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Chapter 3

COASTAL DEFENCE WORKS: A PROPOSAL OF A MATRIX-SYSTEM TO SUPPORT ENVIRONMENTAL IMPACT STUDIES

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ABSTRACT

The Mediterranean coastal zone is characterized by landscapes of outstanding natural value and by a large number of important habitats, especially in terms of biodiversity and functional complexity. Moreover, it is subject to environmental degradation processes due to both the concentration of conflicting interests and the vulnerability typical of these transitional environments. This vulnerability is increased by erosion problems, currently affecting about 15,100 km of European coastlines. In this framework, within the COASTGAP Project (MED Programme) "Coastal Governance and Adaptation Policies in the Mediterranean", ISPRA published the "Guidelines for environmental studies related to the construction of coastal defense works". The Guidelines propose a matrix-

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system which allows to know in advance, for different coastal defence solutions, the main potential impacts on the environment, in particular on the protected habitats and their associated flora and fauna species. This system is intended to be a simplified and useful tool for technicians and Administrations involved in the drafting and/or assessment of environmental impact studies related to coastal defence works. The methodological approach used to develop the matrix-system entails the following steps: analysis of main types of coastal defence works and description of their main physical effects; analysis of the main environmental impacts produced by coastal defences; identification of habitat types *sensu* EU Habitats Directive (92/43/EEC) and their classification into physiographic categories; definition of criteria to match the protected flora and fauna species with the physiographic categories; creation of the "structure/impact *vs* habitat/species" matrix. A total of 9 matrices were created, each one being specific for the following defence work categories: 1) seawalls and dikes, 2) nearshore breakwaters and artificial reefs, 3) groynes (permeable and impermeable), 4) composite groynes, 5) artificial headlands, 6) beach nourishment, 7) beach drainage systems, 8) dune reprofiling, 9) windbreak fences and dune grass planting, dune access management. In this Chapter the methodological approach used to develop the matrix-system and the 9 "structure/impact *vs* habitat/species" matrices are presented.

INTRODUCTION

The Mediterranean coastal zone is characterized by landscapes of outstanding natural value and by a large number of particularly important habitats, in terms of biodiversity and functional complexity. At the same time, coastal environments are extremely sensitive and vulnerable transitional zones, strongly influenced by the increased urbanisation (ports, industries, tourism and infrastructures) and human activities that, together with poor coastal defence policies, have directly or indirectly turned coastal erosion from a natural phenomenon into a problem of growing intensity (Airoldi et al., 2005; Martins et al., 2009).

Currently about twenty thousand kilometers of European coasts, corresponding to around 20%, face serious impacts. Most of the impacted zones (15,100 km) are actively retreating, some of them in spite of coastal protection works (2,900 km). In addition, other 4,700 km have become artificially stabilized (EUROSION, 2004; Sutherland, 2010). As a response to the growing need to reduce erosion and to protect buildings and

infrastructures, defence works have become common features of coastal landscapes (EUROSION, 2004).

Despite their purposes, it is recognized that they produce undesirable effects on coastal and marine environments, especially when protected or sensitive habitats and species are present. For this reason the problems associated with an intense and rapid coastal erosion have raised the attention on shoreline protection not only in terms of preserving economic and social resources, but also in terms of protecting and preserving biodiversity and ecological resources, in accordance with the Integrated Coastal Zone Management (ICZM).

In this framework within the European project COASTGAP "Coastal Governance and Adaptation Policies in the Mediterranean", aiming to capitalize 12 best practices from 9 projects of the cluster (from MED and other programmes), to produce governance and adaptation policies for reducing risk along coastal zones and foster their sustainable development, ISPRA realized specific guidelines for environmental studies related to the construction of coastal defence works (Paganelli et al., 2014). These Guidelines propose a matrix-system which allows to know in advance, for different coastal defence works, the potential impact types expected on marine and coastal environments, and in particular on protected habitats and associated flora and fauna species. The matrix-system represents an effective tool to support existing legislation on Environmental Impact Assessment (E.I.A.) process, and it could be thus helpful to both technicians and Public Administrations involved in the drawing up and/or in the evaluation of the Environmental Impact Study (E.I.S) related to coastal defence works, in particular for the description of the environmental framework and the identification of potential impacts.

THE METHODOLOGICAL APROACH

The matrix-system has been developed based on a bibliographic (non-experimental) approach and includes the following steps:

1) analysis of main types of coastal defence works and description of their main physical and biological effects on the environment;
2) identification of habitat types *sensu* Habitats Directive and their classification into physiographic categories;

3) definition of criteria to match the protected flora and fauna species with the physiographic categories;
4) creation of the matrices named "structure/impact *vs* habitat/species".

In general, the matrices puts in relation:

- each coastal defence work category with the effects and impact types that can be generated on protected marine and coastal environments;
- each impact type with one or more specific physiographic categories potentially involved;
- each impact type, for each physiographic category, with the protected habitat types and the related flora and fauna species potentially involved.

Analysis of Main Types of Coastal Defence Works and Description of their Main Physical and Biological Effects on the Environment

A literature review of the main physical and biological effects related to the structural (groynes, breakwaters, seawalls etc.) and non structural (windbreak fences, dune grass planting and dune access management etc.) coastal defence works commonly adopted in the Mediterranean sea has been made (Wallingford et al., 2000; Pranzini, 2004; Airoldi et al., 2005; Martin et al., 2005; Moschella et al., 2005; Nicoletti et al., 2006; Peterson et al., 2006; Speybroeck et al., 2006; APAT, 2007; POSIDUNE, 2007; Walker et al., 2008; Fanini et al., 2009; Martins et al., 2009; OSPAR, 2009; Pattiaratchi et al., 2009; Bulleri and Chapman, 2010; Dugan et al. 2011; Rizkalla and Savage, 2011).

Coastal defences have been then classified into 9 general categories, as shown below:

- seawalls and dikes;
- nearshore breakwaters (emerged and submerged) and artificial reef;
- groynes (permeable and impermeable);
- composite groynes;
- artificial headlands;
- beach nourishment;

- beach drainage systems;
- dune reprofiling;
- windbreak fences, dune grass planting and dune access management.

