Online ISSN: 0718-1957
RBMO
Revista de Biología Marina y Oceanografía
Vol. 59(2): 162-167, 2024
<https://doi.org/10.22370/rbmo.2024.59.2.4817>

RESEARCH NOTE

Cultivation of sea chub *Girella laevifrons* (Perciformes: Kiphosidae) juveniles on the central coast of Peru

Cultivo de juveniles de baunco *Girella laevifrons* (Perciformes: Kiphosidae) en la costa central del Perú

César Cruz-Castellón[1*], Wilfredo Vásquez-Quispesivana[1], Cynthia Guerrero-Jiménez[1], Henry Buitron-Ramos[1] and José Bardales-Azañero[2]

[1]Departamento Académico de Acuicultura e Industrias Pesqueras, Facultad de Pesquería, Universidad Nacional Agraria La Molina, Av. La Molina s/n, C.P. 15024, La Molina, Lima, Perú

[2]Departamento Académico de Manejo Pesquero, Facultad de Pesquería, Universidad Nacional Agraria La Molina, Av. La Molina s/n, C.P. 15024, La Molina, Lima, Perú

*Corresponding author: cesarcruz@lamolina.edu.pe

Abstract.- An interesting species to diversity aquaculture in Peru is the sea chub *Girella laevifrons*. The objectives of this work were to evaluate the adaptation to culture of *G. laevifrons* juveniles and to determine the productive parameters of growth and survival. Two groups of fish: group 1 (1.35 g) and group 2 (0.99 g) were kept in experimentation for 92 days. At the end of the experiment in both groups, no significant differences were found in the productive parameters as well as in survival where this was 100%. It was concluded that *G. laevifrons* tolerated captivity with high survival in both groups.

Key words: Productive parameters, omnivorous fish, adaptation to cultivation

INTRODUCTION

In Peru, animal mariculture is currently oriented solely to the production of three species: the white shrimp (*Litopenaneus vannamei*) and the scallop (*Argopecten purpuratus*), that yield more than thirty-five thousand tons per year each, and the fine sole (*Paralichthys adspersus*), that yields more than 12 ton per year (PRODUCE 2020). With the aim to gradually add new marine species to animal mariculture in Peru, several Peruvian institutions have been conducting aquaculture research on marine fish such as the cheetah *Anisotremus scapularis* and the grouper *Paralabrax humeralis* (IMARPE 2016). Likewise, National Fund for Fisheries Development (FONDEPES) and Jorge Basadre Grohmann National University of Tacna (UNJBG), have been working since 2016 in the development of technologies for the cultivation of marine fish such as the croaker *Cilus gilberti* and the cheetah *A. scapularis* (Aquahoy 2017)[1]. As a result of these investigations, important advances have been made. For example, in *A. scapularis* it has been investigated in reproducers, larvae and juveniles, aspects related to capture, transport, conditioning and spawning, diet quality, larval quality, the cultivation of fry to juveniles and the sequencing of the mitochondrial genome (Espinoza-Ramos *et al*. 2019, Montes *et al.* 2019, Gomes-dos-Santos *et al.* 2020, Carrera-Santos *et al.* 2022, Cota *et al.* 2022, 2023; Espinoza-Ramos *et al.* 2022a, b). Likewise, in this species it has been possible to develop a larval culture protocol (Castro *et al.* 2021). In the case of the croaker *C. gilberti*, outstanding investigations have dealt with the capture and conditioning of reproductive specimens (Espinoza-Ramos & Contreras-Mamani 2018), the physiological responses to hypoxia (Álvarez *et al.* 2020), molecular markers related to appetite regulation (Álvarez *et al*. 2023), capture and conditioning protocol in captivity (Chili-Layme *et al.* 2023a), and larval culture in laboratory conditions (Chili-Layme *et al.* 2023b). Although it is true that to date important advances have been made in aquaculture research on *A. scapularis* and *C. gilberti*, both species are carnivorous (Méndez-Abarca & Pepe-Victoriano 2020); so in the long term their aquaculture could be unsustainable because fishmeal and oil fish will be scarce. So given this situation regarding the unsustainability of fishmeal and fish oil over time, today one of the great opportunities and challenges in aquaculture is to work with species of low trophic level (herbivores and omnivores) or to use substitute sources for fishmeal and fish oil (HLPE 2014).

