ARTOO

Marine Biology Consultants

Consultancy Report

Client: Natural England

CONDITION MONITORING OF THE ISLE OF WIGHT COASTAL SALINE LAGOONS, 2010

Contract Reference No. FST20/63/062-22479

---

by R N Bamber & R S Robbins

For the attention of:
Rachel Williams

November 2010

Report No. R2/10/319.2

ARTOO Marine Biology Consultants LLP
Ocean Quay Marina, Belvidere Road, Southampton SO14 5QY, United Kingdom
Tel: +44 (0) 2380 829763

SUMMARY

The coastal saline lagoons at three sites on the Isle of Wight, representing all the lagoons of significant conservation merit on the Island, were surveyed in September 2010. The sites were: :

- Yar Lagoon, a relict saltern adjacent to the River Yar at Yarmouth to the western end of the Island and part of the Yar Estuary SSSI,
- Newtown Quay Lagoon, another relict saltern and subsequently a shellfish-holding pond, on National Trust land near Newtown, and part of the Newtown Harbour SSSI and LNR,
- four lagoons at Bembridge, namely Harbour Farm Lagoons 1 and 2 (HFL1 and HFL2), Bembridge Harbour Lagoon (BHL), and East Harbour Lagoon (EHL). These four lagoons are part of the Hampshire and Isle of Wight Lagoons SAC; the first of these is the type-locality for the starlet anemone, *Nematostella vectensis*.

Results were compared with those from previous surveys over the last 23 years. Qualitative surveys of these lagoons were first undertaken in 1987, and the Bembridge lagoons were surveyed again as part of the English Lagoons SAC surveys in 1996, all three sites being revisited in November 1997. In Autumn 2003 all three sites had been surveyed quantitatively.

Results were compared with those from previous surveys over the last 23 years. Qualitative surveys of these lagoons were first undertaken in 1987, and the Bembridge lagoons were surveyed again as part of the English Lagoons SAC surveys in 1996, all three sites being revisited in November 1997. In Autumn 2003 all three sites had been surveyed quantitatively.

Yar Lagoon was found to be a good-quality saline lagoon, generally of stable salinity at or around that of full-strength sea-water, and with a diverse community including eight lagoonal-specialist animal species, two of which, *Gammarus insensibilis* and *Nematostella vectensis*, are scheduled, and two specialist plant species. Biotopes present throughout the lagoon were good and diverse examples of ENLag.IMS.Ann in the soft mud substratum and ENLag.Veg amongst the *Ruppia* spp. and *Chaetomorpha linum*. There are no perceived threats to the integrity of the lagoon. The integrity of the sluices at the southern end of the lagoon is important in maintaining the salinity regime appropriate to the specialist species in this lagoon.

Newtown Quay Lagoon remains consistent as a good-quality saline lagoon, of relatively stable salinity at or around that of full-strength sea-water, and with a diverse and unusual community, including the principal site for *Gammarus insensibilis* on the Isle of Wight. The presence of two estuarine benthic species, the brittle-star *Amphipholis squamata* and the capitellid polychaete *Capitella capitata*, is an unusual feature of the community of this lagoon, and an example of the stochastic nature of lagoonal colonization. These species, together with five animal and two plant lagoonal-specialist species, including the scheduled *Gammarus insensibilis*, form an unusual and diverse assemblage which establishes the conservation importance of this lagoon. Biotopes present throughout the lagoon were ENLag.IMS.Ann in the muddy-sand substratum and ENLag.Veg amongst the *Ruppia* spp. and *Chaetomorpha linum*. There are no perceived threats to the integrity of the lagoon.

The basins of all four lagoons at **Bembridge** are stable and under no direct threat to their integrity, as long as the landowners/occupiers adjacent to the roadside bank of Harbour Farm Lagoon 1 are made aware of the conservation status of the lagoon, and maintain an amiable relationship.

The two basins nearest the Harbour, Bembridge Harbour Lagoon and East Harbour Lagoon, are generally high-salinity lagoons, with specialist communities of conservation importance. The Harbour Farm Lagoons offer a range of diversity of lagoonal habitat on this site: Harbour Farm Lagoon 2 has always been a low-salinity habitat, normally without lagoonal specialists (although with the scheduled polychaete *Alkmaria romijni*) and under continuous threat of reversion to reed-marsh without some active maintenance. Harbour Farm Lagoon 1 is a significant saline lagoon, which had declined in the recent past owing to inhibition of the input of saline water. Fortunately, the resurrection of the culvert at its northwestern corner has allowed the recovery both of the salinity and thereby of the significant species of this lagoon. At the same time, it has apparently eradicated the carp population which was generating its own threat to the integrity of the site by inviting illicit recreational angling.

Throughout the diversity of coastal-saline-lagoonal habitat encompassed by the four Bembridge lagoons, there are nine lagoonal-specialist species, two of them scheduled. Of the last two, elsewhere on the Isle of Wight *Nematostella vectensis* is currently only known from Yar Lagoon, while *Alkmaria romijni* has only been recorded from Wootton Mill Pond

The communities are unusual in the absence of molluscs other than the estuarine clam *Abra tenuis*, itself not a common lagoonal inhabitant (see under Yar lagoon, above).

Overall

In comparison with the UK database of coastal saline lagoons, all of these Isle of Wight Lagoons fall into the "Good High Salinity" lagoons category other than the low-salinity Harbour farm Lagoon 2, and East Harbour Lagoon which is in an early stage of colonization and evolution. Equally, all the sites clustered with the community from the same lagoon in 2003, with the reassuring exception of Harbour farm Lagoon 1. In 2003, at a time when the salinity was significantly reduced, this lagoon was classified as a "Poor High Salinity" lagoon; by 2010 the improvement in the salinity regime had returned the community to one characteristic of a "Good High Salinity" lagoon.

We may therefore conclude that the lagoons on the Isle of Wight surveyed in 2010 have all maintained their good conservation status and their important specialist communities, and one which had shown previous decline in condition had recovered satisfactorily, and would be assumed to continue to improve in that direction.

INTRODUCTION

Coastal saline lagoons are a Priority Habitat under the EU Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora, 1992 (the "Habitats & Species Directive"). As such, they are commonly features of site conservation designations (such as SSSIs) as well as being appropriate as Special Areas of Conservation (SACs) in their own right.

During the survey of the Solent saline lagoon resource in 1997 (Bamber *et al*., 1998), nine potential lagoons were identified on the Isle of Wight. Of these, the Old Mill Pond, Wootton, was regarded as little more than a tidal estuary owing to its management regime, Dodnor Lane Lagoon, Parkhurst, was found to be a freshwater pond, while Seaview Lagoon was found to be of little conservation merit or potential.

The remaining lagoons were found to be of high conservation merit as coastal saline lagoons, owing to their diverse specialist communities. These were:

- Yar Lagoon, a relict saltern adjacent to the River Yar at Yarmouth to the western end of the Island (and not to be confused with the River Yar near St Helens at the eastern end of the island) and part of the Yar Estuary SSSI,
- Newtown Quay Lagoon, another relict saltern and subsequently a shellfish-holding pond, on National Trust land near Newtown, and part of the Newtown Harbour SSSI and LNR,
- and four lagoons at Bembridge, namely Harbour Farm Lagoons 1 and 2 (HFL1 and HFL2), Bembridge Harbour Lagoon (BHL), and East Harbour Lagoon (EHL). These four lagoons are part of the Hampshire and Isle of Wight Lagoons SAC; the first of these is the type-locality for the starlet anemone, *Nematostella vectensis*, while the last was only salt-marsh as recently as 1987, being first recorded as a flooded basin in 1996 (Bamber, 1997).

