# Water Framework Directive Transitional Fish Classification Scheme

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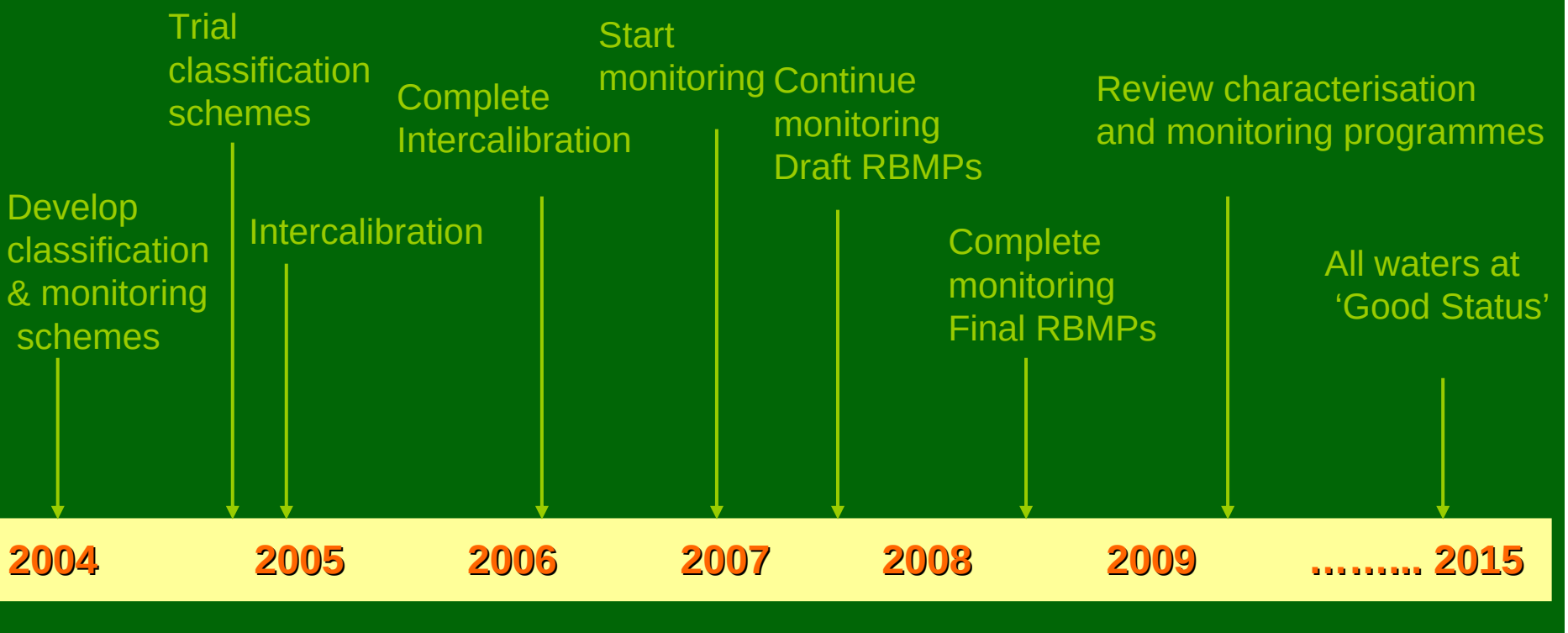
# Water Framework Directive

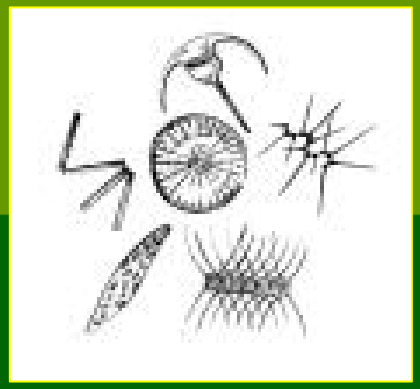
- 22nd Dec 2000 - Directive of EU Parliament
- Requires EU Member States to:
  - develop monitoring programmes
  - develop estuarine classification systems
  - achieve good ecological status of surface waters by 2015

# WFD Timeline



# Biological Quality Elements

Environment Agency



Phytoplankton

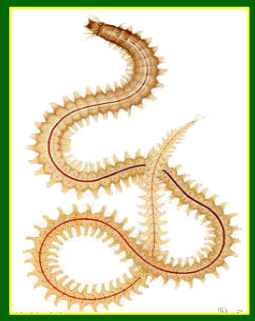
Fish

Biological Quality

Macroalgae

Benthic Invertebrates

Angiosperms



# UK WFD Biological Task Teams

WFD Implementation Steering Group

Technical Advisory Group (TAG)

MPMMG / NMMP

Marine Task Team (MTT)

