Ciencia Pesquera (2016) número especial 24: 5-13

Upgrading the status (taxonomy, fisheries and conservation) of the school shark *Galeorhinus galeus* (Elasmobranchii: Triakidae) in Patagonian waters, South West Atlantic Ocean

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This work summarily reviews the evidence of the existence of different populations of school shark *Galeorhinus galeus* globally; it updates the taxonomy of the species as well as discussing the theoretical pertinence of a single population in the South West Atlantic ocean. It summarizes the conservation status of the species in the area and reports for the first time the collapse of school shark fishing in Argentinian waters. Finally, it extends the latitudinal range of the distribution by two degrees south and discusses the potential impact of climate change in the southward extension of the distribution of the species.
Key words: Vitamin shark, recreational fishing, distribution, climate change.

Actualización del estado (taxonómico, pesquero y de conservación) del cazón *Galeorhinus galeus* (Elasmobranchii: Triakidae) en aguas patagónicas del océano Atlántico Suroccidental

En este trabajo se revisa, en forma resumida, la evidencia de la existencia de diferentes poblaciones de cazón *Galeorhinus galeus* a escala mundial. Se actualiza la taxonomía de la especie y se discute la pertinencia teórica de una sola población en el Atlántico sudoccidental. Se resume el estado de conservación de la especie en la zona y se informa por primera vez del colapso de la pesquería dirigida al cazón en aguas argentinas. Por último, se amplía el intervalo latitudinal de su distribución en dos grados al sur y se discute el efecto potencial del cambio climático para esta extensión meridional de su distribución.
Palabras clave: Tiburón vitamínico, pesca deportiva, distribución, cambio climático.

The triakid shark *Galeorhinus galeus* (Linnaeus 1758) —known in Argentina and Uruguay as "tiburón vitamínico" (vitamin shark), "cazón" (dogfish) or "trompa de cristal" (nose-glass shark)— is a cosmopolitan, abundant, active, strong-swimming, coastal-pelagic shark of temperate continental and insular waters; although it has several characteristic features of oceanic-pelagic species, including the occurrence of individual animals well off the continental shelf (Stevens & Wayte 1999) and long oceanic movements (Walker *et al*. 2008). It is known in the Western South Atlantic: Southern Brazil to Argentina. Eastern Atlantic: Iceland, Norway, Faroe Islands, British Isles to Mediterranean and Senegal, ? Ivory Coast, ? Nigeria, ? Gabon to Zaire, Namibia to South Africa. Western Indian Ocean: South Africa. Western South Pacific: Australia (Western and South Australia, Victoria, Tasmania, New South Wales, southern Queensland), Lord Howe Islands, Chatham Islands, ? New Zealand, Central Pacific: Laysan Islands. Eastern Pacific: British Columbia to southern Baja California, Gulf of California; Peru and Chile (Compagno 1984).

In his remarks on genus *Galeorhinus* Blainville 1816, Compagno (1984) included all nominal species of this genus in the epithet *Galeorhinus*

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galeus. He also suggested that, due to the great dispersion of its populations, *G. galeus* could be subdivided into subspecies. But so far, there have not been detailed comparative morphological studies among *Galeorhinus* populations as a means to elevate some of the latter to a subspecific level.

From the field of genetics, a pioneer work comprising allozyme allele frequencies concluded that "school sharks from sites as distant as the North Atlantic (UK), South Africa, Australia, and New Zealand do in fact represent a single globally-distributed species is inescapable" (Ward & Gardner 2003). More recently, Chabot & Allen (2009) working with samples taken in six dispersed locations around the globe (Australia, North America, South Africa, South America [Argentina and Peru] and Great Britain), analyzed the control region of mitochondrial DNA to assess gene flow between populations of the nominal species. These authors argued that although a single population of *G. galeus* may exist in the southwestern Atlantic, since the sample sizes from South America were extremely small (Argentina n = 1; Peru n = 11) their study failed to detect a unique haplotype from this region. Their results also suggest a large isolation of the populations and a low or non existing gene flow between the North American and South American populations. With similar studies, Hernández *et al*. (2015) reached analogous conclusions concerning the isolation among populations of Australasia (Australia and New Zealand) and the Southeast Pacific coast off Chile. In neither case did the authors consider elevating the involved populations to sub-specific level.

