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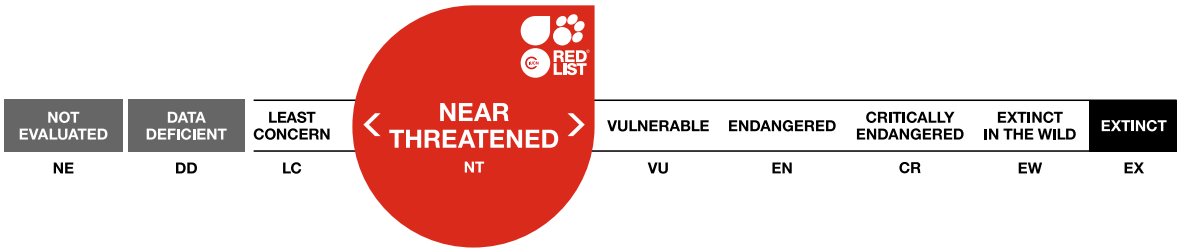
Scoliodon laticaudus, Spadenose Shark

Assessment by: Dulvy, N.K. *et al.*



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Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Chordata	Chondrichthyes	Carcharhiniformes	Carcharhinidae

Scientific Name: *Scoliodon laticaudus* Müller & Henle, 1838

Synonym(s):

- *Carcharias muelleri* Valenciennes, 1839
- *Carcharias palasorra* Bleeker, 1853

Common Name(s):

- English: Spadenose Shark
- Arabic: مراسح شرق

Taxonomic Source(s):

Fricke, R., Eschmeyer, W.N. and Van der Laan, R. (eds). 2020. Eschmeyer's Catalog of Fishes: genera, species, references. Updated 03 February 2020. Available at: http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp.

Taxonomic Notes:

The genus em style="margin: 0px; padding: 0px; font-family: Arial, sans-serif; font-size: 11px; background-color: rgb(255, 255, 255);">Scoliodon, represented by em style="margin: 0px; padding: 0px; font-family: Arial, sans-serif; font-size: 11px; background-color: rgb(255, 255, 255);">S. laticaudus, was previously considered monotypic but now consists of three species with em style="margin: 0px; padding: 0px; font-family: Arial, sans-serif; font-size: 11px; background-color: rgb(255, 255, 255);">S. macrorhynchus resurrected from the junior synonym of em style="margin: 0px; padding: 0px; font-family: Arial, sans-serif; font-size: 11px; background-color: rgb(255, 255, 255);">S. laticaudus (White em style="margin: 0px; padding: 0px; font-family: Arial, sans-serif; font-size: 11px; background-color: rgb(255, 255, 255);">et al. 2010).

Assessment Information

Red List Category & Criteria: Near Threatened A2d ver 3.1

Year Published: 2021

Date Assessed: April 29, 2020

Justification:

The Spadenose Shark (*Scoliodon laticaudus*) is a small (to 91 cm total length) shark that occurs in the northern Indian Ocean from the Gulf of Oman to Myanmar. It is common in coastal and estuarine waters at depths of 10-75 m, but more typically less than 50 m and prefers muddy and sandy substrates and often occurs near large freshwater outflows. It is highly productive with annual large litters of 6–20 pups, early maturation at two years and a short generation length of 4.5 years. The species is caught mainly by trawl and gillnet in industrial and artisanal fisheries and is retained for human consumption. It is the dominant shark landed in Pakistan, northern India, and Bangladesh and fishing pressure is intense

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across most of its range. The high productivity of the species and short generation length likely provide it with resilience to fishing pressure, however, the intense and ongoing fishing pressure on this species is a cause for concern. It is suspected that the Spadenose Shark has undergone a population reduction of 20–29% over the past three generation lengths (14 years) and is close to reaching the population reduction threshold due to levels of exploitation, and it is assessed as Near Threatened (nearly meeting Vulnerable A2d).

Geographic Range

Range Description:

The Spadenose Shark occurs in the Eastern and Western Indian Oceans, from the Gulf of Oman to Myanmar and possibly to Thailand (Ebert *et al*. 2013, Krajangdara 2019). Its status in the Arabian/Persian Gulf is unclear with historic records having suggested its presence (Wright *et al*. 1990) but extensive recent market and fishery surveys have failed to identify it (Moore *et al*. 2012, Jabado et al. 2015a). This species is not present in Sri Lanka (D. Fernando unpubl. data 2020). Records from Tanzanian, Kenya, and Somalia are likely to be misidentifications and this species does not appear in local guidebooks (A.J.L. Temple pers. comm. 9/11/2020).

