PG&E WaveConnect Humboldt Working Group Permitting Authority Subcommittee Meeting

February 2, 2010

HWG

Humboldt Working Group (HWG) Groundrules

- Participate in an active and focused manner – commit to process success.
- Interact with all other members respectfully.
- Communicate interests, not positions.
- Be brief in communications, and be prepared.
- Help involve all.
- Seek solutions for all.
- Commit to a good faith effort.
- Share relevant information.
- Communicate effectively—open, frank communications with the larger community, “not-for-attribution” to individuals in the group.
- Attend all meetings; start on time.
- Keep cell phones on silent.

Facilitator Responsibilities

- Maintain a neutral position as project issues are discussed.
- Help the group accomplish its objectives.
- Help guide the discussion.
- Enforce participant ground rules.
- Help involve all.
- Ask “why” to clarify interests.
- Ensure a smooth process.
- Retain confidential information as confidential to individual participants.
- Manage time.
- Track actions, next steps, deadlines.

Agenda

I. Introductions/Session Overview.....9:00 – 9:05 a.m.

II. Review of Action Items, Updates.....9:05 – 9:15 a.m.

III. Draft Monitoring and Adaptive Management Plans.....
.....9:15 – 11:30 am.

IV. Lunch.....11:30 – 12:15 p.m.

V. Draft Monitoring and Adaptive Management Plans.....
.....12:15 – 2:00 pm

VI. Next Steps, Adjourn.....2:00 p.m.

Action Items/Updates

Monitoring and Adaptive Management

Monitoring & Adaptive Management

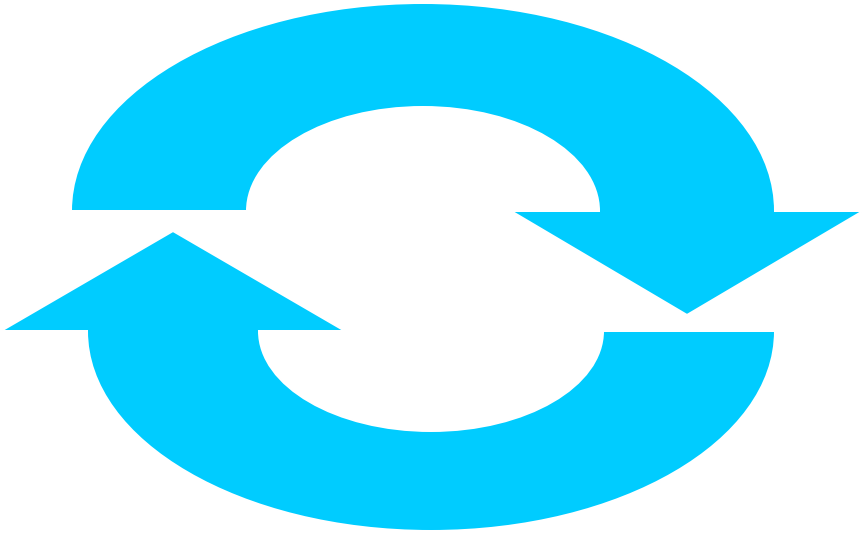
Define
problem, management objectives

Design
monitoring and mitigation plans

Implement
monitoring

Evaluate
results

Revise
monitoring, mitigation, minimization measures



Monitoring & Adaptive Management

Approach:

- **Define the issues**
  - **Stakeholders**
  - **Exposure, risk**
- **Develop specific objectives to address issue**
- **Design monitoring plan to address objectives**
  - **Methods should be focused on addressing objectives**
  - **Identify thresholds for decision-making**
- **Revise or discontinue monitoring or implement mitigation**
  - **Reduce risk associated with scientific uncertainty**

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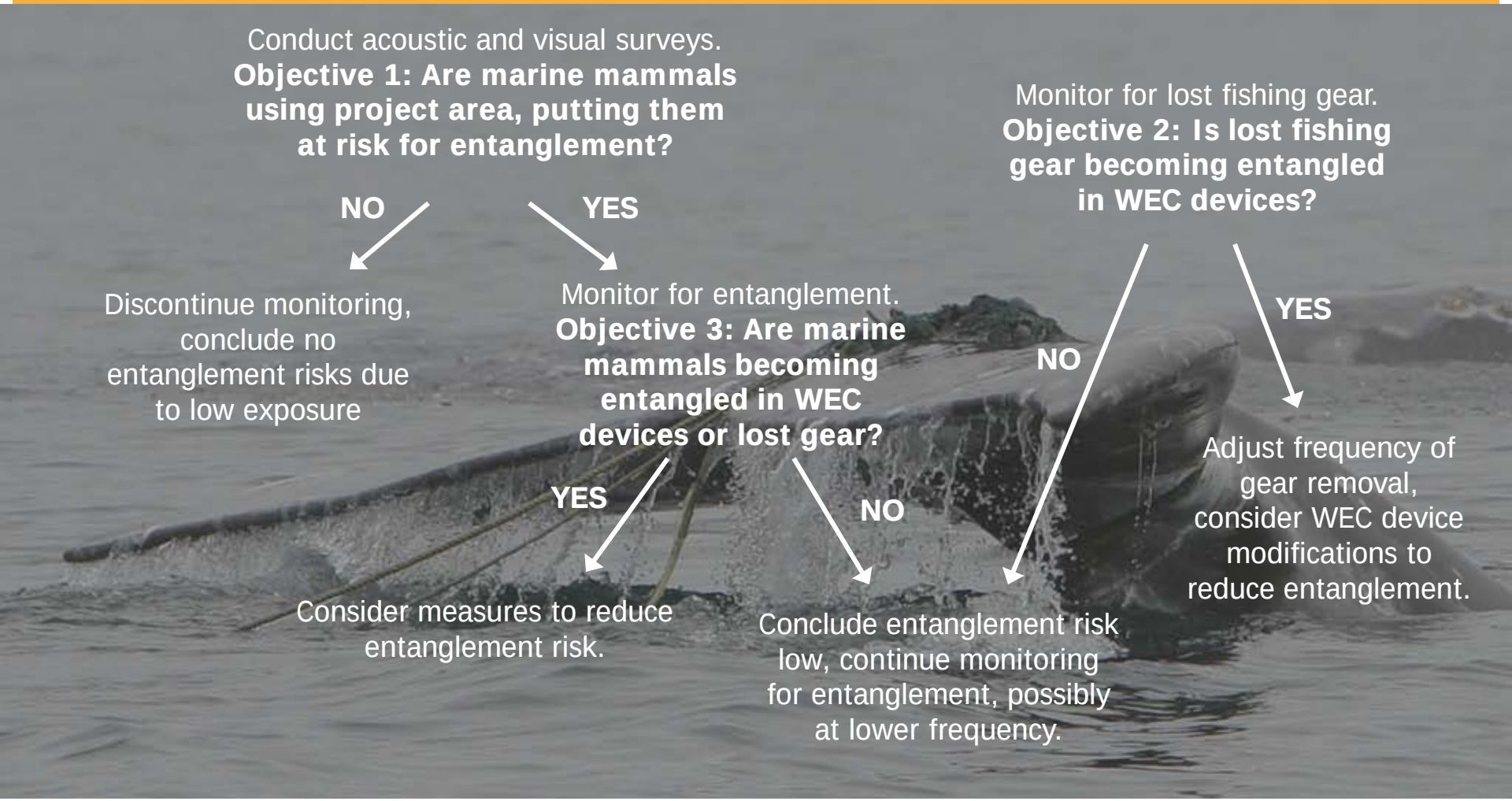
Issue: Marine mammals could become entangled in the WEC devices or lost fishing gear.



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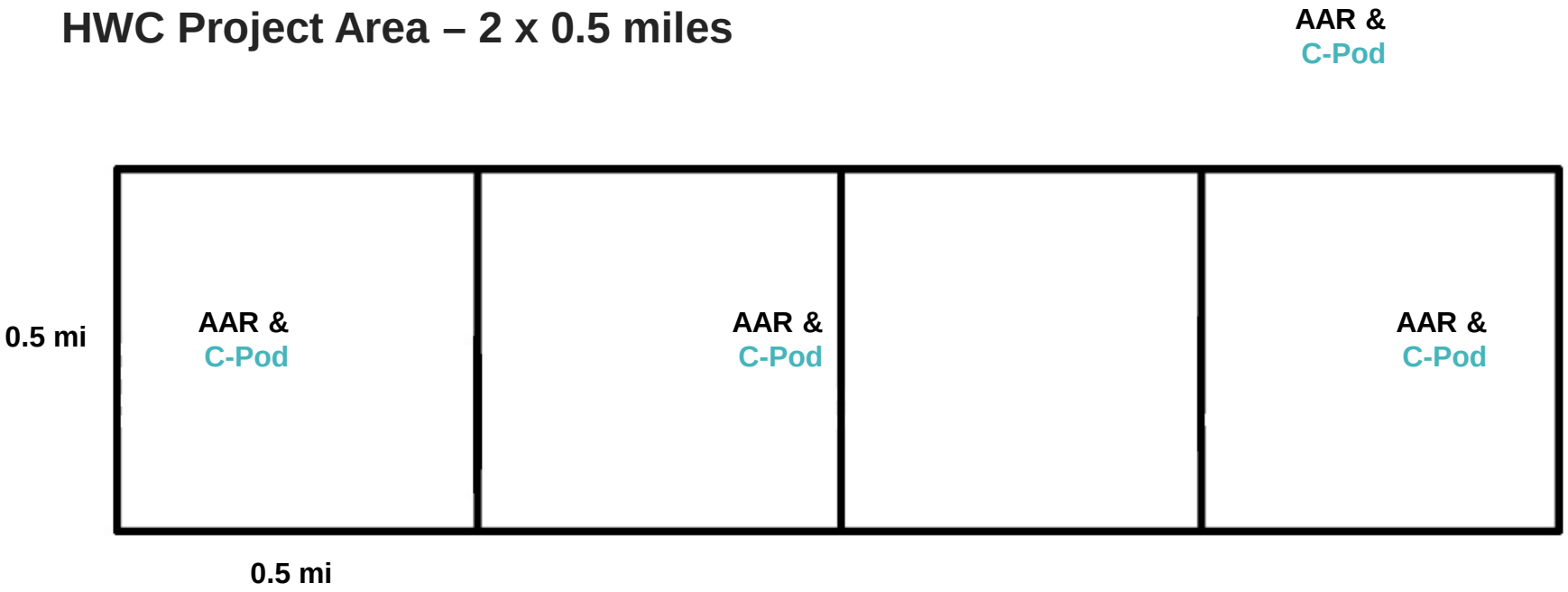
Types of Acoustic Monitoring Devices
Surface and Bottom Deployed Hydrophones

Typical hydrophone and cable for boat deployment.