In South America, one of the nominal species name used for the school shark was *G. vitaminicus* de Buen 1950. It has been used by Angelescu (*ca.* 1954[1]), López (1954), Ringuelet (1958), Angelescu & Boschi (1959), Angelescu (1960), Gneri & Nani (1960), Ringuelet & Aramburu (1960), Cordini (1963), López (1963, 1964 and 1965), Nani (1964[2]), Boschi & Mistakidis (1964[3]), Castellanos (1967), Cervigón & Cousseau (1971), Sadowsky & Menni (1974), Gosztonyi & Menni (1978), Bellisio *et al*. (1979), Menni & López (1979), Menni & Gosztonyi (1982), Menni *et al*. (1984) and Menni (1985). Previously, Berg (1895) named this species as *G. galeus* (L.) Blainville, while Lahille (1928) called it *Galeus canis* Bonaparte 1841, as also did Marini (1929), and Pozzi & Bordale (1935).

In her studies of the vitamin shark, Siccardi (1950) calls this species *G. galeus* with certain reservations. Finally Sadowsky (1977), in a brief communication, sets *G. vitaminicus* de Buen 1950 in synonymy with *G. galeus* (Linnaeus 1758). The latter name was used thereafter in all citations of this shark in southern South America: Menni (1986), Cousseau & Denegri (1997), Chiaramonte (1998), Cousseau & Perrota (2000), Elias *et al*. (2005) and Lucifora *et al*. (2004), among others.

For the south western Atlantic (SWA), Bellisio *et al*. (1979) and Cousseau & Perrotta (2000) updated the distribution of the species in the continental shelf setting the northern and southern limits at the coast of Rio Grande do Sul (28° S, Brazil; Fig. 1) and San Jorge Gulf 47° S (Patagonia; Fig. 1), respectively. Although South American biologists agree that the SWA *G. galeus* population is a single one that could migrate by reproductive needs between southern Brazil and north Patagonia in Argentina (Chiaramonte 2015), tagging experiments were recently performed in the area in order to elucidate the migration pattern of the SWA stock (Cuevas *et al*. 2014). Supporting the aforementioned agreement, some additional evidences have been put forward: during spring and summer, when the breeding females leave their offsprings, the species called "Winter migrant" by Vooren (1997) disappears in southern Brazilian waters, whilst at the same time, it is heavily fished in Uruguay

1. Angelescu V *ca.* 1954. La pesca del cazón o tiburón vitamínico en la región de Monte Hermoso. Informe técnico del Departamento de Investigaciones Pesqueras de la Dirección General de Pesca. Ministerio de Agricultura de la Nación. 13p.

2. Nani A. 1964. Variaciones estacionales de la fauna íctica del área de pesca de Mar del Plata. Segunda reunión de CARPAS. Mar del Plata, Argentina. 27-30 abril 1964. CARPAS/2/Documento técnico 20. 21p.

3. Boschi EE, M Mistakidis. 1964. Resultados preliminares de las campañas de pesca exploratoria de langostino y camarón en Rawson, 1962-1963. Documento técnico CARPAS. 11:1-12.

and Argentina for a short time (de Buen 1952, Chiaramonte 1998). In this way, Nion (1999) reported another peak in the Uruguayan fishery during autumn, when gravid females arrive to the coast. Finally, Bovcon *et al*. (2012[4]) estimated that the parturition in Bahía Engaño (Puerto Rawson, Fig. 1) occurs between December and February, a fact that reinforces the assumption of a single population with nursery areas in the southern part of its distribution.

To assess the conservation status of the *G. galeus* population in the SWA and by a matrix population model with data collected at Bahía San Blas (Fig. 1), Lucifora (2003) found a decrease in the population at an average annual rate of 6.7% to 12.8%. More recently, while within a global scope, *G. galeus* was assessed as VU (Vulnerable) (Red List of IUCN 2007), in the SWA it was classified as CR (Critically Endangered) (Walker *et al.* 2006, Chiaramonte & Di Giácomo 2008). These figures contrast with those presented by the National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks 2009): citing Otero *et al*. (1982) and Massa *et al*. (2004). The NPOA report presented an estimated abundance of *G. galeus* during spring in Buenos Aires and Uruguayan coastal region with numerals of 16 000 t in 1978, 7 332 t in 1994, 17 826 t in 1998 and 61 090 t in 1999. In this context of peril for the SWA population, although there are no-specific fishing regulation established for *G. galeus* in Argentina, some of the norms of Buenos Aires, Chubut and Santa Cruz provinces encompass the angling for the species (NPOA-Sharks 2009, Cedrola *et al*. 2011).

