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Aotearoa New Zealand Marine Activity-Pressure Matrix

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Executive summary

The Department of Conservation (DOC) has initiated a multi-stage project to link human activities to marine pressures within a standardised Aotearoa New Zealand Activities-Pressure Matrix. DOC contracted Earth Sciences New Zealand (ESNZ, formerly NIWA) to populate the matrix which describes the links, or relationships, between human activities and their associated pressures. The first stage was completed in May 2025 where 23 high priority activities were populated, representing five broad activity categories:

- Production of living resources (5 activities).
- Extraction (and disposal) of non-living resources (6 activities).
- Energy generation (4 activities).
- Transport (4 activities).
- Other man-made structures (4 activities).

This report outlines the completion of the remaining sections of the activities-pressure matrix, which includes 34 activities across 6 broad activity groups:

- Coastal Management Activities (6 activities).
- Waste Management Activities (7 activities).
- Extraction of Living Resources (12 activities).
- Recreation and Leisure (4 activities).
- Marine Research (4 activities).
- Defence and National Security (1 activity).

An expert evidence workshop was conducted to initially populate the remaining sections of the matrix, which was used to guide a literature review to provide evidence for each activity-pressure relationship. If evidence was incidentally found for activity-pressure relationships not identified during the expert workshop, these pressures were subsequently added to the matrix.

A confidence scoring system was created to evaluate evidence for each activity-pressure relationship. Scores were based on evidence of the relationship between the activity and pressure being available in:

1. New Zealand peer-reviewed publications,
2. New Zealand grey literature (council reports, consultant assessments of environmental effects etc.),
3. international published and grey literature,
4. expert opinion (including opinions from the expert workshop for this project), and
5. no evidence found of the pressure-activity relationship.

Evidence found that supported the relationships populated in the first tranche were additionally added to the matrix, with confidence scores updated accordingly.

The Activity-Pressure matrix is presented as a companion file to this report [Activity Pressure Matrix_v2.xlsx]. The matrix should be regarded as a living document which can be updated as new research and evidence becomes available.

1 Introduction

The coastal marine environment is subject to ongoing and changing pressures from a variety of human activities (Halpern et al. 2007, MacDiarmid et al. 2011a, MacDiarmid et al. 2012), however the full variety of pressures associated with current and future human activities in the marine environment are poorly understood. It is necessary to understand the types of impacts (pressures) of different activities on marine ecosystems to manage ecosystems and mitigate biodiversity loss.

The Department of Conservation (DOC) has initiated a multi-stage project to link human activities to marine pressures within a standardised Aotearoa New Zealand Activities-Pressure Matrix. DOC contracted ESNZ to populate the matrix, which describes the links, or relationships, between human activities and their associated pressures. A later stage of the project will link pressures to species, habitats, and ecosystems in a pressure-biodiversity matrix to identify which components of biological diversity are impacted by each pressure. Management actions will then be linked to different activities to identify how they can be managed to avoid, remedy or minimise impacts of activities on biodiversity.

An aligned project contracted from the Ministry for the Environment (MfE) to ESNZ as part of the broader work programme of the multi-agency Marine Protected Areas Science Advisory Group (consisting of DOC, MfE, and Fisheries New Zealand) will produce a series of layers providing spatially-explicit representations of stressor footprints derived from human activities (e.g., excess sedimentation, turbidity, nutrient levels, and the spread of non-indigenous species). There are strong synergies between the two projects, with this DOC-led project aiming to identify the broad relationships between human activities and the pressures they create on the marine environment, and the MfE-led project collating the spatially-explicit maps of stressor footprints.

Alongside Fisheries New Zealand (FNZ) and MfE, DOC have also developed a Key Ecological Areas (KEA) framework, describing nine criteria that can be used to identify areas of high conservation value. These criteria include: 1) Vulnerability, Fragility, Sensitivity or Slow Recovery; (2) Uniqueness / Rarity / Endemism; (3) Special Importance for Life History Stages; (4) Importance for Threatened / Declining Species and Habitats; (5) Biological Primary Productivity; (6) Biological Diversity; (7) Naturalness; (8) Ecological Function; and (9) Ecological Services (Freeman et al. 2017). In combination, the DOC-led and MfE-led projects contribute to populating the 'Naturalness' KEA criterion.

To inform the suite of marine pressures to be analysed, DOC reviewed Aotearoa New Zealand and international lists of marine activities and pressures, including those contained in the Joint Nature Conservation Committee (JNCC) Pressures Activities Database (Robson et al. 2018), the MarHADs tool (MacDiarmid et al. 2011b), and assessments of anthropogenic threats to New Zealand marine habitats (Baird and Wood 2012; MacDiarmid et al. 2012). DOC's review resulted in a categorised list of 65 activities (grouped within 11 activity categories) and 35 pressures and their definitions (Appendices A & B).

In May 2025 DOC contracted NIWA (now Earth Sciences New Zealand) to begin populating the activities-pressures matrix, initially focussing on 23 high priority activities across five broad activity categories. The aim of this project was to complete the population of the activity-pressure matrix.

The finalized marine activity–pressure matrix will provide a structured, transparent way to understand how different human activities can generate pressures on marine ecosystems. By systematically mapping activities to the pressures they may cause, the matrix helps:

- Identify which activities have the potential to generate certain pressures, supporting early recognition of where ecological risk may arise.
- Compare across activity types, making it easier to prioritise management attention toward activities that contribute to a wider or more significant set of pressures.
- Support integration with related tools (e.g., pressure–biodiversity and management–activity matrices), helping translate pressures into likely ecological impacts and then into appropriate management responses.

While the matrix is a valuable decision-support tool, several cautions should accompany its use:

- **It reflects potential, not guaranteed, pressures.** A “yes” in the matrix indicates that a pressure could arise, but not that it will occur in all circumstances.
- **The strength or magnitude of pressures is not assessed.** The matrix identifies presence or absence of a potential activity–pressure relationship but does not describe how intense, frequent, or spatially extensive that pressure may be.
- **Evidence varies in quality and completeness.** A substantial proportion of activity–pressure linkages are currently supported by expert judgement alone, highlighting areas where further research is needed and where interpretations should be treated with caution.
- **Precautionary coding may overstate some relationships.** The matrix tends to err on the side of precaution—recording “yes” or “maybe” where a pressure could occur even if it is unlikely. This supports conservative decision-making but may be misinterpreted if context is not clearly communicated.
- **It is a living document.** The matrix is intended to be updated as definitions evolve, new evidence emerges, and expert workshops refine earlier assessments. Ongoing review is important, especially where activity definitions or technologies change.

