Project "Broad-scale marine spatial planning of mammal corridors & protected areas in Wider Caribbean & Southeast & Northeast Pacific" (2010-2012)

Cumulative Human Impact on Marine Ecosystems

Data used to produce the map on the cumulative human impact on marine ecosystems are from the work of Halpern et al. 2008. "A Global Map of Human Impact on Marine Ecosystems". Science 319: 948-952. This represents an ecosystem-specific, multi-scale spatial model that synthesizes 17 global data sets of anthropogenic drivers of ecological change for 14 distinct marine ecosystems (see list below).

All open-access data layers used for this global analysis are available for download from the project website: http://www.nceas.ucsb.edu/globalmarine

A detailed description of the methods used is available in the "Supplementary Online Material" for the 2008 Science paper at: http://www.sciencemag.org/content/319/5865/948/suppl/DC1

The cumulative impact model follows a 4-step process: 1) the assembly of global data for each anthropogenic driver and each ecosystem; 2) each driver was log[X+1]-transformed and rescaled between 0-1 to put them on a single, unitless scale that allows direct comparison, and converted ecosystem data into 1 km^2 presence/absence layers; 3) for each 1 km^2 cell of ocean, each driver layer was multiplied with each ecosystem layer to create driver-by-ecosystem combinations, and then multiplied again by the appropriate weighting variable (these weighting variables come from an expert survey that assessed the vulnerability of each ecosystem to each driver on the basis of 5 ecological traits). The weighting values represent the relative impact of an anthropogenic driver on an ecosystem within a given cell when both exist in that cell, and do not represent the relative global impact of a driver or the overall status of an ecosystem. The sum of these weighted driver-by-ecosystem combinations then represents the relative cumulative impact of human activities on all ecosystems in a particular 1 km2 cell; and 4) to provide ecological meaning to these relative cumulative impact scores, empirical data on the condition of ecosystems to groundtruth the scores was used.

The method resulted in final impact scores ranging from 0.01 to 90.1. The classification of impact levels in 6 categories (very low - very high) on the map is the same as described in Halpern et al. 2008.

- Very low impact (<1.4)
- Low impact (1.4 - 4.95)
- Medium impact (4.95 - 8.47)
- Medium-high impact (8.47 - 12)
- High impact (12 - 15.52)
- Very high impact (> 15.52)

List of all driver data used in analyses with associated native resolution:

Data Layer	Native Resolution	Years Used
Drivers		
Nutrients (fertilizer)	1km^2	1993-2002
Organic pollutants (pesticides)	1km^2	1992-2001
Inorganic pollutants (impervious surfaces)	1km^2	2000-2001
Direct human (population density)	1km^2	2005
Pelagic, low-bycatch fishing	half-degree	1999-2003
Pelagic, high-bycatch fishing	half-degree	1999-2003
Demersal, destructive fishing	half-degree	1999-2003
Demersal, non-destructive, low-bycatch fishing	half-degree	1999-2003
Demersal, non-destructive, high-bycatch fishing	half-degree	1999-2003
Artisanal fishing	1km^2	1999-2003
Oil rigs	30 arc-second (~1km^2)	2003
Invasive species	1km^2	1999-2003
Ocean pollution	1km^2	1999-2003, 2004-2005
Shipping	lat/long data	2004-2005
SST	21km^2	1985-2005
UV	1 degree	1996-2004
Ocean acidification	1 degree	1870 vs. 2000-2009
Ecosystems		**Year Accessed**
Coral	1:250000	2006
Seagrass	1:250000	2006
Mangrove	1:250000	2006
Rocky reef	lat/long data combined with 2 minute bathymetry	2005
Shallow soft	lat/long data combined with 2 minute bathymetry	2005
Hard shelf	lat/long data combined with 2 minute bathymetry	2005
Soft shelf	lat/long data combined with 2 minute bathymetry	2005
Hard slope	lat/long data combined with 2 minute bathymetry	2005
Soft slope	lat/long data combined with 2 minute bathymetry	2005
Hard deep	lat/long data combined with 2 minute bathymetry	2005
Soft deep	lat/long data combined with 2 minute bathymetry	2005
Seamounts	14,287 point data with lat/long	2004
Pelagic waters	derived from 2 minute bathymetry	2006
Deep waters	derived from 2 minute bathymetry	2006