Survey of the Charter Boat Troll Fishery in North Carolina, 1977

CHARLES S. MANOOCH III
and STUART T. LAWS

ABSTRACT—North Carolina's 127 charter boats made 7,935 trips trolling for pelagic fishes in 1977. The number of boats fishing for pelagic species varied from 65 to 107 depending on the month. Excluding billfishes, 238,413 fish weighing 1.6 million pounds (726 metric tons) were caught, an average of 30 fish and 198 pounds per trip.

Major species landed by weight were: king mackerel, Scomberomorus cavalla, *737,680 pounds (334.7t); bluefish,* Pomatomus saltatrix, *244,618 pounds (110.0t); dolphin,* Coryphaena hippurus, *174,735 pounds (79.3t); amberjack,* Seriola *spp., 108,998 pounds (49.4t); and wahoo,* Acanthocybium solanderi, *76,324 pounds (34.6t).*

Catch per unit effort varied with season and geographic area and reflected fish migrations. The highest catch rate occurred in October, 4.9 fish per trip, and the lowest in July, 16.3 fish per trip. Boats fishing out of Oregon Inlet and Hatteras Village usually caught a higher percentage of oceanic pelagic species (dolphin, tunas, etc.) and, as a result, had higher mean weights per fish landed.

Introduction

A study of coastal pelagic fishes (king mackerel, *Scomberomorus cavalla,* Spanish mackerel, *S. maculatus,* and bluefish, *Pomatomus saltatrix*) was made in 1977 by the Beaufort Laboratory, Southeast Fisheries Center, National Marine Fisheries Service, to gather catch and effort and biological data from ocean piers and charter boats in North Carolina. The North Carolina research was to be a pilot study to a future survey of all North Carolina, South Carolina, Georgia, and Florida east coast charter boats and piers.

In this paper we: 1) Describe the fishes caught and habitats fished by North Carolina charter boats during 1977; 2) describe the vessels, gear, and methods; 3) present catch and effort data; 4) compare commercial and recreational landings for certain species; and 5) review factors affecting the future of the charter boat fishery.

Saltwater recreational fishing is important socially and economically. A national survey of hunting, fishing, and wildlife-associated recreation showed that approximately 27 million people fished in saltwater in the United States in 1975, generating $3.45 billion in revenue (U.S. Fish and Wildlife Service, 1977). Approximately 22 percent of these anglers engaged in "deep sea" fishing activities. In North Carolina alone during 1966, about half a million resident anglers caught 15 million pounds (6,800 t) of fish (Hayne, 1968). The annual gross expenditures by nonresident recreational fishermen in one coastal community, Morehead City, N.C., exceeded $2.6 million in 1971, nearly $1.4 million of which contributed to personal income (Hart, 1972).

Despite the great importance placed on some fisheries, including coastal pelagics, by Regional Fisheries Management Councils, the extent of recreational catch and effort is unknown. The problems of sampling marine recreational fisheries are many. Most complicating is the diversity of effort; recreational fishermen fish from small private boats, charter boats[1], headboats[2], piers, bridges, and beaches. There are literally thousands of access points along the southeastern U.S. coast. On-site interviews and sampling of all segments of the recreational fishery would require substantial funding and manpower. Unable to sample all parts, we have chosen to study what we feel is obviously a very important segment of the North Carolina saltwater recreational fishery.

Charles S. Manooch III and Stuart T. Laws are with the Beaufort Laboratory, Southeast Fisheries Center, National Marine Fisheries Service, NOAA, Beaufort, NC 28516.

Fishes and Habitats

The coastal pelagic fish community

[1]A boat for hire which charges on a fixed daily rate regardless of the number of passengers, usually six or less.

[2]Furnishes trips and charges on a per passenger basis for usually 15 to 150 anglers.

consists of species that roam the inshore waters of the South Atlantic Bight (Table 1). These large predators of the community are very important to the recreational and commercial fisheries and include king mackerel, Spanish mackerel, bluefish, and little tunny, *Euthynnus alletteratus*. Coastal pelagic species, both adults and juveniles, migrate south in the fall and winter and north in spring and summer. Spanish and king mackerels spawn offshore, and their young, for the most part, mature there. Bluefish, however, spawn at sea and the juveniles use estuaries as nursery grounds. Costal pelagics occur in the neritic zone, intertidal to the shelf break, and therefore are generally shoreward of the oceanic pelagic species (dolphin, *Coryphaena hippurus,* wahoo, *Acanthocybium solanderi,* tunas, *Thunnus* sp., and billfishes of the genera *Istiophorus, Makaira,* and *Tetrapturus*).

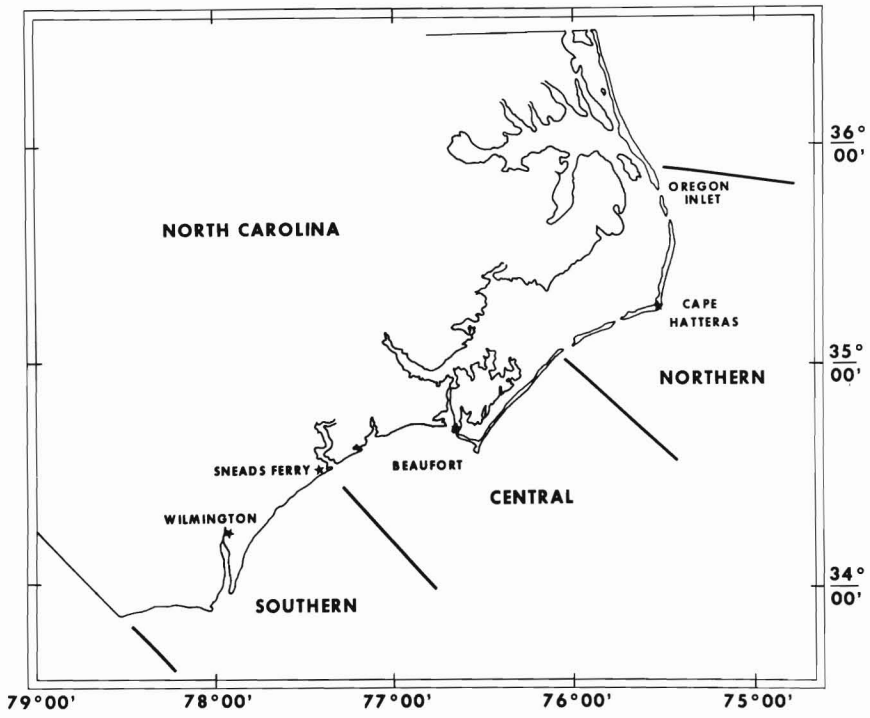
The distribution of oceanic pelagic species is influenced off North Carolina by the Gulf Stream. Gibbs and Collette (1959) referred to the 20°C isotherm as the general preferred minimum low for dolphin in the North Atlantic, and other members of the community tend to stay in warm waters also. As with coastal pelagics, the oceanic species are seasonally abundant. Major species caught by charter boat fishermen are listed in Table 1.

Table 1.—Species of fish generally caught by charter boats trolling in inshore and offshore North Carolina waters.

