Javna ustanova
Zavod za prostorno uređenje Istarske županije
Ente per l'assetto territoriale della Regione Istriana

E08 Coastal Ecosystems and Landscape *Common Indicator 16* – Length of coastal subject to physical disturbance due to the influence of manmade structures – *ISTRIA COUNTY - CROATIA*

REPORT

PAP/RAC
UN environment
MAP

TITLE:

EO8 COASTAL ECOSYSTEMS AND LANDSCAPES COMMON INDICATOR 16 – LENGTH OF COASTLINE SUBJECT TO PHYSICAL DISTURBANCE DUE TO THE INFLUENCE OF MANMADE STRUCTURES – ISTRIA COUNTY – CROATIA - REPORT

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ZAVOD ZA PROSTORNO UREĐENJE Istarske županije
PULA POLA
Ente per l'assetto territoriale della Regione Istriana

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1. INTRODUCTION

The Contracting Parties to the Barcelona Convention (The European Community and all the EU Mediterranean Member States) at their 19th Ordinary Meeting (COP 19, Athens, Greece, 9th-12th February 2016), adopted Integrated Monitoring and Assessment Programme and related Assessment Criteria (IMAP) for marine and coastal environment. IMAP is a key achievement for the Mediterranean region, which enable for the first time a quantitative, integrated analysis of the state of the marine and coastal environment based on common regional indicators, targets and Good Environmental Status (GES) descriptions.

The core of the IMAP are 11 Ecological Objectives: EO1-Biodiversity, EO2-Non-indigenous species, EO3-Commercial species, EO4-Marine food webs, EO5-Eutrophication, EO7-Hydrography, EO8-Coastal ecosystems and landscapes, EO9-Contaminants, EO10-Marine litter and EO11-Underwater noise.

The EO8 reflects the aim of the Barcelona Convention to include coastal areas in the assessment, which became a legal obligation upon the entry into force of its Protocol on Integrated Coastal Zone Management in the Mediterranean (ICZM Protocol). In the Article 16 of the Protocol, the Contracting Parties are required to "set out an agreed reference format and process to collect appropriate data in national inventories "regarding the state and evolution of coastal zones.

The aim of monitoring the EO8 common indicator 16 "Length of coastline subject to physical disturbance due to the influence of manmade structures" is twofold: to quantify the rate and the spatial distribution of the Mediterranean coastline artificialisation and to provide a better understanding of the impact of those structures to the shoreline dynamics.

Common indicator 16 (CI16) has not been yet defined for Croatia coastline, so this report provides a specific type of pilot testing for the indicated indicator with analysis, results and values for the all coastline of the Istria County.

The following reference documents should be taken into account that are integral part of the contract:

- Information standards for the Common Indicator 16 (Annex 1)
- Indicator guidance factsheet for EO8 Coastal Ecosystems and Landscapes Common Indicator 16 "Length of coastline subject to physical disturbance due to the influence of manmade structures" (Annex 2)

Results, which are part of this report are:

1. Narrative report, which includes main characteristics of coastline of the Istria County and its coastal area – the main results of monitoring and difficulties encountered while monitoring. The main indicator units are:

- Km of artificial coastline and percentage (%) of total coastline length
- Percentage (%) of natural coastline on the total coastline length.

2. Graphic map which includes:

- GIS layer (polyline, HTRS 96) – Artificial structures with location and extend of artificial structures with attribute table (CPCODE, ASCODE, ASDES, Municipal, Year)
- GIS layer (polyline, HTRS 96) – Coastline AN (Artificial/Natural coastline) with attribute table (CPCODE, ART_NAT, Municipal, Year, Referent Year).

The Coastline of the Istria County

The Istria County is the westernmost county of Croatia (Figure 1), which includes the biggest part of the Istrian peninsula (2820 km^2 out of 3160 km^2, or 89%). Its coastline is 479,975 km long, with islands and islets making up 576,683 km. The Istria County divided into 41 units of local self-government, 10 cities and 31 municipalities, and 22 of them are coastal (Figure 2).

