

January 2019: Kelp Facts and Resources



Untouched coastline of Hollister Ranch: One Of California's most pristine stretches of beach

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1 Kelp Basics

- Kelp are large brown algae seaweeds of the Laminariales order, 30 different genera
- Assemble in underwater forests along shallow coastal areas; for example: California, Tasmania, New Zealand
- Require cooler water temps: less than 68 °F (58 to 68 °F)
- Consist of: root-like structure (holdfast), stem (stipe), and fronds (photosynthesis)

2 And the Top Two Most Familiar Kelp Species Are...

2.1 The Giant Kelp

- *Macrocystis pyrifera*: one of the most familiar species of kelp (with kelp forests in Monterey Bay)
- Requires cooler ocean temperatures: annual range of 50 to 60 °F
- Will grow from sea floor up to 3 stories, 2 to 3 feet a day

2.2 Bullwhip Kelp

- *Nereocystis luetkeana*: Nereocystic (Greek for "mermaid's bladder")
- Forms thick beds on rocks, and is an important part of kelp forests
- Packed w/potassium, nitrogen, carbohydrates, and nutrients
- Usually annual, sometimes persisting up to 18 months
- The only kelp that drops spore patches so that the right concentration of spores lands near the parent's holdfast

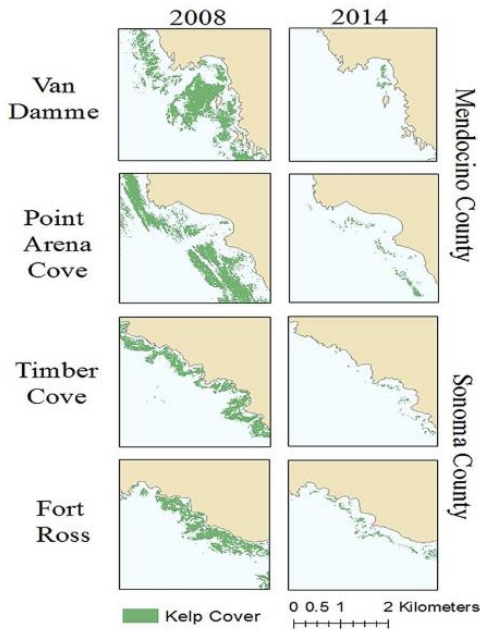
<https://en.wikipedia.org/wiki/Nereocystis>

<http://www.marksdailyapple.com/a-visual-guide-to-sea-vegetables/>

3 California Marine Protected Areas (MPAs)

3.1 Marine range: 29 MPAs covering 18% of state marine area with 243 square kilometers (94 square miles) at maximum protection

3.2 North Coast of California



(3 of 15) Aerial surveys from 2008 and 2014 illustrate collapse of North Coast Kelp Forest. (California Department of Fish and Wildlife)

<https://www.pressdemocrat.com/news/5487602-181/collapse-of-kelp-forest-imperils?artslide=2>