Inter-Agency Maritime Group

Marine Plants Task Team

Marine Fish Task Team

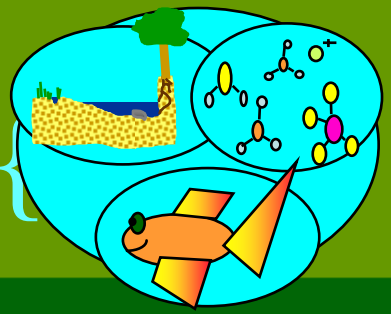
Marine Benthic Invertebrate Task Team

# Surface Water Objectives

ECOLOGICAL STATUS

Environment Agency

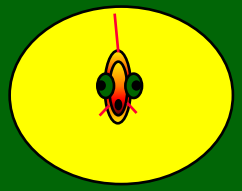
*No or very minor*



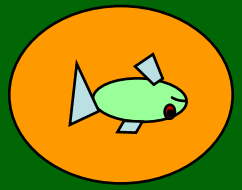
**Physico-chemical *Quality Standards***

***Slight***

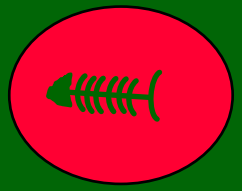
***Moderate***



*Major*



*Severe*



**HIGH**

**GOOD**

**MODERATE**

**POOR**

**BAD**

**Prevent deterioration**

Restore

# Normative Definitions of Transitional Waters - Fish

| Element | High Ecological Status | Good Ecological Status | Moderate Ecological Status |
|---|---|---|---|
| Fish fauna | Species composition and abundance is consistent with undisturbed conditions | The abundance of the disturbance-sensitive species shows slight signs of distortion from the type-specific conditions attributable to anthropogenic impacts on physiochemical or hydromorphological quality elements | A moderate proportion of the type-specific disturbance-sensitive species are absent as a result of anthropogenic impacts on the physiochemical or hydromorphological quality elements |

# What are the disturbance sensitive species?

- Most fish considered to be disturbance sensitive
- Some more sensitive than others e.g. to poor water quality
- Diadromous species particularly sensitive:
  - Either have life cycles associated with TW's or fry which penetrate into freshwaters

Environment Agency

Sea trout -
*Salmo trutta*

Smelt -
*Osmerus eperlanus*

# Fish Survey Design

- Estuarine fish depend upon a range of habitats
- Survey design has to reflect the inherent temporal & spatial variability within a TW
- Bi-annual, multi-method sampling regime has been used to assess and monitor fish communities
- Standardise gear and sampling effort

