

# A Fisheries Dependant Survey of Baitfishes in Puerto Rico

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## ABSTRACT

A three month survey to determine the status of Puerto Rico's baitfish fishery was accomplished through interviews with 158 local fishermen. Results suggest that the North coast is the most productive coast and that there is little or no seasonality in baitfish abundance. The majority of baitfish species belong to the family *Clupeidae* and are caught by cast net or beach seine in grass beds, mangroves, or along accessible beaches during the day, by fishermen who live nearby. The data presented suggest that baitfish landings for 1986 were lower than any of the previous three years examined. Fishermen cite the recent increased fishing effort and "pollution" as the reason for decline.

## INTRODUCTION

Information on the species composition and value landings of baitfishes in the Caribbean is rare. One of the few baitfish studies was conducted by Wagner and Wolfe (1974) who presented results from a Caribbean-wide exploratory effort using various commercial gears to sample baitfishes used in the capture various oceanic pelagic species. The most productive baitfish area during that 1967-1970 study was the Windward Islands. In the northern Caribbean, which was defined by Wagner as extending from Honduras to Puerto Rico, the thread herring, *Opisthonema oglinum*, and the dwarf herring, *Jenkensia lamprotaenia*, were most abundant. A recent baitfish study conducted in the U.S. Virgin Island yielded quantitative results on the abundance and use of *J. lamprotaenia* in an artisanal fishery (Beets and LaPlace, 1991).

This paper describes a three month baitfish survey designed to summarize Puerto Rico's local baitfish industry and was begun in October and continued through December, 1986. The survey was initiated through the joint efforts of the Caribbean Fisheries Management Council and the Fisheries Research Laboratory of CODREMAR (LIP). Specific objectives were to:

1. Identify those species regularly utilized as baitfish by both commercial and recreational fishermen;
2. Determine the habitats fished and the time of day of peak fishing activity;
3. Determine which commercial or recreational species was targeted for capture when using each baitfish species;



4. Determine seasonality, for as many baitfish species as possible by means of fishermen interviews and computerized records.

### METHODS

In October, two port agents were given the task of interviewing local fishermen from 46 pre-selected ports representing 18 municipalities around the island (Figure 1). These ports were chosen because subjective information derived from commercial fishermen indicated that they would be representative of the Puerto Rico baitfish industry.

Prior to field sampling agents devised an interview form based on the above listed objectives. The information from initial interviews was useful in planning subsequent interviews. In order to determine the species composition of baitfish catches, agents often showed fishermen drawings (Fischer 1978) or photographs (Randall 1985) of suspected species but relied mostly on common names surrendered by fishermen and matched with published lists (Erdman 1985). The species codes used in this paper are derived from a numbered list of Puerto Rican English common names (Erdman 1985). Agents also periodically collected specimens of baitfish from the various ports in order to verify identification. These specimens are currently being curated at the Fisheries Research Laboratory but will eventually be deposited in the Vertebrate Museum in the Department of Marine Sciences, University of Puerto Rico, in Mayagüez.

In addition to fishermen interviews, agents extracted information on various baitfish groups (sardines, ballyhoo, mullet and mojarra) from a computerized data base for the period of January 1983 to the present. This data base was that of the Fisheries Research Laboratory of CODREMAR and the determination of monthly and yearly landings was the purpose of this effort.

### RESULTS

During the survey the two agents interviewed baitfish fishermen, obtained baitfish specimens from around Puerto Rico to establish a voucher collection, and extracted baitfish landings data for the period of January 1983 to the present from the Fisheries Research Laboratory's computerized data base. The purpose of these efforts was to further enhance our knowledge of the status of the baitfish fishery.

