16

THE FISHES
of
THE SEVERN ESTUARY

THE FISHES OF THE SEVERN ESTUARY

16.1 Introduction

The Severn Estuary is one of the largest in England covering 55,684 ha. and with a tidal channel extending 111 km inland. It also has one of the world's highest tidal ranges with a mean spring range at Beachley of 12.40 metres, compared with the British Isles average of 4.57 m. The estuary is exposed to the Bristol Channel which has considerable influence on the physical conditions experienced in the estuary itself. There are four large urban developments at Bristol, Portishead, Cardiff and Newport. In addition to the Severn, five major rivers enter the estuary, the Avon and the Parrett on the south shore, and the Usk, Wye and Taff on the north shore. A very large volume of freshwater, often silt-laden, enters the estuary, and strong tidal streams cause turbidity and poor light conditions. (Davies *et al.*, 1990; Davies, 1991).

The whole of the Severn Estuary is an SSSI and in 1988 it was proposed as a RAMSAR site and a special protection area (SPA) of marine biological importance for its shore birds and waders (Mitchell & Probert, 1981; Davies *et al.*, 1990; Davies, 1991).

16.2 Estuarine habitats

Within the estuary there are large areas of littoral mud flats which form essential feeding grounds for waders and wildfowl. Sublittoral habitats include sandbanks, gravel, muddy areas, mud and sand, mixed areas with and without mud, and areas of hard rock substrate. Salt marshes occur on both sides of the Estuary, mainly in the central reaches flanked by wide intertidal mud flats. The flora and fauna on rocky shore are relatively impoverished, but consistent with estuarine ecosystems. (Mitchell & Probert, 1981; Davies, 1991). The diversity of estuarine habitats, the high tidal cycles and the strong currents result in a very rich fish fauna with a very strong maritime element.

16.3 Fish lists

The earliest fish list dates back to Day (1890, 1897) and Boulenger,(1906) Other studies of fishes include Matthews (1933), Potter *et al.* (1986), Lloyd (1941), Claridge *et al.* (1986), Henderson *et al.* (1984), and Hardisty & Huggins (1975). The number of fish species recorded from the Severn Estuary is 111 (see Table 16.1).

16.4 Fish and fisheries

Commercial fixed net fisheries were long established with records of fisheries dating back to the 15th Century that predated all other biological records. There were profitable fisheries for sprat (*Sprattus sprattus*) and salmon (*Salmo salar*), and fishermen also caught lesser spotted dogfish (*Scyliorhinus canicula*), small eyed ray (*Raja microcellata*), thornback ray (*Raja clavata*), conger eel (*Conger conger*), whiting (*Merlangius merlangus*), cod (*Gadus morhua*), ling (*Molva molva*), bass (*Dicentrarchus labrax*), flounder (*Platichthys flesus*), plaice (*Pleuronectes platessa*), sole (*Solea solea*) (NERC, 1972; Severn Tidal Group, 1989). Now only one fixed net fishery remains.

The Severn Estuary and inner Bristol Channel is not significant as a nursery ground owing to the hard substratum and strong currents although, its use as a spawning ground for some species is implied by the presence of eggs and larvae of anchovy, sole, sprat, several species of goby, rockling, and some other 34 species (Mitchell & Probert, 1981).

Seven species of migratory fish are found in the Severn, salmon (*Salmo salar*), sea trout (*Salmo trutta*), eel (*Anguilla anguilla*), twaite and allis shad, (*Alosa fallax* and *A. alosa*), sea lamprey (*Petromyzon marinus*) and lampern (*Lampetra fluviatilis*). The numbers of these species using this estuary are not known, although they are suspected to occur in the Usk, Wye and Severn as the poor water quality of other rivers is likely to prevent passage (Mitchell & Probert, 1981). Migrations of salmon (*Salmo salar*) in the three rivers entering the Severn Estuary are given in Swain (1982).

Eel *(Anguilla anguilla)* and elver fishing is a historical fishery that is discussed in detail in Matthews (1943), Churchward & Hunt (1977), Blenkhorn (1978), Lloyd (1944). Ascending elvers have been analysed for pigment changes, conditins, chemical composition and energy reserves (Boetius & Boetius, 1989).

Bass (*Dicentrarchus labrax*) have been studied to determine their movements on the west coast of the U.K, estuarine dependence, movements, abundance, age composition, growth and diet (Kelley, 1979; Claridge & Potter, 1983; Aprahamian & Barr, 1985).

The whiting (*Merlangius merlangus*) in the Severn Estuary has been studied regarding heavy metal uptake (Badsha & Sainsbury, 1977), age, composition, growth, movements, meristics, and parasites (Potter *et al.*, 1988) and the predator prey relationship with the common shrimp (*Crangon crangon*) (Henderson & Holmes, 1989).

Seasonal changes of fish in the Severn Estuary using power station intake screen data was determined by Potter *et al.*, (1986), and the effects on fishes impingement on screens by Henderson & Holmes (1985). Various studies using fishes caught on power station intake screens in the Severn include: the abundance, movements and size of gadoids (Claridge & Potter, 1984), the seasonal catches, size and meristic data for sprats (*Sprattus sprattus*) (Potter & Claridge, 1985), the distribution, abundance, and size composition of grey mullet (*Mugil sp.*) (Claridge & Potter, 1985), aspects of the biology and heavy metal accummulation of the five bearded rockling (*Ciliata mustela*) (Badsha & Sainsbury, 1978), the biology of the northen rockling (*Ciliata septentrionatis*) (Claridge & Gardner, 1977), the population stability of the sea snail (*Liparis liparis*) over ten years (Henderson & Holmes, 1990), eight species of goby (*Gobiidae*) (Claridge *et al.*, 1985), the size composition, and seasonal changes of abundance of juveniles of soles (*Solea solea*) (Claridge & Potter, 1987) and fecundity determination in soles (Horwood & Walker, 1990).

Food selection of eels (*Anguilla anguillla*), whiting (*Merlangius merlangus*), sprat (*Sprattus sprattus*), the stickleback (*Gasteroteus aculeatus*), and flouner *(Platichthys flesus)* in the Severn Estuary is given in Moore & Moore (1976). Post larval fish distribution is given in Russell (1980).

The sturgeon (*Acipenser sturio*) was recorded in the Severn by Smyth (1639), and two or three were usually taken during the summer in the upper reaches. A 6ft specimen weighing over 100lbs was caught on a sprat-baited long-line at Weston on January 10th, 1941.

