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Colonization of an artificial reef in south-west England—ex-HMS 'Scylla'

KEITH HISCOCK[1], SALLY SHARROCK[2], JAMES HIGHFIELD[3] AND DEBORAH SNELLING[4]

[1]Marine Biological Association, Citadel Hill, Plymouth PL1 2PB, UK, [2]Seasearch, 19 Hawthorn Drive, Wembury, Plymouth PL9 0BE, UK, [3]Plymouth Marine Laboratory, Prospect Place, West Hoe, Plymouth, Devon, PL1 3DH, UK, [4]National Marine Aquarium, Rope Walk, Coxside, Plymouth, PL4 0LF, UK

An ex-Royal Navy frigate, HMS 'Scylla', was placed on the seabed in Whitsand Bay, south Cornwall on 27 March 2004. After five years, the reef supported a mature steel wreck community. The colonization of the reef showed wide fluctuations in species abundance in the first two years but, by 2006, most species that dominated or characterized the reef after five years had settled. Significant colonization events included settlement of barnacles, tubeworms and hydroids within a month and remarkably high settlements of the sea urchin Psammechinus miliaris *and the queen scallop* Aequipecten opercularis *in the first year together with starfish* Asterias rubens*, solitary sea squirts and ephemeral algae. The plumose anemone* Metridium senile*, a characteristic species of wrecks, arrived in late summer 2004 but the widely distributed dead man's fingers* Alcyonium digitatum *was not observed until spring 2005. Wrasse were slow to colonize the reef but were established in small numbers by the end of 2007. Sea fans,* Eunicella verrucosa*, were first observed in August 2007. The species count for the reef stood at 263 taxa by the end of March 2009. The inside of the reef remained poorly colonized even after five years. Areas coated with tributyltin (TBT) antifouling paint only had colonization where the paint had flaked-off or on non-toxic paint markings, but with some indication that colonization may be occurring by a very few species especially near to non-TBT areas. Many species characteristic of natural reefs had not settled and neither do they occur on older wrecks including branching axinellid sponges, some cushion sponges and the yellow cluster anemone* Parazoanthus axinellae*. The artificial reef developed a community that was distinctly different to nearby natural rock reefs and such artificial structures should not be considered as a replacement for damaged or destroyed natural habitats.*

Keywords: artificial reef, shipwreck, colonization, seasonal change, TBT, community development

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INTRODUCTION

Studies of colonization of new artificial surfaces help us to answer science questions concerned especially with dispersal of organisms and likely colonization/recovery rates that are important information for marine environmental protection and management. They help us to understand which species settle readily, which species do not populate new surfaces or colonize very slowly, the time for a community to reach maturity (at least visually), the similarity (or otherwise) of communities on natural and artificial surfaces, and the growth rates of species. Such studies can also help to understand likely recovery rates where natural communities have been damaged and, where antifouling paints have been used on artificial surfaces, if and after how long colonization can occur there. Artificial habitats have often been placed to enhance fisheries or recreational SCUBA diving and have been seen as enhancing biodiversity or as a way of restoring degraded marine ecosystems (see, for instance, Seaman, 2007).

Studies of colonization have been undertaken worldwide and often involve deployment of concrete structures with an associated programme of monitoring settlement (see, for instance: papers in Jensen *et al.*, 2000; Moura *et al.*, 2007; Nicoletti *et al.*, 2007; Relini *et al.*, 2007). In the north-east Atlantic, the biogeographical area in which the study described here was undertaken, colonization on oil industry structures and, more recently, offshore wind farm pilings and other energy devices has been studied. Whomersley & Picken (2003) provide a summary of long-term dynamics of fouling communities on offshore installations. Shipwrecks are another source of information on colonization of artificial surfaces. Leewis *et al.* (2000) described five different communities occurring on wrecks in the southern North Sea off Holland. Detailed descriptions of the communities living on steel wrecks include those of Zintzen *et al.* (2008a) off the Belgium coast and Hiscock (1981) of a wreck off Lundy, south-west England. More detailed unpublished data are also available from the Lundy wreck. Jensen & Collins (1995) undertook a detailed and systematic study of colonization on an artificial reef of concrete blocks in Poole Bay and Leewis & Hallie (2000) of a reef of basalt boulders off the coast of Holland. Most recently, Langhamer *et al.* (2009) describe colonization of mainly concrete surfaces at a test park for wave power devices on the Swedish west coast. 'Scylla' provided the opportunity to describe colonization on a large steel structure in south-west England.

Comparisons of artificial with natural reefs are few and many of the studies of colonization on artificial structures are short term and often on small settlement panels so that

Corresponding author:
K. Hiscock
Email: khis@mba.ac.uk

the species assemblages recorded have had insufficient time and are not subject to the same processes to become similar to natural rock communities. Perkol-Finkel & Benayahu (2005) report distinct differences between coral reef communities and an artificial reef community after ten years. In another study, Perkol-Finkel *et al.* (2006) compared natural coral reef communities and those on a 119-year old shipwreck and concluded that, even after a century, an artificial reef will mimic its adjacent natural communities only if it possesses structural features similar to those of the natural surroundings and that, if the two differ structurally, their communities will remain distinct. Connell (2001) found that different communities developed on artificial habitats compared to natural rock habitats in studies using the same types of settlement panels on pontoons, pilings and natural rock reef habitats in Sydney, Australia. For seabed habitats in Britain, analysis of survey data from the Marine Nature Conservation Review of Great Britain (Connor *et al.*, 2004) identified a distinctive biotope for steel wrecks as '*Alcyonium digitatum* and *Metridium senile* on moderately wave-exposed circalittoral steel wrecks'. For the study of colonization 'Scylla' provided the opportunity to see if a newly placed structure developed into that biotope and also to compare communities on 'Scylla' with those on nearby bedrock.

Parts of the hull of 'Scylla' were coated with tributyltin (TBT) antifouling paint. TBT has been found to have chronic effects on a wide variety of aquatic organisms (see Arai *et al.*, 2009), including decreasing species diversity and abundance in the marine environment (see, for instance, Smith *et al.*, 2008 for the Crouch estuary). A study of colonization of 'Scylla' would help to understand the extent to which the anti-fouling coating remained effective and on which species.

After 'Scylla' had been on the seabed for five years, it was considered timely to record the sequence of colonization in a way that will be useful to those concerned with understanding the character and dynamics of marine communities and the likely marine biological outcomes of any future placements of a steel reef.

MATERIALS AND METHODS

On 27 March 2004, an ex-Royal Navy frigate, HMS 'Scylla', was placed on the seabed in Whitsand Bay, south Cornwall at position 50°19.64′N 4°15.20′W and depth to the seabed 20 m below chart datum. The placement had been licensed under UK Food and Environmental Protection Act regulations. The vessel had been prepared for placement by, amongst other removals, cleaning of potential contaminants, removal of high parts of the superstructure, sealing-off potentially dangerous areas and cutting many large holes in the sides for diver access. After careful consideration, Defra (the Department for Environment, Food and Rural Affairs) decided that there was no requirement for the anti-fouling paint to be removed from 'Scylla' before its placement.

Following the placement of 'Scylla', it became clear that the monitoring that had been put in place to record colonization was not reporting many of the most significant events. To ensure that a record was kept of colonization, a simple methodology was developed that involved recording occurrence of conspicuous species, abundance of those species, seasonal occurrences/changes and growth rates of organisms. The first two authors together with colleagues and using the Seasearch programme of volunteer divers maintained a record of when and what species were seen, aided by acquisition of images. Those observations had started a few days after placement of the vessel. However, the limited personnel, financial and diving resources available meant that the survey was always going to be descriptive and opportunistic, but accurate in terms of identification of species.

Records were made and images were collected on all of the dives that the authors undertook on the reef. Samples were taken when identification of a species required confirmation. The dives were undertaken about once a month in the first 18 months following placement. Subsequently, dives were about every 10 weeks (K.H. undertook 33 dives, S.S. 22 dives). This paper describes colonization and succession over the five years since placement (first dive 30 March 2004 to last dive 18 March 2009).

In addition to recording abundance of conspicuous species, samples of animal and algal turf to identify smaller associated animal species were collected on 30 August 2006 from the foredeck of 'Scylla' using a suction sampler similar to that described by Hiscock & Hoare (1973). In the subsequent week, the suction sampler was used occasionally to collect turf samples but most were collected by scraping on vertical and overhanging surfaces and allowing the scraped material to drop into a bag which was then sealed. Each area sampled was about 0.1 m^2 and nine samples were fully analysed for species present and numbers of individuals. The samples were fixed in 4% formalin and then washed in water before being picked and identified and finally stored in 70% IMS.

To compare the community present on 'Scylla' by the end of summer 2008 with species that occur on natural bedrock reefs, records from sites surveyed off the open coast from off Plymouth Sound to Stoke Point in South Devon were inspected and a representative abundance, taking account of knowledge of the first two authors of the area, noted for lower infralittoral and circalittoral habitats. The records were from Hiscock & Moore (1986) and from a download of records held by the UK National Biodiversity Network for surveys undertaken in 1996 by the Devon Wildlife Trust.

Where abundances of species are referred to, the notations approximately follow the SACFOR (Superabundant, Abundant, Common, Frequent, Occasional, Rare) scale (Connor & Hiscock, 1996) and are for areas on which those species occur and which were not coated in antifouling paint.

The extent of TBT antifouling paint was noted when the hull of the vessel was inspected (by the first author) immediately after being placed in dry dock at Devonport, Plymouth, in November 2003. The vessel had been moored at Portsmouth for many years prior to transfer to Plymouth. Advice from paint specialists in the dockyard suggested that the TBT paint coating was then more than 15 years old. The impact of TBT antifouling paint on colonization of the reef was addressed by observation of whether organisms settling on the reef also colonized areas coated with TBT paint and adjacent to those areas.

RESULTS

All of the taxa observed, collected and identified from photographs are listed in Appendix 1 together with the date first

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recorded and notes on abundance, growth rates (where observed) and any fluctuations in occurrence. Authorities and recent synonyms of species are given in Appendix 1. Appendix 2 is a comparison of species reported from natural bedrock surfaces in similar subtidal habitats to 'Scylla' with abundances of conspicuous species on horizontal, vertical and inner surfaces of 'Scylla'. Appendices 1 and 2 are available in the electronic version of this paper on http://journals.cambridge.org/action/displayJournal?jid=MBI.

Figure 1 illustrates the annual increase in number of taxa observed or reported on the reef. Figure 2 illustrates the colonization sequence for the most characteristic (of different stages of settlement on 'Scylla' or of inshore reefs in the area) conspicuous species.

Colonization by conspicuous species

After initial settlement of opportunistic species (filamentous algae, hydroids, serpulid polychaetes and barnacles especially) in the first one or two months (Stage 1), there was a steady recruitment and growth of species during the first summer including of species that were not necessarily there for the long-term (*Psammechinus miliaris*, *Mytilus edulis* and *Aequipecten opercularis*) (Stage 2). During the first winter after placement, die-back of some seasonally abundant species occurred but also grazing by starfish and sea urchins removed much of the settlement of barnacles and tube worms so that, by late winter, large areas of the reef were again bare (Stage 3). Spring and summer of the second year completed recruitment of most of the species that were to become visually dominant although their abundance and size was low. The sea urchins also declined in abundance removing significant grazing pressure (Stage 4). After two years, winter reductions in abundance of some species were no longer part of succession but natural variability. The next stage was a prolonged period (spring 2006 to summer 2008) when species that were to become dominant grew or expanded in abundance and a very few additional species that were to become conspicuous settled (*Urticina felina*, *Eunicella verrucosa* and *Cellepora pumicosa*) (Stage 5). From the end of the summer of 2008, the reef community was composed mainly of long-lived species or there had been the same seasonal abundances of ephemeral species as in previous years so that the reef community was considered 'mature' (Stage 6).

The time of settlement, seasonal occurrence, location and growth of the most visually abundant species are noted below.

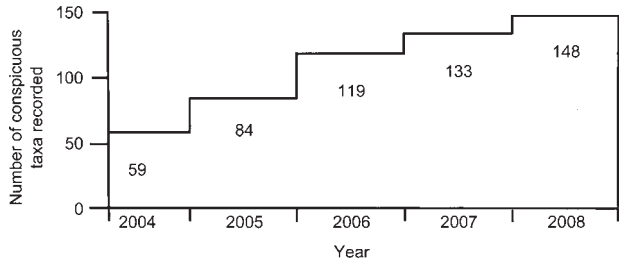

Fig. 1. Increase in the numbers of taxa (mostly identified to species) observed in each year. The taxa are ones that have been recorded by *in situ* survey including from photographs and exclude species identified as genus only and where the same genus is identified elsewhere to species. One hundred and forty-eight taxa are included out of a total of 263 taxa identified by the end of March 2009.

ALGAE (PLANTAE, CHROMISTA AND RHODOPHYCOTA)

Algae showed considerable seasonality in their presence with very sparse occurrence in winter. The earliest algae to be recorded were ectocarpoid (*Hinksia*) species which, on inspection in the laboratory, had many diatom species associated with their filaments. The kelp *Saccorhiza polyschides* settled early on and was noted as 15 cm high on 9 June 2004. Another early colonizer was *Cutleria multifida* as its '*Aglaozonia*' encrusting stage which was first noted in June 2004. In 2004 and 2005, there were very few foliose red algae although filamentous reds were visually dominant in spring through to autumn with *Pterothamnion plumula* and *Polysiphonia elongata* abundant on decks. *Heterosiphonia plumosa* and unidentified Ceramiales were present in samples in July 2004 and *H. plumosa* was noted as 'secondarily dominant' in May 2008. *Brongniartella byssoides* was recorded in 2005 and 2006 and was the dominant red alga in 2007 and 2008. Other conspicuous species that were common on the upward parts of the vessel from spring through to early autumn were *Dictyopteris polypodioides* (=*D. membranacea*), *Dilsea carnosa* and *Kallymenia reniformis*. The fleshy red alga *Scinia turgida*, usually characteristic of disturbed habitats, was present in 2006 and common on decks in summer 2007. *Halopteris filicina*, a frequent species on nearby reefs, was not observed until 2008. In winter, *Callophyllis lacinata* remained conspicuous and *H. filicina* persisted. The midribs of *Delleseria sanguinea* were all that was visible of that species in December but by February new fronds had grown. In early December 2008, there were many very small unidentified algal fronds on the foredeck when silt was swept away, suggesting the beginning of new growth.

