Food resource partitioning among five dominant fish species in the Los Frailes reef, south-western Gulf of California, Mexico

Reparto de recursos tróficos entre cinco especies de peces dominantes del arrecife de Los Frailes, suroeste del Golfo de California, México.

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Abstract.
Partitioning of the food resources among five dominant fish species in the Los Frailes reef, Baja California Sur, Mexico: *Arothron meleagris* (Tetraodontidae), *Stegastes rectifraenum* (Pomacentridae), *Thalassoma lucasanum* (Labridae), *Acanthurus triostegus* and *Prionorus punctatus* (Acanthuridae) was investigated. Stomach contents were analyzed and quantified using the index of relative importance (IRI), diet width was calculated with Levin´s index, and trophic overlap was calculated with the Morisita-Horn index. A total of 94 benthic food items were identified, which consisted mainly of algae (green, red, brown), crustaceans and molluscs. *P. punctatus* (n= 85) and *A. triostegus* (n= 50) can be categorized as herbivores, while *A. meleagris* (n= 101), *S. rectifraenum* (n= 50) and *T. lucasanum* (n=246) can be categorized as omnivores. The diet breadth index (Bi) as well as the overlap index (Cλ) indicated that the five analyzed species had a specialized trophic behavior (Bi= <0.6) and low trophic overlap (Cλ= ≤ 0.1). Based on these results, we conclude that each species has a preference for particular food components, a narrow diet width, and that there is low trophic overlap among them, which allows them to coexist on the reef in high numerical abundances and with minimal interspecific competition for food.

Keywords: Gulf of California, diet, reef fish, trophic interactions, rocky reef, trophic overlap.

Resumen.
Se determinó el reparto de recursos tróficos entre cinco especies de peces dominantes del arrecife de los Frailes, Baja California Sur, México: *Arothron meleagris* (Tetraodontidae), *Stegastes rectifraenum* (Pomacentridae), *Thalassoma lucasanum* (Labridae), *Acanthurus triostegus* y *Prionorus punctatus* (Acanthuridae). Para el análisis y cuantificación de los contenidos estomacales de cada especie se empleó el índice de importancia relativa (IIR) y se determinó la amplitud y la sobreposición de las dietas utilizando el Índice de Levin y Morisita-Horn respectivamente.

Se identificaron un total de 94 componentes alimenticos bénticos, los cuales se constituyeron principalmente por algas (verdes, rojas, cafés), crustáceos y moluscos. *Prionurus punctatus* (n= 85) y *A. triostegus* (n= 50) se categorizaron como especies herbívoras, mientras *A. meleagris* (n= 101), *S. rectifraenum* (n= 50) y *T. lucasanum* (n=246) como especies omnívoras. Tanto el índice de Levin (*Bi*) como el índice de Morisita-Horn (Cl) indicaron que todas las especies de consumidores analizados son especialistas (*Bi*= <0.6) y que el traslapamiento trófico entre sus dietas es bajo (Cl= ≤ 0.1). Los resultados indican que cada especie tiene preferencia por algunos componentes alimenticios específicos, una amplitud de dieta estrecha y un bajo traslape trófico entre ellas, lo cual les permite coexistir en el arrecife con abundancias altas y competencia mínima entre ellas.

Palabras clave: Golfo de California, dieta, Peces arrecifales, Interacciones Tróficas, Arrecife Rocoso, traslape trófico.

INTRODUCTION

The Gulf of California, also known as the Sea of Cortes, is a highly diverse biological area with abundant marine life (Case & Cody, 1983). The highest underwater diversity of this sea is found on rocky bottoms, at less than 50 m depth, mainly along the coasts of the Baja California Peninsula (Thomson *et al*., 2000).

The Los Frailes reef belongs to the Cabo Pulmo Marine Park, in the south-western Gulf of California (Reyes-Bonilla, 1997). This reef has a high fish diversity (236 species, Villareal-Cavazos *et al*., 2000), including species that are very abundant and that remain spatio-temporally on the reef, such as *Arothron meleagris* (Lacèpede, 1798) (Tetraodontidae), *Stegastes rectifraenum* (Gill, 1862) (Pomacentridae), *Thalassoma lucasanum* (Gill, 1862) (Labridae), *Acanthurus triostegus* (Linnaeus, 1758) and *Prionorus punctatus* Gill, 1862 (Acanthuridae). These species generally dominate reef systems in the south-western Gulf of California (Pérez-España *et al*., 1996; Aburto-Oropeza & Balart, 2001).