The allis shad (*Alosa alosa*) was recorded by Smyth (1639) in the Severn. Day (1890) stated that the value of shad (including the twaite shad *Alosa fallax*) and allis equalled or surpassed that of the salmon. It was observed entering the Severn about the middle of April, but was dependent on the water condition. It appeared to avoid floods. Small males were observed to arrive first followed by larger ones. The shad was sometimes taken as far up as Worcester, but has diminished, most likely owing to the navigation weirs. 1868 was a good spring and a large run was observed, while in 1872 the taking of two shad was worth recording. There is still a small run every year (Lloyd, 1941). The allis shad occurs occasionally at Oldbury Power Station and rarely at Berkeley where its reaches a standard length between 300 and 400 mm. (Claridge *et al.*, 1986).

The Severn Estuary is one of the few estuaries where twaite shad have been recorded in numbers other than occasional records.

Twaite shad (*Alosa fallax*) were reported by Day (1890) as arriving two to three weeks after the allis (*A. alosa*) and was also likely to become extinct as it too was unable to reach its spawning beds. Twaite shad are found commonly on the intake screens of Berkeley, Oldbury and Hinkley Point power stations are regularly caught as Uskmouth, but are not present at Pembroke. Between July 1972 and June 1977, 3879 were recorded from Oldbury Power Station with standard lengths for specimens being 23-357 mm. At Hinkley Point Power Station 57 twaite shad were caught over the period October 1980 to December 1984 from monthly samples. An estimated annual catch was calculated to be 2719, 3305, 7676 and 10103 specimens for they years 1981-1984, with a predicted mean annual catch of 5951.

During May 1982 and March 1984 twaite shad were found to be rare at Hinkley Point and Uskmouth, occasional at Oldbury Power Station and only one specimen taken from Berkeley. However, in 1989 unusually high numbers of twaite shad were recorded, which was thought to be a consequence of the unusually high sea temperatures during 1988-89 winter and following spring and summer. In March 1985 20 twaite shad were caught at Hinkley Point. The next reasonable month was September 1989 when 39 were caught (Hardisty & Huggins, 1975; Henderson & Holmes, 1985; Henderson *et al.*, 1984; Claridge *et al.*, 1986; Potter *et al.*, 1986; Holmes & Henderson, 1990).

Spawning stocks occur in the Severn and Wye and are recently reported from the Usk. Much of the spawning is believed to take place in rivers draining into the Severn from which twaite shad migrate downstream in the later summer and autumn. This appears to be closely related to water temperature and shad begin to move out of estuaries when the temperature falls below 19°C. The life history and movements in the Severn are further discussed in Claridge & Gardner (1978), Aprahamian (1988), Severn Tidal Power Group (1989). Twaite shad were examined to determine the occurrence of the cestode parasite *Eubothrium fragile*, branchial and gut parasites and their diet (Kennedy, 1981; Aprahamian, 1985; 1989a, b)

16.5 Impacts

The area contains many different opportunities for water leisure activities, which include marinas, yachting, sailing, canoeing, windsurfing, angling, and SCUBA diving.

The four large **urban** conurbations at Bristol, Portishead, Cardiff and Newport discharge domestic sewage which contributes to a high organic load (Owens, 1984; Davies, 1991). However, strong tidal currents disperse effluents rapidly.

The **heavy industry** and **port facilities** contribute very large volumes of effluent. Discharges also have their source from rivers flowing into the Severn, forming a cocktail of heavy metals and other contaminants. Dumping of sewage, sludge and industrial waste has been carried out in the estuary since

1969 (Owens, 1984; Davies, 1991).

Four large water cooled **electricity generating stations** are sited on the inner and upper Severn Estuary and contribute to thermal pollution (Davies, 1991).

Concentrations of the **heavy metals** zinc, cadmium and lead have been analysed in water and organisms including young whiting *(Merlangius merlangus)*. Other studies have included the ecological implications, dietary habits and heavy metal concentrations in fish. Atmospheric deposition of heavy metals in the Severn Estuary has been recorded as high (Hardistry, Kartar & Sainsbury, 1974). Concentrations in sediments have also been studied (Butterworth *et al.*, 1972; Kartar *et al.*, 1974; Hardisty *et al.*, 1974; Badsha & Sainsbury, 1977; Kartar & Sainsbury, 1977; Milner, 1979. Owens, 1984, Burt *et al.*, 1992).

Weirs form barriers to migratory species (Little *et al.*, 1985).

There has been a long standing proposal to build a **tidal barrage** across the estuary. The implications and impacts on the fish and fisheries have been examined in Millichamp & Staite (1980) and Severn Tidal Power Group (1989). Other aspects of the barrage are given in Mitchell *et al.*, (1981) and Shaw, (1987). Tidal power is reviewed in Mettam (1982) and a bibliography of the Severn Barrage is given in Holbrook (1991).

The impacts of a barrage would affect three major salmon rivers and force fishes through pumps and turbines with the resulting damage to fish. In addition, increased predation on disorientated fish, and reduction in 'clues' for migration, may delay salmon identifying their natal river sections. Fish passes resolve some of these problems, but the design and siting would be critical. A barrage would also change the water flow and sedimentation patterns which could assist some species, but be detrimental to others. There would be restriction of movement and damage or death to migratory species, but its effects would be less on non-migratory species. (Millichamp & Staite, 1980; Mitchell & Probert, 1981; Severn Tidal Group, 1989).

16.6 Water quality

The Severn Estuary has a very large catchment including several industrialised areas which discharge into the estuary. Its large tidal range and flow provide effective mechanisms for flushing the system into the Bristol Channel where dispersal would be very rapid. The NRA (1991) classification identifies the main part of the estuary as "good", dropping off to "fair" quality at centres of population near Swansea and Cardiff (see Figure 16.1). The size of the estuary makes it difficult to get meaningful results from spot checks on water quality (Edmondson & Watts, 1992), and surveys should be confined to small mesocosms within the Severn basin. Burt *et al.* (1992) review the metal contamination of the estuary.

16.7 Summary

The Severn Estuary is a large funnel-shaped estuary with large tidal height and range. The impact on the central channel is that it is exposed to high currents, much scouring and a high sediment load. In sheltered sectors mud deposits settle. The size and habitat diversity ensures that the estuary has a variety of estuarine fishes with a strong marine element. Active ports border the estuary, although suggestions for tidal barrages would have a serious impact on the estuarine habitat. Water leisure activities are on the increase and local marinas and watersports centres are present at most centres of population. Several local fisheries exist. The Severn has been extensively studied and there is a considerable literature.