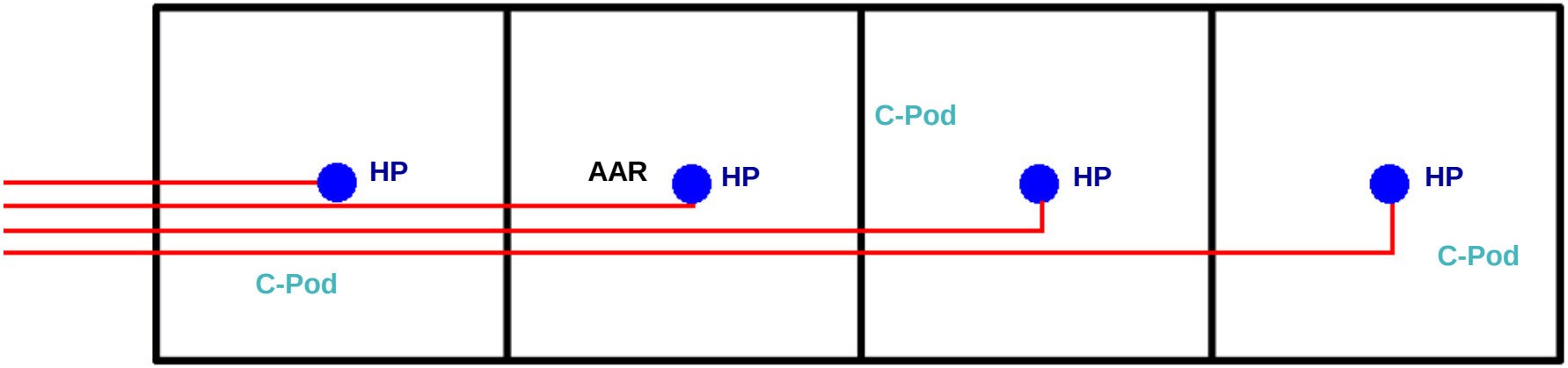
Types of Acoustic Monitoring Devices Before Cable Installation

HWC Project Area – 2 x 0.5 miles



Types of Acoustic Monitoring Devices After WEC Cable Installation

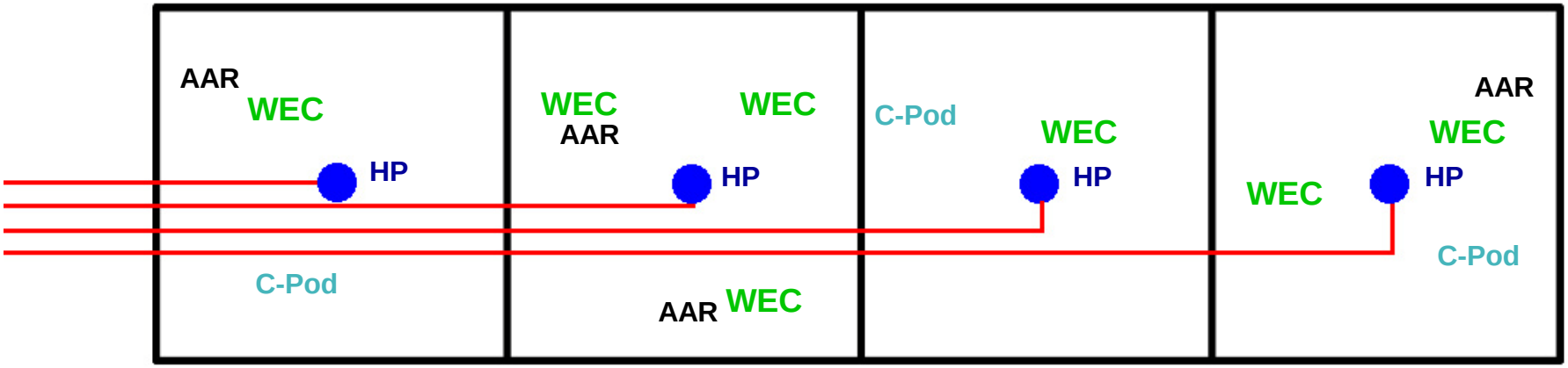
AAR &
C-Pod



AAR &
C-Pod

Types of Acoustic Monitoring Devices After WEC Cable Installation

AAR &
C-Pod



AAR &
C-Pod

Issue: Marine mammals could become entangled in the WEC devices or lost fishing gear.

Method	Before		After	
	Project	Control	Project	Control
Acoustic monitoring, hydrophones connected to subsea cables	X		X	
Acoustic monitoring, autonomous recorders	X		X	
Acoustic monitoring, boat-based hydrophones	X		X	
Visual observations by boat	X		X	
Observations with ROV, divers, and sonar			X	

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which could result in hearing injury or behavioral disturbances.

Conduct acoustic and visual surveys for marine mammals.

Objective 1: Are marine mammals using project area, putting them at risk for noise impacts?

NO → Discontinue monitoring, conclude marine mammals not exposed to noise.

YES → Compare device noise with marine mammal sensitivities.

Objective 3: Is device noise loud enough to cause behavioral disturbances for species using project area?

NO → Discontinue monitoring, conclude devices generating noise but not affecting species in project area.

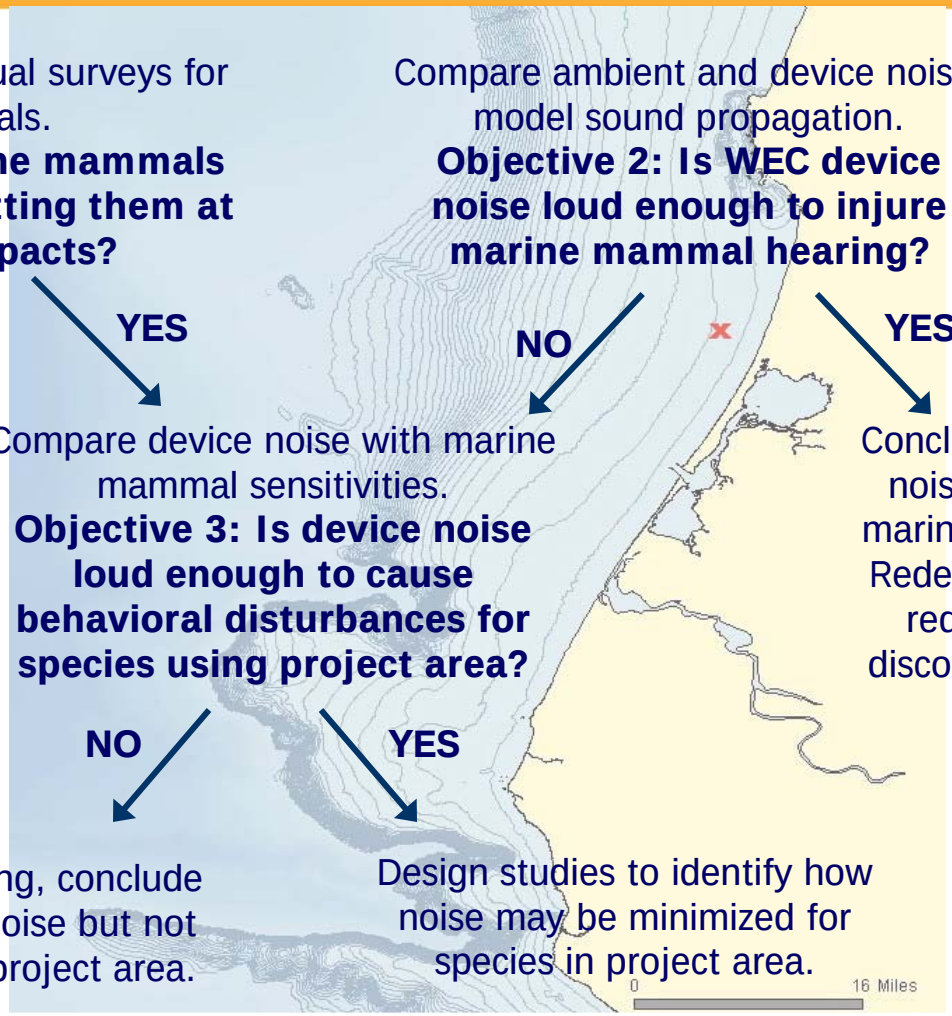
YES → Design studies to identify how noise may be minimized for species in project area.

Compare ambient and device noise, model sound propagation.

Objective 2: Is WEC device noise loud enough to injure marine mammal hearing?

NO → Compare device noise with marine mammal sensitivities.

YES → Conclude that device noise too loud for marine environment. Redesign devices to reduce noise or discontinue devices.



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Issue: Marine mammals may be affected by noise, which could result in hearing injury or behavioral disturbances.

Method	Before		After	
	Project	Control	Project	Control
Acoustic monitoring, hydrophones connected to subsea cables	X		X	
Acoustic monitoring, autonomous recorders	X		X	
Acoustic monitoring, boat-based hydrophones	X		X	
Visual observations by boat	X		X	

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Issue: Marine mammals could be attracted to WEC devices due to increased forage or haul outs, which could put them at risk for other impacts (i.e., entanglement, noise exposure).

Conduct acoustic and visual surveys before & after device installation.
Objective 1: Are marine mammals using the project area more after device installation?

