In-shore & Off-shore UK Monitoring Trials – The Scottish & Welsh Experience!

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Marine Pathways Project - Cardiff, 25 Feb 2015

marinescotland

The Scottish Government
Riaghaltas na h-Alba

SAMS

Scottish Natural Heritage
All of nature for all of Scotland

Why do we need to monitor for Invasive Non-Native Species (INNS)?

- INNS considered one of greatest threats to biodiversity
- Certain INNS can have serious economic and social impacts
- 58 marine species estimated to be established in the UK (Minchin et al. 2013)
- ~£40 million per annum cost to marine-based industries in UK (Williams et al. 2010)
- Increasing recognition at international, European and national level for greater control over the introduction and spread of INNS
- Early warning systems are one way to manage an introduction before the INNS has had time to become established

Hemigrapsus sanguineus
(Asian Shore Crab) © Fiona Crouch

Sargassum muticum
(Japanese Wireweed) © E Cook

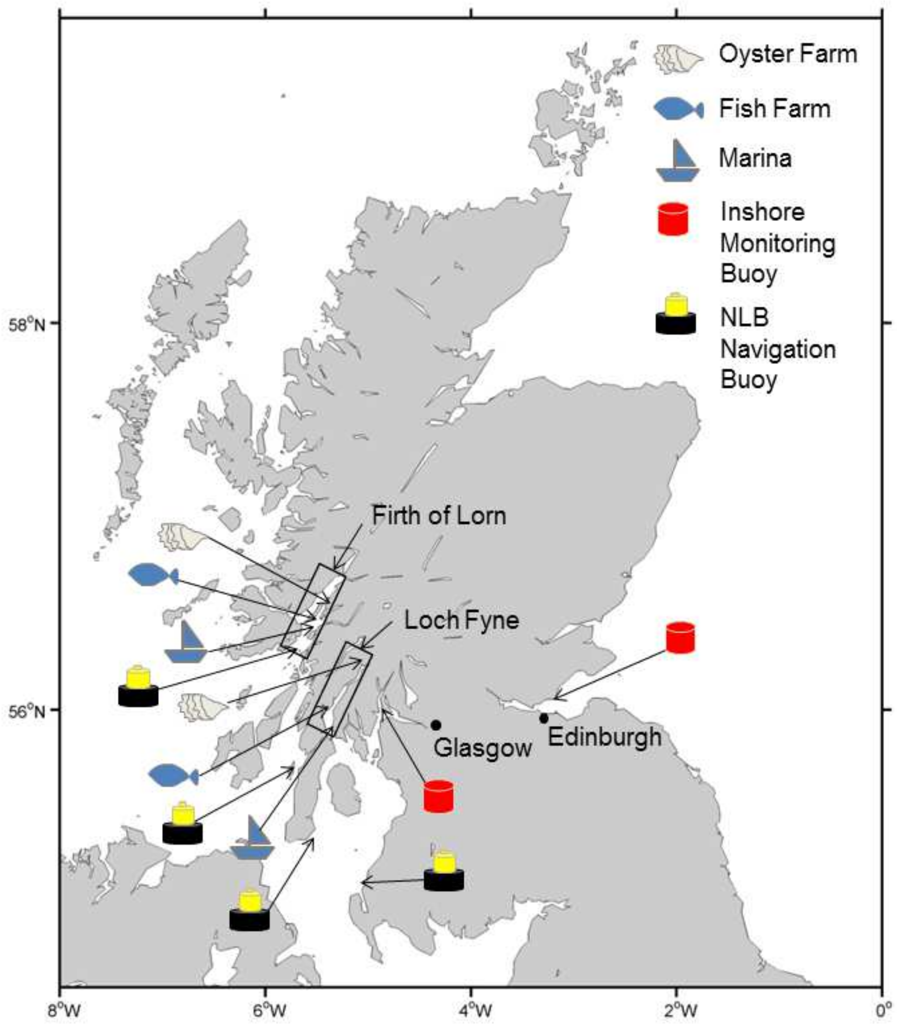
Early Warning Systems

- Lack of new technologies for the early detection of INNS was recently highlighted in a list of the top 20 issues currently facing policy makers (Caffrey et al., 2014)
- Cost-effective approach to dealing with INNS (Leung et al., 2002)
- Detection of DNA in water or in the organisms themselves may significantly enhance surveillance programmes in the future (Jerde et al., 2011, Dejean et al., 2012)
- Lack of molecular information currently available for marine native and INNS and skilled personnel and equipment able to process samples and perform the analyses.

Detection Techniques

- Detection techniques
  - Rapid Assessment Surveys (RAS)
  - Settlement Panels
  - Quadrat scrape samples
  - In-situ & Panel Photography
  - Videography
  - Coring
  - Benthic Sleds
  - Beam trawls
  - Plankton nets
  - Citizen Science Programmes
- No systematic assessment of effective of these techniques in detecting range of marine INNS at a particular location

Scottish Trials - Methodology



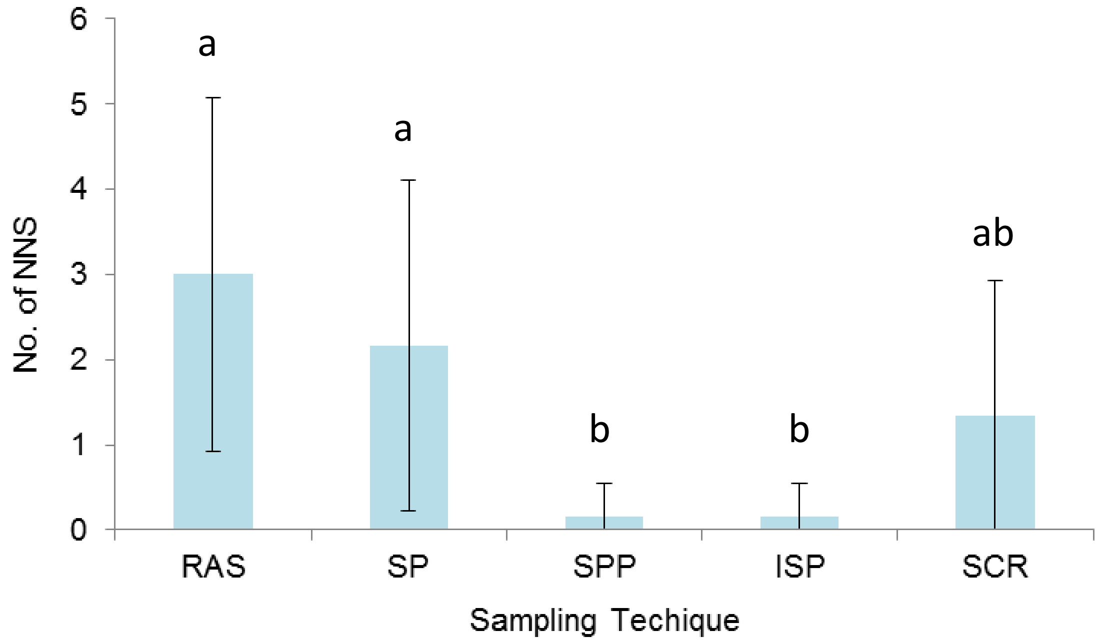
Study location for the comparative study

