5

THE FISHES of THE STOUR ESTUARY

THE FISHES OF THE STOUR ESTUARY

5.1 Introduction

The River Stour was orginally a drowned river valley and forms part of the boundary between Suffolk and Essex. The Stour occupies an area of 2,531 ha and has a tidal channel of 20.5 km. (Beardall *et al.*, 1991; Davidson *et al.*, 1991). The tidal range varies from approximately 4 m. at spring tide to about 2 m. on neap tides. The main channel is relatively narrow with significant mudflats exposed at low water. (Bull *et al.*, 1959). The wide intertidal zone is further described by Kay & Knights (1978).

The whole of the Stour estuary is an SSSI of marine biological importance. (Davies *et al.*, 1990).

5.2 Estuarine habitats

The shore is dominated by mudflats which cover 1,506 ha and a further area of 95 ha of salt marsh. However, where stronger water movement occurs in the channels and where it is exposed to wave action, the sediments grade to a coarser sand and gravel (Bull *et al.*, 1959). The majority of the area is fine silt with patches of sand, silt and gravel (Kay & Knights, 1975). The sedimentary shores contain a good variety of estuarine invertebrates which provide food for a wide range of waders and water fowl and, no doubt, at high tide food for estuarine fishes. (Beardall *et al.*, 1991).

5.3 Fish lists

There is no published fish list available for the Stour Estuary, but it is likely to be similar to those found in the estuaries of Suffolk which is given in Beardall *et al.* (1991). The number of fish species recorded is 11 (see Table 5.1).

5.4 Fish and fisheries

There is no mention of the fishes on the Stour Estuary in the literature that has been examined, although a short list is contained in the Beardall *et al.* (1991) review of the Suffolk estuaries. As bait digging is one of the human impacts on the Stour it must be assumed significant angling occurs on the estuary and that further information on its fishes can be obtained from the personal notes and field logs of anglers and fishermen.

5.5 Impacts

The **organotin contamination** of sediments in the Stour has been studied by Dowson *et al.* (1992) with the conclusion that the boat servicing facilities and infrastructure are the main cause of aquatic environmental pollution. There still remain high concentrations of TBT leaking from boat hulls during the summer months (despite the retail ban on TBT anti-fouling products), or being released from contaminated sediments disturbed during dredging operations.

The Stour estuary extends west to Manningtree where the river and tidal flow are restricted by a **barrage** (Kay & Knights, 1975).

Anglian Water have authorised the legal discharge of **oil** into the Stour which adds to other oil and petroleum products resulting from spillage, bilge discharges, discharges from oil based installations and refineries and run-off from various sources (Beardall *et al.*, 1991). It is likely that petroleum products will have a toxic effect on marine organisms and deter fish migrants.

The Stour has a history of **dredging** dating back to the 1850s with over 5 million cubic metres of sand and gravel taken from the coastal channel between Parkeston Quay and Harkstead.

Bait digging is carried out on the Stour, mainly during the late summer and autumn, but primarily for private use Beardall *et al.* (1991).

Organic effluent and sewage are dispersed into the estuaries and the Stour has 10 outfalls, most of which is untreated or with primary treatment only. The impact on the invertebrate and estuarine faunas are considered by Beardall *et al.* (1991).

There has, in recent years, been an increase in **water recreational activities** including yachting, wind surfing, angling, canoeing, swimming, wild fowling and bird watching. The increase in marinas introduces problems with moorings and pollution as well as the potential threat to the mudflat habitats.

At Bathside Bay 100 ha are to be **reclaimed** to provide an extension to Harwich Harbour.

Cockle fisheries occur in the Stour by means of special dredges which remove the surface substrate and have a detrimental effect on invertebrate populations.

5.6 Water Quality

The quality of the upper reaches of the Stour estuary are considered "good" according to the NRA (1991) survey of estuarine water quality, but with a deterioration at the mouth of the estuary where the pollution from Harwich and Felixstowe Docks reduce water quality (see Figure 5.1). Clearly concern needs to be expressed on some of the human impacts in the region and, in particular the leaking of pollutants during dredging operations and the risk associated with the discharge of oil and petroleum prorducts. Information on the heavy metals of the Stour are given by Burt *et al.* (1992).

5.7 Summary

The Stour Estuary is an interesting area with important wader and wildfowl population making full use of saltmarsh and mudflat feeding grounds. There are significant impacts on the water of the estuary through dredging operations and pollution associated with Felixstowe and Harwich Docks. Useful records are kept by the Suffolk Wildlife Trust, but as yet no significant surveys have been carried out on the fishes of the area.

