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SPAWNING PATTERNS OF FISHES FROM THE NORTHEASTERN CARIBBEAN

por — by
Donald S. Erdman

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SPAWNING PATTERNS OF FISHES FROM THE NORTHEASTERN CARIBBEAN[1]

By
Donald S. Erdman[2]

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[2] Assistant Director of the Commercial Fisheries Laboratory, Department of Agriculture, Commonwealth of Puerto Rico and Project Leader of Puerto Rico's PL 88-309, Project Number 2-258-R-2.

SPAWNING PATTERNS OF FISHES FROM THE NORTHEASTERN CARIBBEAN

ABSTRACT

Precise life histories of most fish species are still unknown. Twenty three years of continuous observations on seasonality of gonad ripeness, presence of leptocephali, postlarvae and juveniles are combined with relevant data from the literature and charted for 350 marine and freshwater fishes from this region.

Individuals of many marine species were found to spawn year-round with seasonal peak spawning once or twice during the year in some cases. Fewer species showed limited and well defined spawning periods. Further evidence of periodic spawning was the frequent occurrence of gonads found in repose in adult fishes.

In some species fat bodies attached to the gonads indicated an approaching spawning period.

LAS FREZADAS DE PECES EN EL NORDESTE DEL CARIBE

RESUMEN

Los ciclos de vida precisos de la mayoría de los peces son desconocidos todavía. Continuas observaciones a lo largo de veinte y tres años (23) sobre la periodicidad de la maduración de las gonadas, la presencia del larvas leptocéfalas y juveniles son combinadas con información importante de la literatura siendo recopiladas en tablas hechas a tal efecto de 350 especies tanto marinas como de aguas interiores de esta región.

En algunos casos, se encontró individuos de varias especies con desove a través de todo el año, con una o dos temporadas de mayor desove durante el año. Pocas especies mostraron períodos de desove limitados y bien definidos. La frecuente ocurrencia de gonadas encontradas en estado de reposo en peces adultos evidencian más aún el desove periódico de estos.

En algunas especies la presencia de cuerpos grasos unidos a las gonadas indican la cercanía del período de desove.

INTRODUCTION

Phenology, the timing of critical events in the life histories of animals, has been a lifelong interest with me, and it early became concentrated on fishes and sea life. But though the question "when does a fish spawn? " appears at first simple, the longer one studies the more variations arise, areas differ, years differ, so that one becomes more, rather than less hesitant to state rules.

Indications of seasonal, periodic, or intermittent spawning are recorded in this paper for 350 species of fish, 336 saltwater and 14 freshwater. Most of the specimens were observed from around Puerto Rico where I have been engaged since 1954 in fresh and saltwater sport fish restoration programs, and in studies of commercial fishes for the Puerto Rican Department of Agriculture. A few data stem from earlier visits.

Relevant information was acquired on several offshore cruises; thus the region included in the paper extends from Antigua (17° N & 62° W) northwestward to Silver Bank (21° N & 70° W) and includes the Virgin Islands.

Items from the literature have been added to round out the picture to date.

METHODS

The incontrovertible proof of spawning periods is, of course, the recurring presence of ripe ova and testes in numbers of individual fishes. Weekly, if not daily, during my years in Puerto Rico I dissected fish as they came in from sport or commercial fishing to determine gonad ripeness and stomach contents. Coded in the chart are data for those fishes which were either stage III —sub-ripe gonads, or stage IV— ripe gonads. Complementary data, equally important, were obtained by observation of the times and numbers of fish when they were not near spawning condition, when gonads were recessed, though these observations are not individually recorded in this paper.

Indications of recently past spawning periods were gained through the observation of the presence and relative abundance of postlarval fishes, both reef and pelagic species. These postlarval fishes I discovered by means of stomach content studies and collections dipnetted under nightlights. I carried on frequent

dipnetting chiefly at La Parguera near the southwest corner of Puerto Rico from 1954 to 1966. Periodic dipnet collections at river mouths provided data on postlarval fish migrations up the rivers from the sea.

The American Museum of Natural History prepared gonad sections of Serranids and blue marlin for microscopic study, and the Florida Department of Natural Resources, bonefish.

The chart entitled "Seasonal spawning indications for fishes from the N.E. Caribbean" is in phylogenetic order following Greenwood et al. (1966).[81]

CODE SYMBOLS USED

el = few elvers; EL = large numbers of elvers; em = embryos is early stages, as in sharks, rays or other fishes; EM = embryos in terminal stages of development; EP = fertilized eggs in pouches of male Sygnathids; f = ovaries with subripe ova, usually yellow or opaque white, and clearly distinguishable without magnification. Most developed ovaries are stage III; F = ovaries with ripe ova, usually transparent and colorless, stage IV; j = juvenile fishes; J = great concentrations of juveniles; le = leptocephali; LE = seasonal peak numbers of leptocephali; m = subripe enlarged testes with slight or no loose milt, stage III; M = ripe testes with loose or running milt, stage IV. Ripe testes are often smaller than stage III; nu = male nuptial colors; po = postlarvae; r = both males and females with subripe enlarged gonads, stage III; R = both males and females with ripe gonads, stage IV; spr = spring, when it is not more precisely defined in the literature; yr = year round spawning, indicated mainly in the literature.

The number in parentheses following a fish name represents the actual or close approximate number of individuals of the species which I examined. The numbers at the end of the line indicate references.

