

seafood profiles

Commercial species of San Diego

FACT SHEETS



photo: T.S. Talley

Get to know San Diego's catch

San Diego appreciates seafood, but surprisingly little of what is available is truly local, that is caught by San Diego's own fishermen off our coast. These pages were compiled as part of a project to raise awareness of the local seafood industry and its unique products. Included are those species profiled during our September 7th, 2013 dockside seafood tasting event.

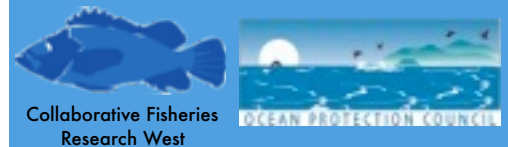
Why local seafood? Sustainability. California has some of the strictest regulations on catches, habitat protection, food safety and workers' rights in the world. So, eating local supports the supply of safe, healthy, environmentally-friendly food; it boosts the local economy; and it strengthens our connections with our coastal environment which heightens our sense of environmental responsibility and maintains San Diego's cultural heritage.

Project leads Dr. Adina Batnitzky &

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Project funding



Project Partners



Chefs: Chelsea Coleman,
Jenn Felmley, Jen Leong,
Cindy Quinonez, Miguel Valdez



The fishermen of:
TUNA HARBOR DOCKSIDE MARKET & DRISCOLL'S WHARF



Pacifico Aquaculture












San Diego Commercial Seafood Profiles

Contained here are fact sheets summarizing information on the biology, fishery, nutrition and culinary uses of each species landed or farmed in San Diego.

Included are a subset of San Diego's species that were profiled during the San Diego Docksides Seafood Tasting & Study held at the docks of San Diego Bay on September 7th, 2013.



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we hope to...

create a set of fact sheets for every one of the species fished or farmed in coastal San Diego County.

This is a work in progress. If you see errors, omissions or have suggestions for improvement, please let us know email: tstalley@ucsd.edu

Website coming soon. We will get these posted on a website for use as reference. They will likely be available at: <http://ca-sgep.ucsd.edu/biographies/theresa-sinicropetalley>

Acknowledgments
We thank Alisha Utter, Kami Shabaz and Jeff Troyano for their help in compiling the information for these sheets. We are also grateful to all of our partners, volunteers, and the participants who made the Sept. 7th Docksides Seafood Tasting and Study possible.

California halibut

Paralichthys californicus

BIOLOGY FACT SHEET

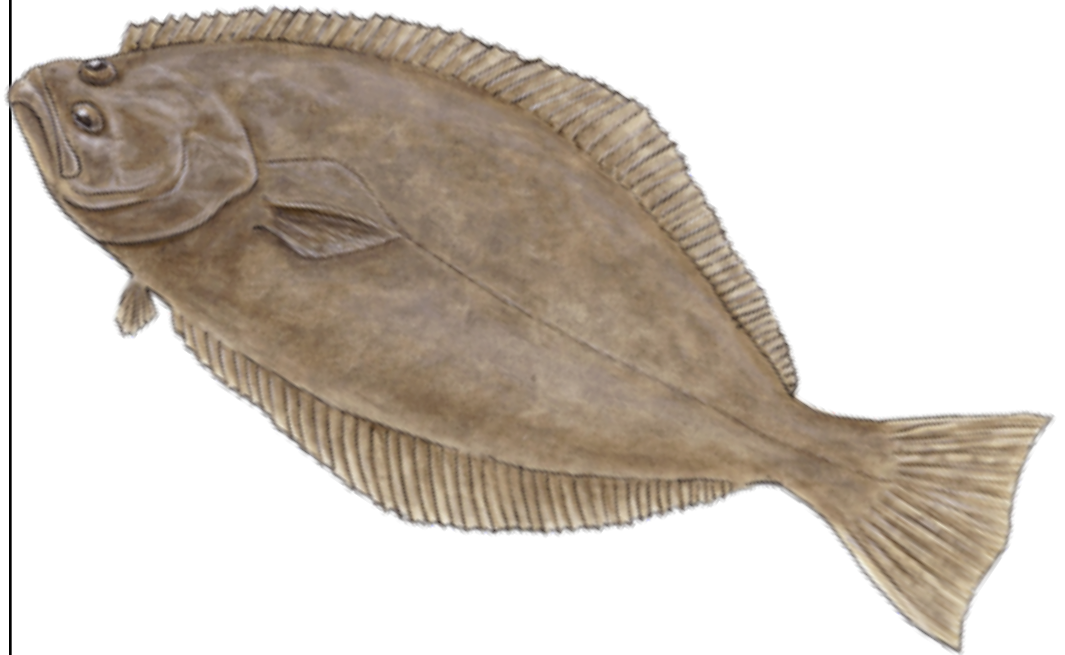


Photo: fishology.blogspot.com

San Diego seafood profiles

Taxonomic description

- Belongs to the family Paralichthyidae with other flounders & sanddabs [2,3]
- Small head with large mouth full of teeth
- Both eyes are on one side of the body so that the fish can lay flat on the seafloor with eyes facing up.
- Eyed side of the body is usually grayish or greenish-brown, and mottled with lighter and darker spots to camouflage with the cobbles, sand or mud of the substrate. The blind, “underside” side is white to cream [3,4].
- Can reach lengths of 150 cm (60”) [2]

Distribution

- From Magdalena Bay, Baja California, Mexico to Washington state, with a separate population in the upper Gulf of California [3]
- Most occur south of San Francisco [4]

Life history

- Major spawning areas are unknown [4].

- Spawning season extends from February to July with most spawning in May [4].
- Adults come up from relatively deep offshore water to spawn inshore at depths of 5-18 m (16-60 feet) [4]
- Eggs are deposited on the substrate surface and fertilization is external [4]
- Larvae and post-larvae are pelagic for several months before the post-larvae settle on the bottom, likely in bays and estuaries [4].
- Juvenile halibut emigrate to deeper water after 1 year and/or at 20 cm in length [1,4].
- Maturity is reached after 2-3 years for males and 3-5 years for females; both may live 30 years [3,4]

Habitat

- Both adults and juveniles are demersal (live on the sea floor), mostly on sandy sediments.
- Uses bays and estuaries as nurseries, possibly to decrease the risk of mortality of newly hatched fish. [2,4]
- The larvae and juveniles are planktivorous, and adults are piscivorous [4]

- Lives from the surf zone to 100 m (330 ft) but most abundant around 30 m (100 ft) [1,4]
- Lies flat and very still, buried or partially buried in sediment on the sea floor where it ambushes its prey, free swimming fish (e.g., Pacific sardine and northern anchovy) [2]

References

- [1] Seafood Watch. 2013. California Halibut. Monterey Bay Aquarium, www.montereybayaquarium.org/cr/cr_seafoodwatch
- [2] Tanaka, T. 2011. California Halibut, *Paralichthys californicus*. 2011 Status of the Fisheries. California Dept. Fish & Wildlife. www.dfg.ca.gov/marine/status/
- [3] Miller, D.L., R.N. Lea. 1972. Guide to the coastal marine fishes of California. Calif. Dept. Fish & Game, Fish Bull. 157. 299p
- [4] Kucas, S., T. Hassler. 1986. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Southwest)- California halibut. U.S. Fish and Wildlife Service, Biological Report 82 (11.44). U.S. Army Corps of Engineers, TR EL-82-4. 8pp. www.nwrc.usgs.gov/wdb/pub/species_profiles/82_11-044.pdf
- [5] Monterey Bay Aquarium. 2013. On exhibit. www.montereybayaquarium.org/animals/

Did you know?

Young halibut hatch with eyes on each side of the head. One eye migrates to the other side as the fish matures and settles near the sea floor [3].

California halibut

FISHERY FACT SHEET

Paralichthys californicus



Photo: <http://www.arimaowners.com/index.php?topic=3222.25>

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Seasonal availability

- Open year-round except trawl fishery, which is open June 16-March 14 [ii]

Managing authority

- California Department of Fish and Game oversees commercial permits & determines/enforces regulations [ii]

Gear type

- 50% of landings from bottom trawl, 25% hook-and-line, & 25% set gillnet [i]

Status of the fishery

- When caught with hook-and-line or bottom trawl, rated as "Good Alternative" by Monterey Bay Aquarium's Seafood Watch program [iii]

- Stock assessments indicate a trend in depletion from 1971-2011, however further data are required [iv].

Potential ecosystem impacts

- Degradation of estuaries & bays that halibut depend on for nursery grounds paired with their limited range make them vulnerable to overfishing [iii]
- One quarter of the total catch is caught with gillnets, which can entangle marine mammals & seabirds, so restrictions have been placed on where gillnets can be set [ii]
- Hook-and-line fishing is considered sustainable since gear is rarely in contact with the seafloor
- Stocks are maintained through a minimum size requirement of 55 cm (22") length, which allows a chance

for the fish to spawn before being eligible for take [ii]

References

- [i] Ish, T., F. Stroman. 2011. Sustainable Fishery Advocates Seafood Report: California Halibut. Rep. Monterey Bay Aquarium. www.montereybayaquarium.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_CaliforniaHalibutReport.pdf
- [ii] Fish and Game Commission. California Dept of Fish & Game. 2012. California Commercial Fishing Digest 2012-2013. nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=47779.
- [iii] "California Halibut." Seafood Watch. Monterey Bay Aquarium. www.montereybayaquarium.org/cr/SeafoodWatch/
- [iv] United States. Natural Resource Management. Department of Fish and Game. Southern California Halibut Stock Assessment. California Department of Fish and Game, 2011.
- [v] Local Catch Monterey Bay. 2013. California Halibut. www.localcatchmontereybay.com/?page_id=903

Did you know?

Fishermen are extremely cautious in handling this predaceous halibut because they know that its extremely sharp teeth can deliver a nasty bite [v].

California halibut

Paralichthys californicus

NUTRITION FACT SHEET



California halibut tacos from food52.com

San Diego seafood profiles

Edible portions

- Usually available as fillets

Culinary uses

- Good advice: cook this fish while fresh!
- Because of the leanness of the fish, freezing can cause the loss of moisture, and it is easy to overcook & dry out. Cook to an internal temperature of 52-54°C (125-130°F) to ensure the fish stays moist and tender [4].
- Common preparations include baked, broiled, batter-fried, grilled, pouched, sautéed, steamed, sushi
- Takes on the flavor of any seasoning or sauces you cook it in, making it a great fish to sauté rather than grill
- Cooking tip: Once sautéed and before it fully cooks, place the pan in the oven to allow the fish to capture the richness of all the flavors [5]

Nutritional information

Cooked, dry heat (5.6 oz) [1]

Nutrition Facts	
Serving Size 159 g	
Amount Per Serving	
Calories 223	Calories from Fat 42
% Daily Value*	
Total Fat 5g	7%
Saturated Fat 1g	3%
Trans Fat	
Cholesterol 65mg	22%
Sodium 110mg	5%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 42g	
Vitamin A 6%	Vitamin C 0%
Calcium 10%	Iron 9%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

NutritionData.com

Description of meat

- Lean fish with a mild, sweet flavor
- Meat includes large, white flakes with a firm and tender texture because of its rich oil content

Toxicity report

- Potentially elevated levels of mercury; safe consumption recommendations are 3 servings per month for adults, 2 for kids 6-12 yrs, & 1 for kids 0-5 yrs old [2,3]

Seasonal availability

- Available fresh year-round

References

- [1] SELF Nutrition Data. 2013. "Fish, halibut, Atlantic and Pacific, cooked, dry heat." USDA SR-21, n.d. Web. 10 Aug 2013. <<http://nutritiondata.self.com/facts/finfish-and-shellfish-products/4063/2>>.
- [2] Environmental Defense Fund Seafood Selector. 2013. "Halibut" <http://seafood.edf.org/halibut>.
- [3] Seafood Watch. 2013. California Halibut. Monterey Bay Aquarium.
- [4] Buchanan, D. 2010. Halibut Culinary Information." Chef's Resources: Culinary Knowledge for Professional Chefs, Foodies, and Culinarians. www.chefs-resources.com/Halibut.
- [5] Cooking Channel, Inc., 10 Aug 2013. California Halibut www.cookingchanneltv.com/videos/california-halibut.html.
- [6] Shaw, H. 2013. Cooking with halibut, the king of flatfish. About.com. http://fishcooking.about.com/od/meetyourfish/p/halibut_profile.htm

Did you know?

Much halibut sold in markets is the much larger Pacific halibut from Alaska. California halibut will be smaller (landed fish are often 4-12 lbs) and sold as fillets [6].

California halibut

CULINARY INFO SHEET

Paralichthys californicus

STEP 1: CLEAN

Tools:

- Sharp Fillet Knife
- Cutting Board

Method:

1. **DIVIDE** Lay the fish top side up and cut following the structure of the gill and then all the way down the fish to the tail.
2. **FILLET 1** On the side of the eyes, cut from the head to the tail, staying just above the rib bones. This may require many separate strokes.
3. **SEPARATE** Fold flesh back and cut along the edge.
4. **FILLET 2** On the other half, make the same cut from tail towards the head, however stop once the gut sack is reached.
5. **SEPARATE** Cut along edge to remove fillet and discard the gut sack.
6. **FILLET 3 and 4** Flip the fish over so the bottom is facing up. Using the same technique as top side, remove two fillets.
7. **REMOVE** If desired, cut out the cheeks from both sides.
8. **SKIN** For each of the four fillets, begin to cut 1/2 in. from the tail and slide knife along the tissue to separate fillet from skin.
9. **TRIM** Remove any remaining skin, bones or gut sack remnants.

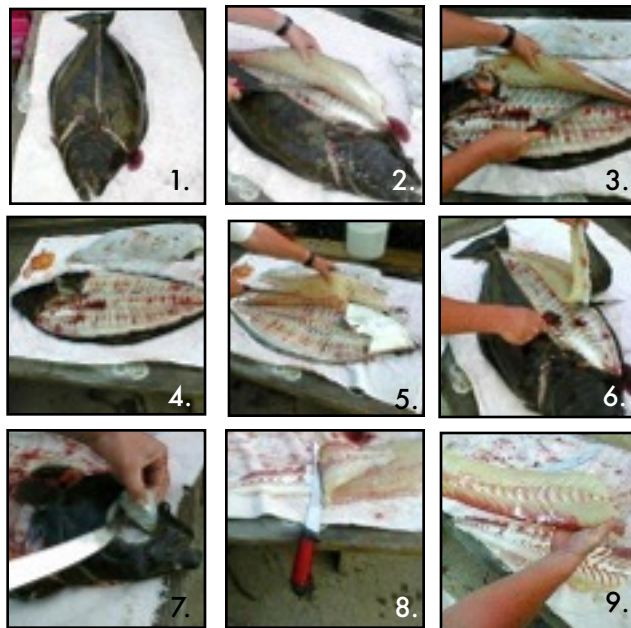


Photo Credit: tillamookbayboathouse.com [1]

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STEP 2: PREPARE

TIP: Halibut is done cooking when the tip of a knife easily flakes the thickest part of the fillet.

Entrée | Herb Crusted Halibut

Adapted from Emeril Lagasse; foodnetwork.com [2]

Ingredients (serves 4):

- 4 tsp. lemon zest
- 4 tsp. fresh dill
- 4 tsp. fresh chives
- 4 tsp. fresh parsley leaves, chopped
- 4 tsp. fresh chervil leaves, chopped
- 2 tsp. black pepper
- 4 halibut fillets
- 1 1/2 tsp. salt
- 4 tsp. Dijon mustard
- 1 tbsp. vegetable oil



Photo Credit: Planet Green; recipes.howstuffworks.com [3]

Method:

1. In a bowl, combine lemon zest, dill, chives, parsley, chervil, and black pepper.
2. Sprinkle fillets with salt and then coat one side of each fillet with 1 tsp of Dijon mustard.
3. Next, press the mustard-coated side into the lemon-herb mixture.
4. Add the vegetable oil to a skillet over medium-heat.
5. Place fillets, coated side down, into the hot oil.
6. Cook for 3 to 3 1/2 minutes, or until crust turns golden.
7. Flip and cook for another 3 minutes, until fish flakes easily when scraped with a knife.

Entrée | San Diego Grilled Fish Tacos

Adapted from finecooking.com [4]



Photo Credit: Brian Hagiwara; finecooking.com [4]

Ingredients (serves 3-4):

- LIME-CILANTRO SOUR CREAM SAUCE**
- 1/3 c. sour cream
 - 1/2 c. mayonnaise
 - 3 tbsp. fresh cilantro, minced
 - 1 lime, zested + 1 tbsp lime juice
- TACOS**
- 1 tsp. ground ancho chile powder
 - 1/4 tsp. ground cumin
 - 1-2 cloves garlic, minced
 - 1/4 tsp. salt
 - 1/8 tsp. black pepper
 - 1 tbsp. olive oil
 - 1 1/2 lb. halibut
 - 12 6-in. corn tortillas
 - 1 1/4 c. green cabbage, shredded
 - 1 1/4 c. red cabbage, shredded
 - Pico de Gallo
 - 2 limes, quartered

Method:

SAUCE

1. In a bowl, combine all ingredients and whisk until smooth. Refrigerate up to 4 hrs before serving.

TACOS

1. In a small bowl, mix ancho powder, cumin, garlic, salt, and pepper. Add the oil and whisk until a loose paste.
2. Rub the fish with the spice paste and let marinate in the refrigerator for up to 4 hrs.
3. Oil grill and preheat to medium-high. Grill fish 3-4 mins. per side. Chop into small pieces.
4. Wrap stack of tortillas in aluminum foil and grill 5 mins., or until heated through.
5. Mix green and red cabbage.
6. To assemble tacos, take 2 tortillas, top with fish, a dollop of sauce, a spoonful of Pico de Gallo, and some cabbage.
7. Serve with a squeeze of lime.

SERVING SUGGESTIONS:

Halibut is versatile and is best served baked, broiled, grilled, poached/pan seared or fried.

OTHER RECIPE IDEAS:

Fish sticks; halibut cakes; fish n' chips; halibut over greens; parchment baked; chowder.



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References

- [1] Tillamook Bay Boathouse LLC. How to Fillet Halibut. www.tillamookbayboathouse.com/halibut.htm
- [2] Lagasse, E. 2007. Halibut Recipe. Food Network. www.foodnetwork.com/recipes/emericlagasse/lemon-and-herb-crusted-halibut-recipe/index.html
- [3] Team Planet Green. Emeril's Herb Crusted Halibut. How Stuff Works. www.recipes.howstuffworks.com/emeric-lagasse-herb-crusted-halibut-recipe.htm
- [4] Thompson, Fred. 2009. Grilled Fish Tacos. Fine Cooking. www.finecooking.com/recipes/grilled-fish-tacos.aspx

Kellet's whelk

Kelletia kelletii

BIOLOGY FACT SHEET



Kellet's whelk laying egg capsules

Photo: scubacayman88, flickr creative commons

San Diego seafood profiles

Taxonomic description

- One of the largest sea snails found in southern California [1].
- Has spindle shaped, spiraled shell that can reach 18 cm (7") in length [1].
- Shells are white to tan with brown spiral lines., but as they age the shell gets covered with light green or purple algae and other encrusting organisms [1].
- The foot tissue is colored yellow with a few black stripes and white spots.