## Seine netting

## Beam trawling

## Otter trawling

## Kick sampling

# Power Station Monitoring

## How to analyse data?

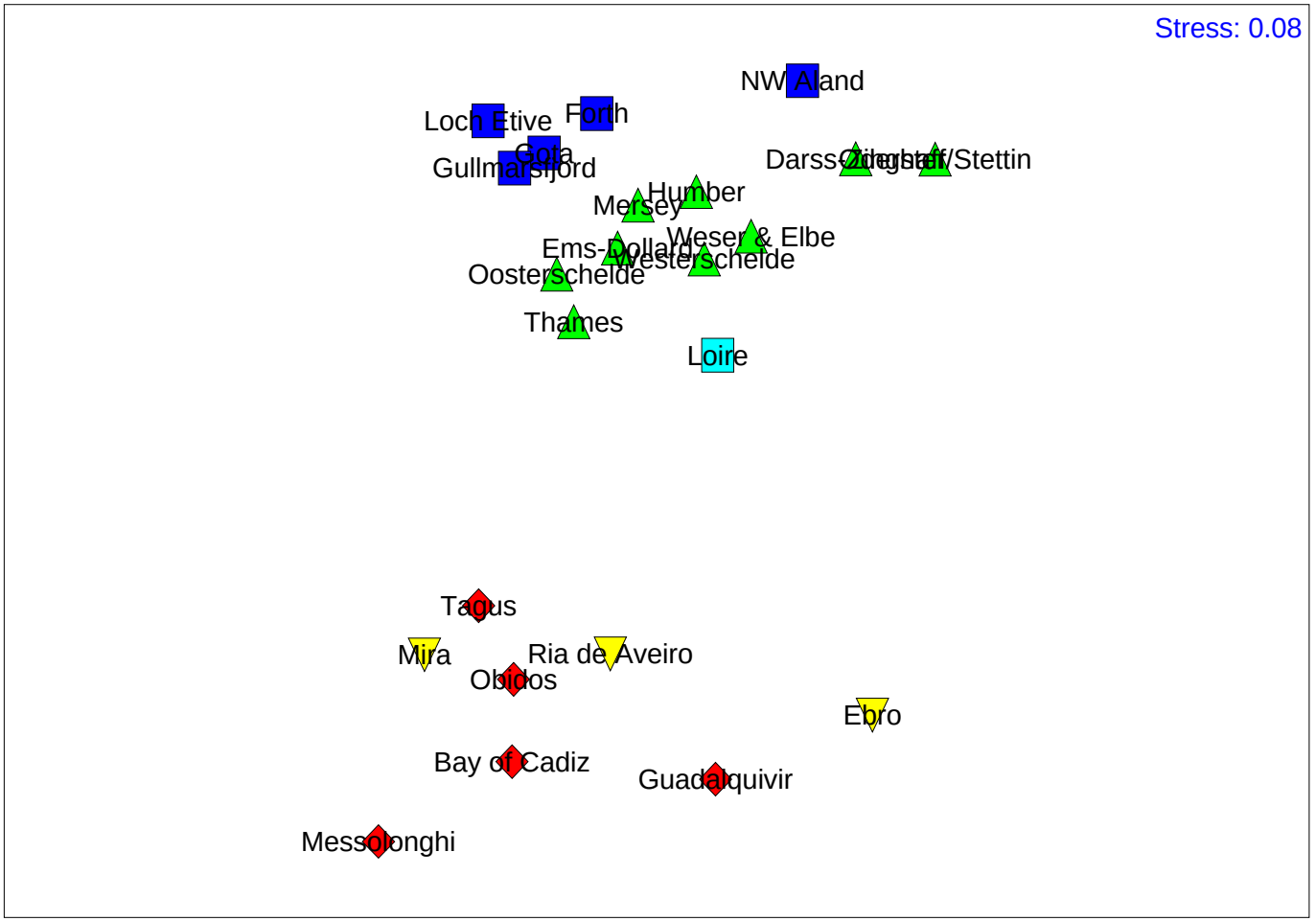
# Data

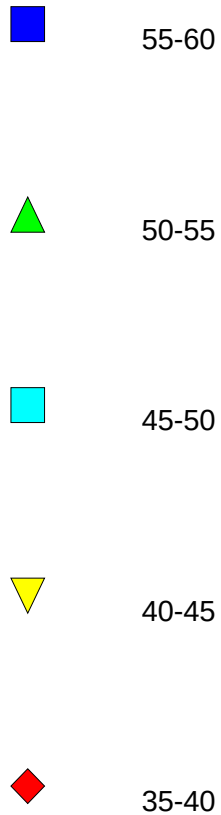
- Currently hold data from:
  - 45 transitional water bodies
  - 406 stations
  - 8800 samples
- Sites vary from freshwater to marine & therefore have complex interpretation of the data
- Historic UK monitoring has concentrated on impacted ‘industrialised estuaries’
- Spent the past 3 years on sampling reference estuaries

# Database & Analysis

- **Unicorn V4** has been developed for WFD to include UK & ROI Transitional fish species and used in association with **PRIMER** multi-variate software - why multi-variate?
- **Univariate** analysis describes association & relationships **between individual** variables
- **Multi-variate** analysis examines the complex inter-relationship **between many** variables simultaneously
- Data derived from a whole range of sampling regimes, monitoring techniques and therefore varying **CPUE**
- Further analysis of species lists with Typology and Eco-Regions - '**Biogeographic'** problem?!

# MDS ordination of fish taxa reported in European estuaries; systems are labelled according to latitude.



# TW Fish Community Metrics

Environment Agency

**Species diversity and composition**

1) ‘Species composition’
2) Presence of ‘Indicator Species’

**Species abundance**

3) Species relative ‘abundance’
4) Number of taxa that make up 90% of the ‘abundance’

**Nursery function**

5) Number of estuarine resident taxa
6) Number of estuarine-dependent marine taxa

**Trophic integrity**

7) Functional Guild Composition
8) Number of benthic invertebrate feeding taxa
9) Number of piscivorous taxa
10) Feeding Guild Composition

# Scoring System

- **Based on Karr methodology** (Assessment of biotic integrity using fish communities, 1981)
  - Score 5 - deviate slightly from reference
  - Score 3 - deviate somewhat from reference
  - Score 1 - deviate strongly from reference
- **Modified (similar to FAME)** and Belgium classification scheme (Jan Breine and Peter Goethals *et al .,* 2005) -
  **Scored now on a 5, 4, 3, 2, 1 scale**

# Relative Score

- Scores of all 10 metrics combined
- ‘Relative Score’ calculated for each sample using the following formula:

