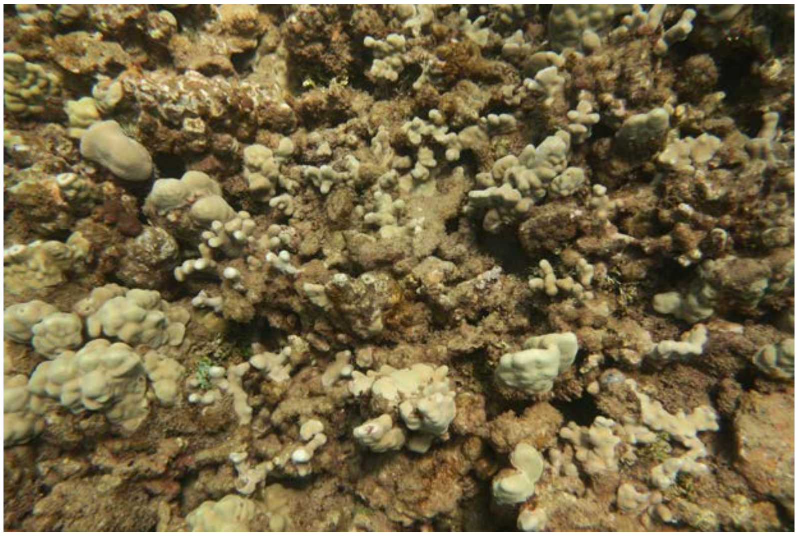
Kahekili Herbivore Fishery Management Area—Results Brief

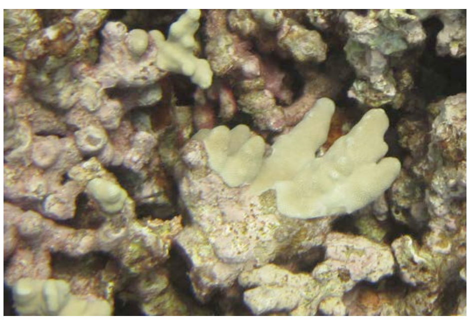
In response to concerns about declining condition of local coral reefs, the state of Hawaii created the Kahekili Herbivore Fishery Management Area (KHFMA) along an approximately 2-mile stretch of coastline in Ka'anapali, West Maui. The KHFMA went into effect in July 2009, and prohibits harvest of coral reef herbivores (i.e., surgeonfishes, parrotfishes, chubs, and sea urchins). This management effort is designed to restore natural grazing processes within this area, and by doing so help to prevent excessive seaweed growth that would otherwise harm corals. Improving reef condition benefits all resources users including fishers, who can continue to fish for non-herbivorous species within the KHFMA.



Coral reef with corals and benthic algae in competition for space

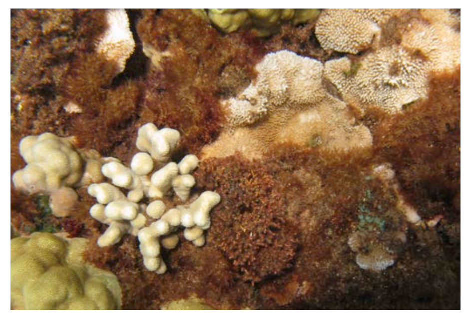
The Importance of Herbivores

Corals, algae (seaweed), and other organisms compete for space on the reef. Corals thrive best when reef algae are dominated by cropped forms: sparse turf and crustose coralline algae (CCA, picture bottom left). CCA is especially important, as it helps new corals to become established on the reef. Just as sheep in a field prevent large plants from developing, coral reef herbivores help to prevent excessive algal growth. Maintaining healthy herbivore populations and controlling other factors that damage corals are ways to increase corals' *resilience* – i.e. their ability to resist and recover from other stressors.



🡐 When herbivores are abundant and nutrient levels are not excessive, dominant algae are usually cropped turf (bare and green) and CCA (pink).

When there are few grazers, dense or upright seaweed develops, including thick turf and macroalgae which can overgrow and stress coral, reduce their growth rate, and even kill them. ➔

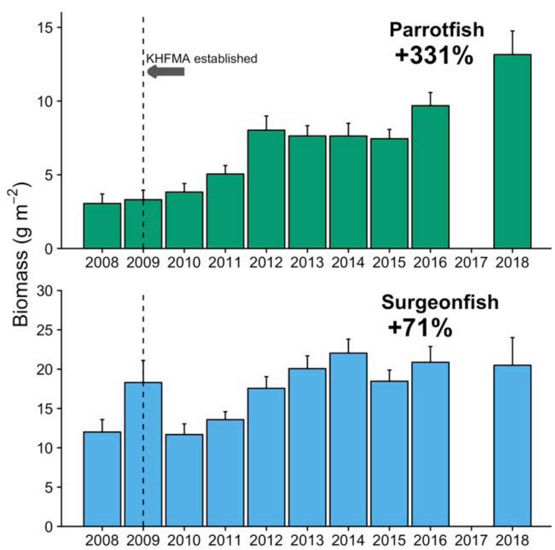


Trends in Herbivorous Fishes, Corals, and Reef Algae in the KHFMA

Since the KHFMA was created in 2009, parrotfish biomass has increased to more than four times its earlier level (+331%). The bullethead parrotfish has become particularly abundant, now making up ~80% of total parrotfish biomass, from ~25% in 2008. Large parrotfishes have become much more abundant. In 2018, biomass of parrotfishes larger than 10 inches in total length was more than 10 times the 2008 level.

