Oregon Rocky Habitat Management Strategy
Site Designation Proposal Template

DISCLAIMER: All rocky habitat site designation proposals MUST be submitted online via the Rocky Habitat Web Mapping Tool (Oregon.SeaSketch.org). If you require assistance with proposal submission, please contact the Rocky Shores Coordinator, Michael Moses, at Michael.Moses@state.or.us.

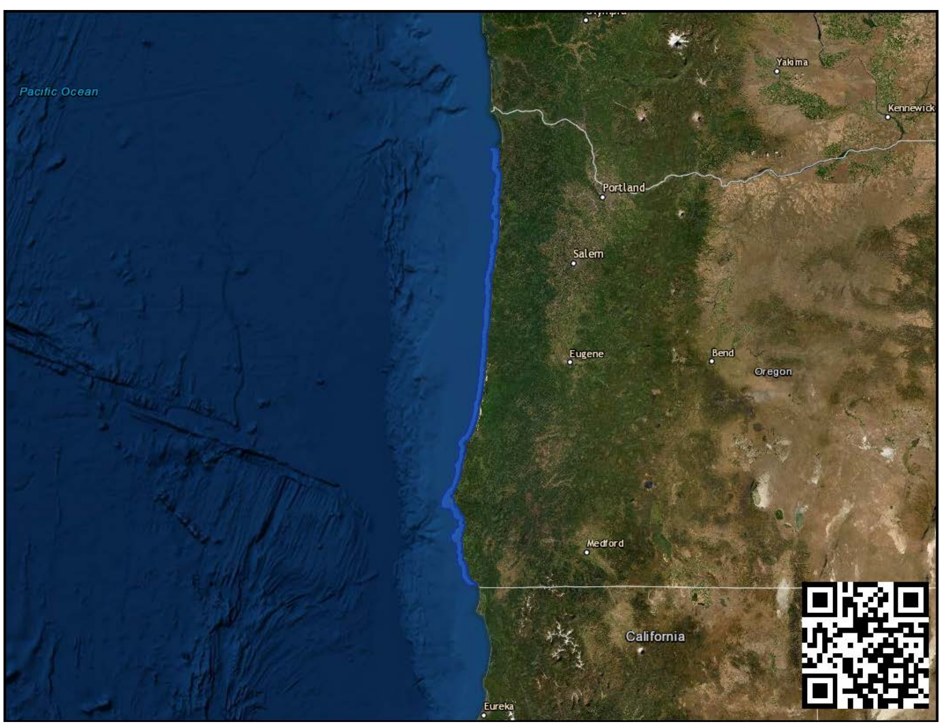
All proposals must be accompanied by a map and site report which may be generated under the "My Plans" tab on the Rocky Habitat Web Mapping Tool, or you can attach your own map to the proposal form. Interested parties should also review the Rocky Habitat Management Strategy to determine the eligibility of possible site designations prior to submitting a designation proposal.

Entities in need of special accommodation should contact staff at the Oregon Coastal Management Program. Due to the depth of agency review, staff cannot guarantee when a proposal will be reviewed by OPAC or LCDC. Please note that a high volume of submissions may increase review timelines.

Have questions? Contact Andy Lanier (Andy.Lanier@state.or.us) or Michael Moses (Michael.Moses@state.or.us).

Proposed Site

All rocky subtidal zones of the Oregon coast that can support kelp forests - http://seasket.ch/O0AL5FPPXn



Contact Information

Please fill out the following section with primary contact information for this proposal. Contact information will be used to provide proposal review updates and ask for questions relating to this proposal.

Name of Principle Contact

Who should be contacted with updates and questions regarding this proposal?

Leigh Anderson

Affiliation, agency, or organization (if applicable)

Many of Oregon recreational divers as listed in 5 Facebook books totaling 3,834 members

Phone Number

[none provided]

Email Address

mrleighanderson@gmail.com

Mailing Address

5231 SW Martha St, Portland, OR 97221

General Proposal Information & Rationale

To the best of your knowledge, fill out the following section with the general site identification and rationale information for your proposed designation.

Proposal Type

Proposals may outline desired additions, deletions, or alterations to rocky habitat site designations, as outlined in the Territorial Sea Plan: Part Three.

___ *New Site Designation (addition)*

___ *Existing Site Removal (deletion)*

_X_ *Alteration to Existing Site*

What type of rocky habitat designation are you proposing?

_X_ *Marine Research Area*

___ *Marine Garden/Education Area*

___ *Marine Conservation Area*

Proposal Rationale and Goals

Please describe the context for why this proposal is being brought forward. a) Please describe the site-specific goals for this proposal. b) What are the outcomes or metrics which could be measured to determine progress toward or achievement of these goals?

This Proposal doesn't fit cleanly into any of the 3 'hammers' (designation types) offered. The 4 kelp forest preservation measures proposed are relevant to every subtidal site that can support kelp forests, including the sites that come out of this process in 2021, and even existing Reserves and MPAs. On the current regulatory path, the Oregon coast will likely join NorCal in losing 90% of kelp forests. This proposal contains 4 specific solutions to prevent a coast-wide kelp forest ecosystem destruction caused by the exploding population of purple-urchins. Please don't reject this Proposal because it doesn't fit neatly into one of 3 buckets or because it addresses the rocky subtidal zones coast-wide. Trying to address the purple urchin threat piecemeal or a couple sites at a time by special permit is too slow. Please join us divers, with a sense of emergency; we see the spreading devastation of urchin barrens nearly every dive.
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TITLE OF PROJECT:

Recreational Divers of Oregon Proposal for Kelp Forest Preservation in Rocky Subtidal Zones of the Oregon Coast

@NBCNEWS: “With a loss of kelp forests, you're going to have a very, very profound impact on an ecosystem,” said Tristin McHugh, Reef Check California’s North coast regional manager. “It's like losing your redwoods. What would happen if you saw 90 percent of your redwoods drop dead right now?” For McHugh and many others, the biggest problem is awareness. Most people don’t even realize what sort of a catastrophe is happening below the sea surface. “This is the fight of our generation,” she said. “If we can't set ourselves up right now, there's going to be nothing for our kids further down the line."

- Specific goals are to prevent extinction of keystone kelp forest ecosystems on the entire Oregon Rocky Coast at least in some rock subtidal sites, due to the out-of-control purple urchin explosion/kelp-predation crisis.

The 4 solutions proposed are considered essential changes in rules for all Oregon rocky reef/intertidal sites. Much more detail and extensive scientific references are included later in the document:

1. Recreational kelp harvest - reduction in harvest limit. Ban on commercial harvest - for Bull & Giant kelp
2. Purple sea urchin harvest/culling rule changes, for implementation by volunteer recreational divers, and scientific divers
3. Critically-Endangered (IUCN designated) Sunflower sea star harvest ban, instead of harvesting allowed
4. Volunteer diver access

b) What are the outcomes or metrics which could be measured to determine progress toward or achievement of these goals?

Metric 1. Site-specific baseline transect urchin counts by volunteer diver surveys with follow-up urchin counts at least annually, preferably quarterly, after culling begun.

Metric 2. Drone aerial photography of kelp area coverages for baseline, at least for some select reefs, such as Cape Lookout, Pacific City and Orford headlands. Site specific absolute and percent change (annually) in kelp bed area. Aerial imagery can be taken by drone annually during peak growing season, georectified and collated with other existing datasets.

Canopy Area is the area at the water surface covered by kelp plants (stipes (aka stalks), bulbs and blades). Bed Area is the area covered by the entire bed (including both plant fronds and gaps between plants). A distance threshold of 25m can be used to determine whether plants were grouped into a bed.

The bed area parameter is sometimes called 'planimeter area' because it is similar to the historical kelp mapping methods that encircle an entire bed, including plants and gaps.

An example of measurement methods can be found in
https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1002/ecy.3031

This level of rigorous data collection can't feasibly be done for all or even most kelp reefs, but the Orford Heads site measurement for urchins and kelp is already underway and can serve as a template and proof of Oregon kelp forest preservation methods.

DIVER REEF TRAINING. Fortunately, ReefCheck.org has a diver training curriculum specifically for kelp forest work. https://www.reefcheck.org/california-program/training-schedule We would like to borrow their training materials.

How does the proposed site improve upon or fill a gap in addressing objectives/policies that are not currently addressed by other designated sites or management measures?

Please address this question in relation to the following topics: a) Maintenance, protection, and restoration of habitats and natural communities. b) Allowing for the enjoyment and use of the area while protecting from degradation and loss. c) Preservation of public access. d) Consideration for the adaptation and resilience to climate change, ocean acidification, and hypoxia. e) Fostering stewardship and education of the area or coastwide.

a) Maintenance, protection, and restoration of habitats and natural communities.

