London’s Ecology - How clean is the Thames?

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16 October 2006

Many claims are made about the cleanliness Thames is, including regularly used statements such as “The cleanest metropolitan estuary in the world” or “The Thames supports over 120 species of fish”. With dolphins, seals and whales appearing in the estuary, plus a seemingly wide diversity of other mammals and birds now occurring within its environs, these statements seem well founded. However, we also see recent press reports of 1000s of fish killed by sewage in the estuary and watch the dirty brown water pass through London. So, what is the story? How clean is the Thames?

To address this I’ll be taking a historical context, looking at how the modern Thames ecology and environment compares with past conditions – how clean is it now? I’ll look at how the estuary was impacted over the last 150 years, how pollution and recovery fluctuated and why during some time periods the Thames was almost dead. I’ll then look more closely at trends in water quality since the 1970s – how have things improved or deteriorated since the big clean up? Finally, I’ll assess the main current problems facing the estuary and what the future may hold.

HISTORICAL CONTEXT: BACKGROUND

The Thames Estuary stretches approximately 110 km (69 miles) from Teddington Weir to the North Sea beyond Southend, passing of course through central London. The development and growth of London and its population provided a major potential impact on the estuarine system, particularly in the 19th century, when London increased in size to be the largest city in the world at that time (4.7 million people), and again in the 20th century when the Greater London area evolved.

The development of London has resulted in the population utilising the Thames Estuary in several ways that have impacted the ecosystem.

Navigation. To enable boats to navigate further upstream (e.g. to Reading), a series of weirs and locks were constructed on the freshwater Thames – by 1809 there were already 26. This impacted the movement of migratory fish, well before any real pollution problems. For example, the Thames salmon declined in numbers during the early 19th century and were virtually absent by 1820 due to returning adults being unable to reach upstream spawning grounds.

Bankside development. The expansion of London resulted in the loss of much of the Thames’s surrounding marshes, with very little natural systems still existing. Construction of embankments and other structures resulted in the gradual narrowing of the estuary, particularly in central London, where it is now about 1/3 of its natural width. Consequently, the estuary is now deeper and faster flowing than in its natural condition. Further major removal of bankside habitat and estuary foreshore resulted from successive flood defence construction along much of the estuary. Drinking water supply. The Thames has always provided London’s drinking water. Originally this was taken from the tidal reaches in the upper estuary, distributed by the original water companies that first appeared in the 1600s. Nowadays, water is abstracted for potable supply from points in the lower freshwater Thames above Teddington, mainly fed into the large reservoirs to the west of London. This use of the estuary conflicted dramatically with the next historical use…

Waste Disposal.In medieval times, human (and other) waste was discharged straight into the street, into tributaries (e.g. the “lost” river Fleet) and in some areas storage tanks. In the 19th Century, public health reforms resulted in periodic flushing of streets and tributaries, washing the waste into the Thames, from where water was still being taken for drinking purposes. The consequence was large outbreaks of disease, particularly Cholera in the mid 1800s.

HISTORICAL CONTEXT: C19th POLLUTION AND REHABILITATION

This procedure also had a major impact on the water quality and health of the estuarine ecosystem. Whilst we do not have any data, it is clear the estuary was exceptionally polluted due to records of the smell produced. This reached a head in the hot weather of 1858 when the smell from the estuary was so bad that Parliament could not sit – this became known as the year of the “Great Stink”. Clearly something had to be done to alleviate the situation.

The engineer Joseph Bazelgette was commissioned to develop a plan to clean up the Thames in London. The result was an astonishing series of 161 km of gravity-powered interceptor sewers constructed in the 1860s to take all the discharges east of London to two major outfalls: Crossness on the south bank and Beckton on the north bank. This alleviated the problem in London, but created a new major pollution zone in the mid-estuary around Barking, where all of London’s waste was now discharged. Here extensive “mud” banks formed, the smell from the river prevented anyone walking along it and a major fishery, one of the largest in the country employing 1320 men, was destroyed. In 1878 a paddle steamer, the Princess Alice, collided with a cargo ship (Bywell Castle) and sank with 800 people on board. Over 600 died, with common rumours that many were overcome by the fumes from the polluted water before they could reach shore.

To solve the problem at the Barking outfalls, large settlement ponds were built to collect solid material before the water waste was discharged. The resulting sludge was dumped by boat in the outer estuary, a procedure that continued until 1998. The water quality of the estuary dramatically improved, with increased levels of dissolved oxygen that were now being measured. Fish populations, such as sprat, returned and people even bathed in the Thames off the Tower of London.

