A Master Plan for

# Marine Nature Reserves in Israel's Exclusive Economic Zone

in the Mediterranean Sea

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The Society for the Protection of Nature in Israel
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**SPNI:** The oldest and largest non-profit environmental protection organization in Israel, a member of the International Union for Conservation of Nature (IUCN) and *Birdlife International* affiliate. SPNI uses a variety of educational, planning, public, scientific, and legal means to protect the biodiversity of Israel and make it accessible to the general public.
https://natureisrael.org/

**The Blue Half:** SPNI's marine program. The goals of the project are to establish marine protected areas, in collaboration with the Israel Nature and Parks Authority, to integrate ecological considerations into the maritime planning process, promote environmental legislation regarding Israel's exclusive economic zone (EEZ), and establish sustainable fisheries management. The project operates the Sea Watch App for reporting marine environmental hazards in real-time.
For more information, please see https://mafish.org.il/english/

**The Israeli EEZ conservation planning project**: The initiative for establishing marine nature reserves in Israel's EEZ.

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*The bathymetric measures presented in the maps in this document were based on Kanari et al. 2020.

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# Executive Summary

The deep sea is the largest natural area under Israeli jurisdiction. Following the global 30 x 30 biodiversity initiative, many countries around the world, Israel among them, adopted **the ambitious target** of **"Ensur[ing] that at least 30 per cent globally of land areas and of sea areas, especially areas of particular importance for biodiversity and its contributions to people, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas."**[1] More recently, countries agreed to establish nature reserves to establish marine protected areas (MPAs) in 30% of the high seas[2].

The guiding principles adopted by the recently elected Israeli government feature a set of policies for establishing marine protection in the Mediterranean, including "enforcing Israeli regulation in the EEZ" and **"planning marine nature reserves in the EEZ."**[3] The area of the **Palmahim Slide** was recently announced as **the first marine nature reserve** designated in the EEZ.

Humans beings have only just begun to discover the secrets of the deep sea because deep-sea scientific exploration is complicated both technically and logistically. Planning a network of marine nature reserves in Israel's EEZ is already a necessity, given the need to protect the unique and vulnerable habitats and the diversity of ecological units that are found in this area. This must be done before the effects of the economic activity and climate change cause irreversible damage to the ecosystem. As of today, Israel's EEZ has no specific legislation for the area, no environmental policy, and no comprehensive planning that can balance between conservation and development needs. The Master Plan for Marine Nature Reserves in Israel's EEZ serves as an ecological basis for spatial planning, which must be established before there is any further economic development in the EEZ. Until legislation and spatial planning are fulfilled, the Master Plan will serve as a basis for advancing conservation efforts at specific sites, and for considering the appropriateness of sector development initiative.

Conservation planning in the deep sea constitutes an enormous challenge, as it requires coping with significant knowledge gaps; therefore, the planning process was designed using advanced methods and reliance on a broad spectrum of professional and scientific consultants. The process was overseen by a steering committee with representatives from the government, governmental authorities, the Academy, and environmental organizations, who provided feedback and essential assistance in developing the plan and its outcomes. In this manner, the master plan for a network of marine nature reserves was formulated by applying knowledge-based recommendations while maintaining the transparency of the entire process.

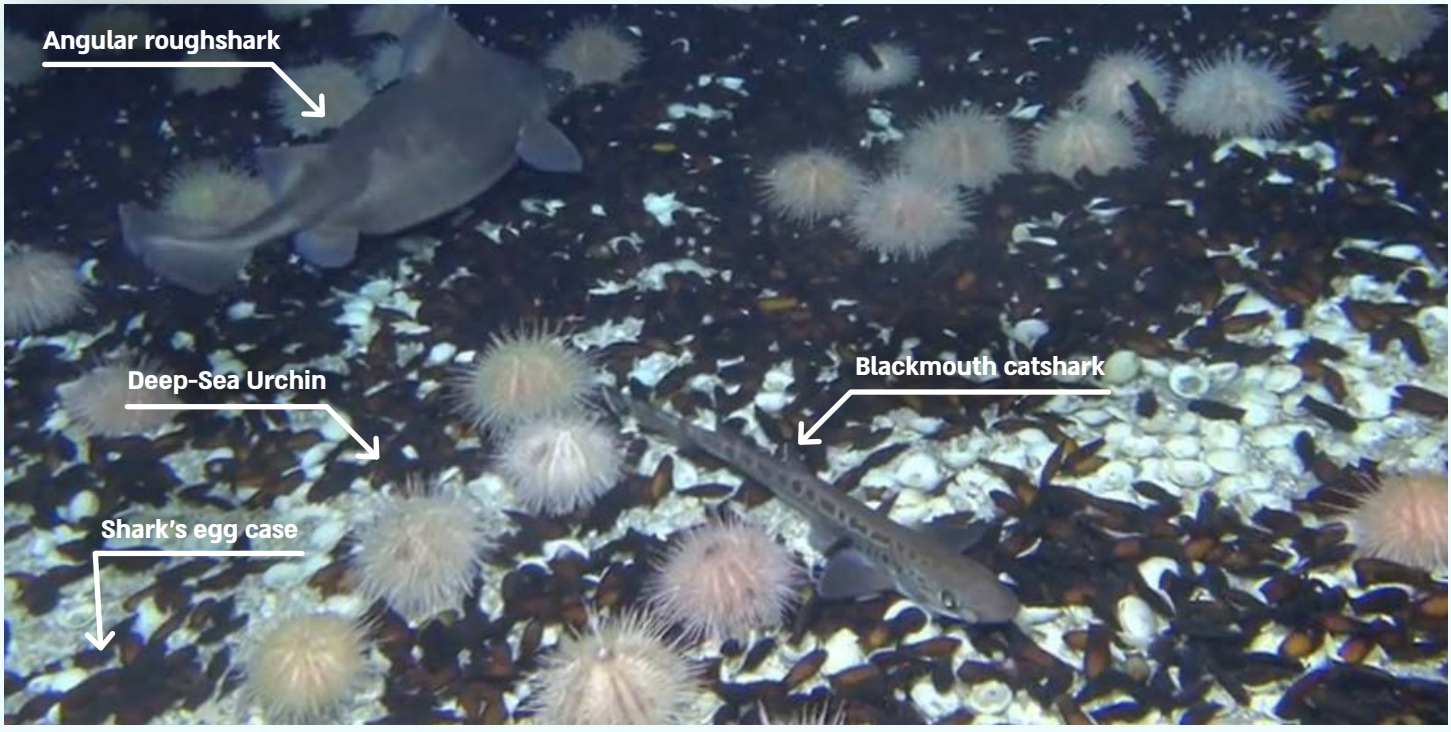
Thus, this master plan was developed based on an ecological analysis which included collecting existing data, analyses, modeling, and predicting the layout of habitats using advanced statistical models. A great deal of information was collected about the human activity in the area, both planned and current, in an effort to avoid, to the best of our ability, spatial conflicts. The planning was based on a range

1. https://www.cbd.int/article/draft-1-global-biodiversity-framework
2. https://www.un.org/bbnj/
3. For the document in Hebrew, see clause 72, p. 6 in https://main.knesset.gov.il/mk/government/Documents/CA37-YT.pdf

of eco-spatial principles that reflect conservation planning approaches, optimal interface with human activities, and the principle of flexibility, which is necessary given the knowledge gaps about the area's characteristics.

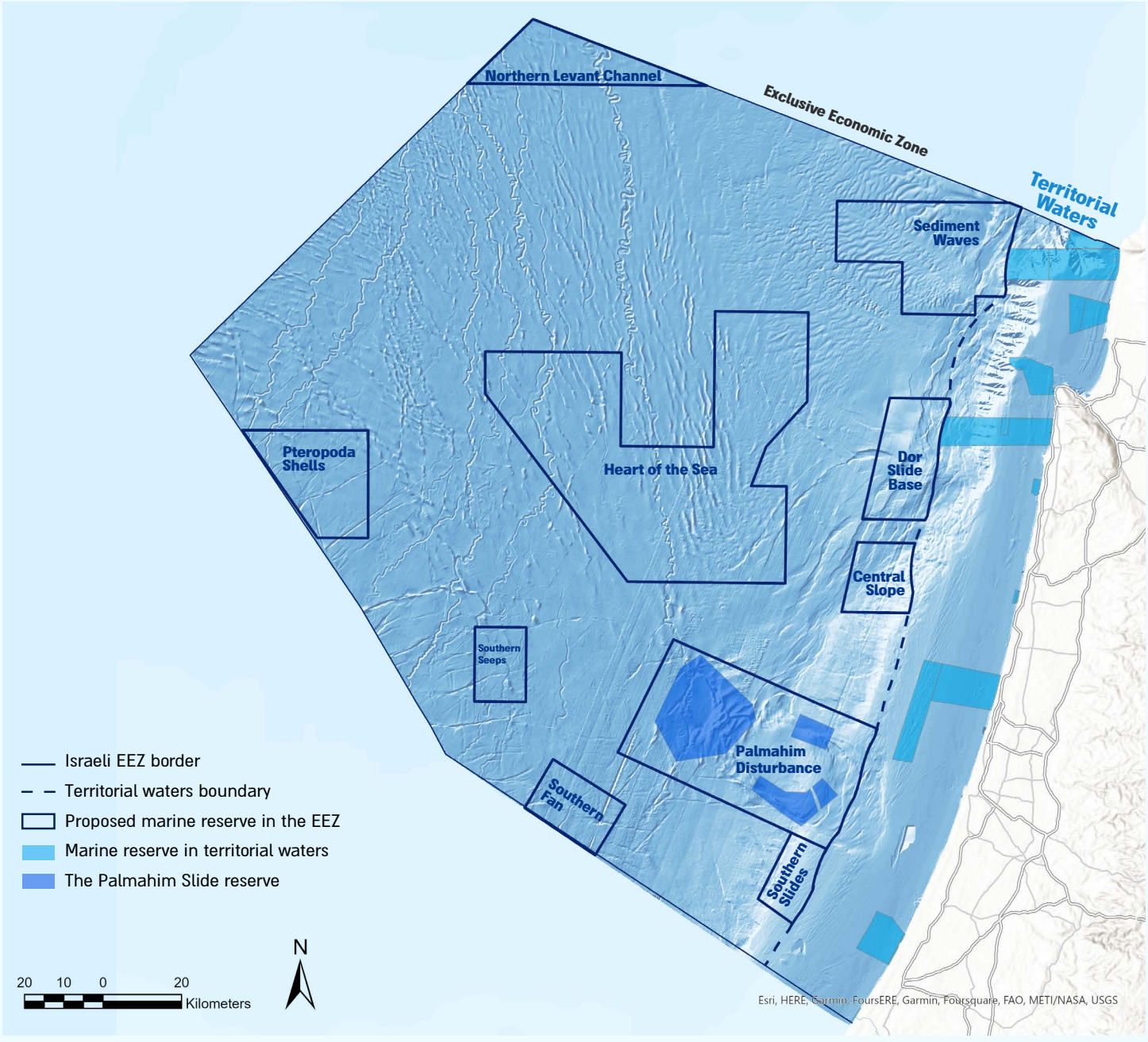
**The plan includes 10 marine reserves encompassing 30% of the EEZ,** in line with the objectives of the Convention on Biological Diversity. **Five of the proposed reserves are located along the continental slope and at the base of the slope because of the high ecological importance of the seabed and the water column.** The reserves on the slope will also serve to connect the current and planned reserves located in the territorial waters (on the continental shelf) with those in the deep sea. This plan allows connectivity between the reserves, as well as an appropriate minimum size for each reserve. Furthermore, **six marine reserves in the plan are designed to provide good protection (of approximately 80%) of the unique habitats,** which are highly prioritized for conservation due to their complex structures, biological richness, functional importance, and uniqueness in the area. The proposed marine reserves represent the majority of benthic and pelagic ecological units. The reserves also protect areas identified as potential climate refuges. Two of the planned nature reserves can serve as transboundary marine protected areas, connecting to protected areas in neighboring countries. The plan also addresses aspects for managing the proposed reserves, prioritization of the steps for implementing the plan, and a proposed outline for updating the plan, in light of the introduction of new scientific knowledge and additional human uses intended in the EEZ.

This Master plan for a network of marine nature reserves within Israel's EEZ must be implemented as soon as possible, to ensure the protection of the unique and vulnerable habitats and the variety of ecological units in the area and to establish a balance between developmental needs and preservation needs, while delivering on Israel's commitment to protect 30% of its EEZ by the year 2030.




Reproduction grouping of deep-sea sharks, Palmahim disturbance, 1250 m deep | Photo: Yizhaq Makovsky, Haifa University; Maxim Rubin-Blum, IOLR; Gilad Antler, Ben-Gurion University and the Inter-University Institute for Marine Sciences.

# The master plan for marine nature reserves in Israel's exclusive economic zone in the Mediterranean Sea



# The Master Plan in Numbers

**30%**

The sea area to be protected by the year 2030

**21,000 km²**

The area of Israel's EEZ

**6300 km²**

The area protected by the proposed marine reserves, according to the master plan

**10**

The number of marine reserves proposed in the master plan

**80%**

The percentage of unique habitats included in the proposed master plan

**89%**

The portion of conservation goals for the protection of ecological representative units met in the proposed master plan

**14**

The number of tools and models used to support decision-making in the process of developing the master plan

**24**

Researchers and other professionals from seven different academic institutes who collaborated in preparing the master plan

**75 km**

The maximal distance between two adjacent reserves

**2**

The proposed marine reserves that could potentially become transboundary reserves

**2100 meters**

The maximal depth in Israel's EEZ

**4009**

The number of observations of 332 different taxa, which served as the basis for the scientific analysis underlying the plan

# List of Terms and Acronyms

**VME**
Vulnerable Marine Ecosystem: A habitat located on the seabed, which is unique either because of its rarity and/or its structural complexity and importance in the ecosystem

**Unique Habitat**
see VME

**Ecological Representation**
The range of environmental conditions, ecosystems, and supporting processes that are represented within protected areas

**Representative Ecological Unit**
A distinct convergence of environmental conditions that enables the existence of characteristic biological populations. Conservation planning aims at including a certain percentage of each representative ecological unit within the protected areas to achieve ecological representation.

**30 X 30**
A general name for the international initiatives for protecting 30% of all land mass and sea areas by the year 2030

**Spatial Conservation Prioritization**
Defining priorities for spatial conservation based on the distribution of habitats, species, and conservation goals, taking into account the socioeconomic activities in the area

**Species distribution model**
A statistical tool used to predict—at various levels of probability--the presence of a species or habitat, based on the environmental conditions in which the species or habitat were previously observed

**Exclusive Economic Zone (EEZ)**
The area beyond the boundary of a country's territorial waters and extending no more than 200 nautical miles, where the coastal country has economic rights to use resources and the obligation to protect nature, according to the 1982 UN Law of the Sea.

**Territorial Waters**
Marine area that extends 12 nautical miles outwards from the coast, over which the coastal country has complete sovereignty, according to the 1982 UN Law of the Sea.

**IOLR**
Israel Oceanography and Limnological Research Institut

**SPNI**
Society for the Protection of Nature in Israel


Shark's embryo in an egg case at 1,200 m depth, Palmahim Disturbance | Photo: Yizhaq Makovsky, Haifa University; Maxim Rubin-Blum, IOLR; Gilad Antler, Ben-Gurion University and the Inter-University Institute for Marine Sciences

# 1 | The Need

**The deep sea is the Earth's largest ecological system and largest carbon reservoir; yet, human exploration of the ocean's potential riches has only just begun.**
**Marine Spatial Planning (MSP) of Israel's territorial waters in the Mediterranean Sea was undertaken by the Planning Administration unit within the Ministry of the Interior, which established a network of marine protected areas (MPAs). By contrast, as of yet, there is no comprehensive policy for marine spatial conservation in Israel's Exclusive Economic Zone (EEZ). This is due to the absence of a legislative framework, as well as the need to survey and characterize the spatial biodiversity of the EEZ.**
**The deep sea is Israel's largest nature zone and we are obligated to protect at least 30% of this area, in line with Israel's pledge to partake in the Convention on Biological Diversity (CBD), the Barcelona Convention, and the government's basic policy underlying this commitment, to advance the establishment of MPAs in the EEZ.**
**There is an urgent need for MSP in the EEZ, if we are to protect the unique and vulnerable habitats and ensure that the MPAs adequately reflect the diversity of representative ecological units. Moreover, spatial planning of the EEZ will ensure the necessary balance between the need for development and the need for conservation, while fulfilling the commitment to protect 30% of the EEZ by 2030—a mere seven years from now!**
**Conservation of the deep sea is required also as part of the national climate strategy, in light of the marine ecosystem's major role in greenhouse gas sequestration.**

# 1. The Biodiversity in Israel's Deep Seas Merits Protection

Recently, members of the International Union for Conservation of Nature (IUCN) have recognized the protection of the Mediterranean's deep-sea biodiversity[4], especially the eastern Mediterranean[5], as a major conservation goal. Israel's EEZ, an area of 21,000 $Km^2$, is similar in size to Israel's land mass. The entire EEZ area consists of the deep sea, which is the habitat and living space of important species, such as sharks, dolphins, whales, and sea turtles, and serves as the breeding area for bluefin tuna and deep-sea sharks.

Inlaid within the EEZ, like gems, there are unique and complex habitats, including deep-sea coral gardens, cold gas (methane) seeps, and deep-hypersaline anoxic basins, that serve as habitats for chemosynthetic communities.

Although most of the seabed in the EEZ is comprised of soft sediment, it is not uniformly so. Some of the sea floor consists of deep-sea sponge grounds that form a complex habitat[41], while other parts are characterized by the accumulation of dead shells, which constitute the habitat of a variety of single-cell creatures (foraminifera)[40].

The continental slope is a highly important geomorphological element: its benthic zone is the habitat not only of sea pens (a type of soft coral) but also of carnivorous Batoidea (stingrays)[67]. The water column above the continental slope is a diversely rich area, which also transports nutrients to the deep-sea regions[35].

There are also cyclonic eddies in the EEZ, where the pelagic zone is exceptionally rich with a wide variety of sea creatures[8].

Although much more has yet to be discovered about the deep-sea areas of Israel, the little that is known is indicative of its importance for biodiversity conservation and future research. Protecting the deep sea is not only ethically important but also practically valuable because its genetic and natural resources could lead to –as of yet undiscovered-biological solutions, medicinal innovations, and the study of biomimicry, for the benefit of all of Israeli society.

4. https://uicnmed.org/docs/mediterraneandeepsea.pdf
5. https://uicnmed.org/docs/deep-sea-eastern-med/DEEP-SEA-EASTERN-MEDITERRANEAN.pdf


# Deep-sea Corals

**Corals are marine organisms that live on the sea-floor substrate.**

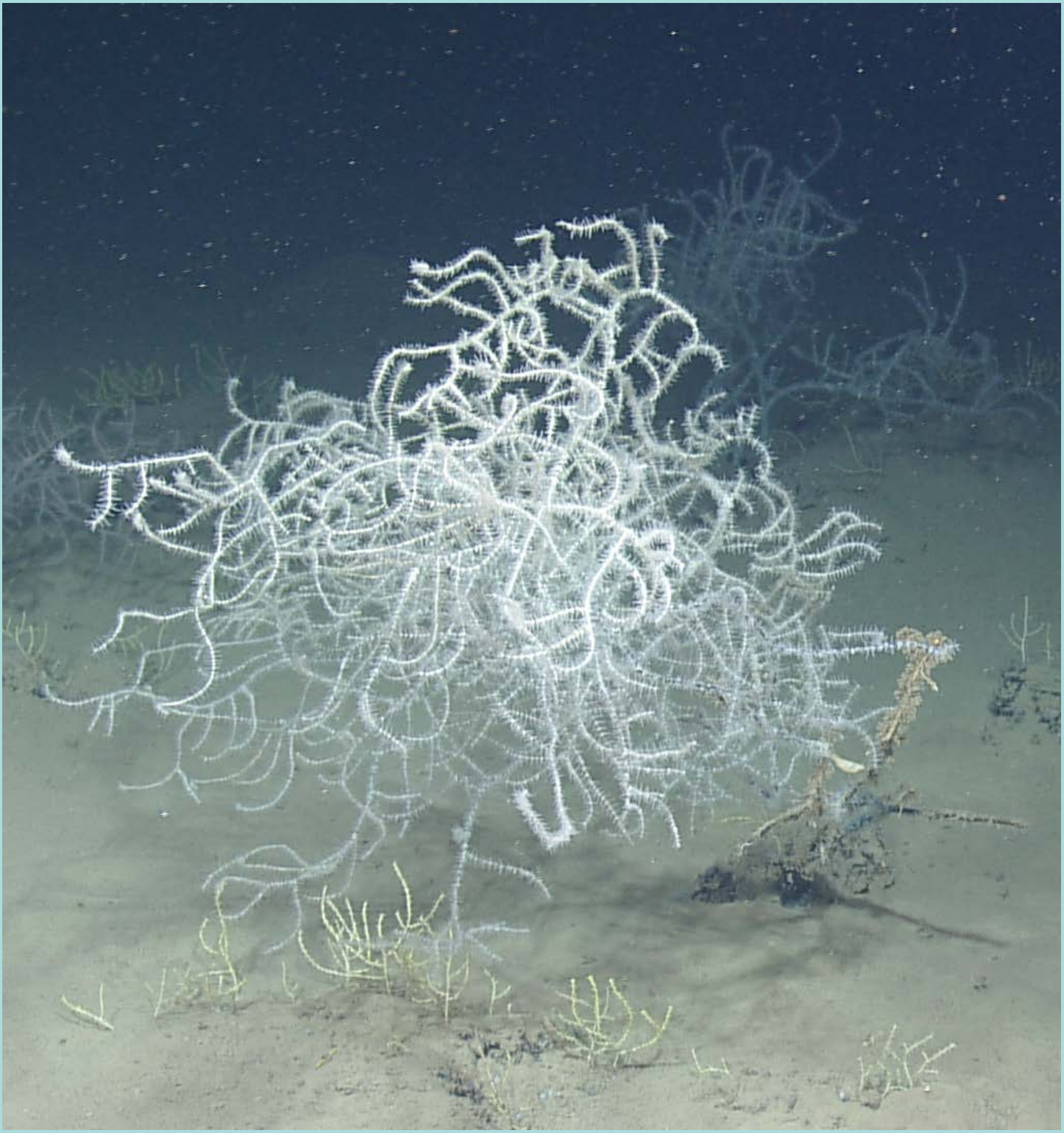
Unlike shallow-water corals, deep-sea corals do not live in symbiosis with algae (because of the lack of sunlight in the deep seas, the algae, which rely on photosynthesis, cannot exist in that depth). Instead, deep-sea corals feed on particles that sink from the higher water column and on microscopic organisms that flow in ocean currents. Therefore, they flourish in areas with strong currents or where the steep topography causes upwelling. This feeding system of passively filtering nutrients out of the surrounding waters requires minimum energy use and thus is well suited to the deep-sea environment. Only when the stinging tentacles on the corals' polyps come in touch with zooplankton or "marine snow" (the organic detritus that falls from the water column above) is food pulled into the mouth of the polyp[72]. Deep-sea corals grow at a very slow rate, approximately by a few microns each year, yet they can live thousands of years and are among the oldest organisms on Earth[70]. As a result, any physical damage to corals is virtually irreversible.

The deep Mediterranean Sea in Israel's EEZ is home to several coral species, including both stony and soft corals, and they form a distinctive and complex habitat in the deep-sea ecosystem. To date, they have been found only at the Palmahim disturbance; however, we expect to find them at other sites within the Israeli deep-sea region. The next nearest site where deep-sea corals have been discovered is on Eratosthenes seamount, south of Cyprus. Although the distribution of deep-sea corals in the Mediterranean basin is scattered, their abundance in the area is greater than previously assumed[43].

Coral gardens form a three-dimensional habitat; a garden is a "forest" of organisms that provides shelter to numerous other organisms, e.g., fish, sea anemones, crabs, mollusks, echinoderms, and worms, and thus is a rich source of biological diversity. In areas where coral gardens were found, there was also a significant increase in the distribution and biomass of benthic fish[18, 19, 61]. Coral gardens also serve as nurseries for sharks and a variety of fish, where they lay eggs and keep the newborns safe until they are fit to leave[12, 39].

Different corals populate specific niches depending on the depth and geomorphology; hence certain species can be found in some coral sites but not in others. Consequently, it is extremely important to study the unique biodiversity of every area of the deep sea and to protect each one individually.

The temperature range in which deep-sea corals are known to thrive is between 4°-13° Celsius; more recently, corals were found also in 17° C water[43]. The average temperature of the Mediterranean is 13°-14° C, which suggests that deep-sea corals in the region are already at the upper end of their thermal tolerance; this in turn means that they are at high risk, as the seas are getting warmer. Beyond climate change, other risk factors that threaten the continued existence of corals include the direct damage caused by bottom-trawl fishing gear and sediment resuspension related to accelerated land erosion or infrastructure construction[43].



***Leiopathes sp.* – a black coral species discovered at the Palmahim disturbance.** Its skeleton is made of protein, and thus it differs from most corals whose skeleton is composed of calcium carbonate | Photo: Adam Weissman and Yizhaq Makovsky, University of Haifa

# 2. 30 X30: 30% of marine area Protected by 2030

The Convention on Biological Diversity, the Barcelona Convention, and the UN Convention on the Law of the Sea all obligate coastal countries to establish marine protected areas including in the EEZ[98].

Recently, following a global campaign for the 30 x 30 initiative, countries throughout the world – including Israel – adopted the ambitious goal of ensuring that at least 30% of land and sea areas are protected by 2030, especially areas of particular importance for biodiversity, by establishing a network of well-connected, ecologically representative, and effectively managed protected areas[13]6. This came several months after Israel had committed to adopting the 30% protection goal in the area of Israel's Mediterranean, based on the 2021 update of the Barcelona Convention[80]. The beginning of 2023 marked another breakthrough, with the signing of the High Seas Treaty, which "Stipulates that environmental impact assessments must be completed before any new exploitation of marine resources in areas beyond national jurisdictions."[7] Initiatives for the planning of marine nature reserves in the EEZ are rapidly being promoted throughout the world. Prominent examples include the Australian government's initiative for planning marine reserves that encompass 37% of the 10,000,000 km$^2$ that constitute Australia's EEZ[8]. This is one of the largest protected areas on the globe and its implementation is now almost entirely implemented. The Irish government is also taking steps to enlarge the scope of protected nature reserves in its EEZ from 2.1% nowadays to 30% by 2030[9]. This initiative has been strongly supported by the public and many nongovernmental organizations have taken steps to advance the planning of protected areas, based on existing scientific knowledge of the area[10]. Furthermore, several island countries in the Pacific Ocean, such as Niue[11] and Palau[12], whose economies strongly depend on the marine environment, have announced that they will provide broad protection encompassing between 40 and 80% of their EEZ. In the US, 26% of the EEZ is protected, and further efforts are invested in allocating additional areas needing protection.

6. "Ensure and enable that by 2030 at least 30 per cent of terrestrial, inland water, and of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures, recognizing indigenous and traditional territories, where applicable, and integrated into wider landscapes, seascapes and the ocean, while ensuring that any sustainable use, where appropriate in such areas, is fully consistent with conservation outcomes, recognizing and respecting the rights of indigenous peoples and local communities, including over their traditional territories."
7. https://www.un.org/bbnj/
8. https://parksaustralia.gov.au/marine/parks
9. https://www.gov.ie/en/press-release/bf4fc-public-consultation-demonstrates-strong-support-for-expansion-of-marine-protected-areas/#
10. https://fairseas.ie
11. https://niueoceanwide.com
12. https://www.bluenaturealliance.org/palau-national-marine-sanctuary

# 3. The Urgency

The deep-sea floor is exceptionally vulnerable to disturbances, and any damage to it leaves its mark over many years. The paucity of nutrients, the absence of sunlight, and the low sedimentation rates are all factors that make it a mostly non-dynamic environment; consequently, its recovery and renewal process after a disturbance is indeed very slow. Hence, in the deep sea, there is no room for mistakes in planning – on the contrary, every step must be well-informed, and taken with utmost precaution.

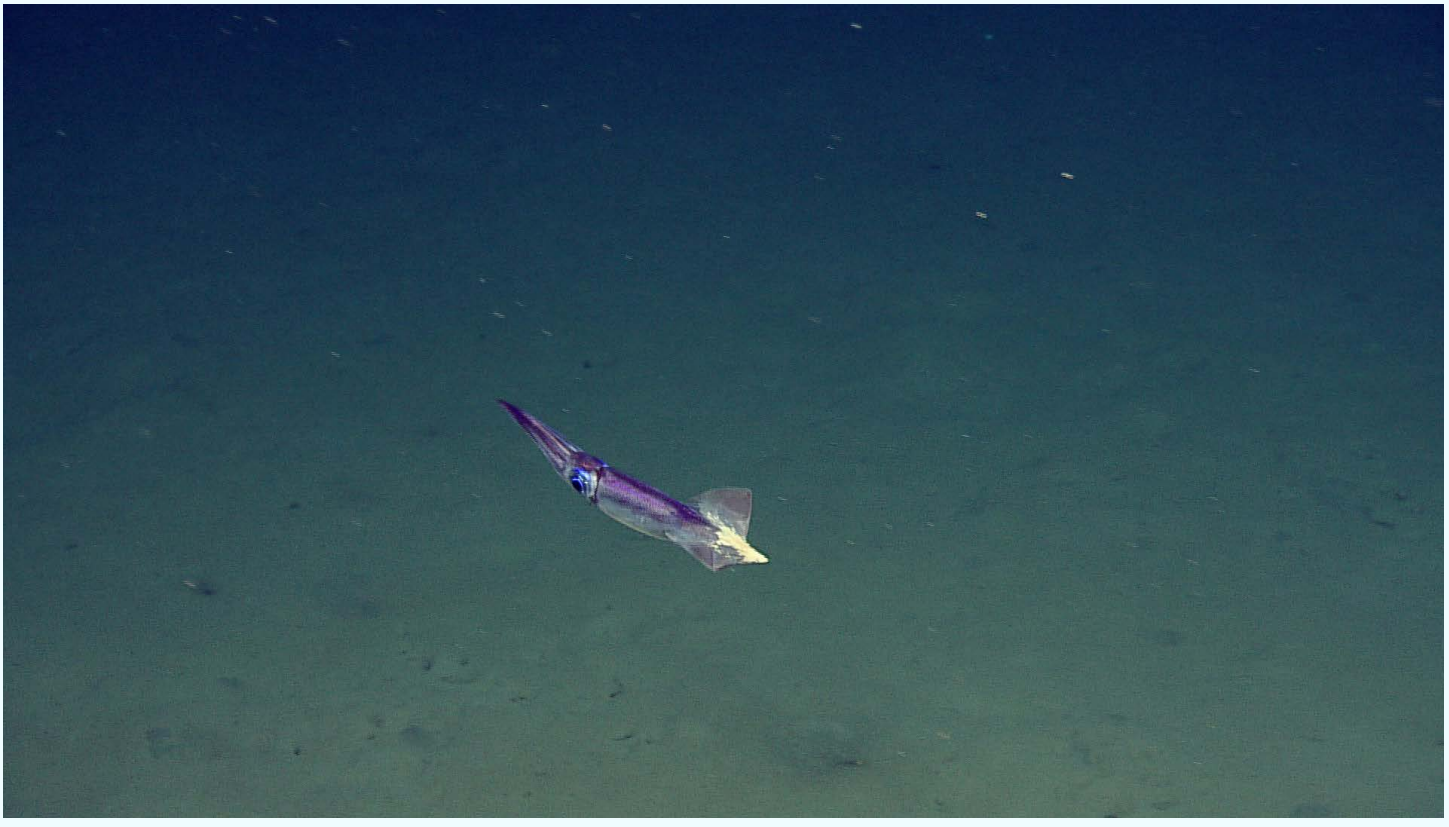
The deep sea is the largest natural area under Israel's jurisdiction and human activity in this zone is relatively low. Nevertheless, economic activities have already taken their toll. The current activity includes waste dumping of fly ash and acidic wastewater, encompassing an area of hundreds of square kilometers, as well as bottom trawl fishing, which damages the seabed and its vulnerable communities on the continental slope. Similarly, pelagic fishing in the water column harms larger and unique animals, such as sea turtles and sharks. Furthermore, the search for resources such as natural gas also harms the seabed and could have a deleterious effect on the entire ecological system, beginning with the seismic surveys conducted for this purpose and ending with the drilling phase (and the risk of leakage). Maritime transportation is another source of pollution that can have wide-ranging damaging effects. Areas that have already been damaged, mostly on the continental slope, are in greatest need of protection, as are areas threatened by potential initiatives to enlarge infrastructures.

Although Israel's economic activities are expanding into deeper and more distant waters, there is still nowadays a great deal of **flexibility in terms of planning**, which would allow the **protection of ecological systems** that are – as of yet – nearly untouched by human impact[20]. However, this window of opportunity for effectively protecting the deep sea is gradually closing[38]: the Department of Energy is seeking to expand the areas in which the search for natural gas is permitted to include also ecologically vulnerable regions. There are constant efforts to examine the promotion of renewable energy and the establishment of aquaculture, even in the deep sea. Expanded infrastructure (such as communication lines) is being planned, and all this is taking place when climate change is challenging the stability and resilience of marine ecosystems, in the sea in general and the deep sea in particular[14, 17].

The year 2030, by which 30% of the ocean must be protected, is virtually around the corner. Given the amount of time necessary to progress from one planning stage to the next, to prepare the announcement and ensure the effective management of deep-sea nature reserves, there is an urgent need for a master plan outlining the establishment of marine nature reserves in the EEZ. This must be underway before any "nails are driven into the coffin," that is, before irreversible damage can be done. Spatial planning for protected areas will also identify less vulnerable areas, which will serve as an anchor for the activities of all stakeholders and other parties with interests in this area.

# 4. Marine Nature Reserves – the core of marine conservation strategy

Marine nature reserves are the most effective and proven method for protecting nature in the sea. Compared to unprotected areas, the nature reserves eliminate the negative effects of local activities and thus allow the natural ecological system to successfully cope with the implications of global climate change[34, 76]. Protecting 30% of the area will enable effective conservation of the ecological system and thus moderate the negative effects of climate change, on the one hand, while on the other hand, it will also enable us to achieve socioeconomic goals[66]. On a global level, protecting at least 30% of natural areas will ensure the sustainability of a variety of habitats that are important for the functioning of the ecological system, as this designated area would be sufficiently large to absorb and store carbon and thus provide significant economic benefits[6, 55, 66, 84]. Consequently, marine nature reserves must be a core and inherent part of any strategic framework for spatial planning of the EEZ, as they would serve as "natural treasure chests," protecting the treasures with which we have been blessed.



**Squid at the deep sea. Photo: Adam Weissman and Yizhaq Makovsky, University of Haifa.**

Diving deep

# The Light Show in the Deep Sea

At a depth of 200 m, the marine environment is wrapped in total darkness. In a dark environment, organisms communicate with each other through sound, "smells" (chemical reactions), "and mostly, through the use of light. Organisms create light through a chemical process called bioluminescence. We are all familiar with fireflies that communicate with each other by flashing lights during the night. On land, this is a unique phenomenon; however, in the deep sea, bioluminescence is the norm. In a study conducted off the coast of California, more than 75% of the organisms observed in the deep sea used light[60]!
The light is the product of a chemical reaction that takes place within the organism, using an enzyme known as luciferase, or in other cases, bacteria that live symbiotically within the organism. What is the function of the light they produce? On land, most animals communicate through sound, whereas in the dark environment of the sea, light can be used to communicate with each other, to lure their next meal, or to mislead predators. Some well-known examples include anglerfish, which have a luminescent fin ray that glows in front of their enormous mouths, to lure their prey, or cuttlefish, which emit a cloud of blinding light when escaping from a predator. However, luminescence is a feature of almost all sea creatures, from bacteria to fish[36].

The gene that creates the light-producing enzyme was cloned from a marine jellyfish and nowadays it is an important instrument in medical research, used primarily for molecular marking. In 2008, the researchers who cloned this gene from the jellyfish were awarded the Nobel Prize in medicine.

At more shallow depths of the mesopelagic zone (up to 200 m deep), a different phenomenon related to communicating through light is called fluorescence. Some marine creatures have proteins in their body that can absorb shortwave light, swallow part of the energy, and through a physio-chemical process, emit light of a longer wavelength. This creates unique color patterns on the animals, which can be seen by using a special lighting and filtering process that absorbs only the reflection of the fluorescent light[36].

A bristle worm (polychaete) | Photo: Shutterstock

# Planning, Legislative Background and Uses of the Master Plan

**The Master Plan for Marine Nature Reserves in Israel's EEZ will serve as the basis for the Marine Spatial Planning (MSP) of the EEZ. The MSP must precede any further developments in the area; thus, it will ensure that a future comprehensive plan intended for implementation will strike an optimal balance between the goals of regional conservation and regional development. Until such a comprehensive plan is presented, this Master Plan will serve as:**

- **A basis for advancing the protection of specific sites;**
- **A knowledge base and point of departure for examining any sector development initiatives;**
- **A basic framework outlining the research and surveying efforts that are needed.**

## 1. Planning and Legislation—The Current State of Affairs

The establishment of marine nature reserves in the EEZ is an acceptable legal practice according to international law, which assigns countries the responsibility of protecting nature within their jurisdictions and encourages them to designate the areas within their EEZs as natural marine protected areas[79].

A well-accepted principle that guides MSP is the ecosystem-based approach. This refers to a comprehensive, knowledge-based plan that is supported by a fundamental layer that allows for sectorial planning within an ecological framework[23].

In Israel, a Marine Spatial Plan for the country's territorial waters was devised as part of the Maritime Policy for Israel's Mediterranean Waters[94]. However, it was not possible to devise an MSP for Israel's EEZ because of insufficient spatial knowledge of the EEZ, the absence of a National Planning and Building Law applicable to the EEZ, and the stalling of legislation on the Marine Areas Act. Consequently, no planning mechanism has been proposed for ensuring a comprehensive and effective way to balance the goals of regional development with those of regional conservation. As a result, currently, sector development activities in the EEZ are conducted randomly, without any framework for providing a comprehensive and balanced plan. The only single step towards the spatial protection of nature in the EEZ taken to date was a proclamation, by the Minister of Environmental Protection, stating that the Nature Protection Values are to be applied to protect the vulnerable Palmahim disturbance site (The 2022 Palmahim Slide Proclamation). This was based on a legal precedent, in which the legal clause on Nature Protection Values was applied to the EEZ. This provides a substantial legal anchor for protecting the unique habitats in the EEZ, where there are concentrations of corals, sharks, sponges, and other natural life forms protected under this law[89, 90, 92].

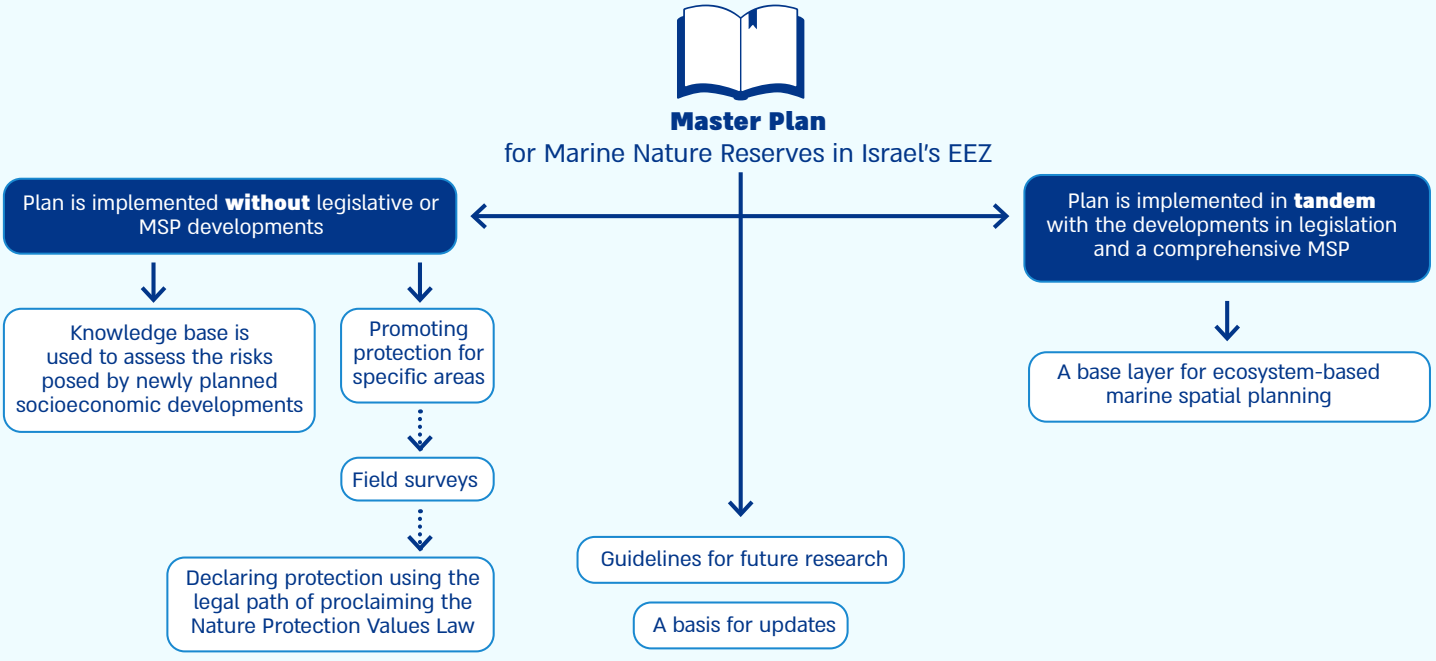
# 2. Uses of the Master Plan

**The Master Plan for Marine Nature Reserves in Israel's EEZ serves as an ecological basis for the MSP, which must be established before there is any further economic development in the EEZ, to maintain an optimal balance between the need for economic development and the need for nature conservation. Maintaining this balance will be possible once the necessary legislation is in place and the MSP has been implemented.**

**Until these conditions are fulfilled, the Master Plan will serve as a basis not only for advancing conservation efforts at specific sites in the EEZ based on the gathering of sufficient ecological information (and using the legal path of proclaiming that the Nature Protection Values are to be applied to protect each specific site) but also for considering the appropriateness of sector development initiatives.** To this end, and in parallel with the efforts to gain official recognition of nature reserves using the existing regulatory means, it is important to establish the necessary legal framework for the EEZ, which should legally anchor the planning mechanism; an integrative planning process; and the founding of a planning institute authorized to make decisions, establish nature reserves, and oversee their effective management[20].

To date, countries around the globe have adopted the goal of protecting 30% of the oceans, and the new Israeli government has included in its guiding principles the Marine Areas Law and ensured "Its application in the EEZ through Israeli regulation," promising to "advance plans for marine nature reserves in the EEZ."[13] Consequently, the time is ripe to assimilate this Master Plan into Israeli regulation and proceed with its active implementation.

Furthermore, the Master Plan will help guide the research efforts to close information gaps, serving as a "roadmap" for collecting the necessary information about the areas intended for protection as marine nature reserves. The pooling of academic and governmental resources will be necessary, to conduct the targeted surveys and provide detailed documentation about the geomorphology and ecology of the proposed nature reserves. The information gathered will be used to identify precise boundaries for the reserves and present detailed plans that will serve as the basis for future proclamations.




13. https://main.knesset.gov.il/mk/government/Documents/CA37-YT.pdf p. 6, article 72 (Hebrew)

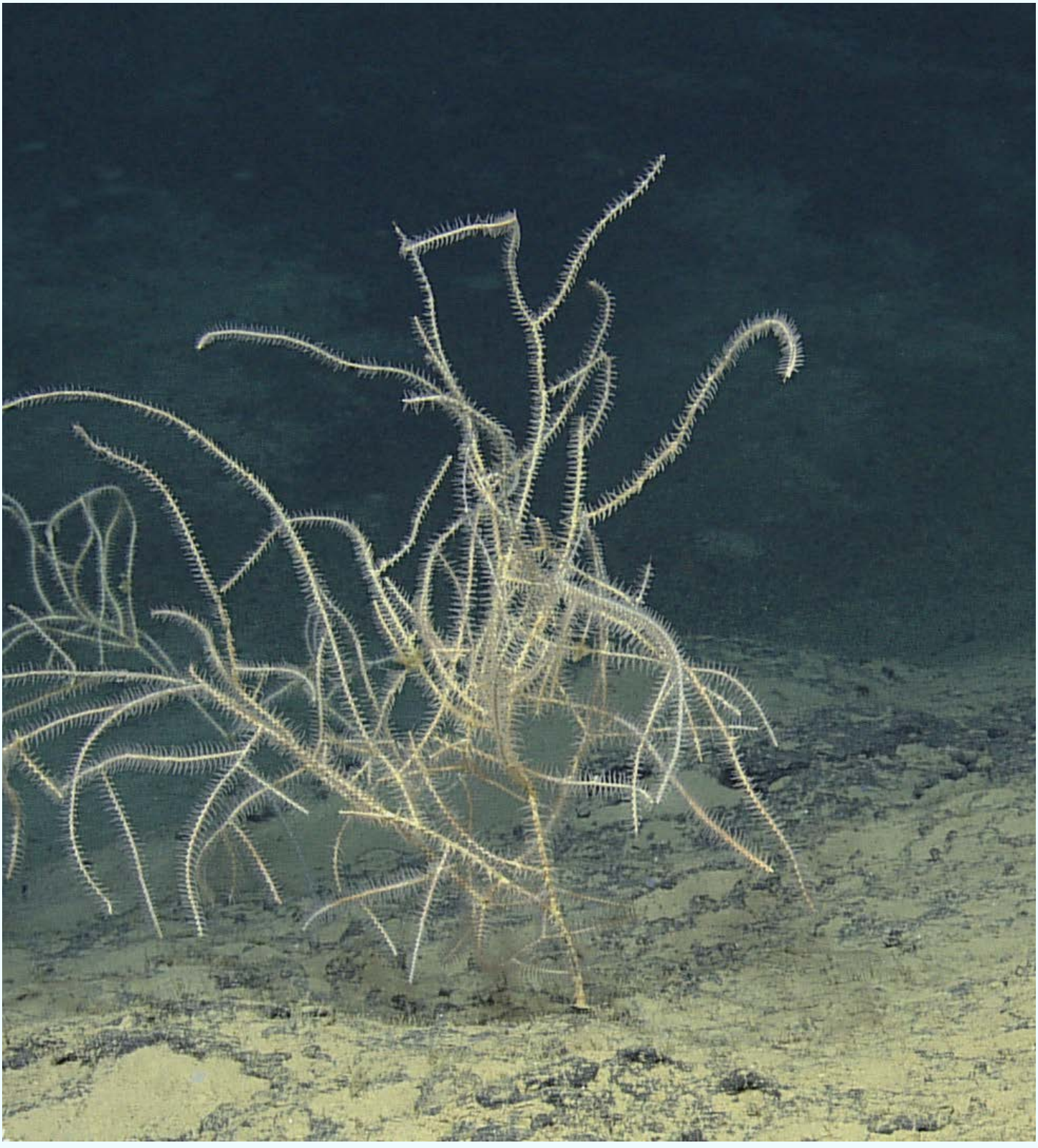
# 2| Vision and Goals

# The Vision

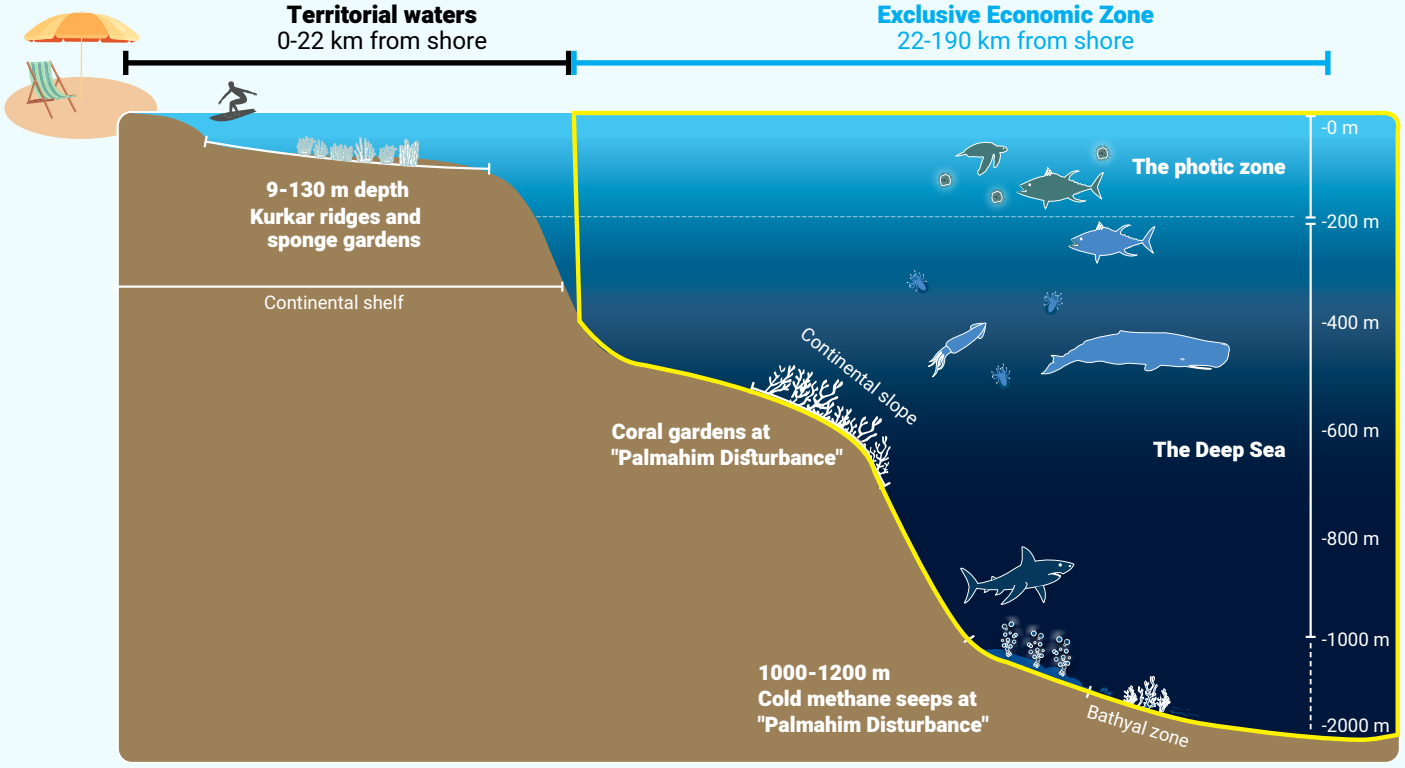
**The biodiversity in Israel's deep sea will be preserved for generations to come and will flourish within marine nature reserves while continuing sustainable human activities in Israel's EEZ.**
**The network of nature reserves will protect all of the unique habitats in the EEZ and the connectivity between them, preserve a representative portion of each ecological unit, and protect areas where important ecological processes, such as primary productivity, climate change mitigation, nutrient transport, and reproduction, take place.**

# The Goals

**The network of marine nature reserves will encompass 30% of the EEZ, providing nature with the resilience to cope with climate changes. The areas within the reserves will be completely protected from the harmful effects of human activity, from the ocean floor and up to the water's surface. The nature reserves will be managed by Israel's Nature and Parks Authority, while ensuring the supply of necessary resources for public relations, supervision, enforcement, and scientific monitoring.**
**The Master Plan for Marine Nature Reserves in the EEZ will contain the most up-to-date scientific and planning information; to this end, it will be updated regularly with the cooperation of the public and stakeholders and thus will serve as the basis for planning and managing human activities in the EEZ.**



**A deep-sea coral at the Palmahim disturbance site** | Photo: Adam Weissman, and Yizhaq Makovsky, University of Haifa




**The cross-section of Israel's Mediterranean; the EEZ is marked with a yellow border**. From Weissman & Rothschild[91]

3

# The Principals Underlying the Master Plan

## Ecology, Uses, and Spatial Prioritization

# A. The Design of the Planning Process

***"Ensur[ing] that at least 30 per cent globally of land areas and of sea areas, especially areas of particular importance for biodiversity and its contributions to people, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas..." [13].***

### A.1. Key Characteristics of Successful Nature Reserves -- Based on Global Scientific Knowledge

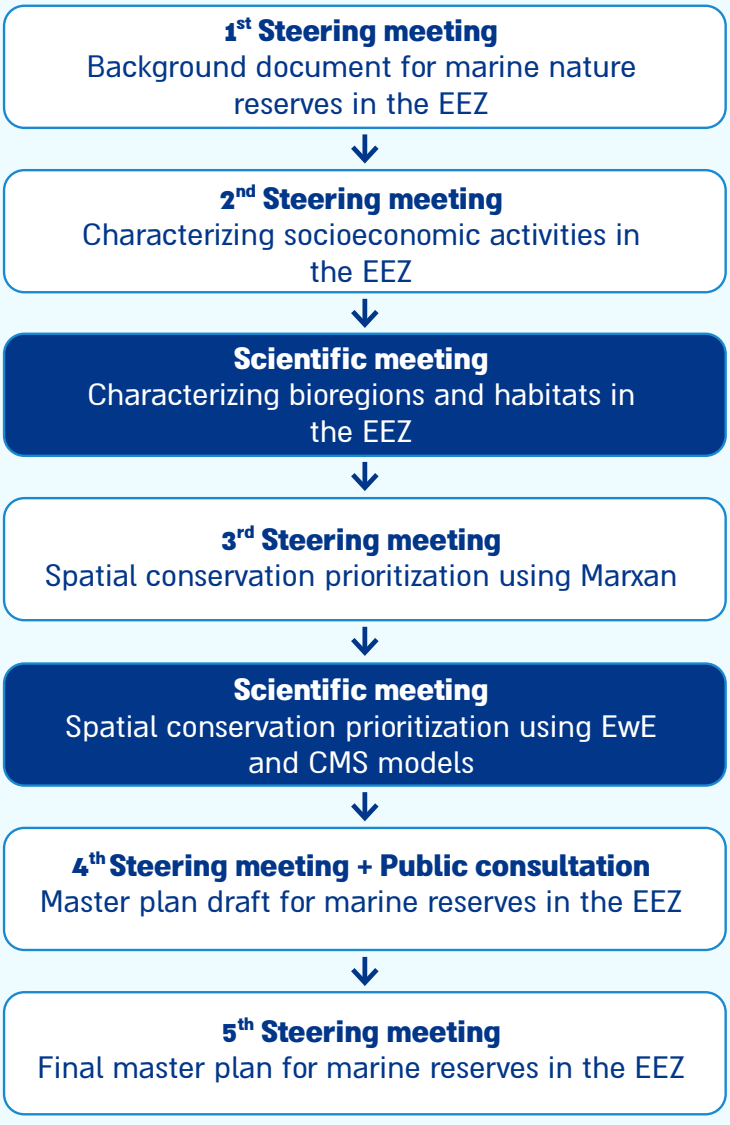
Scientific research has demonstrated that attaining nature conservation goals depends on the ability to adhere to the following major planning principles: including a broad area, representation, replication, connectivity, complete protection from harmful uses, and effective management[34]. Hence, fulfilling the goal of the Convention on Biological Diversity requires the full protection (i.e., a no-take approach) of 30% of the EEZ.
Furthermore, global experience underscores the importance of implementing planning principles that provide a comprehensive view of the economic activities in the area, so as to avoid as much as possible any future conflicts, while identifying possible usage overlaps. Addressing these principles can determine to a great extent the applicability of the plan and, consequently these principles are considered an inherent part of the planning of nature reserves. Accordingly, the key characteristics for successful and effective planning of a network of marine nature reserves are presented in Appendix 1.

