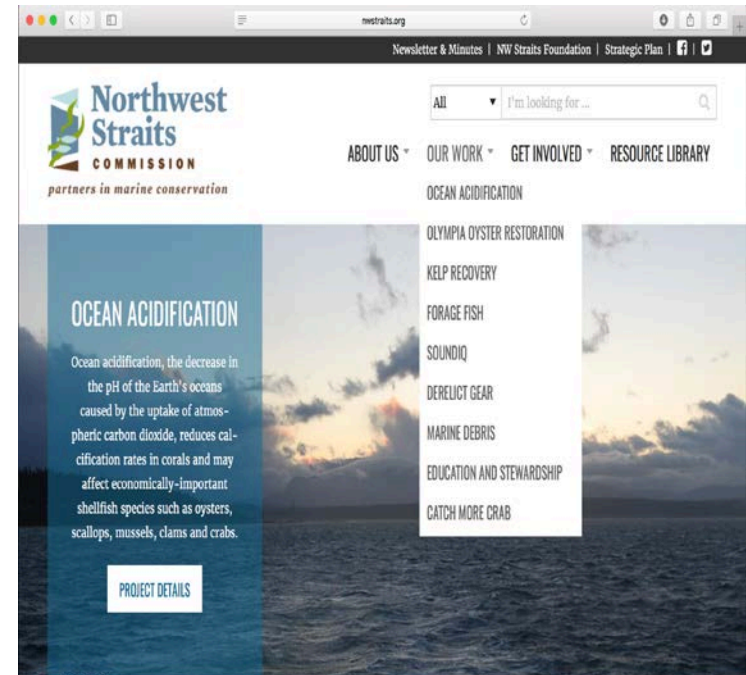


# What are We Trying to do?

Ron Thom and Tom Mumford  
NWSC Science Advisory Committee

**Objective** - Utilize the outstanding work of the MRCs to provide a relevant and science-based perspective on the effects of actions on the Puget Sound ecosystem.



# Net Ecosystem Improvement (NEI)

1. Proposed as a workable method to address the mission of improving *ecosystem health* of the Straits.
2. The ecosystem is fragmented, and some components are lost or degraded.
3. The actions are de-fragmenting the ecosystem by protecting intact habitats and species in combination with restoring lost and degraded habitats and species in the ecosystem.

**Definition** – “...following development, there is an increase in the size and natural functions of an ecosystem or natural components of the ecosystem.” (Thom et al. 2005)

**NEI** =  $\Delta$ function x area x probability

# Northwest Straits Marine Conservation Initiative



## Created to:

“Protect and restore marine waters, species and habitats of the Northwest Straits to achieve ecosystem health and sustainable resource use through a citizen based approach”.

# Northwest Straits Marine Conservation Initiative



## The tough questions:

- How do we quantify and measure MRC project contribution in advancing Puget Sound ecosystem health and protection?
- or
- How can we show we are making a difference?

# Elements

- Clear identification of a *function* or *service* associated with an action
- Evidence-based underpinnings (Diefenderfer et al. 2016)
  - conceptual model; numerical model
  - understood relationship between area (or other quantifiable measure of amount)
  - verification on site and/or data from several comparable areas
- A person or small team dedicated to the analysis, and able to pull information together and conduct the analysis periodically – ***critical***
- Dispersal or publication – make sure the information gets to the right people



# Examples of Structures and Functions

## METRICS FOR EVALUATING THE HEALTH OF RIVER AND STREAM ECOSYSTEMS

### Structural metrics

Biological diversity or species of interest  
Native riparian vegetation width  
Floodplain presence/width  
Canopy cover  
Oxygen level  
Nitrogen, phosphorus concentrations  
Pollutant concentrations  
Organic matter  
Temperature  
Mean annual flow and depth  
Turbidity  
Channel morphology  
Streambed substrate

