Diet Composition of Fish Species from the Southern Continental Shelf of Colombia

R.H. López-Peralta and C.A.T. Arcila

Abstract

The diet composition of 30 fish species belonging to 16 families from the Pacific Coast of Colombia is described. Benthic crustaceans (37.5%) and bony fishes (23.7%, chiefly demersal) were the most important food items for the fish species analyzed. Data on diet composition of the fish species are presented for the first time which can be a source of information for trophic modeling.

Introduction

The marine communities in the Pacific Coast of Colombia have been poorly investigated and require a comprehensive research program that includes population analysis and marine ecology. This paper provides information about food habits of fishes to provide better understanding of trophic relationships among different species in the continental shelf ecosystem of Colombia.

Information about the food habits of fishes is useful in defining predator-prey relationships. A compilation of different food items consumed by a fish species may eventually result in identification of stable food preferences, and in a preliminary estimate of trophic level (Sa-a et al. 1997). Data on diet composition are useful in the creation of trophic models as a tool to understand complex coastal ecosystems.

In the Pacific Coast of Colombia, Rubio (1987) enumerates 172 families of fish (26 Chondrichthyes and 135 Osteichthyes) with 491 genera and 954 species (84 Chondrichthyes and 870 Osteichthyes). In a more recent paper, Álvarez-León et al. (1999) reported a total of 1 110 species. Stomach content studies on fish fauna in this region are almost nonexistent and deal mainly with qualitative information.

Materials and Methods

The study area

The Pacific Coast of Colombia has a high socioeconomic importance. Its ecological characteristics are remarkable (Vargas et al. 1969; Andrade 1986; Meindiger 1987; PRC 1989; Urbano and Castillo 1991; Flóres and Rodríguez 1992). For example: 1) it is one of the regions of the world with a substantial amount of rainfall; 2) there is an occurrence of an upwelling during the first months of the year particularly in coastal areas north of Cabo Corrientes; (3) the general area is influenced by El Niño and La Niña events; and (4) there is a large tidal variation (maximum 6 m).

The study area has a mean depth of 60 m covering 6 870 km^2 located on the Pacific coast of Colombia from 01°56'N to 03°33'N latitude, and to about 12 nm offshore (Fig. 1). The most important fishery banks in the Pacific Coast of Colombia are found in this area. The largest urban centers, the Buenaventura and Tumaco harbors, and Gorgona Island (site of the most important coral reefs in the Pacific Coast of Colombia) are located in this area.

Fish samples and diet composition analysis

Fish samples for analysis of diet composition were collected in December 1997 by means of demersal trawls (30 feet LOA vessels at mean speed of 3.3 knots) in the southern continental shelf of the Pacific Coast of Colombia (Fig. 1).

Diet composition of each species or group of species was defined by the fraction of each prey species consumed to the total consumption following Moreau et al. (1993). The hierarchical structure in FishBase 1997, with the levels of precision for Food I, Food II and Food III, was used to build the diet composition table (Froese and Pauly 1997) to standardize the entries in the food items and related trophic ecology.

Due to conflicting classification of fish species in terms of their habitat, especially for the benthos and demersal species (Rubio 1987; FAO 1992; Froese and Pauly 1997; INPA 1997; Velasco 1998; Velasco and Wolff 1999), FishBase (Froese and Pauly 1997) was used to classify the fish species into their habitat types as follows: pelagic, benthopelagic, demersal, reef-associated, bathypelagic and bathydemersal.

Fig. 1. The study area located in the southern continental shelf of the Pacific Coast of Colombia.

Results and Discussion

A total of 665 fish samples were analyzed, 456 of which had stomach content. However, only 282 (38%) individuals representing 30 species belonging to 16 families were analyzed for stomach content (Table 1 and 2).

Of the 30 fish species, 53% are demersal, 33% are reef-associated, 10% are pelagic and 3% are benthopelagic (Table 1). Except for *Diodon holocanthus*, all other fish species have commercial importance (Fitch and Lavenberg 1971; Hutchins 1984; Leis 1984; FAO 1992; Coppola et al. 1994; Bussing 1995; Hensley 1995; McKay and Schneider 1995; Smith-Vaniz 1995; Sommer 1995; all references are from Froese and Pauly 1997). Some species are by-catches

Table 1. List of fishes sampled from the southern continental shelf of the Pacific Coast of Colombia in December 1997.

