

MEETING NOTES

Kelp Recovery Working Group

April 25, 2018

9:00am-4:00pm

GFNMS 3rd Floor Conference Room

Orientation and Science/Recovery Learning

In attendance:

Working Group members: Sarah Allen, Mark Carr (by phone), Cynthia Catton, Barbara Emley, Michael

Esgro, Mike Graham (by phone), Frank Hurd, Francesca Koe, John Largier, Abby

Mohan, Josh Russo, Sheila Semans, Javier Silva, Bibit Traut, Jan Freiwald, Tom Ford

Technical advisors: Steve Lonhart, Rebecca Flores-Miller (by phone)

Staff members: Rietta Hohman, Sara Hutto, Jenn Gamurot

Welcome

Maria Brown, Sanctuary Superintendent, opened the meeting and welcomed working group members to the Sanctuary offices. She thanked everyone for their time and energy in addressing kelp loss along the north coast and emphasized the critical need for solutions.

Project Orientation

Presentation: “Introduction to the Kelp Recovery Working Group”

Rietta Hohman, Greater Farallones Association

Sara Hutto, Greater Farallones Association

Francesca Koe, Sanctuary Advisory Council, Working Group Co-chair

Rietta and Sara, staff to the working group, provided a brief introduction to the Kelp Recovery Project, spearheaded by Greater Farallones National Marine Sanctuary and Greater Farallones Association, in partnership with California Department of Fish and Wildlife. The Kelp Recovery Working Group was convened by the Sanctuary Advisory Council to better understand the issue of kelp loss along the north coast and to develop recommendations for management, education/outreach, and science/monitoring actions to enhance kelp resilience. The project goals, working group timeline, and working group objectives were reviewed. Francesca discussed working group operating guidelines.

Discussion

Steve- may be helpful to provide a toolkit of things that can be done - listing of what GFNMS and CDFW assets are available - vessels, funding, partners, etc. to understand what we're working with, particularly regulatory topics.

Francesca clarified this meeting will identify the gaps, take inventory of what we have to work with, look at resources we have.

Francesca noted that she will maintain online presence through blogs and #kelprecoveryproject to highlight the important work this group is doing.

State of the Science

Presentation: "Causes and Consequences of Recent Large-Scale Kelp Loss in Northern California"

Cynthia Catton, California Department of Fish and Wildlife, Working Group Co-chair

Cynthia presented on the "Perfect Storm" of multiple large-scale stressors that led to severe impacts to the kelp forest ecosystem in northern California. Stressors included a harmful algal bloom (2011), Seastar Wasting Disease (2013-), persistent warm water (2014-2016), and urchin population boom (2014-). Herbivorous benthic invertebrates were first species to show impacts of long-term starvation due to the large-scale loss of algal growth. Introduced concerns over recovery potential of bull kelp (annual life history) after multiple years of very low growth.

Discussion

Mike G - Bull kelp is an annual, different than giant kelp. Bull kelp relies on previous year for reproductive outputs for recruitment. There are not too many holdouts for refuge for microscopic bull kelp. Need to establish a reproductive crop of bull kelp spores to avoid allee effect, enough spores to saturate the substrate.

Steve - Do we know how far their spores can travel and their life expectancy? Mike G - It drops its actual spores to bottom, has broader dispersal range of tens to hundreds of meters. In that way, it is different than giant kelp. Bull kelp is less prolific than giant kelp. There is nothing to keep them in the dormant state because they are not resource limited.

It is critical to address bull kelp this year due to inability for spore "bank" to replenish. Should consider refuge areas due to broad dispersal, lower reproductive potential.

Cynthia - less productivity on the north coast, greater visibility/warmer temperatures, fewer nutrients.

Nutrients very low - but may be more than sufficient still

Abby - experiments to see how abalone recover - have you looked at extent of population size we would need to have them recover? Cynthia - no, haven't done that math yet. We just fed the abalone as much as they would eat, didn't measure the amount of food we were feeding them.

Bibit - Restoring kelp forests - are you planning to introduce sori? Have you considered oceanographic conditions? Southern warm water tolerance? Cynthia - In the afternoon we'll discuss more of this topic; much of the discussion currently will direct our movement forward. We are focused on areas that had spore production last area - many areas in Sonoma did not have spore production (lack of kelp), so clearing an area may not be enough to have bull kelp come back. Understory species perhaps could recover. We want to minimize the amount that we are manipulating and allow nature to take over, but there are ways we can help facilitate recovery.

