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Feeding Ecology of the Blackwing Searobin *Prionotus rubio* (Jordan, 1886) Over the Western Continental Shelf off Alvarado, Veracruz, Mexico

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Seasonal changes of food habits of the blackwing searobin *Prionotus rubio* were studied over the continental shelf off Alvarado, Veracruz, Mexico, from Sept. 1994 to Aug. 1995. A total of 234 stomachs (182 with identifiable food) were analyzed. Brown shrimp *Farfantopenaeus aztecus*, blue crab *Portunus spinicarpus*, and rock shrimp *Sicyonia dorsalis* were the main dietary items. Low values of prey diversity and dietary breadth suggest the main prey were always relatively abundant over the western continental shelf of the Gulf of Mexico. We concluded the blackwing searobin is part of a trophic guild of demersal marine fish that impact mainly on epibenthic invertebrates.

The searobins of the genus *Prionotus* are bottom-dwelling armored fish easily identified by the presence of three detached lower pectoral rays, which they use to "walk" along the ocean floor (Russell et al., 1992). The spines serve as tactile organs in the search for food. Searobins are also noted for producing sound, especially during spawning season. *Prionotus* species are entirely marine, with distribution in temperate and tropical areas of shallow to moderate depths in the Atlantic Ocean and Gulf of Mexico.

From 15 triglid species reported along the western Atlantic coast, Gulf of Mexico, and Caribbean Sea (Russell et al., 1992), the blackwing searobin *Prionotus rubio* is one of the most numerous in the shrimp bycatch (Huidrobo, 1992). The blackwing searobin is distributed from North Carolina, U.S.A., to Cuba (Russell et al., 1992). Triglid abundance is usually higher in ocean habitats, but habitat-specific patterns of abundance appear to differ between species (McBride and Able, 1994).

In Mexico, the triglids are caught only as bycatch in the shrimp fishery. In spite of their abundance, they are not considered an important fishery (Yañez-Arancibia et al., 1985; Huidrobo, 1992); however, they may be important as forage for many commercially important species (Lewis and Yerger, 1976). Biological information on searobins from the Gulf of Mexico is primarily limited to studies on northeastern and eastern species. Lewis and Yerger (1976) examined distribution, food habits, and reproduction of five species from the northeastern Gulf of Mexico. Ross (1977, 1978, 1983, 1986) treated the relationship of distribution, body size, reproduction, feeding, and resource partitioning of searobins from West Florida Shelf and Tampa Bay. Huidrobo (1992) reviewed the distribution and abundance of searobins in the southeast Gulf of Mexico.

McBride and Able (1994) studied movements for *Prionotus carolinus* and *Prionotus evolans* between offshore and coastal or estuarine habitats along the northeastern U.S. Atlantic coast. They indicated that peaks in reproduction occur at different times during the summer for different species of *Prionotus*. McClure and McEachran (1992) examined hybridization between *Prionotus alatus* and *Prionotus paralatus*. Cruz (1996) described some aspects of the trophic ecology of the triglids over the western continental shelf of the Gulf of Mexico.

Considering the sparse biological information on this species in Mexico, we analyzed the diet composition and seasonal trophic changes of the blackwing searobin *P. rubio* to contribute to the knowledge of its trophic biology in the western Gulf of Mexico.

Materials and Methods

Alvarado, Veracruz, is on the Gulf of Mexico between 18°45′ and 19°N and 95°18′ and 95°42′W. Three seasons are usually recognized in the study area: dry season (Feb.–May), rainy season (June–Sept.), and north-wind season (Oct.–Jan.).

Samples were obtained from the commercial shrimp fishery, which uses standard otter trawls (20 m long, 10 m wide, and 4.5-cm mesh size). Monthly sampling of the commercial fishery was done between Sept. 1994 and Aug. 1995 except during Dec. 1994, Feb. 1995, May 1995, and June 1995 because of adverse weather. Fish

TABLE 1. Summary of food categories in stomach of blackwing searobin on the outer Continental Shelf of the Gulf of Mexico, expressed as percentages based on weight (W), number (n), frequency of occurrence (FO), and index of relative importance (IIRI).