From the 158 interviews conducted between October and December 1986 (Table 1), catches from the Puerto Rico baitfish effort can be summarized as being comprised of 11 principal species or species groups, from an overall list of 50 species (Table 2). These species make up more than 75% of baitfish landings. The principal species listed in order of priority are *Harengula* spp. (23%; predominantly *H. jaguana*), *Hermiramphus* spp. (14%; predominantly *H.*

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**Table 1.** The locality and number of bait fishermen interviews conducted at various ports and municipalities around Puerto Rico during October-November, 1986.

Visited municipalities	Ports	Code	Number of fishermen interviewed	% of Total
Arecibo	Jarealito	050	5	3.16
Arroyo	Playa	270	3	1.90
Cabo Rojo	Pitahaya	370	1	0.63
	Bahia Sucia	371	1	0.63
	Combate	372	1	0.63
	Boqueron	373	3	1.90
	Puerto Real	374	6	3.80
	Joyudas	375	1	0.63
	Carolina	Torrecilla	140	8
Culebra	Pueblo	240	5	3.16
Fajardo	Croabas	180	2	1.26
	Sardinera	181	1	0.63
	Puerto Real	182	2	1.26
Guanica	Bahia	350	3	1.90
	Salinas Pro.	351	6	3.80
	Guaypao	352	3	1.90
	Cana Gorda	353	2	1.26
Guayanilla	Bahia	340	7	4.43
Humacao	Pta. Santiago	210	10	6.33
	Candelero	211	5	3.16
Juana Diaz	Pastillo	310	4	2.53
Lajas	Parguera	360	2	1.26
Loiza	Parc. Vieques	150	2	1.26
	Ancon	151	5	3.16
	Mediania baja	153	1	0.63
Maunabo	El Faro	230	6	3.80
Mayaguez	El Seco	380	1	0.63
	El Mani	381	3	1.90
	Docky	382	1	0.63
Naguabo	El Corcho	200	1	0.63
	Hucares	201	2	1.26
Penuelas	Tallaboa	330	2	1.26
Ponce	Playa	320	5	3.16
Rincon	Parc. Stella	400	3	1.90
	Borrero	401	5	3.16
	Corcega	402	1	0.63
	Playa	290	3	1.90
Salinas	Las Mareas	291	4	2.53
	Aguirre	292	4	2.53
	Parada 9 1/2	130	4	2.53
San Juan	La Puntilla	131	3	1.90

Table 1 (continued).

Visited municipalities	Ports	Code	Number of fishermen interviewed	% of Total
	La Coal	132	5	3.16
Vega Baja	Puerto Nuevo	080	8	5.06
Vieques	Esperanza	250	2	1.26
	Morropo	251	5	3.16
Yabucoa	Guayanes	220	1	0.63
23	46		158	100.00

**Table 2.** Baitfish species as designated by fishermen through the interview process. Species names were selected by agents and/or fishermen from associations with common names lists (Erdman 1985), published photographs (Randall 1968), or drawings (Fischer 1978). An asterisk (\*) means species was collected and preserved for a voucher collection.

Scientific name	Municipality used**	Gear	Common name
Squid	all	Import	calamar
Penaeidae	all	Cast	camarones
Elopidae	all	Gill	sabalo, macaco
<i>Megalops atlanticus</i>	all	Gill	sabalo
<i>Albula vulpes</i>	all	Gill	macaco
Muraenidae	all	Trap	morenas
Clupeidae	all	Cast	arenques, sardinas
<i>Jenkinsia lamprotaenia</i>	all	Cast	mijua
* <i>Anchoa lamprotaenia</i>	all	Cast	mijua (grande)
	Guanica	Cast	
* <i>Harengula humeralis</i>	all	Cast	machuelo
	Guanica	Cast	arencon
	Humacao	Cast	machuelo, sardina
	Vieques	Cast	machuelo
* <i>Harengula jaguana</i>	all	Cast	cascarua, sardina
	Salinas	Cast	sardina blanca
	Cabo Rojo	Cast	sardina blanca
	Humacao	Cast	sardina comun, machuelo
* <i>Harengula clupeiola</i>	Salinas	Cast	sardina blanca
	Cabo Rojo	Cast	cascarua
	Humacao	Cast	machuelo
<i>Harengula</i> sp.	all	Cast	sardinas
* <i>Opisthonema oglinus</i>	Rincon	Gill	sardinas
	Rincon	&	arenca
	Humacao	Cast	arenquilla
<i>Sardinella?</i>	San Juan	Cast	sardina espanola

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Table 2 (continued).