5.8 Recommendations

It is recommended that:

1. A full survey is carried out on the fishes of the Stour Estuary with special provision to examine the impact of the pollution associated with the docks.

2. Strict control of planning policies should be introduced especially with regard to land reclamation.

3. Management procedures involved in the handling of oil and petroleum products should be subjected to detailed review.

4. The impact of dredging on the estuary should be examined.

5.9 References

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Table 5.1 The Fishes of the Stour Estuary

Anguilla anguilla
Clupea harengus
Salmo salar
Salmo trutta
Gadus morhua
Merlangius merlangus
Atherina presbyter
Dicentrarchus labrax
Platichthys flesus
Pleuronectes platessa
Solea solea

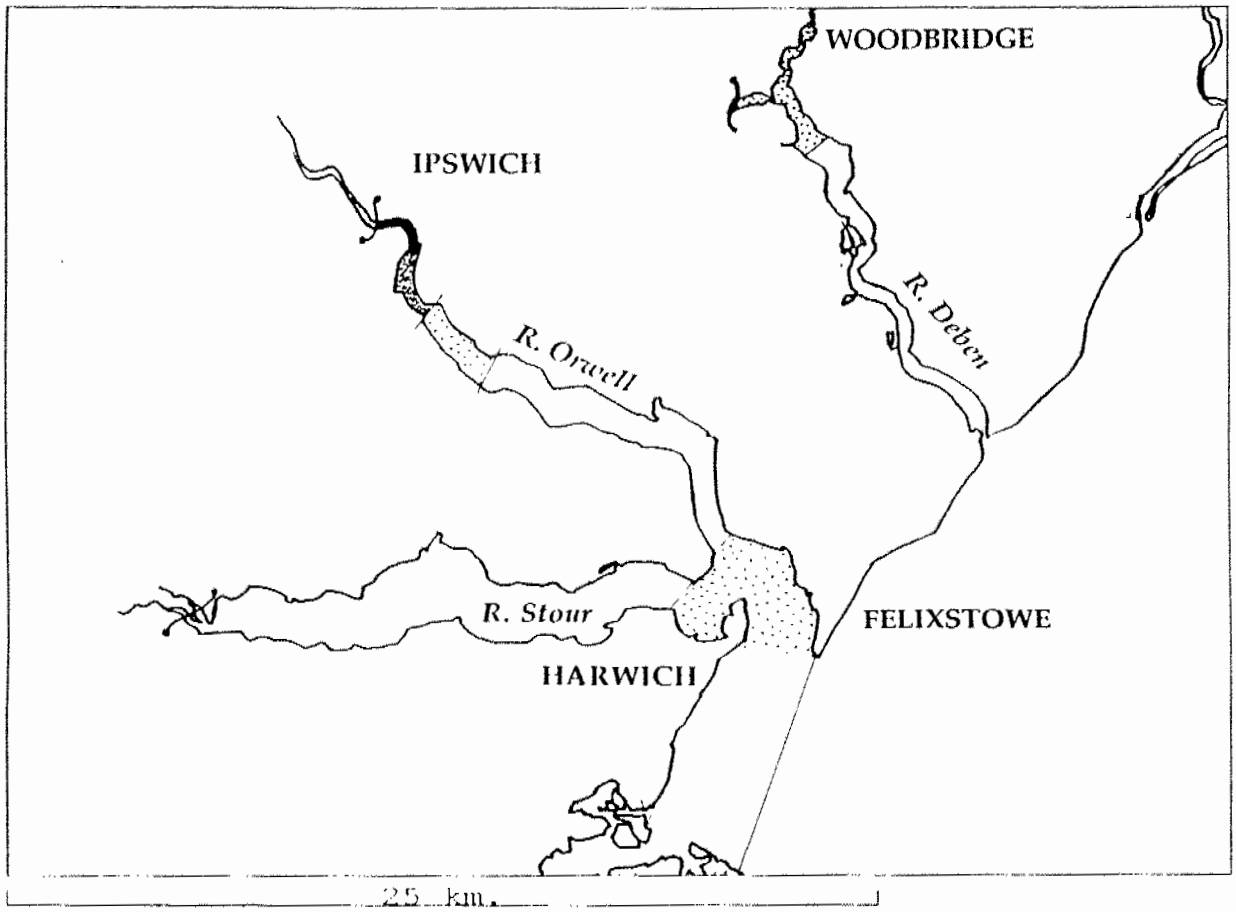

Figure 5.1 Map of the Stour Estuary showing the upper and lower extent of the estuary, the upper tidal limits, and the water quality according to the 1991 NRA Survey. Water quality is characterised as "good" [unmarked], "fair" [medium stipple], "poor" [dense stipple], and "bad" [solid infill].