Inshore SEPA monitoring buoys; Gunnet Ledge (Left) and Dunoon (Right).

Retrieval of Northern Lighthouse Board navigation buoy for routine maintenance (Photo: A. Macleod, SAMS)

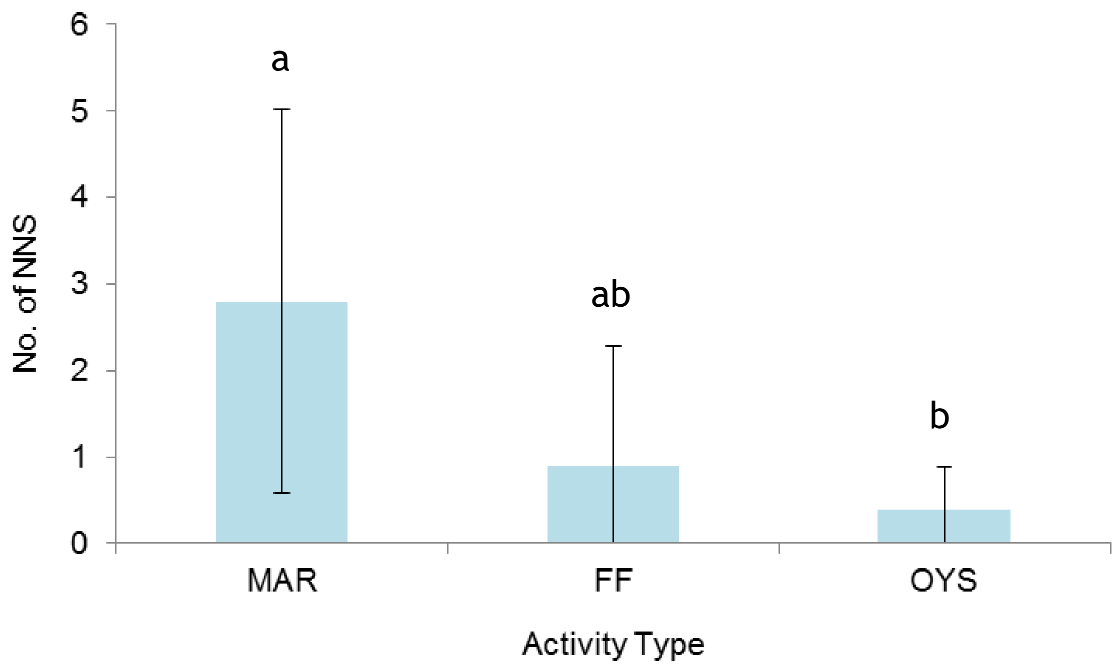
Results - Techniques

- Nine NNS identified from the target list of 19 NNS, including seven sessile or semi-sessile animal species and two macroalgal species
- No significant difference was observed between the two locations (i.e., Firth of Lorn and Loch Fyne) surveyed ($p>0.05$)
- RAS and settlement panels (SP) detected significantly greater numbers of NNS that the photography techniques ($p<0.001$)



Results – Activity Type

- Significantly greater numbers of NNS were found at the Marinas (MAR) compared with the oyster farm (OYS) ($p<0.001$)

