rather small-----*Antennariidæ* (frogfishes), p. 353
- (ee) Mouth small, inferior; gill opening above and somewhat behind axil of pectoral; a single short dorsal fin, consisting of soft rays only; a rostral process present; skin covered with bony tubercles and spines--*Ogcocephalidæ* (batfishes), p. 354
- bb. Ventral fins not definitely with I, 5 rays.
- (g) Form unsymmetrical, the eyes and color on one side, leaving the other side blind and colorless.
- (h) Eyes large, usually separated; mouth moderate or large; teeth generally well developed; margin of preopercle not concealed by skin and scales  
-----*Pleuronectidæ* (flounders), p. 164
- (hh) Eyes small, very close together; mouth small, twisted; teeth small or wanting; margin of preopercle concealed by skin and scales.
- (i) Body oblong or ovate; eyes and color on the right side; caudal fin free from the dorsal and anal; right ventral on ridge of abdomen and continuous with the anal fin-----*Achiridæ* (broad-soles), p. 175
- (ii) Body elongate; eyes and color on the left side; caudal fin joined to the dorsal and anal; ventral fins, if present, free from the anal  
-----*Cynoglossidæ* (tonguefishes), p. 177
- (gg) Form symmetrical, the eyes and color not confined to one side.
- (j) Tail isocercal, the vertebral column pointed behind, the last vertebrae very small; the fins all without spines.
- (k) Ventral fins inserted almost on the chin, in advance of eyes, each developed as a long forked barbel; caudal fin confluent with the dorsal and anal; body more or less eel-shaped  
-----*Ophidiidæ* (ousk eels), p. 335
- (kk) Ventral fins inserted posterior to the eyes, large or small; caudal fin separate and distinct from the dorsal and anal.
- (l) Head elongate, shaped as in the pikes, its upper surface with an excavated area; no barbels; ventral fins normally shaped, well developed; dorsal fins 2, the first one short, the second one long-----*Merlucciidæ* (hakes), p. 162
- (ll) Head not especially elongate and not shaped as in the pikes; chin with a barbel; ventral fins various, with two to seven rays; dorsal fins 1, 2, or 3, extending over most of the back  
-----*Gadidæ* (codfishes), p. 155
- (jj) Tail not isocercal, truncate at base of caudal; at least some of the fins with spines.

- (m) Head rough, bony, with spines, shields, and ridges.
- (n) Head rather high, compressed; interorbital space deeply concave; numerous fleshy cirri on head; pectoral fins moderately large, not especially produced and not divided into two sections... *Hemitripteriidae* (sea ravens), p. 309
- (nn) Head low, blunt, depressed, quadrangular, or nearly entirely covered with bony shields; interorbital not deeply concave; no fleshy cirri; pectoral fins divided into two sections, the inner one greatly produced, used as an organ of flight... *Cephalacanthidae* (flying gurnards), p. 316
- (mm) Head not especially bony, with or without a few spines, no bony shields.
- (o) Body robust, depressed anteriorly, compressed posteriorly; mouth large, broad; teeth short but very strong; scales wanting (in Chesapeake specimens); dorsal fins 2, the first with two or three low spines; ventral fins well developed, jugular, without a true spine  
----- *Batrachoididae* (toadfishes), p. 337
- (oo) Body moderately or greatly elongate, more or less compressed; mouth usually small; teeth various; skin naked or with small scales; dorsal fin single, the anterior part and sometimes the whole fin with spines; ventral fins small, jugular, composed of I, 1 to 3 rays  
----- *Blenniidae* (blennies), p. 332
- (ooo) Body elongate, somewhat compressed, tapering both anteriorly and posteriorly, the caudal peduncle being very long and slender; mouth moderate, oblique; skin naked or with vertically oblong plates on sides; middle or sides of abdomen shielded by the produced innominate bones; dorsal fin preceded by two or more free spines; ventral fins thoracic to subthoracic, with one strong spine and one or two rudimentary soft rays.----- *Gasterosteidae* (sticklebacks), p. 178
- AAA. Ventral fins absent.
- a. Body very elongate, rounded, snakelike; premaxillaries rudimentary or wanting.
- b. Body covered with rudimentary, elongate, imbedded scales, placed at right angles to each other; lower jaw projecting; origin of dorsal far behind pectorals  
----- *Anguillidae* (common eel), p. 111
- bb. Body scaleless; upper jaw projecting; origin of dorsal over or somewhat behind middle of pectorals  
----- *Congridae* (conger eels), p. 116
- aa. Body not snakelike; premaxillary bones present.
- c. Gill membranes not joined to the isthmus.
- d. Body rather deep to very deep and strongly compressed; mouth small; caudal fin deeply forked; size rather small  
----- *Stromateidae* (butterfishes), p. 210
- dd. Body very elongate, compressed, band-shaped, tapering posteriorly; head sharply pointed; mouth large, nearly terminal; teeth very large; scales wanting; dorsal fin beginning on head and extending over entire body; caudal fin wanting  
----- *Trichiuridae* (cutlass fishes), p. 208
- ddd. Body moderately elongate, not compressed; upper jaw greatly produced, forming a sword; caudal fin large and forked; size very large  
----- *Xiphiidae* (swordfishes), p. 209
- cc. Gill membranes broadly joined to the isthmus.
- e. Body inclosed in a bony armor composed of rings or polygonal plates.