Scientific name	Municipality used**	Gear	Common name
<i>Chirocentrodon bleckerianus</i>	all	Cast	pelaiilla
<i>Cetengralulis edentulus</i>	all	Cast	bocona
	Puerto Real	Cast	boquiculebra
	Boqueron	Cast	lapa grande
* <i>Anchoa hepsetus</i>	all	Cast	mijua (pequena) bocua
* <i>Anchoa sp.</i>	Guanica	Cast	mijua (pequena)
* <i>Hemiramphus brasiliensis</i>	all		balaju
	Guanica	Beach seine	balaju
	Humacao	Cast	balaju de altura
<i>Hemiramphus sp.</i>	all	Beach seine	balaju
* <i>Hyporhamphus unifasciatus</i>	all		balaju
	Mayaguez	Beach seine	pico fosforo
	Humacao	Cast	balaju blanco
Centropomidae	all	Beach seine	robalos
<i>Malacanthus plumieri</i>	all	Hook & line	jolocho
<i>Caranx ruber</i>	all	Hook & line	jurel
<i>Selar crumenophthalmus</i>	all	Hook & line	chicharro
<i>Lobotes surinamensis</i>	all	Dip net	pargo sargo macuri, chopá
Gerridae	all	Beach seine	mojarra y muniama
<i>Haemulon aurolineatum</i>	all	Beach seine	mulita
<i>Condon nobilis</i>	Mayaguez	Beach seine	verraco
<i>Pomadasys crocro</i>	Mayaguez	Beach seine	burreteado viejo
<i>Calamus pennatula</i>	all	Beach seine	pluma
<i>Micropogonias furnieri</i>	all	Beach seine	corvina
Mullidae	all	Trap	salmonetes
<i>Mulloidichthys martinicus</i>	all	Trap	salmonete amarillo
Mugilidae	all	Cast & gill	jareas, lisas
<i>Mugil liza</i>	all	Cast &	lisa

Table 2 (continued).

Scientific name	Municipality used**	Gear	Common name
* <i>Mugil curema</i>	all	Cast	jarea
	Vieque	&	jarea
	Salinas	gill	jarea
* <i>Mugil trichodon</i>	Puerto Nuevo	Cast	jarea
	Boqueron	Cast	jarea
<i>Sphyraena picudilla</i>	all	Gill	picudilla
* <i>Polydactylus virginicus</i>	all	Gill & Beach seine	barbu
<i>Sicydium plumieri</i>	all	Dip net	olivo, ceti
<i>Acanthurus bahianus</i>	all	Trap	medico
* <i>Trichiurus lepturus</i>	all	Hook & line	machete, sable
<i>Euthynnus pelamis</i>	all	Hook & line	bacora
<i>E. alleteratus</i>	all	Hook & line	vaca, bonito
Centrarchidae	all	Hook & line	lobinas y chopas

\*\* Municipalities named are those where specimens for the voucher collection were obtained.