[1]Aquahoy. 2017. Estudiantes de UNJBG realizan siembra de alevines de sargo con fines de repoblamiento. <https://www.aquahoy.com/noticias/peces/29130-estudiantes-de-unjbg-realizan-siembra-de-alevines-de-sargo-con-fines-de-repoblamiento>

In this sense, an interesting species that could contribute to the sum of the number of aquaculture species in the mariculture of Peru would be sea chub *Girella laevifrons* (Tschudi, 1846). One of the reasons to highlight in this fish would be its omnivorous nutrition, which is an attractive characteristic for the breeding of new species in aquaculture (Aquahoy 2018)[2].

About this species (*G. laevifrons*), it is a widely represented fish in shallow rocky intertidal zones of the north-central coast of Chile (Stepien 1990, Varas & Ojeda 1990, Muñoz & Ojeda 1997). On the Peruvian coast, it is found from Guañape Islands (8ºS) to Tacna (Pequeño & Sáez 2008).

It is a fish with white, firm and consistent meat, becoming an important resource for artisanal fishermen (Ugaz 2024)[3]. Regarding research carried out on this species (*G. laevifrons*) related to aspects of its breeding in captivity (cultivation), it has only been possible to find the work of Cruz (2019), who evaluated a short 30-day trial on growth and survival of fingerlings using diets with increasing levels (15, 30 and 45%) of the green alga *Ulva lactuca* and determined that the level of 30% of this alga caused the best growth in terms of weight gain (112%) and the higher survival rate (50%).

Therefore, the objectives of this work were to evaluate the adaptation to the cultivation of juveniles under a recirculating aquaculture system and to determine the first productive parameters in terms of growth and survival in captivity.

Materials and methods

An observational study was conducted to determine the potential of *Girella laevifrons* for aquaculture. In October 2018, 120 juveniles between 1 and 9 g of total weight were captured from San Bernardino beach (Casma, Ancash, Peru; 9°5´S, 78°24´30´´W). The fish were transported in four 20 L plastic buckets with 15 L [2 ind. L^{-1} (30 ind. $buck^{-1}$)] of unfiltered seawater to the facilities of the Fish Research Center (CINPIS) of the National Agrarian University La Molina (Lima, Peru).

In the CINPIS the fish were identified according to Chirichigno & Vélez (1998) and before starting the experiment the fish were acclimatized for one week in the marine recirculation system in aquaculture (SRA), at an average density 20 fish per 80 L. This SRA system consists of 5 tanks of 100 L with a capacity of 80 L of seawater, a mechanical filter of 75 L with a capacity of 60 L of use with 1 m^2 of Dunlopillo filtering material, a 15 L biological filter with 1 kg of bioceramic filtering material, a 200 L water reserve tank with a capacity of 100 L, and a submersible power pump with a delivery height of 4 m. Feeding during the acclimatization period consisted of New Life Spectrum marine fish meal of caliber 1 mm, made of 37% protein, 6% lipids and 4% fiber. This food contains among its main ingredients *Ulva* seaweed. Food was delivered *ad libitum* with 3 rations (9 h, 12 h and 16 h), 6 days a week. After the acclimatization period, 75 specimens were selected and the following classes were formed according their weight: group 1 in duplicate (15 specimens of 1.35 ± 0.04 g) and group 2 in triplicate (15 specimens of 0.99 ± 0.06 g). The experiment lasted 92 days.

During the experiment, the mechanical filter was cleaned daily and water replacements were made for the entire system volume of 5%. The water physicochemical parameters were evaluated three times per week. Temperature was measured with a ± 1 °C precision mercury thermometer; salinity was measured with a ± 1 PSU precision refractometer. The pH was determined with pH tapes (Merck®). Dissolved oxygen, ammonia and nitrites were measured with specific Kits (JBL).

Growth controls were performed every 14 days, for which the total weight of all individuals per group was recorded. With the information collected from the biometrics, growth performance was assessed using the following parameters according to Vizcaino *et al.* (2016): specific growth rate (SGR), weight gain (WG), weight gain in percentage (WG %), condition factor (CF), feed conversion ratio (FCR) and survival (S).

[2]Aquahoy. 2018. Nuevas especies para la acuicultura. <https://www.aquahoy.com/entrevista/31005-nuevas-especies-para-la-acuicultura>

[3]Jorge Ugaz Gómez. Ministerio de Agricultura y Riego – MINAGRI, Perú. Comunicación personal, 10 de abril de 2024.

