Eel Management plans for the United Kingdom
Anglian River Basin District

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1. **Introduction**

This Eel Management Plan for the Anglian River Basin District (RBD) aims to describe the current status of eel populations, assess compliance with the target set out in Council Regulation No 1100/2007 and detail management measures to increase silver eel escapement. This will contribute to the recovery of the stock of European eel.

2 **Description of the Anglian River Basin District**

2.1 **The Anglian River Basin District**

The Anglian RBD comprises several large catchments in the northern and south western parts of the RBD, e.g. the Nene, Welland, Witham, Great Ouse and Ely Ouse, as well as multiple smaller catchments throughout, including the Yare, Bure, Waveney, Gipping, Blackwater, Chelmer, Stour and Colne, which are in the south eastern part of the RBD. The rivers all drain to the North Sea along the east coast of England, between the Thames estuary to the south, and the Humber estuary to the north.

The numbers and areas of four main water body types, as defined by the Water Framework Directive, are shown in Table 2.1 (Defra, 2005).

<table>
<thead>
<tr>
<th>Water body type</th>
<th>Number present</th>
<th>Length/Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivers with catchments greater than 10 km²</td>
<td>752</td>
<td>6,426 km</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11541.2 (ha)</td>
</tr>
<tr>
<td>Lakes with areas greater than 0.5 km²</td>
<td>36</td>
<td>44 km²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9537.5 (ha)</td>
</tr>
<tr>
<td>Transitional water bodies</td>
<td>19</td>
<td>332 km²</td>
</tr>
<tr>
<td>Coastal water bodies</td>
<td>13</td>
<td>2,286 km²</td>
</tr>
</tbody>
</table>

**Table 2.1 Water bodies in the Anglian RBD.**

The major river catchments within the RBD: the Witham, Welland, Nene and Great Ouse, drain catchments of approximately 2010 km², 1656 km², 2363 km², and 8587 km² respectively. All of these catchments drain into The Wash, between Boston, to the west, and Kings Lynn, to the east (Figure 2.1). Much of this area is fertile low-lying agricultural land, and substantial impact has been made on the rivers by land drainage and intensive farming practices.
Figure 2.1  The Anglian RBD.

The multitude of smaller catchments within the counties of Norfolk, Suffolk and Essex, typically drain a catchment area of less than 500 km$^2$ each, with the exception of the Colne (534 km$^2$), Chelmer (665 km$^2$) and Stour (1036 km$^2$). The land use varies throughout the counties and includes forestry, industry, and localised pockets of heavy urbanisation, although overall, agriculture dominates.

The RBD has a diverse range of river types, from chalk streams such as the Wensum, to slow flowing, highly eutrophic waters such as the lower reaches of the Great Ouse and Stour.

The Anglian WFD RBD receives the least rainfall of the 11 RBDs in England and Wales, and is considered the driest of the Environment Agency Regions (Environment Agency, 2006).

Prior to the late 1930s, large parts of the RBD were subjected to several hundred years of fenland drainage to create habitable and agricultural land. After the 1940s large areas were drained to optimise the amount of land available for intensive agriculture. This period led to the wide-scale loss of aquatic habitats. However the river systems were still relatively open to migrating eels, except those rivers with
mills and locks. In response to the east coast floods in 1953, the emphasis of management changed from drainage to flood defence. This continues to be the leading factor to the present day. This emphasis on flood defence has lead to the closing off of river systems to migratory species with the construction of large-scale tidal defence schemes, tidal flap valves and locks. This has meant that the tidal limit, which used to influence rivers far inland, has been restricted to estuary level.

Due to the combination of the semi-arid nature of the Anglian RBD and the high water demands for human use and agriculture, there is a high level of water management and monitoring (requiring in-stream structures, weirs etc). This, combined with historic milling and land drainage means that the majority of rivers within the RBD are highly modified and regulated systems. River engineering structures such as dams, weirs, sluices and locks, barrages and flap valves may act as migration barriers to fish, thus having the potential to seriously affect eel populations in upstream freshwater habitats (Knights and White, 1998).

A preliminary assessment has been carried out on the major obstructions to fish migration within the Anglian RBD (Figure 2.2) through a combination of local Fisheries, Flood Defence and Hydrology experience, and field-based evaluation. These barriers have been graded individually in terms of the likelihood of eel passage.

![Figure 2.2 Distribution of obstructions in the Anglian RBD. Barriers are graded in terms of accessibility for eels.](image-url)
More work is required to assess the potential impact of all barriers within the RBD. In addition to using physical barrier attributes, there should be greater utilisation of existing long-term data sets in assessing possible barrier effect. An example of this approach was used in Essex (A. Piper, pers. comm.), where analysis was undertaken using data from 12 routine electric fishing survey sites upstream and 12 downstream of Bures Mill on the River Stour (Figure 2.3) to assess the potential impact of the mill on the eel populations. This mill is considered the most significant barrier to eel migration on the Stour. Upstream densities of eel were significantly lower than those downstream ($P < 0.0005$).

This analysis was based on minimum density estimates provided by multi-species electric fishing. The use of better quality density data from eel-specific electric fishing will allow a more quantitative assessment of the effect of this and other barriers. Such analyses are planned for the first phase of this and other EMPs, where eel-specific surveys and barriers coincide.