- f. Snout tubular, bearing a small mouth at the tip; tail long, sometimes prehensile; body covered with bony rings  
-----*Syngnathidæ* (pipefishes and seahorses), p. 181
- ff. Snout not tubular; mouth small, terminal; tail of moderate length; body covered with boxlike shell, composed of polygonal plates  
-----*Ostraciidæ* (trunkfishes), p. 345
- ee. Body not inclosed in a bony armor; the skin naked, with scales, or beset with prickles and spines of varying sizes.
- g. Teeth fused, forming a continuous cutting edge; body not compressed, somewhat globular in form and capable of considerable inflation; dorsal fin single.
- h. Teeth in each jaw anteriorly divided by a median suture; skin smooth or more or less prickly-----*Tetraodontidæ* (puffers), p. 346
- hh. Teeth in the jaws undivided, having no median suture; body covered with strong bony spines-----*Diodontidæ* (porcupine fishes), p. 349
- gg. Teeth separate, not fused and not forming a continuous cutting edge; body rather deep, compressed; two dorsal fins.
- i. First dorsal with three spines; scales rather large, bony, bearing spines or bony tubercles-----*Balistidæ* (trigger fishes), p. 340
- ii. First dorsal consisting of a single spine; scales small, bearing slender spines, making the surface of the body rough, velvety  
-----*Monacanthidæ* (filefishes), p. 342

## Class LEPTOCARDII

### Order AMPHIOXI

#### Family I.—BRANCHIOSTOMIDÆ. The lancelets

Body elongate, compressed, tapering gradually to both extremities; mouth a longitudinal slit surrounded by a fringe of cirri; eyes and fins rudimentary; color pale, translucent. A single genus is represented in United States waters.

##### 1. Genus BRANCHIOSTOMA Costa. Lancelets

Reproductive organs present on both sides of the median line; anal fin present, with traces of rays; vertebral column not produced backward into a caudal process.

##### 1. *Branchiostoma virginicæ* Hubbs. Amphioxus; Lancelet.

*Amphioxus lanceolatus* Rice, 1873a, p. 503; Andrews, 1893, p. 238.

*Branchiostoma lanceolatum* Jordan and Evermann, 1896-1900, p. 3, Pl. I, fig. 1.

*Branchiostoma virginicæ* Hubbs, Occ. Papers, Mus. Zool., Univ. Mich., No. 105, 1922, p. 8; Sewell's Point, Va.

"The lancelet of Chesapeake Bay appears to differ from the other American species of the genus in the increased number of myotomes. In this respect it resembles the European *B. lanceolatum*, from which, in turn, it is distinguished by the more posterior position of the anus in reference to the lower lobe of the caudal, the relatively shorter distance between this fin lobe and the atriopore, and the more numerous dorsal-ray chambers. It is more closely related to *floridæ* than to *lanceolatum*. All of the lancelets from the east coast of the United States, variously referred to *lanceolatum* or *caribæum*, are perhaps conspecific with the Chesapeake form. It seems not improbable that *virginicæ* and *floridæ* will be found to intergrade.

"Dorsal-ray chambers, 259 to 309 (average of five, 279); anal-ray chambers, 36 to 40 (average of six, 38). Dorsal-ray chambers about two or three times as high as long; dorsal fin about one-eighth as high as body. Anus near middle of lower caudal lobe; origin of this lobe about midway between tip of tail and atriopore. Postanal length, 8.5 to 11.5 in total. Preatrioporal length, 2.4 to 2.7 times postatrioporal length. Myotome formula: 36 to 40+14 to 16+9 to 12=60 to 64 (in type material); 36 to 38+13 or 14+11 to 15=61 to 64 (according to Andrews, 1893). Maximum length, 5.3 cm. (Andrews, 1893.)" (Hubbs, 1922.)

This curious little animal is not represented in our collection. It was first recorded from Chesapeake Bay by Rice (1880, p. 1), who followed European authors in considering the American and European species identical. Andrews (1893, pp. 238 to 240), after examining specimens from several localities, concluded that the specimens from Chesapeake Bay belonged to the European form, *B. lanceolatum*, rather than to the more southern American form, *B. caribæum*. Hubbs (1922, p. 8) found the Chesapeake Bay specimens to represent a new species—*B. virginia*—which differs from other American species in the more numerous myotomes.

These little animals were first made known to science in 1774 from specimens found upon the coast of Cornwall, England, and described by Pallas, who considered them a species of snail and gave them the name *Limax lanceolatus*.

The lancelets live principally in the sand. The young are often taken in plankton nets, but the adults that have been captured are reported either to have been dug out of sand along the shore or taken in dredges. Rice (1880, p. 8) states that live animals kept in glass containers swam much like tadpoles but different, in that the head, or anterior part of the body, moved from side to side as far and as vigorously as the tail. They swam about either on the side or on the abdomen and sometimes on the back but never backward.

The young did not "burrow," but the adults remained hidden in the sand (which was provided on the bottom of the containers) during the day, but at night they came near to the surface or emerged wholly or in part, indicating that the day is their rest period and that they feed at night.