### Functional metrics

Productivity/reproduction, migration, trophic status  
Pollutant removal rates  
Hydraulic retention  
Photosynthetic active radiation  
Biochemical oxygen demand, whole stream metabolism  
Nutrient cycling or flux rates  
Pollutant removal or sequestration  
Decomposition rate  
Thermal regime (magnitude, duration and timing)  
Flow regime (magnitude, duration and timing)  
Sediment flux  
Channel migration, erosion rate  
Streambed mobility

(Palmer and Febria 2012. The heartbeat of ecosystems. Science 336:1393-1394)

# Types of Conceptual Models

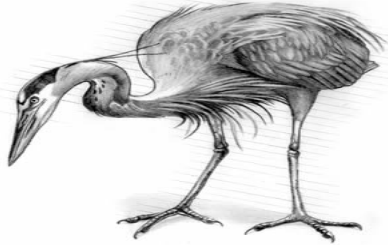
*To understand the system and to determine what needs to be done and how it will help*

- **Ecosystem model** (describes connections among components of an ecosystem; e.g., food web model)
- **Resource specific model** (describes what a resource requires; e.g., eelgrass growth and ecosystem services)
- **Disturbance – Action model** (defines what is wrong, and method to fix the problem; e.g., boat mooring)
- **Action effectiveness model** (describes the results of the actions; e.g., Net Ecosystem Improvement)



**Example of a Conceptual Model**

**Great Blue Heron**



**Orca**

**Scoters and other marine birds**



*food*

*food*

*food*

**Pacific salmon**



*Habitat, nesting sites*

*Food (as larvae)*

**Dungeness crab**



*Feeding habitat, refuges*

**Forage fish**



*food*

*Spawning, feeding, refuges*

**Eelgrass and kelp**



*habitat*

*Spawning sites*

*Habitat, sediment*

*Nesting sites*

*Feeding habitat*

*food*

**Olympia oysters**



*Shade for spawning*

*Habitat, sediment*

**Coastal forests**



*Woody debris*

**Beaches and bluffs**





# Eelgrass Conceptual Model

(Thom et al. 2005)

*Controlling  
Factors*



*Structure*



*Functions*

Light  
(3 moles photosynthetically  
active radiation  $d^{-1}$ )

Temperature  
(7-13 °C)

Salinity  
(10-30 ppt)

Substrata  
(sand-mud)

Nutrients  
(mod. soil;  
low water col.)

Water Motion  
(3m  $s^{-1}$  tidal;  
80cm  $s^{-1}$  burst)

