Hernández CMG, et al., J Aquac Fisheries 2024, 8: 089
DOI: 10.24966/AAF-5523/100089

HSOA Journal of Aquaculture & Fisheries

Research Article

Natural Feeding Of *Lutjanus Novemfasciatus* Juveniles in the Cuyutlan Lagoon, Colima, Mexico

Carolina Monserrat González-Hernández[1], Mirella Saucedo-Lozano[1] and Elaine Espino-Barr[2]*

[1]Universidad de Guadalajara (CUCSUR) Departamento de Estudios para el Desarrollo Sustentable de Zonas Costeras. Gómez Farías No. 82, San Patricio-Melaque, Jal. C.P. 48980. México, 0000-0002-5962-7145, 0000-0002-4566-6266, México

[2]CRIP-Manzanillo, INAPESCA, Playa Ventanas s/n Manzanillo, Colima, C.P. 28200, México

Abstract

Juveniles of *Lutjanus novemfasciatus* were obtained from the commercial fishing of the Cuyutlán lagoon, Colima. A total of 148 organisms were collected (21.3-49.0 cm), of which 99 (67%) presented stomach contents and 49 (33%) were empty. We identified 17 food components: seven species, six genera and four families. The diet of this species is mainly composed of decapods (81.1%) and fish (18.6%). The higher percentage in terms of weight for their contribution to the specific relative importance index was *Penaeus vannamei* (%W=34.75, %PSIRI=27.27). Ontogenic changes were found in the diet, the small individuals did not consume fish until the intermediate sizes, the frequency, weight and number in fish consumption increased in the larger sizes. No significant differences were found between the rainy season and the dry season. The amplitude of the trophic niche was low, which implies a low diversity in the trophic spectrum.

Keywords: Feeding; Juveniles; *Lutjanus novemfasciatus*; Ontogenetic changes

Introduction

Trophic dynamic offers knowledge on the function and structure of a population, which is necessary for the management of commercially exploited resources [1,2]. Studies focused on the feeding of organisms allow to understand the biology of species, since the diet depends on organisms fulfilling their life cycle [3]. However, the feeding of the species can vary according to the site, the season of the year and physiological requirements during growth and reproduction, known as trophic adaptability [4]. Fish from the Lutjanidae family are active demersal predators, which feed regularly during the night, sunrise or sunset and their principal food source are demersal organisms as invertebrates and fish. Due to the quality of their meat, many of these species are of commercial importance in tropical and subtropical regions [5-7]. One the ten species of snappers in the Pacific, from Northern Meico to Peru, Lutjanus novemfasciatus is the largest with a maximum length of 1.7 m [6] and a weight of 35.7 kg [8]. Adults live in rocky zones and coral reefs, and during their juvenile stages they can be found in estuarine systems and river mouths [9]. According to Duncan et al. [10], the length of first sexual maturation is from 55 to 61 cm in males and 60 to 68 cm in females.

The Cuyutlan Lagoon is the largest lagoon in the state of Colima, Mexico, and one of its vessels was declared a RAMSAR site in 2011 [11,12], and despite the fact that multiple studies have been carried out on some organisms [13-16], till now there is no study related to this species even though it is an important resource in the study area.

The objective of this study is to determine the feeding composition, as to its ontogenic and seasonal variations of the juveniles of this species.

Materials and Methods

The study area is the Cuyutlan Lagoon, Colima, Mexico, located on the Pacific Ocean littoral (18° 57' - 19° 03' N y 104° 00' - 104° 19' W), it measures 37 km long by 6 m in width. It is divided by natural and artificial physical barriers into four water bodies called vessels. The communication with the sea is in the middle portion of the lagoon body and the main supply of fresh water comes from the Armeria river [12,17-19].

The analyzed organisms come from biological samples taken from the commercial catches of coastal fishermen. Data of each organism is total length (TL cm). the stomach was conserved in a solution of formalin 10% till the analysis time. Once in the laboratory, the food entities were identified down to the lowest possible taxon based on the degree of digestion of the prey, using guides and specialized keys for each category [9,20-26].

The food entities of the stomach content were counted and weighed, by the numerical method (%N), the gravimetric method (%P) according to Rosecchi & Nouaze [27] and the frequency of occurrence (%FO) of Pinkas et al. [28]. The relative importance of each species of prey of *L. novemfasciatus* was established by the Relative Specific Importance Index for preys (%PSIRI) according to Brown et al. [29], expressed as: %PSIRI= [%Fi x (%PNi + %PPi)] / 2

Where: %PSIRIi is the Relative Specific Importance Index for the prey *i*, %PNi is the specific number in percentage for the prey *i*, and %PPi is the specific weight percentage for the prey *i*.

***Corresponding author:** Elaine Espino-Barr, CRIP-Manzanillo, INAPESCA, Playa Ventanas s/n Manzanillo, Colima, C.P. 28200, México, Tel: 314 106 77 56. 0000-0002-1672-333; Email: elespino@gmail.com

Citation: Hernández CMG, Lozano MS, Espino-Barr E (2024) Natural Feeding Of *Lutjanus Novemfasciatus* Juveniles in the Cuyutlan Lagoon, Colima, Mexico. J Aquac Fisheries 8: 089.