### A.2. The Planning Process and Cooperation with Interested Parties

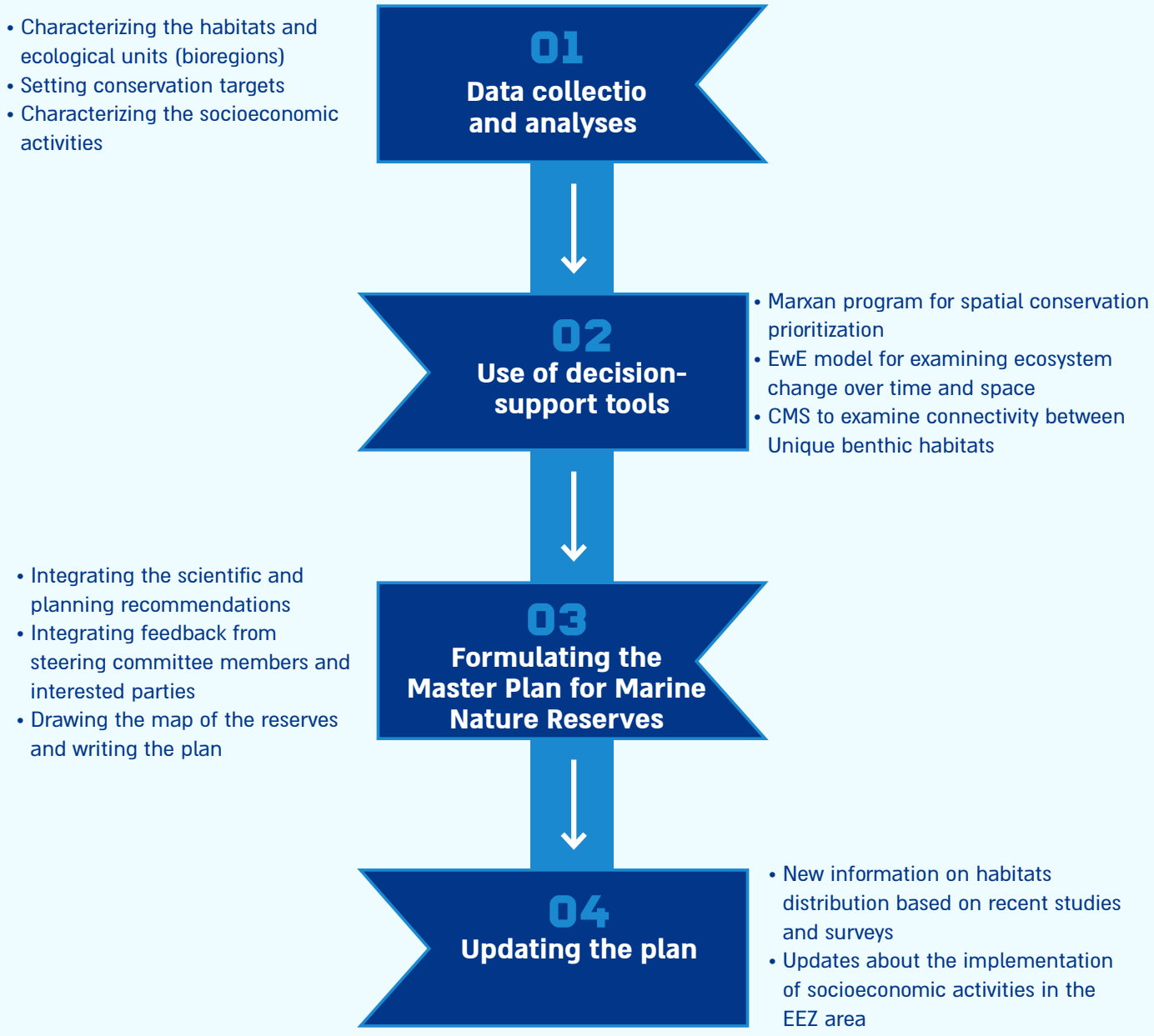
The planning process was designed according to the worldwide approach, which claims that successful spatial planning is based on knowledge, as well as consultation with a wide range of stakeholders and the public, while maintaining complete transparency and integrating elements that ensure flexibility and periodic updating. Accordingly, at the beginning of the process, individual meetings were held with representatives from the various government ministries that are operating in the marine area, local authorities, and representatives from the Academy and environmental organizations (for a detailed list, see Appendix 3). In the course of these meetings, the information-collection process and the plan's formulation were presented to the stakeholders, while examining the knowledge components necessary for formulating the master plan. These representatives were also asked to participate in the steering committee, which eventually included 46 representatives from these interested parties and which accompanied the initiative from start to finish.
In the early stages of the project, the steering committee was presented with the document reporting the background for the plan, the goals, and the anticipated stages of the project, and their feedback was used to update the document (Appendix 1).
At roughly the same time, professional teams were collecting and processing information (regarding habitats, benthic and pelagic ecological units, and socioeconomic information), that would at a later stage serve as the basis for other teams to determine spatial prioritization for conservation. At each stage, the scientific results were

presented to the scientific consultation committee for their input and they were also submitted to a peer review process undertaken by two external scientific consultants. Only after receiving their scientific input, did the project continue to the next stage. The outcomes of this scientific consultation and review process led to the formulation of the current Master Plan for marine protected areas in the EEZ. A draft of this final document was presented to the steering committee and afterward, it was presented to the public at large. The feedback received was integrated into the final plan by the planning committee.

## The planning process: The activities of the steering and scientific committees



# The planning process: Stages in the professional teams' process for formulating the current Master Plan



# B. The Basic Planning Layer
# The Ecosystem

## B.1. The Process of Data Collection, Analyses, and Validation

### Background

Surveying the biological diversity and ecological processes in a given area constitutes the basis for planning nature reserves. The habitats found in the EEZ were first described in a pioneering work conducted as part of the strategic environmental survey of the Israeli Mediterranean, initiated and led by the Ministry of Energy[95]. This document described seven habitats in the EEZ, of these six were small sites (five in the area of the Palmahim disturbance and one in the area termed Gal-C) with the seventh habitat comprising all the rest of the area. Since that survey was conducted, additional studies were deployed, which describe the geomorphological and biological characteristics of the area[e.g., 46, 47, 56, 57, 68, 73]. The latter studies helped update the habitat mapping, in a strategic survey published in 2021, which reported the presence of eight habitats in the EEZ, four of which were outside of the Palmahim disturbance area[47, 96].

Deep-sea research throughout the globe and in Israel is a logistically complex task that requires a great deal of resources, which is why there is a paucity of information available about this area. The knowledge accumulates slowly over the years, which is why there are significant knowledge gaps about the biology and ecology of the deep-sea and the remote pelagic seas.

### Characterizing the Habitats and the Ecological Units as Part of the Current Initiative

To cope with this challenge and provide a basis for the planning of the marine nature reserves, efforts were made as part of the current initiative to collect observational information from a variety of resources and to emphasize the identification of species indicative of unique habitats. Advanced statistical analyses were conducted to describe the biological and environmental diversity in the EEZ and to characterize the distribution of unique habitats in this area. The scientific endeavor was undertaken by a team of 15 investigators from leading academic institutions in the field of deep-sea research: Haifa University, Tel Aviv University, and Israel's Oceanography and Limnological Research Institute. From the very start, the scientific work was accompanied by two external advisors who helped supervise the study methods and results: Prof. Jonathan (Yoni) Belmaker of Tel Aviv University, and Prof. Erik Cordes, of Temple University, Philadelphia, PA, US.

The results included the characterization of the unique habitats and representative ecological units in the benthic zone (Appendix 2) and the characterization of unique habitats and representative ecological units in the pelagic zone (Appendix 5). These results were peer-reviewed by a consulting scientific committee that included 25 researchers and professionals from Israel. The input from both the external consultants (Appendix 4) and from the scientific committee members was for the most part extremely positive and supported the transition to the next

stage of spatial prioritization for conservation.

For the purpose of quality control, some of the analyses were performed a second time while omitting some of the basic factors (e.g., omitting some of the information sources, focusing on data from systematic surveys, analysis based primarily on physical data, etc.). The results of these analyses also validated and confirmed the prior results regarding the characterization of ecological units (Appendix 9 – Responses to Comments).

### Defining Conservation Goals

With the help of the scientific committee, conservation goals were defined for each habitat and ecological unit while referring to a specific portion of each ecological unit and habitat that should be included in the nature reserves. The recommendations were based on knowledge gathered from the global scientific literature about the characteristics of habitats, such as their vulnerability to disturbances, their ability to recover and regenerate after a disturbance, their rarity, and the species they contain. Furthermore, the recommendations were based on the spatial distribution of the ecological units and habitats in the EEZ. Thus, for example, a relatively high degree of protection was recommended for an ecological unit whose total area constitutes only 1% of the EEZ, in comparison to the protection recommended for an ecological unit whose area constitutes more than 30% of the EEZ.

### Analysis of the Results to Determine Spatial Prioritization

The characterization of the habitats and ecological units in the benthic zone (Appendix 2) and in the pelagic zone (Appendix 5), along with the conservation goals as determined in the previous stage and the information about socioeconomic activities (Appendix 7) were all integrated into the Marxan program for spatial prioritization (Appendix 8).

**Background Document**

↓

**Base-layers for Planning**

**Socioeconomic activities in the EEZ**

Spatial distribution of the socioeconomic activities was characterized by Planning Team based on data from the various sectors and was confirmed by the Steering committee

**Conservation targets for each unit and habitat**

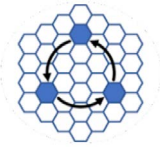
Spatial conservation goals for each ecological unit and habitat determined by experts of the Scientific Consulting Committee

**Distribution of ecological units and habitats**

Distribution of ecological units and habitats in benthic and pelagic zones characterized by professional teams, followed by peer review and conformation issued by the Scientific Consulting Committee

↓

**Spatial conservation prioritization tools**



**Marxan**

Spatial conservation prioritization based on all base-layers for planning

**EWE**

Examining ecosystem change over time and space using the food-web model and Marxan results

**Connectivity Modeling System (CMS)**

Examining connectivity between unique benthic habitats based on the characterization of habitats distribution in the EEZ

↓

**Spatial-planning recommendations for master plan development**

↓

**Formulating the Master Plan after integrating the comments provided in response to the draft**

The planning process was based on the principles for planning nature reserves recommended in the scientific literature, characterization of the environment and activities in the area, and recommendations for spatial prioritization of protected areas areas, based on the outputs of the decision-support tools. All of these components are described in detail in designated reports (see Appendices 1,2,5,6,and 8)

Cargo of amphorae from Byzantine shipwreck at the depth of 1649 m | Photo: The Israeli Antiques Authority

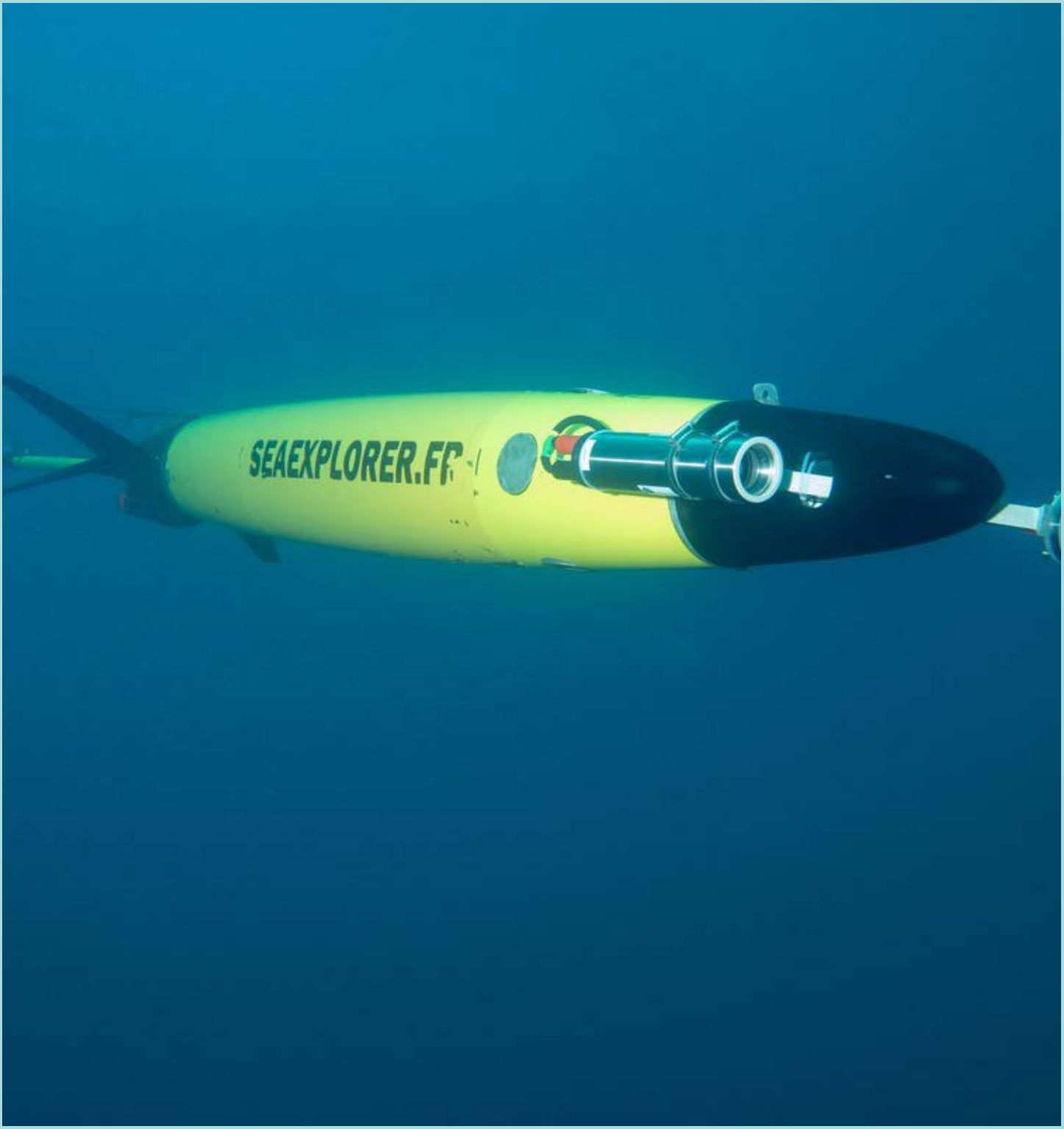

# Deep-sea research: Robots and modeling

Researching the deep-sea is logistically complicated and expensive. In general, an initial preliminary survey is conducted, based on acoustic signals for subterranean mapping, which creates a bathymetric three-dimensional map of the ocean floor and which can be used to understand the consistency of the seafloor (for example, a soft sediment or rocky bottom). In the next stage, to conduct a visual survey, complex robots are used, which are remotely controlled from the research vessel. These robots provide video surveys and collect samples from the seabed using sensitive robotic arms.

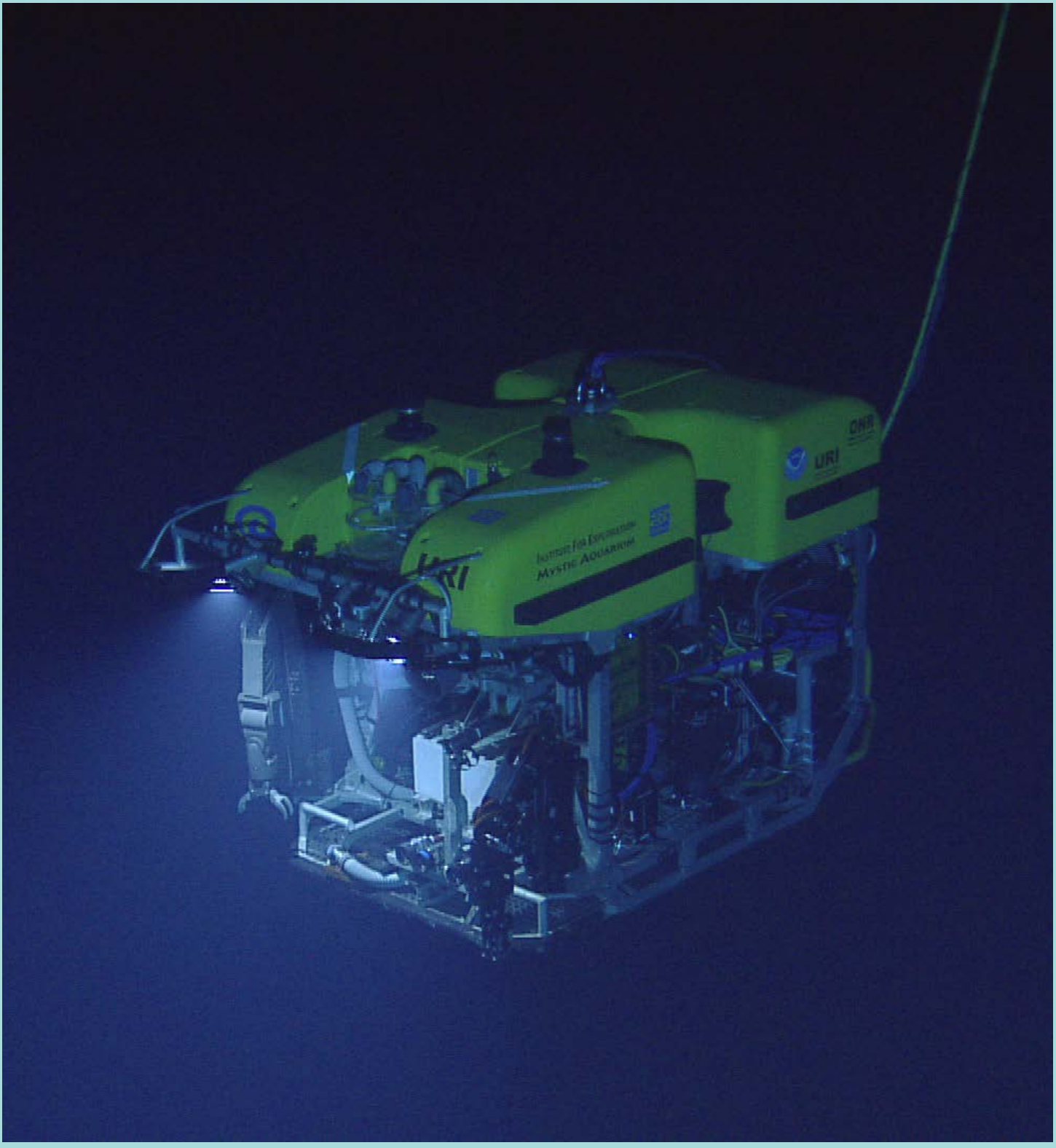
It is impossible to examine and map an enormous area such as Israel's EEZ through direct observation. Consequently, the mapping of habitats and species in the deep-sea is mostly done today by Spatial Distribution Models, which are based on a variety of indicators and used to predict areas in the deep-sea where there is a strong probability that unique ecosystems exist[16, 53, 58]. These models render probability maps indicating the presence of specific habitats in a particular area, based on the analysis of environmental conditions found at sites where unique habitats have already been identified, and then analyzing the probability of such habitats existing in areas with similar characteristics.

The predictive capacity of these models has been shown to be extremely reliable for specific habitats; consequently, many countries use these models to plan and manage their Marine areas[16]. Thus, for example, the International Council for the Exploration of the Sea (ICES) recommends providing the same level of protection to areas identified by the model as having a high probability for containing vulnerable benthic habitats as they would to areas where such habitats have been visually documented [3]. Another example in which models' predictions are considered valid is the US Bureau of Ocean Energy Management, which uses advanced models for predicting the presence of vulnerable habitats in decision-making regarding renewable energy planning. These advanced models are based on geophysical information about the seafloor, sediment characteristics, as well as oceanographic characteristics such as deep-sea temperatures, salinity levels, and even productivity rates on the water's surface.

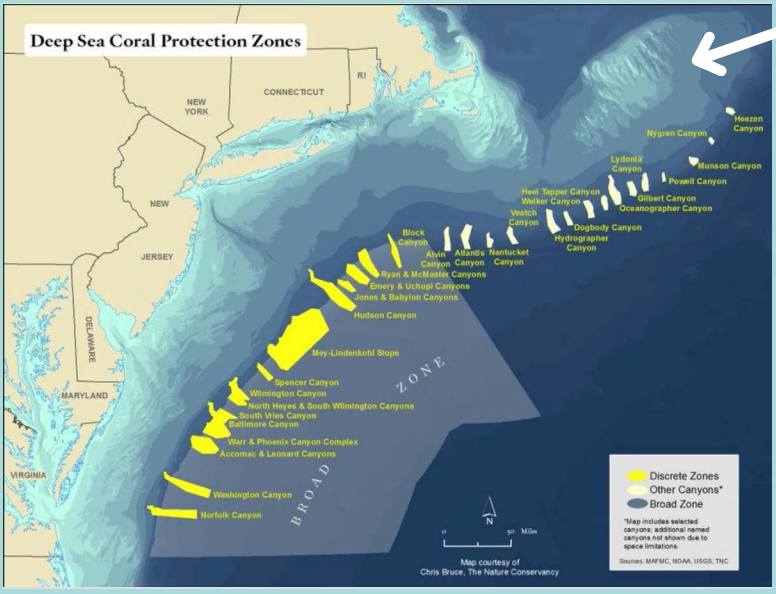
Using the most advanced models for predicting the presence of vulnerable habitats, taking into account various levels of probability, provided a significant basis for preparing the Master Plan For Marine Nature Reserves in Israel's EEZ.

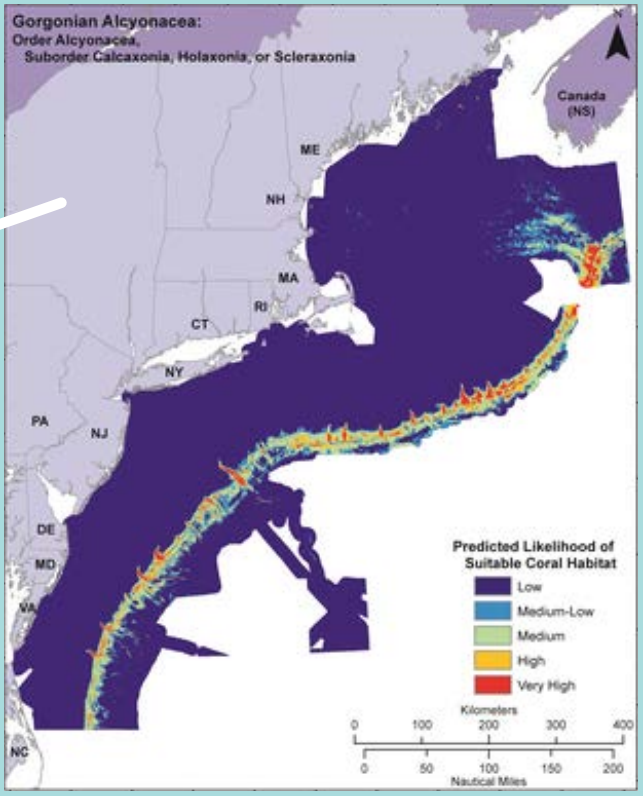



Underwater research in the Mediterranean Sea using the glider SeaExplorer, equipped with UVP6 that enables exploration of the environmental and biological conditions in the water column. Photo: Tamar Guy-Haim and Merav Gilboa, IOLR




The remotely operated underwater vehicle "Hercules" in the Israeli Mediterranean Sea



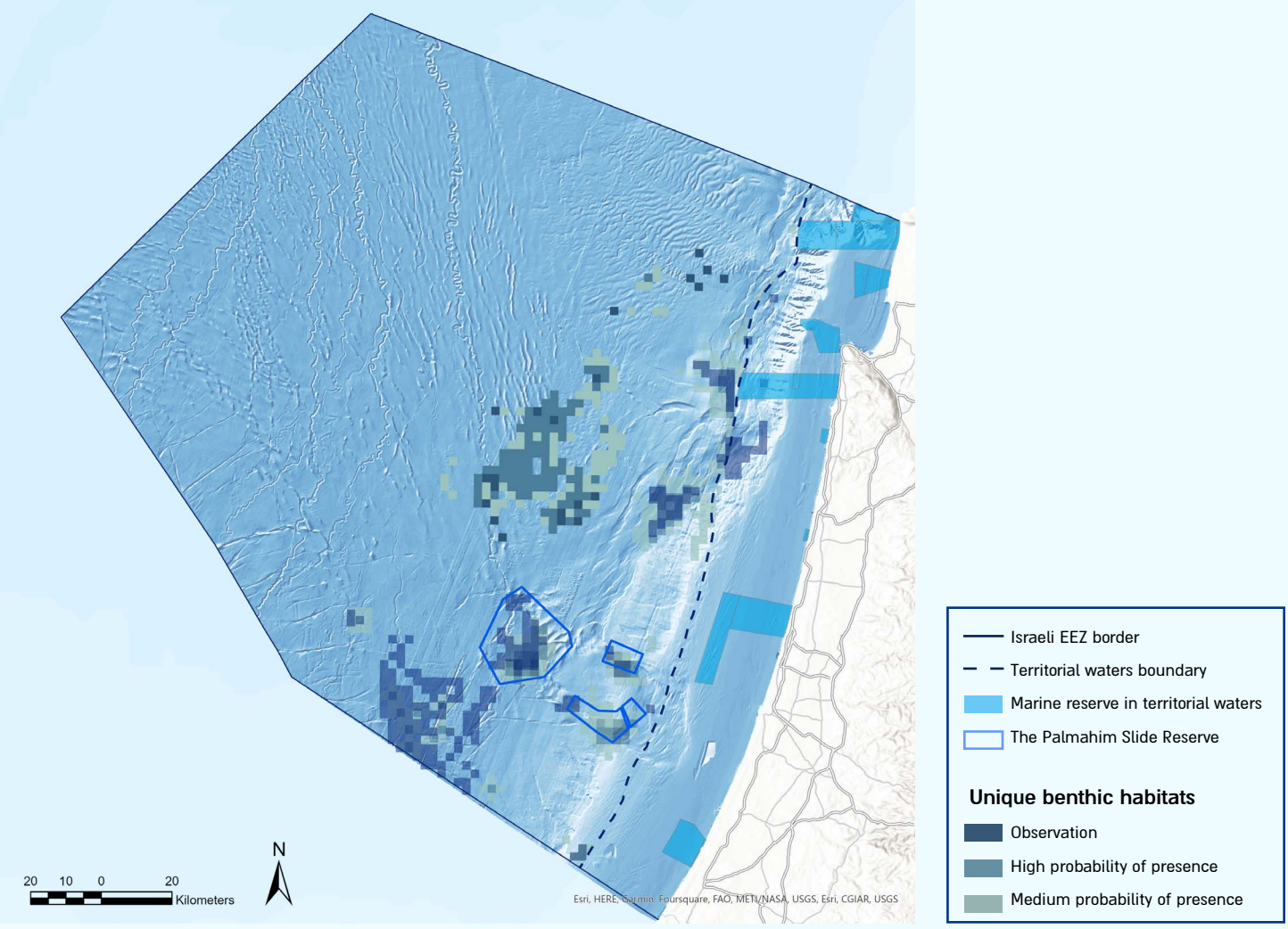




A network of nature reserves along the United States eastern coast, where the planning of the reserves was based on a model predicting the distribution of deep-sea corals in the area. From Kinlan et al. [3, 49], NCCOS, The Nature Conservancy.

# B2. The Major Ecological Findings

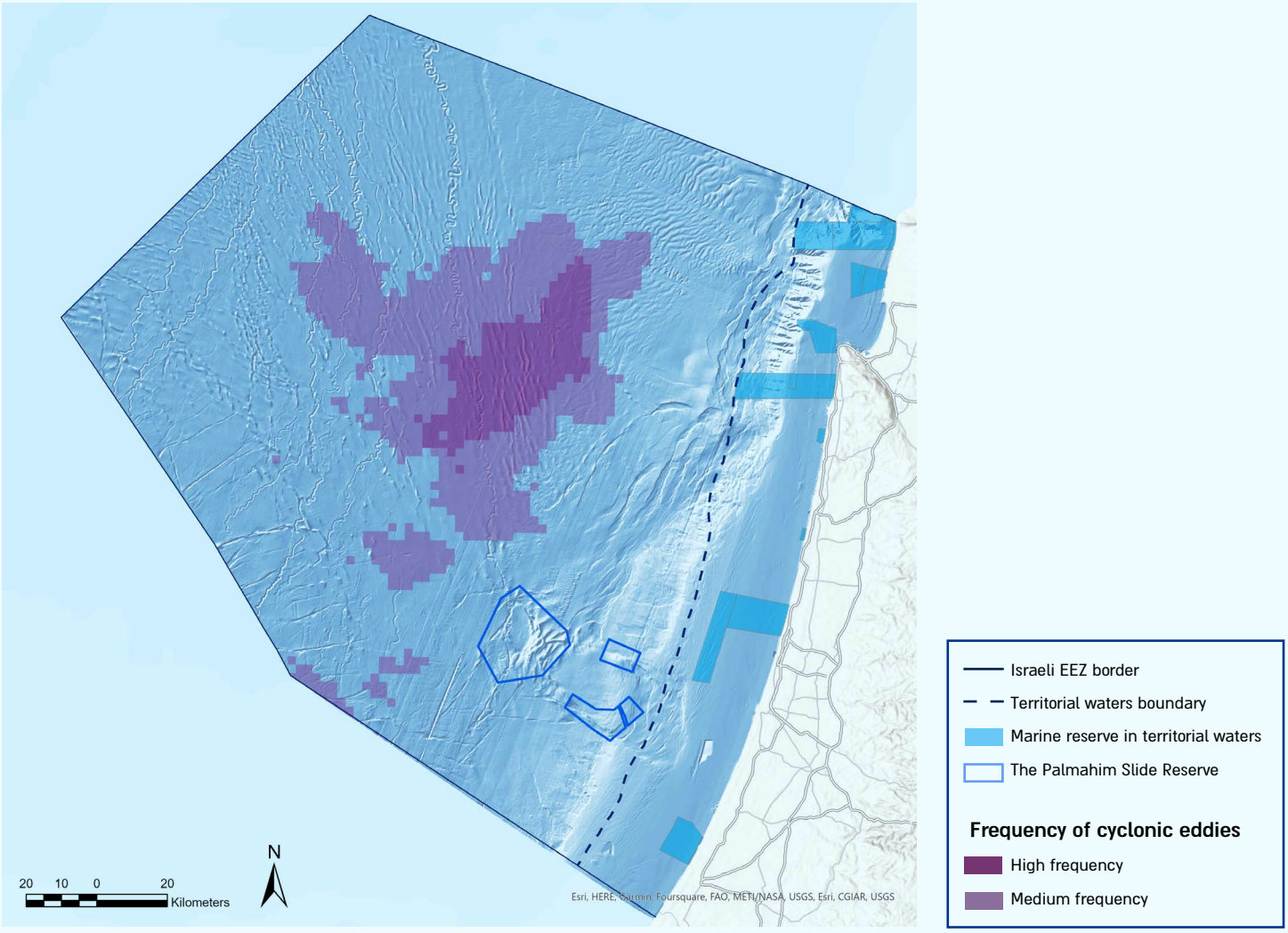
### 1. Unique Habitats

Vulnerable Marine Ecosystems (VME) are the focus of conservation efforts throughout the world. Several VMEs were found in the area of the plan: deep-sea coral gardens, soft sediment sponge aggregations, chemosynthetic systems, and carbonate rocks formed around cold gas (methane) seeps [25, 26, 43, 67]. Unique habitats, identified either through observation or a high probability of presence predicted by the model, constituted about 6% of the EEZ and were designated as a major conservation goal. These habitats were designated for conservation because they are characterized by structural complexity and rich biodiversity in the deep seas, or because they are relatively rare in terms of their distribution. Additional information characterizing the unique benthic ecological units and habitats can be found in Appendix 2.




The distribution of unique benthic habitats, is based on observations of habitats or indicative species (shown in dark blue) and on species distribution modeling (SDM). The darker color indicates a higher probability of presence, whereas light blue indicates a lower probability.

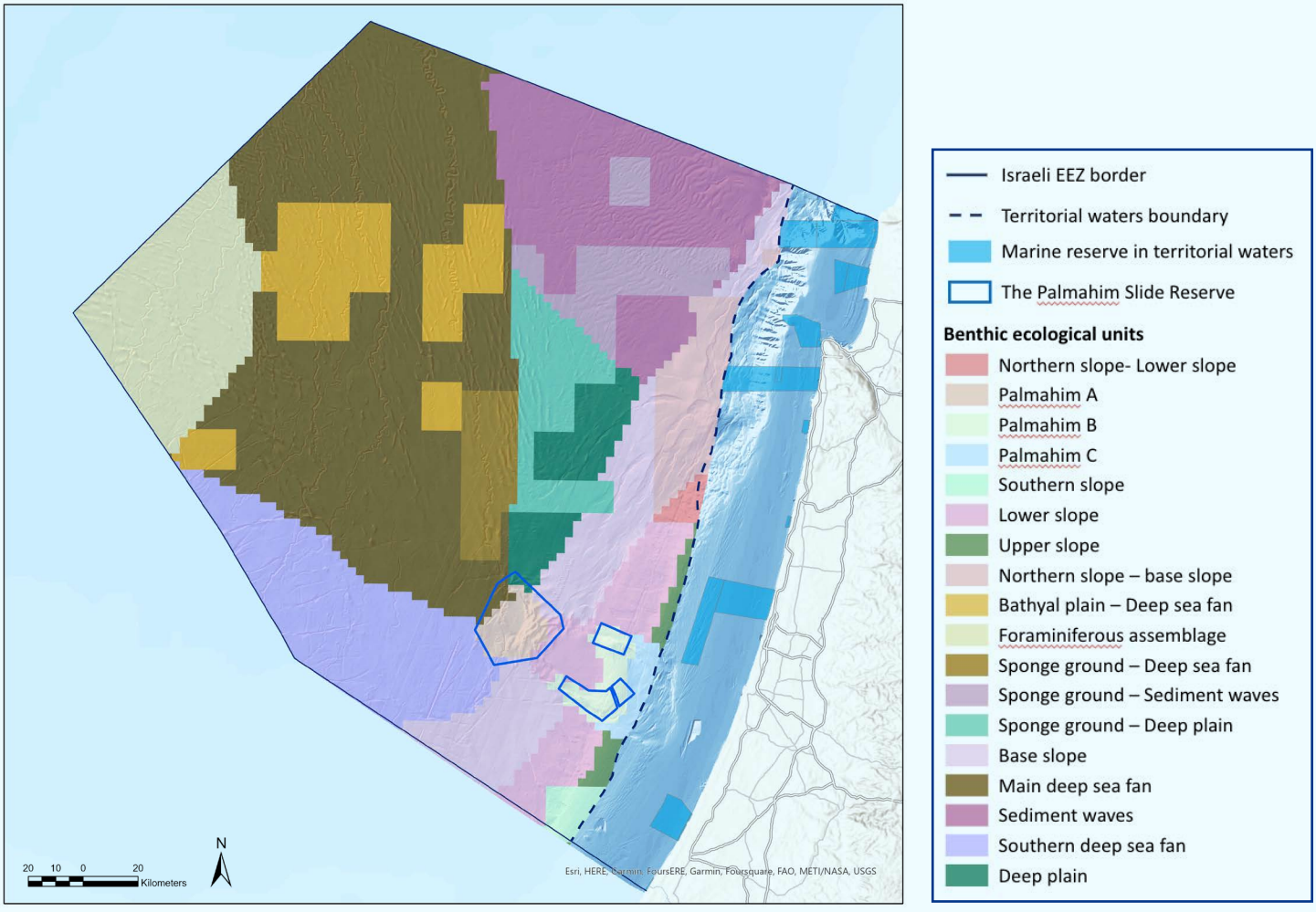
Unique habitats were also identified in the pelagic zone, where there is a high frequency of cyclonic eddies that are characterized by high levels of primary productivity and zooplankton biomass and are therefore targeted for conservation (Appendix 5).



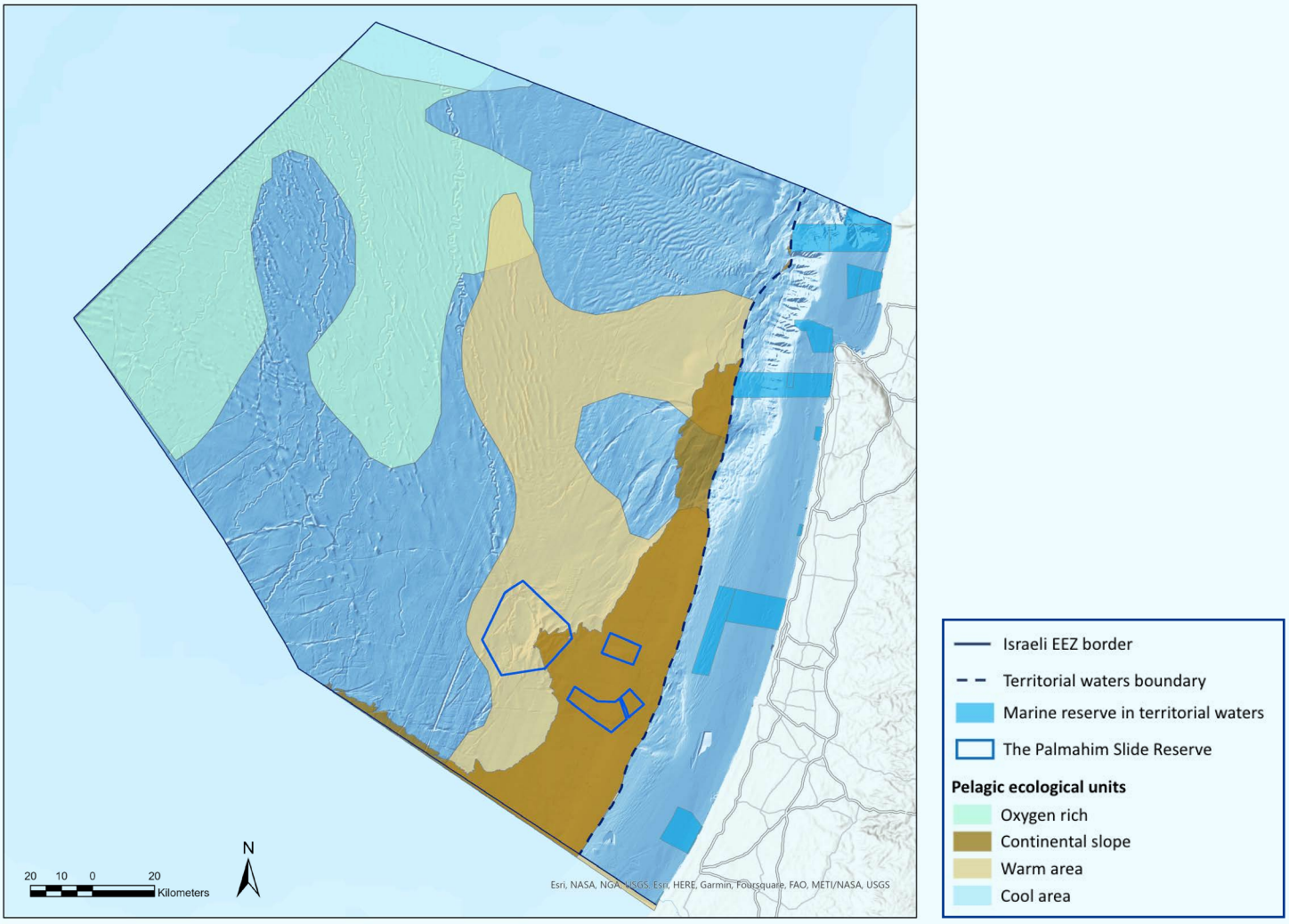

The frequency of cyclonic eddies in the EEZ: dark purple designates high frequency and light purple designates Medium frequency.

### 2. Representative Ecological Units

In Israel's EEZ there are more than 20 representative ecological units in the benthic and pelagic zones. These differ in terms of their biotic and abiotic characteristics, as determined through biological analysis of the findings, as well as depth, sediment, and geomorphological analyses. Extensive scientific literature supports the claim that these abiotic characteristics constitute extremely powerful predictor variables for benthic and pelagic biology, even in areas of huge-volume in the pelagic zone and in benthic soft substrate, which at first glance appear to be identical in nature [86, 87]. In order to preserve biodiversity in the area, a portion of each ecological unit must be protected, thereby ensuring their representativeness in reserves. For more details regarding the characterization of the ecological units, see Appendices 2 and 5.




**Benthic** representative ecological units in the EEZ (for a detailed list of units, see Appendix 2).




Characterized (in color) and uncharacterized (no color) **pelagic** representative ecological units in Israel's EEZ (Appendix 5).

### 3. Conservation Goals

Conservation goals for each habitat and each ecological unit were determined in consultation with the scientific committee; these were used as input for the Marxan tool and as a reference by the planning team, to assess the quality of the plan's spatial alternatives.

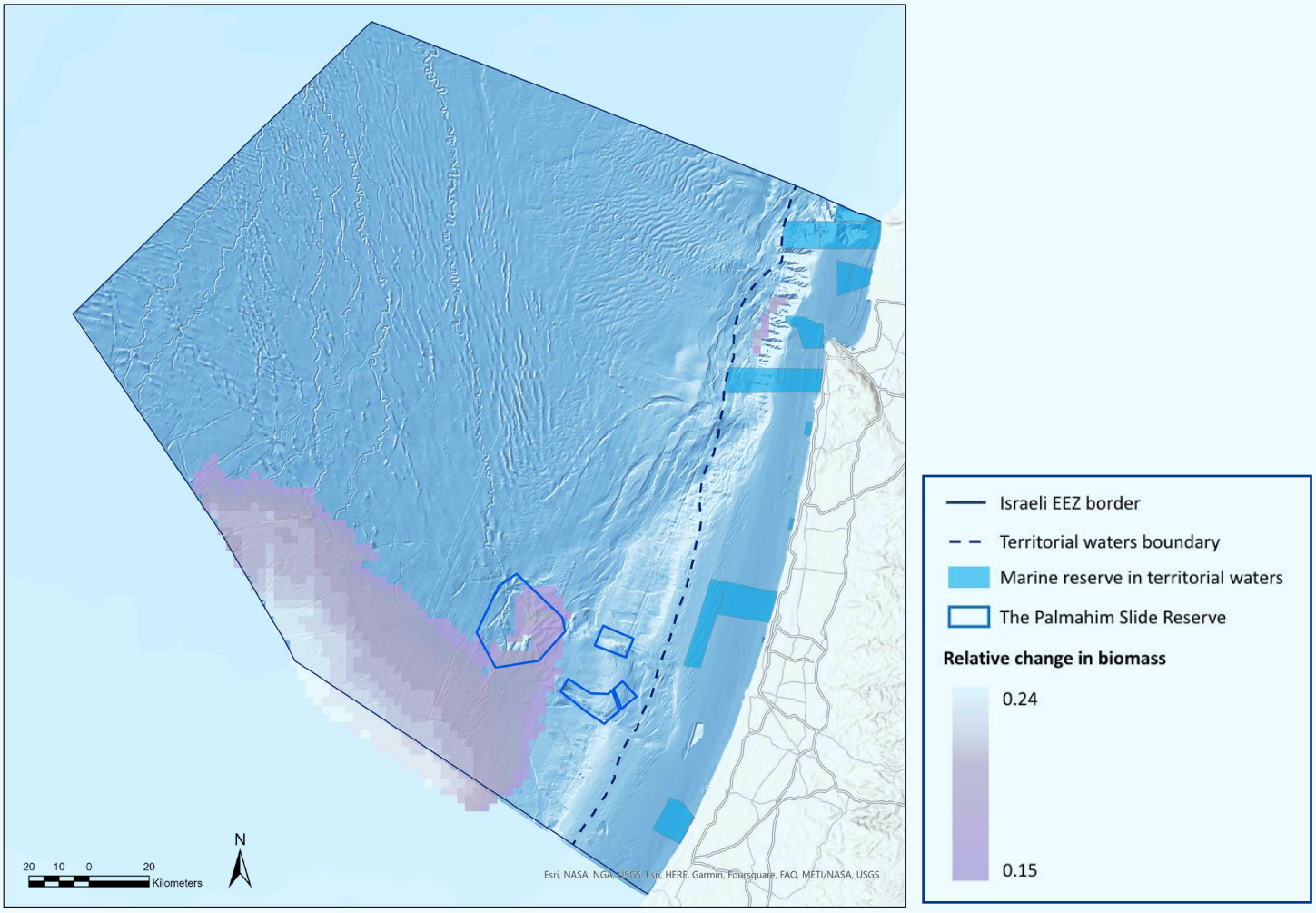
**Table 1: Conservation goals per ecological unit and habitat**

| Conservation Target | Conservation feature | Percentage of the EEZ area | Conservation goal (%) | Low-priority conservation goal (%) |
|---|---|---|---|---|
| **Benthic Representative Ecological Unit** | Bathyal Plain – Deep-Sea Fan | 7.0 | 30 | 20 |
| | Foraminiferous assemblage | 8.4 | 30 | 20 |
| | Northern Slope - Base Slope | 3.3 | 50 | 50 |
| | Northern slope- Lower Slope | 0.4 | 100 | 100 |
| | Palmahim A | 0.9 | 100 | 100 |
| | Palmahim B | 1.0 | 100 | 100 |
| | Palmahim C | 0.7 | 100 | 100 |
| | Southern Slope | 0.7 | 100 | 100 |
| | Sponge ground - Deep Sea Fan | 2.3 | 50 | 30 |
| | Sponge ground - Sediment Waves | 3.4 | 50 | 30 |
| | Sponge ground- Deep plain | 3.7 | 50 | 30 |
| | Base Slope | 7.2 | 30 | 20 |
| | Lower Slope | 4.3 | 50 | 30 |
| | Main Deep-Sea Fan | 31 | 20 | 10 |
| | Sediment Waves | 12.4 | 20 | 10 |
| | Southern Deep-Sea Fan | 9.4 | 30 | 20 |
| | Slope | 1.0 | 100 | 100 |
| | Deep plain | 2.8 | 50 | 30 |

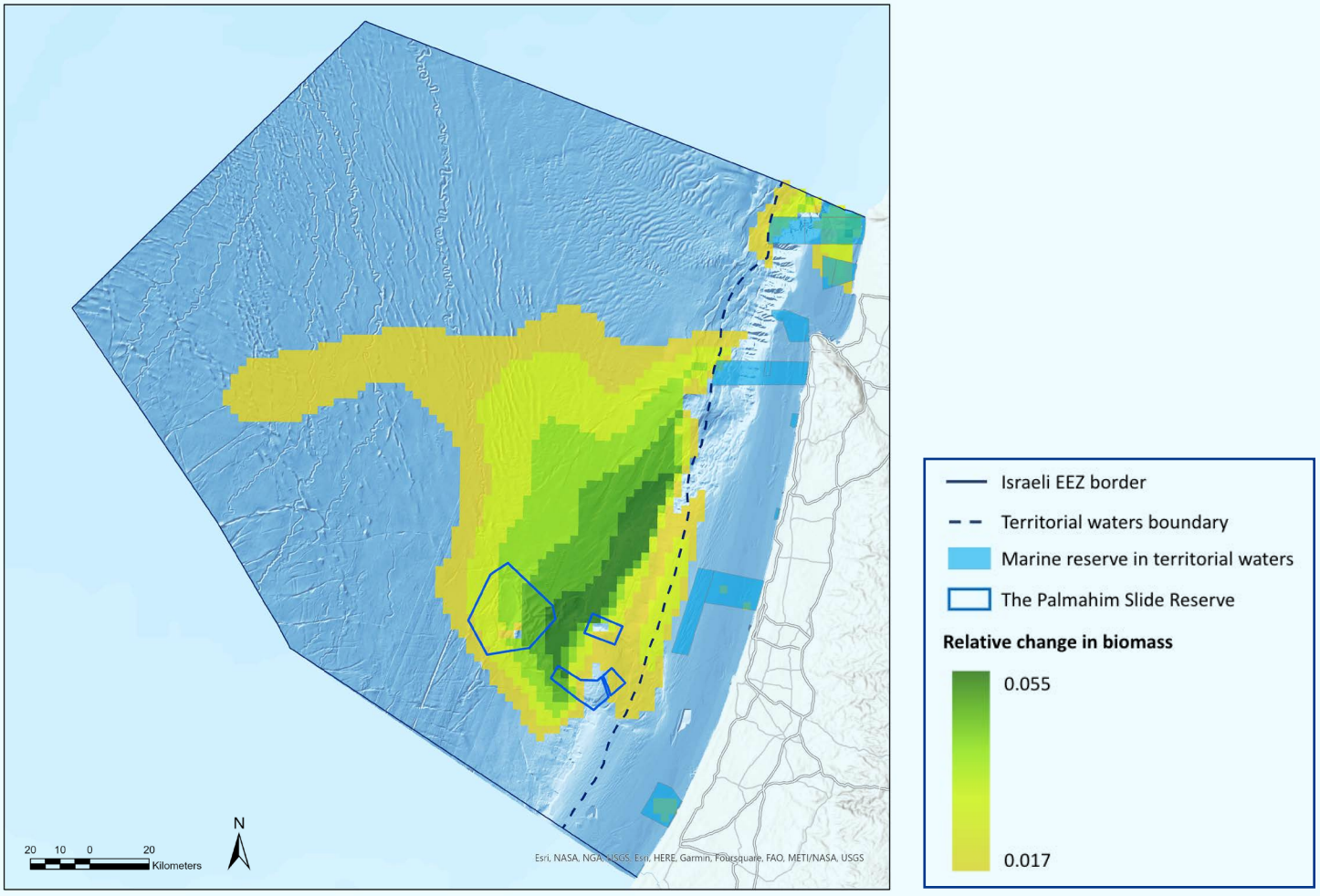
| Conservation Target | Conservation feature | Percentage of the EEZ area | Conservation goal (%) | Low-priority conservation goal (%) |
|---|---|---|---|---|
| **Unique benthic habitats** | Soft bottom sponge ground (prob. 0.7-1) | 0.38 | 100 | 100 |
| | Soft bottom sponge ground (prob. 0.3-0.6) | 1.6 | 60 | 60 |
| | Soft bottom sponge ground (prob.<0.3) | 11.2 | 30 | 20 |
| | Coral garden (prob. 0.7-1) | 0.1 | 100 | 100 |
| | Coral garden (prob. <0.7) | 2.2 | 70 | 70 |
| | Sea pen field | 0.1 | 100 | 100 |
| | Cold seeps (prob. 0.7-1) | 0.2 | 100 | 100 |
| | Cold seeps (prob. <0.7) | 1.6 | 70 | 70 |
| | VME indicator habitat (rock and pockmarks-0.7-1) | 1.2 | 100 | 100 |
| | Rock and pockmarks (prob. 0.4-0.7) | 1.8 | 50 | 30 |
| | Rock and pockmarks (prob. <0.4) | 10 | 30 | 20 |
| | Levant channel* | 3.3 | 20 | 10 |
| **Pelagic representative ecological units** | Pelagic slope | 11.5 | 20 | 10 |
| | Pelagic warm | 28.7 | 20 | 10 |
| | Pelagic cold | 4.8 | 20 | 10 |
| | Pelagic high Oxygen | 28.8 | 20 | 10 |
| **Unique Pelagic area** | Cyclone presence (0.7-1) | 4 | 100 | 70 |
| | Cyclone presence (0.4-0.7) | 23 | 50 | 30 |

### 4. The Food Web Model

Using the Ecopath with Ecosim (EwE) food web model to simulate the ecosystems in Israel's territorial waters and EEZ (Appendix 6) revealed a possible movement of local species to deeper and colder areas due to a rise in water temperatures, under the global warming scenario (RCP 8.5). Two sites were identified as potential climate refuge areas for local species, one of which is located in Israel's EEZ; hence, this site was prioritized for conservation. The model also revealed an area at the base of the continental slope where a significant increase in the biomass of local species is expected, under the RCP 8.5 global warming scenario and taking into account the protection of 30% of the area. Accordingly, the scientific committee recommended that also this area should be prioritized for conservation.



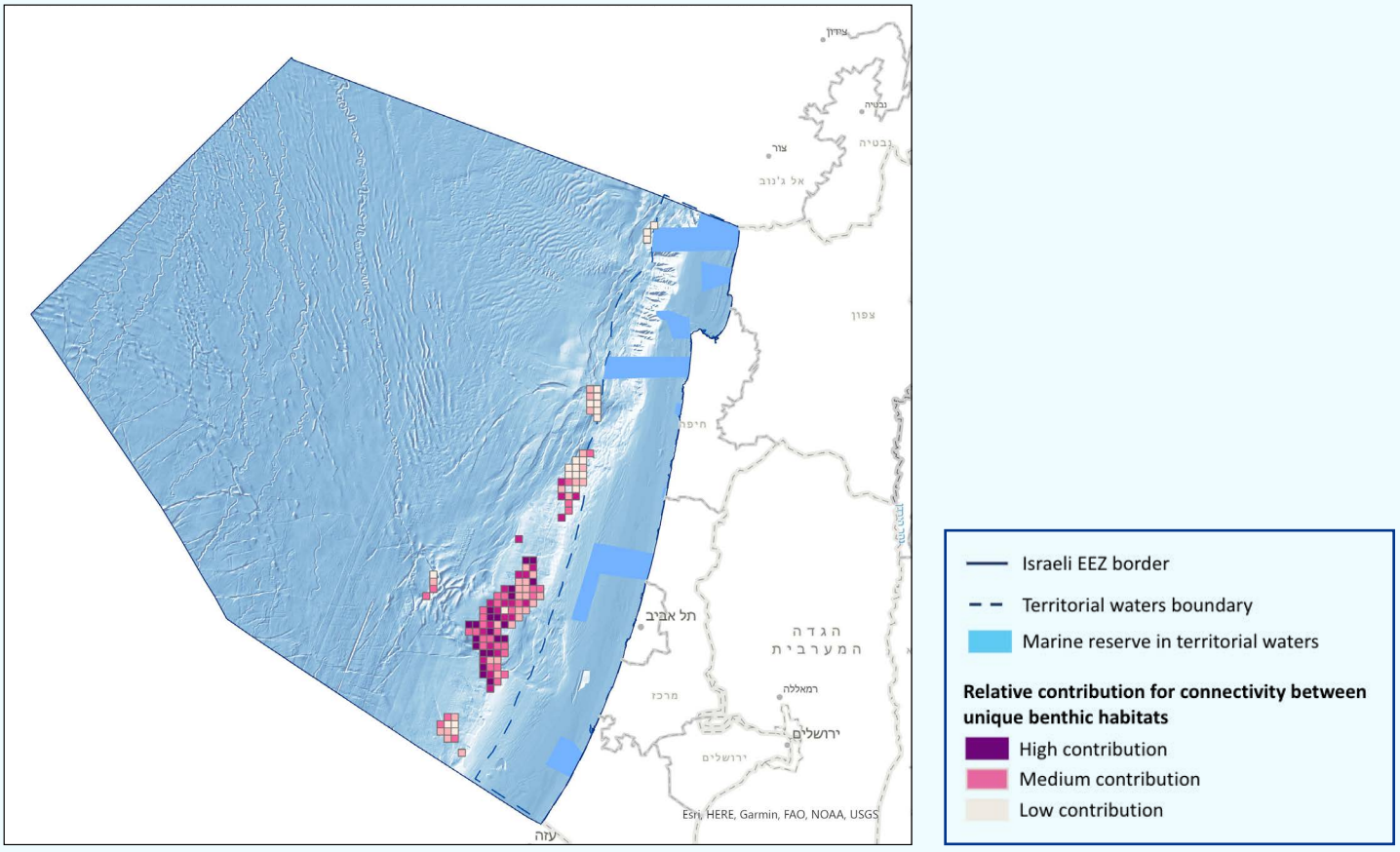

Potential climate refuge for local species, according to the EwE model. The figure shows a relative increase in local deep-sea species' biomass, under a global climate change scenario.




An area where an increase in local species' biomass is expected to occur in response to climate change combined with protection of the area, according to the EwE model.

**5. Connectivity**

Modeling unique benthic habitat connectivity revealed relatively poor connectivity between distant sites compared to a high degree of connectivity within sites. The scientific conclusion derived from this model is the need to protect all of the unique benthic habitats, until future research differentiates between source and sink sites, thus enabling a more precise description of the spatial conditions required to adequately protect these unique habitats.




דוגמה לקישוריות שחושבה בין בתי גידול בקרקעית שמופו על ידי שימוש במודל לתפוצת מינים אינדיקטורים לגני אלמוגים

Deep-sea-dwelling starfish in the order Brisngida that are adapted to live in the deep sea. The starfish have 6-18 long attenuated arms which which evolved and adapted for suspension feeding. This photo is assumed to be the first record of the species from the Eastern Mediterranean | Photo: Adam Weissman, Yizhaq Makovsky, University of Haifa


# "Do It Yourself" – Cold Seep Habitats and the Production of Chemical Energy

Energy independence is an asset. In unique sites in the deep sea, biotic communities have evolved, whose source of energy is not the sun, but rather energy-rich chemical substances, such as methane and sulfides, that seep through the ocean floor. Microorganisms produce energy from these substances in a process similar to that found in the plant world, that is, as primary producers (autotrophs) that use energy released from an inorganic source (inorganic chemical compounds) to build organic material.

These microorganisms use inorganic compounds such as sulfides, or hydrogen as the raw material in an energy-producing chemical reaction – chemosynthesis. The methane is also the source of the carbon used to construct the organic compound.

Using this autotrophic production process, a unique ecological community developed in and around the cold seeps, which differs completely from ecological systems that use sunlight as their energy source.

Some of the creatures that live in the cold seeps live in symbiosis with such organisms, "hosting" them as symbionts within their bodies, as for example do worms that host bacteria that produce energy from sulfides and mollusks that are hosts to methane-oxidizing bacteria.

Other creatures, such as sea urchins and crabs, feed directly on the bacterial mats, "grazing" the bacteria-covered rocks surrounding the cold seeps. Other animals, such as various types of fish, feed on these sea creatures, thus functioning as the heterotrophs in this system. In a radius of hundreds of meters surrounding the methane seeps live creatures like the blind Calliax (ghost) shrimp, which in the process of burrowing into the sea floor alter the texture of the sediment [43].