Nevertheless, the efficiency of these norms for the conservation of the species is still object of dispute (Cedrola *et al*. 2012[5], Cuevas *et al*. in prep[6]).

Due to zoogeographic and demographic factors (historically the ports and cities were mainly focused at the northern area of the line coast of the country near the Pampas fields which concentrated the workforce since the Spanish colonization), the traditional fisheries in Argentina take place in the south central coasts of Buenos Aires province and in northern Patagonia. From south to north, the main fishing ports during the mid 1950's were Rawson, Carmen de Patagones, Necochea (= Puerto Quequén) and Mar del Plata (Fig. 1). Between 1943 and 1952 these fishing harbours played a predominant role in the commercial exploitation of *G. galeus*, with 44 397 tons of the species (whole mass) being landed (90% between 1944 and 1949 according to López 1954, *fide* Mateo 2006). The landings in the early 1950's were Rawson (6 501 t), Carmen de Patagones (5 846 t), Necochea (5 862 t) and Mar del Plata (17 497 t). Also, Bahia Blanca (2 342 t) and Puerto Madryn (1 919 t; Figs. 1 and 2. López 1954, *fide* Mateo 2006) had some relevance. According to Cordini (1963), in 1955 and 1956 Puerto Rawson produced 24% of the total shark landing (as salted fish and liver oil) in Argentina. Between 1957 and 1960, the northern harbours, mainly Mar del Plata and Necochea, increased their importance in shark production. During the following two decades (1960's and 1970's) the school shark landings were kept at low levels, whilst during the 1980's, the school shark became an important resource for coastal fisheries as the target of the shark fisheries in the SWA (Compagno 1984, Bonfil 1994, Chiaramonte 1998), reaching 40.35% of the total landings of cartilaginous fish (whole mass). This activity finally collapsed at the end of the last century (Chiaramonte 2015), and the landings decreased down to less than 5% of the total of cartilaginous fish landed in subsequent years, with a minimum

4. Bovcon ND, PD Cochia, P Ledesma, CRM Baigún, GM Caille, JM Manrique, LR Jones. 2012. Primer registro de una área de cría del cazón vitamínico, *Galeorhinus galeus* (Carcharhiniformes, Triakidae), en el Atlántico Sudoccidental. *Resúmenes del II Simposio Iberoamericano de Ecología Reproductiva, Reclutamiento y Pesquerías*. Mar del Plata. 19-22 de noviembre de 2012.

5. Cedrola, PV, GE Chiaramonte, GM Caille. 2012. Pesca recreativa de tiburones: avances y desafíos para la conservación. VIII Jornadas Nacionales de Ciencias del Mar, Comodoro Rivadavia, Argentina.

6. Cuevas JM, PV Cedrola, GE Chiaramonte, JM Braccini, ML García. (in prep.). Involving the angling community in shark conservation: an alternative for shark conservation in Argentina.

