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Reproduction of *Gerres cinereus* (Percoidei: Gerreidae) off the Mexican Pacific coast

Reproducción de *Gerres cinereus* (Percoidei: Gerreidae) en la costa del Pacífico mexicano

Elaine Espino-Barr^{1*}, Manuel Gallardo-Cabello², Esther G. Cabral-Solis¹, Marcos Puente-Gómez¹ & Arturo García-Boa¹

ABSTRACT

Yellowfin Mojarra *Gerres cinereus* (Walbaum, 1792) off the Mexican Pacific coast is a popular low-cost species, which is caught with gill and cast nets. Knowing breeding seasons, gonadal maturity, fecundity and size at sexual maturity is necessary for fishery management. Samples were obtained from April 2010 to November 2011. Size, sex and gonad maturity were recorded, while the gonadosomatic index and the fecundity and condition factors were calculated using the gravimetric method. To calculate this information by age, growth parameters previously published were used. The female:male ratio was 1:1.024. Mature females were observed year round with two major peaks during July and October. Sexual maturation ($L_{0.5}$) of males and females was 16.40 cm and 20.20 cm, respectively, corresponding to one-year old organisms. First maturity length ($L_{0.25}$) was 15.80 cm in males and 16.50 cm in females. The hepatosomatic index vs length was $LW = 2.00 \cdot 10^{-6} \cdot TL^{4.213}$, resulting in a positive allometric relationship. Condition factor indexes increased during February and September. Average oocyte diameter was 0.31 mm (0.15 to 0.45 mm). Fecundity ranged from 37,784 to 1,746,510 oocytes in females from one to seven years of age, and mean relative fecundity was 1332 oocytes $\cdot g^{-1}$ (294 to 4,430 oocytes $\cdot g^{-1}$). *G. cinereus* has an early sexual maturity, reproduces once or twice a year and has a high fecundity rate, which allows it to be caught all year round, if caught after the first maturity length.

Keywords: Fecundity, maturity period, fish reproduction, minimum spawning size, yellowfin mojarra.

RESUMEN

La mojarra rayada *Gerres cinereus* (Walbaum, 1792) del Pacífico mexicano se captura con redes agalleras y atarrayas, es una especie popular de bajo costo. Para el manejo de la pesquería es necesario conocer las épocas de reproducción, madurez gonádica, fecundidad y talla de primera madurez sexual. Las muestras se obtuvieron de abril de 2010 a noviembre de 2011. Se registraron longitudes, sexo y madurez gonadal, se calcularon índice gonadosomático, factor de condición y fecundidad por el método gravimétrico. Para calcular esta información por edad se utilizaron los parámetros de crecimiento publicados anteriormente. La relación hembra:macho fue 1: 1.024. Se observaron hembras maduras todo el año, con máximos desoves en julio y octubre. La longitud promedio de reproducción ($L_{0.5}$) de machos fue 16.40 cm y de hembras 20.20

¹ Instituto Nacional de Pesca, Playa Ventanas s/n, Manzanillo, Colima, México; elespino@gmail.com*

² Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, México, D. F.; gallardo@cmarl.unam.mx

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cm, que corresponde a organismos de un año de edad. La longitud de primera madurez ($L_{0.25}$) fue 15.80 cm en machos y 16.50 cm en hembras. El índice hepatosomático vs. longitud fue $LW = 2.00 \cdot 10^{-6} \cdot Lt^{4.213}$, resultando alométrica positiva. Los factores de condición mostraron incrementos en febrero y septiembre. El diámetro promedio del ovocito fue 0.31 mm (0.15 - 0.45 mm). El intervalo de la fecundidad fue 37 784 a 1 746 510 ovocitos en hembras de uno a siete años de edad y la media relativa 1 332 ovocitos $\cdot g^{-1}$ (294 a 4 430 ovocitos $\cdot g^{-1}$). *G. cinereus* madura sexualmente temprano, se reproduce una o dos veces al año y tiene una tasa de fecundidad elevada, que permite que se pesque todo el año, si se captura después de la primera reproducción.

Palabras claves: Fecundidad, periodo de madurez, reproducción del pez, talla mínima de reproducción, mojarra rayada.

INTRODUCTION

The Yellowfin Mojarra *Gerres cinereus* (Walbaum, 1792) occurs in the Western Atlantic and Eastern Pacific Oceans from Baja California to Peru. Its habitat is sandy bottoms close to reefs but it also inhabits brackish coastal lagoons. Juveniles form big schools. This species is omnivorous and feeds on vegetable matter, small benthic invertebrates and insects (Allen & Robertson, 1994; Bussing, 1995).

In Mexican waters, *G. cinereus* is caught with gill and cast nets. It is registered in the official statistics together with other species of the Gerreidae family. In 2011, landings of Gerreidae mojarras in Mexico decreased from 81,250 t in 2010, of which 63% was caught off the Pacific coast, to 62,668 t. A total of 8022 t was captured off Colima and Jalisco (SAGARPA, 2012). Within artisanal fishery, *G. cinereus* represents 1.5% of total weight of 146 species of fish landed for commercial purposes. Its price at the beach (when brought to shore) is \$50.00 Mexican pesos per kilogram (\$3.50 US dollar).