Common name	Scientific name	Fishing locality
Bluefish	*Pomatomus saltatrix*	Inshore
Greater amberjack[1]	*Seriola dumerili*	Inshore-offshore
Almaco jack[1]	*Seriola rivoliana*	Inshore-offshore
Dolphin	*Coryphaena hippurus*	Offshore
Great barracuda[1]	*Sphyraena barracuda*	Inshore-Offshore
Little tunny	*Euthynnus alletteratus*	Inshore
Atlantic bonito	*Sarda sarda*	Inshore-Offshore
King mackerel	*Scomberomorus cavalla*	Inshore-Offshore
Spanish mackerel	*Scomberomorus maculatus*	Inshore
Wahoo	*Acanthocybium solanderi*	Offshore
Albacore	*Thunnus alalunga*	Inshore-Offshore
Yellowfin tuna	*Thunnus albacares*	Offshore
Blackfin tuna	*Thunnus atlanticus*	Offshore
Bigeye tuna	*Thunnus obesus*	Offshore
Sailfish	*Istiophorus platypterus*	Inshore-Offshore
Blue marlin	*Makaira nigricans*	Offshore
White marlin	*Tetrapturus albidus*	Offshore
Cobia	*Rachycentron canadum*	Inshore

[1]These species are frequently caught over reefs, wrecks, and around buoys, platforms, etc.

Figure 1.—Three geographical areas used in the survey of North Carolina charter boats.



Survey Methods

Charter boats operating from North Carolina ports were surveyed in 1977 by a combination of personal interviews and log book techniques. The coastline was partitioned into three geographic strata: Northern district, Oregon Inlet to Ocracoke; central district, Harker's Island and Morehead City-Atlantic Beach to Sneads Ferry; and southern district, south of Sneads Ferry to South Carolina (Fig. 1). Creel clerks, one for each district, identified the charter boat population and made initial contacts with each operator to familiarize him with the goals and methods of the survey. Forms for recording daily catches were placed on each boat, filled out by the captain or mate, and picked up by the clerk at least weekly. Some boat crews were contacted daily. Many operators failed to keep daily records but provided data for short recall periods (<1 week) to the clerk when ques-

tioned. Data collected for each boat included number of trips, type of trip, date, fishing locality, and number and estimated weight of each species caught. Clerks periodically sampled landings to obtain estimates of mean weight for each species. Species catch and catch per trip data were generated for each district, monthly, by the method outlined in Table 2.

The study was an incomplete census and the estimates obtained are therefore biased. In general, however, we believe the estimates provide a useful description of a fishery which has received little documentation in the past. In retrospect, it is apparent that the three geographical strata should have been partitioned into two vessel classes because distribution of effort in each district was found to be bimodal rather than unimodal. Boats either fished frequently (15-30 trips/month) or fished much less frequently (2-4 trips/month). Also the type of fishing trip varied and included trolling for oceanic pelagics, trolling for coastal pelagics, and bottom fishing. For the 1978 survey, the charter boat fleet will be divided into six strata according to geographical district and frequency of fishing. We intend to obtain as complete coverage as possible of each stratum. We anticipate even greater cooperation from the boat operators in 1978 because of their enthusiastic response to a preliminary copy of this report we furnished them.

The Charter Boat Fishery

Number of Boats

A total of 127 charter boats operated out of North Carolina ports in 1977; 56 in the northern district, 44 in the

Table 2.—Effort calculations by district, monthly.

District	Trips and records data	April	May	June	July	August	September	October	November	Mean
Northern	A Total no boats	52	53	53	53	56	56	56	52	53.9
	B No boats fishing	16	32	43	47	51	51	48	40	41.0
	C Fishing boats reporting	8	23	30	35	37	10	8	8	19.9
	D No boats reporting	44	44	39	41	42	15	16	18	32.4
	E No trips reported	52	216	347	520	492	165	91	37	240.0 (1,920)
	F No trips with catch data	52	152	104	162	251	165	91	37	126 8 (1,014)
	G No trips/boat (E/C)	6 5	9 4	11 6	14 9	13 3	16 5	11 4	4 6	11 0
	H Total no trips (GxB)	104	301	499	700	678	842	547	184	481 9 (3,855)
	I Percent trips with catch data (F/H)	50	50	21	23	37	20	17	20	29 8
	J Percent of fishing boats providing trip data (C/B)	50	72	70	74	73	20	17	20	49 5
Central	A Total no boats	44	44	43	43	43	43	43	43	43.3
	B No boats fishing	27	29	33	27	30	32	33	32	30.3
	C Fishing boats reporting	25	25	27	18	11	16	16	12	18 8
	D No boats reporting	42	40	37	34	24	27	26	23	31 6
	E No trips reported	136	210	211	143	61	219	270	201	181 4 (1,451)
	F No trips with catch data	136	210	211	143	61	219	237	201	177 3 (1,148)
	G No trips/boat (E/C)	5 4	8 4	7 8	7 9	5 5	13 7	16 9	16 8	10.3
	H Total no trips (GxB)	147	244	257	213	165	438	558	538	320.0 (2,560)
	I Percent trips with catch data (F/H)	93	86	82	67	37	50	42	37	61 8
	J Percent of fishing boats providing trip data (C/B)	93	86	82	69	37	50	48	38	62 9
Southern	A Total no boats	27	27	26	27	27	27	27	27	26.9
	B No boats fishing	22	25	25	21	20	24	26	22	23 1
	C Fishing boats reporting	10	13	14	9	5	10	10	9	10 0
	D No boats reporting	15	15	15	15	12	13	11	14	13 8
	E No trips reported	76	140	114	50	14	112	119	52	84 6 (677)
	F No trips with catch data	76	140	114	42	14	112	119	52	83 6 (669)
	G No trips/boat (E/C)	7 6	10 8	8 1	5 6	2 8	11 2	11 9	5.8	8.0
	H Total no trips (GxB)	167	270	203	118	56	269	309	128	190 0 (1,520)
	I Percent trips with catch data (F/H)	46	52	56	36	25	42	39	41	42 1
	J Percent of fishing boats providing trip data (C/B)	45	52	56	43	25	42	38	41	42 8
Boats actually fishing (ΣB)		65	86	101	95	101	107	107	94	94.4 (755)
Total boats (ΣA)		123	124	122	123	126	126	126	122	124 0 (992)
Percent of fleet fishing $\frac{(\Sigma B)}{(\Sigma A)}$		52 8	69 4	82 8	76 4	80.2	84 9	84 9	77 0	76 1

Charter boat, Morehead City, N.C.

central, and 27 in the southern. The number of boats remained fairly stable within each district for the season. The percentage of the fleet actively fishing varied monthly, averaging 76 percent. Boats were least active in April (53 percent fished) and most active in September and October when 85 percent of the boats made trolling trips (Table 2). Reasons for not fishing included inclement weather, equipment failure, and lack of customers.

Vessels and Equipment

Boats ranged in length from 29 to 55 feet ($\bar{X}$=32), were primarily wooden hulled, although a few are fiberglass, and ranged in age from 0 to 44 years ($\bar{X}$=16). Approximately 60 percent of the boats had a single diesel engine, and about one-fourth of the vessels had twin diesel engines. Speed varied from about 10 to 25 mph (Charles Manooch, pers. obs.). Basic equipment included radios (CB and VHF) and fathometer. More than half of the charter boats had loran, usually loran-A, but some were in the process of changing to loran-C (Abbas, in press).