When applying the activity–pressure matrix, these cautions mean it should be treated as an initial screening tool rather than a direct indicator of ecological risk. Identifying a potential pressure means only that it could occur, not that it will, nor how strong or widespread it might be. Because the matrix does not capture the intensity, frequency, duration, or specific spatial footprint of an activity, further information is always required to determine whether a pressure is likely to be expressed in a particular location. Likewise, the ecological relevance of any pressure depends on whether biodiversity features that are present in the area are susceptible to it. The activity–pressure matrix is therefore a structured starting point that must be supplemented with contextual activity data, local environmental information, and biodiversity sensitivity assessments before informing management decisions.

2 Methodological approach and outcomes

The Activity-Pressure Matrix is provided as a companion file to this report ‘Activity Pressure Matrix_v2.xlsx’. This file is divided into the following tabs:

- Workshop matrix – results of two expert opinion workshops.
- Info – definition of matrix display components.
- Matrix – fully populated Activity-Pressure Matrix.
- Evidence table – list of references providing evidence for each of the identified activity pressure relationships (also provided in Appendix C).
- Evidence table full – the full matrix evidence table including cell numbers without literary evidence. This table should be retained to facilitate the addition of future evidence.

2.1 Expert workshop

A workshop was held on 3 September 2025 to determine whether each type of pressure was anticipated to be associated with each activity. Decisions were based on the expert opinion and knowledge of the workshop participants (ESNZ: Carolyn Lundquist, Emily Douglas; DOC: Shane Geange; Otago Regional Council/Coastal Special Interest Group: Sam Thomas; Fisheries New Zealand: Karen Tunley) (Figure 2-1). These initial relationships were used to inform the literature review. Blank cells indicate no known relationship, ‘maybe’ indicates a possible relationship, and ‘y’ indicates an activity-pressure relationship is expected to exist.

Activity Category	Pressure Theme	Hydrological changes (ishore/local)						Pollution and other chemical changes						Physical loss			
		Temperature changes - local	Salinity changes - local	Water flow (e.g. - tidal current) changes - local	Emergence regime changes - local	Oxygen changes	pH changes	Wave exposure changes - local	Non-synthetic compound contamination - Transition elements & organo-metals	Non-synthetic compound contamination - Hydrocarbon & PAH Contamination	Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals)	De-oxygenation	Nutrient enrichment	Organic enrichment	Radionuclide contamination	Physical loss (to land or freshwater habitat)	Physical change (to another seabed type)
Human Activities	Harvesting - seaweed and other sea-based food (e.g., paua, kina, mussels, pipi etc.)																
	Extraction of genetic resources e.g. bioprospecting & mariculture (biotech technology)									y	y	y	y	y			
4: Production of living resources	Aquaculture - fin-fish			y		y		y	y		y	y	y		y	y	
	Aquaculture - shellfish			y	y	y	maybe	y	y		y	y	y				y
	Aquaculture - macro-algae			y		y	y	y			y	y	y				y
	Ocean fertilization					y	y		y			y	y	y			
	Translocations and transplanting			maybe	y	y	maybe	y				y	y	y			y
5: Extraction (and disposal) of non-living resources	Extraction - sand and gravel (aggregates)			y	y			y	y	y							y
	Extraction - minerals			y	y			y	y	maybe	maybe	y	y	y			y
	Extraction - maintenance dredging			y	y			y	y	maybe	maybe						y
	Salvage operations								y	y	y		y	y	y		y
	Extraction - water (abstraction)	y	y	y	y	y	y	y				y	y	y			

Figure 2-1: Example of the populated matrix from expert workshop.

2.2 Literature review

Evidence of each identified activity-pressure relationship was gathered using google searches of key words, as well as collated publications and work known to the authors. Searches were conducted for each activity by firstly starting with broad search phrases, e.g., ‘environmental impacts of [activity]’, or more specific terms such as ‘effects of [activity] on [pressure]’. When needed, the words ‘in New Zealand’ were added to search terms to specifically target New Zealand literature. The reference sections of relevant publications were reviewed to identify further relevant evidence.

2.3 Matrix population and scoring

The matrix consists of a table enabling visual demonstration of the pressures caused by each activity and the evidence-based confidence in each relationship (Figure 2-2). The matrix can be read horizontally to observe the pressures caused by each activity, or vertically to identify which activities contribute to a pressure of interest. Matrix cells contain numbers linking to the ‘Evidence table’ which consists of a list of references that provide evidence of each activity-pressure relationship, and the evidence type (Figure 2-3). References and evidence types are listed horizontally for each pressure, and a ‘Best’ evidence column indicates the highest evidence type of those included for each pressure (i.e., a mixture of evidence types is common). Up to six references were included for each activity-pressure relationship, and for some only one or two were found.

Activity Category		Pressure Theme	Hydrological changes (inshore/local)						Pollution and other chemical changes						Physical loss		
			Temperature changes - local	Salinity changes - local	Water flow (e.g., tidal current) changes - local	Emergence regime changes - local	Oxygen changes	pH changes	Wave exposure changes - local	Non-synthetic compound contamination - Transition elements & organo-metals	Non-synthetic compound contamination - Hydrocarbon & PAH Contamination	Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals)	De-oxygenation	Nutrient enrichment	Organic enrichment	Radionuclide contamination	Physical loss (to land or freshwater habitat)
1: Coastal Management Activities	Coastal defence & land claim protection (incl. beach realignment)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Coastal boat ramps, docks, ports & marinas	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	Forestry	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
	Farming and Agriculture	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
	Strandline clearance	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
	Reclamations and causeways	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186
2: Waste management activities	Residential and urban wastewater (incl storm water) discharges	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
	Sewage disposal	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254
	Industrial & agricultural liquid discharges	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288
	Waste disposal - munitions (chemical & conventional)	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322
	Dredge & spoil disposal	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356
	Thermal effluent discharges	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
	Rocket abandonment	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424

Figure 2-2: Populated activity pressure matrix. Excerpt from matrix showing colour-coded cells with reference numbers corresponding to evidence table.