Each category as above defined includes all the defence works that potentially produce the same physical and biological effects on marine and coastal environments, resulting from their interference with coastal processes (such as hydrodynamic regime, littoral transport, morpho-dynamics changes etc.).

In order to assure that environmental aspects are adequately considered, the distinction between short-term and long-term physical effects has been made. Short-term effects are generally related to the construction phase (while the installation of the coastal defence is underway) and usually diminish rapidly upon completion. Long-term effects that can occur during the operational or functional phase may be more significant and more difficult to predict on a case-by-case basis. In the matrix-system, the construction phase corresponds to the opening and activity phases of the construction area (phase C), whereas the functioning phase corresponds to the operational phase (phase O).

A comprehensive list of the main potential physical effects and of corresponding biological impacts caused by coastal defences are summarized in Chart 1. It is important to note that the proposed system is not aimed to provide the quantitative estimation of the environmental impacts, as requested in a complete E.I.A. process. In fact, an accurate environmental impact assessment (and an effective management) would require that both environmental aspects of the project area (i.e., littoral transport system, conservation status of habitats and species etc.) and technical-design elements (i.e., form, texture, source and utilization of materials etc.) were adequately considered early in the planning process.

Identification of the Protected Marine-Coastal Habitat Types and their Classification into Physiographic Categories

In order to identify the protected habitat types that can suffer the effects (direct and indirect) generated by the coastal defence works, we referred to the habitat types reported in the Habitats Directive (92/43/EEC). The Directive's description of habitat types is particularly accurate and comprehensive, and

also includes all the types of marine-coastal habitats listed in the SPA/BIO Protocol (Barcelona Convention) and described in Bellan-Santini et al. (2002).

Chart 1. List of the main potential physical effects and of the corresponding biological impacts caused by coastal defence works on marine and coastal environments

COASTAL DEFENCE WORKS	
MAIN POTENTIAL PHYSICAL EFFECTS	POTENTIAL BIOLOGICAL IMPACTS
Loss of substrate linked to the structure placement operations	Loss and/or variation of habitat and of flora and fauna species
Turbidity and suspended load, linked to movements of sediments	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)
Trampling	Effects on flora and fauna
Noise	Effects on the fauna (e.g. disturbances in bird, reptile and mammal species)
Loss of substrate linked to possible down-drift erosion phenomena	Habitat loss and /or variations of habitat, with effects on the flora and the fauna (e.g. changes in species composition)
Substrate variations linked to the changed hydrodynamic conditions	Habitat loss and /or variations of habitat, with effects on the flora and the fauna (e.g. changes in species composition)
Eutrophication linked to the reduced water exchange	Effects on flora and fauna species (e.g. algal bloom and anoxia phenomena)
Loss and /or variation of substrate linked to sediment dumping on sea bottom	Habitat loss and /or variations of habitat, with effects on the flora and the fauna (e.g. suffocation and burial)
Substrate variations linked to the type of sediment dumped	Habitat loss and/or variation of habitat and of flora and fauna species
Over-sedimentation (on all types of bottoms) and consequent bottom instability (soft bottom only) linked to movements of sediments	Effects on flora and fauna species (e.g. problems in the larval settling phase, burial)
Variations of piezometric levels of the underground waters	Effects on the flora species

To identify the protected habitat types, all coastal-marine habitats present on the Italian territory were examined. Given the great geographical and ecological variety of the Italian environments, the considered habitat types seem to be reasonably representative of the whole Mediterranean basin environments. 38 coastal habitats of European interest have been identified, including submerged and dry habitats, low sandy shores, and rocky shores. Most of these habitats are exclusive of coastal environments, i.e., they are only present in these contexts. Only a few are non-exclusive, being present both along the littoral zone and inland.

In order to evaluate the effects caused by the coastal defence categories at the ecosystem level, the protected habitat types were subdivided into 11 environmental units called “physiographic categories”: marine waters, soft bottom (M1); marine waters, hard bottom (M2); *Posidonia oceanica* beds

(M3); estuarine and tidal systems (W1); standing waters, temporary lakes and ponds (W2); coastal brackish and saline lagoons (W3); dry beach (D1); embryodune and avandune (D2); avandune continental side, fixed dune and stabilised sands (D3); interdune and bakdune humid depressions (D4); rocky shores and cliff habitats (C1). These units were identified based on morphogenetic, lythomorphologic and pedological homogeneity criteria.

The physiographic categories can be easily identified on the basis of vegetation, morphological structure and ecological features, and at landscape level. The use of these categories allows a wider and more flexible applicability of the methodology, even when the available information does not allow the habitat types to be classified according to the Directive, for example in non-EU countries.

The 11 physiographic categories were thereafter classified in 4 main macro-environments: marine habitats (M), wetlands and halophytic habitats (W), dune habitats (D) and cliff habitats (C). The marine macro-environment includes 3 physiographic categories of marine habitats (M1, M2, M3), permanently submerged by sea water. The wetlands and halophytic macroenvironment includes 3 physiographic categories of alternatively submerged and emerged habitats (W1, W2, W3).

The dune macroenvironment is constituted by 5 permanently dry habitat categories (D1, D2, D3, D4), and the cliff macroenvironment is characterized by one physiographic category, i.e., rocky shores and cliffs habitats (C1).

The main bibliographic reference adopted for the protected habitats is the Italian manual for the interpretation of habitats of the Directive 92/43/EEC (Biondi et al., 2009). The hierarchical classification of the Italian marine-coastal habitats of European interest in physiographic categories and in macro-environments are reported in Chart 2.

Definition of Criteria to Match the Protected Flora and Fauna Species with the Physiographic Categories

In order to produce a generally applicable tool that is valid for different geographical contexts, it is extremely important to associate the single protected flora and fauna species with the physiographic categories. Therefore, different criteria for protected flora and fauna were defined. It is important to emphasize that in order to identify all the protected habitats and species is essential an expert-based evaluation provided, for example, by botanists, zoologists and geomorphologists.