Fishing tackle used depended on the type of fishing: Larger gear (9/0-16/0 reels and 80-130 pound test line) for oceanic species and smaller gear (4/0-6/0 reels and 40 pound line) for bluefish and mackerels. Lines with spoons, feathered jigs, etc., are trolled behind the boat at the surface or at various depths using weights or planers. Strips of squid or fish are often placed on the hook(s) of artificial lures. Trolling is usually conducted in an almost random fashion until a fish is hooked, and then the boat circles in the same area until the catch rate becomes unsatisfactory.

Trip Types

Trips are either half-day or full-day but, like Abbas, we found that a very few half-day trips were made. Therefore, we standardized trips on a full-day basis.

Fishing Areas

Boats fishing offshore troll in the Gulf Stream (12 miles offshore at Hatteras to 50 miles at Southport) or around natural reef areas just shoreward of the stream. On a full-day trip, boats generally leave before sunrise and return to the docks around 1500 hours. Inshore fishing is around inlets, just outside the surf zone, and in the vicinity of wrecks, and artificial and natural reefs. Captains are aided in their search for pelagic species by fathometers and also by the presence of birds feeding on forage fish which have been injured or forced near the water's surface by predation from below.

Results

Charter boats made 7,935 trolling trips in 1977 and excluding billfishes, caught 238,413 fish weighing 1,568,108 pounds. The average trip produced 30 fish which weighed 198 pounds (Table 3). Catch by species and catch per unit effort data were stratified by district, monthly (Tables 4, 5, 6) and will be discussed below.

Species Composition of Landings

Charter boat anglers caught 18 species of fish by trolling baits (Table 1). The five most frequently caught species by number and weight were: King mackerel, 87,478 and 737,680 pounds; bluefish, 67,262 and 244,618 pounds; dolphin 22,146 and 174,735 pounds; amberjack *Seriola* spp., 6,540 and 108,998 pounds; and wahoo 3,062 and 76,324 pounds (Table 3). Fishermen also caught 35,375 Spanish mackerel which weighed 49,739 pounds. An average 11.0 king mackerel were caught per trip, 8.5 bluefish, 4.5 Spanish mackerel, and 2.8 dolphin. These four species represented 89 percent of the fish landed on a daily average basis.

King mackerel and bluefish were caught each month of the fishing season, but others, specifically cobia, *Rachycentron canadum,* albacore, *Thunnus alalunga,* and bigeye tuna,

Table 3.—Total catch and catch per unit effort made by North Carolina charter boats trolling in 1977, by month.

Species		April	May	June	July	August	September	October	November	Total
	Trips	418	815	959	1,031	899	1,549	1,414	850	7,935
King mackerel	No	10,995	20,425	7,544	1,052	1,038	16,116	19,544	10,764	87,478
	Wt	62,165	102,987	53,402	10,066	10,594	154,016	208,038	136,412	737,680
	No /trip	26.3	25.1	7.9	1.0	1.2	10.4	13 8	12 7	11 0
Spanish mackerel	No	—	1,047	2,088	3,305	1,673	15,225	11,450	587	35,375
	Wt	—	1,102	2,071	4,009	2,169	22,202	17,439	747	49,739
	No /trip	—	1 3	2 2	3 2	1 9	9 8	8 1	0 7	4 5
Bluefish	No	3,039	1,010	3,855	5,510	9,934	11 099	24,547	8,268	67,262
	Wt	25,585	8,214	8,452	9,875	11,931	21 191	89,614	69,756	244,618
	No /trip	7 3	1 2	4 0	5 3	11 1	7 2	17 4	9 7	8 5
Dolphin	No	126	1,591	6,716	5,078	2,645	4,520	1,358	112	22,146
	Wt	2,107	13,977	56,342	36,893	16,981	36 686	10,720	1,029	174,735
	No /trip	0 3	2 0	7 0	4 9	2 9	2 9	1 0	0 1	2 8
Wahoo	No.	27	147	328	554	997	668	296	45	3,062
	Wt	955	3,568	6,588	14,524	28,579	13,775	7,260	1,075	76,324
	No/trip	0 1	0.2	0 3	0 5	1 1	0 4	0 2	0 1	0 4
Little tunny	No	692	435	27	121	240	1,865	2,293	1,247	6,920
	Wt	5,441	3,720	266	961	2,159	16,734	19,967	9,705	58,953
	No /trip	1 7	0.5	<0 1	0 1	0 3	1 2	1 6	1 5	0 9
Yellowfin tuna	No	14	88	43	63	47	540	71	2	868
	Wt	490	2,460	1,685	1,407	1,659	20,081	2,315	100	30,197
	No /trip	<0 1	0.1	<0 1	0 1	0 1	0 3	0 1	<0 1	0 1
Blackfin tuna	No	131	532	11	126	129	1,842	2,062	—	4,833
	Wt	1,044	3,917	135	1,260	1,213	22,915	27,012	—	57,496
	No /trip	0 3	0 7	<0 1	0 1	0 1	1 2	1 5	—	0 6
Bigeye tuna	No	—	14	—	238	359	3	—	—	614
	Wt	—	221	—	238	431	30	—	—	920
	No /trip	—	<0 1	—	0 2	0 4	<0 1	—	—	0 1
Atlantic bonito	No	64	164	137	186	427	253	618	—	1,849
	Wt	285	1,203	841	942	3,328	1,898	4,845	—	13,342
	No./trip	0 2	0 2	0 1	0 2	0 5	0 2	0 4	—	0 2
Albacore	No	—	—	—	—	81	—	—	—	81
	Wt	—	—	—	—	518	—	—	—	518
	No /trip	—	—	—	—	0 1	—	—	—	<0 1
Amberjack	No	136	489	376	341	374	2,342	1,068	1,414	6,540
	Wt	2,919	8,661	7,598	6,672	5,737	37,784	18,613	21,014	108,998
	No /trip	0 3	0 6	0 4	0 3	0 4	1 5	0 8	1 7	0 8
Barracuda	No	—	10	25	270	118	680	213	48	1,364
	Wt	—	98	220	2,720	1,503	7,117	2,007	357	14,022
	No /trip	—	<0 1	<0 1	0 3	0 1	0 4	0 2	0 1	0 2
Cobia	No	—	3	17	1	—	—	—	—	21
	Wt	—	167	352	47	—	—	—	—	566
	No /trip	—	<0 1	<0 1	<0 1	—	—	—	—	<0 1
Totals	No	15,224	25 955	21,167	16,845	18,062	55,153	63,520	22,487	238,413
	Wt	100,991	150 295	137 952	89,614	86,802	354,429	407,830	240,195	1,568,108
	No /trip	36 4	31 8	22 1	16 3	20 1	35 6	44 9	26 5	30 0
	Wt /trip	241 6	184 4	143 8	86 9	96 6	228 8	288 4	282 6	197 6

T. obesus, were caught infrequently (Table 3).

Seasonality of Landings

The availability of pelagic species to the charter boat fishery is influenced by spring and fall migrations. The offshore, Gulf Stream, fishing area has more stable water temperature. Even there, however, pelagic species are only seasonally abundant.

