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Policy pitfalls and opportunities for marine invasive species management in Canada

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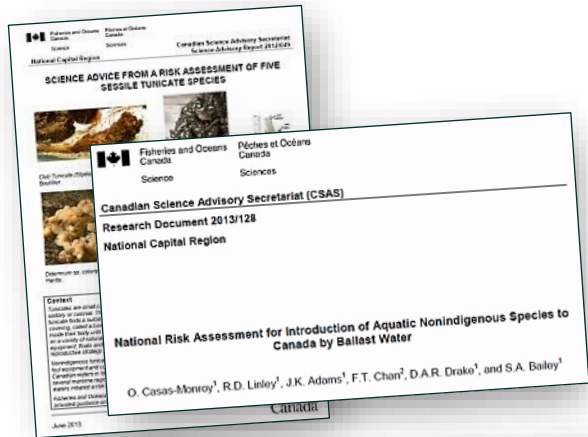
Invasive Species Research Conference, Kamloops, BC - June 20 - 22, 2017

1 – Ecological and Social Systems Analysis (ESSA), Vancouver BC.
2 – Simon Fraser University, Burnaby, BC.





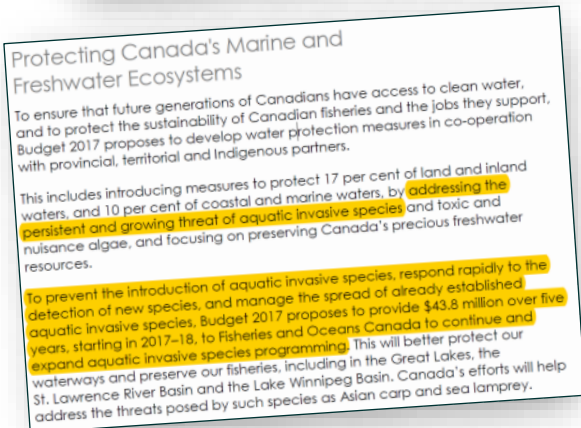
Recent Policy Developments



- ~2007- ongoing 3 (and ongoing) **DFO risk assessments** for marine invasive species



- **2015**
Aquatic Invasive Species Regulations under Fisheries Act Provides legal impetus and framework where little existed before



- **2017**
Federal budget allocation of funds specifically for dealing with aquatic invasive species

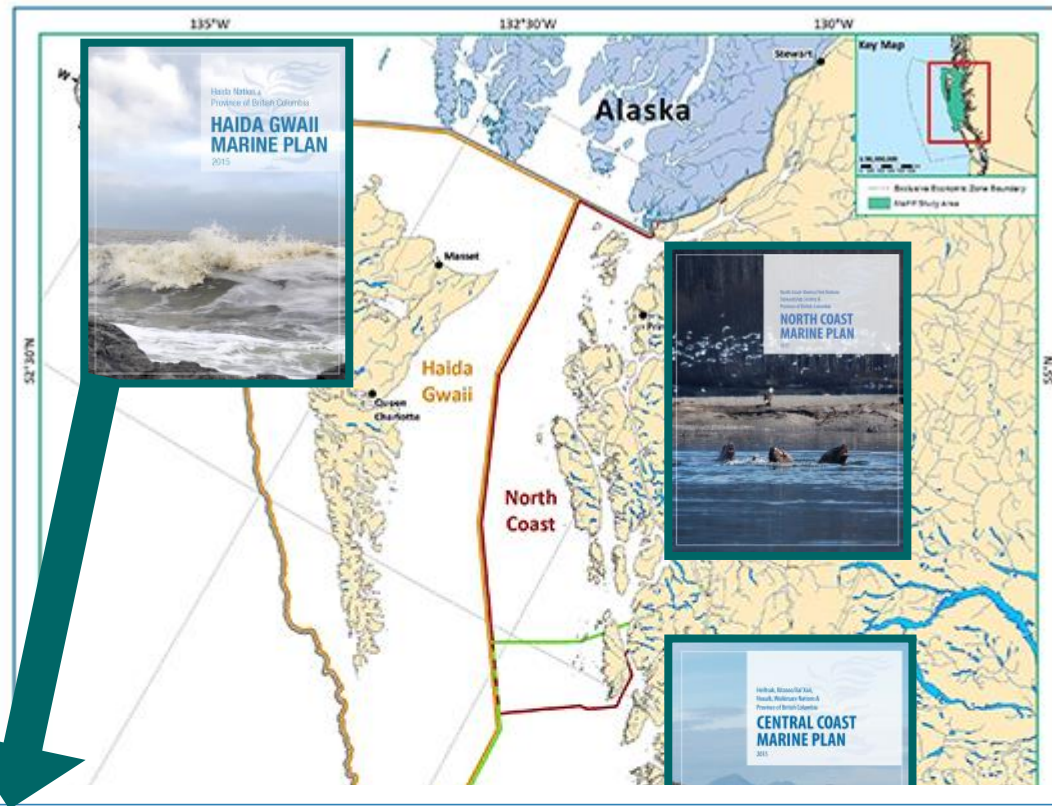
THEORY

PRACTICE



MaPP as a Driving Process in BC

- Plan implementation is a **major driver of MIS theory → practice** in BC
- MaPP Marine Plans have objectives to manage MIS



Issue 4: Impacts of Invasive species

Obj 4.1 Minimize the introduction and impacts of invasive species.