- This proposal is the essence of protection and restoration of Kelp forest habitat! Ignoring these proposals will doom large areas of Oregon kelp forests habitat to extinction within a short number of years.

b) Allowing for the enjoyment and use of the area while protecting from degradation and loss.

- We support the enjoyment of subtidal zones and kelp forests by snorkelers, divers, and recreational fish harvesting where allowed. In the absence of rapid urchin management changes as recommended in this document - these kelp forest habitats will continue to be degraded and lost.

c) Preservation of public access.

- Preserving public access goes hand in hand with our Proposal Idea #4 below, as diver shore access and boat access is required for purple urchin management by divers.

d) Consideration for the adaptation and resilience to climate change, ocean acidification, and hypoxia.

- Kelp forests (and sea grass meadows) are large and effective stores of carbon. For a summary, this Harvard article does a good job.

o http://sitn.hms.harvard.edu/flash/2019/how-kelp-naturally-combats-global-climate-change/

"Recent research... suggests that in addition to creating beautiful habitats, macroalgae such as kelp play a large role reducing the effects of global warming. Kelp has an incredibly fast growth rate (up to two feet per day) and exports a large portion of its biomass out into the deep sea, allowing kelp to permanently remove carbon dioxide from the atmosphere. Removing carbon dioxide from the atmosphere will play a necessary role in preventing rising temperatures and future climate catastrophe."

Pathways for sequestration of macroalgae carbon into the deep sea. As macroalgae grow, they removes carbon dioxide from the atmosphere. Most of the carbon sequestered by macroalgae is sent to the deep sea either in the form of dissolved carbon or in the form of plant detritus which easily floats out to sea thanks to gas-filled bladders. This figure was adapted from Krause-Jensen and Duarte, 2016.
"A paper published in 2016 in Nature Geosciences (https://www.nature.com/articles/ngeo2790) compiled data from previous studies in order to provide an estimate of how much atmospheric carbon is being removed by macroalgae [such as kelp]. Their rough estimate suggests that around 200 million tons of carbon dioxide are being sequestered by macroalgae every year - about as much as the annual emissions of the state of New York." [but not including the major deep ocean carbon sequestration mentioned above.]

e) Fostering stewardship and education of the area or coastwide.

- The essence of this Proposal document is indeed about 'coastwide' stewardship of kelp forests, but we haven't formulated any education ideas yet.

Site Information

To the best of your knowledge, please provide the following information on your proposed rocky habitat site.

Name of Proposed Site

What is the general site name of the area of your proposed location? (Example: Haystack Rock, Cannon Beach)

All rocky subtidal zones of the Oregon coast that can support kelp forests

Site Location

What is the specific location of your proposed site (if applicable)? Use common place names, latitude/longitude, and geographic references to identify the location of the site.

- This proposal applies to all rocky subtidal/reef sites potentially capable of supporting kelp forests (regardless of purple urchin deforestation). Some rocky sites are only intertidal with no good subtidal rocky habitat to enable kelp holdfasts, i.e. subtidal sandy bottoms):
- Applicable sites for the proposed rules include the following from North to South (a fairly representative list, but not perhaps an exhaustive list. Some sites may have lost their kelp forests already.
    - Three Arch Rocks o Cape Lookout (especially the South side kelp forest) << SPECIAL Priority CANDIDATE SITE FOR URCHIN CULLING by N. Oregon volunteer divers if permitted

- Reefs off of Pacific City/Cape Kiwanda/Haystack Rock << SPECIAL Priority CANDIDATE SITE FOR URCHIN CULLING by N. Oregon volunteer divers if permitted
- Government Pt/Depoe Bay/Cape Foulweather/Otter Rock section of coast
- Yaquina Head
- Seal Rock
- Heceta Head
- Gregory Point/Sunset Bay/Cape Arago area
- Simpson Reef/North Cove/Capa Arago area
- Middle Cove/Cape Arago area
- South Cove/Cape Arago area
- Fivemile Point offshore
- Bandon/Coquille Point Rocks
- Blacklock Point
- Cape Blanco and rocks to north
- Blanco Reef (very large kelp habitat)
- Orford Headlands/Coves <<< note this is the principal site for ongoing baseline scientific studies of urchins & kelp forest, close to the OSU Research Station, and a CANDIDATE URCHIN MANAGEMENT SITE, i.e. two coves (where one is a control site; one a future urchin culling site, pending an application TBD and then grant of permits from ODFW.)
- Orford Reef stretching south of Orford Headlands
- Island Rock/Humbug Mt/Lookout Rock
- Sisters Rock/Devils Backbone
- Nesika head to Otter Point
- Rogue Reef and north to Hubbard Mound/Otter Pt
- Crook Pt/Mack Reef/Mack Arch Cove
- Cape Ferrelo
- Boardman State Park rocky subtidal, Rocks
- South Boardman Rock/Twin Rocks
- Twin Rocks/Goat Island
- Chetko Pt and south to Calif. border

NOTE: Research Reserves/Habitat Refuges such as Boiler Bay/Pirates Cove, Whale Cove -- and Marine Reserves are not apparently 'in scope' for modifications this round and are slated for review in 2023 instead. It would be worth considering the specific proposals below - regards Cape Falcon, Cascade Head, Otter Rock, Cape Perpetua and Redfish Rocks reserves which have kelp forest relevance. Urchins creating more and more barrens in reserves and MPAs until 2023 is not good stewardship for this 'house on fire', urgent situation. 'PASSIVE-only PROTECTION ZONE' strategies like Marine Reserves in the case of threatened kelp forest ecosystems may result in the DESTRUCTION OF KEYSTONE HABITAT & BIODIVERSITY in these "Reserves", unless urgent and necessary rule changes are made regarding purple urchins culling policy. INACTION = IMMINENT & ONGOING DESTRUCTION.

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Site Boundaries

Provide a written description of the intended boundaries and scope of the proposed area (e.g. intertidal area, subtidal area, depth contour, etc.) All proposals must include a map of the proposed site boundaries.

- The proposed rocky subtidal zones boundaries are the same as in the Arcgis website mapping system, or those boundaries that are accepted by new sites from other applications in this process.

Site Access Information

How is this site commonly accessed?

- The main concern is preserving/allowing volunteer diver access via shore entry or kayak entry when practical or by boat as needed. Each of the many relevant sites can be accessed by boat. Many are quite impractical to impossible to access by land, due to steep cliffs and/or rugged terrain and/or long distances on foot carrying very heavy dive equipment.

What is your understanding of current management at this site?

This may include site ownership, management authorities, and other key stakeholders.

- This varies by sites listed above. The intent of this proposal is universal to Oregon's subtidal kelp forest habitat.

Site Uses

*To the best of your knowledge, please provide the following information **based on the current site management.***

Site Uses

Describe the current users and uses present at the site. Uses may encompass recreational, commercial, cultural, and scientific.

- Current uses for most of the subtidal kelp forest sites listed above include:
    - o ODFW-allowed harvest of bull kelp and giant kelp in all sites except Marine and Research Reserves
    - o ODFW-allowed harvest of Critically-Endangered Sunflower sea stars in all subtidal (and intertidal) sites
    - o Purple Urchin harvesting, but limited to a mere10/day/person, relative to many billions of population ravaging kelp forests.
    - o Recreational fishing is allowed in some but not all subtidal kelp habitat sites, such as Reserves and MPAs.
    - o Invertebrates harvesting is allowed in some but not all of the subtidal kelp habitat sites, even including Critically-Endangered Sunflower sea stars, as designated by the IUCN.

Site Infrastructure

Please summarize existing site infrastructure. For example: large parking lot, public restrooms, 10-foot stairway leading to cobble beach, etc.

- Since this is more of a universal subtidal proposal, it's not practical to list all the infrastructure amenities of the sites listed above.

Potential Future Site Uses

Please describe potential future site uses of the proposed site if there was no change to current site management. Much like current uses, future uses may encompass recreational, commercial, cultural, and scientific, as well as others not listed.

- Since this is more of a universal subtidal proposal, it's not practical to list all the potential future uses of all the subtidal sites listed above.

Impacts on Site Uses

How will altering this site's management designation impact existing and potential future uses? Please outline the potential positive and negative impacts to current and future users as well as the degree of impact. How does the proposed site management balance the conservation of rocky habitat resources with human use?