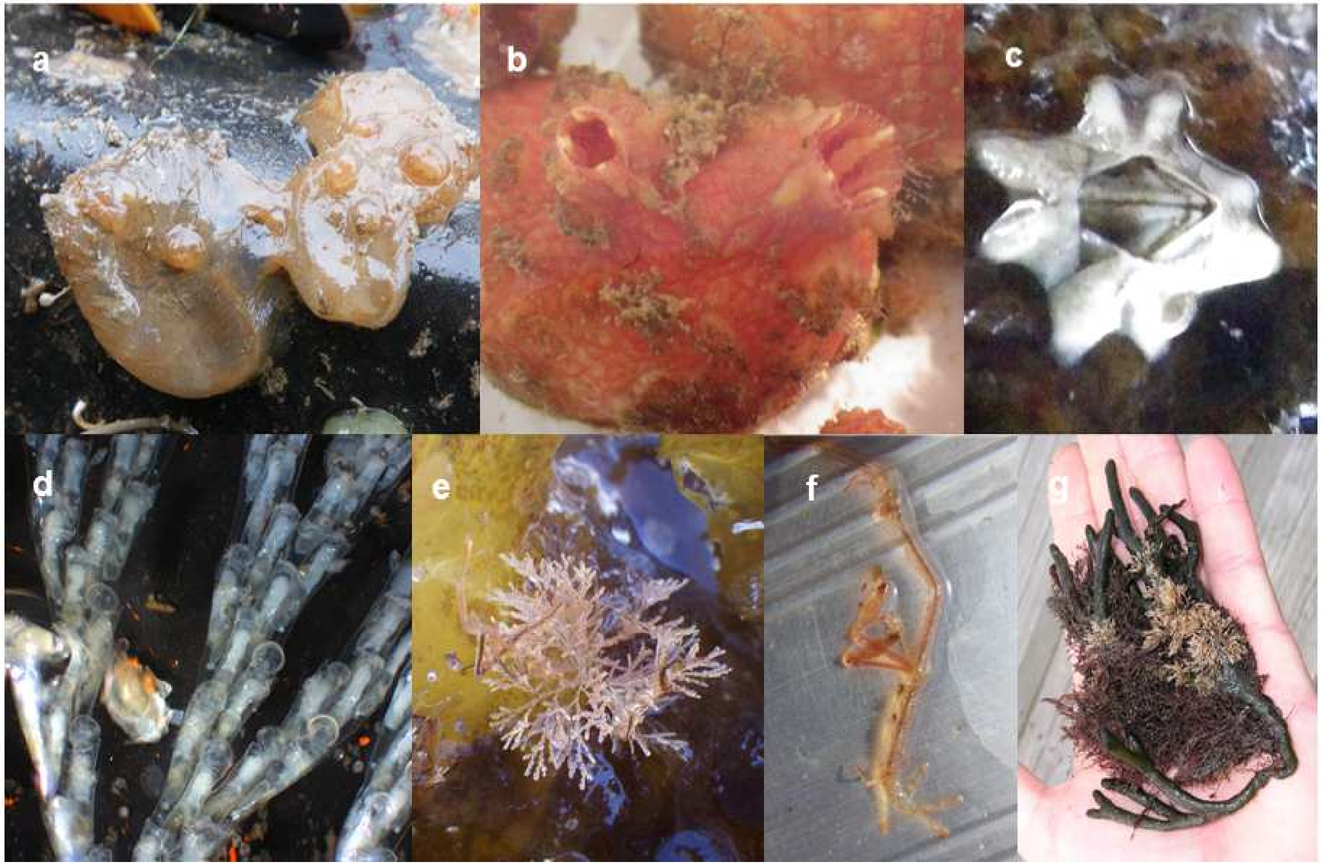


Non-native species identified in the survey locations used for comparing the five early warning techniques; Rapid assessment survey (RAS); settlement panels (SP), settlement panel photography (SPP), in-situ photography (ISP), scrape samples (SCR).

	Marina										Fish Farm										Oyster Farm									
	Loch Fyne					Firth of Lorn					Loch Fyne					Firth of Lorn					Loch Fyne					Firth of Lorn				
	RAS	SP	SPP	ISP	SCR	RAS	SP	SPP	ISP	SCR	RAS	SP	SPP	ISP	SCR	RAS	SP	SPP	ISP	SCR	RAS	SP	SPP	ISP	SCR	RAS	SP	SPP	ISP	SCR
Solitary ascidians																														
Corella eumyota	√	√				√	√			√	√	√																		
Asterocarpa humilis	*	*				√	*			√	*	*																		
Barnacles																														
Austrominius modestus	√	√				√	√														√					√	√			√
Erect bryozoans																														
Bugula simplex	√	√																												
Tricellaria inopinata	√	√			√	√	√				√	√																		
Encrusting bryozoans																														
Schizoporella japonica					√																									
Crustaceans																														
Caprella mutica	√	√	√		√	√	√			√	√	√				√			√											
Algae																														
Codium fragile* subsp. *fragile						√					√																			
Heterosiphonia japonica					√																									
TOTAL NNS	5	5	1	0	4	6	4	0	0	3	4	3	0	0	0	1	0	0	1	0	1	0	0	0	0	1	1	0	0	1

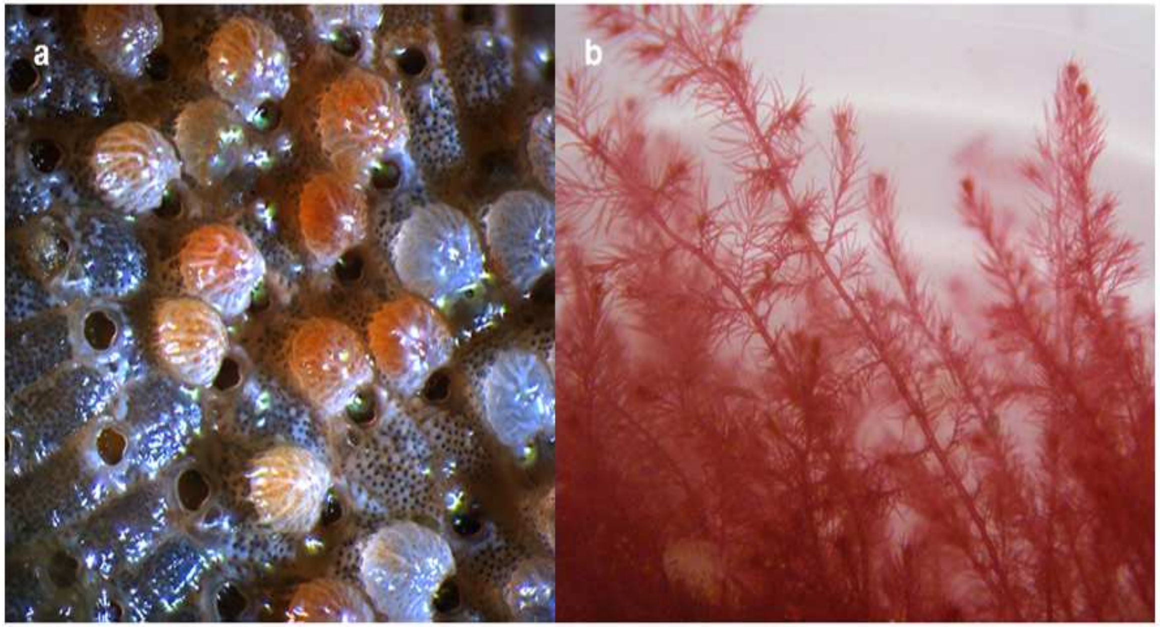
*Possibly juvenile *Asterocarpa humilis*, but unable to verify due to lack of research on this life stage

RAS - Results



Non-native species found during the RAS, *(a) Corella eumyota, (b) Asterocarpa humilis,* (c) *Austrominius modestus*, (d) *Bugula simplex*, (e) *Tricellaria inopinata*, (f) *Caprella mutica* and (g) *Codium fragile* subsp. *fragile* (Photos: C. Beveridge and E. Cook, SAMS).