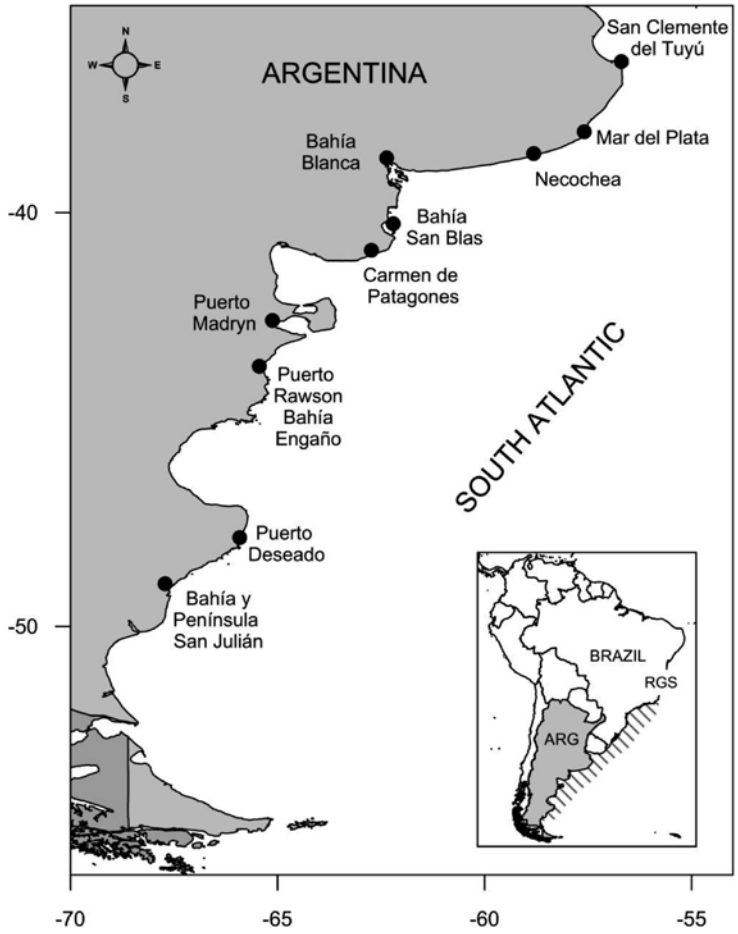

Fig. 1. Distribution area of the school shark *Galeorhinus galeus* in the Southwestern Atlantic Ocean (dashed), indicating the locations mentioned in the text.

of 2.17% in 2008 (Fig. 3). Nowadays, some school sharks are still landed as bycatch of several fisheries. It should be noted that in the national fishery statistics, the school sharks landing records (whole mass) were declared both as "shark nei" and "school shark". These two items were attributed to *G. galeus* in the fishery statistics by Chiaramonte (1998) based on the results of interviews to fishermen conducted by Dr. Terence I. Walker, during the preparation of FAO Fisheries Technical Paper 378 (Walker 1999). The interviews were conducted along the Argentinian coast, between San Clemente del Tuyú and Rawson (Fig. 1), on September-October 1997. All the interviewed fishermen named *G. galeus* indistinctly as "tiburón" (shark) or "cazón" (local name for school shark), doing likewise in their log books. Prefectura Naval Argentina (local Maritime Authority) also reported the name "salida a tiburón" for fishing boats sailing for *G. galeus*. It should be also noted that these figures probably have changed since the end of the school shark directed fishery in 1998 (Chiaramonte 2015). Nevertheless, the declared values have not recovered to the levels recorded at the time of the directed fishery (Fig. 3).

Recent reported captures expand significantly their southern distribution limit of the species in the SWA by two latitudinal degrees. Three females (125, 128, and 130 cm in total length [TL]), were captured on January 7, 2008 on the "Los Instalados" beach (49°23'15" S - 67°39'14" W, at Península San Julián, Santa Cruz, Fig.1). Subsequently, on February 3, 2008, Mr Rubén Ricci captured another female 117 cm TL (Fig. 4), which was tagged with brand spaghetti type

Fig. 2. "Lanchas cazoneras" (shark fishing boats) at Puerto Madryn harbour *ca*. 1943. Photo: Anonymous author.