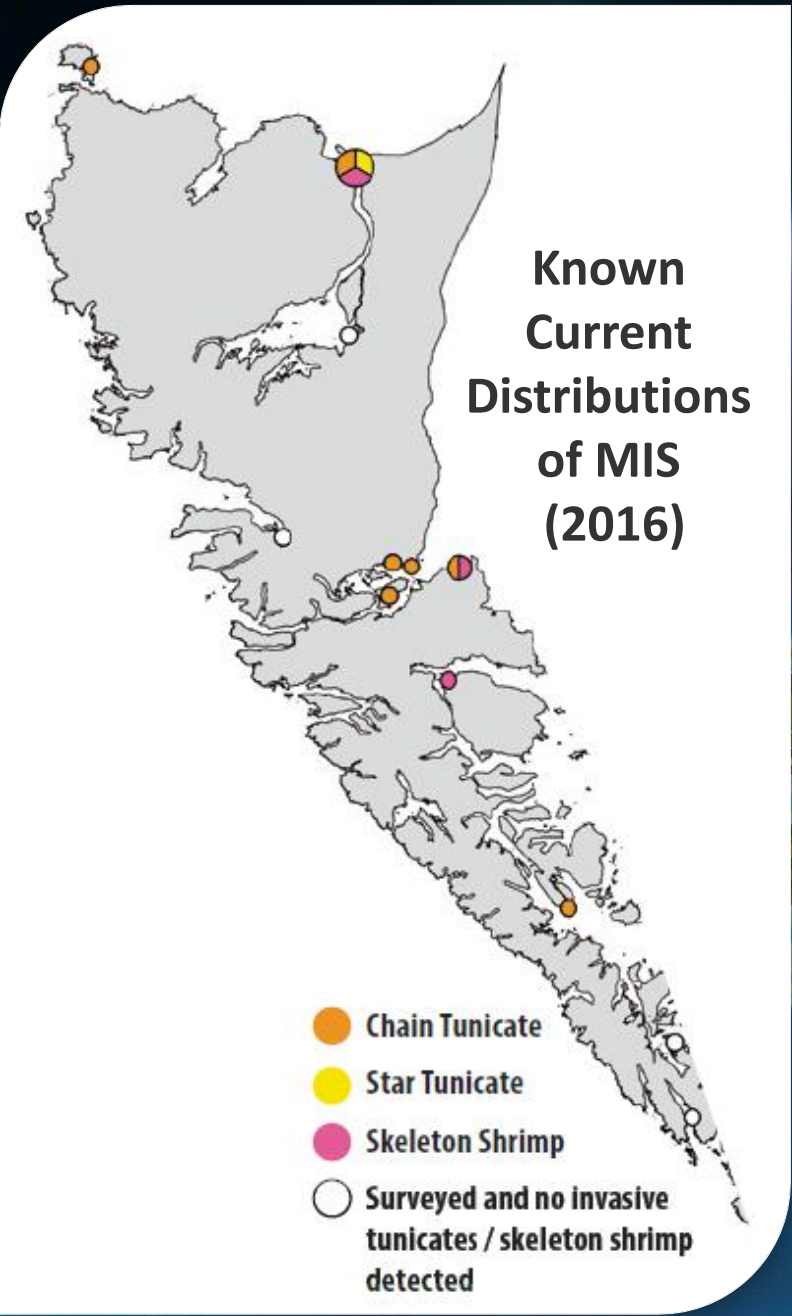
Strategy 4.1A Review effectiveness of existing regulations, Best Management Practices and/or Codes of Practice related to the provincial tenure or CHN management of aquaculture, such as the BC Aquaculture Codes of Practice, and make changes as necessary to prevent the spread of invasive species to Haida Gwaii.
Example - Introduced species of concern include green crab and non-native tunicates

Strategy 4.1B Work with federal agencies to develop management plans that include monitoring, evaluation and management actions for invasive marine species throughout Haida Gwaii.

Strategy 4.1C Develop and implement an educational communication and outreach plan to prevent the introduction, establishment and spread of invasive marine species.

Strategy 4.1D Review the effectiveness of current regulations and guidelines for potential transfer mechanisms (e.g., construction materials, boat trailers) and recommend changes as necessary.









Objectives & Methods

1. Understand where Canada stands in its ability to address marine invasive species

- Policy & program analysis to identify gaps

2. Review the best ways forward

- Interview key experts from Canada / US
- Literature review of best practices & costs(\$) elsewhere

3. Create a unified overview resource as a starting point for future planning

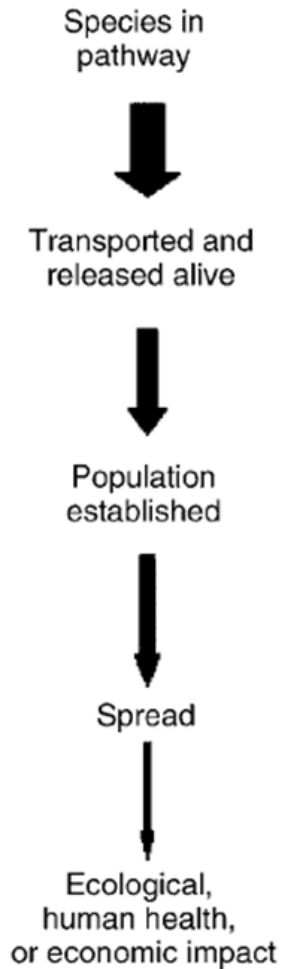
- Synthesis report + presentation

Structuring Framework

Management by Stage of Invasion



Invasion Process



General Policy and Management Options

Prevention

Early detection, rapid response, and eradication

Control and slow the spread

Human adaptation and mitigation



General Policy Overview

The Top 3

- **Aquatic Invasive Species (AIS) Regulations** (*Fisheries Act*)
 - The catch-all and most important policy tool for MIS management
 - **Prohibits transport** of AIS into / around Canada, ability to deny entry / transport
 - **Authorizes deposit of deleterious substances** to control AISs
 - **Empowers agents for enforcement** (Fisheries Officers, Guardians)
 - Enabling, but does not set aside resources for implementation
- **Pacific Aquaculture Regs / Aquaculture Activities Regs** (*Fisheries Act*)
- **Ballast Water Control & Management Regulations** (*Shipping Act*)

