CTMFM
Comisión Técnica Mixta del Frente Marítimo

Corvina
Ficha Técnica

Biología y ecología
Pesca
Manejo
Comercialización

Resource identification [link 1]

Taxonomía

Class: Actinopterygii
Order: Perciformes
Family: Sciaenidae
Specie: *Micropogonias furnieri* (Desmarest, 1823)

Common name

Argentine: corvina rubia, curvina, roncadera
Uruguay: corvina, mingo (juvenil)
Nombre común en inglés: whitemouth croaker

Distinctive external characters

Body slightly elongate moderately compressed. Mouth inferior, nearly horizontal; teeth villiform, forming bands in both jaws, outer row in upper jaw slightly enlarged. Chin with 3 to 5 pairs of small barbels along inner edge of lower jaw; snout with 7 to 8 pores. Preopercular margin serrated, with 3 to 5 spines at angle; 22 to 29 gillrakers short and tough on first gill arch. Scales ctenoid on body and top of head, cycloid on snout, 6 or 7 scales between dorsal fin origin and lateral line in vertical series. Lateral line with 50-54 scales, extending posterior margin of caudal fin. Dorsal fin with a deep notch, 10 spines and I + 27-30; a short spine anterior to second dorsal fin. Anal fin with 2 spines and 7-9. Pectoral fin with 18-19. Caudal margin slightly convex. Colour silvery with a golden cast, back greyish, with distinct oblique dark streaks along scale rows extending to much below lateral line; spinal portion of dorsal fin without small dark dots.

Distinction of similar species in the area

In the area of the Treaty the most similar species is the Argentine croaker, (*Umbrina canosai*), which is different because it has body oblong, elongated and compressed. Tip of snout blunt; mout small and inferior, nearly horizontal; teeth on both jaws villiform, forming bands. Preopercular margin finely serrated. A stout, rigid barbel at tip of lower jaw, its tip rounded; two pairs of large mental pores on ventral side of head laterally. Tip of snout with 8 pores. Scales ctenoid. Lateral line with 48 scales, extending to posterior margin of caudal fin. First branchial arch with 20-24 short gillrakers. Dorsal fin with 11 spines and 21-25 soft rays; a deep notch or almost divided in two; a short spine in front of soft dorsal. Anal fin with 2 spines and 7-8 soft rays. Pectoral fin with 18 rays. Posterior margin of caudal fin slightly concave. Colour upper part of body with many dark longitudinal strips; no well defined dark spot at bases of pectoral fins [link 2].

Geographical distribution

The whitemouth croaker *Micropogonias furnieri* has a wide distribution along the Atlantic coast of America from Veracruz, (Mexico, 20°20' N) to the northern coast of the Gulf of San Matias (41°10'S) in Argentina. The highest concentrations of individuals are recorded south of Cabo Frio (Brazil, 23°S) in coastal and estuaries waters in the southeastern and southern of Brazil and in the area of the Treaty of Rio de la Plata and its maritime front where that specie is the main coastal fishing resource (Fig. 1).

The geographical range of distribution of whitemouth croaker also includes the Caribbean Sea: its presence has been mentioned in islands of the Antillean (Cuba) and in estuarial areas of Guyana, on the South American Caribbean coast [link 3]. Possibly the distribution of the species is even wider: its presence has also been reported for the Chilean coast where its habitat is restricted only to the lagoons of Vichuquén and Torca, to the estuary of the Nilahue estuary near Pichilemu and to the coastal lake Budi (Moreno *et al.,* 1996).

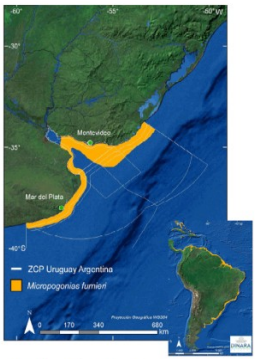


Figure 1. Distribution of the whitemouth croaker (*Micropogonias furnieri*) on the coast of South America and Central America and within the Common Fishing Zone (ZCP). Source: J. M. Caballero, Dirección Nacional de Recursos Acuáticos (DINARA) FAO-DINARA UTF/URU/025/URU "Fisheries Management in Uruguay."

This wide distribution is explained by being a highly plastic species: eurythermic, euryhaline, euryphaga and able to adopt different strategies to ensure the success of reproduction. In the Buenos Aires and Uruguayan coasts it is found in waters whose temperatures oscillate between 10 and 12° C in winter and 19-23° C in summer while salinities up to 33.8 ups. Its trophic strategy characterizes the whitemouth croaker as an omnivorous-opportunist predator, varying its diet with the distribution area of the individuals, the availability of food and the size of the specimens.

Management unit

From different methodologies, considering morphometric, meristic, parasitological, reproductive and genetic aspects, it has been postulated over the course of more than four decades, the existence of a variable number of possible whitemouth croaker population units inhabiting the coasts of the South-West Atlantic. This background indicated that, from Cabo Frio (Brazil) to El Rincón (Argentina), the whitemouth croaker would be structured in four or five population groups [link 4].

The most recent genetic research [link 5], using the mitochondrial DNA control region, allowed the identification of two demographic units in the area of Treaty: one associated with the Rio de la Plata and its maritime front and another on the Uruguayan oceanic coast close to the limit with Brazil which, for fisheries management, is considered until now as a single shared stock. Regarding the location of the spawning and breeding areas of each of these units, the whitemouth croaker population associated with the Rio de la Plata, spawning in the head of the salinity front and has Argentinean and Uruguayan coasts as breeding areas [link 6]. The typical oceanic population is distributed to the east of Uruguay and south of Brazil and reproduces in Uruguayan coastal waters [link 7] and Brazilian waters, although it also occurs in the coastal lagoon of Rocha (Vizziano *et al*., 2002) and If saline intrusion occurs, newly hatched eggs and larvae can be found in the Laguna de Los Patos (Castello, 1986).

According to the review and complementary studies with regard to the population and management units of whitemouth croaker in the Southwest Atlantic conducted by Haimovici (2016), in Brazilian waters, south of Cabo Frio, there are two population units. One of them, the caterinense-paulista or southeastern Brazilian (SEB, 23-29°S) and the others, Rio Grande do Sul or southern Brazil (SB 29-32°S), there being very little connectivity between both, being considered for administrative purposes as two different stocks. On the other hand, the author recognizes the existence of a certain degree of mixture between the population unit SB and that inhabiting the Uruguayan coastal waters, as shown in Figure 2 modified Haimovici (2016) from the results of Volpedo and Cirelli.

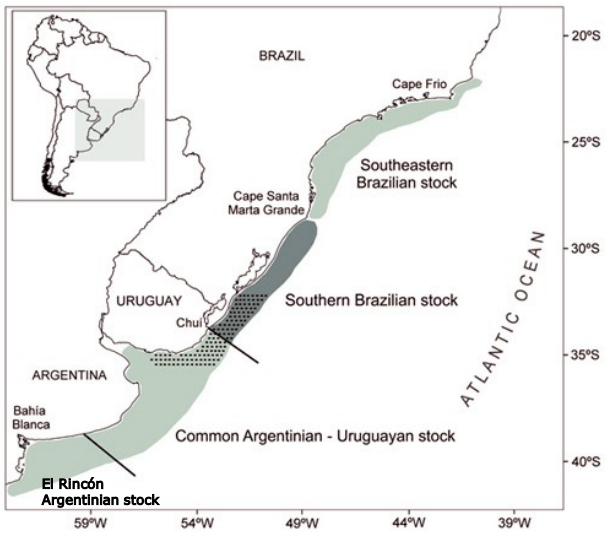


Figure 2. Population and management units of the whitemouth croaker *Micropogonias furnieri* in the South West Atlantic.

Biology and Ecology

Initial ontogeny

M. furnieri is an oviparous species. Their eggs are small and spherical (variable diameter with the advance of the reproductive season = 730 - 1,053 µm) they have small perivitelline space, large and slightly yellowish oily drop. The fecundation is external, passing the embryonic and larval stages in the planktonic community. Issac (*op.cit*.) and Braverman [link 8] synthesize, from information coming from the laboratory and field work of different authors, the knowledge about the embryonic, larval and post-larval development of the species.

There are two antecedents of embryonic and larval development of the whitemouth croaker under controlled experimental conditions carried out in Cuba at the end of the 1970' s [link 9] and more recently in Rio Grande (Brazil) [link 10]

The results presented by García (1979) indicate that at 27° C the duration of development from fertilization to hatching is 16 hours. The newly hatched larvae measured 1.3 mm and kept the oily drop in the yolk sac. After 11 hours and 30 minutes from hatching, the first support structures appear. At 33 hours the pectoral fins develop and after 47 hours, under the experimental conditions mentioned, the mouth is completely formed, the yolk sac reabsorbed and the eyes pigmented. After 96 hours of development a small decrease in size was observed (2.1 TL), chromatophores are visualized in the head, abdomen and ventral part of the trunk and the oily drop has disappeared.

On the other hand, Albuquerque *et al*. (2009) suggest that, at experimental temperatures between 23-25 ° C the development until hatching took place after 20-22 hours. In this experience the newly hatched larvae measured 1.8 mm. The mouth opened after 24 hours from the hatching, feeding began only when the larva was 48 hours old. After a period of mixed feeding, on the 9th day after hatching the embryo development has concluded: the yolk sac and the oily drop are completely reabsorbed and the larva reaches a size of 3.5 mm.

The development during the larval and post-larval phases has been described by Sinque (1980) and Weiss (1981) from material collected in the estuarial regions of Cananéia (25 ° S) and Laguna de los Patos (32 ° S), respectively [link 11]. When the larva reaches 11 mm, it has already obtained the final number of rays and spines in its fins as well as the total number of already ossified vertebrae. According to Braverman (2011), in this moment the larval phase ends and the metamorphosis period begins, characterized by changes in the general form and structural details that involve the acquisition of adult characteristics (including inter alia the displacement of the mouth, flaking, etc.). As well as the abandonment of the planktonic community to associate with a benthic substrate in the settlement process.

Growth

Embryonic, larval, post-larval and metamorphosis phases

Albuquerque *et al*., (*op.cit*.) showed that, under experimental conditions, the larvae begin feeding on the 2nd day after hatching and deposit the first growth ring on their otoliths a day later. They also showed that the rhythm of ring deposition in the otoliths of whitemouth croaker larvae is daily (1 ring = 1 day). In their experiment, after the first month of life the larvae reached a standard length (SL) of 12.99 mm. During this period, the average growth rate was 0.36 mm/day. The maximum rate (0.78 mm/day) corresponded to the end of the experiment when the larvae had a month of life.

