5. Amphibians and reptiles

Common toad *Bufo bufo*

Key Sites: Saltfleetby - Theddlethorpe NNR (TF 470 910).

Summary Status:

- Wildlife and Countryside Act: Schedule 5, Section 9 (5).
- Habitats Directive: not listed.
- Berne Convention: not listed.
- Red Data Book: not listed.
- Breeding Status in the Humber: Breeding.
- Widespread and common or abundant.

Description

The common toad *Bufo bufo* is a widespread amphibian found throughout Britain although this species is absent from Ireland. They are generally brown, grey or dirty green and have the ability to lighten or darken their skin depending on environmental conditions. Their skin is covered in warts which secrete a toxic substance when the toad is seriously threatened. Like most toad species the common toad has short stubby legs. It therefore moves in a series of short hops rather than the large leaps taken by the common frog (Beebee & Griffiths 2000).

The common toad tends to avoid grazed pasture, improved grassland, arable fields, heathland and moorlands in favour of rough grassland, scrub and open woodland. Large permanent water bodies with a good cover of emergent and submerged vegetation are preferred. Unlike other British amphibian species, they are able to inhabit ponds, which support fish, due to the unpalatability of common toad tadpoles (Beebee & Griffiths 2000).

Common toads feed primarily on ground dwelling arthropods such as ants (family Formicidae), beetles (order Coleoptera), spiders (order Araneae) and earwigs (order Dermaptera), although slower moving items such as earthworms (Class Oligochaeta), and gastropods such as slugs and snails are also taken (Gittins 1987 in Beebee & Griffiths 2000).

Distribution within the Humber

As in many kinds of species survey, the observed distribution of records will reflect differences in recording effort as well as the real distribution of a species. Given the relative abundance of this species there has been little systematic surveying in the Humber area. The data in Table 4 has been compiled by Henry Arnold of the Biological Records Centre at Monks Wood from a number of sources and includes published data as well as records from individual recorders. This indicates the large range of the species in the area but is in no way comprehensive in cover. Recent records are also very scarce.

Table 4 Common toad *Bufo bufo* records for the Humber Region (H.R. Arnold pers. comm. 2002)

Grid Reference	Location	Year	Recorder
TA390190	Easington	1959	Hull Science and Field Naturalists Club
TA180280	Hedon	1959	Hull Science and Field Naturalists Club
TA010290	Kirk Ella	1959	Hull Science and Field Naturalists Club
TA160260	Paull, Nr	1959	Hull Science and Field Naturalists Club
TF400800	Saltfleetby-Theddlethorpe	1960	Lincolnshire Naturalists Trust
TA280100	Grimsby	1961	Personal records*
TF400900	Saltfleetby	1961	Lincolnshire Naturalists Trust
TA09029	Hull	1966	Personal records*
TA000200	Barton-upon-Humber	1968	Personal records*
SE900200	Ferriby	1968	Personal records*
TA000200	Hull	1968	Personal records*
TA310050	Humberston	1968	Personal records*
SE900200	Melton, N Ferriby	1969	Anon.
SE702239	Airmyn	1970	Personal records*
TF400900	Saltfleetby-Theddlethorpe Dunes	1970	Personal records*
TA000200		*c*. 1970	A.S. Cooke - survey
SE900200		*c*. 1970	A.S. Cooke - survey
SE800100		*c*. 1970	A.S. Cooke - survey
TF400900	Saltfleetby-Theddlethorpe Dunes	1972	Personal records*
TA300100	Skeffling	1975	Personal records*
TA028280	Anlaby	1978	Personal records*
TA184288	Hedon	1980	Personal records*
TA040280	Hull, Anlaby Common	1985	M.J.S. Swan - amphibian records
SE737228	Goole Glews Hollow	1987	M.J.S. Swan - amphibian records
SE742283	Howden Marsh	1987	M.J.S. Swan - amphibian records
TA021233	Barton Reed Beds	1989	M.J.S. Swan - amphibian records
TF422998	Donna Nook	1989	M.J.S. Swan - amphibian records
TA130252	Goxhill, Dawson City Clay Pit	1989	M.J.S. Swan - amphibian records
TA240092	Grimsby Freshney Bog	1989	M.J.S. Swan - amphibian records
TA047262	Hessle	1989	M.J.S. Swan - amphibian records
TA045263	Hessle Priory Sidings	1989	M.J.S. Swan - amphibian records
TA080243	New Holland Fairfield Pit	1989	M.J.S. Swan - amphibian records
TF467917	Saltfleetby Nr	1989	M.J.S. Swan - amphibian records
TA320007	Tetney Blow Wells	1989	M.J.S. Swan - amphibian records
SE860180	Burton Stather, Stather Road	1993	Toad Warning Signs List
SE750270	Howden	1993	Toad Warning Signs List
SE970200	Sluice Road	1993	Toad Warning Signs List
TA040280	South Ferriby	1993	Toad Warning Signs List
SE900180	Winterton Beck, Thealby Road	1993	Toad Warning Signs List

* Name and address withheld.

Despite the lack of recent records the common toad is still considered to be widespread and common or abundant throughout the north east of England (Hilton-Brown & Oldham 1991). In the Humber region the population of common toad on the sand dunes and marshes at Saltfleetby- Theddlethorpe NNR (TF4791) is thought to be significant (Swan 1999).

Seasonality

Common toads are known to roam much further from water than the common frog outside the breeding season. They only enter the water for a short period in the spring to breed. The start and end of the breeding migrations vary from year to year and depend largely on temperature and rainfall conditions (Beebee & Griffiths 2000). Common toads are mainly nocturnal and there are peaks of migratory activity in the first few hours after dusk (Gittins 1983 in Beebee & Griffiths 2000).

In Britain, female common toads produce anything between 400 and 5000 eggs with an average of around 1500. These are generally laid among vegetation in deep water in communal spawning areas. Tadpoles emerge from the spawn 10 to 14 days after it has been laid but do not become completely free swimming until several days after this, when the yolk has been fully absorbed. Depending on food, crowding and temperature, common toad tadpoles can take between 8 and 12 weeks to complete development. Toadlets emerging from the pond are less than 10mm long but grow rapidly in their first year but are not fully grown and sexually mature until at least 2 or 3 years after metamorphosis. Immature toads do not regularly return to water and can roam considerable distances (Beebee & Griffiths 2000).

Common toad activity is significantly lower between October and February when they enter hibernation (Arnold 1995).

Historical changes and trends

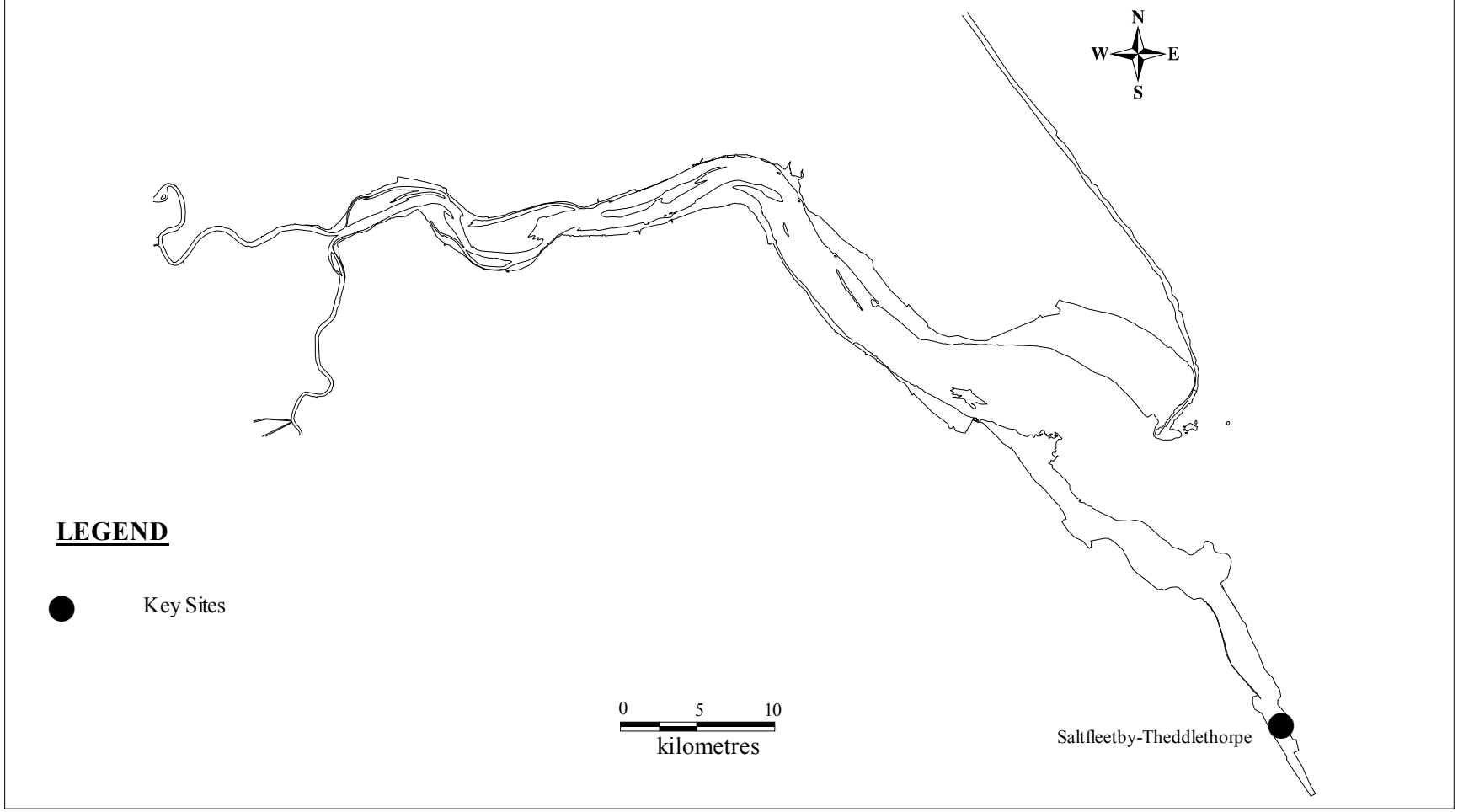
Hilton-Brown & Oldham (1991) stated that the common toad was perceived as widespread and common throughout Britain, although unevenly distributed in the East Midlands, south west England and especially in northern Scotland. There has been little change reported, although the West Midlands, south and south east England are said to have experienced declines (Hilton-Brown & Oldham 1991).

Conservation status

All British amphibians are given some protection by the Wildlife and Countryside Act 1981 (as amended) under Schedule 5 in respect of Section 9(5) only. By a general licence, the sale (transport for sale, possession for sale etc.) of adult specimens of common toads, is permitted except during their breeding season which has been designated 1st February to the 1st May (inclusive).

The common toad is also listed in Appendix III of the Berne convention (Arnold 1995).

Population Distribution of the Common Toad *Bufo bufo.*



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*BEEBEE, T.J.C. & GRIFFITHS, R.A., 2000. *Amphibians and Reptiles - a natural history of the British Herpetofauna*. London: Harper Collins Publishers Ltd.

*HILTON-BROWN, D. & OLDHAM, R.S., 1991. *The Status of the Widespread Amphibians and Reptiles in Britain, 1990, and Changes During the 1980s, Nature Conservancy Council Contract*. Survey No. 131. Peterborough: Nature Conservancy Council.

SWAN, M.J.S., 1999. *Amphibians and Reptile.* Coast and Seas of the UK - Electronic Platform (Phase 1), JNCC.

Natterjack toad *Bufo calamita*

Key Sites: Saltfleetby-Theddlethorpe NNR, Saltfleet Dunes and Donna Nook NNR.

Summary Status:

- Wildlife and Countryside Act: Schedule 5 (as amended).
- Habitats Directive: Annex IV.
- Berne Convention: Appendix II.
- Red Data Book: not listed.
- Breeding Status in the Humber: Breeding at Saltfleetby-Theddlethorpe NNR.
- UK Biodiversity Action Plan priority species.
- Most northerly population of natterjack toad on the east coast of Britain.
- Breeding populations may be genetically isolated in the Humber.

Description

The natterjack toad, *Bufo calamita*, is very similar in appearance to the common toad (*Bufo bufo*) and can be identified easily by a distinctive yellow stripe which runs along the backbone. This species is usually slightly smaller than the common toad, rarely growing to more than 75mm. Background colouration of the upper body ranges from grey-brown to dark olive-green and the throats of males have a blue or purple sheen which is especially distinctive during the breeding season (Beebee & Griffiths 2000).

Like most toads, the natterjack cannot hop like frogs due to its significantly shorter hind limbs (Smith 1951). However, it is generally quite a nimble creature and runs over open ground chasing after prey such as ground beetles (class Carabidae), ants (family Formicidae), and moths (order Lepidoptera). Its short hind limbs are also used for digging burrows in soft sand (Beebee & Griffiths 2000).

Natterjacks have very specific habitat requirements and therefore have a very restricted distribution in the UK. This species is almost exclusively confined to coastal sand dune systems, coastal grazing marshes and sandy lowland heaths although there have been exceptions to this namely in Cumbria (Beebee & Denton 1996). Unlike common toads and frogs, natterjacks will tolerate a low level of salinity (G. Weaver pers. comm. 2002).

On coastal dune sites natterjack toads prefer younger frontal dunes with extensive areas of bare sand although some vegetation cover is needed to provide sufficient shelter and provide suitable habitat for invertebrate prey. Over-fixed dunes make unsuitable hunting areas and encourage habitation by other competing amphibian species (Beebee & Denton 1996).

On dune sites, natterjacks excavate burrows in the sand where they spend most of the day, particularly in the summer. These burrows are also used for hibernation. Although primarily nocturnal, natterjacks can sometimes be seen on sunny mornings particularly around March or early April when they are emerging from hibernation. Later in the year they do not normally appear until dusk when they come out to hunt (Beebee & Griffiths 2000).

Distribution within the Humber

In the Humber Estuary natterjack toads are only found to breed in the sand dunes of Saltfleetby-Theddlethorpe NNR on the Lincolnshire coast. Although this small population is native there has been intensive management to sustain the population. This has included the excavation of artificial ponds, the rearing of spawn in captivity for toadlet release and the clearing of buckthorn and vegetation from ponds (Beebee & Buckley 2001). From here the species appears to have spread naturally to Saltfleet Dunes and the dunes at Donna Nook Nature Reserve, although it is not known whether the species breeds at Donna Nook (UK Biodiversity Steering Group 1999).

Some genetic studies have been undertaken to assess, among other things, whether there is any genetic isolation of Lincolnshire populations, but as of yet a conclusion has not been decided (UK Biodiversity Steering Group 1999).

Seasonality

Natterjack toads enter hibernation late in the year when temperatures regularly drop below freezing. The time of hibernation varies across Britain, but it is usually latest at coastal sites, where it may not occur until November. Natterjacks usually then remain inactive until late February or early March although they may be seen earlier if the weather is mild (Beebee & Griffiths 2000). The natterjacks then emerge in April/May (G. Weaver pers. comm. 2002) and migrate to their breeding ponds.

The breeding season occurs during May and June (G. Weaver pers. comm. 2002) although the timing depends greatly on temperature. Within 5 to 10 days of fertilisation, the embryo is free of the egg, and metamorphosis is usually completed within 6 to 8 weeks (Smith 1951). The development of natterjack eggs and larvae is the fastest of any European amphibian (Beebee & Griffiths 2000). This is thought to be partly because the breeding pools are often temporary and can dry up quickly in the summer before metamorphosis is complete.

New toadlets are approximately 7-9mm long and it is at this stage that the distinctive yellow stripe appears. Growth is rapid after metamorphosis but in Britain the majority of both sexes do not mature until they are 3 years old and are between 50 and 60mm long (Beebee & Griffiths 2000).

Historical changes and trends

Over the past 100 years natterjacks have declined dramatically and only remain in less than a quarter of their former sites. Losses have occurred particularly in the heathlands of southern and eastern England but also in the dunes of north Wales (Beebee & Griffiths 2000).

In Britain, most of the decline in population was due to habitat loss or degradation caused by urban development, scrub encroachment or by changes in grazing pressures. Also, in a few cases, ponds previously used by natterjacks have been badly polluted by acid rain (Beebee & Griffiths 2000).

Excluding translocation sites where populations have been recently re-established, the species can now only be found at four natural sites in Scotland and 35 in England and this

species has become extinct in Wales. Recently, however, it has been introduced by Man to 13 sites, including one in Wales (UK Biodiversity Steering Group 1999).

The specialised habitat requirements of this species deteriorated at Saltfleetby largely as a result of the drastic reduction in rabbits after the myxomatosis outbreak and natterjacks began to decline considerably after the 1950's. By the end of the 1970's the species almost declined to extinction (Smith 1996) and breeding ceased at the Saltfleetby-Theddlethorpe reserve (Beebee & Buckley 2001).

However, due to continuous active management since then, the populations are currently stable and increasing. They are however, still at an unfavourably low level (Farrow & Wright 2000). As there was little successful natural breeding or metamorphosis until the early 1980's (Beebee & Buckley 2001), it is thought that without this management it would be unlikely that the population would have remained sustainable and could have died out (Farrow & Wright 2000).

Farrow & Wright (2000) comment that apart from the specially dug scrapes, there is little natural, suitable habitat left for the population. In general, suitable breeding pools are too few, scrub-free short turf areas for feeding are not extensive enough and common toad populations on natterjack sites are too high, creating too much competition (Farrow & Wright 2000). Common toad tadpoles appear to be able to prevent development of natterjack tadpoles, as well as predating on natterjack spawn and young tadpoles (Beebee 1977 in Arnold 1995). Some of the more widespread species are often common.

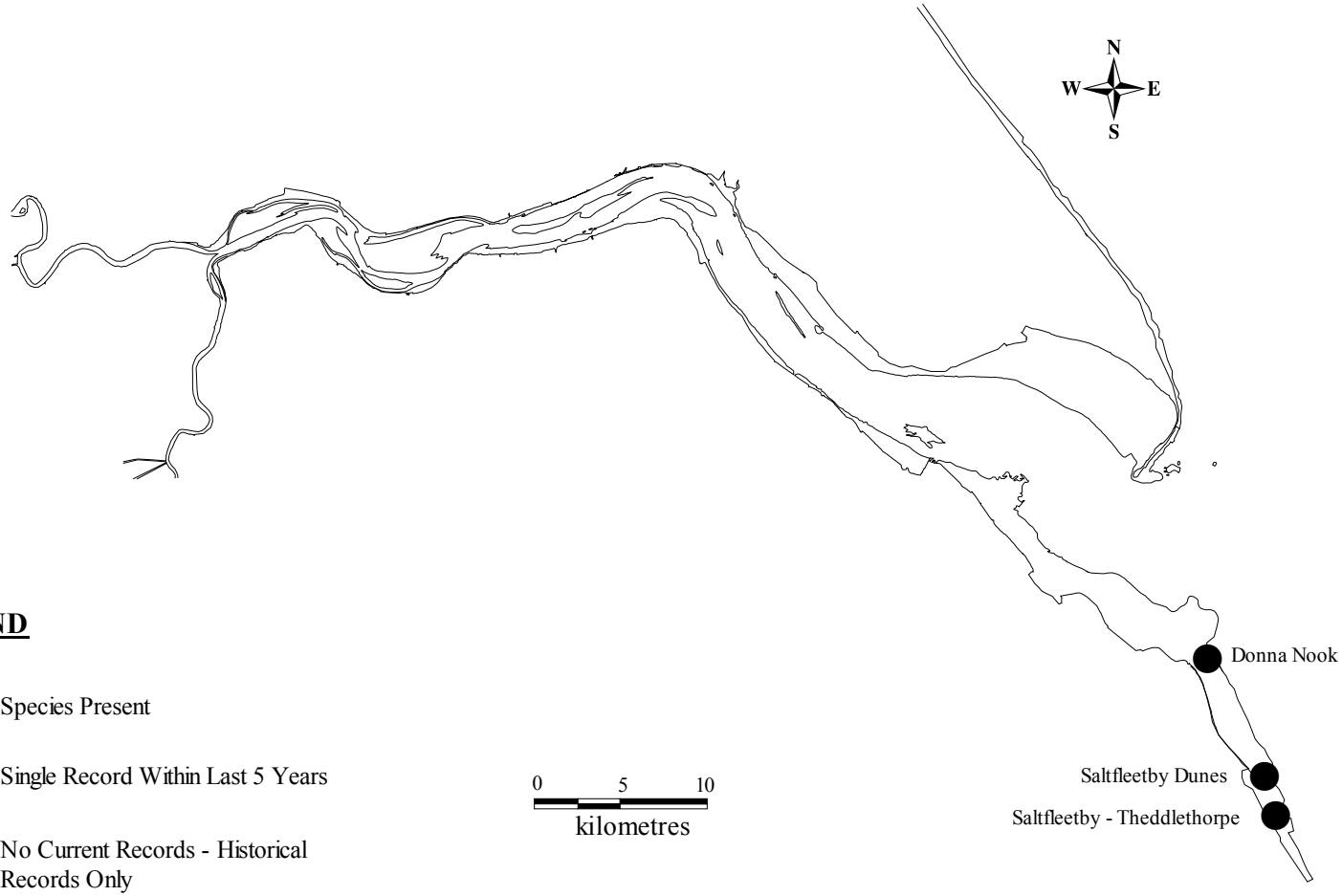
Conservation status

Natterjacks have declined substantially in many other parts of their north European range and are now considered to be 1 of the continents most vulnerable amphibians (Beebee & Denton 1996). The population at Saltfleetby-Theddlethorpe NNR is of particular importance as it is the most northerly population of the natterjack toad on the east coast of Britain (Beebee & Buckley 2001).