Family	Species	Local name	Habitat[a]	N[b]	TL[b] (cm)	N1[b]	n[b]	Fisheries importance [c, d]
Carangidae	*Alectis ciliaris*	Pámpano de hebra	d	9	23.5 - 55.0	6	4	M[4], Z
	Carangoides otrynter	Pámpano	d	17	20.3 - 50.0	13	10	C[5], A, I
	Chloroscombrus orqueta	Arrecha	d	38	13.4 - 0.3	38	7	M[4], Z
	Oligoplites altus	Trancanil	d	1	33.5	1	1	C[4], Y
	Selar crumenophthalmus	Ojón	ra	28	13.2 - 22.0	23	7	H[6], A, Y
	Selene brevoortii	Carecaballo	d	62	16.5 - 44.0	38	33	M[4], Y
	Selene oerstedii	Jorobado	d	8	20.5 - 39.0	2	2	M[4], Y
	Selene peruviana	Espejuelo	d	122	13.7 - 41.0	89	61	M[4], A, I
Diodontidae	*Diodon holocanthus*	Pez erizo	ra	1	28.0	1	1	O[7]
Ephipiidae	*Chaetodipterus zonatus*	Palma rayada	ra	12	20.5 - 98.0	11	2	*
Gerreidae	*Diapterus aureolus*	Mojarra	d	27	7.6 - 13.3	8	3	A, I, Z
	Diapterus peruvianus	Mojarra	bp	102	15.5 - 0.2	88	54	C[8], A, I, X
	Eucinostomus gracilis	Palometa	d	10	8.7 - 16.4	6	4	M[8], A, I
Haemulidae	*Pomadasys panamensis*	Pargo blanco	d	21	10.5 - 9.2	11	5	M[9], X
Lutjanidae	*Hoplopagrus guntherii*	Pargo	ra	2	61.0 - 61.1	1	1	S[4], A, B, I
	Lutjanus colorado	Pargo liso	ra	6	64.0 - 76.0	1	1	C[4], Y
	Lutjanus guttatus	Pargo lunarejo	ra	69	16.8 - 8.5	48	34	C[4], A, I, X
	Lutjanus jordani	Pargo rojo	ra	11	23.0 - 65.0	6	4	C[4] ,A, I, Z
Monacantidae	*Aluterus monoceros*	Chancho	ra	16	33.0 - 48.0	11	7	C[10]
Paralichthyidae	*Ancylopssetta dendrítica*	Lenguado tres puntos	d	1	41.0	1	1	M[11]
	Hippoglossina tetrophthalma	Lenguado	d	1	36.5	1	1	M[12], A, I, Z
Polydactylidae	*Polydactylus approximans*	Barbeta blanca	d	16	17.5 - 29.0	3	3	C[13], X
	Polydactylus opercularis	Barbeta amarilla	d	2	22.0 - 22.3	1	1	A, I, X
Sciaenidae	*Larimus pacificus*	Cajero	p	29	16.2 - 0.5	12	12	Y
Scombridae	*Scomberomorus sierra*	Sierra	p	23	39.0 - 88.5	18	12	C[6], A, I, X
Serranidae	*Diplectrum eumelum*	Cagua	d	6	24.0 - 26.0	2	2	O[14], Z
Sparidae	*Calamus brachysomus*	Pluma marotilla	ra	2	51.0 - 72.0	2	2	C[13], Z
Sphyraenidae	*Sphyraena ensis*	Picuda	p	17	19.2 - 4.5	12	5	C[15], A, I, X
Sphyrnidae	*Sphyrna tiburo*	Cachuda	ra	2	97.0 - 100.0	1	1	C[4], A, I, X
Triglidae	*Prionotus stephanophrys*	Pez gallina	d	4	32.0	1	1	C[13]

[a]/ Habitat categories:
bp = benthopelagic
d = demersal
p = pelagic
ra = reef-associated

[b]/ Sample details:
N = individuals caught
N1 = individuals with stomach content
n = specimens for stomach content analysis
TL = total length

[c]/ Fisheries importance:
A = artisanal fisheries
B = low
C = commercial
H = highly commercial
I = industrial fisheries
M = minor commercial
O = no interest
S = subsistence fisheries
X = observed in more than three market centers
Y = observed in more than two market centers
Z = observed in one market center

[d]/ References:
1 Froese and Pauly (1997)
2 Rubio (1988)
3 INPA (1997)
4 Coppola et al. (1994)
5 Smith-Vaniz (1995)
6 FAO (1992)
7 Leis (1984)
8 Bussing (1995)
9 McKay and Schneider (1995)
10 Hutchins (1984)
11 Hensley (1995)
12 Without reference
13 Fitch and Lavenberg (1971)
14 Heemstra (1995)
15 Sommer (1995)
* = no information

Table 2. Diet composition (in % weight) of fish species from the southern continental shelf of the Pacific coast of Colombia (December 1997).