There are few studies on the trophic ecology of reef fishes in the Gulf of California (*e.g.* Hobson, 1968; Montgomery *et al*., 1980, 1980a; Moreno-Sánchez *et al*., 2009, 2011; Abitia-Cárdenas *et al*., 2011). These studies have described the general food composition of species without taking into account interspecific trophic interactions, which are fundamental for understanding biological interactions and energy flow in ecosystems (Gulland, 1983; Pauly, 1984; Caddy, 1988; Soares *et al*., 1992). The analysis of diet overlap among the dominant species in an ecosystem allows the identification of strategies (generalist, specialist or opportunist) that favour species coexistence, minimizing competition among species and allowing their establishment and dominance (Caragistou & Papaconstantinou, 1994; Cruz-Escalona *et al*., 2000). Several authors have also mentioned that trophic overlap measures among fish species that coexist in a given habitat are useful for comparing the use of food resources (Farnsworth & Ellison, 1996; Cruz-Escalona *et al*., 2000).

In this context, the present study described the diet of *T. lucasanum* in the Los Frailes reef, BCS, analyzing it in conjunction with the diets of *A. meleagris, S. rectifraenum, A. triostegus*, and *P. punctatus* (Moreno-Sanchez *et al*., 2009, 2011;

Abitia-Cardenas *et al*., 2011; Moreno-Sanchez *et al*., 2014), in order to determine diet breadth and dietary overlap, and establish whether there was partitioning of food resources among the five dominant fish species.

MATERIALS AND METHODS

Sampling trips were carried out monthly from November 2004 to October 2006, at the Los Frailes rocky reef, south-western Gulf of California (23° 22′ 54.44″ N; 109° 25′ 4.04″ W). Specimens of *A. meleagris, S. rectifraenum, A. triostegus,* and *P. punctatus* were captured using basic scuba gear and a polespear (Moreno-Sánchez *et al*., 2009, 2011; Abitia-Cárdenas *et al.*, 2011; Moreno-Sánchez *et al.*, 2014), while *T. lucasanum* specimens were caught using a cylindrical net (Clifton, 1996). All samples were obtained between 10:00 a.m. and 16:00 p.m., since all species have diurnal feeding habits.

The length (TL) of each collected organism was recorded, and the stomach was removed. Stomach contents were kept in tagged plastic bags and frozen until later analysis at the Fish Ecology laboratory at the Centro Interdisciplinario de Ciencias Marinas (CICIMAR-IPN). The different food items were separated according to taxonomic group, and identified to the lowest possible taxonomic level, depending on the type and digestion state of prey items.

For taxonomic identification of crustaceans and molluscs the keys by Brusca (1980), Morris *et al*. (1980) and Fischer *et al*. (1995) were used; for algal identification the keys by Dawson (1944, 1961), Abbott and Hollenberg (1976), Dawes (1986) and Espinoza-Avalos (1993) were used. Once the taxonomic identification was complete, stomach contents of all species were analyzed quantitatively, using the following indices: frequency of occurrence (%FO), percent by number (%N) and percent by weight (%W) (Pinkas *et al*., 1971). In order to standardize and evaluate the information obtained from the five species, the Index of Relative Importance was used (Pinkas *et al*., 1971):

$$IIR = (\%W + \%N) * \%FO$$

where IRI = index of relative importance, %W = percent weight, %N = percent number, and %FO = percent frequency of occurrence.

This index combines information from the component indices above and contains information on the contribution of each prey item to the predator (Liao *et al*., 2001). The IRI was also expressed as a percentage (%IRI) (Cortés, 1997), using the following formula:

$$\%IIR = \frac{100 IIR_i}{\sum_{i=1}^{n} IIR_i}$$

The diet breadth (Bi) was calculated using the standardized Levin´s index (Hurlbert, 1978) using the absolute values obtained with the IRI. This index gives values ranging from 0 to 1. Low values (< 0.6) indicate a specialist predator that uses few prey resources and prefers certain prey (specialist predator), and high values (> 0.6) indicate a generalist predator that uses all resources without preference (Labropoulou & Eleftheriou, 1997; Escobar-Sanchez *et al.,* 2006).

$$B_i = \frac{1}{n-1}\left(\frac{1}{\sum_j p_{ij}^2} - 1\right)$$

Where Bi=Levin's standardized index for predator i; p_{ij}=proportion of diet of predator *i* that is made up by prey j; and n=number of prey.

