Appendix C: Prioritized Data Gaps and Workshop Notes

C.1 Prioritized Knowledge Gaps

Knowledge gaps were prioritized based on their value in guiding decisions for kelp conservation and recovery strategies. Knowledge gaps for kelp in Puget Sound are summarized in Table C-1 by highest priority using a weighted value of total votes.

Table C-1. Knowledge gap prioritization results. Knowledge gaps are listed from highest priority to lowest using a weighted number of individual votes. The weight value assigned to each vote is 1 for high, 0.5 for medium, and 0.25 for low priority.

<table>
<thead>
<tr>
<th>Knowledge Gaps for Kelp in Puget Sound</th>
<th>Prioritization for Addressing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What is the potential value of addressing each data gap toward understanding and guiding decisions around kelp conservation and recovery strategies?</strong></td>
<td>High</td>
</tr>
<tr>
<td>Kelp distribution and trends – Assess and monitor current species’ distributions and changes through time in Puget Sound.</td>
<td>54</td>
</tr>
<tr>
<td>Kelp physical stressors – Determine how physical stressors impact kelp reproduction, growth, and survival/mortality in Puget Sound. Physical stressors include temperature, light availability, suspended sediment, sediment deposition and erosion, nutrient availability, and hydrodynamics.</td>
<td>50</td>
</tr>
<tr>
<td>Human impacts – Assess impacts of shoreline armoring, overwater structures, pollution, boat traffic, wastewater effluent, and other human impacts on floating and subtidal kelp beds in Puget Sound.</td>
<td>49</td>
</tr>
<tr>
<td>Kelp priority areas – Identify priority geographic areas for recovery/conservation measures in Puget Sound.</td>
<td>47</td>
</tr>
<tr>
<td>Kelp biological stressors – Determine how biological stressors impact kelp reproduction, growth, and survival/mortality in Puget Sound. Biological stressors include competition with other seaweeds, grazing impacts (urchin, kelp crab, smaller invertebrates), disease, and microbiome.</td>
<td>44</td>
</tr>
<tr>
<td>Restoration – Investigate methods to enhance and restore persistent, floating kelp canopies that have documented declines, and understory beds if declines are documented in Puget Sound.</td>
<td>41</td>
</tr>
<tr>
<td>Management – Understand the effectiveness of current management policies relating to protection/mitigation of kelp from construction, harvest, and other activities in Puget Sound.</td>
<td>42</td>
</tr>
<tr>
<td>Kelp as a habitat – Investigate functional roles of floating and understory kelp beds as habitat and nursery grounds for marine invertebrates, salmon, rockfish, and forage fish in Puget Sound.</td>
<td>37</td>
</tr>
<tr>
<td>Water quality improvement – Understand potential of kelp beds to mitigate nutrient pollution and ocean acidification conditions in Puget Sound.</td>
<td>28</td>
</tr>
<tr>
<td>Kelp developmental biology – Understand environmental thresholds of microscopic life stages and dispersal distances of spores in Puget Sound.</td>
<td>24</td>
</tr>
<tr>
<td>Kelp food webs – Quantify the contributions and describe the pathways of kelp biomass in Puget Sound food webs.</td>
<td>23</td>
</tr>
<tr>
<td>Kelp economics – Assess dollar value of kelp from ecosystem services and role as foundation species in Puget Sound.</td>
<td>11</td>
</tr>
<tr>
<td>Kelp genetics – Investigate genetic diversity and connectivity of Puget Sound kelp beds.</td>
<td>8</td>
</tr>
</tbody>
</table>

Quantification of kelp’s ecosystem services did not rank among the highest priority knowledge gaps in the survey results; however, both the technical and regulatory communities during workshops identified ecosystem services and food web research as a high priority during the
workshops. Similarly, the goal to promote awareness, engagement, and action was not identified as a knowledge gap in survey results, but was a strongly supported action among workshop participants.

C.2 Workshop Notes

C.2.1 Notes from Workshop 1 — March 20, 2018

Workshop Participants

*In Person Attendees:*

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
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<tbody>
<tr>
<td>Brian</td>
<td>Allen</td>
</tr>
<tr>
<td>Kelly</td>
<td>Andrews</td>
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<tr>
<td>Helen</td>
<td>Berry</td>
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<tr>
<td>Emily</td>
<td>Bishop</td>
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<td>Feist</td>
<td>Blake</td>
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<td>Max</td>
<td>Calloway</td>
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<tr>
<td>Dan</td>
<td>Van Hees</td>
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<tr>
<td>Tom</td>
<td>Doerge</td>
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<tr>
<td>Lucas</td>
<td>Hart</td>
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<tr>
<td>Sasha</td>
<td>Horst</td>
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<tr>
<td>Laurel</td>
<td>Jennings</td>
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<tr>
<td>Victoria</td>
<td>Knorr</td>
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<tr>
<td>Tom</td>
<td>Mumford</td>
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<tr>
<td>Adam</td>
<td>Obaza</td>
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<tr>
<td>Betsy</td>
<td>Peabody</td>
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<tr>
<td>Linda</td>
<td>Rhodes</td>
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<tr>
<td>Stephen</td>
<td>Schreck</td>
</tr>
<tr>
<td>James</td>
<td>Selleck</td>
</tr>
<tr>
<td>Suzanne</td>
<td>Shull</td>
</tr>
<tr>
<td>Dan</td>
<td>Tonnes</td>
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<tr>
<td>David</td>
<td>Williams</td>
</tr>
</tbody>
</table>

*WebEx Attendees:*

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sherryl</td>
<td>Bisgrove</td>
</tr>
<tr>
<td>Byron</td>
<td>Rot</td>
</tr>
<tr>
<td>J</td>
<td>Bluhm</td>
</tr>
<tr>
<td>Karin</td>
<td>Roemers-Kleven</td>
</tr>
<tr>
<td>Katy</td>
<td>Davis</td>
</tr>
<tr>
<td>Elisa</td>
<td>Dawson</td>
</tr>
<tr>
<td>Phil</td>
<td>Green</td>
</tr>
<tr>
<td>Eleanor</td>
<td>Hines</td>
</tr>
<tr>
<td>Jordan</td>
<td>Hollarsmith</td>
</tr>
<tr>
<td>Casey</td>
<td>Palmer-Mcgee</td>
</tr>
<tr>
<td>Nicole</td>
<td>Naar</td>
</tr>
</tbody>
</table>

Simulation

Data Gaps and Workshop Notes
WebEx Attendees (continued):
Lily Gierke University of WI-Milwaukee
Paul McCollum Port Gamble Tribe
Kathy Pfister University of Chicago
Solenne Walker WDNR
Kate Tiedman UC Davis
Woodard Todd Samish Tribe
Anna Toledo Island MRC
Sarah Schroeder U Victoria
Braeden Schiltroth Simon Fraser University
Ani Ghosh UC Davis

Workshop Agenda
Puget Sound Kelp Recovery Plan Workshop — March 20, 2018
Theme: Kelp ecosystem services, stressors, and coverage trends

10:00– 10:20 Introductions
10:20– 10:30 Kelp recovery plan introduction (Lucas Hart, NWS Commission)
10:30 – 11:30 Kelp drivers and services (Max Calloway, Evergreen College)
11:30 – 12:30 Lunch (provided; chicken and vegetarian enchiladas)
12:45 – 1:45 Kelp status and trends in Puget Sound (Helen Berry, WDNR)
1:45 – 2:30 Mapping kelp in the Puget Sound using Landsat satellite imagery WebEx (Jordan Hollarsmith, Aniruddha Ghosh, UC Davis)
2:30 – 2:45 Break
2:45 – 3:30 The Cultural Importance of Kelp to Pacific Northwest Tribes WebEx (Nicole Naar, UC Davis)
3:30 – 4:15 Investigating kelp as salmon habitat (Sarah Schroeder, University of Victoria)
4:15 – 5:00 Group Discussion: (potential topics)
  ▪ What data gaps exist in Puget Sound (summarize from presentations and take additional thoughts)?
  ▪ Are there gaps that need to be addressed before we can move forward with kelp recovery?
  ▪ How might we prioritize the data gaps?
  ▪ What research is needed to address data gaps?
**Workshop Notes**

**Links to presentation slides:**
- [https://www.nwstraits.org/media/2537/schroeder-salmon_pres_march20.pdf](https://www.nwstraits.org/media/2537/schroeder-salmon_pres_march20.pdf)
- [https://www.nwstraits.org/media/2536/calloway_2018_3_19_krpworkshop_slides.pdf](https://www.nwstraits.org/media/2536/calloway_2018_3_19_krpworkshop_slides.pdf)
- [https://www.nwstraits.org/media/2538/naar_cultural-importance.pdf](https://www.nwstraits.org/media/2538/naar_cultural-importance.pdf)
- [https://www.nwstraits.org/media/2539/hart_presentation.pdf](https://www.nwstraits.org/media/2539/hart_presentation.pdf)

**Presentation 1 — Lucas Hart, NWS Commission, Introduction:**
- Rockfish Recovery Plan – finalized in Oct 2017
- Kelp is a component of critical habitat and is a piece of rockfish recovery plan implementation
- NW Straits Initiative leading development of kelp recovery plan with NOAA funding
- Kelp recovery plan core team was formed in Oct. 2017. Likely a two-year project.
- Max Calloway is authoring literature review, first step toward understanding kelp trends, stressors and services in Puget Sound
- Year 1, understand the science, identify data gaps, and begin to look at opportunities for recovery
- Second workshop will be planned for June 2018;
- The plan will address all kelp, but most data exists for bull kelp.
  - 22 species in WA
  - 18 species in rockfish recovery area
- Also looking to work with Hollings Scholar, volunteers etc. to fill capacity gaps to complete the plan.
- Hoping to end up with a plan that outlines the known data, identifies data gaps and offers suggestions for moving forward to protect and restore kelp.

**Presentation 2 — Max Calloway, Evergreen State:**
- Interactions and consequences of changing controlling factors in kelp forests
- Bull Kelp life cycle
- Foundation species for habitat, Facilitation Cascades, Ecosystem engineers (wave energy, light availability, sediment accretion and movement)
- Alternative Stable States, responses to changes in resiliency
  - Recovery can be challenging to achieve when perturbation has pushed the habitat to an Alternative Stable State
- Controlling factors – Drivers, stressors, controlling factors, impacts
  - Focus today on how controlling factors impact the ecosystem
- Temp – thermal stress, susceptibility to increased disturbance, changes to community structure
Examples: hot water near hot water outflows of power plant: 3.5 C increase led to 97% decreased in Nereocystis
- Loss of kelp associated to loss of other species
- Resiliency also decreased with increased temperature

Stressors
- Turf is a new phenomenon
- No documented reverses of turf shifts
- Some evidence of urban proximity, eutrophication (nutrients and sedimentation)
- Turf traps more sediment (in Italy found 96% of turf trapped sediment)
  - Filbee-Dexter and Wernberg 2018 Bioscience
- Temp and O2 interactions
  - Connell and Russell 2010 Proceedings: Biological Sciences
- Epiphytism also contributes to loss – with increased nutrients and temp
  - Sair and Chapman
  - Cause is not clear, if % cover directly or decreased kelp growth with temp
- Marine heat waves found to contribute to loss of kelp (study on west coast of Australia)
  - Heat also linked to increased storm, etc, pulse disturbances
  - But even after heat wave, community structure not returning from turf

Salish Sea – our data is only on Nereocystis
- Towards Recovery – monitoring and research, restoration

Questions from attendees:
- Linda Rhodes – CAFW restoration is challenging
- Adam Obaza – loss of sheephead and lobsters, and urchin increases
  - Flux with storm events and urchin abundance, but system shows recovery
  - North CA is a bigger problem, recovery not occurring
- Helen Berry – 2014 warm water caused kelp to crash in N CA, but now grazers seem to be limiting recovery
- Tom Mumford – also coupled with sea star wasting disease
- Adam – commercial harvest of urchins helps, urchin gonad quality better in kelp
- Brian Allen – difference between sediment turf and perennial red folios algae
  - Our Salish Sea reds are part of the kelp community
  - Problematic Turf species are different
- Brian – epiphyte species examples (algae, bryozoan, diatom) have different impacts
- Jordan (phone) – CA urchin barren extents
- Braeden – Simon Frasor U, temp resilience in BC Salish Sea, temp spikes and season variations – 17 C threshold (again temp lowers growth and increases bryozoan)
- Tom M – Nereocystis is annual, and community shifts may still retain kelp canopy but with different species
- Betsy Peabody – Puget Sound lacks the urchin barrens that plague CA
Appendix C — Puget Sound Kelp Conservation and Recovery Plan

- Helen – Small scale barrens around, but not large scale
  - WA also has active fisheries for purple and green
  - Patch is not a barren – localized urchin density
- Stephen S – temp varies in Puget Sound
- Helen – not all areas have good historical temp data, and many areas have good mixing
- Emily Bishop – long term data on sedimentation? Logging?
- Kelly Andrews – CA nuclear plants increased sedimentation and limited recovery, also consider light
- Max C – sediment traps have had mixed results at collecting data on sedimentation rates
- Brian – sedimentation and organic seasonal, varies in estuaries, difference between runoff, organic, feeder bluffs, etc
- Max – also consider pollutants in the sediments (and oil spills)
- Tom M – Sea Cucs? How do they work with cleaning sediments? And their populations are down.

