

Frequently Asked Questions Regarding THE SCIENCE OF MARINE RESERVES RELATING TO OREGON STATE WATERS

prepared by

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(1) What is the difference between a "marine protected area" and a "marine reserve"?

Essentially, a **marine protected area (MPA)** provides some level of lasting protection of the resources within that area (ranging from managed use to full protection), whereas a **marine reserve** provides permanent full protection, allowing no extractive activities (although non-extractive uses may be allowed). Thus, a marine reserve is one kind of marine protected area.

(2) What potential benefits do marine reserves provide above and beyond those of other marine managed areas?

From a scientific perspective, this is a loaded question. The key words here are "potential"—some benefits have been well-documented, others have not (see #6 below)—and "benefit"—which depends on the goal of the marine reserve. The National MPA Center (see mpa.gov on-line) currently recognizes three broad categories of MPA (which can be combined): (1) **natural heritage**, designed to protect marine biodiversity and ocean wilderness in general, (2) **cultural heritage**, designed to protect archaeological sites, such as shipwrecks, as well as tribal sites, and (3) **sustainable production**, designed to benefit fisheries. For natural-heritage and cultural-heritage sites, marine reserves provide the same benefits of full protection afforded to analogous sites on land: protection from habitat/ecosystem damage and looting, respectively. For both natural-heritage and sustainable-production sites, potential benefits of marine reserves include: serving as reference sites for understanding human impacts (see #3 below), providing population insurance for marine species (see #4 below), and replenishing populations of marine species (see #5 below). The National Marine Fisheries Service (NOAA Fisheries) is presently working to integrate MPAs and marine reserves with conventional fisheries management.

(3) How can marine reserves provide reference sites for understanding human impacts?

By prohibiting all extractive activities (fishing, oil drilling, mining, etc.) marine reserves help scientists understand the impacts of those activities on marine ecosystems. For example, fish populations vary due to both natural environmental variation and fishing effects, the latter being both direct (removal of fish) and indirect (bycatch and bottom gear impacts on seafloor habitats). By comparing trends inside marine reserves (environmental variation only) vs outside marine reserves (both environmental variation and fishing effects), scientists can determine how much change in regional fish populations is due to each factor. However, such comparisons provide only partial knowledge because no two areas within a region of the ocean are completely independent of each other.

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(4) How can marine reserves help provide population insurance for marine species?

Essentially, marine reserves set aside a portion of a population to help ensure persistence of that population. For example, the **groundfish "disaster"** (as officially declared by the Secretary of Commerce in 2000) was largely due to 7 of 12 well-assessed species of rockfish (genus *Sebastes*) off our coast being designated as **"overfished"** by the federal government, meaning that their estimated adult population sizes were less than 25% of their unfished levels. If some portion of those populations had been protected in marine reserves, then the probability of crossing the overfishing threshold would have been reduced. Clearly, existing de facto and natural refuges were insufficient to prevent the groundfish disaster. Even after **stock rebuilding plans** are implemented, marine reserves could help to prevent future disasters.

(5) How can marine reserves help replenish populations of marine species?

Conventional management is designed to allow for populations of marine species to replenish themselves based on their "surplus production," which is the natural ability of a population to compensate for increased mortality—as more individuals die, more babies are born. Recent studies of black rockfish (*Sebastes melanops*)—which is the number one species taken by recreational anglers in Oregon waters—show that population replenishment depends on **big, old, fat female fish (BOFFFs)**. The BOFFFs not only produce far more eggs than younger females, but they also produce offspring that grow faster and survive starvation better than offspring from younger females. Most importantly, BOFFFs in all fish species studied have longer spawning seasons than younger fish. In some years, most of the baby fish that survive to juvenile stages are born from BOFFFs, making BOFFFs extremely valuable for population replenishment. How are these findings relevant to the issue of marine reserves? It is well-documented that large, old fish are the first to disappear with even moderate levels of fishing (i.e., **size and age truncation**). **"Slot restrictions"** attempt to resolve this dilemma by post-capture release of both very small and very large fish. The problem is that many marine fish die after being captured, even if released immediately. In such cases, the only practical way to ensure that a substantial number of BOFFFs survive is to implement marine reserves. Recent models suggest that the increased egg quantity and quality generated by BOFFFs inside marine reserves would result in more rapid recovery of overfished rockfish populations than conventional management approaches alone. (Note that models provide hypotheses, NOT facts.)

(6) Beyond the issue of big, old, fat female fish, what are the mechanisms by which marine reserves can replenish populations outside their boundaries?