16.8 Recommendations

It is recommended that:

1. a review is carried out on the fisheries of the Bristol Channel and Severn Estuary.

2. the monitoring of the power station inlet screen is continued as one of the most important data sets on changes of fish population.

3. in the event of a major development such as the barrage, the behavioural ecology of affected species should be examined to review the consequences of such development.

16.9 References

Abou-Seedo, F.S. & Potter, I.C. 1979. The estuarine phase in the spawning run of the river lamprey *Lampreta fluviatilis*. *Journal of Zoology*, **188**, 5-25.

Aprahamian, M.W. 1989. The biology of the twaite shad *Alosa fallax* (Lacepede) in the Severn Estuary. *Journal of Fish Biology*, **33** (Supplement A), 141-152.

Aprahamian, M.W. 1985. The effect of the migration of *Alosa fallax fallax* (Lacepeded) into freshwater, on branchial and gut parasites. *Journal of Fish Biology*, **27**, 521-532.

Aprahamian, M.W. 1988. The biology of the twaite shad *Alosa fallax fallax* in the Severn Estuary. *Journal of Fish Biology*, **33** (Supplement A), 141-152.

Aprahamian, M.W. 1989. The diet of juvenile and adult twaite shad *Alosa fallax fallax* from the Rivers Severn and Wye (Britain). *Hydrobiologia*, **179**, 173-182.

Aprahamian, M.W. & Aprahamian, C.D. 1990. Status of the genus *Alosa* in the British Isles: past and present. *Journal of Fish Biology*, **27** (Supplement A), 257-258.

Aprahamian, M.W., & Barr, C.D. 1985. The growth, abundance and diet of O-group sea bass, *Dicentrarchus labrax*, from the Severn Estuary. *Journal of the Marine Biological Association of the United Kingdom*, **65**, 169-180.

Badsha, K.S. & Sainsbury, M. 1977. Uptake of zinc, lead and cadmium by young whiting in the Severn Estuary. *Marine Pollution Bulletin*, **8** (7), 164-166.

Badsha, K.S. & Sainsbury, M. 1978. Some aspects of the biology and heavy metal accummulation of the fish *Liparis liparis* in the Severn estuary. *Estuarine and Coastal Marine Science*, **7**, 381-391.

Badsha, K.S., & Sainsbury, M. 1978. Aspects of the biology and heavy metal accumulation of *Ciliata mustela*. *Journal of Fish Biology*, **12**, 213-220.

Blenkhorn, A. 1978. Eel and elver fishing on the River Severn. *Water Space*, **14** (Summer), 8-10.

Boetius, I., & Boetius, J. 1989. Ascending elvers, *Anguilla anguilla*, from five European localities. Analyses of pigmentation stages, condition, chemical composition and energy reserves. *Dana*, **7**, 1-12.

Boulenger, G.A. 1906. Zoology: Fishes. In: History of Somerset Volume I ed. by W. Page 54-56 London, Constable (Victoria History of the Counties of England).

Bowers, A.N. & Naylor, E. 1964. Occurrence of *Atherina boyeri* Risso in Britain. *Nature, London*, **202**, 318.

Brander, K. 1977. The assessment of Irish Sea and Bristol Channel fisheries. ICES C.M. Paper Report. No.CM 1977/F:26.

Bristol University, Department of Extra-Mural Studies. 1975. The Severn Barrage: its possible implications. *Bulletin of the Estuarine and Brackish-water Sciences Association*, **11**, p. 8-11 and 14.

Butterworth, J., Lester, P. & Nickless, G. 1972. Distribution of heavy metals in the Severn Estuary. *Marine Pollution Bulletin*, **3** (7), 72-74.

Churchward, A.S. & Hunt, P.C. 1977. The exploitation of eel stocks in the Severn basin. Proceedings of the 8th British Coarse Fish Conference, 69-85.

Claridge, P.N., & Gardner, D.C. 1977. The biology of the northern rockling, *Ciliata septentrionalis*, in the Severn estuary and Bristol Channel. *Journal of the Marine Biological Association of the United Kingdom*, **57**, 839-848.

Claridge, P.N., & Gardner, D.C. 1978. Growth and movements of the twaite shad, *Alosa fallax* (Lacepede), in the Severn estuary. *Journal of Fish Biology*, **12**, 203-211.

Claridge, P.N., Hardisty, M.W., Potter, I.C., & Williams, C.V. 1985. Abundance, life history and ligulosis in the gobies (Teleostei) of the inner Severn Estuary. *Journal of the Marine Biological Association of the United Kingdom*, **65**, 951-968.

Claridge, P.N., & Potter, I.C. 1983. Movements, abundance, age composition and growth of bass, *Dicentrarchus labrax*, in the Severn estuary and inner Bristol Channel. *Journal of the Marine Biological Association of the United Kingdom*, **63**, 871-879.

Claridge, P.N. & Potter, I. C. 1984. Abundance, movements and size of gadoids (teleostei) in the Severn Estuary. *Journal of the Marine Biological Association of the United Kingdom*, **64**, 771-790.

Claridge, P.N. & Potter, I.C. 1985. Distribution, abundance and size composition of mullet populations in the Severn Estuary and Bristol Channel. *Journal of the Marine Biological Association of the United Kingdom*, **65**, 325-335.

Claridge, P.N. & Potter, I.C. 1987. Size composition and seasonal changes in abundance of juvenile sole, *Solea solea*, in the Severn Estuary and inner Bristol Channel. *Journal of the Marine Biological Association of the United Kingdom*, **67**, 561-569.

Claridge, P.N., Potter, I.C. & Hardisty, M.W., 1986. Seasonal changes in movements, abundance, size composition and diversity of the fish fauna of the Severn Estuary. *Journal of the Marine Biological Association of the United Kingdom*, **66**, 229-258.

Clerck, R de. 1974. A note on the spawning season of soles in the Irish Sea, Bristol Channel and southern Bight. International Council for the Exploration of the Sea (C.M. Papers and Reports). F31. 4p.

Davies, J. 1991. Benthic marine ecosystems in Great Britain: a review of current knowledge. Western Channela nd Bristol Channel and approaches. (MNCR coastal sectors 8 and 9). Nature Conservancy Council, CSD Report No. 1173. MNCR Review Report MNCR/OR/009.