Received: June 28, 2024; **Accepted:** July 09, 2024; **Published:** July 15, 2024

To evaluate if the size of the sample (number of stomachs) is enough to describe the diet of *L. novemfasciatus*, trophic diversity accumulation curves of were made from the total number of prey identified, with the use of EstimateS 9.1.0. software [30], per size class and annual season; with a 100 randomizations without replacement, to assure that the curves reach an asymptotic value. Shannon index value [31] was represented in function of the accumulated number of examined stomachs [32]. The curve was considered asymptotic if at least two values prior to the trophic diversity (H´TOT) were in the interval of H´TOT ±0.05 H´TOT [33].

Organisms were grouped by size intervals (<28.0, 28.1-34.0, 34.1-40.', y >40.1cm TL) to analyze the diet related to the increase of the length of the fish. To determine the length values of the species of prey, total length was used. To determine the number of length classes Sturges formula was used:

$K = 1+3.322 (Log10\ n)$

Where: K = number of class intervals and n is the number of total values.

Once the number of class intervals was obtained, the width of this interval was determined, which was calculated with the following formula [34]:

$W = R/k$

Where: W = interval width, R = maximum value minus the minimum value and k = number of intervals.

In addition, an evaluation of the amplitude of the trophic spectrum (niche amplitude) was carried out for the dry and rainy seasons in order to determine the degree of specialization in the diet of *L. novemfasciatus*. For this purpose, the Levins measure [35], standarized by Hespenheiden method [36] was used, with the scale of 0 to 1, considered as a specialist when the value is close to zero and generalist when the value is close to one [37].

Results

General composition of the diet

From 2012 to 2013 148 stomachs of *L. novemfasciatus* juveniles were analyzed, of which 99 67%) presented stomach contents and 49 (33%) were empty. Maximum total length of the sampled organisms was 49 cm and the minimum 21.30 cm. the most representative prey in numeric percentage was *Portunus xantusii* (%N = 20.88), while the percentage in weight was *P. vannamei* (%P = 34.75). The remains of fish presented the most occurrence frequency in percentage (%FO = 21.21), however, the most important prey for its contribution to the PSIRI was *P. vannamei* (%PSIRI = 20.05) and *P. xantusii* (%PSIRI = 15.18), (Table 1).

In the stomach contents 91 food entities were found, which were grouped in seven superfamilies corresponding to the order or decapoda, of the subphylum crustacean: Galathoidea, Xanthoidea, Goneplacoidea, Cancroidea, Portunoidea, Penaeoidea and Cymothoidae, and other two more categories were added: remains of fish and crustaceans. The main food component for its contribution to PSIRI with 81.1% were the Decapods, of which the Peneids were the preferred food (%PSIRI=41.55) (Table 1).

Category	Porcentage values			
	W%	N%	FO%	PSIRI%
DECAPODS				
Galatheoidea				0.58
Family Porcelanidae	0.06	1.10	1.01	0.58
Xanthoidea				13.45
Family Xanthidae	5.77	12.09	5.05	8.93
Eury paneopeous	1.22	6.59	1.01	3.91
Panopeus sp.	0.13	1.10	1.01	0.61
Goneplacoidea				2.42
Family Goneplacidae	1.54	3.30	1.01	2.42
Cancroidea				4.62
Family Cancridae	2.69	3.30	2.02	2.99
Cancer sp.	2.15	1.10	1.01	1.62
Portunoidea				31.01
Crionus ruber	0.83	2.20	1.01	1.52
Callinectes arcuatus	1.51	4.40	2.02	2.95
Portunus xantusii	10.19	20.88	9.09	15.54
Portunus asper	9.75	8.79	6.06	9.27
Portunus sp.	1.28	2.20	2.02	1.74
Penaeoidea				41.55
Penaeus vannamei	34.75	19.78	14.14	27.27
Penaeus brevirostris	6.67	3.30	3.03	4.98
Penaeus californiensis	0.22	1.10	1.01	0.66
Penaeus sp.	9.59	7.69	7.07	8.64
Cymothoidae				0.58
Cymothoa sp.	0.06	1.10	1.01	0.58
Crustaceans ramains	2.76		9.09	1.38
Fish remains	8.82		21.21	4.41

Table 1: List of species in the composition of the trophic content of juveniles of *L. novemfasciatus* %FO (frequency of occurrence), %N (numerical percentaje). %W (weight porcentaje), %PSIRI (Relative Specific Importance Index for preys). Total %PSIRI for each functional group is marked in bold leters.

In this study fish species nwere not identified because of their advanced stage of digestión. The Decapod that obtained the highest percentage was *P. vannamei* (%PSIRI= 27.27). Total number of stomachs were considered enough to describe the throphic spectrum of *L. novemfasciatus*, since the accumulation curve presented a tendency toward asymptote (Figure 1).

Diet composition by size

In the composition of the diet by size, the number of stomachs examined was adequate for its description (<28.0=17, 28.0-34.0=34, 34.1-40.0=33 and >40.1=14) (Figure 2). The prey with higher contribution to the gravimetric index in organisms with smaller sizes than 28.0 cm LT was *P. xantusii* (%P =28.19). Organisms from 28.1 to 3.0 cm LT and from 34.1 to 40.0 cm the most important prey was *P. vannamei* (%P =44.52 and %W=29.09), respectively. For those with lengths higher than 40.1 cm LT, *Portunus asper* (%P =47.34) was the most important. The preys with highest numeric percentage in