*Habitat*.—Chesapeake Bay.

*Chesapeake localities*.—(a) Previous record: Fort Wool, Fortress Monroe, Willoughby Sandspit, and Sewell's Point. (b) Specimens in collection: None.

## Class MARSIPOBRANCHII

### Order HYPEROARTIA

#### Family II.—PETROMYZONIDÆ. The lampreys

Body eel-shaped, more or less cylindrical anteriorly, compressed posteriorly; head not differentiated from the body; mouth nearly or quite circular, suctorial, usually armed with teeth; eyes developed, at least in the adult; gill openings small, rounded, seven on each side, arranged in a row along the chest; dorsal fin notched or divided, its posterior part commonly continuous with the caudal and anal fins around the tail; intestine with a spiral valve.

#### 2. Genus PETROMYZON Linnæus. Lampreys

Teeth present in mouth, arranged in concentric lines, pointed and rather close together, the teeth immediately anterior to mouth two or three in number; the lateral teeth bicuspid; dorsal fins 2, well separated. Of this genus, a single species is known, which lives in the sea but ascends rivers to spawn.

#### 2. *Petromyzon marinus* Linnæus. Lamprey; Lamprey eel.

*Petromyzon marinus* Linnæus, Syst. Nat., ed. X, 1758, 290; European seas. Uhler and Lugger, 1876, ed. I, p. 194, ed. II, p. 164; Bean, 1883, p. 367; Jordan and Evermann, 1896-1900, p. 10, Pl. I, fig. 3; Smith and Bean, 1899, p. 180; Fowler, 1912, p. 51.

Body eel-shaped, somewhat depressed anteriorly, compressed posteriorly; head depressed, its length to first gill opening greater than the distance from the first to the last gill opening, 6.6 in total length; eye of moderate size, 6 in head; interorbital space broad, 3 in head; mouth, or buccal disk, large, its diameter about 2 in head; teeth on each side of mouth bicuspid, a series posterior to the mouth coalesced, the other teeth simple; the origin of the first dorsal distinctly behind the middle of the body, the distance from tip of snout to origin of dorsal 1.9 in total length; the second dorsal well separated from the first, continuous with the rounded caudal, with a depression posteriorly; anal fin represented by a mere fold.

Color in alcohol plain bluish-gray above, pale below. The color in life has been described as mottled brown or black above, occasionally plain bluish, with lower parts whitish or gray.

A single specimen, 158 mm. ( $6\frac{1}{4}$  inches) in length, is at hand and it forms the basis for the foregoing description. This lamprey is readily recognized by the bicuspid teeth on the sides of the mouth and by the divided and well separated dorsal fins.

The lampreys attach themselves to larger fish by means of the suckorial mouth, sucking their blood and making ulcerous sores, often producing death. Surface (1898, p. 212), in an account of the variety *P. marinus unicolor*, records that this lamprey destroyed large numbers of catfish, suckers, carp, etc., in Cayuga Lake, New York. Shad are sometimes taken with lampreys 6 to 14 inches in length hanging on their sides. Kendall (field notes, 1894) reports a 10-inch lamprey clinging to a menhaden only 6 inches in length. Bigelow and Welsh (1925, p. 20) report lampreys preying upon cod, haddock, and mackerel in Massachusetts Bay. At one time lampreys were said to be common in the Chesapeake during the early spring and to have destroyed many shad caught with gill nets. Within recent years, however, it has not been sufficiently abundant in Chesapeake Bay to be considered destructive of other fishes.

This lamprey is anadromous and ascends fresh-water streams in the spring to spawn, coming with the shad and branch herring. The number of eggs produced is large, as many as 236,000 having been found in one individual. The young differ considerably in appearance from the adults. They are blind and toothless and their mouths and fins are different in shape. They live in this state in fresh water for about three or four years and then undergo a transformation, after which they descend to the sea. When mature they return to fresh water to spawn but once and then die.

The young have been found to subsist on minute organisms. The stomachs of adults, while usually containing only blood, have been reported by Goode (1884, p. 677) to occasionally contain large numbers of fish eggs.

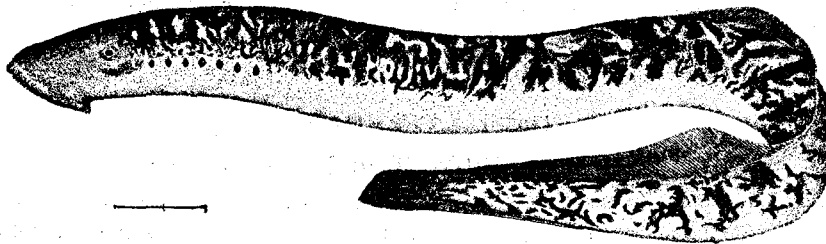


FIG. 25.—*Petromyzon marinus*

This species attains a length of 3 feet, although seldom exceeding 2½ feet. In the past, when it was more plentiful, it was used for food in parts of New England, while in Europe it has been considered a delicacy for many years. In Chesapeake Bay the lamprey is of no commercial value.

*Habitat.*—North Atlantic coasts of Europe and North America; on the American coast from Labrador south to Florida.

