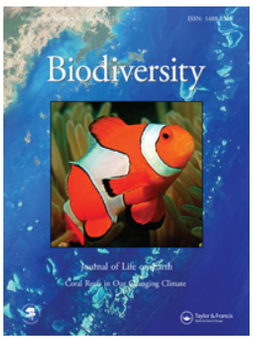

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Measuring the human 'so what' of large-scale coral reef loss?

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The recent mass-bleaching events, as horrible and shocking as they were, provided a natural experiment for us to understand how coral reefs and people might be affected by large-scale global change. Unfortunately, we lack the data we need to evaluate the human consequences of large-scale coral damage – a good, global and empirical set of baseline data on the human dimensions of coral reefs.

Scenario analysis (Cinner et al. 2011), hypothetical thought experiments (Cinner et al. 2016; Pendleton et al. 2016) and predictive models (Brander et al. 2012) form the basis of most studies about the human consequences of large-scale damage to coral reefs caused by climate change and ocean acidification. This is not surprising. Until now, we did not have many examples of large-scale coral bleaching and death. So, we have made educated guesses about the ways we think people might respond to large-scale coral reef loss, based on how people responded in the past to other smaller, localised changes in coral reef conditions. The 2016 bleaching, however, could have provided the first concrete evidence of how people would respond to large-scale declines in coral reef ecosystem health. Unfortunately, our worldwide base of knowledge about the human dimensions of coral reefs is patchy and composed largely of one-off or short-lived data collection efforts. We can't even begin to understand the impact of these large-scale events without more consistent baseline data, over more years, from more places, on human uses of coral reefs.

Failure to collect good baseline data on human uses of ecosystems is an old story. After nearly twenty years of habitat restoration, the United States National Atmospheric and Oceanic Administration (NOAA) found it difficult to point to a baseline of empirical data against which it could show that its habitat restoration projects had improved human wellbeing or created ecosystem-based jobs (Pendleton 2010). Scientists and analysts also found it difficult to assess the loss of ecosystem services caused by the Deepwater Horizon oil disaster because there were no pre-existing baseline data on human uses and ecosystem services for coastal ecosystems throughout the Gulf of Mexico (Committee on the Effects of the Deepwater Horizon Mississippi Canyon-252 Oil Spill on Ecosystem Services in the Gulf of Mexico 2013). As a consequence, we have a diminished understanding of how much harm to people the Deepwater Horizon accident caused. We will never know if people were 'made whole' by court ordered monetary compensation or required remediation.

We know quite a bit about how people benefit from healthy coral reef ecosystems (for reviews see Brander et al. 2012; Burke et al. 2011; Hoegh-Guldberg et al. 2014). Indeed, there have been efforts to collect social and economic data about coral reef ecosystem services, including numerous small-scale studies and even several regional efforts (e.g. the Great Barrier Reef, the Coral Triangle and the South Pacific Community), but the data collected are rarely consistent across studies, places, or time making large-scale, time-series analysis difficult. Data that are collected vary tremendously in terms of accuracy and timeliness. National level data sets (e.g. fisheries data) are often aggregated and can't be easily linked to coral reefs. The best global set of data we have on the jobs and revenues associated with coral reef fisheries is based on data distilled from a larger set of both primary and derived fisheries data (the Sea Around Us[1]) and provides estimates of reef-related fisheries jobs and revenues for 2005 (Teh, Teh, and Sumaila 2013). These estimates have not been updated to reflect newer (2013) global fisheries data available through the Sea Around Us. Estimates of the number of people that live at low elevations and who may depend on coral reefs for shoreline protection can be extracted from remotely sensed data (L. Burke cited in Pendleton et al. 2016), but defining which populations actually depend on coral reefs for shoreline protection (or fisheries, for that matter) is still largely guesswork.

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Figure 1. Small-scale coral reef tourism in Bali, Indonesia.

For most places, we simply fail to collect even the most basic, baseline data about human dependence on coral reef ecosystems.

Without a more global set of real-world data about the people who depend on coral reefs, we are flying blind when it comes to planning for the impacts of global climate change. We can only presume how people will respond to future large-scale changes in coral reef health. It is almost guaranteed that responses to these changes will vary from place to place, from culture to culture, and will be influenced by a host of social, economic and political factors. Without good global-level social and economic data, we have only a rudimentary understanding of who will be most harmed by the effects of climate change and ocean acidification on coral reef ecosystems.

How can we begin to plan for the potential loss of life, livelihoods and mass migrations that may result from future coral reef death? How can we choose where to invest in coral reef management if our goal is to protect people? Which coral reef communities should be compensated by the Green Climate Fund? How will we know if policies that affect coral reefs are contributing to the Sustainable Development goals to which more than 150 countries are committed?

Solid data on the human dimensions and benefits of coral reefs are essential if we are to ever convey the broader social importance of corals to human lives, economies and even national security.

