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The status of smelt *Osmerus eperlanus* in England

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**The status of smelt *Osmerus eperlanus*
in England**

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‘It is evident from the imperfect returns rendered to Mr. Harding, that the amount of interest taken in the Smelt fisheries of the United Kingdom, either by the imperial or local authorities, is small indeed, and that this delicate and delicious fish is, from utter neglect and unfair treatment, becoming lost as a source of food and profit in the localities where it formerly abounded.’ (Southwell 1888).

Summary

Like many other diadromous fishes, the Smelt *Osmerus eperlanus* has declined in many places across Europe. In Scotland, for example, most of the previously recorded populations are extinct. The situation in England is less certain and is the object of this review, which also includes Wales.

Information from fisheries and wildlife organisations, from the literature and from questionnaires carried out in 1966, 1969, 1980 and 2002 was gathered and assembled on a river by river basis. Groups of estuaries were organised according to appropriate coastal areas and the historic and present status of Smelt in each estuary was assessed. Though most of the records of Smelt were from estuarine systems, some were from freshwater ponds and others from more coastal habitats.

Altogether, some 52 estuarine or tidal river systems were recorded as having had stocks of Smelt at some time, together with six fresh waters. However, it was decided that stocks of Smelt in groups of estuaries in close proximity to each other probably belong to single populations; this gives about 21 populations around the coasts of England (19) and Wales (2). Seven (33%) of these are believed to be extinct. Of the freshwater populations, six are ephemeral, with the only permanent one now extinct.

The reasons for the serious declines and extinctions of Smelt are various but four factors are of importance. (a) Pollution has affected many of the estuaries in which Smelt once prospered and stocks and associated fisheries have collapsed as a consequence. (b) Overfishing has been a significant threat in some estuaries. (c) Habitat loss has also had an impact, most notably where spawning grounds have been destroyed by silting, river works or other factors. (d) Access by spawning stocks of Smelt from estuaries to spawning grounds has been disrupted by weirs or other barriers.

Almost all stocks have been affected in the past by one or more of the above factors - some have recovered whilst others are now extinct. The strongest and most permanent stocks seem to be those associated with the larger estuaries (eg the Thames), especially where there is a complexity of minor or nearby smaller estuaries. When the stock in one of these estuaries is eliminated it can be restored by immigration from associated waters. However, in other, more isolated estuaries (eg the Tyne), there is little possibility of recovery through immigration from other waters.

Thus it seems likely that recovery programmes will be necessary if Smelt are to be restored to the more isolated estuaries where they formerly occurred. Obvious candidates for such programmes in England are the Rivers Tyne and Tees on the east coast and the River Eden on the west coast.

Useful monitoring programmes are in progress, or have taken place in the past in larger estuaries such as the Humber, Wash, Thames and Mersey where Smelt still occur, and also in estuaries such as the Tyne, Wear and Tees where Smelt are now extinct. These programmes should be continued and extended to other waters where Smelt occur.

A number of information gaps exist and require to be filled before a complete picture of the status of the Smelt in England can be fully established. At least three are of significance. (a)

Confirmation is needed of the status of stocks in systems where there are few recent records. (b) Catch statistics should be obtained where Smelt are fished commercially, or taken as a bycatch. (c) The ecology and behaviour of stocks of Smelt along the south coast of England requires investigation.

If there is to be no further loss of stocks of Smelt in England, then management programmes need to be set up for each population. These must assess the present status and size of each stock and how each will be monitored. Habitat requirements and their quality must also be assessed, especially access to traditional spawning grounds, their present status and how they may be protected.

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1. Introduction

The Smelt *Osmerus eperlanus* (Figure 1) was once a common species in Great Britain and occurred in the estuaries of most large rivers from the Clyde and Tay southwards. It supported commercial fisheries of varying importance in these estuaries. Over the last two centuries, the species has gone into decline and has disappeared from many rivers. In spite of its return to a few rivers following improved water quality there it has been regarded as significantly threatened in Great Britain for several decades (Maitland 1974, 1979, Maitland & Lyle 1990, 1991, 1992) but little conservation action has been taken to date.

There seems to be little that is new in this situation for over a century ago it was reported that ‘In the summer of 1882 Mr. Harding says that he sent out circulars to sixty-six ports, asking for information as to the regulations in force with regard to the Smelt Fishery in each port. Of the fourteen returns received, eleven speak of a decided decrease in the number of Smelts taken; and in a twelfth ... that “enormous quantities of young Smelts are yearly taken by the Whitebait fishers. ... In only three instances out of the fourteen is it stated that any attempt has been made to regulate the fishery in any way. These exceptions are Breydon, ... Rochester, ...and ... the Medway.’ (Southwell 1888).

Nor is the lack of interest taken by any of the appropriate government agencies new, for it was reported by *Southwell* (1888) that ‘It is evident from the imperfect returns rendered to Mr. Harding, that the amount of interest taken in the Smelt fisheries of the United Kingdom, either by the imperial or local authorities, is small indeed, and that this delicate and delicious fish is, from utter neglect and unfair treatment, becoming lost as a source of food and profit in the localities where it formerly abounded.’

Fortunately, the situation has been changing in recent years. Research on the River Thames in England and the River Cree in Scotland by Hutchinson (1983a) was extended to the rest of Scotland by studies commissioned by Scottish Natural Heritage (Maitland & Lyle 1990, 1996, Lyle *et al* 1996). The present review, dealing largely with the status of the Smelt in England, has been commissioned by English Nature.

2. Objectives

Phase 1 of this study will ‘review any existing data which may be available from records of power stations cooling intake impingement, Environment Agency fisheries staff, CEFAS fisheries surveys and other published or unpublished literature. Although this should focus on England, information from Scotland and Wales should also be included to provide a UK context.’ (Annex A of Tender Document).

This part of the project should identify:

- Current knowledge of the distribution of Smelt in English estuaries and rivers.
- Available data on known and possible spawning grounds, including the characteristics of suitable spawning sites.
- The historic distribution of Smelt, and estuarine and riverine systems that should be targeted for any proposed recovery programme.

3. Ecology

The Sparling occurs from southern Norway around the western coast of Europe (including the Baltic Sea) to north west Spain. It is found in coastal waters but mainly in estuaries and migrates into large clean rivers at spawning time. The species is tolerant of wide salinity changes and there are several non-migratory purely freshwater populations in large freshwater lakes in Finland, Sweden and Norway. The Romans were supposed to have cultivated Sparling in freshwater ponds.

Useful reviews of the literature on Smelt were carried out by Belyanina (1969) and Nellbring (1989) and Maitland & Campbell (1992) have summarised its ecology in the British Isles. A midwater species which is rarely found far from the shore, the Smelt is primarily anadromous in the west and lacustrine in the east of its European distribution. A shoaling species especially during the spawning period (Fabricius 1950), it feeds largely on small crustaceans and small fish. Spawning takes place in the early spring – fecundity ranging from 8,000-50,000 eggs per female depending on size. The eggs are very adhesive (Cunningham 1886) and hatch in about 3-4 weeks.

The Smelt is still abundant in several European rivers. In the tidal parts of the River Elbe, Moller & Dieckwisch (1991) found that it made up 59% of the catches of larval fish there. Estuaries are particularly important to Smelt, not just as feeding sites but also as larval or juvenile nursery areas (Dadswell 1988). Smelt are important as an indicator species of water quality (Andrews 1988). ‘As far as I can find there are no records of postlarvae from British estuaries, probably because there is little collecting with plankton nets near the freshwater region. Where smelt occur, however, the postlarvae should be numerous.’ (Russell 1976).

4. Methods

4.1 Historical data

As well as information available from published literature (see below), historic information is also available from a number of other sources. For example, unpublished data may be held by government agencies (eg the Environment Agency, CEFAS, Scottish Executive, Sea Fisheries Committees) as a result of their routine field sampling. Additionally, many museums have collections of fish and useful data on Smelt may be available from these and from local record centres. Some anglers maintain diaries of their catches and observations and these too can be useful sources of information.

4.2 Literature search

A search for appropriate literature revealed a number of useful publications concerning Smelt in England and Wales. Few of these contained quantitative information but most had useful qualitative data or anecdotal records which have proved invaluable in building up a picture of the past status and distribution of Smelt in different catchment systems. Other than major works written by ichthyologists, more general works on British fish were avoided for they tend to replicate information from older publications and so give an outdated picture of the status of Smelt at the time of publication.

4.3 Questionnaire

A questionnaire (Appendix 1) was prepared and issued widely to appropriate organisations and individuals in England and Wales. Many of these had no information but either passed the questionnaire on to someone else who might have knowledge or returned it with suggestions as to more appropriate sources of information. In general, respondees were helpful and constructive.

In addition to the above questionnaire, information is available from a previous general questionnaire on fish distribution in the British Isles used by the author in 1966 (Maitland 1969), a similar questionnaire carried out in conjunction with 'Anglers' Mail' in 1969 and also from extensive correspondence carried out by Peter Hutchinson (Hutchinson 1983a) and by the author with various fisheries organisations in the 1980s.

One of the problems in assessing any records received has been the confusion between the Smelt *Osmerus eperlanus* and the Sand Smelt *Atherina presbyter*. In general, records from non-estuarine systems are considered carefully, especially those from non-scientists and in several cases have been discarded because it seemed almost certain that *Atherina* rather than *Osmerus* was involved. Even some 'scientific' records can be regarded as very doubtful – the only records for *Osmerus* shown in the Marine Nature Conservation Review database are in the Outer Hebrides, an unlikely area for *Osmerus*, and ignored in the present review.

5. Geographic distribution

The main section of this report is laid out according to the estuarine regions defined by NERC (1975) and Head (1976) and illustrated in Figure 2. The individual estuaries and the regions in which they occur are dealt with by moving clockwise along the coastline, starting at the Tweed (Tyne/Wear) in Northumberland and finishing at the Esk (Solway) in Cumbria. Individual waters discussed in the text are listed alphabetically in Table 1.

Within the section on each estuary, the available information has been assembled in approximately chronological order, giving exact quotes where possible so that original descriptions may not be lost – especially important with ephemeral information from letters and e-mails. A concluding boxed paragraph, in bold, for each estuary gives the author's assessment of the present status of Smelt there.

5.1 Tyne / Wear

'There are no Smelt in this Committee's district (which goes out for 6 miles from baselines) ...' (D. Bradbeer, Northumberland Sea Fisheries Committee, letter dated 2 December, 2002).

5.1.1 River Tweed

Wallis (1769) noted that the Smelt was 'A very rare visitor to the Tweed...'

Smelt were recorded by Johnston (1832-41) as being 'Very rare in the Tweed, where indeed I have heard of only one specimen being taken.' Later (Bolam (1919), he recorded that 'Two specimens were taken in the Tweed during summer 1843.'

Bolam (1919) says that ‘Smelt or Sparling must be considered a very rare visitor to Tweed’. This is not based on any personal observation, but only on what old fishermen told him.

R.N.B. Campbell (Tweed Foundation) has noted (e-mail, dated 21 November, 2002) that ‘if they were so abundant in the Tyne, I find it hard to believe there wasn't a period when they were abundant on Tweed, but I've never come across observations of any such period. Very odd, when you think of the Tweed being halfway between the Tyne and the Forth. In my time, I've never come across them, nor rumours of them.’

It appears therefore that a population of Smelt may have occurred in the Tweed Estuary at one time but that it had died out by the 1850s.

5.1.2 River Wansbeck

It is likely that the Wansbeck Estuary did have a population of Smelt in the past, but there appears to be no definite evidence that this is the case other than the note by Wallis (1769) that Smelt were ‘Taken in great abundance in the Tyne and in our other rivers towards the sea.’

Any population of Smelt which may have been present in the estuary of the River Wansbeck is now extinct.

5.1.3 River Blyth

It is likely that the Blyth Estuary did have a population of Smelt in the past, but there appears to be no definite evidence that this is the case other than the note by Wallis (1769) that Smelt were ‘Taken in great abundance in the Tyne and in our other rivers towards the sea.’

Though Davis & Edwards (1988) note that ‘Sightings reported in the River Blyth and the lower reaches of the River Tyne suggest the numbers of this species may be recovering’ there is no direct evidence to prove that this is the case and substantial sampling in the Tyne (q.v.) has certainly not turned up any specimens.

Any population of Smelt which may have been present in the estuary of the River Blyth is now extinct.

5.1.4 River Tyne

Wallis (1769) noted that Smelt were ‘Taken in great abundance in the Tyne and in our other rivers towards the sea.’

‘Caught in the Tyne at Elswick ... this fish is now, on account of the pollutions of the river, very rare in our district’ (Howse (1890).

‘In the Tyne and the Tees’ (Meek (1905).

Bolam (1919) noted that Smelt were recorded as abundant in the Northumberland Tyne in the 18th century and that ‘it still appears there commonly in the Spring’.

K.E. Banister (Newcastle University: 1966 PSM fish questionnaire) noted that Smelt occurred at the 'Mouth of Tyne. June 1913 – locality for most recent museum specimen.'

'The Tyne and Tees estuaries show pronounced similarities in hydrography, particularly in the lower reaches, both being narrow, stratified estuaries ... about 30 km in length, flowing through densely populated urban and industrial areas. Both estuaries suffer significant effects of pollution ... The Wear has some similarities with the Tyne and Tees estuaries but is shorter (17 km) with a much smaller freshwater input.' (Pomfret *et al* 1988).

'There has been, probably, a great decrease in Tyne and Tees during the past 50 years (B.S.). The smelt has perhaps been affected more than any other fish species by pollution – particularly the pollution of lower stretches and estuaries – and it is regarded as extremely rare in the region, although recent reports suggest a recovery .' (Foster-Smith 2000).

However, no Smelt have ever been taken in sampling carried out in the freshwater reaches of the River Tyne from 1989-2002 and in the estuarine areas from 1981-2002 (S. Peaty, Environment Agency, e-mail dated 21 November, 2002). M.E. Gill (University of Newcastle, letter dated 2 January, 2003) records that 'I have trawled for fish in the Tyne each quarter since 1988 and in the Wear and Tees less frequently, but I have not see a smelt in any of the samples. The Master of the research vessel has ... not seen these fish on any of his outings to other sites along the north east coast.'

Surveys of demersal fish in the Tyne, Tees and Wear estuaries began in 1981 to assess the effects of pollution and its reduction by various control measures (Pomfret *et al* 1988). The number of species (mostly fish) recorded in each estuary from 1982-88 was 45 (Tyne – 880 1-km trawls), 25 (Tees – 225 1-km trawls) and 24 (Wear – 69 1-km trawls). No Smelt were taken in any of these samplings.

It appears that the Smelt, once abundant in the estuary of the River Tyne, is now extinct there.

5.1.5 River Wear

It is likely that the Wear Estuary did have a population of Smelt in the past, but there appears to be no definite evidence that this is the case other than the note by Wallis (1769) that Smelt were 'Taken in great abundance in the Tyne and in our other rivers towards the sea.'

Surveys of demersal fish in the Tyne, Tees and Wear estuaries began in 1981 to assess the effects of pollution and its reduction by various control measures (Pomfret *et al* 1988). The number of species (mostly fish) recorded in each estuary from 1982-88 was 45 (Tyne – 880 1-km trawls), 25 (Tees – 225 1-km trawls) and 24 (Wear – 69 1-km trawls). No Smelt were taken in any of these samplings.

Any population of Smelt which may have been present in the estuary of the River Wear is now extinct.

5.2 Tees

5.2.1 River Tees

Smelt were recorded by Brewster (1796) as ‘Abundant in the Tees, fished there in 1530.’

The status of Smelt in the River Tees was reviewed by Howes & Kirk (1991) who noted that ‘Smelt were commercially exploited in the Tees estuary during the 16th century ...’ In 1530 it was decided that the fishery needed some control and the “Cursitor’s Roll” (Brewster 1796) pronounced that ‘... it is ordered that no man or no sort of fisher ... shall fish with Kydell nets for taking of smelts, sparlings or fry from a certain place called Salthouse so upwards upon the river Tees after St. Marks day (25th April) unto Lammas day (1st August) only hereafter upon pain of 6s. 8d. of every man so doing.’

Before the development of Middlesborough and industrial Tees-side, Surtees (1823) recorded that ‘... the river produces great abundance of excellent fish such as flounders, eels, smelts or sparlings.’

Hogg (1829) observed that *Salmo eperlanus* ‘Frequents the Tees at certain seasons.’

Smelt were still present and common in the River Tees in 1880 (Clark & Roebuck 1881) and still occasionally ‘very common’ after the turn of the century (Grabham 1907).

‘In the Tyne and the Tees’ (Meek 1905).

Alexander *et al* (1935) noted that ‘The spawning was once common ... the present scarcity of spawning in the Tees may be judged from the fact that only 25 specimens were taken ... during six weeks of fishing.’

‘There has been, probably, a great decrease in Tyne and Tees during the past 50 years (B.S.). The smelt has perhaps been affected more than any other fish species by pollution – particularly the pollution of lower stretches and estuaries – and it is regarded as extremely rare in the region, although recent reports suggest a recovery .’ (Foster-Smith 2000). Davis & Edwards (1988) note that ‘Sightings reported in ... the lower reaches of the River Tyne suggest the numbers of this species may be recovering.’

However, no Smelt have ever been taken in sampling carried out in the estuary of the River Tees from 1989-2002 (S. Peaty, Environment Agency, E-mail dated 21 November, 2002). M.E. Gill (Newcastle University, letter dated 2 January, 2003) records that ‘I have trawled for fish in the Tyne each quarter since 1988 and in the Wear and Tees less frequently, but I have not see a smelt in any of the samples. The Master of the research vessel has ... not seen these fish on any of his outings to other sites along the north east coast.’

It appears that the Smelt, once abundant in the estuary of the River Tees, is now extinct there.