*Chesapeake localities.*—(a) Previous records: Potomac River and many points in the upper parts of the bay. (b) Specimens were taken during the present investigation (during April and May) at Havre de Grace, Md., and Lynnhaven Roads, Va.; also observed in the lower Patuxent River, Md., and Kendall reports (field notes, 1894) several from Hampton, Va.

## Class ELASMOBRANCHII

### Subclass SELACHII. The sharks, skates, and rays

#### Order EUSELACHII

#### Family III.—ORECTOLOBIDÆ. The nurse sharks

Body short and subcylindrical to moderately short and depressed; nostrils with a nasoral groove and with a cirrus or barbel; mouth transverse, with labial folds around angles; teeth compressed, with or without lateral cusps on each side of the median one; eyes very small, without nictitating membrane; spiracle minute and behind eye to large and more or less below it; gill slits small to medium, the posterior two or three above base of pectoral; caudal fin narrow, usually without exerted lower lobe; other fins short and broad, no fin spines; no caudal pits.

### 3. Genus GINGLYMOSTOMA Müller and Henle. Nurse sharks

Body moderately elongate, compressed posteriorly, depressed anteriorly; head broad; snout very blunt; nostrils near tip of snout, remote from each other, connected with the mouth by a groove, each anteriorly with a cylindrical barbel; mouth broad, little arched; teeth small, compressed, with a strong central cusp and one or more smaller lateral ones; several series functioning; spiracle minute and behind eye; gill slits moderate, the last two close together and above base of pectoral; dorsal fins rather close together, the first over the ventrals, the second somewhat in advance of anal.

#### 3. *Ginglymostoma cirratum* (Bonaparte). Nurse shark.

*Squalus cirratus* Bonaparte, Tableau Encyclop., Method Nat. Ichthyol., 1788, p. 7; American seas.

*Ginglymostoma cirratum* Lugger, 1877, p. 90. Jordan and Evermann, 1896-1900, p. 26, Pl. IV, fig. 13; Garman, 1913, p. 54, pl. 7, figs. 4 to 6.

Body posteriorly compressed, head and anterior part of body broad, depressed; snout short, broadly rounded; mouth much in advance of eyes, broad; teeth small, with sharp median cusp and a shorter one at each side; nostrils nearly at margin of snout and connected with mouth by a groove, each with a barbel; eye very small, the greatest diameter a little shorter than the longest gill slit in young, proportionately much shorter in adult; spiracle situated just behind eye, very small; denticles on skin below base of dorsal irregular in size, triangular, slightly imbricate, one or three keeled; origin of first dorsal over ventrals; second dorsal a little smaller; caudal long, angles rounded, lower lobe not produced; anal smaller than second dorsal, its origin under middle of second dorsal; pectoral fins nearly as broad as long. Color grayish or yellowish brown above, somewhat paler below. The upper parts either with or without round black spots.

No specimens of this shark are at hand. The above description was compiled from published accounts.

Gudger (1921, p. 58), after examining specimens of this shark taken in southern Florida, with reference to stomach contents, says: "Its food, in keeping with its tooth structure, is mainly confined to invertebrates, squid, shrimp, the so-called crawfish (*Palinurus*), short-spined sea-urchins, small fish, and probably the more thick-bodied, succulent algae. In short, the fish is more or less omnivorous."

The nurse shark, according to Gudger (1921, p. 59), is "ovoviviparous." The eggs are large, about 75 millimeters in diameter when they break through the walls of the ovary, and brownish, horny shells with blunted ends, bearing tendrils (as in some of the egg-laying sharks and rays) are later provided. These egg cases measure from 120 to 140 millimeters in length and 170 to 190 millimeters in circumference. The eggs then remain in the posterior part of the oviduct, where a "saddle-bag shaped" section is provided for them, until the young are hatched.

*Habitat*.—Tropical Atlantic and eastern Pacific; apparently not recorded from the Atlantic coast of America north of Chesapeake Bay.

*Chesapeake localities*.—(a) Previous records: "Southern part of Chesapeake Bay" (Lugger, 1877). (b) Specimens in collection: None; not seen during the present investigation.

### Family IV.—LAMNIDÆ. The mackerel sharks; the man-eater sharks

Body robust; head conical; tail slender, the peduncle depressed, with lateral folds and caudal pits; nostrils oblique, near the mouth but not confluent with it; eyes without nictitating membrane; mouth broad; teeth large; spiracles small or wanting; gill slits wide, all in front of pectorals; first dorsal large; second dorsal and anal small; caudal lunate; pectorals large, falcate.

#### 4. Genus CARCHARODON Müller and Henle. Man-eater sharks

Body very robust anteriorly; head conical; caudal peduncle strong, depressed; teeth large, compressed, serrate, triangular, the upper teeth broadest; first dorsal large, nearly midway between pectorals and ventrals; second dorsal and anal very small; pectorals large.

4. *Carcharodon carcharias* (Linnæus). Man-eater; Great white shark.

*Squalus carcharias* Linnæus, *Syst. Nat.*, ed. X, 1758, p. 235; Europe.

*Lamnidae atwoodi* Uhler and Lugger, 1876, ed. I, p. 191; ed. II, p. 161.

