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.

Knowledge Gaps for Kelp in Puget Sound	Prioritization for Addressing		
What is the potential value of addressing each data gap toward understanding and guiding decisions around kelp conservation and recovery strategies?	High	Medium	Low
Kelp distribution and trends – Assess and monitor current species' distributions and changes through time in Puget Sound.	54	15	0
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.	50	18	1
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.	49	17	3
Kelp priority areas – Identify priority geographic areas for recovery/conservation measures in Puget Sound.	47	19	3
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.	44	22	3
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.	41	23	5
Management – Understand the effectiveness of current management policies relating to protection/mitigation of kelp from construction, harvest, and other activities in Puget Sound.	42	18	9
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.	37	23	8
Water quality improvement – Understand potential of kelp beds to mitigate nutrient pollution and ocean acidification conditions in Puget Sound.	28	27	14
Kelp developmental biology – Understand environmental thresholds of microscopic life stages and dispersal distances of spores in Puget Sound.	24	32	12
Kelp food webs – Quantify the contributions and describe the pathways of kelp biomass in Puget Sound food webs.	23	35	10
Kelp economics – Assess dollar value of kelp from ecosystem services and role as foundation species in Puget Sound.	11	29	29
Kelp genetics – Investigate genetic diversity and connectivity of Puget Sound kelp beds.	8	32	28

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:

Brian	Allen	Puget Sound Restoration Fund
Kelly	Andrews	NOAA
Helen	Berry	WDNR
Emily	Bishop	Port Gamble Tribe
Feist	Blake	NOAA
Max	Calloway	Evergreen College
Dan	Van Hees	Kelp Physiologist
Tom	Doerge	Snohomish MRC
Lucas	Hart	NWS Commission
Sasha	Horst	NWS Commission
Laurel	Jennings	NOAA
Victoria	Knorr	Recovery plan volunteer
Tom	Mumford	Marine Agronomics
Adam	Obaza	Paua Marine Research Group
Betsy	Peabody	Puget Sound Restoration Fund
Linda	Rhodes	Island MRC
Stephen	Schreck	Puget Sound Restoration Fund
James	Selleck	NOAA/NRC
Suzanne	Shull	Padilla Bay NERR/ NWS Commission
Dan	Tonnes	NOAA
David	Williams	Freelance Writer

WebEx Attendees:

Sherryl	Bisgrove	Simon Fraser University
Byron	Rot	San Juan Salmon Recovery Lead Entity Coordinator
J	Bluhm	Samish Indian Nation
Karin	Roemers-Kleven	San Juan MRC
Katy	Davis	UBC and Port Gamble (kelp microbiome)
Elisa	Dawson	Snohomish MRC
Phil	Green	San Juan MRC
Eleanor	Hines	Whatcom MRC
Jordan	Hollarsmith	UC Davis
Casey	Palmer-Mcgee	Samish Indian Nation
Nicole	Naar	UC Davis - PRESENTER

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)
12:30 – 12:45	Report back on relevant lunch discussions – questions/thoughts/insights.
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/2536/calloway_2018_3_19_krpworkshop_slides.pdf
https://www.nwstraits.org/media/2535/berry_-dnr_2018_status_trends_9.pdf
https://www.nwstraits.org/media/2538/naar_cultural-importance.pdf
https://www.nwstraits.org/media/2534/hollarsmith_20mar_nwsc.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
- Focus for this talk will be temperature and other stressors
- 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

<u>Questions from attendees:</u>

  - 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

- 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:

Defining Puget Sound geographically – Kelp Recovery Plan is using the boundaries and Puget Sound Basins outlined in the Rockfish Recovery Plan.