![Figure 2.3 Mean density of eels >99mm (Ind./100m$^2$) (+/-95% C.I.) above and below Bures Mill, a possible barrier to migration, on the River Stour (n=12)](image)

2.2 Current eel population

There is very little commercial catch return information for the Anglian RBD. There has never been a commercial glass eel fishery in operation within the region. The adult eel fishery was relatively strong in the past, although few records were kept. Currently, due to reduced numbers of eels, fishing is patchy and at best a subsistence activity for many of the fishermen. Therefore the present catch return information does not provide the quantity, quality or coverage of information required to adequately assess the population. However reported catch data may be used with limited confidence to highlight trends. The Anglian Region relies almost
solely on monitoring data to assess the status of the eel population. The long-term data sets from several rivers have proved invaluable due to the consistent manner in which they have been monitored.

2.2.1 Glass eel recruitment

Due to the absence of any commercial glass eel/elver catch data for the region, two monitoring traps have been installed on the lower freshwater/saltwater limit; on the Chelmer and Blackwater Canal at Beeleigh in Essex and on the River Stour at Flatford in Suffolk (Plates 1 & 2). These traps are run annually between April and July and provide an indication of the strength of the glass eel run for that year.

Plates 1 & 2 Glass eel/elver trap on the Chelmer and Blackwater canal at Beeleigh in Essex, and on the River Stour at Flatford in Suffolk.

The glass eel and elver data for these traps are shown for 2002 to 2006 for Beeleigh (Figure 2.4) and for 2002 to 2005 for Flatford (Figure 2.5).
Figure 2.4  Glass eel catches from Environment Agency monitoring trap, Beeleigh on the River Chelmer, Essex from 2002 – 2006

The trap was not run continuously at Flatford mill in 2006 due to low flows. On the occasions the trap could be run, no glass eels or elvers were caught and none were observed on the weir as in previous years.

Figure 2.5  Glass eel catches from Environment Agency monitoring trap at Flatford on the River Stour, Suffolk from 2002 – 2005 (trap was not run in 2006).

Although it is not possible to calculate trends in glass eel runs over such a short time, it is worth noting that, apart from moderate increases in catch in 2006 for Beeleigh and in 2004 for Flatford, there have been very low numbers of glass eels/elvers.
caught since an initial peak in catch for both traps in 2002. These traps only provide semi-quantitative data, but indicate that relatively low numbers of glass eels are returning to the East Coast. This is probably due, in part, to the distance of the Anglian coast from the Continental Shelf, tending to produce low densities of eels within rivers on the North Sea coast. It is important to continue this type of monitoring to enable long term trends to be observed.

2.2.2 Yellow Eel Distribution

The Environment Agency Fisheries Monitoring Programme samples yellow eel in the Anglian RBD at 383 sites on a six year rolling programme (i.e. around 63 sites are sampled each year). An additional 136 sites are sampled on an annual basis (i.e. all sites sampled every year) and a further 43 sites are sampled as part of the Water Framework Directive programme of monitoring (i.e. sampled at least every 6 years). These 562 sites are sampled by multi-species surveys and may therefore underestimate the true density of eel (Knights et al., 2001). Survey data from these sites from 2001 to 2005 were available at the time the analyses were carried out for this report.

The distribution of eels throughout the Anglian RBD is shown in Figure 2.6. Although at first glance the upper reaches of many catchments appear to support few eel populations, the only systems that appear to have obvious cut-off points for eels in their upper most reaches are the Great Ouse, Nene and possibly the Welland. The absence of eels in these areas could be due to a number of factors and would need further investigation before any clear conclusions could be drawn, although density dependent dispersal and barrier effects are likely to play a role.
Figure 2.6  Distribution of eel in the Anglian RBD (2001-05 survey data combined).
2.2.3 Abundance and Biomass in the Anglian RBD

Data on yellow eel populations are available from consistent long-term data sets for the majority of Essex and Suffolk catchments, in the south eastern part of the RBD. These data sets are typically derived from quantitative multi-species electric fishing surveys, carried out as part of the Environment Agency’s routine monitoring programme. The catch data were analysed using Carle and Strub (1978) catch depletion population statistics, providing mean density (nos./100m²) and biomass (grams/100m²) for each site, with associated confidence limits for each individual site and for the entire reach.

The density and biomass data for eel in each catchment were plotted against time to identify any possible trends. Statistical significance was then attributed to each trend using a product moment correlation with the assumption that the relationship is linear. The trees (Appendix A1-4) are a pictorial representation of the general trends for each of the main catchments and their principal tributaries. The trees allow the large amount of graphical and statistical information produced in the analyses of each catchment, to be summarised into one figure.

The overall trends for the Chelmer, Blackwater, Stour and Colne suggest a decline in both density and biomass of eel, a statistically significant decline in density for the Chelmer and Stour, and in biomass for the Stour and Colne. Although there are increases in both density and biomass on some of the tributaries of these catchments, the only statistically significant increase is of the density of eels in the Roman River in the Colne catchment. This may be due to its direct and relatively barrier-free connectivity with the estuary.