Prey	W	% W	N	% N	FO	% FO	IRI	% IRI
Crustacea								
Trachypenaeus constrictus	10.06	4.81	6	2.69	4	4.40	32.95	0.92
Scycionia dorsalis	35.94	17.17	40	17.94	20	21.98	771.53	21.54
Portunus spinicarpus	15.22	7.27	39	17.49	27	29.67	734.61	20.51
Solenocera vioscai	0.18	0.09	4	1.79	4	4.40	8.26	0.23
Albunea paretii	0.50	0.24	2	0.90	2	2.20	2.50	0.07
Penaeus aztecus	74.01	35.35	46	20.63	25	27.47	1537.85	42.94
Squilla empusa	4.71	2.25	4	1.79	4	4.40	17.77	0.50
Calappa angusta	10.20	4.87	13	5.83	9	9.89	105.82	2.95
Iliacantha subglobosa	7.32	3.50	24	10.76	11	12.09	172.36	4.81
Leiolambrus nitidus	0.16	0.08	1	0.45	2	2.20	1.15	0.03
Ampelisca spp.	0.01	0.01	6	2.69	1	1.10	2.96	0.08
Macrobrachium spp.	0.18	0.09	7	3.14	4	4.40	14.18	0.40
Raininoides laevis	2.25	1.07	3	1.35	3	3.30	7.98	0.22
Xiphopenaeus spp.	33.00	15.76	9	4.04	6	6.59	130.53	3.64
Squilla chydea	2.66	1.27	3	1.35	2	2.20	5.75	0.16
Calappa flamea	1.67	0.80	2	0.90	2	2.20	3.72	0.10
Callinectes similis	2.03	0.97	1	0.45	1	1.10	1.56	0.04
Diogenidae	0.09	0.04	1	0.45	1	1.10	0.54	0.02
Decapoda remains	1.42	0.68	5	2.24	5	5.49	16.05	0.45
Mollusca								
Macoma spp.	5.00	2.39	4	1.79	2	2.20	9.19	0.26
Osteichthyes								
Bregmaceros cantori	0.01	0.01	2	0.90	2	2.20	1.98	0.06
Scyacium gunteri	2.75	1.31	1	0.45	1	1.10	1.94	0.05
Total	209.35	100	223	100	138	151.65	3581.15	100

were separated from the bycatch and were injected with a solution of 10% formaldehyde neutralized with sodium borate into the abdominal cavity to reduce the digestive processes.

In the laboratory, specimens were measured [standard length (SL)] to the nearest millimeter. For food analyses, the stomachs were removed and their contents were stored in 70% ethanol. All contents were identified to the lowest taxonomic level possible. Prey was identified to the lowest taxon, which was regularly distinguishable for each prey kind. To evaluate the relative importance of each food category, we used percentage of occurrence of food items in stomachs, the number of food items in each category, and wet weight contribution of each prey category (Windell and Bowen, 1978; Hyslop, 1980). We used an analytic balance to weigh food items. Gut contents of males and females were pooled.

Cumulative Shannon-Wiener (H′) plots of gut contents calculated from prey weight values were used to calculate the sample size for each season. Sample size was considered adequate when the curve reached a horizontal asymptote. The minimum sample size calculated was 35 specimens.

To describe the temporal variation in the trophic spectrum, we used the diversity index of Shannon–Wiener (H′) (Krebs, 1989). Diet breadth was calculated with Levin's standardized index (Krebs, 1989) according to Labropoulou and Eleftheriou (1997).

RESULTS

Overall dietary composition.—The blackwing searobin was caught during Sept. 1994, Oct. 1994, Nov. 1994, Jan. 1995, March 1995, April 1995, July 1995, and Aug. 1995. A total of 234 fish were caught (rainy season = 90, north-wind season = 96, and dry season = 48), with an average SL (± SD) of 198 mm ± 31 mm. From the total number of analyzed stomachs, 182 (78%) had food.

Twenty-two food components were identified from three major groups, crustaceans, mollusks, and fish (Table 1). Benthic invertebrates dominated the diet of *P. rubio*. By number, the distribution was brown shrimp *Farfantepenaeus aztecus*, 21%; rock shrimp *Sicyonia dor-*