The reproduction of the Gerreidae family has been researched by García-

Cagide *et al.* (1994) and García-Cagide *et al.* (1999) in Cuba; Sarre *et al.* (2005) in southern Australia; Iqbal *et al.* (2007) and Kanak & Tachihara (2008) in Japan; Ferrer-Montaña (2009) in South America, particularly Venezuela; López-Martínez *et al.* (2011) in Northern Mexican Pacific and Valdez-Zenil *et al.* (2013) in southern Mexico.

The importance of reproduction studies lies in the knowledge acquired regarding population dynamics and feedback mechanism of a species, which allows for the continuity of a species in time and space through the recruitment of new organisms. If the reproduction mechanism is interrupted by capturing individuals that have not yet reproduced at least once in their lifetime, the population may end up in danger of extinction. With the information obtained from captured organisms that have reproduced, maximum sustainable yield models and capture predictions can be used. In addition, reproduction studies allow establishing closed periods (Gallardo-Cabello *et al.* 2007; Espino-Barr *et al.* 2012).

Therefore, the objectives of the present study are to analyze in detail

the reproductive cycle of *G. cinereus* and to learn massive spawning times as well as fecundity values, which will give a solid background for closed seasons and gill net mesh sizes, based on the minimum reproductive size. These fishing measures will allow the species to reproduce at least once, protecting fishery from overexploitation.

MATERIALS AND METHODS

Study site: From April 2010 to November 2011, *G. cinereus* samples were collected monthly from the commercial capture of coastal fishery in Manzanillo, Colima, Mexico (19° 00' - 19° 02' North Latitude and 104° 10' - 104° 21' West Longitude) and Tomatlán, Jalisco, Mexico (19° 58' - 20° 04' N and 105° 26' - 105° 32' W) (Fig. 1). Fish were collected at sunrise and sunset. Total length (TL, cm) and total weight (TW, g) were recorded for 427 individuals (fishermen deliver this species intact). Of those individuals, 179 were transported to the laboratory of the National Fisheries Institute in Mexico, where total length (TL, cm), total weight (TW, g), eviscerated weight (EW, g), and sex were recorded macroscopically for each specimen.

Sexual and gonad maturation were determined *in visu* on fresh organisms taken to the laboratory the same day they were caught. The stages of sexual maturity were determined using the phases described in Sokolov and Wong (1973), Holden and Raitt (1975), Aboussouan and Lahaye (1979) and Espino-Barr *et al.* (2008): Phase I: undefined, sexual glands are

a fine filament, and females and males cannot be differentiated. Phase II: Immature, the gonads start developing, ovaries are rose translucent and testes resemble a whitish lace. Oocytes can be observed. Phase III: Maturing, sexual glands are well differentiated. Ovaries look granular and are pink-yellowish; oocytes are small and opaque and still forming; testes are ivory white. Phase IV: Mature, sexual glands are well developed, ovaries are rose-orange, oocytes are big and transparent, and testes are whitish. Phase V: Spawning, ovaries are brilliant orange; sexual products are ready to be expelled and are pushed out at the slightest pressure, veins are well developed irrigating the entire gonad; testes are pearly white, sperm emerges at a light pressure. Phase VI: Post-spawn, product has been expelled; sexual glands are flaccid, swelled and brownish-gray. Residual oocytes are reabsorbed.

The first spawning TL for males and females was determined by 50% of the accumulative frequency (L_{50}) of stages IV and V of sexual maturation (Sparre & Venema, 1995), and the minimum TL of first spawning (L_{25}) was also recorded to be compared with other authors' findings (Rodríguez-Gutiérrez, 1992). These two stages were considered because they are the closest stages to reproduction. The logistic function was described by the following equation (Gaertner & Laloe, 1986; Sparre & Venema, 1995):

$$H_p = \frac{1}{1 + e^{a+b*L}}$$

where: H_p = percentage of females or males sexually mature, a and b are constants. Its logarithmic transformation is:

$$\ln(1/H_p - 1) = a - b * L$$

and the length at which 50% of the population is sexually mature ($L_{0.5}$) corresponds to:

$$L_{0.5} = a/b$$

The original equation is modified to include $L_{0.5}$:

$$Y = 1/[1 + a(1 - L / L_{0.5})]$$

The minimum TL of first spawning (L_{25}) was also recorded to be compared with other authors' findings.

The gonadosomatic index (GSI) for females and males was calculated according to Rodríguez-Gutiérrez (1992), where gonad weight (GW) is expressed as a function of body weight: $GSI = 100 \cdot GW/TW$ (TW = total weight). To measure physical fitness of fish, we obtained the condition factor $K = (EW \cdot TL^{-3}) * 100$ (Clark, 1928), $K = (TW \cdot TL^{-3}) * 100$ (Fulton, 1902) and $a = TW \cdot TL^{-b}$ and $a = EW \cdot TL^{-b}$ (Safran, 1992), the hepatosomatic index (HSI), expressed as the percentage of liver weight (LW) with respect to the total weight $HSI = 100 \cdot LW/TW$ (Rodríguez-Gutiérrez, 1992). The stomach repletion index is the relation between the stomach weight and the body weight, calculated individually and averaged monthly.

Fecundity (F) and relative fecundity were obtained by the gravimetric method using the wet weight of 20 phase V female gonads

of *G. cinereus*. To estimate total fecundity, two subsamples of 0.1 g were obtained of each individual and put in modified Gilson fluid (Simpson, 1951) for preservation. All oocytes were counted with the help of a stereoscopic microscope and measured with an ocular micrometer.