Fishing trips reflect these seasonal migrations and more trips were made during September and October than any other months. Indeed, 48 percent of all trips occurred from September through November (Table 3). Recreational effort declined in November as vessel operations shifted to commercial fishing, principally for king mackerel. The decline in effort did not, therefore, indicate a decrease in availability. While the catch rate was generally good in the spring—April and May—relatively few trips were made because of bad weather and also many boats were just "gearing up" for the fishing season. Catch rates reflect migrations, and the highest catch rate was recorded in October, 44.9 fish per trip, followed

Table 4.—Catch and catch-per-unit effort made by charter boats trolling in the northern district by month, 1977.

Species		April	May	June	July	August	September	October	November	Total
	Trips	104	301	499	700	678	842	547	184	3,855
King mackerel	No	2,511	8,045	3,393	119	319	8,252	9,211	3,088	34,938
	Wt	13,119	46,805	24,090	1,714	4,179	79,632	105,005	40,762	315,306
	No./trip	24.1	26 7	6 8	0 2	0 5	9.8	16 8	16.8	9.1
Spanish mackerel	No	—	—	—	84	163	2,627	2,407	—	5,281
	Wt	—	—	—	101	261	4,203	3,731	—	8,296
	No /trip	—	—	—	0 1	0.2	3 1	4.4	—	1.4
Bluefish	No.	878	837	3.743	5,460	9,926	1,431	5,744	2,585	30,604
	Wt	7,041	6,890	7.523	9,828	11,911	5,753	48,250	24,041	121,237
	No./trip	8 4	2.8	7 5	7 8	14.6	1 7	10.5	14.0	7.9
Dolphin	No	80	1,204	4,221	3,780	2,583	4,126	1,258	50	17,302
	Wt	1.600	9,229	32,924	28,350	16,531	33,586	10,026	350	132,596
	No./trip	0 8	4.0	8.5	5 4	3.8	4.9	2.3	0.3	4.5
Wahoo	No.	—	84	250	476	956	632	284	40	2,722
	Wt	—	1,532	4.900	13,185	27,628	12,766	6,978	1,000	67,989
	No./trip	—	0.3	0.5	0.7	1.4	0 8	0.5	0.2	0 7
Little tunny	No.	—	58	—	35	108	1,288	1,400	99	2,988
	Wt.	—	467	—	231	799	12,455	13,608	728	28,288
	No /trip	—	0 2	—	<0.1	0.2	1 5	2 6	0.5	0 8
Yellowfin tuna	No	—	59	15	56	34	539	71	—	774
	Wt	—	1,427	626	1,198	1,061	20,051	2,315	—	26,678
	No./trip	—	0 2	<0 1	0 1	<0.1	0.6	0 1	—	0 2
Blackfin tuna	No	131	526	10	126	129	1,726	2,062	—	4,710
	Wt.	1,044	3,832	120	1,260	1,213	21,523	27,012	—	56,004
	No /trip	1 3	1 7	<0 1	0 2	0.2	2 0	3 8	—	1.2
Bigeye tuna	No	—	3	—	238	359	—	—	—	600
	Wt	—	67	—	238	431	—	—	—	736
	No /trip	—	<0 1	—	0 3	0 5	—	—	—	0 2
Atlantic bonito	No	—	20	5	182	373	253	602	—	1,435
	Wt	—	112	45	910	2,648	1,898	4,696	—	10,309
	No./trip	—	0 1	<0 1	0 3	0.6	0 3	1 1	—	0 4
Albacore	No	—	—	—	—	81	—	—	—	81
	Wt	—	—	—	—	518	—	—	—	518
	No /trip	—	—	—	—	0 1	—	—	—	<0 1
Amberjack	No	5	21	100	126	27	160	372	29	840
	W t	150	323	2,460	2,344	567	4,800	7,440	725	18,809
	Wt /trip	<0 1	0 1	0 2	0 2	<0 1	0 2	0 7	0 2	0 2
Barracuda	No.	—	—	—	42	34	109	98	6	289
	Wt	—	—	—	533	615	1,240	980	48	3,416
	Wt /trip	—	—	—	0 1	<0 1	0 1	0 2	<0 1	0 1
Cobia	No	—	3	15	—	—	—	—	—	18
	Wt	—	167	326	—	—	—	—	—	493
	No /trip	—	<0.1	<0 1	—	—	—	—	—	<0 1
Totals	No	3,605	10,860	11,752	10,724	15,092	21,143	23,509	5,897	102,582
	Wt	22.954	70,851	73,014	59,892	68,362	197,907	230,041	67,654	790,675
	No /trip	34 7	36 1	23 6	15 3	22 3	25 1	43 0	32.0	26 6
	Wt /trip	220 7	235 4	146 3	85 56	100 8	235 0	420.6	368 0	205 1
Blue marlin[1]	No	—	2	12	19	14	24	2	0	73
White marlin[1]	No	—	5	40	70	55	152	9	0	331
Sailfish[1]	No	—	2	4	5	30	7	0	0	48
Bluefin tuna[1]	No	—	—	7	—	—	—	—	—	7

[1] These species were not expanded and not included in total No., Wt No /trip, or Wt /trip calculations

Table 5.—Catch and catch-per-unit effort made by charter boats trolling in the central district by month, 1977.