Day, F. 1890. Notes on the fish and fisheries of the Severn. *Proceedings of the Cotswold Naturalists Field Club*, **9**, 202-219.

Day, F. 1897. On the fishes of Weston-super-Mare. *Proceedings of the Zoological Society of London*, **48**, 642-763.

Department of Energy. 1977. Tidal power barrages in the Severn Estuary: recent evidence of their feasibility. iv, 19p. London, H.M.S.O., Energy Paper no. 23.

Hardisty, M.W. & Badsha, K.S. 1986. Seasonal abundance, growth, feeding and age composition of flounder (*Platichthys flesus* (L.)) populations of the Severn Estuary and Bristol Channel. *International Journal of Environmental Studies*, **27**, 89-114.

Hardisty, M.W. & Huggins, R.J. 1973. Lamprey growth as a possible indication of biological conditions in the Bristol Channel. *Nature, London*, **243**, 229-231.

Hardisty, M.W., & Huggins, R.J. 1975. A survey of the fish populations of the middle Severn estuary based on power station sampling. *International Journal of Environmental Studies*, **7**, 227-242.

Hardisty, M.W., Huggins, R.J., Kartar, S. & Sainsbury, M. 1974. Ecological implications of heavy metal in fish from the Severn Estuary. *Marine Pollution Bulletin*, **5**, 12-15.

Hardisty, M.W., Kartar, S., & Sainsbury, M. 1974. Dietary habits and heavy metal levels in fish from the Severn estuary. *Marine Pollution Bulletin*, **5**, 61-63.

Henderson, P.A. & Holmes, R.H.A., 1985. The effect on fish populations of impingement on the screens of Hinkley point 'A' and 'B' cooling water intakes. 17p. CEGB, UK, TPRD/L/2911/N85.

Henderson, P.A., & Holmes, R.H.A. 1989. Whiting migration in the Bristol Channel: a predator-prey relationship. *Journal of Fish Biology*, **34**, 409-416.

Henderson, P.A. & Holmes, R.H.A. 1990. Notable long term population stability in the short-lived fish *Liparis liparis* (L.). *National River Research Report.* ESTD/L10134/R89.

Henderson, P.A. & Holmes, R.H.A. 1990. Population stability over a ten year period in the short-lived fish *liparis Liparis* (L.) *Journal of Fish Biology*, **37**, 605-615.

Henderson, P.A., Holmes, R.H.A., & Bamber, R.N. 1984. The species of fish and arthropods captured during cooling-water extraction by power stations in the Bristol Channel and Severn estuary 1980-1984. *Laboratory Note. Central Electricity Research Laboratories*, No. TRPD/L/2694/N84, [12p.].

Holmes, R.H.A., & Henderson, P.A. 1990. High fish recruitment in the Severn Estuary: the effect of a warm year? *Journal of Fish Biology*, **36**(6), 961-963.

Horwood, J.W., & Walker, M.G. 1990. Determinacy of fecundity in sole (*Solea solea*) from the Bristol Channel. *Journal of the Marine Biological Association of the United Kingdom*, **70**(4), 803-813.

Holbrook, A. 1991. The Severn Barrage: a bibliography 1909-1990. University of Bath.

Hydraulics Research Station. 1978. Tidal power from the Severn Estuary. Report No. 20.

Kartar, S., Hardisty, M.W., Huggins, R.J., & Sainsbury, M. 1974. Ecological implications of heavy metals in fish from the Severn Estuary. *Marine Pollution Bulletin*, **5**, 12-15.

Kartar, S.B. & Sainsbury, M. 1977. Uptake of zinc, lead and cadmium by young whiting in the Severn Estuary. *Marine Pollution Bulletin*, **8**, 164-166.

Kelley, D. 1979. Bass populations and movements on the west coast of the UK. *Journal of the Marine Biological Association of the United Kingdom*, **59**, 889-936.

Kennedy, C.R. 1981. The occurrence of *Eubothrium fragile* (Cestoda: Pseudophyllidae) in twaite shad, *Alosa fallax* (Lacepede) in the River Severn. *Journal of Fish Biology*, **19**, 171-177.

Little, C., Wilson, R.S., Hinton, R.G. & Morritt, D. 1985. Ecology of the upper Severn estuary. A report funded by grants from the Nature Conservancy Council, the Severn Tidal Power Group and the British Ecological Society. 210p. Bristol, University of Bristol. Department of Zoology.

Lloyd, A.J. 1941. Studies on the biology of the Bristol Channel. V. The marine fish fauna of the southern shores of the Bristol Channel. *Proceedings of the Bristol Naturalists Society*, 9 (Series 4), 202-230.

Lloyd, A.J. 1944. Studies on the biology of the Bristol Channel IX. A survey of the fishing industry at Weston-super-Mare during the winter of 1940-41. *Proceedings of the Bristol Naturalists' Society*, **9** (Series 4), 316-327.

McCleave, J.D. 1980. Swimming performance of European eel (*Anguilla anguilla* L.) elvers. *Journal of Fish Biology*, **16**, 445-452.

Matthews, L.H. 1933. The seafish and fisheries of the Bristol district. *Proceedings of the Bristol Naturalists' Society*, **7**, 442-462.

Matthews, L.H. 1943. Studies on the biology of the Bristol Channel XIV. Elvers in the Severn. *Proceedings of the Bristol Naturalist's Society*, **9**, (Series 4), 400-405.

Mettam, C. 1982. Tidal power from the Severn Estuary an essay review. *Nature in Wales*, **1** (1), 50-61.

Mettam, C. 1979. Faunal changes in the Severn Estuary over several decades. *Marine Pollution Bulletin*, **10**, 133-136.

Millichamp, R.I. & Staite, R.M. 1975. Fisheries Considerations p. 78-87. In: Shaw, T.L. (ed.). 1975. An environmental appraisal of the Severn Barrage. 115p. University of Bristol.

Millichamp, R.I. & Staite, E.M. 1980. Fisheries considerations p. 175-184. In: Shaw, T.L. (ed.). 1980. An environmental appraisal of tidal power stations with particular reference to the Severn Barrage.

Milner, N.J. 1971. Studies on bass populations. *Bios*, **5**, 98-107.

Milner, N.J. 1979. Zinc concentrations in juvenile flatfish. *Journal of the Marine Biological Association of the United Kingdom*, **59**, 761-775.

