



# National Fish Tissue Archive

Some Highlights from the first 12 years

**2007-2019**



# Why monitor rivers?

- Many chemicals that we use in the household or industry reach rivers from treated sewage and run-off
- English rivers are quite small by international comparison and the population is dense, especially in the South

→ little dilution per person



# HOW to monitor rivers ?



Collect water sample  
in a bottle?

➔ Too variable, and  
often below limit of  
detection

Misses sediments



Install a passive sampler?

➔ Still can't leave it more  
than about 1 month.



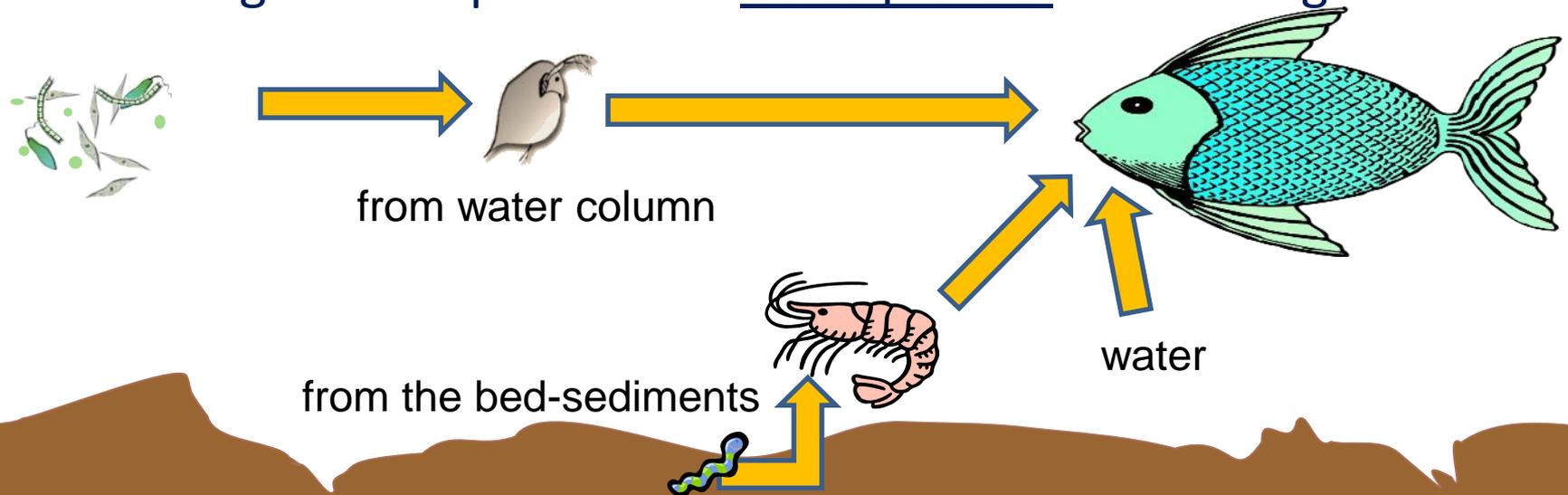
Take bed sediment  
samples?

➔ Is it bioavailable?  
Spatial variability



# Why are fish useful ?

- Chemical exposure directly from water and via their food
- Through food they are also connected to bed sediments
- Higher concentrations than in water for hydrophobic chemicals
- Integration over time: A small fish gives good indication of recent pollution whereas a larger one integrates longer term
- Tissue concentration is a meaningful measure of risk to the organism or its predators
- Archiving the samples allows retrospective monitoring



# Why Archive fish?

Our interpretation of current measurements is often hampered by lack of knowledge of the past

- Samples will be available for future scientists
- Using methods that are not available today
- Looking for compounds we don't yet consider of concern or interest
- Determining trends and their causes
- And other questions I haven't thought of ...



# Why Archive fish?

Our interpretation of current measurements is often hampered by lack of knowledge of the

**today's samples to answer tomorrow's questions with tomorrow's technology**

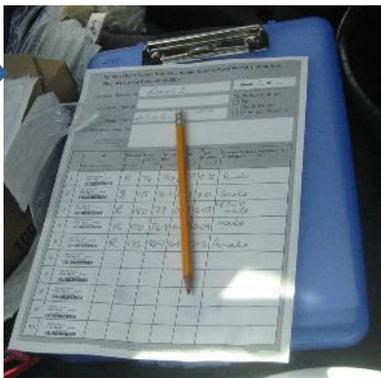
- Determining trends and their causes
- And other questions I haven't thought of ...



# Our approach to fish sampling: The UK National Fish Tissue Archive



In 2007, CEH and the UK Environment Agency (EA) began to build an archive of fish tissue samples from a selection of English rivers.



record: size, weight



frozen on site (liquid N<sub>2</sub>)

- EA monitor fish stocks annually
- normally: throw all back
- now: give us 10 roach (10 cm+) from selected sites