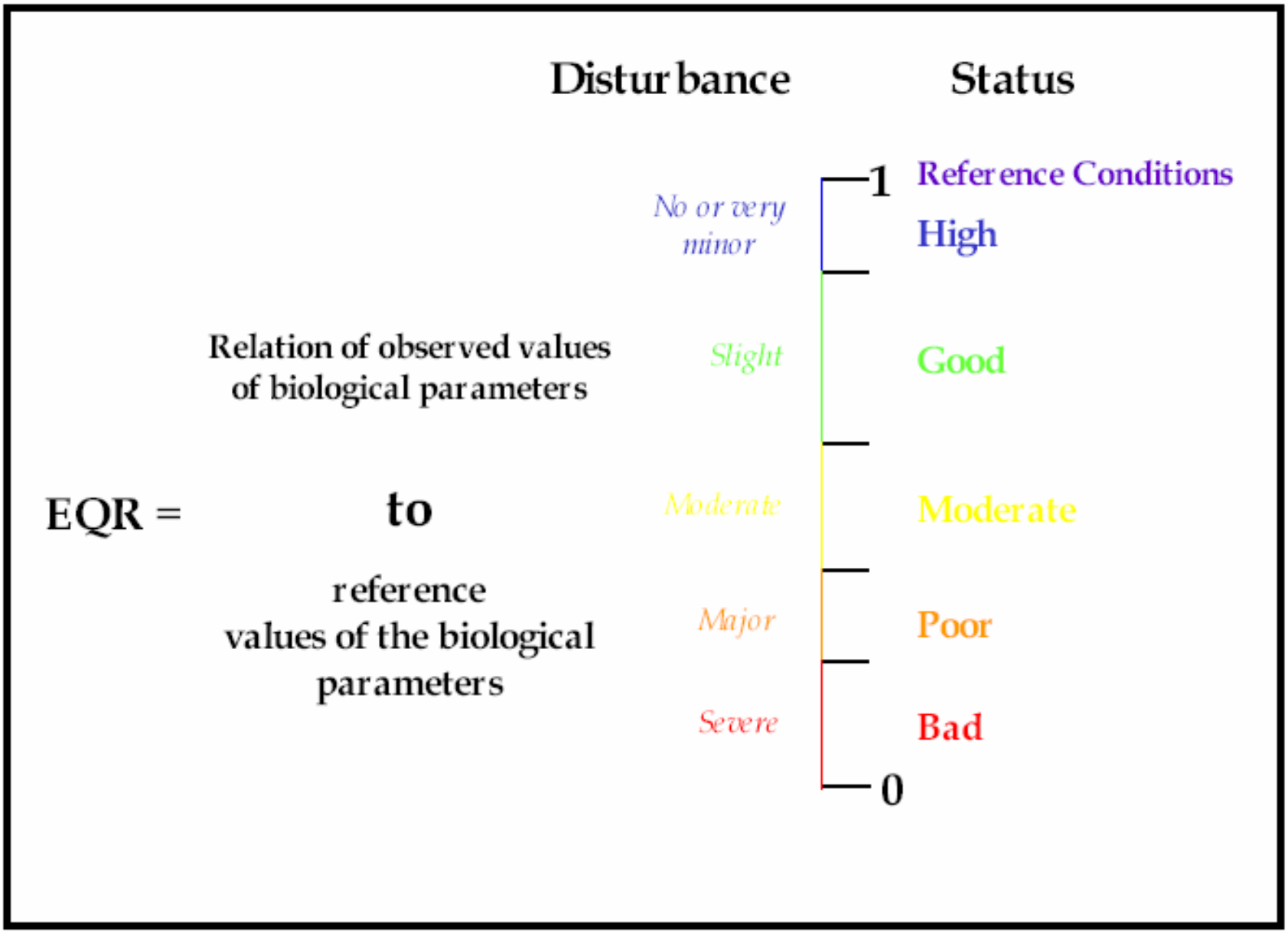
$$RS = \frac{(\text{Total score} - \text{minimum score possible})}{\text{Maximum score possible}}$$

**RS ranges between 0 - 1**

# TW Fish Task Team Interpretation of General & Fish

| Structure & relevance | High Status | Good Status | Moderate Status |
|---|---|---|---|
| **'Species Composition & abundance' – there is a high degree of taxonomic breadth present. Species richness i.e. number of taxa is not a useful measure as this is often dependant upon sampling effort.**<br><br>**Functional Guilds describe the interaction and function of the fish faunal assemblage within an estuary. Each species is allocated a functional category**<br><br>**CA = diadromous species**<br>**FW = freshwater species**<br>**ER = estuarine residents**<br>**MA = marine adventitious**<br>**MJ = marine juveniles**<br>**MS = marine seasonal**<br><br>**Structural changes within the community structure are associated with seasonal patterns.** | ***Species composition & abundance is consistent with undisturbed conditions.***<br><br>**Also key life stages of 'disturbance sensitive species' are present.**<br><br>**Successful migration within and through the transitional water associated with patterns of migration consistent with undisturbed conditions.** | ***The abundance of the disturbance sensitive species shows slight signs of distortion from type specific conditions attributable to anthropogenic impacts on physico-chemical or hydomorphological quality elements.***<br><br>**Distortion of disturbance sensitive sp. & key life stages. May be in terms of age structure as well as presence.**<br><br>**Some disruption to migration patterns within & through the transitional water.**<br><br>**One or more sp within a guild may be absent** | ***A moderate proportion of the type-specific disturbance-sensitive sp. are absent as a result of anthropogenic impacts on the physiochemical or hydromorph quality elements***<br><br>**Removal/absence of disturbance sensitive sp. Including disruption of key life stages.**<br><br>**Major disruption to migration patterns within & through the trans water. Functional Guilds absent in relation to reference conditions.**<br><br>**Non-native fish may be present.** |

