METHODS FOR THE IDENTIFICATION OF EBSAS IN THE ADRIATIC SEA

METODE ZA IDENTIFIKACIJO EKOLOŠKO ALI BIOTSKO POMEMBNIH OBMOČIJ V JADRANSKEM MORJU

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ABSTRACT

The Adriatic Sea is a very special portion of the Mediterranean region, which in spite of its limited water volume has distinctive geographic, geomorphological, oceanographic and ecological characteristics. One of the main tools to protect the Adriatic ecosystem biodiversity and functions from intense human pressures, such as coastal degradation, land-based pollution sources, fisheries and tourism, consists in the establishment of an ecologically representative network of marine protected areas (MPAs). The case for Adriatic MPAs should be best framed within the context of the current efforts of establishing a network of MPAs in the Mediterranean Sea, including in the region's open seas, under the aegis of the Barcelona Convention. Based on a process, which was recently applied to support the development of a representative network of MPAs throughout the Mediterranean, a strategic and hierarchical process is described herein, whereby the existing data and expert knowledge are used to locate the Adriatic Sea areas of conservation importance, through the application of criteria developed within the framework of the Convention of Biological Diversity for the identification of Ecologically or Biologically Significant Areas (EBSAs).

IZVLEČEK

Jadransko morje je zelo poseben del Sredozemske regije, saj ima kljub svojemu omejenemu vodnemu volumnu prav posebne geografske, geomorfološke, oceanografske in ekološke značilnosti. Eno izmed glavnih orodij za zavarovanje biotske pestrosti in funkcij jadranskega ekosistema pred intenzivnimi človekovimi posegi, kot so degradacija obale, kopenski viri onesnaževanja, ribištvo in turizem, je osnovanje ekološko reprezentativnega omrežja morskih zavarovanih območij (MPA-jev). Primer jadranskih zavarovanih območij bi bilo najbolje spraviti v okvir sedanjih naporov za osnovanje mreže MPA-jev v Sredozemskem morju, vključno z regionalnimi odprtimi morji pod zaščito Barcelonske konvencije. Na osnovi procesa, ki se je pred kratkim začel uresničevati z namenom, da se podpre razvoj reprezentativnega omrežja morskih zavarovanih območij po vsem Sredozemlju, je v tem prispevku opisan strateški in hierarhični proces, pri čemer so uporabljeni obstoječi podatki in strokovno znanje za lociranje jadranskih območij naravovarstvenega pomena z uporabo kriterijev, razvitih v okviru Konvencije o biotski raznovrstnosti za identifikacijo ekološko ali biotsko pomembnih območij.

1. INTRODUCTION

The Adriatic Sea, which is recognised as one of the sub-areas of the Mediterranean Sea in the EU Marine Strategy Framework Directive, is a very special, diverse and characteristic portion of the Mediterranean in many ways. It is an elongated body of water, about 800 km long and less than 200 km wide in its widest point, extending across almost 6° of Latitude (from 40°N to 45°45'N, the northernmost in the Mediterranean). The sea is surrounded by land, except for its narrow opening into the Ionian Sea, the Otranto Channel, which is 75 km wide. The Adriatic coastline is subdivided amongst six nations: Italy, Slovenia, Croatia, Bosnia & Herzegovina, Montenegro and Albania. The coastline is flat and largely consisting of sandy beaches along the western (Italian) shores, and rocky and fragmented into many small islands along the eastern shores. The Adriatic is extremely shallow (mean depth 240 m), averaging less than 50 m of depth in its northern part, but with a deep basin in the south, exceeding a depth of 1,400 m. During winter, the northern Adriatic waters can become very cold, and the area is therefore a source of Mediterranean deep waters. The mean salinity in the northern Adriatic is lower than the Mediterranean average, due to the many rivers that flow into the sea (mostly from northern Italy), which also carry large amounts of sediments as well as man-made contaminants from heavily urbanised, agricultural and industrialised northern Italy.