Species		April	May	June	July	August	September	October	November	Totals
	Trips	147	244	257	213	165	438	558	538	2,560
King mackerel	No	2,539	2,741	1,309	388	462	2,718	4,240	5,385	19,782
	Wt	18,132	19,667	10,555	3,610	4,976	22,152	41,128	71,136	191,356
	No /trip	17 3	11 2	5 1	1 8	2 8	6.2	7 6	10 0	7 7
Spanish mackerel	No	—	1,047	2,035	2,263	1,320	10,556	5,456	538	23,215
	Wt	—	1,102	1,981	2,701	1,452	15,834	8,184	673	31,927
	No /trip	—	4 3	7 9	10 6	8 0	24 1	9 8	1 0	9 1
Bluefish	No.	574	154	41	50	8	2,895	15,317	4,288	23,327
	Wt	4,420	1,172	41	47	20	5,211	35,229	43,260	89,400
	No /trip	3 9	0 6	0 2	0 2	<0 1	6.6	27 4	8 0	9 1
Dolphin	No	33	209	2,329	1,192	54	225	41	54	4,137
	Wt	377	2,915	20,679	7,621	410	1,868	365	599	34,834
	No /trip	0 2	0.9	9 1	5 6	0 3	0 5	0 1	0 1	1 6
Wahoo	No	5	20	66	72	41	17	6	5	232
	Wt.	75	415	1,363	1 204	951	403	162	75	4,648
	No /trip	<0 1	0 1	0 3	0 3	0 2	<0.1	<0.1	<0 1	0 1
Little tunny	No	582	358	27	47	132	451	738	1 087	3,422
	Wt	4,671	3,063	266	473	1,360	3,247	5,018	8,457	26,555
	No /trip	4 0	1 5	0 1	0 2	0 8	1 0	1 3	2 0	1 3
Yellowfin tuna	No	14	29	28	7	13	1	—	2	94
	Wt	490	1,033	1,059	209	598	30	—	100	3,519
	No./trip	0 1	0 1	0 1	<0 1	0 1	<0 1	—	<0 1	<0 1
Blackfin tuna	No	—	6	1	—	—	—	—	—	7
	Wt	—	85	15	—	—	—	—	—	100
	No /trip	—	<0 1	<0 1	—	—	—	—	—	<0 1
Atlantic bonito	No	64	12	8	4	50	—	16	—	154
	Wt	285	48	40	32	660	—	149	—	1,214
	No /trip	0 4	<0 1	<0 1	<0 1	0 3	—	<0 1	—	0 1
Amberjack	No	131	452	254	139	347	1,356	529	1,329	4,537
	Wt	2,769	8,063	4,779	2,078	5,170	16,679	8,094	19,483	67,115
	No /trip	0 9	1 9	1 0	0 7	2 1	3 1	0 9	2 5	1 8
Barracuda	No	—	10	25	108	56	267	16	—	482
	Wt	—	98	220	1,155	577	2,697	149	—	4,896
	No /trip	—	<0 1	0 1	0 5	0 3	0 6	<0 1	—	0 2
Cobia	No	—	—	2	1	—	—	—	—	3
	Wt	—	—	26	47	—	—	—	—	73
	No /trip	—	—	<0 1	<0 1	—	—	—	—	<0 1
Totals	No	3,942	5,038	6,125	4,271	2,483	18,486	26,359	12,688	79,392
	Wt	31,219	37,661	41,024	19,177	16,174	68,121	98,478	143,783	455,637
	No /trip	26 8	20 7	23 8	20 1	15 0	42 2	47 2	23 6	31 0
	Wt /trip	212 4	154 4	159 6	90 0	98 0	155 5	176 5	267 3	178 0

by April, September, and May (Table 3). King mackerel and bluefish catches peaked in spring and fall, and Spanish mackerel were caught more frequently in the fall.

Gulf Stream trips produced more dolphin and wahoo during the summer. In 1977, dolphin catches peaked in June and wahoo in August (Fig. 2), while in 1961 and 1962 the best catches of dolphin occurred evenly throughout the summer (Rose and Hassler, 1969), and wahoo were more abundant in Oregon Inlet and Hatteras landings in August and September, from 1964 to 1972 (Hogarth, 1976). For Hatteras-Oregon Inlet, from 1964 to 1972, the overall catch rate of wahoo was 0.24 fish per trip (values ranged from 0.02 to 0.68). Our data for the same area revealed an overall catch rate of 0.4 wahoo per trip (monthly values ranged from 0.1 to 1.1). Amberjack and barracuda, two resident species, had relatively stable catch rates throughout the fishing season.

The average size of several species changed seasonally (Fig. 2). Large, "jumbo" or "Hatteras," bluefish (about 8 pounds) were caught in the spring and late fall, and the small, "snapper," bluefish (1-3 pounds) were taken throughout the summer. Small king mackerel (5-6 pounds), locally known as "snakes," were landed in April and May, and the mean size gradually increased to 12.7 pounds in November. During the fall king mackerel fishery, many fish in the 20-40 pound size category were caught off North Carolina.

Geographical Distribution of Landings

The Gulf Stream is much closer to the coastline in the northern district

Table 6.—Catch and catch-per-unit made by charter boats trolling in the southern district by month, 1977.

Species		April	May	June	July	August	September	October	November	Totals
	Trips	167	270	203	118	56	269	309	128	1,520
King mackerel	No.	5,945	9,639	2,842	545	257	5,146	6,093	2,291	32,758
	Wt.	30,914	36,515	18,757	4,742	1,439	52,232	61,905	24,514	231,018
	No./trip	35 6	35.7	14.0	4.6	4.6	19.1	19.7	17.9	21.6
Spanish mackerel	No.	—	—	53	958	190	2,042	3,587	49	6,879
	Wt	—	—	90	1,207	456	2,165	5,524	74	9,516
	No./trip	—	—	0.3	8.1	3.4	7.6	11.6	0.4	4.5
Bluefish	No.	1,587	19	71	—	—	6,773	3,486	1,395	13,331
	Wt.	14,124	152	888	—	—	10,227	6,135	2,455	33,981
	No./trip	9.5	0.1	0.3	—	—	25.2	11.3	10.9	8.8
Dolphin	No.	13	178	166	106	8	169	59	8	707
	Wt.	130	1,833	2,739	922	40	1,232	329	80	7,305
	No./trip	0.1	0 7	0 8	0.9	0.1	0.6	0.2	0.1	0.5
Wahoo	No.	22	43	12	6	—	19	6	—	108
	Wt.	880	1,621	325	135	—	606	120	—	3,687
	No./trip	0.1	0 2	0 1	<0.1	—	0.1	<0.1	—	0.1
Little tunny	No.	110	19	—	39	—	126	155	61	510
	Wt.	770	190	—	257	—	1,032	1,341	520	4,110
	No./trip	0.7	0.1	—	0.3	—	0.5	0.5	0.5	0.3
Blackfin tuna	No.	—	—	—	—	—	116	—	—	116
	Wt.	—	—	—	—	—	1,392	—	—	1,392
	No./trip	—	—	—	—	—	0.4	—	—	0.1
Bigeye tuna	No.	—	11	—	—	—	13	—	—	24
	Wt.	—	154	—	—	—	30	—	—	184
	No /trip	—	<0 1	—	—	—	<0.1	—	—	<0.1
Atlantic bonito	No	—	132	124	—	4	—	—	—	260
	Wt	—	1,043	756	—	20	—	—	—	1,819
	No./trip	—	0.5	0 6	—	0.1	—	—	—	0.2
Amberjack	No.	—	16	22	76	—	826	167	56	1,163
	Wt.	—	275	359	2,250	—	16,305	3,079	806	23,074
	No./trip	—	0.1	0.1	0 6	—	3.1	0 5	0.4	0.8
Barracuda	No	—	—	—	120	28	304	99	42	593
	Wt	—	—	—	1,032	311	3,180	878	309	5,710
	No /trip	—	—	—	1.0	0.5	1 1	0 3	0.3	0.4
Totals	No.	7,677	10,057	3,290	1,850	487	15,534	13,652	3,902	56,449
	Wt.	46,818	41,783	23,914	10,545	2,266	88,401	79,311	28,758	321,796
	No /trip	46 0	37 2	16 2	15.7	8.7	57.7	44.2	30.5	37.1
	Wt./trip	280.3	154.8	117.8	89.4	40.5	328.6	256.7	224.7	211.7

than in the central and southern districts (Fig. 1). This factor has a direct influence on the distribtuion of inshore and offshore effort, and the species composition of local landings. Charter boats fishing out of Hatteras and Oregon Inlet (northern district) fish offshore, in the Gulf Stream, more frequently than do boats from the south. Thus, more oceanic pelagics, such as dolphin, wahoo, and tunas, are landed in the northern ports. Catch per unit effort for dolphin, wahoo, blackfin tuna, *Thunnus atlanticus,* and yellowfin tuna, *T. albacares,* for the three districts, declined from north to south (Tables 4-6). Conversely, catches of coastal pelagic species were generally larger in the central and southern regions of the State (Tables 4-6). As a result of the oceanic versus coastal pelagic catch distribution, the average fish landed in the northern district was larger than the average fish landed in either of the other districts.