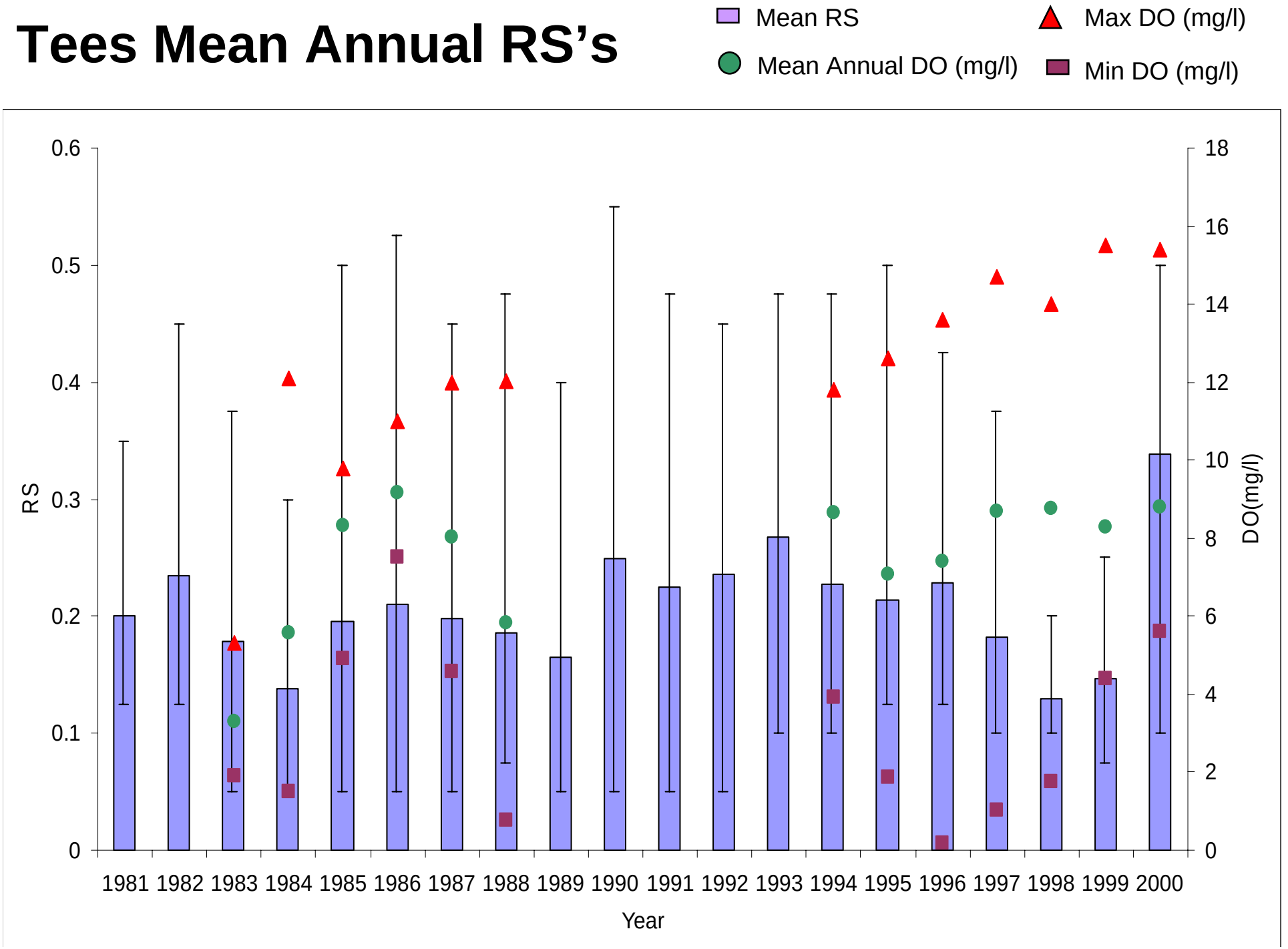
# EQR's & Boundary Criteria



# Tees Analysis

- Tees beam trawl data set (1982 - 2000) analysed at sample level (i.e. each sampling occasion)
- Data compared against reference of beam trawl programmes within E4T2:
  - Blyth, Tyne, Wear & Tees
- Mean annual RS calculated and compared with DO measurements
- Non-reach based assessment