Data sets available for other catchments in the RBD are far less reliable, due to inconsistent survey sites and periods, and often non-quantitative survey methods. In light of this, it has only been possible to determine general trends for these other catchments. No statistical significance can be assigned to these trends (Appendix A5 and A6).

The general trend for eels within these catchments is downwards for both density and biomass, and is similar to the trends observed in the statistically tested catchments. The only catchments which showed exception to this are the Welland, where both density and biomass increased between 2000 and 2005, and the Stiffkey in Norfolk (1988-2000), where biomass increased but density decreased (Appendix A5 and A6).

2.2.4 Population size structure in the Anglian RBD

Information on eel length can be a useful way of examining trends, providing that standard sampling methods and sites are used for the comparisons (since different methods and habitats result in different size selectivities). For example, an increasing average length over time suggests that recruitment of small eels is declining and the population is ‘maturing’. Based on the surveys of eel populations in nine catchments throughout England and Wales, conducted by Kings College London (Bark et al.,
2007), typically, eels less than 150 mm long tend to be ≤5 years old, sexually undifferentiated eels. Those 150 mm to 450 mm are sexually undifferentiated eels, males or immature females. Eels longer than 450 mm are almost all female.

Inconsistent recording of length data for eels has resulted in very limited long-term data sets, although in recent years lengths have been recorded more consistently. Therefore, it is only possible to give a snapshot of the current status for four of the catchments in the RBD where accurate data has been recorded in the Blackwater, Chelmer, Stour and Colne (Figure 2.7). These, in the absence of other data will have to act as an index for the RBD.

![Figure 2.7 Proportion of large female eels (>45cm) as compared to ‘other’ (<45cm) and mean length (cm) (+/- 1 S.E.) captured in surveys on selected Anglian rivers.](image)

The data demonstrate a clear dominance of larger (female) eels in the Blackwater, Chelmer and Stour catchments. The smaller ‘other’ group dominates in the Colne, but the mean size is similar to those for the other rivers. However, using this approach, it is not possible to determine the proportion of young or small female eels from males in the ‘other’ category, i.e. less than 45cm in length, and therefore to establish a true sex ratio for the site ‘population’. Continued accurate recording of length data in routine and eel-specific surveys throughout the RBD will help to form robust data sets from which trends in size structure may be assessed. This may be crucial in formulating management decisions on, for example, stocking or fishing pressure.

A number of netting surveys have been conducted in parts of the RBD. It is not possible, at present, to use such data to derive quantitative estimates of eel...
populations, but research is underway to test and develop such methods (A. Walker, Cefas, pers. comm.).

2.2.5 Estimation of silver eel output.

Silver eel estimation was made using the data collected at 17 sites on the River Colne. The probability model estimated silver eel output for the Colne to be 0.6 kg/ha. The total estimated output of silver eel from the Anglian RBD is 12.6 t / yr.

2.3 The Fishery

2.3.1 Introduction

Licences to fish for eels and glass eels commercially are issued by the Environment Agency on a Regional basis. The Anglian RBD is located within the Anglian Environment Agency Region but does not encompass the entire Region.

The Anglian RBD, due to the size of the coastline, has always had a strong coastal and estuarine fishery, including a commercial eel fishery. The number of licenses issued from 2005 to 2007 for Anglian Region is shown in Table 2.2. It should be noted that:

- The number of licences issued is not the same as the number of fishermen. One fisherman is able to set many traps and fykes.

- The number of licences issued does not equal the number of fishermen within the Anglian RBD. Some of these licence holders will fish outside of the RBD.

<table>
<thead>
<tr>
<th>Fishing Method</th>
<th>Licensed instruments</th>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elver Dip Nets</td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gloucester Wing Nets</td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Small Wingless Traps</td>
<td></td>
<td></td>
<td>264</td>
<td>212</td>
<td>273</td>
</tr>
<tr>
<td>Winged Traps/Fykes</td>
<td></td>
<td></td>
<td>594</td>
<td>556</td>
<td>477</td>
</tr>
<tr>
<td>Fixed Traps</td>
<td></td>
<td></td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2.2 Number of eel licences issued by Environment Agency Anglian Region, 2005 to 2007.

2.3.2 The elver (glass eel) fishery

There have been no elver catches reported in the Anglian RBD in the period 2001 to 2005, for which data were available.
2.3.3 Yellow and silver eel fisheries

Recreational Fishery

Recreational angling for eels within Anglian RBD is generally carried out by specialist anglers, although historically eels often comprised a substantial component of fishing match weights. The vast majority of eels are captured whilst anglers are fishing for other coarse and game species and, in these circumstances, eel are usually returned to the water.

In 2007 a total of 214,240 fishing licences were sold in the Environment Agency Anglian Region. This encompasses the Anglian RBD. A survey of anglers carried out in the 1990s indicated that the average distance travelled to fish by a licence holder was 20 miles and that 35% fished predominantly on rivers (National Rivers Authority, 1995). Assuming that each angler catches one eel per season (Appendix 4) then approximately 50,000 eels are caught by recreational anglers each year. The level of post release mortality has not been assessed.