	A	B	C	D	E	F	G	H	I	J	K	L		
	Activity Group	Activity	Pressure	Matrix cell identifier	Best	Ref 1 Evidence type identifier	Ref 1	Ref 2 Evidence type identifier	Ref 2	Ref 3 Evidence type identifier	Ref 3	Ref 4 Evidence type identifier		
2	1: Coastal Management Act	Coastal defence & land c	Temperature changes - local	1	3	3	Speybroeck							
3	1: Coastal Management Act	Coastal defence & land c	Water flow (e.g., tidal current) changes - loc	3	3	3	Saengsupai	3	da Silva RF		3	Gittman RK		
4	1: Coastal Management Act	Coastal defence & land c	Emergence regime changes - local	4	3	3	Saengsupai			3	Gittman RK	3	Dugan, J.E.,	
5	1: Coastal Management Act	Coastal defence & land c	Oxygen changes	5	3	3	Saengsupai			3	Dugan, J.E.,			
6	1: Coastal Management Act	Coastal defence & land c	Wave exposure changes - local	7	3	3	Saengsupai			3	da Silva RF		3	Kuang C, Cl
7	1: Coastal Management Act	Coastal defence & land c	Non-synthetic compound contamination - Tr	8	3	3	Speybroeck							
8	1: Coastal Management Act	Coastal defence & land c	Non-synthetic compound contamination - H	9	3	3	Speybroeck							
9	1: Coastal Management Act	Coastal defence & land c	De-oxygenation	11	3	3	Saengsupai			3	Dugan, J.E.,			
10	1: Coastal Management Act	Coastal defence & land c	Organic enrichment	13	3	3	Saengsupai			3	Martin, D.,		3	Dugan, J.E.,
11	1: Coastal Management Act	Coastal defence & land c	Physical loss (to land or freshwater habitat)	15	3	3	de Schippe			3	Cantasano,		3	Dugan, J.E.,
12	1: Coastal Management Act	Coastal defence & land c	Physical change (to another seabed type)	16	3	3	Saengsupai			3	Gittman RK		3	Bulleri F, Cl
13	1: Coastal Management Act	Coastal defence & land c	Temporary and/or reversible change of habi	17	3	3	Speybroeck			3	Defeo, O., M			
14	1: Coastal Management Act	Coastal defence & land c	Disturbance of the surface of the seabed	18	3	3	Saengsupai			3	de Schippe		3	Speybroeck
15	1: Coastal Management Act	Coastal defence & land c	Penetration and/or disturbance of the subst	19	3	3	Saengsupai			3	Speybroeck			
16	1: Coastal Management Act	Coastal defence & land c	Changes in suspended solids	20	3	3	Saengsupai			3	Saengsupai		3	de Schippe
17	1: Coastal Management Act	Coastal defence & land c	Siltation rate changes	21	3	3	Saengsupai			3	da Silva RF		3	Saengsupai
18	1: Coastal Management Act	Coastal defence & land c	Underwater noise changes	24	3	3	Popper, A.,			3	Speybroeck			
19	1: Coastal Management Act	Coastal defence & land c	Barrier to species movement	26	3	3	Gittman RK			3	de Schippe		3	Dugan, J.E.,
20	1: Coastal Management Act	Coastal defence & land c	Visual disturbance	28	3	3	Speybroeck							
21	1: Coastal Management Act	Coastal defence & land c	Genetic modification & translocation of ind	29	3	3	Bulleri F, Cl							
22	1: Coastal Management Act	Coastal defence & land c	Introduction or spread of non-indigenous sp	30	3	3	Saengsupai			3	Gittman RK		3	Bulleri F, Cl
23	1: Coastal Management Act	Coastal defence & land c	Mortality	34	3	3	Saengsupai			3	Saengsupai		3	Bulleri F, Cl
24	1: Coastal Management Act	Coastal boat ramps, doc	Water flow (e.g., tidal current) changes - loc	37	3	3	da Silva RF			3	Gittman RK		3	Bulleri F, Cl

Figure 2-3: Evidence table. Excerpt from reference information illustrating ranking of each evidence type. Best column indicates the best evidence type and corresponds to the colours in the table.

The evidence in the matrix was colour-coded according to the evidence type available to support each activity-pressure relationship, as outlined in Table 2-1. Activity-pressure relationships that were incidentally identified during the literature search but not identified during the expert workshop were subsequently added to the matrix. Where a relationship was identified during the expert workshop, but no additional evidence was found, evidence was scored as ‘expert opinion’. For some activity–pressure relationships that had been populated during the first phase of this project, additional evidence uncovered during the literature review was added to the evidence table, and the matrix confidence scores were updated accordingly.

Table 2-1: Colour coding of evidence types.

Identifier	Evidence type
1	New Zealand published literature
2	New Zealand grey literature (council reports, consultant assessments of environmental effects etc.)
3	International published and grey literature
4	Expert opinion. i.e., workshop identified the presence of the stressor type, but no evidence was found.
-	No known relationship

Some New Zealand published literature and New Zealand grey literature, particularly those reviewing environmental effects, drew on overseas studies or literature examining the impacts of activities in other countries (e.g., Hale et al. 2024). This type of evidence was classified as New Zealand literature but is denoted with an asterisk (*) in the evidence table.

2.4 Alterations to previous matrix and activity/pressure definitions

Detailed definitions for each activity and pressure were developed by the Department of Conservation based on those published by the JNCC (Robson et al. 2018). Following the initial phase, and as this project progressed, necessary alterations to the activity and pressure definitions became apparent. Some of these changes were made following discussions during the expert workshop, and others reflect learnings from the literature review.

The definitions of the activity groups that were merged during the expert workshop are presented in the appendix and carried through to the matrix. The following sections detail these changes by category.

2.4.1 Appendix A changes to activity definitions

Energy generation

- Renewable energy – offshore wind (construction, operation & maintenance, decommissioning); merged definitions.
- Renewable energy – wave/tidal energy (construction, operation & maintenance, decommissioning); merged definitions. Note: title updated to include tidal energy.
- Marine hydrocarbon extraction – (construction, operation & maintenance, decommissioning); merged definitions.

Transport

- Vessel berths and vessel moorings; merged definitions.

Recreation & leisure

- Ecotourism – Definition altered to specify inclusion of vessel operations.

Extraction of living resources

- Fishing – seines (encircling); removed ‘excluding beach seining’ from title. Added ‘includes ring seines’ to the definition because they are included in Hauraki Gulf Marine Spatial Plan. Definition altered to specify inclusion ring seining (Hauraki Gulf), and that these methods do not typically involve contact with the seabed: “A method of fishing that uses a large net, called a seine, to encircle and capture schools of fish. This technique is commonly used in both coastal and open ocean environments but typically does not involve contact with the seabed. Includes ring seines.”
- Fishing – beach seines; title altered to include Danish seines. These activities were grouped since they are both bottom contact fishing methods. Updated definition: “Beach seine nets that are deployed from the shore and dragged back to the beach. Often used to target pilchards, mackerel and kahawai. Danish seine is a

demersal fishing method, operated from a vessel, where gear is set by attaching one weighted rope to an anchor buoy and then laying out the rope, net, and second weighted rope in a wide circle as the vessel steams around; once the circle is complete, the ropes are hauled together, herding fish inward, after which towing stops and the net is winched aboard to gather the fish concentrated by the closing ropes.”

- Fishing – diving and snorkelling. In the workshop it was discussed whether this included vessel impacts. However, for the literature review it made more sense to have specific effects of divers/snorkellers separate, and to keep boat effects in the ‘Recreation & leisure > Boating’ or ‘Transport’ categories. This way the effects of shore diving and snorkelling are still captured.

Waste management activities

- Rocket jettisoning: name and definition updated to reduce ambiguity (i.e. intentional disposal versus part of the activity) and align with terminology used in the EEZ Act: Includes debris and deposition of material in the marine environment as a byproduct of space launch activities.

Other man-made structures

- Submarine cables and pipelines - operations, maintenance, decommissioning; merged definitions.