Chart 2. A hierarchical classification of the protected marine-coastal habitat types *sensu* Habitats Directive (92/43/EEC) in physiographic categories and in macro-environments. A habitat present in more physiographic categories is marked with the symbol *p.p.* (*pro parte*). Priority habitats are reported with an asterisk (*) following the code

MACRO-ENVIRONMENTS	PHYSIOGRAPHIC CATEGORIES	PROTECTED MARINE-COASTAL HABITAT TYPES (sensu HABITATS DIRECTIVE)
MARINE HABITATS (M)	Marine waters, soft bottoms (M1)	1110: Sandbanks which are slightly covered by sea water all the time 1160: Large shallow inlets and bays, on soft bottoms
	Marine waters, hard bottoms (M2)	1160: Large shallow inlets and bays , on hard bottoms 1170: Reefs 8330: Submerged or partially submerged sea caves
	Posidonia oceanica beds (M3)	1120*: *Posidonia* beds (*Posidonion oceanicae*)
WETLANDS AND HALOPHYTIC HABITATS (W)	Estuarine and tidal systems (W1)	1130: Estuaries 1140: Mudflats and sandflats not covered by seawater at low tide
	Standing waters, temporary lakes and ponds (W2)	3120: Oligotrophic waters containing very few minerals generally on sandy soils of the West 3130: Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* 3140: Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. 3170*: Mediterranean temporary ponds
	Coastal brackish/ saline lagoons (W3)	1150*: Coastal lagoons 1310: *Salicornia* and other annuals colonizing mud and sand (*p.p.*) 1320: *Spartina* swards (*Spartinion maritimae*) 1410: Mediterranean salt meadows (*Juncetalia maritimi*) (*p.p.*) 1420: Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornietea fruticosi*) 6420: Mediterranean tall humid grasslands of the *Molinio-Holoschoenion* (*p.p.*)
DUNE HABITATS (D)	Dry beach (D1)	1210: Annual vegetation of drift lines 1310: *Salicornia* and other annuals colonizing mud and sand (*p.p.*)
	Embryodune and avandune (D2)	2110: Embryonic shifting dunes 2120: Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) 2230: *Malcolmietalia* dune grasslands (*p.p.*)
	Avandune continental side, fixed dune and stabilised sands (D3)	2130*: Fixed coastal dunes with herbaceous vegetation (grey dunes) 2160: Dunes with *Hippophae rhamnoides* 2210: *Crucianellion maritimae* fixed beach dunes 2230: *Malcolmietalia* dune grasslands (*p.p.*) 2240: *Brachypodietalia* dune grasslands with annuals 2250*: Coastal dunes with *Juniperus* spp. 2260: *Cisto-Lavanduletalia* dune sclerophyllous scrubs 2270*: Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* 6220*: Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*
	Interdune and backdune humid depressions (D4)	1410: Mediterranean salt meadows (*Juncetalia maritimi*) (*p.p.*) 1510*: Mediterranean salt steppes (*Limonietalia*) 6420: Mediterranean tall humid grasslands of the *Molinio-Holoschoenion* (*p.p.*)
CLIFFS HABITATS (C)	Rocky shores and cliffs habitats (C1)	1240: Vegetated sea cliffs of the Mediterranean coasts with endemic *Limonium* spp. 1430: Halo-nitrophilous scrubs (*Pegano-Salsoletea*) 5320: Low formations of *Euphorbia* close to cliffs 5330: Thermo-Mediterranean and pre-desert scrub 5410: West Mediterranean cliff top phryganas (*Astragalo- Plantaginetum subulatae*) 5420: *Sarcopoterium spinosum* phryganas 5430: Endemic phryganas of the *Euphorbio-Verbascion* 8210: Calcareous rocky slopes with chasmophytic vegetation

Criterion Used for the Protected Flora Species

For each of the identified physiographic categories, the methodology considers all the protected wild flora species, grouping them according to the referred habitat.

This is possible because in coastal environments the relationship between flora species and plant communities (habitats) is very strong. Typical littoral plant species are characterized by a strict preference for certain habitats,

peculiar eco-physiological adaptations and high susceptibility to ecological gradients and environmental changes (van der Maarel and van der Maarel-Versluys, 1996; van der Maarel, 2003).

This approach allows the identification of the protected flora species that may be affected by the impact. The kind of effect observed on the single species depends on the type of defence work and on the previous condition of the affected area (environmental quality, degree of human disturbance, etc.).

Criterion Used for the Protected Fauna Species

In order to create a general approach valid for different geographic contexts, we identified a set of "objective" modalities to associate the single protected fauna species with the physiographic categories previously described.

For the animal species the habitat use criterion was used. This criterion describes how an individual uses the physical and biological resources of a given environment. A species can spend time in a habitat to satisfy different needs, which might be biological, ecological and ethological (e.g., the different phases of the life cycle, reproduction, feeding, mating etc.). The same species can, therefore, belong to more habitat types, and the habitats can vary in terms of space and time according to the species needs and traits.

In order to provide a common classification, suitable for all the taxa (invertebrates and vertebrates) and taking into account the most sensitive phases of the species' life cycles, the following 8 habitat use categories were identified:

- Residents and Sessiles (RS): organisms using the same habitat for all their needs (feeding, mating, reproduction, hibernation; etc.) and during all phases of their life cycle;
- Larval Recruitment and Settlement (LRS): this category refers to the larval recruitment and settlement phase and is specific for invertebrates and fishes;
- Feeding (F): this category identifies habitats used by juveniles and adults for feeding only;
- Nursery area (NA): this category identifies the juvenile concentration areas and is valid for fish species in particular;
- Reproduction and Mating (RM): it refers to habitats used by species during the reproduction and/or during mating phases only;

- Nesting and egg Deposition (ND): this category refers to habitats used by species during the nesting and egg deposition phases only;
- Temporary Stationing (TS): it refers to habitats used by some species as shelter and/or for temporary stationing for relatively short periods of time, ranging from some days to one month, as is the case for migration stopovers;
- Prolonged Stationing and Migration (PSM): it refers to habitats used by some species for temporary stationing for longer periods of time (for example birds) and to migration habitats (for example fish migration).