Ephiphyte role

- Linda ask, Tom M answer – some bryozoan (*Membranipora membranacea*) occur on outer coast when warm, and kills kelp.
- Brian A – 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:
    - 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.
    - Thom and Hallum 1990
        - Compared Rigg data 1911 and WDW 1978 maps.
        - Found apparent kelp increases in North Sound, Main Basin, and South Sound.
    - 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.
    - Bainbridge island (Brian A) has seen complete loss, and well documented (fast ferry project), lastly Wing Point.
    - San Juans (Todd W) reviewing Rigg and other data, against modern WDNR remote sensing.
    - 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:
    - Elwha, CA, north into BC, MRC data, Squaxin.
    - Elwha – 10 million tons of sediment.
        - Rubin et al 2017 – dive transects, documented recovery

        - 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.

- <u>Questions from attendees:</u>
    - 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?

    - Helen, allele richness in South Sound low, so recruitment problems
        - Nereocyctis 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
- Remote Sensing – satellite measuring spectral signatures – light reflecting off earth's surface – used to create maps of land cover.
    - 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

  - Identify Future targeted studies for causal mechanisms
- 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 decommisioned, but landsat 8 has been launched

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
- Kelp reflectance and wavelength – varies with kelp density
- 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

  - Does not seem dependent on kelp presence
  - The site was inside bay, therefore warmer and later kelp season

- Questions from attendees:
  - Tom – species of salmon? Not reliably on video
  - 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)
  - Brian A – epibenthic inverts more common in spring too – so food source
    - Salmon were predominately in top shallow water, top 15 cm of water
  - 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
  - Tom M – what species of kelp more important for rockfish and salmon?
    - Saccharina main understory kelp
  - Max C – substrate complexity? Difference in rugosity?
  - 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
  - How do microscopic stages act in the field?
  - Can early life stages be transplanted from the lab to the field successfully?
  - Can you reintroduce kelp using spores?
  - Is Puget Sound spore limited?
- General kelp trends
  - Has peak growth shifted?
- Turf species assemblage
  - Difference between local healthy red *turf* algae compared to problem turf
- Understory kelp
  - 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
  - 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
    - X acres of kelp leads to X $$$
    - 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

Nicole Naar	UC Davis, former NOAA intern
Steve Copps	NOAA
Courtney Greiner	Swinomish Tribe
Byron Rot	San Juan MRC
Victoria Knorr	Recovery Plan Volunteer
Suzanne Shull	Padilla Bay NERR
Braeden Schiltroth	Simon Fraser U
Sherryl Bisgrove	Simon Fraser U
Paul Chittaro	NWFSC
Sarah Schroeder	U Victoria
Helle Andersen	Clallam MRC
Elizabeth Gaar	NOAA
Elisa Dawson	Snohomish MRC
Jamie Kilgo	WDNR
Phyllis Bravinder	Skagit MRC
Solenne Walker	WDNR
Paul McCollum	Port Gamble S'Kallam
Caitlin O'Brien	WWU
Elizabeth Babcock	NOAA
Sebastien Clos-Versailles	UW

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):

https://www.nwstraits.org/media/2842/calloway_kelpecosystem_connections_krpws2.pdf
Restoration action in the Strait of Georgia (Bill Heath):
https://www.nwstraits.org/media/2843/bill-heath_bullkelprestoration-straitofgeorgia_heath.pdf

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

- 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

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)

<u>Questions from Attendees:</u>

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 suitu time lapse camera to examine the site during non-diver presence

Rhodes – bryazoan 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.

Issue	Existing[1] or new data?	Sequence	Lead	Comment
General kelp trends				
Understory kelp	New		DNR, UW	
Distribution	New/existing			Pacunski exisiting data, over 5000 camera drops; Szypulski surveys towed camera and kayak
roles	New			
Assemblages	New			Surveys needed (i.e. scuba), Rhodes (kayak towed video, MRC)
richness	New			
diversity	New			Pacunski future ROV all rockfish habitats
Trends (Has peak growth shifted?)	New			
Canopy forming kelp (*Nereocystis*)	Existing and new		Samish, DNR, NWS Initiative	Sub-canopy species (pteragophora); Olie Shelton herring rake surveys (40 yr data, but potentially spatially limited)
Distribution	Existing			Pacunski exisiting data (also ROV surveys and drift kelp); MRC surveys, low tide and beach wrack
roles	New, current (DNR)			Understanding disturbance
Assemblages	New			Berry (broad scale analysis, video tows)
richness	New			
diversity	New			Understanding succession
Trends (Has peak growth shifted?)	New			Pacunski - using historical data in Max Ent model; Mumford teaching scuba surveys at FHL
To do:				
Compile historical traditional ecological surveys and observations	Existing			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)
Understand economic and socioeconomic implications of kelp absence/presence				

