PNAS
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Supplementary Information for

The gravity of human impacts mediates coral reef conservation gains

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www.pnas.org/cgi/doi/10.1073/pnas.1708001115

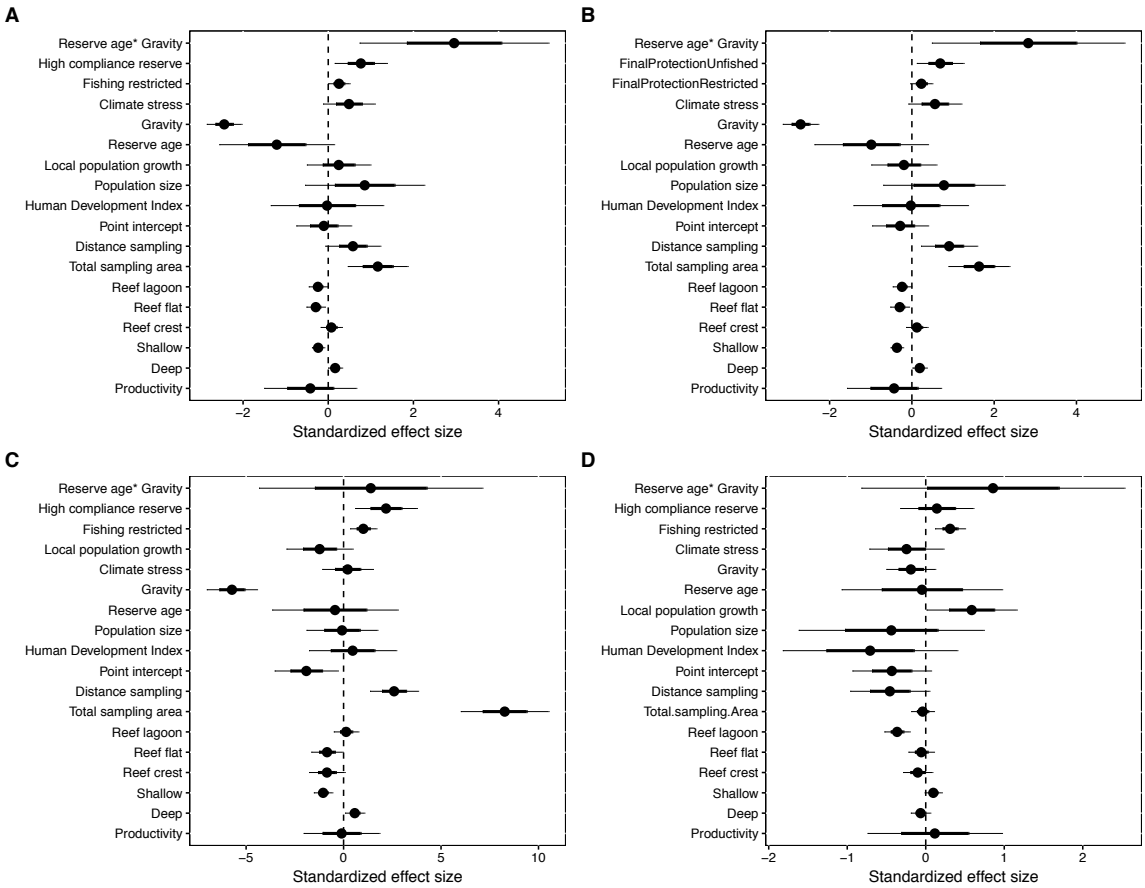
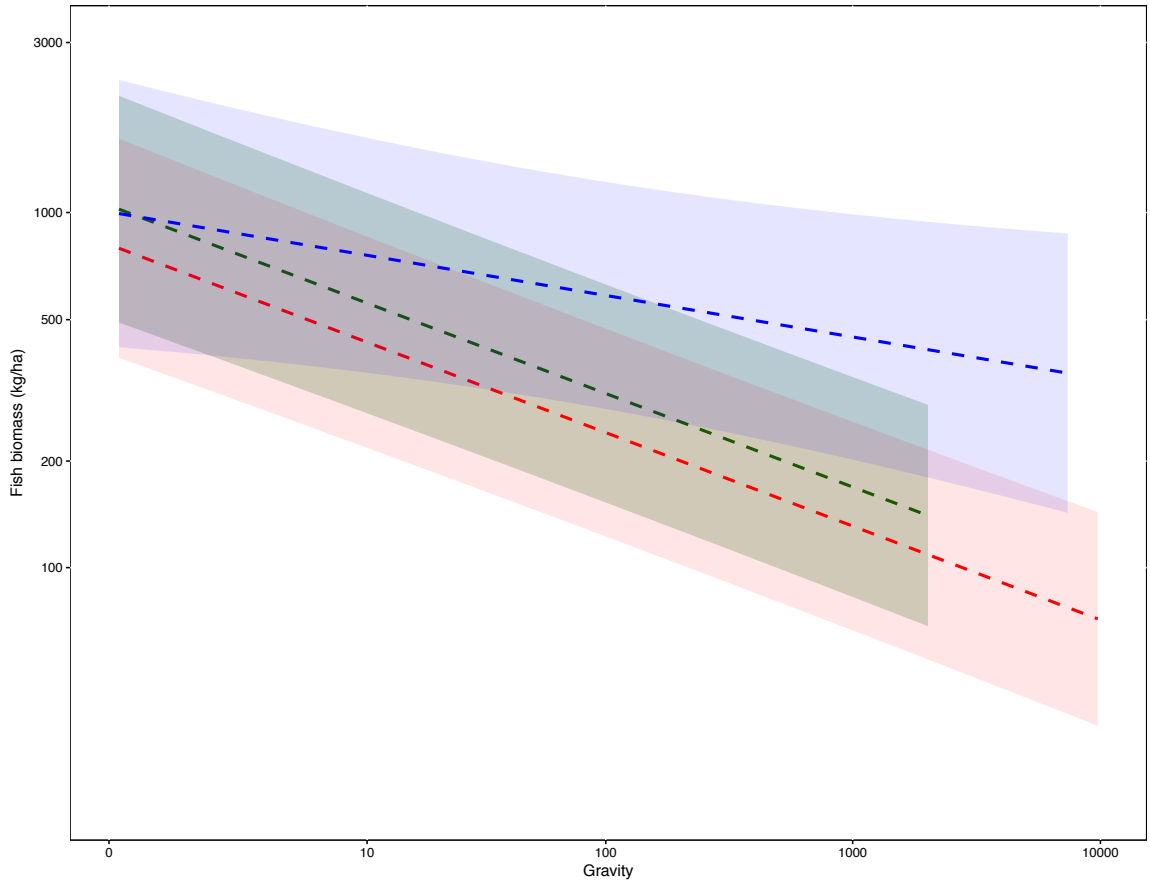


