SPRFMO
South Pacific Regional Fisheries Management Organisation

10th MEETING OF THE SCIENTIFIC COMMITTEE

26 to 30 September 2022, Seoul, Korea

SC10-Doc30
Importance of the Salas y Gómez and Nazca ridges

Chile

Paper on the importance of the Salas y Gómez and Nazca ridges

Gaymer CF[1, 2], Wagner D[2,3] , Álvarez R[1], Bravo L[1], Dewitte B[1,4,5], Easton E[1,6], Hormazábal S[7], Hucke-Gaete R[8,9], Friedlander AM[1, 2], Gorny M[10], Luna-Jorquera G[1], Ramos M[1], Rodrigo C[11] Sellanes J[1, 2], Soto E[12], Thiel M[1], Véliz D[1,13]

[1] Center for Ecology and Sustainable Management of Oceanic Islands (ESMOI), Departamento de Biología Marina, Facultad de Ciencias del Mar, Universidad Católica del Norte, Chile

[2] Coral Reefs of the High Seas Coalition

[3] Ocean Exploration Trust, Honolulu, Hawaii, USA

[4] Centro de Estudios Avanzados en Zonas Aridas (CEAZA), Coquimbo, Chile

[5] Laboratoire d'Etudes en Géophysique et Océanographie Spatiales, Toulouse, France

[6] School of Earth, Environmental, and Marine Sciences, University of Texas Rio Grande Valley, Brownsville, TX, USA

[7] Fundación San Ignacio del Huinay, Pontificia Universidad Católica de Valparaíso, Chile

[8] Marine Mammal Ecology Lab, Instituto de Ciencias Marinas y Limnológicas, Universidad Austral de Chile & Centro Ballena Azul NGO

[9] MIGRAMAR

[10] Oceana Chile, Santiago, Chile

[11] Geología-Facultad de Ingeniería, Universidad Andrés Bello, Viña del Mar, Chile

[12] Centro de Observación Marino para Estudios de Riesgos del Ambiente Costero (COSTAR), Universidad de Valparaíso, Viña del Mar, Chile

[13] Departamento de Ciencias Ecológicas, Facultad de Ciencias, Universidad de Chile, Santiago, Chile

1. Abstract

The Salas y Gómez and Nazca ridges are two adjacent seamount chains located in the southeastern Pacific, which collectively stretch across over 2,900 km of seafloor. Ecosystems in this region are isolated from the South American Continent by the Atacama Trench and the Humboldt Current System, an isolation that has produced a unique biodiversity that is marked by one of the highest levels of marine endemism on Earth. For many taxonomic groups, nearly half of the species are endemic to the region and found nowhere else on the planet. These areas also provide important habitats for blue whales, leatherback turtles, corals, and a multitude of other ecologically important species, including 93 species that are threatened or endangered. Recent explorations in this region have documented the deepest light-dependent marine ecosystems on Earth, numerous species that are new to science, as well as highlighted the rich and culturally diverse human seafaring history of this region. As a result, the Salas y Gómez and Nazca ridges have been distinguished for their extraordinary natural and cultural significance by numerous international bodies and organizations, including as an ecologically or biologically significant marine area (EBSA) by the Convention on Biological Diversity (CBD), an important area by the Global Ocean Biodiversity Initiative and the Global Census of Marine Life on Seamounts, and a Mission Blue Hope Spot. Over 73% of this area falls within areas beyond national

jurisdiction and the area of competence of the South Pacific Regional Fishery Management Organization (SPRFMO). Fishing operations targeting species managed by SPRFMO have been minimal to nonexistent in this region in recent years. Consequently, there is a unique opportunity to proactively protect the extraordinary natural and cultural resources of this region, without significantly impacting the fishing industry. This report builds upon previous papers presented to the SPRFMO scientific committee in 2020 (SC8-Obs01) and 2021 (SC9-Doc31_rev1), by adding numerous scientific information that has emerged since then, strengthening the importance of this area. Collectively, this information highlights the need and urgency to protect the unique natural and cultural resources of the Salas y Gomez and Nazca ridges using the best available conservation measures. For SPRFMO this could be achieved by closing the area of 1,097,846 km^2 that is located in international waters of the Salas y Gómez and Nazca Ridges EBSA to fishing activities under its jurisdiction. The proposed regulations would have little to no impact on fishing operations, however, they would provide enormous advances in safeguarding the unique biodiversity of this region, as well as showcase the global leadership of SPRFMO and its member countries.

2. Introduction

The Salas y Gómez and Nazca ridges are one of the most unique, biodiverse and culturally rich seascapes on Earth, extening over 2,900 km off the west coast of South America (Figure 1) (Rehder 1980; Newman & Foster 1983; Parin 1991; Parin et al. 1997; Poupin 2003; Moyano 2005; Gálvez-Larach 2009; Friedlander et al. 2013; Fernández et al. 2014; Friedlander et al. 2016; Mecho et al. 2019; Sellanes et al. 2019; Wagner et al. 2021; Delgado et al. 2022). The Salas y Gómez and Nazca ridges are two adjacent seamount chains of volcanic origin that lie in the southeastern Pacific Ocean (Mammerickx et al. 1975; Gálvez-Larach 2009; Gálvez 2012a; Yáñez et al. 2012; Rodrigo et al. 2014; CBD 2017; Easton et al. 2019). The more adjacent ridge to the South American Continent, the Nazca Ridge, stretches across roughly 1,100 km of seafloor between the subduction zone off the Peruvian coast and the eastern edge of the Salas y Gómez Ridge (Figure 1). The Nazca Ridge is located mostly in areas beyond national jurisdiction (ABNJ), with a smaller northeastern section that is located in Peru´s national waters. The Salas y Gómez Ridge stretches across approximately 1,600 km between the Nazca Ridge and Rapa Nui, also known as Easter Island (Figure 1). The central portion of the Salas y Gómez Ridge is located in ABNJ, whereas both ends of this ridge fall within the Chilean EEZ around the islands of Rapa Nui and San Felix, respectively. Collectively, the Salas y Gómez and Nazca ridges contain more than 110 seamounts, which represent approximately 41% of all seamounts recorded throughout the southeastern Pacific (Gálvez-Larach 2009; Gálvez 2012a; Yáñez et al. 2012). The shallow waters of the Salas y Gómez and Nazca ridges span across three different but unique ecoregions, including the Easter Island, Juan Fernández and Desventuradas, and Humboldtian Ecoregions (Spalding et al. 2007). The deep waters of this region include two bathyal biogeographic provinces (Southeast Pacific Ridges and Nazca Plate), and one abyssal province (Chile, Peru and Guatemala Basin) (Watling et al. 2013).

3. Geology

3.1. General description & Origin

The southeastern Pacific is a geologically active region, with multiple geological hotspots (Sandwell et al. 2005; Rodrigo & Lara 2014; Harpp et al. 2014; García et al. 2020) and active hydrothermal vents (Baker et al. 2002; Menini & Van Dover 2019). The Salas y Gómez Ridge is formed by hundreds of volcanic edifices that are distributed in groups and chains with a general linear East-West trend, where some of them are morphologically connected and form continuous structures of hundreds of kilometers that sometimes have flat tops like plateaus (Gálvez-Larach, 2009; Rodrigo et al., 2014). The most prominent edifices correspond to Easter and Salas y Gómez islands with heights of more than ~3,200 m with respect to the adjacent seafloor. The average height of the Ridge is around 2,100 m, with the most common range being between 2,000 and

2,500 m (Gálvez-Larach 2009; Rodrigo et al. 2014). Only in the area around the Easter and Salas y Gómez islands, there are over 3,000 circular volcanic submarine structures, where 383 of these are in the range of 200 to 3,000 m height (Rappaport et al. 1997).

Seamounts located on the Salas y Gómez and Nazca ridges are all thought to have been produced by a common hotspot that is located close to the present location of Salas y Gómez Island (Mayes et al. 1990; Kruse et al. 1997; Steinberger 2002; Duncan et al. 2003; Ray et al. 2012; Rodrigo et al. 2014; Harpp et al. 2014). Lavas from Salas y Gomez and adjacent seamounts are higher in Pb and Sr and lower Nd isotopic ratio, supporting the location of the hotspot near Salas y Gómez Island. Moving eastward along the Salas y Gómez and Nazca ridges, the seamounts become progressively older, from 2 million years on the western portion of the chain, to over 27 million years towards the northeastern end (Duncan et al. 2003; Ray et al. 2012; Rodrigo et al. 2014). These seamounts provide a detailed record of the geological formation of this region that tracks the movement of the Nazca Plate as it moves northeastward before it gets subducted under the South American Continent (Von Huene et al. 1997).

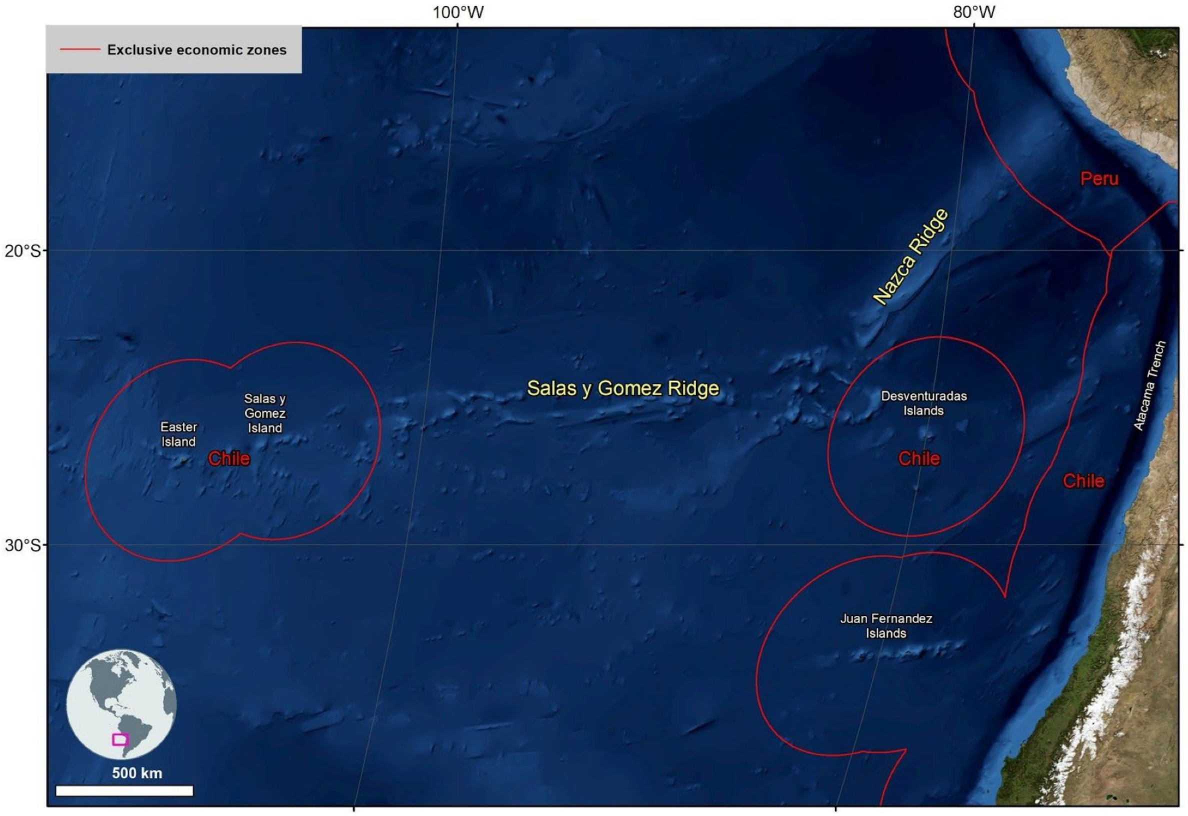


Figure 1. Location of the Salas y Gómez and Nazca ridges. The red lines indicate the national waters of Chile and Peru. Figure from Wagner et al. (2021), information from which was previously presented to the SPRFMO during its scientific committee meetings in October 2020 (SC8-Obs01) and September 2021 (SC9-Doc31_rev1).

4. Oceanographic setting

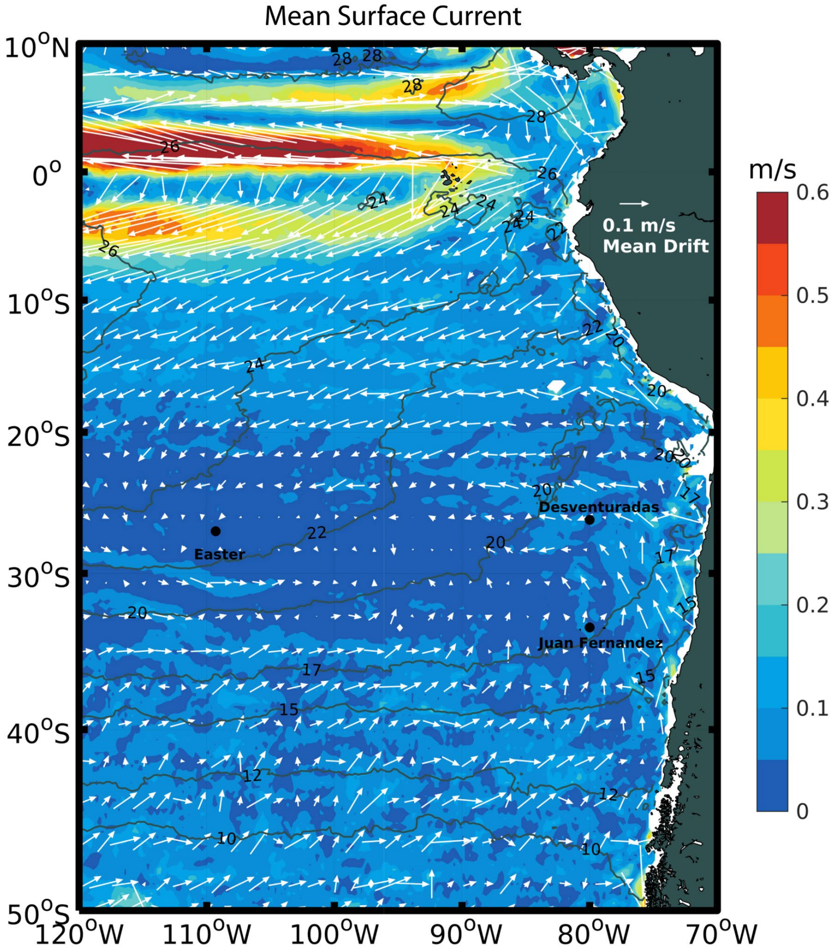
4.1. General description

One of the main features dominating the mean circulation is the South Pacific Subtropical High (SPSH), a downward branch of the Hadley Circulation in the Southeastern Pacific Ocean (SEP) basin (Strub et al. 1998) that determines the presence of a quasi-permanent center of high atmospheric pressure at the surface around 30°S. The SPSH plays a fundamental role in ocean-atmosphere interaction and climate variability at different time and space scales (Flores-Aqueveque et al. 2020). The SPSH covers about half of the interest area (Dewitte et al. 2021) and is responsible for the South Pacific subtropical gyre (SPSG), widely recognized as ultra-oligotrophic zone (Rainmbault & Garcia 2008). This region shows the deepest nutricline and euphotic zone of ocean gyres. In addition, the SEP also hosts one of the largest oxygen minimum zones (OMZs) in the world, a subsurface layer of oxygen-depleted waters (Paulmier & Ruiz-Pino 2009) due to high respiration rates. In the SPSG, the circulation system (Figure 2) is comprised of the westward South Equatorial Current, a narrow poleward western boundary current (East Australian Current), eastward South Pacific Current (streaming along the subtropical convergence zone), and the eastern flank by Humboldt Current Systems (HCS) which is an archetype of eastern boundary upwelling system, that presents a strong wind-driven upwelling and a very active eddy field. At subsurface, the HCS includes the poleward undercurrent, namely, the Peru-Chile Undercurrent (PCUC). The well-documented PCUC has been associated with the presence of oxygen depleted waters at intermediate depth along the coast (Hormazabal et al. 2013), associated with westward propagation of surface eddies (Contreras et al. 2019; Frenger et al. 2018) and feeds the upwelling water.

Longitudinally, the SEP presents oceanographic and hydrographic gradients, moving from the highly productive, temperate, and hypoxic (at mid-depth) waters near the coast of South America, e.g., HCS to warmer, ventilated, and oligotrophic waters to the west at Salas & Gómez Island and Easter Island (Palma & Silva 2006; Fuenzalida et al. 2007). Regarding water mass distribution Schneider et al. (2007) observed three water masses near Easter Island ~108°W. Between the surface and the 250 m the subtropical Water (STW) (>35.5, >19°C), immediately, below this water and until the 700 m was been located the Antarctic Intermediate Water (AAIW) with relative salinity minimum (34.3, 5°C), and below the AAIW was been located the Pacific Deep Water (PDW) (34.7 and 1.7°C). Regarding the distribution of the water mass in the interest area, Figure 3 shows the temperature, salinity, and oxygen sections at ~27°S from the CIMAR 22 cruise (carried out between October 15 and 23, 2017) indicating the water masses in the salinity panel. From 82° W toward the Continent, it weakens the STW (0-200 m) and strengthens in the surface layer the salinity minimum (due to the South Pacific Intermediate Water, ESPIW) and the Equatorial Subsurface Water (ESSW) until the 380 m with a relative salinity maximum and an oxygen minimum (34.7, <0.1 mL/L), and subsequently the AAIW with a similar signal to offshore region.

Superimposed on this mean circulation, there is a relatively energetic mesoscale circulation (non-linear), whose amplitude is greater near the equator and alongshore off Peru and Central Chile, which results from the instability of the mean currents and mesoscale eddies, mainly by the Peru-Chile Undercurrent (Hormazabal et al. 2013; Contreras et al. 2019; Dewitte et al. 2021). Mesoscale eddies generated along the coast have a complex vertical structure, with some cyclonic superficial eddies and other anticyclonic subsurface eddies, called intra-thermocline eddies, associated with the ESSW (Hormazabal et al. 2013; Frenger et al. 2018; Auger et al. 2021). Such eddies can also transport low-oxygen waters and other properties in their core far beyond the longitude of these island systems (Cornejo et al. 2016; Auger et al. 2021). In this sense, the Desventuradas and Juan Fernandez seamount systems are located in the route of westward-propagating eddies generated along the coast of Central Chile and forming a so-called striation in the eddy field (Belmadani et al. 2017). In addition, these topographic elevations potentially affect ocean and local circulation (Rogers 2018). In the case of oceanic islands, there is an island mass effect, as it produces a bloom in phytoplankton in the island wake (Andrade et al. 2014) or sometimes far from the island (Messié et al. 2020). Several physical processes can be involved in the island mass effect, such as coastal upwelling, Ekman pumping, eddies, or internal waves, and even the local human impacts (Gove et al. 2016). Thereby, the bathymetric and longitudinal variation of oxygen, temperature and salinity can influence marine species hosted by the seamounts near the continent, depending on the depth of the top of each seamount and the circulation patterns.

Robust evidence indicates a southward expansion of the SPSH during the last decades associated with global warming (Grise et al. 2018, 2020). This migration is currently strongly impacting climate variability off Chile in two ways i) promoting a megadrought in the central zone (Garreaud et al. 2020) and ii) altering oceanic and coastal atmospheric dynamics by impacting surface winds (Falvey & Garreaud 2009; Belmadani et al. 2014; Ancapichún & Garcés-Vargas 2015) and coastal upwelling (Schneider et al. 2017; Weidberg et al. 2020; Aguirre et al. 2018). Therefore, it is highly probable that this migration of the SPSH also generates impacts on the physical and biogeochemical properties of the insular marine ecosystem. For instance, it yields the expectation that the effectiveness of the physical connectivity will increase both between the Salas y Gomez islet and Easter Island and between the Juan Fernandez and Desventuradas Archipelago (Dewitte et al. 2021).



Mean Surface Current

Figure 2. Mean surface current from drifter data (Laurindo et al., 2017) for the period 1975–2015. Shading is for amplitude and vectors provide the direction (Taken from Dewitte et al. 2021). Contours in gray correspond to the mean sea surface temperature. Black dots indicate the locations of Juan Fernandez Islands, Desventuradas Islands, and Easter Island.

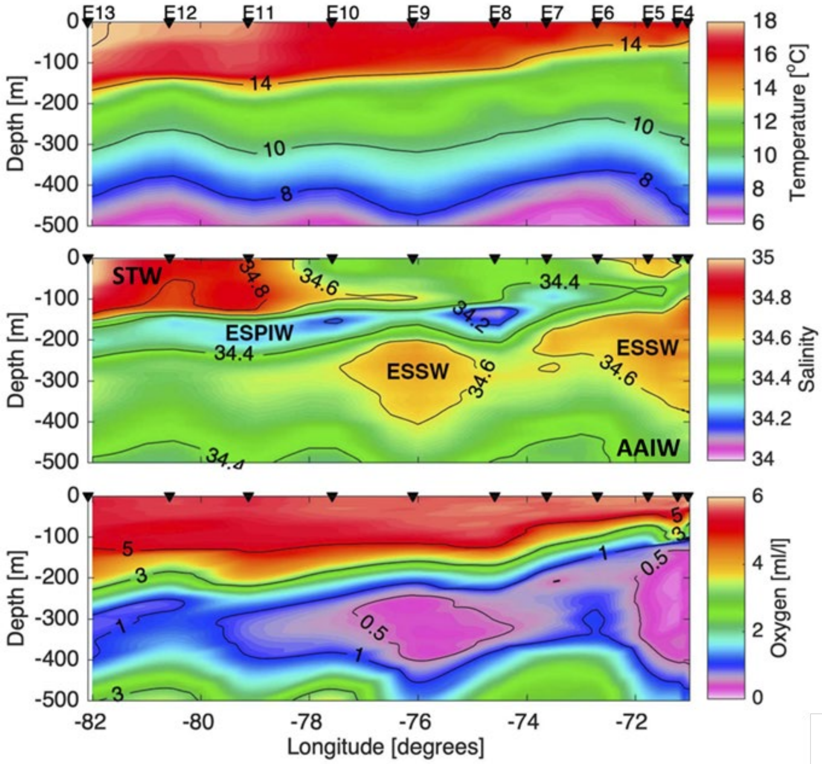


Figure 3. Temperature, salinity, and oxygen sections throughout CIMAR 22 transect at ~27°S (carried out between October 15 and 23, 2017). The water masses are: Subtropical Water (STW), South Pacific Intermediate Water (ESPIW), Equatorial Subsurface Water (ESSW), and Antarctic Intermediate Water (AAIW).

5. Biodiversity and ecology

Despite its geographic proximity to South America, the biodiversity of the Salas y Gómez and Nazca ridges is isolated from South America by the Humboldt Current System and the Atacama Trench (Figure 1; Von Dassow & Collado-Fabbri 2014). In fact, the marine fauna of this region has higher biogeographical affinities to the Western Indo-Pacific than to the Eastern Pacific (Rehder 1980; Newman & Foster 1983; Parin 1991; Parin et al. 1997; Pequeño & Lamilla 1995; Pequeño & Lamilla 2000; Poupin 2003; Burridge et al. 2006; Gálvez-Larach 2009; Dyer & Westneat 2010; Friedlander et al. 2013; Friedlander et al. 2016; Mecho et al. 2019; Sellanes et al. 2019; Wagner et al. 2021). The isolation of the Salas y Gómez and Nazca ridges has produced a unique biodiversity that is marked by one of the highest levels of marine endemism on Earth. For many taxonomic groups, close to half of the species are endemic to the region and found nowhere else on our planet (Rehder 1980; Newman & Foster 1983; Parin 1991; Parin et al. 1997; Poupin 2003; Moyano 2005; Gálvez-Larach 2009; Friedlander et al. 2013; Fernández et al. 2014; Friedlander et al. 2016; Mecho et al. 2019; Sellanes et al. 2019).

In addition to hosting a high abundance and diversity of unique organisms, seamounts on the Salas y Gómez and Nazca ridges provide important habitat and migration corridors for blue whales, leatherback turtles, swordfish, sharks, Jack mackerel, deep-water corals, shallow-water corals, and a myriad of other ecologically important species (Arcos et al. 2001; Gálvez-Larach 2009; Gálvez 2012a; Yáñez et al. 2012; Hucke-Gaete et al. 2014; CBD 2017; Wagner et al. 2021). In particular, the Salas y Gómez and Nazca ridges are home to 93 species that are considered endangered, near threatened or vulnerable to extinction, including 25 species of sharks and rays, 21 species of birds, 16 secies of corals, seven species of marine mammals, seven species of bony fishes, fives species of marine turtles, and one species of sea cucumber (IUCN 2020; Wagner et al. 2021).

Due to its high productivity, the region also provides important habitat for a high diversity and density of seabirds (CBD 2017; Serratosa et al. 2020; Wagner et al. 2021).

Water clarity in the central portion of this region, particularly around the Salas y Gómez Ridge, is exceptionally high. This clarity allows sunlight to reach deeper depths than in other ocean areas. Recent scientific explorations of seamounts on the Salas y Gómez and Nazca ridges indicate that photosynthetic marine communities in this region occur below 300 m depth, deeper than in any other place on Earth (Easton et al. 2019; Wagner et al. 2021).

5.1. Benthic zone

Deep waters surrounding the Salas y Gómez and Nazca ridges intersects a region that has some of the most oxygen poor waters in the world (Ulloa & Pantoja 2009; Fuenzalida et al. 2009; Espinoza-Morribedon et al. 2019). While there is very limited information of the deep-water fauna in this oxygen minimum zone, studies in other parts of the world have shown that such deoxygenated waters host a unique assemblage of species (Rogers 2000). Much like the Humboldt Current System, the oxygen minimum zone near the Salas y Gómez and Nazca ridges may act as an additional biogeographical barrier to dispersal, thereby leading to an increase of deep-water speciation in this region (Rogers 2000).

