JOINT NATURE CONSERVATION COMMITTEE

Marine Nature Conservation Review

Sector 5

South-east Scotland and north-east England

Area summaries

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Coasts and seas of the United Kingdom - MNCR series

11 Bamburgh to Alnmouth

Location		
Position (centre)	NU 250 250	NU 185 353 - NU 257 107
County/District	Northumberland	Berwick-upon-Tweed & Alnmouth
Conservation agency/area	English Nature	Northumbria

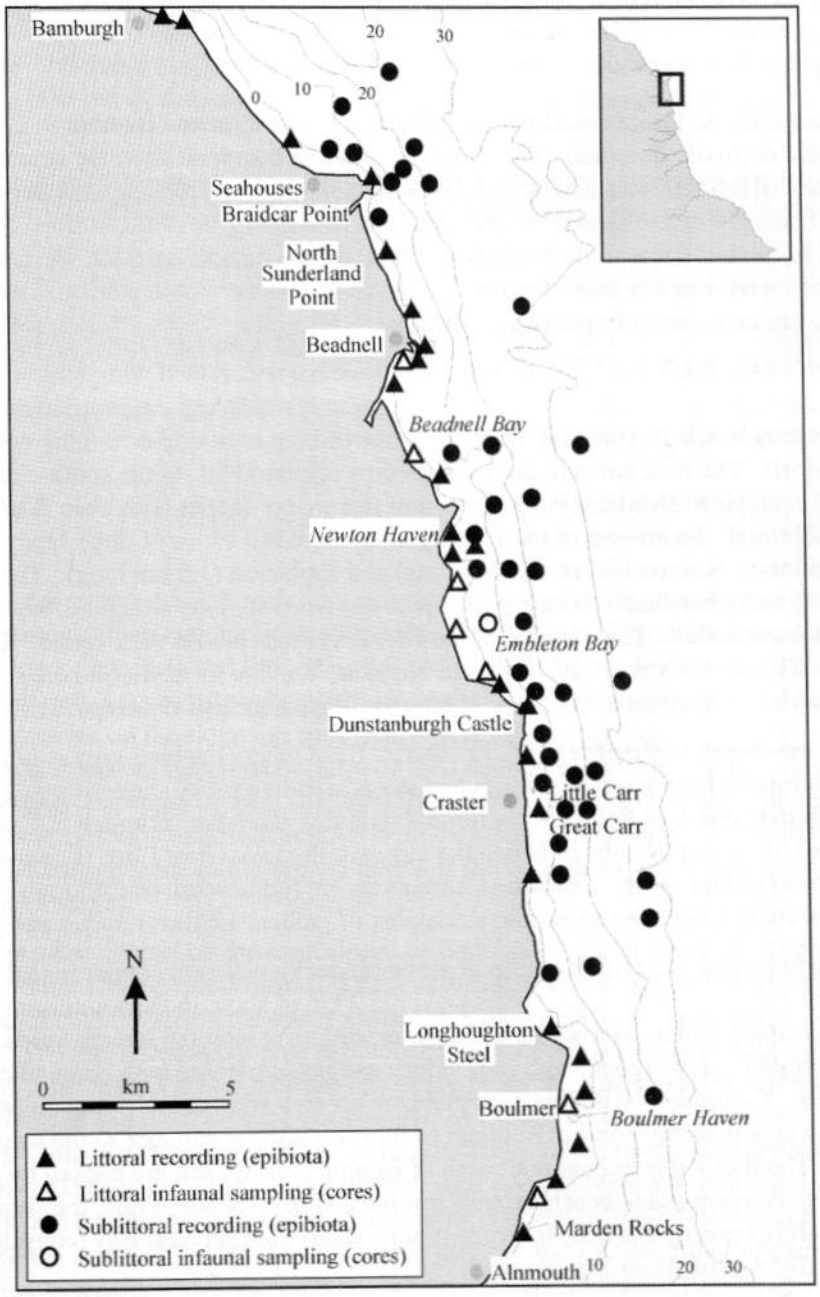

Figure 11.1 Location of area showing sites surveyed and main bathymetric features.

Marine biological surveys

	Survey methods	*No. of sites*	*Date of survey*	*Source*
Littoral	Recording	24	September 1987	Connor (1989)
			June-August 1994	Holt (1994)
	Infaunal cores and granulometry	7	September 1987	Connor (1989)
			July-August 1992	Holt (1994)
Sublittoral	Recording	38	September 1987	Connor (1989)
			June-August 1992	Holt (1994)
	Infaunal cores and granulometry	1	June 1992	Connor (1989)

Introduction

This area includes some 30 km of coastline from Blackrocks Point, below Bamburgh Castle, to Marden Rocks just north of Alnmouth. The shores in this area comprise alternate stretches of bedrock and sandy beaches which are backed by low cliffs or sand dunes. The rock layers run parallel or obliquely to the coast giving the shores variable amounts of shelter from wave action. Most of the coast is exposed to the full fetch of the North Sea from the east or north-east, but wave action is rapidly attenuated on the more extensive wave-cut, rocky platforms. These platforms extend several kilometres out to sea as a series of underwater terraces.

Below Bamburgh Castle there is a 5 km long beach of mobile sand, dotted with outcrops of quartz dolerite (part of the Great Whin Sill), that extends south-eastwards along the shore to Seahouses. Beyond a small sandy beach at Annstead there is a series of long rock ridges running perpendicular to the shore at Beadnell. The rock strata in these ridges dips at around 10° to the south-east so that some of the ridges, for example at Beadnell Point, form uniform wedge shapes with even slopes running down into the sublittoral. South-east of these rocky areas there is a series of three sandy bays at Beadnell (2.5 km long), Newton Haven (0.5 km long) and Embleton (1.5 km long). The bays are separated by small rocky headlands or carrs, most with the strata running straight offshore, that protect the beaches from wave action. The geology of the Newton Haven area is very varied. Emblestone is part of the Whin Sill, nearby Jenny Bells Carr and Newton Point are formed of limestone, Fills Reef is sandstone and the rocky outcrops in the shore of Newton Haven are soft sandstone and shale.

The character of the shoreline changes at Dunstanburgh Head where the blue-grey columnar basalt of the Whin Sill outcrops to form a series of cliffs and steep, slab-like rocky shores dipping eastwards. From Castle Point to Cullernose Point the shores maintain this character, although at Craster there are two wedge-shaped limestone islands, of which the larger of the two, Great Carr, is connected to the mainland coast by a boulder shore. Limestone formations are found south of Cullernose Point at Howick where the rocks have been worn into a complex of gullies, archways, caves and pools.

The shore at Longhoughton is a wide expanse of wave-cut rocky platform similar to that further north at North Sunderland Point. Longhoughton Steel and the 2 km of shore to the south form the largest expanse of uninterrupted littoral bedrock in this area, extending at least 0.5 km seawards from the high tide mark. The terrain is very rugged, with long ridges and pools running both perpendicular and parallel to the coast. Continuous with this rock platform are two arms of low-lying millstone grit which extend seawards from the coast at Boulmer to form a a narrow entrance to the natural harbour of Boulmer Haven. The rocky shores continue south of Boulmer Haven and are backed by dunes or low boulder clay cliffs. A mobile sand beach extends southwards from Seaton Point, interrupted by Marden Rocks, before opening out onto the wide mobile sands of Alnmouth Bay (considered separately in area 14. Alnmouth to Newbiggin Point.)

The linear stretch of coastline from Bamburgh to Alnmouth faces east-north-east and is mostly moderately exposed to wave action. The prevailing south-westerly winds are offshore, although easterly winter gales with a long fetch across the North Sea create high-energy wave action. There is very little natural shelter apart from outlying rocks and low headlands, such as at Newton and Boulmer Haven, which protect small areas of sandy beach. However, the wide wave-cut platforms, typical of many of the rocky shores in this area, significantly reduce wave action.

Tidal streams follow the coastal outline, flowing southwards on the flood and generally more slowly northwards on the ebb. There is a net flow of water southwards due to the combined forces of tide and wind action. This long-shore drift carries small amounts of suspended sediment southwards. Tidal streams are mainly weak (<1 knots) but are locally accelerated around headlands such as at Dunstanburgh where tidal streams of up to 3 knots were experienced by surveyors.

Surface temperature in winter is around 5.5°C and warms to 13.5°C in the summer. Local variations occur depending upon weather conditions. Salinity is fully marine at around 34.5‰ (Lee & Ramster 1991). Poor weather and underwater visibility (<1 m) conditions were experienced during the sublittoral survey of the area in 1992 (Holt 1994). This prevented the collection of adequate data at the time but it emphasises the effect of heavy weather on underwater visibility. Boulder clay silt, which coats much of the underwater substrata, is quickly resuspended by moderate wave action and strong tidal streams, but falls out of suspension after a few days of calm weather coinciding with neap tides.

Physical features	
Physiographic type	Open coast
Length of coast	30 km
Bathymetry	30 m isobath at 2-5.5 km, 50 m isobath at 6.5-13 km offshore
Wave exposure range	Moderately exposed
Tidal stream range	Moderately strong to weak
Tidal range	4.1 (springs), 2.1 m (neaps)
Salinity range	Fully marine

Marine biology

Littoral

The character of the most extensive rock platforms is very mixed, with some shores having both typical sheltered rocky shore communities with dense fucoid algae (Fspi; Fves; Asc.Asc) as well as extensive platforms of barnacle and limpet-covered rock (BPat.Sem). For example, knotted wrack *Ascophyllum nodosum*, a fucoid alga characteristic of sheltered mid-shores, is found between areas dominated by barnacles on the extensive rock platform at Longhoughton Steel. Zonation patterns on these wave-cut platforms are indistinct because of their undulating profile. At Boulmer Haven, high ridges mid-way down the shore support sheltered fucoid-dominated communities on their leeward sides but have more typically exposed biotopes with barnacles and limpets on their seaward sides (FvesB). Another consequence of the rugged terrain is the high abundance of rockpools (Cor; FK) in the gullies between ridges.

Algal zonation is more distinct on the even slopes of Beadnell Point which support species characteristic of more wave-exposed areas. The rock surfaces on the upper mid shore are very pitted compared to the smoother rock on the lower shore, with many small cup-sized pools encrusted with coralline algae. The mid shore is covered in bladder wrack *Fucus vesiculosus* with a turf of short plants of the red algae *Mastocarpus stellatus* on the lower shore. The red algae *Palmaria palmata*, *Osmundea pinnatifida* and the long straps of thongweed *Himanthalia elongata* cover the lower eulittoral (Him). This zone merges with the sublittoral fringe where coralline encrusted rock supports dense kelp *Laminaria digitata* (Ldig.Ldig). Similar algal communities are found on Longhoughton Steel, but in addition overhanging and shaded limestone is bored by the wrinkled rock borer *Hiatella arctica* and supports sponges, the anemone *Sagartia elegans* and the ascidian *Polycarpa scuba* (SByAs). Similar overhang and cave communities have been surveyed at Rumbling Kern, near Howick, where the soft rocks has been eroded into a complex of gullies and tunnels. The walls of the tunnels have an extremely dense covering of the ascidian *Dendrodoa grossularia* with abundant erect and encrusting sponges, an interesting and unusual variation of the SByAs biotope.

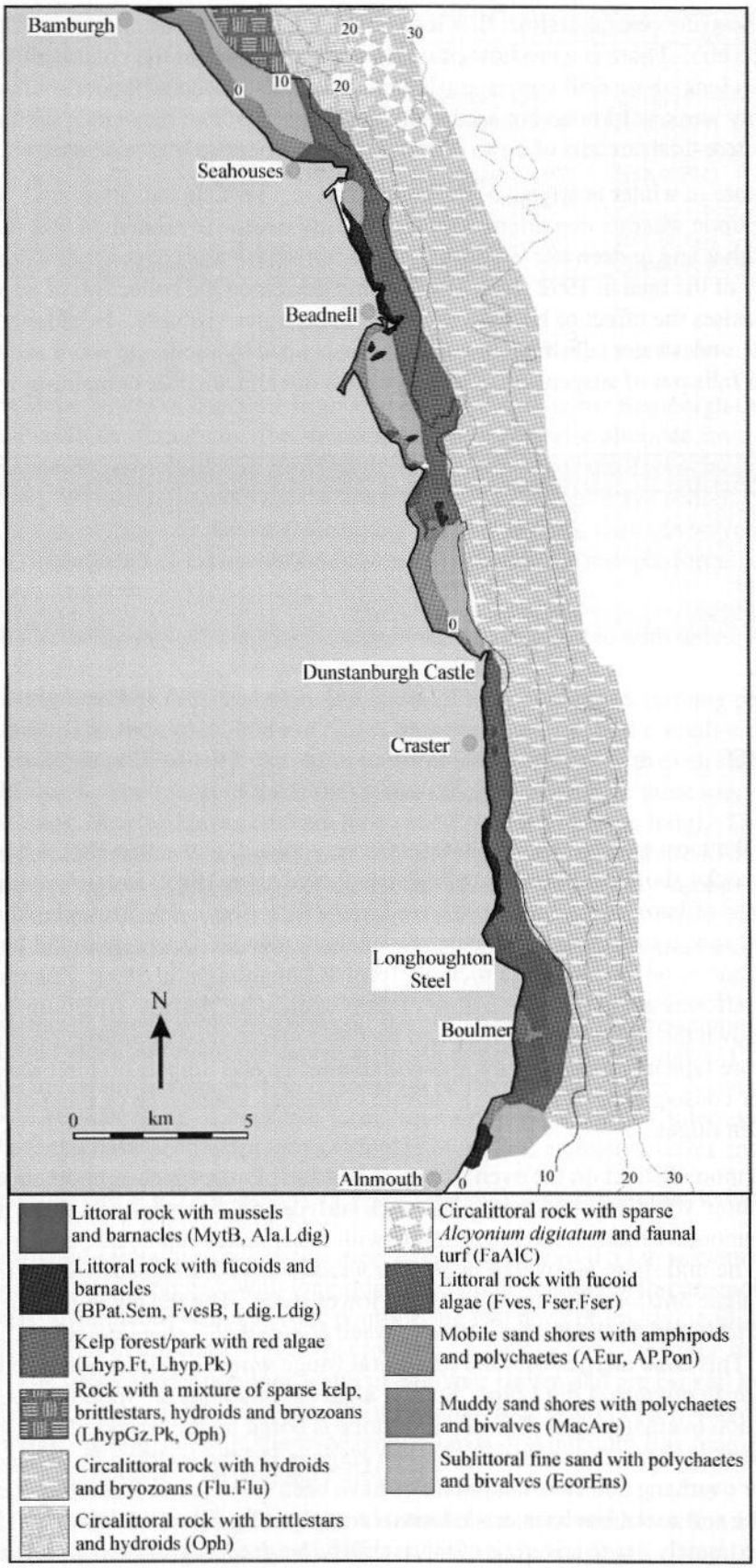

Figure 11.2 Indicative distribution of the main biotopes within the area (based on data from survey sites shown in Figure 11.1 and additional field observations).

Exposed rocky shores and rock faces without protection from wave action are animal-dominated, either with mosaics of algae and barnacles or totally dominated by barnacles and mussels or barnacles and limpets (FvesB; MytB; BPat.Sem). The short, steep bedrock slopes at Queen Margaret's Cove just below Dunstanburgh Castle and at Great Carr and Rumbling Kern, support similar biotopes which are widespread and occur along most of this coastline.

Many of the rocky shores included in this area have patches of boulder field that support dense fucoid algae and shelter a wide range of animals in the interstices and under the boulders (Fves; AscX; Fser.Fser.Bo). Anemones, crabs, littorinids and polychaetes are found in relatively high numbers on the more stable boulder shores such as at Bally Carrs just south of Boulmer Haven. Shallow pools between the boulders also contain a moderately diverse fauna with small gobies and anemones (Cor). The upper faces of the larger boulders on these shores are relatively bare, or dominated by barnacles and limpets.

Biotopes consisting of opportunistic species such as the green alga *Enteromorpha intestinalis* and mussels *Mytilus edulis* colonise sand-scoured rocky carrs that outcrop along many of the beaches in this area, for example in Beadnell Bay (Eph). Thick mats of the red algae *Audouinella* spp. are found where rock occurs in the lower eulittoral of these sediment-influenced shores, binding sediment particles to the rock with its fine filaments (Rho).

The mobile sands of Beadnell Bay and Embleton Bay are characterised by crustacean/ polychaete communities with few species other than burrowing amphipods *Bathyporeia* sp., sparse lugworms *Arenicola marina* and sand-eels *Ammodytes tobianus* burrowing in the mobilised sand washed by the surf on the lower shore (AP.Pon; AP.P). Large numbers of the small polychaete *Capitella capitata*, known to be indicators of organic nutrient enrichment, occur on localised areas of some of these sandy beaches, for example adjacent to Beadnell Harbour, near a small stream crossing Embleton Bay and below the caravan site at Bally Carrs (AP.Pon). It is probable that freshwater run-off from farmland and septic tank overflows are responsible for occurrences of this particular species.

The beach of very fine sand at Newton Haven has been noted in previous studies (Foster-Smith & Foster-Smith 1987; Olive 1984) as being of particular interest for its lower shore biotopes of the burrowing heart urchin *Echinocardium cordatum*, razor clams *Ensis* spp., a variety of bivalves and polychaetes and sparse numbers of the urchin *Echinocardium flavescens*. This site was re-surveyed during 1992 with similar results, emphasising the stable nature of the sediment. This biotope (EcorEns) is more often found in the shallow sublittoral. Soft mud within this area is found only at Boulmer Haven, one of the very few very sheltered areas on this part of the coast. Although the area of mudflat is relatively small compared to those further north such as in Lindisfarne NNR, it is nonetheless rich in terms of species abundance and diversity. Lugworms *Arenicola marina*, obvious by their closely-spaced casts in the dark sediment, are abundant and are accompanied by a variety of other polychaetes, including *Eteone longa*, and the bivalves *Fabulina fabula* and *Macoma balthica* (MacAre). Lower on the same shore, and closer to the entrance of the haven, the slightly coarser, cleaner muddy sand supports dense sand mason worms *Lanice conchilega* and polychaete *Eumida* sp., and large numbers of the bivalves *Fabulina fabula*, *Lucinoma borealis*, *Abra alba* and *Abra prismatica* (Lan).

Sublittoral

Rocky communities dominate the inshore sublittoral areas along this stretch of coast. Bedrock terraces with dense kelp *Laminaria hyperborea* forest form an almost continuous band southwards from Seahouses (Lhyp.Ft), broken only by the sandy sediments off Beadnell Bay and Embleton Bay. A moderate variety of other plants and animals are associated with the kelp stipes and rocky substratum below the forest canopy, with the highest diversity and abundance found in the slightly more tide-swept areas such as off Seahouses, around Beadnell and off Dunstanburgh. Grazing by urchins *Echinus esculentus* is apparent at some sites, where the kelp stipes are almost bare. However, the effects of grazing seem to be patchy as some species-rich sites are found immediately adjacent to heavily grazed areas.

Rocky reefs extend over 5 km offshore to the east and south of Seahouses, but even at this distance the sea bed was only below 30 m to 40 m of seawater. The gradual transition from upper infralittoral to lower infralittoral biotopes, where kelp forest thins to kelp park, is not always distinct, but examples of kelp park (Lhyp.Pk) are probably widespread in this area.

Distinct biotopes are found on the vertical faces of the short steps in the bedrock terracing (AlcByH.Hia). Those terraces softer limestone are highly pitted by boring bivalves such as wrinkled rock borer *Hiatella arctica* and possibly oval piddock *Zirfaea crispata*, although samples of the latter species were not extracted from their burrows. This is a relatively rich animal-dominated biotope, with many species protected from urchin *Echinus* grazing by the vertical inclination and the pitted nature of the rock faces. Encrusting sponges, bryozoans, hydroids, colonial and solitary ascidians and brittlestars are recorded at most of the sites with this biotope. These vertical faces have been illustrated in great detail by Foster-Smith and Foster-Smith (1987) who also describe sub-zones on these faces. Many of these vertical faces are deeply undercut at their bases, providing refuge for edible crabs *Cancer pagurus* and lobsters *Homarus gammarus*.

The bedrock terraces in the circalittoral support biotopes characteristic of tide-swept and slightly silted or sediment-scoured conditions. Turfs of bryozoans *Flustra foliacea* and *Securiflustra securifrons* with erect hydroids such as bottlebrush hydroid *Thuiaria thuja*, *Nemertesia antennina* and *Abietinaria abietina* cover large areas of upward-facing bedrock terrace, particularly on prominent ridges (Flu.Flu). The boring sponge *Cliona celata* is regularly found on the upward-facing limestone surfaces, often alongside the closely packed, muddy tubes of the polychaete *Polydora* sp. A calcareous bryozoan, *Smittina landsborovii*, which forms delicate, orange ridges attached on-edge to rock faces, is found to the north of this survey area off Seahouses and Beadnell, often on the sides of hornwrack *Flustra foliacea*-covered rocks. During MNCR surveys this species has only been recorded in this area and off Holy Island.

Cobbles and boulders are found throughout this area, although mostly in small patches on or near the bedrock reefs. The species recorded on boulders are similar to those on bedrock at equivalent depths, with large numbers of tubeworms *Pomatoceros triqueter* recorded at all the sites. Tide-swept cobbles and coarse gravel off Dunstanburgh Head supports dense turfs of the bryozoans *Flustra foliacea* and *Securiflustra securifrons* as well as the hydroid *Tubularia indivisa* (Flu.Flu).

Towards the south of this area, particularly off Craster and Howick, large numbers of the reef-building polychaete *Sabellaria spinulosa* are recorded. This species consolidates sand particles into a honeycomb reef structure built on either sand or rock. In this area, this species spans the infralittoral and circalittoral zones (Sspi) occurring amongst dense kelp forest and on open rock adjacent to areas of sediment.

The sublittoral clean sand sediments off Newton Haven and Longhoughton Steel support dense populations of heart urchin *Echinocardium cordatum*, razor shells *Ensis siliqua* and *E. arcuatus* (EcorEns). This biotope is widespread along the Northumberland coast, but in this area is restricted to locations adjacent to the sand beaches.

Nature conservation

Conservation sites

Site name	*Designation*	*Centre grid ref.*	*Main features*
Northumberland Shore	SSSI, pSPA	NT 980 575 - NU 010 525	Ornithology
Bamburgh Coast and Hills	SSSI	NU 167 355	Geology, flora
Newton Links	SSSI, NT	NU 230 269	Coastal habitats and flora, ornithology
Castle Point to Cullernose Point	SSSI	NU 260 188	Geology, flora, ornithology
Howick to Seaton Point	SSSI	NU 262 173	Geology, ornithology
Berwickshire and North Northumberland Coast	cSAC	NT 980 575	Marine habitats, seals
North Northumberland Dunes	cSAC	NT 980 575	Dune vegetation
Holy Island and the Farnes	SMA	NU 255 385	Marine biology
North Northumberland	HC	NT 979 576 - NZ 297 933	Landscape
Northumberland Coast	AONB	NU 185 355	Landscape
St Aidan's & Shoreston Dunes	NT	NU 211 327	Coastal habitats
Beadnell & Annstead Dunes	NT, WT	NU 232 298	Coastal habitats
Newton Point	NT	NU 242 253	Coastal habitats
Low Newton-by-the-Sea	NT	NU 241 246	Beach and village
Embleton Links	NT	NU 243 235	Coastal habitats
Dunstanburgh Castle	NT	NU 258 220	Cliffs and castle

Human influences

Sewage discharge

There are a number of outfalls in the area, situated near to the small fishing villages: at Seahouses, where there are storm sewage and emergency overflows just north of the harbour; at the Snook/North Sunderland Point; at Beadnell Point; at North Sunderland harbour; and there is a preliminary treatment outfall at Beadnell Point. At Craster there is a crude sewage outfall, a storm overflow and an emergency overflow outfall near to the small harbour. There are also three outfalls at Bamburgh, two of which discharge raw sewage.

Commercial fishery

The rocky reefs in the area are potted for lobsters and crabs. At Boulmer local fisherman use the natural shelter of the haven for mooring their cobles.

Bait-digging

There are two sites where bait-digging has been banned in this area. A ban was placed on the small area of sheltered sand at Newton Haven (leased by the National Trust) and an attempted prosecution reduced the number of diggers to an average of about four. These four continued to work below the level of low water spring tides, below the protected area, where damage was caused to the population of burrowing sea urchins. The National Trust applied to the Crown Estates Commissioners for a lease of the sea bed in order to control yacht moorings and bait-digging (Fowler 1992).

In Boulmer Haven, Alnwick District Council have attempted to prohibit bait-digging on the foreshore because local fishermen found it difficult to launch their cobles across a beach full of holes. However, digging activity continued and eventually Alnwick District Council enabled the enactment of a by-law to ban digging for bait (Fowler 1992), which has since been overturned in the High Court.

Recreation

The whole of this area is very popular for recreation, particularly with visitors from Tyneside. The Northumberland Coastal Route directs motorists along the scenic routes through north Northumberland but the largest numbers of tourists visit the seaside towns of Seahouses, Beadnell, Craster and

Alnmouth or the castles at Bamburgh and Dunstanburgh. Pleasure boats and fishing trips to the Farne Islands from North Sunderland harbour at Seahouses are particularly busy during mid-summer. Large numbers of divers launch boats in Beadnell Bay in order to get to the Farne Islands. There has been some conflict between tour-boat owners and divers at North Sunderland, and between water sports and fishermen at Beadnell. The whole area is used extensively for the collection of bait (peeler crabs, etc.) and intertidal shellfish.

References and further reading

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Survey sites

Surveys

112: MNCR littoral and sublittoral survey of Berwick to Beadnell including the Farne Islands (Connor 1989).
310: MNCR sublittoral survey of north-east England 1992 (Holt 1994).
311: MNCR littoral survey of north-east England 1992 (Holt 1994).
324: Littoral survey of Beadnell to Dunstanburgh 1987 (Foster-Smith & Foster-Smith 1987).