Commercial Fishery

The yellow eel fisheries in the Anglian RBD operate throughout most of the year with 2005 records showing catches from March through to November. Silver eel fisheries in the Region predominantly catch from September to December.

A total catch of 13,065 kg of yellow eels and 6,659 kg of silver eels were reported in 2005 and a breakdown of the weights caught at different locations within the RBD is shown in Table 2.3. The fishery operates in coastal waters, rivers and stillwaters across the RBD. A number of unknown or unidentified Anglian sites are included in the catch data but because catches are reported for EA Regions, it is not known whether these sites are within the Anglian RBD. The total declared catch data in the Anglian RBD and these unknown sites from 2005 to 2007 is shown in Table 2.4. For each fishery the catch as a % of the total declared catch for England and Wales is also shown. These catches have declined over the reporting period.
### Table 2.3

Yellow and silver eel commercial catch returns in 2005 for different locations across the Anglian RBD.

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Water Type</th>
<th>Water Name</th>
<th>Yellow Eel Catch (kg)</th>
<th>Silver Eel Catch (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglian Region</td>
<td>Coast/Estuary</td>
<td>Unknown Anglian Coast</td>
<td>924</td>
<td>525</td>
</tr>
<tr>
<td>Anglian Region</td>
<td>River</td>
<td>Unknown Anglian River</td>
<td>5,791</td>
<td>3,198</td>
</tr>
<tr>
<td>Anglian Region</td>
<td>Stillwater</td>
<td>Abberton &amp; Hanningfield</td>
<td>1,253</td>
<td>0</td>
</tr>
<tr>
<td>Anglian Region</td>
<td>Stillwater</td>
<td>Heybridge Hall Lake</td>
<td>152</td>
<td>0</td>
</tr>
<tr>
<td>Anglian Region</td>
<td>Stillwater</td>
<td>Tending Hundred</td>
<td>13</td>
<td>24</td>
</tr>
<tr>
<td>Anglian Region</td>
<td>Stillwater</td>
<td>Unknown Anglian Stillwater</td>
<td>250</td>
<td>313</td>
</tr>
<tr>
<td>Blackwater (Anglian Region)</td>
<td>River</td>
<td>River Blackwater</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Bure</td>
<td>River</td>
<td>River Ant</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>Bure</td>
<td>River</td>
<td>River Bure</td>
<td>668</td>
<td>23</td>
</tr>
<tr>
<td>Great Ouse</td>
<td>River</td>
<td>River Great Ouse</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Great Ouse</td>
<td>River</td>
<td>River Ouzel</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Great Ouse</td>
<td>River</td>
<td>Well Creek</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>Lark</td>
<td>River</td>
<td>River Lark</td>
<td>15</td>
<td>35</td>
</tr>
<tr>
<td>Little Ouse</td>
<td>River</td>
<td>Little Ouse</td>
<td>85</td>
<td>25</td>
</tr>
<tr>
<td>Nene</td>
<td>River</td>
<td>River Nene</td>
<td>3,687</td>
<td>2,451</td>
</tr>
<tr>
<td>Stour (Anglian Region)</td>
<td>River</td>
<td>River Orwell</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Stour (Anglian Region)</td>
<td>River</td>
<td>River Stour</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>Yare</td>
<td>River</td>
<td>River Yare</td>
<td>0</td>
<td>56</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>13,065</strong></td>
<td><strong>6,660</strong></td>
</tr>
</tbody>
</table>

**Table 2.4**  
Annual catch returns for eel for 2005 to 2007 for the Anglian RBD and their % of total declared catch in England and Wales.

<table>
<thead>
<tr>
<th>Year</th>
<th>Yellow eel catch (kg)</th>
<th>% of total declared catch in E &amp; W</th>
<th>Silver eel catch (kg)</th>
<th>% of total declared catch in E &amp; W</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>13,065</td>
<td>46</td>
<td>6,659</td>
<td>47</td>
</tr>
<tr>
<td>2006</td>
<td>6,082</td>
<td>25</td>
<td>2,417</td>
<td>22</td>
</tr>
<tr>
<td>2007</td>
<td>3,709</td>
<td>25</td>
<td>194</td>
<td>5</td>
</tr>
</tbody>
</table>

The distribution of catches through the months in 2005 to 2007 is shown in Figures 2.8 and 2.9.
2.4 Silver eel escapement

The Anglian RBD is complex, comprising many different catchments. Eel data for these catchments are, on the whole, patchy and inconsistent. Therefore, two index rivers with consistent data-sets and experiencing the least amount of anthropogenic influence were chosen to represent the best case scenario for the RBD. These were the Blackwater and Colne catchments.
The probability model estimated silver eel output for the Colne to be 0.6 kg/ha. A comparison with other rivers (Table 1; in Eel Management Plan overview for England and Wales) would suggest that it is failing the 40% escapement target.

The Reference Condition Model (RCM) approach has also been used to assess compliance (Appendix 3). However, as ‘historic’ density data are available for these two rivers for 1987, these data have been used to set the reference conditions, rather than applying the RCM based on the reference data from 12 rivers across England and Wales. We acknowledge that there is a large degree of uncertainty associated with this approach and these data.

