

RESEARCH NOTE

Spatial and bathymetric occurrence of *Brama australis* off the Chilean Coast and in the South Pacific Ocean

Ocurrencia espacial y batimétrica de *Brama australis* frente a las costas de Chile y el Océano Pacífico Sur

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Abstract. Data about *Brama australis* distribution along the Chilean coast and the South Pacific is scarce and varied. The aim of this study was to provide new information concerning the spatial and bathymetric occurrence of *B. australis* in the Southern Pacific Ocean. To do this, all data and information available in scientific literature regarding Chile and the South Pacific Ocean were collected, including fishery dependent and independent as well as bycatch data. *B. australis* could be present in a wider latitudinal range from the 27°S to 57°S, including fjords, open ocean, and along a band in the Pacific Ocean, from New Zealand up to the Chilean coast. Thus, *B. australis* shows a wider distribution compared to previous studies especially towards the Southern Chile. Bathymetrically the species occurs with a higher frequency in depths between 100 and 250 m, however a low occurrence was recorded over 500 m depth. A potential association of *B. australis* with the West Wind Drift, which could influence the distribution of the species in the Pacific Ocean and off the Chilean coast, is hypothesized. Further work includes taxonomic studies to confirm the presence of the same species in the distributional area proposed here.

Key words: *Brama australis*, spatial distribution, Chile, South Pacific Ocean

INTRODUCTION

The species *Brama australis* (Valenciennes, 1838) is known in Chile with the common name of reineta, belonging to the family Bramidae. This species normally lives in tropical and temperate waters, within the epipelagic and mesopelagic zones (Thompson & Russell 1996). According to Pavlov (1991), *B. australis* is widely distributed in the Pacific Ocean, although rather restricted to the circulation limits of the subtropical waters in the Southern Hemisphere (27°S-48°S). It can also be found off the New Zealand coast (Horn *et al.* 2013).

In Chile, information about its spatial distribution is scarce and varied amongst authors. Pavéz *et al.* (1998), based on the distribution of a similar species of Bramidae, *Brama japonica*, and its main prey (*Euphausia mucronata*), argue that *B. australis* could exist between 20°S and 46°S. Oyarzún (2001) points out that the species could be found from Coquimbo (29°S) to Chile's southern coast. Reyes & Hüne (2013) suggest a distribution between 27°S and 48°S, and the Chilean Undersecretary of Fishing locates *B. australis* habitat from Chañaral (26°S) to the Gulf of Penas (49°S) (SUBPESCA 2009). From fishery viewpoint, the catches of artisanal fleet are localized mainly

between Iloca and Guafo Island (35°S-44°S), while in industrial fleet, they occur in the southern Chile, from Guafo Island to Gulf of Penas (44°S-47°S) (Gálvez *et al.* 2016)¹. Thus, there exists neither unequivocal information on the general distribution of this species, nor any studies about its distribution off the Chilean coast.

Regarding the bathymetric distribution of *B. australis*, the literature indicates that Bramidae could inhabit depths of 400 to 500 m (Mead 1972, Last & Baron 1994, Thompson & Russell 1996). In Chile, Bahamonde (1977) registered the species between 100 and 500 m, and the richest catches hauled *B. australis* from depths of 150 and 300 m.

B. australis off the Chilean coast supports an important artisanal fishery with annual landings of about 25.000 tons, while the industrial fishery is still incipient, reaching landings of around 2.500 tons in the last year (SERNAPESCA 2016). From a fishery management perspective, the knowledge about the distribution of the species is important because it fosters understanding of the spatial structure of the species (Hutchings *et al.* 2007) and its interaction with fishing activity. Such understanding facilitates the

¹Gálvez P, J Sateler, Z Young, R San Juan, J Olivares, K Belmar, E Garcés & J González. 2016. Convenio de Desempeño 2015. Seguimiento de las Pesquerías Demersales y Aguas Profundas, 2015. Sección II: Pesquería Demersal Centro Sur, 2015. Subsecretaría de Economía y Empresas de Menor Tamaño, IFOP, 194 pp.