And many other (~30) relevant policies....



Relevant Policy Breakdown by Vector

Legislation and Programs Pertinent to Marine Invasive Species Management in British Columbia





Prevention of Dispersal

Vectors of Dispersal: Transportation



Cargo Vessels

MAIN POLICY INSTRUMENTS:

- Ballast Water Control and Management Regulations (>24 m)
- Vessel Pollution and Dangerous Chemicals Regulations (>24 m)

- Requires offshore ballast water transfers, anti-fouling documentation for international vessels entering EEZ
- Requirements for treatment systems gradually coming into force



Small Vessels
(including float planes)

MAIN POLICY INSTRUMENTS:

- Aquatic Invasive Species Regs. (<24 m)

- AIS Regs only policy tool – can stop travel, require cleaning, etc.
- Increasingly recognized as an important vector of local spread



Domestic vessels / voyages exempt from ballast water transfers / anti-fouling documentation

Several other exemptions



Disperse activity over broad area

Requires good understanding of traffic patterns
(*parallel study in Haida Gwaii*)

Low capacity to monitor/enforce

Vectors of Dispersal :Aquaculture

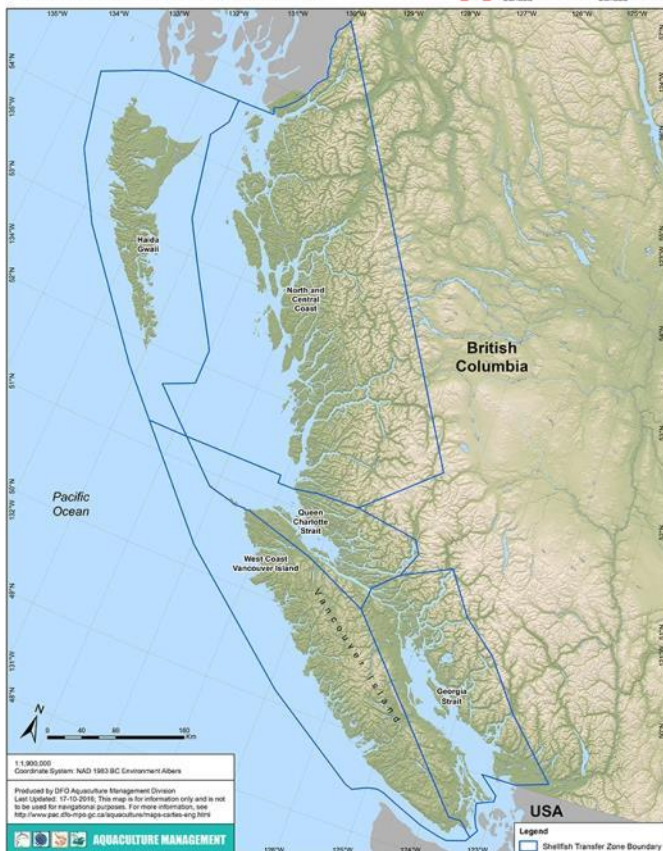


MAIN POLICY INSTRUMENTS:

- Pacific Aquaculture Regulations (and Conditions of Licence)
- Aquaculture Activities Regulations
- Fisheries Act (esp Section 56 - Restricted Waters Protocols)

Shellfish Transfer Zones in British Columbia

Canada Fisheries and Oceans Pêches et Océans Canada



- Transfer of seed / adults between zones requires permit from ITC – explicitly considers risk of invasion
- Transfers to North / Haida Gwaii most closely scrutinized
- Transfers from WCVI restricted in licence conditions due to Green Crab



No oversight over transfers within zones, or transfers of gear only (except WCVI)



Vectors of Dispersal: Other



Aquaculture Gear Transfer




Docks, Coastal Infrastructure

MAIN POLICY INSTRUMENTS:


- Aquatic Invasive Species Regs. (but not yet applied in practice)
- Pacific Aquaculture Regulations (not currently, but potential exists)

- Suspected as source of multiple invasions (e.g., Alaska)
- **DFO study ongoing** to determine risk of transfers from these structures
 - **TALK AT 2:05 PM TODAY IN TERRACE ROOM!**

Currently little practical oversight over these vectors



Marine Debris



**Other Minor Vectors
Fishing**

Regulations (but not yet applied in practice)

Regulations

- **MIND THE GAP** (with red circle icon)
- Labeled minor vector after decline in tsunami debris
- Intentional introductions in temperate oceans v. rare

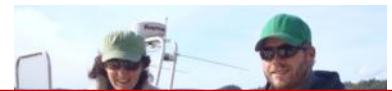


Early Detection

Early Detection Monitoring



- Public reporting to DFO hotline
- DFO / community-based monitoring
 - PlateWatch Program
 - Dive surveys
 - Trap surveys