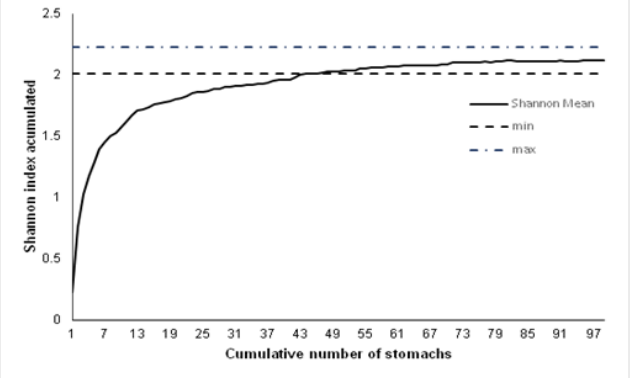

Figure 1: Trophic diversity accumulation curve for juveniles of *L. novemfasciatus*. The solid line corresponds to the Shannon diversity (H') and the dashed horizontal lines indicate the index H' ± 0.05 H´.

organisms with lengths smaller than 28.9 cm LT was the Xanthidae family (%N=20.00). From 28.1 to 34.0 cm LT *Eury panopeous* (%N=18.75) and from 34.1 to 40.0 cm LT *P. vannamei* (%N=23.33). Finally, in bigger lengths than 40.1 cm LT *P. xantusii* was the most important with %N=46.15. (Figure 3). The most frequent prey in organisms of sizes smaller than 28.0 cm LT was *P. vannamei* (%FO=23.53). The most frequemt preys in sizes from 28.1 to 34.0 cm LT were cataloged as fish remains (%FO=26.47). From 34.1 to 40.0 cm LT, also fish remains and also *Penaeus sp.* (%FO=15.15). In sizes bigger than 40.1 cm LT fish remains were found with higher frequency %FO=42.86 (Figure 4).

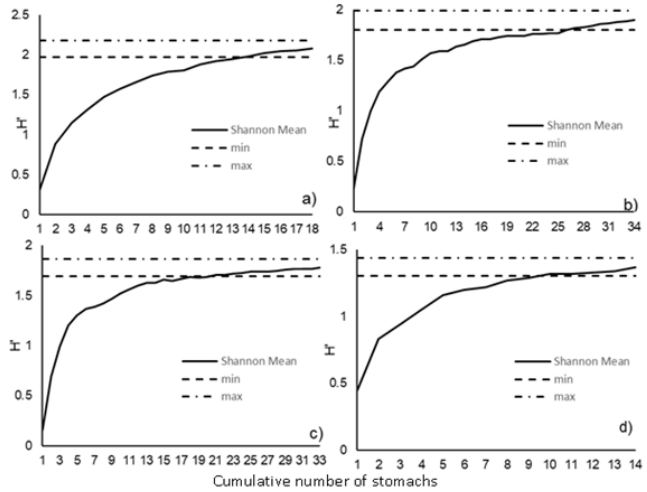

Figure 2: Cumulative curves of trophic diversity (H') by length class of *L. novemfasciatus*: a) <28 cm, b) 28.1- 34 cm, c) 34.1 – 40 cm y d) >40 cm total length.

P. xantusii (%PSIRI=22.09) and *P. vannamei* (% PSIRI=20.46) were the most important preys for their contribution to PSIRI% in sizes smaller than 28.0 cm LT, from 28.1 to 34.0 cm LT and 34.1 to 40.0 cm LT, the most important prey was *P. vannamei* (%PSIRI=30.07, %PSIRI=26.21), and finally for the range of lengths bigger than 40.1 cm LT, the preys with the highest percentage were *P. xantusii* (%PSIRI=30.97) and *P. asper* (% PSIRI=31.36) (Figure 3).

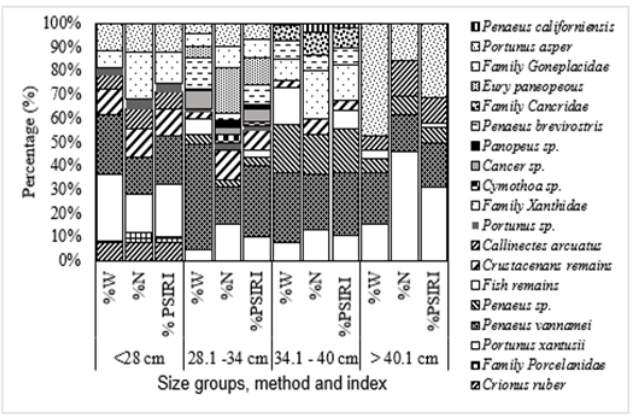

Figure 3: Gravimetric composition (W%), in number (N%), occurrence frequency (FO%) and Relative Specific Importance for preys (PSIRI%), by length class in the diet of *L. novemfasciatus* juveniles.

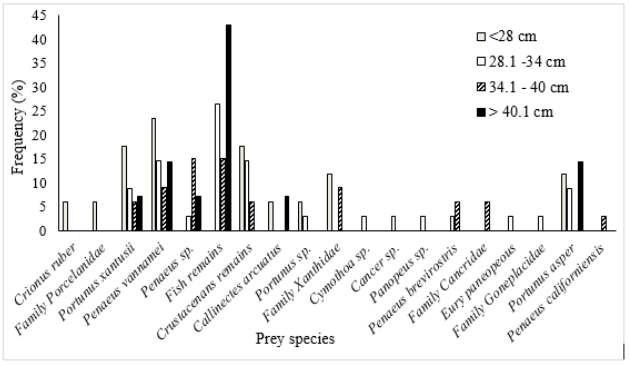

Figure 4: Frequency of Occurrence (%FO) of preys in the diet of *L. novemfasciatus* juveniles, by size clases.

