

# Invasive Alien Species and Parasitic Diseases in Aquatic Ecosystems, and Opportunities to Slow their Spread

Alison M. Dunn





# House of Commons Environmental Audit Committee

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## Invasive species

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### First Report of Session 2019–20

*Report, together with formal minutes relating  
to the report*

*Ordered by the House of Commons  
to be printed 15 October 2019*



# Research

## Policy gaps

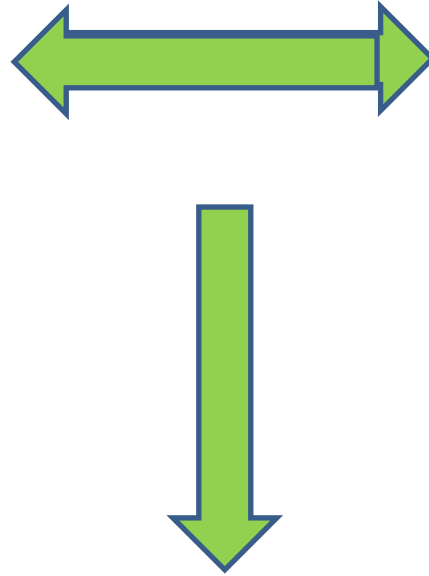
### Awareness of biosecurity and barriers

### Biosecurity protocols

- Effective
- Cost effective (time and £)
- Easy to use for staff, contractors, volunteers, public

### E learning

- Increased awareness
- Improved biosecurity practice



# Stakeholder requirements

1. Socioeconomic argument for biosecurity
2. Identify high risk activities/pathways of spread
3. Identify priority species and management objectives
4. Evidence based biosecurity protocols and training
5. Biosecurity policy

# Impact

- Risk assessments
- New policy
- Resources-training, infrastructure, time
- Increased awareness and behavioural change among staff and volunteers



# Invasive Alien Species and Parasites

## Invasive Alien Species

- social, economic and ecological costs
- threaten food security, ecosystem services, biodiversity, facilitate disease

## Emerging infectious diseases

- social, economic and ecological costs
- threaten wildlife, managed & human populations. Impact on health, food security, wildlife conservation and biodiversity

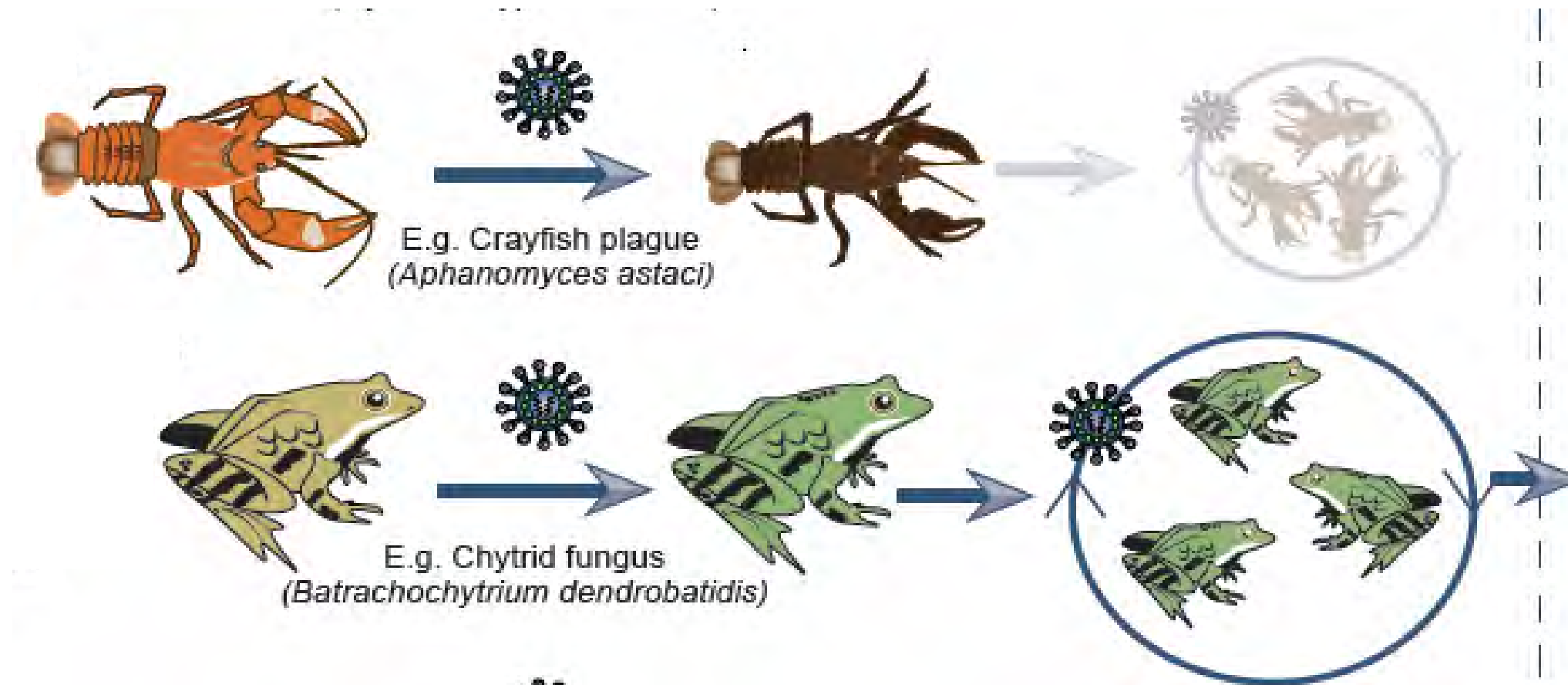


# Invasive Alien Species and Parasites

- Disease is a driver behind the economic, medical or conservation impact for 24 species on the IUCN list “100 of the World’s Worst invaders”
- 8 Invasive parasites (e.g. chytrid, crayfish plague)
- 14 Reservoirs (e.g. rainbow trout)
- 3 Vectors (e.g. mosquitos)