The interspecies dietary overlap was estimated using the Morisita-Horn Index employing the absolute IRI values (Smith & Zaret, 1982).

$$C\lambda = \frac{2\sum_{i=1}^{n}(P_{xi} * P_{yi})}{(\sum_{i=1}^{n} P_{xi}^2 + \sum_{i=1}^{n} P_{yi}^2)}$$

Where Cλ = Morisita-Horn index of overlap between predator x and predator y. P_{xi} = Proportion of prey i of the total prey used by predator x. P_{yi} = Proportion of prey i of the total prey used by predator y. n = Total number of prey.

Cλ values vary from 0, when no elements of the diet are alike, to 1 when all elements occur in equal abundance. The trophic overlap was classified according to the scale proposed by Langton (1982): low overlap = 0.0 to 0.29, middle overlap = 0.30 to 0.65, high overlap = 0.66 to 1.

RESULTS

The trophic spectra of *A. meleagris, S. rectifraenum, A. triostegus* and *P. punctatus* were obtained from studies published by Moreno-Sánchez *et al*. (2009, 2011, 2014), and Abitia-Cárdenas *et al*. (2011), which characterized the diet of these species using the Index of Relative Importance.

Quantitative descriptions of the *T. lucasanum* diet were carried out during the present study. A total of 300 stomachs of this species were analyzed (82% contained food and 18% were empty), and 378 prey items were counted, belonging to 15 food components. These groups included algae, invertebrates (molluscs, crustaceans and others), and fish scales. Gastropods were the most numerous group, followed by ostracods; these two groups comprised 52.9 % of the diet (Table 1). The most important component by weight (47.8 g) and frequency (52.23%) was unidentified organic matter (UOM), followed by copepods, which constituted 29.2 g and 29.9% FO (Table 1). According to the IRI, the food components that made up 98% of the diet were UOM, gastropods, ostracods, shell remains and isopoda. The estimated IRI values for each recorded item in the diet of the five species are presented in Table 2.

Levin´s index indicated that *A. triostegus* (Bi = 0.10) and *P. punctatus* are specialists (Bi = 0.13), as are the omnivorous species *A. meleagris* (Bi = 0.12), *S. rectifraenum* (Bi = 0.30), and *T. lucasanum* (Bi= 0.08). Trophic overlap values were low among all analyzed species (≤ 0.1) (Table 3). Specifically, *A. triostegus* and *P. punctatus* had several food items in common, such as *Cladophora* spp., *Codium simulans*, *Amphiroa valonioides, Ceramium* spp., *Gracilaria* spp., *Jania mexicana*, *Dictyota crenulata*, *Padina concrescens*, and *Sphacelaria* spp. *A. triostegus* and *S. rectifraenum* had the following algae in common: *Bryopsis* spp., *Cladophora* spp., *Rhizoclonium*

Table 1. Trophic spectrum composition of the Cortez rainbow wrasse, *Thalassoma lucasanum* in the Los Frailes reef, B.C.S., presented as absolute and percent values by number (N), weight (W), frequency of occurrence (FO) and index of relative importance (IRI). UOM = Unidentified organic matter.

Tabla 1. Composición del espectro trófico de la arcoiris de Cortés, *Thalassoma lucasanum* en el arrecife de Los Frailes, B.C.S., se presentan los valores absolutos y los porcentajes por número (N), peso (W), frecuencia de ocurrencia (FO) y el índice de importancia relativa (IRI). UOM= Materia orgánica no identificada.