Fig. S1 | Standardized effect size of social drivers and environmental covariates, including 95% uncertainty intervals (thin lines), and 50% (thick lines) for A) the full biomass model (including top predators); B) targeted fish biomass model (excluding top predators); C) the top predators presence/absence model; and D) untargeted Biomass model.



Sig S2| Model- predicted relationships for targeted-only fish biomass excluding top predators/ Blue-marine reserves, red=openly fished, green= restricted fishing. Shaded areas represent 95% confidence intervals.

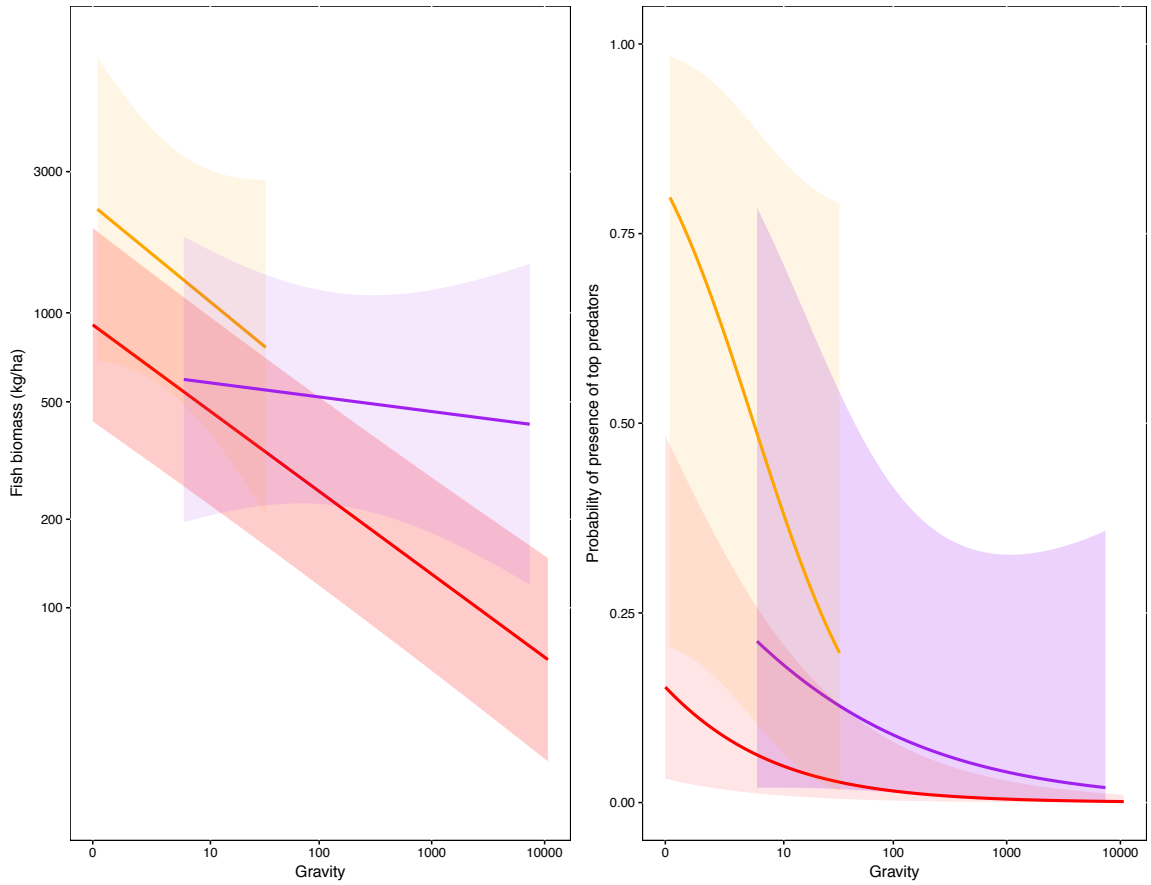


Figure S3 | Model-predicted trends in A) fish biomass and B) probability in encountering top predators with reserves broken into small (≤28km^2- purple) and large(orange). Shaded areas represent 95% confidence intervals.