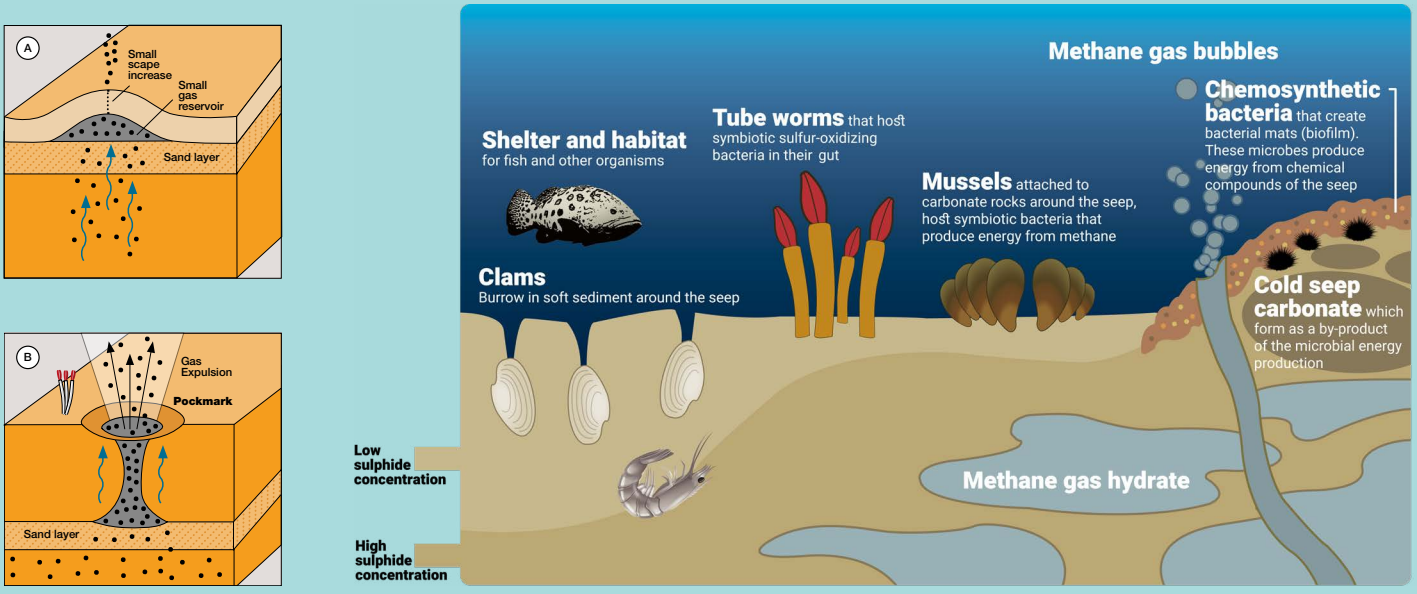
Gas seeps form oases of biodiversity in the deep sea, not only because they are a source of energy and organic substance, but also because they provide a solid substrate in an environment where the substrate is predominantly soft: the bacterial activity in the seeps creates crusty carbonate sediment. In other words, the chemosynthetic microorganisms are "ecosystem engineers." These biogenic rock formations (i.e., rocks created through a biological process) constitute an additional factor that contributes to the structural complexity of the environment and supports biological richness [4]. Moreover, the gas that seeps into the

water column influences the biochemical characteristics of the water above the seeps, so that the chemosynthetic ecosystem is actually three-dimensional.

Cold seeps can manifest in different forms: as bubbles infiltrating through the seabed, pockmarks, mud volcanoes, brine pools, etc. [43]. When the gas seeping ceases, the composition of the surrounding seawater regains its balance and typical composition, at which point many new and different types of creatures, which are not part of the chemosynthetic biosystem, for example deep-sea corals, can settle on the crusty rock formations, creating a new ecological community. These newer communities take advantage of the solid sediment created by the seeps, yet they feed on "marine snow" and energy sources unrelated to the chemosynthetic system.

## Pockmarks

Pockmarks are a geomorphological element found mostly along the basis of the continental slope; the Big Juba in the Odem Forest of the Golan Heights is reminiscent of pockmarks in terms of its formation process and shape. These are topographical indentations that form in areas where seeps of gas slightly push up the fine-grained ocean floor creating a small pocket of highly-pressurized gas. The seeping gas prevents any sediment from falling directly into the cavity that formed. Thus, the diameter of geological pockmarks can range from 1 m to hundreds of meters and reach a depth between 1 to 10 m. Around the pockmarks there is often a flourishing of chemosynthetic biosystems and communities that accompany them are found in the range of several kilometers around the seepage. In the Western Mediterranean Sea there have been reports of communities of deep-sea corals, sea pens, and fish surrounding these sites [43].




Left: Diagram depicting the formation of a pockmark [43].
Right: A schematic depiction of the ecosystem found at cold seeps in the deep sea | Figure adapted from https://www.sciencelearn.org.nz/resources/475-cold-seep-communities. Science Learning Hub – Pokapū Akoranga Pūtaiao, University of Waikato

*Lamellibrachia anaximandri* worms found at cold seep sites at the Palmahim disturbance | Photo: Adam Weissman, and Yizhaq Makovsky, Haifa University.

The Calliax shrimp burrowing into the sediment surrounding the cold seep | Photo: Oz Rittner.

Diving Deep

# Eddies as a Unique Ecological Unit

The sea is an enormous body of water that is in constant movement, which most typically takes the form of currents. Circular currents that are offshoots of the main current are called eddies. The formation of eddies is one of the reasons for the lack of uniformity in the water column, creating ecologically distinct areas.

The direction of the water flow in the eddies determines whether it will cause cold and nutrient-rich water to rise from the ocean floor (upwelling) or if it will push warm and nutrient-deficient water from the surface towards the ocean floor (downwelling). In the northern hemisphere, upwelling is caused by counter-clockwise cyclonic movement and downwelling is caused by clockwise anticyclonic movement.

The direction of the circular movement of the water current of the eddies has an ecological effect:

--Cyclonic eddies have a cold core and cause upwelling, bringing nutrient-rich water to the surface, which thus became available to primary producers (tiny algae) that live in the relatively nutrient-poor top layer of the sea. As a result, there is an increase in primary productivity, which increases the biomass of zooplankton that feed on primary producers[8].

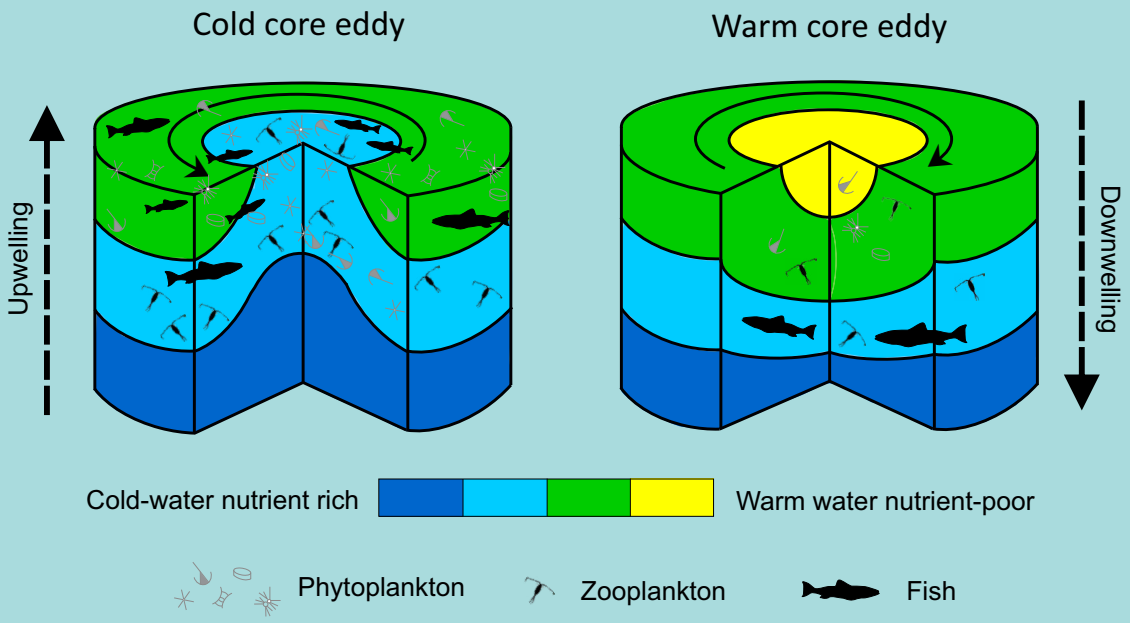
--Anticyclonic eddies have a warm core and cause downwelling; small creatures get caught in the eddies, which thus become an attractive area for predators, as they have easy access to prey from various depths, which has been trapped in the eddy[5].

While some eddies last days, others can last months of even years; regardless, they do not remain in one place for the entire time, but rather they move hundreds and even thousands of km through the ocean space. The diameter of an eddy can also change and span hundreds of km. The location and direction of eddies is relatively easy to detect from space using sensors, which enables their mapping and the identification of areas where they are a relatively common occurrence.

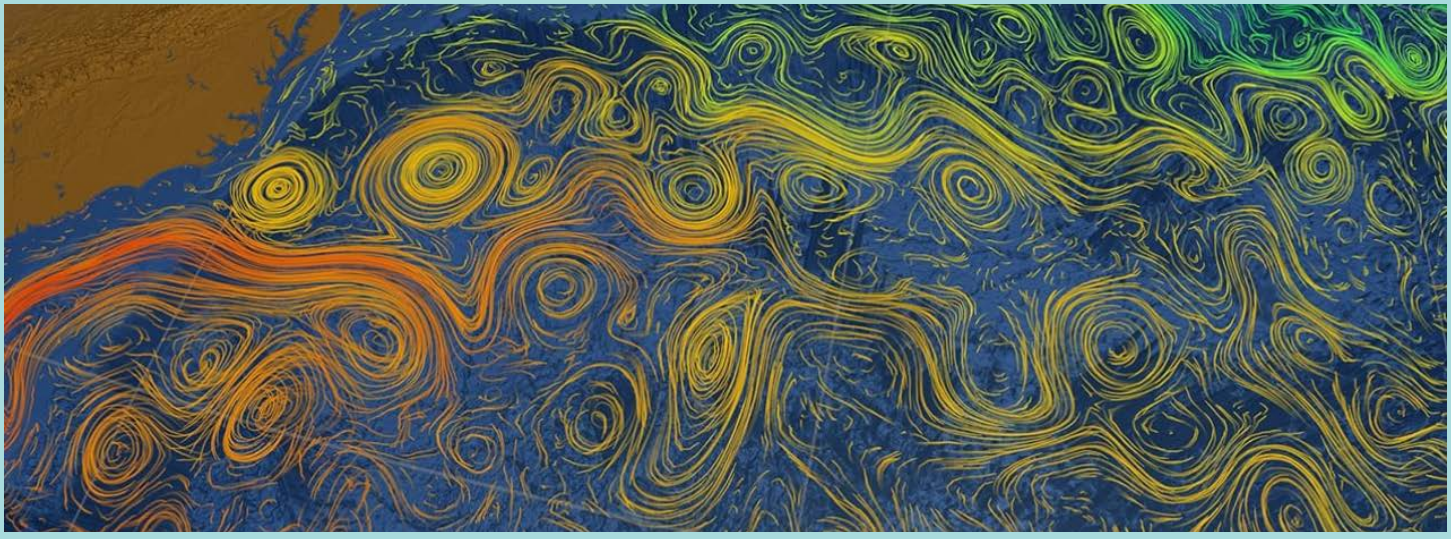
Marine areas where primary productivity is high, such as frontal zones and eddies, are prioritized for conservation throughout the world, because primary productivity is the base of the food web[83].

In the eastern Mediterranean Sea, an area that is relatively nutrient-poor, primary production areas such as cyclonic eddies are extremely important. Hence, in the Master Plan, 50% of the areas with a high incidence of cyclonic eddies were included in the proposed reserves.

Protecting areas where there is a high incidence of anticyclonic eddies is a way to directly protect the predators in an ecosystem and their feeding areas.




On the left: a cold-core eddy creates an upwelling, bringing up nutrients from the sea floor, which leads to a flourishing of algae and a biomass increase in zooplankton in the top layer of the sea; on the right, a warm-core anticyclonic eddy causes downwelling, which leads to a paucity of nutrients in the top water layer. Gilboa et al.[30]



Eddies in the ocean as seen from space: circular currents that detach from the main current. NASA/Goddard Space Flight Center Scientific Visualization Studio

# C. The Basic Planning Layer – Mapping the Socioeconomic Activities

Mapping of the existing and planned human activities is a basic and significant part of the Master Plan for Marine Nature Reserves in Israel's EEZ. This information will help determine how these activities can be integrated into the conservation efforts in terms of spatial overlap. Accordingly, the planning team took the following two steps.

**A. Formulating an activity profile of the area –** this involved the collection, analysis, and mapping of spatial information regarding the existing and planned economic activity in the area, such as the exploration and production of gas and oil, the search for renewable energy sources and the related experimentation, as well as fishing, sailing, and security-related activities. All of the data gathered were assembled in geographic layers, representing the location, scope, and frequency of each existing, planned, and potentially viable economic activity in the EEZ.

**B. Evaluating the economic activity –** this involved classifying the various activities of each sector in relation to their importance to the national economy and the degree to which they are compatible with nature conservation needs. Accordingly, each activity was assigned a numerical value, which was uploaded to the Marxan software program. These values, together with the ecological information, were used to develop the proposed conservation profile.

## C.1. Formulating an Activity Profile

Although the deep-sea is distant and relatively unknown, the human footprint has already affected this area. In Israel's EEZ there are already ongoing activities involving exploration, production, and transportation of fossil fuels, as well as shipping, fishing, security-related activities, research, sailing, etc. Furthermore, additional activities are currently under consideration, involving solutions for renewed energy, aquaculture, and other future uses, some of which we cannot even predict.

Given the difficulty of assessing and mapping future uses, which we cannot yet describe, the guiding principle that was used to formulate this activity profile encompassed only current uses or those planned for the near future.

Another principle was to take a broad approach that extends beyond the boundaries of Israel's EEZ, to consider also the profile of activities in the bordering marine areas of Cyprus and Lebanon. The reason for this is that marine boundaries are permeable and it is likely that activities occurring in bordering zones will have some effect on Israel's EEZ.

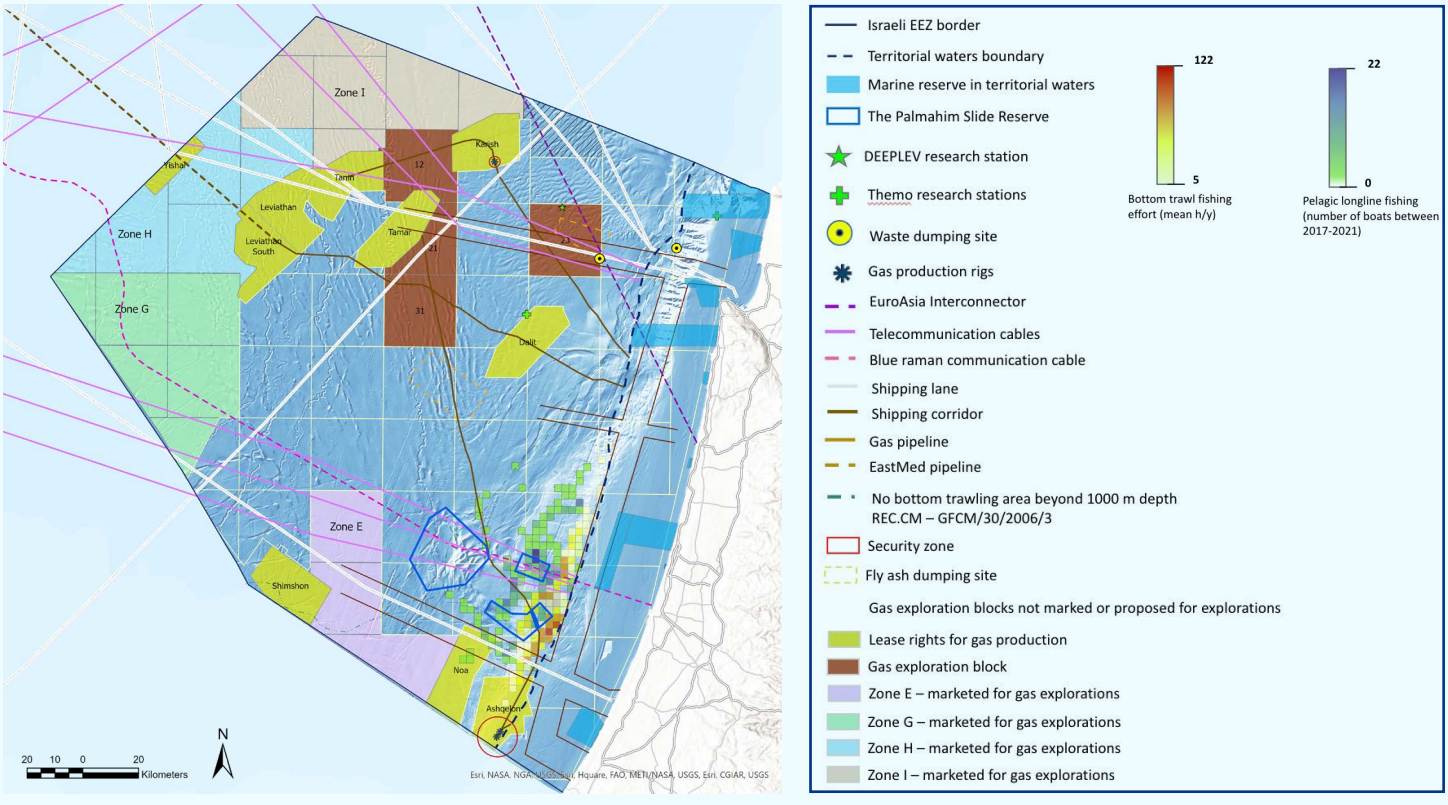
Hence, the activities included in this profile were those about which there was sufficient information to enable their mapping. **At the end of the process, a comprehensive aggregate map was generated, based on all of the uses mapped.**

The data were collected from several sources, among them, meetings held with regulators in Israel and Cyprus;

interviews with representatives of academic research institutes and with entrepreneurial companies; source data from academic studies; the database that was used to prepare the Maritime Policy for Israel's Mediterranean Waters; and data acquired from non-Israeli sources, for example pertaining to shipping activity and wind data in the relevant neighboring EEZs.

The data were collected from all of the sectors active in Israel's waters and adjacent areas; however, due to constraints related to information security or the specific time and date of the activity, not all of the data were uploaded into the Marxan tool. Nevertheless, information that was not included in Marxan, for example, initiatives to plan future infrastructure development or the intention of the Ministry of Energy to prioritize the licensing of hydrocarbon exploration in the sea, was considered in the planning stages and examined alongside the Marxan results, so that the final Master Plan took into account all of the spatial information collected.

As mentioned, all of the data were assembled, analyzed, and mapped to the location, scope, and frequency of each existing, planned, and potentially viable economic activity in the EEZ. A detailed account of the collected layers of information presented according to the various sectors can be found in Appendix 7.




A comprehensive and integrative map of the existing and planned socioeconomic activity in Israel's EEZ.

# C.2 Assessing the Economic Activity

The economic activity assessment was based on a classification of the activities in each sector according to their importance to the Israeli economy and the degree to which each activity coincided or conflicted with the conservation goals. Accordingly, each activity was assigned a value and these were uploaded to the Marxan program. The assigned values not only provided ecological information but were also used to formulate the proposed conservation profile.

This methodology is based on accepted assessments presented in the professional literature, which described planning processes using the Marxan tool in Israel's EEZ [51]. This process includes the following three stages.

1. **First, classification of the uses of marine areas according to their importance and contribution to the Israeli economy.**

This economic classification is based on Israel's official policy document regarding the EEZ, which prioritized the sectors of shipping, hydrocarbon production, and security, given their strategic significance for Israel and the need to ensure their optimal functioning in the future. In geopolitical terms, Israel is an island country and its dependence on maritime commerce is crucial. Approximately 99% of Israel's commerce is via the sea. Israel's ports are approximately one-day's sail from the Suez Canal, which underscores the potential for increasing the transshipment activity in Israel's ports, whereby transshipment could become their major function.

The approach that was prevalent during the formulation of Israel's EEZ policy document was that hydrocarbon production was economically and strategically important to Israel as it can ensure an independent energy source and the ecological advantage of reducing air pollution. Nowadays, this approach needs to be revisited more comprehensively, taking into account the allocation of future gas production (for local use and or export), the types of fuels it can replace, and the economic and climate -related significance of these fossil fuels (natural gas is a powerful greenhouse gas with a strong effect on the climate, whereas the expectation is that the world will transition to renewable energy sources and the use of fossil fuels will be highly taxed).

Defending and protecting the sea area from potential threats to marine infrastructure and from the activities of the various economic sectors is what will enable economic activity in the EEZ. Israel's dependence on shipping as the only gateway for the import and export of produce and fuels, as well as its dependence on natural gas as an energy source in the short term, highlights the importance of guaranteeing security and marine defense.

The value indicating the importance of socioeconomic activities in the Marxan model used a scale from 1 (low importance) to 6 (high importance). It should be emphasized that the level of importance reflects a conservative economic view, rather than the view of either the SPNI or the consulting teams that partnered with us for this project.

2. **Second, determining whether the economic activity or marine spatial use conflicts or coincides with the marine conservation goals.**

The degree of correspondence to the marine conservation goals was assessed qualitatively (yes/no) in terms of spatial use rather than the activity's impact on habitats, because of the insufficient quantitative data and knowledge about the effects of a given activity on benthic and pelagic

14. https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1591

habitats. For example, the scientific literature has clearly demonstrated the effects of drilling for carbon production on benthic and pelagic habitats (during routine times and in the event of a leakage); hence, this activity was defined as incompatible with marine nature reserves, even though its effect on the various habitats may differ. Other activities, such as laying communication cables, can take place alongside nature reserve areas (provided that the work is coordinated, the habitats' vulnerability and location are taken into account, and alternatives are sought).

It is important to note that the assessment of the economic activity was determined in relation to the nature reserves as a sea use with defined spatial distribution, but not in relation to the specific habitats adjacent to the activity areas. Thus, for example, no distinction was drawn between trawl fishing and hydrocarbon production; rather, both categories were determined to be inappropriate in proximity to a marine nature reserve area.

Sites where the economic activity was classified as highly important but also contradicted the conservation goals, e.g., sites where there was active hydrocarbon drilling, were excluded from the selection of potential reserve areas ("locked out" in Marxan terminology). This step was taken not because sites were inappropriate for conservation but rather because they were already located in active gas production areas. Furthermore, with the exception of activities already in the planning phase, such as specific communication cables, future activities and uses were not included in the Marxan tool for a number of reasons, among them the absence of accurate spatial information regarding the location of such activities and the insufficient information regarding the likelihood of the plan being implemented or of policies being changed.

3. **Third, determining which activities correspond to the conservation goals and can coexist spatially alongside a marine nature reserve and then classifying them, taking into account both the economic importance of the activity and its correspondence to the conservation goals.**

The classification scale was determined qualitatively as either low, intermediate or high. Sites with little economic activity were assigned a value of 10, those with intermediate-level activity – a value of 100, and those with intensive activity – a value of 1000. The overall cost of a planning unit was defined as the sum costs of the economic activities within that unit. The cost per unit was also classified (on a scale of low medium and high), to differentiate areas with high cost, and guide the Marxan program to avoid selecting these units. The assigned composite values uploaded to the Marxan program were only for those area cells that had economic activity in one of the model's scenarios.

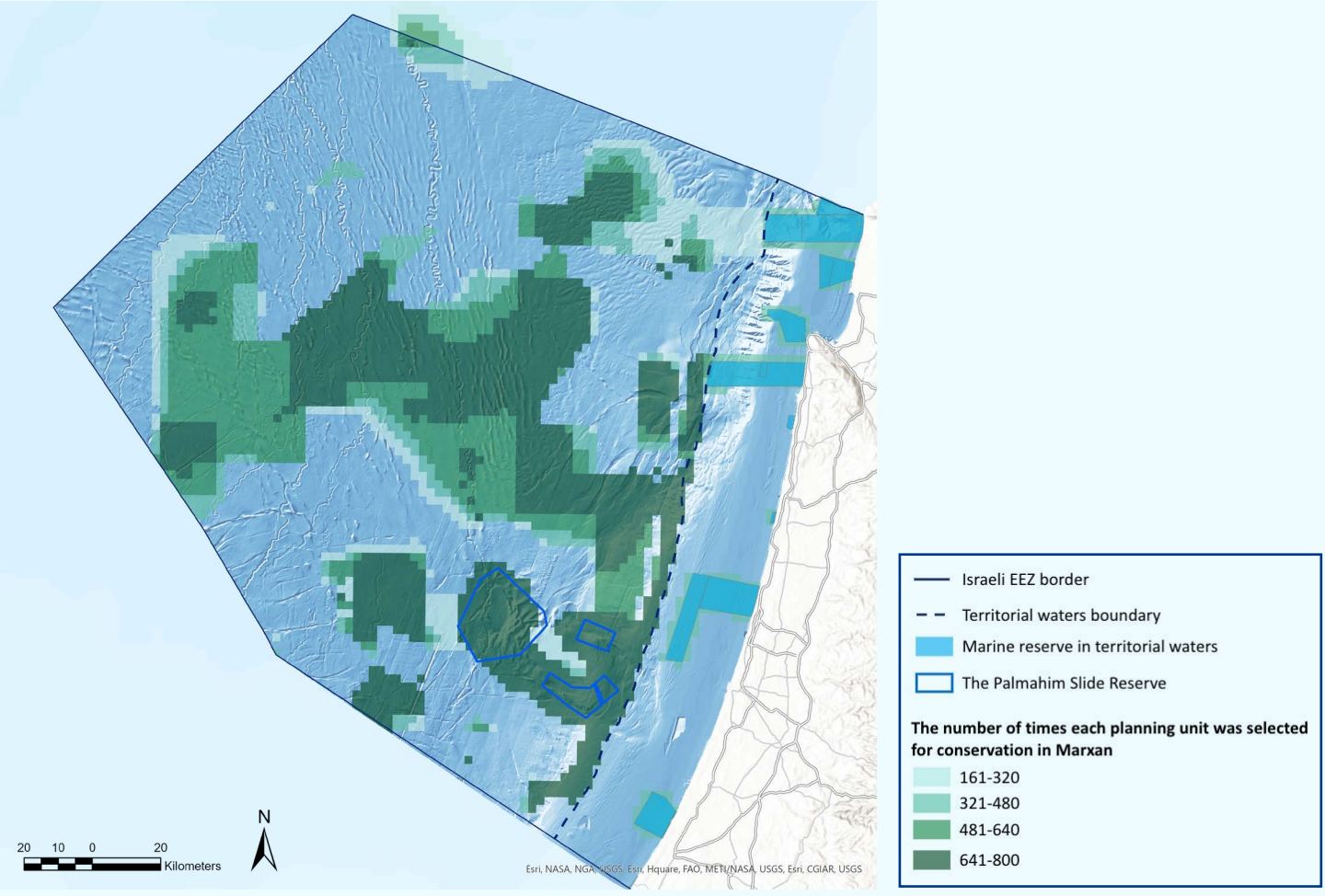
The following table presents the assessment of the economic activity for spatial conservation prioritization using the Marxan tool. Areas in which existing activities are incompatible with the goals of marine nature reserves were not considered for conservation and were defined as "locked-out."

| Sector | Existing activity | Future activity | Socioeconomic importance | Coincides with conservation goals | Assessed cost—composite value |
|---|---|---|---|---|---|
| **Hydrocarbon production** | Inactive wells | | 1 | No | locked out |
| | Active wells | | 6 | No | locked out |
| | Past experimental drillings | | 1 | Yes | Low |
| | Rigs for treatment and production | | 6 | No | locked out |
| | Exploration licenses | | 5 | Yes | Medium |
| | Lease rights | | 6 | Yes | High |
| | Natural gas pipeline | | 6 | Yes | High |
| | | Fourth bid for gas explorations—Phase 1 | 4 | Yes | Future activity – not uploaded |
| | | Fourth bid for gas explorations – Phase 2 | 3 | Yes | Future activity – not uploaded |
| | | Exploration Blocks | 2 | Yes | Future activity – not uploaded |
| | | EastMed pipeline | 6 | Yes | Future activity – not uploaded |
| **Shipping and maritime commerce** | Shipping lanes | | 6 | Yes | High |
| | | Alternative north-south shipping lanes | 6 | Yes | High |
| | Density of shipping lines | | 5 | Yes | Medium |
| **Security** | Areas enclosing strategic infrastructure | | 6 | No | locked out |

| Sector | Existing activity | Future activity | Socioeconomic importance | Coincides with conservation goals | Assessed cost—composite value |
|---|---|---|---|---|---|
| **Fishing** | Trawl fishing | | 1 | No | Low |
| | Pelagic fishing | | 1 | No | Low |
| **Communication infrastructure** | Existing cables | | 6 | Yes | Low |
| | | BlueRaman subsea cables | 6 | Yes | Low |
| | | EuroAsia interconnector power lines | 6 | Yes | Future activity –not uploaded |
| **Marine pollution** | Waste deposit site | | 4 | No | locked out |
| **Renewable energy** | | Area with wind potential | 5 | Yes | Future activity –not uploaded |
| **Research** | THEMO monitoring system | | 4 | Yes | Low |
| | DEEPLEV buoy | | 4 | Yes | Low |

# C.3. Spatial conservation Prioritization Using the Marxan Tool

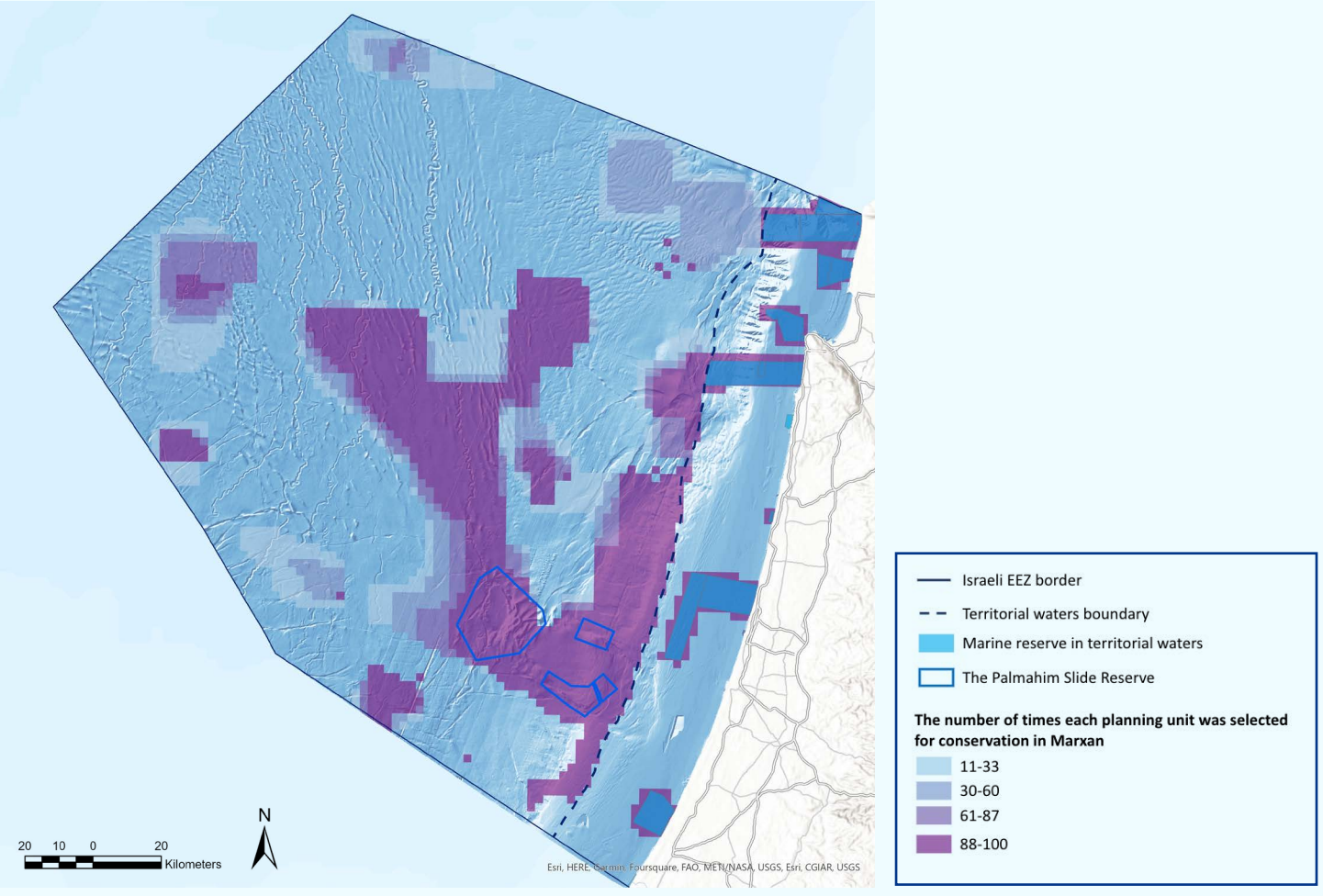
Marxan is an instrument for prioritizing areas for conservation, which is widely used throughout the world. Developed to assist in the planning of nature reserves, it offers spatial solutions for compact nature reserves with only a minimal socioeconomic cost but representing all of the elements of the biological diversity as well as the structural and functional components of the ecosystem in a given area. The ecological layers (Appendices 2 and 5), the conservation goals, and the layers of socioeconomic activities in the area (Appendix 7) constitute the program's input files. Given the need to create a continuum with the protected areas in the territorial waters, all of the areas marked and documented for conservation in the territorial waters were included as "locked-in" areas.




Outcome of Marxan's initial runs. The consensus areas that had the highest incidence of prioritization for conservation (i.e., as a percent of the solutions in which the planned unit was selected for prioritization)

The Marxan analyzed hundreds of different spatial solutions and the outcome of the spatial prioritization identified the best selection in terms of achieving the conservation goals at the lowest cost. The results also present the number of times each planning unit was prioritized in all of the scenarios and runs, thus enabling the identification of "consensus areas," (i.e., those that were prioritized the greatest number of times), which together provided a framework for the planning of the nature reserves. Additional details describing the work methods applied when using the Marxan program and an elaborate description of the results can be found in Appendix 8.

The initial run was followed by an updated run of the Marxan, to obtain more precise results, taking into account changes that occurred during the planning stage, such as changes to the marine border with Lebanon per the signed agreement, the gas companies' decision to forfeit the search permits pertaining to certain areas, and the discovery of gas reservoirs in other areas. Details of the updated run of the Marxan can be found in Addition 1 to Appendix 8).




Outcome of Marxan's updated run, with spatial adjustments for the Lebanese border, the newly discovered gas reservoirs and the areas for which the search permits were forfeited

# D. Formulating a Draft of the Master Plan

## The Planning Principles

In accordance with the background materials previously described:

Using the background document and the planning principles that are based on global scientific knowledge, as well as the basic ecological layers, the socioeconomic layers and the Marxan outcomes, the planning team formulated the following spatial principles for drafting the Master Plan:

**1. Spatial Principles Implementing the Outcomes of the Project's Ecological Analysis**

a. Inclusion of areas that were identified in Marxan's updated run as having the highest incidence of prioritization for conservation—thus minimizing the conflict between conservation and socioeconomic uses of the area--and integrating into the Marxan outcomes the factors of high ecological significance and high viability for the preservation of vulnerable habitats.

b. Inclusion of units assigned high prioritization values based on the team's analysis, which accounted for both socioeconomic importance and correspondence to the conservation goals.

c. Maintaining the conservation goals for each ecological unit, as defined by the scientific committee.

d. Inclusion of units identified in the food web and connectivity analyses.

**2. Eco-spatial Aspects**

a. The spatial scope – A comprehensive area of nature reserves extending over 30% of the EEZ, as specified in the goals of the Convention on Biological Diversity and the Barcelona Convention, including adequate representation of habitats and maximum protection of rich and unique habitats.

b. Minimum area for nature reserves: preference for highly functional marine reserves in a minimal continuous 100 $Km^2$ (Appendix 1,[22]).

c. Three-dimensional protection.

d. Connectivity—Preferably over a maximum distance of 50-100 Km between the reserves (Appendix 1).

e. Preference for simple, regulated polygonal shapes, which can be easily defined, marked on navigation maps, maintained and supervised.

f. Adaptability to climate change – preference for nature reserves that encompass a variety of depths and habitats, as the variety is an indication of potential future optimal functioning of the reserve (resilience and resistance), should climate changes cause changes to species distribution.

g. Preserving the potential for future expansion of the area to encompass transboundary marine protected areas.

**3. Eco-spatial Aspects Overlapping with Human Activity in the Sea**

a. Adjusting to human uses and activities in the sea—seeking to minimize conflicts between human activity and conservation goals, taking into account the activity's national socioeconomic importance and its effects on the ecological functioning of the nature reserves.

b. Spatial updates (that took place after the initial run of the Marxan program and were included in the subsequent run): the discovery of new natural gas reservoirs (blocks 12, 23, 31); the forfeiting of search permits (for areas A, C, D); amendments to the Israel-Lebanon marine border per the new agreement.

c. Principle for managing spatial overlaps between the nature reserves and the search and production of natural gas: as long as the habitats can remain protected:

1. Preferably defining alternative reserve locations to those identified in the Marxan analysis but which coincide with areas designated by the Ministry of Energy for natural gas searches and production.
2. In the areas designated in the fourth bid for natural gas explorations, nature reserves can be proposed, with a preference for equivalent habitats in alternative areas, if at all possible.
3. Overlap with areas where gas-production activities are already established should be avoided. Nature reserves can be defined only in sites where the production has ended and the reservoirs have been emptied (as there the wells have been sealed, no drilling is expected and activities involve only the maintenance of treatment of the infrastructure).
4. Exploration license blocks where new reservoirs have been found—overlap with these should be avoided, as they are expected to be occupied for drilling and related gas-production activities (blocks 12, 23, 31). In case there are unique habitats in such areas, attempts should be made to negotiate with the Ministry of Energy for the exclusion of the habitat areas from the permitted search or production areas.

d. Principles for handling spatial overlaps between ו. the nature reserves and the laying of pipelines—such overlap poses no problem for nature reserves, regarding either existing or future lines (for transporting gas, electric or communication cables). Only overlap with pipelines transporting fossil fuels should be avoided, as far as possible.

e. Principles for handling spatial overlaps between the nature reserves and shipping routes—overlap with routes of maritime commerce is not entirely prohibited but should be minimized, as much as possible.

f. Adjusting to the future trends and goals of economic sector activities in the EEZ:
   1. A substantial reduction in the activities of the natural gas sector is expected in the EEZ, given the global goal of reducing greenhouse gas emissions, which Israel adopted, agreeing to transition to a low-carbon economy and zero-carbon emissions by 2050, and the desire to avoid potential economic fines.
   2. Bottom trawl-fishing is also expected to wane, given the spatial restrictions imposed by Mediterranean regulations and the recommendations included in a marine vision and policy statement [94], which calls for the gradual elimination of this fishing method.

**4. Aspects of Spatial Flexibility and Updating**

a. The proposed polygonal shapes are defined as search areas for potential marine nature reserves, that is, areas where spatial boundaries must be precisely defined, according to surveys performed, followed by research verifying the existence and distribution of habitats. The final boundaries of the nature reserve areas may require an expansion or reduction of the polygons defined in the Master plan.

b. If further surveys or research indicate the ecological importance of additional areas, changes to the spatial layout of the search areas defined in the Master Plan for Establishing Marine Nature Reserves will be considered.

c. If substantial changes occur in the level and distribution of human activity, changes to the spatial layout of the search areas proposed in the Master Plan

for locating representative habitats will be considered, in accordance with the planning principles.

d. As the marine spatial plan for the EEZ progresses and takes into account the comprehensive balance of all the marine uses, the spatial layout of the search areas as proposed in the Master Plan will be re-examined.

e. If there is a proposal to establish transboundary marine protected areas in the eastern Mediterranean, the spatial layout of the search areas may be reconsidered.

# E. Formulating the Final Marine Spatial Plan

The process of formulating the Marine Spatial Plan involved an examination of several alternative locations that may be suitable for establishing the marine nature reserves. The proposed locations were selected based on the highest incidence of prioritization for conservation according to the Marxan analysis and on the analyses performed using three additional planning instruments. The first of these examined whether the locations correspond to and allow for the application of the defined planning principles (described herein); the second examined whether the locations allowed for the human uses of and activities in the EEZ while aiming to minimize potential conflicts; and the third examined whether the locations coincided with the analyzed hierarchy of conservation importance, which represents the habitat conservation goals defined by the scientific committee.

The various options for situating the nature reserves were critically reviewed in terms of their resulting spatial suitability, considering the habitat conservation goals, the intended size of the reserves, the distances between them, and the existing and planned human activities in the EEZ. The spatial alternative that was most suitable on all of the parameters was presented to the steering committee as a draft of the final plan.

The following flow chart presents the process of formulating the MSP.

**01**
**Formulating the Spatial Basis**

**Spatial data | Marxan + update**

**02**
**Zoning**

**Eco-spatial principles for planning marine nature reserves:**

a. A comprehensive area of nature reserves extending over 30% of the EEZ, as specified in the goals of the Convention on Biological Diversity and the Barcelona Convention, including adequate representation of habitats and maximum protection of rich and unique habitats.
b. Preference for highly functional marine reserves in a minimal continuous 100 $Km^2$.
c. Three-dimensional protection.
d. Connectivity—Preferably over a maximum distance of 50-100 Km between the reserves.
e. Preference for simple, regulated polygonal shapes, which can be easily defined, marked on navigation maps, maintained and supervised.
f. Adaptability to climate change – preference for nature reserves that encompass a variety of depths and habitats, as the variety is an indication of potential future optimal functioning of the reserve (resilience and resistance), should climate changes cause changes to species distribution.
g. Preserve the potential for future expansion of the area to encompass transboundary marine protected areas.
h. Adaptation to human activities and uses in the sea while preventing destructive uses of the reserve areas.
i. Reserves' spatial overlap with gas exploration and production activity should be allowed only if compatible with conservation goals.
J. Reserves can overlap with existing and future infrastructure pipes and lines, but overlap with gas pipelines and their accompanying lines should be avoided as much as possible.
k. Overlap with shipping lanes should be avoided as much as possible, although it is not absolutely prohibited.
L. Adaptation to future trends and goals of the sectors currently operating in the maritime space.
M. Maintain planning flexibility, to accommodate new ecological and socioeconomic information.

**Eliminating conflicts and accommodating human uses and activities in the EEZ**

**Spatial analysis rendering a hierarchy of conservation importance**

**03**
**Critical Review of the Resulting Marine Spatial Plan**

**Spatial Analysis**
- The habitat conservation goals
- The intended size of the reserves and the distances between them
- The existing and planned human activities in the EEZ

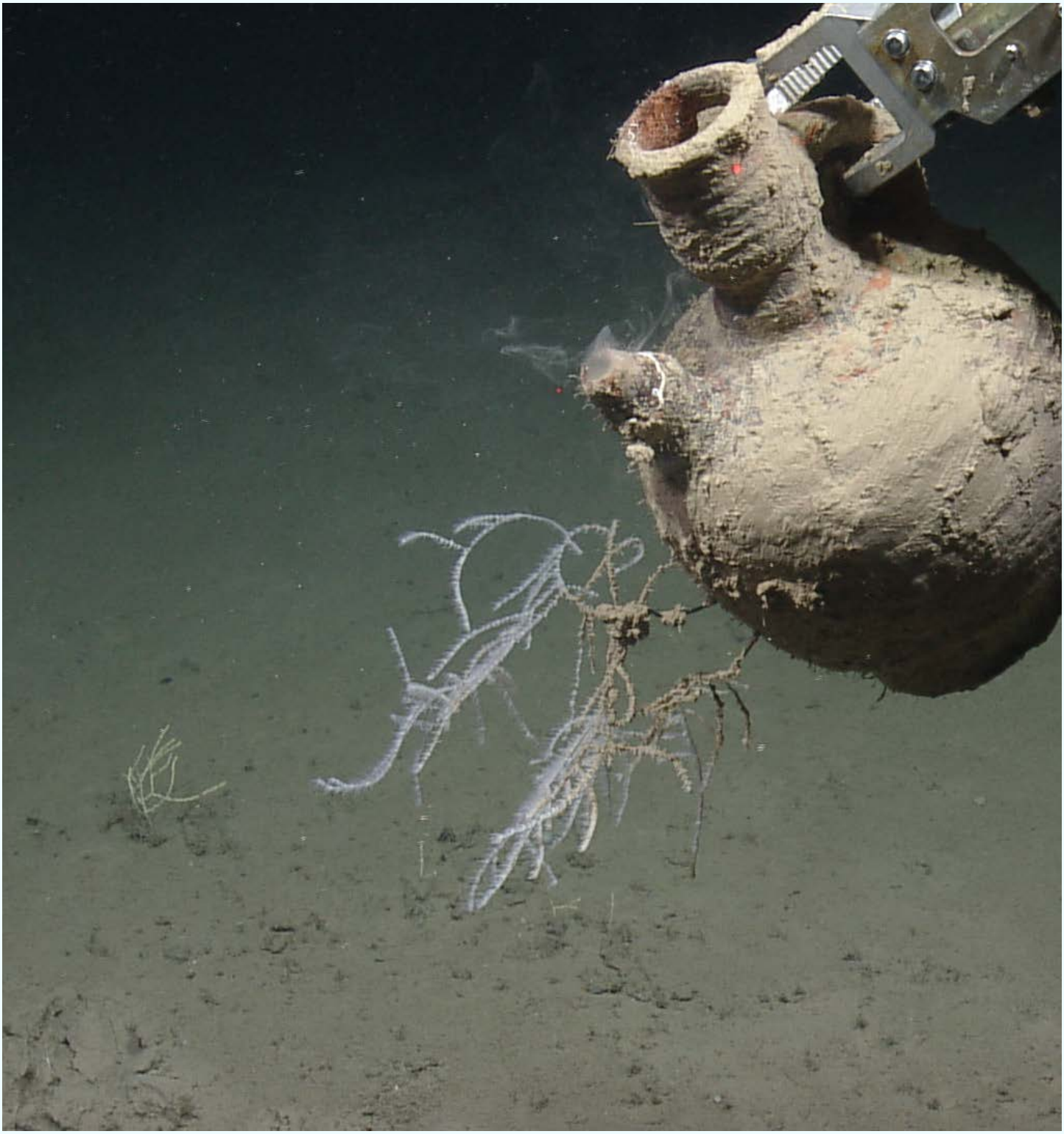
Blackmouth catshark (*Galeus melastomus*), A relatively small shark of about 40 cm. It is the most commonly observed shark in the deep Mediterranean Sea | Photo: Adam Weissman, Yizhaq Makovsky, University of Haifa.

Angular roughshark (*Oxynotus centrina*), a medium sized deep sea shark of about 1 m. Occurs in the Mediterranean Sea and the eastern Atlantic. The population of the species significantly degraded and is considered now endangered probably as a result of being caught as by-catch of bottom-trawl fishing | Photo: Adam Weissman, Yizhaq Makovsky, University of Haifa

4

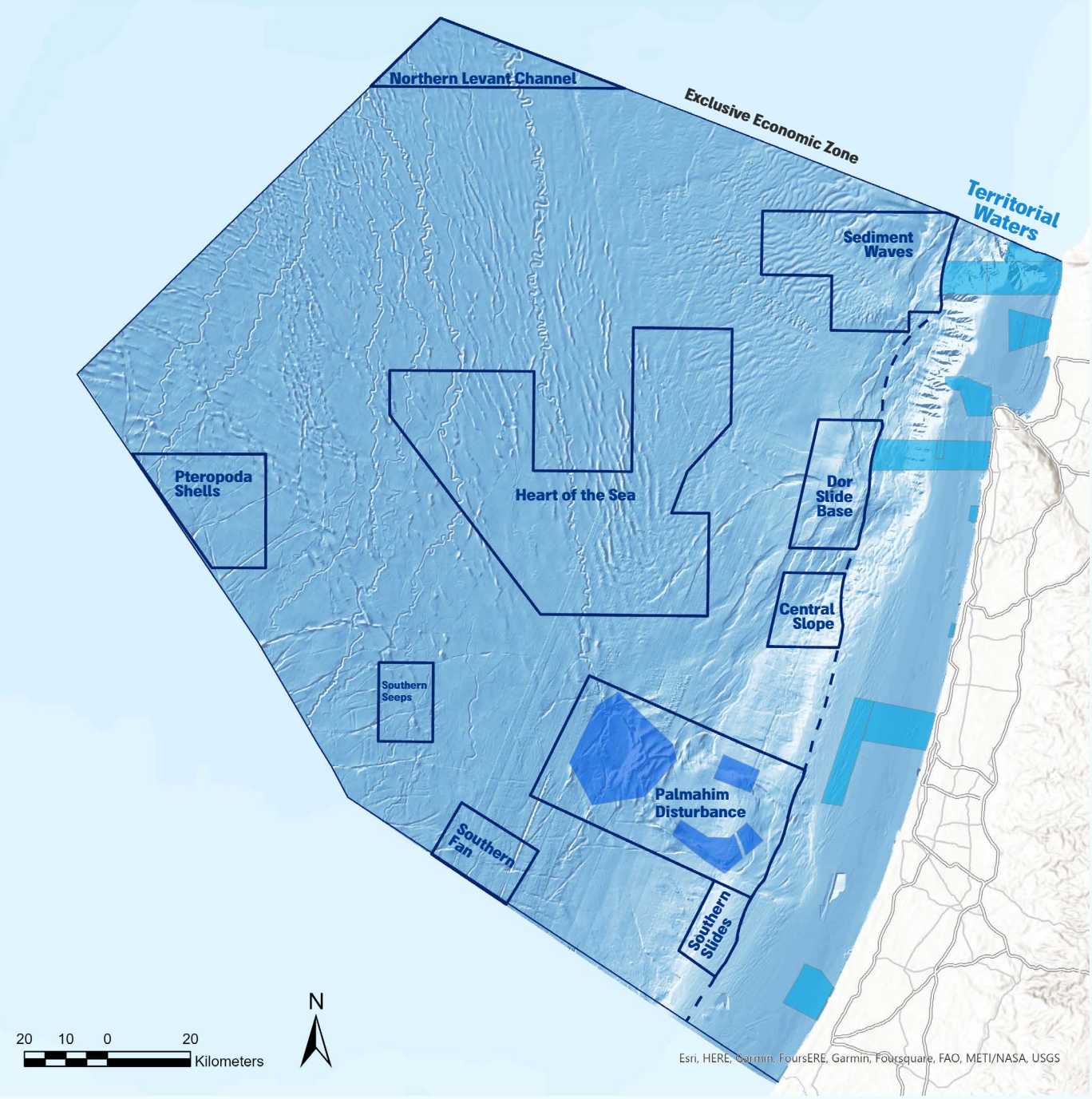
# The Master Plan

## for Marine Nature Reserves in Israel's Exclusive Economic Zone in the Mediterranean Sea



At a depth of 800 m, extracting a Byzantine amphora with a black coral attached to it. This type of cargo, which remained well-preserved in the deep sea, indicates the large scope of maritime commerce and the shipping lines that existed in the Byzantine era | Photo: The Antiquities Authority, Adam Weissman, and Yizhaq Makovsky, Haifa University

# A map of the proposed nature reserve in the EEZ




Israeli EEZ border
Territorial waters boundary
Proposed marine reserve in the EEZ
Marine reserve in territorial waters
The Palmahim Slide reserve

# A. The Major Components of the Marine Spatial Plan

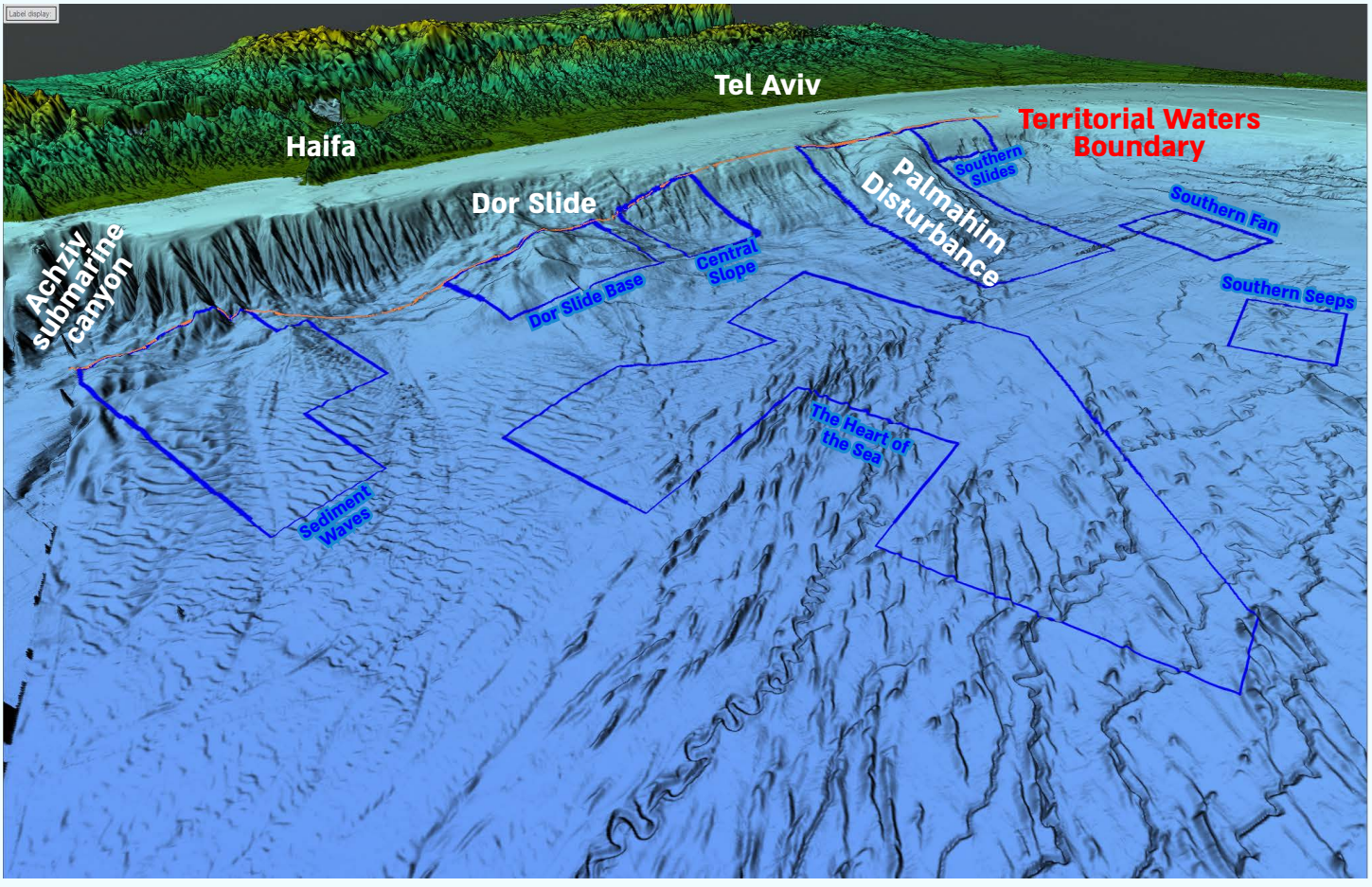
The Plan includes **10 marine nature reserves encompassing 30% of the EEZ area.** The reserves' sizes range from 150m$^2$, in the area of the smallest one, to 2,330 m$^2$ in the largest reserve. The unique **identification features of each reserve** are described in section 6 of this document.

In ecological terms, the MSP meets all of the predefined conservation goals:

- Broad protection, **encompassing 80% of the unique habitat areas** found in the EEZ (based on observations or a high probability of presence)
- Good protection of representative ecological units, **meeting 89% of conservation goals for representative ecological units.**
- Most of the reserves protect both unique habitats and representative ecological units, thus creating **large and compact reserves,** which helps reduce the edge effects of potential human activity
- **There is good connectivity between the majority of the reserves,** with 15-30 Km distances, and others at distances ranging between 40 and 80 Km. In terms of connectivity, the reserves along the slope's axis are **either adjacent to or very near the existing or planned reserves in the territorial waters,** thus creating a **functional continuum and ecological connectivity between the continental shelf and the deep sea.** Hence, this plan complements and continues the spatial planning of the territorial waters.

On a spatial level, **5 of the proposed reserves emphasize the ecological protection afforded to the continental slope and the base of the slope.** The areas along the slope's axis are ecologically and spatially important, for the following reasons.

a. There are unique habitats on the sea floor: cold-gas seeps, coral gardens, sea-pen communities and large flagship species, such as sharks and batoids (rays).
b. High species diversity and concentrations of biomass are found in the pelagic zone above the slope.
c. It is the passageway of nutrients transported from the continental shelf to the deep sea.
d. There is a degree of overlap with areas accommodating sea turtles, according to a preliminary analysis of data from a number of tagged individuals[100].
e. The range of depths gives the area a certain flexibility, with the potential to provide climate refuge in response to global warming, which causes many organisms to migrate to deeper waters.




Five of the nature reserves are located along the continental slope axis which is considered a highly diverse and rich area, both in the pelagic and the benthic zones.

