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# Comprehensive Reassessment of NNS in Welsh marinas

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Front cover: Early stage of *Watersipora subatra*. Image:J Bishop.

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## Executive Summary

Invasive non-native species constitute one of the leading threats to natural ecosystems and biodiversity, and also impose an economic cost on a range of human enterprises, including aquaculture and leisure boating. This project aimed to update the distribution of marine non-native species (NNS) in Wales, provide training and improved resources for key stakeholders in identification of NNS, and give guidance on biosecurity measures and recording schemes.

Rapid assessment surveys (RAS) were carried out at 15 marinas from Conwy to Cardiff, providing detailed current distributions of 20 non-native species along the Welsh coast; this data is of relevance to the establishment of baselines for MSFD monitoring of Good Environmental Status. The most significant observations were the arrival of the kelp *Undaria pinnatifida* in N and S Wales, and the ongoing colonisation of additional sites by species already present, in particular the sea squirts *Corella eumyota* and *Asterocarpa humilis*, and the tube-worm *Ficopomatus enigmaticus*.

As a result of these surveys it is recommended that Holyhead Marina and Milford Marina be considered as key monitoring sites and be surveyed on an annual basis. These are close to a port or ferry terminal, have high numbers of NNS, and are easily accessible. Holyhead is the site of recent first arrivals in Wales by *Undaria pinnatifida*, *Didemnum vexillum* and *Schizoporella japonica*. Pembroke Port at Pembroke Dock should be explored as a possibly superior alternative monitoring site in S Wales. It had the joint highest number of NNS and is adjacent to a ferry port. However, access would need to be arranged with the Port Authority and appropriate protocols agreed. In addition it is recommended that contacts be developed with marina staff at Swansea Marina and Victoria Dock, Caernarfon who could monitor and report levels of easily recognisable brackish water nuisance species such as *Ficopomatus enigmaticus*.

The two training workshops were well attended and received very good feedback. Discussions with attendees at these and a subsequent workshop in Southampton led to the following recommendations:

- Training for marina management should focus on biosecurity and practical advice; they are less interested in NNS ID.
- NNS ID and awareness training is best delivered to marina workers on-site in small groups and should focus on easily recognisable species for which actions would be required.
- Some biosecurity training should be incorporated into existing accredited training schemes for marina staff.

Improved resources for use in the identification of NNS were produced:

- A Welsh version of *The Identification Guide for Selected Marine Non-Native Species* (printed and online).
- *Guide to early life stages of fouling fauna* (online only). This will be extremely useful for any future research or monitoring where settlement panels are deployed for short growing periods.

## Crynodeb Gweithredol

Mae rhywogaethau ymledol anfrodorol yn un o'r bygythiadau pennaf i ecosystemau a bioamrywiaeth naturiol, ac maent hefyd yn achosi cost economaidd i amrywiaeth o fentrau dynol, gan gynnwys ffermio dŵr a chychod hamdden. Nod y prosiect hwn oedd diweddarau dosbarthiad rhywogaethau morol anfrodorol yng Nghymru, darparu hyfforddiant ac adnoddau gwell ar gyfer rhanddeiliaid allweddol wrth adnabod y rhywogaethau hyn, a rhoi arweiniad ar fesurau bioddiogelwch a chynlluniau cofnodi. Cynhaliwyd arolygon asesu cyflym mewn 15 marina o Gonwy i Gaerdydd, gan ddarparu gwybodaeth fanwl o ddosbarthiadau presennol 20 rhywogaeth anfrodorol ar hyd arfordir Cymru; mae'r data hyn yn berthnasol ar gyfer sefydlu gwaelodlinau i waith monitro Cyfarwyddeb Fframwaith y Strategaeth Forol o Statws Amgylcheddol Da. Y digwyddiadau mwyaf arwyddocaol oedd dyfodiad y gwymon *Undaria pinnatifida* yng Ngogledd a De Cymru, a'r coloneiddio parhaus o safleoedd ychwanegol gan rywogaethau sydd yno eisoes, yn enwedig y chwistrelli môr *Corella eumyota* a *Asterocarpa humilis*, a'r pryfyn tiwb *Ficopomatus enigmaticus*.

O ganlyniad i'r arolygon hyn, argymhellir bod Marina Caergybi a Marina Aberdaugleddau yn cael eu hystyried fel safleoedd monitro allweddol ac yn cael eu harolygu'n flynyddol. Maent yn agos i borthladd neu derfynfa fferi, yn gartref i nifer uchel o rywogaethau anfrodorol, ac mae modd cael atynt yn hawdd. Caergybi yw'r safle ar gyfer dyfodiadau cyntaf *Undaria pinnatifida*, *Didemnum vexillum* a *Schizoporella japonica* yng Nghymru. Dylid ystyried Porthladd Penfro yn Noc Penfro fel safle monitro arall yn Ne Cymru, a all fod yn well opsiwn. Mae ei gyfraddau rhywogaethau anfrodorol ymhlith yr uchaf yn y wlad, ac mae o fewn cyrraedd hwylus i borthladd fferi. Fodd bynnag, byddai'n rhaid trefnu mynediad ag Awdurdod y Porthladd a chytuno ar brotocolau addas. Ar ben hynny, argymhellir y dylid datblygu cysylltiadau â staff Marina Abertawe a staff Doc Fictoria yng Nghaernarfon, a fyddai'n gallu monitro ac adrodd ar lefelau rhywogaethau dŵr lled hallt sy'n boendod ac yn hawdd eu hadnabod, megis *Ficopomatus enigmaticus*.

Roedd nifer dda yn bresennol yn y ddau weithdy hyfforddiant, ac roedd yr adborth i'r ddau yn gadarnhaol iawn. Yn dilyn trafodaethau â'r rheini a ddaeth i'r gweithdai hyn, ac un arall yn Southampton, cytunwyd ar yr argymhellion canlynol:

- Dylai'r hyfforddiant ar reolaeth marina ganolbwyntio ar fioggiogelwch a chyngor ymarferol; does dim gymaint o ddiddordeb mewn adnabod rhywogaethau anfrodorol.
- Y dull gorau o ddarparu hyfforddiant adnabod ac ymwybyddiaeth o rywogaethau anfrodorol i weithwyr marina ar y safle yw eu rhannu i grwpiau bychan, a dylai'r

ffocws fod ar rywogaethau sy'n hawdd eu hadnabod y byddai'n rhaid gweithredu o'u herwydd.

- Dylid cynnwys peth o'r hyfforddiant bioddiogelwch yn y cynlluniau hyfforddi staff marina achrededig cyfredol.

Cytunwyd ar adnoddau gwell i'w defnyddio er mwyn adnabod rhywogaethau anfrodorol:

- Fersiwn Gymraeg o *Canllawiau I adnabod rhywogaethau morol anfrodorol dethol* (mewn print ac ar-lein)
- *Guide to early life stages of fouling fauna* (ar-lein yn unig). Bydd hyn yn hynod werthfawr er mwyn unrhyw ymchwil neu fonitro yn y dyfodol lle ddefnyddir setlo paneli ar gyfer cyfnodau tyfu byr.



## 1. Introduction

Artificial structures in ports and marinas, such as floating pontoons, ropes, tyres etc. are frequently the first sites of colonization for non-native species (NNS) and can act as stepping-stones during secondary spread. Such artificial structures have become the primary focus for rapid assessment surveys (RAS) for non-natives as the resulting assemblages are always submerged but readily accessible at any state of the tide, making them ideal for cost-effective surveillance of non-native taxa. Such surveys provide an important baseline for studies of neighbouring natural benthic communities and their ability to withstand invasion. The most recent surveys carried out in Wales were in 2011 (Monnington et al. 2011).

Another key method for NNS detection and monitoring is by the use of settlement panels. These are placed in a marina, left for a specified period e.g. 2 or 6 weeks, then collected and examined to determine which species have settled. However a major problem with this methodology is the difficulty of identifying many of the species before they are fully developed and distinguishing the NNS species from other, often closely related, native species. The development of an open-access guide to these 'Early Stages' would assist many scientists and students monitoring NNS and studying recruitment processes.

There is very limited awareness amongst key stakeholder groups of marine NNS and the problems they present to local biodiversity and ecosystem services such as shellfisheries. Awareness raising and training are vital steps in developing a feeling of responsibility for the environmental effects of maritime activities among relevant stakeholders (the leisure boating industry and its customers, aquaculture, ports and harbours), thereby influencing behaviour.

This project was designed to address the above concerns, and has the following aims:

- To provide detailed current distribution of non-native species from 15 marinas along the Welsh coast, including introductions recognised only recently and not previously targeted.
- To assess the relative risk of invasions in surveyed marinas and thus identify key sites for future monitoring.
- To produce a waterproof identification guide in Welsh for NNS common in artificial habitats.
- To produce an identification guide for early post-settlement developmental stages of fouling species, with emphasis on ascidians and bryozoans.
- To make data widely available via NBN Gateway.

