

Aspects of the Amberjack Fisheries

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RESUMEN

La pesca comercial y deportiva del "amberjack" en el área del Atlántico central occidental se encuentra generalmente localizada y estrechamente ligada a otras pesquerías. La pesca emplea generalmente adultos grandes de cuatro especies del género *Seriola*. El principal apero es cordel y anzuelo, cojidos en, o cerca de, los fondos, pero también en la superficie. Colectiva y potencialmente, la pesquería del "amberjack" representa un recurso que es 1) probablemente subesplotado; 2) empleado indebidamente; y 3) muy mal documentado.

Las cuatro especies se diferencian para su reconocimiento y propósitos estadísticos. Los datos estadísticos limitados y disponibles de su pesca se exponen, y la captura actual es estimada. Los datos biológicos limitados que pudieran ser empleados para su administración son enunciados. Algunas tendencias recientes y métodos para incrementar su utilización y valor son expuestos.

The amberjack fisheries of the western central Atlantic area, both commercial and recreation, are mainly adjunct to or secondary to fisheries for other species. They can extend over most of the inner continental shelf of the western central Atlantic and throughout the West Indies. The catch is usually of large fish, most frequently caught on hook and line, one at a time, and weighs about 4.5 to 45 kg each (10 to 100 lb). The meat yield, about 35 to 50%, is a good quality food.

This report addresses the following major aspects and problems of the amberjack fisheries: Total catch apparently has been increasing in recent years; but to date efforts to record the catch are minimal, and comprehensive catch records do not exist. The use of the catch, as food, has recently been enhanced in a few areas; but much is wasted or underutilized in many areas.

Because of the apparent increasing catches and ready availability of the amberjacks, this report projects the following concern: that the amberjack stocks might be overfished, before catch records and management-related biological data are available to define the current status of the stocks or to predict their fate.

METHODS AND DEFINITIONS

FL—for length, measured in a straight line (parallel to the longitudinal body axis) from the tip of the upper jaw to the middle of the fork of the caudal fin.

RD—round weight, the total uncut weight of the fish.

Lengths of the dorsal and anal fin bases—measured in a straight line from the anterior base of the first ray to the posterior base of the last ray of the fin, excluding the anterior dorsal or anal fin spines.

Length of the second dorsal fin lobe—measured in a straight line from the anterior base of the 2nd dorsal fin to the tip of the lobe.

Upper jaw shape—end of the jaw formed ventrally by the maxilla and dorsally by the shorter supramaxilla; in two species the supramaxilla is expanded dorsally to produce a rounded shape.

Vomer shape—the vomer is on the anteriomedian palate (roof of mouth), covered with granular teeth, and formed of an anterior, expanded head and a posterior shaft.

Gillrakers—counted on the lateral side of the first arch (either right or left side of the head); gillrakers on the anterior ends of the upper and lower limbs of the first gill arch tend to become smaller and may disappear with growth of the fish; only anterior gillrakers that are as long as they are wide are included in the counts.

IDENTIFICATION OF THE SPECIES OF AMBERJACKS

Four species of amberjacks occur in the western central Atlantic (Figs. 1-4):

Greater amberjack, *Seriola dumerili* (Risso, 1810).

Lesser amberjack, *Seriola fasciata* (Bloch, 1793).

Almaco jack, *Seriola rivoliana* (Cuvier, 1833).

Banded rudderfish, *Seriola zonata* (Mitchill, 1815).

Correct species identification is obviously important, because all four species can be included in commercial and recreational catches, probably in all fishing areas. Most prior fishery statistics and other sources of amberjack catch records have either grouped the four species together as “amberjacks” or “*Seriola* spp.” or have failed to distinguish the other three species from greater amberjack. Because the individual and comparative characters of the amberjack species have been so superficially studied and published, the simplified characters presented here to identify the four western central Atlantic species have not previously been available.

Amberjacks larger than about 30 cm (11.8 in) FL and 0.77 kg (1.7 lb) RD can be identified and separated by the following characters (Table 1):

Banded rudderfish—short anal fin base; short 2nd dorsal fin lobe; end of upper jaw moderate; chevron head and long shaft on vomer; 12-16 gillrakers.