Quick review:


Ephiphyte role
- Linda ask, Tom M answer – some bryozoan (*Membranipora membranacea*) occur on outer coast when warm, and kills kelp.
- Brian – Kelp is quick growing substrate, it’s a habitat on the blade too – lots of surface area.
- Cathy Pfister – microbial aspect of kelp, Brooke from Pfister lab is presenting at 2018 SSEC.

Presentation 3 — Helen Berry, Washington Department of Natural Resources:
- Additional info sources
- Knowledge gaps
- Areas of concern – to address in kelp recovery plan
- Data: Status, long-term trends, and short-term trends
- Floating (11%) versus understory kelps (31%):
  - Common in Puget Sound, associated to cooler temp, rocky habitat, higher current.
  - Puget Sound defined by Victoria Sill in Straits of Juan de Fuca.
  - Latest estimate is 18 kelps in Puget Sound (annual and perennial).
  - More kelps in straits, san juans, but 9 species are found in central Puget sound.
  - Really high interannual variability, and variation between species tends to be related, and overall status tends to be stable.
- Long-Term trends:
  o Krumhansl et al. 2016 – reviewed 1,500 global diving datasets.
    ▪ Global stressors influence, but regional trends dominate.
    ▪ Outer coast WA stable, but Puget Sound was concerned lacking enough
      traditional diving based ecological based data to form a conclusion.
  o Thom and Hallum 1990
    ▪ Compared Rigg data 1911 and WDW 1978 maps.
    ▪ Found apparent kelp increases in North Sound, Main Basin, and South
      Sound.
  o 2 areas have been updated (helen with Pfister, Berry and Mumford 2017 Journal of
    Ecology).
    ▪ WDNR 1989-2015 aerial maps with Rigg data 1911 for Straits, agree
      consistent.
    ▪ 1855-2017 South Sound mixed data on Bull Kelp distribution (studies varied
      on focus).
      • Bull kelp only in high passage areas, not embayments, in South
        Sound.
      • Linear extent of shoreline with bull kelp.
      • Split South Sound in 3 sub-regionals (east, west, central).
      • Found some stable abundance, others shift (central down, east
        increased).
    ▪ Biggest change in presence around 1980.
      • Reviewed as proportion of observations.
      • Prior to 1980, equal representation of presence observations.
      • After 1980 East sub region high presence, but elsewhere near zero.
    ▪ Looking at temp data – west subregion reaches 17 C in summer and nitrate-
      nitrite reach 5-10 umol - lowest in summer.
  o Bainbridge island (Brian A) has seen complete loss, and well documented (fast ferry
    project), lastly Wing Point.
  o San Juans (Todd W) reviewing Rigg and other data, against modern WDNR remote
    sensing.
  o Other areas of concern – observations.
    ▪ Gedney, Camano (Tonnes), loss since 1980.
      • Loss of predators (rockfish), sedimentation and logging triggered
        landslides.
    ▪ Elliot Bay recent increase, unknown why.
    ▪ Steamboat Island (Harlin 72 and Mumford & Waaland 2008).
- Short-Term trends:
  o Elwha, CA, north into BC, MRC data, Squaxin.
  o Elwha – 10 million tons of sediment.
    ▪ Rubin et al 2017 – dive transects, documented recovery
Appendix C — Puget Sound Kelp Conservation and Recovery Plan

- Complete loss in 2012-2014 after dam removal, but 2014 also very warm year.
- Conclusions: stressors is turbidity and light, but most sediment carried offshore due to high current environment.
- But by 2017 mostly recovered naturally

  - CA – North shoreline loss, Cynthia Catton 2017
    - Sea star wasting, purple urchin bloom, and warmer temps
    - 90% loss of kelp in CA
    - WA also saw decline in 2014 during el nino and Blob year
      - But WA quickly rebounded in 2015, except for Cherry Point
      - Temp map (satellite) correlates with areas that recovered
      - Well mixed areas staying cooler (also narrow shallow areas don’t have satellite temp data).

  - Strait of Georgia
    - Mixed findings since 2015, some remained absent, others persisted
    - Lab work suggests damage between 17-18 C

  - MRC volunteer data
    - 2015-2017 multiyear
    - 21 sites, acreage varies, standardized based on percent of bed measured.
    - High variation, many users
    - Some areas of concern with decline, inside island county Saratoga passage.

  - Squaxin Island (south Puget sound), bed has persisted, Max study for thesis
    - Detailed monitoring since 2013
    - Bed is contracting, even smaller in 2017.
    - Max depth has become shallow.
    - Concern is if lost, little chance for recovery (lower fitness, lack of regional recruitment).
    - Many thoughts, but little known - Sargassum, turn, sedimentation
    - Recent photos show similar transition as Bainbridge island loss, and others.

- Questions from attendees:
  - Who eats kelp crab? Cabazon, lingcod, rockfish
  - Linda R – observations of kelp crab barrens (Whidbey island)
  - Kelly A – recent warm water may facilitate kelp crab recruitment event
  - Betsy P – Jacque White concludes salmon smolts favor kelp in San Juans
  - Tracy Sanderson, Helen clarify – patterns in seasonal nutrients – summer stratification in non-mixed areas
    - And high loss in island county may be loss of already quite small beds
  - Other understory kelps – ex, pteragophora needs high current environment (from South Whidbey to Straits)
  - Emily B – lack of seed source in recruitment?
Appendix C — Puget Sound Kelp Conservation and Recovery Plan

- Helen, allele richness in South Sound low, so recruitment problems
  - Nereocystis not as broadly dispersed as it once was
- Tom M – gametophyte survival

Presentation 4 — Jordan Hollarsmith – U.C. Davis (remote WebEx):
- Also with Ani Ghosh and Kate Tiedeman (Ted Grosholz lab).
- Previous work in CA and Chili
  - Capturing sites once every 15 days
  - 30 m (squared) resolution with one spectral signature
  - Models to unmix signals – (Multiple Endmember Spectral Mixture Analysis: MESMA)
  - Google Earth Engine: Landsat and Sentinel 2 all using the google servers
- Kelp remote sensing is challenging due to small patchiness, daily tidal changes, and seasonal cycles.
- High turbidity with chlorophyll can resemble kelp.
- Mapping in Puget Sound: small patches, close to coast, turbid water, cloudy.
- Example results from Google Earth Engine
  - Some recent satellites have up to 10 m resolution
- Next steps
  - Find thresholds for smaller beds
  - Repeat over multiple time
  - Mask land to eliminate false positives
  - Assess accuracy with hi-res samples
  - Super high res data (Planet Lan <3 m pixels)
- Considering full watershed, effects of land change (urbanization, deforestation, agriculture)
  - Not just marine effects
  - Is watershed development a driver in long-term kelp decline
  - Thank Tonnes, Woodard, and Steve Cobbs
- Benefits
  - Same method in space in time (Helen B had problems with varied methods)
  - 1984-2013 will address long term decline versus interannual noise.
  - 30 m pixel, to help define bed size
  - Sea surface temp SST – NOAA AVHRR satellites (advanced high res radiometer)
  - Buoy data, additional data
  - Address temporal log and watershed analysis
- Products
  - Change hot spots
  - Watershed change correlated to kelp bed extents
- **Caveats**
  - Conservative bed extents
  - Limited for causal drivers (nutrients, etc)

- **Questions from attendees:**
  - Tom – trends in Causal factors important with climate change, warming, etc
  - Lucas – why stop in 2013? – 2013 landsat 5 decommissioned, but landsat 8 has been launched

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**Presentation 5 — Nicole Naar, U.C. Davis:**

- Cultural perspectives
- Kelp in rockfish bone collagen has decreased over long term.
- Kelp isotope distinct from phytoplankton.
- Isotopic evidence in salmon too, kelp important to many Puget Sound species.
- Local ecological evidence – hunting sea otters, seal, sea urchin, halibut, and crab.
  - Many tales of hunting near, in, and around kelp beds.
  - Kelp stipes hardened and used to make bows.
- Lummi reef net fishing, anchored through kelp beds to capture migrating salmon.
- Roe on kelp
- Kelp also terrestrial grazing for deer.
- Kelp technology
  - Bull kelp stipe used to soften cedar to bend into halibut hooks.
  - Fishing line
  - Basketry, bark rope, hats
  - Food storage (bulbs cut to make funnels, and store liquids – liquor, deer fat)
  - Food prep, fertilizer for gardens, dried kelp for fuel, keep fresh fish, steam pits
  - Medicine –
    - Games and play – Makah kids make wheels and stipes to play harpooning whales
      - Rattles, hockey like pucks, toy blow guns
    - Ceremonial uses – sound effects, send voices or smoke, steam baths and medicinal purposes
    - Some cranial modifications
    - Use the Samish kelp story to anchor our kelp recovery plan.

- **Questions from attendees:**
  - Helen – use of findings? Report? (some issues of publishing sensitive materials)
  - Lucas – reaching out to other tribes?
  - Max C – datasets (Helen – J Watson otter presence work, Pisco work)
Presentation 6 — Sarah Schroeder, M.S. candidate at U. Victoria:

- Kelp as salmon habitat
- Part of Salish Sea Marine Survival Project
  - Habitat loss of the nearshore
- Kelp important but change in BC not well documented
- Satellite imagery – Geoeye, worldview 3
- Kelp survey 2016 – small scale
  - Validation and classification for satellite data
- Test area near Victoria, compared to Anne Schaffer’s work
- Snorkel and small removable stationary UW video techniques to monitor salmon, try two methods to test results
- Three 60 m salmon transects at two sites, one kelp and one without nearby
  - Turbidity
  - Camera placed before snorkel dives, weighted tripod, with two cameras
- Considerations
  - Kelp growth vs salmon migration seasonality
  - When hatchery are released
  - Tides and currents (kelp can block camera)
  - Changes in turbidity and visibility
- Results
  - Current strongly impacts daily turbidity and kelp observations
  - Snorkel video far better at identifying salmon
  - Majority of fish were shiner perch
    - Also other perch, other fish 1%, YOY fish, and rest juvenile salmon
  - Kelp crab 33% of inverts, red rock also
  - Also river otters
  - Remote video was better at capturing salmon behavior in the kelp (they swim away or through when snorkeling)
  - No rockfish or other large predators
  - No urchins
  - Salmon abundance was highest prior to full kelp abundance
  - Inner transects (closest to shore) had significance with salmon and kelp presence
  - Overall no difference in salmon presence, so kelp not determining factor for nearshore salmon presence
    - Salmon also using nearshore shallow rock as refuge
  - Video analysis: Max N = max number of fish observed, with paired Wilcoxon
    - No difference in kelp presence
    - Video has limited view, etc
- Summary
  - Inside nearshore of kelp preferred for salmon outmigration
o Does not seem dependent on kelp presence  
o The site was inside bay, therefore warmer and later kelp season

- Questions from attendees:
  o Tom – species of salmon? Not reliably on video
  o Linda R – nearshore more important for wild salmon than hatchery (sub yearlings)
    ▪ 70% of salmon in beach seine were wild
    ▪ Out migration and nearshore use based on salmon growth (smaller fish use nearshore more)
  o Brian A – epibenthic inverts more common in spring too – so food source
    ▪ Salmon were predominately in top shallow water, top 15 cm of water
  o Kelly A – is goal to recover kelp as species habitat, if salmon use is mismatched
    ▪ Kelp peak varies from July to August between areas (based on temp)
    ▪ Has seasonality of kelp changed over time? Is that cause for mismatch in timing with salmon
  o Tom M – what species of kelp more important for rockfish and salmon?
    ▪ Saccharina main understory kelp
  o Max C – substrate complexity? Difference in rugosity?
  o Emily B – PGST and NOAA nearshore assessment
    ▪ Salmon also converged in shallow embayments following crab zoea
    ▪ Salmon are mobile, using these spaces in transient (not persistent)
    ▪ Acoustic? i.e. hood canal, maybe using areas of lower velocity currents

Data Gaps Discussion:

- Understand kelp early life history
  o How do microscopic stages act in the field?
  o Can early life stages be transplanted from the lab to the field successfully?
  o Can you reintroduce kelp using spores?
  o Is Puget Sound spore limited?
- General kelp trends
  o Has peak growth shifted?
- Turf species assemblage
  o Difference between local healthy red turf algae compared to problem turf
- Understory kelp
  o Understand roles, assemblages, richness, diversity and distribution
- Role of Epiphytes
- Compile historical traditional ecological surveys and observations
- Understand suspected stressors and how the impact floating and understory kelp in Puget Sound
  o Urbanization
Nutrients

- kelp crabs/loss of predators
  - Are kelp crabs a symptom or cause?