At all levels, we need to come together to select a limited core of essential social and economic variables for coral reefs that should be collected globally. These essential variables, on the human dimensions of coral reefs, should not stand alone, but should be considered integral to similar large-scale data collection networks on biophysical dimensions of coral reefs and indeed coastal oceans, worldwide (e.g. the International Coral Reef Initiative's Global Coral Reef Monitoring Network and the Global Ocean Acidification Observation Network, GCRMN). Indeed, some progress has been made on this front. The Socioeconomic Monitoring Initiative for Coastal Management (SocMon) was created with such data in mind. SocMon has provided guidelines on data collection for human dimensions of coral reefs, but SocMon decided early against collecting a consistent core set of data and has never produced a global set of data on the human dimensions of coral reefs that is comparable across place or time (Loper et al. 2008). SocMon's more recent strategic plan (SOCMON 2014) proposes greater consistency across regions, but still does not identify a set of comparable core data for all coral reefs. One of the key objectives of the SocMon strategic plan is the integration of social and biophysical information for improved resource management. This is, in fact being implemented at a regional scale in the Caribbean through an effort by the regional node of the Global Coral Reef Monitoring Network (GCRMN-Caribbean). This regional GCRMN has approved a set of coral reef monitoring guidelines for both ecological and socioeconomic data. The GCRMN-Caribbean baseline scientific monitoring methods will provide a basic framework for monitoring programs to contribute comparable data that support a regional understanding of status and trends of Caribbean coral reefs and will at least allow us to assess the basic socio-economic impacts of large-scale future changes in coral reef health in the Caribbean region.[2] We need to scale-up this approach to the rest of the world.

One key to collecting human dimensions data at a global scale is to focus on a just a handful of variables. If we could do this, we could begin to compile a global set of data on human uses of coral reefs. For instance, the Mapping Ocean Wealth project is using crowd-sourced and social media data to track coral reef tourism (Figure 1), a key measure of coral reef ecosystem services, on a global scale (Spalding, Brumbaugh, and Landis 2016). Whatever we do, we need to concentrate more on collecting at least some data that are consistent over time and space.

The effects of climate change are upon us. The resulting sense of urgency may lead some conservation professionals to think that we don't have time for long-term, global data collection regarding the human dimensions of climate change. They are wrong. If we want the public

to take action to avoid the impacts of climate change – whether it be on coral reefs or any ecosystem – we need to compile a set of concrete and convincing empirical data that demonstrate the real and irrefutable human impacts of climate change, including the human toll of coral reef decline and death and the benefits of maintaining healthy coral reefs. Without such 'proof' – the 'so what' of coral reef loss – the best we can do is offer our educated belief about the human consequences of climate change on coral reefs – a decidedly unscientific approach.

Notes

1. http://www.seaaroundus.org
2. http://www.car-spaw-rac.org/IMG/pdf/gcrmn_carib_social_science_guidelines_nov_30_final-2.pdf.

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References

Brander, Luke M., Katrin Rehdanz, Richard S. J. Tol, and Pieter J. H. Van Beukering. 2012. "The Economic Impact of Ocean Acidification on Coral Reefs." *Climate Change Economics* 3 (1): 1250002. doi:10.1142/S2010007812500029.

Burke, L., Kathleen Reytar, Mark Spalding, and Allison Perry. 2011. *Reefs at Risk Revisited. World Resources Institute*. Washington, DC: World Resources Institute. doi:10.1016/0022-0981(79)90136-9.

Cinner, Joshua E., Carl Folke, Tim Daw, and Christina C. Hicks. 2011. "Responding to Change: Using Scenarios to Understand How Socioeconomic Factors May Influence Amplifying or Dampening Exploitation Feedbacks among Tanzanian Fishers." *Global Environmental Change* 21 (1): 7–12. doi:10.1016/j.gloenvcha.2010.09.001.

Cinner, Joshua Eli, Morgan Stuart Pratchett, Nicholas Anthony James Graham, Vanessa Messmer, Mariana Menezes Prata Bezerra Fuentes, et al. 2016. "A Framework for Understanding Climate Change Impacts on Coral Reef Social-Ecological Systems." *Regional Environmental Change* 16 (4): 1133–1146. doi:10.1007/s10113-015-0832-z.

Committee on the Effects of the Deepwater Horizon Mississippi Canyon-252 Oil Spill on Ecosystem Services in the Gulf of Mexico. 2013. *An Ecosystem Services Approach to Assessing the Impacts of the Deepwater Horizon Oil Spill in the Gulf of Mexico*, 1–247. Washington, DC: National Academy Press.

Hoegh-Guldberg, O., R. Cai, E. S. Poloczanska, P. G. Brewer, S. Sundby, et al. 2014. "The Ocean." In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by Cambridge University Press, 1655–1731. Cambridge, UK and New York, NY, USA: Cambridge University Press.

Loper, C., R. Pomeroy, V. Hoon, P. McConney, M. Pena, A. Sanders, G. Sriskanthan, et al. 2008. *Socioeconomic Conditions along the World's Tropical Coasts*.

Pendleton, Linwood. 2010. *Measuring and Monitoring the Economic Effects of Habitat Restoration: A Summary of a NOAA Blue Ribbon Panel*. Durham, NC: Linwood Pendleton Nicholas Institute for Environmental Policy Solutions, Duke University in Partnership with Restore America's Estuaries.

Pendleton, Linwood, Adrien Comte, Chris Langdon, Julia A. Ekstrom, R. Cooley, et al. 2016. "Coral Reefs and People in a High-CO 2 World : Where Can Science Make a Difference to People ?" *Plos One* 11: 1–21. doi:10.1371/journal.pone.0164699.

SOCMON. 2014. "Global Socioeconomic Monitoring Initiative for Coastal Management (SocMon/SEM-Pasifika), Strategic Plan." December: 18.

Spalding, Mark, Robert Brumbaugh, and Emily Landis. 2016. *Atlas of Ocean Wealth*. Arlington, VA: The Nature Conservancy.

Teh, Louise S. L., Lydia C. L. Teh, and U. Rashid Sumaila. 2013. "A Global Estimate of the Number of Coral Reef Fishers." *PLoS ONE* 8 (6). doi:10.1371/journal.pone.0065397.