Qualitative surveys of these lagoons were first undertaken in 1987 (Sheader & Sheader, 1987), and the Bembridge lagoons were surveyed again as part of the English Lagoons SAC surveys in 1996 (Bamber, 1997), all three sites being revisited in November 1997 (Bamber *et al*., 1998).

In Autumn 2003 all three sites were surveyed in more detail by staff of the Natural History Museum (NHM) on behalf of the Environment Agency, including quantitative analysis of their benthic communities (Bamber et al., 2003).

In 2010, ARTOO Marine Biology Consultants were contracted by Natural England to undertake a repeat survey of the seven lagoons at these three sites. The sites were visited on 1 September 2010.

The survey followed the protocols described in Bamber, Gilliland & Shardlow (2001).

METHODS

Fieldwork was undertaken on 1 September 2010.

Sampling of the lagoons was planned to encompass four techniques.

1. Quantitative benthic sampling was undertaken using a 0.005 m^2 hand-coring-tube, pushed into the sediment to a depth of 10 cm (where possible). Ten core samples were collected at each sampling site (total sample area 0.05 m^2), bulked, and sieved through a 0.5 mm mesh sieve *in situ*. The retained sieve-residue was fixed in 4% formalin within 8 hours of collection.

   Position-fixing was by GPS (±2 m). Site details for all sampling sites are given in Table 1.

2. Qualitative assessment of nektonic species was undertaken by sweeping the lagoon with a 0.5 mm-mesh hand net in appropriate habitats. Species collected were identified *in situ* and returned to the lagoon.
3. Qualitative assessment of the community associated with submerged plants was undertaken by collecting approximately 1 litre of weed, rinsing it in a bucket of water, then sieving the residual water (0.5 mm mesh).
4. Hard substrata (stones, reed-stems, etc.) were examined *in situ* for bryozoans and hydroids.

All retained samples were sorted under the binocular microscope, and all animals counted and identified to species where possible.

At each sampling site, the salinity of the overlying water was measured using a refractometer (±0.5‰), and the pH of the overlying water was measured using a field pH stick (±0.01 units). The salinity and pH of the water of the adjacent sea were also measured. The substratum at each sampling-site was assessed subjectively *in situ*.

With respect to Section 16 (3) (a) of the Wildlife and Countryside Act 1981, all work was carried out under English Nature Licence No. 20100172.

All scientific names are as in the World Register of Marine Species (WoRMS: see www.marinespecies.org).

It is significant that the survey was undertaken after an extended period of dry weather, but immediately after a spell of rainfall.

RESULTS

General

The locations and habitat parameters at each sampling site for each lagoon are shown in Table 1.

The benthic fauna from the quantitative core-sampling is shown in Table 2.

Semiquantitative results for the species from the weed-samples are given in Table 3.

Table 1: Locations and habitat-parameters for sampling sites

LAGOON	Site	Latitude-Longitude	salinity, ‰	pH	depth, m[1]	Sediment
Yar	1	50º42'08.44"N 01º30'22.64"W	34.5	7.9	0.2	soft mud with refractory plant debris
	2	50º42'10.86"N 01º30'23.52"W	34.5	7.92	0.2	
	3	50º42'14.50"N 01º30'23.51"W	34.5	7.95	0.15	
Adjacent sea-water			34	8.1		
Newtown	S basin	50º43'04.43"N 01º24'32.70"W	37	8.71	0.2	muddy sand on pebbles with refractory plant debris
	N basin	50º43'05.04"N 01º24'28.23"W	37	8.65	0.3	
Adjacent sea-water			35	8.1		
HFL 2	E	50º41'18.43"N 01º05'57.28"W	10	9.83	0.3	soft mud on gravel
	W	50º41'12.02"N 01º06'04.07"W	9.5	9.81		soft mud on gravel with refractory plant debris
HFL 1	W	50º41'19.62"N 01º05'55.33"W	15	9.27	0.25	soft mud on gravel
	E	50º41'24.03"N 01º05'48.78"W	17	9.15	0.25	muddy sand
EHL		50º41'24.56"N 01º05'49.83"W	25	8.43	0.2	flocculent mud and plant debris amongst boulders
BHL	W	50º41'25.07"N 01º06'01.57"W	25	8.91	0.15	muddy sand with refractory plant debris
	E	50º41'24.55"N 01º05'57.85"W	25	8.75	0.2	muddy sand
Adjacent sea-water			34	8.16		

[1] depth of water overlying sample

Yar Lagoon (Plate 1)

Environmental conditions

Yar Lagoon was effectively at normal sea-water salinity, and the pH of the water was also within the normal range for sea-water. The water was highly turbid at the time of the visit, probably owing to recent rainfall. No vertical stratification was detected.

The substrata at the sampling sites were of fine soft mud, with much refractory plant debris derived from the extensive marginal salt-marsh (predominantly *Scirpus*, *Spartina*, *Halimione* and *Salicornia*).

No variation in water level was experience during the survey.

Fauna and flora

The benthic community of the lagoon was relatively uniform along the length of the lagoon, and diverse, as has been the history at this site, with a total of 21 species recorded. The dominant species were the annelids *Caulleriella zetlandica* and *Polydora cornuta* (Polychaeta), *Tubificoides pseudogaster* and *T. benedii* (Oligochaeta), and the amphipods *Microdeutopus gryllotalpa*, *Corophium volutator* and the lagoonal specialist *C. insidiosum*. The scheduled starlet sea-anemone *Nematostella vectensis* was present throughout the lagoon, although in lower numbers than in previous surveys. Chironomids were also prevalent but sparse.

Other lagoonal specialist species present, although in relatively low numbers, were the lagoonal cockle, *Cerastoderma glaucum*, the isopod *Lekanesphaera hookeri*[1], and the ostracod *Cyprideis torosa*, while the bryozoan *Conopeum seurati* was patchily present on suitable substrata.

No species other than errant specimens of *Lekanesphaera hookeri* were found during net-sweepings (although the mysid *Praunus flexuosus* was present, and found in the weed-associated fauna). *Conopeum seurati* was found growing on *Ruppia* stipes and on submerged plant stems.

Tasselweed (*Ruppia* spp.) was present in small patches, as were *Ulva lactuca* and *Enteromorpha* spp.; floating mats of wireweed, *Chaetomorpha linum*, were prevalent along the bank of the lagoon were they had been pushed by wind.

The fauna associated with *Chaetomorpha* is shown in Table 3. This community remains dense and diverse, with 13 species recorded including most of the crustaceans found in the benthos (notably not *Corophium volutator*, which, unlike the lagoonal specialist *C. insidiosum*, prefers to construct its tubes in bottom-sediment), with, additionally, the scheduled lagoonal amphipod *Gammarus insensibilis*; this species had not been recorded in this lagoon previously (nor had any species of *Gammarus*).