[1] "Existing" means that the data may exist but needs discovery and analysis before being useful. New means data needs to be collected.

Issue	Existing[1] or new data?	Sequence	Lead	Comment
Create list of ecosystem functions and services	Existing	1		Calloway lit review (rockfish, juvenile forage fish, adult salmon); step 1 develop framework or model; carbon sequestration
X acres of kelp leads to X $$$	New,	2		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
Perform cost benefit analysis	New	3		Target audience to associate importance of kelp to socioeconomic; including other stakeholders (economic, tribes)
Role of kelp as habitat				
Document which species are using kelp as habitat and what are the functional linkages (beyond associations)	Existing and new			CA Reef Check; CA Wheeler North data?; Bruce Leaman 1980s?; gastropod grazers (gap); sea cuc; invasive inverts; competitive spatial species
Rockfish interactions	Existing and new			Rec and comm fishers; intermediate habitat complexity increases diversity; fish structure attraction
Salmon interactions	New			Priority area of concern for PS
Lost fisheries – urchin, cucumber, hake – is there a relationship to kelp losses?	New			Rec and comm fishers
Role of kelp as primary producer				
How does kelp productivity support P.S. food web				Trophic relationships - Ramshaw 2017 (Berry sent), Konigs and Miller
Kelp carbon in inverts, fish, marine mammals	New		Rhodes	Potentially overestimating isotope
Spatial subsidies- kelp productivity used in deep water, offshore	New			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
Role in carbon sequestration	New		PSRF	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
Role of kelp in nitrogen cycling, [nutrient refugia]	New			Low priority, work with Ecology

Issue	Existing[1] or new data?	Sequence	Lead	Comment
				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 examing 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. Incorpoarting more monitoring systems in Saratoga Passage or Skagit Bay would be incredibly helpful especially due to the large freshwater input from Skagit River.
Understand suspected stressors and how they impact floating and understory kelp in Puget Sound				
Climate change stressors				
Thermal threshold in Puget Sound	New, existing			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
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

Issue	Existing[1] or new data?	Sequence	Lead	Comment
				classification; PGST have multibeam around hood canal; WDFW multibeam VAC (Lindquist)
https://walrus.wr.usgs.gov/reports/reprints/WA_seafloor_proceedings_final.pdf http://www.seadocsociety.org/geology-and-bathymetry-of-the-san-juan-islands/				
How does sediment impact kelp	New			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)?
Sediment- light loss, smothering, lack of adhesion				Turbidity and urbanization; organic/nutrient; seasonal primary productivity; site specific
Difference between feeder bluff and anthropogenic sedimentation				Urbanization, longshore transport, scouring and erosion
Role of sea cucumbers				Do they play a role in controlling sedimentation?
				From Suzanne: The data is a 10 year dataset of MERIS satellite imagery shared by Brandon Sackmann of Integral Consulting. He prepared this data for Long Live the Kings. The dataset actually contains several products (kd490, turbidity, chlorophyll calculated using several algorithms …) at a large spatial scale (from Oregon to BC, including entire Salish Sea). Bart Christiaen w/ DNR is using the MERIS data to get at this sedimentation/turbidity issue with his eelgrass monitoring.
Historical fishery pressures				
How much have we taken, what species and what are the direct and indirect impacts on kelp	New			WDFW historical catch reconstruction (RF focus), currently low priority for recovery plan
Trophic cascades in food web	New			Is there research on fish and invert interactions and impacts to kelp (linkage)? – ecological role (cod, RF, etc)
kelp crabs/loss of predators (rockfish)	New			Katie Dobkowski is researching
Are kelp crabs a symptom or cause?				What is the disturbance mechanism, successional change?
Have urchins played a role in Puget Sound?	Existing and New			
Urbanization				Also nearshore development and dredging