Results – Quadrat Scrape Sampling



Two additional NNS found by the scrape sample technique; (a) *Schizoporella japonica* and (b) *Heterosiphonia japonica*. Photos: C. Beveridge, SAMS

Results – Quadrat Scrape Sampling

Monitoring and Navigation Buoys

- Two NNS were found on the SEPA monitoring buoys
  - Bryozoan *T. inopinata*
  - Amphipod caprellid *C. mutica*

- Two NNS were found on the NLB navigation buoys that were sampled by trained NLB crew members
  - Tunicates *Corella eumyota* and *Styela clava*

The clubbed tunicate Styela clava
(Photo: C. Beveridge, SAMS)

Conclusions and Recommendations from Scottish Trials

- RAS most reliable and cost-effective technique for the rapid identification of NNS at a particular site.

- Settlement panels and scrape samples also reliable, particularly in the marinas and could be cost-effective, if samples are collected by trained personnel.

- In-situ and panel photographs were not reliable or cost-effective at detecting NNS. Poor image quality, water clarity and fouling/ siltation of the panels.

- All techniques not without their disadvantages and it is recommended that RAS used in combination with either the scrape or settlement panel techniques to ensure the detection of all the NNS at a particular site.

- Marinas were found to be the most successful location for the detection of NNS, although fish farms and monitoring/ navigation buoys may provide additional locations for early warning monitoring stations.,

Acknowledgements

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LinkedIN – Marine Invasive Species

Wales Marine Non-Native Species Inshore Monitoring Network

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Wales INNS Inshore Monitoring Network

- Assessment of various hotspots sites to determine their suitability for developing an INNS Inshore Monitoring Network

- Focus on assessing the effectiveness of different methods in detecting the range of marine INNS within these hotspot sites

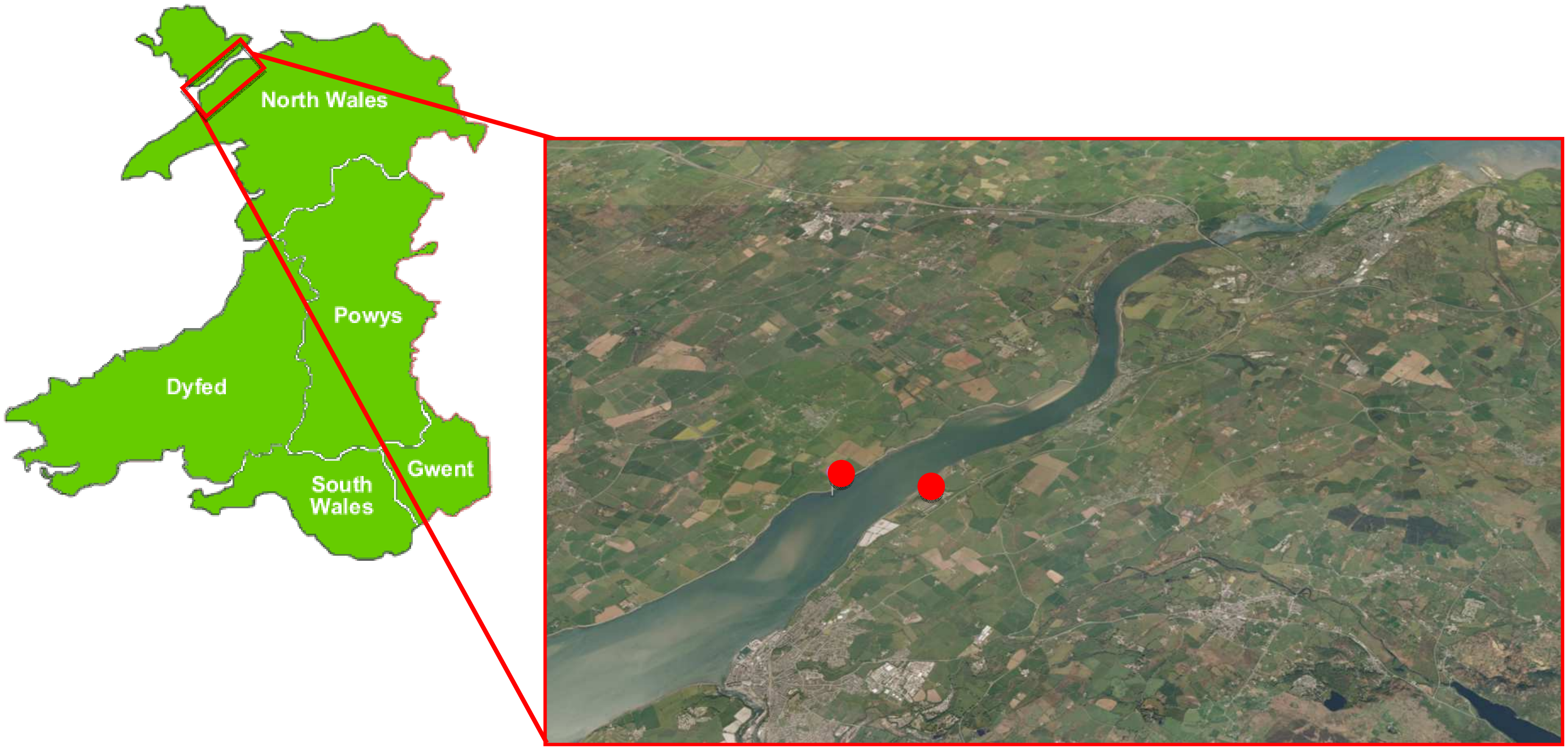
•**Aquaculture sites**
  - Oyster shells
  - Settlement Panels