SGR (% day^{-1})= 100 × {(*ln* Final weight) - (*ln* Initial weight)} / duration of the experiment

WG (g)= Final weight (g) - Initial weight (g)

WG (%)= {(Final weight (g) - Initial weight (g)) / Initial weight (g)} × 100

CF= 100 × Total fish weight (g) / Total length^3 (cm^3)

FCR= Dry feed intake (g) / Weight gain (g)

Survival (%) = *Nf* / *Ni* x 100

where, *ln* is the natural logarithm, *Nf* is the final number of fish; *Ni* is it the initial number of fish. The normality and homogeneity of the variances of the data were verified and Student's t test was performed to determine the significant differences between both treatments. This was done using SPSS 19.0 program for Windows (Colin & Kinnear 2012).

Results and discussion

Environmental variables

The temperature of the culture water fluctuated between 17 and 25 °C, with an average of 21 °C. The averages for the other parameters were as follows: salinity of 35, pH of 8, 0.06 mg L^{-1} of ammonium, 0.6 mg L^{-1} of nitrite and 9 mg L^{-1} of dissolved oxygen (Fig. 1). These values are within the normal range for breeding other species of marine fish (Ortega 2008, 2013).

Growth: Productive parameters

At the end of the experiment, and comparing the results between the two experimental groups of fish, it can be observed that there were no significant differences ($P > 0.05$) in all the growth parameters evaluated (Table 1). The results