*brasiliensis*), *Mugil* spp. (12%; predominantly *M. curema*), *Clupeidae* (11%; this group represents those herring like fishes that fishermen could not positively identify to species from information supplied to them by port agents but are most probably represented by those *cluepids* on this list), *Opisthonema oglinum* (9%), *Harengula humeralis* (9%), *Anchoa* spp. (9%; the three predominant species in Puerto Rico are *A. lamprotaenia*, *A. hepsetus*, and *A. lyolepis*), *Selar* spp. (4%; scads were considered to be baitfish but no samples could be obtained), *Hyporhamphus unifasciatus* (4%), *Jenkinsia lamprotaenia* (3%), and *Chirocentron bleekermanus*? (3%; no specimens could be obtained). When comparing the species composition of voucher collections made during November-December (Table 2) to the entire species list one can see that many species were not collected. While most are present in Puerto Rico, they did not appear in our collections either because they were not abundant when collections were made or they represent misidentifications. Many species from these groups are quite similar and positive identifications can only be made by qualified people with appropriate literature and laboratory facilities. It should be kept in mind that collections of baitfish indicated in Table 2 were made during the month of November, only, and is probably not totally representative of the species composition of Puerto Rico's annual baitfish harvest. It is surprising that

**Table 3.** Estimated monthly catch per effort (CPUE) of baitfishes at each municipality interviewed. Data was derived from 158 interviews with fishermen conducted during October - December, 1986.

Municipality	CPUE	Total pounds/#fishermen
Carolina	1,702	13,616/8
Fajardo	1,502	7,512/5
San Juan	1,444	17,328/12
Rincon	1,502	10,417/9
Naguabo	944	2,832/3
Vega Baja	857	6,860/8
Arecibo	788	3,940/5
Mayaguez	764	3,820/5
Loiza	715	5,719/8
Humacao	647	9,708/15
Cabo Rojo	402	5,232/13
Guayanilla	367	2,566/7
Guanica	366	5,120/14
Juana Diaz	350	1,400/4
Ponce	340	2,038/6
Vieques	323	2,264/7
Arroyo	320	960/3
Lajas	300	600/2
Maunabo	277	1,660/6
Salinas	234	2,580/11
Yabucoa	140	140/1
Culebra	120	600/5

species of the family Atherinidae (especially *Atherinomorus stipes*) were not mentioned as baitfishes by local fishermen. This group of fishes is quite common and abundant around docks, jetties, mangrove islets, and other shallow water habitats in Puerto Rico (Kimmel 1985) where they are often forage for larger, predatory species.

Interview data revealed that San Juan, Carolina, Rincon, Humacao and Fajardo, in the order listed, are the five most productive municipalities in terms of annual estimates of baitfish landings and CPUE (Table 3). Computer data summarized from October and November for the 1983 to 1985 period (Table 4) indicates the North coast as the most productive for baitfish with landings of 22,091 lbs reported for all baitfish groups combined. The East coast reported the lowest landings of 723 lbs for the same period. Because the computerized data was derived from a trip ticket system where data was traditionally lumped according to species groups, individual accounts of landings per baitfish species per coast could not be distinguished. The species groups labeled as mullets, sardines, ballyhoo, and mojarras from this data base and listed on Table 4 were considered by port agents to represent baitfish landings at the respective ports. It



**Table 4.** Landings of baitfish during the months of October and November from 1983 to present. Data from 1983—1985 was extracted from the Fisheries Research Laboratory historical files (Original source for data were fishermen trip tickets). Data for 1986 was collected during the present study.

Month	Year	Coast	#Ports	#Fishermen	Sardine	Mullet	Weight (pounds)			100	101	Gear Frequency*		
							Ballyhoo	Mojarra	Mullet			103	104	107
Oct	1983	North	13	50	1015	581	60	253	—	1	21	4	25	
		East	1	2	—	52	67	—	1	1	—	—	—	
		South	8	25	55	1101	441	22	15	1	10	—	—	
		West	3	7	—	733	300	—	—	7	—	—	—	
1984	North	North	10	50	876	446	150	327	—	—	23	6	21	
		East	2	5	23	68	32	—	1	2	—	—	2	
		South	7	11	90	548	256	13	4	2	6	—	1	
		West	—	—	—	—	—	—	—	—	—	—	—	
1985	North	North	7	22	713	237	26	13	—	—	5	1	16	
		East	2	4	65	—	4	50	1	—	—	—	4	
		South	7	13	—	577	237	9	4	9	—	—	—	
		West	4	16	139	1181	1294	54	2	1	12	—	—	
1986	North	North	6	27	9499	5700	2900	220	1	10	10	—	21	
		East	12	35	3094	1236	9374	—	8	6	6	—	25	
		South	11	33	4635	1084	4098	—	4	11	11	—	23	
		West	5	6	1100	930	800	—	2	3	3	—	2	
Nov	1983	North	11	48	902	786	0	86	—	—	20	4	23	
		East	2	2	—	20	24	—	—	—	1	—	1	
		South	8	20	—	1703	247	50	11	1	10	—	—	
		West	3	5	—	206	745	161	3	5	—	—	—	

