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The science and politics of ecological risk: bioinvasions policies in the US and Australia

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The US and Australia – western democracies with similar histories of public awareness on environmental issues and broadly comparable records of policy and regulatory action to safeguard environmental quality – have responded differently to one of the newest and most significant threats to marine biodiversity: that of biological invasions mediated by the ballast water of commercial shipping. Each country has framed the same invasion risks differently for the purposes of policy and regulation: Australia has decided to use a more narrowly circumscribed, target-species-based approach whereas US policy and regulation takes a more comprehensive and precautionary approach. These somewhat surprising national regulatory choices are traced to differences in the structure of each country’s process for ballast policy decision making and most importantly to the policy role of ecological expertise within this process.

Keywords: comparative policy; risk regulation; science-policy dynamics; ballast water; marine bioinvasions

Introduction

As the range of environmental challenges and opportunities multiplies and environmental coverage enters the media mainstream, cross-national differences in environmental policy are becoming both more numerous and more visible. It no longer takes a policy expert to recognise that food and product safety standards, or the regulation of agricultural biotechnology, are currently stricter in Europe than in the USA. Accumulated policy expertise, though, reveals this to be a reversal of trends dominant 20 years ago (e.g. Vogel 2001). Amidst dynamic changes in the loci of environmental leadership, patterns of cross-national variation themselves remain constant.

While it is no longer surprising that countries with similar capacities for environmental regulation respond differently to the same environmental or...
human health risks (e.g. Brickman et al. 1985, O’Neill 2000, Wiener 2004, Jasanoff 2005), cross-national policy differences remain both practically significant and theoretically interesting.

From a practical standpoint, differences in national policy and regulation can have important equity implications (e.g. Schapiro 2007). The types of normative, political, and institutional dynamics that produce peculiarities in domestic policies can also shape state participation in international environmental institutions and affect the way issues with global and transboundary dimensions are ultimately managed (Raustala 1997, DeSombre 2000, SLG 2001).

On the analytical level, a comparative platform deepens our understanding of national political and institutional dynamics, and offers some of the best opportunities for exploring interactions between science and politics in environmental decision making.

This study seizes one particularly interesting such opportunity: it looks at variations in how the United States and Australia, two countries seen as policy leaders on the emerging ecological issue of marine bioinvasions, have addressed one of the major causes of such invasions – the ballast water of commercial shipping.

The US and Australia share similar experiences with ballast-mediated marine invasions. In approaching the issue, they have also worked with the same evolving and politically uncontested body of ecological knowledge. While facing the same in nature, scale, and dynamics invasion risks, however, the two countries have adopted different policy definitions and regulatory responses to these risks: Australia has settled on a less risk-averse, more narrowly targeted approach, while the US has chosen a more comprehensive and essentially precautionary policy route.

This is especially notable in that it goes against recent political and institutional trends of limited US regard for the precautionary principle. It also clashes with Australia’s reputation for strong biosecurity and its history of quarantines so strict as to periodically incur protectionism accusations and World Trade Organisation (WTO) challenges. Australia’s choice of a more lenient ballast management strategy is even more surprising since regulating foreign ballast is a quarantine measure that immediately benefits important primary industries such as fisheries and aquaculture, while being all but immune to challenges of protectionism (ballast regulation is clearly non-discriminatory in both intention and outcome, applying to Australian and foreign-owned shipping alike and aiming to exclude incidentally transferred organisms that nobody is actually seeking to import).

Acknowledging that policy imperatives are not, and cannot be derived directly from scientific knowledge (Jasanoff and Wynne 1998, Skodvin 2000, Jasanoff 2005), the question still remains: what is it in the US and Australian political and policy process that has helped produce such unexpected – and unexpectedly different – ballast policies from a foundation of shared problem experience and shared ecological knowledge?
The study addresses these questions through a process-tracing approach that applies analytical insights from comparative environmental policy and politics to the evolution of US and Australian ballast controls from the late 1980s to early 2006. Data sources range from peer-reviewed ecological literature and government documents to personal notes from scientific conferences and policy forums, and extensive, open-ended interviews with expert, political, and bureaucratic actors in each country.

