Table 1

Alternative management scenarios	Simulated scenario	Description	Involved changes in Ecosim
No action	Constant effort	~~F~~ixed gear-specific fishing effort based on 2019 levels	Fishing effort stays constant at 2019 levels (=1)
Reef-based Management Scenarios	No Herbivore fishing	Herbivores are caught with spear, net and hook and line fishing in the reef-based fishery. Gear-specific fishing effort was kept at 2019 levels but fishing mortality of the three herbivore fish functional groups was set to zero and we assumed that other species were not caught more.	Fishing mortality was set to zero for the three herbivorous fish groups (reef grazers, browsers, and parrotfishes), effort level stayed constant (=1)
	No Spearfishing	Fishing effort for spearfishing set to zero	Spear fishing effort=0. Other fishing efforts set to 2019 levels (=1)
	No Net fishing	Fishing effort for net fishing was set to zero	Net fishing effort=0. Other fishing effort set to 2019 levels (=1)
	Line Only fishing	Fishing effort for both spearfishing and net fishing was set to zero, “other” was kept at 2019 levels	Spear and net fishing effort =0. Other fishing effort set to 2019 levels (=1)
Deepwater-based Management Scenarios	No MPA1	With opening the no-take MPA, we assumed an increase in the recreational and commercial deepwater-based fishing effort. We also assumed that fishes were easier to catch and, hence, we increased the fishing mortality.	- Fishing effort set to 1.25x 2019 levels for both recreational and commercial deepwater-based fishing, - Fishing mortality of the two bottomfish groups was set to 1.5x 2019 levels
	No MPA2	As in No MPA1 but now we assume that the fishes will ‘learn’ the danger of hook and line in three years and increased fishing mortality is only applied in the first three years.	- Fishing effort set to 1.25x 2019 levels for both recreational and commercialdeepwater-based fishing, - Fishing mortality of the two bottomfish groups was set to 1.5x 2019 levels for the first 3 years only (2020-2022)

Table 2

Objective	Indicator	Original objective (source) and Description of indicator
1. Maintain culturally appropriate food systems		Food provision (Ocean Health Index (OHI) [www.oceanhealthindex.org/]); Manage natural resources that are important to the cultural heritage of Hawai'i (DAR 30x30 draft plan); Manage in a way that promotes social cohesion and resilience (DAR 30x30 draft plan); Ensure nutritional security of vulnerable populations and local consumption of seafood to increase healthy benefit of seafood (Weijerman *et al.*, 2019).
	Biomass of culturally important functional groups	Lacking rigorous research to identify culturally important groups, we instead used economically important groups with an ex-vessel price $\geq 75^{th}$ percentile of the price range ($3.295) (DAR, 2010 data). Groups included were parrotfishes, reef benthic carnivores, bottomfishes (both groups), uku, lobster, and octopus.
	Catch allocated for home consumption or shared within community	We assumed that catch not sold consists of home consumption and sharing with family members, friends, community members, and cultural events (Hospital and Beavers, 2012; Chan and Pan, 2017). Non-commercial catch was calculated from total catch and the historical average non-commercial proportion of the catch for a given functional group. We assumed that the noncommercial allocation of the catch in the future will be similar to the historical allocation on average.
	Variability of fish catch	Coefficient of variation (CV) of the total annual catch across years (Cline *et al.*, 2017; Pellowe and Leslie, 2017).
2. Maintain or optimize intangible benefits of marine resources		Sense of Place (OHI); Recognize the diverse intangible benefits that the ocean provides (DAR 30x30 draft plan); Optimize recreation (Magnuson-Stevens Act); Encourage productive and enjoyable harmony between man and his environment (National Environmental Protection Act); Data on intangible benefits (e.g., aesthetic, sense of place) are extremely limited; hence, we could only include two indicators.
	Dive/snorkel enjoyment	Importance of seeing corals, fish abundance and diversity, and, turtles (Grafeld *et al.*, 2016), effects of resource condition on likelihood to participate in diving/snorkeling in the future (Supplementary information 4).
	Monk seal and dolphin biomass	Charismatic megafauna for wildlife viewing.
3. Sustain marine revenues		Sustain marine revenues (Weijerman *et al.*, 2019); Sustain jobs and thriving coastal economies (Magnuson-Stevens Act).