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

Issue	Existing[1] or new data?	Sequence	Lead	Comment
At what scale is aquaculture possible? Is it enough to make a difference?				Outplanting has been successful, but not yet long-term sustainable
Seed source and recruitment				Back up to stock structure
Need to publish data to support government white papers				
Need to connect with research, concerns, and interests in BC and Georgia Straits much more frequent than Salish Sea Ecosystem Conference				

C.2.3. Notes from Workshop 3 — February 28, 2019

Workshop Participants

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

Lucas Hart	Northwest Straits Commission
Dana Oster	Northwest Straits Commission
Jason Morgan	Northwest Straits Foundation
Nicole Jordan	Northwest Straits Commission
Todd Zackey	Tulalip Tribes
Jude Apple	Padilla Bay Reserve

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	Dana Oster, NW Straits Commission Dan Tonnes, NOAA
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	Max Calloway, Puget Sound Restoration Fund
11:10-11:20	**Break**	
11:20-12:05	**Breakout Discussions – Data Gaps** In groups discuss actions, needs, and strategy around data gaps	Data gaps to be discussed: 1. Kelp physical stressors 2. Kelp biological stressors 3. Human impacts
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	Data gaps to be discussed: 4. Kelp distributions and trends 5. Kelp priority areas-protection and restoration 6. Restoration
2:15-2:45	**Group Reporting** Review breakout group discussions	

2:45-3:10	**Break** Facilitators and core team organize actions
3:10-4:15	**Prioritize Actions** Identify key actions essential for next steps and building a strategy
4:15-4:30	**Meeting wrap up/ Next steps**

Workshop Notes

Links to presentation slides and flip chart notes:

Introduction PowerPoint Slides:
https://www.nwstraits.org/media/2751/intro_kelpworkshop2_28_2019.pdf

Max Calloway PowerPoint Slides:
https://www.nwstraits.org/media/2752/calloway_kelpworkshop2_28_2019.pdf

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: Don't know…perennial species may push out bull kelp/canopy (cite Alaska). Understory succession. See Duggins, 1980, *Ecology,* Kelp Beds and Sea Otters: An Experimental Approach.

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).

<u>Comments following breakout session:</u>

- 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.

- International understory kelp survey protocol, NaGISA.
- Continue monitoring using a protocol for no net loss - Use protocols from other areas (Norway, California, PISCO, etc.).
- 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).
- Need a strategy to implement/enforce current protection plans. Some regulations currently exist for protection.
- Identifying key fish use data as a way to prioritize areas.
- Standardize monitoring efforts through timing and long-term monitoring at Index sites.
- 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.

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

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 can 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

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

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*

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

3:15-4:00	**Kelp management mad libs** Complete the mad libs sentences and report back to the group	
4:00-4:30	**Meeting wrap up/ next steps**	Tom Mumford, Marine Agronomics

Workshop Notes

Presentation links:

Puget Sound Kelp Conservation and Recovery Plan Introduction:
https://nwstraits.org/media/2803/kelpplan_intro6-13-19.pdf

Puget Sound Kelp Trends, Roles, and Stressors:
https://nwstraits.org/media/2802/calloway_kelproletrends6-13-19.pdf

Kelp Data Gaps, Actions, and Goals:
https://nwstraits.org/media/2801/kelp_gaps_actions_goals6-13-19.pdf

Updated Management Framework Diagram:
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.

e. Generate spatial distribution maps of kelp populations and map with known stressor sources and areas of higher stressors for large-scale management guidance and planning.