The analysis is organised into five sections. The next section introduces current ecological understanding regarding invasion risk from ballast. Section three juxtaposes the US and Australian regulatory responses, highlighting the nature and significance of differences in each country’s policy definition of invasion risks. Section four establishes the links between key dynamics in each country’s policy process and the observed national policy outcomes. Section five looks at effectiveness, discussing the extent to which differences in US and Australian regulatory approaches produce differences in exposure to non-indigenous species from ballast. Section six draws the comparison together, discussing the main causes of current differences as they emerge from the analysis.

**Biological invasions and the invasion risks from ballast**

Bioinvasions\(^1\) occur when species are transferred beyond their historic ranges and become established in new environments. Such establishment always entails some, at times profound, disruptions in ecological structure and function. Serious economic and human health consequences are also becoming increasingly common (Ruiz *et al.* 2000, Pimentel 2002).

While the process of human-mediated species transfer is not new, its rate, scale, and impacts have accelerated so significantly in the last few decades as to present an invasion phenomenon qualitatively different from anything experienced in the past.

Ships’ ballast water is in many ways an emblem, as well as a major contributor to this acceleration: it transports an estimated 10,000 species around the world daily (Carlton 1999). Carried for the purposes of balance and stability, ballast water is essential for ensuring safe operating conditions, yet any ballast uptake or discharge is also an uptake/discharge of entire assemblages of marine organisms.

The bioinvasions problem arises from transfer of organisms between coastal regions, since environmental conditions in the open ocean prevent the survival of coastal organisms there, and vice versa. Indeed, exchange of coastal or fresh water ballast with open ocean water (open ocean exchange) is currently the default technique for preventing invasions.

The diversity of ballast-borne organisms is significant, but largely undescribed, and the identity of most organisms discharged with any particular load of ballast is essentially unknown. There are no practicable ways to inventory exhaustively the species content of individual loads of ballast,
especially within a time-frame that can allow the formulation of an immediate management response. Some sampling-based estimates of species assemblages, however, have suggested ballast concentrations of 10 to 100 organisms per litre for zooplankton, 1000 to 1 million organisms per litre for phytoplankton, and billions of organisms per litre for viruses and bacteria (Ruiz and Carlton 2003), in a context where ballast discharges range anywhere from several tons to tens of thousands of tons (Carlton et al. 1995, NRC 1996).

Perhaps most significantly from a policy and regulatory perspective, current ecological understanding is ultimately unanimous about our inability to make exhaustive and reliable predictions regarding which of the many, diverse, and little-known species carried in ships’ ballast will invade where and to what effect. While not all released organisms become established, the invasions that do occur are essentially irreversible.

The only reliable, but limited prediction is that species with a previous invasion history will continue to turn up in new regions given the opportunity for ballast transfer. Ecological understanding, however, clearly suggests that when it comes to ballast discharges, the numerous little known and/or yet unidentified species that have no known invasion history are not risk-free by virtue of their anonymity.

The US and Australian responses to invasion risks from ballast

Within this context, the US has adopted an essentially precautionary approach. It deals with the ecological uncertainty about which of the many ballast-borne species will invade where and to what effect by targeting all ballast-borne organisms for prevention. National regulations, in force since July 2004, require that vessels carrying foreign ballast treat such ballast prior to discharge in US waters, either using the current default procedure of open-ocean ballast exchange, or a Coast Guard-approved functional equivalent.

Australia has, on the other hand, focused its ballast control and management efforts on the confirmed sources of invasion threats alone, designing a regulatory regime to prevent against a small number of target species (about 20) pinpointed as most undesirable based on their past history of invasion.

To do this, Australia relies on a complex system of species-based ballast risk assessment. Australia-bound vessels submit information on ballast origins and voyage specifics to an electronic Decision Support System (DSS) run by the Australian Quarantine and Inspection Service (AQIS). The DSS uses a species-based model of risk assessment to determine the probability that a vessel carries viable individuals from one or more target species to an Australian location where they can survive. If this probability is above a certain threshold, a vessel is required to exchange its ballast prior to discharging in Australian coastal waters. If the probability is below the threshold, the vessel is exempted from ballast treatment requirements (Table 1).
Working with the same understanding of the nature, dynamics, and implications of the invasion risks from ballast, the US and Australia have thus chosen different ways of balancing invasion prevention against regulatory burden for shipping. But the two countries were not always so far apart. Current differences are in fact the result of a policy divergence of sorts. In the late 1980s, the economic and ecological damage caused by the zebra mussel invasion in the Great Lakes, and by toxic algal blooms in major shellfish producing regions in Australia, put ballast water on US and Australian policy agendas.