- To raise awareness of NNS amongst stakeholder groups such as marina operators, yacht owners, port operators and shellfish farmers.
- To increase expertise in identification of NNS in the above groups.
- To provide information of value to government departments, non-departmental public bodies, environmental charities and other organizations concerned with environmental policy and management of invasive alien species.
- To publicize this work via BARS, Twitter, workshops, websites and NNS guides.

Although not part of the same project, identical surveys were undertaken in S England in 2014. The combined data provide a much clearer picture of the current status of NNS in GB marinas and provide valuable baseline data against which the efficacy of pathway management initiatives can be measured.

Bangor University was a partner in the project; assisting with Welsh translation and organisation of the N Wales workshop.

## **2. Surveys**

### **2.1. Methods**

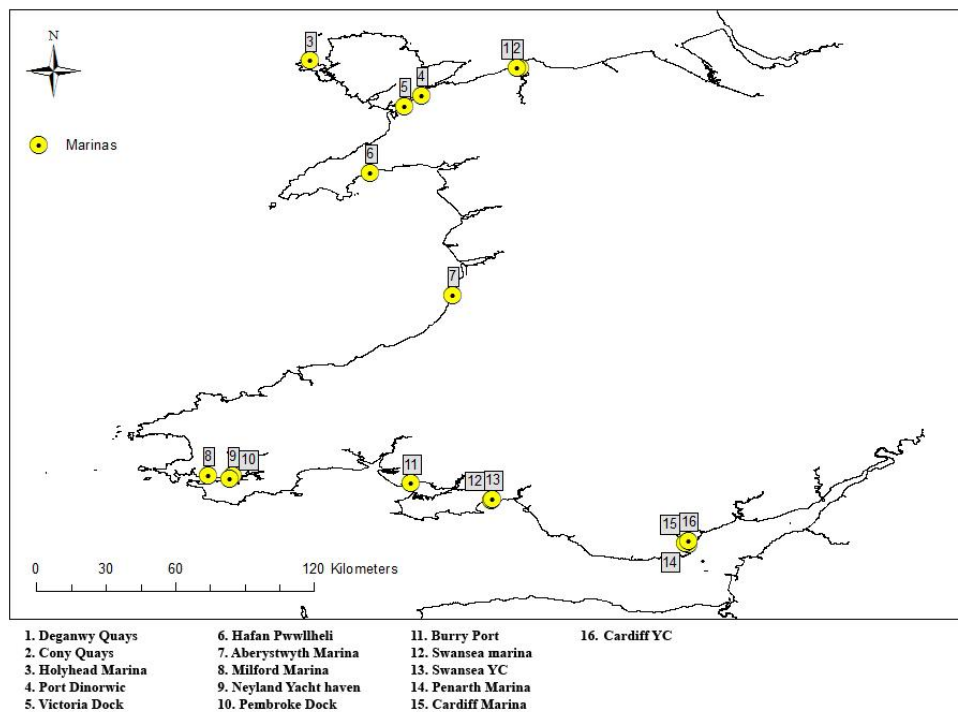
A target list of 33 non-native marine species was drawn up comprising a mixture of Welsh high priority species, species previously identified in marina environments elsewhere in the UK, and species identified as likely arrivals from horizon scanning (Appendix I). Only a limited number of algae were included as NRW had already commissioned an independent set of algal surveys. Fifteen marina sites across Wales were selected and surveyed for the presence of non-native species during June and July 2014 (Figure 1 and Appendix III). Three of these; Penarth, Cardiff Marina and Cardiff Yacht Club, were freshwater sites. An additional site, Pembroke Port at Pembroke Dock, was added while the surveys were in progress when we were invited to examine a pontoon that had been lifted out of the water for maintenance.

The surveys were carried out following the Rapid Assessment Survey protocol detailed in Appendix IV; this methodology has been used in marinas throughout the UK over a number of years. The survey team did not limit their observations to the target list; other non-native species which, if observed, would have been recorded are listed at Appendix II. In addition many native species were recorded. NRW staff and other interested parties accompanied us at some sites to observe the methodology and/or improve their NNS identification skills; a list of these observers is given in Table 1.

While visiting the marinas outreach interactions were initiated with marina operators and interested yacht owners with the aim of raising awareness of NNS, generating a feeling of ownership over their environment and participation in caring for their marinas and the

surrounding habitats. In N Wales Kate Griffith from Bangor University acted as Welsh translator for these interactions.

The specimens collected during the surveys were inspected later in the laboratory to make or confirm identifications.



**Figure 1:** Locations of marinas surveyed for non-native species in June/July 2014.

**Table 1:** NRW, Bangor University and Natural England staff who attended surveys

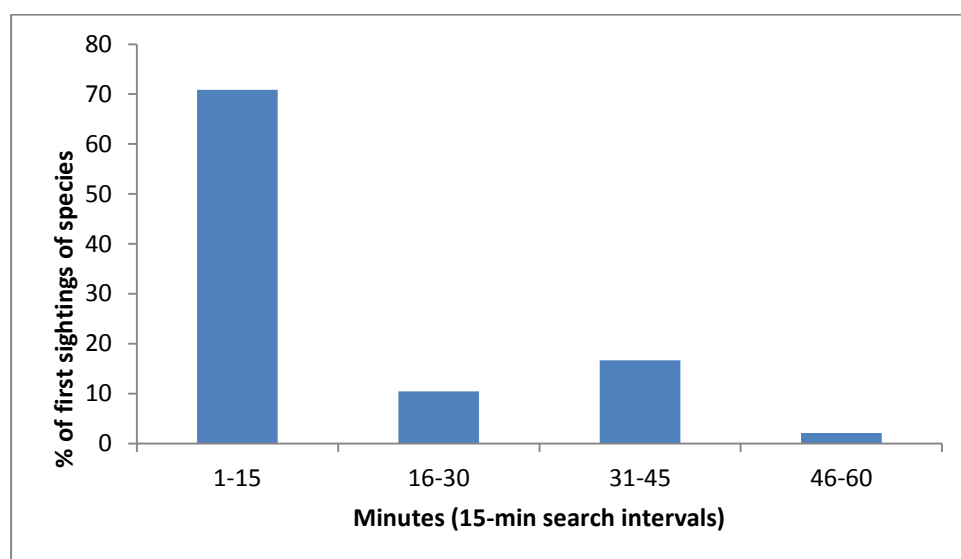
Name	Role	Surveys attended
Rohan Holt	Marine Biologist, NRW	Holyhead, Port Dinorwic, Victoria Dock
Rebecca Boys	Marine Monitoring Assistant, NRW	Holyhead
Ruth Crundwell	Marine Adviser, Natural England	Holyhead
Katherine Griffith	Lecturer, School of Ocean Sciences, Bangor University	Holyhead, Port Dinorwic, Victoria Dock
Mathilde Bue	PhD student, School of Ocean Sciences, Bangor University	Holyhead
Anne Bunker	Senior Marine Conservation Officer, NRW	Milford Haven
Lily Pauls	Senior Marine Conservation Officer, NRW	Milford Haven

## 2.2. Results

The detailed NNS occurrence data is given in Appendix V. The environmental measurements of salinity and temperature are reported in Appendix III. A comparison between these survey results and those of the Cross Wales Report (Monnington et al. 2011) is shown at Appendix VI. All NNS species records and some native species records have been entered into Marine Recorder and transferred to NRW. The survey metadata has been entered into MEDIN.

### *Adequacy of duration of RAS visits*

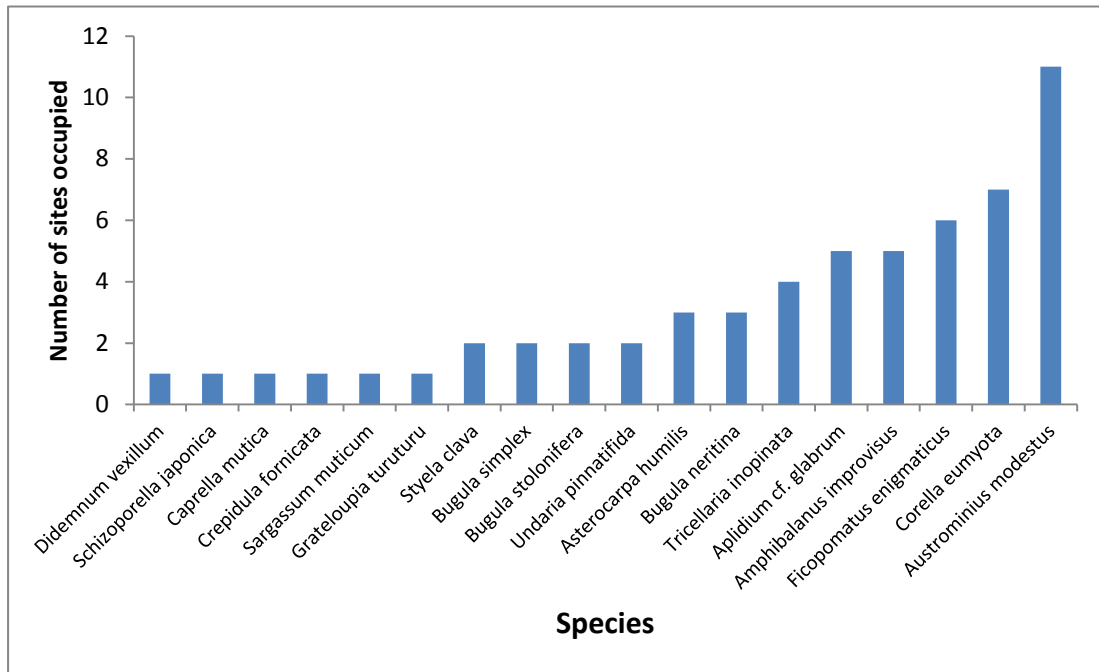
Individual surveyor records of 18 marine NNS from surveys of 13 marinas show that 71% of first sightings by any of the surveyors occurred in the first quarter of an hour at a marina, and only 2% of the records arose during the final quarter of an hour of the 1-hour searches (Figure 2). *Bugula simplex* and *B. stolonifera* were not included as they could not be identified in the field. The Cardiff Bay marinas were excluded as only 2 freshwater NNS were targeted, as was Pembroke Dock since a complete RAS was not carried out.