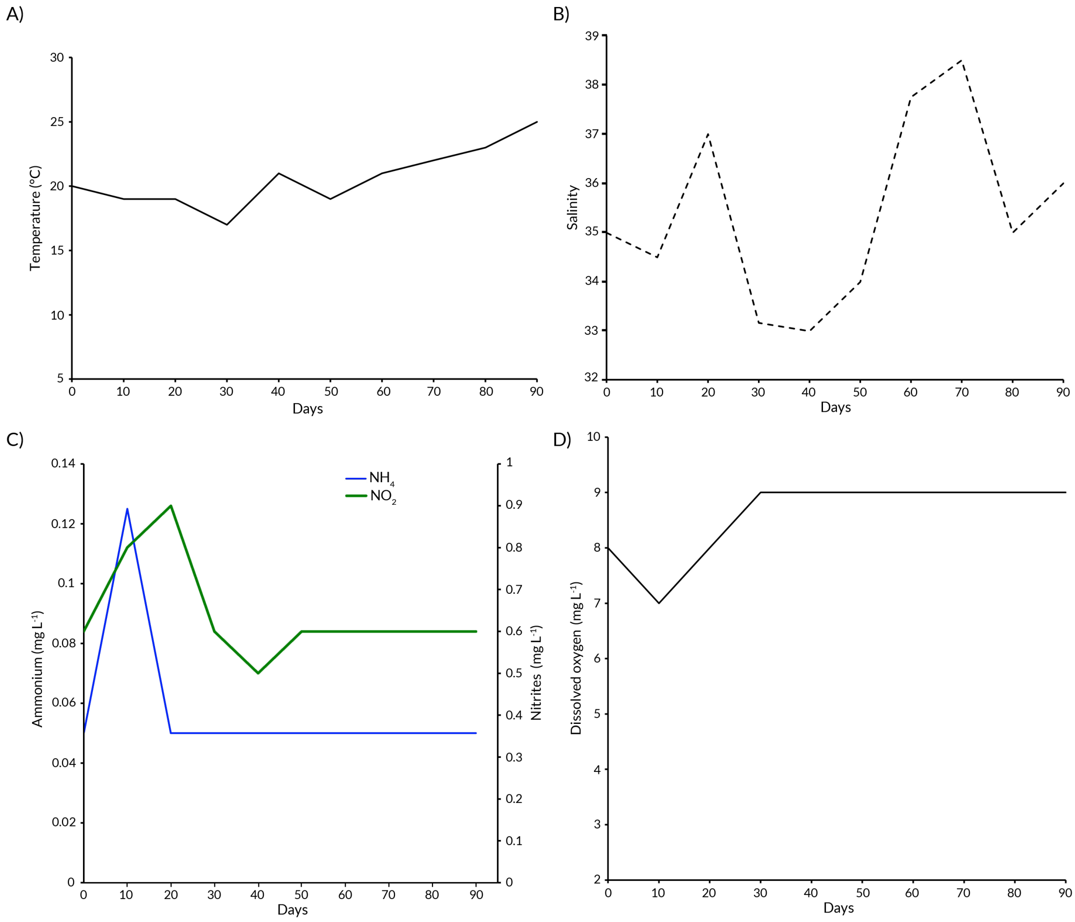

Figure 1. Variation of parameters: A) temperature (ºC), B) Salinity, C) Ammonium and nitrites (mg L^{-1}) and D) dissolved oxygen (mg L^{-1}) in captive culture of *G. laevifrons* juveniles. Average values / Variación de parámetros: A) Temperatura (ºC), B) Salinidad, C) Amonio y nitritos (mg L^{-1}) y D) Oxígeno disuelto (mg L^{-1}) en juveniles de *G. laevifrons* cultivados en cautividad. Valores medios

Table 1. Average ± standard deviation of survival, growth parameters and feeding rates in captive-cultured juveniles of *G. laevifrons* / Media ± desviación estándar de la supervivencia, parámetros de crecimiento e índices de alimentación en juveniles de *G. laevifrons* cultivados en cautividad

Parameters	Experimental groups	
	1	2
S (%)	100	100
FL (cm)	6.09 ± 0.09[a]	5.5 ± 0.09[a]
IW (g)	1.35 ± 0.04[a]	0.99 ± 0.06[b]
FW (g)	3.91 ± 0.10[a]	3.22 ± 0.34[a]
WG (g)	2.56 ± 0.06[a]	2.23 ± 0.35[a]
WG (%)	189.90 ± 1.42[a]	224.29 ± 37.94[a]
I (g/month)	0.85 ± 0.02[a]	0.74 ± 0.11[a]
SGR (% day^{-1})	1.16 ± 0.00[a]	1.27 ± 0.13[a]
DI (g L^{-1})	0.25 ± 0.00[a]	0.19 ± 0.01[b]
DF (g L^{-1})	0.73 ± 0.01[a]	0.60 ± 0.06[a]
IB (g)	20.25 ± 0.63[a]	14.97 ± 0.87[b]
FB (g)	58.70 ± 1.56[a]	48.43 ± 5.19[a]
IIB (g)	38.45 ± 0.91[a]	33.47 ± 5.25[a]
CF	1.67 ± 0.04[a]	1.90 ± 0.21[a]
FCR	1.81 ± 0.02[a]	1.90 ± 0.25[a]

S: Survival, FL: Final length, IW: Initial weight, FW: Final weight, WG: Weight gain, I: Increase in grams per month, SGR: Specific growth rate, DI: Initial density, DF: Final density, IB: Initial biomass, FB: Final biomass, IIB: Increase in biomass, CF: Condition factor, FCR: Feed conversion ratio
[ab]values with different letters indicate significant differences $P < 0.05$

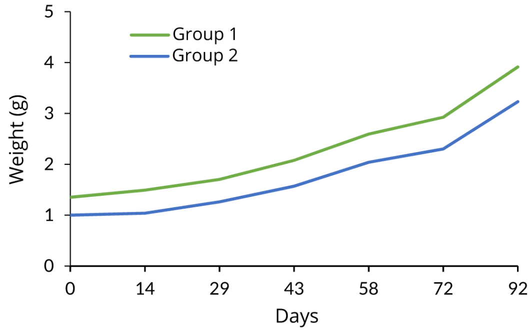

Figure 2. Variation of growth in mean weight for experimental groups of captive- cultured juvenile *G. laevifrons* / Variación del crecimiento del peso medio en grupos experimentales de juveniles *G. laevifrons* cultivados en cautividad

of the growth parameters of the present study compared to other species of marine fish were different. For example, when comparing to *Graus nigra* Philippi, 1887 (a species from the same family as *G. laevifrons*), the results indicate that *G. laevifrons* had a slower growth rate (92 days to reach an average weight of just over 3 g, Fig. 2), since *G. nigra* grew from 0.94 g to 3.29 g in just 45 days (Muñoz *et al*. 2012). On the contrary, the results of the final average weight of the experimental groups of fish in this study were similar to the sole (*Dicologoglossa cuneata*) (De la Roca *et al*. 2009).

