Hydroacoustic Survey Report

River Thurne 2005

This report was prepared in draft form by an Environment Agency employee at the time of the data collection. It has been reviewed and prepared for publication by the current Analysis and Reporting Team in 2021. The facts and conclusions are valid as far as can be determined.

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1.0 Introduction

The River Thurne, located in east Norfolk, is a tributary of the River Bure. It flows from its source (between Horsey and Somerton) south-west to its confluence with the River Bure at Thurne. The River Thurne is tidally influenced although the effects are attenuated compared to the larger rivers. The river and interconnected broads are slightly brackish due to the penetration of sea water under the coastal dunes. Saline concentrations are highest at the upstream end (Horsey Mere, Hundred Stream) and decrease towards the River Bure confluence. Navigation continues up-stream as far as West Somerton though only for small craft. The river lies within the Broads Authority Executive area and forms part of the network of rivers and broads that are the Broads National Park. As such, it provides important recreational opportunities to visitors during the summer and for anglers throughout the year. The River Thurne is famous as a pike fishery (once holding the national pike record) and attracts pike anglers from all over the country.

Hydroacoustic surveys were started on this system in 2004 following successful trials in two large main rivers (Yare and Waveney) in 2003. This is the second hydroacoustic survey on the River Thurne.

Surveys start and end at Thurne Mouth, the confluence with the River Bure, and extend to down-stream of West Somerton, dependent upon the extent of macrophyte growth. The survey also encompasses the main navigation channel through Hickling Broad. The overall total survey length is approximately 24km (both ways combined & inc. Hickling).

2.0 Methods

2.1 Hydroacoustics

An echosounder transmits short pulses of sound (known as ‘pings’) through a transducer beneath the boat. The transducer comprises housing containing ceramic plates that are clapped together in a controlled manner to provide the ‘ping’ under water. It is mounted forward of the craft to prevent background ‘noise’ interfering with the signal and the craft is piloted at approximately 3km/h, working along one side of the river and firing the transducer across the river width. The sound waves from these pulses reflect off objects with densities different to the surrounding water, such as fish swim-bladders. The transducer picks up these returning echoes and amplifies and records them onto a laptop.

Specialist software translates the survey data into a series of pictures called echograms that show the echo reflections from fish, as well as other material such as weed, silt and debris. An analyst must measure the size of the water column by drawing a line that cuts off weed and debris at the bottom of the river. This determines water volume and enables density to be calculated. Within this volume, the analyst looks for the strong echoes that denote fish, which are counted, and weak or untypical echoes, which seem not to be fish and are not counted. The minimum size of fish that can be reliably identified is approx. 5cm. Density of fish is reported for each surveyed section as fish per 1000m^3.

The surveys are conducted at night, since fish are more evenly distributed throughout the water column during hours of darkness and can be more easily surveyed. The absence of other boat traffic also helps greatly. Each river is surveyed twice (once travelling upstream and once downstream) and the best quality data set is chosen for analysis and reporting.

2.2 Validation

Validation surveys were carried out in November in local boatyards (Potter Heigham) and dykes where fish were present for over-wintering.

The fish were captured in the surveys by electro-fishing from a boat. The method involves the deployment of an electro-fishing box, powered by a 240v generator. Output is via hand held fibreglass rods, which hold anodes at the extreme end. The circuit is completed via a cathode trailed in the water adjacent to the boat. The resultant current induces galvanotaxis in fish within range, permitting their subsequent capture. Once captured the fish are identified, measured and scale samples taken for subsequent analysis (for age and growth rates).

The results gives an indication of the composition and health of the fish community in the river as a whole, based on the assumption that the boatyard aggregations are representative of the wider population. Over-wintering in boatyards, backwaters and dykes has been described for various coarse fish species including cyprinids, percids and esocids (per obs.; E.A Boatyard Reports; Jordan & Wortley, 1985; Copp, 1997). The presence of various size classes of pike, and their relatively low numerical representation, would suggest that pike may follow/track the prey fish to such locations as opposed to displaying active over-wintering behaviour, since many pike are still caught by anglers on the main river during this time. Match catch data and personal observations also suggest that larger bream and roach generally stay in the river rather than entering boatyards and dykes. Therefore, the validation surveys are thought to under-represent pike and large bream and roach.