•**Marinas**
  - Settlement Panels
  - Photography of Scraped Quadrats
  - RAS

•**Fisheries - Lobster pots**
  - Settlement Panels

Aquaculture Sites

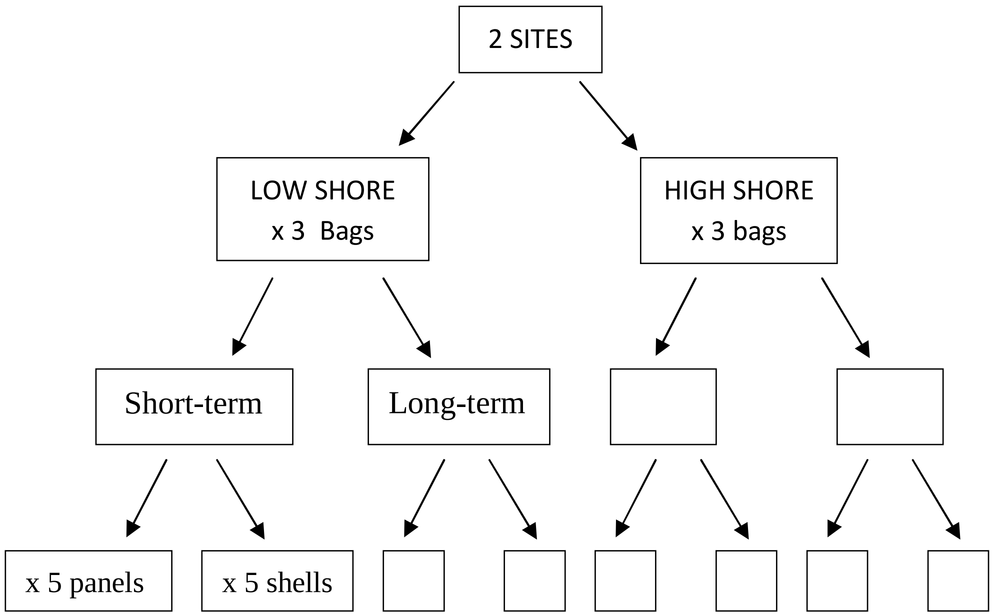
- 2 locations on the Menai Strait – Oyster culture sites

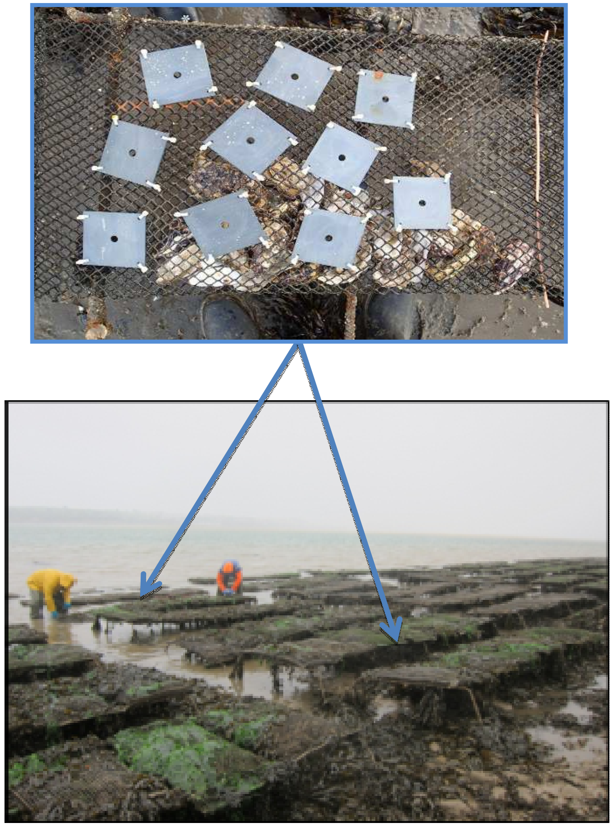


Aquaculture Sites

- **2 sites on the Menai Strait – Oyster culture**
- **Deployed dummy bags on trestles**

SPRING DEPLOYMENT – April





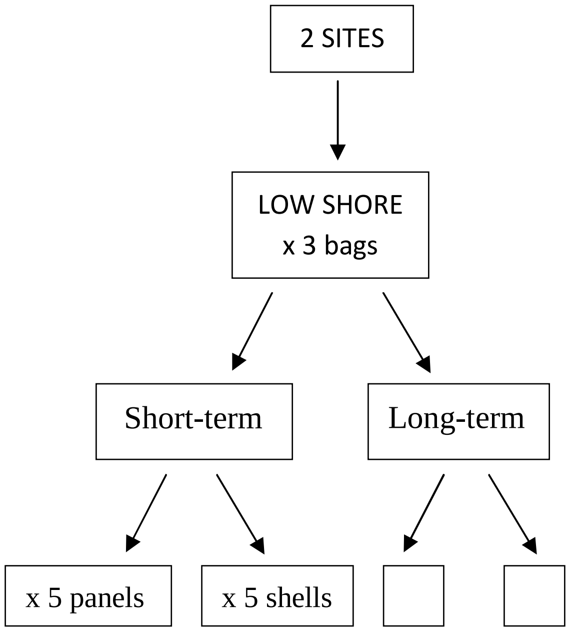
Short-term

Long-term

Aquaculture Sites

- **2 sites on the Menai Strait – Oyster culture**
- **Deployed dummy bags on trestles**

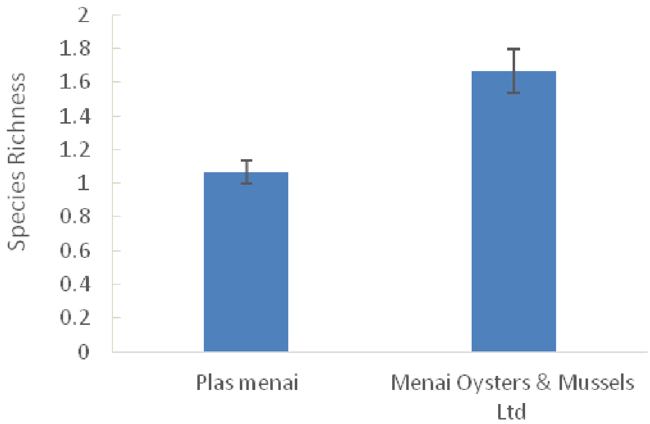
SUMMER DEPLOYMENT – MAY



Short-term

Long-term

Aquaculture Sites – Results and Outcomes



	On GB NNS site as a threat?	STATUS in Wales?
- *Austrominius modestus*	NO	ESTABLISHED
- *Corella eumyota*	YES	ESTABLISHED

- Summer is a more suitable time for detecting NNS
- Long-term monitoring is more effective than short-term
- Monitoring high shore not effective - low species diversity
- Higher abundance of the NNS at “working” aquaculture site
- No difference between the number of NNS found on shells and panels but shells had a greater diversity of native species
- Data from intertidal aquaculture sites - investigation into sub-tidal sites is needed e.g mussel beds

Marina Sites

- 2 sites in Wales
- Holyhead and Milford Haven
    - Settlement Panels
    - Photography of Scraped Areas
    - RAS