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 functionality 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
4. Federal tools (US Army Corps of Engineers, EPA, NOAA):
    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.
6. Develop functional assessment tools.
    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.
- Puget Sound Kelp Conservation and Recovery Plan completed end of 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:
    - Education and outreach should highlight concrete conservation and recovery actions.
    - The urgency of kelp forest loss in the Puget Sound.
    - 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:
    - 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.
    - The Partnership may be a good candidate to maintain higher-level communication between managers within separate agencies.
    - 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:

https://nwstraits.org/media/2802/calloway_kelproletrends6-13-19.pdf

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:

https://nwstraits.org/media/2801/kelp_gaps_actions_goals6-13-19.pdf

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

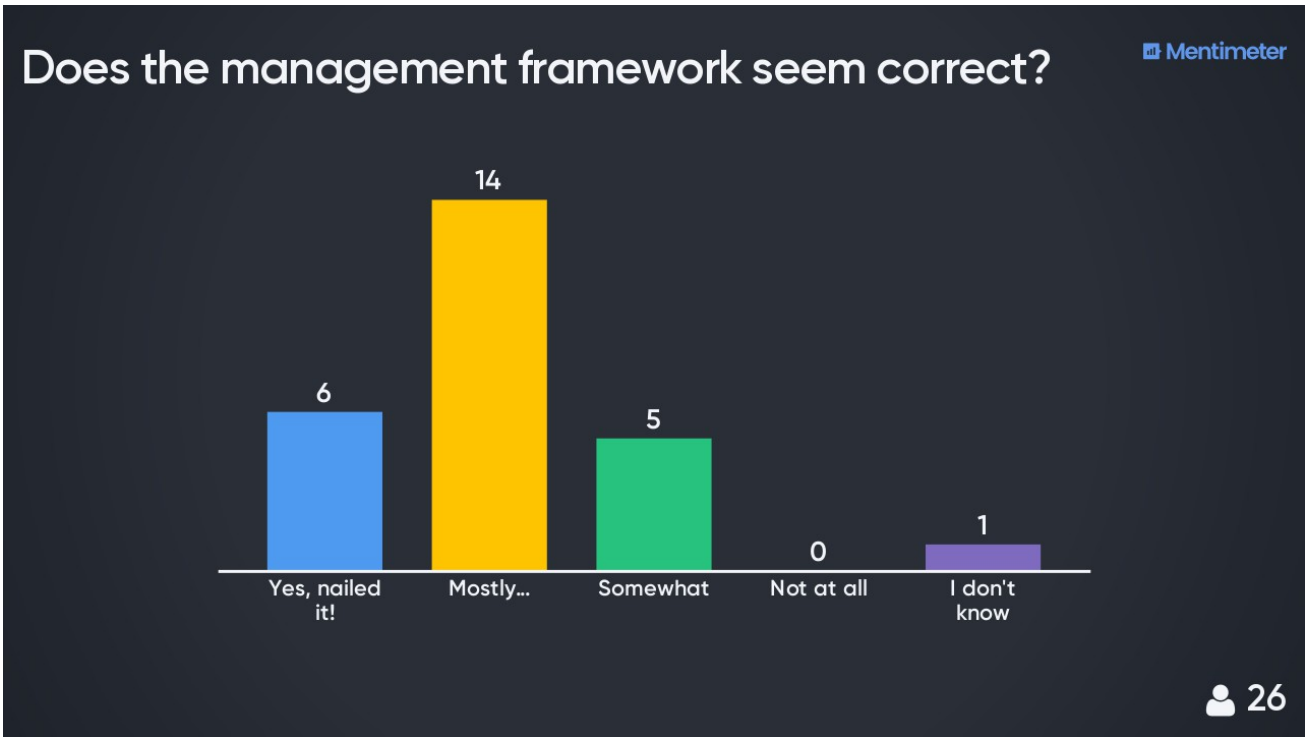
Group Discussion:

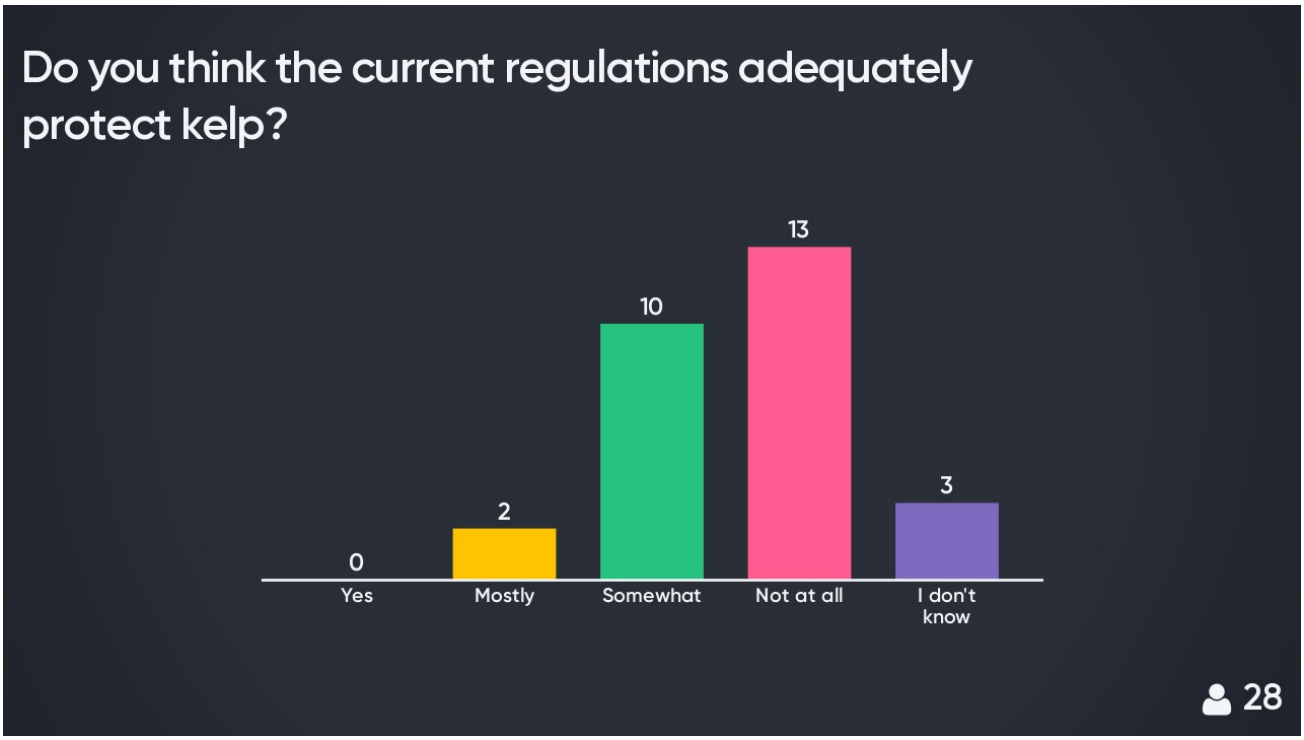
- Given what scientists know, if there is a stressor, it will likely affect all genetically similar kelp the same in Puget Sound.
- There is some kelp restoration work being done in Australia in which temperature is the culprit. In that region, restoration efforts are focused on researching replacing 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?
Mentimeter
14
6
5
0
1
Yes, nailed it!
Mostly...
Somewhat
Not at all
I don't know
26


Do you think the current regulations adequately protect kelp?
13
10
3
2
0
Yes
Mostly
Somewhat
Not at all
I don't know
28

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 losses 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
    - Increases in turf barrens with increase in nutrients and urban cover
    - Nutrient requirements & thresholds by species
    - Piecemeal management=problem
    - 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?
    - Props mow down bull kelp canopies (photosynthetic and reproductive structures on surface canopies).
    - 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.