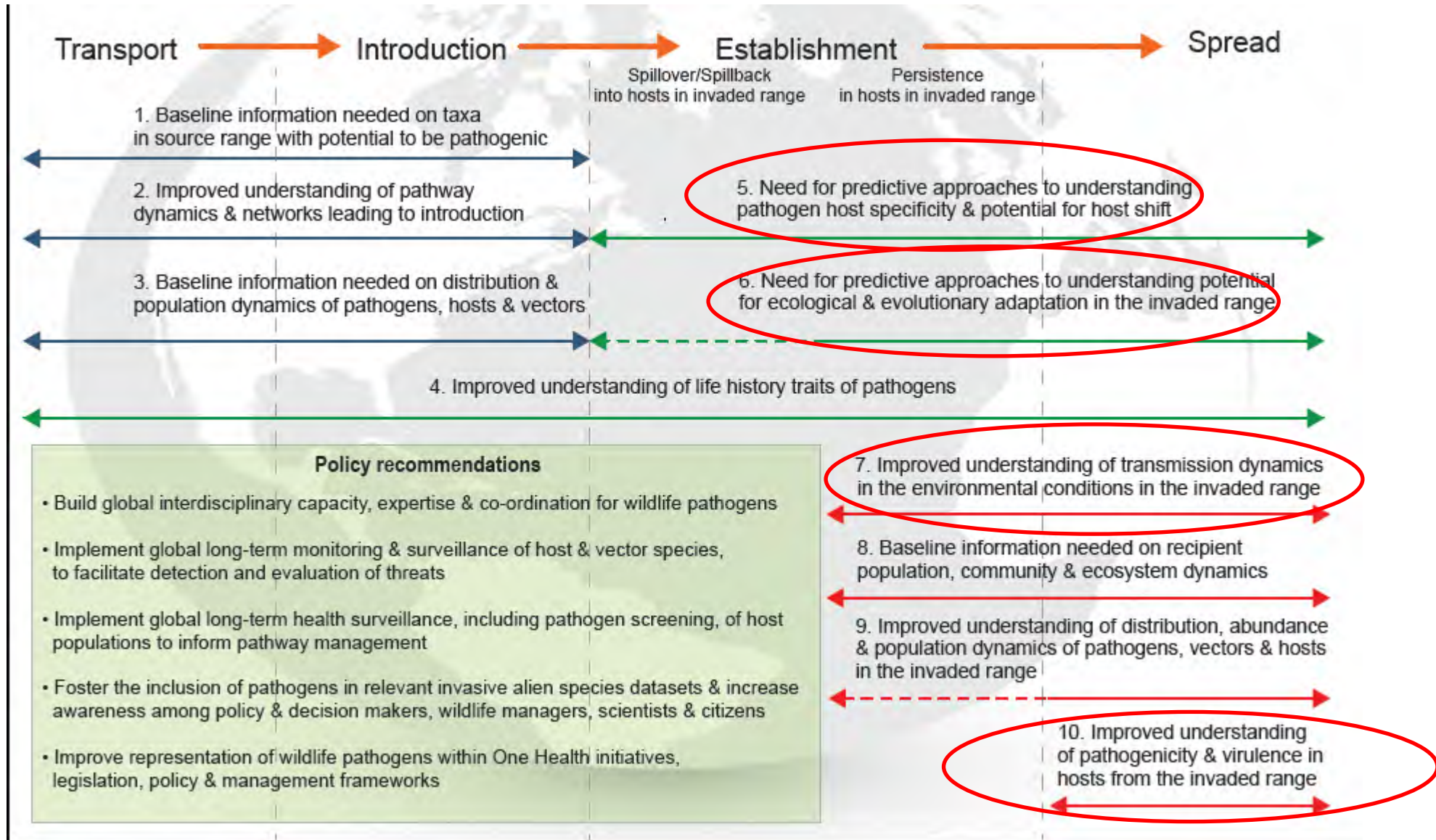


# Predicting the emergence and impact of invasive pathogens



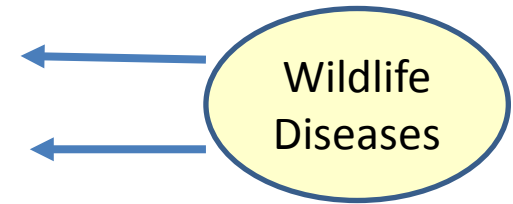
Roy ....Dunn et al. 2016 Alien Pathogens on the Horizon: Opportunities for Predicting their Threat to Wildlife. *Conservation Letters* 10.1111/conl.12297.

