An assessment of French Mediterranean benthic habitats' sensitivity to physical pressures

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The French Natural Heritage Service (UMS PatriNat)
A Centre for Data and Advice on Nature

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Its objective is to deliver scientific advice underpinned by the collection and analysis of biodiversity and geodiversity data, and to harness and promote the advancement of knowledge in the fields of ecology, evolutionary sciences and anthropology. Its expertise, grounded in science, aims to stimulate critical debate regarding public policies on biodiversity, geodiversity and their relationships with society and human beings.

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National Inventory of Natural Heritage

The National Inventory of Natural Heritage (INPN) is an information system developed to centralise, manage and disseminate data on species, habitats, protected areas and the geological heritage of mainland France and its overseas territories. It is the national platform for the French "Information System on Nature and Landscapes" (SINP) and covers both marine and terrestrial environments.
The INPN publishes biodiversity data online according to agreed geographic and taxonomic standards. Data can be accessed at various spatial resolutions: protected areas, 10 x 10 km grids, marine zones, departments and communes. Once validated, this data is used to track and assess biodiversity, as well as to support the development of nature conservation strategies and management plans.
The INPN is the statutory responsibility of the French Natural History Museum (MNHN) (art. L 411.5 of the French Environment Code), and is managed by the Museum's Natural Heritage Service (SPN-MNHN). Data is provided by numerous partner institutions and individuals across France and internationally.

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1 Context

At the request of the French Ministry of Environment (MTES), the UMS Patrimoine Naturel (formerly SPN-MNHN), in close collaboration with benthic scientists, developed a methodology to assess the sensitivity of French benthic habitats to anthropogenic pressures[1].

The aim of this project was to assess the generic sensitivity of French mainland benthic habitats to help steer management actions so as to fulfil the objectives of good ecological or environmental status set out under the European Nature Directives. This work also intended to highlight knowledge gaps regarding the response of benthic habitats to pressures, and to help define future research priorities.

The project produced a generic and standardised database on benthic habitats sensitivity. Coupled with information on the links between pressures and activities, this will allow the identification of risks posed by human activities to benthic habitats.

Sensitivity was assessed according to the methodology described in La Rivière *et al.* (2016). French benthic scientists from both the Mediterranean and Atlantic/English Channel/North Sea were asked to contribute to assessments during two workshops held in Marseille in October 2015. Assessments were based on the best available knowledge presented in scientific literature supplemented by expert judgement where needed.

Assessments were conducted via workshops in order to (i) minimize potential biases of individual experts by clarifying the context and methodology (in person), (ii) share knowledge and (iii) improve the robustness of the assessments. Assessments were carried out by 11 French benthic scientists over the course of two workshops (one for soft substratum habitats, one for hard substratum habitats), supervised by the project manager. Other experts, cited as contributors, were contacted for complementary advice where required.

This document is the English translation of the initial assessment report published in French in 2016 (La Rivière *et al.,* 2016) covering Mediterranean benthic habitats' sensitivity to physical pressures. Other physical, chemical and biological pressures will be defined and assessed in due course.

2 The sensitivity assessment's scope

The terminology, habitat and pressure units, methodological framework and guidance on how to use the resulting assessments are available as a technical report (La Rivière *et al.*, 2016).
Assessing sensitivity involves the following steps for each pressure and each habitat (Figure 1):

- Identifying the key biotic and abiotic elements affecting habitat sensitivity;
- Assessing the habitat's **resistance** to the pressure;
- Assessing the habitat's **resilience** to the pressure;
- **Combining** resistance and resilience scores to generate an overall sensitivity score.

[1] Sensitivity to natural pressures is not considered within the scope of this project

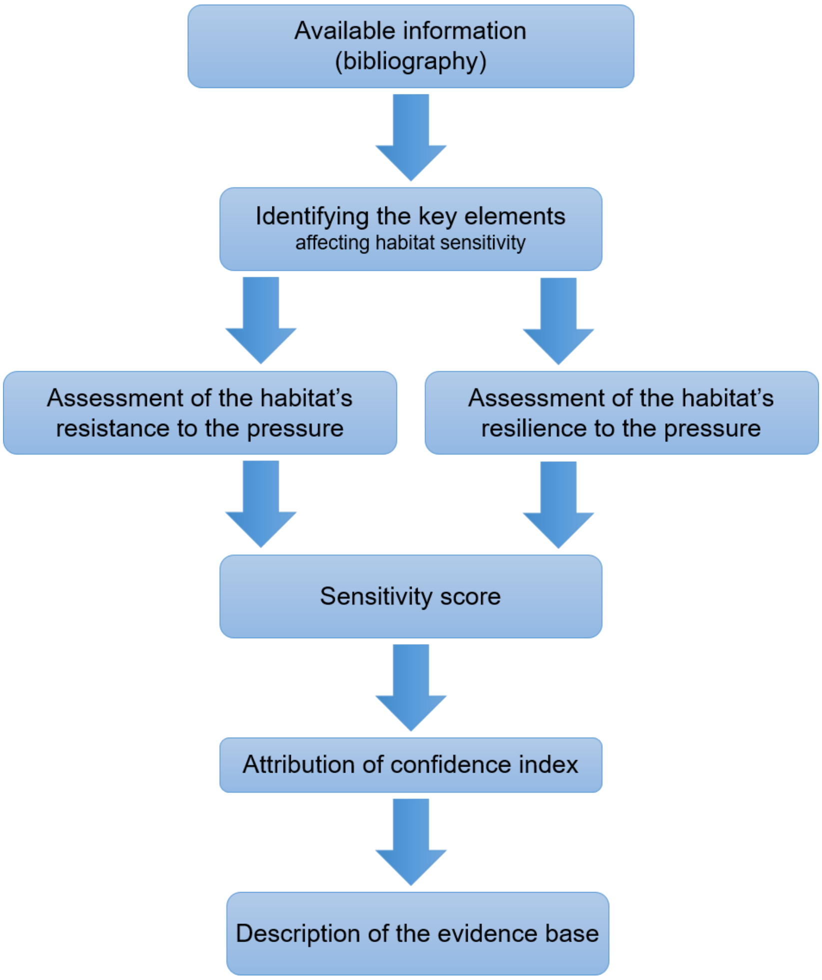

Figure 1. Steps for assessing a benthic habitat's sensitivity to a pressure

A confidence index was assigned to each assessment (resistance, resilience, sensitivity) as an indication of the quality of supporting evidence. Resilience and resistance confidence scores were combined to derive the sensitivity assessment's confidence score.

The resulting sensitivity assessments are semi-quantitative (see semi-quantitative scales in Annex 1). The definitions of physical pressures against which the sensitivity is assessed are available in Annex 2.

Sensitivity was assessed based on the French Mediterranean benthic habitat classification (Michez *et al.*, 2014). This classification (and its relationship with other classifications) is available via the INPN website[2].

3 Methodological assumptions

Certain limitations have to be taken into account when using the sensitivity assessment results, several of which are related to methodological assumptions (La Rivière *et al.*, 2016).

It should be noted that:

[2] https://inpn.mnhn.fr/habitat/cd_typo/32?lg=en

- Sensitivity assessments are generic and non-site-specific.
- The likely effects of a given pressure are assessed at the centre of a habitat's environmental range.
- Habitat sensitivity is affected by local characteristics (natural and/or anthropogenic) and by the health of surrounding habitats. Where such local data is absent, it is recommended that management decisions be taken based on the "generic" sensitivity evaluations produced via this project.
- Associated confidence assessments should be taken into account when considering possible management options. However, according to the precautionary principle, a lack of scientific certainty should not impede the implementation management measures.
- Sensitivity assessments are not absolute: scores are dependent on the magnitude of pressures (as defined in Annex 2).
- If an activity generates a pressure below the magnitude described in the pressure definition, this does not mean that it will not have an impact on a habitat.
- Assessments are made against single pressures and one-off pressure events (e.g. surface abrasion from the pass of one trawl, or habitat removal from one aggregate extraction event).
- Cumulative pressures (of the same or various co-occurring pressures) were not considered, despite being commonplace in the marine environment. It was not possible to consider all scenarios in our generic sensitivity assessments, as the ways individual pressures interact are largely unknown (Halpern *et al.*, 2008).
- The spatial extent of a pressure is assumed to allow for habitat recovery via recolonization (from remaining habitat "edges" or from adjacent areas). If the total surface area of a habitat is destroyed and recolonization is unlikely, the assessment of the resilience is not considered relevant.
- Resilience can only be considered if the pressure has been alleviated or reduced to a magnitude that no longer causes an impact (i.e. allowing habitat recovery).
- Full recovery is a return to the state of the habitat prior to impact, i.e. to a structurally and functionally recognisable habitat and its associated biological community.
- Duration and frequency of pressures could not be considered in generic assessments. Extended and/or frequent exposure to a pressure can decrease the habitat's resilience (and thus increase its sensitivity). It can also affect its environmental or conservation status. In the long term, extended and/or frequent exposure to pressures can induce a change to another habitat type. The duration and frequency of pressures should, therefore, be considered in the development of appropriate management measures.
- Local biotic and abiotic characteristics might also affect a habitat's sensitivity (e.g. ecological/environmental status of the habitat, geographical isolation, hydrodynamic conditions or habitat fragmentation influencing ecological connectivity).
- Sensitivity assessments are based on best available knowledge and may be updated as new data become available.

4 Assessment matrices

Habitat sensitivity was assessed at the "biocenosis" level (there are 32 biocenosis in the habitat classification). Some facies or associations (lower level units) have specific sensitivity levels to certain pressures and are thus assessed separately (8 specific assessments).

Assessments are based on the best available knowledge supplemented by expert judgement. Only references containing directly relevant information for resistance or resilience assessment are cited.

For each habitat unit, a sensitivity assessment matrix is displayed as follows:

- Name of the habitat (+hyperlink to its INPN webpage)
- Related facies or associations (if relevant)
- Hyperlink to corresponding habitat units of other classifications
- One row for each assessed pressure

For each pressure, each sensitivity assessment matrix shows:

- Resistance score (Resist.) and its associated confidence index (CI resist.)
- Resilience score (Resil.) and its associated confidence index (CI resil.)
- Derived sensitivity score (Sensit.) and its associated confidence index (CI sensit.)
- Evidence base used to qualify resistance and resilience
- Evidence type and references

Scores are coded as follows:

- N: None
- VH: Very High
- H: High
- M: Moderate
- L: Low
- VL: Very low
- V: Variable
- NA: Not applicable

Confidence indices are coded as follows:

- H: High
- M: Medium
- L: Low

It should be noted that:

- The « Very Low » sensitivity score does not mean that exposure to the pressure will not result in impact, only that a limited impact was judged likely at the specified pressure magnitude.
- The « Not applicable » sensitivity score means the habitat is not exposed to the pressure (according to best available knowledge).
- The "None" resilience score means the resilience is imperceptible at the specified time scale.

- For biocenosis that include several facies/associations (lower level units or "sub-habitats") with varying resistance/resilience scores, aggregation rules specified in the methodological report should be applied:
    - The "parent" habitat (biocenosis) should be assigned the modal (most frequent) sensitivity score. The highest score (highest sensitivity, lowest resistance, lowest resilience) of one or more of the sub-habitats (facies/association) is indicated in brackets. If the modal score is also the highest score in the aggregation, the presence of lower scores for the sub-habitats is specified with an asterisk.
    - If no modal score is identified, the sensitivity range of the sub-habitats is indicated.
- The confidence index of assessments to both Physical loss pressures (i.e. Habitat loss and Habitat change) is always High as these two pressures result in permanent modification of the habitat in question.

The sensitivity matrices of the French Mediterranean benthic habitats to 12 physical pressures (defined in Annex 2) are presented hereafter. An Excel version can be downloaded via the program's INPN webpage.

I.1.1. Biocenosis of beaches with slowly-drying wracks under glassworts

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) will lead to a total loss of the habitat's characteristics. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	L	H	L	Removal of the substrate would destroy the habitat by eliminating the wrack that forms the superficial deposit. The time needed to accumulate enough wrack to restore the moisture gradient and for characteristic species (e.g. crustaceans, sand fleas) to recolonize is estimated at about five years. Recovery could be faster depending on the frequency of storms, which provide substrate and organisms through wave action. **N.B.** If the depth of extracted substratum is too great, there is a risk of habitat change to a mediolittoral habitat.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	M	L	H	L	L	L	Vertical compression of the substrate leads to increased salinity and reduced availability of oxygen in the sediment. If compression is too strong or chronic (caused, e.g. by regular foot traffic or motorized vehicles), the settling can lead to the loss of Salicornia. Resilience is scored high because of regular moistening by waves during storms, which allows for the biocenosis to be regenerated. If the biocenosis is located in a zone that is rarely hit by waves, resilience could be longer due to low or infrequent marine provision.	Expert judgement
	Surface abrasion	H	L	H	L	L	L	The species characteristic of this biocenosis are buried within the beach wrack layer and are therefore not affected by the superficial abrasion.	Expert judgement
	Light sub-surface abrasion	M	L	M	L	M	L	Resistance is scored moderate as the moist superficial layer of the biocenosis contains nutrients for the crustaceans typical of this biocenosis. The superficial layer takes 3 to 5 years to reform depending on storm frequency.	Expert judgement
	Heavy sub-surface abrasion	N	H	M	L	H	L	Deep abrasion would destroy the habitat by eliminating the wracks and destructuring the deeper sediment layers that provide shelter for the buried fauna that depends on the stratification of moisture and salinity in the substrate. The time needed to accumulate enough wrack to establish a moisture gradient and for recolonization by the sheltered species (e.g. crustaceans, sea fleas) is estimated at about five years. Resilience could be faster depending on the frequency of storms, which provide substrate and organisms through wave exposure.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Reworking of the sediment	N	L	M	L	H	L	Reworking implies the destruction of the wrack layer, the moisture gradient and salinity, and therefore destruction of the biocenosis. The time needed to accumulate enough wrack to re-establish a moisture gradient and for recolonization by the characteristic species (e.g. crustaceans, sea fleas) is estimated at about five years. Recovery could be faster depending on the frequency of storms, which provide substrate and organisms through wave exposure.	Expert judgement
	Light deposition	M	L	M	L	M	L	If the added material is endogenous sediment, resistance is moderate because although the superficial layer of this biocenosis would be smothered, the deposit would be quickly removed by wind and storms. Where the biocenosis is destabilized, resilience is moderate because of the developmental cycle of the characteristic species and the accretion/erosion cycles of this type of habitat. **N.B.** -If the added material is exogenous sediment (e.g. artificial sand brought in to accrete beaches), the habitat type will change due to clogging of the interstices of the biocenosis, which prevents water from draining and species from moving.	Expert judgement

								-If the material deposited is rocky, the habitat type will change because the deposit can't be naturally removed.	
	Heavy deposition	N	L	M	L	H	L	A large deposit cannot be quickly removed by wind and storms. The characteristic species will be forced to recolonize the new substrate (often azoic). Resilience is estimated at about five years. Recovery could be faster depending on the frequency of storms, which provide substrate and organisms through wave exposure. **N.B.** -If the added material is exogenous sediment (e.g. artificial sand brought to accrete beaches), the habitat type will change due to filling of the biocenosis's interstices, which prevents water from draining and species from moving. -If the added material is rocky, the habitat type will change because the deposit can't naturally eliminated.	Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	N	L	M	L	H	L	This biocenosis requires frequent moistening and the recurrent provision of wrack by waves (no resistance to reduced exposure to waves or tide) as well as calm periods to allow for the deposition of wracks and the settlement of communities (no resistance to an increase of exposure to waves or tides). The time required for the accumulation of enough wrack for the establishment of a moisture gradient and recolonization by the sheltered species (e.g. crustaceans, sea fleas) is estimated at about five years. Recovery could be faster depending on the frequency of storms, which provide substrate and organisms through the action of waves.	Expert judgement
	Change in suspended solids	NR		NR		NR		Non-submerged habitat	

I.2.1. Biocenosis of supralittoral sands

I.2.1.a.	Facies with plantless sand with dispersed debris
I.2.1.b.	Facies with depressions with residual dampness
I.2.1.c.	Facies with foreshores with rapid dessication
I.2.1.d.	Facies with washed-up tree trunks
I.2.1.e.	Facies with washed-up Phanerogams (upper part)

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) will lead to a total loss of the habitat's characteristics, defined by a sandy substrate in the supralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	L	H	L	Extraction would destroy the habitat by removing the substrate along with the associated species (e.g. crustaceans, insects). The time needed for the renewal and stabilization of the sediment and debris and for recolonization by the characteristic species (short-lived species) is estimated at about five years. It depends on input from the sea and land due to storms, and may take longer if the shore is exposed to intense human activity. **N.B.** Resilience of specific facies in this biocenosis can be over five years depending on the type of debris and wrack deposited by storms. **N.B**. If the depth of extracted substratum is too great, there is a risk of habitat change into a mediolittoral habitat	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	N	H	H	H	M	H	Buried species will be crushed by the compression, which modifies the capacity for retaining and draining sand. Resilience is estimated at 1 to 2 years due to seasonal storms that allow for the mixing of sediments and the arrival of new individuals.	Directly relevant grey literature: Bellan-Santini *et al*., 1994 ; Bensetitti *et al.*, 2004 ; PNUE-PAM-CAR/ASP, 2007 Peer-reviewed publication: Brown and McLachlan, 2002
	Surface abrasion	M	M	H	M	L	M	This biocenosis is naturally subjected to surface abrasion (by wind, rain and storms) and the majority of the characteristic species are buried. Nevertheless, shallow abrasion eliminates wrack, which acts as shelter and a source of nutrients for certain organisms; resistance is scored moderate and resilience high since the frequency of storms allows for the renewal of the biocenosis. Recovery may take longer if the shore is exposed to a large amount of human activity. *N.B. Abrasion can cause the loss of certain facies typical of this biocenosis.*	Peer-reviewed publications, inference from studies on natural pressures in another region: Brown and McLachlan, 2002 ; Harris *et al.*, 2011
	Light sub-surface abrasion	M	M	H	M	L	M	Shallow abrasion also impacts certain buried species. Resistance is moderate. Resilience is high due to the ability of deeply buried individuals to rise to the surface, and to the provision of material by seasonal storms. Recovery may take longer if the shore is exposed to significant human activity. *N.B. Abrasion can cause the loss of certain facies specific to this biocenosis.*	Peer-reviewed publications, inference from studies on natural pressures in another region: Brown and McLachlan, 2002 ; Harris *et al.*, 2011
	Heavy sub-surface abrasion	L	M	M	M	M	M	Deep abrasion affects the species buried in the substrate that are not able to escape and disturbs the sediment's range of humidity. Resistance is scored low due to the depth of the abrasion which reduces the number of buried individuals that are able to emerge and due to the large contribution that is necessary to restore the biocenosis. Resilience is scored moderate owing to the amount of time takes to stabilize and	Peer-reviewed publications, inference from studies on natural pressures in another region: Brown and McLachlan, 2002 ; Harris *et al.*, 2011

								restructure the sediment enough to recover a similar biocenosis. Resilience may be longer if the coast is exposed to a large amount of human activity. *N.B. Abrasion can cause the loss of certain facies of this biocenosis.*	
	Reworking of the sediment	M	H	M	H	M	H	Reworking affects the structure of the biocenosis and the sediment moisture gradient. Resistance is moderate. Resilience is moderate owing to the time it takes to stabilize and restructure the sediment enough to recover a similar biocenosis.	Directly relevant grey literature: Bensetitti *et al.,* 2004 ; PNUE-PAM-CAR/ASP, 2007
	Light deposition	H	L	M	L	L	L	If the added material is endogenous, resistance is high, as while the superficial layer of the biocenosis would be smothered, the deposit would be quickly removed by wind and storms and the mobile species could rise to the deposited layer. Should the biocenosis be destabilized, resilience is moderate due to the life cycles of the characteristic species and the accretion/erosion cycles for this type of habitat. **N.B.** -If exogenous sediment is added (e.g. quarry sand used to expand the beach), resistance is none, since the interstices of the biocenosis will be filled, preventing water drainage and the free movement of mobile species. Resilience is estimated at 2 to 5 years. -If rocky material is added, there will be a change of habitat type, since the deposit could not be removed naturally.	Expert judgement
	Heavy deposition	N	M	M	M	H	M	A large deposit of material could not be rapidly removed by wind and storms and would bury the biocenosis. Resilience is estimated at about 5 years. Recovery could be faster depending on the frequency of storms, which replenish the substrate and organisms through wave action. **N.B.** -If the added material is exogenous (e.g. quarry sand used to increase size of the beach), there will be a change in habitat type since the interstices of the biocenosis will be filled, preventing water drainage and the movement of mobile species. -If the added material is rocky, there will be a change in habitat type because the deposit will not be able to be eliminated naturally. -If the added material is azoic sand (often used for refilling beaches), resilience may be longer to allow for biological communities to recolonize the sediment.	Peer-reviewed publication: Brown et McLachlan, 2002
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	N	L	M	L	H	L	A change in exposure to tides and waves could potentially lead to a change in habitat type. Maintenance of the biocenosis requires a constant supply of wrack and water from waves (no resistance to decreased exposure to waves or tides) as well as calm periods to allow for the sediment to stabilize and the communities to settle (no resistance to increased exposure to waves or tides). The time needed for sediment stabilization and recolonization by species characteristic of the biocenosis (short-lived species) is estimated at about 5 years depending on storm frequency. Recovery may take longer if the coast is exposed to a large amount of human activity. **N.B.** In the case of extended pressure, there is a risk of habitat change.	Expert judgement
	Change in suspended solids	NR		NR		NR		Non-submerged habitat	