The species is listed in Appendix II of the Berne Convention and Annex IVa of the EC Habitats Directive. It is protected by Schedule 2 of the Conservation (Natural Habitats, etc.) Regulations, 1994 and Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) (UK Biodiversity Steering Group 1999).

This makes it an offence in Britain to intentionally or deliberately kill, injure or capture natterjack toads; disturb them in any way; damage or destroy any part of their habitat; or possess, sell or trade them in any way. The legislation covers all life stages equally and includes spawn, tadpoles and adult natterjack toads (Beebee & Denton 1996).

Population Distribution of The Natterjack Toad *Bufo calamita*.



LEGEND

- Species Present
- Single Record Within Last 5 Years
- No Current Records - Historical Records Only

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*BEEBEE, T.J.C. & BUCKLEY, J., 2001. *Natterjack Toad (Bufo calamita) Site Register for the UK 1970-1999 Inclusive*. Unpublished report by the University of Sussex and The Herpetological Conservation Trust.

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Common frog *Rana temporaria*

Key Sites: Sand dunes and marshes at Saltfleetby NNR (TF 4791) and farmland at Hook Moat (SE 7525).

Summary Status:

- Wildlife and Countryside Act: Schedule 5, Section 9 (5).
- Habitats Directive: not listed.
- Berne Convention: not listed.
- Red Data Book: not listed.
- Breeding Status in the Humber: Breeding.
- Widely distributed throughout the Humber region.

Description

The common frog *Rana temporaria* is approximately 65mm long although males of the species are usually a few millimetres smaller than the female. The colour patterns of common frogs can vary considerably. The background is usually brown or grey, although russet or even yellowish individuals are regularly found. They have long muscular hind legs which enable them to swim and jump (Beebee & Griffiths 2000).

The diet of this species usually reflects what is locally available and includes a wide variety of invertebrates including gastropods such as slugs and snails, beetles (order Coleoptera), caterpillars (order Lepidoptera) and spiders (order Araneae). There is little selectivity, although distasteful items such as wasps and hairy caterpillars are generally avoided (Beebee & Griffiths 2000).

Distribution within the Humber

As in many species surveys, the observed distribution of records will reflect differences in recording effort as well as the real distribution of a species. Given the relative abundance of this species there has been little systematic surveying in the Humber area. The data in Table 5 has been compiled by Henry Arnold of the Biological Records Centre at Monks Wood from a number of sources and includes published data as well as records from individual recorders. This indicates the large range of the species in the area but is in no way comprehensive in cover. Recent records are also very scarce.

Table 5 Common frog *Rana temporaria* records for the Humber region (H.R. Arnold pers. comm. 2002)

Grid Reference	Location	Year	Recorder
TA200000	Old Clee	1937	Personal records *
TA200100	Grimsby	1953	Personal records *
TF450910	Saltfleetby	1959	Lincolnshire Naturalists Trust
TF460880	Theddlethorpe	1959	Lincolnshire Naturalists Trust
TA030280	Anlaby	1960	Hull Science and Field Naturalists Club
TA180280	Hedon	1960	Hull Science and Field Naturalists Club
TA160260	Paull, Nr	1960	Hull Science and Field Naturalists Club
TF400800	Saltfleetby Theddlethorpe	1960	Lincolnshire Naturalists Trust
TA020290	West Ella Road	1960	Hull Science and Field Naturalists Club
TA280100	Grimsby	1961	Personal records *
TA090290	Hull	1966	Personal records *
TA157293	Marfleet	1967	Personal records *
TA000200	Barton-upon-Humber	1968	Personal records *
SE900200	Ferriby	1968	Personal records *
TA157293	Marfleet	1968	Personal records *
TF400900	Saltfleetby-Theddlethorpe Dunes	1968	Personal records *
TA262041	Waltham	1968	Personal records *
TA157293	Marfleet	1969	Personal records *
SE900200	Melton	1969	Anon.
SE701211	Rawcliffe Bridge	1970	Personal records *
SE800100		*c*. 1970	A.S. Cooke - survey
SE900200		*c*. 1970	A.S. Cooke - survey
TF400900		*c*. 1970	A.S. Cooke - survey
TA000200		*c*. 1970	A.S. Cooke - survey
SE700200		*c*. 1970	A.S. Cooke - survey
TA200000		*c*. 1970	A.S. Cooke - survey
SE900100		*c*. 1970	A.S. Cooke - survey
SE948289	Anlaby Common	1972	Personal records *
TF400900	Saltfleetby-Theddlethorpe Dunes	1972	Personal records *
TA028280	South Anlaby	1978	Personal records *
SE870210	Alkborough	1985	M.J.S. Swan - amphibian records
SE800200	Alkborough, Butts Hill, Front Street	1985	Leicester Polytechnic Great Crested Newt Survey
TA017261	Hessle Quarry	1985	M.J.S. Swan - amphibian records
TA040280	Hull Anlaby Common	1985	M.J.S. Swan - amphibian records
TA017261	Hessle Quarry	1985	Leicester Polytechnic Great Crested Newt Survey
SE950250	Welton Water	1986	M.J.S. Swan - amphibian records
SE759255	Hook Moat	1987	M.J.S. Swan - amphibian records
TA044286	Hull Anlaby Common	1987	M.J.S. Swan - amphibian records
TA307063	Humberston Whitehall Farm	1987	M.J.S. Swan - amphibian records
TA000200	Hull	1988	M.J.S. Swan - amphibian records
TA021233	Barton Reed Beds	1989	M.J.S. Swan - amphibian records
TF422998	Donna Nook	1989	M.J.S. Swan - amphibian records
TA130252	Goxhill Dawson City Clay Pit	1989	M.J.S. Swan - amphibian records
TA240092	Grimsby Freshney Bog	1989	M.J.S. Swan - amphibian records
TA038263	Hessle	1989	M.J.S. Swan - amphibian records
TA045263	Hessle Priory Sidings	1989	M.J.S. Swan - amphibian records
TA045287	Hull, Anlaby Common	1989	M.J.S. Swan - amphibian records
TF467917	Saltfleetby Nature Reserve	1989	M.J.S. Swan - amphibian records
TA320007	Tetney Blow Wells	1989	M.J.S. Swan - amphibian records

* Name and address withheld.

Despite the lack of recent records the common frog is still considered to be widely distributed throughout the region and can be found close to suitable breeding pools. Two significant populations have been identified and are situated on the sand dune and marshes at Saltfleetby-Theddlethorpe NNR (TF4791) and the farmland at Hook Moat (SE7525) (Swan 1999).

Seasonality

In Britain, hibernation is a necessity to all common frogs. Some individuals, particularly males, hibernate in the mud at the bottom of ponds while others use damp and sheltered terrestrial refuges such as compost heaps, piles of damp leaves or rotting logs. Common frogs can breathe through their skins while hibernating underwater, although long periods of ice cover can lead to deoxygenation of the water and possible suffocation (Beebee & Griffiths 2000).

Male frogs assemble at spawning sites in early spring to await the arrival of females. Spawn is laid in clumps in the shallows where it is fertilised by the males. Once breeding is complete, adult frogs disperse from the spawning site but often spend the rest of the year in or around the pond. The development of the eggs takes between 10 days and 2 weeks depending largely on the temperature of the pond. Newly hatched tadpoles are approximately 10mm long although are not free swimming until a few days later. Froglets leave the pond after metamorphosis about 10 to 15 weeks after hatching depending on temperature, food and crowding. They then spend their first few weeks on land hiding in thick moist vegetation. After another 5mm of growth they enter hibernation. Immature frogs occasionally return to the pond, although breeding does not start for several years, once they reach a length of at least 50mm (Beebee & Griffiths 2000).

Historical changes and trends

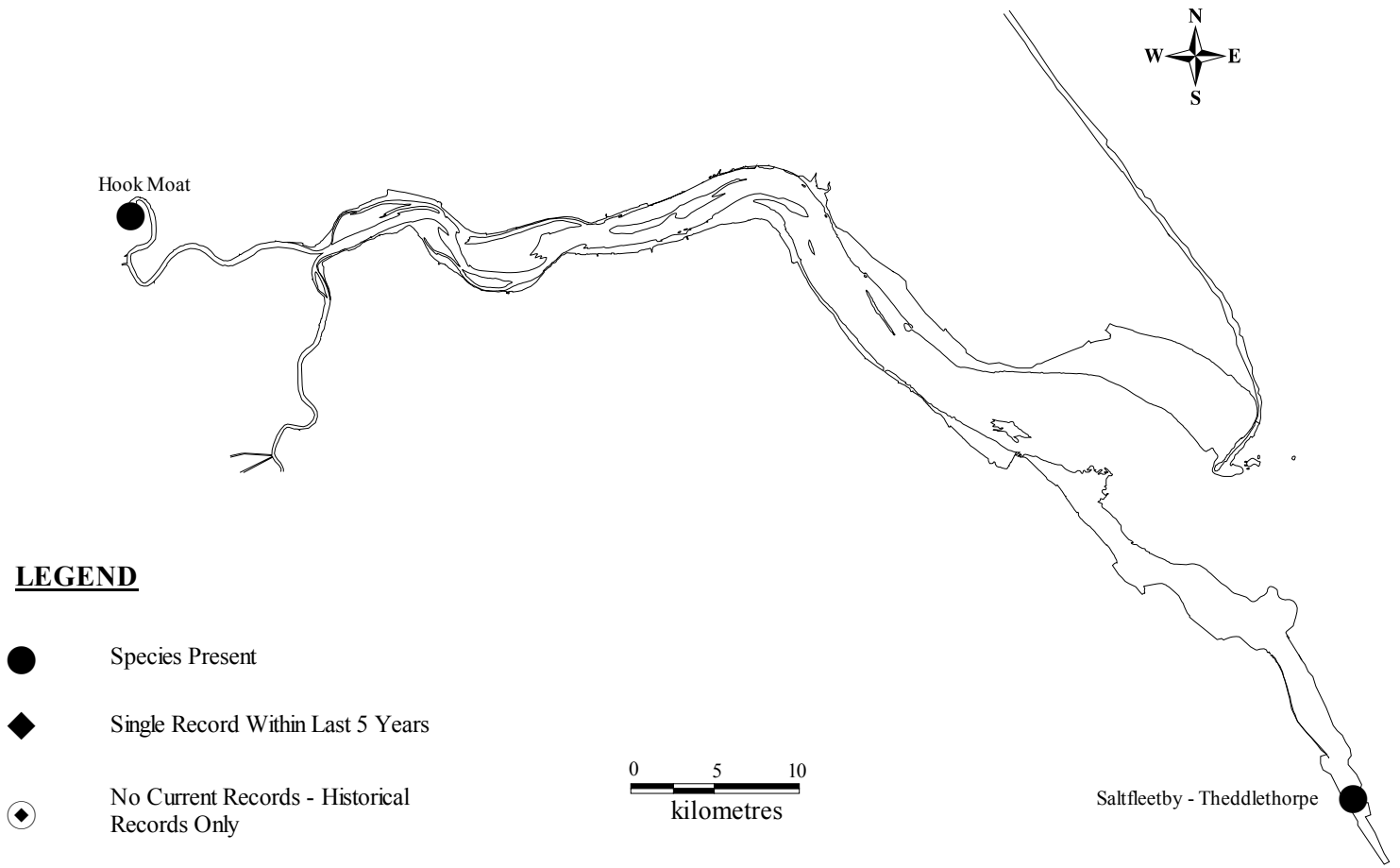
Hilton-Brown & Oldham (1991) stated that the common frog was perceived as widespread and common/abundant throughout Britain except in south west England and East Anglia where the status index failed to reach the "common" threshold. Significant increases have been noted in the West Midlands, East Midlands, south east England, southern England and Wales. The common frog now appears to be more common in urban areas than rural parts and is often reported to have a patchy distribution in the countryside (Hilton-Brown & Oldham 1991). Reasons for the decline in rural populations include habitat loss during WWII and later due to agricultural intensification and sub-urban development. However, since the 1980's the decline in this species has slowed, possibly due to the increasing popularity of garden ponds in urban areas (Hilton-Brown & Oldham 1991).

Despite the large national decline of this species it is now thought that the situation has stabilised. The range of the common frog therefore still extends from the far north of Scotland to the south-western tip of Cornwall (Beebee & Griffiths 2000). Hilton-Brown & Oldham (1991) note that there has been no change in the status of this species around the Humber Estuary but report an increase in the rest of Lincolnshire.

Conservation status

All British amphibians are given some protection by the Wildlife and Countryside Act 1981 (as amended). Under this act it is illegal to sell or trade the common frog (Schedule 5). There has been no significant decline in numbers and the species remains at a favourable conservation status throughout Europe. Currently up to 24% of the world population of common frog is situated in the UK and it occurs in over 100 10km squares in Great Britain (UK Biodiversity Steering Group 1995).

Population Distribution of the Common Frog *Rana temporaria*.



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*BEEBEE, T.J.C. & GRIFFITHS, R.A., 2000. *Amphibians and Reptiles - a natural history of the British Herpetofauna*. London: HarperCollins Publishers Ltd.

*HILTON-BROWN, D. & OLDHAM, R.S., 1991. *The Status of the Widespread Amphibians and Reptiles in Britain, 1990 and Changes During the 1980s*. Peterborough: Nature Conservancy Council Contract, Survey No. 131.

*SWAN, M.J.S., 1999. *Amphibians and Reptiles*. Coast and Seas of the UK - Electronic Platform (Phase 1), JNCC.

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Smooth newt *Triturus vulgaris*

Key Sites: Sand dunes and marshes at Saltfleetby NNR (TF 4791) and farmland at Hook Moat (SE 7525).

Summary Status:

- Wildlife and Countryside Act: Schedule 5, Section 9 (5).
- Habitats Directive: not listed.
- Berne Convention: not listed.
- Red Data Book: not listed.
- Breeding Status in the Humber: Breeding.
- Considered widespread around the Humber Estuary and common in Lincolnshire.

Description

The smooth newt *Triturus vulgaris*, is one of the most widely distributed and often the most abundant species of amphibian in Britain. It is primarily a terrestrial species and is found in a wide range of habitats outside the breeding season. Most habitats are suitable although completely barren habitats with few hiding places are uninhabitable by this species. Breeding ponds are preferably fish-free pools and ditches with a diversity of submerged and emergent vegetation available for egg laying (Beebee & Griffiths 2000).

Both sexes have black spots, are brown or green in colour on the upper body and have an orange flash on their belly which is often more intense in males. Adult males are easily distinguished from females during the breeding season by the sudden development of a fleshy crest which runs along the back. During this time they are often confused with the great crested newt *Triturus cristatus* but can be distinguished by the rounded denticulations on the crest rather than the jagged crest of the great crested newt. After breeding, males lose their crest and their black spots fade a little (Beebee & Griffiths 2000).

Distribution within the Humber

As in many kinds of species survey, the observed distribution of records will reflect differences in recording effort as well as the real distribution of a species. Given the relative abundance of this species there has been little systematic surveying in the Humber area. The data in Table 6 showing smooth newt records for the Humber region has been compiled by Henry Arnold of the Biological Records Centre at Monks Wood from a number of sources and includes published data as well as records from individual recorders. This indicates the large range of the species in the area but is in no way comprehensive in cover. Recent records are also very scarce.

Table 6 Smooth newt *Triturus vulgaris* records for the Humber Region (source: H.R. Arnold pers. comm. 2002, Biological Records Centre, CEH, Monks Wood)

Grid Reference	Location	Year	Recorder
TA390100	Spurn	1903	Personal Records*
SE930260	Brough	1959	Hull Science And Field Naturalists Club
TA090280	Hull	1959	Hull Science And Field Naturalists Club
TA160260	Paull,Nr	1959	Hull Science And Field Naturalists Club
TF450900	Saltfleetby-Theddlethorpe	1959	Lincolnshire Naturalists Trust
TA000290	West Ella	1959	Hull Science And Field Naturalists Club
TA280100	Grimsby Area	1961	Personal Records*
TA010264		1971	Personal Records*
TA158285	Saltend Refinery	1974	Personal Records*
TA158285	Saltend Refinery	1975	Personal Records*
TA011265	Hessle	1977	Personal Records*
TA011265	Hessle	1977	Personal Records*
TA057286	Hull	1978	Personal Records*
TA187287	Hedon	1980	Personal Records*
TA184288	Hedon	1980	Personal Records*
TA183290	Hedon	1980	Personal Records*
TA013259	Hessle	1984	Mary Swan's Amphibian Records
TA025256	Hessle	1984	Mary Swan's Amphibian Records
TA025256	Hessle	1984	Leicester Polytechnic Great Crested Newt Survey
TA013259	Hesslewood Quarry, Hessle	1984	Leicester Polytechnic Great Crested Newt Survey
SE870210	Alkborough	1985	Mary Swan's Amphibian Records
SE800200	Alkborough, Butts Hill, Front Street	1985	Leicester Polytechnic Great Crested Newt Survey
TA240060	Bradley Red barn	1985	Mary Swan's Amphibian Records
TA200000	Grimsby, Bradley, Red Barn	1985	Leicester Polytechnic Great Crested Newt Survey
TA013259	Hessle	1985	Mary Swan's Amphibian Records
TA017261	Hessle Quarry	1985	Mary Swan's Amphibian Records
TA013259	Hessle	1985	Leicester Polytechnic Great Crested Newt Survey
TA017261	Hessle Quarry	1985	Leicester Polytechnic Great Crested Newt Survey
TA018261	Humber Bridge Country Park	1986	Mary Swan's Amphibian Records
SE737228	Goole Glews Hollow	1987	Mary Swan's Amphibian Records
SE759255	Hook Moat	1987	Mary Swan's Amphibian Records
TA153283	Hull The Growths'	1987	Mary Swan's Amphibian Records
TA307063	Humberston Whitehall Farm	1987	Mary Swan's Amphibian Records
TA000200	Hull	1988	Mary Swan's Amphibian Records
TA240092	Grimsby Freshney Bog	1989	Mary Swan's Amphibian Records
TA038263	Hessle	1989	Mary Swan's Amphibian Records
TA047262	Hessle	1989	Mary Swan's Amphibian Records
TA038263	Hessle	1989	Mary Swan's Amphibian Records
TA045263	Hessle Priory Sidings	1989	Mary Swan's Amphibian Records
TF467917	Saltfleetby NR	1989	Mary Swan's Amphibian Records
TA320007	Tetney Blow Wells	1989	Mary Swan's Amphibian Records

* Name and address withheld

Although there is a lack of recent records, smooth newts are thought to be reasonably widespread throughout the region. Two sites which are thought to hold significant populations of this species are the sand dunes and marshes at Saltfleetby NNR, and the farmland at Hook Moat (Swan 1999).

Hilton-Brown & Oldham (1991) classified the populations around the Humber Estuary as being widespread but not common, and those in the rest of Lincolnshire as being common. Smooth newts in both these areas had experienced little change in their population status during the 1980's (Hilton-Brown & Oldham 1991).

Seasonality

Smooth newts begin their migration towards their breeding ponds in early spring, and travel predominantly at night during mild and humid weather conditions. Males usually arrive at the breeding pool before the females and begin to develop their characteristic breeding features only after they have entered the water (Beebee & Griffiths 2000). It may take several weeks for the crest of a male to reach its full height and as such, the males who reach the pond early have a distinct breeding advantage. After mating, a female smooth newt will lay between 200 and 300 eggs which are individually wrapped in the leaves of water plants. These are laid between March and June at variable rates although on average, between three and seven eggs are deposited each day. Depending on temperature and water quality it takes between 10 and 20 days for the eggs to hatch. The larvae are approximately 7mm long and feed on zooplankton. Metamorphosis occurs between July and September at a size of approximately 40mm. However, some larvae hatched late in the season may not reach this size before the winter. These larvae may remain in the pond over winter and metamorphose in the early spring at a larger size. Juvenile smooth newts do not return to water until they reach sexual maturity and return to the pond to breed 2 to 3 years later (Beebee & Griffiths 2000).