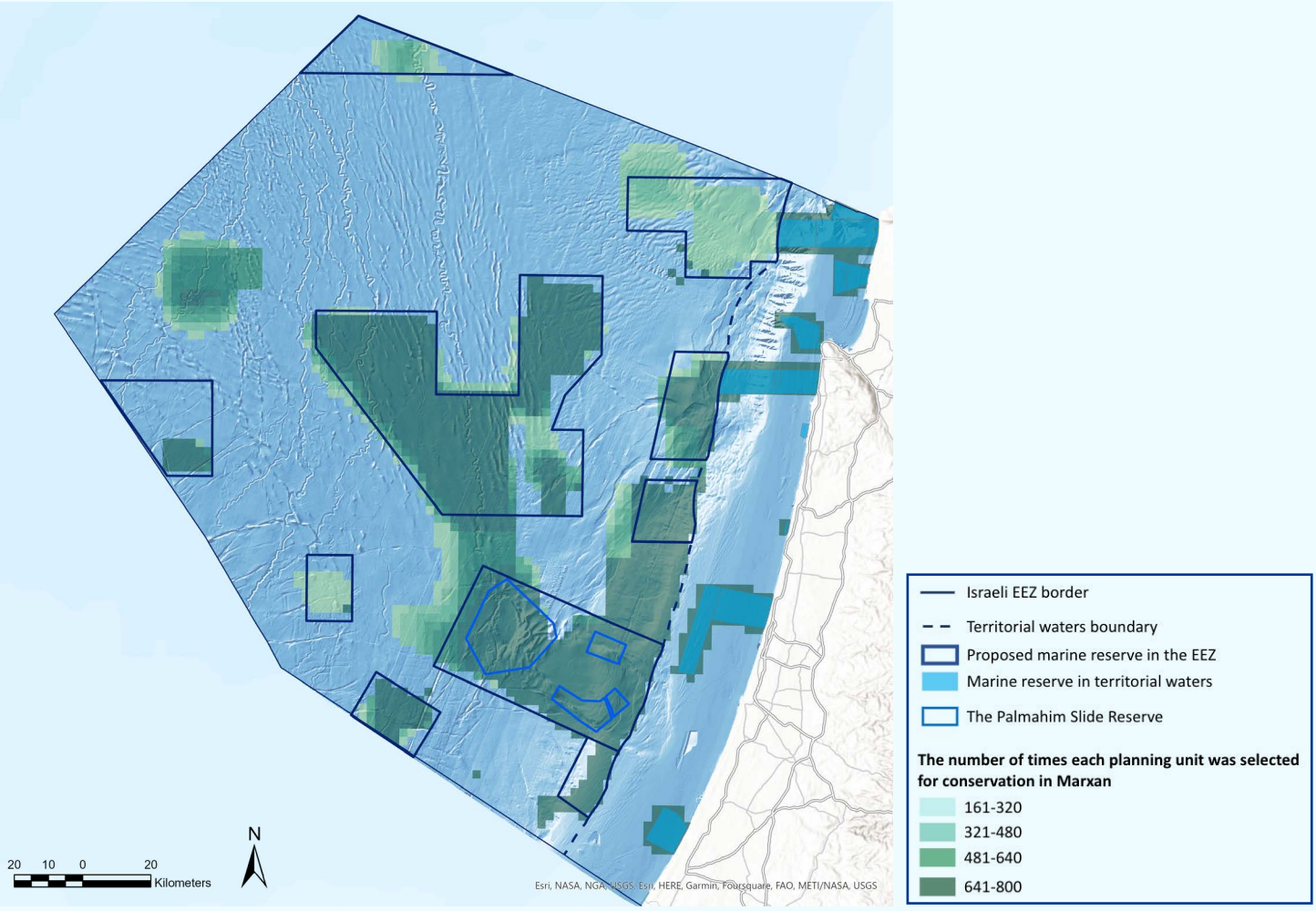
Two of the reserves could potentially become transboundary reserves, one interfacing with Cyprus's EEZ (and perhaps Lebanon's, as well) and the other with Egypt's EEZ.

The central nature reserve in the bathyal plain, **the Heart of the Sea Reserve, protects a variety of habitats**, from soft sediment sponge grounds to cyclonic eddies in the pelagic zone. However, at the center of this reserve, there is a historic dump site of fly ash; therefore, we must consider if this area matches the conservation goals of the reserve, for example, by proposing a pilot study for a research-based deep-sea restoration project.

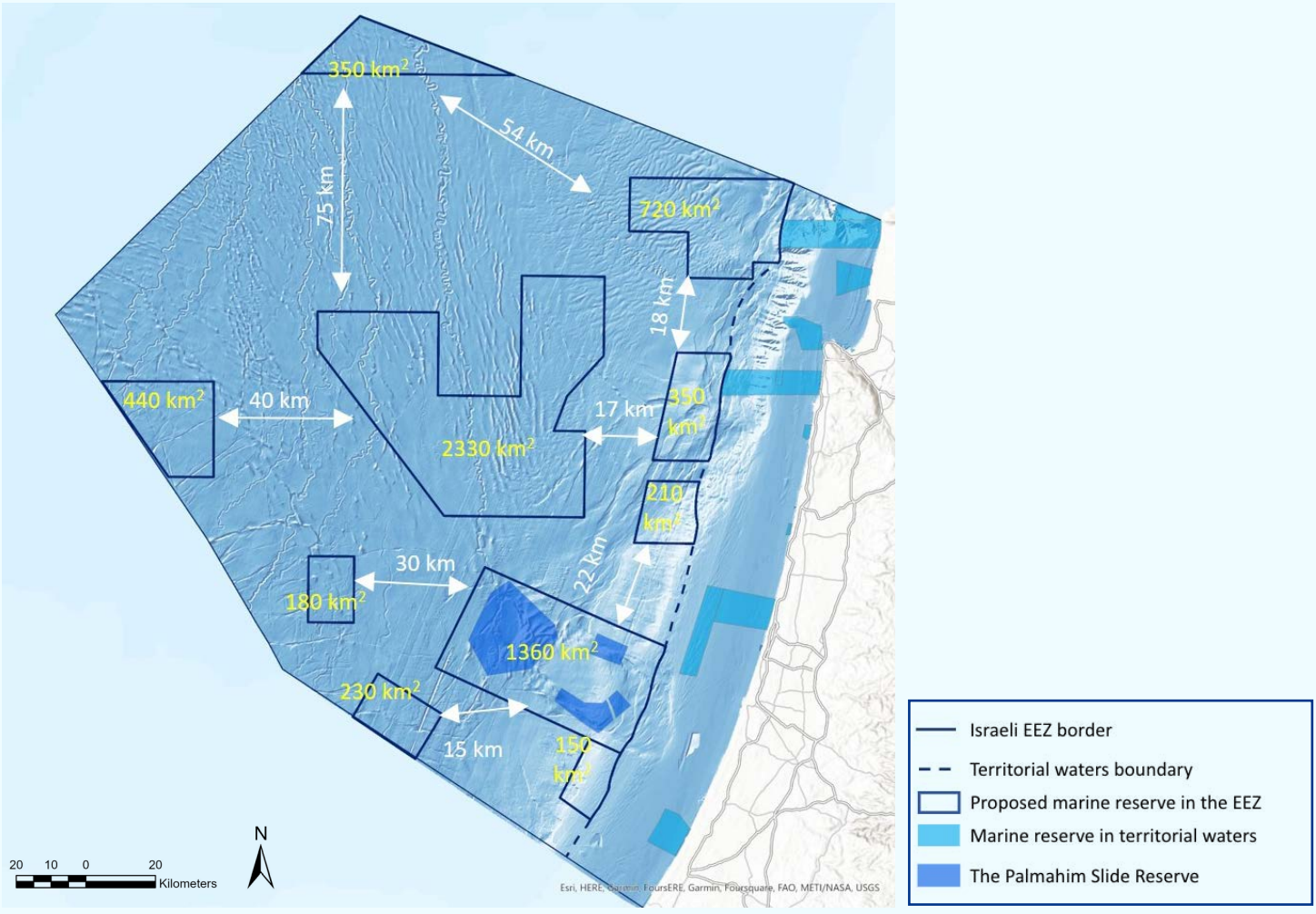
Regarding potential conflicts with socioeconomic activities, the proposed plan for marine nature reserves reflects an effort to avoid conflicts with the hydrocarbon sector, as described in detail in the section on the planning principles. Nevertheless, in a few of the sites, there is **a certain degree of overlap with blocks that the Ministry of Energy has designated for future gas explorations (the fourth bid)**. No other suitable alternative was found for these overlap areas, specifically, in the Southern Fan Reserve in Block E, where observations and forecasts have indicated the presence of chemosynthetic habitats; in **the Reserve of Pteropoda Skeletons** in Block G, which represents an interesting and important habitat; and in the Reserve of the Northern Levant Channel, which is located in the northwestern area of the EEZ that is not represented in any of the other planned reserves. Hence, it is suggested that the **Ministry of Energy should consider updating the map of blocks tendered for future gas searches.**

**The reserves on the slope have a certain degree of overlap with the fishing sector.** As regards bottom trawl fishing, given the small scope of this activity in the EEZ compared to the territorial waters, the high ecological value (identified with a high degree of certainty) of the habitats in the overlap area, and the indications (expressed in both the government's basic guidelines and the Maritime Policy for Israel's Mediterranean Waters) that bottom trawling will soon be prohibited, it is assumed that this overlap does not pose a challenge. Moreover, the fishing activities in the EEZ are currently not regulated or authorized. As regards fishing in the pelagic zone, which currently constitutes a very small branch of Israel's fishing fleet, approximately half of the areas where such activity has been recorded are designated in the current plan as reserves where such fishing activity can continue.

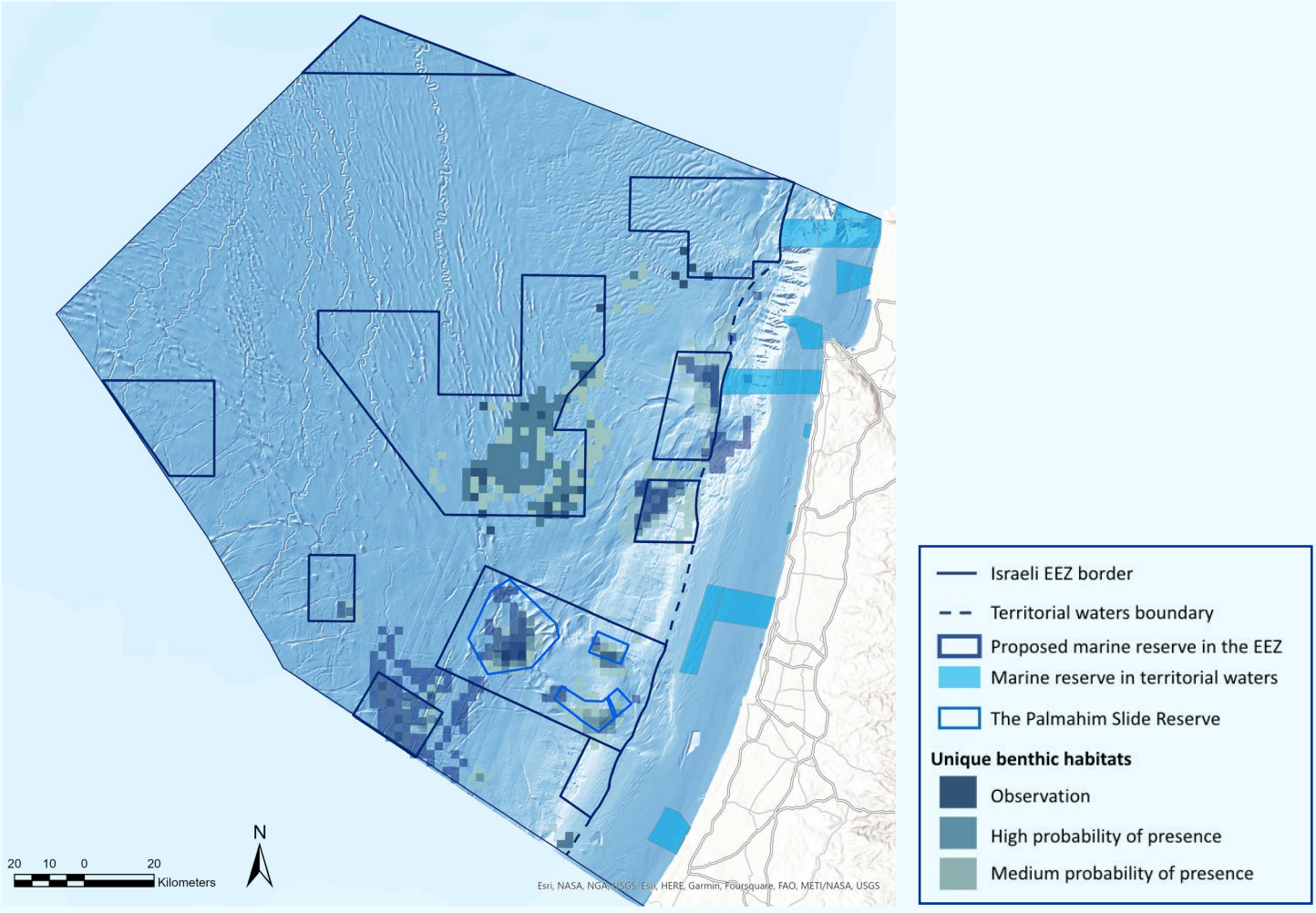
**Almost the entire slope axis was identified as conservation worthy by the Marxan model.** However, to demonstrate a balanced approach, the current plan opted to leave a significant area, across from the Sharon region and across from the Haifa port, without spatial protection, **to allow for flexibility in terms of future blue economic and innovative human activities.**



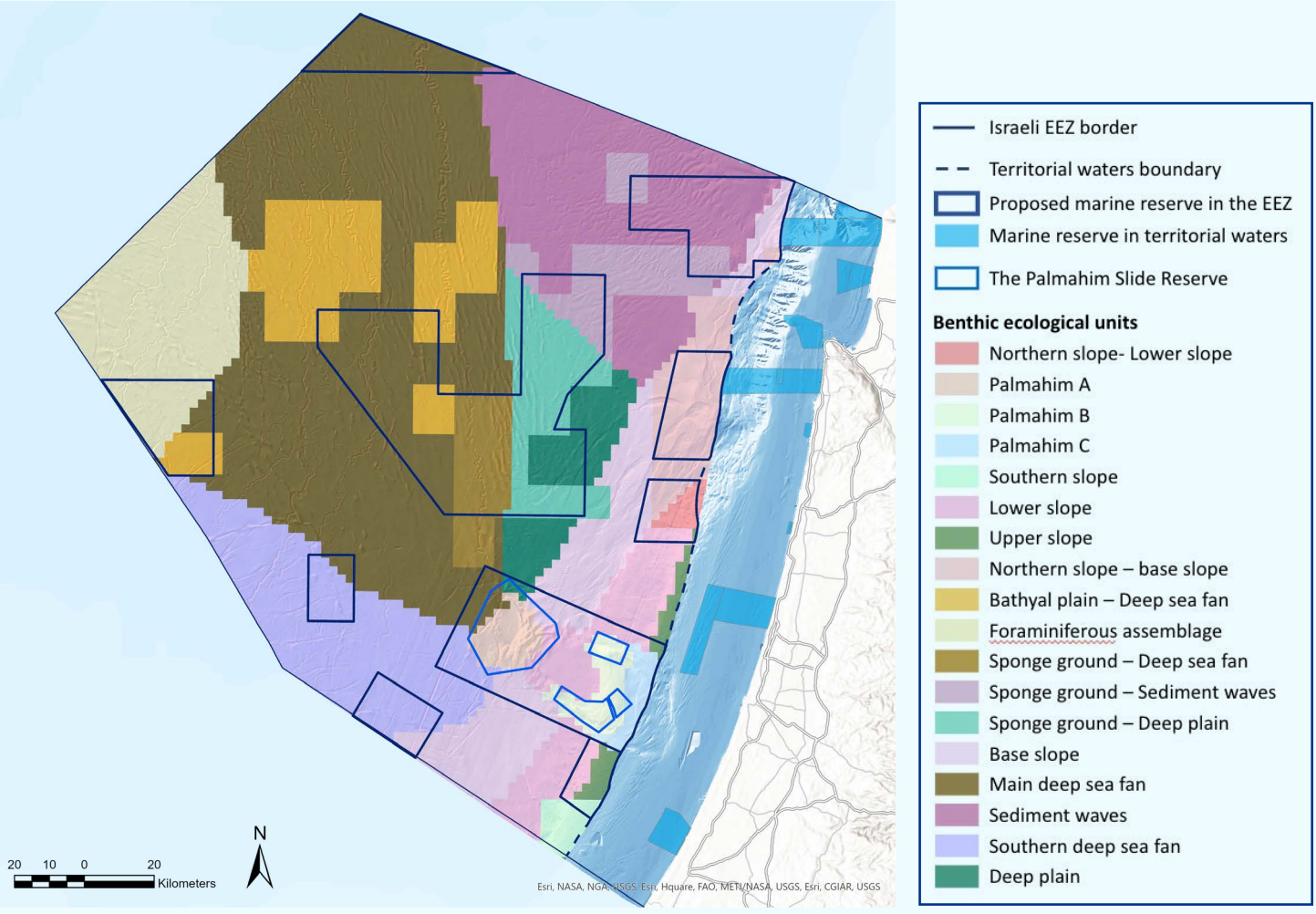

Marine nature reserve plan reflecting the results of the Marxan's spatial prioritization (after updating for spatial changes)



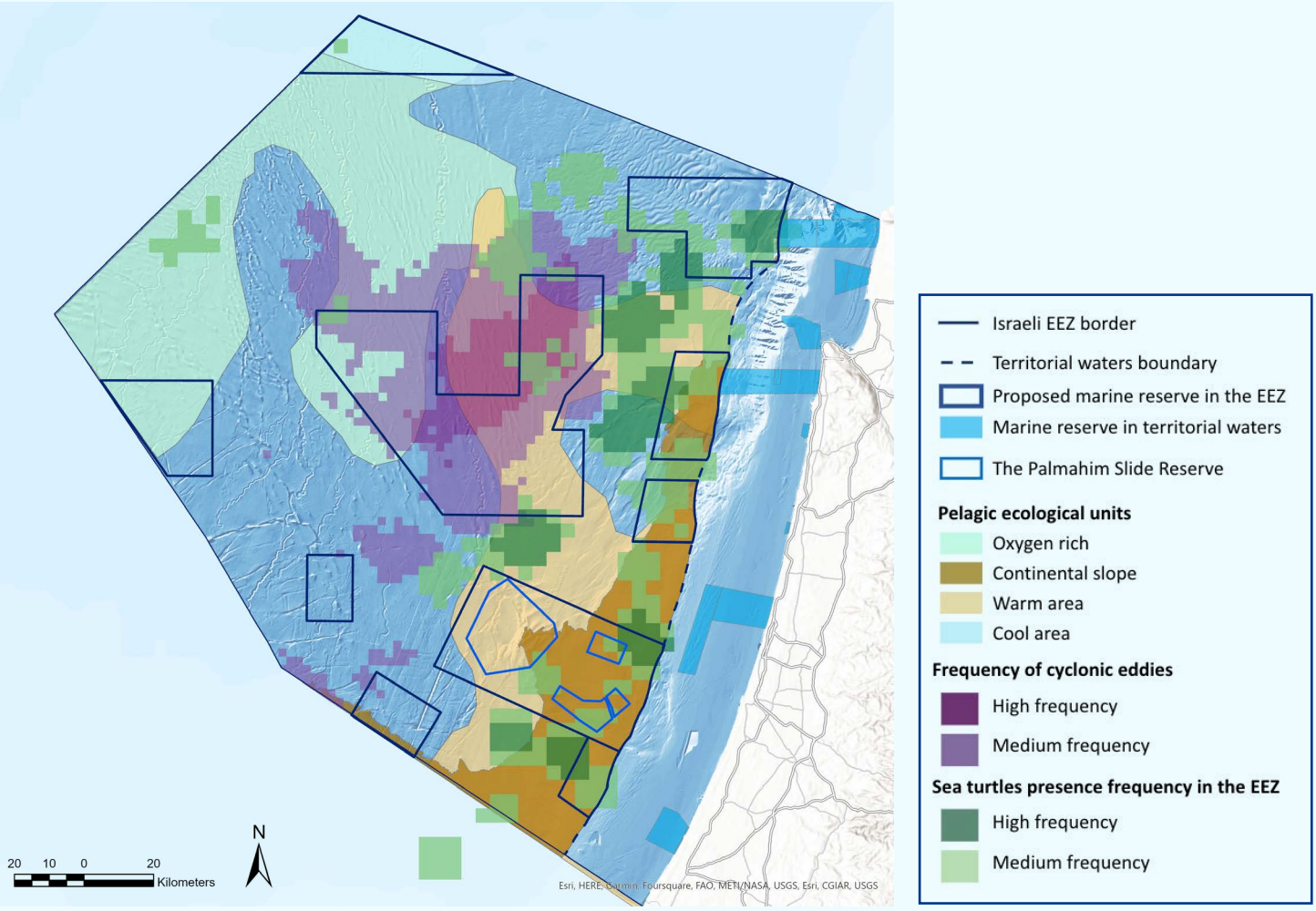

The sizes of the proposed reserves and the distances between them




The marine nature reserves plan and the unique bathyal habitats in the EEZ

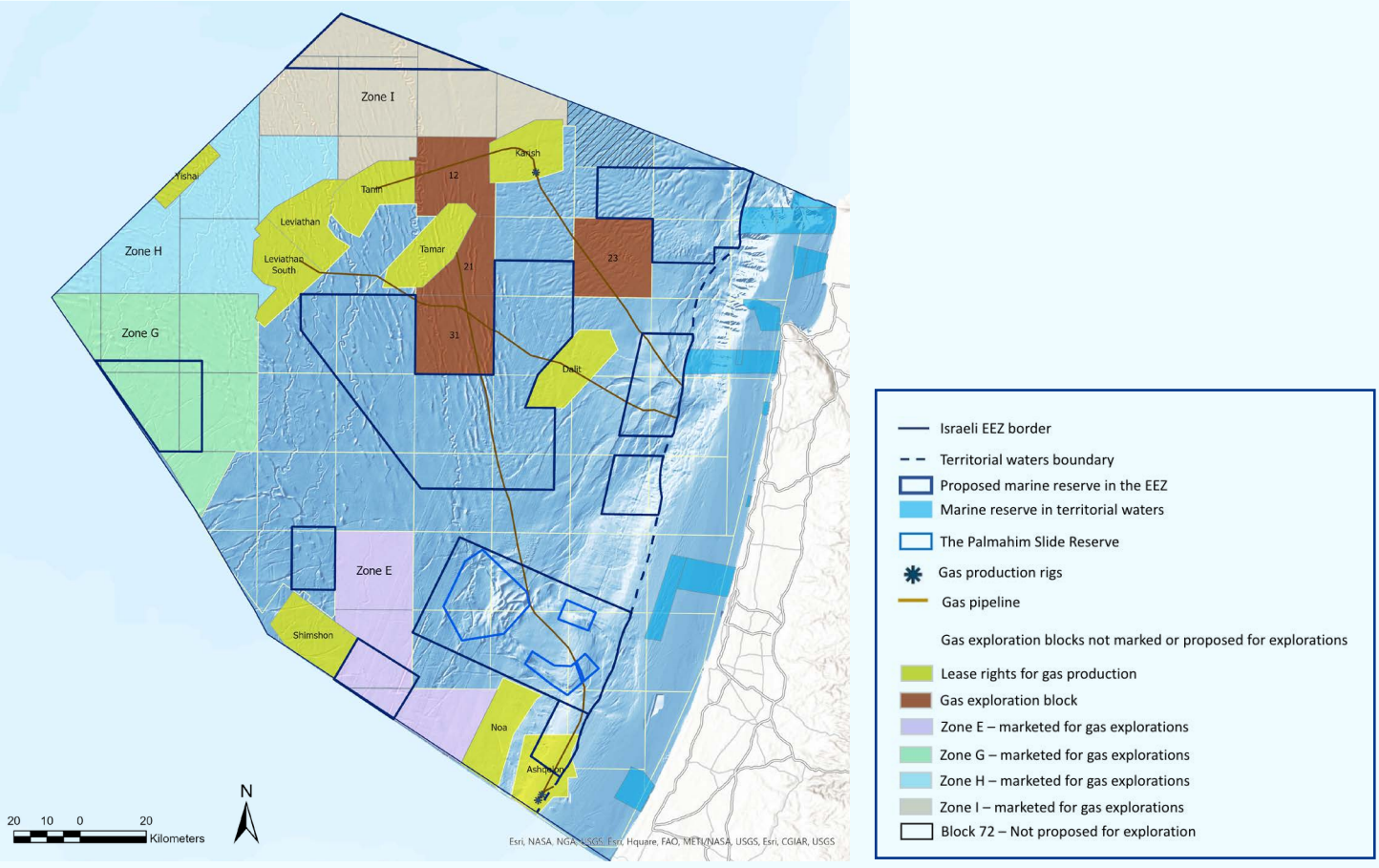



The marine nature reserves plan and the benthic ecological units in the EEZ

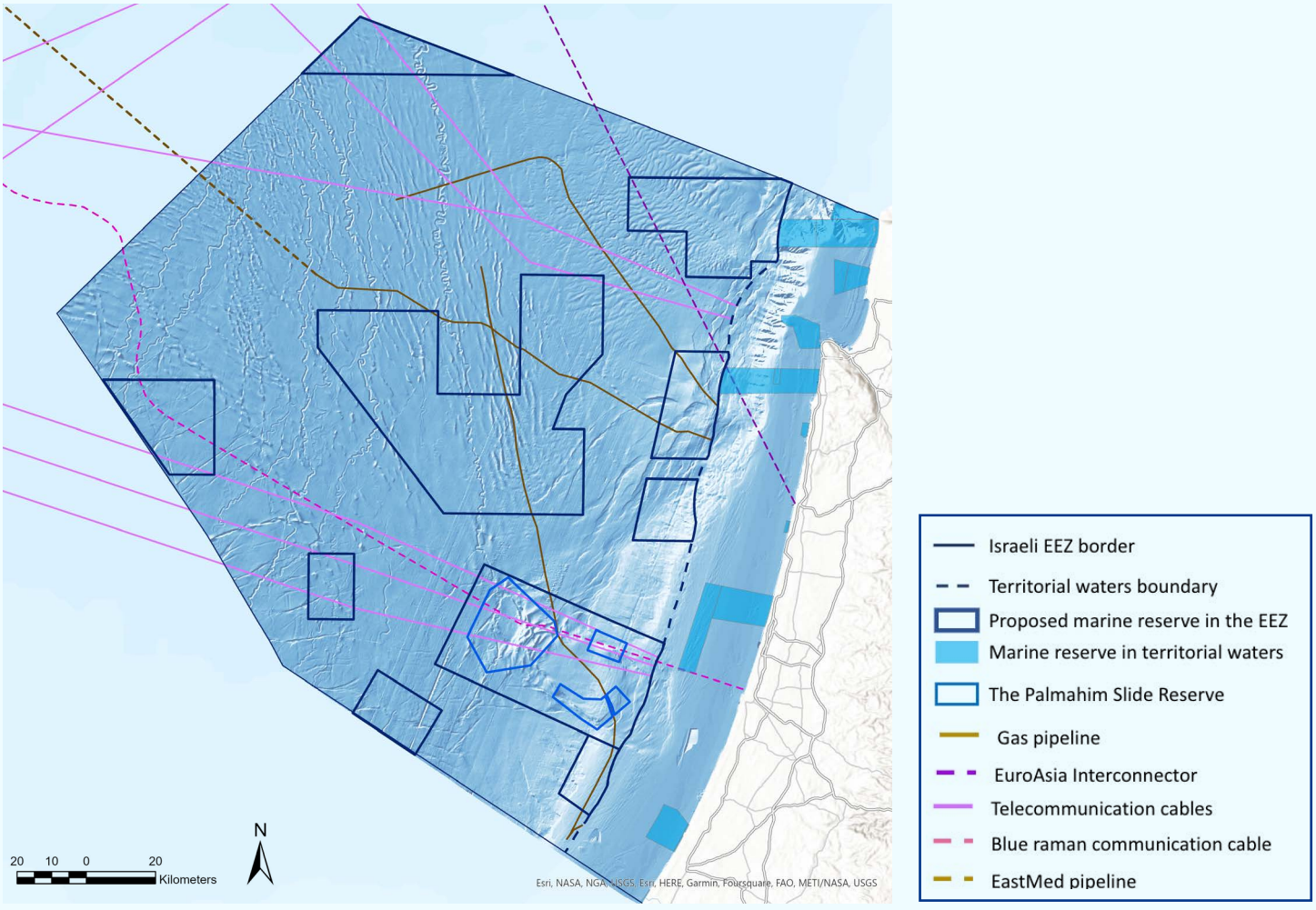



The marine reserves plan, pelagic ecological units, and unique pelagic areas

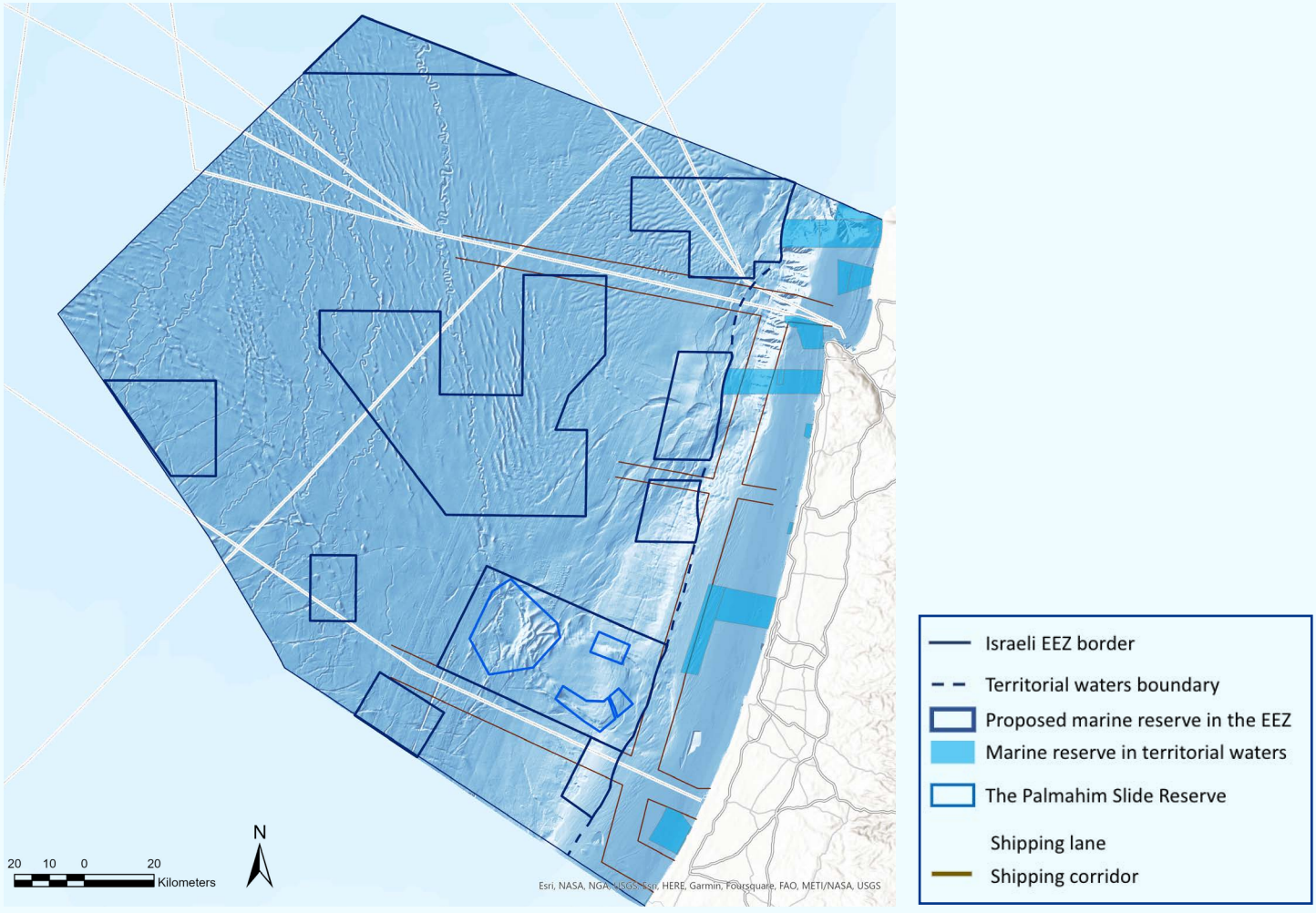
Blackbelly rosefish (*Helicolenus dactylopterus*) resting under a black coral at a depth of 750 m in the coral gardens of the Palmahim Disturbance. The species is a typical ambush predator and normally reaches a length of 25 cm | Photo: Adam Weissman, Yizhaq Makovsky, University of Haifa



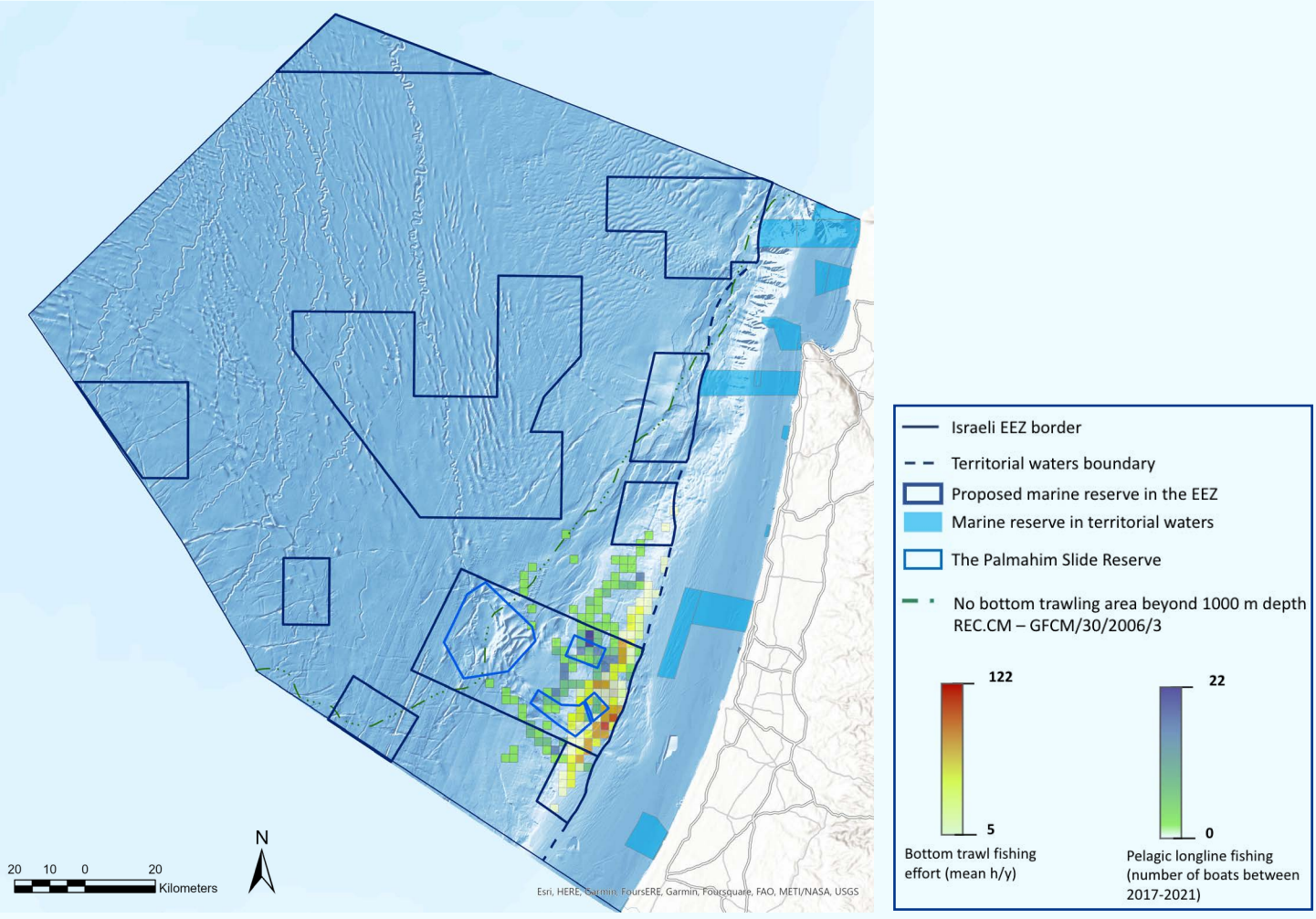

The marine reserves plan and the hydrocarbon sector's activities




The marine nature reserves plan and existing and planned marine infrastructure (cables and pipelines)




The marine nature reserves plan and shipping lanes




The marine nature reserves plan and fishing activities

# B. Activities within the Marine Nature Reserves - Proposed Policy

Generally, the proposed policy statement corresponds to that adopted in the Maritime Policy for Israel's Mediterranean Waters, the document applied to the marine nature reserves located in the territorial waters, which are treated as three-dimensional (including the sea floor and the benthic zone above it) "no-take zones." The policy also takes into account the most recent global and local scientific information concerning the risks to species variability caused by human activity. However, given the dynamic pace of the development of marine technologies, any future innovative human activities should be considered separately.

## 1. Activities Permitted within the Nature Reserves

**Leisure sailing and marine sports activities, scientific research, and nature observations** are activities permitted within the Marine nature reserves, as long as the regulations set by the nature reserve management to minimize any possible negative effects (e.g., throwing litter overboard) are upheld.

**Sailing** within the areas of the nature reserves is also permitted.

**Infrastructure pipelines** - these destabilize the environment where they are placed, but this effect is usually within a defined and limited area. Therefore because of this and their national importance, the laying of infrastructure pipelines and cables within the nature reserves is not forbidden, as long as other options outside the nature reserves have been considered and found lacking. Furthermore, the layout must be marked with precision to avoid harming vulnerable habitats and/or cultural heritage sites within the nature reserves. Notwithstanding, the pipelines that are prone to leakage and pollution, as in the case of fossil fuels, constitute a significant spatial risk and, consequently, there is a clear preference for laying such pipelines outside of the area of the nature reserves, while taking into account the direction of the ocean currents, as much as possible. Furthermore, it is suggested that pipelines with the potential for leakage and pollution, which are placed in proximity or within a nature reserve must be equipped with a monitoring and warning system using the most advanced technologies available, to alert in case of leakage.

**Sites of Cultural Heritage -** any findings on the seabed indicating past human activity that have cultural historical and/or archaeological characteristics are defined by UNESCO as items of cultural heritage. If these are found within the boundaries of the nature reserves, they will be protected in situ, according to the rules outlined in UNESCO's International conventions and the instructions set by the Israel Antiquities Authority.

**National security maintenance and activities will continue to have free reign in the areas of the marine nature reserves,** as outlined in the paragraph on national security in various spatial plans, with a preference for advanced coordination and arrangements, according to the agreement between the Nature and Parks Authority and the Israeli Navy, as proposed in the planning administration's document on the Maritime Policy for Israel's Mediterranean Waters.

16. https://www.unesco.org/en/legal-affairs/convention-protection-underwater-cultural-heritage

In the case of overlap between nature reserve areas and an area designated as a firing range or navy practice, all security-related activities are permitted even if they conflict with the purpose for which the area was originally designated, in accordance with the agreement to be signed between the Nature and Parks Authority and the IDF.

Compliance with IDF instructions will be prioritized also when a structure is installed within the perimeters of a nature reserve, based on the law on security regulations and the safety of public installations, and hence, the IDF can issue any demand necessary for carrying out its responsibility to maintain said installation, in terms of marine security. If a marine installation is erected within the nature reserve, the Ministry of Transportation may prohibit sailing in that vicinity, in compliance with a request from the IDF and in line with the Ministry's legal authority.

## 2. Prohibited activities within the Nature Reserves

There is general agreement in the scientific literature that economic activity that includes using resources, such as extracting minerals or other quarried substances, drilling for gas or oil, and fishing cause severe and ongoing damage to the marine environment and therefore should be prohibited in marine nature reserves[1, 16, 34, 45]. "No-take zones," where the use of natural resources is completely prohibited, are the reserves that render the greatest environmental and socioeconomic benefits[34, 74, 75, 93]. Should there be an essential need to conduct harmful activities within the perimeters of a nature reserve, efforts should be made, based on the principle of flexibility, to locate spatial alternatives that can protect the representative habitats, to avoid harming vulnerable habitats as much as possible.

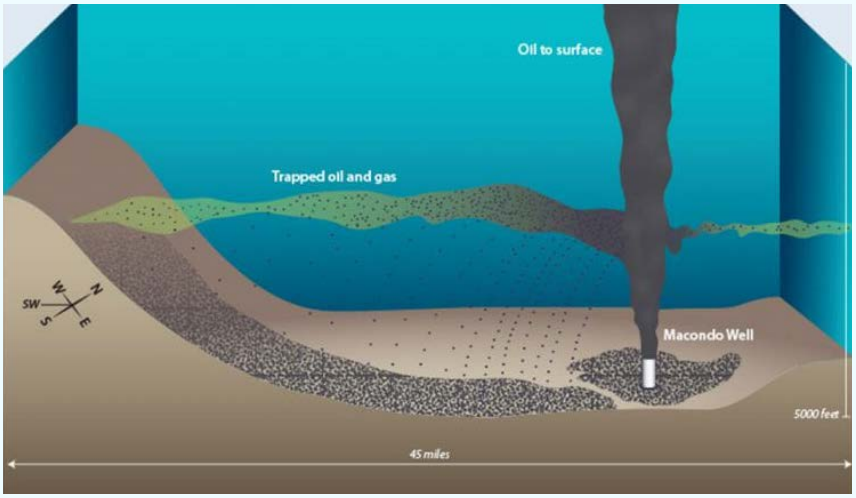
Undesirable activities within the nature reserves include the following.

### 1. Drilling for fossil fuels

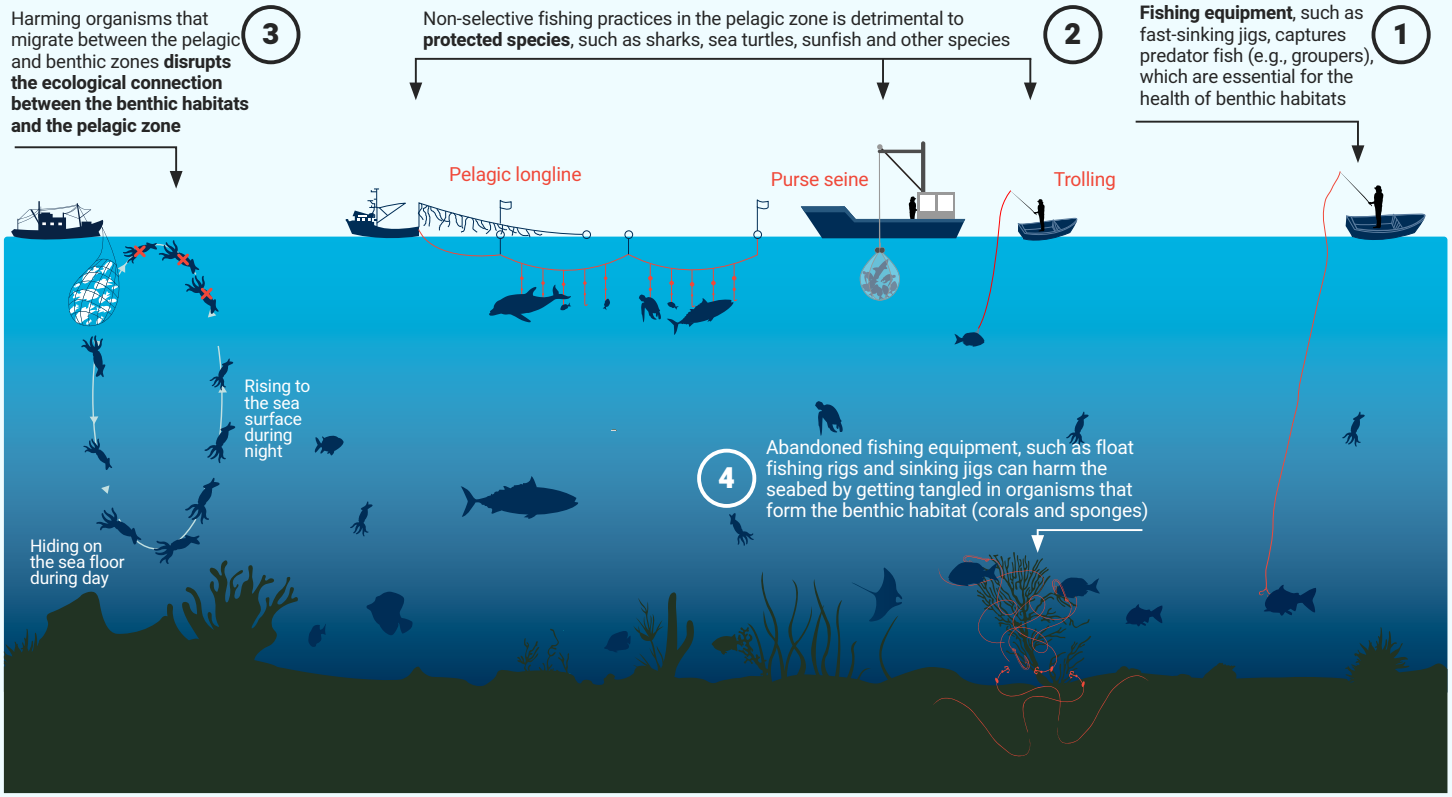
This activity has a significant negative effect on the ecosystems in the vicinity during all stages of production. Seismic surveys could be harmful to the organisms living in the pelagic zone, ranging from zooplankton to megafauna[85]. Building the infrastructure for drilling and transportation has a direct negative effect – albeit in a limited area – on seabed habitats, and the resuspension of sediment during these stages has an indirect detrimental effect, as it buries marine habitats and damages the ability of many filter-feeding organisms to obtain food[24, 81].

During the production stages, the infrastructure chronically emits light and chemical substances that pollute the immediate environment. However, in spatial terms, the main risk is leakage (especially during experimental drilling attempts, which have a greater tendency to malfunction), which can cause substantial and long-term damage to the biological diversity over large spatial areas, both in the pelagic and benthic zones[16]. This is especially true in the deep sea, where there is stratification of the water column and carbon leaking from the wells could get trapped between various water layers for long periods of time[44].

17. More information can be found in section 3 of the Plan's background documentation (Appendix 1).




The distribution of oil after the explosion of a drilling well in Deepwater Horizon, in the Gulf of Mexico, in 2010. Some of the carbon remains trapped under layers of water and does not float upward towards the surface | From: Jack Cook, Woods Hole Institute.




The ecologic risks of pelagic fishing in marine nature reserves.

### 2. Fishing

Bottom fishing, such as bottom trawling or the use of multiple sinking fish hooks, creates irreversible physical damage, as it breaks up and destroys vulnerable habitats and vulnerable organisms (sedentary animals, sharks, batoids, etc.) located along its fishing path. Trawl fishing damages soft-sediment benthic habitats, but also causes the sediment to suspend, thus threatening the lives of sedentary filter-feeding creatures, such as corals and sponges, and it can also cause the release of toxic materials accumulated in the seafloor, which can harm filter-feeders[10, 18, 69].

Fishing methods used in the pelagic zone have a detrimental effect on animals and organisms that are flagship species in the marine environment. For example, longline fishing is a method that places hundreds and even thousands of hooks along one line and has been shown to result in non-selective capture and/or damage to a relatively large number of protected species in Israel (see turtles, sharks, batoids, marine mammals, and others) as bycatch [27, 31, 52, 54]. Fishing in the benthic zone can also harm vulnerable habitats on the seabed, because of the coupling between the benthic and the pelagic zones (see "Deep Diving" frame titled "3D MPA: why a marine nature reserve must be three dimensional and protect the pelagic zone").
Abandoned fishing gear could sink down to the seafloor and tangle in organisms that form the benthic habitat, which over time could cause their breakage and displacement [9]. Unregulated fishing of predators in the ecosystem, and especially pelagic fishing, which aims to catch predator fish, could cause an imbalance in the entire system and thus damage its overall resilience [21, 77].

### 3. Deep-sea mining

Deep-sea mining causes the destruction of and structural changes to the seabed, which results in the loss of benthic habitats. The resuspension of sediment and the release of heavy metals and nutrients in the mining process have been proven to cause physiological changes in invertebrates and fish and to alter primary productivity at distances as far as several kilometers away from the quarry itself. The noise caused by the quarrying activity causes behavioral changes in numerous groups of organisms, ranging from invertebrates to mammals [45, 71].

### 4. Aquaculture

Aquaculture activity can become a possible source of pollution and lead to artificial enrichment of nutrients, which has a particularly noticeable effect in the nutrient-poor, ultra-oligotrophic region of the eastern Mediterranean, and especially in the deep-sea zone. It is also a source of parasites and infectious diseases that can infiltrate the natural fauna[37, 50]. Furthermore, fish, birds and mammals are at risk of getting tangled and caught in the aquaculture nets[7, 63]. The character and distribution of aquaculture's environmental effects change according to the type of farm, the species grown, the farm's location in terms of depth and sea currents, and the production protocol. Nevertheless, as a rule, overlap between aquaculture farms and marine nature reserves could harm the ecological functioning within the reserves and therefore should be generally avoided [29].

### 5. Facilities that project above the water surface

Masts, turbines, rigs, and other installations that project above the water surface could pose a significant risk for birds crashing into them and become a source of light pollution. This is especially true in the eastern Mediterranean, which serves as a migratory axis between Europe, Asia, and Africa[88]. Hence, placing such facilities within the areas of nature reserves could conflict with the predefined conservation goals, and their effects not only under the surface but also above it must be considered.


# 3D MPA: Why a marine nature reserve must be three dimensional and protect the pelagic zone

**The marine ecosystem is dynamic in terms of space and time.**

From the surface to a depth of at least several hundred meters, there is no ecological division between the sea floor and the water column, and between the two zones there are reciprocal processes of predation, feeding, daily vertical movement of organisms from the depth to the surface and back down, as well as the mixing of energy flows and nutrients between the water column (the pelagic zone) and the seabed (the benthic zone).

Some of the organisms find refuge in the benthic habitats during the daytime and go up to the surface at nighttime to find food, a movement pattern that is called diel vertical migration. This is the greatest migration on Earth and it takes place every day, beginning with zooplankton's (microscopic organisms) upward migration, with predators such as fish and cuttlefish following suit [28].

Close ties between the benthic habitats and pelagic organisms were identified in cases of vulnerable marine ecosystems (VMEs), such as sponge grounds, coral reefs, rocky reefs, algae forests and other habitats that form complex structures on the ocean floor[33]. Moreover, gas seeps in unique benthic habitats are changing the biochemical characteristics of the water column above them and clearly demonstrate the bentho-pelagic coupling. Strong ecological ties between the benthic and pelagic zones were found also in areas of complex topography, such as ridges and canyons, the edge of the continental shelf, and areas where ocean currents converge.

Studies of the Mediterranean have shown that benthic and pelagic organisms, even at a depth of hundreds of meters, constitute a single ecosystem with strong reciprocal relationships between the zones. Marine organisms spend various stages of their lives in different areas of the pelagic and benthic zones. A strong connection was found between the zones at a depth of up to 250 meters, whereas an ecological relationship of medium strength was found between the zones at depths ranging from 250 to 600 meters[82]. That is why pelagic fishing, for example, has a cascade effect on benthic habitats and vice versa[2].

Consequently, marine nature reserves must provide three-dimensional protection that includes the sea bed and the water column above it. Hence, activity that harms pelagic organisms (as in the example of pelagic fishing [99], seismic surveys[62], and artificial lighting[59]) disrupts the fabric of life in benthic habitats, even at depths of hundreds of meters or more beneath the surface.

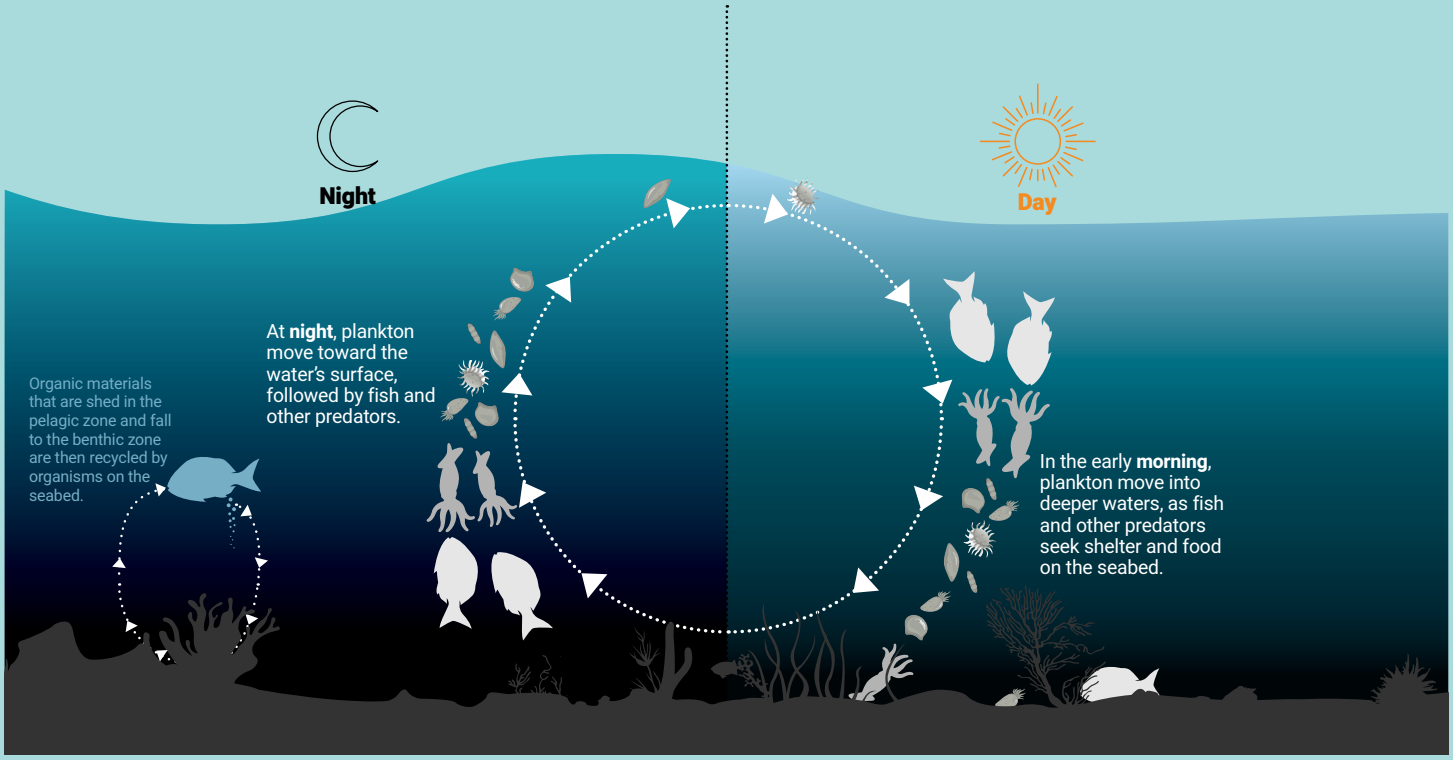
**Sea turtles, mammals, and tuna sample the depths**

Pelagic creatures, including large flagship species (megafauna), are an integral part of the marine nature

reserve and merit protection because they are exposed to risk factors such as fishing and pollution. Recent research findings revealed that species that were traditionally thought to live mostly in the pelagic zone, such as sea turtles, marine mammals, sharks of the open sea and tuna, actually dive to great depths to feed and cool themselves, explore their surroundings and escape from predators[11]. For example, the loggerhead sea turtle, the leatherback sea turtle, the shortfin mako shark and the bigeye thresher shark spend substantial amounts of time at depths of over 100 m and some go even deeper than 500 m. In other words, these animals actively connect the benthic zone with the pelagic zone within the marine nature reserve, and they must receive three-dimensional protection, from the sea floor and through the water column. This vertical movement also contributes to the mixing of the water column and nutrients' transport, which contributes to productivity and carbon intake. As such, the vertical movement assists in the mitigation of climate change.