enforcement of management rules that contribute to the sustainability of the fishery resource. Thus, this study aimed to collect all the information available in Chile about the spatial and bathymetric occurrence of *B. australis* off the Chilean coast. Data were gathered from the monitoring of the demersal fisheries in Chile where *B. australis* was a targeted as well as bycatch species. Also, data from demersal and pelagic surveys regarding the presence of *B. australis* was detected. In addition, the information about the presence of *B. australis* in the oceanic waters was used to produce a broad view on the distribution of this species in the South Pacific Ocean.

MATERIALS AND METHODS

To study the presence of *B. australis* along the Chilean coast (18°21'S-57°00'S), three different sources were analyzed: survey data, commercial bycatch and target hauls. Data of *B. australis* in fishing hauls taken during acoustic surveys from 1993 to 2013 and off the Chilean coast (18°56'S-51°00'S) by the Instituto de Fomento Pesquero² were used. The aim of the acoustic surveys was to estimate the abundance and biomass of different Chilean fishery resources (Table 1). In these surveys, fishing hauls are taking place to collect information about specific target species (anchovy *Engraulis*

ringens, common sardine *Strangomera bentincki*, Chilean jack mackerel *Trachurus murphyi*, South Pacific hake *Merluccius gayi*, Patagonian grenadier *Macruronus magellanicus*, southern hake *Merluccius australis* and southern blue whiting *Micromesistius australis*) and its bycatch. Additional input came from logbook records of the fishing vessels from Central South Demersal Fishery (32°12'S-43°43'S) and Southern Demersal Fishery (36°06'S-57°00'S). This last information was collected by scientific observers aboard fishing vessels from 1997 to 2015. Most information corresponded to hauls targeted at other species, while a smaller amount was aimed to catch *B. australis*. Fishing hauls information from surveys, as well as those from the fishing vessels were taken by mid-water trawl and bottom trawl at different depths depending on the target species.

All hauls that registered *B. australis* as bycatch of other target species in the survey and fishery-dependent data, together with those where *B. australis* was a target species were selected. These fishing hauls carried information about location (latitude, longitude) and haul depth. The information was used to create a geographical map with the spatial location of all hauls where *B. australis* was registered. Besides, the occurrence of fishing hauls with *B. australis* at different depths was summarized in a histogram.

Table 1. Summary of *B. australis* records from different sources of information used in this study. Spatial coverage represents the boundaries with positive hauls of *B. australis* / Resumen de los registros de *B. australis* provenientes de las diferentes fuentes de información usadas en este estudio. La cobertura espacial representa los límites con lances positivos de *B. australis*

Source of data	N° records (hauls) containing <i>B. australis</i>	N° depth records	Period	Spatial coverage of positive hauls		
				Latitude (S)	Longitude (W)	Depth (m)
Fishery monitoring						
Central-South demersal	3,530	3,439	1997 - 2010	32°12' - 43°43'	71°41' - 75°20'	50 - 914
Southern demersal	6,122	1,599	1997 - 2010	36°06' - 57°00'	65°33' - 76°21'	94 - 970
Southern demersal (target species)	491	490	2013 - 2015	41°31' - 52°00'	74°37' - 75°47'	65 - 465
Acoustic surveys						
Anchovy and sardine	46	11	2002 - 2013	27°40' - 41°26'	71°15' - 74°28'	5 - 12
South Pacific hake	193	193	1993 - 2007	33°00' - 41°54'	71°47' - 75°00'	83 - 428
Southern hake and Patagonian grenadier	109	93	2002 - 2011	42°33' - 47°00'	73°00' - 76°14'	100 - 430
Southern blue whiting	78	67	2003 - 2011	47°00' - 50°50'	75°20' - 76°10'	117 - 508
Chilean jack mackerel	116	29	1997 - 2010	34°00' - 43°20'	72°08' - 85°29'	5 - 90
External data						
NIWA*	24	23	2002 - 2005	42°53' - 53°28'	166°52' - 179°58'	260 - 914
Pavlov (1991)	10	10	1989	27°16' - 42°43'	75°15' - 124°26'	15 - 90
Total	10,719	5,954	1993 - 2015	27°16' - 57°00'	65°33' - 179°58'	5 - 970