5.2.2 Freshwater ponds

The culture of Sparling is mentioned by Yarrell (1836), who noted that ‘Colonel Meynell, of Yarm, in Yorkshire, kept Smelts for four years in a fresh-water pond, having no communication with the sea: they continued to thrive, and propagated abundantly. They were

not affected by freezing, as the whole pond, which covered about three acres, was so frozen as to admit of skating. When the pond was drawn, the fishermen of the Tees considered that they had never seen a finer lot of Smelts. There was no loss of flavour or quality,' Houghton (1979) expands on this 'Experiments have been made occasionally in this country to retain it in ponds ... I have often thought that modern pisciculturalists might profitably turn their attention to the cultivation of a fish of such a peculiar and delicate a flavour as the Smelt or Sparling.' So far as the author is aware, no-one has attempted this in recent times but the topic is also referred to elsewhere in connection with Rostherne Mere (Mersey) and freshwater ponds beside the Humber Estuary.

There is no information on the current status of this pond or its fish. It is assumed that the population is now extinct.

5.3 Humber

5.3.1 River Humber

Houghton (1879) recorded that 'Large quantities are taken by nets in the Humber, ...'

Smelt are not mentioned by Riley (1979) and Theaker (1979) in their reviews of fish and fisheries in the Humber Estuary.

J.E. Burton, secretary to the Hull Fish Merchants Protection Association Ltd wrote on 1 December, 1981 that '... smelt are not landed in Hull. No-one has any recollection of any quantity landings, although I think that some were landed during the last war without any commercial success. I am told that smelt or sparling is a west side fish and that there may have been occasional landings at Fleetwood.'

Rees (1982) indicated that there is no commercial smelt fishing in the Humber.

Smelt were recorded by M. Stafford in the period 1983-86 in the Humber Estuary around Hull Docks, where shoals were targeted by anglers for bait (P.J. Coates, South Wales Sea Fisheries Committee, e-mail dated 14 November, 2002).

Very few Smelt were recorded in the Humber Estuary by CEFAS in their coastal surveys (1981-97) of young fish (Figure 3) using intertidal push nets and a 2 m beam trawl (Rogers *et al* 1998) – less than 1 per 1000 m² at one site. Other sites were negative for this species.

However, 'The smelt has been frequently recorded in fish impingement studies carried out on the Humber (Proctor *et al* 2000, Proctor & Musk 2001). During the 1999 survey 762 were recorded, present throughout the year, although its abundance peaked in late spring and early summer. In 2000, the smelt occurred less frequently, with a total annual impingement of 390. The smelt was most abundant during January to March.' (PSM questionnaire response from E. Hawthorne, English Nature, dated 27, November, 2002).

Smelt are still present in the Humber Estuary and it is likely that this population is the basis for any stock of fish which run into the Ouse, Trent and associated waters to spawn.

5.3.2 Freshwater ponds

Smelt are known to thrive in fresh water and have occurred in a number of enclosed freshwater systems in Great Britain. The populations at Rostherne Mere (Mersey) and at Yarm (Tees) (Meynell 1844) are discussed elsewhere but in addition to these, a number of freshwater ponds alongside the Humber Estuary have been found to contain Smelt.

New Holland Pond. Foster (1893) records that Smelt, Herring, Brown Trout and Flounder were kept in a 3 acre flooded clay pit at New Holland, close to the south bank of the Humber.

Earls Cement Ponds. A Kitchin, Doncaster, responding to the 1966 PSM fish questionnaire recorded Smelt on 24 May, 1964 in 'Earls Cement Ponds, Melton, Yorkshire: Common.' In a later questionnaire (Angler's Mail), R. Forsberg recorded Smelt in a 'gravel pit, Melton, Hull' along with Common Bream, Eel and Roach. Howes & Kirk (1991) also refer to Melton Waters '... a large productive coarse fishery connected to the estuary by a sluice system. ... Fishing matches for flounders are regularly held during the winter months and smelt are occasionally caught; indeed, four specimens with a combined weight of 6 oz. were caught and returned to the water alive during a match on 13 October 1985 (T.W. Day pers. comm).'

Watton Water. '... the name of the place is Watton Water near Hull. The only thing I can tell you about the Smelt is what the local people told me when I was fishing. As a matter of fact a chap only this week remarked about there being Smelt in this lake. The position is this: the River Humber runs just at the back of this lake and when the tide comes in there are culverts that let the river run into the lake and that is how the fish get into the lake. There are also Dabs and Perch and also some Roach and a lot of Eels. This water belongs to the Blue Circle Cement Co. and there is talk of the factory closing.' (A. Harrison, letter undated, but about 1980).

Dick Fairfield's Pond and Pelican Pond. These two waters were recorded as having Smelt during the 1950s by Howes & Kirk (1991). 'These were connected to the estuary by sluices allowing access for flounders and other brackish water species which formed the basis of a thriving winter fishery. Most of these sluices are now blocked, the waters isolated from the estuary and managed purely as "coarse" fisheries.' The exact location of these ponds is not yet clear.

There is no indication that any of these ponds contain isolated self-sustaining populations of Smelt. It would appear that all of them receive fish casually through connections with the Humber and that these may be regarded as merely vagrants from that population.

5.3.3 The coast

Recorded once at Redcar by Ferguson (1860).

5.3.4 River Ouse

Though fluctuations in stock abundance were known to occur, Denny (1940) noted that Smelt were occasionally plentiful in the River Ouse at Cawood, '... on 21 December 1834 they were in such abundance that they were sold in Leeds Market at 2d per lb.'

In their review, Howes & Kirk (1991) note that ‘During the mid-19th century, however, the Howden fisheries declined, the Rev. Thomas Clarke ... (1851) claiming that although salmon, trout and smelt were often plentiful, the local fisheries had become nearly valueless. Catch levels in the adjacent fishery at Goole were also probably unexceptional, since Thomas Bunker ... in a lecture ... reported in the Goole Weekly Times (1882) merely refers to the smelt nets catching considerable numbers of flounders.’

Smelt from the Ouse fisheries were still being sold at Doncaster fish market (Sheardown 1872). ‘Although seasonal abundance was known to fluctuate, these steadily rising prices may be evidence of a downward trend in population;’ (Howes & Kirk 1991).

Although not ever present in the Derwent (Clegg 1977), Smelt were still apparently very common in the Ouse as far upriver as Naburn Lock (Clarke & Roebuck 1881) and Grabham (1907) noted that ‘In the months of March and April, Mr Tom Smith nets many of these fish just below Naburn Lock, close to York.’ However, according to Grabham (1915) ‘... smelt netting there in April 1914 was a complete failure.’

Any Smelt which run here can probably be regarded as part of the population in the Humber Estuary.

5.3.5 River Ure

Houghton (1879) recorded that ‘The Smelt is found in ... the Ure on the Yorkshire coast.’

It is probably only on exceptional occasions that Smelt ever ran as far upstream as the River Ure. In addition, any run here can probably be regarded simply as part of the stock in the River Ouse and consequently that of the population in the Humber Estuary.

5.3.6 River Trent

The history of the fisheries of the River Trent has been well reviewed by Easton (1979) on which the following account is based. For many centuries there were excellent fisheries on the river and there is little doubt that these would have included those for Smelt. Walton (1676) called the River Trent ‘One of the finest rivers in the world and the most abounding with excellent salmon and all sorts of delicate fish.’ One of the first lists of fish was by an anonymous writer around 1622, ‘Now if any man shall not believe it that this rivers affords so many kinds of Fishes I have ... set down ...the sorts of Fishes in the Trent ... Smelts ... Of these 18 properly are ye produce of Trent, Sturgeon, Salmon and Smelts are accidental from ye sea.’ The best record of the next century was provided by Deering in 1751 and this also includes Smelt which ‘... are seldom caught higher than Gainsborough.’ In the records of the borough of Nottingham ‘John, Constable of Chester ... Bestowed upon the church and monks of Lenton ... the first draught of sparling next after the draught of his steward in the said Fishery, ...’ During the 1800s all the fisheries started to decline because of pollution and smelt were not mentioned in lists produced in 1871 (River Tame) and 1890 (River Trent around Nottingham). However, as pollution control improved during the 20th Century, most fish populations recovered and by 1978 Smelt (recorded on the power stations screens at Keadby, 16 km upstream of the confluence with the River Ouse) were ‘abundant with tens of thousands at the right state of tide.’ Adult Smelt were caught on rod and line further up the estuary (Easton 1979).

The history of Smelt in the River Trent has also been reviewed by Howes & Kirk (1991) who note that ‘Michael Drayton, in his epic poem Polyolbion published in 1622, refers ... to the “sweet-smelling smelt” occurring in the Trent.’

Smelt were noted as occurring in the Trent and its tributaries and drains by Stonehouse (1839) and commercial fisheries there were producing smelt for Doncaster Market in the 1860s and 1870s (Sheardown 1872).

Peacock (1900) recorded it as ‘present’ and it was regarded by Smith (1915) as being ‘plentiful at Torskey and Lea’.

An estuarine species migrating irregularly up into the Trent and probably entering the lower, brackish reaches of the rivers and drains connected to it.’ (Bunting *et al* 1974).

‘... this species has been recorded in the Trent in the vicinity of West Burton (near Gainsborough) on the basis of CEGB power station intake screenings. In recent times, however, changes in the screening apparatus has reduced their efficiency as a fish sampler so the present position is unclear.’ (R. Sedgwick, Severn-Trent Water Authority, letter dated 13 October, 1982).

‘There are quite a number of smelt in the Trent Estuary. Quite a few juveniles are caught by eel netmen.’ (K. Easton: report of discussion following Hutchinson (1983c)).

P Hickley (Severn-Trent Water, in a letter dated 14 October, 1988) noted that ‘Smelt run up the River Trent with their status varying from one season to the next. I believe last season was better than most.’

N J Fickling (letters dated 14 December, 1990 and 6 January, 1991) confirmed that there were ‘unexploited stocks’ which run up the River Trent.

Howes & Kirk (1991) believed that ‘A residual population may still enter the lower reaches of the Trent, since specimens were occasionally caught ... in adjacent stretches of the Chesterfield Canal during the 1950s (Doncaster Museum records) and others were caught during an angling match at Littleborough ... in November 1966 (Cacutt 1979)’.

There is clearly a run of Smelt in the River Trent, but this can probably be regarded as part of the population in the Humber Estuary.

5.3.7 River Witham

Smith (1915) reports large quantities caught in brackish water in the River Witham.

N J Fickling (letters dated 14 December, 1990 and 6 January, 1991) confirmed that there were ‘unexploited stocks’ which run up the River Witham.

Any run of Smelt in the River Witham can probably be regarded as part of the stock in the River Trent and consequently derived from the population in the Humber Estuary.

5.4 Wash

5.4.1 The Wash

‘The great estuary of the Wash has always been noted for the abundance of this fish (Smelt) taken in its shallows, and in the rivers which discharge themselves into its intricate channels.’ (Southwell 1887).

Patterson (1911) records Smelt in The Wash.

Smith (1915) reports large quantities of Smelt caught in brackish water in the Wash.

‘Smelt enter the estuaries and spawn mainly in March, April and May. Masterman (1913) gives the spawning period in the Wash as late as March and April. Postlarvae occur in the estuaries from May to September.’ (Russell 1976).

In the Wash itself, shrimp boats catch and accidentally kill large numbers of 3 inch smelt (N.J. Fickling, letter dated 6 January, 1991).

Potts & Swaby (1993) do not list Smelt in their list of fish for The Wash.

Very few Smelt were recorded in the Wash by CEFAS in their coastal surveys (1981-97) of young fish using intertidal push nets and a 2 m beam trawl (Rogers *et al* 1998) – less than 1 per 1000 m² at one site (Figure 3). Other sites were negative for this species, except at the mouth of the Great Ouse (q.v.).

‘Smelt are present in the Wash (there used to be a commercial fishery) and I think they are relatively common. They are collected in epibenthic trawl surveys undertaken as part of the Denver Abstraction licence studies for Essex and Suffolk Water. Reports are available from 1998-2002.’ (E-mail from Conor Donnelly, English Nature, dated 25 November, 2002).

It seems likely that the population of Smelt in the Wash represents a common stock to the rivers and coastal harbours of the area.

5.4.2 Wainfleet Haven

Smith (1915) reports large quantities caught in brackish water in Wainfleet Haven.

Any Smelt in Wainfleet Haven can probably be regarded as part of the common population in the Wash.

5.4.3 The Haven

Smith (1915) reports large quantities of Smelt caught in brackish water in Boston Docks.

‘... 50 years ago they were prolific. I have caught 117 in Boston Sluice on the seawater side.’ (B.J. Halliday, report of discussion following Hutchinson (1983c)).

Any Smelt here can probably be regarded as part of the common population in the Wash.

5.4.4 River Welland

Brogden (1899) records Smelt being taken in large quantities in some waters and recalls helping to net 751 specimens in a deep hole in the Welland in a single haul.

Smith (1915) reports large quantities of Smelt caught in brackish water in the Welland.

‘Although smelt have been occasionally recorded in the Spalding area they have not been observed in non-tidal water in the last ten years.’ (R.S.J. Linfield, Anglian Water Authority, letter dated 25 March, 1980).

N.J. Fickling (letters dated 14 December, 1990 and 6 January, 1991) confirmed that there were ‘unexploited stocks’ which run up the River Welland.

Any Smelt in the River Welland can probably be regarded as part of the common population in the Wash.

5.4.5 River Nene

Jenyns (1846) noted that ‘Smelts also occur in the Nene.’

D.E. Moore, Liverpool, responding to the 1966 PSM fish questionnaire, confirmed Smelt in the River Nene in April, 1964, ‘4 miles below Peterborough.’ And in February, 1967, ‘1 mile above Peterborough.’

An anonymous response to the same questionnaire recorded Smelt in the River Nene on 1 October, 1964 at ‘Wisbech, Cambridgeshire, Common.’

Another questionnaire response for the River Nene also came from the Welland and Nene River Authority, confirming Smelt in the River Nene in June, 1966, at the ‘Power Station Cut, Peterborough: Uncommon.’

‘Occasionally caught in the non-tidal river and several were caught by electro-fishing and netting in 1971 at a distance of about five miles above the tidal sluice.’ (R.S.J. Linfield, Anglian Water Authority, letter dated 25 March, 1980).

N.J. Fickling (letters dated 14 December, 1990 and 6 January, 1991) confirmed that there were ‘unexploited stocks’ which run up the River Nene.

Any Smelt in the River Nene can probably be regarded as part of the common population in the Wash.

5.4.6 River Great Ouse

‘In a footnote to a curious old poem entitled the “Life of a Fen-man”, published in Lynn in 1771, it is stated that large quantities of Smelts come up the river Ouse to spawn, and are caught by the Fen-men, who make a considerable profit, “a single share in this fishery having been known to produce £50”. It is probable that much larger quantities are taken now’ (Southwell 1887).

Jenyns (1846) recorded that ‘Smelts ascend the Hundred-foot River in large numbers every year in the months of March and April for the purpose of spawning. At Mepal, and other places higher up, quantities are taken for the table, and distributed about the county. They often have their gills much infested by a species of *Ascaris* ...’ A note recording the occurrence at Mepal is dated 10 April, 1824, when the fish were noted to have been full of spawn. Another reference to Smelt in the Hundred-foot River is dated 21 March, 1826, and the period of their occurrence there is given as from 10 March to 15 April (Wheeler 1973).

‘... the Ouse is the most important, and a very ancient Smelt fishery is known to have been prosecuted in the portion of that river between Wiggshall St. Germans and the town of Lynn, a distance of some seven miles. ... Dr Lowe informs me that in the river they are caught in considerable quantities in “stow-nets” between St. Germans and Lynn as they descend from the spawning grounds, at that time, of course, they are watery and insipid and utterly unfit for food. ... also ... enormous quantities of these fish are captured in the drains and cuts of the Bedford Level, up which they make their way to spawn. They are caught by draw-nets, and occasionally some tons of fish are secured at once.’ (Southwell 1887).

Aldous (1987) refers to a report by Buckland (1875) on the Norfolk fisheries but fails to give the reference. He notes that ‘Buckland also reports on fisheries for smelts and anchovies in the River Great Ouse, but the Joint Committee’s records do not mention these fisheries.’

In response to the 1966 PSM fish questionnaire the Fisheries Officer (Great Ouse House, Cambridge) recorded that Smelt occurred in the ‘River Ouse and Hundred Foot River each spring.’ An anonymous response to the same questionnaire confirmed Smelt in the ‘River Ouse – St German, Norfolk. Common.’

‘A run of smelt occurs up the tidal Ouse and New Bedford River as far as Earith. The fish are mostly observed when the mature fish die in numbers and it is not known if they spawn successfully nor if the young fish descend the river to the sea. Mortalities occur in April or early May but are not observed every year. More usually they are observed every two or three years.’ (R.S.J. Linfield, Anglian Water Authority, letter dated 25 March, 1980).

N.J. Fickling (letters dated 14 December, 1990 and 6 January, 1991) confirmed that there were commercial fisheries ‘yielding 3 to 6 tonnes’ per annum in the Great Ouse.

‘I also remember seeing buckets of smelt being pulled out of Earith and St. Ives locks on the Great Ouse about 10 years ago. I wondered then whether the adults would eat the larvae or eggs of dace or any other young fishes present in the river at that time.’ (E-mail from A Pinder, Centre for Ecology and Hydrology, dated 28 November, 2002).

Hundred Foot River: ‘... 50 lb of smelt were caught in one night during the first week of April 1993 by an eel fisherman. The capture was made using 10 pairs of fyke nets at Oxlode.’ (Environment Agency 1997).

Each September between 1984 and 1996 annual epibenthic trawls of the tidal Great Ouse were carried out by the Environment Agency (1997). Thirty three sites between the Wash and the Denver Sluice were sampled with a continuous 15 minute trawl at each site. The results showed that ‘... smelt have been caught at all sites ... However, the numbers recorded at each site fluctuate widely between years. Highest numbers were recorded in 1993. Large shoals

were recorded in 1994 and 1995. In 1988 smelt were recorded at all the trawl sites.’ (Environment Agency 1997) ‘Personal communications with eel fishermen around the St Germans area of the tidal river report large annual migrations of smelt during February, March and April.’