Country Occurrence:

Native, Extant (resident): Bangladesh; India; Iran, Islamic Republic of; Myanmar (Myanmar (mainland)); Pakistan

Native, Possibly Extant: Sri Lanka; Thailand

FAO Marine Fishing Areas:

Native: Indian Ocean - eastern

Native: Indian Ocean - western

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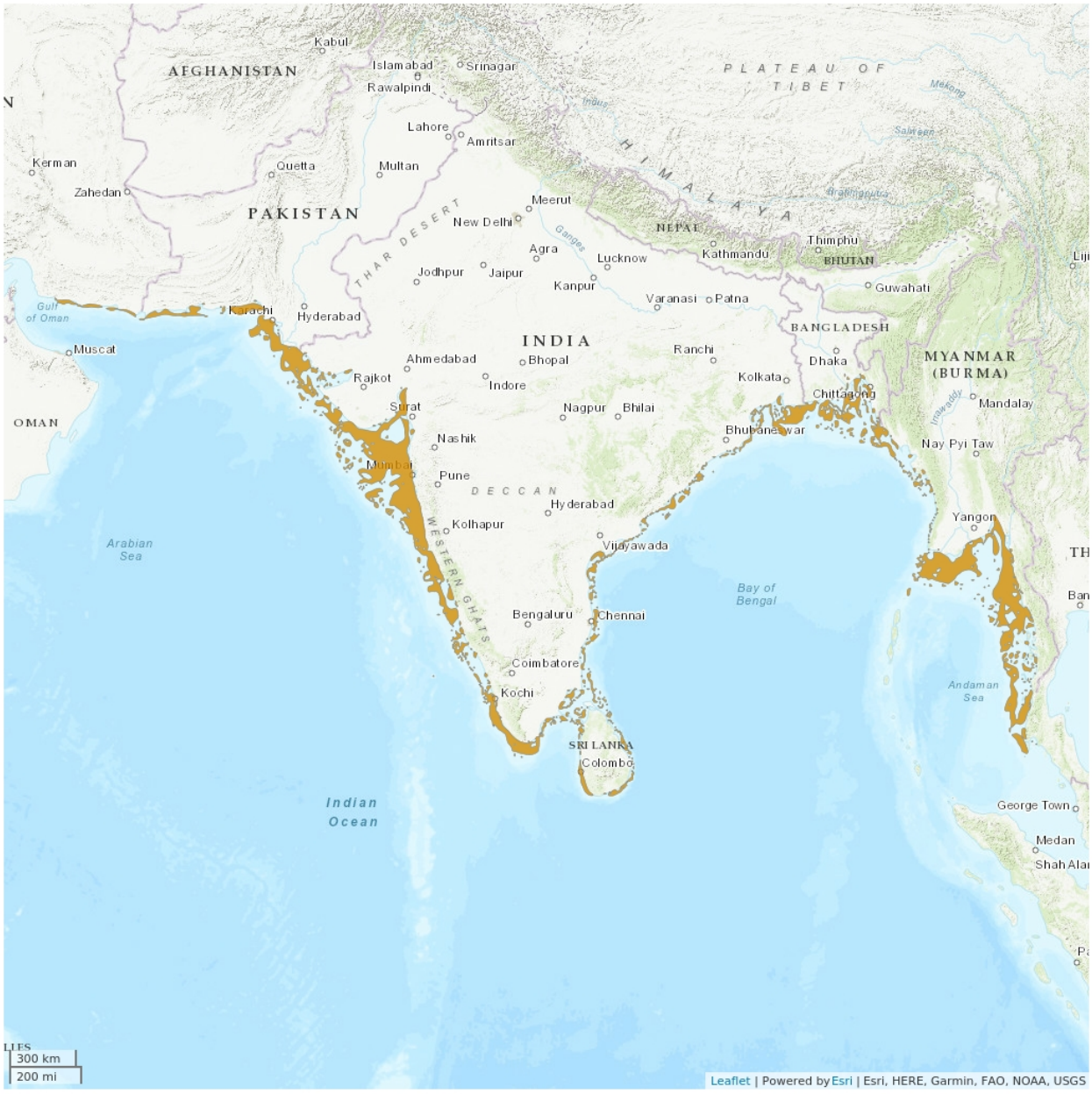
Distribution Map



Legend

EXTANT (RESIDENT)

Compiled by:

IUCN SSC Shark Specialist Group 2020

The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.