For a proper application of the habitat use categories the frequency and the geographical scale of habitat use have to be evaluated for each fauna species. The frequency can be random, seasonal or perennial and in particular, where it is seasonal, the season and/or the reference period must be stated. The scale represents the portion of the habitat that the species actually use and it can be local (for example as in the case of nesting, ND) or wide (as in the case of nursery area, NA).

THE "STRUCTURE/IMPACT *VS* HABITAT/SPECIES" MATRIX-SYSTEM

The proposed matrix-system is organized in 9 "structure/impact *vs* habitat/species" matrices, referring to the specific categories of coastal defences listed below:

- seawalls and dikes;
- nearshore breakwaters (emerged and submerged) and artificial reef;
- groynes (permeable and impermeable);
- composite groynes;
- artificial headlands;
- beach nourishment;
- beach drainage systems;
- dune reprofiling;
- windbreak fences, dune grass planting and dune access management.

As described before, each coastal work category induces similar physical effects on the environment (and hence on habitat types and species) resulting from its interference with coastal processes. Therefore, the analysis of the main physical effects produced by each coastal defence category on the environment allows to identify the main potential biological impact types. The main physical effects and potential biological impacts were considered for both the construction phase (Phase C - *Construction phase*) and the functioning one (phase O - *Operational phase*). The dismantling phase instead has not been considered, since coastal defences generally do not contemplate such phase.

In general, within each macro-environment (marine habitats, wetlands and halophytic habitats, dune habitats and cliff habitats), the matrices put in relation the expected physical effects and potential biological impacts with the specific physiographic categories involved. Within each physiographic category, each potential impact is then associated with the protected habitat types and their associated flora and fauna species.

It is important to note that the matrix-system provides a qualitative list of the expected effects and/or impacts on the involved habitats and species, but not the quantification of their extent (entity). For a careful assessment of potential impacts it is fundamental to gather detailed information on the project's technical and design aspects (such as size, shape, materials used etc.) and on the environmental features of the area concerned (such as hydrodynamics, depositional process, habitat and species' conservation state etc.).

The 9 "structure/impact *vs* habitat/species" matrices are reported in Appendix 1. For an easier reading and understanding of the matrices, a matrix information chart containing useful definitions and in-depth explanations is provided.

COMPILATION AND USE OF THE MATRIX-SYSTEM

The matrix-system compilation consists in formulating specific matrices both for each type of defence structure and for each single area of intervention. Once the type of defence work has been identified, and since the potential impacts are already known (see Chart 1), the following steps have to be followed.

Identification of the reference area. The reference area must be identified through a preliminary survey, based on the technical and environmental

information acquired during the work design phase. The reference area is defined as the area affected by both direct and indirect effects that may be produced by coastal defence works and it includes both emerged and submerged environments.

Identification of protected habitat types. The physiographic categories present in the reference area must be identified through accurate bibliographic investigations and specific field surveys. The protected habitats types (*sensu* EU Habitats Directive) present for each category must also be identified. It is important to note that, for the compilation of the matrix, all the physiographic categories present in the reference area must always be kept. In fact, even in the absence of protected habitat types, the reference area can be characterized by the presence of protected flora and fauna species.

Identification of protected flora species and their assignment to habitat types. Through accurate bibliographic research and specific floristic field surveys, the flora species present in the reference area must be identified, including both species directly linked to existing habitats and protected species under current legislation.

Identification of protected fauna species. Through accurate bibliographic research and specific field surveys, the census of all fauna species present in the reference area must be carried out, taking into account the regulations and conventions in force on fauna protection.

Association of protected fauna species to physiographic categories. Each protected fauna species identified in the reference area must be associated to one or more habitat use categories, specifying the geographical scale of use (local or wide) and the frequency of use (perennial or seasonal), also in order of possibly identify adequate "environmental windows" (i.e., temporal constraint) in which the defence works may be carried out thus minimising the impact.

CONCLUSION

The "structure/impact *vs* habitat/species" matrix-system, developed on a bibliographic basis, is intended to be a simplified multidisciplinary tool which allows to know in advance the protected habitat types and the associated flora and fauna species that could be affected by the impacts produced by coastal defence structures.

An important feature of this system is its hierarchical structure that makes it an effective tool to assess the cause-effect relationships between

"structure/impact" and "habitat/species". By using the matrices, the assessment of the impact type on protected habitats and species may be performed with different levels of detail.

In conclusion, the proposed matrix-system represents a guide to support Public Administrations and technicians involved in the drawing up and/or in the evaluation of the Environmental Impact Study (E.I.S.) required for the realization of coastal defence works. In particular, this system is useful for the description of the environmental framework and the identification of impacts required in the preliminary planning phases.