3.3 National Marine Sanctuaries of Central California

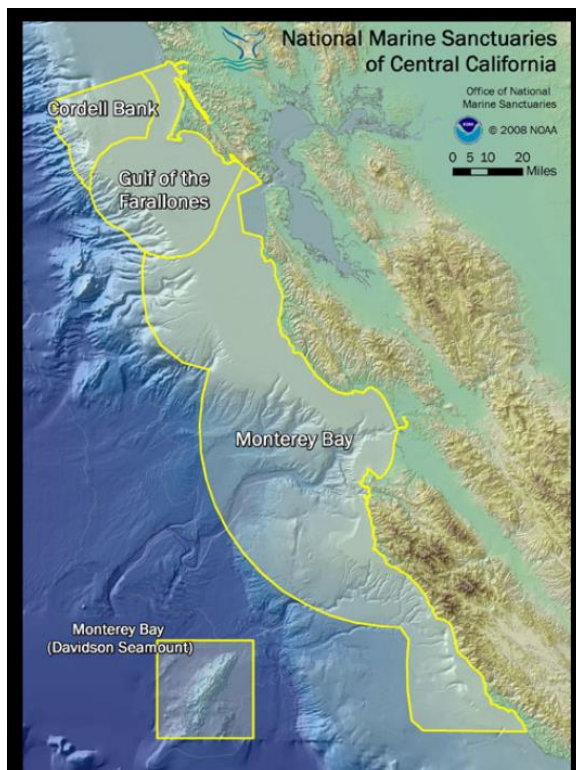


Diagram illustrating the orientation of the 3 [marine sanctuaries](#) of Central California: [Cordell Bank](#), [Gulf of the Farallones](#), and [Monterey Bay](#). Davidson Seamount, part of the Monterey Bay sanctuary, is indicated at bottom-right.

https://en.wikipedia.org/wiki/Marine_protected_area

3.4 Common Misconceptions about MPAs that work against kelp

- The belief that all MPAs are no-take or no-fishing areas. However, less than 1 percent of US waters are no-take areas. MPA activities can include consumption fishing, diving, and other activities.
- The belief that most MPAs are federally managed. Instead, MPAs are managed under hundreds of laws and jurisdictions. They can exist in state, commonwealth, territory and tribal waters.

<https://web.archive.org/web/20070422041945/http://bonita.mbnms.nos.noaa.gov:80/sitechar/kelp1.html#1a>

“The rocky nearshore environment of the Monterey Bay National Marine Sanctuary (MBNMS), like the rest of central California, is characterized by dense forests of kelp growing at depths from 2 m to more than 30 m (Foster and Schiel 1985). The giant kelp *Macrocystis pyrifera* and the bull kelp *Nereocystis luetkeana* are the dominant canopy-forming kelps in this region, and make up the major forests within the MBNMS. Giant kelp forms dense beds in the sanctuary from Cambria to Año Nuevo except in the area between Monterey and Santa Cruz where the sandy substrate is unsuitable for kelp attachment (NOAA 1992). The rocky coastline south of Monterey Bay is characterized by hard granite substrates with only a few sandy beaches which are limited to small coves (McLean 1962). North of Santa Cruz, the bull kelp, which occurs from Point Conception to Unimak Island in the eastern Aleutians (Abbott and Hollenberg 1976, Miller and Estes 1989), becomes the dominant canopy-forming kelp (Foster 1982, Foster and Schiel 1985).

Along the central California coast where the distributions of these two species overlap, giant kelp outcompetes bull kelp for light. Giant kelp dominates areas of relatively low water motion, and is dominant in years with relatively calm sea conditions. Bull kelp is more tolerant of high water motion and dominates more exposed areas (McLean 1962, Foster 1982, Harrold et al. 1988). The shallow areas inshore of these kelp forests are often characterized by canopies of the feather boa kelp *Egregia menziesii*, the intertidal giant kelp *Macrocystis integrifolia*, and the Fucalean alga *Cystoseira osmundacea* (Foster and Schiel 1985).

Foster (1982) observed that at Greyhound Rock, 24 km North of Santa Cruz, *kelp canopies become sparse due to the combined effects of unsuitable substrate and increased water motion*. This may help explain the lack of continuous kelp forests extending from Año Nuevo to the northern end of the MBNMS at Rocky Point.

4 Kelp/Human Interaction: Kelp as Food Source

In the comments at <http://www.marksdailyapple.com/a-visual-guide-to-sea-vegetables/>, one person wrote “I love seaweed salads. Mineral balance is a much under rated issue for most westerners. Iodine for example is not only important for prevention neurological disorders and hormonal balance via thyroid gland, but is also implicated in the prevention of many cancers. The current RDI is totally

inadequate at 125 mcg whereas The Japanese have an average of about 1200 - 1300 mcg per day - mostly from sea veggies. get em in to you! YUM”