Eelgrass  
Biomass  
and Associated  
Community

Carbon Export

Fisheries Resources

Shoreline  
Stabilization

# Disturbance - Action Model

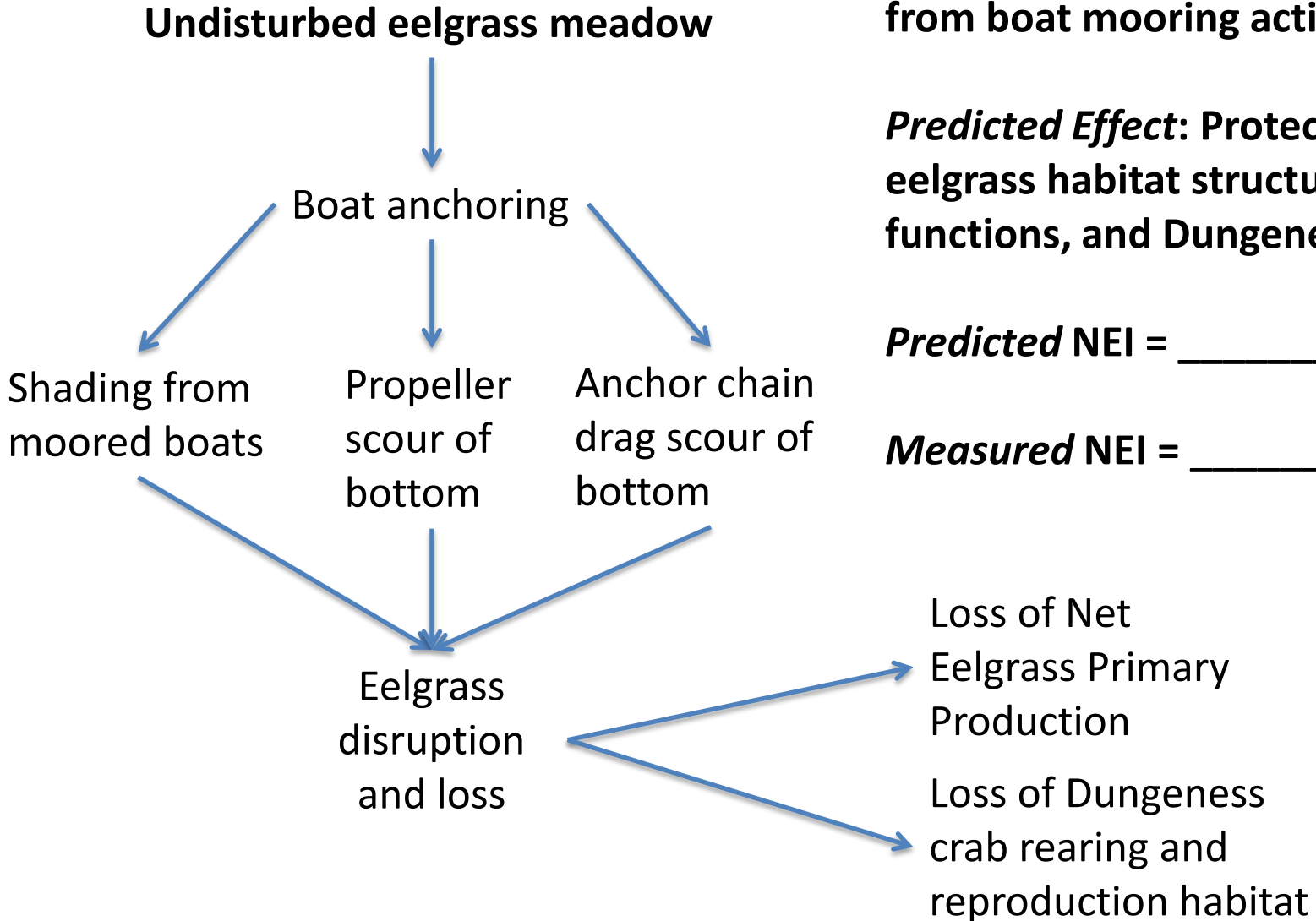
## Example

**Action:** Establish anchor out zone to eliminate disturbances from boat mooring activities

**Predicted Effect:** Protection of eelgrass habitat structure and functions, and Dungeness crab

**Predicted NEI =** \_\_\_\_\_

**Measured NEI =** \_\_\_\_\_



# Net Ecosystem Improvement (NEI)

- NEI =  $\Delta$ function x area x probability
  - *Example Action*: Eelgrass anchor out zone in Port Townsend
    - Functions
      - a. Net primary production of eelgrass (total biomass produced/year)
      - b. Crab refuge and protection (number of crabs protected)
    - Area = 52 acres (210,436m<sup>2</sup>) protected in Port Townsend
    - Data set from Drayton Harbor (Thom et al. 1989), mouth of Sequim Bay (Thom et al. 2008), Straits eelgrass (Christiaen et al. 2016)

# Eelgrass Net Primary Production

(an ecosystem 'function')

- NPP Protected\*:

=  $210,436\text{m}^2 \times 900\text{g dry m}^{-2} \text{ year}^{-1}$

=  $189,392\text{kg eelgrass dry year}^{-1}$

=  $2,083 \text{ tons wet eelgrass year}^{-1}$

- Area of Eelgrass Protected:

= 21.04ha at PT

= 0.6% (0.5 – 0.8%) of total Straits eelgrass ( $3,710 \pm 899\text{ha}$ )\*\*

= 0.09% of total Puget Sound eelgrass ( $23,150\text{ha}$ )\*\*

=  $21.04\text{ha}/4,000\text{ha PSP goal} = 0.5\%$  of goal

(\*Assumes that unprotected eelgrass would be damaged and/or functionally impaired;

