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Subject: Comprehensive Strategy for Aquatic Invasive Species Prevention and Management in the Great Lakes.

Issue:
Aquatic invasive species (AIS) entering the Great Lakes via international shipping vectors are causing severe environmental and socio-economic challenges in the region.

Background:

- **Diversity and Distribution:**
    - The Great Lakes is one of the most invaded freshwater ecoregions worldwide. Out of 188 non-native species identified in the Great Lakes, 78 are considered invasive, causing moderate to high impacts.
    - Invasive species are primarily transported through international shipping via ballast water, sediments and hull fouling from an endemic region to the great lakes.
- **Ecological and socio-economic impacts**:
    - Invasive species disrupt food webs, biogeochemical cycles, and reduce native biodiversity, with significant socioeconomic effects like pathogen transmission affecting both humans and wildlife.
    - Ecological impacts: Environmental health degradation, predator-prey dynamics, competition for resources, water quality reduction, physical ecosystems morph.
    - Socioeconomic impacts: Recreational quality degradation, impact on commercial interests, aesthetic perception impacts, infrastructure damage, hazards to water quality and human health.
    - AIS cost the Great Lakes region up to $138 million annually, with secondary effects like sport fishing losses potentially increasing this to $800 million.

Considerations:

- Ballast Water Exchange (BWE) was mandated in 1993 for ships entering the Great Lakes, reducing live organisms by 80-95%, yet questions about its long-term effectiveness remain given global inconsistency in adoption and enforcement.
- Physical removal, such as winter seining, is effective but limited to certain lakes; rotenone and lake draw-downs are used less frequently due to environmental impact and infrastructure requirements.
- Fish pheromones and environmental DNA (eDNA) are promising tools for invasive species monitoring, with pheromone detection techniques in development for natural

environments and eDNA widely used for its high sensitivity in detecting invasive carp presence.

Policy Options:

1. **Enhance Ballast Water Management Requirements**
    - **Proposal**: Mandate all vessels entering the Great Lakes to adopt advanced ballast water treatment systems beyond BWE.
        - **Pros**: Provides a higher level of organism removal, lowering AIS introduction risks. Reinforces the need for consistent international standards, reducing dependency on individual ship protocols.
        - **Cons**: High implementation and maintenance costs for shipping companies, may face resistance from international ports and shipping alliances.
2. **Increase Early Detection and Rapid Response (EDRR) Efforts**
    - **Proposal**: Invest in technology and workforce to improve AIS monitoring through tracking ships movements and using pheromone detection to improve response times for AIS in the Great Lakes.
        - **Pros**: EDRR can minimize long-term ecological and economic impacts by swiftly managing new invasive species, helps prioritize resources towards high-impact AIS, reducing costs in the long term.
        - **Cons**: High upfront investment required for technology, training, and resource allocation. Response effectiveness varies with the species and available mitigation strategies.
3. **Participatory Invasive Species Task Force with a Focus on Values-Based Deliberation**
    - **Proposal**: Establish a task force comprising federal, state, and local authorities, community representatives, industry stakeholders, and social scientists. This group would focus on managing values-based conflicts and deliberating on acceptable levels of ecological and economic risks.
        - **Pros**: Promotes inclusive decision-making, potentially reducing conflicts. Engages stakeholders to co-create solutions, increasing policy buy-in and long-term compliance.
        - **Cons**: May lengthen the decision-making process due to the need for consensus. Challenges in balancing competing interests may persist, particularly for industry stakeholders.

Conclusion: Given the pressing ecological and economic impacts of AIS on the Great Lakes, a combination of robust ballast water management with early detection and rapid response should be used in the short term while the invasive species task force can work on a long-term sustainable solution to the issue of AIS entering the Great Lakes via international shipping.