Although total effort was not equally divided among districts—3,855 trips in the northern district, 2,560 in the central, and 1,520 in the southern—the average number of trips per boat per month was about the same. Boats in the three regions fished an average of 11.0, 10.3, and 8.0 trips per month (Table 2). Vessels in the southern part of the State generally make bottom fishing trips, which were not included in the effort calculations, while boats at Oregon Inlet and Hatteras do not.

Nontrolling Activities by Charter Boats

Some charter boats not only troll for pelagics, but also make other types of trips such as diving, bottom fishing offshore for reef fish, and bottom fishing in estuaries for cobia and sciaenids. Bottom fishing offshore is the most frequent nontrolling activity. While some charter boats in the central and southern districts advertise bottom fishing, most boats do this only as a secondary choice to trolling. More nontrolling trips were made in the summer when catch rates for pelagic fishes were down. We found (Charles

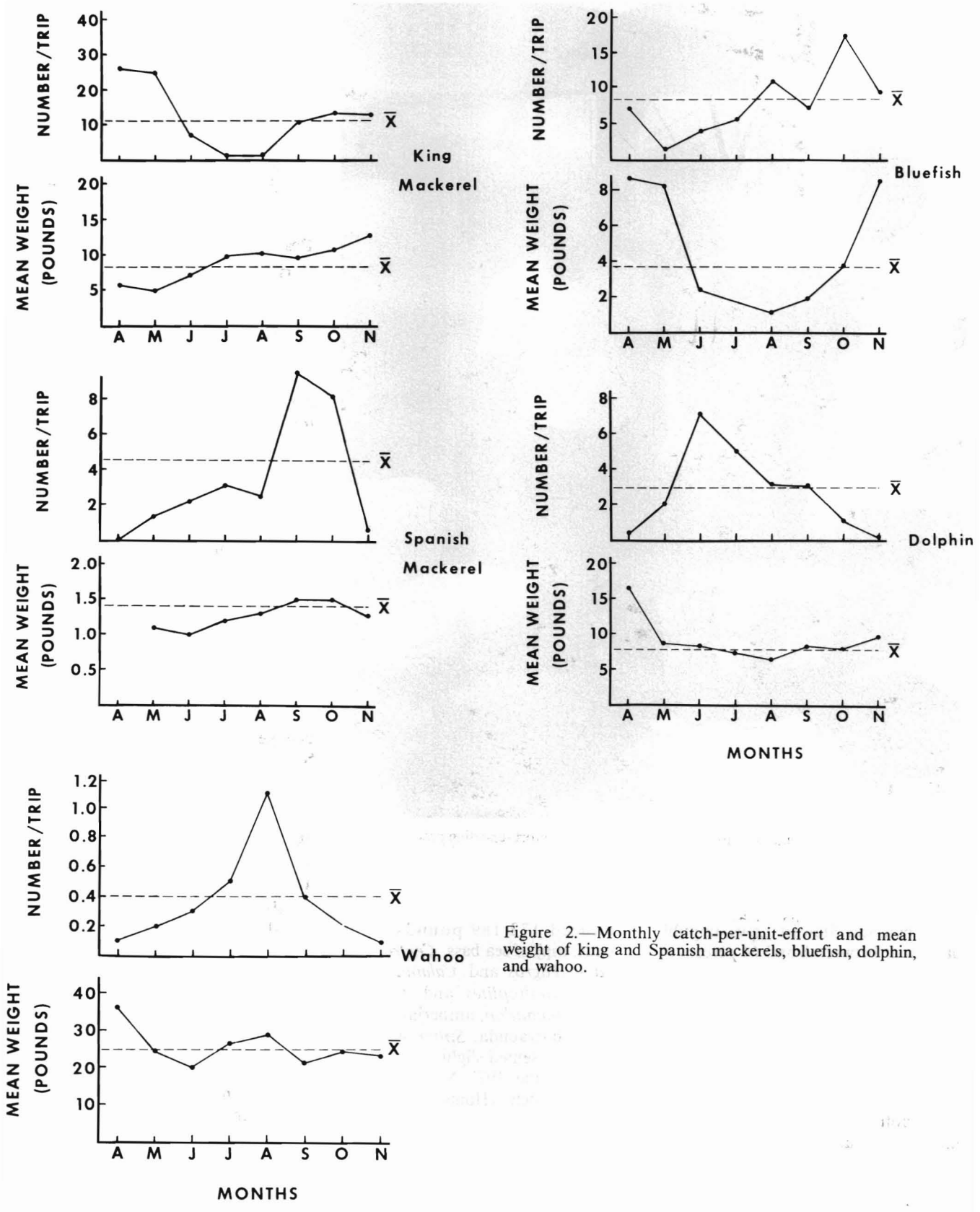
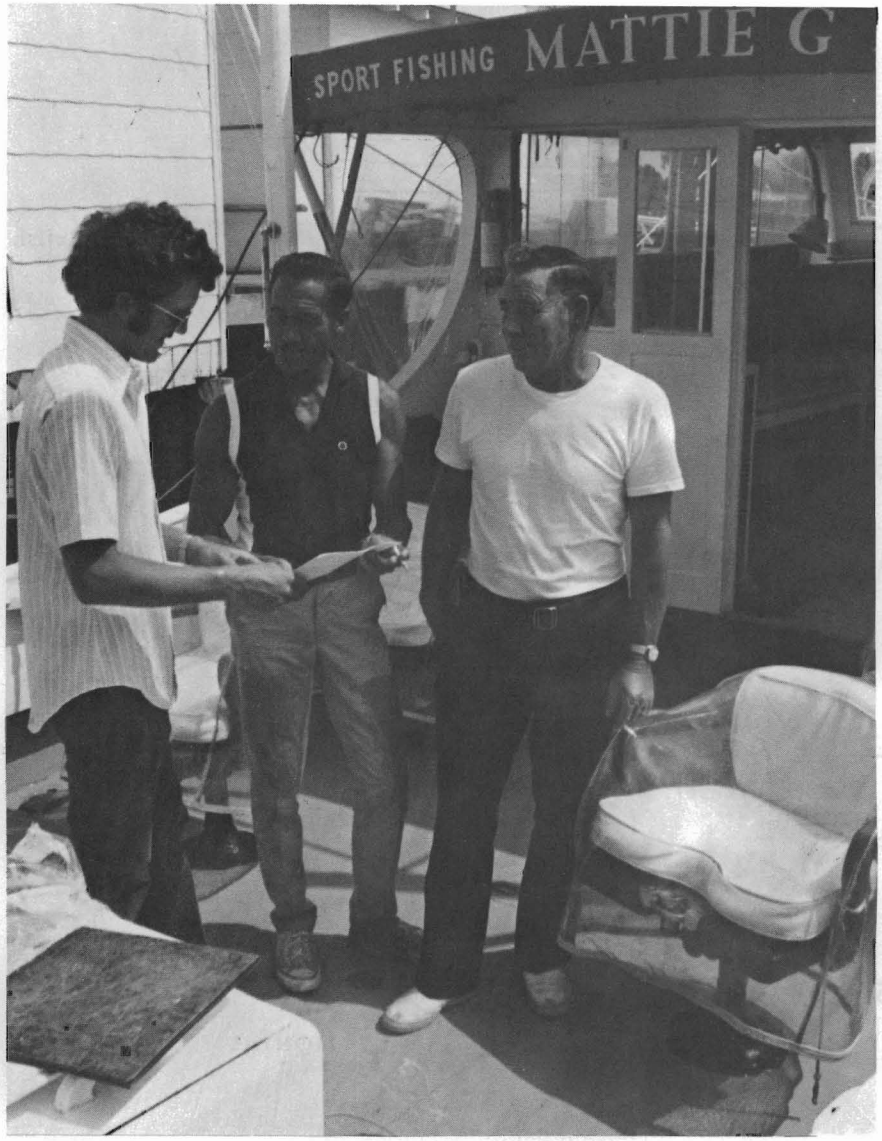