- The main positive benefit is: preservation, or restoration of already predated, kelp forests. Kelp forests are a keystone habitat for a multitude of juvenile and adult marine organisms.
- The proposal includes a necessary element of providing/preserving diver access (shore and/or boat access) for purple urchin management. Volunteer divers are the only practical, near-term method of purple urchin management to protect or restore at least some kelp forests. Divers are intimately familiar with and motivated by the steady encroachment of ugly, devastating purple sea urchin barrens.
    - Sea otter reintroduction if successful, will take very many years to reduce runaway purple urchin populations for kelp forest restoration and is less likely to ever happen in the North coast. Sunflower sea stars, purple urchin control predators, have been decimated by sea star wasting disease and have not recovered according to the August 2020 IUNC Critically Endangered study.

Key Natural Resources

To the best of your knowledge, please provide the following information on your proposed rocky habitat site.

Rocky Habitat Present

Please include as much information as possible on the specific types and composition of rocky habitat present at the site (e.g. rocky intertidal with extensive tidepools, adjacent rocky cliffs, and rocky subtidal).

- Rocky subtidal zones, all sites on Oregon coast capable of kelp forest habitat
- Rocky offshore rocks, all sites on Oregon coast capable of kelp forest habitat

Key Resources

Describe current rocky habitat resources present at the site. These may include, but are not limited to: kelp beds; pinniped haulout or pupping areas; seabird colonies; presence of threatened/endangered/protected species; intertidal diversity (invertebrates, marine plants, etc.).

Kelp beds, or urchin barrens replacing kelp forests, either as incipient barrens or completed barrens. Some sites have haulout or pupping areas nearby such as Seal Rock near Cape Arago, or at Arch Rocks. Threatened species such as Stellar sea lions need keep-out areas for boats.

Some sites have seabird colonies.

Some sites may have a few remining Critically

Flora and Fauna

List the animal and plant species you know exist at this site along with relative abundance.

Flora and Fauna*
List the animal and plant species you know exist at this site along with relative abundance.

- The main species of concern that is endangered at many Oregon Rocky Reef/Subtidal/offshore-rock sites is mostly the Bull kelp (Nereocystis luetkeana) and to a lesser extent, Giant kelp (Macrocystis pyrifera). Oregon coast kelp preservation is the main subject of this proposal - to protect a keystone habitat for a multitude of marine vertebrates and invertebrates in both juvenile and adult forms.
- ** Kelp forests are the foundation, both in structure and productivity, of these significant ecosystems. They create complex three-dimensional habitats (Teagle et al., 2017) which support high biodiversity (Graham, 2004) and are among the most productive ecosystems on the planet (Mann 1973). Kelp act as a food and habitat for a plethora of species (fish, urchins, gastropods) within their forests (Christie et al., 2009; Graham, 2004) and support neighbouring areas through export of drift kelp (Duggins et al., 1989). Kelps shape the physical environment influencing light, sedimentation, wave energy (Eckman et al., 1989; Wernberg et al., 2005). Other goods and services include direct harvesting of kelps for food or biofuels, associated and dependent fisheries, tourism, coastal protection, carbon storage, nutrient cycling, and intrinsic values, such as science, biodiversity, and culture (Bennett et al., 2016; Wernberg et al., 2019).

** Regional declines, such as 90% kelp loss over 350 km in Northern California, USA (Rogers-Bennett & Catton, 2019) can have catastrophic local effects. When these macroalgae kelp forests disappear, frequently left in their wake are less productive and far less biodiverse stable states such as urchin barrens or algal turfs (Graham, 2004).

- FISH and KELP HABITAT

Excerpt from Springer et al, 2007: “The strongest relationships between macroalgae kelp and fishes reflect the importance of habitat structure created by macroalgae kelp for the juvenile stages of fishes. Though a number of studies have described the importance of algal structure as habitat for larval settlement and refuge from predators (see reviews by Carr and Syms (2006) and Steele and Anderson (2006)), almost all of this work has focused on the giant kelp, Macrocystis. Our understanding of the importance of Nereocystis for the recruitment of juveniles to populations of adult reef fishes suffers from a lack of studies targeting this relationship throughout the range of Nereocystis. In the few places and cases were it has been examined, recruitment of several species of fishes, most notably the rockfishes (genus Sebastes) appears to increase in, or is associated with, the presence of Nereocystis.

Four examples of observational studies of the association of juvenile fishes with Nereocystis are particularly noteworthy. One includes the occurrence of recently settled copper rockfish, Sebastes caurinus, in the canopy formed by forests of Nereocystis in the Strait of Georgia, between Vancouver Island and mainland Canada (Haldorson and Richards 1987). Haldorson and Richards (1987) concluded that Nereocystis forests were “especially important habitat” for very young copper rockfish that had recently settled into shallow reef habitats. These young fish eventually migrated down plants to the reef habitat. Webster et al. (unpublished PISCO data, Carr per. comm.) surveyed fish assemblages associated with Nereocystis forests along the central coast of Oregon. Very high numbers of juvenile rockfish, including copper (and perhaps quillback, Sebastes maliger), and fewer juvenile black, Sebastes melanops, rockfish were observed both in the canopy and on the bottom at multiple kelp forests. Similarly, Bodkin (1986) observed aggregations of juvenile rockfish (various species combined) at mid-depth and on the bottom of a Nereocystis forest in central California.”

- ## Excerpt from Springer et al, 2007: “Grazers: Major grazers of Nereocystis kelp include red and purple sea urchins (Strongylocentrotrus franciscanus and S. purpuratus) and red abalone (Haliotis rufescens), as well as limpets (e.g., Collisella pelta), snails (e.g., Tegula spp, Callistoma spp) and crustaceans (Burge and Schultz 1973; Cox 1962; Nicholson 1968). Urchin grazing in particular is well known to exert a powerful influence on kelp forest dynamics, and many studies have documented this effect (e.g., (Duggins 1980; Pace 1981; Paine and Vadas 1969). When urchins are removed from the system, the presence and density of bull kelp sporophytes can increase dramatically. Breen et al. (1976) found that the density and area of Nereocystis kelp beds increased following removal of red sea urchins. Kelp density in these beds also increased. In a study by Pace (1981) performed in Barkley Sound, Nereocystis density increased from 4.6 plants/m2 to 13.9 plants/m2 in a single year following experimental removal of red urchins.

Work by Duggins (1980) showed that in the year following sea urchin removal in Torch Bay, Alaska, kelp biomass increased from zero standing crop to roughly 60 kg wet mass/m2, most of which was bull kelp. Increases in the size and density of Nereocystis kelp beds near Fort Bragg between 1985 and 1988 were appear to have been correlated with the commercial harvest of roughly 32,500 tons of red sea urchins from areas off the Mendocino and Sonoma counties (Kalvass et al. 2004). Several studies have also demonstrated that the seaward limit of bull kelp beds may be set by urchin grazing (Breen et al. 1976; Pearse and Hines 1979).

In addition to direct effects of grazing, the presence of grazers can have important interactive effects with other biotic and abiotic factors. For example, damage by grazers can weaken the structural integrity of the bull kelp stipe/holdfast, and increase an individual plant’s vulnerability to wave action, [especially the case in Oregon’s very exposed coast with up to 30 ft swells and surf in kelp habitat). Koehl and Wainwright (1977) reported that 90% of detached single kelp individuals had broken at a flaw in the stipe.

The purple sea urchin, Strongylocentrotus purpuratus) is a voracious predator of both the principal kelp species that are the subject of this proposal.

**In mid-latitudes like in Oregon where kelps are not at the end of their abiotic (climate change) tolerances, sea urchins are the most important cause of kelp forest loss (Steneck et al., 2002).

Purple sea urchins predating the last kelp on this reef

Persistence of Urchin Barrens Once Established

** After urchin population rapid growth and kelp is predated past a certain point, it can be extremely difficult to reverse phase changes. Ecosystems have feedback loops that in normal balance inhibit radical change. However, major disruptions in certain species such as Sunflower seas stars and purple urchins can push an ecosystem past a phase-transition threshold (Scheffer et al., 2001) and alter the balance sufficiently to transition to a new alternative stable-state. New feedback loops force the return towards this new ecosystem. The 'kelp forest to urchin barrens phase shift' is one of the most common examples of more or less permanent system changes, observed for over 50 years (Lawrence, 1975)... Globally averaged, the urchin population change needed to shift from kelp forests to urchin barrens is an order of magnitude greater than the urchin population threshold required to shift back to kelp forests (668 ± 115 g /sq.m compared to 71 ± 20 g /sq.m, (Ling et al., 2015). In other words, once dense populations of urchins consume kelp forests and create new, stable urchin barrens, even small numbers of urchins can sustain the barrens indefinitely. Restoration efforts therefore must reduce urchin populations to almost nothing to allow kelp regrowth assuming there is enough seed stock left.