Limited deep-sea explorations that surveyed different seamounts across the Salas y Gómez Ridge found that the fauna on every seamount has a unique community composition, with nearly no species shared between opposite ends of the ridge (Comité Oceanográfico Nacional de Chile 2017). These results, together with recent explorations of selected seamounts of the Nazca Ridge within the Chilean EEZ (Tapia-Guerra et al. 2021b), suggest that each seamount of this region is unique, and it is therefore not enough to protect only some of them to protect representative biodiversity. Furthermore, these deep-sea explorations have documented numerous species that are new to science, including fishes (Parin & Shcherbachev 1982; Anderson & Johnson 1984; Parin & Kotlyar 1989; Parin & Sazonov 1990; Parin 1992; Garth 1992; McCosker & Parin 1995; Galil & Spiridonov 1998; Anderson & Springer 2005; Anderson 2008; Motomura et al. 2012; Schwarzhans 2014; Easton et al. 2019), mollusks (Sellanes et al. 2019), polychaetes (Diaz-Diaz et al. 2020) and crustaceans (Gallardo et al. 2021a). For instance, limited ROV surveys at 160-280 m depths recorded six new species of fishes (Easton et al. 2017), 15 morphospecies not previously reported and including two potential new genera of echinoderms (Mecho et al. 2019), dense assemblages of whip black corals (*Stichopathes* spp.) represented by at least four morphospecies (Asorey et al. 2021; Tapia-Guerra et al. 2021a), as well as mushroom-coral (*Cycloseris vaughani*) fields at mesophotic depths off Rapa Nui (Hoeksema et al. 2019). This high rate of discoveries indicates that the marine fauna of this region still contains a large number of undiscovered species, which represent an enormous opportunity for future scientific exploration and conservation (Reiswig & Araya 2014; Fernández et al. 2014; Easton et al. 2017; Wagner et al. 2021). As an example, living individuals of the gastropod *Architectonica karsteni* were recently found on seamounts of the Nazca Ridge (Asorey et al. 2020). This ancient gastropod was previously only known from this region from Miocene paleontologic records in Chilean waters (Asorey et al. 2020).

Furthermore, recent investigations developed at bathyal and abyssal sediments shows that seamount meiofaunal communities are characterized by high diversity of nematodes and low presence of other meiofaunal groups. The sediment geochemistry shows a poor organic content explained by the low values of chlorophyll-a, carbon and nitrogen observed, mainly in the area of Salas y Gomez seamounts (Horacek et al., 2022).

First results on macrofaunal communities (300 micrones) indicate that polychaetes and harpacticoid copepods are dominant at the base of studied seamounts. The overall number of individuals per species is low and the diversity of species is moderate. It is important to note that the number of species was higher in those seamounts where polymetallic nodules were recorded (Soto et al. 2020). Sediment microbial communities were dominated by Proteobacteria (50%) and by the presence of Firmicutes, Acidobacteria, Cloroflexi, Plactinomycetes, Actinobacteria and Gemmatimonadetes (Soto et al. 2020).

5.2. Pelagic zone

The Salas y Gómez Ridge and the southern portion of the Nazca Ridge are located near the center of the South Pacific Gyre, an area characterized by very nutrient-poor waters with the deepest chlorophyll maximum (Ras et al. 2008), and a particularly high biodiversity for picoplankton, siphonophores and other gelatinous pelagic invertebrates (Morel et al 2010; Von Dassow & Collado-Fabbri 2014; González et al. 2019). Studies made by Medellin et al. (2021) about mesozooplankton communities at depths between 0 and 800 meters in the area of Salas y Gómez and Rapa Nui recorded high diversity of copepods. The copepod community was dominated by small-sized species, omnivores and with a higher presence of the cyclopoid order.

Neustonic polychaete assemblages recorded a dominance of meroplanktonic species with higher abundance and diversity of the Spionidae family. The structure of polychaete assemblage is determined by the interaction between mesoscale oceanographic processes (IME) as well as the distance from seamounts and oceanic islands (Gusmao et al. 2022).

5.3. Fishes

Shallow water fishes along the Salas y Gómez and Nazca ridges are found mostly around the emergent islands of Rapa Nui, Motu Motira Hiva, and Desventuradas. These shallow water fish assemblages are primarily of Indo-Pacific origin but are impoverished compared with locations further to the west in the central Pacific. Despite the low taxonomic diversity of these locations, they are known to have some of the highest marine endemism found anywhere on Earth as a result of their extreme geographic and oceanographic isolation (Figure 4; Friedlander et al. 2013, 2016; Friedlander & Gaymer 2021). The first scientific paper on the fishes of Rapa Nui was published in 1912 (Kendall & Radcliffe 1912) and since then numerous papers have been published on the subject. There are currently 164 nearshore and epipelagic species known from Rapa Nui, of which 21.7% are known only from that island (Randall & Cea 2011). At the eastern end of the Salas y Gómez and Nazca ridges, the Desventuradas Islands has only 43 species of nearshore fishes, of which an incredible 56% are endemic to Desventuradas and nearby Juan Fernández islands (Dyer & Westneat 2010). These endemics are numerically dominant components of the fish assemblage at all these locations and these extremely high values of endemism highlight the global significance and uniqueness of these biodiversity hotspots (Friedlander et al. 2013, 2016; Delrieu-Trottin et al. 2019).

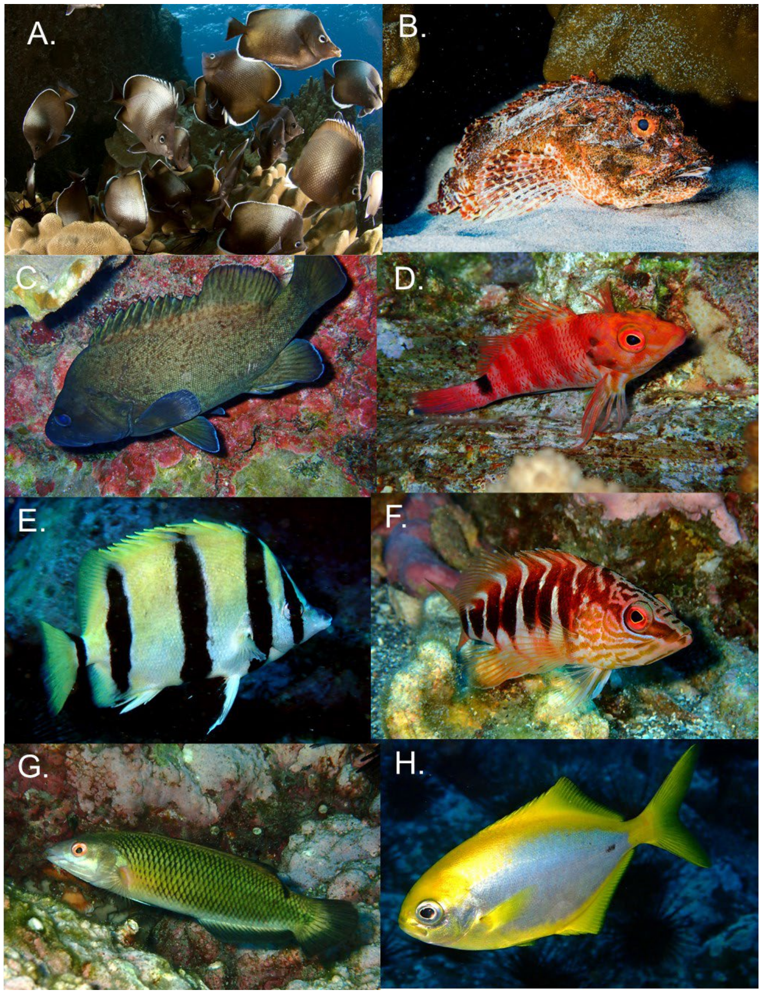


Figure 4. Endemic fishes of the Salas y Gómez and Nazca ridges. A. Easter Island butterflyfish, *Chaetodon litus*, B. Bold scorpionfish, *Scorpaena orgila*, C. Rapanui seabass, *Acanthistius fuscus*, D. Wilhelm's hawfish, *Itycirrhitus wilhelmi*, E. Narrow-barred butterflyfish, *Amphichaetodon melbae*, F. Cabrilla, *Hypoplectrodes semicinctum*, G. Reticulated wrasse, *Malapterus reticulatus*, H. Chilean sandpaperfish, *Paratrachichthys fernandezianus*.

High fish biomass and the abundance of top predators (primarily sharks and jacks) at uninhabited Motu Motiro Hiva compared with Rapa Nui is likely evidence of extensive and long-term overfishing of target species at Rapa Nui (Figure 5; Friedlander et al. 2013; Zylich et al. 2014; Petit et al. 2021, 2022). Similarly, higher fish biomass and more top predators at uninhabited San Ambrosio Island in the Desventuradas Islands compared with the nearby populated Robinson Crusoe Island in the Juan Fernández Archipelago also shows how even small amounts of fishing effort can have significant impacts on the fish assemblages in these small, isolated ecosystems where recruitment is limited (Friedlander et al. 2016).

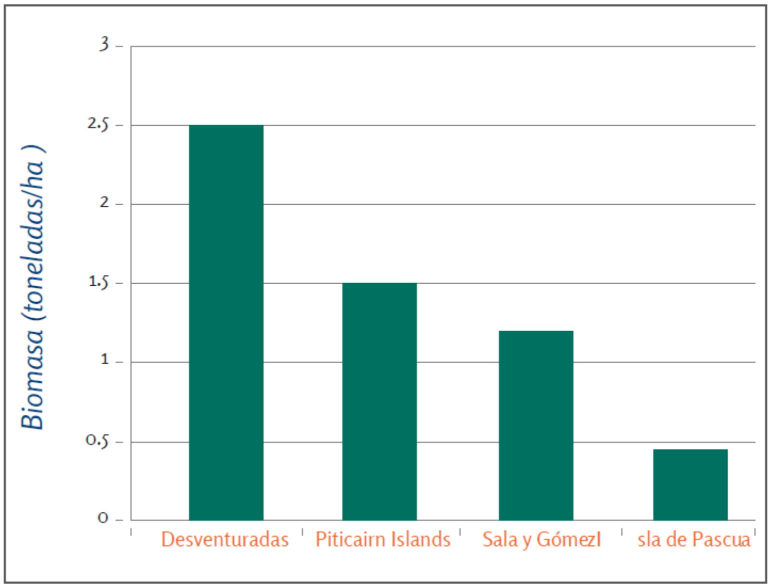


Figure 5. Comparison of coastal fish biomass between islands at both extremes of the Salas y Gómez ridge (Desventuradas, Salas y Gómez and Rapa Nui) and Pitcairn. Taken from National Geographic and Oceana (2013).

The first deep-sea benthic ichthyological collection from the Nazca-Sala y Gomez area was made by the Downwind Expedition of the Scripps Institution of Oceanography in 1958 and consisted of a single specimen of sea robin, *Pterygotrigla picta* (Hubbs 1959). Much of the early comprehensive research on fishes of these ridges comes from Soviet research trawling in the 1970s and 1980s (Parin 1991). From these surveys, a total of 173 species of fishes, in 66 families, exclusive of pelagic species, were described from these seamounts (Parin 1991; Parin et al. 1997). Of these, 136 species in 58 families were found at depths of 160–580 m. The other 37 species are deeper-dwelling species found on the seamount slopes at depths of more than 600 m. As with the shallow water fish assemblages, Parin (1991) found an extremely high degree of endemism (42.8%) in the deep-sea fish fauna. Recent surveys of the deep-dwelling fishes of the Easter Island Ecoregion by Easton et al. (2017) revealed apparent depth breaks in fish assemblages between 150 m and 550 m and between 850 to 1100 m, which are comparable to breaks in the fish assemblages observed by Parin et al. (1997) for seamounts along the Nazca and eastern Salas y Gómez Ridges. Several deeper water fish species endemic to Rapa Nui and Motu Motira Hiva at the western edge of the ridge and are also found near Desventuradas to the east, which suggest some level of species connectivity along this extensive ridge system (Friedlander et al. 2021).

Seamounts on the Salas y Gómez and Nazca ridges provide important habitat and migration corridors for numerous pelagic fishes. There has been historical fishing targeting Chilean jack mackerel (*Trachurus murphyi*), redbaits (*Emmelichthys* spp.), several species of tuna (*Thunnus alalunga*, *T. obe*sus, *T. albacares*, and *Katsuwonus pelamis*), and bonito (*Sarda* spp.) (Gálvez-Larach 2009). Several species of billfishes (Istiophoridae) as well as sharks (*Prionace glauca*, *Carcharhinus* spp., *Sphyrna* spp., and *Alopias* spp.) have previously been recorded as retained catch managed by the Inter American Tropical Tuna Commission (IATTC) in high seas waters of the Salas y Gómez and Nazca ridges (IATTC 2020).

Overall, the shallow and deep-water fish assemblages of the Salas y Gómez and Nazca ridges harbor some of the most unique fish faunas found anywhere on Earth. However, the high degree of endemism also suggests that these assemblages have relatively limited dispersal potential and therefore pose higher extinction risks compared with more widely dispersed species. In addition, these endemics often have small thermal tolerances and unique habitat and environmental requirements, making them more susceptible to climate change. Seamounts are hotspots of pelagic biodiversity and the chain of seamounts along the ridge harbors a diverse assemblage of pelagic fishes and is an important corridor for many commercially important fisheries species.

5.4. Seabirds

Seabirds switch from their reproductive habitat on islands to their foraging habitat at sea: as central place foragers, they rely on marine resources for feeding and need to come ashore for breeding. Seabirds feed in various ways and eat from planktonic prey through invertebrates to fish (Schreiber & Burger 2002). Thus, seabirds are globally essential drivers of nutrient cycling, transferring nutrients from their pelagic feeding grounds to islands on which they roost and breed (Graham et al. 2018). As top marine predators, seabirds respond to changes in the oceanography, ocean productivity, and the ecology of their prey (e.g., squid and fish), shifting their at-sea distributions over multiple temporal scales (i.e., seasonally, interannually).

Around the Nazca and Salas & Gomez Ridges there is three archipelagos grouping a total of 10 islands: Rapa Nui (Rapa Nui, Moto Nui, Motu Iti, and Salas & Gomez), Desventuradas (San Ambrosio, San Felix, and Islote Gonzalez), and Juan Fernández (Robinson Crusoe, Santa Clara, and Alejandro Selkirk). These oceanic islands provide the nesting habitats for almost 24 seabird species (Table 1; Gusmao et al. 2020). For instance, species such as the Christmas Island shearwater (*Puffinus nativiatis*), the White-throated Storm-petrel (*Nesofregetta fuliginosa*), and the Masked booby (*Sula dactylatra*) nest in Salas y Gómez Island. Similarly, the Defilippi's Petrel (*Pterodroma defilippiana*) is an endemic species that only nests on Desventuradas, and Juan Fernández archipelagos. These three insular systems are considered in the list of Important Bird and Biodiversity Areas, which are considered essential sites for the conservation of birds globally (BirdLife 2022). However, seabirds inhabiting these islands are threatened by plastic contamination (Luna-Jorquera et al. 2019) and invasive species (Luna et al. 2018; Varela et al. 2018). The study of Gusmao et al. (2020) revealed that the structure of nesting assemblages across these islands is significantly different, reflecting changes in water temperature, primary productivity, and physiographic features of the islands (i.e., area, elevation and distance to the continent). Notably, species composition between the islands is significantly different and explained mainly by species replacement, highlighting the relevance of developing conservation programs adapted for each island (Plaza et al. 2021).

Tabla 1. Richness of seabird species nesting on the islands around the Nazca and Salas & Gomez Ridges (1=presence; 0=absence). Data extracted from Gusmao et al. (2020).

Archipelago-Islands/Species	**Desventuradas**			**Juan Fernández**			**Rapa Nui**			
	Gonzalez	San Ambrosio	San Felix	Alejandro Selkirk	Robinson Crusoe	Santa Clara	Motu Iti	Motu Nui	Rapa Nui	Salas y Gómez
Anous stolidus	0	1	1	0	0	0	0	1	0	1
Ardenna creatopus	0	0	0	0	1	1	0	0	0	0
Ardenna pacifica	0	0	0	0	0	0	0	1	0	0
Fregata minor	0	0	0	0	0	0	1	1	0	1
Fregetta grallaria	0	1	1	1	1	1	0	0	0	0
Gygis alba	0	0	0	0	0	0	0	0	0	1
Nesofregetta fuliginosa	0	0	0	0	0	0	0	0	0	1
Onychoprion fuscatus	0	1	1	0	0	0	0	0	0	1

Phaethon aethereus	0	0	0	0	0	0	0	0	0	1
Phaethon lepturus	0	0	1	0	0	0	0	0	1	0
Phaethon rubricauda	0	1	0	0	0	0	0	1	1	1
Procelsterna albivitta	1	1	0	0	0	0	0	1	0	1
Pterodroma alba	0	0	0	0	0	0	0	1	0	0
Pterodroma atrata	0	0	0	0	0	0	0	1	0	0
Pterodroma defilippiana	1	1	1	1	1	1	0	0	0	0
Pterodroma externa	0	0	0	1	0	0	0	0	0	0
Pterodroma heraldica	0	0	0	0	0	0	0	1	0	0
Pterodroma longirostris	0	0	0	1	0	0	0	0	0	0
Pterodroma neglecta	0	1	1	0	1	1	0	1	0	1
Pterodroma nigripennis	0	0	0	0	0	0	0	1	0	0
Pterodroma ultima	0	0	0	0	0	0	0	1	0	1
Puffinus nativitatis	0	0	0	0	0	0	0	1	0	1
Sula dactylatra	1	1	1	0	0	0	1	1	0	1
Sula nebouxii	0	0	1	0	0	0	0	0	0	0
Total	3	8	8	4	4	4	2	13	2	12

As mentioned, seabirds depend on the marine ecosystem for feeding and reacting to changes in the oceanography, ocean productivity, and food (i.e., zooplankton, squid, and fish). The Salas y Gómez and Nazca Ridges provide foraging ground for almost 54 seabirds (Table 2), which considers the species breeding on the islands (see above) and species that visit the area for feeding (Serratosa et al. 2020). The latter study established that environmental conditions explain two community-level features highly related to the productivity in the area. First, the seabird abundance gradient observed between the continent and the oceanic islands responds to the distance to the Chilean coast, the ocean depth, and the influence of the coastal upwelling systems. Second, the seabird richness is explained by seasonality and the occurrence of water mass boundaries caused by sea surface temperature gradients. Thus, the environmental conditions of Salas & Gomez and Nazca Ridges greatly influence the distribution and abundance of a significant number of species, shaping the biogeography of seabirds of the South Pacific Ocean.

The marine ecosystem of the Salas & Gomez and Nazca Ridges and oceanic islands associated with it provide suitable nesting sites and foraging ground for a number of seabird species. This whole oceanic system supports a high richness of seabird species, so its protection is vital for conserving them as essential components of the oceanic marine ecosystems.

Table 2. Seabird species registered in the Salas & Gómez and Nazca Ridges. The list considers (a) data on the occurrence and abundance collected through 11 offshore surveys conducted from 2014 to 2017 by the Laboratory of Ecology and Diversity of Seabirds EDAM (Serratosa et al. 2020; Luna-Jorquera unpublished data), and (b) occurrence data obtained from gbif.org (Global Biodiversity Information Facility) and obis.org (Ocean Biodiversity Information System).

n	species	EDAM	GBIF	OBIS	n	species	EDAM	GBIF	OBIS
1	*Anous stolidus*	1	1		**29**	*Procellaria cinerea*	1		
2	*Ardenna bulleri*		1		**30**	*Procellaria westlandica*	1		
3	*Ardenna creatopus*	1	1		**31**	*Procelsterna albivitta*	1	1	1
4	*Ardenna grisea*		1		**32**	*Pterodroma alba*	1	1	
5	*Ardenna pacifica*		1		**33**	*Pterodroma atrata*		1	
6	*Creagrus furcatus*	1	1		**34**	*Pterodroma defilippiana*	1	1	
7	*Daption capense*	1	1		**35**	*Pterodroma externa*	1	1	
8	*Diomedea exulans*	1	1	1	**36**	*Pterodroma heraldica*	1	1	
9	*Diomedea nigripes*		1		**37**	*Pterodroma lessoni*	1		
10	*Diomedea sanfordi*	1			**38**	*Pterodroma longirostris*	1	1	
11	*Fregata minor*	1			**39**	*Pterodroma magentae*			1
12	*Fregetta grallaria*	1	1		**40**	*Pterodroma neglecta*	1	1	1
13	*Fulmarus glacialoides*		1		**41**	*Pterodroma nigripennis*		1	
14	*Gygis alba*			1	**42**	*Pterodroma ultima*	1	1	
15	*Macronectes giganteus*	1	1	1	**43**	*Puffinus gravis*			1
16	*Macronectes halli*	1	1		**44**	*Puffinus griseus*	1		1
17	*Nesofregetta fuliginosa*	1	1		**45**	*Puffinus nativitatis*	1	1	1
18	*Oceanites oceanicus*	1	1		**46**	*Puffinus puffinus*		1	
19	*Oceanodroma markhami*	1			**47**	*Stercorarius chilensis*	1	1	
20	*Onychoprion fuscatus*	1	1		**48**	*Stercorarius longicaudus*		1	
21	*Pachyptila belcheri*	1			**49**	*Stercorarius parasiticus*		1	
22	*Phaethon aethereus*		1		**50**	*Sula dactylatra*	1		
23	*Phaethon lepturus*		1		**51**	*Thalassarche bulleri*	1	1	

24	*Phaethon rubricauda*	1	1	
25	*Phalaropus fulicaria*	1		
26	*Phoebastria irrorata*		1	
27	*Phoebastria nigripes*			1
28	*Procellaria aequinoctialis*	1	1	
52	*Thalassarche chrysostoma*	1	1	1
53	*Thalassarche melanophris*	1	1	1
54	*Thalassarche salvini*		1	
	Total	**36**	**40**	**12**

5.5. Turtles

The Salas y Gómez and Nazca ridges provide migratory corridors and foraging habitats for the five sea turtle species reported in the Eastern Pacific Region. Three of them have been catalogued as critically endangered in the region by the IUCN (*Caretta caretta-South Pacific Subpopulation, Dermochelys coriacea-East Pacific Subpopulation* and *Eretmochelys imbricata*), one as Endangered (*Chelonia mydas*), and one as Vulnerable (*Lepidochelys olivacea*). Particularly in Easter Island, there is evidence of the presence of four of these species. Individuals of *D. coriacea* and *C. caretta* were caught by longline fishery targeting swordfish around the island as part of a research/fishery cruise supervised by the Fisheries Development Institute-IFOP in 2004. Also, in 2016 a juvenile loggerhead (*C. caretta*) was found with fishing line in both anterior flippers causing their amputation and death, and corroborating the presence of the species in Rapa Nui (Thiel et al. 2018). *E. imbricata* was recently described for the island (and Chile) with reports based on underwater photographs and strandings (Álvarez-Varas et al. 2015a; Figure 6), and *C. mydas* has been referred as the most common species in this place with growing research during the last years (Álvarez-Varas et al. 2015b, 2020a,b, 2021, 2022). Although *L. olivacea* has also been mentioned as a turtle species that inhabits Rapa Nui, there are no photographs, fishery reports or museum collection pieces that confirm its presence in the island.

Figure 6. Individual of *Eretmochelys imbricata* swimming in coral reef 200 m west of Hanga Roa Bay, Easter Island (taken from Álvarez-Varas et al. 2015).

Shillinger et al. (2008) tagged forty-six female leatherbacks (*D. coriacea*) in Costa Rica between 2004 and 2007 and confirmed the existence of a persistent migration corridor spanning from the Pacific coast of Central America, across the equator and into the South Pacific Gyre where probably leatherbacks migrate to forage (Shillinger et al. 2008). This multi-year dataset corroborated leatherbacks movements around Easter Island, Salas and Gomez and Juan Fernandez Archipelago (Shillinger et al. 2008; Figure 7). In the same way, Chandler (1991) mentioned that leatherbacks were frequently caught near Juan Fernandez. Another species commonly sighted in Juan Fernandez is *C. mydas*; however, to date there are no scientific or technical reports confirming its presence in this place. A study based on genetic data suggested post-hatchling loggerhead turtles emerging from the southwest Pacific rookeries undertake developmental transoceanic migrations to the southeastern Pacific Ocean associated with the South Pacific subtropical gyre (Boyle et al. 2009). It is probable that the absence of sea turtle reports in some specific areas associated with Salas y Gómez and Nazca ridges is due to a lack in monitoring and research specifically aimed at these species.