# Predicting the emergence and impact of invasive pathogens



# Invasive pathogens-Policy gaps

EU Invasive Alien Species Legislation  
OIE Terrestrial and Aquatic Animal Health Codes  
International plant protection convention



## Policy recommendations

- Build global interdisciplinary capacity, expertise & co-ordination for wildlife pathogens
- Implement global long-term monitoring & surveillance of host & vector species, to facilitate detection and evaluation of threats
- Implement global long-term health surveillance, including pathogen screening, of host populations to inform pathway management
- Foster the inclusion of pathogens in relevant invasive alien species datasets & increase awareness among policy & decision makers, wildlife managers, scientists & citizens
- Improve representation of wildlife pathogens within One Health initiatives, legislation, policy & management frameworks



# House of Commons

## Environmental Audit Committee

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# Invasive species

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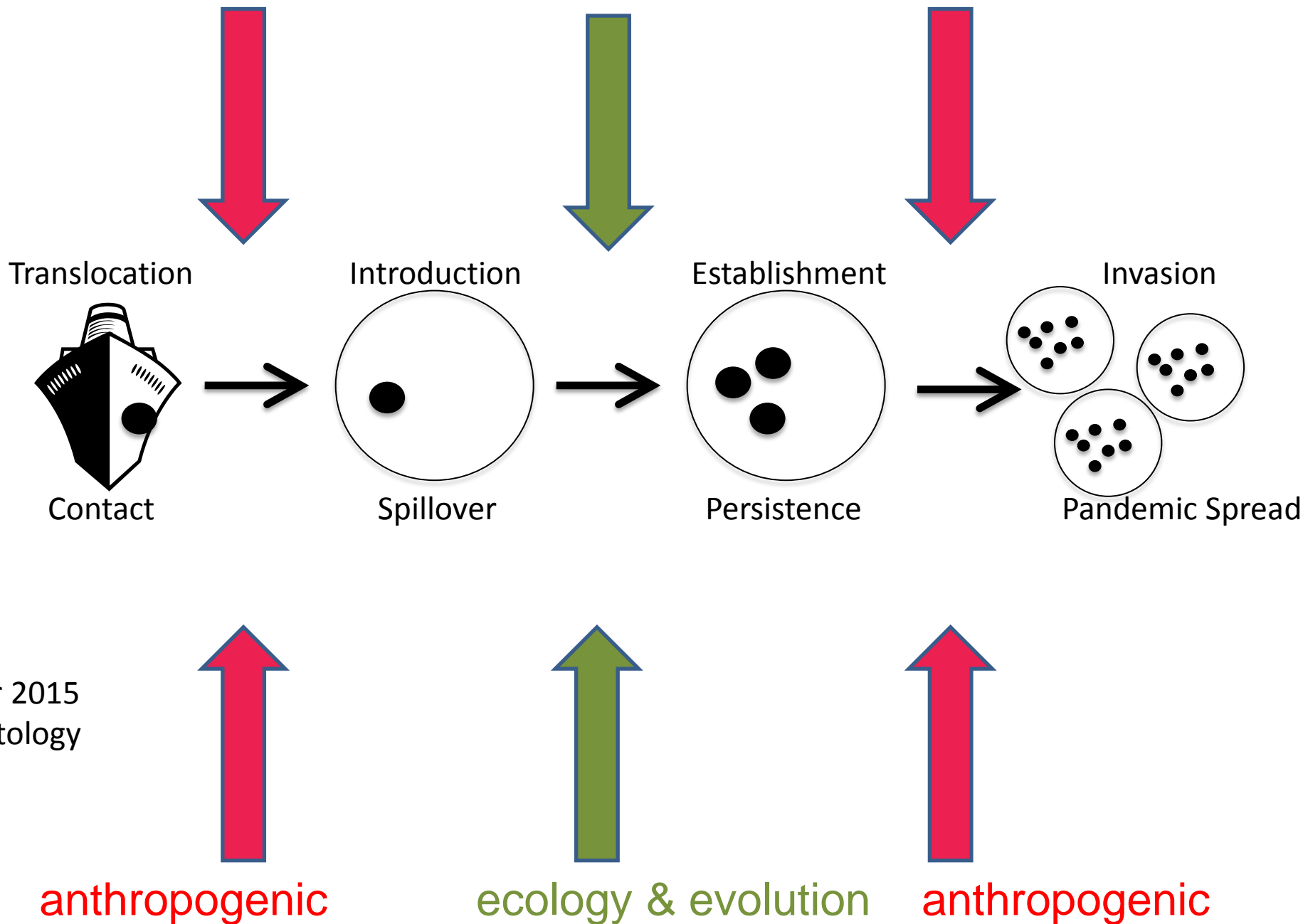
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- Legal targets missed
- Less well funded than plant & animal diseases
- Ballast Water Management Convention
- Public awareness → biosecurity citizens' army
- Water transfers
- Brexit → replace EU Invasive Alien Species Regulation
- Invasive Non Native Species Strategy - include pathogens
- Local Action Groups