Present-day eel production is represented by the 2005 survey data for the Blackwater, and the 2002 data for the Colne. All data have been fitted to exponential curves (Figures 2.12 and 2.13).

![Graph showing eel densities](image)

**Figure 2.10** Predicted and observed eel densities for the Blackwater catchment. Predicted (dashed line) is based on 1987 data for the catchment, considered as reference conditions, and observed (solid line) is based on 2005 electric fishing records for 23 sites extrapolated to the estuary mouth.

By calculating the area beneath both the observed and predicted curves, it can be shown that the population of eels in the Blackwater catchment in 2005 is 54% of the modelled reference conditions, i.e. in 2005, the Blackwater catchment produced 54% of its potential density of eels.
Figure 2.11  Predicted and observed eel densities for the Colne catchment. Predicted is based on 1987 data for the catchment, considered as reference conditions, and observed is based on 2002 electric fishing records for 26 sites extrapolated to the estuary mouth.

By calculating the area beneath both the observed and predicted curves, it is estimated that the number of eels in the Colne catchment in 2002 is 82% of the modelled reference conditions, i.e. in 2002, the Colne catchment produced 82% of its potential density of eels.

The rivers further north in the RBD, specifically those emptying into the Wash, have much longer estuaries and a longer history of impoundment, and as such, it is thought that a greater proportion of the eel stock are held in the estuary and consequently, the curves of decline in density in the freshwater part of the productive habitat would be much steeper. However, there is little data available to quantify this theory and we need more robust data on yellow eel density and distributions, both in the rivers and estuaries. It is clear that more data needs to be collected from river systems across the Anglian RBD. Ideally, eel-specific surveys should be carried out so that a more accurate assessment can be made of the status of eel populations in the RBD.

The same electric fishing survey data were plotted as a time series of eel densities in the Colne and Blackwater. In addition data from the Stour were plotted and these are all presented in Figure 2.12. They suggest an overall decline in the density of yellow eels in these systems since the mid-eighties.
2.5 Eel mortality and available habitat

2.5.1 Eel Habitat

The rivers and waterways throughout the Anglian RBD have been highly modified over the last several centuries, and particularly in the latter half of the last century for the purpose of flood defence. This has lead to a restriction or loss of migratory routes and thus access to habitat, coupled with further complete loss of habitat resulting from land drainage practices to optimise the land available for agriculture.

Neither the data nor the models are available, at present, with which to quantify the impact of such loss of potential eel habitat. An increased coverage of high quality, eel-specific electric fishing surveys will be implemented as part of this plan, and the Environment Agency are funding the further development of spatial eel production models which will be used to assess the contribution of these lost habitats to potential production.

2.5.2 Barriers to migration

The Anglian RBD is the driest region in the country and suffers with low flow problems across the region. These are greatly exacerbated by the high pressure posed by human consumption and agricultural irrigation, with many of the systems being artificially managed with cross-river pumping regimes in order to transport water to supply drinking water reservoirs. The net result of this is that many structures such as weirs and sluices pose an even greater obstacle to eel migration than their sheer physicality, due to the lack of water running over their surfaces at certain times of the year. This is coupled with the lack of water being allowed to pass out of these systems into the estuary.
2.5.3  **Entrainment and Hydropower**

There is currently little information on the level of eel entrainment within the Anglian RBD. However, it is likely that the numerous pumping stations across the RBD are responsible for mortalities of adult yellow eels and migrating silver eels.

In the Anglian RBD there is only one hydropower installation recorded by the British Hydropower Association (www.british-hydro.org). The mortality of eel at this installation has not been estimated.

2.5.4  **Predation**

The Anglian RBD comprised 17% of the freshwater and lake habitat in England and Wales (A Walker, CEFAS, pers. com.), and may expect to constitute 17% of eel consumption by cormorants: 5 to 7.4 tonnes (Appendix 6). With the average length of eel taken at 40-55 cm (Carss and Marzano 2005) or 150-200g this suggests 25,000 to 50,000 eels consumed by cormorants within the Anglian RBD each year.

Predation of eel by other species is considered in Section 1.4.4 of the Overview.

2.5.5  **Water quality and pollution**

The Anglian RBD, although a rural and predominantly farming region is also densely populated around many urban centres, with localised heavy industry. This largely reflects the close proximity of much of the RBD to London, combined with a long coastline that lends to import and export via shipping. Intensive agriculture is thought to apply the greatest pressure on water quality within the RBD.

Due to improvements in the regulation and practices of industry and waste-water treatment etc, the water quality within Anglian RBD is good. The General Quality Assessment (GQA: Overview Section 1.4.2.2) results for Anglian Region show that chemical quality (dissolved oxygen, biochemical oxygen demand and ammonia) for 90% of rivers was good or fair, with 47% classified as good to very good. (Figure 2.13).