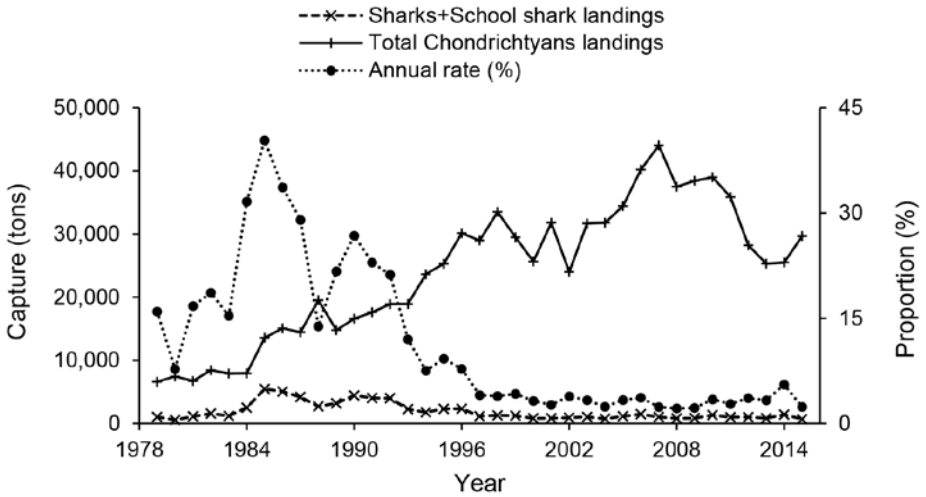

Fig. 3. Declared landings (whole mass) of sharks + school sharks, and their impact (as %) on the overall chondrichthyan landings in the ports of Argentina from 1979 to 2015. 'Sharks' comprises mainly *Galeorhinus galeus,* with few *Carcharhinus brachyurus, Isurus oxyrinchus* and *Prionace glauca* (Chiaramonte 1998). Data source: Secretaría de Agricultura, Ganadería y Pesca-Ministerio de Agroindustria. Source: http://www.agroindustria.gob.ar/site/pesca/pesca_maritima/02-desembarques/index.php

(dart tag MACN-1801[7]) and returned to the sea in good condition. Finally at the same location, in January 27, 2013 another female 113 cm TL was captured.

Although the geographical references of *G. galeus* in the SWA almost always came from information coming from commercial fisheries, in recent years monitoring effort on coastal and embarked recreational fishing has increased (Cedrola *et al*. 2011). This fact could represent

7. http://www.macn.secyt.gov.ar/investigacion/proyectos/vertebrados/ictiologia/pro_tiburones.php

an amendment of the biases in historical records, and not an enlargement of the distribution as presented here. Moreover, anglers from Península de San Julián informed that catches of *G. galeus* are frequent during the summer recreational fishing season.

An alternative view is that the extension of the latitudinal range could be caused by oceanographic changes in response to global climate change. But a further analysis of this hypothesis however could lead to the conclusion that the southward expansion could be driven by the presence of cooler water masses than those of preceding decades and not by global warming as the common sense would suggest.

For the South Atlantic region, Wainer & Venegas (2002) found oscillations of a 25-30 year period in the sea surface temperature (SST) at SWA and that an "anomalous advection of cold waters northward (warm waters southward), owing to a strong (weak) Malvinas Current, is responsible for sea surface temperature anomalies in the subtropical western South Atlantic". In another study of the SST focused at the Antartic Penisula and adyacent area (including Patagonian coasts), Meredith & King (2005) found a warming process since 1965: decadal sea surface temperature anomalies reveals a large cold anomaly during 1955-64 replaced successively by warmer waters until 1994. This process for the SST is somewhat less obvious at 20 m depth and far less evident at 50 m depth (Meredith & King 2005). But in recent years (2007 to 2010) the surface waters in the area tended to be colder than on average (Dehnhard *et al*. 2013). This scenario, far from clarifying it, makes this picture more complex since the occurrence of species associated with warmer waters in the Patagonian coast its not a recent issue and dates back to the last decades.

The captures herein reported reinforce the need for further studies on *G. galeus* to elucidate its life history patterns in southern Patagonia that would surely contribute to improve the conservation actions of this critically endangered species in the SWA. Moreover, we recommend urgent fishery control measures to ensure the sustainability of this depleted population based on the precautionary principle approach for responsible fisheries.

References

Angelescu V. 1960. Operación Centolla en el Atlántico Sur. *Servicio de Hidrografía Naval.* Buenos Aires. Publicación H. 1013. 78p.

Fig. 4. Female *Galeorhinus galeus* (117 cm TL) captured on February 3, 2008 by Mr Rubén Ricci at "Los Instalados" beach (49°23'15" S - 67°39'14" W, Península San Julián, Santa Cruz province), tagged with dart tag -1801. Photo: G. Chiaramonte.

Angelescu V, EE Boschi. 1959. Estudio biológico pesquero del langostino de Mar del Plata en conexión con la Operación Nivel Medio. *Servicio de Hidrografía Naval*. Buenos Aires. Publicación H. 1017. 144p.

Bellisio NB, RB López, A Torno. 1979. Peces marinos patagónicos. *Publicación de la Subsecretaría de Pesca*. *Ministerio de Economía*. Buenos Aires. 280p.

Berg C. 1895. Enumeración sistemática y sinonímica de los peces de las costas argentinas y uruguaya. *Anales del Museo Nacional*. Buenos Aires. Serie II 4(1): 1-120.

Bonfil R. 1994. Overview of world elasmobranch fisheries. FAO. *Fish. Tech. Pap*. 341. 119p.