**Figure 2:** Timings of first sightings of 18 species of NNS by any of 3 surveyors during 1-hour surveys at 13 marinas along the Welsh coast.

### *Species accounts*

A total of eighteen different marine NNS were recorded during the surveys, the most frequently occurring being *Austrominius modestus*, *Corella eumyota*, *Ficopomatus enigmaticus*, *Aplidium* cf. *glabrum* and *Amphibalanus improvisus*, see Figure 3. In addition two freshwater NNS *Dreissena polymorpha* and *Dikerogammarus villosus* were recorded from the three Cardiff Bay sites.



**Figure 3:** Frequency of occurrence of 18 marine NNS at 13 sites around the Welsh coast, ranked from least to most frequent.

*Undaria pinnatifida*

Here we report the first Welsh records of *Undaria pinnatifida*, from Holyhead and Pembroke Dock. At Holyhead a number of mature specimens were found, but all were located in a small area of the marina, near to the visitors’ pontoon, indicating a reasonably recent arrival. At Pembroke Dock only one pontoon, already removed from the water, was examined. This had a number of mature specimens growing on it. *Undaria pinnatifida* was already known from Fleetwood and from Falmouth around the S and E coasts as far as Grimsby. It was also recently found in Ireland (Minchin and Nunn 2013).



**Figure 4:** First Welsh records of *Undaria pinnatifida* from Holyhead and Pembroke Dock

### *Austrominius modestus*

The barnacle *Austrominius modestus* was the most prevalent NNS found during the surveys as was the case during the 2011 surveys (Monnington et al. 2011). It was recorded at 11 of the 13 marine/brackish sites in 2014 and all 9 of the 9 sites in 2011. In the comparison between the 2014 and 2011 surveys (Appendix VI) *A. modestus* was

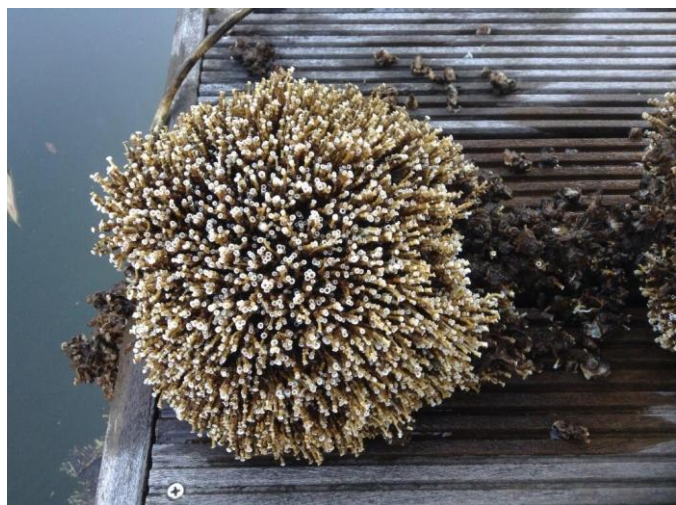


found on both occasions at all sites common to the two sets of surveys. It is the most frequently recorded species from marinas around the UK especially in habitats subjected to fluctuating salinity.

**Figure 5:** *Austrominius modestus* from Burry Port

### *Ficopomatus enigmaticus*

The polychaete tube-worm *Ficopomatus enigmaticus* was recorded at six of the sites visited. There has been an increase in occupancy from 1 to 3 of the seven comparable sites surveyed in 2011 (Appendix VI). At one site, Swansea Marina, it was superabundant and was a severe fouling nuisance on yacht hulls, pontoons and ropes. This species is generally considered to be associated with brackish waters. Our recent surveys in S England also found an increase in abundance and number of sites occupied by this species. This may be due to the mild winter as *F. enigmaticus*, a temperate/warm temperate species, is thought to be at the limit of its range for maintaining populations and sexual reproduction on the S English coast (Zibrowius and Thorp 1989).



**Figure 6:** *Ficopomatus enigmaticus* fouling a rope at Swansea Marina

### *Asterocarpa humilis*

The occurrence of *Asterocarpa humilis* in Milford Haven and Neyland indicates this species is spreading rapidly in Wales, it having only arrived in Holyhead in 2011 (Bishop et al. 2013). In England, where it was first discovered in 2009, it now has a range from Falmouth to Brighton and the species has recently been found in Scotland.

### *Corella eumyota*

This was the second most common NNS recorded during the surveys, being present at 7 of the 13 marine/brackish sites. In 2011 *C. eumyota* was found at three sites, in 2014 this had increased to seven (five in sites common to both surveys). Again this is a species that has spread rapidly around the UK from its first detection in 2004. It is now known to occur all around the coast of GB and Ireland.

### *Didemnum vexillum*

In view of the work that has been done in Holyhead to attempt to eradicate *D. vexillum* and prevent its spread around the Welsh coast, particular care was taken during the surveys to evaluate all didemnid samples. Although *D. vexillum* was still present at Holyhead, it was not confirmed at any other sites. One putative specimen from Port Dinorwic proved too small to identify. As this is the nearest of the sites to Holyhead it is recommended that this site be rechecked in 2015.

Samples of putative *D. vexillum* from the SEACAMS surveys of the Milford Haven Waterway were examined at the MBA but were not confirmed as *D. vexillum*.

### *Aplidium cf. glabrum*

The colonial ascidian *Aplidium glabrum* is a northern species with a UK range limited to the colder waters of N Scotland (Millar 1966). Unpublished data from surveys of the S English coast in 2004 (Arenas et al. 2006) show specimens which keyed out as *Aplidium glabrum* being present at a number of sites. We now consider it probable that this is a different, as yet unidentified, *Aplidium* species not native to the UK, which has been spreading rapidly around the UK and Europe. It was recorded at five sites in Wales during these surveys.

### *Schizoporella japonica*

This encrusting bryozoan was first recorded in the UK at Holyhead marina in 2010 (Ryland et al. 2014), following the first attempt to eradicate *D. vexillum*; at that time it was observed to be covering a large proportion of pontoon surfaces and fenders. During the 2014 surveys it was still abundant at Holyhead but not present at any other Welsh sites. This species is spreading rapidly in Scotland, particularly around Orkney, but in England is currently only present in Plymouth.

### *Tricellaria inopinata*

This erect bryozoan has spread extremely rapidly since the first UK record in 1998, now being found all around the GB coast and also on some natural shores. In Wales we found it definitely at four sites, it was also possibly present at two more, Port Dinorwic and Victoria Dock. At these sites it was provisionally identified in the field, but the limited samples taken for later microscopical examination did not substantiate the occurrences.

### *Bugula simplex* and *Bugula stolonifera*

There are very few UK records of these two *Bugula* species over recent years, although they were known to occur in Wales in the 1950s; this is believed to be due to under reporting (Ryland et al. 2011). We found *B. simplex* at Victoria Dock and Pembroke Dock, *B. stolonifera* at Milford Marina and Pembroke Dock. Recent surveys in S England indicated these species occurred at around a third of sites surveyed.

### *Dreissena polymorpha*

This highly invasive freshwater mussel was noted as abundant or superabundant at the three Cardiff marinas: Penarth, Cardiff Marina and Cardiff YC, all situated within Cardiff Bay, an artificial freshwater lake created in 2001 and colonised by *D. polymorpha* by 2003 (Alix 2010). At Penarth Marina most pontoon sides, ropes and fenders were covered in dense layers of mussels.



**Figure 7:** *Dreissena polymorpha* (Zebra mussels) on a rope at Cardiff Yacht Club

### *Dikerogammarus villosus*

It is believed this freshwater amphipod's invasiveness is associated with that of *D. polymorpha* (Gergs and Rothhaupt 2008). It was first recorded in Cardiff Bay in 2010. We found it at all three Cardiff sites. Cardiff Harbour Authority has a monitoring programme and biosecurity controls in place for *D. villosus* and *D. polymorpha*.



