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Research Article

Rapid coastal survey for targeted alien species associated with floating pontoons in Ireland

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Abstract

Twenty alien species were targeted in a rapid assessment of all Irish coasts during 2005 to 2006 at twenty-nine floating pontoon sites consisting of marinas, jetties or fish-farms. Twelve species were found and the survey provided twenty-five new locality records. Four species had not been recorded previously in Ireland. Three of these were tunicates *Corella eumyota*, *Botrylloides violaceus* and a cryptogenic *Didemnum* sp. The fourth species was not targeted, the amphipod *Monocorophium insidiosum*. The majority of the new locality records (67%) were from the Irish Sea coast. Some of the targeted species were removed from leisure craft hulls: *Balanus improvisus*, *C. eumyota*, *Corophium mutica*, *Didemnum* sp. and *Styela clava*.

Key words: invasive species, marinas, non-natives, rapid assessment, Ireland

Introduction

Rapid assessment surveys assist management in controlling alien species. It may be possible to eliminate them when found at an early stage, reduce their rate of spread or develop techniques to mitigate effects to commercial interests. With few exceptions alien species arriving in Ireland normally first appear in Britain (Minchin and Eno 2002) and are usually found in port regions where merchant and fishing vessels berth, at marinas for leisure craft and in shellfish culture areas (Minchin 2006a, Minchin et al. 2006a). Pontoons of marinas and fish-farms were chosen in this study because the immersed parts of the floating pontoons are not usually treated with antifouling coatings and so can develop extensive plant and invertebrate growths and also may be easily sampled at all tidal states. Fish farm pontoons were used to provide an assessment in coastal areas where marina pontoons do not exist. Worldwide survey techniques vary in their intensity, their duration and purpose.

The port studies undertaken in Australia involved a wide range of sampling techniques, including diving, and these surveys provided extensive accounts of both native and alien biota (Hewitt et al. 1999). There is considerable effort involved in such surveys. In North America, pontoons at marina sites were chosen for sampling by specialists with expertise in different taxonomic groups (Pedersen et al. 2005). The relative ease that species can be collected make this approach time efficient. Many of the species collected in such surveys have little recognisable impact although some invasive forms are readily identifiable. Hayes et al. (2002) developed an approach involving a target list of species not present in Australia that could be sought in future surveys based on four criteria that included known invasiveness elsewhere, their presence with known vectors and whether these vectors were active. In their desk assessment, these were arranged according to relative risk of invasion.

In this risk assessment, features from each of these surveys have been used but these are dependant on the target species being readily identifiable in the field. Such a survey was carried out in Scotland during 2006 (Ashton et al. 2006) where ten marina sites were surveyed revealing

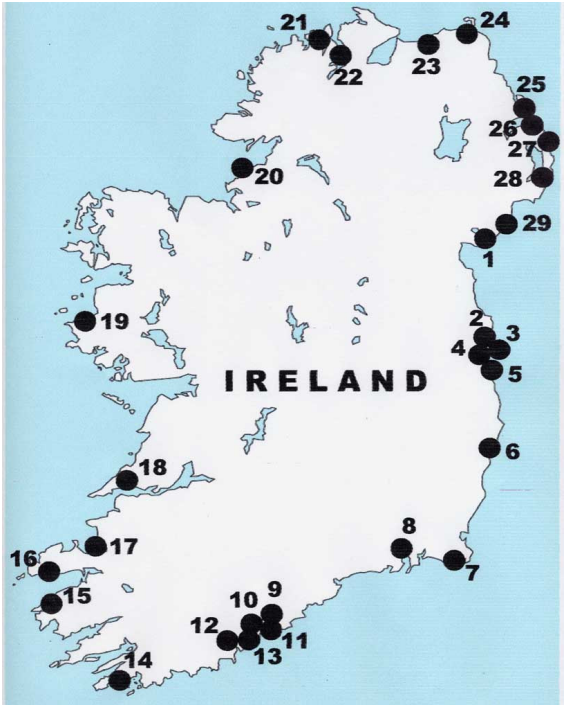

Figure 1. Distribution of sampling sites, see also Annex 2 for positions.

the presence of four out of seven targeted species. In this study twenty-nine sites were visited to search for ten species already introduced to Ireland and to determine whether a further ten other species had arrived in Ireland. Such an approach is likely to be of practical value in monitoring invasive species in the implementation of the European Union's Water Framework Directive and other management studies.