2.4.2 Appendix B changes to pressure definitions

Physical damage (reversible change)

- Temporary and/or reversible change of habitat structure (extraction); definition updated to include impacts on foreshore, beach and dune environments. “Includes disturbance to foreshore, beach or dune habitats.”
- Disturbance of the surface of the seabed; definition updated to include impacts on foreshore, beach and dune environments. “Includes erosion or disturbance to surface substrate in foreshore, beach or dune environments.”
- Penetration and/or disturbance of the substrate below the surface of the seabed; definition updated to include impacts on foreshore, beach and dune environments. “Includes erosion or disturbance to sub-surface substrate in foreshore, beach or dune environments.”

Other physical pressures

- Underwater noise changes; changed title to ‘Noise changes’. Added to definition; ‘Includes noise produced by shore-based activities such as vehicle use and coastal tourist activities.’

3 Next steps and concluding remarks

It is recommended that a targeted quality-assurance review of matrix scoring is undertaken, with a particular focus on the substantial proportion of cells currently supported only by expert opinion. This review will help identify where definitions need refinement, where evidence gaps remain, and where precautionary “yes/maybe” scores may warrant reconsideration.

In parallel, it is recommended that an approach is developed for assessing the relative strength of each activity–pressure relationship, enabling the matrix to move beyond binary presence/absence and toward a more nuanced, evidence-based representation of impact magnitude and likelihood.

This work will complement matrices yet to be developed (pressure – biodiversity, management – activity) that will stand together as a tool to support marine spatial planning in Aotearoa New Zealand. Because research and knowledge about impacts in Aotearoa New Zealand’s marine environment are continually developing, the matrix should be regarded and maintained as a living document.

4 Acknowledgements

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Appendix A Description of Activities used in the Aotearoa New Zealand Activity-Pressure Matrix

An initial list (and definitions) of 65 activities was provided by DOC. Fourteen activities were merged into five broader activity categories (e.g., Submarine cables and pipelines – operations, maintenance and decommissioning instead of three individual categories), reflecting evidence that was difficult to differentiate between impacts during the life cycle of an activity. Merged activities are noted by shaded cells. This resulted in a total of 56 activities in the matrix.

Category Title	Activity Title	Activity Description
Coastal Management Activities	Coastal defence & land claim protection (incl. beach replenishment)	Development and maintenance of coastal defences including management of beaches, bunds, ditches/drainage, managed realignment sites, beach/sediment recharge or on-going sediment feeding, management of vegetation, sand dune stabilisation. Includes consideration of vessels/machinery/vehicles and materials associated with activity.
	Coastal boat ramps, docks, ports & marinas	Building, expanding, and upgrading coastal boat ramps, docks, berths, ports and marinas. This includes creating new facilities as well as improving existing structures. Includes consideration of vessels/machinery/ vehicles, and materials associated with activity e.g., jack-up barges, piling plant, dredgers, barges.
	Forestry	Considers (i) the effects of removing existing forests and (ii) afforestation (the planting of trees). Includes consideration of machinery/vehicles and materials associated with activity.
	Farming and Agriculture	The use of coastal areas for grazing of domestic animals (e.g., cows, sheep and horses) and drainage and fertilisation of coastal areas to improve grazing and agriculture. Includes consideration of machinery/vehicles and materials associated with activity.
	Strandline clearance	Considers the removal of natural debris, such as seaweed and driftwood, that accumulates along the high tide line on beaches. The process of clearing the strandline is often done to maintain the cleanliness and appearance of beaches, but it can also impact the local ecosystem, as the debris provides habitat and nutrients for various coastal species.
	Reclamations and causeways	This activity considers reclaiming land from below the high-water mark to create new areas for quaysides, coastal defences, or port estates. This often involves building new walls or hard defences and filling in behind them to raise the land level. It also considers the vessels, machinery, vehicles, and materials needed for these activities.

Category Title	Activity Title	Activity Description
Waste management activities	Residential and urban wastewater (incl. storm water and aquarium) discharges	This considers the construction, maintenance, and ongoing use of outfall pipes. These pipes could discharge liquids at varying temperatures, salinities, oxygen, nutrient concentrations. Includes consideration of vessels/machinery/vehicles and materials associated with construction, maintenance operational usage of infrastructure.
	Sewage disposal discharges	The release of wastewater, which includes sewage, from sewage treatment facilities. This wastewater can be treated or untreated.
	Industrial & agricultural liquid	The release of liquid waste products from industrial and agricultural activities into the marine environment. Discharges can contain chemical contaminants, organic matter and thermal pollution. These discharges can have significant environmental impacts if not properly managed.
	Waste disposal - munitions (chemical & conventional)	Sites where military ordnance has been discarded. These sites can pose environmental and safety risks due to the potential for chemical leaching and unexploded ordnance. Significant quantities of munitions were disposed of in the ocean around New Zealand after World War II, with continued disposal of obsolete or surplus munitions in subsequent years. Known sites include the Hauraki Gulf and Wellington harbour.
	Dredge & spoil disposal	The disposal of dredged materials originating from the bottom of water bodies, like rivers, lakes and harbours.
	Thermal effluent discharges	The discharge of heated water or steam into the environment, typically into rivers, lakes, or oceans, after being used in the cooling processes, for example in thermal power stations and geothermal power plants.
	Rocket jettisoning	Refers to the practice of jettisoning rocket stages and other space debris over the ocean after they have been used. This is often done to minimize the risk of jettisoned rocket stages causing damage on land. Includes deposition of material in the marine environment as a byproduct of space launch activities.
Extraction of living resources	Fishing – bottom trawling	The use of large, weighted nets dragged along the sea floor to catch fish and other marine organisms. This technique targets species that live near or on the bottom of the ocean, such as flatfish, orange roughy, and squid. Includes single otter trawl, twin otter trawl and beam trawl.
	Fishing – dredging	The dragging of a heavy frame with an attached net or metal mesh bag along the sea floor to collect shellfish and other benthic organisms. This technique is commonly used to harvest species like scallops, oysters, and clams.