Species	W	%W	FO	%FO	N	%N	IRI	%IRI
Phaeophyceae	3.4	3.04	5	2.02	0	0	6.16	0.18
Rhodophyceae	0.3	0.27	1	0.4	0	0	0.11	0
Chlorophyceae	2.1	1.88	7	2.83	0	0	5.33	0.15
Benthic copepods	0.4	0.36	1	0.4	13	3.44	1.54	0.04
Phylum Porifera	0.8	0.72	3	1.21	0	0	0.87	0.03
Class Gastropoda	3.5	3.13	11	4.45	113	29.89	147.09	4.25
Fish eggs	0.4	0.36	2	0.81	30	7.94	6.72	0.19
Isopoda	1.6	1.43	5	2.02	75	19.84	43.06	1.24
UOM	47.8	42.79	129	52.23	0	0	2234.95	64.58
Ostracoda	9.4	8.42	10	4.05	87	23.02	127.25	3.68
Copepoda	29.2	26.14	74	29.96	0	0	783.19	22.63
Shell remains	3.9	3.49	10	4.05	60	15.87	78.4	2.27
Phylum Crustacea	0.3	0.27	1	0.4	0	0	0.11	0
Phylum Echinoder-mata	3.4	3.04	9	3.64	0	0	11.09	0.32
Fish scales	5.2	4.66	8	3.24	0	0	15.08	0.44
TOTAL	111.7	100	247		378	100	3460.93	100

Table 2. Stomach contents of the dominant fish species in the Los Frailes rocky reef, B.C.S., Mexico, according to the index of relative importance (%IRI).

Tabla 2. Resumen del contenido estomacal de las especies dominantes del arrecife rocoso de Los Frailes, B.C.S., México, de acuerdo con el Índice de Importancia Relativa (%IIR).

	Acanthurus triostegus		*Prionorus punctatus*		*Arothron meleagris*		*Stegastes rectifraenum*		*Thalassoma lucasanum*	
Species	IRI	%IRI	IRI	%IRI	IRI	%IRI	IRI	%IRI	IRI	%IRI
Unidentified alga					7.79	0.13				
Chlorophyceae									5.33	0.15
Bryopsis spp.	28.53	0.62					961.59	11.08		
Caulerpa racemosa	0.13	0								
Cladophora spp.	48.94	1.07	3.7	0.05	0.52	0.01	115.01	1.33		
Cladophoropsis fasciculatus	0.08	0								
Codium simulans	0.5	0.01	5.22	0.07						
Derbesia marina	13.11	0.29								
Enteromorpha spp.	0.07	0								
Rhizoclonium spp.	13.43	0.29					601.99	6.94		
Ulva lactuca	19.41	0.42			2.39	0.04	5.39	0.06		
Ulva linza	2356.4	51.5					619.87	7.14		
Rhodophyceae									0.11	0.003
Ahnfeltia spp.	0.18	0								
Amphiroa beauvoisii			13.76	0.17	34.22	0.56				
Amphiroa misakiensis			87.41	1.1						
Amphiroa valonioides	119.54	2.61	57.56	0.73			7.172	0.083		
Centroceras spp.	0.1	0								
Ceramium flaccidum					1.02	0.02				
Ceramium spp.	1.29	0.03	20.3	0.26						
Corallina vancouverensis			5.56	0.07						
Champia spp.	41.04	0.9								
Erythrotrichia spp.	0.05	0								

Table 2 Continued…

Species	*Acanthurus triostegus* IRI	%IRI	*Prionorus punctatus* IRI	%IRI	*Arothron meleagris* IRI	%IRI	*Stegastes rectifraenum* IRI	%IRI	*Thalassoma lucasanum* IRI	%IRI
Galaxaura spp.			4.68	0.06						
Gelidiella aerosa			11.84	0.15						
Gelidiella spp.	667.68	14.59								
Goniotrichum alsidi	0.06	0								
Gracilaria spp.	16.18	0.35	1209.35	15.24	0.45	0.01	191.62	2.21		
Herposiphonia tenella f. secunda			197.82	2.49						
Herposiphonia spp.	5.98	0.13					199.53	2.3		
Hypnea musciformis	38.19	0.84	681.01	8.58						
Hypnea spp.					9.39	0.15				
Jania adhaerens					1.86	0.03				
Jania mexicana	32.08	0.7	459.17	5.79			494	5.69		
Laurencia spp.	115.72	2.53								
Neogoniolithon trichotomum			154.19	1.94						
Pitophilium spp.	0.74	0.02								
Polysiphonia simplex spp.	395.12	8.64								
Polysiphonia pacifica					6.37	0.1				
Polysiphonia spp.			173.25	2.18						
Porphyra spp.	47.05	1.03								
Pterocladia capillacea			168.19	2.12						
Pterocladiella spp.	1.03	0.02								
Phaeophyceae									6.16	0.18
Dictyopteris delicatula	2.62	0.06								
Dictyopteris undulata					1.97	0.03				
Dictyopteris spp. A			133.07	1.68						