Both countries then started with a broadly precautionary intention of preventing all ballast-mediated species transfers through comprehensive controls on ships’ ballast. The US experienced an initial setback, but continued on a course towards putting the original precautionary vision into regulatory and management practice. Australia, in contrast, narrowed its policy goals in the mid-1990s, shifting to its current approach.

**Accounting for US–Australian policy differences**

One immediately logical explanation for these observed differences is practical: perhaps it is actual or contended differences in the exposure of each country to nonindigenous species from ballast or in the susceptibility of US and Australian coastal ecosystems to invasion that account for some of the difference in levels of risk management employed by each country.

There is nothing in current ecological research and understanding, however, to suggest patterns of higher vulnerability, exposure, or invasion probability for coastal ecosystems in one country compared to those of the other. Equally importantly, there have been no political framings portraying invasion risks in one country as more serious, singular, or deserving of mitigation than those faced elsewhere.

Further, even if coastal ecosystem vulnerability and exposure to nonindigenous species from ballast (both notoriously difficult to measure with precision) could be quantified thoroughly and reliably enough to allow for

<table>
<thead>
<tr>
<th>US</th>
<th>Australia</th>
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| A comprehensive approach to prevention  
- All ballast-borne species considered a source of invasion risk and targeted for prevention  
- All foreign ballast subject to treatment requirements | A narrower approach to prevention  
- Only a subset of ballast-borne species – those estimated to pose highest risk of high-impact invasions – targeted for prevention from entry  
- Treatment required only for foreign ballast estimated likely to carry any of these target species |
specific estimates and comparisons of invasion probabilities across the two countries, invasion risk itself is, in fact, the multiple of invasion probability and invasion consequences. With the consequences of most future invasions remaining completely indeterminate when it comes to species transfer through ballast, it will always be hard to reasonably claim that one ecosystem, region, or country continuously exposed to discharges of untreated ballast faces consistently higher or lower invasion risks than another similarly exposed one. That is, a coastal system with an estimated lower nonindigenous species exposure and invasion probability can still experience a single invasion whose consequences are more ecologically, economically, or otherwise devastating than the consequences of half a dozen invasions occurring over the same period in another ecosystem with higher invasion probabilities and invasion rates.

Previous work has directed us to seek explanations for differences in national policy responses to the same environmental or public health problems by looking for cross-national differences in public risk perceptions, problem framing, the nature of national political and policy institutions, the relative strength of environmental movements, and especially the relative openness of the policy process to participation by a range of diverse societal groups and interests (Brickman et al. 1985, Jasanoff 1986, Vogel 1986, Kagan and Axelrad 2000, O’Neill 2000, Schreurs 2002). It has also highlighted the importance of interactions between experts, regulators, and the regulated community, with patterns of interaction sometimes captured under the heading of regulatory style (Vogel 1986, O’Neill 2000). Finally, previous work underscores the importance of the type of scientific expertise mobilised, and of the way expert input and advice is structured into the policy process (Brickman 1984, Jasanoff 1990, 1997, Long 2000).

The broader issue of ballast-mediated marine invasions never gained sustained public or media salience in either country, so differences in public risk perceptions are negligible. Neither does the available evidence suggest that a narrower economic framing – as opposed to a broader ecological framing – was more dominant in either country.

With respect to policy process, Australian ballast decision making has been characterised by a close and cooperative relationship between government and the shipping industry as the regulated community. Within a broader context of emphasis on collaborative modes of decision making, it is also characterised by a more closed structure of participation: non-governmental participants in deliberative and decision-making bodies – such as the pivotal Australian Ballast Water Management Advisory Council – are generally selected based on neo-corporatist principles of aggregating interest representation by type of stakeholder (e.g. Downes 1996). Australian environmental policy has also been marked by increasing industry influence on decision making (Doyle 2000).

These dynamics contrast with a US policy process that is distinctive in its openness to participation by a multiplicity of discordant voices coming from a wide range of societal actors; and also distinctive in having an adversarial,
rather than cooperative mode of policy decision making. Further, in spite of
the considerable and arguably growing influence of corporate interests, US
environmental policy at its broadest is still characterised by the strength and
consistent participation of a wide range of environmental groups, from the
grassroots to the professional (e.g. Kamieniecki 2006). Compared to its
Australian counterpart, the US environmental movement has not only more
ample and more reliable access to the policy process, but also a greater
financial and practical capacity for involvement across a wide range of issues
(e.g. Hamilton and Maddison 2007).