Castellanos ZA de. 1967. Contribución al estudio biológico de *Loligo brasiliensis* BL. *Boletin del Instituto de Biología Marina de Mar del Plata*. Mar del Plata. Contribución 14: 34p.

Cedrola PV, N Bovcon, C Bruno, C Bustamante, GM Caille. 2011. La pesca deportiva de condrictios en el mar argentino. *En*: OC Wohler, PV Cedrola, MB Cousseau (eds.). C*ontribuciones sobre biología, pesca y comercialización de tiburones en la Argentina. Aportes para la elaboración del Plan de Acción nacional*. Consejo Federal Pesquero. Buenos Aires. Argentina, pp: 115-117.

Cervigón F, MB Cousseau. 1971. Catálogo sistemático de la colección ictiológica del Instituto de Biología Marina. *Instituto de Biología Marina*. Mar del Plata. Contribución 169: 28p. (Mimeografiado).

Chabot CL, LG Allen. 2009. Global population structure of the tope (*Galeorhinus galeus*) inferred by mitochondrial control region sequence data. *Molecular Ecology* 18: 545-552.

Chiaramonte GE. 1998. Shark fisheries in Argentina. *Marine & Freshwater Research* 49(7): 601-9.

Chiaramonte GE. 2015. El cazón o tiburón vitamínico *Galeorhinus galeus* (Linnaeus 1758) (Pisces Elasmobranchii: Triakidae) en Argentina. Tesis de Doctorado. Facultad de Ciencias Exactas y Naturales. Universidad de Buenos Aires. Buenos Aires. Argentina. 286p.

Chiaramonte G, E Di Giácomo. 2008. Los condríctios del Mar Patagónico y área de influencia. *En*: Edición del Foro (ed.). *Estado de conservación del Mar Patagónico y áreas de influencia.* [En línea] Foro para la Conservación del Mar Patagónico y Áreas de Influencia. Puerto Madryn. Argentina. 11p. http://www.marpatagonico.org/

Compagno LJV. 1984. *FAO species catalogue 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date*. Parts 1 & 2. FAO Fisheries Synopsis, 125. 655p.

Cordini JM. 1963. *Pesca marítima con base en Rawson (Chubut)*. Publicación de la Dirección General de Pesca, Secretaría de Estado de Agricultura y Ganadería de la Nación. Buenos Aires. 47p.

Cousseau MB, MA Denegri. 1997. Peces. *En*: MB Cousseau (ed.). *Peces, crustáceos y moluscos registrados en el sector del Atlántico Sudoccidental comprendido entre 34° y 55° S, con indicación de las especies de interés pesquero*. Informe técnico. INIDEP. Mar del Plata. Segunda edición, pp: 5: 9-47.

Cousseau MB, RG Perrota. 2000. *Peces marinos de Argentina: biología, distribución, pesca.* INIDEP, Mar del Plata. Segunda edición. 163p.

Cuevas JM, ML García, E Di Giácomo. 2014. Diving behaviour of the critically endangered tope shark *Galeorhinus galeus* in the Natural Reserve of Bahia San Blas, northern Patagonia. *Animal Biotelemetry* 2: 1-6.

De Buen F. 1950. El tiburón vitamínico de la costa uruguaya, *Galeorhinus vitaminicus* nov. sp., y algunas consideraciones generales sobre su biología. *Contribuciones a la Ictiología II, Publicaciones Científicas del Servicio de Oceanografía y Pesca* 4: 153-162.

De Buen F. 1952. El tiburón vitamínico. *Revista Facultad de Humanidades y Ciencias, Ap*. 7: 87-116.

Dehnhard N, M Poisbleau, L Demongin, K Ludynia, M Lecoq, JF Masello, P Quillfeldt. 2013. Survival of rockhopper penguins in times of global climate change. *Aquatic Conservation* 23: 777-789.

Elías I, A Rodríguez, E Hasan, MV Reyna, R Amoroso. 2005. Biological observations of the tope shark, *Galeorhinus galeus*, in the Northern Patagonian Gulfs of Argentina. *Journal of Northwest Atlantic Fishery Science* 35: 261-265.

Gneri FS, A Nani. 1960. El dominio acuático, los peces y las actividades económicas derivadas. *La Argentina. Suma de Geografía*. *Buenos Aires* 5: 175-272.