Table 2 Continued…

Species	*Acanthurus trios-* IRI	%IRI	*Prionorus puncta-* IRI	%IRI	*Arotrhon me-* IRI	%IRI	*Stegastes recti-* IRI	%IRI	*Thalassoma luca-* IRI	%IRI
Dictyopteris spp. B			3.33	0.04						
Dictyota crenulata	26.61	0.58	192.62	2.43			99.91	1.151		
Dictyota dichotoma					1.69	0.03				
Dictyota flabellata			306.91	3.87						
Ectocarpus spp.	6.52	0.14					650.12	7.49		
Lobophora spp.	8.45	0.19								
Padina concrescens	0.01	0	85.38	1.08						
Padina durvillaei					19.16	0.31				
Sphacelaria spp.	17.14	0.38	317.85	4						
PHYLUM CNIDARIA										
Pocillopora spp.					728.51	11.85				
PHYLUM CRUSTA-									0.11	0.003
BALANIDAE										
Balanus spp.					5.35	0.09				
PALINURIDAE										
Panulirus inflatus					11.2	0.18				
Panulirus interruptus					1.54	0.03				
PHYLUM MOLLUSCA										
CLASS GASTROPODA					1.7	0.03			147.09	4.25
Cerithium spp.							868.14	10		
Olivella spp.							843.16	9.72		
Notoacmea fascicularis					25.58	0.42				

Table 2 Continued…

Species	*Acanthurus triostegus* IRI	*Acanthurus triostegus* %IRI	*Prionorus punctatus* IRI	*Prionorus punctatus* %IRI	*Arotrhon meleagris* IRI	*Arotrhon meleagris* %IRI	*Stegastes rectifraenum* IRI	*Stegastes rectifraenum* %IRI	*Thalassoma lucasanum* IRI	*Thalassoma lucasanum* %IRI
Phenacolepas malonei					12.57	0.2				
HIPPONICIDAE										
Hipponix panamensis					18.7	0.3				
CALYPTRAEACEA										
Crepidula aculeata					7.03	0.11				
Crepidula arenata					235.07	3.82				
CLASS PELECYPODA										
MYTILIDAE										
Lithophaga spp.					22.52	0.37				
OSTREIDAE										
Ostrea fisheri					0.79	0.01				
CLASS BIVALVIA					3.83	0.06				
Bivalves							3.49	0.04		
Shell remains							307.03	3.54	78.4	2.27
TELLINIDAE										
Tellina spp.					98.86	1.61				
CRUSTACEA										
COPEPODA									783.19	22.63
Benthic copepods							2418.5	27.87	1.54	0.04
BRACHYURA										
Eriphia verrucosa							92.5	1.07		
Phylum Echinodermata									11.09	0.32
CIDARIDAE										

Table 2 Continued…

Species	*Acanthurus triostegus* IRI	%IRI	*Prionorus punctatus* IRI	%IRI	*Arotrhon meleagris* IRI	%IRI	*Stegastes rectifraenum* IRI	%IRI	*Thalassoma lucasanum* IRI	%IRI
Eucidaris thouarsii					1.09	0.02	4.97	0.06		
ECHINOMETRIDAE										
Echinometra vanbrunti					1614.49	26.26				
ASTEROIDEA										
Phataria unifascialis					1.72	0.03				
ORDER SCLERACTINIA										
PORITIDAE										
Porites spp.					297.06	4.83				
ANNELIDA										
POLICHAETA					0.92	0.01				
BRYOZOA					330.3	5.37				
ISOPODA									43.06	1.24
OSTRACODA									127.25	3.68
PHYLUM PORIFERA					770.48	12.53			0.87	0.03
UROCHORDATA (tunicates)										
Tunicates							79.87	0.92		
Fish scales							0.64	0.01	15.08	0.44
Fish eggs									6.72	0.19
Sand							42.73	0.49		
UOM	551.7	12.05	3644.58	45.92	1872.07	30.45	69.79	0.8	2234.95	64.58
TOTAL	4576	100		100	6148.2	100	8677.45	100	3460.93	100

Table 3. Trophic overlap among the five dominant fish species of the Los Frailes reef, BCS, Mexico. Overlap was calculated with the Morisita-Horn index.