The following expression was used in the calculation: $F = n \cdot G_i/g_i$, where F = fecundity of a sample; n = number of oocytes in the subsample; G_i = weight of the gonad (g) and g_i = weight of the subsample (g) (Holden & Raitt, 1975). The relationship between fecundity and total length and weight was calculated with the formula $F = a \cdot x^b$ where F = fecundity, x = individual weight or length, a = intercept or initial number of oocytes, b = slope or oocyte number changing rate.

The relationships between TL, TW, LW, testis weight (TeW), ovary weight (GW), and fecundity were defined for different ages, using published growth parameters, obtained by sagittal otolith analysis (Espino-Barr *et al.* 2014; 2015).

RESULTS

Since *G. cinereus* cannot be differentiated by their body morphology, they have to be opened and eviscerated; therefore, only 179 organisms were sexed. Using gill nets of different size (2.5-3.0 in) in commercial fishery allowed catching individuals of various age groups.

Gonads were differentiated macroscopically, except for the immature individuals who had never spawned. Ovaries are cylindrical and, when matured, oocytes turn yellowish orange and are

easily observed. Table 1 shows values of the gonad weight (GW, g), length (TL, cm), and total weight (TW, g), eviscerated weight (EW, g), liver weight (LW, g), and fecundity (number of oocytes), for each age group.

Testes are elongated, whitish and smaller than the ovaries. Table 1 shows that in, 4 year-old individuals, ovaries are 17.50 g, while testes are 12.90 g.

Oocyte diameters were 0.31 mm (± 0.70 mm standard deviation: SD),

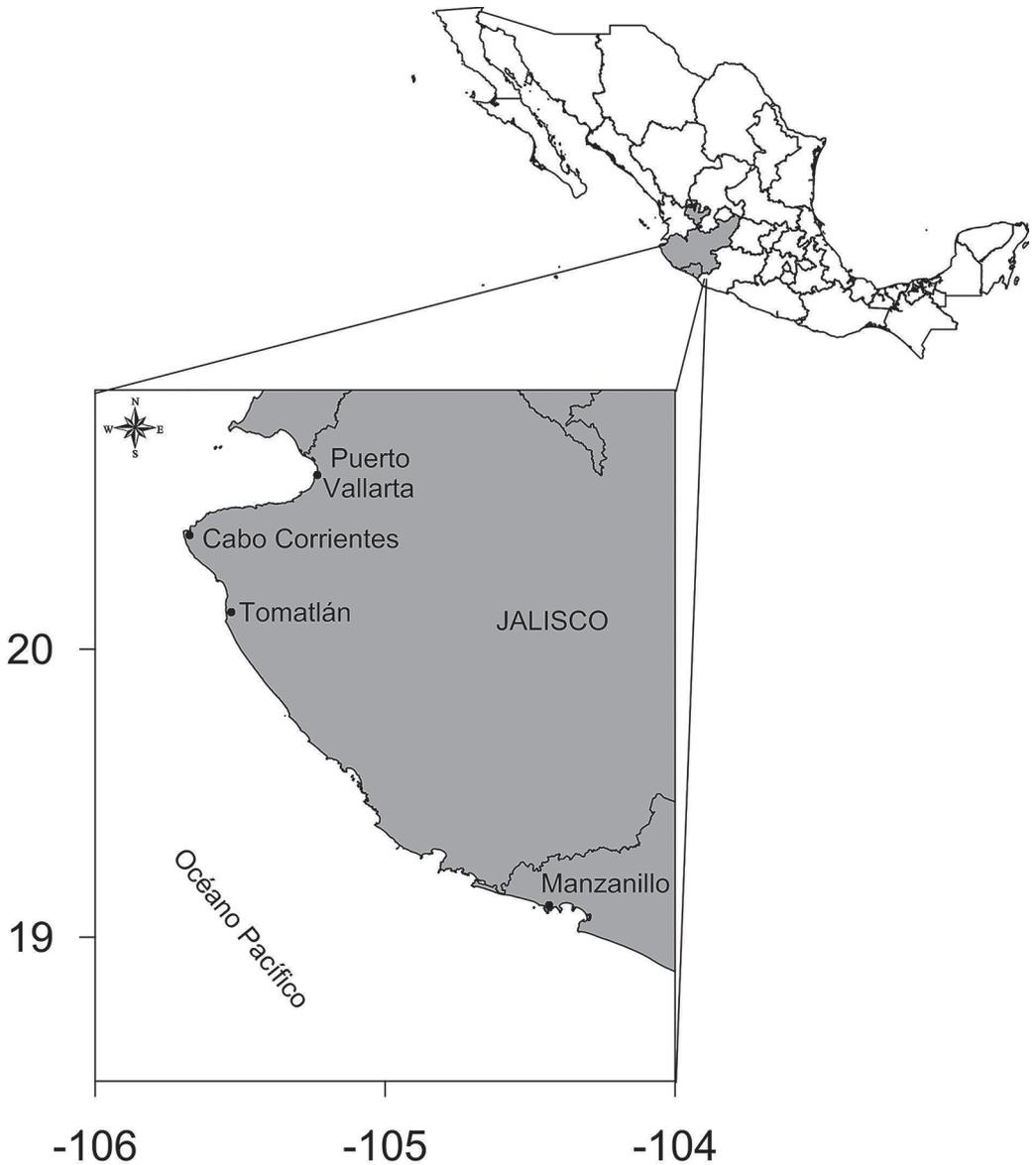


Fig. 1. Location of the sampling sites for *Gerres cinereus*
Fig. 1. Mapa de las zonas de estudio de *Gerres cinereus*

minimum 0.15 mm and maximum 0.45 mm. Fecundity values ranged from 37,784 to 1,746,510 oocytes in females from one to seven years of age, length from 16.80 cm to 44.49 cm, and weight 46.95 g to 1140 g (Table 1). The average value of relative fecundity was of 1332 oocytes·g⁻¹ (ranging from 294 to 4430 oocytes·g⁻¹).