anthropogenic

ecology & evolution

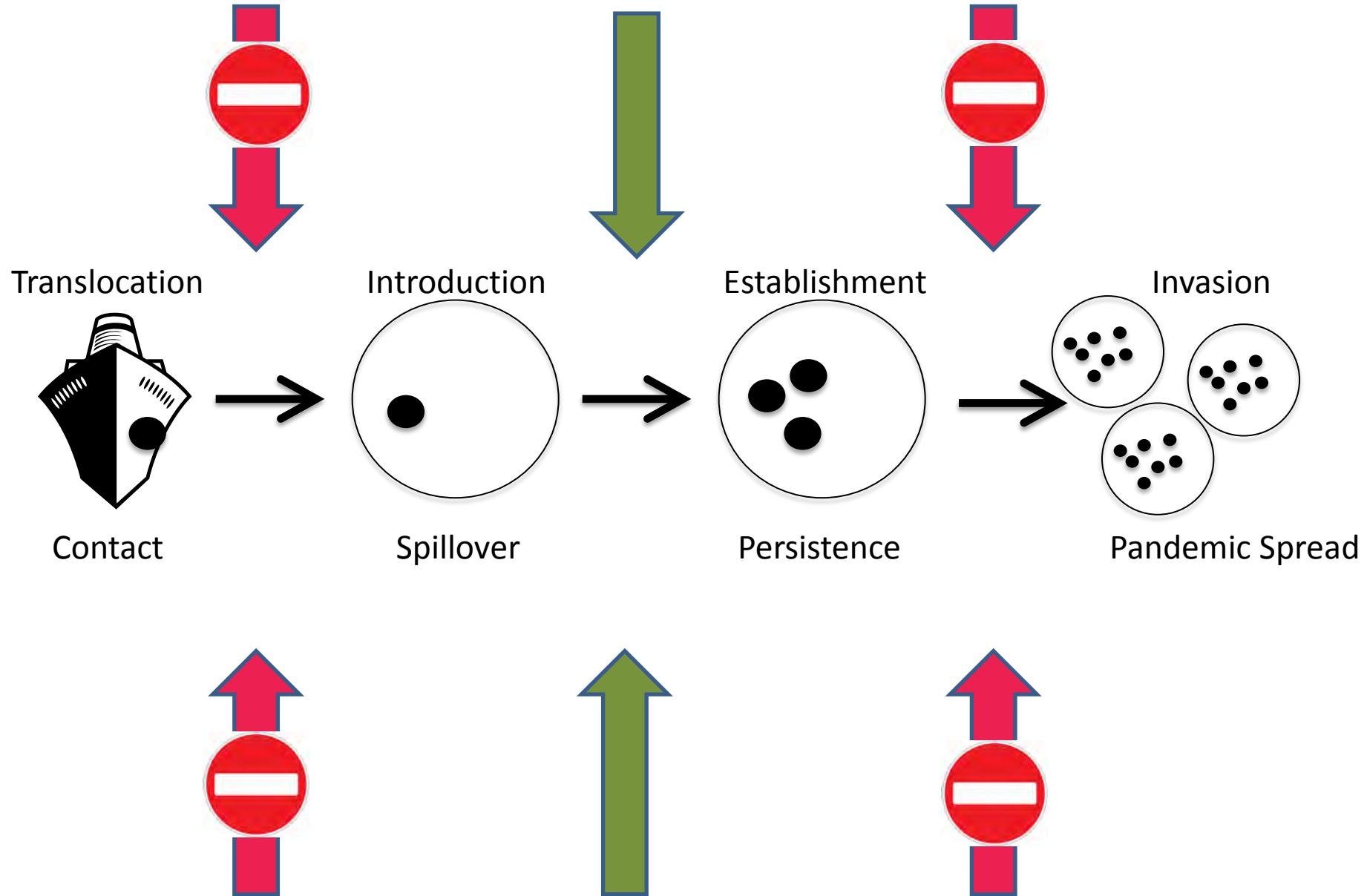
anthropogenic



Dunn & Hatcher 2015  
Trends in Parasitology

Biosecurity

Biosecurity



Biosecurity

Biosecurity

Stakeholder views  
on biosecurity

Aquaculture

Marinas/recreational boating



Disease outbreaks

Invasive Alien Species

Semi-structured interviews with 20 stakeholders





# House of Commons

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# Invasive species

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- Public awareness → biosecurity citizens' army
- Water transfers
- Brexit → replace EU Invasive Alien Species Regulation
- **Invasive Non Native Species Strategy - include pathogens**
- **Biosecurity is a critical first line of defence**
- **Local Action Groups**
- **Coordinated policy**

# Stakeholder views (barriers/opportunities) on Invasive Alien Species biosecurity. Interviews with 15 organisations

## Motivations

Financial, Protect the environment

Organisation Image/  
Reputation

Positive examples  
Peer pressure

Low awareness

Reactive rather than proactive

Barriers

- awareness
- guidance
- engagement
- policy

# Research

## Policy gaps

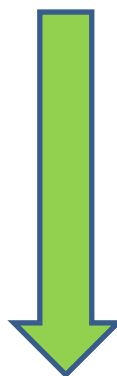
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# Stakeholder requirements

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# Impact

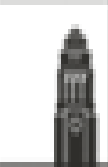
- Risk assessments
- New policy
- Resources-training, infrastructure, time
- Increased awareness and behavioural change among staff and volunteers