Braverman (*op.cit*.) studied the growth of the whitemouth croaker during the larval and early juvenile stages from the analysis of samples collected in March 2006 in the breeding area of the Rio de la Plata and its maritime front. The temperature range corresponding to the samples in which the material analyzed was obtained was from 18°C to 22.7°C. The length range analyzed was 3-25mm TL. The obtained results show that the growth of the croaker in natural environment, during the first 90 days of life, can be described by a Laird-Gompertz model, whose inflection point, which indicates the maximum value of the growth rate, corresponds to larvae of 31 days of life and 10.23 mm of TL. The average growth rate of the larvae and juveniles of the whitemouth croaker in the natural environment (0.237 mm/day) was lower than that reported for controlled experimental conditions. The curve that describes the daily growth in standard length during the first three months of life of the croaker in the area of Rio de la Plata and its maritime front is the following:

$$Le = 2{,}76 \cdot \exp(2{,}31(1-\exp(-0{,}027 \cdot t))$$

Juvenile phase and adult

The whitemouth croaker is a long-lived species, it has been observed a maximum age of 45 years, with rapid growth in the first four years of life, reaching in that period 60% of its total length. The females reach larger size than the males [link 12]. The curves of the von Bertalanffy model adjusted to the total length data for the different ages in males and females collected in the 2006 research cruises [link 13] evidencing the following results:

$$\text{Males: } Lt = 51{,}15\ [1-e^{-0{,}19(t-(-2{,}67))}]$$
(N:495, 2-36 year) (2006)

$$\text{Female: } Lt = 58{,}60\ [1-e^{-0{,}14(t-(-3{,}28))}]$$
(N:616, 2-35 year) (2006)

$$\text{Total: } Lt = 56{,}25\ [1-e^{-0{,}15(t-(-3{,}28))}]$$
(N:1118, 2-36 year) (2006)

The annual parameters of the weight - size relationship did not show significant differences between sexes. The values corresponding to the curve adjusted to measurements from the biostatistical sampling of fish in the port of Mar del Plata, Gral. Lavalle and Rio Salado in 2016 are the following [link 14]:

$$P = -0{,}011 * Lt^{2{,}99} \quad N = 1377$$

Reproduction

The reproductive biology of the whitemouth croaker that inhabits and spawns in the area of the Treaty has been studied through the histological analysis of its ovaries by Macchi *et al.* (2003) [link 15]. Whitemouth croaker is a multiple spawner with indeterminate annual fecundity. The spawning season lasted about six months (November to March). Spawning frequency, determined by using the percentage of females with postovulatory follicles, was about 31% at the beginning of the season and 25% towards the end of the season, which implies that each female releases oocytes every 3 or 4 days, respectively. Given the extension of the spawning season, it can be estimated that a female would spawn between 60 and 45 times during this period. There is a potential relationship between the size of the females and the number of oocytes released at each set (Fp = 0.676* Lt3.282). The number of hydrated oocytes decreased at the end of the breeding season, coinciding with an increase of atresia. Annual egg production for a 40-cm-TL female was estimated to be between $3{,}3 \cdot 10^6$ y $7{,}3 \cdot 10^6$ eggs.

The estimates of length at first maturity (L_{50}) for whitemouth croaker showed highly significant differences between sexes (Militelli and Macchi, 2016). In 4 years analyzed, corresponding to the period 1998-2013, years in which the extractive pressure on the resource increased steadily, the males reached the first sexual maturity at a smaller size than the females. The estimated values of L_{50} for males, females and the total individuals were: 30.7 cm; 34.7 cm and 32.2 cm, respectively. Analogously, the age of first maturity (E_{50}) was: 2.58 (males); 3.2 (females) and 2.86 (total) [link 16].

Feeding

This species is a generalist and opportunistic predator, feeding mainly on crustaceans, bivalves and polychaetes. Showed a tendency to specialization towards one single taxonomic prey type, bivalves, but also consumed other benthic invertebrates like polychaetes or crustaceans.

The general pattern varied according to the size and area considered. While individuals >10 cm TL preyed mainly on *Mactra isabelleana*, smaller juveniles preyed mostly on Mysidacea [link 17]. When considering the functional prey groups, larger whitemouth croakers generally fed on slow motile deposit-feeders invertebrates, bivalves mostly, displaying a common pattern of dietary habits at all the habitats. Smaller croakers of estuarine sites adopted also a mixed strategy, feeding on several prey types *M. furnieri* seems to have the potential for plasticity in its feeding behaviour, and it could be one of the factors that allows for the extensive geographical distribution of this species, throughout different prey exploitation patterns.

Micropogonias furnieri in Budi coastal lagoon, southern Chile, has been classified like an opportunistic omnivorous species. During the summer period anchoveta *Engraulis ringens* was the main prey item. On the other hand, during winter aquatic plants (i.e. undigested remnants of *Myriophyllum aquaticum)* were the main prey [link 18].

Natural mortality

The values of M were estimated from different methods for males, females and both sexes analyzed together (CTMFM 2017). The values of M for males were higher than those of the females. Differences are observed between the results obtained from the application of the different methods. The methods of Alajara and Hoenig that use the maximum observed age (T_{max}), gave very low M values (0.09-0.11). In contrast, Pauly and Taylor methods, which use growth parameters result in values between 0.16 and 0.46 for the two sexes as a whole.

Distribution of the species in the area of the Treaty

Habitat

The area of the Treaty constitutes an area recognized for its high biological productivity. It is a hydrologically complex and dynamic habitat with marked horizontal and vertical density gradients [link 19] [link 20]. Forces of this variability are linked to the seasonal and inter-annual changes of the Rio de la Plata discharges, the seasonal regimes of the winds strongly associated to the latitudinal variations of the South Atlantic high-pressure cell, the nearness of the shelf with the Brazil and Malvinas currents as well as the contribution of nutrients from the southwest of the area transported by the Subantarctic waters of the Argentine shelf.

In the area of the Treaty, the coastal habitat of the species is limited topographically by the isobath 50-60 m, which separates the coastal regime from the continental shelf. In relation to the water masses Negri *et al*. 2016 [link 21] they indicate that waters of sub-Antarctic origin flow south of 38° S, and to the north of 36.5° S diluted waters by the discharge of the Rio de la Plata and waters of subtropical origin are added, principally in summer. Subantarctic Shelf Water, transported from the south, extend parallel to the bathymetry with SW-NE direction with salinity between 33.5 and 34.2 ups.

In the Subantarctic Shelf Water there are three components: the external one with salinity between 33.7 and 34.2 ups, which is located in the outer of the continental shelf; in the middle on the central shelf with lowest salinity resulting from the contribution of diluted waters by continental runoff in the south of the continent; and the coastal one with relatively high salinity values (S> 33.8 ups), coming from the east of El Rincon and originating in the interior of the Golfo San Matías due to the effect of restricted circulation and the predominance of evaporation over local precipitation. The Subtropical waters present are the Tropical Water and the South Atlantic Central Water, transported to the south by the Brazil current, which predominate during the summer and autumn. The Rio de la Plata water is mixed with continental shelf waters, forming a low - salinity layer over the Subantarctic and Subtropical Water, induces a high vertical stratification, isolating the deep layer.

The topography, together with the contributions of continental water and the modifications due to the exchange with the atmosphere, generate a complex ecological and oceanographic system. In the Rio de la Plata, the Barra del Indio constitutes a geomorphological barrier that divides the area internal and external. The internal corresponds with the river discharge and the external to a mixohaline regime where the intrusion of shelf water along the bottom, in the form of a salt wedge, generates a two-layered structure with a strong vertical stratification that decreased towards the outside of the Rio de la Plata. The interfaces

between the mentioned regimes originate two salinity fronts, the bottom one as the boundary between the fluvial regime and the mixohaline, and the surface one as the boundary between the mixohaline regime and the shelf waters.

The entrance to the platform of the diluted water of the Rio de la Plata and its seasonal variation influences the shelf ecosystem modifying the physical-chemical properties of the area, the concentration of nutrients and the biological productivity. The distribution of surface salinity varies seasonally and is forced by winds and continental discharge. In autumn-winter the winds are continental and fresh water discharge reaches maximum values. In that period, there is a drift of water coming from the discharge of the Rio de la Plata in the northeast direction along the Uruguay coast. In spring summer, they show an extension in south-easterly direction, towards the Argentina coast, as a consequence of the oceanic winds and a minimum in the continental discharge. There are also areas whose waters are locally modified by continental contributions, which promote the formation of fronts in the coastal littoral, of importance due to their biological implications.

Areas of concentration and size structure

The information analyzed coming from the coastal research surveys conducted between 1991 and 2013 in autumn and winter of the area of the Treaty arises that, the highest concentrations of the species are located mainly in the sector of the Rio de la Plata and Uruguay costal. The smaller length were found in the internal and mixohaline area of the Rio de la Plata and the Bahia de Samborombón while, at the north of the Uruguayan coast (Chuy) and in the external boundary of the Rio de la Plata, the length were higher. In spring, the highest populations densities are recorded in the inner sector of the Rio de la Plata, with dominate individuals between 10 and 30 cm TL. In summer, the high densities corresponded to spawning concentrations located in agreement with the saline front; there were mostly adult individuals that exceeded 33 cm of TL. In the oceanic area, samples greater than 40 cm of total length predominated (Fig. 3).

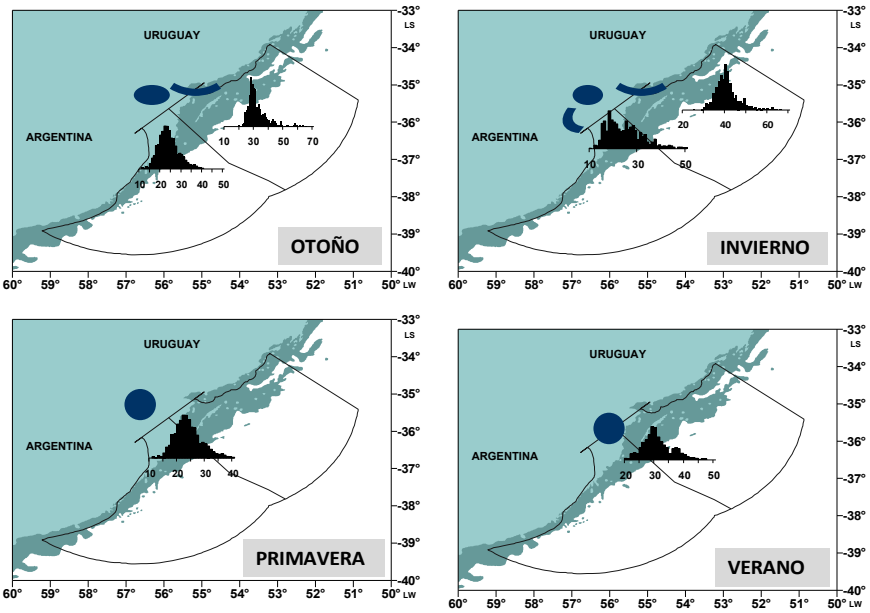


Figure 3. Main areas of concentration and length distribution, information coming from research vessels in the Rio de la Plata and its maritime front.

In general there is stratification in the distribution of whitemouth croaker length from the inner of the Rio de la Plata, coastal areas (Bahia Samborombón and the mouth of the Rio Santa Lucia) to deeper and saline waters. In winter and summer the juveniles (TL<32 cm), remain inside the river while, individuals of bigger sizes occupy deeper and saline water. The movements of these toward inner of the river would be associated with the spawning. The analysis of the spatial-temporal distribution of the densities and population structure between 1991 and 2013 is detailed in the "*Whitemouth croaker diagnosis*" of CTMFM (2017).