Distribution

- Found from central Baja California, Mexico to Point Conception, Calif [1]

Life history

- Much is still unknown about its life cycle
- Growth rates are not well studied, but are thought to be slow at 0.75-1 cm

(0.3" to 0.4") per year until sexual maturity; and only 9 cm (3.5") after 20 years [1]

- Females become sexually mature between 6.6 - 7.1 cm (2.6 - 2.8"), slightly smaller for males [1]
- Fertilization is internal with annual spawning periods March - May [2]
- Egg capsules are deposited on hard substrate with fertilized embryos inside that develop and emerge into the water column as free swimming larvae for an unknown amount of time [2]

Habitat

- Commonly found in kelp forests and on rocky reef habitats, on both rocky, hard and sandy, soft substrates. [1]
- Usually found from 0 m (0 ft) down to 69 m (230 ft) depths. Rarely found in the intertidal zone, although occasionally at lowest elevations or in tide pools [1,2]

- Are opportunistic carnivores that feed on dead or dying organisms on the sea floor[1] or will actively pursue prey such as turban snails [2].
- Predators include the moon snail, sea stars, octopus, and sea otters [1]
- Can be seen feeding along side its predator the giant sea star.

References

- [1] Hubbard, Kristin. 2008. Kellet's whelk. Status of the Fisheries Report 2008. California Dept. Fish & Wildlife, Available: <http://www.dfg.ca.gov/marine/status/>
- [2] SIMoN. Sanctuary Integrated Monitoring Network - Kellet's Whelk - Available: <http://sanctuarysimon.org/species/kelletia/kelletii/kellet's-whelk>
- [3] Rosenthal R.J. 1971. Trophic interaction between the sea star *Pisaster giganteus* and the gastropod *Kelletia kelletii*. Fishery Bulletin 69: 669-679

Did you know?

Kellet's whelk feeds using a prehensile proboscis that extends about twice the length of the shell to reach food in crevices [3].

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Kellet's whelk

FISHERY FACT SHEET

Kellefia kellefii



Photo: Alisha Utter

Kellet's whelk pulled from a trap on the Fish Addiction, San Diego Bay.

San Diego seafood profiles

Seasonal availability

- In California, open season from July 1 through the first Wednesday after March 15th unless the Total Allowable Catch of 45,360 kg (100,000 lbs) for the season is reached or projected to be reached in which case the fishery closes [i]

Managing authority

- California Department of Fish and Wildlife has recently designated and regulated the species as an "emerging fishery".

Gear type

- Caught as bycatch in lobster and crab traps: In 2008, 98% of all harvested Kellet's whelks were taken via lobster and crab traps [ii]
- Harvested by hand by licensed commercial fishermen (divers collect further than 305 m or 1000 ft beyond the low tide mark)

Status of the fishery

- Commercial fishery relatively new; minimal information on the impact of recent increased commercial demands.
- Potentially vulnerable to overfishing due to slow growth rates and need for relatively high density for aggregate spawning.
- However, if the Total Allowable Catch limits are coupled with collaborative data collections & management decisions, responsible growth of this fishery should continue.
- Not yet assessed in the common sustainable fish guides (e.g., NMFS Fish Stock Sustainability Index, Monterey Bay Aquarium Seafood Watch, NOAA Fishwatch.)

Potential ecosystem impacts

- Intensive removal of this predaceous whelk, may increase numbers of its prey, grazers of kelp & other seaweeds (e.g., urchins, limpets, and snails) [iii], which can lead to seaweed overgrowth in rocky reefs & kelp forests [iv].

- Collection methods are low impact—with hand (diver) collection having virtually no impact, and traps potentially causing damage to the seafloor in rough conditions.

References

- [i] "Kellet's Whelk Fishing Regulations." Invertebrate Management Project. Department of Fish and Wildlife, 14 Mar. 2012. www.dfg.ca.gov/marine/invertebrate/kelleiswhelk.asp.
- [ii] Hubbard, K. 2008. Kellet's whelk, *Kellefia kellefii*. Status of the Fisheries Report 2008. California Department of Fish and Wildlife. 28 July 2013. < <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=34437&inline=true> >.
- [iii] Halpern et al. 2006. Strong Top-Down Control in Southern California Kelp Forest Ecosystems. *Science* 312: 1230-1232.
- [iv] Denny, M. W., S.D. Gaines. 2007. *Encyclopedia of tidepools and rocky shores*. Berkeley: University of California Press.

Did you know?

Whelk landings in California likely pre-date 1979, but started to steadily increase in 1993 with the highest take in 2006 at 87 metric tons (the cargo capacity of a Boeing 747)!



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Kellet's whelk

NUTRITION FACT SHEET

Kelletia kelletii



spaghetti with scungilli from www.awellseasonedlife.com

San Diego seafood profiles

Edible portions

- Muscular foot which is similar to abalone.

Description of meat

- Flesh is firm and chewy if untenderized, firm and tender once tenderized.
- Meat is known to be juicy and salty [3]

Culinary uses

- Meat is usually removed from shell for use [e.g., 5]
- To tenderize, meat may be frozen for 5 min, pounded, or pressure cooked.
- Minimal cooking required, 10-15 min in boiling salt water does the trick
- Can serve from shell after lightly boiling
- Use in soups, chowders, fish pies, pasta dishes & seafood salads.
- Featured ingredient in whelk fritters & scungilli, a classic Italian salad

Nutritional information

Whelk, cooked, moist heat (3 oz)[1]

Nutrition Facts	
Serving Size 85 g	
Amount Per Serving	
Calories 234	Calories from Fat 6
% Daily Value*	
Total Fat 1g	1%
Saturated Fat 0g	0%
Trans Fat	
Cholesterol 111mg	37%
Sodium 350mg	15%
Total Carbohydrate 13g	4%
Dietary Fiber 0g	0%
Sugars	
Protein 41g	
Vitamin A 3%	Vitamin C 10%
Calcium 10%	Iron 48%
<small>*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.</small>	
NutritionData.com	

Toxicity report

- No known toxins.

Seasonal availability

- Available fresh from July – March[4]

References

- [1]SELF Nutrition Data. 20013. "Mollusks, whelk, unspecified, cooked, moist heat. <http://nutritiondata.self.com/facts/finfish-and-shellfish-products/4200/2>
- [2]Waterman, J.J. 2001. Processing Mussels, Cockles and Whelk. Food and Agriculture Organization. Ministry of Agriculture, Fisheries and Food. www.fao.org/wairdocs/tan/x5894e/x5894e00.HTM.
- [3]BBC. 2013. Whelk Recipes. BBC - Food Ingredients. www.bbc.co.uk/food/whelk.
- [4]Hubbard, K. 2008. Kellet's whelk, *Kelletia kelletii*. Status of the Fisheries Report 2008. California Department of Fish and Wildlife. 28 July 2013. < <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=34437&inline=true>>
- [5] "Cleaning a whelk." YouTube. Posted 20 Feb 2009 by sellfish. Web. 28 July 2013. < <http://www.youtube.com/watch?v=L8teuNuqRsg>>.

Did you know?

Prehistoric snack? Kellet's whelk shells have been found in archeological and paleontological sites in Southern California [ii]

Kellet's whelk

Kellelia kelleitii

CULINARY INFO SHEET

STEP 1: CLEAN

Tools:

- Stiff Brush
- Large Pot
- Water
- Salt
- Stove
- Removal Tool
- Small Sharp Knife

Method [1]:

1. **CLEAN** In large pot, bring water to a boil. In the meantime, scrub whelk shells with a stiff brush to remove any excess debris.
2. **BOIL** Once water is boiling, add a pinch of salt and cook whelk for 10 minutes*.
**Be sure not to overcook or whelks will be tough!*
3. **COOL** Drain and let sit until cool enough to handle shells.
4. **REMOVE** Insert a small knife or fork into the flesh protruding from the shell and pull gently. All of the flesh may come out, or only the edible part (portion on the right in photo 1.).
5. **RINSE** Clean under running water, keeping only rubbery edible parts.
6. **EMPTY** Locate the mouth, between the two short tentacles (photo 2.). Insert the fillet knife into the mouth, sharp side up. Split the gut open and wash out the contents (photo 3.).
7. **TRIM** Slice off the operculum (the "door" at the entrance of the shell).
8. **PREPARE OR PRESERVE** If desired, flesh can be pounded for added tenderness. The whelk can be eaten immediately or frozen for later use (photo 4.).



Photo Credit: Andrew Grygus; clovegarden.com [1]

San Diego seafood profiles

STEP 2: PREPARE

TIP: Boiled whelks are done cooking when they are tender enough to be easily pierced with a fork.

Appetizer | Sautéed Whelks with Aioli

Adapted from *theglobeandmail.com* [2]

Ingredients (serves 4):

- Aioli**
- 2 egg yolks
 - 1 1/2 tbsp. Dijon mustard
 - 1/2 tbsp. garlic, chopped
 - Pinch of salt and pepper
 - 3 tbsp. water
 - 1 c. extra virgin olive oil

- Whelks**
- 2 tbsp. extra virgin olive oil
 - 3 tbsp. butter
 - 1/2 lb. (~6) whelks, cleaned
 - Pinch of salt and pepper
 - 3 tbsp. shallots, minced



Photo Credit: The Globe and Mail [2]

Method:

- Aioli**
1. Whisk together all ingredients except for olive oil.
 2. Once combined, slowly add olive oil.
 3. Add salt and pepper, to taste.
- Whelks**
4. Place whelks in a large pot, cover with salted water, and boil for 45 minutes. Follow above cleaning instructions from "3." forward.
 5. In a pan, heat olive oil and butter.
 6. Add whelks and season with salt and pepper, to taste.
 7. Sauté 30-45 seconds, until heated thoroughly.
 8. Before removing from pan, mix in shallots.
 9. Plate whelk and drizzle with aioli.
- If desired, serve over greens & fresh tomatoes.*

Entrée | Garlic Butter Whelks over Spaghetti

Adapted from *awellseasonedlife.com* [3]

Ingredients (serves 4):

- 1 lb. (~12) whelks, cleaned
- 7 cloves garlic, chopped
- 3/4 c. extra virgin olive oil
- 1/2 bunch parsley, chopped
- 1 c. white wine*
- *Non-alcoholic substitution: 1/2 c. vinegar + 1 tbsp. sugar + 1/2 c. water
- 1/4 tsp. pepper + pinch of salt
- 1 lb. spaghetti



Photo Credit: awellseasonedlife.com [3]

Method:

1. In a pot, heat 5-6 cups water. Once it reaches a boil, add a dash of salt.
2. Submerge whelks in boiling water. Simmer several hours, until tender. Follow above cleaning instructions from "3." forward.
3. Turn off heat, set aside broth and cut the whelks into bite-sized pieces.
4. In a deep skillet, heat oil and sauté garlic for 2-3 mins.
5. Add the whelks, wine and broth to the skillet, adding salt to taste.
6. Simmer in skillet for 20 mins to 1 hr. Before removing from heat, add parsley and a tbsp. of oil.
7. In a separate pot, boil pasta until almost tender. Drain pasta, add to the broth, and continue cooking until pasta is done.
8. Serve immediately with a sprinkle of parsley.

SERVING SUGGESTIONS:

Whelks are best eaten boiled, poached, steamed or sautéed.

OTHER RECIPE IDEAS:

Pickled whelks; chowder; whelks tossed with salad greens. Search for recipes online under the Italian name, "scungilli".



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References

- [1] Grygus, Andrew. Kellet's Whelk. Clove Garden. www.clovegarden.com/ingred/sf_gpwhelkz.html
- [2] Laprise, Normand. 2010. Chef's Recipe. The Globe and Mail. www.theglobeandmail.com/life/chefs-recipe-sauteed-whelks-with-aioli/article1376592/
- [3] O' Biso, Carol. 2012. A Delectable Spaghetti. A Well Seasoned Life. www.awellseasonedlife.com/a-well-seasoned-life/2012/04/a-delectable-spaghetti-with-scungilli-recipe-with-no-tomato.html

Mediterranean mussel

Mytilus galloprovincialis

BIOLOGY
FACT SHEET



Photo: wtseafood.com

San Diego seafood profiles

Taxonomic description

- Also known as the black mussel because the shell can be dark blue or brown to an almost black color, relatively smooth.
- Two shells are equal, each with a rounded and a slightly bent edge
- Can grow up to 15 cm (6") but is typically found to grow between 5-8 cm (2-3") [3].

Distribution

- Native to the Mediterranean coastline, but found around the world due to unintentional transport of the larvae and adults in ballast water and hull fouling communities of ships traveling overseas for shipping and trade; and intentional introductions for aquaculture [3].

Life history

- Fast growing with high reproductive output
- Can attain 7 cm within its first year at favorable sites [3]
- Can reproduce multiple times per year and reach sexual maturity in 1-2 years
- Reproduces through broadcast spawning, or releasing gametes into the water column [1]
- Fertilized eggs develop into free-swimming larvae, which then attach to rocks.

Habitat

- Found mostly on temperate sheltered and exposed rocky shores; attaches to rocks using byssal threads.
- Extremely tolerant to environmental changes [3].

- Mostly found in the intertidal zone where there are intermediate levels of wave exposure. [3]
- Able to hybridize with sister taxa, including *M. trossulus* (bay mussel) which is native in California.
- Feeds by filtering particles through gills
- Main predators include sea stars & gulls.

References

- [1] Van Erkom Schurink, C. & Griffiths, C.L. 1991. A comparison of reproductive cycles and reproductive output in four southern African mussel species. *Marine Ecology Progress Series* 76: 123-134.
- [2] "Mediterranean Mussel *Mytilus Galloprovincialis*." Department of Agriculture, Forestry and Fisheries. Department of Agriculture, Forestry and Fisheries. Web.
- [3] GISD. 2012. Global Invasive Species Database - *Mytilus galloprovincialis* - Available from <http://www.issg.org/database/species/ecology.asp?si=102&fr=1&sts=sss&lang=EN>
- [4] <http://www.sciencedaily.com/releases/2013/07/130723113657.htm>

Did you know?

Nature's bungee cords! Byssus threads, which mussels use to attach themselves to rocks, are stretchy but also strong so are being explored for uses such as body armor, architectural engineering, and surgical sutures [4].



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Mediterranean mussel

Mytilus galloprovincialis

FISHERY FACT SHEET



Shellfish being harvested at Carlsbad Aquafarm.
Photo: Carlsbad Aquafarm.

San Diego seafood profiles

Seasonal availability

- Available year-round

Managing authority

- Growing methods & product are regulated by federal, state & local agencies: Army Corps of Engineers (lead), NOAA, U.S. Fish & Wildlife Service, US. Dept of Agriculture, Food & Drug Administration, California Dept. of Public Health Services, California Dept. of Fish and Wildlife, County Dept of Public Health) [i].
- Pacific Coast Shellfish Growers Association is an industry-based organization that includes & represents growers along the U.S. Pacific coast in establishing science-based farming practices, & ensuring environmental protection, shellfish safety, & support with regulatory, technology & marketing updates.

Gear type

- Grown off bottom in the water column on vertical lines of rope supported by buoys. When it is time to harvest, ropes are lifted

using booms over a boat deck and the mussel is collected. [ii]
• No fertilizers, chemicals or antibiotics added- food is naturally occurring phytoplankton.

Status of the fishery

- Most U.S. farms collect mussel larvae from wild populations and transfer them to the farm for grow-out to adults [v]. This has little effect on wild populations due to the mussel's high reproductive rates.
- Recent technology has allowed culturing of larvae on the farm [i]

Potential ecosystem impacts

- Aquaculture reduces the pressure on local natural populations and limits the need for imported seafood.
- The presence of mussel and racks create habitat for marine plants and animals, and improve water quality by the mussel filtering algae and particulates. Some benthic disturbance results from shading and organic accumulations beneath racks [i].

- Introduced species that is tolerant of a wide-range of conditions allowing it to thrive in local coastal ecosystems if released as larvae or adults [i, iii].
- Considered "naturalized" & hybridizes with the native blue mussel, *M. trossulus* [iv].

References

- [i] FishWatch. 2013. Blue mussel. NOAA FishWatch U.S. Seafood Facts. http://www.fishwatch.gov/seafood_profiles/species/mussels/species_pages/blue_mussel_farmed.htm
- [ii] Carlsbad Aquafarm. Prod. Brian Robles and Cindy Kendrick. Green-Scene, 2013. YouTube.
- [iii] Lockwood, B.L., G.N. Somero. 2011. Invasive and Native Blue Mussels (genus *Mytilus*) on the California Coast: The Role of Physiology in a Biological Invasion. *Journal of Experimental Marine Biology and Ecology* 400: 167-174.
- [iv] Shinen JS, Morgan SG. 2009. Mechanisms of invasion resistance: competition among intertidal mussels promotes establishment of invasive species and displacement of native species. *Mar Ecol Prog Ser* 383: 187-197.
- [v] European Commission. 2013. Fisheries. http://ec.europa.eu/fisheries/marine_species/farmed_fish_and_shellfish/mussels/index_en.htm

Did you know?

The first recorded organized shellfish farm was a mussel farm in France in 1235 where they cultured mussels on wooden stakes [v].

Mediterranean mussel

Mytilus galloprovincialis

NUTRITION FACT SHEET



Mussels with garlic and ginger from www.iFood.tv
Photo: Powerplantop, flickr creative commons

San Diego seafood profiles

Edible portions

- Entire contents of the shell

Culinary uses

- Best fresh, but may be frozen
- Generally cooked whole, for example, steamed until the shell opens.
- Add mussel to a pan containing favorite ingredients, such as olive oil, garlic, lemon, wine, and red peppers, over medium heat. Once open and cooked, it's ready to eat!
- Other recipes include: paella, seafood couscous, Mediterranean fettuccine, cioppino [4]

Description of meat

- Much meatier than most other mussels
- Delicate flavor with a rich, buttery texture

Seasonal availability

- Available farm fresh in San Diego year-round[2]

Nutritional information

Cooked, moist heat (3 oz) [1]

Nutrition Facts	
Serving Size 85 g	
Amount Per Serving	
Calories 146	Calories from Fat 34
% Daily Value*	
Total Fat 4g	6%
Saturated Fat 1g	4%
Trans Fat	
Cholesterol 48mg	16%
Sodium 314mg	13%
Total Carbohydrate 6g	2%
Dietary Fiber 0g	0%
Sugars	
Protein 20g	
Vitamin A 5%	Vitamin C 19%
Calcium 3%	Iron 32%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

NutritionData.com

Toxicity report

- Farmed mussels are controlled and monitored for safety with no reported contaminants.

- Collecting mussel from local bays is not recommended; biotoxin levels are often unmonitored and depend on quickly fluctuating water quality and algal blooms of the bay. Many of these toxins cannot be cleared with freezing or cooking [3]

References

- [1] SELF Nutrition Data. 2013. Mollusks, mussel, blue, cooked, moist heat. < <http://nutritiondata.self.com/facts/finfish-and-shellfish-products/4187/2>>
- [2] Richards, John B., and George A. Trevelyan. "Culture of Mussels." Trans. California's Living Marine Resources: A Status Report. California Department of Fish and Game, 2001. Web. 10 Aug. 2013. <<http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=34257>>.
- [3] "Mediterranean Mussels." FishChoice.com. FishChoice Inc., n.d. Web. 10 Aug 2013. www.fishchoice.com/buying-guide/mediterranean-mussels.
- [4] This is a great source for all types of recipes. "Mediterranean Mussel Recipes." Yummly. www.yummly.com/recipes/mediterranean-mussels
- [5] www.wildcoast.co.za/facts-about-mussels

Did you know?

Pale white mussel meat indicates a male, and a warmer, more orangey color indicates a female [5].