In spite of its vulnerability due to human pressures (caused by the high population densities along its shores, by the intense level of fisheries, and by the high levels of pollution discharged into the sea, in particular through the Po river), the Adriatic Sea still harbours a very valuable marine biodiversity and includes ecosystems having great ecological, economic, aesthetic and cultural values. Marine mammals are represented by several species of odontocetes (although only bottlenose dolphins, *Tursiops truncatus*, are now regular in the northern part) and by monk seals (*Monachus monachus*), which have recently been repeatedly sighted in Istria and surrounding waters. The marine bird fauna is abundant and diverse, particularly in the north-west and across an area connecting the southern Dalmatian islands in Croatia to the Gargano peninsula in Italy (Carboneras et Requena 2010). In a recent paper, Casale et al. (2010) determined that the northern Adriatic is one of the Mediterranean areas with the highest loggerhead turtle density, whereas the southern Adriatic is an important developmental area for the same species in the first years of life. Furthermore, the Adriatic still contains important nursery areas for several elasmobranch species (Serena, pers. comm.), and used to be a major feeding ground for the now endangered bluefin tuna (*Thunnus thynnus*). The Adriatic Sea's importance for a very large number of fish and benthic invertebrate species is very well known.

Establishing marine protected areas (MPAs) in key locations of high ecological value, and organising MPAs into networks, is considered one of the most effective ways of conserving marine ecosystem biodiversity and functions. The case for Adriatic MPAs should be best framed within the context of the current efforts of establishing a network of MPAs in the Mediterranean Sea, including in the region's open seas, under the aegis of the Barcelona Convention and its Specially Protected Areas of Mediterranean Importance (SPAMI) listings,

both in the territorial waters of the riparian states and in the areas beyond national jurisdiction (ABNJ).

This document briefly describes a process which was recently applied to support the development of a representative network of MPAs throughout the Mediterranean, whereby existing data and expert knowledge is used to identify the Adriatic Sea areas of conservation importance, denominated *Ecologically or Biologically Significant Areas* (EBSAs).

A major challenge in applying the above described process resides in the lack of adequate data, in particular due to the fragmentary knowledge currently existing of the ecology of part of the southern and eastern portions of the Mediterranean basin.

2. THE IDENTIFICATION PROCESS

The process of identifying sites to construct an ecologically representative network of MPAs in the Mediterranean, described in Notarbartolo di Sciara et Agardy (2009), consists of a three-stage hierarchical planning approach.

The first stage, on the widest regional scale, involves subdividing the Mediterranean into few large units (or sub-regions) having some ecological homogeneity.

The second stage foresees the identification within each sub-region of priority conservation areas, i.e., areas which possess high biodiversity values, and/or where significant ecological processes occur, and that raise concern due to their vulnerability to human pressures.

The third stage concerns the development of an ecologically representative network of MPAs (including corridors), which will involve first the identification of sites within the priority areas identified in the previous step, which will constitute the building blocks of an ecologically representative network once declared as MPAs, and second in addressing the socio-economic, legal, administrative and political aspects that are necessary for the formal establishment of such MPAs.

This document addresses in detail only the second of these three stages. The first stage is already concluded, given that the Mediterranean sub-region in which the process will occur – the Adriatic Sea – is already identified and represents the goal of this effort. The third stage, which is outlined only briefly in Section 4 of this document, will demand a dedicated effort in view of the complexities inherent in its political, social and economic implications.

The second stage is of a pure scientific, ecological nature, and involves the identification in the Adriatic Sea of *Ecologically or Biologically Significant Areas* (EBSAs), a process that was developed in recent years under the impetus of the Convention on Biological Diversity (CBD). A first attempt at such process was already the object of an effort led by the RAC/SPA in 2009, in cooperation with the European Commission, and which led to the identification of a number of EBSAs in the Mediterranean, including one in the northern and central Adriatic Sea (UNEP MAP 2010, Annex III). This portion of the Adriatic was selected for having a high natural productivity supporting an extensive food web, including sea birds, loggerhead sea turtles and several shark species, and its selection was based on the criteria of biological productivity, special importance for life history stages of species, and importance

for threatened, endangered or declining species and/or habitats. However, as warned by Notarbartolo di Sciara et Agardy (2009), further analysis, with a finer comb and with more statistically rigorous methodologies, is now needed in each sub-region to ensure that MPAs are designated with sufficient topographical and ecological accuracy, so that the future network of MPAs is maximally effective and representative.

The process involves the application of selection criteria (3.1), the collection of relevant available knowledge (3.2), and the mapping of EBSAs (3.4).