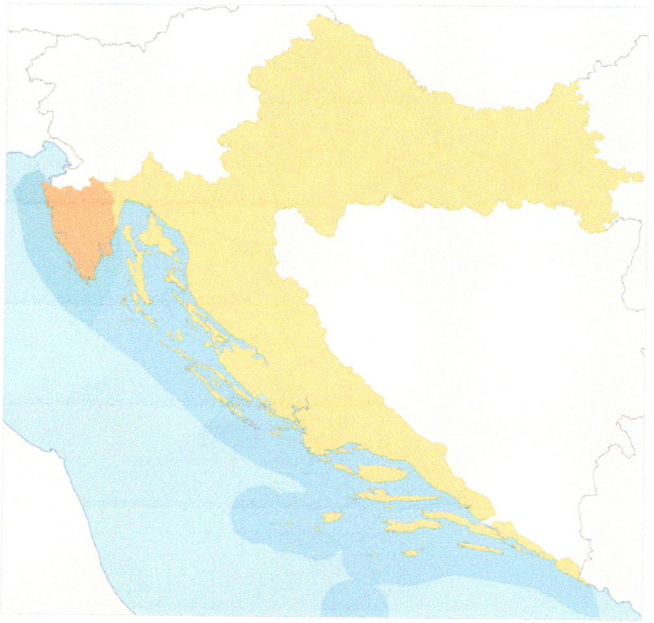

Figure 1: Position of the Istria County in the Republic of Croatia

(Source:https://hr.wikipedia.org/wiki/Hrvatske_%C5%BEupanije)

Figure 2: Administrative division of the Istria County
(Source: Institute for Physical Planning Region of Istria, 2019.)

The wester coast of Istria is flatter and shallower (Figure 3), more indented, while the eastern coast is steeper and less indented (Figure 4).

Figure 3: Natural western coast of the Istria County – island Fržitol-group of Vrsar's islands
(Photo: Latinka Janjanin, 2019.)

Figure 4: Natural eastern coast of the Istria County – municipality of Kršan
(Photo: Latinka Janjanin, 2012.)

Generally, the coast is well developed with lots of bays, deeper small bays, and river mouths. Except for a series of smaller islets in front of the coast from Poreč, Vrsar and Rovinj, the Brijuni archipelago with Medulin's islands stands out in the south.

The majority of the Istrian coast is on the Karst and the limestone grounds. The sinking of Karst recess created specific and branched bays, such as the Pula port, the Medulin bay, the Rovinj, the Poreč or the Vrsar coast. Isolated limestone heights remained as islands.

2. METHOD AND INPUT DATA

Monitoring of the Common Indicator 16 focuses on measuring the length of artificial coastline and its share in total coastline of the Istria County, on a geographical scale 1:5000 (DOF, 2016-2018, State Geodetic Administration).

The coastline has been determined by State Geodetic Administration of the Republic of Croatia.

To support the correct determination of type of the coastal segments coastline, beside photo digital data, spatial development plan of 22 coastal municipalities were used (Buje-Buie, Labin, Novigrad-Cittanova, Poreč-Parenzo, Pula-Pola, Rovinj-Rovigno, Umag-Umago, Vodnjan-Dignano, Bale-Valle, Barban, Brtonigla-Verteneglio, Fažana-Fasana, Funtana-Fontane, Kanfanar, Kršan, Ližnjan-Lisignano, Marčana, Medulin, Raša, Sveti Lovreč, Tar Vabriga-Torre Abrega and Vrsar-Orsera).

The length of artificial coastline has been calculated as the sum of segments on reference coastline identified as the intersection of polylines representing manmade structures with reference coastline ignoring polylines representing manmade structures with no intersection with reference coastline. The minimum distance between coastal defence structures is set to 10 m in order to classify such segments as natural, i.e. if the distance between two adjacent coastal defence structures is less than 10 m, all the segment including both coastal defence structures is classified as artificial.

The information in the attribute tables associated with the GIS information layer, accordingly with "Information standards for the Common Indicator 16"), for the coastline of all the Istria County are:

- CPCODE (two-letter code of Country) – HR
- ART/NAT (code for type of segment of coastline):
  - 0 – Natural coastline
  - 1 – Artificial coastline
- ASCODE (Code of type of artificial infrastructure):
  - 1 – Breakwaters
  - 2-Seawater/Revetments/Sea dike
  - 12 – Port and marinas
- ASDES (description of type of artificial infrastructures)-dock, quay, sea front etc.
- MUNICIPALITY (name of municipality where the polyline of artificial infrastructures is located)
- YEAR (year of production of the information layer) – 2019.
- REF_YEAR (year of the reference coastline used to represent natural and artificial segments)-2016.-2018.

3. RESULTS

The results are prepared according to Indicator guidance factsheet for EO8 Coastal Ecosystems and Landscapes Common Indicator 16 "Length of coastline subject to physical disturbance due to the influence of manmade structures".

Digital data (shapefile format with required attributes) is also an integral part of this report and it is uploaded to INFO/RAC IMAP Info System.

The length of natural coastline of theIstria County is 490,1538 km or 85%, while the total length of constructed coastline of the Istria County is 86.5292 km or 15% (Figure 5, Table 1).

Figure 5: Spatial presentation of constructed structures in the coastal area of the Istria County
(Source: Institute for Physical Planning Region of Istria, 2019.)