Mediterranean mussel

Mytilus galloprovincialis

CULINARY INFO SHEET

STEP 1: CLEAN

Tools:

- Bowl
- Cold Water
- Towel
- Slotted Spoon
- Toothbrush

Method [1]:

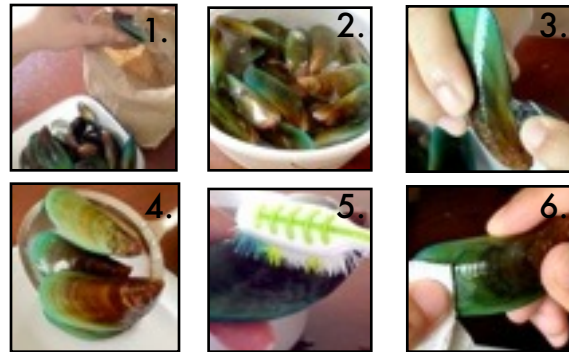


Photo Credit: wikiHow.com
Note: Species pictured is "green mussel"

1. **SORT** Discard any broken or dead mussels (those with open shells that do not close after being lightly tapped on the counter).
2. **CLEAN** Right before cooking, soak mussels in a bowl of cold water for 20 minutes so they can expel any sediment.
3. **DEBEARD** Locate the beard (little brown threads), and pull towards the hinge-end of the mussel. Use a towel to gain a better grip.
4. **DRAIN** Use a slotted spoon to transfer the mussels to a fresh bowl of cold water.
5. **BRUSH** Use a toothbrush to scrub off any growth clinging to the shell and then rinse under running water.
6. **DRY** Pat mussels dry before cooking.

San Diego seafood profiles

STEP 2: PREPARE

Appetizer | French Steamed Mussels

Adapted from Julia Child's "Mastering the Art of French Cooking" [2]

Ingredients (serves 4-6):

- 1/4 c. all-purpose flour
- 3 lbs. mussels, cleaned
- 1 c. dry white wine*
- *Non-alcoholic substitution: 1/2 c. vinegar + 1 tbsp. sugar + 1/2 c. water
- 1/4 c. minced scallions, shallots, or leeks
- 4 parsley sprigs + 1/4 c. parsley, chopped
- 1/2 of a bay leaf
- 1/2 tsp. fresh thyme, chopped
- 1/8 tsp. black pepper
- 3 tbsp. unsalted butter
- 1 baguette, in 1/2-inch slices, drizzled with olive oil & toasted



Photo Credit: yumsugar.com

Method:

1. In a bowl, mix together flour and 4 c. of water. Submerge the cleaned mussels into the mixture, adding additional water as needed to cover the mussels. Allow the mussels to soak at least 30 minutes.
2. Combine wine, onion, parsley sprigs, bay leaf, thyme, pepper, and butter in a stockpot. Bring to a simmer over high heat.
3. Drain the mussels from the mixture and rinse with fresh water.
4. Add mussels to stockpot and cook for 5 mins. Shake the pot frequently for even cooking.
5. Serve in a bowl with cooking broth, parsley and a side of toasted baguette.

Entrée | Spicy Tomato Sauce Mussels over Linguini

Adapted from montereybayaquarium.com [3]

Ingredients (serves 4): Method:

- 4 tbsp. olive oil
 - 1/2 red onion, chopped
 - 2 garlic cloves, sliced
 - 1/2 tsp. red pepper flakes
 - 1 28-oz can Italian tomatoes in puree
 - 1 c. dry white wine*
 - *Non-alcoholic substitution: 1/2 c. vinegar + 1 tbsp. sugar + 1/2 c. water
 - 1 1/2 tsp. fresh thyme, minced
 - 1 tbsp. tomato paste
 - Pinch salt + black pepper
 - 1 lb. linguini
 - 1/4 c. drained capers
 - 2 lbs. mussels, cleaned
 - 1/4 c. chopped Italian parsley
1. In a pot, heat 2 tbsp. oil over medium heat. Add onion, garlic, and pepper flakes. Sauté for 5 minutes, or until golden in color.
 2. Add tomatoes, 1/2 c. wine, thyme, and tomato paste. Bring to a boil, then reduce heat and simmer until thick, about 15 minutes. Stir often, breaking up tomatoes. Season with salt and pepper, to taste.
 3. Cook pasta in salted water for 10 mins, until tender but firm.
 4. Add remaining wine and all the capers to the sauce and boil.
 5. Place mussels in broth and cook 4 mins, or until mussels open.
 6. Drain pasta and place in sauce.
 7. Add remaining oil and stir over high heat for 1 min.
 8. Serve with sprinkle of parsley.

Photo Credit:
Monterey
Bay
Aquarium



SERVING SUGGESTIONS:

Mussels are best eaten steamed, baked, or grilled.

OTHER RECIPE IDEAS:

Curried mussels; stuffed mussels; paella; mussels in saffron cream.

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References

- [1] wikiHow. Available: www.wikihow.com/Clean-Mussels
[2] Childs, Julia. "Mastering the Art of French Cooking". PopSugar. Available: www.yumsugar.com/Julia-Child-Steamed-Mussels-Recipe-24274999
[3] Kidd, Kristine. Monterey Bay Aquarium. Available: http://www.montereybayaquarium.org/cr/cr_seafoodwatch/recipes/mussels_linguini.aspx

Pacific oyster

Crassostrea gigas

BIOLOGY
FACT SHEET



Photo: <http://trialx.org>

San Diego seafood profiles

Taxonomic description

- Elongated, sculpted shell with rounded radial folds (wavy) [3].
- Shell is rounded with fluting when grown on hard substrate; oval, smooth on soft substrate
- Shell color is usually white with purple streaks & spots, inside of shell is white with a purple hue over muscle scar [1,2]
- Shell length is normally 10-15 cm (4-6'), but as long as 38 cm (15') [1]

Distribution

- Occurs naturally in estuarine & coastal waters of Japan and Southeast Asia [1,2]
- Introduced around the world as a way to revive exploited oyster stocks [2]
- In No. America, it occurs from southeastern Alaska to Baja California

Life history

- Can live up to 30 years, but fully mature and able to reproduce after 1 year [2]
- Grows 2.5 cm (1") per year. [3]
- Begins life as a male, but after a year functions as a female [3]
- Spawning is temperature dependent, usually occurring when warm (i.e., often summer breeders)
- Minimum reproduction temperature is 15° C (59° F), maximum temperature is 34° C (93.2° F) [3]
- Fertilization occurs externally, free-swimming larvae group together to find suitable habitats on which to settle. [3]

Habitat

- Found in sheltered waters, from slightly above sea level to subtidal depths of 3 meters (9.8 ft) [3]

- Settles on hard surfaces, such as rocks, pier pilings, shells of adult oysters or other shellfish species [3]
- Filter feeder, feeds on phytoplankton & detritus in the water
- Predators include seastars, crabs, benthic feeding fish, and wading birds [3]

References

- [1] Moore, T.O., J.D. Moore. 2008. Culture of oysters. Status of the fisheries report. California Dept. of Fish and Wildlife.
- [2] Nehring, S. 2011. NOBANIS - Invasive Alien Species Fact Sheet - *Crassostrea gigas*. - From: Online Database of the European Network on Invasive Alien Species - NOBANIS www.nobanis.org.
- [3] NIMPIS 2013, *Crassostrea gigas* reproduction and habitat, National Introduced Marine Pest Information System. www.marinepests.gov.au/nimpis
- [4] <http://animals.nationalgeographic.com/>

Did you know?

It is possible for members of the food oyster family, like this one, to produce pearls but they are in a different family than the pearl oysters [4].

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Pacific oyster

Crassostrea gigas

FISHERY
FACT SHEET



A bag of locally grown Pacific oysters

Photo: www.tastespotting.com

San Diego seafood profiles

Seasonal availability

- Available year-round when farm-raised

Managing authority

- Growing methods & product are regulated by federal, state & local agencies (e.g., Army Corps of Engineers (lead), NOAA, U.S. Fish & Wildlife Service, US. Dept of Agriculture, Food & Drug Administration, County Dept of Public Health) [i].
- Pacific Coast Shellfish Growers Association is an industry-based organization that includes & represents growers along the U.S. Pacific coast in establishing science-based farming practices, & ensuring environmental protection, shellfish safety, & support with regulatory, technology & marketing updates.

Gear type

- Grown in trays submerged in a local embayment. Removed every 3 weeks, rinsed, and put in tumbler, which mimics wave action & breaks off the leading edge where shell

grows. When put back in trays, oyster repairs shell, resulting in a deeper, cupped shape shell & fatter oyster [ii]

- No fertilizers, chemicals or antibiotics added- food is naturally occurring phytoplankton.

Status of the fishery

- Most U.S. farms produce their own juvenile oysters (called "seed") from selected broodstock [i].

Potential ecosystem impacts

- Aquaculture reduces the pressure on local natural populations and limits the need for imported seafood.
- Shells are recycled for uses in the environment (e.g., nest material for endangered least terns or used in construction by humans) [ii]
- This oyster is potentially invasive in local ecosystems due to culinary preference of this Japanese species over the native (i.e., it is prevalent), fast growth and reproductive rates, and tolerance to a wide range of environmental conditions [ii, iii, iv]

- Potentially contributes to spread of other introduced species (e.g., Atlantic oyster drill)
- Improves water quality through its feeding activity which removes algae and particulates.

References

- [i] FishWatch. 2013. Pacific oyster. NOAA FishWatch U.S. Seafood Facts. www.fishwatch.gov/seafood_profiles/species/oyster/species_pages/pacific_oyster_farmed.htm
- [ii] Carlsbad Aquafarm. Prod. Brian Robles and Cindy Kendrick. Green-Scene, 2013. YouTube.
- [iii] University of California Davis. 1996. California Oyster Culture. California Aquaculture. University of California, Davis Department of Animal Science.
- [iv] Johnson, C.S. "A new oyster invades" <http://caseagrannews.org/2013/07/02/a-new-oyster-invades/> July 2013.
- [v] Washington Dept of Fish and Wildlife. 2013. <http://wdfw.wa.gov/fishing/shellfish/oysters/facts.html>

Did you know?

It is a myth that oysters are poisonous during months without the letter "R" in them (summer months); a lot of energy is put into reproduction in these months leaving the meat too thin and watery for marketing [v].

Pacific oyster

Crassostrea gigas

NUTRITION FACT SHEET



Oysters with chili and coriander

Recipe by Riaboo, OpenSourceFood.com

San Diego seafood profiles

Edible portions

- Entire contents of the shell

Culinary uses

- Local oysters are available fresh; imported can be found canned, or frozen [3]
- Shucking, or opening, the oyster requires a special shucking knife inserted into the shell to pry it open, and to cut the hinge and adductor muscle in order to remove meat [e.g. 4].
- Many people prefer raw oyster, but they can also be roasted, steamed, fried, scalloped, stewed, baked, stuffed, boiled, marinated, poached and sautéed
- Used in various recipes, such as oyster stew, pan fried oysters, scalloped oysters with fennel, glazed oysters on crab and leeks, and chicken with oysters and straw mushrooms [e.g. 5]

Description of meat

- The sweet and mild flavor is highly valued
- Has a salty kick with a delicious buttery texture

Nutritional information

Raw (50g or 1.8oz) [1]

Nutrition Facts	
Serving Size 50 g	
Amount Per Serving	
Calories 41	Calories from Fat 10
% Daily Value*	
Total Fat 1g	2%
Saturated Fat 0g	1%
Trans Fat	
Cholesterol 25mg	8%
Sodium 53mg	2%
Total Carbohydrate 2g	1%
Dietary Fiber 0g	0%
Sugars	
Protein 5g	
Vitamin A 3%	Vitamin C 7%
Calcium 0%	Iron 14%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

NutritionData.com

Seasonal availability

- Available farm fresh in San Diego year-round

Toxicity report

- There are no reported contaminants from local farm raised oyster [6]; wild caught oyster from San Diego are not recommended for consumption without bay water quality and oyster toxicity analyses.

References

- [1] Seafood Health Facts. Pacific Oyster, 2013. <http://seafoodhealthfacts.org/seafood_choices/oysters.php>.
- [2] Moore, T. 2008. Pacific Oyster, *Crassostrea gigas*. Status of the Fisheries Report 2008. California Dept of Fish & Wildlife. <http://dfg.ca.gov/serp.html?q=pacific+oyster&cx=001779225245372747843%3A3y4rnp6j9ny&cof=FORID%3A10&ie=UTF-8>
- [3] EDF Seafood Selector. 2013. Monterey Bay Aquarium Foundation. <http://seafood.edf.org/oysters>.
- [4] SeaFishTheAuthority, 2013. How to prepare Pacific Oysters. www.youtube.com/watch?v=qchyy_HrSHc.
- [5] Pacific Coast Shellfish Growers Association, 2013. <http://pcsga.org/previewdns.com/recipes-nutrition/>.
- [6] The Super Green List. 2013. Monterey Bay Aquarium Seafood Watch. www.montereybayaquarium.org/cr/cr_seafoodwatch/sfw_health.aspx
- [7] Main, E. 2013. 6 Surprising Facts about oysters. Rodale News. www.rodale.com/benefits-eating-oysters-0?page=1

Did you know?

Oysters are an aphrodisiac... maybe. Oysters contain more zinc than other foods, and zinc is a key mineral for sexual health in men (severe deficiency can lead to impotence). It is more likely, however, that the power of suggestion is stronger than any direct effect [7]!

Pacific oyster

CULINARY INFO SHEET

Crassostrea gigas

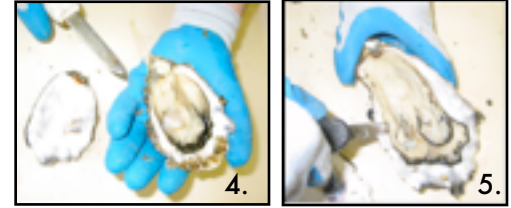
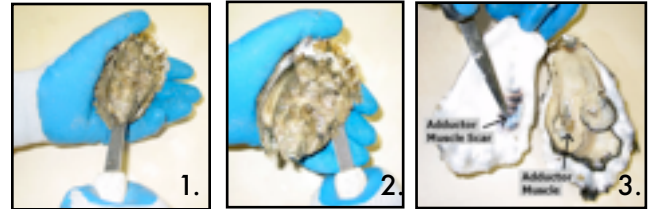
STEP 1: SHUCK

Tools:

- Shucking or oyster knife
- Garden gloves

Method:

1. **TWO TECHNIQUES** are side-entry and hinge-entry shucking, presented here is the hinge-entry shucking method [1]
2. **POSITION** oyster cupped side down, with the hinge facing you (Fig.1).
3. **SEPARATE** Insert the tip of the oyster knife between the two shells where they join at the hinge (Fig. 1). Use a twisting motion to gently pry the shells slightly apart. Move the blade forward along the "roof" of the top shell and sever the adductor muscle where it joins the top shell (approximately the "2 o'clock" position, fig. 2,3). When the muscle has been severed, the top shell will "give" a little.
4. **PRY APART** Gently pry the top shell away from the bottom shell with the knife blade. With the shells just slightly apart, use the knife blade to gently scrape any remaining oyster tissue off the inner top surface of the shell. Remove the top shell (Fig. 4).
5. **FINISH** Move the knife blade underneath the oyster meat and cut the adductor muscle where it is attached to the bottom shell (fig. 5)



Photos: http://wdfw.wa.gov/fishing/shellfish/oysters/how_to_schuck.html [1]

STEP 2: PREPARE

San Diego seafood profiles

Starter | Chili & Coriander Oysters

Adapted from Riaboo; nibbledish.com [2]

Ingredients (serves 6):

- 12 Fresh oysters
- 1 Red chili pepper, large
- 1/2 Cucumber, medium-sized
- 2 limes, juiced
- 1/2 cup fresh coriander
- 1 red onion, medium-sized
- 2 tbsp virgin olive oil
- salt & pepper to taste



Photo: www.nibbledish.com/people/Riaboo/recipes/oysters-with-chilli-and-coriander [2]

Method:

1. De-seed the chili pepper, put it in a blender along with cucumber, onions, coriander, lime juice and olive oil. Blend for a few seconds to roughly chop.
2. Put the mixture in a bowl and add salt & pepper to taste.
3. Clean the oysters under running cold water using a brush to get rid of grit and sand.
4. Open the oysters and arrange on a large plate, then spoon the dressing on top.

Tip: Prepare the dressing ahead of time and refrigerate.

Light Entrée | Elegant Oyster Soup

Adapted from DSPROUT, allrecipes.com [3]

Ingredients (serves 6):

- 2 tablespoons butter
- 1/2 cup carrot, finely chopped
- 1/2 cup onion, finely chopped
- 1/2 cup celery, finely chopped
- 1/2 cup button mushrooms, chopped
- 1/2 cup butter
- 1/4 cup all-purpose flour
- 1 quart chicken broth
- 14 ounces artichoke hearts, drained
- 1 bay leaf
- 3/4 teaspoon salt
- 1/2 teaspoon cayenne pepper
- 1/4 teaspoon dried thyme
- 1/4 teaspoon dried oregano
- 1/4 teaspoon dried sage
- 1 cup heavy cream
- 12 shucked oysters and juice



Photo: RanchersDaughter, allrecipes.com

Method:

1. In a large pot, saute chopped carrot, onion, celery and fresh mushrooms in 2 tablespoons of butter for 5 minutes or until the onions are transparent.
2. In another large pot, melt 1/2 cup butter and stir in the flour. Cook for 5 minutes.
3. Whisk in the chicken broth to the flour mixture. Add the sauteed vegetables, artichokes hearts, bay leaf, salt, cayenne pepper, thyme, oregano and sage. Simmer for 30 minutes over medium heat.
4. Whisk in cream and add oysters; bring to a simmer, but do not boil.

SERVING SUGGESTIONS:

Oysters may also be grilled, fried, baked, stuffed, or roasted

OTHER RECIPE IDEAS:

Oysters casino, scalloped oysters, oysters Rockefeller, or raw with a squeeze of lemon and dash of hot sauce



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References

- [1] http://wdfw.wa.gov/fishing/shellfish/oysters/how_to_schuck.html
- [2] www.nibbledish.com/people/Riaboo/recipes/oysters-with-chilli-and-coriander
- [3] <http://allrecipes.com/Recipe/Elegant-Oyster-Soup/Detail.aspx?evl19=1>

Pacific rock crabs

BIOLOGY FACT SHEET

red: *Cancer productus*
yellow: *Cancer anthonyi*
brown: *Cancer antennarius*



yellow rock crabs in pre-mating embrace taken
at 70' at La Jolla Shores by Volker Kilian

<http://week.divebums.com/2009/Apr27-2009/>

San Diego seafood profiles

Taxonomic description

- Distinguished by their broad carapaces (outer shell) and claws [2]
- Males have slender abdomens and are larger than females, which have broad abdomens where they carry eggs [1,2]
- These crabs grow to different sizes, but rarely exceed 20 cm (8") in width. [1]
- The red rock crab is brick red in color, the brown crab is dark brown with red spots, the yellow crab is light brown to pale yellow with no spots [2]

Distribution

- Found along California's coastline, from Baja California to Washington [2]
- Though the three species ranges overlap, red rock crab is most common in northern California, the brown crab in central California and the yellow crab in southern California [1]

Life history

- Grow in steps, molting the external shell at each step [1].
- Mating occurs throughout the year, but peaks in Spring in California, and happens when females have soft shells just after molting [1].
- Three months after mating, eggs are produced and then fertilized from a sperm packet left by the male during mating. The female carries the eggs for six to eight weeks until they hatch [1].
- Larvae are planktonic and go through seven developmental molts before settling to the bottom as juveniles [1].

Habitat

- Found mostly from the low intertidal to greater than 100 m (328 feet) depth [1].

- Are commonly found in rocky substrates, except for the yellow rock crab which lives on sandy bottoms [1].
- Act as predators and scavengers, using their claws to feed on shelled animals such as snails and clams [1]
- As juveniles they are prey to commercial fishes and invertebrates like octopus [2].
- Adults contribute to the diet of the threatened southern sea otter and other species [2].