Almaco jack—long anal fin base; long 2nd dorsal fin base; end of upper jaw broad and rounded above; elliptic head and short shaft on vomer; 21-29 gillrakers.

Greater amberjack—long anal fin base; short 2nd dorsal fin lobe; end of upper jaw broad and rounded above; elliptic head and long shaft on vomer; 11-19 gillrakers.

Lesser amberjack—intermediate length anal fin base; short 2nd dorsal fin lobe; end of upper jaw narrow; hastate head and long shaft on vomer; 23-26 gillrakers.



Figure 1. The four species of amberjacks in the western central Atlantic area. Top to bottom: Almaco jack, 62.4 cm FL, 3.99 kg RD. Banded rudderfish, 62.0 cm FL, 3.36 kg RD. Greater amberjack, 57.7 cm FL, 2.85 kg RD. Lesser amberjack, 50.7 cm FL, 2.16 kg RD.

STATISTICS OF AMBERJACK LANDINGS

No comprehensive statistics for amberjack landings—commercial or recreational—exist for the western central Atlantic. It is our presumption, based on limited data and experience, that relatively large quantities of amberjack are caught and landed annually within the area, and that only a small fraction of these landings are recorded. Inspection of the presumptively most comprehensive statistical record for the area confirms this. The amberjack landings for 1964-1975 listed by the FAO Yearbook of Fishery

Table 1. Characters for field identification of western central Atlantic amberjacks larger than 30cm (11.8 in) FL and 0.77 cm (1.7 lb) RD

	Length of Anal Fin Base	Length of 2nd Dorsal Fin Lobe	Shape of End of Upper Jaw	Shape of Vomer	Range of Number of Gillrakers
Banded Rudderfish <i>Seriola zonata</i>	SHORT, only 1/2 as long as 2nd dorsal fin base	Short, about as long as pectoral fin (12-14% FL)	Intermediate	CHEVRON head, long shaft	12-16 (upper 2-4, lower 10-12)
Almaco Jack <i>Seriola rivoliana</i>	Long, about 2/3 as long as 2nd dorsal fin base	LONG, about 1.3-1.6 times longer than pectoral fin (18-22% FL)	BROAD, rounded above	Elliptic head, SHORT shaft	21-29 (upper 6-10, lower 15-20)
Greater Amberjack <i>Seriola dumerilii</i>	Long, about 2/3 as long as 2nd dorsal fin base	Short, about as long as pectoral fin (13-14% FL)	BROAD, ROUNDED ABOVE	Elliptic head, long shaft	11-19 (upper 2-7, lower 9-12)
Lesser Amberjack <i>Seriola fasciata</i>	Moderate, about 1/2 to 2/3 as long as 2nd dorsal fin base	Short, about 10-15% shorter than pectoral fin (11-12% FL)	NARROW	HASTATE head, long shaft	23-26 (upper 6-8, lower 17-18)



Figure 2. Heads of the four species from Fig. 1, showing differences between species in shape of the posterior part of the upper jaw: Top left, almaco jack. Top right, banded rudderfish. Bottom left, lesser amberjack. Bottom right, greater amberjack.

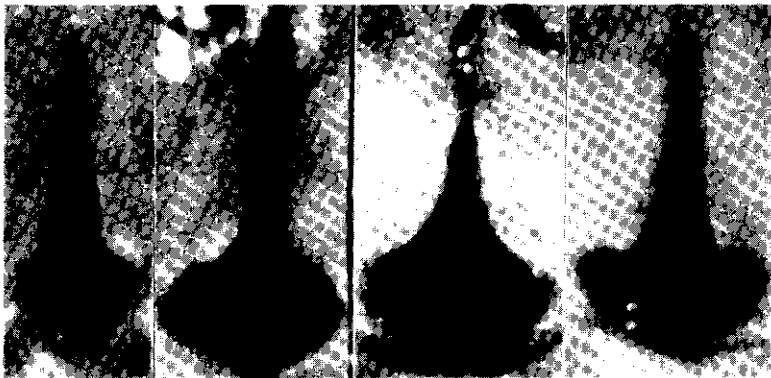


Figure 3. Vomerine tooth patches of the four species of amberjacks in the western central Atlantic area, showing differences among species in shape of the vomer. Left to Right: lesser amberjack (including the palatine tooth patch on one side), greater amberjack, almaco jack, and banded rudderfish.

