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Publication Brief for Resource Managers

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Examining Trends in Ocean Disease

With rising human stresses placed on the environment, understanding disease dynamics is vital to conserving marine ecosystems. Many environmental factors, including climate warming, pollution, exotic species, and fishing, can have complex effects on disease. In recent publications, USGS scientist Dr. Kevin D. Lafferty and colleagues investigated whether marine diseases appear to be on the increase as has been theorized, and discussed factors that can affect increases and decreases in disease.

In the absence of baseline data on changes in marine disease over time, Ward and Lafferty (2004) used normalized publication effort by marine scientists as an indirect way to detect disease trends. They found increased reports of disease outbreaks for turtles, corals (non-infectious bleaching), mollusks, mammals and urchins. They detected no significant trends for seagrasses, decapods, corals (infectious disease) and sharks/rays. They found evidence of decreased reports of disease outbreaks in fishes.

Lafferty et al. (2004) delved into the complexities of predicting infectious disease trends in natural communities. Providing numerous examples, they discussed how anthropogenic stressors can affect the increase or decrease in marine diseases. Climate warming may lead to thermal stress; coastal development leads to habitat destruction and degradation; introduced species bring disease; fishing reduces once common species and favors others; runoff and discharge contain nutrients and pathogens along with fertilizers, pesticides, antibiotics, anthelminthics, and herbicides. Both host species and disease can be affected by these stressors, and differently (e.g., some parasites are actually more sensitive to stressors than their hosts).

Management Implications:

- Disease responds in complex ways to the environment.
- Environmental stressors can affect hosts and parasites, and can increase or decrease disease in marine life.
- Contrary to perceptions, some diseases play positive roles by promoting biodiversity and maintaining ecosystems.
- Parasites may be more sensitive to environmental change than their hosts.
- Although stress may make individuals more susceptible to disease, disease outbreaks are also associated with dense populations, which aid in transmission of disease between individuals of a species.
- Many of the diseases of conservation concern are not host-specific, especially those for which domestic animals serve as reservoir hosts.
- Fishing may alter trophic cascades, which have community-wide implications, including increased epidemics.
- Marine reserves are important not only for fisheries conservation, but also for the conservation of historically dominant community types.

Although infectious diseases are usually perceived as negative, some play positive roles in promoting biodiversity and maintaining ecosystems. In some cases (e.g., trematode worms, which require a functioning ecosystem to persist), parasites can indicate a healthy ecosystem. Huspeni and Lafferty (2004) demonstrated a new comparative technique using trematode communities to assess the success of an estuarine restoration project at Carpinteria Salt Marsh in California. A measure of trematode communities, gathered from dissect-

ing snails that act as first intermediate hosts, provides a single, integrated snapshot of the bird hosts that use an estuary. Further reading on this technique can be found in Huspeni et al. (2005).

The diversity of interactions between environmental disturbance and infectious disease prevents overgeneralizing about whether diseases should increase in natural populations in association with environmental degradation. Disease may increase or decrease, depending on the infectious agent and the factors affecting its host population. Lafferty and Holt (2003) used models of infectious disease dynamics to examine how the effects of stress on host vital rates interact with effects of stress on host susceptibility and recovery. Their results indicate that the impact of host-specific diseases generally declines with stress while non-specific diseases increase with stress.

In Lafferty 2004, the results indicate how fishing top predators can indirectly favor disease transmission in prey populations. He analyzed a 20-year dataset of kelp forest communities at 16 sites in the region of the Channel Islands National Park, California. Historically, lobsters and other predators kept urchin populations at low levels and kelp forests developed a community-level trophic cascade. In geographic areas where lobsters were fished, urchin populations increased greatly, overgrazing algae until starvation eventually limited urchin-population growth. An urchin-specific bacterial disease entered the region after 1992, and dense populations were more likely to experience epidemics and suffer higher mortality than urchins in sites where lobsters were not fished. Epidemics did not reduce the urchin population at a site to the density that predators previously did, demonstrating that disease did not fully replace predators in the trophic cascade. Despite epidemics, urchin populations in fished sites remained dense and algae were still overgrazed.

Behrens and Lafferty (2004) found that community dynamics leading to transitions between kelp forests and barrens are driven by both predation and disease; however the effect of predation is of greater magnitude. Rocky reefs inside marine reserves were more likely to support kelp forests than were fished areas.

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