Diet composition by time of year

According to the composition of the diet by time of year in both seasons (rainy and dry) the predominant prey in terms of weight percentage was *P. vannamei* with %P=38.07 and %P=32.65, respectively. Also as according to the relative specific importance for preys with %PSIRI=29.33 and %PSIRI=25.34, respectively. Regarding the numeric index, the preys that presented a higher percentage during rainy and dry seasons were *P. xantusii* (%N=23.53 and %N=18.03) and *P. vannamei* (%N=20.59 and %N=10.03), respectively. During both seasons fish remains were the most frequent ítem (rainy season: %FO=21.05, and dry season: %FO=20.97) (Figures 5&6).

Regarding the amplitude of the trophic niche, a higher value was observed during dry season. Despite the differences found in observed data between times of the year, there was no statistic significant differe ce between rainy and dry seasons. During all the months a value less tan 1 sas obtained (number: 0.3, weight: 0.3), therefore it can be considered a diet with low trophic diversity. It is considered that the total number of stomachs is enough to be able to describe the trophic spectrum by time of year, since the accumulation curve presented a tendency towards the asymptote (Figure 7).

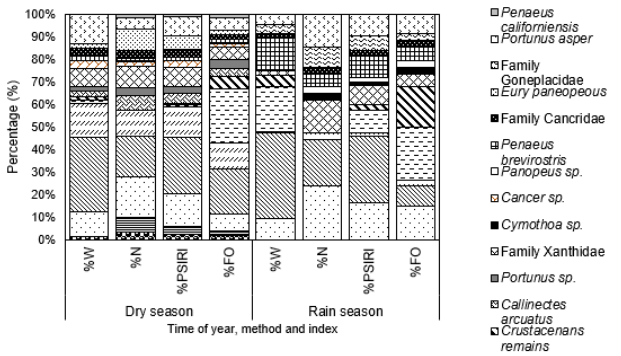

Figure 5: Gravimetric composition (W%), in number (N%), occurrence frequency (FO%) and Relative Specific Importance for preys (PSIRI%), by time of year (dry and rainy) in the diet of *L. novemfasciatus* juveniles.

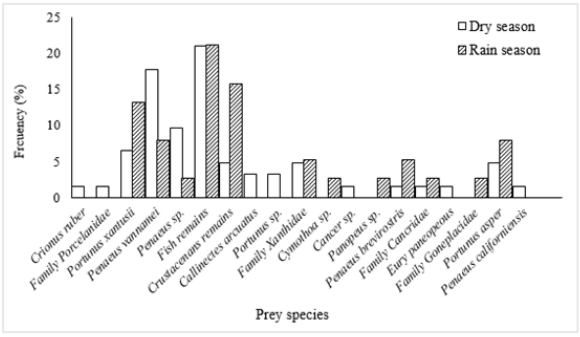

Figure 6: Occurrence frequency (%FO) of preys by time of year (dry and rainy) in the diet of *L. novemfasciatus* juveniles.

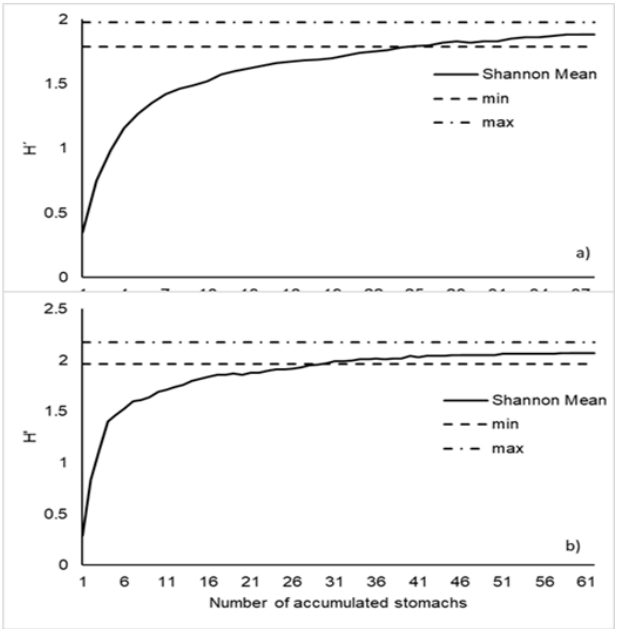

Figure 7: Cumulative curves of trophic diversity (H') by time of year: a) rainy and b) dry, of *L. novemfasciatus* juveniles.

Discussion

In Barra de Navidad lagoon, Aguilar- Betancourt *et al*. [38] report that the diet of *L. novemfasciatus* was mainly composed of decapods (49.9 %) and fish (43.7%) for their contribution to PSIRI and in less proportion stomatopods and mollusks, however, in the present study decapods predominated (81.1%) for their contribution to PSIRI, and in less proportion by stomatopods and mollusks. The variation between the two studies may be due to the characteristics of each estuarine system and the availability of food. The Cuyutlán Lagoon has a wider extension and depth range than the Barra de Navidad lagoon, which could influence the distribution of species and a mainly muddy bottom, with a large amount of detritus [13], which provides optimal conditions for the development of invertebrates. Cruz-Romero & Espino-Barr [19] noted that shrimp and crabs are some of the most abundant invertebrates in the lagoon. Other authors have documented species of the Lutjanidae family base their diet on crustaceans and fish, such as *L. peru, L. guttatus, L. campechanus, L. griseus, L. argentiventris, L. analis* and *L. colorado* [2,38-43]. According to Ruíz-Nieto [44], the most predominant prey of *L. novemfasciatus* in estuarine habitats of Sinaloa were shrimp (Penaeidae), crabs (*Portunus spp.* and *Callinectes spp.),* and fish (not identified), which is similar to the present work. Studies in some species of the Lutjanidae family (juveniles and adults) have shown a preference for crustaceans in their diets, such as in *L. jordani*, *L. synagrisy* and *L. argentiventris* [38,45,46].