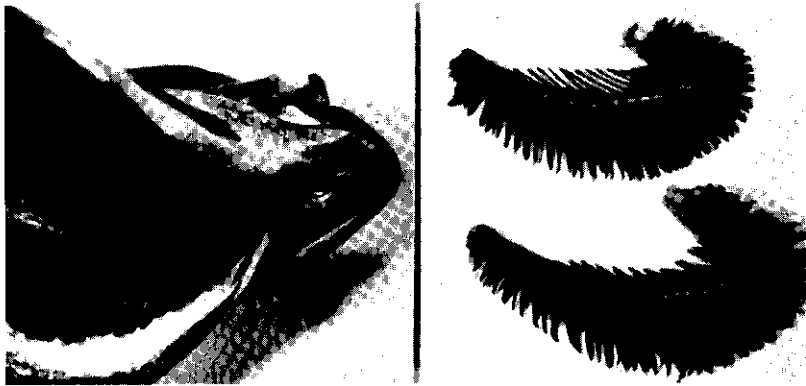


Figure 4. Amberjack gill arches and gillrakers: A: Operculum raised showing lateral side of first gill arch. B: Top, first gill arch of lesser amberjack with 25 gillrakers (7 + 18). Bottom, greater amberjack with 14 gillrakers (3 + 11).

Statistics are obviously based on incomplete estimates. While listing a total of 8,193 metric tons landed for this 12-year period (364 tons for 1975, the latest year currently available), only four countries in the area are listed (Dominican Republic, Mexico, USA, and Venezuela), the USA records are incorrect, and other inadequacies exist. We suspect that for 1975 the amberjack landings in the United States were $2\frac{1}{2}$ times that shown for the entire area by the FAO record, and that the total for the entire western central Atlantic area might have been 10 or more times greater than that recorded during 1975.

Amberjack landing statistics and catch records exist for localized portions of the area for various periods, such as that for madregal (*Seriola* spp.) landings at Veracruz, Mexico, for 1955-1974 (Castro-Aguirre, 1977: 167). In the remainder of this report, we deal only with amberjack landing reports and projections from the United States. We provide the first comprehensive estimate of amberjack landings in the U.S. for a single year.

Commercial Amberjack Landings in the United States

Landings reported for the United States in Current Fishery Statistics by the National Marine Fisheries Service are the most comprehensive and long-term records that we know to exist for amberjack fisheries. These records are presented here by year from 1950 through 1977 and for January-June 1978. Although in the past they have been reported to be only for the greater amberjack, they undoubtedly also included some quantities of the other three amberjack species. These are commercial landing records that were recorded by commercial fish dealers; a small percentage of these records might include catches made by recreational fishing that were sold to dealers; probably most of the records are from strictly commercial fishing vessels. These records comprise catch landings from the state of Florida, with the exception of the following small amounts from other states as follows: Georgia: 1960, 453.6 kg (1,000 lb); 1968, 136.1 kg (300). Alabama: 1952, 226.8 kg (500 lb); 1953, 45.4 kg (100 lb); 1955, 226.8 kg (500 lb); 1959, 453.6 kg (1,000 lb); 1968, 136.1 kg

(300 lb). Texas: 1952, 349.3 (770 lb); 1954, 90.7 kg (200 lb). The total weight recorded for these states during the 28-year period is 2,118.3 kg (4,670 lb), comprising only 0.27% of the total weight recorded for the U.S. during this period.

Commercial landings in Florida: While the Current Fisheries Statistics amberjack landing records for Florida only represent part of the annual landings of amberjacks for the state of Florida, they are historically important in providing the best tangible data base for future back-calculation of historical trends of the fishery. These records for Florida are summarized in Table 2.