Methods

Twenty-nine marina or fish farm floating pontoons, from all Irish coasts (Figure 1 and see Annex 2 for positions), were sampled over the period March 2005 to August 2006. The majority of sites were visited during July and August 2006. Approximately one hour was spent at each site visiting different separate pontoon sections exposed to different conditions. Most marina sites had ca 20 to100 floating units and other sites had 1 to ca 30 floating units. At each site the most sheltered part of the marina to the most exposed, to wind or current movements, were examined. Biota along the submerged sides and ends of pontoons as well as shaded areas where there were fewer macroalgae were examined. Samples were removed from pontoons from close to the water surface to depths of <1m and on the supporting poles for the pontoons to depths of 3.5m. Samples were collected using a scraper and pocket net on a pole or directly removed by hand.

At least six separate pontoon sections were visited at each site where this was possible. Heavily fouled boat hulls of up to 15m overall length berthed alongside marina boardwalks were also examined. Observation was greatly facilitated under sun-bright calm conditions. Selected samples were collected and directly preserved in 90% ethanol.

Target species were selected based on their current known distribution on the coasts of Ireland, Britain or Northern Europe (Annex 1). Twenty species were selected that could be sampled at three different levels: 1) easily recognised and/or sampled by hand from above the water surface 2) obtained with simple sampling equipment 3) easily removed from scraped samples to be later examined microscopically. Identification of unfamiliar species in advance of the survey was aided by a study of images obtained from websites and from photographs or specimens received from other workers. Voucher samples of new records to Ireland were collected and have been deposited in the National Museum of Ireland, Dublin.

Results and discussion

Twelve of the twenty targeted species were found in this study. Two other non-targeted species, one alien and one cryptogenic, were also found. Four of the species were not previously known in Ireland. There were twenty-five new locality records.

Species not previously recorded in Ireland

Three tunicate species were found for the first time in Ireland. The extensive pendulous growths (Figure 2) of the *Didemnum* sp. are reported elsewhere in more detail (Minchin and Sides 2006). Colonies of *Didemnum* sp. were found at two marina sites on pontoons and leisure craft on the Irish Sea coast. It is likely to be a high impacting species of special concern to managers on account of it being able to rapidly foul surfaces. It may have impacts on mussels in hanging culture as a similar form has done in New Zealand (Coutts and Sinner 2004).

Figure 2. Pendulous growth of *Didemnum* sp. attached to a complete mussel shell, Malahide marina, January 2006 (Photo by Dan Minchin).

Figure 3. *Corella eumyota* (with orange siphons) from the hull of a yacht, Marloge marina, Cork Harbour, June 2006 (Photo by Dan Minchin).

The southern circumpolar tunicate *Corella eumyota* was found at five sites on the south-west, southern and eastern Irish coasts. At all sites the collected specimens were in clusters or formed an extensive layer attached by their tunic. At Marloge marina in Cork Harbour it was the dominant fouling organism on the hull of a small yacht (Figure 3 and 4). Photographs of fouling organisms from Fenit taken in March 2005 show large specimens of *C. eumyota*, without any orange colouration, and was attached to *Styela clava*. The species was first recorded in Europe by Lambert (2003) from France and it is likely that it will rapidly expand its range further within Ireland.

The western Pacific colonial tunicate *Botrylloides violaceus* was found at Malahide and Carlingford marinas. The colonies are made up of different colour morphs. The yellow form was the most conspicuous and could be easily seen from a distance of over 10m. Colonies had grown over other fouling species such as mussels, solitary tunicates and algae (Figure 5). None appeared to have any fouling on their upper surfaces. This species is also known to foul shellfish installations (Cohen et al 2001). This can lead to increased labour in farming cultured molluscs.

The amphipod *Monocorophium insidiosum* (Crawford 1937) was found in the sheltered Carrickfergus marina on Belfast Lough. This species has not been recorded in Ireland before and was collected believing it to be the related *M. sextonae*. It is unclear whether the species is introduced. *M. sextonae* was also recorded in this survey and had previously been recorded in Ireland by Costello (1993). In some regions it has become abundant, such as in Lough Hyne on the Irish south-west coast, where it competes with native amphipods (JMC Holmes pers. comm.).