Interestingly, however, in both Australia and the US, environmental NGO
involvement in the processes that produced the core of ballast policy outcomes
discussed in this article has been fairly minimal. In both countries, then, the
available evidence points to the shipping industry, and a relatively small group
of aquatic and marine scientists, as the main actors in ballast policy outside of
government.

The analysis and comparison presented in the following section locate
explanations for observed regulatory differences in the way dominant features
in each country’s policy style, as reflected in the structuring of ballast decision
making, have shaped the policy participation and influence of scientists and the
shipping industry, respectively.

**National ballast policy in the US: a gradual course to precaution**

The 1988 explosion of the Eurasian zebra mussel in the North American Great
Lakes was the beginning of a US ballast policy process that culminated with
the 2004 enactment of mandatory nationwide ballast management require-
ments. Zebra mussels clogged intake pipes for municipal water systems and
power plants, cutting off water supply and littering beaches with massive
clusters of sharp shells and rotting mussel flesh. When these incidents
were linked to the ballast water of international shipping coming into the
Great Lakes through the St. Lawrence Seaway, a bi-partisan group of US
Congressmen from Great Lakes states introduced the first national ballast
control legislation. Reflecting the advice of marine ecologists and enjoying the
support of state and federal resource and conservation agencies, the legislation
introduced a comprehensive view of the problem and a comprehensive view of
the solution. It called for all vessels coming into US waters from foreign
voyages to treat any ballast they would discharge in waters of the US via the
available technique of open-ocean ballast exchange. The only opposition to the
original bill on ballast came from the shipping industry, whose representatives
worked to question and downplay the scope of the issue and the existence of a
problem beyond the Great Lakes (Cox 1990). The legislation that passed² was
appreciably narrower than originally intended: it introduced ballast manage-
ment requirements for vessels coming into the Great Lakes only, and mandated
research on the extent and source of the problem in the remainder of US
waters.
Nonetheless, the US continued on a steady if somewhat halting course towards implementing the original precautionary vision. A key transition came in 1996, when the 1990 legislation was re-authorised and amended to provide for the management of all foreign ballast, even though the extension came with a clear prescription for delay – the US Coast Guard was to start with voluntary ballast management guidelines, and deploy mandatory requirements only if the voluntary ones proved to be ineffective. The new legislation specified a complex, multi-step and generally cumbersome procedure for determining the effectiveness of the initial voluntary ballast management guidelines.\(^3\) Still, in light of continued shipping industry resistance and the strongly anti-regulatory and anti-environmental mood of a Republican Congress,\(^4\) this 1996 Congressional action was nonetheless notable. It eventually became the basis for the current binding and comprehensive national controls on ballast.

What accounts for this US policy pattern? At first glance, it appears that a change in industry stance is critical: the shipping industry started by resisting mandatory and comprehensive national controls on ballast, but eventually came to support them. A closer analysis, however, indicates that this shift in industry position did not lead or prompt regulatory expansion, but rather followed it. Unable to dispute ecological evidence regarding the scope and seriousness of ballast-mediated marine invasions, the US shipping industry grounded its opposition to binding and comprehensive national controls on ballast in safety and feasibility-based objections. Such opposition was, however, abandoned when it started to undercut industry’s core preferences of maximising the uniformity and predictability of regulation, minimising compliance costs, and avoiding operational disruptions and/or delays. Specifically, as industry opposition succeeded in delaying rigorous national-level ballast regulation, several major coastal states successfully mobilised to enact their own ballast policies and regulations. This introduced the possibility for a patchwork of state requirements – a proposition that can be unpopular with a number of industries across a range of policy issues (Stanton 1995, Ludwiszewski and Haake 2008), and one which is especially unpopular with the quintessentially transboundary shipping industry in the case of ballast regulation. The shift in the nature of policy options made binding and comprehensive national controls preferable from an industry perspective.