*Carcharodon carcharias* Jordan and Evermann, 1896-1900, p. 50; Garman, 1913, p. 32, pl. 5, figs. 5 to 9.

Body robust; head a little more than 4 in total length; depth about 5.5; snout conical, blunted at tip; eye above the front of the mouth; pupil vertical; nostrils small, far apart, nearer to the mouth than to tip of snout; spiracles minute, behind eye; mouth large, with labial folds; teeth large, triangular, serrated, in about 24 to 26 rows in each jaw; first dorsal moderate, its origin behind bases of pectorals, a little longer than high; second dorsal very small, its base entirely in advance of anal; caudal fin broad, the lower lobe produced, slightly shorter than upper; anal fin small, similar to second dorsal, its origin behind vertical from the base of that fin; ventral fins small, below middle of the interdorsal space; pectoral fins falciform, the front margin nearly twice the length of the inner margin; a well developed keel on each side of caudal peduncle; deep pit at base of caudal above and below.

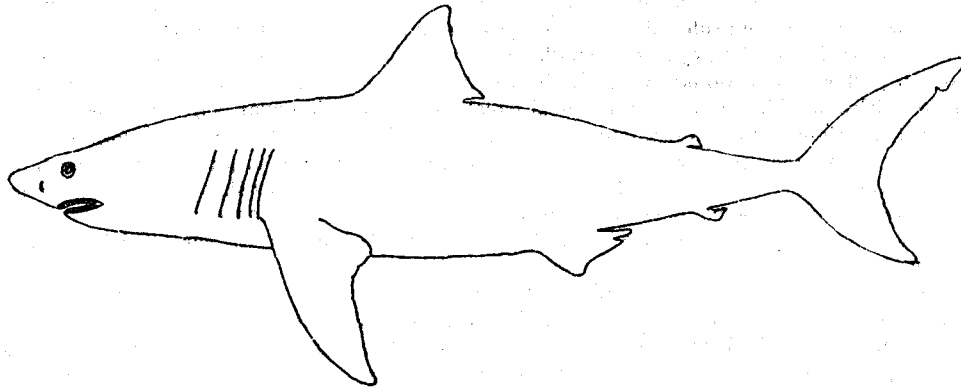


FIG. 26.—*Carcharodon carcharias*

Color grayish, shading to white below; tips and edges of pectorals black.

This is one of the most ferocious of all sharks.

Uhler and Lugger (1876) writing in 1876, stated that this shark was common in Chesapeake Bay as far as the outer harbor of Baltimore. It is uncommon anywhere, however, even in the Tropics, and seldom strays on our Atlantic coast. None were seen during the present investigation, and we know of no record for the Chesapeake since 1876. It is believed, therefore, that the shark referred to by Uhler and Lugger was another species.

The man-eater grows to a length of 40 feet. The jaws of a specimen 36 feet long are in the British Museum.

*Habitat*.—Seas of the Temperate and Torrid zones; in the western Atlantic, rarely as far north as Nova Scotia.

*Chesapeake localities*.—(a) Previous records: Reported entering Chesapeake Bay by Uhler and Lugger (1876). (b) Specimens observed on present investigation: None.

Family V.—GALEIDÆ. The gray sharks

Body elongate; head and snout depressed; eyes lateral, with a more or less perfectly developed nictitating membrane; nostrils below the snout; spiracles present or absent; mouth crescent-shaped, inferior; teeth various; last gill slit above base of pectoral; dorsal fins 2, without spines, the first in advance of ventrals; anal fin present.

KEY TO THE GENERA

- a. Teeth small, numerous, in pavement; spiracles present, small.----- *Mustelus*, p. 47  
 aa. Teeth not in pavement, compressed, more or less triangular, with a large cusp and usually with a broad base; spiracles wanting.

- c. Labial folds wanting; teeth more or less serrate..... Carcharpinus, p. 48  
 cc. Labial folds well developed, present on both jaws; teeth not serrate..... Scollodon, p. 49

### 5. Genus MUSTELUS Linck

Body and tail of about equal length, rather slender; head short, broad, depressed; snout long and flat; spiracles small, behind eyes; eyes with a nictitating membrane; mouth small, crescent-shaped; teeth small, many rowed, pavementlike; dorsal fins similar in shape, the first above the abdomen, the second above the anal; caudal fin not deep, the lower lobe feebly developed; pectoral fins large.

#### 5. *Mustelus mustelus* (Linnaeus). Smooth dogfish.

*Squalus mustelus* Linnaeus, Syst. Nat., ed. X, 1758, p. 235.

*Mustelus canis* Jordan and Evermann, 1896-1900, p. 29.

*Galeorhinus levis* Garman, 1913, p. 176.