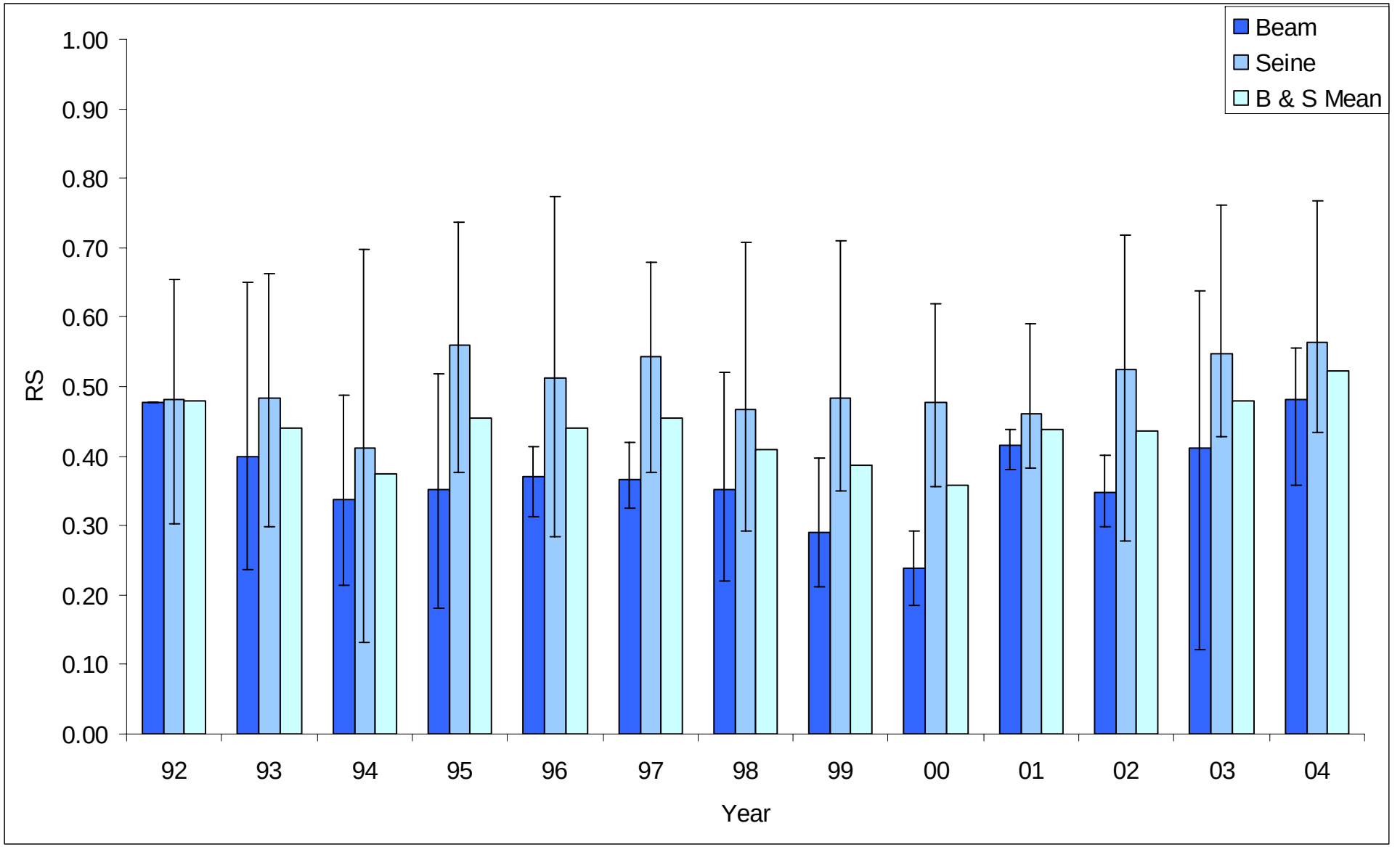
# Tees Mean Annual RS's



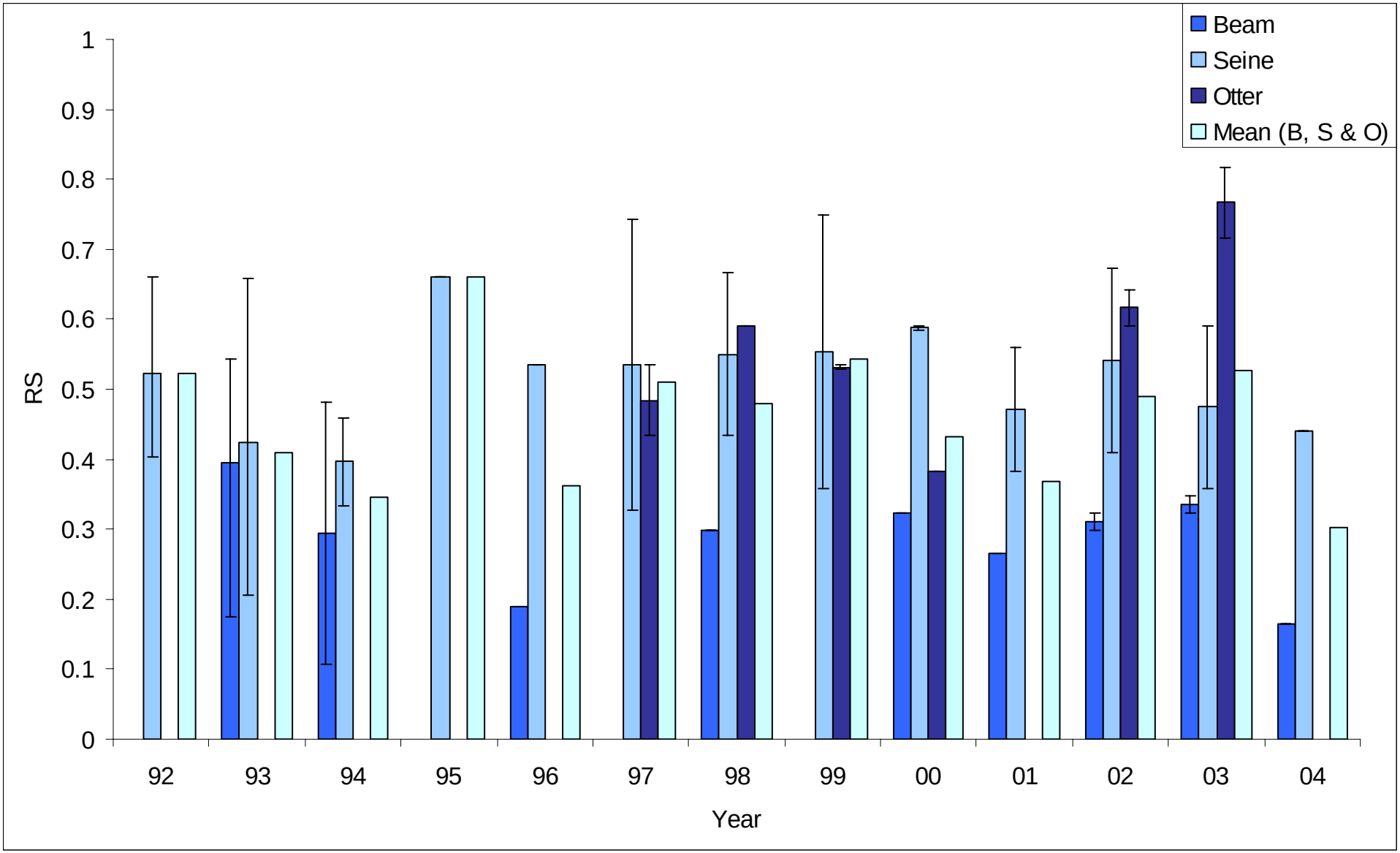
# Thames Analysis

- Based on data from Thames, Anglian and Southern Region - Eco 4 TW3
- Developed ‘method-specific’ references for multi-method techniques to reduce effects of sampling
- References calculated for each metric - based on upper quintile
- ‘RS’ calculated for each sampling occasion to reduce different CPUE
- Used each annual sampling occasion RS to calculate a mean annual RS