6

THE FISHES
of
THE BLACKWATER AND COLNE ESTUARIES

THE FISHES OF THE BLACKWATER & COLNE ESTUARIES

6.1 Introduction

The Blackwater Estuary is a tidal inlet about 21.2 km. long and 1.6 to 2.4 km. wide stretching from Maldon eastwards to Mersea Is, where it joins the estuary of the River Colne. The catchment of the Colne and Blackwater are in the driest part of the British Isles with a limited freshwater run off, especially in summer. Truly estuarine conditions are confined to the upper reaches of the tidal waters, eg. above Wivenhoe on the Colne and above Osea Island on the Blackwater (Davis, 1965a).

The Blackwater Estuary does not have SSSI status, but the whole of the Colne Estuary is an SSSI and is cited as being of marine biological importance for its typical estuarine communities (Davies *et al.*, 1990).

6.2 Estuarine habitats

The Blackwater Estuary has a wide variety of habitats. Studies on the shore of Bradwell showed a shell bank above high water, and saltings, now enclosed by sea walls and by a shell bank. Areas around the shore have substrates of stones and shells, sand and mud, and areas of residual alluvial clay. Bradwell creek has a deep scoured channel (Davis, 1965b,c)

6.3 Fish lists

A published fish list has not been found for the Colne, although it is not expected to differ significantly from the Blackwater. The four most comprehensive fish lists for the Blackwater are in Coughlan (1968), Davis (1964, 1967) and Bamber & Henderson (1981). The number of fish species recorded from the Blackwater and Colne Estuaries is 61 (see Table 6.1).

6.4 Fish and fisheries

The Blackwater herring (*Clupea harengus*) is a distinct subspecies and is an important commercial fish. Herrings are present from September to March with fishing starting in November reaching its peak in January to February. Herring landings have been going through variable periods, which has resulted from others (who hold shore jobs) joining year-round fishermen in those good seasons. This leads to heavy exploitation of the herring stocks when they are spawning (Davis, 1964; Coughlan, 1968). Studies on herring in the Blackwater include Dempsey & Bamber (1983) on the spawning of herring with the decline in stocks, Henderson & Cartwright (1980), on the dispersal of larval herring, Dempsey & Henderson (1980) on larval herring distribution and the siting of power station cooling water intakes and outfalls, Coughlan (1980) on the wastage of larval herring, Henderson *et al*, (1984) on the growth and mortality of larval herring and Henderson & Whitehouse (1980) who studied the vertical and transverse distribution of larval herrings.

Schools of sprat (*Sprattus sprattus*) also come inshore during the winter to spawn. The sprats that are caught from November onwards are of high quality, but many are sold to local farmers as fertilizer or to manufacturers of fish meal (Davis, 1964). Sprat populations declined to very low levels in 1960 and showed no signs of recovery in 1967 (Coughlan, 1968).

The summer fishing season usually begins in late April or May when sole (*Solea solea*), plaice (*Pleuronectes platessa*), thornback ray (*Raja clavata*) and other flatfish are caught in variable numbers (Davis, 1964) Flounders (*Platichthys flesus*) also form part of a small fishery. Cod (*Gadus morhua*) and whiting (*Merlangus merlangus*) are caught infrequently, but appear to be increasing (Coughlan, 1968).

Davis (1963) gives details of the effects of the severe winter 1962/3 on the Blackwater Estuary when ice floes were reported in the creek and along the shore. Despite the power station, the water temperature reached -2.5 °C. Both herring (*C. harengus*) and flatfish were affected by the coldwater which apparently discouraged them from entering the estuary. The fishing season started slowly after the 'freeze' but catches of sole (*S. solea*), plaice (*P. platessa*) and thornback ray (*R. clavata*) were particularly slow to recover.

Sole (*S. solea*) tagging was carried out by Wallace (1977).

The Blackwater Estuary is known to be a nursery area for sea bass (*Dicentrarchus labrax*) (Kelley, 1988).

Species noted on the shore by Davis (1965c) include the butterfish (*Pholis gunnellus*), the three-spined stickleback (*Gasterosteus aculeatus*) and young plaice (*Pleuronectes platessa*).

The sturgeon (*Acipenser sturio*) was last recorded in the region of the Blackwater and Colne at the end of the last century. However, there have been more recent records from the south east coast (Rochard pers. comm. 1991).

6.5 Impacts

There have been no published reports on human impacts on the Colne Estuary. However, the Blackwater has been subjected to a variety of activities that will influence fish populations.

