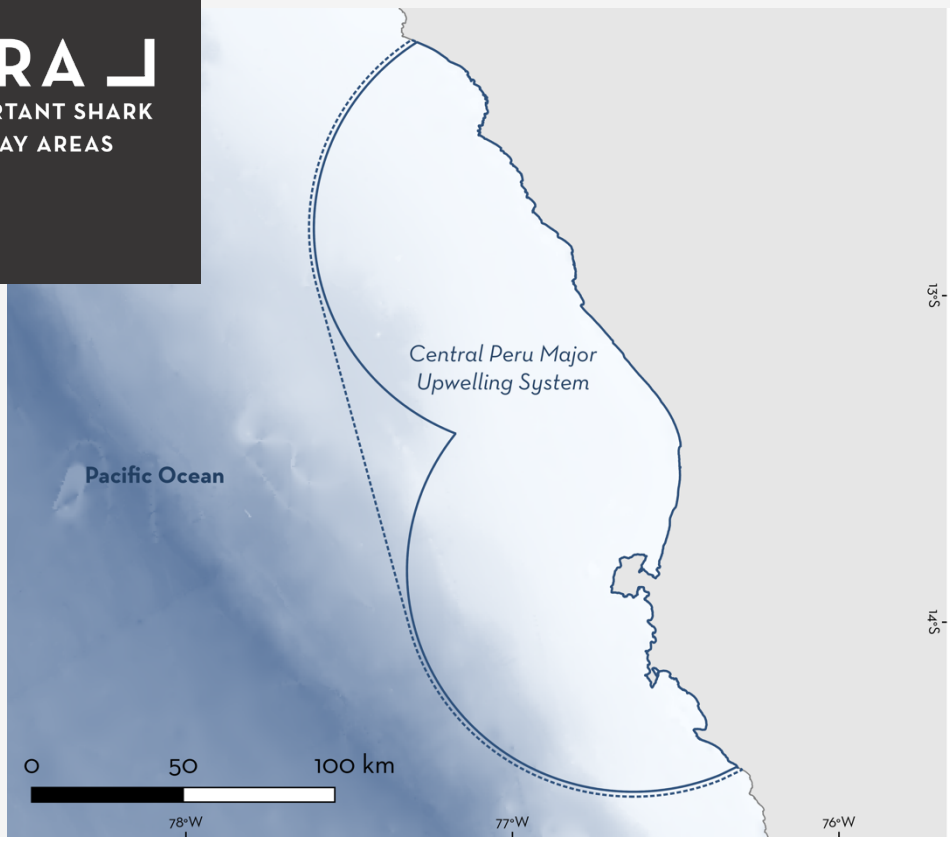
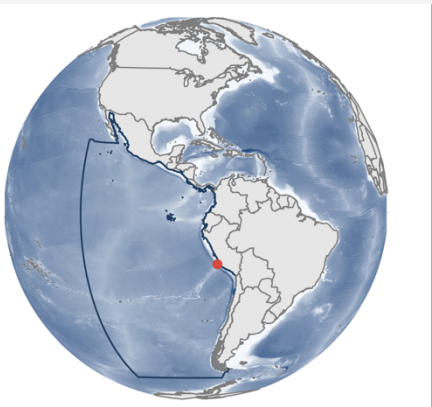
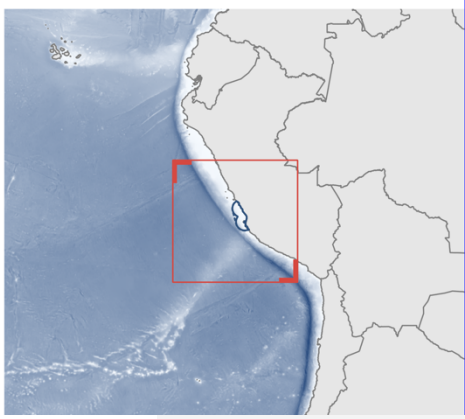
ISRA
IMPORTANT SHARK AND RAY AREAS







Blue lines indicate the area meeting the ISRA Criteria; dashed lines indicate the suggested buffer for use in the development of appropriate place-based conservation measures

CENTRAL PERU MAJOR UPWELLING SYSTEM ISRA

Central and South American Pacific Region

PERU

0–20 metres

20,012 km²

SUMMARY

Central Peru Major Upwelling System ranges from southern Lima to central Ica and is located within the Northern Humboldt Current System, a highly productive marine ecosystem due to coastal upwelling. The area overlaps with two major upwelling centres that generate high productivity year-round and are crucial for the Northern Humboldt Current System to re-establish itself after a warming event (i.e., El Niño). The area is characterised by large sediment flats and subtidal rocky reefs that sustain a diverse and abundant assemblage of pelagic and demersal fishes and benthic macroinvertebrates. Within this area there are: **threatened species** (e.g., Diamond Stingray *Hypanus dipterurus*); **range-restricted species** (e.g., Peruvian Eagle Ray *Myliobatis peruvianus*); **feeding areas** (e.g., Pacific Guitarfish *Pseudobatos planiceps*); and **distinctive attributes** (Chilean Eagle Ray *Myliobatis chilensis*).