Upstream of Hermitage Lock large scale mortalities of Smelt have occurred at Brownhill Stauch. ‘... every year large numbers of smelt were detectable below the Stauch by the distinctive cucumber smell coming from the river. The appearance of the smelt was nearly always at the beginning of April. ... Following reports ... that smelt were running up the tidal river, two fyke nets were placed, for a 24 hour period, one upstream of Brownhill Stauch and one directly below. On 25 March 39 smelt were caught in the downstream net and none in the upstream.’ (Environment Agency 1997).

In the Old Bedford River / Counter Drain ‘A single smelt was recorded in a routine fishery survey in April 1988 ... at the site downstream of Welney. Two other surveys carried out in 1984 and 1993 did not encounter any more smelt.’ (Environment Agency 1997).

In the Old Bedford River / River Delph ‘Routine fisheries surveys carried out in November, December and January, since 1984, failed to reveal the presence of any smelt in this river. However, in April 1995 a mortality was reported at Earith. 330 smelt were found dead and a further 750 were rescued and placed in the Great Ouse the other side of the sluice at Earith.’ (Environment Agency 1997). ‘In March 1997 a special netting survey was carried out in the Old Bedford / Delph. 37 smelt were caught on the concrete apron below the Old Bedford sluice at Earith.’

In the Great Ouse Relief Channel ‘Low numbers of smelt were recorded, at a few sites during routine fisheries surveys carried out in August/September 1985, 1987, 1988 and 1993. In 1991 low numbers were recorded at all the sites sampled.’ (Environment Agency 1997).

In the Ely Ouse ‘In September 1990 a smelt was caught upstream of the confluence with the River Wissey during a routine survey.’ (Environment Agency 1997).

In the Old West ‘A single fish was caught during a routine survey at the Australia Farm site in November 1996.’ (Environment Agency 1997).

In the River Cam ‘A smelt was caught during a routine survey in January/February at the site above Baits Bite Lock.’ (Environment Agency 1997).

In the Middle Level Main drain ‘In November 1979 single fish were found at two sites; Magdalen Bridge and Moores Bridge. In September 1987 low densities were caught at seven sites between the West Bridge and St Germans. Further surveys in April 1980, July 1984, April 1986 and September 1991 and 1994 failed to reveal any further smelt.’ (Environment Agency 1997).

In the Rivers Nar, Babingley, Heacham and Gaywood ‘In surveys carried out on these north Norfolk rivers between January and April since 1985 no smelt have been recorded.’ (Environment Agency 1997).

In inshore coastal fishing surveys (Figure 3) carried out by CEFAS from 1981 onwards (Rogers *et al* 1998), ‘Smelt are shown to be relatively abundant off the mouths of rivers such as the Great Ouse, ...’ M.G. Pawson, CEFAS, e-mail dated 13 December, 2002).

Any Smelt in the River Great Ouse can probably be regarded as part of the common population in the Wash.

5.5 Norfolk / Suffolk

An excellent account of the contemporary smelt fisheries in Norfolk waters is given by Southwell (1887, 1888). This deals with historical aspects of the fisheries there, including methods and catches of fish at various times. A reference to the old smelt fishery may also be found in Wortley (1976).

More recently, N.J. Fickling wrote ‘... there are commercial smelt operations in the eastern rivers in Norfolk, ie the Broads, but these, though sustainable for at least 15 years (... mentioned in Arthur Ransome’s *Coot Club* or *Big Six*), are at risk because other smelt fishermen have moved in. My supplies dropped from 450 stone to 200 stone this year.’ (letter dated 18 November, 2002).

It seems likely that the stocks of Smelt in this area are likely to belong to a common population which is associated with the Broads and the estuarine and brackish waters around Great Yarmouth and Lowestoft.

5.5.1 River Yare

‘... Day has pointed out that a mesh was legalised for taking Smelts as early as the reign of Elizabeth (1558-1603), and an Act passed in the thirty-third year of George II (1760) renders it penal to take or possess “Smelt not 5 inches long”’ (Southwell 1887).

Houghton (1879) recorded that ‘Large quantities are taken by nets... in the Yare of Norfolk, where they grow to a large size, ...’

‘At both Yarmouth and Lowestoft large quantities of Smelts are taken annually. In the autumn, occasionally good sport may be had angling from the piers and in the harbours, ... but the greater number at the latter place are taken in the waters above the town as high as Mutford Lock. At certain states of the tide, ... Smelts are often taken by the drag-net in the sea at Gorleston; but the great fishery is in the shallows and creeks of Breydon.’ (Southwell 1887). ‘... Smelts are not allowed to be taken except by cast-nets between the 10th March and the 12th May. ... the same bye-law applies to the ... Yare.’

‘... on Breydon, the wind-swept estuary of the Yare and Waveney ... During the winter months smelt-netting is carried on at intervals in the main channel of the estuary and the branch channels or “drains” between the mud-flats; ... during the previous April (1904) he had made the record catch of his life, landing no less than eighteen score smelts by one haul of his net.’ (Dutt 1906).

Patterson (1908) records Smelt in the ‘River Yare to Norwich’, and in ‘Breydon’ – also here in Patterson (1906, 1910a) and at ‘Yarmouth, seine-netting’ (Patterson 1905) and ‘Yarmouth ... March to September.’ (Patterson 1910b).

British Museum collection: '1934 (10.24.3): Gt. Yarmouth'.

Hartley (1947) collected just one Smelt in his sampling of the Norfolk Broads in 1939-41. No specific site is given. Eleven other species were taken in the same collection, including Flounder.

'Considerable numbers used to ascend the River Yare to lay their eggs on the river bed in the neighbourhood of Norwich in March and April annually and there was a regular cast-net fishery for them there. The river at Norwich is too highly polluted for their liking now; but they still enter all the broadland rivers in comparatively small numbers, and there has been recent evidence of their breeding in Oulton Broad. Observations made on the growth of smelts in this district by Thomas Southwell, of Norwich, showed that the young fish attained a length of one inch within three months of hatching out; by early August their average length was a little under three inches and by the following March, four inches.' (Ellis 1965).

E.Q. Bitton (East Suffolk and Norfolk River Authority, response to 1966 PSM questionnaire) recorded that Smelt 'Occurs seasonally in all tidal parts of the River Yare and its tributaries.'

'Smelt were certainly once very common in the River Yare ..., numbers being sufficient to support a commercial fishery. This has long since disappeared, although there are still occasional strong runs of smelt up to the tidal limit of the River Wensum in the City of Norwich.' (R.S.J. Linfield, Anglian Water Authority, letter dated 25 March, 1980).

'... they are also caught in the Yare in the Anglian Water Authority. Up to four tonnes of fish are caught a year and they are used to feed local otters.' (P. Hutchinson: report of discussion following Hutchinson (1983c)).

'Smelt, a nationally important estuarine fish species, is in the Broads predominantly restricted to Breydon Water and the tidal reaches of the rivers Waveney and Yare.' (English Nature & Broads Authority 2001).

In inshore coastal fishing surveys carried out by CEFAS from 1981 onwards (Rogers *et al* 1998), 'Smelt are shown to be relatively abundant off the mouths of rivers such as the ... Yare, ...' M.G. Pawson, CEFAS, e-mail dated 13 December, 2002).

Any Smelt in the River Yare can probably be regarded as part of the common population associated with the Broads area.

5.5.2 River Bure

'The fishing extends a short distance up the Waveney to the Burgh Castle Cement Works; very little is done in the North River or Bure.' (Southwell 1887).

Patterson (1908) records Smelt in the River 'Bure at Runham (six miles up)'.

Any Smelt in the River Bure can probably be regarded as part of the common population associated with the Broads area.

5.5.3 River Thurne

Patterson (1908) records Smelt in the River Thurne as in the 'Bure or North River connecting to Hickling Broads ... Potter Heigham, seventeen miles from Yarmouth Bridge

N.J. Fickling (letters dated 14 December, 1990 and 6 January, 1991) confirmed that there were 'unexploited stocks' which run up the River Thurne.

Any Smelt in the River Thurne can probably be regarded as part of the common population associated with the Broads area.

5.5.4 River Wensum

'... Smelts are not allowed to be taken except by cast-nets between the 10th March and the 12th May. ... the same bye-law applies to the ... Wensum.' (Southwell 1887).

'Smelt were certainly once very common in the ... tidal River Wensum, numbers being sufficient to support a commercial fishery. This has long since disappeared, although there are still occasional strong runs of smelt up to the tidal limit of the River Wensum in the City of Norwich. There does not seem to be much historical evidence of strong smelt runs up other broadland rivers, although a small number may turn up each year in our fishery surveys and are occasionally caught by anglers.' (R.S.J. Linfield, Anglian Water Authority, letter dated 25 March, 1980).

Any Smelt in the River Wensum can probably be regarded as part of the common population associated with the Broads area.

5.5.5 The coast

Large quantities of Smelt were reported by Yarrell (1836) as being taken along the sandy shallow waters of the east coast, particularly Lincolnshire.

Smith (1915) recorded that 'The horse nets near Skegness sometimes each catch a score along with the shrimps.'

'Lincolnshire and Essex River Divisions: no records known.' (R.S.J. Linfield, Anglian Water Authority, letter dated 25 March, 1980).

Any Smelt along this coast can probably be regarded as part of the common population associated with the Broads area.

5.5.6 River Waveney

'The fishing extends a short distance up the Waveney to the Burgh Castle Cement Works; very little is done in the North River or Bure.' (Southwell 1887). 'Above the Burgh Cement Works, Smelts are not allowed to be taken except by cast-nets between the 10th March and the 12th May.'

'... on Breydon, the wind-swept estuary of the Yare and Waveney ... During the winter months smelt-netting is carried on at intervals in the main channel of the estuary and the

branch channels or “drains” between the mud-flats; ... during the previous April (1904) he had made the record catch of his life, landing no less than eighteen score smelts by one haul of his net.’ (Dutt 1906).

Patterson (1913) records Smelt in ‘... marshes west of the Waveney.’

N.J. Fickling (letters dated 14 December, 1990 and 6 January, 1991) confirmed that there were commercial fisheries ‘yielding 3 to 6 tonnes’ per annum in the River Waveney.

‘Smelt, a nationally important estuarine fish species, is in the Broads predominantly restricted to Breydon Water and the tidal reaches of the Rivers Waveney and Yare.’ (English Nature & Broads Authority 2001).

‘One other source of information on Smelt is from eel fishermen using fyke nets in tidal reaches of rivers (I know that they catch them in the lower Waveney).’ (M.G. Pawson, CEFAS, e-mail dated 13 December, 2002).

Any Smelt in the River Waveney can probably be regarded as part of the common population associated with the Broads area.

5.5.7 River Alde

British Museum collection: ‘1887 (4.25.6): River Alde, Suffolk’.

E.Q. Bitton (East Suffolk and Norfolk River Authority, response to 1966 PSM fish questionnaire) recorded that in the River Alde, Smelt ‘Occurs seasonally in ... estuary’.

It seems possible that any Smelt in the River Alde are part of a population which is common to the estuarine and coastal areas of the Alde, Deben, Orwell and Stour.

5.6 Essex

5.6.1 River Deben

E.Q. Bitton (East Suffolk and Norfolk River Authority, response to 1966 fish PSM questionnaire) recorded that in the River Deben, Smelt ‘Occurs seasonally in ... estuary’.

It seems possible that any Smelt in the River Deben are part of a population which is common to the estuarine and coastal areas of the Alde, Deben, Orwell and Stour.

5.6.2 River Orwell

‘... three years ago and in previous years they were probably present in small numbers – I had them in my herring net.’ (questionnaire response, dated 26 November, 2002, from R. Marschalek, National Federation of Sea Anglers, East Anglia). ‘... upstream limit at least 5 miles from harbour mouth to Levington and Wrabness.’

It seems possible that any Smelt in the River Orwell are part of a population which is common to the estuarine and coastal areas of the Alde, Deben, Orwell and Stour.

5.6.3 River Stour

E.B.T. Abbott (Flatford Mill Field Centre, response to 1966 PSM fish questionnaire) recorded Smelt on 27 July, 1959 in the ‘Boundary Stream, East Bergholt, 2 miles, Suffolk.’

‘The smelt I caught as a youngster were taken from Felixtowe pier in the early 1960s ... 1962 and 1963. During that time ... I caught approximately seven or eight ‘cucumber smelt’. It seemed to be a species that, at that time, was relatively common in that particular area ...’ (E.J. Derriman, Cornwall Sea Fisheries District, letter dated 28 November, 2002).

Smelt were recorded just south of the Stour Estuary (Figure 3) by CEFAS in their coastal surveys (1981-97) of young fish using intertidal push nets and a 2 m beam trawl (Rogers *et al* 1998).

‘... three years ago and in previous years they were probably present in small numbers – I had them in my herring net.’ (questionnaire response, dated 26 November, 2002, from R. Marschalek, NFSA, East Anglia). ‘... upstream limit at least 5 miles from harbour mouth to Levington and Wrabness.’

Potts & Swaby (1993) do not include Smelt in their list of fishes of the Stour Estuary.

It seems possible that any Smelt in the River Stour are part of a population which is common to the estuarine and coastal areas of the Alde, Deben, Orwell and Stour.

5.6.4 River Blackwater

‘... in the ... Blackwater mouths the species was relatively common in the 1950s and 1960s and must have bred in these short rivers.’ (Wheeler 1979).

Smelt were recorded in 1964 (Essex River Authority, response to 1966 fish questionnaire) in the ‘River Blackwater, Maldon, (2 miles): Uncommon.’

Smelt were recorded just off the Blackwater Estuary (Figure 3) by CEFAS in their coastal surveys (1981-97) of young fish using intertidal push nets and a 2 m beam trawl (Rogers *et al* 1998).

Smelt are listed for the Blackwater Estuary by Potts & Swaby (1993).

It seems possible that any Smelt in the River Blackwater are part of a population which is common to the estuarine and coastal areas of the Blackwater and Crouch.

5.6.5 River Crouch

British Museum collection: ‘1962 (5.25.30): R. Crouch, Essex, between Royal Corinthian Yacht Club and the Roach mouth’.

‘... in the Crouch and ... mouths the species was relatively common in the 1950s and 1960s and must have bred in these short rivers.’ (Wheeler 1979).

Smelt were recorded just off the Crouch Estuary (Figure 3) by CEFAS in their coastal surveys (1981-97) of young fish using intertidal push nets and a 2 m beam trawl (Rogers *et al* 1998).

It seems possible that any Smelt in the River Crouch are part of a population which is common to the estuarine and coastal areas of the Blackwater and Crouch.

5.7 Thames

5.7.1 River Thames

Though their numbers have fluctuated dramatically from time to time, Smelt have been known and fished in the River Thames for many hundreds of years. In his review of the Thames fish and fisheries, Wheeler (1979) noted that ‘... in the Thames ... the smelt was a very valuable food fish and its remains have been found in several London medieval archaeological sites. ... Smelt bones have been identified in several layers dating from Roman Southwark and medieval Westminster. ... The fishery for smelt was probably the most important of all tidal Thames fisheries ... the largest catches being made in winter and early spring when the adults are migratory.’

‘In 1630 Sir Robert Ducie ... forbade smelt fishing westwards of London to Islesworth church from 10 March until 14 September (thus protecting the spawning stock), and to the east of London from 21 October until the Good Friday following.’ (Wheeler 1979).

In notes left behind by Sir Robert Gregory, dated 4 April 1797, it was recorded that ‘Smelts have been so plentiful in the river lately, that on Wednesday the fishermen disposed of them on the banks of the Thames at the rate of 2d. a basket full, containing nearly one hundred; and on Monday, in Deptford Creek, the draught was so great that they were sold in the manner of sprats, by coal measure ...’

Pollution became an increasing problem on the river, but Wheeler (1979) notes that ‘... the state of the water was only one of several factors affecting this fish ... In April, 1828, a deputation from the body of fishermen on the River Thames claiming that the whitebait fishery ... “... had totally destroyed the fishery on the River, and had, in consequence, reduced the petitioners and their wives and families to a state of starvation.”’

Yarrell (1836) observed that the River Thames ‘... between Wandsworth and Hammersmith formerly contained smelt abundantly’, but added that few were taken there then.

Observations by Buckland (1875) concluded that ‘Like other species of the salmon family, the smelt has, from a variety of causes, been induced to quit our shores, or has been hunted out of them, and in the Thames he is no longer a means of profit and an object of keen pursuit among the regular fishermen or the sportsmen. Yet at one time the river swarmed with the fish, and the poor fishermen between London Bridge and Lambeth looked forward to their annual appearance and capture as their resource for paying off the unavoidable debts they contracted during the winter. Immense quantities of smelts were then taken; but now, if the fish appear at all, it is too late to be of advantage to the fisherman, even were their numbers far greater than they are. Below Woolwich, where I believe they now alone appear in the Thames, the angler would scarcely be inclined to go and try his luck among smelt. As many as a hundred dozen of smelt have been taken in the Thames in a day; and we are informed

that they used to be sold in the streets of London “by the name of dried sparlings, being split and dried, and were recommended by the gentlemen who took their gills of a morning as adding to the spirit a particular relish.”

Fitter (1945) quotes an old report (1848) that ‘smelt could be taken near London Bridge’.

‘In March, 1868, Mr Smithers, fishmonger, Duke Street, London Bridge, sent me three live smelts. They were caught in the Thames, nearly up stream as far as Teddington. Mr. Charles, of Arabella Row, also sent me several specimens of Thames smelts caught about this time near Kew Bridge. This is a good sign for the future prospects of the Thames, when we find smelts returning to it.’ (Buckland 1875).

In 1878, smelt were taken by netting below Richmond Bridge (Brougham 1878, 1893).

Houghton (1879) recorded that Smelt ‘... formerly abounded in the Thames, from Wandsworth to Putney Bridge, and from thence to the suspension bridge at Hammersmith some thirty to forty fishing-boats might have been seen working together many years ago. Below Woolwich, where it is said they now alone appear in the Thames, the angler would scarcely be inclined to go and try his luck among Smelt. ... Large quantities are taken by nets in ... the estuary of the Thames.’