In this study, variations in the weight and number of food entities were observed between small and large sizes. This may be because as the size of the predator increases, it looks for heavier prey to maximize the energy gain with respect to the capture effort, possibly due to the approach of the reproductive stage, as mentioned by Rojas [47] and Rojas et al. [48]. Szedlmayer & Lee [40] found that the diet of juvenile *L. campechanus* changes with increasing fish size: before 30.0 cm, their diet consists of shrimp, quetognathids, squid and copepods, after this size, the organisms feed on fish, larger quantities of squid and crabs, and continue to feed on shrimp. These variations in diet during fish growth could be due to morphological changes due to the increase in size, making the capture of prey more efficient [49]. Aguilar-Betancourt et al. [38] found that *L. novemfasciatus* has more piscivorous habits than *L. colorado* and *L. argentiventris*. Due to their morphological characteristics such as a more slender body and flatter head, they are more hydrodynamic and allow for easier displacement, the width of their mouth is larger and they have longer teeth, which makes them more efficient in their capture of prey. Some authors have documented the transition from invertebrate to fish feeding in species of the family Lutjanidae [41,48,50-52].

In the dry season, 14 food components were found and 13 in the rainy season. On the feeding of *Syacium ovale* and *Achirus mazatlanus* in Barra de Navidad lagoon, Padilla-Gutiérrez [49] mentions that a greater diversity was found in dry season, in terms of number and frequency, despite the fact that it is not about the species and lagoon body, the results are similar in terms of diversity in both study periods. Seasonal changes and variation in diet may be due to the availability and abundance of food during the rainy or dry season. Diet variation may be due to changes in the ecosystem to which organisms must adapt [53]. In the study of the feeding habits of *L. argentiventris* and *L. colorado*, Santamaría-Miranda et al. [54] found a low niche breadth, and mentioned that the diet of these species is cyclical in nature because the prey species are always present. This coincides with

the present study, since in general the trophic niche breadth was low showing a specialist tendency; *L. novemfasciatus* consumed *P. vannamei*, *P. xantusii* and fish throughout the year. In tropical regions there is a relative stability with respect to climatic changes throughout an annual cycle, which allows stability in the food base of fish, however, there may be variations in the hydro-meteorological cycles that can influence the feeding habits of fish in different regions [55].

Acknowledgement

This work was made possible by the invaluable support of the coastal fishermen of Laguna Cuyutlán. As well as †Arturo Garcia-Boa and Marcos Puente-Gómez from the Regional Fisheries Research Center (CRIP-Manzanillo) of INAPESCA who were in charge of collecting the samples. Likewise, the Department of Sustainable Development of Coastal Zones of the University of Guadalajara, where the data were analyzed and processed.

References

1. Duncan N, Ibarra-Zatarain Z, Hernández C, García N, Blanco VG, et al. (2009) Maduración del pargo prieto (Lutjanus novemfasciatus) en cautiverio. Avances en manejo y acuicultura ambiental : 39-55.

2. Saucedo-Lozano M, Chiappa-Carrara X (2000) Alimentación natural de juveniles de Lutjanus guttatus (Pisces: Lutjanidae) en la costa de Jalisco y Colima, México. Boletín del Centro de Investigaciones Biológicas 34:159-180.

3. Nikolsky G (1963) The ecology of fishes. Academic Press. London 352.

4. Odum WE, Heald EJ (1972) Trophic analysis of an estuarine mangrove community. Bulletin of Marine Science 22: 671-738.

5. Chiapa-Carrara X, Gallardo-Cabello M, Cervantes JM (1989) Análisis del régimen alimentario de tres poblaciones de la anchoveta Engraulis mordax Girard (Pisces: Engraulidae), en el norte de Baja California. Anales del Instituto de Ciencias del Mar y Limnología, Universidad. Nacional Autónoma de México 16: 361-378.

6. Odum WE, Heald EJ (1972) Trophic analysis of an estuarine mangrove community. Bulletin of Marine Science 22: 671-738.

7. Silva-Bátiz FA, Hernández-Vázquez S, Nené-Preciado JA, Vázquez-Lule AD (2009) Caracterización del sitio de manglar Laguna de Cuyutlán, en Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO). Sitios de manglar con relevancia biológica y con necesidades de rehabilitación ecológica. CONABIO, México.

8. IGFA (1991) International Game Fish Association. Disponible.

9. Fischer W, Krupp F, Schneider W, Sommer C, Carpenter KE, et al. (1995) Guía FAO para identificación de especies para los fines de la pesca Pacífico centro-oriental. Volumen III. Vertebrados parte 2 Roma Italia FAO.

10. Duncan N, Ibarra-Zatarain Z, Hernández C, García N, Velasco Blanco G, et al. (2009) Maduración del pargo prieto (Lutjanus novemfasciatus) en cautiverio. Avances en manejo y acuicultura ambiental. 1a edición. Editorial Trillas 39-55.

11. Trujillo-Retana G (2014) Comparación de los hábitos alimentarios del huachinango del Pacífico Lutjanus peru (Perciformes: Lutjanidae), en el Sur del Golfo de California, México. (Tesis Maestría) Maestría en Manejo de Recursos Marinos. Instituto Politécnico Nacional. Centro Interdisciplinario de Ciencias Marinas La Paz, BCS, México,72.