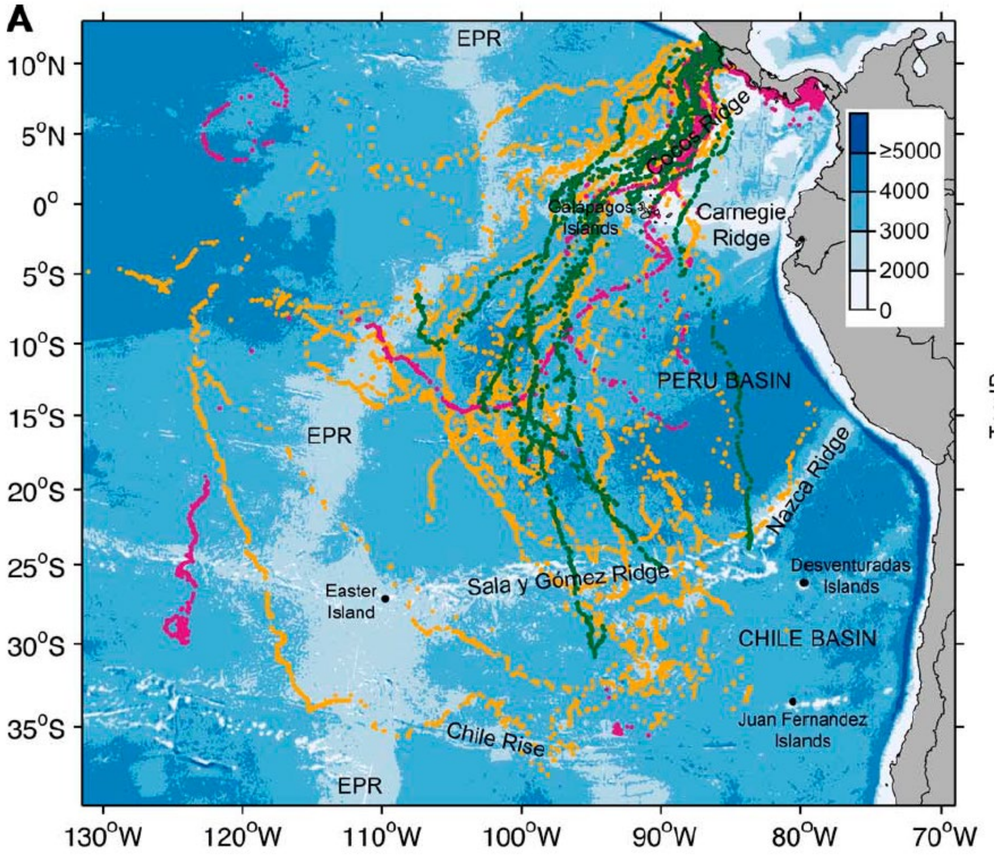


Figure 7. Map and Timeline of Leatherback Sea Turtle Tracking Data. Satellite transmission positions for 46 leatherback turtles from 2004 (n=27, orange), 2005 (n=8, purple), and 2007 (n=11, green), tagged at Playa Grande, Costa Rica, overlaid on bathymetry (in m). Prominent bathymetric features and island groups are labeled (EPR = East Pacific Rise) (Taken from Schillinger et al. 2008).

Recent investigations of *C. mydas* in Rapa Nui have demonstrated the existence of two morphotypes: black and yellow (Álvarez-Varas et al. 2015b). These morphotypes are concordant with two Pacific genetic lineages, which have different natal origins (Álvarez-Varas et al. 2020a, 2021). Black morphotype has its origin in the Eastern Pacific (Galapagos and Mexico), whereas yellow turtles come from French Polynesia (Álvarez-Varas et al. 2022). These findings, together with the evidence of extensive migrations of the critically endangered leatherbacks from Central America (Shillinger et al. 2008) and loggerheads from the southwest Pacific rookeries, highlight the regional connectivity between populations and the relevance of this region for sea turtle conservation globally.

Ultimately, the need of further sea turtle research and protection in the Salas y Gómez and Nazca ridges is also supported by the existence of anthropogenic threats that have been detected in the region such as: bycatch, interaction with fishing gear (entanglements with fishing lines, ghost nets, fishhook ingestion, etc.), boat collisions, organic pollution, plastic pollution, snorkeling/diving with turtles and artificial hand-feeding by tourists and fishermen (Chandler 1991; Vega & Cortés 2005; Álvarez-Varas et al. 2015b, 2022; Thiel et al. 2018).

5.6. Marine mammals

There is a considerable lack of research regarding the status of marine mammals among Chile's EEZ and adjacent oceanic waters. The only systematic investigation on marine mammals performed to date was reported by Aguayo et al. (1998), and included five cruises between 1993-1995, from Valparaiso to Easter Island (Rapa nui) during the austral autumn and spring. Table 3 summarizes available information for the study area.

Table 3: Marine mammals recorded to date in the Nazca Ridge region and their current conservation status according to IUCN (International Union for the Conservation of Nature) and the MMA (Ministry of the Environment, Chile): DD: Data Deficient, EN: Endangered, VU: Vulnerable, LC: Least Concern; IC: Insufficiently Known.

Scientific name	Vernacular name	References	IUCN	MMA
ORDER CETARTIODACTYLA **INFRAORDER CETACEA**				
Family Balaenopteridae				
Balaenoptera musculus	Blue whale	1,10, 11	EN	EN
Balaenoptera edeni	Bryde´s whale	1	DD	DD
Balaenoptera bonaerensis/acutorostrata	Antarctic/Dwarf Minke whale	1, 13	DD	IC
Megaptera novaeangliae	Humpback whale	1,2,3,10	LC	VU
Family Physeteridae				
Physeter macrocephalus	Sperm whale	1,2,4	VU	VU
Family Ziphiidae				
Ziphius cavirostris	Cuvier's beaked whale	1	LC	IC
Mesoplodon densirostris	Blainville's beaked whale	1	DD	IC
Family Delphinidae				
Pseudorca crassidens	False killer whale	1,3,5	DD	IC
Globicephala macrorhynchus	Short-finned pilot whale	10	-	IC
Tursiops truncatus	Bottlenose dolphin	6	LC	LC
Delphinus delphis	Common dolphin	1,7	LC	IC

ORDEN CARNIVORA				
Family Otariidae				
Arctocephalus philippii	Juan Fernandez fur seal	12	LC	VU
Family Phocidae				
Mirounga leonina	Southern elephant seal	8	LC	IC
Hydrurga leptonyx	Leopard seal	7,9,10	LC	IC

Refs.: (1) Aguayo-Lobo et al. 1998; (2) Townsend 1935; (3) Garcia 1989; (4) Whitehead et al. 1996; (5) Cárdenas & Yáñez 1988; (6) Cárdenas et al. 1986; (7) Steadman et al. (1994); (8) Aguayo-Lobo et al. 1995; (9) Aguayo-Lobo et al. (2011); (10) Hucke-Gaete et al. 2014; (11) Hucke-Gaete et al. 2018; (12) Torres (1987); (13) Gales et al. (2013); (14) Félix & Guzman (2014).

Hucke-Gaete (2004) and Hucke-Gaete & Mate (2005) reported the migratory pathways of five blue whales (*Balaenoptera musculus*) instrumented with satellite transmitters in the Gulf of Corcovado, Chile (43°45'S, 73°30'W) during February 2004. During the austral fall, two whales moved north and offshore to the Nazca Ridge region (25°S and ca. 800 km offshore of Chile) where transmissions ceased. More recently, Hucke-Gaete et al. (2018) report further information on blue whale migratory routes (Figure 8) mostly crossing the study area on its eastern portion towards wintering grounds in the Eastern Tropical Pacific. For humpback whales, Félix & Guzmán (2014) report a similar, but more coastal, migratory corridor *en route* to summering grounds.

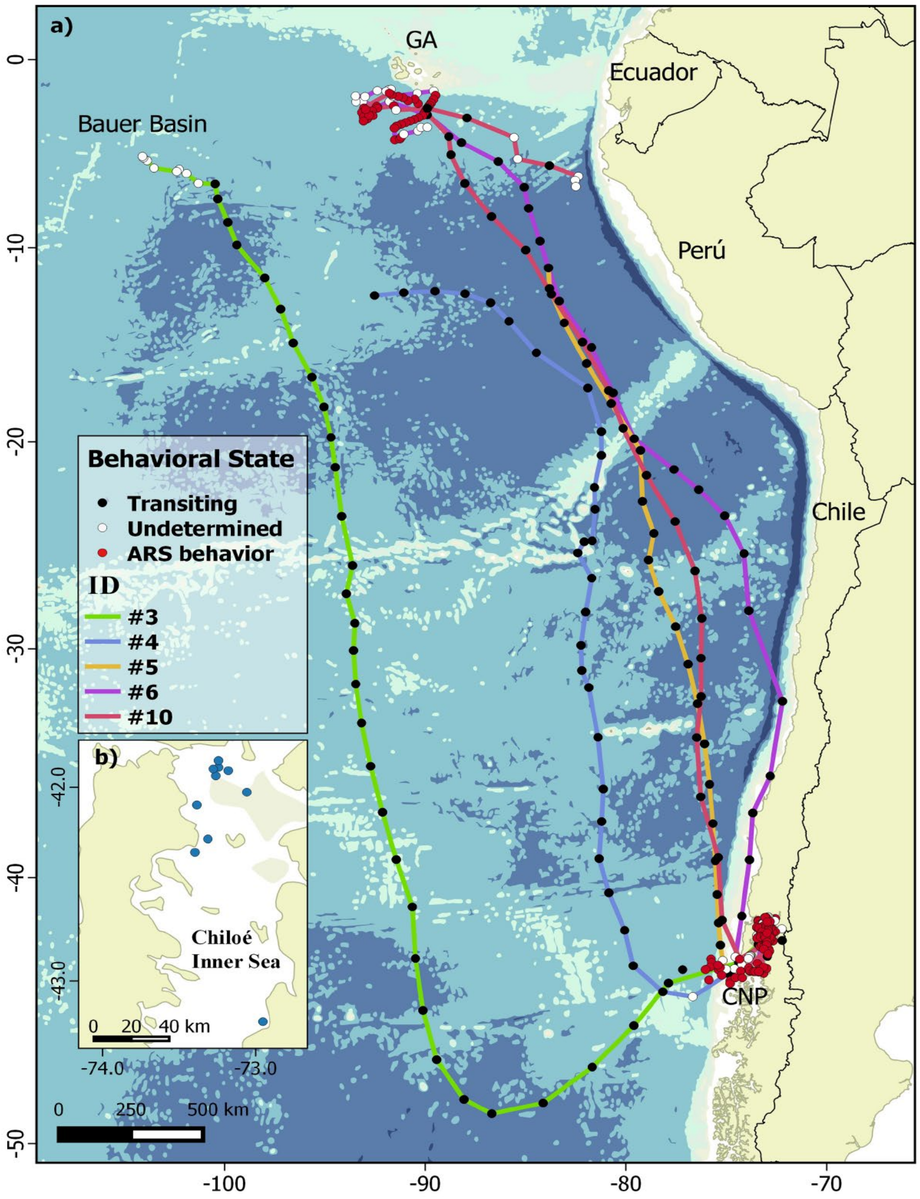


Figure 8: Migratory pathways of five blue whales along the Southeastern Pacific and crossing the Nazca Ridge, monitored using satellite transmitters (taken from Hucke-Gaete et al. 2018).

Recent information on other large whales (i.e. Bryde´s, minke and sperm) is lacking, other than that reported by Gales et al. (2013) on a minke whale migrating from Antarctica to the Salas y Gómez ridge. Small cetaceans are in need of further investigation, since oceanic dolphins and Ziphiids are known to inhabit these types of habitats regularly. In terms of pinnipeds, most records come from vagrants (elephant and leopard seals), but in the case of the endemic Juan Fernández fur seal, the study area is probably a very important region for fulfilling their life history requirements. Securing connectivity between critical habitats such as breeding and feeding grounds for large whales and other migratory species is fundamental. Evidence arising from recent telemetry studies have shed light on the timings and routes used by at least two baleen whale species (blue and humpback) on their migratory habits. As studies progress, further delineation of preferred routes and destinations will become available, but at this point evidence indicates that a conservative corridor should span from Central America (10°N in Costa Rica) to southern Patagonia (56°S in Chile), extending latitudinally for over 7,000 km and longitudinally for a breadth varying from 300 to 2,000 km. The Nazca Ridge is an integral part of this pathway and due considerations on diminishing threats for marine mammal species should be a must.

5.7. Connectivity between marine ecosystems

Both cosmopolitan and endemic species coexist in the Salas y Gómez and Nazca ridges, differing in time and space used by these species in the area. Fishes and turtles are among the species showing large geographic population extension that use this area to feed and follow traveling to other areas in the Pacific Ocean. An example of these species is the green turtle *Chelonia mydas*. *C. mydas* does not breed in the Nazca Ridge Islands and seamounts, however individuals of this species are frequently observed in the Rapa Nui coasts, coexisting the individuals that breeds in the eastern and western Pacific as was revealed by the use of mtDNA and SNPs by Alvarez-Varas et al. (2020, 2021, 2022). Another case is the yellowtail kingfish *Seriola lalandi*, a commercial fish species in both continental and insular systems (Zylich et al. 2014; Sernapesca 2022). Premachandra et al. (2017) used different molecular markers (mtDNA; microsatellites and SNPs) to indicate that there is only one genetic population of *S. lalandi* in the South Pacific. Although there are still no genetic studies on specimens of the Galapagos shark *Carcharhinus galapagensis* inhabiting the Nazca Ridge, large connectivity of its populations is expected considering their broad geographic extension in the Pacific and the null population genetic structure described with mtDNA and SNPs (Pazmiño et al. 2018).

The second group of species are the invertebrates and the reef fishes, which are mostly endemic. The life cycle of most of these organisms includes a low mobility or sedentary benthic adult phase and a planktonic larval phase. Movement of individuals among populations is carried out with the planktonic larvae, thus the distance of the population connectivity being dependent on the duration of the planktonic development. There are species that have a relatively short planktonic development time (up to three weeks) and low connectivity among populations. This is the case of the rudderfish *Kyphosus sandwicensis* that showed low connectivity between Rapa Nui and Salas & Gómez probably mediated by rafting (Valencia et al. 2021). On the other hand, species that have extended planktonic development (more than three months) have the largest connectivity between their populations. Using variability of microsatellite loci and a biophysical model, Meerhoff et al. (2018) described asymmetric connectivity between Rapa Nui and Salas & Gómez for the spiny lobster *Panulirus pascuensis*. Finally, the use of SNPs showed high population connectivity of the sea urchin *Centrostephanus sylviae* inhabiting both Desventuradas Islands and Juan Fernández Archipelago (Veliz et al. 2021).

Overall, the information obtained about connectivity in the Salas y Gómez and Nazca ridges shows that the Salas & Gómez and Nazca Ridges harbors species that travel to both sides of the Pacific Ocean and endemic species inhabiting a narrow area with a connectivity between populations depending on the duration of the planktonic larva development.

6. Cultural significance

6.1. Seafaring

The island of Rapa Nui includes one of the most renowned archaeological sites on Earth, which has been distinguished globally as a World Heritage Site by the United Nations, Educational, Scientific and Cultural Organization (UNESCO 1995). The broader region that contains the Salas y Gómez and Nazca ridges represents the easternmost extent of the Polynesian Triangle, a region with an exceptionally rich and long history of seafaring cultures (Metraux 1940; Anderson 2008; Ioannidis et al. 2020; Delgado et al. 2022).

The human history of the waters surrounding the Salas y Gómez and Nazca ridges is rich and culturally diverse. This ranges from indigenous cultures who first ventured to this remote region close to a thousand years ago to the period of European colonial exploration, as well as the rise of the modern global economy. Voyaging, fishing, and the transportation of commodities across these remote waters left signs of the human history of exploration and exploitation (Delgado et al. 2022).

6.2. Indigenous people

Several communities have profound connections to these remote waters, particularly communities from the islands of Rapa Nui, Juan Fernandez, as well as the Peruvian and Chilean continental coasts (Delgado et al. 2022). Recent evidence suggests that Polynesian voyagers traveled along the Salas y Gómez and Nazca ridges to the South American Continent long before European contact (Ioannidis et al. 2020; Delgado et al. 2022). Wilmé et al. (2016) hypothesized that the early Austronesians used the migration routes of sea turtles to move across the Southern Pacific Ocean, suggesting the importance of these species for the Pacific communities. Likewise, a recent study explored the historical and contemporary role of sea turtles on Rapa Nui, contrasting it with information from other Pacific region societies (Álvarez-Varas et al. 2020b). Such results showed a strong cultural connection among these islands, with turtles represented in their art, culture, mythology, symbolism, popular traditions, and ritual and spiritual life (Álvarez et al. 2020b).

In 2021 the Rapa Nui Sea Council was consulted about ABNJ of the Salas y Gomez and Nazca ridges, and they expressed the importance for them and their interest that this area is protected from actual and potential threats.

7. Major threats

7.1. Fishing activities

Soviet trawling occurred on seamounts of the Nazca and Salas y Gómez ridges for Jack mackerel (*Trachurus murphyi*) and redbaits (*Emmelichthys* spp.) in the 1970s and 1980s (Parin et al. 1997; Arana et al. 2009; Clark 2009). On seamounts around the Juan Fernández Archipelago, a commercial fishery for orange roughy (*Hoplostethus atlanticus*) and alfonsino (*Beryx splendens*) developed in 1998, but was closed in 2006 following decreasing catches (Tingley & Dunn 2018). Despite the closure, damage caused by bottom trawling was seen even a decade later during ROV surveys (OCEANA 2015). On the Nazca Ridge, Chilean and Russian vessels have fished for Chilean jagged lobster (*Projasus bahamondei*) and golden crab (*Chaceon chilensis*) (Parin et al. 1997; Payá et al. 2005; Gálvez-Larach 2009; Vega et al. 2009; Yáñez et al. 2009; Clark 2009; Arana 2014). On the Salas y Gómez Ridge, there has been historic pelagic long-line fishing, which has impacted sharks and other pelagic species (Vega et al. 2009; Gálvez 2012b; Friedlander et al. 2013).

There has been historical fishing targeting Jack mackerel, squid, tuna, striped bonito, marlin and swordfish on the Salas y Gómez and Nazca ridges (Gálvez-Larach 2009; Vega et al. 2009; Morales et al. 2021). However, today most of the fishing in this region targets pelagic species and is primarily focused on ABNJ outside Peruvian national waters of the Nazca Ridge (Figure 9; Global Fishing Watch 2020). Catch data on Jack mackerel, squid and orange roughy in this region are available from the South Pacific Regional Fishery Management Organization (Table 4; SPRFMO 2020a), whereas catch data on tuna and swordfish are available from the Inter-American Tropical Tuna Commission (IATTC 2020). Additional fishing effort data in this region are available from Global Fishing Watch (2020; Figure 9; Table 5).

Table 4. Recent catch data for several species managed by the South Pacific Regional Fishery Management Organization (SPRFMO) in the Salas y Gómez and Nazca ridges. (SPRFMO 2020). Table from Wagner et al. (2021), information from which was previously presented to the SPRFMO during its scientific committee meetings in October 2020 (SC8-Obs01) and September 2021 (SC9-Doc31_rev1).

Common name	Species	Years	Effort (hrs)	Comment
Orange roughy	*Hoplostethus atlanticus*	2007-2017	0	Fishery closed since 2006
Squid	*Dosidicus gigas*	2008-2015	20.5	Only effort recorded in 2016 (all other years it was zero)
Jack mackerel	*Trachurus murphyi*	2008-2016	2.17	Only effort recorded in 2011 (all other years it was zero)
Unidentified bony fishes	Osteichthyes	2008-2015	297	Only effort recorded in 2008 (all other years it was zero)

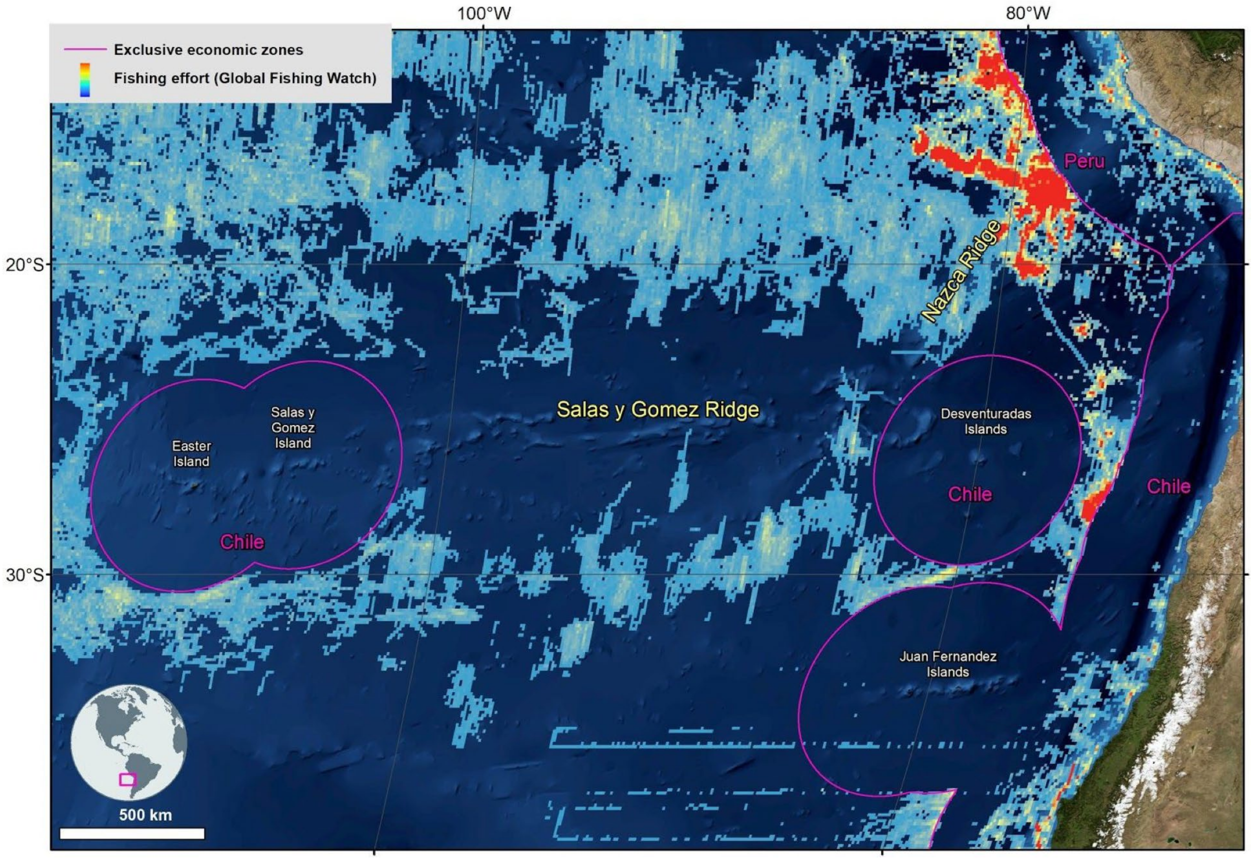


Figure 9. Annual fishing effort around the Salas y Gómez and Nazca ridges in 2016 (Global Fishing Watch 2020). Figure from Wagner et al. (2021), which was also previously presented to the SPRFMO during its scientific committee meetings in October 2020 (SC8-Obs01).

As noted in Table 2, the orange roughy fishery has been closed in this region since 2006, and therefore there is no current catch data from the Salas y Gómez and Nazca ridges (SPRFMO 2020a). According to data reported by SPRFMO, squid fishing is also low in the Nazca and Salas y Gómez Ridges. In 2008-2015, SPRFMO catch data only shows two vessels fishing in the area, for a cumulative time of 20.5 hrs (Table 2). Noteworthy, Global Fishing Watch data shows that squid jiggers were considerably more active in this region in 2012-2020 (Table 5). SPRFMO reported catch data for Jack mackerel and other unidentified bony fishes is also low in this region (Table 4). In 2008-2016, the total cumulative fishing effort was 2.17 hrs for Jack mackerel and 297 hrs for other unidentified bony fishes (SPRFMO 2020a). The total amount of Jack mackerel caught in this region from 2010-2016 was zero (SPRFMO 2020a).

Table 5. Total annual fishing effort (h) by vessel type for the Salas y Gómez and Nazca ridges. Global Fishing Watch (2020). Table from Wagner et al. (2021), which was also previously presented to the SPRFMO during its scientific committee meetings in October 2020 (SC8-Obs01).

Vessel Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	Annual mean
Squid jigger	82,578	120,531	145,632	172,948	192,630	196,833	199,209	194,899	182,322	1,487,582	165,287
Drifting longlines	56,785	72,650	73,405	76,751	76,333	81,127	83,902	84,225	80,089	685,267	76,141
Unknown	39,445	53,249	52,125	62,329	66,677	71,959	97,443	101,704	105,988	650,91	72,324
Non-fishing	4,478	7,591	8,205	9,407	10,190	11,413	10,703	10,732	6,146	78,865	8,763
Pole & line	2,266	2,266	2,266	2,266	5,966	6,914	15,510	16,435	13,411	67,300	7,478
Tuna purse seines	1,518	2,777	3,193	3,954	4,331	5,490	6,323	6,077	5,514	39,177	4,353
Seismic vessel	1,572	1,572	1,572	1,572	1,572	3,876	3,876	3,884	8	19,504	2,167
Specialized reefer	736	736	771	771	1,214	1,176	1,693	1,693	1,174	9,964	1,107
Tug	0	1,500	1,502	1	1	1,502	1,502	1,502	1,502	9,012	1,001
Cargo or tanker	612	612	1,015	869	801	869	1,015	1,194	287	7,274	808
Trawlers	382	446	502	534	565	613	616	626	593	4,877	542
Other purse seines	27	107	107	202	202	375	541	602	594	2,757	306
Passenger	0	0	0	435	443	451	451	451	16	2,247	250
Purse seines	0	0	0	48	48	117	126	126	57	522	58
Patrol vessel	0	0	0	0	0	0	0	167	0	167	19
Set longlines	16	16	16	16	16	16	16	16	16	144	16

Longline and purse seine catch data from IATTC indicate that six fleets (China, Colombia, Ecuador, Peru, Japan and Spain) are responsible for the majority of the catch targeting tuna-like species in the vicinity of the Nazca and Salas y Gómez ridges. In 2013-2017, the Chinese longline fleet caught 438 tons of fish in the area, 88% of which were albacore. Of this volume, approximately 81% was caught in an area north of the Salas y Gómez Ridge. The Chinese fleet obtained a higher catch of albacore and striped marlin within this area when compared to all other global fishing grounds. For all other fishery species, the Chinese fleet obtains higher catches outside the Salas y Gómez and Nazca ridges (Table 6).