Biological quality (macro-invertebrates) showed 98% of the rivers were classed as good or fair quality with 79% classified as good or very good (Figure 2.14).
Nutrient (phosphate and nitrate) GQA status in the region for 2005 was high. These nutrient levels are the most likely parameter to be directly influenced by human activities. The results showed that 70% of the rivers in the Anglian RBD have high concentrations of nitrate, with 31% of these classified as very high. Also 77% of Anglian RBD rivers are classified as having “high” concentrations of phosphate, 9% of these are considered as “excessively” high. Many of the rivers and standing water bodies within the Anglian RBD are considered eutrophic (Environment Agency, 2004).
The seasonal low flows typically experienced across much of the RBD exacerbate the effects of any water quality problems, or pollution events, both in relation to reduced dilution capacity and general oxygen levels within the system.

Although pollutants such as PCBs and DDT were more common historically, they may still be present today in the waterbodies of the Anglian RBD due to the high levels of industry and agriculture in parts the region. These pollutants are cumulative and may affect fertility, cause deformities in offspring or increase stress levels making the eels more susceptible to disease (Morgan, 2002). The pollutants may directly cause mortality when the toxins are released from body fat reserves during the long migration to the Sargasso Sea to spawn (Wood, 2006).

2.5.6 Pathogens and parasites

Anguillicoloides (Anguillicola) crassus was first recorded in Britain in 1987, and in 1995 the National Rivers Authority (NRA) carried out investigations aimed at determining the status of A.crassus in eel stocks throughout the Anglian Region. The investigation took samples from a total of 44 still and flowing waters thought to best represent all the major catchments within the region, and from sites of particular local interest. The results showed all catchments within the region to be affected with the exception of the River Colne in Essex, which has subsequently been shown to have A. crassus in eel stocks (R.Wright, Environment Agency, pers. comm.). The results from the 1995 investigation were compared to those of a similar investigation carried out in 1989 and a strong increase in both the percentages of eels infected and the number of catchments affected by A. crassus was demonstrated (NRA, 1996).

3 Restocking

3.1 Need for restocking

The European Eel Regulation allows for the use of captured eels and glass eels for restocking areas of habitat in order to increase silver eel escapement and work towards meeting the compliance target.

Results from the application of the RCM approach to data from the Blackwater and Colne catchments suggests that the Anglian RBD is meeting the silver eel escapement target. This being the case, there is no need for any consideration of broad-scale eel restocking in this EMP. In the future, when more high quality data are available for the RBD, which may suggest that the escapement target is not being met, then stocking does become a viable management option.

3.2 Past restocking

There are no records of applications to stock any life stage of eels within the Anglian RBD. However a regulated system of applying to stock is a relatively recent requirement and pre-regulation or illegal post-regulation stocking may well have been conducted. The only historic stocking activity known to have been conducted
within the Anglian RBD was that of glass eels into the River Wensum between the 1920s and 1940s (G. Gamble, Environment Agency, pers. comm.). There is very little information available on numbers or the frequency of stocking, but it is thought that the owner of Lenwade Mill conducted this annually on a small scale. He stocked glass eels, believed to have originated from the Severn catchment, into the river above the mill and operated a fixed eel rack from the mill.

### 3.3 Stocking study in the Anglian RBD

A stocking project was carried out in 2008 where 12,000 glass eels were stocked into the upper sections of the River Nene in the Northampton area. It is planned that this project will be continued over a number of years in association with robust monitoring of eel populations. This will help to develop best practice for stocking of glass eel and to assess the impact of stocking on yellow eel populations as well as on silver eel escapement.

### 3.4 Compliance with restocking requirements in the Regulation

This is addressed in Appendix 7.

### 4 Monitoring

In 2008 specific monitoring of yellow eel populations was initiated at ten sites on the Great Ouse catchment in the Anglian RBD.

It is proposed that, from 2009 the following sampling regime is initiated.

- At least two catchments (the Nene and Suffolk Stour) in the RBD to be sampled biennially by eel specific electric fishing at ten sites per catchment (Figure 2.15). Application of these data and eel specific data from the Great Ouse in the Probability model, the RCM and other models will generate better information on compliance with the escapement target.
- Routine electric fishing surveys at 562 sites in the RBD will generate presence/absence, eel length and some population density data that will be incorporated into future models and analysis of the rivers in the RBD.
- Monitoring of glass eel migration at two sites within the RBD (on the Suffolk Stour at Flatford and on the Chelmer & Blackwater Canal at Beeleigh), will generate information on the recruitment of glass eels to the Anglian RBD.
- Monitoring of silver eel migration at one site (at Cotterstock on the Nene) within the RBD, will generate information on escapement of eels from the Anglian RBD.
- The yellow, silver and glass eel fisheries will continue to be monitored through catch returns and the consideration of import and export data.
4.1 Assessment of silver eel escapement

The Anglian RBD has two other sites where silver eel escapement can be measured directly. Dog in a Doublet sluice on the River Nene had an eel pass installed in the mid-nineties following a large eel mortality. Eel passage over this structure can now be monitored. An old eel rack on the Stour at Dedham Mill have recently been restored and monitoring of silver eel escapement is planned to commence in autumn 2008. These two sites together with the site at Cotterstock on the Nene have excellent potential for providing data on escapement, although an assessment of trap efficiency will be required.

Ongoing work to improve the assessment of compliance with the silver eel escapement target is described in Section 1.6.1 of the Overview.