I.3.1. Biocenosis of slow-drying wracks

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) will lead to a total loss of the habitat's characteristics, defined by a substrate of gravel and pebbles in the supralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	L	H	L	Removal of substrate would destroy the habitat by eliminating the wrack that forms the superficial deposit. The time needed to accumulate enough wrack to restore the moisture gradient and for recolonization by associated species (e.g. crustaceans, sand fleas) is estimated at about five years. Recovery could be faster depending on the frequency of storms, which replenish the substrate and organisms through the action of waves. **N.B.** If the depth of extracted substratum is too great, there is a risk of habitat change to a mediolittoral type.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	L	VH	L	VL	L	As pebbles and gravel are hard to compact, this biocenosis is considered highly resilient and resistant to this pressure.	Expert judgement
	Surface abrasion	H	L	H	L	L	L	The characteristic species of this biocenosis are buried and would therefore not be affected by surface abrasion.	Expert judgement
	Light sub-surface abrasion	M	L	M	L	M	L	Resistance is moderate since the moist superficial layer of the biocenosis provides nutrients for the characteristic species of this biocenosis. The superficial layer would take about 3 to 5 years to reform depending on the frequency of storms.	Expert judgement
	Heavy sub-surface abrasion	N	H	M	L	H	L	Deep abrasion would destroy the habitat by moving gravel and pebbles and restructuring the biocenosis. Resilience is estimated at about 5 years. Recovery could be faster depending on the frequency of storms, which replenish the substrate and organisms through wave exposure.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Reworking of the sediment	N	L	M	L	H	L	Reorganization implies the destruction of the biocenosis. Resilience is estimated at about 5 years. Recovery could be faster depending on the frequency of storms, which contribute substrate and organisms through the action of waves.	Expert judgement
	Light deposition	M	L	M	L	M	L	Resistance is moderate since the characteristic species are highly mobile. Should the biocenosis be destabilized, resilience would be moderate due to the life cycles of the characteristic species and the accretion/erosion cycles for this type of habitat. **N.B.** -The addition of fine sediment would induce a change of habitat type because the interstices of biocenosis will be filled, preventing water drainage and the free movement of mobile species. -The addition of rocky material would change the habitat type because the deposit could not be eliminated naturally.	Expert judgement
	Heavy deposition	N	L	M	L	H	L	A major addition of gravel or pebbles would damage the biocenosis by adding substrate (often azoic) that the species would have to recolonize. If the added material lacks organic matter, the characteristic species could be affected by the lack of nutrients. Resilience is estimated at about 5 years. Recovery could be faster depending on the frequency of storms, which replenish the substrate and organisms through the action of waves. **N.B.**	Expert judgement

								-The addition of fine sediment would induce a change of habitat type because the interstices of the biocenosis would be filled, preventing water drainage and the free movement of mobile species. -The addition of rocky material would induce a change of habitat type because the deposit could not be eliminated naturally.	
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	N	L	M	L	H	L	Maintenance of the biocenosis requires a large amount of moisture, a constant supply of wrack from waves (no resistance to a decrease in exposure to waves or tides) and calm periods that allow for the deposition of sand and the settlement of communities (no resistance to an increase in exposure to waves or tides). Resilience is estimated at about 5 years. Recovery could be faster depending on the frequency of storms, which contribute substrate and organisms through the action of waves.	Expert judgement
	Change in suspended solids	NR		NR		NR		Non-submerged habitat	

I.4.1. Biocenosis of the supralittoral rock

I.4.1.a.	Association with Cyanobacteria and *Hydropunctaria amphibia*
I.4.1.b.	Facies with *Melarhaphe neritoides* and *Euraphia depressa* (Syn. *Chthamalus depressus*)
I.4.1.c.	Enclave: Rockpools with variable salinity

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) will lead to a total loss of the habitat's characteristics, defined by a rocky substrate in the supralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	M	H	M	Most of this habitat's characteristic species (lichens, gastropods, crustaceans, etc.) are sessile and would be totally lost should the pressure disturb the integrity of the substratum, as with the example of extraction. Given that (i) these species have short life cycles and are able to recruit and disperse and (ii) the habitat is naturally exposed to extreme wave energy, the time needed for pioneer species and then the typical sessile species to recolonize the exposed substrate is estimated at about 5 years, assuming there are mature individuals nearby. Certain mobile species can also migrate if there is a healthy population in the vicinity. **N.B.** If the depth of extracted substratum is too great, there is a risk of habitat change to a mediolittoral type.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	M	M	M	L	M	Most of this habitat's characteristic species are rigid or encrusting and therefore extremely resistant to compression. Nevertheless, if the integrity or functionality of the habitat (e.g. by frequent pressure), resilience is estimated at about 5 years. **N.B.** In the case of chronic pressure, e.g. repeated trampling, the habitat's resilience and resistance will be altered.	Peer-reviewed publications: Brosnan and Crumrine, 1994 Expert judgement
	Surface abrasion	N	H	M	M	H	M	Most of this habitat's characteristic species (lichens, gastropods, crustaceans, etc.) are sessile and would be totally lost if the habitat is exposed to abrasion. Given that (i) these species have short life cycles and a strong ability to recruit and disperse and (ii) the habitat is naturally exposed to extreme wave energy, the time needed for pioneer species and then typical sessile species to recolonize the exposed substrate is estimated at about 5 years, assuming there are mature individuals nearby. Certain mobile species can also migrate if there is a healthy population in the vicinity.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Light sub-surface abrasion	N	H	M	M	H	M		
	Heavy sub-surface abrasion	N	H	M	M	H	M		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	
	Light deposition	M	M	M	M	M	M	Most of the sessile epifauna would be crushed by a low supply of rocky material. Nevertheless, extreme wave energy and exposure to natural wind often allow the deposit to be eliminated whether it be sedimentary or rocky. If there are mature individuals nearby, resilience is estimated at about 2-5 years.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement.
	Heavy deposition	N	M	M	M	H	M	The characteristic species would be completely destroyed by crushing, suffocation or clogging in the case of a major addition of exogenous material, whether it's sedimentary or rocky. Nevertheless, extreme wave energy and exposure to natural wind most often allow for elimination in case of sedimentary deposits. When rocky material is deposited, the communities will settle back on the bare substrate. Assuming there are mature individuals nearby, the time it takes pioneer species and then the characteristic species to	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low

								recolonize the bare rocky substrate is estimated at about 5 years. **N.B.** When the addition is too extreme, there is a risk of change in level or substrate and therefore of habitat type.	energy") Expert judgement.
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	L	M	L	M	H	M	This habitat depends directly on the moisture level and is defined by it unique hydrodynamic conditions, which differentiate the types of habitat and the upper and lower levels. A change in these conditions, even brief, would lead to a major loss of the habitat's characteristics. Following this kind of change, recovery of the community layering that allows for the differentiation of the various biocenosises would take over 10 years. **N.B**. Prolonged pressure could induce a change of habitat to a mediolittoral type or an emerged habitat.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement.
	Change in suspended solids	NR		NR		NR		Non-submerged habitat	

II.1.1. Biocenosis of muddy sands and muds of lagoons and estuaries

II.1.1.a. Association with halophytes

II.1.1.b. Facies of saltworks

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) will lead to a total loss of the habitat's characteristics, defined by the mediolittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth. *N.B. This biocenosis is, however, highly resistant to changes in sediment granulometry (for a change of sandy substrate, muddy, or sandy-muddy).*	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	M	H	M	Removal of the substrate would destroy the habitat by destabilizing sediment stratification and eliminating species characteristic of the biocenosis. The time needed for the renewal and stabilization of the sediment and recolonization by species characteristic of the biocenosis (short-lived species) is estimated at about 5 years. It could take longer if the shore is exposed to a lot of human activity. **N.B.** If the depth of extracted substratum is too great, there is a risk the habitat will be replaced by an infralittoral biocenosis.	Resistance's confidence index is High as this pressure affects the habitat in-depth. Expert judgement and grey literature regarding the resilience: PNUE-PAM-CAR/ASP, 2007
	Trampling	L	L	M	M	M	L	Compression favours saline seepage and reduces the availability of oxygen in the sediment. This can lead to the loss of phanerogams. Resilience is moderate due to the short life cycles of the characteristic species.	Expert judgement and grey literature regarding the resilience: PNUE-PAM-CAR/ASP, 2007
	Surface abrasion	M	L	H	M	L	L	Most of the species characteristic of this biocenosis are mobile or buried. Only the phanerogams will be affected. Resilience to surface abrasion is high due to the rapid life cycles of the characteristic species.	Expert judgement and grey literature regarding the resilience: PNUE-PAM-CAR/ASP, 2007
	Light sub-surface abrasion	L	L	M	M	M	L	Light sub-surface abrasion penetrates the sediment and therefore disturbs the existing stratification. Resistance is scored low due to the disturbance of the upper centimetres of sediment, but certain mobile organisms can still move underground. Resilience for the biocenosis is estimated at about 5 years. It could be longer if the coast is exposed to a lot of human activity.	Expert judgement and grey literature regarding the resilience: PNUE-PAM-CAR/ASP, 2007
	Heavy sub-surface abrasion	N	L	M	M	H	L	Deep abrasion penetrates the sediment and therefore totally disturbs the existing stratification. Resistance is qualified as none as all the buried species are impacted. Resilience is estimated at about 5 years. Recovery could be longer if the shore is exposed to a lot of human activity.	Expert judgement and grey literature regarding the resilience: PNUE-PAM-CAR/ASP, 2007
	Reworking of the sediment	N	L	M	M	H	L	Rearrangement of the sediment affects its stratification. Resistance is qualified as none because all the buried species are impacted. Resilience is estimated at about 5 years. Recovery could be longer if the shore is exposed to a lot of human activity.	Expert judgement and grey literature regarding the resilience: PNUE-PAM-CAR/ASP, 2007
	Light deposition	M	L	H	M	L	L	This habitat shows moderate resistance and high resilience to a light addition of sedimentary material owing to the large amount of natural silting. A large amount of added rocky material would cause a change in habitat type since the natural hydrodynamic conditions do not allow the rapid elimination of a deposit.	Expert judgement and grey literature regarding the resilience: PNUE-PAM-CAR/ASP, 2007
	Heavy deposition	N	L	M	M	H	L	A large amount of added sedimentary material would cause a silting of the biocenosis, which would be forced to re-establish on the bare substrate. Resilience is estimated at 5 years due to the rapid life cycles of the characteristic species.	Expert judgement and grey literature regarding the

								The addition of rocky material would lead to a change in habitat type. **N.B**. If too much material is added, there is risk of the zonation changing to favour supralittoral habitat.	resilience: PNUE-PAM-CAR/ASP, 2007
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	H	L	VH	M	VL	L	This habitat is naturally exposed to fluctuating hydrodynamic conditions. Resistance and resilience are therefore scored respectively high and very high for a change of short duration. **N.B**. Prolonged pressure could induce a change in the type of habitat.	Expert judgement and grey literature regarding the resilience: PNUE-PAM-CAR/ASP, 2007
	Change in suspended solids	H	L	VH	M	VL	L	Owing to the natural mingling of waters with more or less suspended matter, resistance and resilience for this pressure are scored respectively high and very high for a change of short duration.	Expert judgement and grey literature regarding the resilience: PNUE-PAM-CAR/ASP, 2007

II.2.1. Biocenosis of mediolittoral sands

II.2.1.a Facies with *Ophelia bicornis*

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) will lead to a total loss of the habitat's characteristics, defined by a sandy substrate in the mediolittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth. **N.B.** A change in the granulometry could influence the presence of facies with *O. bicornis*	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	H	L	M	L	Extraction would destroy the habitat by removing the substrate along with the associated species (e.g. annelids, crustaceans, molluscs). The time needed for sediment renewal and stabilization and for recolonization by species characteristic of the biocenosis (mobile short-lived species) is estimated at less than 2 years. It depends on the local hydrodynamic system. **N.B.** If the depth of extraction is too great, there is a risk of habitat change in favour of the biocenosis of the infralittoral zone.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	L	H	VH	L	L	L	Vertical pressure can modify the compactness of the sediment, the substrate's capacity for retention or drainage, and therefore the mobility of the species within. Resistance is therefore scored low. Resilience is estimated at less than a year owing to the waves and storms that allow for sediment transport. **N.B.** In the case of vertical compression that is chronic or too intense, e.g. from constant trampling or vehicles, the habitat's resistance and resilience will be altered.	Grey literature regarding the resistance: Bellan-Santini *et al.,* 1994 ; Bensetitti *et al.,* 2004
	Surface abrasion	H	L	VH	L	VL	L	This habitat is naturally exposed to superficial and shallow abrasion, notably from waves and wind, and the characteristic species can easily move around. Resistance of superficial sediments is therefore high. Resilience is very high owing to the mobility and short life cycles of the characteristic species.	Expert judgement
	Light sub-surface abrasion	H	L	VH	L	VL	L		Expert judgement
	Heavy sub-surface abrasion	M	L	VH	L	L	L	Resistance is scored moderate due to the depth of the abrasion, which reaches more buried organisms than less deep abrasion pressures. Resilience is very high due to the characteristic species' mobility and short life cycles.	Expert judgement
	Reworking of the sediment	M	L	VH	L	L	L	The surface of this habitat is naturally and constantly modified by waves and wind. Deep reworking would reach the buried organisms and impact the structure and integrity of the substrate. Resistance is therefore moderate. Resilience is very high due to the mobility and short life cycles of the characteristic species.	Expert judgement
	Light deposition	H	L	VH	L	VL	L	Resistance is scored high due to the extreme mobility of the characteristic species. The natural hydrodynamic conditions allow for the rapid elimination of a sedimentary deposit or pebbles through the action of wind and waves (very high resilience). **N.B**. A change in granulometry can influence the presence of facies with *O. bicornis* A supply of rocky material would lead to a change in habitat because the natural hydrodynamic conditions do not allow for the rapid removal of the deposit.	Expert judgement
	Heavy deposition	H	L	VH	L	VL	L	Resistance is scored high due to the extreme mobility of the characteristic species. The natural hydrodynamic conditions allow for the rapid elimination of a sediment deposit through the action of wind and waves (very high resilience). **N.B.** A change in granulometry can influence the presence of the facies *O. bicornis*	Expert judgement

								The mediolittoral zone is very narrow in the Mediterranean. The addition of too much material could result in elevating the level of the habitat and therefore changing its type in favour of the supralittoral biocenosis.	
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	N	L	H	L	M	L	The communities in this habitat are strongly influenced by the sediment's moisture level. A change in exposure to tides and waves can therefore lead to a change of habitat A decrease in wave energy can result in silting and therefore lead to a change of habitat. Resilience is scored high. **N.B.** A prolonged change could lead to a change of zonation (supralittoral or infralittoral) and therefore of the corresponding habitat type.	Expert judgement
	Change in suspended solids	H	L	VH	L	VL	L	This biocenosis is naturally exposed to extreme fluctuations in wave energy which leads to a mingling of sediments. Resistance and resilience are therefore scored high and very high respectively.	Expert judgement

II.3.1. Biocenosis of mediolittoral detritic bottoms

II.3.1.a. Facies with banks of dead leaves of *Posidonia oceanica* and other phanerogams (particular assessment of sensitivity)

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a total loss of the habitat's characteristics, defined by a detritic substrate in the mediolittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	H	L	M	L	Extraction leads to the removal of the organic detritic fraction that nourishes the species characteristic of this biocenosis, and therefore to the loss of these organisms. Resilience is scored high due to the mobility of the characteristic species and their short life cycle. **N.B.** The mediolittoral zone is very narrow in the Mediterranean. If the extraction is too deep, there is a risk of habitat change in favour of the infralittoral biocenosis.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	L	VH	L	VL	L	Compression of coarse sediments does not influence their compactness and therefore does not disturb the associated species. Resilience is very rapid due to the natural hydrodynamic conditions that regularly stir up the sediments. **N.B.** In the case of chronic or very intense vertical compression, e.g. from constant trampling or vehicles, resistance and resilience will be altered.	Expert judgement
	Surface abrasion	H	L	VH	L	VL	L	The characteristic species are buried in the sediment and therefore unaffected by surface abrasion.	Expert judgement
	Light sub-surface abrasion	H	H	VH	L	VL	L	Resistance is scored high because shallow abrasion only affects the superficial layer of sediment. The characteristic species are buried in the sediment and can move freely within it. Resilience is very high due to natural hydrodynamic conditions and the short life cycles of the characteristic species.	Expert judgement
	Heavy sub-surface abrasion	M	L	VH	L	L	L	Resistance is scored moderate because deep abrasion can impact species that are buried less deeply. Resilience is very high due to the mobility and short life cycles of characteristic species and the natural stirring of sediments through wave energy.	Expert judgement
	Reworking of the sediment	M	L	VH	L	L	L	This habitat is naturally and regularly transformed by the wind and waves. Resistance of superficial sediments is therefore scored moderate because only some of the species would be affected by a rearrangement of the substratum. Resilience is very high owing to the mobility and the short life cycles of the characteristic species.	Expert judgement
	Light deposition	H	L	VH	L	VL	L	The natural stirring caused by waves and wind allows for the rapid elimination of light deposits without altering the characteristic species.	Expert judgement
	Heavy deposition	H	L	VH	L	VL	L	If the hydrodynamic conditions don't allow for the rapid elimination of the deposit but the added material has the same granulometry as the original substrate, the mobile species can still move within the new layer of sediment. **N.B**. The mediolittoral zone is very narrow in the Mediterranean. The addition of too much material could result in elevating the habitat's zone and therefore of habitat change in favour of the supralittoral biocenosis. In case of a large addition of material of a different nature than the original substrate, there is a risk of habitat change.	Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	N	L	VH	L	L	L	This habitat is naturally exposed to extreme fluctuations in hydrodynamic conditions. A decrease in wave energy leads firstly to reduced inflow of nutrient-rich detritus, and secondly it presents a risk of clogging due to silting (no resistance). In the case of increased wave energy, there will be a change in immersion/emersion cycles, which could induce a habitat change in favour of the infralittoral biocenosis. For species with short life cycles, resilience is scored very high for a pressure of short duration.	Expert judgement

								N.B. Prolonged pressure can lead to a zonation change (supralittoral or infralittoral) and therefore to the type of habitat.	
	Change in suspended solids	H	L	VH	L	VL	L	This biocenosis is naturally exposed to extreme fluctuations in wave energy which lead to a mingling of the substrate (notably during storms). Resistance and resilience are therefore scored high and very high respectively.	Expert judgement

II.3.1.a. Facies with banks of dead leaves of *Posidonia oceanica* and other phanerogams

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a total loss of the habitat's characteristics, defined by a detritic substrate in the mediolittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	L	H	L	The facies consisting of dead seagrass would be destroyed by the removal of the substratum. The time needed for the deposition of new seagrass and its stabilization in a banquette is about 5 years. **N.B.** Recovery could take longer if nearby posidonia meadows have been damaged. In the absence of healthy seagrass beds nearby, resilience is over 25 years.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	L	M	L	L	L	Seagrass banks are highly elastic and resistant to pressure. If altered, resilience is 5 to 10 years. **N.B.** In the case of chronic or very intense pressure, e.g. from repeated trampling or vehicles, the habitat's resistance and resilience will be altered.	Expert judgement
	Surface abrasion	H	L	VH	L	VL	L	Characteristic species are buried in the banks and therefore not affected by surface abrasion.	Expert judgement
	Light sub-surface abrasion	L	H	M	L	M	L	Sub-surface abrasion removes superficial layers where most of the organic debris that provides a food source for the mobile species, or even the whole bank depending on how thick it is (if the bank is thin, resistance is scored as none). Resilience is moderate due to the time it takes for the deposition of new seagrass and its stabilization. **N.B.** Recovery is longer if nearby posidonia meadows are damaged. If there are no healthy seagrass beds nearby, resilience is over 25 years.	Grey literature regarding the resistance: Bensetitti et al., 2004
	Heavy sub-surface abrasion	L	H	M	L	M	L		
	Reworking of the sediment	N	L	M	L	H	L	Rearrangement mixes up the layers and therefore destructures the infiltration strip. Resilience is scored moderate due to the time it takes to replenish and stabilize the seagrass litter.	Expert judgement
	Light deposition	L	L	M	L	M	L	Adding material of any nature alters the structure of the facies without destroying it. Resilience is scored moderate due to the time it takes to replenish and stabilize the seagrass litter. **N.B.** The addition of too much fine sand could lead to the clogging of the banquette and suffocating the associated species.	Expert judgement
	Heavy deposition	L	L	M	L	M	L		Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	L	L	M	L	M	L	A decrease in wave energy leads to a decrease in provision which can lead to erosion of the infiltration strip by reducing its natural size. An increase in wave energy leads to a mechanical erosion of the infiltration strip. The facies will not be totally destroyed if the pressure is of short duration and Resilience is estimated at about 5 years. **N.B.** Prolonged pressure will lead to a loss of the facies.	Expert judgement
	Change in suspended solids	H	L	VH	L	VL	L	This facies is naturally exposed to extreme fluctuations in wave energy, creating a water supply with the amount of suspended solids depending on the mix of sediments. Resistance and resilience are therefore scored respectively high and very high.	Expert judgement

II.4.1. Biocenosis of the upper mediolittoral rock

II.4.1.a. Association with *Bangia fuscopurpurea* (Syn. *Bangia atropurpurea* var. *fuscopurpurea*)
II.4.1.b. Association with *Porphyra* spp.
II.4.1.c. Association with *Nemalion helminthoides and Rissoella verruculosa*
II.4.1.d. Association with *Lithophyllum papillosum* (Syn. *Titanoderma papillosum*) and *Polysiphonia* spp.
II.4.1.e. Facies with *Patella* spp. And *Chthamalus* spp.