To answer this question, it is important to understand that most marine species undergo **larval dispersal**—early juvenile stages drift in ocean currents, often far from the area where they were spawned. Thus, there are two potential ways organisms living inside marine reserves can replenish populations (including fishery stocks) outside their borders: (1) **spillover**, which occurs when animals that settle and grow inside reserves eventually swim out of the reserve, and (2) **seeding** or larval export, which occurs when larvae spawned within reserves drift outside and settle elsewhere. These mechanisms are controversial because they have NOT been well-documented in most marine systems. The reason they are not well-demonstrated is that most existing marine reserves are either tiny (so both spillover and seeding are quickly diluted) or new (so there has not been enough time for such effects to manifest). The largest fisheries closures in the United States that have existed for at least a decade—5,000 square nautical miles of Georges Bank off New England, established in 1994—have provided scientifically rigorous evidence for both mechanisms, but only for two fishery species so far. **Spillover** of haddock (*Melanogrammus aeglefinus*, a groundfish) was documented as commercial catch being greatest near the closures and declining away from the closures. **Seeding** of clam-like scallops (*Placopecten magellanicus*) was evident from the observed distribution and abundance of young-of-the-year compared to predictions of oceanographic models.

(7) Is there any evidence that marine reserves provide such fishery benefits on the West Coast of the United States, especially in Oregon waters?

Both spillover and seeding are augmented when organism abundance and size increase because more crowded populations are more apt to move into adjacent areas (spillover) and larger individuals produce more and better eggs (seeding, see #6 above). Nine independent scientific studies of 13 existing tiny marine reserves in Washington, Oregon, and California, were compiled to compare populations of 17 fishery species (1 sea urchin, 2 abalone, and 14 fishes) inside reserves with populations in nearby fished areas of similar seafloor habitat. (The single Oregon site was Whale Cove, measuring 0.04 square nautical miles.) Considering cases where statistical differences were detectable, in 15 of 17 comparisons (88%), animals were more abundant inside reserves than outside. In 12 of 15 comparisons (80%), animals were larger inside reserves than outside. In 15 of 17 comparisons (88%), animals were calculated to produce more eggs inside reserves than outside. However, although the insurance effect is evident, NEITHER spillover NOR seeding have been documented from these reserves, probably because no existing West Coast reserves have been both large enough and in existence long enough for such benefits to be detectable. (This report is available on-line: depts.washington.edu/mpanews/MPA34.htm#Hixon)

(8) Don't highly migratory species (such as whiting and salmon) and most fish in general swim so much that they will simply pass through marine reserves and render them useless?

Marine reserves are especially useful for protecting and conserving relatively sedentary species that are associated with the seafloor, such as rockfishes and other groundfish, bottom-living invertebrates, and seaweeds (see #6 above). However, even highly migratory or otherwise mobile species may have fixed spawning, nursery, and otherwise susceptible "bottleneck" areas that can be protected via marine reserves.

(9) Won't the displacement of fishing activity by marine reserves cause overfishing in remaining fished areas?

The short answer is that the level of fishing in open areas will depend on the rules and regulations of conventional fisheries management. Marine reserves are not intended to be implemented in the absence of other management tools. In any case, recent models have suggested that net increases in catch can occur with closures of up to 50% of a region via seeding (larval dispersal), based on documented increases in egg production within marine reserves, especially via the BOFFF effect (see #5 above). (Note that models provide hypotheses, NOT facts.)

(10) What percent of a region must be protected to realize the benefits of marine reserves?

The answer to this important question depends on the goal(s) of the reserves (see #2 above). For **natural-heritage reserves**, the bigger the better—larger reserves conserve more habitats and species, including larval dispersal so the sites are self-seeding—so the upper limit of reserve size will depend on socioeconomic considerations. For **cultural-heritage reserves**, a minimum area to include the shipwreck, etc., is sufficient. For **sustainable-production reserves**, 40 published models suggest a range of 10% to 65% of the targeted fishery population (not necessarily the area), with a modal (most frequent) value of 30%. (Note that models provide hypotheses, NOT facts.)

(11) For natural-heritage and sustainable-production reserves, how large should individual marine reserves be and how widely spaced?

This question focuses on the concept of **networks** of marine reserves that replenish each other as well as surrounding areas via seeding (larval dispersal). For **natural-heritage reserves**, the bigger the area, the better (see #10 above), so socioeconomic considerations will be important. However, published analyses of larval dispersal of a variety of invertebrates and seaweeds suggest that reserves 4-6 kilometers (2-3 nautical miles) in diameter should be large enough to contain larvae of short-distance dispersers, and reserves spaced 10-20 kilometers (5-10 nautical miles) apart should be close enough to capture larvae of

long-distance dispersers released from adjacent reserves. For **sustainable-production reserves**, intermediate-sized reserves are recommended, with specific areas and locations depending on the biology of the targeted species. In general, if the reserve is too small, not enough fish will be protected to provide population insurance and to replenish regional populations. If the reserve is too big, too much fishing area will be closed and less reserve edge will be available to take advantage of any spillover (see #6 above).

