Risk Retirement: Habitat Change

Expert Forum

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Andrea Copping
Mikaela Freeman
Lenaïg Hemery
Deborah Rose

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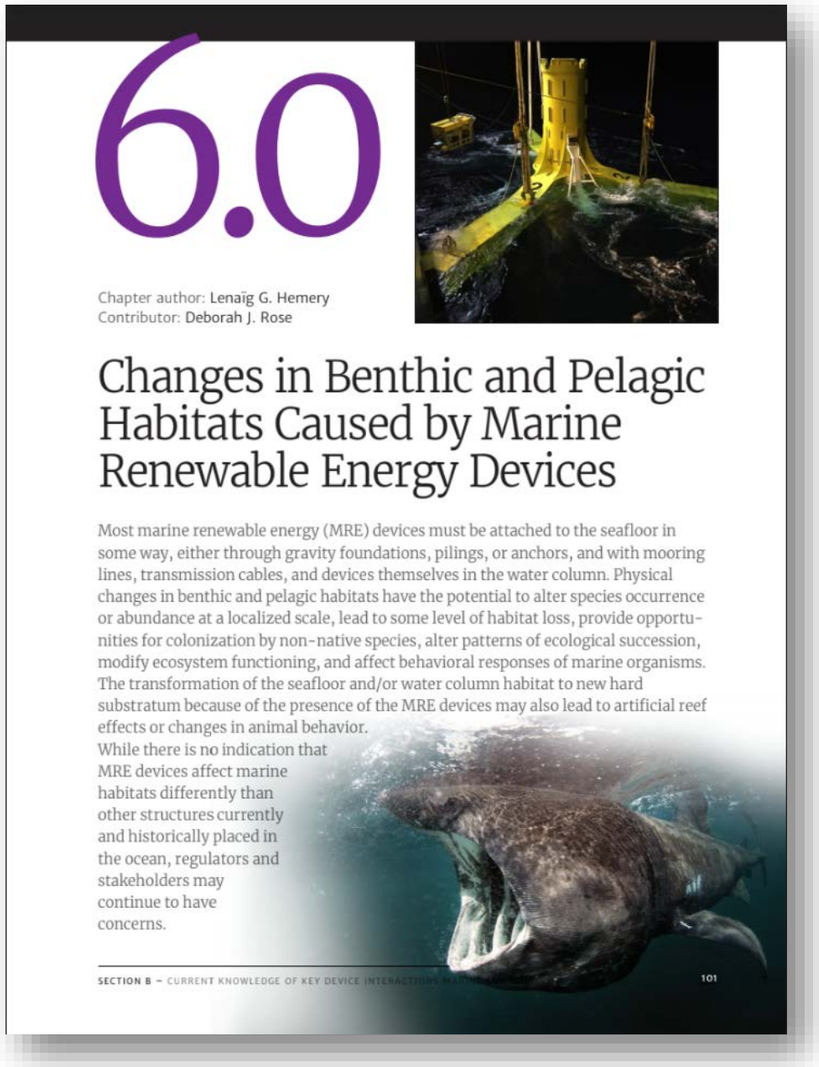
Agenda

- Introductions
- Risk Retirement and Data Transferability
- Habitat Change: Overview and Evidence Base
- Case Studies: Scotland and Oregon
- Discussion / Breakout Groups
- Report Out
- Next Steps



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Chapter author: Lenaïg G. Hemery
Contributor: Deborah J. Rose

Changes in Benthic and Pelagic Habitats Caused by Marine Renewable Energy Devices

Most marine renewable energy (MRE) devices must be attached to the seafloor in some way, either through gravity foundations, pilings, or anchors, and with mooring lines, transmission cables, and devices themselves in the water column. Physical changes in benthic and pelagic habitats have the potential to alter species occurrence or abundance at a localized scale, lead to some level of habitat loss, provide opportunities for colonization by non-native species, alter patterns of ecological succession, modify ecosystem functioning, and affect behavioral responses of marine organisms. The transformation of the seafloor and/or water column habitat to new hard substratum because of the presence of the MRE devices may also lead to artificial reef effects or changes in animal behavior. While there is no indication that MRE devices affect marine habitats differently than other structures currently and historically placed in the ocean, regulators and stakeholders may continue to have concerns.

SECTION B – CURRENT KNOWLEDGE OF KEY DEVICE INTERACTIONS

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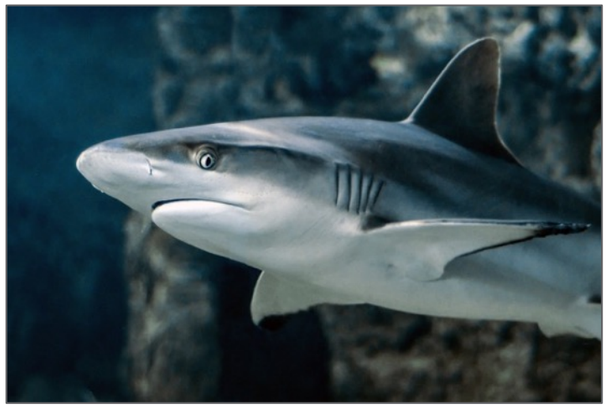
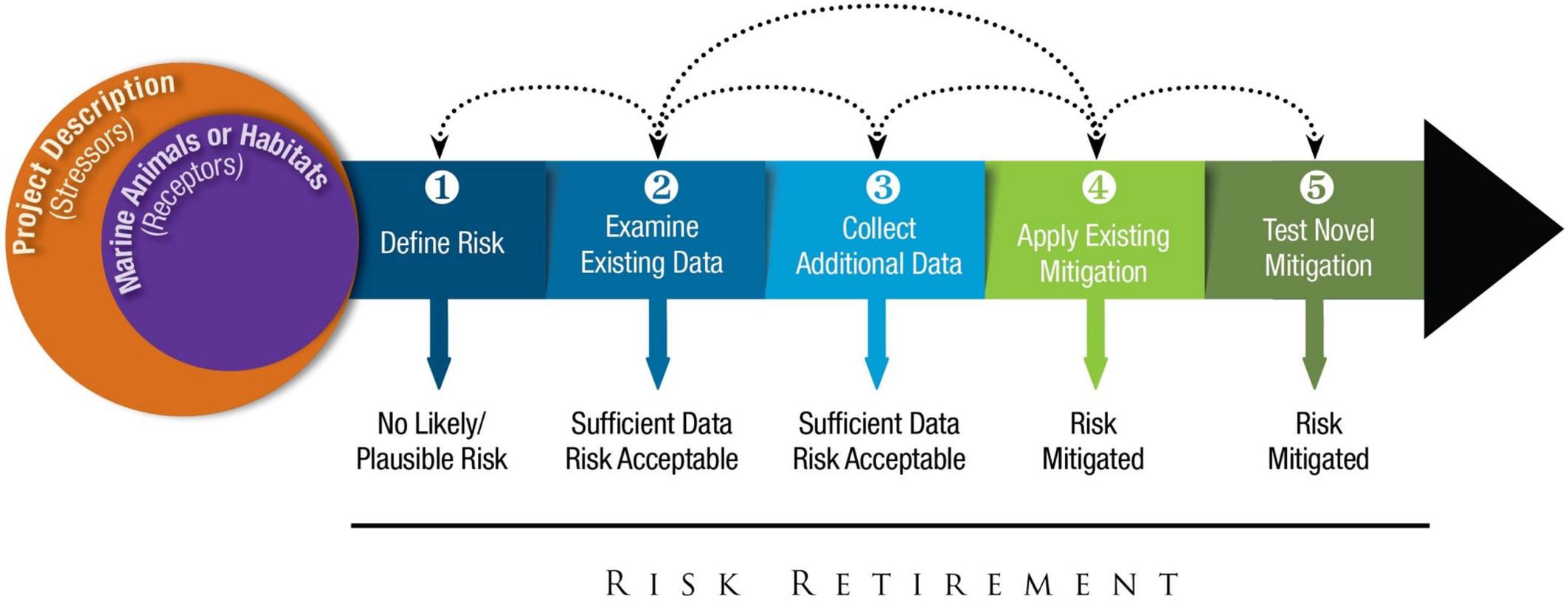
Risk Retirement

What is “risk retirement”?

- For certain interactions, potential risks need not be fully investigated for every project for small developments (1-2 devices).
- Rely on what is already known – already consented/permitted projects, research, or analogous industries.
- A “retired risk” is not dead, and can be revived in the future as more information becomes available for larger arrays.
- Risk retirement does not replace or contradict any regulatory processes.



Pathway to Risk Retirement



Pathway to Risk Retirement

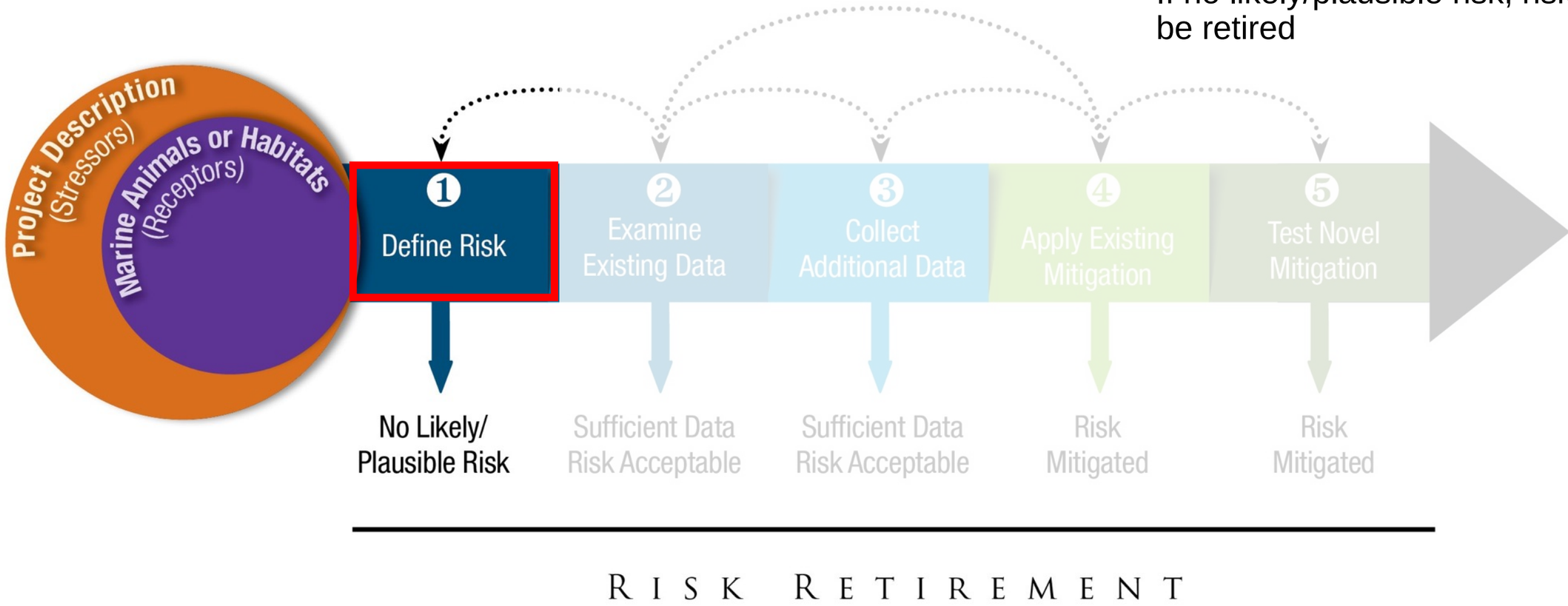
Define Interaction

- Project Description (Stressors)
- Marine Animals or Habitats (Receptors)

Pathway to Risk Retirement

Stage Gate 1

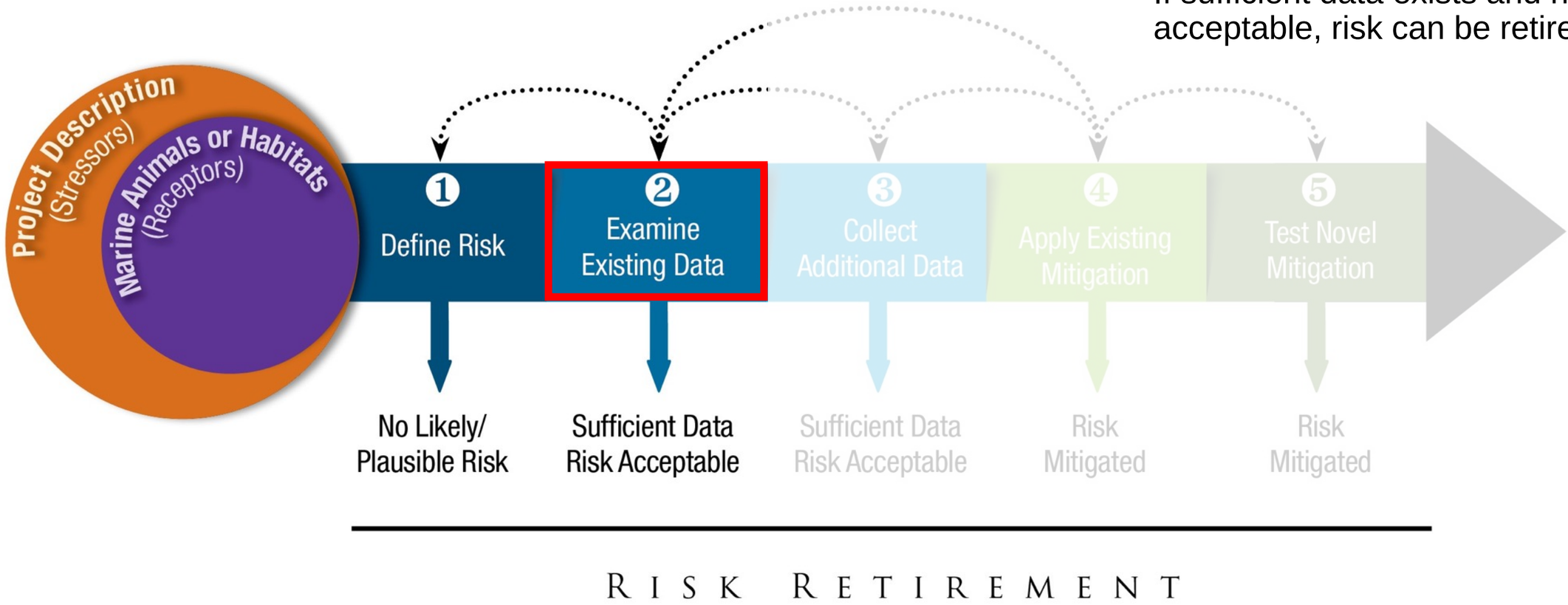
- Define Risk
  - If no likely/plausible risk, risk can be retired



Pathway to Risk Retirement

Stage Gate 2

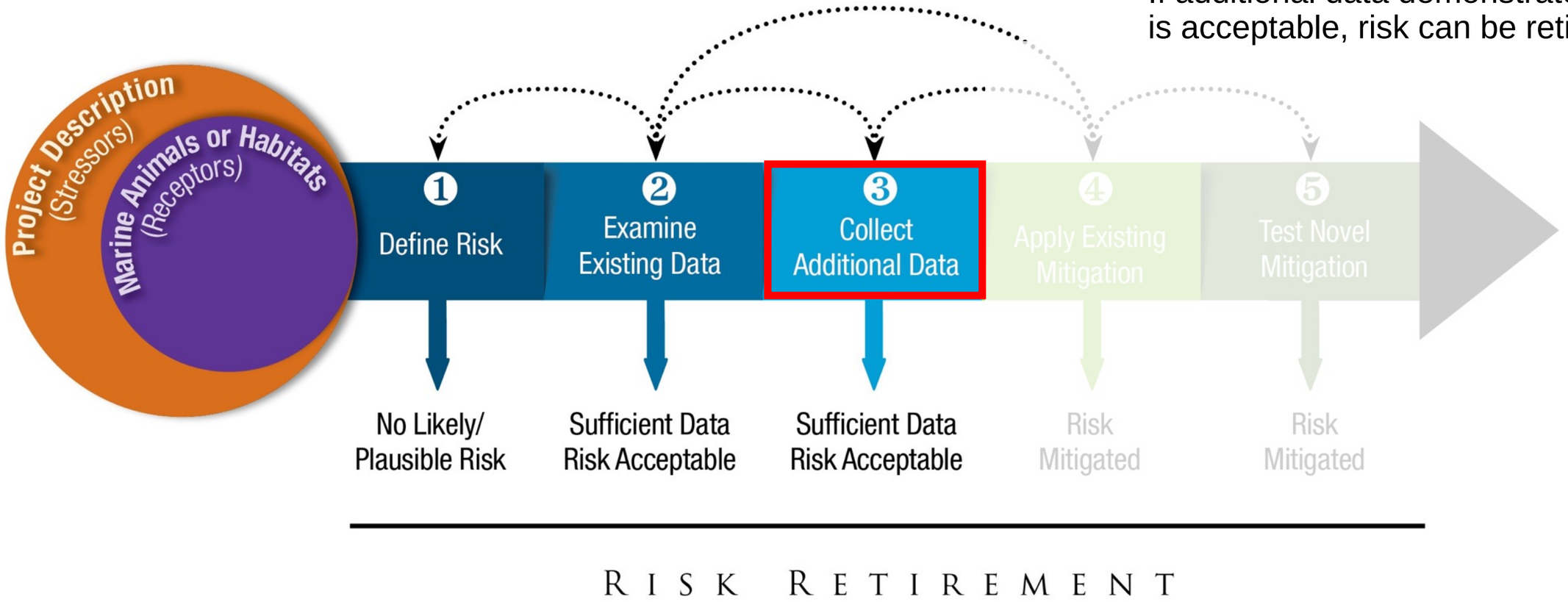
- Examine Existing Data
  - If sufficient data exists and risk is acceptable, risk can be retired



Pathway to Risk Retirement

Stage Gate 3

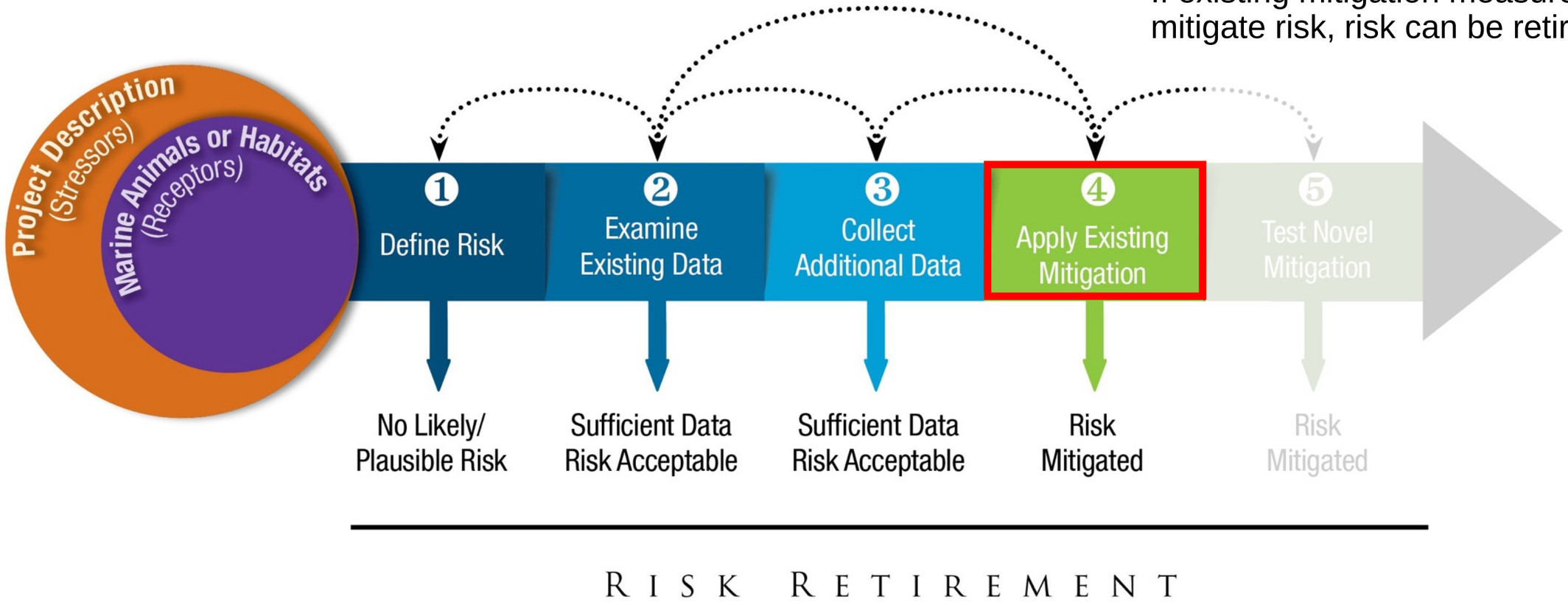
- Collect Additional Data
  - If additional data demonstrates risk is acceptable, risk can be retired



Pathway to Risk Retirement

Stage Gate 4

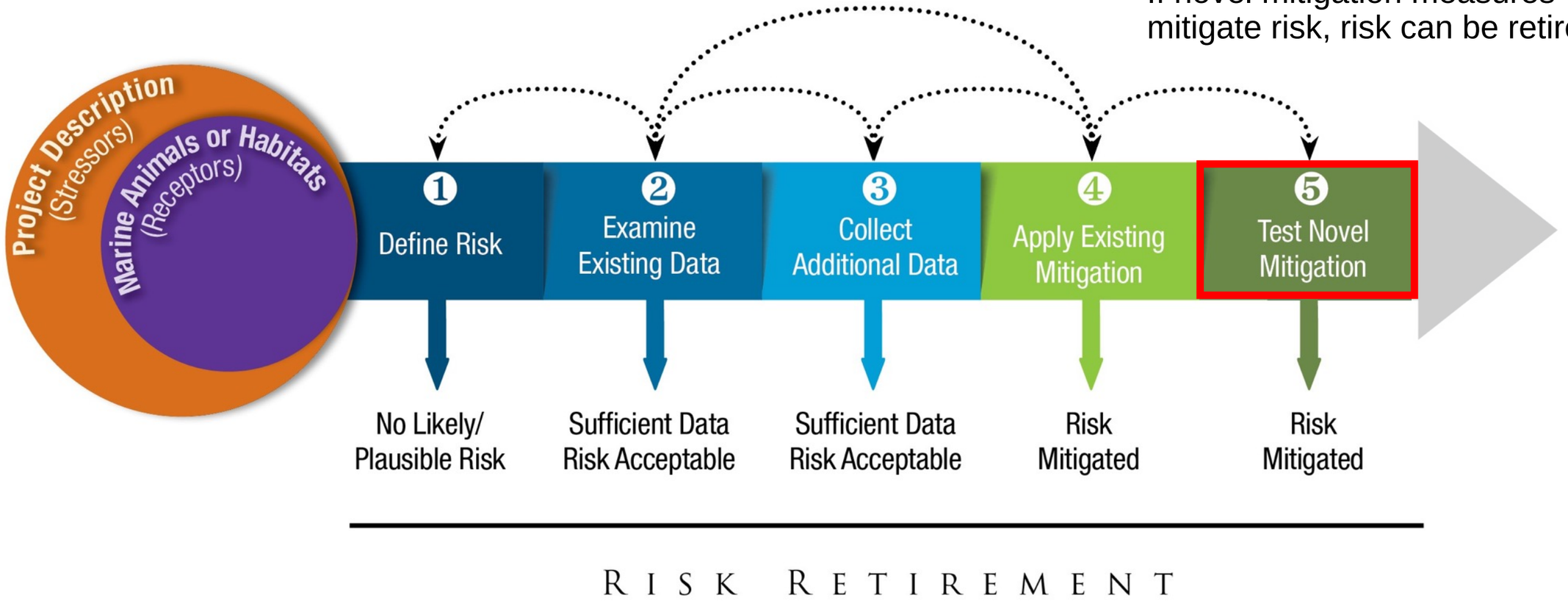
- Apply Existing Mitigation
  - If existing mitigation measures mitigate risk, risk can be retired