Outside the breeding season, smooth newts leave the water and take on a terrestrial existence. At this phase of their annual cycle, they adopt a dry velvety skin which they shed again in the spring in time for the breeding season. On land, they hide in damp refuges such as in logs, compost heaps or under rocks and come out on damp nights to feed (Beebee & Griffiths 2000). They enter hibernation when the minimum temperature drops below 2°c and often move deeper underground to avoid frosts (Griffiths 1984 *in* Beebee & Griffiths 2000). They emerge from hibernation in February and begin migration to their breeding ponds.

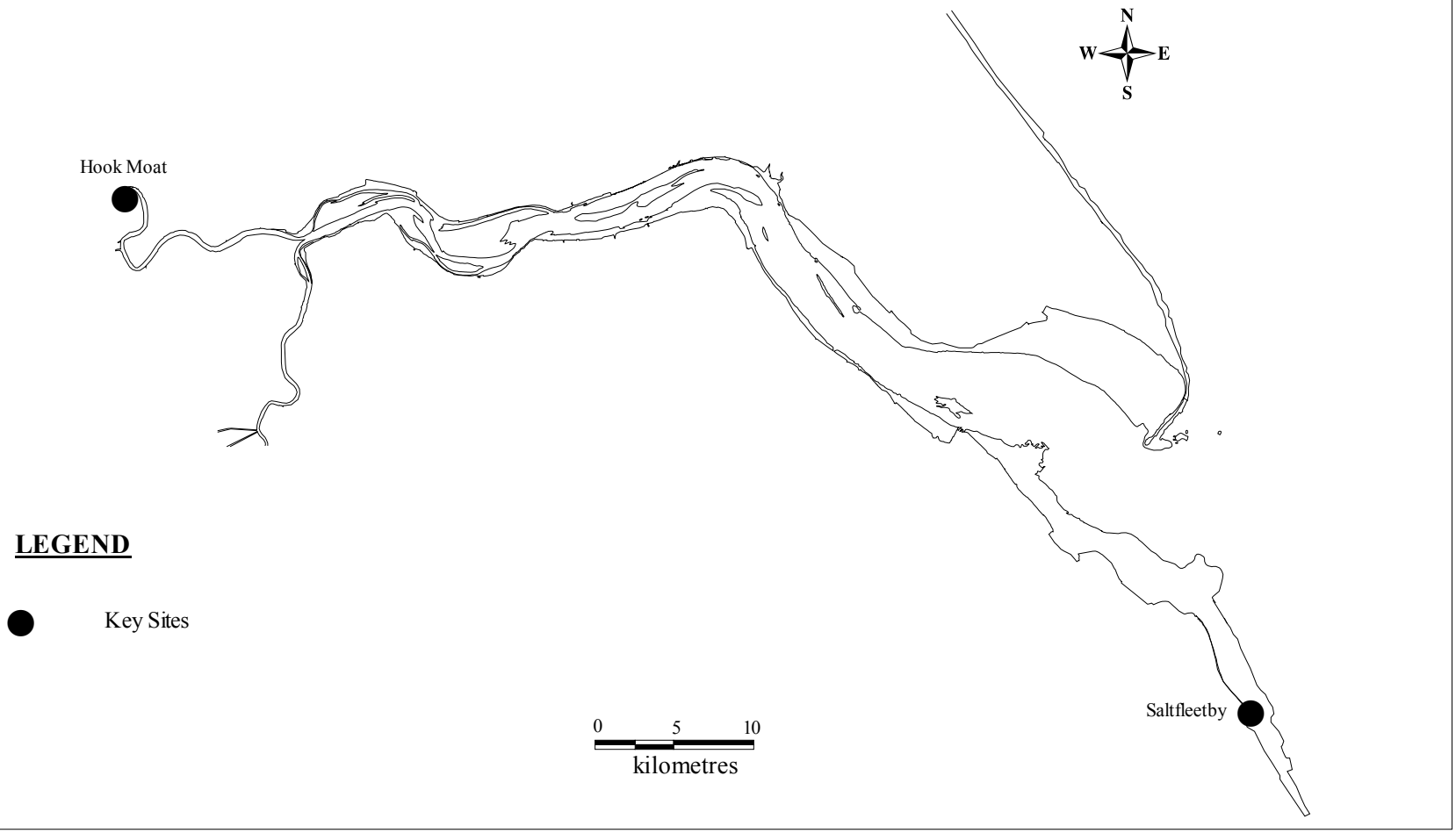
Historical changes and trends

In 1991, Hilton-Brown & Oldham stated that the smooth newt is widespread or common throughout most of Britain, but scarce in south west England and rare or absent from most of northern Scotland. In general, no change has been observed, although decreases seem to have occurred in Wales, and slight increases in East Anglia (Hilton-Brown & Oldham 1991). Beebee & Griffiths (2000) noted that over the last 50 years the smooth newt had probably suffered a general decline particularly in rural areas as a result of habitat deterioration, but its ability to colonise newly created garden ponds may have partly offset these losses in recent times.

Conservation status

All British amphibians are given some protection by the Wildlife and Countryside Act 1981 (as amended) under Schedule 5 in respect of section 9(5) only. This means that by a general licence, the sale (transport for sale, possession for sale etc) of adult specimens of smooth newts is permitted except during their breeding season which has been designated 1st April to 1st August (inclusive). Smooth newts taken at any time from the wild in Devon, Cornwall or Somerset may not be sold.

Population Distribution of Smooth Newts *Triturus vulgaris.*



LEGEND

● Key Sites

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Sand lizard *Lacerta agilis*

Key Sites: None.

Summary Report:

- Wildlife and Countryside Act: Schedule 5.
- Habitats Directive: Annex IVa.
- Berne Convention: Appendix II.
- Red Data Book: not listed.
- Breeding Status in the Humber: N/A.
- UK Biodiversity Action Plan Priority Species.
- Not present in the Humber area - neither at present or historically.

Description

The sand lizard is the largest and rarest of the British lizard species. The total length of adult sand lizards ranges up to 18-19cm, occasionally being longer, with females attaining slightly larger sizes than males. Background colouration on the upper body ranges from grey to pale brown with three main lines, one vertebral and two lateral, of irregular oscillated spots. There are many variations on the basic colour scheme and males in particular often have few or even no spots at all on the flanks (Beebee & Griffiths 2000). Males can be easily distinguished during the breeding season by their bright green flanks. Hatchling sand lizards are decorated from birth with the same distinctive eyespots as their parents. Immature animals generally resemble females in colouration, although sexual dimorphism is often detectable by the end of the second year of life (Beebee & Griffiths 2000).

In England the sand lizard is an inhabitant of dry open country, the sandy heathlands of the south, and the sand dunes of the northern coasts.

Sand lizards generally use the younger frontal dunes in the sand dune complex. In these areas marram grasses *Ammophila arenaria* and lyme grasses *Elymus arenarius* form thick, tangled tussocks amongst open patches of sand. Un-shaded areas of this habitat, on sunny dune ridges, are an ideal environment for the sand lizard. The bare sand is required for egg laying and incubation. South facing topographical features are favoured and continuous areas of mature marram are necessary for cover and foraging areas (Moulton & Corbett 1999).

The sand lizard is an accomplished excavator and is often faithful to a burrow for many months or perhaps even years. These retreats are resorted to at night, in the heat of midday and for hibernation. Burrows are discrete and are usually concealed among the roots of grass or heather. Despite their digging abilities sand lizards are also opportunists and often use burrows abandoned by mice and voles or cracks and crevices in the rock (Beebee & Griffiths 2000).

Sand lizards are intelligent hunters and take a wide range of invertebrate prey. They can be seen chasing bumble bees (genus Bombus), butterflies and moths (order Lepidoptera) and throwing up litter to find the many types of spiders (order Araneae), crickets (order

Orthoptera) and beetles (order Coleoptera) which are also consumed. Young lizards specialise in feeding on flies and spiders (Beebee & Grifiths 2000).

Distribution within the Humber

There have been historical recorded sightings of sand lizards at Spurn point (Kirk 1989). There is however much debate as to the reliability of these sightings as it is thought unlikely that a population would survive at this location due to the flooding and instability of the habitat. This population would also be geographically remote (at a significant level) from other known populations of this species. It has been suggested that sightings were merely misidentification of the common lizard *Lacerta vivipara* which occurs widely on Spurn (Kirk 1989).

Seasonality

Sand lizards emerge from their winter burrows in February, March or May depending on the temperature. Males appear 2 weeks or more before the females and are both drab and lethargic for the first few days, basking near their burrow entrances in the weak early spring sunshine. As the sun strengthens, activity increases and after spring moult males begin to acquire their greenish breeding colours. By mid to late April the time spent basking declines and the lizards become preoccupied with mating and feeding (Beebee & Griffiths 2000).

A clutch of four to 12 eggs is laid between June and July depending on the size of the female. Hatchlings appear during late August/September but when springs are early and warm, double-clutching can occur. In this situation, the first batch of eggs is laid in late May and then a second round of mating occurs in June resulting in another batch of eggs being laid in early July (Beebee & Griffiths 2000).

Hibernation starts surprisingly early in Britain, with the females often hibernating before the end of September (Beebee & Griffiths 2000).

Historical changes and trends

Natural populations have been lost in Kent, Sussex, Hampshire, Wiltshire, Berkshire, Cheshire, north and west Wales and the species presumed former range in Devon and Cornwall. Further substantial colony losses of 97%, 95% and 90% were observed in parts of Merseyside (the Weald, north Surrey and Dorset respectively). Remaining colonies are extremely vulnerable as they are mostly on areas of heath or dune which are threatened by habitat loss and degradation through scrub and tree encroachment, in addition to fire and public interference. Over 90% of the total UK population are in south-east Dorset, the species last remaining threshold (Moulton & Corbett 1999).

Conservation status

The sand lizard is protected through both national and European legislation. Protection is provided by the Wildlife and Countryside Act 1981 (Schedule 5), the Berne Convention 1979 (Appendix II) and the EU Habitats Directive (Annex IVa). It is therefore an offence to kill, injure or capture them; disturb them in any way; damage or destroy any part of their habitat or possess, sell or trade them in any way. Eggs, juveniles and adult sand lizards are all covered equally by the legislation (Moulton & Corbett 1999).

The sand lizard is also listed as UK Biodiversity Action Plan priority species.

Sand lizard *Lacerta agilis*

No map as species is not recorded in the estuary

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6. Fish

Sea lamprey *Petromyzon marinus*

Summary Status:

- Wildlife and Countryside Act: not listed.
- Habitats Directive: Annexes II and V.
- Berne Convention: Appendix III.
- Red Data Book: not listed.
- Breeding Status in the Humber: not breeding.
- Complex biology, with migratory movements through the estuary and spawning and early life stages in freshwater rivers.
- The main period for movement through the estuary is the summer and early autumn, although from sporadic recordings at the South Bank power station on the Humber Estuary, it is difficult to ascertain whether this is outwardly following spawning or migration upstream to enter spawning rivers.
- Insufficient data available to assess Humber population in the context of the UK.

Description

The sea lamprey is a member of the jawless fishes (Petromyzonidae (superclass Agnatha)) found in coastal waters, estuaries and accessible rivers. The group Agnatha which includes the Hagfish (Myxinidae), are modified representatives of the first fishes and show a mixture of primitive and highly specialised features (Miller & Loates 1997).

The sea lamprey is an anadromous species which spawns in freshwater but completes part of its life cycle in estuaries or at sea. They have a cartilaginous skeleton; suctorial discs (as opposed to a distinguishable mouth); slimy, scaleless skin; horny teeth; no paired fins or distinct caudal fin and muscular gill pouches that are supported by gill arches to the outside of the gill membranes (Miller & Loates 1997). Lamprey are frequently parasitic on other species of fish and feed on the body fluids and blood obtained by rasping through the skin of the host. Fish known to have been attacked include shad *Alosa spp.*, cod *Gadus morhua*, haddock *Melanogrammus aeglefinus*, salmon *Salmo salar*, basking shark *Cetorhinus maximus*, sturgeon *Acipenser sturio*, and eel *Anguilla anguilla* (Wheeler 1969). In addition, sea lamprey may feed on marine mammals such as whales (*Balaenoptera spp.*) and the common/harbour porpoise *Phocoena phocoena* (Whitehead *et al* 1989).

Adult sea lamprey enter estuaries during autumn (October) to begin their spawning migration, although individuals have been recorded within the Humber Estuary during winter (Proctor & Musk 2001). They ascend estuaries and spend the winter and spring in freshwater before spawning during the early summer months of May, June and July (Whitehead *et al* 1989; Wheeler 1969). This upstream migration appears to be triggered by temperature and the sea lamprey commence spawning when the water temperature reaches 15°c (Maitland 1980).

In terms of site selection for spawning, sea lamprey prefer warm, swift running freshwater rivers with clean gravel and close proximity to a silt laden muddy or muddy sand river bed for the larval/juvenile 'ammocoetes'. The adults excavate a nest to a depth of approximately 15cm and deposit the eggs in the depression (Wheeler 1969). In general, adults die after spawning (Miller & Loates 1997), although depending on environmental conditions, some may migrate back out to sea and re-spawn during subsequent years.

The ammocoetes bury in mud and muddy sand downstream of the spawning site and feed on fine organic particles and detritus in the mud (Wheeler 1969). The ammocoete larval stage varies in duration with the average annual temperature, but in the British Isles usually lasts for 5 years (Wheeler 1969). Metamorphosis begins in late summer and is complete within 4 months, after which, at an approximate length of 15-20cm, the sea lamprey is equipped for its parasitic mode of life and descends to the sea (Wheeler 1969). Identification of suitable sites in some parts of the UK has been hampered by the absence of comparative population data, and by difficulties in identifying juvenile lamprey (Jackson & McLeod 2002). In addition, there is considerable difficulty to the untrained observer, in distinguishing between the sea lamprey *Petromyzon marinus*, the brook lamprey *Lampetra planeri*, and the river lamprey *Lampetra fluviatilis*.

In terms of distribution, the sea lamprey occurs in estuaries and easily accessible rivers over much of the Atlantic coastal area of western and northern Europe (from northern Norway to the western Mediterranean) and eastern North America (Jackson & McLeod 2002). Within the UK, it is thought to be reasonably widespread in rivers, but although common in some places, it has declined in parts of its range and has become extinct in a number of rivers. It appears to reach its northern limit of distribution in Scotland and does not occur north of the Great Glen (Jackson & McLeod 2002).

Adult sea lamprey are the largest of the lamprey species and may measure up to 120cm in length (Miller & Loates 1997). However, the only reliable way of separating the two commonly occurring anadromous species is to examine the suctorial discs.

Distribution within the Humber

To date, the only documented recording of sea lamprey within the Humber Estuary has come from power station impingement data. Surveys carried out at the South Humber Bank CCGT power station (Stallingborough) during 1999 and 2000 by Proctor *et al* (2000) and Proctor & Musk (2001) indicate that the sea lamprey is present in the Humber Estuary in relatively low abundance, however, it should be stressed that the survey design targeted species of commercial value. The abundance and biomass projected for sea lamprey impinged at the South Humber Bank power station comprised a significant enumerated component. The abundance and biomass recorded for the river lamprey and sea lamprey were combined during the 1999 survey and as a consequence, no data exists for the individual species. The estimated impingement rate for the two species in 1999 was 13,130 with a total biomass of 422.29kg (Proctor *et al* 2000), however, the river lamprey contributed a significant component of this density. During the following sampling year (2000), the species were separated and 109 sea lamprey were estimated to have been impinged over the survey period (12 months) with a total estimated biomass of 10.38kg (Proctor & Musk 2001).

It is difficult to assess the spatial and temporal distribution of lamprey within the Humber Estuary as the gear selectivity is not conducive to the lampreys spatial activity. The majority

of recent surveys have been carried out during periods of limited migratory activity (e.g. CEFAS young fish survey in September), and in addition, the majority of these surveys have concentrated on a specific site for general fish assemblage assessments.

The River Derwent is a cSAC, but although the sea lamprey is an Annex II species and qualifying feature, it is not the primary reason for the site selection. The Environment Agency dataset of lamprey distribution in rivers throughout the Humber catchment indicate that the majority of rivers within the Derwent system contain lamprey. Those that have records of sea lamprey include the River Nidd, River Ouse, River Ure & River Swale, however, the Environment Agency records do not discriminate between species and it is probable that these records include the brook lamprey *Lampetra planeri* (Davies *et al* 2002).

Seasonality

Information based on fish impingement at the South Humber Bank CCGT power station, Stallingborough, indicate that sea lamprey enter estuaries to migrate upstream into spawning rivers throughout the late summer and early autumn months (August, September and October). The species spawn in early summer (May, June and July) before migrating back out to sea if they survive the spawning. The juveniles (ammocoetes) remain within the river system for up to 6 years when they metamorphose and migrate out to the coast during late winter and early spring. It should be noted that the fish impingement studies at Stallingborough did not record any post-ammocoete sea lamprey.

Historical changes and trends

There is little historical information on the status of sea lamprey within the Humber Estuary although its current distribution indicates the Humber as an important migratory corridor to and from rivers such as the Derwent. The UK populations are considered important for the conservation of the species at an EU level, and the species is considered to be reasonably widespread in UK rivers (Jackson & McLeod 2002). In some places the sea lamprey is still common, but it has declined in parts of its range and has become extinct in a number of rivers. It appears to reach its UK northern limit of distribution in Scotland and does not occur north of the Great Glen. Population declines in many parts of Europe have been attributed to pollution, overfishing and migratory route obstructions. Features such as weirs and dams may impede the migration of the sea lamprey as they appear to be poor at ascending obstacles to migration, and are frequently restricted to the lower reaches of rivers (Jackson & McLeod 2002).

Rivers north of the Humber Estuary appear to contain a higher occurrence of lamprey species than those to the south and west. The south and western rivers are in close proximity to the industrial areas of Sheffield, Rotherham, Barnsley and the north Midlands and consequently, there has been a higher incidence of industrial inputs into these river systems. It is probable that water quality and artificial obstacles are the main reasons for the disparity in populations between those riverine systems in the north of the catchment and those to the south and west. It should be noted that as the Database and Atlas of Freshwater Fishes (2002) records the occurrence of lampreys without any speciation, it is difficult to ascertain what percentage are sea lamprey. As such, it is assumed that the majority of recordings are of brook and river lamprey as the sea lamprey does not migrate as far into freshwaters to spawn (Jackson & McLeod 2002). Maitland (1980) reports that the larvae of all three lamprey species are often found together.

Conservation status

The sea lamprey is listed under Appendix III of the Berne Convention, and Annexes II and V of the EC Habitats Directive.

Sea lamprey *Petromyzon marinus*

No map as species distribution in the estuary is not known

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River lamprey *Lampetra fluviatilis*

Summary Status:

- Wildlife and Countryside Act: not listed.
- Habitats Directive: Annexes II and V.
- Berne Convention: Appendix III.
- Red Data Book: not listed.
- Breeding Status in the Humber: not breeding.
- Complex biology, with migratory movements through the estuary and spawning and early life stages in suitable freshwater rivers.
- The main period for movement through the estuary is the summer and early autumn.
- Insufficient data available to assess the Humber population in the context of the UK.

Description

The river lamprey is a member of the jawless fishes (Petromyzonidae (superclass Agnatha)) found in coastal waters, estuaries and accessible rivers. The group Agnatha which includes the Hagfish (Myxinidae) are modified representatives of the first fishes and show a mixture of primitive and highly specialised features (Miller & Loates 1997).

The river lamprey is an anadromous species which spawns in freshwater but completes part of its life cycle in estuaries or at sea. The river lamprey attains a maximum length of 45cm, although are normally between 31cm and 34cm. They have a cartilaginous skeleton; suctorial discs (as opposed to a distinguishable mouth); slimy, scaleless skin; horny teeth; no paired fins or distinct caudal fin; muscular gill pouches that are supported by gill arches to the outside of the gill membranes; and a single median nostril pore on the upper surface of the snout (Miller & Loates 1997). Lamprey are frequently parasitic on other species of fish and feed on the body fluids and blood obtained by rasping through the skin of the host. Fishes known to have been attacked are often migratory species, principally herring *Clupea harengus,* sea trout *Salmo trutta*, and shads *Alosa spp.* (Wheeler 1969).

Adult river lamprey enter estuaries during autumn (September-October) to begin their spawning migration, spending the winter in freshwater. Spawning subsequently occurs during spring (April) when the water temperature reaches approximately 11°c (Wheeler 1969).