Day (1884) records smelt taken at Teddington and others near Kew Bridge (March 1868 and September 1882), at Chiswick and at Hammersmith.

Decreasing numbers in the upper part of the Thames Estuary meant that ‘By the end of the nineteenth century smelt were only commercially fished in the mouth of the river.’ (Wheeler 1979). However, Smelt continued to appear in various places at this time and were recorded at Kew and Richmond (Anonymous 1898) and by Murie (1903) at Richmond (1898), at Westminster (1899) and beyond Blackwall (1900). He noted also that ‘... smelt were to be encountered in most of the creeks and bays between Yantlet and Mucking Flats.’ Cornish (1902) observed Smelt in 1900 and noted that ‘In August the delicate smelts suddenly reappeared at Putney, where they had not been seen in any number for many years. Later, in September, another migration of smelts passed right up the river. Many were caught at Islesworth and Kew, and finally they penetrated to the limit of the tideway at Teddington, and good baskets were made at Teddington Lock.’

Maxwell (1904) recorded that ‘Smelts formerly afforded very profitable fishing in the tidal waters of the Thames, but were driven away by the wholesale pollution which destroyed the nobler salmon. Now, however, that the current has been purified by the joint action of the London County Council and the Thames Conservancy, smelts once more ascend in large shoals as high as Teddington. There and at Richmond they have afforded sport in three or four successive years to juvenile anglers with a red worm; nevertheless, smelts are scarcely entitled to rank as game fish.’

Pollution was very bad at times and Wheeler (1979) believed that there was no evidence to suggest it survived the pollution of the river in the mid-19th and 20th centuries – ‘... although in the outer estuary ... it was common until the 1930s.’

After its disappearance in the 20th century, ‘... the first capture in the river as it began to recover was made in April 1966 when a fish of 143 mm was caught at West Thurrock ...’

(Wheeler 1979). 'During the power station survey of 1967-73 smelt were captured at all the stations on the Thames.' The survey showed 'a fluctuating but steady increase through the six-year period, from nil fish in 1967. It also demonstrates that while smelt occurred with some frequency towards the mouth of the river from 1968 onward, they were penetrating upstream to the west of London in that year and continued to do so each year thereafter.' By 1975, smelt had increased notably and had reached the Blackwall Tunnel area, the Outfalls area and the Dartford Tunnel area.

Andrews (1977) has shown how abundant the smelt were in the upstream tidal river during the extreme drought of 1976, also 'recently hatched fishes taken in June during trawls at Greenwich and London Bridge'. He also caught smelt by trawling at Limehouse Reach, Tower Bridge and Chelsea Reach. 'During 1976 smelt were captured by anglers at several points along the river ... following stormwater discharge from rain-filled sewers, between 30 and 40 dead smelt were recovered from the river at Woolwich.' (Wheeler 1979).

'Nearly 2,500 smelt were taken in 5 h at West Thurrock power station in 1978 during a period of peak occurrence, which contrasts with only isolated captures in the years prior to 1976, when the Thames was of only "poor quality".' (Andrews & Cockburn 1983). Wheeler (1979) concluded that '... there are large numbers of immature smelt in the whole of the lower tideway throughout the year ... spawning takes place in March ... It is not known where the smelt spawn in the Thames but ... it must be upstream of Wandsworth Bridge.'

'Of a sample of 703 smelt, *Osmerus eperlanus*, from the estuary of the River Thames, 2.6% were identified as being synchronous hermaphrodites. ... The hermaphrodite individuals were identified from monthly samples (Feb. 1981 – Mar. 1982) of smelt collected from the screens of CEGB West Thurrock power station (Huddart, 1971).' (Hutchinson 1983b).

Smelt were found to be present in the Royal Docks, London, during a gill netting survey there by Conlan *et al* (1988).

'In 1988 supplies of Smelt were bought from fishermen in the River Thames where they were a bycatch from the eel fishery there. With apparent tighter fisheries enforcement there this supply stopped' (phone call from Malcolm Gilbert, Ammodytes Co., Cornwall, on 22 November, 2002).

'Pilcher (1989) has reported that smelt (*Osmerus eperlanus* L.) are one of the most common fish species in the R. Thames in the late spring, when large shoals enter the tideway to spawn in the Wandsworth area. He has suggested that this region of the Thames is a valuable nursery site for young smelt and other immature euryhaline species.' (Lee & Whitfield 1992). Smelt were captured regularly at Lots Road Power Station on the River Thames at Fulham by Lee & Whitfield (1992) between October 1989 and June 1990 who noted that 'Smooth, white, ovoid tumours were observed on the fins of smelt during their anadromous spring migration and recognised as a form of spawning papillomatosis. Papillomatosis fish constituted about 21% of the population in March and about 19% in April but were not present in any other samples.'

M. Pilcher (e-mail, dated 21 November, 2002) confirmed that he '... used to catch a lot of smelt in the Thames Estuary when I worked up there years ago. Funny looking fish, distinct smell of cucumber and huge teeth in proportion to the size of the fish.'

A useful review of recent aspects of Smelt in the Thames has been provided by Colclough *et al* (1999) in which they reported that 'Establishment of a spawning population took place during the late 1970s (Wheeler 1979). Yeomans (1994) produced a more recent review on Smelt in the Thames, based largely on the power station data. Smelt ascend from the lower estuary below Gravesend to spawn in the Wandsworth area in March/April. Pilcher (1989) reported mature smelt shedding eggs and spawn in the Wandsworth area in April 1986 and April 1987. Spent smelt have been observed on the intake screens at Lot's Road Power Station in late April (Pilcher, pers. comm.). Adults return to the lower reaches soon after spawning. Young fry spread rapidly throughout the estuary and remain until late autumn.'

Surveys by Colclough *et al* (1999) show that young of the year occur at a range of sites above Greenwich in both spring and autumn surveys. 'In a major fish rescue at Canary Wharf in late April 1994, substantial numbers (2,000 plus) of mature smelt at 12-15 cm were removed from an enclosed area and moved to adjacent safety along with approximately 5,000 mixed freshwater and estuarine fish. Catches were similar to those made in another rescue at the same location in November 1989. These rescues illustrate the importance of the remaining dock basins to species such as the smelt. Anglers report substantial catches of smelt from several dock basins in the summer months (Coates, pers. comm. 1996). Shadwell Basin develops a thermocline each summer. Turnover in the autumn has resulted in fish mortalities in some years. Young of the year smelt tend to feature heavily in these mortalities. The attraction of this particular basin to smelt fry is unknown. Wheeler (1979) reported large numbers of smelt in Shadwell Basin. Some smelt may remain in the dock basins permanently. Some angling reports have related to winter catches (Dutton, pers. comm).'

The biology of Smelt was studied in the Thames by Geoghegan (1995). 'Using gill nets he made an unsuccessful attempt to pinpoint the location and exact timing of the spawning. With a kick sample net, he did make some observations on the early appearance of smelt fry. Fry first appeared at 18 mm at Greenwich on 16th May 1995, and then at Battersea Park at 20-23 mm the following day. These are the smallest smelt yet reported from the Thames. At this size it is most likely that the larvae are still drifting passively with the tidal flow. This indicates that the spawning site was likely to be above Battersea Park. A wide range of fry at 18-30 mm were taken at Vauxhall Bridge on 5th June. Fry of a similar size range were taken two days later at Thamesmead.' (Colclough *et al* 1999).

'... Lee Valley Anglers Consultative Association ... say smelt is very common in the lower Lee in London (they call them bleak with teeth) and Dick Hodges ... Thames Angling Preservation Society ... says smelt are prolific in the lower Thames following its recovery in the 1960s.' (E-mail from Fred French, National Association of Fisheries & Angling Consultatives, dated 27 November, 2002).

Barry Walpole is a commercial fisherman who has fished The Medway and other waters (eg the Swale and Stour) for many years. He himself had very good catches in August 2002 in the Medway (q.v.) and he knows fishermen in the River Thames who have had even larger catches, fishing with bigger gear (B. Walpole, 'phone conversation with PSM, 3 December, 2002).

'There is a big smelt population in the Thames estuary, but they tend to be small, under 7 inches. Large numbers are caught – a day's work yields 30-40 stone.' (N.J. Fickling, Lucebaits, letter dated 18 November, 2002).

In inshore coastal fishing surveys carried out by CEFAS from 1981 onwards (Rogers *et al* 1998), ‘Smelt are shown to be relatively abundant off the mouths of rivers such as the ... Thames, ...’ M.G. Pawson, CEFAS, e-mail dated 13 December, 2002).

Regular sampling by the Environment Agency covers a stretch of the Thames from fresh water to brackish water. Recent results for Smelt are as follows (E-mail from Trazar Astley, Environment Agency, dated 13 December, 2002):

Battersea	Greenwich	Tilbury	Chiswick	Battersea	Greenwich	West Thurrock
30/05/02	13/06/02	14/06/02	23/09/02	25/09/02	10/09/02	12/09/02
1	11	7	2	49	1	1

It seems likely that the Smelt stocks in the River Thames are part of a large population which is common to the estuarine and coastal areas of the Thames, Lee, Medway and Swale.

5.7.2 River Lee

Smelt were present in the River Lee from Bow Locks ‘Up until about two years ago when high tide would push open lock gates and the tide would go up as far as Old Ford Lock ... There is now a barrier preventing the stretch being tidal – at least we have lost some Mitten Crabs as a result. ... pleasure anglers caught a few at each sitting ... the earliest was July according to tide heights and they went around December when it got cold. They were about 100-150 mm in length.’ (questionnaire response from D. Meadhurst, Lee Anglers’ Consortium, dated 4 December, 2002).

It seems likely that the Smelt stocks in the River Lee are part of a large population which is common to the estuarine and coastal areas of the Thames, Lee, Medway and Swale.

5.7.3 River Medway

Houghton (1879) recorded that ‘Large quantities are taken by nets in ... the Medway.

Smelt in the River Medway continued to support a fishery in the 1920s and 1930s, although declining in numbers (Marsh 1971) and by the end of the 1950s they had left the river (Waters 1964).

‘So far as the Kent Area is concerned, the only water in which smelt are known to occur is the River Medway estuary. At one time I understand that the smelt fishery was of commercial significance but the estuary is now heavily polluted and has been for a good many years. Hence only the occasional smelt is recorded.’ (B.M. Joslin, Southern Water, letter dated, 28 January, 1980).

Significant numbers of Smelt were recorded in the Medway Estuary by CEFAS (Figure 3) in their coastal surveys (1981-97) of young fish using intertidal push nets and a 2 m beam trawl (Rogers *et al* 1998).

Trawling at three stations in the River Medway by CEFAS on 25 November, 1999 (Environment Agency 2001), produced 42 Smelt at The Swale (NGR: TR 040667), two at The Grain (NGR: TQ 900755) and none at Kingsnorth (NGR: TQ 813713).

Regular sampling has been carried out by the Environment Agency at five stations in the Medway in recent years (Environment Agency 1997b, 1998, 1999, 2000, 2001) and this has provided very valuable information on the distribution and status of Smelt and of many other species there. A summary of the results is as follows:

Sampling station	N G R	No of samples	% with smelt	Total smelt	Smelt/sample
Allington	TQ 745 581	9	0	0	0
Wouldham	TQ 712 644	11	63.6	85	7.7
Borstal	TQ 734 675	10	60.0	248	24.8
Lower Upnor	TQ 770 712	9	33.3	55	6.1
Isle of Grain	TQ 888 744	10	30.0	10	1.0

‘During a routine check of a vessel we saw approximately 24 stone of Smelt. ... A project was carried out to find the spawning areas with little success. This may be repeated.’ (Questionnaire return from C Conroy, Environment Agency, dated 21 November, 2002).

Barry Walpole is a commercial fisherman who has fished the River Medway and other waters (eg the Rivers Swale and Stour) for many years. He mostly fishes a pelagic otter trawl, detecting the shoals by echo sounder, and finds the fish most abundant during the summer and autumn – ‘they disappear during the winter, upstream I think to where the salt water becomes brackish, to spawn. This summer (2002) they were very abundant in August when, on two days, with two hauls on each day, I had 500-600 pounds of clean Smelt per haul. Most of the fish were middle-sized with some large ones. The large ones go to the London market, where they are popular for eating, the smaller fish are sold as bait for Pike.’ (B. Walpole, ‘phone conversation with PSM, 3 December, 2002).

‘This year (2002), when I went to tow a boat from Barking Creek in the early spring (mid-March), I noticed that the Creek was full of Sparling, possibly there for spawning.’ (B. Walpole, ‘phone conversation with PSM, 3 December, 2002).

It seems likely that the Smelt stocks in the River Medway are part of a large population which is common to the estuarine and coastal areas of the Thames, Lee, Medway and Swale.

5.7.4 The Swale

Barry Walpole is a commercial fisherman who has fished The Swale and other waters (eg the Rivers Medway [q.v.] and Stour) for many years. Smelt are common in the Swale and he has had good catches there and in Faversham Creek in recent years. (B. Walpole, ‘phone conversation with PSM, 3 December, 2002).

It seems likely that the Smelt stocks in The Swale are part of a large population which is common to the estuarine and coastal areas of the Thames, Lee, Medway and Swale.

5.8 *Kent / Sussex*

5.8.1 River Rother

In inshore coastal fishing surveys (Figure 3) carried out by CEFAS from 1981 onwards (Rogers *et al* 1998), ‘Smelt are shown to be relatively abundant off the mouths of rivers such as the ... Rother, ...’ M.G. Pawson, CEFAS, e-mail dated 13 December, 2002).

The situation here is uncertain for there is little in the way of estuary associated with the River Rother and no reports of Smelt in the river. As with similar records elsewhere (Adur, Ouse (Sussex), Solent) further research on these stocks is required.

5.8.2 River Ouse

In inshore coastal fishing surveys (Figure 3) carried out by CEFAS from 1981 onwards (Rogers *et al* 1998), ‘Smelt are shown to be relatively abundant off the mouths of rivers such as the ... Sussex Ouse, ...’ M.G. Pawson, CEFAS, e-mail dated 13 December, 2002).

The situation here is uncertain for there is little in the way of estuary associated with the River Ouse and no reports of Smelt in the river. As with similar records elsewhere (Adur, Rother, Solent) further research on these stocks is required.

5.8.3 River Adur

‘Visual observation – large shoals – see CEFAS small fish survey reports.’ (Questionnaire return from R Clark, Shoreham-by-Sea, dated 10 December, 2002).

The situation here is uncertain for there is little in the way of estuary associated with the River Adur and no reports of Smelt in the river. As with similar records elsewhere (Ouse (Sussex), Rother, Solent) further research on these stocks is required.

5.9 *Portsmouth Harbour*

A single specimen of Smelt was noted for the Solent by Morey (1909).

Potts & Swaby (1993) found no records of Smelt in their review of the literature on Chichester, Langstone and Portsmouth Harbours.

In inshore coastal fishing surveys (Figure 3) carried out by CEFAS from 1981 onwards (Rogers *et al* 1998), ‘Smelt are shown to be relatively abundant off the ... Solent Harbours, ...’ M.G. Pawson, CEFAS, e-mail dated 13 December, 2002).

Although Smelt obviously occur along the Solent coast, there is no evidence that they are associated with any of the rivers or estuaries entering the sea in this area. As with similar records elsewhere (Adur, Ouse (Sussex), Rother) further research on these stocks is required.

5.10 Southampton Water

5.10.1 Southampton Water

Sampling of fish on the intake screens of Fawley Power Station started in 1973 and continued for many years. A total of 74 species have been recorded over the years but ‘Although a single smelt was recorded by Reay in April 1973, none have since been found.’ (Reay 1980).

Sampling in 1977 by Turnpenny & Utting (1981) at Fawley Power Station at the south-western extremity of Southampton Water and by beam trawl in the intake channel to the power station collected 29 species of fish, but no Smelt.

During a 12-month study of fish entrainment at Fawley Power Station on Southampton Water, Dempsey (1988) collected 14 species of fish larvae. Though Smelt are normally vulnerable to entrainment at such places (Robin 1988, Maitland 1997, 1998) none were taken in any of these samples.

No Smelt were recorded in Southampton Water by CEFAS in their coastal surveys (1981-97) of young fish using intertidal push nets and a 2 m beam trawl (Rogers *et al* 1998).

However, in the same surveys (Figure 3) ‘Smelt are shown to be relatively abundant off the ... Solent Harbours, ...’ M.G. Pawson, CEFAS, e-mail dated 13 December, 2002).

Although Smelt obviously occur along the Solent coast, there is no evidence that they are associated with Southampton Water or any of the rivers or estuaries entering the sea in this area. As with similar records elsewhere (Adur, Ouse (Sussex), Rother) further research on these stocks is required.

5.11 Poole Harbour

5.11.1 Christchurch Harbour

J.R. Barber (Wessex Rivers, letter dated 20 October, 1988) noted that Smelt were ‘Possibly present in Christchurch Harbour, also estuaries entering it.’ (ie Rivers Avon and Stour).

‘I have also worked (and angled extensively) in the lower Hampshire Avon and Christchurch Harbour, and have never seen or heard a reliable report of smelt there.’ (D.J. Solomon, e-mail dated 11 December, 2002).

Although Smelt obviously occur along the Solent coast, there is no evidence that they are associated with any of the rivers or estuaries entering the sea in this area. As with similar records elsewhere (Adur, Ouse (Sussex), Rother) further research on these stocks is required.

5.11.2 Poole Harbour

In a letter dated 31 December, 1982, D.J. Solomon warns: ‘Beware – several people ... say smelts are common in Poole Harbour – they are referring to sand smelts, but they won’t admit it!’

A.J.R. Barber (Wessex Rivers, letter dated 20 October, 1988) confirmed that ‘Reasonable populations definitely present in Poole Harbour ...’

Are Smelt present now? ‘Probably, but no positive records during last 20 years.’ (A. Strevens, Environment Agency, questionnaire response dated 22 November, 2002).

