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Turning the Tide: Invasive Species Management, Ecosystem-Based Adaptation and Responses to Climate Change

Individually, climate change and invasive species present two of the greatest threats to biodiversity and the provision of valuable ecosystem services. Combined, the complexity of their interactions dramatically increases, and evidence is rapidly growing on how climate change is compounding the already devastating effects of invasive species. Climate change impacts, including warming temperatures and changes in CO₂ concentrations, are likely to increase opportunities for invasive alien species because of their adaptability to disturbance and to a broader range of biogeographic conditions. The impacts of those invasive species may be more severe as they increase both in numbers and extent, and as they compete for diminishing resources such as freshwater. Warmer air and water temperatures may also facilitate movement of species along previously inaccessible pathways of spread, both natural and human-made. From a conservation perspective, there is little point to addressing climate change if the biodiversity we’re trying to protect has already been lost to invasive species.

Ecosystem based adaptation is gaining attention as a cost-effective means of protecting human and ecological communities against the impacts of climate change. Ecosystem based-adaptation is described as building nature’s resiliency to buffer the impacts of climate change, while also helping to meet people’s basic needs. Invasive species can threaten those basic needs and compromise ecosystem functions, by taking advantage of habitat disturbance, species under stress, and other chinks in the armor of otherwise healthy systems. This affects the multiple roles of ecosystems in providing provisioning, regulating, supporting and cultural services. For example,

- **Fisheries** – sea level rise may favor salt-tolerant invasive plant species in brackish water systems and estuaries, which are an important habitat and spawning ground for fish and other species. The Dongtan nature reserve near Shanghai, China, is already seeing encroachment of *Spartina alterniflora* coincident with rising waters. Additionally, warming of waters could contribute to range expansion of marine invasive species, such as the lionfish (*Pterois volitans*) and the mitten crab (*Eriocheir sinensis*), that significantly impact aquatic communities and reef fisheries.
- **Erosion control and storm surge abatement** – natural dune, mangrove and other coastal ecosystems play a key role in buffering the effects of storm surges and other extreme weather events. The establishment of invasive plant species, such as beach vitex (*Vitex rotundifolia*), has exacerbated erosion thereby increasing the vulnerability of inland ecosystems and coastal communities. Introduced nutria (*Myocaster coypus*) and mute swans (*Cygnus olor*) have also had major impacts on wetland ecosystems, by destroying plant
• communities and creating large stretches of open water.

• **Freshwater availability** – temperature rise could spur the incursion and spread of species with detrimental impacts on local water tables and species composition. In the US southwest and in South Africa invasive *Tamarix* species will continue to draw on groundwater reserves even as projected precipitation trends decline.

• **Food security** – healthy ecosystems play a critical role in providing pollination services and seasonal climate variability, particularly temperature and precipitation, helps mitigate against the outbreak and spread of pests and disease. Longer and warmer growing seasons could allow for multiple life cycles of agricultural pests impacting crops and could also favor the early growth of invasive weeds.

• **Economic livelihoods** – aside from direct impacts on primary production, invasive species have significant economic impacts on transport and trade. In North America, warmer winters have not been cold enough to check native populations of bark beetles (e.g., mountain pine and spruce beetles), resulting in mass forest die-offs. While this has been a short-term boom for the lumber industry, it could be a long-term bust for forestry and biodiversity interests.

• **Carbon sequestration** – natural ecosystems play a key role in carbon sequestration from grasslands to forests to supporting soil communities. Invasive species can alter soil composition and also change the dynamic of fire regimes through greater fuel loads and higher burn temperatures. The result could be the disruption and possible replacement of complex ecological webs with high potential for capturing carbon by species-impoverished systems that are less suitable for absorbing carbon.

• **Biodiversity impacts** – scientific evidence is increasingly showing the range expansion for invasive species as a result of climate change, with consequent effects on biodiversity. For example, the spread of White Syndrome across coral reefs and the Chytrid fungus besetting amphibian populations are two major threats to global biodiversity, that have both been linked to climatic warming. Retreating glaciers are also providing newfound habitat for invasive plants, such as the spread of winter grass on deglaciated slopes of Australia’s Heard Island.

As global problems, climate change and invasive species are not specific to any one geography or ecosystem. While the science on the complex interactions of such global change processes continues to evolve, action is clearly needed to mitigate against the combined effects of climate change and invasive species. The sooner these connections are made, the better.

The good news is that with invasive species, we already know many of the key policy and management solutions to combat this problem. These are actions that we should currently be taking to protect plant, animal and human health along with our natural ecosystems. Adding climate change to the mix increases the urgency, while also providing additional direction on how to prioritize efforts around the most critical ecosystem functions to maintain.

**Recommendations** – prevention and management of invasive species is an excellent entry point for the consideration of ecosystem-based activities in response to climate change, particularly as we know the necessary course of action in many cases. While integration of invasive species concerns will differ at the site, national and international scales, a few common principles run throughout:

• Integrate invasive species concerns into assessments of climate change impacts, and specifically in relation to ecosystem-based adaptation activities and plans.

• When considering priority ecosystem functions for climate change adaptation, identify existing invasive species or anticipated species that could affect those functions in order to prioritize prevention and management actions.
• Support inter- and intra-agency dialogue and integrate invasive species in national climate adaptation strategies and action plans and climate change into national invasive species strategies and action plans.
• Prevent the intentional and unintentional introduction of new invasive species as a matter of good practice.
• Avoid the use of known invasive species in habitat restoration activities.

This discussion paper is the first step of a broader investigation of the issue. For more information or to provide comments, please contact:

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