Category Title	Activity Title	Activity Description
	Fishing – midwater trawling	The towing of large net through the water column, to target species that live in the midwater zone, such as mackerel, hoki, and squid.
	Fishing – traps (potting/creeling)	This activity includes the use of pots, creels and traps, as well as fyke nets and other similar gear.
	Fishing – spear fishing	A method of fishing where individuals use a pole spear (Hawaiian sling) or speargun to catch fish. This technique is typically done while snorkelling or diving, and commonly targets snapper, kingfish and butterfish.
	Fishing – set netting	The use of a net that is anchored or staked in place in the water to catch fish as they swim into it. This technique is commonly used in both coastal and freshwater environments to target a variety of fish species, including snapper, flounder and mullet. Non-target species, including protected species, can become entangled in set nets.
	Fishing - lines	The targeted removal of fish species using static hooks and lines that are left in place for a period before being recovered to retrieve the caught fish. Includes hand lines, rod and reel and longlines. Excludes beach seine.
	Fishing - seines (encircling)	A method of fishing that uses a large net, called a seine, to encircle and capture schools of fish. This technique is commonly used in both coastal and open ocean environments but typically does not involve contact with the seabed. Includes ring seines.
	Fishing – Danish and beach seines	Beach seine nets that are deployed from the shore and dragged back to the beach. Often used to target pilchards, mackerel and kahawai. Danish seine is a demersal fishing method, operated from a vessel, where gear is set by attaching one weighted rope to an anchor buoy and then laying out the rope, net, and second weighted rope in a wide circle as the vessel steams around; once the circle is complete, the ropes are hauled together, herding fish inward, after which towing stops and the net is winched aboard to gather the fish concentrated by the closing ropes.”
	Fishing - Diving and snorkelling	This activity involves the collection of target species by divers, snorkelers such as scallops, lobster and kina. Includes recreational diving but excludes spear fishing.
	Harvesting – seaweed and other sea-based food (e.g., pua, kina, mussels, pūpū etc.)	The collection of marine organisms by hand, excluding diving and snorkelling, without the use of nets, traps, lines or other fishing gear. This technique is often used for collecting shellfish, seaweed, and other easily accessible marine resources.
Extraction of genetic resources e.g., bioprospecting (<i>blue technology</i>)	Bioprospecting involves collecting natural materials and developing new products from useful organic compounds found in biological resources. It also considers the vessels, machinery, vehicles, and materials needed for these activities.	

Category Title	Activity Title	Activity Description
Production of living resources	Aquaculture - finfish	This activity considers finfish grown in cages/nets suspended from surface structures or lines. These structures may be anchored to the seabed. It also considers the vessels, machinery, vehicles, and materials needed for these activities.
	Aquaculture - shellfish	This activity considers shellfish (mussels, oysters) grown on racks or trestles in the intertidal or grown on ropes/nets suspended from surface structures or lines. These structures may be anchored to the seabed. It also considers the vessels, machinery, vehicles, and materials needed for these activities.
	Aquaculture – macro-algae	This activity considers seaweed grown on ropes/nets suspended from surface structures or lines. These structures may be anchored to the seabed. It also considers the vessels, machinery, vehicles, and materials needed for these activities.
	Ocean fertilization	Adding nutrients (e.g., iron, nitrogen and/or phosphorous) to the ocean to stimulate the growth of phytoplankton and enhance marine productivity. It also considers the use of vessels to transport and disperse nutrients over targeted areas, and wave pumps and floating tubes that bring nutrient-rich deep water to the surface.
	Translocations and transplanting	This activity considers transplanting or translocating marine organisms to bolster local populations. Examples include replanting seagrass in areas where it has been lost or seeding shellfish beds to enhance and restore local populations.
Extraction (and disposal) of non-living resources	Extraction – sand and gravel (aggregates)	This activity involves removing sand and gravel from the seabed using suction or grab dredgers for construction and beach replenishment. This activity is associated with numerous vessel movements, sediment alteration and resuspension.
	Extraction – minerals	This activity considers the extraction of minerals from the seabed such as polymetallic nodules and includes the use of seafloor mining devices, riser and lifting systems and mining support vessels.
	Extraction – maintenance dredging	This activity includes the periodic or regular removal of material from previously dredged areas (e.g., berths, channels, marinas). The method of dredging may vary, and material may be removed for disposal elsewhere or redistributed within the immediate area. Includes consideration of vessels/machinery/vehicles associated with activity.
	Salvage operations	Includes salvage of vessels or infrastructure, e.g., from oil and gas, wrecked on or near the coast. This activity considers the pressures associated with salvaging, including the removal of wrecked structures and pressures caused by supporting vessels.
	Extraction – water (abstraction)	The temporary or permanent removal of water from the marine environment.

Category Title	Activity Title	Activity Description
	Addition - water	Addition of water (e.g., through freshwater diversion) to the marine environment
Energy generation	Renewable energy – offshore wind construction, operation and maintenance, decommissioning (not including cables)	<p>Construction activities include seabed preparation (possibly dredging), cuttings/dredging disposal, piling, drilling, anchoring, mooring, vessel movement, vessel discharges/emissions, installation of scour protection, introduction of artificial substrate.</p> <p>Operation and maintenance activities include regular vessel movement, vessel discharges, rotor sweep, lighting, presence of turbine and foundation structures. Also includes use of jack up barges for maintenance and deposition of additional scour protection.</p> <p>Decommissioning activities include vessel movement, vessel discharges, use of jack up barges, removal of structures/scour protection and associated habitat, use of explosives, cutting, drilling, excavation of seabed close to foundations.</p> <p>For cabling, please refer to the separate activity which should be considered as part of this activity.</p>
	Renewable energy – wave/tide energy construction, operation and maintenance, decommissioning (not including cables)	<p>Construction activities include seabed preparation (possibly dredging), cuttings/dredging disposal, mooring, anchoring, piling, drilling, vessel movement, vessel discharges/emissions, installation of scour protection, introduction of artificial substrate.</p> <p>Operation and maintenance activities include vessel movement, vessel discharges, lighting, operation of devices.</p> <p>Decommissioning activities include vessel movement, vessel discharges, removal of structures/cables and associated habitat, use of explosives, cutting, drilling.</p> <p>For cabling, please refer the separate activity which should be considered as part of this activity.</p>
	Marine hydrocarbon extraction - exploration	This activity includes searching for oil and natural gas deposits beneath the ocean floor using controlled-source electromagnetic surveys and exploratory drilling. For seismic surveys, please see and include the separate activity.
	Marine hydrocarbon extraction - construction, operation & maintenance, decommissioning (not including pipelines)	Construction activities include the construction of oil and gas infrastructure in the marine environment including, but not limited to, the installation of rock dump to stabilise jack up rigs, cementing, introduction of other protection material such as concrete mattresses, matting and gravel, the temporary installation of infrastructure (such as pipelines, debris baskets, etc), drilling wells and plugging and abandonment, accidental effects, vessel movement, installation of subsea infrastructure etc.