The sample included 178 organisms of *Gerres cinereus*, of which 85 were female (47.75%), 83 male (46.63%), and 10 undetermined (5.62%). The male: female proportion was 1: 1.024.

Monthly variations of relative frequency for gonad maturity phases show that phase II or immature females and males prevail in September and November (Fig. 2a, b), while phase IV, mature, was observed from April to July. Phase V or spawning stage was observed in females from February to May and August to October. Males were in phase V from February to June and August to November. Phase

VI, post-spawning, was observed in females in February, April, June and September, while males were from April to July (Fig. 2a, b).

Length at first maturity was $L_{25} = 16.50$ cm in females (Fig. 3a) and $L_{25} = 15.80$ cm in males (Fig. 3b), corresponding to less than one year of age. First reproduction length was $L_{50} = 20.20$ cm in females and $L_{50} = 16.40$ cm in males (Fig. 3), which corresponds to one year of age.

The gonadosomatic index (GSI) reaches the highest values in June for total length and eviscerated weight (Fig. 4a, b) seconded by a spawning period during October. GSI values decrease during August and February.

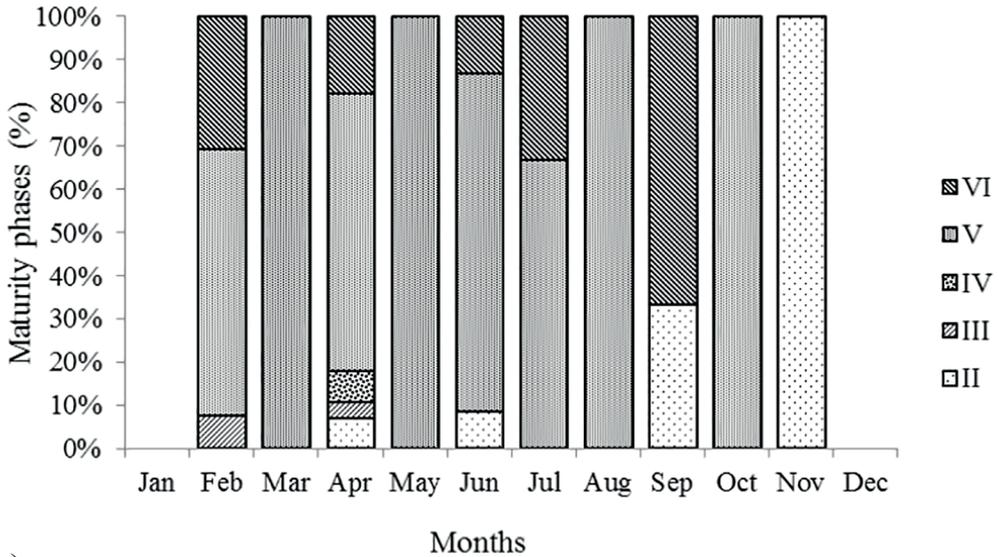
The allometric relationship of the hepatosomatic index (HSI) obtained in the present study was $LW = 2.00 \cdot 10^{-6} \cdot TL^{4.213}$ ($r^2 = 0.895$). The allometric index b indicates that, in terms of length, the liver weight is higher than a cubic proportion, which results in a positive

Table 1. Length (TL, cm), total weight (TW, g), eviscerated weight (EW, g), liver (LW, g), testis weight (TeW, g), ovary weight (GW, g) and fecundity (number of oocytes) for each age group (years)

Cuadro 1. Longitud (TL, cm) peso (TW, g), peso desviscerado (EW, g), hígado (LW, g), peso de testículos (TeW, g), peso de ovarios (GW, g) y fecundidad (número de oocitos) de cada grupo de edad (años)

Age	TL (cm)	TW (g)	EW (g)	LW (g)	TeW (g)	GW (g)	F (eggs)
1	16.76	46.949	40.238	0.287	0.855	1.156	41 322
2	22.67	154.545	132.950	1.026	2.567	3.476	133 185
3	30.00	317.441	273.700	3.343	7.118	9.654	270 104
4	35.33	515.349	445.013	6.654	12.900	17.509	434 755
5	39.83	728.130	629.434	11.032	19.963	27.113	610 514
6	43.25	940.077	813.303	15.611	26.945	36.609	784 669
7	44.40	1 140.639	987.415	17.436	29.645	40.283	948 821

a)



b)