Weight gain ranged between 190 to 225% (Table 1). These values are lower compared to those reported by Flores & Rendic (2011) in *G. nigra* juveniles (370 to 993%). The weight gain results in the present study were higher than those reported by Cruz (2019) for the same species (112%). One of the factors that has probably allowed us to improve weight gain (and growth in general) is the higher percentage of proteins and lipids used in this study (37% and 6%, respectively) compared to a protein and lipid content of 29% and 3% in the study reported by Cruz (2019). Therefore, it seems possible to improve growth parameters if the diet is changed. This result agrees with those reported by You-Syu *et al.* (2019), who investigated the effect of various protein levels on the growth of *Girella mezina*, and found that a higher protein level (40%) improved growth compared to a lower protein level (35%).

Specific growth rate (SGR) fluctuated from 1.16 ± 0.00 to 1.27 ± 0.13% day^{-1}, without significant differences between treatments ($P > 0.05$) (Table 1). Similar SGR values were reported in *G. nigra* juveniles (1.2% day^{-1}) by Flores & Rendic (2011).

Regarding the feed conversion factor, results indicate that these were lower (1.8 and 1.9) (Table 1) and better in terms of consumption efficiency and feed utilization when compared with the juvenile specimens of *G. nigra* studied by Flores & Rendic (2011) and Muñoz *et al.* (2012) (2.7 to 4, and 2.6 and 5.3, respectively).

Survival

The survival was 100% in both experimental groups (Table 1). This result indicates that fish showed great tolerance to the culture conditions. Cruz (2019) obtained a maximum survival of 50% (with specimens weighing less than 0.45 g). The results of this study show that if culture conditions are improved in *G. laevifrons*; then not only growth parameters improve, but also survival. In fact, one of the reasons for the improved survival in the present study compared to Cruz (2019) was probably the different culture system; a recirculation system was used in the present study while Cruz (2019) used aquariums with partial water replacements. Indeed, it is known that one of the advantages of using SRA is the improvement of the quality of water and that this, among other things, keeps ammonium and nitrite at levels that are not toxic to farmed fish (Bregnballe 2015). Another possible reason why the survival results of the present study were better compared to the work of Cruz (2019), is the fact that the total length was not recorded in this study, and therefore the fish were not heavily manipulated. Regarding this, Solis-Murga *et al.* (2010) indicates that the procedures carried out in aquaculture (such as, the recording of weight and size of the fishes), can cause damage, leading to high mortality.

After a period of 92 days of evaluation of the growth and survival until the adaptation to the culture of sea chub juveniles, the following conclusions are reached: firstly, the species adapted well to the culture conditions, since the survival obtained was optimal (100%). Secondly, and when comparing the results with the growth data of *G. nigra*, which is a species of the same family, it is observed that the growth of *G. laevifrons* is slower. However, when comparing the results with Cruz (2019) on the same species (with fingerlings or specimens with an initial weight of 0.45 g), growth was higher.

Acknowledgments

The authors thank biologist Alexander Vasquez for his help in capturing the fish and we gratefully acknowledge Dr. Carlos Saavedra for English revision of the manuscript.

Literature cited

Álvarez CA, I Jerez-Cepa, CB Cárcamo, P Toledo, H Flores & K Brokordt. 2020. Growth performance, physiological responses to hypoxia and flesh quality of Chilean croaker (*Cilus gilberti*) stocked at different densities. Aquaculture 525, 735316. <https://doi.org/10.1016/j.aquaculture.2020.735316>

Álvarez CA, JF Alvarado, M Farías, CB Cárcamo, H Flores, F Guzmán, SS Martín, J Varas, S Messina, F Acosta, N Sandoval, B Vega & PA Santana. 2023. First insights about orexigenic activity and gastrointestinal tissue localization of ghrelin from Corvina drum (*Cilus gilberti*), Aquaculture 571, 739468. <https://doi.org/10.1016/j.aquaculture.2023.739468>

Bregnballe J. 2015. A guide to recirculation aquaculture: An introduction to the new environmentally friendly and highly productive closed fish farming systems, 100 pp. FAO & EUROFISH International Organisation, Rome / Copenhagen. <https://www.fao.org/3/i4626e/i4626e.pdf>

Carrera-Santos LJ, JG Fontes, GRCD Santos, MC Padilha & R Opazo. 2022. Reproductive cycle of the female *Anisotremus scapularis* (Tschudi, 1846) on the marine coast of Callao, basic knowledge to go towards its aquaculture. Frontiers in Marine Science 9, 1033718. <doi: 10.3389/fmars.2022.1033718>

Castro A, N Cota, M Montes & L Carrera. 2021. Protocolo del cultivo larvario de chita *Anisotremus scapularis* en condiciones de laboratorio. Informe Instituto del Mar del Perú 48(1): 20-24.