### *Site accounts*

The susceptibility of a marina to invasion by new NNS is dependent on a number of factors, including but not limited to:

- Closeness to a major port or ferry terminal as a source of propagules.
- Salinity, average and variability: In general marinas which are fully saline and are subject to infrequent salinity excursions harbour more NNS than brackish water sites or those subject to regular fluctuations e.g. in an estuary. However some NNS are highly tolerant of such conditions and may out-compete native species resulting in dominance of a site by a single NNS.
- Depth: Shallow water sites may dry out during low tides; they are also susceptible to greater temperature fluctuations during summer and winter, which may kill off some species. Deeper waters can provide refuges from low salinity events as the waters are often highly stratified with the fresh water forming a surface layer over a higher-salinity lower base layer. NNS may survive at depth on ropes, chains and pilings and then recolonize surface structures rapidly at a later date.
- Ascidians present: The presence of any ascidian species, native or non-native, indicates conditions are suitable for a wide range of fouling organisms.
- Level of enclosure: Lock-gated marinas can be subject to salinity fluctuations if rainwater is retained or there are storm drains which feed into the basin. There is also a factor of larval retention within more enclosed marinas which may lead to larger populations of NNS developing.

The sixteen sites surveyed can be categorised according to these criteria, see Table 2 (some information from Holt and Cordingley (2011)). Holyhead Marina, Pembroke Dock and Milford Marina are clearly prime sites for invasion. The salinities recorded in Appendix III are only a snapshot, and at some sites salinity will fall significantly following heavy rain or at low tide.

The sites with the highest numbers of NNS were Holyhead Marina and Pembroke Dock at both of which 10 species were found, despite only a single pontoon being examined at Pembroke Dock. Milford Marina and Neyland Yacht Haven were also scored relatively highly, 8 and 7 respectively, see Figure 8.

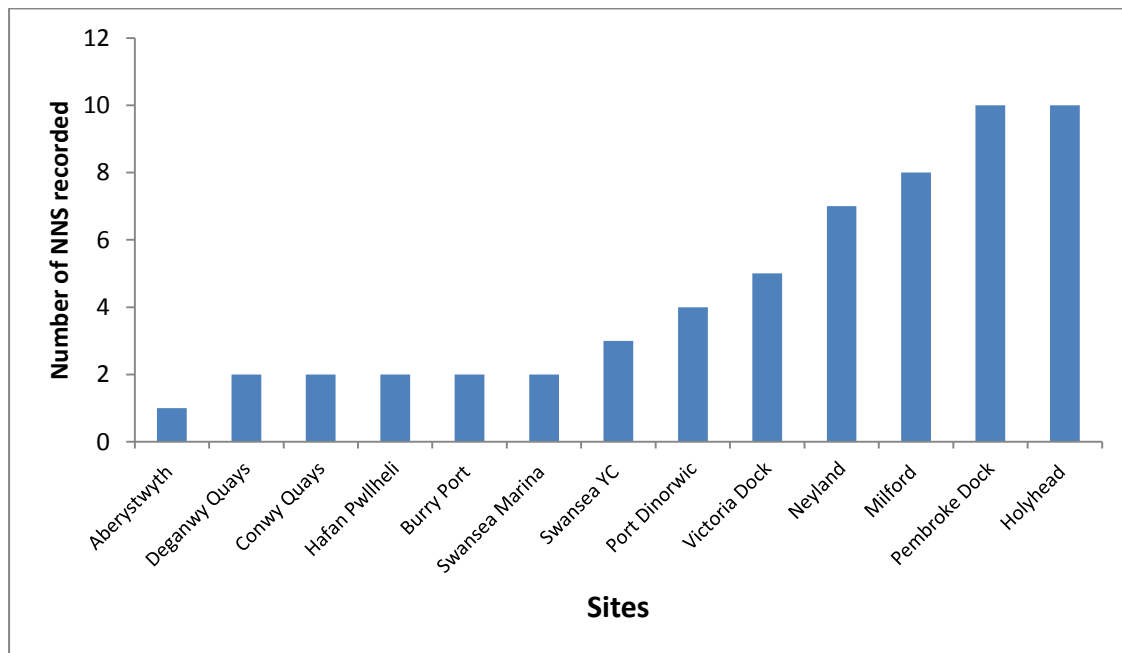
**Table 2:** Categorisation of site susceptibility to invasion by NNS.

Site	Nearby port	Salinity		Shallow	Ascidians present	Susceptibility Score	Lock or sill	Notes
		Average	Tidal fluctuations					
Deganwy Quays	N	B	Y	?	N	0-1	Y	
Conwy Quays	N	B	Y	?	N	0-1	Y	
Holyhead	Y	M	N	N	Y	5	N	
Port Dinorwic	N	M	N	Y	Y	3	N	Dries out
Victoria Dock	N	B	?	?	Y	1-3	Y	
Hafan Pwllheli	N	B	Y	Y	Y	1	N	
Aberystwyth	N	B	Y	?	N	0-1	N	Toxic
Milford	Y	M	N	N	Y	5	Y	
Neyland	Y	B/M	Y	?	Y	3-4	Y	
Pembroke Dock	Y	M	N	N	Y	5	N	
Burry Port	N	M	Y	Y	Y	2	N	
Swansea Marina	Y	B	N	N	Y	4	Y	
Swansea YC	Y	B	N	N	N	3	N	
Penarth Marina	Y	F	N	?	N	2-3	Y	
Cardiff Marina	Y	F	N	?	N	2-3	N	
Cardiff YC	Y	F	N	?	N	2-3	N	

Nearby port – Ship or ferry port within 1km

Salinity - M = Marine, B = Brackish, F = Fresh (Holt & Cordingley 2011), and pers. obs.

Susceptibility Score calculated from 1 point for each of: near port, marine, no fluctuations, not shallow, ascidians present



**Figure 8:** Counts of marine NNS recorded at individual marine/brackish sites around Welsh coast.

At Pembroke Dock only a single pontoon from beside the Carr Jetty, near Gate 4, within Pembroke Port was examined, this had been lifted out of the water a few days before and had started to dry out by the time it was inspected. Aberystwyth Marina has toxic metal riverine input which effectively antifouls the marina (Holt and Cordingley 2011). Penarth, Cardiff Marina and Cardiff Yacht Club are freshwater locations. Only two freshwater NNS were on the target species list and these were found at all three sites. The survey

team were unfamiliar with other NNS likely to found in this habitat (excluding *Dreissena rostriformis bugensis* and *Dikerogammarus haemobaphes*) so these results should not be compared with those from the other sites.



**Figure 9:** Examining pontoon at Pembroke Dock

### **2.3. Discussion**

The most significant observations resulting from the RAS were the arrival of *Undaria pinnatifida* in N and S Wales, and the ongoing colonisation of additional sites by species already recorded in the 2011 Cross Wales project and subsequent surveys; in particular *Corella eumyota*, *Asterocarpa humilis*, and *Ficopomatus enigmaticus*. The recently arrived bryozoan *Schizoporella japonica* is currently limited to Holyhead, as is *Didemnum vexillum*, but they may be expected to increase in geographical range and prevalence in the coming years. Several species which are spreading rapidly in other parts of the UK were not recorded in Wales; these include *Watersipora subatra*, *Botrylloides violaceus* and *Botrylloides diegensis*, although there are isolated records of the *Botrylloides spp.* from previous surveys.

The mean number of NNS recorded at the marine/brackish sites was 4.5 (range 1-10). In comparison the recent surveys around S England found an average of 11.5 (range 3-19) NNS per site. This difference is at least partly explained by the high proportion of brackish sites in the Welsh surveys.

As a result of these surveys and those carried out in 2011 it is recommended that the following sites be considered as key monitoring sites and be surveyed on an annual basis:

- Holyhead Marina - Adjacent to ferry terminal to/from Ireland, highest number of NNS currently present, site of recent first arrivals in Wales by *Didemnum vexillum*, *Schizoporella japonica* and *Undaria pinnatifida*.
- Milford Marina – High number of NNS and near to a busy port. However, the growth on the pontoons appears to be subject to occasional die offs, with more species being

found on the ends of long hanging ropes and cables. This is possibly a result of the marina being lock-gated and subject to occasional storm-drain runoffs.

- Pembroke Port, Pembroke Dock – Although only a single pontoon was examined here, it had the most NNS recorded. It is also a busy ferry port to/from Ireland. If access to this area could be arranged with the Port Authority on a regular basis and protocols developed to allow examination of suitable structures such as ropes and pontoons, it would appear to offer a superior alternative to Milford Marina.

In addition it is recommended that contacts be developed with marina staff at Swansea Marina and Victoria Dock who could monitor and report levels of easily recognisable brackish water nuisance species such as *Ficopomatus enigmaticus*. As these sites have a very depauperate fauna it should also be possible for non-expert staff to spot any new invasive species.