Table 4 (continued).

Month	Year	Coast	#Ports	# Fishermen	Sardine	Weight(pounds)					Gear Frequency*					
						Mullet	Ballyhoo	Mojarra	100	101	103	104	107	109	110	
1984	North		9	35	598	525	75	330			17	2	2		18	
	East		2	3	125	--	--	--		1			2			
	South		7	13	23	979	107	--	8		3			1	1	
	West		3	4	16	91	200	--	1		1				2	
1985	North		10	39	998	893	3430	154			27	7			8	
	East		3	4	26	47	120	--	1				1		1	
	South		7	10	--	211	50	--	3	1	5				1	
	West		2	10	--	317	79	272	1		9					
1986	North		1	2	208	600	3000	100	1		2				2	
	East				--	--	--	--								
	South		6	12	1878	2400	200	--	2						12	
	West		6	18	8270	270	86	--	5		1				12	

\*100—Beach seine; 101—Trap; 103—Gill net; 104—Handline; 107—Trotline; 109—Cast net; 110—Spear

can be seen from Table 4 that landings data derived from fishermen interviews (i.e., October and November, 1986) is consistently higher than computerized landings data. There are several reasons for this. First, computerized data only include the portion of the total baitfish landings which are sold by fishermen and do not reflect the portion used by the fishermen. Second, several species of baitfish may go unreported by fishermen because the species' common names do not appear on the trip ticket list. Third, the interview process was generally more intense than the trip ticket program and more of the "specialized" baitfishermen were interviewed, thus accounting for higher landings. Fourth, while interviewing fishermen, most were asked to recall daily or weekly catches from which monthly estimates were calculated so that final extrapolated estimates of annual landings, presented herein, could be in error.