Species	n	Stages	% composition	Food type			
				I	II	III	Taxa
Alectis ciliaris	4	juveniles	65.23	Zoobenthos	Benthic crust.	Shrimps	*Trachypenaeus*
			30.77	Nekton	Finfish	Bony fish	Crustacea (Decapoda)
			4.00	Detritus	Detritus	Debris	
Aluterus monoceros	7	juveniles/	41.53	Zoobenthos	Cnidarians	other polyps	
		adults	33.54	Zooplankton	Other planktonic	other plankt. Invert.	
			23.61	Zoobenthos	Benthic crust.	Crabs	Portunidae, *Euphylax sp.*
			0.48	Nekton	Finfish	Bony fish	
			0.33	Zoobenthos	Benthic crust.	Amphipods; astracods	
			0.35	Zoobenthos	Cnidarians	other polyps	Anthozoa
			0.14	Zoobenthos	Mollusks	Gastropods	
			0.02	Zoobenthos	Worms		
Ancylopssetta dendrítica	1	adults	100.00	Nekton	Finfish	Bony fish	*Lepophidium* (Ophidiidae)
Calamus brachysomus	7	adults	39.68	Zoobenthos	Mollusks	Gastropods	
			27.78	Zoobenthos	Worms	Crabs	Anomura
			27.42	Zoobenthos	Benthic crust.	Bony fish	
			4.68	Nekton	Finfish	Shrimps	
			0.44	Zoobenthos	Benthic crust.		
Carangoides otrynter	10	juveniles/ adults	27.58	Nekton	Finfish	Bony fish	*Bellator xenisma* (Triglidae)
			25.09	Nekton	Finfish	Bony fish	*Synodus* (Synodontidae)
			17.76	Nekton	Finfish	Bony fish	*Porichthys* (Batrachoidae)
			16.21	Nekton	Finfish	Bony fish	
			6.44	Nekton	Finfish	Bony fish	Pleuronectiformes
			3.81	Zoobenthos	Benthic crust.	Crabs	*Leiolambrus punctatissimus* (Parthenopidae)
			1.89	Zoobenthos	Benthic crust.	other benthic crust.	Decapoda
			1.14	Zoobenthos	Benthic crust.	Shrimps	*Trachypeneus*
			0.08	Zoobenthos	Benthic crust.	Shrimps	*Sicyonia*
Chaetodipterus zonatus	2	juveniles	52.42	Nekton	Finfish		
			47.58	Plants	Other plants	Benthic algae/weeds	
Chloroscombrus orqueta	7	juveniles/	66.51	Detritus	Detritus	Debris	
		adults	20.15	Zoobenthos	Worms		
			13.04	Nekton	Finfish	Bony fish	
			0.30	Zooplankton	Other planktonic	other plankt. Invert.	
Diapterus aureolus	3	juveniles/	74.46	Zoobenthos	Benthic crust.	Ostracods	
		adults	19.10	Nekton	Cephalopods	Squid/cuttlefish	
			5.95	Zoobenthos	Mollusks	Gastropods	
			0.49	Zoobenthos	Worms		
Diapterus peruvianus	54	juveniles/	29.94	Zoobenthos	Echinoderms	other echinoderms	Ophiuroidea
		adults	18.59	Zoobenthos	Mollusks	Bivalves	
			17.10	Nekton	Finfish	Bony fish	
			15.78	Detritus	Detritus	Debris	Crustacea (Decapoda)
			7.78	Zoobenthos	Benthic crust.	Crabs	Xanthidae
			7.59	Zoobenthos	Echinoderms		
			4.76	Zoobenthos	Worms		
			1.64	Zooplankton	Other planktonic	other plankt. Invert.	
			1.43	Zoobenthos	Echinoderms	Sea cucumbers	
			0.23	Zoobenthos	Benthic crust.	Stomatopods	
			0.08	Zoobenthos	Benthic crust.	Isopods	
			0.06	Zoobenthos	Benthic crust.	Ostracods	
			0.02	Zoobenthos	Mollusks	other mollusks	Scaphopoda
Diodon holocanthus	1	juveniles	90.09	Zoobenthos	Mollusks	Gastropods	
			6.79	Zoobenthos	Benthic crust.	Crabs	Anomura
			2.10	Zoobenthos	Benthic crust.	other benthic crust.	Decapoda
			1.02	Zoobenthos	Worms		
Diplectrum eumelum	2	juveniles/	57.43	Zoobenthos	Worms	Crabs	
		adults	21.76	Zoobenthos			
			20.81	Nekton	Finfish	Bony fish	
Eucinostomus gracilis	4	juveniles/ adults	100.00	Zoobenthos	Worms		
Hippoglossina tetrophthalma	1	adults	98.50	Zoobenthos	Benthic crust.	Shrimps	*Penaeus*
			0.92	Zoobenthos	Benthic crust.	Crabs	Xanthidae
			0.58	Zoobenthos	Mollusks	Gastropods	
Hoplopagrus guntherii	1	adults	50.55	Zoobenthos	Echinoderms	sea stars	
			23.70	Zoobenthos	Benthic crust.	Crabs	Majidae
			25.55	Zoobenthos	Echinoderms	Sea cucumbers	
			2.20	Zoobenthos	Benthic crust.	Crabs	*Leiolambrus punctatissimus* (Parthenopidae)
Larimus pacificus	12	juveniles/	87.13	Nekton	Finfish	Bony fish	*Anchoa*
		adults	8.79	Zoobenthos	Benthic crust.	Stomatopods	