Thus, it is the change in the US regulatory landscape that prompted changes in the shipping industry ballast policy stance, rather than the other way around. This landscape change, in turn, occurred in a context where the clearest, most sustained and vigorous leadership for comprehensive ballast management and invasion prevention came from a highly active group of mostly academic scientists. A small but gradually expanding community, US invasion scientists acted both as providers of scientific and technical information and as the interpreters of policy insights to be drawn from the available ecological knowledge.

Taking on an advocacy role, they built an ecological and policy case for precaution, doing so in the face of not only shipping industry opposition, but also
some pre-existing policy bias militating against the comprehensive thinking and action they saw as both urgent and necessary. US marine scientists, for example, encountered – and worked to dispel – several ‘invasion myths’. Perceptions that everything that could be introduced must already be introduced, for example, tended to suggest that preventive measures were likely moot. Simultaneously, claims that invasions are a part of nature, and all we are doing is speeding things up a little, challenged the idea that invasions were in fact a problem to be solved.

In addition, scientists’ efforts for ushering comprehensive policy thinking and action faced a strong public and political tendency towards narrow problem perceptions – a tendency already institutionalised in national statutes such as the Lacey Act and the Noxious Weeds Act, both of which focused on preventing the transfer and introduction of a small number of nonindigenous species declared as injurious on the basis of past negative experiences with them.

Within this context, however, marine scientists developed a research agenda that underscored the full range of invasion risks and consequences associated with ships’ ballast and used it as a key tool in their advocacy for a rigorous and comprehensive policy response.

When the research mandated by the 1990 legislation, for example, was not funded (the allocated funding was never appropriated), scientists approached the US Coast Guard to support the mandated national ballast water and shipping study under a much more modest funding scheme than stipulated in the legislation. The study (Carlton et al. 1995) proceeded to look at ballast water and port operations by a variety of vessel types across major ports throughout the US, documenting, specifically and in detail, the nature and extent of ballast-mediated species transfers and releases into waters of the US.

Augmenting and strengthening the findings and insights of earlier academic work (e.g. Carlton 1985, Hallegraeff and Bolch 1991, Carlton and Geller 1993, Kelly 1993), this study, whose results were pro-actively communicated to legislators and resource agencies by the authors and their research colleagues, raised further awareness and concern across a range of coastal jurisdictions, spurring the first set of state and regional policy action and setting the stage for the 1996 re-authorisation and expansion of the original ballast legislation.

Invited to testify on the proposed 1996 expansion and re-authorisation of the limited 1990 statute, the lead author of the study was both emphatic and forceful in his call for prompt and decisive federal regulatory action:

> every second, more than 650 gallons of non-native organisms are injected into America’s waterways because of the release of ballast water from a foreign port. In the 5 minutes that I will speak this morning, this means that 200,000 gallons of exotic animals and plants have been inoculated somewhere on America’s coastlines.

Clearly, this needs to be stopped.

The good news is that we can stop it.

But we haven’t stopped it yet, and therefore new species continue to invade . . .

The ‘National Invasive Species Act of 1996,’ now before you, at long last begins the rigorous process of reducing these invasions. (Carlton 1996)
US scientists working on marine invasions have been similarly clear and emphatic across a range of communications, including peer-reviewed scientific work and conference presentations (e.g. Carlton and Geller 1993, Cohen 1999), and policy-oriented reports and publications (e.g. Cohen 1998, Cohen and Foster 2000, Carlton 2001, Cangelosi 2002). Further, in their efforts to raise awareness and build policy momentum, US scientists, who participated in the drafting of most ballast water legislation, did not limit themselves to invited appearances and structured opportunities for policy participation, but also worked to create new opportunities, directly reaching out to decision makers.

By critically shaping the understanding of bioinvasions as a policy issue, US ecologists effectively structured the terms of policy debate and delineated legitimate from non-legitimate discourses and perceptions. The successful adoption of a precautionary US approach to the invasion risks from ballast is thus largely traceable to the policy activism of a US knowledge community that bridged the roles of a cognitive and political actor. This pattern stands in sharp contrast with ballast policy dynamics in Australia.

National ballast policy in Australia: from comprehensive to selective prevention

Australia’s transition from an initially precautionary policy vision to a more limited regulatory approach is largely traceable to the closed and corporatist nature of Australian ballast policy decision making, and specifically to the way Australia’s ballast policy process structured shipping industry participation, the scientific research agenda, and the role of scientists as expert advisors.