*Available at <<http://www.fishbase.org/Map/OccurrenceMapList.php?id=54793&genus=Brama&species=australis>>

²<www.ifop.cl>

The presence of *B. australis* in the South Pacific Ocean was inquired using information recorded in the formal literature (Pavlov 1991) and in the open access database of the National Institute of Water and Atmospheric Research (NIWA)³ of New Zealand between 2002 and 2005. In the former case, the fishing hauls were undertaken with mid-water trawls at depths of 15 to 90 m during 1989.

RESULTS AND DISCUSSION

The sources of data of the fishing hauls, which registered *B. australis* as bycatch and target species, are summarized in Table 1. A total of 10,719 positive records were used to create a map of the presence of the species off the Chilean coast (Fig. 1). Although acoustic survey data (anchovy and Chilean jack mackerel cruises) of northern Chile were analyzed, data reveal the occurrence of *B. australis* mainly until the 32°S (Fig. 1). The surveys taking place in lower latitudes in general did not register the species, except for one case that located it at 27°S near to coast. The same location was reported by Pavlov (1991). Information regarding the fishing hauls, with presence of *B. australis* around 40°S (Fig. 1) and with direction towards the open ocean, was taken from the surveys that assessed the Chilean jack mackerel biomass between 1993 and 2010. *B. australis* was reported by Pavlov (1991) in the same area that expands over the same latitude (40°S) until 125°W. The data collected from the Southern Demersal

Fisheries as bycatch verified the presence of the species towards the southern zone off Chile (57°S) and close to the Argentinian border (Atlantic Ocean). The fishing hauls from the demersal fishery where *B. australis* was a target species attained between 41°30'S and 52°00'S. Additionally, the acoustic surveys information shows that the specimens could also be found in the inland waters, fjords and channels of Southern Chilean coast (Fig. 1).

The number of records with bathymetric information used to describe the occurrence of *B. australis* was obtained from 5,464 hauls as bycatch and 490 as target (Table 1). A low number of records (128) showed presence of *B. australis* as bycatch at depths greater than 500 m. Furthermore, these records corresponded to outliers in a box-and-whisker plot (not shown), thereby it was excluded from the histograms. Moreover, its presence at deeper than 500 m has only been reported in technical reports but not formal literature. Thus, bathymetrically over 98% of the records from hauls with *B. australis* as bycatch corresponded to catches from 50 to 500 m (Fig. 2a). The highest frequency of hauls registering *B. australis* were located between 100 and 250 m, however also was observed over to 500 m on some fishing hauls too. Records of *B. australis* as a target species in the demersal fishery support the observation that the greatest presence of the species was in depths of 100 to 250 m (Fig. 2b).