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APPENDIX 1. THE "STRUCTURE/IMPACT *VS* HABITAT/SPECIE" MATRICES

INSTRUCTIONS FOR A CORRECT READING OF THE MATRICES	
Reference area	Area interested by the direct and indirect effects induced by coastal defense structures and that includes both the emerged and submerged environments.
Impacts on protected habitat and species	In the present work we consider the only impacts related to the construction and the operational phases of coastal defense structures, paying particular attention to the ones affecting the protected habitat and the associated flora and fauna species. An Environmental Impact Assessment will have to take into account all the requirements dictated by the current laws.
Accidental impacts and/or impacts deriving from planning and/or construction errors of the defense structures	Not considered in the present work.
Impacts on the landscape	Not considered in the present work.
Pollutants release into the environment	We assume that the terrestrial machinery and the boats used for the construction/development of the defense structures comply with the current regulations on pollutants release into the environment. This work has not considered the impacts linked to contaminant release from the non-natural materials used for the realization of the defense structures (such as non-textile fabrics, geotextiles, etc), because the absence of contaminant-release needs to be previously ascertained.
Sediment accumulation and/or beach accretion, in both its emerged and submerged portions	The beach accumulation and/or accretion phenomena are not considered as impacts in the present work, as the interventions' aim is to restore the pre-erosion situation.
The Construction Phase and the Operational Phase	The Construction Phase (C) is the period of time in which the construction works are in progress, and it is characterized by the presence of workers and mechanical vehicles and machines. The Operational Phase (O) is the period of time in which the defense structure is operational.In the particular case of nourishment, the construction phase includes both the phase in which the sediment is dumped and generally distributed with mechanical machines along the whole area of intervention, and the subsequent period of time, in which wave motion reshapes the profile of the (emerged and submerged) beach, up to the development of an equilibrium profile.This work doesn't take into account the structure's dismantling phase because coastal defense interventions generally only consider the maintenance phases and not the dismissal phase.
Protected flora species	See the protected habitat types sensu Habitats Directive.
Habitat Use categories for protected fauna species	**Habitat Use Categories:** RS – Resident and Sessiles LRS – Larval Recruitment and Settlement F – Feeding NA – Nursery Area RM –Reproduction and Mating ND – Nesting and Deposition TS – Temporary Stop PSM – Prolonged Stop and Migration
Physiographic categories	**Physiographic Categories:** M1 - Marine waters, soft bottoms M2 - Marine waters, hard bottoms M3 - Posidonia oceanica beds W1 - Estuarine and tidal systems W2 - Standing waters, temporary lakes and ponds W3 - Coastal brackish/saline lagoons D1 - Dry beach D2 - Embryodune and avandune D3 - Avandune continental side, fixed dune and stabilized sands D4 - Interdune and backdune humid depressions C1 - Rocky shores and cliffs habitats
Protected Habitat types *sensu* Habitats Directive	**Habitat types sensu Habitats Directive:** 1110 - Sandbanks which are slightly covered by sea water all the time 1160 - Large shallow inlets and bays, on soft bottoms 1170 - Reefs 8330 - Submerged or partially submerged sea caves 1120* - Posidonia beds (Posidonion oceanicae) 1130 - Estuaries"1140 - Mudflats and sandflats not covered by seawater at low tide 3120 - Oligotrophic waters containing very few minerals generally on sandy soils of the West Mediterranean, with Isoëtes spp. 3130 - Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea 3140 - Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. 3170* - Mediterranean temporary ponds 1150* - Coastal lagoons 1310 "Salicornia and other annuals colonizing mud and sand 1320 - Spartina swards (Spartinion maritimae) 1410 - Mediterranean salt meadows (Juncetalia maritimi) 1420 - Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornietea fruticosi) 1430 - Halo-nitrophilous scrubs (Pegano-Salsoletea) 6420 - Mediterranean tall humid grasslands of the Molinio-Holoschoenion 1210 - Annual vegetation of drift lines 2110 - Embryonic shifting dunes 2120 - Shifting dunes along the shoreline with Ammophila arenaria (white dunes) 2130* - Fixed coastal dunes with herbaceous vegetation (grey dunes) 2160 - Dunes with Hippophae rhamnoides 2210 - Crucianellion maritimae fixed beach dunes 2230 - Malcolmietalia dune grasslands 2240 - Brachypodietalia dune grasslands with annuals 2250* - Coastal dunes with Juniperus spp. 2260 - Cisto-Lavanduletalia dune sclerophyllous scrubs 6220* - Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea 1510* - Mediterranean salt steppes (Limonietalia) 1240 - Vegetated sea cliffs of the Mediterranean coasts with endemic Limonium spp. 5320 – Low formations of Euphorbia close to cliffs 5330 - Thermo-Mediterranean and pre-desert scrub 5410 - West Mediterranean clifftop phryganas (Astragalo-Plantaginetum subulatae) 5420 - Sarcopoterium spinosum phryganas 5430 - Endemic phryganas of the Euphorbio-Verbascion 8210 - Calcareous rocky slopes with chasmophytic vegetation *Priority habitats are reported with an asterisk* (*)
Noise	Noise does not have effects on the habitat and on the associated flora species. For this reason, the 'noise' impact has been indicated in the matrices as "non present" (n.p.). The impacts of noise on the habitat-related protected fauna categories must however be considered.

MATRIX 1: SEAWALLS AND DIKES

MACRO-ENVIRONMENTS	MAIN PHYSICAL EFFECTS	Phases (C/O)	MAIN POTENTIAL IMPACTS	CATEGORIES, HABITAT AND SPECIES AFFECTED BY IMPACTS		
				Physiographic categories	Habitat types and associated flora species	Habitat Use Categories (fauna species)
MARINE HABITATS (M)	Loss of substrate linked to structure placement operations	C/O	Loss and/or variations of habitat, and flora and fauna species	M1	1110, 1160	RS, LRS, F, ND, RM, NA
	Substrate variations linked to possible down-drift erosion phenomena	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)	M1	1110, 1160	
				M3	1120*	
	Turbidity and suspended load linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	M1	1110, 1160	RS, NA, F, LRS, RM, PSM
				M2	1160, 1170, 8330	
				M3	1120*	
	Trampling	C	Effects on the flora and fauna	M1	1110, 1160	RS, LRS, ND
	Noise	C	Effects on the fauna (e.g. disturbance in fish and marine reptile species)	M1	n.p.	RS, F, NA, RM, ND, PSM
				M2		
				M3		
WETLANDS AND HALOPHYTIC HABITATS (W)	Turbidity and suspended load linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	W1	1130, 1140	RS, NA, F, LRS, RM, PSM
	Noise	C	Effects on the fauna (e.g. disturbance in the bird fauna, reptile and mammals)	W1	n.p.	RS, F, NA, RM, ND, TS, PSM
				W2		
				W3		
DUNE HABITATS (D)	Loss of substrate linked to structure placement operations	C/O	Loss and/or variations of habitat, and flora and fauna species	D1	1210, 1310	RS, LRS, F, ND, RM, TS, PSM
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
	Loss of substrate linked to possible down-drift erosion phenomena	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)	D1	1210, 1310	
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
	Trampling	C	Effects on the flora and fauna (e.g. invertebrates, birds and, in D1, marine reptiles)	D1	1210, 1310	RS, LRS, ND
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
				D4	1410, 1510*, 6420	
	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	D1	n.p.	RS, F, RM, ND, TS, PSM
				D2		
				D3		
				D4		
CLIFF HABITATS (C)	Noise	C	Effects on the fauna (e.g. disturbance in bird species)	C1	n.p.	RS, F, RM, ND, TS, PSM