** One might assume that, once large populations of urchins devastated their food source, that the site's population would crash (through death or moving elsewhere). However, sea urchins are flexible in their diet and can switch to alternatives such as turfing algae, drift algae, invertebrates, etc. when the preferred kelp food is not available (Lawrence, 1975; Suskiewicz & Johnson, 2017). While urchins survive in barrens, their condition may be poor, with reduced body size and shrunken gonads (uni) (Claisse et al., 2013; Ling et al., 2019; Pert et al., 2018). Thus, barren areas may persist for many decades (Jackson et al., 2001; Steneck et al., 2002) with urchins not in commercially valuable condition. Kelp forest restoration may occur from simply removing urchins (Andrew & Underwood, 1993; House et al., 2018; Leinaas & Christie, 1996; Ling et al., 2010). Methods include crushing/piercing in place (or removal to shore at far, far higher labor cost and far lengthier time-to-rescue for threatened kelp sites.)

- The Critically-Endangered (by IUCN) Sunflower Sea Star (Pycnopodia helianthoides) is the only natural predator of purple sea urchins, however it is on the edge of extinction. An estimated 5.75 billion Sunflower sea stars perished since 2013 due to disease..

** Sea star wasting disease on the Pacific coast of North America is has caused exponential growth in urchin population (Rogers-Bennett & Catton, 2019), as the sunflower star is a key urchin predator (Duggins, 1983).

- https://www.youtube.com/watch?=LKOCLr7VILo&feature=youtu.be

Photo: Healthy Sunflower sea star Photo: Sunflower sea star dying of wasting-disease

- Divers (Homo Sapiens Oregonia ;-) are the only practical, effective and near-term method of purple urchin population control (achievable for select, smaller reefs but only with needed vital ODFW regulation changes or (extensive emergency permits), and perhaps some Rocky Shore site-specific rule modifications if needed to un-restrict diver access.)

Photo: SCUBA diver Photo: Free-diver (no tanks)

- Sea Grass meadow Ecosystems

While kelp forests are the main focus of this document, it's also worth noting that out-of-control purple urchin populations can also convert keystone sea grass meadow ecosystems into barren deserts, while adding to carbon release/climate change.

^^ From Carnell, P.E., et al Overgrazing of Seagrass by Sea Urchins Diminishes 'Blue Carbon' Stocks. (2020).

"Seagrasses are among the Earth's most efficient ecosystems for sequestering carbon [along with kelp forests], but are also in global decline, releasing carbon they have accumulated over geological timescales. One contributor to this global decline is seagrass overgrazing by sea urchins; ... may affect stocks of "blue carbon" by damaging the seagrass root systems that stabilize the carbon-rich sediments under seagrass meadows. ... to investigate a seagrass urchin overgrazing event in Southeast Australia [for one meadow]. We found that seagrass loss significantly diminished local organic carbon stocks. The [carbon release] was also rapid: areas grazed within the preceding 6 months showed a 35% loss of 'blue' carbon, which continued even after urchins had left the area (46% loss after 3 years). High-resolution 3D sonar reconstructions revealed that urchin overgrazing of seagrass caused erosion of the top 30 ± 20 cm of sediment within the 26,892 m2 barren: the equivalent of 8100 ± 5400 m3 of sediment. To calculate the additional CO2 emissions from this erosion, we assumed between 50 and 90% of the seagrass carbon stock (11.7 ± 1.24 t Corg ha-1 in the top 10 cm) would be remineralised, resulting in the release of between 57.8 and 104 tonnes of CO2 equivalents due to sea urchin overgrazing-induced erosion [from just one 6.6 acre meadow]. This study adds to a growing body of evidence that seagrass loss leads to erosion and concomitant loss of blue carbon stocks"

Unique Features

Does this site include any unique or special features in relation to the Oregon Coast? This may include high quality examples of rocky habitats, etc.

- Kelp forests are the main feature/ beneficiary of this proposal, for all Rocky Shores/Reefs/Offshore rocks capable of supporting kelp forests, plus the multitude of marine organisms that inhabit the kelp forest ecosystem.

Values and Resources

Please discuss site values and resources and how a change in designation will impact them.

- Oregon coast kelp forests have tremendous value for recreation, tourism, fish and other marine organisms. Oregon coast sea grass meadows also support a tremendous amount of life.
- Purple urchins have no practical commercial value for uni harvest, and are voracious predators and destroyers of kelp forests and sea grass meadow ecosystems - when they have no predators themselves and their population explodes. Where incipient urchin barrens and high densities of urchins are present, kelp forest and sea grass preservation and restoration must address aggressive reduction of purple urchin infestations as a first step. Any kelp forests, (and sea grass meadows) cannot and will not survive purple urchins' population explosion. The 'house is on fire' NOW and has been since 2014, the year of mass sea star die-off. Northern California has already lost about 90% of their kelp forests to hordes of purple urchins, according to ReefCheck.org. Oregon is headed the same direction.

**Intensive urchin removal to restore kelp forests is not a new strategy:,(Breen & Mann, 1976; Leighton et al., 1966) - been tested in many regions such as California, Norway, Canary Islands, Canada, Australia and New Zealand. Overgrazing by urchins is a primary cause of kelp forest decline. Purple urchin management alone is likely to be sufficient for kelp recovery.

- Sunflower sea stars were declared Critically Endangered as of Aug. 2020, but are sometimes caught and dried for the ornamental market due to Oregon's permissive harvest rules. See this Ebay search for proof of this harvest: www.ebay.com/sch/157019/i.html?_from=R40&_nkw=sunflower+starfish&LH_TitleDesc=0&rt=nc&LH_PrefLoc=1

There is also some Sunflower sea star bycatch in subtidal commercial crab and fish commercial harvesting, and in recreational crabbing, though perhaps less likely for recreational typically done in bays and estuaries. There are reputable anecdotal reports of the commercial bycatch. Education of commercial fisherman to return them safely to the ocean after bycatch, and a ban on harvest is essential.

Regulations & Enforcement

To the best of your knowledge, please provide the following information on your proposed rocky habitat site. Due to the complexity of site regulation and enforcement, this section will not be used to evaluate proposal completeness, but will be considered for the merit of this proposal. Agencies will address gaps where information is available.

Management Consideration

How was enforcement/compliance of management considered in the design of this site proposal? If possible, please estimate the cost to implement this change in site management.

- Recommended Enforcement is per standard ODFW policies and procedures. Staff time is the only significant cost. Mid-year changes to regulations are routine, eg salmon and halibut updates and the public has been long exposed to the need to look for changes.
- Cost would be ODFW (and DSL) staff time to write and promulgate the rules changes through existing channels.

Enforcement Changes

In comparison to current site management, what changes would be necessary to enforce the proposed management measures? This may include the addition or removal of infrastructure, personnel, etc. Include the estimated financial impact of the proposal. Some designations incorporate larger financial or programmatic support. Please identify any entities or funding sources that may be available to continually support this proposal. This information is not required for a proposal to be accepted, but review bodies would like to be informed of any support that is already in place or expected for the site.

- Standard ODFW enforcement policies and procedures. No other changes. Minimal cost. Just some justifiable staff time.
- AFAIK, cash cost to state agencies would be zero. Just staff time.
- Volunteer SCUBA divers would pay for their own travel costs, and tank fills (up to $18 per tank for nitrox fills) and pay for mandatory annual SCUBA equipment inspections-servicing. Free-divers have no per dive cost other than travel and wear and tear on wetsuits.

Needed Regulations

What regulations and enforcement would be necessary to implement this change in management? What regulatory changes at the proposed site would be needed at this site? Which state/federal agencies would be impacted by this change in site management?

- ODFW will need to modify their invertebrate harvest regulations. Read on to next section for specifics.
- Department of State Lands (DSL) will need to modify their kelp harvest regulations. Read on to next section for specifics.

Improvements to Management

How does the proposed site improve upon or fill gaps in addressing objectives/policies that are not currently addressed by coastwide regulations or management?

THIS SECTION CONTAINS our 4 KEY PROPOSALS for all Rocky Reefs/Subtidal sites in Oregon suitable for kelp forest habitat preservation, (or restoration post-destruction). These may also help preserve vital sea grass meadows that can suffer destruction from purple urchins.