Littoral sites

Survey	Site	Site name	Grid reference	Latitude & longitude	Biotopes present
112	24	Harkness Rocks, Bamburgh.	NU 176 359	55°36.9'N 01°43.2'W	YG; PelB; MytFR; Cor; FK; Ala.Myt
112	27	Snook, North Sunderland.	NU 228 315	55°34.6'N 01°38.3'W	Pel; Fspi; Fves; Fser.R; Cor
311	1	Boulmer Haven shore.	NU 269 141	55°25.2'N 01°34.5'W	Fspi; Asc.Asc; FvesB; Fser.R; MytFR; Ldig.Ldig
311	3	Swine Den shore, Dunstanburgh.	NU 260 185	55°27.5'N 01°35.3'W	YG; Ver.Ver; Pel; Fspi; BPat.Sem; FvesB; Fser.Fser; Ldig.Ldig
311	4	Shore at Marden Rocks, Alnmouth.	NU 260 113	55°23.6'N 01°35.3'W	Ver.Ver; Fspi; FvesB; Fves; Fser.R; Cor; Ldig.Ldig
311	17	Braidcarr Rocks, Seahouses.	NU 227 327	55°35.2'N 01°38.3'W	Fspi; FvesB; Fves; Him; Cor; FK; Ldig.Ldig
311	18	Beadnell Point, Seahouses.	NU 241 288	55°33.1'N 01°37.0'W	YG; Ver.Por; MytB; Fves; Him; Cor; Ldig.Ldig
311	19	N Beadnell Bay, Seahouses.	NU 235 286	55°33.0'N 01°37.6'W	Fves; Rho; Eph; Cor; AP.Pon; AP.P
311	20	High Newton Snook.	NU 243 260	55°31.6'N 01°36.9'W	Ver.B; BPat.Sem; Fves; Cor; FK; Ala.Ldig; Ldig.Ldig; Lhyp.Ft; AP.Pon
311	23	Greymare Rock, Dunstanburgh.	NU 254 223	55°29.6'N 01°35.8'W	Fser.R; Ldig.Ldig.Bo
311	24	Queen Margaret's Cove, Dunstanburgh.	NU 259 218	55°29.3'N 01°35.4'W	YG; Ver.Ver; BPat.Sem; Fves; Him; Ala.Ldig
311	25	N of Embleton Burn mouth, Newton.	NU 244 234	55°30.2'N 01°36.8'W	AP.Pon
311	26	S of Embleton Burn mouth, Newton.	NU 246 227	55°29.8'N 01°36.6'W	AP.Pon
311	27	Muckle Carr, Craster, Dunstanburgh.	NU 261 198	55°28.2'N 01°35.2'W	Pra; BPat.Sem; MytB; FvesB; Fves; Fser.R; Cor; FK; SwSed; Ldig; Ldig.Ldig; Ldig.Ldig.Bo
311	28	Rumbling Kern, Dunstanburgh.	NU 263 172	55°26.8'N 01°35.0'W	BPat.Sem; BPat.Fvesl; MytB; Him; SByAs; Ldig.Ldig
311	29	Longhoughton Steel, Boulmer.	NU 271 153	55°25.8'N 01°34.3'W	Fspi; Fves; Fser.R; Cor; FK; Ldig.Ldig; Lhyp.Ft
311	30	S of Longhoughton Steel shore, Boulmer.	NU 271 150	55°25.6'N 01°34.3'W	AscX; FK; SwSed; SByAs; Ldig.Ldig; Lhyp.Ft
311	31	Broadroom End, Seaton Point, Boulmer.	NU 268 126	55°24.3'N 01°34.6'W	Fspi; Fves; Fser.Fser; Cor; Ldig.Ldig
311	32	Bally Carrs and Seaton Bay, Alnmouth.	NU 265 124	55°24.2'N 01°34.8'W	Fves; Fser.R; Cor; Ldig.Ldig; AEur; AP.Pon
311	33	Boulmer Haven sediment.	NU 267 135	55°24.8'N 01°34.6'W	AP.P; Lan; MacAre
311	40	Emblestone, Newton.	NU 245 240	55°30.5'N 01°36.7'W	Fves; Fser.R; Rho; SwSed; Ldig.Ldig.Bo; AP.Pon; AP.P; Lan; EcorEns
324	1	Annstead Rocks, Seahouses.	NU 227 308	55°34.2'N 01°38.4'W	Fves; Fser.R; Fser.Fser; Ldig.Ldig
324	2	Linkhouse Rocks, Seahouses.	NU 230 303	55°33.9'N 01°38.0'W	AscX; FvesB; Fves; MytFR; Him; SR
324	3	Beadnell Haven, Seahouses.	NU 234 295	55°33.5'N 01°37.7'W	Fspi; BPat.Sem; Him; Fser.R; Eph; Ala.Ldig

Littoral sites - continued

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
324	4	Lady's Hole to Beadnell Point, Seahouses.	NU 238 288	55°33.1'N 01°37.3'W	Fves; Fser.R; SR; SByAs; Ldig.Ldig.Bo
324	5	Beadnell Point, Seahouses.	NU 242 288	55°33.1'N 01°36.9'W	Ent; BPat.Sem; Fser.R; Him; Pal; Cor; Ala.Ldig; Ldig; Ldig.Ldig
324	6	Beadnell Bay, Seahouses.	NU 237 261	55°31.7'N 01°37.3'W	AP.P; AP.Pon
324	7	Snook Point, Seahouses.	NU 241 258	55°31.5'N 01°37.0'W	BPat.Sem; FvesB; Fser.R; Him; Ldig.Ldig
324	8	Football Hole, Seahouses.	NU 241 256	55°31.4'N 01°37.0'W	AP; AP.P; BarSnd
324	9	Football Hole to Pern Carr, Seahouses.	NU 242 254	55°31.3'N 01°36.9'W	Fspi; BPat.Sem; MytB; FvesB; Fves; Fser.Fser; Fser.Fser.Bo; Ldig.Ldig.Bo
324	10	Lobster Carr, Seahouses.	NU 246 253	55°31.2'N 01°36.5'W	Fser.R; Fser.Fser; Him; FK; Ala.Ldig; Ldig; Ldig.Ldig
324	11	N Shore Newton, Seahouses.	NU 247 251	55°31.1'N 01°36.5'W	Asc.Asc; Fser.R; Fser.Fser; Fser.Fser.Bo; Him; SR; Ldig.Ldig; Ldig.Ldig.Bo
324	12	Low Newton, Seahouses.	NU 242 246	55°30.9'N 01°36.9'W	Pel; Fspi; Fves; Rho; EntPor; Cor; FK
324	13	Newton Haven, Seahouses.	NU 242 246	55°30.8'N 01°37.0'W	AP.P; EcorEns
324	14	Fills Reef, Seahouses.	NU 248 244	55°30.7'N 01°36.3'W	Fser.R; Ala.Ldig
324	15	Emblestone Transect, Seahouses.	NU 249 242	55°30.7'N 01°36.2'W	YG; Pra; MytB; FvesB; Him
324	16	Emblestone, Seahouses.	NU 249 239	55°30.5'N 01°36.3'W	YG; Ala.Ldig; SCAs
324	17	Jenny Bells Carr, Seahouses.	NU 243 237	55°30.3'N 01°36.9'W	Fspi; Fves; Asc.Asc; Fser.R; Fser.Fser; MytFR; Ldig; Ldig.Ldig
324	18	Embleton Bay, Seahouses.	NU 250 223	55°29.6'N 01°36.2'W	AP.P; AP.Pon; BarSnd
324	19	Dunstanstead Rocks, Seahouses.	NU 249 224	55°29.6'N 01°36.3'W	EntPor; FvesB; Fves; Him; Cor
324	20	Annstead Rocks, Seahouses.	NU 229 306	55°34.1'N 01°38.2'W	Ldig.Ldig; SCAs.ByH; SCAs.DenCla
324	22	Nacker Hole, Seahouses.	NU 236 290	55°33.2'N 01°37.5'W	AlcByH.Hia
324	24	Snook Point, Newton.	NU 246 263	55°31.7'N 01°36.6'W	AlcByH.Hia
324	26	Pern Carr-Ice Carr, Newton.	NU 248 255	55°31.3'N 01°36.4'W	LhypFa
324	28	NE of Fills Reef, Newton.	NU 251 248	55°31.0'N 01°36.1'W	LhypFa; EcorEns
324	30	SE Fills Reef, Newton Haven.	NU 250 245	55°30.8'N 01°36.1'W	LhypFa
324	31	NW Newton Haven.	NU 245 246	55°30.9'N 01°36.7'W	Sspi; Lcon
324	34	Jenny Bells Carr, Newton.	NU 246 237	55°30.4'N 01°36.5'W	LhypFa

Sublittoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & Longitude*	*Biotopes present*
112	25	SE of Harkness Rocks, Bamburgh.	NU 182 355	55°36.7'N 01°42.6'W	AP.Pon
112	26	SE of Shoreston Rocks, St Aidan's Dunes.	NU 210 332	55°35.5'N 01°40.0'W	AP.Pon
112	52	NE Carr End, North Sunderland.	NU 227 323	55°35.0'N 01°38.3'W	LhypR.Ft; Lhyp.Pk; NcirBat
310	1	North Sunderland Buoy, Seahouses.	NU 240 316	55°34.6'N 01°37.1'W	LhypGz.Pk; Flu
310	2	NE Seahouses.	NU 231 328	55°35.3'N 01°38.0'W	FaAlC
310	3	W Dicky Shad, Seahouses.	NU 248 310	55°34.3'N 01°36.3'W	FaAlC; Flu.Flu; IGS
310	4	NE of the Snook, Seahouses.	NU 242 333	55°35.6'N 01°36.9'W	AlcByH.Hia; Oph
310	5	E of the Snook, Seahouses.	NU 245 315	55°34.6'N 01°36.5'W	AlcSec

Sublittoral sites - continued

Survey	Site	Site name	Grid reference	Latitude & longitude	Biotopes present
310	6	The Falls, Seahouses.	NU 235 315	55°34.6'N 01°37.5'W	Lhyp.Pk; SCAs.ByH; AlcByH.Hia
310	7	SE Dicky Shad, off North Sunderland Harbour, Seahouses.	NU 270 286	55°33.0'N 01°34.3'W	Flu.Flu
310	8	Faggot Rock, Newton.	NU 255 261	55°31.7'N 01°35.7'W	Lhyp.TPk; AlcByH.Hia; FaAlC
310	9	NE of Red Brae, Seahouses.	NU 241 300	55°33.8'N 01°37.0'W	Lhyp.Pk; AlcByH.Hia
310	10	E of Newton Point.	NU 291 257	55°31.4'N 01°32.2'W	Flu.Flu
310	11	SE of Castle Point, Dunstanburgh.	NU 283 199	55°28.3'N 01°33.1'W	Flu.Flu
310	12	Jenny Bells Carr, Newton.	NU 248 237	55°30.4'N 01°36.4'W	Lhyp.Ft; AlcByH.Hia
310	13	NE of North Sunderland Harbour, Seahouses.	NU 225 323	55°35.0'N 01°38.4'W	LhypR.Ft
310	14	SE of Castle Point, Dunstanburgh.	NU 267 218	55°29.4'N 01°34.5'W	Flu.Flu
310	15	E of Out Carr, Newton.	NU 257 243	55°30.7'N 01°35.5'W	Flu.Flu
310	16	Mid Embleton Bay, Newton.	NU 252 231	55°30.1'N 01°36.0'W	Lcon; EcorEns
310	17	Castle Point, Newton.	NU 261 218	55°29.4'N 01°35.2'W	Lhyp.Ft; AlcByH.Hia; AlcByH
310	18	NE of Castle Point, Dunstanburgh.	NU 288 230	55°30.0'N 01°32.5'W	Flu.Flu; EcorEns
310	19	Off Little Carr, Dunstanburgh.	NU 262 203	55°28.5'N 01°35.0'W	SabKR
310	20	E of Great Carr, Craster, Dunstanburgh.	NU 265 198	55°28.3'N 01°34.8'W	IGS
310	21	Off Houghton Stile, S of Craster, Dunstanburgh.	NU 281 158	55°26.1'N 01°33.3'W	Flu.Flu
310	22	NE of Houghton Stile, Boulmer.	NU 299 167	55°26.6'N 01°31.6'W	NcirBat
310	24	N of Houghton Stile, Dunstanburgh.	NU 268 163	55°26.4'N 01°34.4'W	FoR
310	25	Offshore of Out Carr, Newton.	NU 261 247	55°30.9'N 01°35.1'W	Flu.Flu
310	54	NE Rumbling Kern, Craster.	NU 270 169	55°26.7'N 01°34.3'W	XKScrR; Sspi; IGS
310	55	Off Great Carr, Craster.	NU 258 196	55°28.2'N 01°35.5'W	SabKR
310	57	Off Great Carr, Craster.	NU 261 198	55°28.2'N 01°35.1'W	Sspi; SabKR; IMS
310	58	Offshore Craster.	NU 272 202	55°28.5'N 01°34.0'W	AlcSec
310	60	Offshore NE of Houghton Stile, Craster.	NU 300 173	55°26.9'N 01°31.4'W	EcorEns
310	62	SE of Howick, Craster.	NU 270 157	55°26.0'N 01°34.3'W	Lhyp.Ft; AlcByH.Hia; SabKR

Compiled by: Rohan Holt

12 Aln estuary

Location

Position (centre)	NU 240 100	
County/District	Northumberland	Alnwick
Conservation agency/area	English Nature	Northumbria

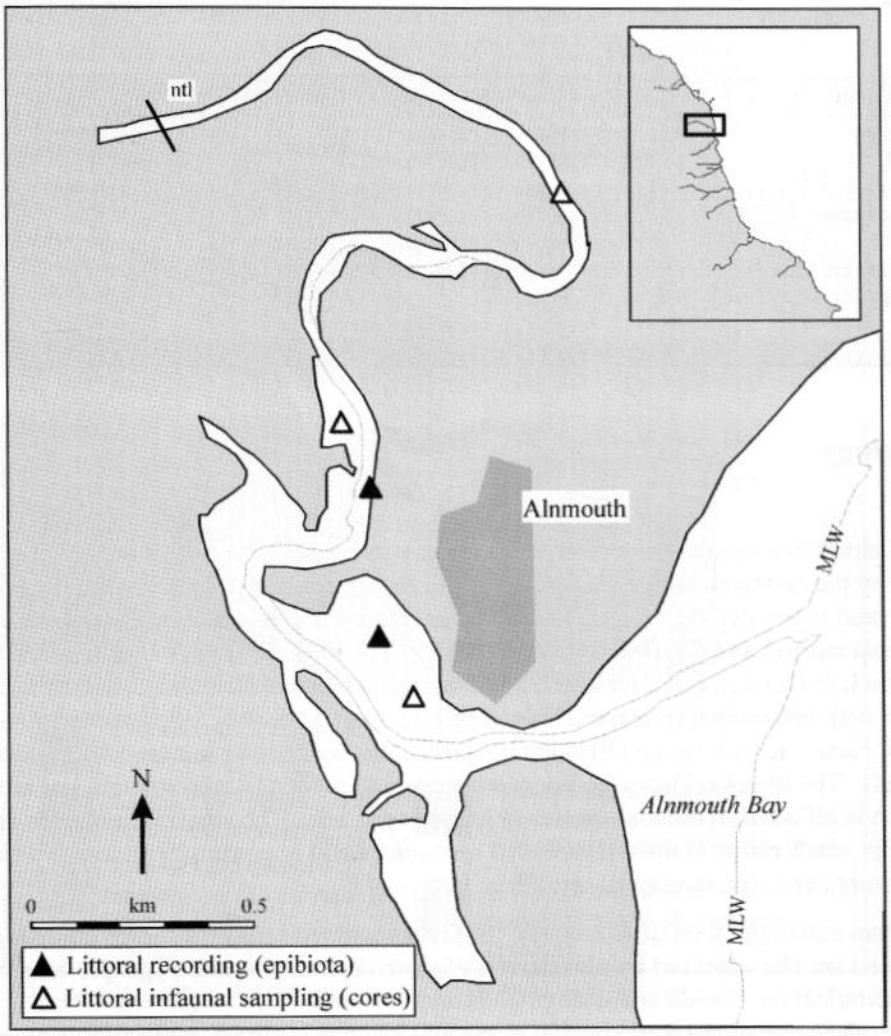

Figure 12.1 Location of area showing sites surveyed and main bathymetric features.

Marine biological surveys

	Survey methods	*No. of sites*	*Date of survey*	*Source*
Littoral	Recording	2	September 1992	Brazier & Murray (1994)
	Infaunal cores and granulometry	3	September 1992	Brazier & Murray (1994)

Introduction

The Aln is a bar-built estuary situated south of the town of Alnmouth. The estuary is small and shallow and at low tide it is fordable at most places. Prior to 1806, the estuary discharged into the sea further south, until a storm opened up the present-day eastward route through the sand dunes. This has left a saltmarsh of scientific interest on the south side of the estuary. The mouth of the estuary is constricted by a sand spit and the narrow channel is subject to strong tidal streams. A clean, mobile sandy beach is present north of the estuary mouth and there is a sand-scoured boulder shore on the south. The mid-and upper estuary comprises small banks of muddy sand with occasional patches of silted cobbles.

Physical features	
Physiographic type	Bar-built estuary
Length of coast	9 km
Area of inlet	52 ha
Length of tidal channel	3.7 km
Bathymetry	Shallow river, largely intertidal
Wave exposure range	Moderately exposed to sheltered
Tidal stream range	Strong to negligible
Tidal range	4.1 m (springs), 2.1 m (neaps)
Salinity range	Fully marine to variable

Marine biology

Littoral

Mobile, well-sorted fine sand at the mouth of the estuary throughout the height of the shore is characterised by the crustaceans *Eurydice pulchra* and *Bathyporeia* spp. (AEur). Stable, level medium-fine sand in the slightly more sheltered lower estuary is dominated by the polychaetes *Eteone longa*, *Arenicola marina* and *Capitella capitata* (AP.P). The littoral fringe is characterised by channelled wrack *Pelvetia canaliculata* (Pel) and the upper eulittoral is characterised by spiral wrack *Fucus spiralis* with few animals present (Fspi). The mid-shore is heavily silted and dominated by bladder wrack *Fucus vesiculosus* and barnacles *Semibalanus balanoides* but few other species are recorded (Fves). The lower eulittoral boulders are subject to moderate tidal streams and are sand-scoured, which is reflected in the low species richness at this site. The algal communities are characterised by small plants of the wrack *Fucus ceranoides* and opportunistic colonisers such as *Porphyra purpurea* and *Enteromorpha* spp. (FcerX).

Further upstream and to the west of Alnmouth, the more sheltered sediment shores contain a higher mud fraction and are characterised by polychaetes *Hediste diversicolor* and *Pygospio elegans*, oligochaetes *Tubificoides benedii* and enchytraeids and the amphipod *Corophium volutator* (MacAre; HedMac.Are). The edge of the river channel in the mid-estuary has areas subject to localised tidal streams where mobile, coarse sand and gravel with few infaunal species other than enchytraeid oligochaetes are recorded (Ol). Silted boulders and cobbles on sediment in the mid- and upper reaches of the estuary are characterised by the wrack *Fucus ceranoides* and green algae *Enteromorpha* spp. (FcerX), whilst the anoxic mud in patches between the boulders and cobbles has an infaunal community characterised by the polychaete *H. diversicolor*, the amphipod *C. volutator* and the oligochaete species *Tubificoides benedii* and *T. pseudogaster* (HedOl) in areas sheltered from tidal streams.

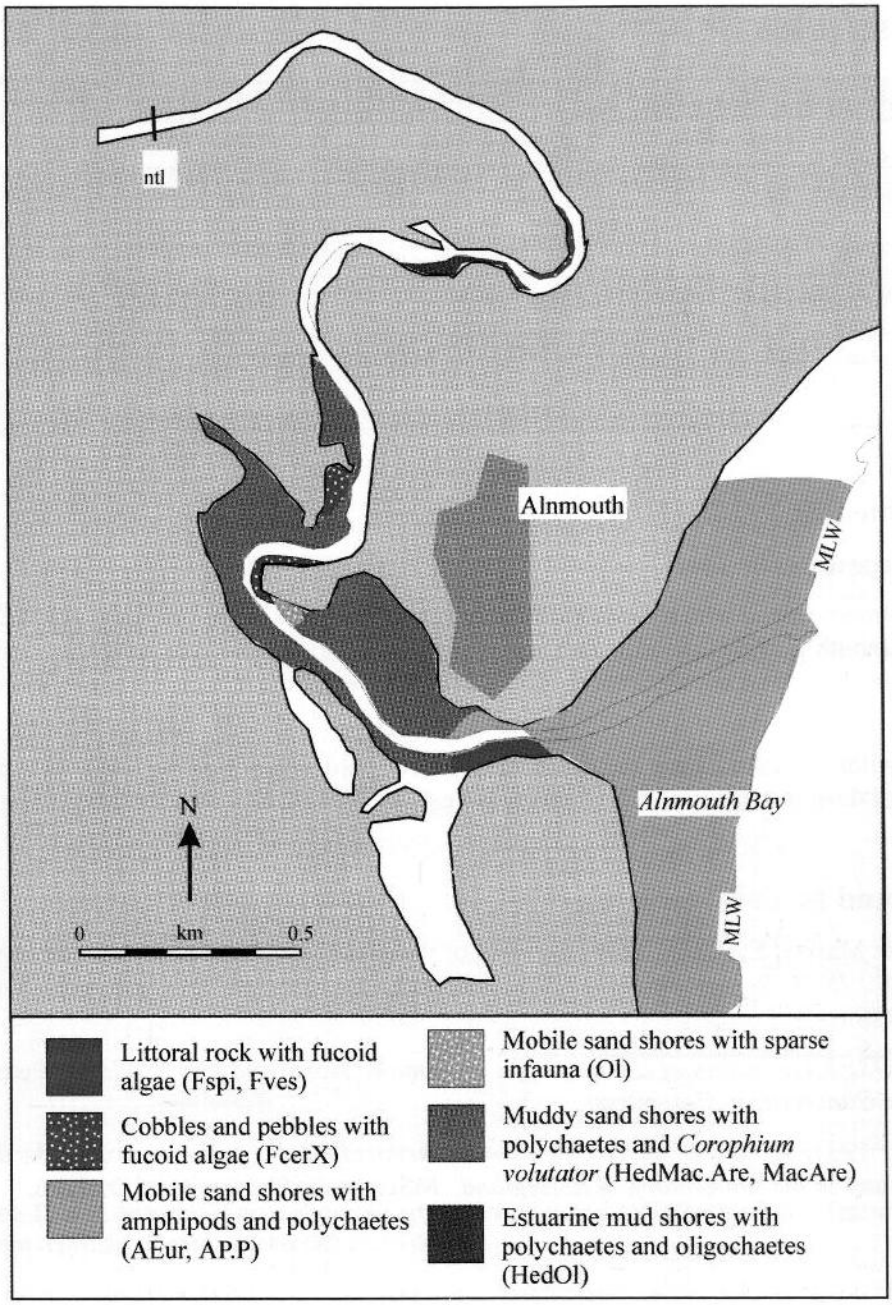

Figure 12.2 Indicative distribution of the main biotopes within the area (based on data from survey sites shown in Figure 12.1 and additional field observations).

Nature conservation

Conservation sites

Site name	*Designation*	*Centre grid ref.*	*Main features*
Northumberland Shore	SSSI, pSPA	NT 980 575 - NU 010 525	Ornithology
Alnmouth Saltmarsh and Dunes	SSSI	NU 245 100	Coastal habitats and flora
North Northumberland Dunes	cSAC	NT 980 575	Dune vegetation
Holy Island and the Farnes	SMA	NU 255 385	Marine biology
Northumberland Coast	AONB	NU 185 355	Landscape
North Northumberland	HC	NT 979 576 - NZ 297 933	Landscape
Buston Links	NT	NU 251 085	Coastal habitats
Alnmouth	NT	NU 241 094	Coastal habitats

Human influences

Coastal developments and uses

The estuary is undeveloped with the exception of the small town on the north bank. A small natural harbour at Alnmouth provides mooring facilities for boats and the large sandy beaches of Alnmouth Bay on the open coast are a popular resort. Some bait-digging takes place in the lower and mid-estuary.

The mudflats within the estuary are being colonised by the cord-grass *Spartina anglica* resulting in the stabilisation and drying of the mudflat. This invasive plant is controlled by the National Trust.

References and further reading

Brazier, D.P., & Murray, E. 1994. Littoral survey of the estuaries of south-east Scotland and north-east England. *JNCC Report*, No. 159. (Marine Nature Conservation Review Report, No. MNCR/SR/26.)

Buck, A.L. 1993. *An inventory of UK estuaries. Volume 4. North and east Scotland.* Peterborough, Joint Nature Conservation Committee.

Howcroft, S.N. 1983. *A study of the role of physico-chemical factors in the control of the distribution of invertebrates in the Aln estuary, N.E. England.* MSc. thesis, University of Durham.

Survey sites

Surveys

314: MNCR littoral survey of the estuaries of south-east Scotland and north-east England, 1992 (Brazier & Murray 1994).

Littoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
314	12	Lower Aln estuary.	NU 243 104	55°23.2'N 01°36.9'W	Pel; Fspi; Fves; EntPor; AEur; AP.P; MacAre; HedMac.Are; HedStr; Ol
314	13	E of Hipsburn, Aln estuary.	NU 243 109	55°23.4'N 01°36.9'W	Fcer; FcerX; HedScr; HedOl
314	14	E Grave Yard, Aln estuary.	NU 248 113	55°23.7'N 01°36.5'W	FcerX; HedOl

Compiled by: Paul Brazier

13 Coquet estuary

Location		
Position (centre)	NU 260 050	
County/District	Northumberland	Alnwick
Conservation agency/area	English Nature	Northumbria

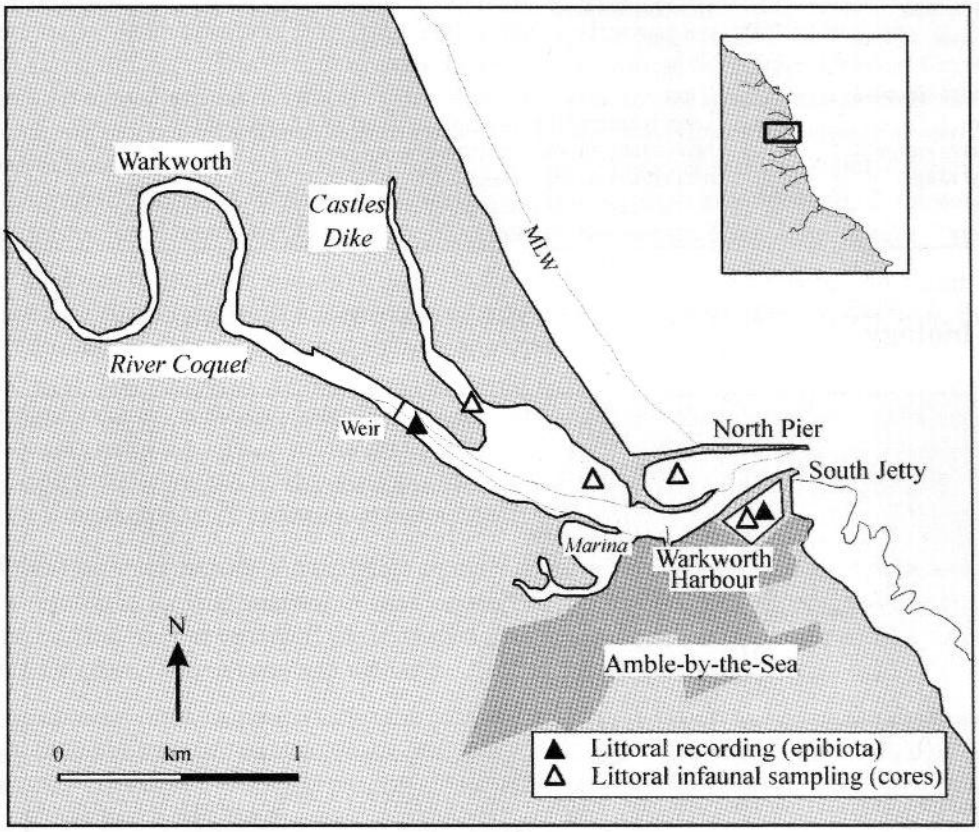

Figure 13.1 Location of area showing sites surveyed and main bathymetric features.

Marine biological surveys				
	Survey methods	*No. of sites*	*Date of survey*	*Source*
Littoral	Recording	2	September 1992	Brazier & Murray (1994)
	Infaunal cores and granulometry	4	September 1992	Brazier & Murray (1994)

Introduction

The Coquet estuary is a bar-built estuary that discharges into the sea north of the town of Amble-by-the-Sea. As well as the main estuary channel, there is also a muddy creek running northwards towards Castles Dike, separated from the open coast by a sand dune system. The south shore of the lower estuary is an urban area, while the upper estuary flows past agricultural land. The mouth of the estuary is protected by 500 m long piers, behind which are large areas of sand that act as wave traps.

Substantial coal staithes were built on the south shore of the lower estuary in the 1870s, the remains of which are now used by a resident inshore fishing fleet. From the staithes to the estuary mouth a channel is dredged to allow passage for the fishing boats and for leisure craft using Amble marina. A weir has been built 1.6 km from the estuary mouth which is over-topped only during spring tides. This restricts the tidal range upstream of the weir to 0.3 m and the communities present are predominantly freshwater in character.

Physical features	
Physiographic type	Bar-built estuary
Length of coast	6.5 km
Area of inlet	80 ha
Length of tidal channel	2 km
Bathymetry	Largely intertidal with narrow channel to 1.5 m depth
Wave exposure range	Moderately exposed to extremely sheltered
Tidal stream range	Moderately strong to negligible
Tidal range	4.3 m (springs), 2.1 m (neaps)
Salinity range	Fully marine to variable

Marine biology

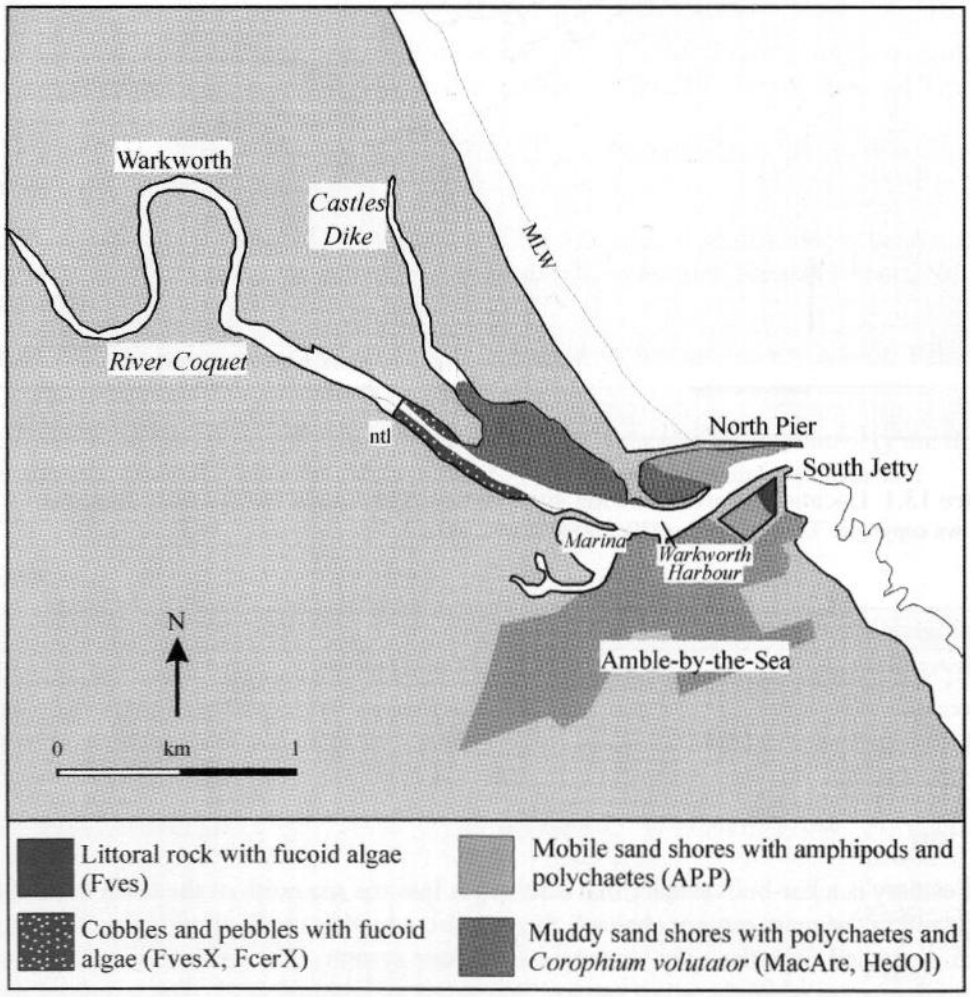

Figure 13.2 Indicative distribution of the main biotopes within the area (based on data from survey sites shown in Figure 13.1 and additional field observations).