3.0 Results

3.1 Hydroacoustic

For clarity of interpretation, the survey data presented are from the up-stream direction run.

The River Thurne was surveyed early September 2005.   Fish density was very variable throughout the system. The majority of survey sections up-stream of Potter Heigham A149 Road Bridge exhibited low densities, typically 0-10 fish/1000m^{-3} (Fig. 1). A pattern of higher fish density was found below this section and also into Hickling Broad navigation channel (Fig. 1).

The largest concentration of elevated densities (>200 fish/1000m^{-3}) were in the navigation channel approaching the Pleasure Boat, Hickling. The highest recorded density was located in the main navigation channel of Hickling Broad, opposite the entrance to Catfield Dyke (447 fish/1000m^{-3}) (Fig. 2).

Overall mean fish density for the River Thurne and Hickling Broad navigation channel was 75.6 fish/1000m^{-3} ($\pm$ S.E. 0.33), a reduction of c.58% from the previous year.

Figure 1. River Thurne fish density distribution (fish/1000m^{-3}), Thurne confluence to Pleasure Boat end of Hickling Broad 2005.

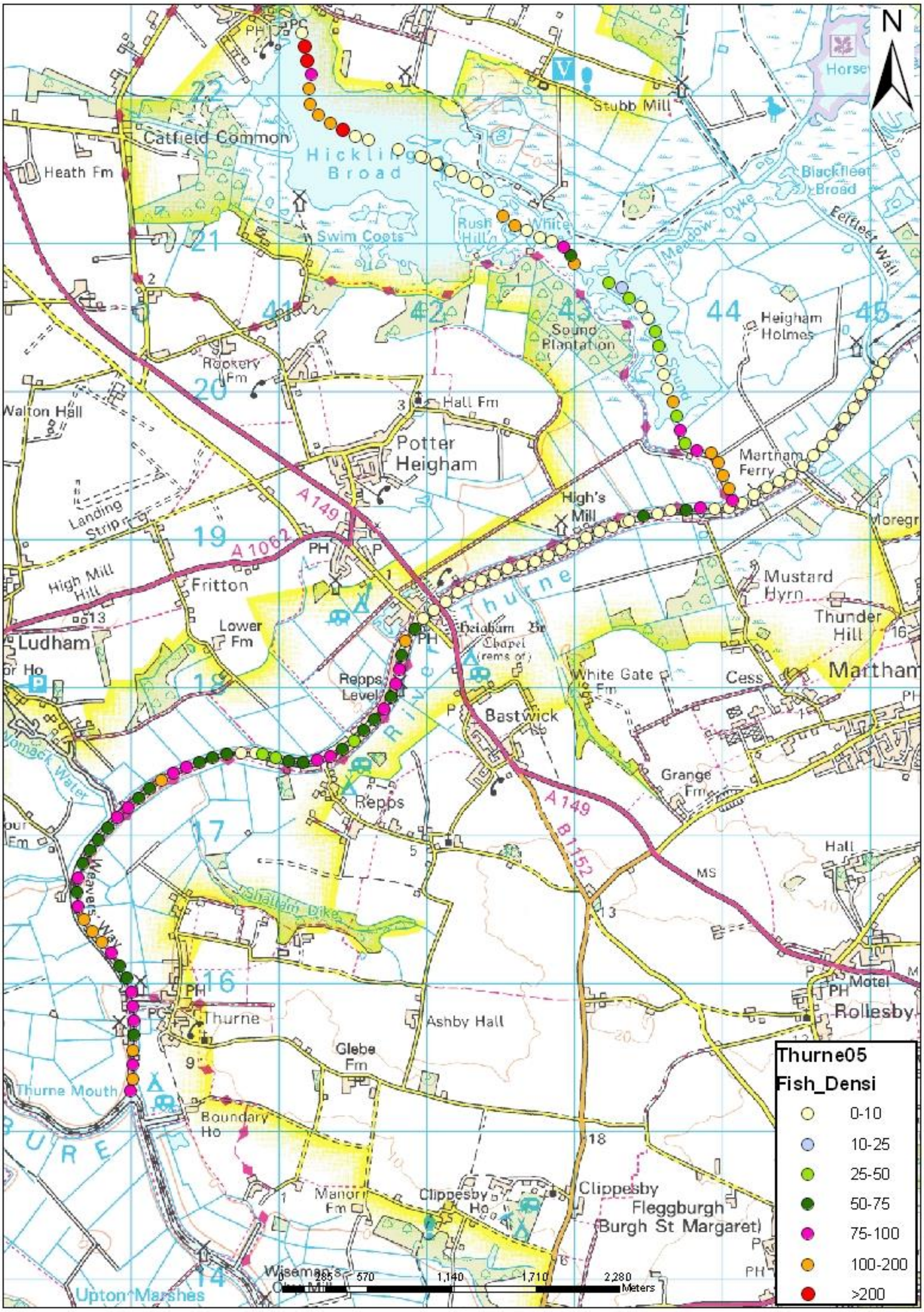
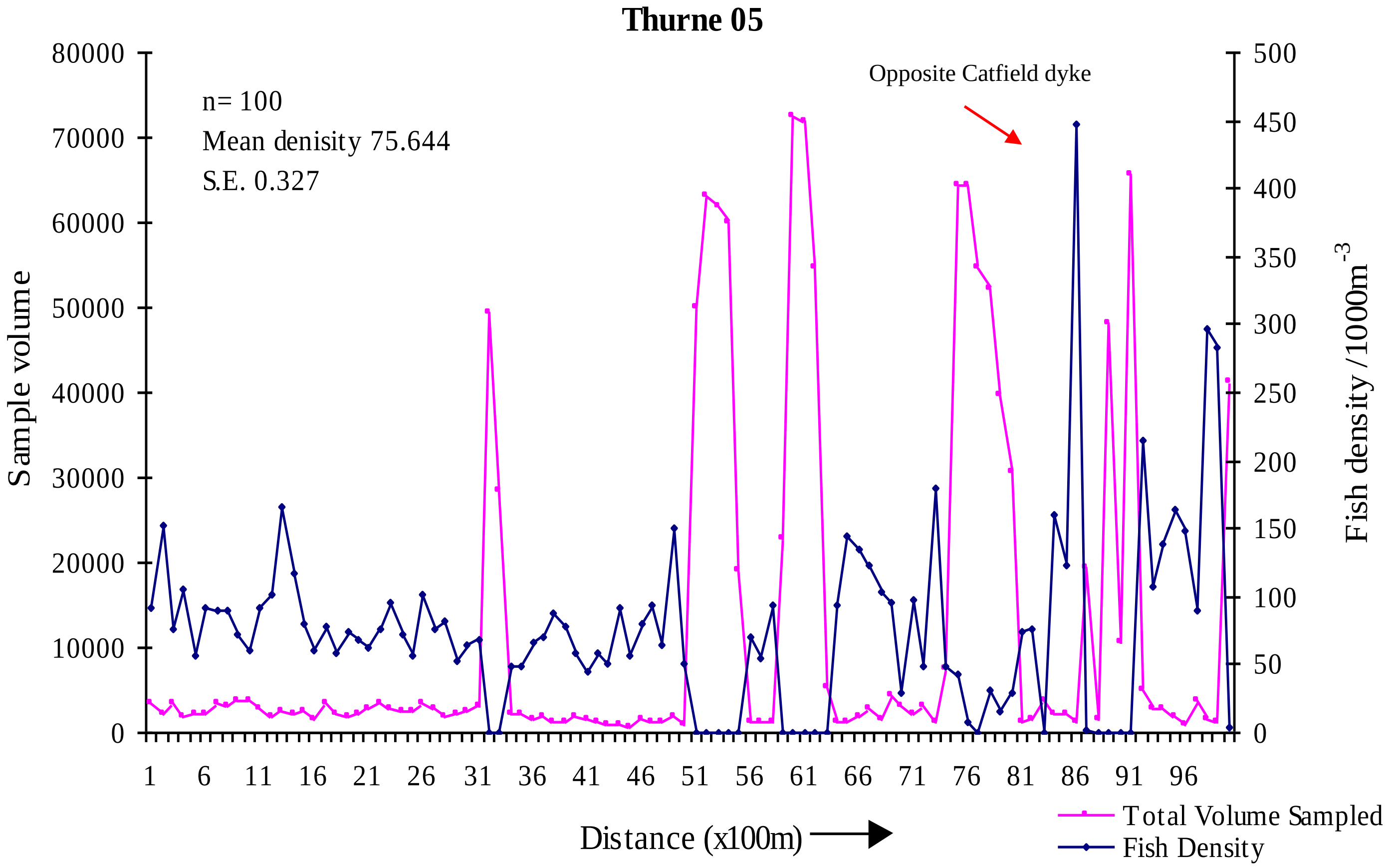