MATRIX 2: NEARSHORE BREAKWATERS (EMERGED AND SUBMERGED) AND ARTIFICIAL REEFS (OFFSHORE)

MACRO-ENVIRONMENTS	MAIN PHYSICAL EFFECTS	Phases (C/O)	MAIN POTENTIAL IMPACTS	CATEGORIES, HABITAT AND SPECIES AFFECTED BY IMPACTS		
				Physiographic categories	Habitat types and associated flora species	Habitat Use Categories (fauna species)
MARINE HABITATS (M)	Loss of substrate linked to structure placement operations	C/O	Loss and/or variation of habitat and of flora and fauna species	M1	1110, 1160	RS LRS F ND RM NA
	Substrate variations linked to the changed hydrodynamic conditions	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)	M1	1110, 1160	
				M3	1120*	
	Turbidity and suspended load, linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	M1	1110, 1160	RS NA F LRS RM PSM
				M2	1160, 1170, 8330	
				M3	1120*	
	Eutrophication linked to the reduced water exchange	O	Effects on the flora and on the fauna (e.g. algal bloom and anoxia phenomena)	M1	1110, 1160	RS LRS NA F ND RM PSM
	Trampling	C	Effects on the flora and fauna	M1	1110, 1160	RS LRS ND
	Noise	C	Effects on the fauna (e.g. disturbance in fish and marine reptile species)	M1	n.p.	RS F NA RM PSM
				M2		
				M3		
WETLANDS AND HALOPHYTIC HABITATS (W)	Loss of substrate linked to structure placement operations	C/O	Loss and/or variation of habitat and of flora and fauna species	W1	1130, 1140	RS LRS F ND R NA TS PSM
	Substrate variations linked to the changed hydrodynamic conditions	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)			
	Turbidity and suspended load linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	W1	1130, 1140	RS NA F LRS RM PSM
	Eutrophication linked to the reduced water exchange	O	Effects on the flora and on the fauna (e.g. algal bloom and anoxia phenomena)	W1	1130, 1140	RS LRS NA F ND RM PSM
	Trampling	C	Effects on the flora and fauna	W1	1130, 1140	RS LRS ND
	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	W1	n.p.	RS F NA RM ND TS PSM
				W2		
				W3		
DUNE HABITATS (D)	Loss of substrate linked to possible down-drift erosion phenomena	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)	D1	1210, 1310	RS LRS F ND RM TS PSM
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
	Trampling	C	Effects on the flora and fauna (e.g. invertebrates, birds and, in D1, marine reptiles)	D1	1210, 1310	RS LRS ND
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
				D4	1410, 1510*, 6420	
	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	D1	n.p.	RS F RM ND TS PSM
				D2		
				D3		
				D4		
CLIFF HABITATS (C)	Noise	C	Effects on the fauna (e.g. disturbance in bird species)	C1	n.p.	RS F RM ND TS PSM

MATRIX 3: GROYNES (PERMEABLE AND IMPERMEABLE)

MACRO-ENVIRONMENTS	MAIN PHYSICAL EFFECTS	Phases (C/O)	MAIN POTENTIAL IMPACTS	CATEGORIES, HABITAT AND SPECIES AFFECTED BY IMPACTS		
				Physiographic categories	Habitat types and associated flora species	Habitat Use Categories (fauna species)
MARINE HABITATS (M)	Loss and/or variation of habitat and of flora and fauna species	C/O	Loss and/or variation of habitat and of flora and fauna species	M1	1110, 1160	RS LRS F ND RM NA
	Substrate variations linked to the changed hydrodynamic conditions	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)	M1	1110, 1160	
				M3	1120*	
	Turbidity and suspended load linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	M1	1110, 1160	RS NA F LRS RM PSM
				M2	1160, 1170, 8330	
				M3	1120*	
	Trampling	C	Effects on the flora and fauna	M1	1110, 1160	RS LRS ND
	Noise	C	Effects on the fauna (e.g. disturbance in fish and marine reptile species)	M1	n.p.	RS F NA RM ND PSM
				M2		
				M3		
WETLANDS AND HALOPHYTIC HABITATS (W)	Loss of substrate linked to structure placement operations	C/O	Loss and/or variation of habitat and of flora and fauna species	W1	1130, 1140	RS LRS F ND RM TS PSM
	Substrate variations linked to the changed hydrodynamic conditions	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)			
	Turbidity and suspended load linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	W1	1130, 1140	RS NA F LRS RM PSM
	Trampling	C	Effects on the flora and fauna	W1	1130, 1140	RS LRS ND
	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	W1	n.p.	RS F NA RM ND TS PSM
				W2		
				W3		
DUNE HABITATS (D)	Loss of substrate linked to structure placement operations	C/O	Loss and/or variation of habitat and of flora and fauna species	D1	1210, 1310	RS LRS F ND RM TS PSM
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
	Loss of substrate linked to possible down-drift erosion phenomena related to the permeability of the structure	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)	D1	1210, 1310	
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
	Trampling	C	Effects on the flora and fauna (e.g. invertebrates, birds and, in D1, marine reptiles)	D1	1210, 1310	RS LRS ND
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
				D4	1410, 1510*, 6420	
	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	D1	n.p.	RS F RM ND TS PSM
				D2		
				D3		
				D4		
CLIFF HABITATS (C)	Noise	C	Effects on the fauna (e.g. disturbance in bird species)	C1	n.p.	RS F RM ND TS PSM