SPONGES (PORIFERA)

Calcareous sponges (*Leucosolenia botryoides* and *Sycon ciliatum*) were the first sponge species to be seen and occurred during late winter early in 2005. Both species appeared to be present in greatest abundance or only in winter to early summer. Demospongiae, *Halichondria bowerbankii* and *Oscarella lobularis*, were much less abundant but were seen sporadically from summer 2006 with many colonies of *O. lobularis* present by 2009. *Hemimycale columella* and *Suberites carnosus* were seen for the first time in 2008.

ANTHOZOA (CNIDARIA: ANTHOZOA)

One of the earliest colonizers was the anemone *Sagartia troglodytes* var. *decorata*, occurring frequently by mid-summer 2004 and still present at the end of 2008. Plumose anemones, *Metridium senile*, characteristic of wrecks in the area, were first observed in late summer of the first year. Elegant anemones, *Sagartia elegans*, also a characteristic species of steel wrecks in the area, were first seen in mid-summer 2005 and by the end of the summer in 2006 were well established with large groups and all of the different colour varieties present. The dahlia anemone, *Urticina felina*, which was abundant on 'Scylla' on arrival from Portsmouth, was first seen at the end of August 2006. It is not a common species off Plymouth and numbers remained low on the reef for the rest of the study period although, based on observation of visible individuals, there may have been some increase in abundance after summer 2008. Jewel anemones, *Corynactis viridis*, were first observed in summer 2004 when they had

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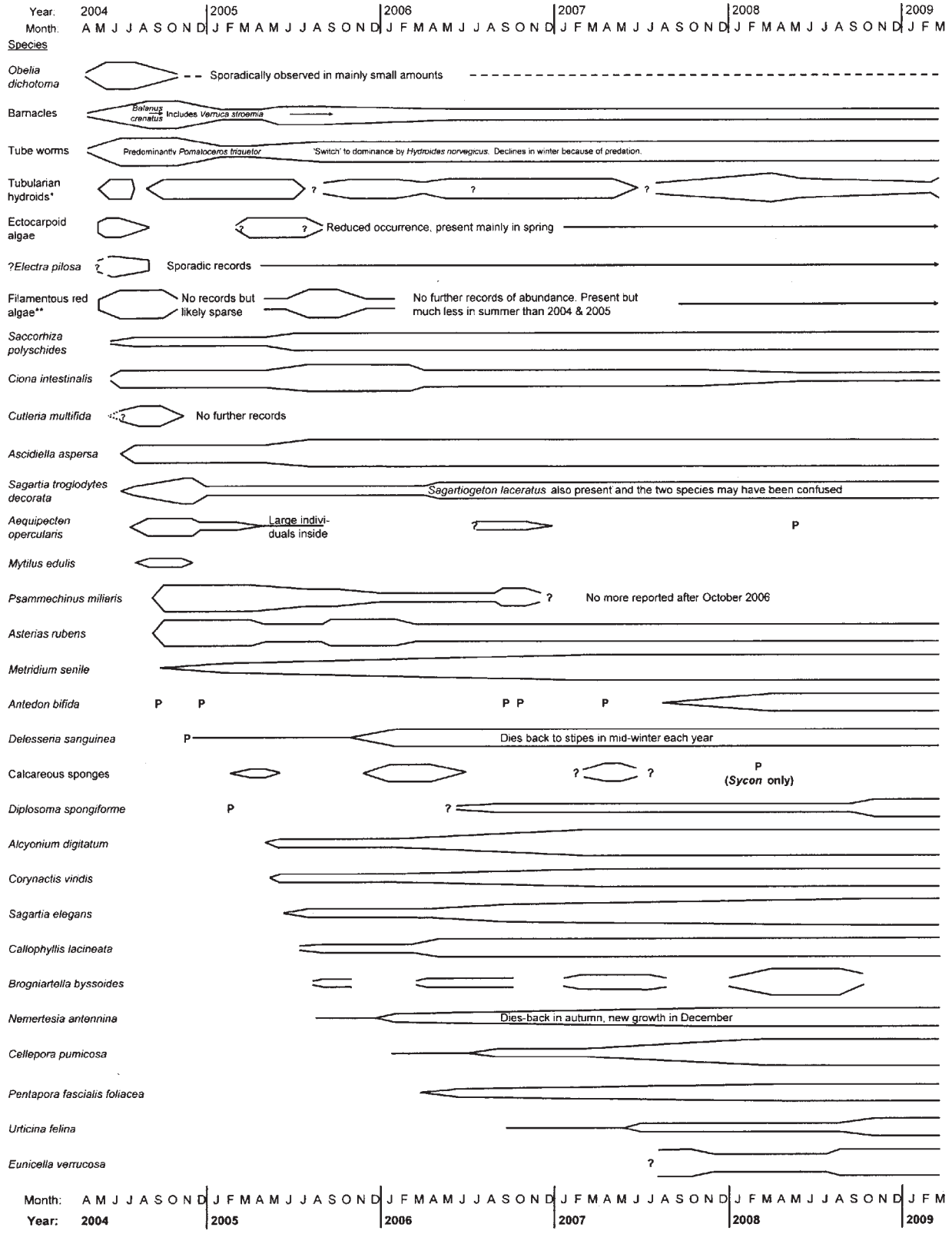

Fig. 2. The arrival, growth and succession of major colonizing species during the first five years of the establishment of a reef community on 'Scylla'. A single line indicates present but very rarely recorded. The width of the histogram is illustrative of abundance (on the surfaces preferred by each species) on a three-point scale approximating to: 1. Rare and Occasional; 2. Frequent and Common; and 3. Abundant and Superabundant (see Appendix 9 of Hiscock, 1996). P, present. *Tubularian hydroids were mainly *Ectopleura larynx* with some *Tubularia indivisa*. **Filamentous red algae were not identified to species on all occasions but were mainly *Pterothamnion plumula*, *Polysiphonia elongata* and unidentified Ceramiales. *Heterosiphonia plumosa* was noted as present in July 2004 and as secondarily dominant in May 2008 but there are insufficient records to plot abundance through time.

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already started to form patches of many individuals produced by asexual division and therefore of the same colour. They occurred mainly on the outer part of the vessel but also inside. The Devonshire cup coral *Caryophyllia smithii* was first observed in September 2005. The coral was still only occasional on the reef after five years and only one has been seen colonized by the barnacle *Bostrychia anglicum*, which lives only on stony corals.

The common alcyonacean *Alcyonium digitatum* was first observed in early summer 2005 and grew to nearly full size in one year although it had only just started to branch in summer 2006. By early 2009, *A. digitatum* had become a visually dominant part of the reef community. The more unusual soft coral *Alcyonium glomeratum*, which occurs on other wrecks in the area as well as on rock reefs, was first observed in April 2007. It remained occasional on the reef at the end of the study. Sea fans, *Eunicella verrucosa*, which are a major feature of the marine life on most wrecks in the area, were especially searched for and eventually found on 12 August 2007, in the fourth year of the reef. There also appeared to be a settlement in summer 2008. Sea fans occur on the bedrock reefs within 50 m of 'Scylla'. Growth was initially rapid and by the end of the first winter, individuals were up to 6 cm high and some had started to branch. By winter 2008–2009, the largest individuals were about 17 cm high and some had several branches.

HYDROIDS (CNIDARIA: HYDROZOA)

Obelia dichotoma was recorded within a month after placement of the vessel. The most conspicuous hydroids to settle early in colonization were Tubulariidae. Both *Tubularia indivisa* and *Ectopleura* (=*Tubularia*) *larynx* were present but were often difficult to tell apart and were most likely interwoven in places. *Ectopleura larynx* was the most abundant. Both species suffered the attentions of facellinid sea slugs which devastated colonies over a few days. Once kelp plants had settled, they were readily colonized by *Obelia geniculata*. A few colonies of the widespread *Sertularella gayi* were observed in early 2006. The widespread antenna hydroid *Nemertesia antennina* was first observed in August 2005 and, in autumn 2006 was still only present in small numbers but in 2007 was common and by 2008 was visually dominant on the decks and some internal horizontal surfaces together with occasional *Nemertesia ramosa*. *Nemertesia* spp. died-back in early winter but showed new growth by about December.

JELLYFISH (CNIDARIA: SCYPHOZOA)

The schyphistomae of *Aurelia aurita* were frequently seen.

GASTROPOD MOLLUSCS (MOLLUSCA: GASTROPODA)

Shelled gastropods have mainly been recorded from samples although some small species (*Nassarius incrassatus* and *Rissoa parva*) may be sufficiently abundant and conspicuous to be seen *in situ*. An unusual find (for hard substratum) was of six juvenile *Aphorrhais pespelecani* in a 0.1 m^2 suction sample from the foredeck (*A. pespelecani* are normally characteristic of muddy sediments). A notable record was of the non-native slipper limpet *Crepidula fornicata* collected in samples in September 2006. Sea slugs were sometimes numerous, feeding mainly on Tubulariidae. The most abundant species appeared to be *Flabellina* (=*Coryphella*) *browni*, *Facelina auriculata* and *Facelina bostoniensis*. However, appearance in massive numbers has been 'fleeting' and may last as little as a week in mid-summer. The nudibranch *Trapania maculata*, which is rare in Britain, was also recorded in one of the scrape samples. *Trapania maculata* is a southern and Mediterranean species which is at its northern most limits in Britain with records from Portland and the Lleyn Peninsula (Picton & Morrow, 1994).

BIVALVE MOLLUSCS (MOLLUSCA: BIVALVIA)

Mussels, *Mytilus edulis*, occurred and grew to a length of about 3 cm during the first summer but only in a few locations. However, they were not seen subsequently except as spat in samples. It is suspected that they were consumed by starfish, *Asterias rubens*. There was a remarkable settlement of large numbers of queen scallop *Aequipecten opercularis* from July to August 2004. Individuals were 15–20 mm across by November but there were much smaller numbers, most likely because of migration away from hard substratum onto sediment off the reef. Most other bivalve molluscs were cryptic and may be more abundant than *in situ* records suggest. For instance, the saddle oyster *Heteranomia squamula* was rarely observed in photographs and samples but was most likely common on hard substratum. *Hiatella arctica* is a nestling species that was common in algal or animal turf samples but was not recorded during *in situ* surveys.

POLYCHAETE WORMS (POLYCHAETA)

The most conspicuous early settlers on 'Scylla' were the serpulid tubeworms *Pomatoceros triqueter* (*P. lamarkii* have also been recorded). Individuals grew rapidly and soon dominated parts of the reef during summer 2004 but were widely separated by mid-winter 2004–2005, most likely having been grazed by sea urchins, *Psammechinus miliaris*. *Pomatoceros triqueter* appeared to be largely displaced in 2005 by a similar tube worm, *Hydroides norvegicus*. Both were significant parts of the fauna and dominant in places by the end of 2008. The peacock worm *Sabella pavonina* was first seen in September 2004 and was occasional by the end of 2008. A chaetopterid (parchment tube) worm (*Chaetopterus variopedatus* was identified from one sample in September 2006) was common on decks in December 2008 and could be seen when silt was swept away. Significant numbers of small cryptic polychaete species were present in the samples collected in September 2006.

BARNACLES (CRUSTACEA: MAXILLOPODA: CIRRIPEDIA)

Balanus crenatus was one of the earliest species to settle, seen four weeks after placement and was conspicuous in the first year but, as with *P. triqueter*, grazed by sea urchins and starfish in the first winter. *Verruca stroemia* settled in 'massive' numbers apparently in early June 2004. There were probably steady but low numbers of both species and they have not been a conspicuous member of the fauna since 2004.

DECAPODS (CRUSTACEA: MALACOSTRACA: DECAPODA)

Crabs, lobsters and shrimps were very slow to settle. There were early records of spiny spider crabs, *Maja squinado* that had no doubt encountered the reef whilst moving over the surrounding seabed. Edible crabs, *Cancer pagurus*, were seen

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in the first year but remained only occasional and present in fissures and openings. Prawns, *Palaemon serratus* had colonized the reef by 2005 and continued to be frequent on the roofs of swim-throughs. The long-clawed porcelain crab, *Pisidia longicornis* was present in samples and is most likely a common member of the cryptic fauna. Small *Inachus* species also seemed to be widely occurring.

AMPHIPODS (CRUSTACEA: MALACOSTRACA: AMPHIPODA)

The tubicolous amphipods *Jassa falcata* and *Monocorophium sextonae* were abundant from late spring through to autumn; the former especially on structures that are subject to strong currents. Several *Astacilla danmoniensis* were observed emerging from muddy tubes from samples collected on 10 December 2008 from algal stumps. *Ericthonius punctatus* was also abundant in those samples. Caprellid amphipods were abundant and were identified as several *Caprella* species together with the similar *Pseudoprotella phasma* and *Phtisica marina*. They were particularly conspicuous in photographs of hydroids. Several other amphipods were identified.