Body long, slender; head narrow, depressed, flattened beneath, about 4 in length; snout moderate, tapering, its length greater than the width of mouth; nostrils large, placed about half as far from the mouth as from the tip of the snout; eye rather small, its length about equal to the pre-narial length of snout, the pupil elongate horizontally, a nictitating membrane present; mouth about twice as wide as long; teeth small, numerous, pavementlike, in about 10 rows, the upper ones with a short and blunt cusplike projection on the posterior margin, lower teeth similar, with less

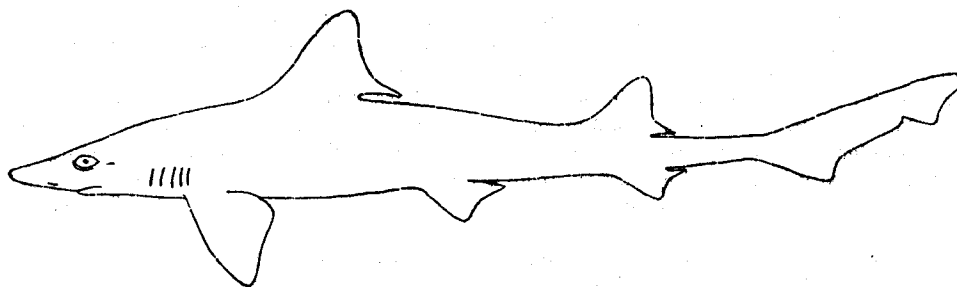


FIG. 27.—*Mustelus mustelus*

prominent cusps, no cusps on teeth near angles of mouth; the skin roughened by rather large, sharply pointed denticles, bearing two or four low keels; origin of first dorsal a little in advance of the posterior margins of the pectorals; second dorsal inserted in advance of the anal, about half as large as the first; caudal fin about 4.5 in total length, the lower lobe scarcely produced; anal fin notably smaller than the second dorsal and inserted under the middle of the base of the second dorsal; ventral fins rather small, inserted nearer the origin of the anal than the base of the anterior rays of the pectoral; pectoral fins of moderate size, about two-thirds as broad as long, the hinder margins only slightly concave.

Color usually uniform grayish, sometimes yellowish or olivaceous and with pale spots; pale underneath.

The smooth dogfish previously has not been recorded from Chesapeake Bay. The present record is offered on the authority of the following field note made by Lewis Radcliffe, at Gwynns Island, Va., May 6, 1915: "Among the fish brought in from pound nets in this locality and landed on the wharf was one smooth dogfish." The same investigator also reports having seen a specimen at Buckroe Beach, Va. The foregoing description is based upon published accounts of the species.

The food of the smooth dogfish consists mainly of the larger crustaceans. Field (1907, pp. 11-13) examined the stomachs of 388 fish caught around Woods Hole, Mass., and found the principal foods to be lobsters, rock crabs, lady crabs, spider crabs, hermit crabs, menhaden, squid, razor clams, and Nereis. Besides menhaden, various species of small fish are eaten indiscriminately.

"The eggs of this dogfish are fertilized internally, and the young are about 1 foot long when born. From 4 to 12 fish are produced at one time." (Smith, 1907, p. 33.) A female examined by Linton at Woods Hole, Mass., contained eight young, each 12½ inches long and ready to be born.

The smooth dogfish is particularly abundant along the coasts of New Jersey and Long Island, extending to Woods Hole, Mass.

The average length of this shark is 2 to 3 feet, but fish as long as 5 feet have been reported.

*Habitat*.—Cape Cod to Cuba, rarely straying to the Bay of Fundy; southern Europe.

*Chesapeake localities*.—(a) Previous records: None. (b) Specimens in present collection: None. This record is based upon a specimen observed at Gwynns Island, Va., May 6, 1915, and another at Buckroe Beach, Va., early in May, 1915, by Lewis Radcliffe.

#### 6. Genus *CARCHARHINUS* Blainville

Body rather robust; head broad, depressed; snout produced; nostrils and mouth inferior; teeth compressed, more or less triangular, with large cusp and usually a broad base; eyes small, with a well developed nictitating membrane; spiracles wanting; first dorsal large, placed not far behind the pectorals; second dorsal small, wholly or partly above the anal; distinct pits at base of each caudal lobe. The embryos are attached to the uterus by a placenta.

#### 6. *Carcharhinus milberti* (Müller and Henle). Milbert's shark.<sup>2</sup>

*Carcharias* (*Prionodon*) *milberti* Müller and Henle, *Plagiostomen*, 1838, p. 38, Pl. XIX, fig. 3 (teeth); New York.

*Carcharhinus milberti* Jordan and Evermann, 1896-1900, p. 37; Smith and Bean, 1899, p. 180.

Body stout; head broad, strongly depressed; snout rather broadly rounded, its preoral part about 1.1 in its length to eye; mouth wide, its width equal to preoral length of snout; eye lateral, small, 4.1 to 5.1 in snout; nictitating membrane evident; interorbital space somewhat greater than length of snout; teeth in upper jaw triangular, the edges serrate, about 29 in outer series, teeth in lower jaw narrow, erect, with finely serrate edges, about 26 in outer series; longest gill slit 3.1 to 3.3 in snout; dermal denticles not overlapping, with three distinct keels; first dorsal with concave outer margin, inserted behind origin of pectorals, its base 2 to 2.15 in distance between dorsals; second dorsal small, its base 5.1 to 5.6 in distance between dorsals; upper lobe of caudal long, 4 to 4.15 in total length; anal opposite the second dorsal and only slightly larger, its outer margin deeply concave; ventral fins inserted at vertical from a point equidistant from the end of the base of the first dorsal and the origin of the second dorsal; pectoral fins longer than broad, 5.9 to 6.4 in total length.