Table 6. Total annual fishing effort (h) by vessel flag for the Salas y Gómez and Nazca ridges. *Vessel flags of countries members of SPRFMO; **Vessel flags of countries cooperating parties. Global Fishing Watch (2020).

Flag	2,012	2,013	2,014	2,015	2,016	2,017	2,018	2,019	2,020	Total	Annual mean
China*	123,814	179,954	202,838	242,148	270,247	281,794	313,989	316,255	298,374	2,229,413	247,713
Spain	46,807	56,553	56,177	57,728	55,119	58,156	58,435	59,568	57,149	505,692	56,188
Japan	4,734	9,801	9,801	9,818	12,030	13,370	15,537	14,487	14,487	104,065	11,563
Taiwan	5,053	5,568	7,510	7,289	7,329	7,038	7,046	6,705	5,473	59,011	6,557
Republic of Korea*	5,455	5,373	5,710	5,710	5,710	6,316	6,316	6,316	6,316	53,222	5,914
Unknown	99	905	1,045	1,366	1,463	4,698	8,347	7,113	4,509	29,545	3,283
Peru*	66	1,064	1,145	2,156	2,680	3,666	4,167	4,276	4,276	23,496	2,611
Ecuador*	252	546	1,637	1,637	1,645	2,192	2,647	2,572	2,459	15,587	1,732
Portugal	1,727	1,727	1,727	1,727	1,727	1,727	1,727	1,727	323	14,139	1,571
Colombia**	709	827	827	827	691	827	827	827	691	7,053	784
Panama**	432	432	252	252	252	897	953	1,188	1,188	5,846	650
Belize	37	37	37	37	578	578	578	578	578	3,038	338
Venezuela	306	306	306	319	319	378	357	378	316	2,985	332
Vanuatu*	196	196	204	66	66	66	742	891	310	2,737	304
USA*	100	37	183	160	240	240	323	202	194	1,679	187
Mexico	0	51	121	141	157	281	281	281	211	1,524	169
Cambodia	302	302	302	302	302	0	0	0	0	1,510	168
Fiji	93	93	93	101	101	101	101	101	101	885	98
Namibia	0	48	48	64	96	112	152	168	168	856	95
Germany	68	68	68	68	0	68	68	68	68	544	60
Argentina	48	48	48	48	48	64	72	72	72	520	58
Iraq	0	0	0	0	0	0	0	176	176	352	39
United Kingdom	8	8	8	8	8	8	8	91	91	238	26
Chile*	16	16	16	25	25	25	25	25	17	190	21
French Southern Territories	0	0	0	0	0	0	92	92	0	184	20
Russia*	11	11	11	11	11	11	19	19	19	123	14
New Caledonia	0	16	16	16	16	16	16	16	8	120	13
Bolivia	0	0	0	0	41	0	24	24	24	113	13
Falkland Islands*	16	16	16	8	16	16	8	8	8	112	12
Saint Vincent & Grenadines	0	0	110	0	0	0	0	0	0	110	12

New Zealand*	8	8	8	8	8	16	16	16	16	104	12
Australia*	0	0	0	8	8	8	16	24	24	88	10
Canada	8	8	8	8	8	8	8	8	8	72	8
Iceland	8	8	8	8	8	8	8	8	8	72	8
Italy	0	8	8	8	8	8	8	8	8	64	7
Brazil	0	0	0	16	16	24	0	0	0	56	6
Mozambique	0	0	0	8	8	8	8	8	8	48	5
Senegal	0	0	0	8	8	8	8	8	8	48	5
Nicaragua	40	0	0	0	0	0	0	0	0	40	4
Cook Islands*	0	0	0	0	0	0	0	19	19	38	4
Cyprus	0	18	18	0	0	0	0	0	0	36	4
Honduras	0	0	0	0	0	0	0	11	11	22	2

Colombia’s purse seine fleet mainly targets skipjack and yellowfin tuna and operates in a substantial portion of the Eastern Tropical Pacific. Within the Salas y Gómez and Nazca ridges, the Colombian fleet concentrates its efforts on the northern portion of the Nazca Ridge. In 2013-2017, catch per unit effort inside the region were between 143-354% higher when compared to the rest of the nearly 28 million square kilometers where the Colombian fleet operates (IATTC 2020).

The Ecuadorian fleet also concentrates its fishing effort in the northern section of the Nazca Ridge and targets bigeye, striped bonito, skipjack, and yellowfin, with skipjack tuna being most important. Catch per unit effort for yellowfin, skipjack, and bonito are higher within the region in comparison to all other fishing grounds where the Ecuadorian fleet operates. The Peruvian purse seine tuna fleet is relatively small and is essentially a coastal fleet operating north of the Nazca Ridge. In 2013-2017, this fleet did not operate in areas directly above seamounts of the Nazca Ridge or the Salas y Gómez Ridge (IATTC 2020).

The Japanese longline fleet operates in a vast area of the Pacific Ocean, but mostly north of the Salas y Gómez Ridge, and also on the Nazca Ridge. In 2013-2017, catch per unit effort for tuna on the Nazca Ridge was almost 26% higher than for all other Pacific fishing grounds. The Spanish longline fleet operates in close proximity of the Salas y Gómez and the Nazca ridges and targets Swordfish exclusively (Vega et al. 2009; IATTC 2020). In 2013-2017, the Spanish fleet caught more than 30% of its total catch within this region, and nearly 5% in areas north of the Nazca or Salas y Gómez Ridges. However, catch per unit effort was higher outside this region. Thus, although the Spanish fleet has caught large percentages of its total catch in this region, it has been much more productive outside of it (IATTC 2020).

7.2. Seabed mining

There are no known oil or gas reserves on or near the Salas y Gómez or Nazca ridges (Lujala et al. 2007), despite several efforts to explore offshore areas in this region (García et al. 2020). However, seamounts on the Salas y Gómez and Nazca ridges are known to possess cobalt-rich ferromanganese crusts on its edifice with contents of Cu+Ni up to 0.3 %; and commercially-valuable manganese nodules are known to exist on both sides of the Nazca Ridge, which could have important concentrations of Cu and Ni (up to 1.38 % Cu+Ni) and Co (mean values up to 0.53 %) (Figure 10; Hein et al. 2013; Miller et al. 2018; García et al. 2020; Toro et al. 2020). Polymetallic massive sulfides are known from hydrothermal vents located to the west of the Salas y Gómez Ridge on the East Pacific Rise (EPR) (Figure 10; García et al. 2020), that that could have similar compositions to those samples obtained further north over the EPR: 35.8% Fe, 9.1 % Zn, 6.8 % Cu, 45.5 % S, 1.2 % SiO2 (Backer et al. 1985). While there are currently no contracts to explore or prospect deep-sea minerals in this region (Miller et al. 2018; ISA 2020), these resources may attract mining interests in the future.

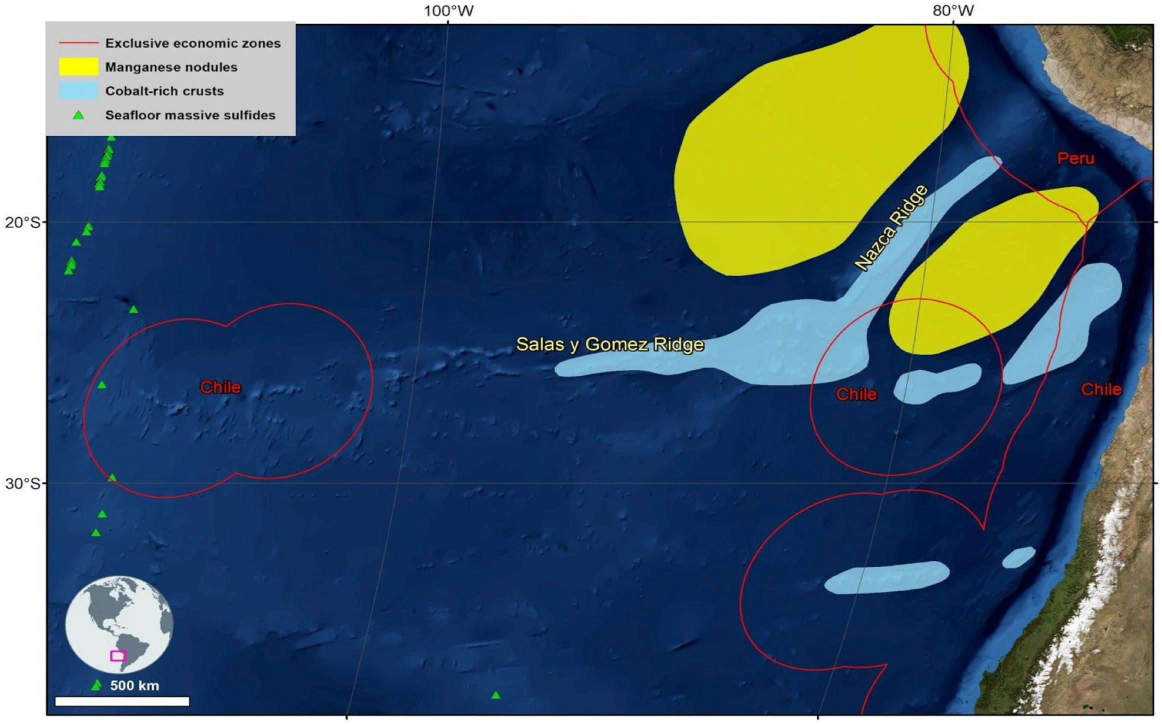


Figure 10. Distribution of commercially valuable seabed minerals around the Salas y Gómez and Nazca ridges (data from Hein et al. 2013). Note that no oil or gas reserves are known to occur in this region (Lujala et al. 2007). Figure taken taken from Wagner et al. (2021), information from which was previously presented to the SPRFMO during its scientific committee meetings in October 2020 (SC8-Obs01).

7.3. Marine litter and pollution

Due to its proximity to the center of the South Pacific Gyre, concentrations of floating litter and marine debris are relatively high in this region, as these pollutants are concentrated and trapped in the circulating waters of this gyre (Eriksen et al. 2014, 2018; Boteler et al. 2019; van Gennip et al. 2019; Luna-Jorquera et al. 2019; Wagner et al. 2021) (Figure 11). Floating marine debris in this region mostly consists of microplastics (Eriksen et al. 2013; Hidalgo-Ruz & Thiel 2013), and medium-sized plastic fragments, lines, buoys, plastic trays, plastic bags and nets (Thiel et al. 2018; Luna-Jorquera et al. 2019). Most recognizable plastic litter originates from the high seas fisheries around Rapa Nui and Salas y Gomez Islands (Luna-Jorquera et al. 2019; Thiel et al. 2021).

These floating pollutants primarily originate from sources on the continental coasts, including cities, beach-goers, aquaculture, and fisheries (Thiel et al. 2018). Also small fishing villages and the large artisanal fishing fleet from the Chilean and Peruvian coast contribute high loads of marine litter (Ortiz-Alvarez et al. 2022). As the transport of the floating litter from continental sources to the center of the gyre may take several years, most of it is breaking down to microplastic fragments, which by far dominate the litter items found around Rapa Nui and Salas y Gomez Islands (Eriksen et al. 2013, 2018; Hidalgo-Ruz & Thiel 2013; Ory et al. 2017; Gallardo et al. 2021b).

This litter affects more than 100 species of marine vertebrates, particularly sharks, fishes, turtles, birds and mammals, through entanglement and ingestion (Thiel et al. 2018; Jones et al. 2021) (Figure 12). Also incorporation of litter collected at sea into seabird nests is commonly observed and reported (Miranda-Urbina et al. 2015; Garcia-Cegarra et al. 2020; Hidalgo-Ruz et al. 2021). Microplastics are ingested by a wide range of fishes (Ory et al. 2017, Chagnon et al. 2018) and also higher level consumers (Santillan et al. 2020; Perez-Venegas et al 2020). Microplastics are often concentrated in small- and mesoscale oceanographic features, such as local fronts (with visual slicks), which has been observed around Rapa Nui, where also zooplankton and fish larvae are often aggregated in these fronts (Gallardo et al. 2021b).

Floating litter could also potentially transport non-indigenous species from other regions around the South Pacific. Some of the identifiable litter items collected on the shores and in the waters surrounding Rapa Nui show indication of having origins in New Zealand and Chile (Rech et al. 2018, 2021). Oceanographic models simulating surface transport of floating particles confirm that litter from the South American continent can reach the Easter Island Ecoregion within 2-3 years (van Gennip et al. 2019). While a range of different species have been identified on floating litter, there were no species from continental coasts reaching Rapa Nui, which possibly is due to the fact that coastal species cannot survive for extended times in the ultraoligotrophic waters of the South Pacific Subtropical Gyre (SPSG; Rech et al. 2021). However, as vast quantities of floating litter are continuously stranding on the shores of Rapa Nui (Thiel et al. 2021), there is an ever increasing risk of non-indigienous species arriving with this litter. This risk is very high for the Nazca ridge and for the proximal portion of the Salas y Gómez ridge, as well as for the Juan Fernandez Archipelago, which are only about 700-800 km off the Chilean continental coast, but floating litter has not been studied for attached organisms.

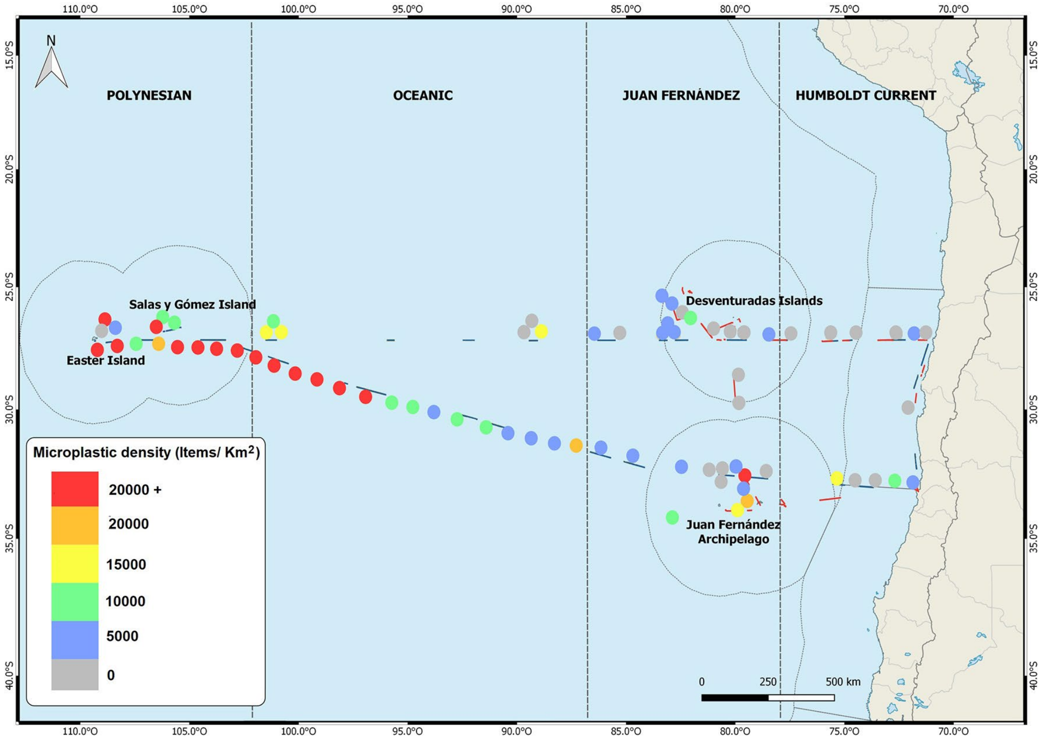


Figure 11. Density of microplastics (0.3–5mm) in the central South East Pacific, in 2015 and 2016. Data from Eriksen et al. (2013, 2018) and M. Thiel, unpublished data. Taken from Thiel et al. (2018).

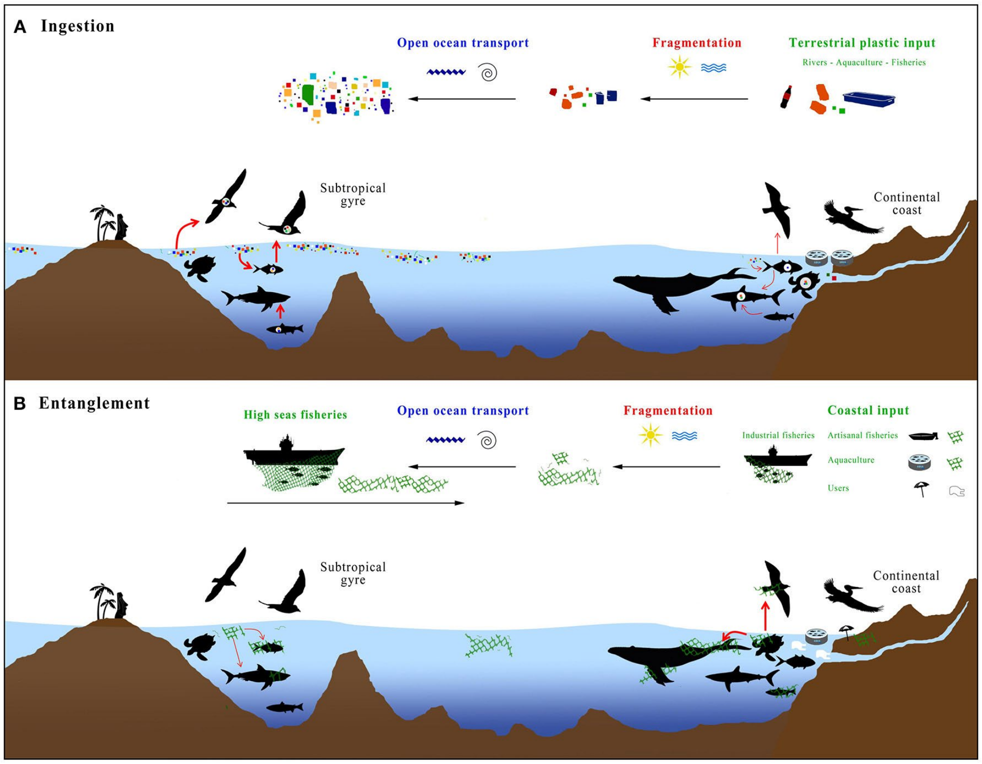


Figure 12. Conceptual model of (A) ingestion, and (B) entanglement by marine vertebrates with anthropogenic marine plastics, highlighting the litter sources and abiotic processes (upper part of figures) and the interactions with marine vertebrates (bottom part of figures). Taken from Thiel et al. (2018).

In contrast to abundant floating marine litter, benthic litter seems to be less abundant. Exploration of mesophotic bottoms through ROV surveys has also shown that, while benthic litter is not observed at mesophotic depths (~60-340 m) of Desventuradas Islands and nearby seamounts within the Chile EEZ, at similar depths off Rapa Nui, fishing lines, plastic ropes tied to anchor stones as well as glass and metal objects are frequently observed (Mecho et al. 2021). Unlike litter observed in Rapa Nui beaches, which is mainly of foreign origin, items observed at depth are evidently local. Further survey on the seamounts in ABNJ are necessary to assess the presence and impact of benthic marine litter

Another emerging threat observed in the Salas y Gómez ridge is the proliferation of filamentous mats covering mesophotic sandy bottoms and coral reefs (Figure 13; Sellanes et al. 2021). Mats have been sighted mainly off Hanga Roa, the main village of the island located on the southwestern side of it and at ~80-90 m in depth. Preliminary morphologic identification indicates that mats (Figure 13A) are composed by at least four filamentous taxa, including two cyanobacteria (cf. *Lyngbya* sp. and *Pseudoanabaena* sp.), a brown alga (*Ectocarpus* sp.), and a green alga (*Cladophora* sp.) (Sellanes et al. 2021). While mesophotic *Leptoseris* spp. reefs at the Hanga Roa side are dead and covered with filaments (Figure 13B), at the northern, and sparsely populated side of the island, mesophotic reefs appear to be healthy (Figure 13C). An ongoing eutrophication process, associated with sewage pollution is preliminarily identified as the most plausible cause explaining the recent proliferation of these mats in front of the village (Sellanes et al. 2021). Stable isotope analysis has also corroborated the incorporation of nutrients of anthropogenic origin by intertidal benthic communities nearby the most urbanized areas of the island (Zapata et al. 2022). The latter can also shed light on the impact that anthropogenic nutrients may have in ABNJ due to heavy use of this area.

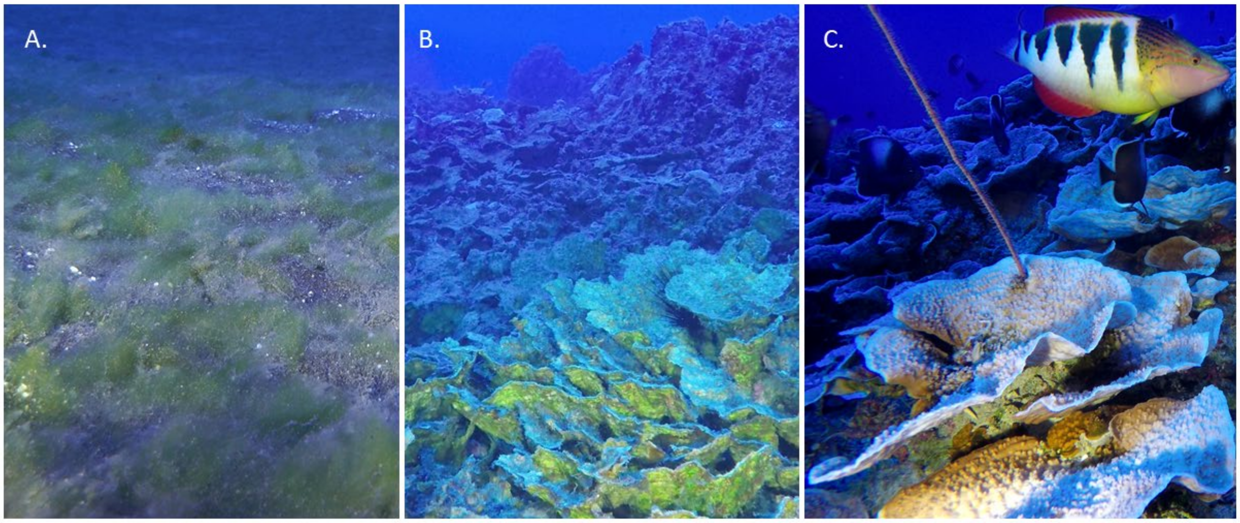


Figure 13. Images from ROV surveys at ~80-90 m depth around Rapa Nui. A. filamentous mats covering sandy bottoms off Hanga Roa, main village of the island, B. dead *Lepstoseris* spp. reef off Hanga Roa, and C. healthy *Leptoseris* spp. reef and a colony of the whip coral *Stichopathes* sp. off Anakena at the northern side of the island.

7.4. Shipping

Commercial shipping is relatively low throughout the waters of this region, with the exception of the northern section of the Nazca Ridge which intersects a major international shipping route connecting ports along the west coast of South America, but also waters surrounding the Salas y Gómez or Nazca ridges have been identified as a major global transshipment location for distant-water fishing fleets (Boerder et al. 2018; Miller et al. 2018; Wagner et al. 2021) (Figure 14). The latter may have several implications for threatened fauna such as sea turtles, sea birds and whales that could be affected by collisions and light pollution (Rodriguez et al. 2017; García-Cegarra & Pacheco 2019; Bedriñana-Romano et al. 2021).

Shipping could also be a risk of non-indigenous species introductions in the ridges, especially in the shallow seamounts, both through hull fouling or the transport of propagules in the ballast water (MacIsaac et al. 2016, Castellanos-Galindo et al. 2022).