NO → Conclude marine mammals not attracted Discontinue monitoring.

YES → Conclude devices may be increasing entanglement risk, noise exposure. Consider measures to reduce attraction.

YES → Are listed fish species attracted to devices (from results of Fish & Invertebrates plan)?

NO → Conclude marine mammal attraction to devices not causing increased predation on listed fish species.

YES → Conclude marine mammal/fish attraction could be causing increased predation on listed fish species. See Fish & Invertebrates plan.

Conduct visual surveys for sea lions at devices.
Objective 2: Are sea lions hauling out on devices?

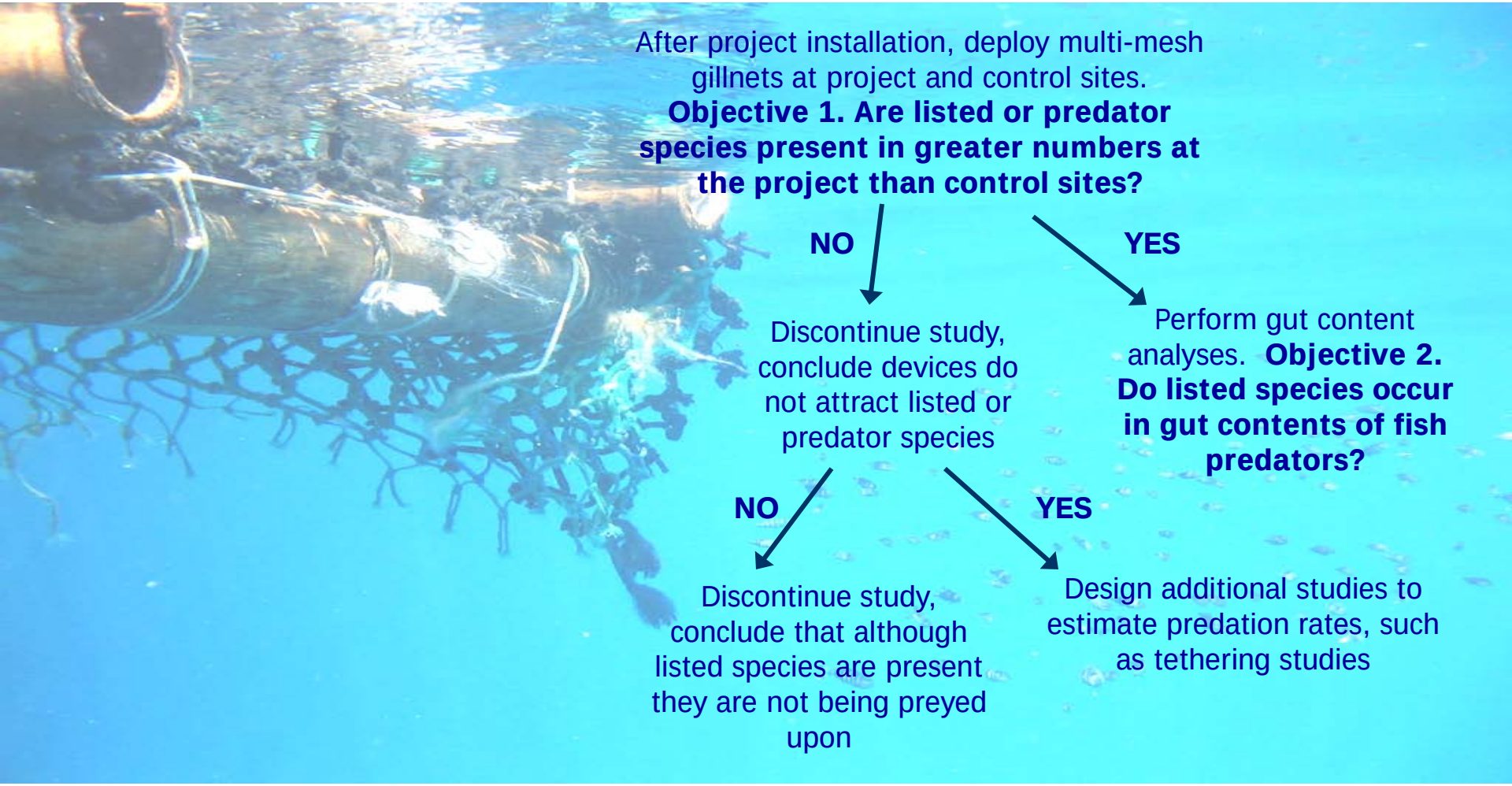
YES → Modify structures to prevent hauling out.

NO → Conclude sea lions unable to haul out on devices. Discontinue monitoring.

Issue: Marine mammals could be attracted to WEC devices due to increased forage or haul outs, which could put them at risk for other impacts (i.e., entanglement, noise exposure).

Method	Before		After	
	Project	Control	Project	Control
Acoustic monitoring, hydrophones connected to subsea cables	X		X	
Acoustic monitoring, autonomous recorders	X		X	
Acoustic monitoring, boat-based hydrophones	X		X	
Visual observations by boat	X		X	
Visual observations with motion-activated cameras			X	

Issue: Water column and surface components of WEC devices could act as a Fish Aggregating Device (FAD effect). If a FAD effect occurs, it could increase predation on listed fish species.



After project installation, deploy multi-mesh gillnets at project and control sites. **Objective 1. Are listed or predator species present in greater numbers at the project than control sites?**

NO → Discontinue study, conclude devices do not attract listed or predator species

YES → Perform gut content analyses. **Objective 2. Do listed species occur in gut contents of fish predators?**

NO → Discontinue study, conclude that although listed species are present they are not being preyed upon

YES → Design additional studies to estimate predation rates, such as tethering studies

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Issue: Water column and surface components of WEC devices could act as a Fish Aggregating Device (FAD effect). If a FAD effect occurs, it could increase predation on listed fish species.

Method	Before		After	
	Project	Control	Project	Control
Multi-mesh gillnets			X	X
Gut content analysis			X	X
Water quality monitoring			X	X

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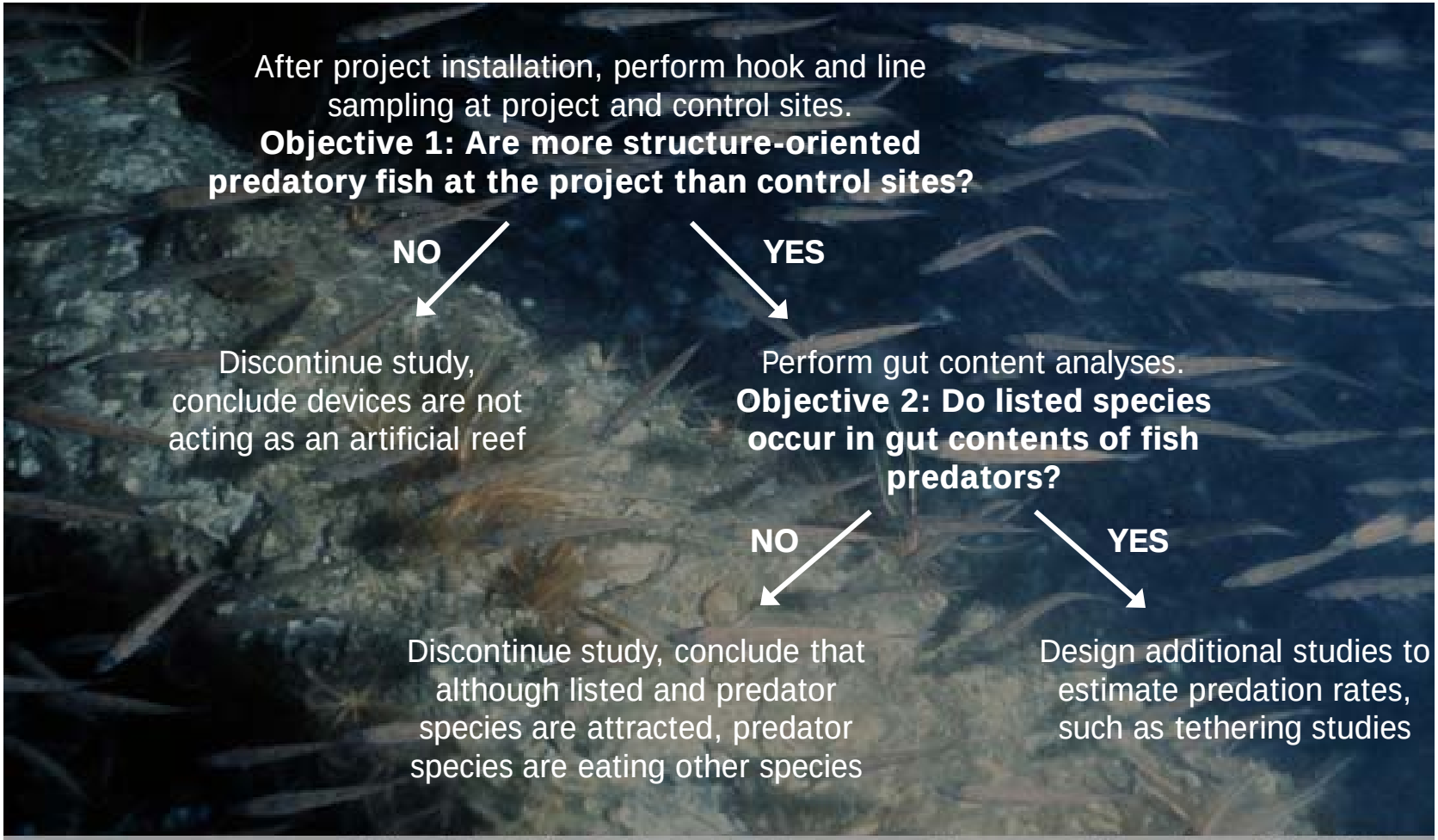
Issue: WEC device anchors could act as an artificial reef. If an artificial reef effect occurs, it could result in increased predation on listed fish species.