Spawning and breeding in the area of the Teatry

The Rio de la Plata and its maritime front constitute the main spawning and breeding area for the whitemouth croaker. Spawning which takes place between November and April, occurs in the inner zone (Macchi and Christiansen, 1996) and coincides with the bottom salinity front (Macchi and Christiansen, 1996, Acha et *al*. 1999). Acha *et al*., (1999) showed surface and the bottom layers defined by the halocline, generated by the discharge of the waters of the Rio de la Plata in contact with the platforms, constituted *per se* a spawning habitat capable of providing the mechanisms that generate stability, concentration of food and retention. Unlike other congener species or of the same species in other latitudes, oceanic spawning and subsequent transport to more protected coastal areas was not observed for this species. The authors showed that the spawning area covers a narrow band across the river

between Montevideo and Punta Piedras at depths ranging from 6 to 8 m. This area is characterized by strong haloclines, reaching 21.5 units m^{-1}. *M. furnieri* eggs were present only below the halocline, in salinities of 9.7-27.3, and at 18.5-20.2°C.

During the spring and summer, spawning occurred in the innermost part of the estuary, near the upstream edge of the salinity wedge and coinciding with the turbidity maximum (up to 150 mg L^{-1}). In the rest of the Rio, the individuals remain in the partially spent stage, moving afterwards to the inner sector where they mature and spawn. Egg distribution in this spawning area occurs in correspondence whit the turbidity and bottom salinity front. This spawning area is also close to the main nursery grounds for this species, which are in Samborombón Bay (Argentine coast) and between Punta Tigre and Montevideo (Uruguayan coast).

Lagos (2003) from data from research vessel conducted between 1987 and 2001 determined the distribution of the whitemouth croaker juvenile (ages under 3 years). These are distributed outside of the Rio de la Plata along the Barra del Indio - coast of the Bahia de Samborombón and have the highest densities (> 10,000 Ind/mn^2). A group of lower density is located on the Uruguayan coast, between Montevideo and Punta del Este. According to their age, a differential distribution of juveniles is observed related to the distribution of salinity within the system. The first stages (juveniles 0+ and 1+) are concentrated inner sectors where salinity is lower and can reach even freshwater; while the older individuals (juveniles 2+) are distributed occupying areas of greater depth on the outside of the river, in a wider range of salinity (Fig. 4).

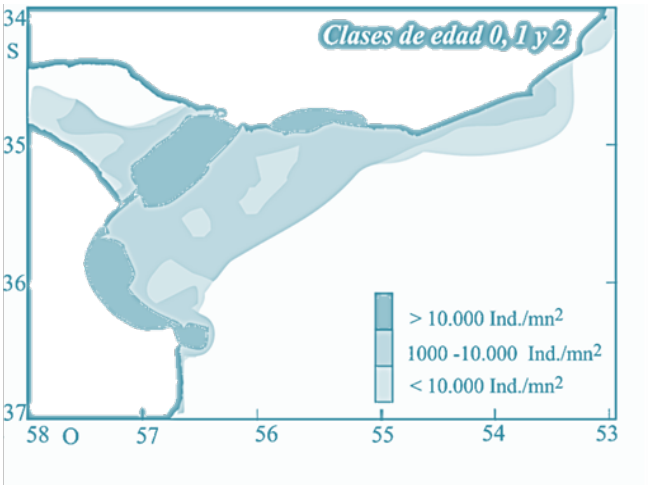


Figure 4. Juvenile distrubution (Lagos, 2003).

Carozza *et al.,* (2004) present a conceptual diagram of the spawning strategy of whitemouth croaker in the Rio de la Plata and its maritime front [link 22]. More recently Jaureguizar *et al.,* (2008) analyzed the distribution of *M. furnieri* at different maturity stages along an estuarine gradient and in relation to environmental factors. Results indicate that bottom salinity horizontal gradient and depth have a major influence on the specie maturity stages spatial distribution; bottom salinity and temperature play a significant although secondary role. Spent and resting adult stages were associated to high salinity, low temperature and bottom salinity gradient while immature, gravid (with hydrated oocytes) and running stages to low salinity and high temperature. Although immature, gravid and running stages were clearly linked to similar bottom salinity they were segregated, with gravid and running stages associated to a strong bottom salinity horizontal gradient. The distinct preferences of the different spawning stages result in a segregated distribution pattern along the main axis of the Rio de la Plata. The area with low salinity and high horizontal bottom salinity gradient (habitat for gravid and running stages) was located at the river head.

Finally, a related point to consider is the existence of a second spawning area, also in spring, although clearly separated from the previous one. This second area is located in marine coastal waters, between La Paloma and Chuy, with high bottom salinity (32 ups) and low temperatures (14° C) [link 23]. Puig and Mesones (2005) [link 7] related to this spawning area, in which in the spring of 1994 high numerical densities of spawning females were recorded. It should be mentioned that this spawning area would be located in the near of the Subtropical Shelf Front, which separates subtropical from Subantarctic waters from a shelf and is considered an extension of the front formed by the Brazil - Malvinas confluence (Piola *et al*., 2000).

Explotation

Fishery indicators

M. furnieri is a traditional coastal fishing resource in the Rio de la Plata and its maritime front, being the dominant species in the so-called "*variado costero*" in Argentina and the first coastal species in commercial catch volume in Uruguay. Until the 1980s, the whitemouth croaker landing by the Argentine fleet ranged between 4,000 and 17,000 t, intensifying towards 1992. As of that year, there was a marked increase in catch reaching 30,000 t due to the expansion of the external market. This situation led to a change in the fishing modality; the coastal and "*rada or ría*" fleets intensified their capture in Bahia de Samborombón, causing an increase in applied effort (No. of boats) in that area. As a result, management measures were implemented restricting the entry of vessels of greater lengths to 21.99 m to operate within the Bahia de Samborombón, thus reducing the volumes of extraction. From 2003 to 2013, the whitemouth croaker landing in the Rio de la Plata increased from 10,000 to 30,000 t. It is from 2013 that there was a decrease of the same until values of the order of 20,000 t in 2016. In the area located north of 39° LS in the last 10 years, the distribution of the catches from the jurisdictional waters represented between 50 and 70%, while the remaining percentage

originated in area of the Treaty waters. In Uruguay, following the Fisheries Development Plan initiated in 1974, as well as the incorporation into the fishery of Argentine vessels in 1981, the catches of the resource in the area increased substantially between 1975 and 1980 from 5,000 to 32,000 tons respectively.

From the beginning of the decade of the 80's until 2008 the catch of the species by the Uruguayan fleet was relatively stable, averaging 25,000 t per year. As of 2008, it decreased progressively until 2016 with catches of around 12,000 t. (Fig. 5).

The monthly averages of catch in both countries allow recognizing certain seasonality in extractive activity. Between June and September, on average, more than 50% of the annual landings of the species accumulate (Fig. 6). The highest averages correspond to the months of July and August, exceeding in both cases the 2,000 t.

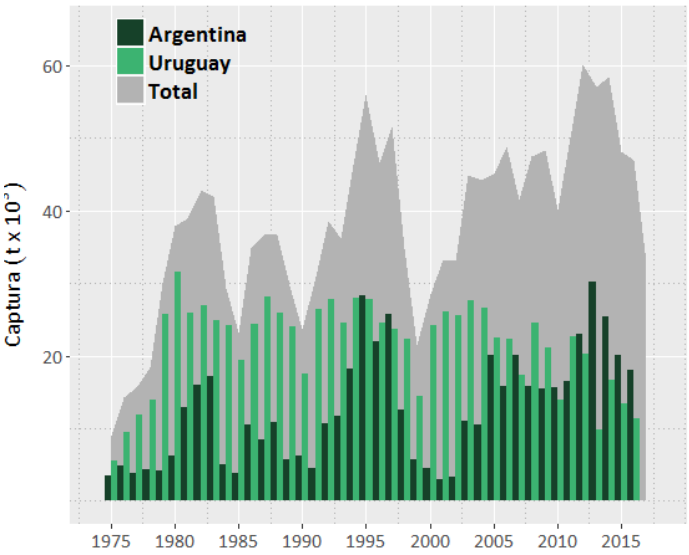


Figure 5. Trend of catches (t) of whitemouth croaker by the Argentine, Uruguayan fleet in the ZCP including jurisdictional waters of each country. Period 1975-2017.

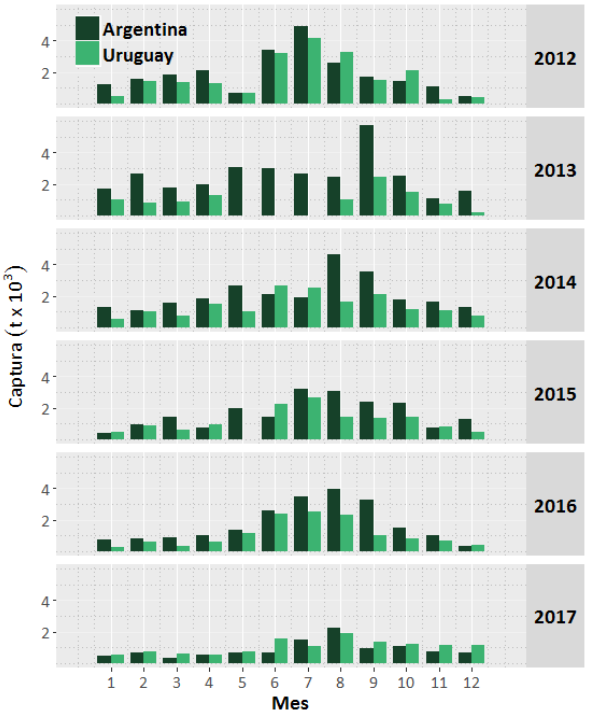


Figura 6. Monthly trend of catches (t) of whitemouth croaker by the Argentine fleet, Uruguayan in the Rio de la Plata and its sea front.

The fishing modality on the whitemouth croaker, both by the Argentine and Uruguayan fleet, is carried out by bottom trawl net and, in particular, by pair trawlers. The main Argentine fleet operating on the specie is divided into two categories with different engine power (EP). The first, with lengths between 7-17 m and up to 350 EP (*rada or ria* and coastal fleet), mostly operates with a fishing pair trawl and has target fishing for the croaker. The second one, of lengths greater than 17 m and power greater than 350 EP with fishing modality generally of bottom trawls, represents more than 50% of the total Argentine catch of the species. The modality of pair trawls to be dominant from the year 2000 in this second category of fleet. In Argentina, between 1992 and 2015, approximately 500 vessels intervened, with the ports of Mar del Plata and Gral. Lavalle being the most important in landing volumes (Fig. 7). In the first case, the larger vessels operate. During the fishing season (July-September) vessel with a base port in Mar del Plata move north, to the Rio Salado and Gral. Lavalle ports to carry out operations in the Samborombón Bay area.