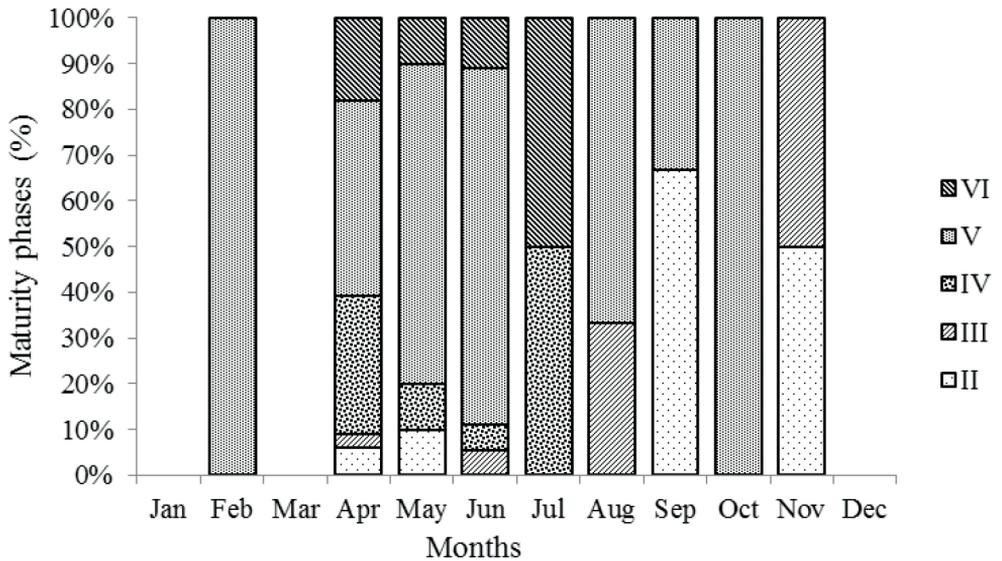


Fig. 2. Monthly relation of sexual maturity in: a) females and b) males of *Gerres cinereus*
 Fig. 2. Relación mensual de la madurez sexual en: a) hembras y b) machos de *Gerres cinereus*

allometric growth of the fish and an increase of its fatty reserves as it ages. HSI variations are shown in Figures 5a and b; maximum values are observed in February and lower values in September.

Variations in the stomach repletion index (Fig. 6a, b) showed higher values during April and May, preceding the spawning season; lower values are observed from October to February and June to October.

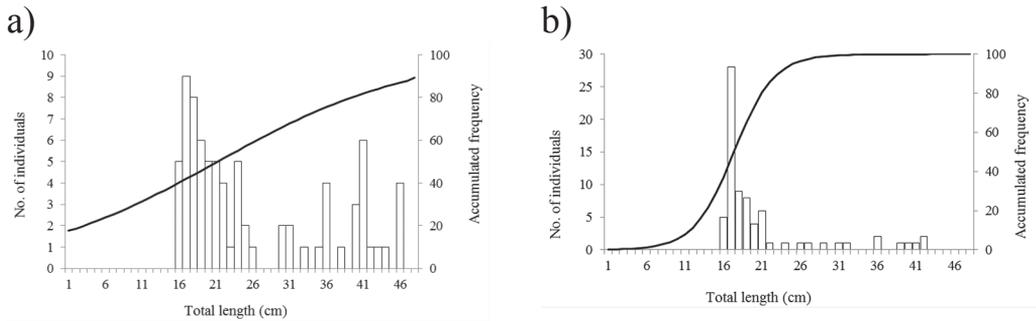


Fig. 3. First maturity length (L_{25}) and first reproduction length (L_{50}) of: a) females and b) males of *Gerres cinereus*

Fig. 3. Longitud de primera madurez (L_{25}) y longitud de primera reproducción (L_{50}) en: a) hembras y b) machos de *Gerres cinereus*

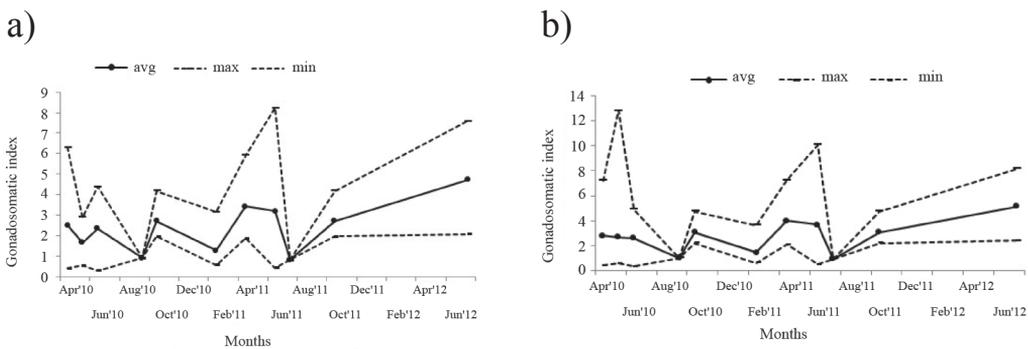


Fig. 4. Monthly variation of the gonadosomatic index (GSI): a) calculated with total weight (g) and b) calculated with eviscerated weight (g)

Fig. 4. Variación mensual del índice gonadosomático (GSI): a) calculado con el peso total (g) y b) calculado con el peso eviscerado (g)

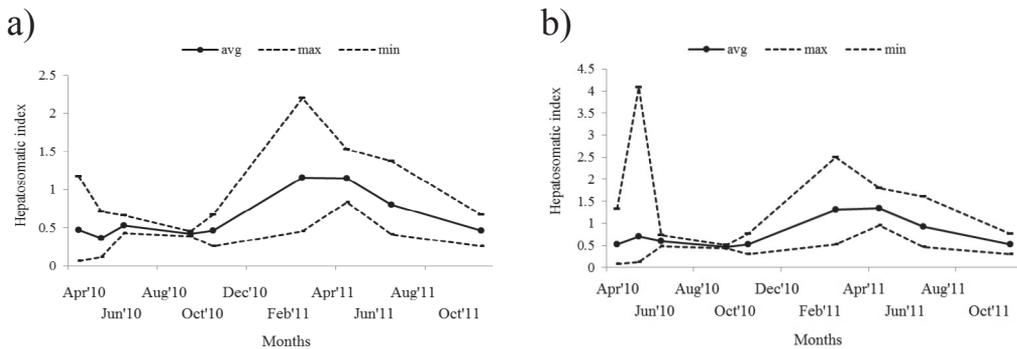


Fig. 5. Monthly variation of the hepatosomatic index (HSI): a) calculated with total weight (g) and b) calculated with eviscerated weight (g)

Fig. 5. Variación mensual del índice hepatosomático (HSI): a) calculado con el peso total (g) y b) calculado con el peso eviscerado (g)

Figure 7 shows the values of the condition factor; the highest values are obtained in February and September.

