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Institutional barriers to the development of a comprehensive ballast-water management scheme in China: Perspective from a multi-stream policy model

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ABSTRACT

Millions of tons of ballast water are released into Chinese waters annually that could contribute a significant invasion vector in the country's marine ecosystem. While some endeavors have been made to assess and mitigate the impact, a comprehensive ballast water management scheme with focus on invasive aquatic species prevention has yet to be formulated on the state level. The policy and politics behind the ballast-water management in China are empirically investigated, focusing specifically on why the scheme failed to evolve and be reformed. Kingdon's multi-stream model was applied with an analytic lens on the problem stream, policy stream, and politics stream. The analysis was aided by public and internal documents related to ballast-water issues, and interviews with people familiar with the issue or who were stakeholders in the issue. Kingdon's model enables the identification of institutional barriers to the development of a comprehensive ballast-water management scheme with focus on invasive aquatic species prevention in China. Policy implications and recommendations are proposed for policy entrepreneurs who could initiate a change to the existing policy.

1. Introduction

China is one of the world's 17 megadiverse countries, with approximately half of its species found nowhere else in the world [1]. But invasive alien species threaten the state's biodiversity and impact the abundance and richness of native species [2]. The country has recorded over 750 invasive alien species to date [3], bringing economic losses each of more than 200 billion yuan [4] each year (the equivalent of 30.8 billion dollars U.S.).

Much of the country's efforts to protect terrestrial ecosystems have been focused on establishing vast nature reserves in which human activities are restricted [5]. Lagging behind, however, is its risk assessment of marine ecosystems and corresponding policies for the regulation of alien biological invasions and harmful pathogens caused by ballast-water transfer, the process used to stabilize marine vessels, which is a significant vector for harmful bacteria and invasive species in aquatic ecosystems [6,7].

Some endeavors have been made to assess and mitigate the impact. For example, Dalian Port was chosen as a demonstrations site for biological baseline surveys under GloBallast Programme Phase I (2000–2004) [8], and several reporting tools for ballast water discharge have been developed by authorities for foreign ships arriving in Chinese ports. However, a comprehensive ballast water management scheme with focus on invasive aquatic species prevention has yet to be formulated on the state level [9].

China has neither signed the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Management convention or BWM Convention; see Fig. 1 for participating states), which sets a long-term goal to limit the permitted concentration of detectible organisms that can remain in treated ballast water [10], nor has it enacted domestic laws or systematic regulations on nonindigenous aquatic nuisance species prevention and mitigation. Ships coming from abroad are not subjected to effective ballast water discharge regulations within Chinese waters [11].

As China's international trade has grown by orders of magnitude over the past two decades (from 293.3 billion USD in 1996 to 4.15 trillion USD in 2016), so have the shipping activities that are responsible for more than 90% of the country's import and export trade [12]. Millions of tons of ballast water are released into Chinese waters annually [13]. Many non-indigenous species released by ballast-water discharge could be fatal to the ecosystem's functioning [14,15]. Toxic algae can cause harmful algal blooms that suffocate or poison aquatic organisms; alien phytoplankton species may have the ability to endanger local native species; and toxic microorganisms could

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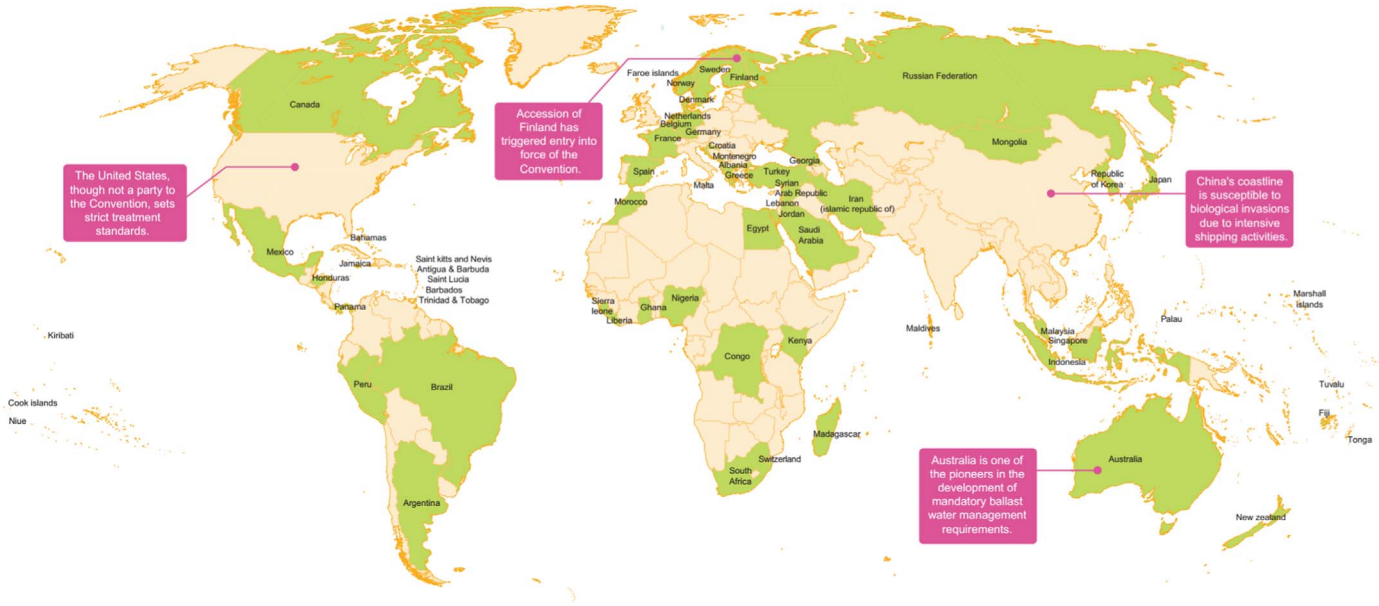