## The Bentho-Pelagic Coupling

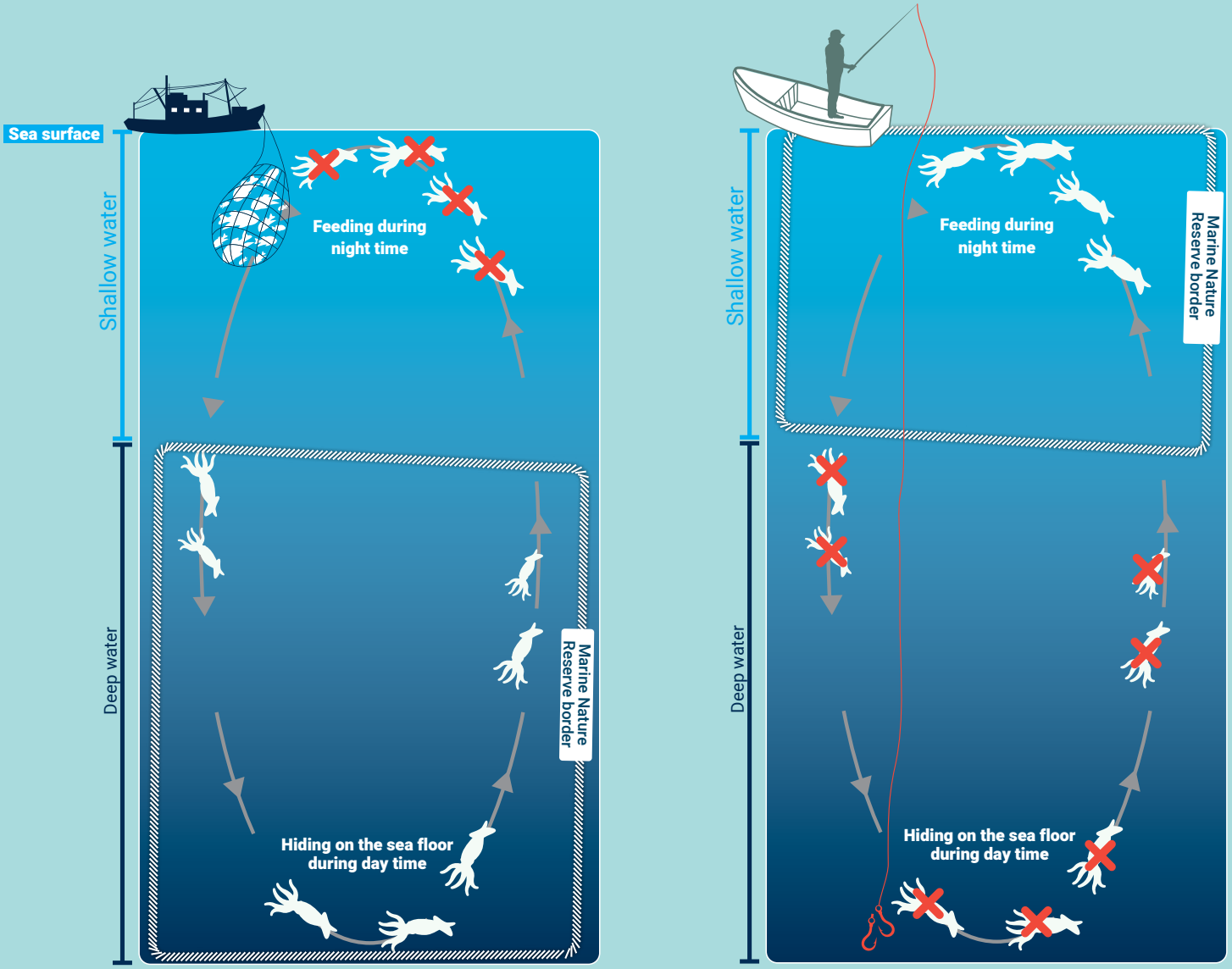
**The vertical movement of organisms creates a mixture of nutrients and energy that flows between the benthic and pelagic zones, through processes of recycling and predation that establish the coupling between the seabed and the water column above it**



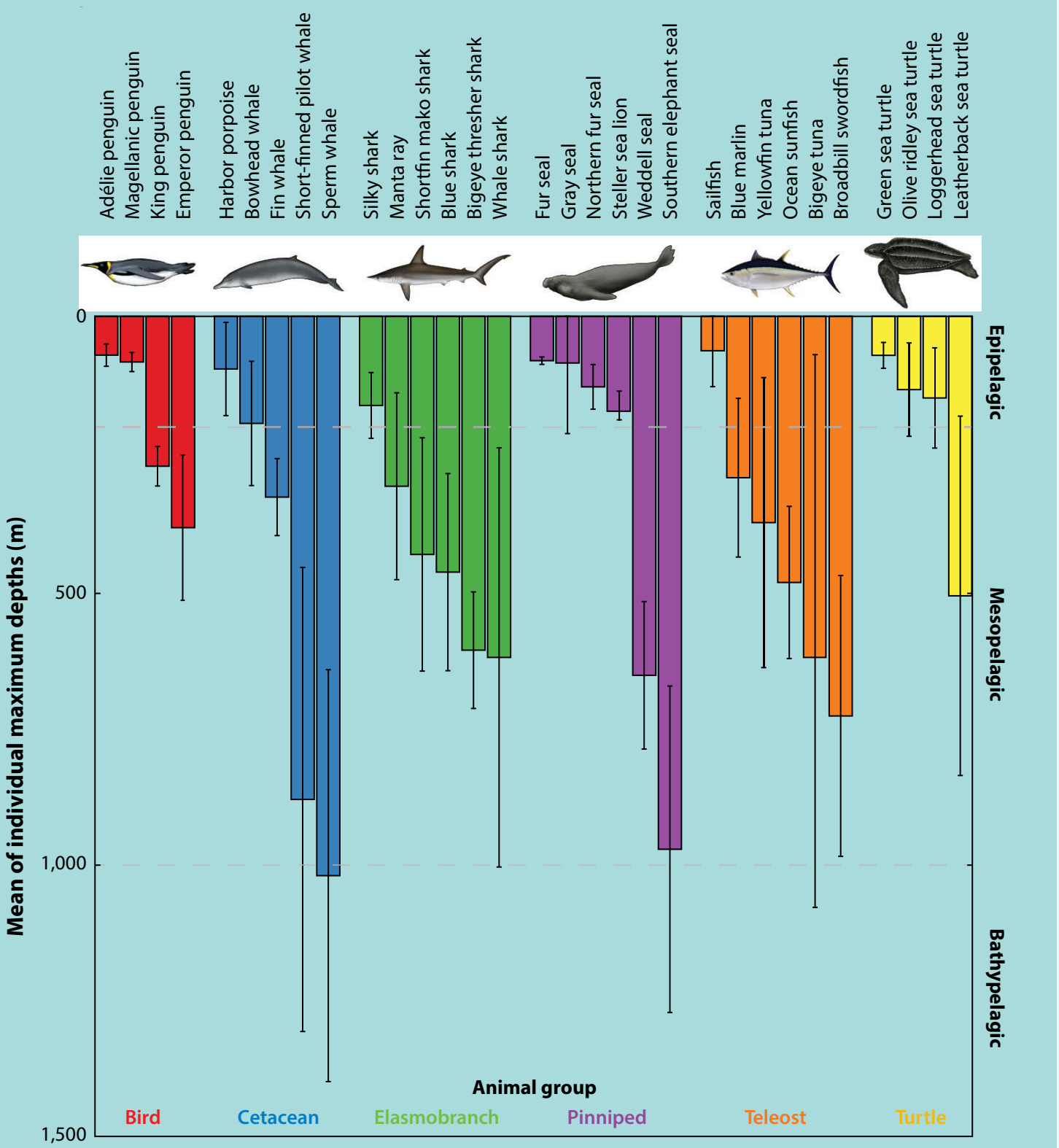

The vertical movement of organisms creates a mixture of nutrients and energy that flows between the benthic and pelagic zones, through processes of recycling and predation.

Protecting only the benthic zone would **prevent cuttlefish from remaining safely in the pelagic zone at night** and would expose them to rod and net fishing.

Protecting only the pelagic zone would **prevent cuttlefish from remaining safely in the benthic zone during the daytime** and would expose them to benthic fishing (trawling, fast-sinking jigs and multiple sinking hooks.




Left: Protecting only the benthic zone would prevent cuttlefish from remaining safely in the pelagic zone at night and would expose them to rod and net fishing | Right: Protecting only the pelagic zone would prevent cuttlefish from remaining safely in the benthic zone during the daytime and would expose them to benthic fishing (trawling, fast-sinking jigs and multiple sinking hooks)




Animals that were traditionally thought to live mostly in the upper pelagic zone actually use the deeper parts of the water column. The diagram demonstrates the connection between the upper and lower parts of the pelagic zone and the benthic habitats | From: Braun et al., 2022 [11]

# C. Implementing the Plan

## 1. Prioritized Order of Implementation

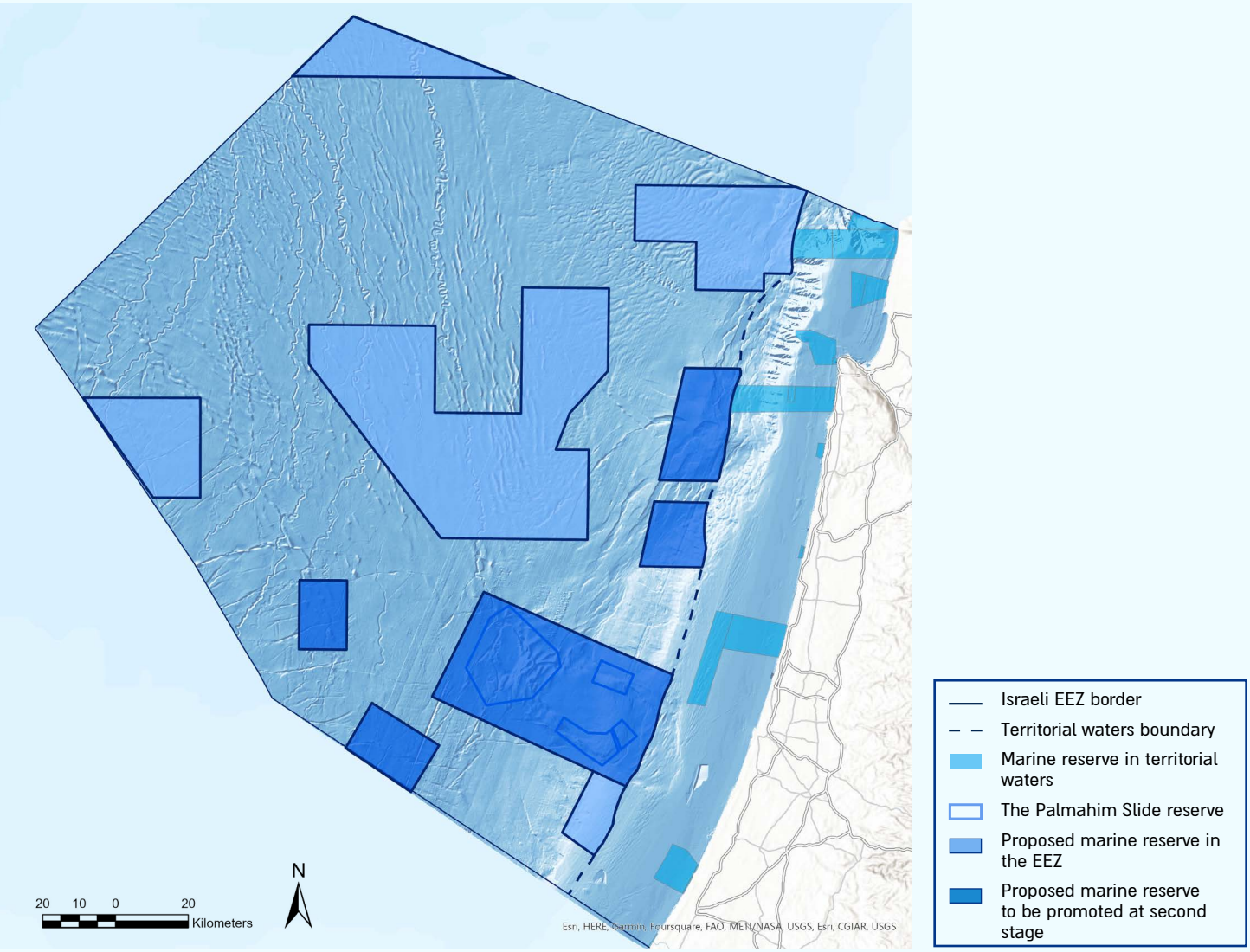
The establishment of new nature reserves is typically an extensive and prolonged process even after the planning stage, due to the complex nature of spatial planning processes[e.g., 32, 64]. Therefore, there is a need to define the order of priorities for implementing the Master Plan, given the assumption that it is impossible to implement all of them simultaneously, and also because of the absence, at this point in time, of a legal framework for regulated spatial planning in the EEZ. However, the schedule for carrying out the global goal of conserving 30% of the area by 2030 requires working on several parts of the project in parallel. This includes promoting the legal framework for the planning of the EEZ, including resources and conducting ecological surveys in the areas designated for conservation, and the pooling of resources for administration, supervision and monitoring, as part of the effort of the Nature and Parks Authority to prepare the capacities needed to maintain deep-sea nature reserves.

The guidelines for determining the prioritized order of implementation included the following:

- **The degree of certainty** regarding the presence of unique habitats in the benthic and pelagic zones or precise spatial knowledge regarding the boundaries of the ecological units.
- **The value** of the habitats and ecological units in the area of the reserve, in terms of their importance to the deep-sea ecosystem and as a focus of global conservation efforts.
- **The degree of urgency** for areas currently affected by socioeconomic activities in the area, or are expected to be affected by such activities in the near future.

Consequently, it is proposed that in the first stage, the major efforts should focus on the ecological survey and promotion of five of the planned reserves, which together constitute approximately 11% of the EEZ: the Palmahim disturbance, the central slope, the Dor slide base, the southern fan, and the southern seeps.

In the second stage, **five** additional reserves, which constitute 19% of the EEZ, should be surveyed and promoted: the Heart of the sea, the sediment waves, the Pteropoda Skeletons, the southern slides, and the northern Levant channel.




The prioritized order of the plan's implementation includes two phases: Top priority --Branch A (shown in dark blue); second priority—Branch B (shown in light blue).

## 2. Surveys for Promoting the Marine Nature Reserves-Enlarging the Resource Pool

The main obstacle delaying the promotion of the marine nature reserves as a detailed plan ready for declaration is knowledge from field studies, which would provide a detailed characterization of the habitats, the ecological inventory and the required boundaries of the reserve. Conducting field studies in the deep sea is a complex and expensive endeavor that requires research vessels and innovative observation equipment. Without a designated budget, the Master Plan cannot be implemented operatively so that their establishment can be declared and administered, for the protection of nature in the sea.

Hence, as part of Israel's desire to comply with the international convention and to conduct a regulated and well-informed scientific process, there is a need to enlarge the pool of resources assigned to Marine research. This can be done by the government designating over the coming decade a specially added budget for conducting the surveys needed to promote the establishment of the nature reserves in the deep sea. Possible sources for such a budget could include the allocation of 10% of the yearly profit from Israel's Natural Gas Fund ("The Fund for Israeli Citizens"), and/or from the Fund for the Development of Open Spaces, for example. Furthermore, academic collaborations should also be considered, for example, through the Horizon Program Fund, which could help focus the efforts to survey the areas of the proposed marine reserves.

Within the framework afforded by the deep-sea surveys, there will be an emphasis on identifying and mapping archaeological findings and submarine heritage items in the area. As the surveys are to encompass a large area of the ocean, there is a need to involve as many interested parties as possible, to comprehensively address the numerous aspects pertinent to a survey of the ocean floor.

# D. The Management of the Nature Reserves

Effective management is needed to derive all of the benefits that the marine nature reserves can provide. Many areas that are considered protected throughout the world do not actively protect the marine environment, because they lack proper management and enforcement in the designated areas. Enforcing the prohibition of extractive and/or harmful activities in the area is what makes a difference between a paper park and a park that is an active no-take zone[1, 34]. The absence of monitoring is equivalent to blind management, which cannot properly measure the essential factors that can ensure the healthy functioning of the nature reserve.

**1. Monitoring**

To assess the value and efficacy of the nature reserves over time, there is a need to constantly and consistently monitor the components and functioning of the ecosystem within the nature reserves and compare the findings with the predefined conservation goals. To this end, periodic

ecological monitoring and research are needed, to provide the necessary assessments and make adjustments to the management of the reserves. The monitoring plan for the reserves (once announced) will be led by the INPA, which is responsible for the marine nature reserves, along with researchers and experts, to determine viable and informative quantitative measures. Monitoring can provide information regarding the distribution of species and habitats, measures of diversity, biomass, productivity, and ecological processes, such as settlement and recruitment of organisms, which can be indicative of the ecosystem's functioning. The monitoring plan will define the measures that reflect the health of the nature reserves, ways to identify any stressful events or deterioration in the ecosystem, and the possible budgetary and operational implications of such developments.

**2. Communication**

Publicity and advanced dialogue is the foundation for ensuring that the parties interested in the nature reserves comply with the rules and regulations. Hence, as is the custom of the INPA, before beginning the enforcement of the regulations of the established Marine nature reserve, a dialogue will be held on the subject of rules of behavior in the nature reserve with the parties interested in operating in the nature reserve (infrastructure organizations, the navy, sailors, fishing associations, etc.).

**3. Supervision**

The effective management of the nature reserve areas in terms of coping with the existing risks and threats requires constant supervision. The immensity of the area, its distance from the shore and the absence of a legal framework for the activities in the EEZ constitute a significant challenge for the efforts to enforce the necessary rules and regulations within the nature reserves. The first step in ensuring enforcement is to see that the enforcing authorities are legally grounded in Israel's legal system pertaining to the EEZ[98]. Secondly, in logistic terms, recent years have seen an increase in the use of advanced technologies for supervising marine protected areas, which can enhance the efficacy of enforcement and reduce its cost. Such advanced technologies include the use of satellite information, acoustic devices, drones and specialized sea and aircraft[97]. All of these involve the need to plan for the designated budgets, as part of the reinforcement of the Nature and Parks Authority, training processes and preparation for increased activity in the areas of the deep-sea nature reserves. Furthermore, enforcement activities within the EEZ should also involve transborder initiatives and collaborations.

**4. Enforcement**

In cases where supervision must be translated into enforcement activities, the INPA's need to manage and oversee such enforcement activities introduces unique challenges related to evidence collection in the deep-sea area that is distant from the coast, as well as potential legal challenges. Hence, it is recommended that the authorities should identify regulation guidelines that would enable enforcement, in accordance with the legal framework, which hopefully will soon be addressed as part of the Marine Areas Law.

5

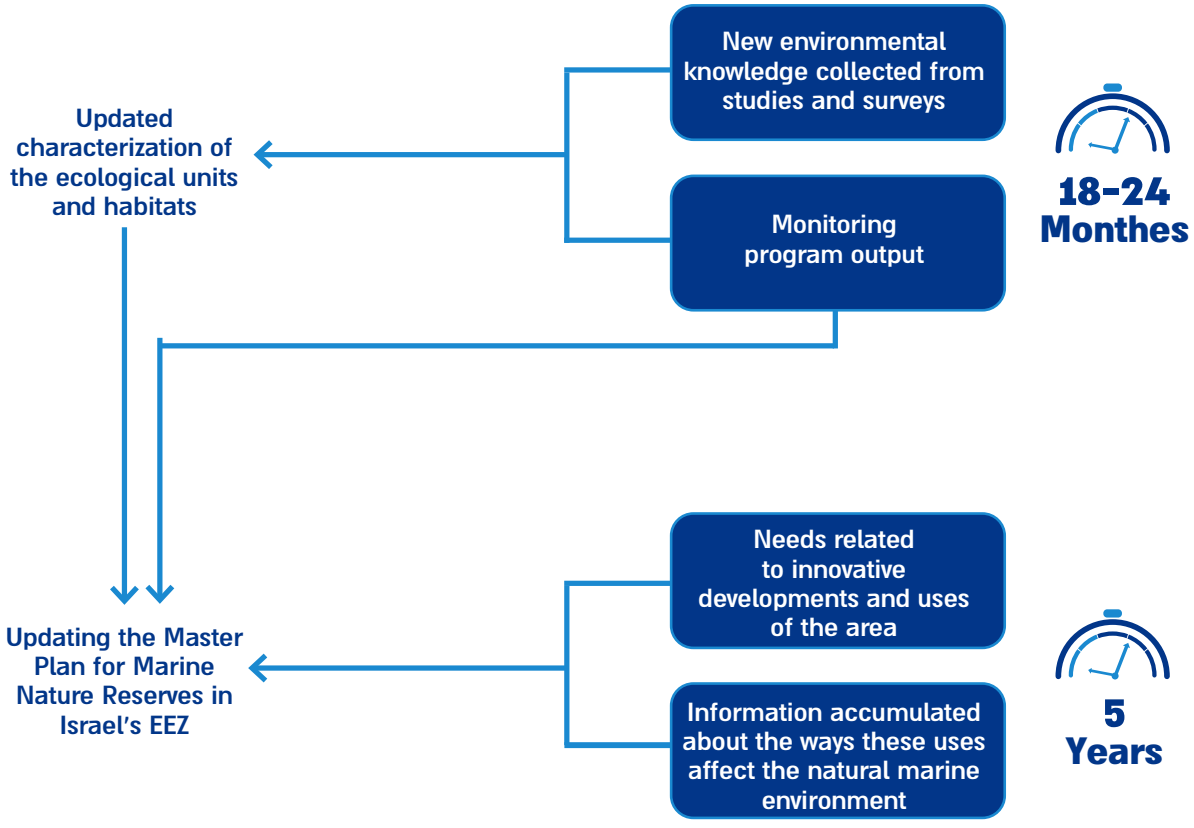
# An Outline for Updating the Master Plan

The Master Plan for Marine Nature Reserves is based on the best scientific knowledge available today and the most advanced methods for this type of process. However, not unlike all of the deep-sea areas throughout the world, there are knowledge gaps regarding the spatial distribution of habitats and ecological units in the area, gaps which need to be addressed and closed by means of targeted research and periodic analysis, taking into account new data.

The recommendations of the project's Scientific Advisory Committee determined that the existing knowledge and information are sufficient to plan a network of reserves. Nevertheless, the committee also recommended periodically updating the characterization of the ecological units and habitats based on new information collected every 18 to 24 months, until such time as a consensus is reached stating that the knowledge gaps in the area are no longer significant. To this end, the Committee recommended focusing the research efforts on areas where there is a need to verify the presence of vulnerable habitats and there are still significant knowledge gaps. The periodic updating of knowledge regarding the ecological units and habitats, along with the output of the monitoring program, will be used to update the master plan for the reserves, which according to the professional literature should occur every 4-5 years[65].

Furthermore, updates to the Master Plan will also address needs related to innovative uses of the area, the type and frequency of economic activities and information accumulated about the ways these uses affect the natural marine environment.

**The outline for updating the Master Plan for Marine Nature Reserves in Israel's EEZ**



6

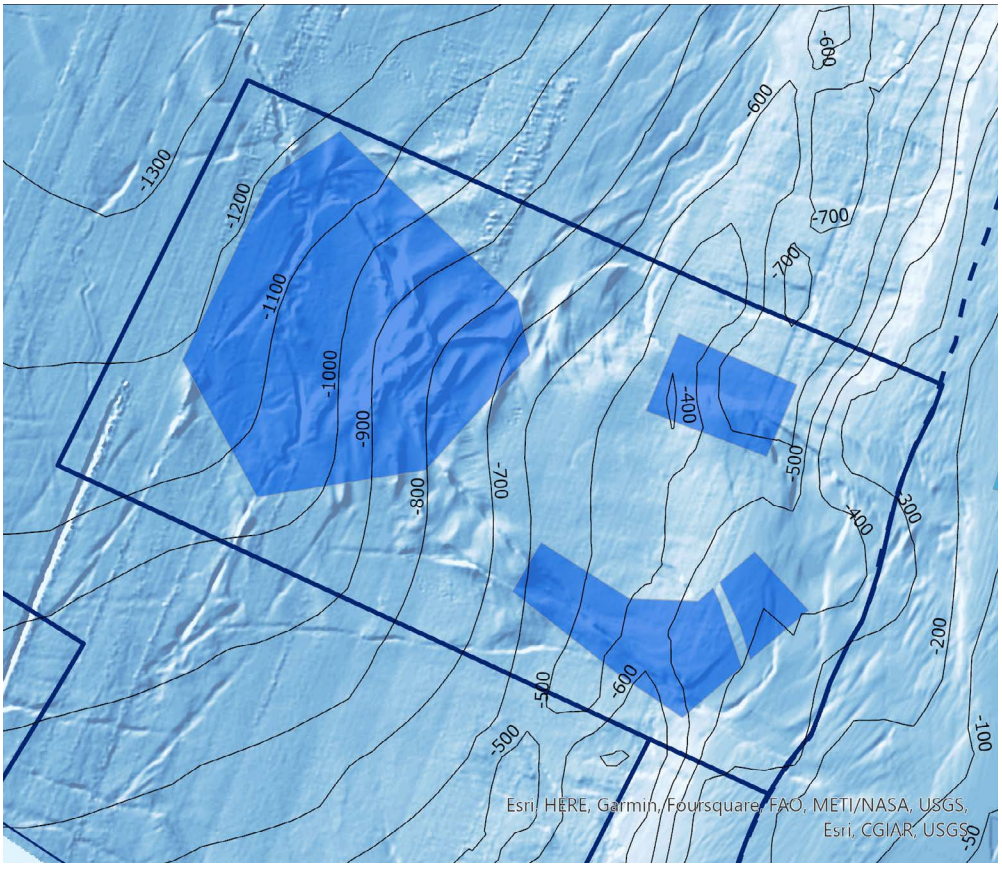
# The 10 Reserves

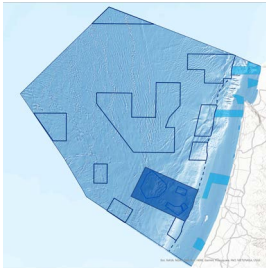
## Detailed Characterization

Batoids living on the soft sediment on the Continental slope and Bathyal plains.  An example of a  Longnosed skate | Photo: Adam Weissman, and Yizhaq Makovsky, University of Haifa

# The Palmahim Disturbance Reserve

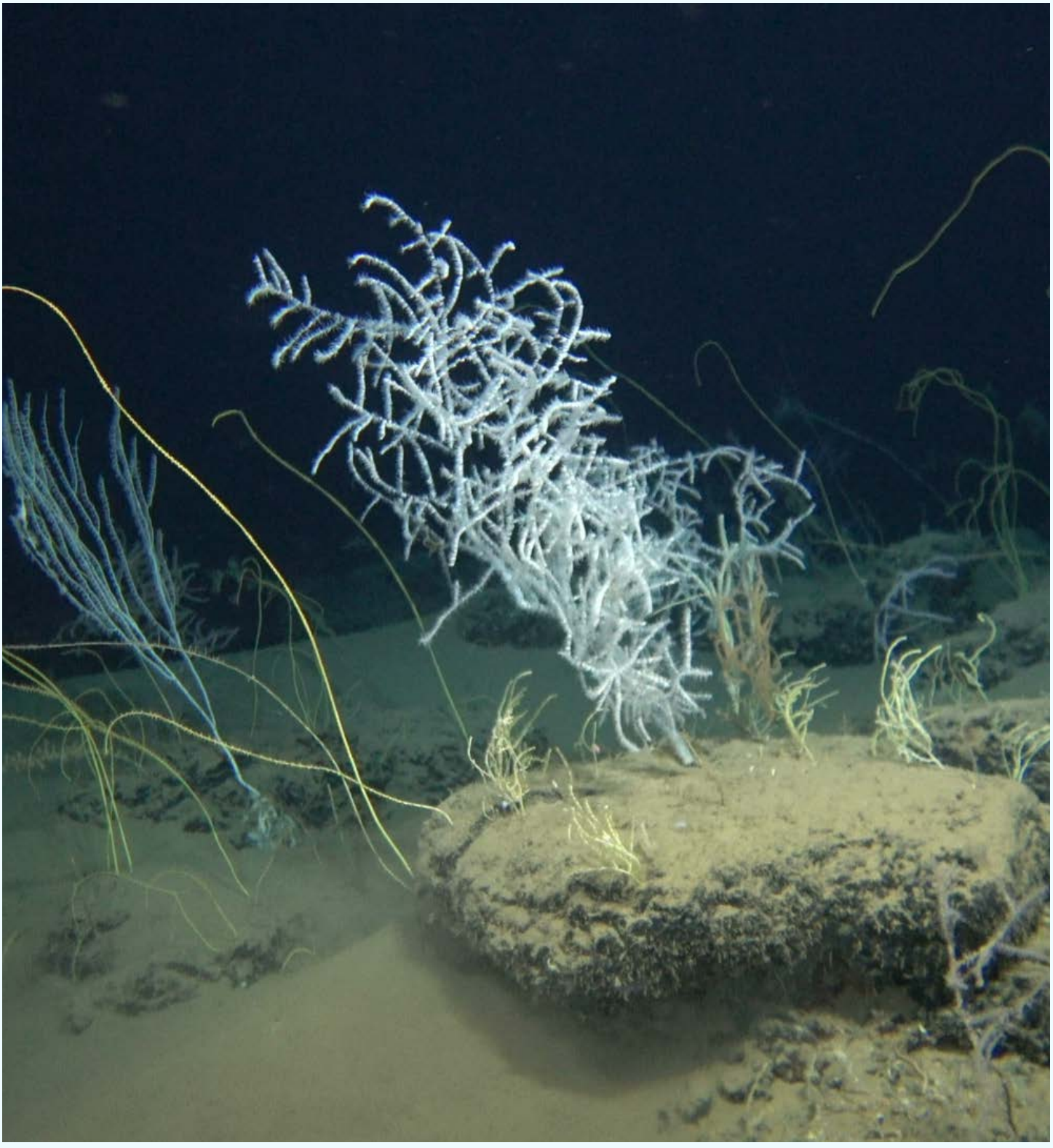
The Palmahim Disturbance Reserve occupies 1,360 km$^2$, encompassing the previously established reserve of the Palmahim Slide. The bathymetric complexity of the Palmahim disturbance supports a range of habitat types and, hence, is considered a unique geological and ecological phenomenon in the eastern Mediterranean. Palmahim Disturbance Reserve can protect the entire area of the disturbance and all of the habitats within this area, which include deep-sea coral gardens, carbonate rocks, methane seeps, deep-hypersaline anoxic basins (brine pools) and nurseries for deep-sea sharks.



Israeli EEZ border
Territorial waters boundary
Depth contours
Proposed marine reserve in the EEZ
The Palmahim Slide Reserve

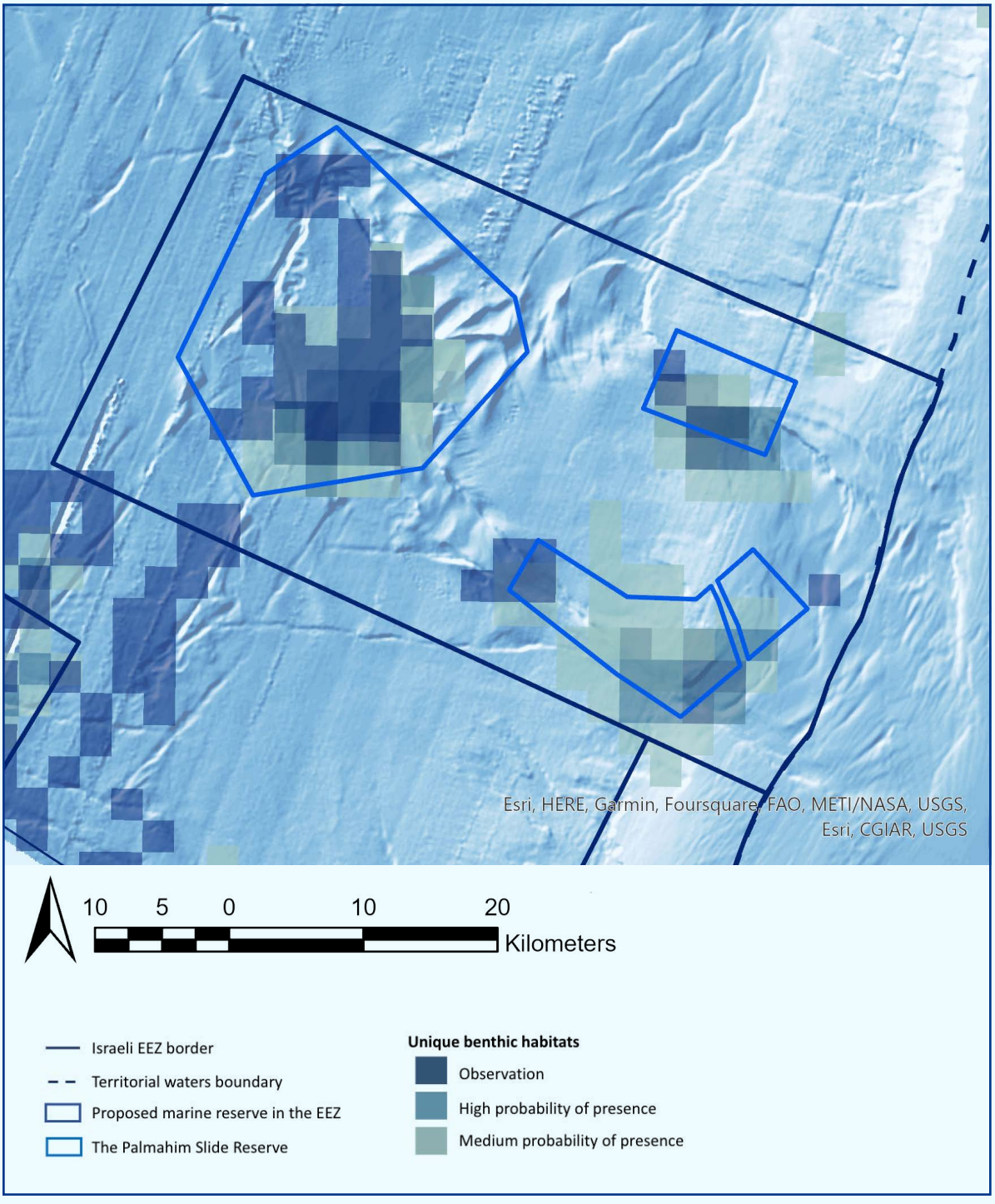
| | | |
|---|---|---|
| N | Area (km$^2$): **1360km$^2$** | Depth range (m): **300-1300m** |
| | Maximal distance from adjacent reserve (km): **23** | 10 5 0 10 20 Kilometers |



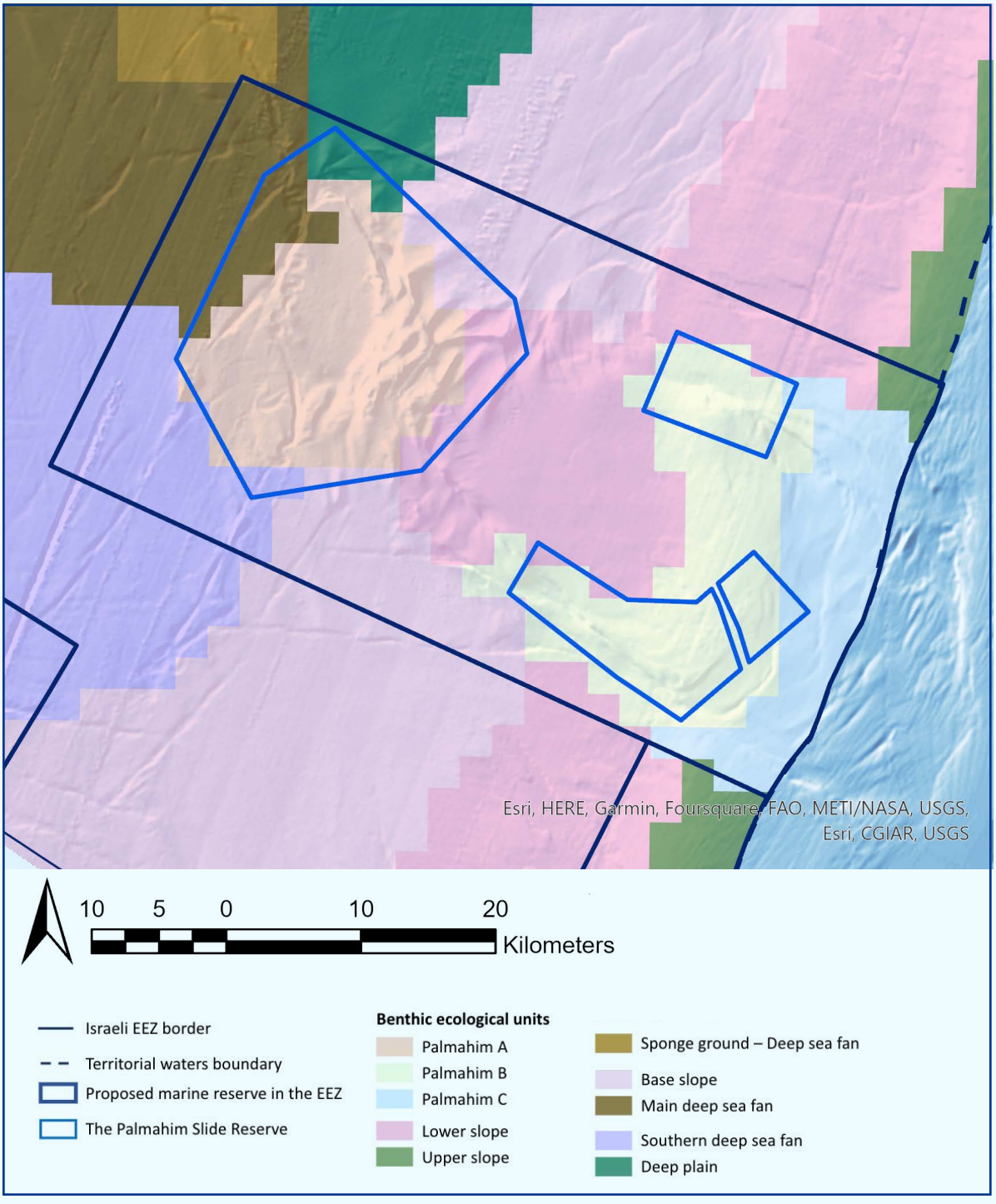
Coral gardens at the Palmahim Disturbance | Photo: Adam Weissman, Yizhaq Makovsky, University of Haifa

Deep-water coral and associated invertebrates | Photo: Adam Weissman, Yizhaq Makovsky, University of Haifa

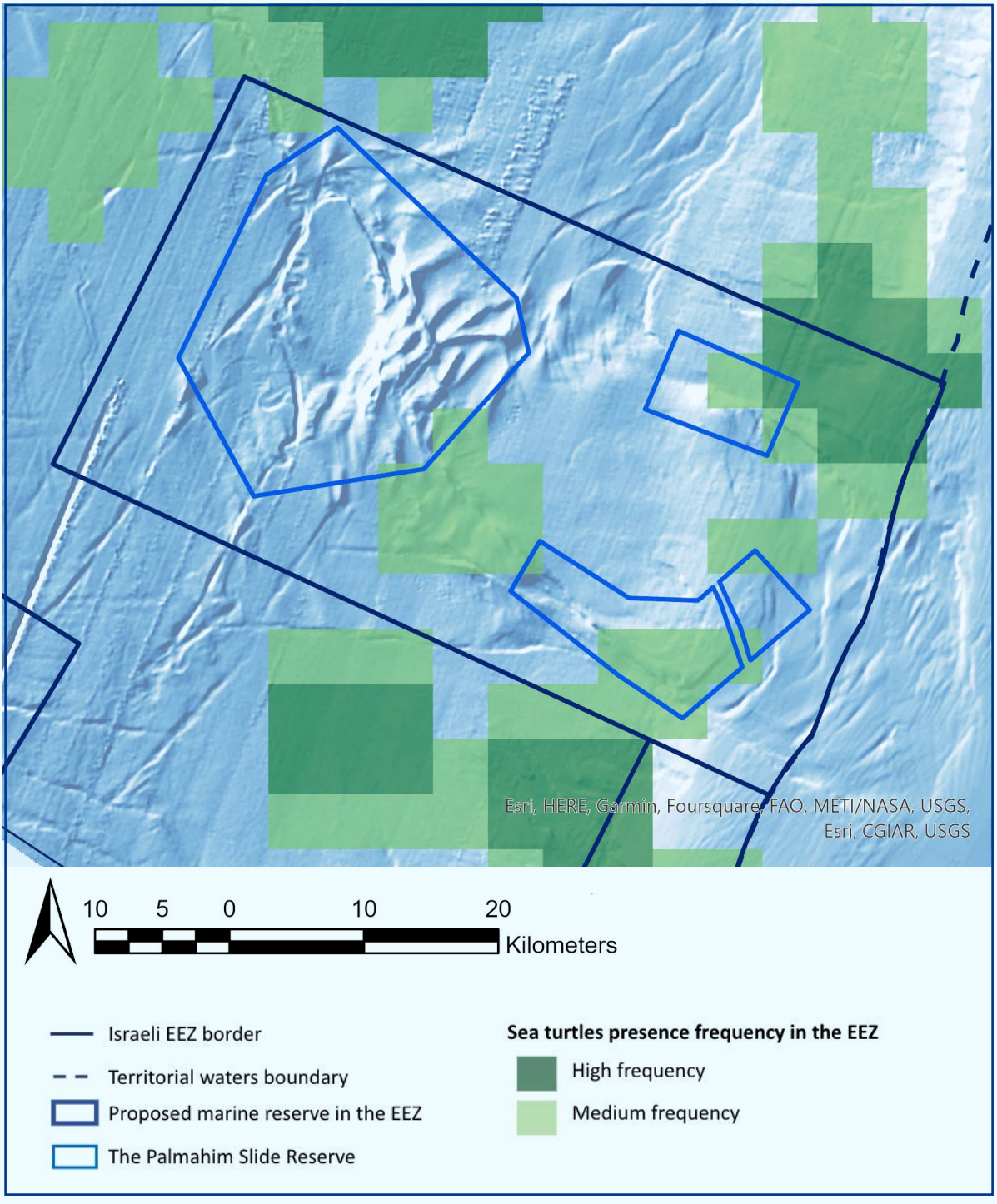
**Unique habitats in the benthic zone of the Palmahim Disturbance Reserve:**
Observations of deep-sea coral gardens, methane seep, carbonate rocks, deep-hypersaline anoxic basins and sea pens



**Representative Ecological Units on the Sea Floor of the Palmahim Disturbance Reserve:**
The majority of the area includes the three ecological units that are components of the Palmahim area (Palmahim A-C), as well as a portion of the ecological units characteristic of the slope and bathyal plains.



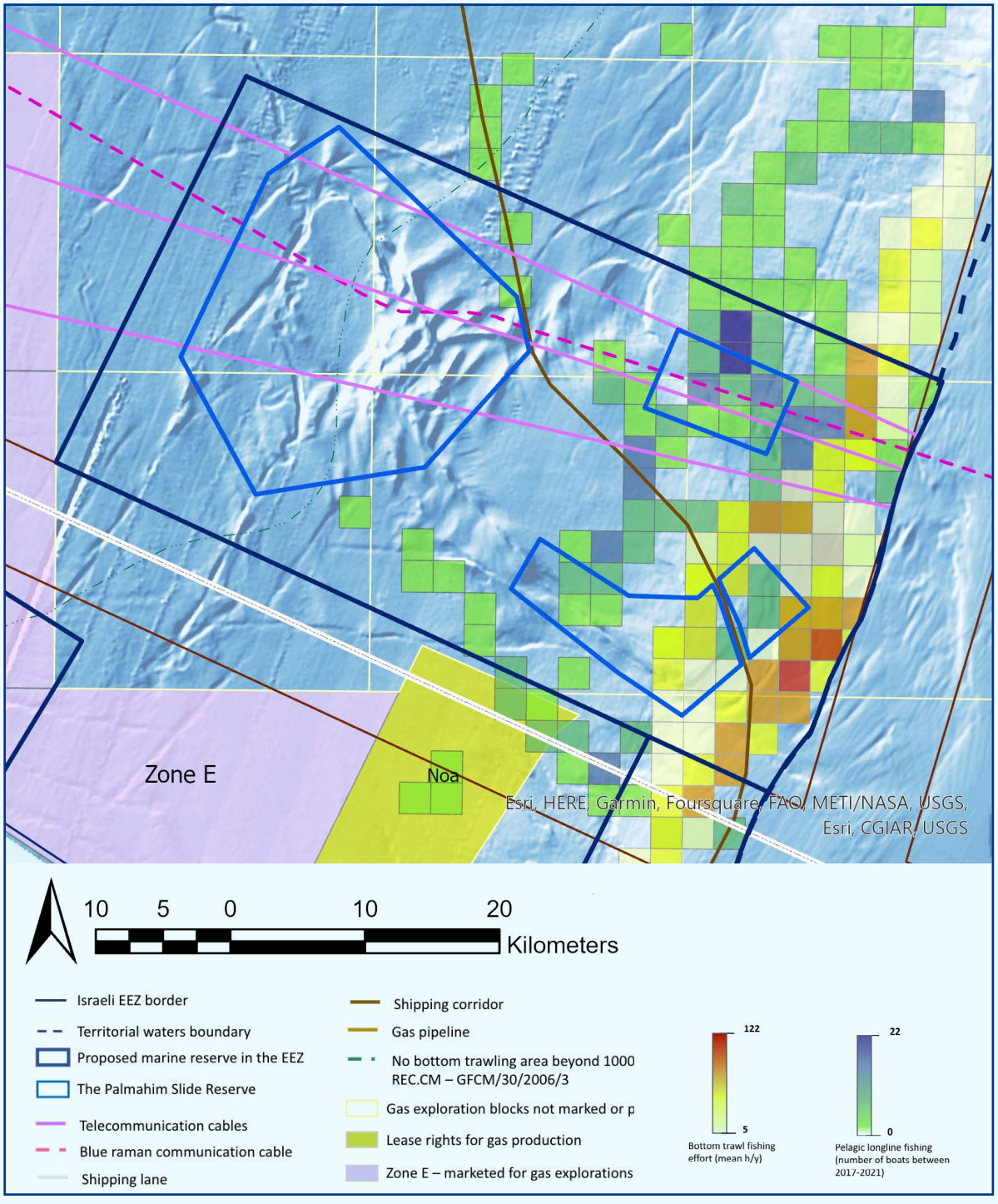
**Unique pelagic areas in the Palmahim Disturbance Reserve:**
In some of this area, year-round highly frequent sea-turtle activity was observed.



**Pelagic ecological units:**

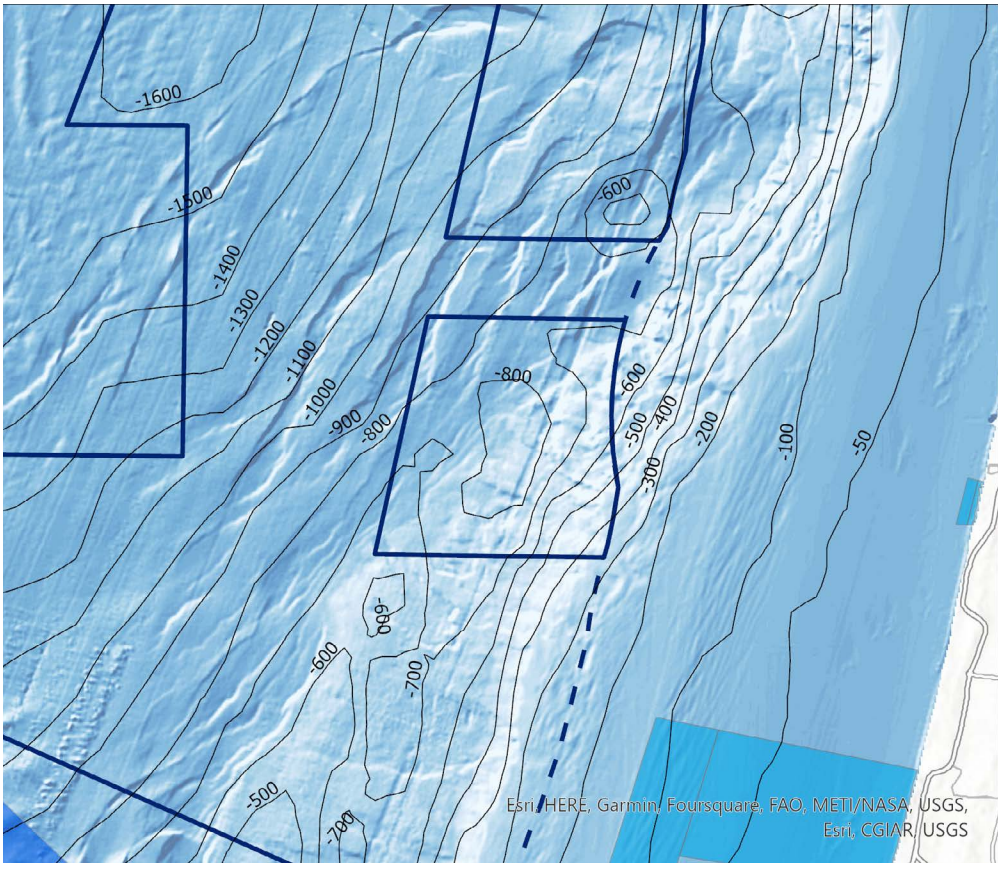
Pelagic ecological unit of the continental slope and pelagic ecological unit that is characterized by relatively warmer temperature

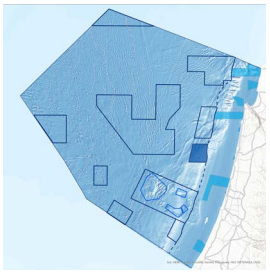
**Socioeconomic activity at the Palmahim Slide Reserve:**
Palmahim Slide reserve, Trawl fishing, pelagic fishing, and infrastructure lines.



# The Central Slope Reserve

The Central Slope Reserve encompasses 210 km² and includes areas where pockmarks were observed on the seabed and where the presence of unique habitats, such as deep-sea coral gardens, is highly probable. The reserve protects a part of the continental slope where the important ecological process of transporting nutrients to the benthic zone occurs, and the area is characterized by a wide range of biological diversity and primary productivity in the pelagic zone.

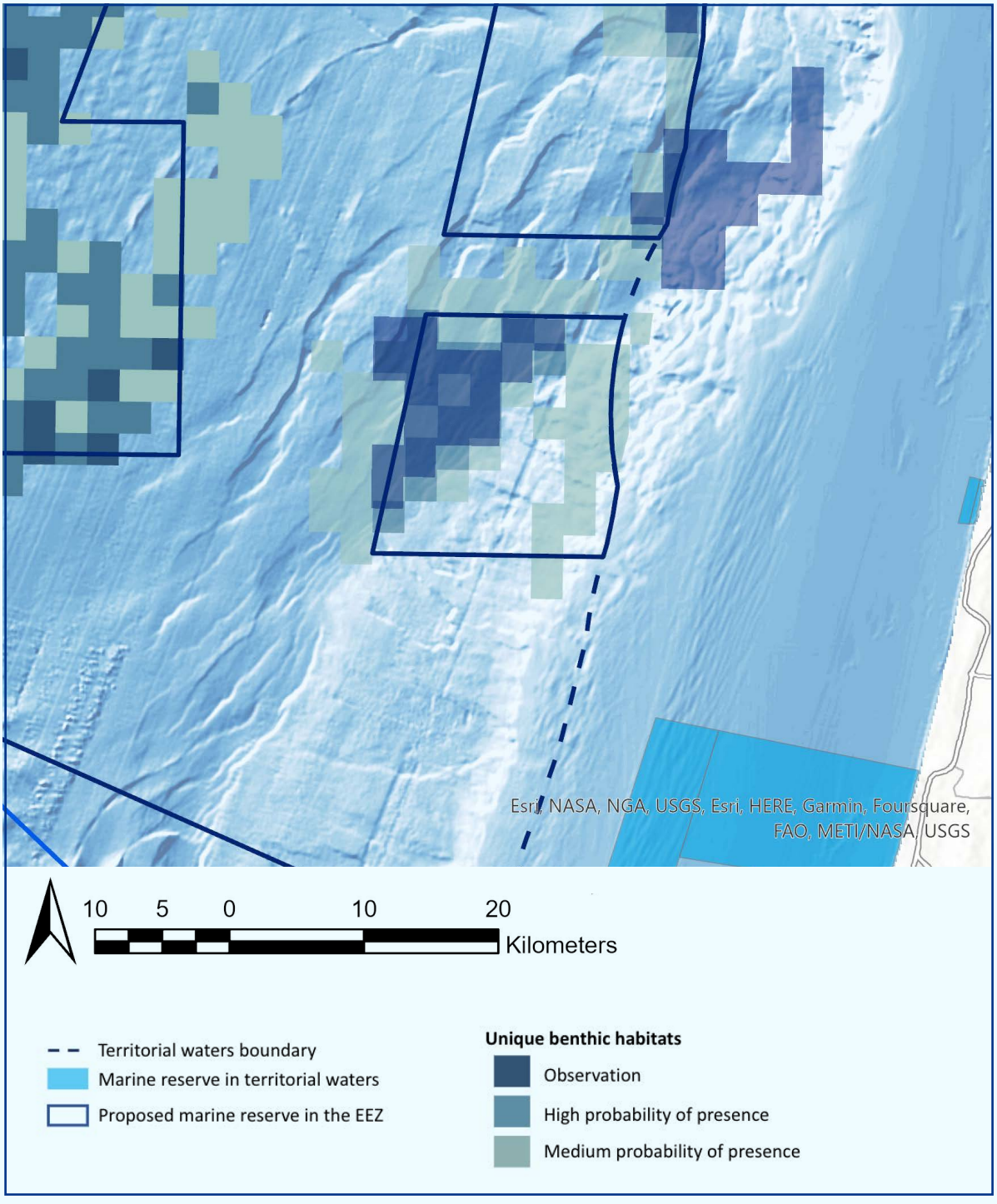


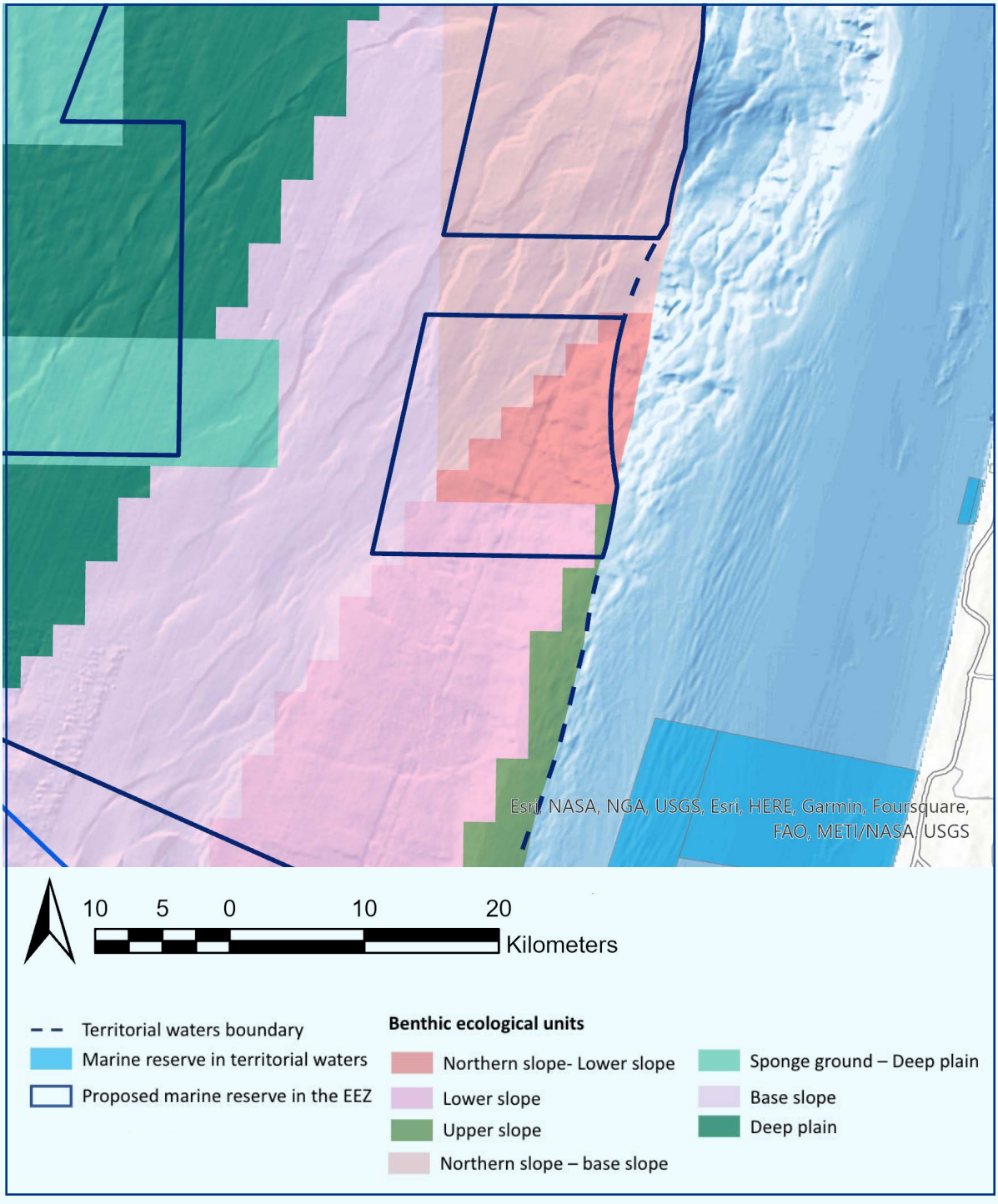
Territorial waters boundary
Depth contours
Proposed marine reserve in the EEZ
The Palmahim Slide Reserve
Marine reserve in territorial waters

| | | |
|---|---|---|
| N | Area (km²): **210** | Depth range (m): **400-900** |
| | Maximal distance from adjacent reserve (km): **20** | 10 5 0 10 20 Kilometers |

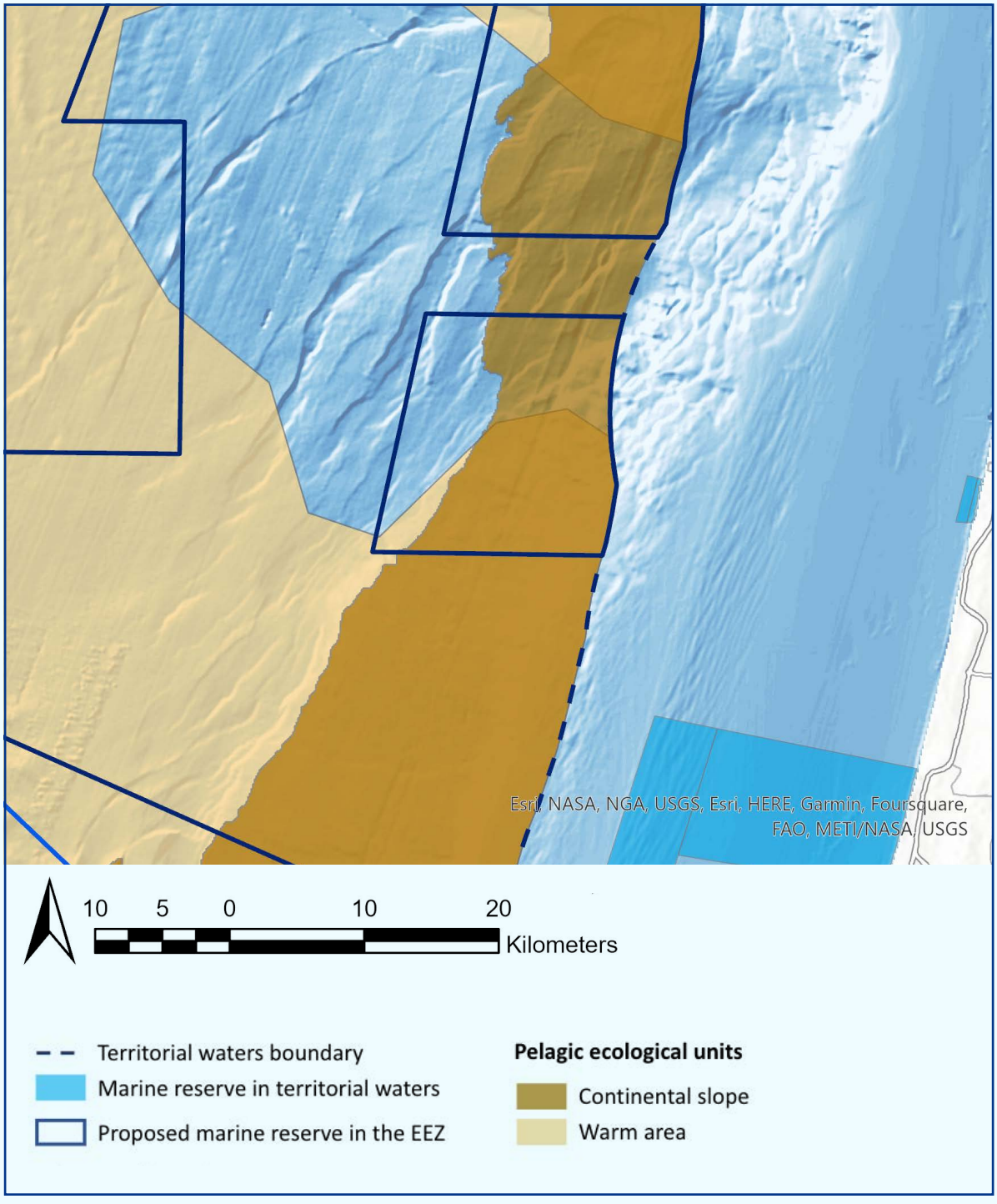
**Unique habitats in the benthic zone of the Central Slope Reserve:**
Observations of pockmarks, and highly probable presence of deep-sea coral gardens and methane seeps



**Representative ecologic units on the sea floor of the Central Slope reserve:**
A portion of the four ecological representative units of the Continental slope and one ecological unit with biological components that are characteristic of the northern part of the continental slope.