Figure 2. Density of fish/1000m^{-3} vs river sample volume, Thurne confluence to Pleasure Boat end of Hickling Broad 2005.



3.2 Validation

Data presented from validation surveys are from sub-sampled populations. Potter Heigham (Herbert Woods) Womack Water and Upton Boat Dyke were sampled. A second validation survey was conducted during the winter of 2006, sampling over wintering fish populations at Catfield Dyke, Hickling. Data presented here largely relates to the Herbert Woods boatyard survey.

A total of 4 species and 1 hybrid were captured in the Herbert Woods survey (Fig. 3a). Roach dominated the survey numerically (82%). The other principle fish species, common bream, comprised 16% of the total numbers captured, with the remaining 2% consisting of roach/bream hybrid, perch and pike (Fig.3a).

The second winter survey, in Catfield Dyke, was also dominated by roach (95%) indicating the preference of this principal fish species to seek over wintering sites (Fig. 3b). The other principal fish species, common bream, did not form a significant proportion of the overall poplulation (1.8%) (Fig. 3b). The remaining 3.4% comprised of pike, perch, dace, rudd, tench, roach/rudd and roach/ bream hybrids and a 3-spined stickleback.

Fish lengths in the first survey, ranged from 42-273mm and 42-238mm for roach and common bream respectively. There were 9 year classes represented from the roach samples (Fig. 4). The 1998 year class, absent from last years survey, were present this time. The strongest year class represented by roach were from 2002 (Fig. 4).

Figure 3a. Species assemblage and proportional representation of individual species within the sub-sample, validation survey, Potter Heigham, River Thurne 2005

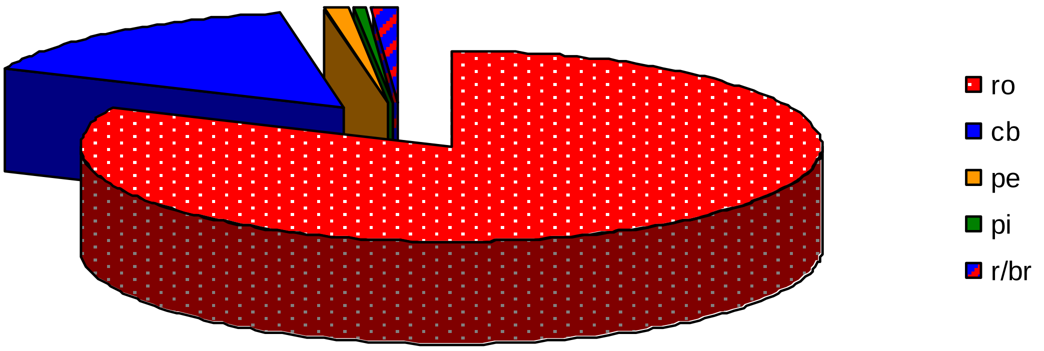


Figure 3b. Species assemblage and proportional representation of individual species within the sub-sample, validation over wintering survey, Catfield Dyke, Hickling, Winter 2006