With regard to the freshwater sites in Cardiff Bay, the Harbour Authority already has routine monitoring programmes and biosecurity controls in place. No additional monitoring is proposed.

### **3. Workshops**

#### **3.1. Description**

Two NNS workshops were organised for marina operators, port operators and shellfish farmers. The training included: Identification of NNS specific to marinas and aquaculture, including some predicted invaders; a practical session with an extensive selection of live and preserved specimens; a trip to a marina to view organisms in situ (only Orielton); and information on how to report sightings using established recording schemes. Following discussions with NRW the content was extended to include biosecurity.

The N Wales workshop was run at Bangor University, Menai Bridge on 09/06/14. Bangor University provided assistance with facilities and Welsh translation. MANW (NWWLT) assisted with a list of potential attendees.

The S Wales workshop was held at Orielton Field Study Centre on 04/07/14 and included a visit to Milford Marina. Anne Bunker (NRW) assisted with a list of potential attendees.

Both courses were advertised via a range of media and organisations including: email flyers (see Appendix VII) to marina operators, aquaculture firms, offshore energy organisations, Wildlife Trusts, local councils, Bangor University etc.; twitter messages via MBA, ShoreThing and Porcupine; and the MBA website.

#### **3.2. Discussion**

The workshops were well attended and received very good feedback; a summary of which is given at Appendix VIII. The workshops were less successful in attracting the

specified target audience of marina operators, port operators and shellfish farmers, with about a third of attendees falling into these categories. A similar workshop was run in Southampton in October and was attended by Environmental Officers from two large marina companies (MDL and Premier) and by representatives from The Green Blue. Discussions with them and with attendees at the Welsh workshops led to the following recommendations:

- Training for marina management should focus on biosecurity and practical advice; they are less interested in NNS ID.
- NNS ID and awareness training is best delivered to marina workers on-site in small groups and should focus on easily recognisable species for which actions would be required e.g. horizon species.
- Some biosecurity training should be incorporated into existing accredited training schemes for marina staff.

NRW have since organised a cross-habitat Biosecurity Workshop in October 2014 and are planning a 2-day Marine Biosecurity Workshop at Orierton in February 2015.

#### **4. Non-native Species Guide**

The *Identification Guide for Selected Marine Non-Native Species* was translated into Welsh, adding two new species *Schizoporella japonica* and *Tricellaria inopinata*. Proof-reading was carried out by staff from Bangor University. Four hundred Welsh waterproof guides were printed. These and one hundred English copies were handed out in all marinas visited, to yacht owners, workshop attendees and NRW observers. Bangor University received a set for use with school outreach activities. The remainder were given to NRW for subsequent distribution. An online version of the Welsh guide can be viewed at [www.mba.ac.uk/bishop/non-native-species-guides/](http://www.mba.ac.uk/bishop/non-native-species-guides/). Subsequently to this, new English and French versions have been produced, with additional species.

#### **5. Guide to Early Stages**

A key method of monitoring NNS is by using settlement panels. These are placed in a marina, left for a specified period e.g. 2 or 6 weeks, then collected and examined to determine which species have settled. However a major problem with this methodology is the difficulties of identifying many of the species before they are fully developed, and distinguishing the NNS species from other, often closely related, native species. One of the aims of this project was to develop an open-access pictorial guide to these 'Early Stages' which could be made available as a PDF on the Web.

## 5.1. Method

An initial assessment was made of the most suitable substrates to reduce problems of reflection and light scattering when being photographed. Two substrates were chosen, black 'Correx', often used for the settlement panels themselves; and clear polystyrene for when under-lighting was necessary.

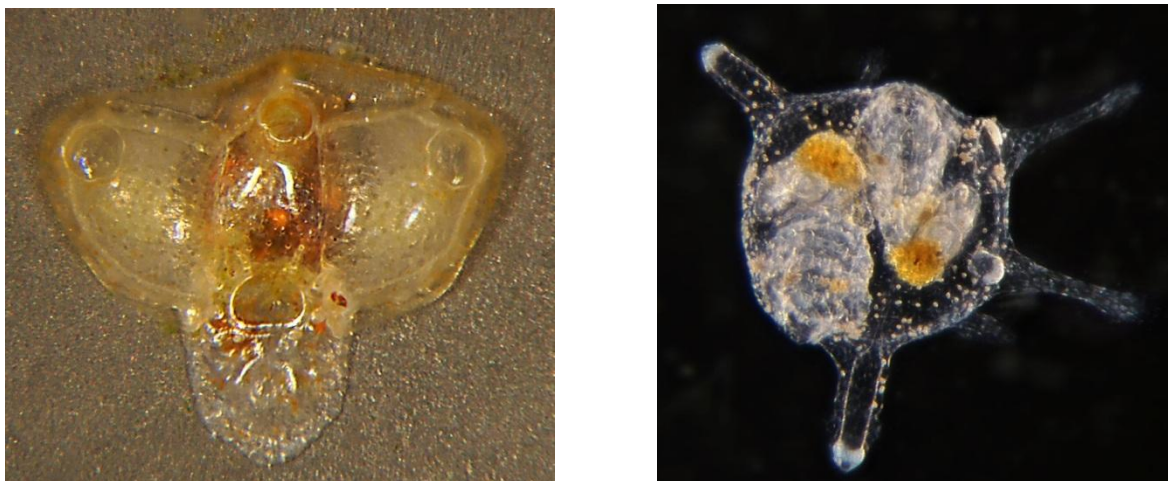
During surveys and subsequent marina visits live specimens of ascidians, bryozoans and other fouling organisms were collected. These were kept alive under a variety of laboratory conditions to facilitate larval production. The larvae were settled and the juvenile stages cultured and photographed at intervals. In addition settlement panels were deployed in local marinas and collected every few days, as an alternative when laboratory settlement was not successful.

The photographs were taken with a Sony NEX 5N camera body mounted via adaptors on Euromex RZ and Watson Microsystem 70 microscopes. The Euromex stage allowed light-field and dark-field illumination from underneath, while Schott and Leica fibre-optic light sources provided incident lighting via a ring-light mounted on the objective lens and flexible swan-neck light guides. Side-views of erect forms were obtained with small right-angle mirrors (Edmund Optics). To obtain greater depth of field, stacked images were combined using Helicon Focus software.

## 5.2. Results

Over 25 different organisms were successfully photographed and included in the Early Stages Guide. Other species proved problematic, some could not be induced to produce larvae and settle, and others would not grow under the culture conditions provided.

It is our intention to add new species and improve some images as and when species become available later in the year. The initial version of the guide is accessible online at [www.mba.ac.uk/bishop/early-stages/](http://www.mba.ac.uk/bishop/early-stages/); we intend that following improvements later this year a new version will be made more widely available.



**Figure 10:** Early stage images of *Schizoporella japonica* and *Diplosoma listerianum*

## **6. Acknowledgements**

We thank the marina operators for allowing access to their sites; Dave Levell, Environmental Manager, Port of Milford Haven, for providing access to Pembroke Dock; and Eira Griffiths, Marina Co-ordinator, for allowing us to visit Milford Marina during the workshop. Also thank you to Anne Bunker (NRW) and Nia Jones (Marine Awareness Officer - North Wales Wildlife Trust) for help with workshop invitations.

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## Appendix I: Target list of species

Non-native species	Description	Level of Threat
<i>Styela clava</i> (Leathery sea squirt)	Solitary, stalked ascidian native to NW Pacific. First recorded in UK 1953 in Plymouth Sound, Devon (Carlisle 1954). Widespread in the UK for some decades.	Detrimental to aquaculture in some world regions, but may increase biodiversity per unit area of substrate.
<i>Asterocarpa humilis</i> (Compass sea squirt)	Solitary ascidian native to S Hemisphere. First recorded in UK in 2009 in SW England (Bishop et al. 2013). Recorded in Holyhead Marina in 2011.	Recently recognised, and spreading rapidly in England, potential fouler of aquaculture equipment, clumps could clog pipes, potential competitor for food and space with cultured bivalves. Now entering natural habitats.
<i>Ciona intestinalis</i> type A	Solitary ascidian, very similar in appearance to native species type B. Considered native to the NW Pacific. Currently known only from the SW coast, Newlyn to Torquay (Nydam and Harrison 2011). For distinguishing features see Sato et al. (2012).	Recently distinguished; threat to biodiversity – ‘cryptic’ species, potentially hybridises with native type B; fouler of aquaculture equipment (as is B); competes for food with farmed species such as mussels and oysters.
<i>Corella eumyota</i> (Orange-tipped sea squirt)	Solitary ascidian, widespread throughout cooler waters of southern hemisphere. First recorded in the UK on the S coast in 2004 (Arenas et al. 2006). Now present throughout the UK.	Widespread in UK, forms large clumps, potential fouler of aquaculture equipment; entering natural habitats.
<i>Botrylloides violaceus</i> (Orange cloak sea squirt)	Colonial ascidian native to NW Pacific. Grows on hard substrates as well as mussels, solitary ascidians and algae. First recorded in UK 2004 on the SW English coast (Arenas et al. 2006).	Widespread in UK, threat to biodiversity and aquaculture through smothering, could block inlet pipes; entering natural habitats.
<i>Botrylloides diegensis</i> (San Diego sea squirt)	Colonial ascidian native to the W coast of N America. First recorded in UK in 2004 on the S English coast. Single record from Burry Port, Wales in 2009.	Spreading in England, threat to aquaculture through smothering.
<i>Botrylloides</i> sp. X	Colonial ascidian, origin and identity unknown.	Recently distinguished. Effects unknown.
<i>Didemnum vexillum</i> (Carpet sea squirt)	A colonial ascidian thought to be native to NW Pacific region (Lambert, 2009). First recorded in UK 2008 in Holyhead Marina (Griffith et al. 2009).	Local threat to biodiversity and local aquaculture through smothering. Thought to be a high impact invasive due to its rapid fouling abilities.
<i>Perophora japonica</i> (Creeping sea squirt)	A colonial ascidian of NE Asian origin, first recorded in Plymouth in 1999 (Nishikawa et al. 2000). Presently occurs in only a limited number of sites in SW and S England, although widespread in France. A record from Milford Haven in 2002, included on various Web sites, was based on a mis-identification.	Starting to appear in natural habitats e.g. off Norfolk coast; Salcombe estuary, Devon; Helford estuary, Cornwall; Strangford Lough, N Ireland.