Figure 2.—Monthly catch-per-unit-effort and mean weight of king and Spanish mackerels, bluefish, dolphin, and wahoo.



Port sampler with captain and mate discussing catch and effort reporting procedures.

Manooch and Stewart Laws, unpubl. data) that between 8 and 64 percent of the central district charter boats made bottom fishing trips, depending on the month, an average of 4.1 trips for these boats per month, and a total catch of 107,498 pounds. In the southern district, from 22 to 63 percent of the fleet made nontrolling trips, an average of 7.6 bottom fishing trips per boat per month, and landed 64,691 pounds of bottom fishes. A total of 980 nontrolling trips were made by the North Carolina charter boat fleet in 1977 and produced 172,189 pounds (175.7 pounds/trip) of sea bass, *Centropristis,* porgies, *Pagrus* and *Calamus,* snappers, *Rhomboplites* and *Lutjanus,* grunts, *Haemulon,* amberjacks, *Seriola,* and barracuda, *Sphyraena.* This weight represented slightly less than 20 percent of the 1977 North Carolina headboat catch (Huntsman[3], unpubl. data).

[3]Gene R. Huntsman, NMFS Beaufort Lab., Beaufort, NC 28516.

A Discussion of the Future of Charter Boat Fishing

As is true with other fisheries, the future of the charter boat fleet will be dictated by economical, social, and biological factors. More precisely, the future status will depend on the availability of fish and fishermen and also the economic net gain achieved by fishing.

Resource Availability

The availability of all species is dictated by abiotic conditions such as temperature, photoperiod, currents, and biotic factors such as food. Temperature is probably the most important physical parameter in determining distribution and migratory patterns of mackerels. Munro (1943) stated that temperature is a limiting factor to the genus *Scomberomorus*; 20°C is reported to be the minimum preferred temperature. Both king and Spanish mackerels make annual migrations to stay in waters 20°C or above. Earll (1883) found Spanish mackerel prefer waters 21°-27°C. Lund and Maltezos (1970) noted that long-range migrations by bluefish were initiated at temperatures of 12°-15°C, whereas local movements, in and out of estuaries, were believed to be triggered by tidal change, local weather conditions, etc. Signs of stress were noted in bluefish at temperatures $<12°C$ and $>29°C$.

Photoperiod is also believed to influence coastal pelagic migrations. Wilk (1977) referred to behavioral studies at the NMFS Sandy Hook Laboratory which revealed that day length was an important stimulus for activity levels of bluefish. During day lengths comparable with spring and fall, the fish swam at higher speeds than during winter day length settings, thus indicating that photoperiod may initiate the northern spring migration and the southern fall migration. There is undoubtedly a complex interaction between temperature and photoperiod that affects the migrations of fishes.

These abiotic factors are important to the management of coastal pelagics because the resource occurs seasonally

and is not always available as is true with offshore demersal species. Fishing effort must be exerted during certain times of the year, generally in spring and fall. Unusually bad weather can drastically reduce fishing activity, and unseasonal temperatures can affect migration patterns and timing.

Habitat alterations and fishing activities by man could influence the availability of fishes. Offshore exploration and development of oil and mineral resources could have both detrimental (spills, sediment turbidities, etc.) and beneficial (construction of platforms which attract fish) effects. Overfishing, or reducing stocks to low levels, in other geographical areas could temporarily reduce the catches of migratory species by North Carolina charter boats.

Production of Pelagic Fish Communities

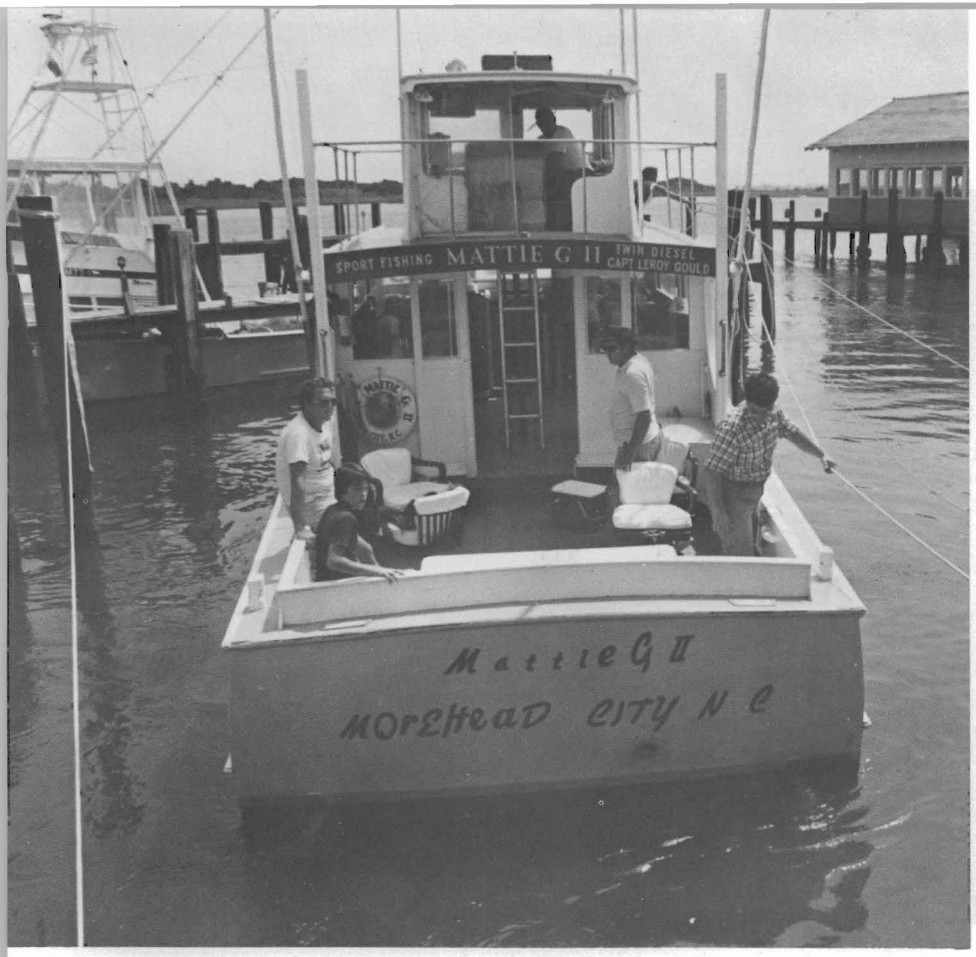
Some fish communities, such as reef fish, are limited by available habitat and restricted, localized production, but the pelagic predator communities are not. Their habitat extends the length of the South Atlantic Bight from shoreline to the shelf break, depending on species, an area of approximately 91,260 km^2. Populations of many of these species are large and will sustain large catches.