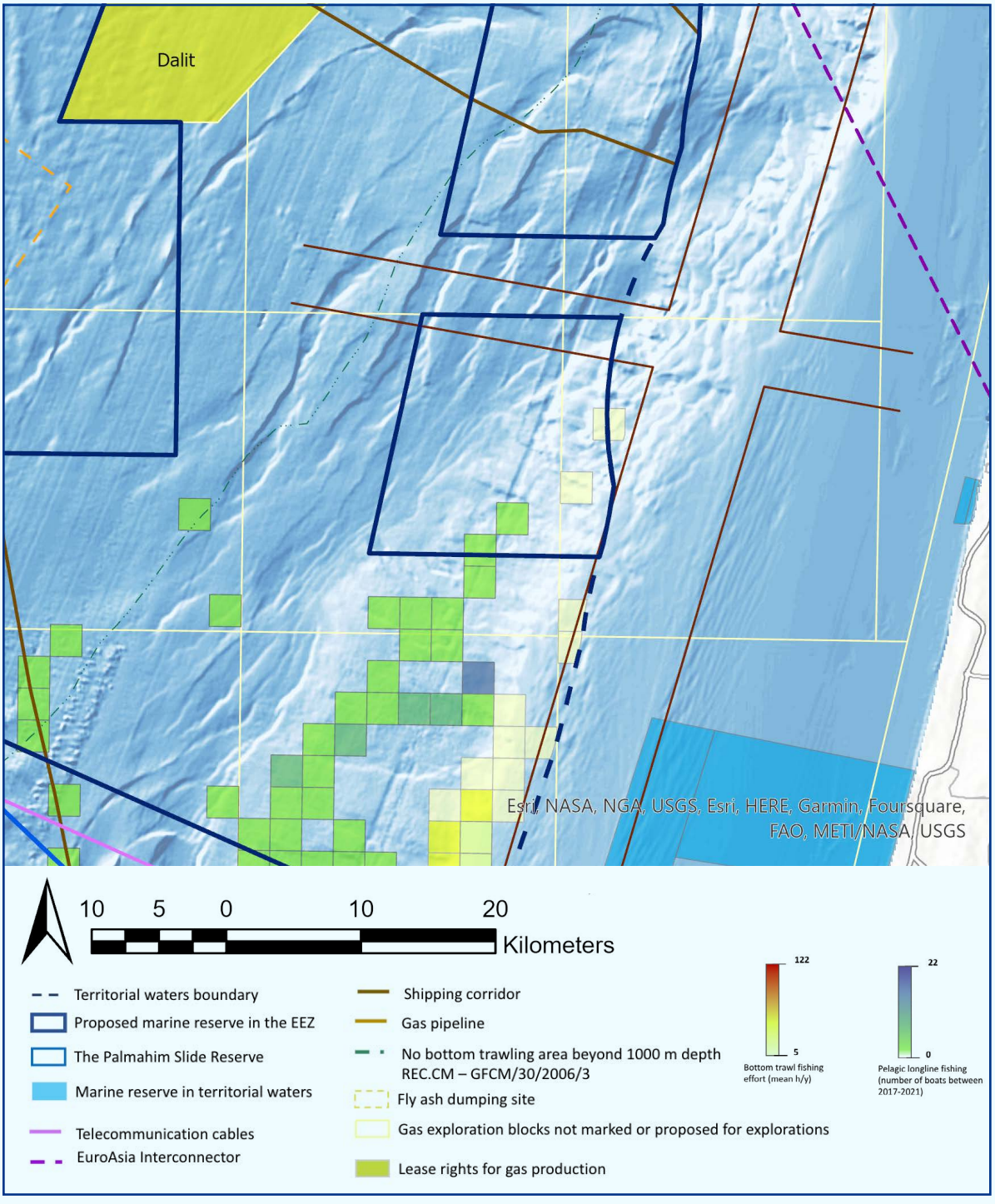


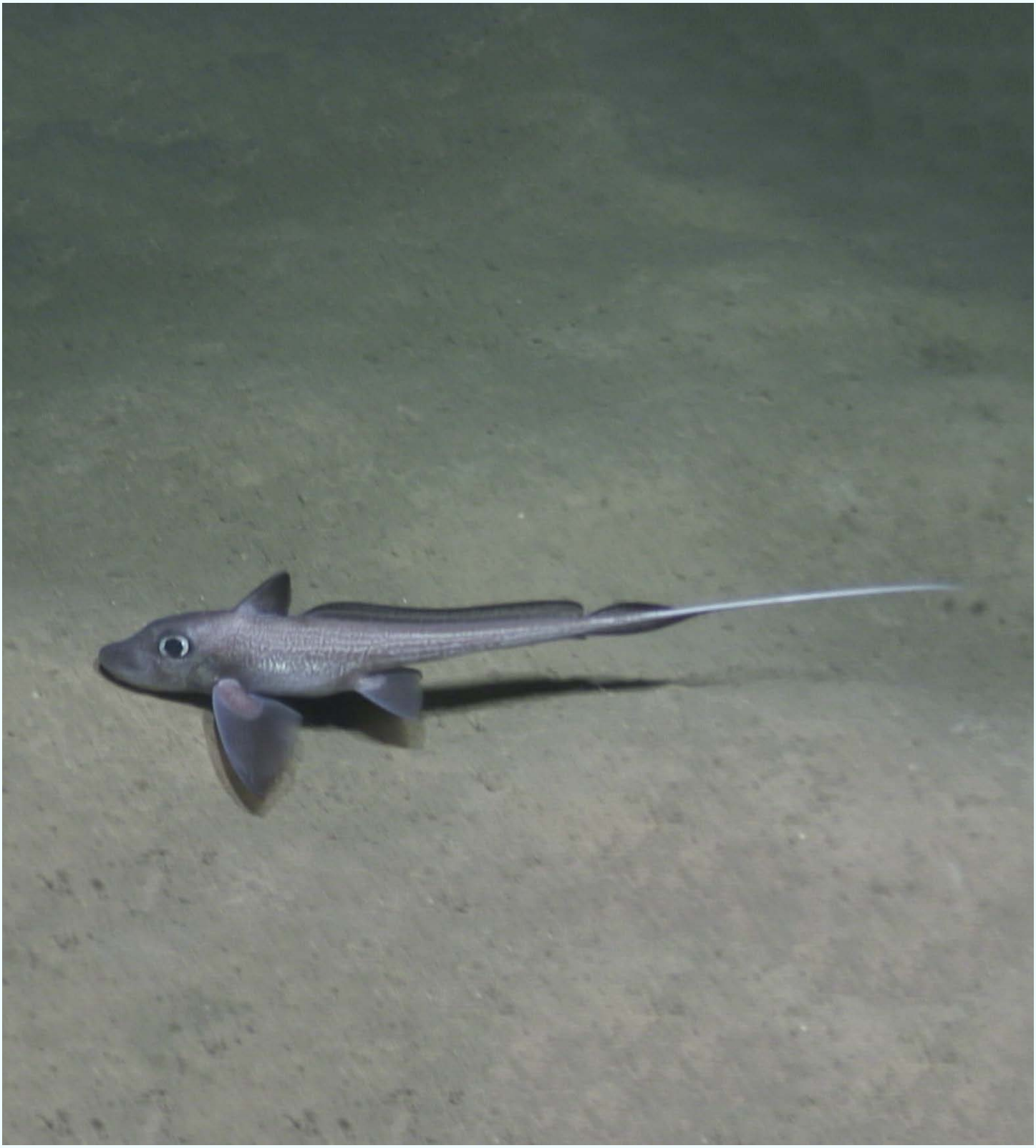
**Pelagic ecologic unit of the Central Slope reserve:**
A pelagic ecological unit of the Continental slope and the edges of a pelagic unit of an area characterized by a relatively high temperature.



**Socioeconomic activities within the Central Slope reserve:**

The reserve partially overlaps with a secondary shipping route, which mostly supplies the electric power station of Orot Rabin and overlaps with the edges of the pelagic fishing activity area.



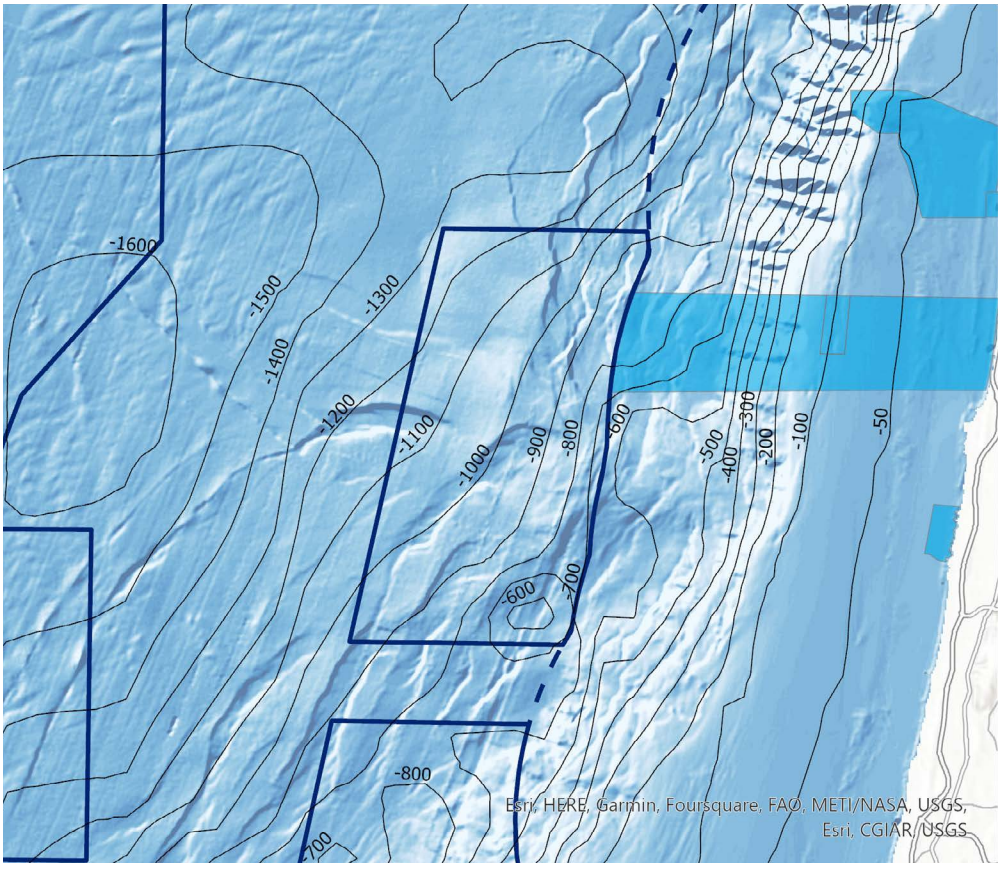


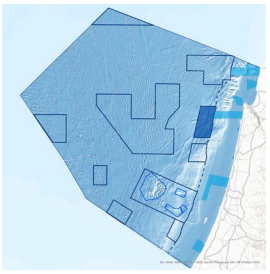
**Deep-sea fish found in the Central Slope reserve.** One example is the Chimaera (ghost shark), a cartilaginous fish typical to the deep sea | Photo: Adam Weissman, and Yizhaq Makovsky, University of Haifa

# The Dor-Slide Base Reserve

This reserve covers an area of 350 km², to the west of the Neve Yam reserve in the territorial waters. The reserve is located at the base of the continental slope, at the foot of the Dor slide. It is one of the two largest and most unique landslides along the Continental slope of the Israeli Mediterranean Sea and is characterized by high bathymetric complexity. Pockmarks have been observed in the area of the reserve, and there is a high probability for the existence of methane seeps throughout about half of the reserve area.

The reserve protects a part of the continental slope's base, where the important ecological process of transporting nutrients to the benthic zone occurs, and the area is characterized by a wide range of biological variability and primary productivity in the pelagic zone.

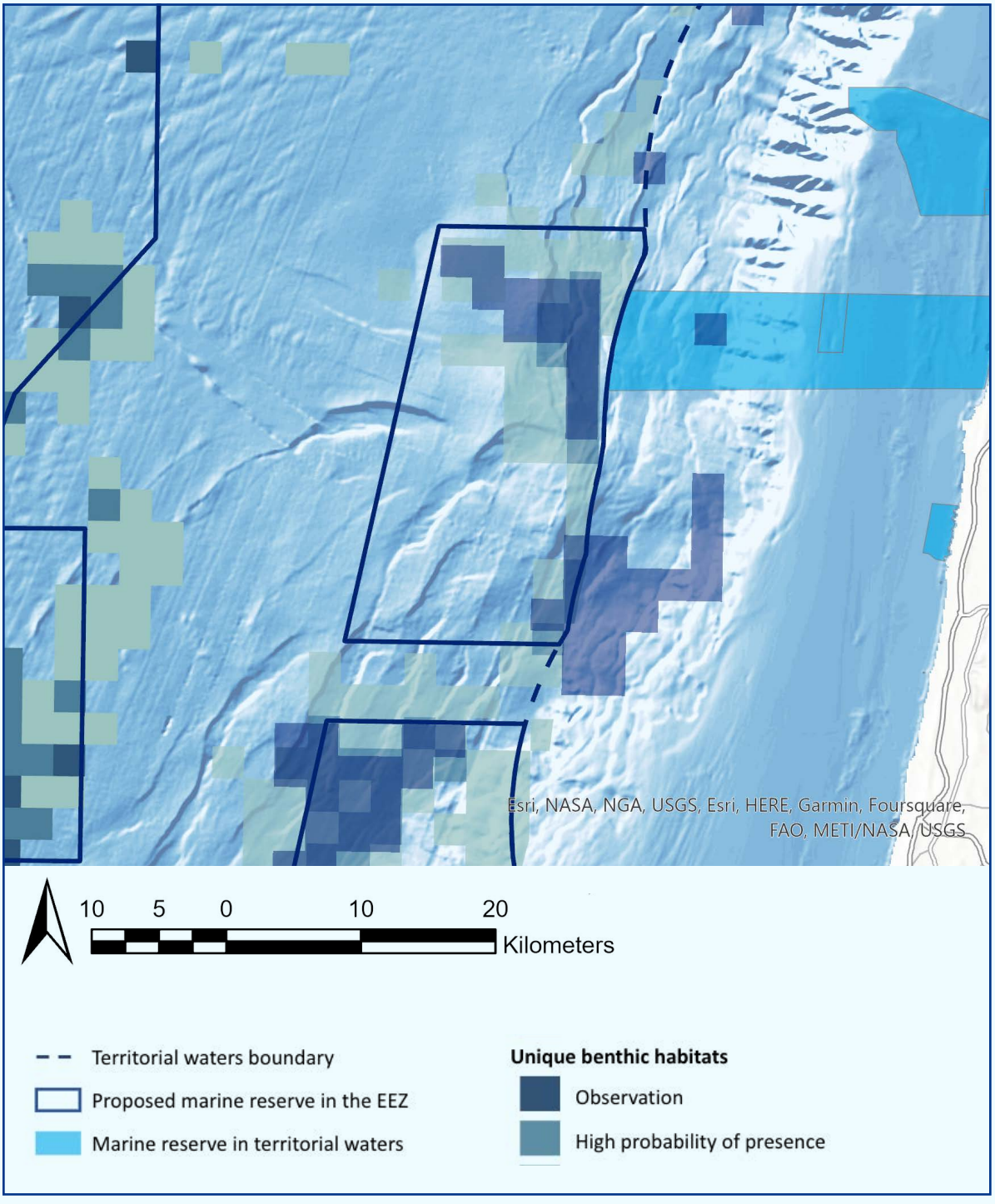


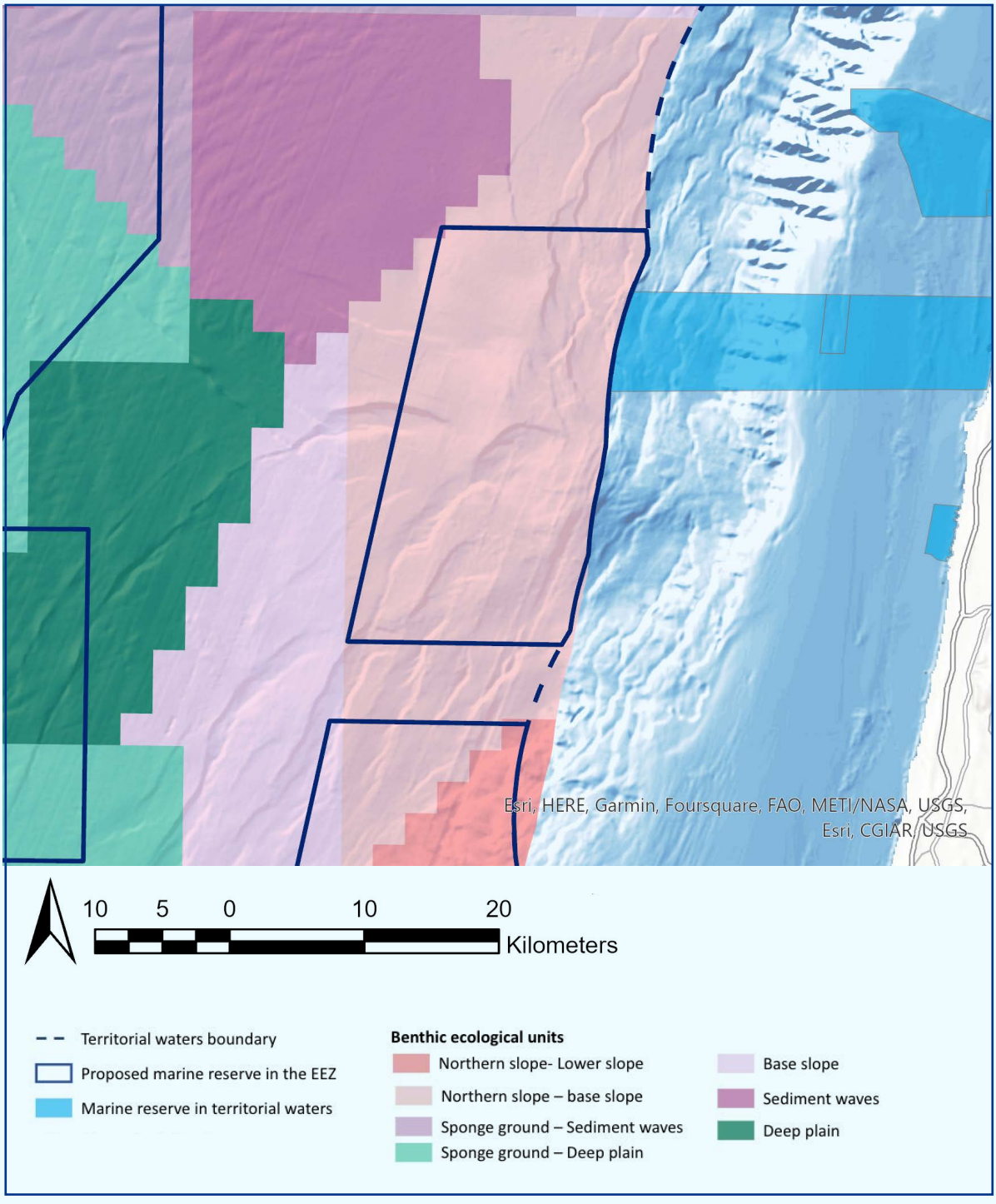
Territorial waters boundary
Depth contours
Proposed marine reserve in the EEZ
Marine reserve in territorial waters

| | | |
|---|---|---|
| N | Area (km²): **350** | Depth range (m): **700-1300** |
| | Maximal distance from adjacent reserve (km): **18** | 10 5 0 10 20 Kilometers |

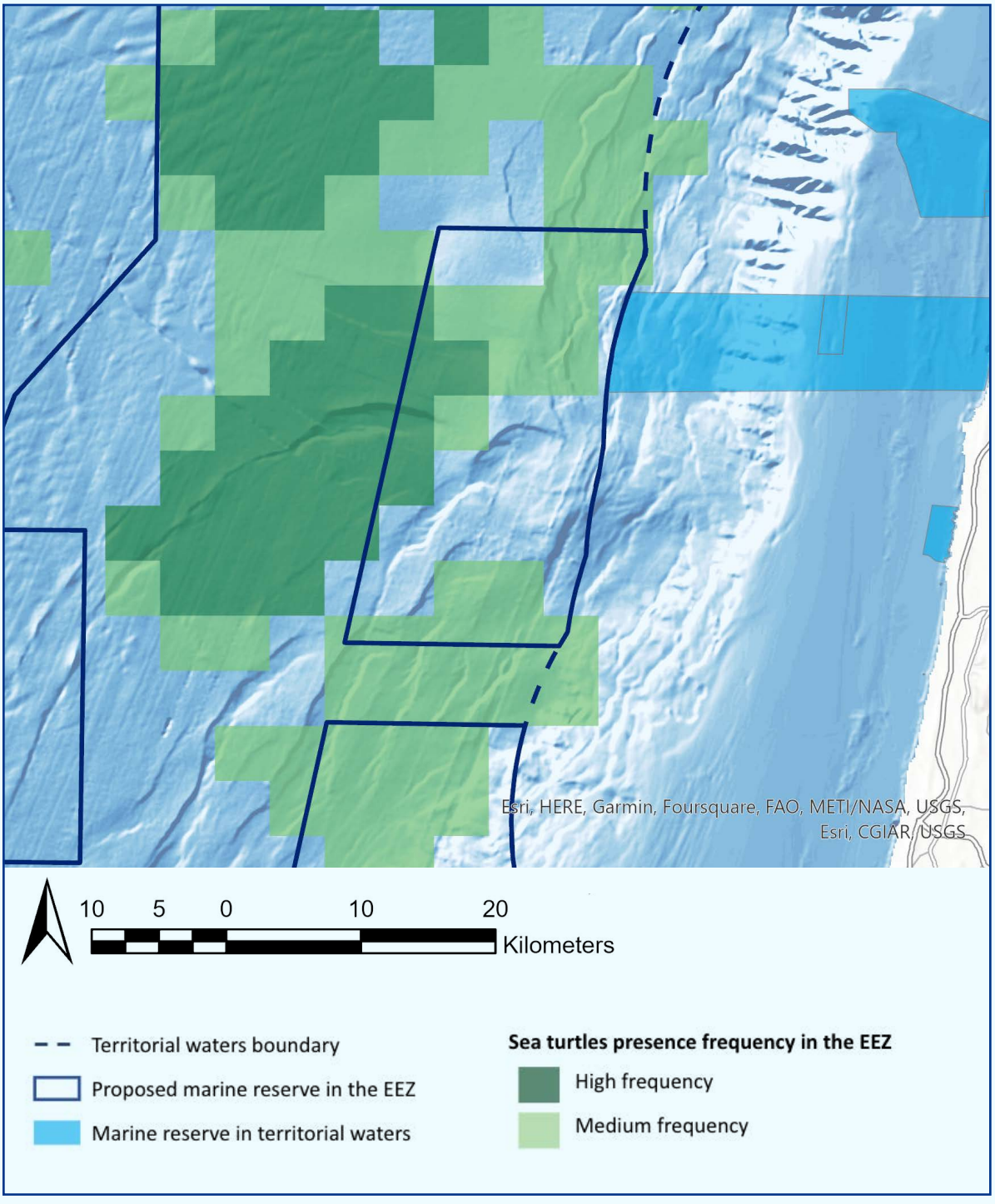
**Unique habitats on the sea floor of the Dor-Slide Base Reserve:**
Observations of pockmarks and high presence probability of methane seeps



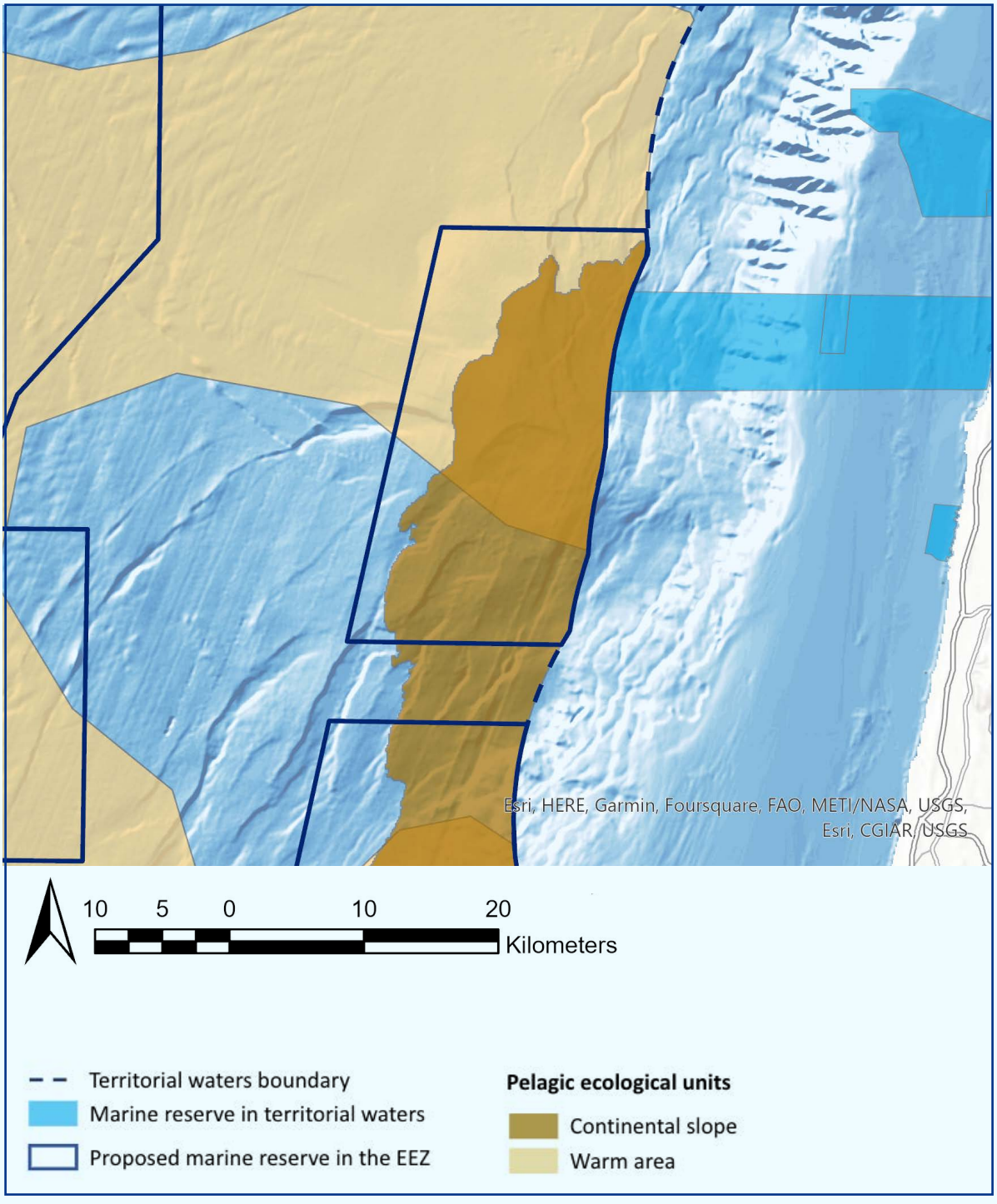
**Representative ecological units in the benthic zone of the Dor-Slide Base Reserve:**
A representative ecological unit of the slope's base, with biological components that are characteristic of the of the northern Continental slope.



**Unique pelagic activity at the Dor-Slide Base Reserve:**
In some of the area, year-round, high frequency sea-turtle activity was observed.

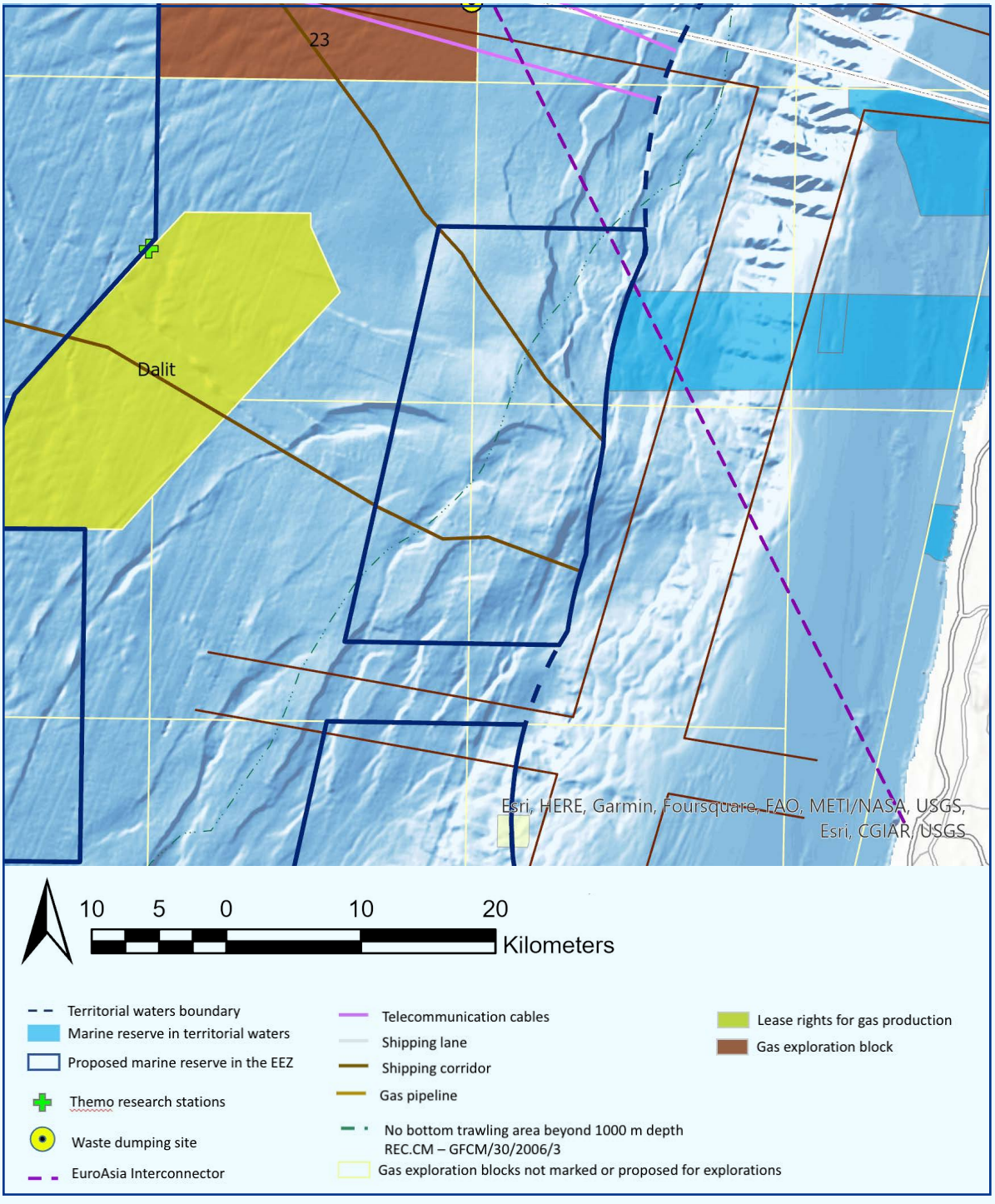


**Pelagic ecological units of the Dor-Slide Base Reserve:**
A pelagic ecological unit of the Continental slope and the edges of a pelagic unit of an area characterized by a relatively high temperature.



**Socioeconomic activities within the Dor-Slide Base Reserve:**

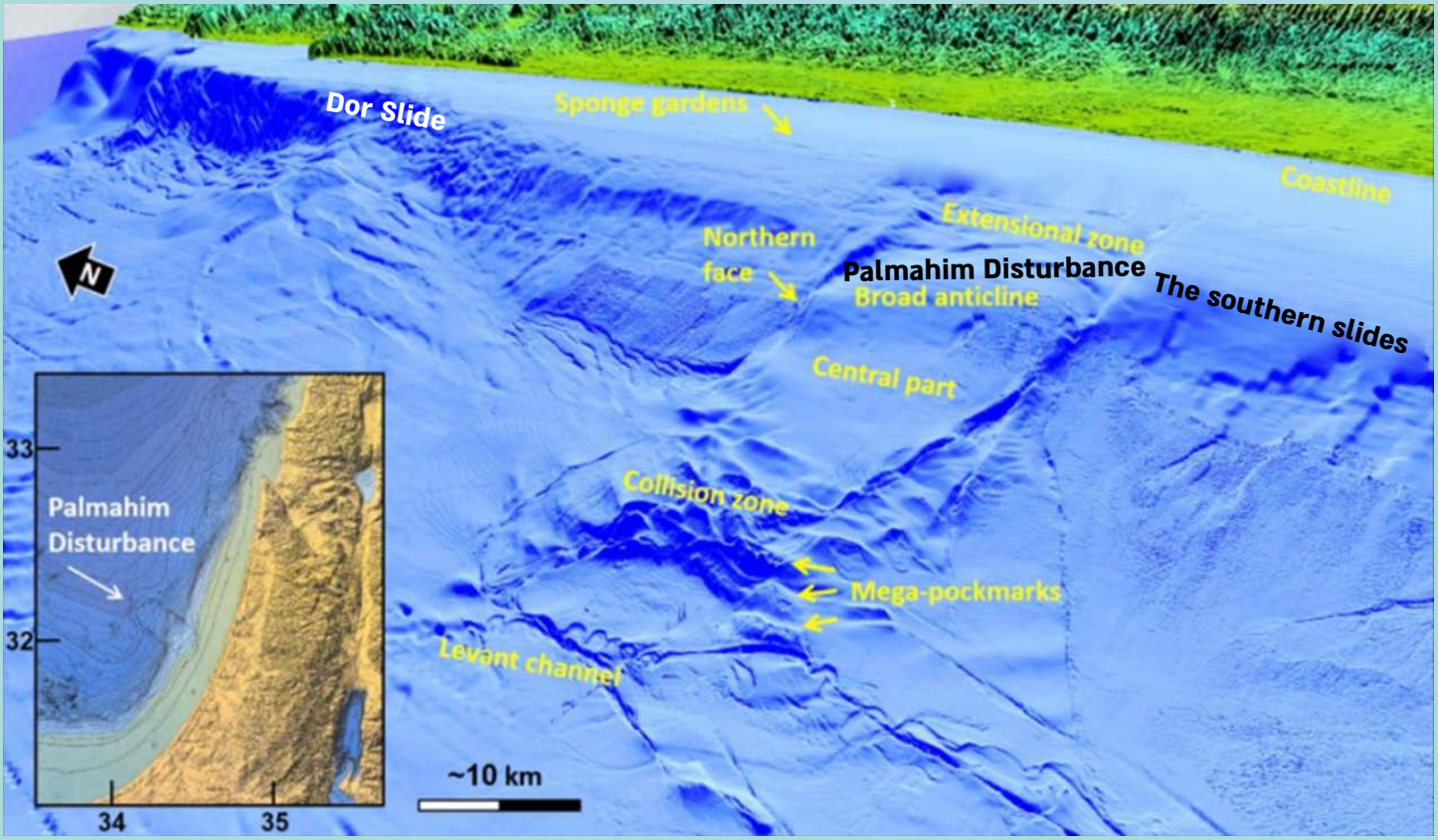
The reserve is located along a major axis which is traversed by infrastructure lines and cables. Hence, should there be a need, additional infrastructure lines will be placed within the area of the reserve.




# Searching for Unique Habitats? Find the disturbance

The deep-sea floor is not geologically uniform. Even in the bathyal muddy plains, which are typically considered to be a homogenous area, one finds ridges, faults, trenches, hills, and other geomorphological formations[46]. However, the most unique formations are the disturbances. Gradual land shifts and movements that occurred millions of years ago caused part of the continental slope to detach and plummet westward. The largest and most impressive of these disturbances in the Israeli EEZ is the Palmahim disturbance - an area 15 km wide by 50 km long, which includes several different topographies. Among these are active gas seeps, rock formations caused by these seeps, and brine pools. The Cliffs, created by the landslides, cause stronger currents that apparently transport nutrients, which, in turn, support deep-sea coral colonies[43]. These phenomena provide the conditions for the unique habitats found in the Palmahim disturbance.

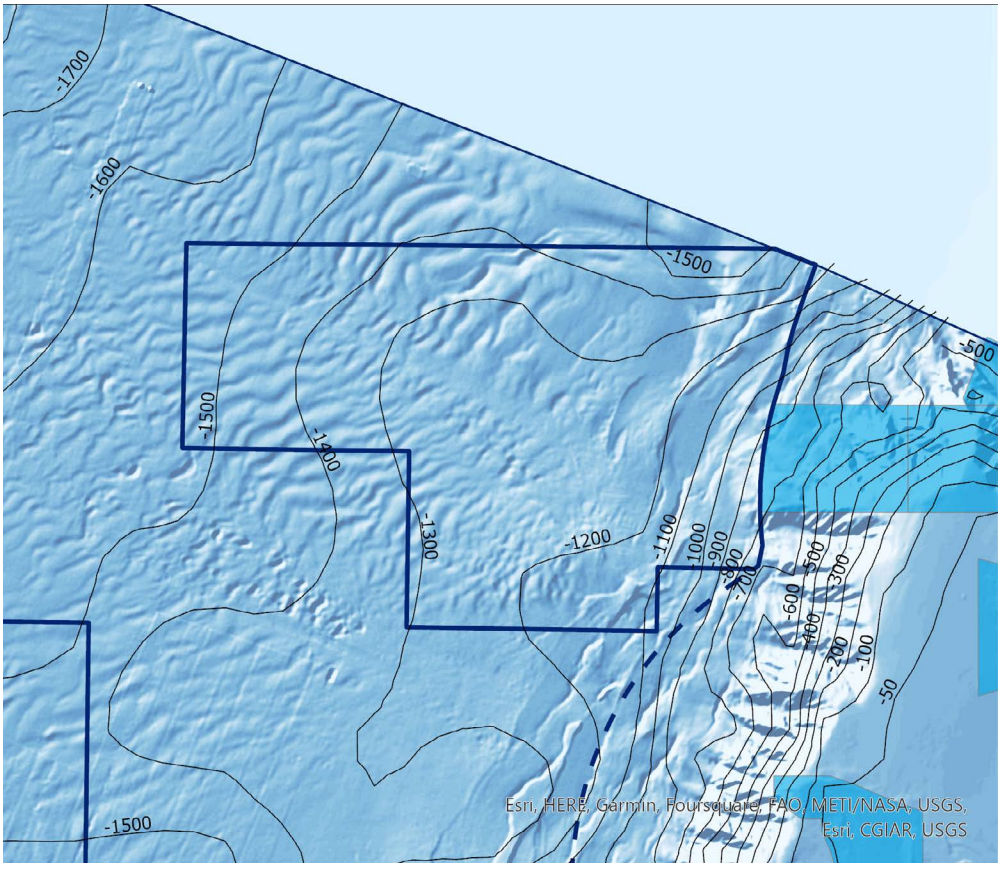
In addition to the Palmahim disturbance, there are other landslides, such as the Dor landslide, which likewise has gas seeps at its base. Farther south, there are several smaller landslides, among them the Goliath landslide located across from the Ashkelon coast, which, to date, have barely been researched. The land disturbances cause structurally complex formations on the seabed, resulting in diverse ecological niches, which are colonized by various species. Consequently, the land disturbances play an important part in creating unique habitats[15]. Three of the nature reserves outlined in the Master Plan protect these unique areas, the entire Palmahim disturbance, the base of the Dor disturbance, and a segment of the southern disturbances.

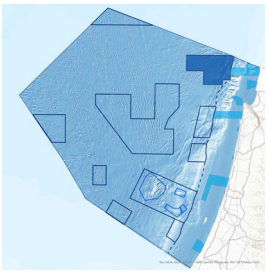



Imaging of the Palmahim disturbance and the various formations found in it | From: Makovsky et al. [57]

# The Sediment Waves Reserve

The Sediment Waves Reserve occupies 720 km$^2$ to the west of the Achziv Reserve, which is in Israel's territorial waters. This is the northernmost reserve among the five that protect the Continental slope axis. The important ecological process of transporting nutrients to the benthic zone occurs within this reserve. It is characterized by substantial biological variability and high primary productivity in the pelagic zone. The bathymetric features in this area indicate sediment waves on the sea floor, where soft-sediment sponge grounds were observed.

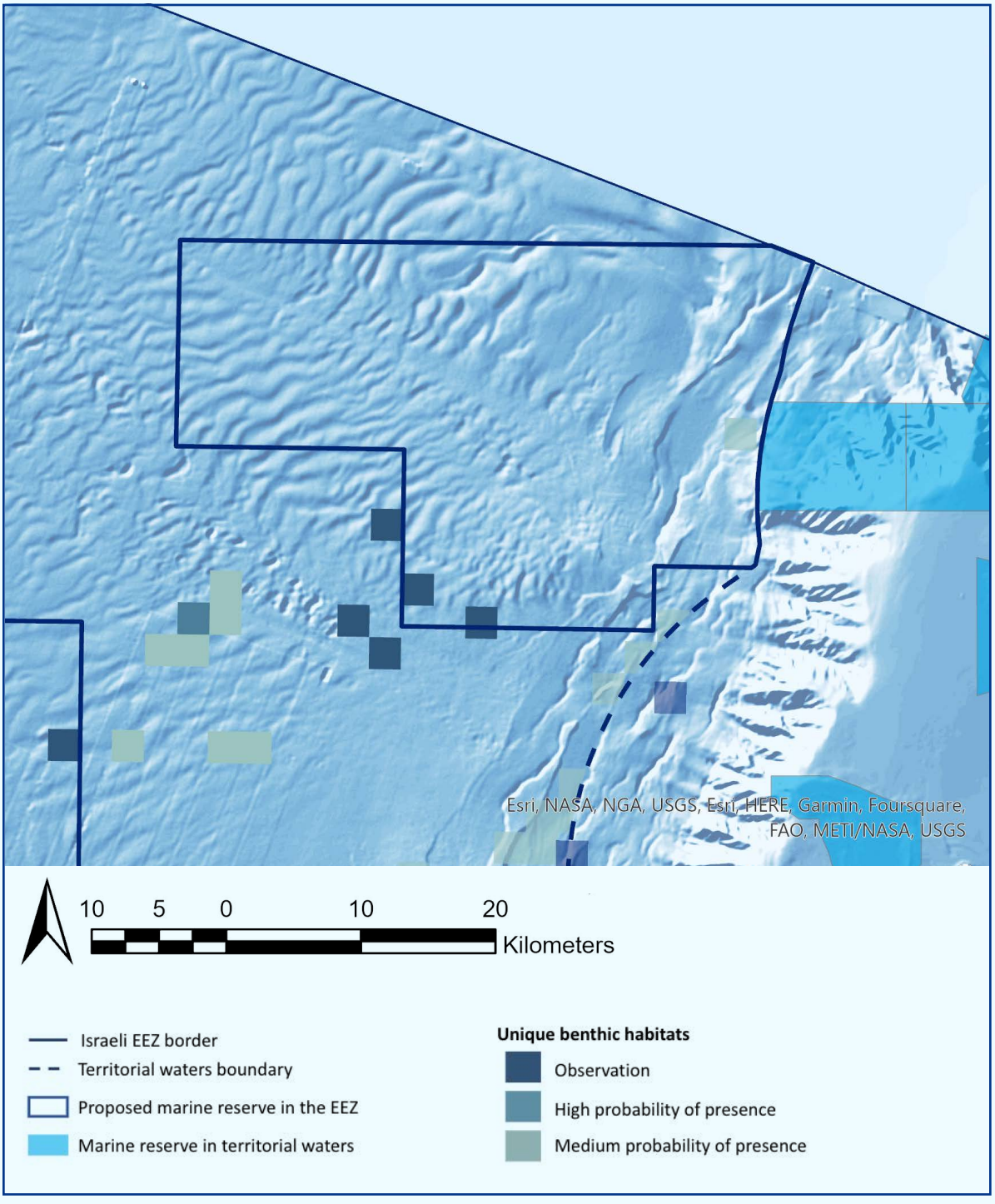


Israeli EEZ border
Territorial waters boundary
Depth contours
Proposed marine reserve in the EEZ
Marine reserve in territorial waters

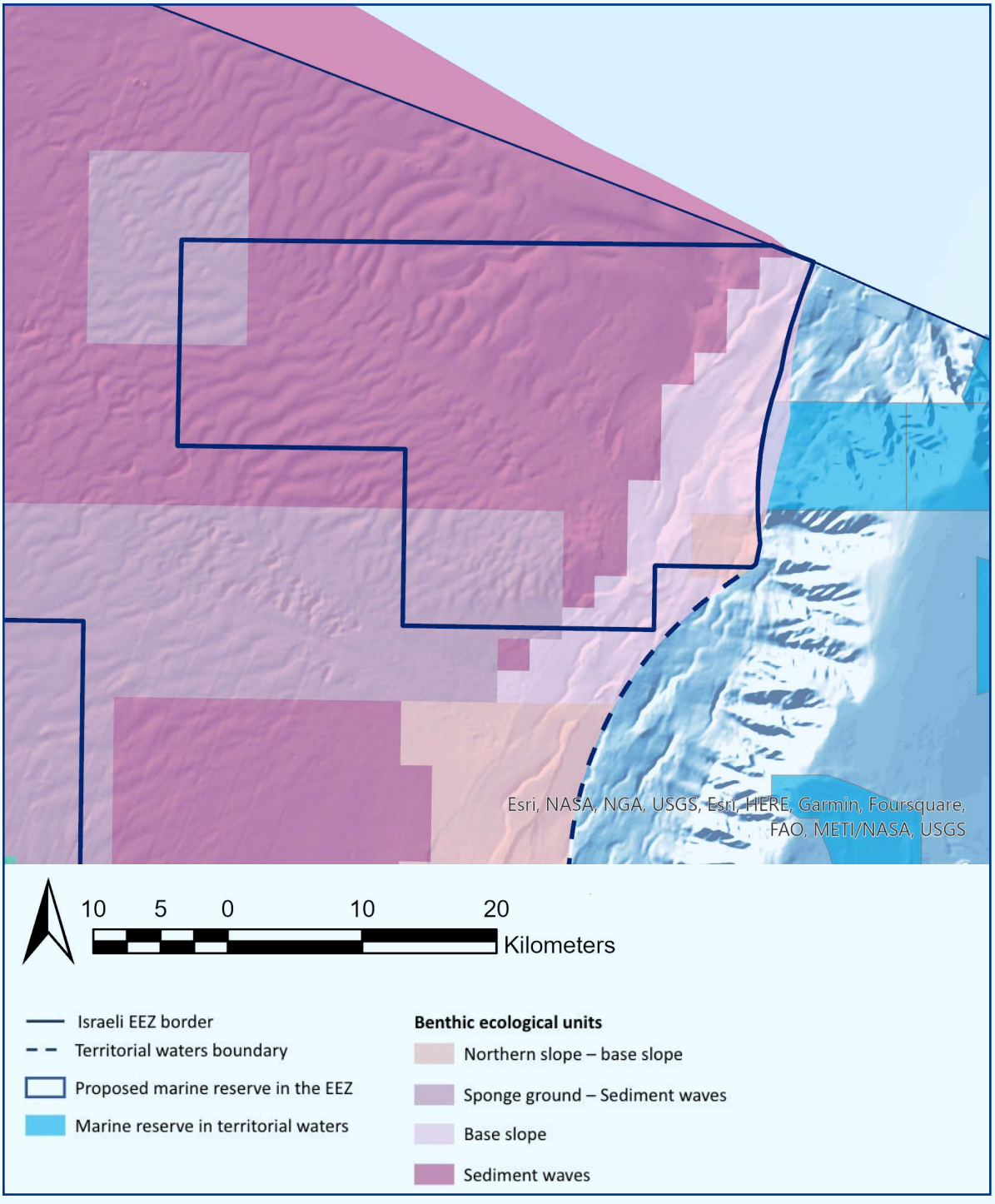
| | | |
|---|---|---|
| N | Area (km$^2$): **720** | Depth range (m): **800-1500** |
| | Maximal distance from adjacent reserve (km): **38** | 10 5 0 10 20 Kilometers |

**Unique benthic habitats in the Sediment Waves Reserve:**
Several soft-sediment sponge grounds were observed.

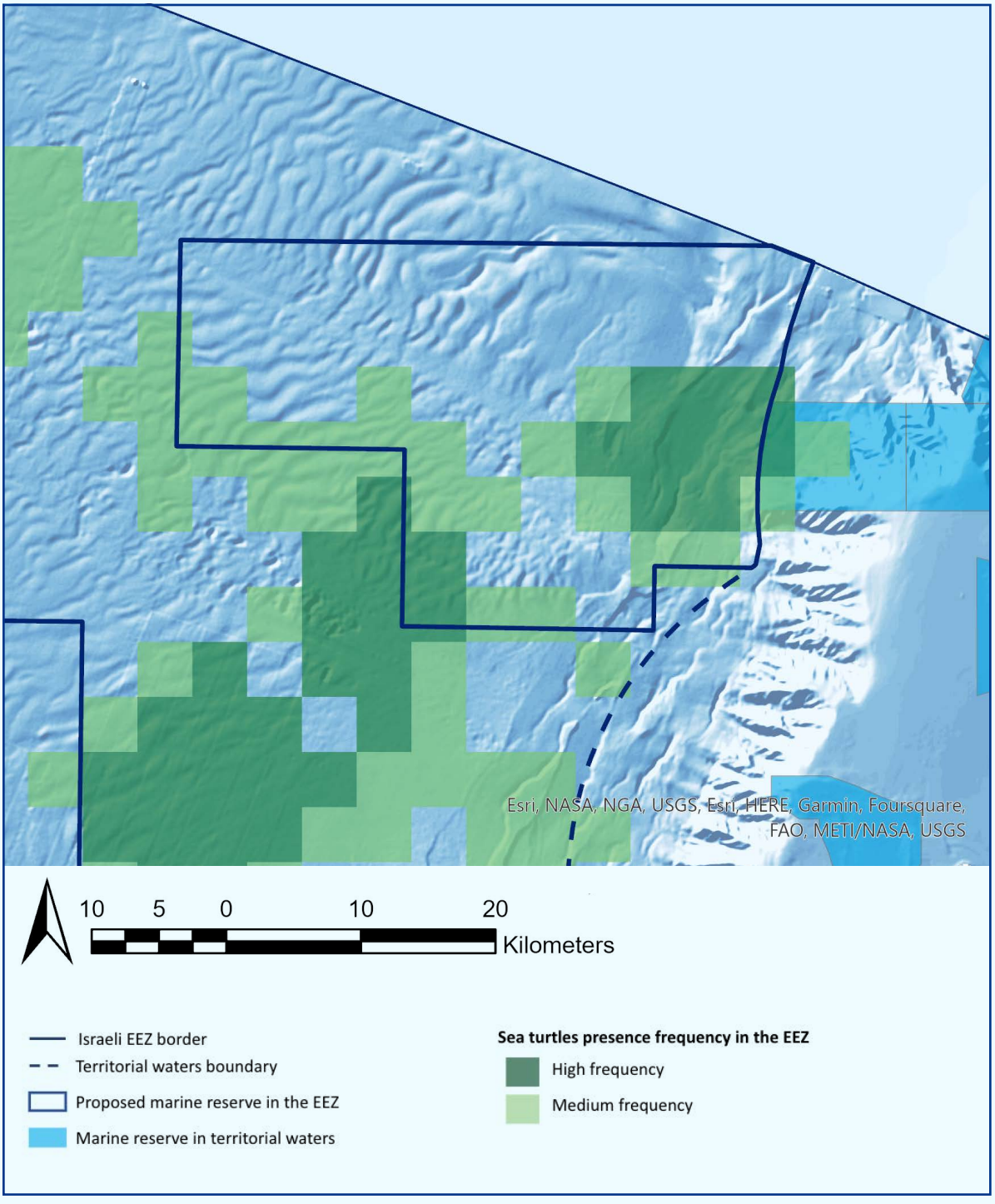


**Benthic ecological units within the Sediment Waves Reserve:**

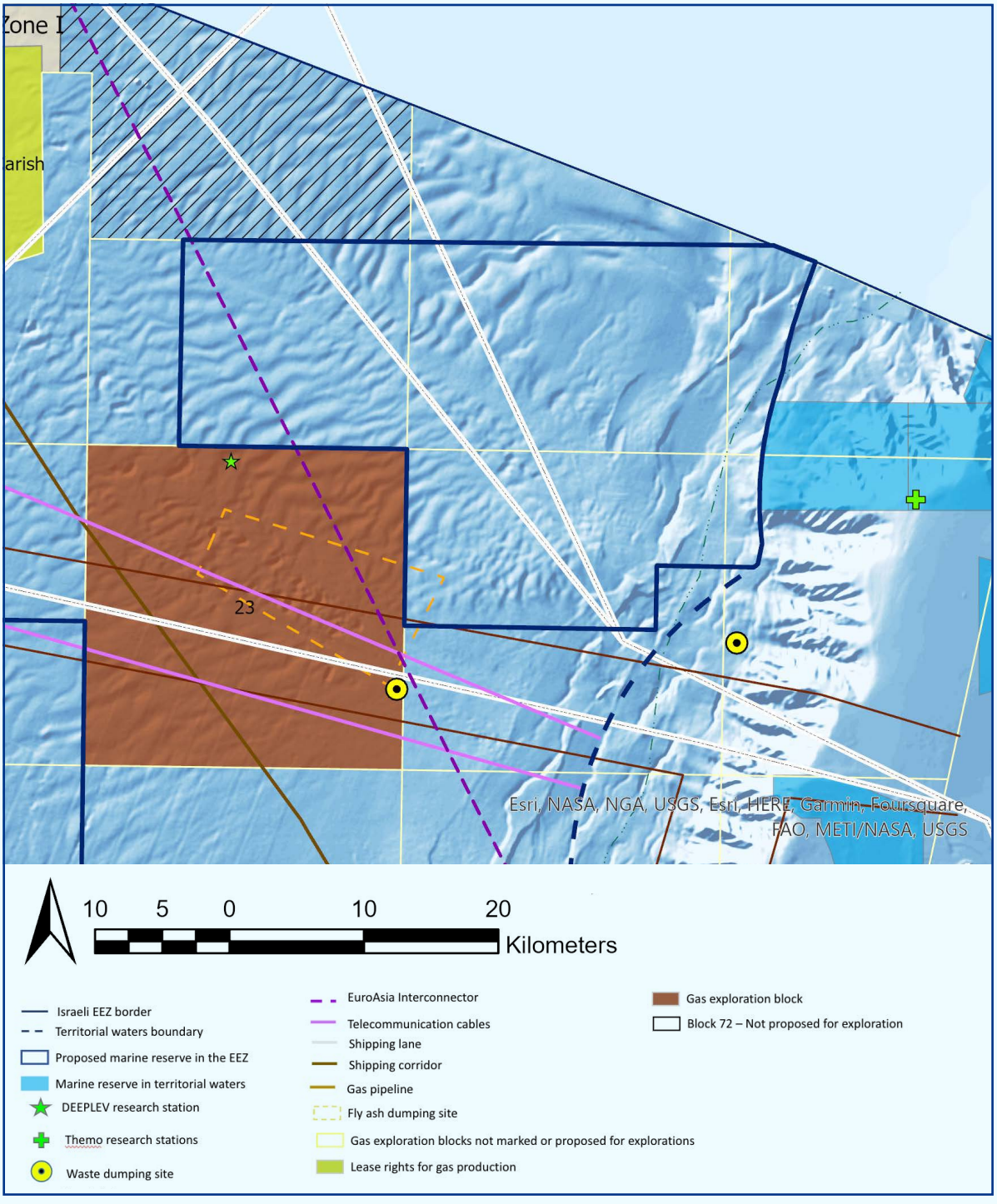
There are two ecological units representative of the Continental slope and two that are representative of the sediment waves, one of which is characterized by the biological component of sponge grounds.



**Unique pelagic areas within the Sediment Waves Reserve:**
Within the reserve and its surroundings, year-round, high frequency sea-turtle activity was observed.