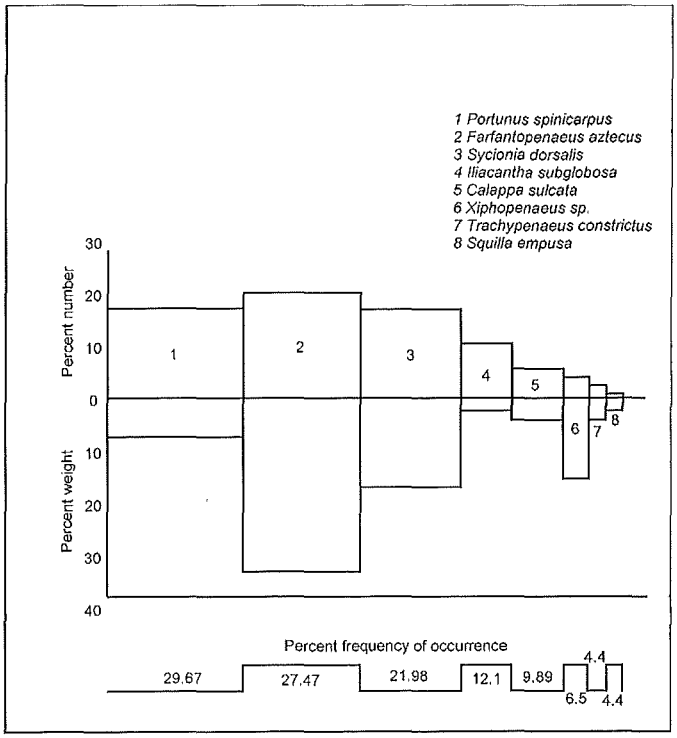

Fig. 1. The major prey species found in the stomach of the blackwing searobin *Prionotus rubio* presented as percent of number of individuals, wet weight and frequency of occurrence.

salis, 18%; blue crab *Portunus spinicarpus,* 17%; and *Iliacantha subglobosa,* 11% (Fig. 1). The rest of the food components had low values (<5%) (Table 1).

The most important prey by weight were the brown shrimp (35%), rock shrimp (17%), shrimp *Xiphopenaeus* sp. (16%), and blue crab (7%). The blue crab (30%), brown shrimp (27%), and rock shrimp (22%) dominated in percentage of frequency of occurrence (Fig. 1).

Seasonal dietary changes.—We did not observe meaningful seasonal dietary changes. During the rainy season, 70 food items were consumed. However, only a few prey species, mostly decapods, were found at high percentage in the diet. The most important prey were the brown shrimp (35%) and the blue crab (35%), followed by the moro crab *Calappa sulcata* (22%), *I. subglobosa* (19%), and *S. dorsalis* (16%). The highest contributions by wet weight were from the first two species, shrimp and crab (39% and 15%), whereas by number, brown shrimp (22%), blue crab (17%), *I. subglobosa* (14%), and moro crab (13%) were the most important (Fig. 2).

During the north-wind season, 60 dietary items were consumed. The decapods *S. dorsalis, F. aztecus,* and *Xiphopenaeus* sp. dominated the diet by frequency of occurrence (24%, 18%, and 15%), by weight (20%, 26%, and 27%), and by number (20%, 13%, and 14%). During this season, these three abundant species accounted for at least 55% of the total diet (Fig. 2).

In the dry season, seven food items were consumed. The most common prey in the diet of the blackwing searobin were the rock shrimp (50%), brown shrimp (45%), and blue crab (45%). The first two species dominated the diet in wet weight (27% and 65%). In number, the rock shrimp (33%), brown shrimp (25%), and blue crab (22%) were the most important dietary items (Fig. 2).

Prey diversity and dietary breadth.—We observed that the prey richness decreased from the rainy to the dry season. The prey diversity had a trend similar to the prey richness, with highest values during the rainy season (H′ = 1.97 bits/individual) and the lowest during the dry season (H′ = 0.93 bits/individual). For diet breadth (Bi), a trend similar to both richness

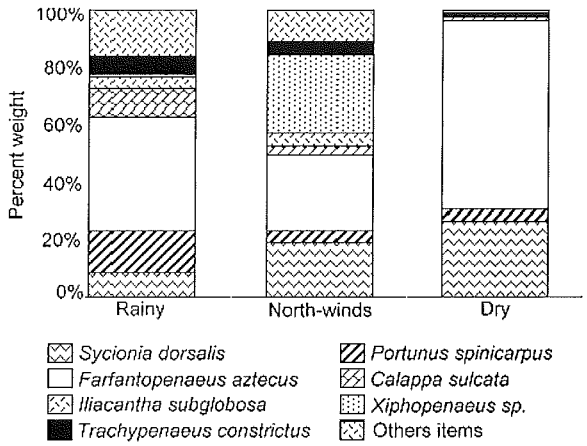

Fig. 2. Seasonal variation of the major prey species in the diet of the blackwing searobin *Prionotus rubio* determined by wet weight over western continental shelf of Gulf of Mexico.

and diversity was found, with the highest values during the north-wind and rainy seasons (0.28 and 0.24) and the lowest during the dry season (0.17) (Fig. 3).