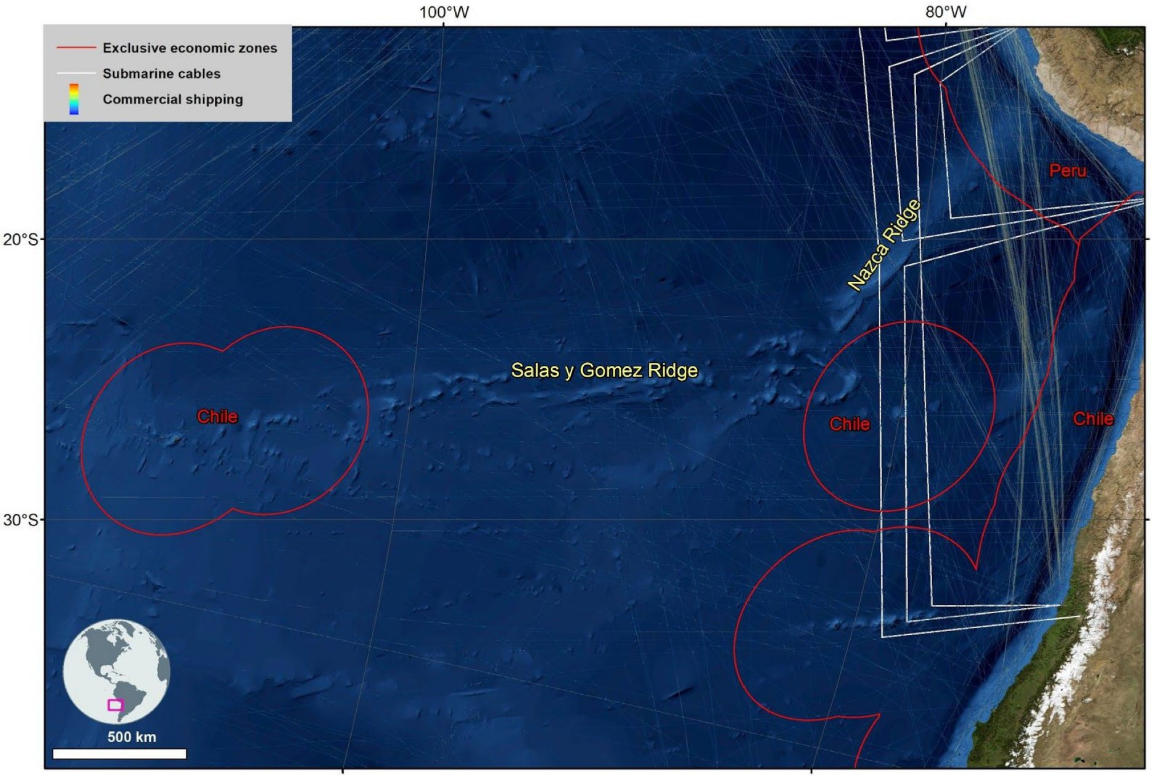


Figure 14. Distribution of commercial shipping routes and submarine cables around the Salas & Gómez and Nazca ridges. Figure from Wagner et al. (2021), information from which was previously presented to the SPRFMO during its scientific committee meetings in October 2020 (SC8-Obs01).

7.5. Submarine cables

There are also several submarine cables that run across the Nazca Ridge, including in ABNJ of this region (Figure 14; ICPC 2020; Wagner et al. 2021). However, in comparison to other human activities in the deep sea, submarine cables are considered to have a relatively low impact on the environment. That said, since the Salas y Gómez and Nazca ridges provide habitat for many fragile benthic species like corals (Gálvez-Larach 2009; Gálvez 2012a; Yáñez et al. 2012; CBD 2017; Easton et al. 2019), any future cable laying through this area should be carefully evaluated and planned. While UNCLOS already affords all States the freedom to lay submarine cables in ABNJ (UNCLOS 1982), activities required to maintain or repair cables need to be considered in this region.

7.6. Climate change

The majority of the Salas y Gómez Ridges and the southern portion of the Nazca Ridge are located near the center of the South Pacific Gyre, a large-scale oceanographic feature characterized by extremely nutrient-poor waters (Von Dassow & Collado-Fabbri 2014; González et al. 2019). This paucity of nutrients makes this region particularly susceptible to anthropogenic and climatic disturbances (Andrade et al. 2014). For example, model climate change predictions indicate that in the next 20-40 years the seafloor of this region will experience an increase in temperature, a reduction in pH and dissolved oxygen (see Figure 15), and changes in export of particulate organic carbon (Cheung & Levin 2018; Levin et al. 2020).

Decreases in dissolved oxygen concentrations are of particular concern, because this region is connected to the one of the most deoxygenated water masses in the world (Ulloa & Pantoja 2009; Fuenzalida et al. 2009; Espinoza-Morribedon et al. 2019). Further decreases of dissolved oxygen levels may make some areas inhabitable for certain species, thereby leading to substantial changes in biodiversity and biogeochemical cycles (Diaz & Rosenberg 2008; Stramma et al. 2008; Keeling et al. 2010). Climate change prediction models further indicate that the Salas y Gómez and Nazca ridges will experience substantial negative impacts by 2100, with the Nazca Ridge being most impacted (Cheung & Levin 2018; Levin et al. 2020) although there are still large uncertainties within minimum oxygen zones with a low consensus amongst models. Plausible consequences of these changes include biogeographic range shifts, habitat loss, decreased biodiversity, and decreased resilience, among others. Importantly, many of these consequences will be compounded by the El Niño Southern Oscillation and the Pacific Decadal Oscillation, which already have widespread impacts throughout the region (Yáñez et al. 2018; Cai et al. 2020; Conejero et al. 2021). The Southeast Pacific Subtropical Anticyclone, which is the dominant forcing mechanism of major currents in the region, has already experienced a poleward shift as a result of climate change and this shift is projected to continue (Ancapichún & Garcés-Vargas 2015; Rykaczewski et al. 2015; Yáñez et al. 2018).

The overall increase in south-easterly trade winds of the South-eastern Pacific in a warmer climate are likely to increase the connectivity pattern between Juan Fernandez and Desventuradas islands, and along the Salas y Gomez ridge, through increasing wind-driven mean ocean currents (Dewitte et al. 2021) (Figure 15). However, it is not clear how the global warming-induced basin-scale changes will impact mesoscale features and fine-scale recirculation patterns within the island and seamount systems, which limits our capacity to predict quantitatively changes in connectivity patterns. Also, how increased vertical stratification will impact vertical mixing in the ocean remains uncertain due to the fact this process is parameterized as a diffusive transport in the coarse resolution ocean models currently used for climate prediction. Tailored downscaling methodologies based on high-resolution Earth System Models thus need to be developed for this particularly challenging region for climate modeling.

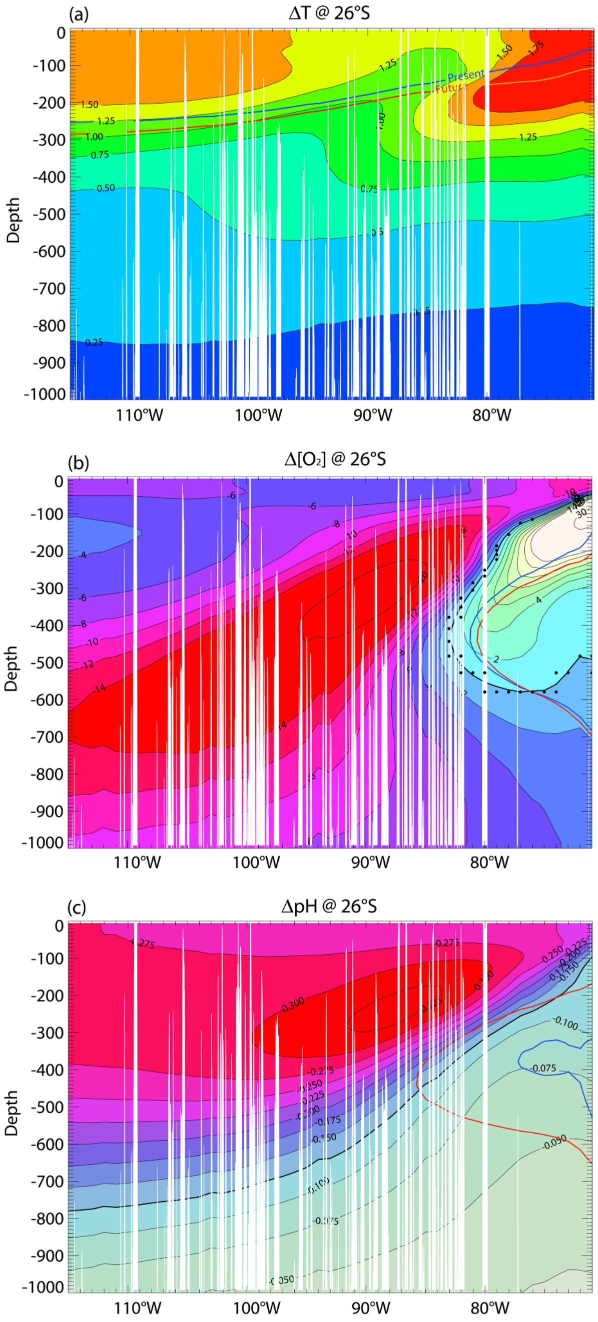


Figure 15. Effect of climate change on the oceanic conditions along a section at 26°S (Salas y Gómez Ridge), as simulated by the NCAR CESM model: difference in mean conditions between the present (1950–2005, 'historical' scenario) and the future (2050–2100, RCP8.5 scenario) for (a) temperature, (b) dissolved oxygen, and (c) pH. The blue and red lines stand for the 15°C isotherms in (a), for the oxygen minimum zone limit, $[O_2] < 1$ ml/L, in (b), and for the pH isopleth of 7.35 in (c) for the (blue) present and (red) future climates. Note the deepening of the 15°C isotherm (a proxy for thermocline depth) by approximately 40 m in the warmer climate and the increase in oxygen content in the vicinity of the oxycline (orange colour, approx. 30 µmol/kg). The model also indicates an overall decrease in pH more pronounced in the surface layer (red–pink colour, approx. 0.3 unit). The black dots in (b) correspond to the locations where the change in oxygen concentration is not significant at the 99% level according to a Wilcoxon rank sum test. Topography from the General Bathymetric Chart of the Oceans (GEBCO version 2019) corresponds to the seamounts and islands within ±1° around 26°S. From Dewitte et al. (2021).

8. Regional governance

The UN Convention on the Law of the Sea (UNCLOS) lays down rules governing uses of the ocean and its resources; however, it does not specify how States should conserve and sustainably use biodiversity in ABNJ. As a result, a host of regional and sectoral agreements covering sectors like fisheries, shipping, and mining were developed both before and after UNCLOS came into force in 1994. As in other ABNJ, human activities in international waters around the Salas y Gómez and Nazca ridges are regulated by different intergovernmental bodies, including the International Seabed Authority (ISA) for mining, the International Maritime Organization (IMO) for shipping, and regional fishery management bodies (fishing), specifically the Inter-American Tropical Tuna Commission (IATTC) for tuna and other highly-migratory fishery species, and the South Pacific Regional Fishery Management Organization (SPRFMO) for non-highly migratory fishery species (Durussel et al. 2017; Boteler et al. 2019; Wagner et al. 2021) (Figure 16).

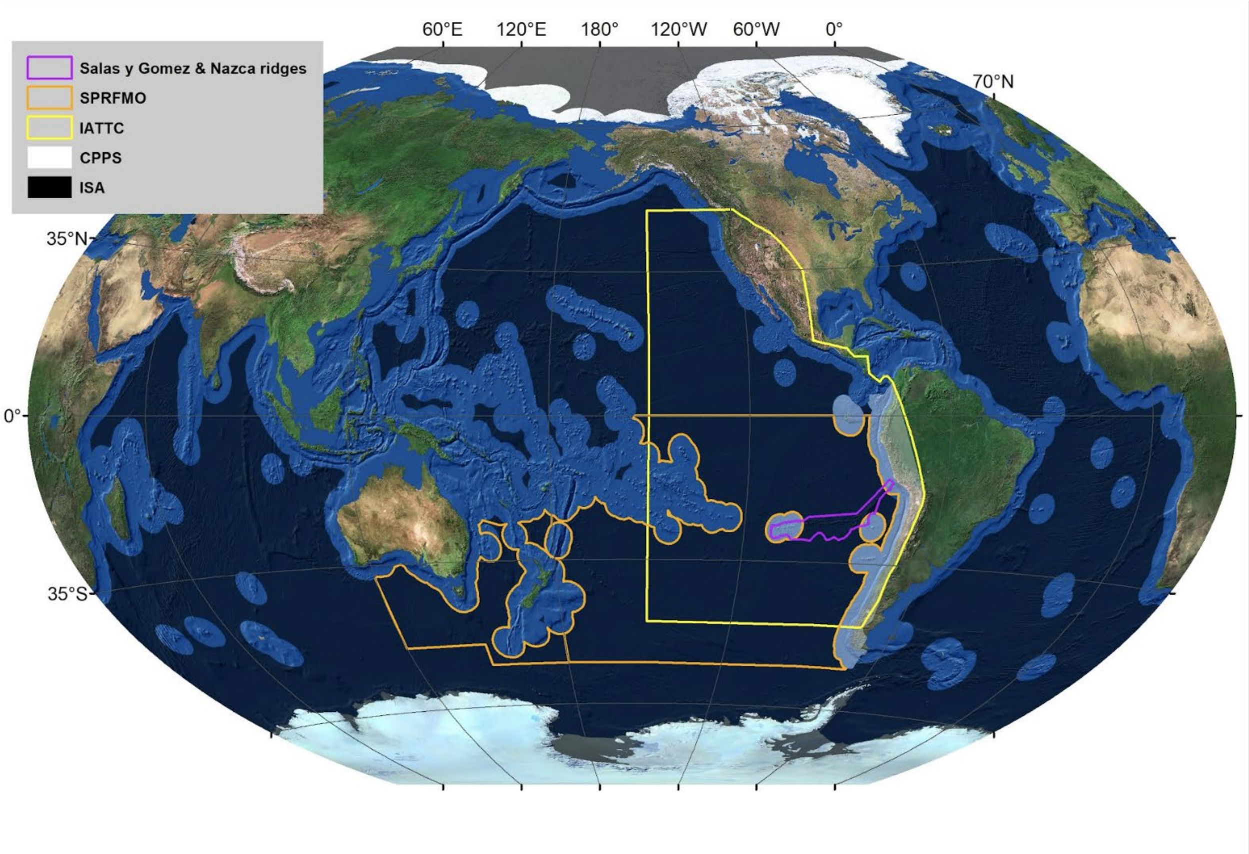


Figure 16. Map showing jurisdictional boundaries of intergovernmental bodies regulating human activities in the area of the Salas y Gomez and Nazca Ridges. (Figure courtesy of D. Wagner, taken from Chavez-Molina et al. *submitted*)

8.1. SPRFMO

SPRFMO regulates fishery resources of non-highly migratory species located in high seas waters of the South Pacific Ocean, including the Salas y Gómez and Nazca ridges. There are 15 current members of SPRFMO (Australia, Chile, China, Cook Islands, Cuba, Ecuador, European Union, Denmark [in respect of the Faroe Islands], Republic of Korea, New Zealand, Perú, Russia, Chinese Taipei, USA, and Vanuatu), as well as four cooperating parties (Colombia, Curaçao, Liberia, and Panama). SPRFMO has implemented fishing effort measures, including total allowable catch, total allowable effort, and allocations by States for some fishery species. Additionally, SPRFMO prohibits the use of large-scale pelagic driftnets and deep-water gillnets, and has by-catch management measures in place for seabirds. SPRFMO maintains a vessel monitoring system, measures on control, inspections in port and at sea, regulates trans-shipment, and implements an on-board observer system. Since 2013, SPRFMO has implemented total allowable catch and total applied effort limitations for Jack mackerel.

Regarding bottom fishing, SPRFMO maintains measures for the identification of vulnerable marine ecosystems, with the opening of all new bottom-fishing areas requiring a research assessment of potential impacts. Specifically, all flagged vessels of SPRFMO member States and cooperating non-contracting Parties are not authorized to engage in bottom-fishing activities in the SPRFMO Convention Area without approval from the SPRFMO Commission (SPRFMO 2020b). Currently, areas that allow for bottom fishing in the SPRFMO Convention Area are all located in the Western Pacific, specifically in the Tasman Sea and the Louisville Ridge (SPRFMO 2020b).

The regulation of bottom fisheries by SPRFMO, and in fact the political impetus to establish SPRFMO in the first place, is a response to a series of United Nations General Assembly resolutions, beginning with Resolution 59/25 adopted in 2004, which commits States individually and through regional fishery management organizations to protect deep-sea biodiversity in ABNJ by managing bottom fisheries in a way that prevents significant adverse impacts on vulnerable marine ecosystems. United Nations General Assembly Resolution 61/105 adopted in 2006 called for the closure of areas where vulnerable marine ecosystems are known or likely to occur, unless bottom fisheries can be managed to prevent significant adverse impacts. These commitments have been reaffirmed and elaborated upon in subsequent resolutions adopted by the United Nations General Assembly. In addition, States have expanded upon these commitments to marine conservation more broadly, such as through the adoption of the 2030 Sustainable Development Goals (SDGs), in particular SDG 14, Target 2, which calls for avoiding significant adverse impacts on marine ecosystems and strengthening their resistance.

8.2. IATTC

The IATTC is responsible for the conservation and management of tuna and other highly-migratory fishery resources in the eastern Pacific Ocean. IATTC has 21 members (Belize, Canada, China, Chinese Taipei, Colombia, Costa Rica, Ecuador, El Salvador, European Union, France, Guatemala, Japan, Kiribati, Republic of Korea, Mexico, Nicaragua, Panama, Peru, USA, Vanuatu, Venezuela) and five cooperating non-members (Bolivia, Chile, Honduras, Indonesia and Liberia). The geographical scope of IATTC covers both the national jurisdiction of its member States and the high seas in the Eastern Pacific, including those of the Salas y Gómez and Nazca ridges. The main fisheries species managed by the IATTC are yellowfin, albacore, skipjack, bigeye, Pacific bluefin tuna, and various species of billfish and sailfish. Conservation measures implemented by the IATTC include restricting purse-seine fishing activity through spatio-temporal closures (72-day annual closure of the entire fishery, as well as 30-day annual closure of an area west of the Galapagos Islands known as El Coralito), limiting the number of fish-aggregating devices each purse seine fishing vessel can have at a given time, and total annual catch limits for bigeye tuna caught by long-line fishing vessels (IATTC 2017).

8.3. ISA

The International Seabed Authority (ISA) regulates mineral-related activities in the international seabed beyond the limits of national jurisdiction, also known as the “Area” (UNCLOS 1982; Miller et al. 2018). It does so by giving out exploration and (in the future) exploitation leases for seabed minerals, setting terms for the approval of contracts, and is charged with establishing the necessary measures for the effective protection of the marine environment from the harmful effects of mining activities, and otherwise acting on behalf of humankind as a whole (Miller et al. 2018). To date, such measures have been focused on designating areas of particular environmental interest (APEI), which are provisionally protected from future mining activities (ISA 2020).

There are currently no exploration contracts for deep-sea minerals in the Area of the South Pacific, nor are any areas closed to mining in this region (Miller et al. 2018; ISA 2020). In other places in the Pacific, ISA has previously issued exploration contracts in the Clarion Clipperton Zone and the North West Pacific, and is currently developing regional environmental management plans (REMPs) for the North West Pacific (ISA 2020). A prerequisite for any future exploitation contracts in the current discussions around draft regulations for exploitation (ISA 2018) is that a regional environmental management plan (REMP) must be in place. Therefore, REMPs provide for regional-scale management of deep-sea mining, but it is unclear to what extent other uses and values will be considered in management planning for seabed mining. There is at present a REMP for the CCZ, and workshops were held in 2020 to develop REMPs for the international seabed Area in the North West Pacific and the Mid-Atlantic Ridge. There are no current discussions for REMPs for the South Pacific in the Area surrounding the Salas y Gómez and Nazca ridges.

8.4. IMO

The International Maritime Organization (IMO) regulates international shipping activities, including through the designation of particular sensitive sea areas (PSSAs), which may be protected by ship routing measures, such as areas to be avoided by all ships, or by certain classes of ships (Prior et al. 2010; Boteler et al. 2019). There are currently no PSSAs anywhere in international waters, nor are there any PSSAs or shipping route limitations around the Salas y Gómez and Nazca ridges. However, with the exception of the northern section of the Nazca Ridge, this region does not contain any major commercial shipping routes (Figure 14; Halpern et al. 2015). Additionally, through the International Convention for the Prevention of Pollution from Ships (MARPOL), IMO defines certain sea areas as "special areas" in which the adoption of special mandatory methods for the prevention of sea pollution is required. There are no MARPOL special areas in the South Pacific. Within the Chilean waters of this region, the Chilean Navy is currently developing higher standards for ballast water release within all oceanic MPAs of the region (Figure 17).

As noted above, a host of regional and global agreements covering different sectors regulate human activities in international waters around the Salas y Gómez and Nazca ridges. To date, there has been a lack of coordination between many of these international bodies. To overcome these challenges, in 2015 the United Nations General Assembly agreed to develop an international legally-binding instrument under UNCLOS on the conservation and sustainable use of marine biological diversity in ABNJ, also known as the BBNJ treaty. The negotiations for the treaty are still ongoing, with the fourth and final scheduled session being postponed as a result of the international coronavirus crisis (Montenegro-Hoyos et al. 2022).

8.5. CPPS

The Permanent Commission of the South Pacific (CPPS) is a strategic regional alliance that aims to foster collaboration in marine policy, conservation, and research amongst its members. CPPS has four member States (Chile, Peru, Ecuador, and Colombia), and the CPPS is also the Executive Secretariat of the Southeast Regional Seas Programme, to which Panama is also a member. CPPS promotes mechanisms for political coordination between these five States on marine policy, marine pollution, resource exploitation, conservation, research and environmental protection, including the development and management of MPAs. While the jurisdiction of CPPS generally lies in the national jurisdictions of its member States, under Article 1 of the 1981 Lima Convention, the CPPS jurisdiction can extend to adjacent high seas areas that could be affected by marine pollution (CPPS 2012a; Durussel et al. 2017).

In 2012, CPPS member States signed the Galapagos Commitment, in which they committed to promote coordinated action regarding their interests in living and non-living resources in ABNJ (CPPS 2012b; Durussel et al. 2017; Boteler et al. 2019). CPPS has an active working group on marine biological diversity in ABNJ, whose main goal is studying, monitoring and advising about conservation and sustainable use in these areas.

9. International distinctions

9.1. EBSA

As a result of its unique biodiversity, as well as its ecological and cultural significance, the Salas y Gómez and Nazca ridges have been highlighted by numerous international bodies and organizations. In 2014, the Salas y Gómez and Nazca ridges were recognized as an ecologically or biologically significant marine area (EBSA) at the 12th Meeting of the Conference of the Parties (CBD 2014), following a regional workshop to facilitate the description of EBSAs in the Eastern Tropical and Temperate Pacific (Figure 17; CBD 2013). Prior to the workshop, Parties, Governments and other organizations provided detailed scientific justifications to describe potential EBSAs (CBD 2012). Two separate scientific proposals were submitted for the Salas y Gómez and Nazca ridges that summarized the ecological significance of this region (Gálvez 2012a; Yáñez et al. 2012). As defined by the Conference of the Parties to the Convention of Biological Diversity, EBSAs are significant marine areas that are in need of protection or enhanced management and are evaluated based on seven criteria, including uniqueness, special importance for life history stages of species, importance for threatened or endangered species, vulnerability, biological productivity, biological diversity, and naturalness (CBD 2008). The Salas y Gómez and Nazca ridges were determined to be of high importance on all but two of the EBSA criteria (productivity and rarity), thereby underscoring the exceptional importance of protecting this region (CBD 2014).

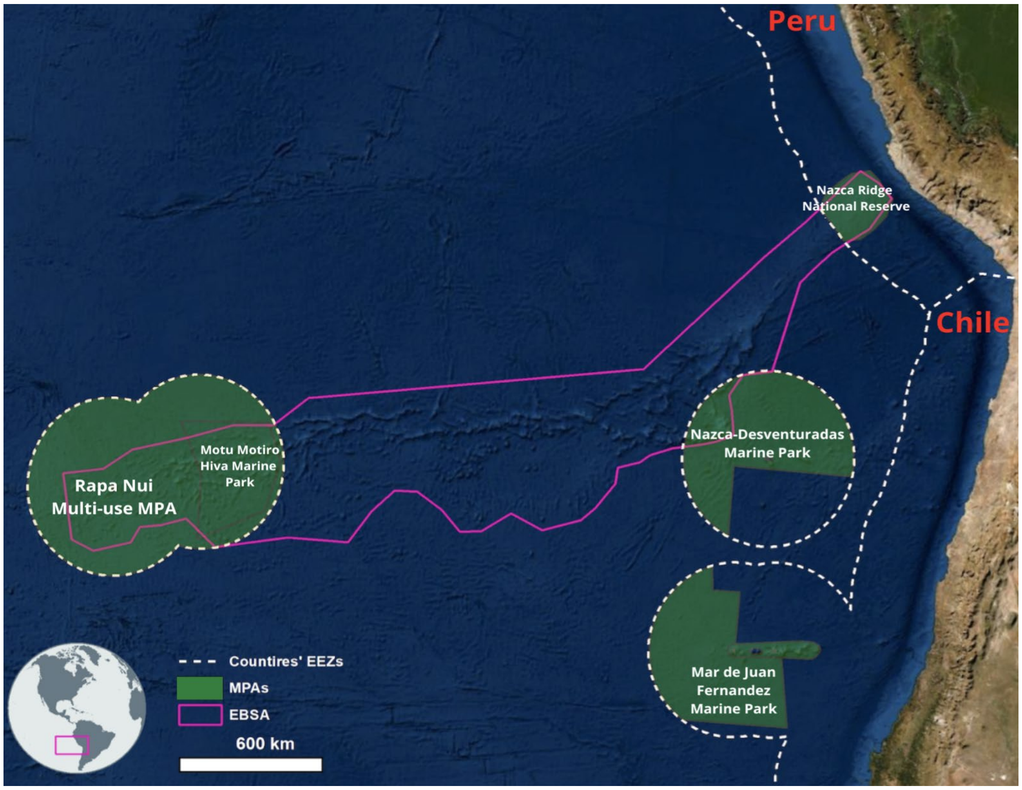


Figure 17. Map showing the location of the ecologically or biologically significant area (EBSA) on the Salas y Gómez and Nazca ridges, and the marine protected areas created by Chile and Peru.