\*\*Christiaen et al. 2016)

# Dungeness Crab Protection

(contributes to an ecosystem 'service')

- Area of eelgrass protected =  $210,436\text{m}^2$
- Median crab density\* =  $0.16\text{m}^{-2}$  (range  $0.019 - 0.314\text{ m}^{-2}$ )
- Crabs protected =  $0.16\text{m}^{-2} \times 210,436\text{m}^2$ 
  - median = 33,670
  - range = 3,998 – 66,077

(\*Thom et al. 1989)



# Current MRC Projects

Kelp recovery

Ocean acidification

Sound IQ- data

Derelict gear

Olympia oyster restoration

Blue carbon storage

Herring spawning support

Marine debris

Juvenile salmon support

Phytoremediation

Catch More Crab

Rain gardens

Nearshore restoration

Pinto abalone restoration

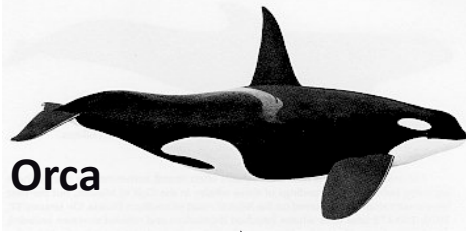
Crabber outreach

General outreach

# Great Blue Heron



# Orca



# Scoters and other marine birds



# Pacific salmon



# Dungeness crab



# Forage fish



# Eelgrass and kelp



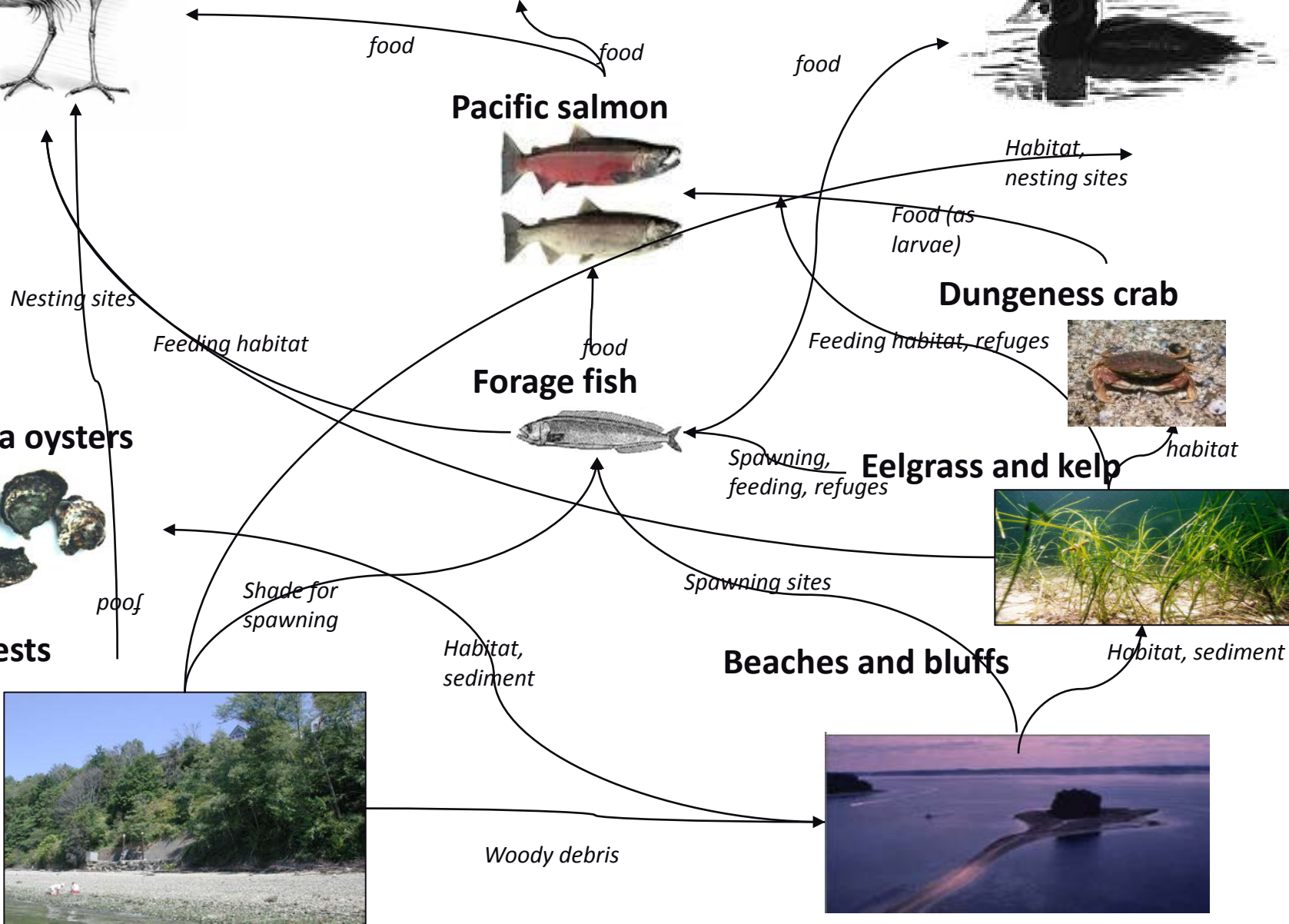
# Olympia oysters



# Beaches and bluffs



# Coastal forests



Kelp recovery

Ocean acidification

Olympia oyster restoration

Derelict gear

Pinto abalone restoration

Blue carbon storage

Herring spawning support

Marine debris

Juvenile salmon support

Phytoremediation

Rain gardens

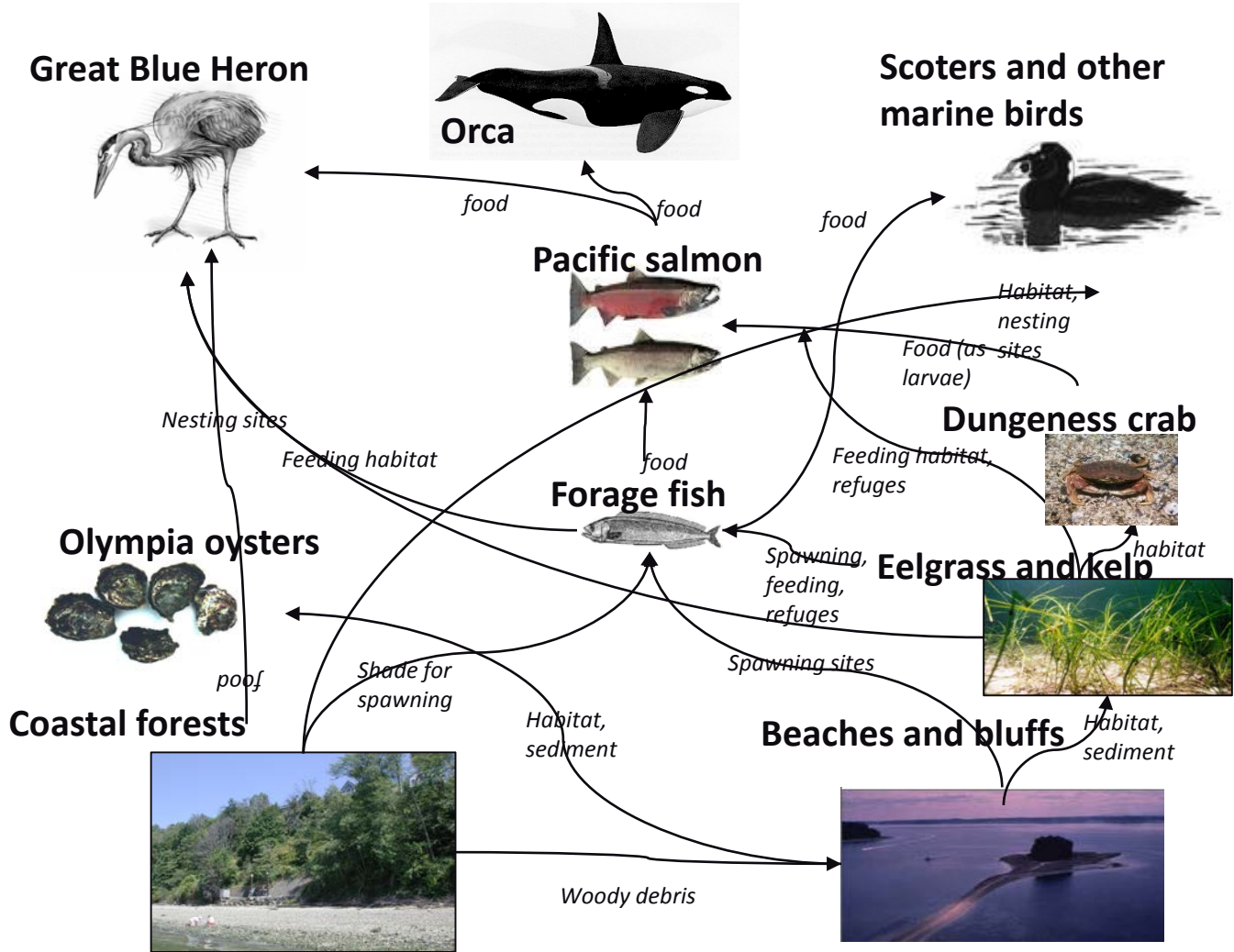
Bowman Bay restoration

Catch More Crab

Crabber outreach

Sound IQ- data

General outreach



# Time line for Implementation of Net Ecosystem Improvement Process

| Completed by              | Action  | Responsibility         | Outcome   |
|---------------------------|---|------------------------|---|