Table 2. Florida commercial amberjack landings recorded yearly by Current Fishery Statistics, 1950 through 1977, by total catch (kg and lb), percentage of total by east coast or west coast, and percentage caught by gear type (*, not available)

Year	Total Catch (kg)	Total Catch (lbs)	East Coast %	West Coast %	Hand Line %	Troll Line %	Other Gear %
1950	19,323	42,600	68.6		*	*	*
1951	22,453	49,500	52.1		31.7	68.3	-
1952	37,286	82,200	54.3		59.6	40.4	-
1953	35,653	78,600		55.0	57.9	42.1	-
1954	49,125	108,300		78.3	50.9	20.1	29.0
1955	8,573	18,900	50.3		69.3	26.5	4.2
1956	3,447	7,600		81.6	72.4	14.5	13.1
1957	32,977	72,700		78.9	80.2	11.3	8.5
1958	24,857	54,800		60.8	90.0	10.0	-
1959	27,942	61,600	79.7		78.4	21.6	-
1960	22,589	49,800	67.1		92.6	7.4	-
1961	5,489	12,100		57.0	90.9	9.1	-
1962	7,122	15,700		61.2	91.1	3.8	5.1
1963	9,027	19,900		70.9	99.0	-	1.0
1964	7,802	17,200		57.0	43.0	-	57.0
1965	7,575	16,700	50.3		100.0	-	-
1966	13,608	30,000	69.7		99.0	1.0	-
1967	25,356	55,900	60.1		100.0	-	-
1968	17,781	39,200	65.3		93.1	6.9	-
1969	43,319	95,500		84.1	100.1	-	-
1970	26,536	58,500	66.2		99.1	-	0.9
1971	30,255	66,700		67.2	100.0	-	-
1972	25,356	55,900		79.6	76.6	-	23.4
1973	34,065	75,100		51.3	89.5	0.7	9.8
1974	42,003	92,600		62.1	96.8	0.5	2.7
1975	65,681	144,800		62.8	*	*	*
1976	73,302	161,600		59.1	*	*	*
1977	72,485	159,800		64.7	*	*	*

Florida landings by year: The 28-year recorded landing total is 790,987.7 kg (1,743,800 lb). After an early high recorded landing in 1954 and the lowest recorded landing in 1956, the annual landings began to increase in 1966. The record landings of the 3-year period 1975-1977 (211,468.3 kg, 46,200 lb) nearly equal the total for the previous 7 years. The record year of 1976 registered a total landing of 73,302 kg. (161,600 lb). This was followed in 1977 by the second highest year, with a decrease of 1.1%. Reports for the first 6 months of 1978 show a total landing of 45,030 kg (99,272 lb); if the catch for the second half of 1978 follows trends of recent years, the total 1978 landing will be between 61,094 and 69,684 kg (134,686 and 153,625 lb); this will be a decrease of 3.9 to 15.7% from 1977.

Florida landings by area: The recorded landings by area of east coast (Nassau to Dade counties) and west coast (Monroe to Escambia counties) has alternated from an east coast high of 79.7% in 1959 to a west coast high of 84.1% in 1969. The west coast catch has predominated for the most recent 7 years. For the 3-year period 1974-1976 on the west coast, Bay County (Panama City) accounted for 31.6% of the total period catch, Okaloosa County (Destin) for 30.0%, and Pinellas County 13.2%. For the same period on the east coast, St. Lucie County (Ft. Pierce) landed 54.7% of the total recorded and Brevard County 22.8%; Dade County recorded only 0.5% for this period.

Florida landings by gear: The catch by gear has consistently been primarily by hand line (rod and reel, hydraulic reels, and electric reels in recent years). Catch by troll line was important in the early 1950s. Other gear reported includes run around gill net, common haul seine, drift gill net, and shrimp trawls.

Florida landings by month: Based on records for the 5-year period 1972-1976, the average monthly amberjack landings by percent of the total annual landings ranged from 4.4% in October to 13.0% in May. The 3-month period of March-May totals 46.5% of the average annual landings, and the 5-month period of March-July comprises 65.5% of the annual average. Based on analysis by quarter for averages of this 5-year period, slight differences occur in landing between the east and west coasts of Florida:

East coast	25.5%	32.2%	21.5%	20.8%
West coast	22.5%	34.8%	25.1%	17.6%
Both coasts	24.0%	33.5%	23.3%	19.2%.

Ex vessel price in Florida commerical landings: For the 5-year period 1972-1976, the ex vessel price has tended to increase slightly as follows (in round weight price per pound): 1972, \$.054; 1973, .080; 1974, .088; 1975, .125; and 1976, .107. Preliminary records for the first half of 1978 show an increase to \$.141 per pound. The average annual price on the east coast has ranged \$.01 to \$.035 higher than on the west coast during the 1972-1976 period.