Pathway to Risk Retirement

Stage Gate 5

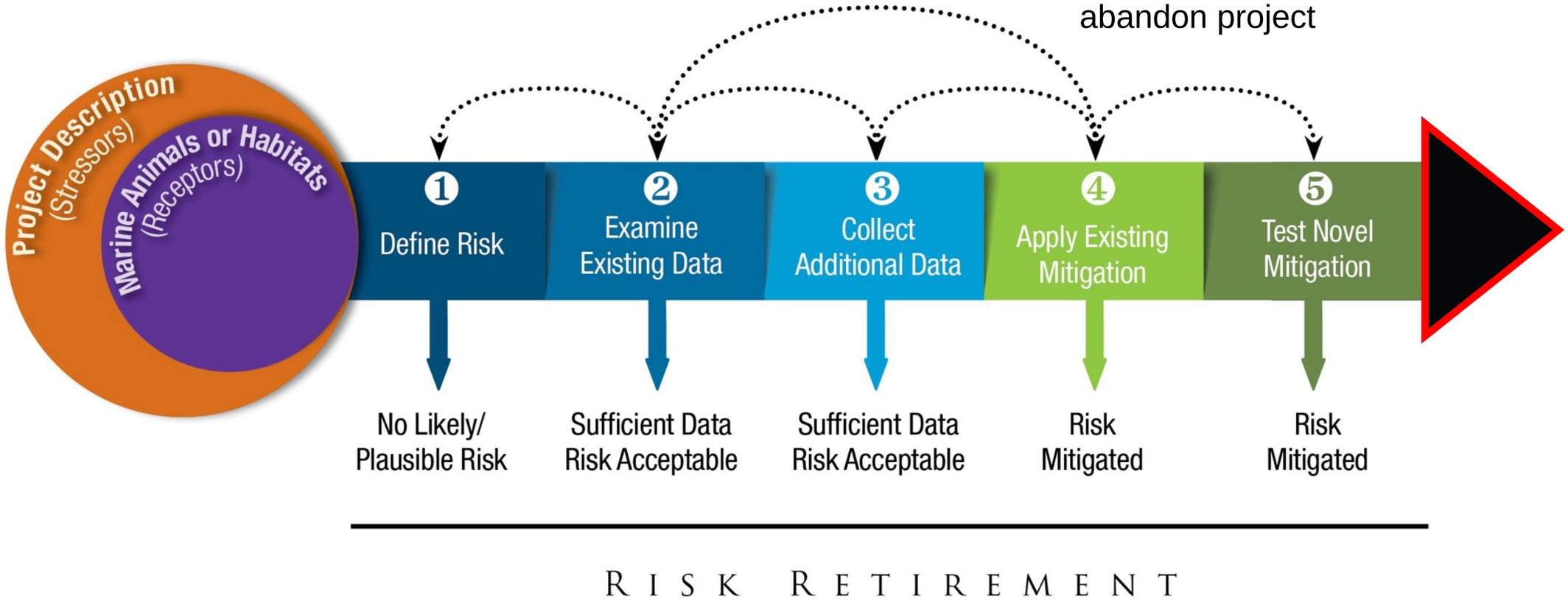
- Test Novel Mitigation
  - If novel mitigation measures mitigate risk, risk can be retired



Pathway to Risk Retirement

End of Pathway

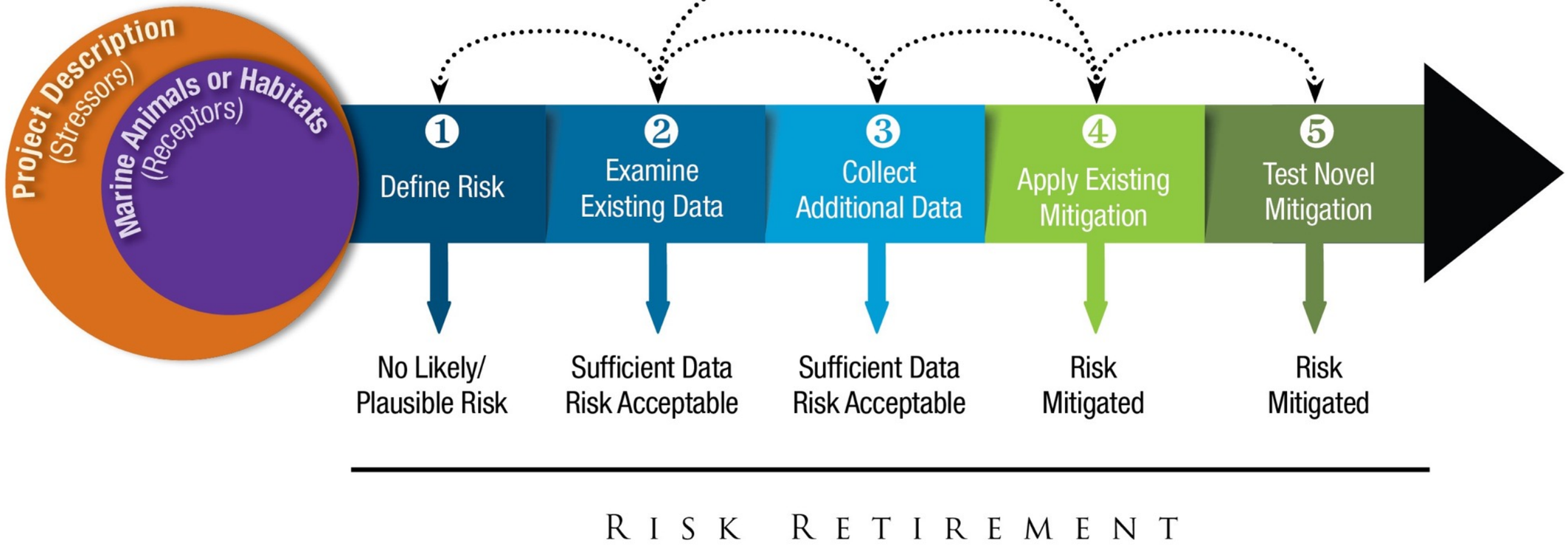
- If risk is significant and cannot be mitigated, redesign or possibly abandon project



Pathway to Risk Retirement

Data Transferability Process

- Need to ensure datasets from consented/permitted projects are readily available and comparable

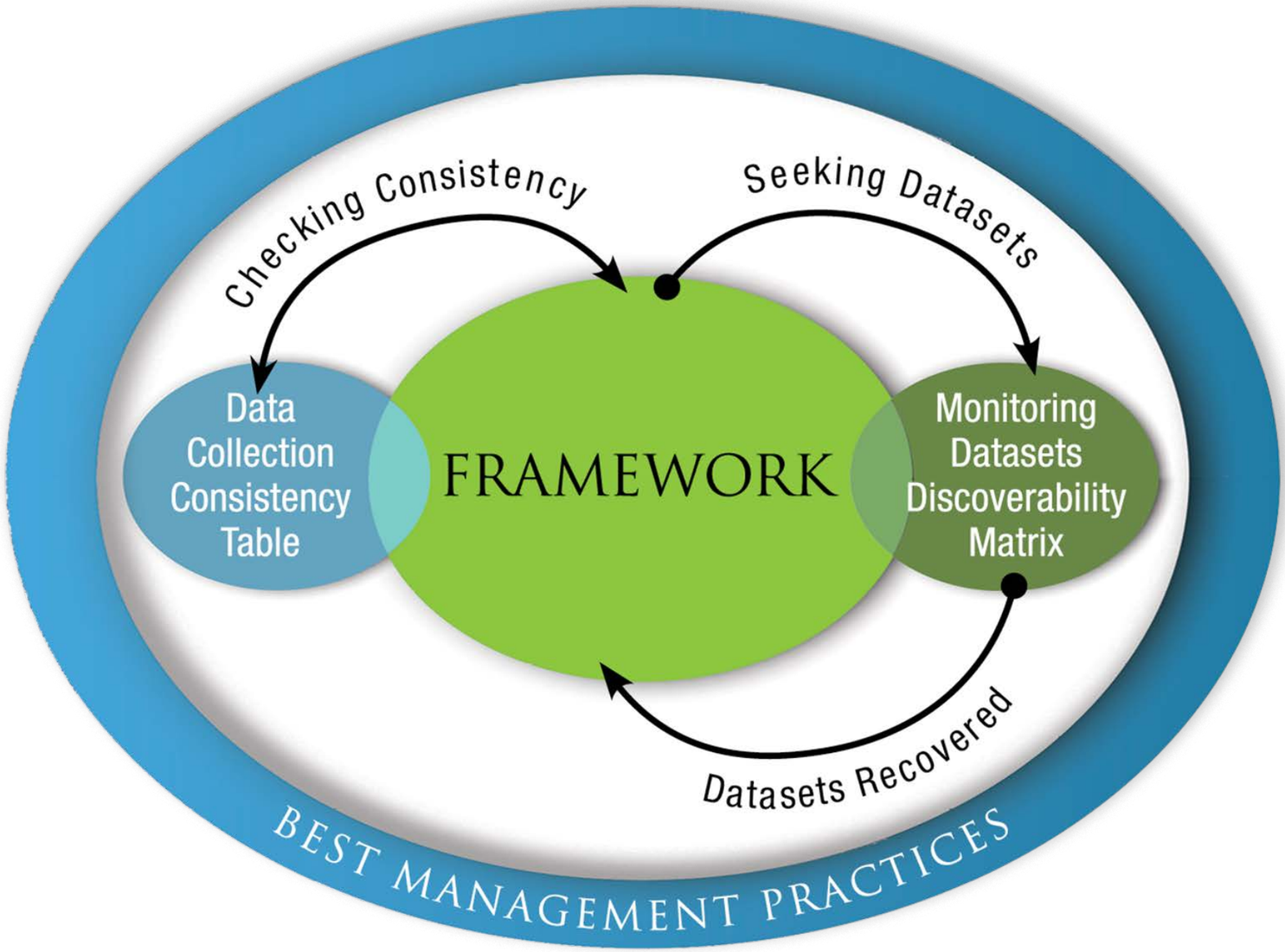


Data Transferability and Collection Consistency

What do we mean by “data transferability” and “data collection consistency”?

- Data/information collected through research studies and monitoring from other projects should inform new projects.
- Site-specific data will be needed for all new projects.
- Data from established projects may reduce site-specific data collection needs.
- Similarities to other industries may inform new MRE projects.
- These data sets that might be “transferred” need to be collected consistently for comparison.

Data Transferability Process



Monitoring Datasets Discoverability Matrix:
https://tethys.pnnl.gov/monitoring-datasets-discoverability-matrix

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Habitat Change: Overview and Evidence Base

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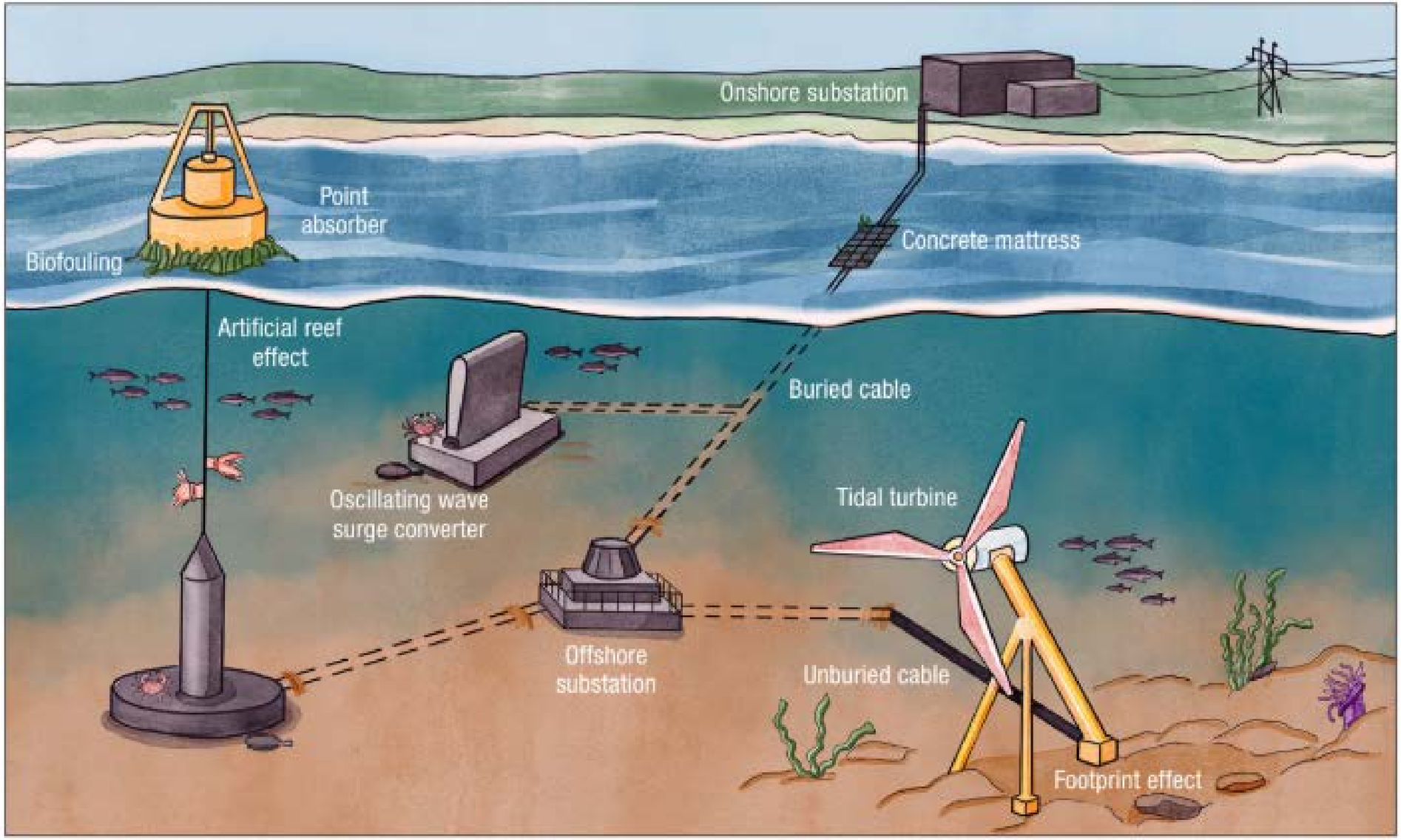
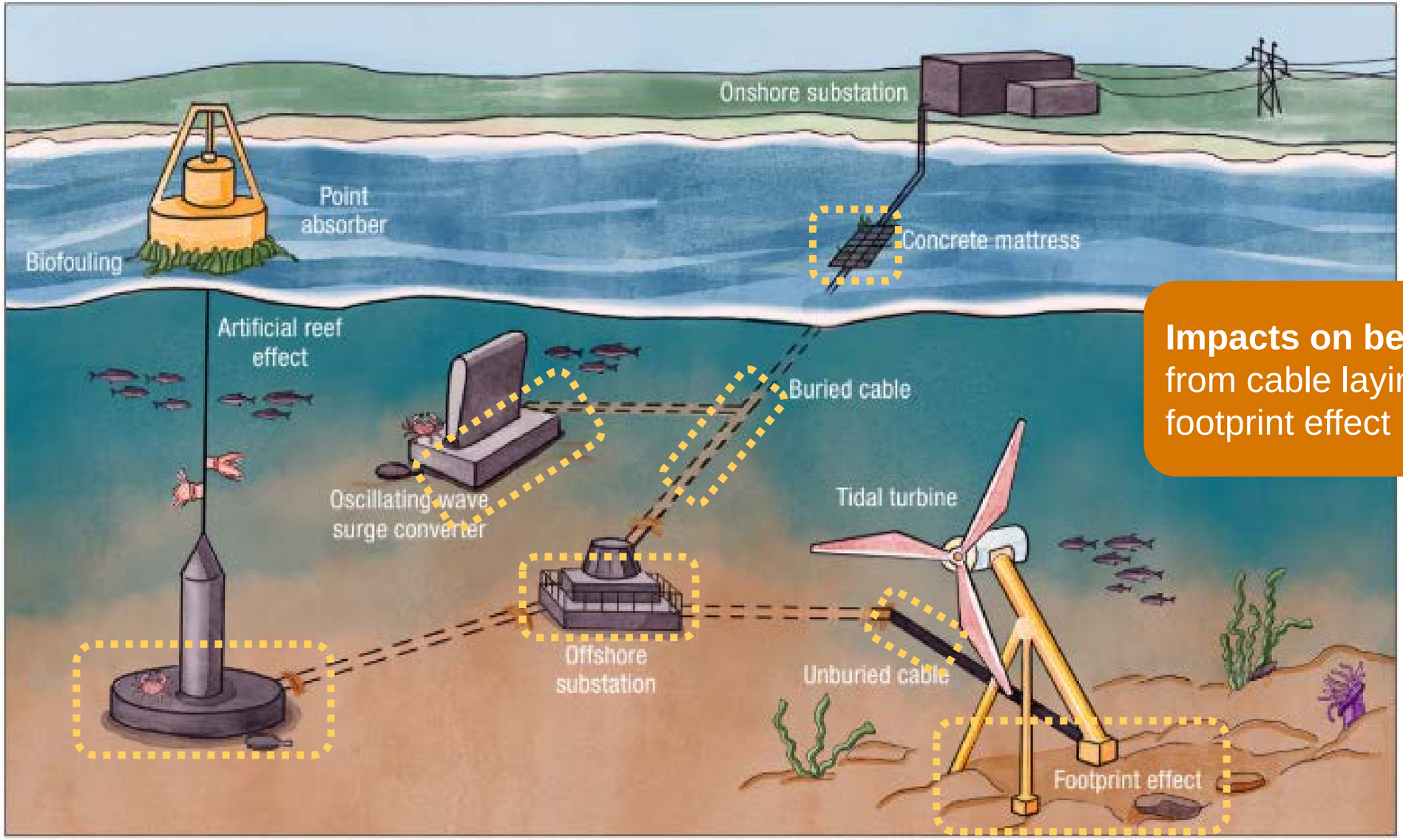
Overview

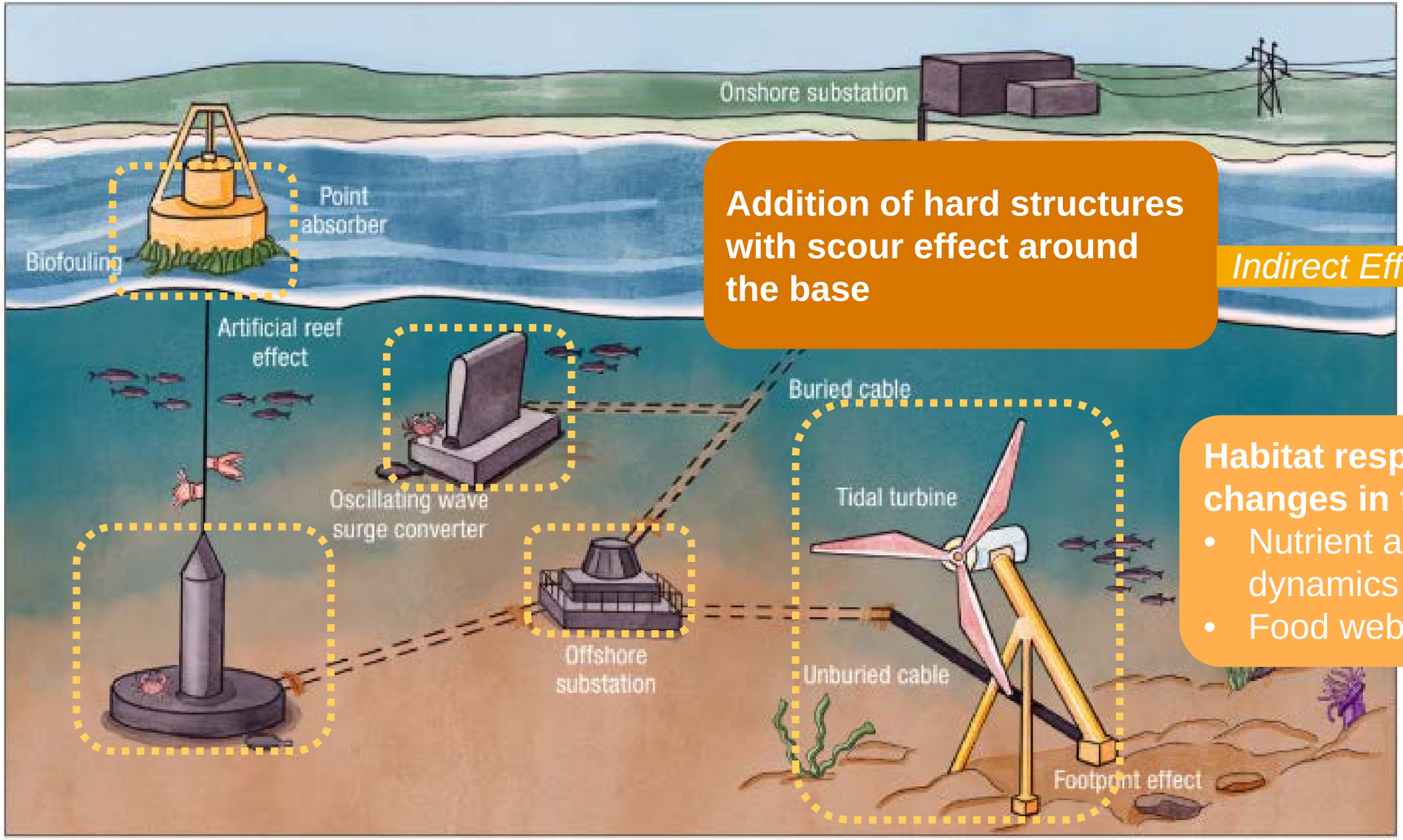


Overview



Impacts on benthos from cable laying, footprint effect

Overview



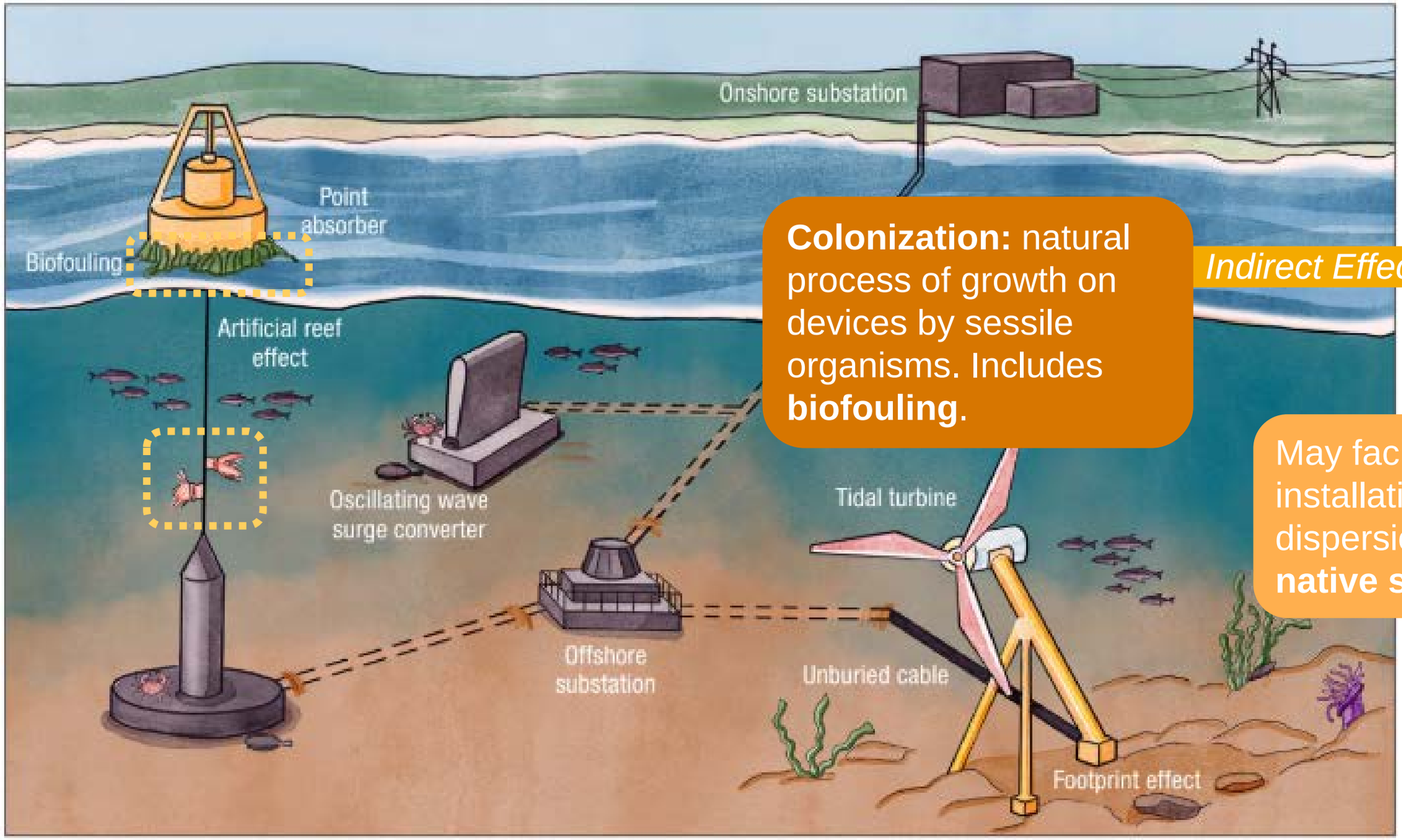
Addition of hard structures with scour effect around the base