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

	Science needs	Management action linked to research needs	votes
	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	
Distributions/ trends	Distributions- where kelp currently is and where it has been historically or could be	designate protected areas or priority areas to reduce stressors	13
		spatially-explicit management	
		more informed regulatory and non-regulatory actions	
	what areas are a priority for protection and recovery	site level reviews in a landscape context	
		develop leasing and land management decisions	
		target conservation areas	
	understory kelp distribution and abundance and change analysis	so county/local planners will reference that information when considering applications (both to consider individual permit application and more landscape scale planning)	
	species specific distributions	figure out BMP for kelp harvest	
kelp harvest/ fisheries	how much kelp is harvested	manage harvest	4
		harvest reform/spatial management	
	creel data	manage take	
restoration	genetic information	inform restoration methods and planning	4
	if/how kelp restoration/mitigation can be successful	develop mitigation guidance for compensation of impacts (hierarchy-preservations enhancement, creation of kelp bed)	
		in kind and in place mitigation	
		mitigate and authorize restoration	

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

TMDL
Federal
critical areas
essential fish habitat
ESA
clean water act
NPDES
no net loss- 2008 mitigation rule
eelgrass-macroalgae vegetation survey guidance

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.

Category (votes)	Tools we need	Short term	Long term
Improve definitions, regulatory permitting framework, and enforcement (12)	to connect evidence to regulations	x	x
	enforcement		x
	better understanding and regulated seaweed licenses		x
	permitting changes		x
	federal regulations language/interpretation of (non-rooted) rules to include attached plants		
	clarify Army Corps definition of SAV		
	scientific collection authorization	x	
	streamlined permitting framework for farming kelp		x
	better regulatory/permitting framework, esp aquaculture		x
	recreational harvest codes		x
	include kelp in the Corps definition of "vegetated shallows" and the Clean Water Act. AS is, the current definition of "vegetated shallows" refers to only "rooted" vegetation		
	better enforcement of current rules	x	
Develop criteria and identify protected/priority areas for existing and future kelp (11)	to be able to designate "potential" habitat as "protected" (for example, if kelp substrate is available but does not yet contain kelp, we should have a tool to protect the potential habitat	x	
	regulations and actual protection that doesn't allow traffic within a kelp bed		x
	mapping of kelp and species abundance/life stages/use		
	change analysis on existing video data from historic to present understory kelp		
	direct/defacto conservation areas/reserves		x
	marine spatial planning		x
	ecosystem based/comprehensive MRAs		x
	to identify priority kelp areas		
	better land use planning		x
	an understanding of metapopulation dynamics		x
	priority conservation areas		x

Communication/Education (7)	increase coordination between local regulators and state/federal govt - enable ability to tackle cumulative impacts	x	x
	increased awareness/education/engagement from public agencies		
	communities, local jurisdictions, public to understand importance of kelp	x	x
	agency initiative (WDFW, WDNR, ECY)	x	
	education/outreach/advocacy/leadership	x	
	local SMPs/Ecology		x
	public education/outreach strategy	x	x
Stressor thresholds and impact reduction (6)	storm water management		x
	water quality monitoring	x	x
	research findings on stressors		
	WQ standards specific to kelp- lethal & sublethal impacts (e.g. temperatures that affect soros, sedimentation)		
	quantitative data to improve and set thresholds	x	x
	water quality rules	x	x
Coordinated long term monitoring and standardize survey protocols (5)	BMPs for monitoring and managing		
	survey protocols	x	
	standardize survey guidelines		
	long term monitoring and program		x
	multi-year survey requirements (like eelgrass requirements in CA related to CZA)		x
Develop functional assessment tools (4)	impact-specific guidance	x	
	guidance (C/E, SMAs, etc)	x	x
	functional assessment tools	x	
	guidance (like wetlands guidance)		x
In kind and in place mitigation (3)	mitigation banking		x
	restoration/mitigation guidance based on success/risk research of kelp restoration/mitigation		x
	in kind and in place mitigation actions	x	x