Recreational Amberjack Landings in the United States

Recreation fishing for amberjacks in the U.S. has existed for decades. Recreational catches of amberjacks, from New York to Texas, were mainly

adjunct to fishing for other, more popular or preferred, species. In recent years, the fishing for, the catches of, and the landings of amberjacks have undoubtedly increased appreciably. Because of the amberjack's relatively ready availability and aggressive behavior when hooked, many sport fishermen have recently fished for amberjacks, either when other species were not available, or as a primary recreational fish.

Charter vessels land the majority of amberjack catches in many areas. Private vessels, usually 20 ft and longer, account for an appreciable number in some areas. Party vessels usually take fewer than the other two vessel types.

The distinction between recreational and commercial fishing for amberjacks has degenerated in recent years (as it has for some other species). As the food use of amberjacks has increased (see below), recreational fishermen and operators of recreational rental vessels have been selling part or all of their amberjack catches to commercial dealers or to the public.

No comprehensive records of these landings have been published or maintained. However, some fishery or other agencies have been collecting recreational fishery statistics for some elements of the marine recreational fishery in some states. We have utilized some of these statistics in the section below.

Total Amberjack Landings in the United States

We estimated the total amberjack landings during 1977 in the U.S. from North Carolina to Texas, by both recreational and commercial fishing. These estimates were made by direct, recent contacts with many individuals throughout this area. In some areas the estimates were based on programmed collection of landing data from various fisheries in those areas. In others, they merely reconstructed estimates of the landings, based on interviews with dealers, fishermen, and fishery biologists. These estimates, in numbers and weights of amberjacks landed, are given in Table 3. The estimates of numbers are more realistic than are those for weights.

The total of the amberjack landings in the southeastern U.S. for 1977 is estimated at 104,360 fish and 1,393.5 metric tons (3,072,000 lb). The total weight we estimate is 19.2 times that recorded for U.S. commercial amberjack landings for 1977 in Current Fishery Statistics (Table 2), and, conversely the commercial record is 5.2% of the estimated total landing.

This is the first time, of which we are aware, that significant effort has been made to estimate the total annual amberjack landings for the U.S. or any other major fishing area. The effort was made because we suspected that these landings were appreciable and were greater than fishermen, fishery biologists, or fishery managers had reason to suspect. No confidence limits can be applied to the estimated numbers of amberjacks recorded in Table 3. Because we attempted to produce conservative estimates of numbers and weights, we further estimate that the real number landed might be 80% greater or 15% less than our presented estimate.

Total Amberjack Landings in Florida

The estimated amberjack landings in Florida during 1977 accounted for 68% by number and 73.4% by weight of the totals estimated for the entire U.S.

Table 3. Estimated total U.S. amberjack landings by state, in numbers and round weight (kg and lb), during 1977

State	Number	Weight	
		kg	lb
North Carolina	8,900	83,100	183,200
South Carolina	5,250	47,129	103,900
Georgia	2,450	24,993	55,100
Florida	70,710	1,020,827	2,250,500
Alabama	7,150	71,578	157,800
Mississippi	400	7,258	16,000
Louisiana	500	7,938	17,500
Texas	9,000	130,637	288,000
Totals	104,360	1,393,459	3,072,000

during 1977. We made these estimates by county or multiple county area. The numbers and weights estimated for the nine county areas are given in Table 4. The Collier-Pasco areas comprised 36.9% of the total, followed by the St. Lucie-Broward area with 15.1%.

In Table 4 we compare by county area the estimated total landing weights with the recorded landing weights generated by Current Fishery Statistics from commercial dealer records. The percentage differences between the two data sources vary from zero to 24.8% by county area and 7.2% from the entire state. The average weight estimated for the state is 14.4 kg (31.8 lb). Converting the recorded commercial dealer weight to number of amberjack by this factor yields an estimated 5,160 fish, implying that 92.7% of the number of amberjacks landed in Florida during 1977 were not recorded in those statistics.