Littoral

In the wave trap behind the south pier, a series of natural sandstone bedrock ridges and large boulders span the vertical extent of the eastern part of the shore. The upper shore bedrock is sand-scoured and dominated by the fast-growing algae *Porphyra purpurea* and *Enteromorpha* spp. (EntPor). The mid-shore rock has a covering of silt with a community characterised by bladder wrack *Fucus vesiculosus*, limpets *Patella vulgata* and barnacles *Semibalanus balanoides* (Fves). The lower shore boulders are subject to weak tidal streams and sand scour and are dominated by the sand-binding red algae *Audouinella* spp., with the brown alga *Chorda filum* occurring in patches of sand between the boulders. Moderately wave-exposed rock and sediment habitats are notably absent at the entrance to the Coquet estuary. The sandflats at the west end of the south wave trap and the majority of the flats on the opposite shore are characterised by polychaetes *Eteone longa*, *Scoloplos armiger*, *Capitella capitata* and *Arenicola marina* (MacAre). The sediment at the most exposed, easternmost site on the north shore is slightly more mobile and is characterised by the polychaetes *E. longa*, *Paraonis fulgens* and *Spio martinensis* (AP.P). A transition to more silty sand characterised by the polychaetes *Pygospio elegans*, *C. capitata*, *A. marina* and the oligochaetes *Tubificoides benedii*, *T. pseudogaster* and enchytraeides is evident in the sheltered area to the landward end of the wave trap.

Within the inlet that leads north towards Castles Dike, stable muddy sand supports communities with a reduced species richness and these are characterised by the polychaete *Hediste diversicolor*, the amphipod *Corophium volutator* and the oligochaetes *T. benedii*, *T. pseudogaster* and enchytraeides (HedOl). One site on the upper shore was noted for the firmness of the mud and is characterised by glasswort *Salicornia* sp., a pioneer saltmarsh community. Towards the upper reaches of Castles Dike, the mudflats are covered by a mat of the eelgrass *Zostera angustifolia*, which creates a stable habitat for a community characterised by the polychaetes *Pygospio elegans*, *C. capitata*, *A. marina*, oligochaetes and amphipod *C. volutator* (HedOl; Znol).

A bank of pebbles at the mouth of a drainage channel flowing from Castles Dike into the estuary is the only hard substrata in the mid-reaches of the Coquet estuary. This habitat appears to be very mobile and scoured and the species recorded are restricted to barnacles *Semibalanus balanoides*, gammarids and the green algae *Enteromorpha* spp. (BLlit).

Up the main channel of the estuary to the weir, the estuary narrows and the banks become steeper. The estuary banks consist of heavily silted cobbles and pebbles lying on mud which support occasional bladder wrack *Fucus vesiculosus* and barnacles *Semibalanus balanoides* (FvesX). The steep face of the weir is dominated by a very dense cover of the wrack *Fucus ceranoides* and the green algae *Enteromorpha* spp. (FcerX). Habitats upstream of the weir were not surveyed due to the restricted marine influence.

Nature conservation

Conservation sites

Site name	*Designation*	*Centre grid ref.*	*Main features*
Warkworth Dunes and Saltmarsh	SSSI	NU 260 059	Coastal habitats and flora
River Coquet and Coquet Valley Woodland	SSSI	NT 786 082 - NU 260 051	River habitats, woodland, invertebrates, fish, otters, ornithology
Northumberland Shore	SSSI, pSPA	NT 980 575 - NU 010 525	Ornithology
North Northumberland Dunes	cSAC	NT 980 575	Dune vegetation
Holy Island and the Farnes	SMA	NU 255 385	Marine biology
Northumberland Coast	AONB	NU 185 355	Landscape
North Northumberland	HC	NT 979 576 - NZ 297 933	Landscape

Human influences

Coastal developments and uses

Much of the lower and mid-estuary on the south side has been developed, originally as coal staithes, but more recently as quayside for the fishing fleet at Amble-by-the-Sea. In addition to vessels at the quayside, there are a number of recreational boats moored in the estuary and in the small marina in the mid-estuary. Areas of littoral sediment are under potential threat from sand extraction activities and increasing intensity of bait-digging.

References and further reading

Brazier, D.P., & Murray, E. 1994. Littoral survey of the estuaries of south-east Scotland and north-east England. *JNCC Report*, No. 159. (Marine Nature Conservation Review Report, No. MNCR/SR/26.)

Buck, A.L. 1993. *An inventory of UK estuaries. Volume 4. North and east Scotland.* Peterborough, Joint Nature Conservation Committee.

Davidson, N.C., Laffoley, D.d'A., Doody, J.P., Way, L.S., Gordon, J., Key, R., Drake, C.M., Pienkowski, M.W., Mitchell, R., & Duff, K.L. 1991. *Nature conservation and estuaries in Great Britain.* Peterborough, Nature Conservancy Council.

Survey sites

Surveys

314: MNCR littoral survey of the estuaries of south-east Scotland and north-east England, 1992 (Brazier & Murray 1994).

Littoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
314	15	NE Coquet estuary.	NU 268 050	55°20.2'N 01°34.6'W	AP.P; MacAre; PCer
314	16	South Jetty.	NU 272 049	55°20.2'N 01°34.2'W	EntPor; Fves; Mas; AP.P
314	17	NW Warkworth Harbour.	NU 265 050	55°20.3'N 01°34.9'W	BLlit; MacAre; HedOl
314	18	S Castles Dike.	NU 260 053	55°20.4'N 01°35.4'W	NVC SM8; Znol; HedOl
314	19	NW the Braid.	NU 257 052	55°20.4'N 01°35.6'W	FvesX; FcerX

Compiled by: Paul Brazier & Eleanor Murray

14 Alnmouth to Newbiggin

Location		
Position (centre/limits)	NU 290 020	NU 250 110 - NZ 320 880
County/District	Northumberland	Alnwick, Castle, Morpeth and Wansbeck
Conservation agency/area	English Nature	Northumbria

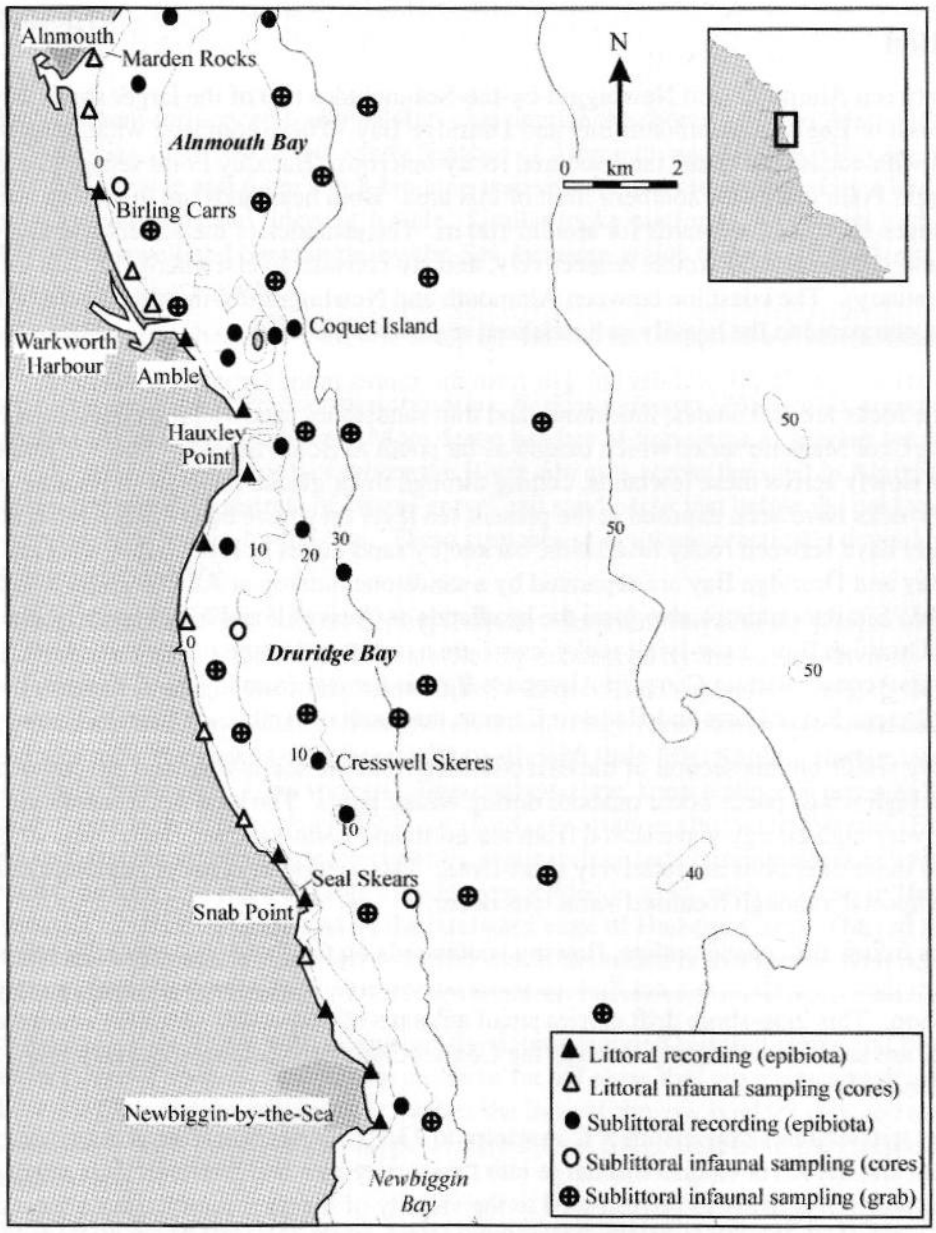

Figure 14.1 Location of area showing sites surveyed and main bathymetric features.

Marine biological surveys

	Survey methods	*No. of sites*	*Date of survey*	*Source*
Littoral	Recording	10	June-August 19922	Holt (1994)
	Infaunal cores and granulometry	8	June-August 1992	Holt (1994)
Sublittoral	Recording	14	June 1992-May 1993	Holt (1994)
	Infaunal cores and granulometry	2	May 1993	Holt (1994)
	Infaunal grab samples (0.1 m² Van Veen grab) and granulometry	21	January-February 1993	University of Newcastle-upon-Tyne (unpublished data)

Introduction

The coast between Alnmouth and Newbiggin-by-the-Sea includes two of the larger sandy bays on the north-east coast of England: Alnmouth Bay and Druridge Bay. These comprise wide, long beaches of mobile sand with occasional small sand-scoured rocky outcrops. Hauxley Point separates the two bays and Newbiggin Point marks the southern limit of this area. Both headlands are low-lying, with sandstone ridges stretching seawards for around 100 m. The estuaries of the Rivers Aln and Coquet enter the sea at Alnmouth and Amble respectively, and are considered elsewhere (12. Aln estuary and 13. Coquet estuary). The coastline between Alnmouth and Newbiggin-by-the-Sea is relatively undeveloped compared to the heavily industrialised regions to the south.

Extensive wave-cut platforms of millstone grit form the shores in the far north of this area. South of Alnmouth the rocks are soft shales, limestones and thin sandstones sandwiching coal seams forming the low-lying Coal Measure series which extend as far south as South Shields. The Aln and the Coquet flow slowly across these lowlands, cutting through thick glacial deposits of boulder clay. Where softer rocks have been exposed at the present sea level they have been eroded to form a series of wide, sandy bays between rocky headlands, backed by sand dunes or low boulder clay cliffs. Alnmouth Bay and Druridge Bay are separated by a sandstone outcrop at Amble which also forms Coquet Island. Similar outcrops also form the headlands at Cresswell and Newbiggin-by-the-Sea to the south of Druridge Bay. Low-lying rocky 'carrs' are a common feature of beaches along the Northumberland coast. Birling Carrs, in Alnmouth Bay, is formed from layers of limestone and sandstone, whereas Silver Carrs and Hadston Carrs to the south of Amble are primarily sandstone.

The prevailing winds on this section of the east coast are from the south-west and are consequently offshore, but high wind speeds occur onshore during winter gales. The long fetch across the North Sea can result in very high-energy wave action from the north and north-east, although bouts of heavy weather from these directions are relatively short-lived. This section of coast is predominantly moderately exposed although localised variations occur.

Tidal streams follow the coastal outline, flowing southwards on the flood and generally more slowly northwards on the ebb . There is a net flow of water southwards due to the combined forces of tide and wind action. This long-shore drift carries small amounts of suspended sediment southwards. Tidal streams are accelerated slightly through the Coquet Channel, reaching approximately 1.5 knots during the flood of spring tides.

Surface water temperatures range from 5°C in winter to 13.5°C in summer (Lee & Ramster 1981). The River Aln and the River Coquet discharge into this survey area and although their effect on salinity is unknown, it is likely to be restricted to the vicinity of the river mouths and a short distance offshore. Mean surface salinity is 34.5‰ (summer) 34.35‰ (winter) on the Northumberland coast (Lee & Ramster 1981). Between summer 1992 and spring 1993 turbidity varied considerably in this area and underwater visibility ranged from 0.5 m to 8 m. Underwater visibility is quickly reduced by the combined effects of prolonged heavy rain, swell action and tidal currents stirring up silt washed into the sea from the rivers. It takes several days of calm weather for the fine particles to re-settle and form a layer of silt over the sea bed.

Physical features	
Physiographic type	Open coast
Length of coast	27 km
Bathymetry	45 m isobath within 3 mile limit
Wave exposure range	Exposed and moderately exposed
Tidal stream range	Moderately strong to negligible
Tidal range	4.2 m (springs), 2.3 m (neaps)
Salinity range	Fully marine

Marine biology

Littoral

Sediment and sediment-influenced rocky habitats characterise the shores between Alnmouth and Newbiggin-by-the-Sea. The two broad, sandy beaches of Alnmouth and Druridge Bay are approximately 250 m wide and 6 km and 8 km long respectively and are separated by a low headland of wave-cut rocky platforms and ridges at Amble. Similar rocky platforms are present to the south of Druridge Bay at Cresswell and Newbiggin-by-the-Sea, between which there is a 3 km stretch of shoreline backed by colliery waste.

The sand on the large open beaches is mobile and well-drained and supports a characteristically low infaunal biomass with occasional polychaetes *Scolelepis squamata* and lugworms *Arenicola marina* with the burrowing amphipods *Pontocrates arenarius*, *Bathyporeia* spp., *Haustorius arenarius* and *Eurydice pulchra* (AEur; AP.P; AP.Pon). More dense patches of lugworms *A. marina* are found in more stable and sheltered areas north of where the River Aln cuts across the sand in Alnmouth Bay. Highly unstable and mobile substrata of coarse gravel and sand occur just below the coal spoil tips at Headagee, north of Newbiggin-by-the-Sea. These stretches of coast are practically devoid of macrofauna and flora (BarSh).

Small, low-lying rocky outcrops, such as Birling Carrs in Alnmouth Bay and the fringes of the larger carrs such as Hadston Carrs in Druridge Bay, are clearly influenced by the strong scouring action of wave-mobilised sand. Some of the rocky shores have a strip of sand separating the rock formations from the upper shore and consequently there are no littoral fringe rock communities. At the interface between sand and rock, the rock is often scoured smooth with little life. Slightly further away from the sand, opportunistic green algae *Ulva* spp. and *Enteromorpha* spp. form a slippery green belt where seasonal scour action leaves the rock available for rapid colonisation after winter storms (EntPor). More established, but nonetheless characteristically scour-influenced communities occur where scour is less severe on the tops and sides of large boulders embedded in sand, such as those in Hauxley Haven, on the rocks at Birling Carrs and on the landward edge of Hadston Carrs. The red alga *Porphyra purpurea* with green algae *Enteromorpha* spp. is abundant in this habitat with densely-packed small mussels *Mytilus edulis*, barnacles *Semibalanus balanoides* and limpets *Patella vulgata*.

The more extensive rocky shores with ridges, gently sloping stepped bedding plains and boulder fields support a wider range of species, forming the zones of fucoid algae that are characteristic of rocky shores. Where the high water mark extends reaches the base of the low boulder clay and sandstone cliffs, the substrata is often too friable to support many littoral fringe lichens or the channelled wrack *Pelvetia canaliculata*.

In the eulittoral of the more ridged bedrock shores, fucoid-dominated communities (Fves; Fser.Fser) occur in areas of localised shelter but are interspersed with dense patches of barnacles and limpets on vertical faces and more wave-exposed prominent features (FvesB). This alternation of communities is well illustrated at Bondi Carrs just south of Hauxley, where a series of long parallel ridges running perpendicular to the shore support dense bladder wrack *Fucus vesiculosus* and serrated wrack *F. serratus* with the red alga *Osmundea pinnatifida* on one side and animal-dominated barnacle-limpet communities on the other. A boulder field with a rich underboulder fauna of sponges and colonial ascidians was also surveyed at this site (Fser.Fser.Bo). The relative abundance of each fucoid species

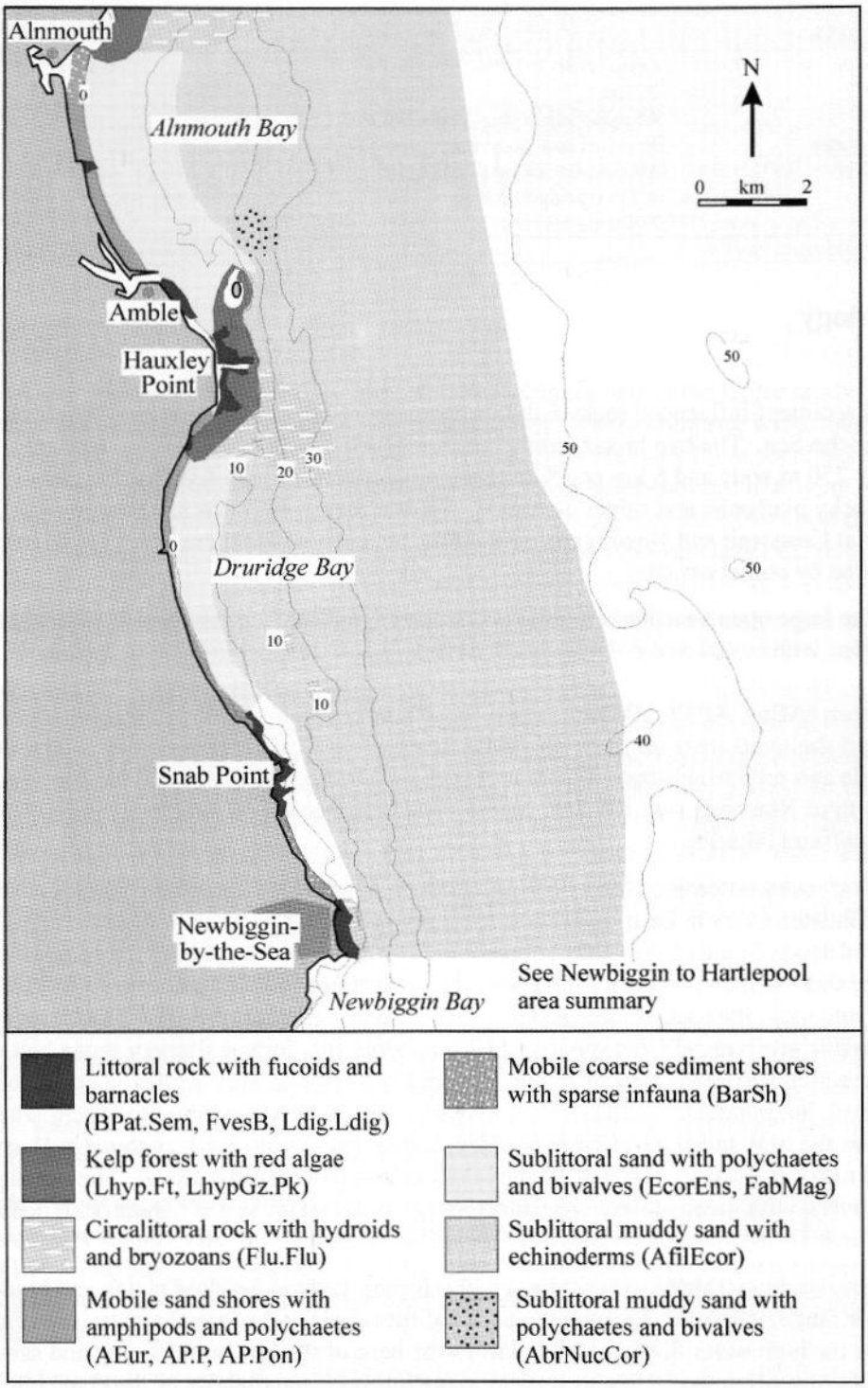

Figure 14.2 Indicative distribution of the main biotopes within the area (based on data from survey sites shown in Figure 14.1 and additional field observations.

on the near-horizontal wave-cut platforms is dependent on the height of the platform above sea level. For example, the shore at Newbiggin Point up to the base of the sea defences and low cliffs is almost entirely dominated by serrated wrack *F. serratus*, a species characteristic of the lower eulittoral. The wide, smooth rocky platforms of Hadston Carrs, the Skears at Cresswell and Snab Point have relatively low diversity of habitats. The flat rocks have fewer features than the more ridged shores, with little other than large, shallow pools (Cor) and small, angular boulders. Overall, the flat bedrock in the mid-shore is dominated by abundant common periwinkles *Littorina littorea*, mosaics of fucoid algae and barnacles, and coralline algae (FvesB).

Apart from serrated wrack *F. serratus* the lower eulittoral of the rocky shores in this area almost invariably support spongy mats of the filamentous red alga *Audouinella* spp. which binds sediment particles. It is a species characteristic of silty and turbid areas and often has the red alga *Ahnfeltia plicata* and the brown alga *Cladostephus spongiosus* growing amongst it or nearby. Examples of this species assemblage were surveyed on bedrock and boulder tops at Amble, Cresswell and Newbiggin-by-the-Sea (Rho). The most silted shore sites surveyed along this coastline were at Headagee on the shore below the colliery spoil tips at Lynemouth. Shale and coal slurry is constantly washed into the sea here which increases turbidity and smothering effects well beyond natural levels from boulder clay run-off. Fucoid abundance is moderately high although diversity of other plants and animals is below that at other sites in this area.

In general, sublittoral fringe rocky communities in this area are rather poor in species. The long rock ridges and wave-cut platforms slope seawards into the sublittoral fringe, so that at some sites wide platforms covered with kelp *Laminaria digitata* are exposed at low tide (Ldig.Ldig). Variable amounts of red algae *Palmaria palmata*, *Mastocarpus stellatus*, *Chondrus crispus* and *Odonthalia dentata* occur on the kelp stipes and on the rock although the combined effects of pollution and grazing by urchins *Echinus esculentus* result in large areas covered by nothing but coralline algae. Short vertical steps in the bedrock and the sides and undersides of boulders are colonised by the sponges *Halichondria panicea* and *Halisarca dujardini*, occasional tufts of hydroids *Dynamena pumila*, and beadlet anemone *Actinia equina.* The tubeworm *Pomatoceros triqueter* and the barnacle *Verruca stroemia* are also regularly found attached to the underside of small boulders and cobbles. Silty horizontal crevices in the short vertical faces and boulder interstices provide dimly-lit, permanently damp microhabitats occupied by the dahlia anemone *Urticina felina* and shore crabs *Carcinus maenas*, with small purse sponges *Grantia compressa* and *Scypha ciliata* hanging from the roofs of the crevices or boulder sides. Examples of these species assemblages are present at Bondi Carrs, south of Amble.

Consolidated sand tubes of the polychaete *Sabellaria spinulosa* are found in a gully on the shore at Cresswell and occur regularly in small numbers under boulders throughout this area. This species requires a supply of suspended sediment to manufacture its tubes and thrives along the Northumberland coast, particularly in shallow water amongst the kelp forests in the sublittoral fringe and upper infralittoral (SabKR; Sspi). Large patches of *S. spinulosa* with the red alga *Polysiphonia elongata* growing over them are found amongst kelp forest at a depth of 3 m east of Hadston Carrs.

Sublittoral

Like their sublittoral fringe counterparts, the *Laminaria hyperborea* kelp forests just offshore on shallow (3 m below chart datum) bedrock plains are particularly silty, scoured and fairly heavily grazed by urchins *Echinus esculentus*, particularly on the east side of Coquet Island (LhypGz.Ft).

Further offshore, in depths of 15-30 m, much of the sea bed consists of expanses of horizontal bedrock plains and stepped terraces, punctuated by cobble and boulder fields and patches of muddy sand and shell gravel. All surfaces are covered by silt, as in the shallower habitats, and moderate tidal streams were experienced at most sites by the surveyors. Rocky circalittoral habitats were surveyed offshore at the north end of Alnmouth Bay, along the east side of Coquet Island, off Hauxley, Hadston Carrs and along the whole stretch of coast from Cresswell to Newbiggin-by-the-Sea. Very similar assemblages of species occur at each site with only minor variations and all are characteristic of the moderate scour and silted conditions (Flu.Flu; FaAlC). The hornwrack *Flustra foliacea* (a bryozoan) forms a turf on boulder tops and covers large portions of the flat bedrock. Hydroids such as *Abietinaria abietina*,

Thuiaria thuja and *Tubularia indivisa* are present on boulder tops, ridges and edges of short vertical faces and the tubeworm *Pomatoceros triqueter* is often abundant on vertical sides. Siphons of the bivalve *Mya truncata* are occasionally found protruding from pockets of sediment between boulders and pelican's foot shells *Aporrhais pespelicani* are also found on the sediment. However, the overall diversity of erect hydroids, bryozoans, sea squirts and sponges is rather poor. Of note is the occurrence of the featherstar *Antedon bifida* and the Devonshire cup-coral *Caryophyllia smithii* which are found in small numbers off Cresswell Skeres. Although common in other parts of Britain there are few records of these species this far south on the east coast.

Sublittoral muddy fine sand in Alnmouth and Druridge Bays supports sparse polychaetes including *Nephtys hombergii*, *Spio* spp., *Spiophanes bombyx* and *Chaetozone setosa*. Bivalves *Nucula nitidosa*, *Fabulina fabula*, *Abra alba* and *Chamelea gallina* are also present. Further offshore in deeper water, for example off Cresswell, the sediment consists of finer sand with a subsurface layer of mixed shell and mud. Brittlestars *Amphiura* spp. and *Ophiura albida*, starfish *Asterias rubens*, heart urchins *Echinocardium cordatum* and the slender sea-pen *Virgularia mirabilis* are present in moderate numbers in this habitat with a large variety of polychaetes (AfilEcor; FabMag). This corresponds to the assemblages of species described in the area by Buchanan *et al.* (1978). Offshore sediments are often mixed with pebbles and cobbles. Reef-building polychaetes *Melinna cristata* and *Sabellaria spinulosa* and the horse mussel *Modiolus modiolus* are present at some of these mixed sediment sites in this area, each of these species providing hard substrata for the settlement of other benthos (AbrNucCor).

Nature conservation

Conservation sites

Site name	*Designation*	*Centre grid ref.*	*Main features*
Northumberland Shore	SSSI, pSPA	NT 980 575 - NU 010 525	Ornithology
Alnmouth Saltmarsh and Dunes	SSSI	NU 245 100	Coastal habitats and flora
Warkworth Dunes and Saltmarsh	SSSI	NU 260 059	Coastal habitats and flora
Low Hauxley Shore	SSSI	NU 283 016	Geology
Hadston Links	SSSI	NZ 273 995	Coastal habitats and flora
Cresswell Ponds	SSSI, WT	NZ 283 944	Coastal habitats and flora
Cresswell & Newbiggin Shores	SSSI	NZ 295 942 - NZ 305 854	Geology
Amble Dunes	LNR	NU 280 037	Coastal habitats
North Northumberland Dunes	cSAC	NT 980 575	Dune vegetation
Holy Island and the Farnes	SMA	NU 255 385	Marine biology
Northumberland Coast	AONB	NU 185 355	Landscape
North Northumberland	HC	NT 979 576 - NZ 297 933	Landscape
Coquet Island	SSSI, SPA, RSPB	NU 294 047	Ornithology
Buston Links	NT	NU 251 085	Coastal habitats
Druridge Bay	NT, CP	NZ 285 965	Coastal habitats

Human influences

Sewage discharge

There is a general increase in the amount of sewage entering the sea towards the south of this area. Outfalls are sited at: Pan Rocks in Amble (discharges 1,109 m³/day); at Hauxley, where a storm overflow from the sewage works at High Hauxley discharges into the sea; the sea outfall at Hadston discharges 1,050 m³/day; Cresswell and Cresswell caravan park outfalls discharge over 203 m³/day; Summerhouse Lane sea outfall discharges 6,390 m³/day; twin outfalls for the Ashington main sewer at Newbiggin-by-the-Sea discharges 12,200 m³/day and two other outfalls at Church Point in Newbiggin-by-the-Sea discharge 1,000 m³/day (National Rivers Authority data, 1993).

Industrial effluent discharge

Most of the effluent discharged into the sea in this area comes from open cast and mined coal workings. Water is continuously pumped out of Old Hauxley Deep Mine via an outfall 1 km north of Low Hauxley village and is reported to contain low levels of heavy metals (I. Douglas, Northumberland Wildlife Trust, pers. comm.). British Coal Opencast have an outfall at Hauxley Links (5,200 m³/day) and there are three outfalls associated with British Coal Corporation's works at Ellington (19,600 m³/day, 19,600 m³/day, 8,640 m³/day), one of which discharges heavy metals. British Alcan's outfall situated at Lynemouth releases 13,090 m³/day of effluent (NRA data).

Dredging and spoil dumping

Alnmouth and Druridge Bays are not dredged or used for colliery waste, but at Lynemouth to the south of Druridge Bay colliery waste and inert fill has been continuously bulldozed onto the beach for a number of years. Fly-ash from Blyth power station is dumped south of this area (P. Morrison, Northumberland County Council, pers. comm.).

Mineral extraction

Gravel and sand has been extracted from the beach in Druridge Bay at a rate of 40,000 tonnes per year but this ceased in 1996. The considerable tonnage of material removed has caused concern for the dunes appear to be receding at a rate of up to 2 m per year. The beach also appears to have subsided by several metres, due to the collapse of underground coal mines, and the sea now reaches further inshore. Beach material is apparently not being replaced as fast as it is being removed.