- Positive ID is visual and requires a taxonomist
- Creates a bottleneck and very long processing times (months)
- Seriously limits *true EDRR*

- **Genetic / eDNA** methods in development will help, but not quite ready for widespread use
- **TALKS AT 9:55 – 11:20 AM TOMORROW IN MOUNTAIN ROOM!**



Rapid Response & Controlling Spread

Legislative Overview

Controlling Spread



- **AIS Regulations** provide catch-all authority to stop transport, mandate cleaning, and otherwise respond and EDUCATE
- Grant authority to **Fisheries Officers & Fisheries Guardians**

MIND THE GAP

- Capacity Limited
- Regulations still new
- Training & operational guidelines needed

- **Great** potential to help increase AIS Regs enforcement capacity
- Especially in **aboriginal communities**
- 2017 federal budget has committed **\$25 million over five years to funding aboriginal guardian programs**



(Hamayas Stewardship Network)

Legislative Overview



MIND THE GAP

No info on policy position, interaction with AIS regs

Just one example of lack of integration with existing marine programs

MIND THE GAP

Almost any “pest control” approach *requires registration for legal use*

Very *long, complex, expensive*, product registration process

Makes difficult to have a truly rapid response unless treatments pre-registered

• **HOWEVER – require further**

• **Fisheries Act** →

Fisheries Protection Program

• **Pest Management Regulatory Act (PMRA)** →

Pest Management Regulatory Agency

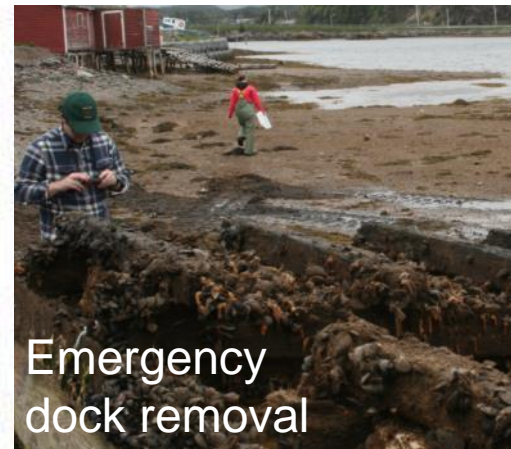
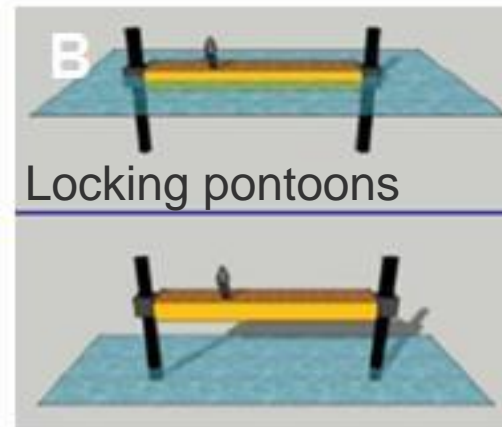
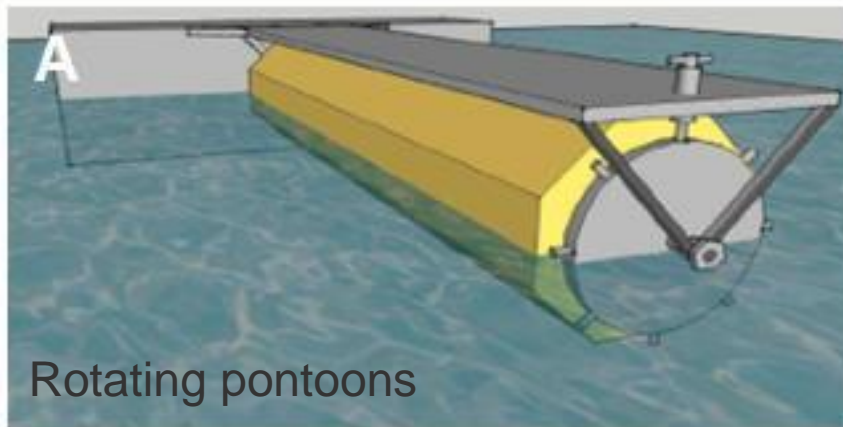


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Methods for Reducing Colonization Exposure

- Kills encrusting organisms via drying, limits colonization



(Cook 2011)

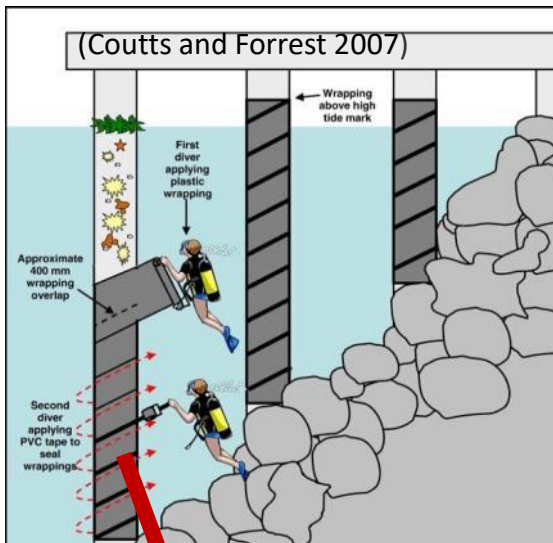
(DFO)



Methods for Reducing Colonization

Enclosure

- Kills encrusting organisms via anoxia, limits further colonization
- Trap mobile organisms





Methods for Reducing Colonization

Chemical Treatment

- Most are “everyday” substances selected for low toxicity
- Tested on invasive tunicates the East Coast, Alaska, Washington, New Zealand, and UK...