Jan - Experiment w/abalone - do you have any thoughts as to why it takes so long for them to recover their reproductive status? Cynthia - would really like to talk to a physiologist! Looking at doing some research on ocean acidification impacts on larval abalone. Wanted to get a huge number of abalone spawning to get a diverse genetic pool, so we did a beach spawn with 50 animals but none of them spawned. In 2014 - prior to when we were aware of oceanographic conditions, the following year we gave them more time to become reproductive. Took some back to the lab to fatten them up, but it took 1.5 years to get them to spawn. Red abalone are relatively easy to spawn normally, but not this time.

Jan - are we going to talk about fish? Fish depend on kelp too, but have not seen any decline in fish populations. Many studies have been inconclusive, would expect them to decline because they are losing their habitat with kelp loss. Now that we can't fish for abalone anymore, there might be more spear fishermen.

Regional sampling - have you seen effects near Russian River sampling for abalone/kelp due to influx of nutrients/freshwater/pollutants? No, much of the habitat around Russian River mouth is sand, not rocky reef. For abalone fishery, historically we have the most robust populations north of Jenner. Probably has to do turbidity and sandy habitat. Recent reports of mortality on the north coast, may have to do with salinity. Nutrient load is likely to not be a major factor (John L.).

Tom Ford - if there are stands of bull kelp, be tactical - help existing stands persevere. Find refugia for juvenile gametophytes and sporophytes, examine substrate type on a small scale may have influence on management decisions.

Francesca - past two years in harvesting abalone in headlands in Mendocino down through Sea Ranch. Purple urchin barrens are everywhere. Bull kelp around double point is more present,

possible to transplant? Saw a shallower foot in collecting abalone, also they did not grip the substrate as strongly as they normally had to (didn't have to sneak up on them). Last year we were able to just pick them up in shallow areas, didn't have to dive. Very different patterns close to each other. Cynthia - will be important to look at those dynamics. Heard about a robust bull kelp population off of Half Moon Bay, Reef Check did a couple of surveys but it's a dicey place to dive. Bull kelp is popping up in weird places and not present where it's supposed to be. Answer may be complicated, influence from drought, less turbidity, very interesting dynamics.

Cynthia - Shrinkage scores that we've been using are from looking straight now at abalone, have to squash them down a bit to see thickness. There is some pretty extreme starvation, wide potential range inclusive of a lot of different conditions. Found deeper pockets of abalone, but they were the exception rather than the rule. Other sites - we saw abalone up very high in shallow areas on top of each other because any algal growth will be in shallow areas.

Depth threshold for purple urchins and bull kelp? Cynthia - purples are more abundant in shallow areas, red urchins are more abundant at depth (around 60 feet). Several years ago would not have seen hardly any purple urchins past 55 ft (1-2 individuals) now will see dozens, sometimes hundreds. Bull kelp on good years can get much deeper than 60 feet.

Josh - worried about what it will do to the fish, already getting reports from some recreational fishermen that they are not seeing fish. Fishermen have mostly stopped fishing in Sonoma (has been much more heavily impacted than Mendocino). Some spear fishermen have moved from Sonoma up to Mendo. Recreational abalone fishermen transferring to spear fishermen? Many ab divers come from Sac and valley. Easier for them to get to and fish in Monterey; so many folks may not want to travel to Sonoma/Mendo. Hook and line, kayakers fishing deeper.

Bibit - we want to be careful with our messages to the public - want to make sure we're not saying that we'll just let nature recover (nature does it best). It's alright to say that we are doing active management. Cynthia - there are certain processes that if there is a certain way forward for it to happen on it's own, we may get more robust results than if we try to force it (i.e. spore availability). If we are selecting just a few individuals to put in an area, how can we do that in the best way, a more organic way than what we would create artificially?

Meredith - anyone doing any ecological modeling that takes into account climate change and if it would impact the frequency of sea star wasting disease, etc? Do we have any forecast on modeling for kelp forest ecosystems when it comes to multiple stressors? There are some forecasts and interesting dynamics on things we haven't considered before; we need to consider different scenarios, including worst case scenario (making recommendations for weathering the transition away from bull kelp). Will *Macrocystis* become the dominant species in northern CA, and what would that transition look like?