(12) What scientific tools are available for planning and implementing marine reserves?

Scientists can now map seafloor habitats with unprecedented accuracy using multi-beam sonar combined with Geographic Information Systems (GIS). New GIS-based computer programs facilitate site selection. New genetic and biochemical methods allow scientists to track larval dispersal, thereby monitoring marine reserve networks (see #11 above). The Geographical Positioning System (GPS) and Vessel Monitoring Systems (VMS) facilitate both compliance and enforcement.

(13) What can marine reserves NOT accomplish?

Reserves cannot protect marine resources against mobile threats, such as pollutants, invasive species, diseases, and global warming, although it has been suggested that healthy intact ecosystems are more resilient to such disturbances. Marine reserves may also cause unforeseen indirect effects, such as protected predators consuming targeted prey species or protected dominant competitors excluding subordinate species. However, there is no scientific evidence that generalized predators, such as lingcod and sea lions, would consume increased production within reserves (see #7 above). In any case, such uncertainties indicate the need for adaptive management (see #14 below). Marine reserves are certainly NOT a panacea, but rather an under-utilized tool to be integrated with conventional ocean management.

(14) Why are marine reserves so controversial?

From my perspective as a scientist, the controversy arises from four sources: (1) Marine reserves are the most extreme kind of marine protected areas: permanent protection from all extractive activities. Less restrictive MPAs are less controversial. (2) With any system as large and complex as the ocean, certainty is impossible. Although the best available natural science suggests that marine reserves are a useful tool to be added to conventional ocean management, there will ALWAYS be major gaps in our knowledge. This is why many advocate **adaptive management**, in which we learn from doing in accordance with the **precautionary approach** (i.e., the risk of conservation action is less than the risk of inaction). Marine reserves that do not meet their goals should be modified or removed. (3) What one person sees as protection, another sees as restriction. Important here is the time frame of one's perspective, ranging from short-term economic considerations to long-term conservation objectives. Given the slow growth and long life spans of many marine animals in our region, such as rockfishes, new marine reserves may not provide net benefits for at least a decade. (4) There is fear, anger, and mistrust in the wake of the groundfish disaster (see #4 above).

(15) What is the Marine Protected Areas Federal Advisory Committee (MPA-FAC) recommending to the federal government?

The MPA-FAC comprises 30 stakeholders with broad expertise and regional representation throughout the coastal United States and territories, and is charged with the task of advising the federal government regarding the process of establishing of a national system of MPAs (see mpa.gov on-line). Our first set of recommendations was offered to the Secretaries of Commerce and the Interior in June 2005, emphasizing extensive stakeholder involvement, inter-governmental cooperation, the best available natural and social science, sustainable funding, and adaptive management (see #14 above).

(16) Haven't recent actions by the Pacific Fishery Management Council (PFMC), such as trawl footrope restrictions, groundfish rebuilding plans, Rockfish Conservation Areas, and Essential Fish Habitat designations, made marine reserves unnecessary?

It is important to realize that these recent remedial actions by the PFMC—which include de facto marine reserves—apply largely to **federal waters** (3-200 nautical miles offshore). Given the slow growth and long life spans of many marine animals in our region, such as rockfishes, it may be a decade or more before the effects of these actions are known. Importantly, many groundfish species, including rockfishes, lingcod, and some flatfishes, use estuaries and rocky reefs in **state waters** (0-3 nautical miles offshore) as **nursery habitats** before moving offshore as they approach maturity. This coupling of state and federal waters means that conservation actions in federal waters alone are insufficient. At the present time, the only non-estuary area resembling a marine reserve in Oregon is the 0.04 square nautical mile Whale Cove, located between Depoe Bay and Newport, which was closed to collection of any sea life except seaweeds in 1967. The need for marine reserves to separate the effects of extractive activities from **environmental variation** (see #3 above), to provide **population insurance** for fished species (see #4 above), to protect the **big, old, fat female fish** that are the most productive spawners of inshore as well as offshore species (see #5 above), among other reasons reviewed above, are equally applicable to both state waters and federal waters. Additionally, many fished species confined to nearshore waters have not undergone **population assessments**, making implementation the precautionary approach (see #14 above) all the more important in state waters.

(17) Are there reasons besides fisheries sustainability for establishing marine reserves and protected areas in Oregon state waters?

Yes, Oregon's **Statewide Planning Goal 19** (see egov.oregon.gov/LCD/docs/goals/goal19.pdf on-line) is "to conserve marine resources and ecological functions for the purpose of providing long-term ecological, economic, and social value and benefits to future generations." This goal fits squarely under the federal category of "natural heritage" MPAs implemented to conserve marine biodiversity (see #2 above).