‘I have examined many fyke nets in Poole Harbour when looking at the eel fishing bycatch. I never found any *Osmerus*, but *Atherina* were fairly common.’ (A. Strevens, Environment Agency, E-mail dated 25 November, 2002).

In inshore coastal fishing surveys (Figure 3) carried out by CEFAS from 1981 onwards (Rogers *et al* 1998), ‘Smelt are shown to be relatively abundant off ... Poole Harbour, ...’ M.G. Pawson, CEFAS, e-mail dated 13 December, 2002).

It seems likely that Smelt are present in Poole Harbour and that this is the same population which runs into the River Frome.

5.11.3 River Frome

In 1981 C.A. Mills (Freshwater Biological Association, letter dated 25 November, 1981) wrote that ‘No smelt have been recorded in the Frome (as far as I can ascertain) ...’

‘I once caught one in the mid 1980s on the tidal Frome, just downstream of Wareham on rod and line. ... Bill Beaumont recalls catching about 30 on the tidal Frome while testing our boom-boat in about 1986.’ (E-mail from A Pinder, Centre for Ecology and Hydrology, dated 28 November, 2002).

In 1988 A.J.R. Barber (Wessex Rivers, letter dated 20 October, 1988) seemed confident that ‘Reasonable populations definitely present in ... lower Frome ...’

‘Anton Ibbotson caught one specimen in 1989 while electric fishing in the East Stoke mill stream. ... It appears that the only time we have sampled the lower river in the spring, smelt have been caught.’ (E-mail from A Pinder, Centre for Ecology and Hydrology, dated 28 November, 2002).

Are Smelt present now? ‘Probably, but no positive records during last 20 years.’ (A. Strevens, Environment Agency, questionnaire response dated 22 November, 2002).

It seems probable that a small stock of Smelt occurs in the River Frome and that this is the same population which is found in the Piddle and Poole Harbour.

5.11.4 River Piddle

In a memorandum, dated 31 December, 1982, D.J. Solomon (Ministry of Agriculture, Fisheries and Food) confirmed that ‘On April, 17 1975 I caught a single smelt in a salmon smolt trap on the R. Piddle, Dorset.’

C.A. Mills (Freshwater Biological Association, letter dated 25 November, 1981) noted that a Smelt ‘... was caught by a salmon netsman, probably close to the river mouth, four or five years ago.’

A.J.R. Barber (Wessex Rivers, letter dated 20 October, 1988) confirmed 'Reasonable populations definitely present in ... lower ... Piddle ...'

Are Smelt present now? 'Probably, but no positive records during last 20 years.' (A.Stevens, Environment Agency, questionnaire response dated 22 November, 2002).

It seems probable that a small stock of Smelt occurs in the River Piddle and that this is the same population which is found in the Frome and Poole Harbour.

5.11.5 Portland Harbour

M. Gray has observed and photographed Smelt on several occasions whilst diving in Portland Harbour questionnaire response dated

5.12 Devon / Cornwall

Apart from the two waters mentioned below, there is no evidence of Smelt in any of the many other rivers in Devon and Cornwall.

'There are no Smelt in the Cornwall area, though Sand Smelt are common in some places'(phone call from Malcolm Gilbert, Ammodytes Co., Cornwall, on 22 November, 2002).

5.12.1 Kingsbridge Estuary

Smelt are listed by Potter & Swaby (1993) in their review of the Salcombe and Kingsbridge estuaries but there are no other reports of Smelt in this area. (see Allen & Todd 1900).

This record is similar to the others from small estuarine areas along the south coast of England (Adur, Ouse (Sussex), Rother, Solent) and further research is required to determine the status and breeding grounds of these stocks.

5.12.2 River Tamar

Buckland (1875) recorded that '... but for actual bait, with a rod and line at flood tide, a red worm is generally thought all that is necessary. At Plymouth, where I have both witnessed and enjoyed a great deal of smelt fishing, I have seen nought else employed. ... Lambhay Point was a favourite resort for smelt fishers some years since. Traffic encroachments have now interfered considerably with the successful prosecution of the sport in this immediate quarter. ... At Plymouth ... no perceptible diminution of numbers has been discoverable except at the old rendezvous of Lambhay Point. In the Sound, near "The Mallard" excellent smelt fishing is still to be had, and great quantities are taken there during the summer months.'

'*Osmerus* first appeared in the Tamar in 1968. There appears to be no valid old records of its presence and locally "smelt" refers to *Atherina*. Since 1969 *Osmerus* have regularly bred in the Tamar. There is no commercial fishery for the species here and a smelt fishery in the estuary would be unpopular because of the salmon and sea-trout runs.' (P. Dando, letter dated 27 October, 1980).

Note that, whilst the comment by P. Dando is generally correct regarding the use of the name 'smelt' in this area, this should not invalidate the record by Buckland (1875) who was very familiar with *Osmerus* and the above quote is from an account of *Osmerus eperlanus* in his book.

'The most noteworthy change is the appearance of the smelt, *Osmerus eperlanus* L., in the estuary. This fish has not previously been recorded from the south coast of Devon and Cornwall and there are no recent records in its occurrence on the south coast west of Sussex.' (JMBA 1973).

'*Osmerus* post-larvae were observed in the Tamar again during 1973. The survival of the juvenile smelt was good and adult fish with maturing gonads were caught towards the end of the year. A permanent population of this species now appears to be established.' (JMBA 1974).

'*Osmerus* had a successful spawning in the Tamar again in 1974. Observations on larval and post-larval distribution indicated that the species spawned just below Gunnislake Weir and that the feeding area for the post-larvae was between 5 and 10 km downstream from the spawning zone.' (JMBA 1975).

'... the spawning grounds are just below Gunnislake Weir. ... I have a lot of trawl data and also plots of larval and post-larval distributions for the Tamar. A similar survey for the Dart did not show any. I spent a lot of time looking at old records and in the majority of these 'smelt' referred to *Atherina*. There was one for the Exe for which the species was uncertain. ... smelt were there (Tamar) in 1981 with population densities up to 4 per m³. Most of the samples are still with me and I have a lot of scales and scale readings.' (P.R. Dando, University of Wales, Bangor, e-mail dated 20 November, 2002).

As a bycatch, Smelt were taken in the River Tamar in 1988 in EA licensed salmon seine nets at Weir Quay (P.J. Coates, South Wales Sea Fisheries Committee, e-mail dated 14 November, 2002).

Potts & Swaby (1993) record that 'Cucumber smelt (*Osmerus eperlanus*) has been caught by beam trawl in the Tamar Estuary but only following high rainfall and when the salinity is low (Hutchings, pers. comm. 1992).'

'Adults observed by myself in National Marine Monitoring Programme annually: 1999, 2000, 2001 – qualitative information only, though a range of sizes. ... anecdotal evidence of large numbers of smelt migrating ... Spawning in and around tidal limit at Gunnislake.' (S. Toms, Environment Agency, e-mail dated 3 December, 2002).

A permanent population of Smelt appears to be present in the estuary of the River Tamar.

5.13 Bristol Channel

5.13.1 River Severn

There is a long history of fisheries and fish research on the Severn Estuary and the smaller estuaries of rivers flowing into it (Day 1890, Matthews 1933, Russell 1980, Holbrook 1991).

There appear to be no records of Smelt ever having occurred there. Much of the recent work has been based on fish collected from power station trash screens (Hardisty & Huggins 1975, Henderson *et al* 1984, Henderson & Holmes 1985, Claridge *et al* 1986, Potter *et al* 1986), to which Smelt are normally very vulnerable. Claridge *et al* (1986) note that 'Extensive sampling of the intake screens of power stations in the Severn Estuary (Berkeley, Oldbury-upon-Severn and Uskmouth) and Bristol Channel (Hinkley Point) yielded a total of 97 species of lampreys, elasmobranchs and teleosts. ... A comparison between our data and those of earlier workers indicates that no major change has occurred in the composition of the fish fauna of the Severn estuary during this century ...' The conclusions from these studies are that Smelt are absent from this very large and important estuary.

'My information with regard to the Severn is that smelt are absent from the estuary although this is based on casual observation rather than quantitative survey.' (R. Sedgwick, Severn-Trent Water Authority, letter dated 13 October, 1982).

'I have spoken to our Fishery Officer, who covers the Severn, and in his 25+ years he has not found any Smelt in routine surveys or at the power station intakes.' Questionnaire reply from C. Crundwell, Environment Agency, dated 17 December, 2002.

'I have not heard of any Smelt being caught in our waters ... (estuaries of the Rivers Brue, Avon, Parret and Severn)'. E-mail from C. Snaden, National Federation of Sea Anglers, Severn Division, dated 1 January, 2003.

Perhaps surprisingly, there is no evidence of Smelt ever having been present in the estuary of the River Severn.

5.13.2 River Usk

I. Wisley, a net fisherman in South Wales, has fished in the area for 35 years, but has never seen a Smelt (phone call, 27 November, 2002).

As with the Severn, there is no evidence of Smelt ever having been associated with the River Usk or its estuary.

5.14 South Wales

5.14.1 Milford Haven

A. Winstone (Welsh Water, in a letter dated 27 September, 1988) confirmed that Smelt were 'Present in ... Milford Haven.' It is unclear if this record refers to *Osmerus* or *Atherina* and further confirmation is required for this area.

5.15 Cardigan Bay

5.15.1 Rivers Ystwyth and Dovey

There are no records from these rivers, but Potts & Swaby (1993) record Smelt in several sea areas from Bardsey Island to the north (squares 4-5°W x 52.5-53°N; 4-5°W x 53-53.5°N; 4-5°W x 53.5-54°N).

5.16 *Nothwest Wales*

5.16.1 River Conwy

British Museum collection: '1863 (10.10.1-3): Conway, Shropshire'.

Houghton (1879) noted that 'The finest Smelts I ever see come from the Conwy, where they grow to the length of ten or even twelve inches; but the specimens exposed for sale in the fish-shops are much smaller.'

'Occurs in many estuaries, especially that of the Conwy River.' Forrest (1919).

Jenkins (1925) recorded Smelt in the River Conwy '... near the upper limit of tidal waters.'

Having discussed the status of the smelt fishery with his head bailiff and with one of the two netsmen, B.E. Jones (Welsh Water Authority, letter dated 30 January, 1980) concluded that 'It is apparent that the fishery in the Conwy has considerably declined over the last 5-6 years when catches of 30-40 dozen were being taken in a four-hour period. In 1978, the last year that was fished, very few smelt were taken and netting has subsequently ceased. When fish were being taken in larger numbers they were selling at 50p per dozen. The only netting site is at Talycafn (OS 115 787 718) where fish were caught in March and April, average size being 6-7 inches with fish up to 8 or 9 inches. Smelt run up as far as Llanrwst (OS 115 793 627) to spawn, approximately 13 miles from the river mouth.'

In 1980 R.S. Hughes (netsman) reported 'catches of 20 to 30 dozen fish.' (personal communication to the Nature Conservancy Council).

In 1984, the Welsh Water Authority (1986 Interim Report) reported '93 caught in seine net at SH 792 634 in April, comprising 85 males, 7 females and 1 immature fish.' This same catch is referred to by Department of Energy (1990) '... and the population could be estimated to be several thousands of reproductive fish.'

In 1988, A. Winstone, Welsh Water, (letter dated 27 September, 1988) recorded Smelt 'Present in the lower reaches of the Rivers ... Conwy ... Spawning grounds known on the River Conwy.'

'10-20 adults caught by commercial netsman – March –April.' 'Reports of younger Smelt in summer by another netsman.' (Welsh Water Authority, 1988 Annual Report).

'Angler observed spawning activity at SH 792 634.' (Welsh Water Authority, 1989 Annual Report) and a netsman (R.S. Hughes) reported 'catches of 4-5 dozen fish.' (personal communication to the Nature Conservancy Council)

In 1989, netsman, R.S. Hughes, reported 'catches of 3 dozen fish.' (personal communication to the Nature Conservancy Council).

In 1990, the NRA reported 'juveniles abundant at two sites in July - 50-100 fish per haul using seine nets – SH 794 753 and SH 781 708.' (personal communication to the Nature Conservancy Council).

Netsman, R.S. Hughes, reported ‘catches of half a dozen fish (in total) from March, 1990, onwards throughout the year.’ (personal communication to the Nature Conservancy Council).

In 1991, S. Bryan (Nature Conservancy Council, letter dated 8 February, 1991) noted that ‘... the River Conwy is the only confirmed breeding site in Wales, ...’

There is still a population of Smelt in the estuary of the River Conwy.

5.17 Dee & Clwyd

5.17.1 River Dee

Brookes (1740) recorded that Smelt ‘... are also caught in the River Mersey below Warrington-Bridge, where the Tide brings up the Salt-Water, ...’

Pennant (1776) found that Smelt were ‘abundant’ in the River Dee, where there was a regular fishery.

Houghton (1879) recorded that ‘... they are found in the ... Dee ...’

Walker (1893) recorded that Smelt ‘has become almost extinct in the Dee.’

Smelt were confirmed in the Dee Estuary by NCC (1978).

‘According to the netsmen, smelt have been caught in very small numbers in two other rivers in the past: the Dee 5-10 years ago and the Seiont 7-8 years ago. This record for the Seiont however has not been substantiated by the local bailiffs and must therefore be regarded as dubious.’ (B.E. Jones, Welsh Water Authority, letter dated 30 January, 1980).

In a letter dated 19 September, 1980, H.G. Pearce (University of Liverpool) noted that ‘... I am working on the Dee at present. I have a few smelt preserved in formalin (0+ to 3+ approximately) but I’m sure I could get more as they seem to be quite abundant. ... a micromesh net ... has caught the smelt I’ve caught up to date bar one in fresh water ... the salmon netsmen regularly catch large numbers. With the ‘spring’ tides at the end of August they should be well into the canalised semi-freshwater area.’

Smelt are ‘Present in the lower reaches of the Rivers Dee, ...’ (A. Winstone, Welsh Water, letter dated 27 September, 1988).

‘I understand that we catch adult and juvenile Smelt in the salmon trap at Chester on the Welsh Dee.’ (e-mail from Mark Diamond, Environment Agency, dated 24 January, 2003).

A small population of Smelt still seems to exist in the estuary of the River Dee.

5.18 Mersey

5.18.1 River Mersey

‘... the Rev. Samuel Langley, Rector of Swettenham from 1649-57, described how, in the Mersey at Warrington, “ten or even twenty fish are caught at one haul of the seine” (e-mail from M. Greenhalgh, dated 27 January, 2003).

‘All references in the literature point to the former abundance of the Smelt in local waters.’ (Johnstone 1910). Leigh (1700) recorded that ‘... vast quantities of Sparlings or Smelts’ were taken in the Mersey.

At one time, Smelt were so important in the Mersey area that in 1824 ‘Sparling Street’ was ‘built from the profits of the local Sparling (Smelt) fishery.’ (D’Arcy 1982).

Byerley (1854) refers to Sparling as being common in the Mersey.

Houghton (1879) recorded that ‘... they are found in the Mersey, ...’ but in that same year it appeared that they were apparently absent from, or at least very scarce in the Mersey: ‘The Mersey used to be famous for Smelts. They were all got near Warrington. Some were got below Runcorn. There are no Smelts caught now in any part of the Mersey.’ (Buckland & Walpole 1879).

Herdman & Dawson (1902) record Smelt ‘... off Blackpool.’

Johnstone (1910) notes that ‘It still occurs at the mouth of the Mersey near the Formby shore.’

Coward (1916) noted that ‘A number of medium-sized Smelts – some between four and six inches in length – were taken in Latchford Lock on January 17th, 1910, and are now preserved in the Warrington Museum.’

‘Smelt have been recorded in the last year or so from the Mersey Estuary (in the tidal Manchester Ship Canal) ...’ (D. Cragg-Hine, North West Water, letter dated 28 January, 1980).

Wilson *et al* (1988) describe the increasing pollution of the Mersey since the advent of the Industrial Revolution and the gradual loss of almost all its fish and fisheries. Conditions deteriorated so much that ‘throughout the 1950s and early 1960s anoxic conditions in the estuary were common and fish were reportedly absent from the upper estuary for much of the time.’ Gradually conditions started to improve and some fish were recorded as returning during the 1970s. In 1976 the North West Water Authority ‘instituted a regular monitoring programme by collecting fish from two industrial intake screens at Stanlow and Runcorn on the Manchester Ship Canal. Surveys in the middle an upper estuary with a 2-m beam trawl began in 1981 ...’ By 1987 40 different species had been recorded but the numbers were always low and ‘It seems highly probable that the fish populations have been restricted by poor water quality.’ (Wilson *et al* 1988).

Potter & Swaby (1993) do not list Smelt in their review of the fishes of the Mersey estuary.

‘I know that one Smelt has been caught in the Mersey in the last 2 or 3 years ...’ (e-mail from Mark Diamond, Environment Agency, dated 24 January, 2003). ‘Historically, the River Mersey used to be one of the main fisheries for Smelt with Warrington being the key port producing barrels of salted Smelt for transport around the country over a century ago. The only remaining evidence of this is the name of Sparling Street in Warrington.’

It is uncertain whether a viable population of Smelt still exists in the Mersey Estuary and the original stock may well be extinct.

5.18.2 Rostherne Mere

The earliest reference to the fish of Rostherne Mere appears to be King in 1656 (Ray 1686) but the most important early studies were those of Ray (1686) and Brookes (1740), both of whom discussed the existence and origin of the smelt population. Brookes called the fish ‘the Sprat or Sparling’ and notes that ‘In Rotherston, or Rostern-mere in Cheshire, there are Sprats taken annually for ten Days about Easter, which are not to be distinguish’d in any manner from Sea-Sprats, being the same Colour, Shape and Taste. ... Some ... suppose they were first carry’d into the Lake by an extraordinary Inundation, and have bred there ever since, only, like the Char, making their Appearance at the Time of Spawning’

In February, 1895, Coward (1912a) ‘... cut a number out of the ice and submitted them to the late D. Gunther, but from some years prior to that date, and from then until the present year, I have only heard of it having been seen once.’ These two fish were found by Ellison & Chubb (1962, 1963) to be still present in the collections of the British Museum (Natural History) and they record that ‘We examined the two fish, the total lengths of which were 77.5 and 82.5 mm.’