4.2 Price monitoring system

This is addressed in Appendix 8.

4.3 Catch and effort sampling system

This is addressed in Appendix 9.

4.4 Origin and traceability of live eels
5 Measures

The Probability Model currently suggests that the Anglian RBD is failing the 40% silver eel escapement target, although there is very little confidence in this assessment. Therefore, we are implementing measures to collect more robust data on eel production and continuing to develop modelling approaches to improve the compliance assessments. The most likely causes of why the RBD is failing are:

- Barriers to migration for all life stages
- Wide-scale loss of habitat
- Entrainment and impingement

Therefore, we are implementing a series of measures to enhance eel production in the RBD. Potential measures are discussed below, followed by details of those measures that have been implemented recently, and those which will be implemented in the first year, and remainder of the first phase, of this EMP.

5.1 Measures to meet Escapement Objective

Monitoring

There is a large amount of reliable and consistent long-term eel density and biomass data available for Essex and Suffolk rivers, although individual length and weight data have only been collected for the last five years. However eel data for the rest of Anglian RBD are limited.

More extensive monitoring of eel populations across the whole RBD is needed in order to enable greater confidence in the estimation of silver eel escapement. This includes glass eel recruitment into the basin, targeted monitoring of yellow eel populations in freshwater and silver eel escapement. This has been addressed in Section 4 and 4.1 and will be detailed below.

Reduction of the fishery pressure.

Eel fisheries in this RBD are localised and take a relatively high proportion of the estimated silver eel escapement with in some years (2005) the total declared catch equated to the level of escapement (12.6 t). It is realised that the data is limited but there are grounds to reduce fishing pressure within Anglian RBD.

However, it is essential that exploitation is sustainable and it is important that the Environment Agency works closely with the industry to ensure awareness of the eel issue and the need to deliver the 40% escapement target. The information from the eel fishery is of poor quality and, although a new catch return system was imposed in 2005, there still remains a large proportion of the catch that has not been allocated to a river. The quality of data gathered in future years needs to be improved.
Whilst this information is being collected and a better assessment of the eel fishery is made, the fishery should be kept within its existing limits by not allowing the number of instruments to be increased or the range of where they are currently set. This would be as a precaution until more detailed information is gathered on stocks and the fishery. In the northern part of the RBD commercial eel exploitation has been banned on Environment Agency-owned waters.

**Improving access and habitat.**

This is addressed in Section 1.4.2 of the Overview, and detailed below.

**Stocking of glass eel**

This is considered in detail in Section 1.4.5 of the Overview and in Appendix 7.

There is currently no evidence that the Anglian RBD is failing the escapement target, and therefore the requirement for stocking is a low priority. However, the stocking study on the Nene will continue (resources permitting).

**Predator control**

No action will be taken to control predators (see Overview Section 1.4.4).

**5.2 Measures taken 2007 to 2009**

The following measures have recently been implemented or will be implemented before July 2009:

**Monitoring**

- Eel specific monitoring commenced at ten sites in the Great Ouse catchment and ten sites on both the Nene and Suffolk Stour.

- Established two glass eel index sites on the River Stour and the Chelmer & Blackwater Canal. Opportunities to monitor glass eel also exist on the rivers Glen, Welland, Wensum, Yare and great Ouse.

- Installation of camera at the Dog in the Doublet Sluice on the River Nene, to monitor glass and silver eel migration.

- Silver eel trap restored at Cotterstock on the Nene.

- Silver eel trap restored at Dedham Mill on the Stour.

**Improving access and habitat**

- Installation of glass eel passes at a number of sites across the RBD (Table 5.1).
River | Location
--- | ---
Stour | Judas Gap
Stour | Flatford
Stour | Dedham
Blackwater | Langford Mill
Chelmer & Blackwater Canal | Hoe Mill Control Gate
Chelmer & Blackwater Canal | Kings Mill
Chelmer & Blackwater Canal | Sandford Mill
Chelmer & Blackwater Canal | Barnes Mill
Ivel | Tempsford
Welland | Tallington
Welland | Maxey Cut
Welland | Low Locks
Welland | Fulney Lock
Glen | Kate’s Bridge
Lynn | Partney weir
Bain | Coningsby
Great Eau | Saltfleet Sluice

Table 5.1 Sites where glass eel passes have been or are due to be installed

- Identification of barriers to migration where a minor (low cost) project will improve passage of elvers/eels. Prioritisation of sites across the RBD.

- Feasibility study completed and designs produced for eel passage solutions at Hemingford Sluice on the Great Ouse system, Houghton Mill on the River Ivel and at Brownshill on the Great Ouse.

- Feasibility studies completed and prioritisation of major eel passage improvement schemes on the South Forty Foot Drain, Rivers Glen, Nene, Welland, Stour and Dedham Old River.

- Collaboration with University of Southampton on a PhD research project on the behaviour of eels at barriers to migration.

- Feasibility study to identify options for floodplain still waters for improving silver eel escapement.

- Study to identify habitat use in fenland rivers by different life stages of eel to better target future enhancement schemes.