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or in biological zone (depth band) will lead to a total loss of the characteristics of the habitat, defined by a rocky substrate in the mediolittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	M	H	M	Most of this habitat's characteristic species (algae, gastropods, crustaceans, etc.) are sessile and will be lost if the habitat is exposed to a pressure such as extraction that impacts the integrity of the substratum. Given that these species (i) have short life cycles and a strong ability to recruit and disperse and (ii) the habitat is naturally exposed to extreme wave energy, the time needed for recolonization of the exposed substrate by pioneer species and then by the characteristic sessile species is estimated at about 5 years, assuming there are mature individuals nearby. Certain mobile species can also migrate if there is a healthy population in the vicinity. **N.B.** The extraction of too much substrate could lead to a zone change and therefore a habitat change.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	M	H	M	L	M	Certain characteristic species of this habitat are flexible (e.g. algae) or rigid (e.g. molluscs and crustaceans) and are therefore highly resistant to compression. Nevertheless, if the integrity and functionality are disrupted (e.g. by frequent pressure), resilience is estimated at about 5 years. **N.B.** In the case of chronic pressure, from repeated trampling for instance, the habitat's resistance and resilience will be altered.	Peer-reviewed publications: Brosnan and Crumrine, 1994 Expert judgement
	Surface abrasion	N	H	M	M	H	M	Most of this habitat's characteristic species (lichens, gastropods, crustaceans, etc.) are sessile and will be lost if the habitat is exposed to abrasion. Given that (i) these species have short life cycles and a strong recruitment and dispersion capacity, and (ii) the habitat is naturally exposed to high wave energy, the time needed for characteristic species to recolonize the newly exposed substratum is estimated at around 5 years. Resilience depends on the presence of a healthy, similar habitat (with mature individuals) in the vicinity.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Light sub-surface abrasion	N	H	M	M	H	M		
	Heavy sub-surface abrasion	N	H	M	M	H	M		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	
	Light deposition	M	M	M	M	M	M	Most of the sessile epifauna will be crushed by even a small addition of rocky material. Nevertheless, extreme wave energy and exposure to natural wind allows for elimination of the deposit, whether it be sedimentary or rocky. If mature individuals are in the vicinity, resilience is estimated at 2-5 years.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement.
	Heavy deposition	N	M	M	M	H	M	Characteristic species would be completely destroyed by crushing, smothering or clogging if too much exogenous material is added, whether it be sedimentary or rocky. Nevertheless, in the case of added sedimentary material, extreme wave energy and exposure to natural wind often allows for the removal of the deposit.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low

								In the case of added rocky material, communities will resettle on the bare substratum. Assuming there are mature individuals in the vicinity, recolonization time for the bare rocky substrate by pioneer species and then by characteristic species is estimate around 5 years. **N.B.** The addition of too much material could result in level and/or substrate change and therefore of habitat.	energy") Expert judgement.
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	L	M	L	M	H	M	This habitat is directly dependent on moisture and is defined by unique hydrodynamic conditions that differentiate the types of habitats on upper and lower levels. A change in hydrodynamic conditions would lead to a major loss of this habitat's characteristics (and often to a change in association or facies). Following this type of change, the zonation of communities that allows for a differentiation between biocenosis would take over 10 years to re-establish. **N.B.** With prolonged pressure, there is a risk of a change in the type of facies or particular associations of this biocenosis, or even a habitat change in favour of the supralittoral or lower mediolittoral, and possibly infralittoral.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement.
	Change in suspended solids	NR		NR		NR		Permanently non-submerged habitat	

II.4.2. Biocenosis of the lower mediolittoral rock

II.4.2.a. Association (entablature) with *Lithophyllum byssoides* (Syn. *Lithophyllum lichenoides*) (particular assessment of sensitivity)
II.4.2.b. Association with *Neogoniolithon brassica-florida* and *Lithophyllum byssoides* (Syn. *Lithophyllum lichenoides*)
II.4.2.c. Association with *Titanoderma ramosissimum* (Syn. *Goniolithon byssoides* sensu Kützing)
II.4.2.d. Association with *Nemoderma tingitanum*
II.4.2.d. Association with *Gelidium* spp.
II.4.2.f. Association with *Ulva* spp. (Syn. *Enteromorpha* spp.)
II.4.2.g Rockpools sometimes associated with vermetids (infralittoral enclave)

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or in biological zone (depth band) will lead to a total loss of the characteristics of the habitat, which is defined by a rocky substrate in the mediolittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	M	H	M	Most of this habitat's characteristic species (algae, gastropods, crustaceans, etc.) are sessile and will be lost along with the substratum. Few mobile species have the possibility to leave. Given that (i) these species have short life cycles and a strong capacity to recruit and disperse, and (ii) the habitat is naturally at an extreme wave energy, the time needed for the recolonization of the exposed substratum by pioneer species and then by typical sessile species is estimated at about 5 years, assuming there are mature individuals nearby. Certain mobile species will also be able to migrate if a healthy population exists in the vicinity. **N.B**. If too much substrate is extracted, there is a risk of change in zonation and therefore of habitat.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	M	M	M	L	M	Certain characteristic species of this habitat are flexible (e.g. algae) or rigid (e.g. molluscs and crustaceans) and are therefore highly resistant to compression. Nevertheless, if the integrity and functionality of the habitat are disrupted (e.g. by frequent pressure), resilience is estimated at about 5 years. **N.B.** In the case of chronic pressure, from repeated trampling for instance, the habitat's resistance and resilience will be altered.	Peer-reviewed publications: Brosnan and Crumrine, 1994 Expert judgement
	Surface abrasion	N	H	M	M	H	M	Certain characteristic species of this biocenosis (algae, gastropods, crustaceans, etc.) are sessile and will therefore be totally lost if the habitat is exposed to abrasion pressure. Mobile species will be removed. Given that (i) all these species have short life cycles and a strong capacity to recruit and disperse and (ii) the habitat is naturally exposed to extreme wave energy, the time needed for recolonization of the exposed substratum by pioneer species and then by typical sessile species is estimated at about 5 years, assuming there are mature individuals nearby. Certain mobile species can also migrate if a healthy population is nearby.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Light sub-surface abrasion	N	H	M	M	H	M		
	Heavy sub-surface abrasion	N	H	M	M	H	M		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	
	Light deposition	M	M	M	M	M	M	Most of the sessile epifauna will be crushed by even a light addition of rocky material. Nevertheless, strong hydrodynamics and exposure to natural wind often allows for the deposit to be removed, whether it be sedimentary or rocky. If mature individuals are in the vicinity, resilience is estimated at 2-5 years.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement.
	Heavy deposition	N	M	M	M	H	M	Characteristic species would be completely destroyed by crushing, smothering or clogging if too much exogenous material is added, whether it be sedimentary or rocky. Nevertheless, in the case of added	Grey literature, inference from studies on similar habitats and same pressure:

							sediments exposure to strong hydrodynamics and natural wind often allows the deposit to be removed. If rocky material is added, communities will resettle on bare substrate. Assuming there are mature individuals in the vicinity, recolonization of bare rocky substrate by pioneer species and then by characteristic species is estimated at about 5 years. **N.B.** The addition of too much material could result in changing the zonation or substratum and therefore the habitat.	Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement.
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	L	M	L	M	H	M	This habitat is directly dependent on moisture and is defined by unique hydrodynamic conditions that differentiate the types of habitats on the upper and lower levels. A change in hydrodynamic conditions would lead to a major loss of the habitat's characteristics (and often to a change in association or facies). Following this type of change, the zonation of communities that allows for the differentiation between biocenosis would take over 10 years to re-establish. **N.B.** In the case of prolonged pressure, there is a risk of a change in the type of facies or particular association of this biocenosis or even a change in habitat in favour of a supralittoral or upper mediolittoral, even infralittoral zone.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "High energy intertidal rock, moderate energy, low energy") Expert judgement.
	Change in suspended solids	NR		NR		NR		Permanently non-submerged habitat	

II.4.2.a. Association (entablature) with *Lithophyllum byssoides* (Syn. *Lithophyllum lichenoides*)

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or in biological zone (depth band) will lead to a total loss of the characteristics of the habitat, which is defined by a rocky substrate in the mediolittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	N	H	VH	H	Extraction would completely destroy the layers of bio-concretion and could touch the solid core. In this case, corbel recovery takes over a century, when the damage is not irreversible, because thalli grow only 2-3 cm per year.	Peer-reviewed publications: Laborel, 1987 ; Laborel *et al.*, 1994 ; Boudouresque, 2004
	Trampling	M	H	M	H	M	H	Compression leads to a notable change in the association by altering the external, living layer of the corbel. If only the upper layer is altered, and the hardened structure remains intact, and if the pressure ends, resilience is possible at between 5 to 10 years. **N.B**. In the case of chronic compression, from repeated trampling for instance, the whole structure will be destroyed and resilience will be over a century (very high sensitivity).	Peer-reviewed publications: Laborel, 1987 ; Laborel *et al.*, 1994 ; Boudouresque, 2004
	Surface abrasion	M	H	M	H	M	H	Superficial abrasion affects only the corbel's external living layer and leads to notable changes in the association, which can recover within 5 to 10 years, once the pressure is alleviated.	Peer-reviewed publications: Laborel, 1987 ; Laborel *et al.*, 1994 ; Boudouresque, 2004
	Light sub-surface abrasion	N	H	V	H	V	H	Shallow sub-surface abrasion would destroy the outer living layer and could touch the inner corbel and thereby destroy the entablature completely. **Resilience depends on the corbel's position relative to the water level**. If high (and therefore battered), recovery will be rapid (high resilience; moderate sensitivity). If low (and therefore calm), no resilience will be possible because the corbel will pass into the infralittoral zone (no resilience; high sensitivity).	Peer-reviewed publications: Laborel, 1987 ; Laborel *et al.*, 1994 ; Boudouresque, 2004
	Heavy sub-surface abrasion	N	H	N	H	VH	H	Deep sub-surface abrasion would totally destroy the association by affecting the outer living layer as well as the inner layers of the corbels, including the solid core. In this case, corbel recovery would take centuries, when the damage is not irreversible, as thalli only grow about 2-3 cm a year.	Peer-reviewed publications: Laborel, 1987 ; Laborel *et al.*, 1994 ; Boudouresque, 2004
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	
	Light deposition	N	H	N	H	VH	H	Extreme wave energy and exposure to natural wind usually allows for the deposit to be naturally eliminated if sedimentary material is added before it smothers or clogs the organisms. Otherwise, there is clogging and a change of habitat. The addition of rocky material would crush and totally destroy the characteristic species. Communities would therefore have to resettle on a new, bare substrate. When the damage is not irreversible, corbel recovery could take centuries. **N.B.** The addition of too much material could result in a change of zonation or substrate and therefore a habitat change.	Peer-reviewed publications: Laborel, 1987 ; Laborel *et al.*, 1994 ; Boudouresque, 2004
	Heavy deposition	N	H	N	H	VH	H		Peer-reviewed publications: Laborel, 1987 ; Laborel *et al.*, 1994 ; Boudouresque, 2004
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	N	H	N	H	VH	H	Formation of corbels requires extremely stable conditions during multiple centuries. A change in hydrodynamic conditions would lead to a destruction of the association that would take many decades or even centuries to rebuild.	Peer-reviewed publications: Laborel, 1987 ; Laborel *et al.*, 1994 ; Boudouresque, 2004
	Change in suspended solids	L	H	M	H	M	H	The submerged cavities of the association risk being filled by suspension particles. Nevertheless, for a pressure lasting less than a year, the natural hydrodynamic conditions should allow for recovery in less than ten years.	Peer-reviewed publications: Laborel, 1987 ; Laborel *et al.*, 1994 ; Boudouresque, 2004

II.4.3. Biocenosis of mediolittoral caves

II.4.3.a. Association with *Phymatolithon lenormandii* et *Hildenbrandia rubra*

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or in biological zone (depth band) will lead to a total loss of the characteristics of the habitat, which is defined by a rocky substrate in the mediolittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	L	H	L	Removal of the substratum, although highly improbable for this hard-to-access habitat, would destroy the biocenosis by eliminating the epigeal species. Available data do not allow us to know precisely how this biocenosis's resilience to this type of pressure. Given that the characteristic species are pioneer species and the habitat is exposed to agitated hydrodynamic conditions, the time needed to recolonize the bare substrate is estimated at 2 to 10 years.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	L	M	L	L	L	The characteristic species of this biocenosis are encrusting and therefore extremely resistant to compression. Nevertheless, if the integrity and functionality of the habitat are disrupted (e.g. by frequent pressure), resilience is estimated at about 5 years. **N.B.** Chronic pressure reduces the habitat's resistance and resilience.	Expert judgement
	Surface abrasion	H	L	M	L	L	L	The characteristic species of this biocenosis are encrusting and therefore very resistant to a superficial abrasion. Nevertheless, if the integrity and the functionality of the habitat are disturbed (e.g. by frequent pressure), resilience is estimated at about 5 years. **N.B.** Chronic pressure could reduce the habitat's resistance and resilience.	Expert judgement
	Light sub-surface abrasion	N	H	M	L	H	L	Penetration and abrasion of the substrate would destroy the biocenosis, which is dominated by species living on the surface of the substrate. The available data do not allow us to know the precise resilience of this habitat to this pressure. If the characteristic species of the biocenosis are pioneer species and the habitat is exposed to agitated hydrodynamic conditions, the time needed for the recolonization of the exposed substrate is estimated at 2 to 10 years.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Heavy sub-surface abrasion	N	H	M	L	H	L		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	
	Light deposition	L	L	M	L	M	L	The strong hydrodynamics and natural exposure to winds characteristic of the biocenosis in the mediolittoral zone allow for the rapid removal of a sedimentary deposit before it is able to smother or clog the epifauna. If bare rocky material is added, resistance is scored low. Available data do not allow us to know the precise time necessary for the establishment of characteristic species. Given that the species of this biocenosis are pioneer species and the habitat is exposed to hydrodynamic agitation, the time needed to colonize the substrate is estimated at 2 to 10 years. **N.B.** The addition of too much material could result in a change of zonation or substrate and therefore a habitat change.	Expert judgement
	Heavy deposition	L	L	M	L	M	L		Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	L	L	M	L	M	L	This biocenosis is defined by unique hydrodynamic conditions that differentiate it from other biocenoses on upper or lower levels. A short-term change in hydrodynamic conditions would lead to a major loss of the habitat's characteristics (low resistance). Available data do not allow us to know the precise Resilience for this biocenosis with regard to this type of pressure. Given that the characteristic species of this biocenosis are pioneer species and the habitat is exposed to agitated hydrodynamic conditions, the time needed for the recolonization of the bare substrate is estimated at 2 to 10 years. **N.B.** Prolonged pressure could lead to a change in zonation (supralittoral or infralittoral) and therefore in the type of habitat.	Expert judgement
	Change in suspended solids	NR		NR		NR		Permanently non-submerged habitat	

III.1.1. Euryhaline and eurythermal lagoon biocenosis

12 associations et 4 facies

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	V	H	V	H	V	H	A change in biological zone (depth band) would lead to a total loss of the characteristics of the habitat, which is defined by the infralittoral zone. By definition, this habitat could not recover at a different depth (no resistance, no resilience; very high sensitivity). However, this habitat is highly resistant and resilient to changes in substratum that replace one particular association or facies by another but that do not modify the biocenosis itself (very low sensitivity). **N.B.** A change in substrate can lead to a loss of one facies or association in favour of another.	Directly relevant grey literature: Bensetitti *et al.*, 2007 ; PNUE-PAM-CAR/ASP, 2007 Expert judgement
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	H	H	M	H	Extraction would destroy the habitat by removing the substratum and associated species, mainly epigeal or shallowly buried species (e.g. phanerogams, algae, bivalve molluscs). The time needed for sediment renewal and stabilization and for recolonization by species characteristic of the biocenosis (short life cycles), once the pressure is alleviated or reduced, is estimated at less than 2 years. It depends on whether there is a healthy biocenosis in the vicinity from which to repopulate. **N.B.** Resilience for some species, such as the Mytilidae, can be longer than for others.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.*, 2010 (habitat "Saline lagoons") Directly relevant grey literature: Bensetitti *et al.*, 2007 ; PNUE-PAM-CAR/ASP, 2007 Peer-reviewed publication: Chessa *et al.*, 2007
	Trampling	M	H	H	H	L	H	Vertical compression would lead to a notable degradation of the habitat by damaging the typical epigeal or shallowly buried species (e.g. phaneograms, algae, bivalve molluscs) without risking a change in habitat type. The time needed for the characteristic species of the biocenosis (short life cycles) to recolonize, once the pressure is alleviated or reduced, is estimated to be at least 2 years. **N.B.** Resilience for some species, such as the Mytilidae, can be longer than for others.	Directly relevant grey literature: Bensetitti *et al.*, 2007 ; PNUE-PAM-CAR/ASP, 2007 Expert judgement
	Surface abrasion	L	H	H	H	M	H	Surface abrasion would lead to severe degradation of the habitat by damaging characteristic species, mostly epigeal or shallow buried species (e.g. phanerogams, algae, bivalve molluscs) (low resistance). The time needed for characteristic species of this biocenosis (short life cycles) to recolonize, once the pressure is alleviated or reduced, is estimated at less than 2 years. **N.B.** Resilience for some species, such as the Mytilidae, can be longer than for others.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.*, 2010 (habitat "Saline lagoons") Directly relevant grey literature: Bensetitti *et al.*, 2007 ; PNUE-PAM-CAR/ASP, 2007 Peer-reviewed publication: Chessa *et al.*, 2007
	Light sub-surface abrasion	N	H	H	H	M	H	Sub-surface abrasion would destroy the biocenosis by destabilizing the substrate and its stratification, and a loss of characteristic species, mostly epigeal or shallowly buried (e.g. phanerogams, algae, bivalve molluscs). The time needed for the sediment to stabilize and for recolonization by the characteristic species of this biocenosis (species with short life cycles) once the pressure is alleviated or reduced, is estimated at less than 2 years. **N.B.** Certain species, like the Mytilidae, can have a longer resilience period than other species.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.*, 2010 (habitat "Saline lagoons") Directly relevant grey literature: Bensetitti *et al.*, 2007 ; PNUE-PAM-CAR/ASP, 2007 Peer-reviewed publication: Chessa *et al.*, 2007
	Heavy sub-surface abrasion	N	H	H	H	M	H		
	Reworking of the sediment	N	H	H	H	M	H	Reorganization of the substrate would lead to a destabilization of its stratification and a loss of typical epigeal species. The time needed for the sediment's stabilization and recolonization by characteristic species of this biocenosis (with short life cycles), once the pressure is alleviated or reduced, is estimated at less than 2 years.	Directly relevant grey literature: Bensetitti *et al.*, 2007 ; PNUE-PAM-CAR/ASP, 2007

								N.B. Resilience for some species, such as the Mytilidae, can be longer than for others	Peer-reviewed publication: Chessa *et al.,* 2007
	Light deposition	H	H	VH	H	VL	H	Most of the characteristic species here are highly resistant to light additions of sedimentary material, thanks to their mobility or their height above the substrate. **N.B.** The facies with *Ficopomatus enigmatic*us (III.1.1.m) would be completely destroyed due to the small size of the characteristic species (no resistance). The time needed for this species to recolonize is estimated at less than two years if there is a healthy facies is in the vicinity (high resilience; moderate sensitivity). A change in granulometry could favour one facies or the other or particular associations within this biocenosis. Due to the lagoon's naturally hydrodynamics, added material of a different nature than the original substrate won't be eliminated.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "Saline lagoons") Directly relevant grey literature: Bensetitti *et al.,* 2007 ; PNUE-PAM-CAR/ASP, 2007 Peer-reviewed publication: Chessa *et al.,* 2007
	Heavy deposition	L	H	H	H	M	H	The characteristic species have a low resistance to the heavy addition of sedimentary material. The time needed for recolonization of the substrate by these species (short life cycles), once the pressure is alleviated or reduced, is estimated at less than 2 years. **N.B.** The facies with *Ficopomatus enigmaticus* (III.1.1.m) would be completely destroyed due to the small size of the characteristic species (no resistance). The time needed for this species to recolonize is estimated at less than two years if there is a healthy facies in the vicinity (high resilience; moderate sensitivity). A change in granulometry could favour one facies or another or particular associations within this biocenosis. If material of a different nature than the original substrate is added, the deposit won't be eliminated, given the lagoon's naturally low wave energy.	Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "Saline lagoons") Directly relevant grey literature: Bensetitti *et al.,* 2007 ; PNUE-PAM-CAR/ASP, 2007 Peer-reviewed publication: Chessa *et al.,* 2007
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	N	H	H	H	M	H	Reduced hydrodynamics would lead to a lack of water renewal and to dystrophy. Drastically increased hydrodynamics would lead to a change of habitat in favour of a fully marine habitat (lack of provision in fresh water) or in favour of a fully freshwater habitat (lack of salt water). Resilience is estimated at less than 2 years (except in the case of habitat change for which resilience is over 25 years).	Directly relevant grey literature: Bensetitti *et al.,* 2007 ; PNUE-PAM-CAR/ASP, 2007
	Change in suspended solids	L	H	H	H	M	H	An increase in the sediment or in the load of organic matter would lead to a major degradation of the biocenosis by reducing the amount of light and killing typical photosynthetic species, and/or by clogging filter-feeders. Resilience is estimated at less than 2 years.	Expert judgement Grey literature, inference from studies on similar habitats and same pressure: Tillin *et al.,* 2010 (habitat "Saline lagoons") Peer-reviewed publication: Garrido *et al.,* 2013

III.2.1. Biocenosis of fine sands in very shallow waters

III.2.1.a Facies with *Lentidium mediterraneum*

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) will lead to a total loss of the characteristics of the habitat, which is defined by a fine sand substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	H	L	M	L	Removal of substrate would destroy the habitat by eliminating characteristic species (annelids, bivalves, crustaceans, etc.) living buried or on the bottom. Given that the habitat is exposed to extreme natural wave action, the time needed for renewal of bare substrate is estimated at 1 to 2 years. Resilience can be longer if the hydrodynamic and meteorological conditions don't provide enough sediment.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	M	H	VH	L	L	L	Compression can change the sediment compactness. As the characteristic species are very mobile and able to bury themselves in the substrate, resistance is therefore considered moderate. Resilience is estimated at less than a year due to the action of waves (especially during storms), which stir up the sediment. **N.B.** In the case of chronic or very intense subsidence pressure, e.g. from repeated trampling or motorized vehicles, the habitat's resistance and resilience will be altered.	Grey literature regarding the resistance: Bensetitti *et al.,* 2004
	Surface abrasion	H	L	VH	L	VL	L	The characteristic species of this biocenosis are buried and mobile and therefore not affected by superficial abrasion. Resistance is scored high and resilience very high due to the short life cycles of characteristic species, their mobility, and extreme wave energy that allows for the surface sediment to be renewed rapidly.	Expert judgement
	Light sub-surface abrasion	H	L	VH	L	VL	L	The characteristic species of this biocenosis are mobile and able to leave or to bury themselves deeper. Resistance is scored high and resilience very high due to the short life cycles of the species, their mobility, and the extreme natural wave energy that allows for the quick replenishment of surface sediment.	Expert judgement
	Heavy sub-surface abrasion	M	L	VH	L	L	L	Certain characteristic species of this biocenosis will be eliminated by deep abrasion. Resistance is therefore scored moderate. Resilience is scored very high due to the short life cycle of characteristic species, their mobility, and extreme natural wave energy that stirs the sediment.	Expert judgement
	Reworking of the sediment	H	H	VH	L	VL	L	This habitat is located in the beach's maximum wave energy zone and is therefore naturally exposed to extreme redistribution (particularly during storms), when organisms either bury themselves or leave.	Grey literature regarding the resistance: Bensetitti *et al.,* 2004
	Light deposition	H	L	VH	L	VL	L	On one hand, this habitat is characterized by its mobile species that can move up to the deposited layer of sediment and on the other hand by extreme wave energy that allows for the quick removal of exogenous material. Resistance is scored high and resilience very high. **N.B.** Careful attention must be paid to the level of the habitat on a local scale and the quantity of added material. If the habitat is shallow and/or if a large quantity of material is deposited, there is a risk of a change in zonation of the mediolittoral zone and therefore a change in the habitat type. If a large amount of material that is not of the same nature as the original substrate is added, there is a risk of habitat change since the substrate will be altered.	Expert judgement
	Heavy deposition	H	L	VH	L	VL	L		
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	M	H	H	L	L	L	This habitat features strong hydrodynamics. Its latitudinal extent is directly linked to the local hydrodynamics. Resistance is scored moderate for a short change in hydrodynamic conditions, which would affect certain species of this biocenosis. Resilience is estimated at between 1 and 2 years. **N.B.** A prolonged reduction in hydrodynamics would lead to a calm environment, which would effectively modify the biocenosis through silting.	Expert judgement
	Change in suspended solids	H	L	VH	L	VL	L	This habitat is naturally stirred and exposed to extreme fluctuations in turbidity. Resistance is therefore scored high and resilience is very high.	Expert judgement