9.2. Other distinctions

In addition to its distinction as an EBSA, the Salas y Gómez and Nazca ridges have also been recognized as an important area by experts consulted by the Global Ocean Biodiversity Initiative (GOBI) and the Census of

Marine Life on Seamounts (CENSEAM) (Dunstan et al. 2011; Gálvez 2012b). Furthermore, these ridges were recognized by Mission Blue as a Hope Spot, which are special places that are scientifically identified as critical to the global health of our ocean (Mission Blue 2020). The islands of Salas y Gómez, San Félix and San Ambrosio are all considered Important Bird Areas (IBA) by BirdLife International, as these islands host important colonies of Christmas Island Shearwater (*Puffinus nativiatis*), Masked Booby (*Sula dactylatra*), White-throated Storm-petrel (*Nesofregetta fuliginosa*), de Filippi's Petrel (*Pterodroma defilippiana*), and Chatham Petrel (*Pterodroma axillaris*) (CBD 2017). These islands, as well as Rapa Nui, are considered key biodiversity areas (KBA) by the KBA Partnership Program (KBA 2020). The waters around Salas y Gomez Island and the Desventuradas Islands are both considered critical habitats, as defined by the criteria of the International Finance Corporation's Performance Standard (Martin et al. 2015).

Several studies have recently been conducted to identify priority conservation areas in ABNJ (Clark et al. 2014; Clark & Reville 2020; Visalli et al. 2020; Sala et al. 2021; Wagner et al. 2021). While these studies used widely different approaches and datasets, all of them identified the Salas y Gomez and Nazca ridges as one of the most important areas to protect in ABNJ globally.

9.3. MPAs

As a result of the exceptional natural and cultural significance of the region, several protected areas have been established in and around the Salas y Gómez and Nazca ridges (Figure 17). Within Chilean waters of the region there are five marine protected areas (MPAs). These include (1) the Mar de Juan Fernández Marine Park, which is a no-take MPA designated in 2018 that protects 262,000 km^2 offshore of the Juan Fernández Archipelago, in addition to Mar de Juan Fernández Multiple-Use Coastal Marine Protected Area, a multi-use area of 24,000 km^2 around the islands designated in 2016 and expanded in 2018, (2) the Nazca-Desventuradas Marine Park, which is a no-take MPA designated in 2015 that protects 300,035 km 2 around the islands of San Félix and San Ambrosio, (3) the Motu Motiro Hiva Marine Park, which is a no-take MPA designated in 2010 that protects 150,000 km^2 around Salas y Gómez Island, and (4) the Rapa Nui Multi-Use Coastal Marine Protected Area designated in 2018, which bans all industrial fishing and deep-sea mining in the 579,368 km^2 around Easter Island, but allows the Rapanui people to fish with traditional methods (Friedlander & Gaymer 2021). The Rapa Nui Multi-Use Coastal Marine Protected Area is currently the largest MPA in the Americas (Paredes et al. 2019; Aburto et al. 2020). Furthermore, the Rapa Nui National Park and World Heritage Site protects 68 km^2 or 40% of the land of Easter Island, and the Salas & Gómez Nature Sanctuary protects all of the 0.15 km^2 of land on Salas y Gómez Island (WDPA 2020). Since 2014, all seamounts located within the Chilean waters of this region are protected from bottom trawling by the Chilean Vulnerable Marine Ecosystems Law (Martínez et al. 2015).

In 2021 Peru created the Dorsal de Nasca National Reserve to protect 62,392 km^2 around the Nazca Ridge (Figure 17; Castellanos-Galindo et al. 2022). Specifically, the proposed reserve seeks to prohibit all fishing activities at depths deeper than 1000 m, thereby protecting all of the seafloor of the Nazca Ridge that falls within Peruvian waters (SERNANP 2020). While the recent efforts by Chile and Peru provide important advances to safeguarding the unique biodiversity and cultural resources of this region, all of the seamounts that fall within ABNJ are unprotected and under threat. Importantly, ABNJ represents the largest portion (73%) of the Salas y Gómez and Nazca ridges, as well as the most threatened from a myriad of impending stressors (see above).

9.4. International conservation efforts

A global alliance of partners whose objective is to protect coral reefs in areas beyond national jurisdiction, called the "Coral Reefs of the High Seas Coalition" has been working for three years to collect all the scientific information and propose conservation measures to protect the Salas & Gómez and Nazca ridges. As a result, a large number of scientific papers and educational materials summarizing this information have been published in the last 3 years (https://www.coralreefshighseas.org/where-we-work), including a paper presented to the SPRFMO during its scientific committee meetings in October 2020 (SC8-Obs01).

In parallel, the Strong High Seas (Strengthening Regional Ocean Governance for the High Seas) project, has worked the last five years to strengthen regional ocean governance for the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction in the Southeast Pacific in a joint effort of several international and regional partners, with the support of CPPS (https://www.prog-ocean.org/our-work/strong-high-seas/).

In October 2020, Chile presented a partial submission to extend the limits of the Eastern Continental Shelf of the Easter Island Chilean Province, to the Commission on the Limits of the Continental Shelf of the United Nations Convention on the Law of the Sea (UNCLOS). This area reaches 700 Mn and covers 550,000 km^2 on the western portion of the Salas y Gómez Ridge (Government of Chile 2020) (Figure 18), which includes around 2/3 of the Salas & Gómez ridge. This was presented as a way of caring for natural resources and protecting marine biodiversity (Catellanos-Galindo et al. 2022).

In April 2021, Chile announced the launch of efforts to create a high seas marine protected area (MPA) in the Salas y Gómez and Nazca ridges, as a priority measure to address the climate crisis. This is the first political action carried out by a government to protect this area. After the announcement, the proposal was presented to the scientific committee of SPRFMO in September 2021 (SC9-Doc31_rev1), and more recently in June 2022 announced during the UN Ocean Conference in Lisbon. Although these are important steps, it must be agreed upon with the other countries of the Southeast Pacific, such as Peru and Ecuador.

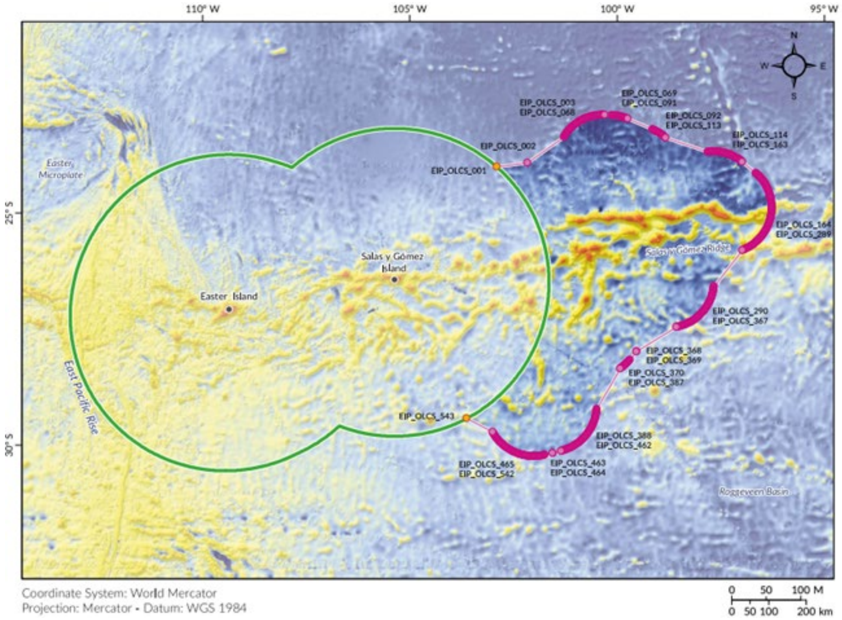


Figure 18. The outer limits of the eastern continental shelf of the Easter Island Province. Taken from Government of Chile (2020).

10. Recommendations to SPRFMO

Many previous studies have documented the extraordinary biological, ecological, oceanographic, geological, and cultural significance of the Salas y Gómez and Nazca ridges. These studies noted not only the remarkable uniqueness of species and habitats of this region, but also their vulnerability to impending impacts. As a result, Chile has already protected most of the habitats of the region that fall within its jurisdiction, and Peru has protected a large portion of the deep-water habitats that lie within its national waters. However, over 73% of the biologically and ecologically significant area falls within ABNJ, where it is unprotected and already being impacted by climate change and plastic pollution, with overfishing looming in the future. Deep-water surveys of this region have noted that every seamount has a unique faunal composition (Comité Oceanográfico Nacional de Chile 2017), thereby emphasizing that it is not enough to protect only some of them in order to protect representative biodiversity. While the recent efforts by Chile and Peru to establish MPAs in the national waters of this region provide important advances, these efforts could be undermined if surrounding ecosystems in ABNJ cannot be properly managed and conserved, especially considering their role as a biological corridor for several endangered species, but also in the connectivity of protected areas.

The nutrient poor waters that surround a big portion of the Salas y Gómez and Nazca ridges makes this region particularly susceptible to climate change impacts, which are predicted to intensify substantially in the next decades. According to United Nations General Resolution 71/123 (article 185), regional fishery management organizations should take into account the potential impacts of climate change in taking measures to manage deep-sea fisheries and protect vulnerable marine ecosystems. The high seas play a critical role as a global carbon sink (Heintze et al. 2015; Li et al. 2019), and protecting international waters of the Salas y Gómez and Nazca ridge would represent an important global contribution towards mitigating impacts of anthropogenic carbon emissions.

Importantly, fishing effort has been relatively low in this region, and thereby there is a unique opportunity to proactively protect the extraordinary cultural and natural resources of this region, without significantly impacting the fishing industry. According to SPRFMO data, recent catch data in the waters around the Salas y Gómez and Nazca ridges has been minimal (SPRFMO 2020a). Thus, protection of this area would have low impacts on fishing activities managed by SPRFMO. Protecting this area would, however, have major global benefits for ecosystem connectivity, climate regulation, food security, and other ecosystem services. Seamounts and other deep-water habitats found on the Salas y Gómez and Nazca ridges represent important reservoirs of global marine biodiversity (Appeltans et al. 2015), and via connectivity with surrounding waters, they also play a critical role of sustaining productivity more broadly (O'Leary & Roberts 2008). Furthermore, protecting this region would be seen as a great accomplishment to the world as a whole, and provide a global example for conserving biodiversity in ABNJ. Specifically, it would establish an example of a high seas protected area being established by neighboring countries that have similar interests in a shared ecosystem, thereby showcasing global leadership. This has already been successfully done in other high seas areas by member countries of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and the Convention on the Conservation of Antarctic Marine Life (CCAMLR), which established marine protected areas in ABNJ of the Northeast Atlantic and Southern Ocean, respectively (Durussel et al. 2017). These successful examples highlight that high seas protected areas are possible, but require international cooperation and coordination.

Moreover, all of the other regional fishery management organizations with the legal competence to manage bottom fisheries in ABNJ have established closed areas to protect vulnerable marine ecosystems and biodiversity. Increased protections in this region would therefore also be consistent with the commitments adopted through the United Nations General Assembly resolutions on bottom fisheries, the Sustainable Development Goals and other marine conservation objectives and obligations, including the obligation to protect habitats of special concern and biodiversity in Articles 5-6 of the 1995 United Nations Fish Stocks Agreement.

While the ongoing negotiations by the United Nations provide hope that there may soon be a mechanism to protect marine biodiversity in ABNJ, sectoral organizations like SPRFMO, IATTC, IMO and ISA already have mechanisms to protect the unique biodiversity of the region from harmful practices. For most of the ABNJ there is very little scientific information available, thereby making conservation planning difficult. In contrast, there is a great amount of scientific information available for the Salas y Gómez and Nazca ridges, all of which indicates that this region is of great natural and cultural significance, as well as threatened by a myriad of impending impacts. Commercial activities in this region are still absent or relatively low, so there is a time-sensitive opportunity to conserve its natural and cultural resources before they are lost forever.

10.1. Proposed regulations by SPRFMO

Given its exceptional natural and cultural significance, the Salas y Gómez and Nazca ridges should be comprehensively protected from exploitation, pollution and other anthropogenic threats using the best available conservation measures. As summarized in this paper, several intergovernmental organizations regulate human activities in the biologically and ecologically significant area of the Salas y Gomez and Nazca ridges, including SPRFMO for management of non-highly migratory fishery species, IATTC for management of tuna and other highly-migratory fishery species, ISO for shipping, ISA for mining, and CPPS for regional collaboration amongst Chile, Peru, Ecuador, and Colombia in marine policy, resource exploitation, conservation, environmental protection, and research. While actions will be required within each one of these organizations to conserve the fragile and unique resources of the region, actions by SPRFMO will be key, and the following recommendations emerge:

- The area located in ABNJ of the Salas y Gomez and Nazca EBSA should be closed to fishing activities regulated by the SPRFMO (Figure 17). This area includes an important collection of seamounts of the southeastern Pacific Ocean and encompasses an area of approximately 1,097,846 km^2 (Figure 17). Legal fishing activities of species managed by SPRFMO have been minimal to nonexistent in recent years (SPRFMO 2020a). Specifically, the orange roughy fishery has been closed in this region since 2006, and fishing effort for squid and Jack mackerel have been minimal (Table 2; SPRFMO 2020a). Thus, these proposed regulations would cause little to no impact on ongoing fishing operations, however, they would provide enormous advances in safeguarding the unique biodiversity of this region from future threats. Furthermore, they would showcase the global leadership of SPRFMO and its member countries.
- SPRFMO should work closely with other intergovernmental organizations that have jurisdiction over the Salas y Gomez and Nazca ridges to ensure that the best available conservation measures are enacted. SPRFMO already has Memoranda of Understanding and Collaborative Arrangements with IATTC and CPPS to advance cooperation and collaboration on matters of mutual interest.
- While management measures are developed, SPRFMO should not accept any proposals for exploratory fishing in the region, since this could cause irrevocable harm to these extremely unique and fragile ecosystems.
- Research and capacity development activities should be expanded to support further scientific understanding of the Salas y Gómez and Nazca ridges.

11. Future research efforts

Research joint efforts have been planned for this region for the following years. The recently finished CIMAR 26 cruise organized by the Chilean National Oceanographic Committee was monitoring the Salas & Gomez ridge including Rapa Nui and Salas y Gómez Island, focusing on oceanographic conditions, litter abundance, seabirds at sea and cetaceans. In 2023, the CIMAR 27 cruise will visit the easternmost part of the Salas y Gómez ridge, the westernmost portion of the Nazca ridge and Desventuradas islands. A Falkor cruise (Schmidt

Ocean Institute) is also funded for studying the Nazca ridge, although the date has been delayed due to the pandemic.

Presently, an international joint cruise is being planned for 2023 by the Center for Ecology and Sustainable Management of Oceanic Islands (ESMOI) to focus on exploring selected seamounts in the Salas y Gómez ridge.

This unprecedented scientific effort will allow filling gaps of knowledge in an area that has increasingly been studied in recent years.

12. References

Aburto JA, Gaymer CF, Govan H. 2020. A large-scale marine protected area for the sea of Rapa Nui: From ocean grabbing to legitimacy? Ocean Coast. Manage. 198: 105327.

Aguayo-Lobo A, Ibanez P, Rauch M & Vallejos V (1995). Primer registro del elefante marino del sur, Mirounga leonina, en la isla de Pascua, Chile. Serie Científica INACH (Chile), 45: 123-129.

Aguayo-Lobo A, Bernal R, Olavarria C, Vallejos V, Hucke-Gaete R (1998). Observaciones de cetáceos realizadas entre Valparaíso e Isla de Pascua, Chile, durante los inviernos de 1993, 1994 y 1995. Rev. Biol. Mar. Oceanogr., (Chile), 33: 101-123.

Aguayo-Lobo A, Acevedo J, Brito JL, Acuña P, Basoi M, Secchi E, Dalla-Rosa L (2011). Presence of the leopard Seal, *Hydrurga leptonyx* (De Blainville, 1820), on the coast of Chile: an example of the Antarctica - South America connection in the marine environment. Oecologia australis, 15(1): 69-85.

Aguirre C, García-Loyola S, Testa G, Silva D, Farías, F (2018). Insight into anthropogenic forcing on coastal upwelling off south-central Chile. Elem Sci Anth, 6: 59.

Álvarez-Varas R, Flores M, Demangel D, García M, Sallaberry-Pincheira N (2015a). First confirmed report of hawksbill sea turtle *Eretmochelys imbricata* in nearshore waters of Easter Island (Rapa Nui). Revista de Biología Marina y Oceanografía 50(3): 597-602.

Álvarez-Varas R, Petitpas R, Stowhas P, Fuentes-Hurtado M. (2015b). Conservation research needs of Easter Island (Rapa Nui) marine turtles. Chelonian Conservation and Biology 14(2): 184-192.

Álvarez-Varas R, Heidemeyer M, Riginos C, Benítez HA, Reséndiz E, Lara-Uc M, Godoy DA, Muñoz JP, Alarcón-Ruales D, Vélez-Rubio G, Fallabrino A, Zárate P, Piovano S, Alfaro-Shigeto J, Ortiz-Alvarez C, Mangel J, Esquerré D, Medrano C, Vianna JA, Veliz D (2020a) Integrating morphological and genetic data at different spatial scales in a cosmopolitan marine turtle species: challenges for management and conservation. Zoological Journal of the Linnean Society 191(2): 434–453.

Álvarez-Varas R, Barrios-Garrido H, Skamiotis-Gómez I, Petitpas R. (2020b). Cultural role of sea turtles on Rapa Nui (Easter Island): Spatial and temporal contrast in the Pacific island region. Island Studies Journal, 15(1): 253-270.

Álvarez-Varas R, Rojas-Hernández N, Heidemeyer M, Riginos C, Benítez HA, Araya-Donoso R, Reséndiz E, Lara-Uc M, Godoy DA, Muñoz-Pérez JP, Alarcón-Ruales DE, Alfaro-Shigueto J, Ortiz-Alvarez C, Mangel JC, Vianna JA, D Veliz (2021) Green, yellow or black? Genetic differentiation and adaptation signatures in a highly migratory marine turtle. Proceedings of the Royal Society B. 288: 20210754.

Álvarez-Varas R, Medrano C, Benítez HA, Guerrero F, León Miranda F, Vianna JA, Gonzalez C, Véliz, D (2022). Genetics, Morphometrics and Health Characterization of Green Turtle Foraging Grounds in Mainland and Insular Chile. Animals 12: 1473.

Ancapichún S, Garcés-Vargas J (2015). Variability of the Southeast Pacific Subtropical Anticyclone and its impact on sea surface temperature off north-central Chile. Ciencias Marinas, 41(1), 1-20.

Anderson A (2008). Traditionalism, interaction, and long-distance seafaring in Polynesia. The Journal of Island and Coastal Archaeology 3: 240-250.

Anderson WD, Johnson GD (1984). A new species of *Callanthias* (Pisces: Perciformes: Percoidei: Callanthiidae) from the Southeastern Pacific Ocean. Proceedings of the Biological Society of Washington 97: 942-950

Anderson WD, Springer VG (2005). Review of the perciform fish genus *Symphysanodon* Bleeker (Symphysanodontidae), with descriptions of three new species, *S. mona* , *S. parini* , and *S. rhax*. Zootaxa 996: 1-44.

Anderson WD (2008). A new species of the perciform fish genus *Plectranthias* (Serranidae: Anthiinae) from the Nazca Ridge in the eastern South Pacific. Proceedings of the Biological Society of Washington 121: 429-437.

Andrade I, Hormazábal S, Correa-Ramírez M (2014). Time-space variability of satellite chlorophyll-a in the Easter Island Province, southeastern Pacific Ocean. Latin American Journal of Aquatic Research 42: 871-887.

Ancapichún S, Garcés-Vargas J (2015). Variability of the Southeast Pacific Subtropical Anticyclone and its impact on sea surface temperature off north-central Chile. Ciencias Marinas 41(1): 1–20.

Appeltans W, Ahyong ST, Anderson G, Angel MV, Artois T, Bailly N, Bamber R, Barber A, Bartsch I, Berta A, et al. (2012). The magnitude of global marine species diversity. Current Biology 22: 2189-2202.

Arana PM, Álvarez Pérez JA, Pezzuto PR (2009). Deep-sea fisheries off Latin America: an introduction. Latin American Journal of Aquatic Research 37: 281-284.

Arana PM (2014). Chilean jagged lobster, Projasus bahamondei , in the southeastern Pacific Ocean: current state of knowledge. Latin American Journal of Aquatic Research 42: 1-17.

Arcos D, Cubillos L, Núñez S (2001) The Jack mackerel fishery and El Niño 1997-1998 effects off Chile. Progress in Oceanography 49: 597-617.

Asorey CM, Sellanes J, Easton EE, Bieler R, Mecho A (2020). *Architectonica karsteni* Rutsch, 1934 (Gastropoda: Architectonicidae) in seamounts of the Nazca-Desventuradas Marine Park: first record in Chilean waters since the Miocene. Nautilus 134: 61-70.

Asorey CM, Sellanes J, Wagner D, Easton EE (2021). Complete mitochondrial genomes of two species of *Stichopathes* Brook, 1889 (Hexacorallia: Antipatharia: Antipathidae) from Rapa Nui (Easter Island). Mitochondrial DNA Part B. 6(11): 3226-3228.

Auger P, Bento J, Hormazábal S, Morales C, Bustamante A (2021). Mesoscale variability in the boundaries of the oxygen minimum zone in the eastern South Pacific: Influence of intrathermocline eddies. Journal of Geophysical Research: Oceans, 126, e2019JC015272.

Bäcker H, Lange J, Marchig V (1985). Hydrothermal activity and sulphide formation in axial valleys of the East Pacific Rise crest between 18 and 22°S. Earth and Planetary Science Letters. 72: 9-22.

Baker ET, Hey RN, Lupton JE, Resing JA, Feely RA, Gharib JJ, Massoth GJ, Sansone FJ, Kleinrock M, Martinez F, Naar DF, Rodrigo C, Bohnenstiehl D, Pardee D (2002). Hydrothermal venting along Earth's fastest spreading center: East Pacific Rise, 27.5°–32.3°. Journal of Geophysical Research 107: 2130.

Bedriñana-Romano L, Hucke-Gaete R, Viddi FA, Johnson D, Zerbini AN, Morales J, Mate B, Palacios DM (2021). Defining priority areas for blue whale conservation and investigating overlap with vessel traffic in Chilean Patagonia, using a fast-fitting movement model. Sci. Rep. 11, 1–16.

Belmadani A, Echevin V, Codron F. et al. (2014). What dynamics drive future wind scenarios for coastal upwelling off Peru and Chile? Clim Dyn 43: 1893–1914.

Belmadani A, Concha E, Donoso D, Chaigneau A, Colas F, Maximenko N, Di Lorenzo E (2017). Striations and preferred eddy tracks triggered by topographic steering of the background flow in the eastern South Pacific. Journal of Geophysical Research: Oceans 122: 2847–2870.

BirdLife International (2022) Important Bird Areas factsheet. Downloaded from www.birdlife.org/datazone/site/search on 16/08/2022.

Boerder K, Miller NA, Worm B (2018). Global hot spots of transshipment of fish catch at sea. Science advances 4(7): eaat7159.

Burridge CP, Meléndez R, Dyer BS (2006). Multiple origins of the Juan Fernández kelpfish fauna and evidence for frequent and unidirectional dispersal of cirrhitoid fishes across the South Pacific. Systematic Biology 55: 566-578.

Boteler B, Wanless R, Dias M, Packeiser T, Awad A, Yannicelli B, Zapata Padilla LA, Aburto J, Seeger I, Hampton S, Jackson L, Wienrich N, Ajagbe A, Hazin C, Castellanos Galindo GA, German Naranjo L, Fredy Suárez C, Prussmann J, Valenzuela S, Gómez Giraldo LS, Higgins ML, Contreras C, Luna G, Luna N, Munizaga M, Sellanes J, Tapia C, Thiel M (2019). Ecological baselines for the Southeast Atlantic and Southeast Pacific: status of marine biodiversity and anthropogenic pressures in areas beyond national jurisdiction. STRONG High Seas Project. 105 pp.

Boyle MC, FitzSimmons NN, Limpus CJ, Kelez S, Velez-Zuazo X, Waycott M. (2009). Evidence for transoceanic migrations by loggerhead sea turtles in the southern Pacific Ocean. Proceedings of the Royal Society B: Biological Sciences 276(1664): 1993-1999.

Burridge CP, Meléndez R, Dyer BS (2006). Multiple origins of the Juan Fernández kelpfish fauna and evidence for frequent and unidirectional dispersal of cirrhitoid fishes across the South Pacific. Systematic Biology 55: 566-578.

Cai W, McPhaden MJ, Grimm AM, Rodrigues RR, Taschetto AS, Garreaud RD, ... & Vera C (2020). Climate impacts of the El Niño–southern oscillation on South America. Nature Reviews Earth & Environment 1(4): 215-231.

Cárdenas JC, Yañez J (1988). Importancia del desarrollo de un programa de investigaciones cetológicas en el sector de las islas oceánicas chilenas. En: Actas y Conclusiones del 1er Taller sobre Conservación y Manejo de Mamíferos Marinos Chilenos. Valdivia, Chile.

Cárdenas JC, Stutzin M, Oporto J, Cabello C, Torres D (1986). Manual de identificación de los cetáceos chilenos. Proyecto WH-445, Cetáceos-Chile, CODEFF, Santiago. 102 pp.

Castellanos-Galindo GA, Hampton S, Germán Naranjo L, Zapata Padilla LA, Bueno Martínez PA, Gaymer CF, Boteler B, Durussel C (2022). Estudio sobre medidas para apoyar esfuerzos de conservación en áreas fuera de la jurisdicción nacional en la región del Pacífico Sudeste. Proyecto STRONG High Seas. 70 pp.