A substantial **commerical fishery** for herring (*C. harengus*), and a lesser fishery for other species exists in the Blackwater Estuary (see section Fish and fisheries for details). Traditionally gill or drift nets have been used, although newer techniques such as Danish pair trawls and midwater trawls are being used. These are non-selective and likely to be more damaging to fish populations. Davis (1964) also noted the extensive use of gillnets as having a deleterious effect on the fishery. Commercial landing takes place at the local ports Tollesbury, Brightling Sea, West Mersea and Maldon. The impact of commercial fishing on estuarine fishes is likely to be considerable and there is evidence of over exploitation. (Davis, 1964).

The Blackwater also supports a large oyster and **shellfish fishery**. The future prospects of the Blackwater fishing industry is unpredictable (Davis, 1964; Coughlan, 1968).

To determine the effect of the **power station** at Bradwell, the fauna and habitats have been studied by Davis (1965 a,b,c), (Dempsey & Henderson, 1980) Bamber & Henderson (1981). Davis, (1964) recorded the concentration of large numbers of bass (*Dicentrarchus labrax*) and mullet (*Mugil sp.*) in the warmer water around the station effluent as well as the large numbers of sprat (*S. sprattus*) taken into the power station cooling system. **Radioactive discharges** from Bradwell power station were measured by Mitchell (1970) who confirms the radiological safety of discharges by analysing oyster flesh.

Angling is a popular hobby, and sport fishermen have visited the Blackwater Estuary for many years. In recent years the numbers have increased greatly.

A proposal to **dredge gravel** from spawning areas of the herring (*C. harengus*) was turned down on the grounds it would have seriously damaged the herring stocks (Davis, 1963).

Organotin contamination in sediments was studied by Dowson *et al.* (1992), who concluded that the major impact on the aquatic environment is via boat service facilities such as boat yards, marinas and mooring sites. High concentrations coincided with summer boat usage either from TBT leaking from boat hulls after the retail ban or desorption from contaminated sediments as a result of dredging. Heavy metal contamination is given in Burt *et al.*, 1992.

6.6 Water quality

The water quality has been determined as "good" for the Blackwater and Colne estuaries (NRA, 1990) (see Figure 6.1), although some concern might be expressed on the impact of the Bradwell Power Station. Water quality determinands for the Blackwater and Colne Estuaries are given in Edmondson & Watts (1992).

6.7 Summary

The populations of fishes in the Blackwater have been reported as being very variable with some evidence of overfishing of the herring (*C. harengus*) and the sole (*S. solea*) populations. Pollution may have contributed to the decline in the herring population, but overfishing is a more serious threat. The fisheries were affected by the severe winter of 1962/63 when fish appeared to avoid the estuary.

6.8 Recommendations

It is recommended that;

1. the fish fauna of the Blackwater Estuary be studied further and records be updated from anglers, fishermen, and statistics from the MAFF.

2. the Colne Estuary is surveyed in detail and that the fish population should be recorded in relation to its community structure and available habitats.

3. the non-commercial fishes of both sections of the Blackwater and Colen are subjected to a detailed examination.

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Table 6.1 The Fishes of the Blackwater and Colne Estuaries

Petromyzon marinus
Lamna nasus
Scyliorhinus canicula
Galeorhinus galeus
Mustelus mustelus
Squatina squatina
Raja clavata
Dasyatis pastinaca
Acipenser sturio
Anguilla anguilla
Conger conger
Clupea harengus
Sprattus sprattus
Salmo salar
Salmo trutta
Osmerus eperlanus
Diplecogaster bimaculata
Ciliata mustela
Gadus morhua
Gaidropsarus vulgaris
Merlangius merlangus
Micromesistius poutassou
Trisopterus luscus
Trisopterus minutus
Merluccius merluccius
Belone belone
Scomberesox saurus
Zeus faber
Gasterosteus aculeatus
Spinachia spinachia
Syngnathus acus
Syngnathus rostellatus
Aspitrigla cuculus
Trigla lyra
Myoxocephalus scorpius
Taurulus bubalis
Agonus cataphractus
Cyclopterus lumpus
Liparis liparis
Dicentrarchus labrax
Trachurus trachurus
Mugil sp.
Trachinus sp.
Parablennius gattorugine
Zoarces viviparous
Pholis gunnellus
Callionymus lyra
Aphia minuta
Gobius niger
Gobiusculus flavescens
Pomatoschistus minutus
Psetta maxima
Scophthalmus rhombus
Zeugopterus punctatus
Glyptocephalus cynoglossus
Hippoglossoides platessoides
Limanda limanda
Microstomus kitt
Platichthys flesus
Pleuronectes platessa
Solea solea