Just a comment about the iodine and toxicity. Iodine can flush out heavy metals like lead, cadmium, arsenic and mercury out of the tissues and leave the burden on the kidneys and liver to eliminate. This most likely is where the negative effects of high iodine intake come from. These metals along with chlorine, fluorine and bromine are released from the tissues and are all toxic to the thyroid and body. People with low iodine levels will also store more of these toxic halides. Seaweed on the other hand has substances that bind to heavy metals and offset the toxicity of releasing these heavy metals via the iodine. I can't say that hijiki's high arsenic content is neutralized by the seaweed's sodium alginate, but it does bind up and remove heavy metals. People with Hashimoto's thyroiditis (most common hypothyroid) will benefit, but be more sensitive to iodine. (They will also improve greatly by going gluten-free.)

Whole Foods has a huge selection of sea veggies. I get all of mine there. Rinsing or not rinsing is really a matter of personal preference, in my opinion. When we throw these into miso soup, which I eat almost every day, I never rinse them. I also love certain ones not wet at all, just really crispy, straight from the bag. Some of them take some getting used to, but the health benefits are remarkable. My hair and skin have never looked better!”

5 Kelp/Human Interaction: Why are Kelp Forests the PBC Honoree for 2019?

- When you save a kelp forest you save a multitude. One of the highest sites of marine biodiversity can be found in kelp marine forests. Kelp marine structures form “marine canopy” layers. Framework infrastructure allows for a multi-organism ecosystem.
- Humans are an indirect threat to the greater ecosystem that includes humans as apex predators when the kelp forests are allowed to be eradicated to the point of extinction through human indifference.
- Kelp are much like the tropical forest canopies in their world shaping. Decreased numbers means decreased populations of the very organisms that depend on kelp to survive. Immense biodiversity in kelp forest infrastructure rivals that of coral reefs and tropical rainforests.
- Kelp numbers are down. Bring their numbers up and you will see a resurgence in healthy waters as expressed by the resulting increase in numbers of sea organisms that depend on the kelp forest environment. Take a second to imagine a world without a rainforest canopy. Now try and imagine a world without kelp forests. Though hidden away from easy viewing, kelp forest infrastructure is Priceless.
- The PBC Honoree designation will bring focus on the role of Kelp in a healthy ocean environment and our role in supporting it at all of our educational programs, events, and our organized clean-up/habitat restoration actions.

6 Kelp/Human Interaction: Why do Kelp Forests Matter? Of What Value Kelp Forests?

- Impact on fisheries: serve as safe havens to juvenile fish and invertebrate species

- Impact on climate warming: absorb atmospheric carbon dioxide and sequesters CO₂
- Impact on erosion control: help to dampen wave action during storms
- Impact on household items: used commercially in shampoo, toothpaste, etc.
- Impact on food (direct): component of some ice cream, in sushi as a direct food source; red sea urchins have commercial value on sushi menus
- Impact on food (indirect): act as a food source for some invertebrates such as abalone and sea urchins

Collapse of kelp forest imperils North Coast ocean ecosystem



(2 of 15) Offshore of Elk, in Mendocino County, a large red abalone climbs a bare kelp stalk in search of food that has already been stripped away. (California Department of Fish and Wildlife)

<https://www.pressdemocrat.com/news/5487602-181/collapse-of-kelp-forest-imperils?artslide=1>

7 Name Three Dangers to Kelp Forests

- Warming water temps
- Pollution: relatively clear water required (for spawning? <Verify>)
- Purple sea urchins: have a voracious appetite for the holdfast (root part of the plant).
Note: Predators of the purple sea urchins, the sea otters and sunflower sea star, have been decimated. The urchins can withstand slightly warmer temps and starvation so they create ecological wastelands, which can be very difficult to recover from.