Yellowtail rockfish, *Sebastes flavidus*, young-of-the-year, Platform Irene, © Rick Starr

Issue: WEC device anchors could act as an artificial reef. If an artificial reef effect occurs, it could result in increased predation on listed fish species.

Method	Before		After	
	Project	Control	Project	Control
ROV and/or other observation			X	
Hook and line			X	X
Gut content analysis			X	X
Water quality monitoring			X	X

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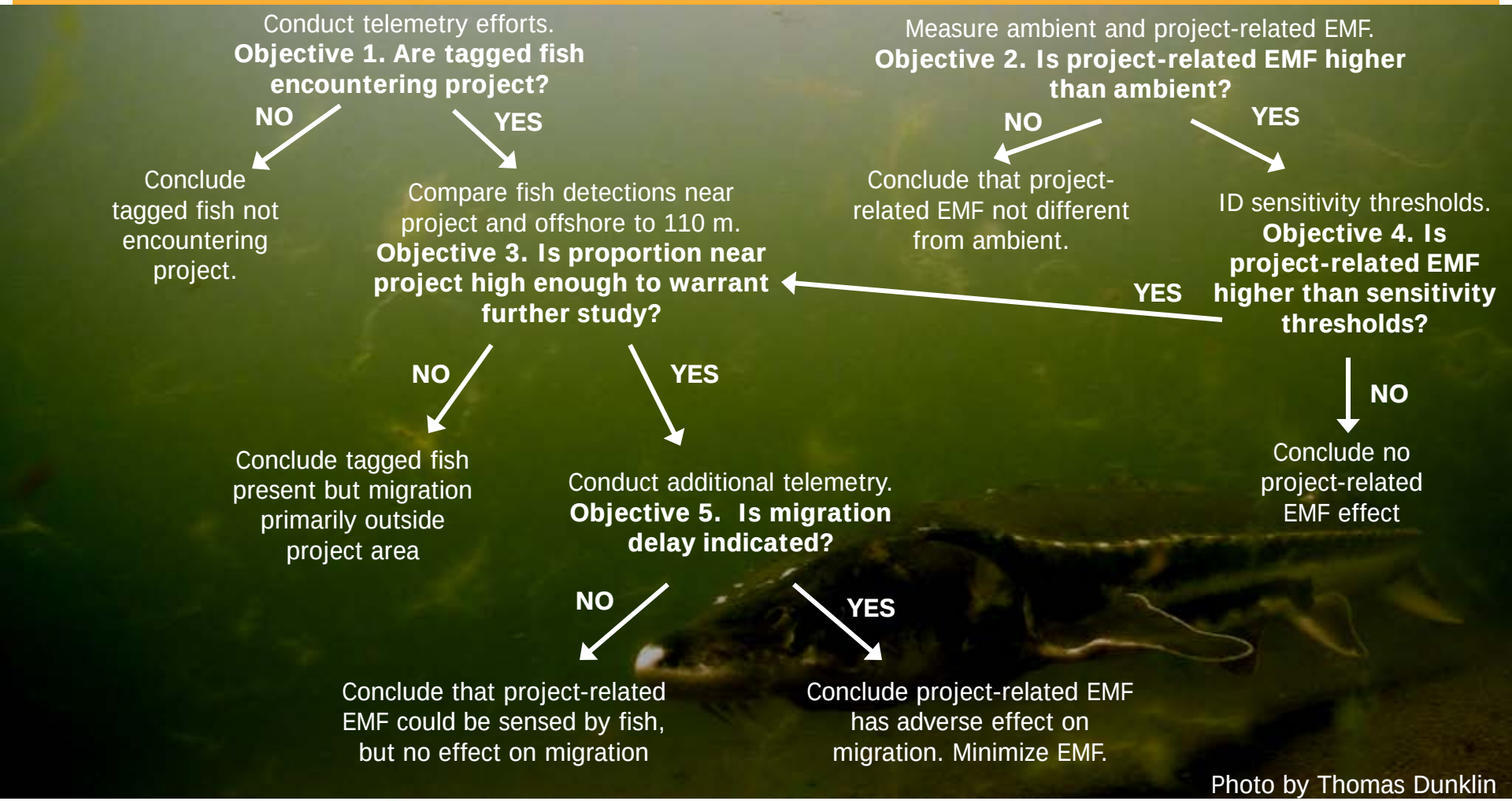
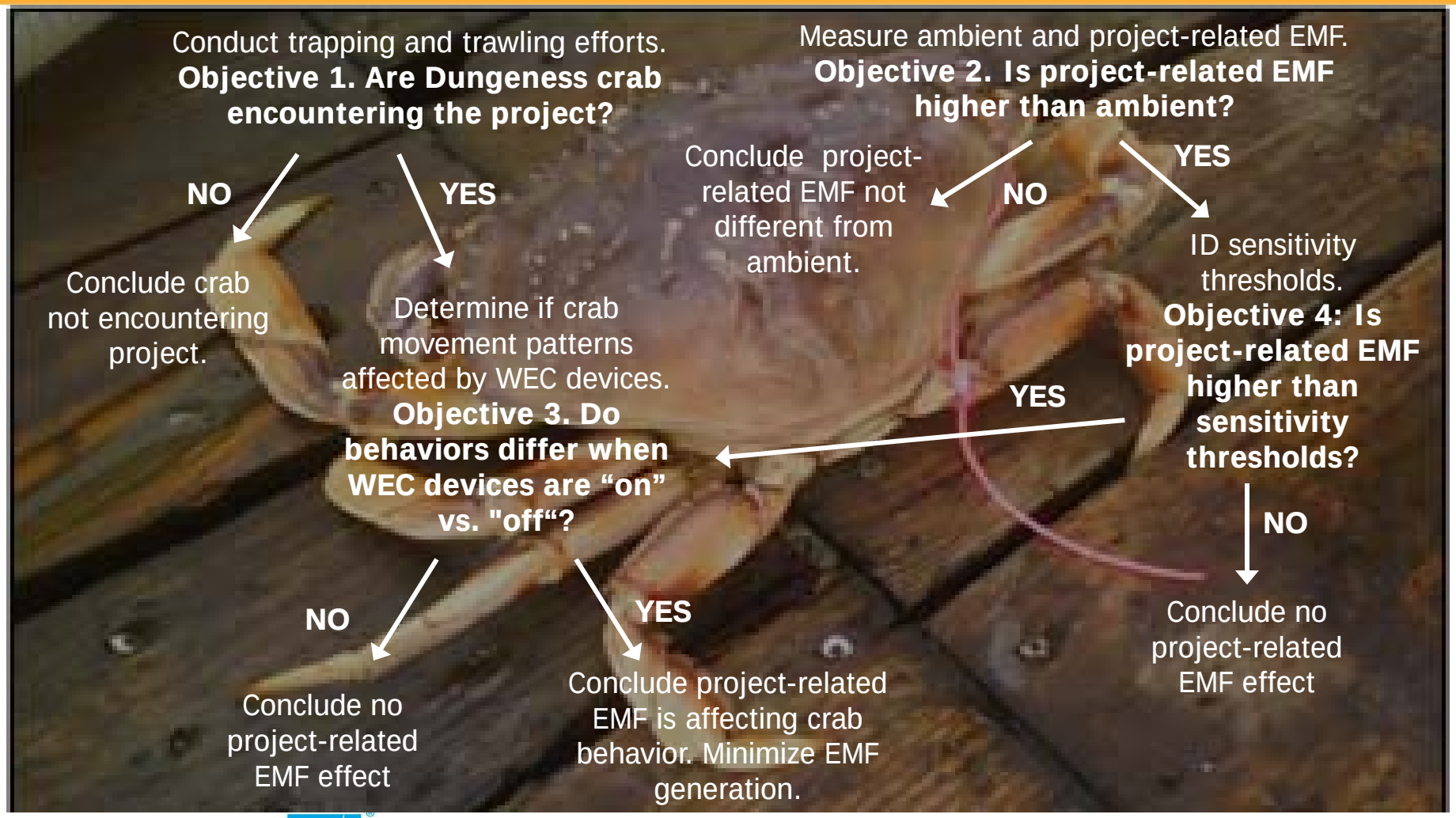
Issue: Electric and magnetic fields (EMF) generated by the project could negatively change behavior and movement patterns of green sturgeon.



Issue: Electric and magnetic fields (EMF) generated by the project could negatively change behavior and movement patterns of green sturgeon.

Method	Before		After	
	Project	Control	Project	Control
EMF modeling and measurement	X	X	X	X
Telemetry	X		X	
Water quality monitoring	X		X	

Issue. Electric and magnetic fields (EMF) generated by the project could negatively change behavior and movement patterns of Dungeness crab.



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Issue. Electric and magnetic fields (EMF) generated by the project could negatively change behavior and movement patterns of Dungeness crab.