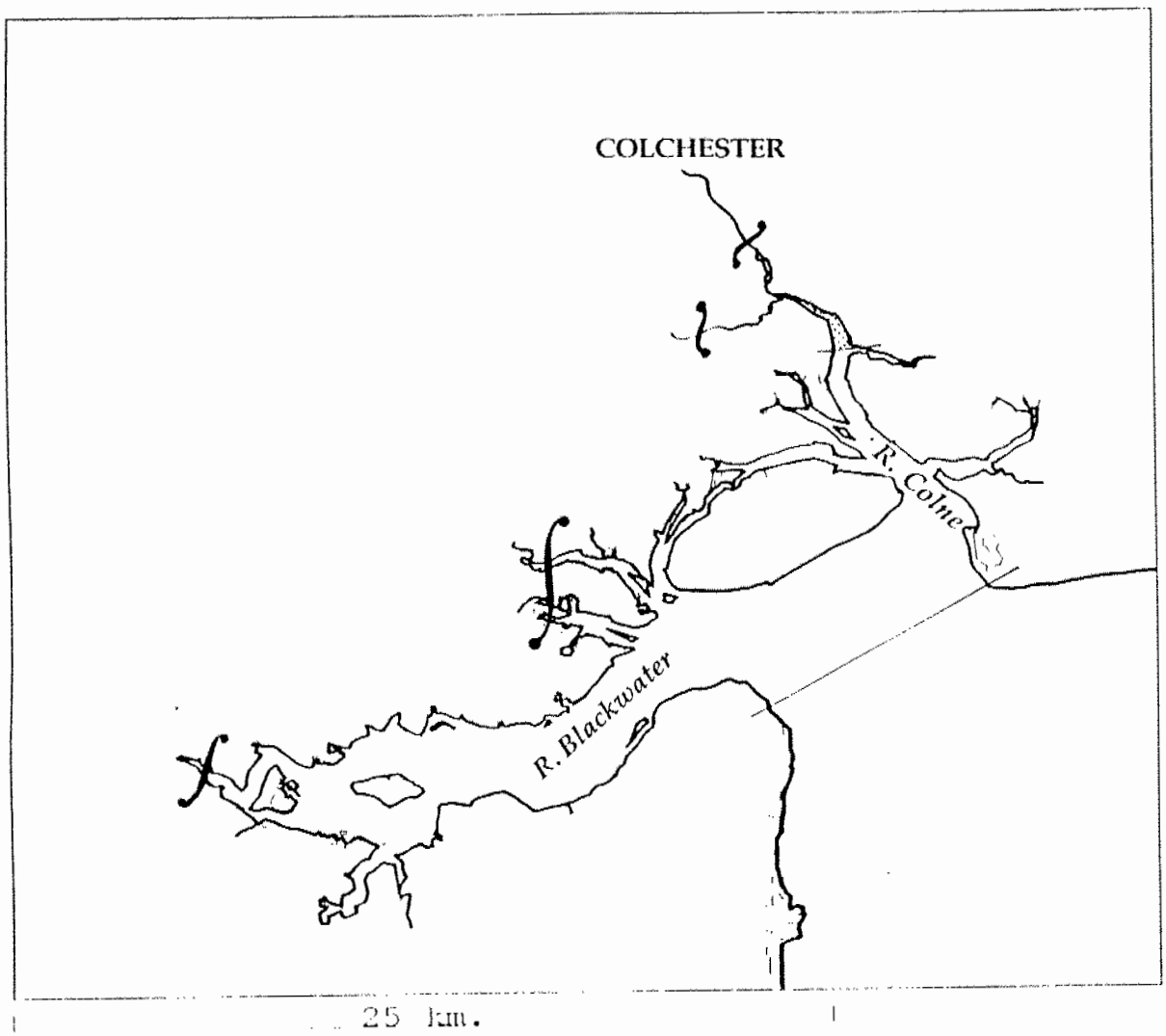

Figure 6.1 Map of the Blackwater and Colne Estuaries showing the upper and lower extent of the estuary, the upper tidal limits, and the water quality according to the 1991 NRA Survey. Water quality is characterised as "good" [unmarked], "fair" [medium stipple], "poor" [dense stipple], and "bad" [solid infill].

7

THE FISHES of THE THAMES ESTUARY

THE FISHES OF THE THAMES ESTUARY

7.1 Introduction

The Thames drains into the southern North Sea and has its upper tidal limit at Teddington Weir over 95 km. from its mouth. The Thames has a long history of use and abuse by man. Its history and its fishes are given in the book by Wheeler (1979). The Thames Estuary has a total area of 4,745 ha. and a tidal channel from the mouth at Southend on Sea that extends 83 km.