12. Torres J, Quintanilla-Montoya AL (2014) Alteraciones antrópicas: historia de la Laguna de Cuyutlán, Colima. Investigación Ambiental 6: 29-41.

13. Fischer W, Krupp F, Schneider W, Sommer C, Carpenter KE, et al. (1995) Guía FAO para identificación de especies para los fines de la pesca Pacífico centro-oriental. Volumen III. Vertebrados, parte 2. Roma Italia, FAO.

14. Serrano-Pinto V, Caraveo-Patiño J (2002) A benthic mollusks checklist from Laguna Cuyutlan, Colima, México. Hidrobiológica 12: 166-169.

15. Claro R, Lindeman KC (2008) Biología y manejo de los pargos (Lutjanidae) en el Atlántico occidental. Instituto de Oceanología, CITMA, La Habana Cuba: 472: 878-959.

16. Quijano-Scheggia S, Olivos-Ortiz A, Gaviño-Rodríguez JH, Castro-Ochoa F, Rivera-Vilarelle M, et al. (2011) Primer reporte de Pseudo-nitzschia brasiliana y P. micropora (Bacillariophycea) en la Laguna de Cuyutlán, México. Revista de Biología Marina y Oceanografía 46: 189-197.

17. Torres J, Quintanilla-Montoya AL (2014) Alteraciones antrópicas: historia de la Laguna de Cuyutlán, Colima. Investigación Ambiental 6: 29-41.

18. Luna JHR (1987) Rehabilitación de la Laguna de Cuyutlán, Colima. En: VII Congreso Nacional de Oceanografía. Ensenada Baja California, México 265.

19. Chávez Comparán JC, Hammann MG (1989) Diet of the mojarras, Gerres cinereus and Diapterus peruvianus (Pisces: Gerreidae) in Cuyutlan Lagoon, Colima, Mexico during summer. Ciencias Marinas 15: 71-80.

20. Rathbun MJ (1930) The cancroid crabs of America of the families Eurylidae, Portunidae, Atelecyclidae, Cangridae and Xanthidae. Bulletin of the United States. National Museum 152: 1-229.

21. Allen GR, Fischer WF, Krupp W, Schneider C, Sommer KE, et al. (1995) Guía FAO para la identificación de especies para los fines de la pesca. Pacífico Centro-Oriental. Volumen III. Roma Italia: 1231-1244.

22. Hendrickx ME, Salgado-Barragán J (1991) Los estomatópodos (Crustacea: Hoplocarida) del Pacífico mexicano. Publicaciones Especiales. Instituto de Ciencias del Mar y Limnología. Universidad Nacional Autónoma de México. 10: 1-200.

23. Hendrickx ME (1995) Camarones. En: Fischer W, Krupp F, Schneider W, Sommer C, Carpenter KE, Niem VH (eds). Guía FAO para la identificación de especies para los fines de la pesca. Pacífico Centro-Oriental. FAO 417-537.

24. Hendrickx ME (1995) Cangrejos. En: Fischer W, Krupp F, Schneider W, Sommer C, Carpenter KE, Guía FAO para la identificación de especies para los fines de la pesca. Pacífico Centro-Oriental. FAO 565-636.

25. Pérez-Farfante I, Kensley B (1997) Penaeoid and Sergestotoid shrimps and prawns of the world. Keys and diagnoses for the families and genera. Memoires du Museum National d´Histoire Naturelle París 175: 1-13.

26. Eschmeyer WN (2013) Catalog of Fishes. Electronic version Internet Publication, San Francisco, California Academy of Sciences.

27. Rosecchi E, Novaze Y (1987) Comparaison de cinq índices alimentaires utilisés dans y' analyse des contenus stomacaux. Revue des Travaux de l'Institut des Pêches Maritimes, 49: 11-123.

28. Pinkas L, Oliphant MS, Iverson LK (1971) Food habitats of albacore, bluefin tuna, and bonito in California Waters. The California Department of Fish and Game's Fish Bulletin 152: 1-105.

29. Acero A, Garzón J (1985) Los pargos (Pisces: Perciformes: Lutjanidae) del Caribe colombiano. Actualidades Biológicas 14: 89-99.

30. IGFA (1991) International Game Fish Association.

31. Magurran AE (2004) Ecological diversity and its measurements. Princeton University Press, Princeton NJ US.

32. Figueiredo M, Morato T, Barreiros JP, Afonso P, Santos RS (2005) Feeding ecology of the white seabream, Diplodus sargus, and the ballan wrasse, Labrus bergylta, in the Azores. Fisheries Research 75: 107-119.

33. Nikolsky G (1963) The ecology of fishes. Academic Press. London: 352.

34. Serrano-Pinto V, Caraveo-Patiño J (2002) A benthic mollusks checklist from Laguna Cuyutlan, Colima, México. Hidrobiológica 12: 166-169.

35. Levins R (1968) Evolution in changing environments. Some theoretical explorations. Princeton University Press, Princeton, New Jersey 123.

36. Hespenheiden HA (1975) Ecología de los productores primarios en la Laguna de Celestúm, México. Patrones de variación espacial y temporal. (Tesis de doctoral). Universidad de Barcelona. España 233.