In terms of site selection for spawning, river lamprey prefer high quality river types with clear water and areas of gravels, silt or sand for spawning (Jackson & McLeod 2002). The adults excavate a nest and then spawn slightly upstream thereby allowing the eggs to fall to the bottom and into the excavated nest. A number of adults die after spawning (Miller & Loates 1997) although, depending on environmental parameters, many may survive and return to the sea to re-spawn in subsequent years. The juvenile lamprey, known as ‘ammocoetes’ bury in rich organic mud downstream of the nesting site and feed on fine organic particles and bacteria in the mud (Wheeler 1969). The larval ammocoete stage lasts for approximately 5 years, with metamorphosis beginning in early autumn and ending in the spring of the sixth year. The newly metamorphosed lamprey which measure approximately

12cm immediately commence their downstream migration (Wheeler 1969). Estuaries are considered important migratory routes with near-shore coastal margins being important migratory and feeding grounds. Identification of suitable spawning sites in some parts of the UK has been hampered by the absence of comparative population data, and by difficulties in identifying juvenile lampreys (Jackson & McLeod 2002). In addition, there is considerable difficulty to the untrained observer, in distinguishing between the river lamprey *Lampetra fluviatilis* and both the brook lamprey *Lampetra planeri*, and the sea lamprey *Petromyzon marinus*. It has been suggested that the river and brook lampreys are a paired species (Zanandrea 1959), e.g. the same species, although, the term 'satellite species' has been used to describe the close relationship between the two species (Vladykov & Kott 1979).

In terms of distribution, the river lamprey is found only in western Europe, where it has a wide distribution from southern Norway to the western Mediterranean. Within the UK, it is thought to be widespread and has been recorded from numerous inland rivers and estuaries along the north and east coasts, south and west coasts, Wales and Scotland. There are a few land-locked populations, including one in Scotland which is seen as having special European importance (Jackson & McLeod 2002).

Adult river lamprey rarely exceed 45cm in length and are smaller than sea lamprey *Petromyzon marinus*, which measure up to 120cm (Miller & Loates 1997). However, the only reliable way of separating the two species is to examine the suctorial discs.

Distribution within the Humber

To date, the only documented recording of river lamprey within the Humber Estuary has come from power station impingement data, although a single specimen measuring approximately 20cm was recorded during the flounder bioaccumulation survey conducted by the Environment Agency in 2002 (N. Proctor pers. obs. 2002).

Surveys carried out at the South Humber Bank CCGT power station (Stallingborough) during 1999 and 2000 by Proctor *et al* (2000) and Proctor & Musk (2001) indicate that the river lamprey is present in the Humber Estuary in moderate abundance, however, it should be stressed that the survey design targeted species of commercial value. The abundance and biomass projected for river lamprey impinged at the South Humber Bank power station comprised a significant enumerated component. The river lamprey and sea lamprey abundances were additionally combined during the 1999 survey, although the river lamprey contributed a significant component of the total density. The estimated impingement rate for both species in 1999 was 13,130 with a total biomass of 422.29kg (Proctor *et al* 2000), whereas, during the following sampling year (2000), when the species were separated, 16,619 river lamprey were calculated to have been impinged with a total biomass of 451.3kg (Proctor & Musk 2001).

It is difficult to assess the spatial and temporal distribution of lamprey within the Humber Estuary as the gear selectivity is not conducive to the lampreys spatial activity. The majority of recent surveys have been carried out during periods of limited migratory activity (e.g. CEFAS young fish survey in September), and in addition, have concentrated on a specific site for general fish assemblage assessments.

The Derwent is an excellent example of a river lamprey population which inhabit a number of rivers flowing into the Humber Estuary. As a consequence, the River Derwent has cSAC

status although only the lower reaches of the Derwent are designated, reflecting the spawning distribution of the species in the system. The Environment Agency dataset of lamprey distribution in rivers throughout the Humber catchment indicate that the majority of rivers within the Derwent system contain lamprey. Those that have records of lamprey include the River Nidd, River Ouse, River Ure & River Swale, however, the Environment Agency records do not discriminate between species and it is probable that these records include the brook lamprey *Lampetra planeri* (Davies *et al* 2002).

Seasonality

Information based on fish impingement at the South Humber Bank CCGT power station, Stallingborough, indicate that river lamprey enter estuaries to migrate upstream into spawning rivers throughout the late summer and early autumn months (August, September and October), although there are occasional recordings of solitary individuals throughout the year. The species spawn in spring (April) before migrating back out to sea if they survive the spawning. The juveniles (ammocoetes) remain within the river system for up to 6 years when they metamorphose and migrate through the Humber Estuary during summer. Within the Humber Estuary, the peak migration of post ammocoetes occurs during June, July and August (Proctor *et al* 2000; Proctor & Musk 2001).

Historical changes and trends

There is little historical information on the status of river lamprey within the Humber Estuary although its current distribution indicates the Humber as an important migratory corridor to and from spawning rivers such as the Derwent. The UK populations are considered important for the conservation of the species at an EU level, and the species is widespread in the UK, occurring in many rivers from the Great Glen in Scotland southwards to south west Wales and the English south west coast with populations considered to be strong (Jackson & McLeod 2002). Population declines in many parts of Europe have been attributed to pollution, overfishing and migratory route obstructions e.g. artificial obstacles such as weirs or dams which impede migration (Jackson & McLeod 2002).

Rivers north of the Humber Estuary appear to contain a higher occurrence of lamprey species than those to the south and west. The south and western rivers are in close proximity to the industrial areas of Sheffield, Rotherham, Barnsley and the north Midlands and consequently, there has been historically, a higher incidence of industrial inputs into these river systems. It is probable that water quality and artificial obstacles are the main reasons for the disparity in populations between those riverine systems in the north of the catchment and those to the south and west.

Conservation status

The river lamprey is listed under Appendix III of the Berne Convention, and Annexes II and V of the EC Habitats Directive.

River lamprey *Lampetra fluviatilis*

No map as species distribution in the estuary is not known

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Allis shad *Alosa alosa*

Summary Status:

- Wildlife and Countryside Act: Schedule 5, Section 9 (4) (a).
- Habitats Directive: Annexes II and V.
- Berne Convention: Appendix III.
- Red Data Book: not listed.
- Breeding Status in the Humber: not breeding.
- Rarely recorded in the Humber, with little information available on status.

Description

The allis shad *Alosa alosa* is a member of the herring family (Clupeidae) and is less common than the second European shad species, the twaite shad (*Alosa fallax*). Allis shad occur along the Atlantic coast of Europe, from southern Norway to Spain, and in the Mediterranean eastwards to northern Italy (Jackson & McLeod 2002).

The allis shad is a migratory, anadromous species which occurs in shallow nearshore coastal waters and estuaries. It is possible that this species may breed in the Solway Firth although at present, there is no clear evidence of spawning stocks. Hybrids with twaite shad have however been reported by Maitland & Lyle (2001).

During the breeding season, the allis shad migrates into large rivers with strong currents and stony or sandy beds in order to spawn (normally May). During spawning, the eggs are released into the current where they settle into interstitial gaps in 'gravelly' substrata. The same spawning sites tend to be favoured each year, and these shallow, gravel areas, usually adjacent to deep pools, are thought to be the most favourable spawning habitat. The majority of all adults are believed to die after spawning, however, there is conflicting opinion with respect to the fate of adult post-spawning stock. Wheeler (1969) indicates that the adults migrate immediately back to the sea, however, Jackson & McLeod (2002) state that almost all adults die following spawning. In contrast, A. Turnpenny (pers. comm. 2002) suggests that the level of survival and subsequent re-spawning is determined by environmental conditions preceding the initial spawning period.

Juvenile allis shad develop in the rivers and estuaries throughout their first and second years before migrating out to sea. They rarely exceed 50cm in length but tend to be larger than twaite shad *Alosa fallax* which usually measure up to 40cm in length. However, the only reliable method of separating the two species is by examining the gills. Twaite shad have only 40-60 gill-rakers (comb-like structures that are used to filter zooplankton) on the first gill arch, whereas allis shad have 90-130 (Jackson & McLeod 2002). Wheeler (1969) and Whitehead *et al* (1989) give no indication of the lifespan for the allis shad.

Distribution within the Humber

To date, the only recording of allis shad has come from power station impingement data. Surveys carried out at the South Humber Bank CCGT power station (Stallingborough) by Proctor *et al* (2000) and Proctor & Musk (2001) indicate that the allis shad is present within the Humber Estuary but has a low abundance. For the 1999 survey, only one allis shad was recorded on a single occasion during the sampling period (during October 1999), and as a result of this low occurrence, was estimated to represent less than 0.01% of the total abundance and biomass for the fourth sampling quarter (October to December). The impingement rate for the species in 1999 was subsequently estimated to be 7, with a total biomass of 2.2kg. During the sampling year for 2000, no allis shad were recorded.

It is almost impossible to assess the community structure of allis shad within the Humber Estuary from the single individual recorded at the power station. However, the allis shad population appears to be much smaller than that of the twaite shad. The size of the allis shad recorded was significantly lower than that observed for the twaite shad, however, it should be noted that the current method of sampling for fish within estuaries does not facilitate the capture of a pelagic species present in limited abundance. In particular, the majority of recent surveys have been carried out during periods of limited migratory activity (e.g. CEFAS young fish survey in September). Surveys have concentrated on specific sites for general fish assemblage assessments and used gear that is none-selective for the allis shad's behaviour.

In addition, there has been a single recording of shad (*Alosa* sp.) within the Humber catchment, this being a single specimen recorded in the River Don in 1998 (Davies *et al* 2002).

Seasonality

Information based on allis shad spawning migrations in France indicate that allis shad enter estuaries to migrate upstream into spawning rivers around May. The species spawn and subsequently migrate back out to sea if they survive the spawning. The juveniles remain within the river system for up to 2 years before migrating out to sea.

Within the Humber Estuary, a single allis shad was recorded during October 1999, but no further recordings were made during 2000 (Proctor *et al* 2000; Proctor & Musk 2001).

Historical changes and trends

As previously noted, the allis shad is found along the western coastline of Europe, from southern Norway to Spain and the eastern Mediterranean (Jackson & McLeod 2002). However, the species has declined substantially throughout Europe and is now virtually absent from many rivers within the UK where it used to spawn. Such population decreases within many parts of Europe have been attributed to pollution, overfishing and migratory route obstructions. The only realistic breeding populations left are thought to be in a few French rivers. There are no comprehensive population size estimates available for the allis shad in the UK (Jackson & McLeod 2002).

In addition, there are no defined spawning stocks of allis shad within the UK, although the species is present in rivers flowing into the Solway Firth (south-west Scotland) where

hybrids with twaite shad *Alosa fallax* have been reported by Maitland & Lyle (2001). It is possible that the allis shad has spawned within the Solway Firth system, although there is no clear evidence to support this. There are incidental recordings of allis shad from rivers in south west England and Wales.

Conservation status

The species is listed under Appendix III of the Berne Convention and Annexes II and V of the EC Habitats Directive. It is also included in Section 9(4)(a) of the Wildlife and Countryside Act (1981), (amended April 1998), which makes it an offence to intentionally obstruct access to spawning areas, or to damage or destroy gravels used for spawning. The allis shad is also protected under Schedule 5 of the Wildlife and Countryside Act (1981) in respect of section 9(1) so it is an offence to intentionally kill, injure or take specimens. It is additionally included in the priority short list of the Steering Group Report (HMSO1995a, 1995b).

Allis shad ***Alosa alosa***

No map as species distribution in the estuary is not known

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Twaite shad *Alosa fallax*

Summary Status:

- Wildlife and Countryside Act: Schedule 5, Section 9 (4) (a).
- Habitats Directive: Annexes II and V.
- Berne Convention: Appendix III.
- Red Data Book: not listed.
- Breeding Status in the Humber: not breeding.
- General status still largely unknown, but predominantly recorded during the summer and early autumn. Breeding status in the estuary is unknown.

Description

The twaite shad *Alosa fallax* is a member of the herring family (Clupeidae) and is more common than the second European shad species, the allis shad *Alosa alosa*. Twaite shad occur along the western coastline of Europe, from southern Norway to Morocco and along the eastern Mediterranean (Jackson & McLeod 2002). Three populations appear to be clearly defined, one formed by French Mediterranean and Morocco populations, a second by Portuguese southern populations, and a third including Atlantic populations from north Portugal and France (Alexandrino 2001). Twaite shad have also been reported as far east as the Baltic Sea (Aprahamian *et al* 2001).

The twaite shad is an anadromous species which migrates from marine waters into the lower reaches of estuaries between April and June to spawn in freshwater near the tidal limit (Miller & Loathes 1997), generally no more than 100-120km from the estuary mouth. The majority of adults die after spawning, although UK populations appear to have an unusually high proportion of repeat spawners - up to 25% (Jackson & McLeod 2002). There are no comprehensive population size estimates available for the twaite shad in the UK (Jackson & McLeod 2002).

The habitat requirements of twaite shad are not fully understood however, on the River Usk and the River Wye, twaite shad are known to spawn at night in a shallow area near deeper pools in which the fish congregate. The eggs are demersal and are released into the water column, where they sink into the interstices between coarse gravel/cobble substrates (Jackson & McLeod 2002). Upon hatching, the fry slowly drift down river with the current before autumn and descend to the sea at an approximate length of 14cm (Miller & Loates 1997) where they remain until sexual maturity. Recruitment seems to be greatest during warm years, and high flows between May and August may result in fry being washed prematurely out to sea (Jackson & McLeod 2002).

Twaite shad rarely exceed 40cm in length, and are usually smaller than allis shad *Alosa alosa* which measure 30-50cm. However, the only reliable way of separating the two species is to examine the gills. Twaite shad have only 40-60 gill-rakers (comb-like structures that are used to filter zooplankton) on the first gill arch, whereas allis shad have 90-130 (Jackson & McLeod 2002). Wheeler (1969) and Whitehead *et al* (1989) give no indication of the lifespan for the twaite shad, but note that at the maximum recorded size limit, fish are estimated to be between 6 and 7 years old.

Distribution within the Humber

To date, the most frequent recording of twaite shad has come from power station impingement data. Surveys carried out at the South Humber Bank CCGT power station (Stallingborough) by Proctor *et al* (2000) and Proctor & Musk (2001) indicate that the twaite shad is present in the Humber Estuary in relatively low abundance. The 1999 site survey recorded 15 twaite shad during the 12 month survey period with the species initially being recorded during March. No individuals were recorded between April and June. The species subsequently occurred more frequently between July and the end of November, although it never represented more than 0.01% of the total assemblage or 0.7% of the total biomass. The higher biomass indicates that the majority of twaite shad impinged during 1999 were large, mature individuals with the occasional younger adult. The smallest specimen recorded measured 215mm and weighed 0.216g, compared to the largest individual weighing 0.941g. However, the greater number of larger and more mature fish produced an average weight of 0.724g. No juveniles were recorded within the fish assemblage impinged by the power station from the Humber Estuary.

The 2000 survey recorded eight twaite shad in total, with the average size of specimens decreasing by approximately 40% when compared to 1999 survey period. The community structure of those individuals recorded at the power station indicates that the large mature adults which dominated the assemblage during 1999 were largely replaced by younger adults during 2000.

The lack of juvenile specimens recorded within the impinged assemblage does not necessarily indicate that there is an absence of spawning stock or potential for a limited spawning stock presence within the Humber Estuary and/or its tributaries. However, the current method of sampling for fish within estuaries does not facilitate the capture of a pelagic species present in limited abundance. In particular, the majority of recent surveys have been carried out during periods of limited migratory activity (i.e. the CEFAS young fish survey in September). Surveys have concentrated on specific sites for general fish assemblage assessments and used gear that is none-selective for the twaite shad's behaviour. In addition, there has been a single recording of shad (*Alosa* sp.) within the Humber catchment, this being a single specimen recorded in the River Don in 1998 (Davies *et al* 2002).

Seasonality

Information from around the UK indicates that twaite shad enter estuaries to migrate upstream into spawning rivers between April and June. The younger males appear to enter the system first followed by the larger females and older males. The species spawn and subsequent migrate back out to sea if they survive spawning. The juveniles remain within the river system for a period of up to 12 months before migrating out to sea the following spring.

Long-term, or seasonal data for the species are extremely limited for the Humber Estuary. Using the power station impingement data recorded by Proctor *et al* (2002) and Proctor & Musk (2001), twaite shad were recorded from March through to November, although it should be noted that during the 2 year survey period, no consistent temporal distribution was

evident for the species other than during the late summer/early autumn (Proctor & Musk 2001).

Historical changes and trends

As previously noted, the twaite shad is found along the western coastline of Europe, from southern Norway to Morocco and along the eastern Mediterranean, but has declined substantially throughout Europe (Jackson & McLeod 2002). It is now virtually absent from many rivers in the UK where it once spawned and population declines in many parts of Europe have been attributed to pollution, overfishing and migratory route obstructions (Jackson & McLeod 2002).

With the exception of recent power station impingement data (Proctor *et al* 2000; Proctor & Musk 2001) few records exist of twaite shad in the Humber Estuary. However, within the UK, spawning stocks of twaite shad are known to occur in only a few rivers on the England/Wales border, flowing into the Severn estuary (Carstairs 2000) and a few rivers in Wales. No defined spawning stocks are known north of this, although the species is present in rivers flowing into the Solway Firth, south-west Scotland, where hybrids with allis shad *Alosa alosa* have been reported (Maitland & Lyle 2001).

Twaite shad migrate through the waters of the Carmarthen Bay and Estuaries cSAC to reach spawning sites in the Afon Tywi (River Tywi). The Taf-Tywi-Gwendraeth estuary is also an important nursery area for juveniles and it is likely that twaite shad feed in the inshore waters of Carmarthen Bay (Jackson & McLeod 2002). Similarly, twaite shad has long been known to spawn in the River Usk which is one of the largest rivers in south Wales. The Usk is one of only four sites in the UK where a known breeding population of twaite shad occurs (the Rivers Wye and Tywi are other SAC sites).

With respect to the River Wye (an extensive river system spanning the border between England and Wales), twaite shad have been abundant here for many years. Twaite shad often spawn at or just above the tidal limit, but in the Wye they migrate over 100km upstream with the highest spawning site being at Builth Wells. Data held by the Environment Agency indicate that, of the three selected rivers, the largest spawning areas for this species occur on the Wye (Jackson & McLeod 2002).

In addition, the twaite shad has been recorded in the inner reaches of the Dee estuary, but is considered as being rare in the Dee tributaries and is unlikely to spawn in this river. The species has been recorded in many UK estuaries and rivers, especially on the west coast, although many of these recordings are of incidental occurrence and indicate a presence rather than a spawning population.

Conservation status

The species is listed under Appendix III of the Bern Convention and Annexes II and V of the EC Habitats Directive. It is also included in Section 9(4)(a) of the Wildlife and Countryside Act (1981), (amended April 1998), which makes it an offence to intentionally obstruct access to spawning areas, or to damage or destroy gravels used for spawning. The twaite shad is also protected under Schedule 5 of the Wildlife and Countryside Act (1981). It is additionally included in the priority short list of the Steering Group Report (HMSO 1995a, 1995b).

Twaite shad *Alosa fallax*

No map as species distribution in the estuary is not known

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Migratory Fish Species

Atlantic salmon *Salmo salar*, Sea trout *Salmo trutta*, Eel *Anguilla anguilla* and Smelt *Osmerus eperlanus*.

Atlantic salmon *Salmo salarm*

Key Sites:

The River Ure, River Wharfe and River Derwent are considered potential sites for salmon migration. Similarly, Aprahamien & Robson (1995) indicate that the River Trent has an emerging run of salmonid species, although they do not specifically imply salmon. Furthermore, current Environment Agency data gives no indication of this emerging run.

Summary Status:

- Wildlife and Countryside Act: not listed.
- Habitats Directive: Annexes II and V.
- Berne Convention: Appendix III.
- Red Data Book: not listed.
- Breeding Status in the Humber: not breeding.

Description

The Atlantic salmon *Salmo salar* is a widespread anadromous species found throughout many rivers in the UK, a number of which have adult runs in excess of 1,000. The UK salmon population comprises a significant proportion of the total European stock, and Scottish rivers in particular are a European stronghold for the species (Jackson & McLeod 2002).

Adults spawn in shallow, gravel areas by excavating shallow pits called 'redds'. They prefer areas in clean rivers and streams with a swift water flow. Following a period of 1 to 6 years, the young salmon migrate downstream to the sea as 'smolts'. With their innate homing instinct, the salmon subsequently return to spawn in the river of their birth after 1 to 3 years at sea. This behaviour has resulted in genetically distinct stock between rivers and even within individual rivers, with some evidence of further genetic distinctiveness in the tributaries of large rivers (Jackson & McLeod 2002).

The ecological and hydrological characteristics of the salmon rivers vary considerably, together with the life-cycle strategies adopted by the salmon within them. There are particularly strong contrasts between northern and southern rivers, and the UK's varied climate, geology and terrain means that high diversity can be found within some of the large rivers (Jackson & McLeod 2002). The cool and wet climate in the north, often with harder, more resistant rocks and steeper slopes, results in salmon rivers that are sparsely vegetated, nutrient-poor and prone to sudden increases in flow ('spates') in response to heavy downfalls or sudden snow-melt. As a result, salmon may take several years to reach the smolt stage and migrate to sea (Jackson & McLeod 2002). However, in the south, rivers flow across

softer terrain and rocks, in a warmer, drier climate. Here, salmon often grow sufficiently quickly to smolt as yearlings.