Juvenile lagoon cockles were frequent, as was *Nematostella vectensis*, while the nemertean cf. *Myoisophagus sanguineus*, which is thought to be a distinct lagoonal specialist species, was common in the weed although not recorded from the benthos.

[1] Previously *Sphaeroma hookeri*

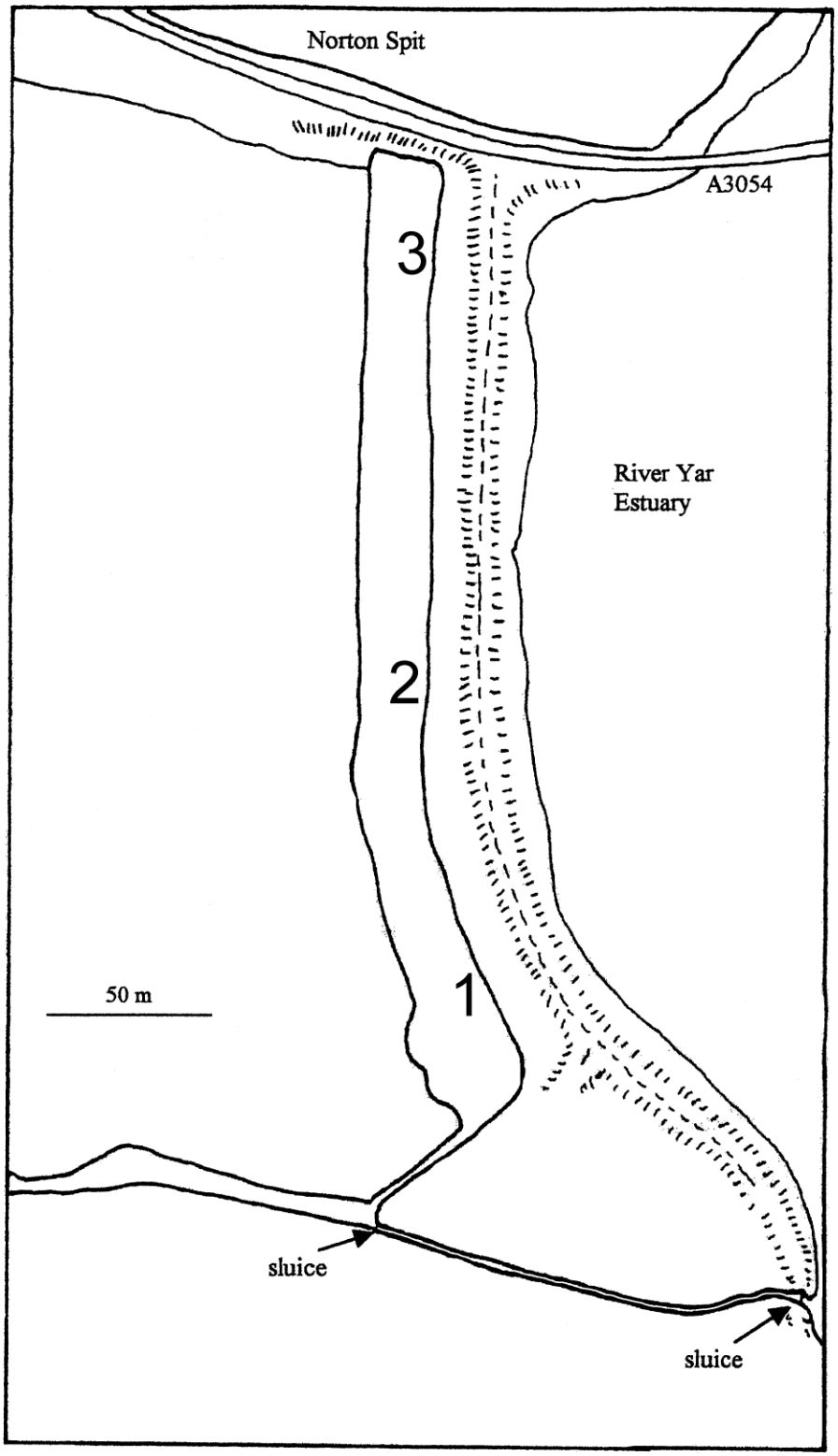

Figure 1. Diagrammatic plan of Yar Lagoon (after Bamber *et al.*, 2003) showing sampling-sites 1 to 3.

Table 2: Numbers of benthic species per 0.05 m^2 from quantitative core-samples at all sample-sites. Lagoonal specialist species are highlighted in blue.

Isle of Wight	Yar Lagoon			Newtown		Bembridge						
	1	2	3	S	N	HF 1 W	HF 1 E	HF 2 E	HF 2 W	EHL	BHL W	BHL E
CNIDARIA												
Nematostella vectensis	24	9	51			14	168			79	7	496
Sagartia troglodytes		1			11							
NEMERTEA												
Nemertean indet.					1	1					1	
cf. *Myoisophagus sanguineus*				3								4
ANNELIDA												
Hediste diversicolor						17	23	3			17	26
Malacoceros fuliginosus				2	5							
Streblospio shrubsolii			11				4				4	2
Pygospio elegans	4											
Polydora cornuta	26	14			5							
Caulleriella zetlandica	335	196	166									117
Capitella capitata		2		93	114		3					
Alkmaria romijni						2		7				
Tubificoides amplivasatus									9			
Tubificoides pseudogaster	122	44	39	12	6	87	52	8	4	52	33	63
Tubificoides benedii	28	27	4	59	21							7
CRUSTACEA												
Praunus flexuosus			1			1						
Idotea chelipes				23	1		4					
Lekanesphaera hookeri		2				11	67	23				
Gammarus insensibilis				16	32							
Gammarus duebeni					4							2
Gammarus zaddachi								2				
Corophium insidiosum	111	94	58	47	7	9	134			8		74
Corophium volutator	26	63	48	3							3	651
Microdeutopus gryllotalpa	12	32	7	144	62							
Melita palmata							1					
Palaemonetes varians	1	3		1		3				3	1	
INSECTA												
Corixidae							2	4	8			
Chironomidae	9	16	9	3	9	133	86	63	49	118	5	33
Other insect larvae			2			1		1	8			
MOLLUSCA												
Cerastoderma glaucum	2	5										
Abra tenuis		1	2								73	355
Hydrobia ulvae				34	17							
ECHINODERMATA												
Amphipholis squamata				177	192							
PISCES												
Pomatoschistus microps		1			1							
Gasterosteus aculeatus			1						2			
Non-quantitative species												
Cyprideis torosa	*					*	*	*	*			
Conopeum seurati		*			*	*	*	*			*	

NB: *Cyprideis torosa* and *Conopeum seurati* recorded only as presence.