Mitchell, R., Probert, P.K., McKirdy, A.P., & Doody, J.P. 1981. Severn tidal power: nature conservation. Report commissioned by the United Kingdom Atomic Energy Authority, acting on behalf of the Secretary of State for Energy, and submitted in partial fulfilment of agreement number E/5A/CON/4006/51/056. [37p.]. Nature Conservancy Council.

Moore, J.W. & Moore, I.A. 1976. The basis of food selection insome estuarine fishes. Flounder *Platichthys flesus* (L.) in the Severn Estuary. *Journal of Fish Biology*, **9**, 139-156.

Moore, J.W. & Moore, I.A. 1976. The basis of food selection in some estuarine fishes. Eels, *Anguilla anguillla* (L.), whiting, *Merlanguis merlangus* (L.), sprat, *sprattus sprattus* (L.), and stickleback, *Gasterosteus aculeatus* (L.). *Journal of Fish Biology*, **9**, 375-390.

Natural Environment Research Council. 1972. The Severn Estuary and the Bristol Channel. *Natural Environment Research Council, Publication Series C*, No. 9. 19p.

Owens, M. 1984. Severn Estuary - an appraisal of water quality. *Marine Pollution Bulletin*, **15**, 41-47.

Palmer, C.J. & Culley, M.B. 1983. Aspects of the biology of the sandsmelt *Atherina boyeri* Risso, 1810. (Teleostei: Atherinidae) at Oldbury-upon-Severn, Gloucestershire, England. *Estuarine and Coastal Shelf Science*, **16**, 163-173.

Palmer, M., & Probert, P.K. 1981. Natural environment of the Severn estuary and Bristol Channel area. A bibliography prepared as part of a contract research programme for the Department of Energy (Agreement No. E/5A/CON/4006/51/056). 47p. Nature Conservancy Council. (NCC Bibliography Series No. 4).

Potter, I.C. & Claridge, P.N. 1985. Seasonal catches, size and meristic data for sprat *Sprattus sprattus* in the Severn Estuary. *Journal of the Marine Biological Association of the United Kingdom*, **65**, 667-675.

Potter, I.C., Claridge, P.N., & Warwick, R.M. 1986. Consistency of seasonal changes in an estuarine fish assemblage. *Marine Ecology Progress Series*, **32**, 217-228.

Potter, I.C., Gardner, D.C. & Claridge, P.N. 1988. Age composition, growth, movements, meristics and parasites of the whiting *Merlangius merlangus* in the Severn Estuary. *Journal of the Marine Biological Association of the United Kingdom*, **68**, 295-313.

Potter, I.C., & Hilliard, R.W. 1987. A proposal for the functional and phylogenetic significance of differences in the dentition of lampreys (Agnatha: Petromyzontiformes). *Journal of Zoology, London*, **212**, 713-737.

Potter, I.C. & Huggins, R.J. 1973. Observations on the morphology, behaviour and salinity tolerance of downstream migrating river lampreys (*Lampetra fluviatilis*). *Journal of Zoology*, **169**, 365-379.

Russell, F.S. 1980. On the distribution of postlarval fish in the Bristol Channel. *Bulletin of Marine Ecology*, **8**, 283-290.

Severn Tidal Power Group, 1989. Severn Barrage project detailed report. Volume 4. Ecological Studies, landscape, and nature conservation. (ETSU TID 4060-P4).

Shaw, T.L. 1987. The Severn Barrage. p 1-7. In: The Nautical Institute. Conference Barrages and coastal technology. 148p. The Nautical Institute.

Shackley, S.E. & King, P.E. 1977. The reproductive cycle and its control, frequency of spawning and fecundity in *Blennius pholis* L. *Journal of Experimental Marine Biology and Ecology*, **30**, 73-83

Smyth, J. 1639. Lives of the Berkeleys in the county of Gloucester. Edited by Sir John Maclean, 1883-85. Gloucester.

Swain, A. 1982. The migrations of salmon (*Salmo salar* L.) from three rivers entering the Severn estuary. *Journal du Conseil Permanent International pour l'Exploration de la Mer*, **40**, 76-80.

Titmus, G., Claridge, P.N. & Potter, I.C. 1978. Growth and abundance of O-group herrings *Clupea harengus* L. *Linnaen Society Zoological Journal*, **64**, 251-260.

Table 16.1 The Fishes of the Severn Estuary

Lampetra fluviatilis
Petromyzon marinus
Cetorhinus maximus
Scyliorhinus canicula
Scyliorhinus stellaris
Galeorhinus galeus
Squalus acanthias
Squatina squatina
Raja batis
Raja clavata
Raja montagui
Raja undulata
Acipenser sturio
Anguilla anguilla
Conger conger
Alosa alosa
Alosa fallax
Clupea harengus
Sardina pilchardus
Sprattus sprattus
Engraulis encrasicholus
Salmo salar
Salmo trutta
Argentina sphyraena
Maurolicus muelleri
Lophius piscatorius
Ciliata mustela
Ciliata septentrionalis
Gadus morhua
Gaidropsarus vulgaris
Melanogrammus aeglefinus
Merlangius merlangus
Micromesistius poutassou
Molva molva
Phycis blennoides
Pollachius pollachius
Pollachius virens
Raniceps raninus
Trisopterus esmarkii
Trisopterus luscus
Trisopterus minutus
Merluccius merluccius
Atherina boyeri
Atherina presbyter
Zeus faber
Capros aper
Gasterosteus aculeatus
Pungitius pungitius
Spinachia spinachia
Entelurus aequoreus
Nerophis lumbriciformis
Nerophis ophidion
Syngnathus acus
Syngnathus rostellatus
Syngnathus typhle
Aspitrigla cuculus
Eutrigla gurnardus
Trigla lucerna
Trigloporus lastoviza
Myoxocephalus scorpius
Taurulus bubalis
Agonus cataphractus
Cyclopterus lumpus
Liparis liparis
Liparis montagui
Dicentrarchus labrax
Polyprion americanus
Trachurus trachurus
Spondyliosoma cantharus
Argyrosomus regius
Mullus surmuletus
Chelon labrosus
Liza ramada
Centrolabrus exoletus
Crenilabrus melops
Ctenolabrus rupestris
Labrus bergylta
Labrus mixtus
Echiichthys vipera
Coryphoblennius galerita
Parablennius gattorugine
Pholis gunnellus
Ammodytes tobianus
Gymnammodytes semisquamatus
Hyperoplus lanceolatus
Callionymus lyra
Callionymus reticulatus
Aphia minuta
Buenia jeffreysii
Crystallogobius linearis
Gobius niger
Gobius paganellus
Gobiusculus flavescens
Lebetus sp.
Pomatoschistus lozanoi
Pomatoschistus microps
Pomatoschistus minutus
Scomber scombrus
Xiphias gladius
Lepidorhombus whiffiagonis
Psetta maxima
Scophthalmus rhombus
Zeugopterus punctatus
Arnoglossus laterna
Glyptocephalus cynoglossus
Limanda limanda
Platichthys flesus
Pleuronectes platessa
Solea solea
Balistes carolinensis
Mola mola