The species is subject to many pressures in Europe, such as pollution, the introduction of non-native salmon stocks, physical barriers to migration, exploitation from netting and angling, physical degradation of spawning and nursery habitat, and increased marine mortality (Jackson & McLeod 2002).

Distribution within the Humber

To date, the Atlantic salmon *Salmo salar* has been recorded only once during fish impingement studies carried out at the South Humber Bank CCGT power station, Stallingborough (Proctor *et al* 2000), although anecdotal evidence indicates that this species has been previously observed in the power station trash pits. However, this anecdotal evidence should be treated with caution as it is likely that the species previously seen in the trash pits was the sea trout *Salmo trutta*. Environment Agency records show the salmon species being present in the Humber Estuary tributaries during 1996 when four fish were recorded in the River Ure. However, prior to this, a single fish was recorded in the River Hull in 1990 (Davies *et al* 2002).

Seasonality

The Atlantic salmon spawning 'runs' occur during April to August, with the adults migrating far upstream. Spawning usually takes place from October to December, at 5 to 6 years of age. The spent adults referred to as 'kelts' return to the sea to spawn the following year, although for many, this will be the final spawning run. The juveniles remain in freshwater as 'parr' for between one and three years before descending as smolts (Whitehead *et al* 1989).

Historical changes and trends

The salmon was frequently recorded in the River Ouse in the late 19th Century and during the early 20th Century. However, there were no further recordings until the mid 1960's and 1970's when the species was found in the River Ure, River Wharfe, together with a single fish recording from the River Trent (Davies *et al* 2002). This indicates that the Humber Estuary is not an important migratory corridor for the salmon in the context of English rivers that have significant salmon 'runs'.

Conservation status

Under the 1991 Water Resources Act, the Environment Agency has a responsibility to regulate and protect salmon from rivers to coastal waters out to the 6 nautical mile limit (Aprahamien & Robson, 1995). The salmon *Salmo salar* is listed under Appendix III of the Bern Convention and Annexes II and V of the EC Habitats Directive. Annex Va of the EC Habitats Directive describes those animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures. Similarly, Annex IIa describes animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation. It should be noted that salmon is an Annex II species only in freshwaters throughout the EU, and therefore marine and estuarine Special Areas of Conservation are excluded from selection. The Atlantic salmon is not on the IUCN Red List of Threatened Species (Hilton-Taylor 2000).

Sea trout *Salmo trutta* sub-species

Key sites:

The River Wharfe and River Ouse are considered potential sites for sea trout migration, and Aprahamien & Robson (1995) indicate that the River Trent has an emerging run of salmonid species, although it should be noted that they do not specifically imply sea trout. Furthermore, current Environment Agency data gives no indication of this emerging run.

Summary status:

- Wildlife and Countryside Act: not listed.
- Habitats Directive: not listed.
- Berne Convention: not listed.
- Red Data Book: not listed.
- Breeding Status in the Humber: not breeding.

Description

The sea trout *Salmo trutta* is a sub-species of the brown trout which bears the same scientific name (*Salmo trutta fario*). The sea trout is a widespread anadromous species found in numerous rivers within the UK. Like the salmon, it has a preference for clean rivers and streams. Adults spawn in areas of shallow gravel, excavating shallow pits, referred to as 'nests' or 'redds', and following a period of 2 to 5 years, the young sea trout migrate downstream to the sea.

The species is subject to many pressures in Europe, including pollution, physical barriers to migration, exploitation from netting and angling, physical degradation of spawning and nursery habitat, and increased marine mortality (Jackson & McLeod 2002).

Distribution within the Humber

To date, the Sea trout *Salmo trutta* has been recorded only once during fish impingement studies carried out at the South Humber Bank CCGT power station, Stallingborough (Proctor *et al* 2000), although anecdotal evidence suggests that this species has been previously observed in the power station trash pits. Current fisheries information (G. Bartlett pers. comm. 2002) indicates that over the last 2 or 3 years there has been a strong run of sea trout along the adjoining coast. Up to date Environment Agency data, indicate that the sea trout was recorded in the River Wharfe as recently as 1997 and in the River Ouse during the years 1991, 1992 and 1996 (Davies *et al* 2002).

Seasonality

The sea trout spawning 'runs' take place during spring, summer or autumn, but in general, occur from September/October to January, with adults between 3 and 4 years of age migrating upstream to spawn between October and January. Spent adults return to the sea to spawn the following year. The juveniles remain in freshwater for up to 5 years before descending to the sea (Whitehead *et al* 1989).

Historical changes and trends

The sea trout was recorded consistently at the confluence of the River Humber and the River Ouse during the early 19th Century and between the 1920's and the 1950's. There are no other recordings until the mid 1960's from the River Ouse at Selby and from the outer Humber Estuary at Tetney Haven (Davies *et al* 2002).

Conservation status

Under the 1991 Water Resources Act, the Environment Agency has a responsibility to regulate and protect sea trout in rivers to coastal waters out to the 6 nautical mile limit (Aprahamien & Robson, 1995). The sea trout *Salmo trutta* is subject to a closed season and minimum landing sizes are in place where the species is targeted by commercial static netsmen. The sea trout is not on the IUCN Red List of Threatened Species (Hilton-Taylor 2000).

Eel *Anguilla anguilla*

Key sites:

Frequently occurring throughout the Humber region, although possibly in decline in the River Ouse (Aprahamiem & Robson 1995).

Summary status:

- Wildlife and Countryside Act: not listed.
- Habitats Directive: not listed.
- Berne Convention: not listed.
- Red Data Book: not listed.
- Breeding Status in the Humber: not breeding.

Description

The eel *Anguilla anguilla* is a widespread catadromous species found in the majority of rivers in the UK. The eel larvae as 'leptocephali' travel in Atlantic surface waters from the Sargasso Sea, for approximately 2 to 3 years to rivers and estuaries surrounding the UK, Europe and the North Western Atlantic. The eels usually migrate into freshwater, following metamorphosis in brackish water systems, as elvers where they remain for many years. However, not all eels migrate into freshwater and some, predominantly males, remain along the inshore coastal margins (Wheeler 1969).

Whilst in freshwater, the elvers grow into the adult form, feeding on bottom dwelling invertebrates such as molluscs and insect larvae. Crustaceans and fish are rarely eaten but may form part of the diet of larger adult fish (Wheeler 1969).

The adults, commonly referred to as 'silver eels' during the spawning migration, leave river systems to return to the Sargasso Sea. Males generally migrate to spawning grounds at approximately 9 years of age and the females at 12 years. They appear to begin the

migration during autumn, and movement is largely confined to moonless or dark nights and usually in flood water. During this period, eels may occasionally travel for short distances overland when the ground is wet following heavy rainstorms. In September and October, silver eels can be abundant at river mouths and it is during this period when they are most susceptible to capture in fixed traps (Wheeler 1969).

Silver eels subsequently undergo a final metamorphosis at the onset of the spawning migration. The eyes enlarge, the jaws weaken, the gut atrophies and the gonads increase in size. As a consequence, the eel no longer feeds.

It is thought that the eels travel mid water to the spawning grounds in the Sargasso Sea and spawning takes place during spring and early summer. After spawning it is assumed the eels die.

The species is a valuable food fish within European waters and as a consequence is subject to significant commercial pressure. Due to eels spending long periods in freshwater, and local fisheries being dependent on recruitment from migrating elver into the local river systems, they are highly susceptible to over-exploitation from netting and angling and increased marine mortality (Wheeler 1969).

Distribution within the Humber

The eel has been frequently recorded during fish impingement studies carried out at the South Humber Bank CCGT power station, Stallingborough (Proctor *et al* 2000; Proctor & Musk 2001). However, as the species tends to migrate along the low water margins and the power station intakes are sited in the deep water channel, it is probable that the impingement data are not a true reflection of the level of migratory activity. Current Environment Agency data indicate that eels are reasonably common in most of the major freshwater systems classed as tributaries of the Humber Estuary (Davies *et al* 2002).

Seasonality

The eel spawning migrations occur during autumn, but generally commence during September/October. Spawning takes place from spring to early summer. Following their migration across the Atlantic, the leptocephali enter estuaries on North Sea coasts in March and April (Whitehead *et al* 1989).

Historical changes and trends

Historically, the eel has been recorded throughout all of the Humber Estuary tributaries with a fishery on both banks of the River Humber (New Holland, Barton and East Halton on the South Bank and Sammy's Point, Paull and Hessle on the North Bank). However, the fishery is now limited to a few operators with a small number of nets and probably indicates that the eel is in decline within the Humber Estuary.

Conservation status

Under the 1991 Water Resources Act, the Environment Agency has a responsibility to regulate, protect and monitor eel fisheries from rivers to coastal waters out to the 6 nautical mile limit. There are no current protective/conservations measures for the eel other than

minimum landing sizes where eels are taken for commercial fishing purposes. The eel is not on the IUCN Red List of Threatened Species (Hilton-Taylor, 2000).

Smelt *Osmerus eperlanus*

Key Sites: No specific key areas are identified for the smelt.

Summary status:

- Wildlife and Countryside Act: not listed.
- Habitats Directive: not listed.
- Berne Convention: not listed.
- Red Data Book: not listed.
- Breeding Status in the Humber not breeding.
- Listed under the IUCN Red List of Threatened Species as data deficient (DD). Currently, there is inadequate information available on the species to make a direct, or indirect, assessment of its status based on its distribution and/or population (Hilton-Taylor, 2000).

Description

The smelt *Osmerus eperlanus* is a small anadromous fish species which has a widespread distribution throughout the North Atlantic and European waters from the White Sea southward to western coast of France (including Baltic Sea, southern North Sea and British Isles). However, despite this widespread distribution, the smelt is considered to be amongst several of the most threatened species in UK waters.

The adults congregate at the mouths of rivers during winter and enter rivers during early spring. Spawning occurs during this period in estuarine or slightly brackish waters, after which, the adults return to the sea or outer estuary. The young tend to remain within the estuary for the remainder of the summer (Wheeler 1969).

The current lack of knowledge regarding the geographical distribution and likely spawning potential of the species within English estuaries does not allow for a specific evaluation to be undertaken on its current status. English Nature are in the process of awarding a research contract to better define the special and temporal distribution of smelt in English estuaries and riverine systems.

Distribution within the Humber

The smelt has been frequently recorded during fish impingement studies carried out at the South Humber Bank CCGT power station, Stallingborough (Proctor *et al* 2000; Proctor & Musk 2001). The assessed abundance during the 1999 survey was 762 with a total biomass of 31.6kg. Smelt was recorded throughout the year, although its abundance peaked during late spring and early summer (April to June). For the survey carried out during 2000 (Proctor & Musk 2001), the smelt occurred less frequently, with an estimated total annual impingement of 390 and a total biomass of 12.13kg. The smelt was most abundant during January to March and was absent during the late summer (July to September), however, these

differences in distribution for the survey years 1999 and 2000 may be accounted for by the reduction in sampling effort during the survey period 2000.

Environment Agency data show that the smelt has been recorded in two ponds on the south bank of the Humber during the 1950's and there are two occurrences on the north bank at Melton Waters and Hedon Haven (Davies *et al* 2002). There are no recordings of the species in freshwater or tidal upper estuarine sites.

Seasonality

The adult smelt spawn in early spring (February to April). The juveniles remain throughout summer and migrate to the inshore coastal margins by autumn (Whitehead *et al* 1989).

Historical changes and trends

There is little or no historical evidence regarding the smelt, other than that most UK and European estuaries contained fisheries, and that these have severely declined with a few small scale fisheries left on the European continent.

Conservation status

Within the IUCN Red List of Threatened Species the smelt is listed as data deficient (DD). This designation is applied to a species when there is inadequate information to make a direct, or indirect, assessment of its status based on its distribution and/or population (Hilton-Taylor, 2000). Data deficient is therefore not a category of threat or lower risk. The assignment of smelt in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. The smelt has no other current conservation status within the UK

Migratory Fish

No map as species distribution in the estuary is not known

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7. Marine Invertebrates

Intertidal Invertebrate Communities

Description

The intertidal invertebrate communities within estuaries may be divided into infaunal and epifaunal components. The infauna being generally described as; those invertebrate organisms that live in the sediments below the surface of the seabed, as opposed to the epifauna, which live on the surface and in some species, have far greater mobility.

The density and diversity of invertebrate species within intertidal zones are usually dictated by environmental parameters and the nature of the substratum. Salinity is a limiting factor for many species, in that, those with a tolerance of more saline waters (stenohaline marine organisms) will be found towards the outer estuary and invertebrate species with a low tolerance of elevated salinity (oligohaline freshwater species), will be found towards the head of the estuary and into freshwater river systems. Between these two zones of varying salinity are those organisms that are able to tolerate a wider range of salinities, these organisms are said to be euryhaline.

Sediment type, tidal height and hydrology are also important factors influencing the abundance and range of species found. Specific sediments will produce common community types with the nature of the sediment, tidal height and local hydrology dictating the abundance observed. The intertidal invertebrate communities are adapted to the harsh environment produced by the variable physico-chemical regime and suspended sediment inputs from the coast and freshwater flows from tributaries.

Distribution within the Humber

Infauna

The intertidal zones of the upper Humber Estuary are comprised primarily of extensive mud/sand banks which are exposed at low water. The upper Humber Estuary can be defined as being from Trent Falls to Hessle on the North bank and to Barton-on-Humber on the South bank.

The fauna can be described as paucid in that the diversity is typically low and dominated by a few species that are well adapted to low salinity, principally the oligochaete worm species; *Paranais litoralis*, and *Heterochaeta costatus*, although the abundance of these oligochaetes can be extremely high. The ragworm *Nereis (Hediste) diversicolor* is often present in moderate abundance, from the upper reaches of the estuary to the outer estuary and together these animals comprise the MNCR biotope LMu.HedOl. A full list of biotope codes found within the Humber Estuary can be seen in Table 20 within the Habitats and Features section at the end of this report. Areas of low salinity sand with oligochaetes (LSa.Ol) and barren shingle (LSa.BarSa) have also been reported in the upper estuary. This extensive distribution within the estuary illustrates its ability to tolerate a wide range of salinities and as such is classified as a typical estuarine species (McLusky 1989).

Within the upper estuary the densities of invertebrates are higher on the upper and mid shore than on the lower shore (Barnett 1984), due to the fact that the lower shore consists of fluid

mud due to continuous reworking of sediments by wave and current action. Anderson (1976) showed that lower shores of tidal mudflats are subject to constant resuspension and deposition whereas the upper shore is generally subjected to deposition of particulate matter.

The middle part of the estuary has an increased diversity in comparison to that observed in the intertidal flats of the upper Humber Estuary. The middle estuary covers the area from Hessle to Hawkins Point (north bank) and Barton-on-Humber to Doverstrand (south bank). The intertidal invertebrate communities within this stretch of the Humber include species previously described as oligohaline (freshwater-brackish), euryhaline (tolerant species) and stenohaline (marine). As the mid estuary overlaps with the upper and outer stretches, species of limited tolerance are found on the periphery towards their upper and lower limits of salinity tolerance. The diversity is increased with the presence of salinity tolerant species and it is these euryhaline species that contribute the greater part of the total abundance (McLusky 1989).

The dominant taxa are the oligochaete worms; *Tubificoides benedii* and *Paranais litoralis,* the polychaetes worms; *Nereis (Hediste) diversicolor* (ragworm)*, Pygospio elegans, Streblospio shrubsoli* and *Nephtys hombergii* (Catworm), the bivalve mollusc; *Macoma balthica* (Baltic tellin) is common on both banks whilst the gastropod *Hydrobia ulvae* (laver spire shell) is increasingly more common on the north bank than the opposing shore. These species generally form a range of sandy-mud biotopes corresponding to LMu.HedMac (with sub-biotopes LMu.HedMacStr, HedMacScr) and LSa.MacAre and mud biotopes corresponding to LMu.Hed.Str, LMu.Hed.Cvol and LMU.Hed.Ol. When sampling intertidal zones, workers have become increasingly aware that a number of species may be extremely variable in their distribution and density over time. An example of this is the amphipod *Corophium volutator* which has been absent from a number of sites within the Humber Estuary during the 1980's but following an estuary-wide immigration has consistently remained abundant at certain sites during subsequent years (Scott 1996).

The outer estuary intertidal zones exhibit the greater diversity with the influx of stenohaline marine species, although generally these species are present in low abundance. In addition, a greater variety of substrata are present towards the mouth of the estuary (where expansive sand flats adjoin the mudflats) and this also leads to an increase in species diversity in the outer estuary. Mussel beds at Spurn Bight and at the low water margins at Cleethorpes also contribute to the overall variety of substrata and as a consequence support a higher diversity than observed in the upper and middle reaches of the estuary. Typical outer estuarine infaunal species include polychaetes such as *Nereis* (*Hediste) diversicolor* (ragworm), *Arenicola marina* (lugworm), *Tharyx* spp., *Aphelochaeta* spp. *Nephtys cirrosa* (catworm), *Eteone longa/flava* and *Polydora* spp., amphipods such as *Bathyporeia* spp. and *Pontocrates* spp. and bivalves such as *Scrobicularia plana*, *Retusa obtusa* and *Cerastoderma edule* (cockle) (Halls 1986; May 1994; Bishop 2000). These species form a range of biotopes including LSa.CerPo and LSa.MacAre in muddy sands, LMU.HedMac, LMu.HedMacStr and LMU.HedMacScr in sandy-muds and muds, and LSa.AmSco.Eur, LSa.AmSco.Pon, LSa.Po and LSa.Lan in sandy habitats.

Epifauna

The epifaunal communities present within the Humber Estuary are essentially dominated by highly mobile species. Whilst salinity is a limiting factor in the distribution of these species, substrata is not so limiting for the mobile species. It is however, a mitigating factor for the

paucity of sessile species. The high deposition of sediment in the Humber ensures that there are very few intertidal sites that offer favourable settlement to sessile epifaunal species, those that are present are usually man-made; sea defences, pier & jetties, cranches and debris from construction (both new & old). The greater diversity of sessile organisms occurs in the mid to outer estuary with the barnacles *Balanus improvisus* and *Elminius modestus* the dominant components. Recent subtidal research by IECS indicates that since 1996 *Elminius modestus* has out-competed *Balanus improvisus* (Cutts 1998). *Sagartia* spp. (anemones) are relatively common on the mussel beds at Spurn Bight and *Gammarus* spp. (sand-hoppers) are abundant where fucoid seaweeds such as *Fucus vesiculosus* (Bladder-wrack) are common (Proctor *et al* 1998).

Whilst the majority of epifaunal species are to be found exclusively in the subtidal, the estuarine intertidal zones do support a number of epifaunal species, although this is limited to a few abundant species, principally the green shore crab (*Carcinus maenas*), brown shrimp (*Crangon crangon),* and where a hard substratum dominates; the sea slater (*Ligia oceanica)*. Mysid species will migrate across the intertidal zone during flooding tides, however, these species are principally subtidal and as such are not discussed at length (Hayward & Ryland 1990).

Generally the south bank intertidal fauna is comparable to that of the north bank, however, it is probable that any major specific differences may be accounted for by variable effects of hydrology on both banks of the Humber Estuary and different sediment characteristics. In addition, the analysis of samples for each bank of the Humber Estuary are carried out by different agencies, therefore, there are likely to be differences in approach and level of taxonomic discrimination.

Seasonality

The seasonality of intertidal invertebrates is difficult to ascertain as all data is collected at the same time each year, however, it is likely that reproduction and recruitment occur during the late spring and summer months (May to September). Historically, all surveys have been carried out to avoid this period, in order to establish stable community types and densities.

Historical changes and trends

There are long term datasets for intertidal invertebrates for both the north and south banks and these datasets indicate that there has been no apparent reduction in the structure of intertidal communities within the Humber Estuary. These datasets will continue to contribute significant understanding of the functioning of these communities in addition to maintaining the monitoring strategies in place.

The recent improvement in taxonomic literature has meant taxonomists are better able to define species which until recently were left at a low level of discrimination, consequently intertidal communities are being better described with a resultant increase in species diversity.