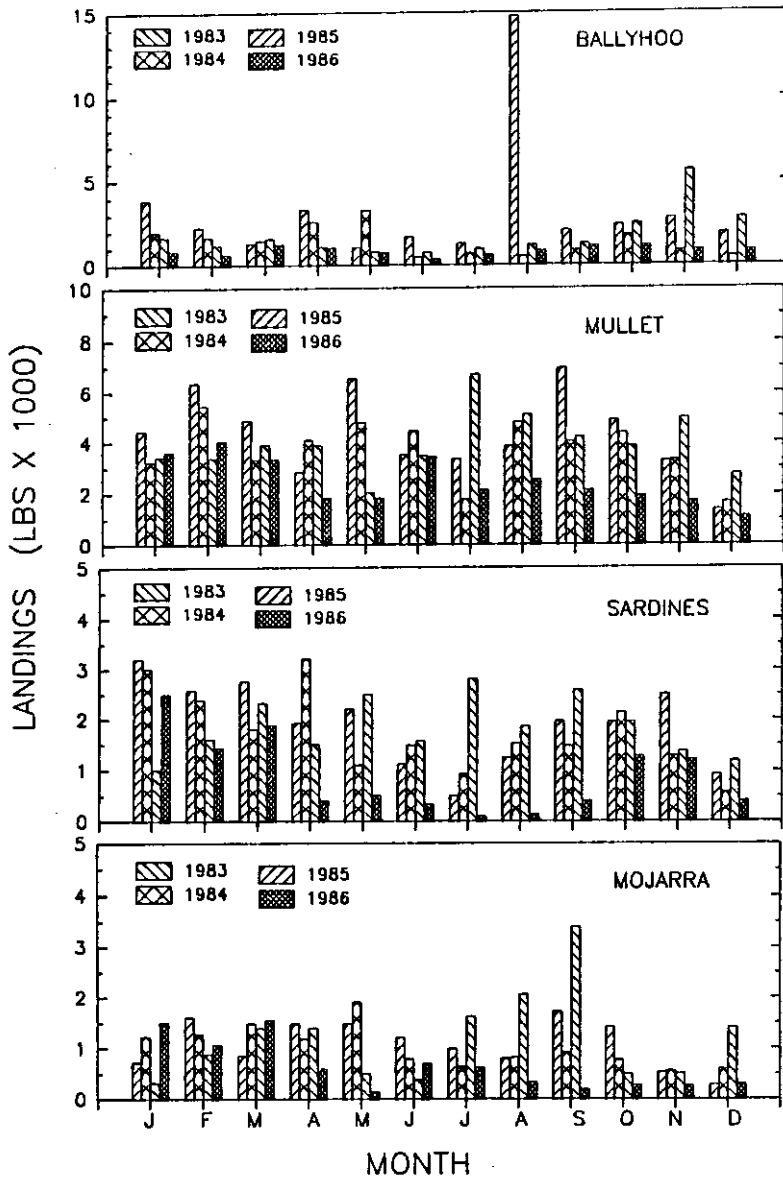
Figure 2 represents monthly landings of sardines, ballyhoo, mullets, and mojarras for the period of January, 1983 to December, 1986. This data was extracted from the computerized data base at the Fisheries Research Laboratory. For all four of these species groups little or no seasonal trends can be identified. There seems to be a very slight trend towards a bimodal distribution in landings

**Table 5.** Frequency of fishing gear used to capture baitfish. Data collected from interviews conducted around Puerto Rico during October - December, 1986.

Fishing gear	Frequency	%
Cast net	122	63.54
Seine net	28	14.58
Gill net	36	18.75
Dip net	4	2.08
Hook and line	1	0.52
Trap	1	0.52
Total	192	100.00

with the early summer months being the period of lowest landings. The 1983 August peak for ballyhoo indicated on Figure 2 was approximately twelve times above subsequent years and is thus considered of questionable validity. One general trend which is fairly consistent in the data for this period for these species groups is that 1986 landings are less than those reported from previous years.

Most baitfish fishermen fish from the shoreline around their home ports but occasionally will fish from nearby ports to obtain baitfish. The three principal gears and the percent frequency used are cast nets (65%), gill nets (17%), and beach seines (17%) (Table 5). Most fishermen (82%; 117 fishermen) fish for baitfish throughout the year (Table 6) and suggest little or no seasonality in their



**Table 6.** Distribution of monthly effort of baitfish fishermen in Puerto Rico. Data collected from fishermen interviews during October - December, 1986.

Month	Number of Fishermen	%
January	11	37.93
February	10	34.48
March	7	24.14
April	9	31.03
May	11	37.93
June	11	37.93
July	10	34.48
August	10	34.48
September	13	44.83
October	16	55.17
November	15	51.72
December	13	44.83

Note: One hundred twenty-nine of 158 go fishing every month of the year, representing a 81.64% of the baitfish fishermen interviewed during October-December, 1986.

**Table 7.** Distribution of daily effort of baitfish in Puerto Rico. Data collected from fishermen interviews during October - December, 1986.

Time	Number of fishermen	%
Day	88	55.70
Night	10	6.33
Both	53	33.54
No answer	7	4.43
Total	158	100.00

**Table 8.** The frequency of lunar phase period fished by the 62 of 158 fishermen answering positively (39.24%) to using lunar phase for fishing. Data collected from interview process during October-December, 1986.