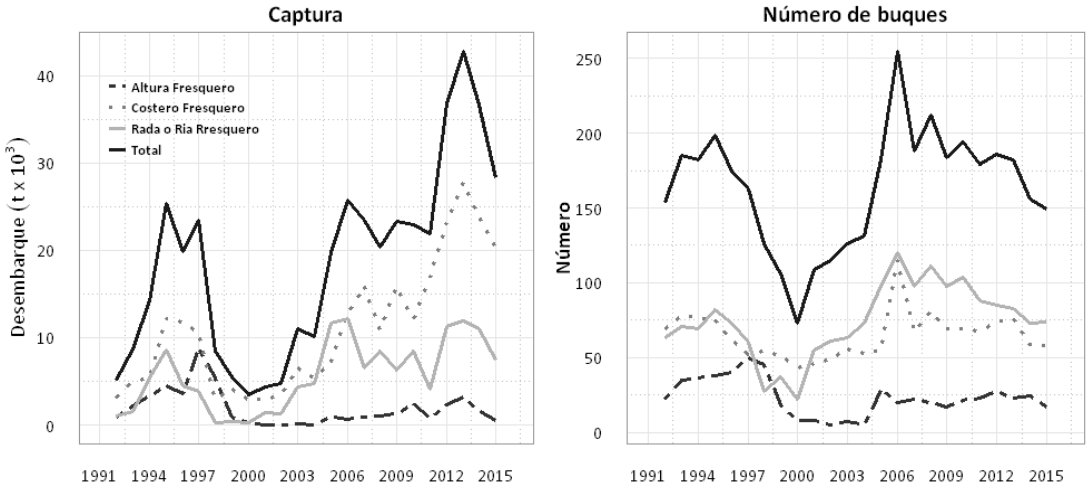


Figure 7. Trend in the number of vessels and catch of whitemouth croaker (thousands of tons) landed by type of fleet in Argentine. Period 1992-2015.

The Uruguayan industrial trawls fleet from its beginning until 1995 included coastal vessels, with lengths less than 21 m and without limitations in the fishing area, except that, they could not tow less than 5 km from the coast. These vessels worked in pairs. Likewise, medium height vessels operated, with length between 21 and 26 m, east of Isla de Flores, which operated on argentine hake, whitemouth croaker and stripped weakfish. As of 1997, fishing permits vessels larger than 10 GRT were granted taking into account, among other considerations, the target species. Thus, Category B includes vessels whose target species are whitemouth croaker, whiting and its by-catch. They operate with bottom trawls, either independently using gates, or the pair trawlers. The ship number in this category increased from 18 to 35 units between 1996 and 2001, later stabilized in 33, of which 1 operates with trawl and the rest to pair trawl (Fig. 8).

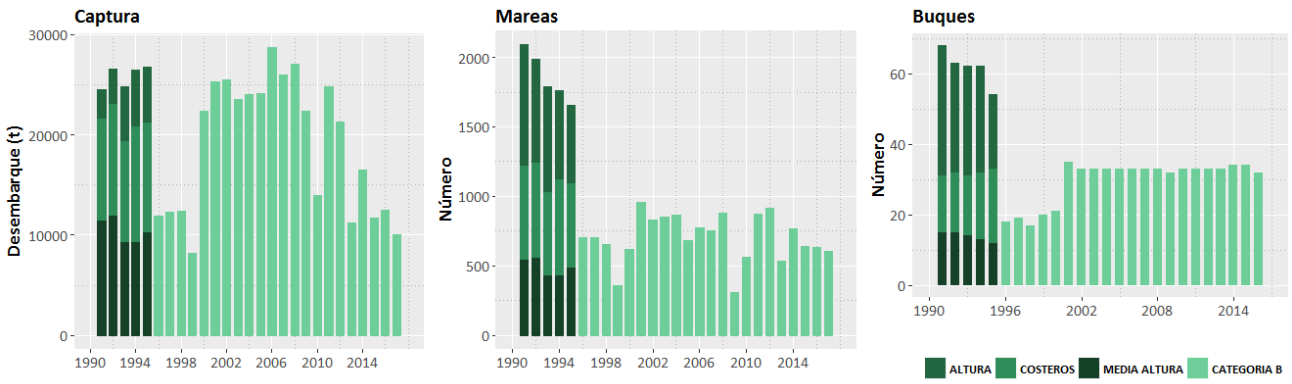


Figure 8. Total annual catch of Whitemouth croaker (tons) and number of vessel per type of coast Uruguayan fleet operating in the Rio de la Plata and area of the Treaty.

Both the Argentine and Uruguayan fishing fleet operating on the resource, showed a marked concentration of the catches on the grids 35° S - 55° W and 35° S - 56° W, (henceforth 3555, 3556), located in Rio de la Plata. The Argentine fleet operates systematically in grid 3656 where it made the largest catches. The vessel from the port of Mar del Plata presented two maximums landing in 2007 and 2012 around 6,000 t, while in the port of Gral. Lavalle, landings increased progressively reaching 4,000 t. The Mar del Plata fleet increased the capture values in the 3555 and 3556 grids, reaching 6,000 t in 2013 and 2014, and in 2013, extraction levels of the order of 10,000 t, grid 3655, located outside the Rio de la Plata. Instead, Gral. Lavalle the landing increased in grid 3557 (near the coast of Samborombón Bay) and in 3556 the catch decreased by 2015 (Fig. 9). The effort applied by the Mar del Plata fleet was much greater than that exerted by the fleet of General Lavalle. The greatest number of hours used for fishing were applied in the grid in 3655 (around 20,000 hs per year) and in 3656 with a maximum of 40,000 hs.

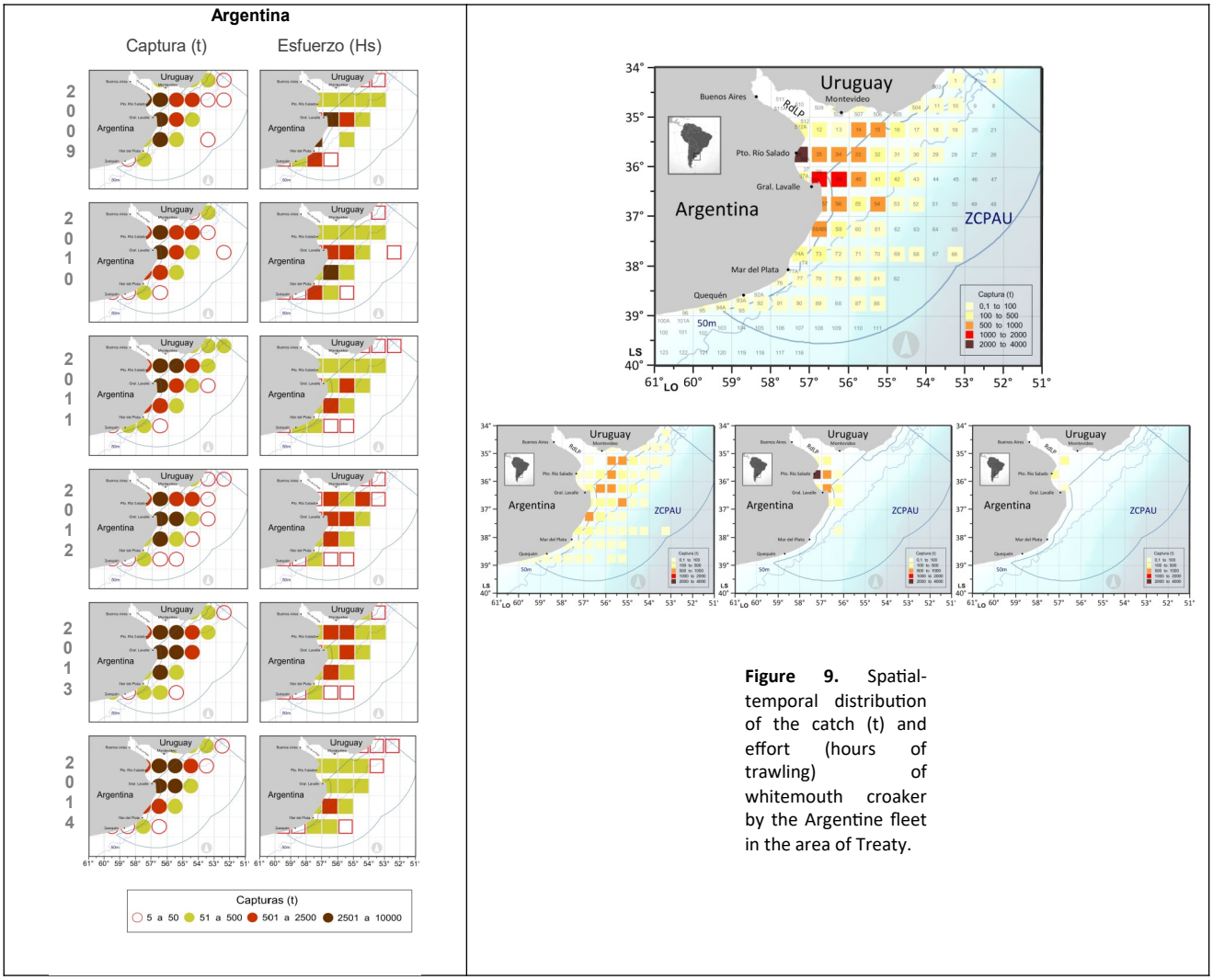


Figure 9. Spatial-temporal distribution of the catch (t) and effort (hours of trawling) of whitemouth croaker by the Argentine fleet in the area of Treaty.

The Argentine fleet of Mar del Plata port has two periods of maximum extraction. One, in April and May and the second between July and September. As of 2013, the maximum catches made by this fleet are in August and September. Gral. Lavalle fleet has higher catches in July and August. The Uruguayan fleet, between July and September, represents between 29 and 53% of the total annual catch. Regarding the effort expressed in hours, two annual periods were observed, one in March and April (3,500 average hours) and the second in October and November (3,000 average hours), both related to low catches.

The most frequent length in the Argentine commercial landings varied between 30 and 45 cm TL, with the maximum size recorded being 80 cm TL. The monitoring of the length landed during the fishing season in Bahia de Samborombón indicated that average decreased from the 1990s from 43-46 cm to 29-41 cm in 2010. Also, in this period, the age range decreased from 1 to 45 years, with age classes equally represented at ranges between 2 and 35-37 years, with individuals of age 2 and 3 predominating.

The operation area of the Uruguayan fleet is mainly on grids 3555 and 3556, presenting the highest volumes of capture and effort (hs) in the last three decades. The remaining grid squares not only showed low values but also minimal inter-annual variation (Fig. 9). The 3556 grid, located in the Rio de la Plata, represented approximately 50% of the total annual catch in the all operation area of the fleet. The annual average of capture in that grid was approximately 8,500 t, however, in 2006, 2008 and 2011 the registered values ranged between 11,000 and 12,500 t. The greatest effort, associated with the highest catches, was observed at 3556 (maximum 17,000 h in 2008). In grid 3555, the second in importance in terms of catch and effort, it was observed that, as of 2008, the average catch decreased from 5,600 to 3,300 t between 2009 and 2014, in the same way for the trawling hours from 11,000 to 7,500.