Marina Sites

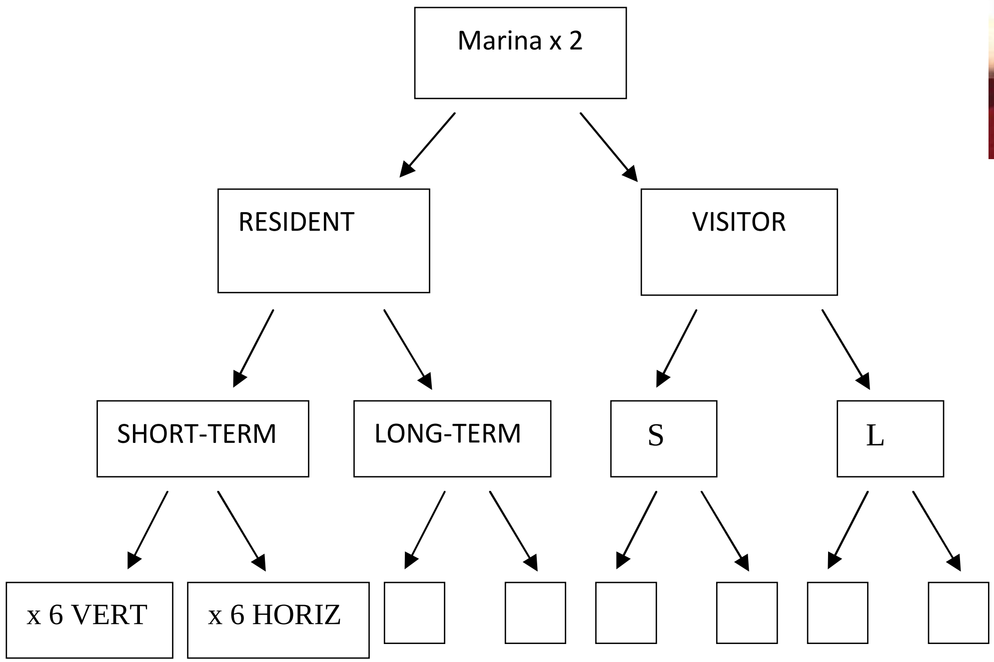
Settlement Panels Assessment

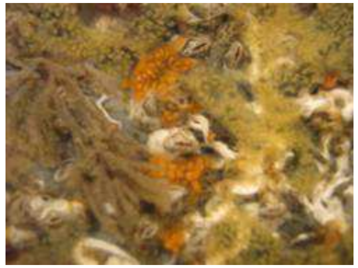
Investigated a No of Factors

- **Timing**
  - ➢ Spring vs Summer
- **Duration**
  - ➢ Short-term vs Long-term
- **Location**
  - ➢ Resident vs Visitor
- **Panel Orientation**
  - ➢ Vertical vs Horizontal

Marina Sites

- Settlement Panels
  - Spring and Summer deployment





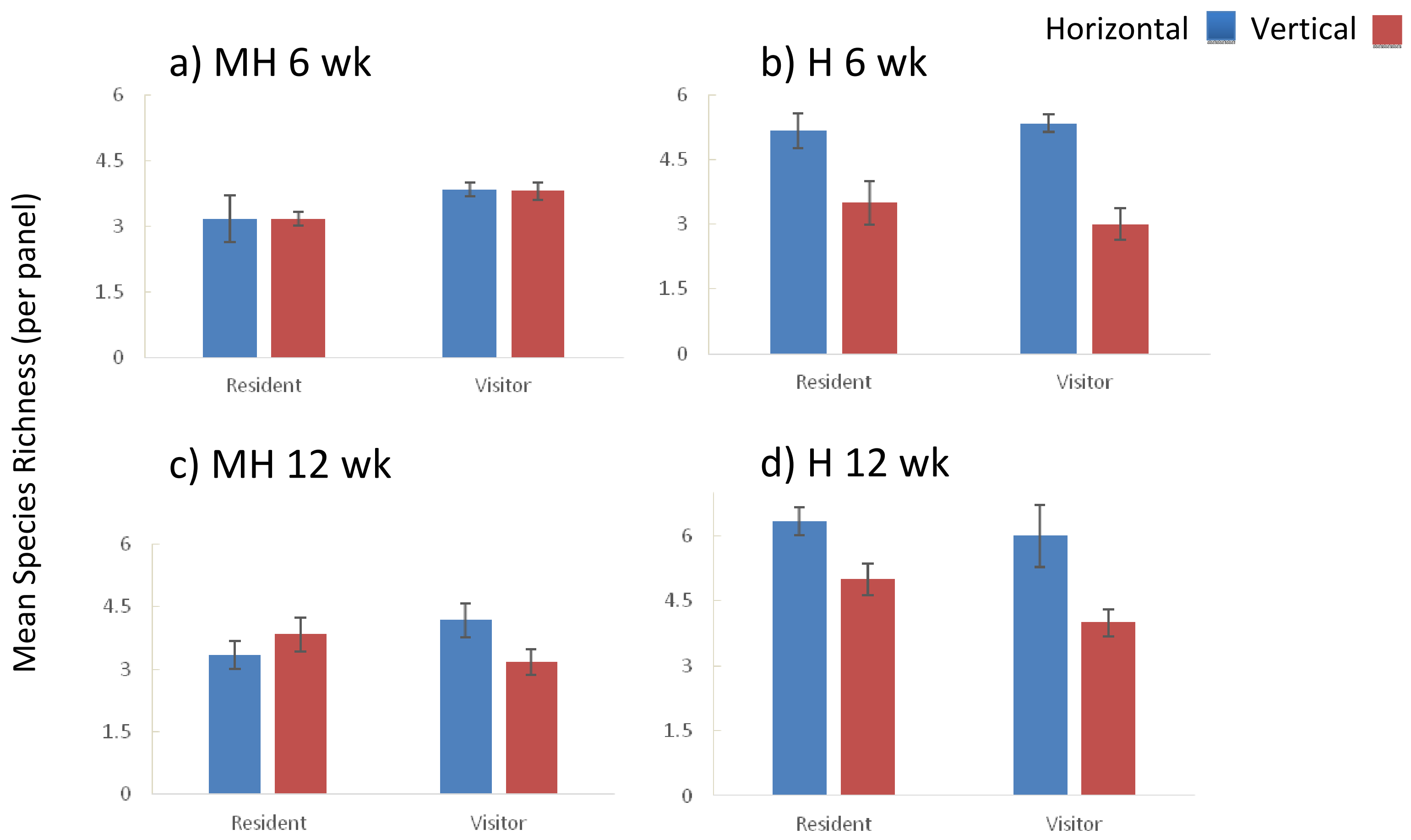
Each panel – ALL species ID and % cover estimated for each species