Commercial fishery

Amble has been a fishing port since the early 1800s, although in recent years the number of fishing vessels regularly using the harbour has declined to around 20 seine-netters in 1992. Lobster- and crab-potting is carried out on the rocky reefs in Alnmouth and Druridge Bays and around Newbiggin Point. There is also a small-scale drift-netting fishery for salmon and sea trout. Drift-nets are laid perpendicular to the coastline along the routes taken by migrating salmon.

Bait-digging

Digging for lugworms and ragworms for bait has been practised by local anglers for many years, particularly around Low Hauxley. However, commercial digging has recently begun in the area and is monitored by Northumberland County Council. Bait-digging is banned on the foreshore in Druridge Bay (P. Morrison, Northumberland County Council, pers. comm.). The whole coast is used extensively for collection of bait (peeler crabs) and shellfish.

Recreation

Public access along this whole stretch of coast is relatively easy, although parts of Alnmouth and Druridge Bays are not served by main roads. Leisure boating from Amble and Warkworth marina is now an important industry in this area. Small speedboats and sailing dinghies use the lower estuary and yachts and larger vessels visit frequently to use the moorings or marina area. Jet-skis are banned. There are also organised trips around Coquet Island and for tourists. SCUBA diving and fishing are

also popular activities. All boating activities involve the potential risk of disturbance to breeding seabirds (particularly eiders), seals and cetaceans.

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Survey sites

Surveys

310: MNCR sublittoral survey of north-east England, 1992/93 (Holt 1994).
311: MNCR littoral survey of north-east England, 1992 (Holt 1994).
392: Dove Marine Laboratory, University of Newcastle-upon-Tyne sublittoral infaunal survey of Alnmouth and Druridge Bay. Unpublished data.

Littoral sites

Survey	Site	Site name	Grid reference	Latitude & longitude	Biotopes present
311	2	Hauxley Haven shore, Amble.	NU 290 032	55°19.3'N 01°32.5'W	FvesB; Fves; Fser.Fser; Ldig.Ldig
311	5	Bondi Carrs, Amble.	NU 291 019	55°18.6'N 01°32.4'W	Fspi; BPat.Sem; FvesB; Fser.R; Fser.Fser.Bo; Cor; Ldig.Ldig.Bo
311	6	Shore at Snab Point, Cresswell.	NZ 304 926	55°13.6'N 01°31.3'W	Fspi; Fves; Asc.Asc; Rho; XR; BLlit
311	34	SE of Pan Rocks, Amble.	NU 276 046	55°20.0'N 01°33.8'W	Fspi; BPat.Sem; Fves; Pal; XR; Cor; FK; Ldig.Ldig
311	35	Hadston Carrs, Amble.	NU 283 009	55°18.0'N 01°33.2'W	EntPor; FvesB; MytFR; Fser.Fser.Bo; Ldig.Ldig
311	36	NE of Druridge Links, Amble.	NZ 278 967	55°15.8'N 01°33.7'W	AP.P; AP.Pon
311	37	Hemscott Hill Links, Amble.	NZ 286 949	55°14.8'N 01°32.9'W	AP.Pon
311	38	Hadston Links, Amble.	NZ 285 989	55°17.0'N 01°33.0'W	AP.Pon
311	39	Cresswell North, Newbiggin.	NZ 297 938	55°14.2'N 01°31.9'W	Fspi; MytB; BPat; Fves; XR; MytFR; MytX; Cor; Ldig.Ldig; Lhyp.Ft; SCAn.Tub
311	41	N side of North Pier, Amble.	NU 268 052	55°20.4'N 01°34.6'W	AP.Pon
311	42	E of Warkworth, Alnmouth Bay.	NU 260 064	55°21.0'N 01°35.3'W	AP.Pon
311	43	Birling Carrs, Amble.	NU 255 078	55°21.8'N 01°35.8'W	Ver.B; EntPor; MytB; Fves; MytFR; AEur; AP.Pon
311	44	S of Alnmouth.	NU 252 099	55°22.9'N 01°36.1'W	AEur; AP.Pon
311	45	N end of Alnmouth Bay.	NU 255 108	55°23.4'N 01°35.8'W	AP.Pon
311	46	S of Headagee, Newbiggin.	NZ 307 906	55°12.5'N 01°31.0'W	BarSh
311	47	Beacon Point, Newbiggin.	NZ 318 890	55°11.6'N 01°30.0'W	Fspi; Fves; Fser.R; Fser.Fser; Mas; MytFR; Cor; FK
311	48	Headagee, Newbiggin.	NZ 303 918	55°13.1'N 01°31.4'W	EntPor; FvesB; Fves; Fser.R; FK

Sublittoral sites

Survey	Site	Site name	Grid reference	Latitude & longitude	Biotopes present
310	23	Coquet Channel, Amble.	NU 292 038	55°19.6'N 01°32.3'W	LhypGz.Pk
310	26	E of Marmouth Scars, Alnmouth.	NU 289 127	55°24.4'N 01°32.5'W	Flu.Flu; Sspi
310	56	E of Coquet Island, Amble.	NU 299 049	55°20.2'N 01°31.6'W	Flu.Flu; IGS
310	59	ENE of Coquet Lighthouse, Amble.	NU 300 048	55°20.2'N 01°31.5'W	LhypGz.Pk; FaAlC
310	61	Boulmer Stile, Alnmouth.	NU 269 123	55°24.2'N 01°34.4'W	XKScrR
310	63	Seaton Shad, Alnmouth.	NU 266 106	55°23.3'N 01°34.7'W	LhypGz.Pk
310	64	E of Birling Carrs, Alnmouth.	NU 255 079	55°21.9'N 01°35.7'W	NcirBat
310	65	ESE of Hadston Carrs, Amble.	NZ 313 997	55°17.4'N 01°30.3'W	FaAlC.Abi
310	66	E of Hadston Carrs, Amble.	NU 285 009	55°18.0'N 01°33.0'W	LhypGz.Ft; SabKR
310	67	Near White Bank, N Druridge Bay, Amble.	NU 303 006	55°17.9'N 01°31.3'W	Flu.Flu
310	68	Mid Coquet Road, Amble.	NU 286 044	55°20.0'N 01°32.9'W	Lhyp.Ft; EcorEns
310	69	Centre of Druridge Bay, Amble.	NZ 289 979	55°16.4'N 01°32.6'W	FabMag
310	70	SE of Cresswell Skeres, Newbiggin.	NZ 313 946	55°14.6'N 01°30.3'W	Flu.Flu
310	71	North Cresswell Skeres, Newbiggin.	NZ 309 960	55°15.4'N 01°30.7'W	Flu.Flu
310	72	The Scars, Newbiggin.	NZ 301 937	55°14.2'N 01°31.5'W	Lhyp.Ft; AlcByH.Hia
310	73	Offshore from Seal Skerrs, Newbiggin.	NZ 331 927	55°13.6'N 01°28.7'W	AfilEcor
310	74	E of Black Dyke, Newbiggin.	NZ 326 885	55°11.3'N 01°29.2'W	Flu.Flu
392	1	ENE of Newbiggin.	NZ 373 900	55°12.2'N 01°24.7'W	AfilEcor
392	2	ENE of the Outer Carrs, Newbiggin.	NZ 333 880	55°11.1'N 01°28.5'W	AmpPar
392	3	3 miles E of Seal Skears, Cresswell.	NZ 355 935	55°14.0'N 01°26.4'W	AfilEcor
392	4	2 miles E of Seal Skears, Cresswell.	NZ 339 926	55°13.6'N 01°27.9'W	AfilEcor
392	5	1 mile E of Seal Skears, Cresswell.	NZ 321 925	55°13.5'N 01°29.6'W	AfilEcor
392	6	30m E of Radio Mast, Druridge Bay.	NZ 324 967	55°15.8'N 01°29.3'W	AfilEcor
392	7	E of Radio Mast, Druridge Bay.	NZ 307 966	55°15.7'N 01°30.9'W	FabMag

Sublittoral sites - continued

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
392	8	10m E of Radio Mast, Druridge Bay.	NZ 290 966	55°15.8'N 01°32.6'W	FabMag
392	9	3 miles E of South Broomhill, Druridge Bay.	NZ 333 976	55°16.2'N 01°28.5'W	AfilEcor
392	10	E of South Broomhill, Druridge Bay.	NZ 283 976	55°16.3'N 01°33.1'W	FabMag
392	11	3 miles E of Hauxley Head, Amble.	NU 353 034	55°19.4'N 01°26.5'W	AfilEcor
392	12	E of Hauxley Head, Amble.	NU 313 030	55°19.2'N 01°30.3'W	AfilEcor
392	13	E of Hauxley Head, Amble.	NU 303 029	55°19.1'N 01°31.3'W	AfilEcor
392	14	3 miles NE of Warkworth Harbour.	NU 324 069	55°21.3'N 01°29.3'W	AfilEcor
392	15	1.5 miles NE of Warkworth Harbour.	NU 295 059	55°20.8'N 01°32.0'W	AbrNucCor
392	16	6m N of N pier, Warkworth Harbour.	NU 274 053	55°20.5'N 01°34.0'W	FabMag
392	17	ENE Birling Carrs, Alnmouth.	NU 308 089	55°22.4'N 01°30.7'W	AfilEcor
392	18	ENE Birling Carrs, Alnmouth.	NU 291 085	55°22.1'N 01°32.4'W	FabMag
392	19	NE Birling Carrs, Alnmouth.	NU 261 080	55°21.9'N 01°35.2'W	FabMag
392	20	3 miles E of Alnmouth.	NU 312 108	55°23.4'N 01°30.3'W	AfilEcor
392	21	E of Alnmouth.	NU 292 108	55°23.4'N 01°32.2'W	FabMag

Compiled by: Rohan Holt

15 Newbiggin to Hartlepool

Location		
Position (centre)	NZ 426 608	NZ 320 880 - NZ 533 336
County/District	Northumberland, Tyne and Wear, Durham, Cleveland	Wansbeck, Blyth Valley, Hartlepool, N Tyneside, S Tyneside, Sunderland, Easington
Conservation agency/area	English Nature	Northumbria

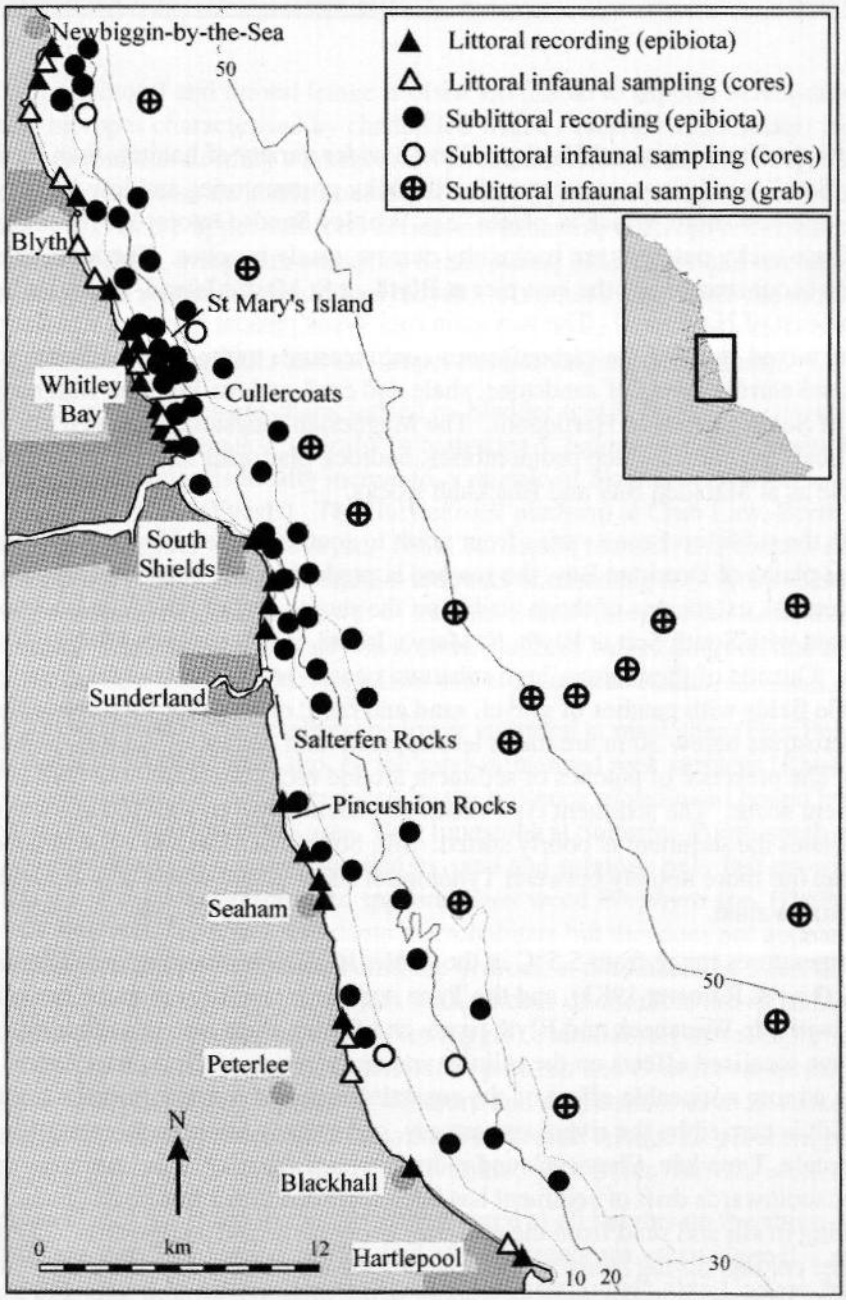

Figure 15.1 Location of area showing sites surveyed and main bathymetric features.

Marine biological surveys

	Survey methods	*No. of sites*	*Date of survey*	*Source*
Littoral	Recording (epibiota)	23	May-August 1993	MNCR survey 397
	Infaunal cores and granulometry	10	August 1992	MNCR survey 397
	Infaunal cores and granulometry	1	July 1991	Evans *et al.* (1994)
Sublittoral	Recording (epibiota)	46	May-June 1993	MNCR survey 398
	Infaunal grab samples (0.1 m² Day grab) and granulometry	14	March 1981-September 1990	Shillabeer (1991)
	Recording (epibiota)	7	May-July 1992	Johnston (1992a, b)
	Infaunal grab samples (0.1 m² Day grab) and granulometry	7	July 1993	Turner *et al.* (1993)
	Infaunal cores	4	May-June	MNCR survey 398

Introduction

The coastline between Newbiggin and Hartlepool has a wider variety of habitats than the bays to the north and south. Small, sandy bays interspersed with rocky promontories and low-lying outcrops occur at the mid- and low shore, which in places (e.g. Whitley Sands Outcrop) form shallow inshore reefs. Many of these rocky outcrops are backed by narrow, sandy beaches. The most extensive bedrock platforms occur seaward of the east pier at Blyth, at St Mary's Island, at Souter Point south of South Shields and east of Hartlepool. The two main rock types present between Newbiggin and Hartlepool are the mixed strata of the carboniferous coal measures to the north of South Shields, which have clearly defined narrow layers of sandstone, shale and coal, and the Permian-Magnesian limestone exposures south of South Shields to Hartlepool. The Magnesian limestone is eroded unevenly in many places along the coast to produce steep promontories, bedrock platforms and upper shore cliffs with caves, for example as at Marsden Bay and Blackhall Rocks.

The substratum in the sublittoral zone varies from north to south. At Newbiggin, immediately south of the extensive sand plains of Druridge Bay, the sea bed is predominantly sandy. Sublittoral rocky outcrops are, in general, extensions of those visible on the shore. For example, bedrock and boulder fields are associated with South Spit at Blyth, St Mary's Island and from Souter Point south to Pincushion Rock. Outside of these areas, hard substrata consist of small, low-lying outcrops or boulder and cobble fields with patches of gravel, sand and mud, or mixtures of these sediment fractions. Hard substrata below 30 m are much less apparent and consist of cobbles within poorly sorted sediment. The presence of patches of sediment around rock means that the hard substrata experience sediment scour. The sediment type varies considerably from location to location, although at the majority of sites the sediment is poorly sorted. Silt, both flocculent and consolidated, is present throughout the area but more notably between Tynemouth and Seaham where a flocculent layer covers hard and soft substrata alike.

Mean surface temperatures range from 5.5°C in the winter to 13°C in the summer. The mean surface salinity is 34.5‰ (Lee & Ramster 1981), and the Tyne and Wear rivers provide the majority of the freshwater input, with the Wansbeck and Blyth rivers and Seaton Burn also contributing. The plumes from the rivers have localised effects on the salinity and temperature of the coastal water. However, the estuaries have a more noticeable effect on the coastal shores and benthos through sediment loading and deposition. Silt is carried by the rivers and estuary, particularly after heavy rainfall in the catchments (Weardale, Tynedale, Cheviots), and reduced water velocity in the estuaries results in silt deposition. A net southwards drift of sediment has been recorded along this coast (Evans 1957; Eagle *et al.* 1979) resulting in silt and sand from the estuaries being dispersed southwards. The silt is rapidly lifted into the water column during storm events, causing increased turbidity and a drop in light penetration inshore. Human activities such as colliery waste disposal, estuary dredging and spoil dumping, fly-ash dumping in the past and coastal development provide further sources of local silting.

Physical features	
Physiographic type	Open coast
Length of coast	57 km
Bathymetry	Gradual slope with 50 m depth at 13 km offshore
Wave exposure range	Moderately exposed
Tidal stream range	Weak to negligible
Tidal range	North Shields: 4.3 m (springs), 2.1 m (neaps) Hartlepool: 4.6 m (springs), 2.4 m (neaps)
Salinity range	Fully marine with slight influence from three main estuaries

Marine biology

Littoral

Soft rock in the supralittoral and littoral fringe is often too friable to support lichen-dominated communities and biotopes characterised by channelled wrack *Pelvetia canaliculata*. Sparse yellow and grey lichens are found at St Mary's Island and Tynemouth on harder rocks (YG) and channelled wrack *P. canaliculata* is sparse on stable boulders south of St Mary's Island and on bedrock at Blackhall Rocks (Pel). In the upper eulittoral zone most extensive outcrops are characterised by spiral wrack *Fucus spiralis* (Fspi), often with barnacles *Semibalanus balanoides* and mussels *Mytilus edulis* dominating the steep and vertical rock surfaces (MytB). At other sites, where the rock is too friable or the exposure is too great for the attachment of algae, the flat upper shore bedrock is completely dominated by barnacles *S. balanoides* and the limpet *Patella vulgata* (BPat.Sem).

In the mid eulittoral, most shores are characterised by bladder wrack *Fucus vesiculosus* (Fves), immediately below the spiral wrack *F. spiralis* or barnacles *S. balanoides* and limpets *P. vulgata* zone. Where exposure to wave action is locally increased, a mosaic of bladder wrack *Fucus vesiculosus*, barnacles and limpets is found (FvesB). The flat bedrock platform at Crab Law, Blyth is more exposed to the north than other sites surveyed. Here, barnacles, mussels and limpets characterise the full extent of the littoral zone with no substantial amounts of macroalgae (MytB). There are no sites sufficiently sheltered for the extensive growth of knotted wrack *Ascophyllum nodosum* although small patches are recorded (Asc.Asc), particularly on boulder fields or ridged bedrock that afforded localised shelter, such as on the east side of St Mary's Island and at Sharpness Point.

Serrated wrack *Fucus serratus* characterises the lower eulittoral at most sites (Fser.Fser), often with cushions of the red algae *Audouinella* spp. on the sand-influenced rock surfaces (Rho). The diversity of macroalgae and epifauna is generally reduced by the presence of sediment bound by *Audouinella* spp. to the rock surfaces throughout the area. Soft limestone at Salterfen Point, south of Pincushion Rocks and Featherbed Rocks is severely scoured by sand and supports only fast-growing opportunistic algae such as the green algae *Enteromorpha* spp. and laver weed *Porphyra* spp. (EntPor). The rock is also highly pitted with many crevices and damp microhabitats but this does not appear to enhance the diversity of species present. At Sharpness Point, the bedrock is dominated by a turf of read algae *Mastocarpus stellatus* and *Laurencia pinnatifida* with patches of coralline crusts and limpets *Patella vulgata* in-between (Fser.R). At Spittal Carrs (Newbiggin) a similar turf of red algae is recorded on vertical walls of gullies with the sponges *Halichondria panicea* and *Grantia compressa* and barnacles also present (SR). More shaded overhangs at Whitburn and a mid-shore cave at Velvet Beds (South Shields) are animal-dominated, characterised by the breadcrumb sponge *H. panicea*, purse sponge *G. compressa* and, at Whitburn, a high density of the wrinkled rock borer *Hiatella arctica* (SByAs).

Throughout the area, rockpools are frequently encountered at all heights on the shore. Upper shore rockpools in bedrock with *Enteromorpha* spp. and other filamentous green algae (G) are recorded at several sites. South-east of St Mary's Island, the rarely recorded green alga *Codium fragile* ssp. *atlanticum* is found in a single pool. Shallow rockpools lined with either boulders, cobbles or bedrock are recorded at most rocky sites (Cor). The rockpools are typically characterised by coral weed *Corallina officinalis*, pink coralline algae, the red algae *Mastocarpus stellatus, Ceramium* spp. and

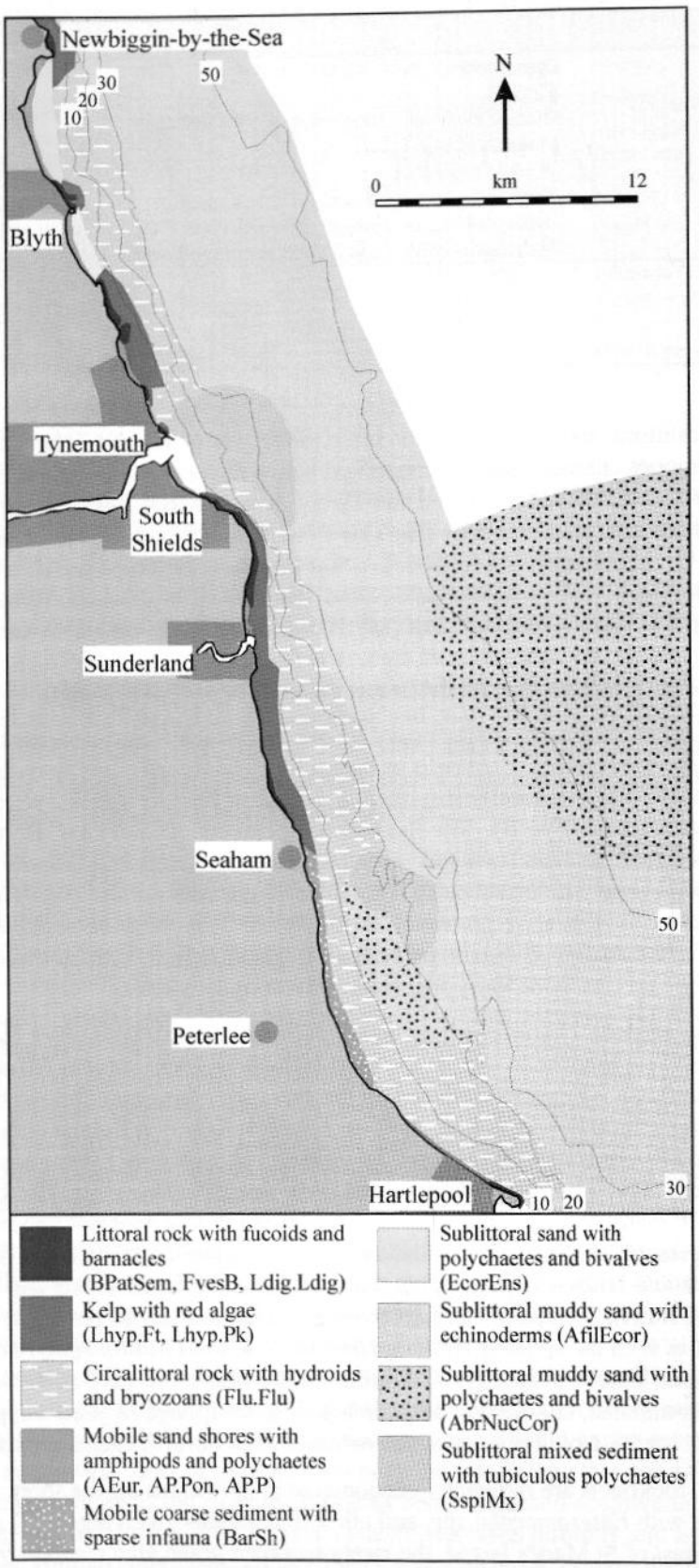

Figure 15.2 Indicative distribution of the main biotopes within the area (based on data from survey sites shown in Figure 15.1 and additional field observations).

Dumontia contorta, the green algae *Cladophora* spp., occasional fucoid algae and juvenile kelp *Laminaria* spp. Barnacles *Semibalanus balanoides*, limpets *Patella vulgata* and common periwinkles *Littorina littorea* are the predominant fauna in the pools and in small damp areas on level bedrock and around the bases of boulders. Deeper rockpools are characterised by similar species as those in shallow rockpools but with a greater frequency of the kelp *Laminaria digitata*, green algae *Ulva* spp. and more typically sublittoral species such as the dahlia anemone *Urticina felina*, the white tortoiseshell limpet *Tectura virginea*, the saddle oyster *Anomia ephippium*, the gooseberry sea squirt *Dendrodoa grossularia*, the star squirt *Botryllus schlosseri*, and the red weed *Rhodomela* spp. (FK). Shores subjected to sand scour east of St Mary's Island, on Whitley Sands Outcrop and White Steel also have rockpools that are filled with sand and characterised by the presence of scour-resilient algae such as *Ahnfeltia plicata*, *Polyides rotundus*, *Cystoclonium purpureum*, *Ceramium nodulosum* and sea oak *Halidrys siliquosa* (SwSed).

The sublittoral fringe, with kelp *Laminaria digitata*, is only recorded at five exposures of the harder sandstone bedrock between Seaton Sluice and Marsden Bay (Ldig.Ldig). Kelp-dominated sublittoral fringe is present at Souter Pointer and Whitburn where the algal cover is sparse (though not surveyed) and at Throston Scar, Hartlepool where kelp *L. digitata* is abundant in gullies in the extensive bedrock platform. The only other extensive hard bedrock is at Crab Law (Blyth), Salterfen Point and Blackhall Rocks where the sublittoral fringe is dominated by mussels *Mytilus edulis* (MytFves; MytFR).

The majority of sediment shores are of mobile medium and coarse sand with few species. Stretches of sand with no coastal defence walls south of Blyth, at Seaton Sluice and at Hartlepool Point have an upper shore and strandline with a few species of enchytraeid oligochaetes and gammarid species (Tal). Very few species are recorded (all in low abundance) in the mobile shingle at Shippersea Point and in the colliery waste on the shores adjacent to Easington Colliery (BarSh). The mid-shore is characterised by burrowing amphipods such as *Eurydice pulchra* (AEur). The lower shores at Tynemouth Long Sands and adjacent to Featherbed Rocks are also particularly coarse and mobile and are characterised by amphipods such as *Bathyporeia elegans* and *Pontocrates arenarius* (AP.Pon; AP.P). Lower shores of more stable sediment between Blyth and Tynemouth are colonised by the polychaetes *Paraonis fulgens* and *Scolelepis squamata* (AP.P; AP.Pon), while at the mouth of the Wansbeck estuary and in the shelter of Cullercoats Bay where water retention of the sediment is good, a greater number of polychaete species, including *Capitella capitata* and lugworm *Arenicola marina,* are recorded (MacAre).

Sublittoral

Upper infralittoral kelp *Laminaria hyperborea* forests (Lhyp.Ft) are recorded from Newbiggin to Salterfen Rocks (1 km south of Sunderland), although they are less dense at this southernmost site. The red algal turf on rock beneath the kelp is sparser than at other locations on the north-east coast of England and is dominated by the red alga *Dilsea carnosa*, pink coralline crusts, *Plocamium cartilagineum* and sea beech *Delesseria sanguinea*. Between Blyth and Sunderland, at depths of 3 to 6 m, a lower infralittoral zone of sparse kelp *L. hyperborea* is present (Lhyp.Pk). The heavily silted and pitted rock of the lower infralittoral is characterised by sparse red algal species, mostly *P. cartilagineum* and coralline crusts, sparse hydroids, dahlia anemones *Urticina felina*, tubeworms *Pomatoceros triqueter* and grey topshells *Gibbula cineraria*. South of Salterfen Rocks, however, sublittoral rock outcrops are heavily silted and often severely scoured by sand, which reduces the algal abundance.

The circalittoral zone is shallow in this area, to the point that the sublittoral fringe and infralittoral zone characterised by macroalgal growth are absent. This reflects the very poor water clarity on this stretch of coast and, consequently, the very shallow photic zone. North of Sunderland, the upper circalittoral zone begins at a depth of approximately 6 m. The characterising species are sea beech *Delesseria sanguinea*, sparse coralline crusts, the sponges *Leucosolenia botryoides* and *Scypha ciliata*, dead-man's fingers *Alcyonium digitatum*, tubeworms *Pomatoceros triqueter*, hornwrack *Flustra foliacea* and the common sea urchin *Echinus esculentus* (Flu.Flu). The species richness is low and, in most cases, the algae and hydroids are sparse and appear to be in poor condition. Decapod crustaceans, bryozoans and ascidians are notably scarce at these heavily silted and often sand-scoured sites. Tubeworms

P. triqueter dominate the vertical surfaces of the stepped bedrock or boulders, which are heavily pitted by the wrinkled rock borer *Hiatella arctica* (AlcByH.Hia). Below 10 m red algae are absent and a thin turf of hydroids and bryozoans characterise the community. The hydroids most frequently recorded are *Tubularia indivisa*, *Nemertesia antennina*, *Abietinaria abietina* and *Thuiaria thuja* together with dead-man's fingers *A. digitatum*. Of interest are the occurrences of species scarcely recorded in Sector 5, such as the hydroid *Halecium muricatum* recorded off Blyth and the bottlebrush hydroid *Thuiaria articulata* recorded at seven sites.