Stocking of glass eel

- Stocking study initiated on the River Nene.
5.3 **Measures to be taken 2009 to 2012**

The following measures are planned to be implemented from July 2009:

**Monitoring**

- Continue to improve quality of data collected on eel populations from 562 multi-species electric fishing survey sites.

- Establish a biennial programme of yellow eel monitoring on at least one further catchment in the RBD by eel specific electric fishing at ten sites.

- Continue to collect and validate data on glass eel recruitment at nine sites across the RBD.

- Continue to collect and validate data on silver eel escapement at three sites across the RBD.

- Investigate safe monitoring methods for yellow eel in wide lowland rivers where water voles are present.

- Installation of a permanent eel pass and trap at Taverham on the River Wensum for recording silver eel migration.

- Trap at Dedham Mill on the Stour to provide silver eel data to feed into CEFAS R&D and to eel PhD at University of Southampton.

- Commercial eel fisheries will continue to be monitored through catch returns and through the assessment of import and export data. Illegal exploitation of yellow eel and glass eel will be targeted by enforcement teams.

- Monitor the effectiveness of novel eel passage solutions.

**Improving access and habitat**

In 2009/2010 it is proposed to install 48 passes in Anglian RBD (Figure 5.1). In addition there will be the:
• Implement eel passage solutions at Hemingford Sluice on the Great Ouse system, Houghton Mill on the River Ivel and at Brownshill on the Great Ouse.

• Installation of simple eel passage solutions at priority sites already identified for minor projects.

• Continue to assess the major obstructions to glass eel migration in the Anglian RBD. A comprehensive action plan will be produced, with a full list of priority sites for major eel passage improvement works.

• The Programme of Measures for the Water Framework Directive will be a good opportunity for improving habitat and access for eel populations. All opportunities should be taken to influence waterbodies for the benefit of eel populations.

**Reducing the impacts of entrainment**

• All abstraction points in the RBD will be assessed for their likely impact on eel populations and appropriate screening recommended.
• All pumping stations in the RBD will be assessed for their likely impact on eel populations and appropriate screening suggested.

• Any applications for hydropower installations in the RBD will be assessed for their likely impact on eel populations and appropriate screening recommended.

Stocking of glass eel

• In addition to the stocking study, further consideration will be given to stocking within the Anglian RBD and a stocking plan for the release of small numbers of glass eels will be produced. This will include pre and post stocking surveys.

Stakeholder engagement

• An Eel Management Plan Implementation Group will be convened comprising representatives of the Environment Agency Area Teams with responsibility for the Anglian RBD. This will make decisions on bidding for limited resources.

All of these actions will be subject to resources being available. The actions proposed in the period from 2009 to 2012 are detailed in Table 5.2. Measures that will have a direct effect on silver eel escapement are qualified in terms of their presumed benefit, where:

- short = <5 years
- medium = 5-15 years
- long = >15 years

Note that only the shortest term is given and that the classification is for the time to effect silver eel escapement and not the time for the measure to be implemented.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Actions to be carried out (subject to resources being available)</th>
<th>Timescale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploitation</td>
<td>• Monitor commercial eel fisheries through catch returns and through the assessment of import and export data.</td>
<td>short</td>
</tr>
<tr>
<td></td>
<td>• Illegal exploitation of yellow eel and glass eels will be targeted by enforcement teams</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Initiate a price monitoring and reporting system for eels less than 12cm long.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Initiate a system to ensure the traceability of all live eels imported or exported from the UK</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• If necessary bring in byelaws to limit fisheries and protect stocks</td>
<td></td>
</tr>
<tr>
<td>Habitat</td>
<td>• Produce maps of available &amp; potentially available eel habitat within the River basin district, identify significant areas for habitat restoration works</td>
<td>medium</td>
</tr>
<tr>
<td></td>
<td>• Use the Environment Agency's consenting of works on rivers and stillwaters and their own works programme to improve eel producing habitat.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Identify waterbodies within the Water Framework Directive Programme of Measures with significant opportunities for improving eel habitat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Identify all surface water abstraction points, pumping stations and hydropower installations within the RBD and quantify their impact on eel populations</td>
<td></td>
</tr>
</tbody>
</table>
Table 5.2 Proposed actions 2009-2012

5.4 Measures beyond 2012 to achieve the Escapement Objective

It is intended that, in the period 2009 to 2012, actions will be reviewed in response to improved information on the effectiveness of the measures identified above.

6 Control and Enforcement

These are addressed in Appendix 12.

7 Modification of Eel Management Plans

EMPs will be updated as and when new data become available. New data will feed into the ICES / EIFAC Eel Working Group country report for the UK and will be reviewed for the next reporting round in 2012.
APPENDIX A  Trends in density and biomass of yellow eel in Essex and Suffolk rivers, sampled by electric fishing.

Appendix A1  Density and Biomass trends for the Chelmer Catchment 1986 – 2004 (n = 57). Arrows indicate direction of trend, with p values showing statistical significance. Red arrows highlight significant negative trends and green arrows highlight significant positive trends. Black arrows indicate a trend but that it was not significant.


Appendix A5

Trends in both density and biomass for the Witham, Ivel, Ouzel and Welland catchments. Arrows indicate direction of trends, although not statistically tested.