BRYOZOA

A sea-mat, most likely *Electra pilosa* but samples were not collected, occurred in early June 2004, and formed conspicuous star-shaped colonies on fabric lining the bridge and on surfaces elsewhere. As soon as there were mature kelp fronds to colonize, *Membranipora membranacea* occurred. The orange pumice bryozoan *Cellepora pumicosa* was not seen on the reef until January 2006 but became abundant by August 2007 and was a visually dominant species on the outer surfaces of the reef throughout 2008. Similarly, Ross 'coral', *Pentapora fascialis foliacea*, was first seen in January 2006 and, by the end of 2008, the fragile colonies were about 20 cm across but mainly restricted to places protected by protruding structures. However, colonies that had just started to produce foliose structures were frequent on the foredeck in early March 2009. Patches of encrusting orange Bryozoa, identified as *Schizomavella linearis* in samples, occurred widely on open surfaces. Erect branching Bryozoa are not a common part of the reef community to the west of Plymouth and have not colonized to any great extent on 'Scylla', although several species have been recorded. Although common on many wrecks and rock reefs in the area, *Alcyonidium diaphanum* has been observed only once from 'Scylla'.

ECHINODERMS (ECHINODERMATA)

The spiny starfish *Marthasteris glacialis* appeared on 'Scylla' shortly after placement, believed to be individuals wandering over the seabed and encountering the reef. The common starfish, *Asterias rubens*, settled in large numbers in autumn 2004 and has persisted since then but as mostly small individuals. The green sea urchin *Psammechinus miliaris* settled in large numbers in the first year. Those numbers dwindled during early 2005 until, by mid-summer, few could be seen but a 'midden' of urchin shells suggested they had been predated. There was no apparent settlement in 2005 but, in 2006, there were several 8–10 mm individuals in a scraped sample. The feather star *Antedon bifida* was slow to establish and, although individuals were seen occasionally, it was not until summer 2007 that large numbers of small individuals were seen. By 2008, large numbers of large individuals colonized spars inside the reef and, in late 2008, were a visually dominant species on the grid afterdeck. The widespread sea urchin *Echinus esculentus* was very slow to colonize (or at least to be seen on open surfaces) and the maximum number seen in one dive has been three. The cucumarians *Leptopentacta elongata* and *Thyone fusus* were present in samples collected in September 2006.

ASCIDIANS (CHORDATA: TUNICATA: ASCIDIACEA)

Large solitary ascidians (*Ciona intestinalis* and *Ascidiella aspersa*) were the most conspicuous large species to settle and were first seen in June 2004. Numbers declined later that year probably as a result of depredations of starfish and urchins but large solitary ascidians remained a dominant part of the reef community, both on outer and inner surfaces at the end of 2008. Abundance of *C. intestinalis* appears to have reduced in 2008. *Ascidia mentula*, *Botryllus schlosseri* and *Diplosoma spongiforme* are other conspicuous ascidian species on the reef. *Stolonica socialis*, which is widely distributed on reefs in the area, was not observed until May 2008. One of the most notable species recorded was the non-native leathery sea squirt *Styela clava* which is not normally seen outside of Plymouth Sound. There have been several settlement events for *S. clava* based on appearance of small 'fresh' individuals.

FISH (CHORDATA: VERTEBRATA: PISCES)

Poor cod, *Trisopterus minutus*, were present on the reef within days of placement but have remained in small numbers since. Similarly, bib, *Trisopterus luscus*, which are a major feature of nearby wrecks, were not noted until August of the first year and remained present in only small numbers by the end of 2008. Pollack, *Pollachius pollachius*, had a similar 'slow start' but, by 2007, were abundant at the upper edges of the reef. Wrasse have been very slow to colonize the reef and were present in only small number during 2008. The abundance of pollack and wrasse declined on the reef during winter. Similarly, leopard spotted gobies, *Thorogobius ephippiatus*, were not seen until summer 2006 although suitable habitats (silty fissures and corners) had been present since 2004. There are many vagrant or migratory species that have colonized 'Scylla' for periods of time and then moved on.

Succession

Figure 2 illustrates occurrence, expansion of populations and, in some cases, decline of the most visually abundant species on 'Scylla' over five years since placement. 2005 and 2006 were years of large fluctuations and transition to a community dominated by species that were there for the long-term. Successional change in the first year after placement was dominated by the grazing activities of sea urchins and starfish which conspicuously removed barnacles and tube worms but probably also species that would have become abundant early on if grazing had not been so severe. The barnacle *Verruca stroemia* settled later than *Balanus crenatus* in the first year and took-over dominance by barnacles. The tube worm *Hydroides norvegicus* also became more conspicuously abundant after the first year than *Pomatoceros* sp. (p). Although it was the autumn of 2004 and the spring of 2005 that saw the arrival of two visually dominant species (*Metridium senile* and *Alcyonium digitatum* respectively) they were not

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to reach a density and size that made them dominant features until 2007. However, they did not have to out-compete or grow-over other species as far as we could tell as there were bare surfaces for them to colonize. Also, the demise of the *Psammechinus miliaris* sea urchins in 2005, most likely because wrasse had colonized the reef and eaten them, allowed significant settlement of a wide range of species. It was not until 2006 that foliose algae established in large amounts and a variety of species, albeit seasonally in spring and summer. The round domed colonies of *Cellepora pumicosa* were a late arrival and only became abundant in late 2007. One of the last major colonizers in the five years of study was, arguably, the most significant: the sea fan *Eunicella verrucosa* is a protected species in Britain. The 'Scylla' study shows that, if there are populations nearby, *E. verrucosa* can recruit readily but most likely not every year. The abundance of the solitary sea squirt *Ascidiella aspersa* had not apparently diminished after five years although that of another initial colonizer, *Ciona intestinalis*, had declined significantly by 2007 and 2008.

Effect of TBT coatings on colonization

In dry dock, the areas of hull coated with TBT anti-fouling paint were observed to be from about 1 m below the boot line and extended all over the steel hull except where there were divers lines (~10 cm wide black lines along the length of the hull) or fibreglass acoustic domes. The propeller shaft was also apparently painted with non-toxic paint. Observations in the dry dock were that the TBT coated parts of the hull were free of fouling.

Observations over the first five years of the vessel being on the seabed were that the TBT coated areas remained mainly free of colonization. Close inspection of images showed that, adjacent to areas where colonization was dense, some small patches of tubicolous amphipods occurred on the TBT coated areas which, in turn, appeared to become colonized by *Ectopleura larynx*. Under the stern, some *E. larynx* colonies appeared to be attached to TBT coated areas. Barnacle scars have also been observed in the same sort of area. Mobile species such as starfish and sea urchins have never been seen on the coated areas, although topknot *Zeugopterus punctatus*, have. Where paint has flaked-off, blistered to rusty metal or on areas coated with non-TBT paint, colonization by anemones, hydroids, alcyonaceans, barnacles, tube-building amphipods and ascidians was very dense and extended right up to the TBT coated areas.

Fate of the records

The records given in Appendix 1 have been entered into a Marine Recorder database and, once processed, they will be sent to the UK National Biodiversity Network (www.searchnbn.net) where they can be viewed and downloaded. Images, presentations and recording forms related to colonization of ex-HMS 'Scylla' are available from www.marlin.ac.uk. Specimens from the sampling exercise in September 2006 are held by Unicomarine Ltd. A set of dated digital images of species has been lodged with the Data Archive for Seabed Species and Habitats (www.dassh.ac.uk) at the Marine Biological Association.

DISCUSSION

Comparison with species present on nearby bedrock reefs

Comparisons of the communities that have developed on parts of 'Scylla' with natural hard substratum communities help to better understand the extent to which artificial reefs can replace or mimic natural reef communities. Such comparisons are, as pointed-out by Perkol-Finkel & Benayahu (2005), scarce. Our comparison of the conspicuous species present on natural bedrock reefs in the same area as 'Scylla' with those on different surfaces of the artificial reef is shown in Appendix 2. One hundred and twenty-two conspicuous species are listed in Appendix 2 of which 39 species recorded on bedrock reefs had not been recorded from 'Scylla' by the end of the study. Nine species were recorded on 'Scylla' but not the natural bedrock reefs. The species are listed in Table 1.

Species that were most notably absent from 'Scylla' included many sponges, especially axinellid sponges and some cushion sponges, and the yellow cluster anemone *Parazoanthus axinellae* that also do not occur on shipwrecks in the area that are more than 60 years old (personal observations). The abundance of some species on 'Scylla' was still low by the end of the study compared to on rock or shipwrecks. Colonization by the sea urchin *Echinus esculentus* had been slow and numbers remained low on 'Scylla' by the end of the study. However, on wrecks that are surrounded by sand (such as the Maine off Bolt Tail), sea urchin numbers are also very low. The same situation occurs for the sea cucumber *Holothuria forskali* which has not yet been seen on 'Scylla' and is sparse on wrecks surrounded by sediment. The absence of encrusting coralline algae is notable but some of the algae not recorded on 'Scylla' are ones that typically occur in the upper circalittoral zone and might not be expected to be present in the lower infralittoral conditions on the decks of the reef: *Myriogramme heterocarpum*, *Polyneura gmelinii* and *Rhodymenia pseudopalmata*. The conclusion by Perkol-Finkel *et al.* (2006) that even after a century an artificial reef will mimic its adjacent natural communities only if it possesses structural features similar to those of the natural surroundings, seems likely to apply also to artificial reefs in temperate waters but, furthermore, there may be species that are long-lived and slow growing or that have short larval dispersal times that should not be expected to colonize.

The species recorded from 'Scylla' but not on the rock reefs used in comparison are ones that, nevertheless, occur on rock reefs in different conditions. For instance, *Metridium senile* occurs on shipwrecks in the area and on offshore wave or tide-exposed rock reefs. *Antedon bifida* occurs in small numbers on some offshore reefs but, as with *Ectopleura larynx*, is abundant on some reefs in Plymouth Sound. *Oscarella lobularis* has been seen on reefs in Plymouth Sound but nowhere in the abundance that it has been seen on 'Scylla'. The fleshy red seaweed *Scinaia turgida* occurs on disturbed substrata such as cobbles. The occurrence on 'Scylla' of sometimes large amounts of the leathery sea squirt *Styela clava*, not normally seen outside of Plymouth Sound ('Scylla' is about 12 km from the Plymouth Sound breakwater), is notable. However, one individual has been seen (by K. Hiscock) on the wreck of the 'Rosehill' to the

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Table 1. Species recorded in inspected records from open coast bedrock reefs near Plymouth but not on 'Scylla' and species recorded on 'Scylla' but not on open coast bedrock reefs. ( )*, one unconfirmed record on 'Scylla'. Records from 'Scylla' are to 18 March 2009.

Species recorded from inspected records from bedrock reefs off the open coast near Plymouth but not on 'Scylla'		**Species recorded on 'Scylla' but not from inspected records from bedrock reefs off the open coast near Plymouth**
Algae	*Tethya citrina*	Algae
Calliblepharis ciliata	Sea anemones	*Scinaia turgida*
Carpomitra costata	(*Actinothoë sphyrodeta*)*	Sponges
Corallinacea indet. (pink encr.)	*Parazoanthus axinellae*	*Oscarella lobularis*
Cryptopleura ramosa (and as *Acrosorium uncinatum*)	Hydroids	Sea anemones
Drachiella spectabilis	*Abietinaria abietina*	*Metridium senile*
Halarachnion ligulatum	*Aglaophenia tubulifera*	*Sagartiogeton lacerata*
Myriogramme heterocarpum	*Halecium halecinium*	Hydroids
?*Myriogramme bonnemaisonii*	Polychaetes	*Ectopleura larynx*
Polyneura gmelinii	*Filograna implexa*/ *Salmacina dysteri*	Polychaetes
Rhodophyllis sp.	Crustaceans	*Sabella pavonina*
Rhodymenia pseudopalmata	*Homarus gammarus*	Echinoderms
Schottera nicaeensis	Molluscs	*Antedon bifida*
Sponges	*Calliostoma zizyphinum*	Ascidians
Amphilectus fucorum	Bryozoans	*Ciona intestinalis*
Axinella damicormis	*Parasmittina trispinosa*	*Styela clava*
Axinella dissimilis	Echinoderms	
Axinella infundibuliformis	*Aslia lefevrei*	
Ciocalypta penicillus	*Asterina gibbosa*	
Cliona celata	*Henricea* sp.	
Pachymatisma johnstonia	*Holothuria forskali*	
Polymastia boletiformis	*Pawsonia saxicola*	
Raspailia hispida	Ascidians	
Raspailia ramosa	*Clavelina lepadiformis*	
Stelligera stuposa		

west of 'Scylla'. Ascidians generally have short dispersal distances but there have been several settlement events for *Styela* based on appearance of small 'fresh' individuals on 'Scylla'. The absence of *Clavelina lepadiformis* and the 'late arrival' of *Stolonica socialis*, both commonly seen on rock reefs, may also be due to poor larval dispersal for those species.

Species expected but not yet seen or in low abundance on 'Scylla'

Species that are commonly seen on wrecks in the area out of Plymouth but not yet observed on 'Scylla' include the sandaled anemone *Actinothoë sphyrodeta* (although there is a possible sighting), the yellow cushion sponge *Cliona celata*, the painted topshell *Calliostoma zizyphinum* and the cotton spinner *Holothuria forskali*. Numbers of lobster, *Homarus gammarus*, on wrecks in the area are low but, as a species particularly looked for by divers, it is remarkable that none had been reported from 'Scylla'. Some species that occur abundantly on steel wrecks in the area out of Plymouth were still scarce on 'Scylla' by the end of 2008: *Caryophyllia smithii, Echinus esculentus* and all of the wrasse species. More unusual/scarce species that have colonized steel wrecks elsewhere out of Plymouth include the Weymouth carpet coral *Hoplangia durotrix*, the southern cup coral *Caryophyllia inornata*, the pink sea fingers *Alcyonium hibernicum* and the football seasquirt *Diazona violacea*, but none of those species have yet been seen on 'Scylla'.