| 15 October 2017           | Discussion of approach and next steps with SAC  | SAC                    | Agree on approach   |
| 31 October 2017           | Develop draft plan  | SAC                    | Draft plan to EC  |
| 6 November 2017 (EC call) | Draft plan discussion with EC   | EC                     | Agree on approach and recommend revisions                                 |
| 8 December 2017           | Acquire final approval by NWSC - WebEx meeting. Approve use of 100% of funds for coordinator.                                     | SAC/NWSC               | NWSC gives green light to move forward with plan                          |
| 10 December 2017          | Create talking points (fact sheet) for MRC staff.   | SAC/NWSC               | Concise sheet that allows MRC staff to convey message to MRCs             |
| 12 December 2017          | 1. Present NEI at NWSC Lead Staff meeting (Padilla Bay)<br>2. Walk through project identification steps.<br>3. Provide fact sheet | SAC/NWSC               | Summary of feedback and suggested revisions                               |
| 20 December 2017          | 1. List of Ecosystem Coordinator qualifications<br>2. Position duration determination (3 mo., 6 mo., etc.?)                       | SAC/NWSC               | List of qualifications and the extent of time coordinator will be needed. |
| 30 December 2017          | Ecosystem project coordinator Personnel forms completed   | NWSC Director          | Begin process of Hiring Ecosystem Coordinator                             |