2.1 SELECTION CRITERIA

The process described in UNEP MAP (2010), and endorsed by the Focal Points for SPAs, involves the adoption of operational criteria for identifying potential SPAMIs in the open seas, including the deep sea. These include a combination between the criteria for SPAMIs included in Annex I to the 1995 SPA/BD Protocol to the Barcelona Convention, and criteria which had been developed within the framework of a number of other relevant organisations (e.g., GFCM, CBD, IMO PSSA, etc.).

However, considering that the theme of this document is circumscribed to the identification of EBSAs in the Adriatic Sea, as a further refinement in this sub-region of the work promoted by the RAC/SPA in 2009, only the seven criteria which are relevant to the identification of EBSA (Convention on Biological Diversity 2008) will be considered here. These are:

1. **Uniqueness or rarity**: area contains either
   (i)   unique ("the only one of its kind"), rare (occurs only in few locations) or endemic species, populations or communities, and/or
   (ii) unique, rare or distinct, habitats or ecosystems; and/or
   (iii) unique or unusual geomorphological or oceanographic features.
2. **Special importance for life history stages of species**: areas that are required for a population to survive and thrive.
3. **Importance for threatened, endangered or declining species and/or habitats**: area containing habitats for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species.
4. **Vulnerability, Fragility, Sensitivity, or Slow Recovery**: areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.
5. **Biological productivity**: area containing species, populations or communities with comparatively higher natural biological productivity.
6. **Biological diversity**: area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.
7. **Naturalness**: area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.

2.2 COLLECTION OF AVAILABLE KNOWLEDGE

The ecological knowledge of the Adriatic Sea must be reviewed to enable locating on the map the presence of natural features that are relevant on the basis of the seven CBD criteria listed above.

The types of knowledge that are relevant to the process include information on the distribution of key physical and biogenic habitats; the distribution of habitats of selected species such as cetaceans, the monk seal, marine birds, ichthyofauna (including sharks and rays); and hotspots of benthic biodiversity. In addition, and particularly when detailed knowledge of species is unavailable, the presence of geomorphological and oceanographic features (such as seamounts, canyons, ridges, upwelling areas, frontal systems, etc.) can be used as proxies for the presence of elements having a high biodiversity value.

The types of knowledge listed above can be accessed in a number of ways:

1. Through reviews of scientific publications, both published and from the "grey" literature, cruise reports, fisheries data, internet-based databases, conference presentations, detailed maps of the sea bottom, etc.

2. From GIS maps of the distribution of particular taxa, which are becoming increasingly available through species-based efforts. One example is the GIS mapping of seabird distribution (Carboneras et Requena 2010), resulting in 10x10 km cells that are weighed according to the conservation value of the seabird species present, which is computed on the basis of the number of species observed per cell and their conservation status (Fig. 1).
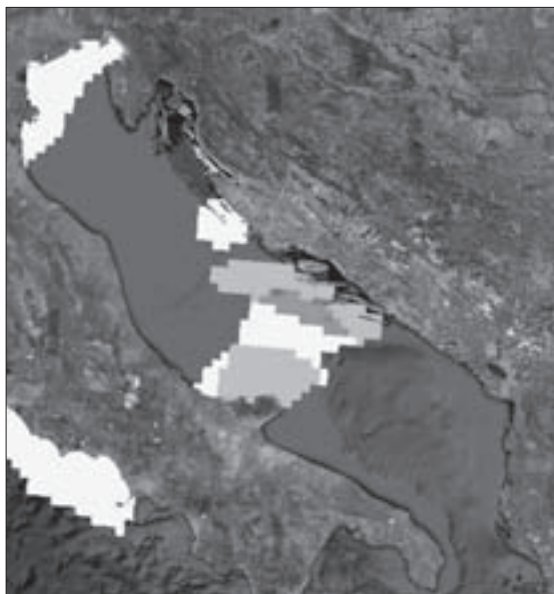

Fig. 1: Distribution of seabirds in the Adriatic Sea, subdivided into three levels (bright orange = highest, yellow = lowest) of conservation status (Carboneras et Requena 2010)
Slika 1: Razširjenost morskih ptic v Jadranskem morju, razdeljena na tri ravni (živo oranžna = najvišja, rumena = najnižja) varstvenega statusa (Carboneras in Requena 2010)

3. Through the collection of expert opinion (a.k.a. Delphic method), performed by inventorying knowledge from key experts in all the relevant fields of marine science (marine geology,

oceanography, remote sensing, and ecology of the relevant species). In this respect it is important to consider that this method of collecting useful knowledge is very rapid and can be quite helpful in an initial phase of the investigations, also considering that in many instances this is the only method available. However, being opinion-based, its results are often very subjective, imprecise, and the relative weights (e.g., from one expert to another) are difficult to assess; therefore this method should be limited preferably to an initial phase, while more rigorous quantitative data are being collected.