Potts & Swaby (1993)

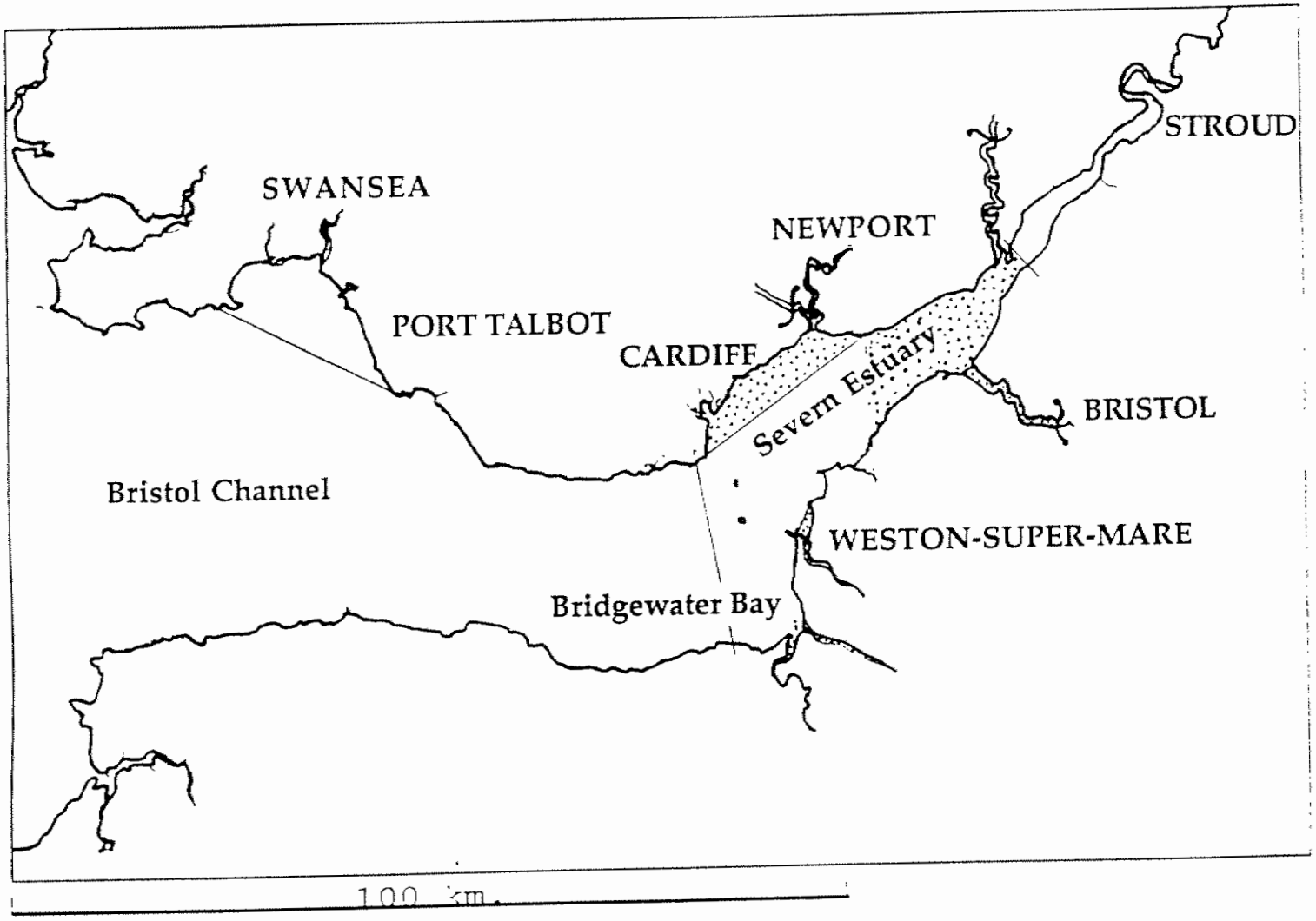

Figure 16.1 Map of the Severn Estuary showing the upper and lower extent of the estuary, the upper tidal limits, and the water quality according to the 1991 NRA Survey. Water quality is characterised as "good" [unmarked], "fair" [medium stipple], "poor" [dense stipple], and "bad" [solid infill].

17

THE FISHES of THE DEE ESTUARY

THE FISHES OF THE DEE ESTUARY

17.1 Introduction

The River Dee enters Liverpool Bay a few miles west of the Mersey forming a funnel shaped estuary running SSE-NNW. Chester once stood at the estuary head, but is now 15 km. from this point. The Dee Estuary covers an area of approximately 16,101 ha has a tidal channel of 37 km. It has been heavily modified by human activities and the river is confined to a narrow meandering channel. The whole estuary is an SSSI and is an important site for waders and wildfowl (Stopford, 1951; Pugh-Thomas, 1975; NCCNW, 1978).

17.2 Estuarine habitats

There are extensive areas of mudflats, sand banks and saltmarsh which support an abundant and varied flora and fauna. The habitats and fauna of the Dee Estuary are very similar to the Ribble and Mersey , although it is situated at a higher tidal level that the other two and therefore does not have the sand typical of an outer estuary. Of interest is the presence of highly saline pools on the south marsh of the Dee. The estuary bed is continually changing and has been for more than 200 years (Stopford, 1951; Popham, 1966; NCCNW, 1978)

17.3 Fish lists

The only published fish list for the Dee is by Ellison & Chubb (1962), although fishes have been recorded as part of other surveys (Stopford, 1951; NCCNW, 1978), and as single species studies (Johnstone, 1910; Johnston, 1981; Miller, 1975). Records exist at the University of Bangor, Menai Bridge Laboratory. The study of the fish life is "unfortunately far from complete" (NCCNW, 1978) and this situation has not yet been remedied satisfactorily. However, studies of the commercial fishes of Liverpool Bay have been carried out by Holden (1975) and are of some relevance to the Dee. The number of fish species recorded from the Dee Estuary is 21 (see Table 17.1).