Color in life, taken from two specimens—a male, 635 millimeters (25 inches), and a female, 620 millimeters (24 $\frac{3}{8}$  inches)—bluish gray above, white below; highest part of both dorsals and upper extremity of caudal slightly dusky; tip of pectoral of one fish slightly dusky underneath.

This shark is represented in the collection by six specimens—five females and one male—ranging from 450 to 648 millimeters (17 $\frac{3}{4}$  to 25 $\frac{1}{2}$  inches) in length. Although rather rare in Chesapeake Bay, it is perhaps more common than any other shark except the spiny dogfish. The only fish taken during the collecting of 1921 were caught off Janes Island, Crisfield, Md., where, on September 16, the catch was two, fishing one and one-half hours; on September 18 the catch was five, fishing six hours with hook and line at depths of 50 to 90 feet. During 1922 five sharks of this species were caught at Ocean View, Va., with seines, on October 6, 10, 17, and 18.

Like most sharks, this species feeds chiefly on fish. The stomachs of two specimens examined contained fragments of fish bones, and another had eaten one pinfish (*Lagodon rhomboides*).

The young on the coast of Long Island are born during June and July, from 8 to 14 at one time, and about equally, males and females (Nichols and Murphy, 1916, p. 16).

This is one of the medium-sized sharks, attaining a maximum length of about 8 feet. A fish 18 inches in length weighed 1 $\frac{1}{4}$  pounds; 24 $\frac{3}{8}$  inches, 3 $\frac{3}{8}$  pounds; 25 inches, 3 $\frac{1}{2}$  pounds.

*Habitat*.—Middle Atlantic and middle eastern Pacific (Garman, 1913, p. 133); northward on the Atlantic coast of America to Woods Hole, Mass.

*Chesapeake localities*.—(a) Previous records: Fort Washington and Glymont, Md. (b) Specimens in collection or observed in the field: Crisfield, Md., September, 1921; Ocean View, Va., October, 1922.

<sup>2</sup> This shark is also known as the blue shark, but we discard this name in order to avoid confusion with *Galeus glaucus*, a shark of wide distribution and which for many years has been known to fishermen and whalers as the "blue shark."

7. Genus *SCOLIODON* Müller and Henle

This genus differs from *Carcharhinus* in the presence of labial folds, which extend some distance along the jaws from the angles of the mouth, and the teeth, which are never serrate.

7. *Scoliodon terræ-novæ* (Richardson). Sharp-nosed shark.

*Squalus terræ-novæ* Richardson, Fauna Bor. Amer. III, 1836, p. 289; "Newfoundland," where the species does not occur.  
*Scoliodon terræ-novæ* Bean, 1891, p. 94; Jordan and Evermann, 1896-1900, p. 43; Garman, 1913, p. 115, pl. 2, figs. 1 to 4.

Body moderately robust; head rather broad; snout rather short, broadly rounded, preoral portion 1 to 1.05 in length to eye, its width at nostrils 1.05 in preoral length and 1.1 in length to eye; eye rather small, its diameter somewhat greater than width of nostril; interorbital area convex, 1.05 to 1.15 in snout; nostrils obliquely placed, the outer angles being notably in advance of the inner ones, the inner angles about two-thirds as far from the mouth as from tip of snout, narial valve with a sharply pointed lobe; distance from nostril to eye 3.1 to 3.2 in snout; internarial space two times diameter of eye; mouth rather strongly arched, its width at angles 1.2 to 1.25 in preoral part of snout; labial folds short, the upper one notably less than one-third the length of the jaw, about two-thirds the length of eye, 3.8 to 4.15 in preoral part of snout and 2.3 to 2.8 in internarial, the lower fold shorter, 6.35 to 6.75 in preoral part of snout; teeth not serrate, with broad bases and rather narrow cusps, the anterior ones erect, those of the sides directed inward and backward; gill slits rather narrow, the longest about 2.5 in internarial, 1.1 to 1.15 in distance from eye to outer angle of nostril; first dorsal rather large, its outer margin concave, the lower lobe pointed, its origin about two times diameter of eye behind vertical from axil of pectoral, its base 2.4 in distance between dorsal fins; second dorsal moderate, its origin over or a little behind middle of base of anal, its base 6.05 to 7.4 in distance between the dorsal fins; upper lobe of caudal very long, pointed, 3.85 in total length, the lower lobe broad, 6.4 to 6.75 in the upper lobe; anal fin with concave margin, its base 1.85 to 1.95 in distance from anal to base of caudal; ventral fins small, inserted equidistant from axil of pectoral and posterior margin of base of anal, the claspers about two-thirds the length of the fins in specimens 360 millimeters in length; pectoral fins moderate, the posterior margin little concave, reaching about opposite middle of base of dorsal.

Color bluish gray above; pale below.

This shark was not seen during the present investigation. It may be distinguished from the other sharks of this family known from Chesapeake Bay by the presence of folds in the lips, which extend forward from the angles of mouth, and by the smooth teeth.

The food of this shark is rather varied, consisting, however, largely of fish and crustaceans. The young, according to Smith (1907, p. 34), are born during the summer. The usual length attained is about 3 feet. This small shark, which is common on the South Atlantic coast, probably rarely enters Chesapeake Bay.