Indirect Effect

Habitat responses to changes in flow

- Nutrient and plankton dynamics
- Food webs

Overview

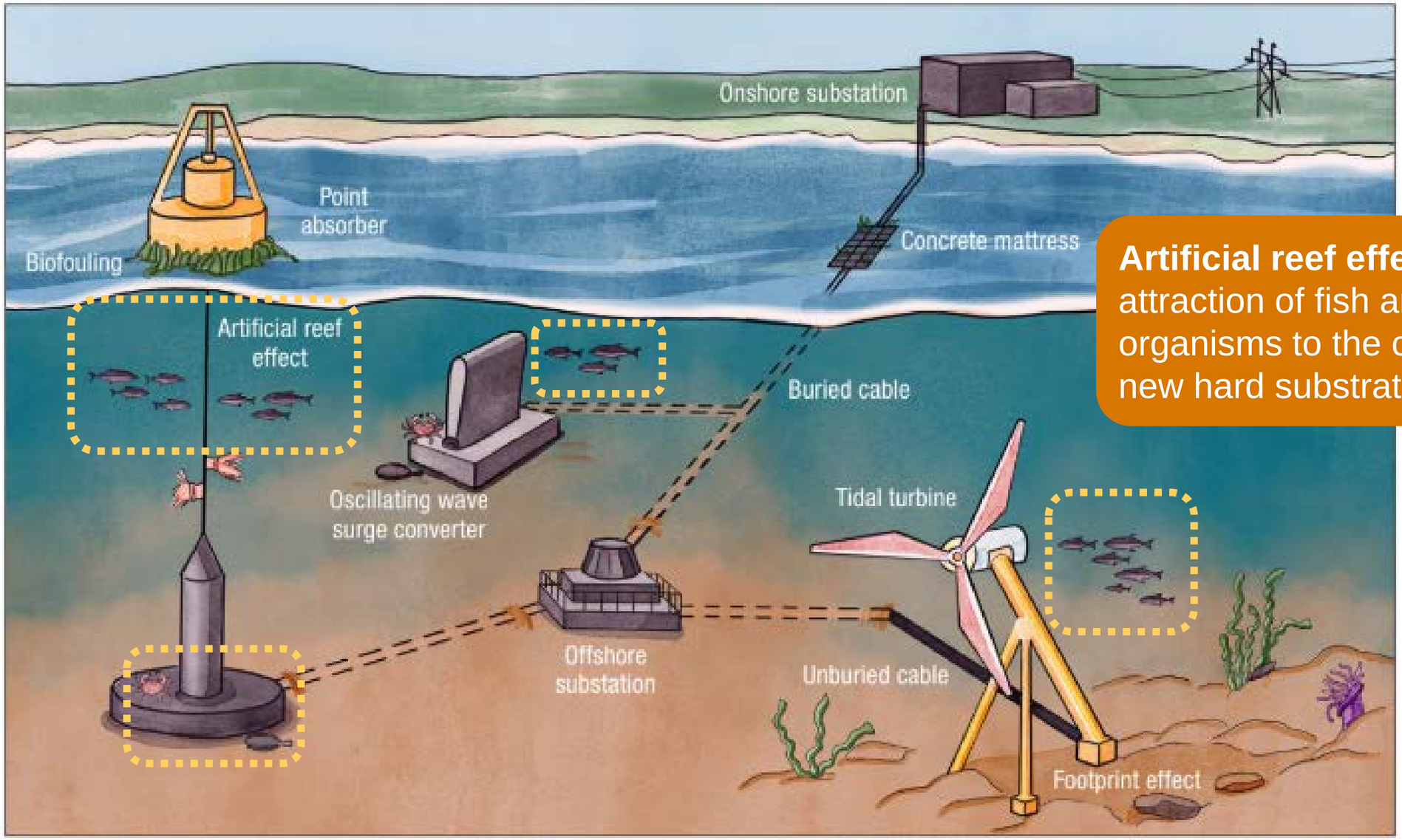


Colonization: natural process of growth on devices by sessile organisms. Includes **biofouling**.

Indirect Effect

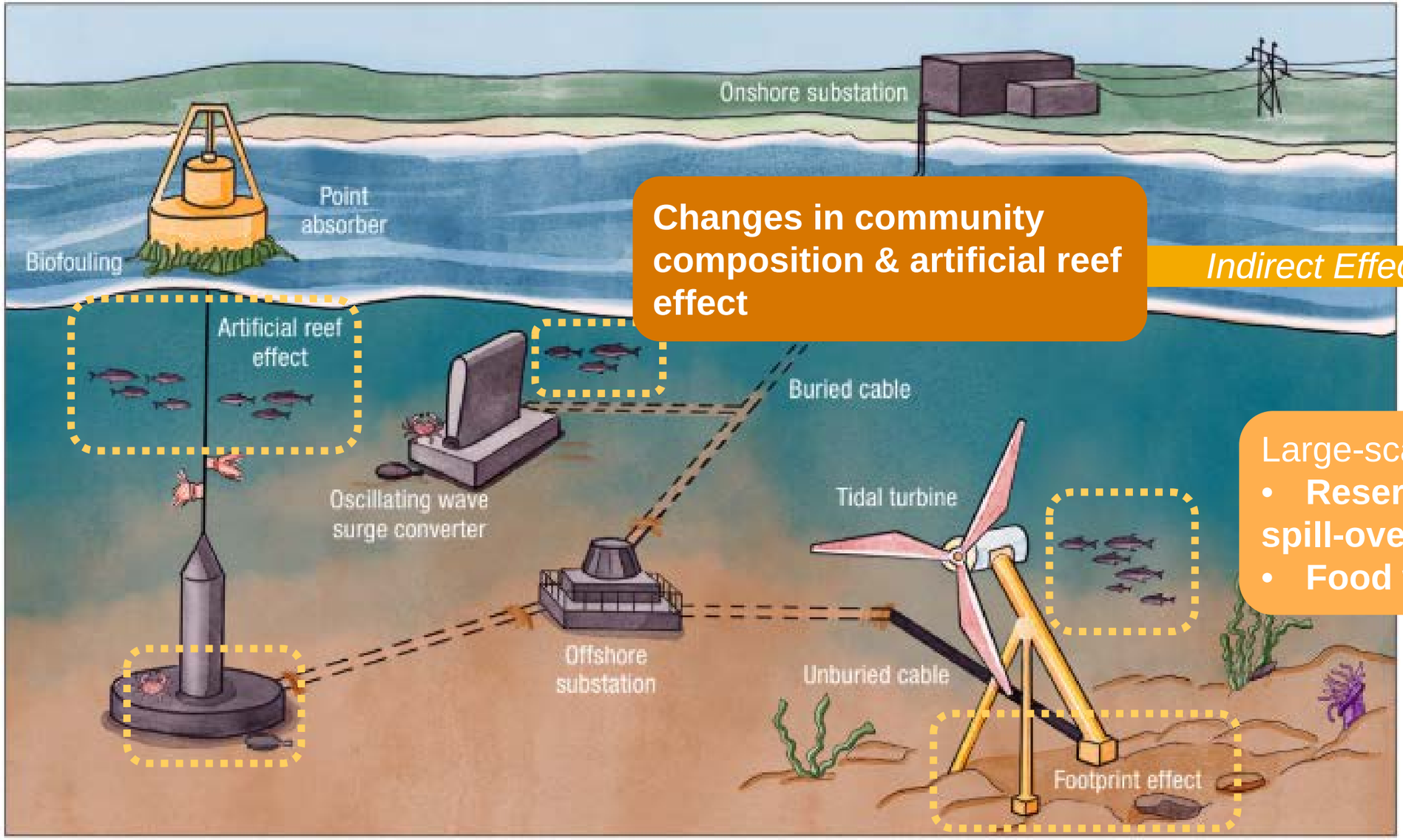
May facilitate the installation and dispersion of **non-native species**

Overview



Artificial reef effect: attraction of fish and other organisms to the colonized new hard substrate

Overview



Changes in community composition & artificial reef effect

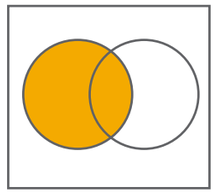
Indirect Effect

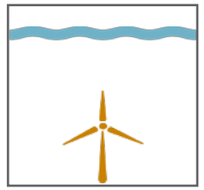
Large-scale effects:

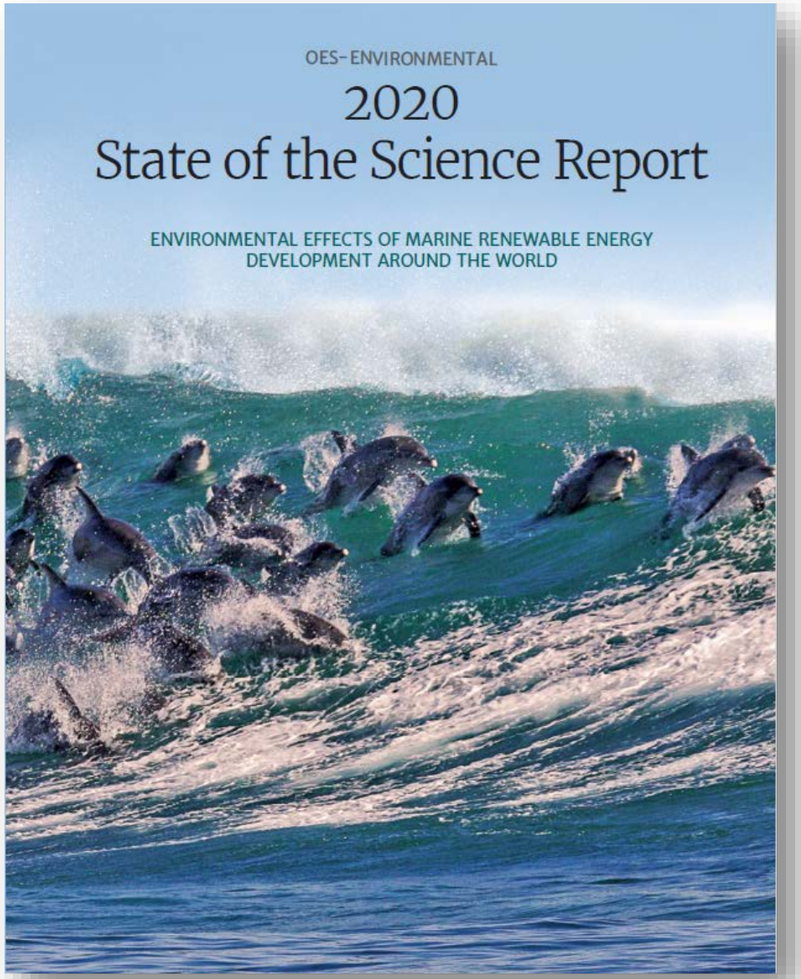
- **Reserve** and **spill-over**
- **Food web**

Evidence Base for Habitat Change

- Learning from Surrogate Industries
- Effects of Device Installation/Removal on Benthos
- Changes in Community Composition On and Near Devices
- Artificial Reef Effect







Learning from Surrogate Industries

- Offshore wind

- Fish aggregating devices (FADs), sunken vessels, oil & gas platforms, power & communication cables, oceanographic buoys

Summary Statement: Structures in the marine environment have been studied for many years, and we know a lot about these processes already. With some thought given to specific applications, data collected in other industries can be relevant to MRE.

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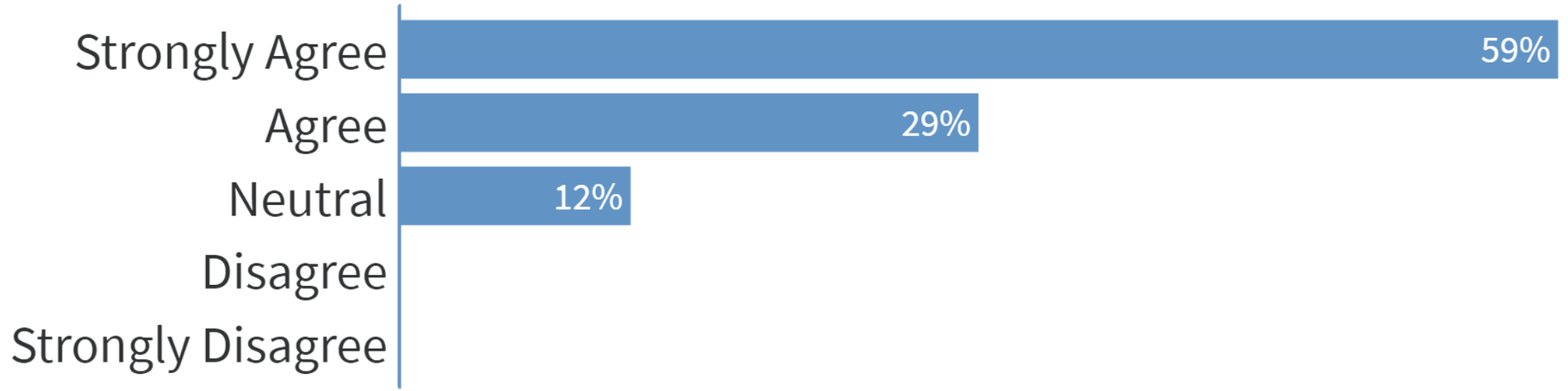

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Effects of Device Installation/Removal on Benthos

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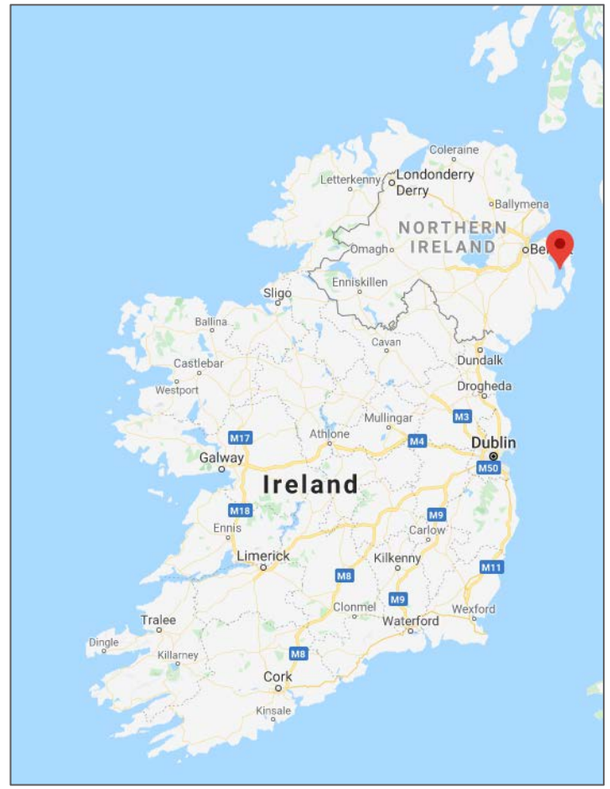
SeaGen Tidal Turbine (Keenan et al. 2011)

50% of the visible surface area of the device had been colonized after 2 years (37.6m^2).

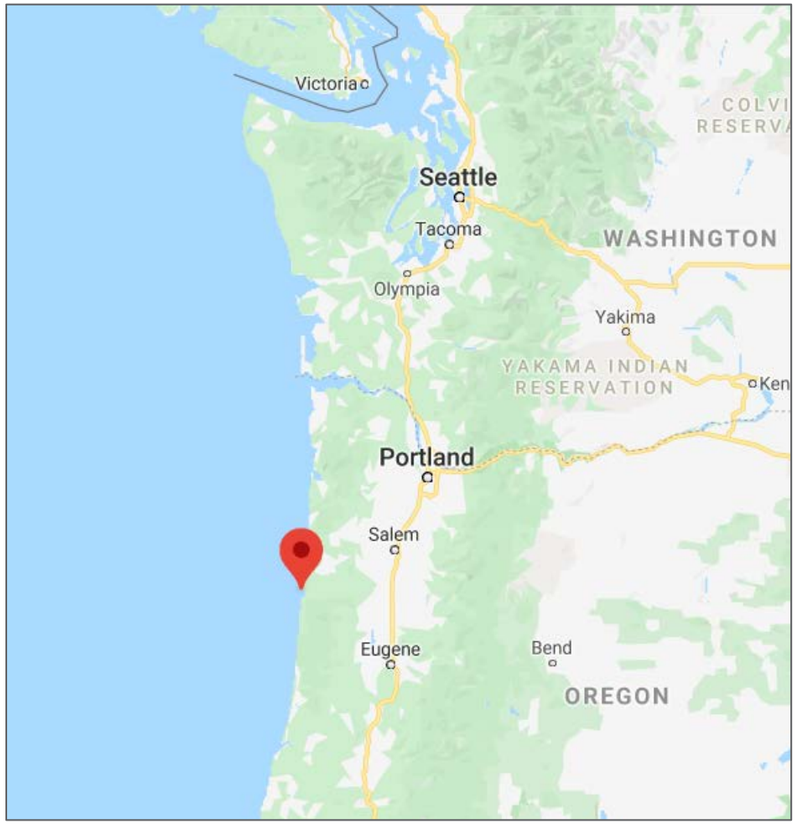
This surpasses the area that was removed from the footprint due to installation (36.3m^2).



Effects of Device Installation/Removal on Benthos

WEC Anchors at PacWave North, Newport, OR

No significant differences in sediment or macrofauna were observed between anchors and surrounding seabed or reference points on installation or removal of anchors.

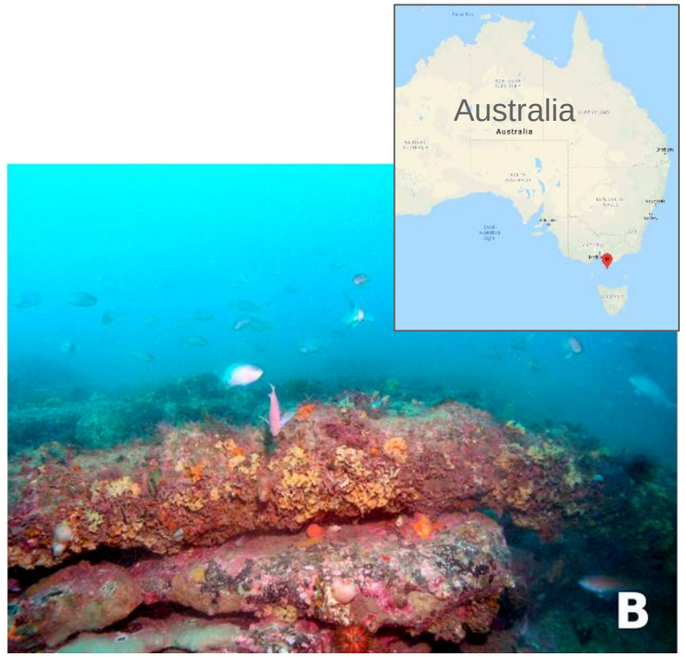


Effects of Device Installation/Removal on Benthos

Review of Impacts of Cables (Taormina et al. 2018)

A literature review of cable impacts from multiple industries reported low impacts on the benthos. Most impacts are positive, adding substrate for colonizers.

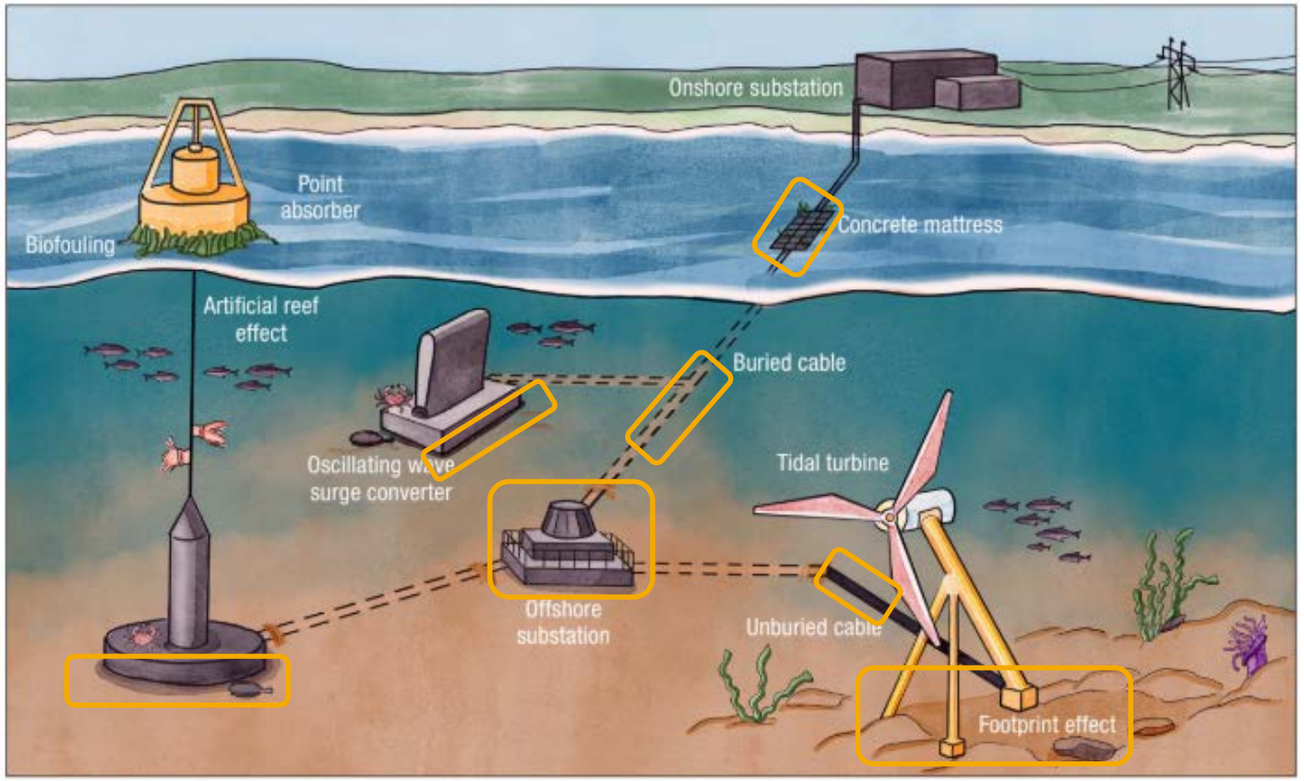
Most habitats recover quickly from cable installation, especially if critical or unique habitats are avoided in cable siting.