Table 3: Relative abundance of species from qualitative weed-samples in each lagoon where submerged weed was present, "SACFOR" scale. (S – suberabundant; A – abundant; C – common; F – frequent; O- occasional; R – rare). **Lagoonal specialist species are highlighted in blue.**

Isle of Wight	**Yar Lagoon**	**Newtown**	**Bembridge**	
	Site 1	S	HF1	HF2
Weed:	*Chaetomorpha*	*Ruppia/ Enteromorpha*	*Ruppia*	*Ruppia*
CNIDARIA				
Nematostella vectensis	F		F	
NEMERTEA				
cf. *Myoisophagus sanguineus*	C			
ANNELIDA				
Hediste diversicolor			R	
Caulleriella zetlandica	F			
CRUSTACEA				
Cyprideis torosa			C	
Praunus flexuosus	R			
Idotea chelipes		C		
Lekanesphaera hookeri	O		A	C
Gammarus duebeni			O	
Gammarus insensibilis	R	A		
Corophium insidiosum	A		C	
Corophium volutator	R			
Microdeutopus gryllotalpa	F	C		
Melita palmata	F	R		
Palaemonetes varians		F		R
INSECTA				
Corixidae				C
Chironomidae	R		F	
Other insect larvae				R
MOLLUSCA				
Cerastoderma glaucum	F			
Abra tenuis	O			
Hydrobia ulvae		C		
ECHINODERMATA				
Amphipholis squamata		R		
BRYOZOA				
Conopeum seurati			O	

Biotopes

Lagoonal biotopes in England and Wales were defined by Bamber (1997), but have yet to be formalized into the national system.

The benthic biotope present throughout Yar Lagoon was a good example of ENLag.IMS.Ann, while the plant-associated community was again a good and diverse example of ENLag.Veg, the latter not capable of being mapped as *Chaetomorpha linum* floats around the lagoon.

Physical structure and management

The configuration of Yar Lagoon has remained consistent over time, and would be expected to remain so. The area (0.5 ha) and depth (0.25 m) of the lagoon is as they were found to be in 1997 and 2003 (Bamber *et al*., 1998; 2003)

The sluices in the feeder creek at the southern end of the lagoon control the flow between the Yar Estuary and the Lagoon. These appeared to be entirely functional in 2010. Their integrity is important in maintaining the salinity regime appropriate to the specialist species in this lagoon.

Remarks

The presence of the cirratulid polychaetes *Caulleriella zetlandica* has always been an unusual feature of this site; the species is unusual for coastal saline lagoon communities, although also found in two other lagoons in the Solent region, Normandy Farm Lagoon near Lymington and Bembridge Harbour Lagoon on the Isle of Wight (see below), and Yar Lagoon also shares with both of these another species unusual for lagoons, the estuarine clam *Abra tenuis*. The other unusual species recorded historically at this lagoon is the tunicate *Molgula manhattensis*, in an unusually naked form; it was not found at Yar in 2003, nor in the present survey.

The low numbers of the lagoon cockle, *Cerastoderma glaucum*, reflect the findings of the 2003 survey which found declining recruitment of this species between 2000 and 2003. Insufficient specimens were collected in 2010 to allow analysis of the population year-class structure.

Nevertheless, Yar Lagoon remains consistent as a good-quality saline lagoon, generally of stable salinity at or around that of full-strength sea-water, and with a diverse community including eight lagoonal-specialist animal species, two of which are scheduled, and two specialist plant species.

There are no perceived threats to the integrity of the lagoon.

Newtown Quay Lagoon (Plate 2)

Environmental conditions

Newtown Quay Lagoon was slightly hyperhaline at 37‰, the adjacent waters of Newtown harbour being at a normal sea-water salinity of 35‰. At 8.65 to 8.71, the pH of the water was also above the normal range for sea-water (7.8 to 8.2), attributed to photosynthetic activity of the submerged plants and planktonic algae in the lagoon. No vertical stratification was detected.

The substrata around both basins were of muddy-sand overlying pebbles, with refractory plant debris.

No variation in water level was experience during the survey.

Fauna and flora

The benthic community of the lagoon was relatively uniform throughout both basins, and diverse, as has been the history at this site, with a total of 19 species recorded, including both lagoonal specialist species and estuarine species, some of which are unusual denizens of the saline-lagoonal habitat.

The brittle-star *Amphipholis squamata* and the capitellid polychaete *Capitella capitata* were dominant in the lagoon, both estuarine species, the former only recorded elsewhere in lagoons of the Solent region in Little Anglesey Lagoon, Gosport; neither species was found at Newtown in the 1997 survey at this site, but were recorded in 2003. Similarly, the estuarine gastropod *Hydrobia ulvae* and the anemone *Sagartia troglodytes* were common at this site, but not found in lagoons elsewhere on the Isle of Wight during 2010, and of the two oligochaete species found to be common, the more estuarine species *Tubificoides benedii* was more abundant than the more-typically lagoonal *T. pseudogaster*.

The remaining dominant species were the amphipods *Microdeutopus gryllotalpa* and the lagoonal specialists *Corophium. insidiosum* and the scheduled *Gammarus insensibilis*, together with the lagoonal-specialist isopod *Idotea chelipes*.

Other lagoonal specialist species present, although in relatively low numbers, were the nemertean, cf. *Myoisophagus sanguineus,* and the bryozoan *Conopeum seurati*, patchily present on suitable substrata.

Tasselweed (*Ruppia* spp.) was present in patches throughout the lagoon, and *Enteromorpha* spp. And floating mats of wireweed, *Chaetomorpha linum*, were prevalent along the banks of the lagoon were they had been driven by wind.

The fauna associated with mixed *Ruppia-Chaetomorpha* is shown in Table 3. This community comprises most of the crustaceans found in the benthos, although surprisingly not *Corophium insidiosum*, together with brittle-stars and *Hydrobia ulvae*, both likely to have migrated into the weed from the benthos.

The only species found during net-sweepings were occasional *Idotea chelipes* and prawns, *Palaemonetes varians*. *Conopeum seurati* was found growing on stones and on submerged plant stems.

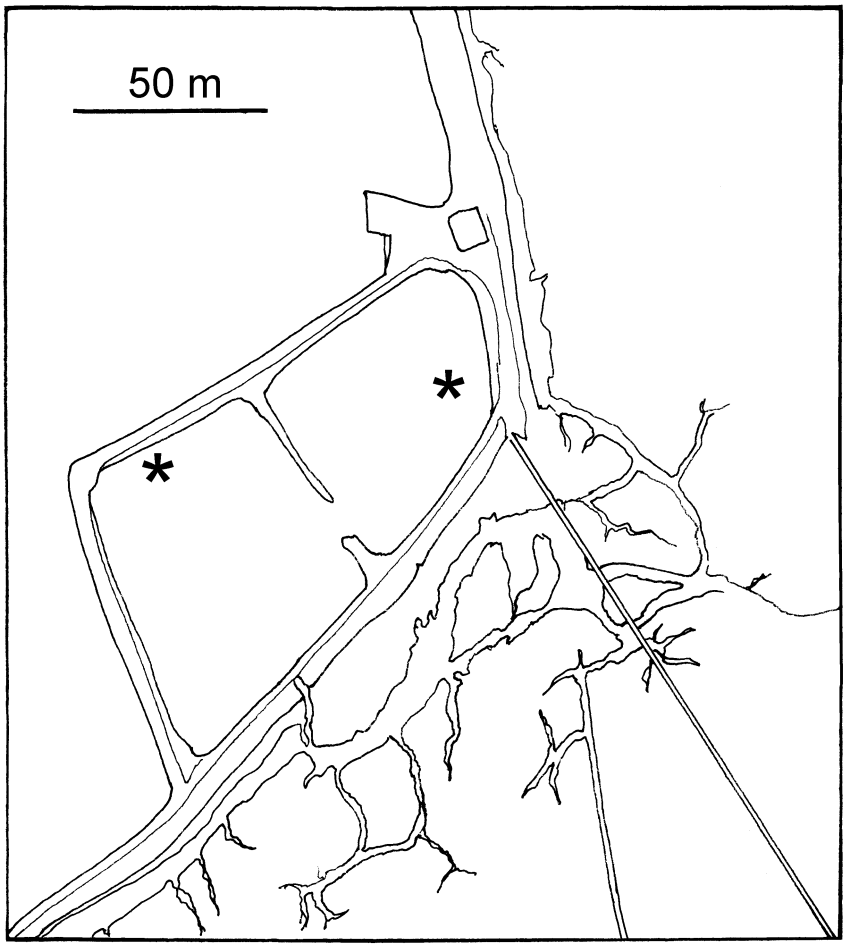

Figure 2. Diagrammatic plan of Newtown Quay Lagoon showing sampling-sites.