CBD (2008). Decision adopted by the Conference of the Parties to the Convention on Biological Diversity at its Ninth Meeting. Marine and Coastal Biodiversity. Conference of the Parties to the Convention on Biological Diversity Ninth Meeting. Bonn, Germany, 19-30 May 2008. Agenda item 4.9. 12 pp.

CBD (2012). Compilation of submission of scientific information to describe EBSAs in the Eastern Tropical and Temperate Pacific Region. Eastern Tropical and Temperate Pacific Regional Workshop to facilitate the description of ecologically or biologically significant marine areas. Galápagos Islands, Ecuador, 28 to 31 August 2012. 18 pp.

CBD (2013). Report of the Eastern Tropical and Temperate Pacific Regional Workshop to facilitate the description of ecologically or biologically significant marine areas. Galápagos Islands, Ecuador, 28 to 31 August 2012. 247 pp.

CBD (2014). Decision adopted by the Conference of the Parties to the Convention on Biological Diversity. Conference of the Parties to the Convention on Biological Diversity Twelfth Meeting. Pyeongchang, Republic of Korea, 6-17 October 2014. Agenda item 21. 59 pp.

CBD (2017). Ecologically or Biologically Significant Areas (EBSAs) - Dorsal de Nazca y de Salas y Gómez (Salas y Gómez and Nazca Ridges). 8 pp.

Chagnon C, Thiel M, Antunes J, Ferreira JL, Sobral P, Ory NC (2018). Plastic ingestion and trophic transfer between Easter Island flying fish (*Cheilopogon rapanouiensis*) and yellowfin tuna (*Thunnus albacares*) from Rapa Nui (Easter Island). Environmental Pollution 243: 127-133.

Chandler M (1991). New records of marine turtles in Chile. Marine Turtle Newsletter 52: 8-11.

Cheung W, Levin L (2018). Model-averaging time of emergence of climate change in each RFMO area. Pp 60-99. In: Deep-ocean climate change impacts on habitat, fish and fisheries. Levin L, Baker M, Thompson A (eds). FAO Fisheries and Aquaculture Technical Paper No. 638. Rome, FAO. 186 pp.

CPPS (2012a). Estatuto sobre competencias y estructura de la Comisión Permanente del Pacífico Sur. 12 pp.

CPPS (2012b). Compromiso de Galápagos para el Siglo XXI. VIII reunión de ministros de relaciones exteriores de la Comisión Permanente del Pacífico Sur. Puerto Ayora, Galápagos, Ecuador. 17 de agosto de 2012. 6 pp.

Chavez-Molina V. et al. (2022). Protecting the Salas y Gomez and Nazca Ridges: a review of policy pathways for increasing conservation measures in international waters of the Southeast Pacific. Marine Policy (*submitted*)

Clark MR (2009). Deep-sea seamount fisheries: a review of global status and future prospects. Latin American Journal of Aquatic Research: 501-512.

Clark MR, Rowden AA, Schlacher TA, Guinotte J, Dunstan PK, Williams A, O'Hara TD, Watling L, Niklitschek E, Tsuchida S (2014). Identifying Ecologically or Biologically Significant Areas (EBSA): a systematic method and its application to seamounts in the South Pacific Ocean. Ocean & Coastal Management 91: 65-79.

Clark N, Reveille G (2020). A path to creating the first generation of high seas protected areas -science-based method highlights 10 sites that would help safeguard biodiversity beyond national waters. The PEW Charitable Trusts. 42 pp.

Comité Oceanográfico Nacional de Chile (2017). Crucero CIMAR 22 Islas Oceánicas (13 de octubre al 14 de noviembre de 2016) resultados preliminares. 130 pp.

Conejero C, Dewitte B, Garçon V, Sudre J, Montes I (2021). ENSO diversity driving low-frequency change in mesoscale activity off Peru and Chile, Scientific Reports 10: 17902.

Contreras M, Pizarro O, Dewitte B, Sepulveda H, Renault L (2019). Journal of Geophysical Research: Oceans 124: 5700-5722.

Cornejo M, Bravo L, Ramos M, Pizarro P, Karstenssen J, Gallegos M, Correa M, Silva N, Farías L, Karp L (2016). Biogeochemical characteristics of a long-lived anticyclonic eddy in the eastern South Pacific Ocean. Biogeosciences 13: 2971-2979.

Delgado JP, Brennan ML, Rapu-Haoa SA, Leong JHR, Gaymer CF, Carabias D, ... & Wagner D (2022). The hidden landscape: Maritime cultural heritage of the Salas y Gómez and Nazca ridges with implications for conservation on the high seas. Marine Policy 136: 104877.

Delrieu-Trottin EL, Brosseau-Acquaviva S, Mona V, Neglia EC, Giles C, Rapu-Edmunds C, Saenz-Agudelo P (2019). Understanding the origin of the most isolated endemic reef fish fauna of the Indo-Pacific: coral reef fishes of Rapa Nui. Journal of Biogeography 46: 723–733.

Dewitte B, Conejero C, Ramos M, Bravo L, Garçon V, Parada C, Sellanes J, Mecho A, Muñoz P, Gaymer C (2021). Understanding the impact of climate change on the oceanic circulation in the Chilean island ecoregions. Aquatic Conservation: Marine and Freshwater Ecosystems 31(2): 232-252.

Diaz-Diaz OF, Rozbaczylo N, Sellanes J, Tapia-Guerra JM (2020) A new species of *Eunice* Cuvier, 1817 (Polychaeta: Eunicidae) from the slope of the Desventuradas Islands and seamounts of the Nazca Ridge, southeastern Pacific Ocean. Zootaxa 4860(2): 211-226.

Duncan RA, Naar DF, Pyle DG, Russo CJ (2003). Radiometric ages for seamounts from the Easter-Salas y Gomez-Nazca hotspot track. EGS - AGU - EUG Joint Assembly. Abstracts from the meeting held in Nice, France, 6 - 11 April 2003. Abstract 7056.

Dunstan PK, Clark MR, Guinotte J, O'Hara T, Niklitschek E, Rowden AA, Schlacher T, Tsuchida S, Watling L, Williams A (2011). Identifying Ecologically and Biologically Significant Areas on Seamounts. Gland, Switzerland: IUCN. 14pp.

Durussel C, Soto Oyarzún E, Urrutia SO (2017). Strengthening the legal and institutional framework of the Southeast Pacific: focus on the BBNJ package elements. The International Journal of Marine and Coastal Law 32: 635-671.

Dyer BS, Westneat MW (2010). Taxonomy and biogeography of the coastal fishes of Juan Fernández Archipelago and Desventuradas Islands, Chile. Revista de Biología Marina y Oceanografía 45: 589-617.

Easton EE, Sellanes J, Gaymer CF, Morales N, Gorny M, Berkenpas E (2017). Diversity of deep-sea fishes of the Easter Island Ecoregion. Deep-Sea Research Part II: Topical Studies in Oceanography 137: 78-88.

Easton EE, Gorny M, Mecho A, Sellanes J, Gaymer CF, Spalding HL, Aburto J (2019). Chile and the Salas y Gómez Ridge (Chapter 27). Pp, 477-490. In: Loya Y, et al. (eds.), Mesophotic Coral Ecosystems, Coral Reefs of the World 12. Springer Nature Switzerland.

Eriksen M, Lebreton LC, Carson HS, Thiel M, Moore CJ, Borerro JC, Galgani F, Ryan PG, Reisser J (2014). Plastic pollution in the world's oceans: more than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. PLoS One 10: e111913.

Eriksen M, Liboiron M, Kiessling T, Charron L, Alling A, Lebreton L, et al. (2018). Microplastic sampling with the AVANI trawl compared to two neuston trawls in the Bay of Bengal and South Pacific. Environ. Pollut. 232: 430-439.

Eriksen M., Maximenko N, Thiel M, Cummins A, Lattin G, Wilson S, Hafner J, Zellers A, Rifman S (2013). Plastic pollution in the South Pacific subtropical gyre. Mar. Pollut. Bull. 68: 71–76.

Espinoza-Morriberón D, Echevin V, Colas F, Tam J, Gutierrez D, Graco M, Ledesma J, Quispe-Ccalluari C (2019). Oxygen variability during ENSO in the tropical South Eastern Pacific. Frontiers in Marine Science 5: 525.

Falvey M, Garreaud R (2009). Regional cooling in a warming world: recent temperature trends in the southeast Pacific and along the west coast of subtropical South America (1979–2006). J Geophys Res 114: D04102.

Félix F, Guzmán HM (2014). Satellite tracking and sighting data analyses of southeast Pacific humpback whales (*Megaptera novaeangliae*): Is the migratory route coastal or oceanic? Aquatic Mammals 40(4): 329-340.

Fernández M, Hormazábal S (2014). Overview of recent advances in oceanographic, ecological and fisheries research on oceanic islands in the southeastern Pacific Ocean. Latin American Journal of Aquatic Research 42: 666-672.

Fernández M, Pappalardo P, Rodríguez-Ruiz MC, Castilla JC (2014). Synthesis of the state of knowledge about species richness of macroalgae, macroinvertebrates and fishes in coastal and oceanic waters of Easter and Salas y Gómez islands. Latin American Journal of Aquatic Research 42: 760-802.

Flores-Aqueveque V, Rojas M, Aguirre C, Arias P, González C (2020). South Pacific Subtropical High from the late Holocene to the end of the 21st century: insights from climate proxies and general circulation models, Clim. Past 16: 79-99.

Frenger I, Bianchi D, Sührenberg C, Oschlies A, Dunne J, Deutsch C, et al. (2018). Biogeochemical role of subsurface coherent eddies in the ocean: Tracer cannonballs, hypoxic storms, and microbial stewpots? Global Biogeochemical Cycles 32: 226-249.

Friedlander AM, Ballesteros E, Beets J, Berkenpas E, Gaymer CF, Gorny M, Sala E (2013). Effects of isolation and fishing on the marine ecosystems of Easter Island and Salas y Gómez, Chile. Aquatic Conservation: Marine & Freshwater Ecosystems 23: 515-531.

Friedlander AM, Ballesteros E, Caselle JE, Gaymer CF, Palma AT, Petit I, Varas E, Muñoz Wilson A, Sala E (2016). Marine Biodiversity in Juan Fernández and Desventuradas Islands, Chile: global endemism hotspots. PLoS One 11(1): e0145059.

Friedlander AM, Gaymer CF (2021). Progress, opportunities and challenges for marine conservation in the Pacific Islands. Aquatic Conservation: Marine and Freshwater Ecosystems 31: 221-231.

Friedlander AM, Goodell W, Giddens J, Easton EE, Wagner D (2021). Deep-sea biodiversity at the extremes of the Salas y Gómez and Nazca ridges with implications for conservation. PloS ONE 16(6): e0253213

Fuenzalida R, Schneider W, Blanco JL, Garces-Vargas J, Bravo L (2007). Sistema De Corrientes ChilePerú Y Masas De Agua Entre Caldera E Isla De Pascua. Revista Ciencia y Tecnología del Mar 30: 5-16.

Fuenzalida R, Schneider W, Garcés-Vargas J, Bravo L, Lange C (2009). Vertical and horizontal extension of the oxygen minimum zone in the eastern South Pacific Ocean. Deep Sea Research Part II: Topical Studies in Oceanography 56: 992-1003.

Gales N, Bowers M, Durban JW, Friedlaender AS, Nowacek DP, Pitman RL, Read AL, Tyson RB (2013). Advances in non-lethal research on Antarctic minke whales: biotelemetry, photo-identification and biopsy sampling. SC/65a/IA12, Working paper presented at the 65th IWC meeting, Jeju, Korea. Available from www.iwcoffice.org. 15 pp.

Galil BS, Spiridonov VA (1998). *Mursia zarenkovi* new species (Decapoda, Calappidae) from the Southeastern Pacific. Crustaceana 71: 904-908.

Gallardo MA, Macpherson E, Tapia JM, Asorey CM, Sellanes J (2021a) A new species of *Munida* Leach, 1820 (Crustacea: Decapoda: Anomura: Munididae) from seamounts of the Nazca-Desventuradas Marine Park. PeerJ 9(e10531): 1-18.

Gallardo C, Ory NC, Gallardo MDLA, Ramos M, Bravo L, Thiel M (2021b) Sea-Surface Slicks and Their Effect on the Concentration of Plastics and Zooplankton in the Coastal Waters of Rapa Nui (Easter Island). Frontiers in Marine Science 8: 688224.

Gálvez M (2012a). Description of area meeting CBD's criteria in the Eastern Tropical and Temperate Pacific Region. Area: Salas y Gómez and Nazca Ridges. Convention of Biological Diversity. 6 pp.

Gálvez M (2012b). Salas y Gómez and Nazca - treasures in the high seas of the Southeastern Pacific. South Pacific Regional Fishery Management Organization. 11th Meeting of the Science Working Group. Lima, Peru. 15-19 October, 2012. SWG-11-INF-07. 4pp.

Gálvez-Larach M (2009). Seamounts of Nazca and Salas y Gómez: a review for management and conservation purposes. Latin American Journal of Aquatic Research 37: 479-500.

Garcia H (1989). Registros nuevos. En: J. Gibbons, P. Ruiz y G. Sanhueza (Eds.). Boletín No. 3 de la Red de avistamiento de Cetáceos (RAC) CODEFF-Chile. Santiago, Chile. 5 pp.

García M, Correa J, Maksaev V, Townley B (2020). Potential mineral resources of the Chilean offshore: an overview. Andean Geology 47: 1-13.

García-Cegarra AM, Pacheco AS (2019). Collision risk areas between fin and humpback whales with large cargo vessels in Mejillones Bay (23°S), northern Chile. Marine Policy 103: 182–186

Garcia-Cegarra AM, Ramirez R, Orrego R (2020). Red-legged cormorant uses plastic as nest material in an artificial breeding colony of Atacama Desert coast. Marine Pollution Bulletin 160: p.111632.

Garreaud R, Boisier J, Rondanelli R, Montecinos A, Sepúlveda H, VelosoAguila D (2019). The Central Chile Mega Drought (2010–2018): A climate dynamics perspective. Int J Climatol. 40(1): 1–19.

Garth JS (1992). Some deep-water Parthenopidae (Crustacea, Brachyura) from French Polynesia and nearby eastern Pacific ridges and seamounts. Bulletin du Muséum national d'histoire naturelle 14: 781-795.

GBIF.org (27 April 2022) GBIF Occurrence Download https://doi.org/10.15468/dl.69y8nc

González CE, Escribano R, Bode A, Schneider W (2019). Zooplankton taxonomic and trophic community structure across biogeochemical regions in the Eastern South Pacific. Frontiers in Marine Science 5: 498.

Gove J, McManus M, Neuheimer A, Polovina J, Drazen J, Smith C, Merrifield M, Friedlander A, Ehses J, Young C, Dillon A, Williams G (2016). Near-island biological hotspots in barren ocean basins. Nature Communications 7: 10581.

Government of Chile (2020). Easter Continental Shelf of Easter island Province. Executive Summary. 34 pp.

Graham NAJ, Wilson SK, Carr P, Hoey AS, Jennings S, MacNeil MA (2018). Seabirds enhance coral reef productivity and functioning in the absence of invasive rats. Nature 559: 250-253.

Grise K, Davis S (2020). Hadley cell expansion in CMIP6 models. Atmos. Chem. Phys. 20: 5249-5268.

Grise K, Davis S, Staten P, Adam O (2018). Regional and Seasonal Characteristics of the Recent Expansion of the Tropics. Journal of Climate 31(1): 6839-6856.

Gusmao JB, Luna-Jorquera G, Fernández C, Luna N, Plaza P, Portflitt-Toro M, Serratosa J, Nuñez P, Varela AI, Rivadeneira MM (2020). The role of island physiography and oceanographic factors in shaping species richness and turnover of nesting seabird assemblages on islands across the south-eastern Pacific. Journal of Biogeography 47: 2611–2621.

Gusmao JB, Diaz O, Gallardo C, Hidalgo-Ruz V, Kiessling T, Mecho A, Meerhoff E, Rozbaczylo N, Thiel M (2022). Water depth and mesoscale oceanography drive neustonic polychaete assemblages in the SE Pacific Ocean. Marine Ecology Progress Series 682: 123–136.,

Halpern BS, Frazier M, Potapenko J, Casey KS, Koenig K, Longo C., Lowndes JS, Rockwood RC, Selig ER, Selkoe KA, Walbridge S (2015). Spatial and temporal changes in cumulative human impacts on the world's ocean. Nature Communications 6: 7615.

Harpp KS, Hall PS, Jackson MG (2014). Galápagos and Easter - a tale of two hotspots. Pp. 27-40. In: The Galápagos: a natural laboratory for the earth sciences, geophysical monograph 204. First Edition. Harpp KS, Mittelstaedt E, d'Ozouville N, Graham DW (eds). American Geophysical Union. John Wiley & Sons, Inc.

Hein JR, Mizell K, Koschinsky A, Conradac TA (2013). Deep-ocean mineral deposits as a source of critical metals for high- and green-technology applications: Comparison with land-based resources. Ore Geology Reviews 51: 1-14.

Heinze C, Meyer S, Goris N, Anderson L, Steinfeldt R, Chang N, Le Quere C, Bakker DCE (2015). The ocean carbon sink – impacts, vulnerabilities and challenges. Earth System Dynamics 6: 327-358.

Hidalgo-Ruz V, Luna-Jorquera G, Eriksen M, Frick H, Miranda-Urbina D, Portflitt-Toro M, ... & Thiel M (2021). Factors (type, colour, density, and shape) determining the removal of marine plastic debris by seabirds from the South Pacific Ocean: Is there a pattern? Aquatic Conservation: Marine and Freshwater Ecosystems 31(2): 389-407.

Hidalgo-Ruz V, Thiel M (2013). Distribution and abundance of small plastic debris on beaches in the SE Pacific (Chile): a study supported by a citizen science project. Marine Environmental Research 87: 12-18.

Hoeksema B, Sellanes J, Easton E (2019). A high-latitude, mesophotic Cycloseris field at 85 m depth off Rapa Nui (Easter Island). Bulletin of Marine Science 95(1): 101-102.

Horacek III, H. J, Soto E, Quiroga E, Ingels J (2022). Meiofaunal Nematode Abundance, Composition, and Diversity at Bathyal to Hadal Depths in the Southeast Pacific Ocean. Deep Sea Research Part I 188: 103837.

Hormazábal S, Combes V, Morales CE, Correa-Ramírez MA, Di Lorenzo E, Nuñez S (2013). Intrathermocline eddies in the coastal transition zone off central Chile (31–41°S). Journal of Geophysical Research-Oceans 118: 4811-4821.

Hubbs CL (1959). Initial discoveries of fish faunas on seamounts and offshore banks in the Eastern Pacific. Pacific Science 13: 311-316.

Hucke-Gaete R (2004). Distribución, preferencia de hábitat y dinámica espacial de la ballena azul en Chile: 1997-2004. Doctoral Thesis. Escuela de Graduados, Universidad Austral de Chile. 145 pp.

Hucke-Gaete R, Mate B (2005). Feeding season movements and fall migration to wintering areas for Chilean blue whales. Abstracts of the 16th Biennial Conference on the Biology of Marine Mammals, 12-16 December 2005, San Diego, CA, USA.

Hucke-Gaete R, Aguayo-Lobo A, Yancovic-Pakarati S, Flores M (2014). Marine mammals of Easter Island (Rapa Nui) and Salas y Gómez Island (Motu Motiro Hiva), Chile: a review and new records. Latin American Journal of Aquatic Research 42: 743-751.

Hucke-Gaete R, Bedriñana-Romano L, Viddi F, Ruiz J, Torres-Florez JP, Zerbini AN (2018). From Chilean Patagonia to Galapagos, Ecuador: novel insights on blue whale migratory pathways along the Eastern South Pacific. PeerJ 6: e4695.

IATTC (2017). Resolution C-17-02. Conservation measures for tropical tunas in the eastern Tropical Pacific during 2018-2020 and amendment to resolution C-17-01. Inter-American Tropical Tuna Commission 92nd Meeting. Mexico City, Mexico. 24-28 July, 2017. 5pp.

IATTC (2020). Inter-American Tropical Tuna Commission catch reports, data, tagging, and other reports. Online resources available at: https://www.iattc.org/CatchReportsDataENG.htm.

Ioannidis AG, Blanco-Portillo J, Sandoval K, Hagelberg E, Miquel-Poblete JF, Moreno-Mayar JV, Rodríguez-Rodríguez JE, Quinto-Cortés CD, Auckland K, Parks T, Robson K, Hill AVS, Avila-Arcos MC, Sockell A, Homburger JR, Wojcik GL, Barnes KC, Herrera L, Berríos S, Acuña M, Llop E, Eng C, Huntsman S, Burchard EG, Gignoux CR, Cifuentes L, Verdugo RA, Moraga M, Mentzer AJ, Bustamante CD, Moreno-Estrada A (2020). Native American gene flow into Polynesia predating Easter Island settlement. Nature 583: 572-577.

IUCN (2020). The IUCN Red List of Threatened Species. Version 3. Available online at: https://www.iucnredlist.org/resources/spatial-data-download.

ISA (2020). International Seabed Authority Maps. Available online at: https://www.isa.org.jm/maps.

Jones JS, Porter A, Muñoz-Pérez JP, Alarcón-Ruales D, Galloway TS, Godley BJ, Santillo D, Vagg J., Lewis C (2021). Plastic contamination of a Galapagos Island (Ecuador) and the relative risks to native marine species. Science of The Total Environment 789: 147704.

KBA (2020). World database of key biodiversity areas. Available online at: http://www.keybiodiversityareas.org/site/mapsearch.

Keeling RE, Körtzinger A, Gruber N (2010). Ocean deoxygenation in a warming world. Annual Reviews of Marine Science 2: 199-229.

Kendall WC, Radcliffe L (1912). The shore fishes. Reports on the scientific results of the expedition to the tropical Pacific, 35. Cambridge, U.S.A.

Kruse SE, Liu ZJ, Naar DF, Duncan RA (1997). Effective elastic thickness of the lithosphere along the Easter Seamount Chain. Journal of Geophysical Research 42: 27305-27317.

Levin LA, Wei CL, Dunn DC, Amon DJ, Ashford OS, Cheung WWL, Colaço A, Dominguez-Carrió C, Escobar EG, Harden-Davies HR, Drazen JC, Ismail K, Jones DOB, Johnson DE, Le JT, Lejzerowicz F, Mitarai S, Morato T, Mulsow S, Snelgrove PVR, Sweetman AK, Yasuhara M (2020). Climate change considerations are fundamental to management of deep-sea resource extraction. Global Change Biology 26: 4664-4678.

Li H, Ilyina T, Müller WA, Landschützer P (2019). Predicting the variable ocean carbon sink. Science Advances 5: eaav6471.

Lujala P, Rod JK, Thieme N (2007). Fighting over oil: introducing a new dataset. Conflict Management and Peace Science 24: 239-256.

Luna N, Varela AI, Brokordt K, Luna-Jorquera G (2018). Assessing Potential Predation Risk by Introduced Predators on Unattended Eggs in the Red-Tailed Tropicbird, *Phaethon rubricauda*, on Rapa Nui (Easter Island). Tropical Conservation Science 11: 1940082918785079.

Luna-Jorquera G, Thiel M, Portflitt-Toro M, Dewitte B (2019). Marine protected areas invaded by floating anthropogenic litter: an example from the South Pacific. Aquatic Conservation: Marine and Freshwater Ecosystems 29(S2): 245-259.

MacIsaac HJ, De Roy EM, Leung B, Grgicak-Mannion A, Ruiz GM (2016). Possible ballast water transfer of lionfish to the eastern Pacific Ocean. PLoS One. 11(11): 1–12.

Mammerickx J, Anderson RN, Menard HW, Smith SM (1975). Morphology and tectonic evolution of the East Central Pacific. Geological Society of America Bulletin 86: 111-118.

Martin CS, Tolley MJ, Farmer E, Mcowen CJ, Geffert JL, Scharlemann JPW, Thomas HL, van Bochove JH, Stanwell-Smith D, Hutton JM, Lascelles B, Pilgrim JD, Ekstrom JMM, Tittensor D (2015). A global map to aid the identification and screening of critical habitat for marine industries. Marine Policy 53: 45-53.

Martínez-Tilleria KP 2015. Optimización de un portafolio de conservación marino-terrestre para Chile: efectos y consecuencias de la integración. PhD Thesis. Programa de Doctorado en Biología y Ecología Aplicada, Universidad de La Serena & Universidad Católica del Norte, La Serena, Chile. 399 pp.

Mayes CL, Lawver LA, Sandwell DT (1990). Tectonic history and new isochron chart of the south Pacific. Journal of Geophysical Research 95: 8543-856.

McCosker JE, Parin NV (1995). A new species of deepwater worm-eel, *Muraenichthys profundorum* (Anguilliformes: Ophichthidae), from the Nazca Ridge. Japanese Journal of Ichthyology 42: 231-235.

Mecho A, Easton EE, Sellanes J, Gorny M, Mah C (2019). Unexplored diversity of the mesophotic echinoderm fauna of the Easter Island ecoregion. Marine Biology 166: 91.

Mecho A, Dewitte B, Sellanes J, van Gennip S, Easton EE, Gusmao JB (2021a) Environmental Drivers of Mesophotic Echinoderm Assemblages of the Southeastern Pacific Ocean. Frontiers in marine Science 8: 574780.

Mecho A, Sellanes J, Aguzzi J (2021b) Seafloor litter at oceanic islands and seamounts of the southeastern Pacific. Marine Pollution Bulletin 170: 112641.