Comparison with other studies of artificial reefs

COLONIZATION AND SUCCESSION

Our account of the types of species colonizing 'Scylla' and the length of time taken for the community to reach a composition that appeared stable is broadly similar to that of other long-term studies of artificial reefs. Species with larvae or spores in the water at the time of placement are likely to settle almost immediately and be conspicuous after a few days or weeks (tube worms, barnacles and hydroids on 'Scylla', on the basalt reef described by Leewis & Hallie, 2000 and from concrete structures off the west coast of central Italy: Nicoletti *et al.*, 2007). Some mobile species such as fish, crustaceans and echinoderms may also encounter and colonize the reef very soon after placement. However, a study of colonization and succession of major groups of organisms on four offshore installations in the North Sea (Whomersley & Picken, 2003), suggested a much slower rate of colonization on some structures than on 'Scylla' with hydroids and tube worms generally abundant from the first year but anemones (*Metridium senile* is specifically mentioned) appearing or becoming abundant only after three to five years and soft corals (*Alcyonium digitatum*) appearing in the third to fifth year. On the 'Gannet Alpha' platform, *M. senile* and *A. digitatum* began to recruit in the second year.

Method of colonization might not always be as expected. We believe that *Metridium senile* reached 'Scylla' as larvae but Leewis & Hallie (2000) observed that the anemone

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(presumably as an anemone) had been transported to the reef they were studying on currents.

Comparison of the rate of increase in number of taxa and eventual total number of taxa recorded on 'Scylla' with other artificial reefs needs to take account of depth to the reef and turbidity (and therefore whether or not algae colonize), geographical location (some biogeographical areas are naturally richer/poorer in species), structural complexity of the reef and on method of study. Jensen & Collins (1995) illustrate colonization on concrete blocks by about 90 species during the first year (June 1989 to June 1990), rising to about 220 species during the second year and reaching about 240 species after 30 months: a much higher rate of colonization than for 'Scylla'. Furthermore, their species numbers were for macro fauna and flora and did not include smaller species associated with animal and algal turfs. Based on detailed information (J. Mallinson, personal communication), whilst tube worms, barnacles and solitary ascidians made a rapid appearance (as on 'Scylla'), so too did wrasse and gobies which were very slow to colonize 'Scylla', whilst foliose algae were also much quicker to colonize in Poole Bay and the variety was higher than that recorded on 'Scylla'.

As for total numbers of species recorded on artificial surfaces, after about five years on the seabed, the MV 'Robert' off Lundy had been colonized by 222 recorded plant and animal taxa (Hiscock, 1981), after 30 months, the concrete and fuel ash blocks in Poole Bay by about 240 plant and animal taxa (not including small species associated with turfs) and very thorough sampling from ten shipwrecks in the Belgium part of the North Sea had recorded 224 animal species (V. Zintzen, personal communication) (compared to 127 species or higher taxa identified by Leewis *et al.* (2000), from 21 shipwrecks in the adjacent waters off Holland). Taking account of the different methods used and such features as higher turbidity in the North Sea, the total species count seems similar for the different reefs although the variety of species colonizing the Poole Bay reef was much higher than for 'Scylla'.

SIMILARITY OF COMMUNITIES ON `SCYLLA´ WITH OTHER ARTIFICIAL REEFS

How 'predictable' are the types of community likely to develop on artificial reefs such as 'Scylla'? Studies of shipwrecks in the southern North Sea by Leewis *et al.* (2000) distinguished six communities: *Metridium senile*; tube dwelling amphipods; *Halichondria panicea*, *Hydractinia* species—*Cuthona nana*; Campanularidae–*Tubularia* [=*Ectopleura*] *larynx*; *Psammechinus miliaris*; *Mytilus edulis*. Assemblages on different parts of 'Scylla' could be identified with all of those communities except *Hydractinia* species—*Cuthona nana* but the *Mytilus edulis* community never developed to any significant density and was extremely short-lived, whilst the *Psammechinus miliaris* community lasted only the first winter and early summer of 2005 before, it is believed, wrasse predated them: species not abundant in the North Sea. The records of Zintzen *et al.* (2008a) from North Sea shipwrecks suggest a very similar community to that which has developed on 'Scylla' characterized most conspicuously by *Metridium senile* and by *Tubularia* [=*Ectopleura*] *larynx* and *Tubularia indivisa*. *Asteria rubens*, *Sagartia* sp. and *Pomatoceros triqueter* were also important characterizing species as they were on 'Scylla' but the southern North Sea wrecks also had *Diadumene cincta*, a species mainly restricted to variable salinity conditions in the Plymouth area. *Mytilus edulis*, which colonized 'Scylla' early in 2004 but failed to establish, was common on the North Sea wrecks as was *Psammechinus miliaris* and *Aequipecten opercularis*, both of which were abundant in the first year on 'Scylla'. The turf fauna of inconspicuous species on the North Sea wrecks was, as on 'Scylla', dominated by a very high abundance of amphipod species, especially tubicolous species and passive suspension feeders. Conspicuous species abundant on 'Scylla' but not on the North Sea wrecks were *Alcyonium digitatum*, *Cellepora pumicosa* and large solitary ascidians, although *A. digitatum* was mentioned as on offshore wrecks in the North Sea.

There are regional differences in steel wreck/reef communities even in south-west England waters. For instance, the MV 'Robert' off Lundy (Hiscock, 1981) had a high abundance, as did southern North Sea wrecks, of Ross worm *Sabellaria spinulosa* which were scarcely present on 'Scylla'. The 'Robert' was visually dominated by a turf of erect Bryozoa, which have been notable as very scarce on 'Scylla', as they are on rock reefs and wrecks in the area. However, wrecks in Bigbury Bay to the east of Plymouth have a higher colonization by erect branching Bryozoa than 'Scylla' or other wrecks and rocks near to 'Scylla'. In the Plymouth area, many steel wrecks are dominated by barnacles, especially *Verruca stroemia*, which, although present widely on 'Scylla' were not conspicuously dominant. Brittle stars, *Ophiothrix fragilis*, are a conspicuous feature of some wrecks in Mounts Bay Cornwall (personal observations) as they were on the North Sea wrecks but were in small numbers and highly cryptic on 'Scylla'.

The dominant and characteristic species present on 'Scylla' by the end of the study corresponded, with few exceptions, to those listed as characterizing species of the 'Circalittoral fouling faunal communities' biotope '*Alcyonium digitatum* and *Metridium senile* on moderately wave-exposed circalittoral steel wrecks' (Connor *et al.*, 2004). However, *Actinothoë sphyrodeta*, one of the five most characteristic species in the biotope, had not yet colonized 'Scylla' whilst another anemone, *Sagartia elegans*, which was common on 'Scylla', is not listed as a characteristic species of the biotope. Elements of another biotope in the same biotope grouping, '*Ascidiella aspersa* on circalittoral artificial substrata', could also be identified on 'Scylla'.

SEASONAL VARIATION AND STOCHASTIC CHANGE IN SPECIES PRESENT

Whilst Figure 2 gives some record of variation in abundance of species and Appendix 1 information on particular species present on 'Scylla', observations are descriptive rather than quantitative. Changes in the occurrence and abundance of tubularian hydroids on 'Scylla' were similar to those recorded by Zintzen *et al.* (2008b) for *Tubularia indivisa* on a North Sea shipwreck where species richness in the associated community ranged from 15 to 42 through the year. Changes were not only seasonal but related to predation events, particularly of sea slugs on tubularian hydroids.

Impact of TBT anti-fouling paint

Our study has revealed that, more than 20 years after TBT paint was applied to 'Scylla', it is still effective in maintaining

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the hull clear of fouling. This lack of colonization by both sessile and mobile species on TBT coated areas suggests that whole organism effects are related to avoidance of poisonous areas or the death of early stages of settled organisms. Nevertheless, the observation that tube-building amphipods have settled (in a very minor way) on coated areas and, in turn, seem to facilitate other organisms such as tubularian hydroids settling may mean that eventual colonization is a possibility. No literature has been found describing colonization on TBT coated surfaces.

It is notable that species had settled right up to TBT coated parts of the hull and that rust blisters were observed to provide locations where species could settle and form 'oases' of life surrounded by lethal or unpalatable paint. Hydroids appeared to thrive on such areas and may benefit if their predators, nudibranch sea slugs, cannot cross the paint.

The measurement of TBT levels in organisms (one each of *Asterias rubens*, *Metridium senile*, *Tubularia* sp., *Ciona intestinalis* and *Alcyonium digitatum*) collected from 'Scylla' as a part of required monitoring (Snelling, 2006) recorded levels that ranged from 18–218 g/kg 15 months after the vessel had been placed. After two years, similar results were obtained although one sample of *Alcyonium digitatum* taken from the lower part of the hull (closest to TBT coated areas) contained 780 g/kg TBT. Further work is needed to identify the concentration of TBT in organisms and how far away from the painted areas there are or may be both lethal and sublethal effects on both large conspicuous species and on smaller turf-dwelling organisms.

Sampling methods

The authors realize that, ideally, there would have been a systematic and well-designed programme of recording and sampling to catalogue the colonization of the reef. However, the results described here inform scientific knowledge of such matters as recovery potential, maturity times and connectivity distances for species and were obtained by structured opportunistic observation and sampling. Nevertheless, some approaches were not successful and included that some records made by recreational divers had to be discarded as they could not be validated by images or by parallel records by reliable recorders. A significant issue seemed to be that non-scientist divers would identify to the nearest species illustrated in a photographic guide rather than indicating that something was unidentifiable or turning to a more comprehensive source to aid identification.

Informing environmental protection and management

The study of colonization of 'Scylla' described here contributes to our understanding of ecosystem processes that are relevant to assessing likely recovery rates of damaged marine ecosystems. However, a much longer period of observation than our five years will be needed to assess whether species that are believed not to recruit to new surfaces or to be very slow growing or that reproduce infrequently will eventually colonize. One of the last major colonizers in the five years of study was, arguably, the most significant: the sea fan *Eunicella verrucosa* is a protected species in Britain and easily damaged by mobile fishing gear. The 'Scylla' study shows that, if there are populations nearby, it can recruit readily but most likely not every year.

The observation that TBT anti-fouling paint continued to be effective in preventing colonization is a significant matter for consideration in any future placement of discarded vessels and it would be informative, for environmental protection and management, to understand better how TBT is affecting species on 'Scylla' and if TBT from the vessel is affecting the surrounding area.

Our study has shown that, although a diverse community has developed on 'Scylla', it is distinctly different to nearby natural rock reefs and, in particular, it lacks species that are considered rare, scarce or threatened, notably the branching and cushion sponges. Whilst artificial reefs are often seen as enhancing biodiversity in an area or as helping to restore degraded ecosystems, artificial surfaces do not appear to attract some of the rare, scarce and threatened species colonizing rock reefs, and should not be seen as a replacement for natural surfaces.

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APPENDIX 1

Species recorded from ex-HMS 'Scylla'. Dates when species were first observed or sampled and notes on expansion, growth and loss are given. Records from the sampling exercises undertaken during the week 4 to 8 September in 2006 are given the date 08/09/2006. Samples were taken from nine locations and identified species were recorded only as 'present'. Taxonomy including vernacular names is from the World Register of Marine Species (www.marinespecies.org) in January 2009 with additional vernacular names from Wood (2007). Species names are given alphabetically within the taxonomic levels they are usually separated to. Records of abundance are approximately to the SACFOR (Superabundant, Abundant, Common, Frequent, Occasional, Rare) scale (Connor & Hiscock, 1996) except that some species have been transitory and an abundance is only given in 'Notes'. Specimens from the sampling in September 2006 are held by Unicomarine. Images of species used for identification are deposited in the Data Archive for Seabed Species and Habitats (www.dassh.ac.uk) and further specimens and pressed algae are held by K. Hiscock.