To the north-east of Whitley Shad and east of Whitburn Steel (at 32 m and 18 m depth respectively) species richness and abundance, particularly of hydroids, is greater than elsewhere in the area. Bryozoan diversity is low and of the twelve bryozoan species recorded hornwrack *Flustra foliacea* is predominant, with only a few recordings of the other species. Other frequently found species are tubeworms *P. triqueter*, hermit crabs *Pagurus bernhardus*, common starfish *Asterias rubens*, common brittlestars *Ophiothrix fragilis*, sea urchins *Echinus esculentus* and a higher frequency than elsewhere in north-east England of the gas mantle ascidian *Corella parallelogramma*. The piddock *Hiatella arctica*-bored limestone throughout the sublittoral provides a microhabitat for decapod crustaceans such as the edible crab *Cancer pagurus* and squat lobsters *Galathea* spp., brittlestars *Ophiothrix fragilis* and *Ophiopholis aculeata*, gas mantle ascidian *Corella parallelogramma*, blennies and gobies, although the species diversity is low probably owing to silting of the bedrock surfaces. At Marsden Point and south of Pincushion Rocks there is a significant abundance of the boring sponge *Cliona celata* in addition to sparse hydroid and bryozoan turf in the circalittoral zone (Flu.Flu). Throughout the sublittoral hard substrata from Newbiggin to Hartlepool high levels of suspended sediment encourage the growth of the polychaete *Sabellaria spinulosa* which forms layers of sand tubes across the rock surface (SabKR).

The wreck of the *Eugenia Chandriss* is one of many artificial 'reefs' along the coast from Newbiggin to Hartlepool and these harbour a rich fauna. The iron structures of the wreck provide a substratum that stands proud of the scoured and silted areas associated with this stretch of coast, while still being washed by relatively strong tides which encourages a high diversity of species (AlcTub). This wreck is probably representative of many in the area and supports a thick faunal turf composed of dead-man's fingers *Alcyonium digitatum*, hydroids *Tubularia* spp. (particularly *T. indivisa*), *Hydrallmania falcata*, *Sertularia* spp., anemones *Metridium senile* and *Sagartia elegans*, bryozoans *Alcyonidium parasiticum*, hornwrack *Flustra foliacea*, solitary and colonial ascidians and an associated mobile fauna of spider crabs *Inachus* sp., *Hyas* spp., sea slugs *Tritonia hombergii* and *Doto* spp. and brittlestars *Ophiothrix fragilis*.

Sublittoral sediments shallower than 15 m depth are predominantly of fine sand with the sand mason worm *Lanice conchilega*, razor shells *Ensis* spp., crabs *Liocarcinus depurator* and *Corystes cassivelaunus* and plaice *Pleuronectes platessa* the conspicuous species (EcorEns). These sites show evidence of silting in the troughs of sand ripples and are considered low in species diversity compared to similar habitats elsewhere in Sector 5. A greater number of polychaete and bivalve species are recorded where sediments are muddy and of a mixed sediment grade; these are generally found further offshore than the sandy sediments and to the south. The species found include the polychaetes *Nephtys* spp., *Spiophanes bombyx*, *Magelona mirabilis*, *Chaetozone setosa*, *Owenia fusiformis* and bivalves *Fabulina fabula* and *Abra* spp. (AbrNucCor). Few amphipod and echinoderm species are recorded in inshore muddy sediments. In deeper water the diversity of polychaetes, bivalves and echinoderms is greater, reflecting the increased stability of the substratum (AfilEcor). In addition to the species mentioned above, the polychaetes *Sthenelais limicola*, *Goniada maculata*, *Lumbrineris gracilis*, *Prionospio fallax*, *Scalibregma inflatum*, the bivalves *Tellimya ferruginosa* and *Phaxas pellucidus* and the brittlestars *Amphiura* spp. and heart urchins *Echinocardium cordatum* are recorded frequently here. Stable sites are found off Tynemouth and off Seaham, the former being characterised by the presence of horse mussels *Modiolus modiolus* and a diverse bivalve population, the latter with the polychaete *Sabellaria spinulosa* common (SspiMx); both sites have a higher proportion of cobbles and gravel.

Nature conservation

Conservation sites

Site name	*Designation*	*Centre grid ref.*	*Main features*
Northumberland Shore	SSSI	NT 980 575 - NU 010 525	Ornithology
Sandy Bay	SSSI	NZ 305 860	Geology
Tynemouth to Seaton Sluice	SSSI	NZ 346 755	Geology, ornithology
Trow Point to Whitburn Steel	SSSI	NZ 400 648	Geology, flora, ornithology
Seaham Harbour	SSSI	NZ 429 499	Geology
Durham Coast	SSSI	NZ 436 476	Coastal habitats and flora, invertebrates
Hart Warren Dunes	SSSI	NZ 494 363	Coastal habitats and flora
St Mary's Island	LNR	NZ 353 754	Coastal habitats
The Leas & Marsden Rock	NT	NZ 388 665	Coastal habitats
Beacon Hill	NT	NZ 440 455	Coastal habitats
Hawthorn Dene & Chourdon Point	NT	NZ 440 460	Coastal habitats
Warren House	NT	NZ 445 425	Coastal habitats
Blackhall Rocks	WT	NZ 473 387	Coastal habitats

Human influences

Coastal development and uses

Coastal protection walls have been built at Blyth, Whitley Bay, Tynemouth, Sunderland, Seaham and Hartlepool in addition to the piers and harbour walls at Tynemouth, Sunderland and Seaham.

Spoil dredgings from the estuaries are dumped 6 km east of Blyth, 4 km north east of the mouth of the Tyne estuary, 3 km east of the mouth of the Wear estuary, 2 km south of Seaham Harbour and 8 km east of Hartlepool. The dredging waste dumped at sea has a localised smothering effect on the benthos and is also responsible for a general increase in suspended silt along this stretch of the coast (Eagle *et al.* 1979; McHugh 1974; Pomfret & McHugh 1983; Rees *et al.* 1992).

Since the industrial revolution much of the coastline of Tyne and Wear, Durham and Cleveland has been influenced by the effects of industrial pollution, both directly into the littoral and sublittoral zones and from waste disposal into the Tyne, Wear and Tees estuaries (Shillabeer & Tapp 1990). Colliery waste has been deposited onto the littoral zone at two locations. At Lynemouth, 5 km north of Newbiggin, large amounts of shale waste and coal fines are bulldozed to low water where it is continually eroded away by wave action (Nunny 1978). Similarly, south of Seaham approximately 1.2 x 10^6 tonnes per annum of shale minestone was bulldozed onto the beach and an additional 1.0 x 10^6 tonnes per annum of fine tailings was piped onto the beach at two separate sites (Limpenny *et al.* 1992). However, beach tipping no longer occurs at Seaham. As with dredgings, it is likely that the silting caused by the colliery waste is localised and quickly joins the net flow of sediment southwards (Rowlatt *et al.* 1990).

Fly-ash waste from coal fired power stations, was, until 1993, dumped east of Blyth. The environmental impact of this activity was studied by Eagle *et al.* (1979) and Bamber (1983, 1984). With the wholesale closure of collieries in Northumberland and Durham, the amount of input of colliery waste into the marine environment will rapidly be reduced. However, species richness and water quality in the area is generally poor which may be related to the input of industrial waste, spoil and colliery dumping in the area. Consents have been granted by the EA for the discharge of mine water at Newbiggin Point, South Shields, Seaham, Easington and Horden. There are also consents for chemical discharges at Wansbeck, Sunderland and Hartlepool.

Sewage

There are sewage discharge outfalls throughout the length of coast from Newbiggin to Hartlepool, discharging waste that ranges from unscreened and untreated storm overflows to domestic sewage subjected to secondary treatment. The problem of raw sewage reaching the sea during flood events

has largely been controlled in recent years at North Tyneside, Sunderland and Hartlepool, the main centres of population, and a new system is expected to be on-line soon at Seaham.

Recreation

Tynemouth, Whitley Bay and the lighthouse on St Mary's Island attract many visitors in the summer. Litter and debris is a problem in some sites and, in localised areas, the rocks on the shore are bare through trampling. The sandy beaches are cleared of litter everyday during the peak holiday season by using a tractor-towed 'Surf rake'; there is speculation that this activity can diminish the infauna of the beaches and destabilise the sediment, causing the sand to erode during storm events, particularly as a natural strandline of loose algae is not able to develop.

Fisheries

Inshore fisheries consist of small craft working either creels or drift-nets. Lobster fishermen work the rocky reefs east of Blyth, St Mary's Island, Souter Point and Hartlepool. Edible crabs *Cancer pagurus* are taken from the shore at low water on spring tides at Hartlepool. Drift-netting for salmon is particularly popular around the piers at Sunderland and North and South Shields, where the salmon are guided into the nets along the pier walls. Drift-nets are also used along much of the rest of the coast.

Intensive collection of common periwinkles *Littorina littorea* from the shore has been observed east of St Mary's Island on the boulder fields. This is also a popular site for the collection of peeler crabs *Carcinus maenas* as bait for sports anglers, resulting in boulders continually being turned. Boulder-turning for peelers was also observed at Newbiggin and east of Blyth. Less intense winkle-picking was observed at Tynemouth, Whitburn, Salterfen Point, Pincushion Rocks and Blackhall Rocks. Bait-digging for ragworms and lugworms was evident at Sandy Island and St Mary's Island.

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Survey sites

Surveys

311: MNCR littoral survey from Berwick-upon-Tweed to Newbiggin, 1992 (Holt 1994).
317: Littoral survey carried out by staff of the Dove Marine Laboratory, Tyne and Wear during 1991 (Evans *et al.* 1994).
319: Grab sampling survey, ICI 1990 (Shillabeer 1991).
356: Sublittoral survey, Analytical and Environmental Services 1992 (Johnston 1992a, b).
397: MNCR littoral survey from Newbiggin to Saltburn, 1993.
398: MNCR sublittoral survey from Newbiggin to Saltburn, 1993.
461: Grab sampling survey of North-east England, Analytical and Environmental Services 1993 (Turner *et al.* 1993).

Littoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
311	7	Shore at S side of Newbiggin Point.	NZ 319 879	55°11.0'N 01°29.9'W	Fspi; BPat.Sem; Fser.R; Fser.Fser; Rho; RhoCv; Cor
317	3	Cullercoats Bay.	NZ 365 712	55°02.0'N 01°25.7'W	Tal; MacAre; Ol
397	1	Sand Beach, Newbiggin Bay.	NZ 311 875	55°10.8'N 01°30.6'W	BarSnd
397	2	Spittal Carrs, Newbiggin Bay.	NZ 312 871	55°10.6'N 01°30.6'W	BPat.Sem; EntPor; MytB; MytFR; Cor; FK; SR
397	3	North Beach, North Blyth.	NZ 315 823	55°08.0'N 01°30.3'W	AP.P
397	4	Crab Law, Blyth.	NZ 322 818	55°07.7'N 01°29.6'W	BPat.Sem; MytB; FvesB; XR; Cor
397	5	Sandy Island, Seaton Sluice.	NZ 335 770	55°05.1'N 01°28.5'W	Tal; AP.P
397	6	Rocky Island, Seaton Sluice.	NZ 339 769	55°05.1'N 01°28.1'W	Fspi; BPat.Sem; MytB; Fves; Mas; Cor; Ldig.Ldig
397	7	NW of St Mary's Lighthouse, Whitley Bay.	NZ 352 753	55°04.2'N 01°26.9'W	Fspi; Eph; Fves; Fser; Rho; Ldig.Ldig
397	8	E of Bait Island, Whitley Bay.	NZ 353 754	55°04.3'N 01°26.8'W	YG; Ent; Fspi; BPat.Sem; Rho; G; Cor; FK
397	9	S of Curry's point, Whitley Bay.	NZ 352 748	55°03.9'N 01°26.9'W	Pel; Fves; Fser.R; Cor; Ldig.Ldig.Bo
397	10	Whitley Sands outcrop, Whitley Bay.	NZ 353 734	55°03.2'N 01°26.8'W	BPat.Sem; Rho; SwSed
397	11	Brown's Point, Whitley Bay.	NZ 366 717	55°02.3'N 01°25.6'W	Ver.Ver; Ver.B; MytB; BPat.Sem; Fves; Fser.R; Rho; FK; Ldig.Ldig
397	12	Bear's Head Rock, Tynemouth.	NZ 368 706	55°01.7'N 01°25.4'W	EntPor; Rho; MytFR
397	13	Sharpness Point, Tynemouth.	NZ 372 700	55°01.3'N 01°25.0'W	YG; Ent; BPat.Sem; Fves; Asc.Asc; Fser.R; Rho; FK; Ldig.Ldig
397	14	Velvet Beds, Marsden.	NZ 398 657	54°59.0'N 01°22.6'W	BPat.Sem; Fspi; Fser.Fser; G; Cor; SR; SByAs; Ldig.Ldig
397	15	Potter's Hole, Marsden.	NZ 412 636	54°57.9'N 01°21.3'W	Ent; Fspi; MytB; Fser.R; FK
397	16	Souter Point, Marsden.	NZ 415 629	54°57.5'N 01°21.1'W	BPat.Sem; Fspi; FvesB; Fser.R; SR
397	17	S White Steel, Whitburn.	NZ 412 616	54°56.8'N 01°21.3'W	Fspi; BPat.Lic; BPat.Cat; Fves; Rho; BLlit; Cor; SwSed; SByAs
397	18	Salterfen Point, Sunderland.	NZ 419 540	54°52.7'N 01°20.8'W	Ent; MytB; Fves; MytFves; MytFR; EphX; FK
397	19	S of Pincushion Rocks, Sunderland.	NZ 420 520	54°51.6'N 01°20.7'W	Ent; BPat.Sem; Fser.R; Cor

Littoral sites - continued

Survey	Site	Site name	Grid reference	Latitude & longitude	Biotopes present
397	20	Beach N of Featherbed Rocks, Seaham.	NZ 427 503	54°50.7'N 01°20.1'W	EntPor
397	21	Featherbed Rocks, Seaham.	NZ 430 499	54°50.5'N 01°19.8'W	Ver.B; Ver.Ver; Fspi; BPat.Sem; Fves; MytFR; AEur
397	22	E of Cambois, Blyth.	NZ 306 845	55°09.2'N 01°31.1'W	AEur; AP.P
397	23	SE of Gloucester Lodge Farm, Seaton Sluice.	NZ 328 782	55°05.8'N 01°29.1'W	Tal; AP.P
397	24	Whitley Links, Whitley Bay.	NZ 353 732	55°03.1'N 01°26.8'W	AEur; AP.P
397	25	Tynemouth Long Sands.	NZ 368 705	55°01.6'N 01°25.4'W	AP.P; AP.Pon
397	26	Shippersea Point, Peterlee.	NZ 444 452	54°47.9'N 01°18.5'W	Eph; BPat.Sem; MytB; FvesB; Fser.Fser; BarSh
397	27	Easington Colliery, Peterlee.	NZ 444 442	54°47.4'N 01°18.5'W	AP.P
397	28	Hartlepool Point, Peterlee.	NZ 455 408	54°45.6'N 01°17.5'W	BarSh
397	29	Blackhall Rocks, Peterlee.	NZ 474 388	54°44.5'N 01°15.8'W	Pel; Fspi; Fves; MytFR
397	30	Southern North Sands, Hartlepool.	NZ 516 349	54°42.3'N 01°11.9'W	AP.P; AP.Pon
397	31	Throston Scar, Hartlepool.	NZ 528 345	54°42.1'N 01°10.8'W	BPat.Sem; FvesB; Rho; MytFR; Cor; Ldig.Ldig

Sublittoral sites

Survey	Site	Site name	Grid reference	Latitude & longitude	Biotopes present
319	1	Blackhall, ENE pit headgear, Station 1/1.	NZ 482 397	54°45.0'N 01°15.0'W	FabMag
319	2	Blackhall, ENE pit headgear, Station 1/2.	NZ 482 397	54°45.0'N 01°15.0'W	FabMag
319	3	Blackhall, ENE pit headgear, Station 1/3.	NZ 482 397	54°45.0'N 01°15.0'W	FabMag
319	4	Blackhall, ENE of pit headgear, Station 2/1.	NZ 482 397	54°45.0'N 01°15.0'W	AbrNucCor
319	5	Blackhall, E of pit headgear, Station 2/2.	NZ 482 397	54°45.0'N 01°15.0'W	FabMag
319	6	Blackhall, E of pit headgear, Station 2/3.	NZ 482 397	54°45.0'N 01°15.0'W	AfilEcor
319	102	MM dumping ground, Station 15, Tees Bay.	NZ 658 464	54°48.5'N 00°58.5'W	AbrNucCor
319	103	MM dumping ground, Station 17, Tees Bay.	NZ 651 594	54°55.5'N 00°59.0'W	AbrNucCor
319	104	MM dumping ground, Station 19, Tees Bay.	NZ 651 436	54°47.0'N 00°59.2'W	AbrNucCor
319	105	Control North, Station 1, Tees Bay.	NZ 518 573	54°54.5'N 01°11.5'W	AbrNucCor
319	106	Control North, Station 2, Tees Bay.	NZ 513 558	54°53.7'N 01°12.0'W	AbrNucCor
319	107	Control North, Station 3, Tees Bay.	NZ 544 581	54°54.9'N 01°09.0'W	Lcon
319	108	Control North, Station 4, Tees Bay.	NZ 555 589	54°55.3'N 01°08.0'W	AbrNucCor
319	109	Control North, Station 5, Tees Bay.	NZ 566 598	54°55.8'N 01°07.0'W	Lcon
356	3	Newbiggin Foul Outfall, Transect 1 (Northern).	NZ 323 866	55°10.4'N 01°29.5'W	EcorEns
356	4	Newbiggin Foul Outfall, Transect 2 (Southern).	NZ 321 859	55°10.0'N 01°29.6'W	EcorEns
356	5	Newbiggin Outfall Transect 3 (Northern).	NZ 327 872	55°10.7'N 01°29.1'W	EcorEns
356	6	Newbiggin Foul Outfall, Transect 4 (Southern).	NZ 319 855	55°09.8'N 01°29.9'W	Flu.Flu; EcorEns
356	7	Whitburn Steel, Transect 1, Sunderland.	NZ 421 611	54°56.6'N 01°20.5'W	Flu.Flu
356	8	Brierdene, Transect 1, Whitley Bay.	NZ 357 740	55°03.5'N 01°26.4'W	Lhyp.Ft; Lhyp.Pk
356	9	Brierdene, Transect 2, Whitley Bay.	NZ 361 706	55°01.7'N 01°26.0'W	FoR; Flu.Flu
398	1	Centre of Cambois Bay, Blyth.	NZ 329 858	55°09.9'N 01°28.9'W	EcorEns
398	2	Inshore South Spit, Blyth.	NZ 329 810	55°07.3'N 01°29.0'W	SabKR
398	3	South Spit, E of Blyth.	NZ 335 810	55°07.3'N 01°28.4'W	FaAlC.Abi; Flu.Flu
398	4	Offshore South Spit E of Blyth.	NZ 346 808	55°07.2'N 01°27.3'W	Flu.Flu
398	5	E of Colville Rock, Blyth.	NZ 346 770	55°05.2'N 01°27.4'W	Flu.Flu; EcorEns
398	6	2 miles E of Seaton Sluice.	NZ 362 785	55°05.9'N 01°25.8'W	Flu.Flu
398	7	E of Outer Bell Rock, Whitley Bay.	NZ 345 763	55°04.7'N 01°27.5'W	Lhyp.Pk; SabKR; IGS
398	8	N side of St Mary's Island, Whitley Bay.	NZ 351 756	55°04.4'N 01°27.0'W	Lhyp.Pk
398	9	SE side of St Mary's Island, Whitley Bay.	NZ 355 753	55°04.2'N 01°26.6'W	SCAs.DenCla; SabKR
398	10	Inshore SE of St Mary's Island, Whitley Bay.	NZ 355 748	55°04.0'N 01°26.5'W	SabKR
398	11	N of Briar Dene Bushes, Whitley Bay.	NZ 364 752	55°04.2'N 01°25.7'W	Flu.Flu

Sublittoral sites - continued

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
398	12	1 mile NE of St Mary's Island, Whitley Bay.	NZ 378 763	55°04.8'N 01°24.4'W	Flu.SerHyd; IMS
398	13	Leading light, ½ mile E of Curry Point, Whitley Bay.	NZ 373 753	55°04.2'N 01°24.9'W	AlcByH.Hia
398	14	1 mile NE of Whitley Shad, Whitley Bay.	NZ 389 736	55°03.3'N 01°23.3'W	Flu.Flu
398	15	S of Whitley Shad, Whitley Bay.	NZ 373 716	55°02.2'N 01°24.9'W	IMX
398	16	Brown's Point, Whitley Bay.	NZ 366 721	55°02.5'N 01°25.6'W	Lhyp.Ft
398	17	Inshore Sharpness Point, Tynemouth.	NZ 373 701	55°01.4'N 01°24.9'W	Lhyp.TFt
398	18	NE of North Pier, Tynemouth.	NZ 403 716	55°02.2'N 01°22.1'W	Flu.Flu; IMS
398	19	SE of South Pier, South Shields.	NZ 420 693	55°01.0'N 01°20.5'W	Flu.SerHyd
398	20	Wreck of the *Eugenia Chandriss*, Tynemouth.	NZ 386 685	55°00.6'N 01°23.7'W	AlcTub
398	21	Inshore off Marsden Point, Tynemouth.	NZ 398 657	54°59.1'N 01°22.6'W	Lhyp.TFt; XKScrR
398	22	E Marsden Point, Whitburn.	NZ 402 661	54°59.3'N 01°22.3'W	Flu.Flu
398	23	Offshore, ENE of Marsden Point.	NZ 416 672	54°59.8'N 01°20.9'W	Flu.Flu; IMS
398	24	SE of Souter Point, Whitburn.	NZ 425 626	54°57.3'N 01°20.1'W	Flu.Flu
398	25	E of Souter Point, Whitburn.	NZ 430 645	54°58.4'N 01°19.6'W	Flu.Flu; IMS
398	26	N of Whitburn Steel, Sunderland.	NZ 418 632	54°57.7'N 01°20.8'W	SabKR
398	27	E of Whitburn Steel, Whitburn.	NZ 429 608	54°56.4'N 01°19.8'W	Flu.Flu
398	28	Offshore Whitburn Steel, Whitburn.	NZ 446 603	54°56.1'N 01°18.1'W	Flu.SerHyd; IMX
398	29	NE of Louis Rocky Patch, Seaham.	NZ 456 497	54°50.4'N 01°17.3'W	Flu.Flu
398	30	Hendon Rock, Sunderland.	NZ 431 568	54°54.2'N 01°19.6'W	AlcByH.Hia; Flu.Flu
398	31	Salterfen Rocks, Sunderland.	NZ 416 539	54°52.7'N 01°21.0'W	XKScrR
398	32	Offshore E of Hendon Rock, Sunderland.	NZ 460 575	54°54.6'N 01°16.8'W	Flu.Flu
398	33	East of Pincushion Rocks, Seaham.	NZ 424 527	54°52.0'N 01°20.2'W	AlcByH.Hia; IGS
398	34	SE of Pincushion Rocks, Seaham.	NZ 453 514	54°51.3'N 01°17.6'W	Flu.Flu
398	35	Offshore E Seaham Harbour, Sunderland.	NZ 484 514	54°51.3'N 01°14.7'W	Flu.Flu
398	36	Chaurdon Point, Seaham.	NZ 445 454	54°48.1'N 01°18.4'W	Flu.Flu; IGS
398	37	E of Dawdon Colliery, Seaham.	NZ 466 491	54°50.0'N 01°16.4'W	Flu.Flu; AfilEcor
398	38	Easington Colliery, Peterlee.	NZ 450 437	54°47.1'N 01°18.0'W	Flu.SerHyd
398	39	Offshore Shippersea Bay, Seaham.	NZ 474 459	54°48.3'N 01°15.7'W	Flu.Flu; IMS
398	40	Offshore Dogger Rocks, Seaham.	NZ 465 428	54°46.7'N 01°16.6'W	AbrNucCor
398	41	ENE of Peterlee shore.	NZ 512 439	54°47.2'N 01°12.1'W	Flu.Flu
398	42	NE of Blackhall Colliery, Seaham.	NZ 487 423	54°46.3'N 01°14.5'W	IGS
398	43	1 mile NE of Blackhall Rocks, Seaham.	NZ 499 404	54°45.4'N 01°13.4'W	Flu.Flu
398	45	E of Blackhall Rocks, Hartlepool.	NZ 533 391	54°44.6'N 01°10.2'W	Flu.SerHyd
461	1	Offshore Cambois Bay, Blyth.	NZ 356 855	55°09.7'N 01°26.4'W	AfilEcor
461	2	Offshore Seaton Sluice.	NZ 385 778	55°05.6'N 01°23.7'W	AfilEcor
461	3	Offshore Tynemouth.	NZ 422 707	55°01.7'N 01°20.3'W	AfilEcor
461	4	Offshore South Shields.	NZ 443 681	55°00.3'N 01°18.4'W	AbrNucCor
461	5	Offshore Whitburn.	NZ 475 638	54°57.9'N 01°15.4'W	AbrNucCor
461	6	Offshore Seaham.	NZ 501 475	54°49.2'N 01°13.2'W	SspiMx
461	7	Offshore Peterlee, Hartlepool.	NZ 554 405	54°45.3'N 01°08.3'W	AfilEcor

Compiled by: Paul Brazier

16 Wansbeck estuary

Location		
Position (centre)	NZ 300 850	
County/District	Northumberland	Wansbeck
Conservation agency/area	English Nature	Northumbria

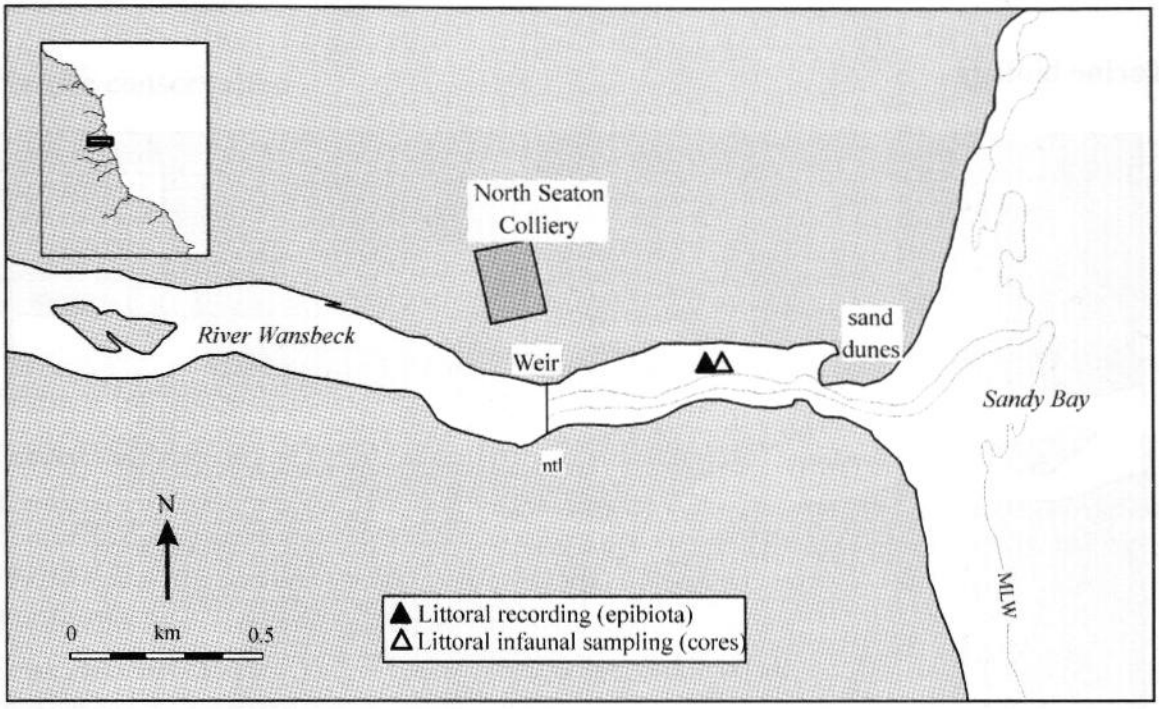

Figure 16.1 Location of area showing sites surveyed and main bathymetric features.

Marine biological surveys				
	Survey methods	*No. of sites*	*Date of survey*	*Source*
Littoral	Recording (epibiota); infaunal cores and granulometry	1	September 1992	Brazier & Murray (1994)

Introduction

The Wansbeck estuary is a small, shallow, bar-built estuary whose limit of tidal influence has been shortened by the construction of a weir. Between the weir and the estuary mouth, the estuary forms a shallow basin dominated by cobbles in its upper reaches and consists of muddy sand at the seaward end. The estuary widens towards the mouth, particularly on the north bank behind the sand dunes. The estuary mouth consists of narrows, formed by encroaching sand dunes on the north shore and a sea wall to the south. East of the narrows on the open coast there is a sandy shore derived from long-shore drift.