Category Title	Activity Title	Activity Description
		<p>Operation and maintenance activities include production/operation, with routine supply, return of wastes to shore, power generation, chemical use, produced water, and re-injection of reservoirs.</p> <p>Decommissioning activities include the plugging and abandonment of wells, removal of structures and associated habitat, use of explosives, cutting, drilling. Disturbance of drill arisings and cuttings. Placement of rock to cover remaining structures or to provide base for jack-up legs. Includes operation by supporting vessels, vessel discharges, use of ROVs, lifting and jack-up rigs.</p> <p>For pipelines, please see and include the separate activity.</p>
Transport	Shipping – port operations	Includes trans-shipment of cargo, loading and unloading of vessels, landside handling, logistics and on-ward transportation e.g., road, rail within port estate. Includes handling of hazardous cargo. Includes consideration of vessels/machinery/vehicles associated with activity.
	Vessel berths and moorings	<p>Operational use of berths and the presence of these structures and vessels using them. Includes consideration of vessels when berthing/berthed.</p> <p>Use of vessel moorings and activity associated with mooring a vessel. Mooring is a temporary or permanent structure to which a vessel may be secured, e.g., swing mooring, trot, fore and aft mooring, pile mooring. Includes consideration of vessels when mooring or moored.</p>
	Anchoring	Covers activity of anchoring generically and use of allocated anchorage areas where vessels are permitted to anchor inside and outside harbours/ports. Including consideration of vessels when anchoring, anchored or weighing anchor
	Shipping – general (at sea)	Movement of all commercial or ‘non-recreation’ vessels of all scales, from container ships, tankers, cruise liners to pilot vessels, tugs and small watercraft, (including fishing vessels when not fishing). Includes operational, incidental and accidental discharges/emissions from all types of vessels, including noise pollution, exhaust fumes, wastes and wastewater, sewerage, oils, lubricants and chemicals, marine litter and other flotsam and jetsam.
Recreation & leisure	Coastal tourist sites (public beaches & resorts)	Includes activities where a vessel is not used. Includes swimming, surfing and event type activities (e.g., beach clean-ups, festivals).
	Ecotourism (whale watching, scuba diving etc)	Exploration and appreciation of marine environments while minimizing environmental impact and promoting conservation. Examples include snorkelling and diving, whale and dolphin watching, kayaking and paddle boarding, marine biology tours. Includes vessel operations.

Category Title	Activity Title	Activity Description
	Boating	Recreating on a boat. Encompasses a wide range of activities, including cruising, sailing, motorboating, kayaking and canoeing, and yachting.
	Vehicle use on the foreshore	Operation or parking of vehicles on the area of land that lies between the high and low tide marks along a coast. Vehicles can damage sensitive ecosystems, such as dunes and tidal flats, and disturb wildlife.
Marine research & exploration	Physical sampling	Physical sampling of the seabed, foreshore (intertidal) and/or water column in situ using a variety of marine survey techniques. It also considers the vessels, vehicles, and materials needed for these activities.
	Remote sensing	This includes methods of obtaining data or images from a distance, e.g., from satellites, AUV or aircraft and includes LIDAR. It also considers the vessels, vehicles, and materials needed for these activities.
	Seismic surveys	Any survey that uses airguns, including 2D/3D/4D and OBC (On Bottom Cabling) surveys and any similar techniques that use airguns. It also considers the vessels, vehicles, and materials needed for these activities.
	Sonar surveys	The use of echo sounders underwater for research or exploratory purposes as well as military purposes. It also considers the vessels, vehicles, and materials needed for these activities.
Defence and national security	Military activities	Military exercises undertaken that involve the use of the sea surface (e.g., boats, surface explosions and surface target towing), water column (e.g. submarine use and diving) or seabed (e.g., installation and operation of seabed mounted equipment, seabed sampling and degaussing).
Other man-made structures	Submarine cables and pipelines - operations, maintenance, decommissioning	<p>Includes the laying cables and pipelines. Methods vary depending on the water depth and include laying either directly on the seabed, covered with material for protection, or buried. Seabed trench excavation through ploughing and hydraulic jetting is frequently used for burial. Protection can also be added where there is a reasonable risk of damage by rock placement on the seabed over the cable or pipeline. It also considers the vessels, vehicles, machinery and materials needed for these activities.</p> <p>This activity includes the retrieval or access of cables and pipelines for repairs or maintenance and their replacement following maintenance. The activity also includes vessel movement and anchoring during the operation.</p> <p>Includes the removal or decommissioning of a cable or pipeline when it is no longer needed. When removal is deemed appropriate, cables and pipelines may be retrieved through grabbing and raising.</p>

Category Title	Activity Title	Activity Description
		The decommissioning process can include vessel movements and anchoring along the cable or pipeline route.
	Gas storage operations (carbon capture & natural gas storage)	This activity includes gas injection into submarine storage sites, often referred to as subsea gas storage. It includes injecting gases like carbon dioxide (CO ₂) or natural gas into geological formations beneath the seabed for both carbon capture and storage (CCS) and natural gas storage. It also considers the vessels, vehicles, machinery and materials needed for these activities.
	Artificial reefs and other environmental structures	Artificial reefs are human-made structures placed underwater to promote marine life. They can be made from a variety of materials, including concrete, steel, tires, natural materials (e.g., rocks, shells), specialized structures designed to mimic natural reef formations and sunken vessels. It also considers the vessels, vehicles, machinery and materials needed for the placement and maintenance of artificial reefs.
	Cultural & heritage sites/structures (e.g., wrecks, archaeological sites etc.)	Includes the presence of wrecks and archaeological sites.

Appendix B Description of Pressures used in the Aotearoa New Zealand Activity-Pressure Matrix

Category Title	Pressure Title	Pressure Description
Local hydrological changes (within a specific, often geographically limited, area)	Temperature changes - local	Events or activities that change local water temperature, like thermal discharges from power stations or temperature changes in the vicinity of subsea power cables, can affect the area around the source. This does not include regional temperature changes from global warming.
	Salinity changes - local	Events or activities increasing or decreasing local salinity. This includes freshwater discharges from pipelines that reduce salinity; hydro-morphological modification (e.g., navigational dredging) if this alters the halocline, or erection of barrages or weirs that alter freshwater/seawater flow/exchange rates.
	Water flow (e.g., tidal current) changes - local	Changes in water movement associated with tidal streams (the rise and fall of the tide, riverine flows), prevailing winds and ocean currents. The pressure is associated with activities that have the potential to modify hydrological energy flows. For example, tidal energy generation devices remove (convert) energy, and such pressures could be manifested leeward of the device; dredging may deepen and widen a channel and therefore decrease the water flow; canalisation &/or structures may alter flow speed and direction; managed realignment (e.g., seawalls) can alter tidal streams.
	Emergence regime changes - local	Events or activities that change how long and how often intertidal species are underwater or exposed during tides. For example, beach re-profiling could change gradients and therefore exposure times, dredging may change the natural tidal range, managed realignment can reduce the intertidal area. This excludes pressure from sea level rise.
	Oxygen changes	Changes in the oxygen levels in seawater, including marine deoxygenation (decreases in oxygen levels). Anthropogenic-induced marine deoxygenation can result from excessive nutrient additions (like nitrogen and phosphorous) into the marine environment (e.g., from agricultural runoff and wastewater), which can lead to algal blooms which consume oxygen when they decompose.
	pH changes	Activities that result in changes in the pH of marine waters. This includes the run-off of nitrogen-based fertilizers, which can indirectly affect pH levels through processes like eutrophication and the discharge of untreated or partially treated wastewater into the ocean, which can introduce various chemicals that alter the pH of marine waters.

