

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

AMVRAKIKOS GULF ISRA

Mediterranean and Black Seas Region

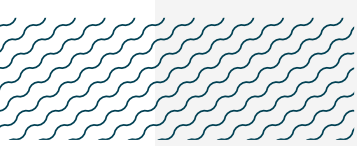
SUMMARY

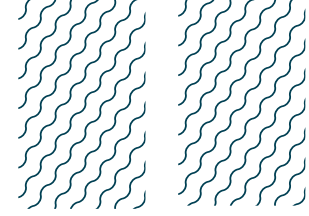
Amvrakikos Gulf is a shallow and semi-enclosed embayment in northwest Greece. The gulf is ~35 km long and 6–15 km wide, with freshwater input from the Arachthos and Louros Rivers. These rivers create extensive delta complexes, including freshwater marshes, wet meadows, and seasonally inundated land. Amvrakikos Gulf is isolated from the Ionian Sea by the narrow, shallow Preveza channel (~600 m wide; 8.5 m mean depth). The area is characterised by a well-stratified water column comprised of a brackish water surface layer and a saline water benthic layer. The gulf has been designated as a National Park of Greece and includes a Key Biodiversity Area, two Natura 2000 sites, and a Ramsar site (Wetland of International Importance). Within this area there are: **threatened species** (e.g., Spiny Butterfly Ray *Gymnura altavela*); and **reproductive areas** (e.g., Duckbill Eagle Ray *Aetomylaeus bovinus*).

CRITERIA

Criterion A - Vulnerability; Sub-criterion C1 - Reproductive Areas

—	—
GREECE	—
—	—
0-60 metres	—
—	—
481.4 km²	—
—	—





DESCRIPTION OF HABITAT

Amvrakikos Gulf is one of the largest semi-enclosed embayments in the Mediterranean Sea, located in northwestern Greece. At the northern border of the gulf, there are a complex lagoonal system and an extensive delta which is caused by the two main rivers (Arachthos and Louros). Amvrakikos Gulf is isolated from the Ionian Sea by a narrow, shallow strait, the Preveza channel (~600 m wide; 3 km long; 8.5 m mean depth).

The environmental state of Amvrakikos Gulf is highly influenced by the high river influx and evaporation rate, causing strong stratification of the water column throughout the year due to either salinity or temperature fluctuations. A well-stratified two-layer structure in the water column develops in the gulf, where a two-layer flow prevails at the entrance to the gulf, with brackish out-flowing water at the surface and saline inflowing water near the seabed. This morphology and water circulation pattern makes the Amvrakikos Gulf the only Mediterranean Sea fjord.

The western part of the gulf is suffering from seasonal hypoxia, whereas the eastern part is affected by seasonally anoxic conditions (Ferentinos et al. 2010; Kountoura & Zacharias 2011). Through time, the gulf has developed into a very sensitive environment that can easily be affected by climatic factors like temperature (Prandekou et al. 2022). The great variety of habitats occurring within the area are formed by the deltas of the Louros and Arachthos Rivers which flow into the north part of the gulf, forming 20 large and small lagoons, sand bars, salt marshes, reedbeds, wet meadows, mudflats, and riverine zones with remnants of riparian forest and hills between and among the lagoons. Its reedbeds and salt marshes, as well as the complex of lagoon systems comprise the most extensive in Greece. The lagoons (the largest and most important being Tsoukalio, Logarou, and Rodia) are characterised by high biological productivity. The seabed has a sandy to muddy substrate which is covered by seagrass meadows of *Cymodocea nodosa* in the shallower parts while the deeper part is muddy, which offer suitable habitat for different life history stages of marine fishes, including rays (Tuya et al. 2020; Moreno et al. 2022).

Amvrakikos Gulf is designated as a National Park of Greece, and includes two Natura 2000 sites (GR2110001, GR2110004) while the northern part is designated as a Ramsar site (Wetland of International Importance; 23,700 ha; 3GRO09). The eastern mainland part of the gulf is also designated as the Amvrakikos Gulf Key Biodiversity Area (KBA 2023).

This Important Shark and Ray Area is benthopelagic and is delineated from inshore and surface waters (0 m) to 60 m depth based on the bathymetry of the area.

ISRA CRITERIA

CRITERION A - VULNERABILITY

Three Qualifying Species considered threatened with extinction according to the IUCN Red List of Threatened Species™ regularly occur in the area. These are the Critically Endangered Duckbill Eagle Ray (Jabado et al. 2021a), and the Endangered Common Smoothhound (Jabado et al. 2021b) and Spiny Butterfly Ray (Dulvy et al. 2021).

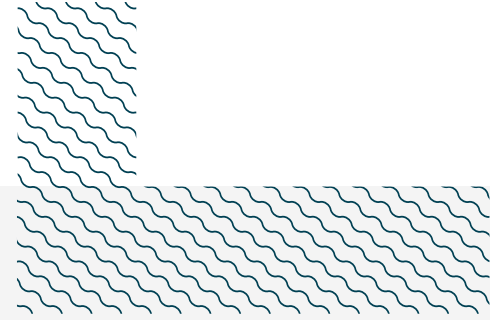
SUB-CRITERION C1 – REPRODUCTIVE AREAS

Amvrakikos Gulf is an important reproductive area for one shark and two ray species. Unpublished data gathered during 2022–2023 provides supporting information for reproductive activities (iSea unpubl. data 2023).