Species already recorded in Ireland

Extensions to the range of eight of the ten targeted species already present in Ireland were found. A further non-targeted species, the anemone *Haliplanella lineata* (Verrill, 1869), was found in Fenit in Tralee Bay. Four specimens were collected. While this bay has a wild oyster fishery, no layings of imported oysters are known. An introduction from such a source is possible. Individuals were found imported with half-grown oysters to Dungarvan Bay in 1993 and Waterford Harbour, since 2001, arriving from France. It is possible that it was introduced as hull fouling. Fenit is a small shipping port and ships are known

Figure 4. Part of colony of *Corella eumyota* removed from a fouled yacht, Marloge marina, Cork Harbour, June 2006 (Photo by Dan Minchin).

Figure 5. Different colour morphs of *Botrylloides violaceus* overgrowing the mussel *Mytilus edulis* taken from the Carlingford marina, June 2006 (Photo by Dan Minchin).

to arrive here from northern Europe. The only other known locality in Ireland for *H. lineata* is from the Ardfry rapids ca 100km to the north in Galway Bay (Ryland and Nelson-Smith 1975).

The Pacific brown algae *Colpomenia peregrina* and *Sargassum muticum* are now present on most Irish coasts. *C. peregrina* had not been previously recorded from Schull Harbour and *S. muticum* was collected from three new localities. Algal fragments of *S. muticum* were found floating close to marina pontoons. Adjacent area searches revealed stands of the plant in shallow water or specimens cast ashore. Both species are dispersed naturally but some may be spread inadvertently with hull fouling or oyster movements.

At the sheltered marina at Arklow the serpulid *Ficopomatus enigmaticus* was found at depth on the supporting poles for the floating platform below a low salinity layer due to discharges of the Avoca River. *F. enigmaticus* was also found at the Poolbeg marina in the estuarine area of the River Liffey draining into Dublin Bay. This species was not previously known from the Irish east coast.

The crustacean *Monocorophium sextonae* continues to expand its range occurring on the southern and the eastern coasts but remains unknown on the western coast. In comparison, the Pacific amphipod *Caprella mutica* now occurs on east, south and west coasts. It was abundant in Dun Laoghaire Harbour during the summer but no specimens were found over-winter despite extensive sampling (Minchin and Holmes 2006).

The tunicate *Styela clava* was found for the first time in the Owenabue Estuary at the Royal Cork Yacht Club, Crosshaven, Cork Harbour, attached to the hulls of two cabin cruisers one of which had been idle over two years. Specimens were found on hulls of craft in Marloge, Cork Harbour and Dun Laoghaire Harbour. While the species was known from the innermost part of Cork Harbour (Minchin and Duggan 1988), their presence at Crosshaven extends the known range within the harbour. With recent expansions to several areas in Ireland (Minchin et al. 2006b) it is likely to extend its range further. All present and previous collections and observations have been of small numbers. However, there are conditions when this species can cause extensive economic damage to the hanging culture of some molluscs (Bourque et al. 2003).

Species not found in the survey

The Pacific tunicate *Perophora japonica* was first described in Britain from the Fleet on the south coast (Baldock and Bishop 2001) and since then has appeared in south-west Wales (Bishop et al. 2003). The species is easily identifiable and may yet be found in Ireland.

The slipper limpet *Crepidula fornicata* has been recorded as being established in Ireland at one time but no populations are now known to exist. The species is present on the south coast of Britain, south-west and North Wales. Small males have been found in low numbers associated with imports of half-grown Pacific oysters from France arriving to Waterford Harbour since 2000. These will have been imported in mesh bags, none were found following some months of cultivation and had probably become crushed within the oysters bags. Small green crabs were regularly associated with imported oyster consignments and this may be a route for the entry of the Pacific grapsid

crabs *Hemigrapsus penicillatis* and *H. sanguineus*. These crabs are normally found on shores and it is unclear whether they are likely to be found on floating pontoons. Although *Crassostrea gigas* supports a large oyster fishery in Ireland, and apart from a small number of settled individuals being found in the wild, it is not known to recruit in Irish coastal waters. Nevertheless, there are concerns about large settlements elsewhere in northern Europe in The Netherlands and in Germany. Some settlements are also recorded from the south coast of Britain with rare settlements known from North Wales.