In Australia, the policy role of scientists has been an enabling rather than a guiding one. Where US scientists used their expertise-based authority to define the policy dimensions of the problem and outline regulatory approaches, the expertise of Australian scientists has been primarily summoned to help implement policy visions evolving through consultation between government and industry actors.

In fact, the ultimate adoption of a selective, species-based national approach to managing the invasion risks from ballast is in many ways an unanticipated policy consequence from the planned delivery of mandated regulatory science.

As in the US, ballast water and marine bioinvasions landed on the Australian policy agenda in the late 1980s thanks to a single cluster of significant and noticeable invasion events: major blooms of toxic microalgal species known to accumulate in shellfish and cause paralytic and toxic shellfish poisoning in humans appeared in the waters of Tasmania, one of Australia’s major shellfish producing regions. The Commonwealth Scientific and Industrial Research Organization (CSIRO) traced the species to ships’ ballast water, prompting the Australian Quarantine and Inspection Service, then in charge of both shellfish safety and shipping quarantine, to take a policy lead.

Using the existing statutory authority of Australia’s Quarantine Act of 1908, and the same body of ecological knowledge that was available to US
decision makers, AQIS developed a set of ballast management guidelines for all vessels coming to Australia from foreign voyages. Although voluntary, these guidelines had an 80% compliance rate following their formal introduction in 1990.⁵

The narrowing of Australia’s approach to invasion risks from ballast emerged out of a policy process intended to stabilise and formalise the 1990 guidelines, and spearheaded by the Australian Ballast Water Management Advisory Council (ABWMAC), whose constitutive mission was to complete and implement a national ballast management strategy. Operating under the de facto leadership of AQIS, ABWMAC was explicitly intended as an expertise and key stakeholder council and as a cooperative partnership between government and industry (IABWMAC 1995, AQIS 1996a, Paterson 2001). It was composed of representatives from federal and state agencies with transportation, primary industry (fisheries and aquaculture), and environmental mandates; it had extensive representation from the shipping industry, and several other industries with interest in ballast regulation, including mining, fisheries and aquaculture.⁶ ABWMAC also included a slot for conservation interests, which was to be filled by an NGO representative aggregating the positions of environmental groups.

ABWMAC’s permanent membership included a scientist from CSIRO’s Marine Division, and based on meeting minutes, the Council intended to solicit the opinion and advice of invasion biology and ecology experts from the broader Australian marine science community. The bulk of policy-relevant research and advisory functions, however, were performed by a small group of biologists and ecologists from CSIRO and the Commonwealth Bureau of Rural Sciences, who were working under the agenda-setting and research-directing authority of ABWMAC and affiliated government agencies.

Crystallising in the early deliberations of ABWMAC, the idea of a selective, species-based rather than comprehensive approach to ballast regulation had its origins in the early 1990s work of several successive government–industry working groups that focused on invasion risks from coastal as opposed to international species transfers (i.e. on the question of species transfers through the ballast water of coastal as opposed to international shipping).

The issue of invasion risks from coastal shipping came up because its ballast remained uncontrolled (both in Australia and the US) although it had a clear potential to transfer already established invasive species to new coastal locations.⁷ While initial neglect of invasion risks from coastal ballast was probably the result of simple oversight, and while maturing ecological research and policy understanding has put such ballast on the regulatory radar screen in both countries, the greater practical challenges of managing coastal ballast have nonetheless produced ongoing delays in comprehensive national controls in both Australia and the US.⁸

In the mid-1990s, Australian government–industry working groups strove to balance the concerns of fisheries and aquaculture interests against those of shipping, recommending that coastal ballast be managed to prevent the
transfer of known marine pests between Australian ports, but that ballast management requirements be imposed only on coastal ballast considered to pose sufficient risk of such transfer (CBWG 1995).

Given that the species content of any particular load of ballast is unknown, the ability to impose ballast management requirements selectively called for a system of species-based risk assessment. Consequently, ABWMAC set a formal mandate for conducting the ecological research and ballast risk modelling needed to develop such a system, and scientists from CSIRO’s marine division got the task of completing the mandate.

To all apparent effect at the time, developing technical capacity for the selective management of coastal ballast should have helped to extend Australia’s scope of protection by allowing it to at least partially address the invasion risks from previously unmanaged coastal ballast. Within the ABWMAC process, however, the concept of selective ballast controls and species-based ballast management was significantly transformed.

