SPRFMO
South Pacific Regional Fisheries Management Organisation

9th MEETING OF THE SCIENTIFIC COMMITTEE

Held virtually, 27 September to 2 October 2021

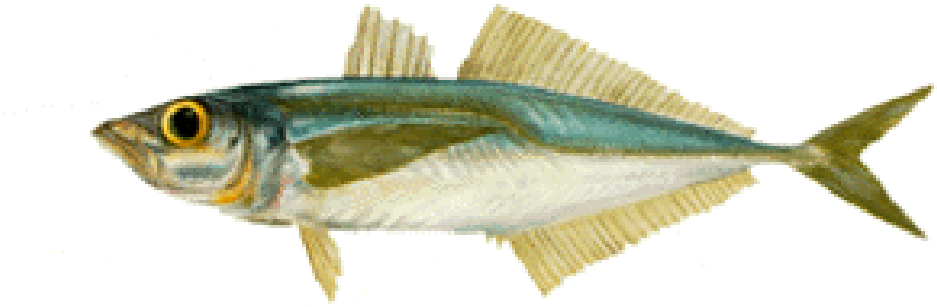
SC9-WP01_rev1

CJM *Trachurus murphyi* Species Profiles

Background

At the second 2021 SPRFMO SC Web Meeting (29/30 June 2021) it was noted that the Species Profiles on the SPRFMO website require updating and Working Group Chairs were asked to coordinate revisions for the relevant resources. This document contains an updated Jack mackerel species profile which was further edited during SC9. The SC agreed that the Secretariat remove the outdated versions, finalise drafts based on this expert review and load the new short versions to the website. The Species Profiles for Jack mackerel (CJM) included in this document was accepted by the SC, pending final editorial changes.

Code: CJM
Scientific name: *Trachurus murphyi*



Taxonomy

Phylum	Chordata
Class	Osteichthyes/Actinopterygii
Order	Perciformes
Family	Carangidae
Genus and species	*Trachurus murphyi* (Nichols, 1920)
Scientific synonyms	Historically *Trachurus symmetricus murphyi*
Common names	Chilean Jack mackerel (FAO, Chile, Russia), Murphy's mackerel (New Zealand), Pacific Jack mackerel (Russia), Peruvian Jack mackerel (Australia, Russia), Jack mackerel, horse mackerel, jurel (Chile, Peru, Ecuador).
Molecular (DNA or biochemical) bar coding	Available in the Barcode of Life Data System (BOLD), at: http://www.boldsystems.org (Ref.:https://www.boldsystems.org/index.php/Public_SearchTerms?query=%22Trachurus%20murphyi%22[tax], see in Public Data to access DNA sequences).See also Poulin et al. 2004.

Species characteristics

Global distribution and depth range

The Chilean jack mackerel is distributed in the sub-tropical waters, of the south eastern Pacific Ocean, both inside areas under national jurisdiction and on the high sea, ranging from the Galapagos Islands and south of Ecuador in the north to southern Chile; ranging from the South America in the east to Australia and New Zealand in the west (Evseenko 1987, Jones 1990, Serra 1991a, and Elizarov et al. 1993; Kotenev *et al*., 2006; Gerlotto *et al*., 2012) (see Fig. 1).

Aggregations of *T. murphyi* can be found at depths between 0 and 300 meters (Serra 1991a, Guzman et al. 1983, Bahamonde 1978, Anon 1984, Anon 1985, Dioses 2013). The species exhibits a diurnal migratory behaviour, with fish being found deeper during the day (50-180 m) than at night (10-40 m) (Cordova et al. 1998).