Amberjack Landings in Dade County, Florida

The total number of amberjacks landed in Dade County (Miami), Florida, during 1977 is estimated at 6,027 (Table 5). Despite the limitations of this estimate, it is based on the most comprehensive sampling program available to us. An intensive survey of the amberjack landings by charter vessels at one of the four major marinas (Miamarina) in Dade County was conducted from May 1970 through April 1978, with a preliminary survey in April 1977 (RKB). The number of each species landed during each month was estimated, based on factors of days during a month that were not sampled. Estimates of landings by all Dade charter vessels for the first 3 months were generated from several sources, and estimates for the remaining months were based on a factor of 1.3129, estimating that 76.2% of all charter vessel catches were made at Miamarina. Estimates of numbers landed by month by all Dade County fishing efforts were based on a factor of 1.1765, estimating that 85% of all amberjack landed were caught by charter vessels.

Table 4. Amberjack landings by Florida county area in 1977, in numbers and weights estimated by this report, in weights recorded by commercial dealers, and in percent recorded weight of estimated weight

County Area	Estimated	Weight estimated, all sources		Weight recorded, commercial		Percent weight recorded
		kg	lb	kg	lb	
Nassau-Volusia	2,538	39,010	86,000	1,518	3,346	3.9
Brevard-Indian River	1,995	26,082	57,500	5,946	13,109	22.8
St. Lucie-Broward	10,785	138,847	306,100	18,039	39,768	13.0
Dade	6,027	78,432	172,910	0	0	0.0
Monroe	8,460	122,798	270,720	860	1,897	0.7
Collier-Pasco	26,330	408,517	900,610	12,080	12,080	3.0
Levy-Gulf	1,350	15,309	33,750	538	1,187	3.5
Bay-Walton	4,380	63,576	140,160	15,759	34,742	24.8
Okaloosa-Escambia	8,835	128,255	282,750	19,688	43,403	15.4
East Coast	21,345	282,371	622,510	27,539	60,711	9.8
West Coast	49,365	738,456	1,627,990	46,898	103,391	6.4
Total Florida	70,710	1,020,827	2,250,500	74,437	164,102	7.3

The data for total number of amberjacks estimated landed by Miamarina charter vessels during the 12-month intensive sampling period (Table 5) show peak landings during March-April-May (53.8% of the total) and minimum landings during August-September (1.6%).

The data for the numbers of each species sampled (Table 5) show that three of the four amberjack species present in the area were landed (with a single specimen of the lesser amberjack recorded here subsequent to the survey). Greater amberjack predominated with 82.3% of the total landings sampled and were the most abundant species in the landings in all but 2 months. The almaco jack was 17.2% of the total landings sampled and was the most abundant of the three species landed during October and January. The banded rudderfish was rare and only sampled during January through April.

UTILIZATION

Amberjacks have traditionally and effectively been underutilized by fishermen and fish dealers in the U.S. Commercial fishermen have often disdained amberjack when they were fishing for snapper, grouper or mackerel. Fish dealers have long purchased small amounts of amberjacks for low prices; ex vessel prices paid in Florida averaged \$.07 to \$.11 per pound from 1950 through 1970, and have risen to a high of only \$.117 per pound in 1977. Recreational fishermen have overwhelmingly sought other more popular gamefish species. Although sportfishermen have regarded the amberjack as a strong or exciting fighter on rod and reel, those caught were too frequently left to spoil at the dock.

Table 5. Amberjack landings by month from Dade County, Florida, 1977-1978, in estimated numbers of the three species and in total for all species (numbers in parentheses not included in 12 month totals)

Total Year	Mo.	Greater amberjack	Almaco jack	Banded rudderfish	Miamarina charter amberjack	Dade charter vessels Total amberjack	Dade, all vessels Total amberjack
1977	Jan	-	-	-	-	623	733
	Feb	-	-	-	-	497	585
	Mar	-	-	-	-	1005	1183
	Apr	694	5	0	699	918	1078
	May	553	41	0	594	780	916
	Jun	187	41	0	228	299	352
	Jul	200	35	0	235	308	363
	Aug	38	9	0	47	62	73
	Sep	12	6	0	18	24	28
	Oct	42	89	0	131	172	202
	Nov	91	34	0	125	164	193
	Dec	122	86	0	208	273	321
1978	Jan	184	294	2	480	-	-
	Feb	355	27	1	383	-	-
	Mar	738	34	2	774	-	-
	Apr	773	4	13	790	-	-
Totals	(12 months)	3295	700	18	4013	5125	6027

Much of this misuse of amberjack by fishermen continues, but utilization has greatly increased in a few fishing centers within the past 2 to 5 years. This upgraded utilization has been in two directions, as a gamefish and as food.