At first, AQIS remained emphatic about the need to continue working with a broad definition of invasion risk, and the need to continue solidifying a precautionary national strategy for ballast management and bioinvasions prevention. The agency envisioned species-based risk assessment as a tool to be superimposed on, not substituted for, comprehensive national controls on ballast (AQIS 1996b). In addition to the idiosyncratic coastal voyage context, for example, species-based risk assessment was seen as a useful auxiliary tool in cases where vessels were unable to fully exchange their ballast due to safety or other pressing operational constraints; in those types of cases, ballast risk assessment could help make a decision about whether a vessel carrying untreated ballast should be allowed to make operationally necessary ballast discharges in Australian waters, or whether the invasion risks associated with that vessel were great enough to justify requiring remedial management procedures prior to discharge.

AQIS even formally outlined a two-pronged Australian strategy of seeking to minimise, through improved ballast water management, the risk of introduction of all exotic marine organisms, while also targeting, for the purposes of research and domestic ballast water management, those species and organisms already identified as real or potential problems (AQIS 1995). As the ecological and risk modelling research of CSIRO scientists produced the first quantitative models for species-based ballast risk assessment, however, shipping industry expectations that these models be used as a basis for all ballast management in Australia were not far behind. In other words, as regulatory science created a tool that made it possible to attain some regulatory relief in exchange for narrowing the targets of prevention, it also created pressures to expand the regulatory use of this tool.

Initially committed to comprehensive prevention against all invasion risks from ballast, AQIS ultimately conceded to a de facto paradigm shift in its regulatory approach, accepting the idea of selective, species-based assessment and management of the invasion risks from foreign ballast. The shift in agency
position is clearly captured in the following succession of statements by Australia’s leading ballast policy official at the time. As late as 1997, this AQIS official is on the record stating that:

for ballast water management reasons (as distinct from Research and Development reasons) every vessel must prima facie be considered a threat, and hence we should not . . . adopt a solely targeted species approach. (ENRC 1997, p. 193)

In 1999, this same leading official signals the completion of Australia’s shift in policy and regulatory philosophy by insisting that:

unless we take a targeted approach . . . all vessels would have to be treated as high risk and therefore all vessels would have to undergo some ballast treatment option. From shipping perspective and a world trade perspective as well as an environmental and management perspective, this is just not an option . . . I believe from a practical, management and shipping perspective, we have no choice in this country but go down the targeted species list for our management considerations. (D. Paterson transcribed in Hillman 1999, p. 73)

The question of effectiveness

The most obvious and direct way to gauge and compare policy effectiveness is to look at numbers and rates of invasion after implementation of respective national ballast regimes. Several factors, however, hinder the practical application of such measures (Ruiz and Reid 2007). Most importantly, comprehensive and up-to-date inventories of introduced marine species are lacking for most coastal ecosystems, making for uncertain invasion baselines. Given the variety of mechanisms responsible for marine species transfer and introduction, it can be sometimes hard to definitively attribute new invasions to ships’ ballast.

As a result, comparing regulatory design and implementation still remains a logical way to gauge relative effectiveness for the two national systems. The comparison reveals a particularly interesting pattern: early ballast management practices in the two countries have been far more similar than the nature of regulatory intentions and regulatory design might have led us to expect. Specifically, a post-implementation review completed by AQIS found that a majority of Australia-bound vessels end up directly performing open ocean ballast exchange, rather than using the DSS system to obtain a ballast risk assessment that could potentially spare them the need for exchange (Snell and McLachlan 2003). This rather unexpected dynamic has been partly attributed to the experience of ship operators with the DSS system: discovering that they tend to get a high-risk classification in many of their Australia-bound voyages, operators found it preferable to initiate ballast exchange early on in a voyage, giving themselves the maximum time and flexibility to complete the exchange, rather than waiting for a DSS ballast risk assessment and thereby running a risk of being unable to complete the prescribed exchange prior to an Australian
arrival (which also means running the risk of being prohibited from discharging any high-risk ballast, and having their voyage and/or cargo operations potentially disrupted). The prevalence of high-risk determinations for the ballast of Australia-bound vessels, is, in turn, a result of the highly data-intensive models for ballast risk assessment (these being the basis of the DSS) operating in conditions of practical data scarcity, and so operating at a low resolution.