CRITERIA

Criterion A – Vulnerability; Criterion B – Range Restricted;
Sub-criterion C2 – Feeding Areas; Sub-criterion D1 – Distinctiveness

DESCRIPTION OF HABITAT

Central Peru Major Upwelling System ranges from southern Lima to central Ica off the coast of Peru. Situated within the Humboldt Current Large Marine Ecosystem (LME), this area overlaps with the Northern Humboldt Current System (NHCS) which is considered a highly productive marine ecosystem due to a coastal upwelling that produces large amounts of zooplankton supporting complex trophic interactions (Pennington et al. 2006). Oceanographic features associated with wind forces create a strong upwelling and high levels of primary productivity in coastal Peru (Bakun and Weeks 2008; Montecino and Lange 2009). This area is influenced by the most intense alongshore winds in the NHCS causing an active year-round upwelling, leading to the continuous availability of zooplankton (e.g., euphausiids, copepods) (Gutierrez et al. 2011) which is an important prey for Peruvian Anchoveta *Engraulis ringens* (Espinoza and Bertrand 2008). This productivity allows the development of a high biomass of Peruvian Anchoveta (Bakun and Weeks 2008), representing ~10% of the global fisheries production and one of the largest biomasses of pelagic schooling fish worldwide (Chavez et al. 2008).

The area is characterised by soft substrates and intertidal benthic habitats, which allow for various invertebrates to dominate, depending on the substrate type. In the soft benthos off central Peru, polychaete worms constitute the most abundant infaunal coloniser (Tarazona et al. 2003) while the sand crab *Emerita analoga* (Sanchez and Alamo 1974; Pastor et al. 2017; Silva-Garay et al. 2018) dominates the sandy intertidal area. In the rocky intertidal habitats, the Dwarf Mussel *Semimytilus algosus* dominates (Paredes 1974; Tokeshi et al. 1989; Pastor et al. 2017). Within this area, there is a high abundance of Hairy Crab *Romaleon setosum* that inhabits a mixture substrate of hard and soft bottoms. According to Peruvian official fishery landings between 2015–2021, the first and second highest landings of Hairy Crab and Dwarf Mussel, respectively, along the Peruvian coast, are in Ica region, within this area. Thus, this area presents an ideal foraging condition for rays to feed year-around.

Within the NHCS there are six major upwelling centres that are crucial for the upwelling to re-establish itself after a warming event (e.g., El Niño) (Bertrand et al. 2004). These have been delineated as Ecologically or Biologically Significant Marine Areas (EBSA), namely the Humboldt Current Upwelling System in Peru and the Permanent Upwelling Cores and Important Seabird Areas of the Humboldt Current in Peru (CBD 2020). There are also two marine reserves situated within the area: Paracas, and Chincha and Ballestas Islands which belong to Sistema de Islas, Islotes y Puntas Guaneras. Paracas is considered a Key Biodiversity Area.

This Important Shark and Ray Area is delineated from inshore and surface waters (0 m) to a depth of 20 m based on the depth range of the Qualifying Species within this area.

ISRA CRITERIA

CRITERION A – VULNERABILITY

Four Qualifying Species considered threatened with extinction according to the IUCN Red List of Threatened Species™ regularly occur in the area. These are the Vulnerable Chilean Eagle Ray (Dulvy et al. 2020a), Peruvian Eagle Ray (Dulvy et al. 2020b), Diamond Stingray (Pollom et al. 2020), and Pacific Guitarfish (Kyne et al. 2020).

CRITERION B – RANGE RESTRICTED

Central Peru Major Upwelling System holds the regular presence of Chilean Eagle Ray and Peruvian Eagle Ray as resident range-restricted species. Both species are restricted to the Humboldt Current LME and regularly occur during the austral summer months (Benavides et al. 2022).

According to Peruvian official fishery landings (1997–2015), these species represent the most landed rays in Peru and are regularly captured by small-scale fisheries within this area (Gonzalez-Pestana et al. in press). Furthermore, a fishery mainly targeting these species has developed (Galindo et al. 2017; Yarihuaman and Gavilano 2021).