Johnstone (1910) recorded that ‘At times large numbers of the Smelts are netted in the mere; and occasionally when it is frozen the fish are crowded together in patches of open water, or even embedded in the ice. The Rostherne Smelts are small, owing, no doubt, to retardation of growth induced by complete isolation from the sea.’

Regan (1911) noted that ‘In many Swedish lakes the Smelt is a freshwater resident throughout the year, and in Britain this seems to be the case in Rostherne Mere in Cheshire, whilst they have been found to thrive and breed in ponds.’

Subsequently, Coward (1916) recorded that ‘On April 4th I found two Smelts dead at the edge of Rostherne. One measured 100 mm. And the other 83 mm. One is preserved in the Manchester Museum and the other in the Biological Museum of the Liverpool University.’

Several years later, Coward (1924) noted that ‘The only interesting FISH note is that on March 31st, 1922, I found, for the third time, one of the Rostherne Smelts, proving that the species is still surviving in the mere.’

A summary of historical and recent evidence of Smelt in the Mere was provided by Ellison & Chubb (1968) and they concluded that it was a lacustrine form which had occurred as a relict since the last post-glacial period. Apparently the only specimens known to exist are two which T.A. Coward cut from ice covering the Mere in 1895 – now preserved in the British Museum. Further specimens were collected in 1912 and 1922 - the last recorded occurrence, but it has not been possible to trace these (Ellison & Chubb 1968). Apart from the earlier

studies of fish in the Mere (Dawkins 1907, Kenyon & Newton 1907, Okell 1907, Carter 1908, Graves 1909, Coward 1912a, 1912b, 1924, Tattersall & Coward 1914) there have been numerous studies of fish in the Mere during the late 20th Century (Rizvi 1968, Banks 1970, Badsha & Goldspink 1982, Goldspink 1978, 1983); none of these found Smelt and it must be concluded that this species is extinct there now.

Its extinction there, as with the Vendace *Coregonus albula* in Scotland (Maitland & Lyle 1991) can be attributed to the gradual eutrophication of the Mere (Reynolds & Sinker 1976), so much so that it is now considered to be a seasonally anoxic lake (Brinkhurst & Walsh 1967, Davison & Woof 1984). 'In the absence of any significant organic pollution from human sources, this condition is attributed to the deposition of faeces from the very large bird population on the lake, both resident and transitory.' (Brinkhurst & Walsh 1967).

It is clear that, not only are Smelt extinct now in Rostherne Mere, but it would be unrealistic to try to reintroduce them there because of the extreme eutrophication of that water.

5.18.3 Coastal waters

'Estuarine netsman Ray Ball was quite familiar with the smelt and had caught smelt when shrimping off the Southport coastline.' (Chris Heap, e-mail dated 28 November, 2002).

'I am currently sampling inshore waters including examining the by-catch of shrimpers in the Ribble Estuary/North Merseyside shore. So far this winter, no smelts.' (e-mail from M. Greenhalgh, dated 27 January, 2003).

5.19 Ribble

5.19.1 River Ribble

Johnstone (1910) records Smelt taken 'off Formby'.

'... there used (... within living memory) to be a fishery for sparling in the ... and Ribble estuaries. There were also cases of fishermen being caught fishing for sea trout illegally who then claimed that they were fishing for sparling legally.' (Letter from E.D. Le Cren, dated 25 February, 1993).

'Smelt have been recorded in the last year or so from the Mersey Estuary (in the tidal Manchester Ship Canal) and from the Ribble Estuary just downstream of Preston. We also have reliable reports of smelt being taken in the Lune Estuary a short distance downstream of Lancaster in the early 1970s. It is likely that they occur in other rivers such as the Wyre and West Cumbrian rivers, but we have no positive records.' (D. Cragg-Hine, North West Water, letter dated 28 January, 1980).

'In 1977 I found two smelts in the stomach of a sea trout caught in the Pinfold Channel (Ribble Estuary) ... (e-mail from M. Greenhalgh, dated 27 January, 2003).

Smelt were recorded from the inner estuary of the River Ribble by Sewell (1983), but were apparently uncommon. 'Studies on the fish populations in the inner estuary of the River Ribble ... were carried out between March 1978 and September 1980. Monthly seine and

otter trawl samples were taken at five sites along a 11.5 km stretch of the estuary downstream from the upper limit of saltwater intrusion. The samples were collected at high water on spring tides.'

In monthly gill netting surveys of Preston Dock between May 1987 and April 1988, Conlan *et al* (1988) found that 'Smelt were present in small numbers for most of the year. Their presence in other brackish-estuarine docks ... suggests that the low-salinity dock environment is a suitable habitat for this fish.' Most of the fish caught were 2+ and 3+ years of age. Other studies have indicated the importance of disused docks to various estuarine fish (Henry *et al* 1988a, 1988b).

'Estuarine netsman Ray Ball was quite familiar with the smelt and ... was of the opinion that there were smelt in the Ribble estuary albeit a few.' (Chris Heap, e-mail dated 28 November, 2002).

It seems likely that there is still a small population of Smelt in the estuary of the River Ribble.

5.20 Morecambe Bay

5.20.1 Morecambe Bay

'Ellison & Chubb reported a 9" (22.5 cm) smelt from the Battery Shier (Shear), Morecambe on 12 December 1968 and described the species as "fairly common there" ...' (e-mail from M. Greenhalgh, dated 27 January, 2003).

D Cragge-Hine (in a letter dated 15 August, 1988) noted that 'Smelt still occur in limited numbers in the Morecambe Bay area ...'

Potts & Swaby (1993) list Smelt in their review of the fishes of the Morecambe Bay area on the basis of the study by Corlett *et al* (1987).

'... Flookburgh fishermen ... do catch odd smelt when fishing for white bait in the spring. ... they do not keep them and do not regard them as being of commercial value. ... Regarding spawning areas and upstream limits, Greenodd on the Leven estuary was mentioned by one of the fishermen as a place to catch smelt. The water here where the River Crake meets the River Leven would be classed as brackish.' (R. Bland, e-mail dated 11 December, 2002).

Smelt were caught in Cavendish Dock, Barrow-in-Furness 'during last dock survey, September, 2002.' (questionnaire response from Jonathon Rebbeck, APEM, dated 27 January, 2003). There are previous records 'from August 1991 to present' and some length/weight data for samples. There are previous surveys of these docks (Markowski 1962).

Smelt still seem to occur in the Morecambe Bay area and it seems possible that there is a single population there or that, perhaps more likely, there are southern (Wyre and Lune) and northern (Kent and Leven) populations.

5.20.2 River Wyre

In 1981, the British rod-caught record Smelt was taken by G. Idiens at Fleetwood, Lancashire. It weighed 191 gm (National Anglers' Council 1991).

'To my knowledge, we have only one merchant who has any dealing with this species and he would prefer to discuss the matter by telephone rather than write to you.' (letter from J.F. Coe, The Fleetwood Fish Merchants' Association Ltd., 18 December, 1981).

It is likely that they occur in other rivers such as the Wyre and West Cumbrian rivers, but we have no positive records.' (D. Cragg-Hine, North West Water, letter dated 28 January, 1980).

'... in June 2002 examined one washed up on the saltmarsh above Shard Bridge (Wyre Estuary) (e-mail from M. Greenhalgh, dated 27 January, 2003).

If Smelt still occur in the River Wyre, it seems likely that this stock is just part of the Morecambe Bay population or certainly that of south Morecambe Bay (along with the River Lune).

5.20.3 River Lune

K. Denham, Morecambe, responding to the PSM fish questionnaire in 1966 (Maitland 1969) noted that he had taken smelt off Sunderland Point, River Lune, in 1963, 1964, 1965 and 1966.'

'... there used (... within living memory) to be a fishery for sparling in the Lune ... estuaries. There were also cases of fishermen being caught fishing for sea trout illegally who then claimed that they were fishing for sparling legally.' (Letter from E.D. Le Cren, dated 25 February, 1993).

'... We also have reliable reports of smelt being taken in the Lune Estuary a short distance downstream of Lancaster in the early 1970s. (D. Cragg-Hine, North West Water, letter dated 28 January, 1980).

'None of the River Lune fishermen have any Whitebait nets set at present, we will probably not start again until September. We will keep what we get for you and by late autumn should have a reasonable amount ...' (H. Gardner, letter dated 11 July, 1982)

Smelt still occur in the River Lune, though it seems likely that this stock is just part of the Morecambe Bay population, or certainly that of south Morecambe Bay, along with that of the River Wyre.

5.20.4 River Kent

'The only quantitative data I can provide for you comes from a series of seine nettings (80 yards long, 60 yard warps) conducted in the Leven and Kent estuaries in August 1980. The average numbers of smelt caught were <1 (11 nettings) and 5 (6 nettings) for each estuary respectively.' (Letter from D. Evans, Lancashire and Western Sea Fisheries Joint Committee, 28 October, 1980).

D Cragge-Hine (in a letter dated 15 August, 1988) noted that smelt ‘... have been reported as spawning in the tidal reaches of the River Kent in recent years.’

‘Steve Manning ... informed me that they do catch Smelt, or Cucumber Fish as he called them, early in the year when they are fishing for White Bait in both the Leven and Kent Estuaries.’ (Roy Bland, e-mail dated 2 December, 2002).

Smelt still occur in the River Kent, though it seems likely that this stock is just part of the Morecambe Bay population, or certainly that of north Morecambe Bay, along with that of the River Leven.

5.20.5 River Leven

Watson (1925), discussing the English Lake District fisheries, recorded that ‘The sparling fisheries are much less important now than formerly. The principal fishery in the district is in the Leven and Duddon estuary. Mr. S. Hart Jackson gave Buckland the information that the sparling came into the bay in the early autumn, following the way of the salmon; that they were heavy with spawn in February; that spawning commenced about the middle of March and was completed by the middle of April.’

Jenkins (1925) noted that it occurred in the River Leven ‘... near the upper limit of tidal waters.’

‘The only quantitative data I can provide for you comes from a series of seine nettings (80 yards long, 60 yard warps) conducted in the Leven and Kent estuaries in August 1980. The average numbers of smelt caught were <1 (11 nettings) and 5 (6 nettings) for each estuary respectively.’ (Letter from D. Evans, Lancashire and Western Sea Fisheries Joint Committee, 28 October, 1980).

‘Steve Manning ... informed me that they do catch Smelt, or Cucumber Fish as he called them, early in the year when they are fishing for White Bait in both the Leven and Kent Estuaries.’ (Roy Bland, e-mail dated 2 December, 2002).

Smelt still occur in the River Leven, though it seems likely that this stock is just part of the Morecambe Bay population, or certainly that of north Morecambe Bay, along with that of the River Kent.

5.20.6 River Duddon

Herdman & Dawson (1902) record Smelt ‘in the Barrow Channel’

Watson (1925), discussing the English Lake District fisheries, recorded that ‘The sparling fisheries are much less important now than formerly. The principal fishery in the district is in the Leven and Duddon estuary. Mr. S. Hart Jackson gave Buckland the information that the sparling came into the bay in the early autumn, following the way of the salmon; that they were heavy with spawn in February; that spawning commenced about the middle of March and was completed by the middle of April.’

Smelt are not listed by Potts & Swaby (1993) in their review of the fishes of the Duddon Estuary.

It seems likely that the Smelt population which used to inhabit the Duddon Estuary was independent from those stocks associated with Morecambe Bay further south. It appears now to be extinct.

5.21 Solway

5.21.1 The Solway Firth

An early record is that of Houghton (1879) who noted that ‘... they are found in the Solway Frith ...’

The value and history of the Sparling in the Solway is well known, thanks to Maxwell (1897). ‘Londoners have no idea of the real excellence of smelts. To be eaten in perfection, the fish should be carried from the nets into the kitchen and served forthwith. There comes to mind a quiet fishing village on Solway shore. It is early on a winter morning, but the air is still and warm. The small-meshed seine is coming slowly to shore, filled with a shoal of pearly “sparlings”. As they are drawn from the muddy water of the estuary, a fragrance as of cucumbers and violets diffuses itself, plainly perceptible at a distance of more than fifty yards. The fish, as soon as landed, are neatly packed in small boxes and sent off to the great towns, where they command a high price - 3s or 4s. a pound. But by the time they arrive at their destination they will have lost much of their delicate texture and exquisite flavour, which we shall presently be savouring in the inn parlour close at hand.’

‘Fred Graham, a haaf net fisherman who has fished the Solway since 1960 ...remembers some of the older netmen mentioning that they used to at one time set sparling nets on the supports for the railway viaduct that used to cross the Solway.’ (e-mail from Chris Bowman, Cumberland News, dated 16 December, 2002). In April 1964 Fred Graham donated a large specimen of Smelt to the Tullie House Museum in Carlisle.

Other specimens of Smelt in the Tullie House Museum are two caught by Neville Dean at Burgh by Sands in May, 1961, and one caught by Alex Smith at Bowness on Solway in June, 1961 (e-mail from Chris Bowman, Cumberland News, dated 24 January, 2003).

Colin Murray, a haaf net fisherman, ‘... believes that his father may have been one of the last men to fish for smelt on a commercial basis in this area.’ (e-mail from Chris Bowman, Cumberland News, dated 16 December, 2002). ‘Prior to the outbreak of World War Two his father, John Murray, used to shoot a 300 yard long seine net in the pools left in the river channel and use to catch eels, whitebait and smelt. ... the smelt were purchased by a firm from Hull who used to send the boxes and labels for their dispatch to Hull by rail .. the smelt had to be alive on the day of dispatch in order to reach Hull fresh. ... His father never took up the smelt fishing again after he returned from the war. Colin ... had also taken the odd smelt in the haaf nets over the years, although it is a long time since he had one. However, ... there could still be a few about as occasionally they still get the distinctive smell of cucumbers on their nets.’

However, the situation in the Solway has deteriorated in recent years, as confirmed by E.J. Perkins (University of Strathclyde, letter dated 30 October, 1980) ‘...at the present time smelt have no effective commercial value in the waters of the Cumbria Sea Fisheries District. This is a species which used to be taken in the Solway Firth with a modest degree of frequency in

our routine trawl survey in the early and middle 1960s. Since then, however, it seems to have declined considerably, a view shared by ourselves and the fishermen. So much so indeed that whereas we used to get them in the routine trawls we no longer do so. Certainly, they turn up from time to time in some beach nets but they must now be regarded as scarce in the Solway Firth at least.'

Smelt are not listed by Potts & Swaby (1993) in their review of the fishes of the Solway Estuary.

With the exception of the stock in the River Cree, Scotland, which is threatened, all the other stocks of Smelt in the Solway now appear to be extinct.

5.21.2 River Eden

In a chapter dealing with the River Eden, Grimble (1913) notes 'Both sides of the Solway are infested by sparling, or smelt, fishers, who begin operations in August and fish throughout the winter with very small-mesh nets; they work chiefly at night, and it is well known they fish really for *salmonidae*, and that the sale of all the sparling in the district would not suffice to pay the crew of one boat.'

'No smelt in the Eden, only place on Solway is Wigtown Bay and Luce Bay (Solway Firth Review, 1996, Solway Firth Partnership.' (Brian Irving, e-mail dated 29 November, 2002).

Fred Graham, 'a haaf net fisherman who has fished the Solway since 1960 told me that for the first 20 years that he fished he used to catch the occasional Smelt which managed to get caught up in the nets.' (e-mail from Chris Bowman, Cumberland News, dated 16 December, 2002). '... the smelt used to come regularly on certain tides and at times the haaf net used to literally bounce with the number of smelt passing through the mesh of the net, and after a shoal had passed through the net and the net was removed from the water it has a distinct aroma of cucumbers. ... it is some 15 years since he last caught a smelt. ... he kept records of all the fish he caught and that between 1960 and the early 1980s he caught 15 smelt ... the fish he donated to Tullie House Museum in Carlisle was caught and donated on 17th April 1964 ... unlike other haaf netters who fished further down the estuary Fred said that he fished mainly on Burgh Marsh on the Eden estuary and that he personally thought that the smelt he caught were destined for the Eden and that his smelt were caught around March-April period.'

'I remember a report of Smelt in the Eden within the last ten years. I should mention that we do not undertake much sampling that would detect the presence of Smelt in the north west estuaries, so they may be there.' (e-mail from Mark Diamond, Environment Agency, dated 24 January, 2003).

It seems quite likely, but not certain, that the stock of Smelt which used to run into the Eden is, like the other stocks in the upper Solway, now extinct. Whether these were one population or more is uncertain, but the former seems more likely.

6. *Historic distribution*

Current knowledge of the past and present status of Smelt populations around England and Wales has been reviewed above. It is clear that Smelt were at one time common in estuarine situations all along the east coast from the Tweed to the Thames. Likewise on the west coast this species was common from the Solway to the Conwy. Its occurrence elsewhere is uncertain. Yarrell (1836) stated that the Smelt appears to be almost exclusively confined to the eastern and western coasts of Great Britain. Couch (1862) also noted that no Smelts have been recognised along the shores of England from the Thames westward to Land's End. Yet, as indicated above, a few populations are found along this coast at present. Whether this is a recent phenomenon or not is uncertain. In addition, Smelt 'also occur at very low abundance (<1 fish per 1000 m²) in other coastal sites apparently well away from fresh water. For example along the Sussex coast we have found a few individuals at Littlestone on Sea, Dungeness, off Winchelsea, Hastings and St Leonards. Only Rye Harbour is close to a decent freshwater input. Catches from these locations amount to less than 10 individuals in the past 15 years.' (S. Rogers, CEFAS, e-mail dated 3 February, 2003).

The paucity of Smelt along the south coast of England is perhaps not really surprising (though see below) for there are no large estuaries there to compare with those of the Thames or the Humber. The same is true of the west coast of Wales. However, the Severn Estuary would appear to be a very suitable habitat for Smelt, yet it has never apparently been recorded there, which seems surprising.