Think about critical knowledge gaps that we need to address.

Restoration and Recovery

Presentation: “The Growth of a Kelp Project: Informing the Physical, Chemical, and Biological Characteristics of Coastal Management in Southern California”

Tom Ford, Executive Director of the The Bay Foundation

Tom discussed this collaborative project with UC Davis Bodega Marine Lab and LMU LA Frank R. Seaver College of Science and Engineering to conduct restoration of giant kelp off of the Palos Verdes peninsula, considering both ecological and economic recovery. To date they have restored 44 acres of kelp forest habitat and culled 3.4 million urchins over a period of four years. Results showed a 250% increase in kelp canopy and a significant increase in reef diversity within restoration sites. They also measured a 168% increase in red urchin gonad biomass. He also discussed the initial project to outplant red urchins in preparation for white abalone recovery, as well as some work that has been done on kelp forest hydrodynamic research.

Discussion

Tom shared that using hammers to remove the urchins was the best path forward in the Southern California project. Steve asked Tom about funding for his program. It was funded by a restoration site from a company that dumped contaminants into the Santa Monica Bay (similar to a Superfund site underwater). It was also a threat to public health. Cost about 2.5 million to implement.

Mike E. asked about the scalability of Tom’s program. Tom’s program was hugely labor intensive to remove all the urchins and they had to set up strategic removal methods.

Mike Graham mentioned anecdotal reports of synchronized spawning when the urchins were being smashed. Also, how do you deal with the invasive *Sargassum horneri*? In Southern California, *Macrocystis* has pushed it out.

In Southern California, the work was permitted with a scientific collecting permit from CDFW, which ensured pre-and post monitoring.

Presentation: “Salish Sea Bull Kelp Restoration Research”

Braeden Schiltroth - MsC candidate, Simon Frazier University

Braeden discussed some global trends in kelp forest dynamics, namely regime and range shifts and influences of temperature changes and other stressors. Their project goals include identifying temperature limits for early reproductive success in bull kelp, evaluate whether certain kelp populations exhibit a resiliency to warm temperatures and establish/continue restoration in the Salish Sea by monitoring kelp performance and determining how to establish a self-sustaining kelp bed. They grew kelp by seeding spools of string around culture rope, which were then attached to a grid and monitored over time. So far they can get good growth and reproduction at restoration sites, but cannot as of yet recolonize. Much of Braeden's work was on evaluating stress resiliency in kelp and they found that 17 degrees C in SST appears to be around the upper limit for spore production and is the temperature at which germination decreases significantly, whereas 20 degrees C kills off spores. Warm conditions lead to a shortened reproductive season for bull kelp.

Discussion

Mike G asked if the adult densities were long enough to stimulate recruitment on the mooring lines. Are the sporophytes showing up on the lines? Braeden clarified yes, but undetermined where they are coming from. It is suspected that they are growing on the lines.

Braeden- focusing on sea surface temperature, compared with bottom temperatures.

Cynthia noted there may be some subpopulations that are more heat resistant than others. Are they investigating into genetic analyses? Braeden said the warm and cool sites acted pretty similar in terms of temperatures. He is looking at metabolic byproducts as stress markers and different reactions to warm temperatures. Looking to collect from the Stanley Park site in the future.

Presentation: KELPRR Program: Protecting the Bull Kelp Spore Bank

Cynthia Catton, California Department of Fish and Wildlife; Working Group Co-chair

Cynthia described KELPRR (Kelp Ecosystem and Landscape Partnership for Research on Resilience), the partnership of stakeholders, scientists, and resource managers that has formed in response to the recent bull kelp loss in northern California. She described the program goals on multiple time scales. In 2018, the goals of the program are to assess the potential for enhancing kelp growth at strategic locations within Sonoma and Mendocino counties, through focused reductions of purple urchin populations. Future work, including additional site selection, will be informed by the Kelp Recovery Working Group recommendations. The long-term goals include developing viable commercial markets for purple urchin materials, to provide future opportunities for commercial divers to control urchin barren conditions.

Discussion

How are they dealing with long-term effects of urchins in terms of stakeholder prioritization? Looking at the larger patches of kelp. The effort was initially focused on one cove; now that there is more interest, there is an opportunity to spread the effort out.