DISCUSSION

Unlike most northern fishes with their distinct spawning periods, tropical fishes tended to show prolonged spawning periods. Individuals of some species were found in spawning condition any month of the year; other species showed peak periods in addition, when greater numbers of individuals were in spawning condition. Few species had limited spawning periods. During the first half of the year more species, in both marine and fresh waters, were found in spawning condition.

Sharks: Because of the long and uncertain periods of gestation, periodicity in shark spawning was inconclusive except possibly for two species. Recently born nurse sharks, *Ginglymostoma*, appeared in numbers in September 1956, 1957, and 1965. Local fishermen reported young nurse sharks in late summer. In September 1974 and 1975, *Rhizoprionodon*, small sharpnose sharks, still showing red umbilical scars, bit on handlines at night or were caught in gill net sets in Bramadero Bay south of Mayagüez.

Bonefish: Numerous *Albula* leptocephali (423 measured from 44 to 66 mm S.L.) appeared under nightlights every month of the year at La Parguera, but larger numbers were observed from March to May. More ripe or subripe adults were found in January than other months; 351 adults were dissected for gonad analyses. Enlarged fat bodies attached to the gonads preceded gonad development.

Elops leptocephali, 26 to 30 mm, were collected once, in September 1959, from the Añasco river mouth. *Megalops*, 24 to 26 mm, appeared at the same time. *Megalops* were also collected from the south of the Guanajibo River in July 1968 and September 1974.

Eels: *Anguilla rostrata* leptocephali, 78 to 96 mm, were collected at La Parguera in June 1962 and July 1964. Numerous elvers were reported at Dos Bocas dam on November 17, 1947. Over a hundred elvers were collected from the Culebrinas River at Margarita dam on December 5, 1972.

Batfishes: *Ogcocephalus parvus* and *O. vespertilio* males displayed their nuptial coloring, red lips and pinkish abdomen, during the spawning season from January to April.

Flying fish: *Cypselurus heterurus*, ripe adults, were the more common larger flying fish found in dolphin stomachs from December to April, the time of profuse spawning and greater abundance of this species.

Houndfish: *Tylosurus crocodilus* juveniles were found in March off La Parguera especially during calm spells, in conjunction with large floating beds of Sargassum, such as in late March 1959 and 1969. Masurekar (1968)[46] described large bunches of eggs washed ashore along the coast of Bombay in October and November.

Silversides: *Allanetta harringtonensis* were observed one July afternoon in a large school, all ripe males and females, milling

around, crowded in shallow water over sand bottom, actively spawning. They were slow and easily caught with a small seine. This was off the east coast of Puerto Rico at Lobos Cay, east of Fajardo. As common as are silversides, of the very few times I have seen them in spawning condition this was the most impressive.

Red hind: *Epinephelus guttatus* spawning runs took place one or two days after the full moon in January or early February off La Parguera from 1954 through 1966 except for 1957 and 1965, when there were no well defined runs. At other times of year adult red hinds had undeveloped gonads.

Snappers: Lutjanidae spawned more in spring and summer. From March through May off San Juan, and over Silver Bank in early September, 80% of adult yellow-tail snappers, *Ocyurus chrysurus*, had ripe or subripe gonads, whereas in November and December all those dissected had undeveloped gonads. The closely related lane snappers, *Lutjanus synagris*, spawned from March to September with a peak in May, along the west coast south of Mayagüez. At La Parguera, one female with subripe ovaries was found as early as January 30.

Deepwater red snappers such as *Rhomboplites aurorubens*, *Lutjanus vivanus* and *L. buccanella* had varying spawning patterns. Off the south coast of Puerto Rico, 71% of 150 *Rhomboplites* had subripe or ripe gonads in February and March 1976, and 87% of 143 from April to June. On the other hand, in that same period, 25% of *L. buccanella* had gonads approaching spawning condition, and only three males of 141 *L. vivanus* had slight amounts of milt in small testes. In March 1969 at offshore Grappler Bank, of 24 silk snapper adults, there were four males with ripe testes and five females with subripe stage III ovaries, and at Anguilla Bank in April 1968 there were 11 stage IV males and 16 stage III females among 46 silk snappers. There may be less spawning close to the coast compared with offshore areas.

Grunts: Pomadasyidae did not show well defined spawning periods. Individuals of *Conodon nobilis* were found in or near spawning condition in all months except March-April and June-August in the same habitat south of Mayagüez as the lane snapper.

Jacks (Carangidae): Postlarval blue runners, *Caranx crysos* (Mitchill), or *C. fusus* (Geoffrey-St. Hilaire), a possible synonym, occurred in 4% of 600 dolphin stomachs. These postlarvae aver-

aged 50 mm and were more frequent and numerous in dolphin stomachs during April-May than other months.

Several large runs of juvenile blue runners were reported at La Parguera from September to November 1956. On October 4, a boat caught 97 blue runners which averaged 200 mm in length and weighed 12.7 kg. On November 2, two seine hauls produced 100 kg of blue runners of similar size. Such numbers of blue runners were not seen again other years through 1965. Even the size class was rare. Local fishermen believed that these unusual runs of small blue runners were caused by disturbed weather. A small hurricane had passed through the eastern part of the island on August 12, 1956.