Range.—Cape Cod, Mass., to Brazil.

Chesapeake localities.—(a) Previous record: Cape Charles, Va. (b) Specimens in the collection: None.

## Family VI.—SPHYRINIDÆ. The hammerhead sharks

This family resembles the species of the genus *Carcharhinus*, differing in the peculiar modification of the head, which is greatly depressed and broadly expanded, hammer-shaped. The eyes are far apart, being situated on the lateral margins of the expanded head; nictitating membrane present; no spiracles; nostrils remote from each other and distinct from the mouth; labial folds rudimentary; teeth compressed; first dorsal fin large, in advance of ventrals; second dorsal and the anal small, opposite; lower lobe of caudal prominent. A single genus is known.

8. Genus *SPHYRNA* Rafinesque

Body elongate, compressed; head much depressed, with a broad expansion on each side, more or less hammer-shaped; eyes far apart, placed on lateral edges of the broadly expanded head; nictitating membrane present; no spiracles; mouth inferior, strongly arched; labial folds rudimentary; teeth compressed, more or less triangular, with broadly expanded bases and a notch



on posterior edge; first dorsal behind the origin of the pectorals and in advance of the ventrals; second dorsal over the anal; caudal pits present; lower lobe of caudal produced, upper lobe long.

## KEY TO THE SPECIES

- a. Head very broad, its greatest width about 3 in total length; anterior outline of head irregular, a deep concavity over each nostril.....*zygæna*, p. 50  
 aa. Head less broadly expanded, its width about 5 in the total length; anterior outline of head regularly convex, no concavity over nostrils.....*tiburo*, p. 51

8. *Sphyrna zygæna* (Linnaeus). Hammerhead shark.

*Squalus zygæna* Linnaeus, Syst. Nat., ed. X, 1758, p. 234; America.

*Sphyrna zygæna* Lugger, 1877, p. 88; Jordan and Evermann, 1896-1900, p. 45.

*Cestracion zygæna* Garman, 1913, p. 157, pl. 1, figs. 1 to 3.

Body elongate, compressed; head very broad, hammer-shaped, the front margin broadly and irregularly convex, with a deep concavity at each nostril; width of head at eyes from 3 to 3.25 in total length; nostril close to eye, with a long groove on margin of snout; mouth moderate, its width a little shorter than preoral length of snout; teeth similar in both jaws, oblique, cusps triangular, the lateral ones with a notch at base posteriorly; first dorsal high, its height greater than the length of its base, the outer margin concave, its origin a little behind axil of pectoral; second dorsal small, its posterior angle notably produced; upper lobe of caudal long, the lower lobe also produced, its length about 2.75 in the upper lobe; anal fin a little longer than the second dorsal, the outer margin deeply concave, its origin a little in advance of the second dorsal; ventral

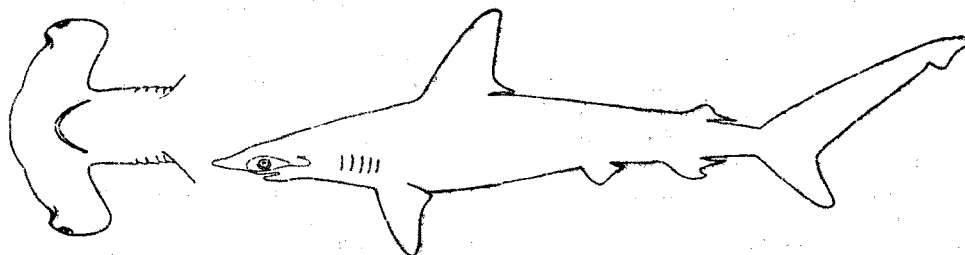


FIG. 28.—*Sphyrna zygæna*

fins small, inserted slightly more than half as far from origin of anal as from base of pectoral; pectoral fins moderate, scarcely reaching to base of first dorsal, the lower angle not produced and the posterior margin of fin slightly concave.

Color of fresh specimen lead gray above, lower parts grayish white; tips of pectorals black; the tips of the other fins dark.

No specimens of this shark were preserved. The description herewith was compiled from published accounts.

Lugger (1877, p. 89) states that the hammerhead shark was so very common in the mouth of Miles River, Md., during the summer of 1876 that the fishermen were forced to abandon that ground. The species is not reported by other observers. During the present investigation only three individuals were seen. A hammerhead was taken on July 15 and another one on July 17, 1916, in pound nets in Lynnhaven Roads, and in the same locality a 2-foot specimen was caught with hook and line on June 26, 1921.

The food of this shark, according to stomach examinations made by investigators at Beaufort, N. C., consists of fish and crustaceans. Gudger (1907, pp. 1005-1006) took an almost perfect skeleton and many fragments of skeletons of the sting ray (*Dasybatus say*) from the stomach of a specimen of this shark, and he found imbedded in various parts of the shark numerous spines of the sting ray. In all, 50 spines were extracted, mainly from the mouth parts, and, according to this author, all that were present quite certainly were not recovered. This particular shark was harpooned while it was in pursuit of a sting ray and the evidence would suggest that this sting ray may form a considerable part of the food of this species of shark.