Jan asked about seed banks and the best way to choose a site. Tom shared that in Southern California, the efforts averaged 25 urchins per square meter. They did not spread largely after the removal efforts in Southern California. The die off did not help with killing them all off.

Sarah asked about the sites chosen. Cynthia said that some sites are chosen through the CDFW monitoring program. Jan has some of the same sites as well. We want to choose sites we have information on to compare with what we're seeing this year. Important to monitor sites that are also not manipulating.

Mike E shared that this fall, the long term MPA monitoring action plan from CDFW/OPC will be released which can be tied in to these efforts.

Frank asked if there was a general sense of the scale in terms of hours. Josh said they paid for 27 dive days. They are clearing 2,000 feet a day and have cleared 50,000 square feet so far.

Steve noted that now that there are recreational fishers with a sport fishing license, they can collect 20 gallons per day, but how is that effort being captured? There is a need for control and monitoring in terms of unleashing people to collect the urchins, to ensure that the efforts are being documented. Are there mechanisms in place for this to account for what's happening? Cynthia clarified that the 20 gallon collection is an emergency rulemaking for 180 days; it is a time period to make an observation if it is successful. Sheila noted that there is a lot of outreach into the removal efforts for the community. CDFW works with diver groups to add data to the website. It is important to educate diver groups about the messaging.

Josh has talked with dive shops to coordinate removal efforts and generally everyone is on board. Looking for long term data on what they were like, what they will be in the future. Without the recreational component, the commercial cannot happen. The abundance of urchins is mostly in the smaller shore areas. He will be trying to hold more frequent removal events. Hoping to have a large sized workforce of volunteers going forward.

Francesca added that people are gravitating towards organized events, which serves the community.

Javier shared concerns about extraditing urchins as a species. Tribes look to use them as resources.

Francesca noted that once we have a list of sites, some sites may be better suited for recreational, some may not be. If we do arrive at a list of sites appropriate for volunteers it can be provided to other agencies to coordinate efforts.

Sarah suggested collecting data from visitors - the messaging makes a difference and should be communicated as “volunteers”. Also, safety should be first priority.

Javier noted that cultural resources also include archeological sites, and to look at all resources as coastal resources as a whole.

Reflections Roundtable

Working Group members were invited to reflect on what was discussed today, their individual perspectives, and priorities moving forward.

Mike Graham - comments: it's such a great story to think about collecting hundreds of thousands of urchins and utilizing them for some type of resource that isn't wasted. There is activity going on in Moss Landing to see if they can develop a non-sushi related uni product and how to develop marketing. Connect with Cynthia on this! Recovery potential - limited genetic structure north of SF in the bull kelp population, similar to several other species of kelp, a positive when thinking about bringing bull kelp spore material from another region to the north coast because they are genetically similar. Much is at stake - livelihoods, aesthetics, economics, if the current state persists. Cynthia - have you seen any recruits in areas w/high waves, urchins, etc on north coast? Commercial urchin divers haven't reported any, but soon CDFW/Noyo will get an ROV in the water to monitor, Reef Check will also soon be monitoring. Diablo nuclear power plant - warmer water output caused shifts in bull kelp beds.

Mark Carr - concerned based on discussion today that cart is before the horse, there are pre-existing efforts in place but the role of this working may need to step back and look at the overarching goals. Two spatial scales - 1: just go to particular areas and re-establish kelp forests in those areas; 2: identify areas that can be restored to create spore sources that will then re-establish populations along the coast when conditions approve. High swell disturbance and disease are two natural processes that act at broad spatial scales; one of these ways may be the way that we get coast-wide restoration. Should establish these “spore islands” that can quickly react and provide spores when conditions improve. This solution really impacts spatial objectives - let's get clarity. Braeden discussed how they are raising Nereo and then outplanting it, which may have low success. Other way, how to increase natural predators such as sea stars. Have there been discussions to raising sea stars (*Pycnopodia*) and outplanting them? Then there's mechanical removal of urchins. Size of clearing and isolation of clearing? If you're not doing

this in isolated areas, we might be destined for failure. Most effective way to conduct those removals - how far do spores disperse from Nereocystis beds? How far apart do we separate these areas so we've blanketed as much of this coastline as we can? Bottom line - there's a whole lot of questions to address. This group needs to think about all of these things and implications of each approach and how to utilize really great resources (urchin divers, recreational divers).