Physical features	
Physiographic type	Bar-built estuary
Length of coast	4 km
Area of inlet	15 ha
Length of tidal channel	1.7 km
Bathymetry	Largely intertidal with shallow channel
Wave exposure range	Moderately exposed to sheltered
Tidal stream range	Strong to negligible
Tidal range	4.2 m (springs), 2.2 m (neaps)
Salinity range	Fully marine to variable

Marine biology

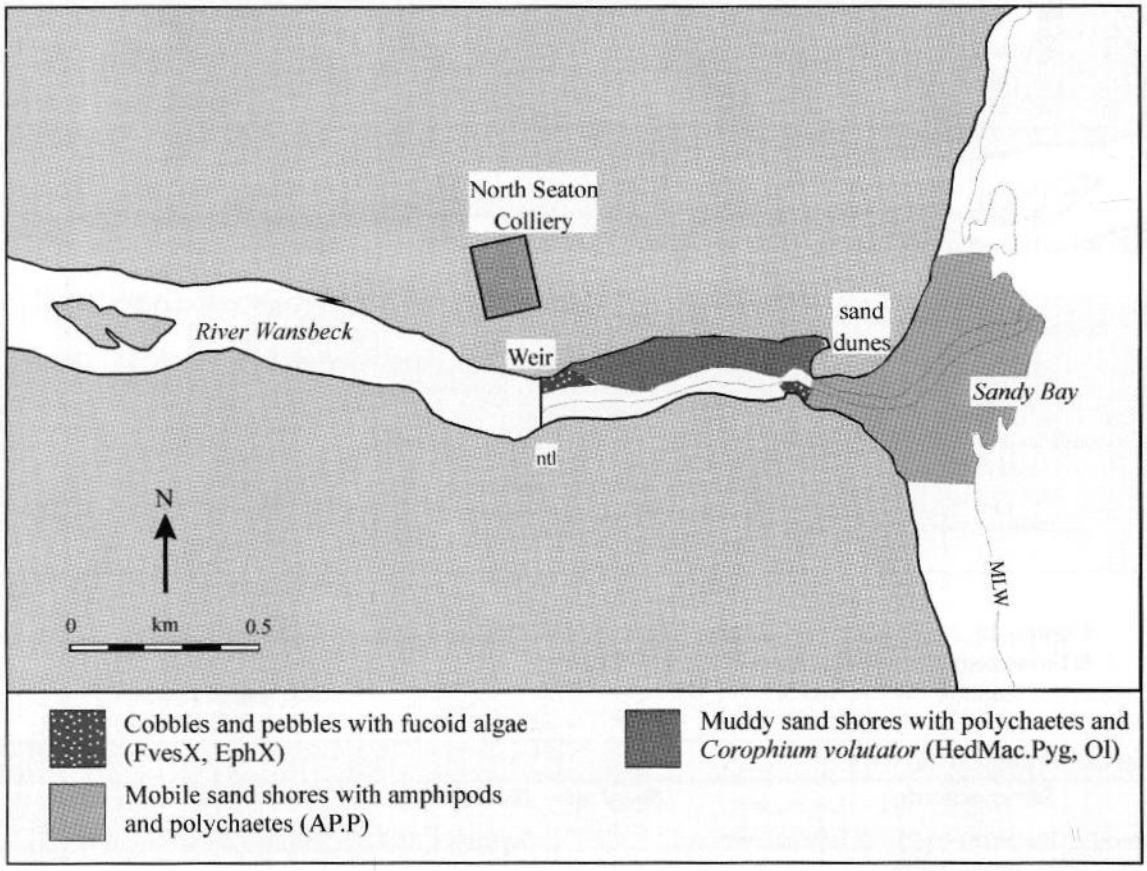

Figure 16.2 Indicative distribution of the main biotopes within the area (based on data from survey sites shown in Figure 16.1 and additional field observations).

Littoral

The stable, medium and fine sand on the north shore at the entrance to the estuary is characterised by polychaete species *Eteone longa*, *Hediste diversicolor* and *Capitella capitata* (AP.P). The sea wall on the south side of the narrows at the estuary mouth is exposed to strong tidal streams and sand scour and is consequently characterised by opportunistic colonisers such as the algae *Porphyra umbilicalis* and *Enteromorpha* spp. (EphX). Upstream of, and adjacent to, the narrows on the north shore is an area of highly mobile sand caused by the strong tidal streams. This area of rippled sand is characterised by the amphipods *Eurydice pulchra* and *Bathyporeia* spp. (AP.P). Sheltered behind the

encroaching dunes is an area of muddy sand with the polychaete *H. diversicolor*, the amphipod *Corophium volutator* and oligochaete *Tubificoides pseudogaster* and enchytraeids (Ol), despite this area being particularly impoverished due to the influx of wind-blown coarse sand from the dunes. A large proportion of the mid-estuary constitutes muddy sand characterised by the polychaete *H. diversicolor*, the oligochaetes *Tubificoides benedii* and *T. pseudogaster* and the amphipod *C. volutator* (HedMac.Pyg). The muddy sand is replaced gradually upstream by heavily silted cobbles. The community on the cobbles adjacent to the weir is characterised by bladder wrack *Fucus vesiculosus,* barnacles *Semibalanus balanoides* and *Elminius modestus* (FvesX), whilst the weir itself is dominated by the green algae *Enteromorpha* spp. (EphX).

Nature conservation

Conservation sites

Site name	*Designation*	*Centre grid ref.*	*Main features*
Northumberland Shore	SSSI, pSPA	NT 980 575 - NU 010 525	Ornithology
Cresswell and Newbiggin Shores	SSSI	NZ 295 942 - NZ 305 854	Geology

Human influences

Coastal developments and uses

The estuary is largely undeveloped, with only a small sea wall at the entrance. A septic tank overflow from an adjacent caravan park flows into the narrows on the north shore. The water quality has been classified as grade A by the National Rivers Authority.

The intertidal area is used for bait collection.

Small pleasure boats have moorings in the deepest part of the estuary, and the intertidal area is used for walking and horse-riding.

References and further reading

Brazier, D.P., & Murray, E. 1994. Littoral survey of the estuaries of south-east Scotland and north-east England. *JNCC Report*, No. 159. (Marine Nature Conservation Review Report, No. MNCR/SR/26.)

Buck, A.L. 1993. *An inventory of UK estuaries. Volume 4. North and east Scotland.* Peterborough, Joint Nature Conservation Committee.

Davidson, N.C., Laffoley, D.d'A., Doody, J.P., Way, L.S., Gordon, J., Key, R., Drake, C.M., Pienkowski, M.W., Mitchell, R., & Duff, K.L. 1991. *Nature conservation and estuaries in Great Britain.* Peterborough, Nature Conservancy Council.

Survey sites

Surveys

314: MNCR littoral survey of the estuaries of south-east Scotland and north-east England, 1992 (Brazier & Murray 1994).

Littoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
314	20	Wansbeck estuary.	NZ 301 855	55°09.7'N 01°31.6'W	FvesX; EphX; AP.P; HedMac.Pyg; Ol

Compiled by: Paul Brazier

17 Blyth estuary

Location		
Position (centre)	NZ 300 820	
County/District	Northumberland	Wansbeck and Blyth Valley
Conservation agency/area	English Nature	Northumbria

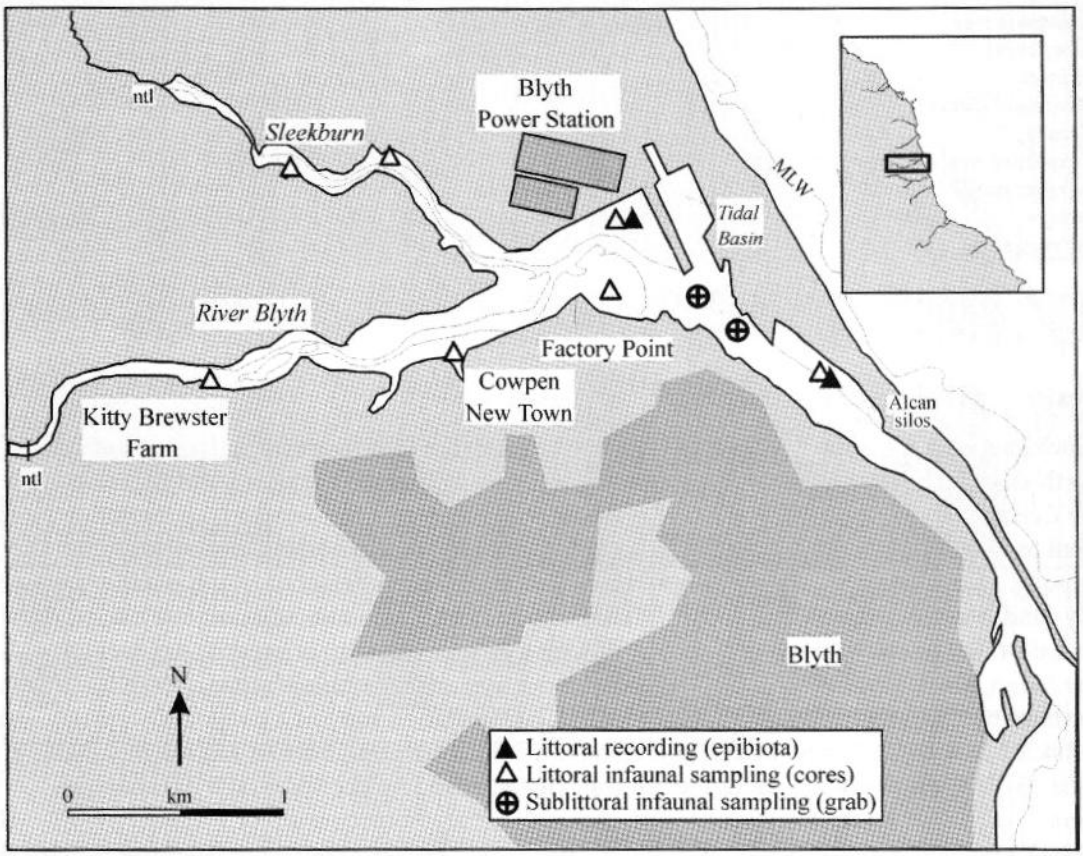

Figure 17.1 Location of area showing sites surveyed and main bathymetric features.

Marine biological surveys

	Survey methods	*No. of sites*	*Date of survey*	*Source*
Littoral	Infaunal cores and granulometry	7	September 1992	Brazier & Murray (1994)
Sublittoral	Infaunal grab samples (0.1 m² Day grab) and granulometry	1	June 1992	NRA (unpublished data)
	Infaunal grab samples (0.1 m² Van Veen grab) and granulometry	2	November 1990	Confidential data

Introduction

The Blyth and its tributary, Sleek Burn, flows eastwards past a predominantly industrial landscape into the North Sea. The estuary is deflected south-east at the mouth by a spit and is extensively trained by 2.5 km of coastal protection walls. Most of the lower Blyth estuary is canalised to form Blyth Harbour and Cambois tidal basin. West and upstream of the tidal basin is predominantly sediment, with hard substrata limited to a muddy shingle plain and sea wall adjacent to the Blyth power station, and silted rubble in the upper estuary and Sleek Burn.

Physical features	
Physiographic type	Complex estuary
Length of coast	19 km
Size of inlet	168 ha
Length of tidal channel	7 km
Bathymetry	Dredged to 5 m in the lower estuary
Wave exposure range	Moderately exposed to ultra sheltered
Tidal stream range	Moderately strong to negligible
Tidal range	4.2 m (springs), 2.2 m (neaps)
Salinity range	Fully marine to variable

Marine biology

Littoral

The intertidal area in the lower estuary is restricted to a 300 m long muddy sandflat behind staithes on the north-east shore. The infauna of the muddy sand here supports polychaetes and the common cockle *Cerastoderma edule* (PCer). Factory Point, parts of Sleek Burn and parts of the south shore adjacent to Cowpen New Town, are characterised by the polychaete *Hediste diversicolor*, the amphipod *Corophium volutator* and oligochaetes *Tubificoides* spp. (HedOl). Communities in the muddy sand sites adjacent to Blyth power station and on the lower shore adjacent to Cowpen New Town are similar to those mentioned above but with a greater diversity of polychaetes including *Eteone longa*, *Streblospio shrubsolii*, *Apelochaeta marioni* and *Capitella capitata* (HedStr). Mid- and upper shore boulders and cobbles adjacent to Blyth power station support a community characterised by barnacles *Semibalanus balanoides*, common periwinkles *Littorina littorea* and rough winkles *L. saxatilis* (BLlit), with a small area of the sea wall characterised by knotted wrack *Ascophyllum nodosum* (AscX). The sheltered west-facing shore at Factory Point consists of a mussel *Mytilus edulis* bed (MytX) on muddy sand with small cobbles. Bricks and broken concrete in the upper estuary are heavily silted and subject to sewage enrichment. Species diversity here is low with occasional bladder wrack *Fucus vesiculosus* and very few fauna (FvesX). Anoxic fluid muddy sand to the east of Factory Point and in the upper reaches of both Sleek Burn and the Blyth estuary is characterised by the polychaete *H. diversicolor*, the amphipod *C. volutator* and the oligochaete *Tubificoides pseudogaster* (HedOl).

Sublittoral

The sublittoral muds throughout the Blyth estuary are colonised by polychaetes *Eteone longa*, *Ophryotrocha hartmanni*, *Apelochaeta vivipara* and *Capitella capitata* and oligochaetes *Tubificoides benedii*, *T. pseudogaster* and *T. swirencoides* (AphTub). The mussel *Mytilus edulis* is the only bivalve that is abundant in the Blyth estuary, and is recorded in the sublittoral in the middle reaches of the estuary.

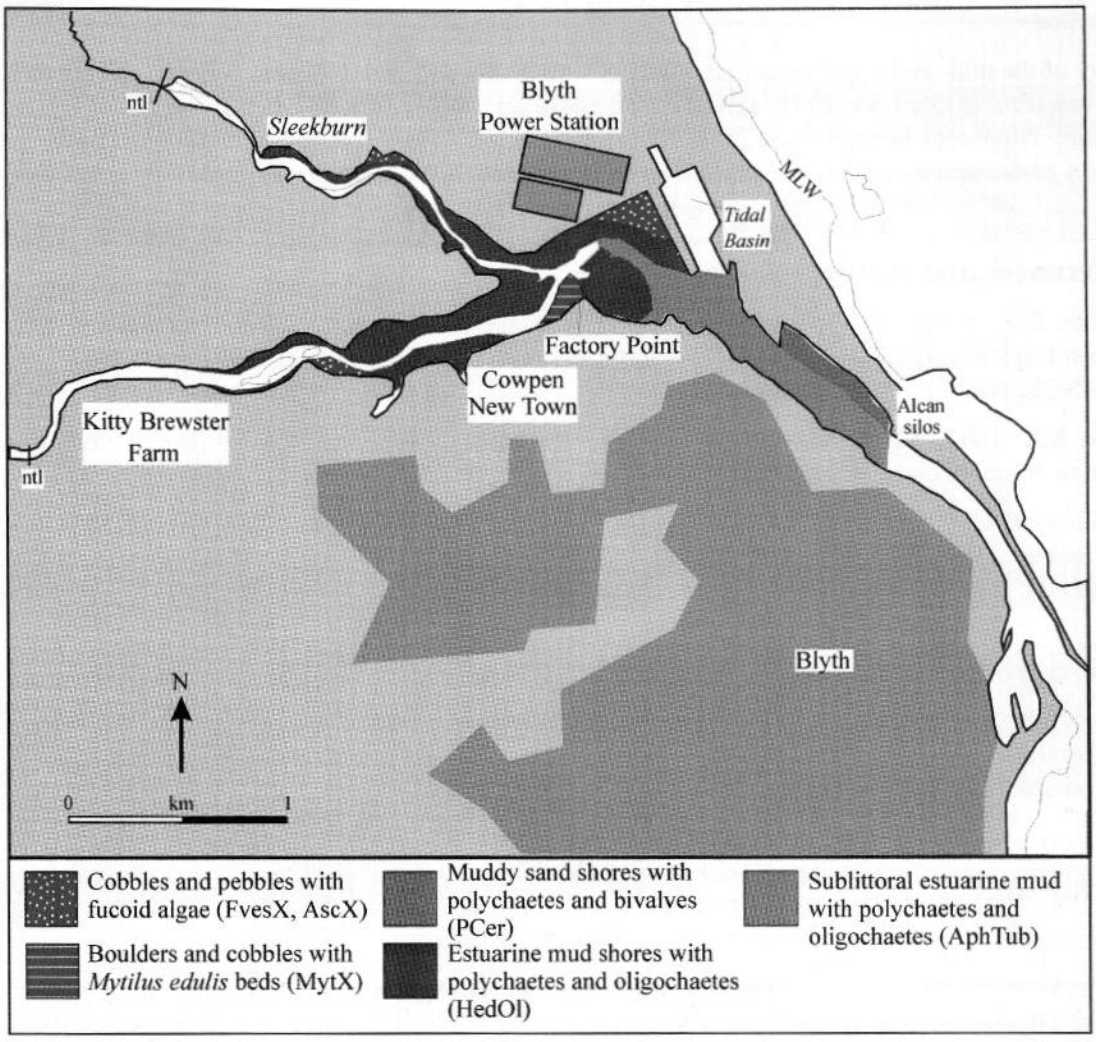

Figure 17.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 17.1, and additional field observations and cited literature).

Nature conservation

Conservation sites			
Site name	***Designation***	***Centre grid ref.***	***Main features***
Northumberland Shore	SSSI	NT 980 575 - NU 010 525	Ornithology

Human influences

Coastal developments and uses

From the entrance of the estuary up to the Alcan storage silos the tidal channel has maintenance dredging to 5 m depth. The port facility on both sides of the estuary is used for the import of bauxite and petroleum coke. The Cambois power station, built in 1960 on the north shore, intakes cooling water from the estuary, discharging out to sea. There are some leisure activities on the Blyth estuary

including bait-digging in the mid-estuary; extensive moorings in the mid-estuary and boating from the marina at the estuary mouth.

Pollution

Many of the mid- and upper estuarine mudflats were badly polluted with heavy metals and pulverised fuel ash (Frid & Garwood 1991) and domestic waste was observed in this area as a result of fly-tipping. Numerous untreated sewage outfalls enter the mid- estuary on the south shore. The water quality of the estuary has been classified by the National Rivers Authority as grade A.

References and further reading

Brazier, D.P., & Murray, E. 1994. Littoral survey of the estuaries of south-east Scotland and north-east England. *JNCC Report*, No. 159. (Marine Nature Conservation Review Report, No. MNCR/SR/26.)

Buck, A.L. 1993. *An inventory of UK estuaries. Volume 4. North and east Scotland.* Peterborough, Joint Nature Conservation Committee.

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Survey sites

Surveys

314: MNCR littoral survey of the estuaries of south east Scotland and north east England, 1992 (Brazier & Murray 1994).

316: Infaunal grab and core sampling of the estuaries of north east England by the National Rivers Authority, 1992. Unpublished data.

Littoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
314	21	N side Staithes, Blyth Estuary.	NZ 315 822	55°07.9'N 01°30.3'W	PCer
314	22	Blyth Power Station.	NZ 303 829	55°08.3'N 01°31.4'W	AscX; BLlit; HedStr
314	23	Factory Point.	NZ 303 827	55°08.2'N 01°31.4'W	MytX; BLlit; HedOl
314	24	Town Farm, Sleek Burn.	NZ 292 833	55°08.5'N 01°32.5'W	FvesX; HedOl
314	25	N of Sleekburn Grange Farm.	NZ 278 833	55°08.5'N 01°33.8'W	FvesX; HedOl
314	26	NW Cowpen New Town.	NZ 296 824	55°08.1'N 01°32.1'W	HedStr; HedOl
314	27	Kitty Brewster Farm.	NZ 284 823	55°08.0'N 01°33.2'W	FvesX; FcerX; HedOl

Sublittoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
316	20	Blyth Estuary sublittoral.	NZ 308 825	55°08.1'N 01°31.0'W	AphTub

Compiled by: Paul Brazier

18 Tyne estuary

Location		
Position (centre)	NZ 320 660	
County/District	Tyne and Wear, Northumberland	Gateshead, Newcastle-upon-Tyne, North Tyneside, South Tyneside
Conservation agency/area	English Nature	Northumbria

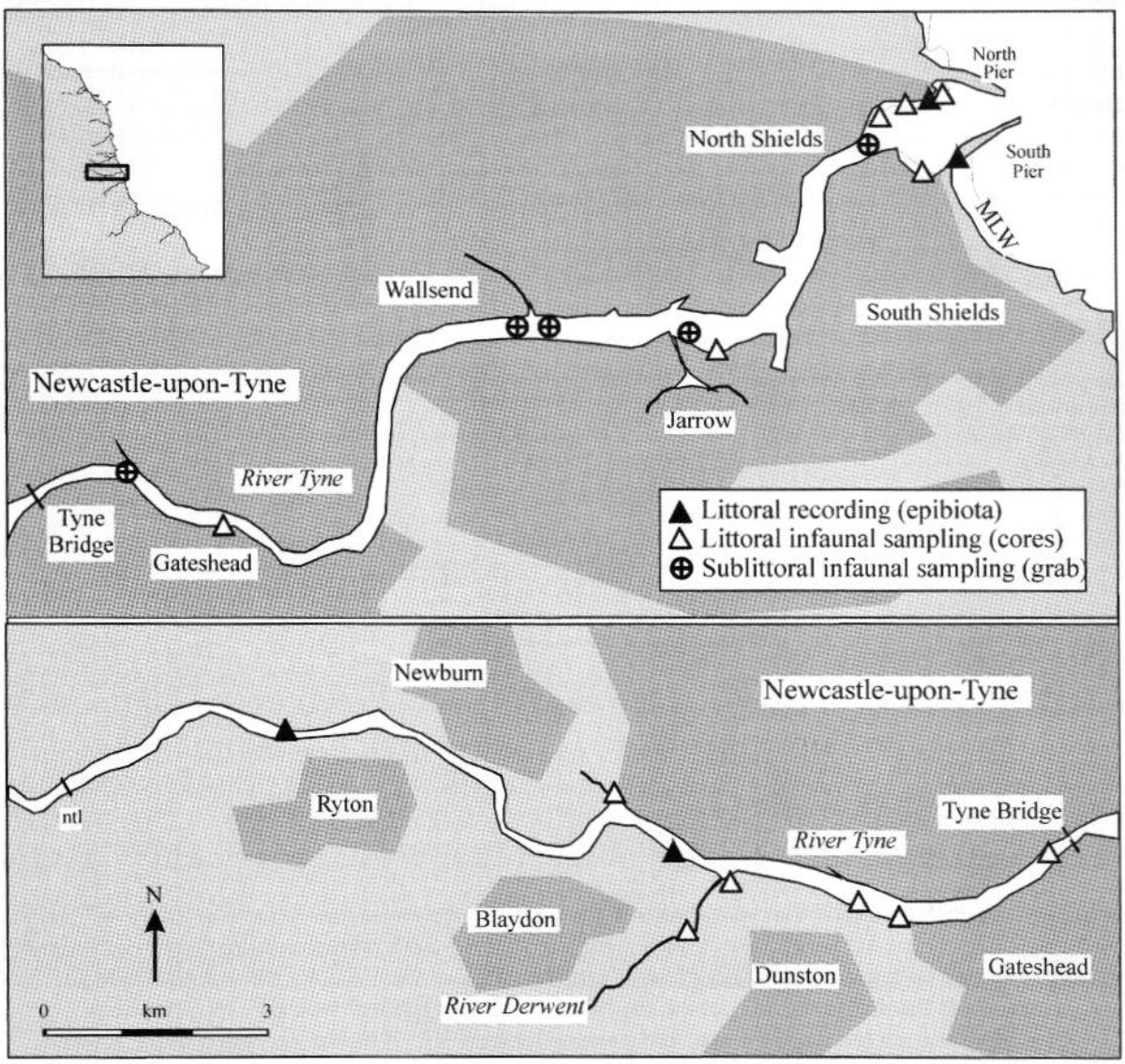

Figure 18.1 Survey area, showing main bathymetric features and location of sites surveyed.

Marine biological surveys				
	Survey methods	*No. of sites*	*Date of survey*	*Source*
Littoral	Recording (epibiota)	3	September 1992	Brazier & Murray (1994)
	Infaunal cores and granulometry	11	September 1992	Brazier & Murray (1994)
	Infaunal cores and granulometry	1	August 1991	Evans *et al.* (1994)
Sublittoral	Infaunal grab samples (0.1 m² Day grab) and granulometry	5	June 1992	NRA unpublished data

Introduction

The Tyne estuary is the most urbanised and industrially developed of the estuaries in north-east England. It is a long and narrow estuary with over 27 km of port facilities, harbour walls and coastal protection walls. Protection is afforded to the mouth of the estuary by the North and South Piers, with wave traps at Mussel Scarp on the north bank and Herd Sands on the south bank. With the exception of Jarrow Slake 4 km from the estuary mouth and at the Dunston Coal Staithes, littoral areas are limited to the steep banks of the mid-estuary and some cobble banks near to the upper limit of marine influence.

Physical features	
Physiographic type	Complex estuary
Length of coast	66 km
Size of inlet	792 ha
Length of tidal channel	32.7 km
Bathymetry	Dredged to between 5.2 m and 8.2 m up to the bridges
Wave exposure range	Moderately exposed to ultra sheltered
Tidal stream range	Moderately strong to negligible
Tidal range	4.3 m (springs), 2.1 m (neaps)
Salinity range	Fully marine to low

Marine wildlife features

Littoral

Adjacent to the North Pier the small shore of fine sand is sheltered by an extensive bedrock platform. To the west of this is a sandstone bedrock plain known as Black Middens, which shelters the sandflats at Mussel Scarp. The South Pier is built of blocks of stone alongside which is a stretch of exposed coarse sediment. Black Middens and the boulders of the South Pier show vertical zonation of biotopes similar to that found on the open coast. The upper eulittoral is characterised by spiral wrack *Fucus spiralis* with the black lichen *Verrucaria maura* (Fspi). On the south shore, the mid eulittoral is characterised by dense bladder wrack *F. vesiculosus* (Fves), whereas on the more sheltered north shore it is characterised by knotted wrack *Ascophyllum nodosum* (Asc.Asc). Rockpools are present in the lower eulittoral at Prior's Haven adjacent to the North Pier, with serrated wrack *F. serratus*, kelp *Laminaria digitata,* sea lettuce *Ulva* spp. and a sparse fauna (FK). With the exception of the lower eulittoral on the south shore, which is dominated by serrated wrack *F. serratus* (Fser.Fser.Bo), the lower shore between the estuary mouth and Mussel Scarp is characterised by the presence of the filamentous red algae *Audouinella* spp. (Rho). Throughout the height of the shore, the less wave-exposed bedrock of the north shore has a higher recorded number of species per habitat than the South Pier. The north shore sandy habitats at the mouth of the estuary are also richer in species than those on the south shore. The poorly sorted, highly mobile sand adjacent to South Pier is characterised by the polychaetes *Anaitides maculata*, *Spio martinensis* and *Magelona mirabilis* (AP.P). The more sheltered sandflats at Prior's Haven and Mussel Scarp are of stable, fine sand with the polychaetes *Eteone longa*, *Anaitides mucosa*, *Scoloplos armiger*, *S. martinensis*, *Chaetozone setosa* and *Capitella capitata* dominating the infauna (AP.Pon). The lower shore at Prior's Haven is similar with sublittoral muddy

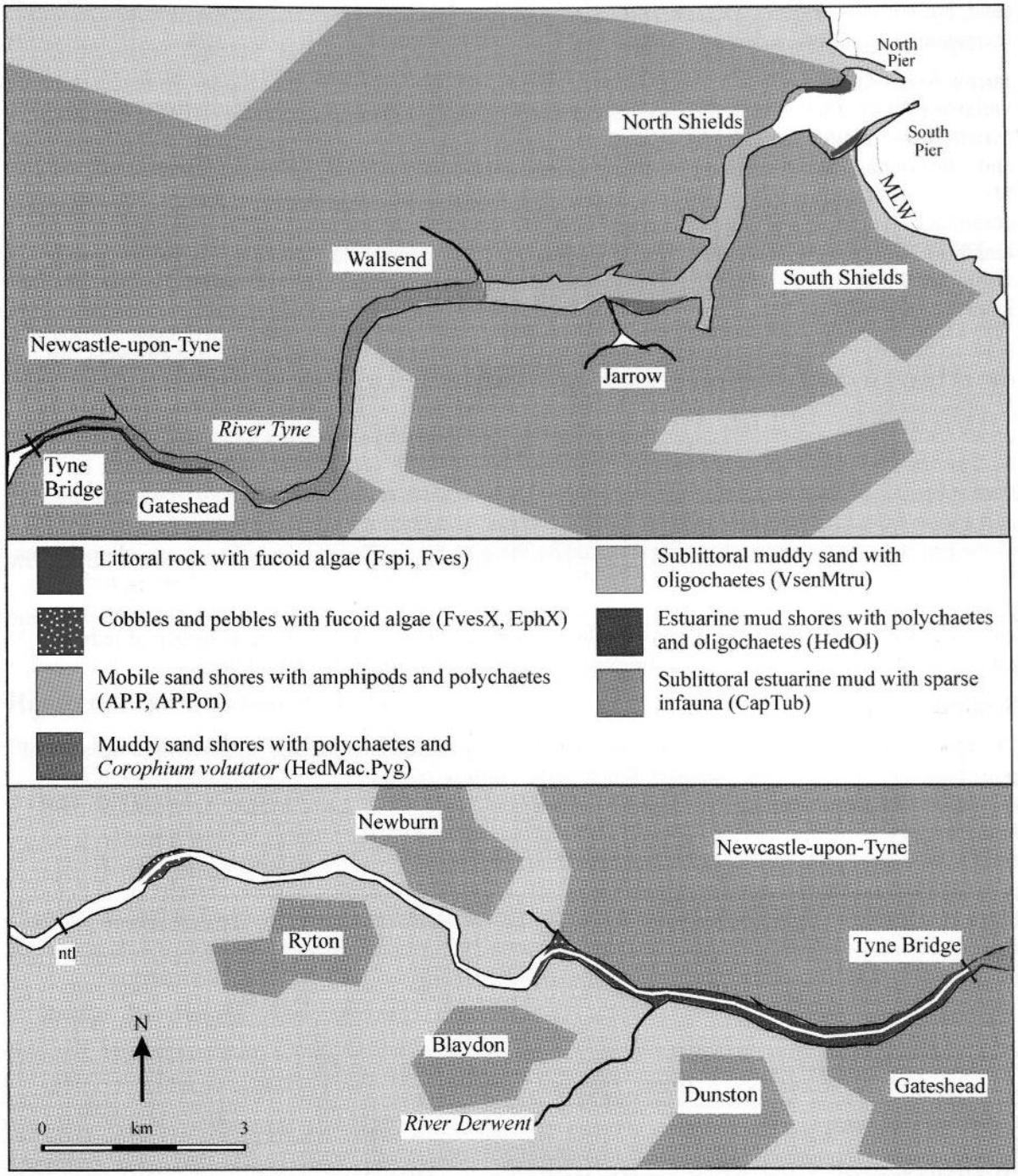

Figure 18.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 18.1, and additional field observations and cited literature).

sand, but with the bivalves *Angulus tenuis* and *Fabulina fabula* and the sand-eel *Ammodytes tobianus* increasing the infaunal richness.