More sportfishermen are beginning to regard amberjack as a choice gamefish. In many cases this began when other preferred gamefish were not immediately available, and amberjack fishing was used to provide the recreation, or, in the case of charter or party vessels, to satisfy the customers. Now, many sportfishermen are returning to fish for amberjack as choice recreational species, especially when jig-fished in mid-water over a wreck or on the bottom with live bait; some quantities of this catch are brought to the surface and released alive by sportfishermen, especially in south Florida. Spearfishing for large amberjack is becoming increasingly popular in some areas, as off St. Petersburg and the Mississippi coast.

Smoked amberjack is becoming more popular throughout most of Florida, and is the predominant method of preparation; the retail price of smoked

amberjack is about \$3.00 per pound. The catch, listed on the menu amberjack at some restaurants in Pinellas and Okaloosa counties, is served fried, broiled, or in sandwiches.

One dealer in Okaloosa County reports boneless fillets with the lateral red muscle removed have a 1-year minimum shelf-life when frozen wet in polyethylene bags.

Fresh fillets are sold at some charter boat docks in Dade County. Recent price has been \$1.50 per pound for greater amberjack and \$1.75 per pound for almaco jack, at \$0.25 per pound increase from early 1977; greater amberjack are sold in the round for about \$0.60 per pound.

Commercial dealer prices to commercial fishing vessels and some recreational vessels that sell amberjack to dealers have been about \$0.10 to \$0.15 per pound in recent years in most areas, but have increased to about \$0.30 per pound from a few dealers who have created or augmented markets for amberjack. Some seafood restaurants own vessels that catch amberjack or buy amberjack directly from commercial fishing vessels.

Quantities of amberjack are appreciably upgraded in value when mounted by professional taxidermists for sport fishermen, but most of the catch is still used as bait by snapper and grouper, shark, and crab fishermen. Amberjack catches in some areas attains transitory value when charter and party vessels bring it to the docks to display for and impress tourists, or when private sport fishing vessels bring it to the docks during tournaments or fishing sprees. Much of this catch is left to spoil. Variable techniques are used in handling the catch on board vessels; Gutting soon after catching, soaking a few hours in refrigerated brine, and packing in ice yields quality meat for 2 weeks or more. Lacking refrigeration or ice, amberjack will keep for 1 or 2 days when gutted, washed, and kept moist in shade. Skinning and cutting out the band of lateral red muscle on each side of the body will maintain better flavor. Icing without gutting or skinning is satisfactory for 4 to 12 hours. For greater amberjack heavier than about 9 kg (20 lb) we support the recommendation of cleaning by cutting ribless fillets without opening or cutting into the visceral cavity, especially in tropical areas.

Meat yield for two filets is about 45 to 55% round weight; thoroughly trimmed and boneless fillets yield about 35% round weight. Gutted weight is about 91.5 to 95.5% round weight.

Amberjacks have been indicated as the cause of ciguatera at some times in some parts of the world, including the West Indies. We have reports that they are rejected as food for this reason at some localities in Puerto Rico and the Virgin Islands. However, we know of their increasing use as food in the United States, and we have not been able to obtain any accounts of ciguatera associated with eating amberjack in the United States.

When cleaned, many of the larger specimens of all four species of amberjacks are shown to contain a parasite in the muscle, usually isolated in the caudal peduncle area and extending in very large fish along the posterior margins of the dorsal fin base. These amberjacks are the second intermediate host of a larval tapeworm. Parasitologists claim that larval tapeworms cannot infect man or other mammals, but mature to their adult stage only in

elasmobranch fishes, probably one or more species of large sharks.

STATUS OF BIOLOGICAL KNOWLEDGE

The status of biological knowledge, especially aspects that would be useful to management, of the four western central Atlantic species of amberjacks is meager. Limited and localized studies on amberjack biology are in progress in Dade County, Florida (RKB). Some aspects of extant knowledge and lack of knowledge are summarized below.