17.4 Fish and fisheries

The Dee Estuary supports very important fish stocks. The main species being the flounder (*Platichthys flesus*), bass (*Dicentrarchus labrax*), and two grey mullet species (*Chelon labrosus* and *Liza ramada*). It also has some significance as a nursery ground for the mullet, which sometimes occur in large numbers during the summer, and the outer estuary acts as a nursery for flatfish (NCCNW, 1978). Flounders (*Platichthys flesus*) spawn close to the coast in spring in about 2.5 to 4.0 m. of water. The young migrate upstream feeding near the bottom in shallow water, and are able to reach considerable distances up freshwater tributaries. The migrations and movements of the flounder in the Dee have been studied by Johnson (1981).

Plaice (*Pleuronectes platessa*) spawn offshore, and eggs and larvae drift until they metamorphose and move to inshore waters, including the outer parts of the Ribble, Mersey and Dee. The sole (*Solea solea*) follows a similar pattern to plaice, but young sole prefer muddy to sandy bottoms. Whiting (*Merlangius merlangus*) spawn in a similar area to plaice and sole with young appearing inshore up to one year old, including the Dee (NCCNW, 1978).

The bass (*Dicentrarchus labrax*) fishery has increased significantly, when previously it was considered an angler's fish.

Salmon (*Salmo salar*) and sea trout (*Salmo trutta*) are commercially and recreationally important in the River Dee, and most records of fish in the Dee relate to these two species. The patterns of movement of salmon and sea trout are not well known in the Dee, but net catches indicate more fish follow channels on the Welsh side. Salmon enter the Dee throughout the year, but usually peak runs occur in early spring, mid summer and early autumn. Since the war (1945) catches have declined and are believed to be caused by netting at sea, an outbreak of ulcerative dermal necrosis (UDN), increased poaching, loss of spawning areas owing to major construction and major land drainage work Adult salmon are caught, by trammel and drift net, in small numbers in the Dee from late January. The main migration upstream begins in late May to June until the autumn. Spawning takes place October to December in tributaries. During the summer large numbers of salmon and grilse (one year at sea) are found in the tidal waters. In May and June thousands of smolts descend to the sea. Sea trout (*S. trutta*) have a similar life history, but are present in smaller numbers than salmon in the Dee (NNCW, 1978; Rice & Putwain, 1987).

The age-structure and lifespan of the common goby (*Pomatoschistus microps*) was determined with specimens taken from the Dee (Miller, 1975).

Eels (*Anguilla anguilla*) are also present and form an important food for birds (NCCNW, 1978). Other fish recorded from the Dee Estuary include whitebait, sandeels (*Ammodytes sp.*), Sprats (*Sprattus sprattus*), the smelt (*Osmerus eperlanus*), pipefish (*Syngnathus sp.*), three-spined stickleback (*Gasterosteus aculeatus*), and ten spined stickleback (*Pungitius pungitius*). The twaite shad (*Alosa fallax*) has also been recorded above Queensferry and Shotton (NCCNW, 1978)

The fishes in the Dee are also commercially important in the outer estuaries and coastal area , and schools of small fish are important for fish eating birds. The commercial fishes of Liverpool Bay are examined by Holden, 1975. (NCCNW, 1978).

17.5 Impacts

Land reclamation began in 1732 and continued until 1860 in the upper reaches. The river being confined to the Welsh side. This land is now used for crop growing and human habitation and marshes for sheep and cattle grazing (NCCNW, 1978)

Once an important **port**, its economic significance has declined since the end of the 19th Century (NCCNW, 1978)

Navigational channels have been cut by dredging (Pugh-Thomas, 1975)

Human disturbance is considered to be greatest impact (NCCNW, 1978)

Discharges of **domestic sewage** are generally not damaging although there have been cases of diseased fish reported during hot summers when non-ionised ammonia (which is toxic to fishes) forms and when algal blooms are likely to affect the pH of the water (Rice & Putwain, 1987).

Trace metals have been found to be high in the Dee. (Rice & Putwain, 1987; Burt *et al.*, 1992)

Recreational activities are mainly sailing (NCCNW, 1978), but there is also a wide range of other water sports.

The Dee is one of the most favoured for a **freshwater impoundment scheme** (Pugh-Thomas, 1975), and which would destroy the estuarine habitats.

17.6 Water Quality

The Dee Estuary was studied to determine the quality of water in reservoirs that would have water pumped from the upper part of the estuary, but it was suggested that algal blooms would affect the reservoirs (Corlett, 1972)

The Dee Estuary is essentially a 'clean' river, able to support a salmon fishery (NRA, 1991) (see Figure 17.1). The open shape of the estuary enables rapid mixing thus avoiding chronic pollution problems (Rice & Putwain, 1987). Nutrient levels have remained high for a number of years (Edmondson & Watts, 1992).

17.7 Summary

The Dee is an open estuary with relatively little pollution. It has a rich fish fauna which is likely to reflect a strong marine influence. The salmonids provide important commercial and recreational fisheries in conjunction with fisheries for a number of other estuarine species.

17.8 Recommendations

It is recommended that:

1. a survey is carried out on the salmon and sea trout populations of the river Dee to identify the extent to which commercial pressures are affecting populations.

2. a detailed survey is carried out on the non commercial fishes of the Dee.

3. a study is carried out on the feeding relationship between waders and wildfowl, estuarine fishes and estuarine invertebrates.

17.9 References

Alabaster, J.S. 1990. The temperature requirements of adult Atlantic salmon, *Salmo salar* L. during their upstream migration in the River Dee. *Journal of Fish Biology*, **37**, 659-661.

Buxton, N.E. 1978. The Dee Estuary Water Storage Scheme feasibility study. Vol. 1. A general report outlining the methods used in the study and the findings arising from the investigations. Vol. 2. A detailed account of the ornithological studies. Vol. 3. A detailed account of the benthic invertebrate studies. Vol. 4. A bibliography of ecological work on the Dee estuary. Reading, Department of the Environment, Central Water Planning Unit.