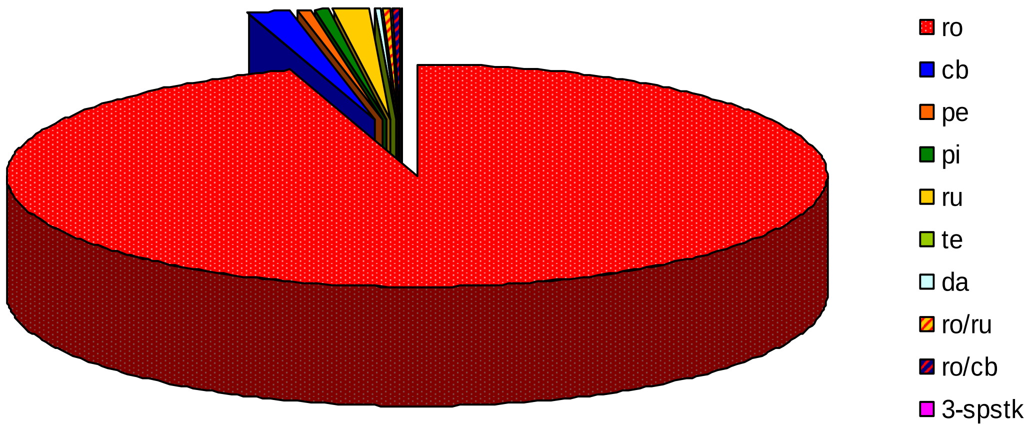
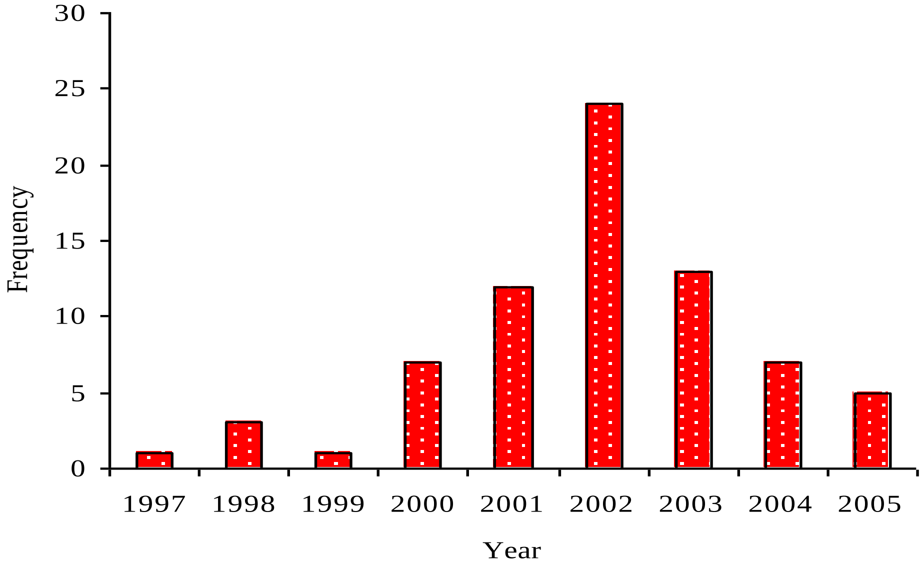
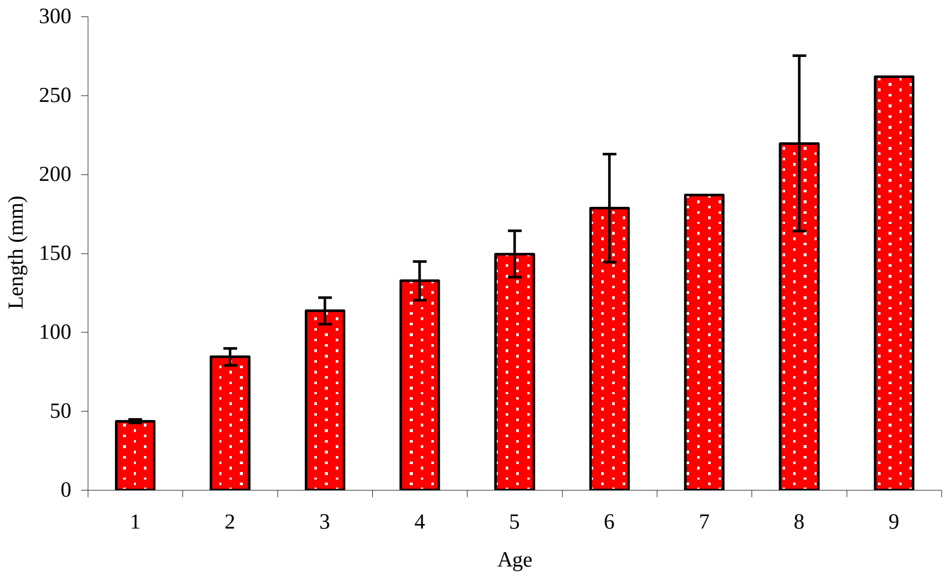