SUB-CRITERION C2 – FEEDING AREAS

Central Peru Major Upwelling System is an important feeding area for four ray species: Chilean Eagle Ray, Peruvian Eagle Ray, Diamond Stingray, and Pacific Guitarfish (Silva-Garay et al. 2017; Manrique & Mayaute 2017; Gonzalez-Pestana et al. 2021; Yarihuaman and Mantari 2021). The exceptional high productivity of this area provides an ideal habitat for a highly abundant demersal and pelagic community; this in turn creates foraging conditions for rays which are highly abundant in this area.

The diet of Chilean Eagle Ray has been studied in two periods (June to December 2015; May to September 2019) where a total of 247 individuals, mostly juveniles, were sampled (Manrique and Mayaute 2017; Yarihuaman and Mantari 2021; Gonzalez-Pestana et al. 2021). The most important prey species was Peruvian Anchoveta (86–87% Prey-specific Index of Relative Importance [PSIRI]). In these studies, 72–83% of stomachs contained food items. The presence and importance of Peruvian Anchoveta in the diet of the Chilean Eagle Ray is likely explained by the high availability and year-round abundance of this prey.

Peruvian Eagle Ray regularly occurs in this area with official fishery data (2010–2021) indicating that 17% of total Peruvian landings for this species originate from this location (third and fourth most important landing sites for this species). The diet of Peruvian Eagle Ray has been studied over several periods (October 2012 to 2014; May to September 2019) where a total of 59 individuals, mostly juveniles, were sampled (Silva-Garay et al., 2017; Yarihuaman and Mantari 2021). The most important prey species were polychaete worms (43% PSIRI) and Peruvian Anchoveta (14% PSIRI). In these studies, 84% of stomachs contained food items (Yarihuaman and Mantari 2021).

Diamond Stingray and Pacific Guitarfish are two of the most landed rays in Peruvian fisheries (Gonzalez-Pestana et al. in press). This area encompasses the second and first most important landing site where these species have been recorded according to Peruvian official fishery landings (2010–2021), respectively.

The diet of Diamond Stingray has been studied over multiple periods (October and March of 2012 to 2015; June to December 2015; May to September 2019) where a total of 227 individuals, mostly adults, were sampled (Manrique and Mayaute 2017; Yarihuaman and Mantari 2021; Gonzalez-Pestana et al. 2021). The most important prey species were Peruvian Anchoveta, Dwarf Mussel, and polychaete worms that varied according to the studies. These prey species are highly abundant in this area. In these studies, 72–83% of stomachs contained food items.

The diet of Pacific Guitarfish has been studied over multiple periods (October and March of 2012 to 2015; June to December 2015; May to September 2019). A total of 236 individuals, mostly adults, were sampled (Manrique and Mayaute 2017; Yarihuaman and Mantari 2021; Gonzalez-Pestana et al. 2021). The most important prey species were crabs (e.g., Hairy Crab) (50–52% PSIRI) and schooling fish (e.g., Peruvian Anchoveta) (19–22% PSIRI). Overall, 78–86% of stomachs contained food items.

SUB-CRITERION D1 – DISTINCTIVENESS

Chilean Eagle Ray displays unique ecological and behavioural characteristics within Central Peru Major Upwelling System due to its high predation on the Peruvian Anchoveta (Silva-Garay et al. 2018; Gonzalez-Pestana et al. 2021; Yarihuaman and Mantari 2021). This high consumption of pelagic prey is unique among its family (Myliobatidae). Eagle rays possess flattened, well-developed tooth plates suitable for crushing hard-shelled benthic prey (Motta 2004). Of the 11 recognised species of myliobatids, the diet of seven species have been studied. In all species, hard-shelled, bottom-dwelling invertebrates such as crabs, shrimps, bivalves, gastropods, and polychaete worms have been identified as dominant prey groups (Gray et al. 1997; Jardas et al. 2004; Sommerville et al. 2011; Valls et al. 2011; Szczepanski and Bengtson 2014; Last et al. 2016). The diets of the three other species are presumed to be similar (Last et al. 2016).

The high consumption of Peruvian Anchoveta by Chilean Eagle Ray (86–87% PSIRI) in this area is also in marked contrast to the diet of this species in northern Peru (3.6% PSIRI) (Gonzalez-Pestana et al. 2021). The ability of this species to move to pelagic habitats might allow them to increase their foraging opportunity by exploiting different foraging habitats in the NHCS (Silva-Garay et al. 2018; Gonzalez-Pestana et al. 2021). The unique oceanographic condition of this area fosters this exceptional abundance of a schooling pelagic fish that promotes this unique feeding behaviour.