HISTORICAL CONTEXT: 20th CENTURY POLLUTION AND RECOVERY

Following WWI there was a massive increase in the population of London, but conditions in the Thames remained reasonably healthy due to the overcapacity built into the sewage system by the Victorians. However, bombing of WW2 saw major damage to London’s infrastructure, and once again waste began to enter directly into the Thames. Few funds were available for sewage system reconstruction and with the large population the system could not cope. By the 1950s the estuary was probably in the worst state it had ever been. Surveys in this decade recorded oxygen levels at below 5% for 52 km and a 20 km stretch of the Thames around the two main outfalls having no measurable oxygen in the water! No fish populations were present for a 69 km stretch from Kew to Gravesend. The Thames was basically lifeless for most of its upper length, save for some hardy worms in the mud banks.

The 1960s saw economic recovery and investment in sewage infrastructure, coupled with an emerging environmental awareness. Major full treatment sewage works were constructed, small works closed and most waste diverted to the site of the two original outfalls at Beckton and Crossness. By 1976 all sewage was being fully treated and over the 1960s-1970s dramatic increases in water quality, as judged by oxygen levels, was apparent. Recovery was monitored using the returning fish community, documenting when new species returned to live in the Thames. A steady increase in species was recorded, including a lot of odd “one off” species such stingray, angler fish, seahorses and even goldfish! These are included in the total fish species (>120) ever recorded in the Thames but this is not the same as saying the Thames supports over 120 fish species! By the end of the 1970s the estuary was considered rehabilitated.

WHERE ARE WE NOW? TRENDS IN WATER QUALITY SINCE REHABILITATION

Over the last 20-30 years, the Environment Agency have been monitoring water quality in the Thames, so these data provide an opportunity to look at trends since the late 1970s. What has happened in the Thames? Has it got any better? Any worse? Stayed the same? How clean is the Thames now compared with the 1970s when it was considered recovered? I have analysed these data to look for trends in key variables that affect water quality of the estuary.

Suspended solids. The Kinks called the Thames “dirty old river” in their 1960s song Waterloo Sunset. Indeed the Thames was pretty grim in the 1960s, but the dirty look does not necessarily mean polluted. All estuaries are naturally muddy places and many big rivers, such as the Amazon, are brown. This is because the water carries lots of silt and clay particles – even a pristine Thames would still be muddy! However, these suspended solids can be enhanced by poor sewage outfalls and other particulates. Trends in solids in the Thames since 1977 show that the overall levels dropped in the late 1980s and have remained lower, and constant, ever since. The Thames is therefore less muddy now than it was 30 years ago – perhaps a good sign that now we have mainly natural mud, not elevated with other substances!

Heavy Metals. Elements such as copper, mercury, cadmium and zinc are key potential pollutants from industry (and other activities) that can have toxic effects on organisms. Since 1980, there has been a dramatic, exponential decrease in the concentration of metals in Thames estuary water samples, indicating clear clean up of these particular problematic pollutants. Pesticides. The run-off from agricultural land into rivers and estuaries carries with it any pesticides that have been put on the land. By their very nature, pesticides can be fatal to organisms, so are a real concern in aquatic systems. Even in small doses they can have major effects, for example influencing the hormonal or endocrine systems of organisms. However, samples from the Thames show that levels of pesticides in the water have been decreasing dramatically since records began in 1988 – some of the worst pesticides are now barely measurable. Again the Thames is much cleaner in terms of pesticides than even 20 years ago.

Fertilizers. Also carried down rivers to the estuary from agricultural land, increased fertilizers in aquatic systems can boost nutrient supplies for plants and, potentially, cause eutrophication and algal blooms – key signs of a polluted system. Both major nutrients, nitrogen and phosphorus, have shown significant declines in Thames estuary water since 1977 and 1988 respectively. Dissolved oxygen. As seen from the history of the Thames, oxygen in the water is a key measure of the health of the system. Organic material (e.g. sewage) is broken down by bacteria which use up the oxygen in the water – too much material, such as in the 1950s, and all oxygen is used up. Trends in average oxygen levels in the Thames have varied up and down since 1977, but worryingly the last 4 years have seen some of the lowest levels of oxygen in the estuary since this time, equivalent to the mid-1970s when the Thames was still recovering. This trend is even more evident when the minimum recorded levels of oxygen are considered, with a continued decrease in the minimum oxygen levels since the late 1980s.