Lunar phase	Frequency	%
Full	18	23.38
New	20	25.97
First Quarter	10	12.99
Last Quarter	29	38.76
Total	77	100.00

**Table 9.** Frequency of habitat type utilized by baitfish fishermen around Puerto Rico. Data collected from interview process during October - December, 1986.

Habitat	Frequency	%
Grass beds	34	14.53
Mangroove	47	20.08
Reef	21	8.97
Beach	83	35.47
Open sea	11	4.70
River mouth	9	3.85
Bay	23	9.83
Lagoon	6	2.56
Total	234	100.00

catches but cite the winter months (October through January) as the most productive (see Figure 2). The majority of baitfish fishermen interviewed (58%; 82 fishermen) only fish during the day (Table 7) and most do not use the phases

**Table 10.** The most sought after species and the number of different species of baitfish used to catch them. N is the number of fishermen who reported catching targeted species. Data collected from the interview process during October - December, 1986.

Code	Targeted species	N	#Baitfish	Frequency
233	<i>Scomberomorus cavalla</i>	113	26	194
140	<i>Ocyurus chrysurus</i>	73	26	151
136	<i>Lutjanus synagris</i>	55	21	77
139	<i>Lutjanus vivanus</i>	54	31	128
134	<i>Lutjanus analis</i>	47	24	87
203	<i>Sphyraena barracuda</i>	27	28	46
109	Carangidae	25	22	51
88	<i>Epinephelus guttatus</i>	22	14	39
225	Scombridae	20	16	41
155	<i>Haemulon plumieri</i>	20	16	38
127	Coryphaenidae	17	18	37
142	<i>Rhomboplites aurorubens</i>	15	18	46
237	Istiophoridae	13	12	28
229	<i>Euthynnus pelamis</i>	9	8	15

**Table 11.** The most frequently used baitfish and the number of species targeted. N is the number of fishermen who reported using the respective baitfish species. Data collected from the interview process during October - December 1986.

Code	Baitfish species	N	#Sp. Tgt.	Frequency
39B	<i>Harengula</i> sp.	76	38	308
55B	<i>Hemiramphus</i> sp.	47	45	168
197	Mugilidae	45	33	148
36	Clupeidae	40	37	143
44B	<i>Anchoa</i> sp.	40	18	105
40	<i>Opisthonema oglinum</i>	37	25	105
38	<i>Harengula humeralis</i>	32	29	125
120	<i>Selar crumenophthalmus</i>	18	20	52
56	<i>Hyporhamphus unifasciatus</i>	17	28	67
229	<i>Euthynnus pelamis</i>	11	14	36
37	<i>Jenkinsia lamprotaenia</i>	11	15	36
00	<i>Sepioteuthis</i> sp.	9	27	56
41	<i>Chirocentrodon taeniatus</i>	8	9	17
43	<i>Centengraulis edentulus</i>	8	12	33
233	<i>Scomberomous cavalla</i>	8	16	27
01	Penaeoidea	5	10	15
28	<i>Albula vulpes</i>	5	9	14
42	Engraulidae	4	15	18
147	Gerreidae	4	12	15
26	<i>Elops saurus</i>	3	8	8

of the moon to guide their fishing effort. For the 62 fishermen who said that they did rely on the moon to fish, none of the four lunar phases stood out as better than another (Table 8). Grass beds, mangroves, and open beaches are the favorite harvest areas for local fishermen (Table 9).

Most baitfishes are utilized by the fishermen who collect them but are occasionally sold when in unusual abundance. Approximately 11% (17) of the fishermen interviewed rely on the baitfish industry for their livelihood. The

**Table 12.** The fishermen's opinion as to the status of baitfish fishery in Puerto Rico. Data was derived from 158 interviews with fishermen conducted during October - December, 1986.