References

- [1] Leet, W.S. 2001. Rock Crab. California's Living Marine Resources: A Status Report. California Department of Fish and Wildlife.
- [2] Carroll, J.C., R.N. Winn. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)-brown rock crab, red rock crab, and yellow crab. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.117). U.S. Army Corps of Engineers, TR EL-82-4. 16 pp
- [3] Schmitt, W. L. "The Marine Decapod Crustacea of California." Google Books. N.p., n.d. Web. 7 Aug. 2013.

Did you know?

Crustacean chivalry: Males will often guard a female who is preparing to molt, by holding her under his abdomen [2].

Pacific rock crabs

FISHERY FACT SHEET

red: *Cancer productus*
yellow: *Cancer anthonyi*
brown: *Cancer antennarius*



Photo: Alisha Utter

Zack Roach & Luke Halmay selling family-caught crab & sea urchin
Tuna Harbor, San Diego Bay

San Diego seafood profiles

Seasonal availability

- Year-round [i]

Managing authority

- As of 2002, the Fish and Game Commission was authorized to adopt regulations to manage annual general trap permits & catch regulations in accordance with the Marine Life Management Act of 1998 [ii]

Gear type

- Baited rectangular traps made of welded mesh or collapsible plastic attached to a buoy.
- Most commercial trapping occurs 27-73 m (90-240 ft) deep on open sandy bottoms or nearby rocky reefs [ii]
- Commercial crab boats are typically small & may set 200+ traps, which must each be raised & emptied every 96 hrs, weather permitting [ii]
- Prior to 1991, only the trapped crabs' claws were harvested; clawless crabs were returned to the ocean with the hope that claws would

regenerate. Today, it is illegal to harvest only claws and most are landed alive for sale at fresh fish markets [ii]

Status of the fishery

- There is little to no information on the fishery in California
- One of the only major near shore fisheries with no restricted access and a low capital entry requirement; if these factors result in increased fishing pressure (high intensity for long periods of time), reductions in crab abundance and size may result [ii].
- The fishery is sustained by setting a minimum harvest on pre-reproductive crabs (<4.25 in. width at widest part of the body shell) and by including a 3.24 in escape ring on traps [i]
- Beneficial future management efforts include: increased collaborative data collections, testing effects of a restricted access program in areas of high fishing intensity, gear modifications to reduce bycatch of other species [ii].

Potential ecosystem impacts

- No information is available for this particular fishery, but use of baited traps in general may lead to unintended catch, damage to seafloor in rough conditions, and entanglement of marine mammals in buoy lines. Solutions exist for most of these potential effects (e.g., release of bycatch, breakaway lines) [iii]

References

- [i] California Fish and Game Commission. Marine Region. 2013. California Commercial Fishing: Commercial Fishing Digest. State of California.
- [ii] Parker, D.O. 2002. Annual Status of the Fisheries Report. California Dept of Fish & Wildlife. Marine Region.
- [iii] Monterey Bay Aquarium. 2013. Fishing Methods Fact Card: Traps and Pots. www.montereybayaquarium.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_TrapsandPots&TrawlingFactCards.pdf
- [iv] Parker, D.O. 2001. Rock Crabs. California's Living Marine Resources: A Status Report. Calif Dept of Fish & Game.

Did you know?

NorCal is missing out: 85-90% of the commercial rock crab landings are in southern California, because the Dungeness crab is the fishery focus in northern California [iv].

Pacific rock crabs

NUTRITION FACT SHEET

red: *Cancer productus*
yellow: *Cancer anthonyi*
brown: *Cancer antennarius*



Photo: <http://www.catalinawholesale.com>

San Diego seafood profiles

Edible portions

- Claw meat is most commonly eaten, however the entire crab may be used in some recipes.

Culinary uses

- Crack the shell as you would an egg: be gentle to not destroy the contents [3]
- Use the claws, or crack the entire shell & clear out guts, to cook in sauce or broth.
- Meat does not re-heat well, but freezes well so freeze until ready for use [4].
- Easy preparation ideas:
 - boil the claws in a broth containing your favorite seasoning and serve with melted butter or mayo
 - cook whole cleaned crab in tomato-based sauce for pasta or pizza
 - cook claws in cioppino, paella, or seafood stew
 - steam or boil claws, remove meat and use in crab cakes or casseroles.

- Popular dishes include crab cakes, bisques and chowders, pastas, and even crab mac-n-cheese [5].

Nutritional information

Hard shell crab, steamed [1]

Nutrition Facts	
Serving Size 1 cup, cooked, flaked and pieces	
Amount Per Serving	
Calories 119	Calories from Fat 19
%	
% Daily Values*	
Total Fat 2.08g	3%
Saturated Fat 0.267g	1%
Polyunsaturated Fat 0.796g	
Monounsaturated Fat 0.328g	
Cholesterol 117mg	39%
Sodium 708mg	38%
Potassium 379mg	
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 23.64g	
Vitamin A 0%	Vitamin C 6%
Calcium 12%	Iron 6%

* Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Nutrition Values are based on USDA Nutrient Database SR18

Description of meat

- Claw meat is very sweet

Toxicity report

- No known contaminants.

Seasonal availability

- Available fresh year-round [2]

References

- [1] Fatsecret. 2013. Steamed Hard Shell Crab. www.fatsecret.com/calories-nutrition/generic/crab-hard-shell-steamed
- [2] California Fish and Game Commission. Marine Region. 2013. California Commercial Fishing: Commercial Fishing Digest. State of California
- [3] <http://vimeo.com/54756986>
- [4] Shaw, H. 2013. Pacific Red & Rock Crabs: Cheap & Plentiful. Fish & Seafood Cooking. About.com. http://fishcooking.about.com/od/meetyourfish/p/Pacific_crab.htm
- [5] Santa Monica Seafood. 2012. Introducing Pacific Stone Crab Meat!. www.santamonicafood.com/blog/2012/04/10/introducing-pacific-stone-crab-meat/.
- [6] Amistaadt, A.J. How to cook red rock crab. eHow. http://www.ehow.com/how_5057747_cook-red-rock-crab.html

Did you know?

For rock crabs 4-6" wide, figure on 8-10 crabs per person if just using the claws [6].

Pacific rock crabs

CULINARY INFO SHEET

red: *Cancer productus*
yellow: *Cancer anthonyi*
brown: *Cancer antennarius*

STEP 2: PICKING COOKED CRAB

Tools:

- Nutcracker
- Newspaper (picking gets messy!)

Method:

1. **PREP** Remove each claw by grabbing the base and pulling it away. If the crab is small (top shell is $5\frac{1}{2}$” wide), discard the body or use it in stocks or sauces. If the crab is big also pick the body and legs for meat.
2. **PICKING CLAW MEAT** Pull the lower part of each claw off. This often pulls the inner claw meat with it, but if needed pinch the meat and pull it away from the cartilage
3. **Crack the rest of the claw** and knuckles with a nutcracker. Gently increase pressure until the claw is cracked, then pick away the shell and extract the meat. If you crush it too forcefully, you will mash the meat and bits of shell will get into it.
4. **PICKING BODY MEAT** Slip your finger under the plate on the bottom of the crab, peel it back by grabbing the base of it, and pull the whole thing away.
5. **Open the body** by wedging your thumbs on opposite sides of the body (fig.1), then pull the top of the crab away from the bottom of the crab. Start cleaning the inside by grabbing the front end of the crab and pinching away the whole mass.
6. **Remove** the feathery gills that line the side of the body, and throw them away. Scrape out the greenish stuff (the liver, also called “mustard”); it’s edible and many love it. If you have a female crab you may see bright orange roe, or eggs. Some eat this warmed and served on toast, put into crab cakes, or added to crab soups.
7. **Pick** out the meat located in cartilage-lined channels in each side of the body.



Photo: http://fishcooking.about.com/od/crablobsterrecipes/ss/crab_picking.html [1]

San Diego seafood profiles

STEP 1: COOKING

Prep | Boiling rock crab

Adapted from www.ehow.com [2]

Tools:

- Live rock crabs
- Large lobster pots, at least 2
- Salt

Method:

1. Fill a pot with very cold water, add a couple of trays of ice and set it aside.
2. Fill another pot with water up to 3-4” from the top. Add ¼ cup of salt for each gallon of water, and bring to a rolling boil.
3. Drop the crabs into the boiling water one at a time, taking care not to overcrowd the pot. Each crab should move freely about in the water with the boiling action. If you have a lot of crabs, cook them in batches.
4. Once the crabs have been added and the water stops boiling, cover the pot. Return it to a boil, and continue to cook for 12-15 minutes. When the crabs begin to float to the surface of the water, cook for another 2-3 minutes.
5. Remove the crabs from the boiling water with tongs and plunge them immediately into the pot of ice water to halt the cooking process and prevent shrinkage and drying of the meat.
6. Cool the cooked crabs in the ice water for 3-4 minutes. Remove them from the water and drain them. You can let them cool further if they're still too warm to handle comfortably with your fingers. It's all right to begin picking out the meat at any time after removal from the ice water.
7. Put any unused whole cooked crabs into plastic sealable food storage bags. They'll keep in the refrigerator for up to a week.



Photo: <http://seattlefoodshed.wordpress.com>

STEP 3: PREPARING

Light Entrée | Crab Cakes

Adapted from Linda Check, allrecipes.com [3]



Photo: Jessica, allrecipes.com

Method:

1. In a medium bowl, whisk together egg, mayonnaise, lemon juice, red pepper flakes, tarragon, and scallions. Gently stir in crabmeat, being careful not to break up meat. Gradually mix in cracker crumbs, adding until desired consistency is achieved.
2. Heat oil in a skillet over medium heat. Form crab mixture into 4 patties. Place patties in skillet, and cook until golden brown, about 5 to 6 minutes on each side.

Ingredients (serves 4):

- 1 egg
- 3 tbsl mayonnaise
- 4 tsp lemon juice
- 1/8 tsp red pepper flakes
- 1 tsp dried tarragon
- 1 tbsl minced green onions
- 8 ounces crabmeat
- 1/2 cup crushed buttery round crackers
- 1 tbsl butter or olive oil

Picking a crab seems like a lot of work, but you'll get the hang of it and be picking crabs in a few minutes each.

SERVING SUGGESTIONS:

Crab meat can be picked before serving for use in recipes, or after serving to be eaten right from the shell.

OTHER RECIPE IDEAS:

Try crab meat in dip, soup, salad, scampi, pasta dishes or simply out of the shell with a little lemon.



References

- [1] http://fishcooking.about.com/od/crablobsterrecipes/ss/crab_picking.html
- [2] www.ehow.com/how_5057747_cook-red-rock-crab.html
- [3] <http://allrecipes.com/Recipe/Best-Ever-Crab-Cakes/Detail.aspx?ev19=1>

Pacific sardine

Sardinops sagax

BIOLOGY FACT SHEET



Photo: sardineking.com

San Diego seafood profiles

Taxonomic description

- Small schooling fish with a silver body and dark spots on its back
- Can grow to 16" (41 cm) long, but are regularly seen less than 12" (30 cm)
- One of the 18 species of the herring family found worldwide [1]
- At times as been the most abundant fish species in the California Current [1]

Distribution

- Worldwide, found in the subtropical and temperate waters of the Pacific and Indian Oceans and in the Atlantic by South Africa [2]
- Along western North America, found from the Gulf of California to southeastern Alaska [1]

Life history

- Can live as long as 14 years old, however, 90% of the population is younger than 6 years old. [1]
- Sardine matures when smaller and by age 1 during years of low total biomass, and when larger and older (≥ 2 yrs old) in years of high total biomass [1]
- Spawning occurs in schools in the upper 50 m (165 ft) of the water column [1]
- Most spawning occurs between 13°-17° C (55° - 63° F), with shifts northward and lasting for longer periods during warmer conditions
- Peaks in spawning are April - August in the north, and January - April in southern California

Habitat

- A temperate, coastal pelagic fish (i.e., open water) [1].

- Migratory, traveling in very large schools but are an important prey item for marine life such as birds and larger pelagic fish [1]
- Filter feeders that feed on phytoplankton and zooplankton [2]

References

- [1] Protasio, C. 2011. Pacific sardine, *Sardinops sagax*. Status of the Fisheries Report 2011. California Dept. Fish & Wildlife. <http://www.dfg.ca.gov/marine/status/>
- [2] Monterey Bay Aquarium, Seafood Watch - Pacific Sardine. www.montereybayaquarium.org/cr/cr_seafoodwatch
- [3] Cabrillo Marine Aquarium. 2013. Pacific Sardine. www.cabrillomarineaquarium.org/exhibits/socal-species-details.asp?id=21

Did you know?

Overcrowded classrooms: The Pacific sardine forms schools of up to 10 million fish [3]!



UC San Diego

Pacific sardine

FISHERY FACT SHEET

Sardinops sagax



Photo: Pacific Media Productions (PMP)

San Diego seafood profiles

Seasonal availability

- Fishery open year-round [i]
- Landings fluctuate due to shifting environmental conditions associated with Pacific Decadal Oscillation & changes in sea surface temperature [ii]

Managing authority

- NOAA Fisheries Service manages the fishery under the Coastal Pelagic Species Fisheries Management Plan, which was implemented by the Pacific Fishery Management Council (PFMC) [iii]

Gear type

- Round haul gear (purse seines, drum seines, & lampara nets) used to encircle schools (iii)
- Seines/nets are dragged through the water column, limiting the potential for disrupting the ocean bottom [ii]

Status of the fishery

- NMFS Fish Stock Sustainability Index classifies the stock as a “4” out of 4, reflecting that the stock has known status, is not overfished or subject to overfishing, & maintains a biomass at or above maximum sustainable yield [iv].
- Fishery declined and collapsed from the late 1940’s to late 1980’s due to several heavily-debated factors. In 1999 after a moratorium, the fishery was deemed “fully recovered” [iii]
- The PFMC sets an overfishing limit, an acceptable biological catch, & an annual catch target [i].

Potential ecosystem impacts

- Although fishing efforts may catch non-target species, most are sold for human consumption (i.e. Pacific Mackerel); discarded “bycatch” makes up <1% of landings [ii]
- A significant reduction in the amount of forage fish biomass, such as sardines, can disrupt ecosystem functioning given that they transfer plankton into a food source for higher trophic level organisms [ii]

- Sardine biomass is negatively correlated with that of anchovy, which flourish under “warm regime” Pacific Decadal Oscillation conditions. If sardine stocks are low enough, anchovies may fill the vacant ecological niche [ii].

References

- [i] Pacific Fishery Management Council. 2012. Coastal Pelagic Species: Current Season Management.
- [ii] Hislop, K. 2013. Seafood Watch: Pacific Sardine Report. Rep. Monterey Bay Aquarium.
- [iii] Protasio, C. 2011. Pacific Sardine. Status of the Fisheries 2011. California Dept of Fish & Wildlife. <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=65547&inline=true>
- [iv] NOAA National Marine Fisheries Service. 2008 Status of the Fisheries. United States Department of Commerce.
- [v] NOAA, National Marine Fisheries Service. 2013. 2nd Quarter 2013 Update. United States Dept of Commerce.
- [vi] Lindgren, M., et al. 2013. Climate, fishing & fluctuations of sardine and anchovy in the California Current. PNAS. <http://www.pnas.org/content/early/2013/07/05/1305733110.full.pdf>

Did you know?

The sardine fishery collapse of the 1950’s may not have been solely due to overfishing as was long thought, but due to climate change and/or natural long-term fluctuations of fish populations [vi].

Pacific sardine

NUTRITION FACT SHEET

Sardinops sagax



slow grilled sardines by mark bittman

www.more.com

San Diego seafood profiles

Edible portions

- May be eaten whole or after scaling and gutting the fish.

Culinary uses

- When buying local, fresh sardines look for bright eyes, shiny skin, firm to the touch and a fresh smell [2,4]
- Good advice: never freeze fresh sardines!
- Can be used in numerous delicious, easy dishes, such as ceviche, fish tacos, salsas, tomato sauces for pasta, smoked sardine pâté, and on pizza
- Simplicity is key! Some easy preparation ideas include [4,5]:
 - marinate in salt, olive oil, & lemon juice; then grill, pan-sear, or broil
 - combine with onions, olives & fennel
 - top with chopped tomato, & rosemary, basil or oregano

Toxicity report

- No known contaminants.

Nutritional information

Fresh (3.5 oz) [1]

Nutrition Facts	
Serving Size 100 grams (100g)	
Amount Per Serving	
Calories 125	Calories from Fat 45
% Daily Values*	
Total Fat 5g	8%
Saturated Fat -	
Cholesterol -	
Sodium -	
Total Carbohydrate 0g	0%
Dietary Fiber -	
Sugars -	
Protein 20g	
Vitamin A -	Vitamin C -
Calcium	Iron -

*Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

- Promotes good cardiovascular health- rich in omega-3 fatty acids, vitamin B12, EPA, & DHA, which lower triglyceride & cholesterol levels, and reduce risk of atherosclerosis [4,5]
- Promotes good bone health- rich in vitamin D, which aids uptake of calcium [4,5]
- Is a great, inexpensive source of protein [4]

Description of meat

- Smaller sardines have a delicate flavor, while the larger ones have a fuller, oilier taste that is similar to (but milder than) anchovies [4].

Seasonal availability

- Available fresh year-round [2,3]

References

- [1] Fat Secret: All things food and diet. 2013. Fresh sardines. www.fatsecret.com/Diary.aspx?pa=fjrd&rid=72915
- [2] Fish Watch. 2012. US Seafood Facts, National Oceanographic and Atmospheric Administration www.fishwatch.gov/seafood_profiles/species/sardine/species_pages/pacific_sardine.htm
- [3] Protasio, Chelsea. 2011. Pacific Sardine, *Sardinops sagax*. Status of the Fisheries Report 2008. California Department of Fish and Wildlife. 28 July 2013. <http://dfg.ca.gov/serp.html?q=pacific+sardine&cx=001779225245372747843%3A3y4rnp6j9ny&co=FORID%3A10&ie=UTF-8&siteurl=http%3A%2F%2Fdfg.ca.gov%2F>
- [4] The World's Healthiest Foods. 2013. The George Matelijan Foundation. <www.whfoods.com>
- [5] The Super Green List. 2013. Monterey Bay Aquarium Seafood Watch. www.montereybayaquarium.org/cc/cr_seafoodwatch/sfw_health.aspx

Did you know?

Sardine is considered one of the healthiest foods in the world [4]!

Pacific sardine

CULINARY
INFO SHEET

Sardinops sagax

STEP 1: CLEAN

Tools:

- Cutting Board
- Paring Knife

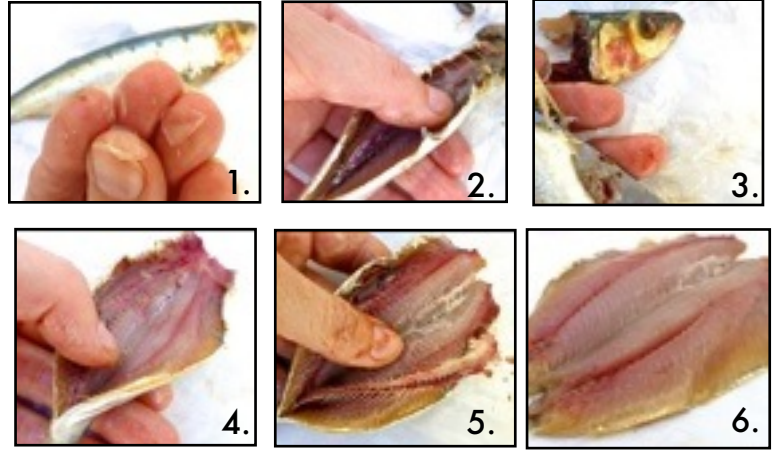


Photo Credit: frugal-foodie-recipes.com [1]

Method:

1. **SCALE** Drag the back of the knife from the tail to head to remove the scales.
2. **CLEAN** Beginning at the anus, make a slit down the entire length of the underside and remove innards, rinsing as needed.
3. **TRIM** Slice off the head and fins.
4. **BUTTERFLY** Create a fillet by opening both sides of the fish.
5. **DEBONE** Starting in the upper body, gently remove the ribs, backbone, and tail from the flesh by pulling upward.
6. **TIDY** Remove any stray bones remaining in the fillet by hand.