	Length (km)	Procentage (%)
Natural	490,1538	85
Artificial	86,5292	15
TOTAL:	***576,683***	***100***

Table 1: Coastline delineation – Natural and artificial - the Istria County

(Source: Institute for Physical Planning Region of Istria, 2019.)

Spatial distribution of different type of artificial infrastructure shown in Figure 6 and Table 2. The artificial structures are dominated by "Port and marinas" (67,26%), while significantly less represented "Breakwaters" (20,53%) and "Seawaters/Revetments/Sea dike" (12,21%).

As we can see on Figure 4, most of artificial structures are located on the western coast, nearest the famous touristic destinations (Umag-Umago, Poreč-Parenzo, Vrsar-Orsera,Rovinj-Rovigno) and Pula on the south. The eastern coast of the County is less tourist developed than the western part, so, it's not surprising that the presence of artificial structures is smaller.

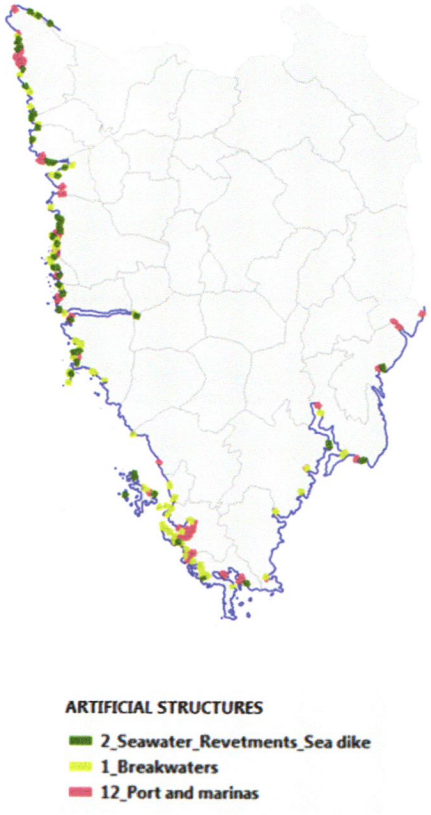

Figure 6: Type of artificial infrastructure on the coastline of the Istria County
(Source: Institute for Physical Planning Region of Istria, 2019.)

ASCODE	TYPE OF ARTIFICIAL INFRASTRUCTURE	LENGTH (Km)	PROCENTAGE (%)
1	Breakwaters	17,7679	20,53
2	Seawaters/ Revetments/ Sea dike	10,5666	12,21
3	Groins	0,0000	0
4	Jetties	0,0000	0
5	River mouth structures	0,0000	0
12	Port and marinas	58,1947	67,26
	TOTAL:	**86,5292**	**100**

Table 2: The length and type of artificial coastline in the Istria County
(Source: Institute for Physical Planning Region of Istria, 2019.)

Sandy and pebble beaches in the Istria County are rare. Therefore, some units of local self-government and tourist resorts have decided to concrete and leveled the rocky coast in order to provide citizens and tourists easier access to the sea (Figure 7, Figure 8). The concreted beaches, just mentioned, are coded under 2- Seawaters/Revetments/Sea dike, as well as sea front (Croatian "riva") that are typical of any seaside town. Those manmade structures are defence against the big sea waves and they serve mainly as promenades.

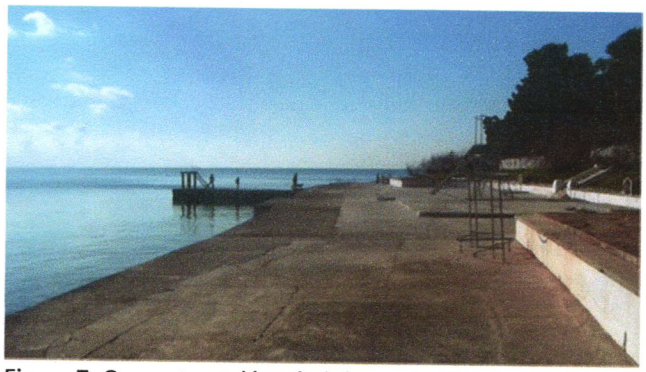

Figure 7: Concrete and leveled the rocky coast – "Valkane" beach, city of Pula
(Photo: Latinka Janjanin, 2012.)

Figure 8: Concrete and leveled the rocky coast "Lungomare" beaches, city of Pula
(Photo: Latinka Janjanin, 2012.)

The "Breakwaters" (ascode 1) whose projection to the coastline coincided with the purpose of the space in the spatial planning documentation "special purpose port", in the graphic part of the report are designated as 12-Port and marinas (Figure 9).

Figure 9: Fishing - sports port and marina, city of Poreč-Parenzo
(Photo: istarski.hr., 2018.)