Effects of Device Installation/Removal on Benthos

Summary Statement:

For small numbers of devices, there may be a net positive or neutral effect from installation of underwater structures on the benthos. If properly sited, negative effects are minimal.



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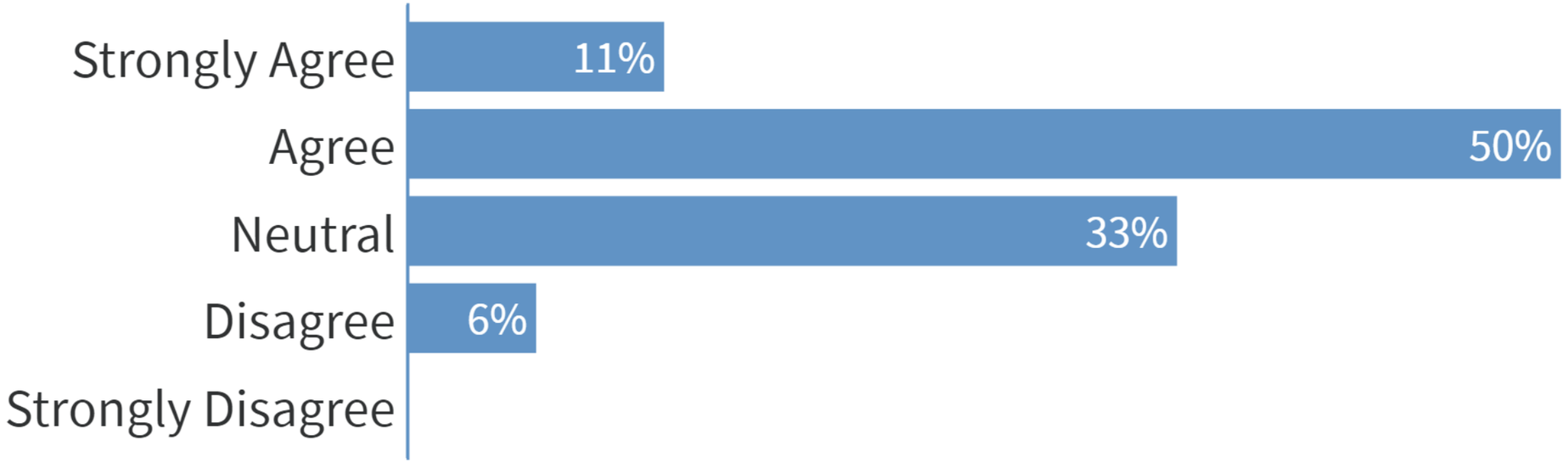

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Changes in Community Composition On and Near Devices

Changes in Community Composition

Orkney Fouling Communities (Want et al. 2017)

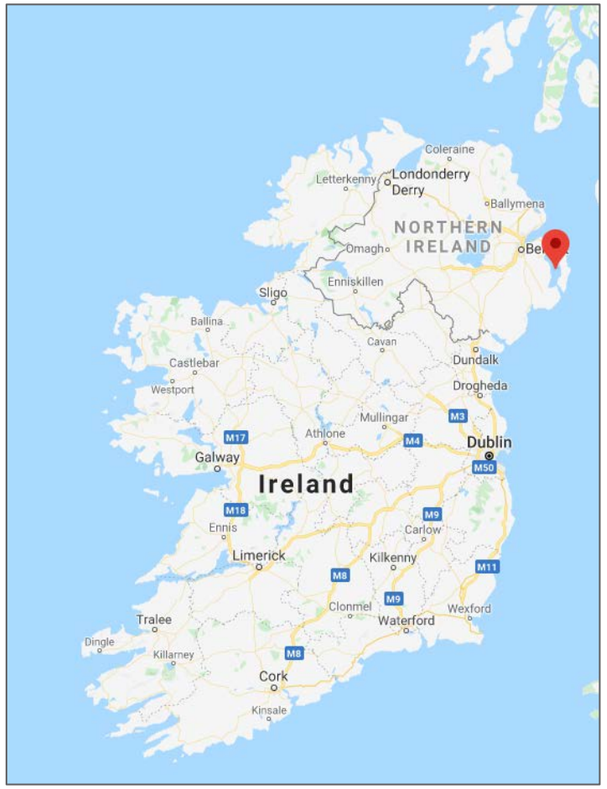
MRE infrastructure fouling communities are significantly different from harbors/marinas due to presence of key species.

Changes in Community Composition

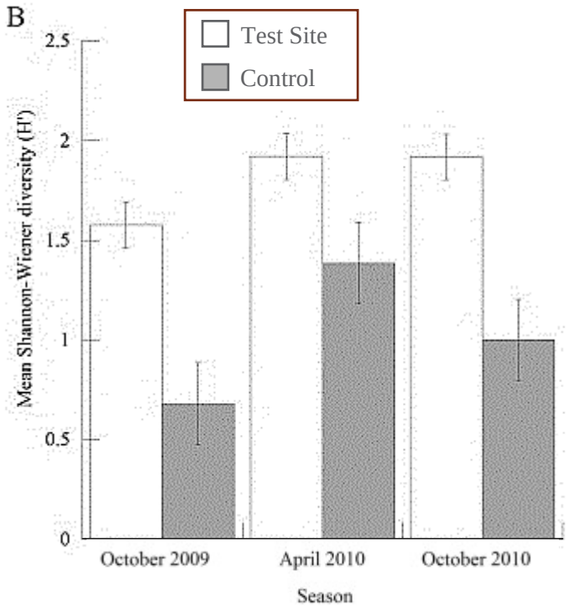
SeaGen Tidal Turbine (Keenan et al. 2011)

Observed changes in benthic community are a result of normal competition/succession, without negative impacts from turbine installation.

Changes in the vicinity of SeaGen are consistent with changes at the reference station.

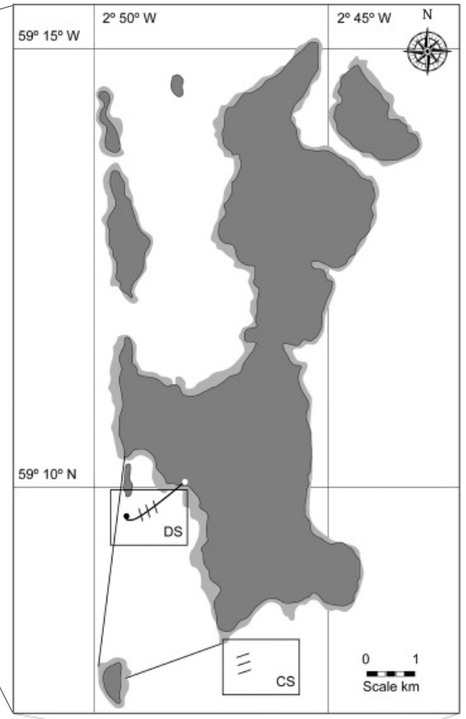


Changes in Community Composition



OpenHydro tidal device at EMEC, Fall of Warness (Broadhurst & Orme 2014)

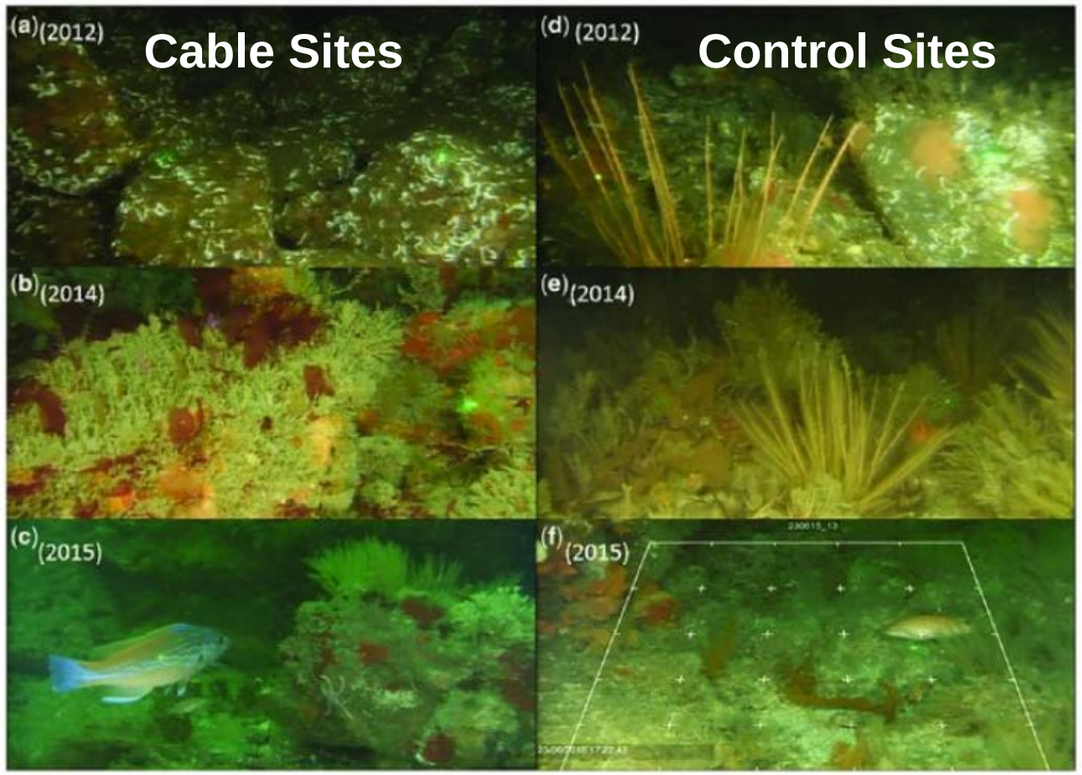
Compared to a control site, the benthos at the device site had increased species richness, biodiversity and significantly different community composition.

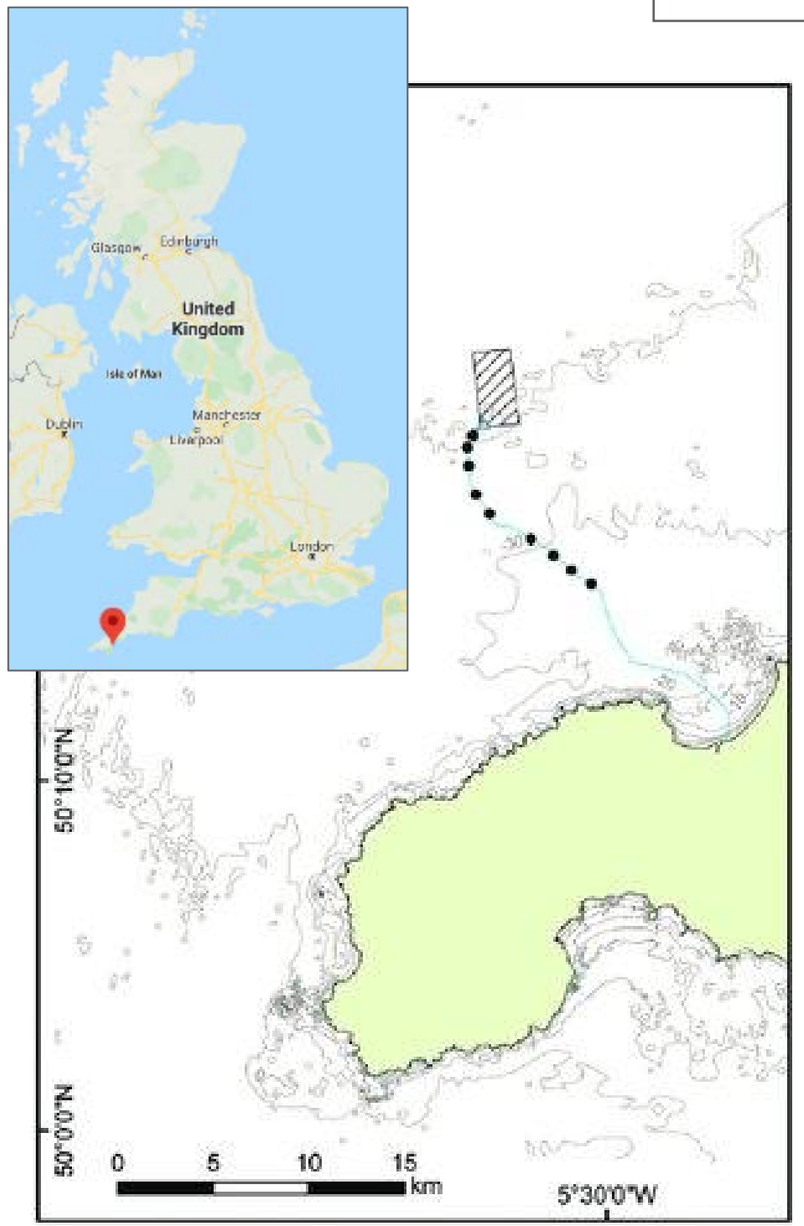


Changes in Community Composition

Wave Hub Cables, UK (Sheehan et al. 2018)

Epibenthic assemblage composition differed over years, though abundance was similar in all years between cable and control sites.





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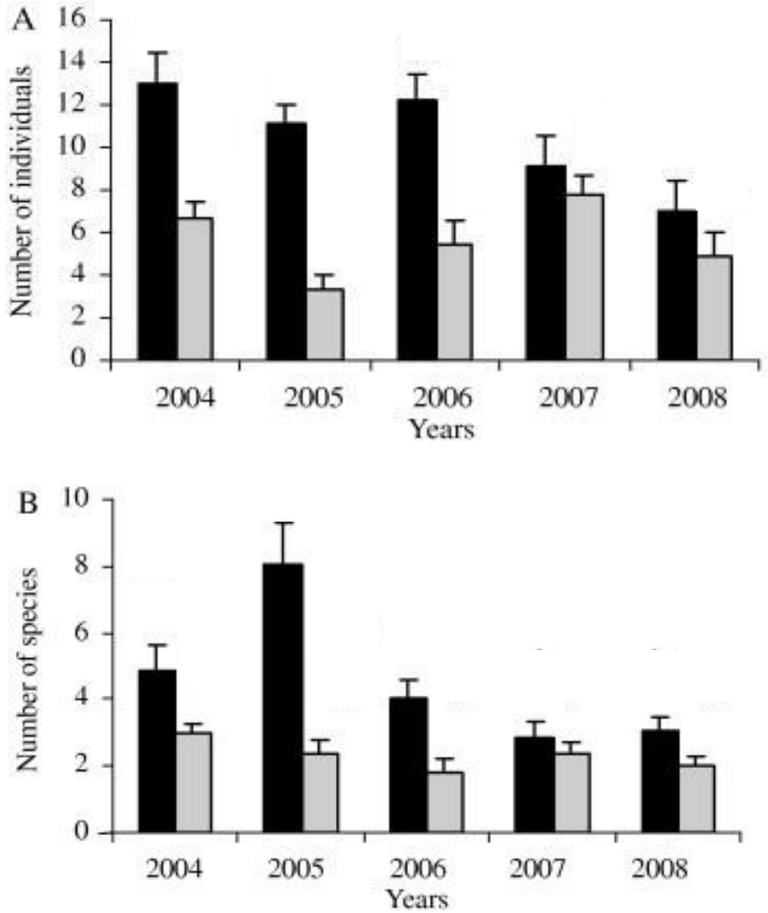
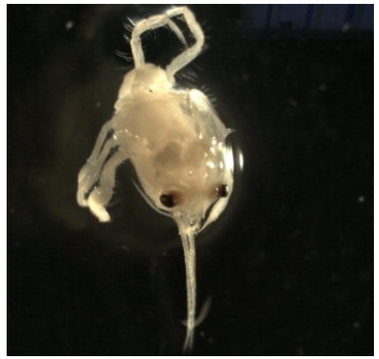


Lysekil Wave Park, Sweden (Langhamer 2010)

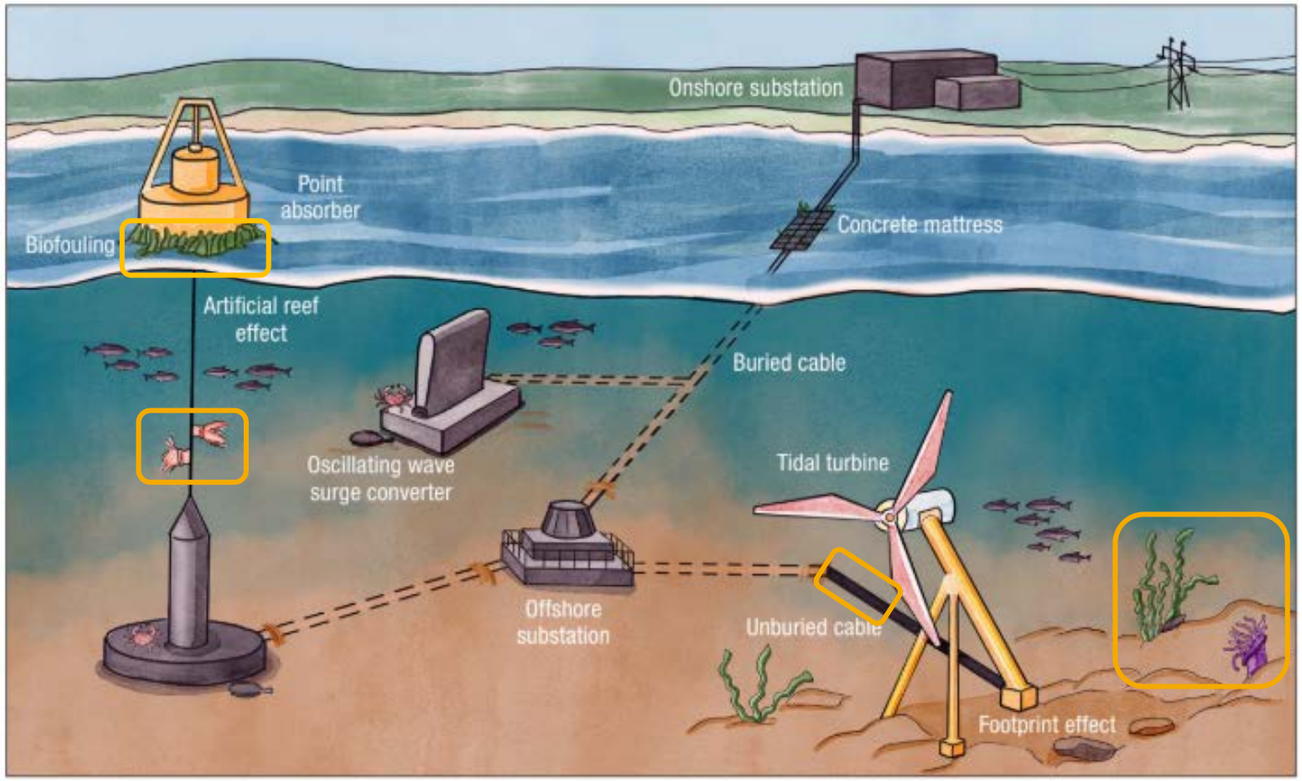
Macrofaunal biomass, density of organisms, species richness and biodiversity in the research site was higher compared to the reference site.



Changes in Community Composition

Summary Statement:

Hard structures in the water column or on the surface will become colonized and benthic communities in the near vicinity may change, but these changes are neutral unless they facilitate colonization of non-native, invasive species.



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Artificial Reef Effect

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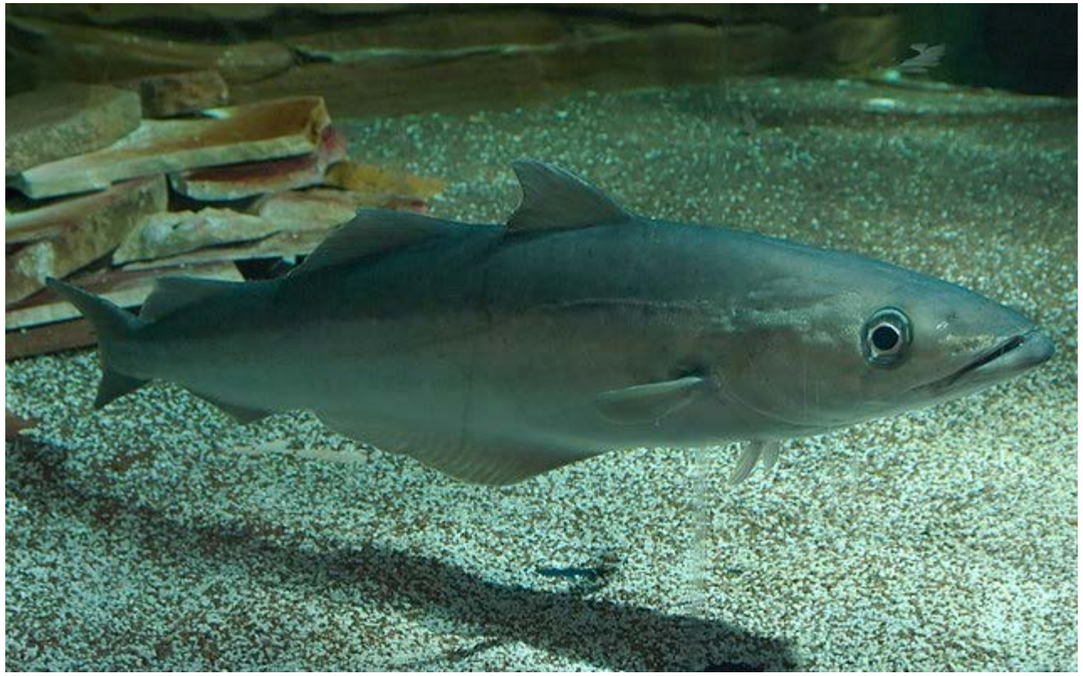
OpenHydro tidal device at EMEC, Fall of Warness (Broadhurst et al. 2014)

Pollack were observed shoaling temporarily around the device. No other species were identified.



Artificial Reef Effect

Lysekil Wave Park (Langhamer et al. 2009)

More fish and crabs were present around foundations than at control sites, though the differences observed were not statistically significant due to small sample sizes.