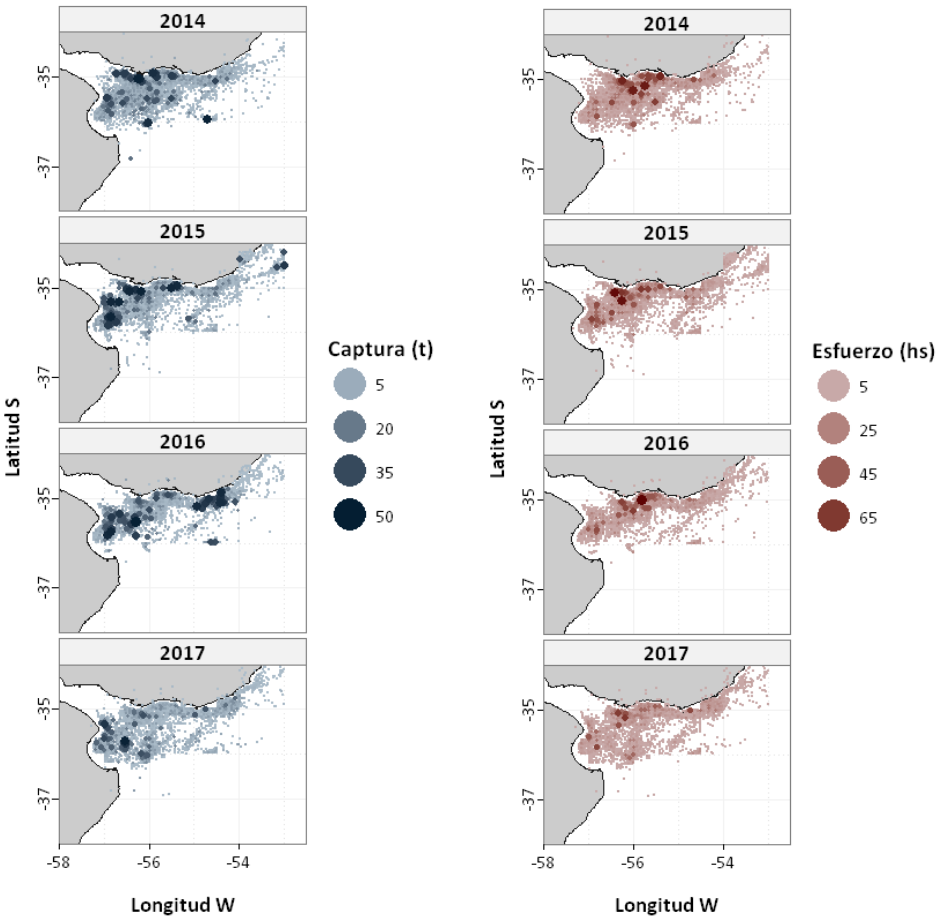


Figure 8. Distribution of the catch (tons) and effort (trawling hours) of the Uruguayan fleet.

Status of resource

As of 2007, the stock assessment, diagnosis and other management measures directed to this species are discussed within the *Grupo de Trabajo Costero Argentino-Uruguayo* (GTC) of the CTMFM. In this context, a work plan to be followed was outlined, in order to advance the management recommendations for the area of the Treaty and adjacent waters. In this sense, a common database of the Argentine and Uruguayan commercial fleet was formed, obtaining indices of relative abundance (catch per unit effort CPUE) for both fleets as a whole. In 2010, the GTC raised the need to advance in the application of a stock assessment model that would contemplate the population structure, for which, by conducting a workshop, it was agreed to use the *ASPM* (*Age Structured Production Model*). Currently, to provide information on the state of the resource, the results of the application of a production model and a statistical evaluation model integrated in the *Stock Synthesis* (SS3) are used.

Stock assessment

For the stock assessment of the resource in the year 2017, abundance indices constructed from a General Linear Model (GLM) were used. The CPUE values corresponding to each tide, expressed in kilograms per hour of trawl and catch of whitemouth croaker from the Uruguayan commercial fleet (U) corresponding to the period 2002-2016, a nominal index (t/mn^2) (CU) were used as basic data, and finally, a nominal index (t/mn^2) of Argentine research vessel carried out in spring (CA). It is also considered as a basic input to the stock assessment models, the annual whitemouth croaker catch data declared by Argentina and Uruguay in the Rio de la Plata, its marine front and adjacent jurisdictional waters between 1950 and 2017.

Surplus production model

The surplus production model (Schaefer, 1954) was used to determine indicators of stock productivity. The parameters of the model, its uncertainty and the performance indicators of the management strategy were estimated with Bayesian methods. This model was applied using the index of the Uruguayan fleet (U).

Schaefer model fitting to the CPUE (kg/h) data is presented in Figure 10. Estimates for 2017 determined an average total biomass of 232,200 t and an exploitation rate for 2016 of 0.23. The results indicated that the resource in the year 2017 is reduced to 39% of the virginal condition. The whitemouth croaker total biomass estimated with the model for the year 2017 was slightly lower than

that estimated for 2016 (Fig. 10). As of 2012, the total biomass values are below the Biomass at Maximum Sustainable Yield (B_{MSY}) of 291,800 t. The increase in total biomass corresponded to a decrease in fishing mortality. The mean value of MSY was 45,920 t with a 95% probability interval of 36,010 to 53,490 t and the replacement yield (RY) of 41,320 t (IP95% from 26,140 t to 55,660 t).

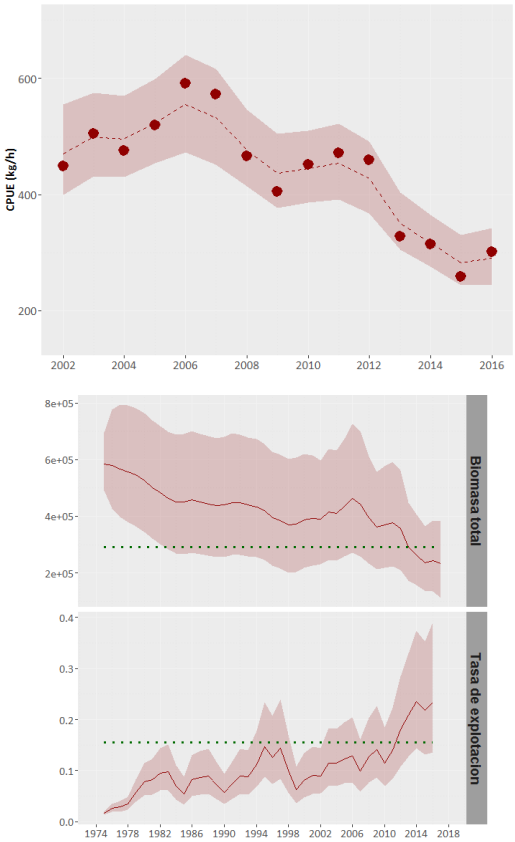


Figure 10. Catch-per-unit-effort (CPUE) indices of abundance CPUE (Kg/h) observed (crosses) and predicted (solid line) in the base case runs for surplus model, trend of total biomass (thousands of tons) and exploitation rate. The shaded band indicates the 95% probability interval. The horizontal lines indicate B_{MYS} (291,800 t) y F_{MSY} (0.15).

Age – structured model

For the integrated model, indices of abundance were obtained from the Uruguayan commercial fleet operating in the Rio de la Plata grids (U) and indexes from Argentine (CA) and Uruguayan (CU) research vessel. Likewise, an instantaneous rate of natural mortality determined as M = 0.22 was considered for all ages and years. We included 14 age classes and age 15+ as plus group. The age structure information came from Argentine landing sampling and research vessel from both countries. Available information was added from the length distributions from the landing samples of the Argentine fleet (1997 - 2016), Uruguayan (1980 - 1987) and research campaigns carried out in the spring. The Beverton and Holt function and variability were used through the estimation of an error term. Informative a priori distributions were considered for recruitment at the beginning of the period and for parameter h of the Stock-Recruitment relationship (with an average value of 0.8 according to the analysis of the stock assessment of the specie in the year 2016).

In the application of the integrated model, the total biomass for the year 2017 was estimated in the range of 231,066 to 267,061 t, according to the fitted made. The values corresponding to the spawning biomass in the same year vary between 165,686 and 168,207 t. The mean depletion of the spawning biomass was estimated between 0.30 and 0.31. Figure 11 shows the fitted of the index of abundance and the trajectories of the spawning and total biomass resulting from the application of this model for each index used.

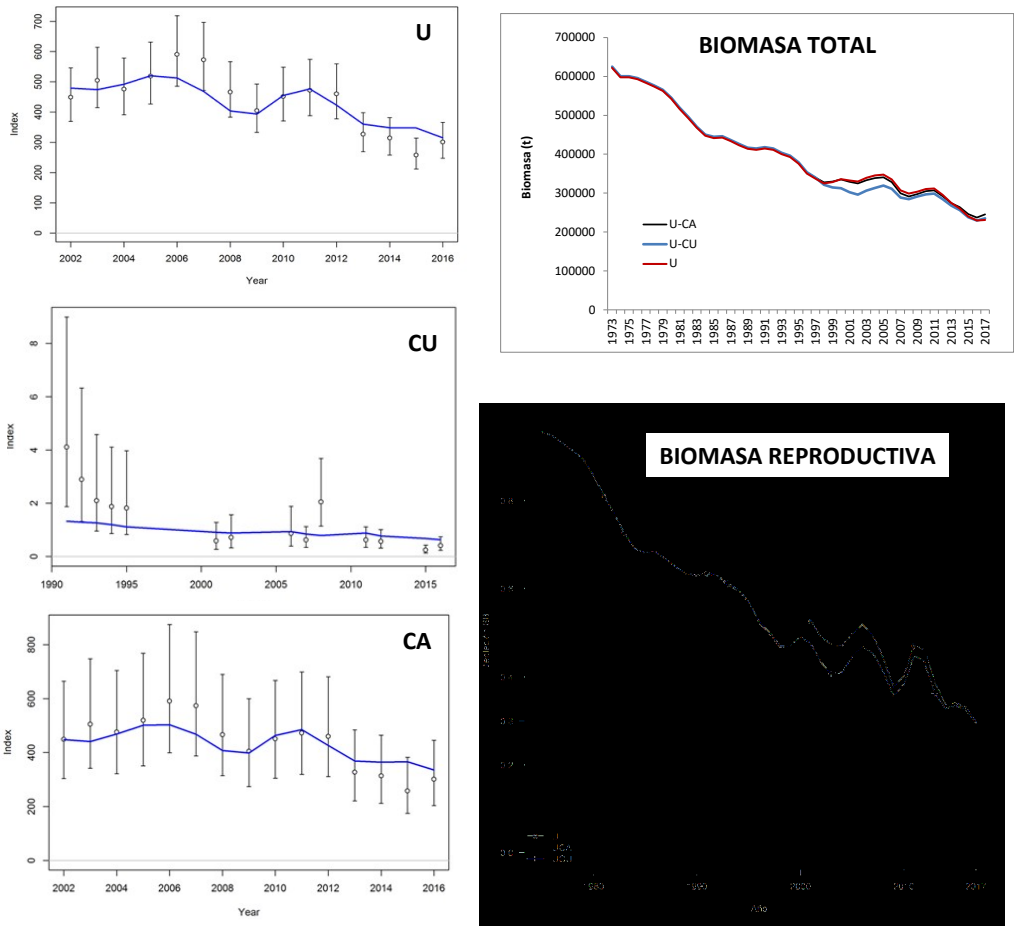


Figure 11. Fitting of the U index (Uruguayan fleet), CU (Uruguayan research cruises carried out in spring, CA (Argentine research cruises carried out in the spring). Trajectories of total biomass and spawning biomass from the application of the age - structured model.