Status	Frequency	%
Same	48	30.4
Better	5	3.2
Worse	103	65.2
No Opinion	2	1.2
Total	158	100.0

**Table 13.** Reasons given by fishermen for the present declining status of Puerto Rico's baitfish fishery. Data was collected from 158 fishermen through the interview process during October - December, 1986.

Reason	Frequency	%
Increased Effort	73	38.4
Pollution	43	22.6
Weather	17	9.0
Habitat Alterations	27	14.2
Natural Fluctuations of abundance of resources	15	7.9
Others	15	7.9
Total	190	100.0

fishermen report that the baitfishes are utilized to attempt to catch 16 favored commercially and recreationally important species or species groups (Table 10) but that as many as 45 different species are captured with a single species of baitfish (Table 11).

Of the 158 fishermen interviewed 65% stated that the fishery was in worse condition now than in previous years; 30% said it was the same, while 3% said it was better. Two fishermen declined to answer since they had entered the fishery only recently (Table 12). Reasons for the decline included 1) heavy fishing pressure (= increased effort), 2) pollution, 3) disturbance of habitats from increased recreational activities, 4) weather, and 5) natural fluctuations in population abundance (Table 13).

#### DISCUSSION

The term "baitfish" in Puerto Rico could be defined as any fish or invertebrate that is catchable and is used to attract "desirable" species to the gear used. I offer this definition to point out that while some fish and invertebrates are always used as bait some are used both as bait (when small or otherwise not saleable) and as marketable seafood (*e.g.*, *Scomberomorus cavalla*, *Trichiurus lepturus*, *Mugil spp.*, mojarras, etc.). For this reason an occasional "baitfish" species in this report may also be cited as a "targeted" species for the commercial market.

The Puerto Rico baitfish fishery, while not very organized, seems to accommodate the local artesanal fishing industry so that there is no overwhelming dependency on imported baits, although imported squid from California are used regularly by both commercial and recreational fishermen. The fishery is comprised primarily of fishes of the family Clupeidae. The



baitfishes collected locally are adequate attractants for the targeted commercial, sport, or recreational species sought. Most baitfishes are used with a hook and line gear but a few are used in traps. While few fishermen depend solely on monies gained from capturing and selling baitfish, many take advantage of the sport fishing tournament season by increasing their effort towards the capture and subsequent sale of baitfish to recreational fishermen. The larger baitfishes such as mullet, bonefish, and ballyhoo are excellent sportfishing baits. During most of the year, however, baitfish are utilized by the fishermen who collect them.

Little or no seasonality exists in the commercial landings of baitfishes around Puerto Rico. The opinion of the fishermen, however, is that the period from October through December is the most productive.

The North coast is the least productive, in terms of commercial fishing (Weiler and Suarez-Caabro 1980, Calderon and Collazo 1984), but it has a higher catch per effort for baitfishes than any other coast. Quite possibly the fishermen on the north coast have more time to spend capturing baitfish since other fishery resources are low. In addition, fishermen around the metropolitan area of San Juan take advantage of the intensified sport fishing activities in this area and frequently supply baitfishes to sport fishermen (Miguel Rolon, personal communication).

Most baitfishes are caught in grass beds or mangroves or along accessible beaches during the day by fishermen who live nearby. These fishermen generally use cast nets or beach seines from the shore to capture baitfishes in the shallows. A few, however, use boats with outboard engines to travel to nearby reefs or other areas where desired baitfish are known to congregate.

Data presented in this report (Figure 2) suggest that baitfish landings (*i.e.*, sardines, ballyhoo, mullets, and mojarras) for 1986 were lower than any of the previous three years examined. The majority of fishermen interviewed for this study also stated that the baitfish fishery was worse now when compared to the past. Reasons for the fishery's decline, as cited by fishermen range from increased fishing effort to "pollution." Because of these indications the status of baitfish stocks should be closely monitored and managed to avoid destruction of these valuable key resources.

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