Invasive species (distribution and ecological effects)

Thermal threshold

- Puget Sound has limited temperature data
- Braeden Schiltroth and Sheryl Bisgrove are collecting temperature threshold data for kelp in British Columbia
- Synthia Catton has information out of California

How does sediment impact kelp

- Sediment traps are only useful to a certain degree, they do not indicate benthic accumulation.
- Difference between feeder bluff and anthropogenic sedimentation

Pollutants

- Harvest (WA closed for commercial, but open for recreational)
- Historical fishery pressures
  - How much have we taken, what species and what are the impacts?
- Climate change stressors (including sea level)
  - Role in carbon sequestration, is there enough info? Do we need more?
  - Role of kelp in nitrogen cycling, nutrient refugia?

- Need to publish data to support government white papers
- Role of kelp as habitat
  - What is important about nearshore for salmon? Is it related to kelp?
  - Rockfish interactions
  - Is kelp good for fisheries?
    - Lost fisheries – urchin, cucumber, hake – is there a relationship to kelp losses?

- Role of sea cucumbers
  - Do they play a role in controlling sedimentation?
- Have urchins played a role in Puget Sound?
- Seed source and recruitment
- Understand physiological patterns
  - kelp condition
  - Fecundity
  - Pigment analysis
- Stock structure
- Identify restoration sites that can support kelp
  - What areas that will support kelp?
  - well mixed areas
- Genetic populations/distinct populations in Puget Sound
  - Lily Gierke, UW Milwaukee is studying this
• Document which species are using kelp as habitat and what are the Functional linkages (beyond associations)
• Do we know how to restore kelp? How do we restore kelp sustainably?
• At what scale is aquaculture possible? Is it enough to make a difference?
• Understand economic and socioeconomic implications of kelp absence/presence
  o X acres of kelp leads to X $$$
  o cost benefit analysis
• Need to connect with research, concerns, and interests in BC and Georgia Straits much more frequent than Salish Sea Ecosystem Conference

C.2.2 Notes from Workshop 2 — June 8, 2018

Workshop Participants

In Person Attendees:
Jamey Selleck      NOAA
Max Calloway       Evergreen College, PSRF
Brian Allen        PSRF
Joe Burcar         Ecology
Katie Conroy       NOAA Intern
Lucas Hart         NW Straits
Sasha Horst        NW Straits
Stephen Schreck    PSRF
Austin Rose        Whatcom MRC
David Williams     Freelance Writer
Bob Pacunski       WDFW
Kalloway Page      NRC
Bill Heath         Project Watershed BC
Dan Tonnes         NOAA
Tom Doerge         Snohomish MRC
Emily Bishop       Port Gamble S’Klallam Tribe
Linda Rhodes       Island MRC
Lynne Barre        NOAA
Kelly Andrews      NOAA
Jhanek Szypulski   Central WA U, PNP Treaty
Linda Rhodes       NOAA, Island MRC
Genoa Sullaway     NOAA
Emily Chui         NOAA Intern

WebEx Attendees:
Anne Toledo        Island MRC
Karin Roemers-Kleven San Juan MRC
Tom Mumford        Marine Agronomics
Helen Berry        WDNR
Katy Davis         UBC
Workshop Agenda
Puget Sound Kelp Recovery Plan Workshop #2 June 8, 2018
Theme: Ecosystem linkages, data gaps and associated research and monitoring.

10:00 – 10:20  Introductions
10:20 – 10:30  Year 1 recovery plan updates (Lucas Hart)
10:30 – 11:15  Kelp connection to ecosystem factors (Max Calloway)
11:15 – 12:00  Restoration action in the Strait of Georgia (Bill Heath)
12:00 – 1:00  Lunch (provided)
1:00 – 2:00  Data gaps overview—have we captured the main topics?
2:05 – 3:05  Identifying ongoing vs. new research and monitoring associated with data gaps and current leads
3:10 – 4:10  Sequencing the data gaps
4:10 – 4:30  Wrap up/ next steps

Workshop Notes
Links to presentation slides:
Year 1 recovery plan updates (Lucas Hart):
https://www.nwstraits.org/media/2844/hart.presentation.pdf
Kelp connection to ecosystem factors (Max Calloway):
Presentation 1 — Lucas Hart, Introduction:

Rockfish Recovery Plan – Finalized in Oct 2017

- Provides a framework for kelp recovery as important habitat
- Agenda, presentations, scope and plan
- Framework to discuss Data gaps

Background and intro of kelp recovery plan

- Core team formed in October 2017
- Literature review started in October 2017 (Max Calloway as primary author)
- First workshop in March – stressors, trends, and data gaps
- Draft literature review and data gaps to be completed in September 2018
- Year 2 – review and finalize the plan in September 2019

Geographic boundaries

- PSERNP watershed boundaries
- Georgia Basin referenced where appropriate
- Plan organized around a Drivers – Stressors – Controlling Factors – Impacts (DSCr) model
- Response – Research needs, regulatory, management

Presentation 2 — Max Calloway:

Kelp Ecosystem Connections

- Trophic and ecosystem support for higher fish species
- Objective is to demonstrate importance to Salish Sea ecosystems

Seagrass Meadows Support Global Fisheries Production

- Trends – nursery, stock fisheries, trophic subsidies, biodiversity

Direct Grazing

- Not the most common
- Examples include urchins, kelp crab, Littorina snails (Lacuna vincta)

Detrital pathways

- Blades erode to provide POC and DOC (particulate and detrital organic carbon)
- Provide 17-100% of annual NPP
- Dislodgement form rafts, up to 43% of annual NPP
- Australia PSA include importance of Beach Wrack to shorelines and trophic interactions

Stable Isotope Analysis

- Nitrogen and carbon
- Used to examine trophic use of kelp
- Clear differences between terrestrial and marine systems
Appendix C — Puget Sound Kelp Conservation and Recovery Plan

- Examining differences between plankton and kelp as sources of carbon
- 35-45% of diet for higher level trophic finfish comes from kelp
  - Attaching a dollar value, using WDFW economic data
  - Rough estimates for net economic value for salmon could be as high as $3 mil/yr
- There are some limitations to isotope analysis
- Historical analysis found differences in carbon contributions before and after European presence, as a consequence of removing otters

Foundation Cascades
- Structural benefits
  - Nursery functions, food subsidies
- Structural Diversity is also important
  - Larger kelp = increased faunal abundance
  - Increased blade complexity = increased invert biodiversity
  - Canopy kelp has a greater effect than artificial structures
  - Studies in Norway and Alaska found relationships between inverts and kelp
- Ecosystem engineer –
  - Shade – limits light availability, many invert exhibit negative phototaxy
  - Water Motion – reduces flow
  - Scouring – reduced sediment accumulation

Fish
- Kelp as nursery, fishery, and hunting grounds
- Kelp provides habitat
- Provide refuge
  - Donelan et al 2017, Ecology – examined refuge quality
  - Reduce predation, improved tissue growth rate
  - O’Brien et al 2018, J of Exp Mar Bio and Eco – turf habitats had reduced refuge and foraging
- Forage fish
  - Spawning, planktonic food sources
- Rockfish
  - Most abundant species in kelp habitats, nursery
  - Detrital transport also important to deep sea habitats, and to adult rockfish
- Salmon
  - Research on diets of juvenile salmon in Puget Sound
  - Importance of terrestrial insects related to fresh water inputs
  - In areas with shoreline armoring, salmon rely more on marine inverts
  - Isotopic studies found chinook and coho rely more on marine inverts than other salmon species (which rely more on pelagic)
  - Some evidence that salmon also use kelp as refuge, particular for smolt outmigration, and juvenile salmon are attracted to overwater structures
Appendix C — Puget Sound Kelp Conservation and Recovery Plan

Strengthening connections in Puget Sound
- Diet studies
- Monitoring and field surveys methods

Questions from Attendees:
Tonnes – kelp importance to salmon
Allen – disconnect between diet studies and habitat use for salmon
  - literature on fish assemblages in kelp
  - need for plankton tows with kelp surveys
Rhodes – no other chemical tracers, other than stable isotope
Mumford – suggest examining recreational, commercial, and tribal fishers
  - fishing popular around kelp beds
Allen – shift from canopy to turf kelps may reduce invert diversity
Hart – what is the difference between richness, abundance, and diversity
Mumford – eelgrass role
Burcar – climate change and seasonal impacts to kelp
  - discussed as first workshop, temp (17 C threshold), salinity, etc
Katie Davis – methods for characterizing kelp assemblages
  - eDNA as a new tool to identify fish species use
Allen – what macroalgal habitat structures are important to rockfish?
  - Pacunski – most WDFW work has focused on adult fish, but YOY found on a variety of algal structures
  - Andrews – some seagrass work with kelp too, and varies greatly between species
    - Ex yelloweye settle on rock, and not as much in kelp
  - Pacunski – scuba surveys, drift mats, kelp mats, mostly nearshore common species
    - Again varies greatly on species, and ROV surveys has identified previously assumed rare species, and capturing more of real diversity in Puget Sound

Presentation 3 — Bill Heath:

Bull Kelp Restoration in the Straits of Georgia, and northern Salish Sea
- Collaborative project with Project Watershed Society, Nile Creek Enhancement Society, and Simon Fraser U (and also U Vic and U Wisconsin)

Bull kelp forests are a key nearshore habitat
- Important to salmon highway
- Beds in serious decline, as a result of a combination of factors
- Research and action objectives include growth and survival, restoration efforts, and stress resiliency

Bull kelp life history
• Adult sporophyte stage is focus of studies, but current work on gametophyte to identify conditions for suitable growth of susceptible stages
• Trophic cascade interactions

Survey sites
• Maude Reef and Denman Island near Hornby Island
• Cape Lazo Shoal, was a natural bed until around 2008

Experimental design
• Attachment of seeded spool lines onto a concrete anchor
• Examining feasibility of culturing kelp
• Hobo data loggers for temperature and light, since 2012, data downloaded every two months
• Sori production started in May, and can continue till October during cooler years
• 17 C agreed as a critical threshold for kelp

Temperature effects
• Sori start in May, but may stop in June during warmer years (2015)
• Sporophyte tolerance to 18 C for 30-35 days
• Spore revival can occur with lower temps
• Spore germination reduced at 17 C, and terminate at 20 C
• Dieck 1993 found Gametophyte upper range to 23 C for 2 weeks

Next steps
• Funding from Costal Restoration Fund
• Mapping of historical and current bull kelp distribution
• Sea urchin exclusion and relocation studies
• Seeding of bull kelp and Saccharina latissimi in exclusion and long-line
• Continued monitoring

Can long-line cultivation work for restoration?
• Requires a network of sites established to provide spore source
• There is increased efforts by other groups in BC as well
• Restoration efforts could be limited by climate change, as warmer temps push north

Site selection
• Substrate: bedrock, boulder, cobble
• Moderate wave exposure
• Nutrient availability
• Appropriate environmental factors (temp, light, turbidity, pH, herbivory, diversity)

Questions from Attendees:
Doerge – variation in temp with depth (surface versus depth)
  - Both important to understand kelp exposure
Mumford – long-line seeding resulting in reoccurring/natural settlement (gametophyte bank)
- Some evidence of localized settlement, but not yet multi-year recruitment
- Maude Reef appears to have the most optimal conditions for early growth and survival
- Early season warming negatively impacts the primary reproductive season
- DNA sampling of natural recruitment may provide evidence of restoration success

Allen – larval abundance for fish and inverts in the beds
  - Use of an in situ time lapse camera to examine the site during non-diver presence

Rhodes – bryozoan colonies on kelp in Puget Sound
  - BC also finds large coverage between May and June
  - Appear to impact early growth

Rhodes – floating blades as seed source for kelp distribution
Allen – full kelp can also pick up and move with rocks attached, as flotation exceeds anchoring
  - Maturation of spores can continue when moved, but survival is diminished

Andrews – importance of light intensity and depth with early survival and growth
  - Light and temp appear very important to establish nursery areas for best survival
  - No noticeable growth differences within the limited range of test beds

Mumford – blue light at depth versus red light at surface used for stipe and blade production
Allen – light availability between May and August is always limited to less than 10 m.
  - Areas with rivers (sedimentation and salinity) and other turbidity issues impact kelp.
## Data Gaps Discussion

The information presented in Table C-2, below, is based on a list from Kelp Recovery Plan Workshop 1 (3/27/2018) and summarization created by Tom Mumford (5/15/2018). The table includes edits added during Kelp Recovery Plan Workshop 2 (6/8/2018).