Method	Before		After	
	Project	Control	Project	Control
EMF modeling and measurement	X	X	X	X
Telemetry			X	
Trapping	X		X	
Trawling	X		X	
Water quality monitoring	X		X	

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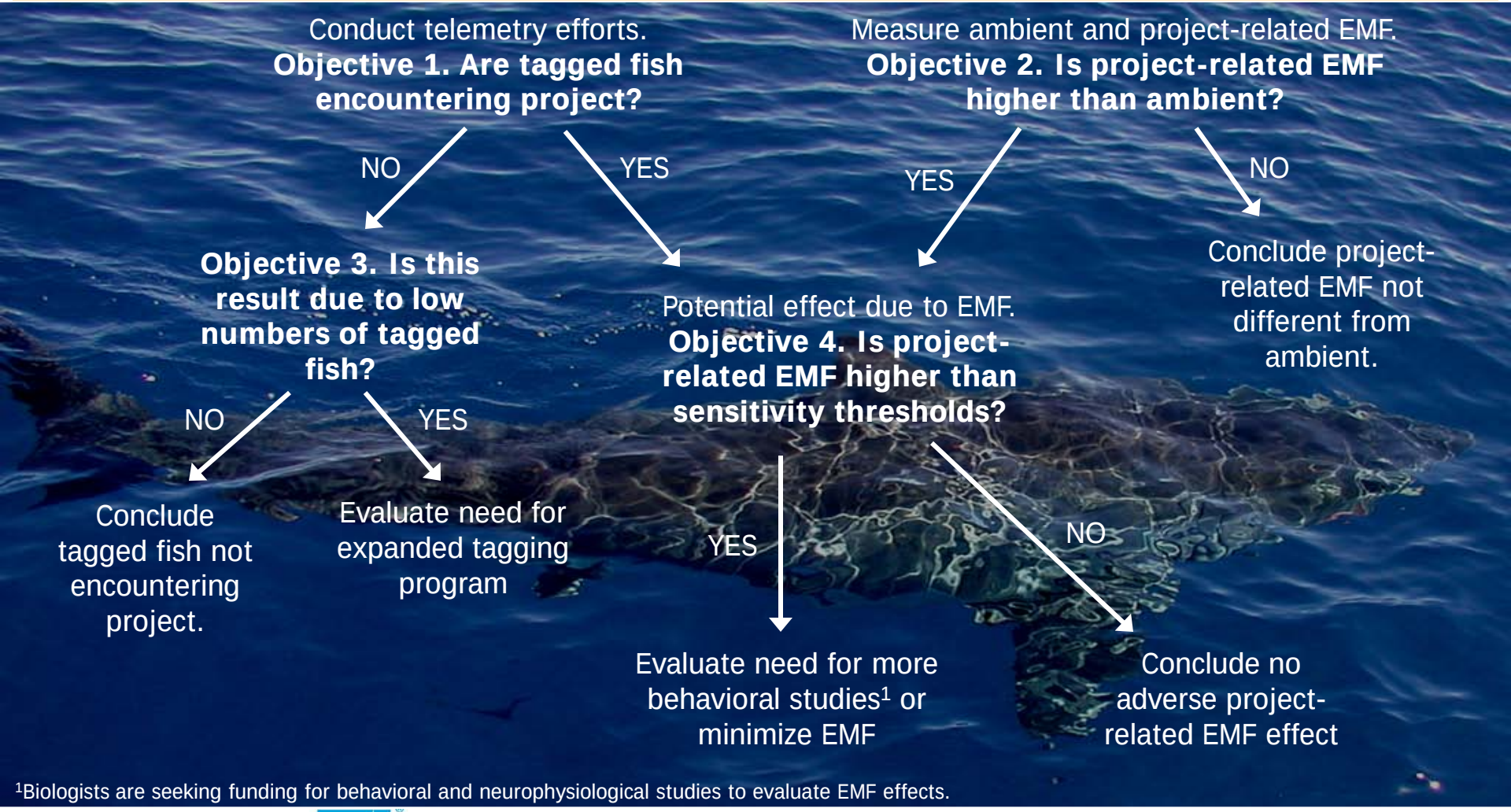
Issue: Electric and magnetic fields (EMF) generated by the project could negatively change behavior and movement patterns of elasmobranchs.



[1]Biologists are seeking funding for behavioral and neurophysiological studies to evaluate EMF effects.

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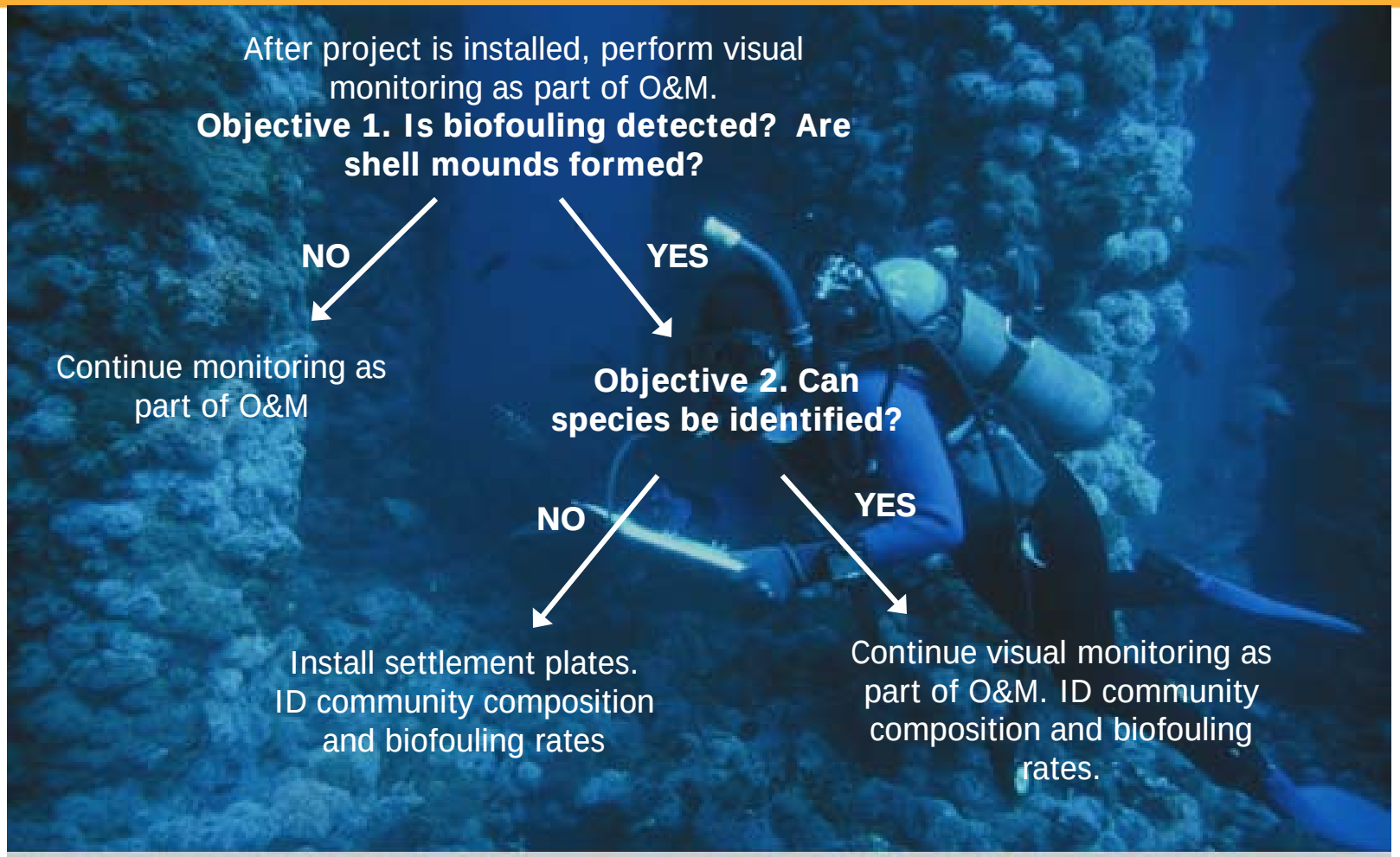
Issue: Electric and magnetic fields (EMF) generated by the project could negatively change behavior and movement patterns of elasmobranchs.

Method	Before		After	
	Project	Control	Project	Control
EMF modeling and measurement	X	X	X	X
Telemetry	X		X	
Water quality monitoring	X		X	

Issue: Biofouling will likely occur on the WEC devices, moorings or anchors, and could result in formation of "shell mounds" on the sea floor that could provide habitat for invasive, non-native species



Conducting platform surveys, Lovelab, Platform Gina, © James Forte

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Issue: Biofouling will likely occur on the WEC devices, moorings or anchors, and could result in formation of "shell mounds" on the sea floor that could provide habitat for invasive, non-native species

Method	Before		After	
	Project	Control	Project	Control
ROV and/or other observation			X	
Settlement plates			X	
Water quality monitoring			X	

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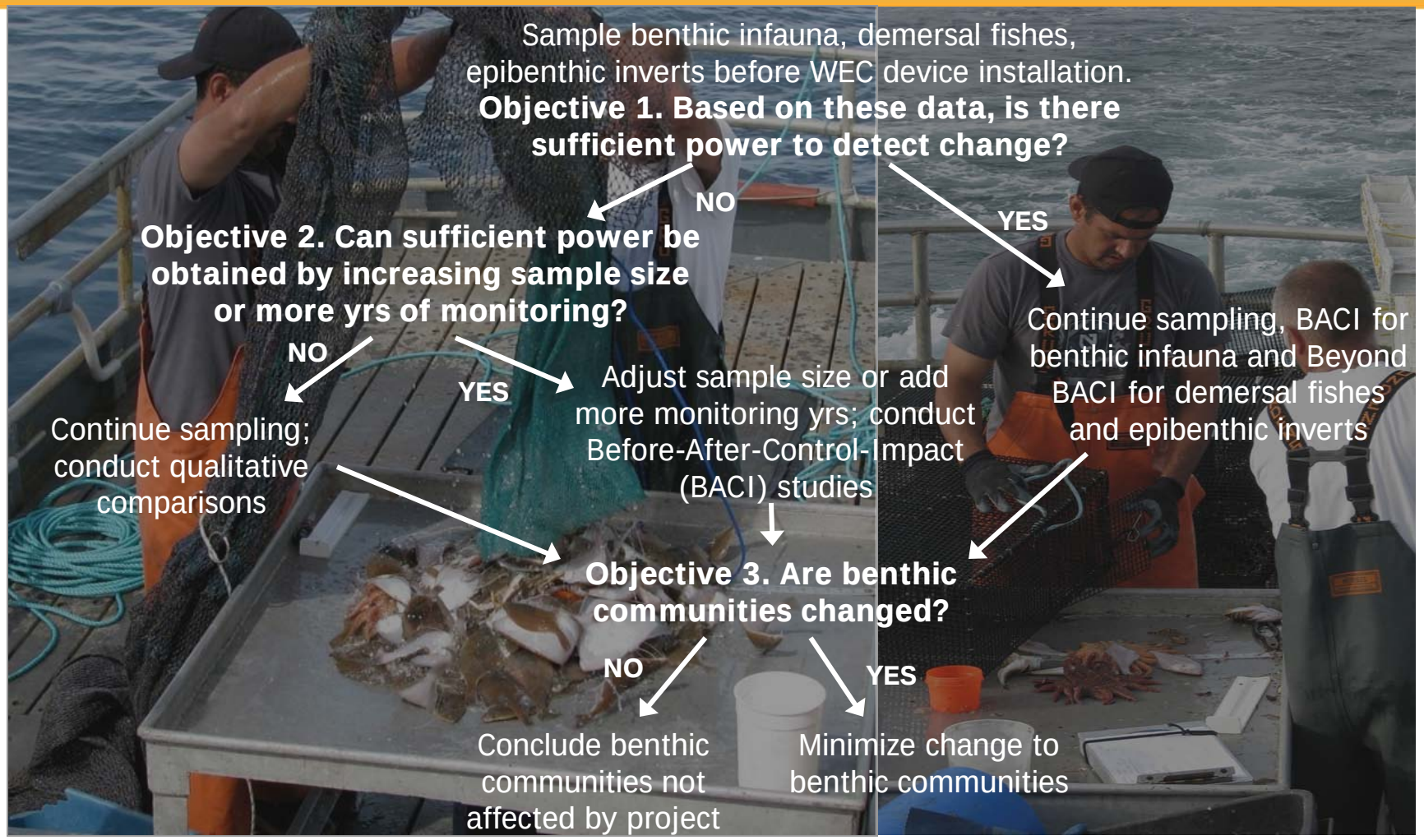
Issue: Project construction and WEC devices, especially anchors and WEC cables, will affect the benthic community primarily by displacement and scour.