# **Yorkshire Dales Biosecurity and Invasive Non Native Species steering group.**



**NERC** SCIENCE OF THE ENVIRONMENT



**UNIVERSITY OF LEEDS**

**The Environment Agency (EA), Yorkshire Dales National Park Authority (YDNPA), Nidderdale Area of Outstanding Natural Beauty (NAONB), Natural England (NE), Forestry Commission (FC), National Trust (NT), Yorkshire Wildlife Trust (YWT), Yorkshire Dales Rivers Trust (YDRT), Ribble Rivers Trust (RRT), Dales to Vale River Network (DVRN), Yorkshire Water.**

# **Local Authorities: Developing evidence based resources and strategies to slow the spread of aquatic INNS through river catchments in Yorkshire**

**University of Leeds  
Leeds City Council  
Barnsley Metropolitan Borough Council**

**Wakefield Council  
Sheffield City Council  
Sheffield City Council  
Calderdale Council  
Harrogate Borough Council  
Scarborough BC  
Rotherham MBC  
Bradford MDC  
Wakefield Council  
East Riding of Yorkshire Council**

**Yorkshire Wildlife Trust  
Environment Agency  
Dales to Vale Rivers Network  
Yorkshire Water  
Yorkshire Invasive Species Forum**



# Requirements identified by stakeholders

## Workshop →

1. **To provide socioeconomic argument for proactive approach (biosecurity).** To leverage funding
2. **Identify high risk activities and potential pathways of spread.** To enable stakeholders to target biosecurity
3. **Identify priority species for action** and identify management approaches
4. **Evidence-based biosecurity guidance and materials and training tailored to stakeholders**
5. **Help stakeholders develop and embed a standardised biosecurity framework for stakeholders, contractors and other users of their land**

# 1. To provide socioeconomic argument for proactive approach (biosecurity)

To help stakeholders leverage funding and develop pro-active approach



House of Commons  
Environmental Audit Committee

## Invasive species

First Report of Session 2019–20

**Comparative costs :**  
Floating pennywort

Thames £600k in 2018  
Yorkshire £35K in 2018

Evidence for **human mediated spread**

Spiralling annual control costs



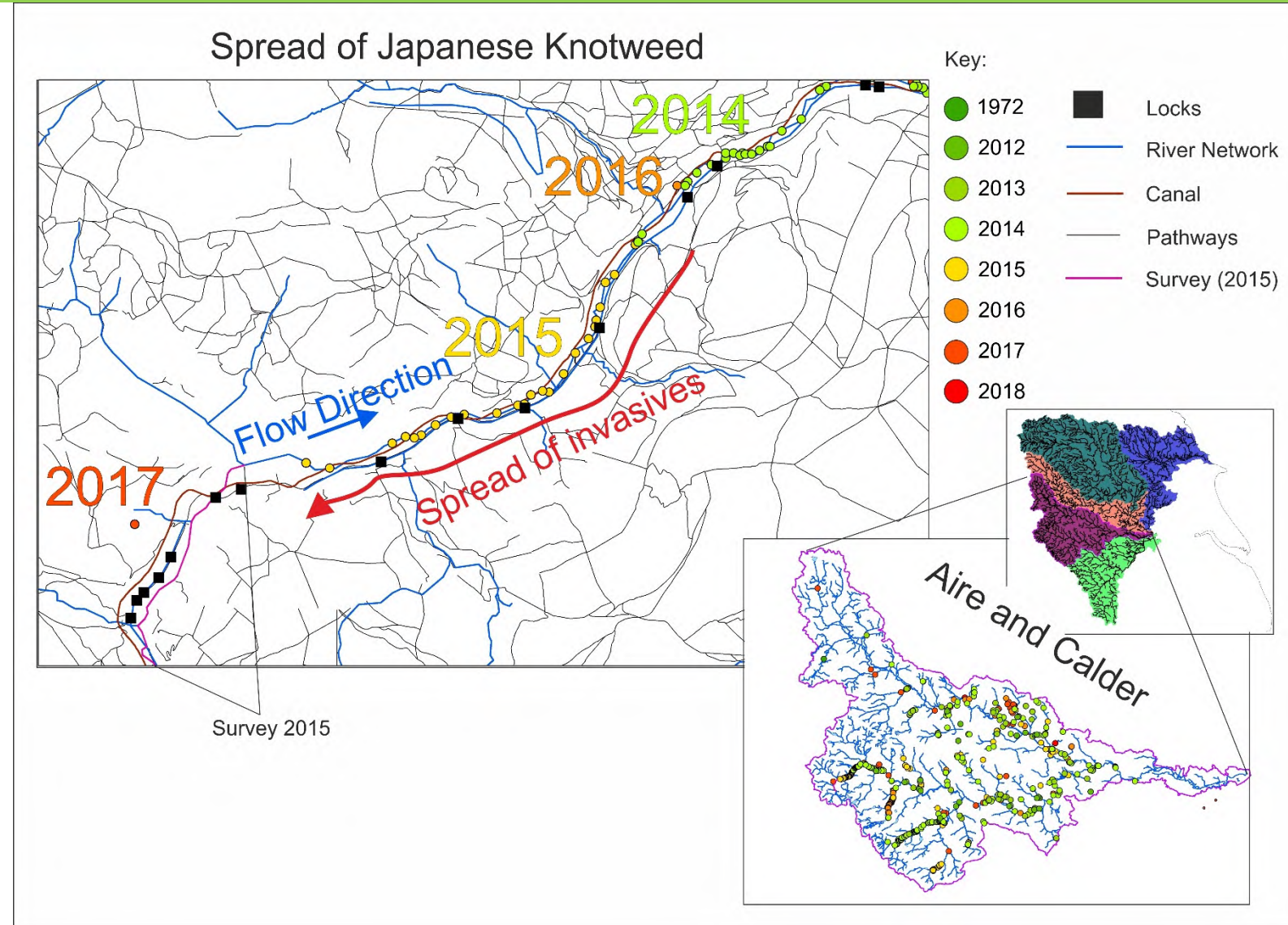
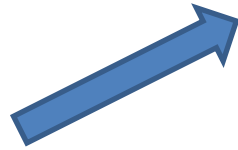
*It is hundreds to thousands of times cheaper to prevent invasive species from establishing, rather than tackling them once they are established*