III.2.2. Biocenosis of well-sorted fine sands

III.2.2.a. Association with *Cymodocea nodosa* on well-sorted fine sands (particular assessment of sensitivity)

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, which is defined by a fine sand substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	H	M	M	M	Removal of the substrate would severely degrade the habitat by eliminating characteristic species of this biocenosis (annelids, crustaceans, bivalves, echinoderms, etc.) that live on the substrate or shallowly buried. During periods of strong hydrodynamic activity, notably during storms, the depth of the substrate can change naturally by as much as several meters. Resilience is therefore scored high.	Grey literature regarding the resilience: Bensetitti *et al.*, 2004 Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	NR		NR		NR		The habitat's altitudinal position and hydrodynamic conditions don't expose it to activities that would cause compression (trampling, engines, fishing traps, etc.).	
	Surface abrasion	H	L	VH	L	VL	L	The characteristic species of this biocenosis are buried and therefore unaffected by superficial abrasion.	Expert judgement
	Light sub-surface abrasion	M	L	H	L	L	L	Sub-surface abrasion disturbs shallowly buried species, but not all the characteristic species, as some are buried deeper than 5 cm. Resilience is scored high because the characteristic species are mobile and therefore able to recolonize the affected substrate from unaffected zones.	Expert judgement
	Heavy sub-surface abrasion	N	H	H	M	M	M	Deep abrasion affects the integrity of the substrate as well as the characteristic species, including those buried deepest. During periods of strong hydrodynamic activity, notably during storms, the substrate can be reworked by as much as several meters in depth. Resilience is therefore scored high.	Grey literature regarding the resilience: Bensetitti *et al.*, 2004 Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Reworking of the sediment	N	H	H	M	M	M	As with heavy sub-surface abrasion, this pressure affects the integrity of the substrate as well as the characteristic species, including those buried deepest. During periods of strong hydrodynamic activity, notably during storms, the substrate can be reworked by as much as meters in depth. Resilience is therefore scored high.	Grey literature regarding the resilience: Bensetitti *et al.*, 2004 Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Light deposition	V	L	V	M	V	L	**In the case of the added sedimentary material:** The addition of less than 5 cm of well-sorted sand (or sedimentary substrate) would not lead to a notable change in the biocenosis since the characteristic species are mobile and able to move back to the surface of the deposited sediment. Resilience is high due to the natural hydrodynamic conditions that allow for the rapid elimination of such a deposit. (High resistance, high resilience; low sensitivity) **In the case of added rocky material:** a light addition would compress the substrate and compact the sediment, which would affect the mobile species buried within. The natural hydrodynamic condition should allow for removal of the deposit within 1 to 2 years (low resistance, high resilience; moderate sensitivity)	Grey literature regarding the resilience: Bensetitti *et al.*, 2004 Expert judgement
	Heavy deposition	H	L	H	M	L	L	The addition of a large amount of well-sorted sands (or sedimentary substrate) would not lead to a notable change in the biocenosis since the characteristic species are mobile and able to move back to the surface of the deposit.	Grey literature regarding the resilience: Bensetitti *et al.*,

							Resilience is high owing to the natural hydrodynamic conditions, which allow for the rapid elimination of such a deposit. If too much is added, there is a risk of habitat change. **N.B.** A large amount of added rocky material cannot be eliminated by wave energy and would lead to a change in habitat type.	2004 Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	M	M	H	M	L	M	This habitat is naturally exposed to fluctuations in wave energy, in particular due to seasonal cycles of storms. Resistance is scored moderate because certain characteristic species can be disturbed. A decrease in wave action can lead to silting, while an increase can impoverish the biocenosis (particularly by eliminating the superficial organic film that is used as a source of nourishment). Resilience is scored high. **N.B.** In the case of prolonged wave action, the risk of disturbance is associated with the disturbance of the natural erosion/sedimentation cycle. A prolonged change in wave energy can also modify the granulometry of the substrate and lead to a in a change of habitat.	Directly relevant grey literature: Bensetitti *et al.,* 2004 ; PNUE-PAM-CAR/ASP, 2007
	Change in suspended solids	H	L	VH	L	VL	L	This habitat is generally scored as resistant and resilient to an increase in particle load since the characteristic species are buried and the sediment is stirred regularly.	Expert judgement

III.2.2.a. Association with *Cymodocea nodosa* on well-sorted fine sands

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, which is defined by a fine sand substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	H	H	H	Extraction would destroy the association by removing the substrate along with the characteristic species. Resilience is estimated at 5 to 10 years, assuming that there are other healthy herbariums in the vicinity to provide propagules, pollen, or seeds, or that the existing rhizomes of the herbarium are not completely destroyed by extraction.	Peer-reviewed publication: Cancemi *et al.*, 2002
	Trampling	NR		NR		NR		The altitudinal position and hydrodynamics of this biocenosis don't expose it to activities that cause vertical compression (e.g. fishing traps)	
	Surface abrasion	N	H	M	H	H	H	Resistance is scored as none since the superficial abrasion would destroy the leaves as well as the rhizomes at the surface of the substrate (not anchored in the sediment) and the epifauna. If there other healthy individuals in the vicinity from which to regenerate the meadow, resilience for the upper part of the association is estimated at 2 to 5 years.	Peer-reviewed publication: Cancemi *et al.*, 2002
	Light sub-surface abrasion	N	M	M	M	H	M	Resistance is scored as none since sub-surface abrasion would destroy the association by eliminating *Cymodocea* leaves and rhizomes and associated species, whether they be epigeal or buried. Resilience is the same as for the extraction pressure (5 to 10 years) and depends on the presence of a healthy meadow nearby.	Peer-reviewed publication: Cancemi *et al.*, 2002
	Heavy sub-surface abrasion	N	M	M	M	H	M		Peer-reviewed publication: Cancemi *et al.*, 2002
	Reworking of the sediment	N	M	M	M	H	M	Like with heavy sub-surface abrasion, this pressure disturbs the integrity of the substrate as well as all the characteristic species, including those that are buried deepest.	Peer-reviewed publication: Cancemi *et al.*, 2002
	Light deposition	H	M	H	M	L	M	The addition of less than 5 cm of sedimentary material won't have a notable effect on the association. Resilience is scored high due to the natural hydrodynamic conditions, which allow for the removal of small deposits. **N.B.** The addition of rocky material would crush the leaves and associated epifauna and destroy the biocenosis, and would not necessarily be removed through hydrodynamics.	Peer-reviewed publication: Cancemi *et al.*, 2002
	Heavy deposition	N	M	M	M	H	M	A large amount of added sedimentary material would smother the characteristic species. Resilience is estimated at 5 to 10 years, assuming there are other healthy meadows nearby to provide propagules, pollen and seeds to regenerate the association. **N.B.** The addition of rocky material would lead to a change in habitat type.	Peer-reviewed publication: Cancemi *et al.*, 2002
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	M	M	M	M	L	M	This habitat is naturally exposed to hydrodynamic fluctuations, in particular due to seasonal cycles of storms. Resistance is therefore scored moderate, since the association is sensitive to desalination which can be caused by a change in hydrodynamics. Less water movement could lead to silting whereas an increase could alter the meadow. Resilience is scored high for a pressure of short duration. **N.B**. In case of a prolonged hydrodynamic change, the risk is linked to the disruption of the natural erosion/sedimentation cycle. A prolonged change could also lead to a change in the granulometry of the substrate and therefore to a in a change of habitat.	Peer-reviewed publication: Cancemi *et al.*, 2002
	Change in suspended solids	M	M	VH	M	L	M	Resistance is scored moderate since *C. nodosa* lives at different depths and is little affected by changes in turbidity. However, certain associated species can be affected by clogging of their respiratory or feeding organs. The association's vitality is diminished if the water is not very clear. Given that this species has deciduous leaves and is an annual plant, resilience is considered very high in cases where pressure lasts less than a year. **N.B.** In case of prolonged modification, there's a risk of altering photosynthesis and clogging the associated filter-feeders and suspension-feeders, and therefore of losing the association.	Peer-reviewed publication: Cancemi *et al.*, 2002

III.2.3. Biocenosis of superficial muddy sands in sheltered waters

III.2.3.a.	Association with *Cymodocea nodosa*, *Zostera noltei*, *Caulerpa prolifera* and *Caulerpa ollivieri*
III.2.3.b	Facies with *Pestarella tyrrhena* and *Bornia sebetia* (Syn. *Kellia corbuloides*)
III.2.3.c.	Facies with fresh water resurgences with *Cerastoderma glaucum* and *Cyathura carinata*
III.2.3.d.	Facies with *Loripes lucinalis and Tapes* spp.

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, which is defined by a muddy-sandy substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	H	M	M	M	Extraction would destroy the habitat by removing the substrate along with the characteristic species, mainly epigeal or shallowly buried species (e.g. phanerogams, algae, bivalve molluscs). Once the pressure is alleviated or reduced, the time needed to renew and stabilize sediment and for recolonization by the characteristic species of this biocenosis (short life cycles) is estimated at less than 2 years. It depends on the proximity of a healthy biocenosis that can contribute individuals. **N.B.** This habitat is shallow. Extraction could change the habitat type.	Grey literature relevant to the habitat: Bensetitti et al., 2007; PNUE-PAM-CAR/ASP, 2007 Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	M	M	H	M	L	M	Vertical compression would lead to a notable degradation of the habitat by damaging the typical epigeal or shallowly buried species (e.g. phaneograms, algae, bivalve molluscs) without risking a change of habitat. The time needed for the characteristic species of the biocenosis (short life cycles) to recolonize, once the pressure is alleviated or reduced, is estimated to be at least 2 years.	Grey literature relevant to the habitat: Bensetitti et al., 2007 ; PNUE-PAM-CAR/ASP, 2007
	Surface abrasion	L	M	H	M	M	M	Surface abrasion would lead to the severe degradation of the habitat by damaging characteristic species, mostly epigeal or shallowly buried (e.g. phanerogams, algae, bivalve molluscs) (low resistance). The time needed for these species (short life cycles) to recolonize, once the pressure is alleviated or reduced, is estimated at less than 2 years.	Grey literature relevant to the habitat: Bensetitti et al., 2007 ; PNUE-PAM-CAR/ASP, 2007
	Light sub-surface abrasion	N	M	M	M	M	M	Sub-surface abrasion would destroy the biocenosis by destabilizing the substrate and its stratification, and the loss of the characteristic species, mostly epigeal or shallowly buried (e.g. phanerogams, algae, bivalve molluscs). Once the pressure is alleviated or reduced, the time needed for sediment stabilization and recolonization by the characteristic species of this biocenosis (species with short life cycles) is estimated at less than 2 years.	Grey literature relevant to the habitat: Bensetitti et al., 2007 ; PNUE-PAM-CAR/ASP, 2007
	Heavy sub-surface abrasion	N	M	H	M	M	M		
	Reworking of the sediment	N	M	H	M	M	M	Rearrangement of the substrate would lead to a destabilization of its stratification and a loss of typical epigeal species. The time needed for the sediment's stabilization and recolonization by characteristic species of this biocenosis (with short life cycles), once the pressure is alleviated or reduced, is estimated at less than 2 years.	Grey literature relevant to the habitat: Bensetitti et al., 2007 ; PNUE-PAM-CAR/ASP, 2007
	Light deposition	H	M	H	M	L	M	Most of the characteristic species have a high resistance to a light addition of sedimentary material due to their mobility or their height above the substrate. This habitat is good at withstanding the addition of fine sand. **N.B.** The addition of material with a different granulometry can influence the presence of one facies or another and particular associations of the biocenosis. **N.B.** With the addition of material of a different nature than the original substrate, there is a risk of	Grey literature relevant to the habitat: Bensetitti et al., 2007 ; PNUE-PAM-CAR/ASP, 2007

								habitat change due to the naturally weak hydrodynamics, which doesn't allow for the removal of the deposited material.	
	Heavy deposition	L	M	H	M	M	M	The characteristic species have a low resistance to a large addition of sedimentary material. Once the pressure is alleviated or reduced, the time needed for recolonization of the substrate by the characteristic species of the biocenosis (short life cycles), is estimated at less than 2 years. **N.B.** The addition of material that has a different granulometry can influence the presence of one facies or another and particular associations of this biocenosis. **N.B**. If added material is of a different nature than the original substrate, there is a risk of habitat change due to the naturally weak hydrodynamics, which doesn't allow for the removal of the deposited material.	Grey literature relevant to the habitat: Bensetitti et al., 2007 ; PNUE-PAM-CAR/ASP, 2007
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	L	M	H	M	M	M	The habitat has a low resistance to changes in wave energy, which particularly influences the presence of one or the other facies and particular associations of this biocenosis. Resilience is estimated at less than 2 years. **N.B.** In the case of a prolonged change in wave energy, there is a risk of a change in habitat	Grey literature relevant to the habitat: Bensetitti et al., 2007 ; PNUE-PAM-CAR/ASP, 2007
	Change in suspended solids	L	M	N	M	M	M	An increased load of sediment or organic matter would lead to severe degradation of the biocenosis by decreasing the amount of light and killing off the typical photosynthetic species, and/or by clogging filter-feeders. Resilience is estimated at less than 2 years.	Grey literature relevant to the habitat: Bensetitti et al., 2007 ; PNUE-PAM-CAR/ASP, 2007

III.3.1. Biocenosis of coarse sands and fine gravels mixed by the waves

III.3.1.a. Association with rhodolithes on coarse sands and fine gravels mixed by the waves (*Lithophyllum dentatum*, *Lithophyllum racemus*, *Lithophyllum incrustans*)

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, which is defined by a coarse sand and gravel substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	M	H	M	This biocenosis does not exceed a few decimetres in depth, so the removal of substrate would destroy the habitat. The time needed for the renewal of sediment and recolonization by the characteristic species of the biocenosis is estimated at 2 to 5 years. It depends on the proximity of a healthy biocenosis that can provide individuals (larvae, juveniles or adults).	Grey literature relevant to the habitat: Bensetitti *et al.*, 2007; PNUE-PAM-CAR/ASP, 2007 Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	M	VH	M	VL	M	Coarse sand and gravel are not easily compacted. Resistance is therefore scored high. This habitat is located in zones where the naturally strong hydrodynamic activity allows for rapid recovery through the stirring of sediment.	Grey literature relevant to the habitat: Bensetitti *et al.*, 2007 ; PNUE-PAM-CAR/ASP, 2007
	Surface abrasion	H	M	VH	M	VL	M	This habitat is located in zones where the hydrodynamic activity is naturally strong. It therefore has high resistance and high resilience to superficial abrasion.	Grey literature relevant to the habitat: Bensetitti *et al.*, 2007 ; PNUE-PAM-CAR/ASP, 2007
	Light sub-surface abrasion	N-L	L	M	L	M-H	L	This biocenosis is characterized by infauna with low resistance to sub-surface disturbance. Resilience is estimated at 2-5 years due to the short lifespans of the characteristic species, i.e. ephemeral fauna (**moderate sensitivity**). **The case of rhodolith associations on SGBV (III.3.1.a.)**: Rhodoliths are a fragile species (no resistance) but with relatively short life cycles (**moderate resilience, high sensitivity**).	Expert judgement
	Heavy sub-surface abrasion	N-L	L	M	L	M-H	L		
	Reworking of the sediment	L	L	M	L	M	L	This habitat is located in zones where the wave energy is naturally very extreme and is therefore naturally mixed around on the surface. However, a deep reorganization would disturb the buried species and the structure of the substrate. As for the sub-surface abrasion, resistance is scored low and the resilience is moderate.	Expert judgement
	Light deposition	H	M	M	M	VL	M	This habitat is naturally stirred by it hydrodynamics, so an addition of material of the same nature as the original substrate will be rapidly removed. **N.B.** The addition of material of a different nature could lead to a change in habitat type. This habitat cannot withstand the least amount of silting. Fine sediment would clog the habitat's interstices and biocenosis and smother the organisms. If too much material is added, the communities will be crushed.	Grey literature relevant to the habitat: Bensetitti *et al.*, 2007 ; PNUE-PAM-CAR/ASP, 2007
	Heavy deposition	L	M	L	M	H	M	Resilience to a large amount of added material that would smother the present communities is low. If too much material is added, there will be a risk of a change in zonation and therefore of habitat, since this habitat is shallow. Resilience is considered to be low; nevertheless it depends on the ability of the local hydrodynamics to eliminate the deposit. **N.B.** The addition of material of a different nature than the original substrate will lead to a change of habitat, since this habitat cannot withstand the least amount of silting. If the added material is too heavy, the communities will be crushed.	Grey literature relevant to the habitat: Bensetitti *et al.*, 2007 ; PNUE-PAM-CAR/ASP, 2007
Hydrological changes	**Hydrodynamic changes**	L	L	VH	L	L	L	This habitat is naturally exposed to strong wave action and cannot withstand the least amount of silting. Resistance is therefore scored low with regard to changes of short duration because even a temporary reduction in	Expert judgement

(temporary and/or reversible change)								wave action would lead to an increase in fine particle sedimentation. Resilience is scored very high. **N.B.** A prolonged change could result in a change of habitat.	
	Change in suspended solids	L	L	M	L	M	L	This habitat is located in clear waters. An increase in particle load would reduce water clarity and could clog organisms. In the case of rhodolith associations, the photosynthetic process of photophilic species would be altered. Resistance is therefore scored low. For a pressure of short duration, resilience is estimated at 5 years.	Expert judgement

III.3.2. Biocenosis of sands and gravels under the influence of bottom currents (infralittoral position)

III.3.2.a. Maërl association on sands and gravels under the influence of bottom currents (*Lithothamnion coralloides* and *Phymatolithon calcareum*) (particular assessment of sensitivity)
III.3.2.b. Association with rhodolithes on sands and gravels under the influence of bottom currents (*Lithophyllum racemus* and *Lithothamnion* spp.)
III.3.2.c. Facies with *Ophelia neglecta*

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	A	H	A	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	A	H	A	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, which is defined by a coarse sand and gravel substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	A	H	L	L	H	L	Extraction would destroy the biocenosis by removing the substrate along with the associated species, mostly epigeal or shallowly buried (e.g. algae, molluscs, echinoderms, annelids). The time needed for the renewal of sand and gravel and for recolonization by the characteristic species of the biocenosis is estimated at over 10 years. It depends on the proximity of a healthy biocenosis that can supply individuals. **N.B.** The particular associations of this biocenosis have a longer resilience	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	M	VH	M	VL	M	Since coarse sand and gravel are not easily compacted, resistance is scored high. This habitat is located in zones with strong hydrodynamics that naturally stirs the sediment and allows for rapid recovery.	Grey literature relevant to the habitat: Bensetitti *et al.*, 2004 ; PNUE-PAM-CAR/ASP, 2007
	Surface abrasion	H	M	VH	M	VL	M	This habitat is located in zones with strong currents that naturally create continuous superficial abrasion. Resistance and resilience are scored respectively high and very high.	Grey literature relevant to the habitat: Bensetitti *et al.*, 2004 ; PNUE-PAM-CAR/ASP, 2007
	Light sub-surface abrasion	L	L	M	L	M	L	This biocenosis is characterized by epifauna and endofauna with low resistance to sub-surface disturbance. Resilience is estimated at 5 to 10 years due to short life cycles of the characteristic species and to the natural hydrodynamics, which allows for the provision of new individuals.	Expert judgement
	Heavy sub-surface abrasion	L	L	M	L	M	L		
	Reworking of the sediment	L	L	M	L	M	L	As for sub-surface abrasion, resistance is scored low and resilience high.	Expert judgement
	Light deposition	H	M	VH	M	VL	M	As this habitat is naturally stirred up through wave action, a light addition of sand and gravel will be quickly eliminated. **N.B.** The hydrodynamic characteristics of this habitat don't allow for the short-term elimination of deposits of materials of a different nature than the original substrate (muds and fine sands that would clog the interstices or rocky materials). This biocenosis cannot withstand the least silting. An addition of this kind would lead to a change in habitat type.	Grey literature relevant to the habitat: Bensetitti *et al.*, 2004 ; PNUE-PAM-CAR/ASP, 2007
	Heavy deposition	L	M	L	M	H	M	Resistance to the addition of a large amount of material that would smother the communities is considered low. Resilience is considered low, but nevertheless depends on local wave energy and its capacity for eliminating deposits. **N.B.** The hydrodynamic characteristics of this habitat don't allow for the elimination of deposits of materials of a different nature than the original substrate (muds, fine sands or rocky materials) in the short term. This biocenosis cannot withstand the least silting. An addition of this kind would lead to a change in habitat type.	Grey literature relevant to the habitat: Bensetitti *et al.*, 2004 ; PNUE-PAM-CAR/ASP, 2007
Hydrological changes (temporary	**Hydrodynamic changes**	L	M	M	M	M	M	This biocenosis requires the presence of strong currents. A reduction in wave energy would lead to reduced oxygen in the sediment and an increase in fine sediments, and this biocenosis cannot withstand the least silting. Resistance is therefore scored low. Resilience is scored moderate for a short-term pressure of this kind.	Grey literature relevant to the habitat: Bensetitti *et al.*, 2004 ; PNUE-PAM-CAR/ASP, 2007

and/or reversible change)								**N.B.** The position of this biocenosis is tied to very specific currents. A prolonged change in hydrodynamic conditions would lead to the loss of the biocenosis and a change of habitat.	
	Change in suspended solids	L	L	M	L	M	L	This habitat is located in clear waters. An increase in particle load would lead to a decrease in water clarity and could clog the organisms. In the case of the rhodolithes association, the photosynthetic process in photophilic species will be altered. Resistance is therefore scored low. Resilience is estimated at 5 years for a short-term pressure	Expert judgement

III.3.2.a. Maërl association on sands and gravels under the influence of bottom currents (*Lithothamnion coralloides* and *Phymatolithon calcareum*)