Issue: Project construction and WEC devices, especially anchors and WEC cables, will affect the benthic community primarily by displacement and scour.

Method	Before		After	
	Project	Control	Project	Control
Grab sampling	X	X	X	X
Trapping	X	X	X	X
Trawling	X	X	X	X
Water quality monitoring	X	X	X	X

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Lunch

Seabird Monitoring and Adaptive Management Plan

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Define Issues

- **Issue 1:** Will seabirds be attracted to lights on the project structures and therefore be at risk of mortality due to this behavior or collision with these structures?

- **Issue 2:** Will project structures capture or snag drifting fishing gear that may pose an entanglement risk to seabirds, or will any component of the structures themselves pose an entanglement risk?

- **Issue 3:** Will the project expose seabirds to oil or other chemicals?

- **Issue 4:** Will seabirds be attracted to the project structure for the purposes of foraging, roosting, or nesting; and does this behavior pose a risk of injury or mortality due to collision, entanglement, or exposure to chemicals?

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Monitoring Methods

	ISSUE 1		ISSUE 2	ISSUE 3	ISSUE 4
	Lighting attraction	Collision	Entanglement	Oil	Attraction
Direct observation (night)	YES	YES			YES
Direct observation (day)			YES	YES	YES
Direct observation (underwater)			YES		
Thermal infrared imaging	YES	YES			YES
Radar	YES				
Carcass surveys		YES	YES	YES	
Feedback from project crew and local mariners		YES	YES	YES	YES

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Issue 1. Light Attraction and Collision

Will seabirds be attracted to lights on the project structures and therefore be at risk of mortality due to this behavior or collision with these structures?

Objectives

- Evaluate whether seabirds are attracted to project lighting at night.
- Document any behaviors that appear related to project lighting (e.g., circling, collision), and evaluate potential for project lights to increase risk of seabird collision with project structures.
- Monitor for evidence of mortality potentially resulting from collision.

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Issue 1. Light Attraction and Collision

Monitoring Recommendations

- Direct observation (night)
- Thermal infrared imaging
- Radar
- Carcass surveys
- Feedback from project crew and local mariners

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Issue 1. Light Attraction and Collision

Survey Methods

Direct Observation (night)

Birds monitored using infrared night vision goggles or binoculars.

Detection distance = 400 m (1,310 ft) (Larkin 2005, as cited in Kunz et al. 2007).

Costs: Relatively inexpensive (~$1,500 per unit)

Advantages

- Technique is relatively simple.
- No additional lighting required, so no confounding attraction to boat.
- May be able to observe bird collisions.

This technique has been used to monitor birds at wind energy projects (Mabee et al. 2006, as cited in Kunz et al. 2007).

Disadvantages and Constraints

- Difficult to identify birds.
- Poor visibility (e.g., fog or precipitation) will hinder observations.
- Boat movements likely to interfere with observations, especially at night.
- If safety lights are used on boats, birds may be attracted to boat.
- Safety concerns of boating at night.
- Labor-intensive and requires skilled observers.

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Issue 1. Light Attraction and Collision

Survey Methods

Thermal Infrared Imaging

Cameras automatically triggered by heat radiated from passing bird.

Detection distance = 3 km (2 mi) (Larkin 2005, as cited in Kunz et al. 2007).

Costs: Relatively expensive equipment; cameras cost $60–200,000. Data analysis by trained individuals could be time-consuming

Advantages

- No attraction to boat lights.
- Digital images captured and stored.
- Collision detection possible.
- Can be used in tandem with other methods (e.g., radar) to improve data quality (Kunz et al. 2007).
- Cameras with motion detection could be installed on project to record bird use of structure.
- Data collection and equipment maintenance can be done during regular operations and maintenance activities or other trips to the project site.

Disadvantages and Constraints

- Equipment vulnerable to damage from salt water.
- Poor visibility (e.g., fog or precipitation) will hinder observations.
- Requires a power source.
- May be able to collect some information on size or species of birds detected.
- Shore-based sampling will unlikely be able to detect the birds in the project area.
- Salt spray may accumulate on camera lens; cameras may need to be installed with miniature windshield wipers and windshield wiper fluid (Cunha et al. 2008).

This technique has been used to monitor birds flying in the vicinity of wind turbines (Descholm et al. 2006, Betke et al. 2008, both as cited in Kunz et al.) and passerines in Sweden (Zehndner and Karlsson 2001, Zehndner et al 2001).

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Issue 1. Light Attraction and Collision

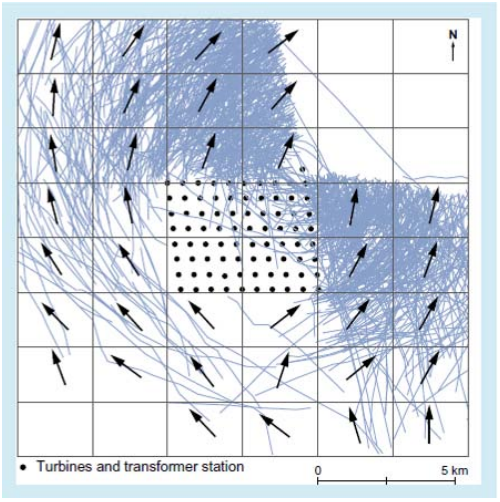
Survey Methods

Radar (marine or surveillance)

Pros: provides information on bird movement patterns

Cons: can not use data collected during rain; can not assess collision or species identification; and ground clutter may inhibit detection of species flying close to the water.

Marine-type radar at a wind farm in Germany (Borst 2008)



Bird movement near an offshore wind farm in the North Sea using marine-type radar (Christensen & Hounisen 2004)

Issue 1. Light Attraction and Collision

Survey Methods

Marine Radar

Scanning antenna detects airborne targets (single bird or flock of birds) and can record their movements in a three-dimensional space.

Detection distance = individuals within a few kilometers and flocks up to 10 km (6 mi); however, detection at ocean is <500 m (150 ft).

Costs: Inexpensive equipment if purchased off the shelf, however, expensive if 'done correctly' using special unit (Larkin 2005). Data analysis by trained individuals could be time-consuming.

Advantages

- Widely used method for monitoring bird movements.
- Available off-the-shelf, require minimal modification or maintenance, repair personnel are available, dependable and easy to operate, portable, have high resolution. Can be used on moving boats, vehicles, or from land.
- Can monitor spatial flight patterns during both day and night (Christensen et al. 2003).
- Shore-based passive: No safety issues or cost of captain, stability, ease of deployment, available power supply, low cost, rapid repair and maintenance, flexibility to chose height to minimize radar clutter (Desholm et al. 2006).
- Marine-based active or passive: More likely to detect birds compared with shore-based passive method.

Disadvantages and Constraints

- Deployment of units for full year is rare (Kunz et al. 2007).
- Lack of existing protocols to address specific hypotheses (Kunz et al. 2007).
- Shore-based passive: Detection distance decreases with wave height (>1 m [>4ft]) and fog (R. Golightly, pers. comm., 2010), wave reflection, multi-path effects (sea clutter) (Borst 2008), and curve of Earth.
- Marine-based radar should be attached to secure platform or ship larger than 40 m (131 ft) to reduce ocean noise clutter in data (Desholm et al. 2006). Requires a power source.
- Sampling offshore requires hiring boat, and measures to ensure employee safety.
- Need ability to adjust system between vertical (to record altitude) and horizontal (to record height information). May need two systems if secured in ocean. If based on shore, one radar can be automatically rotated.

This technique has been used to monitor bird migration at offshore wind farms (Christensen and Hounisen 2005; Christensen et al. 2003; Desholm et al. 2002; Desholm et al. 2003;Kahlert et al. 2004; Wilkelman 1989) in addition to monitoring murrelets, petrels, and shearwaters (Hammer et al. 1995; Buger 2001; Cooper et al. 2006, Day et al. 2003, all cited in Kunz et al. 2007).

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Issue 1. Light Attraction and Collision

Survey Methods

Shore-based surveillance radar

Surveillance radar based on shore used to monitor wave energy and general security of the off-shore facilities could be adapted to also incorporate monitoring of seabirds

Costs: Reduced if security radar can be used. Data analysis could be time-consuming

Advantages

- On-shore radar equipment would already be present.
- Shore-based passive sampling does not require hiring boat and captain.

This technique has been not been identified for use in other studies.