37. Krebs CJ (1989) Ecological methodology. Harper Collins Publishers, New York USA 550.

38. Santamaría-Miranda A (1998) Hábitos alimenticios y ciclo reproductivo del huachinango, Lutjanus peru (Nichols y Murphy, 1922) (Pisces: Lutjanidae) en Guerrero, México. (Tesis Maestría en Manejo de Recursos Marinos). Instituto Politécnico Nacional. Centro Interdisciplinario de Ciencias Marinas, La Paz, Baja California Sur, México.

39. Szedlmayer ST, Lee JD (2004) Diet shifts of juvenile red snapper (Lutjanus campechanus) with changes in habitat and fish size. Fishery Bulletin, 102: 366-375.

40. Guevara E, Álvarez H, Mascaró M, Rosas C, Sánchez A (2007) Hábitos alimenticios y ecología trófica del pez Lutjanus griseus (Pisces: Lutjanidae) asociado a la vegetación sumergida en la Laguna de Términos, Campeche, México. Revista de Biología Tropical 55: 989-1004.

41. Flores-Ortega JR, Godínez-Domínguez E, Rojo-Vázquez JA, Corgos A, Galván-Piña VH, et al. (2010) Interacciones tróficas de las seis especies de peces más abundantes en la pesquería artesanal en dos bahías del Pacífico Central Mexicano. Revista de Biología Tropical, 58: 383-397.

42. Oliveira-Freitas M, Abilhoa V, Costa GH, Silva G (2011) Feeding ecology of Lutjanus analis (Teleostei: Lutjanidae) from Abrolhos Bank, Eastern Brazil. Neotropical Ichthyology 9: 411-418.

43. Saucedo-Lozano M, Chiappa-Carrara X (2000) Alimentación natural de juveniles de Lutjanus guttatus (Pisces: Lutjanidae) en la costa de Jalisco y Colima, México. Boletín del Centro de Investigaciones Biológicas 34:159-180.

44. Ruiz-Nieto IC (2005) Hábitos alimenticios de Hoplagrus guentherii, Lutjanus argentiventris, L. colorado, L. guttatus, L. novemfasciatus, L. peru (Pisces: Lutjanidae) presentes en las costas del Centro del Sur de Sinaloa. (Tesis de Maestría), Posgrado en Ciencias del Mar y Limnología. UNAM.

45. Ramírez-Luna V, Navia AF, Rubio EA (2008) Food habits and feeding ecology of an estuarine fish assemblage of northern Pacific Coast of Ecuador. Pan-American Journal of Aquatic Sciences 3: 361-372.

46. Cabral-Solís EG, Espino-Barr E (2004) Distribución y abundancia espacio-temporal de los peces en la Laguna de Cuyutlán, Colima, México. Oceánides 19: 19-27.

47. Santamaría-Miranda A, Saucedo-Lozano M, Herrera-Moreno MN, Apún-Molina JP (2005) Hábitos alimenticios del pargo amarillo Lutjanus argentiventris y del pargo rojo Lutjanus colorado (Pisces: Lutjanidae) en el norte de Sinaloa, México. Revista de Biología Marina y Oceanografía 40: 33-44.

48. Rojas JR, Maravilla E, Chicas B (2004) Hábitos alimentarios del pargo mancha Lutjanus guttatus (Pisces: Lutjanidae) en Los Cóbanos y Puerto La Libertad, El Salvador. Revista de Biología Tropical 52: 163-170.

49. Padilla-Gutiérrez SC (2017) Alimentación natural de los lenguados Achirus mazatlanus y Syacium ovale en la laguna de Barra de Navidad, Jalisco. (Tesis de licenciatura). Universidad de Guadalajara. Centro Universitario de la Costa Sur. Departamento de Estudios para el Desarrollo Sustentable de Zonas Costeras. Licenciatura en Biología Marina, Autlán de Navarro, Jalisco, México: 50.

50. Saucedo-Lozano M (2000) Alimentación natural de juveniles de Lutjanus peru (Nichols y Murphy, 1992) y Lutjanus guttatus (Steindachner, 1869) (Lutjanidae: Perciformes) en la costa de Jalisco y Colima, México. (Tesis de Maestría).

51. Rojas-Herrera AA, Chiappa-Carrara X (2002) Hábitos alimenticios del flamenco Lutjanus guttatus (Pisces: Lutjanidae) en la costa de Guerrero, México. Ciencias Marinas 28: 133-147.

52. Trujillo-Retana G (2014) Comparación de los hábitos alimentarios del huachinango del Pacífico Lutjanus peru (Perciformes: Lutjanidae), en el Sur del Golfo de California, México. (Tesis Maestría) Maestría en Manejo de Recursos Marinos. Instituto Politécnico Nacional. Centro Interdisciplinario de Ciencias Marinas La Paz, BCS, México,72.

53. Pratchett MS, Berumen ML (2008) Interespecific variation in the distribution and diets of coral reef butterfly fishes (Teleostei: Chaetodontidae). J Fish Biol 73: 1730-1747.

54. Sierra LM, Popova OA (1989) Dinámica del ritmo de la alimentación de varias especies de peces neríticos del Golfo de Batabanó en diferentes años: Reporte de Investigación del Instituto de Oceanología. Academia de Ciencias de Cuba. La Habana Cuba 2: 1-19.

55. Trujillo-Retana G (2014) Comparación de los hábitos alimentarios del huachinango del Pacífico Lutjanus peru (Perciformes: Lutjanidae), en el Sur del Golfo de California, México. (Tesis Maestría) Maestría en Manejo de Recursos Marinos. Instituto Politécnico Nacional. Centro Interdisciplinario de Ciencias Marinas La Paz, BCS, México,72.