OVERALL SUMMARY OF NNS

NON NATIVE SPECIES	Summer 6 weeks		Summer 12 weeks	
	MH	H	MH	H
Ciona intestinalis A	R	-	R	R
Corella eumyota	-	R	R	R
Styela clava	-	-	-	-
Botrylloides violaceus	R	R	R	R
Perophora japonica	-	-	-	-
Didemnum vexillum	-	R	-	-
Asterocarpa humilis	-	R	-	R
Crepidula fornicata	-	-	-	-
Ficopomatus enigmaticus	O	-	F	-
Bulgula neritina	F	R	F	F
Tricellaria inopinata	R	O	R	F
Schizoporella japonica	-	R	-	R
Watersipora subtorquata	-	-	-	-
Caprella mutica	R	R	R	R
Austrominius modestus	O	R	O	R
Total species	**7**	**9**	**8**	**9**

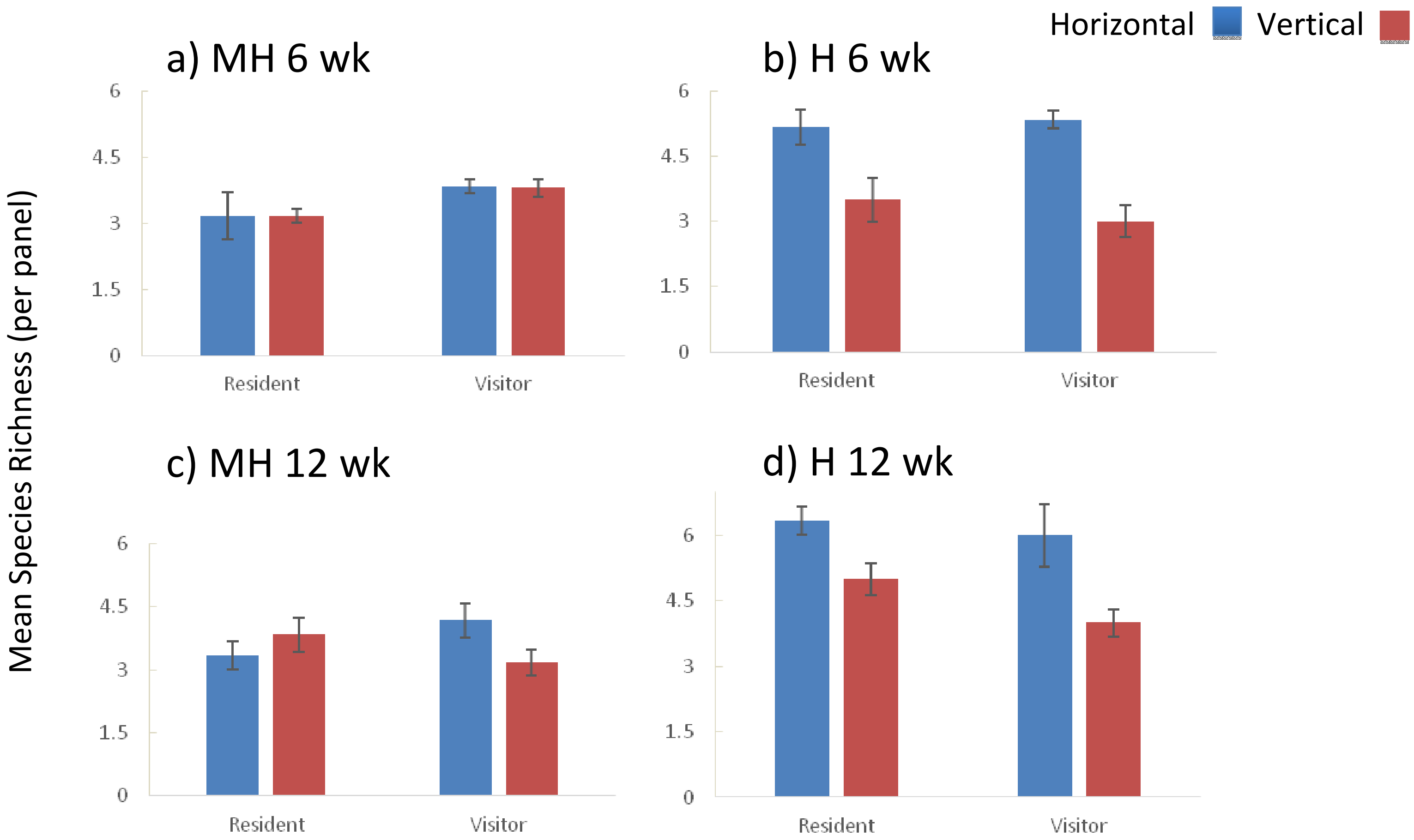
Table 1. The presence and abundance of target Non Native species using the SACFOR scale within Milford Haven marina (MH) in South Wales and Holyhead marina (H) in North Wales marinas (S = Super Abundant, A = Abundant, C = Common, F = Frequent, O = Occasional, R = Rare).