Some parts of the natural coast are strewn with rocks, gravel or fine sand (Figure 10, Figure 11). As these are moving structures, they are not taken into account in calculation of constructed coastline. But such structures cause / or can cause irreversible destruction of habitats and biodiversity in the coastal area.

Figure 10: Gravel and big stones strewn on natural coast, municipality Vrsar-Orsera (western coast of the Istria County)
(Photo: Latinka Janjanin, 2019.)

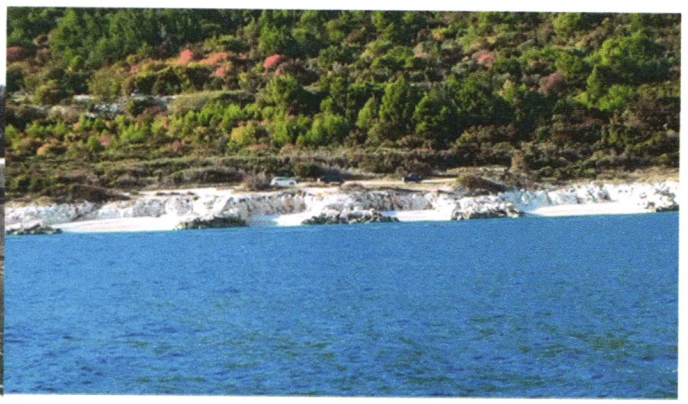

Figure 11: Gravel strewn on natural coast, city of Labin (eastern Coast of the Istria County)
(Photo: Latinka Janjanin, 2012.)

4. CONCLUSION AND RECOMMENDATION

The purpose of this report is monitoring of the Common Indicator 16 "Length of coastline subject to physical disturbance due to the influence of manmade structures" for the Istria County. The length of natural coastline of the Istria County is 490,1538 km or 85%, while the total length of constructed coastline of the Istria County is 86.5292 km or 15%. The artificial structures are dominated on western coast by "Port and marinas" (67,26%), while significantly less represented "Breakwaters" (20,53%) and "Seawaters/Revetments/Sea dike".

Digital data (shapefile format with required attributes) is an integral part of this report and it's uploaded to INFO/RAC IMAP Info System.

So far, no such data existed for the Istria County. The inclusion of the EO8 Common Indicator aims to address the need for a systematic monitoring in Mediterranean regarding the physical disturbance of coastline due to the influence of manmade structures.

Although not solid structures, big stones, gravel or fine sand are very often located on coastline and cause, or can cause, permanent and non-reversible destruction of coastal habitats and landscapes. Therefore, we suggest that they be taken into account as well in length of coastline subject to physical disturbance during the next monitoring.

5. REFERENCES

Spatial Development Plan of the municipality of Buje-Buie ("Službene novine Grada Buja - Gazzetta ufficiale della Citta di Buie" br.: 02/05., 10/11., isp. 01/12., 05/15., 21/18 i 08/19-pročišćeni tekst).

Spatial Development Plan of the city of Labin ("Službene novine Grada Labina" br.: 15/04., 04/05., 17/07., 09/11. i ispr. 01/12.

Spatial Development Plan of the city of Novigrad-Cittanova ("Službene novine Grada Novigrada" br.: 01/08., 04/11., pročišćeni tekst 04/11., ispr. 06/11., 04/12., ispr. 01/14., 07/14., pročišćeni tekst 09/14. i 08/15.)

Spatial Development Plan of the city of Poreč-Parenzo ("Službeni glasnik Grada Poreča" br.: 14/02., 08/06., 07/10. i pročišćeni tekst 08/10.)

Spatial Development Plan of the city of Pula-Pola ("Službene novine Grada Pule" br.: 12/06., 12/12., 05/14., pročišćeni tekst 08/14., 07/15., 10/15. -pročišćeni tekst, 05/16., 08/16. - pročišćeni tekst, 02/17., 05/17., pročišćeni tekst 08/17. i 20/18.)

Spatial Development Plan of the municipality of Bale-Valle ("Službeni glasnik općine Bale" br.: 07/06., 06/14. i 03/16.)

Spatial Development Plan of the city of Rovinj-Rovigno ("Službeni glasnik Grada Rovinja - Rovigno" br.: 9A/05., 06/12., pročišćeni tekst 01/13., ispr. 07/13., 7/13., 03/17. i pročišćeni tekst 07/17, 7/19 i pročišćeni tekst 8A/19.)

Spatial Development Plan of the city of Umag-Umago ("Službene novine Grada Umaga" br.: 03/04., 09/04 - ispr., 06/06, 08/08 - pročišćeni tekst., 05/10., 05/11., 05/12., 21/14.,10/15., 11/15. 19/15., 02/16 - pročišćeni tekst, 12/17. i 18/17 - pročišćeni tekst.)