Chinese mitten crabs *Eriocheir sinensis* were found for the first time in Ireland in Waterford Harbour during 2006 (Minchin 2006b and J Caffrey pers. comm.). The nearest region where they are established is in the Thames River. Chinese mitten crabs are often recorded in small numbers in many north European ports. However, if introduced and established in Waterford Estuary the species may have consequences for inland fisheries. Since the time of this survey some more specimens have been collected in the same estuary (J Caffrey pers. comm.)

The north-west Pacific kelp *Undaria pinnatifida* is likely to arrive in Ireland but none were found on this occasion. It would be expected to be found attached to floating pontoons.

Assessment of the method

The survey method, by familiarisation of the species from photographs, was effective in finding targeted species that had not been seen before by a researcher. The survey revealed potential pests: *Didemnum* sp., *B. violaceus*, *C. eumyota*, *S. clava*, *F. enigmatic*us, and *S. muticum*. The majority of new distribution records were from the Irish Sea coast and it is likely that further species may be found at Carlingford. The method is likely to be more useful as more marinas are constructed. This method will provide for a better rapid coastal coverage and at low cost. It would seem practical that a larger number of species could be targeted in a survey of this nature. There is every possibility that some targeted species will have been overlooked; but if present in moderate abundance and not forming isolated clusters they would be expected to be seen.

The survey method has shortcomings. Although mobile species are found within the fouling biota (including decapoda, amphipoda, annellida, nematoda, copepoda, flatworms, and some fishes) the majority of the species found were sessile or adherent. The targeted crab species may not have been found in this study as these are more usually found on shores or over sediments or other habitat types. Highly mobile species, such as fishes, are less likely to be found in such surveys. The use of grabs, baited traps and light traps are likely to reveal more alien species if used.

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Annex 1. Target list of species searched for during the 2005-2006 Irish survey.

Species	Sampling level	Nearest known region where established	Reference
Colpomenia peregrina Sauvageau, 1927	1	Ireland	Minchin 1991
Undaria pinnatifida (Harvey) Suringar, 1873	1	S coast of Britain	Fletcher & Farrell 1999
Sargassum muticum (Yendo) Fensholt, 1955	1	Ireland	Boaden 1995
Balanus amphitrite Darwin, 1854	2-3	S North Sea	Eno et al. 1997
Balanus improvisus Darwin, 1854	2-3	Ireland	Minchin 2004
Botrylloides violaceus Oka, 1927	1-2	S coast of Britain	JDD Bishop pers. comm.
Caprella mutica Schurin, 1935	1-3	Ireland	Tierney et al. 2004
Corella eumyota Traustedt, 1882	1-2	S coast of Britain	JDD Bishop pers. comm.
Crassostrea gigas Thunberg, 1793	2	Ireland	de Grave et al. 1998
Crepidula fornicata Linnaeus, 1758	2	Wales	Minchin et al. 1995
Didemnum sp	1	Northern France	Lambert pers. comm.
Elminius modestus Darwin, 1854	1	Ireland	O'Riordan 1996
Eriocheir sinensis H. Milne-Edwards, 1853	2	Thames River, Britain	Clark et al. 1998
Hemigrapsus penicillatus (de Haan, 1835)	2	Northern France and The Netherlands	Gollasch 1999
Hemigrapsus sanguineus (de Haan, 1853)	2	The Netherlands	d'Udekem d'Acoz and Faasse 2002
Ficopomatus enigmaticus (Fauvel, 1923)	1-3	Ireland	Minchin 2004
Monocorophium sextonae (Crawford, 1937)	2-3	Ireland	Costello 1993
Perophora japonica Oka, 1927	2	SW Wales	Bishop et al. 2003
Rhithropanopeus harrisii (Gould, 1841)	2	S Wales	D Minchin pers. ob. 2005
Styela clava Herdman, 1882	1-2	Ireland	Minchin et al. 2006b

Annex 2. Distribution of sampling sites in Ireland in 2005-2006 and records of non-native species found. New species records appear in bold.