Biotopes

The benthic biotope present throughout Newtown Quay Lagoon was a good example of ENLag.IMS.Ann, while the plant-associated community was again a good and diverse example of ENLag.Veg, the latter not capable of being mapped as *Chaetomorpha linum* floats around the lagoon while *Ruppia* occurs as unpredictable patches.

Physical structure and management

The configuration of Newtown Quay Lagoon has remained consistent over time, and would be expected to remain so. An area of the sea-wall near the north-east corner was noted as being under repair in 2003 (Bamber et al., 2003): this area was still "under repair" in 2010. The area (0.75 ha) and maximum depth (0.35 m) of the lagoon is as they were found to be in 1997 and 2003 (Bamber *et al*., 1998; 2003).

The culvert in the bank at the landward side of the southern basin controls the flow between the Lagoon and the adjacent salt-marsh creek. The water-exchange culvert was entirely functional in 2010. Its integrity is important in maintaining the flooding of the lagoon, and thus the sublittoral habitat necessary for the specialist species present.

The embankment around the lagoon basins forms part of the popular public walking route down from Newtown Village, across the saltmarsh, using the recently-enhanced boardwalk, and thence to the sea-wall, with the bench outside the boathouse at the north corner of the lagoon a popular resting spot.

These activities appear to offer no threat to the integrity of the lagoon or its habitats. The local management by the National Trust affords the site valuable protection.

Remarks

The presence of the estuarine benthic species listed above is an unusual feature of the community of this lagoon, and an example of the stochastic nature of lagoonal colonization. These species, together with five animal and two plant lagoonal-specialist species, including the scheduled *Gammarus insensibilis*, form an unusual and diverse assemblage which establishes the conservation importance of this lagoon.

Newtown Quay Lagoon remains consistent as a good-quality saline lagoon, of relatively stable salinity at or around that of full-strength sea-water, and with a diverse and unusual community, including the principal site for *Gammarus insensibilis* on the Isle of Wight.

There are no perceived threats to the integrity of the lagoon.

Bembridge Lagoons

The complex of four lagoons at Bembridge has evolved over the last three decades. The landward pair of lagoons, the Harbour Farm Lagoons, are much larger, and are principally part of the drainage system of the Brading Marshes, while the seaward pair are percolation lagoons isolated behind the coast road and sea-wall embankment adjacent to Bembridge Harbour.

Harbour Farm Lagoon 2, to the southwest, has always been a low-salinity system, prone to incursion by reeds, although the landowner has maintained effective control over the reeds over the years; the area of the lagoon basin is 3.7 ha, but in some years the area of open water has been markedly less than this owing to the extent of the *Phragmites* bed in the lagoon. This lagoon drains over a narrow causeway into Harbour Farm Lagoon 1.

Harbour Farm Lagoon 1 is a 3.9 ha lagoon which also has a culverted connection with Bembridge Harbour Lagoon, through the embankment along its northern margin, and thus higher salinity water; this culvert was found to be collapsed during a survey in 2002 (Gasca, 2003), at which time carp were present in the lagoon; the survey in 2003 (Bamber *et al*., 2003) found the general community to be very reduced. The repair of the culvert in the mid 2000s has allowed higher salinity water back into this lagoon. Harbour Farm Lagoon 1 is notable as the type-locality for the scheduled starlet sea-anemone, *Nematostella vectensis*.

East Harbour Lagoon, to the east of Bembridge Harbour Lagoon, first began to flood in the 1990s, initially as a small pond, but now extends along the sea-wall with an area of about 1 ha. Water supply is again via seepage from Bembridge Harbour, and physicochemical conditions normally reflect those of Bembridge Harbour Lagoon.

Bembridge Harbour Lagoon lies between the embankment guarding the northern margin of Brading Marshes and the sea-wall of Bembridge Harbour. It is supplied with saline water from percolation though the sea-wall, and has a connection at its western end to a ditch which feeds through a sluice into the River Yar, although the water level is often too low to maintain this connection.

These lagoons were surveyed previously in 1996, 1997, and quantitatively in 2003 (Bamber, 1997; Bamber *et al*., 1998; 2003).