Jarrow Slake consists of muddy sand characterised by species able to tolerate higher silt levels and a variable salinity, such as the polychaetes *E. longa*, *Pygospio elegans*, *C. capitata* and *Mediomastus fragilis*, oligochaetes *Tubificoides benedii* and *T. pseudogaster*, the amphipod *Corophium volutator*, and a low abundance of bivalves including the common cockle *Cerastoderma edule* and sand gaper *Mya arenaria* (HedMac.Pyg; HedStr). In the more sheltered and anoxic areas of Jarrow Slake the community has a low species richness and is characterised by the polychaete *Hediste diversicolor*, the amphipod *C. volutator* and oligochaete species (HedOl). However, the character and extent of the sediments were substantially altered in Jarrow Slake to accommodate a freight shipping terminal built in 1994.

Anoxic fluid mud is found at the Dunston Coal Staithes and at the confluence with the Derwent just east of Blaydon and the community is particularly impoverished with only the polychaete *H. diversicolor* and the oligochaete *Heterochaeta costatus* recorded in the infauna. Sites towards the upper reaches of the estuary comprise silted cobbles and rubble characterised by algal communities with an impoverished faunal community, interspersed with fluid anoxic mud. The community on the hard substrata is characterised by bladder wrack *Fucus vesiculosus*, green algae *Enteromorpha* spp. and sparse barnacles *Semibalanus balanoides* upstream to Newburn (FvesX). Within the same stretch of the estuary, the anoxic mud is characterised by the polychaete *Hediste diversicolor* and oligochaetes *Heterochaeta costatus*, *Tubificoides benedii*, *T. pseudogaster* and enchytraeid oligochaetes, with few other species present (HedOl). At Ryton Island the cobble banks are covered by the opportunistic green algae *Enteromorpha* spp. and have a low species diversity, reflecting the influence of reduced salinity (EphX). The brackish-water bryozoan *Conopeum seurati* is also found here.

Sublittoral

The species richness of the sublittoral mud sampled in the mid-estuary is low, consisting of occasional polychaetes *Ophryotrocha hartmanni*, *Malacoceros fuliginosus* and *Capitella capitata* and oligochaetes *Tubificoides benedii*, *T. pseudogaster* and *T. swirencoides* (CapTub; AphTub). In the lower estuary, a greater diversity of polychaetes *Eteone longa*, *O. hartmanni*, *Scoloplos armiger*, *Chaetozone setosa*, *Capitella capitata* and *Mediomastus fragilis* and oligochaetes *T. benedii*, *T. pseudogaster* and *T. swirencoides* are recorded (CapTub). It is here also that the community is rich in bivalves such as mussels *Mytilus edulis*, horse mussels *Modiolus modiolus*, *Abra alba*, smooth artemis *Dosinia lupinus*, the pullet carpet shell *Venerupis senegalensis*, striped venus *Chamelea gallina* and sand gaper *Mya arenaria*, particularly at Lloyd's Hailing adjacent to Mussel Scarp (VsenMtru).

Nature conservation

Conservation sites

Site name	*Designation*	*Centre grid ref.*	*Main features*
Close House Riverside	SSSI, WT	NZ 130 652	Flora
Tyne Riverside	CP	NZ 160 656	Recreation

Human influences

Coastal developments and uses

The Tyne estuary has more than 27 km of port facilities, harbour walls and coastal protection walls. The mouth of the estuary is sheltered by two piers. The estuary is canalised upstream of Mussel Scarp and, with the exception of Jarrow Slake, the littoral areas are restricted to small cobble banks beneath walls and piles. The remaining area of muddy sand at Jarrow Slake has been in-filled to build a shipping terminal, leaving a littoral width of just a few metres. The loss of littoral habitat as a result of developments has reduced the nature conservation value of the Tyne estuary considerably.

Shipping

The docks on the Tyne are very active with 8.5 million tonnes of shipping using the estuary in 1990 (Lloyds of London 1990). The estuary has been dredged from the mouth 18 km upstream to the bridges, although most of the dredging was in the lower 8 km where the majority of the vessels operated. In addition to the substantial port facilities, on both sides of the estuary there are numerous marinas and moorings for small vessels. where cargo is loaded and where ships undergo refits.

Pollution

During the surveys considerable amounts of domestic litter and debris lined the shores of the estuary, and at many sites there was evidence of oil pollution. Despite recent efforts to improve the water quality of the Tyne estuary, during times of low water flow levels of nutrient can be high due to inflows of sewage both into the River Tyne and into the estuary and its tributaries. The poor quality of water from the Derwent River is likely to reduce the species richness through toxic and smothering effects. The National Rivers Authority have graded the water quality of the upper reaches of the Tyne estuary as grade A, but grade D at the confluence of the Derwent River at Blaydon. The water quality improved downstream through grades C and B to become grade A at the mouth of the estuary.

Recreation

Windsurfing and sailing takes place at the mouth of the estuary in the shelter of the piers. Intertidal areas in the lower estuary have been subject to bait-digging and peeler crab collecting. The upper estuary upstream of Newburn is undeveloped and largely unspoilt and is used for water-skiing and other water sports.

References and further reading

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Survey sites

Surveys

314: MNCR littoral survey of the estuaries of south-east Scotland and north-east England, 1992 (Brazier & Murray 1994).

316: Infaunal grab and core sampling of the estuaries of north-east England by the National Rivers Authority, 1992. Unpublished data.

317: Littoral survey carried out by the Dove Marine Laboratory, Tyne and Wear during 1991 (Evans *et al.* 1994).

Littoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
314	28	South Pier.	NZ 375 680	55°00.3'N 01°24.8'W	Eph; Fves; Rho; Fser.Fser.Bo; Ldig.Ldig.Bo
314	29	Herd Sands.	NZ 371 680	55°00.3'N 01°25.1'W	Rho; AP.P
314	30	Prior's Haven.	NZ 375 691	55°00.9'N 01°24.8'W	Fspi; Asc.Asc; Rho; FK; AP.Pon; Lan
314	31	Mussel Scarp.	NZ 365 685	55°00.5'N 01°25.7'W	Rho; AP; AP.Pon; MacAre
314	32	Jarrow Slake.	NZ 354 637	54°57.9'N 01°26.8'W	HedStr; HedMac.Pyg; HedOl
314	33	Friar's Goose.	NZ 279 633	54°57.8'N 01°33.8'W	HedOl
314	34	Tyneside Bridges.	NZ 250 634	54°57.8'N 01°36.5'W	HedOl
314	35	W of Dunston Staithes.	NZ 233 627	54°57.5'N 01°38.1'W	HedOl
314	36	W of Dunston Coal Staithes.	NZ 225 628	54°57.5'N 01°38.9'W	HedOl
314	37	Derwent Haugh.	NZ 206 632	54°57.7'N 01°40.6'W	HedOl
314	38	Allot Gardens, Swalwell.	NZ 202 627	54°57.5'N 01°41.0'W	HedOl
314	39	NE Blaydon Haughs Viaduct.	NZ 199 638	54°58.1'N 01°41.3'W	FvesX
314	40	Under A1 Road Bridge.	NZ 145 639	54°58.1'N 01°46.4'W	HedOl
314	41	Ryton Island.	NZ 147 651	54°58.8'N 01°46.2'W	EphX
317	1	Black Middens.	NZ 366 688	55°00.7'N 01°25.6'W	AP.P; AP.Pon; MacAre

Sublittoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
316	4	Newcastle opposite the quayside.	NZ 263 640	54°58.2'N 01°35.3'W	AphTub
316	6	Willington Gut.	NZ 319 661	54°59.3'N 01°30.0'W	CapTub
316	7	Rohm and Haas.	NZ 324 661	54°59.3'N 01°29.6'W	CapTub
316	8	River Don.	NZ 344 657	54°59.0'N 01°27.7'W	MytV
316	9	Lloyd's Hailing.	NZ 369 688	55°00.7'N 01°25.3'W	VsenMtru

Compiled by: Paul Brazier

19 Wear estuary

Location		
Position (centre)	NZ 390 580	
County/District	Tyne and Wear	Sunderland City
Conservation agency/area	English Nature	Northumbria

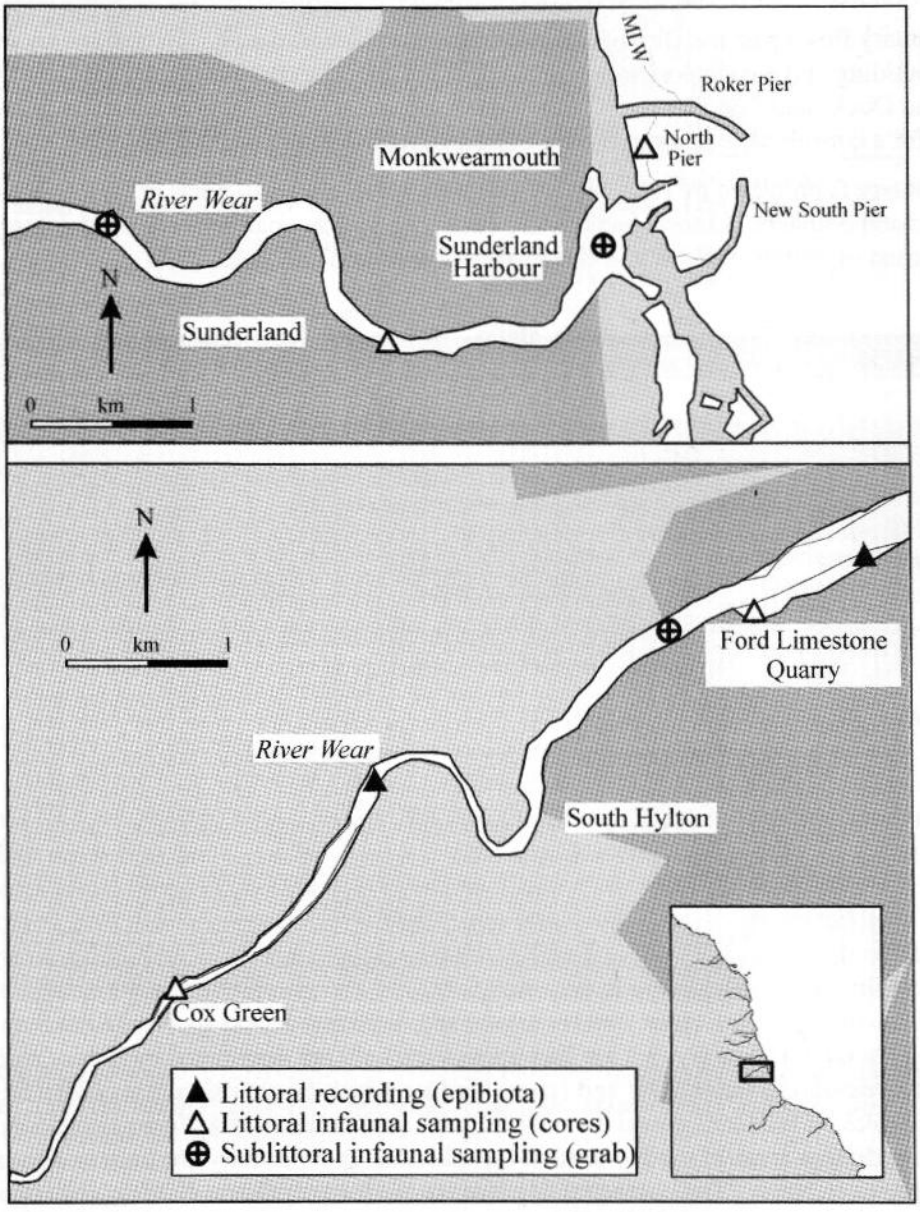

Figure 19.1 Location of area showing sites surveyed and main bathymetric features.

Marine biological surveys				
	Survey methods	*No. of sites*	*Date of survey*	*Source*
Littoral	Recording (epibiota)	2	September 1992	Brazier & Murray (1994)
	Infaunal cores and granulometry	4	September 1992	Brazier & Murray (1994)
Sublittoral	Infaunal grab samples (0.1 m² Day grab) and granulometry	3	June 1992	NRA unpublished data.

Introduction

The Wear estuary flows past the City of Sunderland. The lower estuary has a long history of industrial use in ship-building and coal export which resulted in 5 km of the channel being canalised by the walls of Sunderland Docks and flood defence walls. The Tyne and Wear Development Corporation is responsible for a considerable amount of non-industrial redevelopment along the riverside.

The lower estuary is protected by two piers, adjacent to which are small areas of moderately wave-exposed sand and boulders. Littoral habitats are otherwise scarce, apart from the mid-estuary where the banks consist of muddy cobbles and small areas of soft mud and sand.

Physical features	
Physiographic type	Complex estuary
Length of coast	36 km
Size of inlet	200 ha
Length of tidal channel	17.0 km
Bathymetry	Partially dredged to 5 m in lower estuary
Wave exposure range	Moderately exposed to extremely sheltered
Tidal stream range	Moderately strong to negligible
Tidal range	4.3 m (springs), 2.2 m (neaps)
Salinity range	Fully marine to low

Marine biology

Littoral

The sediment at the northern end of Roker Beach is poorly sorted sand with robust polychaetes *Paraonis fulgens*, *Scolelepis squamata* and *Spio martinensis* (AP.Pon). The lower shore rocky communities associated with the pier and boulder sea defences are predominantly characterised by the sand-binding filamentous red algae *Audouinella* spp. (Rho), while in the mid eulittoral, bladder wrack *Fucus vesiculosus* dominates with a low diversity of species typical of variable salinity, rocky habitats (Fves). Silted cobbles in the mid- and upper estuary support communities characterised by bladder wrack *F. vesiculosus* and green algae *Enteromorpha* spp. with few faunal species (BPat.Sem). Some pontoon pilings in the mid-estuary that are less impacted by silt are dominated by barnacles *Elminius modestus* and *Semibalanus balanoides* and sparse bladder wrack *Fucus vesiculosus* (BPat.Sem). The upper shore cobbles on mud and gravel are covered with the bladder wrack *Fucus vesiculosus* (FvesX). The sediment areas of muddy sand in the mid- and upper estuary are fluid and anoxic which reduces the species richness. The characterising species are the polychaete *Hediste diversicolor*, the amphipod *Corophium volutator* and oligochaete species *Heterochaeta costatus*, *Tubificoides benedii* and *T. pseudogaster* (HedOl). The flat mid-shore near to the Ford Limestone Quarry in the mid-estuary has the additional polychaete species *Pygospio elegans* and *Streblospio shrubsolii,* which are normally found near to estuary mouths or in sheltered bays. The cobbles in the upper estuary are sparsely populated with the green algae *Enteromorpha* spp. with oligochaetes *H. costatus* in the muddy matrix but with few polychaetes or gammarids (EphX).

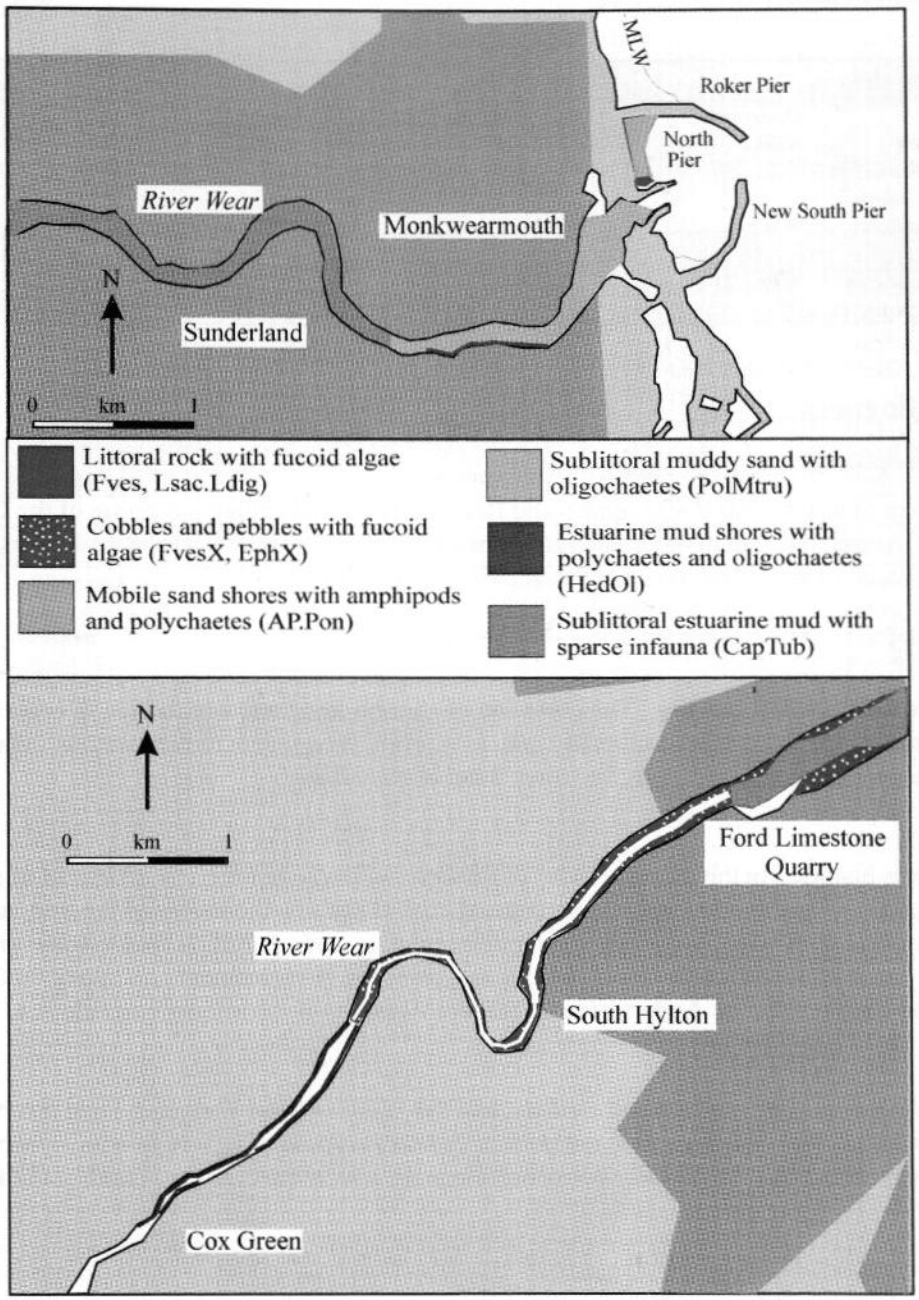

Figure 19.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 19.1, and additional field observations and cited literature).

Sublittoral

The sublittoral site at Hylton Bridge is characterised by the polychaete *Hediste diversicolor* and oligochaete species, particularly *Heterochaeta costatus* (HedOl). An increased diversity in both polychaete and oligochaete species (CapTub) is recorded downstream of Pallion. The most species recorded are at Sandy Point, adjacent to Sunderland Harbour, with high numbers of the polychaetes *Anaitides mucosa*, *Ophryotrocha hartmanni* and *Capitella capitata*, *Tubificoides* spp. and the bivalves *Fabulina fabula* and *Abra alba* (PolMtru).

Nature conservation

Conservation sites

Site name	*Designation*	*Centre grid ref.*	*Main features*
Wear River Bank	SSSI	NZ 360 577	Geology
Claxheugh Rock and Ford Limestone Quarry	SSSI	NZ 363 574	Geology, flora
Washington Wildfowl Park	WWT	NZ 333 561	Ornithology
Timber Beach	WT	NZ 369 584	
James Steel Riverside Park	CP	NZ 325 550	Recreation

Human influences

Coastal developments and uses

The lower 4 km of estuary has docks, quays and flood defence walls along the centre of the City of Sunderland. Upstream of Sunderland, the littoral habitat is more extensive where the banks are formed of boulders instead of walls and are adjacent to pasture and wetland.

Shipping

Ship-building was historically one of the two main industries in the Wear estuary although this has declined since the mid-20th century. The cessation of ship-building and a reduction in coal output has reduced the amount of shipping considerably and, as a result, dredging activities are less intense. The estuary is dredged to a depth of 5 m in the lower 2 km of the estuary.

Pollution

Coal export was historically the major activity of Sunderland docks but there is no export of coal today. Coal particles and residual spoil from disused coal mines line the shores of the mid- and upper estuary. Otherwise there is no major industrial pollution. Domestic pollution, waste water and sewage are known to cause high nutrient levels in the estuary, resulting in enrichment and anoxia in the sediment. The National Rivers Authority rated the water quality of the estuary as grade A to B.

Recreation

The river banks are used by walkers and cyclists, and the Wildfowl and Wetlands Trust reserve adjacent to the estuary is an attraction to the public. A small amount of leisure boating occurs in the mid- and upper estuary and the recently constructed marina now attracts larger vessels into the mouth of the estuary.

References and further reading

Brazier, D.P., & Murray, E. 1994. Littoral survey of the estuaries of south-east Scotland and north-east England. *JNCC Report*, No. 159. (Marine Nature Conservation Review Report, No. MNCR/SR/26.)

Buck, A.L. 1993. *An inventory of UK estuaries. Volume 4. North and east Scotland.* Peterborough, Joint Nature Conservation Committee.

Davidson, N.C., Laffoley, D.d'A., Doody, J.P., Way, L.S., Gordon, J., Key, R., Drake, C.M., Pienkowski, M.W., Mitchell, R., & Duff, K.L. 1991. *Nature conservation and estuaries in Great Britain.* Peterborough, Nature Conservancy Council.

Lloyds of London. 1990. *Annual summary of merchant ships.* London, Lloyds Register of Shipping.

Survey sites

Surveys

314: MNCR littoral survey of the estuaries of south-east Scotland and north-east England, 1992 (Brazier & Murray 1994).

316: Infaunal grab and core sampling of the estuaries of north-east England by the National Rivers Authority, 1992. Unpublished data.

Littoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
314	43	Roker Beach.	NZ 409 585	54°55.1'N 01°21.7'W	Fves; Rho; Lsac.Ldig; AP.Pon
314	44	Wearmouth Bridge.	NZ 396 574	54°54.5'N 01°22.9'W	HedOl
314	45	S of Weardale Way.	NZ 365 578	54°54.8'N 01°25.8'W	FvesX
314	46	Below Ford Limestone Quarry.	NZ 361 576	54°54.7'N 01°26.2'W	BPat.Sem; HedOl
314	47	Low Barmston Farm.	NZ 339 567	54°54.2'N 01°28.2'W	EphX
314	48	Cox Green.	NZ 326 553	54°53.4'N 01°29.5'W	HedOl

Sublittoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
316	10	Hylton Bridge.	NZ 348 563	54°54.0'N 01°27.4'W	HedOl
316	11	Pallion.	NZ 375 582	54°55.0'N 01°24.8'W	CapTub
316	12	Sandy Point.	NZ 406 577	54°54.7'N 01°22.0'W	PolMtru

Compiled by: Paul Brazier

20 Tees Bay

Location

Position (centre/limits)	NZ 578 298	NZ 533 336 - NZ 680 220
County/District	Cleveland	Hartlepool, Langbaurgh
Conservation agency/region	English Nature	Northumbria

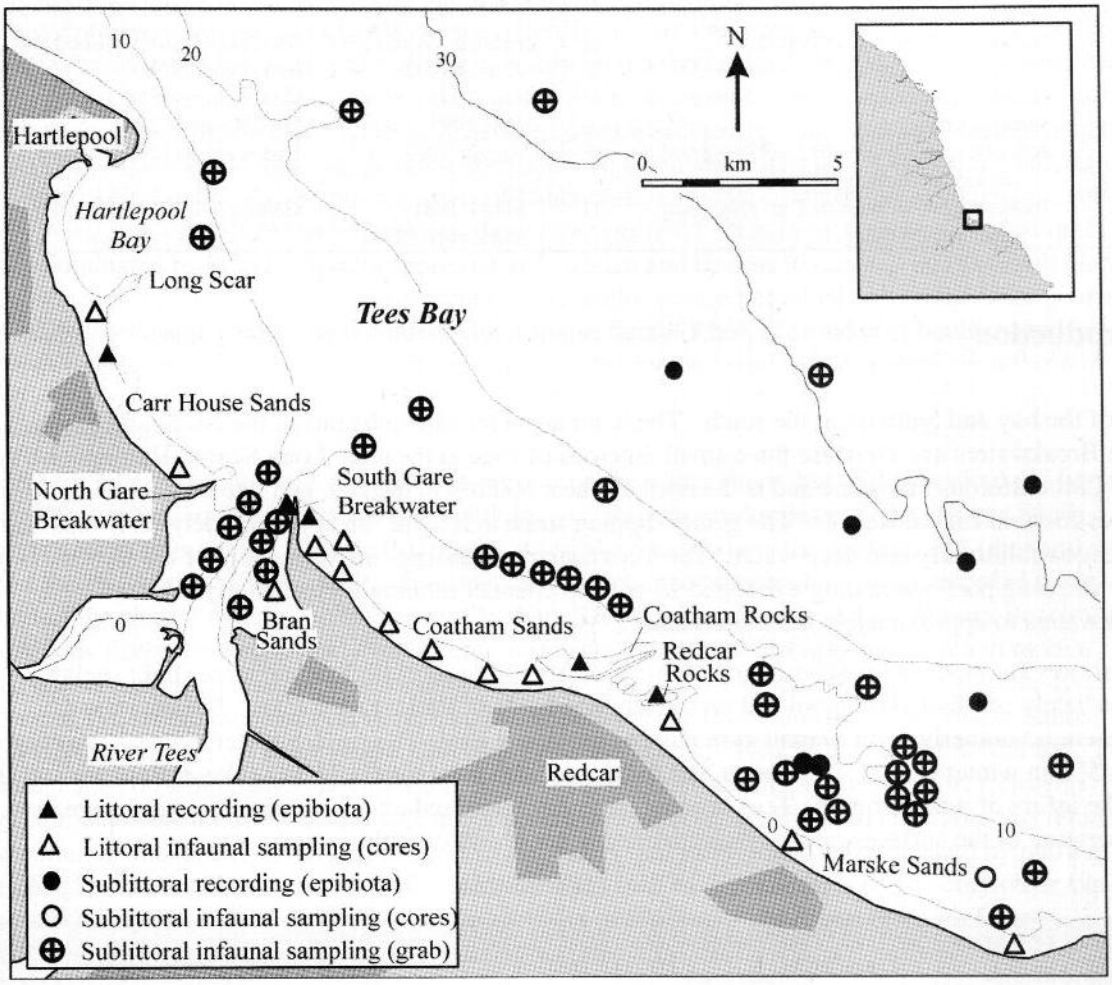

Figure 20.1 Location of area showing sites surveyed and main bathymetric features.

Marine biological surveys				
	Survey method	*No. of sites*	*Date of survey*	*Source*
Littoral	Recording (epibiota)	1	September 1992	Brazier & Murray (1994)
	Recording (epibiota)	4	August 1993	MNCR survey 397
	Infaunal cores and granulometry	1	September 1992	Brazier & Murray (1994)
	Infaunal cores and granulometry	7	August 1993	MNCR survey 397
	Infaunal grab samples (0.1 m² Day grab) and granulometry	5	March 1981-September 1990	Shillabeer (1991)
Sublittoral	Infaunal grab samples (0.1 m² Day grab) and granulometry	7	October 1991	Tapp *et al.* (1992)
	Infaunal cores and granulometry	2	February-April 1992	NRA survey (unpublished data)
	Recording (epibiota)	2	August 1992	Johnston (1992)
	Recording (epibiota)	5	June 1993	MNCR survey 398
	Infaunal cores	1	June 1993	MNCR survey 398
	Infaunal grab samples (0.1 m² Day grab) and granulometry	2	August 1993	Turner *et al.* (1993)
	Infaunal grab samples (0.1 m² Day grab) and granulometry	71	March 1981-September 1990	Shillabeer 1991

Introduction

Tees Bay is predominantly sandy, bordered by an extensive bedrock platform at Hartlepool at the north end of the bay and Saltburn at the south. There are artificial hard substrata at the North and South Gare Breakwaters and there are three small outcrops of rock in the area: Long Scar in Hartlepool Bay is of Carboniferous limestone and is the northernmost outcrop in the bay, and two bedrock outcrops of Lower Jurassic Lias at Redcar. The gently dipping strata at Redcar run approximately east-west, and continue sublittorally into deep water. The Tees estuary discharges into the centre of the bay and is a busy shipping port, warranting a dredged 15 m deep channel running north-easterly between the breakwaters to approximately 4.5 km offshore.