DISCUSSION

The highest length growth rates of *G. cinereus* (calculated by Espino-Barr *et al.* 2014; 2015) are in groups one and two years of age, after which length growth rate starts to diminish and total weight and gonad weight start to rise, as well as the fatty reserve index. Therefore, two fundamental periods were considered in the life cycle of *G. cinereus*: first, when most of the energy obtained through food is used to increment length (to avoid depredation and interspecific competence) and second, when this energy is oriented to form the sexual products (Fig. 8) (Espino-Barr *et al.* 2008, Cabral-Solís *et al.* 2010).

Sexual proportion was 1:1.024 female: male, similar to 1.2:1 female: male found in *Eugerres mexicanus* in the Usumacinta river in Mexico (Valdez-Zenil *et al.* 2013). Higher

values were found for *Eugerres plumieri* in the Maracaibo lake, Venezuela, 1.77:1 female: male (Ferrer-Montaño, 2009).

Although the presence of mature *G. cinereus* happens throughout the entire year, massive spawning occurs in June followed by a second period of massive spawning observed in October. Table 2 shows spawning periods for different species of the Gerreidae family. Except for *Eugerres mexicanus*, the other species show the massive spawning period at the end of spring and in the summer. In the case of *G. cinereus* from the coast of Cuba (García-Cagide *et al.* 1999), its main spawning peak was at the same period as in the Central Mexican Pacific coast.

According to its first sexual maturity length, *Gerres oyena* from Japan is a precocious species (compared to others of the same family). It matures at lengths of 8.97 cm (females) and 8.14 cm (males), followed by *Gerres equulus* also from Japan, with first sexual maturity length values of 14.1

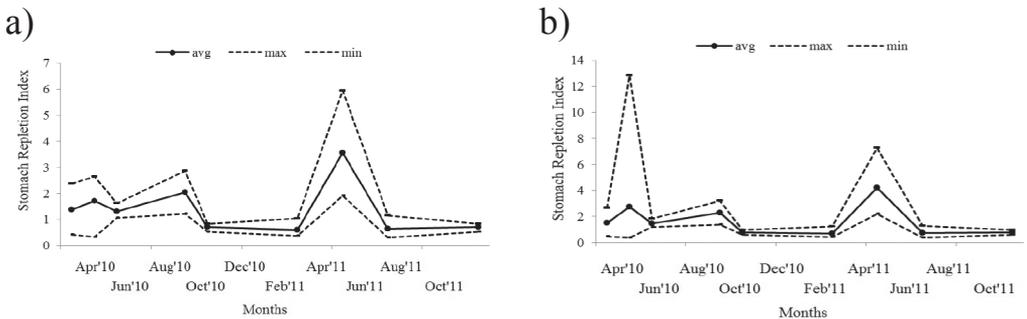


Fig. 6. Monthly variation of the stomach repletion index (GRI): a) calculated with total weight (g) and b) calculated with eviscerated weight (g)

Fig. 6. Variación mensual del índice de repleción gástrica (GRI): a) calculado con el peso total (g) y b) calculado con el peso eviscerado (g)

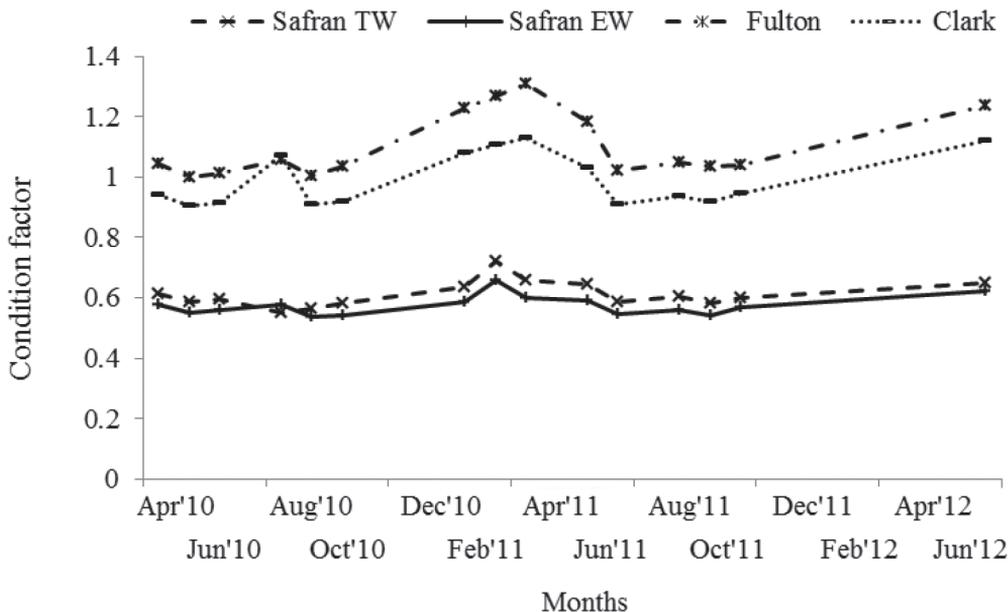


Fig. 7. Monthly values of the relative condition factor
 Fig. 7. Valores mensuales del factor de condición relativo