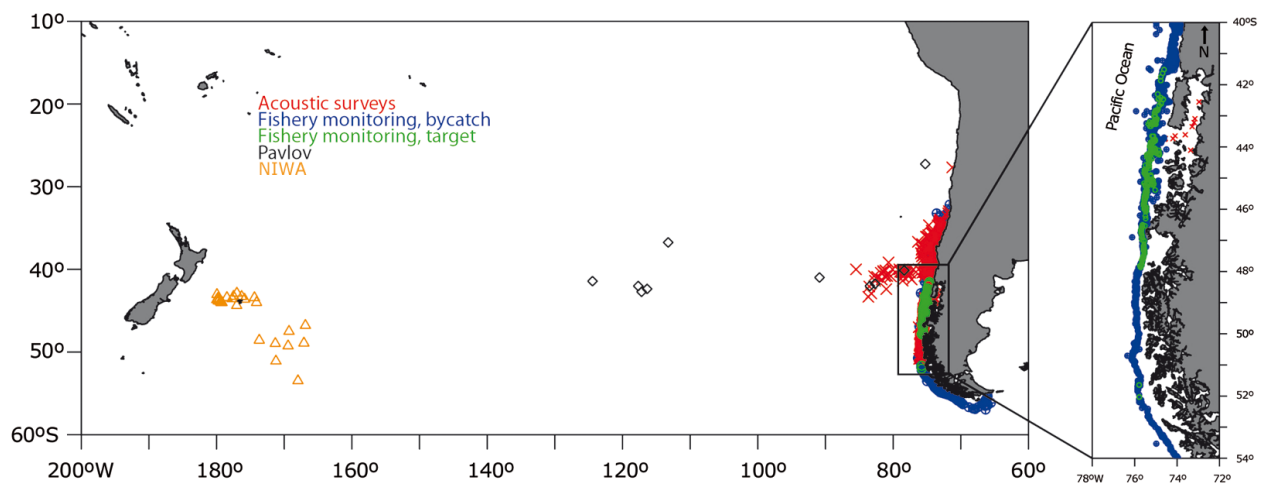


Figure 1. Distribution of the fishing hauls where *B. australis* registered a positive presence. Acoustic survey records (red cross), demersal fishery monitoring (bycatch: blue circles; target species: green circles). Records from Pavlov (1991) information (black diamond) and NIWA information (orange triangle). Zoom details are acoustic survey records in fjords (red cross), further fishery monitoring (bycatch and target) / Distribución de los lances con presencia de *B. australis* en las capturas. Registros en cruceros acústicos (cruces rojas), registros provenientes del monitoreo de las pesquerías demersales (captura incidental: círculos azules; especie objetivo: círculos verdes). Registros provenientes de Pavlov (1991) (diamantes negros) y NIWA (triángulos naranjos). En aumento el detalle de los registros presentes en los canales (cruces rojas) y aquellos provenientes del monitoreo de las pesquerías demersales (captura incidental y especie objetivo)

³NIWA, data available at <<http://www.fishbase.org/Map/OccurrenceMapList.php?id=54793&genus=Brama&species=australis>>

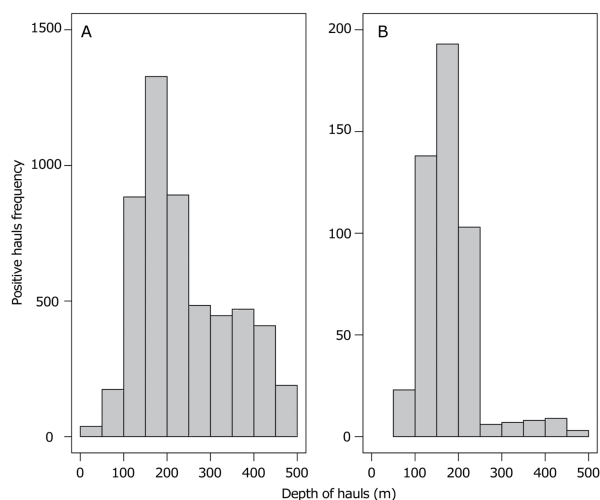


Figure 2. Frequency of the fishing hauls with a positive presence of *B. australis* regarding depth. Data correspond to records taken during the acoustic survey and the monitoring of demersal fishery *B. australis* as bycatch (A) and target hauls (B) / Frecuencia de lances de pesca con presencia de *B. australis* respecto a la profundidad registrada. Los datos corresponden a registros tomados durante cruceros acústicos y el monitoreo de las pesquerías demersales, captura incidental (A), especie objetivo (B)

Results show that *B. australis* could be present in a wider latitudinal range compared to the one proposed by previous authors (Pavlov 1991, 1994; Reyes & Hune 2013), particularly regarding its extension along the southern coast of Chile. A recent study supports these findings. It postulates that the feeding areas of *B. australis* off Chile would be located between 36°S and 47°S, with potential spawning areas in oceanic waters (80°W) (Ferrada *et al.* 2015). However, Torres *et al.* (2006) reported the species in the Gallegos River 51°36'S and 69°13'W, and also on the Argentinian Southern platform around 46°S (Gorini & Jaureguizar 2008).