Bullethead parrotfish: terminal phase (left) and initial phase (right)

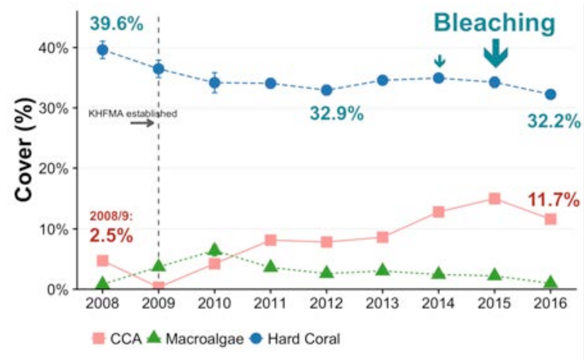
Surgeonfish biomass has also increased, to a little under twice what it was in 2008 (+ 71%). Surgeonfishes tend to be long-lived (30+ years in many cases), and studies from other marine protected areas have shown that surgeonfish typically take longer to recover following protection than many other groups of fish.



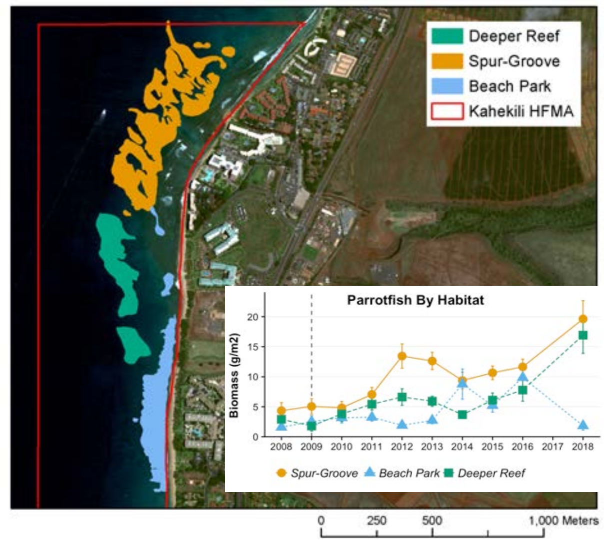
Trends in herbivorous fishes
from 2008 to 2018

Trends in the KHFMA (continued)

The reef itself has also changed – there is reduced cover of problem seaweeds (‘macroalgae’, and dense turf), and there has been about a 4-fold increase in crustose coralline algae (CCA). These changes have likely greatly improved conditions for corals. Coral cover, which had been declining at the time of the KHFMA establishment, leveled off and appeared to be increasing through 2013 and 2014. In 2015, Maui was hit by a major bleaching event, which resulted in a small decline in coral cover (described below).



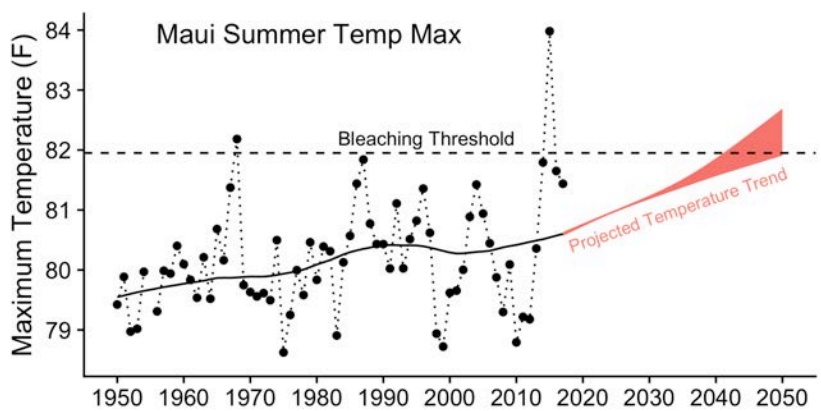
Although there are many positive changes within the KHFMA, not all areas have improved equally. The map to the right shows three major reef areas within the KHFMA, and changes to parrotfish biomass within those zones. In both the spur and groove zone approximately offshore of Honokowai Point (orange in the figure and graph), and the deeper-reef areas (green), parrotfish biomass has increased substantially. In contrast, there has been little to no recovery of parrotfish biomass in the near-shore shallow reef close to the Kahekili Beach Park (blue). Fundamental differences in reef type may be partially responsible for those different trends, but it could also represent a lack of compliance on the relatively accessible nearshore reefs. Declines in numbers of some large-bodied and desirable fishery species since 2014, including the redlip parrotfish (*uhu palukaluka*) and bluespine unicorn (*kala*), are also indications that a low level of poaching is probably preventing full recovery from occurring across all of the KHFMA.



Climate Change, Coral Bleaching and Coral Mortality

Corals are very vulnerable to even small increases in temperature above their normal levels. When temperatures rise, many corals ‘bleach’ - expelling the symbiotic algae that live inside their tissues, give them their color, and provide most of their food. When elevated temperatures are sustained for several weeks, corals begin to starve and may die. A prolonged period of very high temperatures in 2015 led to mass bleaching and substantial coral death across much of Hawaii. Maui was not the worst affected island, but still ~20% of all Maui coral died during and following that event. Impacts varied a lot around the island, but one of the worst affected areas was at Olowalu, which lost ~40% of its coral (30.4% ± 2.0% in 2014-15, 20.2% ± 1.2% in 2016-17).

The figure to the right shows the average temperature in the warmest month in each year. The ‘bleaching threshold’ is 1.8 ^{o}F above the average summer maximum. Evidence from bleaching events around the world shows that coral bleaching occurs when temperatures remain above that level for several weeks or more. Until recently only very unusually warm years would reach that level, and coral reefs had time to recover between events. As temperatures rise, bleaching events are likely to become much more frequent and severe, and coral reefs will have less time to recover between events.



Maui Temperature trends from 1950, and projected to 2050. Historical trend comes from ocean observation data; projections are based on International Panel for Climate Change (IPCC) scenarios.

Maintaining healthy herbivore communities is one way we can help corals to rebound from bleaching in the future.