<i>Aplidium</i> cf. <i>glabrum</i>	A colonial ascidian, similar in zooidal morphology to native <i>Aplidium glabrum</i> , but found in warmer waters than are typical of the native species (Millar 1966). Origin and identity unknown.	Widespread in UK, threat to biodiversity and aquaculture through smothering, could block inlet pipes; entering natural habitats.
<i>Tricellaria inopinata</i> (Tufty-buff bryozoan)	An erect bryozoan native to temperate Pacific. Capable of enduring a wide spectrum of temperatures and salinities, as well as high organic content. Settles on a wide range of anthropogenic and natural substrata. First recorded in UK 1998 on S English coast (Dyrynda et al. 2000).	Widespread in UK, probably under-reported in Wales. Fouling nuisance and can affect biodiversity; entering natural habitats.
<i>Bugula neritina</i> (Ruby bryozoan)	A purplish-brown bryozoan that forms erect, bushy growths. Present from SW Scotland around Welsh and English coasts to Lowestoft. First recorded in c.1911 but by late 1990s was thought to be no longer present, a rapid recolonization has since occurred (Ryland et al. 2011)	Widespread in UK, can affect biodiversity. An abundant fouling organism that colonises a variety of sub-tidal substrata including artificial structures and vessel hulls.
<i>Bugula simplex</i>	Erect straw coloured bryozoan that forms funnel-shaped colonies. Thought to be native to eastern seaboard of N America or the Mediterranean. Few UK records, including Holyhead and Milford Haven (Ryland et al. 2011).	Effect unknown.
<i>Bugula stolonifera</i>	Greyish-buff erect bryozoan which forms short compact tufts. Native to the Atlantic and Mediterranean. Known from S Wales and a few isolated English sites (Ryland et al. 2011).	Effect unknown.
<i>Watersipora subatra</i> (Red ripple bryozoan)	An orange/red encrusting bryozoan from the S Hemisphere. Occurring from the lower intertidal to shallow sub-tidal. First recorded in Plymouth in 2008 (Ryland et al. 2009), it is now known from Plymouth to Poole Harbour and in France from Brittany and Bordeaux.	Tolerant to copper based antifoulants. Spreading rapidly in England. It is highly invasive and has become common on coastlines throughout global cool-temperate waters since the 1980s.
<i>Schizoporella japonica</i> (Orange ripple bryozoan)	A bright orange encrusting bryozoan native to the N Pacific. Recorded in Holyhead marina in 2010, only other UK records are from Scotland and Plymouth (Ryland et al. 2014).	Recently recognised as an invasive species. Can form encrustations on ships, piers, buoys and other man-made structures in harbours and marinas. May compete for space with native species and <i>S. japonica</i> is known to inhibit the growth of adjacent species.
<i>Diadumene lineata</i> (Orange-striped anemone)	Small orange-striped anemone, native to Pacific. Probably introduced from Japan into the Atlantic towards the end of the 19th century. Distributed around Britain and throughout continental Europe (Stephenson, 1935 & Williams 1975).	Effect unknown.

<i>Austrominius modestus</i> (Darwin's barnacle)	Four-plated barnacle native to Australasia, first recorded in UK in 1946 (Crisp 1958).	Widespread throughout UK, competes for space with native barnacles. This species has largely displaced other barnacles in estuaries in SW Britain although impacts are less significant on exposed rocky shores.
<i>Amphibalanus amphitrite</i> (Striped barnacle)	Species of acorn barnacle native to SW Pacific and Indian Oceans. First recorded in UK 1937 in Shoreham Harbour, Sussex (Bishop 1950). Populations have been found in S England and S Wales.	Now occurring on S coast of England. Can be a fouling nuisance on yacht hulls and equipment.
<i>Amphibalanus improvisus</i> (Bay barnacle)	Smooth, white or pale grey, 6-plated barnacle with a cosmopolitan distribution. First recorded in the UK by Darwin in 1854. Tolerant of brackish waters.	May dominate and outcompete native species, especially for available habitat. It can be a nuisance through fouling of ships' hulls, water inlet pipes, aquaculture products and equipment and other submerged structures.
<i>Caprella mutica</i> (Japanese skeleton shrimp)	Amphipod native to NE Asia. First recorded in the UK in 2000 from a salmon farm in Oban, Scotland (Willis et al. 2004).	Widespread, serious threat to native skeleton shrimp populations even at low densities. On the west coast of Scotland, their abundance can reach 300,000 individuals m <sup>-2</sup> . It has the potential for significant impacts on benthic communities.
<i>Dikerogammarus villosus</i> (Killer shrimp)	Freshwater amphipod native to Ponto-Caspian region of E Europe. First UK record was in 2010, from Grafham Water in Cambridgeshire (MacNeil et al. 2010). It was also found in Wales in the same year.	Threat to the native amphipod species; attacks and feeds on a range of insect species such as damselflies and waterboatmen, could cause the local extinction of some species.
<i>Dreissena polymorpha</i> (Zebra mussel)	Small striped freshwater mussel, native to the Ponto-Caspian region of E Europe. Recorded in Cambridgeshire in the 1820s and in Cardiff Bay in 2003 (Alix 2010).	Disruption of ecosystems by monospecific colonization, damage to harbours and waterways, and water treatment and power plants. Water treatment plants are most affected because the water intakes bring the microscopic free-swimming larvae directly into the facilities.
<i>Crepidula fornicata</i> (Slipper limpet)	Medium sized gastropod native to E coast of the Americas from Canada and Mexico. British population was introduced in 1890 in association with imported oysters (Eno et al. 1998) and has been present in the Milford Haven Waterway since the 1950s.	Habitat alteration, threat to biodiversity and aquaculture. Now a pest in commercial oyster beds.

<i>Urosalpinx cinerea</i> (American oyster drill)	A gastropod native to E coast USA. First recorded in Essex oyster grounds in 1927 (Orton and Winckworth 1928). Now widely distributed across Essex and Kent coasts.	Threat to aquaculture through feeding on bivalves. It is a major pest to the commercial oyster industry preying heavily on both native and introduced oyster species. It feeds preferentially on oyster spat and has been reported to decimate stocks of oyster spat in some estuaries.
<i>Crassostrea gigas</i> (Pacific oyster)	A bivalve mollusc with thick, rough shells. Occurs naturally in Japan and SE Asia. First introduced from Portugal into the River Blackwater, Essex, in 1926 (Utting and Spencer 1992). Re-introduced in 1965 to Conwy, North Wales (MAFF quarantine) from the USA and British Columbia (Walne and Helm 1979)	Displacement of native oysters; reef formation leading to habitat alteration.
<i>Ficopomatus enigmaticus</i> (Trumpet tube worm)	A tube worm of unknown origin. Occurs in warm and temperate regions of both S and N hemispheres. Originally observed in London Docks in 1922 (Monro 1924), it favours coastal brackish waters.	Aggregations can change the geomorphology of the local ecosystem by altering hydrodynamic and sediment characteristics, and provide complex habitat for benthic species. May enhance water quality by removing particulate matter, but also reported to increase eutrophication in some instances. The tubes can be a fouling nuisance and block pipes.
<i>Undaria pinnatifida</i> (Wakame)	Large brown alga indigenous to temperate regions of Japan, China and Korea. Grows on hard substrates from low intertidal to approx. 18 m. Tolerant of salinities as low as 20 (Wallentinus 2007). First recorded in UK June 1994 in the Solent (Fletcher and Manfredi 1995).	Competes for space with native kelp species. May be a nuisance fouling jetties, vessels, moorings and buoys.
<i>Sargassum muticum</i> (Wireweed)	Large brown alga indigenous to Japan and NW Pacific. Grows on hard substrates in shallow water down to approx. 5 m. First recorded in UK 1971 in Isle of Wight (Farnham et al. 1973).	Overtops and shades native seaweeds. Fouling hazard to yachts.
<i>Grateloupia turuturu</i> (Devil's tongue weed)	Large red alga found growing on hard substrates down to 2 m below low water mark. Native to Pacific, probably Japan. Probably introduced to UK by spores travelling in ballast water. First recorded at Southsea beach in the Solent, in 1969 (Farnham and Irvine 1973).	Threat to native red algae, the large, broad blades may shade neighbouring species.