- Chlorine and bleach
- Freshwater sprays
- Freshwater bath
- Brine bath
- Lime
- Concrete Powder (in-situ)
- Anti-Fouling Coatings

Full evaluation + costs in report

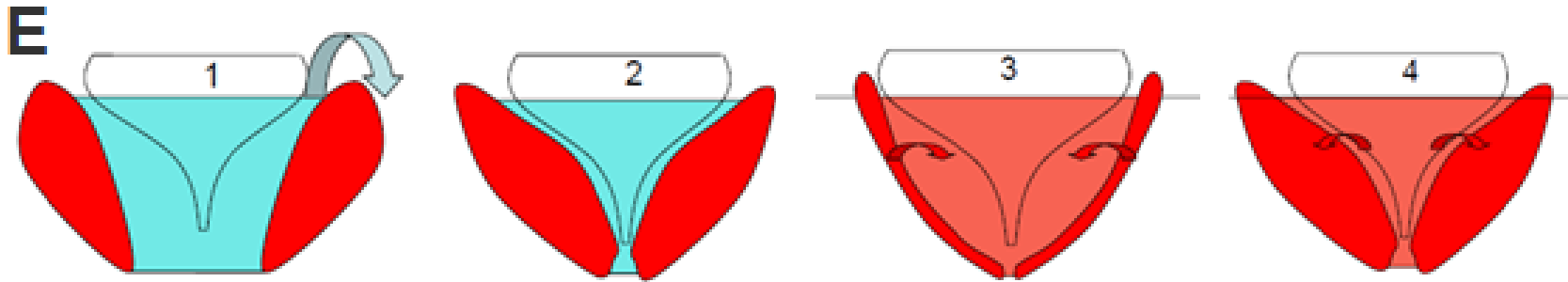
Method	Purpose	Targeted Organisms	Effectiveness of Treatment	Drawbacks to Method	Cost Estimates
Chemical Removal					
Seabed tenting	Covering of organisms on seabed using tents or wraps, which may be accompanied by the application of a chemical treatment within tents or “treatment domes”.	All fouling organisms	1. Effective but also kills native organisms 2. Biquin A24 grade geotextile fabric used to smother mussels, killed most <i>D. vesiculosum</i> (Coutts and Fowell 2007)	1. Kills native benthic organisms in addition to AIS (Looke et al. 2009) 2. The techniques cannot target a very large area of the sea bed 3. Some organisms survive in gaps of fabric (Coutts and Fowell 2007)	Moderate to high 1. Uncertain due to experimental nature, but roughly USD \$500,000 spent on tenting treatments of the seabed in an eradication attempt on Sitka kelpour, Alaska
Chlorine and bleach	Structures can be dipped into chlorine or can be added to a slip liner to kill fouling organisms	All fouling organisms, often used to target fouling tunicates on aquaculture gear	1. effectively kills organisms in slip liner (Culver 2012) 2. 0.5% solution for 20 secs and 2 min had 100% mortality of <i>D. vesiculum</i> (Denny 2008)	1. May leak into surrounding water and harm native organisms (Culver 2012) 2. Mussel mortality was ~5-6% in both baths	Low
Freshwater sprays	Applied to aquaculture to kill tunicates	Fouling tunicates	1. Short term 5-min sprays did not kill tunicates (Carman et al. 2016) 2. Long term 10-min sprays killed <i>Hydrobia</i> tunicates and <i>D. vesiculum</i> (Carman et al. 2016)	1. Long-term sprays caused 4% more mussel mortality than short term sprays (Carman et al. 2016) 2. May have different effects on other shellfish	Low
Freshwater bath	Structures can be dipped into freshwater or can be added to a slip liner to kill fouling organisms	Fouling tunicates	1. Short term 8 hour sprays killed <i>Hydrobia</i> tunicates and <i>D. vesiculum</i> (Carman et al. 2016) 2. Long term 24 hr sprays killed <i>Hydrobia</i> tunicates and <i>D. vesiculum</i> (Carman et al. 2016)	1. Short term baths had 2% less mussel mortality than long term baths (Carman et al. 2016) 2. May have different effects on other shellfish	Low
Brine bath	Applied to aquaculture to kill tunicates	Fouling tunicates	1. Short and long baths (10 and 20 sec): killed <i>Hydrobia</i> tunicates and <i>D. vesiculum</i> (Carman et al. 2016) 2. Dipping in brine bath was effective for killing <i>S. diluvii</i> (Cree 2017)	High mussel mortality, mortality lower in short baths ~20% (Carman et al. 2016)	Low, but costly if shellfish stock suffers mortality
Lime	Structures can be dipped into lime solution or can be added to a slip liner to kill fouling organisms	All fouling organisms, often used to target fouling tunicates on aquaculture	1. 5% lime had 20% mortality of <i>D. vesiculum</i> at 20 secs and 80% at 2 minutes (Denny 2008) 2. 10% lime had 20% mortality of <i>D. vesiculum</i> at 20 secs and 97% at 2 minutes (Denny 2008) 3. Effective for killing <i>S. diluvii</i> in Scotland (Cree 2017)	1. Low mussel mortality however numerous native species are vulnerable including some fish and invertebrates 2. Treatment can alter pH of estuaries (Looke et al. 2009)	Low
Concrete Powder	Applied in situ directly to encrusted surfaces to smother organisms on berths or submerged structures	Fouling tunicates	1. Effective at smothering tunicates (K. Sjöberg, pers. comm.) 2. Kills <i>D. vesiculum</i> on berths (Coutts and Fowell 2007)	1. Can smother other species and lead into water column (K. Sjöberg, pers. comm.) 2. Very costly (Coutts and Fowell 2007)	Low cost for concrete powder, but high cost of permitting and personnel, valuable for divers teams likely to be similar as for wrapping at £1 A45 / beam / day (Noyon et al. 2011)
Anti-Fouling Hull or Dock Coatings	Toxic and non-toxic hull coatings that prevent fouling organisms from settling	All fouling organisms	Effective if applied properly and regularly maintained	Improper application reduces effectiveness, can leak into water	Low - £200-300 for a typical yacht and usually combined with pressure-washing, also reduces need for other cleaning methods (Noyon et al. 2011)