Artificial Reef Effect

Review of surrogates for MRE, U.S. West Coast and Hawai'i (Kramer et al. 2015)

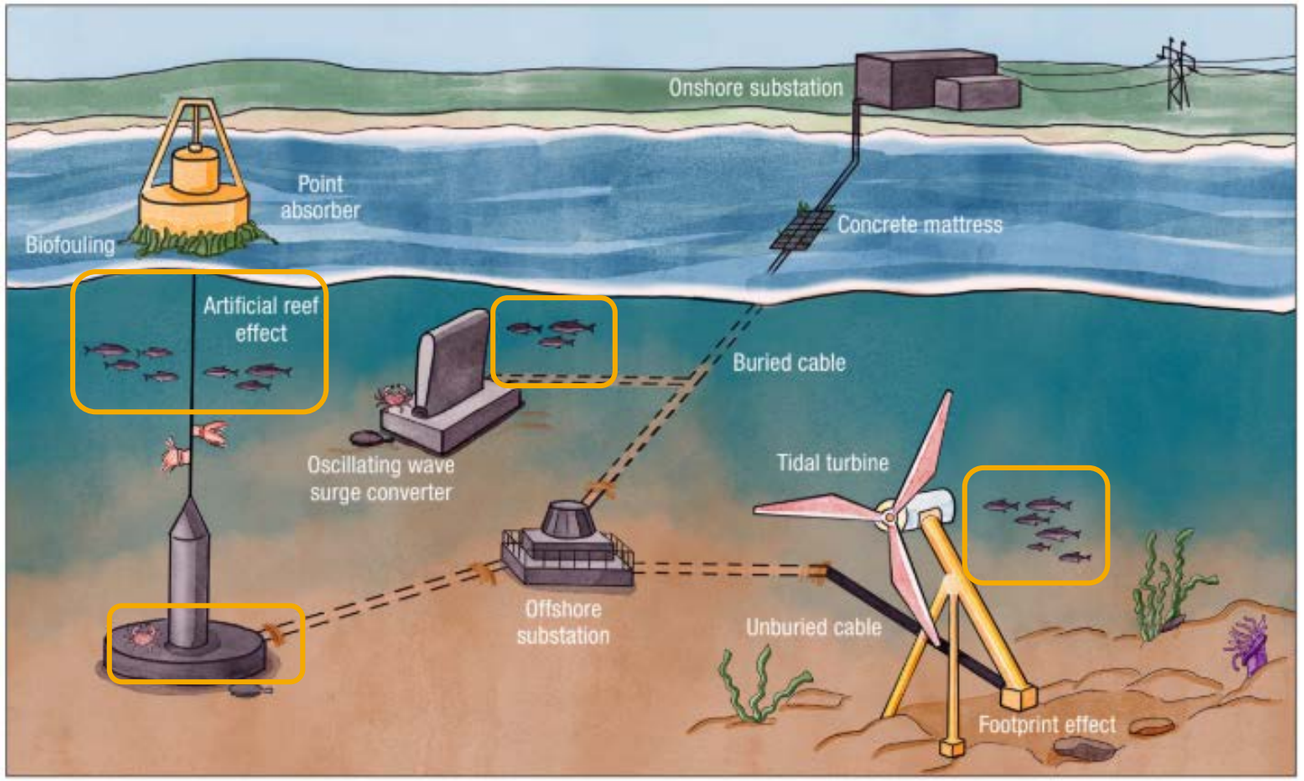
MRE devices are expected to function as small-scale reefs, with variation based on geographic location.

Negative effects on special status fish species due to increased predation are not likely.

Artificial Reef Effect

Summary Statement:

MRE devices display the same artificial reef effects as other industries. Impacts are likely to be neutral or may result in a positive effect on species abundance.



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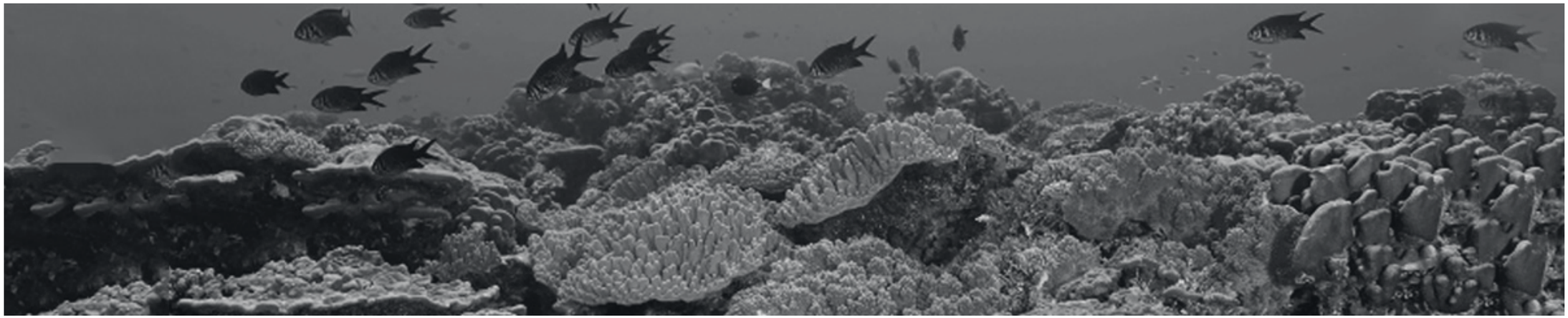
Habitat Change Evidence Base

For a list and links to all studies used to compile the habitat change evidence base, visit https://tethys.pnnl.gov/habitat-change-expert-forum



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Case Studies

Scotland example

Presented by Jennifer Fox

Ocean Energy orjip working to accelerate offshore consenting

aquatera environmental services and products

Oregon example

Presented by Sarah Henkel

Oregon State University

Case Study: Scotland

18th August, 2020

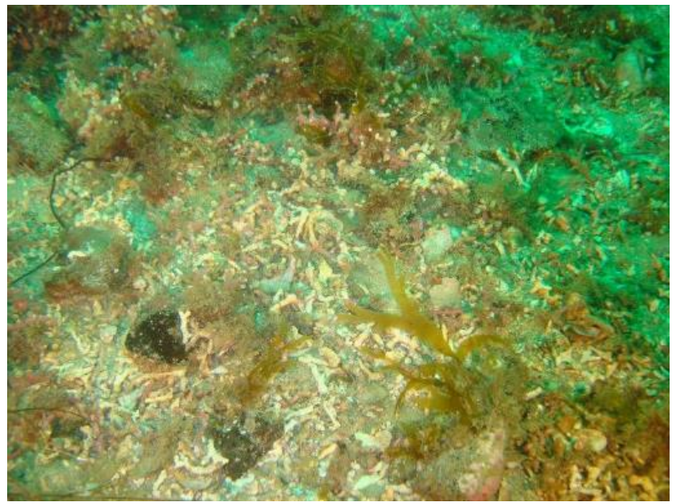
Jennifer Fox

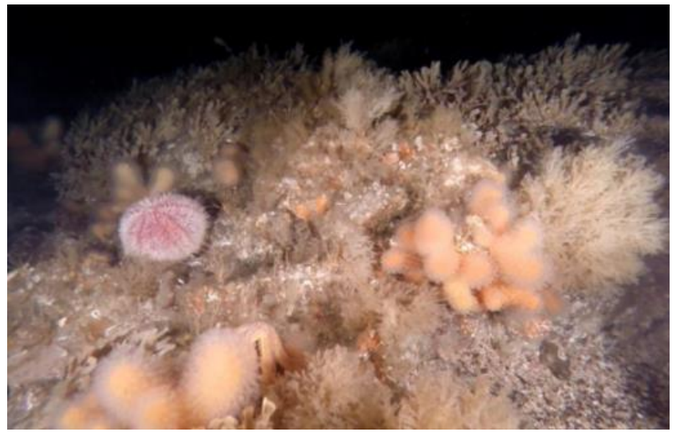
Ocean Energy orjip™ working to accelerate offshore consenting

aquatera environmental services and products

Contents

- Habitat change in EIA
  - Impact assessment in Brims and Meygen
  - Cumulative impact assessment
  - Mitigation measures
  - Key conclusions
- Habitat change in Project Environmental Monitoring Plans
  - Two examples from EMEC





MeyGen

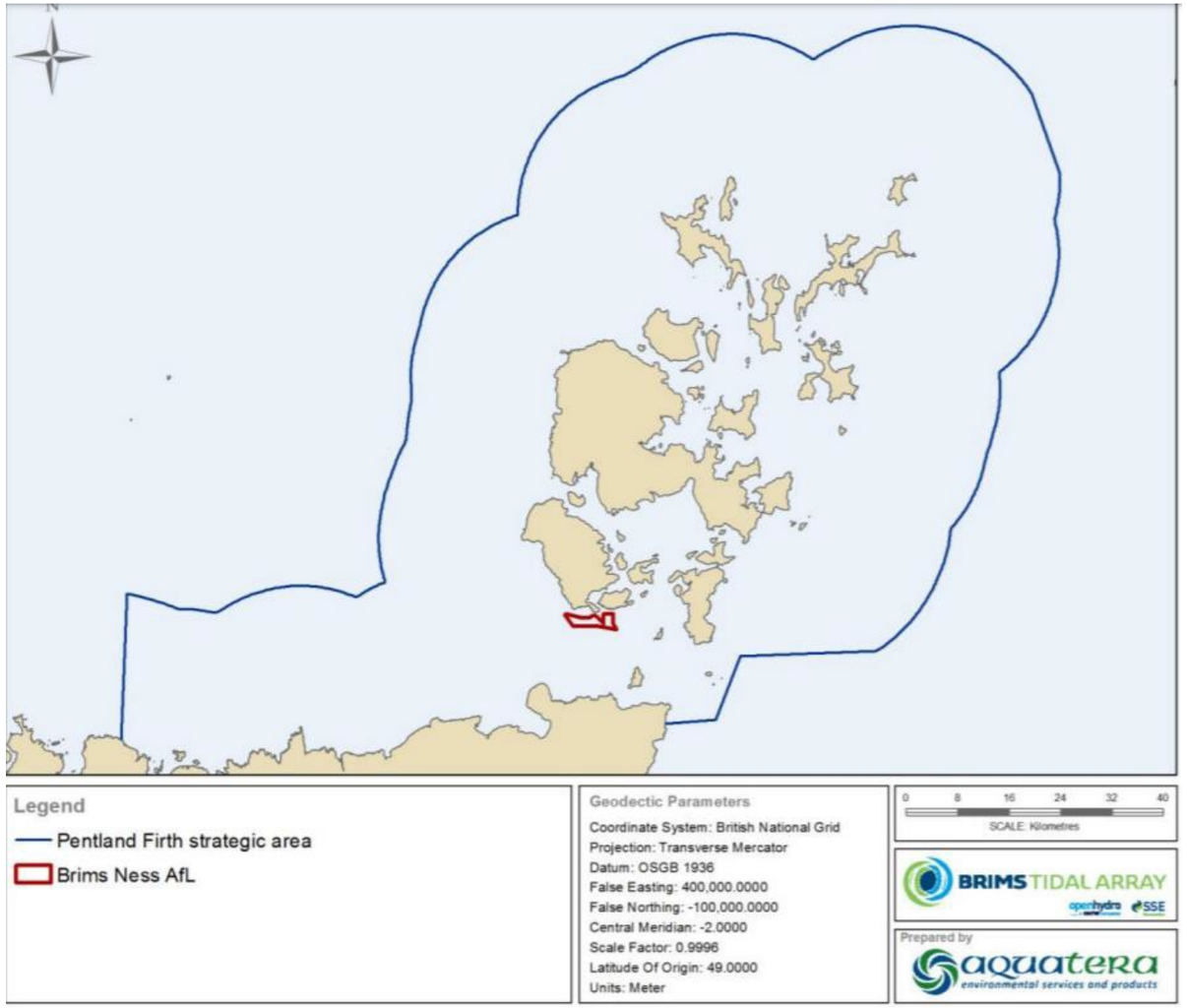
- 2014- EIA completed and Marine License granted
- 2015- Onshore construction commenced
- 2018- MeyGen Phase 1A officially enters into operation

- Consent was sought in phases
  - Phase 1 consent for 86 MW
  - Phase 2 consent will be sought separately (312 MW)
- Turbines 1 MW capacity each, with an export cable to shore each

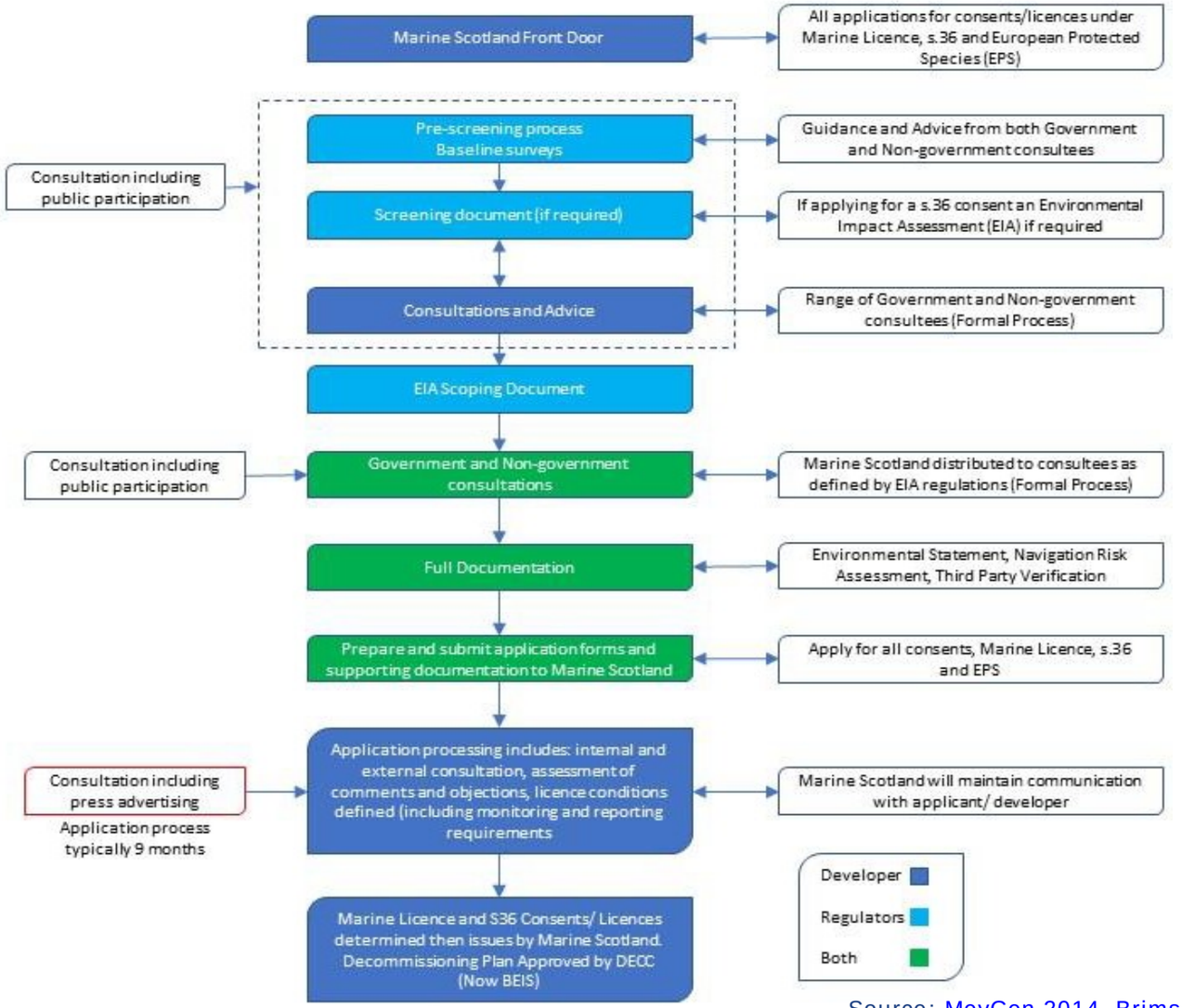
Source: Gillespie, 2020 Presentation. OES Environmental International Monitoring Forum

Brims

- OpenHydro
- EIA submitted 2016
- Indications were positive that it would be consented
- 200 turbines with capacity of 200MW



Key stages of Environmental Impact Assessment



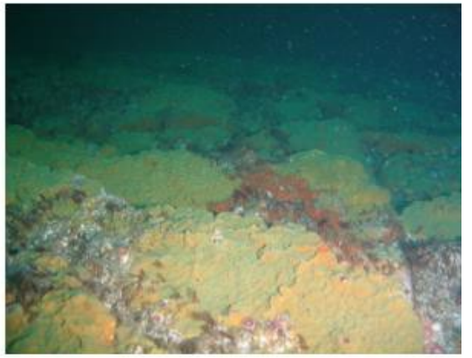
Magnitude	Sensitivity				
	Very high	High	Medium	Low	Negligible
Severe	Severe	Severe	Major	Moderate	Minor
Major	Severe	Major	Major	Moderate	Minor
Moderate	Major	Major	Moderate	Minor	Negligible
Minor	Moderate	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible
Positive	Positive	Positive	Positive	Positive	Positive

Sensitivity of Receptor	Magnitude of effect			
	High	Medium	Low	Negligible
High	*MAJOR*	*MAJOR*	*MODERATE*	*MINOR*
Medium	*MAJOR*	*MODERATE*	*MINOR*	*MINOR*
Low	*MODERATE*	*MINOR*	*NEGLIGIBLE*	*NEGLIGIBLE*
Negligible	*MINOR*	*NEGLIGIBLE*	*NEGLIGIBLE*	*NEGLIGIBLE*

Source: MeyGen 2014, Brims 2016 & Scottish Government, 2012 Scottish Government (2012) Flow chart for Marine Licensing process.

Direct physical impact and loss of habitat

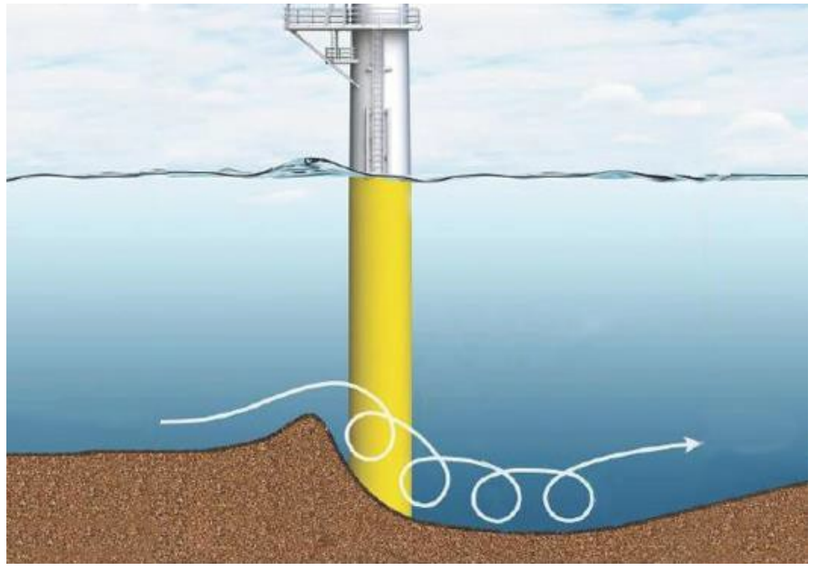
- Sessile species damaged or destroyed
- Mobile species will move away
- No species of specific conservation significance
- No large aggregations of animals
- Damage during installation would be temporary
- Kelp is a Priority Marine Feature in Scotland.
  - Less than 4% of the kelp in this area.



Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Minor	Minor	Not Significant

Seabed scour

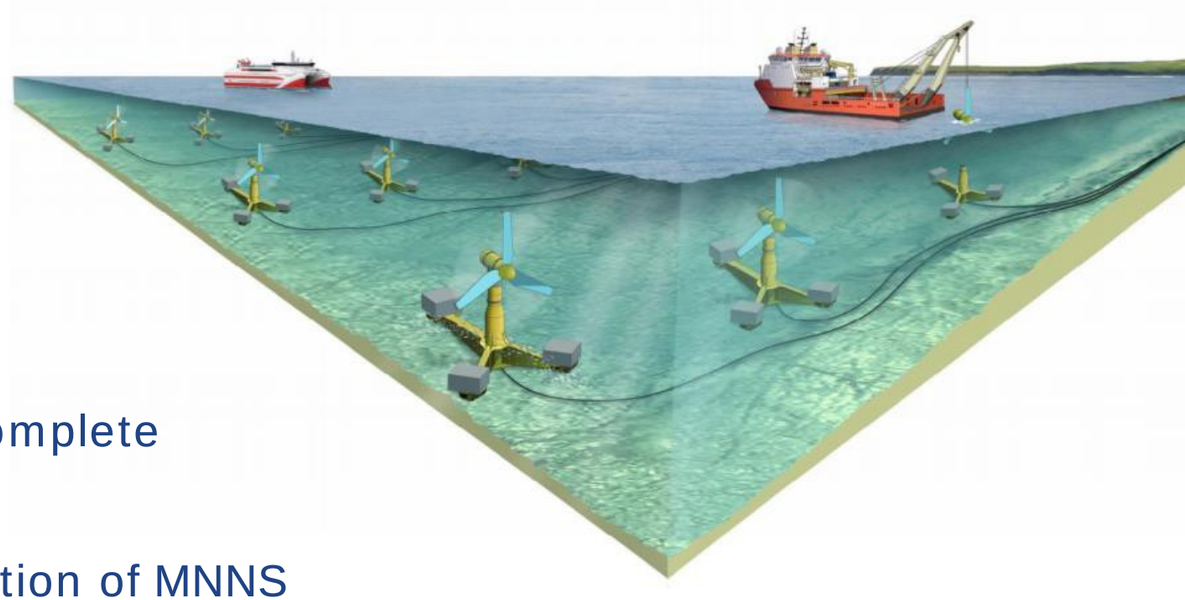
- Even minor changes can effect species distribution
- Scour effect is greater at cables.
  - Cable protection will be used.
- Low level of sediment cover in the AfL area
- Temporary presence of vessel anchors increase effect
  - Spatial extent will be minor and highly localised



Infrastructure type	Receptor Sensitivity	Mitigation	Residual Magnitude	Residual Significance
Support structures and subsea hubs	Medium	-	Negligible	Minor
Inter-array cables (including protection)		BE01, BE02, PD01	Negligible	Minor
Export Cables (including protection)		BE01, BE02, PD01	Low	Minor
Vessel moorings		GM07, PD12	Negligible	Minor
Overall			**Low**	**Minor**

Marine non-native species

- Most MNNS introduced would not be viable
  - environmental conditions (Temp, salinity, suspended sediment)
  - niche availability (organic content of sediment, prey species, competition with native species)



- Risk to native populations: reduction in numbers of a complete failure
- Biotopes are not considered to be at risk of the introduction of MNNS
- Local UK-based boats will be used, limiting this risk
- Low level of conservation importance of the benthic habitats in the area, the sensitivity is medium
- The impact could be major but due to the unlikelihood of occurrence, this is deemed as minor

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Minor	Minor	Not Significant

Introduction of new hard structures (Colonization, artificial reef effect)

- New habitat similar to existing (rocky) habitat
- Potential change in species composition is limited
- May be additional colonization from species not common e.g. blue mussels.
  - This provides a food source for fish, echinoderms and crustaceans
- Antifouling measures will limit this effect
- Due to this, plus the low conservation significant of the benthic habitats in this area, deemed not significant.