Table C-2. Summary of data gap issues and data availability, sequence to address, and lead identified during discussions in Kelp Recovery Plan Workshop 1 and Workshop 2.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Existing¹ or new data?</th>
<th>Sequence</th>
<th>Lead</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General kelp trends</strong></td>
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</tr>
<tr>
<td>Understory kelp</td>
<td>New</td>
<td>DNR, UW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution</td>
<td>New/existing</td>
<td></td>
<td>Pacunski existing data, over 5000 camera drops; Szypulski surveys towed camera and kayak</td>
<td></td>
</tr>
<tr>
<td>Assemblages</td>
<td>New</td>
<td></td>
<td>Surveys needed (i.e. scuba), Rhodes (kayak towed video, MRC)</td>
<td></td>
</tr>
<tr>
<td>richness</td>
<td>New</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>diversity</td>
<td>New</td>
<td></td>
<td>Pacunski future ROV all rockfish habitats</td>
<td></td>
</tr>
<tr>
<td>Trends (Has peak growth shifted?)</td>
<td>New</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canopy forming kelp (Nereocystis)</td>
<td>Existing and new</td>
<td>Samish, DNR, NWS Initiative</td>
<td>Sub-canopy species (pteragophora); Olie Shelton herring rake surveys (40 yr data, but potentially spatially limited)</td>
<td></td>
</tr>
<tr>
<td>Distribution</td>
<td>Existing</td>
<td></td>
<td>Pacunski existing data (also ROV surveys and drift kelp); MRC surveys, low tide and beach wrack</td>
<td></td>
</tr>
<tr>
<td>Assemblages</td>
<td>New, current (DNR)</td>
<td></td>
<td>Understanding disturbance</td>
<td></td>
</tr>
<tr>
<td>richness</td>
<td>New</td>
<td></td>
<td>Berry (broad scale analysis, video tows)</td>
<td></td>
</tr>
<tr>
<td>diversity</td>
<td>New</td>
<td></td>
<td>Understanding succession</td>
<td></td>
</tr>
<tr>
<td>Trends (Has peak growth shifted?)</td>
<td>New</td>
<td></td>
<td>Pacunski - using historical data in Max Ent model; Mumford teaching scuba surveys at FHL</td>
<td></td>
</tr>
<tr>
<td><strong>To do:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compile historical traditional ecological surveys and observations</td>
<td>Existing</td>
<td></td>
<td>Nicole Naar is working on one component of this, post-doc in 2019 – supporting kelp aquaculture; potential for recreational and commercial fishing knowledge (fishing clubs, identifying on maps)</td>
<td></td>
</tr>
</tbody>
</table>

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¹ “Existing” means that the data may exist but needs discovery and analysis before being useful. New means data needs to be collected.
### Appendix C — Puget Sound Kelp Conservation and Recovery Plan

<table>
<thead>
<tr>
<th>Issue</th>
<th>Existing or new data?</th>
<th>Sequence</th>
<th>Lead</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create list of ecosystem functions and services</td>
<td>Existing</td>
<td>1</td>
<td>Calloway lit review (rockfish, juvenile forage fish, adult salmon); step 1 develop framework or model; carbon sequestration</td>
<td></td>
</tr>
<tr>
<td>X acres of kelp leads to X $$$</td>
<td>New</td>
<td>2</td>
<td>Rockfish associated kelp habitat; need to identify which service (salmon, other sp); association to traditional foods; CA MPA and harvest docs; kelp as biofiltration and nutrification; lost fisheries</td>
<td></td>
</tr>
<tr>
<td>Perform cost benefit analysis</td>
<td>New</td>
<td>3</td>
<td>Target audience to associate importance of kelp to socioeconomic; including other stakeholders (economic, tribes)</td>
<td></td>
</tr>
</tbody>
</table>

**Role of kelp as habitat**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Lead</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document which species are using kelp as habitat and what are the functional linkages (beyond associations)</td>
<td>CA Reef Check; CA Wheeler North data?; Bruce Leaman 1980s?; gastropod grazers (gap); sea cuc; invasive inverts; competitive spatial species</td>
<td></td>
</tr>
<tr>
<td>Rockfish interactions</td>
<td>Rec and comm fishers; intermediate habitat complexity increases diversity; fish structure attraction</td>
<td></td>
</tr>
<tr>
<td>Salmon interactions</td>
<td>Priority area of concern for PS</td>
<td></td>
</tr>
<tr>
<td>Lost fisheries – urchin, cucumber, hake – is there a relationship to kelp losses?</td>
<td>Rec and comm fishers</td>
<td></td>
</tr>
</tbody>
</table>

**Role of kelp as primary producer**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Lead</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>How does kelp productivity support P.S. food web</td>
<td>Trophic relationships - Ramshaw 2017 (Berry sent), Konigs and Miller</td>
<td></td>
</tr>
<tr>
<td>Kelp carbon in inverts, fish, marine mammals</td>
<td>Rhodes</td>
<td>Potentially overestimating isotope</td>
</tr>
<tr>
<td>Spatial subsidies- kelp productivity used in deep water, offshore</td>
<td>Work with OCNMS; kelp as a blue carbon source, but not quantified; kelp important to fisheries as habitat (but nutrient role unknown – primary prod and export); identifying sub-types of kelp beds and species assemblages</td>
<td></td>
</tr>
<tr>
<td>Role in carbon sequestration</td>
<td>PSRF</td>
<td>Low priority; land contributions and seasonal timing of productivity, and linkage to life history; much of kelp productivity is seasonally exported (surveys needed to determine quantity); PSRF data available in July; other Mumford lit (DOC and carbon source); aquaculture lit but may not be comparable in situ</td>
</tr>
<tr>
<td>Role of kelp in nitrogen cycling, [nutrient refugia]</td>
<td>Low priority, work with Ecology</td>
<td></td>
</tr>
</tbody>
</table>
### Data Gaps and Workshop Notes

#### Issue

**Understand suspected stressors and how they impact floating and understory kelp in Puget Sound**

<table>
<thead>
<tr>
<th>Climate change stressors</th>
<th>Lead</th>
<th>Sequence</th>
<th>Existing¹ or new data?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal threshold in Puget Sound</td>
<td>Braeden Schiltroth and Sheryl Bisgrove</td>
<td>New, existing</td>
<td>Braeden Schiltroth and Sheryl Bisgrove are collecting temperature threshold data for kelp in British Columbia; Cynthia Catton has information out of California; Bill Heath’s presentation; surface versus depth difference; Salish Sea is unique with depth distribution; Berry since 2011 aerial kelp surveys and temp, and compared to CA, and kelp recovery associated to water mixing; temp and plant fecundity</td>
</tr>
</tbody>
</table>

| Sea level rise impacts | New | Modeling? Any current research (UW)? Tombolo Society maps? Identifying kelp associated to side-scan sonar is difficult and needs to be groundtruthed; NRCS potential data for substrate, Mike Racine sonar data; Shorezone |

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¹ Existing data refers to data that already exists in the literature or databases. New data refers to data that has not been collected or published before.

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Other comments - A comment from Courtney Greiner at Swinomish: I would also second Nicole's comment (I believe it was Nicole) looking at kelp restoration and associated traditional foods. Additionally, it would be helpful if there was some standard monitoring protocol that outlines basic methods as well as preferred time of year, depth range, targeted kelp species, targeted associated species. Maybe it already exists but it would be great to see what criteria we may be able to incorporate into subtidal studies we are already conducting or maybe a “simple” survey we could start to conduct.

Also from Courtney: Related to carbon sequestration, I know Brian and PSRF are examining the buffering effect of kelp in the water column. I would encourage more studies like this looking at the spatial and temporal effects of kelp on water conditions and chemistry (temperature, pH, and aragonite saturation state in particular).

Courtney: In terms of water property monitoring, Whidbey basin only has continuous temperature measurements in Penn Cove. Incorporating more monitoring systems in Saratoga Passage or Skagit Bay would be incredibly helpful especially due to the large freshwater input from Skagit River.
<table>
<thead>
<tr>
<th>Issue</th>
<th>Existing¹ or new data?</th>
<th>Sequence</th>
<th>Lead</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>How does sediment impact kelp</td>
<td>New</td>
<td></td>
<td>Max Calloway is researching; Sediment traps are only useful to a certain degree, they do not indicate benthic accumulation. (so, method to improve?) Eric Grossman, SnoCo estuary, Agricultural development, port maintenance dredging; historical loss of habitat (model)?; impacts to kelp recruitment; impacts of accumulated toxins (mumford – EPA study in Newport)?</td>
<td></td>
</tr>
<tr>
<td>Sediment- light loss, smothering, lack of adhesion</td>
<td></td>
<td></td>
<td>Turbidity and urbanization; organic/nutrient; seasonal primary productivity; site specific</td>
<td></td>
</tr>
<tr>
<td>Difference between feeder bluff and anthropogenic sedimentation</td>
<td></td>
<td></td>
<td>Urbanization, longshore transport, scouring and erosion</td>
<td></td>
</tr>
<tr>
<td>Role of sea cucumbers</td>
<td></td>
<td></td>
<td>Do they play a role in controlling sedimentation?</td>
<td></td>
</tr>
<tr>
<td>Historical fishery pressures</td>
<td></td>
<td></td>
<td>WDFW historical catch reconstruction (RF focus), currently low priority for recovery plan</td>
<td></td>
</tr>
<tr>
<td>How much have we taken, what species and what are the direct and indirect impacts on kelp</td>
<td>New</td>
<td></td>
<td>WDFW historical catch reconstruction (RF focus), currently low priority for recovery plan</td>
<td></td>
</tr>
<tr>
<td>Trophic cascades in food web</td>
<td>New</td>
<td></td>
<td>Is there research on fish and invert interactions and impacts to kelp (linkage)? – ecological role (cod, RF, etc)</td>
<td></td>
</tr>
<tr>
<td>Kelp crabs/loss of predators (rockfish)</td>
<td>New</td>
<td></td>
<td>Katie Dobkowski is researching</td>
<td></td>
</tr>
<tr>
<td>Are kelp crabs a symptom or cause?</td>
<td></td>
<td></td>
<td>What is the disturbance mechanism, successional change?</td>
<td></td>
</tr>
<tr>
<td>Have urchins played a role in Puget Sound?</td>
<td>Existing and New</td>
<td></td>
<td>Also nearshore development and dredging</td>
<td></td>
</tr>
</tbody>
</table>

¹ This column indicates whether the data is existing or new for the issue.
### Appendix C — Puget Sound Kelp Conservation and Recovery Plan