# 1. To provide socioeconomic argument for proactive approach (biosecurity)

To help stakeholders leverage funding and develop pro-active approach

Barrier....Human or natural spread

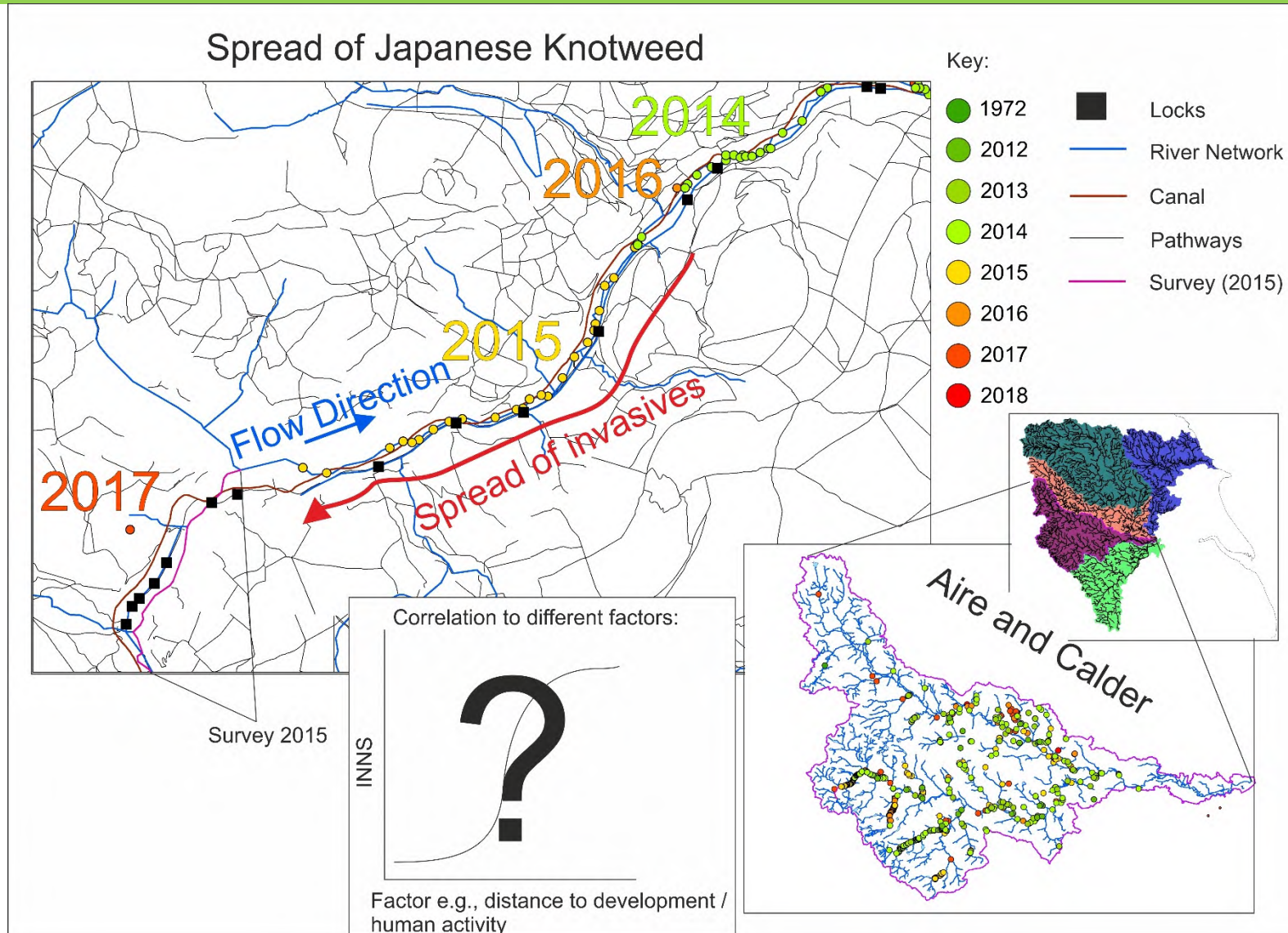
Evidence for human mediated spread



## 2. Identify high risk activities and potential pathways of spread

### GIS mapping to identify factors associated with initial and secondary introductions

Risk assessment workshops → Biosecurity action plans



**What activities are associated with spread?**  
GIS mapping and GLMs

Building/development  
Recreation  
Fly tipping

## 2. Identify high risk activities and potential pathways of spread

GIS mapping to identify factors associated with initial and secondary introductions