A few adult blue runners, 500 g or more in weight, were caught by the La Parguera fishery every year. More of these adult blue runners were in spawning condition from March through May than at other times of year. The spawning for the species, however, is protracted.

The ubiquitous leatherjacket, *Oligoplites saurus*, has a habit of jumping out of water. In March, April and November, running ripe females jumped out and landed in my boat, incidentally demonstrating protracted spawning for the species. Other jacks with prolonged spawning periods were *Caranx latus*, *C. ruber*, *C. hippos* and *C. lugubris*.

Dolphin: Coryphaenidae. Of 600 *Coryphaena hippurus* dissected for gonad analyses, 90% of the adult females had stage III subripe ovaries throughout the year, except for August when no dolphin have been examined. The largest and smallest females with stage III ovaries were a 41 pounder in February and a four pounder in July. Greatest numbers of dolphin were caught in February when greater spawning activity was indicated by the presence of more semi-transparent ova in the ovaries. Females outnumbered males three to one.

In 590 dolphin stomachs, I found 51 species of postlarval or juvenile fishes. Only flying fishes were usually adults. There were changes in the diet of dolphins which reflected the seasonal availability of fish species near the sea surface. Seasonally the chief species found in dolphin stomachs were:

Winter = *Cypselurus heterurus*, *Hemiramphus balao*, *Acanthurus* spp., *Cantherines pullus*

Spring = *Parexocoetus brachypterus*, *Cantherines pullus*, *Psenes cyanophrys*, *Caranx crysos*

Summer = *Cantherines pullus*, *Balistes capriscus*, *Priacanthus* spp.

Autumn = *Xanthichthys ringens*, *Cantherines pullus*, *Pseudupeneus maculatus*

The most numerous and frequent year-round food animal of dolphin and other pelagic fishes was the juvenile filefish, *Cantherines pullus*, averaging 50 mm T.L. Remarkably abundant in late September and October were sargassum triggerfishes, *Xanthichthys ringens*, 50 to 75 mm.

Porgies: Sparidae had a limited spawning season. At La Parguera on February 16, 1954, over 100 *Archosargus rhomboidalis* crowded into one fish pot in less than two fathoms of water. The majority were females of 200 to 220 mm S.L. with running ripe transparent ova. In following years February continued to be the peak spawning month of this species, although spawning extended from November to March. *Calamus pennatula* and *C. penna* were found in spawning condition in February and March.

Mullets: Most Mugilidae showed concentrated spawning in autumn and winter. *Mugil liza* is know to be heavy with spawn in January. At the end of a spawning run in mid-December in a mangrove lagoon at Joyuda on the west coast of Puerto Rico, of twelve *M. curema*, 245 to 354 mm F.L., seven were subripe, five females and two males. The bodies of these mullets with developed gonads were elongate, similar to river fish. The five mullets with short, deep bodies were like sea-run mullet and contained undeveloped gonads. Juvenile *M. curema*, 25 mm, were present all months off La Parguera, more numerous in February.

Agonostomus, unlike the other mullets, were found ripening in June in the fresh waters of Melania Reservoir, subripe females and a ripe male. Postlarvae were dipnetted at sea under lights at night off Aguadilla in October.

Joturus pichardi,, the hog nose mullet, according to Cházari (1884)[66] who quoted Mexican fishermen, spawned at river mouths in October; the adults returned upstream in November and the young migrated upriver in December. *Joturus* occurs in the Añasco River, Erdman (1974),[80] collected in April.

Barracuda: *Sphyraena barracuda* juveniles of 25 mm were found every month in the year off La Parguera, though they were more numerous in summer and autumn. Few adult barracuda contained ripe gonads in winter. Enlarging fat bodies preceded the ripe gonads.

Parrotfish: Scarids are commonly associated with coral reefs and form a large portion of the fish pot catch. Of the many parrotfish which I dissected from the commercial catch, most had completely recessed gonads; only a few were developed or ripe. Yet juveniles were present all year. On two occasions when I observed several ripe fish in December 1956, the transparent flowing ova of *Sparisoma aurofrenatum* were round, and those of *Scarus taeniopterus*, elongate, a noteworthy difference described by Winn and Bardach (1960).[71]

Gobies: Three species of Gobiidae exhibited male nuptial colors from May to November. *Sicydium plumieri* spawned in the fast upland streams on rock or rubble bottom, and postlarval migrations upriver from the sea began at river mouths on or just after the last quarter phase of the moon from July through December; Erdman (1961).[74] *Evorthodus lyricus* males sported two red stripes on a long tail and red on the anal fin in May at the Guanajibo River mouth, and in August at the Sabana River. *Gobionellus boleosoma* males in a mangrove lagoon near Luquillo beach in November displayed a broad red stripe on the upper edge of the tail and a small red band near the edge of the pectoral fin. An Eleotrid goby male, *Gobiomorus dormitor*, 356 mm, caught from Loíza reservoir in August, showed dark green nuptial color.

Blennies: *Hypleurochilus aequipinnis*, the oyster blenny, in December was observed protecting its eggs in an open oyster shell on a mangrove root in a shallow, mud bottom bay east of La Parguera. The terminal embryos were wiggling actively and their hearts beating rapidly. Another oyster blenny in December and one in March were seen guarding less developed eggs in oyster shells.