Common Smoothhound is both targeted and accidentally caught (n = 196 observed in 2022–2023) depending on the season and fishing gear used, with 8.2% of individuals classified as neonates (<40 cm total length [TL] which is the size-at-birth as reported by Otero et al. [2019]) and 73.5% of individuals (40.5–55.0 cm TL) classified as young-of-the-year (YOY). Juveniles and YOY individuals were recorded from May to August 2022 and from May to July 2023. Pregnant females with fully formed embryos represented 3.1% of samples and were recorded in April 2023. From May to August, there is a predictable increase in the number of YOY individuals accidentally captured.

Duckbill Eagle Ray is a regular bycatch (n = 83 observed in 2022–2023) with 57.8% of individuals recorded being neonates (iSea unpubl. data 2023) according to morphometric measurements (<45 cm disc width [DW]; Otero et al. 2019). This species was recorded in fishing trips from February to October during 2022–2023 and appears to use the area year-round. The species was first recorded in the area by scientists in 2010 (Zogaris & Dussling 2010) but local ecological knowledge indicates its historical presence for at least 30 years.

Spiny Butterfly Ray is a regular bycatch in the area (n = 100 observed in 2022–2023) with 24% of individuals recorded measuring 30.5–37.0 cm DW which is less than the published size-at-birth (38–44 cm DW; Otero et al. 2019) and 23% of individuals in total were classified as neonates (<45 cm DW; Otero et al. 2019). These individuals were recorded from April to October 2022–2023. Two pregnant females carrying four and one pups were recorded in February 2022 and July 2023, respectively. The species has been recorded as bycatch in February, and from April to October, but is considered to use the area year-round. It was first recorded in the area by scientists in 2020 (Ciriaco et al. 2020) but local ecological knowledge shows it has been present for at least 30 years.



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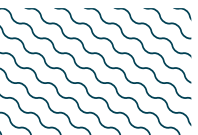
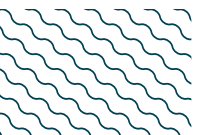
QUALIFYING SPECIES

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
SHARKS											
<i>Mustelus mustelus</i>	Common Smoothhound	EN	5-800	X		X					
RAYs											
<i>Aetomylaeus bovinus</i>	Duckbill Eagle Ray	CR	0-150	X		X					
<i>Gymnura altavela</i>	Spiny Butterfly Ray	EN	10-150	X		X					

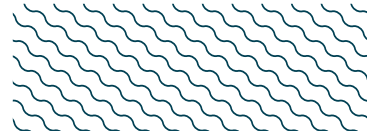
SUPPORTING SPECIES

Scientific Name	Common Name	IUCN Red List Category
SHARKS		
<i>Carcharhinus plumbeus</i>	Sandbar Shark	EN
<i>Galeorhinus galeus</i>	School Shark	CR
RAYS		
<i>Bathytoshia lata</i>	Brown Stingray	VU
<i>Dasyatis marmorata</i>	Marbled Stingray	NT
<i>Dasyatis pastinaca</i>	Common Stingray	VU
<i>Dasyatis tortonesei</i>	Tortonese's Stingray	DD
<i>Myliobatis aquila</i>	Common Eagle Ray	CR
<i>Torpedo marmorata</i>	Marbled Torpedo Ray	VU
<i>Torpedo torpedo</i>	Ocellate Torpedo	VU

IUCN Red List of Threatened Species Categories are available by searching species names at www.iucnredlist.org. Abbreviations refer to: CR, Critically Endangered; EN, Endangered; VU, Vulnerable; NT, Near Threatened; LC, Least Concern; DD, Data Deficient.



SUPPORTING INFORMATION



There are indications that Amvrakikos Gulf may be important for the reproduction of five ray species.

Common Stingrays and Tortonese's Stingray have both been documented from the gulf where they are a regular bycatch. It is, however, difficult to identify the samples gathered ($n = 322$) to the species level due to morphological similarities (Saadaoui et al. 2016). About one-fifth of individuals recorded (21.7%) measured 11–16 cm DW which is around the size-at-birth for the two species (12 cm and 16 cm DW, respectively; Otero et al. 2019). Additionally, 2.1% of pregnant females were assessed after observation of their reproductive system (two of the individuals were at a late stage of pregnancy and completely formed embryos were present in their uteri) and two individuals were released alive (iSea unpubl. data 2023) being at a late stage of pregnancy (Follesa & Carbonara 2019). The species has been recorded from February to October but are considered to use the area all year round.

Brown Stingray was recorded four times in the gulf, because the size and morphology of samples allowed correct identification and was further confirmed with genetic analysis for the two individuals caught in 2022. A pregnant female was recorded in August 2022 (iSea unpubl. data 2023). Immature samples of Brown Stingray are difficult to identify due to morphological similarities with *Dasyatis* spp. and pending analysis of genetic samples gathered will confirm the number of neonates and young-of-the-year.

Common Eagle Ray is a regular bycatch in the area ($n = 52$ observed in 2022–2023) with 11.8% recorded individuals with measurements close to the known size-at-birth (21–25.5 cm DW; iSea unpubl. data 2023). The species was recorded in fishing trips sporadically in February, March, August, and September 2022, and July of both 2022 and 2023, but may use the area year-round. Further information is required on the regularity of neonates in the area to understand its importance for reproduction.

Ocellate Torpedo are a regular bycatch in the area ($n = 129$ observed in 2022–2023) with 6.2% of individuals recorded being pregnant females. The species has been recorded from February to September but is likely to use the gulf year-round. Further information is required on the regularity of pregnant females in the area to understand its importance for reproduction.

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