Corlett, J. 1972. Water quality in estuarine barrage reservoirs with special reference to Morecambe Bay. 2: Biology. Algal growth, nutrients, brief comments on Dee and Wash Schemes. *Water Treatment Exam.*, **21**, 119-26.

Ellison, N.F. & Chubb, J.C. 1962. The marine and freshwater fish of Lancashire and Cheshire. *Lancashire and Cheshire Fauna Society*, **41**, 1-34.

Holden, M. 1975. The commercial fish of Liverpool Bay. In: Liverpool Bay - An assessment of its present knowledge. Liverpool Bay Study Group. *Natural Environment Research Council Series C*, No. 14.

Johnstone, J. 1910. The fishes of Cheshire and Liverpool Bay. The Vertebrate Fauna of Cheshire and Liverpool Bay, 2, 17-168.

Johnston, P.M. 1981. Migrations and movements of the flounder, *Platichthys flesus* (L.), affecting distribution of the species in the River Dee, North Wales. In: Proceedings of the Second British Freshwater Fisheries Conference, Liverpool, 13-15 April 1981, p. 129-142. University of Liverpool.

Miller, P.J. 1975. Age structure and lifespan in the common goby, *Pomatoschistus microps*. *Journal of Zoology, London*, **177**, 425-448.

Nature Conservancy Council North Wales. 1978. Dee estuary research review. [131p.] Bangor, Nature Conservancy Council, North Wales Region.

Parsons, J.N. 1978. A study of the ecology of the flounder, *Platichthys flesus*, in the Dee Estuary. 148p. PhD Thesis, University of Salford.

Popham, E.J. 1966. The littoral fauna of the Ribble Estuary, Lancashire, England. *Oikos*, **17**, 19-32.

Pugh-Thomas, M. 1975. The conservation of estuaries with particular reference to research on the Dee estuary. *Landscape Research News*, **1** (10), 12-13.

Rice, K.A., & Putwain, P.D. (compliers) 1987. The Dee and Mersey estuaries: environmental background. 42p. London: Shell UK.

Stopford, S. 1951. An ecological survey of the Cheshire foreshore of the Dee estuary. *Journal of Animal Ecology*, **20**, 103-122.

Table 17.1 The Fishes of the Dee Estuary

Acipenser sturio
Anguilla anguilla
Alosa alosa
Alosa fallax
Sprattus sprattus
Salmo salar
Salmo trutta
Osmerus eperlanus
Merlangius merlangus
Gasterosteus aculeatus
Pungitius pungitius
Syngnathus sp.
Dicentrarchus labrax
Mugil sp.
Liza aurata
Ammodytes sp.
Pomatoschistus microps
Pomatoschistus minutus
Platichthys flesus
Pleuronectes platessa
Solea solea

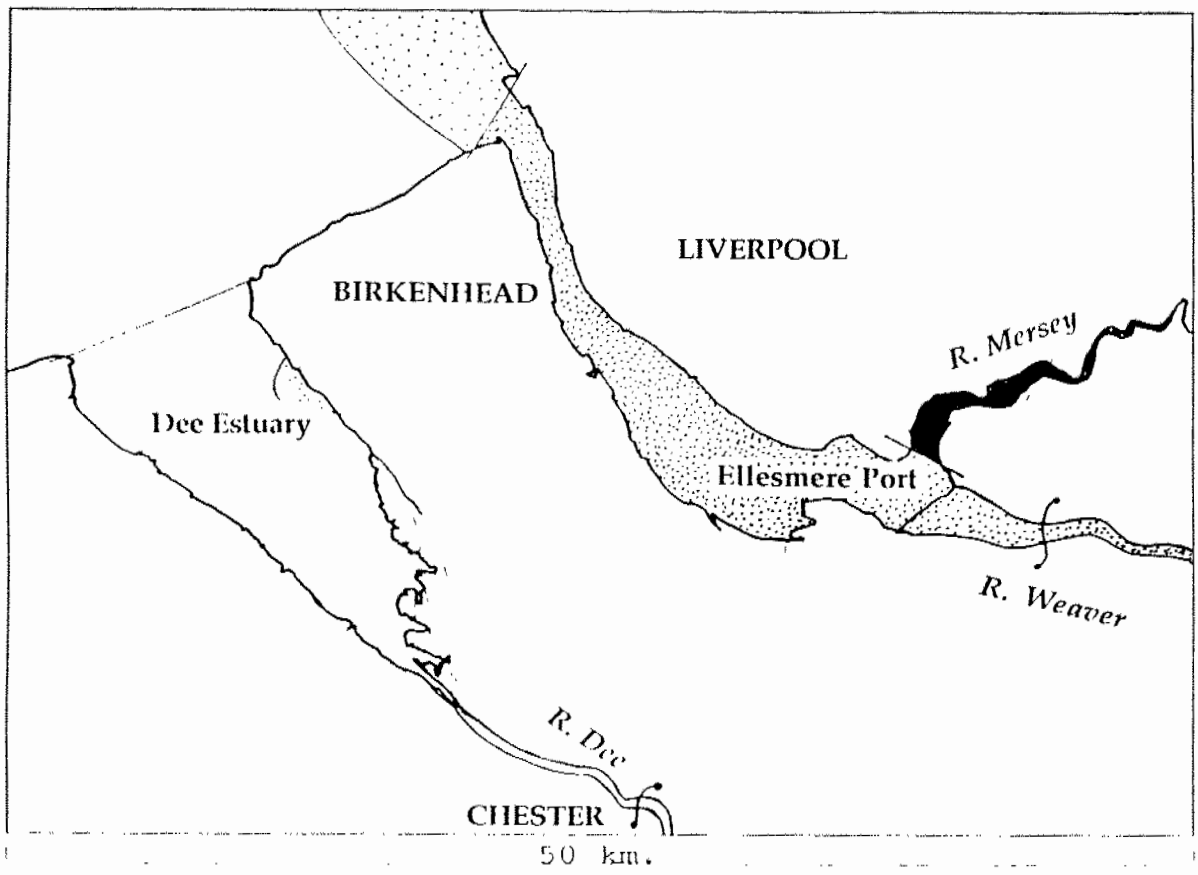

Figure 17.1 Map of the Dee Estuary showing the upper and lower extent of the estuary, the upper tidal limits, and the water quality according to the 1991 NRA Survey. Water quality is characterised as "good" [unmarked], "fair" [medium stipple], "poor" [dense stipple], and "bad" [solid infill].