Biomass projections

The projections of total biomass between 2018 and 2031 for different levels of constant catch are presented in Figure 12. Considering the fitted made using U, the projections indicate that, in case of maintaining the current catch levels (33,000 t), the biomass values would increase exceeding in 2024 the target BRP (B_{MSY}). If constant catch levels were maintained at 42,000 t, the total biomass would remain stable, although below that BRP. If the limit value of 40% of B_0 were taken as a limit of BRP, annual catches in the order of 42,000 t would keep the population slightly above this value (Fig. 12). Note that, with capture levels above that value, the population biomass values would fall well below the reference level.

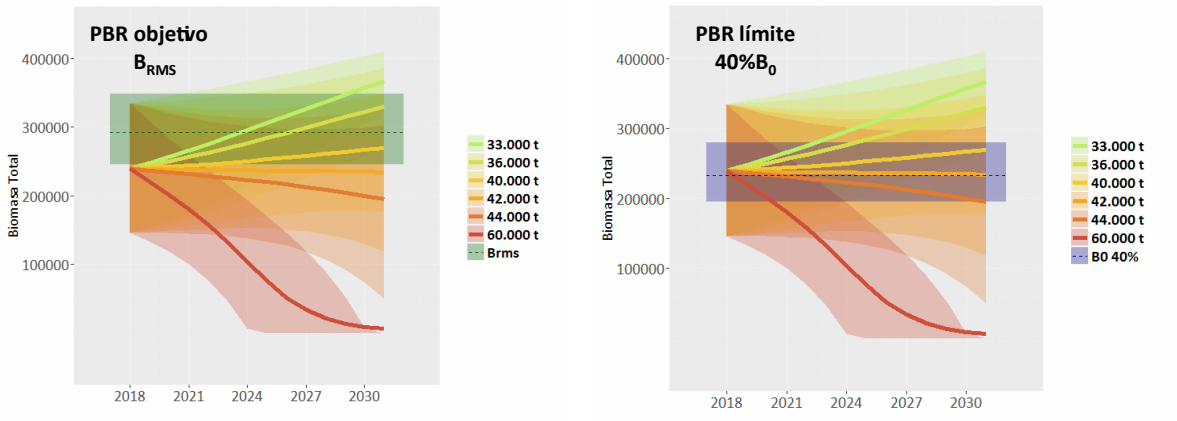


Figure 2. Projections of the Surplus model for the Whitemouth croaker total biomass in different scenarios of constant catches.

From the results of the application of the *SS3,* using the U index, the projections of total biomass of the population between 2018 and 2031 were made for different levels of constant capture. The estimated catch for 2017 (33,000 t), the CTP established for 2017 and recent historical catches were taken as reference. For the estimation of recruitments from 2017, Beverton and Holt stock-recruit model was taken into account. The levels of spawning biomass considered target reference points (40% BRV) and thresholds reference points (30% BRV) are indicated in Figure 13. It can be observed that the current levels of spawning biomass are located just above the thresholds PBR (Figure 13).

When analyzing the trajectories of the projections for different levels of constant capture, in all cases a marked increment is observed corresponding to the first years of the projection. The reason for this rise, even for high levels of capture, is due to the age structure applied, which is strongly influenced by the recruitment values for the years 2015 and 2016. Although there is some concordant evidence on the abundance of these cohorts from research vessel in the coastal region of breeding in Samborombón Bay, it will be necessary to corroborate the strength of these annual classes given the impact on the estimation of the CBA.

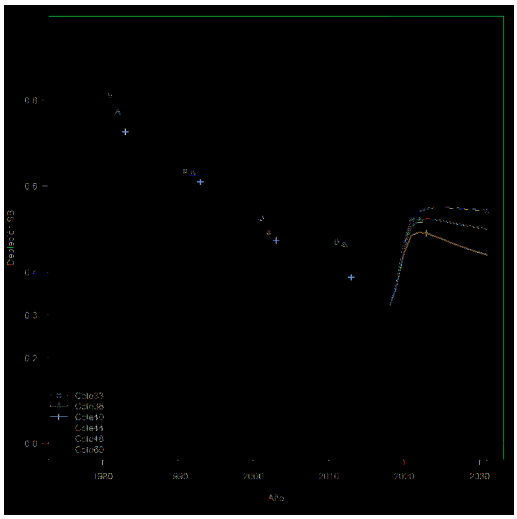


Figure 13. Projection to constant capture of reproductive biomass depletion with the uncertainty associated with U index and the capture scenarios considered.

Kobe Plot

The final base case model estimated that the current biomass (B_{2017}) was lower than the B_{MSY} and current F (F_{2017}) was less than F_{MSY}, with a probability of ≥ 90% of being in the quadrant that indicates that although the resource is not being overfished at present, it has been overexploited (Fig. 14).

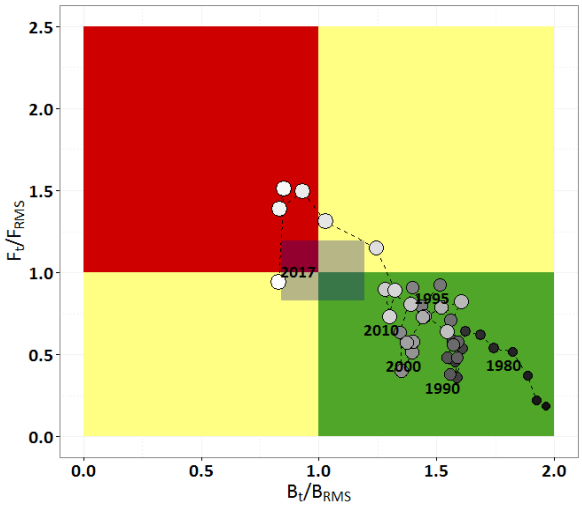


Figure 14. Kobe plot. (A) Trend and current status of the whitemouth croaker population. (B) Projections of total biomass (B/B_{MSY}) and fishing mortality (F/F_{MSY}) with respect to the reference elements of the MSY estimated by the global model.

Figure 15 shows the estimated projections of the biomass and the catch rates with respect to the MSY and the probabilities of incidence in each quadrant of the Kobe plot per year projected under the different capture values. With catches of 33,000 and 40,000 t, the trajectories indicate decreasing fishing mortality and an increasing trend of biomass. Catches of the order of 44,000 t and above would result in increasing fishing mortalities and a decreasing trend of biomass find the population in overexploitation.

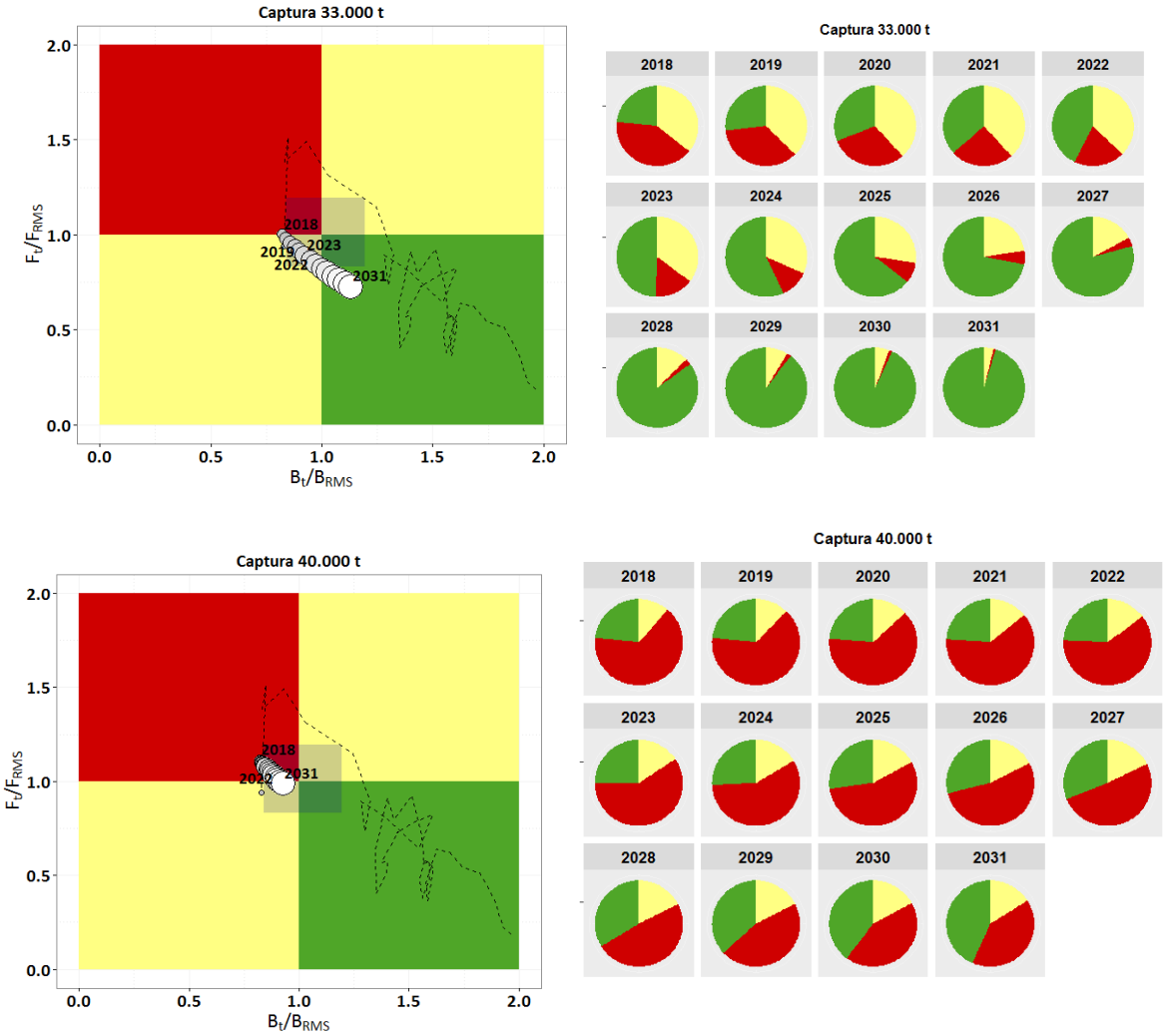


Figure 15. Kobe plot. (A) Trend and current status of the whitemouth croaker population. (B) Projections of total biomass (B/B_{MSY}) and fishing mortality (F/F_{MSY}) with respect to MSY estimated by the global model, considering constant catch of 33,000 and 40,000 t. Kobe pie plot.