- Whereas - the purple urchin population explosion (a voracious kelp (and sea grass) predator) is rapidly endangering many if not most of the entire Oregon coast's kelp forest ecosystems, (an ODFW survey of just one reef, the Orford Reef, estimated "350 million purple sea urchins", "a 10,000 fold increase since 2014" - the 2nd year of devastating sea-star wasting disease, and...
- Whereas - the kelp forest ecosystem is a supremely critical, keystone habitat for the majority of subtidal marine flora and fauna, both in juvenile forms and adult forms, and...
- Whereas - the last natural predator of purple urchins, the Sunflower sea star (Pycnopodia helianthoides), is on the verge of extinction from 'sea star wasting disease', and the Sunflower sea star has been declared 'Critically-Endangered' by the International Union for Conservation of Nature (IUCN) in August of 2020, and regulations have not caught up with that listing. https://www.iucnredlist.org/species/178290276/178341498#assessment-information and https://www.iucnredlist.org/species/pdf/178341498/attachment

The IUCN study used more than 61,000 underwater surveys from 31 datasets and showed no signs of the population's recovery in any region it is known to be located since the disease outbreak began in 2013. On IUCN's 7-step scale of concern, "Critically Endangered" status is only one step away from "Extinct in the Wild" status. While there is an active U.S. market for Sunflower sea stars such as https://tinyurl.com/yal2mylb And...

Whereas -there is by-catch of Sunflower sea stars:

An Excerpt from the Supplemental Information PDF of the IUCN's Critically-Endangered Sunflower sea star study:

"Despite the absence of any targeted fishery for Pycnopodia, it can be commonly encountered as bycatch in bottom-contacted crab pot/trap and trawl/seine fisheries ... Additional uncertainties for Pycnopodia as bycatch are the handling and release practices by harvesters, which have the potential to be directly related to their survival. For example, the complex and delicate body structure of Pycnopodia has been reported to be difficult at times to disentangle from pot, trap, or net fishing gear without some injury or mutilation (T. Frierson pers. obs. 2020). Survival rates following these types of injuries and handling prior to release would be very challenging to measure, but a conservative assumption is that survival is not 100%."

and...

Whereas - 2020 and 2021 ODFW regulations allow the harvest of up to 10 Sunflower sea stars day per person: Pg. 82 of 2021 ODFW regulation:

"... Starfish..." Daily Limit" - "10 in aggregate"

PROPOSAL #1: Ban the harvest of Sunflower sea stars (Pycnopodia helianthoides) (except for scientific permits or for cultivation and release back onto urchin infested areas)

o Note that the public should find it quite easy to differentiate the Sunflower sea star due to its many-legged configuration (and size for adults) vs the typical 5-legged sea star. (ODFW already educates the public on many 'flavors' of rockfish - Sunflower vs not sunflower is easier than ID'ing rockfish variants.)
o Note the ebay link above that shows the active U.S. ornamental market for dried Sunflower sea stars.
o Important to Educate crab fisherman and long-line, bottom trawl fisherman to carefully return Sunflower sea star by-catch to the ocean, in case they are sometimes treated as nuisance species to cull, or kept for sale to the ornamental market.
o Note that the Marine Garden (Marine Education Area), Marine Research Area and Marine Conservation Area regulatory standards in the Rocky Habitat Strategy doc are nominally closed to sea star harvest, which is good, but is not sufficient to protect Sunflower sea stars - it needs to be a coast-wide rule.
o Note that there might be a way to 'farm' Sunflower sea stars and release them to threatened reefs, but would take substantial funding and research. The U. of Washington and/or the Nature Conservancy may have work in this area, which should be pursued for potential on the Oregon coast.

PROPOSAL #2: Allow unlimited harvest or culling-in-place of purple urchins (Strongylocentrotus purpuratus) in subtidal zones only, (not in intertidal zones), for as long as they are judged by ODFW to be a significant threat to kelp forest ecosystems (which may be many decades or longer).

This rule should also be enabled for all Marine Reserves and MPAs before their kelp forest ecosystems are destroyed, as an Emergency action at least. Inaction or delay till a 2023 review period (or beyond) will result in more kelp forest habitat being lost to permanent urchin barrens. This is the Catch-22 of Marine Reserves and MPAs - if they remain off-limits to rule changes required to actually 'preserve' them, then purple urchins have 'open season' to destroy them NOW and for 3 deadly years to come!

o Whereas - 2020 and 2021 ODFW rules put a recreational harvest limitation of only 10 urchins per day per person: Pg. 82 of 2021 ODFW regulations are: "... Urchins..." "Daily Limit" - "10 in aggregate".

Some math will put this hopelessly low limit in context of kelp preservation action:

To clear the large Orford Reef mentioned above (with 350m purples) using current ODFW recreational urchin harvest limits would take 10 divers working 60 days per year, x only 10 urchins per day, a whopping 58,000 years to clear.

- What if volunteer kelp preservation divers all applied for and were granted a commercial license, for 50 urchins per day? In the example above Orford reef alone would still take an absurd 11,600 years to clear.

From ODFW, regards COMMERCIAL Urchin harvest:

“Oregon Rule 635-005-0850, Size and Catch Limits - Sea Urchin [Commercial] Fisheries: (1) It is unlawful to take, land or possess for commercial purposes, more than 50 sea urchins (purple and red combined) per permit holder, per day, per trip ...

(2)A holder of a current sea urchin permit may take more than 50 purple sea urchins between two inches and three and one-half inches in diameter, provided the permit holder obtains a "Special Commercial Purple Sea Urchin Permit" only available at the Charleston ODFW Field Office. [an 8 hour drive round trip for a Portland area diver] The Department may attach terms and conditions to any special commercial permit including, but not limited to, on-board observers, area or time limits, and preharvest dive surveys of urchin beds.”

[This special commercial purple program is really not meant for administering hundreds of volunteer kelp-preserving divers ihmo. It also has 3 fundamental flaws (even if it could be administratively scaled up to hundreds of volunteer divers):

1. To preserve endangered kelp forests, the science is clear that nearly ALL purples must be removed. So leaving smaller or larger purples than the allowed size-range according this special purple permit - doesn’t preserve endangered kelp forests.
2. To expect hundreds of individual divers to travel to Charleston perhaps multiple times - to handle onboard observers, pre-harvest surveys, etc hurdles is just not going to be viable. We need to reduce hurdles not increase them for volunteerism to work.
3. Culling-in-place is our goal and THE only practical method of kelp forest protection using divers re purples. It has been done successfully in multiple locations if not in Oregon yet. The commercial special purples permit requires harvest to shore, for which there is no market, and which requires vastly more effort vs culling in place,. Even small reefs requiring ‘harvest to shore’ method would burn out the most devoted volunteer divers, let alone putting at risk shore divers or kayak divers with bulky bags of urchins. Getting ashore through surf is hard enough without a big bag of sharp spiky things banging around your body or small kayak! Very few of us divers own a blue water boat that could handle the harvesting method.

(Even for the rare boat in our community, until COVID-19 is cleared, we can’t put a bunch of volunteer divers on a boat.)

Comparison of State Regulations for Purple Sea Urchins
Oregon California
Limit (all areas) 10 specimens 35 specimens
Limit (select areas) 10 specimens 40 gallons1
Culling in place Not permitted Permitted by emergency rule2

1 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=177494&inline; California select areas include Sonoma, Mendocino, and Humboldt counties [which is more than 275 miles (>1/3) of California’s coastline]
2 Culling permitted in Caspar Cove, Mendocino County

Note that California found "the expanded bag limit was not as broadly successful as originally anticipated due to the logistical constraints and physical difficulties of [divers] bringing such large and unwieldy quantities of PSU [purple sea urchins] safely back to shore."

www.reefcheck.org/california-program/ Reef Check is advocating for two additional kelp forest restoration sites in Mendocino County: Noyo Harbor, and Portuguese Beach. "All 3 sites can serve as refuges and seed banks for surrounding areas in hopes that kelp can reestablish in northern California where it has been lost from 100's of miles of coast. In addition to the ecological benefits of this project, it will also provide a substantial economic benefit to the fishing community of Fort Bragg, which has been hard hit by the effective loss of its two most important fisheries."

ReefCheck is also running an urchin removal experiment at Lover's point, Monterey, California.

Urchin clearing operations have also been done at 2 reefs of Palos Verdes, California.
Note that Oregon's ODFW could implement a purple urchin culling-in-place rule on an emergency basis early in 2021, with multiple subtidal sites, then follow up with more permanent rules. Saving just one cove like California did is far too limited/cautious for the 'house on fire' situation at hand. Sometimes being bold is what is required - like now and here for the Oregon coast.