Species	n	Stages	% composition	Food type			
				I	II	III	Taxa
			4.07	Nekton	Finfish	Bony fish	
			0.01	Zoobenthos	Benthic crust.	other benthic crust.	
Lutjanus colorado	1	adults	34.70	Zoobenthos	Benthic crust.	Crabs	Munidae
			29.37	Detritus	Detritus	Debris	Crustacea
			24.65	Zoobenthos	Benthic crust.	Crabs	*Portunus*
			11.28	Zoobenthos	Benthic crust.	Crabs	Calappidae
Lutjanus guttatus	34	juveniles/	28.99	Zoobenthos	Echinoderms	sea stars	
		adults	11.63	Nekton	Finfish	Bony fish	
			9.98	Zoobenthos	Benthic crust.	Stomatopods	
			9.88	Zoobenthos	Benthic crust.	Crabs	Majidae
			8.26	Nekton	Finfish	Bony fish	*Chloroscombrus orqueta*
			6.63	Nekton	Finfish	Bony fish	*Anchoa*
			5.77	Nekton	Cephalopods	Squid/cuttlefish	
			4.81	Nekton	Finfish	Bony fish	*Selene peruviana*
			4.62	Zoobenthos	Benthic crust.	Shrimps	
			4.26	Zoobenthos	Benthic crust.	Stomatopods	*Squilla panamensis*
			1.51	Nekton	Finfish	Bony fish	Anguilliformes
			0.78	Detritus	Detritus	Debris	Decapoda
			0.74	Zoobenthos	Benthic crust.	Stomatopods	*Eurysquilla*
			0.53	Zooplankton	Other planktonic	other plankt. Invert.	
			0.50	Zoobenthos	Benthic crust.	Shrimps	*Sycionia*
			0.33	Zoobenthos	Benthic crust.	Shrimps	Solenocera
			0.32	Zoobenthos	Benthic crust.	other plankt. Invert.	Decapoda
			0.17	Zoobenthos	Benthic crust.	Crabs	Parthenopidae
			0.15	Zoobenthos	Benthic crust.	Shrimps	*Sicyonia disdorsalis*
			0.12	Zoobenthos	Benthic crust.	Shrimps	*Processa*
			0.02	Zoobenthos	Benthic crust.	Isopods	
Lutjanus jordani	4	juveniles/	96.97	Nekton	Finfish	Bony fish	*Decapterus*
		adults	1.83	Detritus	Detritus	Debris	Crustacea
			1.20	Zoobenthos	Benthic crust.	Stomatopods	Squillidae
	1	adults	65.28	Zoobenthos	Benthic crust.	Stomatopods	Squillidae
Oligoplites altus			34.72	Zoobenthos	Benthic crust.	Stomatopods	
Polydactylus approximans	3	juveniles/ adults	88.50	Zoobenthos	Benthic crust.	Shrimps	
			7.00	Zoobenthos	Benthic crust.	Shrimps	*Trachypeneus*
			3.70	Zoobenthos	Benthic crust.		
			0.60	Detritus	Detritus	Debris	
			0.20	Nekton	Finfish	Bony fish	
Polydactylus opercularis	3	juveniles	41.67	Nekton	Finfish	Bony fish	
			21.10	Detritus	Detritus	Debris	Crustacea (Decapoda)
			18.30	Zoobenthos	Benthic crust.	Shrimps	*Solenocera*
			14.72	Zoobenthos	Benthic crust.	Shrimps	*Processa*
			4.21	Zoobenthos	Benthic crust.	Bivalves	Cardiidae
Pomadasys panamensis	5	juveniles/	42.76	Nekton	Finfish	Bony fish	
		adults	22.04	Zoobenthos	Benthic crust.	Amphipods	Hyperiidae
			20.91	Zoobenthos	Benthic crust.	Stomatopods	Squillidae
			14.29	Detritus	Detritus	Debris	
Prionotus stephanophrys	1	adults	63.71	Zoobenthos	Benthic crust.	Crabs	Majidae
			23.47	Zoobenthos	Benthic crust.	Crabs	*Leiolambrus punctatissimus*
			9.20	Zoobenthos	Benthic crust.	Crabs	(Parthenopidae) Iliacantha (Leucosiidae)
			3.62	Zoobenthos	Benthic crust.	Crabs	Xanthidae
Scomberomorus sierra	12	juveniles/	81.85	Nekton	Finfish	Bony fish	*Selene peruviana*
		adults	13.15	Nekton	Finfish	Bony fish	*Chloroscombrus orqueta*
			2.08	Nekton	Finfish	Bony fish	
			1.40	Nekton	Finfish	Bony fish	*Trichiurus lepturus*
			1.28	Zoobenthos	Benthic crust.	Crabs	*Xanthidae*
			0.07	Zoobenthos	Benthic crust.	Stomatopods	*Hemisquilla*
			0.17	Zoobenthos	Mollusks	Bivalves	
Selar crumenophthalmus	7	juveniles/	74.67	Nekton	Finfish	Bony fish	
		adults	22.48	Zooplankton	Other planktonic	other plankt. Invert.	
			2.74	Detritus	Detritus	Debris	Crustacea
			0.11	Zoobenthos	Worms		
Selene brevoortii	33	juveniles/	30.47	Nekton	Finfish	Bony fish	
		adults	22.83	Zooplankton	Other planktonic	other plankt. Invert.	
			14.86	Zoobenthos	Benthic crust.	other benthic crust.	*Decapoda*
			10.13	Zoobenthos	Benthic crust.	Crabs	*Euphylax*
			4.47	Zoobenthos	Benthic crust.	Shrimps	*Trachypeneus*
			4.39	Zoobenthos	Benthic crust.	Crabs	*Portunus*
			4.15	Detritus	Detritus	Debris	Crustacea (Decapoda)
			2.91	Nekton	Finfish	Bony fish	*Porichthys*
			1.83	Zoobenthos	Benthic crust.	Shrimps	*Solenocera*
			1.14	Zoobenthos	Benthic crust.	Stomatopods	