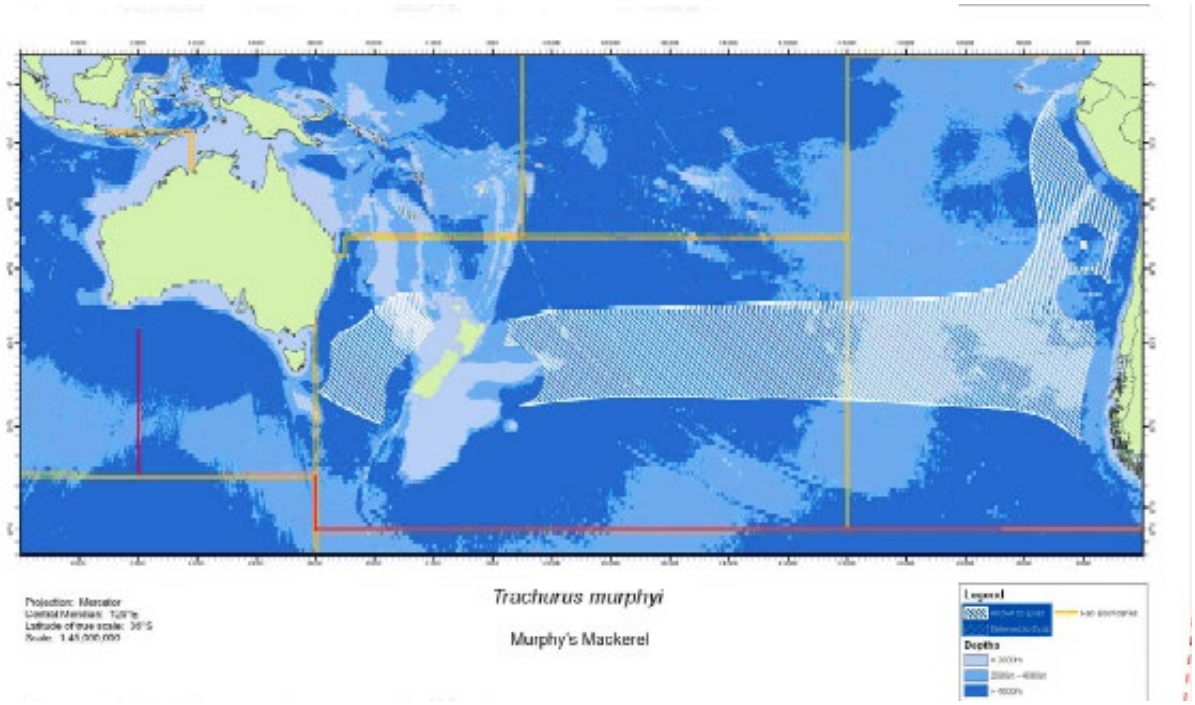


Figure 1. Distribution of Jack mackerel in the high seas in the South Pacific

Distribution within South Pacific area

Elizarov *et al*. (1993) coined the phrase "Jack mackerel belt" to describe the distribution of *T. murphyi* across the South Pacific (Fig. 1). The Jack mackerel belt is described as having a north-south breadth of "10 to 15 degrees" across "the southern sub region of the southeast Pacific Ocean (SEPO) and southwest Pacific Ocean (SWPO)", which varies with season as "spawning groups concentrate mainly in the north of 40ºS in spring and summer and south of 40ºS in autumn and winter to feed".

The stock assessment of Jack mackerel that are carried out on behalf of SPRFMO Commission are based on two hypotheses of population structure. One hypothesis establishes the existence of a single stock caught in the South-central and northern zone of Chile, the national jurisdictional waters of Peru and in the SPRFMO convention area. The other hypothesis establishes the existence of a stock caught in the south-central and northern zone of Chile and in SPRFMO convention area and a stock caught only in the Peruvian jurisdictional waters. Other hypotheses on the jack mackerel population structure have been suggested and discussed in different studies (SPRFMO 2008, Hintzen et al 2014, Gerlotto 2012, 2021).

General habitat and behaviour

T. murphyi is a schooling pelagic species adapted to both neritic and oceanic environments. According to the average catch pattern by fishing areas of jack mackerel *T. murphyi*, the highest concentrations registered in Peruvian and Chilean coastal ocean are associated with the high dynamics of coastal upwellings (Ñiquen and Peña 2008, Chernyshkov *et al*. 2008, Vásquez *et al*. 2020). At the interdecadal scale, variability patterns (warm and cold periods) seem to define favourable and unfavourable scenarios for *T. murph*yi. Likewise, studies by Dioses (1995) and Gretchina *et al*. (1998) indicate that the oceanic fronts formed by the convergence of cold coastal waters and surface subtropical waters, would be the preferred habitat of *T. murphyi* resource, which is evidenced by the catches of this resource. On the other hand, Bertrand *et al*. (2004) report that *T. murphyi* is mainly located in oxygenated waters (above oxycline). It is noted that, the optimal oxygen content value for the presence of jack mackerel *T. murph*yi would be between 1 and 3 ml/L, above oxycline (Dioses 2013a).