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Spatial Development Plan of the municipality of Brtonigla-Verteneglio ("Službene novine Općine Brtonigla" br.: 08/08., ispr. 08a/08., 06/11., pročišćeni tekst 07/11., 09/12., pročišćeni tekst 09/12., 03/13., pročišćeni tekst 03/13. i 06/17.)

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Spatial Development Plan of the municipality of Funtana-Fontane ("Službeni glasnik općine Funtana" br.: 02/08., 03/12., 05/15., pročišćeni tekst 05/15., 02/18. i pročišćeni tekst 05/18.)

Spatial Development Plan of the municipality of Kanfanar ("Službeni glasnik Općine Kanfanar" br.: 04/01., 04/04., 02/08., 07/14. i 06/15.)

Spatial Development Plan of the municipality of Kršan ("Službeno glasilo općine Kršan" br.: 06/02., 01/08., 18/10., 14/12., pročišćeni tekst 23/12., 06/14., pročišćeni tekst 11/14., 06/17. i pročišćeni tekst 07/17.)

Spatial Development Plan of the municipality of Ližnjan-Lisignano ("Službene novine Općine Ližnjan - Lisignano" br.: 02/09., 03/14., 07/15., 02/17., 03/17. i 09/17 - pročišćeni tekst.)

Spatial Development Plan of the municipality of Marčana (Službene novine Opcine Marčana br.: 9/2009.)

Spatial Development Plan of the municipality of Medulin ("Službene novine Općine Medulin" br.: 02/07., 05/11., 08/16. i pročišćeni tekst 08/18.)

Spatial Development Plan of the municipality of Raša ("Službene novine Općine Raša" br.: 12/11., 06/16. i pročišćeni tekst 08/16.)

Spatial Development Plan of the municipality of Sveti Lovreč ("Službene novine općine Vrsar" br.: 04/07. i "Službene novine Općine Sveti Lovreč" br.: 01/17.)

Spatial Development Plan of the municipality of Tar-Vabriga/Torre Abrega (Službeni glasnik Općine Tar-Torre-Vabriga-Abrega, br.: 13/13. 12/14., 09/15. i 15/17.)

Spatial Development Plan of the municipality of Vrsar-Orsera ("Službeni glasnik Grada Poreča" br.: 15/06. i "Službene novine Općine Vrsar - Orsera" br.: 04/07., 06/14. i 04/17.)

6. ANNEXES

6.1. ANNEX 1: Information standards for the Common Indicator 16

6.2. ANNEX 2: Indicator guidance factsheet for EO8 Coastal Ecosystems and Landscapes Common Indicator 16 "Length of coastline subject to physical disturbance due to the influence of manmade structures"

Annex 1.

Information standards for the Common Indicator 16

GIS information standards:

- Artificial structures
- Coastline artificial/natural

Name of GIS layer: Artificial_structures

Type of GIS Layer: polyline

Geographical Reference Systems: WGS 84 decimal degree

Attribute table:

Content	**Description**
Ecological Objective	**EO8. Coastal ecosystem and landscape**
IMAP Common Indicator	**CI16. Length of coastline subject to physical disturbance due to the influence of manmade structures**
Parameter	**Location and extend of artificial structures**
Attribute table	Specify the following information in the attribute table associated with the GIS information layer: • CPCODE: Two-letter code of Country • ASCODE: Mandatory. Integer. Code of type of artificial infrastructure. The following code list should be used: ○ 1 Breakwaters ○ 2 Seawater/Revetments/Sea dike ○ 3 Groins ○ 4 Jetties ○ 5 River mouth structures ○ 12 Port and marinas • ASDES: Optional. Text. Description of type of artificial infrastructures • Municipal: Optional. Text. Name of municipality or local administrative region where the polygon of impervious surface is located • Year: Mandatory. Text. Year of production of the information layer
Variables	Border on the sea side of coastal artificial structures
Spatial resolution	10 m or higher as produced by photo digitalization or CAD (Computer Aided Design) software
Vertical coverage	1 level at sea surface
Coordinate Reference System	WGS 84 or ETRS 89 decimal degrees
Temporal coverage	Every 6 years
Data format	GIS Layer: polyline or polygon

Name of GIS layer: Coastline_AN
Type of GIS Layer: polyline

Geographical Reference Systems: WGS 84 decimal degree

Attribute table:

Content	**Description**
Ecological Objective	**EO8. Coastal ecosystem and landscape**
IMAP Common Indicator	**CI16. Length of coastline subject to physical disturbance due to the influence of manmade structures**
Parameter	**Artificial/Natural coastline**