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Population

There are no species-specific population trends. Fisheries in the region have experienced increased demand for sharks since the 1970s due to the shark fin trade and as a result, effort is increasing in traditional shark fisheries in many areas (Henderson *et al*. 2007, Jabado *et al*. 2015b). Reports from India indicate that several shark stocks are either declining or have already collapsed (Mohamed and Veena 2016). While there is limited species-specific information available on this species in the region, it is marketed for consumption across its range, and the presence of intensive fisheries mean that like many other sharks in the region it has declined.

In Pakistan, it is one of the most commonly landed shark species although over the past 10 years, there has been about a ~30% decline in landings (M. Khan pers. comm. 9 February 2017, 12 December 2020). Similarly, in India, this is one of the dominant shark species caught in the northern states (Kizhakudan et al. 2015). This species is the dominant component of the shark catches in Gujarat, with an annual average landing of 6,364 t, and it represented 67% of shark catch during 2012–2016 (Sen et al. 2019). Recent catches have been stable and a length-based stock assessment suggests the exploitation ratio is around 0.53 suggesting the stock is overfished and overfishing is occurring (i.e. E>0.5) (Sen et al. 2019). Annual catches in Maharashtra between 2010–2015 were approximately 3,131 t (G.B. Purushottama pers. comm. to K.V. Akhilesh 9 February 2017). At the Cochin Fish Harbor (Kerala state), in 1981–1982, this species represented between 4.7–8.0% of shark landings, but these landings contributed <1% in 2008 (Akhilesh *et al*. 2011). In 2003–2004, reports indicate that 11,795 t were landed along the northwest coast of India and 47 t in the southwest (Raje *et al*. 2007). Trawl data from Mumbai in Maharashtra indicate declines in landings of this species from 1,269 t in 1999 to 839 t in 2005, and it represented 66% of landed species by weight during the 1991–2005 period (Raje *et al*. 2015). When scaled to three generation lengths (14 years) of the Spadenose Shark this is equivalent to a population reduction of 85%. In Karnataka, trawlers accounted for 72% of the catch of this species and mostly operated within depths of 10–50 m (Thomas *et al*. 2020) The average catch of Spadenose Shark for the period 2012–2017, was estimated to be 112 t, which formed about 13% of the total shark landing in the region, the average catch-per-unit-effort (CPUE) was 3.4 kg (Thomas *et al*. 2020).

This species is the most frequently landed shark species in Bangladesh and comprises 58% of shark landings (A.B. Haque unpubl. data 2020). This species is mainly taken as bycatch of the Hilsa Shad (Tenualosa ilisha) drift gillnet fishery. A length-based stock assessment suggests the exploitation ratio is around 0.57 suggesting the stock is overfished and overfishing is occurring (i.e. E>0.5) (Karim *et al*. 2017). This species, or one like it, is known from Myanmar and captured with demersal trawls, gillnets and line gears (Psomadakis *et al*. 2019, A. Maung unpubl. data 2020).

Although landings data are not a direct measure of abundance, these can be used to infer population reduction where landings have decreased while fishing effort has remained stable or increased. Reconstructed catches of mainly carcharhinids are available for the western and northern Indian Ocean and Red Sea (Large Marine Ecosystems 31–34), ranging from Tanzania to Thailand (Zeller and Pauly 2016). Reconstructed catches rose rapidly since the 1960s peaking at a catch of 90,984 t in 1974. Since then catches have declined by 58 over 42 years (1974–2016), with a very steep decline in catch of 48% over 12 years (2004–2016). When scaled to three generation lengths (14 years) of the Spadenose Shark, this is equivalent to a population reduction of 54%.

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The species is likely to be resilient enough to withstand moderate fishing mortality and there may be localised stability in catch trends. With increasing fishing pressure across the Indian Ocean region, it is suspected that this species has declined by 20–29% over the past three generation lengths (14 years) and is close to reaching the population reduction threshold due to levels of exploitation.