If culling in place is allowed, the same 10 divers x 60 days mentioned above could cull-in-place 1.8 million purple urchins in a year, at 3,000 per day per diver (** rates from urchin culling studies) - plenty of capacity to save some smaller select reefs from kelp forest extinction (though a pitifully small remediation on a large site such as Orford Reef at a mere 0.5% of total purples there.)

** Regarding practicality of diver efficacy, two large projects were conducted in Palos Verdes, California with over 18 hectares cleared in 6,600 diver hours of removal [culling would have been vastly more labor-efficient than removal], (House et al., 2018) and in Victoria, Australia with ½ of a square kilometer urchin cleared with 163 hours of diving (Gorfine et al., 2012).

** Culling-in-place Method: By far the most labor efficient method is to crush or pierce purple urchins in place. Crushing or piercing urchins in place has been used by many studies, especially for larger scale removals. Tools can include: abalone bars, rock hammers (Breen & Mann, 1976; Guarnieri et al., 2020; Himmelman et al., 1983; Keats et al., 1990). Knives or other thin implements can be used in crevices (Guarnieri et al., 2020) or iron rods (Taino, 2010). Most culling was performed with SCUBA gear, while 2 studies used more agile freedivers (Kitching & Ebling, 1961; Taino, 2010).
[Freedivers can more easily access tight spaces around boulders and crevices but have more limited bottom times per hour, though freedivers can stay active for long after their SCUBA friends' usual 1 or 2 tanks are consumed.]

A landmark culling urchins for kelp restoration study was done in an Italian marine reserve published at: https://www.frontiersin.org/articles/10.3389/fmars.2020.00519/full

"The systematic removal of sea urchins covered a total area of approximately 1.2 hectares. [~ 3 acres] It was carried out in two sites with a linear extent of approximately 200 m, and it was achieved by means of a belt transect method in which transect lines (‰ˆ 33 culling transects for each site) were laid perpendicular to the coast ... Divers positioned themselves on one side of the line and advanced in parallel, creating a "cleaning front" so that approximately 3 m from both sides of the lead core rope along that path remained free of sea urchins. Divers worked in parallel during 8 days of activity until the entire experimental sites were cleaned. All visible individuals were culled using hammers; a knife was employed to remove them from crevices." Productivity was as follows, "A total amount of ‰ˆ 92,500 sea urchins were removed during the 8 days spent in the culling ... The number of divers per day who were engaged in the culling activity varied from a minimum of 5 up to 8 per day, each of them spending approximately 90 min underwater. A total of 84 h was devoted to the intervention, which corresponds to an average culling rate of 18.38 urchins per minute per diver. [Thus 1,654 culls per 90 minute SCUBA dive).

Results: “Our study showed that, 36 months after sea urchin removal, ...A progressive contraction of barren extent was observed, with a reduction in bare substrate of 50% at T4 (2018) in favor of macroalgal [kelp] stands. To our knowledge, this is the first large-scale experiment demonstrating that local recovery of discrete areas characterized by “extensive barrens” (i.e., thousands of m2 of bare rock) within a relatively short time span can be feasible. At the end of the experiment, two wide areas of 6000 m2 showed an overall increase in both erected and turf-forming algae. This result supports previous evidence on the potential of control measures aimed at reducing sea urchin abundance in an attempt to restore the vegetative component of overgrazed temperate rocky reefs (Ling et al., 2010; Bonaviri et al., 2011; Tracey et al., 2015; Piazzi and Ceccherelli, 2019).

Culled-in-place urchins remain underwater to be consumed by smaller organisms. Culling in place is one of the most thorough methods of removal, with little impact on the environment or other species. By contrast, collecting urchins in bags and transporting to the beach for disposal has been tried in California but this method was enormously more labor-intensive, and offers no real advantages, since the uni is so sparse in most purple urchins - it’s not a commercial value ROI proposition to bring ashore, especially empty of value are ‘zombie’ purple urchins from completed barrens.

A potential concern about ODFW’s ‘no-waste’ rule is nullified by purple urchins’ complete lack of commercial value for uni. Urchin barren purples are essentialy near-empty shells. There has never been a viable commercial fishery for purples, only for red urchins.

o Note that the Marine Research Area and Marine Conservation Area regulatory designations in the Rocky Habitat Strategy document (Section D) are nominally closed to purple urchin harvest or culling, a blanket policy which gravely endangers kelp forests both in existing sites or new 2021 sites in these categories by forbidding purple urchin management/culling. Expanding this to even more sites in 2021 without a purple urchin (subtidal only) would be a self-imposed kelp-forest disaster.

o Regards MPAs and Culling, there is precedent:
@@ https://www.frontiersin.org/articles/10.3389/fmars.2020.00519/full Guarnieri, et al 2020, “Large-Scale Sea Urchin Culling Drives the Reduction of Subtidal Barren Grounds in the Mediterranean Sea”, “within the MPA of Porto Cesareo ...one of the largest Italian marine reserves” - an excerpt “... given the hysteretic behavior of subtidal macroalgal [kelp] systems (Filbee-Dexter and Scheibling, 2014; Ling et al., 2015), barren-state conditions may persist for years despite the establishment of mitigation strategies [e.g., Marine Protected Areas (MPAs)] aimed at the recovery of adult sea-urchin-predators (Pinnegar et al., 2000; Babcock et al., 2010; Galasso et al., 2015).

KELP HARVEST

- Whereas - Oregon State DSL regulations allows kelp harvest: “Below extreme low tide, removal of marine plants is regulated under ORS 274, and administered by the Department of State Lands (DSL). Individuals may harvest up to 2000 pounds of wet kelp per year for personal consumption from submerged lands (below extreme low tide) within the territorial sea without a lease from DSL (ORS 274.895).”
- Whereas - https://oregonshores.org/article/key-bills-salem-affect-coast The Oregon Shores Conservation Coalition wrote this commentary regards needed legislation:

“ This bill addresses an issue that has been under the surface for a long time. There appears to have been some undercover commercial harvest going on for years, particularly on the central coast. There were really were no meaningful regulations by ODFW, DSL, or OPRD to deal with intertidal seaweed harvest...commercial or personal use. It has been a worrisome gap. This bill gets rid of the antiquated kelp leasing rules for DSL, including the entire concept of proprietary leasing which is aimed at large-scale commercial harvest of bull kelp in offshore beds but is totally silent on intertidal seaweeds. ... and it addresses a real-world need, which is to provide some meaningful regulation over a wild food product that is in demand. It limits purposes of harvest to "human consumption," not fertilizers or feedstock for chemical extraction. And it specifically requires ODFW to adopt provisions that would ensure that seaweeds grow and reproduce. It also gives ODFW the authority to specify how someone could harvest for personal, not commercial, use.”

o PROPOSAL #3: Reduce ODFW and/or DSL’s KELP HARVEST harvest limits for Bull kelp and Giant kelp, for recreational harvest (and ban commercial harvest if not already done), unless used exclusively for: research, science-education or kelp forest restoration. ODFW to reduce harvest from 2,000 pounds, to (example only) ~ 50 or 100 pounds.

- Will be important to include any revised kelp harvest rule also in the ODFW rules/pamphlets/website for broader communication to target audience in the public (vs DSL’s communication channels only, which are not as widely read by the ocean visiting public).
- A reduction to a small number of pounds/year, such as 50 or 100 pounds per year can accommodate for example a teacher harvesting a small amount of kelp to show their science students.
- Commercial harvest of bull and giant kelp - it is difficult to find statistics. Search of DSL website was not useful. Seaweed is harvested commercially in 35 countries worldwide, bringing in an estimated $5 billion to $6 billion in sales for medicine, as gelling and thickening agents or in cosmetics and fertilizer.

- Whereas - human recreational divers are the only practical, and near-term method of mitigating purple urchins, at least on some selected reefs, and ‘scientist/supervised divers’ are far too few to effect kelp preservation in any significant scale, then:

o PROPOSAL #4: Diver access - Preserve exiting access and not add restrictions for recreational (or scientific) divers for shore-dive access or dive-boat access to subtidal zones/rocks & reefs, unless there is clear and compelling scientific justification - such as threatened mammal restrictions, e.g. seasonal 1,000 ft keep-out radius around Stellar sea lion haul-outs.

Note that one could envision a shore access being restricted from general public for some reasons, yet divers, whose numbers are inherently relatively tiny in number, could be allowed access to shore dive entry points for purple urchin remediation.