4. Through the implementation of *in situ* field campaigns, to be decided on the basis of evidence of severe knowledge gaps deriving from the analyses mentioned above (points 1 through 3), and of course on the necessary availability of human and financial resources.

Expert opinion surveys can be performed in different ways. The method used by Notarbartolo di Sciara et Agardy (2009) involved engaging selected experts in a survey (see the Annex 1), and asking survey participants to provide one or more polygons with a short description of the relevance of each polygon to the exercise. Given that the polygons were scored on the basis of each of the seven CBD criteria, a "mild" quantitative approach could be introduced, to compare and rank the relative importance of the polygons based on the CBD criteria.

To perform an analysis of the presence of EBSAs in any specific Mediterranean sub-region, such as in the case at hand of the Adriatic Sea, and with the opportunities offered by a more limited territorial extension, which can be scrutinised within more comfortable deadlines than what was possible with the pan-Mediterranean exercise (Notarbartolo di Sciara et Agardy 2009), it may be advisable to create an *ad hoc* multi-disciplinary group (composed by one expert for each of the relevant disciplines and methods), charged to perform a thorough inventory of the available knowledge and expertise, including the identification, enrolment and involvement in the process of the various scientific institutions that are known to actively operate in the sub-region.

The availability of spatially more precise information (e.g. through GIS analyses) and of quantitative data (e.g. through survey-derived spatial modelling) will eventually allow the application of more rigorous methods to identify EBSAs, for example through decision support tools such as the MARXAN software (Ardron et al. 2008).

However, seeking too much precision in the placement of polygons on a map may become a hindrance when considering that critical habitat of highly mobile species, such as marine mammals and birds, may change significantly from year to year (as exemplified by the observed fluctuation of fin whale distribution in the north-western Mediterranean; Panigada, pers. comm.). Therefore, for best results, distributional data for mobile species should be integrated over several years of observation before being used to identify EBSAs; often, such integration may be unintentionally provided through expert opinion, which in such cases may be more accurate than hard data collected over a short period.

2.3 MAPPING

All spatially-explicit data obtained through the above methods are transposed on a map to highlight the locations and delimitations of EBSAs. This can be done either through one of the

many professional GIS software packages available, or very easily (i.e. by anyone without the need for specialised GIS expertise and software availability) through Google Earth.

Google Earth allows for the handy creation of polygons that can be labelled, identified through colour and text, be made to acquire variable degrees of transparency so that overlays between polygons are visible, and saved on ".kmz" or ".kml" files that are quite easy to handle and exchange through email.

By way of example, 86 polygons collected with a survey performed by Notarbartolo di Sciara et Agardy (2009) were overlaid on the map of the Mediterranean Sea through Google Earth (Fig. 2 and 3). EBSAs can be inferred in those locations where polygons are clustered together (e.g. the Alborán Sea, the Strait of Sicily and the northern Adriatic Sea).
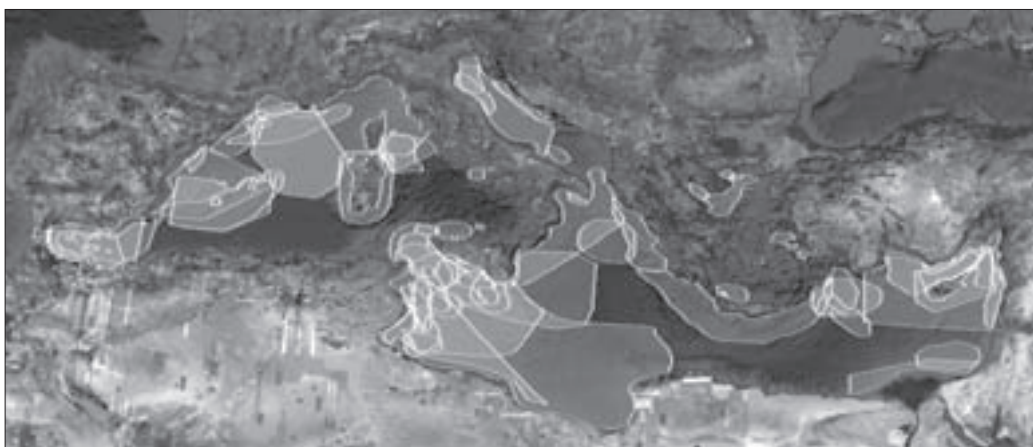