Synthesis of the results and management recommendations for 2017

The range of Biologically Acceptable Catch CBA estimates for 2018 ranged between 30,000 t and 52,000 t depending on the model and the criteria used for the respective adjustments and projections. It should be mentioned that, according to the methodology used, these estimates refer to the totality of the resource both that which is distributed in the area of Treaty and that which is fished in adjacent coastal waters, north of the parallel 39º S. In order to maintain this resource in values compatible with the biological reference points internationally recognized as sustainable, the GT recommends that the total catches remain between 36,000 t and 41,340 t (CR_{2018}) for the year 2018. This last value corresponds to the catch of replacement, which maintains stable population levels although it would not allow recovery towards target levels.

	Modelo Global*		Modelo Estructurado**		
Índices	**RMS**	**CR_{2018}**	***BRLP > 0,3 BRV FC***	***BRLP > 0,4 BRV FC***	
U	45.920	41.340	46.332	30.682	
U – CU			47.260		
U – CA			52.028		
				U	**U-CU**	**U-CA**
B_{2017}	232.200 (112.600– 382.400)		**BTV(t)**	622.106	624.109	624.052
B_{RMS}	291.800 (245.400 – 348.300)		**BRV(t)**	557.876	559.246	559.566
B_{2017}/B_{RMS}	0,791 (0,399 – 1,203)		**BT_{2017} (t)**	231.066	267.061	243.323
B_{2017}/K	0,395 (0,200 – 0,602)		**BR_{2017} (t)**	165.686	168.207	173.096
F_{RMS}	0,155 (0,128 – 0,184)		**Depleción de BT**	0,37	0,43	0,39
			Depleción de BR	0,30	0,30	0,31
¿Qué nos dice cada modelo sobre el estado del stock?	*Si bien el stock no se encuentra sobrepescado, niveles de captura del orden de 42.000 t mantendrían a la Biomasa poblacional por debajo de la B_{RMS}, aunque por encima de la B=0,4 en un mediano y largo plazo.*		*Stock ligeramente por encima de la Biomasa Reproductiva de referencia (BR= 0,3), pero caería por debajo de la misma con valores de captura superiores a las 44.000 t*		
CBA estimada para 2018: 36.000 a 41.340 t					

* Modelo dinámico de Schaefer: Indicadores del estado actual del recurso: Rendimiento Máximo Sostenible (RMS), CR_{2018}: Captura de reemplazo, que permite que la biomasa de 2018 sea igual a la de 2016, biomasa correspondiente al RMS (B_{RMS}), B_{2016}, biomasa estimada para 2017, B_{2017}/B_{RMS}: proporción de la biomasa en 2017 respecto de la biomasa RMS, B_{2017}/K: proporción de la biomasa actual en función de K, F_{RMS} tasa de explotación para el RMS.
** Estimaciones de biomasa y biomasa reproductiva virgen correspondientes al año 2017, así como la depleción de la biomasa reproductiva.

Current management measures

- Resolución CTMFM Nº 8/96. Corvina, establecer una talla mínima de desembarque.
- Resolución CARP Nº 3/98. Área protegida de corvina.
- Resolución CTMFM Nº 10/00 (Modifica Art. 1 Resol. 7/97). Norma modificando eslora máxima/total de buques autorizados a operar en un sector de la Zona Común de Pesca.
- Resolución Conjunta CARP-CTMFM Nº 01/04. Norma estableciendo la prohibición del uso de artes de pesca de arrastre de fondo para la protección de las concentraciones de reproductores de la especie corvina (*Micropogonias furnieri*).
- Resolución Conjunta CARP-CTMFM Nº 02/06. Establece los criterios a tener en cuenta para la investigación de los recursos corvina y pescadilla, a fin de dictar las resoluciones de manera conjunta que sean convenientes.
- Resolución Conjunta CARP - CTMFM Nº 03/17. Norma estableciendo la captura total permisible y cupos de distribución para el año 2018, así como otras medidas de manejo para la especie corvina (*Micropogonias furnieri*) en el área del Tratado.

Comercialización[1]

The whitemouth croaker is commercialized fresh in the domestic market and frozen in the external market.

In terms of volume, Argentine exports of whitemouth croaker in the 2011-2016 periods averaged 33,800 t, where 2015 was the lowest value in the five-year period (27,823 t). The share of this specie in total exports of fishery products has descended steadily from 9.1% in 2011 to 6.0% in 2015, with a slight increase in 2016 (6.9%). Similar situation occurred with the incidence of whitemouth croaker in total fish exports, where it fell between 2011and 2015 from 16.0% to 12, 8% increasing to 6.9% (Fig. 15). It can be mentioned in relation to 2017 that, although the information corresponds to the amount accumulated up to November 30, the volume of whitemouth croaker exported was 16,600 t [Informe de Coyuntura a Diciembre 2017].

The average price per ton of Argentine exports of whitemouth croaker has remained relatively stable between 2011 and 2016, reaching in those years values, expressed in US dollars (USD) FOB, of 1,308 and 1,473, respectively. In 2011, exports of croaker reached a value of USD 47,259,410, equivalent to 3.4% of the total exported for fishery products while, in 2016, the value of croaker exports (USD 41,945,000) contributed 2.4% to the total exported.

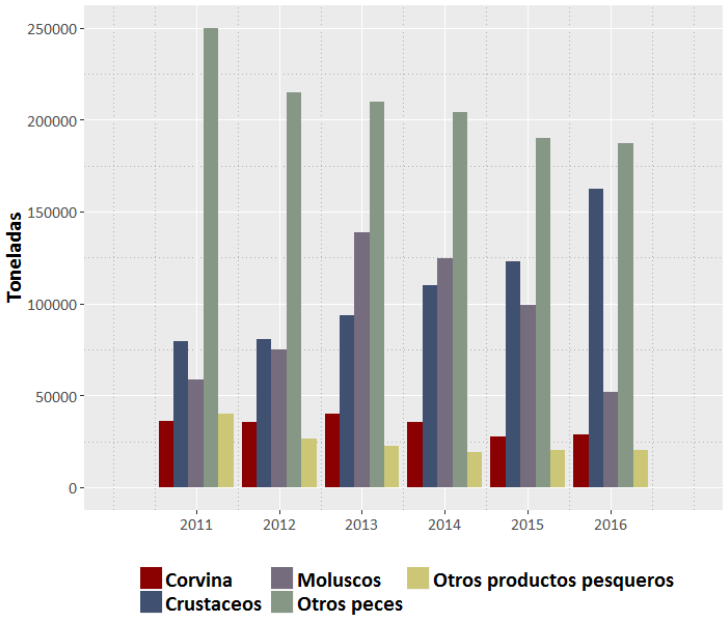
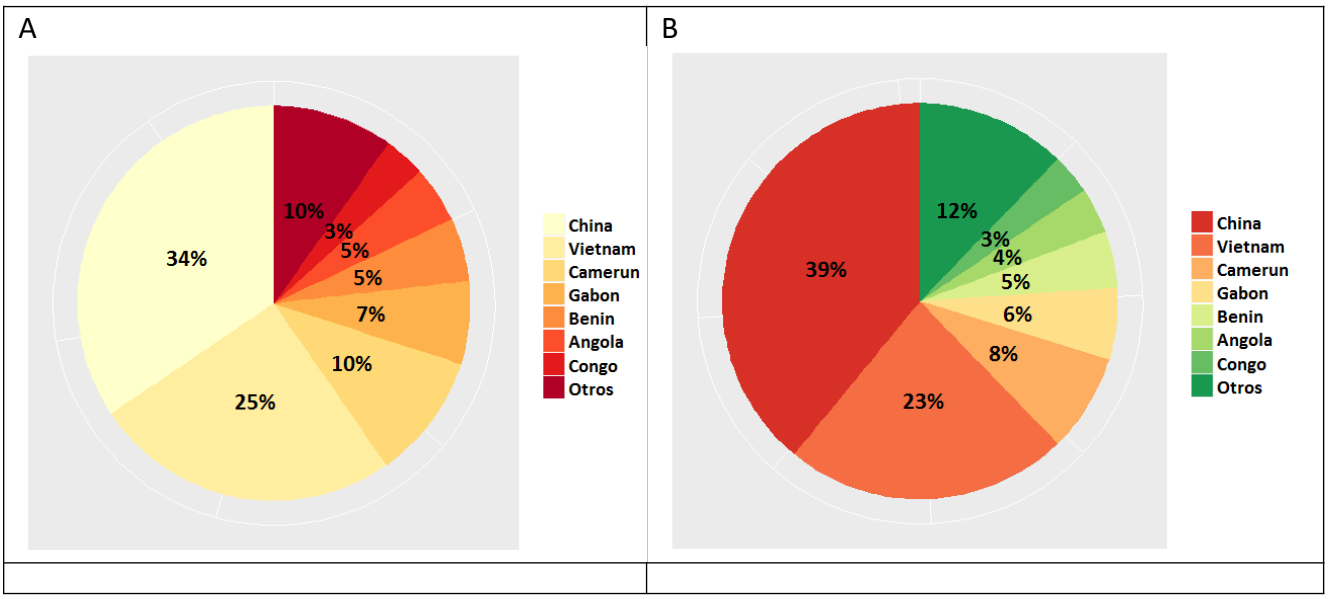


Figure 15. Whitemouth croaker contribution to the total volume (t) of fishery products exported by Argentina in the 2011-2016 periods.

The main destinations of whitemouth croaker exports in 2016 were China, Vietnam and several African countries, which together account for almost 90% of the total exported, corresponding to a value of USD 35,677,000. It should be noted that the whitemouth croaker is exported frozen whole, HG and as frozen HG *pan ready*. The export volumes, price and destination of each of these products vary as indicated in the report prepared by the *Dirección de Economía Pesquera de la SSPyA de Argentina*. For example, frozen HG was exported exclusively to Europe (768 t at an average price of USD 1,736), while as *pan ready* it was only exported to the USA. (163 t, average price USD 2,830) [link 24].



[1] La información para el desarrollo de este capítulo proviene de los informes anuales sobre comercialización de productos pesqueros elaborados por la DINARA [Boletín Estadístico Pesquero] y la Dirección de Economía Pesquera de la Subsecretaría de Pesca y Acuicultura [Exportaciones e Importaciones pesqueras – Informes anuales]. Los volúmenes exportados por cada país incluyen no sólo las capturas correspondientes al área del Tratado, sino también aquéllas realizadas en las aguas propias adyacentes y pueden incorporar desembarques correspondientes a otras unidades de manejo, como por ejemplo la corvina capturada en El Rincón.

Between 2009 and 2015, Uruguayan exports of whitemouth croaker averaged 23,400 t, equivalent to 30.6% of the total volume of exports of fishery products. Together with the Argentine hake they have constituted, on average, 50.3% of the volume of these exports (Fig. 16). There was a 25% decrease in the volume exported in 2015 compared to 2014.

In value, Uruguayan whitemouth croaker exports averaged 43,085 USB (FOB) in that period, decreasing by 27% in 2015 compared to 2014. During this period, the average price per ton ranged between USD 1,418 in 2009 and USD 1,941 in 2015.