Non-Regulatory Management Mechanisms

To the best of your knowledge, please provide the following information on your proposed rocky habitat site.

Management Mechanisms

What non-regulatory mechanisms are required at this site in order to meet the goals of the proposed designation? These may include, but are not limited to, public access management, on-site enhancement, and educational intercepts.

- Education via ODFW publications, rule books, DSL publications, and other communications by governmental and environmental organizations.

Support for Management Mechanisms

How do you propose to support these mechanisms? Some designations incorporate larger financial or programmatic support. Please identify any entities or funding sources that may be available to continually support this proposal. This information is not required for a proposal to be accepted, but review bodies would like to be informed of any support that is already in place or expected for the site.

- Recreational divers in Oregon are passionate about preservation of the underwater environment, and have witnessed the spreading urchin barren devastation first-hand since 2013. There are many divers who are ready and willing to save a few select reefs if allowed by ODFW regulations to cull-in-place purple urchins. These volunteers can easily be reached by posting requests and guidance to the 5 principal Oregon-divers social media groups on Facebook, whose memberships total (as of 12/27/20) is 3,834 divers:
    - The breakdown of available Oregon divers is best estimated by social media groups: There are 702 free-divers listed + 3,132 SCUBA-divers listed (471, 83, 940 and 1,638 in online groups), totaling 3,834 divers, (minus some overlap between groups and out-of-state 'guest members') so call it at least 2,000 divers. Some of those members aren't experienced or motivated to tackle the rough conditions of Oregon coast diving, so one can estimate say, 1,000 divers who can do the urchin volunteer work.

At 15 dives per year x 3,000 purples per dive that totals 45m culls, so that's enough urchin-culling capacity to save some select smaller reefs (a few acres each) from kelp forest extinction. 45 m culls would however be only 12% of Orford reef - to put it in context. Effective kelp forest protection by divers requires near total eradication of purples on a smaller, more sand-isolated reef. The largest Oregon reefs, regrettably, may be un-salvageable. The 'purple hordes' are on the march NOW with much damage done since 2013, when sea stars began their tragic die-off.

o Specifically in North Oregon this proposal's authors are most familiar with, the:
(1) reefs off of Pacific City/Cape Kiwanda, and
(2) the south side of Cape Lookout (coincidentally being proposed for wildlife habitat classification by the Audubon Society of Lincoln City)

o ...are both excellent candidates for kelp preservation due to:

(a) their small enough size, i.e. a few acres instead of hundreds or thousands of acres of reef
(b) excellent boulder/bedrock kelp forest terrain quality,
(c) distance from other big purple urchin concentrations separated by miles of sand, preventing re-infection.
(d) there's enough sparse kelp left currently to save - for re-seeding the reef
(e) Both reefs have at least some protection from damaging winter storms depending on the direction of swells. Winter swells in Oregon up to 30 ft in height can be quite rough on kelp forests.
(f) These two highly endangered kelp forest sites are also closest to the largest concentration of divers in the state - the Portland/Vancouver metro area - for a proximate source of volunteers. The 2021 kelp growing season is urgent to save the thinned out kelp that is still remaining at both these sites - as well as other reefs that are already under assault by hordes of purple urchins.

These two beautiful reefs, and others, already suffer very thinned-out kelp forests and CANNOT wait another year or two for urchin culling to start. Their 'house is on fire' right NOW. Complacency or delay will result in a phase transition to a permanent urchin barren.

o **Some urchin remediation projects have used volunteer divers, especially in Japan and California (Collier & Machovina, 2005; House et al., 2018; Taino, 2010; Watanuki et al., 2010). Culling urchins is labor-intensive, but provided volunteers are competent scuba divers or free-divers), it is readily teachable, efficient and requires no special/expensive equipment.
o **Effectiveness of urchin removal on kelp growth - In previous studies, success was measured in the kelp mass or area (or reduced urchin counts). Urchin culling can be very effective, as well as efficient. For 43 studies that tested changes in kelp to statistical significance 60% had significant increases in kelp - while another 26% had partial gains. For 26 other less-statistically rigorous studies), the results are similar: 73% had kelp gains, 19% had partial kelp growth. Just 12% of studies showed no effectiveness, but may have had flaws such as incomplete removal of urchins.
o ** Worldwide, the time it takes for kelp recovery at least for canopy type we're interested in, on temperate reefs is about 18.5 ± 2.0 months after complete urchin removal (Ling et al., 2015).
o ** For the rate of culling possible by divers, Wilson and North (1983) listed much faster rates of 2,100 to 4,200/hr or 35 to 70 per minute, with an average of 3,000 per hour for experienced divers culling dense areas with more than 30 urchins per sq.m. Leighton et al. (1966) had rates of (1,000 to 2,000/hr, or 17 to 35 urchins per minute. In another case, 3.6 million urchins were removed for an average of 9.0 urchins/min with original urchin density of ~18 urchins/sq.m. (House et al., 2018). These 3 studies came from southern California work.
o ** To value the contribution of volunteer recreational divers, cost estimates are hard to come by. For Tasmania, Australia, commercial divers quoted $1.6 million for 1.15 sq. km of urchin-infested reef, or USD$9,805 per hectare assuming 1.5 urchins per sq.m. (Tracey et al, 2014). However, the costs of culling varied greatly by depth: time/cost of working in 15-20 m of water was more than 3.5 times greater than <10 m (Tracey et al., 2014); the depth range of 15-20 m accounts for almost half (46%) of the total project cost. So, an important lesson is to focus depths of 10ft to 15 meters where the best kelp depth zone is. In Victoria, Australia, costs were estimated at AUD $35,000 for 163 hours and culling just over 200,000 urchins (Gorfine et al., 2012). Tracey et al. (2014) estimated the Tasmanian rates were 1.46x greater than those reported by Gorfine in Victoria, which is ~$6,700 pr hectare. In comparison, in the Mediterranean, kelp re-seeding (with urchin removal) ranged on the order of ,¬1140 per 200 sw.m, or ~USD$62K per hectare (Medrano et al., 2020).
o Volunteer diver time at no-cost to the state is quite valuable.

o ** Recreational dive clubs can provide initial removal labor and ongoing manual urchin removal, or 'weeding of the kelp forest's pests' (Lisson, 2018).

o ** Removing only a portion of urchins, even 2/3 of them is not enough for kelp regrowth and thus is not effective (Andrew & Underwood, 1993; Carnell & Keough, 2016; Hill et al., 2003; Prince, 1995; Sanderson et al., 2016). This adds support to the concept of non-linearity of the urchin-kelp balance and that urchins can maintain barrens quite long term (Ling et al., 2015).
o ** Urchin density, sea conditions, urchin size, experience of workers, and dive-depth all affect removal efficiency. Commercial divers estimated the time and cost of working in 15-20 m depth was at least 3.5 times greater effort than <10 m (Tracey et al., 2014). No comparison is available on the rate of SCUBA versus freediving, [though freedivers have to take about 2:1 surface intervals between 'drops' to work on the bottom, so SCUBA is definitely more productive urchin culling potential per hour - by a factor of 2

to 3.]
An important test by a commercial shellfish diver found that culling in place is an impressive 2.4 x faster versus collection and removal to the beach (Lisson, 2018) and requires fewer resources (e.g. large boats, time to put in sacks and haul to shore and back). Commercial boats equipped with suction dredge with a diver operating the suction head is very expensive capital-wise and operating expense wise with no commercial payoff from purples, so dredging is judged not practical at scale.
o ** There are urchin-management-kelp-restoration projects worldwide, such as in Orford Headlands in Oregon, South California plus North California, and Haida Gwaii,islands Canada (Eger, 2020), Plus New Zealand and Italy.

Stakeholder Engagement

To the best of your knowledge, please provide the following information on your proposed rocky habitat site.

Letters of Support

Before submitting your proposal, please attach any materials or letters of support gathered as part of the development of this proposal. You may include meeting resources, campaign materials, etc.

[none provided]

Stakeholder Collaboration

Describe the steps taken to develop this proposal in collaboration with stakeholders. a) Please describe the community support and opposition for this proposal. b) Please list the communities, organizations, and groups that have worked to develop and support this proposal, as well as those in opposition of the proposal.

- A core group of Portland area recreational divers authored this document: Leigh Anderson was the principal author. Dan Semrad, Kurt Grote and Quinn Keough were the other principals.
- Published several drafts of this proposal for review and feedback on the 5 main Oregon diving social media sites, with uniformly positive responses from fellow divers.
- Given the late start for this proposal, there's not been time to gather support letters. All 5 online-groups of Oregon divers (3,834 members) have been given access to 3 successive drafts uploaded to each online site, with many divers expressing support and good suggestions given.