Gosztonyi AE, RC Menni. 1978. Lista de especies capturadas en la segunda etapa y lances de pesca en los cuales aparecieron. *En*: MB Cousseau (ed.). *Informe de la parte argentina sobre la campaña de pesca exploratoria del buque japonés "Orient Maru"*. Contribuciones Científicas del INIDEP 360: 21-22.

Hernández S, R Daley, TI Walker, JM Braccini, A Varela, MP Francis, PA Ritchie. 2015. Demographic history and the South Pacific dispersal barrier for school shark (*Galeorhinus galeus*) inferred by mitochondrial DNA and

microsatellite DNA mark. *Fisheries Research* 167: 132-142.

IUCN. 2007. *IUCN red list of threatened species*. Gland, Switzerland. http://www.iucnredlist.org/

Lahille F. 1928. Nota sobre unos peces elasmobranquios. *Anales del Museo Nacional de Historia Natural "B. Rivadavia"* 34: 299-339.

López RB. 1954. La pesca en la República Argentina durante el año 1952. *Revista del Museo Municipal de Ciencias Naturales y Tradicional de Mar del Plata* 1(2): 26-49.

López RB. 1963. Peces marinos de la República Argentina. *Consejo Federal de Investigación y Evaluación de los Recursos Naturales, Argentina* 7(3): 105-219.

López RB. 1964. Problemas de la distribución geográfica de los peces marinos suramericanos. *Boletín del Instituto de Biología Marina* 7: 57-63.

López RB. 1965. Peces demersales del sur del Brasil, Uruguay y norte de la Argentina. Distribución geográfica. *Anales 2° Congreso Latino-Americano de Zoología* 2: 155-179.

Lucifora LO. 2003. Ecología y conservación de los grandes tiburones costeros de Bahía Anegada, Provincia de Buenos Aires, Argentina. Tesis de Doctorado. Facultad de Ciencias Exactas y Naturales de la Universidad Nacional de Mar del Plata. Mar del Plata. Argentina. 410p.

Lucifora LO, RC Menni, AH Escalante. 2004. Reproductive biology of the school shark, *Galeorhinus galeus*, off Argentina: support for a single southwestern Atlantic population with synchronized migratory movements. *Environmental Biology of Fishes* 71: 199-209.

Marini TL. 1929. Enumeración de los peces coleccionados en las inmediaciones del laboratorio de Biología Marina de Puerto Quequén. *Physis* 9: 451-454.

Massa AM, LO Lucífora, HM Hozbor. 2004. Condrictios de la región costera bonaerense y uruguaya. *En*: R Sanchez, S Bezzi (eds.). *Los espacios marítimos argentinos y sus recursos pesqueros*. Tomo 4. Biología y evaluación del estado de explotación. Publicaciones especiales INIDEP, Mar del Plata. 359p.

Mateo J. 2006. Sembrando anzuelos para tiburones. Las demandas vitamínicas de la II Guerra Mundial y el desarrollo de la pesca comercial marítima en Argentina (1943-1952). *Boletín del Instituto de Historia Argentina y Americana "Dr. Emilio Ravignani"*. Tercera serie 29: 119-150.

Menni RC. 1985. Distribución y biología de *Squalus acanthias*, *Mustelus schmitti* y *Galeorhinus vitaminicus* en el Mar Argentino en agosto-septiembre de 1978 (Chondrichthyes). *Revista del Museo de La Plata (nueva serie) sección zoología.* 13(138): 151-182.

Menni RC. 1986. Shark biology in Argentina: a review. *In*: T Uyeno, R Arai, T Taniuchi, K Matsuura (eds.). *Proceedings of the second international conference Indo-Pacific fishes*. Ichthyological Society of Japan. Tokyo, pp: 425-436.

Menni RC, HL López. 1979. Biological data and otolith (*sagitta*) morphology of *Polyprion americanus* and *Schedophilus griseolineatus* (Osteichthyes, Serranidae and Centrolophidae). *Studies on Neotropical Fauna & Environment* 14: 17-32.

Menni RC, AE Gosztonyi. 1982. Benthic and semidemersal fish associations in Argentine sea. *Studies on Neotropical Fauna & Environment* 17: 1-29.

Menni RC, RA Ringuelet, RH Aramburu. 1984. *Peces marinos de la Argentina y Uruguay.* Editorial Hemisferio Sur. Buenos Aires. 359p.