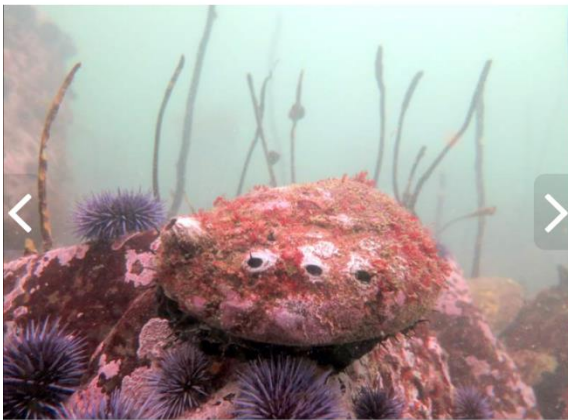


(5 of 15) Large groups of purple urchins are wiping out whole kelp forests, depriving other species such as abalone for space and food. (California Department of Fish and Wildlife)

<https://www.pressdemocrat.com/news/5487602-181/collapse-of-kelp-forest-imperils?artslide=4>

8 What are Current Areas of Greatest Concern?

- Southern California: 70% reduced kelp forests
- Tasmania: 90% reduction due to 4x degree increase in H₂O temps
- Northern California: bull kelp forests are disappearing due to sea star die off in 2013 and unusual wind and currents patterns slowing the upwelling of cold water from the bottom. Big impacts on abalone and fishing industry.



(4 of 15) With little kelp to feed on, red abalone and sea urchins along the North Coast are starving as they compete for food. (California Department of Fish and Wildlife)

<https://www.pressdemocrat.com/news/5487602-181/collapse-of-kelp-forest-imperils?artslide=3>

9 Mitigation

9.1 Habitat creation: San Diego uses scrapped vessel to creating an artificial reef



“The El Rey was a Kelco kelp cutter vessel that harvested the top three feet of the kelp canopy from Point Conception to Mexico. It was capable of carrying 300 tons of kelp. As a kelp cutter, it had a very unusual appearance.

In her 35-year career, she made some 3600 voyages and traveled more than 800,000 miles. The vessel was retired in 1981 and destined for the scrap yard. Instead, the San Diego Council of Diving Instructors and The California Department of Fish and Game requested her for an artificial reef program. Kelco donated the retired ship. It was cleaned to prevent pollution and prepared to be diver safe. On April 2, 1987, the El Rey was towed to the mission beach. A U.S. Navy Demolition Team used explosives to sink her. She came to rest upright on the bottom.

The wreck has deteriorated over the years. There are many fish living in the wreck. The wreck provides a great opportunity for photographers as there is an abundance of marine life swimming around and living inside the wreck.”

https://en.wikipedia.org/wiki/Wreck_Alley

<http://divebums.com/wrecks/El-Rey-before-sinking-photos.html>

<http://divebums.com/wrecks/El-Rey-after-sinking-photos.html>

9.2 Sea urchin harvest: efforts to eradicate urchins involve volunteer divers going out and harvesting the urchins before they form urchin barrens or marine deserts

“...This transformation caused a cascade of devastating repercussions. Without kelp to eat, the red abalone population crashed, prompting the state to put an indefinite ban on recreational harvesting. A small fishery for red urchins - commercially valuable, unlike the smaller purples - also collapsed as the urchins’ prized golden gonads shriveled with the stress of starvation. Kelp forests also play an important role in marine ecosystems, soaking up carbon and offering valuable habitat to fish, invertebrates and marine mammals such as sea otters, which normally prey on urchins and keep their numbers down. The disappearance of kelp along other parts of California’s shores has restricted sea otters’ range and been linked to an increase in shark attacks, as sharks tend to avoid areas of kelp.”

<https://www.newsdeeply.com/oceans/articles/2018/04/09/california-mobilizes-to-save-invaluable-kelp-will-efforts-be-in-vain>

9.3 Marine Agriculture: Seaweed farming for Food and Fuel

‘Still, California is home to many aspiring seaweed growers. GreenWave has received letters from more than a hundred people about farming seaweed in the golden state.

From Smith’s perspective, it’s not an option of whether or not the world should embrace and boost seaweed farming for food production. He says: “If climate change is as bad as we think it will be, I don’t see how we can’t do this.””