Fig. 2: Locations of 86 polygons referring to areas scored for one or more of the CBD criteria for the identification of EBSAs in the Mediterranean Sea (Notarbartolo di Sciara et Agardy 2009)
Slika 2: Lokacije 86 poligonov v območjih, ki dosegajo enega ali več kriterijev Konvencije o biotski raznovrstnosti za identifikacijo ekološko ali biotsko pomembnih območij v Sredozemskem morju (Notarbartolo di Sciara et Agardy 2009)
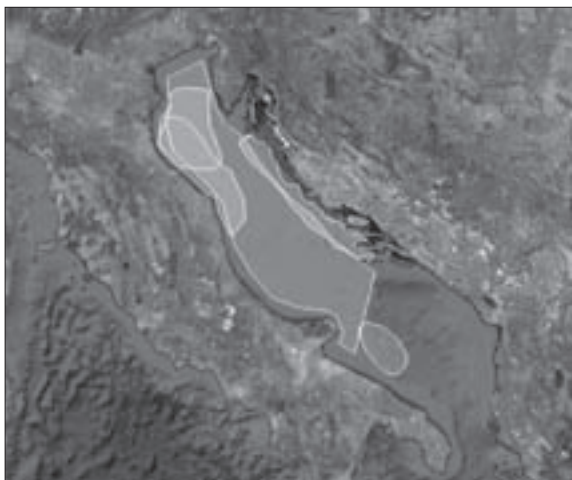

Fig. 3: Locations of 5 polygons referring to areas scored for one or more of the CBD criteria for the identification of EBSAs in the Adriatic Sea (Notarbartolo di Sciara et Agardy 2009). Polygons refer to areas important for marine turtles, nursery areas for elasmobranchs, suitable areas for small pelagics, and deep-sea coral reefs.

Obviously the overlap and clustering of polygons can only be a first, rough indication of the presence of an EBSA; in such areas, finer-scale analyses should be performed as soon as possible for more accurate assessments.

3. FROM EBSAS TO SPAMIS

After EBSAs have been identified and mapped in the Adriatic sub-region, and even before the creation of MPAs within such EBSAs is considered under the aspects of existing threats and socio-economic, institutional, governance, administrative and political angles, much remains to be done to provide guidance to the concerned riparian governments about the optimal order for MPA (or SPAMI) planning and implementation, and how each protected area should be designed.

Declaring protected areas spanning each identified EBSA would not necessarily assure that a representative network would be created to maximize biodiversity conservation in the Adriatic Sea. Given that the overall objective of establishing a network of representative marine protected areas is to capture the full suite of Adriatic biodiversity and utilise protected areas to conserve it, the entire network of sites must be evaluated in terms of its geographical representation, as well as its representation of all major habitat types.

"Scientific criteria and guidance for selecting areas to establish a representative network of marine protected areas, including in open ocean waters and deep-sea habitats" were provided by CBD (Convention on Biological Diversity 2008, Table 2, Annex III). To effectively be part of a representative network, an MPA should fulfil the following criteria: the area must be within an EBSA; the area must be representative (details on the approaches for dealing with the issue of representativity in an MPA network are presented in the working document "Representativity and coherence of MPA networks: concepts and applicability to the Mediterranean Sea" prepared by Chedly Rais for this International Workshop); the area must offer connectivity, allowing for linkages whereby they benefit from larval and/or species exchanges, and functional linkages from other network sites; ecological features (i.e., species, habitats and ecological processes that naturally occur in the given biogeographic area) must be replicated in different MPAs to account for uncertainty, natural variation and catastrophic events; and finally, sites must be adequate and viable (i.e. they should have size and protection sufficient to ensure the ecological viability and integrity of the feature(s) for which they were selected).

The MPA network evaluation could be best performed through the application of statistically rigorous methodologies (e.g. through a combination of Delphic methods and decision support tools such as MARXAN, see Ardron et al. 2008), to ensure that the proposed network of MPAs is maximally effective and representative.