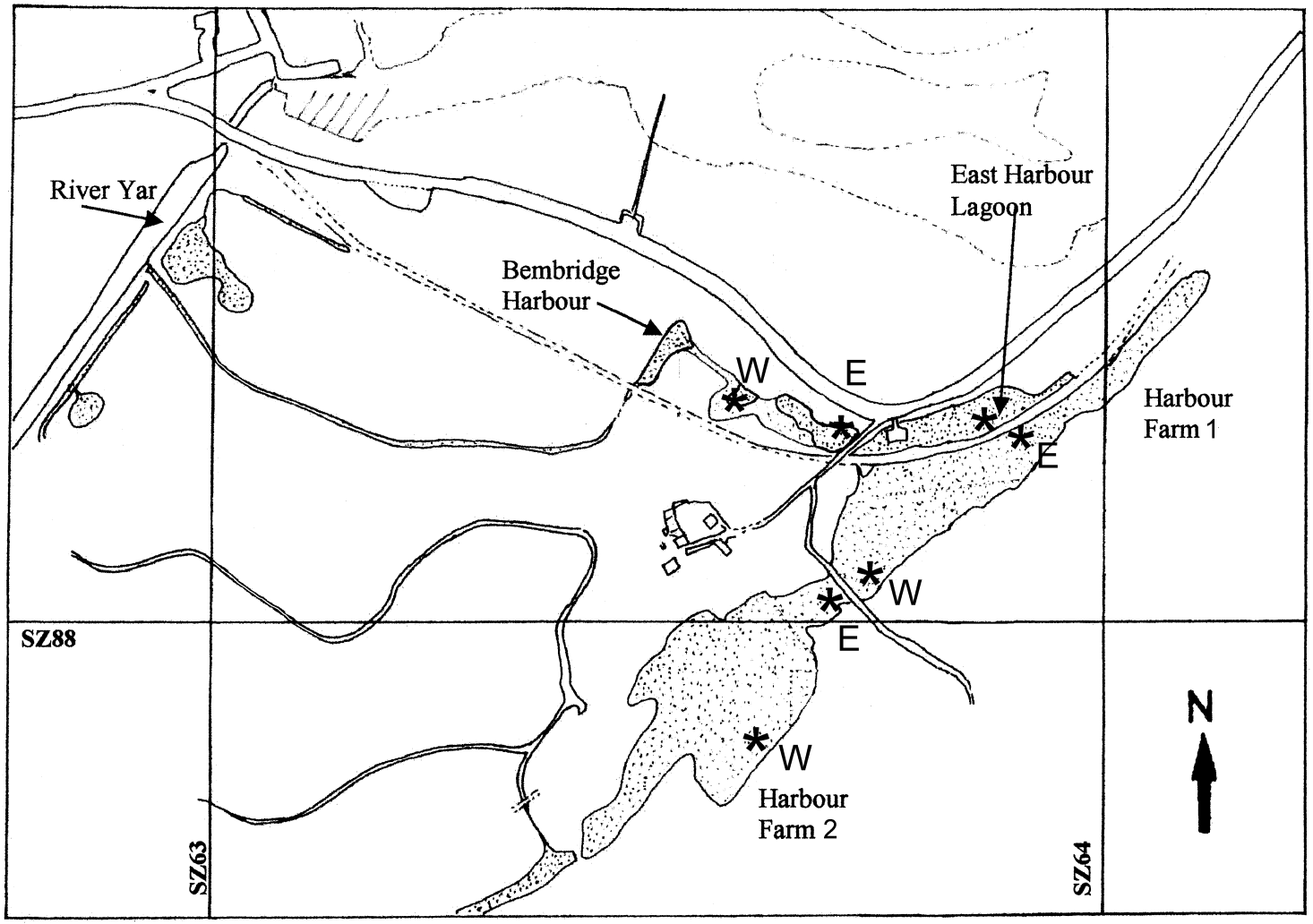

Figure 3. Diagrammatic map of Bembridge Lagoons (after Bamber *et al*. 2003) showing sampling-sites.

Harbour Farm Lagoon 2 (HF2) **(Plate 3)**

Environmental conditions

Harbour Farm Lagoon 2, at about 10‰, was at a low salinity, but historically has normally been lower than this, being heavily influenced by freshwater input from the Brading Marshes. The pH of the water was high, higher than that of the adjacent lagoons, but the carbonate-bicarbonate buffering system in the water is less effective at these lower salinities. No vertical stratification was detected.

The substrata at the sampling sites were of soft mud on gravel, with much refractory plant debris derived from both tasselweed, the marginal stands of *Phragmites*, and debris washed in from Brading Marshes. Marginal submerged areas showed signs of having been recently dried out (cracking).

No variation in water level was experienced during the survey, which, owing to the recent rainfall, was slightly higher than the centre of the causeway between this basin and Harbour Farm Lagoon 1 (Plate 4).

Fauna and flora

The benthic community of Harbour Farm Lagoon 2 was relatively sparse, dominated by chironomid midge larvae. Oligochaetes were rare, predominantly *Tubificoides pseudogaster*, but towards the southwestern part of the lagoon *T. amplivasatus*, a species tolerant of lower salinities, was also present; this region also supported a number of low-salinity or freshwater insect larvae. Towards the causeway end, where conditions were slightly more saline, the lagoonal-specialist isopod *Lekanesphaera hookeri* was common, and in this region the only amphipod recorded, *Gammarus zaddachi*, together with ragworm, *Hediste diversicolor*, were also present.

The scheduled lagoonal-specialist polychaete *Alkmaria romijni* was sparse near to the causeway. Two other lagoonal-specialist species, the ostracod *Cyprideis torosa* and the bryozoan *Conopeum seurati* was patchily present on suitable substrata.

This community reflects a pattern of low-salinity or freshwater assemblages towards the southwestern area of the lagoon, near the Brading Marsh drainage, while, in the vicinity of the causeway, where some mixing of species from Harbour Farm Lagoon 2 is likely during these periods of overflow of the causeway, more saline species are present.

Tasselweed (*Ruppia* spp.) was present in small patches near the causeway, mainly as drift. The associated fauna is shown in Table 3, a very sparse assemblage reflecting the insects larvae and isopod found in the benthos, together with the euryhaline prawn *Palaemonetes varians*.

Biotopes

The benthic biotope present throughout Harbour Farm Lagoon 2 was ENLag.IMS.Ann.Imp, as found (and "mapped") in Bamber (1997), while what there was of the plant-associated community was an impoverished example of ENLag.Veg.

Physical structure and management

The configuration of the basin of Harbour Farm Lagoon 2 has remained consistent over time; the open area of the water varies in response to invasion by, and clearance of, *Phragmites*. It is considered that it has been this management of the marginal reeds which has solely been responsible for maintaining a lagoon at this site, and that the basin would otherwise have

reverted to reed-marsh. Otherwise, there are no perceived threats to the integrity of the lagoon.

The integrity of the causeway separating Harbour Farm Lagoons 1 and 2 is important in minimizing drainage of lower-salinity water from the latter into the former.

Detailed surveys along a transect near the purported septic-tank discharge in this lagoon in 2003 found no effect on the biota of the lagoon.

Harbour Farm Lagoon 1 (HF1) (Plate 5)

Environmental conditions

Harbour Farm Lagoon 1, at about 16‰, was at a higher salinity than Harbour Farm Lagoon 2, and an improvement on recent historical conditions in this lagoon, despite the recent rainfall; the improvement is attributed to the reinstatement of the culvert connecting with Bembridge Harbour Lagoon. At around 9.2, the pH of the water was higher than that of normal sea-water, but within the range found in coastal saline lagoons supporting good specialist communities. No vertical stratification was detected.

The substrata in the lagoon were of soft mud on gravel towards the southwestern end, grading to muddy sand across most of the basin, with rubble in the vicinity of the northern embankment margin, and much refractory plant debris derived from both tasselweed and the marginal stands of *Phragmites*. Again, marginal submerged areas near the causeway showed signs of having been recently dried out (cracking).

No variation in water level was experienced during the survey.

Fauna and flora

The benthic community of Harbour Farm Lagoon 1 was effectively a more dense and diverse form of the community found at the eastern (causeway) end of Harbour Farm Lagoon 2, dominated by chironomid midge larvae and the oligochaete *Tubificoides pseudogaster*, together with ragworm, the isopod *Lekanesphaera hookeri*, and, unlike Harbour Farm Lagoon 2, the lagoonal-specialist amphipod *Corophium insidiosum*. The starlet sea-anemone, *Nematostella vectensis*, was also present, and like most species other than chironomids and oligochaetes, commoner in the main body of the lagoon than near the causeway.

The scheduled polychaete *Alkmaria romijni* was sparse near to the causeway. Three other lagoonal-specialist species were present, the ostracod *Cyprideis torosa* and the bryozoan *Conopeum seurati*, and the isopod *Idotea chelipes*.

This assemblage comprises species tolerant of reduced salinity, but preferring a range between 20 and 40‰, verifying the fact that this lagoon has returned to a higher salinity range compatible with the maintenance of a good lagoonal community.

Tasselweed (*Ruppia* spp.) was present patchily throughout the lagoon, although showing early die-back. The associated fauna is shown in Table 3, comprising similar species to those dominating the benthos, including *Nematostella vectensis*.

Biotopes

The benthic biotope present throughout Harbour Farm Lagoon 1 was a typical example of ENLag.IMS.Ann, as found (and "mapped") in Bamber (1997), while what there was of the

plant-associated community was a typical example of ENLag.Veg except for the lack of hydrobiid gastropods, which have always been rare or absent in the Isle of Wight lagoons.