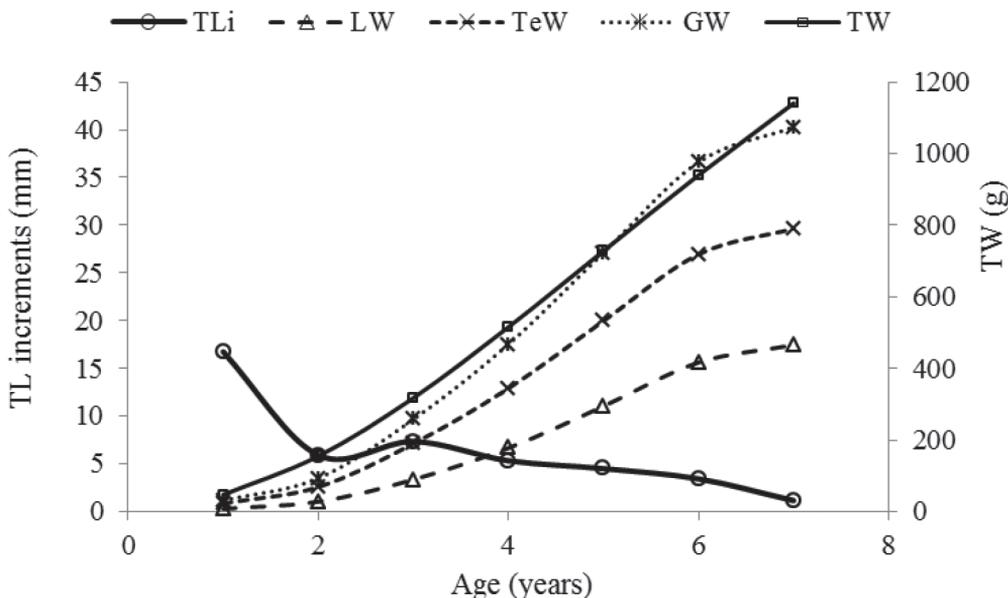


Fig. 8. Relationship between age and total length increment (TLi, cm), total weight (TW, g), liver weight (LW, g), testes weight (TeW, g), gonad weight (GW, g) of *Gerres cinereus*
 Fig. 8. Relación entre la edad y el incremento de longitud total (TLi, cm), peso total (TW, g), peso de hígado (LW, g), peso de testículos (TeW, g) y peso de gónadas (GW, g) de *Gerres cinereus*

Table 2. Spawning seasons and first maturity (L_{25}) and reproduction (L_{50}) lengths of different species of the Gerreidae familyCuadro 2. Temporadas de desove y tallas primera madurez (L_{25}) y de reproducción (L_{50}) de diferentes especies de la familia Gerreidae

Species	Country	Spawning season	L_{25} (cm)	L_{50} (cm)	Author
<i>Paraquula melbournensis</i>	Australia	August		11.5 F, 12.1 M	Sarre <i>et al.</i> (2005)
<i>Eucinostomus currani</i>	Mexico (Gulf of California)	March-August			López-Martínez <i>et al.</i> (2011)
<i>Eugerres mexicanus</i>	Mexico (Usumacinta River)	February	20.5 F, 17.3 M		Valdez-Zenil <i>et al.</i> (2013)
<i>Eugerres plumieri</i>	Venezuela (Maracaibo Lake)		18.0 F, 17.0 M		Ferrer-Montaño (2009)
<i>Gerres equulus</i>	Japan	July	14.1 F		Iqbal <i>et al.</i> (2007)
<i>G. oyena</i>	Japan	April and May	8.97 F, 8.14 M	10.4 F, 9.2 M	Kanak and Tachihara (2008)
<i>G. cinereus</i>	Cuba	August	20		García-Cagide <i>et al.</i> (1999)
<i>G. cinereus</i>	Mexico (Central Pacific)	July and October	16.5 F, 15.8 M	20.2 F, 16.4 M	Present study

cm in females. *G. cinereus* presented intermediate values, compared to other species: 16.5 cm females and 15.8 cm males. Nevertheless, the minimum spawning age found in this study was before the first year of life. In Cuba, *G. cinereus* matures at 20 cm TL (García-Cagide *et al.* 1999), a higher value than in the Pacific coast. Higher values were found in *Eugerres mexicanus* of the Usumacinta River: 20.5 cm in females and 17.3 cm in males (Valdez-Zenil *et al.* 2013), and in *E. plumieri* of Lake Maracaibo, Venezuela, at 18 cm for females and 17 cm for males (Ferrer-Montaño, 2009).

The first *G. cinereus* reproduction sizes were the highest at 20.2 cm in females and 16.4 cm in males, corresponding to ages 1 and almost 2.

Comparately, *G. oyena* in Japan was smaller: 10.4 cm in females and 9.2 cm in males (Kanak & Tachihara, 2008); and also in Australia (Sarre *et al.* 2005), *Paraquula melbournensis* was 11.5 cm in females and 12.1 cm in males.