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QUALIFYING SPECIES

Scientific Name	Common Name	IUCN Red List Category	Global Depth Range (m)	ISRA Criteria/Sub-criteria Met								
				A	B	C1	C2	C3	C4	C5	D1	D2
RAYS												
Hypanus dipterurus	Diamond Stingray	VU	0–150	X			X					
Myliobatis chilensis	Chilean Eagle Ray	VU	0–100	X	X		X				X	
Myliobatis peruvianus	Peruvian Eagle Ray	VU	0–50	X	X		X					
Pseudobatos planiceps	Pacific Guitarfish	VU	1–50	X			X					

SUPPORTING SPECIES

Scientific Name	Common Name	IUCN Red List Category
SHARKS		
Mustelus mento	Speckled Smoothhound	CR
Squatina armata	Chilean Angelshark	CR
Triakis maculata	Spotted Houndshark	CR
RAYS		
Urotrygon chilensis	Blotched Round Ray	NT
CHIMAERAS		
Callorhinchus callorynchus	American Elephantfish	VU

IUCN Red List categories: *CR, Critically Endangered; EN, Endangered; VU, Vulnerable; NT, Near Threatened; LC, Least Concern; DD, Data Deficient.*

REFERENCES

Bakun A, Weeks SJ. 2008. The marine ecosystem off Peru: What are the secrets of its fishery productivity and what might its future hold? *Progress in Oceanography* 79: 290–299. https://doi.org/10.1016/j.pocean.2008.10.027

Benavides M, Velez-Zuazo X, Alonso A, Aguilar R, Alcázar P, Vásquez I, Ogburn M. 2022. Residency and movement patterns of elasmobranchs around a large marine infrastructure located in the central coast of Peru using acoustic telemetry. Poster presented at Sharks International 2022.

Chavez FP, Bertrand A, Guevara-Carrasco R, Soler P, Csirke J. 2008. The northern Humboldt current system: Brief history, present status and a view towards the future. *Progress in Oceanography* 79(2–4): 95–105. https://doi.org/10.1016/j.pocean.2008.10.012

Chavez F, Messie M. 2009. A comparative analysis of eastern boundary upwelling ecosystems. *Progress in Oceanography* 83: 80–96. https://doi.org/10.1016/j.pocean.2009.07.032

Dulvy NK, Acuña E, Bustamante C, Herman K, Velez-Zuazo X. 2020a. *Myliobatis chilensis*. *The IUCN Red List of Threatened Species* 2020: e.T60123A124441181. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T60123A124441181.en

Dulvy NK, Acuña E, Bustamante C, Herman K, Velez-Zuazo X. 2020b. *Myliobatis peruvianus*. *The IUCN Red List of Threatened Species* 2020: e.T60126A124441708. http://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T60126A124441708.en

Espinoza P, Bertrand A. 2008. Revisiting Peruvian anchovy (*Engraulis ringens*) trophodynamics provides a new vision of the Humboldt current system. *Progress in Oceanography* 79(2–4): 215–227. https://doi.org/10.1016/j.pocean.2008.10.022

Secretariat of the Convention on Biological Diversity (CBD). 2020. Ecologically or Biologically Significant Marine Areas (EBSAs). Special places in the world's oceans. Volume 5: Eastern Tropical and Temperate Pacific Ocean. Available at: https://www.cbd.int/marine/ebsa/booklet-05-ettp-en.pdf Accessed September 2022.

Galindo O, Quispe S, Keichi H. 2017. La pesqueria artesanal de elasmobranquios en Pisco, 2007-2016. Primer Simposio Peruano de Tiburones, Rayas y Especies afines. Libro de Resumenes, Lima.

Gray AE, Mulligan TJ, Hannah R. 1997. Food habits, occurrence, and population structure of the bat ray, *Myliobatis californica*, in Humboldt Bay, California. *Environmental Biology of Fishes* 49: 227–238.

Gonzalez-Pestana A, Silva-Garay L, Quiñones J, Mayaute L, Manrique M, Segura-Cobeña E, Espinoza P, Moscoso V, Velez-Zuazo X, Alfaro-Shigueto J, Mangel JC. 2021. Geographic and ontogenetic variation in the diet of two commonly exploited batoids (Chilean eagle ray and Pacific guitarfish) off Peru: evidence of trophic plasticity. *Environmental Biology of Fishes* 104(12): 1525–1540. https://doi.org/10.1007/s10641-021-01157-w

Gonzalez-Pestana A, Velez-Zuazo X, Alfaro-Shigueto J, Mangel JC. In press. Batoid fishery in Peru (1950-2015): Magnitude, management and data needs. *Revista de Biología Marina y Oceanografía.*

Gutierrez D, Bouloubassi I, Sifeddine A, Purcea S, Gou-banova K, Graco M, IMARPE. 2009. Informe Tecnico: Situación actual de los cangrejos comerciales en el litoral. Callao: Instituto del Mar del Perú.