<table>
<thead>
<tr>
<th>Issue</th>
<th>Existing(^1) or new data?</th>
<th>Sequence</th>
<th>Lead</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrients</td>
<td></td>
<td></td>
<td></td>
<td>Also sedimentation; competitive role with turf species from Suzanne: On nutrients USGS has regional mapping of Puget Sound N and P called SPARROW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><a href="https://water.usgs.gov/nawqa/sparrow/mrb/7.html">https://water.usgs.gov/nawqa/sparrow/mrb/7.html</a></td>
</tr>
<tr>
<td>Pollutants</td>
<td></td>
<td></td>
<td></td>
<td>Yet kelp still does well near urban shorelines</td>
</tr>
<tr>
<td>Invasive species (distribution and ecological effects)</td>
<td></td>
<td></td>
<td></td>
<td>DNR whidbey work? Mostly in state parks, not widespread (and maybe not nereocystis)</td>
</tr>
<tr>
<td>Harvest (WA closed for commercial, but open for recreational)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understand kelp life history- gametophyte phase</td>
<td>New</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How do microscopic stages act in the field?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can early life stages be transplanted from the lab to the field successfully?</td>
<td>current</td>
<td></td>
<td></td>
<td>PSRF; other literature on staining sporophytes, or DNA</td>
</tr>
<tr>
<td>Can you reintroduce kelp using spores?</td>
<td>current</td>
<td></td>
<td></td>
<td>PSRF, if out-planted at the right time of year</td>
</tr>
<tr>
<td>Is Puget Sound spore limited?</td>
<td>New</td>
<td></td>
<td></td>
<td>PSRF, experiment with spore release, but better to create a bed as source</td>
</tr>
<tr>
<td>Distribution by species</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longevity/“seed bank”</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turf species assemblage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference between local healthy red turf algae compared to problem turf</td>
<td>New</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understand physiological patterns</td>
<td>New</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>kelp condition</td>
<td></td>
<td></td>
<td></td>
<td>kelp condition index started by Northwest Straits Commission, Tom Mumford, Helen Berry</td>
</tr>
<tr>
<td>Fecundity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role of Epiphytes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genetic populations/distinct populations in Puget Sound</td>
<td></td>
<td></td>
<td></td>
<td>Lily Gierke, UW Milwaukee is studying this</td>
</tr>
<tr>
<td>Stock structure</td>
<td></td>
<td></td>
<td></td>
<td>Adaptation to temp tolerance</td>
</tr>
<tr>
<td>Do we know how to restore kelp? How do we restore kelp sustainably?</td>
<td>Existing</td>
<td></td>
<td></td>
<td>Bill Heath is working on this. Do not start until we figure out what caused losses</td>
</tr>
<tr>
<td>Identify restoration sites that can support kelp</td>
<td></td>
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<td></td>
<td>PSRF; consider temp for long-term (i.e. south sound could be more susceptible); need for multiple sites to test; PSNERP kelp reports</td>
</tr>
<tr>
<td>well mixed areas</td>
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</table>
### Appendix C — Puget Sound Kelp Conservation and Recovery Plan

#### Data Gaps and Workshop Notes

<table>
<thead>
<tr>
<th>Issue</th>
<th>Existing1 or new data?</th>
<th>Sequence</th>
<th>Lead</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>At what scale is aquaculture possible? Is it enough to make a difference?</td>
<td></td>
<td></td>
<td>Outplanting has been successful, but not yet long-term sustainable</td>
<td></td>
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<tr>
<td>Seed source and recruitment</td>
<td></td>
<td></td>
<td></td>
<td>Back up to stock structure</td>
</tr>
<tr>
<td>Need to publish data to support government white papers</td>
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<tr>
<td>Need to connect with research, concerns, and interests in BC and Georgia Straits much more frequent than Salish Sea Ecosystem Conference</td>
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</tr>
</tbody>
</table>
C.2.3. Notes from Workshop 3 — February 28, 2019

Workshop Participants

Jamey Selleck  
Phyllis Bravinder  
Max Calloway  
Jenna Judge  
Franchesca Perez  
Emily Buckner  
Kelly Andrews  
Linda Rhodes  
Tina Whitman  
Lindy Hunter  
Kimberle Stark  
Dan Tonnes  
Judy D’Amore  
Tom Mumford  
Todd Woodard  
Sherryl Bisgrove  
Jodie Toft  
Rich Childers  
Stephen Schreck  
Austin Rose  
Camille Speck  
Helen Berry  
Steve Copps  
Tom Doerge  
Brian Allen  
Suzanne Shull  
Casey Palmer-McGee  
George Stearns  
Braeden Schiltroth  
Steve Rubin  
Nam Siu  
Terrie Klinger  
Betsy Peabody  
Cathy Stanley  
Cinde Donoghue  
Laurel Jennings  
Bob Cecil  
Katie Conroy  
Emily Bishop  
NOAA, NRC, Skagit MRC  
Skagit MRC  
Puget Sound Restoration Fund  
Puget Sound Partnership  
Stillaguamish Tribe, Snohomish MRC  
University of Washington  
Jefferson MRC  
Marine Agronomics  
Samish Indian Nation  
Simon Fraser University  
Puget Sound Restoration Fund  
WDFW  
Puget Sound Restoration Fund  
Whatcom MRC  
WDFW  
WDNR  
NOAA  
Snohomish MRC  
Puget Sound Restoration Fund  
Padilla Bay Reserve, Northwest Straits Commission  
Samish Indian Nation  
Puyallup Tribe  
Simon Fraser University  
USGS  
WDFW, Jefferson MRC  
University of Washington  
Puget Sound Restoration Fund  
Tulalip Tribes  
WDNR  
NOAA  
Whatcom MRC
Workshop Agenda

Objective: Identify and coordinate actions to create a strategy in addressing critical data gaps for Puget Sound kelp conservation and recovery.

Location: Padilla Bay Reserve, 10441 Bayview-Edison Rd, Mount Vernon
Date/Time: Thursday, February 28, 2019 10:00 am – 4:30 pm

10:00-10:40 Welcome and Introductions
Meeting goals and agenda review
Group introductions
Goal of Kelp Conservation and Recovery Plan

10:40-11:10 Review of Puget Sound Kelp Data Gaps
What is known and what isn’t known: reviewing high priority data gaps and needs

11:20-12:05 Breakout Discussions – Data Gaps
In groups discuss actions, needs, and strategy around data gaps

12:05-1:00 Lunch (provided)

1:00-1:30 Group Reporting
Review breakout group discussions

1:30-2:15 Breakout Discussions – Data Gaps
In groups discuss actions, needs, and strategy around data gaps

2:15-2:45 Group Reporting
Review breakout group discussions
Workshop Notes

Links to presentation slides and flip chart notes:

Introduction PowerPoint Slides:

Max Calloway PowerPoint Slides:

Flip chart photos: https://www.nwstraits.org/media/2753/kelpflipchartnotes_2_28_2019.pdf

Additional Puget Sound Kelp Conservation and Recovery Plan materials:
https://www.nwstraits.org/our-work/kelp/

Presentation 1 — Dana Oster, Puget Sound Kelp Conservation and Recovery plan Intro:

- Meeting Objective: Identify and coordinate actions to create a strategy in addressing critical data gaps for Puget Sound kelp conservation and recovery
- Kelp Problem Statement: full statement available in link above
  - The 24 species of kelp in the Puget Sound provide important habitat & ecosystem services.
  - Bull kelp appears to be in decline, particularly in the central and south sound. But data is sparse.
  - The precise functions, trends and distributions of the other 23 species of understory and mid-story kelp are poorly understood.
  - We are taking the precautionary approach, with the goal of improving monitoring, conservation, and restoration actions (particularly for bull kelp).
- Timeline:
  - Year 1 focused on understanding the science available on Puget Sound kelp, creating literature review, and data gaps summarizing all unknowns about Puget Sound Kelp
  - Year 2 is focused on prioritizing the data gaps and outlining actions to address data gaps.
    - Draft plan will be available for review July 2019 and project is complete by September 2019
- Survey sent out in December 2018 to gather kelp communities priority data gaps to address kelp conservation and recovery strategy. The top 6 of 7 high priorities were used to focus the February workshop actions discussion. Management as the 7th priority data gap will be the focus of a second workshop soon to be scheduled in Spring 2019.

Presentation 2 — Max Calloway, Kelp 101 and data gaps:

Slides available in link above.

Questions (Q) Response (R):

Q: In South Puget Sound where bull kelp is declining, is it being replaced?
   R: Invasives (like sargassum) may be replacing it.

Q: Is there good evidence for negative nutrients impacts and links to turf species presence?
   R: Adding more Nitrogen and Carbon to system, depending on species, can have an impact.
   R: Turf with more Carbon can take up more Nitrogen.
   R: Kelp can only take so much Nitrogen.

Q: What is the % of adults that produce sporophytes, was that presented as 10%?
   R: Clarified that percentage (~20-30%) was about kelp making it to canopy.

Q: Are temperature and ability to utilize nutrients related?
   R: Plant needs to photosynthesize/respirate more when temperature increases, will thus need more nutrients.

Q: Where are we at with our understanding of other kelp species both in distribution and in habitat value/role in food web?
   R: Understanding limited to bull kelp distributions in Puget Sound.
   R: Invert abundance much higher in kelp habitat than eelgrass/etc., regardless of floating canopy leads to increase in forage fish.

Q: Is there Evidence of genetic differences between South Sound kelp beds and other parts of Puget Sound?
   R: South Sound bull kelp has lowest allelic diversity, most likely from inbreeding or adaptation.

Q: Potential repercussions for that lack of allelic diversity?
   R: Population genetically isolated or specially adapted? Still up in the air. No conclusions can be drawn at this time.

Q: Southern California long-term study about kelp decline, do we have something similar?
   R: Global trends show 1/3 of kelp is declining, 1/3 of kelp is increasing, 1/3 of kelp show no change.
   R: Means we need better monitoring to investigate this more.
   R: Warm ocean blob/urchin barren/sea star wasting/harmful algal bloom led to significant declines in Northern California. Not just the cause of 1 thing, but all factors played in to declines and loss.
   R: Do we have something like urchin barrens here?
R: urchins are in Puget Sound, but there are not documented cases of urchin barrens fully replacing kelp forest.

Q: So there are local changes in Puget Sound but overall is kelp staying relatively the same?
   R: Historical data interviews can be used to get at ways to really figure out if these changes are significant.

Q: Do we really need a recovery plan if these are just micro changes?
   R: Confident in loss of canopy forming species, should focus on local conditions to try and mitigate loss in specific sites.

Q: Can we define urchin barren?
   R: No min./max. size, otter recovery led to decrease in bull kelp.

   R: Role of disturbance in canopy/understory interactions relatively unknown.

   R: Density less important -> outcome more so, urchins preventing future recruitment of kelp, we shouldn’t focus on urchins as a ‘bad thing’ necessarily.

   R: Does an urchin barren work the same way here as other places? Are they a healthy disturbance regime?

Q: Temperature effects on kelp crab?
   R: Temperature effect on blade growth more significant than crab density. Kelp crabs may still have a significant impact (Calloway thesis research).

Q: Some kelp beds that never make it the surface, affects our understanding of the distribution, what does it mean when they don’t make it to the surface?
   R: Possibly symptom of beds on their last leg?

   R: Bull kelp stipes persist in red-light blue-light, perhaps it is an indication of changes in water quality?

**Breakout Session #1 & 2:**

Discussion question: What are possible short term and long-term actions/strategies that can help address the data gaps (physical stressors, biological stressors, human impacts, distributions and trends, priority areas, restoration)?

The workshop participants were split into 4 breakout groups (photos of flip chart notes are available in links provided section above).

**Comments following breakout session:**

- Dive videos and underwater towed videos from rockfish surveys? How can it be applied to kelp?
  - Data (videos) are there, just needs to be analyzed for kelp species and fish presence.

- Scale of monitoring study?
  - Unsure, how do we select sites?

- Need to figure out correlation between kelp declines and fish declines by region.

- Identifying data/research that’s already in place is key.

- Study of remote sensing monitoring methods at UVic currently underway, focus is primarily narrow fringing kelp beds. Possibly a collaborative opportunity?
  - Methods might be expensive.
o International understory kelp survey protocol, NaGISA.

o Continue monitoring using a protocol for no net loss - Use protocols from other areas (Norway, California, PISCO, etc.).

o Incorporate historical data and historical survey methods including outreach to non-traditional sources to identify historical kelp distribution (NOAA and NWSC Hollings scholar project is one example).

o Need a strategy to implement/enforce current protection plans. Some regulations currently exist for protection.

o Identifying key fish use data as a way to prioritize areas.

o Standardize monitoring efforts through timing and long-term monitoring at Index sites.

o Identify a criteria for priority areas.

Prioritize Actions:
The facilitators and kelp core team simplified the actions discussed in breakout groups for a prioritization exercise. The workshop participants were given 4 stickers to vote for the action or actions that are most important next steps in kelp conservation and recovery. The voting flip chart results can be viewed in the linked pdf of all the flip charts.

Actions which scored above 10 votes:

- Fish use of kelp habitat.
- Expand monitoring of existing beds and exposure.
- Trophic interactions (food web).
- Identify distribution/trends of understory species.
- Historic/Traditional Ecologic Knowledge (TEK).
- Water quality.
- Population genetics/strain development.
- Best Management Practices (BMP) for restoration methods.

Results are summarized in Table C-3 below:
### Table C-3. Priority areas for Puget Sound Kelp restoration and conservation identified by workshop participants.