The SSSIs sited along the Thames estuary include Higham Marshes, Cliffe, Cooling, and Medway Marshes, the Swale and Warden Point. These are mainly of marine botanical importance (Davies *et al.*, 1990).

7.2 Estuarine habitats

The River Thames has a very long tidal channel and shows a full range of estuarine habitats. The mouth of the estuary has a full maritime influence with extensive mud flats which have an extensive benthic infauna that provide feeding grounds for fishes, waders and wildfowl. The habitat diversity should provide the basis for a significant fish fauna.

7.3 Fish lists

The NRA (Thames Region) maintain a list of all the species of fishes recorded in the Thames since 1964. This totals 118, of which 99 are estuarine or marine (Thomas, pers. comm. 1992). Fishes have been recorded in other studies including Andrews *et al.* (1982) Wharfe *et al.* (1984) with rare and little known fishes detailed in Andrews & Wheeler (1985). A total of 101 fishes have been recorded in the present compilation (see Table 7.1).

7.4 Fish and fisheries

Commercial fisheries existed at one time all along the tidal Thames, but increasing pollution resulted in the decline in fish populations (Wheeler, 1958, 1963, 1969). As the river became cleaner, the fish began to return, with 23 species, of mainly marine fishes, recorded on West Thurrock power station intake screens during 1965 (Wheeler, 1969). A total of 53 estuarine and marine species of fish were captured between 1967 and 1973. (Gameson & Wheeler, 1977).

The lampern (*Lampetra fluviatilis*) fishery in the Thames was substantial but declined, it was last recorded in 1899 in the estuary. However, it was again taken on West Thurrock power station in 1964 and 1967 (Wheeler, 1969).

Salmon (*Salmo salar*) and sea trout (*Salmo trutta*) were caught commercially, but were in decline in the Thames throughout the 18th and 19th centuries. The last record of salmon was in 1833 (Wheeler, 1969), and for sea trout was before 1900. Since the cleaning operations the re-stocking of the Thames with salmon by the Thames Water Authority, the "Thames Salmon Rehabilitation Scheme", has been somewhat successful with the return of adults caught in traps (NRA pers. comm. 1992). Previous attempts are given and implications of a salmon run are discussed in Higgins (1982).

Smelt (*Osmerus eperlanus*) were abundant in the lower Thames and supported a fishery, but none were recorded after 1958. By 1968 smelt had been taken on West Thurrock intake screens and were reported from other sites which imply a population recovery (Wheeler, 1969). Hermaphroditic smelt have been reported from the Thames by Hutchinson (1983).

The Thames herring (*Clupea harengus*) stock, its life history, assessment methods, management and future prospects are detailed in Wood (1981).

The eel (*Anguilla anguilla*) was also commonly fished for and was the only species able to pass through the polluted lower Thames. This, it is reported, was achieved by swimming their heads above water (Wheeler, 1969). They are still abundant in the lower Thames.

The flounder (*Platichthys flesus*) was reported as abundant in the Thames, declined owing to pollution and have now returned (Gameson & Wheeler, 1977).

The sprat (*Sprattus sprattus*) fishery catches in the Thames estuary for 1968-1969 are given in Johnson (1970).

The sturgeon (*Acipenser sturio*) were netted in the Thames estuary (Wheeler, 1969).

In 1836 shad (*Alosa sp.*) were reported to be abundant in the Greenwich area and were fished for commercially although they had declined at Westminster and above Putney Bridge. The twaite shad was more common in the lower Thames than the allis shad (*Alosa alosa*), but the two were rarely distinguished in the fishing literature. Both shads were found chiefly in February and March with shad fishing being essentially seasonal. Twaite shad (*Alosa fallax*) were reported as abundant by Murie (1903), but later had been reported as in decline though it was still caught further down the estuary, and was possibly breeding in creeks in Southend where it was regularly caught by anglers (Wheeler, 1958, 1969). A single twaite shad was recorded from West Thurrock intake screens between April and July 1968, two in October 1975, one in November 1975, October 1977, November 1977 and 1990. A single specimen was caught off Blackwell Point in January 1976. (Wheeler, 1969; Andrews *et al.*, 1982; Thomas pers. comm. 1992). Allis shad (*A. alosa*) have been recorded singly from West Thurrock in September 1975 and 15 July 1976, and from Blackwell Point in February 1976 and Richmond on 29 September 1977 (Andrews *et al.*, 1982).

Records of rare and little known fishes in the Thames are annotated in Andrews &Wheeler (1985).