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abla 3. Traslape trófico entre las cinco especies de peces dominantes del arrecife de Los Frailes Baja California Sur, México. El traslapamiento fue calculado con el índice de Morisita-Horn.

	A. triostegus	*P. punctatus*	*A. meleagris*	*S. rectifraenum*	*T. lucasanum*
A. triostegus	*				
P. punctatus	0.03	*			
A. meleagris	0.002	0.005	*		
S. rectifraenum	0.17	0.1	0.0004	*	
T. lucasanum	0	0	0.0005	0.009	*

spp., *Ulva lactuca*, *U. linza, A. valonioides, Gracilaria* spp., *Heterosiphonia* spp., *J. mexicana*, and *D. crenulata*. *S. rectifraenum* and *P. punctatus* both fed on *Cladophora* spp., A. *valonioides, Gracilaria* spp., *J. mexicana, D. crenulata*. The omnivores *A. meleagris* and *S. rectifraenum* consumed *Cladophora* spp., *Ulva lactuca, Gracilaria* spp., and *Eucidaris thouarsii*. Despite having diet items in common, diet overlap was low, because the proportions of these shared items were minimal in the diet. Additionally, *T. lucasanum* did not have any species in common with *A. triostegus* or *P. punctatus.*

DISCUSSION

Although there are previous studies of the feeding habits of reef fish in the Gulf of California (e.g., Hobson, 1968; Montgomery *et al*., 1980; Pérez-España & Abitia-Cárdenas, 1996; Aburto-Oropeza *et al*., 2000; Abitia-Cárdenas *et al*., 2011; Moreno-Sánchez *et al*., 2009, 2011, 2012), few studies have focused on resource partitioning or on interactions among coexisting species (Cruz-Escalona *et al*., 2000, 2010). This information is vital to understand the mechanisms that favour coexistence and energy flow in ecosystems, as well as interspecific trophic interactions (Gulland, 1983; Pauly, 1984; Caddy, 1988; Soares *et al*., 1992; Cruz- Escalona *et al*., 2000).

According to stomach content analyses, two fish feeding guilds could be identified: herbivores and omnivores. The herbivores *A. triostegus* and *P. punctatus* fed exclusively on algae; *A. triostegus* consumed 35 algae species and *P. punctatus* consumed 23 algae species, which represented 58% and 36% respectively, of all macroalgae present in the Los Frailes reef (Anaya-Reyna & Riosmena-Rodríguez, 1996). However, only 3 to 5 algae species were the most important in the diet of these herbivorous fish species, and therefore Levin´s index categorized them as specialists. According to Gerking (1994), specialist species feed on a reduced number of food components, independently of the abundance of the resource in the habitat.

Selective feeding habits attenuate competition to a minimum. *A. triostegus* fed mainly on green algae, especially on *Ulva linza*, which can comprise up to 50% of its diet, while *P. punctatus* fed mainly on red algae (which comprised up to 40% of its diet). *P. punctatus* consumed mainly *Gracilaria* spp. as well as brown algae (which makes up 13% of the diet), and this was confirmed by the low diet overlap value between the two species ($C\lambda = 0.03$).

The differentiation of diets allows these species to coexist in the Los Frailes reef. Choat and Bellwood (1985) found that the adaptations that favoured trophic resource distribution between two herbivorous fish species (*Acanthurus lineatus* and *Ctenochaetus striatus*) in a Lizard Island reef were differences in dentition, mandible shape, and digestive tract. Although no description of the mandibular apparatus (dentition) or digestive tract of *A. triostegus* and *P. punctatus* were carried out, it is probable that morphological differences allowed them to select different algae when feeding. In order to clarify this point it would be necessary to conduct studies on the functional morphology of the jaw apparatus and digestive tract of these species.

Species that fed on invertebrates in higher proportion and on algae in lower proportion were catalogued as omnivores (*A. meleagris,* *S. rectifraenum* and *T. lucasanum*). The range of food components for these species was large, comprising algae as well as invertebrates such as benthic copepods, barnacles, snails, lobsters, sea stars and polychaetes. However, the trophic overlap among species was almost nil ($C\lambda = \leq 0.009$), since each species had a few important components in the diet, and these important components did not coincide among the analyzed species. The diet of each species was dominated by a few food items, and Levin´s index categorized them as specialists.