It has been well documented that infaunal invertebrates can be sporadic in their distribution across mudflats. This is especially the case where currents are variable and as a consequence the nature of the sediment is affected. A major factor in the distribution of invertebrates and the structure and functioning of intertidal communities has been the input of organic and in-

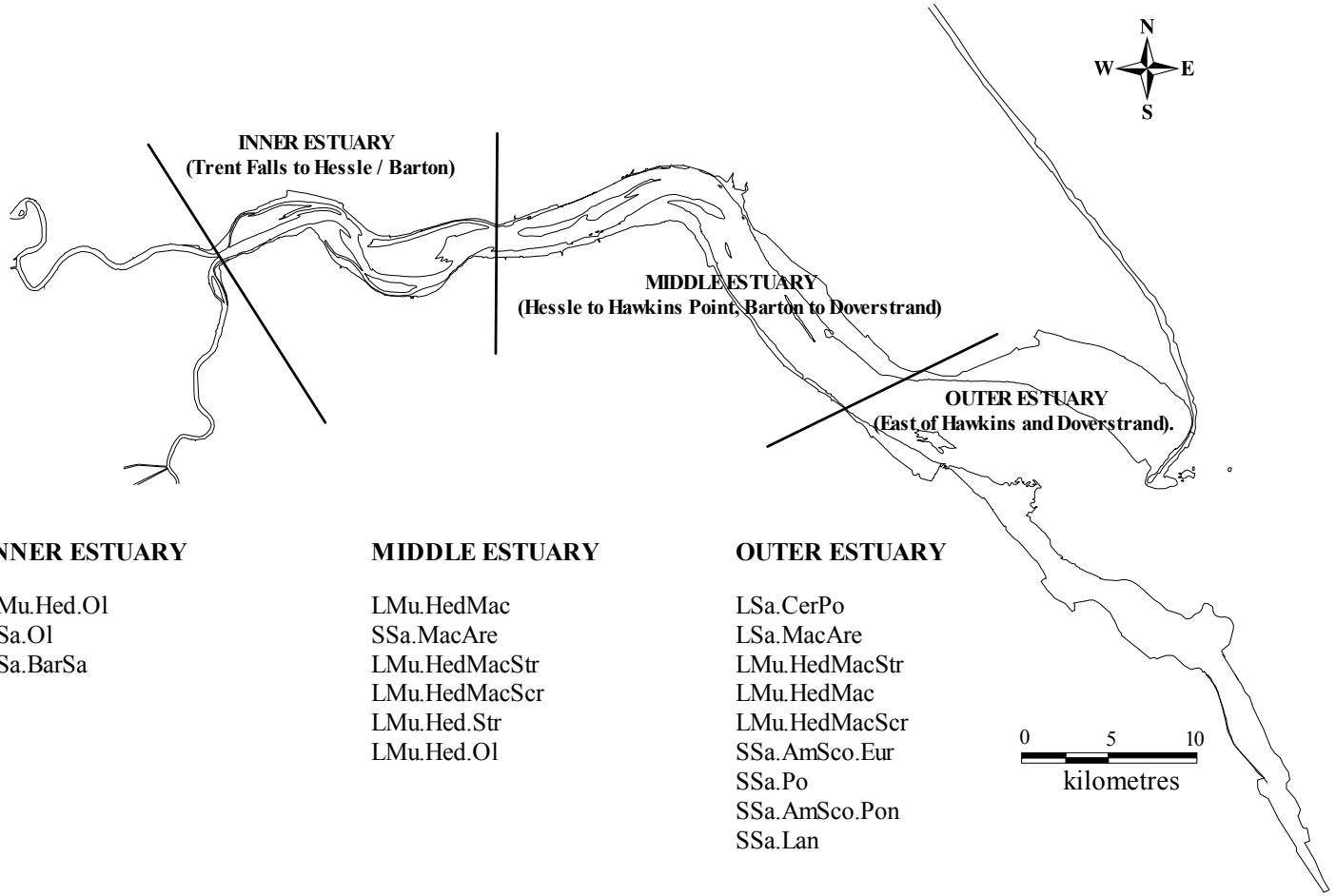
organic material across the intertidal zone. Where these inputs have been high, specific communities have been identified based on the dominant indicator species present. The middle estuarine *Capitella capitata* community was indicative of such a community driven by organic inputs (Barnett 1984). As these inputs were reduced the community structure changed, as in the case of *Capitella capitata*, which had almost disappeared from the intertidal invertebrate assemblage by the 1990's, after being the dominant component of the intertidal community of the middle estuarine monitoring sites (Environment Agency Data 1981-1991). On the south bank in the Grimsby area there was also a decline in pollution tolerant organisms such as *Capitella capitata* following the closure of the nearby intertidal sewage outfall in November 1986 (National Rivers Authority 1993).

In recent years there have been a number of occurrences of non-native species, principally the Chinese mitten crab (*Eriocheir sinensis*) which has been recorded in the River Ancholme. This species builds burrows in mud banks and lives in freshwater rivers, migrating into brackish water to spawn. Current concerns are based on the destruction of river banks which have sea defence implications and out-competing the green shore crab (*Carcinus maenas*) and other estuarine macrofaunal invertebrates (Clark *et al* 1998).

Conservation status

The intertidal invertebrate communities will be included under existing SSSI, SPA and Ramsar designations which cover significant areas of the intertidal habitats in the Humber. In addition, species such as the tentacled lagoon worm *Alkmaria romijni* which has been found at Barton, New Holland, East Halton and Killingholme is listed as scarce in the UK and is also listed under the UK Biodiversity Action Plan. As the intertidal invertebrate communities provide a valuable food source for other bird and fish species of conservation interest inhabiting the intertidal zone the invertebrate communities will also be included in any future designations of the area as a SSSI, SPA, Ramsar or other site of scientific or conservation value . Furthermore, the intertidal mudflats and sandflats not covered by the tide at low water are an interest feature in their own right under the Habitats Directive and as such the intertidal invertebrate communities would require monitoring should the Humber become a Special Area of Conservation (SAC).

Possible Intertidal Biotopes, Sectional Assessment Based on Text.



INNER ESTUARY	MIDDLE ESTUARY	OUTER ESTUARY
LMu.Hed.Ol	LMu.HedMac	LSa.CerPo
SSa.Ol	SSa.MacAre	LSa.MacAre
SSa.BarSa	LMu.HedMacStr	LMu.HedMacStr
	LMu.HedMacScr	LMu.HedMac
	LMu.Hed.Str	LMu.HedMacScr
	LMu.Hed.Ol	SSa.AmSco.Eur
		SSa.Po
		SSa.AmSco.Pon
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Subtidal Invertebrate Communities

Description

Subtidal benthic communities comprise of the plants and animals living in, on or near those areas of the sea floor which are permanently covered by water (i.e. below the lowest astronomical tide). Together with the intertidal benthic communities they form one of the most important components of the marine ecosystem (Holme & McIntyre 1984) and in the Humber form the main prey items for the fish and avifaunal populations in the area. Conventionally the benthos has been subdivided on the basis of size (primarily with regard to the zoobenthos) into microbenthos (<0.1mm) which includes bacteria, unicellular algae and the protozoa, meiobenthos (0.1 to 0.5 or 1mm) which includes small crustacea (e.g. copepods and some amphipods), molluscs and worms (e.g. nematodes), macrobenthos (>0.5 or 1mm) which includes the larger polychaetes, crustacea, shellfish and echinoderms and megabenthos e.g. the large decapod crustacea and demersal fish.

The Humber has been proposed as a Special Area of Conservation under the EC Habitats Directive with regard the Annex 1 habitat 'Estuaries'. The subtidal habitats (and associated communities) form an important sub-feature of the estuary (the primary interest feature) particularly with regard to function and include subtidal sandbanks (which are an interest feature in their own right under the Habitats Directive), subtidal gravels and mixed sediments and subtidal muds, clays and glacial till. The subtidal environment makes up approximately 55% of the total area of the Humber (16800 ha) and is highly variable and dynamic both spatially and temporally with regard environmental parameters such as salinity, sediment type, hydrodynamic regime, sediment load, turbidity and dissolved oxygen/organic load. Such factors vary seasonally and also daily due to the change in tidal regime. Consequently the subtidal communities of the Humber are subject to considerable stress from both natural fluctuations in the above parameters and anthropogenic change e.g. due to sewage/industrial waste disposal and dredging activities.

In general, the community structure of the subtidal environment is governed primarily by the salinity gradient and also by hydro-physical conditions e.g. tidal currents which regulate to some extent the sedimentary environment and control the supply and distribution of food, planktonic larvae, suspended sediment and water borne pollutants (Snelgrove & Butman 1994; Pethick 1988). Local variation may also occur due to changes in organic loads, freshwater input etc. and the degree of variation in the hydro-physical/chemical regime mean that the subtidal communities are also highly variable. In terms of the macro-benthos the estuary can be split into four main regions corresponding to the upper, middle, lower and outer estuary (Environment Agency 1994). These regions correspond primarily to changes in salinity and within these regions variation in community structure are correlated to tidal current strength and sediment type. As in most estuaries the diversity of the subtidal environment is typically quite low and many areas are populated by relatively few taxa often in high abundance and in general terms species diversity increases towards the mouth of the estuary where more marine conditions are encountered.

Assemblage distribution

Broad scale monitoring of the macro-infauna inhabiting the subtidal regions of the Humber Estuary has been carried out by the Environment Agency over the past 20 years and has revealed a number of communities in the Humber which are relatively consistent over time.

These communities are illustrated in the accompanying map. In the upper reaches of the Humber, from Trent Falls to Hull, the subtidal sedimentary environment is primarily comprised of fine sand or slightly muddy fine sand which is subject to a degree of tidal current action, particularly in the main channels. This in conjunction with the low salinity in this region has led to the development of a typical upper estuary impoverished sand/muddy sand community. This community has relatively few species, particularly in the upper reaches (averaging between two to five per $0.3m^2$) and low abundances (typically averaging between 15 to 55 individuals per $0.3m^2$). Generally, due to the low numbers of animals no one species dominates such habitats but typically mysid crustacea (opossum shrimps) such as *Neomysis integer* and amphipods (sand hoppers) such as *Gammarus* spp. are characteristic of this habitat (MNCR biotope SSa.NintGam - a full list of biotope codes found within the Humber Estuary can be seen in Table 20 within the Habitats and Features section at the end of this report). Other important species include the rag worm *Hediste diversicolor* and periodically oligochaetes such as *Limnodrilus hoffmeisteri* may be important. This community extends further down the Humber as far as Hull with the upper limits of this community generally somewhere between Barton-upon-Humber and Hull Docks.

Further downstream east of Hull and stretching down to the lower region of the estuary at Immingham a 'mid-estuary' community is prevalent. This community is also subject to moderate to strong tidal currents in the main channels but adjacent to these slightly more settled areas of sand or muddy sand are present. This area falls between the reduced salinity habitats further up the estuary and the more marine influenced habitats downstream and as a consequence is noteworthy of having had components of both upper and lower estuary communities. It also marks a transition zone where the subtidal assemblage shifts from being dominated by reduced salinity tolerant mobile crustacea to being dominated by infaunal polychaetes (Allen 2001) and can be described as a transitional sand/muddy sand community.

In addition, occasional numbers of estuarine tolerant marine taxa are also present here. The number of species in this community average from between 5 to 10 per $0.3m^2$. The total abundance of the infauna is generally slightly higher than the upper estuary community and averages between 80 to 200 individuals per $0.3m^2$. Dominant species are the polychaetes *Capitella capitata* and *Arenicola marina* with mysid and gammarid crustacea present in lower numbers (SSa.EstMoSa & SSa.Ncir in sandier areas and SMu.Cap in muddier habitats). Other important taxa in muddier habitats include the Baltic tellin *Macoma balthica*, the oligochaete *Tubificoides benedii* and the marine polychaete *Eteone longa* (Environment Agency 1980-1995).

In the lower region of the estuary between Immingham and Cleethorpes a variety of habitats are found with areas of hard ground or coarse gravels, gravelly-sands and cobbles in the main channels where strong tidal currents have scoured the estuary floor. Adjacent to these areas are tide swept marine/variable salinity sands and areas of consolidated nearshore mud and sandy/gravelly-mud. Species richness in this area is variable but generally higher than further upstream and species abundance is also highly variable. The tideswept marine sands generally have <100 individuals per $0.3m^2$ and 5 to 15 species per $0.3m^2$ and the nearshore muds and gravelly or sandy-muds often have in excess of 3000 animals per $0.3m^2$ and species richness of 20-30 taxa per $0.3m^2$. The areas of hard ground and coarse sediment have been relatively poorly surveyed, although it is likely that they are dominated by encrusting fauna such as hydroids, bryozoa, ascidians and serpulid worms such as the keel worm *Pomatoceros* spp. on the cobbles/rock. The mobile marine/variable salinity sands are

dominated by polychaete worms such as *Nephtys* spp., the isopod *Eurydice pulchra*, the polychaetes *Ophelia limacina* and *Glycera* spp. and various spionid polychaetes e.g. *Spio filicornis, S. martinensis* and *Spiophanes bombyx* (SSa.Ncir and SSa.MoSa). The nearshore mud and gravelly/sandy mud communities are much more stable with a diverse community often with high numbers of *Polydora* spp. and *Pygospio elegans* along with cirratulid polychaetes such as *Tharyx* spp. and *Aphelochaeta* spp. and the tubificid oligochaete *Tubificoides benedii* (SMu.PcilCvol & SMu.AphTub in muddier areas and variants of SMx.AphPol/SMx.CreMed in mixed substrata). Sandier muds found in this region with lower numbers of *Polydora* spp. may be dominated by *Nephtys hombergii* and in some areas *Phoronis muelleri* or *Corophium volutator* may periodically become dominant (SMu.NhomTub). *Macoma balthica* may be also prevalent in such habitats (SMu.NhomMac) particularly nearer the shore (Environment Agency 1980-1995).

In the outer estuary around Spurn Head the mobile marine sands in and around the main channels described above are accompanied by more stable marine sands and slightly muddy sands. Due to higher, more stable salinities these habitats are often more diverse than those upstream due to the influx of truly marine taxa (which are present in low numbers) and consequently the numbers of species in this area may reach 30-40 taxa per $0.3m^2$ although on average 10 to 20 taxa per $0.3m^2$ is more typical. Abundances may vary considerably with average abundances ranging from 50-300 individuals per 0.3 m^2.

The dominant taxa in these areas are the spionid polychaetes, *Spio filicornis*, *S. martinensis* and *Spiophanes bombyx* but they are accompanied by more marine species such as haustoriid and oedicerotid amphipods e.g. *Bathyporeia* spp. and *Pontocrates* spp. (SSa.NcirBat) along with the polychaetes *Nephtys cirrosa, Glycera* spp., *Chaetozone setosa, Scoloplos armiger, Eteone longa* and the bivalve *Abra alba* (Environment Agency 1980-1995). In the mid to outer estuary there are periodically high numbers of the juvenile mussel *Mytilus edulis* presumably following recruitment from the relatively small populations of intertidal mussel beds between Grimsby and Cleethorpes and at Spurn (Gameson 1982) or from outside the estuary.

Beyond the mouth of the estuary the seabed is characterised by coarse gravels, shell and cobble with bryozoans such as the hornwrack (*Flustra foliacea*), the horse mussel *Modiolus modiolus*, areas of the reef forming polychaete *Sabellaria spinulosa* and a variety of mobile and sessile epifauna (Barne *et al* 1995).

In terms of mobile epifauna, mysids and shrimp dominate the upper to mid estuary with species such as *Gammarus* spp., *Neomysis integer* and to a lesser extent *Crangon crangon* dominant. Towards the mouth of the estuary *Neomysis* and *Gammarus* disappear with an increase in other species of crustacea e.g. the shore crab *Carcinus maenas* and other mysids such as *Gastrosaccus spinifer* and *Schistomysis* spp. *Crangon crangon* is present throughout the estuary but also shows a slight increase in numbers towards the lower reaches of the Humber (Gameson 1982).

Seasonality

In terms of the macro-infauna, relatively little data is available for the subtidal populations as most surveys are repeated at the same time of year (usually in the spring or autumn) to avoid biases in data caused by recruitment. Obviously this implies a seasonal increase of juveniles during the summer months and an influx of juvenile species from outside the estuary may

also be evident. The periodic spats of *Mytilus edulis* mentioned in the previous section are an example of this whilst the spionid worm *Polydora* has exhibited enormous increases in numbers over the summer months. Seasonal variation in numbers of oligochaetes have been observed in the upper reaches of the estuary with species more commonly associated with freshwater habitats e.g. *Tubifex tubifex, Nais elinguis* and *Limnodrilus hoffmeisteri* appearing in subtidal samples at certain times of year. This has been correlated with an increase in downstream drift due to increased freshwater inflow rather than due to recruitment (Gameson 1982). Mobile epifaunal taxa such as *Neomysis integer* and *Gammarus* spp. show distinct seasonal variation due to a high over-wintering mortality whilst *Crangon crangon* may exhibit periodic fluctuations due to seasonal migration (Tiews 1970). In general most subtidal invertebrates will show a reduction in numbers over winter months and species inhabiting the outer areas of the estuary may exhibit some seasonal variation due to storm events over the winter and spring months. In the very outer estuary around Spurn and further north to Easington, periodic sedimentary disturbance due to high tidal flows, and wave action due to storm events and the prevailing winds make the benthic infauna extremely difficult to monitor due to their extremely high natural variability (Allen 2000).

Historical changes and trends

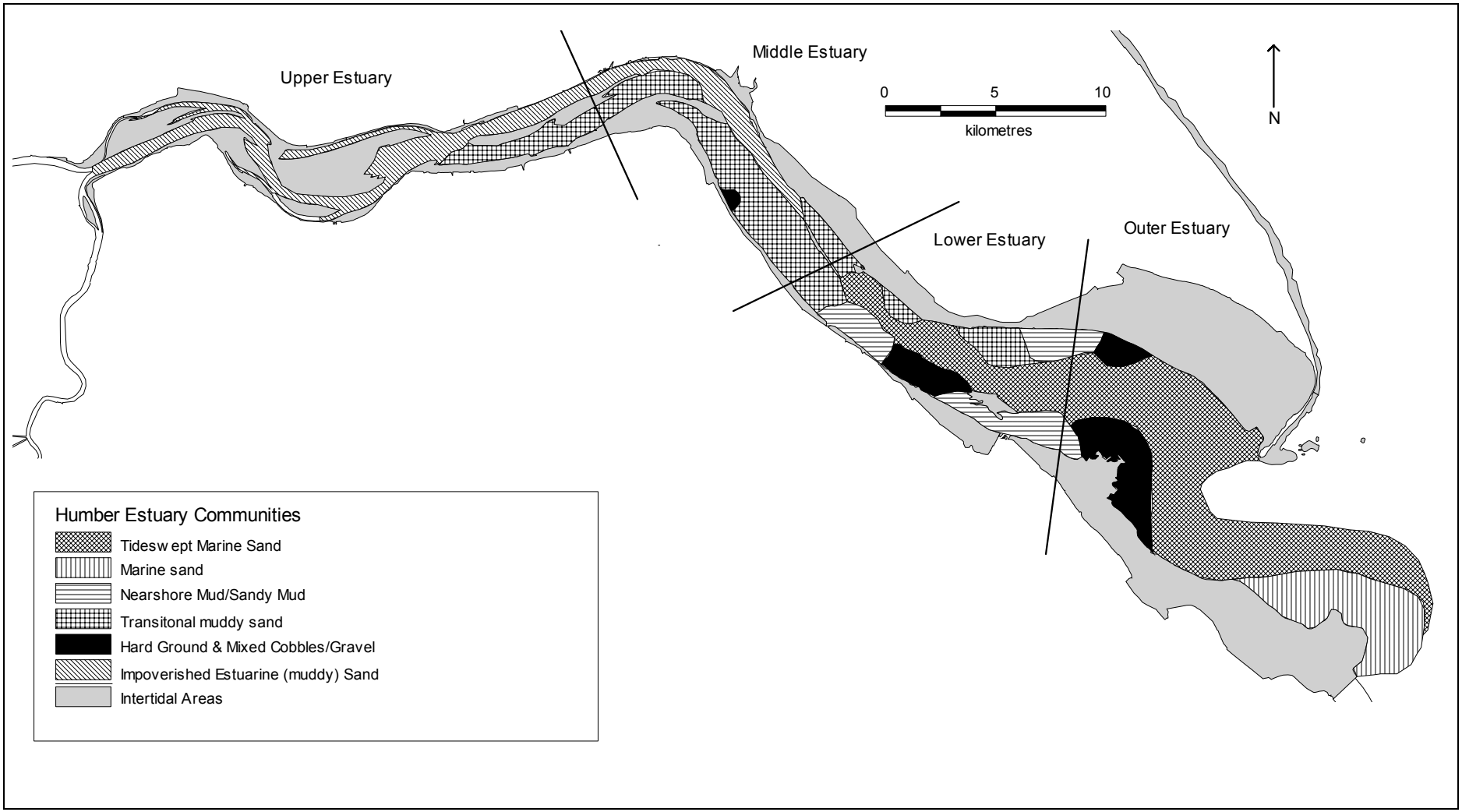
Numerous surveys over the last 30 years have been carried out in the Humber although in many cases long term historical data does not exist with the exception of the Environment Agency's quinquenial and annual routine monitoring stations. Information from these surveys indicate that in general terms the subtidal populations of the Humber are relatively stable with four main estuary regions based on salinity and communities further structured by sediment type. However, survey data between 1980 to 1995 indicate that whilst the main communities outlined in the previous sections are prevalent, the communities present in the four main estuary regions show a degree of fluctuation due to either change in the salinity regime/increased annual river flow, movement of the subtidal sediments and channels and stochastic variation in recruitment. Consequently the degree of dominance by key taxa may vary considerably year on year and given the dynamic nature of the estuary this is understandable. This is illustrated by the accompanying figures which highlight the main subtidal communities between 1980 and 1995. For example, data from 1985 showed an influx of more marine taxa up into the upper reaches of the estuary where taxa such as the amphipod *Dyopedos monacanthus* and the isopod *Eurydice pulchra* dominate the upper estuary sand community in place of more typical estuarine taxa such as *Gammarus* spp. and *Neomysis integer* (Environment Agency 1980-1995). Between 1980 and 1990 the upper estuarine, reduced salinity, mobile sand community was also reported to have reduced in range as far as Read's Island (NRA 1993) and this is evident in the following map although data from 1995 indicates that this community has subsequently expanded again.