Methods for Reducing Colonization

Chemical Treatment + Enclosure

- **Applied in enclosures** to maintain concentrations, limit dispersal



(Holt & Cordingley 2011 – hypothetical “Treatment Slip” design)



(Photos by I. Davidson, reproduced from SERC 2017 – field trial in Sitka Harbour, Alaska)

RR / Control Tools in Practice



RR / Control Tools in Practice



Stage of Mgmt



Potential Tools

Reporting
↓
Containment
↓
Removal / Control

DFO Hotline, Report to FO/ FG - *get positive ID*

FO can order stop on activity

DFO reg interventions

→ AQ Licence Conditions

→ Restricted Waters Protocol

Can surface be easily removed from water?

YES



Expose to Air

NO



NO TOOLS CURRENTLY ACCESSIBLE IN THIS SPACE

MIND THE GAP

STOP

Physical / chemical removal

PMRA

FPP



Mitigating Impacts





Methods for Mitigating Impact

- One of the most difficult phases to research
- Mainly depends on removal / control
- Also includes habitat restoration



Impacts of many MIS **not well understood**

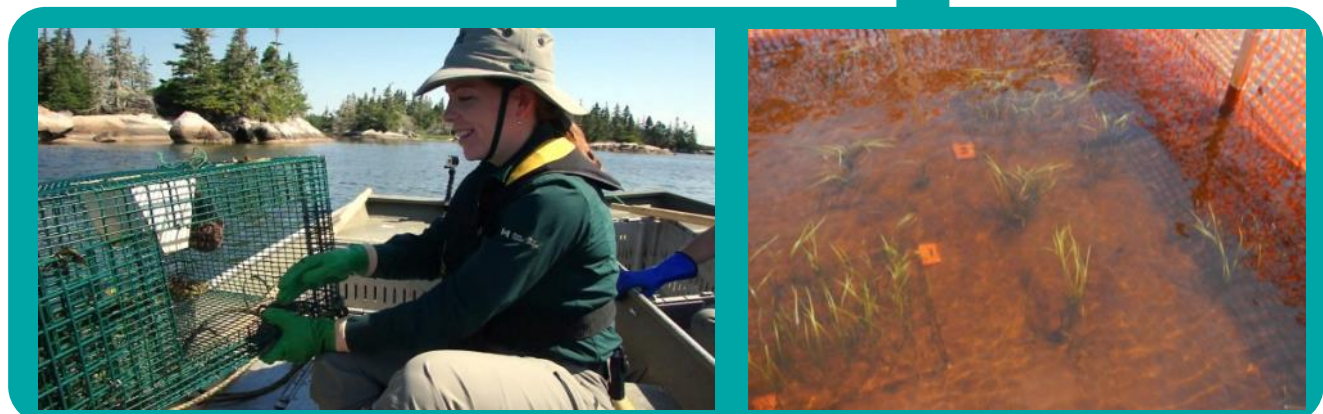
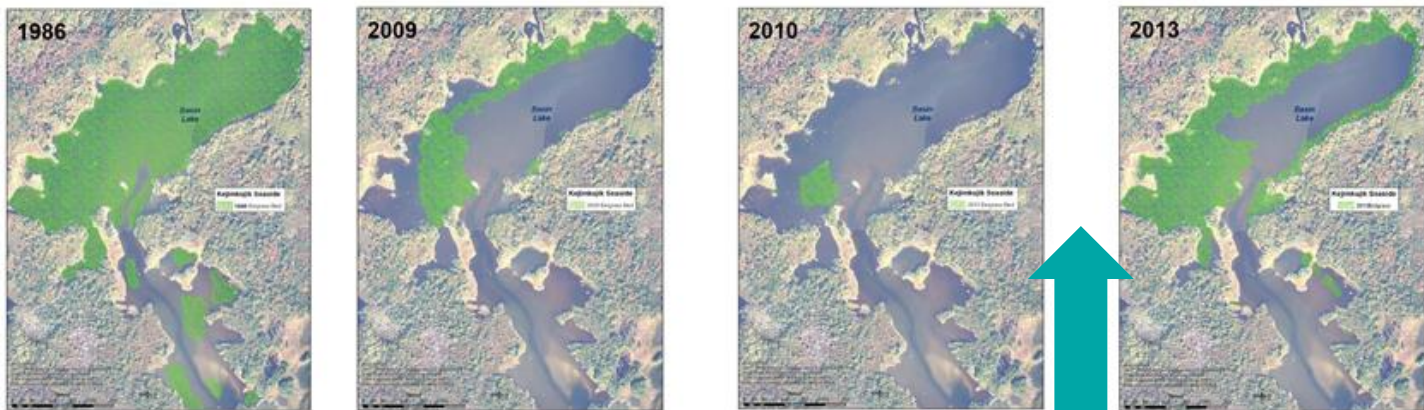
Makes it very difficult to identify and implement appropriate mitigation