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Name	Date first noted	Generalized maximum abundance during the year by end of 2008	Notes
Kingdom: PLANTAE			
Division: CHLOROPHYTA			
Class: Ulvophyceae			
?*Chaetomorpha* sp.	26/06/2004		In image
Ulva lactuca Linnaeus, 1753 (sea lettuce)	07/09/2005		Noted on one occasion as 'scattered'.
Kingdom: CHROMISTA			
Phylum: BACILLARIOPHYTA			
Class: Bacillariophycea			
Bacillariophycea indet.	12/05/2004		High abundance of diatoms in samples of ectocarpoid algae
Phylum: OCHROPHYTA			
Class: Phaeophyceae			
Cutleria multifida (J.E. Smith) Greville, 1830	25/06/2004		First seen as crusts (*Aglaozonia* stage) on the hull and probably this species in its foliose form also seen in 2004
Desmarestia sp.	23/04/2005		Present on the bridge
Dictyopteris polypodioides (De Candolle) J.V. Lamouroux, 1809 (=*D. membranacea*) (midrib fan weed)	18/08/2006	Occasional	Identified from pressed specimen and conspicuous in images. Also recorded in summer 2008
Dictyota dichotoma (Hudson) J.V. Lamouroux, 1809 (forkweed) (brown fan weed)	18/08/2006	Occasional	Identified from pressed specimen. Also recorded on 22/05/2008
Ectocarpacea indet. (maiden's hair)	12/05/2004		Patchy but extensive coverage (Common) on shallow upward facing surfaces in late spring of first year but, by 30/07/2004, noted that very few conspicuous ectocarpoids left. Also recorded mid-March to mid-June 2005 and doubtless present at other times but not again in the initial abundance. Patchy cover on a scraped area of horizontal deck on 22/05/2008. See *Hinksia* sp. and *Hinksia sandriana* below
Hinksia sp.	12/05/2004		Several species of this ectocarpoid alga present (identified from sample by Dr D. Schroeder)
Hinksia sandriana (Zanardini) P.C. Silva, 1987	30/07/2004		(Identified from sample by Dr D. Schroeder)
Laminaria ?*hyperborea* (Gunnerus) Foslie, 1884 (tangle or cuvie or forest kelp)	07/09/2004		In images of the bow on 07/09/2004. On 15/06/2006, a small individual but with a frond and holdfast typical of *L. hyperborea*
Saccharina latissima (Linnaeus) C.E. Lane, C. Mayes, Druehl & G.W. Saunders (=*Laminaria saccharina* J.V. Lamouroux, 1813) (sugar kelp)	15/07/2005		A few in summer 2005 on the shallowest part
Saccorhiza polyschides (Lightfoot) Batters, 1902 (furbelows)	09/06/2004	Frequent	Settled in the first year and about 15 cm long when a few first seen on 09/06/2004. By 30/07/2004, plants were up to 50 cm long. Visually dominant on upper surfaces in June 2005. Always present on the uppermost areas and on rails but sparse. Recorded as 'Frequent but widely separated' on 10/12/08
Halopteris filicina (Grateloup) Kützing, 1843	10/12/0008	Frequent	Frequent on decks
Phylum: RHODOPHYCOTA			
Class: Rhodophyceae			
Bonnemaisonia asparagoides (Woodward) C. Agardh, 1822	15/07/2005		Identified from an image
Brongniartella byssoides (Goodenough & Woodward) F. Schmitz, 1893	07/09/2005	Abundant	Identified from specimens in 2005. The dominant red alga during spring and summer on upward facing surfaces in 2007 and 2008 at least
Callophyllis lacineata (Hudson) Kützing, 1843	15/07/2005	Frequent	Most likely present in 2005 and, by summer 2006, a conspicuous part of the biota on upward facing surfaces. Common amongst other foliose algae in 2008 at least and persisting into the winter
Ceramiales indet.	30/07/2004		In collection
?Corallinales indet. (encrusting)	23/04/2005		Thin patches on the upper part of the starboard side near the bow. On tubes of *Pomatoceros* on 17/08/2007. Very thin red 'stains'. No sign of pink encrusting algae

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Name	Date first noted	Generalized maximum abundance during the year by end of 2008	Notes
Delleseria sanguinea (Hudson) J.V. Lamouroux, 1813 (sea beech)	06/11/2004	Common	Very few in 2004. One recorded on 06/11/2004 as 4 cm high. By 2008, the second most conspicuous foliose algae during spring and summer
Dilsea carnosa (Schmidel) Kuntze, 1893 (red rags)	18/08/2006	Frequent	Early records but not validated. First validated records are in August 2006 and in May 2008 when it was frequent on the decks
Grateloupia turuturu Yamada, 1941	07/09/2005		Pressed specimen identified by Professor C. Maggs
Hypoglossum hypoglossoides (Stackhouse) Collins & Hervey, 1919	28/04/2007	(Frequent)	Identified from photograph in 2007 and pressed specimen on 22/08/2008. Probably Frequent
Heterosiphonia plumosa (J. Ellis) Batters, 1902	30/07/2004	Abundant	Sampled on 30/07/2004. Probably present in all years and noted as 'secondarily dominant' on 22/05/2008
Kallymenia reniformis (Turner) J. Agardh	18/08/2006	Common	Recorded as 'Common on upfacing surfaces' on 18/08/2006 and on 22/05/2008. Most likely present every spring and summer
Lomentaria orcadensis (Harvey) F.S. Collins	25/03/2006		In image of *Tubularia larynx*
Nitophyllum punctatum (Stackhouse) Greville, 1830	22/05/2008		
Phyllophora crispa (Hudson) P.S. Dixon, 1964	22/05/2008		
?*Platoma marginiferum* (J. Agardh) Batters	17/05/2007		In image
Plumaria plumosa (Hudson) Kuntze, 1891 (=*Plumaria elegans* F. Schmitz, 1889)	18/05/2006		Identified from pressed specimen
?*Polyneura hilliae* (Greville) Kylin	22/05/2008		Identified from pressed specimen
Polysiphonia elongata (Hudson) Sprengel, 1827	30/07/2004		One of the dominant species on the decks in summer 2004. Not recorded in subsequent years
Polysiphonia elongella Harvey, 1833	07/09/2005		Pressed specimen identified by Professor C. Maggs
Polysiphonia sp.	22/05/2008		
Pterothamnion plumula (J. Ellis) Nägeli, 1855	30/07/2004		Generally abundant on upward facing surfaces in summer 2004
Rhodophyta indet. (filamentous)	12/05/2004		Present in samples on 12/05/204
?*Schizymenia dubyi* (Chauvin ex Duby) J. Agardh, 1851	19/09/2008		In images
Scinaia turgida Chemin	18/05/2006	Common	Present in 2006 and common on decks in summer 2007. Regularity of occurrence uncertain and a species typical of seasonally disturbed habitats
Kingdom: PROTOCLISTA			
Lagotia viridis Wright, 1858	08/09/2006		In one sample 08/09/2006
Kingdom: ANIMALIA			
Phylum: PORIFERA			
Class: Demospongiae			
Halichondria bowerbanki Burton, 1930 (bread-crumb sponge)	20/08/2006		In image. Also recorded on 28/08/2006 and summer 2008 and image on 10/12/2008
Halisarca ?*dujardini* Johnston, 1842	28/08/2006		In image. Identified by B. Picton
Hemimycale columella (Bowerbank, 1874) (crater sponge)	16/09/2008	Rare	Small colonies in 2008. Two small colonies seen on the foredeck on 18/03/2009
Oscarella lobularis (Schmidt, 1862)	15/06/2006	Occasional	Also recorded on 28/07/2006 and Occasional in summer 2008
Porifera indet. (yellow crust)	30/07/2004		Reported once
Suberites carnosus (Johnston, 1842)	10/12/2008		One small individual on the aft deck
Class: Calcarea			
Leucosolenia ?*botryoides* (Ellis & Solander, 1786) (spiky lace sponge)	18/02/2005	Occasional	Seen particularly during the winter to early summer. Frequent at times. May be *Leucosolenia complicata* (Montagu, 1818) (advice from B. Picton)
Leucosolenia ?*variabilis* (Haeckel, 1870)	06/04/2006		Spreading over extensive areas of the bow in images between balls of *Leucosolenia* ?*botryoides* on 06/04/2006. In images on 01/05/06
Leucosolenia sp.	08/09/2006		In three samples
Sycon ciliatum (Fabricius, 1780) (purse sponge)	18/02/2005	Occasional	Seen particularly during the winter and early spring. Frequent at times

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Name	Date first noted	Generalized maximum abundance during the year by end of 2008	Notes
Phylum: CNIDARIA			
Superclass: Anthozoa			
Alcyonium digitatum (Linnaeus, 1758) (dead men's fingers)	10/06/2005	Common/Frequent	Colonies were about 10 mm across/high when first observed. Five weeks later, they were about 35 mm high, and 10 weeks later, 50 mm high. After one year, colonies appeared near to full size and were beginning to branch. Colonization was sparse in 2005 and did not occur in all areas but was much denser in subsequent years. Small individuals were again observed in August 2006. By 2008, a visually dominant part of the community. All white except one brown individual observed on 28/01/2006 and a very few more subsequently. Very small (~8 mm across) but frequent individuals on 18/03/2009
Alcyonium glomeratum (Hassal, 1843) (red fingers)	28/04/2007	Rare	When first observed, a colony about 4–5 cm long. By late 2008, a few small colonies recorded from the sides and rudder. On 18/03/2009, one observed colony was large with ~ six branches
?*Actinothoë sphyrodeta* (Gosse, 1858) (sandaled or white striped anemone)	26/06/2004		In images from June 2004 and October 2007 but identification uncertain
Corynactis viridis Allman, 1846 (jewel anemone)	09/08/2005	Occasional	The 2005 records were of widely separated individuals in small groups. Patches remained small during 2005 but some dense stands were present from 2006
Caryophyllia smithii Stokes & Broderip, 1828 (Devonshire cup coral)	07/09/2005	Occasional	Recorded by Seasearch divers on 6 November 2004 but not found in searches during May and July 2005. One found on the port side in September 2005. Recorded as Frequent on decks on 12/10/2008. A common species on nearby wrecks
Cerianthus lloydii Gosse, 1859 (burrowing anemone)	07/09/2005		Small individuals in mud pockets inside
Eunicella verrucosa (Pallas, 1766) (pink sea fan)	12/08/2007	Common	Searched for but not found on15/06/07. The first one recorded was 15 mm high and by mid-August, individuals were 1 to 3 cm high and unbranched with density estimated as 4–5 per m^2 on horizontal surfaces at deck level. Abundance was ~1 per 0.1 m^2 along the walkways in autumn 2007 but much reduced during winter 2007/2008 and density less than 1 per 10 m^2 on walkways and other surfaces by spring 2008. Growth rate was rapid at first with colonies 4 to 5 cm high by mid-December 2007 and up to 6 cm high and branching by spring 2008. In December 2008, density was patchy but up to four per 0.1 m^2 and individuals were generally 6 m high or less high in December 2008
Metridium senile (Linnaeus, 1767) (plumose anemone)	25/09/2004	Abundant	Recorded on 30/08/2004 but record not validated. On 25/09/04, one small one found. Becoming more abundant during the winter of 2004/2005 with up to one per m^2 in January and recorded as 'Common and quite large' on 18/02/2005. Rising in abundance during 2006 and, by 2007, dominating some structures. Present especially on the sides but also inside the reef. By the end of 2008, a visually dominant part of the reef community
Sagartia elegans (Dalyell, 1848) (elegant anemones)	10/06/2005	Frequent/Common	Several var. *rosea* in an image of the bow on 10/06/2005. One var. *mineata* seen in September 2005. Becoming more abundant during 2006 and, by October, varieties *venusta*, *rosea* and *mineata* had been reported. The variety *nivea* was also present. Most conspicuously on the sides and stern and in corner habitats but, in December 2008 and later, many var. *venusta* were observed scattered on the foredeck
Sagartiogeton laceratus (Dalyell, 1848)	21/07/2004	Frequent	Mainly identified from images. Often several seen together on barish surfaces in early 2006. By late 2007, part of the dense cover with other species

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Name	Date first noted	Generalized maximum abundance during the year by end of 2008	Notes
Sagartia troglodytes var. *decorata* (Price in Johnston, 1847)	30/07/2004	Occasional	Present in large numbers (Frequent to Common) in summer 2004 but some may have been small *Sagartiogeton laceratus*. Recorded on several occasions in 2004 but as 'now occasional only' in November 2004 and 'not found' on 30 January 2005 but recorded on several occasions later in 2005. Subsequent records from 2008
Urticina felina (Linnaeus, 1767) (dahlia anemone)	28/08/2006	Occasional	First observed in image from 28/08/2006. Several together at sides of walkways in 2007. Some on decks. Possibly less in 2008
Superclass: Hydrozoa			
Campanulariidae indet.	08/09/2006		In two samples
Clytia hemispherica (Linnaeus, 1767)	09/06/2004		Present on collected *Verruca stroemia* and various hydroids. Widespread on wreck surfaces and other organisms but only identified when specimens collected. Also on 18/03/2009
Corymorpha nutans Sars, 1835 (solitary stalked hydroid)	25/05/2008		One on a metal spar at the stern
Ectopleura larynx (Ellis & Solander, 1786) (=*Tubularia larynx* Ellis & Solander, 1786) (branched oaten pipe hydroid)	12/05/2004	(Frequent)	Two colonies were seen on 12/05/2004. By 09/06/2004 there were 'occasional colonies anywhere'. On 23/07/2004, the colonies had been completely consumed. Similarly, on 15/07/2005, there were no live ones, only tubes. Swarms of facellinid nudibranchs have been observed on many occasions on *Tubularia*. Most abundant on rails and wires but also on areas where antifouling paint has flaked-off and where they might be protected from predators. Declines greatly in abundance during mid-winter (January–February and into March). Apparently new growth on rails in images on 18/03/2009
Eudendrium ramosum (Linnaeus, 1758)	09/06/2004		New growth attached to long-dead Eudendriidae (from Portsmouth tenure). Also, probably this species on 21/07/2006
Kirchenpaueria pinnata (Linnaeus, 1758)	18/02/2005		Identified from image. Growing in an 'oasis' of organisms amongst TBT coated paint. Also on 01/05/2006 in image
Nemertesia antennina (Linnaeus, 1758) (antenna hydroid)	17/08/2005	Abundant	In an image on 17/08/2005. The first recorded observation on 28/01/2006 was of '*Nemertesia* spp.' and noted as at 'one location' (image shows *N. antennina*). Recorded as 'common inside' on 18/08/2006. Overall, sparse in 2006 but was the most conspicuous hydroid and common in places by 2007. Dying back in early winter and new growth noted on 10/12/08
Nemertesia ramosa (Lamarck, 1816) (branched antenna hydroid)	05/04/2007	Rare/Occasional	Seen in images on 05/04/2007 and 22/05/2008. Sampled with gonothecae on 18/03/2009
Obelia dichotoma (Linnaeus, 1758) (sea thread hydroid)	23/04/2004		Sporadic patches with a stolon length of up to 20 mm and height of branches 10 mm four weeks after placement. By 12/06/2004, present in many places and forming bushy growths in some. Gonothecae on 12/06/2004. 'Much less' by 30/07/2004 and possibly consumed by predators. Probably this species in images on 20/08/2006. Most likely widely present but inconspicuous. In samples on 18/03/2009
Obelia geniculata (Linnaeus, 1758) (kelp fur)	15/07/2005	Abundant	Present on kelp fronds and extensively by the end of the summer
Plumularia setacea (Linnaeus, 1758) (little seabristle)	18/03/2009		Most likely widely present but inconspicuous. Attached to *Nemertesia* spp. In samples on 18/03/2009
Sertularella gayi (Lamouroux, 1821)	28/03/2006	Rare	Observed and photographed on a few occasions
Sertularia cupressina (Linnaeus, 1758) (sea cypress/white weed)	26/02/2009		One clump seen and sampled from aft deck. In samples on 18/03/2009
Sertulariidae indet.	08/09/2006		In three samples