Fig. 1. Sixty-six states that have acceded to the Ballast Water Management Convention as of October 9, 2017. Authors' illustration based on IMO data.

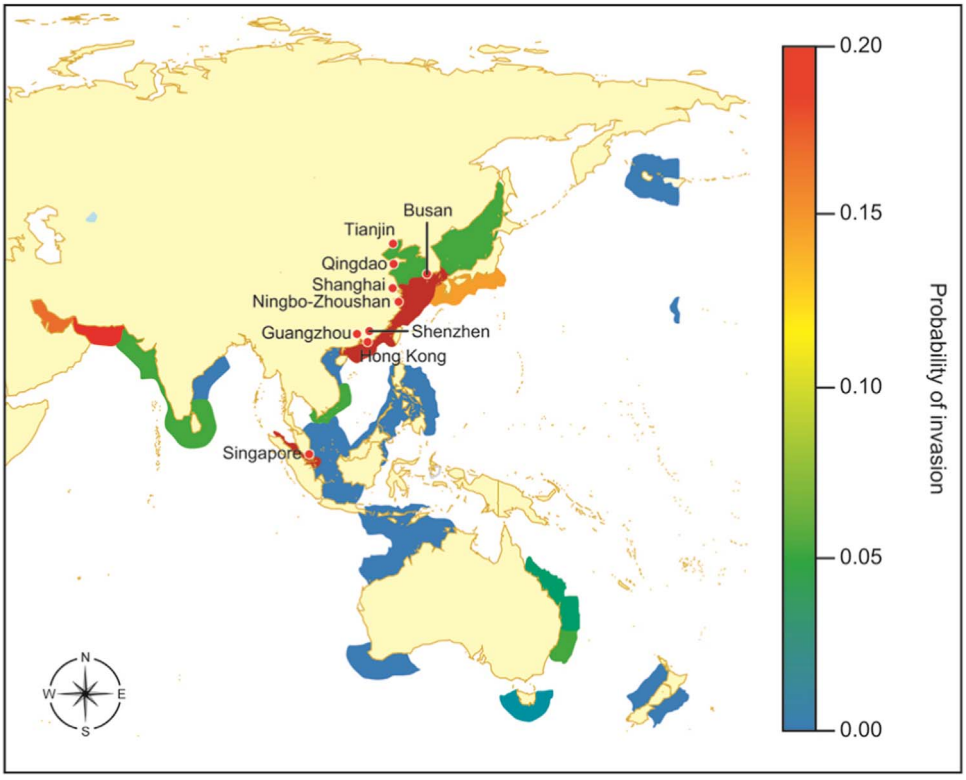

Fig. 2. East Asia coasts are vulnerable to biological invasion due to intensive shipping activities. Illustration adapted from [16], which shows predicted invasion probabilities of 97 marine algal species to formerly unoccupied areas.

contaminate seafood and the drinking-water supply. The failure to curb ballast-water damage in the past has exacerbated the threat to biodiversity conservation and public health, even could endanger shared coastlines with its neighbors in the Asia-Pacific region (see Fig. 2) [16].

While other coastal states face similar challenges, many have developed regulations and protocols as the principal instrument to curb ballast-water damage. One of the leading examples is the United States. The plague of zebra mussels in the Great Lakes area largely motivated the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, which requires ships entering the Great Lakes to exchange their ballast water in the open ocean [17]. As threats of nonindigenous aquatic nuisance species (particularly zebra mussels and Eurasian ruffe) across the country escalated, an updated National Invasive Species Act was signed into law in 1996, requiring the U.S. Coast Guard (USCG) to regulate ballast- water discharge nationwide [18]. The U.S. government has incorporated an array of detailed regulations into the Code of Federal Regulations, and offenders face heavy civil penalties and felony charges. In addition to the USCG, the EPA is authorized under the Clean Water Act to regulate ballast water discharge, and delegated states are authorized to set even more stringent standards [19]. To address this