Species	n	Stages	% composition	Food type			
				I	II	III	Taxa
			0.13	Nekton	Finfish	Bony fish	Pleuronectiformes
			1.11	Zoobenthos	Benthic crust.	Shrimps	*Processa*
			0.76	Zoobenthos	Benthic crust.	Shrimps	
			0.64	Zoobenthos	Benthic crust.	Crabs	Parthenopidae
			0.10	Zoobenthos	Benthic crust.	Shrimps	*Sicyonia*
			0.04	Zoobenthos	Benthic crust.	Isopods	
			0.03	Zoobenthos	Benthic crust.	amphipods	Hyperiidae
			0.01	Zoobenthos	Worms		
Selene oerstedii	2	juveniles/	89.24	Zoobenthos	Benthic crust.	Crabs	Calappidae
		adults	10.76	Detritus	Detritus	Debris	Crustacea
Selene peruviana	64	juveniles/	35.13	Nekton	Finfish	Bony fish	Engraulidae
		adults	18.51	Nekton	Cephalopods	Squid/cuttlefish	
			13.44	Nekton	Finfish	Bony fish	
			12.31	Nekton	Finfish	Bony fish	*Trichiurus lepturus*
			5.96	Zoobenthos	Benthic crust.	Ostracods	
			3.69	Detritus	Detritus	Debris	Decapoda
			3.11	Zoobenthos	Benthic crust.	Shrimps	
			2.46	Zoobenthos	Benthic crust.		Decapoda
			1.85	Zoobenthos	Benthic crust.	Stomatopods	
			1.75	Zooplankton	Other planktonic	other plankt. Invert.	
			0.66	Zoobenthos	Benthic crust.	Shrimps	*Processa*
			0.66	Zoobenthos	Benthic crust.	na/other echinoderms	Ophiuroidea
			0.34	Nekton	Finfish	Bony fish	Lutjanidae
			0.12	Plants	Other planktonic	Benthic algae/weeds	
			0.01	Zoobenthos	Benthic crust.	Stomatopods	*Squilla panamensis*
Sphyraena ensis	5		95.18	Nekton	Finfish	Bony fish	
			4.82	Zoobenthos	Benthic crust.	other benthic crust.	
Sphyrna tiburo	1	adults	61.50	Zoobenthos	Benthic crust.	Crabs	
			38.50	Nekton	Cephalopods	Squid/cuttlefish	

in shrimp fisheries (Rubio 1988) and are caught in artisanal and industrial fisheries (INPA 1997).

