Supporting Online Material for

Trophic Downgrading of Planet Earth

James A. Estes,* John Terborgh, Justin S. Brashares, Mary E. Power, Joel Berger, William J. Bond, Stephen R. Carpenter, Timothy E. Essington, Robert D. Holt, Jeremy B. C. Jackson, Robert J. Marquis, Lauri Oksanen, Tarja Oksanen, Robert T. Paine, Ellen K. Pikitch, William J. Ripple, Stuart A. Sandin, Marten Scheffer, Thomas W. Schoener, Jonathan B. Shurin, Anthony R. E. Sinclair, Michael E. Soulé, Risto Virtanen, David A. Wardle

*To whom correspondence should be addressed. E-mail: jestes@ucsc.edu

Published 15 July 2011, *Science* **333**, 301 (2011)
DOI: 10.1126/science.1205106

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SOM Table 1. Examples of regime shifts in terrestrial, freshwater, and marine ecosystems resulting from the loss or addition of large-bodied vertebrates. Those based on linkages across 3 or more species are noted with an asterisk

Ecosystem	Perturbation/Location	Response	Reference
Terrestrial			
Arctic tundra	Extinction of megaherbivores/Siberia	Conversion of steppe to tundra	(*43*)
*Arctic tundra	Introduction of arctic fox/Aleutian Islands	Conversion of grass-land to tundra	(*47*, *74*)
* Boreal forest	Self-introduction of moose/Isle Royale	Reduction of balsam fir	(*63*)
* Temperate forest	Extirpation of wolf/Yellowstone National Park	Overbrowsing of aspen, cottonwood, willow	(*75*, *76*)
*Temperate forest	Restoration of wolf/ Yellowstone National Park	Recovery of riparian vegetation	(*25*, *77*)

Table 1 (continued)

*Temperate forest	Extirpation of large predators/Europe, Japan, and eastern United States	Eruption of cervid populations, overbrowsing, altered forest composition	(*78-80*)
*Temperate forest	Loss of cougar/Zion National Park	Eruption of mule deer, loss of riparian vegetation and associated biodiversity, altered channel morphology	(*61*)
Temperate forest	Introduction of red deer/New Zealand	Overbrowsing, altered composition of forests	(*81*)
*Tropical forest	Loss of jaguar, cougar, Harpy eagle/Venezuela	Explosion of herbivores, suppression of tree recruitment	(*82*)
*Tropical forest	Decimation of large birds and mammals by hunting/neotropics	Altered tree recruitment	(*83*, *84*)
*Tropical savanna	Decimation of ungulates by Rinderpest epidemic/Serengeti	Increased extent and frequency of fires	(*30*, *85*)
Tropical savanna	Recovery of white rhino/South Africa	Appearance of grazing lawns, reduced incidence of fire	(*86*)
Subtropical bush	Predator control of dingo/Australia	Mesopredator release/ proliferation of exotic mesopredators and herbivores/reduced biodiversity	(*87*)

Table 1 (continued)
Freshwater

*Tropical river	Exclosures and enclosures/Panama	Fishing birds protect algae from grazing catfish	(*88*, *89*)
* Temperate stream	Exclosures and enclosures/Oklahoma	Piscivorous bass protect algae from grazing minnows	(*69*)
*Temperate stream	Predator introduction/New Zealand	Invasive trout protect algae from grazing insects	(*90*, *91*)
*Boreal stream	Predator introduction/Hokkaido	Invasive trout protect algae from grazing insects	(*92*)
* Fresh water lake	Remove piscivore trophic level	Reduced water clarity, increase in phytoplankton and primary production, increased N:P ratio, increased response to nutrient inputs, net flux of CO_2 into the lake	(*26*, *93*)
*Fresh water lake	Introduction of non-native top piscivore	Reorganization of fish community, species loss	(*94*)

Table 1 (continued)
Marine

*Temperate subtidal	Sea otter recovery	Recovery of kelp forest	(*95*)
*Temperate subtidal	Overharvest of cod	Urchin outbreak; collapse of kelp forests	(*96*)
*Temperate estuarine	Decimation of apex sharks	Outbreak of cow-nosed rays, shellfish decline	(*19*)
Tropical coastal	Reduced grazing by green turtles	Reduced recycling of turtle grass	(*97*)
*Coral reefs	Overfishing	Reduction in crustose coralline algae resulting in reduced reef calcification,	(*98*)
*Coral reefs	Overfishing followed by disease	Reef overgrowth by algae	(*99*)
Continental shelf	Overharvest of cod	Shrimp increases	(*100*)
*Open ocean (North Pacific)	Pink salmon fluctuation	zooplankton decline, chlorophyll increase	(*101*)

*Open ocean (North Atlantic)	Overharvest of cod	Planktivorous fish, zooplankton, chlorophyll	(*102*)

Table 1 (continued)

*Open ocean (North Atlantic)	Overharvest of cod	Sprat increase, zooplankton decline	(*103*, *104*)
*Open ocean (North Pacific)	Overharvest of great whales	Killer whale diet shift, pinniped population declines	(*105*)
*Open ocean (Southern Ocean)	Overharvest of great whales	Krill increase, adelie penguin diet shift	(*106*)
*Open ocean (Black Sea)	Overfishing	Planktivorous fish, gelatanous plankton, zooplankton, phytoplankton	(*107*)

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