Disadvantages and Constraints

- Need to develop algorithms to switch between security, wave energy, and bird detections.
- Need to assess appropriate decibels of reflectivity (dBZ) for monitoring targets.
- Care needed in interpreting imagery; refraction of radar beam can occur and influence strength of radar echoes (Diehl et al. 2003). Offshore location of the project may result in this phenomenon.

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Issue 1. Light Attraction and Collision

Carcass Surveys

Survey Methods

Document sea bird injury or mortality by conducting both on-site and beach surveys and using pilot tests to release bird carcasses and pilot test objects.

Advantages

- Information available from the Coastal Observation and Seabird Survey Team (COASST) monitoring program will be examined for use in establishing pre-project, baseline rates of stranding.
- Pilot testing will determine:
  - The location where seabirds injured or killed in the project area would be most likely to wash ashore;
  - The probability that birds injured or killed in the project area will drift all the way to shore; and
  - Baseline mortality and beaching rates under pre-project conditions.

Depending on wind direction and surface current, it is anticipated carcasses would wash ashore between Mad River Beach and Bay Street.

Disadvantages and Constraints

Survey locations are based on the following assumptions about birds injured or killed in the project area:

- Pilot test bird carcasses will be an appropriate proxy for seabird carcasses;
- Birds will wash ashore versus being lost to sinking, predation/scavenging by other animals, or other offshore factors;
- Birds will be detected by surveyors versus being lost due to predation, scavenging, displacement by animals (including domestic dogs), collection by people between surveys, or being hidden in driftwood or other material;
- Birds will wash ashore on the beaches and locations selected for surveying; and
- Birds will drift in the same direction as bird carcasses in the pilot test.

Issue 1. Light Attraction and Collision

Survey Methods

Feedback from project crew or and local mariners

During construction or maintenance activities, project crew and local mariners will be asked to report any instances of fishing gear or animals being entangled.

Costs: Inexpensive.

Advantages

- Additional observations increase the likelihood of identifying entanglement.
- A form will be provided to facilitate consistent data collection.
- Increases the likelihood of survival of an injured bird.

Disadvantages and Constraints

- Birds may be lost prior to detection by sinking, predation/scavenging by other animals, or other factors;
- Surface surveys will be constrained to the depth of water clarity.

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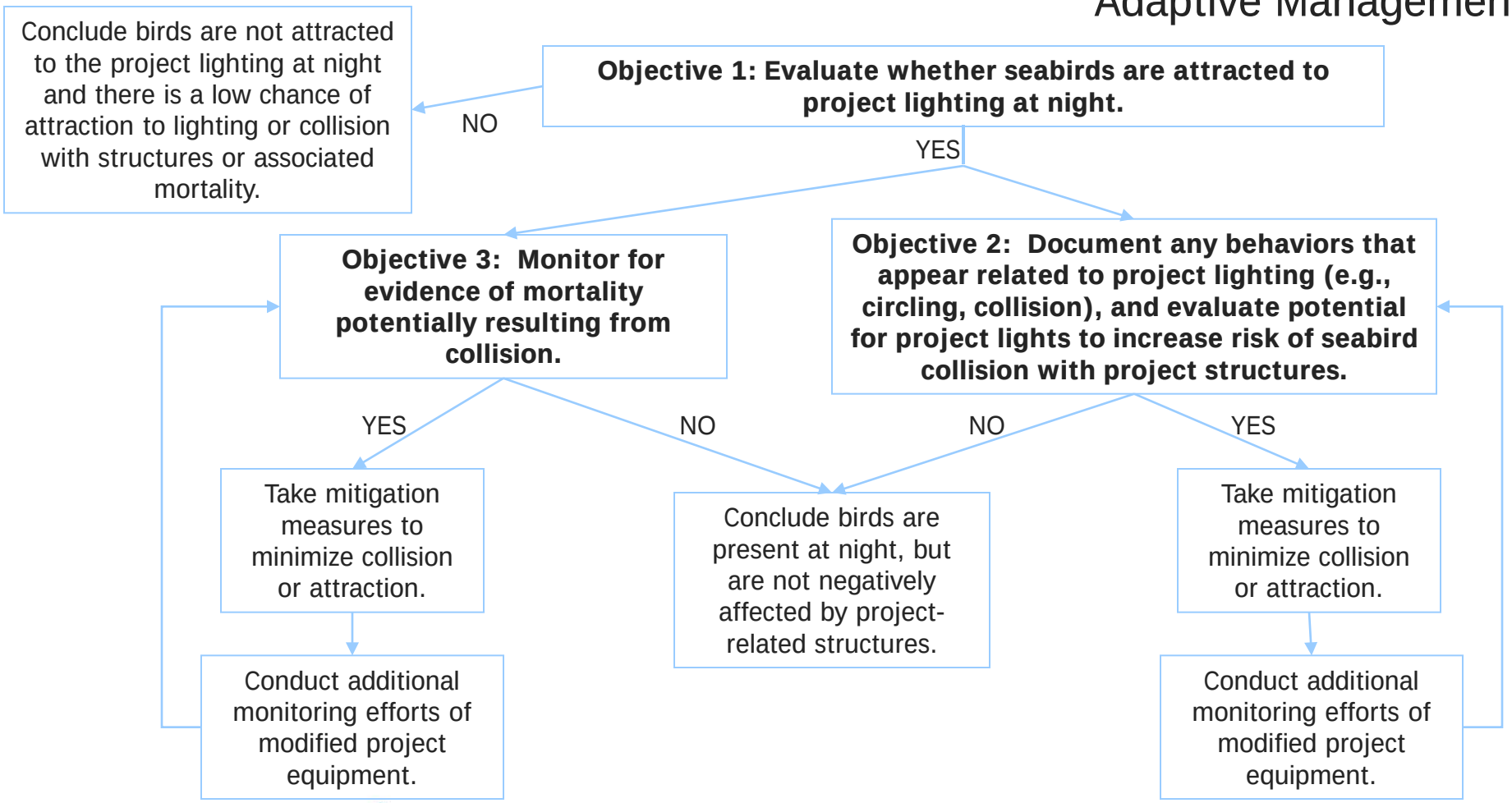
Issue 1. Light Attraction and Collision

Adaptive Management



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Issue 2. Entanglement

Will project structures capture or snag drifting fishing gear that may pose an entanglement risk to seabirds, or will any component of the structures themselves pose an entanglement risk?

Objectives

- Determine whether drifting fishing gear collects or becomes snagged on any part of the project structure.
- Evaluate the potential for, or document occurrence of, seabirds becoming entangled in mooring lines or any fishing gear attached to the structure.
- Monitor for any indirect evidence that seabird mortality may be resulting from entanglement at the project site.

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Issue 2. Entanglement

Monitoring Recommendations

- Direct observation (day)
- Direct observation (underwater)
- Carcass surveys
- Feedback from project crew and local mariners

Issue 2. Entanglement

Survey Methods

Direct Observation (day and underwater)

Direct day-time observation from boats (surface) and Underwater observation (direct or ROV's) to observe any entangled birds.

Costs: Surface surveys are relatively inexpensive; underwater surveys can be expensive.

Advantages

- Surface and underwater observation can be conducted during operation and maintenance activities.
- Side-scan sonar is fairly inexpensive and may be sufficient to detect entanglement.
- Increases the likelihood of survival of an injured bird.

Disadvantages and Constraints

- Surface surveys will be constrained to the depth of water clarity.
- Underwater surveys may be constrained due to poor visibility or diving conditions.
- Entangled animals may be lost prior to detection by becoming dislodged and sinking, or by predation or scavenging by other animals.
- Underwater surveys using direct observation and ROVs are relatively expensive, but feasible if combined with regular operations and maintenance activities.
- Direct observation surveys could be delayed due to weather or visibility conditions.

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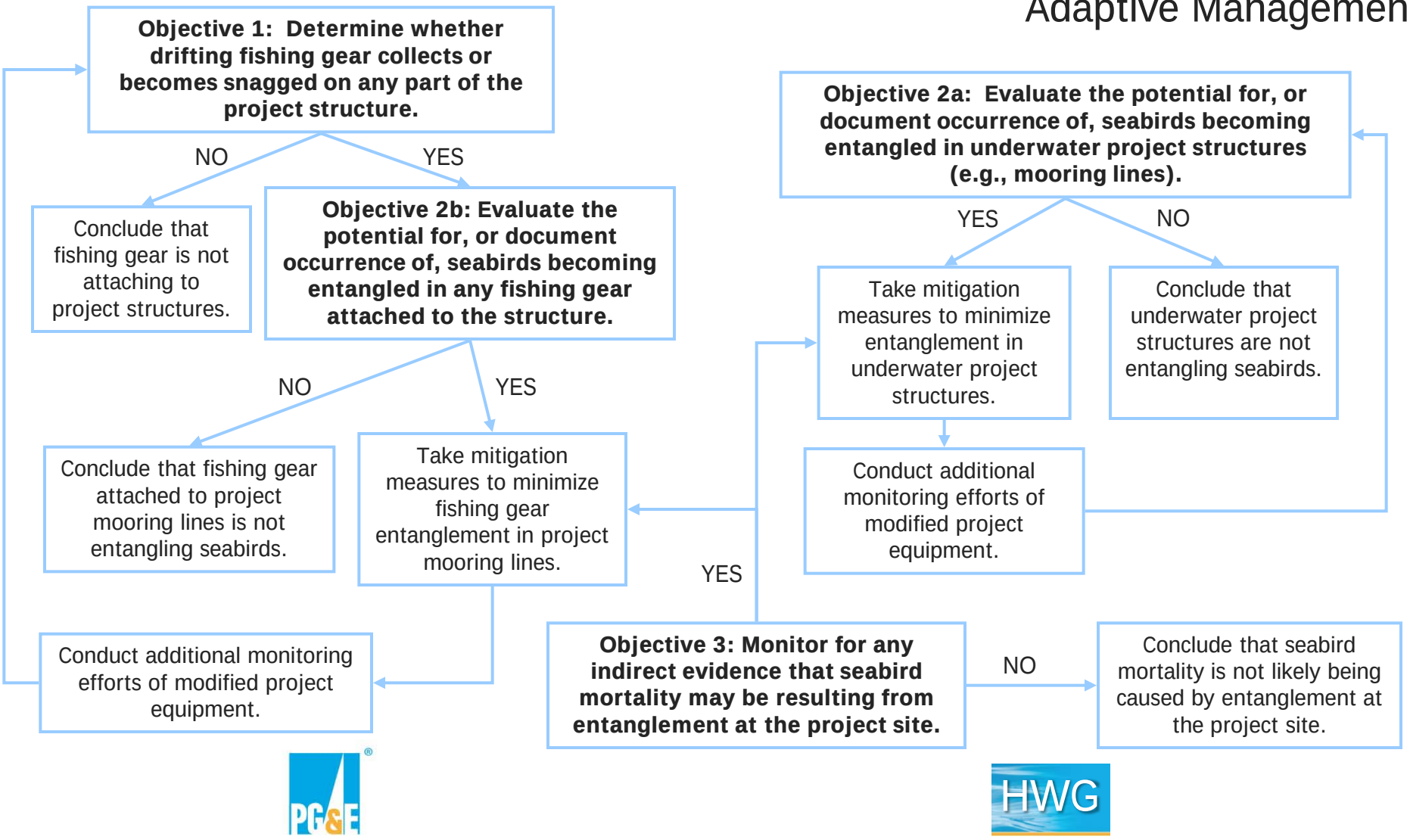
Issue 2. Entanglement