San Diego seafood profiles

STEP 2: PREPARE

TIP: Sardines are done cooking when they are opaque, browned, and the tip of a knife easily flakes the thickest part.

Appetizer | Grilled Sardines

Adapted from wholeliving.com [2]

Ingredients (serves 4):

- 1 lb. fresh sardines (~8 fish), cleaned
- 1 tbsp. + 2 1/2 tsp. extra virgin olive oil
- 3/4 tsp. sea salt
- 1/4 tsp. pepper, freshly ground
- 6 in baguette, cut into 16 thin slices
- 1 clove of garlic
- Vegetable oil cooking spray
- 1 lemon, sliced into wedges



Photo Credit: Lara Robby, wholeliving.com [2]

Method:

1. Coat sardines using 1 tbsp. of oil.
2. Season with 1/2 tsp. salt and 1/8 tsp pepper.
3. Rub clove of garlic on cut slices of bread and dress with remaining oil, salt, and pepper.
4. Coat grill pan with cooking spray and heat to medium-high.
5. Grill sardines for 2 mins. per side, or until cooked through.
6. Grill bread for 1 min. per side.
7. Serve on a platter with bread and lemon wedges.

Entrée | Broiled Sardines with Lemon and Thyme

Adapted from nytimes.com [3]

Ingredients (serves 4):

- 12 fresh thyme sprigs + garish
- 1 thinly sliced lemon + wedges
- Pinch of salt and pepper
- 3 tbsp. extra virgin olive oil
- 1 1/2 lbs. sardines (~12 fish), cleaned (may leave head + tail)



Photo Credit: nytimes.com [3]

Method:

1. Adjust oven rack 2-4 inches from broiler. Place empty pan in oven and heat for 5 mins.
2. Wrap each thyme sprig in a lemon slice and stuff one into each sardine. Season with salt and pepper, to taste.
3. Remove pan from oven and pour in half of the olive oil. Place the sardines in the pan and drizzle with remaining oil.
4. Broil sardines for 4-5 minutes, or until cooked through.
5. Gently remove sardines with a spatula, pour the pan juices over them, sprinkle with thyme, and serve with lemon wedges.

SERVING SUGGESTIONS:

Sardines are best baked, broiled, or grilled*.

*Sardine skin is fragile. Use a buffer, such as grape leaves, to keep skin intact.

OTHER RECIPE IDEAS:

Over pasta with tomato sauce; sliced into a dressing; tossed in a salad, tapas; on a sandwich.



References

[1] d' Arville, June. Frugal Foodie. Available: www.frugal-foodie-recipes.com/How-To-Clean-Fish.html

[2] Martha Stewart Living. Whole Living. Available: www.wholeliving.com/131909/grilled-fresh-sardines

[3] The New York Times. Available: www.nytimes.com/2010/12/29/dining/29minirex.html

red ogo seaweed

Gracilaria pacifica

BIOLOGY FACT SHEET



Photo: Wendell Wood (ww@oregonwild.org) [3]

San Diego seafood profiles

Taxonomic description

- Colored pale red to pinkish [1,2]
- Has a central axis from which up to 14 branches arise, each with 2-3 orders of branching [2]
- Slender branches, 1– 2.5 mm (0.04– 0.10”) diameter [1]
- Grows to 30–90 cm (1– 3 ft) tall [2]
- Used to be grouped with another species and classified as *Gracilaria verrucosa* [2]

Distribution

- Found from Southern California to Alaska [2]

Life history

- Like many seaweeds, it has separate, free-living sporophyte (2n) and gametophyte (1n) stages.
- Each stage looks similar, with the female gametophytes most obvious when

reproductive due to dark bumpy reproductive structures (cystocarps) on branches [2].

Habitat

- Found on soft substrates, with fine to coarse texture [4]
- Infrequent, discontinuous distribution on coarse sand or rocks with the ability to form dense beds in some areas [1,4]
- Mostly found in sheltered water from subtidal to high intertidal elevations [1,4]
- Commonly grows in association with a closely related seaweed, *Gracilaria lemaneiformis* [1]

References

- [1] Abbott, I., G. Hollenberg. 1992. Marine Algae of California. Stanford University Press. 844 pp. (listed as *G. verrucosa*)
- [2] Abbott, I.A., J.N. Norris. 1985. Taxonomy of economic seaweeds with reference to some Pacific and Caribbean species. California Sea Grant College Program.
- [3] Guiry, M.D. & Guiry, G.M. 2013. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org/search/species/detail/?species_id=4965
- [4] Schaeffer, K., K. McGourty, and N. Cosentino-Manning (eds.) 2007. Report on the subtidal habitats and associated biological taxa in San Francisco Bay. NOAA Santa Rosa Office.

Did you know?

When the complex sugar (polysaccharide) in the cell walls of this and other red algae is boiled, it produces agar, a gelatinous substance used as a food thickener.

red ogo seaweed

FISHERY FACT SHEET

Gracilaria pacifica

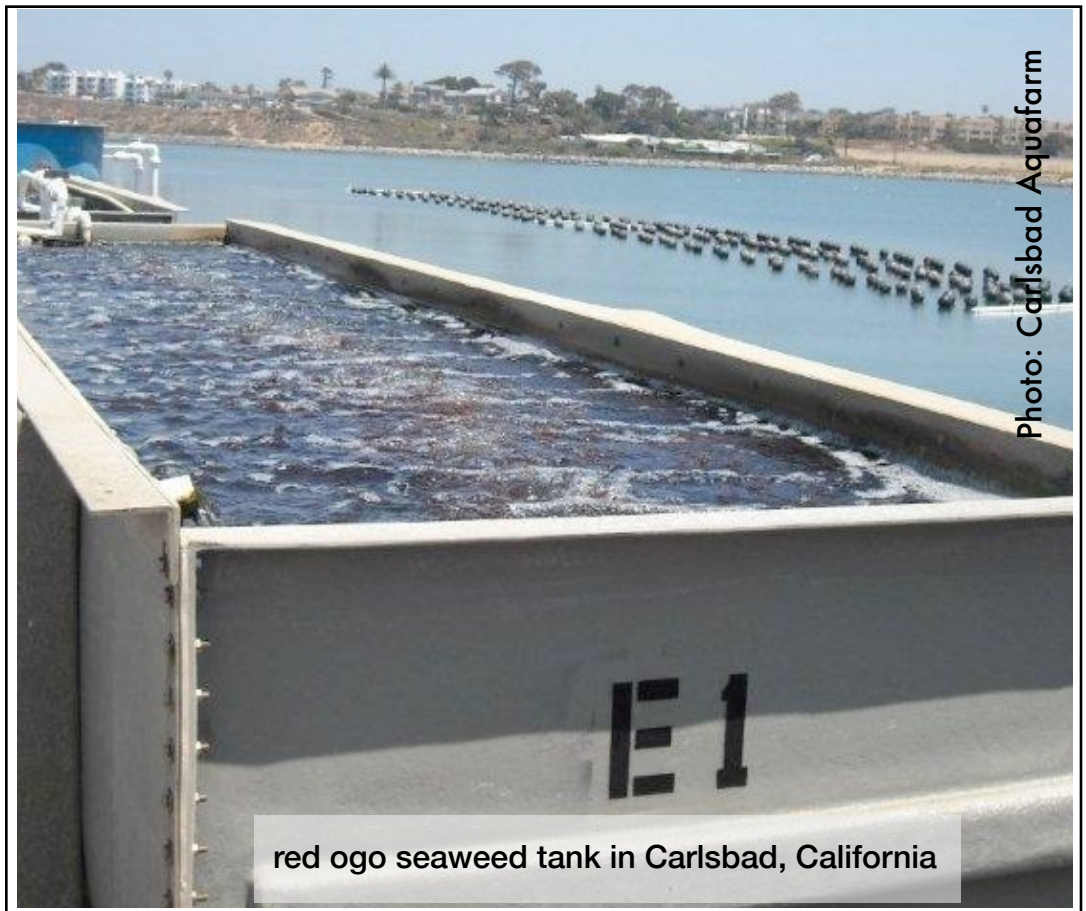


Photo: Carlsbad Aquafarm

red ogo seaweed tank in Carlsbad, California

San Diego seafood profiles

Seasonal availability

- Available May – November
- Takes a few months to create a harvestable mass [i]

Managing authority

- Growing methods & product are regulated by federal, state & local agencies (e.g., Army Corps of Engineers (lead), NOAA, U.S. Fish & Wildlife Service, US. Dept of Agriculture, Food & Drug Administration, County Dept of Public Health).
- California Aquaculture Association promotes sustainable commercial production of plants and animals by conserving California's land & water.

Gear type

- Grown in onshore tanks containing seawater & exposed to natural sunlight [i]

• In Hawai'i, a related species is grown in baskets at the surface of fish ponds where it can utilize excess nutrients [ii].

Status of the fishery

- *G. pacifica* is native to this coast and it not currently under any threat of decline.
- Abundant enough to form beds in some parts of its range, especially in response to nutrient addition.

Potential ecosystem impacts

- Aquaculture reduces the pressure on local natural populations and limits the need for imported seafood.
- No direct ecosystem effects of the gear except for the loss of upland habitat to make room for the tanks.
- Farming of this seaweed, as with most, improves water quality through the removal of nutrients.

References

- [i] Carlsbad Aquafarm. Prod. Brian Robles and Cindy Kendrick. Green-Scene, 2013. YouTube.
- [ii] Glenn, EP, et al. 1998. A sustainable culture system for *Gracilaria parvispora* (Rhodophyta) using sporelings, reef growout and floating cages in Hawaii. *Aquaculture* 165: 221-232
- [iii] Schaeffer, K., K. McGourty, and N. Cosentino-Manning (eds.) 2007. Report on the subtidal habitats and associated biological taxa in San Francisco Bay. NOAA Santa Rosa Office.
- [iv] FactoLex. 2013 *Gracilaria*. http://en.factoLex.com/Gracilaria:algae_red

Did you know?

Many other members of this genus, *Gracilaria*, are also collected and farmed for food and use as thickeners, especially in developing countries [iv].

red ogo seaweed

NUTRITION FACT SHEET

Gracilaria pacifica



red ogo seaweed salad

Recipes from the Kitchn (www.thekitchn.com)

San Diego seafood profiles

Edible portions

- Whole seaweed is eaten

Culinary uses

- Can be stored up to three days in a refrigerator in a covered container (do not place in water)
- Dipping the seaweed into boiling water for approximately ten seconds diminishes saltiness and brightens color, but reduces crispiness [2]
- Is great marinated, added to salads, sandwiches or pastas, or in any dish as a substitute for lettuce.
- Examples of dishes include seaweed and cucumber salad (with feta cheese and lemon) and healthy wraps with seaweed wrapped around rice, seafood or other meats.

Description of seaweed

- Crispy texture with a slightly salty taste
- When fresh, the seaweed has a bright red color, however changes to dark green once cooked [1]

Nutritional information

Considered a “superfood” because it is high in important trace minerals, and potassium, iron, calcium, magnesium and iodine [1]

Serving Size: 1 cup (80g or 2.8oz), fresh

Calories (kcal):	24
Protein (g):	1
Carbohydrate (g):	5
Total Dietary Fiber (g):	0
Total Fat (g):	0
Vitamin A (%):	13
Vitamins C, E (%):	0
Thiamin (mg):	0.02
Riboflavin (mg):	0.14
Niacin (mg):	0.08
Folate (mcg):	2.40
Vitamin B-6 (mg):	0.00
Vitamin B-12 (µg):	0.00
Calcium (mg):	472
Iron (mg):	6
Magnesium (mg):	96
Phosphorus (mg):	17
Zinc (mg):	0
Potassium (mg):	34
Sodium (mg):	60

Percent Daily Values are based on a 2000 calorie diet. [3]

Toxicity report

- There are no known contaminants

Seasonal availability

- Available farm fresh in San Diego May – November.

References

- [1] Ho, Emily. "Recipe: Red Ogo Seaweed Recipes." theKitchn. Apartment Therapy, 06 Aug 2008. Web. 13 Aug 2013. <<http://www.thekitchn.com/la-farmers-market-report-seawe-58761>>.
- [2] "Red Ogo Seaweed Information and Facts." Specialty Produce. Specialty Produce, 03 Sep 2011. Web. 13 Aug 2013. <<http://www.specialtyproduce.com/index.php?item=195>>.
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Did you know?

Eat with the fishes?! Red ogo seaweeds are not only popular with humans, they are also used for aquarium-fish food [4].

red ogo seaweed

Gracilaria pacifica

CULINARY
INFO SHEET

STEP 1: CLEAN

Tools:

FRESH

- Cold water

DRIED

- Newspaper OR oven
- Warm water

Method:

1. **FRESH** If not using immediately, store seaweed covered in the refrigerator for up to 5 days. Only rinse under fresh, cold water immediately before use.
2. **DRIED** To preserve fresh seaweed for long-term use, dry seaweed on newspaper in a sunny spot or place it in a warm oven for a few hours. When ready to use, submerge dried seaweed in warm water for a few minutes, until tender.



Photo: Carlsbad Aquafarm

San Diego seafood profiles

STEP 2: PREPARE

Appetizer | Red Ogo Seaweed Slaw

Adapted from sippitysup.com [1]

Ingredients (serves 4):

Dressing

- 2 tsp. sugar
- 1 tsp. crushed red pepper flakes
- 1/4 c. cilantro, chopped
- 2 tbsp. back sesame seeds
- 1 tbsp. ginger, peeled and grated
- 2 tbsp. olive oil
- 1 tbsp. fish sauce
- 1 lime, juice only

Base

- 2 c. red ogo, chopped
- 1/2 c. chinese red cabbage, shredded
- 1/2 c. carrots, shredded
- 1/2 c. red bell pepper, thinly sliced
- 1/2 c. shitake mushrooms, thinly sliced
- 3 scallions, thinly sliced
- (Optional) red chili peppers
- (Optional) 1 c. arame seaweed



Photo Credit: sippitysup.com [2]

Method:

1. In a bowl, combine ingredients for the dressing. In a larger serving bowl, combine ingredients for the base.
2. Mix dressing with base and serve immediately. If desired, top with arame.

SERVING SUGGESTIONS:

Red ogo may be eaten raw or boiled for 10 seconds to diminish saltiness, reduce crispness, and brighten color.

OTHER RECIPE IDEAS:

Tofu poke; seafood salad with ogo; garnish for fish; ogo tossed with fruit.

Entrée | Red Ogo and Tofu Salad

Adapted from thekitchn.com [2]

Ingredients (serves 4):

Dressing

- 2 tbsp. rice vinegar
- 1 tbsp. sesame oil
- 1 1/2 tsp. honey/agave
- 1 in. ginger, grated
- (Optional) Soy sauce/tamari/liquid amino acids

Base

- 1 c. red ogo, torn or chopped
- 1 c. (~2 small Japanese/Persian) cucumbers, sliced
- 6 oz. firm tofu, cubed

Garnish

- Chives, chopped
- Black sesame seeds



Photo Credit: Gregory Han; thekitchn.com [3]

Method:

1. In a bowl, combine sesame oil, rice vinegar, honey and ginger.
2. Add seaweed, cucumbers and tofu and mix by tossing.
3. If additional salt desired, add soy sauce.
4. Serve immediately with a garnish of chives and sesame seeds.

References

References

- [1] Greg, H. 2010. Notes from the Kona Coast: Ogo Slaw. www.sippitysup.com/notes-from-the-kona-coast-ogo-slaw/
- [2] Ho, E. 2008. Red Ogo Seaweed Salad. [theKitchn](http://thekitchn.com).
- [3] www.thekitchn.com/la-farmers-market-report-seawe-58761



UC San Diego

red sea urchin

Strongylocentrotus franciscanus

BIOLOGY
FACT SHEET

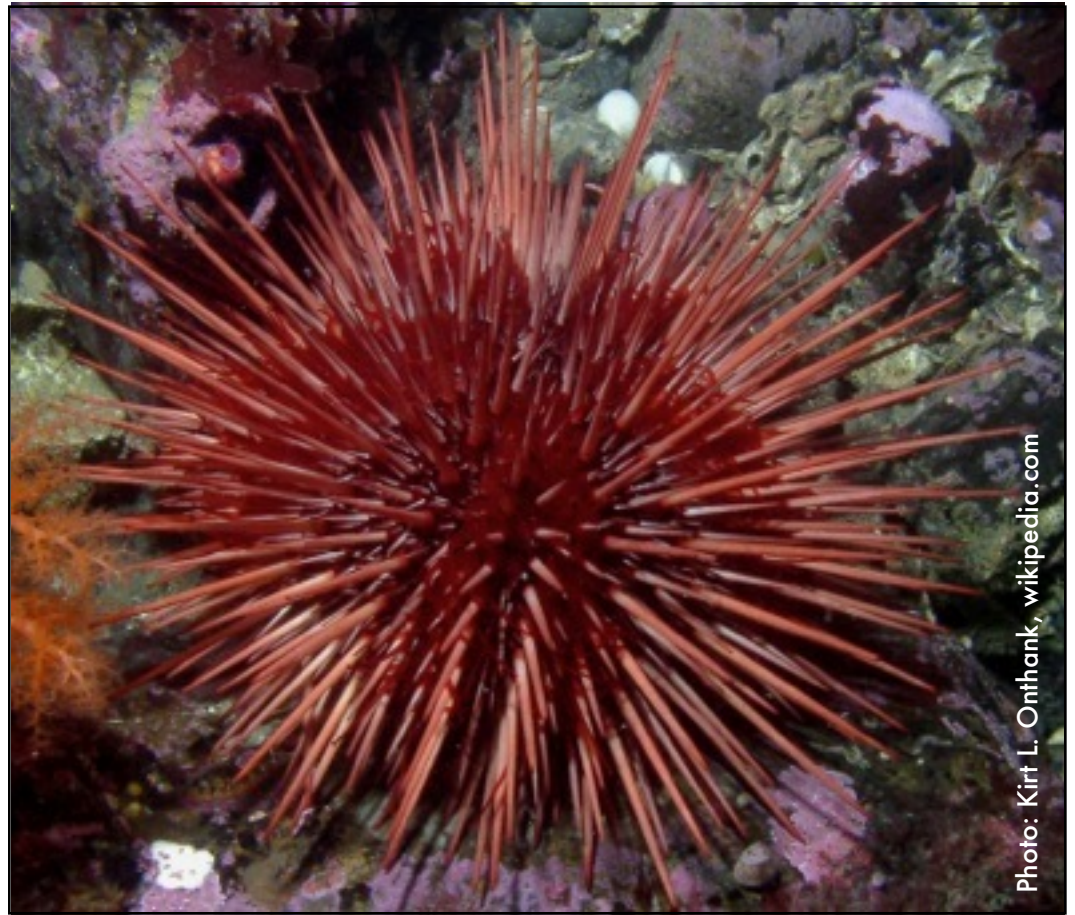


Photo: Kirt L. Onthank, wikipedia.com

San Diego seafood profiles

Taxonomic description

- An echinoderm, in the marine invertebrate group along with sea stars, brittle stars, and sea cucumbers.
- This largest species of sea urchin can grow to be 18 cm (7") diameter with spine lengths of 8 cm (3") [1].
- Recognizable by its dark red almost black body color and large spines.