In addition, certain taxa such as *Corophium volutator* and *Polydora* spp. have historically fluctuated enormously and in some areas of the Humber (and nationally) *Corophium* disappeared completely or showed a significant reduction during the 1980's and in the lower Humber was replaced by species such as *Polydora* (Gameson 1982; Environment Agency 1992). Numbers of *Capitella capitata* in the middle estuary have also varied over the past 20 years with highest numbers recorded in 1991-1992 (Environment Agency 1994). In some areas this may be due to an increase in organic loadings to the subtidal due to the effects of newer long sewage outfalls redistributing organic matter from the intertidal to the subtidal but also due to the low freshwater flows in these years. *Capitella* has been a dominant species for many years in the middle estuary, particularly in the intertidal and shallow

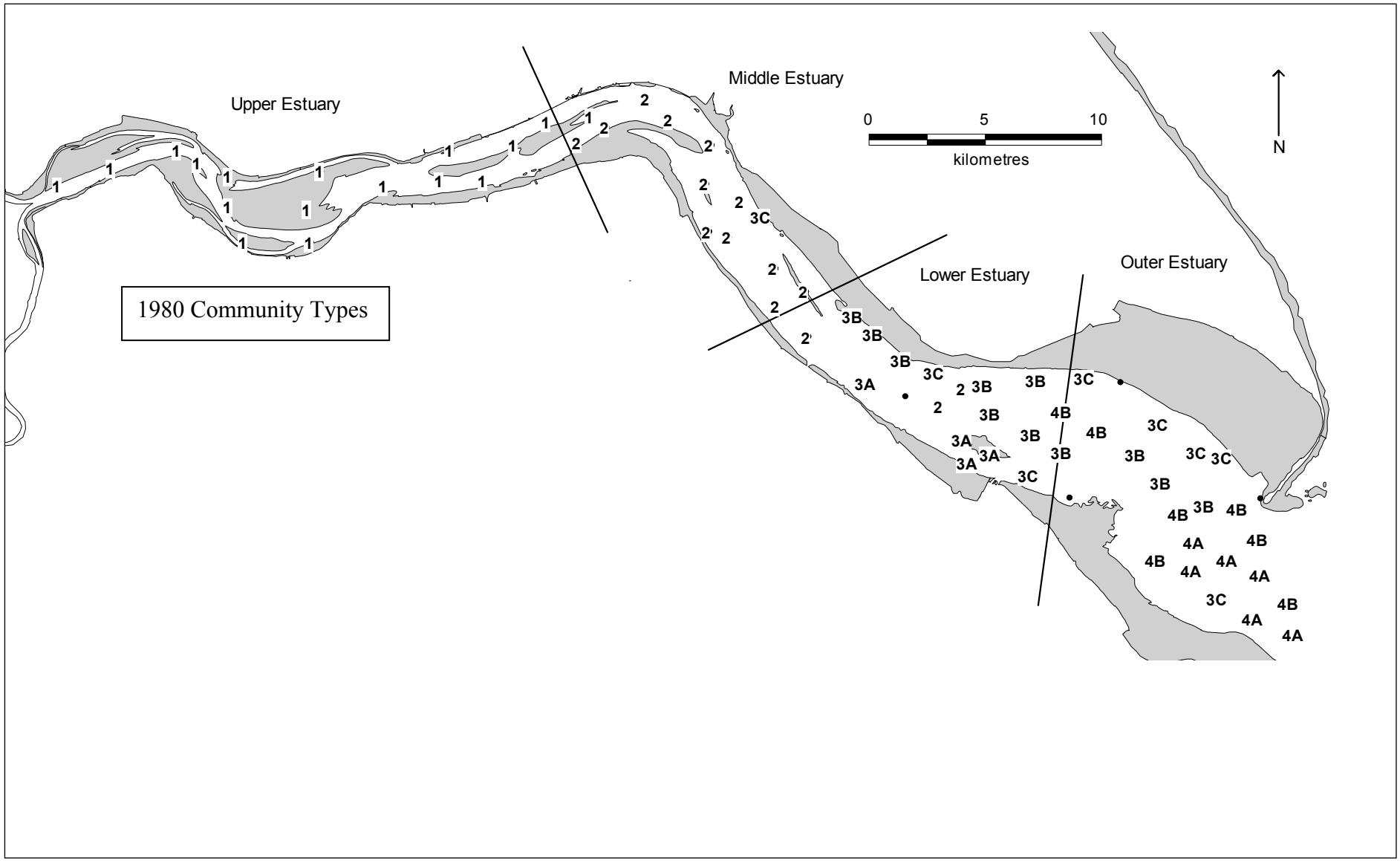
subtidal and numbers peaked in 1991-1992 and have generally continued to dominate since, albeit at lower numbers. Such fluctuations may be due to variations in the salinity regime and the level of organic enrichment (Environment Agency 1994). Numbers of cirratulid polychaetes, notably *Aphelochaeta* species have also increased over the past 10 years but the reasons for this are unclear (although improvements in the taxonomic resolution of this group may have a bearing on this). Additionally, some areas of the Humber have undergone increased accretion and a general fining of sediments over the past 5 years. For example, at Saltend in the middle estuary increased deposition of sediment and an increase in silt content has occurred in the intertidal and shallow subtidal (Read & Allen 2001). Whilst the basic assemblage has remained broadly similar there has been a shift in community structure with increased dominance by oligochaetes and a reduction in larger infauna such as *Hediste diversicolor* (Allen 2001). In general terms, however, despite natural variation and changes in the sedimentary regime the subtidal benthic communities are relatively stable and represent typical estuarine assemblages.

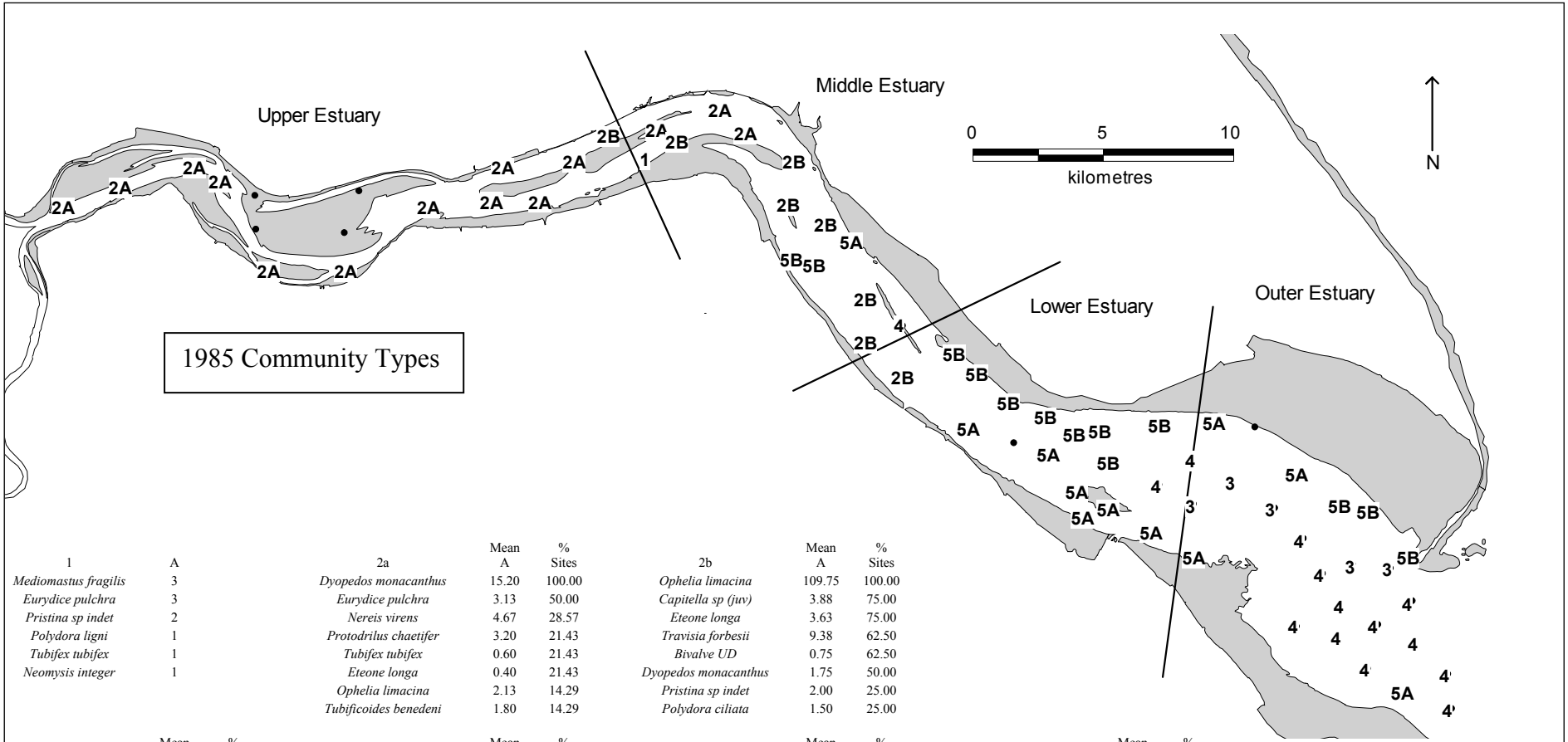
Conservation status

There are no subtidal records for internationally or nationally scarce species on the Humber, although the tentacled lagoon worm *Alkmaria romijni* has been recorded at several intertidal locations. Patches of the reef building polychaete *Sabellaria spinulosa* are also present in the outer estuary and off the mouth of the Humber and the species is listed under the biogenic reefs habitat features in the Habitats Directive (92/43/EEC) (Holt *et al* 1998). At present the subtidal assemblages are not specifically cited for their conservation status under existing legislation although the subtidal areas of the upper Humber between Trent Fall and Hessle are included under the SPA and RAMSAR designations. However, should the Humber become a SAC the subtidal habitats would be an important sub-feature of the estuary and consequently the individual habitats (subtidal gravels, muds, clays) including those which are interest features in their own right under the Habitats Directive (e.g. subtidal sandbanks) would require monitoring. At present the estuary comprises a number of 'typical' estuarine communities although data on the relative proportion and importance of such communities in the context of the UK are not available. The subtidal communities also form an important component of the biological resource of the Humber Estuary both in terms of the trophic structure, overall production and as a food resource for the fish and avifaunal populations which are cited in the Habitats Directive (92/43/EEC) and other legislation. Overall, the status of the subtidal invertebrate fauna indicate that the quality of the Humber is generally moderate to good and due in part to its size (and the variety of habitats within it) the Humber is likely to be one of the richest estuarine ecosystems in the UK both in terms of biomass/production and also in the variety of biotopes present.



Stylised Map of the Humber Estuary Subtidal Benthic Communities (adapted from Gameson 1982).


Upper Estuary
Middle Estuary
Lower Estuary
Outer Estuary
0
5
10
kilometres
N
1980 Community Types



1	A
Mediomastus fragilis	3
Eurydice pulchra	3
Pristina sp indet	2
Polydora ligni	1
Tubifex tubifex	1
Neomysis integer	1

2a	Mean A	% Sites
Dyopedos monacanthus	15.20	100.00
Eurydice pulchra	3.13	50.00
Nereis virens	4.67	28.57
Protodrilus chaetifer	3.20	21.43
Tubifex tubifex	0.60	21.43
Eteone longa	0.40	21.43
Ophelia limacina	2.13	14.29
Tubificoides benedeni	1.80	14.29

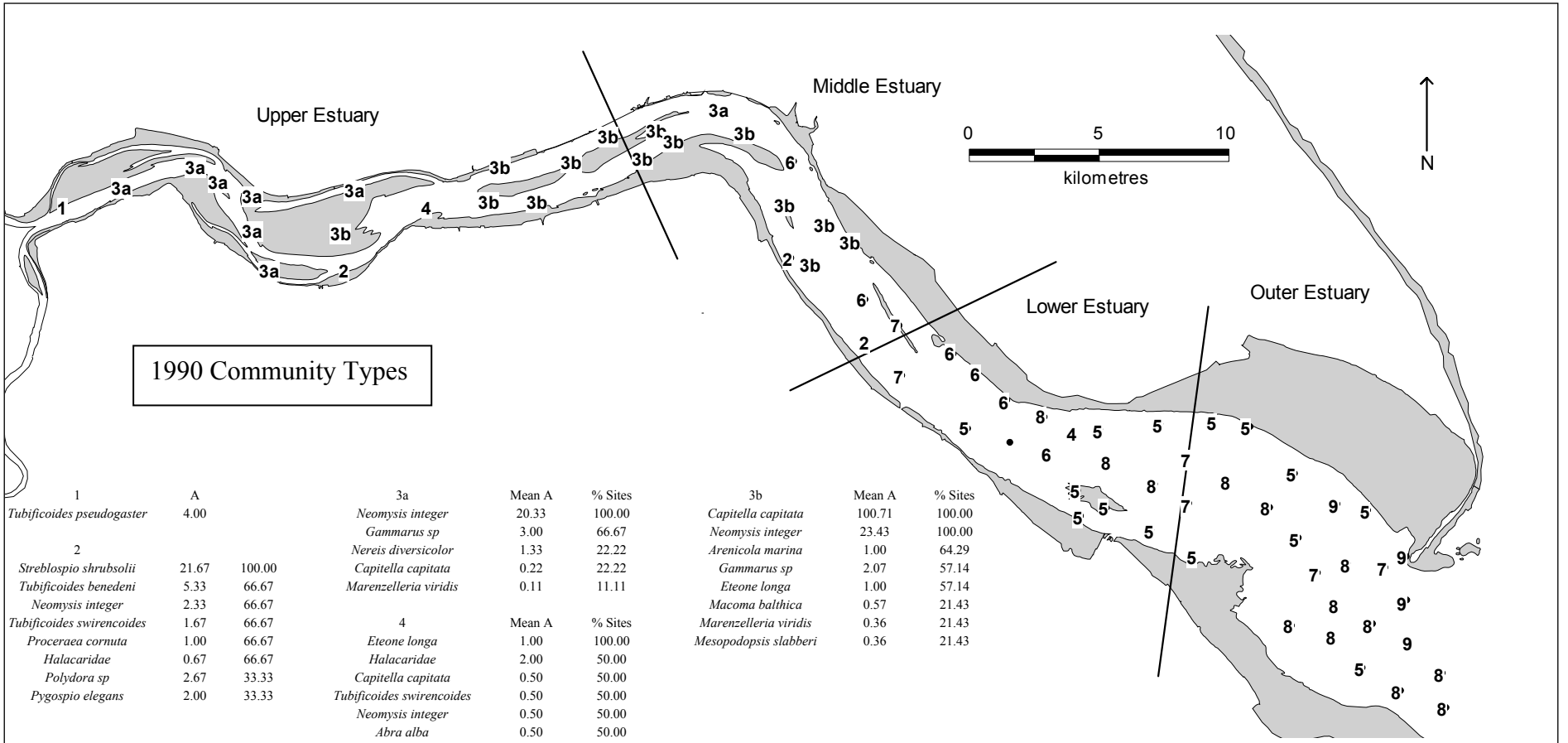
2b	Mean A	% Sites
Ophelia limacina	109.75	100.00
Capitella sp (juv)	3.88	75.00
Eteone longa	3.63	75.00
Travisia forbesii	9.38	62.50
Bivalve UD	0.75	62.50
Dyopedos monacanthus	1.75	50.00
Pristina sp indet	2.00	25.00
Polydora ciliata	1.50	25.00

3	Mean A	% Sites
Tanaidae indet	3.20	100.00
Corophium volutator	1.00	60.00
Opisthobranchidae	0.60	40.00
Nephtys longosetosa	0.40	40.00
Gammarellus homari	17.40	20.00
Nephtys sp (juv)	0.40	20.00
Nemertea	0.20	20.00
Harmothoe lunulata	0.20	20.00

4	Mean A	% Sites
Nephtys sp (juv)	15.14	92.86
Glycera tridactyla	4.00	78.57
Gammarellus homari	1.93	64.29
Scolelepis squamata	1.07	50.00
Bivalve UD	1.07	50.00
Opisthobranchidae	0.93	50.00
Eteone longa	1.00	42.86
Ophelia limacina	0.64	42.86

5a	Mean A	% Sites
Polydora ligni	44.67	100.00
Pristina sp indet	111.25	91.67
Magelona papillicornis	200.58	83.33
Glycera tridactyla	15.33	83.33
Eteone longa	14.00	83.33
Opisthobranchidae	4.00	83.33
Limnodrilus hoffmeisteri	279.58	75.00
Bivalve UD	77.75	75.00

5b	Mean A	% Sites
Nephtys longosetosa	4.71	92.86
Bivalve UD	11.07	78.57
Glycera tridactyla	4.07	78.57
Magelona papillicornis	2.43	71.43
Pristina sp indet	4.29	57.14
Opisthobranchidae	1.57	57.14
Ophelia limacina	1.21	50.00
Dyopedos monacanthus	2.71	42.86



1	A	
Tubificoides pseudogaster	4.00	

2		
Streblospio shrubsolii	21.67	100.00
Tubificoides benedeni	5.33	66.67
Neomysis integer	2.33	66.67
Tubificoides swirencoides	1.67	66.67
Proceraea cornuta	1.00	66.67
Halacaridae	0.67	66.67
Polydora sp	2.67	33.33
Pygospio elegans	2.00	33.33

3a	Mean A	% Sites
Neomysis integer	20.33	100.00
Gammarus sp	3.00	66.67
Nereis diversicolor	1.33	22.22
Capitella capitata	0.22	22.22
Marenzelleria viridis	0.11	11.11

4	Mean A	% Sites
Eteone longa	1.00	100.00
Halacaridae	2.00	50.00
Capitella capitata	0.50	50.00
Tubificoides swirencoides	0.50	50.00
Neomysis integer	0.50	50.00
Abra alba	0.50	50.00

3b	Mean A	% Sites
Capitella capitata	100.71	100.00
Neomysis integer	23.43	100.00
Arenicola marina	1.00	64.29
Gammarus sp	2.07	57.14
Eteone longa	1.00	57.14
Macoma balthica	0.57	21.43
Marenzelleria viridis	0.36	21.43
Mesopodopsis slabberi	0.36	21.43

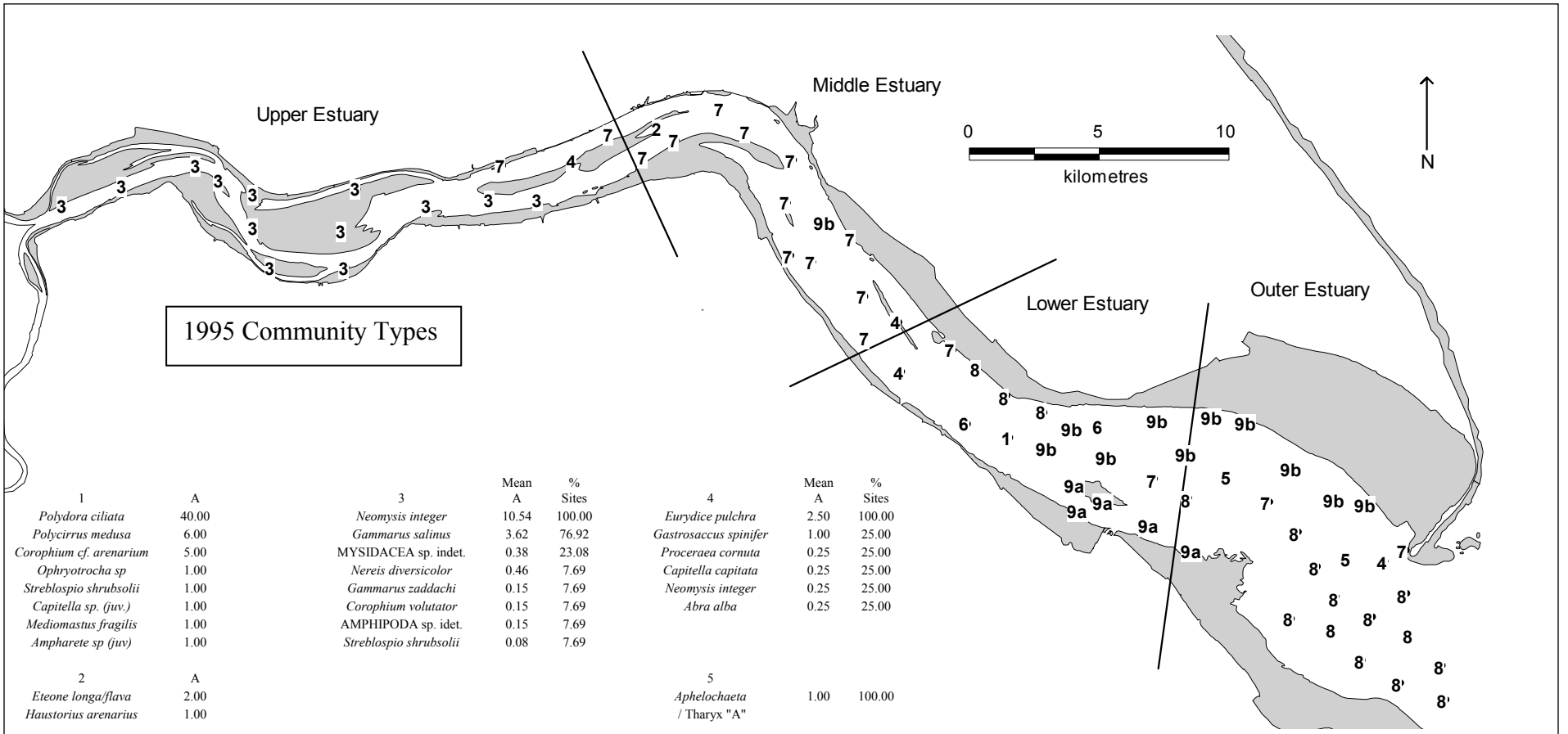
5	Mean A	% Sites
Tharyx spp	222.94	93.75
Pygospio elegans	37.19	93.75
Tubificoides swirencoides	12.75	81.25
Mediomastus fragilis	23.25	75.00
Scoloplos armiger	16.88	75.00
Nereis longissima	18.56	62.50
Nephtys sp (juv)	6.13	62.50
Polydora sp	1597.50	56.25