Figure 4. Roach year class strength, validation survey, Potter Heigham River Thurne 2005



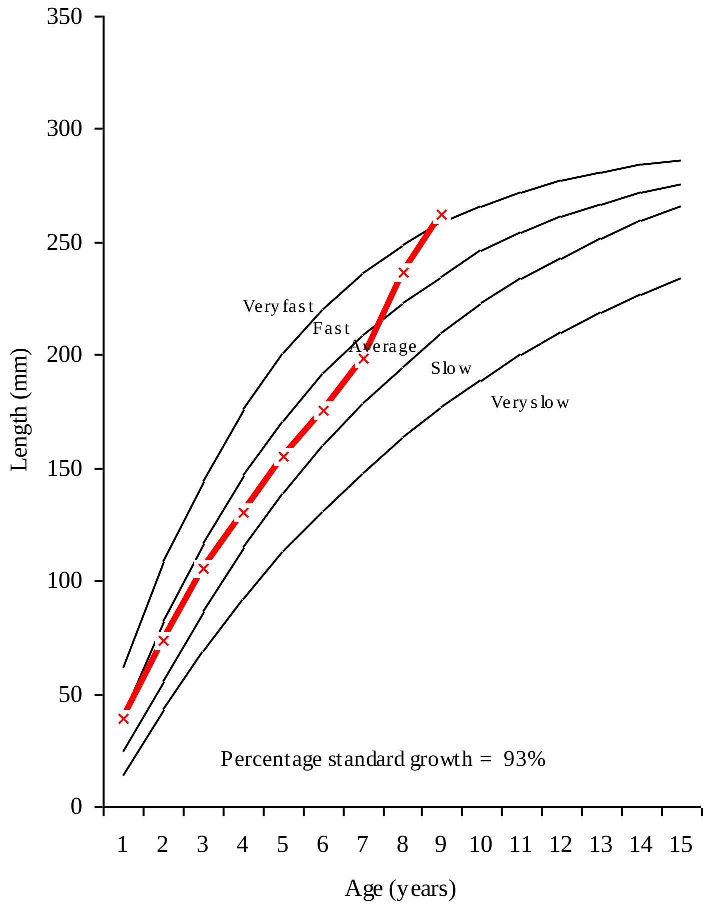
Mean length of 1 year roach was 44mm (+S.E.1.14) (a decrease from 51.6mm, 2004) (Fig. 5). Eight year old fish showed the highest variability in size (Fig. 5). Absence of standard error for 9 year old fish (Fig 5) is due to only catching a single fish.

Figure 5. Mean length at age (+ 1 S.E.) of roach, validation survey, Potter Heigham, River Thurne 2005