MATRIX 4: COMPOSITE GROYNES

MACRO-ENVIRONMENTS	MAIN PHYSICAL EFFECTS	Phases (C/O)	MAIN POTENTIAL IMPACTS	CATEGORIES, HABITAT AND SPECIES AFFECTED BY IMPACTS		
				Physiographic categories	Habitat types and associated flora species	Habitat Use Categories (fauna species)
MARINE HABITATS (M)	Loss of substrate linked to structure placement operations	C/O	Loss and/or variation of habitat and of flora and fauna species	M1	1110, 1160	RS LRS F ND RM NA
	Substrate variations linked to the changed hydrodynamic conditions	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)	M1	1110, 1160	
				M3	1120*	
	Turbidity and suspended load linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	M1	1110, 1160	RS NA F LRS RM PSM
				M2	1160, 1170, 8330	
				M3	1120*	
	Eutrophication linked to the reduced water exchange	O	Effects on the flora and on the fauna (e.g. algal bloom and anoxia phenomena)	M1	1110, 1160	RS LRS NA F ND RM PSM
	Trampling	C	Effects on the flora and fauna	M1	1110, 1160	RS LRS ND
	Noise	C	Effects on the fauna (e.g. disturbance in fish and marine reptile species)	M1	n.p.	RS F NA RM ND PSM
				M2		
				M3		
WETLANDS AND HALOPHYTIC HABITATS (W)	Loss of substrate linked to structure placement operations	C/O	Loss and/or variation of habitat and of flora and fauna species	W1	1130, 1140	RS LRS F ND RM TS PSM
	Substrate variations linked to the changed hydrodynamic conditions	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)			
	Turbidity and suspended load linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	W1	1130, 1140	RS NA F LRS RM PSM
	Eutrophication linked to the reduced water exchange	O	Effects on the flora and on the fauna (e.g. algal bloom and anoxia phenomena)	W1	1130, 1140	RS LRS NA F ND RM PSM
	Trampling	C	Effects on the flora and fauna	W1	1130, 1140	RS LRS ND
	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	W1	n.p.	RS F NA RM ND TS PSM
				W2		
				W3		
DUNE HABITATS (D)	Loss of substrate linked to structure placement operations	C/O	Loss and /or variation of habitat and of flora and fauna species	D1	1210, 1310	RS LRS FND RM TS PSM
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
	Loss of substrate linked to possible down-drift erosion phenomena	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)	D1	1210, 1310	
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
	Trampling	C	Effects on the flora and fauna (e.g. invertebrates, birds and, in D1, marine reptiles)	D1	1210, 1310	RS LRS ND
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
				D4	1410, 1510*, 6420	
	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	D1	n.p.	RS F RM ND TS PSM
				D2		
				D3		
				D4		
CLIFF HABITATS (C)	Noise	C	Effects on the fauna (e.g. disturbance in bird species)	C1	n.p.	RS F RM ND TS PSM

MATRIX 5: HEADLANDS

MACRO-ENVIRONMENTS	MAIN PHYSICAL EFFECTS	Phases (C/O)	MAIN POTENTIAL IMPACTS	CATEGORIES, HABITAT AND SPECIES AFFECTED BY IMPACTS		
				Physiographic categories	Habitat types and associated flora species	Habitat Use Categories (fauna species)
MARINE HABITATS (M)	Loss of substrate linked to structure placement operations	C/O	Loss and/or variation of habitat and of flora and fauna species	M1	1110, 1160	RS LRS F ND RM NA
	Substrate variations linked to the changed hydrodynamic conditions	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)	M1	1110, 1160	
				M3	1120*	
	Turbidity and suspended load linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	M1	1110, 1160	RS NA F LRS RM PSM
				M2	1160, 1170, 8330	
				M3	1120*	
	Noise	C	Effects on the fauna (e.g. disturbance in fish and marine reptile species)	M1	n.p.	RS F NA RM ND PSM
				M2		
				M3		
WETLANDS AND HALOPHYTIC HABITATS (W)	Loss of substrate linked to structure placement operations	C/O	Loss and/or variation of habitat and of flora and fauna species	W1	1130, 1140	RS LRS F ND RM NA TS PSM
	Substrate variations linked to the changed hydrodynamic conditions	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)			
	Turbidity and suspended load linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	W1	1130, 1140	RS NA F LRS RM PSM
	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	W1	n.p.	RS F NA RM ND TS PSM
				W2		
				W3		
DUNE HABITATS (D)	Loss of substrate linked to structure placement operations	C/O	Loss and/or variation of habitat and of flora and fauna species	D1	1210, 1310	RS LRS F ND RM TS PSM
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
	Substrate variations linked to the changed hydrodynamic conditions	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)	D1	1210, 1310	
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
	Trampling	C	Effects on the flora and fauna (e.g. invertebrates, birds and, in D1, marine reptiles)	D1	1210, 1310	RS LRS ND
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
				D4	1410, 1510*, 6420	
	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	D1	n.p.	RS F RM ND TS PSM
				D2		
				D3		
				D4		
CLIFF HABITATS (C)	Noise	C	Effects on the fauna (e.g. disturbance in bird species)	C1	n.p.	RS F RM ND TS PSM