Adaptive Management



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Issue 3. Oil

Will the project expose seabirds to oil or other chemicals?

Objectives

- Document any instances of oil or chemical leaks or spills at the project site and evaluate potential risk to seabirds associated with any such event.
- Monitor for evidence of seabird fouling or mortality that may be a result of oil or chemicals associated with the project.

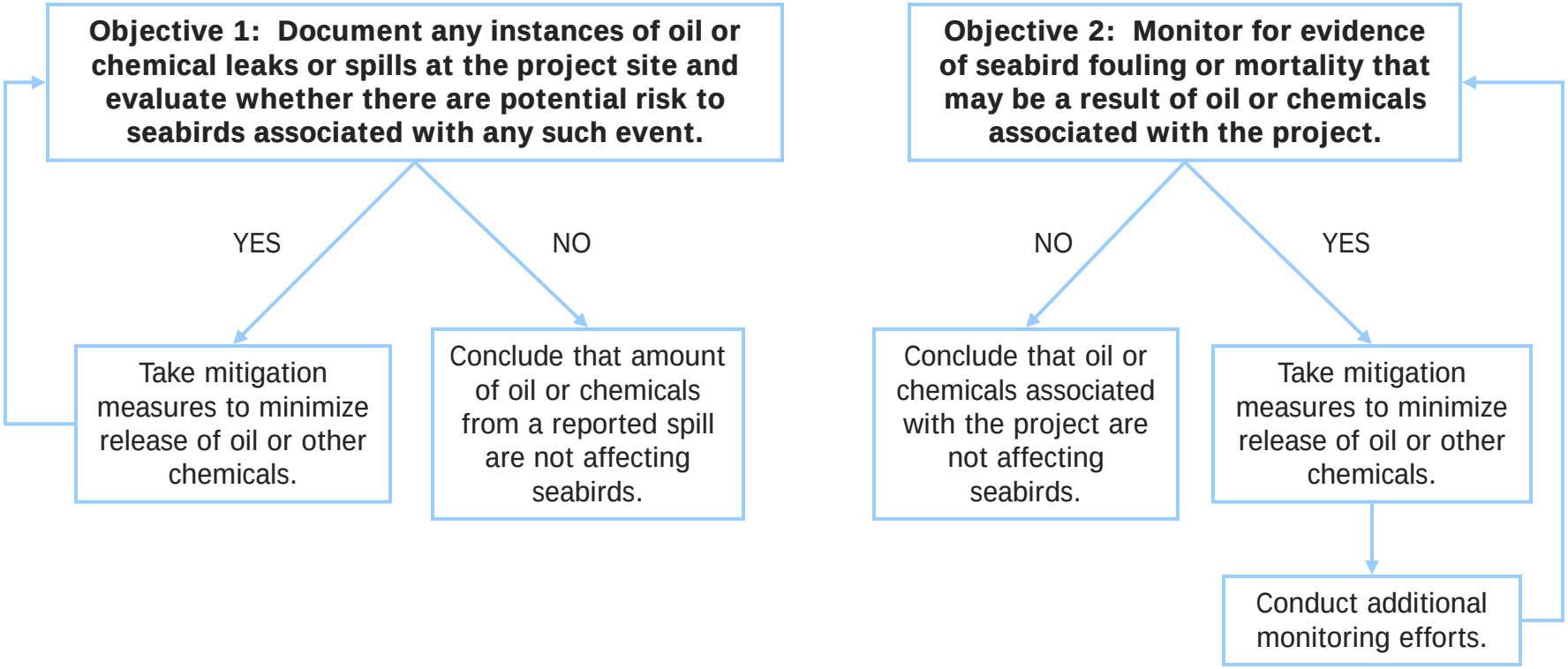
Issue 3. Oil

Monitoring Recommendations

- Direct observation (day)
- Carcass surveys
- Feedback from project crew and local mariners

Issue 3. Oil

Adaptive Management



Issue 4. Attraction

Will seabirds be attracted to the project structure for the purposes of foraging, roosting, or nesting; and does this behavior pose a risk of injury or mortality due to collision, entanglement, or exposure to chemicals?

Objectives

- Monitor to determine whether seabirds are using the project structure for roosting or nesting.
- Monitor to determine whether any seabirds are congregating or foraging in the immediate vicinity of the project structure.
- Evaluate whether any observed use of the structure by seabirds poses any risks to seabirds, or any indirect risk to other resources, such as fish prey congregating at the structure.

PG&E

HWG

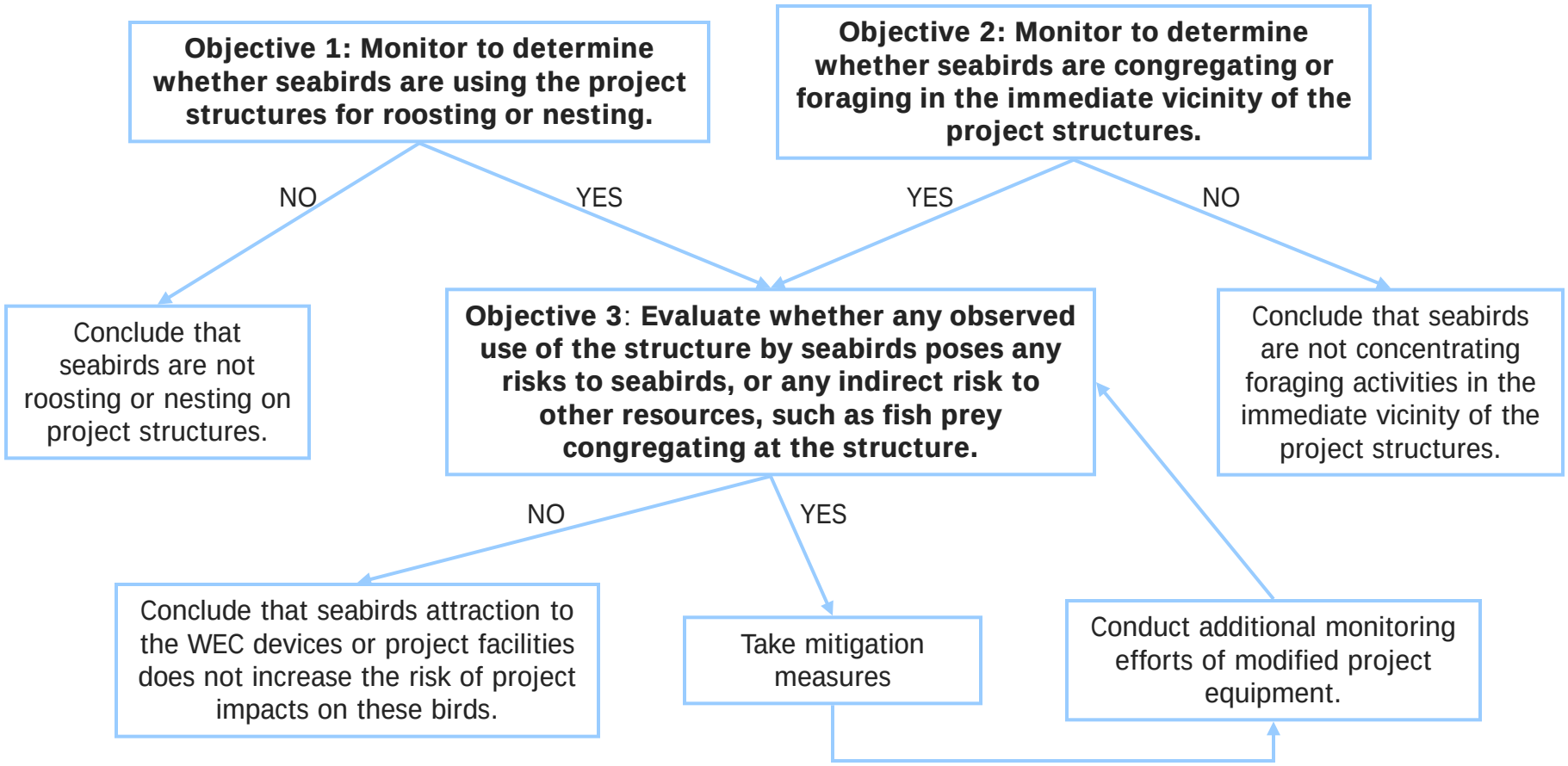
Issue 4. Attraction

Monitoring Recommendations

- Direct observation (night)
- Direct observation (day)
- Thermal infrared imaging
- Carcass surveys
- Feedback from project crew and local mariners

Issue 4. Attraction

Adaptive Management



Next Steps