Meredith MP, JC King. 2005. Rapid climate change in the ocean west of the Antarctic Peninsula during the second half of the 20th century. *Geophysical Research Letters* 32: L19604. doi: 10.1029/2005GL024042.

Nion H. 1999. La pesquería de tiburones en Uruguay con especial referencia al cazón (*Galeorhinus galeus* Linnaeus 1758). *En*: R Shotton (ed.). *Case studies of management of elasmobranch fisheries*. FAO Fisheries Technical Paper 378(1): 219-267.

NPOA-Sharks. 2009. Plan de acción nacional para la conservación y el manejo de condrictios (tiburones, rayas y quimeras) en la República Argentina. (National plan of action for the conservation and management of sharks). Consejo Federal Pesquero. Subsecretaría de Pesca y Acuicultura, Secretaría de Ambiente y Desarrollo Sustentable y Ministerio de Relaciones Exteriores, Comercio Internacional y Culto. Buenos Aires. 64p.

Otero H, SI Bezzi, MA Renzi, GA Verazay. 1982. *Atlas de los recursos pesqueros demersales del mar argentino*. INIDEP Contribución No. 423. 248p.

Pozzi AJ, LF Bordale. 1935. Cuadro sistemático de los peces marinos de la República Argentina. *Anales de la Sociedad Científica Argentina* 120: 145-189.

Ringuelet RA. 1958. El cazón o tiburón vitamínico precisa medidas de conservación. *Boletín Conservación* 2(17): 2-4.

Ringuelet RA, RH Aramburu. 1960. Peces marinos de la República Argentina. *Agro* 2(5): 1-141.

Sadowsky V. 1977. A especie *Galeorhinus vitaminicus* de Buen 1950, e um sinonimo da especie

cosmopolita *Galeorhinus galeus* (L. 1758). *Ciencia e Cultura (Supl. Resumos)* 29(7): 801-802.

Sadowsky V, RC Menni. 1974. Sobre *Raja platana* Günther 1880 (Chondichthyes, Rajidae). *Physis* 33(86): 23-32.

Siccardi E. 1950. El problema del tiburón en la economía pesquera e industrial. *Actas del Primer Congreso Nacional de Pesquerías Marítimas e Industrias Derivadas.* Mar del Plata. 24-29 de octubre de 1949. Actas, T. ii, pp: 121-146.

Stevens JD, SE Wayte. 1999. A review of Australia's pelagic shark resources. *Fisheries Research and Development Corporation, Final Report, Project 98/107*, Canberra, 64p.

Vooren CM. 1997. Demersal elasmobranchs. *In*: U Seeliger, C Odebrecht, JP Castello (eds.). *Subtropical convergence environments: The coast and sea in the Southwestern Atlantic*. Springer-Verlag, Heidelberg, Germany, pp: 141-146.

Wainer I, SA Venegas. 2002. South Atlantic multidecadal variability in the climate system model. *Journal of Climate* 12: 1408-1420.

Walker TI. 1999. *Galeorhinus galeus* fisheries of the world. *In*: R Shotton (ed.). *Case studies of management of elasmobranch fisheries*. FAO Fisheries Technical Paper 378(2): 728-773.

Walker TI, RD Cavanagh, JD Stevens, AB Carlisle, GE Chiaramonte, A Domingo, DA Ebert, CM Mancusi, A Massa, M McCord, G Morey, LJ Paul, F Serena, CM Vooren. 2006. *Galeorhinus galeus. In*: 2007 IUCN Red List of Threatened Species. IUCN, Gland, Switzerland. http://www.iucnredlist.org/details/39352/0

Walker TI, BL Taylor, LP Brown, AE Punt. 2008. Embracing movement and stock structure for assessment of *Galeorhinus galeus* harvested off Southern Australia. *In:* MD Camhi, EK Pikitch, EA Babcock (eds.). *Sharks of the open ocean: Biology, fisheries and conservation*. Blackwell Publishing, Oxford, UK, pp: 369-392.

Ward RD, MG Gardner. 2003. Stock structure and species identification of school and gummy sharks in Australasian waters. *Fisheries Research and Development Corporation, Final Report, Project FRRF 93/11 and FRDC 93/64*, Canberra. 91p.

Recibido: 5 de junio de 2016.
Aceptado: 27 de julio de 2016.