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, which is defined by a coarse sand and gravel substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	N	H	VH	H	Extraction would destroy the association by removing the substrate and associated species. Resilience is estimated at over 25 years (species with long life cycles) and depends on the proximity of a healthy association that can provide individuals.	Peer-reviewed publications: Barbera *et al.*, 2003 ; Bordehore *et al.*, 2000
	Trampling	N	M	N	M	VH	M	Compression would destroy the maërl thalli. Resistance is therefore scored as none. Resilience is estimated at over 25 years (species with long life cycles) and depends on the proximity of a healthy association that can supply individuals.	Peer-reviewed publications: Barbera *et al.*, 2003 ; Bordehore *et al.*, 2000
	Surface abrasion	N	H	N	H	VH	H	Maërl that forms branched epigeal structures will be totally eliminated by superficial abrasion of the substratum. Resilience is estimated at over 25 due to the life cycles of the characteristic species.	Peer-reviewed publications: Barbera *et al.*, 2003 ; Bordehore *et al.*, 2000
	Light sub-surface abrasion	N	H	N	H	VH	H	Maërl that forms branched epigeal structures will be totally eliminated by superficial abrasion of the substratum. The superficial layer of the association is the living, active part. Resilience for this association is estimated at over 25 years due to the slow growth of its characteristic calcareous algae species.	Peer-reviewed publications: Barbera *et al.*, 2003 ; Bordehore *et al.*, 2000
	Heavy sub-surface abrasion	N	H	N	H	VH	H		Peer-reviewed publications: Barbera *et al.*, 2003 ; Bordehore *et al.*, 2000
	Reworking of the sediment	N	H	N	H	VH	H	As for abrasion, reworking destroys the structure of the association. Resistance is scored as none. Resilience is estimated at over 25 years due to the slow growth rate of the characteristic species	Peer-reviewed publications: Barbera *et al.*, 2003 ; Bordehore *et al.*, 2000
	Light deposition	H	H	VH	H	VH	H	As the hydrodynamic conditions naturally stir up the habitat, a light deposit of sand or gravel will be rapidly eliminated. **N.B.** The hydrodynamic characteristics of this habitat don't allow for the short-term removal of deposits of materials of a different nature than the original substrate (mud, fine sand or rocky materials). Since this association cannot withstand the least silting, such an addition would lead to the loss of the association.	Peer-reviewed publications: Barbera *et al.*, 2003 ; Bordehore *et al.*, 2000 Grey literature relevant to the habitat: PNUE-PAM-CAR/ASP, 2007
	Heavy deposition	N	H	N	H	VH	H	Resistance is scored as none since too much added sand or gravel would bury the association. An addition of this kind would clog organisms or inhibit photosynthesis. Resilience is over 25 years. **N.B.** The hydrodynamic characteristics do not allow for the removal of a deposit that is of a different nature than the original substrate (mud, fine sand or rocky materials) in the short term. This association cannot withstand the least amount of silting. Such an addition would lead to the total loss of the association.	Peer-reviewed publications: Barbera *et al.*, 2003 ; Bordehore *et al.*, 2000 Grey literature relevant to the habitat: PNUE-PAM-CAR/ASP, 2007
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	L	H	M	H	H	H	The presence of maërl is determined by hydrodynamics. Even a short change in hydrodynamic conditions would lead to a major loss of characteristic species. A reduction in hydrodynamics would lead to reduced oxygen availability in the sediment and to an increase in fine sedimentation, whereas the characteristic calcareous algae cannot withstand the least silting. Resistance is therefore scored low. Resilience is over 25 years. **N.B.** A prolonged change in hydrodynamic conditions will lead to a change of habitat.	Peer-reviewed publications: Barbera *et al.*, 2003 ; Bordehore *et al.*, 2000 Grey literature relevant to the habitat: PNUE-PAM-CAR/ASP, 2007

	Change in suspended solids	L	H	N	H	H	H	The presence of photophilic algae requires clear waters. An increase in the particle load would decrease water clarity and could clog the organisms. The photosynthetic process in photophilic species would be altered. Resistance is scored low. Resilience is over 25 years. **N.B.** A prolonged modification would lead to the loss of the association.	Peer-reviewed publications: Barbera *et al.,* 2003 ; Bordehore *et al.,* 2000 Grey literature relevant to the habitat: PNUE-PAM-CAR/ASP, 2007

III.4.1. Biocenosis of infralittoral pebbles

III.4.1.a. Facies with *Gouania willdenowi*

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, which is defined by a pebbly substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	N	M	VH	M	Extraction would destroy this biocenosis by removing substrate along with the characteristic species, especially since this habitat is not very deep. The natural hydrodynamics would not supply the gravel needed to recreate a colonisable substrate and this small, sparse biocenosis would be unlikely to have a healthy habitat nearby to supply new larvae or adults. **N.B.** Particular attention must be paid to the extent of the habitat and the quantity of material extracted. If the habitat is not very large and/or the amount of extracted material is very large, there will be a habitat change.	Grey literature relevant to the habitat: Bensetitti *et al.*, 2007 Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	L	VH	L	VL	L	Gravel is very difficult to compact, therefore resistance is scored high. This habitat is located in zones with strong hydrodynamics, allowing for rapid recovery through the rolling of gravel.	Expert judgement
	Surface abrasion	H	L	VH	L	VL	L	This habitat is located in zones with naturally strong wave action that abrades and rolls the gravel. Resistance and resilience are scored respectively high and very high. The characteristic species are able to escape into the sediment for shelter. **N.B.** Abrasion can affect fish of the species *Gouania willdenowi*, which forms an unusual and rare facies, and which hides under the pebbles.	Expert judgement
	Light sub-surface abrasion	H	L	VH	L	VL	L		
	Heavy sub-surface abrasion	H	L	VH	L	VL	L		
	Reworking oL the sediment	H	L	VH	L	VL	L	As for abrasion, resistance and resilience are scored high owing to the constant rolling of the pebbles by waves.	Expert judgement
	Light deposition	H	L	M	L	VL	L	Natural stirring through wave action allows for exogenous gravel to mix with the natural substrate (high resistance, very high resilience). **N.B.** However, should a large amount of material of a different nature (sand, mud, or rocks) be added, there would be filling of the interstices between gravel or crushing that would block the gravel's movement without eliminating the deposit, with a resulting change of habitat.	Expert judgement
	Heavy deposition	H	L	VH	L	VL	L		
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	H	M	VH	M	VL	M	This biocenosis is naturally exposed to strong hydrodynamics and shows high resistance to temporary increases (with mobile species capable of protecting themselves) as well as high resistance to temporary decreases (with a film of diatoms forming on pebbles that is used for food by many organisms). **N.B.** This biocenosis is conditioned by the strength of the local hydrodynamics. A prolonged change in hydrodynamic conditions would result in the loss of the biocenosis.	Grey literature relevant to the habitat: Bensetitti *et al.*, 2007
	Change in suspended solids	H	L	VH	L	VL	L	This biocenosis is located in zones with strong currents and is not particularly sensitive to temporary increases in turbidity.	Expert judgement

III.5.1. Biocenosis of the *Posidonia oceanica* meadow

III.5.1.a. Barrier reef, striped meadow, atoll
III.5.1.b. Association of dead matte of *Posidonia oceanica*
III.5.1.c. Association of dead matte of *Posidonia oceanica* with *Caulerpa prolifera*, *Cymodocea nodosa*, *Penicillus capitatus*

Relationship with other classifications

WARNING: The resistance of *Posidonia oceanica* meadows to all types of pressure is strongly influenced by its state of conservation (Tudela, 2004).

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of this habitat. By definition, this habitat cannot recover on a different substratum or at a different depth.	Peer-reviewed publications: Boudouresque *et al.,* 1994 ; Meinesz and Lefevre, 1976, 1978 ; Meinesz *et al.,* 1981,
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	N	H	VH	H	Removal of the substrate would lead to the destruction of the habitat from by pulling out Posidonia leaves and rhizomes and associated species. As the leaves and rhizomes grow particularly slowly (at most a few centimetres per year), resilience is over 25 years once the pressure has ceased.	Peer-reviewed publications: Badalamenti *et al.*, 2006 ; Boudouresque and Jeudy de Grissac, 1983
	Trampling	M	H	V	H	V	H	Posidonia leaves are flexible and therefore resistant to temporary vertical compression. Some associated species, such as *Pinna nobilis,* would on the contrary be crushed. **Resilience depends on the intensity of the compression,** notably in the case of anchoring, the type of anchor and the anchoring technique used (Milazzo *et al.,* 2004b). In the case of low intensity (e.g. placement of a fish trap or small anchor), resilience would be very high (low sensitivity). Should the compression be intense (anchoring of a yacht or cruise ship) or repeated, the habitat may take decades to recover (no resilience, high sensitivity) once the pressure has ceased.	Peer-reviewed publications: Boudouresque and Jeudy de Grissac, 1983 ; Milazzo *et al.,* 2004a and b
	Surface abrasion	M	H	H	H	L	H	Superficial abrasion strips Posidonia leaves (and the sessile species upon them) without penetrating the matte. The matte and associated infauna remain intact. As such, certain associations are affected by superficial abrasion, but the biocenosis is still recognizable (passage from III.5.1.a to III.5.1.b or c).	Peer-reviewed publications: Bensetitti *et al.,* 2004 ; Boudouresque and Jeudy de Grissac, 1983 Expert judgement
	Light sub-surface abrasion	N	H	M	H	VH	H	Sub-surface abrasion strips off the leaves and rhizomes and eliminates their associated species, affecting each association of the biocenosis. The three-dimensional structure is functional and therefore the biocenosis is lost along with its characteristic species (no resistance). Resilience for the seagrass is over 25 years once the pressure ceases.	Peer-reviewed publications: Bensetitti *et al.,* 2004 ; Badalamenti *et al.,* 2006 ; Boudouresque and Jeudy de Grissac, 1983 ; González-Correa *et al.,* 2005 (and references therein) ; Tudela, 2004
	Heavy sub-surface abrasion	N	H	N	H	VH	H		
	Reworking of the sediment	N	L	L	H	H	L	Backfilling on this habitat is prohibited. Nevertheless, in a theoretical context, the meadow has no resistance to reworking and low resilience (10-25 years) for backfilling over a very limited surface that would allow healthy meadow to recolonize the disturbed area.	Expert judgement
	Light deposition	H	H	H	H	L	H	This habitat regularly receives natural deposits of sediment which it needs to consolidate the matte. Resistance and resilience to the light addition of sand is therefore considered high. **N.B.** In the case of added mud or rocks, there would be a change of habitat due to the modified substrate, since these meadows cannot withstand the least silting and would be crushed by a heavy amount of material.	Peer-reviewed publications: Boudouresque *et al.,* 1984, 1994 ; Boudouresque and Jeudy de Grissac, 1983 ; Tudela, 2004
	Heavy deposition	N	H	N	H	VH	H	A large amount of added sand (more than 70 $dm^3.m\text{-}2.an^{-1}$) would smother the Posidonia and associated species should the deposited material not be immediately removed by hydrodynamics. Resilience is over 25 years. **N.B.** If too much mud, gravel, or rock is added, the change of substrate will lead to a change of habitat, since the seagrass meadow cannot withstand the slightest amount of silting and would be crushed by a heavy amount of material.	Peer-reviewed publications: Boudouresque *et al.,* 1984, 1994 ; Boudouresque and Jeudy de Grissac, 1984

Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	M	H	L	H	M	H	Although this habitat is naturally exposed to extreme fluctuations in hydrodynamics, a prolonged change lasting several months would disturb the erosion/accretion cycle of the seagrass by changing the amount of sedimentation. If the pressure lasts for less than a year, resilience is estimated at 10 years. **N.B.** A prolonged change could lead to a change in zonation and therefore a change of habitat.	Peer-reviewed publications: Boudouresque *et al.,* 1984, 1994 ; Boudouresque and Jeudy de Grissac, 1984
	Change in suspended solids	V	H	N	H	V	H	Resistance to this pressure is scored low for the lower end of the seagrass meadow where the light is naturally limited. Outside the lower end of the meadow, resistance is scored high as long as the pressure is temporary. If the seagrass is damaged, resilience is non-existent, given the time it takes to grow. **N.B.** A prolonged change leads to a complete loss of Posidonia leaves and a change of habitat.	Peer-reviewed publications: Bensetitti *et al.,* 2004 ; Boudouresque *et al.,* 1984 ; Boudouresque and Jeudy de Grissac, 1985 ; Tudela, 2004

III.6.1. Biocenosis of infralittoral algae

22 associations and 4 facies (particular assessment of sensitivity)

Relationship with other classifications

Associations and facies that are particular to this biocenosis have been distributed into three groups (A, B, C) depending on their similarity of response to pressures (see next tabs)

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, which is defined by a rocky substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M (N)	L	H (VH)	L	Cf description of association and particular facies groups	
	Trampling	H (M)	L	VH (N)	L	L (VH)	L	Cf description of association and particular facies groups	
	Surface abrasion	N	H	M (N)	L	H (VH)	L	Cf description of association and particular facies groups	
	Light sub-surface abrasion	N	H	M (N)	L	H (VH)	L	Cf description of association and particular facies groups	
	Heavy sub-surface abrasion	N	H	M (N)	L	H (VH)	L	Cf description of association and particular facies groups	
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	
	Light deposition	M (N)	L	M (N)	L	M (VH)	L	Cf description of association and particular facies groups	
	Heavy deposition	N	L	M (N)	L	H (VH)	L	Cf description of association and particular facies groups	
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	N-H	L	N-VH	L	L-VH	L	Cf description of association and particular facies groups	
	Change in suspended solids	NN M	L	NN H (N)	L	L-H	L	This habitat is sensitive to the amount of suspended matter for two reasons: turbid waters reduce the possibility of photosynthesis and therefore alter the algal population, and sedimentation fills the interstices between algae and eliminates small cryptic fauna. Resistance and resilience differ depending on the associations and facies in the infralittoral algae biocenosis.	

III.6.1. Group A

Biocenosis of infralittoral algae

The constituent and characteristic species of the associations and facies in this group are long-lived and are intrisically resistant to temporary pressures of moderate intensity

III.6.1.a.	Association with *Cystoseira amentacea* var. *stricta* / *Cystoseira mediterranea*
III.6.1.b.	Association with *Cystoseira crinita*, *C. foeniculacea* (Syn. *C. discors*) and *C. compressa* / *C. crinitophylla*
III.6.1.c	Association with *Cystoseira brachycarpa*, *C. funkii* et *C. spinosa* var. *tenuior* / *C. squarrosa*
III.6.1.d.	Association with *Cystoseira sauvageauana* and *C. barbata*
III.6.1.e.	Association with *Cystoseira spinosa* and *C. usneoides*
III.6.1.f.	Association with *Sargassum* spp.
III.6.1.j.	Association with *Halopithys incurva* and *Digenea simplex*
III.6.1.y.	Facies with *Cladocora caespitosa*

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	As with heavy sub-surface abrasion, this pressure affects the integrity of the substrate as well as the characteristic species, including those buried deepest. During periods of strong hydrodynamic activity, notably during storms, the substrate can be reworked by as much as meters in depth. Resilience is therefore scored high.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	M	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, defined by a rocky substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	N	M	VH	M	Extraction would destroy the associations and facies of this group by eliminating the constituent epigeal species and their associated species (no resistance). Given that the species have very long life cycles, the time needed to recolonize the exposed substratum by pioneer species and for the association/facies to resettle is estimated at over 25 years. **N.B.** The removal of too much substrate could result in a change in zonation and therefore a change of habitat.	Peer-reviewed publications: Thibaut *et al.,* 2005 (and references therein) ; Perkol-Finkel and Airoldi, 2010 Expert judgement
	Trampling	M	M	V	M	V	M	Most species characteristic of this group are flexible or resistant to temporary vertical compression. However, some characteristic species will be crushed. **Resilience depends on the intensity of compression,** notably in the case of anchoring, the type of anchor and the anchoring technique. If the intensity is low (e.g. depositing a crate or small anchor), resilience will be very high. If the compression is very high intense (e.g. anchoring a yacht or an ocean liner), or repeated (e.g. constant trampling), the habitat will take decades to recover (no resilience) once the pressure ceases.	Peer-reviewed publications: Milazzo *et al.,* 2002, 2004a Expert judgement
	Surface abrasion	N	H	N	M	VH	M	The species that make up the associations and facies of this group are sessile and therefore would be totally eliminated by abrasion. Given that these species have long life cycles, recolonization of the substrate will take more than 25 years. **Resilience is strongly influenced by the spatial scale of the pressure: if the pressure is localized compared with the extent of a habitat, resilience can be scored high.**	Peer-reviewed publication: Perkol-Finkel and Airoldi, 2010 Expert judgement
	Light sub-surface abrasion	N	H	N	M	VH	M		
	Heavy sub-surface abrasion	N	H	N	M	VH	M		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	
	Light deposition	V	L	V	L	V	L	**Case of added sedimentary material:** The long-lived sessile species in this group are resistant to a light addition of sedimentary material, which corresponds to certain natural events. Some species that populate the micro-cavities will nevertheless be smothered if too much sediment is added. Resilience is considered to be moderate. It can be rapid if the hydrodynamic conditions allow for rapid removal of the deposit **(moderate resistance, moderate resilience; moderate sensitivity).** **The case of added rocky material:** Resistance to added rocky material is non-existent because the epigeal species are crushed. Given that the species have long cycles, the time needed to recolonize the new substrate by pioneer species and then by characteristic species is estimated at over 25 years **(no resistance, no resilience; very high sensitivity)**	Expert judgement

	Heavy deposition	N	L	N	L	VH	L	Epigeal species will be completely destroyed by crushing, smothering or clogging if too much exogenous material is added, whether it be sedimentary or rocky. With the addition of rocky material, given that the species are for the most part long-lived, the time needed to recolonize the new substrate by pioneer species and then by characteristic species is estimated at over 25 years. **N.B.** If too much rocky material is added, there is a risk of change in zonation and therefore a change of habitat. If too much sedimentary material is added, the deposit will not be eliminated through wave action, and there will be a change in substrate and therefore in habitat.	Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	N	L	N	L	VH	L	The associations and facies of this group are dependent on a stable hydrodynamic regime that determines the exposure pathway of these communities (battered or stable) and therefore their distribution on the infralittoral zone. A change in these conditions leads to a complete loss of features in each of the facies/associations, with resilience at over 25 years given that the characteristic species are long-lived.	Expert judgement
	Change in suspended solids	NR or M	L	NR or N*	L	H*	L	Resistance and resilience differ depending on the associations and the facies of the infralittoral algae biocenosis. All the vegetal populations on the bottom part of the infralittoral zone (limited exposure to light) are sensitive to increased turbidity. The increase in particle load affects the survival of photophilic species and of species with filtering organs that become clogged. This pressure is inapplicable to species that live on the surface. **III.6.1.a: Not relevant** **III.6.1.b: Not relevant** **III.6.1.c: Moderate Resistance, No Resilience - High Sensitivity** **III.6.1.d: Not relevant** **III.6.1.e: Moderate Resistance, No Resilience - High Sensitivity** **III.6.1.f: Moderate Resistance, No Resilience - High Sensitivity** **III.6.1.j: Moderate Resistance, Low Resilience - Moderate Sensitivity** **III.6.1.y: Moderate Resistance, Very High Resilience - Low Sensitivity**	Peer-reviewed publication: Sant, 2003

III.6.1. Group B

Biocenosis of infralittoral algae

Overgrazed facies

III.6.1.x Overgrazed facies with encrusting algae and sea urchins

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, defined by a rocky substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	L	H	L	Extraction of the substratum would destroy this facies by removing characteristic epigeal species (sea urchins and encrusting algae). With ongoing recruitment of sea urchins, it would take about 5 years for individuals to reach maturity, which would allow for the regeneration of an overgrazing facies. **N.B.** The removal of too much substrate could result in a change in zonation and therefore of habitat.	Expert judgement Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	L	VH	L	VL	L	Sea urchins are highly resistant to compression from traps and rarely subjected to trampling. Encrusting algae are also highly resistant to compression. Owing to the rate of urchin recruitment and the mobility of adults, resilience to this pressure is scored very high.	Expert judgement
	Surface abrasion	N	H	M	L	H	L	The sea urchins and encrusting algae characteristic of this facies live on the surface of the sea floor and would be totally eliminated in the case of abrasion. If the predator population doesn't change, recruitment of new individuals would take 5 years. **N.B.** In the case of the lasting elimination of the sea urchin population, there is a risk the facies is replaced by an algal association (Hereu, 2004).	Expert judgement Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Light sub-surface abrasion	N	H	M	L	H	L		
	Heavy sub-surface abrasion	N	H	M	L	H	L		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern rocky substrate.	
	Light deposition	M	L	M	L	M	L	A light addition of exogenous material would cover the substrate and the encrusting algae. Sea urchins, on the other hand, are mobile and can move out of the way. They also possess a rigid exterior that enables them to resist the weight of a light deposition. Resistance is therefore scored moderate. Resilience is estimated at roughly 5 years but depends on whether hydronynamic conditions allow for the removal of the deposit. If the deposit persists, there is a risk of habitat change.	Expert judgement
	Heavy deposition	N	L	M	L	H	L	The sea urchins and encrusting algae characteristic of this facies would be smothered by a heavy addition of sedimentary material or crushed by the addition of rocky material. If the predator population doesn't change, the time needed to recruit new individuals is estimated at roughly 5 years. **N.B.** The addition of too much rocky material could lead to a change in zonation and therefore of habitat. In the case of added sedimentary material, the deposit could not be eliminated through wave action, leading to a change of substrate and of habitat.	Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	H	L	VH	L	VL	L	Sea urchins are not affected by hydrodynamic changes. **N.B.** A prolonged change could lead to a change in zonation and therefore to another type of habitat.	Expert judgement
	Change in suspended solids	M	L	VH	L	L	L	Sea urchins are not affected by changes in water clarity but can be affected by particle deposits and the change in the development of the algae on which they feed. **N.B.** A prolonged changed could lead to a change in habitat type.	Expert judgement

III.6.1. Group C

Biocenosis of infralittoral algae

Species with rapid development

III.6.1.g.	Association with *Corallina elongata and Herposiphonia secunda*
III.6.1.h.	Association with *Gelidium spinosum*
III.6.1.i.	Association with *Colpomenia sinuosa / Hydroclathrus clathratus*
III.6.1.k.	Association with *Padina pavonica, Dictyotales, Stypocaulon scoparium and Laurencia* spp. */ Anadyomene stellata*
III.6.1.l.	Association with *Codium* spp.
III.6.1.m.	Association with *Alsidium helminthochorton*
III.6.1.n.	Association with *Cladostephus spongiosus* (Syn. *C. hirsutus) and Dasycladus vermicularis*
III.6.1.o.	Association with *Acetabularia acetabulum*
III.6.1.p.	Association with *Ulva* spp.
III.6.1.q.	Association with *Pterocladiella capillacea and Schottera nicaeensis / Botryocladia botryoides*
III.6.1.r.	Association with *Lomentaria articulata* and *Plocamium cartilagineum*
III.6.1.s.	Association with *Pterothamnion crispum* and *Compsothamnion thuyoides*
III.6.1.t.	Association with *Lobophora variegata*
III.6.1.u.	Association with *Dictyopteris polypodioides* (Syn. D. membranacea), *Zonaria tournefortii*
III.6.1.v.	Association with *Rhodymenia ardissonei* and *Rhodophyllis divaricata*
III.6.1.w.	Facies with *Mytilus galloprovincialis*
III.6.1.z.	Facies with large Hydrozoans