Tuna: Scombrids carried on prolonged spawning. *Euthynnus pelamis* individuals were found in or near spawning condition (stage III or IV) every month of the year. *Scomberomorus cavalla* were in spawning condition mainly in July and August but I found one female with translucent ova as early as April 10 and a ripe male as late as November 12. *S. regalis* showed less peaked and more extended spawning, virtually all year. *Thunnus atlanticus* juveniles, 250 mm, formed the bulk of stomach contents found in blue marlin in September. More ripe adults were found in April-May and September-October, the clearest example of bimodal peaks which I encountered. Two bluefin tuna, *T. thynnus*, a female 305 lbs. and a male 261 lbs. with gonads in repose, were caught off San Juan on January 18, 1960.

Blue marlin: Out of a total of 633 *Makaira nigricans* dissected for gonad studies, 485 were males and 148, females. Some 400 of the males were approaching or in spawning condition from May through November. During the 23 years of my study, however, there were only three females with transparent running ripe ova: September 24, 1966, 246 lbs. Erdman (1968) [82]; September 6, 1970, 276 lbs.; and September 12, 1975, 282 lbs. All three of these fish were thin and in poor condition; undoubtedly they were partially spent. Females were more frequently caught in July and August when sex ratios were nearly equal. Two postlarval blue marlin were caught in a neuston net 60 miles south of St. Croix on November 9, 1972 (DISCOVERER cruise, CICAR program).

Triggerfish: *Balistes capriscus* juveniles from 25 to 40 mm were frequently found in pelagic fish stomachs, but the adults were rarely caught in fish pots. *B. vetula*, on the other hand, is commonly caught in fish pots, but juveniles are rare in collections. In February at Mona Island, I observed two 45 mm *B. vetula* which could swim only downwards, at a 45° angle, probably a temporary adaptation from postlarval planktonic life to the juvenile and adult bottom existence.

FRESHWATER FISHES

More than twenty species of exotic freshwater fishes are established in Puerto Rico and reproduce in the wild. My observations indicated that north American species tended to have longer spawning periods here than on the continent.

Threadfin shad: Forty ripe *Dorosoma petenense*, 100 mm F.L. were stocked in Guajataca reservoir on May 30, 1963. Evidence of reproduction appeared a year later, June 9, 1964, when two size groups were caught, 40 postlarvae 10 to 19 mm in length, and 8 juveniles 21 to 28 mm. Since then shad have been abundant in this 800 acre reservoir.

Catfishes: The four species of *Ictalurus* in the reservoirs were found with developed ovaries and ova from January to March.

Rosy barb: Nuptial colored males of *Barbus conchonius*, with females, were seined from downstream Rio Arroyata in late March 1971 and transferred to the Maricao Fish Hatchery, where the first successful spawning took place the following year in early May.

Bass: Largemouth bass, *Micropterus salmoides*, peak spawning was in the cooler weather at both Maricao in the mountains and the reservoirs nearer sea level from January to March. Individual pairs at Maricao have spawned at the end of December, and once one pair, spawned in August. *M. coosae* spawned in the rivers mainly in March and April.

Sunfishes: The bluegill sunfish, *Lepomis macrochirus*, was introduced to Puerto Rico in 1915. At Maricao and in the wild they have spawned year-round. Evidence of lunar related activity occurred when a large group of small bluegills spawned profusely at Patillas reservoir during the fifth and sixth day after the full moon in July 1964.

The other sunfishes, the shellcracker *L. microlophus*, and the redbreast *L. auritus*, showed more restricted spawning periods. Nuptial black male shellcrackers were seen guarding their nests in shallow water at Loíza and Dos Bocas reservoirs in February and March. Their spawning was observed to follow the full moon at the same interval as the bluegills. A few redbreast males were seen in March guarding nests on sand bottom downstream from Jayuya.

Tucunaré: *Cichla ocellaris* fingerlings, 60 to 80 mm, were received from the Buga fish hatchery in Colombia on January 27, 1967. The first hatch of fry at Maricao occurred six months later on August 8. Thereafter, successful spawning at Maricao took place only from May to August because of low water temperatures the rest of the year. To successfully hatch eggs, tucunaré required water temperatures which remained at 80° F or more. Increasing information on tucunaré in the reservoirs has indicated more extended seasonal spawning. A male with a nuptial red nuchal hump, characteristic of the spawning period, was caught from Las Curias reservoir on October 18, 1972: it weighed 800 g and measured 380 mm. Two adults accompanying 25 mm fry were reported at Toa Vaca reservoir on January 25, 1974. In spite of these incidents of late season and winter spawning, more profuse spawning occurred during the spring and summer.

Tilapia: *Tilapia mossambica*, *T. hornorum*, and *T. melanopleura rendalli* spawned year-round, with somewhat lessened activity in winter.

SUMMARY

Individuals of most fish species considered in this paper were found in spawning condition any month. It was also true that individual adults of most species had gonads in repose or completely resorbed any time in the year. Postlarvae of several species were found all months.

Year-round presence of postlarval reef fishes in various pelagic fish stomachs indicated prolonged spawning of squirrelfishes, goatfishes, doctorfishes, trigger and filefishes.

Year-round presence of juveniles indicated intermittent spawning of coral reef fishes such as Pomacentrids, Labrids and Scarids with slight seasonal variation. As common and numerous as adult Scarids were, they were almost always found with resorbed gonads.