In the past, it appears that at least 21 stocks of Smelt were present in estuary systems in England and Wales (Table 2). The relationships among these are uncertain. Some may have been quite isolated from others and therefore relatively self-contained (eg River Tyne), whereas others may well be considered as one stock which merged for much of the year in a common estuarine or fairly enclosed coastal area (eg Rivers Thames, Lee, Medway and Swale).

In Scotland, Smelt populations have been recorded from at least 15 river systems (Lyle & Maitland 1995, Maitland & Lyle 1996), but over the last century the species has suffered a severe decline and has disappeared from all its former sites except three – the Rivers Cree, Forth and Tay. Most of the former populations were on the west coast, extending from the Clyde (Scott 1901) to the Solway (Service 1902). The remaining populations are regarded as having a high conservation importance (Maitland 1985).

In Ireland, the current status of Smelt is uncertain (Maitland 1996), but it has been recorded from the River Foyle (Vickers 1974) and from the River Shannon and an associated water, the River Fergus (Kennedy 1948). As in other estuarine systems, Smelt face significant threats in these waters, a fact emphasised by the massive kill of Smelt which took place in the Shannon, near Limerick, in 2001, due to a pollution incident.

7. Present status

It is apparent that several stocks have disappeared during the 20th Century and whilst several others appear to be thriving at present a number of others are of rather uncertain status.

7.1 Extinct stocks

Certain estuaries are known to have had thriving populations of Smelt in the past, but it seems probable that these are now extinct. The list includes the Rivers Duddon, Eden, Tees and Tyne. In other cases, Smelt have been occasionally recorded but, though it is likely, it is less certain that there was a permanent population and no Smelt have been recorded recently (eg Blyth, Tweed, Wansbeck and Wear).

7.2 Successful stocks

A number of waters have been well known for Smelt for many centuries and the species still appears to thrive there. The list includes the Rivers Adur, Blackwater, Conwy, Crouch, Frome, Great Ouse, Humber, Kent, Leven, Medway, Nene, Swale, Tamar, Thames, Waveney and Yare). In others, though the species is probably still present, there is less evidence as to its status there (Rivers Dee, Lune, Mersey, Ribble, Thurne, Trent, Welland and Witham).

7.3 Uncertain status

The information from a number of estuaries is sketchy and it is uncertain if this is due to the fact that Smelt occur there rarely or that there has been little fishing to reveal the extent of the population. Small populations may have been there in the past (and could still be there) or alternatively fish may be simply vagrants from nearby successful stocks. The list includes several estuaries, all of which would warrant further investigation – the Rivers Alde, Bure, Deben, Ouse, Ouse (Sussex), Piddle, Rother, Stour and Wensum.

7.4 Temporary stocks

Apart from Rostherne Mere, all the stocks of Smelt which occur or have occurred in standing fresh waters should probably be regarded as temporary, for there is little evidence of reproduction to establish permanent stocks. The sites include Dick Fairfield's Pond, Earls Cement Ponds, New Holland Pond, Pelican Pond, Watton Water, Yarm Pond

7.5 Coastal areas

Smelt do occur occasionally in some open coastal areas where they can probably be regarded as vagrants. However, they do occur very regularly in other inshore areas where they are almost certainly associated with the stocks from nearby estuaries.

8. *Spawning sites*

8.1 *Timing and habitat*

From the various descriptions of the spawning of *Osmerus eperlanus* and related species of Osmeridae (Flagg 1972, Laprise & Dodson 1989) a number of common factors seem to emerge.

1. Mature adults congregate in the upper estuary during the winter, preparatory to spawning in the spring.
2. Timing of spawning seems to be dictated by temperature and tides and may vary from estuary to estuary, especially from north to south. In general, assuming the incoming river is not in spate, spawning is likely to take place during the highest of spring tides when the water has reached at least 5°C (Lyle *et al* 1996).
3. Spawning takes place in fresh water usually, but not always, somewhere near the head of tide where there is a significant current.
4. The substrate over which the fish spawn and to which the highly adhesive eggs attach is normally clean gravel, stones or macrophytes of various kinds. To an extent, the Smelt is opportunist, for example in the River Cree in Scotland they frequently spawn over clean stones in shallow water (Maitland & Lyle 1996), whereas in the River Shannon at Limerick where the river is deep, they spawn alongside thick growths of *Fontinalis* moss growing on vertical man-made stone walls (F. Igoe, personal communication). Frequently, because they spawn at the highest tides some eggs are lost at the edge of the river, through being left high and dry when the tide recedes.
5. The annual spawning, which takes place over just a few days, is communal, and usually at night, when a high proportion of the adult population is present and involved.

8.2 *Recorded sites*

Although Smelt have been recorded from a large number of estuaries around the British Isles, in only a few places has the actual spawning site been identified. For example, in Scotland, where there are significant populations in the estuaries of the Tay and Forth, it has not yet been possible to identify the exact spawning sites in spite of considerable survey. Similarly, in the River Thames, though general areas have been identified where the Smelt are believed to spawn, the identity of actual spawning grounds has not yet been established.

River Great Ouse (Hundred Foot River): ‘In March 1997 during the smelt spawning run a large amount of smelt spawn was observed on the gravel and the emergent vegetation directly below Brownhill Stauch ... A sample of this spawn was incubated in a tank. The eggs hatched after 6 days indicating its viability.’ (Environment Agency 1997).

River Yare ‘Considerable numbers used to ascend the River Yare to lay their eggs on the river bed in the neighbourhood of Norwich in March and April annually and there was a regular cast-net fishery for them there.’ (Ellis 1965).

River Thames: Wheeler (1979) concluded that ‘... spawning takes place in March ... It is not known where the smelt spawn in the Thames but ... it must be upstream of Wandsworth Bridge.’

Pilcher (1989) has reported that smelt are one of the most common fish species in the River Thames in the late spring, when large shoals enter the tideway to spawn in the Wandsworth area.

The Environment Agency has provided a list of ‘Thames Smelt Spawning Survey Sites’. These are: 1. Thamesmead, 2. Greenwich, 3a. Limehouse, 3b. Shadwell, 4. Cherry Gardens, 5. Southwark, 6. Vauxhall, 7. Battersea Park, 8. Battersea Church Road, 9. Putney/Wandsworth North Bank, 10. Putney/Wandsworth South Bank, 11. Hammersmith, 12. Mortlake, 13. Strand-on-the-Green, Islesworth, 15. Richmond. However, ‘The list of spawning sites are merely sites which have been investigated but on no occasion has it been proven that smelt have spawned without doubt in these locations. However the sites were chosen from various historical observations of smelt caught in these areas heavily laden with milt or eggs or sesssile eggs and very young fry. Many attempts have been made to locate sites but due to spawning occuring over such short periods these occasions have been missed.’ Trazar Astley, Environment Agency, e-mail dated 3 January, 2003.

River Tamar: ‘*Osmerus* had a successful spawning in the Tamar again in 1974. Observations on larval and post-larval distribution indicated that the species spawned just below Gunnislake Weir and that the feeding area for the post-larvae was between 5 and 10 km downstream from the spawning zone.’ (JMBA 1975).

River Conwy: B.E. Jones (Welsh Water Authority, letter dated 30 January, 1980) concluded that ‘Smelt run up as far as Llanrwst (OS 115 793 627) to spawn, approximately 13 miles from the river mouth.’

River Kent: D. Cragge-Hine (in a letter dated 15 August, 1988) noted that smelt ‘... have been reported as spawning in the tidal reaches of the River Kent in recent years.’

9. Commercial aspects

It is clear from the records that commercial fisheries for Smelt have taken place for hundreds of years and been of significant economic importance locally in many estuaries around Great Britain. Though, for various reasons (see below), many of these fisheries have now stopped, several still operate, albeit on a lesser and sometimes sporadic and opportunistic basis.

9.1 Fishing methods

A variety of fishing methods are used to catch Smelt.

In the northwest of England, Smelt were usually caught by seine netting along the estuary shores. ‘... although the smelt formed the basis of a cottage industry in the past, its commercial importance today is *nil*. In Victorian times smelt were highly regarded by the rich who would pay up to half a guinea / lb. For this delicacy. The fish were caught in seine nets (one inch mesh) each spring in such estuaries as the Duddon, Leven and Conwy. Catches were never high and an old saying that “a cigar-box full of smelt was enough for one week’s wages” suggests that they didn’t have to be! Today smelt are occasionally taken as a small

by catch in the local shrimp and whitebait fisheries and as such are considered by the fishermen to be a 'trash' species.' (Letter from D. Evans, Lancashire and Western Sea Fisheries Joint Committee, 28 October, 1980).

Another method of fishing for sparling was at one time employed, as described by Dutt (1906). '... near the junction of the Yare and Wensum, two or three cast-netters may still be found in spring, industriously netting from dusk until late in the evening or early in the morning. Each boat contains two men, one of whom, by "back-watering" with his oars, keeps the boat from being carried downstream ... while the netter ... stands at the stern on a little deck made of half a dozen boards. Over one arm is slung the lead-weighted net, which from time to time, with a swaying turn and a sudden jerk, he casts upon the water in such a way that it expands to its full circumference as it falls, ... For a few moments the net is allowed to sink in the deep water ... and as it sinks its leads cause it to assume the shape of an inverted funnel; then it is carefully drawn towards the side of the boat, the funnel of net meanwhile closing as the leads come together, and by a quick final movement it is lifted on to the little deck at the stern of the boat. ... there is always a chance of a fair catch being made, or even a good one, which will reward the patient fisherman for many fruitless casts.'

Buckland (1871) reported that 'There exist in the estuaries of many of the Scotch rivers, especially at Wigtown Bay and the mouth of the Nith, a fish called the smelt or sparling (*Salmo eperlanus*). I heard great complaints in the Solway, and also in Wigtown Bay, that the sparling fishery interferes with the salmon fishery. The following evidence I obtained from Mr. George Hodgkinson, lessee of Lord Galloway's fishery, Newton Stewart:- The best fishing time for sparling is in September. In November and December there are none to be had, but they can be caught again in March and April, when they come up to spawn. They spawn exactly at the head of the tideway among the small shingle-stones; they never go further up the river than the brackish water extends. The sparling are very small in June and July. At that time they run fourteen or twenty to the pound; from end of July to end of August they get larger; in September they are at their prime; and in November and December they will run sometimes four to the pound, but there are very few of them. The average size is six, seven, eight, nine to the pound in September. September is decidedly the best month for sparlings. The price averages eightpence per pound all the year round.'

In Scotland, In the estuaries of the Tay and Forth, the most common method of fishing for Smelt is by boom net from boats moored in the estuary.

9.2 *Catches and usage*

G.R. Watkin, Chief Inspector of the Fishmongers' Company wrote on 30 November, 1981 that 'Present supplies of smelt are sporadic and almost entirely imported from Holland. Indeed, I can remember no instance of local supplies of this fish in the last 25 years.'

E. Margerison, in a letter from the Manchester Wholesale Fish Merchants' Association Limited (dated 4 December, 1981) noted that '... regarding Sparling species. The amount of this type of fish sold here in Manchester is negligible. Approximately 1 ton per year. This comes into Manchester Market from Ayre, is sold for human consumption, mainly to coloured immigrants.'

'There are commercial fisheries yielding 3 to 6 tonnes of smelt per annum on at least two Norfolk / Suffolk rivers ...' (N.J. Fickling personal communication, 14 December, 1990).

‘What I need to emphasise to you is that smelt populations, where fished for by people who have been doing it for years, are sustainable. However, the big increase in interest in this fish for pike baits has resulted in newer companies requiring more smelt. Whether this can be sustained I do not know. We do not seem to be able to obtain decent smelt from abroad either – certainly not 7-10 inch fish.’ (N.J. Fickling, Lucebaits, letter dated 18 November, 2002).

Smelt are sought after by Pike fishermen for bait and, in the past, some of the commercial catch has been sold for this purpose. The Ammoditytes Co. in Cornwall (Malcolm Gilbert, phone call on 22 November, 2002) has obtained Smelt in the past from the Thames (late 1980s). These were a bycatch in the eel fishery there but stricter enforcement of the eel fishery there closed this source. Then fish were sourced from the River Tay (C. Johnston and M. Doig, Newburgh) in the early 1990s but this too stopped. Then Smelt were sourced through Billingsgate. These fish were from the Netherlands where a ‘whitebait’ fishery for small Smelt has larger ones as a byproduct. Smelt should be 150+ mm if they are to be useful as bait. No Smelt are being purchased by the Ammoditytes Company at the moment but, through the Internet, the possibility of using Polish stocks from the Baltic is being explored.’

Howes & Kirk (1991) concluded that ‘commercially exploitable stocks in the Tees, Humber, Trent and Ouse collapsed during the late 19th and early 20th centuries and subsequent records indicate the survival of no more than token populations.’

In the Medway, ‘During a routine check of a vessel we saw approximately 24 stone of Smelt.’ (Questionnaire return from C. Conroy, Environment Agency, dated 21 November, 2002).

In the River Medway ‘This summer (2002) they were very abundant in August when, on two days, with two hauls on each day, I had 500-600 pounds of clean Smelt per haul. Most of the fish were middle-sized with some large ones. The large ones go to the London market, where they are popular for eating, the smaller fish are sold as bait for Pike.’ (B. Walpole, ‘phone conversation with PSM, 3 December, 2002).

In the Solway, Colin Murray, a haaf net fisherman, ‘... believes that his father may have been one of the last men to fish for smelt on a commercial basis in this area.’ (e-mail from Chris Bowman, Cumberland News, dated 16 December, 2002). ‘Prior to the outbreak of World War Two his father, John Murray, used to shoot a 300 yard long seine net in the pools left in the river channel and use to catch eels, whitebait and smelt. ... the smelt were purchased by a firm from Hull who used to send the boxes and labels for their dispatch to Hull by rail .. the smelt had to be alive on the day of dispatch in order to reach Hull fresh. ... His father never took up the smelt fishing again after he returned from the war.’

10. Conservation

Because of the catastrophic decline in the numbers of stocks of Smelt in Scotland, conservation measures have been advocated for some time by Maitland (1974, 1979), Hutchinson & Mills (1987) and Maitland & Lyle (1990, 1992). Maitland & Lyle (1996) have advocated the restoration of stocks to rivers formerly inhabited by this species where present conditions seem suitable. However, in spite of significant threats to the last remaining west coast stock of Sparling in Scotland, in the River Cree, no agency has yet been prepared to sponsor such a project.

Wheeler (1979) concluded that ‘The return of smelt to the tidal Thames in such large numbers is the most impressive proof of the improvement in the condition of the water ... No other species so clearly demonstrates the success of the various authorities in controlling pollution. Moreover, it is a result which has direct benefits to man, for the smelt, although small, is now often caught by anglers, and soon there will be an ample stock in the river for a commercial fishery ...’

Howes & Kirk (1991) noted that ‘Since it would appear that a residual smelt population still exists in the Humber/Trent system and that given the opportunity, fish seasonally visit accessible estuary-side clay pits and the mouths of freshwater inlets, it would seem desirable as a conservation measure to manage more of these waters as smelt breeding and rearing sites with a view to re-establishing the large and commercially valuable populations which previously occurred.’

‘Currently smelt *Osmerus eperlanus* are being recognised as a possible key indicator species as a part of the Habitats Directive, hence the data collected and new research being carried out on this species in the Thames. In addition the current need for information on estuarine species brought about by the Water Framework Directive has initiated a project which is being run by a team at Crossness. ... we are currently collating a dataset of estuarine fish communities of the UK as a part of the Agency’s Water Framework Directive R&D project.’ (T. Astley, Environment Agency, e-mail dated 11 December, 2002).

‘... a project working on the combined sewer overflow has recently carried out real time data on smelt DO thresholds etc. However due to their sensitive disposition none below 8 cm survived trials, therefore more work may be carried out on larval stages in the future.’ (T. Astley, Environment Agency, e-mail dated 11 December, 2002).

11. Conclusions

A summary assessment of the present state of stocks of Smelt in England and Wales is given in Table 2 and Figure 4. Individual river stocks which are associated with a common estuary, or estuaries which enter the sea close together are concluded to belong to a common population and, unless there is evidence to the contrary, should be treated as such as far as management is concerned. Altogether, a minimum of 21 estuarine populations are recognised (Table 2, Figure 4), at least seven of which (33%) appear to be extinct. The exact status of several of the other populations, which still seem to be extant, is uncertain. The single freshwater population, in Rostherne Mere, has been extinct since 1922.

11.1 Pressures

The reasons for the serious declines and extinctions of smelt populations are various but four important factors are known to operate, separately or together, in some waters. Other recorded factors (Anders & Weise 1993) are generally of less importance.

- a. Pollution has certainly affected many of the estuaries in which Smelt once prospered and smelt populations and associated fisheries have collapsed as a consequence. In the Thames, stocks managed to recover as water quality improved and the same is taking place now in the River Forth in Scotland. However, in systems such as the Tyne and

Tees, the once abundant populations have been completely eliminated and may well never be restored with direct conservation action.

- b. Overfishing has certainly been a significant threat in some estuaries. At one time, the Smelt was a very popular fish for human consumption and there is still a good market here and for use as pike bait. Smelt been pursued intensively by commercial fishermen in many estuaries, but as a species, it is very vulnerable to overfishing. This is because not only does the adult population congregates in one small area near the head-of-tide at spawning time, but as a short-lived species there are relatively few year-classes involved. This means that if a high proportion of the stock is taken each year for several years, the population is likely to collapse and become extinct. Maxwell (1897) was well aware of this threat in the Solway: 'There is no close time provided for these fish by law; hence in some rivers – the Annan and the Nith, for example – where they have been netted to the verge of extinction, and the industry, once profitable, no longer pays.' His warnings were correct and the Sparling is now extinct in all of the upper Solway rivers, including the River Eden.
- b. Habitat loss can also have direct effects on stocks of Smelt, most notably where spawning grounds have been destroyed by silting, river works or other factors. For example, the spawning grounds of the Sparling in the River Cree are threatened by silting from agricultural activities upstream and by algal and fungal growths on the spawning substrate as a result of local sewage and road effluent discharges.
- c. Access by spawning stocks of Smelt from estuaries to spawning grounds can be disrupted by weirs or other barriers (as well as by chemical barriers due to pollution).