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, defined by a rocky substrate in the infralittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	L	H	L	Extraction would destroy the associations/facies of this group by removing the typical epigeal species. Given that the species have short life cycles and a strong capacity to recruit and disperse, the time needed to recolonize the exposed substratum by pioneer species and then by the characteristic species is estimated at 2 to 5 years if mature individuals are nearby. **N.B.** The removal of too much substrate could result in a change in zonation and therefore of habitat.	Expert judgement Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	L	H	L	L	L	Most characteristic species of the associations/facies of this group are flexible and therefore very resistant to compression. Nevertheless, some organisms like mussels, corallines and sea lettuces will be crushed. Resistance is therefore scored moderate. Resilience is scored high if the pressure is exerted on only a small portion of the habitat.	Expert judgement
	Surface abrasion	N	H	M	L	H	L	Characteristic sessile species will be totally lost if the habitat is exposed to abrasion. Given that these species have short life cycles and a strong capacity to recruit and disperse, the time needed for recolonization of exposed substratum by pioneer species and then by characteristic species is estimated at 2 to 5 years, assuming there are mature individuals in the vicinity. **Resilience is strongly influenced by a spatial pressure scale (if the pressure is localized relative to the extent of the habitat, resilience is scored high).**	Expert judgement Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Light sub-surface abrasion	N	H	M	L	H	L		
	Heavy sub-surface abrasion	N	H	M	L	H	L		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	

	Light deposition	L	L	M	L	M	L	Resistance is scored low, no matter what kind of material is added. Filtering, grazing, or slightly erect organisms will be affected by a sedimentary material deposit. Epigeal species will be crushed by the addition of rocky material. Resilience is scored moderate. Recovery can be faster if local conditions allow for the quick elimination of a sedimentary deposit. If rocky material is added, given that these species have a strong capacity to recruit, the time needed for the recolonization of the bare substrate is estimated at between 2 to 5 years, if mature individuals are nearby.	Expert judgement
	Heavy deposition	N	L	M	L	H	L	If too much rocky material is added, the characteristic epigeal species are totally destroyed by crushing. Given that these species have short lifespans and a strong ability to recruit, the time needed to recolonize the bare substrate is estimated at 2 to 5 years, assuming there are mature individuals are nearby. **N.B.** Unless the local wave action or the slope of the substrate allows for the rapid removal of sedimentary deposits, there will be a change in the type of facies/associations, or even a change in the type of biocenosis.	Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	M	L	H	L	L	L	Resistance varies depending on the facies or association considered (depending on the local hydrodynamics). It's generally scored moderate for a short change in hydrodynamic conditions because only certain species are affected. Resilience is estimated at less than 2 years for a pressure of short duration. **N.B.** A prolonged modification will lead to a change in facies or association or even a change of habitat.	Expert judgement
	Change in suspended solids	NR or M	L	NR or H	L	NR or L		Resistance and resilience vary depending on the associations and facies of the biocenosis of the algae on the infralittoral zone. This pressure is not applicable to species that live at the surface. The increase in particle load affects the survival of photophilic species and the species with filtering organs, which become clogged. Communities with species that need more or less light are scored moderately resistant (risk of clogging) and highly resilient to a <u>pressure of short duration.</u> **N.B.** If the increase in the particle load is too high, there is a risk of clogging the organisms (and therefore destroying the biocenosis by eliminating the characteristic species), in particular for **facies III.6.1.w and III.6.1.z. (no resistance, moderate resilience; high sensitivity).** **III.6.1.g: Moderate resistance, High resilience - Low sensitivity** **III.6.1.h: Not relevant** **III.6.1.i: Not relevant** **III.6.1.k: Not relevant** **III.6.1.l: Moderate resistance, High resilience - Low sensitivity** **III.6.1.m: Not relevant** **III.6.1.n: Not relevant** **III.6.1.o: Not relevant** **III.6.1.p: Not relevant** **III.6.1.q: Not relevant** **III.6.1.r: Not relevant** **III.6.1.s: Not relevant** **III.6.1.t: Not relevant** **III.6.1.u: Moderate resistance, High resilience - Low sensitivity** **III.6.1.v: Moderate resistance, High resilience - Low sensitivity** **III.6.1.w: Moderate resistance, High resilience - Low sensitivity** **III.6.1.z: Moderate resistance, High resilience - Low sensitivity**	Expert judgement

IV.1.1. Biocenosis of coastal terrigenous muds

IV.1.1.a. Facies of soft muds with *Turritella communis*
IV.1.1.b. Facies of sticky muds with *Virgularia mirabilis* and *Pennatula phosphorea*
IV.1.1.c. Facies of sticky muds with *Alcyonium palmatum with Parastichopus regalis* (Syn. *Stichopus regalis*)

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	NR		NR		NR		Deep habitat is not concerned by this pressure	
Physical loss (permanent change)	**Habitat change** (to another type)	N	H	N	H	VH	H	A change of substrate would lead to the total loss of the characteristics of the habitat, which is defined by a muddy substrate. By definition, this habitat could not recover on a different substrate.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	L	H	L	Extraction would destroy the biocenosis through the removal of the substrate and of the characteristic species, mostly epigeal or shallowly buried. Once the pressure has been alleviated or reduced, the time needed for the renewal of the mud, its stabilization, and recolonization by the species characteristic of the biocenosis, is estimated at 2 to 5 years. It depends on the proximity of a healthy biocenosis that can contribute individuals.	Expert judgement Resistance's confidence index is High as this pressure affects the habitat in-depth.
Physical disturbance or damage (temporary and/or reversible change)	**Trampling**	M	L	H	L	L	L	Vertical compression of the substrate would destroy the characteristic epigeal species but not the buried species. As these species have short life cycles, resilience is estimated at 1 to 2 years. **N.B.** The mud's degree of compaction influences which of the particular facies of this biocenosis is present.	Expert judgement
Physical disturbance or damage (temporary and/or reversible change)	**Surface abrasion**	M	L	H	L	L	L	Surface abrasion would destroy the characteristic epigeal species but not the buried species. As these species have short life cycles organisms, resilience is estimated at 1 to 2 years.	Expert judgement
Physical disturbance or damage (temporary and/or reversible change)	**Light sub-surface abrasion**	L	L	H	L	M	L	Light abrasion destroys not only the epigeal species but also the shallowly buried organisms (such as certain echinoderms) and disrupts the integrity of the substrate, notably the stabilised surface layer. Resilience is estimated at 1 to 2 years due to short life cycles of the characteristic species. **The case of facies with Alcyonium palmatum (IV.1.1.c) and with Virgularia mirabilis (IV.1.1.b)**: these slow-growing species require a compacted mud substrate to grow. Resilience for these two facies is therefore estimated at 2 to 10 years (moderate resilience; moderate sensitivity).	Expert judgement
Physical disturbance or damage (temporary and/or reversible change)	**Heavy sub-surface abrasion**	L	L	M	L	M	L	Deep abrasion destroys both the epigeal and buried species and affects the integrity of the substrate, notably the stabilised surface layer. Resilience is estimated at 2 to 5 years to take into account stabilization of the sediment and colonization by the characteristic species.	Expert judgement
Physical disturbance or damage (temporary and/or reversible change)	**Reworking of the sediment**	L	L	M	L	M	L	Reworking disturbs the surface layer of stabilised muds on which the development of the epigeal species depends. Resilience is estimated at 2 to 5 years, which takes into account sediment stabilization and colonization by characteristic species.	Expert judgement
Physical disturbance or damage (temporary and/or reversible change)	**Light deposition**	H	L	VH	L	VL	L	This biocenosis is characterised by a high rate of natural sedimentation. It is therefore only slightly sensitive to light additions of muds. **N.B.** This habitat's hydrodynamic characteristics don't allow for the elimination of added sand, gravel or rocky material in the short term. The addition of a substrate of a different type than the original would therefore result in a change of habitat.	Expert judgement
Physical disturbance or damage (temporary and/or reversible change)	**Heavy deposition**	L	L	M	L	M	L	A heavy addition of mud would result in the clogging of erect species. Resilience is estimated at 2 to 5 years due to the substrate's capacity for recolonization by larvae of sessile species from healthy habitats in the vicinity, and by mobile buried species. **N.B.** This habitat's hydrodynamic characteristics don't allow for the elimination of added sand, gravel or rocky material in the short term. The addition of a substrate of a different type than the original would therefore result in a change of habitat.	Expert judgement

Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	L	L	M	L	M	L	An increase in hydrodynamic activity would disturb the compacted mud layer. The time required for mud renewal and stabilization of the sediment is estimated at 2 to 5 years. A reduction in hydrodynamics would affect the transport of larvae and the process of sedimentation of fine particles and therefore influence which of the particular facies of this biocenosis is present. **N.B.** Prolonged modification would result in a change of habitat	Expert judgement
	Change in suspended solids	H	L	VH	L	VL	L	This biocenosis is located in naturally turbid waters and is therefore not impacted by a temporary increase in turbidity. **N.B.** An increase in particle load could reflect a reduction in sedimentation that could impact the biocenosis in the long term.	Expert judgement

IV.2.1. Biocenosis of muddy detritic bottoms

IV.2.1.a Facies with *Ophiothrix quinquemaculata*

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	NR		NR		NR		Deep habitat is not concerned by this pressure	
	Habitat change (to another type)	N	H	N	H	VH	H	A change of substrate would lead to the total loss of the characteristics of the habitat, which is defined by a muddy detritic substrate. By definition, this habitat could not recover on a different substrate.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	L	H	L	Extraction of the substrate would destroy the biocenosis by removing it along with the characteristic epigeal and shallowly buried species, and by destabilising the substrate's structure (no resistance). Facies with *O. quinquemaculata* also score no resistance, as this species grows on hardened muds. Once the pressure has been alleviated or reduced, the time needed for mud renewal and stabilization and for recolonization by the species characteristic of the biocenosis is estimated at 5 to 10 years. It depends on the local rate of siltation and on the proximity of a healthy biocenosis that can contribute individuals.	Expert judgement Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	L	L	M	L	M	L	Species that are preferentially restricted to detritic substrates have low resistance to sediment compaction. Species that are preferentially restricted to muddy substrates show greater resistance. Resistance for this biocenosis is scored low. Resilience for this biocenosis is 5 to 10 years due to naturally weak hydrodynamics.	Expert judgement
	Surface abrasion	M	L	M	L	M	L	Surface abrasion affects the erect species but not those that live buried. Resistance is therefore scored moderate. Resilience is estimated at 5 to 10 years due to the life cycles of the characteristic species and to the hydrodynamics of the habitat. **N.B.** The facies with *O. quinquemaculata,* characterised by organisms living on the surface of the substrate, will be destroyed by abrasion **(no resistance, moderate resilience; high sensitivity).**	Expert judgement
	Light sub-surface abrasion	L	L	M	L	M	L	Light sub-surface abrasion would cause notable changes to the biocenosis through the elimination of the shallowly buried characteristic species and destabilization of the surface structure of the substrate (e.g. hardened muds). Once the pressure has been alleviated or reduced, the time needed for the stabilization of the substrate and for recolonization by the species characteristic of the biocenosis is estimated at 5 to 10 years. It depends on the local rate of siltation and the proximity of a healthy biocenosis that can contribute individuals. **N.B.** The facies with *O. quinquemaculata,* characterised by organisms living on the surface of the substrate, will be destroyed by abrasion (no resistance, moderate resilience; high sensitivity).	Expert judgement
	Heavy sub-surface abrasion	N	L	M	L	H	L	Deep sub-surface abrasion would destroy the biocenosis through the elimination of the characteristic species and by destabilising the substrate's structure. The time needed for the stabilization of the substrate and for recolonization by the species characteristic of the biocenosis, once the pressure has been alleviated or reduced, is estimated at 5 to 10 years. It depends on the local rate of siltation and the proximity of a healthy biocenosis that can contribute individuals. **N.B.** The facies with *O. quinquemaculata,* characterised by organisms living on the surface of the substrate, will be destroyed by abrasion (no resistance, moderate resilience; high sensitivity).	Expert judgement
	Reworking of the sediment	L	L	M	L	M	L	Reworking of the substrate would lead to notable changes in biocenosis due to the elimination of the shallowly buried characteristic species and to destabilization of the surface structure of the substrate (e.g. hardened muds). The time needed for the stabilization of the substrate and for recolonization by the species characteristic of the biocenosis, once the pressure has been alleviated or reduced, is estimated at 5 to 10 years. It depends on the local rate of siltation and the proximity of a healthy biocenosis that can contribute individuals.	Expert judgement
	Light deposition	H	L	M	L	VL	L	The existence of this biocenosis depends on a slow to moderate rate of siltation. It is therefore highly resistant to a light addition of sediment of the same nature as the original substrate.	Expert judgement

								N.B. The natural hydrodynamic characteristics don't allow for the removal of a rocky deposit in the short term.	
	Heavy deposition	N	L	N	L	VH	L	The natural hydrodynamic conditions don't allow for the elimination of a significant deposit of material. In the case of added mud, There's a risk of habitat change that would favour the biocenosis of coastal terrigenous muds; in the case of added sand, there's a risk of habitat change that would favour the biocenosis of the coastal detritic; in the case of added rocky material, the change would be in favour of a hard substrate biocenosis.	Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	M	L	M	L	M	L	Though this biocenosis is dependent on a precarious hydrodynamic balance, it shows moderate sensitivity to a temporary pressure. **N.B.** Should hydrodynamic activity decrease for a prolonged period, there would be silting in the biocenosis (and a change in habitat that would favour the biocenosis of coastal terrigenous muds). Should it increase for a time, the biocenosis would lose mud (with a change of habitat in favour of the biocenosis of the coastal detritic).	Expert judgement
	Change in suspended solids	H	L	M	L	L	L	This biocenosis is found in naturally turbid waters and is therefore not impacted by a temporary increase in turbidity. **N.B**. An increase in particle load could reflect a decrease in sedimentation that could impact the biocenosis in the long term.	Expert judgement

IV.2.2. Biocenosis of the coastal detritic

7 associations and 3 facies

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	NR		NR		NR		Deep habitat is not concerned by this pressure	
	Habitat change (to another type)	N	H	N	H	VH	H	A change of substrate would lead to the total loss of the characteristics of the habitat, which is defined by a detritic substrate. By definition, this habitat could not recover on a different substrate.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	L	H	H	H	Extraction would destroy the biocenosis by destablilizing the substrate and eliminating the characteristic epigeal and buried species. The time needed for recolonization of the exposed substratum by the characteristic species of this biocenosis is estimated at over 10 years. It depends on the proximity of a healthy biocenosis that can contribute individuals.	Peer-reviewed publications on similar habitat and same pressure: Simonini *et al.,* 2005 , 2007
	Trampling	L	L	M	L	M	L	Biological communities of this biocenosis require a relatively loose substrate. Sediment compaction would limit drainage of the substrate. The time needed for the stirring of compacted sediment and recolonization is estimated at about 5 years.	Expert judgement
	Surface abrasion	M	L	M	L	M	L	This habitat is located in zones with generally weak hydrodynamics with occasional strong currents that create a natural surface abrasion. Resistance and resilience are scored moderate. **N.B.** Surface abrasion can affect associations or particular facies of this biocenosis.	Expert judgement
	Light sub-surface abrasion	L	L	M	L	M	L	Shallow abrasion would destroy epigeal and shallowly buried species as well as the superficial layer of the sediment. Once the pressure is alleviated or reduced, the time needed for stabilization of the sediment and recolonization by characteristic species of the biocenosis is estimated at between 5 and 10 years. It depends on the proximity of a healthy biocenosis that can contribute individuals.	Expert judgement
	Heavy sub-surface abrasion	N	L	L	L	H	L	Deep abrasion would destroy the biocenosis by destabilizing the substrate and eliminating the characteristic epigeal species and buried species. Once the pressure is alleviated or reduced, the time needed for the stabilization of the sediment and recolonization by the characteristic species of the biocenosis is estimated at over 10 years. It depends on the proximity of a healthy biocenosis that can contribute individuals.	Expert judgement
	Reworking of the sediment	N	L	L	L	H	L	Similar to heavy sub-surface abrasion, reworking would alter the integrity of the structure and therefore the sediment and associated species. Resilience is scored low.	Expert judgement
	Light deposition	H	L	M	L	L	L	The habitat is not particularly sensitive to a light addition of material that is of the same nature as the original substrate. **N.B.** Should material of a different nature be added, there is a risk of a change in habitat because the biocenosis is sensitive to silting. Only exceptionally are this habitat's hydrodynamics strong enough to prevent sedimentation of fine terrigenous particles. It is unlikely that a deposit of material could be eliminated in a short amount of time.	Grey literature directly relevant to the habitat and pressure : PNUE-PAM-CAR/ASP, 2007
	Heavy deposition	N	L	L	L	H	L	Should too much material be added, even of the same nature as the original substrate, the characteristic species would be buried. Since only exceptionally is this habitat exposed to strong hydrodynamics, it is unlikely that a large deposit could be removed in a short time. The time needed for the deposited sediment's stabilization and colonization by characteristic species is estimated at over 10 years. **N.B.** If too much material of a different nature is added, there's a risk of change in habitat, as the biocenosis is sensitive to silting.	Grey literature directly relevant to the habitat and pressure : PNUE-PAM-CAR/ASP, 2007
Hydrological changes (temporary	**Hydrodynamic changes**	N	L	L	L	H	L	Most of the time, this biocenosis requires weak or inexistant hydrodynamic activity, but occasionally strong enough to prevent siliting. The presence of certain currents can nevertheless condition the appearance of certain facies or associations. If hydrodynamic energy decreases, there is silting in the biocenosis (and a change of habitat in favour of a muddy detritic biocenosis).	Grey literature directly relevant to the habitat and pressure : PNUE-PAM-CAR/ASP, 2007

and/or reversible change)								**N.B.** In the case of prolonged pressure, there will be a change in habitat type.	
	Change in suspended solids	N	L	L	L	H	L	An increase in particle load would decrease water clarity and therefore lead to changes in photosynthetic processes that would jeopradize the survival of photophilic organisms. There would also be clogging of filter-feeders and suspension-feeders. Resilience is estimated at over 10 years. **N.B.** A prolonged change would lead to the loss of certain associations.	Expert judgement

IV.2.3. Biocenosis of the shelf-edge detritic bottoms

IV.2.3.a. Facies with *Neolampas rostellata*

IV.2.3.b. Facies with *Leptometra phalangium*

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	NR		NR		NR		Deep habitat is not concerned by this pressure	
	Habitat change (to another type)	N	H	N	H	VH	H	A change of substrate would lead to the total loss of the characteristics of the habitat, which is defined by a detritic substrate. By definition, this habitat could not recover on a different substrate.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	N	H	VH	H	The extraction of substrate, though unlikely at this depth, would result in the destruction of the habitat. Resilience, where possible, is approximately a century due to the thanatocenotic nature of the substrate.	Expert judgement Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	NR		NR		NR		This habitat is not exposed to this pressure (usually occuring at the break of slope)	
	Surface abrasion	L	L	L	L	H	L	Surface abrasion would destroy the characteristic epigeal species but not the buried species. The time needed for recolonization by the species affected on the surface is estimated at 10-15 years. **N.B.** Both of the facies characteristic of this biocenosis are highly sensitive to abrasion (no resistance, resilience very high).	Expert judgement
	Light sub-surface abrasion	L	L	N	L	H	L	Shallow abrasion destroys not only the epigeal species, but also shallowly buried organisms. Resilience is estimated at over 25 years due to the long life cycles of the characteristic species and the reach of the thanatocenotic substrate. N.B. Both of the facies characteristic of this biocenosis are highly sensitive to abrasion (no resistance, resilience very high).	Expert judgement
	Heavy sub-surface abrasion	N	H	N	L	VH	L	Shallow abrasion destroys all of the species of this habitat and changes the integrity of the sediment. Resilience is estimated at over 25 years due to the long life cycles of the characteristic species and the reach of the thanatocenotic substrate. N.B. Both of the facies characteristic of this biocenosis are highly sensitive to abrasion (no resistance, resilience very high).	Expert judgement Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Reworking of the sediment	L	L	M	L	H	L	Reworking of the sediment would result in major changes to the biocenosis by destabilizing the structure of the sediment and therefore the associated community (without the loss of individuals). The time needed for the restructuration and stabilization of the sediment is estimated at 10-15 years due to the weak hydrodynamics of this biocenosis.	Expert judgement
	Light deposition	H	L	H	L	L	L	This biocenosisis is exposed to natural sedimentation and consists of a mixed substrate. The presence of a weak current at the break of slope allows for the elimination of deposits of less than 5 cm of light material; habitat sensivity to a light addition of material that is identical in nature to the original substrate is therefore low. **N.B.** Should the added material change the muddy fraction of the biocenosis, generally comprising 20-25%, there could be a change of habitat. The addition of rocky material would change the habitat.	Expert judgement
	Heavy deposition	L	L	L	L	H	L	A heavy addition of material would result in a major loss of characteristic species by smothering or clogging. Resilience is estimated at 10 to 15 years, since the hydrodynamic activity around this biocenosis is generally weak, but the situation at the break of slope near upwelling/downwelling (vertical currents) can allow for the elimination of a sedimentary deposit without a change of biocenosis.	Expert judgement

								N.B. Should the addition be too great, there's a risk of habitat change in favour of a biocenosis characterized by another type of substrate (e.g. a biocenosis of coastal terriginous muds). The addition of material mustn't modify the muddy fraction of the biocenosis, Should the added material change the muddy fraction, generally comprising 20-25%, the risk is a change of habitat. The addition of rocky material would lead to a change of habitat.	
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	N	L	L	L	H	L	The natural hydrodynamic conditions around this biocenosis are generally weak. A reduction in hydrodynamics will affect larvae transport and the sedimentation of fine particles, influencing the presence of either of the facies of this biocenosis. **N.B.** A prolonged modification of hydrodynamic conditions would result in a change of habitat.	Expert judgement
	Change in suspended solids	H	L	VH	L	VL	L	This habitat's sensitivity to the particle load is very low. **N.B.** A prolonged change would lead to clogging of organisms.	Expert judgement

IV.2.4. Biocenosis of sands and gravels under the influence of bottom currents (circalittoral position)