Category Title	Pressure Title	Pressure Description
	Wave exposure changes - local	Local changes in length, height and frequency of waves. Exposure on an open shore is dependent upon the distance of open seawater over which wind may blow to generate waves (the fetch) and the strength and incidence of winds. Anthropogenic sources of this pressure include artificial reefs, breakwaters, barrages, wrecks that can directly influence wave action or activities that may locally affect the incidence of winds, e.g., a dense network of wind turbines may have the potential to influence wave exposure, depending upon their location relative to the coastline.
Pollution and other chemical changes	Non-synthetic compound contamination - Transition elements & organo-metals	The increase in the levels of transition elements compared with background concentrations, due to their input from land/riverine sources, by air or directly at sea. For marine sediments the main elements of concern are Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead and Zinc. Organo-metallic compounds such as the butyl tins (Tri butyl tin and its derivatives). These can be highly persistent and chronic exposure to low levels has adverse biological effects (e.g., imposex in molluscs).
	Non-synthetic compound contamination - Hydrocarbon & PAH contamination	Increases in the levels of these compounds compared with background concentrations. Naturally occurring compounds, complex mixtures of two basic molecular structures: straight chained aliphatic hydrocarbons (relatively low toxicity and susceptible to degradation) and multiple ringed aromatic hydrocarbons (higher toxicity and more resistant to degradation). These fall into three categories based on source (includes both aliphatics and polyaromatic hydrocarbons): petroleum hydrocarbons (from natural seeps, oil spills and surface water runoff), pyrogenic hydrocarbons (from combustion of coal, woods and petroleum) and biogenic hydrocarbons (from plants & animals). Ecological consequences include tainting, some are acutely toxic, and can cause carcinomas and growth defects.
	Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals)	Increases in the levels of these compounds compared with background concentrations. Synthesised from a variety of industrial processes and commercial applications. Chlorinated compounds, which include polychlorinated biphenols (PCBs), dichlor-diphenyl-trichloroethane (DDT) & 2,3,7,8- tetrachlorodibenzo(p)dioxin (2,3,7,8- TCDD), are persistent and often very toxic. Pesticides vary greatly in structure, composition, environmental persistence and toxicity to non-target organisms. Includes insecticides, herbicides, rodenticides & fungicides. Pharmaceuticals and Personal Care Products originate from veterinary and human applications compiling a variety of products, including over the counter medications, fungicides, chemotherapy drugs and animal therapeutics, such as growth hormones. Due to their biologically active nature, high levels of consumption, known combined effects, and their detection in most aquatic environments they have become an emerging concern. Ecological consequences include physiological changes (e.g., growth defects, carcinomas).

Category Title	Pressure Title	Pressure Description
	De-oxygenation	Any deoxygenation that is not directly associated with nutrient or organic enrichment. The lowering, temporarily or more permanently, of oxygen levels in the water or substrate due to anthropogenic causes (some areas may naturally be deoxygenated due to stagnation of water masses, e.g., inner basins of fjords). This is typically associated with nutrient and organic enrichment, but it can also derive from the release of ballast water or other stagnant waters (where organic or nutrient enrichment may be absent). Ballast waters may be deliberately deoxygenated via treatment with inert gases to kill non-indigenous species.
	Nutrient enrichment	Increased levels of nitrogen, phosphorus, silicon (and iron) in the marine environment compared to background concentrations. Nutrients can enter marine waters by natural processes (e.g., decomposition of detritus, riverine, direct and atmospheric inputs) or anthropogenic sources (e.g., wastewater runoff, terrestrial/agricultural runoff, sewage discharges, aquaculture, atmospheric deposition). Nutrients can also enter marine regions from 'upstream' locations, e.g., via tidal currents to induce enrichment in the receiving area. Nutrient enrichment may lead to eutrophication (see also organic enrichment). Adverse environmental effects include deoxygenation, algal blooms, changes in community structure of benthos and macrophytes.
	Organic enrichment	Resulting from the degraded remains of dead biota & microbiota (land & sea), faecal matter from marine animals, flocculated colloidal organic matter and the degraded remains of sewage material, domestic wastes, industrial wastes etc. Organic matter can enter marine waters from sewage discharges, aquaculture or terrestrial/agricultural runoff. Black carbon comes from the products of incomplete combustion (PIC) of fossil fuels and vegetation. Organic enrichment may lead to eutrophication (see also nutrient enrichment). Adverse environmental effects include deoxygenation, algal blooms, changes in community structure of benthos and macrophytes.
	Radionuclide contamination	Introduction of radionuclide material, raising levels above background concentrations. Such materials can come from land or sea -based operations (e.g., oil platforms, medical sources) and historical disposal of radioactive waste from contaminated medical equipment and radium at sea.
Physical loss (permanent change)	Physical loss to land or freshwater habitat	The permanent loss of marine habitats. Associated activities are land claim, new coastal defences that encroach on and move the Mean High Water Springs mark seawards, dredging if it alters the position of the halocline. This excludes changes from one marine habitat type to another marine habitat type.
	Physical change to another seabed type	The permanent change of one marine habitat type to another marine habitat type, through the change in substratum, including to artificial (e.g., concrete). Associated activities include the

Category Title	Pressure Title	Pressure Description
		installation of infrastructure (e.g., surface of platforms or wind farm foundations, marinas, coastal defences, pipelines and cables), the placement of scour protection where soft sediment habitats are replaced by hard/coarse substrate habitats, removal of coarse substrate (marine mineral extraction) and dredging where the residual habitat differs structurally from the activity state, creation of artificial reefs, mariculture, the protection of pipes and cables using rock dumping and mattressing techniques, placement of cuttings and piles from oil & gas activities. This pressure excludes dredging where the depth of sediment is changed locally but the sediment typology is not changed.
Physical damage (reversible change)	Temporary and/or reversible change of habitat structure (extraction)	Temporary and/or reversible change of habitat structure through habitat extraction, e.g., from marine mineral extraction where a proportion of seabed sands or gravels are removed but a residual layer of seabed is similar to the pre-dredge structure and as such biological communities could re-colonise; or navigational dredging to maintain channels where the silts or sands removed are replaced by non-anthropogenic mechanisms so the sediment typology is not changed. Includes disturbance to foreshore, beach or dune habitats.
	Disturbance of the surface of the seabed, including abrasion	The disruption or alteration of the seabed's top layer due to various activities. This can be caused by natural processes like hydrodynamics and bioturbation, as well as human activities such as bottom contact fishing gear, anchoring, propeller wash from vessels, aquaculture, port anchorage, dredging, the construction and maintenance of offshore installations. These activities can lead to changes in the geological, physical, and chemical conditions of the seabed, impacting the benthic (seafloor) ecosystems. Abrasion relates to the damage of the seabed surface. Activities associated with abrasion can cover relatively large spatial areas (such as fishing with towed demersal trawls) or relatively localised activities (such as potting or bottom longlining).
	Penetration and/or disturbance of the substrate below the surface of the seabed	The disturbance of sediments where there is limited or no loss of substrate from the system. The physical impact on the layers beneath the seabed's surface. This includes activities that penetrate or disturb the sediment, such as anchoring, taking of sediment/geological cores, cone penetration tests, cable burial (ploughing or jetting), certain fishing activities, e.g., scallop dredging, bottom trawling, compression of sediments, e.g., from the legs of a jack-up barge could also fit into this pressure type. These activities can cause changes in the physical structure and composition of the seabed, potentially impacting marine habitats and ecosystems. Includes erosion or disturbance to sub-surface substrate in foreshore, beach or dune environments.