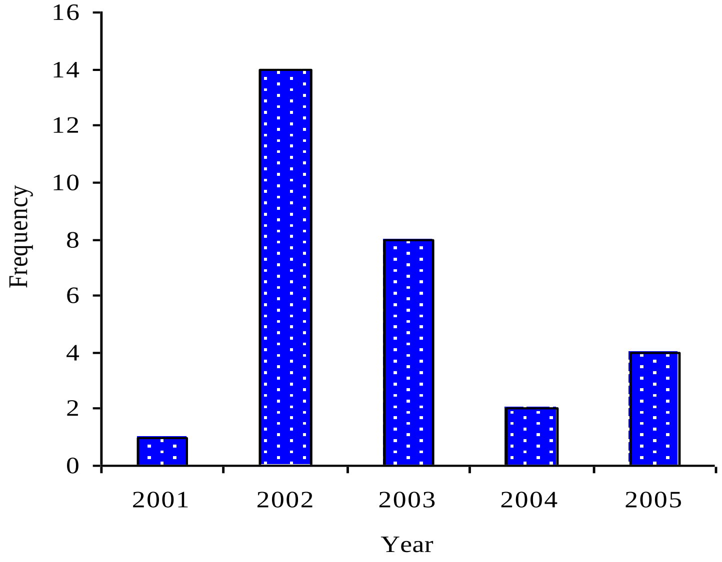
Growth rates for roach at the Potter Heigham (Herbert Woods) site produced growth rates of 93% (Fig. 6), compared to the national average (NFL unpub.). The highest growth rates were found in fish between 8 and 9 years.

Figure 6. Growth rates of roach (compared to National growth rates for Southern rivers NFL unpubl.), validation survey, Potter Heigham, River Thurne 2005.



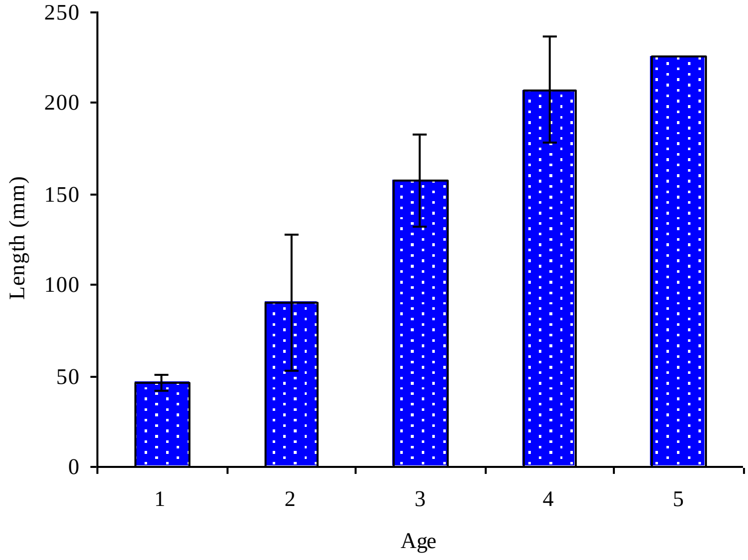
The bream 2002 year class dominated the bream population samples (Fig. 6). The age class exhibiting the highest variability in growth was 2 year old fish (Fig. 7) though this may be attributable to small sample size.

Figure 7. Bream year class strength, validation survey, Potter Heigham River Thurne 2005



Absence of standard error for 5 year old fish (Fig 7) is due to only catching a single fish.

Figure 8. Mean length at age (+ 1 S.E.) of bream, validation survey, Potter Heigham, River Thurne 2005



4.0 Discussion

4.1 Hydroacoustics

The 2004 hydroacoutic fish survey of the River Thurne was conducted in mid-late summer (August). Surveying in autumn greatly reduces the incidence of weed entrapment on the transducer, rotator and associated mountings. This in turn results in clearer echograms and less 'down time' clearing weed from the equipment. As a consequence of the later survey time (September) in 2005, weed growth was markedly less extensive than the previous year, enabling successful surveying beyond Martham Ferry.

Fish density distribution (Fig. 1) formed pronounced clumps or 'hot-spots' at various points along the river in contrast to the previous survey.

It is interesting to note that the two highest densities of the survey were at the entrance to Catfield Dyke (Fig. 2), and approaching the Pleasure Boat end of the Broad. Elevated densities (100-200 fish/1000m^{-3}) were also observed at the confluence between the river and dyke leading into Hickling Broad and at the entrance to Candle Dyke from Hickling Broad. This follows a similar pattern of high density found from the previous year's survey (2004). The longest contiguous elevated density was in the river from Thurne mouth to downstream of Potter Heigham (Fig. 1).