HERALD

Advances In Industrial Biotechnology | ISSN: 2639-5665

Advances In Microbiology Research | ISSN: 2689-694X

Archives Of Surgery And Surgical Education | ISSN: 2689-3126

Archives Of Urology

Archives Of Zoological Studies | ISSN: 2640-7779

Current Trends Medical And Biological Engineering

International Journal Of Case Reports And Therapeutic Studies | ISSN: 2689-310X

Journal Of Addiction & Addictive Disorders | ISSN: 2578-7276

Journal Of Agronomy & Agricultural Science | ISSN: 2689-8292

Journal Of AIDS Clinical Research & STDs | ISSN: 2572-7370

Journal Of Alcoholism Drug Abuse & Substance Dependence | ISSN: 2572-9594

Journal Of Allergy Disorders & Therapy | ISSN: 2470-749X

Journal Of Alternative Complementary & Integrative Medicine | ISSN: 2470-7562

Journal Of Alzheimers & Neurodegenerative Diseases | ISSN: 2572-9608

Journal Of Anesthesia & Clinical Care | ISSN: 2378-8879

Journal Of Angiology & Vascular Surgery | ISSN: 2572-7397

Journal Of Animal Research & Veterinary Science | ISSN: 2639-3751

Journal Of Aquaculture & Fisheries | ISSN: 2576-5523

Journal Of Atmospheric & Earth Sciences | ISSN: 2689-8780

Journal Of Biotech Research & Biochemistry

Journal Of Brain & Neuroscience Research

Journal Of Cancer Biology & Treatment | ISSN: 2470-7546

Journal Of Cardiology Study & Research | ISSN: 2640-768X

Journal Of Cell Biology & Cell Metabolism | ISSN: 2381-1943

Journal Of Clinical Dermatology & Therapy | ISSN: 2378-8771

Journal Of Clinical Immunology & Immunotherapy | ISSN: 2378-8844

Journal Of Clinical Studies & Medical Case Reports | ISSN: 2378-8801

Journal Of Community Medicine & Public Health Care | ISSN: 2381-1978

Journal Of Cytology & Tissue Biology | ISSN: 2378-9107

Journal Of Dairy Research & Technology | ISSN: 2688-9315

Journal Of Dentistry Oral Health & Cosmesis | ISSN: 2473-6783

Journal Of Diabetes & Metabolic Disorders | ISSN: 2381-201X

Journal Of Emergency Medicine Trauma & Surgical Care | ISSN: 2378-8798

Journal Of Environmental Science Current Research | ISSN: 2643-5020

Journal Of Food Science & Nutrition | ISSN: 2470-1076

Journal Of Forensic Legal & Investigative Sciences | ISSN: 2473-733X

Journal Of Gastroenterology & Hepatology Research | ISSN: 2574-2566

Journal Of Genetics & Genomic Sciences | ISSN: 2574-2485

Journal Of Gerontology & Geriatric Medicine | ISSN: 2381-8662

Journal Of Hematology Blood Transfusion & Disorders | ISSN: 2572-2999

Journal Of Hospice & Palliative Medical Care

Journal Of Human Endocrinology | ISSN: 2572-9640

Journal Of Infectious & Non Infectious Diseases | ISSN: 2381-8654

Journal Of Internal Medicine & Primary Healthcare | ISSN: 2574-2493

Journal Of Light & Laser Current Trends

Journal Of Medicine Study & Research | ISSN: 2639-5657

Journal Of Modern Chemical Sciences

Journal Of Nanotechnology Nanomedicine & Nanobiotechnology | ISSN: 2381-2044

Journal Of Neonatology & Clinical Pediatrics | ISSN: 2378-878X

Journal Of Nephrology & Renal Therapy | ISSN: 2473-7313

Journal Of Non Invasive Vascular Investigation | ISSN: 2572-7400

Journal Of Nuclear Medicine Radiology & Radiation Therapy | ISSN: 2572-7419

Journal Of Obesity & Weight Loss | ISSN: 2473-7372

Journal Of Ophthalmology & Clinical Research | ISSN: 2378-8887

Journal Of Orthopedic Research & Physiotherapy | ISSN: 2381-2052

Journal Of Otolaryngology Head & Neck Surgery | ISSN: 2573-010X

Journal Of Pathology Clinical & Medical Research

Journal Of Pharmacology Pharmaceutics & Pharmacovigilance | ISSN: 2639-5649

Journal Of Physical Medicine Rehabilitation & Disabilities | ISSN: 2381-8670

Journal Of Plant Science Current Research | ISSN: 2639-3743

Journal Of Practical & Professional Nursing | ISSN: 2639-5681

Journal Of Protein Research & Bioinformatics

Journal Of Psychiatry Depression & Anxiety | ISSN: 2573-0150

Journal Of Pulmonary Medicine & Respiratory Research | ISSN: 2573-0177

Journal Of Reproductive Medicine Gynaecology & Obstetrics | ISSN: 2574-2574

Journal Of Stem Cells Research Development & Therapy | ISSN: 2381-2060

Journal Of Surgery Current Trends & Innovations | ISSN: 2578-7284

Journal Of Toxicology Current Research | ISSN: 2639-3735

Journal Of Translational Science And Research

Journal Of Vaccines Research & Vaccination | ISSN: 2573-0193

Journal Of Virology & Antivirals

Sports Medicine And Injury Care Journal | ISSN: 2689-8829

Trends In Anatomy & Physiology | ISSN: 2640-7752