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Minor	Minor	Not Significant

Cumulative impacts

- List of projects identified which, together with project (Meygen or Brims) could result in cumulative impacts
- Installation and Construction & Decommissioning:
  - Due to temporary nature of this phase, and timing of other projects- no cumulative impacts considered
- Operation and Maintenance:
  - Cumulative impact of loss of habitat and species was assessed. Due to low diversity communities, dominated by sessile fauna, this is considered to be minor and therefore non significant.
  - MNNS considered to be increased risk with cumulative projects but mitigation measures are considered to be appropriate to minimise this risk

Mitigation measures

- Survey, deploy and monitor strategy adopted
- Baseline survey to fully define the habitat types and presence of species
  - Detailed cable route surveys to avoid sensitive habitats
- Installation layout clearly defined and communicated (e.g. kelp clearance)
- Minimisation as far as practicable the depth and diameter of the turbine foundation piles
- Non-toxic lubricants used
- All vessels will adhere to all relevant guidance (including the IMO guidelines)
- Cable protection management measures in place to minimise rock placement and hence minimise seabed disturbance
- Marine standard anti fouling coatings on turbines and associated infrastructure only to be used where necessary

Conclusions

- None of these impacts were assessed as significant
- Standard mitigation measures were employed
- Site selection to avoid species and habitats of conservation importance/significance
- Early, regular and efficient communication with regulator and other key consultees is key




EMEC

- Consented wave and tidal test sites
- Monitoring plan is required for each installation
- Environmental mitigation and monitoring plan (EMMP) or Project environmental monitoring plan (PEMP)
  - Validate/challenge assumptions made during EIA relating to any potential significant effects
  - Inform adaptive management protocols (where applicable)
  - Core part of the technology development process

Project Environmental Monitoring Plan

- Tocardo, 2017 & SME, 2015
- MNNS- Devices cleaned before transportation to Orkney
  - Biofouling Management Plan with details of antifouling paints used, biofouling inspections to be carried out, removal or biofouling and waste management
  - Use of anti-fouling paints
  - Good practice measures according to IMO standards to be implemented by vessels
- Habitat creation/ colonization & associated fish aggregation
  - No specific mitigations or monitoring proposed
  - Engagement with ORJIP OE to identify potential opportunities for research

Contact details

Jennifer Fox

aquatera
environmental services and products

Jennifer.fox@aquatera.co.uk

Tel: 01856 850 088

www.orjip.org.uk

PacWave

Sarah Henkel
Hatfield Marine Science Center
Associate Director, Pacific Marine Energy Center
Environmental Studies Lead, PacWave

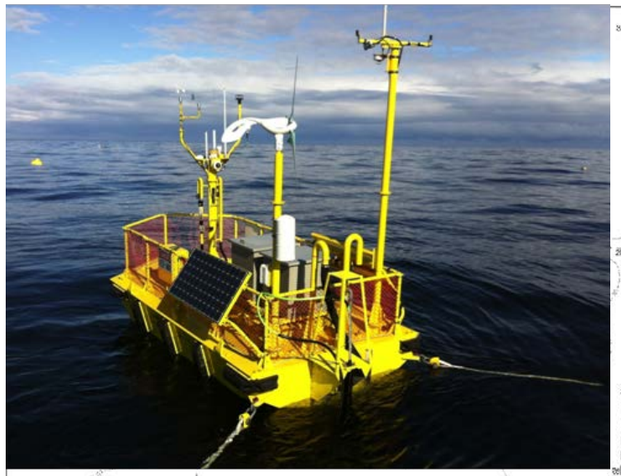
Oregon State University

PacWave Test Sites

PacWave North

Established autonomous test site for small-scale, prototype, and maritime market technologies

1 nm x 1 nm – single test at a time



PacWave South

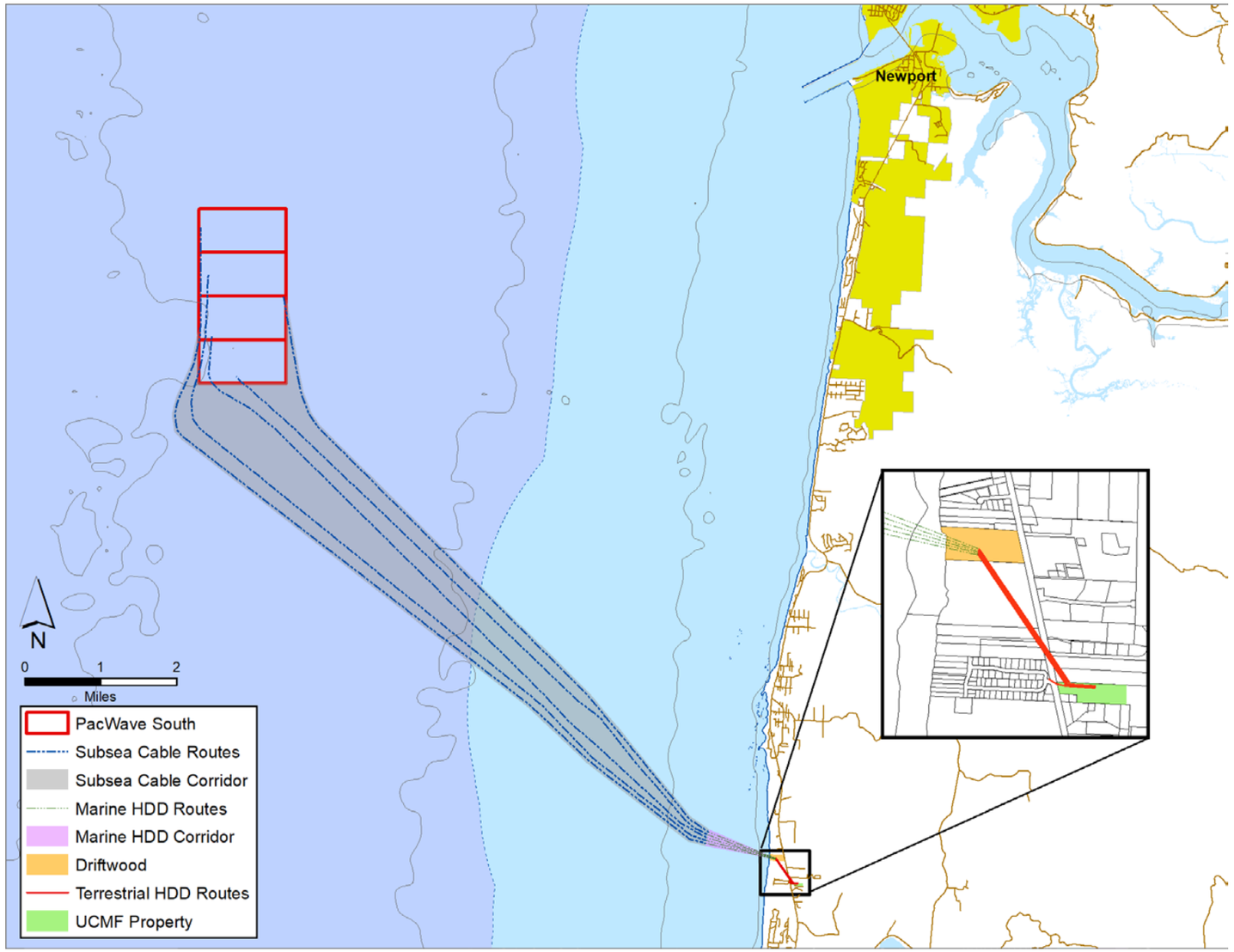
An in-development, state-of-the-art, pre permitted, accredited, grid-connected wave energy test facility

1 nm x 2 nm – 4 separate berths

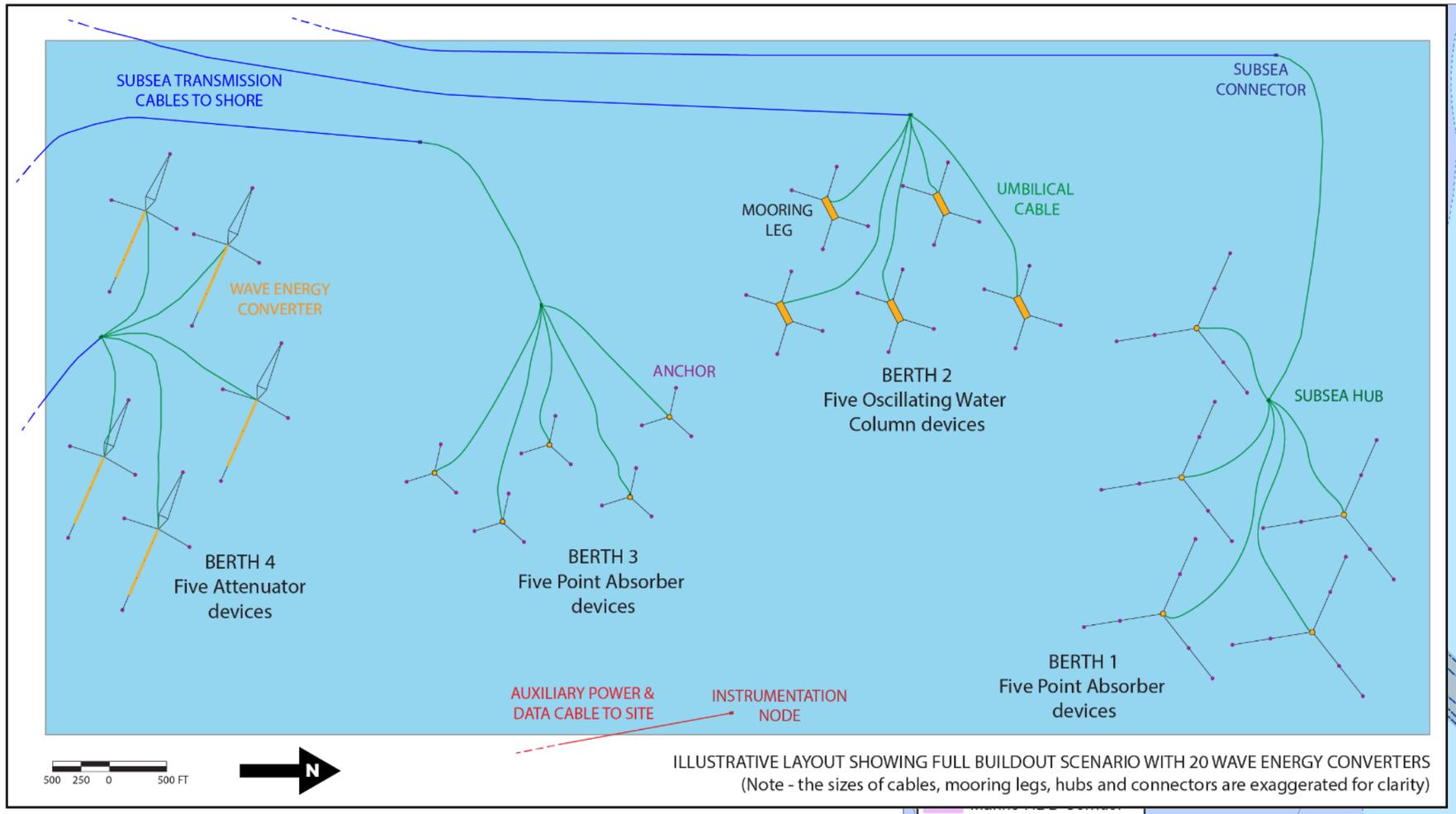
PacWave South

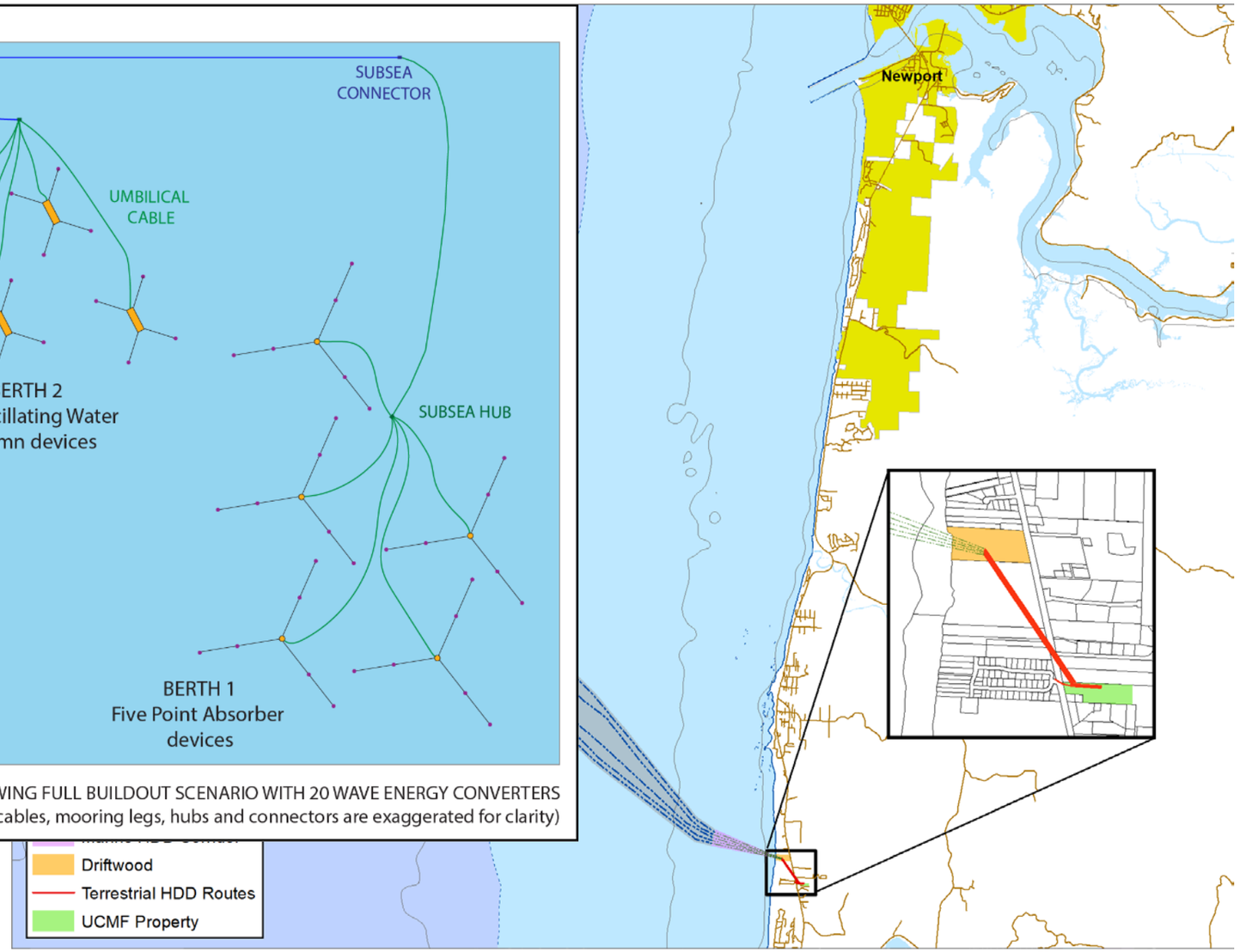
- Four test berths ~7 miles offshore
- Up to 20 MW and 20 devices
- Individual devices or arrays
- Five subsea power and data cables
- Shoreside Utility Connection and Monitoring Facility (UCMF)
- Connection to local utility district

- Design and permitting phase (current)
- Construction phase (2021-2022)
- Operational phase (2023)



PacWave South





Learning from Surrogate Industries

Lessons from other Offshore Energy Installations

Oil Platforms attract reef organisms to previously sandy areas. Species composition depends on depth.

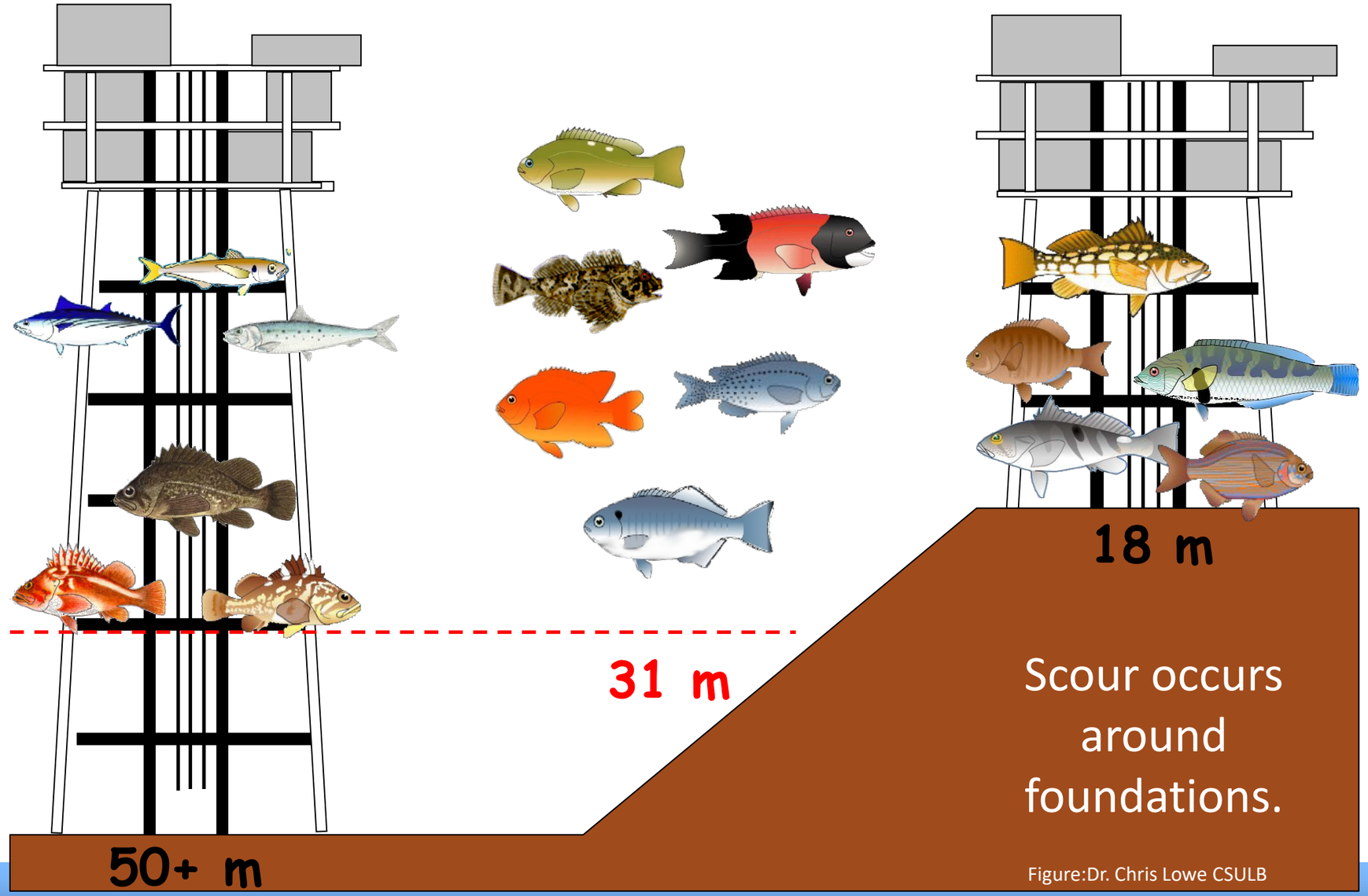


Figure:Dr. Chris Lowe CSULB

Shell mounds form under oil platforms and around wind turbines.

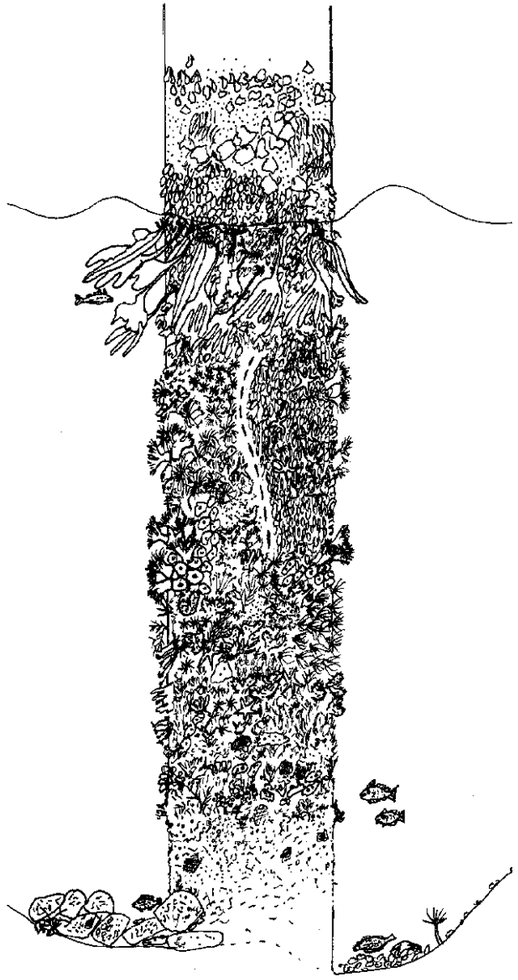
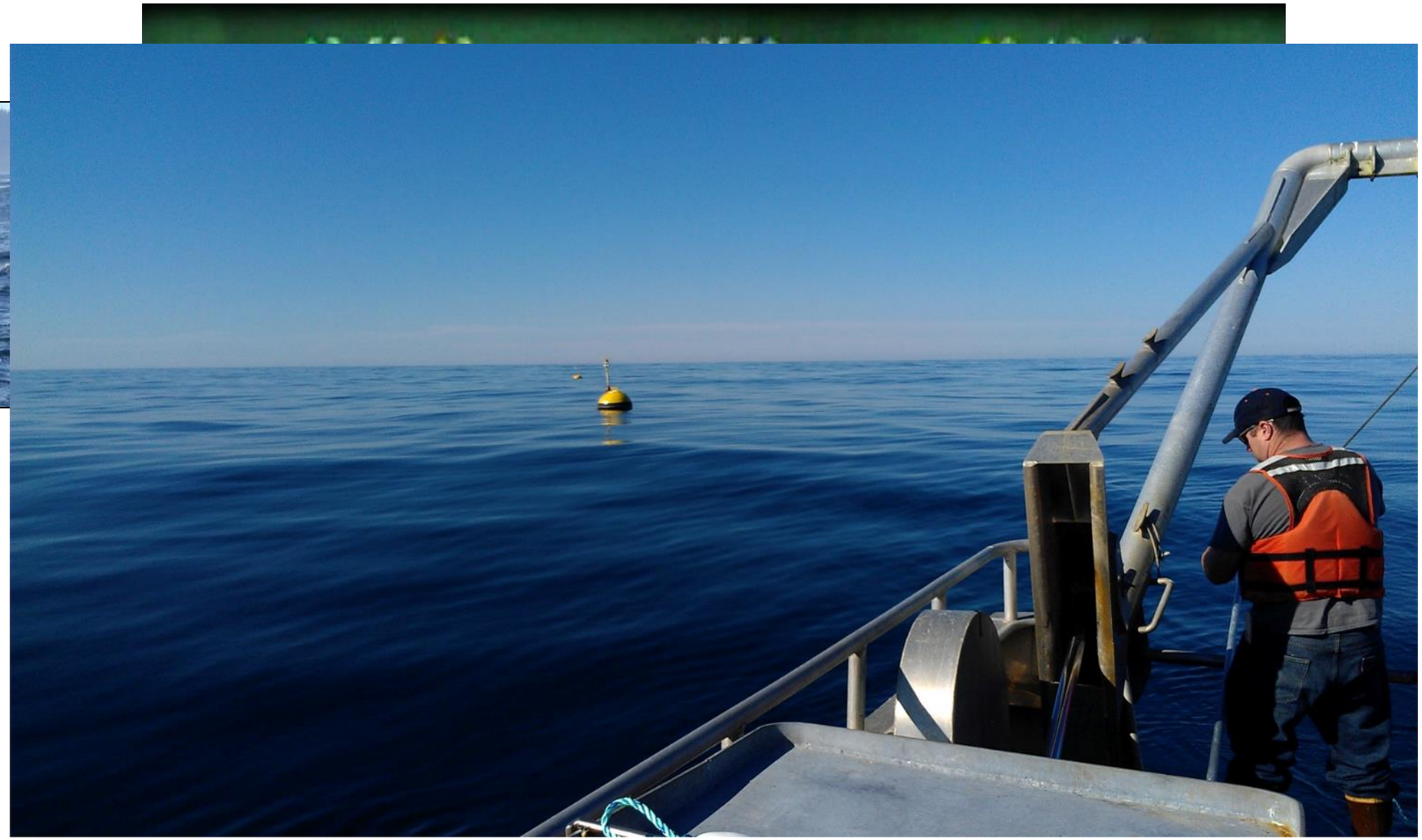