The diet composition shows that the main food items were benthic crustaceans (crabs 15.1%, shrimps 13.8% and stomatopods 8.6%) and bony fishes (23.7%), mostly demersal species (Table 2).

Amphipods, isopods and ostracods are usually designated as zoobenthos (benthic crustaceans) within the hierarchy of food items table in FishBase (Froese and Pauly 1997), hence in this study they were grouped in the same way for consistency. It can be noted, however, that amphipods belonging to family Hipperidae are usually pelagic and those species belonging to Gammaridae are essentially found on the bottom, but most of them are able to swim (Ruppert 1996). In addition, ostracods mainly inhabit near the bottom, even though most of the species are planktonic, while isopods are mainly benthic (bottom-dwelling) animals.

In some fish samples, sand and mud were found in the stomach contents. However, it was not possible to separate and weigh them. For this reason, they were not included as food items. The food item "worms" included organisms such as annelids, sipunculids and nemertines, and they were collectively measured. Detritus is defined as decomposing organic debris, small pieces of dead and decomposing plants and animals. Hence, organic detritus considered in the diet composition includes debris (carcasses) as in the ecology and food item tables from FishBase (Froese and Pauly 1997).

Information about trophic ecology (food items and/or diet composition) in FishBase exists only for the following species: *Selar crumenophthalmus* (Hiatt and Strasburg 1960; Randall 1967), *Diodon holocanthus* (Randall 1967, 1985), *Polydactylus approximans* (González and Soto 1988), *Scomberomorus sierra* (Collette and Nauen 1983), *Sphyrna tiburo* (Cortés et al. 1996) and *Prionotus stephanophrys* (Mendieta and Samamé 1984). This paper gives information about diet composition of 24 species (see Table 1) which can be used to supplement FishBase.

Identification of stomach content of fishes is not easy since the food items are usually completely digested or unidentifiable. In addition, most of the fish samples have empty stomachs. In this study, due to the low catches of some species or the relatively low number of fish samples with identifiable stomach contents, the diet composition of several species obtained is not representative and must be considered as preliminary. It is therefore suggested that a vigorous research program should be developed to increase the number of species studied for their natural diets and the results of the studies documented with a series of papers describing the diet composition of a variety of fish species.

It is also interesting to note that fishes that feed on phytoplankton were absent in the samples. Apparently, El Niño events may

indirectly influence the presence of these fishes. The phytoplankton biomass in the study area was low (Medina 1988), compared with the rest of the coastal waters off the Pacific Coast of Colombia. This is also attributed to the great river runoff in the central and southern parts of the continental shelf. During the El Niño event, a decrease in chlorophyll *a* (used as an indirect measure of phytoplankton biomass) has been reported (Arntz and Fahrbach 1996). Abiotic parameters and qualitative phytoplankton variation corroborated the occurrence of El Niño event in the Pacific Coast of Colombia in December 1997 (Medina 1988; López-Peralta et al. 1998a, 1998b, 1999). This El Niño episode is considered the strongest of the last century. Positive and negative biological consequences of this event include quantitative and qualitative changes on marine communities, as well as alterations in geographical distribution of some populations (Arntz and Fahrbach 1996). This points out the occurrence of changes in finfish food habits as well; therefore it is necessary to analyze diet composition of fishes in other periods in order to establish food consumption variability of fish stocks in the Pacific Coast of Colombia.

Acknowledgments

This work was supported by the Ministry for the Environment of Colombia and was carried out at the Instituto de Investigaciones Marinas y Costeras (INVEMAR). The authors thank their colleagues at INVEMAR: Alba Idalia Mosquera, Manuel Alejandro Ramírez, Anabella Zuluaga, María Isabel Criales, Augusto Angulo and Carlos Fernández.

References

Álvarez-León, R., J.V. Rodríguez-Mahecha and R.H. Orozco-Rey. 1999. Avances en el catálogo sobre peces de Colombia, presentes en aguas dulces, estuarinas y marinas, p. 8. ***In*** Resúmenes V Simposio Colombiano de Ictiología. Com. Reg. de Cien. y Tecnol. de la Amazonía, Leticia.

Andrade, J. 1986. Condiciones de movimiento geostrófico del Pacífico Colombiano basado en datos obtenidos por la Armada Nacional. Oceanogr. Físico, Escuela Almirante Padilla, Cartagena. 72 p. Thesis.

Arntz, W. and E. Fahrbach. 1996. El Niño: Experimento climático de la naturaleza. Fondo de Cultura Económica, México. 312 p.