<i>Codium fragile fragile</i> (Green sea fingers)	Green seaweed with spongy finger-like branches. Native to the Pacific Ocean: Japan and Korea. In GB it was first recorded from the Yealm Estuary, Devon in 1939, growing on oyster shells (Silva 1955).	Has the potential to compete with native species for space, forming dense assemblages and potentially altering community structure. A nuisance to fisheries and aquaculture, particularly on NW Atlantic shores, it fouls nets and may attach to uplift and move commercially produced shellfish and seaweed.
<i>Colpomenia peregrina</i> (Oyster thief)	Brown alga forming inflated thin-walled hollow spheres. Native to the Pacific Ocean. Introduced to Cornwall and Dorset from France in 1907 (Cotton 1908).	May smother native species; can attach to oysters, become air-filled and buoyant then float away with the animal.
<i>Chrysomenia wrightii</i> (Golden membrane weed)	Large, glistening red seaweed. Indigenous to Japan. First UK record from Falmouth in 2013 (Bunker 2013).	Effects unknown.

**Appendix II: Additional non-native species whose presence would have been noted**

*Celtodoryx ciocalyptoides*

*Mnemiopsis leidyi*

*Ensis directus*

*Rapana venosa*

*Hemigrapsus sanguineus*

*Hemigrapsus takanoi*

*Eriocheir sinensis*

*Megabalanus coccopoma*

*Solidobalanus fallax*

*Dreissena rostriformis bugensis*

*Dikerogammarus haemobaphes*

*Hydroides ezoensis*

*Ammothea hilgendorfi*



**Appendix III: Details of sites surveyed with dates of the surveys and environmental measurements**

Marina code	Site	Geographical co-ordinates	No. of berths	Date of survey	Salinity, surface	Salinity, 2m	Temp., surface °C	Temp., 2m °C
DEG MAR	Deganwy Quays, Conwy	53.291515, -3.827582	165	11/06/2014	31.1	32.8	16.6	15.2
CON MAR	Conwy Quays, Conwy	53.291720, -3.839941	500	11/06/2014	31.1	32.6	16.7	15.5
HOL MAR	Holyhead Marina, Holyhead	53.320428, -4.643464	240	11/06/2014	34.6	34.4	13.4	13.3
PRT DIN	Port Dinorwic, Y Felinheli	53.185911, -4.210162	200	12/06/2014	33.9	34.0	15.1	14.8
VIC DOC	Victoria Dock, Caernarfon	53.143205, -4.276526	46	12/06/2014	25.5	33.7	15.8	15.3
PWL HBR	Hafan Pwllheli, Pwllheli	52.886561, -4.407411	400	12/06/2014	10.0	32.6	19.7	17.8
ABER MAR	Aberystwyth Marina, Aberystwyth	52.409907, -4.087131	150	13/06/2014	4.2	31.1	15.5	15.4
MIL HAV	Milford Marina, Milford Haven	51.711482, -5.037984	300	03/07/2014	31.8	31.4	18.6	17.4
NEY MAR	Neyland Yacht Haven, Neyland	51.710571, -4.942048	420	03/07/2014	32.2	32.8	18.4	18.2
PEM DOCK	Carr Jetty, Gate 4, Pembroke Dock, Pembroke	51.697619, -4.955359	N/A	04/07/2014				
BUR MAR	Burry Port Marina, Burry Port	51.679993, -4.249523	450	02/07/2014	22.0	28.1	21.8	21.0
SWAN MAR	Swansea Marina, Swansea	51.615365, -3.939288	400	02/07/2014	16.1	17.9	20.5	20.2
SWAN YC	Swansea Yacht Club, Swansea	51.618150, -3.932700	200	02/07/2014	14.2	23.1	19.4	19.0
PEN MAR	Penarth Marina, Cardiff	51.444900, -3.174815	350	01/07/2014	0.2	0.2	21.1	20.8
CAR MAR	Cardiff Marina, Cardiff	51.447742, -3.185564	350	01/07/2014	0.2	0.2	21.0	20.1
CAR YC	Cardiff Yacht Club, Cardiff	51.457898, -3.173999	200	01/07/2014	0.2	0.2	21.1	19.8

#### **Appendix IV: Rapid assessment survey (RAS) protocol**

Surveys were undertaken at any state of tide from the surface (i.e. from floating pontoons, without diving or snorkelling). Each marina was contacted in advance for permission to undertake the survey and to enable preparation of any required documentation or safety requirements. JDDDB, CAW and ALEY visited each marina as a team to conduct the RAS. At each site, the available pontoons were apportioned equally between the three staff, who worked independently for one hour. In addition to inspection of the pontoons themselves, submerged artificial substrates such as hanging ropes, keep cages, fenders, etc., and natural substrates such as kelps were pulled up and examined. Hooks and scrapers were used if necessary to access material for inspection. The 15-minute interval (1-15, 16-30, 31-45, 45-60 min) in which each target species was first encountered was recorded, and an estimate of abundance made on a three-point scale ([Not recorded], Rare-occasional, Frequent-common, Abundant-superabundant). Specimens were collected to substantiate significant findings, or for discussion. At the end of the hour the staff gathered to compare notes and record joint summary observations on a standard form. Specimens were discussed and relaxed prior to preservation if required for laboratory identification or as tokens of significant records. Salinity and temperature were recorded using a YSI 30 meter.

An assessment of the adequacy of the one-hour search interval was made by checking that the rate of discovery of new taxa had fallen to a very low level by the fourth 15-minute interval. Additional time was added when necessary at larger or more complex sites.

On completion of the survey all equipment was washed with a disinfectant and then rinsed in fresh water to prevent transfer of NNS between sites. Where specific biosecurity controls were in place, e.g. Cardiff Bay, these were followed and equipment was not reused between sites.

## Appendix V: Occurrence of non-native fouling organisms at 16 sites on the Welsh coast in 2014

Notes:  
 Abundance scores: Adapted and abbreviated SACFORN scale: 3 = Abundant/Superabundant, 2 = Frequent/Common, 1 = Rare/Occasional, 0 = Not present, blank = Not looked for or not noticed, ? = ID uncertain  
 Pembroke Dock: This site was a single pontoon that had been lifted a few days earlier and had started to dry out, so a complete RAS could not be carried out.

MARINA/SITE	DATE	ASCIDIANS										BRYOZOANS						OTHER ANIMALS										ALGAE					Total		
		<i>Styela clava</i>	<i>Asterocarpa humilis</i>	<i>Ciona intestinalis</i> 'A'	<i>Corella eumyota</i>	<i>Botrylloides violaceus</i>	<i>Botrylloides diegensis</i>	<i>Botrylloides species 'X'</i>	<i>Didemnum vexillum</i>	<i>Perophora japonica</i>	<i>Aplidium</i> cf. <i>glabrum</i>	<i>Tricellaria inopinata</i>	<i>Bugula neritina</i>	<i>Bugula simplex</i>	<i>Bugula stolonifera</i>	<i>Watersipora subatra</i>	<i>Schizoporella japonica</i>	<i>Diadumene lineata</i>	<i>Austrominius modestus</i>	<i>Amphibalanus amphitrite</i>	<i>Amphibalanus improvisus</i>	<i>Caprella mutica</i>	<i>Dikerogammarus villosus</i>	<i>Dreissena polymorpha</i>	<i>Crepidula fornicata</i>	<i>Urosalpinx cinerea</i>	<i>Crassostrea gigas</i>	<i>Ficopomatus enigmaticus</i>	<i>Undaria pinnatifida</i>	<i>Sargassum muticum</i>	<i>Grateloupia turuturu</i>	<i>Codium fragile fragile</i>		<i>Colpomenia peregrina</i>	<i>Chrysymenia wrightii</i>
Deganwy Quays, Conwy	11/06/2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Conwy Quays, Conwy	11/06/2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Holyhead Marina, Holyhead	11/06/2014	1	2	0	2	0	0	0	1	0	1	2	1	0	0	3	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	10	
Port Dinorwic, Y Felinheli	12/06/2014	0	0	0	2	0	0	0	0?	0	2	1?	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	4	
Victoria Dock, Caernarfon	12/06/2014	0	0	0	1	0	0	0	0	0	1	1?	0	1	0	0	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	5		
Hafan Pwllheli, Pwllheli	12/06/2014	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2		
Aberystwyth Marina, Aberystwyth	13/06/2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		
Milford Marina, Milford Haven	03/07/2014	1	1	0	1	0	0	0	0	0	0	1	1	0	1	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	8		
Neyland Yacht Haven, Neyland	03/07/2014	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	3	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	7		
Pembroke Dock, Pembroke	04/07/2014				1					1	1	1	1	1			1						1			1	1						10		
Burry Port Marina, Burry Port	02/07/2014	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2		
Swansea Marina, Swansea	02/07/2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	2		
Swansea Yacht Club, Swansea	02/07/2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	3		
Penarth Marina, Cardiff	01/07/2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	2		
Cardiff Marina, Cardiff	01/07/2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	2		
Cardiff Yacht Club, Cardiff	01/07/2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	2		
<b>Total</b>		<b>2</b>	<b>3</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>11</b>	<b>0</b>	<b>5</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>64</b>		