Biological characteristics

Morphology

Body elongate and slightly compressed. Enlarged, scute-like scales on primary lateral line. Termination of dorsal accessory lateral line below 2nd to 5th soft ray of dorsal fin. Pectoral fin tip extending to be above the two detached spines anterior to the anal fin. Eye moderate size with well-developed adipose eyelid. Posterior margin of upper jaw below anterior margin of eye. Jaws vomer, palatine, and tongue bearing minute teeth (Kawahara et al. 1988).

Colour when fresh: dark blue dorsal body, silver-white ventrally; upper posterior margin of opercula bears a black spot; pale pelvic fins; caudal, pectoral, and dorsal fins dusky; anal fin pale in the front, dusky in the rear.

Reproduction

Several authors have described *T. murphyi* to be an indeterminate batch spawner, based on histological studies and on the oocyte-size-frequency-distribution (OSFD) of reproductively active females, and their “presence over a long temporal extension of seven to nine months per year” (Dioses et al. 1989, George 1995, Oyarzún et al. 1998, Leal *et al*., 2013, Perea *et al*., 2013). This conclusion is supported by evidence from Evseenko (1987) and Bailey (1989) who state that *T. murphyi* spawns wherever environmental conditions are suitable. The suitable environmental conditions seem to be water warmer than 15 ºC, with highest densities having been found in waters

of 16 – 19 ºC, and low current (less than 15 cm.s^{-1}) (Evseenko 1987, Núñez *et al*. 2004, Cubillos *et al*. 2008). During the period of most intensive spawning, 10–15% of females spawn each day, meaning that the average female spawns every 7–10 days at this time (Oyarzún and Gacitua 2002, Oliva et al. 1995)

Trachurus murphyi spawns, throughout its whole distribution range, in austral spring and summer, with the main spawning season from October to December (Serra 1983 and 1991a, Elizarov et al. 1993, Oyarzún et al. 1998, Leal et al. 2013, Perea *et al*., 2013) . Santander and Flores (1983) and Dioses *et al.* (1989) described Jack mackerel spawning in Peru as mainly occurring between 14º00'S and 18º30'S. However, more recent analyses by Ayon and Correa (2013) show that between 1966 and 2010 Jack mackerel larvae were present (and therefore spawning is inferred) every year along the whole Peruvian coast, with clear year to year north-south shifts in the centres of higher larvae abundance associated with shifts in environmental conditions. They describe important changes with time in the spatial larvae distribution. The centers of gravity of the larvae spatial distribution per year also showed some important differences in the distribution by latitude and distance from the coast, with three clear periods: the first one between 1966 and 1978 with main larvae concentrations between 14°S and 18ºS closer to the coast; the second between 1979 and 1994 more to the north, between 4°S and 14ºS, and more offshore; and, the third one between 1995 and 2010, with the centers of gravity located in an intermediate position between the other two (Ayon y Correa 2013). *T. murphyi* spawns regularly in Peruvian waters but the reproductive activity has a greater variability, lesser abundance and longer spawning period compared to the spawning occurring off Chile (Perea et al. 2013).

The main jack mackerel spawning grounds are located between 30°S and 40°S off central Chile, in coastal and oceanic waters extending beyond 200 miles of the EEZ to about 93º W (Serra 1991b, Núñez et al. 2004, and Arcos et al. 2005). In this region, the spawning activity is associated with the Subtropical front location that reaches its maximum latitudinal extension during austral spring-summer, and on the interannual scale modulates the meridional location of the jack mackerel spawning centroid (Gretchina *et al*. 1998, Cubillos et al., 2008; Núñez *et al*. 2008). Larval otolith microstructure analysis has revealed a spatial age gradient with the smallest/youngest larvae specimens found primarily in the offshore area and the largest/oldest found in the coastal area, implying offshore-inshore larval drift (Vásquez *et al*. 2013). Furthermore, an additional area of spawning has been recorded in the area between 105°E and 125°E (Kotenev et al 2006). In this region, favourable oceanographic conditions can increase larval survival and support the occurrence of juvenile jack mackerel (Parada *et al*. 2017). Historically, jack mackerel spawning records also have been reported within the EEZ of northern Chile with significant interannual variability and associated with coastal upwelling centers (Braun & Valenzuela, 2008).