Attribute table	Specify the following information in the attribute table associated with the GIS information layer:
	• CPCODE: Two-letter code of Country
	• ART_NAT: Mandatory. Integer. Code for type of segment of coastline. Use the following code list:
	  ○ 0 Natural coastline
	  ○ 1 Artificial coastline
	• Municipal: Optional. Text. Name of municipality or local administrative region where the polygon/polyline of segment of coastline is located
	• Year: Mandatory. Text. Year of production of the information layer
	• Ref_Year: Mandatory. Year of the reference coastline used to represent natural and artificial segments

Variables	Segment of artificial/natural of coastline
Spatial resolution	10 m or higher as produced by photo digitalization and interpretation
Vertical coverage	1 level at sea surface
Coordinate Reference System	WGS 84 or ETRS 89 decimal degrees
Temporal coverage	Every 6 years
Data format	GIS Layer: polyline

Annex 2.

Indicator guidance factsheet for EO8 Coastal Ecosystems and Landscapes Common Indicator 16 "Length of coastline subject to physical disturbance due to the influence of manmade structures"

Ecological Objective 8: The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved

Indicator Title*	Length of coastline subject to physical disturbance due to the influence of manmade structures	
Relevant GES definition	**Related Operational Objective**	**Proposed Target(s)**
Physical disturbance to coastal areas induced by human activities should be minimized.	The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved.	Negative impacts of human activities on coastal areas are minimized through appropriate management measures.
The CORMON on coast and hydrography meeting (21-22 May 2019, Rome) agreed that the GES, targets and measures cannot be expressed quantitatively (as a threshold value) but due to country specific circumstances (socio-economic, cultural, historical) should be defined by the countries themselves. In doing so the CPs should take their spatial development and planning policies into account, as well as the legal obligations of the Barcelona Convention, in particular the ICZM Protocol. The above GES definition and Proposed target(s) are just examples.		
Rationale		
Justification for indicator selection Mediterranean coastal areas are particularity threatened by coastal development that modifies the coastline through the construction of buildings and infrastructure needed to sustain residential, commercial, transport and tourist activities. The land, intertidal zone and near-shore estuarine and marine waters are increasingly altered by the loss and fragmentation of natural habitats and by the proliferation of a variety of built structures, such as ports, marinas, breakwaters, seawalls, jetties and pilings. These coastal manmade infrastructures cause irreversible damage to landscapes, losses in habitat and biodiversity, and strong influence on the configuration of the shoreline. Indeed, physical disturbance due to the development of artificial structures in the coastal fringe can disrupt the sediment transport, reduce the ability of the shoreline to respond to natural forcing factors, and fragment the coastal space. The modification of emerged beach and elimination of dune system contribute to coastal erosion phenomena by lessening the beach resilience to sea storms. Coastal defence infrastructures have been implemented to solve the problem together with beach nourishment but preserving the natural shoreline system with adequate sediment transport from river has proved to be the best solution. Monitoring the length of coastline subject to physical disturbance due to the influence of manmade structures and its trend is of paramount importance to preserve habitat, biodiversity and prevent coastal erosion phenomena, as well as for its importance in land-sea interactions. Until now there has not been systematic monitoring in Mediterranean regarding this, in particular not quantitatively based monitoring or any major attempt to homogenously characterize coastal ecosystems on a wider Mediterranean basis. The status assessment of EO8 aims to fill this gap.		
Scientific References		

Indicator Title*	Length of coastline subject to physical disturbance due to the influence of manmade structures

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Rochette, J., Puy-Montbrun, G., Wemaëre, M., and Billé, R. (2010). Coastal setback zones in the Mediterranean: a study on Article 8-2 of the Mediterranean ICZM Protocol. n°05/10 December 2010, IDDRI

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Policy Context and targets

Policy context description

ICZM Protocol (Article 8, point 3):

The Parties shall also endeavour to ensure that their national legal instruments include criteria for sustainable use of the coastal zone. Such criteria, taking into account specific local conditions, shall include, inter alia, the following:

(a) identifying and delimiting, outside protected areas, open areas in which urban development and other activities are restricted or, where necessary, prohibited;
(b) limiting the linear extension of urban development and the creation of new transport infrastructure along the coast;
(c) ensuring that environmental concerns are integrated into the rules for the management and use of the public maritime domain;
(d) providing for freedom of access by the public to the sea and along the shore;

Indicator Title*	Length of coastline subject to physical disturbance due to the influence of manmade structures

(e) restricting or, where necessary, prohibiting the movement and parking of land vehicles, as well as the movement and anchoring of marine vessels, in fragile natural areas on land or at sea, including beaches and dunes.

Targets

Negative impacts of human activities on coastal areas are minimized through appropriate management measures.