The *Boletín Estadístico Pesquero* prepared by [DINARA] based on data from the *Dirección Nacional de Aduanas del Uruguay*, indicates that, in 2015, the whitemouth croaker contributed to 31.2% of the exports of the fishing sector as a whole.

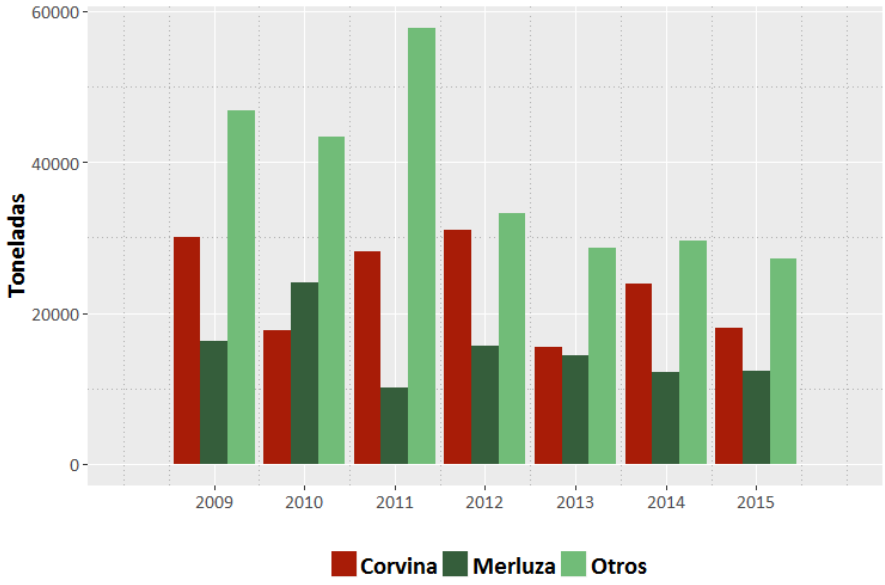


Figure 16. Whitemouth croaker contribution to the total volume (t) of fishery products exported by Uruguay between 2009 and 2014. .

REFERENCES

Acha, E.M., Mianzán, H., Lasta, C.A., Guerrero, R. 1999. Estuarine spawning of the whitemouth croaker *Micropogonias furnieri* in the Rio de la Plata, Argentina. Marine and Freshwater Research 50(1): 57-65.

Albuquerque, C.Q., Muelbert, J.E., Sampaio, L.A.N. 2009. Early developmental aspects and validation of daily growth increments in otoliths of *Micropogonias furnieri* (Pisces, Sciaenidae) larvae reared in laboratory. Pan-Am. J. Aquat. Sci., 4 (3): 259-266.

Beltrán, C., Jiménez, C., Fierro, P., Peña-Cortés, F., Tapia, J., Hauenstein, E., Vargas-Chacoff, L. 2013. Alimentación de *Micropogonias furnieri* (Osteichthyes: Sciaenidae) en el lago costero Budi, Sur de Chile. Revista de Biología Marina y Oceanografía 48(1): 193-197.

Braverman, M. 2011. Historia de vida temprana de la corvina rubia (*Micropogonias furnieri*, Sciaenidae) en el estuario del Río de la Plata. Tesis Doctoral. Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires. 200 pp.

Carozza, C.R.2012. Estructura y dinámica poblacional de la corvina rubia *(Micropogonias furnieri*, Desmarest, 1823) del extremo sur de su distribución (Pcia. De Buenos Aires, Argentina). Tesis doctoral Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Mar del Plata. 136 pp.

Carozza, C., Lasta, C., Ruarte, C., Cotrina, C., Mianzán, H., Acha, E.M. 2004. Corvina rubia (*Micropogonias furnieri*). En: El Mar Argentino y sus Recursos Pesqueros. Tomo 4: Los peces marinos de interés pesquero. Caracterización biológica y evaluación del estado de explotación. Eds: R.P. Sánchez & S.I. Bezzi, Mar del Plata, Argentina: INIDEP, 255-270.

Castello, J.P. 1986. Distribución crecimiento y maduración sexual de la corvina juvenil (*Micropoonias furnieri*) en el estuario de la "Lagoa Dos Patos", Brasil. Physis, Buenos Aires, 44 (106):21-36

Chiesa, E., Pin, O.D., Puig, P. 2006. Características biológicas de la corvina (*Micropogonias furnieri*) en el Río de la Plata y su Frente Marítimo. En: Menafra R Rodríguez-Gallego L Scarabino F & D Conde (eds). Bases para la conservación y el manejo de la costa uruguaya. VIDA SILVESTRE URUGUAY, Montevideo. 668 pp.

Cousseau, M.B.; Perrotta, R.G. 2013. Peces marinos de Argentina: biología, distribución, pesca. 4a. ed. Mar del Plata, Instituto Nacional de Investigación y Desarrollo Pesquero INIDEP. 193 pp.

Garcia, T. 1979 Desarrollo embrionario y primeros estadios larvales de *Micropoqonias furnieri* obtenidos mediante tratamiento hormonal. Ciencias, Ser.8 Invest.Mar., Habana, (46):18 p.

Giberto, D.A., Bremec, C.S., Acha, E.M., Manzan, H.W. 2001. Estructura de la comunidad bentónica y predación de la corvina rubia (*Micropogonias furnieri*, Scienidae) en el estuario del Río de la Plata, Argentina-Uruguay. En: COLACMAR 9º, Congreso Latinoamericano sobre Ciencias del Mar, San Andrés, Colombia.

Haimovici, M., Cardoso, L.G., Gatto Unpierre, R. 2016. Stocks and management units of *Micropogonias furnieri* (Desmarest, 1823) in southwestern Atlantic. Lat. Am. J. Aquat. Res., 44(5): 1080-1095.

Isaac, V. 1988. Synopsis of biological data on the whitemouth croaker, *Micropoqonias furnieri* (Desmarest, 1823). FAO Fish. Synop., (150):35 p.

Jaureguizar, A.; Militelli, M. y Guerrero, R., 2008. Distribution of *Micopogonias furnieri* at different maturity stages along an estuarine gradient and in relation to environmental factors. Journal of the Marine Biological Association of the United Kingdom, 88(1):175-181.

Lagos, N. 2003. Distribución espacial de los juveniles de corvina rubia (*Micropogonias furnieri*, sciaenidae) en el estuario del río de la Plata. Proyecto Freplata (PNUD/GEF/ RLA/99/G31). INIDEP.

Macchi G., Acha E., Militelli M.I. (2003) Seasonal egg production of whitemouth croaker (*Micropogonias furnieri*) in the Rıo de la Plata estuary Argentina-Uruguay. Fish. Bull., 10: 332-342.

Marquez, A., Pereira, A. 2013. Reseña de herramientas genéticas utilizadas en el análisis de la estructura poblacional de las corvinas del Río de la Plata y su Frente Marítimo. Frente Marítimo, 23: 291- 299.

Martínez, A., L., Ortega. 2016. Comunidades fitoplanctónicas al NE de la Zona Común de Pesca Argentino-Uruguaya. Frente Marítimo, 24: 231-249.

Masello, A., Scarabino, F., Gamarra, M., R., Menafra. 2001 Estudio de contenidos estomacales y hábitos alimenticios de *Micropogonias furnieri*. Pp 149-164 *In*: Vizziano Puig Mesones & Nagy (eds) El Río de la Plata. Investigación para la Gestión del Ambiente, los Recursos Pesqueros y la Pesquería en el Frente Salino. Programa Ecoplata, Montevideo.

Militelli, M.I., Macchi, G.J., Rodrigues, K. 2013. Comparative reproductive biology of Sciaenidae family species in the Río de la Plata and Buenos Aires Coastal Zone, Argentina. Journal of the Marine Biological Association of the United Kingdom (JMBA), 93(2): 413–423.

Militelli, M.I., Macchi, G. 2006. Spawning and fecundity of striped weakfish, *Cynoscion guatucupa*, in the Río de la Plata estuary and adjacent marine waters, Argentina-Uruguay. Fish. Res., 77: 110-114.

Militelli, M.I., Macchi, G. 2016. Estructura de edades de la poblacion desovante de corvina rubia (*Micropogonias furnieri*) y su relación con el potencial reproductivo. Informe de Investigación Nº48. INIDEP. 16 pp.

Moreno, C.A., Rubilar, P.S., Zuleta, A., Soto E. 1996. Diagnóstico biopesquero para el manejo de pesquerías del lago Budi, IX Región. Gobierno Regional de la Araucanía y UACH. Informe Final, 88 pp.

Negri, R.M., Molinari, G., Carignan, M., Ortega, L. Ruiz, G.M., Cozzolino, E., Cucchi-Colleoni, A.D., Lutz, V., Costagliola, M., García, A., Izzo, S., Jurquiza, V., Salomone, A., Odizzio, M., La Torre, S., Sanabria, M., Hozbor, M-V., PeressuttiS. R., Méndez, S., Silva, R., Martínez, A., Cepeda, G., Viñas, M.D., Diaz, M.V., Pájaro, M., Mattera B., Montoya, N., Berghoff, C., Leonarduzzi, E. 2016. Ambiente y Plancton en la Zona Común de Pesca Argentino-Uruguaya en un escenario de cambio climático (marzo, 2014). Frente Marítimo, 24: 251-316.

Piola, A.R., Campos, E.J.D., Möller O.O., Charo, Jr. M., Martínez C. 2000. Subtropical shelf off Eastern South America. J Geophys Res, 105:6565–6578.

Puig, P., Mesones, C. 1998. Determinación y caracterización de áreas de desove de corvina rubia (*Micropogonias furnieri*). Resúmenes del XIII Simposio Científico de la Comisión Técnica Mixta del Frente Marítimo. Mar del Plata, Argentina, 29-32.

Puig, P., Mesones, C. 2005. Determinación y caracterización de áreas de desove de corvina. Frente Marítimo, 20: 35-39.

Salvador, J. M., Sáez, M., Despos, J., Buono, P.2017. Distribución de frecuencia de longitudes y edades de los desembarques de corvina rubia (*Micropogonias furnieri*) provenientes de los puertos Río Salado, General Lavalle, y Mar del Plata. Año 2016. Informe de Investigación Nº18. INIDEP. 21 pp.

Sinque, C. 1980. Larvas de Sciaenidae (Teleostei) identificadas na regio estuarino-lagunar de Cananéia. Bol. Zool, Univ. Sffo Paulo, 5: 39-77.

Vizziano, D., Forni, F., Saona, G., Norbis, W. 2002. Reproduction of *Micropogonias funieri* in a shallow temperate coastal lagoon in the southern Atlantic. Journal of Fish Biology, 61: 196–206.

Volpedo, A.V., Fernández Cirelli, A. 2006. Otolith chemical composition as a useful tool for sciaenids stock discrimination in Southwestern Atlantic. Scientia Marina, 70 (2): 325-334.

Weiss, G. 1981. Ictioplancton del estuario de Lagoa dos Patos, Brasil. Ph.D. Thesis, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, 164 pp.