<table>
<thead>
<tr>
<th>Priority Areas for Restoration</th>
<th>vote</th>
<th>Priority Areas for Conservation</th>
<th>vote</th>
<th>Distribution &amp; Trends</th>
<th>vote</th>
<th>Human Impacts</th>
<th>vote</th>
<th>Physical Stressors</th>
<th>vote</th>
<th>Biological Stressors</th>
<th>vote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best management practices for restoration methods</td>
<td>10</td>
<td>Fish use of kelp habitat</td>
<td>14</td>
<td>Develop protocols (diving, drones, kayaks, use Norways methods, understory (multibeam))</td>
<td>15</td>
<td>Water quality</td>
<td>12</td>
<td>Nutrient monitoring in water and kelp tissue (implications to kelp)</td>
<td>8</td>
<td>Trophic interactions (food web)</td>
<td>10</td>
</tr>
<tr>
<td>Population genetics/strain development (tolerant kelp seeds)</td>
<td>10</td>
<td>Expand monitoring of existing beds and exposure to stress</td>
<td>13</td>
<td>Identify distribution/trends of understory species (long-term/short-term)</td>
<td>12</td>
<td>Connections with land use</td>
<td>7</td>
<td>Temporal temperature (seasonal vs multiyear)</td>
<td>5</td>
<td>Life stage vulnerability</td>
<td>4</td>
</tr>
<tr>
<td>Criteria for restoration sites (substrate, historical presence, WQ)</td>
<td>6</td>
<td>Develop criteria for priority areas</td>
<td>7</td>
<td>Historic/Traditional ecologic knowledge</td>
<td>11</td>
<td>Kelp harvest</td>
<td>3</td>
<td>Water column temperature</td>
<td>3</td>
<td>Competitive interactions btw kelp species</td>
<td>3</td>
</tr>
<tr>
<td>Remove sargassum</td>
<td>1</td>
<td>total</td>
<td>34</td>
<td>Aerial photography/ground truthing</td>
<td>2</td>
<td>fish harvest</td>
<td>1</td>
<td>Sediment (turbidity vs substrate variance)</td>
<td>2</td>
<td>grazer impacts</td>
<td>1</td>
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<tr>
<td>total</td>
<td>27</td>
<td>Data repository</td>
<td>0</td>
<td>boating impacts</td>
<td>0</td>
<td>Light</td>
<td>1</td>
<td>microbial communities (beneficial, harmful…)</td>
<td>0</td>
<td>pathogens and disease</td>
<td>0</td>
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<tr>
<td>total</td>
<td>40</td>
<td>trash/derelict gear/other marine debris impacts to kelp</td>
<td>0</td>
<td>Spatial temperature data</td>
<td>0</td>
<td></td>
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<td></td>
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<tr>
<td>total</td>
<td>23</td>
<td>total</td>
<td>19</td>
<td>total</td>
<td>18</td>
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</tbody>
</table>
Group reflection on voting results:

- Land use-water quality are connected, as are fish use of kelp habitat and trophic interactions.
- Distribution and Priority Areas for Conservation were the two areas that had the most votes overall.
- Combine water quality and general physical stressors.
- Importance of monitoring design, which stressors are the most important?
- Funding from NOAA Rockfish team for Kelp Recovery? How do we balance conservation vs. recovery?
  - We shouldn’t just think of kelp when considering rockfish recovery, they may not be the whole picture…what other vegetative structures are there? We should think about habitat generally for Rockfish Recovery.
  - System and biological recovery is the goal, not linking salmon to kelp because of data gaps, it seems like kelp are important to rockfish so let’s ride that train while we get more info.
- Habitat benefits and food web function not considered a priority from the data gaps prioritization survey, worried they are going to fall through the cracks.
  - But they scored high today as primary data gaps and actions to take, so optimistic outlook.
- First address questions of habitat benefits and food webs and then move to recovery.
- Telling the story vs. implementing a management plan…need the evidence that kelp is important to other organisms for funding, support, etc. (intermediate step).
  - Including salmon and forage fish.
- Prioritize actions (data gaps) here and then bring to Management workshop to see what managers think about our list, may make two lists: research actions and management actions.
- Language already there about kelp being critical habitat, but we need best available science to determine regulatory enforcement and protocols (need quantification, the nitty gritty details).
- Eelgrass world has been effectively knit into the regulatory framework…we need to do the same.
- That may change how we prioritize areas for conservation, there’s just not enough information for regulators to make decisions.
- Language only discusses critical habitat nothing on food web support.
- What is our strategy for moving our action items to managers?
  - For more targeted implementation need to include managers in the conversation earlier.
  - How can no net loss be applied?-from the perspective of a regulator. How do you use best available science to put monetary value for mitigation?
  - How do we assign value to natural resources?…Should explore ecosystem services more in order to make those value judgements.
- What about in Canada?
Not much is going on connecting kelp habitat and regulation, some pockets around Vancouver island, some money in trying to put some kelp beds back in…DFO may be interested.

Puget Sound Partnership is interested in coordinated monitoring on both sides of the border.

- Eventually the goal will be to have one list of prioritized actions for research and another list for recovery and conservation efforts.

C.2.4 Notes from Workshop 4 — June 13, 2019

Workshop Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betsy Peabody</td>
<td>Puget Sound Restoration Fund</td>
</tr>
<tr>
<td>Brandon Clinton</td>
<td>US Army Corps of Engineers</td>
</tr>
<tr>
<td>Brian Allen</td>
<td>Puget Sound Restoration Fund</td>
</tr>
<tr>
<td>Camille Speck</td>
<td>Washington Dept. of Fish and Wildlife</td>
</tr>
<tr>
<td>Casey Palmer-McGee</td>
<td>Samish Indian Nation</td>
</tr>
<tr>
<td>Cinde Donoghue</td>
<td>Washington Dept. of Natural Resources</td>
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<tr>
<td>Craig Burley</td>
<td>Washington Dept. of Fish and Wildlife</td>
</tr>
<tr>
<td>Dan Tonnes</td>
<td>NOAA- National Marine Fisheries Service</td>
</tr>
<tr>
<td>Dana Oster</td>
<td>Northwest Straits Commission</td>
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<tr>
<td>Eleanor Hines</td>
<td>Whatcom Marine Resources Committee</td>
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<tr>
<td>George Stearns</td>
<td>Puyallup Tribe</td>
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<tr>
<td>Gus Gates</td>
<td>Surfrider Foundation</td>
</tr>
<tr>
<td>Helen Berry</td>
<td>Washington Dept. of Natural Resources</td>
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<tr>
<td>Jamey Selleck</td>
<td>NOAA- National Marine Fisheries Service</td>
</tr>
<tr>
<td>Jamie Kilgo</td>
<td>Washington Dept. of Natural Resources</td>
</tr>
<tr>
<td>Jenna Judge</td>
<td>Puget Sound Partnership</td>
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<tr>
<td>Jodie Toft</td>
<td>Puget Sound Restoration Fund</td>
</tr>
<tr>
<td>Juliana Houghton</td>
<td>US Army Corps of Engineers</td>
</tr>
<tr>
<td>Kalloway Page</td>
<td>University of Washington</td>
</tr>
<tr>
<td>Kristin Swenndal</td>
<td>Washington Dept. of Natural Resources</td>
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<tr>
<td>Lalena Amiotte</td>
<td>Washington Dept. of Natural Resources</td>
</tr>
<tr>
<td>Lucas Hart</td>
<td>Northwest Straits Commission</td>
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<tr>
<td>Max Calloway</td>
<td>Puget Sound Restoration Fund</td>
</tr>
<tr>
<td>Nam Siu</td>
<td>Washington Dept. of Fish and Wildlife</td>
</tr>
<tr>
<td>Naomi Gebo</td>
<td>Washington Dept. of Natural Resources</td>
</tr>
<tr>
<td>Neil Harrington</td>
<td>Jamestown S'Klallam Tribe</td>
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<tr>
<td>Nicole Jordan</td>
<td>Northwest Straits Commission</td>
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<tr>
<td>Pamela Sanguinetti</td>
<td>US Army Corps of Engineers</td>
</tr>
<tr>
<td>Phil Green</td>
<td>San Juan Marine Resources Committee</td>
</tr>
<tr>
<td>Phill Dionne</td>
<td>Washington Dept. of Fish and Wildlife</td>
</tr>
</tbody>
</table>
Appendix C — Puget Sound Kelp Conservation and Recovery Plan

Rich Childers  Washington Dept. of Fish and Wildlife
Steve Copps  NOAA- National Marine Fisheries Service
Steve Rubin  United States Geologic Survey
Tom Mumford  Marine Agronomics
Tom Ostrom  Suquamish Tribe

Workshop Agenda

Kelp Conservation and Recovery Plan - Management Workshop- June 13, 2019

Objectives:
1. Identify priority research and monitoring actions to inform management/regulatory changes to better protect kelp.
2. Identify currently available management tools that can further help conservation and restoration of kelp.
3. Assess opportunities for additional tools that can further kelp conservation and restoration

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00-10:30</td>
<td>Welcome and introductions</td>
<td>Dana Oster, NW Straits Commission</td>
</tr>
<tr>
<td></td>
<td>Meeting goals and agenda review</td>
<td>Dan Tonnes, NOAA</td>
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<td></td>
<td>Group introductions</td>
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<td></td>
<td>Kelp Conservation and Recovery Plan</td>
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<tr>
<td>10:30-11:15</td>
<td>Puget Sound kelp: roles, trends &amp; stressors</td>
<td>Max Calloway, Puget Sound Restoration Fund</td>
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<tr>
<td></td>
<td>Review of regional trends, ecology, ecosystem services and stressors</td>
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<tr>
<td>11:15-11:30</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>11:30-12:00</td>
<td>Kelp data gaps and actions</td>
<td>Dana Oster, NW Straits Commission</td>
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<tr>
<td></td>
<td>Review high priority kelp knowledge gaps and priority actions</td>
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<tr>
<td>12:00-1:00</td>
<td>Lunch (not provided)</td>
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<tr>
<td>1:00-1:30</td>
<td>Management framework</td>
<td>Max Calloway, Puget Sound Restoration Fund</td>
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<tr>
<td></td>
<td>Review understanding of current framework</td>
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<tr>
<td>1:30-2:30</td>
<td>Human activities and kelp</td>
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<tr>
<td></td>
<td>In small groups discuss scenarios of human activities and kelp</td>
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<tr>
<td>2:30-2:45</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>2:45-3:15</td>
<td>Human activities and kelp group reporting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review breakout group discussions</td>
<td></td>
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</tbody>
</table>
### Workshop Notes

**Presentation links:**

Puget Sound Kelp Conservation and Recovery Plan Introduction:  

Puget Sound Kelp Trends, Roles, and Stressors:  

Kelp Data Gaps, Actions, and Goals:  

Updated Management Framework Diagram:  
[https://nwstraits.org/media/2798/kelpmanagementframeworkdiagram-v7.pdf](https://nwstraits.org/media/2798/kelpmanagementframeworkdiagram-v7.pdf)

**Workshop Objectives and Key Takeaways:**

**Objective 1:** Identify priority research and monitoring actions to inform management/regulatory changes to better protect kelp.

Breakout discussions and prioritization activities highlighted three primary research and monitoring needs that support a number of management/regulatory strategies to better protect kelp:

1. **Quantify physical stressors’ impacts on kelp growth, condition, and trends.**
   
   Discussion focused on water temperature, nutrient pollution, sediment transport, and shoreline improvements (direct project footprint and indirect impacts). Data on impacts to kelp will assist with some of the following management opportunities:
   
   a. Prioritize the top tier of most impactful stressors to focus management actions and regulatory protection.
   
   b. Implement total maximum daily loads (TMDLs) for nutrients and other pollutants in reaches with proximity to kelp beds.
   
   c. Quantify kelp impact water quality thresholds to inform National Pollution Discharge Elimination System (NPDES) and other discharge permits/regulations for point and non-point sources when possible.
   
   d. Avoid, minimize and compensate for negative impacts to kelp beds e.g. establishing effective buffers.
2. **Develop functional assessments to quantify kelp forest ecological functions.**

With a focus on strengthening our understanding of kelp forests as ecosystem foundations (nursery habitat, food-web subsidies, biodiversity support) and engineers (ocean acidification amelioration, nutrient pollution mitigation, natural breakwater). A more complete understanding of kelp forest ecological function will assist with some of the following management opportunities:

   a. Increase the ability of existing regulations to protect kelp by documenting functions that must be protected or mitigated. Inform mitigation guidance (both avoidance and compensatory mitigation).

   b. More fully apply ESA protections and regulations to kelp habitats that support ESA listed species.

   c. Generate political will to support regulation changes.

   d. Develop communication strategy targeting regulators, managers, policy makers and the general public focused on the critical nature of kelp habitats.