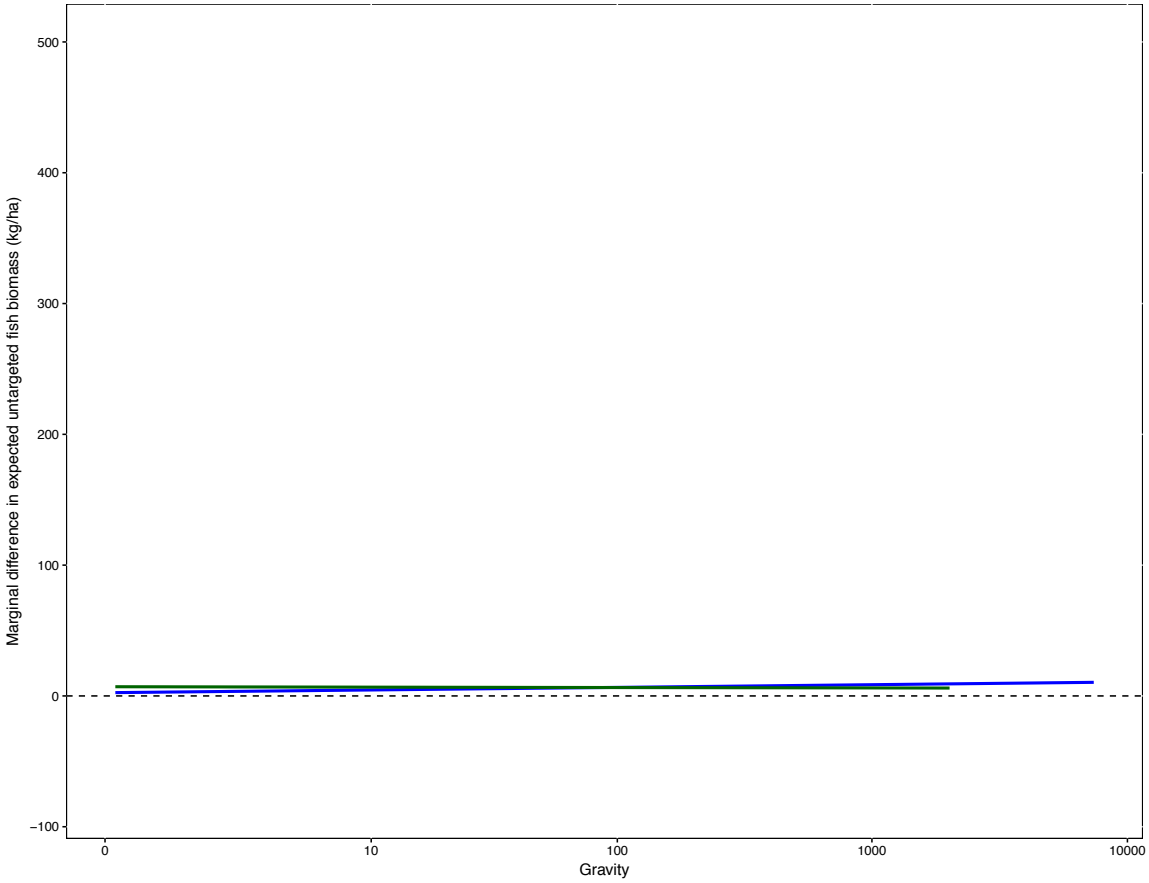


Figure S4 | Comparison of conservation gains between targeted (A) and untargeted (B) fish biomass models. Note: models plotted here on the arithmetic scale were linear on the log-scale used for estimation.

Table S1 | List of fish families included in the study, their common name, and whether they are commonly targeted in artisanal coral reef fisheries. Due to varying tastes, values, and preferences, not all families listed as target species will necessarily be targeted in ever coral reef fishery. X means not included in category. Note: Targeting of reef fishes can vary by location due to gear, cultural preferences, and a range of other considerations.

Fish family	Common family name	Fishery target	Top predator
Acanthuridae	Surgeonfishes	All	X
Balistidae	Triggerfishes	Non-Target<20cm; Target >20cm	X
Carangidae	Jacks/Trevallies	<50cm	>50cm
Carcharhinidae	Sharks	X	All
Diodontidae	Porcupinefish	Non-Target	X
Ephippidae	Spadefishes	All	X
Ginglymostomatidae	Sharks	X	All
Haemulidae	Grunts/Sweetlips	All	X
Heterodontidae	Sharks	X	All
Kyphosidae	Sea Chubs/Drummers	All	X
Labridae	Wrasses and Parrotfish	Non-Target<20cm; Target >20cm	X
Lethrinidae	Emperors	All	X
Lutjanidae	Snappers	All not included in top predators	Selected species over 50cm
Monacanthidae	Filefish	Non-Target	X

Mullidae	Goatfishes	All	X
Nemipteridae	Coral Breams	All	X
Pinguipedidae	Sand perch	Non-Target	X
Pomacanthidae	Angelfishes	Non-Target<20cm; Target >20cm	X
Serranidae	Groupers	<50cm	>50cm
Siganidae	Rabbitfishes	All	X
Sparidae	Porgies	All	X
Sphyraenidae	Barracuda	<50cm	>50cm
Sphyrnidae	Sharks	X	All
Synodontidae	Lizardfish	Non Target	X
Tetraodontidae	Pufferfish	Non Target	X
Zanclidae	Moorish Idol	Non Target	X

Table S2 | Travel time estimates by land cover type. Adapted from Nelson (2008)

Global Land Cover Class	***Speed associated (km/h)***
Tree cover, broadleaved, deciduous & evergreen, closed; regularly flooded Tree Cover, Shrub, or Herbaceous Cover (fresh, saline, & brackish water)	1
Tree cover, broadleaved, deciduous, open *(open= 15-40% tree cover)*	1.25
Tree cover, needle-leaved, deciduous & evergreen, mixed leaf type; Shrub Cover, closed-open, deciduous & evergreen; Herbaceous Cover, closed-open; Cultivated and managed areas; Mosaic: Cropland / Tree Cover / Other natural vegetation, Cropland / Shrub or Grass Cover	1.6
Mosaic: Tree cover / Other natural vegetation; Tree Cover, burnt	1.25
Sparse Herbaceous or sparse Shrub Cover	2.5
Water	20
Roads	60
Track	30
Artificial surfaces and associated areas	30
Missing values	1.4

Table S3 | Targeted biomass model comparisons using AIC, ΔAIC and conditional R^2 between different types of gravity considering 3 buffer sizes (50, 250 and 500 km) and 3 exponents (travel time to the power of 1, 2 and 3). ΔAIC is calculated from the most parsimonious model (the lowest AIC) which is provided by the gravity within 500km-buffer and using square travel time.

