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**Restoration action effectiveness: employing the concept of net ecosystem improvement**

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Mission and Questions

Mission: “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”

The Tough Questions:

– How do we quantify and measure MRC project contribution in advancing Puget Sound ecosystem health and protection?
– How can we show we are making a difference?
Objective of this Work

• Utilize the outstanding work of the seven Marine Resources Committees (MRC’s) to provide a relevant and science-based perspective on the effects of citizen-based actions on the health of the Puget Sound ecosystem.
  – Assess ability to quantify the outcomes
  – Make sure the approach is backed by the MRCs and Commission
Net Ecosystem Improvement (NEI)

• The ecosystem is fragmented, and some components are lost or degraded.
• 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.
• NEI is being initiated as a workable method to address the mission of improving *ecosystem health* of the Straits.

**NEI 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)

\[ NEI = \Delta \text{function} \times \text{area} \times \text{probability} \]
NEI Elements
(Diefenderfer et al. 2016, *Ecosphere*)

- Identify the *function* or *service* associated with an action using evidence summarized in a conceptual model
- Establish relationship between area (or other quantifiable measure of amount) and function
  - Verify relationship on site or with data from several comparable areas
- Define the area over which that function operates at your site
- Document assumptions
- Develop a focused monitoring plan as needed
- Develop a team dedicated to the analysis
- Disseminate the results
Great Blue Heron

Orca

Pacific salmon

Scoters and other marine birds

Dungeness crab

Eelgrass and kelp

Beaches and bluffs

Olympia oysters

Coastal forests

Nesting sites

Feeding habitat

Spawning sites

Shade for spawning

Spawning, feeding, refuges

Feeding habitat, refuges

Habitat, nesting sites

Food (as larvae)

Habitat, sediment

Food

Habitat,
sediment

Habitat,
nesting sites

Habitat,
food

Ecosystem Model

Example

Example of an Ecosystem Model

Example of an Ecosystem Model
EXAMPLE: Jefferson County MRC

Eelgrass Protection Program
(contact Cheryl Lowe; http://www.jeffersonmrc.org/projects/)
Disturbance - Action Model

Undisturbed eelgrass meadow

- Boat anchoring
  - Shading from moored boats
  - Propeller scour of bottom
  - Anchor chain drag scour of bottom

Eelgrass disruption and loss

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 = ___________

- Loss of Net
- Eelgrass Primary Production
- Loss of Dungeness crab rearing and reproduction habitat
Action Effectiveness Model (NEI) Applied to the *Eelgrass Protection Program*

- NEI = Δfunction 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 (210,436m²) 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*:
  = 210,436m² x 900g dry m⁻² year⁻¹
  = 189,392kg eelgrass dry year⁻¹
  = 2,083 tons wet eelgrass year⁻¹

• Area of Eelgrass Protected Perspective:
  = 21.04ha at PT
  = 0.6% (0.5 – 0.8%) of total Straits eelgrass (3,710 ±899ha)**
  = 0.09% of total Puget Sound eelgrass (23,150ha)**
  = 21.04ha/4,000ha 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 = 210,436m²
• Median crab density* = 0.16 m⁻² (range 0.019 – 0.314 m⁻²)
• Crabs protected = 0.16 m⁻² x 210,436 m²
  – median = 33,670 (range = 3,998 – 66,077)
• Contribution to harvestable males**
  – median = 6,415 (range = 762 – 12,590)

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
Summary

• Provides science-based evidence of action effectiveness
• Places actions in a broader ecosystem perspective
• Simple to calculate and communicate
• Helps proposers explain how effectiveness will be assessed
• Provides basis for an action-effectiveness monitoring plan
• Provides link to the mission
• Helps justify funding for the program
• Initiated in 2018 with the hire of a part time staff member