Distribution

- Found on the west coast of North America as far south as the tip of Baja California, Mexico [2,3]

Life history

- Spawns year round and peaks June – November in San Diego [3].

- When eggs are fertilized they develop into free-swimming larvae for 6-8 weeks until they settle to the sea floor and become juveniles [1]
- Larval and juvenile growth rates depend on water temperature.
- Can live 200 years [4] but most don't

Habitat

- Lives from lower rocky intertidal to depths of 160 m (525 ft).
- Major food source is kelps, so is common in kelp forests
- In San Diego, main predators include spiny lobster & California sheephead [2]; north of Pt. Conception main predator is the sea otter.
- Sensitive to water temperature changes as well as low salinity.

- Sea urchin feeding removes giant kelp so it can structure the whole forest ecosystem.

References

- [1] Red Sea Urchins, *Mesocentrotus franciscanus* ~ MarineBio.org." MarineBio Conservation Society. Web. July 8, 2013. <<http://marinebio.org/species.asp?id=45>>. Last update: 1/14/2013
- [2] Tegner, M. J., P. K. Dayton. 1981. Population structure, recruitment & mortality of two sea urchins (*Strongylocentrotus franciscanus* and *S. purpuratus*) in a kelp forest. *Mar Ecol Prog Ser* 5: 255-268.
- [3] Kato, S, S.C. Schroeter. 1985. Biology of the Red Sea Urchin, *Strongylocentrotus franciscanus*, and Its Fishery. California. *Marine Fisheries Review* 43: 1-20. <http://spo.nmfs.noaa.gov/mfr473/mfr4731.pdf>
- [4] Ebert, T. 2003. Red sea urchins found to live up to 200 yrs. *Science Daily* www.sciencedaily.com/releases/2003/11/031106051646.htm

Did you know?

Among their spines, urchins have two other types of arms: suctioning tube feet and claw-like pedicellaria used to grab food, move and clean themselves. Look closely!



Sea Grant
California

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red sea urchin

FISHERY FACT SHEET

Strongylocentrotus franciscanus



Sea urchin fishing boat offloading at
Driscoll's Wharf in San Diego Bay

Photo: Pete Halmay

San Diego seafood profiles

Seasonal availability

- In California, available year-round with reduced effort Mon-Thurs from April-Oct[1]

Managing authority

- California Department of Fish & Wildlife regulates the fishery
- California Sea Urchin Commission represents interests of California's sea urchin divers; operates under state law to ensure environmental, economic and social sustainability of the fishery.

Gear type

- Fishers use hookah lines for diving to depths of 12-33 m (40-110 ft)
- Collected by hand from crevices using a rake and placed in a collection basket
- In So. California, red sea urchins must have a minimum test diameter of 3.25" (8.2 cm)

Status of the fishery

- Little sustainability concern for local stocks at current level of exploitation & productivity
- Current efforts partner scientists & local fishers to expand monitoring & attain a "profitable, sustainable, locally managed fishery"[3]
- In 1987, after a 1970's State control effort that left ~75% of urchin population depleted in California[2], the industry initiated a moratorium on the fishery, including limited entry, seasonal closures & minimum size limits.
- Despite there being only 18 urchin divers in San Diego with an average age of over 50yr, no new dive permits can be issued at this time

Potential ecosystem impacts

- Minimal impacts when the management strategy considers: (a) amount of sea urchin relative to kelp biomass. E.g., the local fishery may limit population booms that form sea urchin barrens, areas where all of the kelp has been eaten. (b) the harvest of only high quality ("fat") sea urchins (≤50% of total),

which leaves plenty behind to function in the ecosystem and "fatten up".

- In areas with limited rocky substrate, juvenile urchins may depend on the spines of larger, adult urchins for shelter [4] so high harvest rates may affect sea urchin recruitment in these conditions.

References

- [1] California Fisheries Fund . 2009. California Sea Urchin. California Fisheries Atlas .California Fisheries Fund. http://californiafisheriesfund.org/reso_atlas_urch.html.
- [2] Good, D. 2012. Fishing with the Urchin King Pete Halmay. San Diego Magazine. www.sandiegomagazine.com/San-Diego-Magazine/June-2012/The-Urchin-King/.
- [3] California Ocean Protection Council. Nov 2008. The San Diego Sea Urchin Project. www.opc.ca.gov/webmaster/ftp/project_pages/CA_Fisheries/SDWA_Final_Report_NoAppendices.pdf.
- [4] Nishizaki M.T., D.J. Ackerman. 2004. Juvenile-adult associations in sea urchins *Strongylocentrotus franciscanus* and *S. droebachiensis*: Is nutrition involved? Marine Ecology Progress Series 268: 93-103.
- [5] Halmay, Pete. "San Diego Sea Urchin Fishery." Personal interview. 12 July 2013.

Did you know?

The California sea urchin fishery began in 1970 and most were exported to Japan until ca. 2000, when the Japanese economic bubble burst and sea urchins became popular in domestic markets

red sea urchin

NUTRITION FACT SHEET

Strongylocentrotus franciscanus



Uni appetizer at Baci Ristorante, www.sandiegobaci.com; Photo: Kristen Goodrich

San Diego seafood profiles

Edible portions

- The gonads of both male and female red urchins are a culinary delicacy, known as either “roe,” “uni” or “ricci del mar.”
- Gonad quality is ranked on the size, color, texture, taste, and firmness [1]

Description of meat

- Roe, or uni, has smooth, buttery texture with a sweet, complex taste

Culinary uses

- Local sea urchin is mostly available live or fresh.
- Cleaning and cracking the test (the shell) is manageable. Instructions can be found in multiple online resources (e.g., [4])
- Sea urchin can prepared many ways: Freshly cracked & eaten from the test, as sushi, like caviar on pasta, rice, seafood, crackers & cheese, as a flavor enhancer in soups, custards, and pasta dishes[2]

Nutritional information

Sea urchin raw (3.5 oz) [2,3]

Nutrition Facts	
Serving Size 3 pcs of sushi (100g)	
Amount Per Serving	
Calories 120	Calories from Fat 43.2
%	
Total Fat 4.8g	
Saturated Fat 0.63g	
Cholesterol 290mg	
Sodium 220mg	
Total Carbohydrate 3.3g	
Dietary Fiber 0g	
Sugars 0g	
Protein 16g	
Vitamin A -	Vitamin C -
Calcium -	Iron -
7%	97%
3%	9%
1%	0%
* Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.	

Omega 3 fatty acids 1.83 grams
Zinc 17.00 ppm

Toxicity report

- No known toxins

Seasonal availability

- Year round

References

- [1] Leet, W.S., C.M. Dewees, R. Klingbeil, E.J.Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Dept of Fish and Wildlife. www.dfg.ca.gov/marine/status/status2001.asp.
- [2] Fat Secret: All Things Food and Diet. 2013. Uni (sea urchin). www.fatsecret.com/diary.aspx?pa=fjrd&rid=1948231
- [3] Pacific Urchin Harvesters Association. 2013. Sea Urchin Nutritional Information. <http://puha.org/assets/sea-urchin-nutritional-information.asp>.
- [4] Taste with the eyes. 2013. www.tastewiththeeyes.com/2013/03/do-you-know-how-to-clean-a-sea-urchin/.

Did you know?

Fishermen can predict the quality of sea urchins by “reading the bottom”, or assessing habitat conditions such as food supply, water movement, replenishment of sea urchins.

red sea urchin

Strongylocentrotus franciscanus

CULINARY INFO SHEET

STEP 1: CLEAN

Tools:

- Rubber Gloves
- Cutting Board
- Kitchen Shears
- Spoon

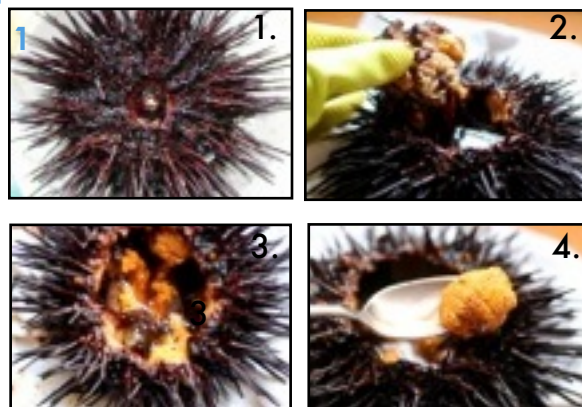


Photo Credit: tastewiththeeyes.com [1]

Method:

1. **POSITION** Using gloves, place the sea urchin on a cutting board with the hole facing you.
2. **OPEN** Insert kitchen shears into the hole and cut in a shallow circle large enough to fit your spoon.
3. **SEPARATE** Drain the liquid and organs from the hole.
4. **COLLECT** Use a spoon to remove the roe (uni) intact.
5. **CLEAN** Gently rinse the uni under cold water, then drain.

San Diego seafood profiles

STEP 2: PREPARE

Appetizer | Uni Bruschetta

Adapted from Pacific Urchin Harvesters Association [2]

Ingredients (serves 4):

- 1/4 yellow onion, minced
- 1/2 tbsp. dry sherry*
- *Non-alcoholic substitution: orange juice
- 1/2 tbsp. fresh lemon juice
- 1/2 tbsp. cilantro, chopped
- 1 tbsp. extra virgin olive oil
- 2 sea urchin (~10 pieces of uni)
- Pinch of salt and pepper
- 12 slices of baguette



Photo Credit: Flickr |
iheartummy.blogspot.com [3]

Method:

1. In a bowl, combine the minced onion, sherry, lemon juice, cilantro, & 1 tbsp. of olive oil.
2. Gently toss the uni in the mixture, adding salt & pepper to taste.
3. While mixture is marinating, brush the bread slices with remaining olive oil and grill over medium heat until both sides are golden.
4. Slice the toast, top with uni mixture and serve.

Entrée | Uni Pasta

Adapted from Pacific Urchin Harvesters Association [2]

Ingredients (serves 4):

- 2 tbsp. extra virgin olive oil
- 1-2 cloves of garlic, crushed
- Pinch of chili pepper
- 3/4 lb. spaghetti or linguine
- 1 sea urchin
- Pinch of salt
- 2 tbsp. parsley, minced



Photo Credit: Flickr | Casa dell'Albero [4]

Method:

1. In a pot, bring water to a boil.
2. Heat olive oil in a pan and sauté garlic with chili pepper until light golden color.
3. Place pasta in pot and cook according to package directions.
4. As pasta is cooking, mix uni with garlic mixture and sauté for 7-8 minutes, adding salt to taste.
5. Drain the pasta and mix well with uni-garlic mixture.
6. Sprinkle with parsley and serve immediately.

SERVING SUGGESTIONS:

Uni is best eaten raw, sautéed, or baked.

OTHER RECIPE IDEAS:

With soy sauce/lemon over rice; ceviche; risotto; mousse; chowder.

Many dishes may be served using the urchin shell as a bowl.



UC San Diego

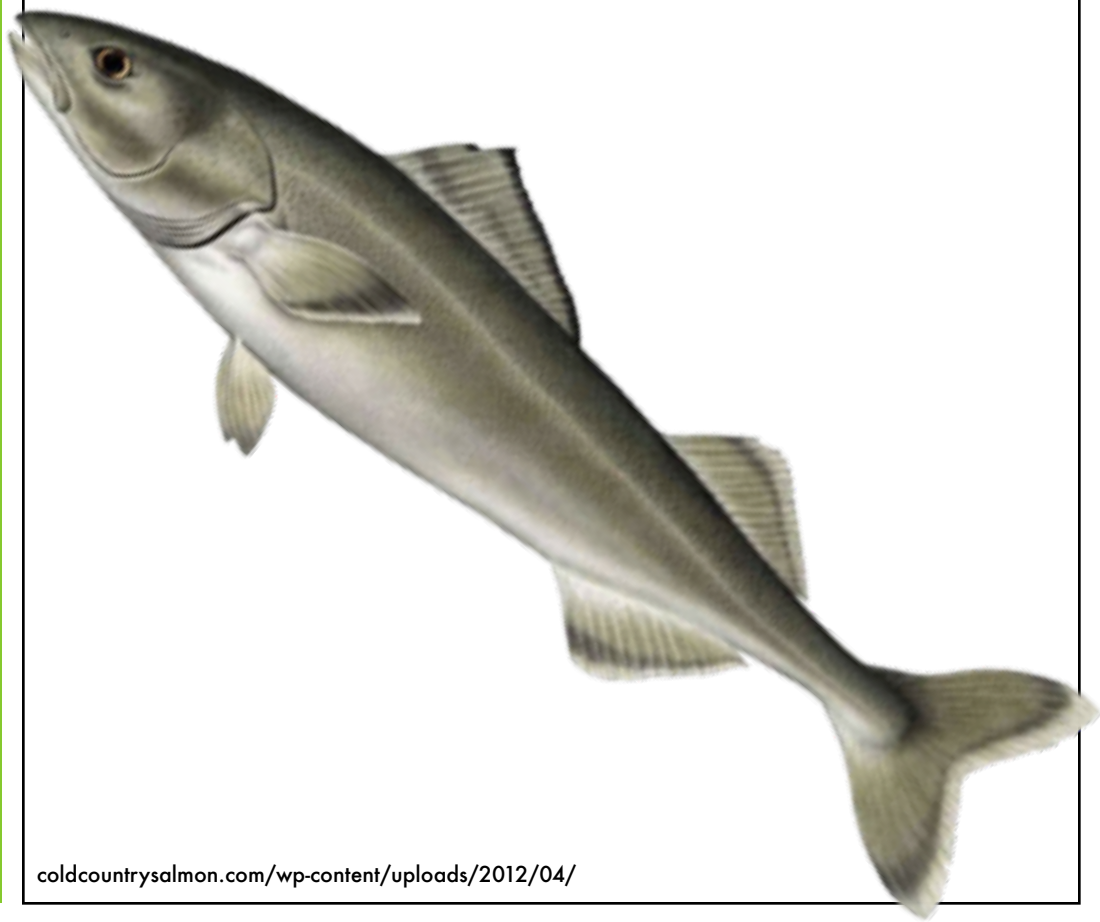
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- [1] Lynn, Lori Taste With the Eyes. Available: www.tastewiththeeyes.com/2013/03/do-you-know-how-to-clean-a-sea-urchin/
- [2] PUHA. Pacific Urchin Harvesters Association. Available: www.puha.org/assets/sea-urchin-recipes.asp
- [3] iheartummy. Available: iheartummy.blogspot.com/2013/03/sea-urchin-bruschetta-uni-toast.html
- [4] Casa dell'Albero. Available: www.flickr.com/photos/casadellalbero/

sablefish

BIOLOGY FACT SHEET

Anoplopoma fimbria



coldcountrysalmon.com/wp-content/uploads/2012/04/

San Diego seafood profiles

Taxonomic description

- Also known as black cod, butterfish.
- In the family Anoplopomatidae.
- Superficially resembles members of the cod family (Gadidae) but is not related.
- Long; dark gray to black on upper half of body, lighter gray on the lower half [1].
- Has separate dorsal fins; these are used to tell it apart from its relative skilfish [1]
- Can grow up to 1 m (3 ft) and weigh up to 25 kg (55 lb).

Distribution

- Found along the northeastern Pacific Ocean from northern Mexico to Alaska [1]
- Most commonly found in Alaska
- There are two populations in eastern Pacific, Northern and Southern [2]
- Also found in the western north Pacific.

Life history

- Long-lived species with 40 yr old fish commonly caught
- Some known to live 90 years or more [2]
- Reproduces March – April in Alaska; January – March in California to British Columbia [2]
- Spawning and early egg development occurs in deeper water
- Hatched larvae swim to surface waters to feed on small zooplankton
- Juveniles remain inshore until age 2 and begin to migrate to deeper water
- Fully mature around ages 5-7 yr [1,3]

Habitat

- Lives on the ocean bottom at depths 200 m (650) feet and deeper.
- Some found down to 3000 m (9800 ft) [2]
- Smaller juvenile fish live near the surface close to the coast.

- Generally found associated with soft substrates on the seafloor
- Feed on a variety of different organisms such as small invertebrates, fish, squid, and even jellyfish.
- Diet depends on multiple factors like life stage, location, season and year [1]

References

- [1] ADGF. Alaska Department of Fish and Game - Sablefish - Available: <http://www.adfg.alaska.gov/index.cfm?adfg=sablefish.main>
- [2] NOAA Fish Watch. Fish Watch and Seafood Profiles - Sablefish - Available: http://www.fishwatch.gov/seafood_profiles/species/cod/species_pages/sablefish.htm
- [3] California Dept. Fish & Wildlife, Status of the fishery - Sablefish - Available: <http://www.dfg.ca.gov/marine/status/>

Did you know?

Although commonly called “black cod”, this fish is not related to cod family, it is one of only two species in its own family.



UC San Diego

sablefish

FISHERY FACT SHEET

Anoplopoma fimbria



Photo: seanag.com

San Diego seafood profiles

Seasonal availability

- Year-round with lower catch limits during the winter months (spawning season) [i]

Managing authority

- Managed jointly by the California Dept of Fish & Wildlife, NOAA Fisheries and the Pacific Fisheries Management Council [iv,v]
- Covered under the Pacific Coast Groundfish Fishery Management Plan, which defines coast-wide catch limits for fishing groups & gear types, daily trip limits, individual fishing quotas, & observer coverage amounts [ii, iv]

Gear type

- Primarily fixed gear (baited longlines & baited traps) [ii, iv], where traps are submerged ~0.5 mile deep and emptied after 3-4 days [iii]
- Occasionally bottom trawls [iv], which are used for various deepwater species [ii]

Status of the fishery

- NMFS Fish Stock Sustainability Index classifies the stock as a “4” out of 4, reflecting that the stock has known status, is not overfished or subject to overfishing, and maintains a biomass at or above maximum sustainable yield. [ii]
- Classified as a “Good Alternative” by Monterey Bay Aquarium’s “Fish Watch” (would be “Best Choice” if ranked using only fixed gear, not trawling) [vi]

Potential ecosystem impacts

- Impact of commercial fishing efforts on sablefish habitat are minimal & temporary [iii]
- Bottom trawls often catch unintended species, however many of these are collected for human consumption [ii]
- Bycatch is reduced across all gear types through catch reporting per the West Coast Groundfish Trawl Catch Share Program,

which requires a certified observer at all times on trawl vessels & part-time on fixed gear operations [ii].

References

- [i] Stewart, I.J., J.T. Thorson, C. Wetzel. 2011. Status of the U.S. Sablefish Resource in 2011. National Marine Fisheries Service, NOAA. 29 July 2013. www.pccouncil.org/wp-content/uploads/Sablefish_2011_Assessment.pdf.
- [ii] NOAA. 2013. Sablefish. FishWatch: U.S. Seafood Facts. NOAA, n.d. 29 July 2013. www.fishwatch.gov/seafood_profiles/species/cod/species_pages/sablefish.htm; www.fishwatch.gov/features/meet_phil_harris_black_cod_fisherman.htm
- [iii] "About Philip Harris." Sea Nag. Blogger, Aug. 2011. Web. 29 July 2013.
- [iv] McKnight, C. and R. Leos. 2008. Sablefish, *Anoplopoma fimbria*. 2008 Status of the Fisheries. California Dept of Fish & Wildlife, Web. 26 July 2013.
- [v] NMFS. 2008. 2008 Status of the Fisheries. National Marine Fisheries Service, NOAA. 26 July 2013. www.nmfs.noaa.gov/sfa/statusoffisheries/2008/StatusFisheries_2008.pdf
- [vi] Monterey Bay Aquarium. Seafood Watch: West Coast Consumer Guide Fall/Winter 2013. Print.