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum would lead to a complete loss of the characteristics of the habitat, which is defined by a coarse sand and gravel substrate. This biocenosis does not tolerate the least silting. This biocenosis could not recover on a substrate of different granulometry.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	L	L	H	L	Extraction would destroy the biocenosis through the removal of the substrate and associated species, mostly epigeal or shallowly buried. The time needed for the renewal of sand and gravel and for recolonization by the species characteristic of the biocenosis is estimated at over 10 years. It depends on the proximity of a healthy biocenosis that can contribute individuals. *Considering the predominant hydrodynamics, the generally limited surfaces occupied, and the depth of this habitat, it is unlikely to be exposed to extraction (Bensetitti et al., 2004).*	Expert judgement Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	H	L	VH	L	VL	L	Sands and gravels are not easily compacted. This habitat is located in zones where hydrodynamic activity is naturally very strong, stirring up the sediment and allowing for rapid recovery. Given the position of this habitat, exposure to vertical compression is unlikely.	Expert judgement
	Surface abrasion	H	L	VH	L	VL	L	This habitat is located in zones with strong currents that cause virtually constant surface abrasion. Resistance and resilience are therefore scored high and very high respectively.	Expert judgement
	Light sub-surface abrasion	L	L	M	L	M	L	This biocenosis is characterized by epigeal species and endofauna with low resistance to sub-surface disturbance. Resilience is estimated at 5 to 10 years owing to the short life cycles of the characteristic species and to the natural hydrodynamic conditions that supply new individuals.	Expert judgement
	Heavy sub-surface abrasion	L	L	M	L	M	L		
	Reworking of the sediment	L	L	M	L	M	L	As for sub-surface abrasion, resistance is scored low and resilience moderate.	Expert judgement
	Light deposition	H	L	VH	L	VL	L	This habitat is exposed to strong currents and a deposit of sand or gravel will be rapidly eliminated. **N.B.** The hydrodynamic conditions of this habitat don't allow for the removal of deposits of materials that differ in nature from the original substrate (such as muds and fine sands that would fill the interstices or rocky materials) in the short term. This biocenosis cannot withstand the least silting. An addition of this kind would lead to change of habitat.	Expert judgement
	Heavy deposition	N	L	N	L	VH	L	A heavy addition of material would bury the community. Resilience is considered none, but nevertheless depends on the capacity of the local hydrodynamics to remove deposits. **N.B.** The hydrodynamic conditions of this habitat don't allow for the short-term elimination of deposits of materials that differ from the original substrate (muds, fine sands or rocky materials). This biocenosis cannot withstand the least silting. An addition of this kind would lead to a change of habitat.	Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	L	L	M	L	M	L	The presence of this biocenosis depends on the presence of strong currents. A reduction in hydrodynamics would result in decreased oxygenation of the sediment and increased sedimentation of fine particles. As this biocenosis cannot withstand the least silting, resistance to this short-term pressure is scored low. Resilience is scored moderate. **N.B.** The position of this biocenosis is tied to very specific currents. A lasting change in hydrodynamics could threaten its existence, notably by increasing the sedimentation of fine particles, as this biocenosis cannot tolerate the slightest silting.	Expert judgement
	Change in suspended solids	H	L	VH	L	VL	L	This habitat has low sensitivity to temporary changes in the particle load. **N.B.** A prolonged modification will result in clogging of organisms.	Expert judgement

IV.3.1. Coralligenous biocenosis

7 associations and 5 facies

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, defined by a rocky substrate in the circalittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	N	L	VH	L	Extraction would destroy the biocenosis by eliminating the biogenic substrate and the species characteristic of this cavity habitat as well as erect species living on the surface (algae, cnidarians, bryozoan etc.). Given that the engineering species have long life cycles and a low capacity to recruit and disperse, the time needed to rebuild a biogenic substrate and for its colonization by pioneer species and then characteristic species is over 25 years (about a century). **N.B.** The removal of too much substrate could change the zonation and therefore the habitat.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	M	L	M	L	M	L	If the compression does not alter the biogenic substrate and its cavity fauna, resistance to this pressure is scored moderate, since only erect species will be affected. Some erect species are relatively flexible, but vertical compression could cause breakage in some individuals. **N.B.** If the compression impacts the bio-constructed substrate, the cavities will be obstructed and their populations destroyed. Resilience in this case is estimated at over 25 years.	Expert judgement
	Surface abrasion	M	H	N	H	H	H	Surface abrasion does not alter the concretion or the organisms of the cavity fauna, but it does eliminate the characteristic erect species of the particular associations/facies. Erect organisms that are injured but not shorn will be rapidly colonized by epibionts, the weight of which will eventually cause breakage in the supporting organisms. This biocenosis's overall resistance to surface abrasion is scored moderate, since the substrate is not impacted. The organisms affected by surface abrasion are long-lived and will take several decades to recover. <u>This pressure could well result in changes of particular facies/associations without changing the actual biocenosis.</u> **N.B.** The various associations and facies of this biocenosis do not share the same resistance and resilience to surface abrasion. Associations IV.3.1.a, b, c and facies IV.3.1.h, i, j, k: no resistance; no resilience - very high sensitivity Associations IV.3.1.d, e, f, g, and facies IV.3.1.l: moderate resistance; moderate resilience - moderate sensitivity	Peer-reviewed literature: Ballesteros, 2006 ; Garrabou *et al.*, 1998 ; Linares and Doak, 2010 ; Linares *et al.*, 2010 ; Piazzi *et al.*, 2012 ; Teixidó *et al.*, 2013
	Light sub-surface abrasion	N	H	N	H	VH	H	By stripping the rock or overturning blocks of it, sub-surface abrasion impacts erect species and the cavity fauna as well as the active part of the coralligenous concretion, which takes tens if not hundreds of years to form. Given that the species characteristic of the concretion are long-lived, with little capacity for recruitment and dispersal, the time needed for the substrate to reform and for its colonization by pioneer species and then the characteristic species is more than 25 years (approximately a century). Moreover, the active part of the concretion allows for the installation of boring organisms, increasing the substrate's resilience and therefore that of the biocenosis.	Peer-reviewed literature: Ballesteros, 2006 ; Linares and Doak, 2010 ; Linares *et al.*, 2010 ; Piazzi *et al.*, 2012 ; Teixidó *et al.*, 2013
	Heavy sub-surface abrasion	N	H	N	H	VH	H		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	

	Light deposition	V	L	M	L	V	L	**Resistance varies according to local conditions and to the type of material added.** The case of a light addition of sediments: The coralligenous in stations that are not exposed to heavy runoff or that are found in oligotrophic waters will show moderate resistance to a light addition of sedimentary materials that would clog the cavities and the associated fauna. The coralligenous of stations exposed to heavy runoff or in waters laden with sediment or organic matter show high resistance to the light addition of sedimentary material. Resilience in both cases is scored moderate, as the deposit will be difficult to eliminate hydrodynamically once trapped in the community's three-dimensional structure. The case of a light addition of rocky material: the characteristic species will be totally crushed. Resilience is similar to resilience in the case where the rock is laid bare through extraction or in the case of heavy sub-surface abrasion (no resistance, no resilience; very high sensitivity).	Expert judgement
	Heavy deposition	N	L	N	L	VH	L	The characteristic epigeal and cavity species of this biocenosis would be totally destroyed by clogging, or by crushing should a large amount of exogenous material be added, unless the biocenosis is located on an incline on which the deposit would not remain in the long term. Should rocky material be added, the communities would have to resettle on bare substrate. Given that these species are long-lived with a low capacity for recruitment and dispersal, the time needed to form the biogenic substrate and for colonization by pioneer species and then the characteristic species is more than 25 years (approximately a century). In the case of a large addition of sediments that could not be eliminated hydrodynamically or thanks to the inclination of the substrate, there would be a change of substrate and therefore in the type of biocenosis (pressure: habitat change).	Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	H	L	VH	L	VL	L	This habitat is naturally exposed to significant hydrodynamic fluctuations. **N.B.** A lasting change in hydrodynamic conditions could result in a change of habitat by affecting sedimentation processes and nutrition in filter-feeders and suspension-feeders, and therefore the biocenosis.	Expert judgement
	Change in suspended solids	V	M	M	M	V	M	**Resistance varies according to local conditions.** The coralligenous in stations that are not exposed to heavy runoff or located in oligotrophic waters are moderately resistant to changes in suspended solids. Resilience is scored moderate (for a short change). **N.B.** A lasting change would alter the bathymetric extent of the habitat through the loss of sciaphilous engineer species in darker zones, and possibly result in a change of habitat.	Peer-reviewed literature : Ballesteros, 2006 ; Hong, 1980 Expert judgement

IV.3.2. Biocenosis of coralligenous platforms

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, defined by a soft substrate in the circalittoral level. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	N	L	VH	L	Extraction would destroy the biocenosis through the elimination of the bio-constructed substrate and habitat's associated species. Given that the engineering species characteristic of this habitat are long-lived, with a low capacity for recruitment and dispersal, the time needed to renew the substrate and for its colonization by pioneer species and then the characteristic species is more than 25 years (approximately a century). **N.B.** The removal of too much substrate could lead to a change in zonation and therefore of habitat.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	M	L	M	L	M	L	If the compression does not alter the biogenic substrate and the associated cavity fauna, resistance is scored moderate, as only erect organisms are affected. Some erect species are relatively flexible, but vertical compression could cause breakage in certain individuals. If the biogenic substrate is not altered by the compression, resilience is scored moderate. **N.B**. Should the compression reach the bio-constructed substrate, the cavities will be obstructed and their population destroyed. Resilience in this case is estimated at over 25 years.	Expert judgement
	Surface abrasion	M	H	N	M	H	M	Surface abrasion doesn't alter the concretion, but it does eliminate the characteristic erect species. The overall resistance of this biocenosis to surface abrasion is scored moderate, as the substrate is not affected. The organisms affected by surface abrasion are long-lived and will take several decades to recover.	Directly relevant grey literature: PNUE-PAM-CAR/ASP, 2007 Expert judgement
	Light sub-surface abrasion	N	H	N	M	VH	M	By stripping the rock or overturning blocks of it, sub-surface abrasion alters the erect species composition as well as the active part of the coralligenous concretion, which takes decades if not hundreds of years to form. Given that the characteristic concretion species are long-lived with a low capacity for recruitment and dispersal, the time needed for the renewal of the substrate and colonization by pioneer species and then the characteristic species is more than 25 years (approximately a century). Moreover, altering the active part of the concretion allows for boring organisms to settle, which increases resilience in the substrate and therefore the biocenosis.	Directly relevant grey literature: PNUE-PAM-CAR/ASP, 2007 Expert judgement
	Heavy sub-surface abrasion	N	H	N	M	VH	M		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern rocky substrates	
	Light deposition	V	M	L	M	V	M	**Resistance varies according to local conditions.** The case of a light addition of sediments**:** The coralligenous that is not exposed to heavy runoff or found in oligotrophic waters with low sediment inflow shows low resistance to added sediment which risks clogging the concretion and associated fauna. The coralligenous in stations exposed to heavy runoff or located in waters laden with sediment and organic matter are highly resistant to a light addition of sediment. The addition of rocky material would lead to a change of habitat. Resilience depends on local hydrodynamics, which influence the time needed to eliminate the deposit. With sufficient date lacking, resilience is considered to be low due to the slow dynamics of the populations associated with this biocenosis and the average hydrodynamic conditions encountered in this habitat.	Directly relevant grey literature: PNUE-PAM-CAR/ASP, 2007 Expert judgement

	Heavy deposition	N	M	M	M	VH	M	Should a large amount of exogenous material be deposited, the epigeal species characteristic of this biocenosis would be totally destroyed due to the obstruction of photosynthesis, smothering or crushing. Given that these species are long-lived with a low capacity for recruitment and dispersal, the time needed for the renewal of the biogenic substrate and its colonization by pioneer species and then the characteristic species is more than 25 years (approximately a century).	Directly relevant grey literature: PNUE-PAM-CAR/ASP, 2007 Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	M	M	L	M	M	M	This habitat is naturally exposed to bottom currents with little fluctuation. A change in hydrodynamic conditions would alter sedimentation processes which would in turn have a notable effect on the biocenosis. In the absence of sufficient data, resilience is scored low due to the slow dynamics of the populations associated with this biocenosis. **N.B**. A lasting change in hydrodynamic conditions could lead to a change in habitat type due to the effect on sedimentation processes and nutrition in filter-feeders and suspension-feeders and therefore on the biocenosis.	Directly relevant grey literature: PNUE-PAM-CAR/ASP, 2007 Expert judgement
	Change in suspended solids	V	L	M	L	V	L	**Resistance varies according to local conditions.** The coralligenous in stations that are not exposed to heavy runoff or located in oligotrophic waters show moderate resistance to changes in suspended solids. The coralligenous in stations exposed to heavy runoff or that are used to suspended solids or organic matter are highly resistant. Resilience is scored moderate (for a short-term pressure). **N.B.** A lasting modification could lead to a change in the bathymetric extent of the habitat, if not a change of habitat type, through the loss of sciaphilous engineering species in the darker zones.	Expert judgement

IV.3.3. Biocenosis of semi-dark caves

IV.3.3.a. Facies with *Parazoanthus axinellae*

IV.3.3.b. Facies with *Corallium rubrum* (particular assessment of sensitivity)

Relationship with other classifications

The mobile fraction (muddy and detritic substrates) of cave bottoms is also considered.

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, defined by a sedimentary and a rocky substrate in the circalittoral level. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	F	M	H	M	Extraction of the substrate would destroy the habitat through the elimination of the species characteristic of the habitat's rocky parts (anthozoa, sponges, bryozoa...) (no resistance). The species in the mobile part of the substrate are usually buried, but would also be eliminated should the substrate be removed. Given that input of sediment and larvae is limited due to the sheltered, confined configuration of the habitat, the stabilization of the substrate and recolonization of the bare substrate by pioneer species and then the characteristic species should take 10 to 25 years.	Peer-reviewed publication: Denitto *et al.*, 2007 Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	F	M	M	M	M	M	Compression of the substrate, be it the rocky or mobile portion of the habitat, would lead to a major loss of the habitat's characteristics, as the organisms normally present live in a confined, highly protected environment and therefore low in resistance. That said, their proximity to the outer environment allows for a resilience estimate of 2 to 10 years.	Peer-reviewed publication: Denitto *et al.*, 2007 Expert judgement.
	Surface abrasion	F	M	F	M	H	M	Surface abrasion would result in a major loss of the habitat's characteristics since the organisms living on the rocky substrate are erect species and the most diverse fraction of the meiofauna living in the mobile substrate is buried in the first few millimetres disturbed by surface abrasion. The overall resilience dynamics of the habitat are unknown but assumed to be low due to the population dynamics.	Peer-reviewed publication: Denitto *et al.*, 2007 Expert judgement.
	Light sub-surface abrasion	N	H	F	M	H	M	The habitat will be totally destroyed by sub-surface abrasion as the substrates would be stripped. Resilience is scored low due to the low dynamics of the populations and the time needed to stabilize the mobile fraction and the sheltered configuration of the habitat, which limits recruitment.	Peer-reviewed publications: Denitto *et al.*, 2007 ; Fichez, 1991b Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Heavy sub-surface abrasion	N	H	F	M	H	M		
	Reworking of the sediment	N	M	F	M	H	M	This pressure doesn't apply to the rocky parts. For the mobile fraction, even though buried species won't be affected, reworking disturbs the stratification of the substrate, which takes several decades to put in place. Resistance is scored as none and resilience is assumed to be low.	Peer-reviewed publications: Denitto *et al.*, 2007 ; Fichez, 1991b Expert judgement.
	Light deposition	N	M	F	M	H	M	The hydrodynamic conditions in semi-dark caves are naturally calm and don't allow for the elimination of deposited material. Added exogenous sediment would therefore bury and smother the entire population. Added rocky material would crush the communities with low dynamics. Resilience is scored low in terms of a return to a similar structural and functional state (time needed for recolonization by pioneer species and then biological successions).	Peer-reviewed publication: Denitto *et al.*, 2007 Expert judgement.
	Heavy deposition	N	M	F	M	H	M		

Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	F	M	F	M	H	M	A reduction in hydrodynamics could result in the loss of filter-feeders and suspension-feeders, and the replacement of this biocenosis by a dark cave biocenosis. (IV.3.4). An increase in hydrodynamics would stir if not destroy the erect species, which are used to calm conditions, and could bring in new species (larvae, mobile organisms), including predators of the characteristic species of this biocenosis. This habitat's overall resilience dynamics are unknown but are assumed to be low due to the low population dynamics. **N.B.** In the case of prolong hydrodynamic change, there could be a habitat change.	Peer-reviewed publication: Denitto *et al.,* 2007 Expert judgement.
	Change in suspended solids	M	M	F	M	M	M	This habitat is found in stable environmental conditions and is characterised by generally clear waters. A change in water clarity would lead to a major decline in the species present. Resistance is scored moderate as the destruction is not total. This habitat's overall resilience dynamics are unknown but are assumed to be low due to the low population dynamics. **N.B.** A prolonged change could lead to a change in the oligotrophic character of the water body and in turn a change of biocenosis.	Peer-reviewed publication: Fichez, 1991a Expert judgement.

IV.3.3.b. Facies with *Corallium rubrum*

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, which is defined by a rocky substrate in the circalittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	N	H	VH	H	Removal of the substrate would destroy the facies by eliminating the red coral colonies and other characteristic sessile species (sponges, bryozoa, cnidaria). The species *C. rubrum* is particularly slow-growing (less than 50 mm per year), with a low dispersal capacity and a low recruitment rate. Resilience for a facies with *C. rubrum* can be more than 25 years.	Peer-reviewed publications : Bramanti *et al.*, 2014 ; Garrabou and Harmelin, 2002 ; Santangelo *et al.*, 2012 and references therein
	Trampling	L	H	N	H	H	H	Colonies of *C. rubrum* have a rigid, fragile skeleton and would be destroyed by compression. Other species of this facies could resist this pressure. Due to red coral's particularly slow growth rate (about 1 cm per year), low dispersal capacity and low recruitment rate, resilience is estimated at more than 25 years.	Peer-reviewed publications : Bramanti *et al.*, 2014 ; Garrabou and Harmelin, 2002 ; Santangelo *et al.*, 2012 and references therein
	Surface abrasion	N	H	N	H	VH	H	Surface or sub-surface abrasion would result in the total loss of red coral colonies and the other characteristic epigeal species (sponges, bryozoa, cnidaria). Resilience is estimated at over 25 years due to the very long growth cycles and low recruitment capacity of the characteristic species.	Peer-reviewed publications : Bramanti et al., 2014 ; Garrabou and Harmelin, 2002 ; Santangelo et al., 2012 and references therein
	Light sub-surface abrasion	N	H	N	H	VH	H		
	Heavy sub-surface abrasion	N	H	N	H	VH	H		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	
	Light deposition	H	H	VH	H	VH	H	Because this facies grows on a slope, a light addition of material would be eliminated before affecting the species present.	Peer-reviewed publications : Bramanti *et al.*, 2014 ; Garrabou and Harmelin, 2002 ; Santangelo *et al.*, 2012 and references therein
	Heavy deposition	N	H	N	H	VH	H	Though unlikely, were a large amount of added material to settle on the substrate, it could smother, clog or crush the sessile organisms. Resilience is estimated at over 25 years.	Peer-reviewed publications : Bramanti *et al.*, 2014 ; Garrabou and Harmelin, 2002 ; Santangelo *et al.*, 2012 and references therein
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	L	H	N	H	H	H	A reduction in hydrodynamics could result in the loss of the characteristic filter-feeders and suspension feeders and in the replacement of this biocenosis by a dark cave biocenosis. (IV.3.4). An increase in hydrodynamics would stir if not destroy the erect species, which are used to calm conditions, and it could introduce new species (larvae, mobile organisms) including predators of the characteristic species of this biocenosis. Resilience is estimated at over 25 years. **N.B.** In the case of a lasting modification, there could be a change of habitat.	Peer-reviewed publications : Bramanti *et al.*, 2014 ; Garrabou and Harmelin, 2002 ; Santangelo *et al.*, 2012 and references therein
	Change in suspended solids	M	H	L	H	M	H	This facies is naturally exposed to stable conditions and is characterized by generally clear waters. A change in water clarity could result in the clogging and smothering of the species present. Resistance is scored low as the impact is not total destruction. **N.B.** In the case of a lasting modification, the oligotrophic character of the water body could change, resulting in a change of biocenosis.	Peer-reviewed publications : Bramanti *et al.*, 2014 ; Garrabou and Harmelin, 2002 ; Santangelo *et al.*, 2012 and references therein

IV.3.4. Biocenosis of caves and ducts in total darkness

Relationship with other classifications

The mobile fraction (muddy and detritic substrates) of cave bottoms is also considered.

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or a change in biological zone (depth band) would lead to a complete loss of the characteristics of the habitat, defined by a sedimentary substrate and a rocky substrate in the circalittoral zone. By definition, this habitat cannot recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	N	M	VH	M	Removal of the substrate would destroy the habitat through by eliminating the characteristic species of the rocky part of this biocenosis (sponges, bryozoa, etc.), which are sessile. Mobile species in the biocenosis tend to be buried, but would also be eliminated should the substrate be removed. Given that the addition of sediment or larvae is limited due to the sheltered, confined configuration, and the fact that most of the characteristic species are long-lived (very slow growth rate, the stabilization of the substrate and recolonization of the bare substrate by pioneer species and then the characteristic species would take more than 25 years.	Peer-reviewed publication: Denitto *et al.*, 2007 Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	M	M	L	M	M	M	Most of the characteristic species of this biocenosis are encrusting (sponges) or fairly rigid (bryozoa), but their constructions in an environment that is very calm physically make them less resistant mechanically than they would be in a mediolittoral cave, for instance. Resistance to this pressure is therefore scored moderate. Little is known about the pressure's effect on this biocenosis. As most of the characteristic species are sponges with lifespans of over 10 years, resilience is scored low.	Peer-reviewed publication: Denitto *et al.*, 2007 Expert judgement.
	Surface abrasion	L	M	L	M	H	M	Most of the species characteristic of the rocky part of this biocenosis (sponges, bryozoa...) are sessile species that would be lost if the habitat is exposed to abrasion. On mobile bottoms, surface abrasion could remove 80% of the meiofauna (low resistance). Given that (i) these species are long-lived with a low capacity for recruitment and dispersal and (ii) there is little of the water renewal needed to supply new larvae, the time needed for the recolonization of the substrate by pioneer species and then the characteristic species is about 10 to 25 years, assuming there are mature individuals in the vicinity.	Peer-reviewed publication: Denitto *et al.*, 2007 Expert judgement.
	Light sub-surface abrasion	N	H	N	M	VH	M	Sub-surface abrasion would totally strip the rocky substrate, exposing the bare rock. On mobile substrates, sub-surface abrasion totally strips the rocky substrate, exposing the bare rock. On mobile substrates, sub-surface abrasion impacts the upper anoxic layer of the sediment, which takes several decades to form. Resistance is therefore scored as none. Resilience is scored none due to the time it takes for species to recolonize the bare substrate and for biological successions to restore the functional biocenosis (low population dynamics and a sheltered habitat that limits the input of new recruits.	Peer-reviewed publications: Denitto *et al.*, 2007 ; Fichez, 1991b Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Heavy sub-surface abrasion	N	H	N	M	VH	M		
	Reworking of the sediment	N	M	N	M	VH	M	This pressure doesn't apply to the rocky parts. For mobile bottoms, even if the buried species are not affected, reworking disturbs the stratification of the substrate, which takes decades to put in place. Resistance and resistance are scored none.	Peer-reviewed publications: Denitto *et al.*, 2007 ; Fichez, 1991b Expert judgement.
	Light deposition	N	M	N	M	VH	M	The species characteristic of the mobile fraction live both at the surface or buried in a shallow layer of sediment. Those on the rocky part are epigeal. These species are adapted to an oligotrophic environment, with very little natural inflow. The hydrodynamic conditions of dark caves are naturally calm and don't	Peer-reviewed publication: Denitto *et al.*, 2007 Expert judgement.