Physical structure and management

The configuration of the basin of Harbour Farm Lagoon 1 has remained consistent over time. We were unable to gain safe access to the bank adjacent to the boatyard at the northeastern end of the lagoon, where there had been problems with encroachment into the lagoon for the purpose of angling for the carp: no evidence of carp was found, and the 2010 salinity regime would be expected to preclude their survival in this lagoon.

The reed-banks to the southeastern side of the lagoon do not appear to be spreading unduly into the open water of the basin.

The integrity of the causeway separating Harbour Farm Lagoons 1 and 2 is discussed above. Maintenance of this causeway has been undertaken creditably by the landowner.

East Harbour Lagoon (EHL) **(Plate 6)**

Environmental conditions

East Harbour Lagoon 2 had a salinity of 25‰, presumed to be depressed by the recent rainfall; historically this site has often been hyperhaline, and there is no significant freshwater input other than rainfall. The pH of the water was just higher than the normal range of sea-water, although lower than that of the adjacent lagoons: much of this basin is shaded by trees, and which may limit photosynthetic activity. No vertical stratification was detected.

The substratum of this lagoon was of flocculent mud amongst boulders, with much refractory plant debris derived from adjacent saltmarsh.

No variation in water level was experienced during the survey.

Fauna and flora

The benthic community of this recently formed lagoon was essentially a reduced form of that in Harbour farm Lagoon 1. Dominant species were chironomid midge larvae, the oligochaete *Tubificoides pseudogaster*, and the starlet sea-anemone, *Nematostella vectensis*. The only other species found were *Corophium insidiosum* and *Palaemonetes varians*. No polychaetes were present.

No submerged plants were found in the lagoon other than small tufts of *Enteromorpha* on some marginal boulders. Net sweepings did collect specimens of the isopod *Lekanesphaera hookeri*.

Biotopes

Earlier surveys of this lagoon had not classified the biotope owing to its early stage of development. By 2010 the benthic biotope was representative of a reduced form of ENLag.IMS.Ann.Imp, throughout the lagoon.

Physical structure and management

There is no known management of this lagoon. The basin structure is stable, and there is as yet no encroachment of marginal reeds, nor is any expected as the salinity of the lagoon is too high for successful colonization by *Phragmites*. At present, there are no perceived threats to the integrity of the lagoon, although pollutant input from the road may be a potential risk.

Bembridge Harbour Lagoon (BHL) **(Plates 7, 8)**

Environmental conditions

Bembridge Harbour Lagoon showed clear signs of the recent dehydration at this site, followed by the effects of recent rainfall. The lagoon was fragmented into two pools, and did not connect with the outflow ditch to the Yar River. Much of the marginal areas of the lagoon were cracked muddy sand, including areas submerged shallowly.

The salinity in both pools was 25‰, and the pH of the water was high at 8.8 to 8.9. No vertical stratification was detected. The substrata throughout the lagoon were of muddy-sand, with refractory plant debris derived from the marsh grasses adjacent to the water and from the surrounding trees.

No variation in water level was experienced during the survey.

Fauna and flora

The quantitative sampling sites were on recently re-flooded cracked substratum towards the west of the lagoon, and in the permanent deeper pool to the east of the lagoon.

The benthic community of the eastern sample-site was relatively dense and diverse, dominated by two species of *Corophium* – the estuarine *C. volutator* and the lagoonal *C. insidiosum* – together with the estuarine clam *Abra tenuis*, the polychaete *Caulleriella zetlandica*, and a dense population of the starlet sea-anemone *Nematostella vectensis*. Other polychaetes present were ragworm and a few specimens of the estuarine spionid *Streblospio shrubsolii*. Chironomid larvae were common, and the lagoonal nemertean cf. *Myoisophagus sanguineus* was also present.

The community at the western (rehydrated) site was a reduced example of that described above, demonstrating the facility for recolonization shown by these lagoonal species. Generally, the same species were present (including *Nematostella vectensis*) but in much lower densities, with the notable exceptions of *Caulleriella zetlandica* and *Corophium insidiosum*. The former is a small, distinctly endofaunal, burrowing species rather than being actively mobile, while the latter is thought to be more dependent upon its burrow than its estuarine congener, *C. volutator* (itself also rare at the western site), and thus also less actively dispersive, although capable of limited swimming.

No submerged plants were present. Net sweeps amongst the marginal reeds to the northern side of the lagoon indicated a high density of *Nematostella vectensis* in the slightly more flocculent sediment. Sweeps also collected the euryhaline prawn *Palaemonetes varians*.

Biotopes

The benthic biotope present throughout Bembridge Harbour Lagoon was again a typical form of ENLag.IMS.Ann.Imp, as found (and "mapped") in Bamber (1997). There was no plant-associated biotope.

Physical structure and management

The configuration of the basin of Bembridge Harbour Farm has remained consistent over time, and is expected to remain so. The outflow-ditch to the west of the lagoon is only important for the integrity of the lagoonal habitat because it allows the discharge of excess rainwater. The marginal *Phragmites* to the north of the basin is not considered to pose any threat of encroachment into what is normally a hyperhaline lagoon. There is no active management of the lagoon, and there are no other perceived threats to the integrity of the lagoon.

Remarks on the Bembridge Lagoons

The basins of all four lagoons are stable and under no direct threat to their integrity, as long as the landowners/occupiers adjacent to the roadside bank of Harbour Farm Lagoon 1 are made aware of the conservation status of the lagoon, and maintain an amiable relationship.

The two basins nearest the Harbour are generally high-salinity lagoons, with specialist communities of conservation importance. The Harbour Farm Lagoons offer a range of diversity of lagoonal habitat on this site. Harbour Farm Lagoon 2 has always been a low-salinity habitat, normally without lagoonal specialists (although with the scheduled polychaete *Alkmaria romijni*) and under continuous threat of reversion to reed-marsh without some active maintenance. Harbour Farm Lagoon 1 is a significant saline lagoon, which had declined in the recent past owing to inhibition of the input of saline water – reduced salinity is one of the main threats to the integrity and conservation status of coastal saline lagoons (Bamber *et al*., 2001). Fortunately, the resurrection of the culvert at its northwestern corner has allowed the recovery both of the salinity and thereby of the significant species of this lagoon. At the same time, it has apparently eradicated the carp population which was generating its own threat to the integrity of the site by inviting illicit recreational angling.

Throughout the diversity of habitat encompassed by these four lagoons, there are nine lagoonal-specialist species, two of them scheduled. These scheduled species are each only known from one site elsewhere on the Isle of Wight: *Nematostella vectensis* is currently also known from Yar Lagoon, and *Alkmaria romijni* has been recorded from Wootton Mill Pond (Gilliland and Sanderson, 2000), a site currently not deemed to represent a saline lagoon (Bamber *et al*., 1998).

The communities are unusual in the absence of molluscs other than the estuarine clam *Abra tenuis*, itself not a common lagoonal inhabitant (see under Yar lagoon, above).