Figure: Hiscock et al. 2002

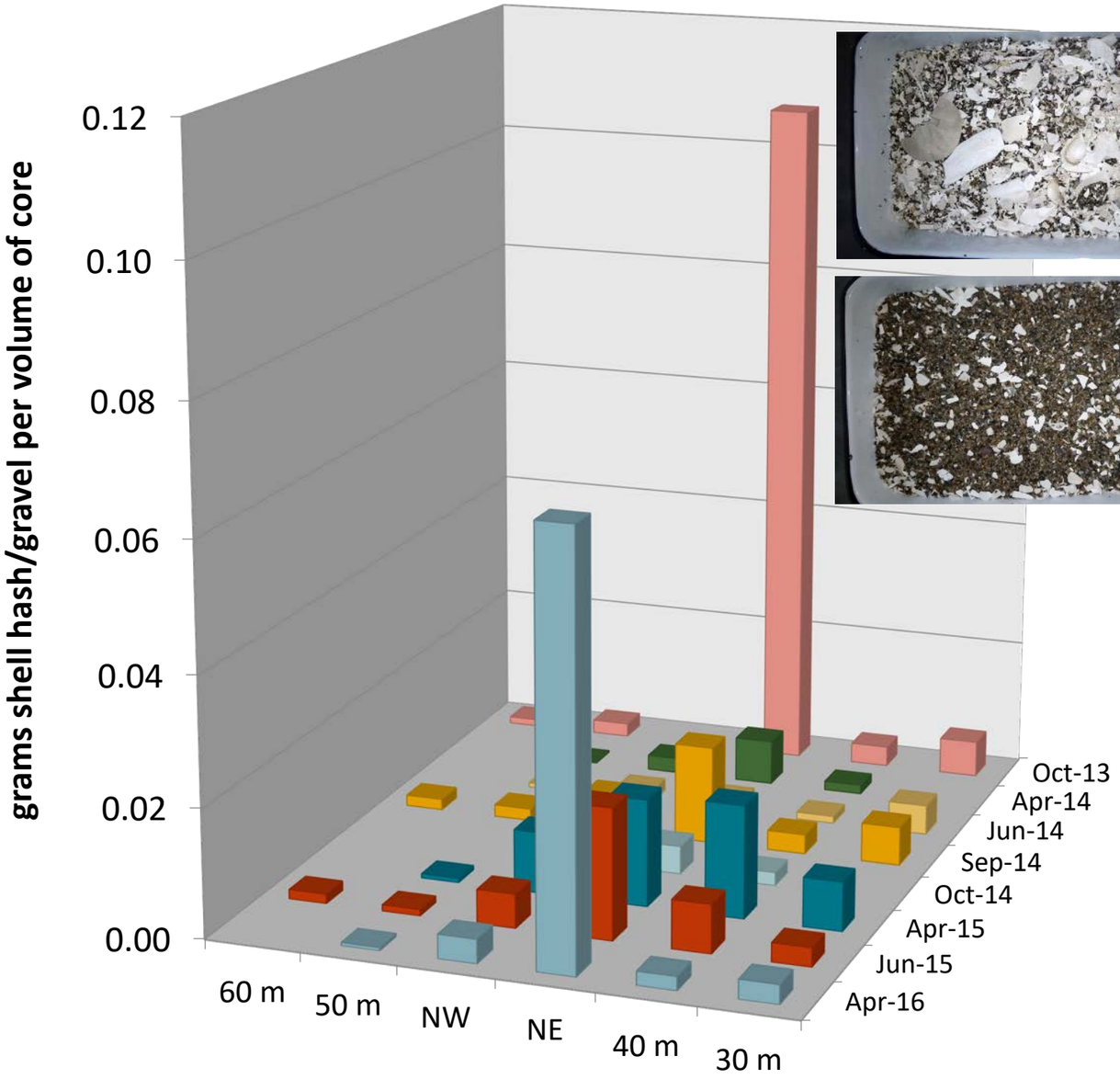
2012 ROV Survey of Wet-NZ test at PacWave-North

2012 ROV Survey of Wet-NZ test at PacWave-North



Starting in 2013, box cores collected around anchors in addition to reference areas

Residual (>1 mm) Proportion



Potential Effects on Number of Species

Inshore anchor had slightly lower peak richness
Offshore anchor had slightly higher peak richness
Generally lower richness than reference

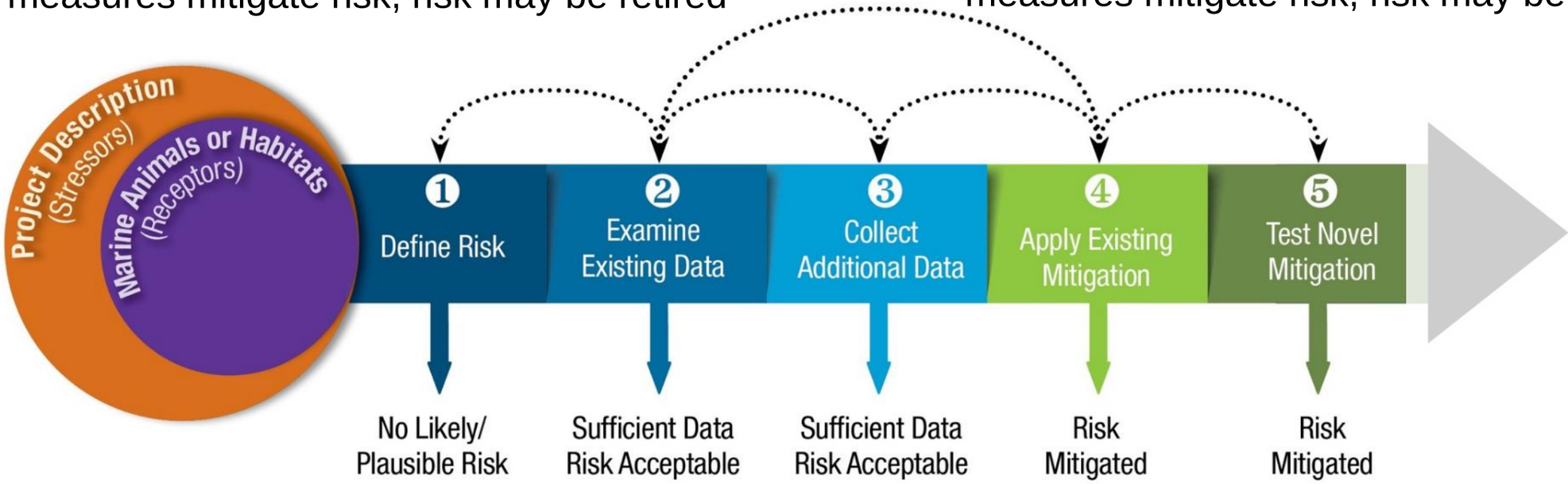
PacWave Permitting *Mirrors* Risk Mitigation Pathway

Stage Gate 4

- Apply Existing Mitigation - If existing mitigation measures mitigate risk, risk may be retired

Stage Gate 5

- Test Novel Mitigation - If novel mitigation measures mitigate risk, risk may be retired



Approach for Habitat/Community Change

- Apply Existing Monitoring Strategy (box core surveys)
  - If existing monitoring tools *quantify* changes *and these are limited in magnitude or extent*, risk may be *accepted*

Approach for Artificial Reef

- Test Novel Tool (Autonomous ROV surveys)
  - If novel mitigation measures *quantify* changes, risk may be *accepted*

For PacWave, risk is mitigated by monitoring.

Pre- and Post-construction Monitoring & Mitigation

Protection, Mitigation & Enhancement Measures

- EMF
- **Benthic habitat and fauna**
- **Organism interactions**
- Entanglement & collision
- Acoustics
- Pinniped haulout
- Birds & bats
- Aquatic resources & endangered species
- Ocean users
- Cultural resources

Monitoring*

- **Benthic sediment & fauna**

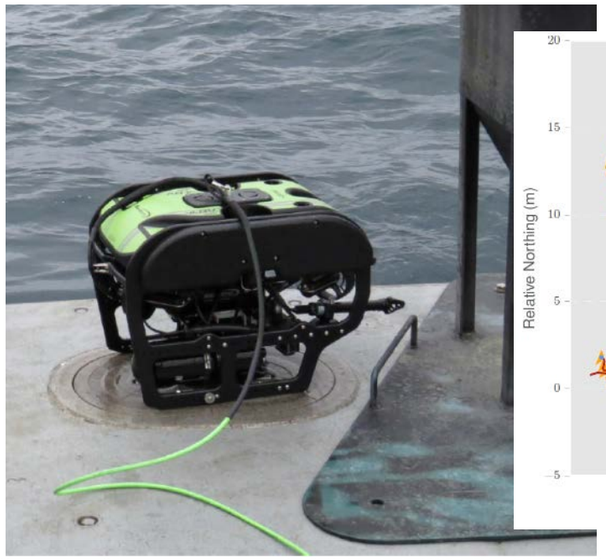
  -Effects of Installation/ Removal on Benthos

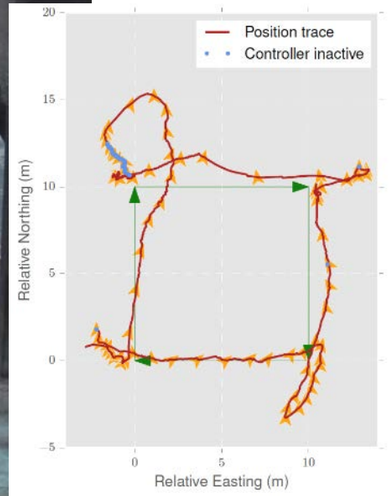
  -Colonization and Changes in Community Composition
- **Organism interactions**

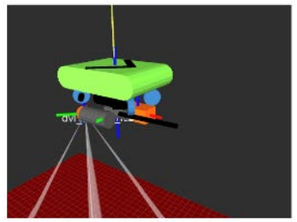
  -Artificial Reef Effect
- Acoustics
- EMF

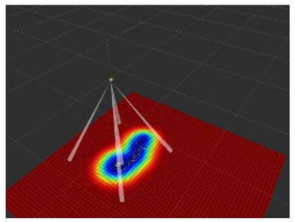
* Subject to adaptive management

Benthic and AR Monitoring

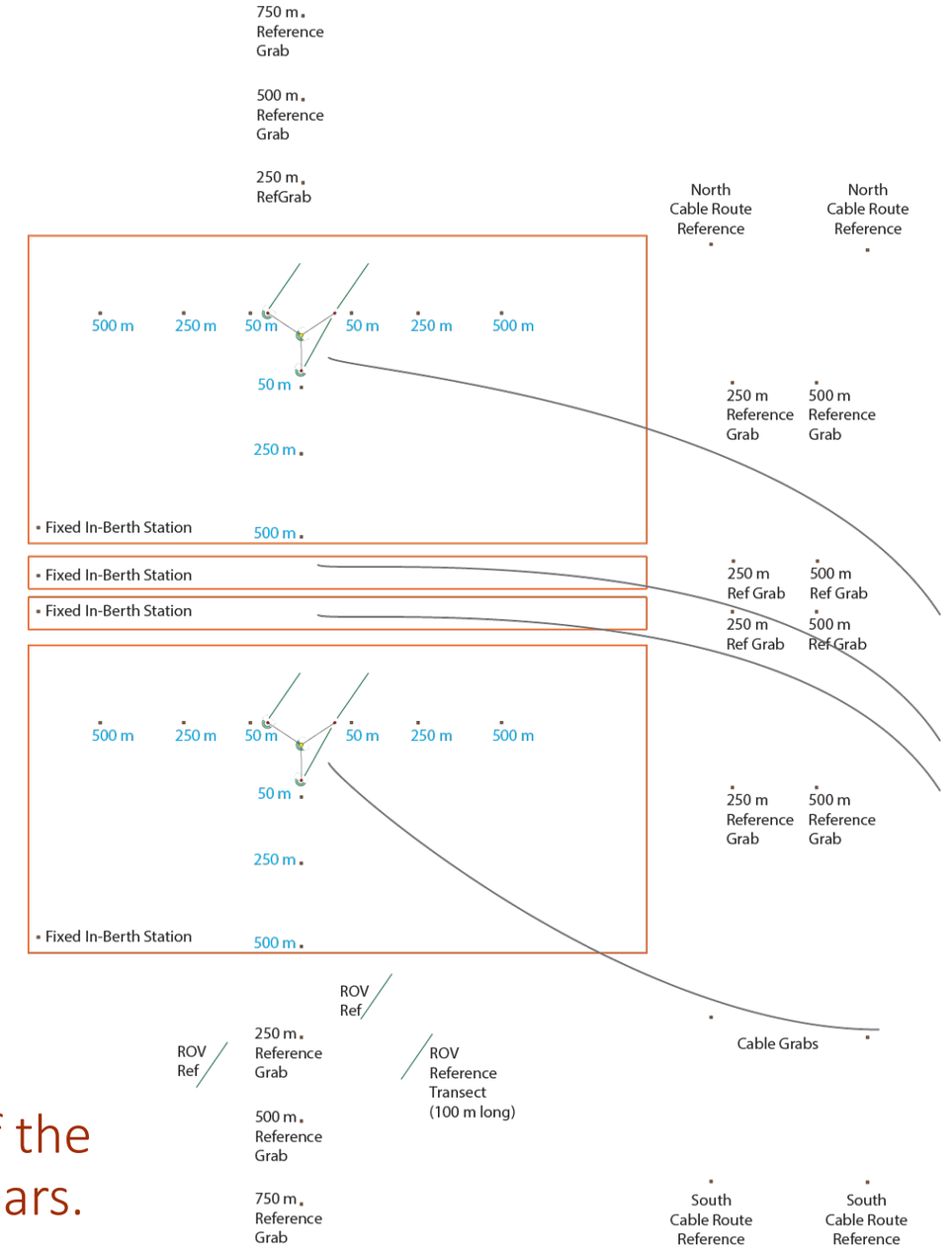








(a) Navigation visualization. (b) Depth GP model.



Every spring and late summer for first five years of the project – cable surveys may conclude after two years.

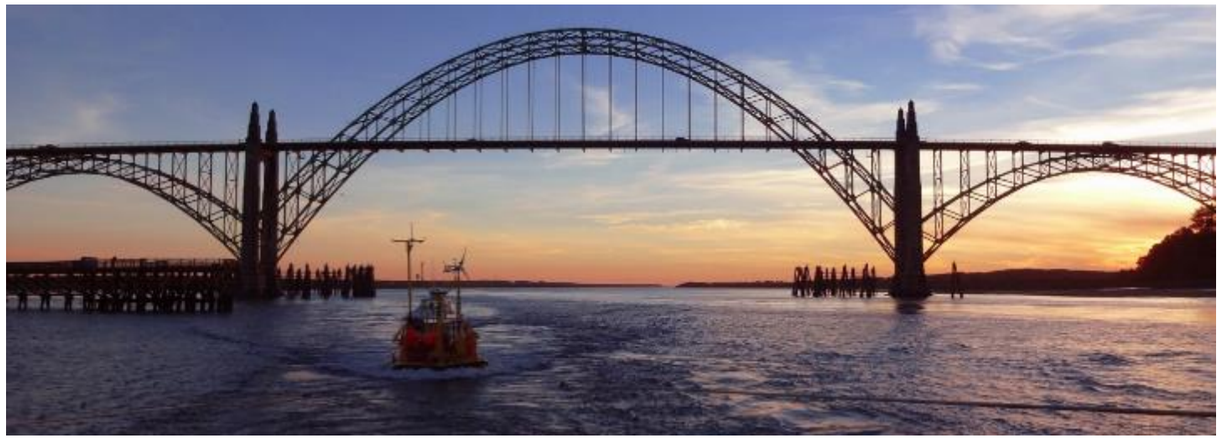
PacWave

Current Project Status

On April 23, 2020, the Federal Energy Regulatory Commission (FERC) published notice of an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for the PacWave South Hydrokinetic Project, and requested public comments be filed within 45 days.

On June 7, 2020 the FERC FONSI became final.

On July 1, 2020, pursuant to the requirements of the National Environmental Policy Act (NEPA), the U.S. Department of Energy (DOE) issued a Finding of No Significant Impact (FONSI) for the proposed action. An environmental impact statement will not be prepared.



PacWave

TESTING WAVE ENERGY FOR THE FUTURE

Contacts:

Burke Hales	Chief Scientist	bhales@coas.oregonstate.edu
Justin Klure	Project Manager	jklure@peventuresllc.com
Dan Hellin	Operations & Logistics	dan.hellin@oregonstate.edu
Sarah Henkel	Environmental Studies	sarah.henkel@oregonstate.edu
Doug Brusa	Development	Doug.Brusa@OSUFoundation.org
		541-207-8686 cell

pacwavenergy.org

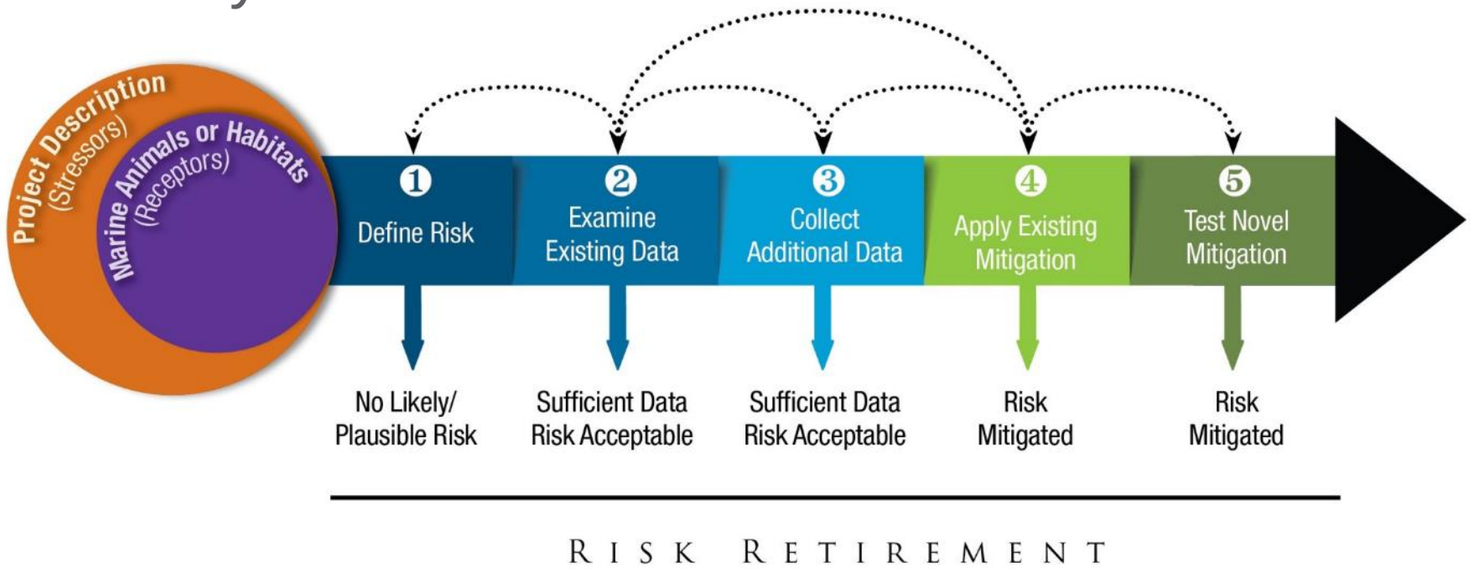
Discussion in Breakout Groups

- We will discuss risk retirement for each category of habitat change in small groups:
  - Learning from surrogate industries,
  - Effects of installation/removal on benthos,
  - Colonization and changes in community composition, and
  - Artificial reef effect.

- End with each breakout group moderator reporting out on their discussion.

Discussion – Surrogate Industries

- Learning from surrogate industries
  - Are there industries in your experience that are most relevant for data transferability?

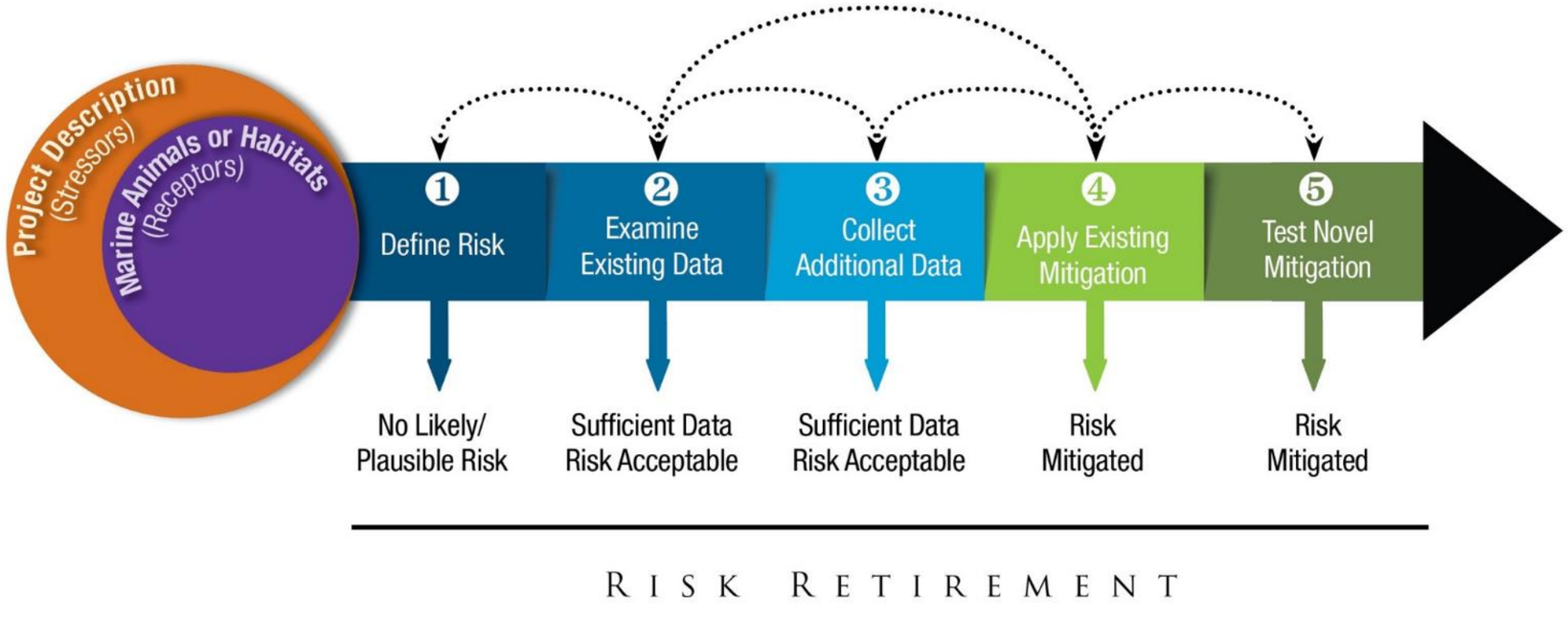


- Is it reasonable to transfer data from other industries to aid in risk retirement for habitat change?

Discussion – Effects of Installation/Removal on Benthos

- Do you feel confident there is enough data to understand the risk and retire it for small numbers of MRE devices (1-2)?
  - Effects of installation/removal on benthos

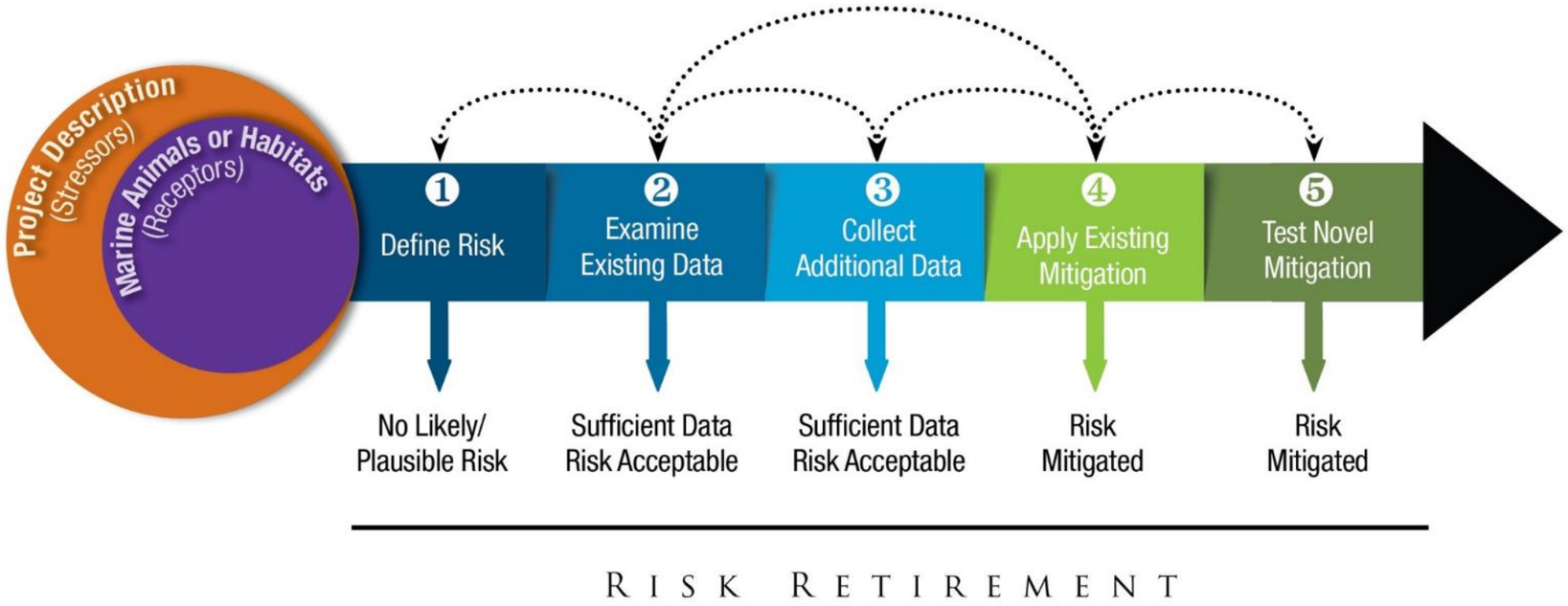
- What are the caveats for risk retirement for this category?