The shores are moderately exposed to wave action from the east, with local areas of slight shelter immediately south of Hartlepool and on the landward side of Redcar rock scars. The net flow of sediment is southerly, with a small gyre within Hartlepool Bay. The surface water temperature ranges from 5°C in winter to 12°C in summer and the mean surface salinity is 34.3‰ (Lee & Ramster 1981), but the influx of water from the Tees estuary causes localised reduction in salinity and a change in temperature of the surface waters. It also increases the turbidity of the water.

Physical features	
Physiographic type	Open coast
Length of coast	30 km
Bathymetry	Gradual slope with 50 m depth at 15 km offshore
Wave exposure range	Moderately exposed to the east
Tidal stream range	Weak to negligible
Tidal range	4.6 m (springs), 2.3 m (neaps)
Salinity range	Fully marine with slight influence from the Tees estuary

Marine biology

Littoral

Within Tees Bay the diversity of littoral habitats is low, largely owing to the small amount of extensive bedrock outcrops. The preponderance of extensive mussel beds on the rock outcrops also means that the diversity of littoral hard substrata biotopes is limited. All of the bedrock outcrops are dominated in the upper and mid-shore by flat, dense beds of mussels *Mytilus edulis* (MytFves; MytFR). Large amounts of sediment are bound in the mussel beds. The mussels *M. edulis* are mostly covered by the

opportunistic green algae *Enteromorpha* spp. but at Redcar Rocks the red algae *Porphyra* spp. covers the mussels in some areas. The presence of mussel beds, algae *Enteromorpha* spp. and *Porphyra* spp. suggests organic enrichment or reduced salinity at these sites. A greater diversity of shore biotopes is recorded on either side of the South Gare Breakwater where the substrata of concrete and boulders provide gradients of varying height and exposure. The upper eulittoral is characterised by the barnacle *Semibalanus balanoides* which dominates the boulders and concrete (BPat.Sem). This biotope often extends into the mid and lower eulittoral, although patches of bladder wrack *Fucus vesiculosus* are present on both sides of the breakwater.

Extensive tracts of boulders on the mid and lower shore are covered by opportunistic algal species such as *Enteromorpha* spp. and *Porphyra* spp. (EphX), and on the lower shore the sediment-binding red alga *Audouinella* spp. is also present, particularly on the west (estuarine) side (Rho). The serrated wrack *Fucus serratus* (Fser.Fser) is recorded on the lower shore on the south side of the South Gare Breakwater, where boulders are relatively sheltered from wave action, and it is also present in a narrow band on Coatham Rocks, Redcar. Shallow rockpools on Coatham Rocks are mostly sandy and scoured with sugar kelp *Laminaria saccharina*, sparse filamentous red algae, common periwinkles *Littorina littorea* and small shoals of sand-eels *Ammodytes tobianus* (FK). A narrow zone of the sublittoral fringe dominated by kelp *L. digitata* is present at Coatham and Redcar Rocks and on the South Gare Breakwater (Ldig.Ldig). The sublittoral fringe is generally scoured or silted, with kelp *L. saccharina* and *Audouinella* spp. frequently recorded with a sparse fauna (Rho). The sides of boulders and bedrock overhangs in the sublittoral fringe are dominated by the breadcrumb sponge *Halichondria panicea*, barnacles *Semibalanus balanoides*, purse sponge *Grantia compressa* and the hydroid *Dynamena pumila*.

Poorly sorted sand, gravel and shell is often present on the upper shore, but with a particularly barren fauna (Tal) at Seaton Sands, Redcar and Saltburn. Amphipods predominate at Carr House Sands, Seaton Sands, adjacent to Coatham Rocks and at Marske Sands where the medium and fine sand is better sorted (AEur; AP.Pon; AP.P). In some cases, a few other species have been recorded for the full extent of the shore. At Carr House Sands, Coatham Sands, Redcar Sands and at Saltburn Beach the amphipods *Bathyporeia* spp. and *Pontocrates arenarius*, the isopod *Eurydice pulchra* and mobile polychaetes such as *Scolelepis squamata* and *Paraonis fulgens* are recorded. The polychaete diversity is greater still where the sands are more stable, for example the lower shores at Carr House Sands, inside the breakwaters at Bran Sands, Coatham Sands, adjacent to Redcar Rocks and at Marske. Two muddier sites on Bran Sands are characterised by the polychaetes *Hediste diversicolor*, *Capitella capitata*, oligochaetes *Tubificoides* spp. and a few bivalve species such as thin tellin *Angulus tenuis* and common cockle *Cerastoderma edule,* and it is likely that these areas are influenced by nutrient-enriched, variable salinity water (HedOl; HedMac.Pyg) (see 21. Tees estuary). The only other site where significant numbers of bivalves are recorded is immediately south-east of South Gare Breakwater where thin tellin *A. tenuis* is abundant in wet areas (AP.Pon).

Sublittoral

Sublittoral hard substratum is very scarce in Tees Bay. The only outcrops of rock are patches of shelving bedrock and of boulders and cobbles at Longscar, which extend into Hartlepool Bay, and to the east of West Scar at Redcar. Poor visibility conditions mean that study of inshore bedrock has not been possible. Circalittoral silted bedrock and boulders between 17 m and 33 m depth are recorded with a sparse turf of hydroids and bryozoans (Flu.Flu). The characterising species on bedrock are dead-man's fingers *Alcyonium digitatum*, hydroids *Nemertesia antennina* and *Abietinaria abietina*, dahlia anemones *Urticina felina*, peacock worms *Sabella pavonina*, tubeworms *Pomatoceros triqueter*, piddocks *Hiatella arctica* and *Zirfaea crispata*, hornwrack *Flustra foliacea*, featherstars *Antedon bifida*, crevice brittlestars *Ophiopholis aculeata*, urchins *Psammechinus miliaris* and gas mantle ascidians *Corella parallelogramma*. The pitting of the soft rock by piddocks provides protection for the echinoderm species and solitary ascidians (AlcByH.Hia). Shipping wreckage in Tees Bay is not uncommon and provides a substratum clear of the sand-scour of the sea bed and is exposed to the tidal

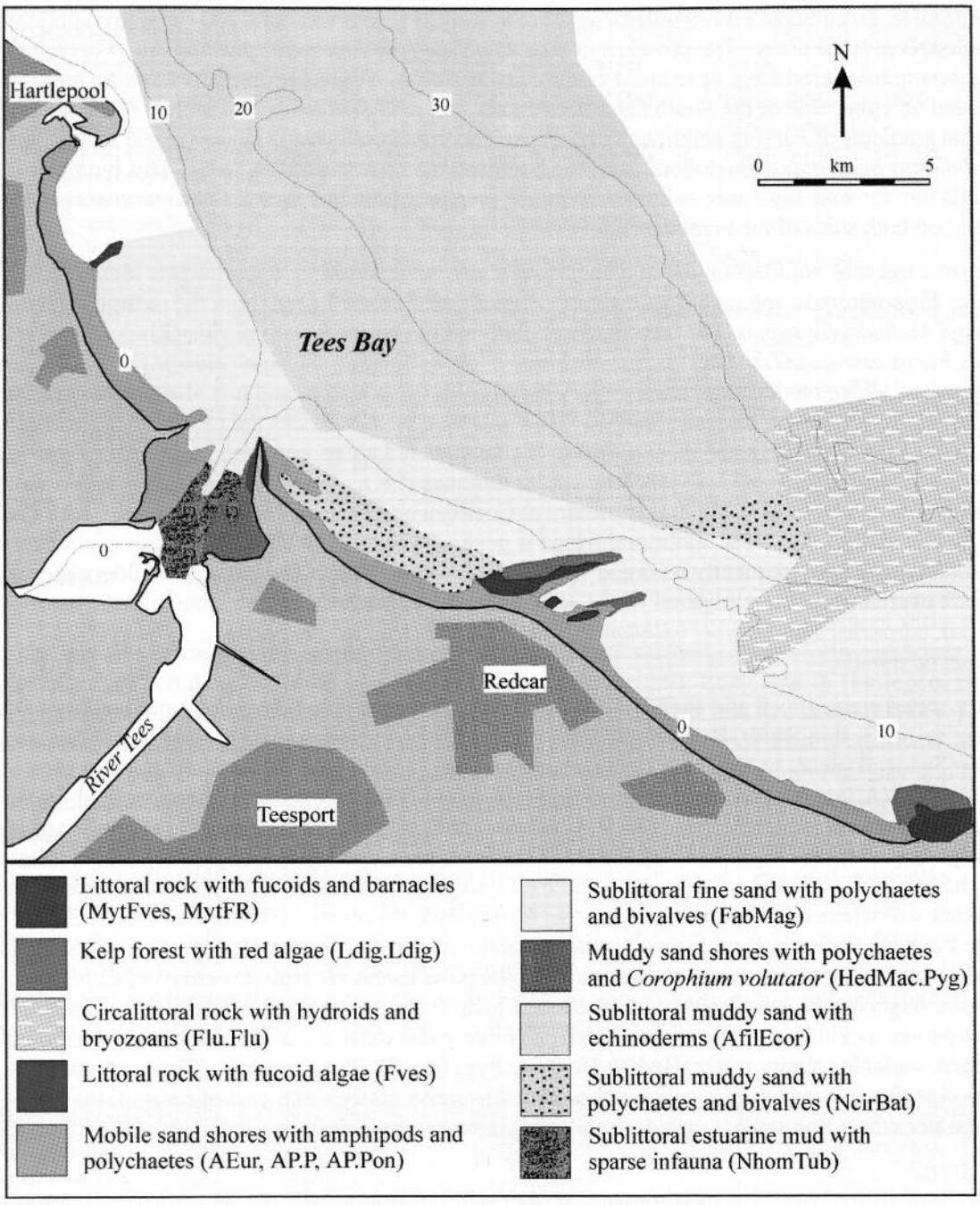

Figure 20.2 Indicative distribution of the biotopes within the area (based on data from survey sites shown in Figure 20.1 and additional field observations).

streams. Here a turf of the hydroid *Tubularia indivisa* and dead-man's fingers *A. digitatum*, bryozoans *F. foliacea* and *Securiflustra securifrons* and the gas mantle ascidian *C. parallelogramma* can be found (AlcTub).

Of particular interest is the presence of the featherstar *Antedon bifida* at six sites north east of Redcar, at a concentration and abundance that is not equalled elsewhere in Sector 5. There are only a few records of this species in Sector 5, along the Northumberland coast and at the Farne Islands.

Inshore sand with the polychaetes *Nephtys* spp., *Spiophanes bombyx*, *Magelona mirabilis*, *Chaetozone setosa*, amphipods *Bathyporeia* spp., bivalves *Phaxas pellucidus*, *Fabulina fabula* and *Chamelea gallina* is largely recorded offshore to a depth of 22 m, south-east of Redcar, although this biotopes is predominantly found between sea level and a depth of 14 m (FabMag). At the mouth of the Tees estuary and north of Redcar, most sites are of muddy sand with a less diverse community than inshore sand or offshore muddy gravel habitats (NcirBat). A similar suite of polychaetes to that in the inshore sand sites is found, but crustacean and bivalve species are less frequently recorded, with the exception of the crustacean *Diastylis bradyi* which is more abundant. Between the breakwaters of the Tees estuary, muddy fine sand is characterised by fewer polychaete species and the oligochaete *Tubificoides benedii* (NhomTub). Offshore from Hartlepool Point and offshore at Redcar, infaunal records indicate that four sites have a greater species richness than inshore. Polychaete species recorded in addition to those inshore are *Mediomastus fragilis* and *Owenia fusiformis*, with high abundance of the bivalves *Nucula nitidosa*, *Phaxas pellucidus*, *Fabulina fabula*, *Gari fervensis*, *Abra alba*, *Chamelea gallina*, brittlestars *Amphiura* spp. and *Ophiura* spp. and the heart urchin *Echinocardium cordatum* (AbrNucCor).

Nature conservation

Conservation sites

Site name	*Designation*	*Centre grid ref.*	*Main features*
Hartlepool Submerged Forest	SSSI	NZ 520 315	Geology
Seaton Dunes and Common	SSSI	NZ 535 285	Flora, invertebrates, ornithology
Teesmouth (North Gare and Seal Sands)	NNR	NZ 540 275 & NZ 530 260	Ornithology
Seal Sands	NNR, SSSI	NZ 529 260	Ornithology
Cowpen Marsh	SSSI, WT	NZ 500 259	Ornithology
South Gare and Coatham Sands	SSSI, WT	NZ 547 262	Flora, invertebrates, ornithology
Redcar Rocks	SSSI	NZ 605 253	Geology, ornithology
Teesmouth & Cleveland Coast	Ramsar, SPA	NZ 535 265	Ornithology

Human influences

Shipping

As a major port and industrial estuary the Tees has been a busy shipping route for many decades. During the period April 1992 to March 1993, 5,477 ships and 503 ships arrived at Tees and Hartlepool respectively. Approximately half of the shipping in the Tees is tankers, the remainder being ferries, dry bulk carriers and container ships. Hartlepool docks handle only dry bulk cargoes (P.J. Lewis, Tees and Hartlepool Port Authority, pers. comm.).

From South Gare Breakwater to 4.5 km north-east of the mouth to the Tees, the estuary is dredged to 15.4 m below chart datum . The dredgings are dumped 6.5 km north-east of Redcar in designated areas. The remnants of three slag dump sites, from steel works in the last century, can still be seen as sandbanks immediately south of the South Gare Breakwater.

Pollution

The flux of chemical and domestic waste from the Tees estuary has been reduced considerably over the last two decades although Greenpeace still rate the Tees estuary as one of the most polluted estuaries in the UK (see 21. Tees estuary).

Untreated sewage outfalls operate at Saltburn and, throughout the bay, screened storm overflows permit the rapid drainage of rainwater when necessary. The steel works at Redcar require cooling water which is discharged just below low water at Coatham Sands, adjacent to the previously

mentioned slag dump sites (NRA). This outfall has been seen to be of interest to herring gulls, suggesting a readily available supply of food for the birds. Litter and debris is a problem along the strandline immediately north and south of Hartlepool (pers. obs.).

Recreation

All of the sandy beaches are popular summer resorts, with a developed frontage at Seaton Carew, Redcar and Saltburn providing for the large population around Tees Bay and for visitors from further afield. Within the piers of the estuary, outside of shipping lanes, dinghy sailing and windsurfing is popular, largely from the South Gare Breakwater Club and the marina at Hartlepool.

Oil and gas

An oil pipeline runs from Seaton Sands approximately north-east, and a more recently constructed gas pipeline runs from Coatham Sands parallel with the oil line. Trawling or anchoring is not permitted in the vicinity of either of the pipelines.

Fisheries

Owing to the lack of hard sublittoral substrata, there is little potting for crabs or lobsters. The low reef extending north-east from Redcar has some potting inshore and up to the 3-mile limit offshore. Some salmon drift-netting occurs off the point at Hartlepool, but the high degree of shipping within Tees Bay restricts the areas in which static fishing is possible. Trawling activities are also hampered by the regulations governing anchoring or trawling near oil and gas pipelines. Some small-scale shore collection of mussels *Mytilus edulis*, common periwinkles *Littorina littorea*, edible crabs *Cancer pagurus* and lobsters *Homarus gammarus* has occurred at Hartlepool and at Redcar. Bait-digging is widespread at Carr Sands, Bran Sands, inside the estuary mouth and Coatham Sands. Anglers sailing from the South Gare Breakwater marina fish the low reef out from Redcar and offshore from Saltburn.

References and further reading

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Survey sites

Surveys

314: MNCR littoral survey of the estuaries of south-east Scotland and north-east England, 1992 (Brazier & Murray 1994).
315: Grab sampling survey, ICI 1991 (Tapp *et al.* 1992).
316: Infaunal grab and core sampling of the estuaries of north-east England by the National Rivers Authority 1992. Unpublished data.
319: Grab sampling survey, ICI 1981 (Shillabeer 1991).
356: Sublittoral survey, Analytical and Environmental Services 1992 (Johnston 1992).
397: MNCR littoral survey from Newbiggin to Saltburn, 1993.
398: MNCR sublittoral survey from Newbiggin to Saltburn, 1993.
461: Grab sampling survey of north-east England, Analytical and Environmental Services 1993 (Turner *et al.* 1993).

Littoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
314	50	South Gare Breakwater, Tees Estuary.	NZ 558 282	54°38.7'N 01°08.1'W	BPat.Sem; Fves; Rho; EphX
314	51	Bran Sands, Tees Estuary.	NZ 553 265	54°37.8'N 01°08.5'W	AP.P; HedMac.Pyg; HedOl
319	110	Redcar Beach, Station 4/17.	NZ 558 276	54°38.4'N 01°08.1'W	AP; NcirBat
319	111	Redcar Beach, Station 4/16.	NZ 563 276	54°38.4'N 01°07.6'W	AP.Pon
319	112	Redcar Beach, Station 4/15.	NZ 578 262	54°37.6'N 01°06.2'W	AP.P; NcirBat
319	113	Redcar Beach, Station 4/14.	NZ 590 257	54°37.3'N 01°05.1'W	AP.P; NcirBat
319	114	Redcar Beach, Station 4/13.	NZ 598 257	54°37.3'N 01°04.4'W	AP.P; NcirBat
397	32	Carr House Sands, Hartlepool.	NZ 525 305	54°40.0'N 01°11.1'W	AP.P; AP.Pon
397	33	Little Scar, Hartlepool.	NZ 527 305	54°40.0'N 01°10.9'W	MytFR
397	34	Seaton Sands, Hartlepool.	NZ 537 287	54°39.0'N 01°10.0'W	AEur; AP.Pon
397	35	S of South Gare Breakwater, Redcar.	NZ 557 281	54°38.6'N 01°08.2'W	Ent; EntPor; BPat.Sem; Fves; Fser; Fser.R; Fser.Fser; G; SByAs; Ldig
397	36	E of South Gare Breakwater, Redcar.	NZ 558 276	54°38.4'N 01°08.1'W	Tal; AP.P; AP.Pon
397	37	The Hampstead, Redcar.	NZ 598 256	54°37.3'N 01°04.4'W	AP.P; AP.Pon
397	38	Coatham Rocks, Redcar.	NZ 605 258	54°37.4'N 01°03.7'W	EntPor; MytFves; Fser.Fser; MytFR; FK; Ldig.Ldig.Bo
397	39	Redcar Rocks.	NZ 615 254	54°37.1'N 01°02.8'W	MytFves; MytFR; Ldig.Ldig
397	40	S of Redcar Rocks.	NZ 618 248	54°36.8'N 01°02.5'W	AP.P; AP.Pon
397	41	Marske Sands, Saltburn.	NZ 642 229	54°35.8'N 01°00.3'W	AP.Pon
397	42	Saltburn Beach.	NZ 665 220	54°35.3'N 00°58.2'W	AEur; AP.P; AP.Pon

Sublittoral sites

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
315	21	Tees Estuary, site 2/1.	NZ 547 282	54°38.7'N 01°09.1'W	AbrNucCor
315	22	Tees Estuary, site 2/2.	NZ 554 283	54°38.8'N 01°08.4'W	AbrNucCor
315	23	Tees Estuary, site 2/3.	NZ 547 276	54°38.4'N 01°09.1'W	Ncir
315	24	Tees Estuary, site 2/4.	NZ 553 276	54°38.4'N 01°08.5'W	CapTub
315	31	Tees Estuary, site 3/1.	NZ 547 273	54°38.2'N 01°09.1'W	NhomTub
315	32	Tees Estuary, site 3/2.	NZ 553 272	54°38.2'N 01°08.5'W	NhomTub
315	41	Tees Estuary, site 4/1.	NZ 545 268	54°37.9'N 01°09.3'W	NhomTub
316	17	Bran Sands, Tees Estuary.	NZ 547 266	54°37.9'N 01°09.0'W	NhomTub
316	19	No. 5 Buoy, Tees Estuary.	NZ 552 284	54°38.9'N 01°08.6'W	AbrNucCor
319	1	Langbaurgh Outfall, Transect A-B.	NZ 639 243	54°36.5'N 01°00.6'W	EcorEns
319	7	NW of the Heugh, Station 1/1.	NZ 569 342	54°42.0'N 01°07.0'W	FabMag
319	8	NW of the Heugh, Station 1/2.	NZ 569 342	54°42.0'N 01°07.0'W	AfilEcor
319	9	NW of the Heugh, Station 1/3.	NZ 569 342	54°42.0'N 01°07.0'W	FabMag
319	10	SE of Blackhall Rocks, Station 2/1.	NZ 569 342	54°42.0'N 01°07.0'W	FabMag
319	11	SE of Blackhall Rocks, Station 2/2.	NZ 569 342	54°42.0'N 01°07.0'W	FabMag
319	12	SE of Blackhall Rocks, Station 2/3.	NZ 569 342	54°42.0'N 01°07.0'W	FabMag
319	13	Off North Gare, Station 1/1.	NZ 544 320	54°40.8'N 01°09.3'W	FabMag
319	14	Off North Gare, Station 1/2.	NZ 544 320	54°40.8'N 01°09.3'W	AbrNucCor
319	15	N of North Gare, Station 1/3.	NZ 544 320	54°40.8'N 01°09.3'W	FabMag
319	16	SE of the Heugh, Station 2/1.	NZ 546 327	54°41.2'N 01°09.1'W	FabMag
319	17	SE of the Heugh, Station 2/2.	NZ 546 327	54°41.2'N 01°09.1'W	FabMag
319	18	SE of the Heugh, Station 2/3.	NZ 546 327	54°41.2'N 01°09.1'W	FabMag
319	19	NE of South Gare, Station 1/3.	NZ 565 290	54°39.2'N 01°07.3'W	FabMag
319	20	NE of South Gare, Station 1/2.	NZ 565 290	54°39.2'N 01°07.3'W	FabMag
319	21	NE of South Gare, Station 1/1.	NZ 565 290	54°39.2'N 01°07.3'W	FabMag
319	22	E of Seaton Carew, Station 3/1.	NZ 578 298	54°39.6'N 01°06.1'W	AbrNucCor
319	23	E of Seaton Carew, Station 3/2.	NZ 578 298	54°39.6'N 01°06.1'W	AbrNucCor
319	24	E of Seaton Carew, Station 3/3.	NZ 578 298	54°39.6'N 01°06.1'W	AbrNucCor
319	25	E of River Tees entrance, Station 1/1.	NZ 610 283	54°38.8'N 01°03.2'W	FabMag
319	26	E of the River Tees entrance, Station 1/2.	NZ 611 246	54°36.8'N 01°03.2'W	FabMag
319	27	E of River Tees entrance, Station 1/3.	NZ 610 283	54°38.8'N 01°03.2'W	FabMag
319	28	N of West Scar, Station 2/1.	NZ 610 243	54°36.6'N 01°03.3'W	FabMag
319	29	N of West Scar, Station 2/2.	NZ 610 243	54°36.6'N 01°03.3'W	FabMag
319	30	N of West Scar, Station 2/3.	NZ 610 243	54°36.6'N 01°03.3'W	FabMag
319	31	E of Salt Scar.	NZ 587 272	54°38.2'N 01°05.4'W	FabMag
319	32	N of Coatham.	NZ 591 276	54°38.4'N 01°04.9'W	FabMag
319	33	NW of West Scar.	NZ 595 274	54°38.3'N 01°04.6'W	FabMag
319	34	NE of Tod Point.	NZ 600 272	54°38.2'N 01°04.2'W	FabMag
319	35	NE of Coatham.	NZ 604 270	54°38.1'N 01°03.8'W	FabMag
319	36	Saltburn, NW of Huntcliff, Station 1/1.	NZ 682 240	54°36.4'N 00°56.5'W	AbrNucCor
319	37	Saltburn, NW of Huntcliff, Station 1/2.	NZ 682 240	54°36.4'N 00°56.5'W	AbrNucCor
319	38	Saltburn, NW of Huntcliff, Station 1/3.	NZ 682 240	54°36.4'N 00°56.5'W	AbrNucCor
319	39	Saltburn, E of Redcar, Station 2/1.	NZ 658 243	54°36.6'N 00°58.8'W	FabMag
319	40	Saltburn, E of Redcar, Station 2/2.	NZ 658 243	54°36.6'N 00°58.8'W	AbrNucCor
319	41	Saltburn, E of Redcar, Station 2/3.	NZ 658 243	54°36.6'N 00°58.8'W	FabMag
319	42	Saltburn, E of Marske.	NZ 678 229	54°35.8'N 00°57.0'W	FabMag
319	43	Saltburn, N of Skelton Beck.	NZ 667 225	54°35.6'N 00°58.0'W	FabMag
319	44	Saltburn, ESE of Redcar.	NZ 667 225	54°35.6'N 00°58.0'W	FabMag
319	45	Saltburn, N of Skelton.	NZ 669 221	54°35.4'N 00°57.8'W	FabMag
319	46	Saltburn, NNW of Brotton.	NZ 669 219	54°35.3'N 00°57.8'W	FabMag
319	47	SE of Salt Scar, Station 1/2.	NZ 628 252	54°37.1'N 01°01.5'W	FabMag
319	48	SE of Salt Scar, Station 1/6.	NZ 629 248	54°36.9'N 01°01.5'W	FabMag
319	49	Langbaurgh, SE of Salt Scar, Station 1/9.	NZ 640 239	54°36.4'N 01°00.5'W	AbrNucCor
319	50	Langbaurgh, SE of Salt Scar, Station 1/10.	NZ 642 237	54°36.3'N 01°00.2'W	FabMag
319	51	Langbaurgh, SE of Salt Scar, Station 1/12.	NZ 643 236	54°36.2'N 01°00.1'W	FabMag
319	52	Langbaurgh, SE of Salt Scar, Station 1/14.	NZ 643 232	54°36.0'N 01°00.2'W	FabMag
319	53	Langbaurgh, E of Redcar, Station 3/16.	NZ 656 238	54°36.3'N 00°59.0'W	FabMag
319	54	Langbaurgh, E of Redcar, Station 3/14.	NZ 655 243	54°36.6'N 00°59.1'W	FabMag
319	55	Langbaurgh, E of Redcar, Station 3/10.	NZ 654 247	54°36.8'N 00°59.1'W	FabMag
319	56	E of Redcar, Station 3/2.	NZ 646 256	54°37.3'N 00°59.9'W	FabMag
319	57	Langbaurgh, E of Redcar, Station 2/16.	NZ 658 238	54°36.3'N 00°58.8'W	FabMag
319	58	Langbaurgh, E of Redcar Sands, Station 2/14.	NZ 654 239	54°36.4'N 00°59.1'W	FabMag

Sublittoral sites - continued

Survey	*Site*	*Site name*	*Grid reference*	*Latitude & longitude*	*Biotopes present*
319	59	E of Redcar Sands, Station 2/2.	NZ 628 239	54°36.4'N 01°01.6'W	FabMag
319	60	Skinningrove, Station 26/10.	NZ 709 316	54°40.5'N 00°54.0'W	FabMag
319	61	Skinningrove, Station 26/20.	NZ 709 316	54°40.5'N 00°54.0'W	FabMag
319	62	Skinningrove, Station 26/30.	NZ 709 316	54°40.5'N 00°54.0'W	FabMag
319	63	Sandsend, Station 10/10.	NZ 722 324	54°40.9'N 00°52.8'W	NcirBat
319	64	Sandsend, Station 10/20.	NZ 722 324	54°40.9'N 00°52.8'W	NcirBat
319	65	Sandsend, Station 10/30.	NZ 722 324	54°40.9'N 00°52.8'W	NcirBat
319	66	Sandsend, Station 10/40.	NZ 722 324	54°40.9'N 00°52.8'W	NcirBat
319	67	Sandsend, Station 10/50.	NZ 722 324	54°40.9'N 00°52.8'W	NcirBat
319	68	Sandsend, Station 10/60.	NZ 722 324	54°40.9'N 00°52.8'W	NcirBat
319	95	MM dumping ground, Station 1.	NZ 769 512	54°51.0'N 00°48.1'W	AfilEcor
319	96	MM dumping ground, Station 5.	NZ 734 400	54°45.0'N 00°51.4'W	AfilEcor
319	97	MM dumping ground, Station 3.	NZ 782 438	54°47.0'N 00°47.0'W	AfilEcor
319	98	MM dumping ground, Station 7.	NZ 722 474	54°49.0'N 00°52.5'W	AfilEcor
319	99	MM dumping ground, Station 9.	NZ 653 468	54°48.7'N 00°59.0'W	AbrNucCor
319	100	MM dumping ground, Station 11.	NZ 702 437	54°47.0'N 00°54.5'W	AfilEcor
319	101	MM Dumping ground, Station 13.	NZ 656 395	54°44.8'N 00°58.8'W	AbrNucCor
356	2	Langbaurgh Outfall Survey, Transect C-B.	NZ 639 243	54°36.5'N 01°00.6'W	Flu.Flu; EcorEns
356	46	2.5 miles off West Scarr, Hartlepool.	NZ 611 311	54°40.2'N 01°03.1'W	AlcTub; NcirBat
398	47	2 miles off Redcar Sands, Saltburn.	NZ 632 281	54°38.6'N 01°01.1'W	IMS
398	48	Offshore Saltburn Sands.	NZ 670 272	54°38.1'N 00°57.6'W	Flu.Flu
398	49	Inshore Saltburn Sands.	NZ 659 233	54°36.0'N 00°58.7'W	FabMag
398	50	1.5 miles off Saltburn Sands.	NZ 665 252	54°37.0'N 00°58.2'W	AlcByH.Hia; Flu.Flu
398	51	3.5 miles off Marske Sands, Saltburn.	NZ 670 287	54°38.9'N 00°57.6'W	Flu.Flu; IMS
398	8	Offshore Hartlepool.	NZ 593 358	54°42.8'N 01°04.7'W	AfilEcor
461	9	Offshore Redcar.	NZ 644 299	54°39.6'N 01°00.0'W	AfilEcor

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