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Name	Date first noted	Generalized maximum abundance during the year by end of 2008	Notes
Tubularia indivisa (Linnaeus, 1758) (tall Tubularia) (oaten pipe hydroid)	09/06/2004	(Occasional)	*T. indivisa* appeared to be mixed-in with the predominantly *E. larynx* and the comments for that species apply to *T. indivisa*. The date given is for when both species were present
'*Tubularia*' spp.	12/05/2004		Several single tubes several cm high were recorded in May 2004. The species is often difficult to identify *in situ* and there may be mixed groups but most seem to be *E. larynx*
Superclass: Scyphozoa			
Aurelia aurita (Linnaeus, 1758) (moon jellyfish)	28/01/2006		Attached scyphistomae observed on both inside and outside surfaces in January, May, August and December
Phylum: PLATYHEMINTHES			
Class: Turbellaria			
Turbellaria indet.	08/09/2006		In four samples
Phylum: NEMERTINI			
Nemertini indet.	08/09/2006		In six samples
Phylum: NEMATODA			
Nematoda indet.	08/09/2006		In two samples
Phylum: MOLLUSCA			
Class: Gastropoda			
Acmaea virginea (Müller O.F., 1776) (white tortoiseshell limpet)	08/08/2006		In one sample
Aeolidia papillosa (Linnaeus, 1761) (grey sea slug)	08/08/2006		In one sample
Aporrhais pespelecani (Linnaeus, 1758) (pelicans foot shell)	30/08/2006		Six juveniles in samples collected on the foredeck. Also seen on sediment adjacent to the reef. (Identification confirmed by Dr J. Light.)
?*Bittium reticulatum* (da Costa, 1778)	10/12/2008		In sample
Buccinidae indet.	08/09/2006		In one sample
?*Caloria elegans* (Alder & Hancock, 1845)	07/10/2006		In photograph from the starboard side
Coryphella lineata (Lovén, 1846)	25/05/2008		
Crepidula fornicata (Linnaeus, 1758) (slipper limpet)	08/09/2006		In three samples. Notable that this distinctive species, which is a non-native, has not been seen *in situ* or in images
Chrysallida suturalis (Philippi, 1844)	08/09/2006		In one sample
Cuthona sp.	28/04/2007		Feeding on '*Tubularia*' sp.
Dendronotus frondosus (Ascanius, 1774) (frond aeolis) (Christmas tree sea slug)	09/06/2007		
Doto pinnatifida (Montagu, 1804)	17/08/2007		In photograph
Eubranchus farrani (Alder & Hancock, 1844)	19/04/2004		Present with eggs. (Identification confirmed by B. Picton.)
Eubranchus exiguus (Alder & Hancock, 1848) (balloon aeolis)	26/06/2004		In image. (Identified by B. Picton.)
Eubranchus pallidus (Alder & Hancock, 1842)	19/04/2005		In collection. (Identified by B. Picton.)
Flabellina (=*Coryphella*) *browni* (Picton, 1980)	26/07/2004	Abundant	The species is seen sporadically through the year feeding on '*Tubularia*' hydroids and laying eggs. In 2004, it appeared to 'arrive' on 26 July, destroy the hydroids within a week and was reported crawling down the sides of the vessel and away over the sediment on 3 August (S. Syson, personal communication)
Flabellina pedata (Montagu, 1815) (violet sea slug)	06/05/2008		
Facelina auriculata (Müller, 1776)	26/06/2004		Feeding on '*Tubularia*' sp. Present in large numbers with eggs in March and April 2005
Facelina bostoniensis (Couthouy, 1838) (boston facelina)	26/06/2004	Common	One of the most abundant sea slugs that occur in large numbers for a short period feeding on *Tubularia* spp. (Identified by B. Picton.)
Gibbula cineraria (Linnaeus, 1758) (grey top shell)	28/01/2006		One on the foredeck
Goniodoris nodosa (Montagu, 1808)	08/09/2006		In one sample

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Nassarius incrassatus (Ström, 1768) (=*Nassarius (Hinia) incrassata* (Ström))	15/07/2005		In images on 15/07/2005 and 07/10/2006. Many in suction samples taken on 30/08/2006. Also, in seven samples on 08/09/2006. Most likely an abundant part of the cryptofauna
Janolus cristatus (delle Chiaje, 1841) (crystal sea slug)	09/06/07		Also recorded on 16/09/2008
Odostomia acuta Jeffreys, 1848	08/09/2006		In three samples
Onchidoris muricata Müller O.F., 1776)	08/09/2006		In one sample
Onoba semicostata (Montagu, 1803)	08/09/2006		In two samples
Euspira pulchella (Risso, 1826) (=*Polinices pulchellus*) (common necklace shell)	08/09/2006		In one sample
Polycera faeroensis Lemche, 1929 (yellow edged polycera)	20/08/2006		In images in 2006 and recorded again on 09/06/2007 and in May and August 2008
Retusa truncatula (Bruguière, 1792)	08/09/2006		In one sample
Rissoa interrupta (J. Adams, 1800)	08/09/2006		In three samples
Rissoa parva (da Costa, 1778)	08/09/2006		In seven samples. On 10/12/2008, there was a very high abundance on the afterdeck, visible after sweeping silt away. Samples were of *R. parva* var. *interrupta* (J. Adams, 1798)
Trapania maculata Haefelfinger, 1960	08/09/2006		In one sample. A species that was first reported from Britain in 1976 and considered nationally rare
Class: Bivalvia			
Aequipecten opercularis (Linnaeus, 1758) (queen scallop)	26/07/04		Small individuals in late July 2004 when noted as 'in ones and twos, much less than one per m^2 on vertical hull'. Large numbers were present by the end of August in 2004 on rails, decks and sides. By 6 November 2004, individuals were about 15–20 mm across but there were many fewer. There was no settlement observed in 2005 but 'stragglers' from 2004 continued to be present and reported up to 70 mm across on 15/07/2005. There was another settlement in 2006 with individuals about 12 mm across on 30/08/2006 and 16 mm on 07/10/2006 but sparse. In three of eight samples on 08/09/2006. None were seen in 2007. A small (10 mm) individual was present in a sample collected on 22/05/2008
Anomiidae indet.	08/09/2006		In four samples
Heteranomia squamula (Linnaeus, 1758)	25/06/2004		Small individuals in photograph on 26/06/2004 and 29/09/2004
Hiatella arctica (Linnaeus, 1767) (red nose)	08/09/2006		In six samples. One in sample on 10/12/2008. Probably a common member of the cryptofauna
Modiolarca subpicta (Cantraine, 1835) (=*Modiolarca tumida* (Hanley, 1843))	08/09/2006		In four samples
Modiolus modiolus (Linnaeus, 1758) (horse mussel)	08/09/2006		In one sample
Musculus discors (Linnaeus, 1767) (mat mussel)	08/09/2006		In one sample
Mya truncata Linnaeus, 1758	08/09/2006		In one sample
Mytilus edulis Linnaeus, 1758 (edible mussel)	26/07/2004		One small individual in photograph on 26/07/2004. Present in 2004 initially as spat in large numbers on netting and railings especially. By 25/09/2004, there were clumps of large individuals on the roof of walkways. Still present as solitary individuals on sides and as clumps on roof of walkway on 06/11/2004. Looked for but not found on 30/01/2005 and subsequently in 2005. Most likely eaten by starfish (*Asteria rubens*) that settled in late summer 2004. Present in five of seven samples on 08/09/2006. Possibly one in 'oasis' paint flake under stern on 10/12/2008
Parvicardium ovale (Sowerby G.B. II, 1840)	08/09/2006		In one sample
Class: Cephalopoda			
Loligo vulgaris Lamarck, 1798 (common squid)	06/05/2008		Eggs recorded on 06/05/2008 and in hawse pipe on 22/05/2008. Other reports of mating behaviour over the reef

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Name	Date first noted	Generalized maximum abundance during the year by end of 2008	Notes
Phylum: ANNELIDA			
Class: Polychaeta			
Alentia gelatinosa (M. Sars, 1835)	08/09/2006		In three samples
Anaitides longipes Kinberg, 1866	08/09/2006		In four samples
Anaitides mucosa (Oersted, 1843)	08/09/2006		In two samples
Chaetopterus variopedatus Cuvier, 1827	08/09/2006		In one sample. Possibly this species seen as parchment tubes about 60 mm long on decks cleared of silt on 10/12/2008
Eumida sp.	08/09/2006		In one sample
Eunereis longissima Johnston, 1840	08/09/2006		In one sample
Harmothoe impar (Johnston, 1839)	08/09/2006		In six samples
Harmothoe sp.	08/09/2006		In three samples
Hydroides norvegicus Gunnerus, 1768	25/09/2004	Common	Subordinate to *Pomatoceros* sp. (p) in 2004 and 2005 but, by 15/06/2006, recorded as 'most [relevant] surfaces now dominated by *Hydroides*'. Continued high abundance on vertical surfaces not coated with antifouling paint subsequently. In six samples on 08/09/2006
Jasmineira elegans Saint-Joseph, 1894	08/09/2006		In two samples
Lepidonotus clava (Montagu, 1808)	08/09/2006		In one sample
Lepidonotus squamatus (Linnaeus, 1758)	08/09/2006		In two samples
Lumbrineris gracilis Ehlers, 1868	08/09/2006		In one sample
Marphysa sanguinea (Montagu, 1815)	08/09/2006		In one sample
Neanthes irrorata (Malmgren, 1867)	08/09/2006		In four samples
Nematonereis hebes Verrill, 1900 (=*N. unicornis*)	08/09/2006		In two samples
Nereis pelagica Linnaeus, 1758	08/09/2006		In five samples
Nereis zonata Malmgren, 1867	08/09/2006		In seven samples
Ophryotrocha sp.	08/09/2006		In one sample
Polycirrus sp.	08/09/2006		In two samples
Polydora caeca (Örsted, 1843)	08/09/2006		In one sample
?*Polydora ciliata* (Johnston, 1838)	17/08/2007		Most likely this species seen living in colonies of *Cellepora pumicosa*
Pomatoceros lamarki (Quatrefages, 1866)	08/09/2006		In six samples
Pomatoceros triquetor (Linnaeus, 1758) (keel worm)	23/04/2004	Abundant	One of the first species to settle. Very small tubes on dead oyster valve photographed four weeks after placement. High density of separated individuals about 7 mm long on rudders and other locations near the stern on 12/05/2004. Approximately 20 mm long tubes following black lettering on signs on 04/06/2004. In eight samples. Several per 0.01 m^2 (Abundant) and some 20 mm long on 09/06/2004. Abundance greatly reduced during winter 2004/05 most likely due to predation by sea urchins and starfish and low in 2005. Partially usurped by *Hydroides norvegicus* after 2005 when sea urchin numbers had declined but still occurring widely and Superabundant in places
Protula tubularia (Montagu, 1803)	07/09/2005	Occasional	In photograph in 2005 and occasionally seen subsequently amongst other tube worms
Pterocirrus macroceros (Grube, 1860)	08/09/2006		In one sample
Sabella pavonina Savigny in Sars, 1835 (peacock worm)	25/09/2004	Occasional	A few on the stabilizer edges on 25/09/2004. Mainly seen in the swim-throughs, often attached to cables
Sabellaria spinulosa Leuckart, 1849 (Ross worm)	08/09/2006		In one sample
Scoletoma sp.	08/09/2006		In two samples
Serpula vermicularis Linnaeus, 1767 (organ pipe worm)	28/08/2006		In one sample. In images on 28/08/2006
Subadyte pellucida (Ehlers, 1864)	08/09/2006		In five samples
Syllidia armata Quatrefages, 1866	08/09/2006		In five samples
Syllis hyalina Grube, 1863 (=*Typosyllis hyalina* (Grube, 1863))	08/09/2006		In four samples
Syllis variegata Grube, 1860 (=*Typosyllis variegata* (Grube, 1860))	08/09/2006		In four samples

