Estimating the Economic Impacts of Aquatic Invasive Species

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Why estimate the economic impacts?

- AIS are increasingly a threat to aquatic ecosystems and to national, regional, local economies
- Policymakers lack economic data to inform decisions
- Economic data would address that gap and inform policy and resource allocation decisionmaking
  - Broaden public and policymaker understanding of AIS impacts
    - Could result in enhanced public support for policies and associated resources
  - Facilitate comparison of AIS economic impacts with other pollution economic impacts
  - Inform analyses of efficient and effective prevention and management approaches
- Enhance Federal, state, regional, local, Tribal capacity to target AIS

Caulerpa taxifolia

Uncertainty about the economic impacts

- Several studies document prevention, management, and control costs for specific AIS in limited geographic locations

BUT

- There are no comprehensive national or regional estimates of AIS economic impacts

Previous national economic impact estimates

- 1993 – U.S. Office of Technology Assessment estimated *cumulative* cost to U.S. of invasive species (terrestrial and aquatic) of $131-$185 billion (2003 $) for period 1906-1991
- 2005 - Pimental *et. al*. estimated annual cost to U.S. of all invasives to be $128 billion (2003$)
- Neither estimate covers all AIS in U.S.

Concerns about prior studies

- OTA and Pimentel *et. al.* estimates are anecdotal, not empirically derived
- Those estimates neither reflect impacts on ecosystem services nor explicitly consider potential benefits provided by some invasives
- Although widely cited, those estimates are only a first step in estimating true scale of economic impacts
- Two studies illustrate difficulty of quantifying impacts of invasive species at a national, even regional, scale of aggregation
- Studies include terrestrial invasives; cannot identify AIS-specific data

A review of the literature

- Lovell, Stone, and Fernandez (2006) reviewed the economic literature on AIS impacts

- More than 60 studies covering invertebrates, plants, crustaceans, and fish species were reviewed

Steyla clava underneath Pleasant Harbor guest dock (Puget Sound)
Photo by Janna Nichols

Literature review highlights

- Impacts of invasives can be categorized into five types: production, price and market effects, trade, food security and nutrition, and financial costs (Evans 2003)
- Control of invasive species is a public good and is only as good as the weakest provider of control; this calls for coordinated response among affected parties (Perrings, 2002)
- A few bioeconomic models have been used (e.g., zebra mussels [Leung *et. al.* 2002] and lake trout [Settle and Shogren 2002])
- Are quite a few studies on the trade impacts or origins of AIS
  - Levine and D'Antonio (2003) predict that invasive mollusks will increase between 4 to 36 percent from 2000 to 2020

Species	Location	What's Measured	Impacts (2003 $)
Sea Lamprey	St. Mary's River, Michigan	Lampricide Treatment	$4.2 million/treatment
Zebra Mussel	Great Lakes	Treatment costs per industrial facility	$248,000/yr
Ruffe	Lake Erie	Estimated lost sport fisheries	$724 million/10 yrs
Caulerpa taxifolia	Southern California coast	Rapid response and monitoring costs	$4.3 million/2 yrs
Hydrilla	Florida	Lost recreational benefits in one lake	$857,000/yr
Aquatic plants	Florida	Avoided flood damage to citrus crops	$6,345/acre

Economic Impacts of Aquatic Invasive Species Workshop

- Sponsored by EPA
- July 20-21, 2005 in Washington, DC
- 66 participants
  - 12 invited experts (6 economists, 6 ecologists)
  - Federal agency staff--EPA, NOAA, USACE, USDA, USFWS, USGS, USCG, Smithsonian

Workshop goals

- Identify potential conceptual frameworks and bioeconomic tools for use in subsequent development of national and regional estimates of market and non-market economic impacts of AIS
- Assemble national experts for cross-disciplinary exchange, information transfer

Australian spotted jellyfish
Phyllorhiza punctata

Workshop format

- Keynote address
  - Ben Grumbles, Assistant Administrator, U.S. EPA Office of Water
- Keynote speeches
  - Dr. David Lodge, Notre Dame University (ecologist)
  - Dr. Jason Shogren, Univ. of Wyoming (economist)
- Breakout sessions followed by plenary sessions
- Federal agency discussion at end of meeting