The Medway is an estuary at the seaward end of the Thames, on the southern shore. Fish populations have been studied as it is an important flatfish nursery and supports a stable community of fishes. Seasonal distributions of numbers and abundance of fishes have been studied from monthly samples from Kingsnorth Power Station (on the Medway) (Wildish, 1970; Wharfe & Van den Broek, 1977; Van den Broek, 1978, 1979a, 1979b; Wharfe *et al.*, 1984).

7.5 Impacts

The Thames was **grossly polluted** over a long period and it was not until 1860, when it came to the attention of parliament, that actions were taken to improve its condition (Higgins, 1982). The water in the Thames is extracted for **domestic supply** in its higher reaches and lower down has a dispersal function as well as being used for industry.

A very large range of **industrial effluents** are discharged into the Thames including thermal pollution from power stations (Elkington, 1977).

From historic times the Thames has been a **centre of urbanisation** with its associated problems of pollution and discharge. **Domestic sewage** from the large urban population is steadily increasing. Activated sludge plants, have helped with solid fractions, but liquid is still being discharged (Wheeler, 1969). The disposal of the sewage sludge generated is by dumping outside the estuary (Shelton, 1971).

Heavy metal (mercury, zinc, copper, lead and cadmium) concentrations in macroinvertebrates and fish were found to be low although some heavy metals levels were high near industrialised areas. Seasonal levels of chlorinated hydrocarbons and heavy metals in fish were studied from samples in the Medway Estuary (Wharfe & Van den Broek, 1977; Van den Broek, 1979a; Burt *et al.*, 1992).

The Thames is a major **port** with associated and berthing facilities and the risk of pollution from oil and petroleum products.

7.6 Water quality

The Thames has undergone a vigorous clean up programme and there is evidence that wildlife is returning (Bates, 1977; Andrews & Rickard, 1980). The water quality according to the NRA report (1991) is "fair", as shown in Figure 7.1.

The water quality objectives set for the tideway by the NRA (pers. comm. 1992) include a series of chemical and biochemical standards that ensure the middle reaches of the Thames Estuary support an estuarine fish population and a commercial eel fishery, and the seaward reach supports a marine fishery. Regular water sampling, monitoring of discharges, and surveys of fishes are undertaken to meet these objectives.

Good water quality conditions prevail in the Medway and fishes caught show a diversity and seasonal abundance, and the change in community structure, with increases in smelt and herring, are attributed to improved water quality (Wharfe *et al.*, 1984).

7.7 Summary

The Thames has been the subject of a very considerable literature which reviews the socio-economic and industrial impacts on the river. Since the middle of the 19th century the pollution of the Thames has been recorded and only in the last twenty years have serious attempts been made to reduce pollution. The success of such measures are seen with the increase in fish populations which are a major indication of aquatic environmental recovery.

7.8 Recommendations

It is recommended that:

1. The monitoring and sampling of water quality and fish surveys currently undertaken by the NRA should be maintained.

2. A review is made of the commercial fishery activities of the Thames Estuary.

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Table 7.1 The Fishes of the Thames Estuary

Lampetra fluviatilis
Petromyzon marinus
Scyliorhinus canicula
Mustelus mustelus
Raja clavata
Raja undulata
Dasyatis pastinaca
Acipenser sturio
Anguilla anguilla
Conger conger
Alosa alosa
Alosa fallax
Clupea harengus
Sardina pilchardus
Sprattus sprattus
Engraulis encrasicholus
Salmo salar
Salmo trutta
Osmerus eperlanus
Lophius piscatorius
Ciliata mustela
Ciliata septentrionalis
Enchelyopus cimbrius
Gadus morhua
Gaidropsarus mediterraneus
Gaidropsarus vulgaris
Melanogrammus aeglefinus
Merlangius merlangus
Micromesistius poutassou
Molva molva
Pollachius pollachius
Raniceps raninus
Trisopterus esmarkii
Trisopterus luscus
Trisopterus minutus
Merluccius merluccius
Belone belone
Scomberesox saurus
Zeus faber
Gasterosteus aculeatus
Pungitius pungitius
Spinachia spinachia
Entelurus aequoreus
Hippocampus hippocampus
Hippocampus ramulosus
Nerophis lumbriciformis
Syngnathus acus
Syngnathus rostellatus
Syngnathus typhle
Myoxocephalus scorpius
Aspitrigla cuculus
Eutrigla gurnardus
Trigla lucerna
Trigloporus lastoviza
Micrenophrys lilljeborgi
Taurulus bubalis
Agonus cataphractus
Cyclopterus lumpus
Liparis liparis
Liparis montagui
Dicentrarchus labrax
Trachurus trachurus
Spondyliosoma cantharus
Mullus surmuletus
Chelon labrosus
Liza aurata
Liza ramada
Ctenolabrus rupestris
Labrus bergylta
Labrus mixtus
Echiichthys vipera
Zoarces viviparous
Pholis gunnellus
Ammodytes marinus
Ammodytes tobianus
Hyperoplus lanceolatus
Callionymus lyra
Aphia minuta
Gobius niger
Gobius paganellus
Pomatoschistus lozanoi
Pomatoschistus microps
Pomatoschistus minutus
Pomatoschistus pictus
Thorogobius ephippiatus
Scomber scombrus
Phrynorhombus regius
Psetta maxima
Scophthalmus rhombus
Zeugopterus punctatus
Arnoglossus laterna
Hippoglossoides platessoides (unconfirmed)
Limanda limanda
Microstomus kitt
Platichthys flesus
Pleuronectes platessa
Buglossidium luteum
Solea solea
Balistes carolinensis
Mola mola