No community oppostion to date. The draft proposal has only been shared to date with the 5 online groups of divers.

At a later date, there are online group survey features which will make it easy and quick to solicit volunteers (assuming regulatory changes enable us.)

- The Sunflower sea star's IUCN "Critically Endangered" status is key evidence for one of our 4-part proposals was very thoroughly researched and includes the following organizations which are 'supporters by very obvious reference', though not directly contacted by the authors of this Proposal document:

o Oregon State University scientists
o The Nature Conservancy

o The Kitasoo/Xai'xais Natio
o The Heiltsuk Nation
o The Wuikinuxv Nation
o The Nuxalk Nation
o The Haida Nation
o iNaturalist
o Glacier Bay National Park and Preserve
o Gulf Watch Alaska
o National Park Service Southwest Alaska
o Olympic Coast National Marine Sanctuary
o Parks Canada
o Birch Aquarium at Scripps Institute of Oceanography
o Aquarium and Rainforest at Moody Gardens
o Aquarium du Quebec
o Shedd Aquarium
o Oregon Coast Aquarium
o Rotterdam Zoo

Feedback from Stakeholders

List and explain both positive and negative opinions received regarding this proposal. While preparing this proposal and conducting stakeholder outreach, describe the main comments of support and issues of concerns voiced regarding this proposed change in site management/designation.

Stakeholder/Diver Opposition:
- One diver stated that despite many visits over many years to the Central coast that he never saw any kelp harvesting going on, so why reduce kelp harvest?
- No opposition to culling-in-place of purple urchins
- No opposition to banning Sunflower seastar harvest

Public Outreach

List and describe engagement opportunities where the public has had the opportunity to learn about and/or comment on this proposal (e.g. conferences, meetings, tabling events).

- Oregon diver social media groups x 5, with total membership of 3,384. Online discussion threads and successive drafts (3) were uploaded for review before this submission.

Additional Information

To the best of your knowledge, please provide the following information on your proposed rocky habitat site.

Local Knowledge

How does this proposal incorporate local knowledge?

- All of us Oregon coast divers have seen urchin barrens and diminishing kelp forests at favorite Oregon coast dive sites. It is tragic and happening quite rapidly, with some kelp forests already eaten to extinction by purple urchins - Northern California has lost 90% of their kelp forests according to ReefCheck.org - Oregon would be wise to preserve before urchin barrens take over.

Scientific Knowledge

How does this proposal incorporate scientific knowledge?

In addition to the numerous scientific references cited elsewhere, the showcase Oregon urchin/kelp forest restoration science experiment is underway at Orford Headlands.

- The Oregon State University Port Orford Field Station | Marine Studies Initiative has already conducted some baseline studies in the Orford Head coves, in preparation for a controlled area vs urchin culling area experiment - that is pending application to, and granting of, an ODFW special permit for culling. However, urchin culling/kelp forest success has been reported in many other regions already, as noted above.

<Aerial Photo showing two adjacent coves, and the baseline transect lines where baseline data has been collected. One cove kept as a control, one cove to be culled of urchins (pending a permit application TBD and granting of permits.)

Goals and Policies

Which goals and policies in the Rocky Habitat Management Strategy does this proposal address, and how?

A. Consistent with Statewide Planning Goal 19, actions that are likely to affect rocky habitats shall be developed and conducted to conserve marine resources and ecological functions for the purpose of providing long-term ecological, economic, and social values benefits. <<< The kelp preservation proposals in this document further this goal directly, because kelp forests are a keystone marine ecosystem.

B. Protection of rocky habitat resources (i.e. living marine organisms and their habitat) shall be prioritized over development of non-renewable ocean resource uses. <<< The keystone habitat that is kelp forest is helped via the proposals above regards sea stars, purple urchin and kelp harvesting, along with allowing diver access.

D. Public access shall be preserved to the maximum extent practicable and minimize user conflict. <<< Especially vital for volunteer diver access via shore or boat access, for purple urchin mitigation projects in rocky reef/subtidal zones.

E. Agencies may create temporary access restrictions at individual rocky habitat sites, when necessary, to ensure visitor safety, ensure resource and habitat protection, and to manage for user conflicts. Any non-emergency, temporary access restriction must be accompanied by a scientific basis or decision rationale that describes the management concern and the duration of the access restriction. <<< Please try not to exclude volunteer divers even if general public is excluded. Oregon coast diving is difficult enough as it is, with rugged shores, poor underwater visibility, large ocean swells, underwater surge, (and the occasional Great White shark). And urchin mitigation volunteering will be difficult, tiring work. Please don't make it even harder or raise more barriers to volunteer diving.

G. Managing agencies shall administer regulations, permits and other agreements in a way that

considers the long-term conservation of rocky habitats and organisms. <<< ODFW and DSL are arguably/nominally in violation of this goal unless the agencies change the regulations as noted above with respect to:
(a) ODFW - allowing harvesting of Sunflower sea stars despite the August 2020 IUCN designation of "CRITICALLY-ENDANGERED".
(b) ODFW rules that protect gigantic and growing (billions of) destructive purple urchins via very low limits,
(c) DSL allowing harvesting of bull/giant kelp

K. Management actions shall consider adaptation and resilience to climate change, ocean acidification, and hypoxia effects on rocky habitat ecosystems. <<< Kelp forests sequester carbon in their large living biomass,and in the biomass which thrives inside it, which also reduces ocean acidification. Kelp also cycles into the deep ocean sediments after winter storms sequestering carbon in the ocean deeps. All the above proposals preserver kelp forests.

L. Foster and promote research and monitoring, compatible with the Rocky Habitat Management Strategy, including effects of climate change, ocean acidification, and hypoxia. <<< The baseline controlled experiments at Orford Head is important and consistent with this goal. See this Oregon Kelp Alliance 10/20 newsletter: https://mailchi.mp/eec48f972b43/orka-supports-baseline-data-collection-in-port-orford-oregon Wherever possible, if ODFW does allow urchin culling-in-place, volunteer divers will do baseline urchin counts along transect lines, plus follow-up urchin counts For kelp measurement, drone photos of kelp area before and after urchin mitigation.

Watershed Conditions

What land or watershed activities/conditions exist adjacent to this site?

- While these proposal apply to ALL Oregon rocky reefs/subtidal sites capable of kelp re/growth, there is no known fresh watershed impact regards sea stars, purple urchin, kelp harvest, diver access, in subtidal zone, as proposed in this document.

Existing Protected Areas

Are there any other overlapping protected areas within the site?

- Depends on the site, but not really relevant to this proposal to detail all those sites. There is no subtidal zone that should be excluded, except for pinniped isolation zones.

Site Characteristics

Please include descriptions of other characteristics of the site or adjacent area.

- Depends on the site, but this proposal can't feasibly detail all those sites, 'other characteristics".

Additional Designation Rationale

Please describe any other reasons you think this site warrants a change in designation.

n/a

Other Proposals

Should this proposal be evaluated in conjunction with other proposals your entity has submitted? The merit of all proposals are evaluated independently unless otherwise indicated by the proposing entity. Review bodies reserve the right to also evaluate proposals spatially in relation to one another.

none

Additional Information

What other information would you like to include about this site or your proposal?

- We used the provided oregon shore zone map of kelp zones to determine that most if not all subtidal areas in or nearby Rocky Shores/Reefs under consideration are relevant to this proposal to be enacted for kelp forest preservation, (Note: this map data kelp locations may be smaller than the historical range pre-2013 i.e. before the sea star wasting disease devastated the Sunflower sea star population.) https://www.oregonshorezone.info/

As an active Oregon diver since 1985, I have personally witnessed two once-thick kelp beds near Cape Kiwanda marked on this map no longer exist, or are so thinned out as to be nearly gone. A dense population of purple urchins infest the bottom in those locations.

Scientific References:

Scientific Literature Cited or Related

** Miller, K. (2020). Sea urchins and macroalgal [kelp] restoration in urchin barrens: a review (of 79 projects) on removing “the spiny enemies”, Pre-publication draft. Text in this proposal is paraphrased from the paper at author’s request- by Leigh Anderson.

** Miller, K. (2020). Large-scale removal of sea urchins to restore kelp forests in the Hauraki Gulf”, Pre-publication draft. Institute of Marine Science, University of Auckland
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Additional Materials

If there are any additional documents, materials, etc. that you feel may be relevant or pertinent to your proposal, please attach them here.

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