This differentiation allowed the establishment of A. *meleagris, S. rectifraenum* and *T. lucasanum* as the most dominant omnivorous species (by numerical abundance) in the Los Frailes reef. This was facilitated in part by the behaviour of each species on the reef. *A. meleagris* is a solitary wandering species that inhabits waters from 0.5 m to 35 m depth, and has a dentition consisting of 4 plates that allow it to feed on hard food items, such as sea urchins, corals, sponges, molluscs and bryozoans (Robertson & Allen, 2008). These same trophic items have been found in studies carried out in several regions of the Eastern Tropical Pacific (Glynn *et al*., 1972; Guzmán & López, 1991; Reyes-Bonilla & Calderón-Aguilera, 1999).

Stegastes rectifraenum is a territorial species that occupies specific places on the reef and defends them vigorously from other species, and feeds mainly on benthic copepods, on *Bryopsis* spp., *Cerithium* spp., *Olivella* spp. and *Ectocarpus* spp. Its territorial behaviour restricts its food consumption to certain trophic components, due to the limited mobility it has on the reef, and to the size of its mouth and teeth (Montgomery, 1980b; Thomson *et al*., 2000; Aguilar-Medrano *et al*., 2011). *Thalassoma lucasanum* is the most conspicuous, abundant (numerically) and dominant species on the Los Frailes rocky reef. It consumed benthic food items, such as crabs, gastropods, ostracods, isopods, algae and fish scales. According to Hobson (1968), *T. lucasanum* feeds on bottom organisms such as crustaceans, algae, and soft corals, which was also reported in the present study. It should be mentioned that fish scales present in the stomach contents of *T. lucasanum* could be due to this species visiting cleaning stations and probably feeding on the scales of the fish that it cleans (Hobson, 1968). A considerable quantity of UOM in the stomach contents was also recorded, as well as food items very little to not at all digested. This is probably due to *T. lucasanum* feeding all day long, as Hobson (1968) reported in a trophic behaviour study that included 800 hours of filming. Levin´s index determined that *T. lucasanum* was a specialist. However, this result should be treated with caution due to the low taxonomic resolution of prey, occasioned by the advanced degree of digestion and small prey size.

In general, the trophic spectrum of the analyzed species spanned the principal benthic fauna of the Los Frailes reef, which is a habitat with high structural complexity (high number of cavities, rugosity, substrate heterogeneity, depth variation, waves) that fosters the existence of highly variable and abundant prey species (e.g., algae, invertebrates) that are the main food source for the dominant fish species (Moreno-Sánchez *et al*., 2014). Even though there were high numbers of food components in the diet of the dominant fish species, it is clear that there is trophic distribution, with selection of only a few food items, according to the availability of food resources on the reef, which allows the minimization of interspecific competition and enables species coexistence on the Los Frailes reef.