Marina Sites – RESULTS FROM SUMMER



There was no significant effect of location within the marina upon number of NNS detected (Resident = Visitor)

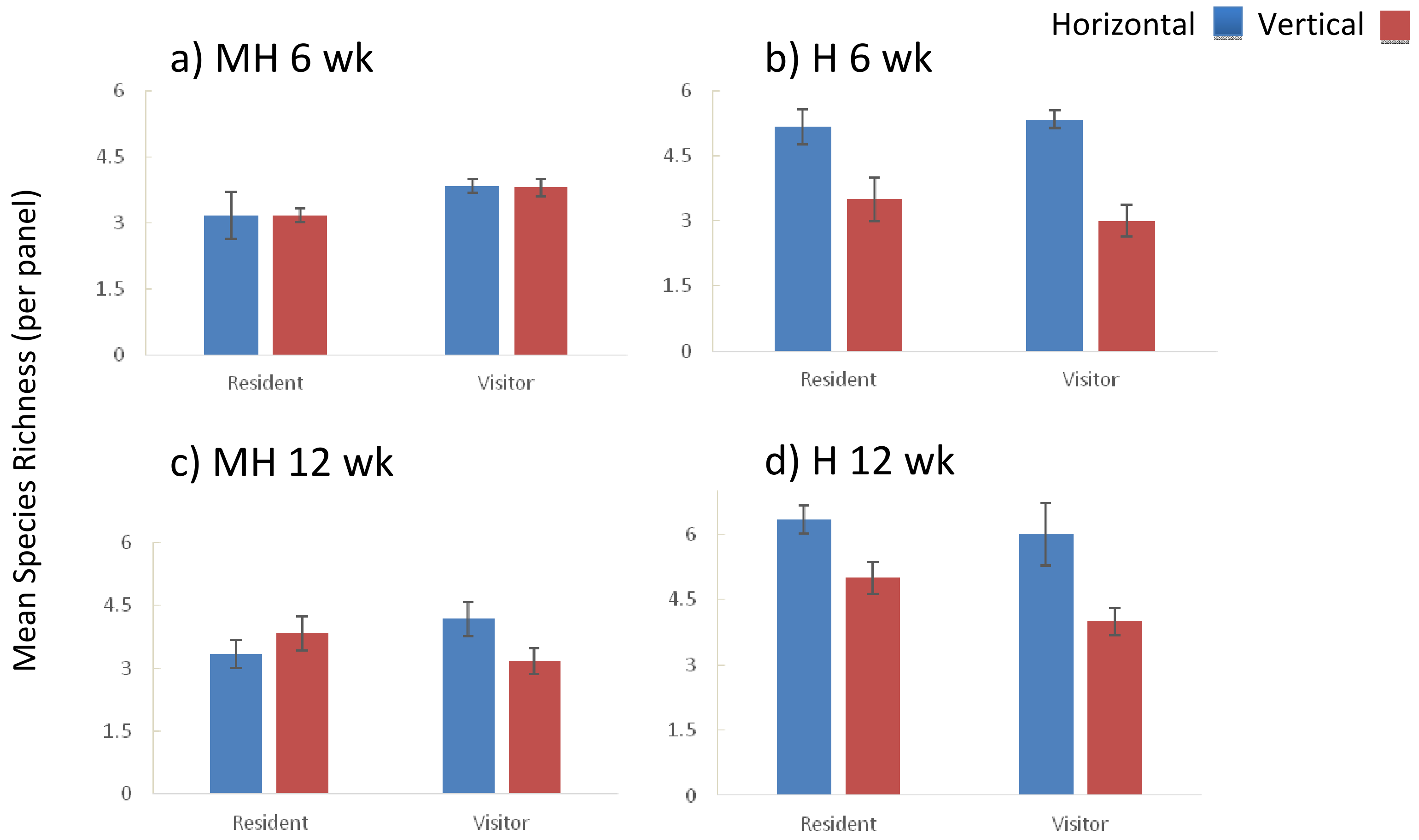
Marina Sites – RESULTS FROM SUMMER



Duration of panel deployment was shown to have a significant impact on number of NNS detected 12 wk > 6 wk ($p \leq 0.006$)

This effect only present at Holyhead

Marina Sites – RESULTS FROM SUMMER



Orientation of the panel was shown to have a significant impact on the number of species detected Horizontal > Vertical ($p > 0.0001$)

This effect was only present at Holyhead

OVERALL SUMMARY OF NNS

NON NATIVE SPECIES	Summer 6 weeks		Summer 12 weeks		MBA RAS data	
	MH	H	MH	H	MH	H
Ciona intestinalis A	R	-	R	R	0	0
Corella eumyota	-	R	R	R	1	1
Styela clava	-	-	-	-	1	1
Botrylloides violaceus	R	R	R	R	0	0
Perophora japonica	-	-	-	-	0	0
Didemnum vexillum	-	R	-	-	0	1
Asterocarpa humilis	-	R	-	R	1	1
Crepidula fornicata	-	-	-	-	0	0
Ficopomatus enigmaticus	O	-	F	-	2	0
Bulgula neritina	F	R	F	F	1	1
Tricellaria inopinata	R	O	R	F	1	2
Schizoporella japonica	-	R	-	R	0	3
Watersipora subtorquata	-	-	-	-	0	0
Caprella mutica	R	R	R	R	0	1
Austrominius modestus	O	R	O	R	2	0
Undaria pinnatifida	-	-	-	-	0	1
Bugula stolonifera	-	-	-	-	1	0
Total species	**7**	**9**	**8**	**9**	**8**	**9**

Table 1. The presence and abundance of target Non Native species using the SACFOR scale within Milford Haven marina (MH) in South Wales and Holyhead marina (H) in North Wales marinas (S = Super Abundant, A = Abundant, C = Common, F = Frequent, O = Occasional, R = Rare). RAS (0 = Absent; 1 = Occasional; 2 = Common; 3 = Abundant)

Lobster Pots

Pilot Study for monitoring fisheries

•5 x settlement panels attached to a lobster pot

•Dummy pot to be deployed at 5 sites around Wales

•Pots deployed but not collected at arranged times – pots were lost in storms

Conclusions

- Aquaculture sites
  - At intertidal sites only low-shore areas should be monitored - further studies are required to assess sub-tidal sites
- Marinas - Settlement panels
  - In order to get a representative sample of the NNS in a marina horizontal **and** vertical panels should be used and left for longer periods of time
- Marinas vs RAS
  - RAS is useful for detecting species that may not recruit onto settlement panels or those that take longer to grow e.g. *Styela clava*
- Marinas
  - combination of settlement panels and RAS would be most effective **BUT** people with the relevant expertise to conduct RAS are essential
- Lobster pots
  - The fishermen are extremely willing to participate so there is potential to develop this further

Acknowledgements

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SOS: Farng and Tim for their help in the field: Oyster farm operators Shaun and Jon - especially for their assistance at the sites. Marina Staff at Milford Haven and Holyhead.