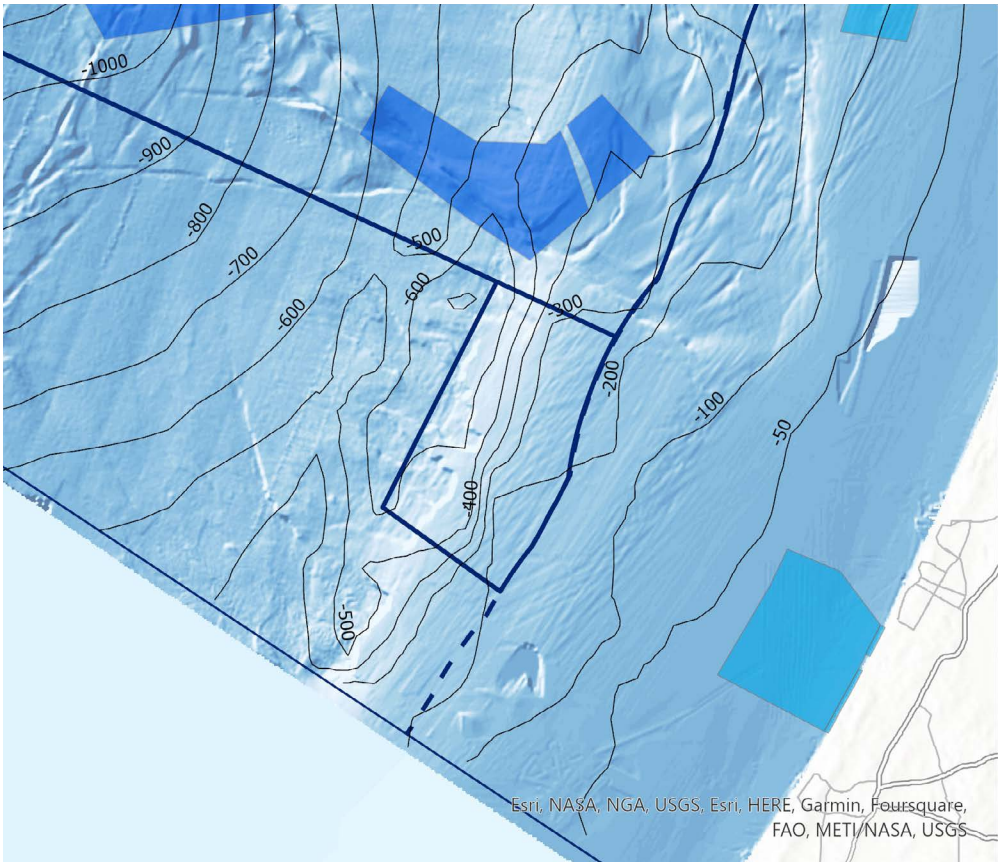
**The reserve is located in proximity to the northern perimeter of Israel's EEZ:**
In the southwestern corner of the reserve, there is overlap with a previous (currently defunct) dumping site and to the east and south there are two active dumping sites. The west side of the reserve is expected to be traversed by a planned power line.

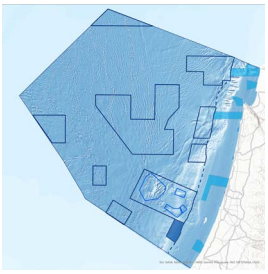


**A variety of anemones (of the Cerianthus genus) that live semi-buried in soft-sediment, surrounded a tube which they secrete**. Sand grains and sediment particles stick to the outer side of the tube, which is flexible and allows the anemone to retract into the tube when disturbed | Photo: Adam Weissman, Yizhaq Makovsky, University of Haifa

# The Southern Slides Reserve

The area of the Southern Slides Reserve is 150 km$^2$ and it is located to the south of the Palmahim Disturbance Reserve. It is the shallowest among the reserves and it protects a few small slides that create a bathymetric complexity and is part of the only area with a biological composition that matches that of the southern continental slope. This is the southernmost reserve of the five that protect the continental slope axis, which features the important ecological process of transporting nutrients to the benthic zone as well as noticeable biological diversity and high pelagic primary productivity.



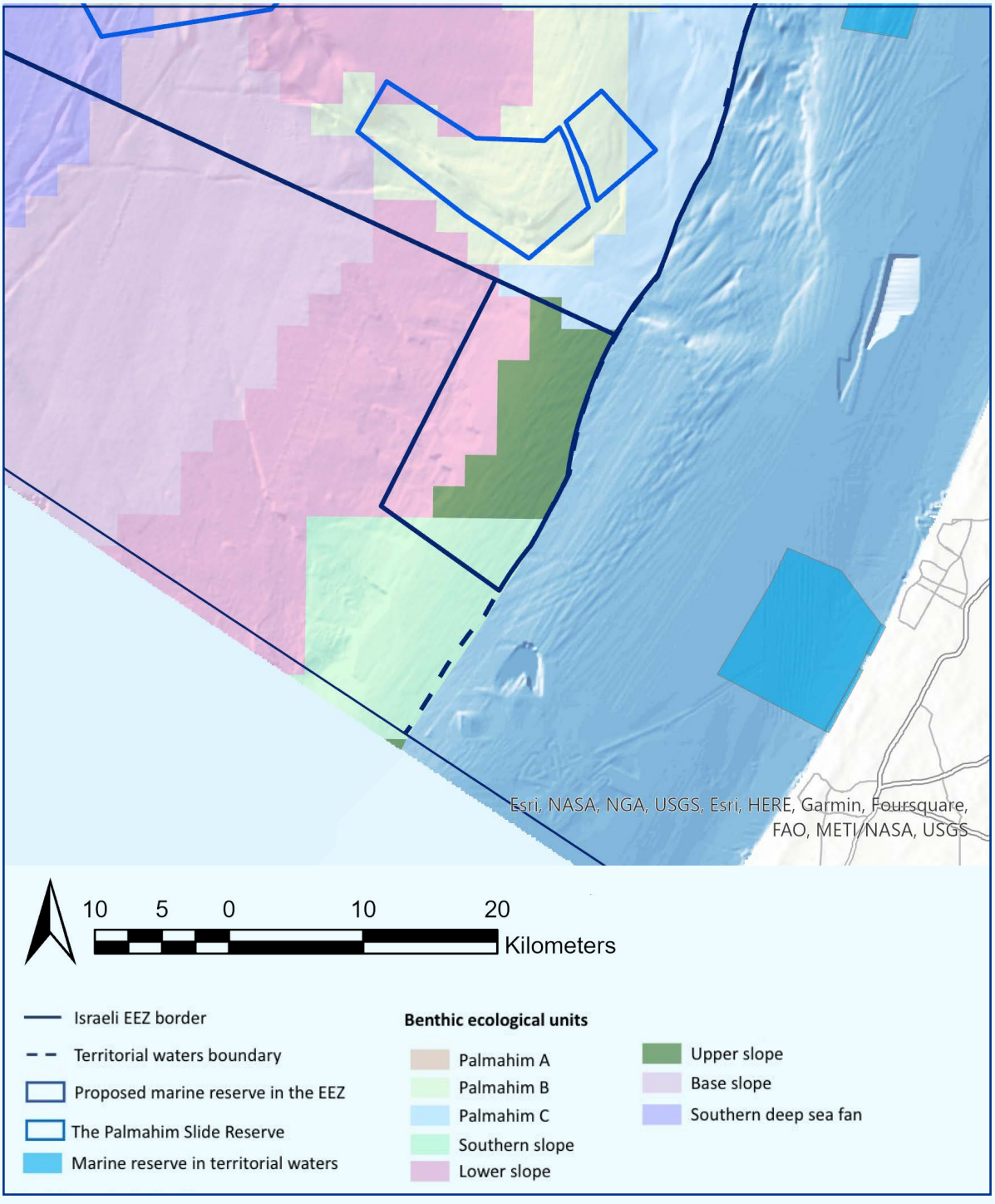



Israeli EEZ border
Territorial waters boundary
Depth contours
Proposed marine reserve in the EEZ
The Palmahim Slide Reserve
Marine reserve in territorial waters

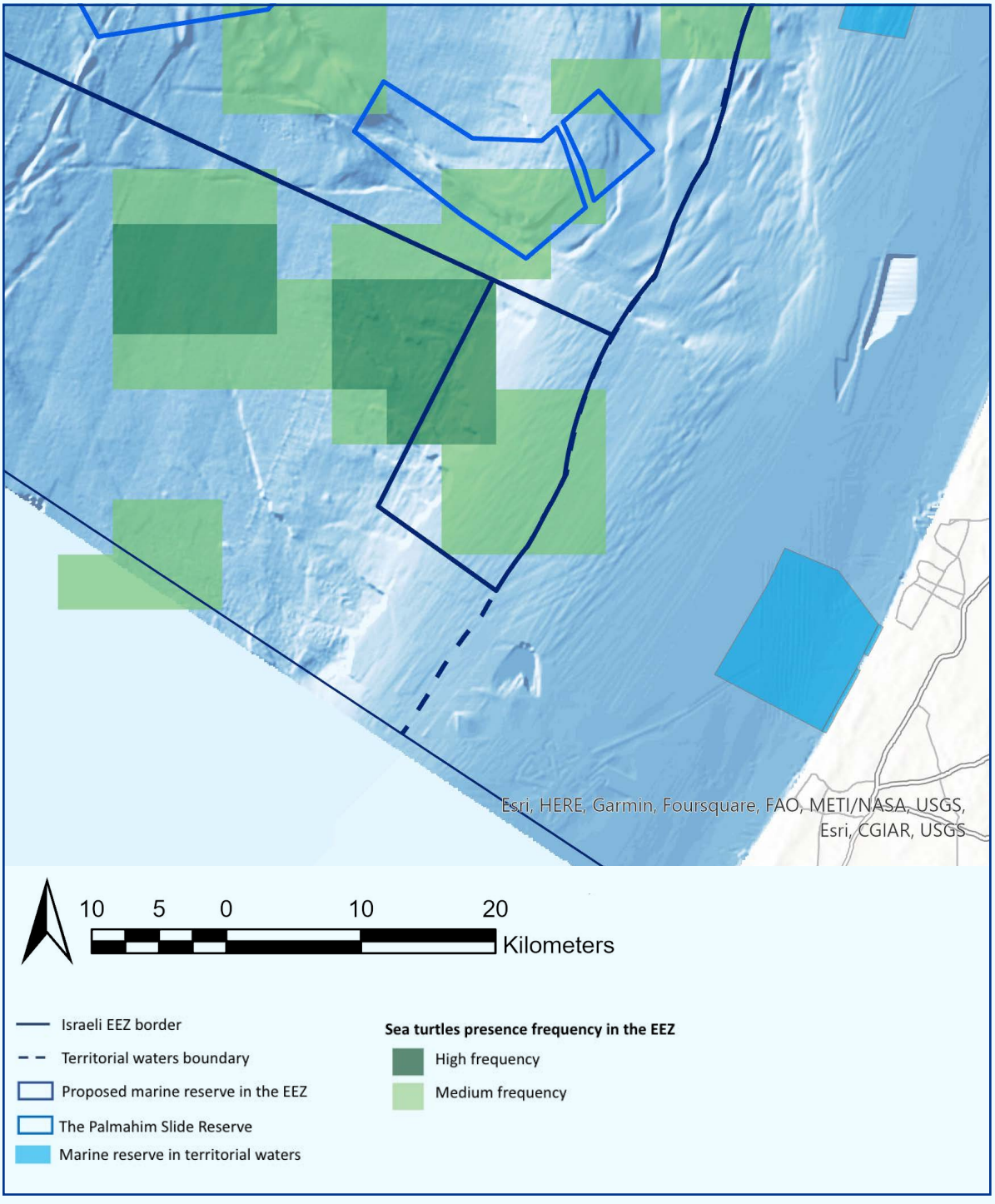
| | | |
|---|---|---|
| N | Area (km$^2$): **150** | Depth range (m): **200-600** |
| | Maximal distance from adjacent reserve (km): **34** | 10 5 0 10 20 Kilometers |

**Benthic ecological units in the Southern Slides Reserve:**

Three units are representative of the continental slope; one of these is characteristic of the southern continental slope, which is represented only in this reserve

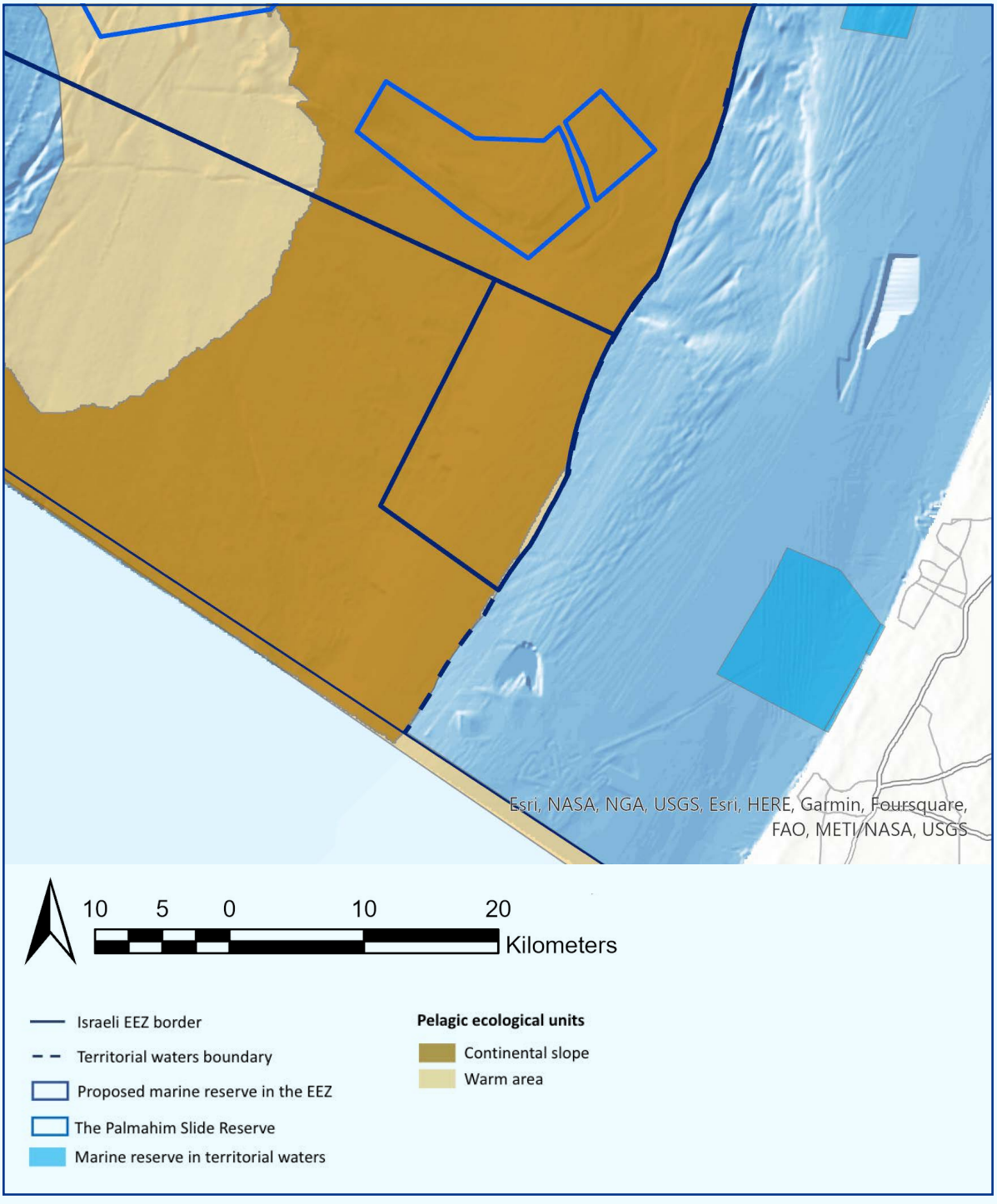


**Unique pelagic areas:**
In parts of the area, highly frequent sea-turtle activity was noted throughout the year.

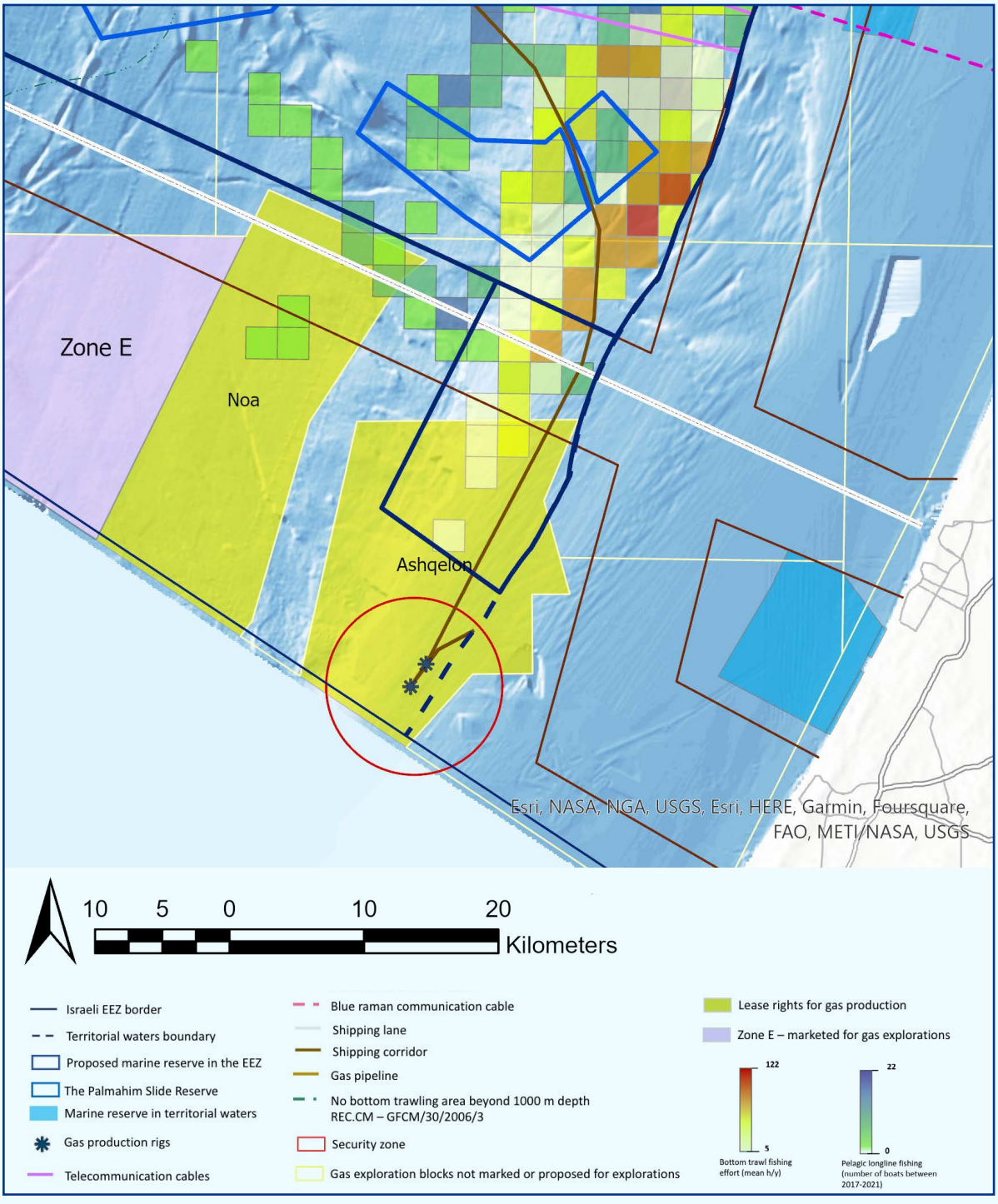


**Pelagic ecologic units:**

A pelagic ecological unit of the continental slope.



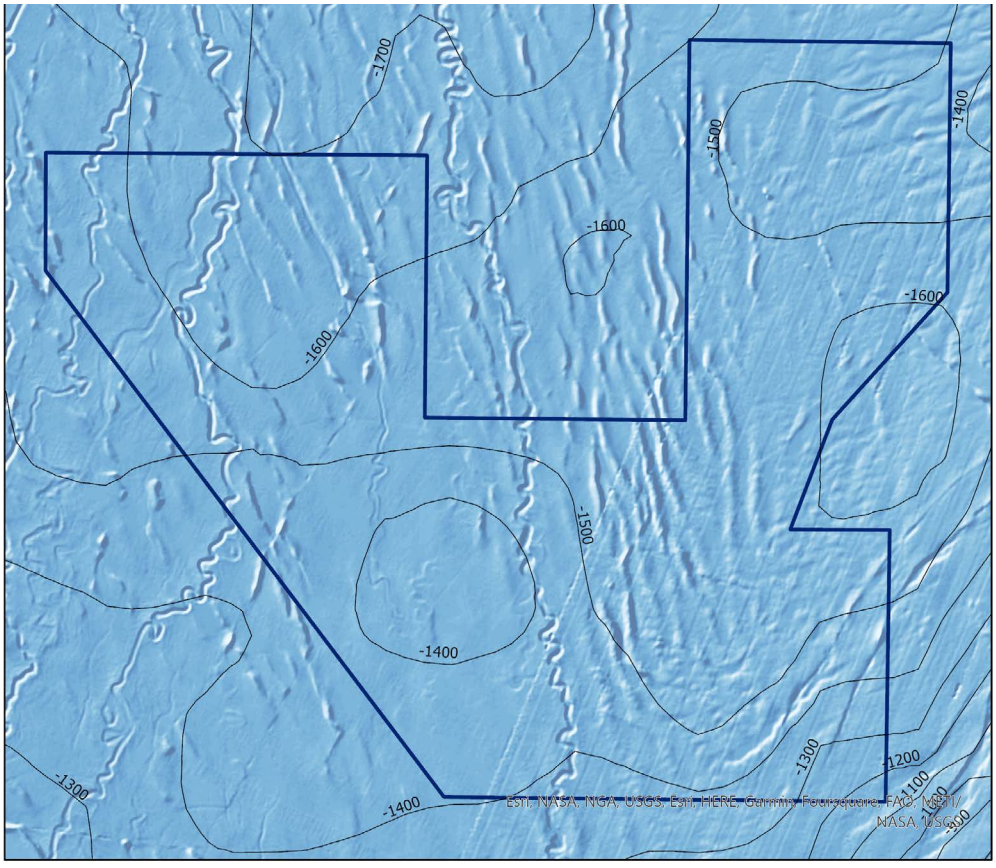
**Socioeconomic activities in the Southern Slides Reserve:**
The reserve overlaps with a major maritime corridor and with an area designated for gas search and production, in which drilling has ceased. The reserve also overlaps with the southern edge of a summer trawl-fishing area.



Shrimps in coral gardens, Palmahim disturbance. Photo: Adam Weissman, and Yizhaq Makovsky, University of Haifa

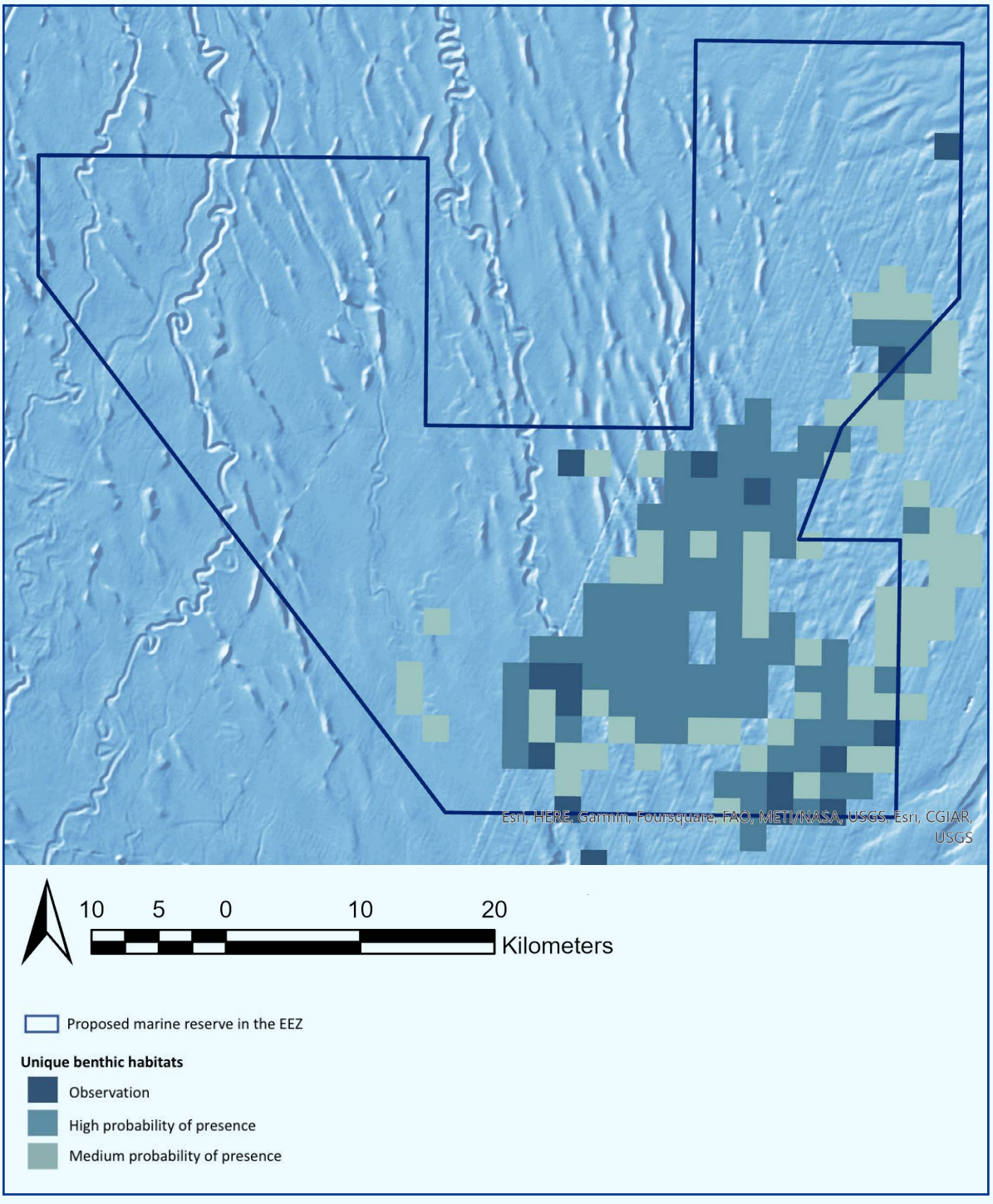
# The Heart of the Sea Reserve

This is the largest of the planned reserves, encompassing an area of 2,330 km² in the middle of Israel's EEZ. This reserve protects soft-sediment sponge grounds on the sea bed, a segment of the Levant Channel and the body of water that is prone to frequent cyclonic eddies, which indicates a high level of primary production and high plankton biomass.



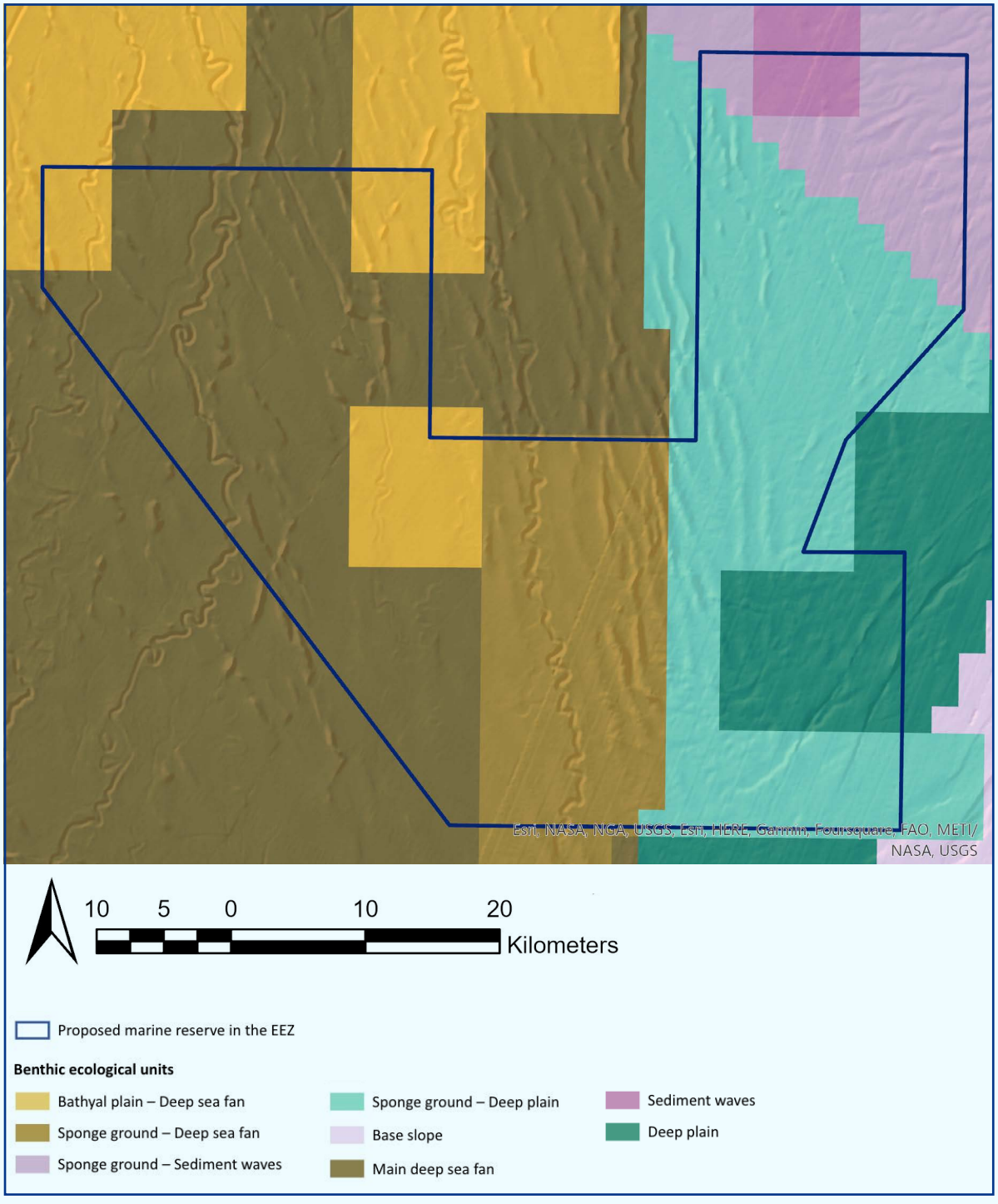

| | | |
|---|---|---|
| N | Area (km²): **2,330** | Depth range (m): **1200-1700** |
| | Maximal distance from adjacent reserve (km): **48** | 10 5 0 10 20 Kilometers |

**Unique benthic habitats:**
Observations of soft-sediment sponge grounds and a high probability for their presence within one-third of the reserve's area.

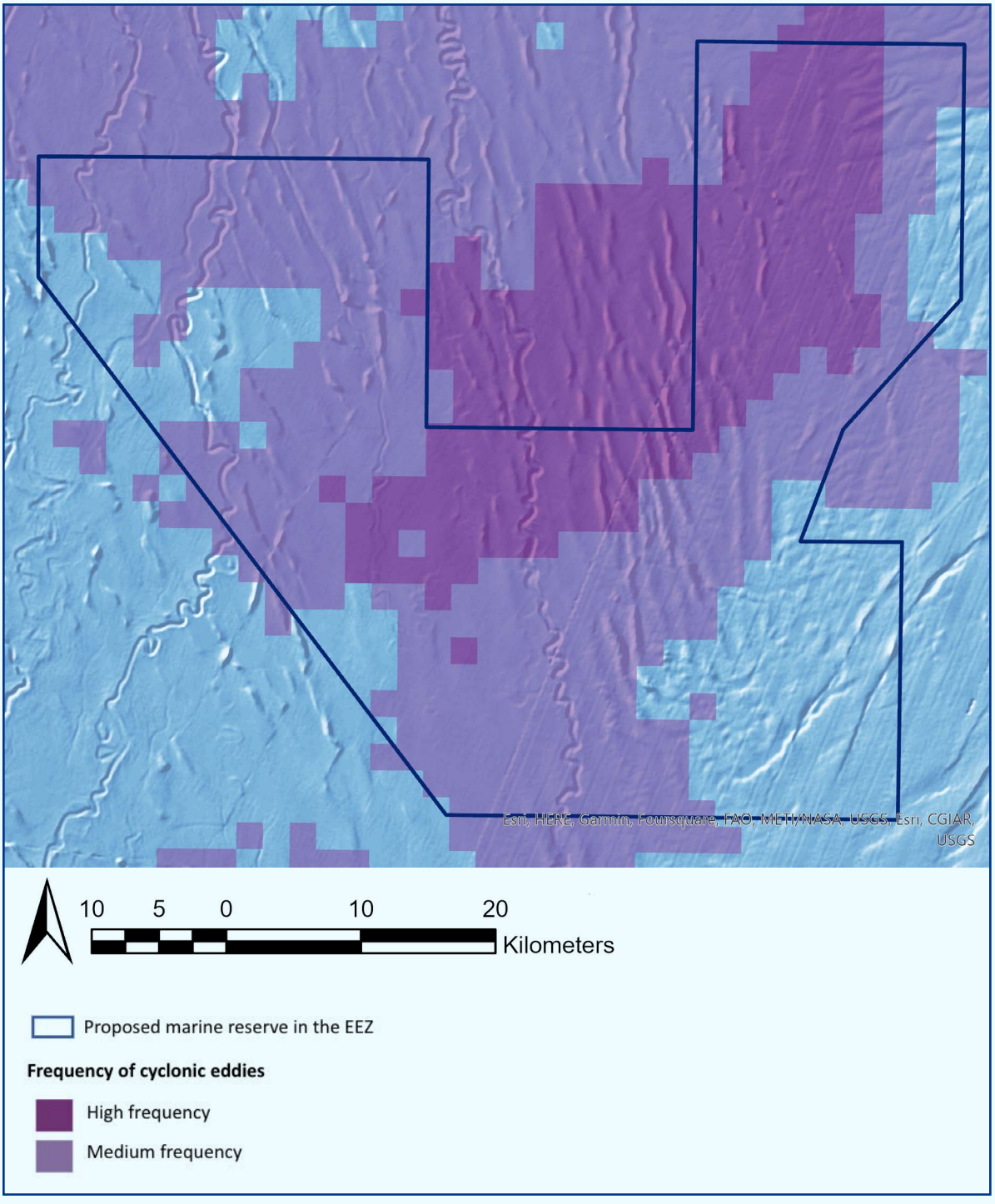


**Benthic ecological units:**

The entire area of the reserve is in the Bathyal Plains, yet it also includes three domains with different geomorphological features and biological components. In addition to the segment of the Levant Channel, seven ecological units are represented in the reserve.

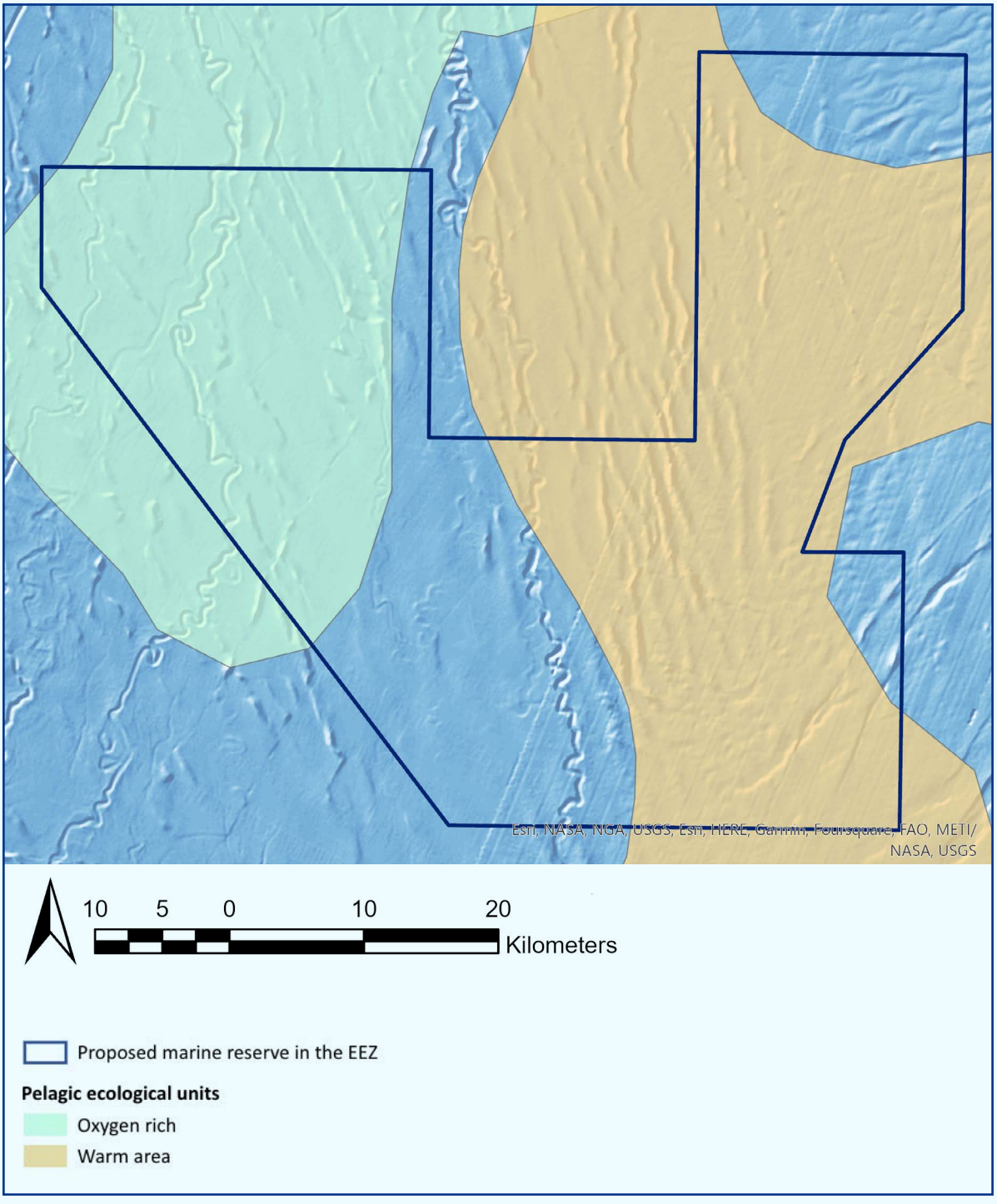


**Unique pelagic areas:**
This is the only reserve that protects an area characterized by frequent cyclonic eddies.



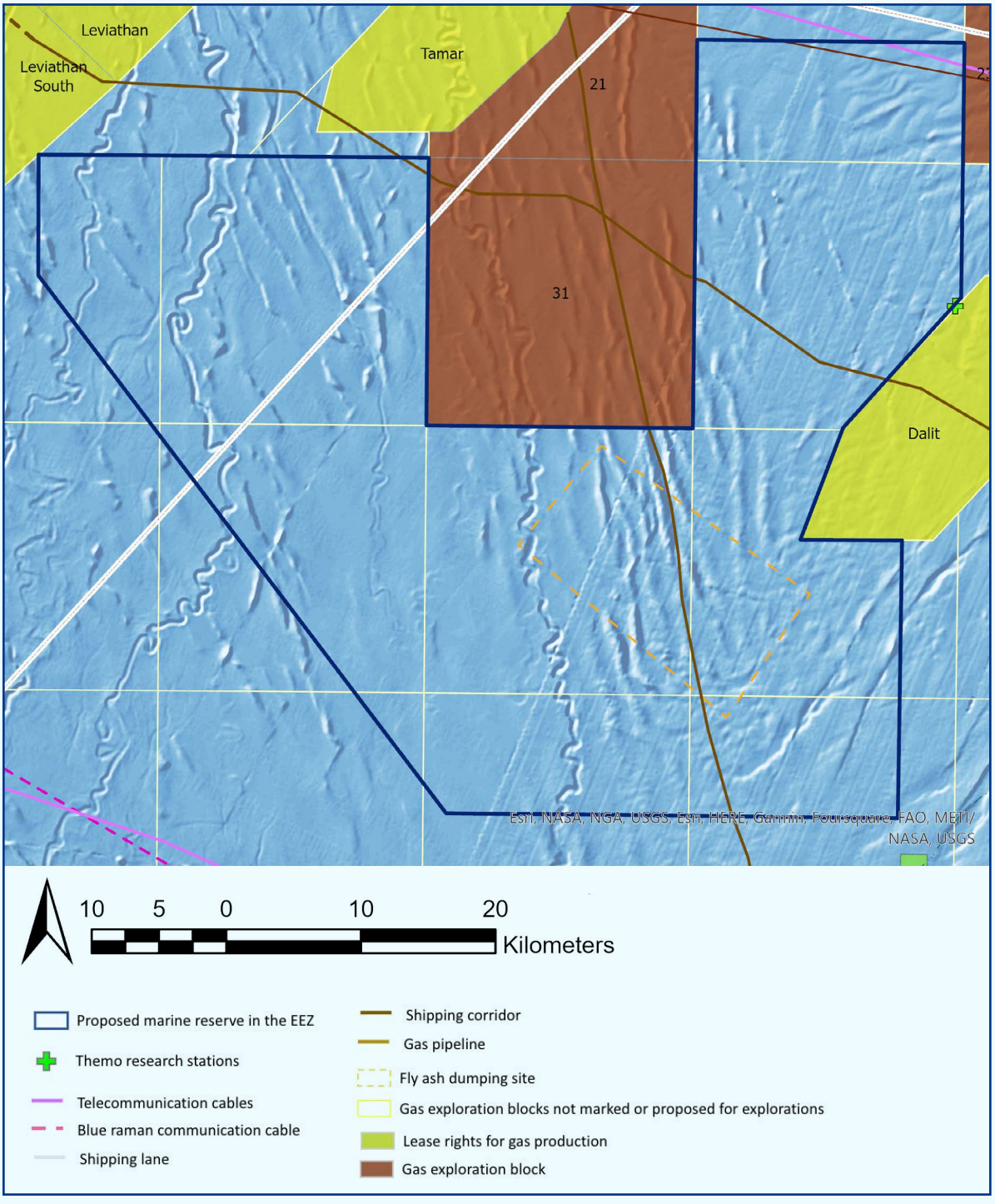
**Pelagic ecological units:**

One pelagic ecological unit is characterized by relatively high temperatures and one is characterized by a relatively high oxygen concentration.



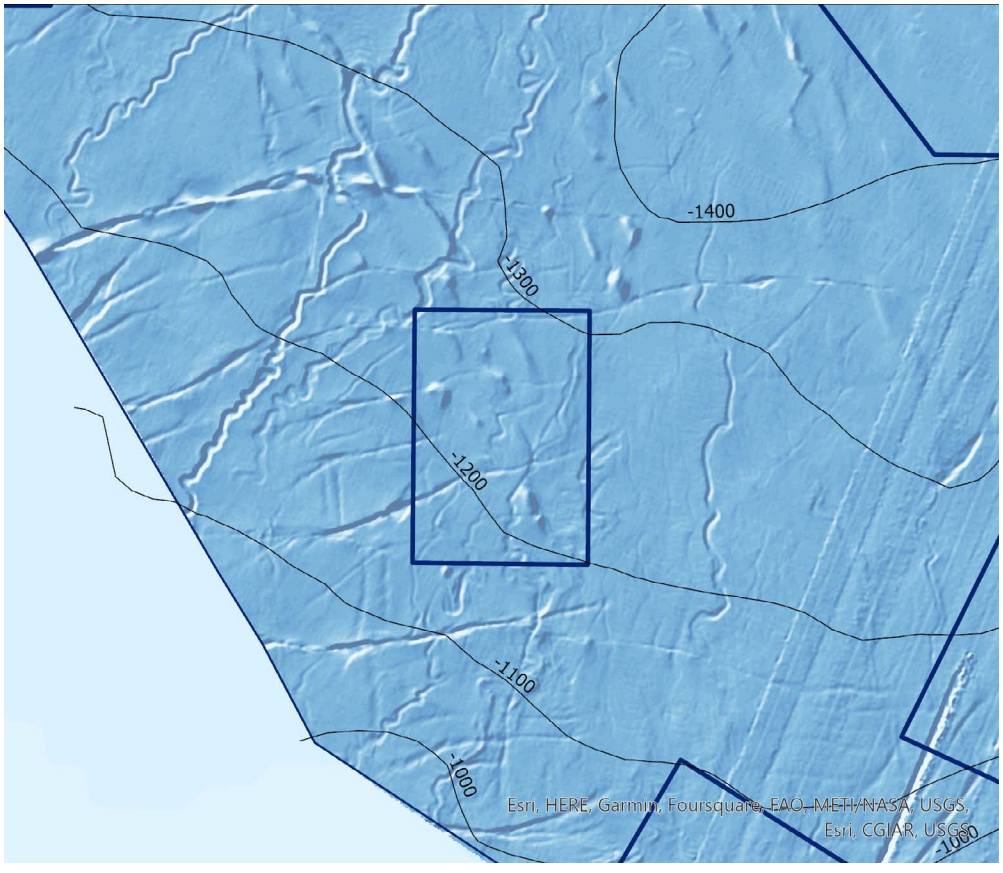
**Socioeconomic activity:**

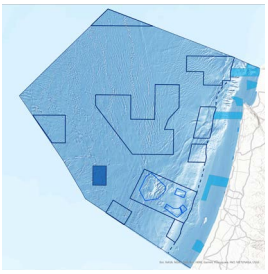
The site overlaps with an area that had been a fly-ash dumping site and contains active gas pipe infrastructure. It partially overlaps with a maritime corridor and communication cable lines. The reserve is surrounded by areas in which the gas sector is actively involved in exploring, drilling, and production.



# The Southern Seeps Reserve

The Southern Seeps Reserve encompasses an area of 180 km$^2$ and it protects unique habitats in carbonate rocks and methane seeps. It also protects an area that has been identified as a potential climate refuge for benthic species in the event of an increase in sea-water temperature, as well as the fan of sediments that originate in the area of the Nile Delta.

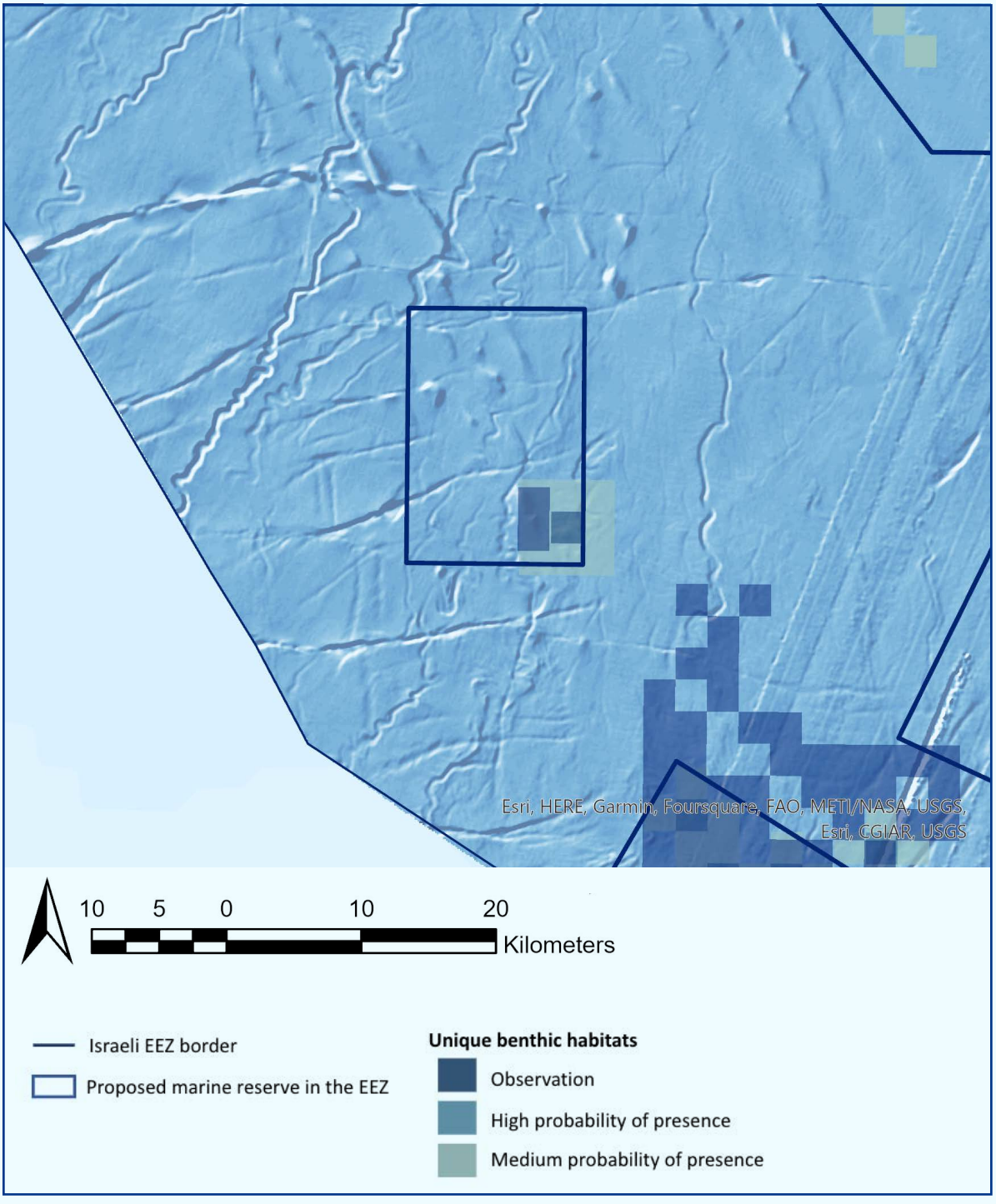


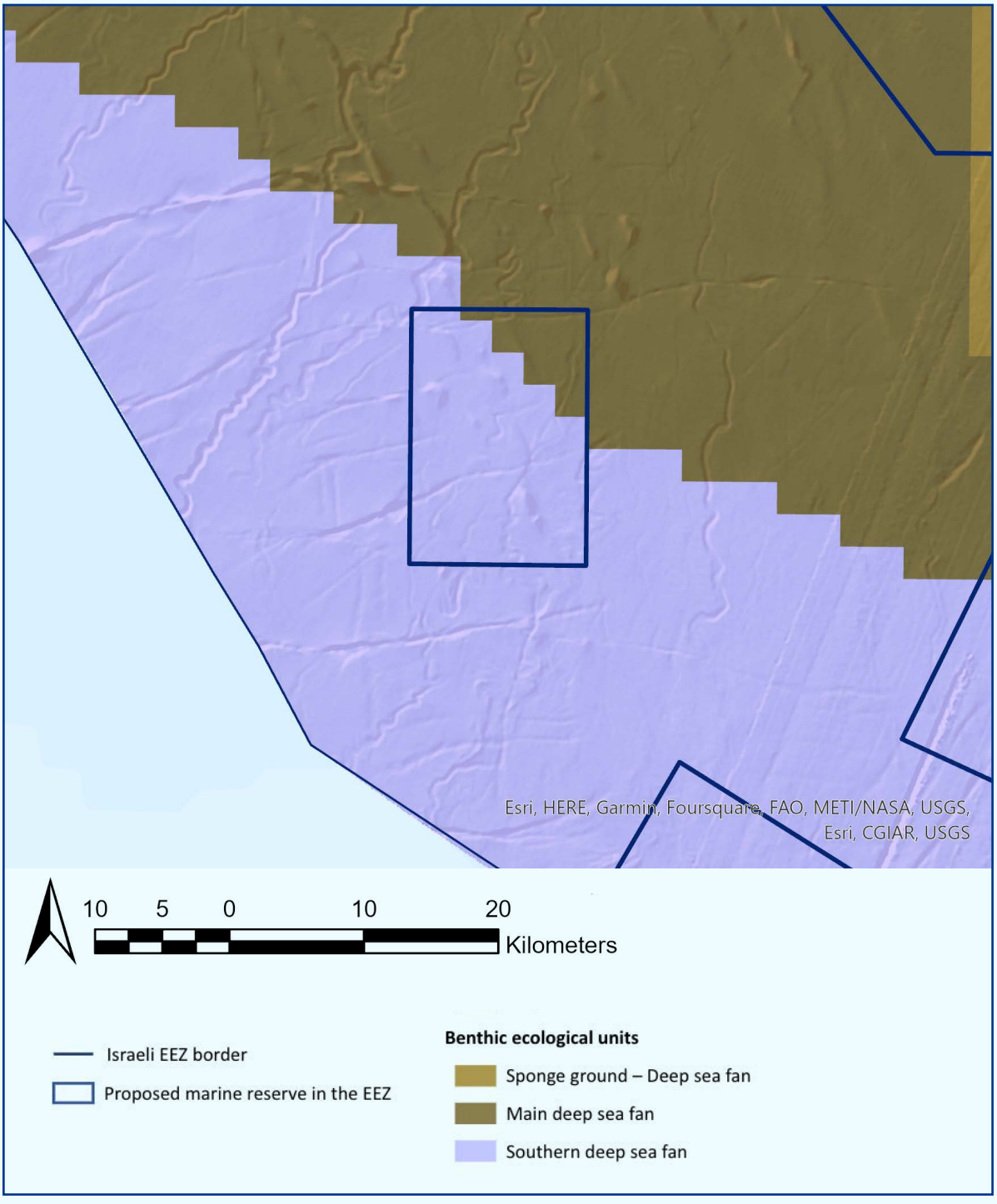
Israeli EEZ border
Territorial waters boundary
Depth contours
Proposed marine reserve in the EEZ
The Palmahim Slide Reserve
Marine reserve in territorial waters

| | | |
|---|---|---|
| N | Area (km$^2$): **180** | Depth range (m): **1200-1300** |
| | Maximal distance from adjacent reserve (km): **30** | 10 5 0 10 20 Kilometers |

**Unique Benthic habitats:**
Observations of carbonate rocks and methane seeps.

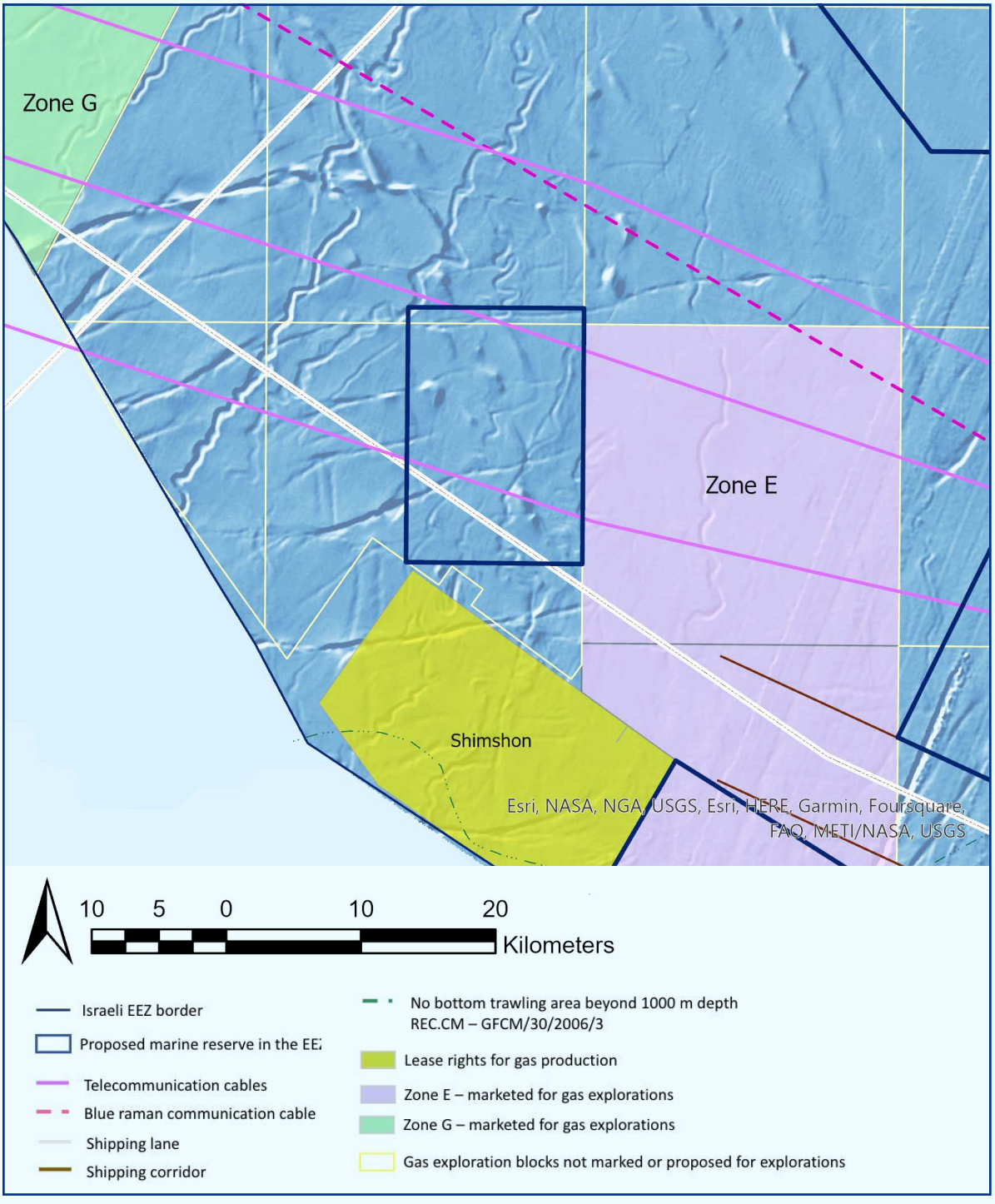


**Benthic ecological units:**
An ecological unit representative of the southern benthic fan with sediments that originate in the area of the Nile Delta, as well as a small segment of an ecological unit representative of the main deep-sea fan in the Bathyal plain.