Continued

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Name	Date first noted	Generalized maximum abundance during the year by end of 2008	Notes
Phylum: ARTHROPODA			
Subphylum Chelicerata			
Class Pycnogonida			
Achelia echinata Hodge, 1864	08/09/2006		In three samples
Callipallene brevirostris (Johnston, 1837)	08/09/2006		In one sample
Subphylum: Crustacea			
Class: Maxillopoda			
Infraclass: Cirripedia			
Balanus crenatus Bruguière, 1789 (crenulated acorn barnacle)	23/04/2004		A group of small *Balanus crenatus* photographed on the hull four weeks after placement. Very high settlement of barnacles on 12/05/04 but extremely small on that date. On 12/05/2004, the size of larger (earlier settled) individuals was about 5 mm across and density about 20 per 0.01 m^2 where present. Barnacles were subordinate to tube worms in coverage and density throughout and scarcely visible after other species had taken dominance. There were no specific records of *B. crenatus* after 2006
Elminius modestus Darwin, 1854 (Australasian barnacle)	20/08/2006		In a photograph on the side of the vessel below an anti-fouled area
Megatrema anglicum (Sowerby, 1823)	18/03/2009		One found after inspection of about 20 *Caryophyllia smithii*
Verruca stroemia O.F. Müller, 1776 (verruca barnacle)	09/06/2004		Tiny *V. stroemia* on collected paint blister on 09/06/2004. Probably this species described as 'massive settlement of barnacles' on 09/06/2004. In all nine samples 08/09/2006. Also, a very high settlement of barnacles recorded on 20/08/2006. Probably present continuously but not specifically recorded. In samples on 18/03/2009
Class: Malacostraca			
Subclass Eumalacostraca			
Superorder Eucarida			
Order: Decapoda			
Cancer pagurus Linnaeus, 1758 (edible crab)	30/08/2004	Rare	Single records in 2004. Possibly Occasional by summer 2008. Present in fissures and in openings. Present in two sample 08/09/2006
Eurynome sp.	08/09/2006		In one sample.
Galathea strigosa (Linnaeus, 1767) (spiny squat lobster)	09/06/2007		One recorded
Galatheidae indet.	06/11/2004		Rarely seen and recorded mainly from inside
Hippolyte varians Leach, 1814	09/06/2004		Collected with ectocarpoid algae. In one sample 08/09/2006
Hippolytidae indet.	08/09/2006		In one sample
Inachus phalangium (Leach's spider crab)	08/09/2006		In one sample
Inachus sp.	08/09/2006		In one sample. One dislodged from roof of walkway by bubbles on 07/10/2006
Liocarcinus depurator (Linnaeus, 1758) (harbour crab)	07/09/2005		One inside on silt
Maja squinado (Herbs, 1788) (spiny spider crab)	06/11/2004	Rare	Records of solitary individuals on several occasions
Necora puber (Linnaeus, 1767) (velvet swimming crab)	06/11/2004	Occasional	Small numbers recorded inside especially from 2005
Palaemon serratus (Pennant, 1777) (common prawn)	15/07/2005	Frequent	The earliest record of 'shrimps' (on the rudder) was 16/04/2004. The first record of *P. serratus* was on 15/07/2005 when there were several full grown individuals seen on the ceilings inside. The junction between walls and ceiling inside the reef appears the favoured habitat
Pandalus montagui Leach, 1814 (humpback prawn)	09/06/2007		Reported on 09/06/2007 and in images on 17/08/2007
Pilumnus hirtellus (Linnaeus, 1761)	08/09/2006		In two samples
Pisidia longicornis (Linnaeus, 1767) (long-clawed porcelain crab)	08/09/2006		In five samples
Superorder Peracarida			
Order: Amphipoda			
Ampelisca diadema (Costa, 1853)	08/09/2006		In one sample

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Name	Date first noted	Generalized maximum abundance during the year by end of 2008	Notes
Aoridae indet.	08/09/2006		In two samples
Apherusa bispinosa (Bate, 1857)	08/09/2006		In one sample
Astacilla (=*Arcturella) danmoniensis* (Stebbing, 1874)	10/12/2008		Several emerging from muddy tubes collected on algae stumps
Astacilla sp.	08/09/2006		In one sample
Caprella acanthifera Leach, 1814	08/09/2006		In two samples
Caprella linearis Linnaeus, 1767	08/09/2006		In four samples
Caprella penantis (Leach, 1814)	08/09/2006		In one sample
Caprella septentrionalis Krøyer, 1838	08/09/2006		In two samples
Caprella tuberculata Bate & Westwood, 1868	08/09/2006		In one sample
Caprellidae indet.	17/08/2007		Caprellid amphipods were frequently seen in images of Hydrozoa, especially *Nemertesia* sp. Also using *Eunicella verrucosa* as an elevation structure
Dexamine spinosa (Montagu, 1813)	08/09/2006		In one sample
Ericthonius punctatus (Bate, 1857)	08/09/2006		In one sample. Also, large numbers on collected *Tubularia* sp. (p) on 10/12/2008
Iphimeda nexa Myers & McGrath, 1987	08/09/2006		In one sample
Jassa falcata (Montagu, 1808)	08/09/2006	(Frequent)	In seven samples on 08/09/2006 but most likely present from soon after placement. Tubicolous amphipods that appear to be this species in images are abundant in places of accelerated tidal flow but also widely distributed on vertical surfaces and amongst worm tubes etc. Numbers appeared to decline in late winter and increase in summer
Leptocheirus hirsutimanus (Bate, 1862)	08/09/2006		In one sample
Monocorophium sextonae (Crawford, 1937)	08/09/2006		Present in nine samples. Also, large numbers in muddy tubes on collected *Tubularia* sp. (p) on 10/12/2008
Phtisica marina Slabber, 1769	08/09/2006		In seven samples
Pseudoprotella phasma (Montagu, 1804)	08/09/2006		In four samples
Stenothoe monoculoides (Montagu, 1815)	08/09/2006		In four samples
Order: Isopoda			
Cymodoce truncata Leach, 1814	08/09/2006		In one sample
Phylum: BRYOZOA (ECTOPROCTA)			
Class: Gymnolaemata			
Order: Cheilostomatida			
Bicellariella ciliata (Linnaeus, 1758)	26/06/2004		In images on two occasions
Bryozoa indet. (orange, encrusting)		Occasional	No date is given for first observation but orange encrusting Bryozoa were present in 2006 at least and continue to be seen as small patches mainly on vertical surfaces. See *Schizomavella linearis*
Bugula turbinata Alder, 1857	28/08/2006		Also on 22/05/2008. Rarely seen
Bugula angustiloba (Lamarck, 1816) (=*B. flabellata* (J. V. Thompson, in Gray, 1848))	15/06/2006	Occasional	Occasionally in images. In one sample on 08/09/2006
Bugula plumosa (Pallas, 1766)	09/06/2007		In images on 09/06/2007 and 06/05/2008. Rarely seen
Cellaria sp.	28/08/2006		In images. Also on 16/09/2008
Chartella papyracea (Ellis & Solander, 1786)	28/07/2006		In image
Cellepora pumicosa (Pallas, 1766) (orange pumice bryozoan)	28/07/2006	Abundant	Possibly present in images from the stern on 28/01/2006 but certain record from image on 28/07/2006. Present in two samples on 08/09/2006 and on 06/10/2006 when 'several large colonies' recorded. Becoming abundant by August 2007. Normally deep orange in colour but tended to be 'washed-out' in colour during the winter. A visually dominant species on the outer part of the reef in 2008 and early 2009
Electra pilosa (Linnaeus, 1767) (hairy sea mat)	09/06/2004		Probably this species present on vertical surfaces but especially notable as star-shaped colonies on fabric lining of the bridge on 09/06/2004. Continued to be obvious during summer 2004 but not afterwards although most likely present. In image on 15/07/2005 and recorded on 16/09/2008. In three samples on 08/09/2006

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Name	Date first noted	Generalized maximum abundance during the year by end of 2008	Notes
Membranipora membranacea (Linnaeus, 1767) (sea mat)	08/09/2006	Abundant	Extensively present on kelp (*Saccorhiza polyschides*) fronds and on foliose red algae. In four samples on 08/09/2006
Omalosecosa ramulosa (Linnaeus, 1767) (monkey puzzle bryozoan)	20/08/2006		Present in a photograph. Also recorded on 28/08/2006 and 16/09/2008
Pentapora fascialis foliacea (Pallas, 1766) (=*P. foliacea* (Ellis & Solander, 1786) (potato crisp bryozoan)	25/03/2006	Occasional	Searched for but not found on 28/01/2006. The colony on 25/03/06 had plates and was about 8 cm across but colonies located in summer 2006 were described as crusts with plates just starting. By 15/06/2007, colonies were about 15 cm across and up to 25 cm across on 10/12/2008. Crustose colonies with erect portions at early stage of growth were present on several parts of the foredeck on 18/03/2009. Colonies most likely persisted where they were protected by structures such as racks and steps or on vertical surfaces not on main routes for divers
Schizomavella linearis (Hassall, 1841)	18/03/2009	?Frequent	Identified from a sample from the portside hause pipe but likely to be the most common orange flat encrusting bryozoan
Schizoporella sp.	08/08/2006		In one sample
Scruparia chelata (Linnaeus, 1758)	08/09/2006		In two samples
Scrupocellaria reptans (Linnaeus, 1767)	08/09/2006		In two samples
Scrupocellaria sp.	28/01/2006		In images on several occasions
Smittina affinis (Hincks, 1862)	08/09/2006		In one sample
Order: Ctenostomatidae			
Alcyonidium diaphanum (Hudson, 1778) (sea chervil/finger bryozoan)	12/08/2007		One colony in image on 12/08/2007
Class: Stenolaemata			
Order: Cyclostomatida			
Crisia sp. (white claw sea moss)	25/05/2008		In image. In sample on 18/03/09
Disporella hispida (Fleming, 1828)	08/09/2006		In one sample
Plagioecia patina (Lamarck, 1816) (=*Diastopora patina* (Lamarck, 1816))	28/04/2007		In images on three occasions
Phylum: ENTOPROCTA			
Order: Colonialies			
Barentsia sp.	08/09/2006		In one sample
Phylum: ECHINODERMATA			
Subphylum: Asterozoa			
Class: Asteroidea			
Asterias rubens Linnaeus, 1758 (common starfish)	25/09/2004	Common	Although observed on the seabed near the reef in summer 2004, the first records on the reef are of common ~50 mm individuals on 25/09/2004. There was another settlement in 2005 when, on 07/09/2005, 10 mm individuals were recorded. Abundance was Common or Abundant during winter 2004/05 and, with *Psammechinus miliaris*, they extensively denuded the reef. However, size remained small. In four samples on 09/08/2006
Luidia ciliaris (Philippi, 1837) (seven armed starfish)	10/12/2008		Many small individuals on the aft deck. On 26/02/2009, several about 7 cm across seen on the aft deck.
Marthasterias glacialis (Linnaeus, 1758) (spiny starfish)	12/05/2004	Occasional	First seen as a large individual on the propeller shaft and subsequently occasional large individuals on the reef, most likely having found it from the surrounding sediment
Ophiothrix fragilis (Abildgaard, 1789) (common brittlestar)	20/08/2006		In five samples on 08/09/2006. A large individual in an image on 20/08/2006 and small ones in image on 10/12/2008. Probably widespread but sparse and very cryptic
Ophiura albida Forbes, 1839 (white flecked sand brittlestar)	08/09/2006		In one sample. In samples on 10/12/2008
Ophiura sp.	20/08/2006		Recorded on two occasions
Subphylum: Crinozoa			
Class: Crinoidea			

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Name	Date first noted	Generalized maximum abundance during the year by end of 2008	Notes
Antedon bifida (Pennant, 1777) (rosy featherstar/common featherstar)	25/09/2004	Frequent/Common	A large individual was seen on 25/09/2004 and solitary individuals in November 2004 but not reported again until September 2006. Juveniles were present on 17/08/2007. By 2008, abundant in places and dominating some spars and ribs inside. Scattered individuals along the sides. Large numbers attached to the grid on the helicopter deck in winter 2008/09 at least
Subphylum: Echinozoa			
Class: Echinoidea			
Echinus esculentus Linnaeus, 1758 (edible/common sea urchin)	30/09/2007	Rare	Maximum of three seen in one dive. Individuals seen were large and it might be that small individuals were present earlier but hidden
Psammechinus miliaris (P.L.S. Müller, 1771) (green sea urchin/shore urchin)	25/09/2004		When first observed, there were densities of more than one per 0.1 m² in places and on 30/01/2005 approximately five per 0.1 m² in places. During winter 2004/2005 and, with *Asterias rubens*, they extensively denuded the reef. There were less observed in June of 2005, many less in July when a midden of broken shells was found on the foredeck suggesting that they had fallen prey, probably to fish. There were still many present in October 2005 but, on 28/01/2006 only one was found by each of two divers. In seven samples on 08/09/2006. On 07/10/2006, several were seen amongst the faunal turf and described as 'heavily disguised'. None were seen in 2007 or 2008
Class: Holothuroidea			
Leptopentacta elongata (Düben & Koren, 1846)	09/08/2006		In one sample
?*Ocnus lacteus* (Forbes & Goodsir, 1839)	15/08/08		Probably this species in image
Thyone fusus (O.F. Müller, 1776)	08/09/2006		In one sample
Phylum: CHORDATA			
Subphylum: Tunicata			
Class: Ascidiacea			
Ascidia mentula Müller, 1776 (red sea squirt)	23/04/2005	Occasional	
Ascidiella aspersa (Müller, 1776) (fluted sea squirt)	25/06/2004	Abundant	The first individual recorded was seen when it was ~30 mm long. Although 'held-back' by the urchins and starfish in the first year, it rapidly became visually dominant with *Ciona intestinalis* on the sides of the vessel and patchily inside so that, by summer 2006, it was Abundant to Superabundant in places. [Although a certain identification, some characteristics on this species are at variance with some descriptions.]
Botrylloides leachii (Savigny, 1816)	15/06/2006		Sometimes difficult to differentiate with *Botryllus schlosseri*. Several colonies reported in summer 2008
Botryllus schlosseri (Pallas, 1766) (star sea squirt)	30/07/2004	Occasional	The first record is a 'probable'. Definitely present on 25/09/2004. Continued as Occasional on the sides of the reef. In one sample on 08/09/2006
Ciona intestinalis (Linnaeus, 1758) (yellow [ringed] sea squirt)	09/06/2004	Frequent	The first record is of one individual found on a roof inside and a patch of scattered individuals over ~1 m² on the side. By 25/06/2004, there were large numbers but scattered. By 30/01/2005, they were dominant on black paint and scattered on grey paint on the hull. There was a further settlement with many small individuals on 15/07/2005. Numbers declined in 2006 but there was a settlement in 2007 with small individuals seen on 15/06/2007. They were very sparse by summer 2008 and recorded as 'odd ones embedded in epifauna' on 10/12/2008. In one sample on 08/09/2006
?*Corella parallelogramma* (Müller, 1876) (gas mantle sea squirt)	25/09/2004		Also recorded on 23/03/2006. Most likely this species in images on 28/08/206 although might be *Corella eumyota*
?*Diplosoma listerianum* (Milne-Edwards, 1841) (grey slime sea squirt)	25/05/2008		Identified from image by B. Picton