| 15 January 2018           | Outline steps needed to identify candidate projects for NEI assessment  | SAC                    | List of steps for identifying MRC projects that fit needs of NEI          |
| 30 January 2018           | NEI WebEx presentation to MRCs (with in person option in Padilla Bay)   | SAC/NWSC               | Summary of feedback and suggested revisions                               |
| 5 February 2018 (EC call) | Summary of findings discussion with EC  | EC and Staff           | Decision on revisions   |
| 28 February 2018          | Revised plan to EC ( <a href="#">See document outlining content ideas</a> )   | EC and Staff           | Final plan guidance decision  |
| 28 February 2018          | Finalize Ecosystem Coordinator hiring   | NWSC Director          |   |
| 1,2 March 2018            | Role out current plan at Retreat  | Director and Staff     | NWSI members and partners are educated on objectives                      |
| 15 March 2018             | Initiate plan   | NWS Initiative         |   |
| 30 Sept 2018              | Coordinator works with MRCs to identify projects that can be assessed by NEI  | Coordinator/ SAC/ NWSC | Report summarizing findings.  |
| Oct 2018 – Sept 2019      | Coordinator assesses projects identified in 2018  | Ecosystem coordinator  | Final report and fact sheets  |
| 2019 to Infinity          | Annual implementation of model and project assessments  |                        | Ongoing assessment of project contributions to Puget Sound recovery.      |