Many fishes, such as bonefish, spawned year-round with one or more periods of intensified spawning. Moon phase correlated with the peak spawning of a few species such as the freshwater gobies.

Pelagic fishes, dolphin and skipjack tuna individuals, were found with near ripe ovaries throughout the year; blue marlin had developed gonads or ripe gonads between late March and early November.

Fishes in the same family tended to have similar spawning patterns. Sparids spawned in winter; Lutjanids in spring and summer and Carangids protracted year-round.

Certain fish species in spawning condition, red hinds and yellowtail snappers for example, were easier to catch than the same species with undeveloped gonads, a fact recognized by commercial fishermen.

Introduced freshwater fishes from temperate zones, largemouth bass and bluegills, showed more protracted spawning in Puerto Rico than in their native habitat.

In a number of species, ripe males were found both earlier and later than ripe females.

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From 1954 through 1973, I was project leader of the Sport Fisheries Restoration program (Dingell-Johnson Act, projects F-1-4 to 20 and F-4-1) including 1973 with the Department of Natural Resources to which new agency the program was transferred. Since 1974, I have been Assistant Director of the Commercial Fisheries Laboratory of the Department of Agriculture of Puerto Rico, which is aided by the Commercial Fisheries Research and Development Act of 1964 (as amended) PL 88-309.

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Erdman

SEASONAL SPAWNING INDICATIONS FOR FISHES FROM THE N. E. CARIBBEAN

No.	J—F	M—A	M—J	J—A	S—O	N—D	Fish species and references
1			R	R			Asymmetron lucayanum 1
2			em				Rhincodon typus (1) 2
3				em	em	em em	Ginglymostoma cirratum (10) 3
4					em	em	Galeocerdo cuvieri (2) 3
5	em		j,m				Negaprion brevirostris (3) 4
6	j,em	F j		em	j j	j j,em	Rhizoprionodon porosus (24) 5,6
7		spr	spr				Carcharhinus acronotus (4) 7
8		EM		em			C. falciformis (10) 8
9	em	EM	M M	M	em	em em	C. limbatus (10) 7,9
10	em	em EM					C. longimanus (10) 10
11			j				C. maculipinnis (1)
12			em				C. springeri (10) 6
13	EM				em	m	Prionace glauca (1) 11,12
14		EM					Mustelus norrisi (10)
15		em f		EM		EM J	Sphyrna mokarran (10) 3,13
16		em			EM em		Dasyatis americana (3) 3,6
17				EM		em	Aetobatus narinari (10) 14,15
18		em					Manta birostris (1) 14
19	f,	M,f f			le	f, f	Elops saurus (20) 3,16,17

No	J—F	M—A	M—J	J—A	S—O	N—D	Fish species and references
20	f		j,m	le	le		Megalops atlantica (18) 5,15,17
21	R R	LE	LE	le	le M	le	Albula vulpes (351) 19,20
22	EL		le	le	el	EL EL	Anguilla rostrata (200) 21
23	f						Conger triporiceps (1)
24	le			le	le		Rabula acuta 22
25		f					Gymnothorax funebris (10)
26	F	f					G. moringa (10) 6
27		f				f	G. vicinus (10 6
28		F			j		Echidna catenata (2) 23
29		spr					Muraenesox savanna (1) 5
30		f					Ophichtus gomesi (10)
31					f		O. spinicauda (1)
32					po		Synaphobranchus infernalis (10)
33		R	R	R			Moringua edwardsi 24,25
34	le	EL				le	Myrophis punctatus 26
35	r	F f	F f				Harengula humeralis (200) 27,28
36			F				H. pensacolae (200) 27,29
37		f	M R	r			Opisthonema oglinum (500) 30
38	f f						Jenkinsia lamprotaenia (200) 5,31
39	R R						Sardinella anchovia 32,33
40				F			Anchoa hepsetus (1)

No.	J—F	M—A	M—J	J—A	S—O	N—D	Fish species and references
41		r					A. lyolepis (50)
42	r						A. parva (100)
43	f		f				Cetengraulis edentulus (50 34
44					f		Chirocentrodon taeniatus (4)
45	m	f f,M				PO M	Synodus intermedius (100) 6,35
46	yr	yr	yr	yr	yr	yr	Acyrtops beryllinus 36
47			R	R,j			Gobiesox strumosus 37
48		f					Acyrtus rubiginosus 38
49	yr	yr	yr	yr	yr	yr	Histrio histrio 39
50	nu						Ogcocephalus parvus (1) 40
51	nu	nu					O. vespertilio (10)
52		f					Brotula barbata (1)
53			em				Ogilbia cayorum (1)
54	R F	f f,F				f M,f	Cypselurus heterurus (200)
55				R			C. cyanopterus (1) 41
56	R R						C. comatus (1) 42
57	f		R		R R	R R	Parexocoetus brachypterus (100) 43
58	yr	yr	yr	yr	yr	yr	Exocoetus volitans (2) 42,44
59	j						E. obtusirostris (1)
60	F			F			Hirundichtys speculiger 42
61	yr	yr	yr	yr	yr	yr	H. affinis (2) 45