**See Mark C's notes [here](#) for greater detail on these thoughts.

Rebecca - if urchins are going to move after clearing an area, should intertidal area be considered? Then a lot more folks could be involved. Cynthia - the regulations specify a gear type, not intertidal or subtidal. Deliberate decision made to encourage people to work within the area that we want them to to minimize damage (can dive at high tide & reduce trampling). Want to work with partners w/outreach and convey the right message - urchins are a resource and we are using this resource to help the ecosystem and minimize damage to the ecosystem.

Tom Ford - Agree with Mark Carr, but at the same time there is a swell of interest that can/should be utilized. Would be happy to continue to play a role and assist as needed, since they have navigated many of these issues already. Benefits of integrating these partners is very high.

John Largier - great seeing this working deal with this issue, there's a lot of work to do, much work is being done. How do we know if anything like this has happened before? Is it realistic to do nothing? We have to consider this alternative and what it would look like. Not advocating that we do nothing, but we should develop that thinking a little more than we did today. Kelp patches are not all the same; we need to know how they differ in chemistry/topography/composition/etc. Should have an idea of what the sites look like on local scale. If we have a recovery opportunity when urchins get knocked out, how do we utilize it. Don't want to suppress enthusiasm from interested people, we can talk about ways to address the error.

Barbara - coming into it knowing very little about the issue heading into it. For Tom Ford - is there a big enough difference between south of Point Conception and northern conditions? Tom - Yes.

Steve Lonhart - are these urchins the result of one or two recruitment events and we're just looking at a cohort? What are the dynamics of larval transport? If there had not been a coinciding warm water event, would we be seeing these? Is it an acute or persistent problem? Are there new urchins entering the system? This will be fundamental to addressing the approach to the problem.

Frank Hurd - lots of information together, this going around the circle is really bringing forward important questions and will be thinking these over.

Jan Freiwald - agree with Steve, need to consider urchin larval dynamics and potentially re-introducing predators (sea stars).

Mike Esagro - OPC is very aware of the issue, recognize the severity and extent of the issue, ready to help in whatever way they can, very supportive of local efforts. OPC mandate - make science-informed decisions. There are a lot of knowledge gaps we need to address. Also do need to consider that this is an alternative stable-state.

Francesca Koe - Loved seeing Tom's presentation because it showed that when people come together, great things can happen.

Sarah Allen - Don't let the science get in the way of the good. Really enjoyed all the discussion today.

Josh Russo - Appreciates all the knowledge in this room from researchers and their perspectives. Fairly confident that this was a single recruitment event. Goal for the Watermen's Alliance is to raise as much money as possible to clear coves as soon as possible. Intention is not to kill all the urchins, just to clear these specific sites to help kelp persist.

Meredith McPherson - Learned a lot today. Mark made a lot of good points about the types of environmental influences that can remove urchins, we should look at the cost of maintaining these sites until those influences occur. Should look at those patches of kelp and determine why they have persisted.

Javier Silva - Supportive of kelp recovery, not many tribal people have seen the scale of the issue, learned a lot today and wants to stay involved and determine a way of helping the kelp. Many tribal folks are concerned about the quality of resources from the ocean.

Wrap-up and Next Steps

The meeting was adjourned after the group decided the same meeting location will be used for the remaining in-person meetings (August 2, Sept 13) and that staff would work on convening a second conference call for continued discussion (in addition to the scheduled webinar on June 6 at 10am).

Information/Data Gaps Identified:

- Genetic variability of abalone and possible variation in response to kelp loss
- Biomass estimates of urchins as related to kelp extent

- Potential impact to fish – both from kelp decline and increased fishing pressure (as harvesters switch from inverts)
- Shrinkage score to estimate abalone health may not be most appropriate – thinner and weaker anecdotally
- Impact of climate change – are there any forecasts for kelp?
- What are source populations of larvae?
- What are the coastal oceanographic processes that transport larvae?
- Are persistent Nereo patches due to lack of urchins or resilience of kelp?
- Is there economic data on the locations that produce the most red abs and red urchins?
- Sample size and distribution – core tons term sample locations pair with random sites with broader distribution. Review sampling design.
- Test effects of cages over Nereo holdfasts