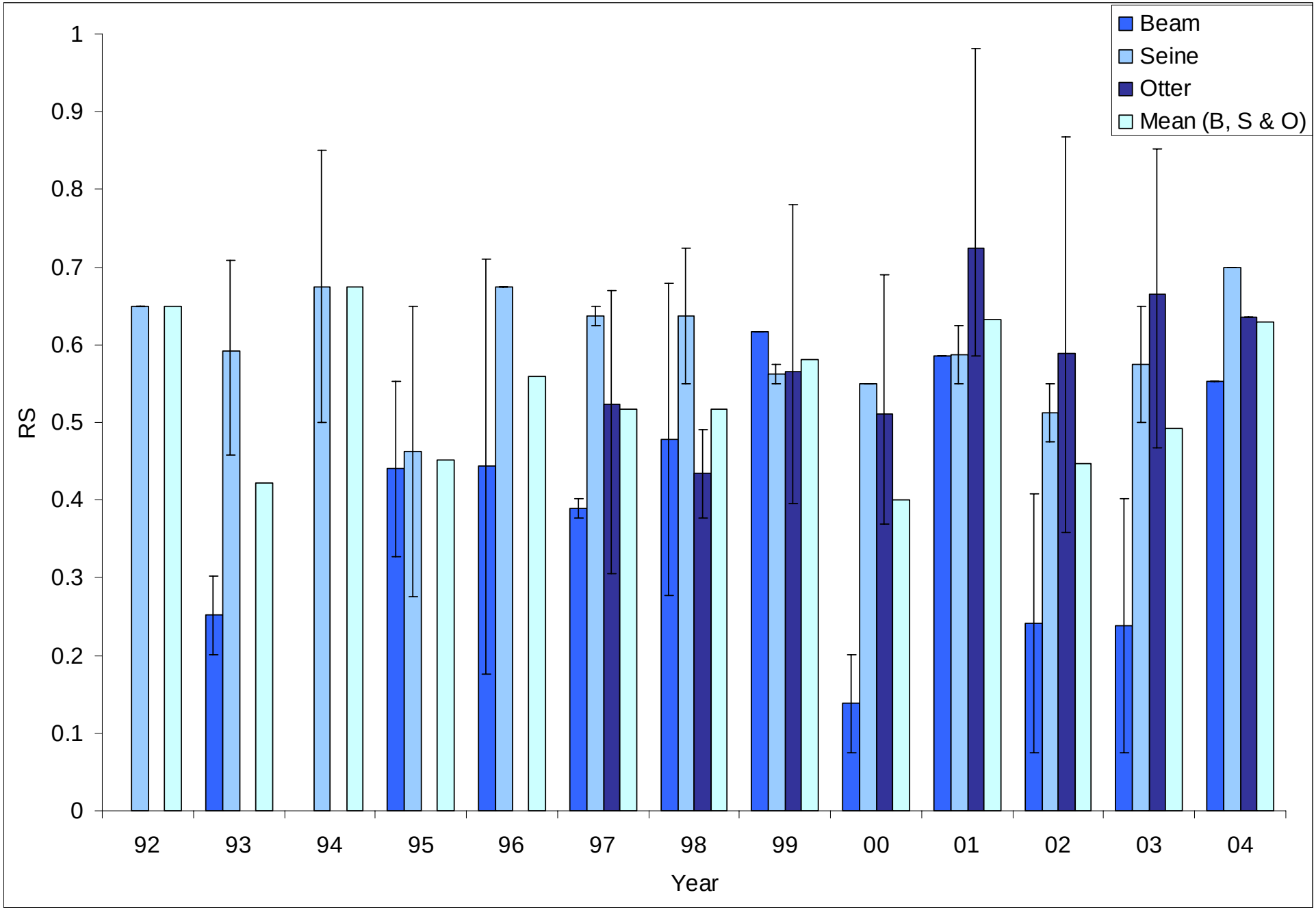
# Upper Thames - Mean annual RS's



# Mid Thames - Mean annual RS's



# Lower Thames - Mean annual RS's



# Conclusions

- Reach based assessment necessary in larger TW's as water-bodies will be delineated in relation to pressures etc.
- Method-specific references essential but require further analysis e.g:
  - Multi-method reference suitable for Thames
  - Beam trawl programme provides useful reference for Tees – however excludes certain species (sea trout), as shown by seine net catches

# Current Work

- Further testing and evaluation of metrics and boundary criteria
- Re-development of reference conditions to incorporate ‘expert judgement’
- Association of relative scores with significant pressures e.g. DO, temperature
- Analyses of differences between sample level and annual level analysis
- Working with EU NEAGIG Fish colleagues & Paul Quataert (Belgium) ‘European Index’ for WFD


I never dreamed that WFD monitoring could be so exciting

# General Normative Definitions of Ecological status

| Element | High Status | Good Status | Moderate Status |
|---|---|---|---|
| General | There are no, or only very minor, anthropogenic alterations to the values of the physico-chemical and hydromorphological quality elements for the surface water body type from those normally associated with that type under undisturbed conditions.<br>The values of the biological quality elements for the surface water body reflect those normally associated with<br>that type under undisturbed conditions, and show no, or only very minor, evidence of distortion.<br>These are the type-specific conditions and communities. | The values of the biological quality elements for the surface water body type show low levels of distortion resulting from human activity, but deviate only slightly<br>from those normally associated with the surface water<br>body type under undisturbed conditions. | The values of the biological quality elements for the surface water body type deviate moderately from those<br>normally associated with the surface water body type under undisturbed conditions. The values show moderate<br>signs of distortion resulting from human activity and are significantly more disturbed than under conditions of good status. |