Only once a blueprint for an MPA (or SPAMI) network, which is ecologically representative of the Adriatic Sea, is completed from the scientific point of view, on the basis of the process outlined above, the conditions will be mature for the setting up the necessary procedure of coordination and consultation between neighbouring countries, to address all the necessary

political, legal, socio-economic, administrative, and institutional aspects of the network creation process.

4. LITERATURE

1. Ardron, J.A., H.P. Possingham, C.J. Klein (eds) (2008): MARXAN good practices handbook; external review version; 17 May, 2008. Pacific Marine Analysis and Research Association, Vancouver, BC, Canada. 155 p. www.pacmara.org

2. Casale, P., M. Affronte, G. Insacco, D. Freggi, C. Vallini, P. Pino d'Astore, R. Basso, G. Paolillo, G. Abbate, R. Argano (2010): Sea turtle strandings reveal high anthropogenic mortality in Italian waters. Aquatic Conservation: Marine and Freshwater Ecosystems, DOI: 10.1002/aqc.1133

3. Carboneras, C., S. Requena (2010): GIS mapping of seabird distribution – a pan-Mediterranean perspective. Poster. 39th Congress of the CIESM, Venice, May 2010.

4. Convention on Biological Diversity (2008): Report on the expert workshop on ecological criteria and biogeographic classification systems for marine areas in need of protection. SBSTTA 13th Meeting, Rome, 18–22 February 2008. 25 p.

5. Notarbartolo di Sciara, G., T. Agardy (2009): Identification of potential SPAMIs in Mediterranean Areas Beyond National Jurisdiction. Contract N° 01/2008_RAC/SPA, High Seas. 70 p.

6. UNEP MAP (2010): Report of the Extraordinary Meeting of the Focal Points for SPAs. Istanbul, Turkey, 1 June 2010. ENEP(DEPI)/MED WG.348/5. 23 p.

ANNEX 1
PRILOGA 1

<div align="center">

Expert Survey
for the identification of Ecologically or Biologically Significant Areas
in Mediterranean Areas Beyond National Jurisdiction

</div>

Date

Dear Colleague:

We have been asked by UNEP MAP's Regional Activity Centre / Specially Protected Areas (RAC/SPA) of Tunis to provide an expert opinion based on collective knowledge about the presence in the Mediterranean Sea of the so-called *Ecologically or Biologically Significant Areas* (also known as EBSAs) where the establishment of SPAMIs (= *Specially Protected Areas of Mediterranean Importance*) might be recommended to the Contracting Parties to the Barcelona Convention in the near future. In particular, the current effort is concentrated on the identification of EBSAs in Mediterranean areas beyond national jurisdiction, i.e., generally at a distance from the coast greater than 12 nautical miles (22,2 km).

Given what you know about the attached subset of the Mediterranean Sea <xxxx> we are kindly asking you to identify such noteworthy areas by drawing one or more polygons on the map. Such areas may be characterised by a number of features significant for marine biodiversity, including benthic features (e.g. seamount communities, cold water coral reefs, coral, sponge and bryozoan aggregations, hydrothermal vent ecosystems, cold seeps, canyons, trenches), pelagic habitats (e.g. upwelling areas, fronts, or gyres), or the presence of vulnerable and/or highly migratory species, critical habitats and corridors (e.g. cetaceans, seabirds, sea turtles, sharks and rays, highly migratory fish, or discrete deep-sea fish populations.).

When in doubt, we recommend that you be inclusive rather than exclusive.

We would also like to determine, which of the following criteria support your assessment for each polygon:

1. Uniqueness or rarity
2. Special importance for life history of species
3. Importance for threatened, endangered or declining species and/or habitats
4. Vulnerability, fragility, sensitivity, slow recovery
5. Biological productivity
6. Biological diversity
7. Naturalness

For definitions and a further explanation of the criteria, please see the attached documentation[1].

In light of this, could you score each criterion for its importance in determining each polygon's value by checking the appropriate boxes in the table below as follows:

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[1] The documentation is not attached here. It can be found in the Convention on Biological Diversity (2008).

Criterion	0 not at all	1 a little	2 somewhat	3 a lot	4 completely
Uniqueness or rarity					
Special importance for life history of species					
Importance for threatened, endangered or declining species and/or habitats					
Vulnerability, fragility, sensitivity, slow recovery					
Biological productivity					
Biological diversity					
Naturalness					

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