Colin D & P Kinnear. 2012. IBM SPSS statistics 19 made simple, 654 pp. Psychology Press, New York.

Cota N, A Castro, M Montes & L Carrera. 2022. Mejoramiento de dieta de acondicionamiento de reproductores de chita *Anisotremus scapularis* con uso de vitaminas y ácidos grasos. Boletín Instituto del Mar del Perú 37(2): 285-301.

Cota N, LJ Carrera, A Castro-Fuentes, O Leon, L Flores, A Ruiz, J Lazo & N Duncan. 2023. Reproductive performance and egg and larvae quality from first generation peruvian grunt *Anisotremus scapularis* (Tschudi, 1846): a comparative analysis with spawns from wild broodstock. Frontier in Marine Science 10, 1287439. <doi: 10.3389/fmars.2023.1287439>

Chili-Layme VF, E Morales-Huayhua, L Machaca-Chacoli & L Rodríguez-Ruiro. 2023a. Protocolo de captura y acondicionamiento de Corvina (*Cilus gilberti*) en sistema de cautiverio, 46 pp. Fondo Nacional de Desarrollo Pesquero, Lima.

Chili-Layme VF, O Morales-Olín, J Pino-Choqueapaza, L Machaca-Chacoli, F Ticona-Limache & L Ilasaca-Apaza. 2023b. Protocolo de cultivo larvario de Corvina (*Cilus gilberti*) en condiciones de laboratorio, 40 pp. Fondo Nacional de Desarrollo Pesquero, Lima.

Chirichigno N & J Vélez. 1998. Clave para identificar los peces marinos del Perú, 502 pp. Publicación Especial, Instituto del Mar del Perú, Callao.

Cruz CA. 2019. Una dieta a base de harina de *Ulva lactuca* mejora el crecimiento de alevines de bauncos *Girella laevifrons* (Pisces: Kyphosidae). Scientia Agropecuaria 10(2): 191-197.

Espinoza-Ramos LA & Z Contreras-Mamani. 2018. Captura y acondicionamiento de reproductores de corvina *Cilus gilberti* en el centro de acuicultura Morro Sama - Tacna, Perú. Ciencia & Desarrollo 17: 43-49.

Espinoza-Ramos LA, VF Chilli-Layme, R Pepe-Victoriano, J Pino-Choqueapaza & Z Contreras-Mamani. 2019. Captura, acondicionamiento y primer desove de sargo *Anisotremus scapularis* en la Región Tacna. Ciencia & Desarrollo 25: 68-74. <https://doi.org/10.33326/26176033.2019.25.867>

Espinoza-Ramos LA, JM Quispe-Mayta, VF Chili-Layme & M Nande. 2022a. Effect of stocking density on growth, feed efficiency, and survival in Peruvian Grunt *Anisotremus scapularis* (Tschudi, 1846): From fingerlings to juvenile. Aquaculture Journal 2(1): 13-22. <https://doi.org/10.3390/aquacj2010002>

Espinoza-Ramos LA, R Pepe-Victoriano, J Huanacuni & M Nande. 2022b. Effect of transportation time and stocking density on seawater quality and survival of *Anisotremus scapularis* (Perciformes: Haemulidae). Journal of the World Aquaculture Society 53(5): 1042-1050. <https://doi.org/10.1111/jwas.12865>

Flores H & J Rendic. 2011. Conducta alimenticia, supervivencia y crecimiento de juveniles silvestres de *Graus nigra* Philippi, 1887 en cautiverio (Perciformes: Kyphosidae). Latin American Journal of Aquatic Research 39(3): 607-612.