No.	J—F	M—A	M—J	J—A	S—O	N—D	Fish species and references
62		F					Prognichthys gibbifrons (6)
63		F		F		F	Oxyporhamphus micropterus 42
64		F					Euleptorhamphus viridis (10)
65	f	F F					Hemiramphus brasiliensis (300)
66	f	f					H. balao (50)
67		f					Hyporhamphus unifasciatus (1) 5
68	f						Chriodorus atherinoides (1) 1
69		f	F				Strongylura timucu (1) 6
70			F				Platybelone argalus (10)
71		j,f			F	F	Tylosurus crocodilus (20) 5,46
72			f f	F			Atherinomorus stipes (200)
73			r	R			Allanetta harringtonensis (1000)
74				F			Melanorhinus microps (5)
75	R	m			R		Holocentrus ascensionis (150) 35
76	R	f,M	R	M	R M		H. rufus (122) 35
77	f						H. marianus (4)
78	j	j	j		j	j	Ostichthys trachypomus (20)
79		po	po	po	po	po	Holocentrus vexillarius (10) 47
80		f					Myripristis jacobus (7)
81	F	j j	j	j	j j	f,j	Aulostomus maculatus (12) 35
82				j			Fistularia tabacaria (5)

No.	J—F	M—A	M—J	J—A	S—O	N—D	Fish species and references
83	Ep	Ep		Ep			Syngnathus dunckeri 1
84	Ep	Ep		Ep			S. elucens (1) 1,48
85	Ep						S. jonesi 48
86				Ep			S. pelagicus 1
87	Ep	Ep					S. rousseau 5,6
88				Ep	Ep		Corythoichtyts brachycephalus (10) 49
89	Ep						C. albirostris (1) 1
90		Ep		Ep	Ep		Oostethus lineatus (10)
91		Ep	Ep	Ep			Hippocampus reidi (2) 50
92				R			Scorpaena bergii 27
93						j	S. grandicornis (5)
94				j			S. plumieri (20 28
95				F			S. brasiliensis 6
96	j	j M	j	j	j		Dactylopterus volitans 28,41
97	f	f R	F	j	M		Centropomus undecimalis (20) 5,18
98	f	f f					C. parallelus (24)
99		f	f			j	C. ensiferus (20) 5
100		R	R	R			Epinephelus cruentatus (9) 35,52,53
101	f			F		f	E. fulvus (146) 35
102				R R	j		E. itajara (14) 54
103		F					E. flavolimbatus 55
104	po	M j				f	E. striatus (32)
105	R R						E. guttatus (144)
106						f	E. adscensionis (10)
107	f	f R	R				E. morio (37) 56
108	f	F		F		F	E. mystacinus (64) 35
109					F		E. inermis (7) 6
110	f					f,M M	E. afer (10) 48
111	M,f	M,f M	R				Mycteroperca veneosa (41) 35
112	M	f					M. tigris (10) 40
113	j						M. interstitialis (11)
114	j	f j,f					Paranthias furcifer (10) 5
115		F					Diplectrum radiale (10)
116	f	F					Serranus phoebe (10)
117		spr					S. tabacarius (10) 5
118		r,R					S. tigrinus 28
119				R			S. tortugarum 27
120		R					Bullisichthys caribbaeus (1) 57
121		spr					Dules dispilurus 5
122		R					Gramma loreto 58
123				R	R		Pseudopriacanthus altus 59
124		f					Priacanthus cruentatus (10)

No.	J — F	M — A	M — J	J — A	S — O	N — D	Fish species and references
125			r		F	f	P. arenatus (10)
126			em	F			Apogon maculatus 27
127		f					A. binotatus 5
128			em	em			A. pseudomaculatus 14
129	f						A. pigmentarius 5
130			em		em		Astrapogon stellatus (10) 1
131		m					Malacanthus plumieri (50) 28
132	f						Caulolatilus cyanops (10)
133		m		f,j			Rachycentron canadum (10)
134				j			Echeneis naucrates (20)
135		j				j	Remora remora (2)
136			F		j		R. osteochir (11)
137	f j	F F	j			F	Oligoplites saurus (100)
138		M R				F	Seriola rivoliana (20) 35
139	f	R		R		R	S. dumerili (20) 35
140		f					Decapterus punctatus (50)
141				f			D. macarellus (50)
142		f	f	j	f,j		Selar crumenophthalmus (50)
143		M,f r	r	M f			Caranx ruber (100)
144		f	F		M		C. bartholomaei (20) 35
145	po	M po	r		j	M	C. crysos (300)
146		f f	M		R f,j		C. hippos (10) 5,35
147	R	M,f r	M,f R	f R			C. latus (300) 35
148		r M,f			M,f		C. lugubris (50)
149	f	M					Vomer setapinnis (50)
150		M			j		Selene vomer 35
151		m					Hemicaranx amblyrhynchus (1)
152			j	f	po		Alectis crinitus (10)
153	f	j		M,f			Chloroscombrus chrysurus (100)
154	j		j	j		j	Trachinotus falcatus (30)
155			m		f		T. goodei (30)
156				j		j	Elagatis bipinnulatus (10)
157	R R	R j	f f	f	f f	F f	Coryphaena hippurus (600) 60
158		f	f		f		C. equiselis (20)
159		j	f	f			Lutjanus cyanopterus (10)
160		m	M	F	M		L. griseus (50) 61
161	f	r,F f	f				L. jocu (30) 35
162		f,m f			R		L. apodus (20) 5
163	M	M R	R R		R		Ocyurus chrysurus (300) 54
164	f r	F F	R f	R f	f j		Lutjanus synagris (250) 62
165				F			L. mahogoni (10) 6
166	m	M,f m	r f	m			L. analis (50)