Annual productivity may be quite different between the inshore, coastal zone, and the offshore or oceanic zone. Annual production of coastal waters, sandwiched between fertile estuarine waters and the sterile oceanic waters, is relatively low. Odum (1971:51) ranked various ecosystems by their gross primary productivity. Estuaries were highest, 2,000 gC/m^2 per year, open ocean lowest, 100, and coastal zones, 200.

Energy sources to the coastal zone are diversified. Major sources of energy to the coastal zone are migrating organisms, euphotic zone fixation, watershed runoff, and transport from upwelled offshore waters. As migratory stocks move from differing types of areas—estuaries, rivers, coastal and oceanic zones—they utilize seasonal pulsations in productivity. Migrating

Catch of Spanish and king mackerels.

Recording biological information.



The end of a successful fishing trip.

stocks are incorporated into the energy cycle and then break away and emigrate to another area. In some instances the population's new young experience their first year of rapid growth in the systems visited by the parent stock. The impact of these stock movements is immense in terms of energy transfer in and out of local systems by death, waste products, reproduction, and food consumption.

From a managerial standpoint, mobility and the utilization of seasonal energy is important. A species can benefit from one area during a productive period and then move on to another location when conditions become less favorable, i.e., migratory stocks are not restricted to one geographical area for "better or for worse" as are relatively sedentary species.

Biological Characteristics of Pelagic Fishes

The principal biological factors which would influence the fishery are growth, natural mortality rates, and reproductive characteristics. Pelagic species attain their maximum size very rapidly. They are not only fast-growing but are relatively short-lived and experience high annual mortality rates compared with some other groups of fish, again including reef fish. Fishery science has demonstrated that species displaying these characteristics can be fished fairly heavily without overexploitation; stock(s) replenishment is usually rapid.

Coastal pelagic fishes demonstrate reproductive strategies such as high fecundity and protracted spawning, which have definite advantages because eggs and larvae are not as highly susceptible to short-term environmental degradation as for some other species. Also, most pelagic species are not dependent upon estauries as nursery areas. While currents, temperatures, and other naturally occurring conditions can adversely affect spawning and survival of young, man's negative influence is presently minimal on offshore nursery areas. An aspect which may be working to the detriment of the resource is that potential spawners are sometimes removed by fishing before they reproduce for the first time. An example is king mackerel (Beaumariage, 1973).

Competition Among User Groups

North Carolina charter boat operators and commercial fishermen compete for at least four species: king mackerel, Spanish mackerel, bluefish, and cobia (U.S. National Marine Fisheries Service, 1978). Although the charter boat segment of the total recreational catch may range from a low percentage (as with bluefish) to a high percentage (as with dolphin), of the four species caught by commercial fishermen, charter boats alone landed more for two: Three times more pounds of king mackerel, and slightly more Spanish mackerel (49,736 to 46,223 pounds). Commercial landings of bluefish were 9.5 times greater than charter boats because the commercial fishery nets this species, the commercial season lasted a full 12 months, and charter boats place a relatively low priority on bluefish except when large individuals are available. Cobia were relatively insignificant to both fisheries, less than 1,000 pounds for each.

For the development of fish management plans, researchers and managers need to know the total landings for a given species. Commercial data are available, and our survey provides catches for North Carolina charter boats. The recreational landings of tunas, dolphin, and wahoo as listed herein account for most of the recreational catch for these species in North Carolina. Rose and Hassler (1969) estimated that charter boats contributed 96 percent of the North Carolina catch of dolphin; we would assume similarly high percentages for tunas and wahoo.

Coastal pelagics present a problem for total catch analysis, because they may be caught from small private

boats, piers, bridges, and surf. We realize that our survey, although describing a significant recreational fishery, represents a relatively small percentage of the total recreational catch of bluefish, Spanish mackerel, and perhaps king mackerel. We attempted to get some idea of the total catch of these three species by questioning eight fisheries biologists, five from the Beaufort Laboratory and three from the North Carolina Division of Fisheries, Morehead City, N.C. All have worked professionally with recreational fisheries and are avid fishermen. We asked each, independently, to estimate the total recreational catch for the three species, given the 1977 North Carolina charter boat landings. Mean pounds estimated for king mackerel, Spanish mackerel, and bluefish were 1,299,314, 256,089, and 1,613,401, respectively. We plotted these estimates and selected five per species with the least variation between estimates. Average poundages with 95 percent confidence limits were: 1,221,860 (961,760-1,481,690) for king mackerel; 239,636 (219,798-259,474) for Spanish mackerel; and 1,548,664 (1,288,122-1,809,206) for bluefish. We believe these data are the best available for North Carolina for 1977.

These revised estimates indicate the importance of recreational fishing in the State. Recreational fishermen caught 5.0 times more pounds of king mackerel, 5.4 times more pounds of Spanish mackerel, and 0.7 times as many pounds of bluefish as commercial fishermen.

Economics

Abbas (In press) suggested that the average North Carolina charter boat operates in the "red," losing money each year. We suspect that there is a bimodal distribution of the economic returns. A segment of the fleet does quite well financially while another, those boats that fish less often, does not. Although the price of an average trip has increased since 1961 (Rose and Hassler 1969; Abbas, in press), the operating costs have increased drastically. Variable costs, mainly repairs, fuel, mate's salary, and fixed costs, primarily vessel depreciation (Abbas, in press), reduce the net returns to the boat operator-owner. Perhaps the most critical long-term factor affecting the economical status of the fleet is fuel. Not only is fuel expensive, but trolling expends energy at a high rate. Boats are constantly underway going to and from the fishing grounds, searching for fish, and fishing.

Another factor which will continue to influence the fishery is that more people own boats capable of fishing coastal waters, and some are able to fish in the Gulf Stream. The option of chartering a boat may not be as appealing, particularly to North Carolina residents, as in the past. Something is occurring, however, which offsets this because more charter boats are operating than ever before. Since 1961 the number of charter boats has increased from 90 (Rose and Hassler 1969) to 127. A cursory inspection of the ports in March 1978 indicated that more vessels will be operating in 1978. Perhaps the increasing out-of-state tourist trade, which generally does not trailer boats as frequently, is filling the charter fleet demand.

In summary, although costs of fishing are rising, the number of charter boats in North Carolina is increasing and angler success is relatively high. It is difficult to predict the future of the fishery by analyzing data from only 1 year. Perhaps the data presented here will serve as a baseline study and will be expanded in the future to include other geographical areas and segments of the recreational fishery. The subject of recreational catch and effort needs immediate attention for the management of marine fishery resources.

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