Did you know?

While only recently gaining popularity, U.S. and Canadian fishermen have been harvesting this sablefish since the late 1800's [ii]

sablefish

NUTRITION FACT SHEET

Anoploploma fimbria



Sautéed sablefish with ginger-soy glaze from NourishNetwork.com, Photo by Alison Ashton

San Diego seafood profiles

Edible portions

- Also known as black cod or butterfish
- Sold headed and gutted, as fillets or steaks

Description of meat

- Commonly known as the “butterfish” because of its rich, mild flavor and velvety texture [2,3]
- Meat consists of large, delicate flakes that melt in your mouth

Culinary uses

- To fillet, check out eHow food (www.eHow.com) [4]
- Common preparations include baked, broiled, grilled, sautéed, smoked, steamed, sushi
- The fat makes it difficult to overcook the fish
- Key Preparation Note: Has large pin bones that run along the center of the fish, so make sure to remove these before preparing
- Some popular recipes include miso-glazed black cod, black cod in tomato stew, olive oil poached black cod with lemons and capers, pan-roasted fish with Thai curry sauce, glazed

cod with asparagus and mushrooms, and Miso seafood stew [5]

Nutritional information

- Cooked dry heat, ½ fillet (5.3 oz) [1]

Nutrition Facts	
Serving Size 151 g	
Amount Per Serving	
Calories 377	Calories from Fat 267
% Daily Value*	
Total Fat 30g	46%
Saturated Fat 6g	31%
Trans Fat	
Cholesterol 95mg	32%
Sodium 109mg	5%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 26g	
Vitamin A 10%	Vitamin C 0%
Calcium 7%	Iron 14%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

NutritionData.com

Toxicity report

- There are no known contaminants

Seasonal availability

- Available year-round in San Diego

References

- [1] SELF nutrition data. 2013. “Fish, sablefish, cooked, dry heat”. <http://nutritiondata.self.com/facts/finfish-and-shellfish-products/4230/2>
- [2] “Sablefish.” FishWatch: U.S. Seafood Facts. National Oceanic and Atmospheric Administration, 20 May 2013. Web. 10 Aug 2013. www.fishwatch.gov/seafood_profiles/species/cod/species_pages/sablefish.htm
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- [4] eHow food. 2013. How to fillet sablefish. www.ehow.com/how_8652544_fillet-sablefish.html
- [5] “Black Cod Sablefish Recipes.” Yummly. www.yummly.com/recipes/black-cod-sablefish
- [6] Wikipedia. 2013. <http://en.wikipedia.org/wiki/Sablefish>

Did you know?

Sablefish was an ingredient in the “Larry David Sandwich” in an episode of the HBO comedy series *Curb Your Enthusiasm* (Season 5, Episode 1) [6]

sablefish

CULINARY
INFO SHEET

Anoplopoma fimbria

STEP 1: CLEAN

Tools:

- Cutting Board
- Sharp Knife
- Fork OR Pair of Tweezers



Photo Credit: Kathryn Hill; thekitchn.com [2]

Method [1]:

1. **CLEAN** Rinse fish under cold water.
2. **TRIM** Use a knife to remove the head from the gills forward.
3. **CUT** Hold the tail and cut just above the fish's ribs, down the length of the fish.
4. **BUTTERFLY** Open both sides of the fish to make a fillet.
5. **DEBONE** Use a fork or pair of tweezers to remove remaining bones*.
**Look closely, sablefish have small pin bones!*
6. **SCALE** Use a knife to slice away the skin from the fillet, removing as little meat as possible*.
**If desired, skip this step and leave skin intact.*

San Diego seafood profiles

STEP 2: PREPARE

TIP: For a richer flavor, fillets may be marinated for up to 3 days prior to serving.

Entrée | Olive Oil Poached Sablefish with Citrus and Thyme

Adapted from *gildedfork.com* [3]

Ingredients (serves 4):

- 2 lbs. sablefish fillets (~4 fillets)
- 3 tsp. sea salt
- 1/2 tsp. black pepper
- 2 large lemons, thinly sliced
- 1/4 c. fresh thyme
- 1/2 c. almonds, roughly chopped
- 2 c. extra virgin olive oil



Photo Credit: Mark Tafoya; *gildedfork.com* [3]

Method:

1. Preheat oven to 350° F.
2. Season fish with salt and pepper and allow to marinate for a few minutes at room temperature.
3. Place the slices from one lemon in an 8-inch glass baking dish and sprinkle with 1/8 cup fresh thyme. Place the fillets on top.
4. Cover fillets with remaining lemon slices, 1/8 cup fresh thyme, almonds and olive oil. Cook for 1 hour to 1 hour 15 mins.
5. Serve fillets with top layer of lemons and a drizzle of poaching oil.

Entrée | Miso Glazed Sablefish

Adapted from *thekitchn.com* [4]

Ingredients (serves 4):

- 2 lbs. sablefish (~4 fillets)
 - 1/2 c. sugar
 - 1 c. miso, preferably dark
 - 1/2 c. mirin, sake or white wine*
- *Non-alcoholic substitution: 1/4 c. sugar dissolved in 1/4 c. vinegar*



Photo Credit: Anjali Prasertong; *thekitchn.com* [4]

Method:

1. Set rack 3-4 inches from heat source and turn on broiler.
2. In a small saucepan over low heat, warm sugar, miso and mirin to a near boil, stirring to blend.
3. Place fillets in a skillet or baking dish. Pour half mixture on top.
4. Broil fillets for ~10 minutes, until sauce is brown and bubbling.
5. Continue to broil ~3 minutes more, or until cooked through.

TIP: Sablefish is done cooking when it is opaque and the thickest part flakes easily with the tip of a knife.

SERVING SUGGESTIONS:

Sablefish is best served raw, grilled, pan roasted, smoked, or poached.

OTHER RECIPE IDEAS:

Curried sablefish; faux-nagi; sablefish poached in cream sauce; escabeche; sablefish broiled with teriyaki sauce; herb crusted sablefish.



UC San Diego

References

- [1] Davidson, Amy. 2013. How to Filet a Black Cod Fish. eHow. www.ehow.com/how_6458217_fillet-black-cod-fish.html
- [2] theKitchn. 2010. From the Fishmonger: Black Cod. www.thekitchn.com/from-the-fishmonger-black-coda-116568
- [3] Di Capua, Sandra. 2013. Sablefish Recipe. Gilded Fork. www.gildedfork.com/olive-oil-poached-fish/
- [4] Hill, Kathryn. 2010. Sablefish Recipe. theKitchn. www.thekitchn.com/recipe-nobu-miso-marinated-black-cod-117238

white seabass

Atractoscion nobilis

BIOLOGY FACT SHEET

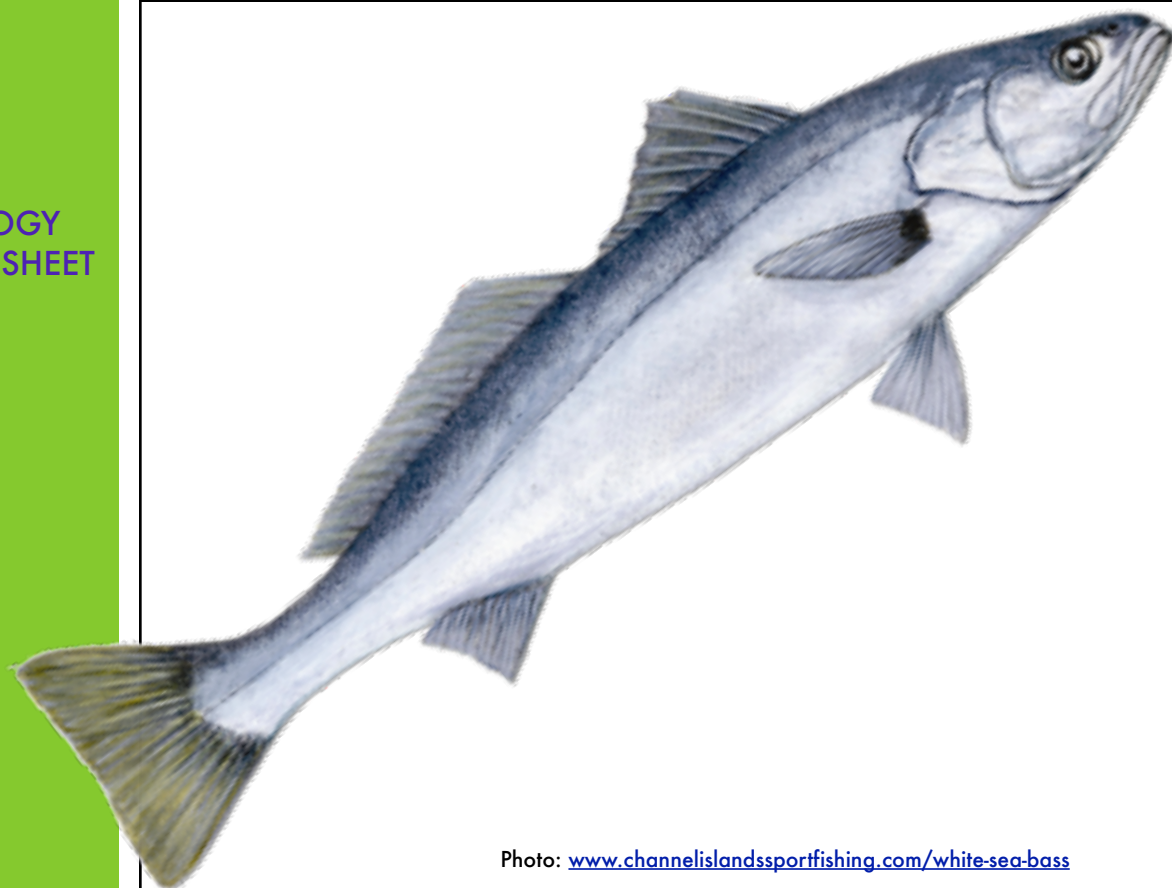


Photo: www.channelislandssportfishing.com/white-sea-bass

San Diego seafood profiles

Taxonomic description

- Largest species of croaker (family: Sciaenidae)
- Emit croaking sounds by hitting the abdominal muscle against the swim bladder [2].
- Large, mobile fish with average size of 9 kg (20 lbs) and just over 1 m (3 ft), but the largest recorded in California was 42 kg (93 lbs) and 1.5 m (5 ft) long [1,2]
- Blue to gray in color on the back, with a silver belly; Juveniles have dark vertical stripes on their back.

Distribution

- Ranges from Magdalena Bay, Baja California, Mexico to the San Francisco area, and in the northern Gulf of California [1,2].
- During the strong El Niño of 1957-1959 (i.e., warm waters), it was found as far north as Juneau, Alaska [2]
- The center of the population seems to be off central Baja California [2].

Life history

- Spawning usually occurs from April to August with a peak in late spring – early summer [1].
- Broadcast spawners: releases gametes in the water for fertilization. Release is usually at night to reduce predation on the eggs, which are the largest (1.3 mm or 0.5" diameter) of any croaker on the west coast [1,2].
- Age of maturity is uncertain, but all have probably spawned at least once by age 6 (81 cm or 32' long) and can live to 20 yrs [2].

Habitat

- Newly hatched seabass inhabit open, shallow coastal waters (4-8 m or 12-30 ft deep) sometimes hanging out in drifting seaweed.
- Juveniles (ages 1-3 yr) may move into protected bays where they use eelgrass beds for cover and feeding grounds; older juveniles are found near piers and jetties with kelp beds nearby.
- Adults use many habitats: rocky reefs, kelp beds, offshore banks or the open ocean. [1]

- Found in schools or as solitary individuals
- Adults prey on Pacific mackerel, Pacific anchovies, Pacific herring, Pacific sardines, market squid and pelagic red crabs. [1,2]
- A mix of human activities (pollution, overfishing and habitat destruction) and natural environmental conditions contributed to the long term decline of this species but spawning in captivity and release of seabass has enhanced populations [1].

References

- [1] Crooke, S., A. Louie. 2006. White Seabass. Status of the Fisheries Report. California Dept. Fish & Wildlife, Available: <http://www.dfg.ca.gov/marine/status/>
- [2] Seafood Watch. 2013. White Seabass. Monterey Bay Aquarium. Available: http://www.montereybayaquarium.org/cr/cr_seafoodwatch

Did you know?

White seabass is not a seabass, it is a member of the Croaker family so named because the males make croaking noises [2].



UC San Diego

white seabass

Atractoscion nobilis

FISHERY FACT SHEET



Photo: Hubbs-Sea World Research Institute

San Diego seafood profiles

Seasonal availability

- June–March if the optimum yield remains below 1.2 million lbs for the season

Managing authority

- The Fish & Game Commission partners stakeholders, evaluates stocks, & determines regulations.
- In 2002, the Commission adopted the White Seabass Fishery Management Plan, part of the State Finfish Management Project, requiring annual stock assessment, report & stakeholder meeting. [i,v]
- California Department of Fish & Wildlife enforces regulations, maintains catch records and monitors stocks.

Gear type

- Most drift gillnets, some hook-and-line.
- Gear regulations limit bycatch of non-target species & damage to environment (e.g., set

gillnets were banned in state waters in 1994) [ii, v].

Status of the fishery

- Stocks are recovering off our coast after declines in the mid to late 1900s [i]
- Through Hubbs-Sea World Research Institute in Carlsbad, the Ocean Resources Enhancement & Hatchery Program provides juveniles to 13 grow-out facilities, which release the fish to replenish wild stocks.
- Relatively resilient to fishing pressure given young maturity age, high fecundity, & a fishing season sensitive to breeding season when fish aggregates to spawn
- The 2009-2010 White Seabass Fishery Management Plan Annual Assessment reported no overfishing [iii].
- Monterey Bay Aquarium's "Fish Watch" classification of "Best Choice" when caught by hook-and-line and "Good Alternative" when caught via gillnets [iv]

Potential ecosystem impacts

- Hook-and-line & drift gillnets don't contact the seafloor, but weighted set gillnets can damage seafloor.
- Bycatch of non-target species is minimal due to gear regulations.

References

- [i] Dept of Fish and Game. 2002. Final White Seabass Fishery Management Plan. State of California,.
- [ii] "White Seabass." State Finfish Management Project. California Department of Fish and Wildlife, 2013.
- [iii] Dept of Fish and Game. 2011. White Seabass Fishery Management Plan 2009-2010 Annual Review.
- [iv] Seafood Watch. 2013. "White Seabass." Monterey Bay Aquarium. www.montereybayaquarium.org/cr/cr_seafoodwatch
- [v] Crooke, S., ALouie. 2006. White Seabass. Status of the Fisheries Report. California Dept. Fish & Wildlife, www.dfg.ca.gov/marine/status/
- [vi] Hubbs Sea World Research Inst. 2013. http://www.hswri.org/Save_Your_White_Seabass_Heads.php

Did you know?

Since 1986, over 1.5 million juvenile white seabass have been released along our coast to enhance natural populations. Hubbs-Sea World Research Institute asks fishers to save their seabass heads which, if part of the program, contain a microchip used to track the fish [vi].

white seabass

Atractoscion nobilis

NUTRITION FACT SHEET



Photo: Iain Bagwell; Styling: Mary Clayton Carl

White Sea Bass with Orange-Fennel Relish on www.myrecipes.com

San Diego seafood profiles

Edible portions

- Sold fresh as steaks, fillets, or whole

Culinary uses

- To prepare fresh filets for cooking, cut the fillet down the middle and trim off the dark "blood line" [e.g., 5]
- May be kept frozen
- Typical cooking methods include grill, sear, bake, broil, or sauté, may also be steamed or poached but is firm enough where these methods aren't necessary.
- Simple recipes are best for this delicious fish- sear skin-on with olive or grapeseed oil and lemon [5].
- Other recipe ideas include: white seabass with orange-fennel relish, miso-glazed with asparagus, Cuban style, and prepared with confetti vegetables with lemon-butter [4]
- Also great cold as a salad topper: slowly simmer the fish in olive oil and then wait until it cools and top salad.

Nutritional information

Mixed species, raw (4.5 oz) [1]

Nutrition Facts	
Serving Size 129 g	
Amount Per Serving	
Calories 125	Calories from Fat 23
% Daily Value*	
Total Fat 3g	4%
Saturated Fat 1g	3%
Trans Fat	
Cholesterol 53mg	18%
Sodium 88mg	4%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 24g	
Vitamin A 5%	Vitamin C 0%
Calcium 1%	Iron 2%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

NutritionData.com

Description of meat

- Low-fat fish with a mild flavor
- Known for its firm, meaty texture
- Meat has thick, large, white flakes

Toxicity report

- No known contaminants, voted "Best Choice" by Monterey Bay Aquarium [3]

Seasonal availability

- Available in San Diego June–March [2]

References

- [1] "Fish, sea bass, mixed species, raw." SELF Nutrition Data: Know What You Eat. USDA SR-21 <http://nutritiondata.self.com/facts/finfish-and-shellfish-products/4117/2>.
- [2] Crooke, S. A. Louie.. 2006. White Seabass, *Atractoscion nobilis*. Status of the Fisheries Report 2006. California Department of Fish and Wildlife. <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=34417&inline=true>.
- [3] "White Seabass." Seafood Watch. Monterey Bay Aquarium, n.d. Web. 10 Aug 2013. www.montereybayaquarium.org/cr/seafoodwatch/web/sfw_factsheet.aspx?gid=83.
- [4] This is a great source for all different types of recipes. Yummly, White Seabass Recipes. www.yummly.com/recipes/white-sea-bass
- [5] "Cooking Tips White Seabass: Farmers Market Bag, Catalina Offshore Products." www.youtube.com/watch?

Did you know?

Because white seabass is so firm, it adapts well to almost any cooking method. In particular, recipes for true sea bass or grouper can be used for this fish.

white sea bass

Atractoscion nobilis

CULINARY INFO SHEET

STEP 1: CLEAN

Tools:

- Cutting Board
- Paring Knife

Method:

1. **SCALE*** Lay fish on cutting board. With one hand, secure tail and with the other, use a knife to scrape off the scales, moving from the tail towards the head. Rinse with cold running water.

*Depending on the preparation, skin may be left on.

2. **CUT** Beginning towards the tail, make a slice along the belly.
3. **REMOVE** Extract and dispose of the innards.
4. **REMOVE** Insert an index finger into the gill and pull strongly to extract completely. Rinse both the inside and outside of the fish under cold running water.
5. **CUT** Make a slice behind the head down to the bone.
6. **UPPER FILLET** From this cut, move the knife parallel to the cutting board in a saw-like motion, remove the skin with as little flesh as possible. Complete by detaching the skinless fillet.
7. **LOWER FILLET** Use same technique on lower portion of fish, leaving behind the bone.
8. **TRIM** Even out the fillets by slicing off the membrane and portions with blood.
9. **DEBONE** Using the knife, remove any bones remaining from the back of the fillets.