Methods for Mitigating Impact

Restoration of Affected Habitats

- Time lapse of seagrass loss (due to green crabs) and recovery (following trapping + restoration) in Basin Lake in Kejimikujik National Park, NL





Where To From Here?

THEORY

PRACTICE



Priorities Going Forward



-  **Operationalize eDNA detection methods**
 - To improve the potential for *true early detection*
-  **Research and seek pre-emptive approval for control options**
 - So that options are ready when needed for *true rapid response*
-  **Research to better understand risk & impacts**
 - To understand priorities, effective pathways for mitigation





Priorities Going Forward



Increase public awareness of coastal users

- Awareness campaigns for public, fishers, aquaculture operators



Improve capacity for inspection / enforcement

- Develop procedural guide for implementing AIS regs
- Recruit & train more FOs / FGs on application of AIS Regs



Develop MIS management plans (local + regional)



Work together to close major remaining policy gaps

- Ballast/hull transfer on large vessels, domestic transfers
- Clarify intersections with other programs, policies



(Haida Gwaii, Lonely Planet)



Thank You!

Contacts

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Acknowledgements

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Accompanying Report

Tamburello, N., Francis, F., Olson, E. 2017. Policy Assessment for Managing Aquatic Invasive Species in Haida Gwaii. Report prepared by ESSA Technologies Ltd. for the Marine Plan Partnership (MaPP). **81 pp** + appendices.