Funding dependent

# To Do List: (what's next)

- Hire net ecosystem improvement coordinator:
  - Will work with MRCs to identify projects amenable to net ecosystem improvement analysis (through September 2018)
- Obtain funding for net ecosystem improvement coordinator to:
  - Work with MRCs to create conceptual model
  - Define measurable/quantifiable functions and components
  - Analyze and publish results.
  - October 2018 – September 2019
- Refine MRC actions to fit this approach, as appropriate
  - Integrate necessary metrics into projects
  - Give feedback to MRC's - provide adaptive management to improve process and results
- Assure that results are delivered to
  - Sponsors, scientific community, environmental managers, policy/decision makers, elected and judicial officials, public

## Questions:

- What is role of Commission and MRC's?
- What is role of SAC?



# What can the MRC's do?

- Discuss net ecosystem improvement (talking points follow)
- Work with net ecosystem improvement coordinator to discuss project evaluation
- Integrate metrics into projects that allow them to be evaluated in the short and long term
- In the long term, assure that results are delivered to
  - Sponsors, scientific community, environmental managers, policy/decision makers, elected and judicial officials, public

# Talking Points

## Definition of Net Ecosystem Improvement (NEI)

- NEI is defined as “...following development [an action to improve conditions such as restoration, enhancement, creation and protection], there is an increase in the size and natural functions of an ecosystem or natural components of the ecosystem.” (Thom et al. 2005).
- NEI balances the improvements made relative to the losses.
- $NEI = \text{change in function} \times \text{area} \times \text{probability}$

## Why Net Ecosystem Improvement is important for the NWS Initiative?

- It provides a method to evaluate and quantify the effectiveness of actions taken by the NWSI.
- Provides a prospective of how NWSI actions impact the broader ecosystem.
- Provides evidence of success that supports requests for continued funding of the Initiative as well as in communication and outreach tools.
- Proposed as a workable method to address the NWSI mission of improving ecosystem health of the Straits.

## What are the basic steps to performing NEI measures?

- Develop or locate simple conceptual models that illustrate the connection between recovery and protection actions and effects on ecosystem elements (e.g., eelgrass habitat) and functions (e.g., Dungeness crab survival).
- Compile available data, or conduct a study, to provide quantitative data on the elements and/or functions shown in the conceptual model. For example, the density of Dungeness crab in eelgrass meadows.
- Apply these data to the NEI model ( $NEI = \text{change in function} \times \text{area} \times \text{probability}$ ) to calculate the change in function (e.g. crab density) per unit area times the area protected or restored.

# Talking Points Continued

## **What are the ideal elements a project possesses to make it amenable to NEI assessment?**

- A reasonable estimate of the area affected by the action.
- Density, percent cover or other quantitative estimate on the resource species or function from the region. Preferably data are available from several sites to provide an idea of spatial variance.
- Clear evidence of the connection between the species or function and the habitat and action being taken.
- Data that allows the scale-up of the project estimate to larger geographic areas to provide context and perspective.

## **What steps will the NWSI be taking?**

- Educating MRCs and staff on NEI
- Hiring part time net ecosystem improvement coordinator to work with MRCs to identify projects that can be evaluated using NEI through September 2018.
- Seeking funding to continue NEI coordination and project assessments after 2018.

## **What will be asked of the MRCs?**

- An open dialogue about NEI
- Consider NEI when planning future projects. For example:
  - Design projects that collect meaningful metrics that can be evaluated across time and space.
  - Consider the ecosystem elements your projects will impact (what other things is this project linked to and how will our project affect them?)
- Utilize NEI outcomes in outreach endeavors to illustrate the impact MRC projects are having on the ecosystem.