Gomes-dos-Santos A, M Nande, L Espinoza-Ramos, R Pepe-Victoriano, Z Contreras-Mamani, J Huanacuni, J Quispe-Mayta, C Fernández-Cárdenas, E Froufe & L Castro. 2020. Constructing the mitochondrial genome of the Peruvian grunt *Anisotremus scapularis* Tschudi, 1846 (Lutjaniformes: Haemulidae) using RNA-seq data. Mitochondrial DNA Part B, 5(2): 1921-1923. <doi: 10.1080/23802359.2020.1754950>

HLPE. 2014. Note on critical and emerging issues for food security and nutrition. A report by the high level panel of experts on food security and nutrition, 26 pp. Committee on World Food Security, Rome.

IMARPE. 2016. Anuario científico tecnológico IMARPE 2016, 276 pp. Instituto del Mar del Perú, Callao.

Méndez-Abarca F & R Pepe-Victoriano. 2020. Peces marinos del norte de Chile I, 79 pp. Fundación Reino Animal & ONG por la Conservación de la Vida Salvaje, Arica.

Montes M, A Castro, J Linares, L Orihuela & L Carrera. 2019. Embryonic development of Peruvian grunt *Anisotremus scapularis* (Perciformes: Haemulidae). Revista de Biología Marina y Oceanografía 54(2): 166-173. <https://dx.doi.org/10.22370/rbmo.2019.54.2.1881>

Muñoz A & F Ojeda. 1997. Feeding guild structure of a rocky intertidal fish assemblage in central Chile. Environmental Biology of Fish 49: 471-479.

Muñoz A, E Segovia & H Flores. 2012. Deshabituación alimentaria y crecimiento de juveniles de *Graus nigra* (Philippi, 1887) en condiciones de cultivo. Latin American Journal of Aquatic Research 40: 578-583.

Ortega A. 2008. Cultivo de dorada (*Sparus aurata*), 45 pp. Fundación Observatorio Español de Acuicultura, Madrid.

Ortega A. 2013. Cultivo de lubina (*Dicentrarchus labrax*), 48 pp. Fundación Observatorio Español de Acuicultura, Madrid.

Pequeño G & S Sáez. 2008. El estatus taxonómico de *Doydixodon laevifrons* (Tschudi, 1846) (Osteichthyes: Kyphosidae). Revista Peruana de Biología 15: 101-104.

PRODUCE. 2020. Anuario estadístico pesquero y acuícola 2017. Ministerio de la Producción, Lima. <https://ogeiee.produce.gob.pe/index.php/en/shortcode/oee-documentos-publicaciones/publicaciones-anuales/item/825-anuario-estadistico-pesquero-y-acuicola-2017>

Solis-Murgas L, Perez-Ribeiro PA, L Santos-Costas, Â Augusto-Eloy & P Viera e Rosa. 2010. Aceite de clavo como anestésico para el pez pacu (*Piaractus mesopotamicus*). Anales de Veterinaria de Murcia 26: 69-76.

Stepien CA. 1990. Population structure, diets and biogeographic relationships of a rocky intertidal fish assemblage in central Chile: high levels of herbivory in a temperate system. Bulletin of Marine Science 47: 598-612.

Varas E & F Ojeda. 1990. Intertidal fish assemblages of the central Chilean coast: diversity, abundance and trophic patterns. Revista de Biología Marina 25: 59-70.

Vizcaíno AJ, SI Mendes, JL Varela, I Ruiz-Jarabo, R Rico, FL Figueroa, R Abdala, M.Á Moriñigo, JM Mancera & FJ Alarcón. 2016. Growth, tissue metabolites and digestive functionality in *Sparus aurata* juveniles fed different levels of macroalgae, *Gracilaria cornea* and *Ulva rigida*. Aquaculture Research 47: 3224-3238. <https://doi.org/10.1111/are.12774>

You-Syu H, L Wen-Liang & H Yuan-Shing. 2019. Effects of dietary protein levels and replacement of fish meal with *Spirulina* powder on the growth performance of Girella (*Girella mezina*). Journal of Taiwan Fisheries Research 27: 33-45.

Received 6 June 2023

Accepted 27 June 2024

Associated Editor: Renzo Pepe Victoriano

RBMO CITATION STYLE

Cruz-Castellón C, W Vásquez-Quispesivana, C Guerrero-Jiménez, H Buitron-Ramos & J Bardales-Azañero. 2024. Cultivation of sea chub *Girella laevifrons* (Perciformes: Kiphosidae) juveniles on the central coast of Peru. Revista de Biología Marina y Oceanografía 59(2): 162-167. <https://doi.org/10.22370/rbmo.2024.59.2.4817>