OCB-OA: OA and human well-being

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What are some of the possible or actual societal impacts of OA?

Basic: Ocean acidification is expected to have negative overall effects on many marine species. This could alter marine food chains and food supply to humans. This could also decrease the storm protection from reefs, tourism opportunities, and other benefits (like biodiversity and habitat) that are difficult to value. Over one billion people around the world depend primarily on marine fisheries for most of their protein intake. Decreasing harvests could especially hurt the poorest people and the least developed nations that have the fewest agricultural alternatives. These challenges may influence population migrations to more urbanized regions, which may lead to further social disruption and even conflict. — K. Segarra, C. St. John, S. Cooley

Intermediate: Ocean acidification may result in substantial losses and redistributions of marine services. Some of these services include biodiversity, habitat, food provisioning, storm protection, tourism and recreation (Cooley et al 2012). The potential socioeconomic impacts of ocean acidification will likely initiate with the reduction of catch potential (Allison et al. 2005; Hoegh-Guldberg et al. 2007; Iglesias-Rodriguez et al. 2008). Ocean capture fisheries and aquaculture are both critical to the economy and food security of coastal nations. Marine capture fisheries contribute to global food security because they provide over 1.5 billion people with over 20% of their animal protein intake (FAO 2009) and provide the most important source of animal protein in developing countries (UN-DESA). In 2007, the wild fish and shellfish catch of the U.S. fishing industry were valued at $3.7 B (Cooley and Doney 2009).

Factors such as poverty and pre-existing political stability will likely determine the resiliency of coastal communities in the face of ocean acidification. Some of the least developed countries in the world, whose inhabitants are among the world's poorest and almost twice as reliant on fish as their more developed counterparts (average of 27% of dietary protein compared to 13% in developed nations) are also those most likely to experience the worst harms of climate change (Allison et al. 2009) and ocean acidification. The fisheries and aquaculture trade directly employs roughly 42 million people, the majority of which are in developing countries (Worldfish 2009). Underdeveloped and/or small island states are highly vulnerable to the impacts of ocean acidification and climate change (Allison et al. 2009, Cooley et al. 2012). Diminishing fisheries may shift demand for protein to agriculture and livestock, which are also under pressure from climate change (Allison et al. 2009).

Changes in food supply in developing nations could begin to alter regional demographics. Migration induced by ocean acidification and climate change will likely drive populations from vulnerable, coastal areas into urban areas. The ability of these urban centers to support their swelling populations is unlikely (NIC 2010). These migrants are typically overwhelmingly male, leaving the rural populations with a disproportionate ratio of females (NIC 2010). These migrations may create serious social tensions and strain urban infrastructure. The erosion of social stability may lead to radicalization of some sectors of the community and potentially create conditions for terrorism (WWF; Ackerman et al. 2008).

Although more information is needed about the likely biological and socioeconomic impacts of ocean acidification, it is clear that increasing social and economic resilience is crucial for those populations that will likely be most affected by ocean acidification. . —C. St. John, K. Segarra, S. Cooley

How might OA affect international or national security?

Basic: Ocean acidification has the potential to create regional instability if it harms the health and availability of commercial fish stocks and other goods and services derived from the sea, like coastal protection by coral reefs from storms and tsunamis. These changes will impact the food supply and economic opportunities of vulnerable nations. Tensions within and between nations could develop as human communities seek alternative places to live, areas to fish, or ways to generate income. Ultimately, ocean acidification may contribute to widespread social and political instability by promoting human migration and competition for scarce natural resources. —K. Segarra, C. St. John, S. Cooley

Intermediate: Ocean acidification has the potential to increase instability in regions of the world where the effects of increasing pH on marine life will threaten the sustenance of over one billion people. Ocean acidification may harm a wide range of organisms (e.g. some phytoplankton, mollusks, crustaceans, echinoderms, corals, and fish) and therefore cause major perturbations in marine food webs and harm to marine ecosystems (Hoegh-Guldberg et al. 2007; Fabry et al. 2008; Doney et al. 2009). Societies dependent upon marine ecosystems could suffer disruptions in food supply, economy, and even social stability in the coming decades.

The local impacts of ocean acidification on fisheries are difficult to predict at this time. Ocean acidification is expected to drive fish species to warmer, shallower waters as high latitude and deep ocean waters are acidifying at the fastest rates. At the same time, species will be responding to climate change-related impacts such as ocean warming. Ocean warming is expected to decrease the total catch potential in tropical waters by 60% (Cheung et al. 2010). In contrast, polar regions are expected see a dramatic increase in catch potential (Cheung et al. 2010). It is currently unclear how fish and other marine species will adapt to an ocean that is both increasingly warm and acidifying.

Seafood presently constitutes the major source of protein for over a billion people, and coral reefs provide storm and tsunami protection to

numerous coastal communities while supporting diverse marine ecosystems filled with economically, nutritionally, and ecologically important species. Losses or changes of marine food webs and reefs due to OA, warming, and other stressors will require that many people look elsewhere for nutrition and income. Damaged reefs will expose more coastal human settlements to impacts from catastrophic events. Declining fish shares and migrating fisheries may lead to tensions between nations over territory and fishing rights.

The most vulnerable nations are those that have the least ability to adapt to the changing environment. Communities that rely heavily on fish as an income and food source and are also stressed by other impacts of global change (e.g. sea-level rise, increased storm frequency and intensity, drought, and salt water contamination of water supplies) are most likely to experience security issues related to ocean acidification when competition with neighbors for scarce natural resources increases.

Ocean acidification and other aspects of global change may play a significant role in human migration (Myers 2002; Dupont 2008). These massive movements of populations in response to changes in food and economic security could result in conflict, even contributing to civil war, state failure, and mass cross-border migrations (Ackerman 2008). The displacement of people to regions that are already facing difficulty supporting their own indigenous populations may lead to further instability and conflict (Ackerman et al. 2008; Dupont 2008).

In an age of increasing global economic inter-dependence, regional economic crises may have far-reaching implications for the global economy. Stressed societies are more vulnerable to extremist ideologies, which have the ability to impact societies far removed from the original problem. Human migrations are devastating for migrants and present immense social and political challenges to the receiving nations. Ultimately, ocean acidification is both a regional and global security threat. —C. St. John, K. Segarra, S. Cooley

Last updated: September 19, 2012

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