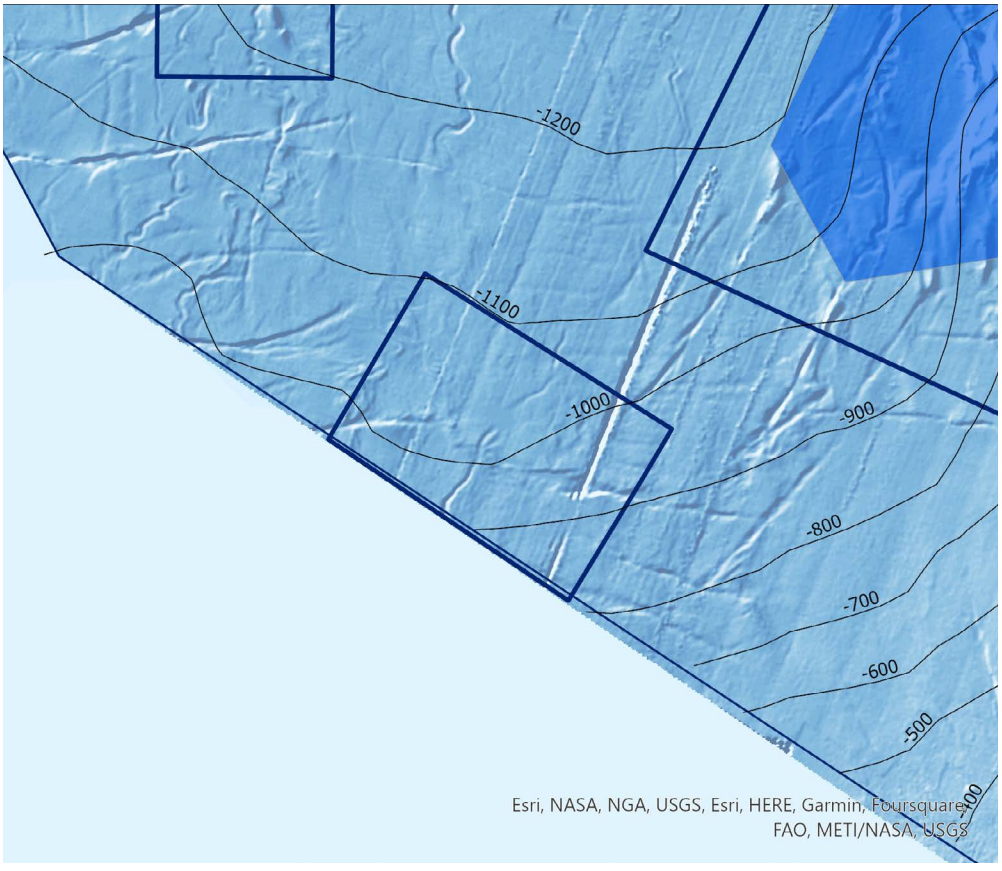
**Socioeconomic activity:**

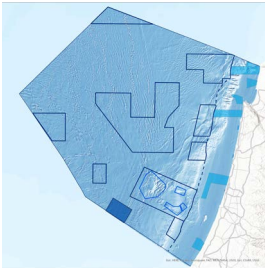
An overlap with communication cables and proximity to an area that will be tendered for gas explorations



# The Southern Fan Reserve

The 230 km$^2$ area of this reserve is located along the southern border of Israel's EEZ. It protects an area where multiple pockmarks have been observed, which indicates a strong likelihood of the presence of carbonate rocks and methane seeps in that area. The reserve protects an area that was identified as a potential climate refuge for benthic species in the event of an increase in sea-water temperature resulting from global warming, as well as a fan of sediments originating from the area of the Nile Delta.

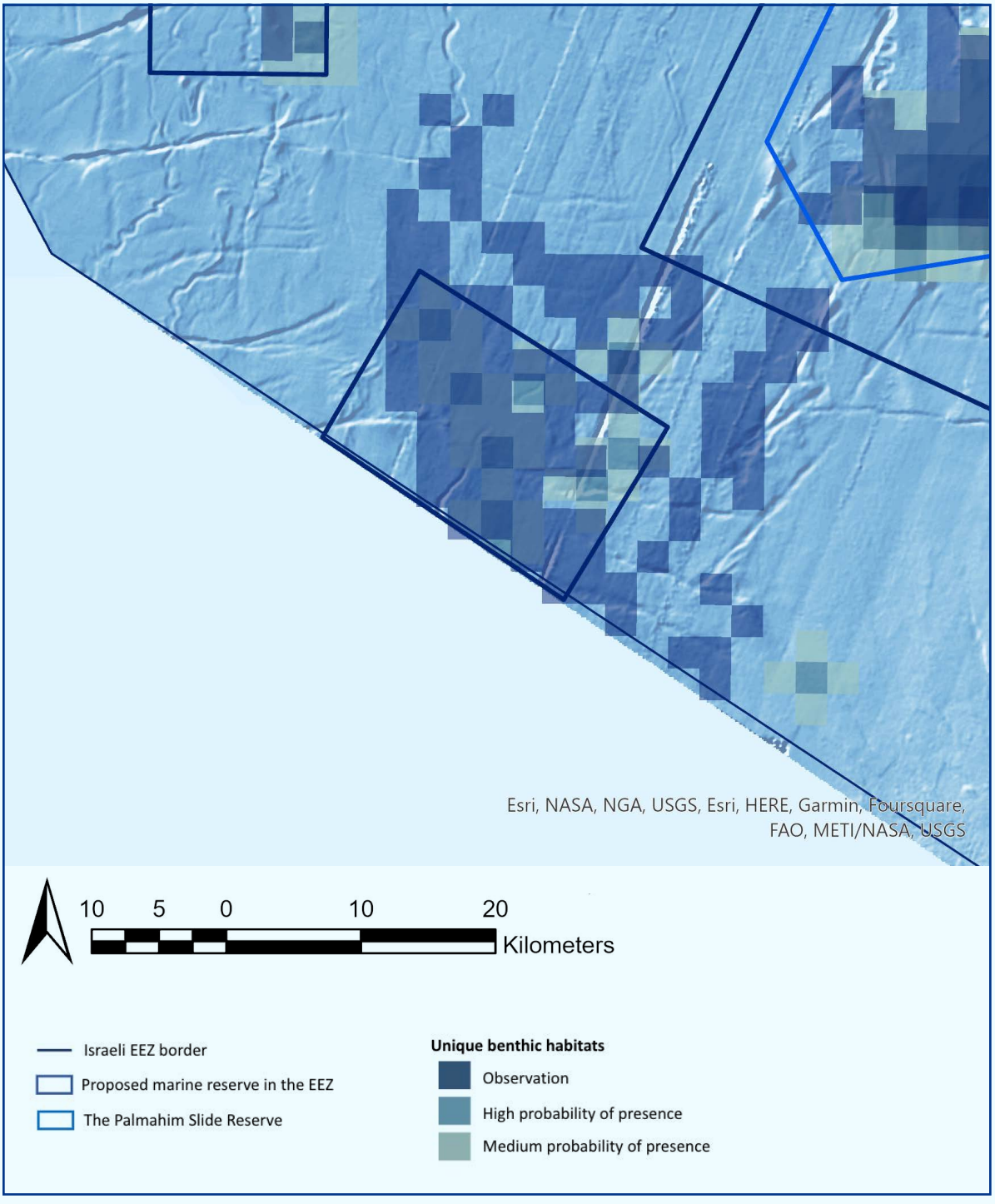


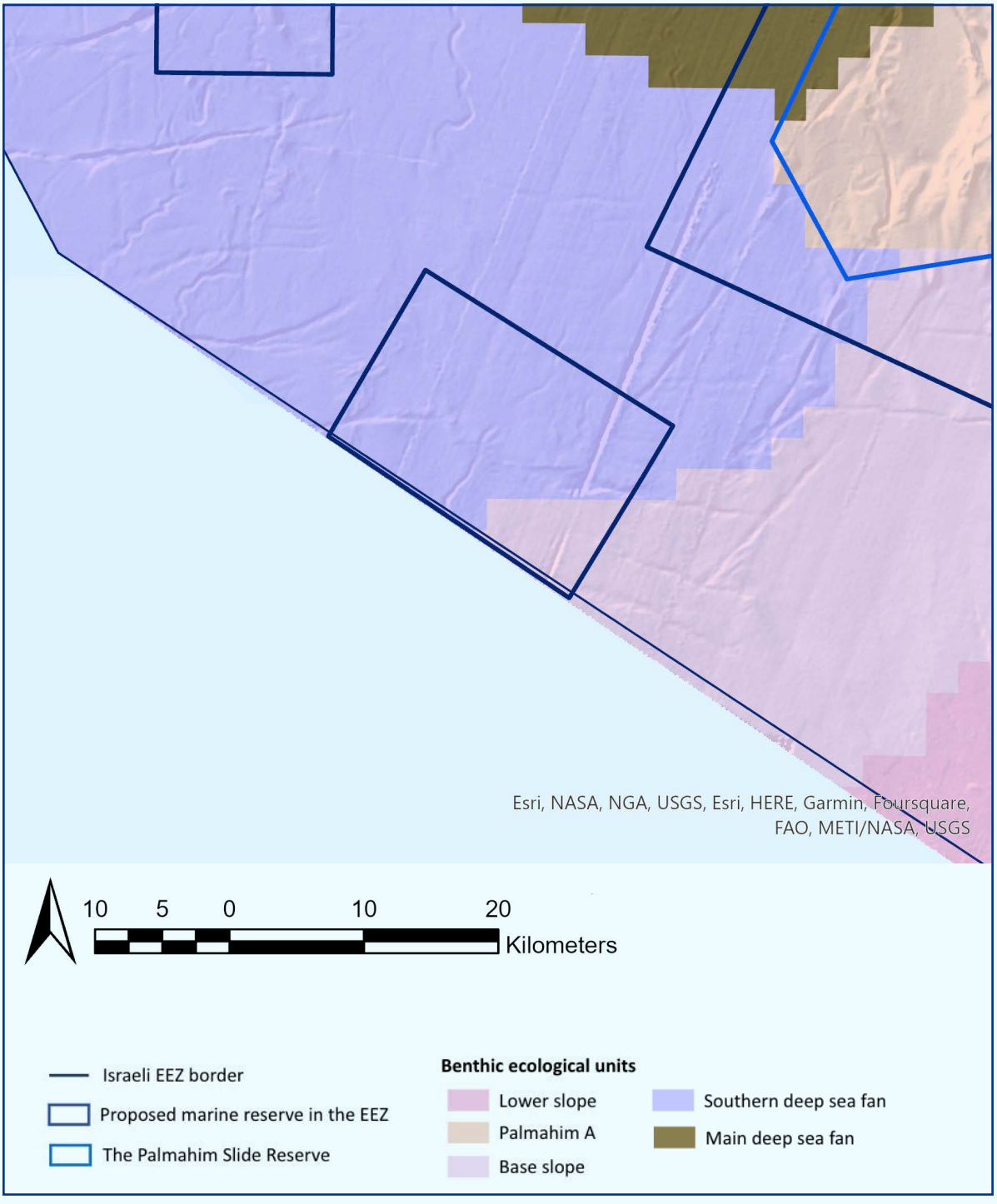
Israeli EEZ border
Depth contours
Proposed marine reserve in the EEZ
The Palmahim Slide Reserve

| | | |
|---|---|---|
| N | Area (km$^2$): **230** | Depth range (m): **800-1100** |
| | Maximal distance from adjacent reserve (km): **34** | 10 5 0 10 20 Kilometers |

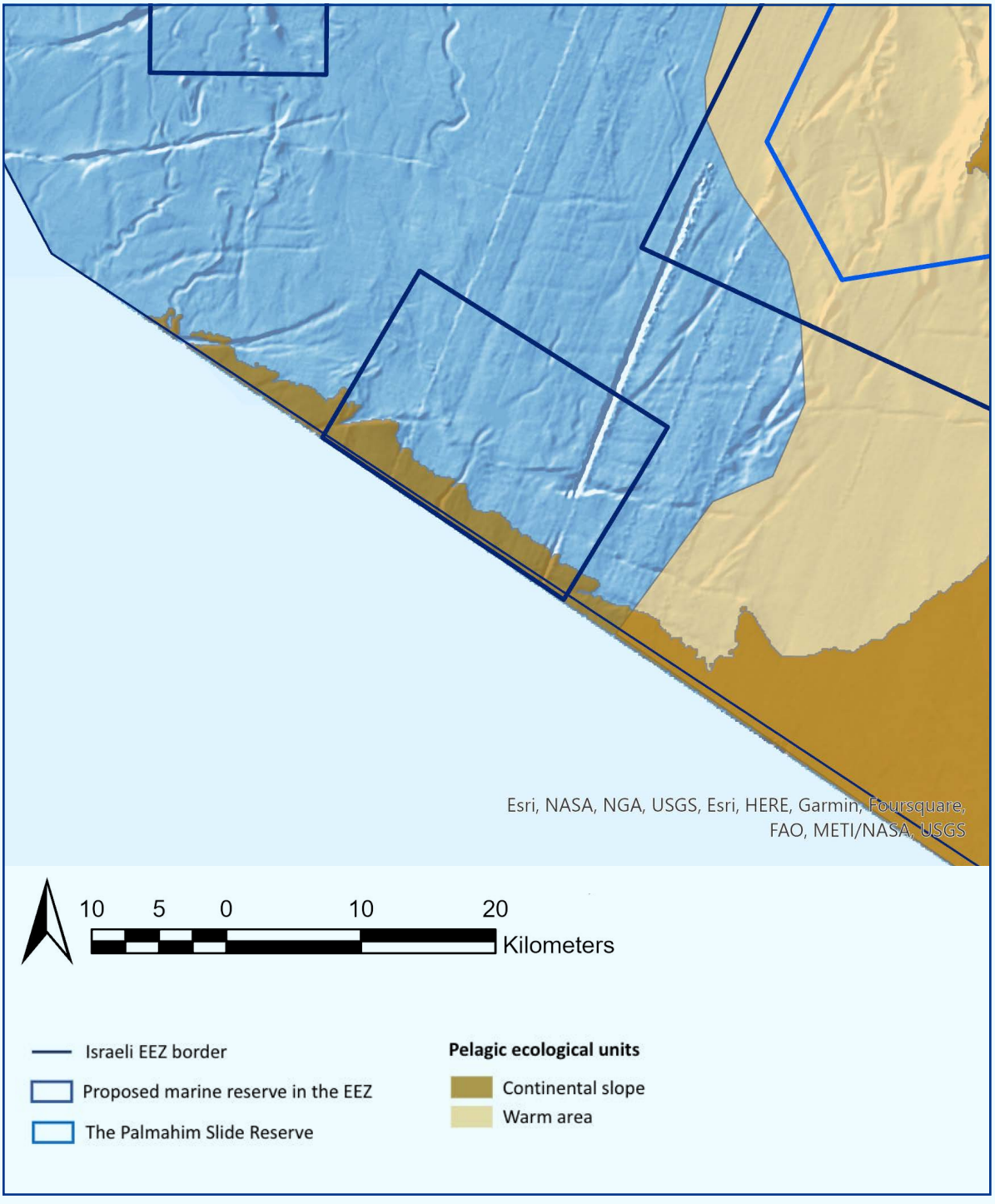
**Unique benthic habitats:**
Numerous observations of pockmarks and a high probability for the presence of carbonate rocks and methane seeps.



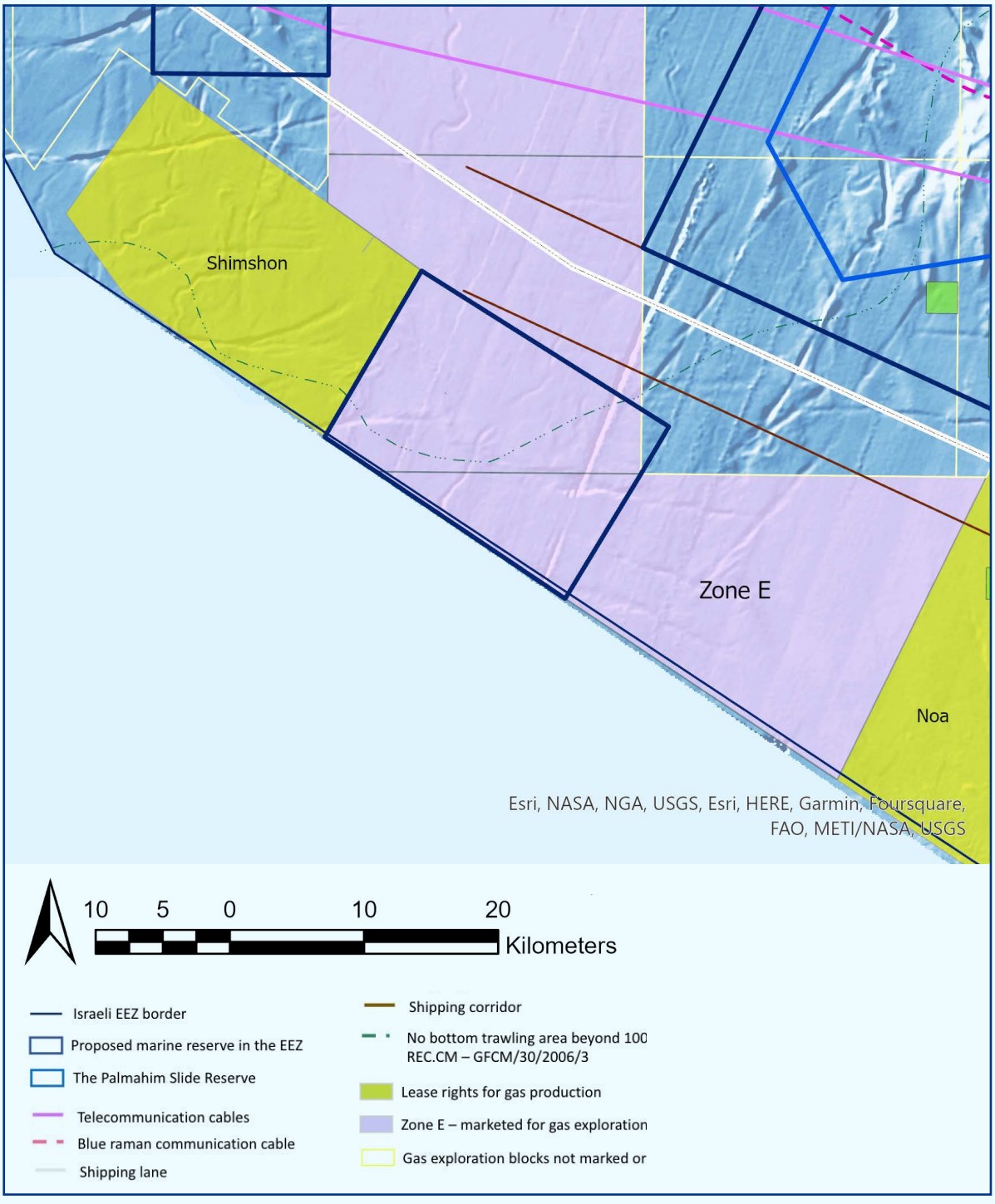
**Benthic ecological units:**
An ecological unit representative of the benthic southern fan, with sediments originating from the Nile area and a small representative segment of the ecological unit of the bottom of the continental slope.



**Pelagic ecological units:**
The margins of the pelagic ecological unit of the continental slope.



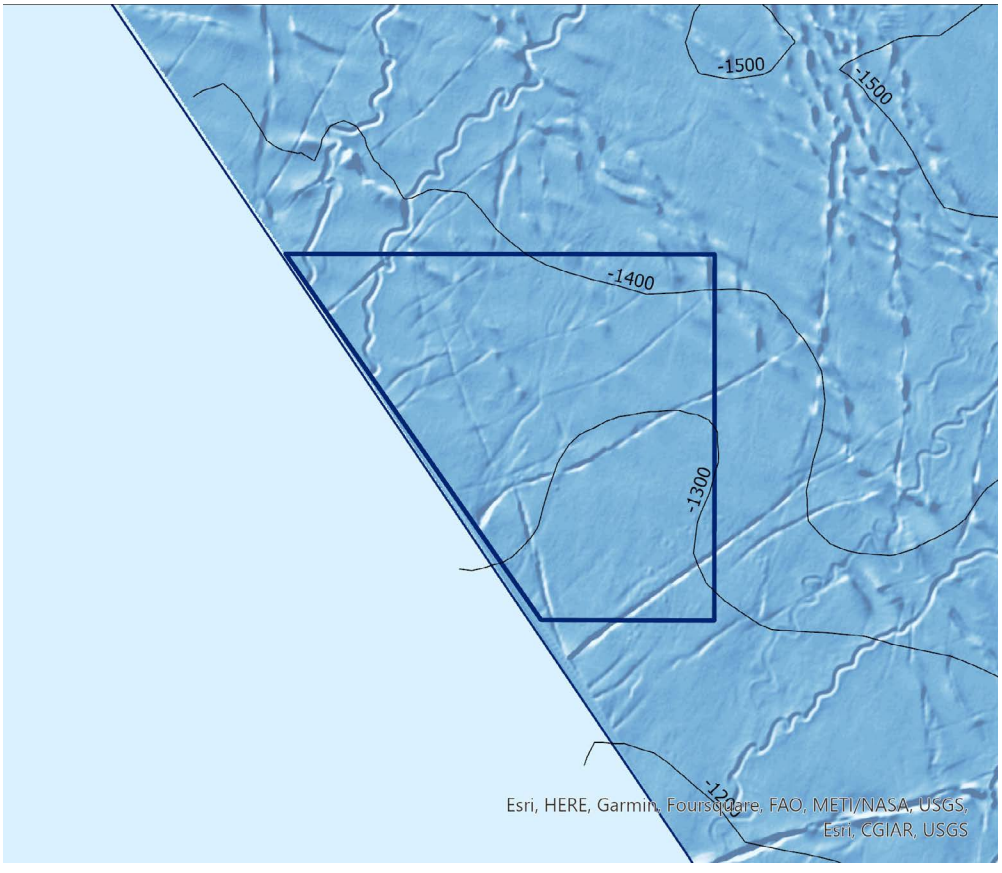
**Socioeconomic activity:**
The reserve overlaps an area that will be tendered for gas exploration and is adjacent to an inactive gas production area and a major maritime traffic lane.

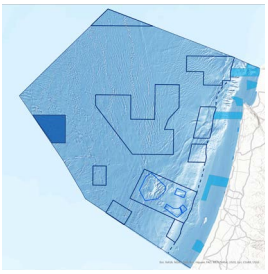


**Greeneye fish (*Chlorophthalmus agassizi*) that have circumglobal distribution.** The green flourescence of the fish's eye lenses help it detect prey better in dimly lit water | Photo: Adam Weissman, Yizhaq Makovsky, University of Haifa

# Pteropoda Skeletons Reserve

The Pteropoda Skeletons Reserve occupies an area of 440 km$^2$ along the southwestern border of Israel's EEZ. It protects an oxygen-rich pelagic zone and a carbonate-rich benthic zone in which there is a unique assemblage of foraminifera situated atop the empty pteropod mollusk shells. The reason for the accumulation of pteropod skeletons at this location is, as of yet, unknown. This reserve could potentially serve as a large transnational reserve that could extend beyond Israel's EEZ.



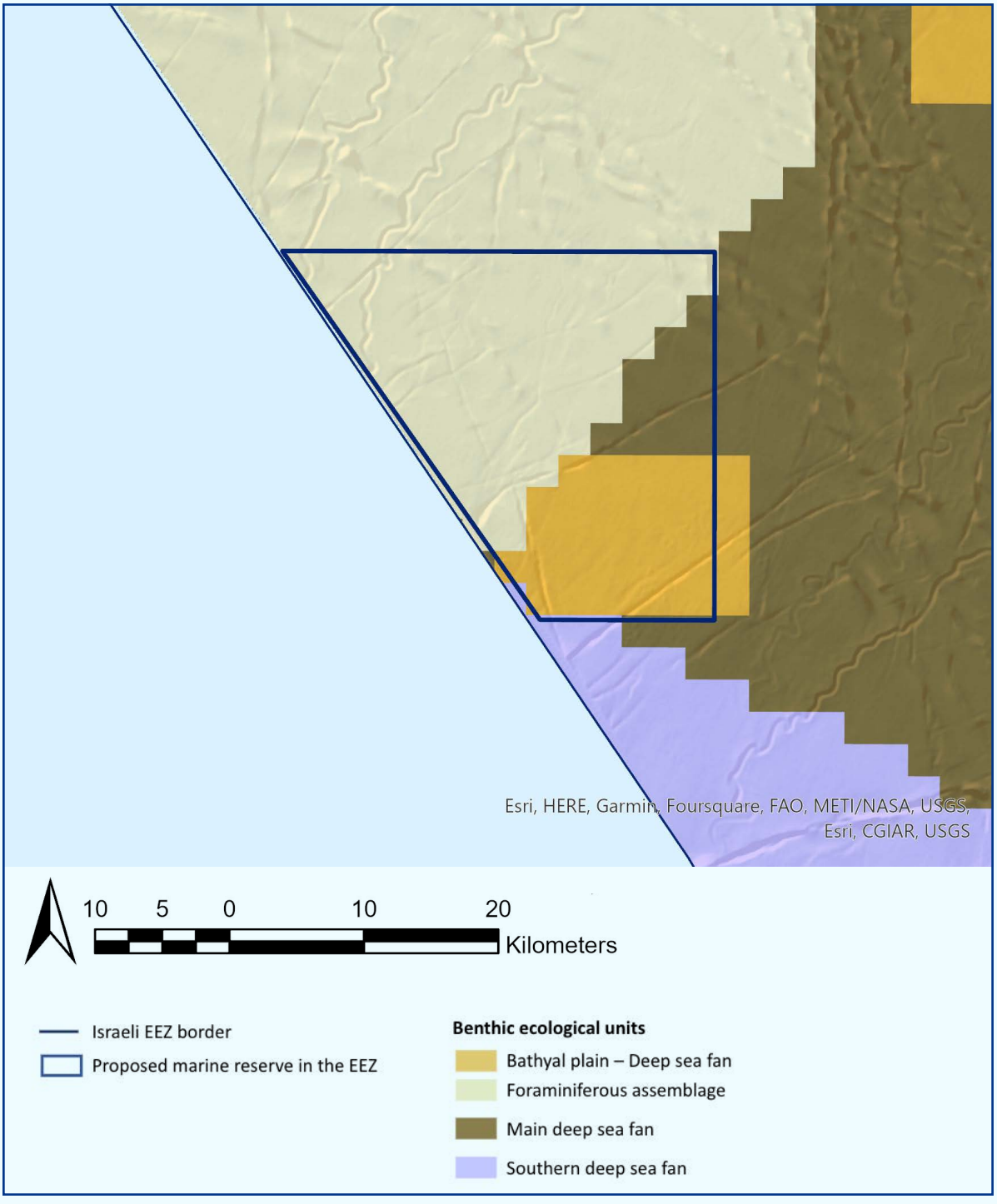



Israeli EEZ border
Depth contours
Proposed marine reserve in the EEZ

| | | |
|---|---|---|
| N | Area (km$^2$): **440** | Depth range (m): **1300-1400** |
| | Maximal distance from adjacent reserve (km): **30** | 10 5 0 10 20 Kilometers |

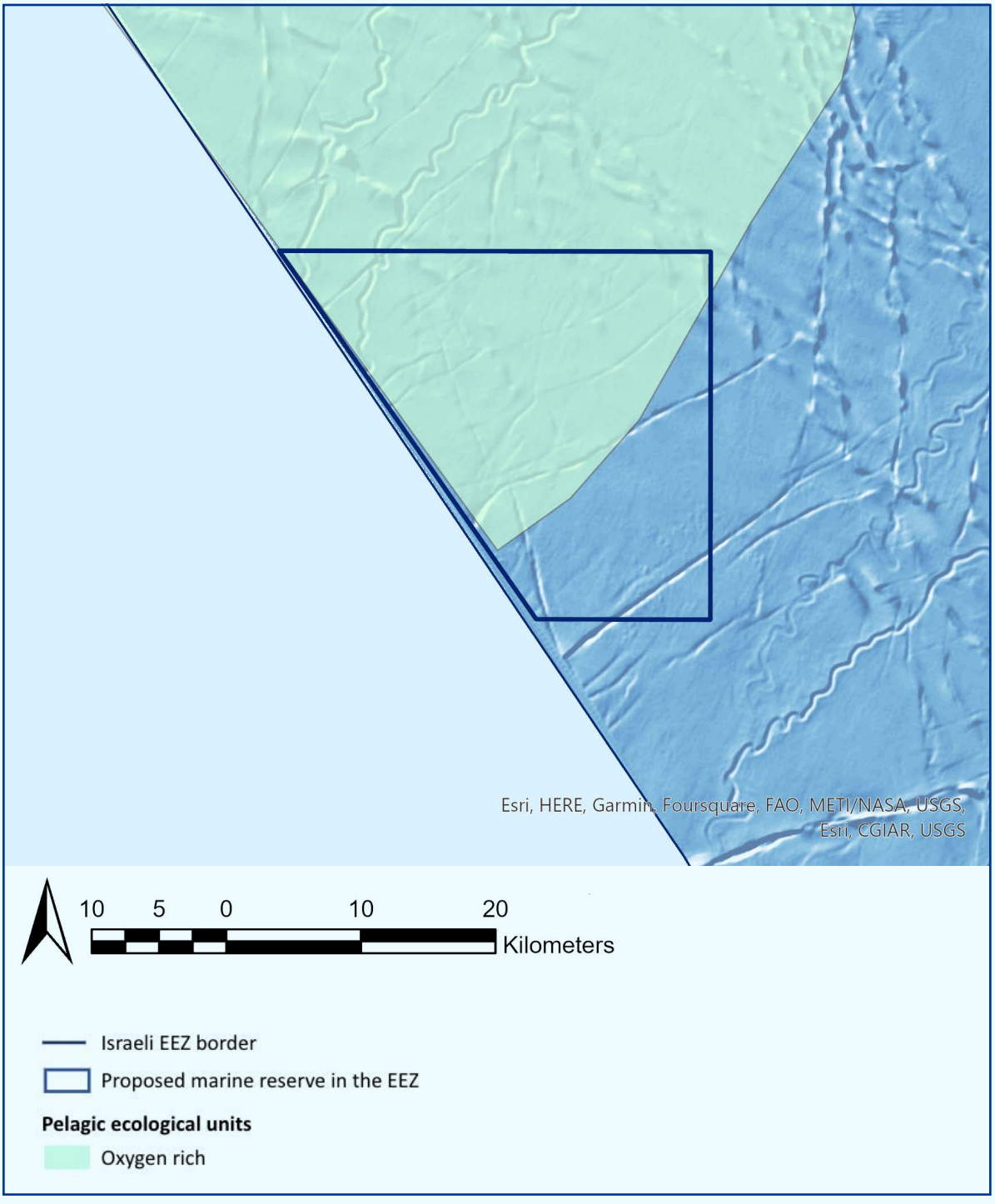
**Benthic ecological units:**

Three ecological units are representative of the main deep-sea fan: one with a unique assemblage of foraminifera and one with biological components representative of the Bathyal plains.



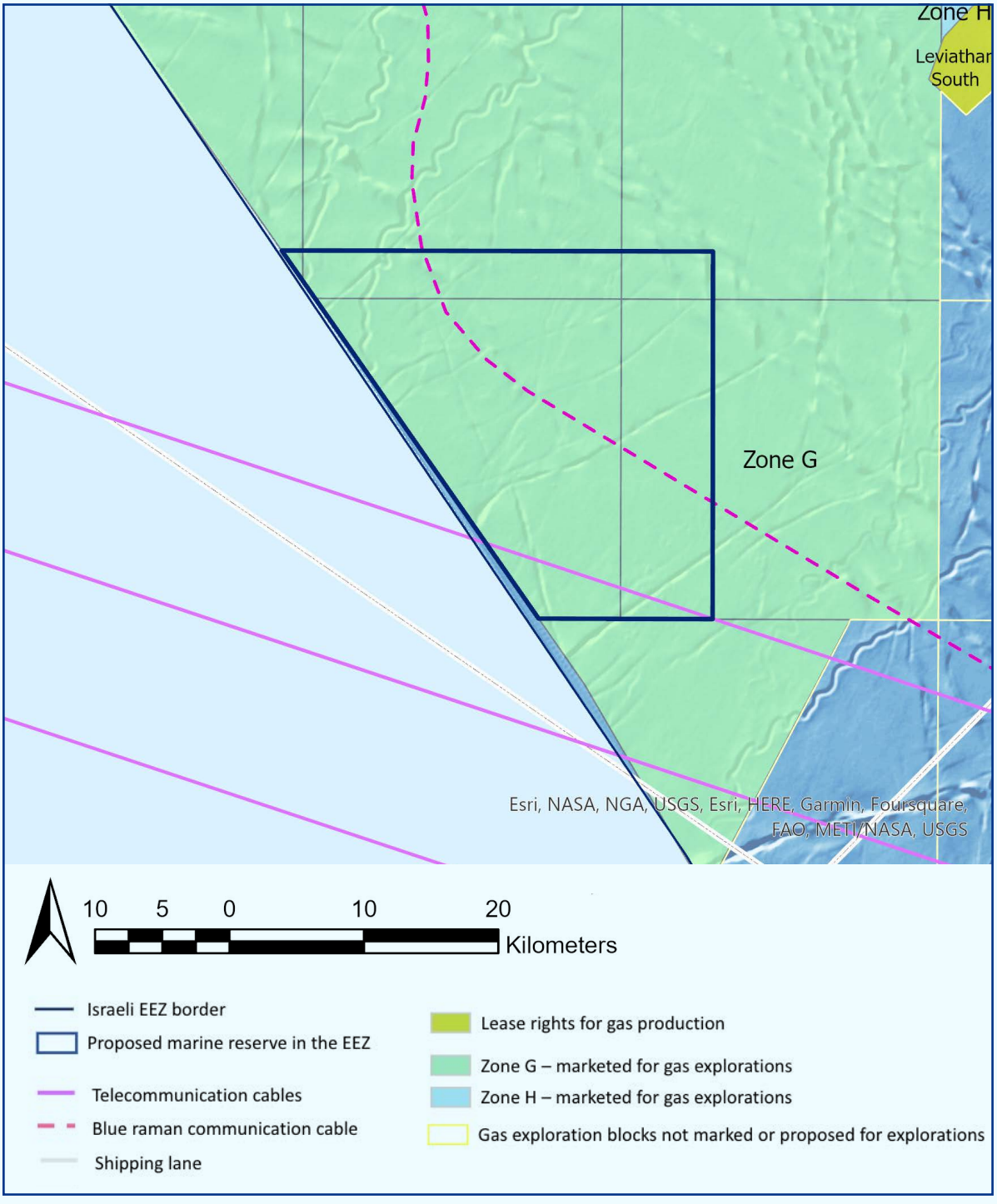
**Pelagic ecological units:**

The margins of the pelagic ecological unit is an oxygen-rich area.



**Socioeconomic activity:**

The reserve overlaps with an area to be tendered for gas explorations and communication lines.



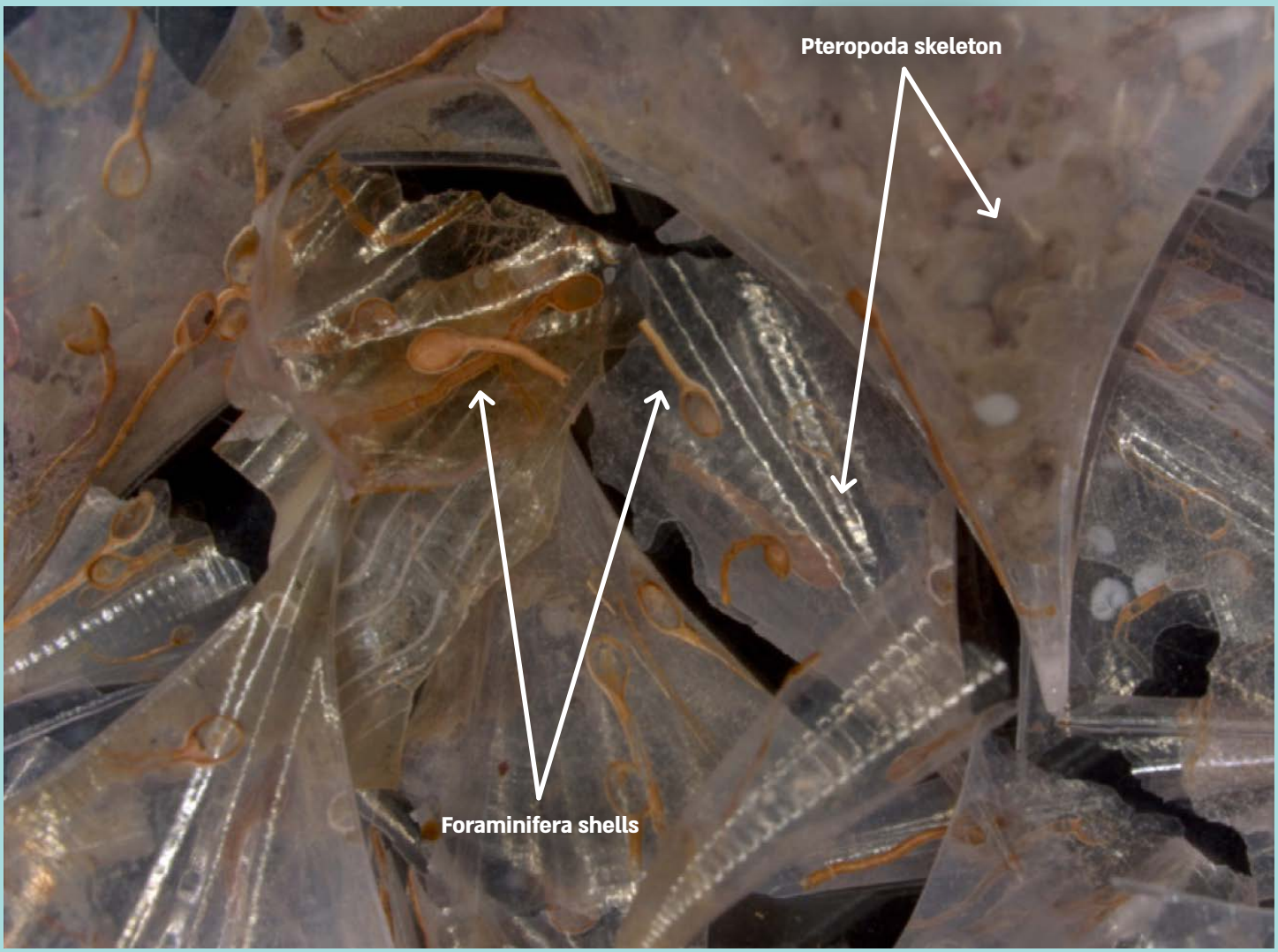

# What's small, helps the research of climate change, and gauges the ecological condition of the marine environment? Foraminifera

Foraminifera (Latin for "hole bearers") are tiny single-celled organisms that have hard shells. These diverse species have a variety of beautiful shells of different shapes (see figure below). The shells are of calcium carbonate or aragonite (which is characteristic of the heliolites and miliolid orders of foraminifera), or agglutinated sediment particles. Their sizes range from 100 micrometers to a few millimeters. Some feed on dissolved organic matter, bacteria, single-celled algae, and even microscopic crustaceans. They capture their food using microscopic pseudopodia, which are used also for moving around the seabed. Most of the foraminifera have a calcareous skeleton (i.e., they produce the carbonate shells through the adsorption of CO2 from the surrounding water); hence, they play an important role in the carbon cycle, by reducing atmospheric carbon levels. Unfortunately, climate change and the increase in the sea's acidity level are endangering the skeletal stability of this important group of creatures[48].

Approximately 4,000 types of benthic foraminifera live on or under the seafloor. Various types populate different sea environments and, therefore, those found in the deep sea are completely different from those found in the shallow continental shelf. Foraminifera shells provide important information about the environment, in the past and in the present. The shells' lasting durability within the geological record, which covers hundreds of millions of years, allows us to reconstruct past ecological conditions (climate changes, sea pollution, and changes in the features and composition of the sea floor).

A joint study conducted by Israel's Geological Institute and the Oceanography and Limnological Research Institute enabled the characterization of various habitats in the depths of the Mediterranean through the collection of live and dead foraminifera sampled from the sea floor[40]. Based on the assemblage of currently live foraminifera, six biotopes have been defined in the deep-sea area between the edge of the continental shelf and Israel's EEZ border in the west. A unique biotope, located in the western part of this segment, contained a high concentration of benthic agglutinated foraminifera, which were situated on top of the empty pteropod mollusk shells (these are pelagic gastropods with aragonite skeletons, see figure). These biogenic assemblages, which accumulated on the deep-sea floor after the death of the pteropoda, apparently increased the levels of carbonate measured in the area and provided a relatively solid substrate for the assemblage of certain types of foraminifera. In light of this unique phenomenon, the southwestern part of this area was included in the Pteropoda Skeletons Reserve.

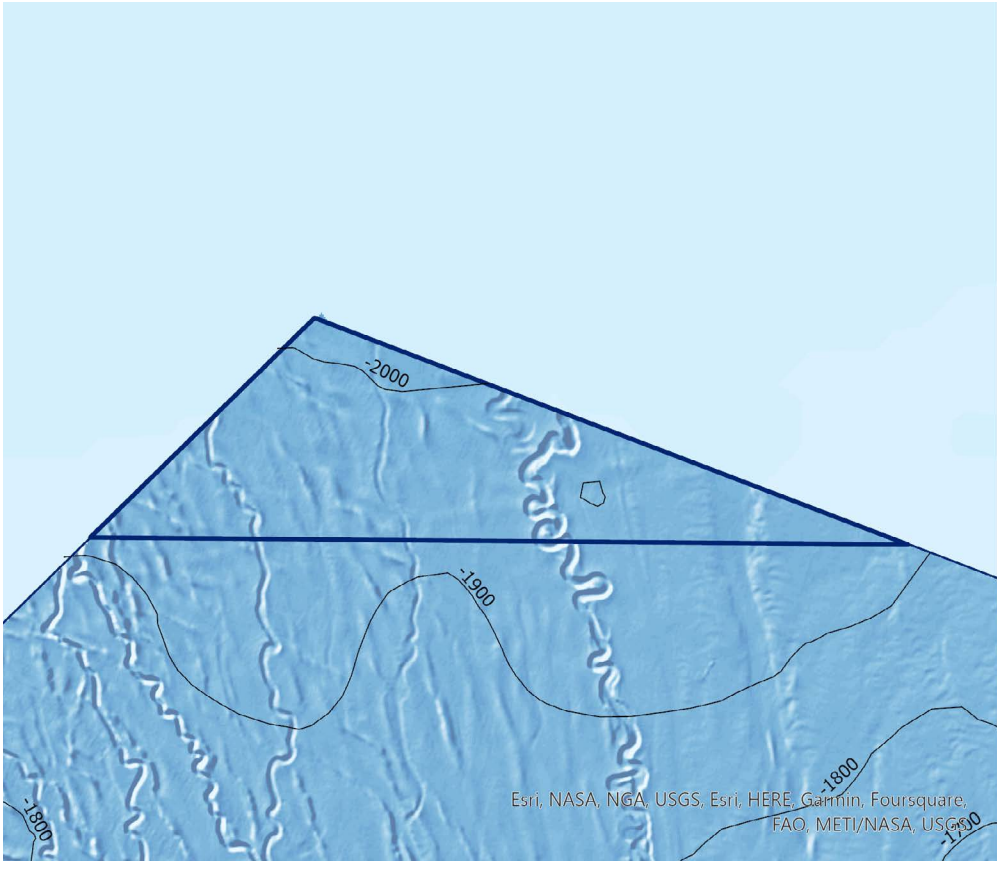
Foraminifera shells found in various sediments throughout the world | From Schmiedl[78]

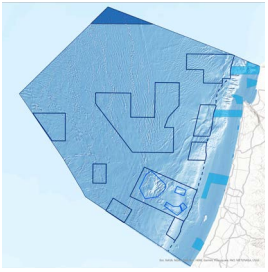



Benthic types of foraminifera adhering to the dead pteropod shells that accumulated in the western part of the bathyal plains in Israel's EEZ | From Hyams-Kaphzan et al.[40]

# The Northern Levant Channel Reserve

The Northern Levant Channel Reserve encompasses an area of 350 km$^2$ in the northwestern corner of Israel's EEZ. It is the deepest among the proposed marine nature reserves. It protects the northern part of the Levant Channel and in the future, it could become part of a larger transnational reserve that would extend beyond Israel's EEZ.



Israeli EEZ border

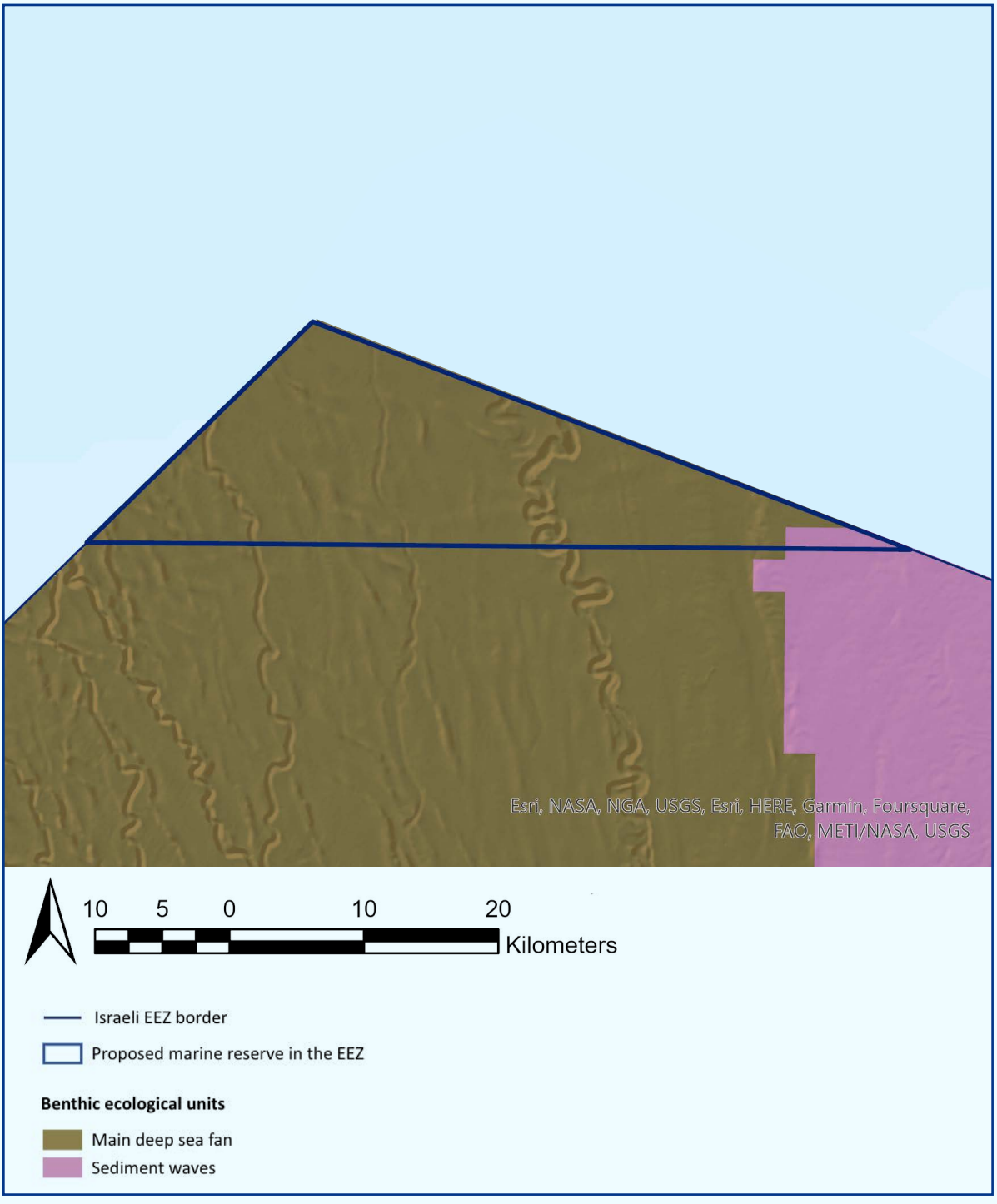
Depth contours

Proposed marine reserve in the EEZ

| | | |
|---|---|---|
| N | Area (km$^2$): **350** | Depth range (m): **1900-2000** |
| | Maximal distance from adjacent reserve (km): **50** | 10 5 0 10 20 Kilometers |

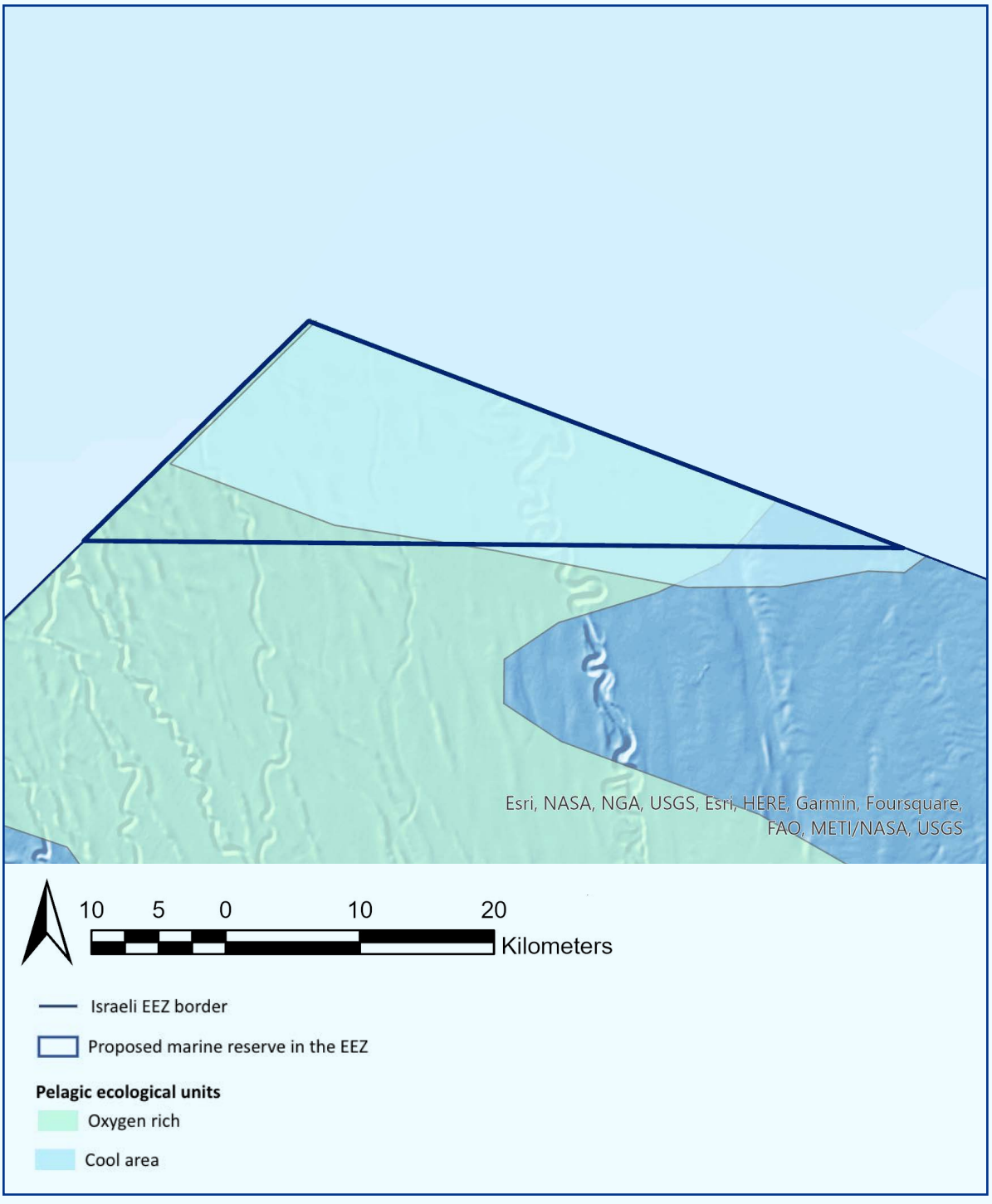
**Benthic ecological units:**

The northern end of the Levant Channel and the ecological unit representative of the main deep-sea fan.



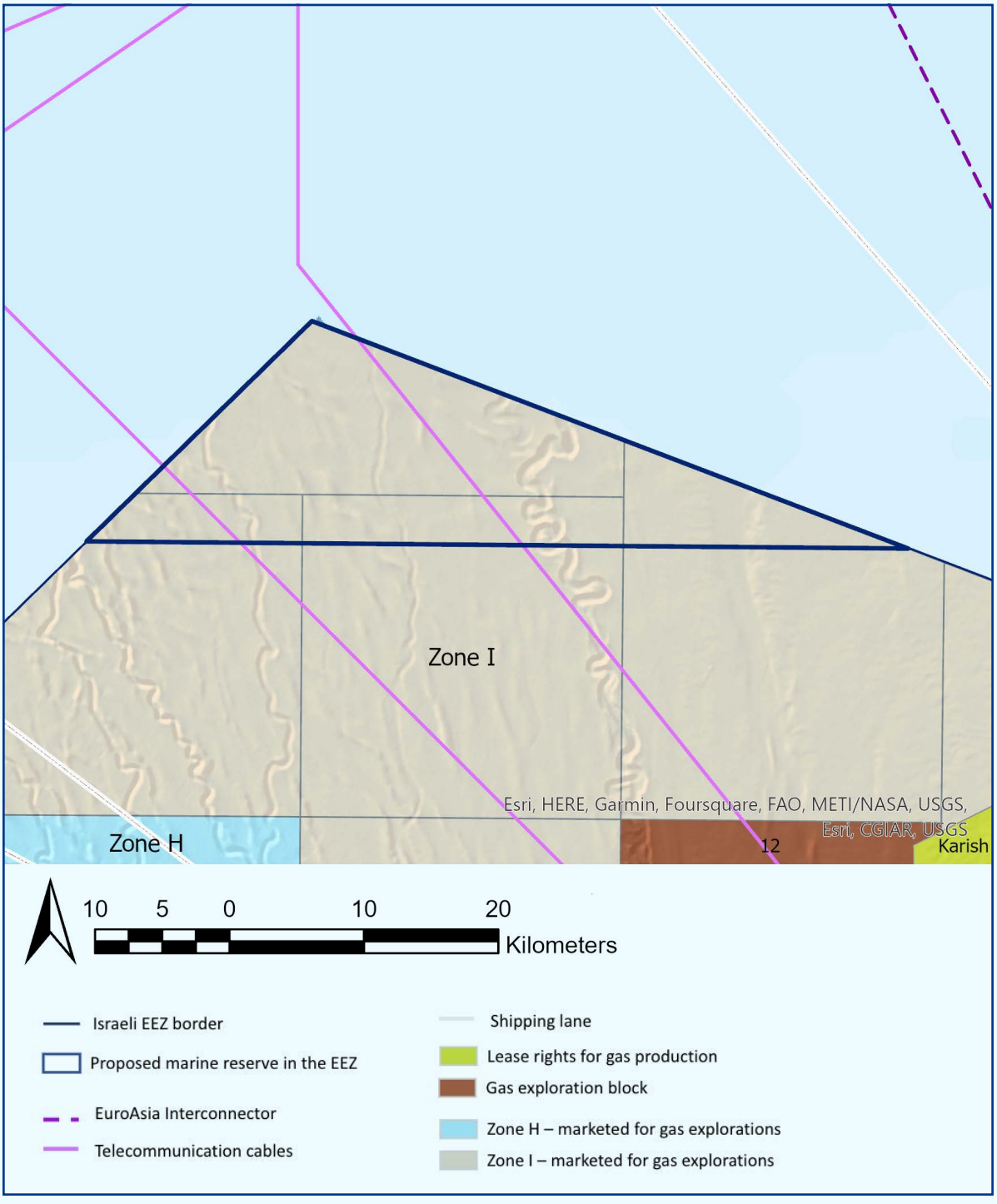
**Pelagic ecological units:**

The pelagic ecological unit of an area characterized by relatively low temperatures, which is represented solely in this reserve, along with a pelagic ecological unit characterized by a high concentration of oxygen.



**Socioeconomic activity:**

The reserve is adjacent to the northern and western borders of Israel's EEZ and overlaps with an area that will be tendered for gas explorations and communication lines.



7

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# 8| Appendices

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Appendix 1

**Background document for the Master Plan for Marine Nature Reserves in the EEZ [in Hebrew]**

Appendix 2

**Characterization of benthic ecological units and unique benthic habitats in the Israeli EEZ**

Appendix 3

**Participants to the project's committees [in Hebrew]**

Appendix 4

**External advisors review on the characterization of benthic ecological units and unique benthic habitats**

Appendix 5

**Characterization of pelagic ecological units and habitats in the Israeli EEZ**

Appendix 6

1. **EwE food-web model to examine spatio-temporal ecosystem changes in relation to climate change and conservation scenarios**
2. **Connectivety Modelling Sysytem to examine connectivity between unique benthic habitats**

Appendix 7

**Data layers of socioeconomic activities in the Israeli EEZ [in Hebrew]**

Appendix 8

**Report on spatial conservation prioritization using Marxan**

Appendix 9

**Reply to reviews and comments received from members of the scientific and steering committees throughout the planning process [in Hebrew]**