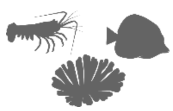
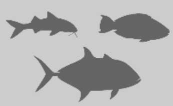
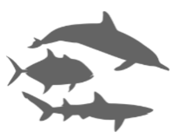
	Total fisheries value	Sum of revenue per pound of fish species sold (DAR, 2010 data).
4. Maintain biologically diverse and productive marine ecosystems		Maintain biologically diverse and productive marine ecosystems and foster the long-term sustainable use of marine resources in an ecologically and culturally sensitive manner through the use of a science-based ecosystem approach to resource management. (Western Pacific Regional Fisheries Management Council Hawaiʻi Archipelago Fisheries Ecosystem Plan); Promote sustainable fisheries (PIFSC Science Plan, 2019); Support healthy marine ecosystems (OHI); Assessment of coral reef ecosystems resilience to the effects of climate change (Weijerman, 2017); Can coral reef ecosystem resilience be changed through spatial management, such as no-take areas or Herbivore Enhancement areas (Weijerman, 2017)
	Biodiversity	Adapted Kempton's Q diversity index by taking into account functional group instead of species (Ainsworth and Pitcher, 2006).
	Trophic level of fish community	Mean trophic level weighted by biomass (see Supplementary information 2, Table S2 for trophic levels across functional groups) (Weijerman *et al.*, 2013, 2018)
	Biomass of apex predators	Functional groups: Sharks, roving piscivores (jacks), dolphins, monk seals, deepwater and reef benthic piscivores (grouper, eel, scorpionfish, trumpetfish) (Weijerman *et al.*, 2013)
	Herbivorous fish biomass	Functional groups: Grazers (surgeonfishes), browsers (chubs, unicornfish), and parrotfishes (Weijerman *et al.*, 2018; Wongbusarakum *et al.*, 2019)