Breakout session topics

- Key impacts of aquatic invasive species
- Priorities for assessing impacts
- Potential methods for measuring impacts
- Shortcomings in current methods and tools

Key impacts identified

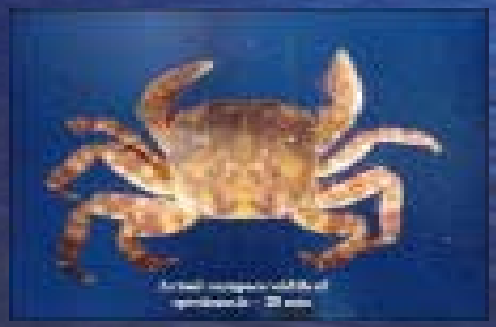
Alterations	Misc. Impacts	Costs
Commercial, recreational fishing, including aquaculture	Disease regulation	Monitoring, detection
Habitat	Weed/pest ctrl. effects on transport.	Prevention
Food Webs	Recreation (e.g., swimming, boating)	Education
Water supplies (e.g., drinking, indus-trial, agricultural)	Aesthetics	Eradication/control
Genetic resources	Cultural, spiritual, religious, inspirational, sense of place values	Restoration
Flood control		Property value
Storm protection		
Erosion control		
Water purification		

Priorities for assessing impacts

- Project selection criterion #1: magnitude and severity of impact
  - areal extent
  - degree to which ecosystem functioning is affected
  - types of areas affected (e.g., sensitive, pristine, degraded)
  - degree to which people are affected
  - which people are affected
  - time horizon of impacts (short- or long-term) and irreversibility
  - economic and ecological systems' capacity to adapt to impacts

Priorities for assessing impacts

- Project selection criterion #2: feasibility of addressing the AIS impact
  - attributing the impact to AIS
  - valuing the impact
  - options for preventing, mitigating, or remediating the impact



Suggested approaches

- Bioeconomic models
  - combination of ecological/biological models and economic models
- CGE models
  - computable general equilibrium models; look at impacts across different economic sectors
    - advantages: well developed, have built-in aggregation capabilities to facilitate going back and forth among regions, account for all interactions among industries
    - limitations: don't account for dynamics well and only incorporate market impacts
- Green accounting
  - Specifically includes natural resources in countries' national income accounts

Start with regional impacts

- Workshop recommendation: develop local- or regional-level impact estimates (e.g., at waterbody or watershed level)
  - Economic and ecological models generally work better at regional levels
  - Stakeholder interest in and potential management responses to AIS often occur at regional level
  - National estimate of AIS impacts could be developed by aggregating regional estimates

Timely estimates are needed

- Workshop recommendation: develop estimates focusing on regions, species, and impacts that are already well-studied
  - use existing market and non-market valuation techniques rather than developing new ones
  - use initial studies to develop standard approach/ framework that could be used to build additional estimates

northern snakehead *Channa argus*

Possible methodology

- In the following order:
  - identify most important ecosystem services in a particular region (or subregion, such as a watershed)
  - identify impacts of AIS on those services
  - use existing valuation methods to assess the economic value of those impacts
- This method can be used to evaluate single or multiple species causing impacts and would be repeated in each region.

Post-workshop activities

- Formed interagency workgroup to identify and plan economic study of AIS impacts
- Post workshop materials on EPA website (www.epa.gov/economics)
- Two potential studies identified on European Green Crab and on AIS in Lake Champlain

For more information

- www.epa.gov/economics (click on Econ. Impacts of AIS workshop)
- Email: Sabrina Ise-Lovell (Ise-lovell.sabrina@epa.gov)
  or Marilyn Katz (katz.marilyn@epa.gov)
- Lovell, Stone and Fernandez (2006) "Economic Impacts of Aquatic Invasive Species: A review of the literature", *Agric. And Res. Econ. Rev.*, April 2006.