Additional country-specific criteria should be taken into account for definition of targets, measures and interpretation of results regarding this indicator due to strong socio-economic, historic and cultural dimensions in addition to characteristic geomorphological and geographical conditions in each respective country (reflected in policy documents, strategies and other country-specific documents). Interpretation of results should be left to the countries taking above criteria into account.

Policy documents

Protocol on the ICZM in the Mediterranean - http://www.pap-thecoastcentre.org/pdfs/Protocol_publikacija_May09.pdf

Indicator analysis methods

Indicator Definition

The monitoring aim of the EO8 common indicator is twofold: (i) to quantify the rate and the spatial distribution of the Mediterranean coastline artificialisation and (ii) to provide a better understanding of the impact of those structures to the shoreline dynamics. It has an operational target on impact, thus it is associated to concrete implementation measures related to specific human activities (i.e. appropriate management measures) to minimize negative impacts and to inform about progress towards GES.

Methodology for indicator calculation

The monitoring of this Common Indicator entails an inventory of the length and location of manmade coastline (hard coastal defence structures, ports, marinas (see Figure 1). Soft techniques e.g. beach nourishment are not included.

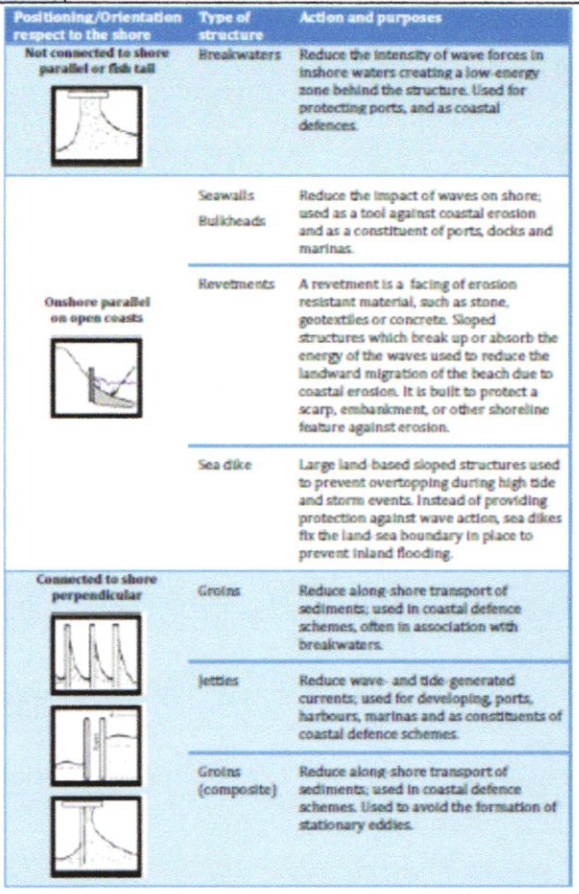
With regard to the coastline to be considered: the fixed reference official coastline as defined by responsible Contracting Party should be considered. The optimal resolution should be 5 m or 1: 2000 spatial scale.

Once a proper geographic scale has been established, monitoring should focus, in particular, on the location, the spatial extent and the types of coastal structures taking into account the minimum coastal length that can be classified as artificial or natural.

The identification procedure of manmade structures should be carried on based on typical situations added to the indicator guidance factsheet, including the minimum size (length, width of manmade structures) to be taken into account.

As monitoring should be done every 6 years, every CP should fix a reference year in the time interval 2000-2012 in order to eliminate the bias due to old or past manmade infrastructures.

Indicator Title*	Length of coastline subject to physical disturbance due to the influence of manmade structures



Positioning/Orientation respect to the shore	Type of structure	Action and purposes
Not connected to shore parallel or fish tail	Breakwaters	Reduce the intensity of wave forces in inshore waters creating a low-energy zone behind the structure. Used for protecting ports, and as coastal defences.
Onshore parallel on open coasts	Seawalls Bulkheads	Reduce the impact of waves on shore; used as a tool against coastal erosion and as a constituent of ports, docks and marinas.
	Revetments	A revetment is a facing of erosion resistant material, such as stone, geotextiles or concrete. Sloped structures which break up or absorb the energy of the waves used to reduce the landward migration of the beach due to coastal erosion. It is built to protect a scarp, embankment, or other shoreline feature against erosion.
	Sea dike	Large land-based sloped structures used to prevent overtopping during high tide and storm events. Instead of providing protection against wave action, sea dikes fix the land-sea boundary in place to prevent inland flooding.
Connected to shore perpendicular	Groins	Reduce along-shore transport of sediments; used in coastal defence schemes, often in association with breakwaters.
	Jetties	Reduce wave- and tide-generated currents; used for developing ports, harbours, marinas and as constituents of coastal defence schemes.
	Groins (composite)	Reduce along-shore transport of sediments; used in coastal defence schemes. Used to avoid the formation of stationary eddies.