6	Mean A	% Sites
Tubificoides benedeni	3.57	100.00
Nephtys hombergii	2.57	85.71
Macoma balthica	3.86	71.43
Capitella capitata	22.14	57.14
Nephtys sp (juv)	2.14	57.14
Nephtys cirrosa	4.14	42.86
Arenicola marina	1.14	42.86
Tubificoides swirencoides	1.00	42.86

7	Mean A	% Sites
Nephtys cirrosa	3.50	100.00
Capitella capitata	0.83	50.00
Schistomysis kervillei	0.50	50.00
Scoloplos armiger	1.00	33.33
Nephtys sp (juv)	0.33	33.33
Eurydice pulchra	0.33	33.33
Neomysis integer	0.33	16.67
Nephtys hombergii	0.17	16.67

8	Mean A	% Sites
Spio martinensis	18.92	100.00
Nephtys cirrosa	14.15	100.00
Scoloplos armiger	4.69	92.31
Abra alba	3.77	92.31
Spiophanes bombyx	19.31	69.23
Nephtys sp (juv)	3.00	53.85
Pygospio elegans	1.08	53.85
Nephtys hombergii	0.85	53.85

9	Mean A	% Sites
Mytilidae indet (juv)	3.25	100.00
Abra alba	6.00	75.00
Arenicola marina	2.50	75.00
Nephtys cirrosa	1.25	75.00
Capitella capitata	0.75	75.00
Nephtys hombergii	0.75	25.00
Scoloplos armiger	0.50	25.00
Spiophanes bombyx	0.50	25.00



1	A
Polydora ciliata	40.00
Polycirrus medusa	6.00
Corophium cf. arenarium	5.00
Ophryotrocha sp	1.00
Streblospio shrubsolii	1.00
Capitella sp. (juv.)	1.00
Mediomastus fragilis	1.00
Ampharete sp (juv)	1.00

2	A
Eteone longa/flava	2.00
Haustorius arenarius	1.00

3	Mean A	% Sites
Neomysis integer	10.54	100.00
Gammarus salinus	3.62	76.92
MYSIDACEA sp. indet.	0.38	23.08
Nereis diversicolor	0.46	7.69
Gammarus zaddachi	0.15	7.69
Corophium volutator	0.15	7.69
AMPHIPODA sp. idet.	0.15	7.69
Streblospio shrubsolii	0.08	7.69

4	Mean A	% Sites
Eurydice pulchra	2.50	100.00
Gastrosaccus spinifer	1.00	25.00
Proceraea cornuta	0.25	25.00
Capitella capitata	0.25	25.00
Neomysis integer	0.25	25.00
Abra alba	0.25	25.00

5	Mean A	% Sites
Aphelochaeta / Tharyx "A"	1.00	100.00

6	Mean A	% Sites
Polydora spp.	4178.00	100.00
Corophium volutator	752.00	100.00
Pygospio elegans	135.50	100.00
Mytilus edulis (juv.)	57.50	100.00
Arenicola marina	56.00	100.00
NEMERTEA	35.50	100.00
Pholoe synophthalmica	13.50	100.00
Neoamphitrite figulus	8.00	100.00

7	Mean A	% Sites
Capitella capitata	68.71	100.00
Arenicola marina	6.00	52.94
Mytilus edulis (juv.)	0.88	47.06
Neomysis integer	1.18	35.29
Eteone longa/flava	0.71	35.29
Macoma balthica	0.88	29.41
Aphelochaeta / Tharyx "A"	0.41	23.53
Nephtys cirrosa	0.35	23.53

8	Mean A	% Sites
Nephtys cirrosa	11.06	100.00
Scoloplos armiger	4.06	93.75
Chaetozone setosa	8.31	50.00
Spio martinensis	0.81	50.00
Mytilus edulis (juv.)	0.69	37.50
Pontocrates altamarinus	0.50	37.50
Nephtys hombergii	2.06	31.25
Capitella capitata	1.19	31.25

9a	Mean A	% Sites
Aphelochaeta / Tharyx "A"	2368.00	100.00
Tubificoides swirencoides	155.80	100.00
Ampharete acutifrons	53.80	100.00
Pygospio elegans	24.80	100.00
Streblospio shrubsolii	23.60	100.00
Aricidea minuta	22.80	100.00
Tubificoides pseudogaster	38.20	80.00
Nephtys hombergii	15.00	80.00

9b	Mean A	% Sites
Nephtys hombergii	17.00	100.00
Aphelochaeta / Tharyx "A"	6.09	90.91
Macoma balthica	4.55	90.91
Nephtys cirrosa	1.64	81.82
Mytilus edulis (juv.)	3.36	63.64
Scoloplos armiger	7.91	54.55
Arenicola marina	0.82	54.55
Tubificoides swirencoides	19.09	45.45

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Tentacled lagoon worm *Alkmaria romijni*

Key Sites: Killingholme Haven Pits SSSI.

Summary Status:

- Wildlife and Countryside Act: Schedule 5.
- Habitats Directive: not listed.
- Berne Convention: not listed.
- Red Data Book: not listed.
- Breeding Status in the Humber: Breeding.
- UK Biodiversity Action Plan Species.
- Nationally Scarce.
- Most northerly populations in the UK.

Description

The tentacled lagoon worm *Alkmaria romijni* measures up to 7mm long, and has eight tentacles that are thread-like and slimy (White 2002). It builds a mucus tube in the surface of mud and feeds on surface deposited organic material (Bamber *et al* 2001).

This species has six gills that are banded by rings of greenish-grey pigment (White 2002). This species is found in lagoons and sheltered tidally restricted estuarine sites. It appears to have a preferred salinity range of 5 to 20 PSU and is found on the southern shores of the North Sea as far north as the Humber, along the English Channel and round into Pembrokeshire (Bamber *et al* 2001).

Distribution within the Humber

A survey conducted by the University of Southampton Oceanography Department on the Humber Estuary in 1987 found tentacled lagoon worms at two claypits at TA 050 234 and TA 055 236 between Barton cliff and New Holland. It was also found at Killingholme (TA 167198). At this time it was thought to exist in only a few sites in the UK (Sheader 1987).

A one-off survey by the National Rivers Authority (1991) around the sewage outfall at Barton-upon-Humber found *Alkmaria romijni* to be present (Gilliland & Sanderson 2000) and in 1995 a single specimen of this species was found on the South Bank low shore at New Holland (Binnie Black & Veatch 1999).

The routine intertidal survey conducted by the NRA/Environment Agency found the following records of *Alkmaria romijni* between 1985 and 1999 (Table 7).

Table 7 Routine Intertidal Survey (NRA/Environment Agency 1985 - 1999)

Year	Number of Individuals Recorded	
	Barton	**New Holland**
1985	-	201 (low shore)
1986	-	1 (low shore)
1987	-	-
1988	-	-
1989	-	-
1990	-	-
1991	1 (middle shore)	8 (low shore)
1992	-	13 (low shore)
1993	1 (middle shore)	50 (low shore)
1994	-	3 (low shore)
1995	-	1 (low shore)
1996	-	-
1997	1 (middle shore)	-
1998	-	-
1999	-	1 (middle shore)

This survey also discovered a single specimen in 1997 at East Halton and five specimens in 1999 at Doverstrand (low shore) (NRA / Environment Agency 1985 - 1999).

It has been shown that this species has been present in the Humber over at least the last 25 years, albeit at a restricted distribution and in varying abundance. The three saline lagoons at Killingholme Haven Pits SSSI presently support *Alkmaria romijni* (Farrow & Wright 2000).

Seasonality

This lagoon worm is resident all year round and no seasonality is displayed in its breeding behaviour. Larval development lasts 3 months. Larvae reside within the tubes of the female for up to the first 12 days. They then become free-living on the surface of the sediment and develop their own tube at about 20 days (White 2002).

Historical changes and trends

This species was only recorded at three sites in the UK in 1991; subsequently it has occurred at a number of further sites, where in the past it may have been mistaken as a juvenile of commoner species (Bamber *et al* 2001).

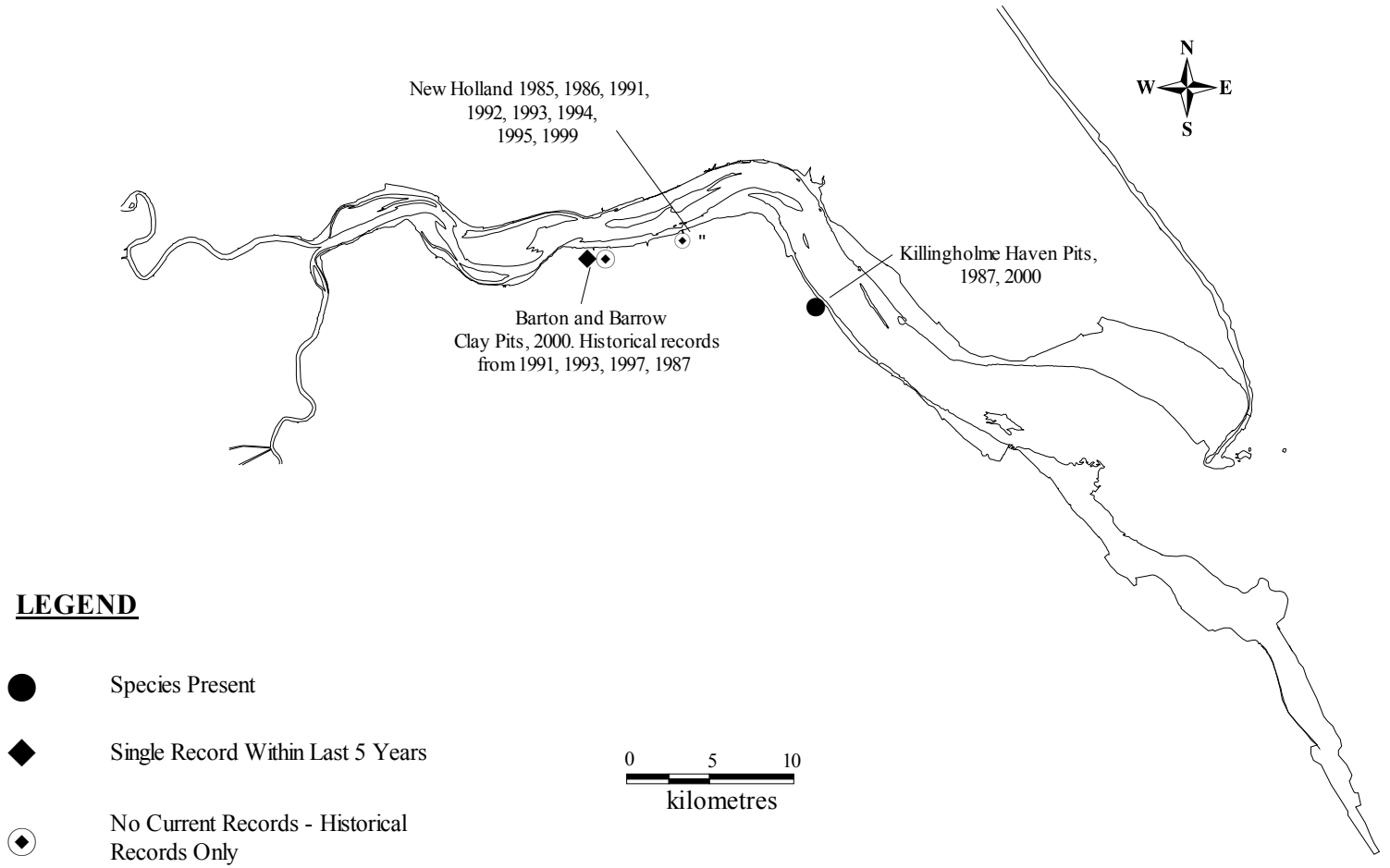
The tentacled lagoon worm has now been recorded from 27 sites around the UK (Gilliland & Sanderson 2000). The majority of these are estuaries and the remainder are lagoons. The species may be under-recorded due to its small size (White 2002).

Conservation status

The populations of this species in the Humber Estuary are the most northerly recorded populations in the UK (White 2002).

Alkmaria romijni is included in the Wildlife and Countryside Act, Schedule 5 and has been listed in the UK Biodiversity Action Plan as being a species of conservation concern. Its UK status has also been stated as 'scarce' by Sanderson (1996) categorising it as occurring in 9 to 55 10km squares with water of marine saline influence (Bamber *et al* 2001).

Population Distribution of the Tentacled Lagoon-Worm *Alkmaria romijni*



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Lagoon sand shrimp *Gammarus insensibilis*

Key Sites: Humberston Fitties Lagoon in Lincolnshire.

Summary Status:

- Wildlife and Countryside Act: Schedule 5.
- Habitats Directive: not listed.
- Berne Convention: not listed.
- Red Data Book: RDB 3 (rare).
- Breeding Status in the Humber: Breeding.
- Most northerly population of this species in the UK.
- One of two populations in the east coast region.

Description

The lagoon sand shrimp (the amphipod crustacean *Gammarus insensibilis*) is a lagoonal specialist species for which little published biological and ecological information exists. It is always associated with macrophytes, and in particular with drifting mats of the green alga *Chaetomorpha linum*, which has been found at all sites where the lagoon sand shrimp has been recorded (Bamber *et al* 2001).

The lagoon sand shrimp grows up to approximately 19mm in length. The head has lateral lobes that slope forwards and the eyes are moderately large and kidney shaped (White 1999).

The species is limited to sheltered brackish water habitats with a variety of sediments ranging from organic muds to shingle, with various admixtures of sand and silt-clay. Site characteristics for this species include a regular tidal input of sea water with low or absent fresh water input. The site must have a small tidal range so that water is retained at all states of the tide and at all seasons. The tidal range for inhabited sites is found between 10 and 58 PSU, although it is usually found between 15 and 35 PSU, with seasonal variation (Bamber *et al* 2001).

Distribution within the Humber

This species has recently been recorded at Humberston Fitties Lagoon in Lincolnshire which is the most northerly population of this species in the UK (White 1999). The lagoon at Humberston Fitties probably originated as an upper saltmarsh pool. Although modified by former use as a boating lake, it retains a diverse flora and fauna typical of lagoons of high salinity (Farrow & Wright 2000).

Seasonality

Reproduction of this species continues throughout the year although there appears to be a peak in reproductivity during the summer months. Temperature is thought to affect the speed of development and average life span (White 1999).

Historical changes and trends

Within the UK, the amphipod is fairly widely distributed in lagoons along the south and east coasts of England, between Dorset and Lincolnshire. The species was initially recorded in the UK at only two localities; the Chesil Fleet in Dorset (recorded in 1947 as *G. locusta*) and New England Creek on the Thames estuary in Essex (1939 again as *G. locusta*) (Bamber *et al* 2001).

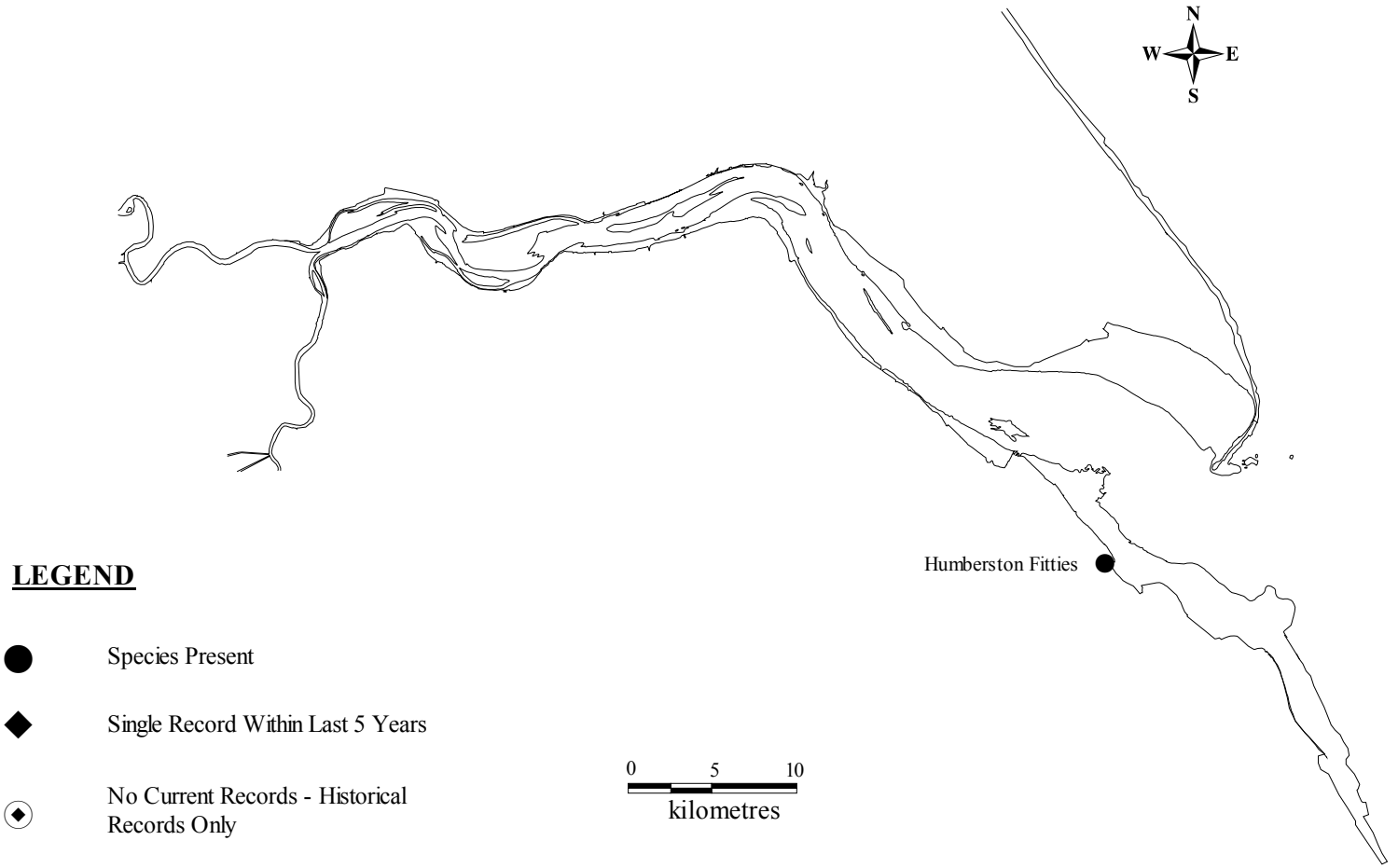
It has since been recorded more frequently on many sites on both the south and east coasts of the UK. As the species is morphologically close to *Gammarus locusta* it may be under-recorded in parts of its range (White 1999).

Conservation status

The lagoon sand shrimp is protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). Since 1988, it has been illegal in Britain to catch or handle the species without a specific licence.

The national status of this species has been identified as scarce and therefore occurs in 9 to 55 10km squares. It has also been identified as a priority species under the UK Biodiversity Action Plan (White 1999).

Population Distribution of the Lagoon sand shrimp *Gammarus insensibilis*



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