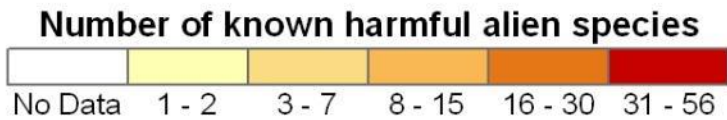
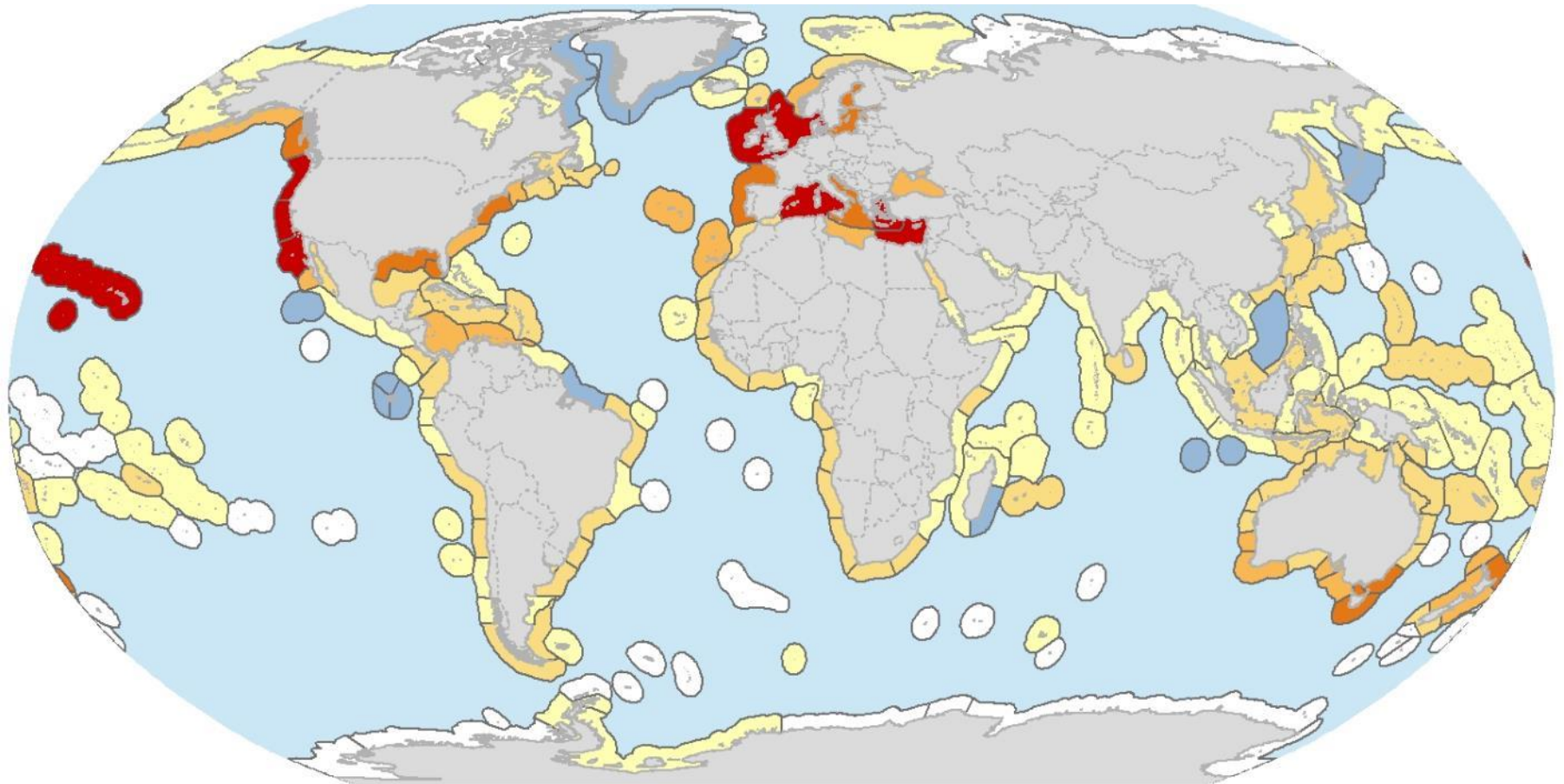
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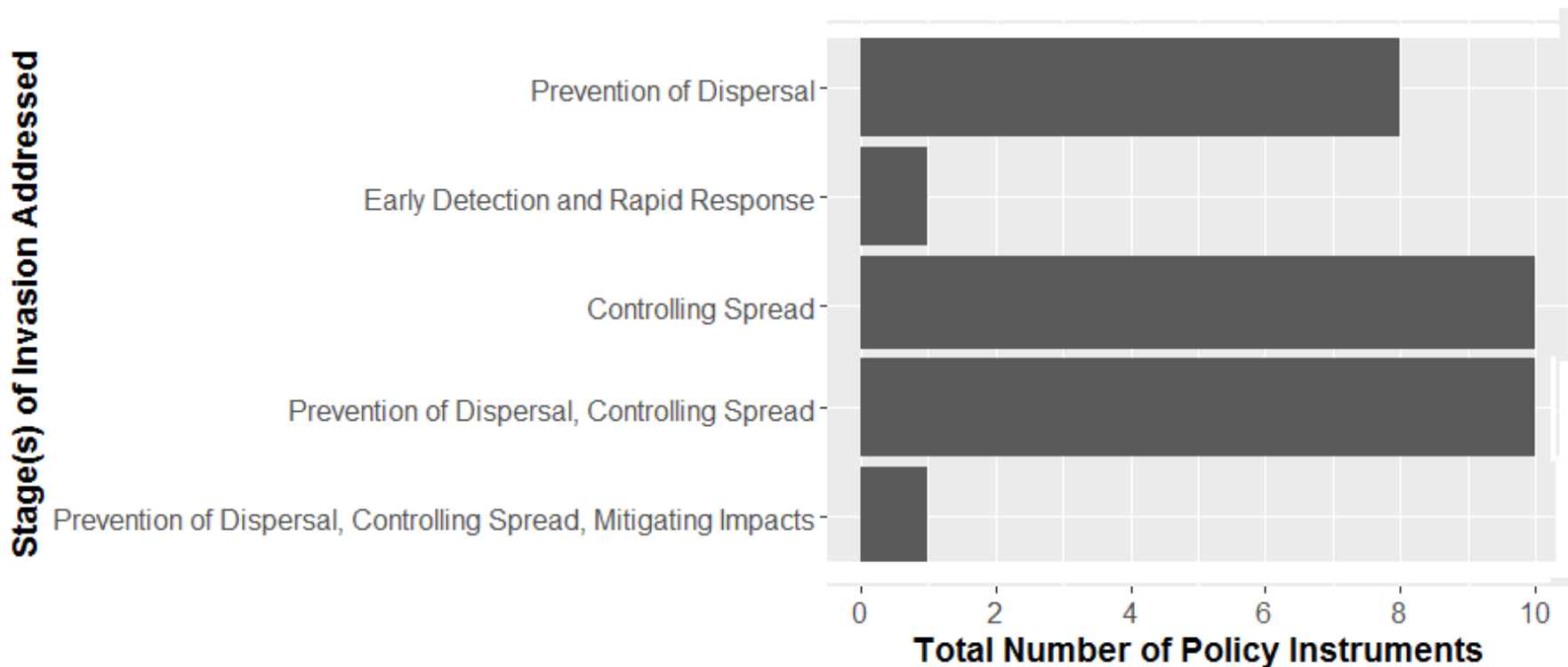
West Coast Context





General Policy Overview

- And many other (~30) relevant policy instruments....
 - Most aimed at Preventing Dispersal & Controlling Spread



Legislative Overview

Controlling Spread



- **PMRA Pest Control Products Approval**

- Broad definition of Pest Control Product encompasses virtually ANY device or substance

“(a) a **device** that is manufactured, represented, distributed or **used to directly or indirectly control, destroy, attract or repel a pest or** to mitigate or prevent the injurious, noxious or troublesome effects of a pest; and

(b) a **compound or substance** that is not an ingredient of a pest control product described in paragraph (a) of that definition but is **added to or used with such a product** to enhance or modify its physical or chemical characteristics or to modify an effect on host organisms in connection with which the product is intended to be used.”

- *Such products **MUST be approved and registered** before they can be legally used*

Legislative Overview

Controlling Spread



- **PMRA Pest Control Products Approval**

- Approval process designed for corporate proponents registering for-profit, heavy industrial chemicals / pesticides
- Conventional process is **complex, expensive** (up to \$100,000s), and **long** (~12 – 18 months)
- “Emergency approvals” are available in special circumstances, but still take weeks to several months



Very long, complex product registration process

Makes difficult to have a truly **rapid** response