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Name	Date first noted	Generalized maximum abundance during the year by end of 2008	Notes
Diplosoma spongiforme (Giard, 1872)	18/02/2005	Occasional	First sighting was of a large patch on the bow. Probably Occasional but noted as 'lots of patches' in December 2008. Identified from image on 16/09/2008 by B. Picton
Stolonica socialis Hartmeyer, 1903 (orange sea squirt)	22/05/2008	Rare	Observation was of a small patch on the port side below the bridge
Styela clava Herdman, 1881 (leathery sea squirt)	23/04/2005	Occasional	A few present in 2005 but more abundant in early 2006 with a 'grove' of about 20 individuals described on 15/06/2006 on the port side. There were very few in 2007 and by summer 2008, none could be found. However, on 19/09/2008 occasional small individuals were present and, on 18/03/2009, two large individuals were seen. In two samples on 08/09/2006
Subphylum: Vertebrata			
Superclass: Pisces			
Balistes capriscus Gmelin, 1789 (=*Balistes carolinensis* Gmelin, 1789) (grey trigger fish)	07/2008		Reported by D. Peake
Callionymus lyra Linnaeus, 1758 (dragonet)	21/06/2004		Also on 17/08/2007. Observed from photographs
Centrolabrus exoletus (Linnaeus, 1758) (rock cook)	06/05/2008	Occasional	First recorded in summer 2008 when groups were present amongst seaweeds especially on shallowest parts
Chelon labrosus (Risso, 1827) (thick-lipped grey mullet)	07/10/2006		Often present in late summer as shoals
Chirolophis ascanii (Walbaum, 1792) (Yarrell's blenny)	25/05/2008		One. Yarrell's blenny (a northern species) was observed at several locations near Plymouth in spring 2008
Conger conger (Linnaeus, 1758) (conger eel)	12/06/2004	Rare	Rarely seen and possibly not resident during first five years
Ctenolabrus rupestris (Linnaeus, 1758) (goldsinny wrasse)	18/08/2006	Occasional	Although reported on 06/11/2004, this wrasse was not reliably seen until summer 2006. Possibly becoming frequent during the summer by 2008
Dicentrarchus labrax (Linnaeus, 1758) (bass)	06/05/2008		
Labrus bergylta Ascanius, 1767 (ballan wrasse)	29/03/2004	Occasional	The first was seen only 45 hours after sinking. Subsequently, mainly sporadic records but consistently small numbers in 2008. Three or four large individuals foraging on the foredeck on 18/03/2009
Labrus mixtus Linnaeus, 1758 (cuckoo wrasse)	06/05/2008	Rare	One female seen on 19/09/2008. A late arrival and very few compared with nearby wrecks
Molva molva (Linnaeus, 1758) (ling)	15/09/2007		
Parablennius gattorugine (Linnaeus, 1758)	06/11/2004		Another reported on 09/06/2007. In image on 25/05/2008
Pollachius pollachius (Linnaeus, 1758) (pollack)	30/03/2004	Common	Solitary individuals in first year, sparse and generally small in 2005, sparse in 2006 but abundant at the edges of the reef by 2007 and subsequently. Less in mid-winter
Pomataschistus sp.	17/08/2007		One inside the reef
Solea solea (Linnaeus, 1758) (sole)	30/08/2004		One on the aft deck
Symphodus (=*Crenilabrus*) *melops* (Linnaeus, 1758) (corkwing wrasse)	30/01/2005	Occasional	One seen on the walkways in early 2005 but observed numbers remained very low. A few seen on 18/03/2009
?*Syngnathus acus* Linnaeus, 1758 (greater pipefish)	24/04/2004		Reported by G. Rhodes on aft deck
Taurulus bubalis (Euphrasen, 1786) (long-spined sea scorpion)	06/11/2004	Rare	Often photographed
Thorogobius ephippiatus (Lowe, 1839) (leopard spotted goby)	17/06/2007	Rare	Present in silty corners inside the reef
Trachurus trachurus (Linnaeus, 1758) (scad)	30/08/2004		Shoals in late summer
Trisopterus luscus (Linnaeus, 1758) (bib or pouting)	30/08/2004	Occasional	Small numbers under the hull and inside the reef
Trisopterus minutus (Linnaeus, 1758) (poor cod)	12/04/2004	Frequent	Probably this species seen as a shoal of 20–30 (D. Pelley) on 12/04/2006 and on 23/04/2004, a shoal of very small individuals under the stern. Numbers had subsequently consolidated but, by the end of 2008, it was still not as abundant as on nearby wrecks
Zeugopterus punctatus (Bloch, 1787) (topknot)	06/11/2004		In photographs on 06/11/2004 (J. Hagger) and 03/03/2005. Two together on TBT anti-fouling paint coated areas on 26/02/2009 and two together inside on 18/03/2009
Zeus faber Linnaeus, 1758 (John Dory)	07/09/2005		A wandering predator found especially on wrecks

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There is a record of *Ostrea edulis* from samples collected in September 2006 but shells of that species persisted from the vessel's tenure in Portsmouth and the species has not been seen alive *in situ*. The record has not been included.

APPENDIX 2

Comparison of conspicuous species present on natural bedrock reefs from locations off the coast east of Plymouth and on surfaces of 'Scylla' by the end of 2008 (see Appendix 1). (Data from tables 12 & 13 of Hiscock & Moore (1986), from surveys undertaken by Devon Wildlife Trust in 1996 and from personal observation in the same period as the 'Scylla study.) P, present, no record of abundance, usually a single record; ( ), seasonal abundance. Species recorded as Rare in one habitat only have been excluded. Species names were those current in www.marinespecies.org on 30 July 2009. Abundances are approximately those given in Appendix 9 of Hiscock (1996).

	Natural rock reefs—lower infralittoral/ upper circalittoral	**Natural rock reefs—circalittoral**	**'Scylla', upward facing surfaces (decks, not including shallowest parts)**	**'Scylla', outward facing external surfaces (sides of the hull and super-structure)**	**'Scylla', internal surfaces (walls of and structures in swim-throughs)**
Algae					
Bonnemaisonia asparagoides	C	F	P	-	-
Brongniartella byssoides	C	F	A	-	-
Calliblepharis ciliata	O	-	-	-	-
Callophyllis lacineata	O	-	F	-	-
Carpomitra costata	O	-	-	-	-
Corallinacea indet (pink encr.)	F	F	-	-	-
Cryptopleura ramosa (and as *Acrosorium uncinatum*)	F	O	-	-	-
Delleseria sanguinea	F	O	C	-	-
Desmarestia aculeata	R	-	P	-	-
Dictyopteris polypodiodes	F	O	O	-	-
Dictyota dichotoma	O	O	O	-	-
Dilsea carnosa	O	-	F	-	-
Drachiella spectabilis	O	O	-	-	-
Halarachnion ligulatum	O	R	-	-	-
Halopteris filicina	F	-	F	-	-
Heterosiphonia plumosa	F	-	A	-	-
Hypoglossum hypoglossoides	-	R	F	-	-
Kallymenia reniformis	O	O	C	-	-
Myriogramme heterocarpum	O	-	-	-	-
?*Myriogramme bonnemaisonii*	-	O	-	-	-
Phyllophora crispa	O	R	P	-	-
Polyneura gmelinii	F	O	-	-	-
Polyneura hilliae	O	-	P	-	-
Pterothamnion plumula	O	-	P	-	-
Rhodophyllis sp.	F	O	-	-	-
Rhodymenia pseudopalmata	O	O	-	-	-
Schottera nicaeensis	O	O	-	-	-
Scinaia turgida	-	-	C	-	-
Sponges					
Amphilectus fucorum	-	O	-	-	-
Axinella damicornis	-	O/F	-	-	-
Axinella dissimilis	-	O/C	-	-	-
Axinella infundibuliformis	-	O	-	-	-
Ciocalypta penicillus	-	O	-	-	-
Cliona celata	R	F	-	-	-
Halichondria cf. *bowerbankii*	-	O	-	P	-
Hemimycale columella	O	O	-	R	-
Leucosolenia botryoides	-	O	-	O	-
Oscarella lobularis	-	-	-	O	R
Pachymatisma johnstonia	-	O	-	-	-
Polymastia boletiformis	-	O/F	-	-	-
Raspailia hispida	-	F	-	-	-
Raspailia ramosa	-	O	-	-	-
Stelligera stuposa	-	O	-	-	-

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	Natural rock reefs—lower infralittoral/ upper circalittoral	Natural rock reefs—circalittoral	'Scylla', upward facing surfaces (decks, not including shallowest parts)	'Scylla', outward facing external surfaces (sides of the hull and super-structure)	'Scylla', internal surfaces (walls of and structures in swim-throughs)
Sycon ciliatum	-	R	-	O	-
Tethya citrina	-	O	-	-	-
Sea anemones and corals					
Actinothoë sphyrodeta	O	O	-	?	-
Alcyonium digitatum	F	C	F	C/A	F
Alcyonium glomeratum	-	O	-	R	-
Caryophyllia smithii	O	F	O	R	-
Corynactis viridis	-	F	O	F	O
Eunicella verrucosa	-	A	F	C	-
Metridium senile	-	-	C	S	F
Parazoanthus axinellae	-	O	-	-	-
Sagartia elegans	-	P	F	C	-
Sagartiogeton laceratus	-	-	F	F	F
Sagartia troglodytes	O	-	O	O	O
Urticina felina	-	R	O	O	-
Hydroids					
Abietinaria abietina	O	O	-	-	-
Aglaophenia tubulifera	-	F	-	-	-
Ectopleura larynx	-	-	(F)	(F/C)	(O)
Halecium halecinium	O	-	-	-	-
Nemertesia antennina	O	F	A	O	O
Nemertesia ramosa	O	F	R/O	-	-
Obelia dichotoma	-	O	P	P	-
Plumularia setacea	-	O	P	P	-
Sertularia gayi	-	F	-	R	-
Tubularia indivisa	-	R	(O)	(O)	-
Polychaetes					
Filograna implexa/*Salmacina dysteri*	-	O	-	-	-
Hydroides norvegicus	-	P	P	C	?
Pomatoceros triquetor	O	O	C	F	C
Protula tubularia	-	R	-	O	R
Sabella pavonina	-	-	-	R	O
Crustacea: Cirripedia					
Verruca stroemia	O	O	P	P	?
Crustacea: Decapoda					
Cancer pagurus	-	O	R	-	R
Homarus gammarus	R	R	-	-	-
Necora puber	-	R	-	-	O
Maja squinado	O	O	R	-	-
Palaemon serratus	-	P	-	-	F
Crustacea: Amphipoda					
Amphipoda indet. (tubes)/*Jassa falcata*	-	R	(F)	(F)	-
Molluscs					
Calliostoma zizyphinum	-	O	-	-	-
Bryozoans					
Alcyonidium diaphanum	-	O	(R)	-	-
Bugula angustloba (=*B. flabellata*)	O	O	-	R	-
Bugula turbinata	-	P	-	R	-
Chartella papyracea	-	O	-	R	-
Crisiidae indet.	-	O	-	P	-
Cellepora pumicosa	F	O	F/C	C/A	C/A
Electra pilosa	F	O	P	P	-
Omalosecosa ramulosa	-	O	-	R	-
Parasmittina trispinosa	O	F	-	-	-
Pentapora fascialis foliacea	-	F	O	O	-
Schizomavella linearis	O	-	?F	?O	-

Continued

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	Natural rock reefs—lower infralittoral/ upper circalittoral	Natural rock reefs—circalittoral	'Scylla', upward facing surfaces (decks, not including shallowest parts)	'Scylla', outward facing external surfaces (sides of the hull and super-structure)	'Scylla', internal surfaces (walls of and structures in swim-throughs)
Scrupocellaria spp.	-	O	-	P	-
Echinodermata					
Antedon bifida	-	-	F	F	C
Ascidia mentula	-	O	-	O	O
Asterina gibbosa	O	O	-	-	-
Asterias rubens	F	F	A	C	O
Aslia lefevrei	R	O	-	-	-
Echinus esculentus	O	C	-	R	R
Henricea sp.	-	O	-	-	-
Holothuria forskali	-	C	-	-	-
Marthasterias glacialis	O	F	O	O	-
Pawsonia saxicola	-	O	-	-	-
Ascidiacea					
Ascidiella aspersa	-	R	O	A	C
Ascidia mentula	-	O	-	O	O
Botryllus schlosseri	R	O	O	O	O
Ciona intestinalis	-	-	-	F	F
Clavelina lepadiformis	O	O	-	-	-
Diplosoma sp./*spongiforme*	-	O	O	O	O
Morchellium argus	-	O	-	-	-
Stolonica socialis	-	F	-	R	-
Styela clava	-	-	-	O	-
Fish					
Centrolabrus exoletus	F	F	O	-	-
Ctenolabrus rupestris	O	O	O	O	O
Labrus bergylta	-	O	O	O	-
Labrus mixtus	O	F	R	-	-
Pollachius pollachius	O	O	C	O	-
Parablennius gattorugine	-	O	-	R	R
Symphodus (=*Crenilabrus*) *melops*	R	-	O	-	-
Thorogobius ephippiatus	-	O	-	-	R
Trisopterus luscus	O	O	-	-	O
Trisopterus minutus	-	R	-	-	F

Correspondence should be addressed to:
K. Hiscock
Marine Biological Association
Citadel Hill, Plymouth
PL1 2PB, UK
email: khis@mba.ac.uk

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