Figure 1. Hard coastal defence structures, modified from the EUROSION Shoreline Management Guide, EU, 2004. Taken from IMAP guidelines, page 134, Table 1.

Indicator units

- Km of artificial coastline and % of total length of coastline.
- Percentage (%) of natural coastline on the total coastline length.

The length of artificial coastline should be calculated as the sum of segments on reference coastline identified as the intersection of polylines representing manmade structures with reference coastline ignoring polylines representing manmade structures with no intersection with reference coastline. The minimum distance between coastal defence structures should be set to 10 m in order to classify such segments as natural, i.e. if the distance between two adjacent coastal defence structures is less than 10 m, all the segment including both coastal defence structures is classified as artificial.

List of Guidance documents and protocols available

Monitoring and assessment methodological guidance on EO8: coastal ecosystems and landscapes (within IMAP guidelines)

EUROSION Shoreline Management Guide (European Commission and Directorate General Environment, 2004, Annex 2)

Data Confidence and uncertainties

Indicator Title*	Length of coastline subject to physical disturbance due to the influence of manmade structures

Regarding data confidence, both geographic scale and resolution of images have to be properly selected depending on type and density of coastal manmade structures. A specific cost/benefit analysis has to be carried on to choose the right balance among resolution, an acceptable level of uncertainties and the necessity to assure comparability of results at Mediterranean level.

Methodology for monitoring, temporal and spatial scope

Available Methodologies for Monitoring and Monitoring Protocols

Space and airborne earth observation systems are the most suitable tool to conduct the monitoring strategy of the EO8 common indicator, i.e. very high resolution (VHR) satellite imagery, aerial photographs, laser scanners etc. Beyond earth observation data, identification techniques and procedures used through GIS tools also have to be described

Available data sources

CORINE land cover, national spatial plans, World Imagery Basemap feature (in ArcGIS 10.1), Landsat satellite imagery, Google earth, aerial photographs surveys.

Spatial scope guidance and selection of monitoring stations

The exact territorial extent of the monitoring should be presented.
The optimum spatial scale for a proper identification of manmade structures should be 5 m by satellite imagery or aerial photographs.

Temporal Scope guidance

Monitoring manmade structures data should be updated at least every 6 years, while shoreline survey of sandy coastline under anthropogenic pressure should be, if possible, repeated annually (at the same time of the year)

Data analysis and assessment outputs

Statistical analysis and basis for aggregation

The total length of coastline estimated as being subjected to physical disturbance due to the influence of manmade structures should be summed. In addition, the share of this coastline in total country's coastline should be determined. If an official coastline is available, i.e. an institutional body provides a GIS polyline, then such coastline can be used to "project" the identified manmade structures in order to classify parts of the coastline as being subjected to physical disturbance due to the influence of manmade structures. Geographic scale of maps and cartography used to identify manmade structures could be different but not too much form the ones used for the official coastline. In case if such official coastline is not available or its geographic scale is too coarse with respect to one needed to properly identify manmade structures, then coastline will be defined by the same maps/cartography used for manmade structures identification.

Expected assessments outputs

The total length of coastline influenced by manmade structures and the share of this coastline in total country's coastal length should be provided on a map showing the coastline subject to physical disturbance due to manmade structures (artificial segments) in red line and the rest (natural segments) in green line.
The assessment output should be reported as a common shape file format with GRS as WGS84.
Shape file with other GRS will also be accepted if provided with a complete .prj file that allows GRS transformations by standard GIS tools.

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Known gaps and uncertainties in the Mediterranean

In order to implement EO8 indicator with an acceptable level of accuracy, recent data sources with proper spatial resolution and complete coastline coverage should be used jointly with adequate GIS tools and expert team.
Capacity building can be readily assessed for each CP as such resources are generally available for the Mediterranean Region also taking into account the increasing efforts on satellite imagery products (ESA Sentinels constellation). So, once a common framework of data sources, GIS procedures and way of representing the output of EO8 indicator are agreed, a common implementation work for all CPs could be in principle settle down.

Contacts and version Date

Key contacts within UNEP/MAP for further information

Version No	Date	Author
V.1	27/6/16	PAP/RAC & Giordano Giorgi
V.2	27/7/16	Giordano Giorgi
v.3	23 March 2018	PAP/RAC

* The CORMON on coast and hydrography meeting (21-22 May 2019, Rome) indorsed the change of the term 'manmade structures' with the term 'human made structures' to respect the gender-neutrality. This change is pending EcAp Coordination Group and COP decision.