	Heavy deposition	N	M	N	M	VH	M	allow for the elimination of deposits. The addition of 5 cm of exogenous sediment would bury and smother the entire population, while the addition of rocky material would crush the communities with weak dynamics. This biocenosis would take 25 years to return to a similar structural and functional state (the time needed for recolonization by pioneer species and then biological successions).	Peer-reviewed publication: Denitto *et al.,* 2007 Expert judgement.
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	L	M	L	M	H	M	The environment of this habitat is naturally very calm. A change in hydrodynamic conditions would lead to a significant decline in the species present, notably filtering and suspension-feeding organisms. Resistance is scored low because the effect is not completely destructive for a change that lasts less than a year. If there's an increase in hydrodynamics, there's a risk of (i) introducing new species that compete for space and resources, (ii) mingling of the surface sediment layer and (iii) a change in the oxygenation of the environment. If there's a reduction in hydrodynamics (e.g. a cave closing) there is a risk of (i) removal of occasional visitors that represent an important place in the trophic network (ii) removal of food supply, and (iii) anoxia if the replenishment of water is completely prevented. Resilience is scored low since the destruction of the community isn't total, so recovery is long but less than 25 years. **N.B.** In the case of a prolonged change, there's a risk of change in habitat type.	Peer-reviewed publication: Denitto *et al.,* 2007 Expert judgement.
	Change in suspended solids	L	M	L	M	H	M	This habitat occurs under stable environmental conditions and is characterized by generally clear waters. A change in water clarity would lead to a notable decline in the species present. Resistance is scored low as the effect would not be totally destructive, but would still be more significant than a change in suspended solids in the semi-obscure cave biocenosis. **N.B.** In case of a prolonged modification, the oligotrophic nature of the water could change, resulting in a change of biocenosis.	Peer-reviewed publication: Fichez, 1991a Expert judgement.

IV.3.5. Biocenosis of shelf-edge rock

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	N	H	N	H	VH	H	All marine habitats are considered to have no resistance to this pressure and to be unable to recover from a permanent loss of habitat to land or a freshwater habitat, although no specific evidence is described.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum or in biological zone (depth band) will lead to a total loss of the characteristics of the habitat, which is defined by a sedimentary substrate and a rocky substrate in the circalittoral zone. By definition, this habitat could not recover on a different substratum or at a different depth.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	L	L	H	L	The removal of substrate would destroy the biocenosis by eliminating the sessile species characteristic of this habitat (sponges, cnidarians, bryozoans, etc.). Given that these species are long-lived, with a low capacity for recruitment and dispersal, the time needed for recolonization of the substrate by pioneer species and then the characteristic species is estimated at 10 to 25 years, assuming there are other individuals nearby.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	M	L	L	L	M	L	Resistance is scored moderate as the community would not be completely destroyed by vertical compression. Resilience is scored low due to the slow population dynamics associated with this habitat.	Expert judgement
	Surface abrasion	M	L	L	L	M	L	Like compression, surface abrasion would alter only a part of the community. The flexible or encrusting organisms will not be destroyed. Resilience is scored low due to the slow population dynamics associated with this habitat.	Expert judgement
	Light sub-surface abrasion	N	H	N	L	VH	L	Sub-surface abrasion totally strips the rocky substrate, exposing the bare rock and therefore eliminating the characteristic epigeal species. Resilience is scored as none due to the time needed for the species to recolonize the untouched substrate and for the biological successions to reform a functional biocenosis.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Heavy sub-surface abrasion	N	H	N	L	VH	L		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	
	Light deposition	M	L	L	L	M	L	This biocenosis is in a zone that is naturally exposed to strong hydrodynamics that allow for the quick elimination of minor sedimentary deposits. Should rocky material be added, certain organisms will be crushed, but not the whole community. Resistance is scored moderate. The recolonization of the bare rocky substrate by pioneer species and then by the characteristic species should take 10 to 25 years (low resilience), assuming there are mature individuals nearby.	Expert judgement
	Heavy deposition	N	L	L	L	H	L	The characteristic species will be smothered or crushed if too much rocky material is added. The time needed for recolonizing the untouched rocky substrate by pioneering species then by characteristic species is estimated at 10-25 years if mature individuals are nearby. If too much sedimentary material is added and the local hydrodynamic conditions don't allow for the rapid elimination of the deposit, there will be a change in the type of substrate and therefore a habitat change.	Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	H	L	L	L	M	L	This habitat is naturally exposed to extreme fluctuations in hydrodynamic conditions. Resistance is scored high for a change that lasts less than a year. A decrease in hydrodynamism risks reducing nutrient provisions for filter-feeders and suspension-feeders characteristic of this biocenosis. If a community is altered, resilience is scored low due to the slow dynamics of the communities associated with this habitat. **N.B.** a lasting modification could result in a change of habitat (notably due to silting in the case of a decrease in wave energy)	Expert judgement
	Change in suspended solids	L	L	L	L	H	L	An increase in suspended solids could result in clogging in filter-feeders and suspension-feeders. When this pressure is temporary, resilience is scored low due to the slow dynamics of communities associated with this habitat. **N.B.** A prolonged modification could result in a change of habitat (notably by changing the sedimentation process).	Expert judgement

V.1.1. Biocenosis of bathyal muds

6 facies

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	NR		NR		NR		Deep habitat not concerned by this pressure	
	Habitat change (to another type)	N	H	N	H	VH	H	A change of substrate would lead to the total loss of the characteristics of the habitat, which is defined by a muddy substrate. By definition, this biocenosis could not recover on a substrate with a different granulometry.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	L	H	L	Extraction would destroy the biocenosis and the characteristic species, which are epigeal and buried. The time needed for mud renewal and recolonization by the characteristic species of the biocenosis is estimated at over 5 to 10 years. Resilience could be longer in the case of weak hydrodynamics or if the habitat is isolated, conditions that limit the provision of larvae. Given the position of this habitat, exposure to extraction pressure is unlikely. **N.B.** Resilience in certain facies (notably facies V.1.1.a, c and d) can be over 25 years due to the long life cycles of the characteristic species.	Expert judgement. Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	NR		NR		NR		Deep habitat is not concerned by this pressure	Expert judgement
	Surface abrasion	L	L	M	L	M	L	Surface abrasion affects the erect species but not the buried species. Resistance is scored low. Resilience is estimated at 5 to 10 years due to the life cycles of the characteristic species. Recovery will take longer in the case of weak hydrodynamics or if the habitat is isolated, conditions that limit the provision of larvae. **N.B.** Resilience in certain facies (notably facies V.1.1.a, c and d) can be more than 25 years due to the long life cycles of the characteristic species.	Expert judgement
	Light sub-surface abrasion	N	L	M	L	H	L	Sub-surface abrasion would destroy the biocenosis, which is characterized by epifauna and shallowly buried endofauna as well as stabilized sediment. Resilience is estimated at 5 to 10 years due to the life cycles of the characteristic species. Recovery will take longer in the case of weak hydrodynamics or if the habitat is isolated, conditions that limit the provision of larvae. **N.B.** Resilience for certain facies (notably facies V.1.1.a, c and d) can be more than 25 years due to the long life cycles of the characteristic species.	Expert judgement
	Heavy sub-surface abrasion	N	L	M	L	H	L		
	Reworking of the sediment	N	L	M	L	H	L	Reworking of the sediment would destroy the biocenosis which is characterized by epifauna and shallowly buried endofauna as well as stabilized sediment. Resilience is estimated at 5 to 10 years due to the lifespans of the characteristic species. Recovery will take longer in the case of weak hydrodynamics or if the habitat is isolated, conditions that limit the provision of larvae.	Expert judgement
	Light deposition	H	L	H	L	L	L	This habitat is located in zones with significant natural siltation. Resistance to the addition of material of the same origin is therefore high. **N.B.** A change in sediment granulometry could result in a change of facies (within the same biocenosis). The hydrodynamic characteristics of this habitat don't allow for the short-term elimination of a deposit of sand, pebble, gravel or rocky material. The addition of a substrate other than the original type would therefore result in a change of habitat.	Expert judgement
	Heavy deposition	N	L	N	L	VH	L	Resistance is scored as none since the addition of too much material would bury the biocenosis. Resilience is scored as none, but nevertheless depends on the capacity of the local hydrodynamics to remove the deposit. **N.B.** The hydrodynamic characteristics of this habitat don't allow for the removal of a sand, pebble, gravel or rocky material deposit in the short term. The addition of a substrate of a type other than the original would therefore result in a change of habitat.	Grey literature on similar habitat and same pressure: Tillin *et al.*, 2010 (habitat "Deep-sea mud") Expert judgement

								N.B. Resilience for certain facies (notably facies V.1.1.a, c and d) can be more than 25 years due to the long life cycles of the characteristic species.	
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	M	L	H	L	L	L	A change in hydrodynamic conditions could result in a facies change within the biocenosis, without a change of the biocenosis itself.	Grey literature on similar habitat and same pressure: Tillin *et al.*, 2010 (habitat "Deep-sea mud") Expert judgement
	Change in suspended solids	H	L	VH	L	VL	L	The sensitivity of this habitat to a temporary change in suspended solids is low. **N.B.** A prolonged change would result in the clogging of organisms.	Expert judgement

V.2.1. Biocenosis of bathyal detritic sands with *Gryphus vitreus*

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	NR		NR		NR		Deep habitat not concerned by this pressure	
	Habitat change (to another type)	N	H	N	H	VH	H	A change of substratum would lead to the total loss of the characteristics of the habitat, which is defined by a detritic sand substrate. By definition, this biocenosis could not recover on a substrate of different granulometry.	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	M	H	H	H	*G. vitreus* belongs to the epifauna that would be removed along with the surface sediment. Resilience is estimated at about 5 years due to this species's low population density. Resilience could be longer in the case of weak hydrodynamics or an isolated habitat, conditions that limit the provision of larvae.	Peer-reviewed publications: Emig, 1985 ; 1989a ; 1989b
	Trampling	NR		NR		NR		Deep habitat is not concerned by this pressure	
	Surface abrasion	N	H	M	H	H	H	As *G. vitreus* is part of the epifauna, individuals would be destroyed by abrasion. Resilience is estimated at about 5 years due to this species's low population density. Resilience could be longer in the case of weak hydrodynamics or an isolated habitat, conditions that limit the provision of larvae.	Peer-reviewed publications: Emig, 1985 ; 1989a ; 1989b
	Light sub-surface abrasion	N	H	M	H	H	H		
	Heavy sub-surface abrasion	N	H	M	H	H	H		
	Reworking of the sediment	N	H	M	H	H	H	A reworking of the substrate would mean the overturning of the pebbles, gravel and debris to which the individuals of *G. vitreus* are attached. Resilience is estimated at about 5 years due to this species's low population density. Recovery could be longer in the case of weak hydrodynamics or an isolated habitat, conditions that limit the provision of larvae.	Peer-reviewed publications: Emig, 1985 ; 1989a ; 1989b
	Light deposition	H	H	H	H	L	H	A light addition of sandy or muddy material could be rapidly eliminated by currents. **N.B.** The hydrodynamic characteristics of this habitat don't allow for the elimination of deposits of pebbles, gravel or rocky materials in the short term. The addition of a substrate of a type other than the original would therefore result in a change of habitat.	Peer-reviewed publications: Emig, 1985 ; 1989a
	Heavy deposition	N	H	M	H	H	H	A heavy addition of sand would result in the rapid impoverishment or elimination of brachiopods due to suffocation or clogging. Resilience is estimated at about 5 years due to this species's low population density. Recovery could be longer in the case of weak hydrodynamics or an isolated habitat, conditions that limit the provision of larvae. **N.B.** The hydrodynamic characteristics of this habitat don't allow for the elimination of deposits of pebbles, gravel or rocky materials in the short term. The addition of a substrate of a type other than the original would therefore result in a change of habitat.	Peer-reviewed publications: Emig, 1985 ; 1989a
Hydrological changes	**Hydrodynamic changes**	N	H	M	H	H	H	This habitat is characterized by moderate to high hydrodynamism, which strongly limits sedimentation. A modification of these conditions would result the loss of the biocenosis.	Peer-reviewed publications: Emig, 1985 ; 1989b

(temporary and/or reversible change)								Resilience is estimated at about 5 years due to this species's low population density. Recovery could be longer in the case of weak hydrodynamics or an isolated habitat, conditions that limit the provision of larvae.	
	Change in suspended solids	M	H	M	H	M	H	This deep habitat is unlikely to be exposed to this pressure. Should it be exposed: resistance to an increase in suspended solids would be moderate (suspension-feeders could be clogged).	Peer-reviewed publications: Emig, 1985 ; 1989b

V.3.1. Biocenosis of bathyal rocks

7 facies

Relationship with other classifications

Category	Pressure	Resist.	CI resist.	Resil.	CI Resil.	Sensit.	CI sensit.	Evidence base	Evidence type
Physical loss (permanent change)	**Habitat loss**	NR		NR		NR		Deep habitat not concerned by this pressure	
	Habitat change (to another type)	N	H	N	H	VH	H	A change in substratum would lead to a complete loss of the characteristics of the habitat, defined by a rocky substrate. By definition, this habitat cannot recover on a different substratum;	Expert judgement. Confidence index is High due to the permanent nature of impacts arising from this pressure.
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	N	H	N	M	VH	M	Removal of the substrate would destroy the biocenosis through the elimination of the characteristic species of this biocenosis (sponges, anthozoa, etc.). Given that (i) these species are long-lived with a low capacity for recruitment and dispersal, and that (ii) this habitat is naturally due to its depth and is therefore very stable, the time needed for the recolonization of the bared substrate by pioneer species and then the characteristic species is more than 25 years.	Peer-reviewed publication: Fabri *et al.*, 2014 Expert judgement Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Trampling	M	L	N	M	H	L	The species characteristic of this biocenosis are mostly erect organisms that would be totally degraded by vertical compression. Recovery would be very long as the characteristic species are long-lived and have a low recruitment capacity.	Peer-reviewed publication: Fabri *et al.*, 2014 Expert judgement
	Surface abrasion	N	L	N	M	VH	L	Surface abrasion would eliminate the erect species characteristic of this habitat. Given that (i) these species are long-lived with a low capacity for recruitment and dispersal and (ii) the habitat is naturally protected owing to its depth and is therefore very stable, the time needed for recolonization of the substrate is more than 25 years.	Peer-reviewed publication: Fabri *et al.*, 2014 Expert judgement
	Light sub-surface abrasion	N	H	N	M	VH	M	Sub-surface abrasion totally strips the rocky substrate, exposing the bare rock and at the same time eliminating all characteristic species. Recovery would take more than 25 years due to the time needed for these long-lived species to recolonize the bare substrate and for biological successions to re-establish the functional biocenosis.	Peer-reviewed publication: Fabri et al., 2014 Expert judgement Resistance's confidence index is High as this pressure affects the habitat in-depth.
	Heavy sub-surface abrasion	N	H	N	M	VH	M		
	Reworking of the sediment	NR		NR		NR		This pressure does not concern bedrock substrates	
	Light deposition	L	L	N	M	H	L	This biocenosis is found in a naturally stable environment. The addition of rocky material, even minimal, would result in the crushing or clogging of most of the epigeal organisms (a light addition would not affect the biocenosis as a whole). In the case of added rocky material, recovery would take more than 25 years due to the time needed for these long-lived species to recolonize the bare substrate and for the biological successions to re-establish the functional biocenosis. Hydrodynamism around this biocenosis is naturally low and would not allow for the elimination of a sedimentary deposit.	Peer-reviewed publication: Fabri *et al.*, 2014 Expert judgement
	Heavy deposition	N	L	N	M	VH	L	The characteristic species would be smothered or crushed by the addition of rocky material. The time needed for recolonization of the bare rocky substrate by pioneer species and then the characteristic species is estimated at more than 25 years. The addition of sediment would result in a change of habitat.	Peer-reviewed publication: Fabri *et al.*, 2014 Expert judgement
Hydrological changes (temporary and/or reversible change)	**Hydrodynamic changes**	NR		NR		NR		Deep habitat not concerned by this pressure	
	Change in suspended solids	L	L	N	M	H	L	This biocenosis is located in a naturally stable environment. A change in suspended solids of short duration would result in the clogging of most of its organisms. As these species are long-lived, recovery would be very slow. **N.B.** A prolonged modification (notably silting) could result in a change of habitat.	Peer-reviewed publication: Fabri *et al.*, 2014 Expert judgement

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6 Annex 1. Resistance, resilience and sensitivity scales

Table 1. Resistance scale

None	Low	Medium	High
Habitat destruction, corresponding to a **total loss** of biotic characteristics (e.g. disappearance of characteristic, structuring and/or engineer species) and abiotic characteristics (e.g. loss of the substratum) **potentially causing a change of habitat type.**	**Severe degradation** of a habitat, corresponding to a **major loss** of its biotic characteristics (e.g. major decline in characteristic, structuring and/or engineer species) and abiotic characteristics (e.g. severe degradation of the substratum) **potentially causing a change of habitat type.**	**Some modification** of the habitat's biotic characteristics (e.g. decline in characteristic, structuring and/or engineer species) or abiotic characteristics (e.g. substratum degradation) **without changing the habitat type.**	**No notable modification** of the biotic or abiotic characteristics of the habitat. Some biological processes, like feeding, respiration and reproduction rates may be affected, but **no effect on population viability** of characteristic, structuring and/or engineer species.

Table 2. Resilience scale

None	Low	Medium	High	Very High
at least 25 years	10-25 years	2-10 years	1-2 years	within 1 year

Table 3. Sensitivity scale defined by the combination of resistance and resilience scores

Resistance \ Resilience	None > 25 yr	Low 10-25 yr	Medium 2-10 yr	High 1-2 yr	Very High < 1 yr
None	Very High	High	High	Medium	Low
Low	High	High	Medium	Medium	Low
Medium	High	Medium	Medium	Low	Low
High	Medium	Medium	Low	Low	Very Low

7 Annex 2. Physical pressures definitions

Definitions from the methodological report La *Rivière et al.*, 2016.

Pressure category	Pressure	Definition
Physical loss (permanent change)	**Habitat loss**	The permanent loss of an existing marine habitat to land or to a freshwater water habitat. All habitats are considered « very highly sensitive » to this pressure, although deep-sea habitats are considered « not exposed ».
	Habitat change (to another type)	The permanent replacement of one marine habitat by another marine habitat, through a change in substratum and/or a change in biological zone (depth band). This can be caused by i) the addition of a new substratum or ii) the extraction of existing substratum permanently exposing a different seabed type. For soft sediment habitats, a change in substratum is defined here as a change in 1 class of the modified Folk classification (see Annex 1). This includes change to artificial substratum. *NB: This pressure can arise from other physical pressures (physical disturbance or hydrological changes) where the magnitude, frequency or duration of exposure leads to a permanent change in habitat type.*
Physical disturbance or damage (temporary and/or reversible change)	**Substratum extraction**	Substratum removal (including of biogenic habitats) which i) exposes substratum of the same type, or ii) temporarily exposes substratum of another type. *NB: This pressure becomes « habitat change » if:* - *The removal exposes substratum of a different type and environmental/hydrodynamic conditions do not allow the newly exposed seabed to return to its original substratum type* - *The depth of extraction leads to a change in bathymetry.*
	Trampling	The vertical compression of the seabed and its associated species.
	Surface abrasion	Mechanical action resulting in disturbance of the seabed surface and associated species (epifauna and epiflora), yet with limited or no loss of substratum.
	Light sub-surface abrasion	Mechanical action resulting in disturbance of the seabed and associated species either i) penetrating the sediment down to 5 cm depth or ii) scouring hard substrata.
	Heavy sub-surface abrasion	Mechanical action resulting in disturbance of the seabed and associated species either i) penetrating the sediment beyond 5 cm depth or ii) scouring hard substrata.
	Reworking of the sediment	The displacement and rearrangement of seabed sediment without any net loss of substratum. This pressure does not apply to bedrock substrates.
	Light deposition	The addition of up to 5 cm of material on the seabed. This pressure concerns the addition i) of material of the same type as the original substratum, or ii) of a different type but where hydrodynamic conditions allow its rapid removal. *NB: This pressure becomes « habitat change » if the original biological communities are not able to recolonize the deposited substratum.*
	Heavy deposition	The addition of more than 5 cm of material on the seabed. This pressure concerns the addition i) of material of the same type as the original substratum, or ii) of a different type but where hydrodynamic conditions allow its rapid removal. *NB: This pressure becomes « habitat change » if the original biological communities are not able to recolonize the deposited substratum*
Hydrological changes	**Hydrodynamic changes**	Changes in water movement associated with tidal streams, currents, or wave exposure for less than 1 year. *NB: This pressure becomes « habitat change » where new hydrodynamic conditions provoke a change in biological composition by changing the immersion/emersion rate, or by changing the nature of the seabed.*
	Change in suspended solids	An increase in sediment or organic matter (particulate or dissolved) concentrations in the water column that leads to a change in water clarity and/or affects filter-feeding organisms, for less than 1 year. *NB: This pressure becomes « habitat change » if an increase in suspended matter permanently changes biological community composition.*

ABSTRACT

This report presents the assessment of French Mediterranean benthic habitats' sensitivity to physical anthropogenic pressures, based on best available knowledge, and in collaboration with scientific experts.

It summarises the methodological framework and limitations, and provides assessment matrices for each habitat. Each matrix displays, for each pressure, a resistance score, a resilience score and a combined sensitivity score, with associated confidence indices, and a description of the evidence base and type.

The generic sensitivity assessments produced by this project aim to serve as a tool in helping the monitoring and management of the marine environment, notably in assessing the risks posed by human activities to benthic habitats.

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