**Risk assessment workshops → Biosecurity action plans**



**Risk assessments key activities**

### **Mitigation**

Planning- time, location, order of visits

Equipment

Biosecurity

**Biosecurity Action plans**

## 2. Identify high risk activities and potential pathways of spread

GIS mapping to identify factors associated with initial and secondary introductions

**Risk assessment workshops → Biosecurity action plans**



### Biosecurity Action Plans & Infrastructure

eg. Yorkshire Wildlife Trust, national park, Nidderdale AONB, rivers trusts- environment management

e.g. Yorkshire Water engineering & site works

e.g. National Trust angling

e.g. Yorkshire Water canoeists

# 3. Identify priority species for action

## Yorkshire Dales Top 31 management objectives

Approach modified from Booy, O., et al. Biol Invasions (2017) 19: 2401. [https://doi.org/10.1007/s10530-017-1451-z\\_](https://doi.org/10.1007/s10530-017-1451-z_)

	GBNSS Impact Score	Location	YD Impact Score	Management objective	MO Type	Brief description and notes	Feasibility	YD I x F
Hydrocotyle ranunculoides Floating pennywort	4	Aire catchment Teeside + Manchester + Preston + Blackpool	5	not present in YD but to be confirmed by EA survey in 2019	RR		H	15
Heracleum mantegazzianum Giant hogweed	3	Nearby	5	Eradication from Yorkshire Area	ER	Only on site ID + on edge. More info available 2019 Small window based on current distribution	H	15
Dreissena polymorpha Zebra mussel	5	Near Skipon, Ripon River Aire + Ure, within Nidderdale AONB. No reservoirs within NP.	5	protecting water transfers from biofouling (YW) not currently in place	AP	Bio bullets Acid dosing Pressure washers Cost high - £100s/£5k per reservoir	H	15
Himalayan balsam	3	Widespread - largely absent from moors	5	Partial eradication	AP	SSSIs, SINCS, protected sites, shingly banks as priority	H	15

## 4. Deliver easy-to-use, evidence-based biosecurity guidance and materials tailored to stakeholders

Whenever you leave the water, remember to **Check Clean Dry**



**CHECK**

**Check** your gear after leaving the water for mud, aquatic animals or plant material. Remove anything you find and leave it at the site.