Discussion

We found high dietary items within the trophic spectrum of the blackwing searobin (22 food items). However, only some prey of the benthic habitat were dominant within the diet. The frequent presence of benthic prey such as shrimp, crab, and other invertebrates in the stomach contents suggests the blackwing searobin fed generally on benthic prey. Ross (1977) mentioned that searobins are part of a guild of marine demersal fishes that use primarily epibenthic and infaunal invertebrates.

This dominance of the diet by epibenthic crustaceans, which parallels that recorded for similar-sized triglids (Ross, 1983, 1986; Schmitter-Soto and Castro-Aguirre, 1996), implies that *P. rubio* forage on the bottom. This conclusion is consistent with the observations that triglids frequently swim close to the bottom surface and their enlarged pectoral fins are used for detecting prey on that surface (Morte et al., 1997).

The very low contributions made to the diets of *P. rubio* by infauna, such as polychaetes, cumaceans, and isopods, indicate that this triglid does not feed extensively on the bottom, as is

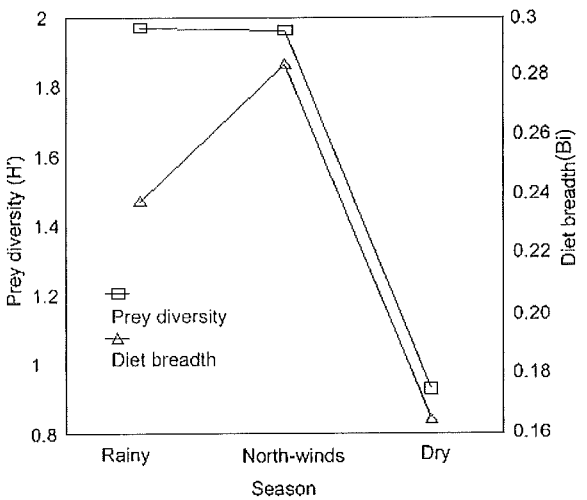

Fig. 3. Prey diversity (H') and diet breadth (Bi) of the blackwing searobin *Prionotus rubio* according to Shannon-Wiener and Levin's index.

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the case of other triglids in the Gulf of Mexico. Springer and Woodburn (1960) identified polychaetes and small crustaceans from stomachs of *Prionotus sictulus* from Tampa Bay. Reid (1954) listed mysidaceans, copepods, amphipods, penaeid shrimp, and polychaetes from *P. sictulus* in waters of the Gulf of Mexico.

Ross (1983) indicated that triglids in the Gulf of Mexico feed basically on crustaceans (mainly pasiphaeid shrimp), polychaetes, and lancelets. However, in an interspecies analysis, he found that the dominance of fish (*Bregmaceros atlanticus*) is higher in *Prionotus roseus, P. alatus,* and *Prionotus salmonicolor.* In contrast, we found low contribution by fish (*Bregmaceros cantori* and *Syacium gunteri*) in the diet of the blackwing searobin. The differences frequently found between the dietary compositions of the triglid species at different sites indicated that these species respond to variations in the relative availability of the various potential prey at those sites (Platell and Potter, 1999).

No seasonal changes in the diet of *P. rubio* were observed. The lack of such variation in the dietary compositions of the three seasons suggests the main prey were always relatively abundant. Our findings agree with the published information on food habits of other triglid species in the Gulf of Mexico (Ross, 1983). Schmitter-Soto and Castro-Aguirre (1996) also found low seasonal changes in the food habits of three species of triglids analyzed along the west coast of Mexico.

The greater dominance of *F. aztecus, S. dorsalis,* and *P. spinicarpus* in the diet of *P. rubio* would explain the seasonal low diversity values (rainy = 1.97, north wind = 1.96, and dry = 0.93) and trophic breadth (rainy = 0.24, north wind = 0.28, and dry = 0.17). In Mexico, brown shrimp and blue crab support two of the most important fisheries in the Gulf of Mexico (Yañez-Arancibia et al., 1985). Divita et al. (1983), Minello and Zimmerman (1984), and Minello et al. (1987) have indicated many species of fish have a strong impact on some populations of commercially important species (shrimp, crab); however, in the Gulf of Mexico, this impact has not been evaluated.

We conclude that the searobin blackwing *P. rubio* is part of a trophic guild of demersal marine fish that feed on epibenthic invertebrates. The crustaceans constituted the most important prey in the food preferences of blackwing searobin over the western continental shelf off Alvarado, Veracruz. Within the benthic crustaceans, the incidence of brown shrimp, blue crab, and rock shrimp is caused by their higher occurrence close to the bottom in comparison with infaunal prey species found such as polychaetes, gammarid amphipods, cumaceans, and isopods.

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