3. **Describe kelp distributions and trends.**

A clear understanding of historic and current distributions of bull kelp and understory kelp is needed to assist with some of the following management opportunities:

   a. Designate kelp protected or priority areas.

   b. Better implement spatially explicit management strategies and site level reviews.

   c. Identify candidate bull kelp restoration sites.

   d. Develop recreational kelp harvest management strategy to assess impacts and locations.

**Additional research needs discussed included:** fisheries management, restoration methods, and kelp aquaculture. Details on these topics can be found in the full Kelp Management Mad Libs results.

**Objective 2: Identify currently available management tools that can further help conservation and restoration of kelp.**

Breakout discussions and prioritization activities identified a number of state and federal management tools currently available for kelp protection. With limited exceptions, regulations and management tools generally address all species of kelp and afford equal protection to kelp as to eelgrass. However, in practice, participants felt that eelgrass was granted greater protection due to greater awareness of its ecological benefits. The list is not exhaustive, it contains the tools identified by participants that can assist in kelp conservation. Many workshop participants felt that application of the tools below could be strengthened to further protect and recover kelp.

1. **Washington Department of Natural Resources (WDNR) tools:**
   
   a. Aquatic reserves

   b. Aquatic land leases, management strategy, and withdrawal letters
2. Washington Department of Fish and Wildlife (WDFW) tools:
   a. Hydraulic Project Approvals (HPAs)
   b. Recreational shellfish and seaweed licenses
   c. Harvest enforcement
3. Washington Department of Ecology tools:
   a. Shoreline Management Act (SMA)/ Shoreline Master Program (SMP)
   b. Discharge permits, TMDLs
   c. Nutrient reduction program
   a. Clean water act, NPDES
   b. No net-loss mitigation rule
   c. US Army Core of Engineers eelgrass and macroalgae vegetation survey guidance
      (in final development)
   d. Essential fish habitat, critical areas, and ESA species protections

Objective 3: Assess opportunities for additional tools that can further kelp conservation and restoration.

Breakout discussions and prioritization activities identified opportunities for additional tools and gaps in current regulations that can further protect kelp. The opportunities are summarized in seven categories:

1. Improve definitions, regulatory permitting framework, and enforcement.
   a. Develop tools that explicate the functions and values of kelp so that regulators can
      more fully implement avoidance of impacts and mitigation.
   b. Assess and adjust recreational harvest codes and management.
   c. Better enforce current rules and regulations for recreational harvest.
   d. Close loopholes for shoreline development such as exemptions for maintenance
      projects.
   e. Include kelp and “attached” vegetation in the Army Corps of Engineers’ “rooted
      vegetated shallows” definition.
   f. Consider programs with stronger frameworks in other states, such as the Coastal
      Zone Management Act implementation in California.
   g. Streamline or change permitting process for scientific collection authorization.
   h. Streamline permitting framework for kelp aquaculture.

2. Develop criteria and identify protected/priority areas for existing and future kelp.
   a. Designate protected kelp beds and identify priority areas for restoration.
   b. Strengthen stressor reduction and mitigation regulations in protected kelp habitat
      areas.
   c. Use landscape scale kelp distributions for spatial planning and management.
3. Communication/Education.
   a. Promote interagency involvement, education, and coordination.
   b. Educate decision makers and the public about the importance of kelp forests.
   c. Coordinate regional research and monitoring.
   d. Address social impacts of kelp loss (fisheries, recreation, etc.).

4. Stressor thresholds and impact reduction.
   a. Use quantitative data to improve and set thresholds and water quality standards specific to kelp (lethal and sub lethal impacts).
   b. Establish coordinated long-term monitoring on relationship between stressors and kelp trends.

5. Coordinated long term monitoring and survey methods toolkit.
   a. Develop best management practices for monitoring and managing kelp.
   b. Standardize survey guidelines.
   c. Develop multi-year survey requirements.

   a. Create guidance for assessment (e.g., wetlands guidance).
   b. Provide impact-specific guidance.

7. In kind and in place mitigation.
   a. Create mitigation banks of kelp protection and restoration projects.
   b. Develop restoration/mitigation guidance.

Meeting wrap up/ next steps:

The timeline for the current plan is as follows:
- Draft plan available for peer review and public comment summer/fall 2019.

The group discussed how to continue the work of the Kelp Conservation and Recovery Plan after the current NOAA funding for the Northwest Straits Commission to lead the effort ends in December 2019.
- Create a final survey to assess ability and willingness of recovery plan workshop attendees in assisting with continued coordination.
- Communicate with key interest groups who were not present in the meantime (before December 2019).
  - Participants are encouraged to reach out to colleagues in local governments and the Department of Ecology to express the need for their involvement in this process.
  - Incorporate more non-profit groups in continued recovery and communications efforts.
Public outreach and education are urgently needed. Northwest Straits Commission can take on a portion of this effort, but all participants of this and previous kelp workshops are encouraged to engage in kelp outreach and education activates when possible, focusing on:
  o Education and outreach should highlight concrete conservation and recovery actions.
  o The urgency of kelp forest loss in the Puget Sound.
  o Adopting a “learn from the past” mentality focusing on the loss of other marine habitats in the Puget Sound region.

Puget Sound Restoration Fund is working with NOAA to continue work on kelp restoration methods and research.

Department of Natural Resources work will continue research describing long-term regional trends and monitoring of select individual forests.

Puget Sound Partnership:
  o Puget Sound Ecological Monitoring Program (PSEMP) is in a good position to help with coordination and communication following the November deadline. Jenna Judge agreed and suggested forming a subgroup.
  o The Partnership may be a good candidate to maintain higher-level communication between managers within separate agencies.
  o Add kelp to the vital signs and develop an implementation strategy.

Extended Notes:
Presentation summarized how the kelp conservation and recovery plan began and what the process has been for the 2-year project.
Today’s workshop is the fourth in a series to better understand the science and state of kelp in Puget Sound, and to bring together the state of the science and current regulatory framework.
A draft plan will be available for peer review and public comment later in summer or early fall 2019.

Puget Sound kelp: roles, trends & stressors:
Max Calloway presented on Puget Sound kelp, stressors, and trends.
Presentation slides are available here:

Group Discussion:
We have a big collective job of telling the full story of kelp, why it’s important, what to be looking for and how we find ways to conserve and restore it.

More information on the stressors and why/how they are stressing the kelp.
Modeling efforts would be helpful for managers.
Temperature seems to be a big factor influencing kelp resiliency.
Researchers are looking at the microbiome which might be affected by stressors.
The group agreed there is a need to coordinate on index sites more and perhaps couple monitoring efforts with other monitoring activities including ocean pH levels, temperature, biodiversity, etc. The list below is the preliminary list of Index sites where kelp monitoring of some kind is currently underway. A later task will identify methods, dates, frequency, and needs for additional sites.

**Index Sites:**

**WDNR:**
- Shading study of understory kelp - Nisqually Reserve
- Kelp harvest study - Libbey Beach, Whidbey Island
- Sequim (Clallam County)
- Indian Island (Jefferson County)
- Squaxin Island (Mason County)
- Smith and Minor Island
- Salt Creek/Tongue Point
- Salmon Beach (Tacoma Narrows, Pierce County)

**USGS:**
- Kelp stressors - Elwha nearshore subtidal dive surveys 2008-2019
- Dam removal, seastar wasting, sediment

**Puget Sound Restoration Fund:**
- Elliott Bay Marina Breakwater (King County)
- Magnolia (King County)
- Jefferson Head (Kitsap County)
- Tyee Shoal (Kitsap County)

**Northwest Straits Commission and Marine Resources Committees kelp kayak surveys of kelp area:**
- Whatcom MRC - (SW Lummi Island, Aiston Preserve, Cherry Point, Alden Bank)
- Skagit MRC - (Shannon Point, Biz Point, Coffin Rocks)
- Snohomish MRC - (Edmonds, Mukilteo, Meadowdale, Hat Island)
- Island MRC - (Ben Ure Island, Hoypus Point, Polnell Point, Ebeys Landing, Possession Point, Camano Island State Park)
- Jefferson MRC - (North Beach) - outfall impact reference site
- Clallam MRC - (Freshwater Bay, Clallam Bay)
- San Juan MRC - (Fawn Island, Reef Island, Pole Pass)

**Kelp data gaps and actions:**
Dana Oster presented on the general outline of the Puget Sound Kelp Conservation and Recovery Plan, and how the high priority data gaps and actions identified in previous workshops support the goals of the plan.

Presentation slides are available here:

Q: What specific things can be regulated (that we know of for certain)?
A: Regulators need specific information on the impacts of stressors before they can enforce regulation. We need more information on stressors before implementation of regulation can take place. Example: An over water structure should be ‘x’ distance from kelp.

Q: What are the impacts you feel you have enough information on?

Shading
Not enough information:
Nutrients
Sediment
Temperature
Turbidity

Impacts within and beyond the footprint of structures or projects

Indirect impacts

**Group Discussion:**
- Given what scientists know, if there is a stressor, it will likely affect all genetically similar kelp the same in Puget Sound.
- There is some kelp restoration work being done in Australia in which temperature is the culprit. In that region, restoration efforts are focused on researching replacing the kelp species with temperature resistant species.
- We need to assess and quantify kelp forest ecosystem value to accurately compensate for impacts and losses.
- Dive into the functions kelp is providing so it can be quantified (similar to the eelgrass habitat). Call it out in the criteria for goal 4 & 5.
- Regulators fall back on ESA species to identify protection prioritization. Function of kelp should be identified and tied to ESA species when applicable.

**Management Framework**
- The group agreed it is essential to have broad participation across the agencies/groups that are responsible for various aspects of kelp management.
- After the management framework was presented, participants provided edits to the management framework diagram. The revised diagram can be seen here:

Poll results:
Does the management framework seem correct?

- Yes, nailed it!: 6
- Mostly...: 14
- Somewhat: 5
- Not at all: 0
- I don't know: 1

Do you think the current regulations adequately protect kelp?

- Yes: 0
- Mostly: 2
- Somewhat: 10
- Not at all: 13
- I don't know: 3
Breakout Group Discussions

Breakout groups selected at least two examples of human activities or other aspects of kelp management and discussed existing tools that protect kelp and tools that are needed to better protect kelp. The following activities were selected for further discussion:

- Improvements (land-use, degradation)
- Protected areas
- Aquaculture
- Point source/non-point source
- Fisheries management
- Recreational harvest
- Navigation

Question 1: What existing tools are there to minimize (avoid, conserve) impacts to kelp? Are these tools being used effectively? Please differentiate between gaps in regulations, implementation, enforcement or other components of the larger management framework.

- Kelp is generally afforded the same protection as eelgrass in regulations (with some possible exceptions.) But awareness and enforcement are much lower.
- ACOW River and Harbor Act protects all lands, they have to remain navigable and functioning.
- Compensatory mitigation for new projects (ACOE).
- Federal management “2008 mitigation rule” to avoid impacts and minimize. Applicant has to demonstrate that they will mitigate.
Did they minimize” is too philosophical of a question (what counts as demonstrated minimization?)

- Hydraulic Project Approvals (HPA’s)- managed by Washington Department of Fish and Wildlife (WDFW), Authority
  - WDFW new (#1579) increased enforcement capability for HPAs.
- Washington Department of Natural Resources (WDNR)- leasing and other authorizations, withdrawal letters and special designations such as aquatic reserves.
- Upland owners have rights to tidelands use and 70% of tidelands are privately owned, so land ownership is an important tool.
- Cabezon protection and/or catch limits to maintain predator control (on grazers).
- 401 & 404 for constructing outfalls
- Discharge permits
- Interim/macroalgae survey guidelines (WDFW)
- Low Impact Development and raingardens
- Seaweed/shellfish licenses
- National Pollutant Discharge Elimination System (NPDES) permit- clean water act
- Department of Ecology’s Nutrient Reduction Program (https://ecology.wa.gov/Water-Shorelines/Puget-Sound/Helping-Puget-Sound/Reducing-Puget-Sound-nutrients/Puget-Sound-Nutrient-Reduction-Project)
- Protected areas are established and managed by a wide range of groups to meet diverse goals.

Question 2: Where are gaps or opportunities within regulations to improve protection of kelp? What scientific information is needed to support the proposed management tool?