Jardas I, Šantić M, Pallaoro A. 2004. Diet composition of the eagle ray, *Myliobatis aquila* (Chondrichthyes: Myliobatidae), in the eastern Adriatic Sea. *Cybium* 28(4): 372–374.

Kyne PM, Charvet P, Areano EM, Cevallos A, Espinoza M, González A, Gonzalez-Pestana A, Herman K, Mejía-Falla PA, Morales-Saldaña JM, Navia AF, Velez-Zuazo X. 2020. *Pseudobatos planiceps*. *The IUCN Red List of Threatened Species* 2020: e.T44584A124433864. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T44584A124433864.en

Last P, Naylor G, Séret B, White W, de Carvalho M, Stehmann M. 2016. *Rays of the world*. Clayton: CSIRO Publishing.

Montecino V, Lange CB. 2009. The Humboldt Current System: Ecosystem components and processes, fisheries, and sediment studies. *Progress in Oceanography* 83 (1–4): 65–79. https://doi.org/10.1016/j.pocean.2009.07.041

Manrique MR, Mayaute LF. 2017. Hábitos alimentarios de las rayas *Pseudobatos planiceps* (Garman, 1880), *Hypanus dipterurus* (Jordan & Gilbert, 1880) y *Myliobatis chilensis* (Philippi, 1892), en Pisco, Ica, Perú, 2016. Unpublished Bachelor's Thesis, Universidad Nacional San Luis Gonzaga, Ica.

Paredes C. 1974. El modelo de zonacion en el orilla rocosa del departamento de Lima. *Revista Peruana de Biologia* 1: 168–191.

Pennington JT, Mahoney KL, Kuwahara VS, Kolber DD, Calienes R, Chavez FP. 2006. Primary production in the eastern tropical Pacific: a review. *Progress in Oceanography* 69: 285–317. https://doi.org/10.1016/j.pocean.2006.03.012

Pollom R, Bizzarro J, Burgos-Vázquez MI, Cevallos A, Velez-Zuazo X, Avalos C, Espinoza M, González A, Herman K, Mejía-Falla PA, Navia AF, Pérez Jiménez JC, Sosa-Nishizaki O. 2020. *Hypanus dipterurus*. *The IUCN Red List of Threatened Species* 2020: e.T60152A80677563. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T60152A80677563.en

Sanchez G, Alamo V. 1974. Algunos aspectos de la biologia del muy muy *Emerita analoga*. Instituto del Mar del Perú. *Serie de Informes Especiales* 167.

Silva-Garay L, Pacheco AS, Velez-Zuazo X. 2018. First assessment of the diet composition and trophic level of an assemblage of poorly known chondrichthyans off the central coast of Peru. *Environmental Biology of Fishes* 101(10): 1525–1536. https://doi.org/10.1007/s10641-018-0797-0

Sommerville E, Platell ME, White WT, Jones AA, Potter IC. 2011. Partitioning of food resources by four abundant co-occurring elasmobranch species: relationships between diet and both body size and season. *Marine Freshwater Research* 62: 54–55. https://doi.org/10.1071/MF10164

Szczepanski JA, Bengtson DA. 2014. Quantitative food habits of the bullnose ray, *Myliobatis freminvillii*, in Delaware Bay. *Environmental Biology of Fishes* 97: 981–997. https://doi.org/10.1007/s10641-014-0282-3

Tarazona J, Gutiérrez D, Paredes C, Indacochea A. 2003. Overview and challenges of marine biodiversity research in Peru. *Gayana (Concepción)* 67: 206–231. https://doi.org/10.4067/S0717-65382003000200009

Tokeshi M, Romero L, Tarazona J. 1989. Spatial coexistence of mussel-associated, free-ranging polychaetes in a subtropical intertidal habitat. *Journal of Animal Ecology* 58: 681–692.

Yarihuaman LR, Gavilano PJ. 2021. Hábitos alimentarios de los batoideos de importancia comercial de Pisco -Ica, Mayo–Septiembre 2019. Unpublished Bachelor's Thesis, Universidad Nacional San Luis Gonzaga, Ica.

Valls M, Quetglas A, Ordines F, Moranta J. 2011. Feeding ecology of demersal elasmobranchs from the shelf and slope off the Balearic Sea (western Mediterranean). *Scientia Marina* 75: 633–639. https://doi.org/10.3989/scimar.2011.75n4633