No.	J—F	M—A	M—J	J—A	S—O	N—D	Fish species and references
167	f,M	R			R		L. buccanella (1173) 35
168	f,M	M,f R	f	f	R	R	L. vivanus (1369) 35
169	f,M	R R	R f				Rhomboplites aurorubens (400) 23,35
170	f,M	R R			M		Apsilus dentatus (611) 35
171				f		f	Pristipomoides macrophthalmus (20) 27
172		f j					Etelis oculatus (10) 31
173					M		Lobotes surinamensis (10) 48
174	F	M,f f	m R	F	F R	f	Gerres cinereus (100) 35
175				M			Eucinostomus gula (1)
176				f			E. argenteus (1)
177		M,f	f		M,f		Diapterus rhombeus (50)
178		f			f		D. plumieri (20) √
179						f	D. olisthostomus (1)
180	R	R					Haemulon bonariense 35
181	f	R M,f			M,f		H. album (20) 35,54
182	R	R M	F	R F			H. aurolineatum (300) 6,35
183	m	F					H. striatum (20) 35
184	M	R	R				H. chrysargyreum (10) 23,35
185	F	f f					H. carbonarium (10) 23,35
186		M,f f			R		H. flavolineatum (100)
187			R F	F			H. macrostomum (10) 35
188	R	f R			R		H. melanurum (10) 35
189	f		f		M		H. parrai (30)
190	R	F R			R	R	H. plumieri (100) 35
191	R f	F				f	H. sciurus (30) 35
192	f	f	f	F		F R	Anisotremus surinamensis (20) 6
193		R		R	R	R	A. virginicus (10) 35
194	f	f	f		f		Brachydeuterus corvinaeformis (20) ✓
195	f	f		j			Pomadasys crocro (50)
196	f f		f		M f	M M	Conodon nobilis (50)
197	f	m,f					Calamus penna (20)
198	f	f					C. pennatula (50)
199	R	M,f	F			M M,f	Archosargus rhomboidalis (500) 35
200	yr	yr	yr	yr	yr	yr	Cynoscion jamaicensis (20) 63
201		f	r		f		Larimus breviceps (30)
202				f			Odontoscion dentex (100)
203				M			Bairdiella sanctaeluciae (1)
204	F f	F	F	F	F	f F	B. batabana (50) 35
205					f	f	Ophioscion adustus (10)
206			f	M			Micropogon furnieri (20)
207		F		F f	F		Equetus punctatus (20) 35
208			f		M		Stellifer stellifer (100)

No.	J—F	M—A	M—J	J—A	S—O	N—D	Fish species and references
209	M M,f	R po			j M		Pseudupeneus maculatus (200) 35
210				R			Upeneus parvus (5) 64
211	M	F f	F	j			Mulloidichthys martinicus (50) 35
212			R	j j	M,R	j	Chaetodipterus faber (30) 35
213		j f	j		po po	j	Chaetodon capistratus (100)
214		f					C. striatus (50)
215		f					C. sedentarius (20)
216			F				C. ocellatus (10) 35
217		po j					Prognathodes aculeatus (5)
218	R	M	F R				Pomacanthus arcuatus (10) 28,35
219		m j	F j				P. paru (10) 28,35
220	F	f	F		j		Holacanthus tricolor (10) 35
221	R	f R		R		j	H. ciliaris (10) 35
222		j					Kyphosus sectatrix (1)
223	j	j					K. incisor (10)
224			R	R			Eupomacentrus adustus (10) 27
225	R	em	em R		R		E. fuscus (20) 35
226					f		E. leucostictus (20)
227	yr	yr	yr	yr	yr	yr	E. partitus 65
228	r,j	R				R j	Abudefduf saxatilis (30) 6,35
229			j		em		A. taurus (20) 28
230			M,f				Chromis multilineata (50)
231		M					C. cyanea (1)
232		f					Microspathodon chrysurus 5
233	po j	j	j	m	R f	f M,f	Mugil curema (300)
234	f						M. liza (1)
235					R	j	Joturus pichardi (1) 66,80
236			M,f	f	po	j	Agonostomus monticola (100)
237	j f	M,f M	f	F	M,f j	j	Sphyraena barracuda (300)
238		f	f				S. guaguancho (10)
239		f					S. picudilla (10)
240		j j	F		f j		Polydactylus virginicus (100) 35
241			F				P. oligodon 67
242	f M,f	F				f	Lachnolaimus maximus (10) 35
243	F						Bodianus rufus (10)
244	yr	yr	yr	yr	yr	yr	Thalassoma bifasciatum (50) 68
245				R			Halichoeres buvittatus (50) 27
246		F R				F	H. radiatus (10) (10) 28,35,69
247			R	R			Doratonotus megalepis 27
248		F				F	Hemitripterus martinicensis 70
249						F	H. splendens 70
250	R	R	R			R	Sparisoma viride (20) 35