Fish density appears to be lower immediately below, and extensively above, the A149 Road Bridge (0-10 fish/1000m^{-3}) including the stretch upstream of Marthm Ferry. These sections had the lowest density estimates of the survey. This is in contrast to high densities here in 2004, although it was not possible to survey upstream of Martham Ferry then due to weed growth..

The overall mean density for the River Thurne, between the top end of Hickling Broad and Thurne Mouth, was 75.6 fish/1000m^{-3} ($\pm$ S.E. 0.33). This is a reduction compared to 179 fish/1000m^{-3} ($\pm$ S.E. 11.8) in 2004. After only 2 surveys, it is not possible to tell which is representative or if the reduction will be sustained.

This estimate is to be considered representative of the river rather than definitive, since no method is able to portray the fish population 100%. The survey indicates overall fish density of fish >75mm. Fish within the littoral margin or within extensive macrophyte beds (i.e. Hickling, off main channel) may also be excluded due to background noise preventing post processing analysis and/or reflecting echoes from entrained air, weed and mudbanks.

4.2 Validation

The data presented in Section 3.2 is from sub-sampled populations and therefore, indicative of that sub sample and not necessarily reflective of the over wintering populations. Nevertheless, trends and general patterns can de gleaned from the data. Certain aspects of the data are valid whether from a sub-sample or not. Sub-sampling is used where the fish populations are in a torpid or vulnerable condition to prevent excess mortality and stress, which can also indirectly lead to further mortality.

Three over wintering sites were surveyed, Womack End Dyke, Boundary Dyke and Herbert Woods, Potter Heigham, though only the later is presented here. Herbert Woods is acknowledged to be a significant over wintering site, and has a fish barrier that is deployed during saline incursions to protect the over wintering stocks within. Additionally, an over wintering survey was conducted during the winter months (January/February) at Catfield Dyke, Hickling.

Growth rates for roach at Herbert Woods site were variable. Younger age classes were average, becoming categorised as fast when reaching 8 and 9 years old. The high standard error of 8 year old fish is attributable to the presence of a single smaller individual. A larger sample size would narrow the standard error and increase confidence in the estimate. Overall, the sub sample portrayed roach well, with 9 year classes present.

The number of bream age classes represented (n=5) was smaller than for roach. This is to be expected if the hypothesis of larger, older bream being less reliant on over wintering than their smaller, younger con-specifics holds true. However, the pre-dominance of 2002 year class is surprising. If younger fish are more prone to the effects of inadequate over wintering habitat, it would be expected that the younger age classes would dominate sub sample estimates. Observations of large numbers of smaller fish (roach and bream) were made during the survey, which may confirm this, though without samples robust confirmation is not possible.

Few piscivores were captured during the boat yard survey.

Although Catfield Dyke was surveyed during February 2006, the data is valid for 2005 hydroacoustic validation purposes. The reasons for this are that fish do not grow significantly over this winter period, and are often tightly shoaled in relatively confined areas, thereby facilitating comparisons of growth rates, species representation and year classes. Fish are not deemed to be recruited into the following year class until spring, when metabolic requirements increase with the concomitant increase in feeding and growth and thus, are still technically the previous year fish.

Roach dominated the sub samples of Catfield Dyke (95%) (Fig. 3b). Common bream were only just higher numerically than rudd, a species which is know to favour the littoral margins of Hickling Broad (Per. Obs.).

5.0 Conclusions

- River Thurne is suitable for hydroacoustic surveys.
- Mean density 75.6 fish/1000m^{-3}, a decline of 58% on 2004 survey estimates.
- Surveying the Hickling Broad sections are worthwhile, revealing good fish populations (macrophyte growth dependent).
- Fish density ‘hot-spots’ are not so apparent within the river (survey dependant), but some elevated densities are apparent in Hickling Broad.
- Later survey date enabled more extensive survey of the river sections above Martham Ferry.
- Some similarity of elevated densities between surveys.
- Of the 2 principal fish species, roach utilise the over wintering sites more extensively than common bream.
- The hydroacoustic surveys are unlikely to be able to accurately survey the 1 year old roach since their mean length (51mm) is under the threshold of reliable hydroacoutic survey quantification (>75mm).