DISCUSSION

The structure of the Isle of Wight lagoons studied herein has been stable in the long term. They are all relatively isolated from anthropogenic pressures other than the proximity of the road and adjacent commercial sites at the eastern Bembridge lagoons. The present results appear to confirm the consistency of their communities and habitat regime found in the previous surveys over the last two decades.

One technique being employed to classify lagoons in the UK is to compare the benthic community structure with that of a standard suite of UK lagoons, based on quantitative data. This can interpret appropriate-quality communities even when specialist species are not well represented (i.e. where they have not had the opportunity to recruit).

The quantitative data for the Isle of Wight lagoons were analyzed against the standard UK database (which includes the 2003 data from these Isle of Wight lagoons), held at Artoo Marine Biology Consultants, by cluster-analysis of Bray-Curtis similarity, based on log-transformed data owing to the overdominance of certain species in lagoonal communities. The resulting dendrogram is shown as Figure 4.

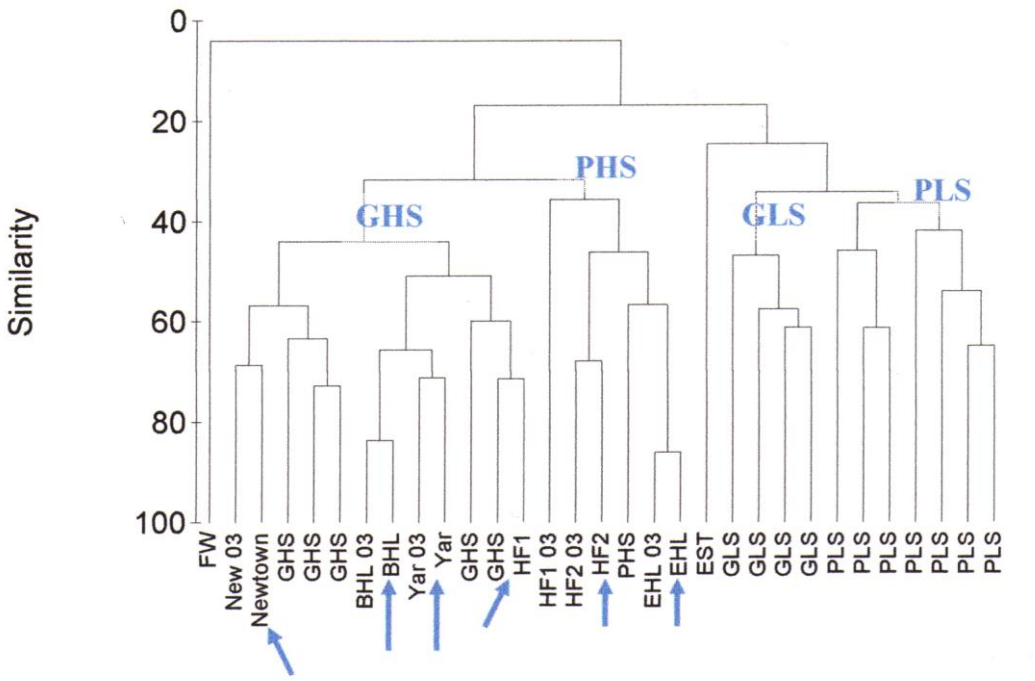

Figure 4. Bray-Curtis similarity dendrogram (%) of UK coastal saline lagoons including Isle of Wight lagoons in 2010 (arrowed) and in 2003 (suffixed '03'), based on benthic communities (log-transformed data). GHS – "good" higher-salinity lagoons; PHS – "poor" higher-salinity lagoons; GLS – "good" lower-salinity lagoons; PLS – "poor" lower-salinity lagoons; FW – freshwater site; EST – estuarine site.

Within the standard lagoon suite, two clusters of "good" lagoons exist, characterized by their dominant oligochaete species, viz the higher salinity, *Tubificoides pseudogaster* communities typical of southern England (Cluster GHS) and the lower salinity *Heterochaeta costata*

communities found in Wales (Cluster GLS). The surrounding sites are impoverished higher-salinity (PHS) or lower-salinity (PLS) lagoons and one paralagoonal estuarine and one paralagoonal freshwater habitats.

As can be seen, all of these Isle of Wight Lagoons fall into the "Good High Salinity" lagoons cluster other than the low-salinity Harbour farm Lagoon 2, and East Harbour Lagoon which is in an early stage of colonization and evolution. Equally, all the sites clustered with the community from the same lagoon in 2003, with the reassuring exception of Harbour farm Lagoon 1. In 2003, at a time when the salinity was significantly reduced, this lagoon was classified as a "Poor High Salinity" lagoon; by 2010 the improvement in the salinity regime had returned the community to one characteristic of a "Good High Salinity" lagoon – now within the same subcluster as Yar Lagoon and Bembridge Harbour Lagoon.

We may therefore conclude that the lagoons on the Isle of Wight surveyed in 2010 have all maintained their good conservation status and their important specialist communities. One which had shown previous decline in condition had recovered satisfactorily, and would be assumed to continue to improve in that direction.

ACKNOWLEDGEMENTS

We are very grateful for the on-site hospitality and permissions from Pema Brunet, the National Trust Volunteering Warden at Newtown, and, as ever, from Mr and Mrs Ken Hicks, the landowners at Bembridge Farm.

REFERENCES

Bamber R.N., 1997. Assessment of saline lagoons within Special Areas of Conservation. *English Nature Research Reports* No. **235**. 55 pp + 7 Appendices.

Bamber R.N., Evans N.J. & Robbins R.S., 2003. Habitats Regulations review of consents: Solent and Isle of Wight lagoons survey. *Natural History Museum Consultancy Report to the Environment Agency* No. ECM 635K/03. December 2003. 84 pp.

Bamber R.N., Gilliland P.M. & Shardlow, M.E.A., 2001. *Saline lagoons: a guide to their management and creation (interim version)*. UK Saline Lagoon Working Group Publication. Peterborough; English Nature. 95 pp + Appendices.

Bamber R.N., Sheader M., Sheader A. & Somes R., 1998. Assessment of the Solent saline lagoon resource, 1997. FAWLEY arl Consultancy Report to Hampshire and Isle of Wight Wildlife Trust No. FCR 265/97. 100 pp + Appendices.

Gasca, D., 2003. Isle of Wight Lagoons Investigation. Bembridge Lagoons Final Report. *Atkins Water Report to the Environment Agency Southern Region*, Ref, 5002084/60/DG/40; 78pp + Appendices.

Gilliland P.M. & Sanderson W.G., 2000. Re-evaluation of marine benthic species of nature conservation importance: a new perspective on certain "lagoonal specialists" with particular emphasis on *Alkmaria romijni* Horst (Polychaeta: Ampharetidae). *Aquatic Conservation: Marine and Freshwater Ecosystems*, **10**; 1–12.

Plate 1. Yar Lagoon from the north

Plate 2. Newtown Quay Lagoon from the southwest, towards the boathouse

Plate 3. Bembridge: Harbour Farm Lagoon 2, from the causeway

Plate 4. Causeway between Harbour Farm Lagoons 1 and 2.

Plate 5. Bembridge: Harbour Farm Lagoon 1, from the causeway

Plate 6. Bembridge: East Harbour Lagoon from the east.

Plate 7. Bembridge Harbour Lagoon from the west.

Plate 7. Bembridge Harbour Lagoon, western end showing dried margin in background.