Figure 1

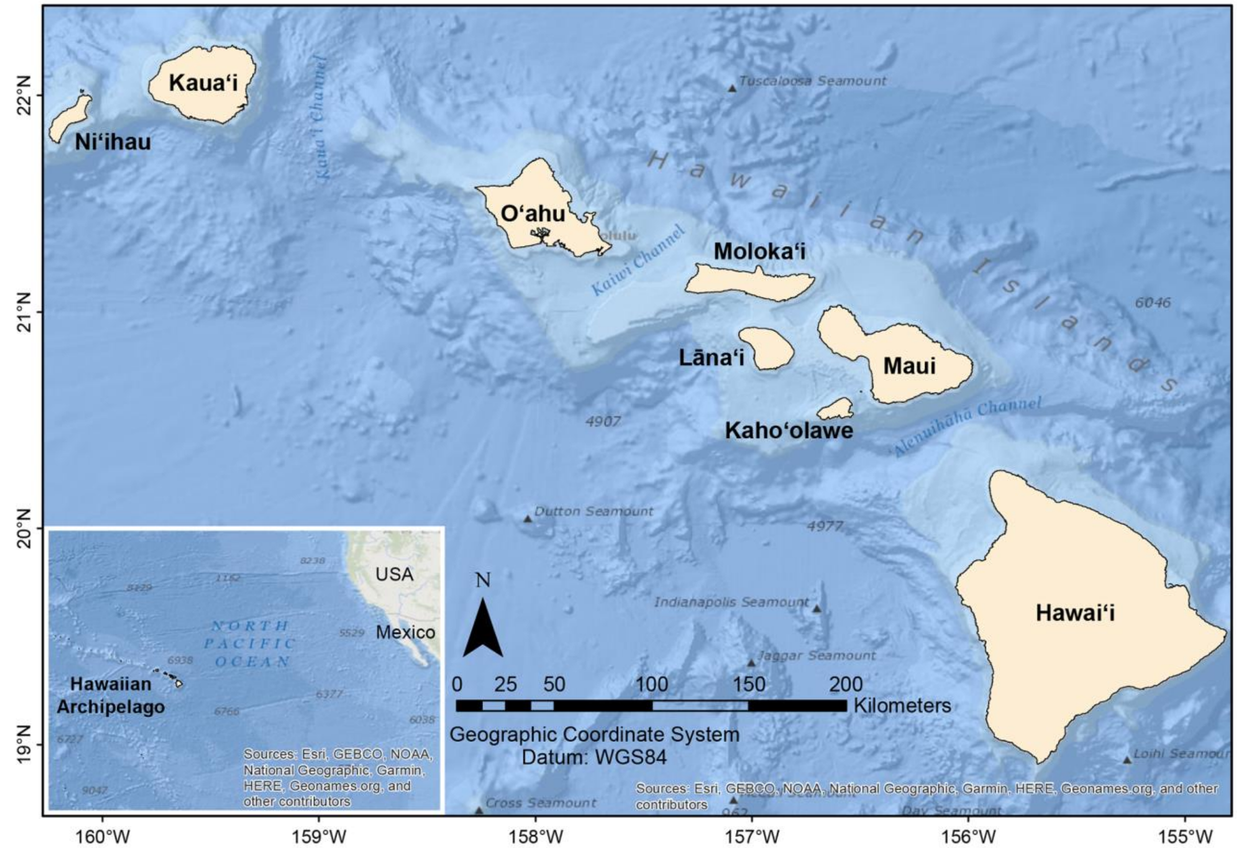


Figure 2

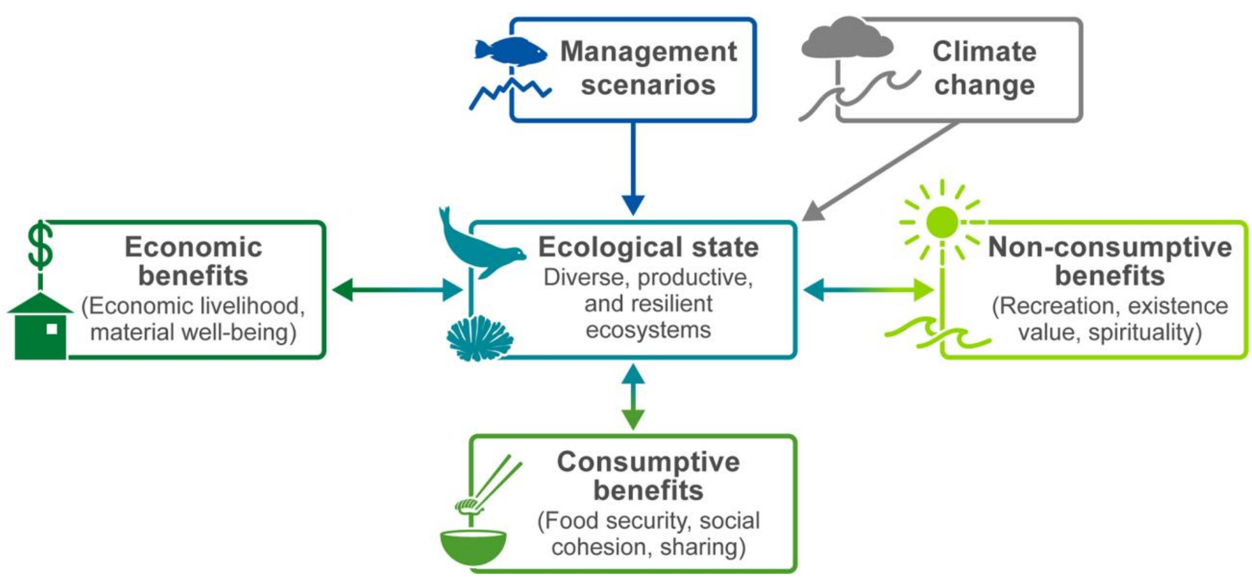


Figure 3

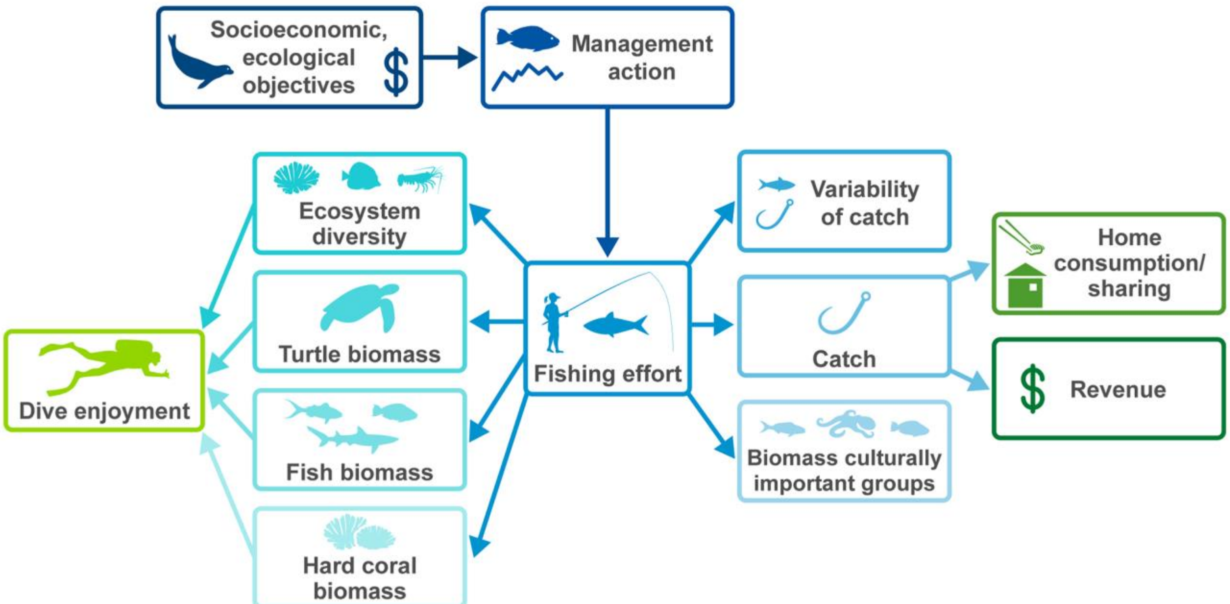


Figure 4

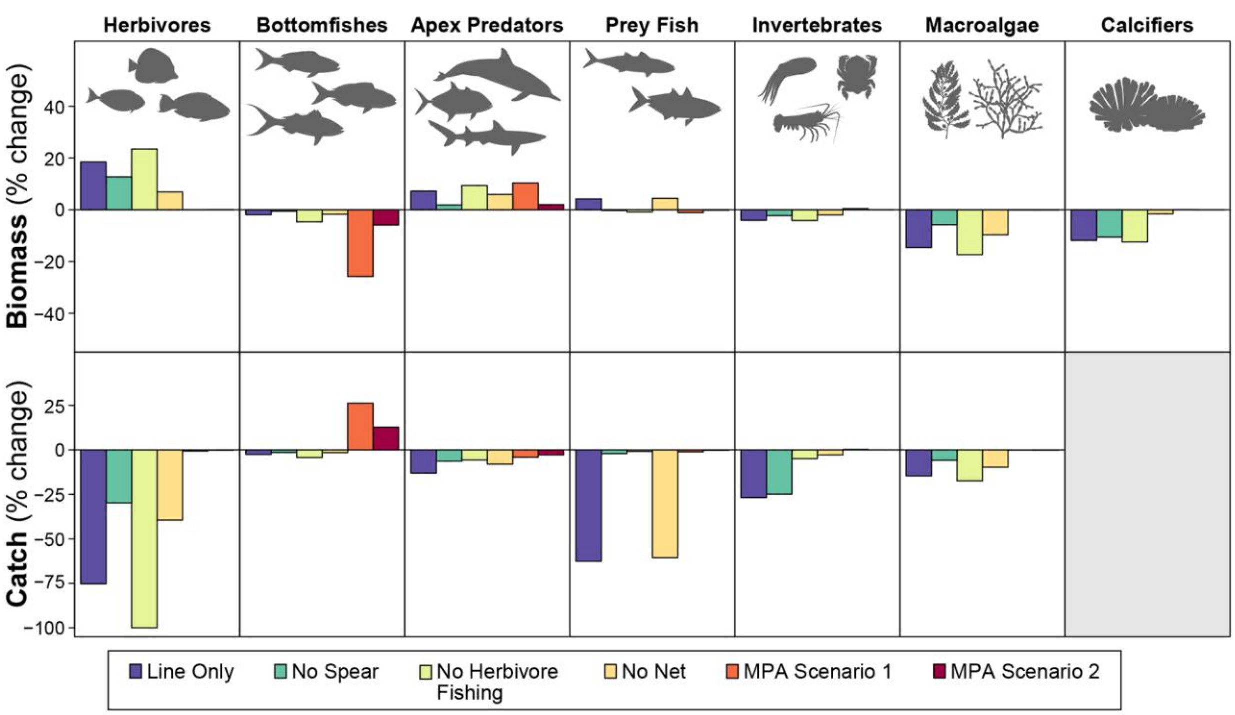


Figure 5

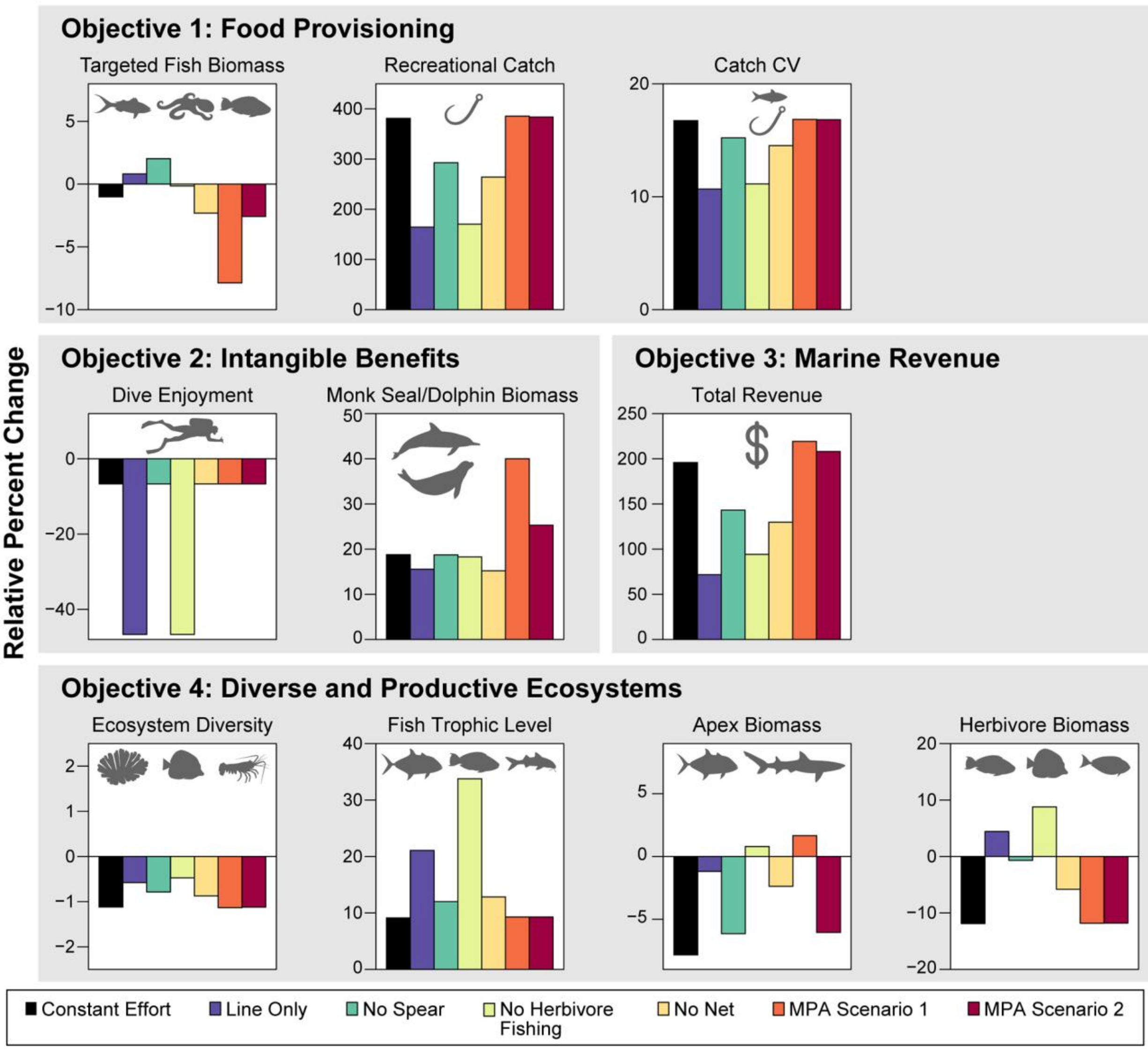