Bussing, A. 1995. Gerreidae, p. 114-1128. ***In*** W. Fischer, F. Krupp, W. Schneider, C. Sommer, K.E. Carpenter and V. Niem (eds.) Guía FAO para la identificación de especies para los fines de la pesca. Pacífico Centro-Oriental. 3 Vols. FAO, Rome.

Collette, B.B. and C.E. Nauen. 1983. FAO species catalog. Vol. 2. Scombrids of the world. An annotated and illustrated catalog of tunas, mackerels, bonitos and related species known to date. FAO Fish. Syn. 125. Vol. 2, 137 p.

Coppola, S.R., W. Fischer, L. Garibaldi, N. Scialabba and K.E. Carpenter. 1994. SPECIESDAB: Global species database for fishery purposes. User's manual. FAO Computerized Information Series (Fisheries). No. 9. FAO, Rome. 103 p.

Cortés, E., C.A. Manire and R.E. Hueter. 1996. Diet, feeding habits, and diel feeding chronology of the bonnethead shark *Sphyrna tiburo*, in southwest Florida. Bull. Mar. Sci. 58(2):353-367.

FAO. 1992. FAO Yearbook. Fishery statistics: catches and landings. Vol. 74. FAO Fish. Series 43. 677 p.

Froese, R. and D. Pauly. 1997. FishBase 97 CD-ROM. ICLARM, Manila.

Fitch, J.E. and R.J. Lavenberg. 1971. Marine food and game fish of California. University of California Press, USA. 179 p.

Flóres, R. and G. Rodríguez. 1992. Condiciones oceanográficas. Cruceros hidroacústicos de evaluación de peces pelágicos pequeños en el Pacífico Colombiano PEC/PELAG 1991. Prog. Reg. Coop. Téc. Pes. CEE/PEC ALA/87/21, Min. Agri.-INPA, 11 p.

González, G.D. and L.D. Soto. 1988. Hábitos alimenticios de peces depredadores del sistema lagunar Huizache-Caimanero, Sinaloa, México. Inst. Cienc. del Mar. y Limnol. Univ. Nal. Autón. México 15(1):97-124.

Heemstra, P.C. 1995. Serranidae, p. 1565-1613. ***In*** W. Fischer, F. Krupp, W. Schneider, C. Sommer, K.E. Carpenter and V. Niem (eds.) Guía FAO para la identificación de especies para los fines de la pesca. Pacífico Centro-Oriental. 3 Vols. FAO, Rome.

Hensley, D.A. 1995. Paralichthyidae, p. 1349-1380. ***In*** W. Fischer, F. Krupp, W. Schneider, C. Sommer, K.E. Carpenter and V. Niem (eds.) Guía FAO para la identificación de especies para los fines de la pesca. Pacífico Centro-Oriental. 3 Vols. FAO, Rome.

Hiatt, R.W. and D.W. Strasburg. 1960. Ecological relationships of the fish fauna on coral reefs of the Marshall Islands. Ecol. Monogr. 30(1):65-126.

Hutchins, J.B. 1984. Monacanthidae. ***In*** W. Fischer and G. Bianchi (eds.) FAO species identification sheets for fishery purposes. Western Indian Ocean - Fishing Area 51(3). FAO, Rome.

INPA. 1997. Tablas de desembarques de la pesca artesanal e industrial en el Océano Pacífico Colombiano. Inst. Nal. Pesca y Acuacultura, Bogotá.

Leis, J.M. 1984. Diodontidae. ***In*** W. Fischer and G. Bianchi (eds.) FAO species identification sheets for fishery purposes. Western Indian Ocean - Fishing Area 51(2). FAO Rome.

López-Peralta, R.H., A.I. Mosquera., M.I. Criales, C.A. Trujillo and J.A. Angulo. 1998a. Proyecto Ecología Trófica Pacífico. Informe de actividades. Inst. Inv. Marinas y Costeras, INVEMAR,

Santiago de Cali. Agosto 1998. 36 p.

López-Peralta, R.H., C. Fernández, A.I. Mosquera., C.A. Trujillo, M.I. Criales and J.A. Angulo. 1998b. El sistema nerítico del Pacífico Colombiano: una aproximación a la modelación trófica. Resultados preliminares. Mem. XI Sem. Nal. De Polotica, Ciencias y Tecnologías del Mar, Bogotá, 26-30 Octubre.

López-Peralta, R.H., C. Fernández, C.A. Trujillo and J.A. Angulo. 1999. Proyecto Ecología Trófica Pacífico. Informe de actividades. Inst. Inv. Marinas y Costeras, INVEMAR, Buenaventura. Julio 1999.

McKay, M.J. and M. Schneider. 1995. Haemulidae, p. 1136-1173. ***In*** W. Fischer, F. Krupp, W. Schneider, C. Sommer, K.E. Carpenter and V. Niem (eds.) Guía FAO para la identificación de especies para los fines de la pesca. Pacífico Centro-Oriental. 3 Vols. FAO, Rome.