Permitting/mitigation:
- ID functions of kelp (human and ecological) –identification of kelp functions so that impacts can be adequately mitigated or fees charged.
- Bottom caveat: “if we’re trying to manage at the permit desk, we’ll lose.”
- Need to purchase lands to lock up rights for conservation.
- Banks for kelp mitigation – like California Banks for eelgrass and in lieu fees.
- In kind and in place mitigation (or as close as possible).
- Quantitative data for mitigation.
- Change “rooted” to mean “attached” in US ACE definitions.
- Guidance on functions of kelp.
- Include kelp in evaluation process.
- Guidance on how to apply regulations without supporting data.
- ‘Maintenance’ is a back door to many improvements. Exempted by nationwide permit (NMFS is currently trying to close this loophole through defining baseline and impact fees).
- CZMA is implemented/enforced weakly in WA. It has the potential to be a strong tool (see CA and gulf coast).
• Need better protection against construction impacts, such as turbidity.

Bigger picture management/Cumulative impacts:
• Reserves generally don’t have sufficiently authority to preclude a wide range of uses. We need the authority to fully protect areas, but no individual agencies have this scope of authority (for example, navigation, fishing).
• Permits need to consider cumulative impacts of stressors on kelp.
• ESA tends to look at projects individually, this loses cumulative perspective.
• Broaden the scope and understand the cumulative impacts of kelp loss.
• Improve scientific links to salmon and protected species.
• Address social impacts of losing kelp.

Education and outreach:
• Educate on benefits of kelp and value to salmon.
• “Hearts & Minds” campaign for legislative and public awareness.

Priority protection areas:
• Identify priority areas for protection/ Spatial planning.
• Purchase rights.
• Protect areas for future kelp restoration with potential habitat.
• What size matters for protecting kelp beds? What constitutes a kelp bed to need mitigation?
• Puget Sound wide protocols/ survey guidelines.
• Find ways to fully protect areas (most groups have ability to protect against a subset of stressors).

Stressor management:
• Expand discharge permits.
• Identify nutrient needs of kelp.
• Gaps- exceedance threshold specific to kelp or other plants/SAV
  o Increases in turf barrens with increase in nutrients and urban cover
  o Nutrient requirements & thresholds by species
  o Piecemeal management=problem
  o Coordinated framework needed!
• What are enforcement or compliance tools for regulators?
• (outfalls) lets provide spatial designations on distributions (areas for conservation, restoration potentials)
• How is boating impacting kelp?
  o Props mow down bull kelp canopies (photosynthetic and reproductive structures on surface canopies).
  o Increase wave energy.

Recreational harvest/scientific collection/kelp aquaculture:
• Need spatial and temporal management for recreational harvest.
• Build enforcement capacity and modify rules so that enforcement is easier (such as considering changing harvest limits to be based on volume, which is easier to assess in the field).
• Conduct a harvest impacts assessment.
• Better define/standardize harvest guidelines/permits.
• Improve procedures for obtaining authorization from WDNR for scientific and display collection.
• Where should kelp aquaculture be allowed and what are the potential impacts to native kelp and the ecosystem?

Kelp Management Mad Libs
Workshop participants completed the three following sentences. The results for each sentence are grouped into categories and tallied in Tables C-4, C-5, and C-6.

1. **We need to know** ____________________________ so that we can do ____________________________ to **better protect kelp**. (scientific information) (management/policy tool)

Table C-4. Workshop results: Science needs and management actions linked to research needs.

<table>
<thead>
<tr>
<th>Science needs</th>
<th>Management action linked to research needs</th>
<th>votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prioritization of the most important/harmful kelp stressors (if appropriate, by region.)</td>
<td>Target management efforts to address most deleterious stressors</td>
<td></td>
</tr>
<tr>
<td>Stressor thresholds and impacts</td>
<td>implement measures to decrease pressures and strengthen regulations</td>
<td></td>
</tr>
<tr>
<td>linkages among pressure, stressors, and kelp condition</td>
<td>set TMDLs, NPDES, and other regulations</td>
<td></td>
</tr>
<tr>
<td>stormwater/sewer - where outfalls</td>
<td>abatement of old outfalls, water quality</td>
<td>27</td>
</tr>
<tr>
<td>point-non-point water quality-kelp thresholds (min &amp; max) nutrients/contaminants, sediments (oviual &amp; light reduction)- seasonality effects on different life stages</td>
<td>prioritize pressure/stressor reduction</td>
<td></td>
</tr>
<tr>
<td>how to minimize the impacts of outfalls</td>
<td>quantify impacts and make a case for needing to avoid and compensate for impacts</td>
<td></td>
</tr>
<tr>
<td>overwater structures- shading extent, light requirements</td>
<td>develop leases and manage aquatic land uses</td>
<td></td>
</tr>
<tr>
<td>how kelps impacted by work in the waters (shading, water quality, dredging, construction, etc). How big of a buffer is needed</td>
<td>stewardship measures, develop regulations</td>
<td></td>
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<tr>
<td>the scale of impacts</td>
<td>planning on an appropriate scale</td>
<td></td>
</tr>
<tr>
<td>changing ocean impacts to kelp</td>
<td>develop protection measures</td>
<td></td>
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<tr>
<td>Puget Sound temperature regimes</td>
<td>identify areas of kelp refugia</td>
<td></td>
</tr>
<tr>
<td>species dependence on kelp/ cumulative impacts to foodweb</td>
<td>raise awareness within agencies</td>
<td>15</td>
</tr>
<tr>
<td>community richness &amp; diversity</td>
<td>regulatory habitat management</td>
<td></td>
</tr>
<tr>
<td>ecological function &amp; how much ecological function has already been lost</td>
<td>regulate development</td>
<td></td>
</tr>
<tr>
<td>functions of kelp</td>
<td>engage hearts and minds of the public and decision makers</td>
<td></td>
</tr>
</tbody>
</table>
### Science needs

- **how to quantify aquatic resource functions for kelp**
  - develop functional assessments to quantify impacts and mitigation guidance (definition and mitigation)
  - better enforcement of regulations

- **Kelp connection to salmon (ESA species)**
  - ESA related kelp conservation
  - expand on education and outreach

<table>
<thead>
<tr>
<th>Science needs</th>
<th>Management action linked to research needs</th>
<th>votes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distributions/trends</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distributions- where kelp currently is and where it has been historically or could be</td>
<td>designate protected areas or priority areas to reduce stressors</td>
<td></td>
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<tr>
<td></td>
<td>spatially-explicit management</td>
<td></td>
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<td></td>
<td>more informed regulatory and non-regulatory actions</td>
<td></td>
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<tr>
<td>what areas are a priority for protection and recovery</td>
<td>site level reviews in a landscape context</td>
<td></td>
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<tr>
<td></td>
<td>develop leasing and land management decisions</td>
<td></td>
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<tr>
<td></td>
<td>target conservation areas</td>
<td></td>
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<tr>
<td><strong>kelp harvest/fisheries</strong></td>
<td>species specific distributions</td>
<td></td>
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<tr>
<td></td>
<td>figure out BMP for kelp harvest</td>
<td></td>
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<tr>
<td>how much kelp is harvested</td>
<td>manage harvest</td>
<td></td>
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<tr>
<td>creel data</td>
<td>harvest reform/spatial management</td>
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<tr>
<td><strong>restoration</strong></td>
<td>genetic information</td>
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<td></td>
<td>inform restoration methods and planning</td>
<td></td>
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<tr>
<td>if/how kelp restoration/mitigation can be successful</td>
<td>develop mitigation guidance for compensation of impacts (hierarchy-preservations enhancement, creation of kelp bed)</td>
<td></td>
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<td></td>
<td>in kind and in place mitigation</td>
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<td></td>
<td>mitigate and authorize restoration</td>
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</tbody>
</table>

2. **We have currently in place to minimize impacts to kelp.**

   *(management tool)*

C-5. Workshop results: Washington State and federal management tools in place to minimize impacts to kelp.

#### WDNR

- aquatic reserves
- withdrawal letters
- Seaweed harvest regulations
- aquatic land leases and management strategy

#### WDFW

- HPAs
- shellfish/seaweed licenses
- seaweed harvest enforcement

#### Ecology

- SMA/ SMPs
- discharge permits
- nutrient reduction program
### 3. We need ___________ to improve protection of kelp. Short-term ☐ Long-term ☐ (management tool)

Table C-6. Workshop results: Management tools needed to improve protection of kelp in short term and long term.

<table>
<thead>
<tr>
<th>Category (votes)</th>
<th>Tools we need</th>
<th>Short term</th>
<th>Long term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve definitions, regulatory permitting framework, and enforcement (12)</td>
<td>to connect evidence to regulations</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>enforcement</td>
<td></td>
<td>x</td>
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<td></td>
<td>better understanding and regulated seaweed licenses</td>
<td>x</td>
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<td></td>
<td>permitting changes</td>
<td>x</td>
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<td></td>
<td>federal regulations language/interpretation of (non-rooted) rules to include attached plants</td>
<td>x</td>
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<td></td>
<td>clarify Army Corps definition of SAV</td>
<td>x</td>
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<td></td>
<td>scientific collection authorization</td>
<td></td>
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<td></td>
<td>streamlined permitting framework for farming kelp</td>
<td>x</td>
<td></td>
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<td></td>
<td>better regulatory/permitting framework, esp aquaculture</td>
<td>x</td>
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<td></td>
<td>recreational harvest codes</td>
<td>x</td>
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<td></td>
<td>include kelp in the Corps definition of &quot;vegetated shallows&quot; and the Clean Water Act. AS is, the current definition of &quot;vegetated shallows&quot; refers to only &quot;rooted&quot; vegetation</td>
<td>x</td>
<td></td>
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<tr>
<td></td>
<td>better enforcement of current rules</td>
<td>x</td>
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<tr>
<td>Develop criteria and identify protected/priority areas for existing and future kelp (11)</td>
<td>to be able to designate &quot;potential&quot; habitat as &quot;protected&quot; (for example, if kelp substrate is available but does not yet contain kelp, we should have a tool to protect the potential habitat)</td>
<td>x</td>
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<td>regulations and actual protection that doesn't allow traffic within a kelp bed</td>
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<td>mapping of kelp and species abundance/life stages/use</td>
<td>x</td>
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<td>change analysis on existing video data from historic to present under story kelp</td>
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<td>direct/defacto conservation areas/reserves</td>
<td>x</td>
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<td>marine spatial planning</td>
<td>x</td>
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<td>ecosystem based/comprehensive MRAs</td>
<td>x</td>
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<td>to identify priority kelp areas</td>
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<td>better land use planning</td>
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<td>an understanding of metapopulation dynamics</td>
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<td>priority conservation areas</td>
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<tr>
<td>Domain</td>
<td>Action</td>
<td>Notes</td>
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<td>--------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
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<tr>
<td>Communication/Education (7)</td>
<td>increase coordination between local regulators and state/federal</td>
<td>x</td>
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<td>govt - enable ability to tackle cumulative impacts</td>
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<td>increased awareness/education/engagement from public agencies</td>
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<td>communities, local jurisdictions, public to understand importance of</td>
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<td></td>
<td>kelp</td>
<td>x</td>
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<td>agency initiative (WDFW, WDNR, ECY)</td>
<td>x</td>
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<td>education/outreach/advocacy/leadership</td>
<td>x</td>
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<td>local SMPs/Ecology</td>
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<td>public education/outreach strategy</td>
<td>x</td>
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<tr>
<td>Stressor thresholds and impact reduction (6)</td>
<td>storm water management</td>
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<td>water quality monitoring</td>
<td>x</td>
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<td>research findings on stressors</td>
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<td>WQ standards specific to kelp - lethal &amp; sublethal impacts (e.g.</td>
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<td>temperatures that affect soros, sedimentation)</td>
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<td>quantitative data to improve and set thresholds</td>
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<td>water quality rules</td>
<td>x</td>
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<td>Coordinated long term monitoring and</td>
<td>BMPs for monitoring and managing</td>
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<td>standardize survey protocols (5)</td>
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<td>standardize survey guidelines</td>
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<td>long term monitoring and program</td>
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<td>multi-year survey requirements (like eelgrass requirements in CA</td>
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<td>related to CZA)</td>
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<td>Develop functional assessment tools (4)</td>
<td>impact-specific guidance</td>
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<td>guidance (C/E, SMAs, etc)</td>
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<td>functional assessment tools</td>
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<td>guidance (like wetlands guidance)</td>
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<td>In kind and in place mitigation (3)</td>
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<td>restoration/mitigation guidance based on success/risk research of kelp</td>
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<tr>
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<td>in kind and in place mitigation actions</td>
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