The hepatosomatic index obtained in this study was $b = 4.213$ ($r^2 = 0.895$), which indicates a positive allometric growth, since fish increase their fatty reserves as they grow older. Monthly values showed that the liver accelerates its activity of reserving fatty acids during the periods before spawning; therefore, their weight increases considerably. The highest activity of fatty acid reserves is in February and starts to decrease in June and August, as well as in October during the spawning period.

Similarly, in the Island of Okinawa in south Japan, hepatosomatic index in *Gerres oyena* decreases during the maximum gonadic development that occurs in April and May for both sexes (Kanak & Tachihara, 2008).

The most active feeding seasons are during the periods of time prior to spawning, in spring; the most active months are April and May; the stomach repletion index decreases during the spawning months, and declines significantly after the second massive spawning period, that is October.

The stomach repletion index decreases in winter and increases in spring (Fig. 6a, b). This cycle is associated with environmental conditions and their effect on the food supply (Claro *et al.* 2001). The reproduction cycle is closely related to the availability of enough food for offspring (Canan *et al.* 2011).

Condition factor reaches the maximum values during February with either model: Fulton (1902); Clark (1928) and Safran (1992), and decreases during spawning seasons, that is, during June to September; and November-December, after the massive spawning of October.

Similarly, Fulton's condition factor of *G. equulus* from Japan reached its maximum values during the spawning season from June to September (Iqbal & Suzuki, 2009). In the Island of Okinawa (south Japan), this condition factor decreases during the gonadic development in *G. oyena* (Kanak & Tachihara, 2008).

Recruitment length of *G. cinereus* to the fishing area was at 14 cm TL and

occurred in April, which means that this species spends 9 months as part of the plankton system and other marine strata before becoming part of the adult population. The same happens to *Eugerres plumieri*, which recruits to the adult population during April (Ferrer-Montaña, 2009).

No evidence of migratory movement was found in *G. cinereus* as to spawn in the sea. Adults were found both inside the lagoons and out in the sea, contrary to what has been reported for the species of *G. melanopterus* in the Bay of Guaratuba in Paraná, Brazil, where adults are known to migrate out to sea to spawn during summer and come back to the bay during fall and winter (Chaves & De Castro, 2001). In addition, *G. rappi*, *G. acinaces* and *G. filamentosus* were described as going in estuaries when reaching 10 mm standard length and stay there till they reach sexual maturity between 70 and 110 mm, after which females and males leave the estuary before eggs mature (Cyrus & Blaber, 2006).

A fishing ban has not been established in Mexico for the Gerreidae family. In the case of *Eucinostomus currani* from the Gulf of California, it is protected during the shrimp ban, because it is caught as bycatch (López-Martínez *et al.* 2011).

As García-Cagide *et al.* (1983) summarizes, the Gerreidae family is basically composed of tropical species of fish that reach sexual maturity at early ages. Sexual products developed rapidly and can be observed all months of the year, as opposed to species of temperate and cold climates that reach sexual maturity at an advanced age,

take a long period of time to form sexual products and have a very specific spawning season.

These observations must be reinforced with research on other members of the Gerreidae family because these can represent adaptive as well as evolutionary advantages of this family in relation to other fish groups (García-Cagide *et al.* 1994).

Table 3 shows fecundity values in species of three phylogenetic close

families (Nelson *et al.* 2004; Nelson, 2006): Haemulidae, Lutjanidae and Gerreidae, and how *G. cinereus* occupies an intermediate position compared to the species of other families. *G. cinereus* has a higher fecundity value than *Haemulon aurolineatum*, *H. plumieri*, *H. sciurus*, *Lutjanus argentiventris* and *L. carponotatus*, but lower than *Haemulon album*, *Lutjanus guttatus*, *L. campechanus*, *L. erythropterus*, *L. malabaricus* and *L. sebae*.

Table 3. Fecundity (minimum and maximum) of species of Haemulidae and Lutjanidae family and of *Gerres cinereus*
Cuadro 3. Fecundidad (mínima y máxima) de especies de las familias Haemulidae y Lutjanidae y de *Gerres cinereus*

Author	Country	Species	Min	Max
García-Cagide <i>et al.</i> (1994)	Cuba	<i>Haemulon aurolineatum</i>	29,000	81,000
	Cuba	<i>H. album</i>	800,000	2,200,000
	Cuba	<i>H. plumierii</i>	64,000	312,000
	Cuba	<i>H. sciurus</i>	47,000	25,000
Cruz-Romero <i>et al.</i> (1996)	Manzanillo, Mexico	<i>Lutjanus argentiventris</i>	75,900	356,000
		<i>L. guttatus</i>	66,400	2,170,000
Allen (1985)	La Paz, BCS, Mexico	<i>L. campechanus</i>	9,300,000	
Collins <i>et al.</i> (1996)	Florida, USA, Gulf of Mexico	<i>L. campechanus</i>	11,613	59,665,760
Evans <i>et al.</i> (2008)	Australia Great Barrier Reef	<i>L. carponotatus</i>	7,074	748,957
McPherson <i>et al.</i> (1992)	Australia Great Barrier Reef	<i>L. erythropterus</i>	5,000,000	7,000,000
		<i>L. malabaricus</i>	5,000,000	7,000,000
		<i>L. sebae</i>	5,000,000	7,000,000
This study	Central Mexican Pacific	<i>Gerres cinereus</i>	37,784	1,746,510

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