Current Population Trend: Decreasing

Habitat and Ecology (see Appendix for additional information)

The Spadenose Shark is demersal in coastal and estuarine waters at depths of 10–75 m, but mostly less than 50 m (Weigmann 2016, Sen *et al*. 2019, R.W. Jabado unpubl. data 2020). The species prefers muddy and sandy substrates and often occurs near large freshwater outflows. It reaches a maximum size of 91 cm total length (TL), males mature at 24–36 cm TL and females mature at 33–35 cm TL (Ebert et al. 2013, Weigmann 2016, Sen *et al*. 2018, R.W. Jabado unpubl. data 2020). Breeding occurs throughout the year (Devadoss 1979) and females probably mate at least once each year. Reproduction is placentotrophic viviparity, with potentially the most significant placental investment in offspring of all elasmobranchs (Wourms 1993). Litter sizes are 6–20, with a mean of 13 (Devadoss 1979) and young are born throughout the year after a gestation period of 5–6 months with a size-at-birth of 12–15 cm TL (Ebert *et al*. 2013). Female age-at-maturity is around two years and maximum age is seven years; generation length is therefore 4.5 years (Nair 1976).

Systems: Marine

Use and Trade

The meat of this species is often sold fresh for human consumption at local markets across the region. In Pakistan and India, the meat is cut into fillets, dried, and salted for domestic sales or trade with neighbouring countries. Fins are not considered valuable due to their small size but are still traded internationally (Jabado *et al*. 2015b, Cardeñosa *et al*. 2020).

Threats (see Appendix for additional information)

This species is commonly taken in fisheries throughout the Indian Ocean. This includes coastal set gillnet fisheries for a wide range of fish including bony fish and sharks. It is also caught incidentally in demersal trawls for shrimp and fish. In some parts of the region, it is also commonly taken in handline fisheries. Fisheries that catch this species are often small-scale artisanal fisheries, although some trawl fisheries are carried out by commercial and foreign vessels. In some regions (e.g. India, Pakistan) fishing effort on this species has been increasing in recent years. For example, in India, there are over 13,400 gill netters operating along the west coast, with many other types of net gear also deployed in coastal areas (CMFRI 2010). Furthermore, there were about 6,600 trawlers operating in the Indian state of Gujarat in the early 2000s (Zynudheen *et al.* 2004). This number almost doubled to 11,582 trawlers in 2010 (CMFRI 2010). In Pakistan waters, about 2,000 trawlers operate in shelf waters, targeting shrimp in shallow waters and fish in deeper shelf waters (M. Moazzam Khan pers. comm. 6 February 2017).

Conservation Actions (see Appendix for additional information)

There are no species-specific conservation measures in place. India and Pakistan have seasonal trawl bans that might benefit the species, however, incidental catches occur in other fisheries (e.g., gillnetting). In India, coastal waters up to 9 km from shore and five to ten fathom depth (at specified

areas) are restricted for mechanised fishing in Indian coastal states Gujarat and Maharashtra, where the Spadenose Shark is caught in large quantity (K.V. Akhilesh unpubl. data 2020). Further research is needed on population size and trend, and life history, and catch rates should be monitored.

Credits

Assessor(s): Dulvy, N.K., Simpfendorfer, C., Akhilesh, K.V., Derrick, D., Elhassan, I., Fernando, D., Haque, A.B., Jabado, R.W., Maung, A., Valinassab, T. & VanderWright, W.J.

Reviewer(s): Carlson, J. & Rigby, C.L.

Contributor(s): Krajangdara, T. & Temple, A.

Facilitator(s) and Compiler(s): Dulvy, N.K., Jabado, R.W., Rigby, C.L., Sherman, C.S., Simpfendorfer, C. & VanderWright, W.J.

Authority/Authorities: IUCN SSC Shark Specialist Group (sharks and rays)

Bibliography

Akhilesh, K.V., Ganga, U., Pillai, N.G.K., Vivekanandan, E., Bineesh, K.K., Shanis, C.P.R. and Hashim, M. 2011. Deep-sea fishing for chondrichthyan resources and sustainability concerns— a case study from southwest coast of India. *Indian Journal of Geo-Marine Sciences* 40(3): 347-355.

Cardeñosa, D., Shea, K.H., Zhang, H., Feldheim, K., Fischer, G.A. and Chapman, D.D. 2020. Small fins, large trade: a snapshot of the species composition of low-value shark fins in the Hong Kong markets. *Animal Conservation* 23: 203–211.

CMFRI. 2010. Marine Fisheries Census (2010), Part 1. India, Govt. of India, Ministry of Agriculture, Dept. of Animal Husbandry, Dairying & Fisheries and Central Marine Fisheries Research Institute, Indian Council of Agricultural Research. New Dehli.