<https://www.theguardian.com/sustainable-business/2017/jun/29/seaweed-farms-us-california-food-fuel>

9.4 Marine Biofuel: Seaweed biofuels—a green alternative that might just save the planet

“Many millions of pounds are being invested in seaweed research from Vietnam to Israel to Chile because producing biofuels in the sea removes at a stroke many of the serious problems with conventional biofuels. Though important as greener alternatives to oil, many biofuels are produced from food crops, such as corn and sugar, which drives up global prices in a world where a billion people are already hungry. Biofuel production also consumes increasingly scarce freshwater and the worst examples - those from palm oil - can produce more carbon dioxide than diesel.

“Seaweed does not have any of those problems,” says Phil Kerrison, another marine scientist, back at the Sams labs. Seaweed farming has even been shown to clean up the pollution from fish farms and kelp grows far more quickly than land plants, turning sunlight into chemical energy five times more efficiently.””

<https://www.theguardian.com/environment/2013/jul/01/seaweed-biofuel-alternative-energy-kelp-scotland>

<https://www.greenwave.org/>

9.5 Marine biofuel revenue: Why Seaweed and not solar may be the energy of tomorrow

“Seaweed, in all its slimy glory, can be processed into a biofuel that could be used to power our homes and vehicles. The DOE’s Advanced Research Projects Agency-Energy (ARPA-E) program is funding projects across the country to make the large-scale cultivation of seaweed a reality, supporting another alternative to fossil fuel use.

Of the two latest projects funded, \$995,978 went to Makai Ocean Engineering of Honolulu to help build an ocean simulating model that will aid researchers in designing offshore seaweed farms, and \$500,000 went to Kampachi Farms of Kailua-Kona to test harvesting methods for seaweed grown on these farms. Kampachi Farms will also develop an offshore seaweed farm.”

<https://www.nbcnews.com/mach/science/why-seaweed-not-solar-may-be-energy-tomorrow-ncna809426>

10 Resources

1. Yale Environment 360, As Oceans Warm, the World’s Kelp Forests Begin to Disappear
2. BBC: Army of Sea Urchins- Planet Earth, You Tube
3. Exploring Ecosystem: Coastal Food Webs, Ca Academy of Sciences
4. CA Sea Otter: A Gap in the Pt. Reyes Ecosystem
5. National Geographic 177:2; 2-XX (Feb 1990), Between Monterey Tides
6. An Ocean Garden, The Secret Life of Seaweed
7. Mechanical seaweed harvesting on the west coast of Norway, by Bertie, 31 Oct 2011
8. collapsing kelp forests
9. <https://nmsmontereybay.blob.core.windows.net/montereybay-prod/media/sac/2018/180615/agenda.pdf>
10. <https://www.surfrider.org/programs/rise-above-plastics>
11. <https://nmsmontereybay.blob.core.windows.net/montereybay-prod/media/sac/2018/180216/sacmin.pdf>
12. <https://montereybay.noaa.gov/sac/sacma.html#2018>
13. <https://montereybay.noaa.gov/sac/sacma.html>
14. https://montereybay.noaa.gov/sac/rap/history/rap_history.html
15. <https://link.springer.com/article/10.1007/s11434-015-0803-2>; Development of China’s biofuel industry and policy making in comparison with international practices
16. <https://www.renewableenergyworld.com/articles/2013/06/from-the-beach-to-the-pump-is-kelp-a-viable-biofuel.html>
17. <https://www.sciencedaily.com/releases/2014/09/140929154251.htm> (Drawing a line in the sand: Partisanship and environmental issues in U. S. coastal regions)

18. www.greenwave.org

11 Keywords

Sustainable Sea wide Harvesting, Aquaculture, Sustainable Harvesting of Seaweed (overharvesting damages the sea bed leaving other organisms to move in, organisms per square meter vs. up to 190,000 organisms per square meter in seaweed environment; the “density is amazing”).