## Appendix VI: Comparison of 22 non-native species surveyed at 7 sites on the Welsh coast in 2011\* and 2014

Notes:

? = unable to confirm id, bold X = change between surveys

\*Monnington et al. 2011

MARINA/SITE	DATE	ASCIDIANS					BRYOZOANS					OTHER ANIMALS										Total 2014	Total 2011		
		<i>Styela clava</i>	<i>Corella eumyota</i>	<i>Botrylloides violaceus</i>	<i>Didemnum vexillum</i>	<i>Perophora japonica</i>	<i>Tricellaria inopinata</i>	<i>Bugula neritina</i>	<i>Watersipora subatra</i>	<i>Schizoporella japonica</i>	<i>Diadumene lineata</i>	<i>Austrorhynchus modestus</i>	<i>Amphibalanus amphitrite</i>	<i>Caprella mutica</i>	<i>Crepidula fornicata</i>	<i>Urosalpinx cinerea</i>	<i>Crassostrea gigas</i>	<i>Ficopomatus enigmaticus</i>	<i>Eriocheir sinensis</i>	<i>Rapana venosa</i>	<i>Undaria pinnatifida</i>			<i>Sargassum muticum</i>	<i>Grateloupia turuturu</i>
Deganwy Quays, Conwy	11/06/2014										X													1	
	07/07/2011										X														1
Conwy Quays, Conwy	11/06/2014										X													1	
	07/07/2011										X														1
Port Dinorwic, Y Felinheli	12/06/2014		X		?		?				X											X		3	
	04/07/2011		X				X	X			X											X			5
Victoria Dock, Caernarfon	12/06/2014		X				?				X						X							3	
	05/07/2011		X					X			X						X								4
Hafan Pwllheli, Pwllheli	12/06/2014		X								X													2	
	06/07/2011	X									X														2
Milford Marina, Milford Haven	03/07/2014	X	X				X	X			X						X							6	
	06/07/2011	X					X				X														3
Neyland Yacht Haven, Neyland	03/07/2014		X				X				X						X						X	5	
	05/07/2011	X	X	X			X				X												X		6
																								21	22
	<b>Total 2014</b>	<b>1</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>			
	<b>Total 2011</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>			



# MARINE NON-NATIVE SPECIES : A ONE-DAY WORKSHOP

June 10<sup>th</sup> 2014 9.30am-4pm

School of Ocean Sciences (Bangor University)  
Menai Bridge

This workshop offers a basic introduction to:

- ❖ Identification of non-native fouling species found in marinas and ports, such as seaweeds, barnacles and sea squirts
- ❖ Guidance on sending in records
- ❖ Ways to reduce the introduction and spread of non-natives

Intended for: marina & port operators and users, shellfish farmers, divers, fishers

**To book or for more information**

Email: [cwo@mba.ac.uk](mailto:cwo@mba.ac.uk) Tel: 01752 633335



Appendix VII (b)



## RHYWOGAETH FOROL ESTRON: GWEITHDY UNDYDD

Dydd Mawrth 10<sup>fed</sup> Mehefin 9.30 – 4.00pm  
Ysgol Gwyddorau Eigion (Prifysgol Bangor)  
Porthaethwy

Mae'r gweithdy yn cynnig cyflwyniad sylfaenol i'r canlynol:

- Adnabod rhywogaethau estron sy'n tyfu ar arwynebau solet mewn marinas a phorthladdoedd, megis gwymon, gwyddau môr a chwistrelli môr
- Canllaw sut i anfon cofnodion
- Ffyrdd o leihau'r nifer o rywogaethau estron sy'n cael eu cyflwyno neu eu lledaenu

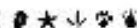
Ar gyfer: gweithredwyr a defnyddwyr marinas a phorthladdoedd, ffermwyr pysgod cregyn, plymwyr, pysgotwyr a phobl eraill sy'n cael eu cyflogi gan y sector morol

**I archebu lle neu i gael rhagor o wybodaeth**

Anfonwch e-bost: [cwo@mba.ac.uk](mailto:cwo@mba.ac.uk) Ffoniwch: 01 752 633335



Hysbysuwr Cymru  
Biodiversity Wales



PARTNERIAETH BIOAMRYWIAETH CYMRU

WALES BIODIVERSITY PARTNERSHIP



## MBA Training Course Feedback Form

The MBA would welcome comments on our training courses. This will help us develop our future training program. If you have any additional comments or would like to elaborate or clarify any points, please include these on the reverse of this sheet.

Course Title:

NNS WORKSHOP-BANGOR, N WALES

Date of Course: 09/06/14

<i>Content</i>	N/A	Poor/ no	Average/ partly	Good/ mostly	Excellent/ completely
Were the expected items covered in sufficient detail?				14%	86%
Was the content suited to your requirements?				7%	93%
Was the course content easy to understand?			7%		93%
Was the supporting information sufficient?				21%	79%

<i>Trainer(s)</i>	N/A	Poor	Average	Good	Excellent
How well conducted was the training?				7%	93%
How well paced was the delivery of information?			7%	7%	86%
How effectively did the trainer(s) deliver the information?			7%		93%

<i>Facilities</i>	N/A	Poor	Average	Good	Excellent
Rate the training facilities				36%	64%
Rate the standard of equipment				7%	93%
Rate the refreshment facilities				43%	57%
Rate the lunch provided				64%	36%

Would you recommend others to do this course? 100% Yes/ 0% No

Would you attend similar courses run by the MBA in the future? 100% Yes/ 0% No

If so, what topics would you like to see covered?

*Fish (2). Algae (3). Seabirds. ID workshops based on habitat.*

*Follow up NNS course – more detail (2).*

What would you have improved about the course?

*Microphones for presenters. Field trip. Longer. More time on microscopes (2).*

*Welsh + English on slides easier to read if I separate columns rather than below.*

*Some information not covered I handout. More diagnostic characters for id.*

What did you like most about the course?

*Practical sessions (3). Expert knowledge (3). Good/live specimens (6).*

*Mix of practical and theory (3).*

*Good level of detail while catering for range of expertise.*

How did you hear about the course?

*Colleague/friend (3). Works newsletter (2). Work email (4).*

*Bangor university (2). From MBA mailing list.*



## **MBA Training Course Feedback Form**

The MBA would welcome comments on our training courses. This will help us develop our future training program. If you have any additional comments or would like to elaborate or clarify any points, please include these on the reverse of this sheet.

Course Title:  
NNS WORKSHOP-ORIELTON, S WALES  
Date of Course: 04/07/14

<i>Content</i>	N/A	Poor/ no	Average/ partly	Good/ mostly	Excellent/ completely
Were the expected items covered in sufficient detail?				22%	78%
Was the content suited to your requirements?				44%	56%
Was the course content easy to understand?				39%	61%
Was the supporting information sufficient?				28%	72%

<i>Trainer(s)</i>	N/A	Poor	Average	Good	Excellent
How well conducted was the training?				11%	89%
How well paced was the delivery of information?				28%	72%
How effectively did the trainer(s) deliver the information?				22%	78%

<i>Facilities</i>	N/A	Poor	Average	Good	Excellent
Rate the training facilities				33%	67%
Rate the standard of equipment				39%	61%
Rate the refreshment facilities			11%	39%	50%
Rate the lunch provided			11%	33%	56%

Would you recommend others to do this course? 100% Yes/ 0% No

Would you attend similar courses run by the MBA in the future? 100% Yes/ 0% No

If so, what topics would you like to see covered?

*Subtidal spp. taxonomy. Control of NNS – case studies. Horizon scanning.*

*Marine invertebrate ID course. Shellfish ecology.*

What would you have improved about the course?

*More weblinks to images. Full day at marina. Weather. More practical (2).*

*More detail on impacts, less on physiology. More on how to tackle NNS.*

What did you like most about the course?

*Trip to marina. Hands-on specimens/live specimens (6). Practical (3).*

*Ascidians. Expertise of trainers (2) Enthusiasm of trainers. Well balanced for audience mix. Local dimension.*

How did you hear about the course?

*Milford Haven Waterway Environmental Surveillance Group (2)*

*Pembroke Biodiversity Partnership (2). NRW (Anne Bunker) (9) Work/Colleague.*