No.	J—F	M—A	M—J	J—A	S—O	N—D	Fish species and references
251	R		R			F	S. aurofrenatum (4) 35
252						F	S. radians (1)
253	F m,F		M	f		f	S. rubripinne (16) 35,69
254			R	R			Cryptotomus roseus 27
255	R		f M		F	m	Sparisoma chrysopterum (100) 35,69
256		j					Scarus coelestinus (10)
257	R	R	R	R	R		S. croicensis 35,69
258						F	S. taeniopterus 35
259			R	R			S. guacamaia (30) 71
260	F f		F f	F			S. vetula (10) 35,69
261			em				Opistognathus whitehursti 1
262		em					O. maxillosus 1
263		EM					Dactyloscopus tridigitatus 1
264			R	R	po		Ophioblennius atlanticus (1) 27
265		em				EM	Hypleurochilus aequipinnis (15)
266			F	F			Emblemaria pandionis 27
267			F	em			Acanthoemblemaria aspera 27
268			em				Hemiemblemaria simulus 27
269					f		Labrisomus nuchipinnis (1)
270			M				L. bucciferus (1) 1
271			F				Malacoctenus macropus 27
272						F	M. aurolineatus 72
273						F	M. erdmani 72
274		F					M. delalandi 23
275		nu			nu		Evorthodus lyricus (2)
276						nu	Gobionellus boleosoma (6)
277		M		f	M,f	po	f Awaous tajasica (100)
278			f		f		Ginsburgellus novemlineatus (20) 38,73
279		nu			po	PO nu	po Sicydium plumieri (1000) 74
280			f f				Gobiosoma evelynae (10) 73
281						f	Varicus bucca 75
282	em						Coryphopterus glaucofraenum (20)
283	f			f			Barbulifer ceuthoecus 73
284		f					Nes longus 73
285						j	Erotelis smaragdus (1)
286				r j		j	j Elacotelis pisonis (50)
287	j	j	m	F			m f Dormitator maculatus (100)
288			f	f nu			j Gobiomorus dormitor (200)
289	po R	j m				M	Acanthurus bahianus (300) 35
290	R	f,m f		R			A. caeruleus (100) 35
291	R		R				A. chirurgus (50) 35
292						f	Gempylus serpens (1)

No.	J — F	M — A	M — J	J — A	S — O	N — D	Fish species and references
293	f						Promethichthys prometheus (1)
294		F				m	Ruvettus pretiosus (2)
295	M,f	f					Trichiurus lepturus (50)
296			M	j		M	Thunnus albacares (3)
297			M				T. alalunga (10)
298		m m,f	f f	m,f	R m,f	M	T. atlanticus (200)
299	*						T. thynnus (2)
300	M		m				Auxis thazard (2)
301	r r	M,f r	M,f f	f f	M R	r	Euthynnus pelamis (50)
302			R M,f	f f	f r		E. alletteratus (50)
303			m,f	M f	M f		Acanthocybium solanderi (30)
304		f	M,f R	R R	f	m	Scomberomorus cavalla (100)
305	M	M	R	f j	F M	M,f M	S. regalis (100)
306	j	j	j j				Xiphias gladius (4)
307			po				Istiophorus platypterus (1)
308		m m	f M	M	R M	po	Makaira nigricans (600)
309		f f	f				Tetrapterus albidus (50)
310						f	T. pfluegeri (1)
311	j	po					Psenes cyanophrys (20)
312		j	j				Nomeus gronovii (16)
313		M					Peprilus alepidotus 5

No.	J — F	M — A	M — J	J — A	S — O	N — D	Fish species and references
314			po				Bothus ocellatus (6)
315		R					B. lunatus 77
316				R			Achirus lineatus 78
317	F,j	f M	F	F			Balistes vetula (100) 28,35
318	j	j j	j j		j	j	B. capriscus (50)
319					J	J j	Xanthichthys ringens (200) 79
320	po	M,f					Melichthys niger (15)
321		M,f					Canthidermis sufflamen (2)
322		F		F j		F	Alutera schoepfi (5) 35
323			F			F	A. scripta 35
324	j	j R	R j	j	j	j	Cantherines pullus (500) 35
325		F					C. macroceros
326		f					Acanthostracion quadricornis 1
327				F			A. polygonius 35
328		f			f		Lactophrys trigonus (18)
329	f	f po		po	po	po	L. triqueter (20) 25
330			F				L. bicaudalis 35
331	j			j		j	Sphaeroides spengleri (100)
332	r			f		j	S. testudineus (50)
333		m	j		j		Lagocephalus laevigatus (30)
334	F	F	j	j		j	Diodon hystrix (50) 35

No.	J—F	M—A	M—J	J—A	S—O	N—D	Fish species and references
335	po						Mola mola (1)
336		po					Masturus lanceolatus (1)
	FRESHWATER FISHES						
1			R po				Dorosoma petenense
2			f				Ictalurus punctatus
3	f	f					I. marmoratus
4	f						I. catus
5	f						I. nebulosus
6					f		Carassius auratus
7		nu	po				Barbus conchonius
8	j						Pimephales promelas
9	R R	R R		R		R	Micropterus salmoides
10		R R					M. coosae
11	R	R	R	R	F M	f,m	Lepomis macrochirus
12	nu,R	R	M				L. microlophus
13		M	M				L. auritus
14	j	r	R,po	R	R M		Cichla ocellaris

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Departamento de Agricultura
Department of Agriculture
Area de Servicios Especiales
Area of Special Services
Apartado 10163, Santurce
P. O. Box 10163, Santurce
San Juan, Puerto Rico 00908