Fish community. Samples taken from West Thurrock power station up to 1992 showed a continued increase in the diversity of fish species in the Thames, indicating that recovery was continuing for at least 12 years after the late 1970s. More recently, key migratory fish have been reappearing in the Thames, such as Sea Lamprey and Twaite Shad, both indicating that the Thames is in a state fit for even the most fussy fish.

So, when we look at most measures of pollution, the Thames is probably in the cleanest state it has been in living memory, if not more. However, recent years have seen a decrease in the oxygen levels, and more dramatic minimum levels reached? Why might this be?

CURRENT AND FUTURE PROBLEMS IN THE THAMES ESTUARY

To understand why we are have continued problems with low oxygen events in the Thames, we have to look at three main factors that combine to influence how much oxygen is in the system and result in the one major remaining pollution issue on the Thames.

Temperature. The speed of bacterial breakdown is affected by how warm the water is – the warmer the water, the faster the bacteria work and the quicker oxygen is removed. Therefore, low oxygen events are more common in summer than winter. However, there is a longer term problem – probably due to climate change, the estuary is gradually getting warmer. Average temperatures of the water in the estuary have shown a significant increase of 2.7 °C over the last 30 years – a very quick rate of increase. Warmer waters mean more likelihood of oxygen removal if high levels of organic material enter the estuary.

Dissolved oxygen sags in summer. In recent years, London has experience some severe storms in summer (in particular 2004). The sewer systems cannot cope with the increased volume of water, so (like your bath) water overflows through drains designed for such events, but the mix of sewage, debris and storm water goes straight into the estuary through a series of storm drains known as Combined Sewer

Overflows (CSOs). Most of these storms occur in very warm weather, when the Thames is also warm, so this sudden influx of waste soon results in oxygen being depleted from the water. Additionally, as the waste is completely untreated, these storm events cause increases in pathogens in the water (as measured by E. coli counts) and thus increased health risk. The dramatic removal of oxygen in affected stretches of the Thames results in dissolved oxygen sags and are the cause of the occasional large fish kills as witnessed in 2004. To counter this, the Thames Bubbler was constructed – a mobile oxygen generation plant that pumps oxygen into critical areas to try and keep levels just high enough to sustain life. This treats the symptoms rather than the cause; to rectify the situation completely a massive new interceptor system is needed to collect these sporadic CSO discharges and move them to the sewage treatment works. The severity of oxygen sags is increased by a further factor. Drought conditions. From all accounts, the SE of England is becoming dried, yet the population are using more and more water. Trends show that rates of water abstraction from the Thames have increased continually since 1900 and, if anything, have been accelerating in recent years. The consequence is that there is less water in the freshwater Thames to enter the estuary – indeed in 1976 flow ceased altogether. The long term trend shows a slow decline in the flows of the river Thames, due to a combination of reduced rainfall and increased abstraction. This reduction in water entering the estuary affects the ecology – more marine species can move further up the estuary for example. However, it has knock-on effects for the development of oxygen sags as low flows in summer mean less water to flush away the output from the CSOs, so the sewer material remains longer in one place and has a greater chance of removing the oxygen from the estuary.

One further problem faces the Thames unconnected with storm impacts and dissolved oxygen.

Sea Level Rise. The large increase in flood defence construction around the Thames was partly due to the 1953 floods of Canvey Island, where a storm surge pushed sea water levels over the top of the banks, flooding the town with significant loss of life. However, since this time, sea levels have been increasing in the Thames due to the impact of global warming and post-glacial tilting (Britain still recovering from the weight of the last ice age). The rate of sea level rise is increasing, and projected to increase even more dramatically, with the consequence that London will potentially be flooded within the next 100 years, perhaps less, if nothing is done. There is a need to plan now, but what should be done? Do nothing and evacuate most of London? Turn London into the new Venice? Probably not options. Build even higher walls all around the Thames and new Thames Barriers than can cope with the elevated sea levels? Develop managed retreats – large areas in the outer estuary we allow to flood? But where? Build an enormous barrier along the front of the estuary from Essex to Kent to stop the tide getting into the whole estuary? But what would the Thames estuary be then?

Whatever we do, the estuary and its environment will be affected. A special project (Thames Estuary 2100) has been set up to come up with the best options.

To keep up with what is happening in the Thames, or join in local interest groups, visit the Thames Estuary Partnership's Thames Web site at:http://www.thamesweb.com/

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