From a taxonomic point of view, other species of the family Bramidae in Chile have been identified, therefore, some doubt that the findings shown here correspond all to the same species of *B. australis* still persists. Thus, the database of the National Aquatic Biodiversity Information System (NABIS) of New Zealand describes the species *Xenobrama microlepis* (Bramidae) as a species present off southern Chile and may be confused with *B. australis*. Besides, Nakamura (1986) and Pequeño (1989) described the species *Brama dussumieri* as part of the family Bramidae off the Chilean coast. However, recently Ferrada *et al.* (2015), through genetic analysis, reported one evolutionary unit and one stock of *B. australis* off the Chilean coast up to 55°S.

On its bathymetric distribution, results sustain that the highest frequency of hauls registering *B. australis* occurred at depths of 100 to 250 m, although hauls below 500 m also recorded the species. Crucially, most of the records used in this study corresponded to hauls where *B. australis* was not target species but bycatch. However, the few records with the species as a target of the fishery corroborate the result discussed above. Moreover, these findings agree with those of Gálvez *et al.* (2015)⁴, who reported *B. australis* at depths of 150 m to 280 m in the fishing hauls where it was target species off Southern Chile (42°S-47°S) in 2012 and 2014.

In spite of the spatial and temporal discontinuity of the samples, the records provided by Pavlov (1991, 1994) and NIWA, suggest that *B. australis* could be distributed along the Pacific Ocean (65°-185°W), and from the Northwest of New Zealand (42°53'S-53°28'S) to the Chilean coast. In this work, the records of *B. australis* as bycatch show that the species may be found from 27°S to 57°S, even in the inland waters of southern Chile. The findings here suggest a distribution pattern of the species similar to the one described for Chilean jack mackerel but in disagreement with its northern boundary. The records used here only detect the occurrence of *B. australis* until 27°S, but the Chilean jack mackerel reaches latitude close to the Equator (Grechina 1998).

Thus, regarding the results obtained in this work, a potential association of *B. australis* with the West Wind Drift, which could influence the distribution of the species in the Pacific Ocean and off the Chilean coast is hypothesized. This is based in Pavlov (1994), who proposed a migratory pattern distributed in a broad area of the Southern Pacific Ocean. On the other hand, the records from NIWA indicate the presence of the species around New Zealand. Furthermore, the findings reported by Letelier *et al.* (2009) indicate that *B. australis* is part of the diet of *Xiphias gladius* in oceanic waters (over 80°W) of the Pacific Ocean. In addition, these results reveal the occurrence of the species towards the southern area of the Chilean coast, and in fishing haul targeting Chilean jack mackerel in the open ocean and over the 85°W.

Although the findings in this work provide a new vision about the potential distribution of *B. australis* off the Chilean coast and within the Southern Pacific Ocean, it is necessary to develop further studies. This involves that the bulk of information should arise as a target species, and clarify the existence of one or more species of the family Bramidae within the range of occurrence of *B. australis* proposed here.

⁴Gálvez P, J Sateler, K Belmar, Z Young, E Garcés, R San Juan, J Olivares, K Riquelme & J González. 2015. Convenio I: Asesoría Integral para la pesca y acuicultura 2013. Proyecto 1.9: Programa Seguimiento de las Pesquerías Demersales y Aguas Profundas, 2013. Sección II: Demersales Centro Sur. Subsecretaría de Economía y Empresas de Menor Tamaño, IFOP, 150 pp.

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