MATRIX 6: BEACH NOURISHMENT

MACRO-ENVIRONMENTS	MAIN PHYSICAL EFFECTS	Phases (C/O)	MAIN POTENTIAL IMPACTS	CATEGORIES, HABITAT AND SPECIES AFFECTED BY IMPACTS		
				Physiographic categories	Habitat types and associated flora species	Habitat Use Categories (fauna species)
MARINE HABITATS (M)	Loss and/or variation of substrate linked to sediment dumping on sea bottom	C/O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. suffocation and burial)	M1	1110, 1160	RS LRS F ND RM NA
	Substrate variations linked to the type of sediment dumped	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)			
	Turbidity and suspended load linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	M1	1110, 1160	RS NA F LRS RM PSM
				M2	1160, 1170, 8330	
				M3	1120*	
	Over-sedimentation (on all types of bottoms) and consequent bottom instability (soft bottoms only) linked to movement of sediments	C	Effects on the flora and fauna (e.g. problems in the larval settling phase, burial)	M1	1110, 1160	RS LRS ND
				M2	1160, 1170, 8330	
				M3	1120*	
	Noise	C	Effects on the fauna (e.g. disturbance in fish and marine reptile species)	M1	n.p.	RS F NA RM ND PSM
				M2		
				M3		
WETLANDS AND HALOPHYTIC HABITATS (W)	Loss and/or variation of substrate linked to sediment dumping on sea bottom	C/O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. suffocation and burial)	W1	1130, 1140	RS LRS F ND RM NA
	Substrate variations linked to the type of sediment dumped	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)			TS PSM
	Turbidity and suspended load, linked to movement of sediments	C	Effects on the flora (e.g. a decreased photosynthetic ability) and on the fauna (e.g. a decreased predatory ability)	W1	1130, 1140	RS NA F LRS RM PSM
	Over-sedimentation (on all types of bottoms) and consequent bottom instability (soft bottoms only) linked to movement of sediments	C	Effects on the flora and fauna (e.g. problems in the larval settling phase, burial)	W1	1130, 1140	RS LRS ND
	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	W1	n.p.	RS F NA RM ND TS PSM
				W2		
				W3		
DUNE HABITATS (D)	Loss and/or variation of substrate linked to sediment dumping on sea bottom	C/O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. suffocation and burial)	D1	1210, 1310	RS LRS F ND RM TS PSM
	Substrate variations linked to the type of sediment dumped	O	Habitat loss and/or variations, with effects on the flora and fauna (e.g. changes in species composition)			
	Trampling	C	Effects on the flora and fauna (e.g. invertebrates, birds and, in D1, marine reptiles)	D1	1210, 1310	RS LRS ND
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
				D4	1410, 1510*, 6420	
	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	D1	n.p.	RS F RM ND TS PSM
				D2		
				D3		
				D4		
CLIFF HABITATS (C)	Noise	C	Effects on the fauna (e.g. disturbance in bird species)	C1	n.p.	RS F RM ND TS PSM

MATRIX 7: BEACH DRAINAGE SYSTEMS

MACRO-ENVIRONMENTS	MAIN PHYSICAL EFFECTS	Phases (C/O)	MAIN POTENTIAL IMPACTS	CATEGORIES, HABITAT AND SPECIES AFFECTED BY IMPACTS		
				Physiographic categories	Habitat types and associated flora species	Habitat Use Categories (fauna species)
MARINE HABITATS (M)	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	M1	1110, 1160	RS F NA RM ND PSM
				M2	1160, 1170, 8330	
				M3	1120*	
WETLANDS AND HALOPHYTIC HABITATS (W)	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	W1	n.p.	RS F NA RM ND TS PSM
				W2		
				W3		
DUNE HABITATS (D)	Removal/movement of substrate linked to structure placement operations (drainage systems and drainage pipes)	C	Loss of habitat and of flora and fauna species	D1	1210, 1310	RS LRS F ND RM TS PSM
	Loss of substrate linked to structure placement operations (catch basins)	C/O	Loss of habitat and of flora and fauna species	D1	1210, 1310	
	Variations in the piezometric levels of the underground waters	O	Effects on the flora species	D1	1210, 1310	
	Trampling	C	Effects on the flora and fauna (e.g. invertebrates, birds and, in D1, marine reptiles)	D1	1210, 1310	RS LRS ND
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
				D4	1410, 1510*, 6420	
	Noise	O	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	D1	n.p.	RS F RM ND TS PSM
				D2		
				D3		
				D4		
CLIFF HABITATS (C)	Noise	C	Effects on the fauna (e.g. disturbance in bird species)	C1	n.p.	RS F RM ND TS PSM

MATRIX 8: DUNE REPROFILING

MACRO-ENVIRONMENTS	MAIN PHYSICAL EFFECTS	Phases (C/O)	MAIN POTENTIAL IMPACTS	CATEGORIES, HABITAT AND SPECIES AFFECTED BY IMPACTS		
				Physiographic categories	Habitat types and associated flora species	Habitat Use Categories (fauna species)
MARINE HABITATS (M)	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	M1	n.p.	RS F NA RM ND PSM
				M2		
				M3		
WETLANDS AND HALOPHYTIC HABITATS (W)	Noise	C	Effects on the fauna (e.g. disturbance in bird, reptile and mammal species)	W1	n.p.	RS F NA RM ND TS PSM
				W2		
				W3		
DUNE HABITATS (D)	Substrate variations linked to sediment dumping	C	Habitat loss and/or variations, with effects on the flora and fauna (e.g. burial, suffocation)	D2	2110, 2120, 2230	RS LRS F ND RM
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
	Trampling	C	Effects on the flora and fauna (e.g. invertebrates, birds and, in D1 only, marine reptiles)	D1	1210, 1310	RS LRS ND
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	
	Noise	C	Effects on the fauna (e.g. disturbance in bird species)	D1	n.p.	RS F RM ND TS PSM
				D2		
				D3		
				D4		
CLIFF HABITATS (C)	Noise	C	Effects on the fauna (e.g. disturbance in bird species)	C1	n.p.	RS F RM ND TS PSM

MATRIX 9: WINDBREAK FENCES, DUNE GRASS PLANTING AND DUNE ACCESS MANAGEMENT

MACRO-ENVIRONMENTS	MAIN PHYSICAL EFFECTS	Phases (C/O)	MAIN POTENTIAL IMPACTS	CATEGORIES, HABITAT AND SPECIES AFFECTED BY IMPACTS		
				Physiographic categories	Habitat types and associated flora species	Habitat Use Categories (fauna species)
DUNE HABITATS (D)	Trampling	C	Effects on the flora and fauna (e.g. invertebrates, birds and, in D1 only, marine reptiles)	D1	1210, 1310	RS LRS ND
				D2	2110, 2120, 2230	
				D3	2130*, 2160, 2210, 2230, 2240, 2250*, 2260, 6220*	