Potts & Swaby (1993)

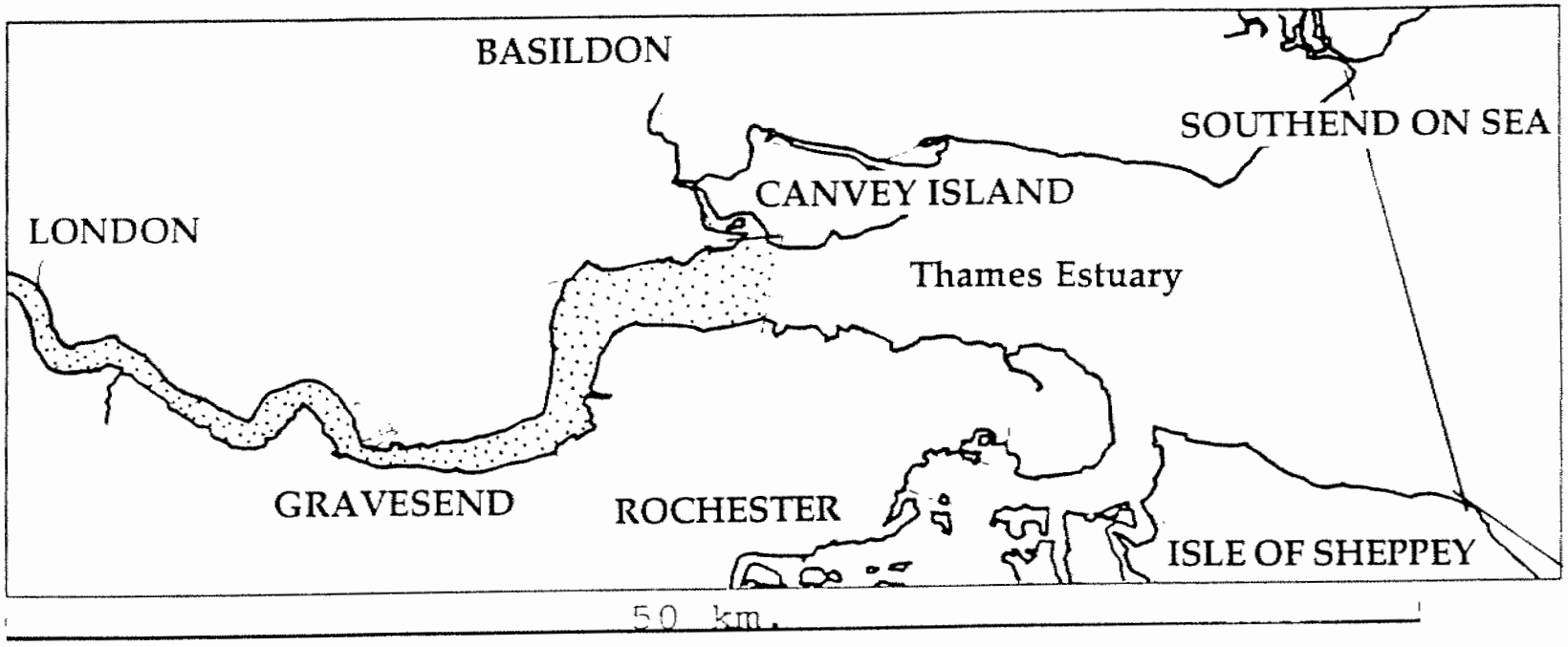

Figure 7.1 Map of the Thames Estuary showing the upper and lower extent of the estuary, the upper tidal limits, and the water quality according to the 1991 NRA Survey. Water quality is characterised as "good" [unmarked], "fair" [medium stipple], "poor" [dense stipple], and "bad" [solid infill].