In the US, at the same time, Coast Guard monitoring has suggested high levels of compliance with mandatory ballast exchange requirements (USCG, personal communication). The two countries are therefore much closer together in terms of their actual management of invasion risks from ballast than the intentions and design behind their respective regulatory systems set them up to be.

Australia, however, has continued work on refining the system for ballast risk assessment to deliver the capacity for selective imposition of ballast management requirements on Australia-bound as well as domestic voyage vessels: CSIRO marine scientists have been fine-tuning the design and implementation of the risk models, working under research contracts with responsible Commonwealth agencies, the Department of Agriculture, Fisheries and Forestry at the lead (Hayes et al. 2004, 2005, 2007, McEnnulty et al. 2006).

If both countries remain committed to their respective ballast management approaches, the difference in US and Australian levels of risk management and thus risk acceptance will most likely deepen as emerging on-board ballast treatment technologies make ballast management both more reliable and more effective.

Conclusion
Past research, much of it focusing on US-European comparisons of environmental regulation, has identified a number of considerable differences in the ways western democracies confront environmental and health hazards, attributing much of the observed variation to differences in key political and institutional structures that underlie environmental decision making in each country (Brickman et al. 1985, Jasanoff 1986, O’Neill 2000). Significant recent work on comparative regulatory politics has also re-emphasised the importance of interplay between agency and structure, highlighting the formative policy role of agency-driven processes such as issue interpretation and meaning creation, the construction of environmental narratives and problem frames (Jasanoff 2005).

The present study adds nuance to existing insights, showing how the principal importance of political structure and regulatory style can stem from their role in defining the parameters for scientific agency within a country’s policy and regulatory process. Working within a pluralist and relatively open political process and a related broader tradition of expert activism, US scientists framed the ballast-mediated marine bioinvasions problem for policy,
set the research agenda, and advocated, in the face of shipping industry opposition, for comprehensive policy and regulatory action. The ecological and risk modelling work of Australian scientists was also critical for enabling Australia’s current regulatory approach. Much of this research, however, was conducted pursuant to specific regulatory mandates, with scientists’ policy input and influence constrained within the closed and corporatist structure of the Australian ballast policy process.

Compared to the formative policy role of the US knowledge community, the Australian one has played a largely enabling role. As a result, and in contrast to the situation in the US, Australia had no strong policy voice to counterbalance the shipping industry’s preference for containing the reach and scope of regulatory controls on ballast. Australian bureaucrats, who were the first to introduce the idea of precaution, were acting, through their agencies, as environmental and natural resource trustees, but they were also performing the function of balancing stakeholder interests in a context where the shipping industry was a dominant stakeholder.

Ultimately, then, the most important way in which political structure and regulatory style have played a role in shaping national ballast policy outcomes is by structuring the nature of scientific input into each country’s process of policy decision making, and thereby shaping the ability and inclination of scientists to actively express policy opinions and to advocate policy directions and regulatory solutions.

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Notes
1. Also referred to as non-native, nonindigenous, exotic and alien species.
4. NISA 1996 was passed during the ‘Contract with America’ ideological hold on Congress.
5. Data from documents distributed at the 1st meeting of IABWMAC (Interim Australian Ballast Water Management Advisory Council), Hobart, 21 February 1995.
6. Some of the informants for this research have even characterised ABWMAC and the ballast policy process it led as involving a greater than usual degree of consultation and collaboration between government and shipping industry as the regulated community.
7. As well as the largely overlooked potential to cause new invasions by translocating US or Australian species to US or Australian coastal locations beyond the species historic ranges.
8. The challenges of managing coastal ballast – by either exchange or treatment (when on-board ballast treatment technologies become more widely available) are largely associated with the prevailing nature of coastal voyages, which are often shorter in length and duration, and routed in near-coastal waters. Completing an open-ocean
ballast exchange, for example, may call for a coastal voyage vessel to deviate from its normal route in order to go into open-ocean water, and may entail voyage delays beyond those associated with the detour, since exchanging large volumes of ballast may take up to several days. With speed and timeliness of delivery amongst the most critical competitive pressures on contemporary shipping, and with contemporary vessels costing tens of thousands of dollars per day to operate, voyage delays can be especially costly.

9. Open ocean ballast exchange can, for example, be unsafe and/or impossible to perform under rough weather conditions at sea.

References


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