Devadoss, P. 1979. Observations on the maturity, breeding and development of *Scoliodon laticaudus* Müller and Henle off Calicut coast. *Journal of the Marine Biological Association of India* 21: 103–110.

Ebert, D.A., Fowler, S. and Compagno, L. 2013. *Sharks of the World*. Wild Nature Press, Plymouth.

Henderson, A.C., McIlwain, J.L., Al-Oufi, H.S. and Al-Sheili, S. 2007. The Sultanate of Oman shark fishery: Species composition, seasonality and diversity. *Fisheries Research* 86: 159-168.

IUCN. 2021. The IUCN Red List of Threatened Species. Version 2021-2. Available at: www.iucnredlist.org. (Accessed: 04 September 2021).

Jabado, R.W., Al Ghais, S.M., Hamza, W., Henderson, A.C., Spaet, J.L.Y., Shivji, M.S. and Hanner, R.H. 2015b. The trade in sharks and their products in the United Arab Emirates. *Biological Conservation* 181: 190–198.

Jabado, R.W., Al Ghais, S.M., Hamza, W., Shivji, M.S. and Henderson, A.C. 2015a. Shark diversity in the Arabian/Persian Gulf higher than previously thought: insights based on species composition of shark landings in the United Arab Emirates. *Marine Biodiversity* 45(4): 719–731.

Karim, E., Qun, L., Mahmood, M.A., Baset, A., Hoq, M.E., Shamsuzzaman, M.M. and Das, A. 2017. Assessment of some demographic trends of Spadenose shark (*Scoliodon laticaudus*) of the Bay of Bengal, Bangladesh. *Indian Journal of Geo Marine Sciences* 46(10): 1986–1995.

Kizhakudan, S.J., Zacharia, P.U., Thomas, S, Vivekanandan, E, and Muktha, M. 2015. Guidance on National Plan of Action for Sharks in India. . CMFRI Marine Fisheries Policy Series .

Krajangdara, T. 2019. Sharks and Rays of Thailand. Country Report. Department of Fisheries, Thailand.

Mohamed, K.S. and Veena, S. 2016. How long does it take for tropical marine fish stocks to recover after declines? Case studies from the Southwest coast of India. *Current Science* 110: 584–594.

Moore, A.B.M., McCarthy, I.D., Carvalho, G.R. and Peirce, R. 2012. Species, sex, size and male maturity composition of previously unreported elasmobranch landings in Kuwait, Qatar and Abu Dhabi Emirate. *Journal of Fish Biology* 80: 1619-1642.

Nair, K. 1976. Age and growth of the yellow dog shark *Scoliodon laticaudus* Müller and Henle from Bombay waters. *Journal of the Marine Biological Association of India* 18: 531–539.

Psomadakis, P.N., Htun Thein, Russell, B.C. and Mya Than Tun. 2019. *Field identification guide to the living marine resources of Myanmar. FAO Species Identification Guide for Fishery Purposes*. FAO and MOALI, Rome.

Raje, S.G., Sivakami, S., Mohanraj, G., Manojkumar, P.P., Raju, A. and Joshi, K.K. 2007. An atlas on the Elasmobranch fishery resources of India. CMFRI Special Publication, 95. 1-253.

Raje, S.G., Thakurdas, Sundaram, S. and Raje, R.K. 2015. Fishery and some aspects of biology of major species of sharks from Mumbai waters. *Journal of Indian Fisheries Association* 42: 69–79.

Sen, S., Chakraborty, S.K., Vivekanandan, E., Zacharia, P.U. and Kizhakudan, S.J. 2019. Population dynamics and stock assessment of spadenose shark *Scoliodon laticaudus* Muller and Henle 1839 along Gujarat coast of India. *Indian Journal of Geo Marine Sciences* 48: 423–433.

Sen, S., Chakraborty, S.K., Zacharia, P.U., Dash, G., Kizhakudan, S.J., Bharadiya, S.A. and Gohel, J.K. 2018. Reproductive strategy of spadenose shark, *Scoliodon laticaudus* Muller and Henle, 1839 along north-eastern Arabian Sea. *Journal of Applied Ichthyology*.

Thomas, S., Purushottama, G., Nataraja, G. and Kizhakudan, S.J. 2020. Fishery and biological characteristics of the spadenose shark *Scoliodon laticaudus* Müller & Henle, 1838 from the Eastern Arabian Sea. *Regional Studies in Marine Science* 34: 101085.