Map ref.	Location	Location coordinates		Dates of surveys	Species present	Dominant fouling organisms
		Latitude,°N	Longitude,°W			
1	Carlingford marina	54°03.01'	06°11.27'	03.08.2005 28.06.2006	***B. violaceus, C. mutica,*** ***C. eumyota, Didemnum*** *sp.,* *E. modestus,* ***M. sextonae,*** ***S. muticum***	mussels, tunicates
2	Malahide marina	53º27.26'	06º09.21'	12.10.2006 05.07.2006	***B. violaceus, Didemnum*** *sp.,* *E. modestus.* ***M. sextonae***	mussels
3	Howth marina	53º23.35'	06º03.68'	17.04.2005 18.01.2006 05.07.2006	*E. modestus*	tunicates
4	Poolbeg marina	53º20.40'	06º12.50'	05.07.2006	***F. enigmaticus***	barnacles
5	Dun Laoghaire marina	53º17.82'	06º08.08'	20.08.2005 18.01.2006 05.07.2006	***C. mutica, C. eumyota,*** *M. sextonae,* ***S. clava****, E. modestus*	tunicates
6	Arklow marina	52º47.72'	06º08.66'	07.07.2006	***F. enigmaticus****, E. modestus*	barnacles
7	Kilmore Quay marina	52º10.46'	06º 35.40'	07.07.2006	No alien species recorded	tunicates
8	Waterford marina	52º15.64'	07º06.28'	20.04.2006	*B. improvisus*	barnacles
9	Marloge marina,	51°52.02'	08°12.34'	17.06.2006	***C. mutica, C. eumyota,*** *E. modestus, M. sextonae, S. clava*	mussels, tunicates
10	Royal Cork marina	51º48.28'	08º18.25'	21.06.2006	*E. modestus,* ***M. sextonae, S. clava***	mussels
11	Crosshaven boatyard marina	51º48.32'	08º17.39'	21.06.2006	*E. modestus*	mussels
12	Kinsale marina	51º42.10'	08º31.05'	21.06.2006	*E. modestus*	mussels
13	Castlepark marina	51º41.78'	08º30.65'	21.06.2006	*E.modestus*	mussels
14	Schull pontoon	51º31.70'	09º32.89'	21.06.2006	***C. peregrina****, E. modestus*	mussels
15	Cahirciveen marina	51º56.54'	10º14.04'	21.06.2006	No alien species recorded	mussels
16	Dingle Marina	52º08.29'	10º16.67'	20.06.2006	*E. modestus*	mussels
17	Fenit marina	52º16.25'	09º51.75'	31.03.2005 20.06.2006	***C. eumyota****, E. modestus,* ***S. clava, H. lineata***	tunicates
18	Kilrush marina	52º38.10'	09º29.67'	02.06.2005	*B. improvisus, F. enigmaticus*	varied
19	Rosroe pontoon	53º37.40'	09º 52.25'	03.07.2006	*E. modestus*	mussels
20	Mullaghmore pontoon	54°27.78'	08°26.23'	08.08.2005	No alien species recorded	mussels
21	Mulroy pontoon	55º13.38'	07º42.38'	29.06.2006	No alien species recorded	mussels
22	Swilly marina	55º05.13'	07º28.33'	29.06.2006	*E. modestus*	tunicates
23	Coleraine marina	55º07.60'	06º40.39'	29.06.2006	No alien species recorded	light fouling
22	Ballycastle marina	55º12.40'	06º16.38'	29.06.2006	No alien species recorded	mussels, tunicates
25	Carrickfergus marina	54º42.65'	05º48.80'	29.06.2006	***C. eumyota, M. insidiosum***	varied
26	Bangor marina	54º39.86'	05º40.19'	28.06.2006	*E. modestus*	mussels, tunicates
27	Donaghadee marina	54º39.10'	05º30.00'	28.06.2006	No alien species recorded	
28	Portaferry marina	54º22.57'	05º31.79'	28.06.2006	*S. muticum, E. modestus*	mussels
29	Ardglass marina	54º15.51'	05º36.50'	28.06.2006	***S. muticum****, E. modestus*	mussels