Category Title	Pressure Title	Pressure Description
	Changes in suspended solids	Changes in water clarity from sediment & organic particulate matter concentrations. It is related to activities disturbing or introducing sediment and/or organic particulate matter and mobilising it into the water column. Could be 'natural' land run-off and riverine discharges or from anthropogenic activities such as all forms of dredging, disposal at sea, cable and pipeline burial, secondary effects of construction work such as breakwaters. Particle size, hydrological energy (current speed & direction) and tidal excursion are all influencing factors on the spatial extent and temporal duration. Salinity, turbulence, pH and temperature may result in flocculation of suspended organic matter.
	Siltation (sedimentation) rate changes	Alteration (increases or decreases) of the natural rates of siltation (sedimentation) through the settling out of silt/sediments suspended in the water column. Activities associated with this pressure type include mariculture, land claim, navigational dredging, disposal at sea, marine mineral extraction, cable and pipeline laying and various construction activities. It can result in short lived sediment concentration gradients and the accumulation of sediments on the sea floor. IS related to light smothering, where a thin layer of material covers something, restricting its access to air or light but not completely cutting it off.
Other physical pressures	Litter	Refers to any human-made solid material that is discarded, disposed of, or abandoned in the coastal marine environment or ocean. This includes items like plastics, metals, wood, rope, and fishing gear, as well as their broken-down pieces, such as microplastics. Ecological effects can be physical (smothering), biological (ingestion, including uptake of microplastics; entangling; physical damage; accumulation of chemicals) and/or chemical (leaching, contamination).
	Electromagnetic changes	Localised electric and magnetic fields associated with operational power cables and telecommunication cables (if equipped with power relays). These cables may generate electric and magnetic fields that could alter behaviour and migration patterns of sensitive species (e.g., sharks and rays).
	Noise changes	Increases over and above background noise levels (consisting of environmental noise (ambient) and incidental man-made/anthropogenic noise (apparent)) at a particular location. Species known to be affected are marine mammals and fish. Effects include hearing loss, discomfort, injury, and in extreme cases, death in addition to indirect effects such as acoustic masking and behavioural modification. The impact depends on factors like sound pressure, loudness, exposure level, and frequency. High amplitude and low-frequency sounds are particularly harmful. Noise can travel long distances (10s of kms) but is affected by water depth and seabed features. Noise levels associated with construction activities, such as pile-driving, are typically significantly greater than operational phases (i.e., shipping, operation of a wind farm). Includes noise produced by shore-based activities such as vehicle use and tourist activities.

Category Title	Pressure Title	Pressure Description
	Introduction of light	Direct inputs of light from anthropogenic activities. This includes lighting on structures during construction or operation to allow 24 h working; new tourist facilities (e.g., promenade or pier lighting), lighting on oil & gas facilities etc. Ecological effects may be the diversion of bird species from migration routes if they are disorientated by or attracted to the lights. It is also possible that continuous lighting may lead to increased algal growth.
	Barrier to species movement	Obstacles that prevent animals from moving freely between different habitats. These barriers can disrupt migration, breeding, feeding, and other essential activities. Barriers include physical structures such as tidal barrages; infrastructure including offshore wind farms, mariculture setups; pollution where high levels of turbidity act as a barrier by inhibiting navigation; electromagnetic fields that some species find difficult to cross and habitat alteration that fragments habitats and makes it difficult for species to move between them. Includes upriver movements or movements across open waters. Species affected are mostly birds, fish, mammals.
	Death or injury by collision	Injury or mortality from collisions of biota with both static &/or moving structures. Examples include collision with rigs (e.g., birds), static screens in intake pipes (e.g., fish at power stations), wind turbine blades (e.g., birds), tidal devices (e.g., fish & mammals) and fishing vessels (birds).
Biological pressures	Visual disturbance	The disturbance of animals by anthropogenic activities. Examples include increased vessel movements, such as during construction phases for new infrastructure (bridges, cranes, port buildings etc), increased personnel movements, increased tourism, increased vehicular movements on shore disturbing bird roosting areas, seal haul out areas etc
	Genetic modification & translocation of indigenous species	Genetic modification can be either deliberate (e.g., introduction of farmed individuals to the wild, GM food production), accidental (e.g., escapees from salmon farms or the translocation of GM species in ballast water) or a by-product of other activities (e.g., mutations associated with radionuclide contamination). Anthropogenic movement of native species to new regions can also introduce different genetic stock.
	Introduction or spread of non-indigenous species	The introduction of non-indigenous species, e.g., Asian paddle crab, Mediterranean fan worm, exotic Caulerpa, and their subsequent spreading. Ballast water, hull fouling, stepping stone effects (e.g., aquaculture farms) may facilitate the spread of such species.
	Introduction of microbial pathogens	The introduction of microbial pathogens via untreated or insufficiently treated effluent discharges, run-off from terrestrial sources (e.g., toxoplasmosis) and vessels, ballast water releases. Escapees (e.g., farmed salmon) could be infected and spread pathogens. Aquaculture could release contaminated faecal matter, from which pathogens could enter the food chain.

Category Title	Pressure Title	Pressure Description
	Removal of target species	The removal of target species through commercial exploitation of fish & shellfish stocks, recreational fishing, bioprospecting and scientific sampling. The physical effects of fishing gear on seabed communities are addressed by the " Disturbance of the surface of the seabed, including abrasion" and "Penetration and/or disturbance of the substrate below the surface of the seabed" pressure types, so this pressure addresses the direct removal / harvesting of biota. Ecological consequences include the sustainability of stocks, impacting energy flows through food webs and the size and age composition within fish stocks.
	Removal of non-target species	By-catch associated with fishing activities, bioprospecting, research, mineral extraction and dredging etc. This pressure addresses the direct removal of individuals, the physical effects of fishing gear on seabed communities are addressed by the " Disturbance of the surface of the seabed, including abrasion" and "Penetration and/or disturbance of the substrate below the surface of the seabed" pressure types. Ecological consequences include disruption of food webs and changes to the population dynamics of marine biota.

Appendix C Matrix evidence

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