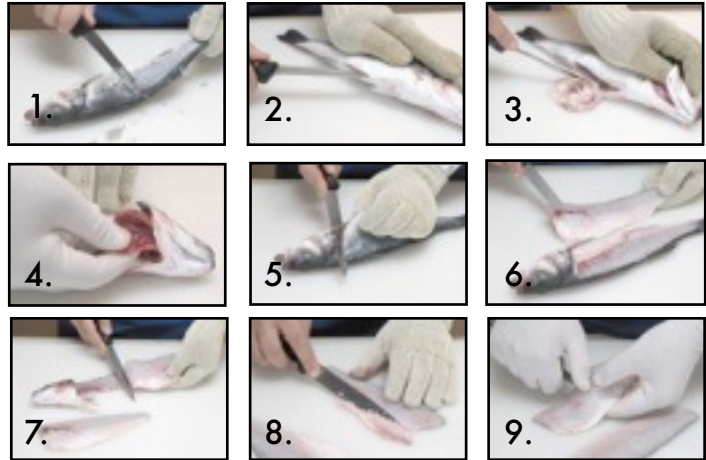


Photo Credit: academiabarilla.com [1]

San Diego seafood

STEP 2: PREPARE

TIP: To prevent curling, score raw fish diagonally two-three times and press with a metal spatula while cooking.

Entrée | Pan Seared Sea Bass

Inspired by fisherman Zack Roach; *The Fish Addiction* [2]

Ingredients (serves 4):

- Salt and pepper, to taste
- 2-3 tbsp. flour
- 4 sea bass fillets (skin may remain intact)
- Grape seed OR olive oil, to coat pan
- 1 lemon, quartered



Photo Credit: divaeatsworld.com [3]

Method:

1. Season fillets with salt and pepper. Lightly dust each side with flour.
 2. In a skillet over medium-high, heat enough oil to shallowly coat the bottom of the pan.
 3. Add fillets and cook 3-5 minutes per side, depending on thickness.
 4. Serve with a squeeze of lemon juice.
- If desired, serve with white rice and favorite vegetable.

TIP: When cooking sea bass, flip turns opaque in color 1/4 of the way up fillet. Fish is done cooking when easily flakes with fork.

Entrée | Pan Roasted Sea Bass with Citrus-Heirloom Tomato Vinaigrette

Adapted from *brainfoodblog.wordpress.com* [4]

Ingredients (serves 4):

VINAIGRETTE

- 1 c. heirloom tomatoes, chopped
- 1/4 c. red wine vinegar
- 1 tbsp. Italian parsley, chopped
- 1 tsp. fresh thyme, chopped
- 1 1/2 tbsp. lemon rind, grated
- 1 tbsp. fresh lemon juice
- 1/2 tsp. sea salt
- 1/4 tsp. black pepper
- 1/3 c. extra virgin olive oil or coconut oil (melted)

FISH

- 1 lb. sea bass fillets, with skin
- Salt and pepper, to taste
- 1 tsp. olive oil



Photo Credit: brainfoodblog.wordpress.com [4]

Method:

1. Combine tomatoes and vinegar in saucepan over medium heat and cook for 3 mins.
2. Stir in remaining vinaigrette ingredients.
3. Sprinkle fish with salt and pepper.
4. Add 1 tsp. oil to a cast iron skillet over medium-high heat. Add fillets, skin-side down, and cook for 2 mins.
5. Move skillet to oven and bake at 450° for 5 mins.
6. Serve fillets skin-side up, topped with sauce.

SERVING SUGGESTIONS:

Sea bass is versatile and is best served baked, broiled, fried, sautéed, steamed, smoked or grilled.

OTHER RECIPE IDEAS:

Honey glazed white sea bass; sea bass amandine; cioppino; miso-marinated sea bass.



UC San Diego

References

- [1] Barilla Group. How to Fillet a Sea Bass. Academia Barilla. www.academiabarilla.com/italian-recipes/how-to/filleting-bass.aspx
- [2] Roach, Zack. 2013. *The Fish Addiction*.
- [3] Diva Eats World. Pan Seared Bass W/ Barley-Corn Salsa. www.divaeatsworld.com/?page_id=2146
- [4] H & H Fresh Fish Co. 2012. Cal White Sea Bass. <http://brainfoodblog.wordpress.com/2012/06/12/cal-white-seabass-with-love/>

yellowfin tuna

Thunnus albacares

BIOLOGY FACT SHEET

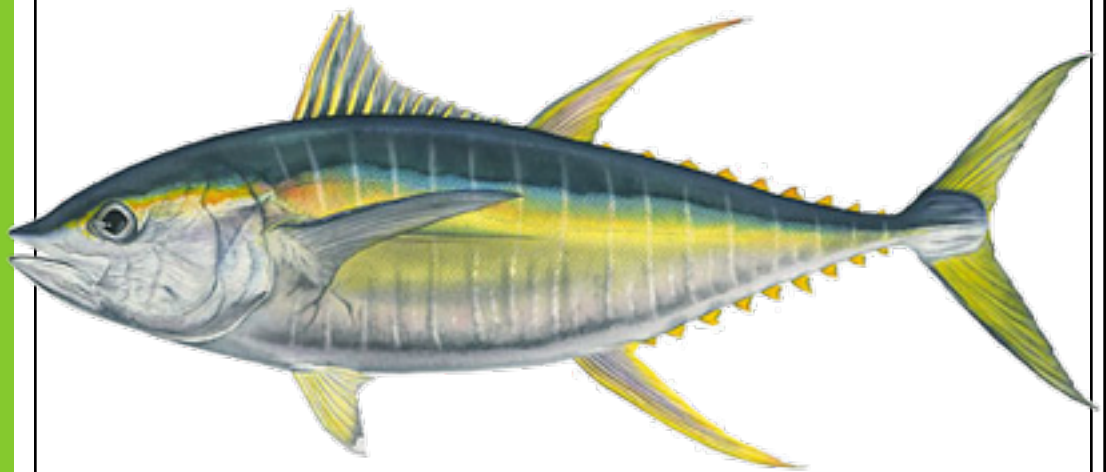


Photo: <http://www.njsaltwaterfisherman.com>

San Diego seafood profiles

Taxonomic description

- Sleek torpedo-shaped body for fast movement.
- Coloration: dark blue on the back, changes from yellow to silver down to the belly.
- Dorsal and anal fins are bright yellow giving the fish its name.
- Difficult to distinguish from other tuna species except for the elongated, sickle-shaped dorsal and anal fins found on large adults [2]
- Can grow to be 1.8 m (6 feet) long and over 180 kg (400 lbs) [1]

Distribution

- Highly migratory fish and are found in warm seas all over the world except the Mediterranean [2].
- Can travel across the entire ocean basin. [1]

Life history

- Fast growing fish with a somewhat short life span of 6 to 7 years. [1]

- Live 8 yrs, but most are mature enough to reproduce around age 2 or 3 [2].
- Spawn at sea throughout the year in tropical waters, and in spring –summer in cooler waters. [1,2]
- 24° C (75° F) is thought to be the lowest temperature limit for spawning. [2]
- Can produce two to seven million eggs per spawn. [2]

Habitat

- Travel in schools of similarly sized fish [??wiki]
- Mostly found in the surface layer (≤ 100 m or 330 ft) of the open ocean above the thermocline, but capable of diving over 1000 m (3300 ft) [1]
- Typically found in water temperatures between 15° – 31° C (59° - 88° F). [3]
- Known to make migratory trips to higher latitudes as the temperature of the water increases. [1]
- Gather in areas with high productivity where smaller prey is available.

- Feed opportunistically in open ocean on small fish, squid and invertebrates such as pelagic crabs [2,3]
- Predators include sharks, billfish and large marine mammals.

References

- [1] FishWatch. 2013. Yellowfin Tuna. National Oceanic and Atmospheric Administration (NOAA) Fish Watch & Seafood Profiles. www.fishwatch.gov/seafood_profiles/species/tuna/species_pages/pacific_yellowfin_tuna.htm
- [2] South Atlantic Fishery Management Council. 2013. Yellowfin Tuna. www.safmc.net/fishidandregs/fishgallery/yellowfintuna/tabid/257/default.aspx
- [3] Froese, R., Pauly, D., eds. 2008. "Thunnus albacares" in FishBase. www.fishbase.org/summary/SpeciesSummary.php?genusname=Thunnus&speciesname=albacares
- [4] Horst, J. 2013. Yellowfin! Louisiana Fisheries. www.seagrantfish.lsu.edu/resources/factsheets/yellowfin.htm

Did you know?

No other fish can swim as fast or far as tuna; its fins help reduce turbulence and drag as it swims through the water [4].

yellowfin tuna

Thunnus albacares

FISHERY FACT SHEET



Photo: Point Loma Sportfishing

San Diego seafood profiles

Seasonal availability

- Fishery open year-round, mostly recreational off San Diego in August & September

Managing authority

- Managed federally under the Highly Migratory Species Fisheries Management Plan where NOAA & the Pacific Fishery Management Council establish permit & operational requirements, gear restrictions, & mandatory workshops for fishers [i].
- As a member of the Inter-American Tropical Tuna Commission (IATTC), the U.S. has implemented purse seine fishery closure & catch retainment requirements to limit illegal discarding of undersized tuna [i]
- International Dolphin Conservation Program sets guidelines to reduce bycatch of dolphins & undersized tuna [i]

Gear type

- Mostly purse seines, but troll, hook-and-line, & pelagic longlines are also used. Hook and line is used recreationally.

Status of the fishery

- NOAA defines population as “abundant” and fishing rate as “sustainable” [i]
- Monterey Bay Aquarium’s “Fish Watch” lists hook-and-line tuna as “Best Choice” [ii]
- Most regulations focus on reducing the catch and mortality of non-target species.
- U.S. fishermen responsibly harvest tuna by following strict international and domestic regulations aimed at reducing fishery impacts on other species (e.g., longliners use special hooks and bait that reduce bycatch; fishers train in the safe release of non-target species; vessels are regularly monitored by scientists & managers who reassess management actions as needed [i]

Potential ecosystem impacts

- Species is fairly resistant to fishing pressure given early maturing, high fecundity, moderate life span, & wide distribution [iii]
- Troll & hook-and-line have relatively low bycatch [i] whereas purse seines and long lines potentially result in moderate to high bycatch of species associated with yellowfin

- schools if actions are not taken to reduce bycatch and mortality rates [i]
- Purse seiners using fish aggregating devices (FADs, manmade floating objects) to attract yellowfin must take precautions to avoid bycatch of juvenile yellowfin & non-target pelagic species.

References

- [i] FishWatch: 2013. Pacific Yellowfin Tuna. NOAA. www.fishwatch.gov/seafood_profiles/species/tuna/species_pages/pacific_yellowfin_tuna.htm.
- [ii] Seafood Watch: 2013. Yellowfin Tuna. Monterey Bay Aquarium. www.montereybayaquarium.org/cr/seafoodwatch/web/sfw_factsheet.aspx?fid=219.
- [iii] Roberts, S. 2010. Seafood Watch Yellowfin Tuna Report. Monterey Bay Aquarium. Monterey Bay Aquarium. www.montereybayaquarium.org/cr/cr_seafoodwatch/content/media/mba_seafoodwatch_yellowfintunareport.pdf.
- [iv] “Highly Migratory Species: Background.” Pacific Fishery Management Council. Pacific Fishery Management Council, 20 Nov. 2012. Web. 10 Aug. 2013. www.pcouncil.org/highly-migratory-species/background/

Did you know?

Yellowfin tuna, like other tuna species, is highly migratory. It can travel across entire ocean basins and therefore requires cooperative international management to ensure its abundance and sustainability [i].

yellowfin tuna

Thunnus albacares

NUTRITION FACT SHEET



tuna poke- recipe from norecipes.com

San Diego seafood profiles

Edible portions

- Usually sold as rounds, loins, or steaks

Description of meat

- Mild, meaty flavor; firm texture
- The flesh has a deep red color when raw

Culinary uses

- Eaten raw or cooked, but this fish loses its flavor & dries out when well-done [5].
- May be frozen, but tightly wrap in plastic & keep it out of direct contact with ice or water to ensure a longer shelf-life
- Common preparations are to grill or sear the outside leaving the center rare [6].
- Before cooking, season the steaks (this can be as simple as salt & pepper)
- Searing is easy- heat oil in pan over medium-heat, then place & cook the seasoned steak to desired temperature
- Common recipes include seared ahi, ahi burgers, ahi tacos, ahi salads, sesame crusted tuna, ahi tuna steak,

Nutritional information

Raw (3 oz, 85 g) [1]

Nutrition Facts	
Serving Size 85 g	
Amount Per Serving	
Calories 92	Calories from Fat 7
% Daily Value*	
Total Fat 1g	1%
Saturated Fat 0g	1%
Trans Fat	
Cholesterol 38mg	13%
Sodium 31mg	1%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 20g	
Vitamin A 1%	Vitamin C 1%
Calcium 1%	Iron 3%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

NutritionData.com

Toxicity report

- No consumption advisories are listed for troll or pole-caught yellowfin as these methods catch younger tuna with lower mercury levels [3]

- Potential for mercury accumulation in larger tuna only (caught by seine or longline). Recommended servings that can safely be eaten per month are 4 or more for adults, 3 for kids 6-12 yr old, 3 for kids 0-5 yr old [4]

Seasonal availability

- Fresh in San Diego August–September [2]

References

- [1] SELF Nutrition Data: Know What You Eat. 2013. Fish, tuna, fresh, yellowfin, raw. <http://nutritiondata.self.com/facts/finfish-and-shellfish-products/4150/2>.
- [2] California Dept. of Fish & Wildlife. 2013. Marine Sportfish Identification: Tunas & Mackerels. www.dfg.ca.gov/marine/mspcont1.asp.
- [3] Monterey Bay Aquarium. 2013. "Yellowfin tuna." Seafood Watch. www.montereybayaquarium.org/cr/SeafoodWatch/web/sfw_factsheet.aspx?fid=219.
- [4] EDF Seafood Selector. 2013. Tuna. Environmental Defense Fund. <http://seafood.edf.org/tuna>.
- [5] Riches, D.. 2013. Grilling Tuna: Rare or well you need to know the best method for grilling tuna. About.com. <http://bbq.about.com/od/finhandseafood/a/aa103004a.htm>
- [6] Bauer, E.. 2006. Seared Ahi Tuna. Simply Recipes. http://www.simplyrecipes.com/recipes/seared_ahi_tuna/

Did you know?

Yellowfin is sold as "light tuna" when canned, is called "ahi" when sold fresh or frozen, and called "maguro" when in sushi [3].

yellowfin tuna

CULINARY
INFO SHEET

Thunnus albacares

San Diego seafood

STEP 1: CLEAN

Tools:

- Cutting Board
- Fillet Knife

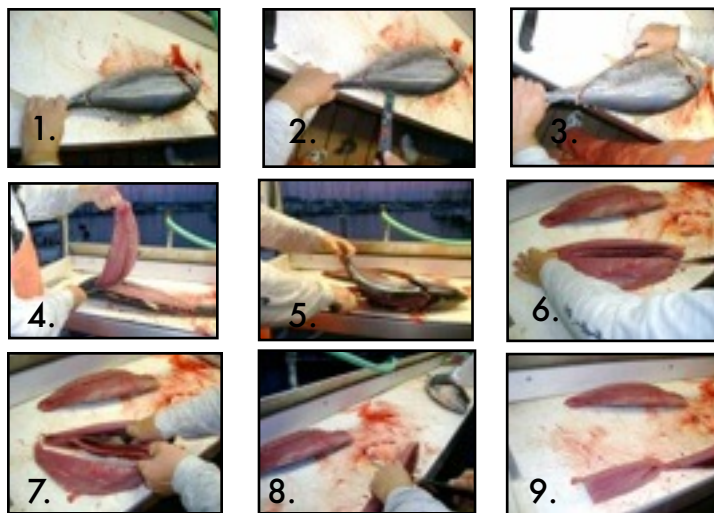


Photo Credit: bdoutdoors.com

Method:

1. **CUT** Slice downward, just behind the gills, until knife reach the spine. Leaving knife an inch deep, slice towards the tail. Once at tail, slice along the belly up to the gills. Repeat this 360° cut until fillet is sliced just above the spine. At this point, flip to the other side, still leaving fillet intact (Photos 1-3).
2. **FILLET** On both sides, continue the cut immediately above the bone to create two fillets connected right on top of the spine (Photos 4-5).
3. **SEPARATE** Slice beneath each fillet towards the head to disconnect. Flesh above the spine may be used for sushi (Photo 6).
4. **DEBONE** Slicing at an angle, cut out the rib section on each fillet.
5. **SCALE** Remove the skin off of each fillet, only doing a small portion per cut for larger fish (Photo 7).
6. **TRIM** Slice off the concave piece of very dark meat (Photo 8).
7. **PORTION** Slice into desired size for cooking.

STEP 2: PREPARE

TIP: Avoid overcooking tuna given that it hardens as it cooks. Take it off heat when the center is still red/pink.

Entrée | Tuscan-Style Grilled Tuna Steaks

Adapted from rachelraey.com [2]

Ingredients (serves 4):

- 4 (8 oz., 1 inch thick) tuna steaks
- 1 lemon, zested
- 3 (2 tbsp) fresh rosemary, only leaves
- Handful flat leaf parsley
- 3 cloves garlic, crushed
- Salt and pepper, to taste
- Extra virgin olive oil



Photo Credit: rachaelray.com

Method:

1. Rinse tuna steaks and pat dry.
2. On a cutting board, chop lemon zest, rosemary, parsley and garlic together. Once chopped, mix in salt and pepper.
3. Drizzle olive oil over both sides of each steak.
4. Rub herb and garlic mixture evenly into fish and let stand 10 mins.
5. Grill tuna steaks for 4-6 mins on each side (on high heat on indoor electric grill; medium-high heat on outdoor gas grill; 6 inches from hot charcoal).

Entrée | Sesame Crusted Tuna with Wasabi-Ponzu Sauce

Adapted from yummly.com [4]

Ingredients (serves 4):

SAUCE

- 1 tbsp. green onions, chopped
- 2 tbsp. low sodium soy sauce
- 2 tbsp. orange juice
- 1 tbsp. rice vinegar
- 1 tsp. brown sugar
- 1 tsp. lemon rind, grated
- 2 tsp. lemon juice
- 2 tsp. hone
- 1 1/4 tsp. prepared wasabi paste
- 1 tsp. fresh peeled ginger, grated
- 2 tsp. vegetable oil

FISH

- 4 (6 oz., 3/4 inch thick) tuna steaks
- 1/4 tsp. salt
- 3 tbsp. sesame seeds*
- 2 tbsp. black sesame seeds*
- (Optional) green onions, sliced

Method:

1. In a bowl, whisk together all sauce ingredients.
2. Heat oil in a nonstick skillet over medium-high heat.
3. Sprinkle salt on tuna.
4. In a shallow dish, combine sesame seeds and dredge both side of tuna in them.
5. Add tuna to pan. Cook 3 minutes or as well done as preferred. Be cautious of hot sesame seeds popping from pan.
6. If desired, garnish with green onions. Serve with sauce.



Photo Credit:
yummly.com

SERVING SUGGESTIONS:

Yellowfin tuna is best served raw, grilled, pan seared, fried, broiled, or baked.

OTHER RECIPE IDEAS:

Sashimi; ceviche; poke; yellowfin burgers; tuna confit; marmitako; grilled over citrus; tuna salad.

Search for recipes online under the name, "ahi".



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References

- [1] Goodwin, Scott. 2012. A Better Way to Fillet Tuna. BD Outdoors. www.bdoutdoors.com/article/how-to-fillet-tuna/
- [2] Ray, Rachael. 2007. Tuscan-Style Grilled Tuna Steaks. Rachael Ray. www.rachaelray.com/recipe.php?recipe_id=275
- [3] Bonom, David. 2004. Sesame Crusted Tuna with Wasabi-Ponzu Sauce. Yummly. www.yummly.com/recipe/external/Sesame_crusted-Tuna-With-Wasabi_ponzu-Sauce-My-Recipes