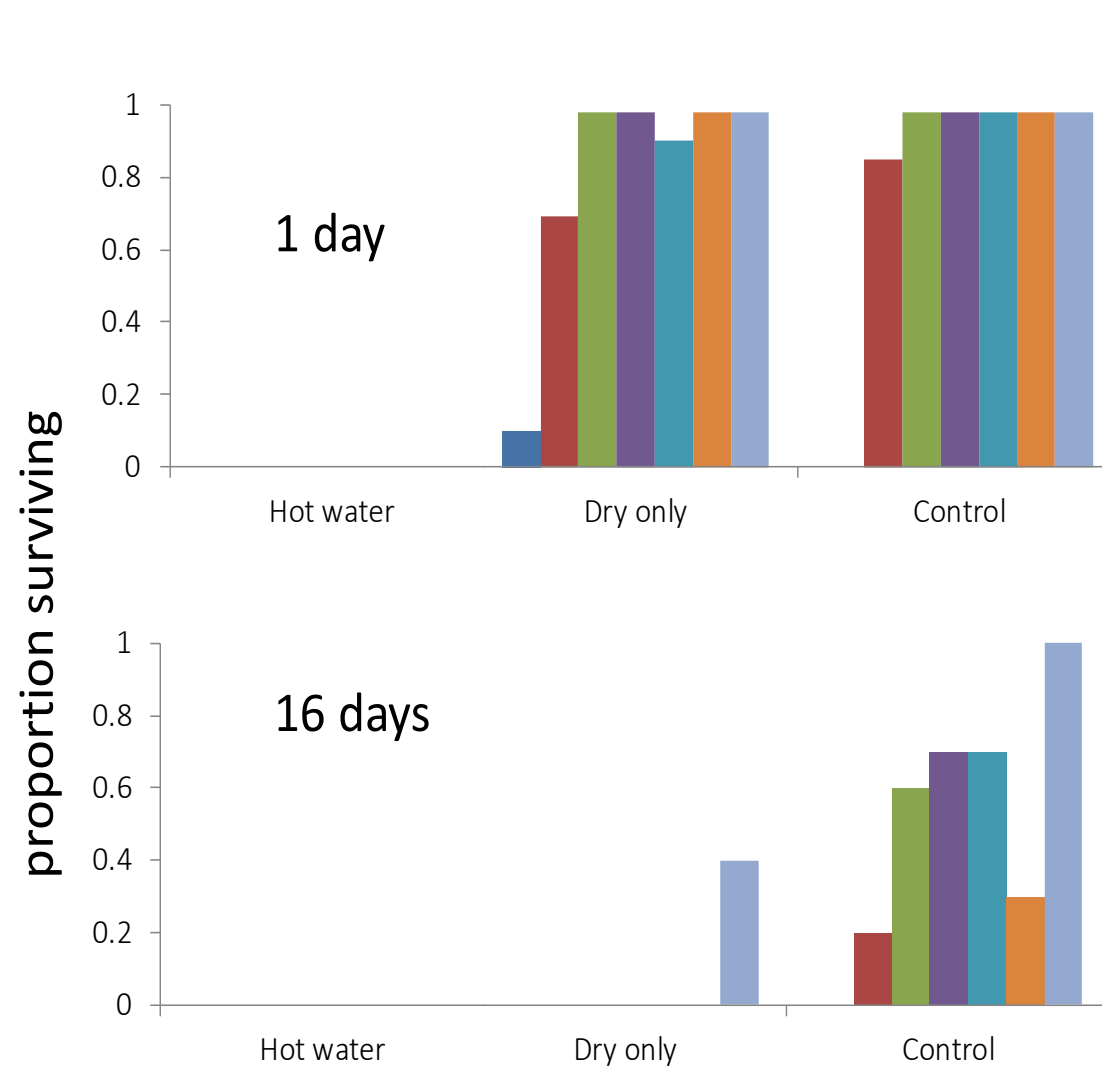
**CLEAN**

**Clean** everything thoroughly as soon as you can, paying attention to nets, waders, and areas that are damp and hard to access. Use hot water if possible.

**DRY**

**Dry** everything for as long as possible before using elsewhere as some invasive plants and animals can survive for two weeks in damp conditions.

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Shannon et al 2018, Management of Biological Invasions  
Anderson et al. 2015 Biol Invasions

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**HOT WATER**  
Soaking equipment/clothes  
for 10 mins at 60°C  
kills INNS

100% mortality		killer shrimp						parrots feather					
70-90% mortality		<i>Dikerogammarus villosus</i>						<i>Myriophyllum aquaticum</i>					
<70% mortality		Time (minutes)						Time (minutes)					
		0.6	1	5	10	15		0.6	1	5	10	15	
Temperature (°C)	40	100	100	100	100	100		40	0	10	10	0	15
	45	100	100	100	100	100		45	0	30	55	55	40
	50	100	100	100	100	100		50	0	95	100	100	100
	55	100	100	100	100	100		55	5	100	100	100	100
	60	100	100	100	100	100		60	100	100	100	100	100
		zebra mussel						Australian stonecrop					
		<i>Dreissena polymorpha</i>						<i>Crassula helmsii</i>					
		Time (minutes)						Time (minutes)					
		0.6	1	5	10	15		0.6	1	5	10	15	
Temperature (°C)	40	100	100	100	100	100		40	5	0	10	0	0
	45	100	100	100	100	100		45	5	0	60	50	100
	50	100	100	100	100	100		50	15	70	100	90	100
	55	100	100	100	100	100		55	70	100	100	100	100
	60	100	100	100	100	100		60	100	100	100	100	100

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*Monday C2 3:40 PM*

**Developing Practical Biosecurity  
Recommendations for the use of High-  
Pressure Hot Water Spray Machines**

*Stephanie J. Bradbeer, University of Leeds*



*Tue E2 2.30pm*

**Invaders Must Die: Mortality of Invasive Macrophytes,  
Bivalves, and Crustacean Species following Exposure to  
Aquatic Disinfectants or Steam Treatments**

*Neil Coughlan, Queen's University Belfast*

4. Deliver easy-to-use, evidence-based biosecurity guidance and materials tailored to stakeholders

# BETTER BIOSECURITY

[https://openeducation.blackboard.com/mooc-catalog/courseDetails/view?course\\_id= 1189 1](https://openeducation.blackboard.com/mooc-catalog/courseDetails/view?course_id= 1189 1)

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# BETTER BIOSECURITY

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## e-Learning

- A method of training
- Educational and relatable
- Bridge the gap between awareness and behaviour by illustrating skills

## Benefits

- Relatively cheap
- Flexible
- Accessible
- Alternative to face-to-face
- **Effectiveness >1000 participants, 600 completed surveys**

# Research

## Policy gaps

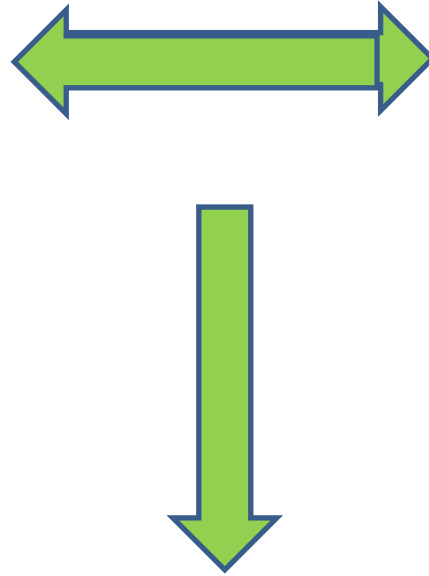
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# Thanks to

- Steph Bradbeer
- Cat Shannon
- Chloe Sutcliffe
- Ben Pile
- Dan Warren
- Mel Hatcher
- Jaimie Dick et al.
- Claire Quinn
- Paul Stebbing
- Helen Roy
- Chris Hassall
- Lori Lawson Handley

- Sarah Clarke
- Ellie Paganini
- Janet Richardson
- Jenny
- Poppy Leeder
- Finn Barlow Duncan



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