Marine Bioinvasions:
Vectors, Invasion Pulse, and Strategies

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Biological invasions are one of the greatest drivers of ocean and coastal change in the U.S. in 2002.

Virtually no habitat, community, or ecosystem now remains untouched by invasions, which in turn have led to profound challenges in our ability to formulate a coordinated and comprehensive national ocean policy. Invasions cause permanent, irreversible economic, environmental, and societal impacts. Given this, a major 21st century policy bullseye is invasion deterrence, reduction, and prevention.

The nature and tempo of invasions in coastal U.S. waters today may be both a sensitive environmental single and a harbinger of the scale of environmental change. Invasions may be seen, in part, as the "thread that binds" the other major causes (habitat alteration, chemical pollution and eutrophication, fisheries impacts, and global climate change) of manmade hazards and alterations to the marine environment.

All of these hazards and impacts alter the donor or recipient environments for bioinvasions and the potential for species transport and colonization. The modern-day increase in species invasions is, in part, the result of the collision between (1) the many ways in which humans have been and continue to alter our coastal marine environment and (2) the vastly increased potential for species transport in the 21st century.

Vectors for the accidental introduction of exotic species today include shipping (ballast water and ballast sediments and external (hull) and internal (seachest) fouling), the movement of drilling platforms, the aquaculture (mariculture), live seafood, and aquarium industries, and the live bait industry. In many regions of the country, all of these and other vectors are in play simultaneously (creating multivector management challenges!) -- and, in many regions, the role of these vectors is increasing due to the rapid expansion in the volume and speed of the global flow of trade products and humans.

As a result, U.S. coastal waters itch with new invasions:

* A 3-foot long Pacific fouling seaweed has colonized southern New England.

* The most abundant crab in Long Island Sound is a Japanese species that arrived in 1993.

* A 6"-long Asian carnivorous snail has colonized Chesapeake Bay.

* A 2-foot tall, massive Pacific jellyfish has invaded the Gulf of Mexico.

* The Mediterranean "killer seaweed" Caulerpa has become established in southern California.

* The carnivorous European green crab became established in San Francisco Bay and is spreading north and south.

* Atlantic salmon have become established in the Pacific Northwest.

... and the list goes on and on, with daily, weekly, and monthly arrivals in all U.S. coastal waters. Given the extraordinary scale of living and non-living natural, historic, and cultural resources in the American marine environment, these ongoing invasions are **environmental roulette of the first order.**

Invasions threaten life (through disease transport) and property, severely impact coastal stewardship of fishery and other resources, and impact marine-related commerce and transportation. And yet there is a profound potential for optimism, through national and international prevention and education programs. There are superb possibilities for the engagement of the private sector for innovative approaches, superb possibilities for enhancing close cooperation among and between government agencies and departments (both Federal and state) to generate coherent, cost-effective, efficient, and consistent regulations and management, and, importantly, superb possibilities for the United States to take a global leadership role in marine bioinvasion policy and management. Action recommendations focus on federal legislation (some linked to international initiatives) that works to seriously downgrade the potential for species transport -- parallel, perhaps, to the seriousness with which airport and other transportation hub security has been upgraded at the beginning of the 21st century.