Medina, L. 1988. Cambios en la composicion y abundancia de la comunidad microalgal del Pacifico Colombiano, en relacion con el evento El Niño 97-98. Bol. Cient. CCCP 7:55-56.

Meindiger, P. 1987. La plataforma continental del Pacífico Colombiano (desde la frontera con el Ecuador hasta el sur de Buenaventura). Estudio morfológico, hidrológico y sedimento-logía. Min. Def. Nal. Armada Nal. CIOH. 28 p.

Mendieta, A. and M. Samamé. 1984. Avance de las investigaciones del "vocador" *Prionotus stephanophrys* en el área de su distribución, p. 17. ***In*** Libro de resúmenes I Congreso Nacional de Biología Pesquera, 28 de Junio al 01 de Julio 1984. Colegio de Biólogos Regional del Norte, Trujillo-Perú.

Moreau, J., W. Ligtvoet and M.L.D. Palomares. 1993. Trophic relationship in the fish community of Lake Victoria, Kenya, with emphasis on the impact of Nile perch (*Lates niloticus*), p. 144-152. ***In*** V. Christensen and D. Pauly (eds.) Trophic models of aquatic ecosystems. ICLARM Conf. Proc. 26, 390 p.

PRC. 1989. El Pacífico: Una nueva dimensión para Colombia. Presidencia de la República de Colombia. Vol. 1, 76 p.

Randall, J.E. 1967. Food habit of reef fishes of the West Indies. Stud. Trop. Ocean. Miami 5:555-847.

Randall, J.E. 1985. Guide to the Hawaiian reef fishes. Harrowood Book, Newton Square, Pennsylvania.

Rubio, E. 1987. Lista sistemática de peces costeros y de profundidad del Pacífico Colombiano. Centro de Publicaciones, Fac. Ciencias, U. del Valle, Cali, 258 p.

Rubio, E. 1988. Estudio taxonómico de la ictiofauna acompañante del camarón en áreas costeras del Pacífico de Colombia, p. 169-183 ***In*** Mem. VI Sem. Nal. Ciencias del Mar, 5-7 Dic., Bogotá.

Ruppert, E.Y.R. Barnes. 1996. Zoología de los invertebrados. McGraw-Hill, México. 921 p.

Sa-a, P., M.L.D. Palomares and D. Pauly. 1997. The FOOD ITEMS Table. ***In*** FishBase. 1997. CD-ROM. ICLARM, Manila.

Smith-Vaniz, W.F. 1995. Carangidae, p. 940-986. ***In*** W. Fischer, F. Krupp, W. Schneider, C. Sommer, K.E. Carpenter and V. Niem (eds.) Guía FAO para la identificación de especies para los fines de la pesca. Pacífico Centro-Oriental. 3 Vols. FAO, Rome.

Sommer, C. 1995. Sphyraenidae, p. 1618-1621. ***In*** W. Fischer, F. Krupp, W. Schneider, C. Sommer, K.E. Carpenter and V. Niem (eds.) Guía FAO para la identificación de especies para los fines de la pesca. Pacífico Centro-Oriental. 3 Vols. FAO, Rome.

Urbano, J. and F. Castillo. 1991. Reunión extraordinaria del Comité Técnico Nacional ERFEN, El Niño 1991. Inf. Téc. CIOH, Cartagena, Colombia. 30 p.

Vargas, C., E. Cajiao, R. Steer, P. Monsalve and R. Conbariza. 1969. Estudio preliminar descriptivo de algunas variables oceanográficas del Pacífico Colombiano (Programa ACENTO 1965, 1966). Dep. Oceanogr. Escuela Naval, Cartagena, Colombia. 50 p.

Velasco, A. 1998. Zur Gemeinshaftsstruktur und trophischen Stellung marin-ästuariner Jungfishfauna vor der kolumbianischen Pazifikküste, University of Bremen, Bremen. 109 p. Dr. rer. nat. dissertation.

Velasco, A. and M. Wolf. 1999. Ictiofauna juvenil marino-estuarina de fondos blandos frente a la costa Pacífica de Colombia: comparación de la composición por especies de juveniles y adultos, p. 21-22. ***In*** Resúmenes V Simposio Colombiano de Ictiología. Com. Reg. de Cien. y Tecnol. Amazonía, Leticia.

R.H. López-Peralta *is from Universidad Militar 'Nueva Granada', Colombia and* **C.A.T. Arcila** *is from Fundación Sila Kangama, Colombia.*
Email: rlopez@santander.umng.edu.co