Length at maturity

Mean length at first spawning has been reported to vary between 21 and 30 cm fork length in different areas (Basten & Contreras 1978, Cubillos et al. 2008, Leal et al. 2013, Abramov and Kotylar 1980, Dioses et al. 1989, Perea et al. 2013)

Growth

T. murphyi has a moderate growth rate (Cubillos et al. 1998). The maximum recorded age in Chile is 19 years, in New Zealand 35 years and in Peru 11 years.

Growth parameters of the Bertalanffy growth function from several studies indicate that L∞ is between 70 and 81 cm, W∞ around 3700 gr, K between 0.094 and 0.155 and t0 between -0.89 and -0.36 (Dioses 2013b, Kochkin 1994, Gili et al. 1996.

Age determination

The ageing analysis of *T. murphyi* in Chile have been validated using three methods: 1) daily microincrement readings in sagittal otoliths of young-of-the year (YOY) fish to validate the first annulus; 2) modal progression of strong year-classes (PSYC) to validate the second and third annuli, and 3) bomb radiocarbon analysis of otolith cores to validate the absolute age in older fish over 40 cm fork length (FL). The result showed a fast growth in the firsts two years, identifying two false rings compared with currently ageing estimation (Cerna et al 2016; Araya et al. 2019). These finding were consistent with bomb radiocarbon method that validated the age of older fish (Cerna et al. 2016; Ojeda et al. 2008).

In Peru, the age and growth of Jack mackerel has been determined by the direct reading and measuring of annual growth rings in whole otoliths (Dioses 2013b) and have been confirmed by independent observations through the reading of micro-increments or daily rings in otoliths (Goycochea 2013) and length frequency analysis of commercial and research survey catches (Diaz 2013). The same author tested the validity of the methodology being used by checking the growing similarity between rings (whose growth decreases with the formation of a new ring) and the monthly variation of otolith marginal increment, while Goycochea (2013) and Diaz (2013) obtained very similar results using independent methods and different sources of data.

Natural mortality

Natural mortality has been estimated to be in the range of 0.22 to 0.31 y^{-1} based on size composition data, growth functions and other traits (Cubillos et al. 2008, Canales and Serra, 2008 unpublished report)

Role of species in the ecosystem

This species is a generalist feeder capable of utilising a wide range of prey species (Konchina 1979) and may be acting as an energy flow channeler from primary producers to top predators. In the Peruvian upwelling system, the Euphausiidae is the dominant prey for Jack Mackerel and contribute with 49% (Alegre et al., 2015). However, its wide range of prey species shows that it is not restricted to this role. Population size of *T. murphyi* can be extremely high, as indicated by the "bloom" event in the early to mid-1990s when 4.4 Mt were taken in the Chilean fishery in 1995 and which coincided with a peak in aerial sightings records in New Zealand waters (P.R. Taylor, NIWA, New Zealand, unpublished data) and with the relatively high catches and abundance indices off Peru (Segura and Aliaga 2013, Ñiquen et al. 2013).

Little is known about its predators, though Bailey (1987) tentatively identified juvenile jack mackerel from the stomachs of albacore tuna (*Thunnus alalunga*) taken in the central South Pacific (36ºS to 42ºS and 148ºW to 165ºW) as *T. murphyi*. It has also been found in the stomach contents

of swordfish off the Chilean coast (M. Donoso, IFOP, Chile, pers. comm.). Generally, it can be expected that its predators will be similar to those of other carangid mackerels and will include tunas, billfish, and sharks. As a consequence of the large size of the Jack mackerel and its important role as both predator and prey, this species is likely an important node in Pacific Ocean predator-prey networks.

Impacts of Fishing

Habitat damage

No direct habitat damage known in the mid-water trawl and purse seine fisheries and such damage is unlikely due to the gear types used.

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