Model	Sites with population within buffer (n=2233)	AIC	ΔAIC	Conditional R^2
50km-gravity				
Travel time	1682	7146	16	0.59
Travel time^2	1682	**7138**	8	0.60
Travel time^3	1682	**7138**	8	0.60
250km-gravity				
Travel time	1860	7153	23	0.59
Travel time^2	1860	**7135**	5	0.59
Travel time^3	1860	7140	10	0.60
500km-gravity				
Travel time	1937	7176	46	0.60
Travel time^2	1937	**7130**	0	0.59
Travel time^3	1937	7186	56	0.57

Table S4 | Model fit estimates for both targeted fish biomass and top predator are measured with the marginal R-squared, which describes the proportion of variance explained by the fixed factors alone, and conditional R-squared, which describes the proportion of variance explained by both the fixed and random factors. The relative importance of each variable is also presented for both targeted fish biomass and top predator models. To get those, all the possible models (i.e. all the possible combination of variables) are ranked using AICc, and all models within ΔAICc< 3 of the top ranked model are kept. The relative importance of each variable is based on the sum of Akaike weights of all the possible models (i.e. all the possible combination of variables) in which the variable is present.

Variables	Targeted biomass model	Top predator model
Model fit estimates		
marginal R-squared	0.18	0.47
conditional R-squared	0.58	0.63
Relative variable importance		
Management*Gravity	0.13	0.57
Management	0.14	1
Gravity	1	1
Local population growth	0.43	0.31
Reef fish landings	0.21	0.35
Population size	0.26	0.51
Tourism	0.50	0.51
Voice and accountability	0.21	0.31
Human Development Index	0.22	0.34
Census method	0.60	X
Total sampling area	1	1
Habitat	0.89	1
Depth	1	1
Productivity	0.16	0.32

Table S5| List of nation/states included in the study, and number of reef sites by management type.

COUNTRY	OPENLY FISHED	RESTRICTED	HIGH COMPLIANCE RESERVES
AMERICAN SAMOA (AM SAM)	96	8	0
AUSTRALIA	0	91	15
BELIZE	3	9	0
BRAZIL	0	6	12
BRITISH INDIAN OCEAN TERRITORY	0	6	36
CAYMAN ISLANDS	3	0	0
COLOMBIA	3	0	0
COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS (MARIANA)	70	0	2
COMORO ISLANDS	7	0	0
CUBA	0	0	3
EGYPT	6	0	0
FEDERATED STATES OF MICRONESIA	1	0	0
FIJI	15	1	0
FRENCH POLYNESIA	122	0	0
GUAM	9	4	1
HAWAII	221	1	2
INDONESIA (INDO)	90	108	2
JAMAICA	8	2	0
KENYA	23	0	9
KIRIBATI	50	0	0
MADAGASCAR (MADA)	38	0	0
MALDIVES	0	40	1
MARSHALL ISLANDS	15	0	0
MAURITIUS	10	0	4
MAYOTTE	8	0	0
MEXICO (MEX)	3	0	6
MOZAMBIQUE (MOZ)	18	2	4
NETHERLANDS ANTILLES	0	14	0
NEW CALEDONIA (NEW CAL)	224	10	0
OMAN	8	0	0
PALAU	0	2	0
PANAMA	13	0	0
PAPUA NEW GUINEA (PNG)	18	10	0

PHILIPPINES	1	0	0
PACIFIC REMOTE ISLAND AREAS (PRIA)	0	111	0
REUNION	14	0	0
SEYCHELLES (SEY)	0	53	3
SOLOMON ISLANDS	60	0	2
TANZANIA	37	0	4
TONGA	6	0	0
VENEZUELA	7	7	0