Medellín-Mora J, Escribano R, Corredor-Acosta A, Hidalgo P and Schneider W (2021) Uncovering the Composition and Diversity of Pelagic Copepods in the Oligotrophic Blue Water of the South Pacific Subtropical Gyre. Frontiers in marine Science 8: 625842.

Meerhoff, E., Yannicelli, B., Dewitte, B., Díaz-Cabrera, E., Vega-Retter, C., Ramos, M., ... & Véliz, D. (2018). Asymmetric connectivity of the lobster Panulirus pascuensis in remote islands of the southern Pacific: importance for its management and conservation. Bulletin of Marine Science 94(3): 753-774.

Menini E, Van Dover CL (2019). An atlas of protected hydrothermal vents. Marine Policy 108: 103654. Miller KA, Thompson KF, Johnston P, Santillo D (2018). An overview of seabed mining including the current state of development, environmental impacts, and knowledge gaps. Frontiers in Marine Science 4: 418.

Messié M, Petrenko A, Doglioli AM, Aldebert C, Martinez E, Koenig G, Moutin T (2020). The delayed island mass effect: How islands can remotely trigger blooms in the oligotrophic ocean. Geophysical Research Letters 47(2): e2019GL085282.

Metraux A (1940). Ethnology of easter Island. Bernice P. Bishop Museum Bulletin 160: 432 pp.

Miller KA, Thompson KF, Johnston P, Santillo D (2018). An overview of seabed mining including the current state of development, environmental impacts, and knowledge gaps. Frontiers in Marine Science 4: 418.

Miranda-Urbina D, Thiel M, Luna-Jorquera G (2015). Litter and seabirds found across a longitudinal gradient in the South Pacific Ocean. Mar. Pollut. Bull. 96: 235–244.

Montenegro-Hoyos AC, Muñoz-Carvajal EA, Wallberg BN, Seguel ME, Rosales SA, Viña-Trillos NA, Torres-Avilés DS, Villarroel AE, Gaymer CF, Squeo FA (2022). Biodiversity in Times of COVID-19 and its Relationship with the Socio-Economic and Health Context: A Look from the Digital Media. Environmental Management 70: 369-380.

Morel A. et al (2010). The most oligotrophic subtropical zones of the global ocean: similarities and differences in terms of chlorophyll and yellow substance. Biogeosciences 7: 3139-3151.

Motomura H, Kanehira N, Imamura H (2012). Redescription of a poorly known Southeastern Pacific Scorpionfish (Scorpaenidae), *Phenacoscorpius eschmeyeri* Parin and Mandrytsa. Species Diversity 17: 145–150.

Morales N, Heidemeyer M, Bauer R, Hernández S, Acuña E, van Gennip S, Friedlander AM, Gaymer CF (2021). Residential movements of top predators at Chile's most isolated marine protected area: implications for the conservation of the Galapagos shark, *Carcharhinus galapagensis*, and the yellowtail amberjack, *Seriola lalandi*. Aquatic Conservation: Marine and Freshwater Ecosystems 31(2): 340-355.

Moyano HI (2005). Bryozoa de la placa de Nazca con énfasis en las islas Desventuradas. Ciencia y Tecnología del Mar 28: 75-90.

National Geographic & OCEANA. (2013). Islas Desventuradas. Biodiversidad marina y propuesta de conservación. Informe de la expedición "Pristine Seas". Febrero del 2013. 62 pp.

Newman WA, Foster BA (1983). The Rapanuian Faunal District (Easter and Sala y Gómez): in search of ancient archipelagos. Bulletin of Marine Science 33: 633-644.

OBIS.org (26 April 2022). OBIS occurrence Download https://mapper.obis.org/?taxonid=1836&geometry=POLYGON%20((-78.0469%20-9.2756,%20-144.3164%20-8.9285,%20-144.3164%20-46.5589,%20-73.3008%20-44.5905,%20-72.7734%20-19.1452,%20-78.0469%20-9.2756))

Oceana (2015). Biodiversidad del bentos en los montes submarinos JF1 y JF2 del archipiélago de Juan Fernández.

O'Leary BC, Roberts CM (2018). Ecological connectivity across ocean depths: implications for protected area design. Global Ecology and Conservation 15: e00431.

Ortiz-Alvarez C, Alfaro-Cordova E, Bielli A, Mangel JC, Alfaro-Shigueto J (2022). Solid waste assessment in a coastal fishing community in Peru. Marine Pollution Bulletin 178: 113632.

Ory NC, Sobral P, Ferreira JL, Thiel M (2017). Amberstripe scad *Decapterus muroadsi* (Carangidae) fish ingest blue microplastics resembling their copepod prey along the coast of Rapa Nui (Easter Island) in the South Pacific subtropical gyre. Sci. Total Environ. 586: 430–437.

Palma S, Silva N (2006). Epipelagic siphonophore assemblages associated with water masses along a transect between Chile and Easter Island (eastern South Pacific Ocean). Journal of Plankton Research 28: 1143–1151.

Pazmiño D, GE Maes, ME Green, CA Simpfendorfer, EM Hoyos-Padilla, CJA Duffy, CG Meyer, SE Kerwath, P Salinas-de-León, L Herwerden (2018). Strong trans-Pacific break and local conservation units in the Galapagos shark (Carcharhinus galapagensis) revealed by genome-wide cytonuclear markers. Heredity 120: 407–421.

Paredes F, Flores D, Figueroa A, Gaymer CF, Aburto JA (2019). Science, capacity building and conservation knowledge: the empowerment of the local community for marine conservation in Rapa Nui. Aquatic Conservation: Marine and Freshwater Ecosystems 29(S2): 130-137.

Parin NV (1991). Fish fauna of the Nazca and Sala y Gomez Submarine Ridges, the easternmost outpost of the Indo-West Pacific Zoogeographic Region. Bulletin of Marine Science 49(3): 671-683.

Parin NV (1992). *Argyripnus electronus*, a new sternoptychid fish from the Sala y Gomez submarine ridge. Japanese Journal of Ichthyology 39: 135-137.

Parin NV, Shcherbachev YN (1982). Two new Argentine fishes of the genus *Glossanodon* from the Eastern South Pacific. Japanese Journal of Ichthyology 28: 381-384.

Parin NV, Kotlyar AN (1989). A new aulopodid species, *Hime microps*, from the Eastern South Pacific, with comments on geographic variations of *H. japonica*. Japanese Journal of Ichthyology 35: 407-413.

Parin NV, Sazonov YI (1990). A new species of the genus *Laemonema* (Moridae, Gadiformes) from the Tropical Southeastern Pacific. Japanese Journal of Ichthyology 37: 6-9.

Parin NV, Mironov AN, Nesis KN (1997). Biology of the Nazca and Sala y Gomez submarine ridges, an outpost of the Indo-West Pacific fauna in the Eastern Pacific Ocean: composition and distribution of the fauna, its communities and history. Advances in Marine Biology 32: 145-242.

Paulmier A, Ruiz-Pino D (2009). Oxygen minimum zones (OMZs) in the modern ocean. Progress in Oceanography 80: 113-128.

Payá I, Montecinos M, Ojeda V, Cid L (2005). An overview of the orange roughy (*Hoplostethus* sp.) fishery off Chile. An international Conference on Governance and Management of Deep-Sea Fisheries. Queenstown, New Zealand. FAO Fisheries Report No 772: 97-116.

Pequeño G, Lamilla J (1995). Desventuradas Islands, Chile: the easternmost outpost of the Indo-West Pacific zoogeographic region. Revista de Biologia Tropical 44: 929-931.

Pequeño G, Lamilla J (2000). The littoral fish assemblage of the Desventuradas Islands (Chile) has zoogeographical affinities with the western Pacific. Global Ecology and Biogeography 9: 431-437

Perez-Venegas DJ, Toro-Valdivieso C, Ayala F, Brito B, Iturra L, Arriagada M, Seguel M, Barrios C, Sepúlveda M, Oliva D., Cárdenas-Alayza S (2020). Monitoring the occurrence of microplastic ingestion in Otariids along the Peruvian and Chilean coasts. Marine Pollution Bulletin 153: p.110966.

Petit IJ, Gaymer CF, Friedlander AM, Gusmao JB (2021). Human at the top of the food web: are coastal benthic communities at Rapa Nui affected by fishing?. Environmental Biology of Fishes 23: 1-9.

Petit IJ, Gaymer CF, Friedlander AM, Gusmao JB (2022). Depth as a fish refuge from spearfishing at Rapa Nui: Flight behaviour in the Pacific rudderfish *Kyphosus sandwicensis*. Aquatic Conservation: Marine and Freshwater Ecosystems 32: 727–740.

Plaza P, Serratosa J, Gusmao JB, Duffy DC, Arce P, Luna-Jorquera G (2021). Temporal changes in seabird assemblage structure and trait diversity in the Rapa Nui (Easter Island) multiple-use marine protected area. Aquatic Conservation: Marine and Freshwater Ecosystems 31: 378-388.

Poupin J (2003). Crustacea Decapoda and Stomapoda of Easter Island and surrounding areas. A documented checklist with historical overview and biogeographic comments. Atoll Research Bulletin 500: 1-50.

Premachandra HKA, Lafarga-De la Cruz F, Takeuchi Y, Miller A, Fielder S, O'Connor W, … Knibb W (2017). Genomic DNA variation confirmed *Seriola lalandi* comprises three different populations in the Pacific, but with recent divergence. Scientific Reports 7(1): 1-11.

Prior S, Chircop A, Roberts J (2010). Area-based management on the high seas: possible application of the IMO’s particularly sensitive sea area concept. The International Journal of Marine and Coastal Law 25: 483-522.

Raimbault P, Garcia N (2008). Evidence for efficient regenerated production and dinitrogen fixation in nitrogen-deficient waters of the South Pacific Ocean: impact on new and export production estimate. Biogeosciences 5: 323-338.

Randall JE, Cea A (2011). Shore fishes of Easter Island. University of Hawaii Press. Honolulu.

Rappaport Y, Naar DF, Barton CC, Liu ZJ, Hey RN (1997). Morphology and distribution of seamounts surrounding Easter Island. Journal of Geophysical Research 102: 713-724.

Ras J. et al (2008). Spatial variability of phytoplankton pigment distributions in the Subtropical South Pacific Ocean: Comparison between in situ and predicted data. Biogeosciences 5(2): 353-369.

Ray JS, JMahoney JJ, Duncan RA, Ray J, Wessel P, Naar DF (2012). Chronology and geochemistry of lavas from the Nazca Ridge and Easter Seamount Chain: an ∼30 myr hotspot record. Journal of Petrology 53: 1417-1448.

Rech S, Thiel M, Pichs YJB, García-Vazquez E (2018). Travelling light: fouling biota on macroplastics arriving on beaches of remote Rapa Nui (Easter Island) in the South Pacific subtropical gyre. Mar. Pollut. Bull. 137: 119-128.

Rech S, Gusmao JB, Kiessling T, Hidalgo-Ruz V, Meerhoff E, Gatta-Rosemary M, Moore C, de Vine R, Thiel M (2021). A desert in the ocean–Depauperate fouling communities on marine litter in the hyper-oligotrophic South Pacific subtropical gyre. Sci. Total Environ. 759: 143545.

Rehder HA (1980). The marine mollusks of Easter Island (Isla de Pascua) and Sala y Gómez. Smithsonian Contributions to Zoology: 1-167.

Reiswig HM, Araya JF (2014). A review of the Hexactinellida (Porifera) of Chile, with the first record of *Caulophacus Schulze*, 1885 (Lyssacinosida: Rossellidae) from the Southeastern Pacific Ocean. Zootaxa 3889: 414-428.

Rodrigo C, Lara LE (2014). Plate tectonics and the origin of the Juan Fernández Ridge: analysis of bathymetry and magnetic patterns. Latin American Journal of Aquatic Research 42: 907-917.

Rodrigo C, Díaz J, González-Fernández A (2014). Origin of the Easter Submarine Alignment: morphology and structural lineaments. Latin American Journal of Aquatic Research 42: 857-870.

Rodríguez A, Holmes ND, Ryan PG, Wilson KJ, Faulquier L, Murillo Y, Raine AF, Penniman JF, Neves V, Rodríguez B, Negro JJ, Chiaradia A, Dann P, Anderson T, Metzger B, Shirai M, Deppe L, Wheeler J, Hodum P, Gouveia C, Carmo V, Carreira GP, Delgado-Alburqueque L, Guerra-Correa C, Couzi FX, Travers M, Corre ML (2017). Seabird mortality induced by land-based artificial lights. Conservation Biology 31: 986-1001.

Rogers AD (2018). Chapter Four - The Biology of Seamounts: 25 Years on, Editor(s): Charles Sheppard, Advances in Marine Biology, Academic Press, 79, 137-224.

Rogers AD (2000). The role of the oceanic oxygen minima in generating biodiversity in the deep sea. Deep Sea Research Part II: Topical Studies in Oceanography 47: 119-148.

Sala E, Mayorga J, Bradley D, Cabral RB, Atwood TB, Auber A, ... & Lubchenco J (2021). Protecting the global ocean for biodiversity, food and climate. Nature 592(7854): 397-402.

Sandwell D, Anderson DL, Wessel P (2005). Global tectonic maps. pp. 1-10. In: Plates, Plumes, and Paradigms. Special papers (Geological Society of America). No.388. Geological Society of America, Boulder, CO.

Santillán L, Saldaña-Serrano M, De-La-Torre GE (2020). First record of microplastics in the endangered marine otter (*Lontra felina*). Mastozoología neotropical 27(1): 211-215.

Schreiber EA, Burger J (2002). Biology of Marine Birds. CRC Press LLC, 2000 N.W. Corporate Blvd., Boca Raton, Florida 33431: Boca Raton.

Schneider W, Donoso D, Garcés-Vargas J, Escribano R (2017). Water-column cooling and sea surface salinity increase in the upwelling region off central-south Chile driven by a poleward displacement of the South Pacific High. Progress in Oceanography 151: 38-48.

Shillinger GL, Palacios DM, Bailey H, Bograd SJ, Swithenbank AM, Gaspar P, Wallace BP, Spotila JR, Paladino FV, Piedra R, Eckert SA, Block BA (2008). Persistent leatherback turtle migrations present opportunities for conservation. PLoS Biology 6(7): e171.

Schwarzhans W (2014). Head and otolith morphology of the genera *Hymenocephalus*, *Hymenogadus* and *Spicomacrurus* (Macrouridae), with the description of three new species. Zootaxa 3888: 1-73.

Sellanes J, Gorny M, Zapata-Hernández G, Alvarez G, Muñoz P, Tala F (2021) A new threat to local marine biodiversity: filamentous mats proliferating at mesophotic depths off Rapa Nui. PeerJ 9:e12052

Sellanes J, Salisbury RA, Tapia JM, Asorey CM (2019). A new species of *Atrimitra* Dall, 1918 (Gastropoda: Mitridae) from seamounts of the recently created Nazca-Desventuradas Marine Park, Chile. PeerJ 7: e8279.

SERNANP (2020). Expediente técnico preliminar: Reserva Nacional Dorsal de Nasca. Mayo 2020. Available online at: http://www.sernanp.gob.pe/reserva-nacional-dorsal-de-nasca.

Sernapesca (2022) Anuarios estadísticos de pesca y acuicutura. http://www.sernapesca.cl/ informacion-utilidad/anuarios-estadisticos-de-pesca-y-acuicultura.

Serratosa J, Hyrenbach KD, Miranda-Urbina D, Portflitt-Toro M, Luna N, Luna-Jorquera G (2020). Environmental drivers of seabird at-sea distribution in the Eastern South Pacific Ocean: assemblage composition across a longitudinal productivity gradient. Frontiers in Marine Science 6: 838.

Soto E. et al (2020). First results of the Project "Deep-sea soft-bottom benthic communities: Exploring biogeography and genetic connectivity of southeast Pacific Seamounts". Deep-Sea life, Issue 14.

SPRFMO (2020a). Public domain data sets. Available online at: https://www.sprfmo.int/data/catch-information/.

SPRFMO (2020b). SPRFMO Conservation and Management Measures. Available online at: https://www.sprfmo.int/measures/

Spalding MD, Fox HE, Allen GR, Davidson N, Ferdaña ZA, Finlayson M, Halpern BS, Jorge MA, Lombana A, Lourie SA, Martin KD, McManus E, Molnar J, Recchia CA, Robertson J (2007). Marine ecoregions of the world: a bioregionalization of coastal and shelf areas. Biosciences 57: 573-583.

Steadman DW, Vargas-Casanova P & Cristino-Ferrando C (1994). Stratigraphy, chronology, and cultural context of an early faunal assemblage from Easter Island. Asian Perspectives 33(1): 79-96.

Steinberger B (2002). Motion of the Easter hot spot relative to Hawaii and Louisville hot spots. Geochemistry, Geophysics, Geosystems 3: 850.

Stramma L, Johnson GC, Sprintall J, Mohrholz V (2008). Expanding oxygen minimum zones in the tropical oceans. Science 320: 655-658.

Strub PT, Montecino V, Rutllant J, Salinas S (1998). Coastal ocean circulation off western South America, in The Sea, vol. 11, The Global Coastal Ocean: Regional Studies and Syntheses, edited by A. R. Robinson and K. H. Brink, pp. 273–314, John Wiley, Hoboken, N. J.

Tapia-Guerra JM, Asorey CM, Easton EE, Wagner D, Gorny M, Sellanes J (2021a) First ecological characterization of whip black coral assemblages (Hexacorallia: Antipatharia) in the Easter Island Ecoregion, southeastern Pacific. Frontiers in Marine Science 8:755898

Tapia-Guerra JM, Mecho A, Easton EE, Gallardo MA, Gorny M, Sellanes J (2021b) First description of deep benthic habitats and communities of oceanic islands and seamounts of the Nazca Desventuradas Marine Park, Chile. Scientific Reports 11: 6209.

Thiel M, Lorca BB, Bravo L, Hinojosa IA, Meneses HZ (2021). Daily accumulation rates of marine litter on the shores of Rapa Nui (Easter Island) in the South Pacific Ocean. Marine Pollution Bulletin 169: 112535.

Thiel M, Luna-Jorquera G, Álvarez-Varas R, Gallardo C, Hinojosa IA, Luna N, Miranda-Urbina D, Morales N, Ory N, Pacheco AS, Portflitt-Toro M, Zavalaga C (2018). Impacts of marine plastic pollution from continental coasts to subtropical gyres—fish, seabirds, and other vertebrates in the SE Pacific. Frontiers in Marine Science 5: 238.

Tingley G, Dunn M (2018). Global review of orange roughy (*Hoplostethus atlanticus*), their fisheries, biology and management. FAO Fisheries and Technical Paper 622: 128pp.

Toro N, Jeldres RI, Órdenes JA, Robles P, Navarra A (2020). Manganese Nodules in Chile, an alternative for the production of Co and Mn in the future-a review. Minerals 10: 674.

Torres D (1987). Antecedentes sobre el lobo fino de Juan Fernández, *Arctocephalus philippii*, y proyecciones para su estudio. Pp 287-317. In: Islas Oceánicas Chilenas: Conocimiento Científico y Necesidades de Investigaciones. Castilla, J.C. (Ed.), Ediciones Universidad Católica de Chile. 353 pp.

Townsend CH (1935). The distribution of certain whales as shown by logbook records of American whaleships. Zoological, N.Y. 19: 1-50.

Ulloa O, Pantoja S (2009). The oxygen minimum zone of the eastern South Pacific. Deep Sea Research Part II: Topical Studies in Oceanography 56: 987-991.

UNCLOS (1982). United Nations Convention on the Law of the Sea. 202 pp.

UNESCO (1995). Convention concerning the protection of the world cultural and natural heritage. Report of the World Heritage Committee Nineteenth Session. Berlin, Germany. 4-9 December 1995. 127 pp.

Valencia E, Meerhoff E, Díaz-Cabrera E, Guerrero F, Roja-Hernández N, Vega-Retter C, Veliz D (2021). Weak connectivity and population cohesiveness in rudderfish *Kyphosus sandwicensis* (Teleostei: Kyphosidae) inhabiting remote oceanic islands. Aquatic Conservation: Marine and Freshwater Ecosystems 31: 356–366.

Van Gennip SJ, Dewitte B, Garçon V, Thiel M, Popova E, Drillet Y, Ramos M, Yannicelli B, Bravo L, Ory N, Luna-Jorquera G, Gaymer CF (2019). In search for the sources of plastic marine litter that contaminates the Easter Island Ecoregion. Scientific Reports 9: 19662.

Varela AI, Luna N, Luna-Jorquera G (2018). Assessing potential Argentine Ant recruitment to pipping eggs in the Red-tailed Tropicbird on Rapa Nui (Easter Island). Emu-Austral Ornithology 118: 381–385.

Vega R, Cortés M (2005). Informe de Crucero SUBPESCA. Monitoreo y análisis de las operaciones de pesca conjunta del pez espada CE/Chile. Pesca de investigación del pez espada en la zona de Isla de Pascua. 44 pp.

Vega R, Cortés M (2005). Monitoreo y análisis de las operaciones de pesca conjunta del pez espada CE/Chile (Pesca de investigación del pez espada en la zona de Isla de Pascua). Informe de Crucero. IFOP y Subpesca, 32 pp.

Vega R, Licandeo R, Rosson G, Yáñez E (2009). Species catch composition, length structure and reproductive indices of swordfish (*Xiphias gladius*) at Easter Island zone. Latin American Journal of Aquatic Research 37: 83-95.

Veliz D, Rojas-Hernández N, Fibla P, Dewitte B, Cornejo-Guzmán S, Parada C (2021). High levels of connectivity over large distances in the diadematid sea urchin *Centrostephanus sylviae*. PLoS ONE 16(11): e0259595.

Visalli ME, Best BD, Cabral RB, Cheung WWL, Clark NA, Garilao C, Kaschner K, Kesner-Reyes K, Lam VWY, Maxwell SM, Mayorga J, Moeller HV, Morgan L, Crespo GO, Pinsky ML, White TD, McCauley DJ (2020). Data-driven approach for highlighting priority areas for protection in marine areas beyond national jurisdiction. Marine Policy 122: 103927.

Von Dassow P, Collado-Fabbri S (2014). Biological oceanography, biogeochemical cycles, and pelagic ecosystem functioning of the east-central South Pacific Gyre: focus on Easter Island and Salas y Gómez Island. Latin American Journal of Aquatic Research 42: 703-742.

Von Huene R, Corvalán J, Flueh ER, Hinz K, Korstgard J, Ranero CR, Weinrebe W (1997). Tectonic control of the subducting Juan Fernández Ridge on the Andean margin near Valparaiso, Chile. Tectonics 16: 474-488.

Wagner D, Friedlander AM, Pyle RL, Brooks CM, Gjerde KM, Wilhelm TA (2020). Coral reefs of the high seas: hidden biodiversity hotspots in need of protection. Frontiers in Marine Science 776.

Wagner D, van der Meer L, Gorny M, Sellanes J, Gaymer CF, Soto EH, ... & Morgan LE (2021). The Salas y Gómez and Nazca ridges: A review of the importance, opportunities and challenges for protecting a global diversity hotspot on the high seas. Marine Policy 126: 104377.

Watling L, Guinotte J, Clark MR, Smith CR (2013). A proposed biogeography of the deep ocean floor. Progress in Oceanography 111: 91-112.

WDPA (2020). World Database of Protected Areas. Available online at: https://www.protectedplanet.net/

Weidberg N, Ospina-Alvarez A, Bonicelli J, Barahona M, Aiken C, Broitman B, Navarrete S (2020). Spatial shifts in productivity of the coastal ocean over the past two decades induced by migration of the Pacific Anticyclone and Bakun's effect in the Humboldt Upwelling Ecosystem. Global and Planetary Change 193: 103259.

Whitehead H (1996). Variation in the feeding success of sperm whales: temporal scale, spatial scale and relationship to migrations. J. Anim. Ecol. 65(4): 429-438.

Wilmé L, Waeber PO, Ganzhorn JU (2016). Marine turtles used to assist Austronesian sailors reaching new islands. Comptes Rendus Biologies 339(2): 78-82.

Yáñez E, Silva C, Vega R, Espíndola F, Álvarez L, Silva N, Palma S, Salinas S, Menschel E, Häussermann V, Soto D, Ramírez N (2009). Seamounts in the southeastern Pacific Ocean and biodiversity on Juan Fernández seamounts, Chile. Latin American Journal of Aquatic Research 37: 555-570.

Yáñez E, Silva C, Marabolí J, Gómez F, Silva N, Órdenes A, Leiva F, Morales E, Bertrand A, Rojas P, Campalans J, Gamonal A, Chong J, Menares B, Sepúlveda JI, Palma S, Claramunt G, Oyarzún C, Meléndez R, Vega R (2012). Área marina de protección de la biodiversidad de recursos pelágicos en los montes submarinos de la Cordillera Nazca. Apéndice modelo para la presentación de la información científica para la descripción de áreas marinas de importancia ecológica o biológica. Convenio Sobre la Diversidad Biológica. 5 pp.

Zapata-Hernández G, Sellanes J, Muñoz P (2022). Stable isotopes reveal overlooked incorporation of diffuse land-based sources of nutrients and organic matter by intertidal communities at Rapa Nui (Easter Island). Marine Pollution Bulletin 176: 113415.

Zylich K, Harper S, Licandeo R, Vega R, Zeller D, Pauly D (2014). Fishing in Easter Island, a recent history (1950–2010). Latin American Journal of Aquatic Research 42(4): 845-856.