Weigmann, S. 2016. Annotated checklist of the living sharks, batoids and chimaeras (Chondrichthyes) of the world, with a focus on biogeographical diversity. *Journal of Fish Biology* 88(3): 837-1037.

White, W.T., Last, P.R., Naylor, G.J.P., Harris, M. 2010. Resurrection and redescription of the Borneo Broadfin Shark *Lamiopsis tephrodes* (Fowler, 1905) (Carcharhiniformes: Carcharhinidae). In: Last, P.R., White, W.T., Pogonoski, J.J. (ed.), *Descriptions of New Sharks and Rays from Borneo. CSIRO Marine and Atmospheric Research Paper No. 032*, pp. 45-59. CSIRO Marine and Atmospheric Research, Hobart.

Wourms, J.P. 1993. Maximization of evolutionary trends for placental viviparity in the spadenose shark, *Scoliodon laticaudus*. *Environmental Biology of Fishes* 38: 269–294.

Wright, J.M., Clayton, D.A. and Bishop, J.M. 1990. Tidal movements of shallow water fishes in Kuwait Bay. *Journal of Fish Biology* 37(6): 959?974.

Zeller, D. and Pauly. D. 2016. Marine fisheries catch reconstruction: definitions, sources, methodology and challenges. In: Pauly, D. and Zeller, D. (eds), Global Atlas of Marine Fisheries: Ecosystem Impacts and Analysis. Washington, D.C.

Zynudheen, A.A., Ninan, G., Sen, A. and Badonia, R. 2004. Utilization of trawl bycatch in Gujarat (India). *27* NAGA Worldfish Center Quarterly((3&4)): 20-23.

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External Resources

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Appendix

Habitats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Habitat	Season	Suitability	Major Importance?
9. Marine Neritic -> 9.2. Marine Neritic - Subtidal Rock and Rocky Reefs	Resident	Suitable	Yes
9. Marine Neritic -> 9.4. Marine Neritic - Subtidal Sandy	Resident	Suitable	Yes
9. Marine Neritic -> 9.5. Marine Neritic - Subtidal Sandy-Mud	Resident	Suitable	Yes
9. Marine Neritic -> 9.6. Marine Neritic - Subtidal Muddy	Resident	Suitable	Yes
9. Marine Neritic -> 9.10. Marine Neritic - Estuaries	Resident	Suitable	Yes

Use and Trade

(http://www.iucnredlist.org/technical-documents/classification-schemes)

End Use	Local	National	International
Food - human	Yes	Yes	Yes

Threats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Threat	Timing	Scope	Severity	Impact Score
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.3. Unintentional effects: (subsistence/small scale) [harvest]	Ongoing	Whole (>90%)	Causing/could cause fluctuations	Medium impact: 7
	Stresses:	2. Species Stresses -> 2.1. Species mortality		
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.4. Unintentional effects: (large scale) [harvest]	Ongoing	Whole (>90%)	Causing/could cause fluctuations	Medium impact: 7
	Stresses:	2. Species Stresses -> 2.1. Species mortality		

Conservation Actions in Place

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Action in Place
In-place research and monitoring
Action Recovery Plan: No
Systematic monitoring scheme: No
In-place land/water protection

Conservation Action in Place
Conservation sites identified: No
Area based regional management plan: No
Occurs in at least one protected area: Unknown
Invasive species control or prevention: No
In-place species management
Harvest management plan: No
Successfully reintroduced or introduced benignly: No
Subject to ex-situ conservation: No
In-place education
Subject to recent education and awareness programmes: No
Included in international legislation: No
Subject to any international management / trade controls: No

Conservation Actions Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Action Needed
1. Land/water protection -> 1.1. Site/area protection
3. Species management -> 3.1. Species management -> 3.1.1. Harvest management
3. Species management -> 3.1. Species management -> 3.1.2. Trade management

Research Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Research Needed
1. Research -> 1.1. Taxonomy
1. Research -> 1.2. Population size, distribution & trends
1. Research -> 1.3. Life history & ecology
1. Research -> 1.4. Harvest, use & livelihoods
3. Monitoring -> 3.1. Population trends
3. Monitoring -> 3.2. Harvest level trends

Additional Data Fields

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Distribution
Lower depth limit (m): 75
Upper depth limit (m): 10
Habitats and Ecology
Generation Length (years): 4.5

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