Discussion – Colonization and Changes in Community Composition

- Do you feel confident there is enough data to understand the risk and retire it for small numbers of MRE devices (1-2)?
  - Colonization and changes in community composition

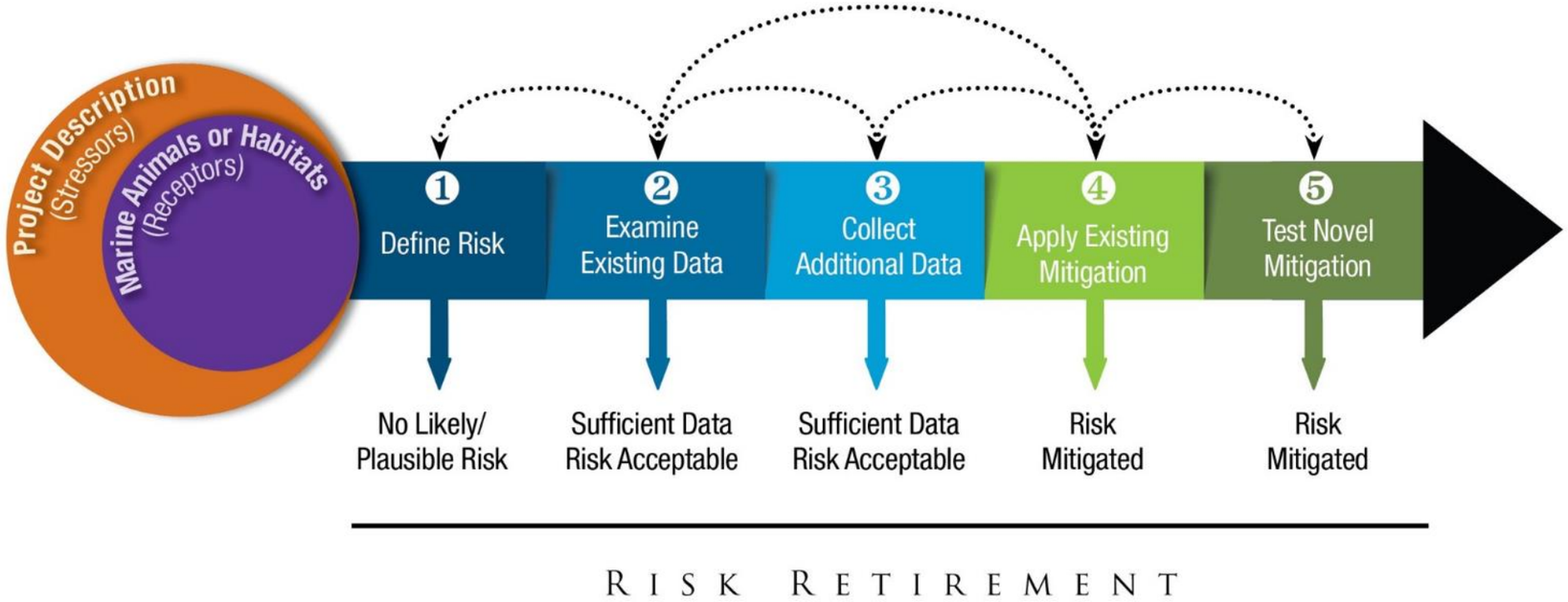
- What are the caveats for risk retirement for this category?



Discussion – Artificial Reef Effect

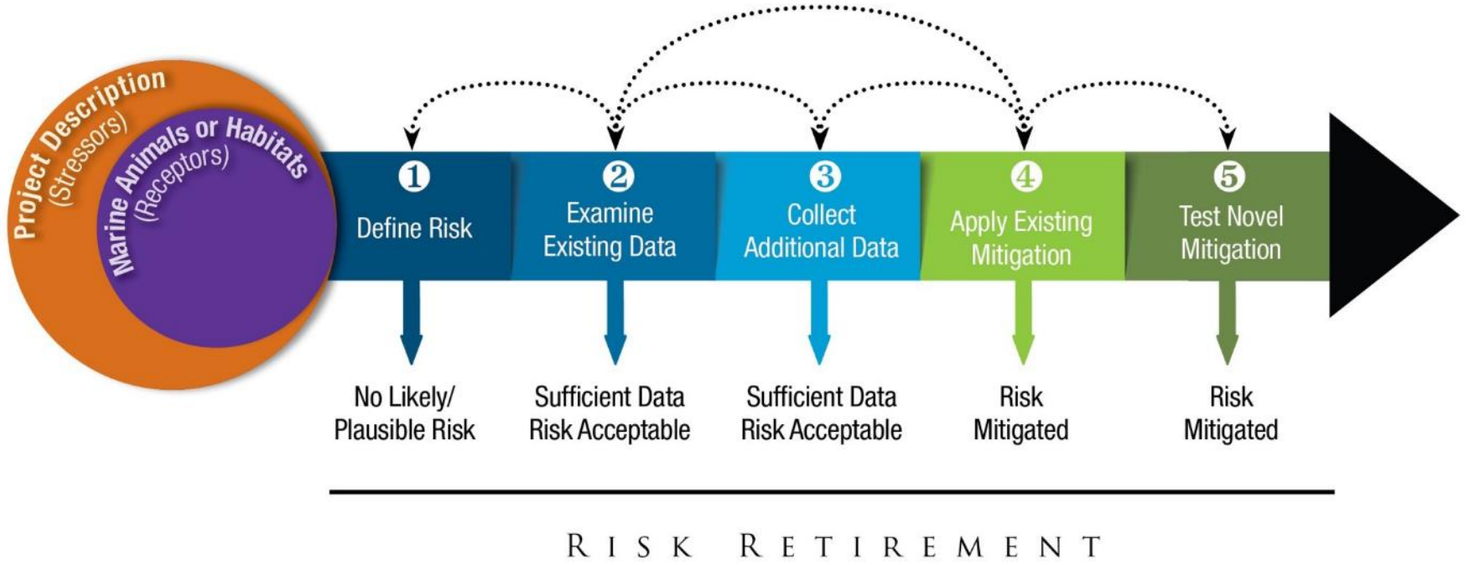
- Do you feel confident there is enough data to understand the risk and retire it for small numbers of MRE devices (1-2)?
  - Artificial reef effect

- What are the caveats for risk retirement for this category?



Discussion – Habitat Change

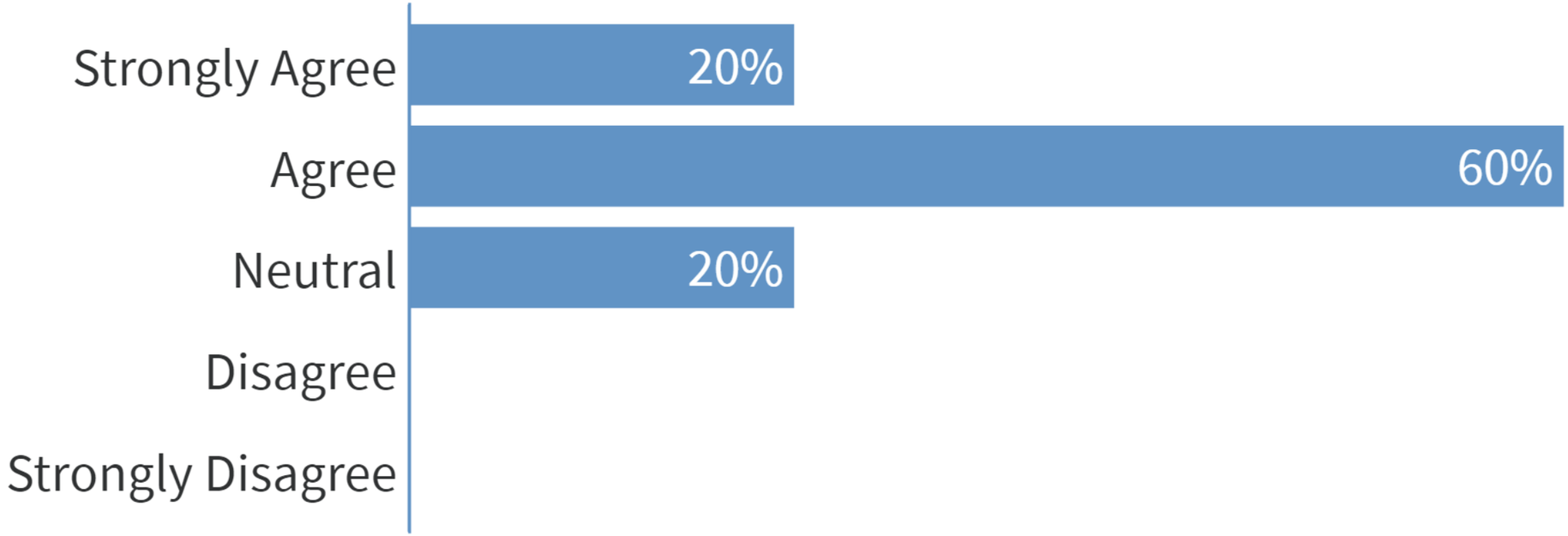
- What are your thoughts on the possibility of risk retirement for habitat change for small numbers of MRE devices overall?



- What are the caveats for risk retirement for habitat change?
  - "Habitat change could be a retired risk if _____."

Retiring Risk

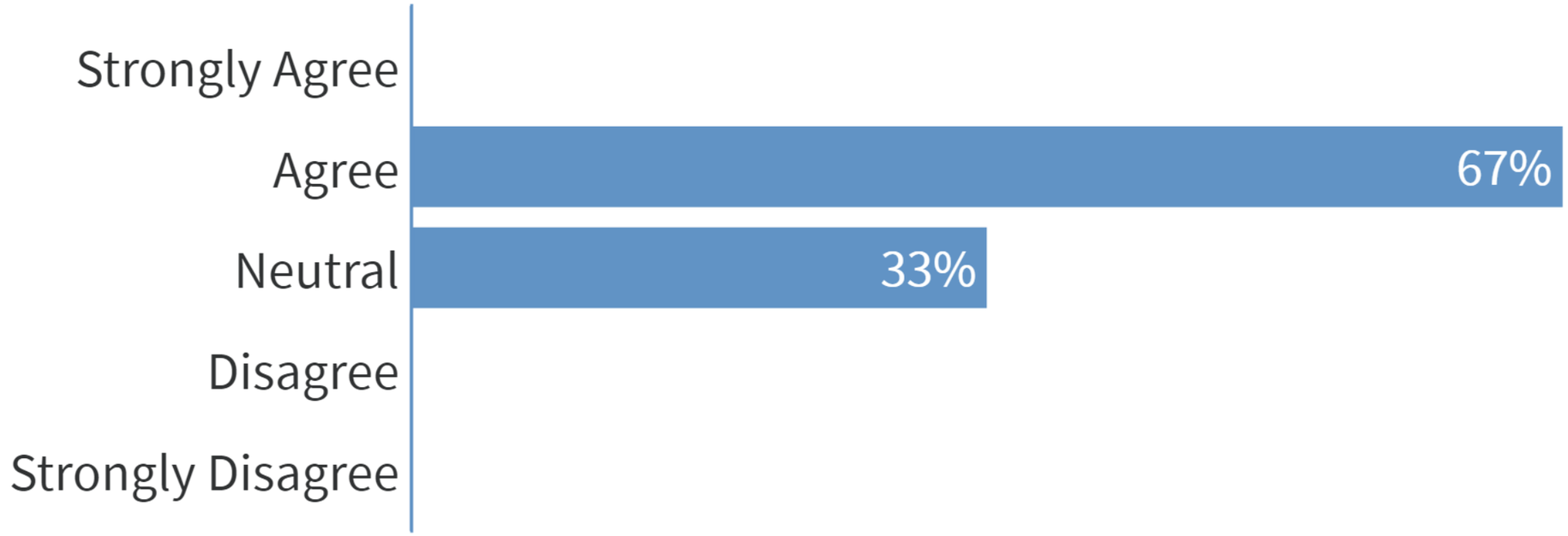
Can risk be retired for impacts from device installation/removal on the benthos for small numbers of MRE devices?



Answers to this poll are anonymous

Retiring Risk

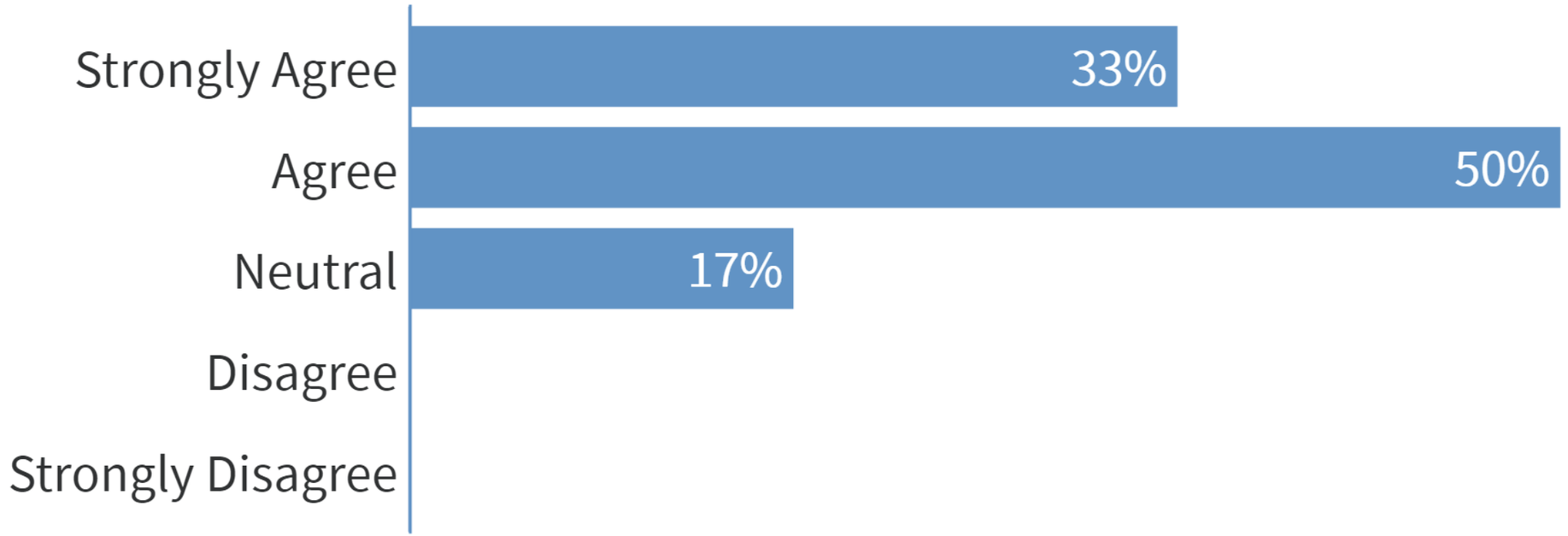
Can risk be retired for colonization and changes in community composition from small numbers of MRE devices?



Answers to this poll are anonymous

Retiring Risk

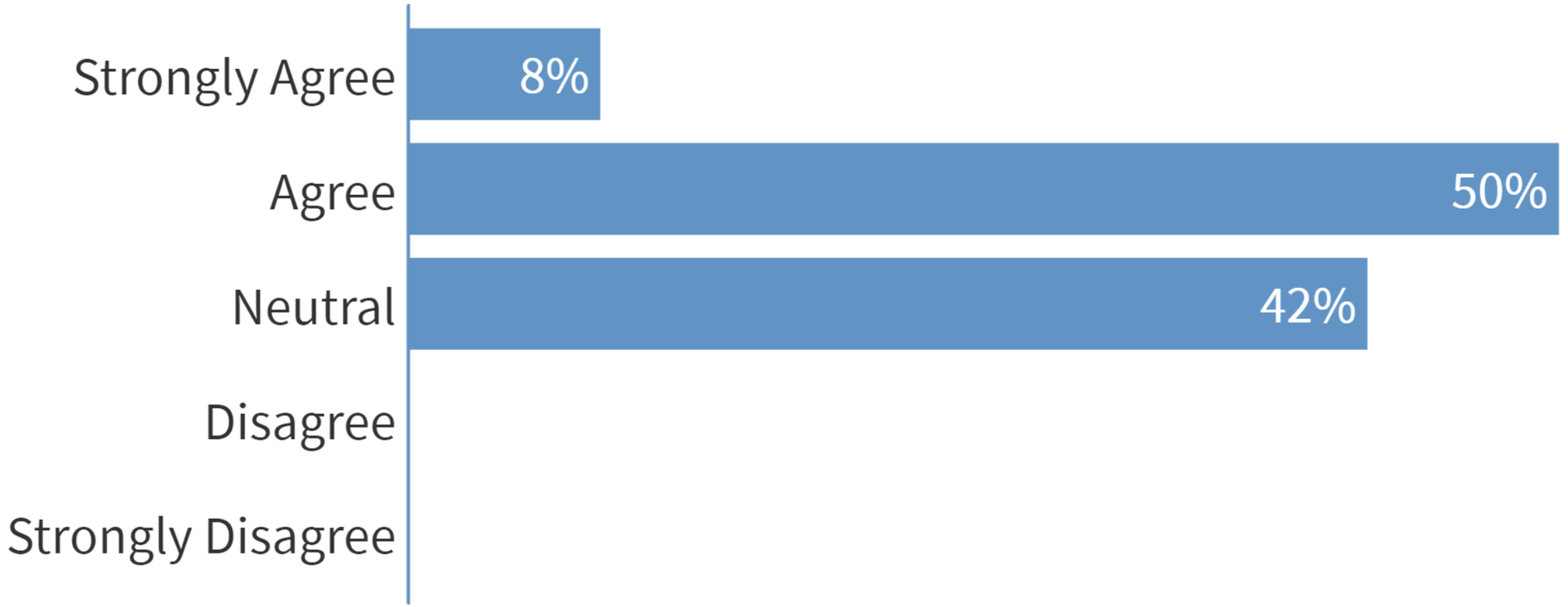
Can risk be retired for artificial reef effects from small numbers of MRE devices?



Answers to this poll are anonymous

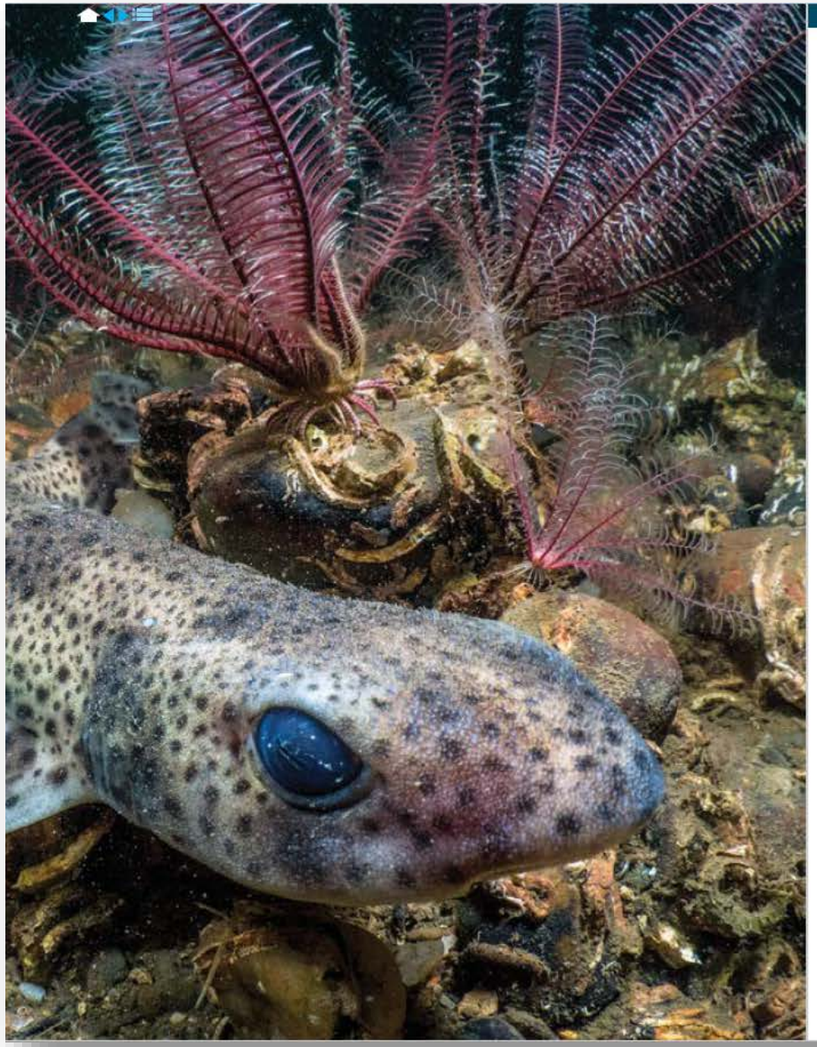
Retiring Risk

Can risk be retired for changes in habitat from MRE devices?



Answers to this poll are anonymous

Report out



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Chapter author: Lenaïg G. Hemery
Contributor: Deborah J. Rose

Changes in Benthic and Pelagic Habitats Caused by Marine Renewable Energy Devices

Most marine renewable energy (MRE) devices must be attached to the seafloor in some way, either through gravity foundations, pilings, or anchors, and with mooring lines, transmission cables, and devices themselves in the water column. Physical changes in benthic and pelagic habitats have the potential to alter species occurrence or abundance at a localized scale, lead to some level of habitat loss, provide opportunities for colonization by non-native species, alter patterns of ecological succession, modify ecosystem functioning, and affect behavioral responses of marine organisms. The transformation of the seafloor and/or water column habitat to new hard substratum because of the presence of the MRE devices may also lead to artificial reef effects or changes in animal behavior. While there is no indication that MRE devices affect marine habitats differently than other structures currently and historically placed in the ocean, regulators and stakeholders may continue to have concerns.

Wrap Up and Next Steps

- A recording of this discussion will be available at https://tethys.pnnl.gov/events/risk-retirement-habitat-change-expert-forum.
- Public webinar on risk retirement in September
- Guidance documents
  - To provide guidance on risk retirement in an accessible format for the entire evidence base that regulators can use
  - Developed for each stressor
- Evaluating risk retirement for changes in oceanographic conditions (white paper)

Pacific Northwest
NATIONAL LABORATORY

Thank you!

Andrea Copping

andrea.copping@pnnl.gov

Mikaela Freeman

mikaela.freeman@pnnl.gov

Lenaïg Hemery

lenaig.hemery@pnnl.gov

Deborah Rose

deborah.rose@pnnl.gov

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