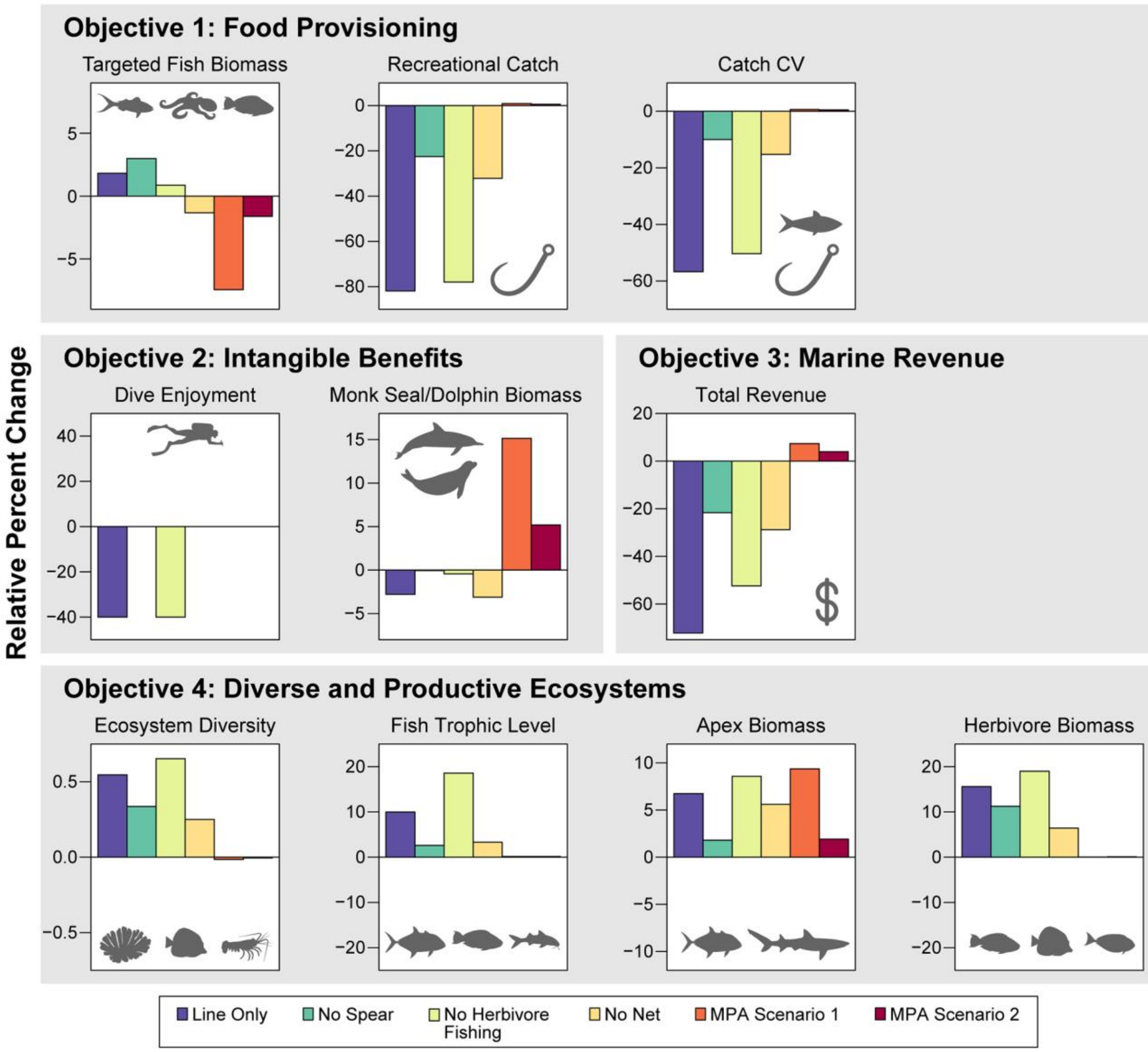

Objective 1: Food Provisioning
Targeted Fish Biomass
Recreational Catch
Catch CV
Objective 2: Intangible Benefits
Dive Enjoyment
Monk Seal/Dolphin Biomass
Objective 3: Marine Revenue
Total Revenue
$
Objective 4: Diverse and Productive Ecosystems
Ecosystem Diversity
Fish Trophic Level
Apex Biomass
Herbivore Biomass
Relative Percent Change
Constant Effort
Line Only
No Spear
No Herbivore Fishing
No Net
MPA Scenario 1
MPA Scenario 2

Figure 6



Relative Percent Change
Objective 1: Food Provisioning
Targeted Fish Biomass
Recreational Catch
Catch CV
Objective 2: Intangible Benefits
Dive Enjoyment
Monk Seal/Dolphin Biomass
Objective 3: Marine Revenue
Total Revenue
Objective 4: Diverse and Productive Ecosystems
Ecosystem Diversity
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