Size

Records of maximum sizes for three of the four species are considered tentative because of previous uncertainty of specific identification. The best available maximum size records we have deciphered are as follows: Greater amberjack, 80.3 kg (177 lb) RD, from Trinidad. Hook and line record of 67.6 kg (149 lbs), 150 cm FL, from Bermuda. Gutted weight catch of 71.36 kg (RD ca 76.7 kg, ca 169 lb), reported in 1978 from Ft. Pierce Florida. Almaco jack, 24 kg (54 lb) RD, from Bermuda. Hook and line record of 15.7 kg (34.5 lb) RD, 103 cm FL, from off Panama City, Florida. Banded rudderfish, 5.2 kg (11.4 lb) RD, 69 cm FL, from off Beaufort, North Carolina. Report of 80 cm FL unsubstantiated. Lesser amberjack, 4.6 kg (10.1 lb) RD, 67.5 cm FL, from off Beaufort, North Carolina.

Average annual size records for one year exist for two of the species from charter vessel landings in Dade County, Florida, for March 1976 through February 1977 (Gentle 1977). These are similar to records being compiled by the more recent study (RKB). The fork length ranges and means are: Greater amberjack, 50-128 cm, mean 100.4 cm and Almaco jack, 42-92 cm, mean 64.9 cm.

Round weight yearly, ranges and means for two species from Dade County are preliminarily estimated as: Greater amberjack, 0.18 - 49.8 kg (0.4 - 110 lb), mean 14.8 kg (32.8 lb) and Almaco jack, 0.36 - 13.6 kg (0.8 - 30 lb), mean 4.6 kg (10 lb).

Distribution

The greater amberjack probably ranges throughout the western central Atlantic area in epipelagic waters and on continental and insular slopes to depths of at least 366 m (200 fathoms). The almaco jack is similar in aerial range, but possibly does not go as deep. Records of banded rudderfish and lesser amberjack do not give a comprehensive picture of distribution; but they possibly exist throughout the area, and the lesser amberjack is known to go to at least 238 m (130 fathoms).

Significant patterns of distribution exist from exploratory fishing records in the Bahamas (Thompson, 1978) and the Caribbean and adjacent waters (Kawaguchi, 1974).

Migration

The Cooperative Gamefish Tagging Program (NMFS/WHOI) has tagged more than 3,000 amberjacks since 1959. Preliminary study of the 531 recoveries indicates that most amberjacks are recaptured within the general area of their release. However, investigators feel that there is some evidence of migra-

tory groups which occasionally mingle with resident groups, as part of an annual cycle. The longest distance between the point of tagging and place of recapture is 1560 miles from Jacksonville, Florida, to Colombia, South America. The longest time at large for an amberjack is 7.3 years, set in 1975 (NMFS/WHOI 1978). This is a valuable but low intensity volunteer effort by sportfishermen, and the results are commensurably limited.

Age and Growth

No comprehensive studies are known to us. Tests of scales (RKB) and vertebrae and otoliths (FHB) are being made to determine if these parts will indicate years of life and growth patterns.

Reproduction

Knowledge of reproduction in amberjacks is fragmentary. Occurrence of *Seriola* spp larvae in the eastern Gulf of Mexico and Florida Straits in all seasons shows that, as a group, amberjacks spawn year-round (Leak 1977, Fahay 1975, Aprieto 1974, Dooley 1972). Spawning seasons among the four species have not been conclusively determined by larval surveys (Fahay 1975, Aprieto 1974, Dooley 1972).

In the Caribbean, Erdman (1977) found some ripe *S. dumerili* in all seasons and ripe specimens of *S. rivoliana* in March, April and November. Thompson and Munro (1974) collected 2 ripe *S. dumerili* off Pedro Bank, one in August and one in November. They also collected one ripe *S. rivoliana* in November at the same location.

Recently collected data on gonad condition and sex ratio from Miami and Panama City, Florida, and Morehead City, North Carolina, are being analyzed (RKB).

Food and Feeding

One comprehensive study on stomach contents of amberjack from the charter vessel fishery is in progress (RKB). Other references contain limited data. Examination of greater amberjacks at Miamarina shows that they are opportunistic feeders. Food items are predominantly fish, but include crustaceans and cephalopods. Randall (1967) examined the stomachs of eight greater amberjacks from the West Indies. Two stomachs were empty and the other six contained exclusively fish.

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