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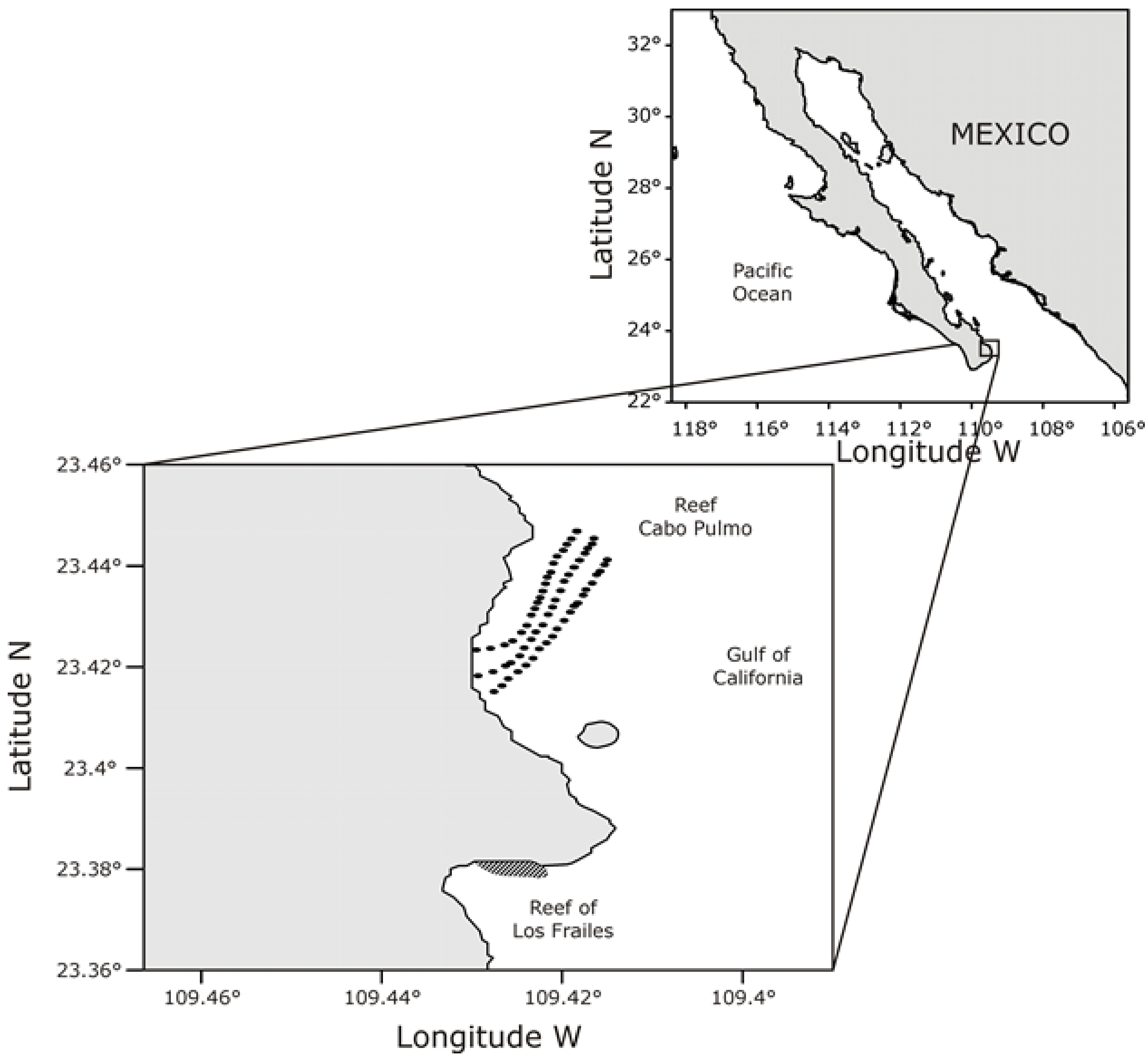

Figure 1. Los Frailes rocky reef, Baja California Sur.
Figura 1. Arrecife rocoso de Los Frailes, Baja California Sur.

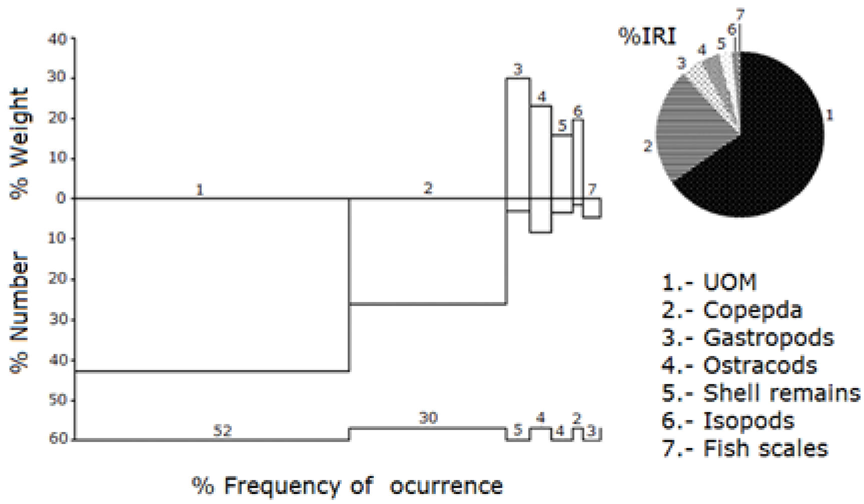

Figure 2. Main prey of the Cortez rainbow wrasse, *Thalassoma lucasanum* shown as percent number, percent weight, frequency of occurrence, and index of relative importance (%IRI). UOM=.Unidentified organic matter.

Figura 2. Presas principales de la arcoiris de Cortés, *Thalassoma lucasanum* mostradas como porcentajes de número, porcentajes de peso, frecuencia de ocurrencia, e índice de importancia relativa (IRI). UOM= Materia orgánica no identificada.