11.2 Recovery

It is clear that, whilst almost all stocks have been affected in the past by one or more of the above factors, some have recovered whilst other are now extinct. The Thames is a good example of the former and the Tyne of the latter. The strongest and most permanent stocks seem to be those associated with the larger estuaries where there is a complexity of minor or nearby smaller estuaries. Thus when the stock in one of these estuaries, large or small, is eliminated by pollution or other factors, it appears to be relatively easily restored by immigration from associated waters when conditions return to normal. This appears to be what has happened in the Thames. However, in other, more isolated estuaries, there is little possibility of recovery through immigration from other waters, and this is likely to have been the scenario with the Tyne, Tees and other systems where the Smelt is now extinct. It is evident that the Smelt is very much an estuarine species (Figure 3) and, though it has been recorded in small numbers in coastal waters this is the exception rather than the rule. A century ago, Johnstone (1910) noted that 'It is essentially an estuarine species, gregarious when it ascends brackish or waters of low salinity in the winter or spring, and is apparently solitary in the open sea.'

Thus it seems likely that recovery programmes will be necessary if Smelt are to be restored to the more isolated estuaries where they formerly occurred. Obvious candidates for such programmes in England are the Tyne and Tees on the east coast and the Eden on the west coast.

11.3 Monitoring

Useful monitoring programmes have are in progress, or have taken place in the past in larger estuaries such as the Humber, Wash, Thames and Mersey where Smelt still occur and also in estuaries such as the Tyne, Wear and Tees where Smelt are now extinct. These programmes should be continued and extended to other waters where Smelt occur.

11.4 Research

A number of information gaps exist and require to be filled before a complete picture of the status of the Smelt in England and Wales can be fully established. At least three are of significance.

- a. Uncertainty exists as to whether stocks still exist in some estuaries where Smelt occurred in the past, for there are few recent records for such systems. These include the Frome, Mersey, Ribble and Lune. Such systems require survey. Also, those estuaries where Smelt are believed to be extinct, but there has been no monitoring (as in the Tyne and Tees), should be investigated further (eg Blyth, Wansbeck, Duddon and Eden).
- b. There appears to be little formal information on the commercial catches of Smelt in any estuary, yet it is apparent that commercial fishermen are operating in a number of systems, for example, the Wash, the Broads and the Thames – sometimes with substantial catches. If these fisheries are to be sustainable then catch statistics must be available to inform any management programmes.
- c. There is considerable uncertainty regarding stocks of Smelt along the south coast of England. It is clear that the previous concept that there were no Smelt in this area is wrong for there appear to be small (but vulnerable) populations in the Frome, Piddle and the Tamar. More surprising perhaps have been the catches of Smelt (Figure 3) along the south coast at quite a number of places (Rogers *et al* 1998), but little evidence so far of runs of Smelt in associated estuaries and rivers. Such systems require further investigation and include the Adur, Ouse (Sussex), Rother, Solent and Kingsbridge Estuaries.

11.5 Management

If there is to be no further loss of stocks of Smelt in England then management programmes need to be set up for each population. These will require to assess the present status and approximate size of each stocks and how each will be monitored. Habitat requirements and their quality will also require to be assessed, as well as access to traditional spawning grounds, their present status and how they may be protected. In the Thames in England and the Forth in Scotland the relevant pollution control agencies – respectively the Environment Agency and the Scottish Environment Protection Agency – have indicated in the past the value of the Smelt as an indicator species. This role could be increasingly important under the requirements of the Water Framework Directive when it is implemented in the United Kingdom.

The recent Salmon and Freshwater Fisheries review and the proposed new fisheries bill present opportunities for the protection and monitoring of Smelt in estuarine and coastal

waters in England. Unlike the current situation, the Review leaves no doubt that the remit of the Environment Agency should include anadromous fish in coastal waters and fish which are not of angling or commercial concern. There is an opportunity in the proposed fisheries bill resulting from the Review to give enhanced powers for licensing and controlling the use of gear. Any such powers should require adequate recording of catches of all fish species, including Smelt, to be kept.

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Tables

Table 1a. Rivers in England and Wales where Smelt have been recorded

Rivers are recorded as National Grid References of head-of-tide sites (likely to be close to spawning areas), as indicated on OS 1:63 360 maps. Exceptions are where one river merges into another above the head-of-tide (eg Ure into Ouse) where the NGR of the junction is given.

SITE	NATIONAL GRID REFERENCE	LOCAL NAME	HYDROMETRIC AREA	
River Adur	51 189 175	Bines Green	41	Sussex R Gp
River Alde	62 390 576	The Maltings	35	E Suffolk Rs
River Blackwater	62 839 084	Maldon	37	Essex R Gp
River Blyth	54 276 821	Bebside	22	Coquet Gp
River Bure	63 324 162	Sedge Fen	34	Norfolk R G
River Conwy	23 790 635	Tan-lan	66	Conway &
River Crouch	51 768 941	Southlands Farm	37	Essex R Gp
River Deben	62 291 502	Melton	35	E Suffolk Rs
River Dee	33 406 657	Chester	67	Dee (Ch're)
River Duddon	34 197 883	Duddon Bridge	74	Esk (C'bria)
River Frome	30 923 872	Wareham	44	Frome
River Great Ouse	53 587 010	White Hall Farm	33	Great Ouse
River Humber	54 125 270	Mid Estuary	26-29	4 HA's
River Kent	34 496 852	Levens Bridge	73	Kent Gp
River Lee	15 383 827	Bromley	39	Thames
River Leven	34 328 830	Lady Syke	73	Kent Gp
River Lune	34 481 632	Lancaster	72	Wyre & L
River Medway	51 747 581	Allington	40	Kent R Gp
River Mersey	33 607 864	Warrington	69	Mersey & I
River Nene	53 274 994	North Side	32	Nene
River Orwell	62 150 445	Ipswich	36	Stour (E&S)
River Ouse	44 594 444	Naburn Grange	27	Ouse
River Ouse (Sussex)	51 433 148	Barcombe	41	Sussex R Gp
River Piddle	03 929 884	Northport	44	Frome Gp
Poole Harbour	30 000 890	Mid Harbour	44	Frome Gp
River Ribble	34 553 287	Preston	71	Ribble
River Rother	51 933 227	Reighton	40	Kent R Gp
River Severn	32 817 216	Maisemore	54	Severn
River Stour	62 079 328	Flatford Mill	36	Stour E & S
The Swale	51 970 663	Fowley Island	40	Kent R Gp
River Tamar	20 435 708	Gunnislake	47	Tamar
River Tees	45 384 098	Holme Farm	25	Tees Gp
River Thames	51 170 714	Teddington	39	Thames
River Thurne	63 454 204	Martham Broad	34	Norfolk R G
River Trent	43 809 611	Cromwell Lock	28	Trent
River Tweed	36 934 510	Union Bridge	21	Tweed
River Tyne	45 119 645	Wylam	23	Tyne (N'ld)
River Ure	44 500 600	Linton Lock	27	Ouse
River Wansbeck	54 256 858	Sheepwash	23	Coquet Gp
River Waveney	63 364 917	Benstead Marshes	34	Norfolk R G
River Welland	53 258 241	Spalding	31	Welland
River Wensum	63 226 093	Norwich	34	Norfolk R G
River Witham	53 323 444	Boston	30	Witham
River Yare	63 243 068	Trouse Newton	34	Norfolk R G

Table 1b. Lake and marine systems in England and Wales where Smelt have been recorded

National Grid References are recorded at near mid-point, as indicated on OS 1:63 360 maps.

SITE	NATIONAL GRID REFERENCE	LOCAL NAME	HYDROMETRIC AREA	
Freshwater sites				
Dick Fairfield's Pond	?			
Earls Cement Ponds	54 958 248	Ings Cottage	26	Hull Gp
New Holland Pond	54 078 241	New Holland	29	Ancholme G
Pelican Pond	?			
Rostherne Mere	33 744 842	Rostherne	69	Merey & Ir
Watton Water	54 076 491	Watton Carrs	26	Hull Gp
Marine sites				
Christchurch Harbour	40 175 915	Mid Harbour	43	Avon & S
Knightsbridge Estuary	20 743 410	Mid Estuary	46	Dart Gp
Milford Haven	12 905 045	Mid Haven	61	Cleddau Gp
Morecambe Bay	34 375 675	Mid Bay	72-73	Wyre/Lune+
Poole Harbour	40 000 890	Mid Harbour	44	Frome Gp
Portland Harbour	30 690 760	Mid Harbour	44	Frome Gp
Southampton Water	14 490 033	Fawley	42	Hants R G
The Haven	53 323 444	Boston	30	Witham & S
The Solway	35 040 530	Mid Solway	75-79	5 HAs
The Wash	53 585 445	Mid Wash	30-33	4 HAs
Wainfleet Haven	35 543 597	Wainfleet Clough	30	Witham & S

Table 2. A summary of known populations of Smelt in England and Wales, including the year of last known record

Sites are listed from A (Tweed) in the north east clockwise round to V (Upper Solway) in the north west (see Figure 4).

NO	ESTUARY SYSTEM	PRESENT STATUS	LAST RECORD	CONSERVATION PRIORITY	NOTES
A.	Tweed	extinct	1843	discuss restoration	status of original population uncertain
B.	Blyth	extinct	1769	discuss restoration	includes Blyth (1769) and Wansbeck (1769)
C.	Tyne	extinct	1913	restoration	includes Tyne (1913) and Wear (1769)
D.	Tees	extinct	1935	restoration	once abundant
E.	Humber	extant	2000	management	includes Humber (2000), Ouse (1907), Trent (1966), Ure (1879) and Witham (1991)
F.	Wash	extant	1997	management	includes Great Ouse (1997), Nene (1991) and Welland (1991)
G.	Broads	extant	2001	management	includes Bure (1900), Thume (1991), Waveney (2001), Wensum (1980) and Yare (2001)
H.	Orwell/Stour	extant	1999	management	includes Alde 1966), Deben (1966), Orwell (1999) and Stour (1999)
I.	Blackwater	extant	1997	management	includes Blackwater (1997) and Crouch (1997)
J.	Thames	extant	2002	management	includes Lee (2000), Medway (2002), Swale (2002) and Thames (2002)
K.	South Coast	extant?	1998	research status	includes Adur (1997), Ouse (1997), Rother (1997), Solent (1997)
L.	Frome	extant?	1989	research status	includes Frome (1989), Piddle (1988), Poole Harbour (1997)
M.	Tamar	extant	2001	management	research data available from P Dando
N.	Conwy	extant	1991	management	CCW responsibility
O.	Dee	extant	1988	research status	CCW responsibility
P.	Mersey	extant?	1980	research status	once abundant
Q.	Rostherne	extinct	1922	restore locally?	historical information good
R.	Ribble	extant?	1988	research status	once common
S.	S Morecambe	extant?	1982	research status	includes Lune (1982) and Wyre (1980?)
T.	N Morecambe	extant	2002	management	includes Kent (2002) and Leven (2002)
S.	Duddon	extinct	1925	restoration	once common
T.	U Solway	extinct	1985	restoration	includes Eden (1985), Esk (1985), (Annan (1940) and Nith (1940))

Figures

Figure 1. The Smelt or Sparling, *Osmerus eperlanus*.

Figure 2. Major divisions of the coastline of the United Kingdom, showing the tidally influenced length of each river system (after NERC 1975).

Figure 3. The mean catch rate of Smelt during CEFAS surveys from 1981-97 (from Rogers *et al* 1998).

Figure 4. The distribution of major systems (stippled) which have at present (or have had in the past) populations of Smelt. The letters correspond to those listed in Table 2. Open circles represent populations believed to be extinct; closed circles are existing populations.

Figure 1. The Smell or Sparling, *Osmerus opercularis*.

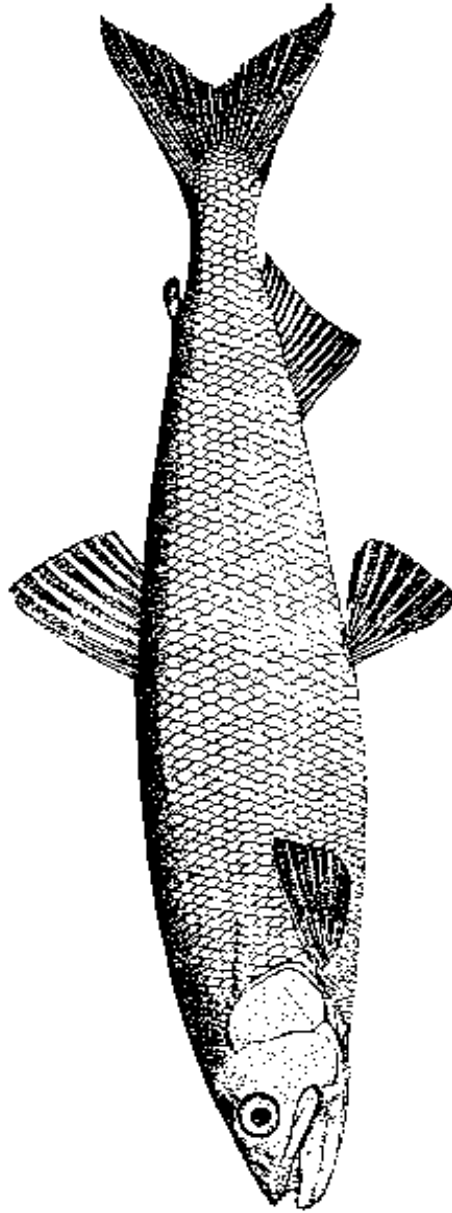


Figure 2. Major divisions of the coastline of the United Kingdom, showing the tidally influenced length of each river system (after NERC 1975).



Figure 3. The mean catch rate of Smelt during CEFAS surveys from 1981-97 (from Rogeneset al. 1998).

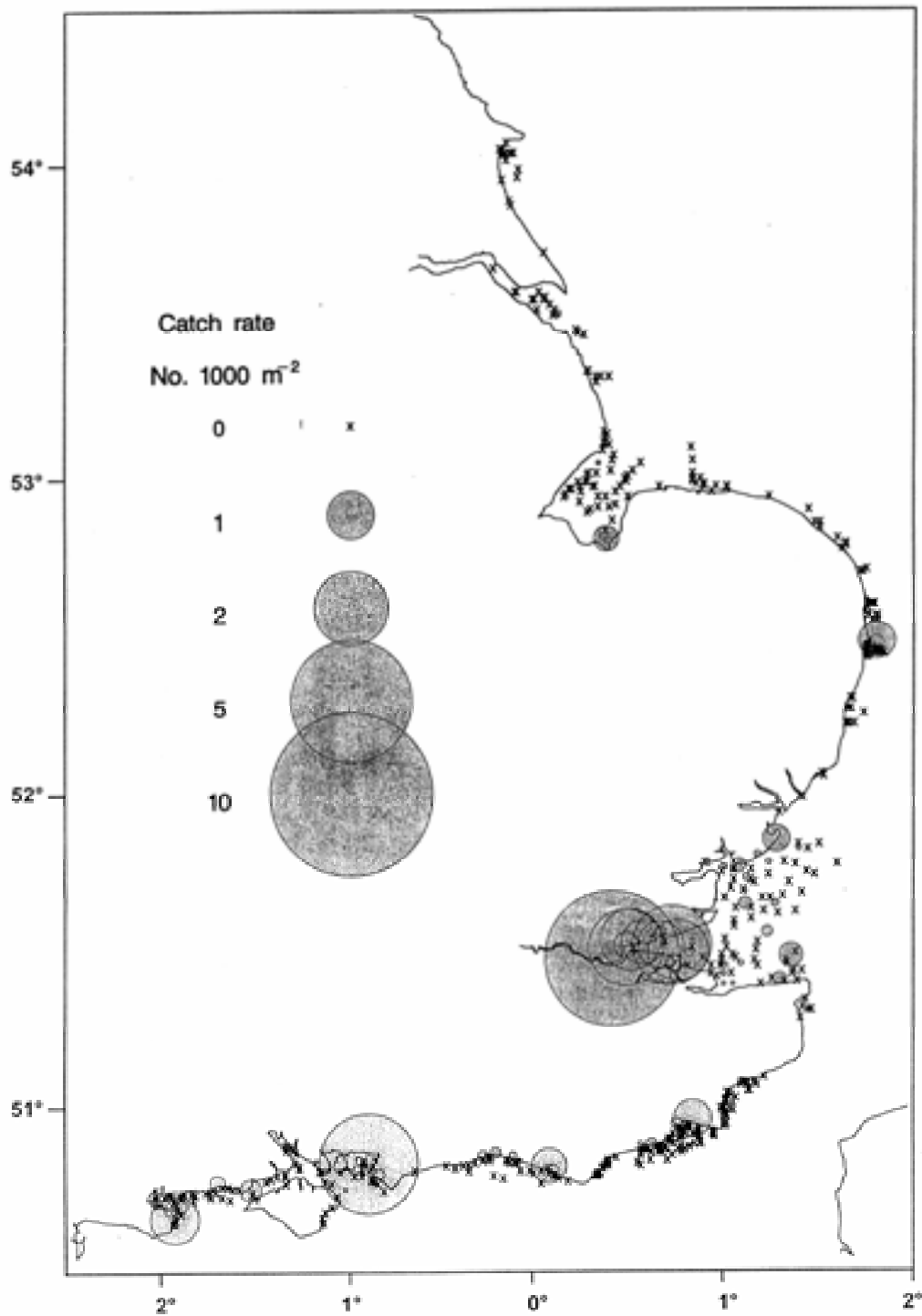


Figure 4. The distribution of major systems (stippled) which have at present (or have had in the past) populations of Smelt.





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