Vacuum packed and stored at -80°C



cryogrinding of some fish



bottled fish powder

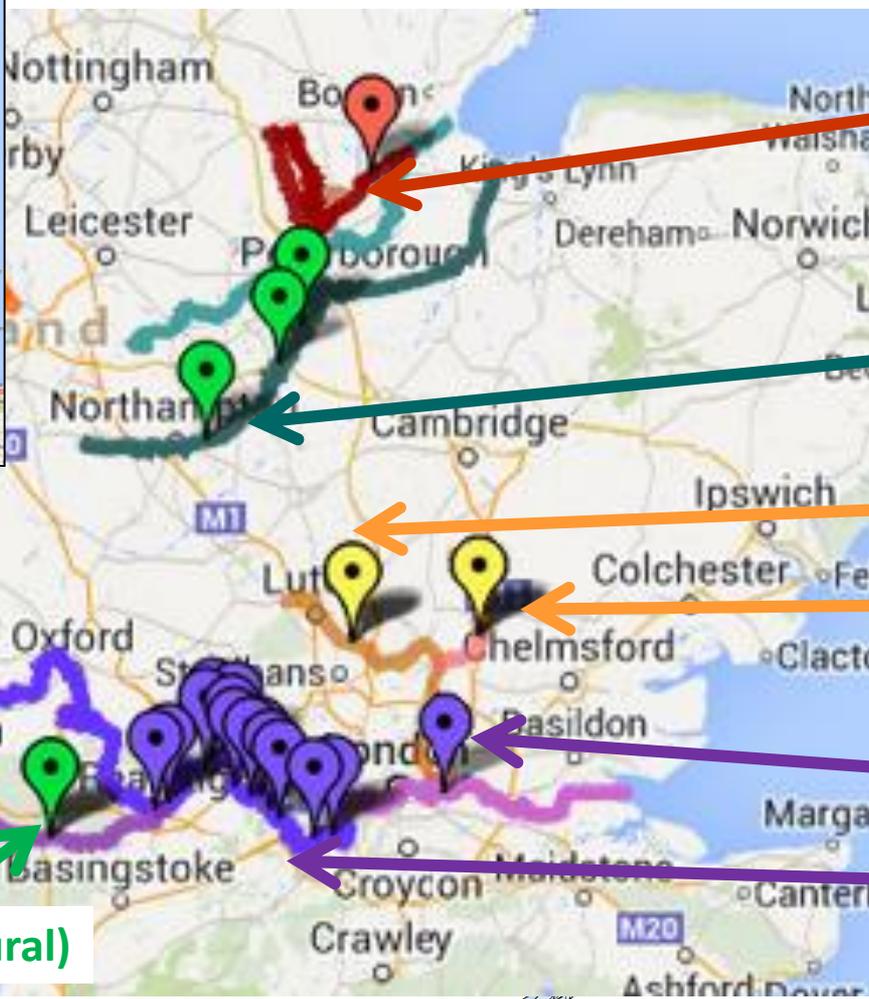


# Fish archive numbers

- 2118 fish collected between 2007 and 2018, and stored at  $-80^{\circ}\text{C}$  as a resource for future retrospective monitoring
- Around 10% have been analysed for a number of metals and/or POPs (organochlorine pesticides, PCBs, PBDEs)
- Some had their gut contents analysed for the presence of micro-plastics or for anti-microbial resistance (AMR) genes



# Sites where fish have been analysed for chemical contamination



Glen (rural)

Along the Nene downstream of Northampton (urban)

Lee (urban)

Stort (urban)

Thames estuary, only eels in 2007 (urban)

Lower Thames (urban)

Upper Thames (rural)

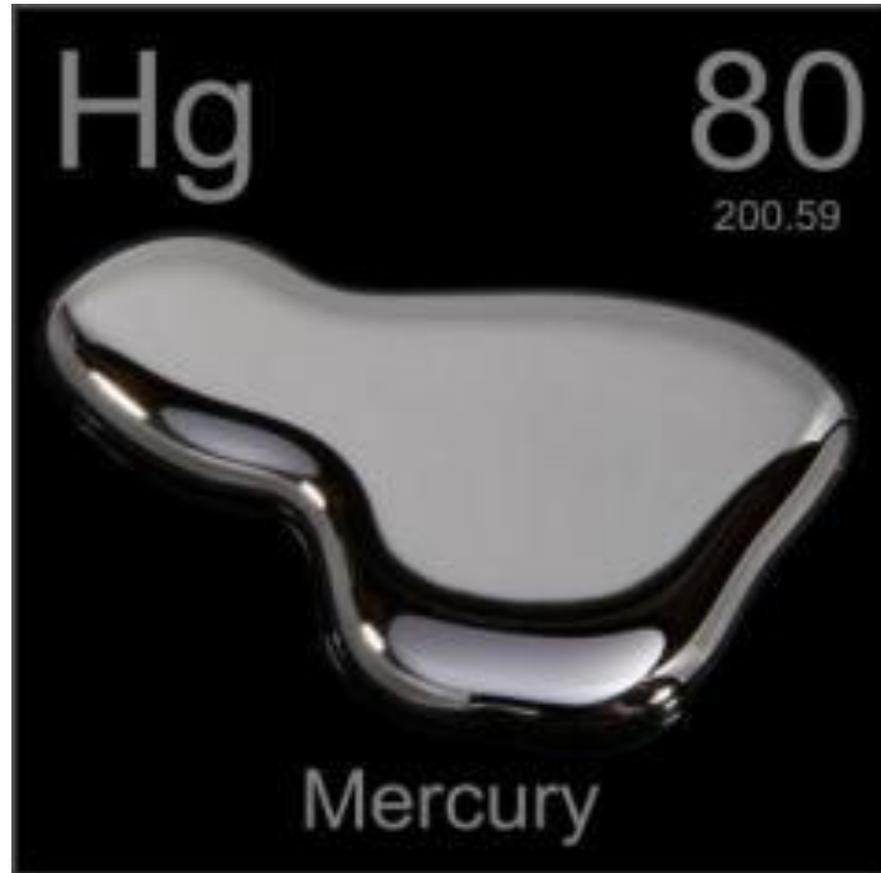
Kennet (rural)



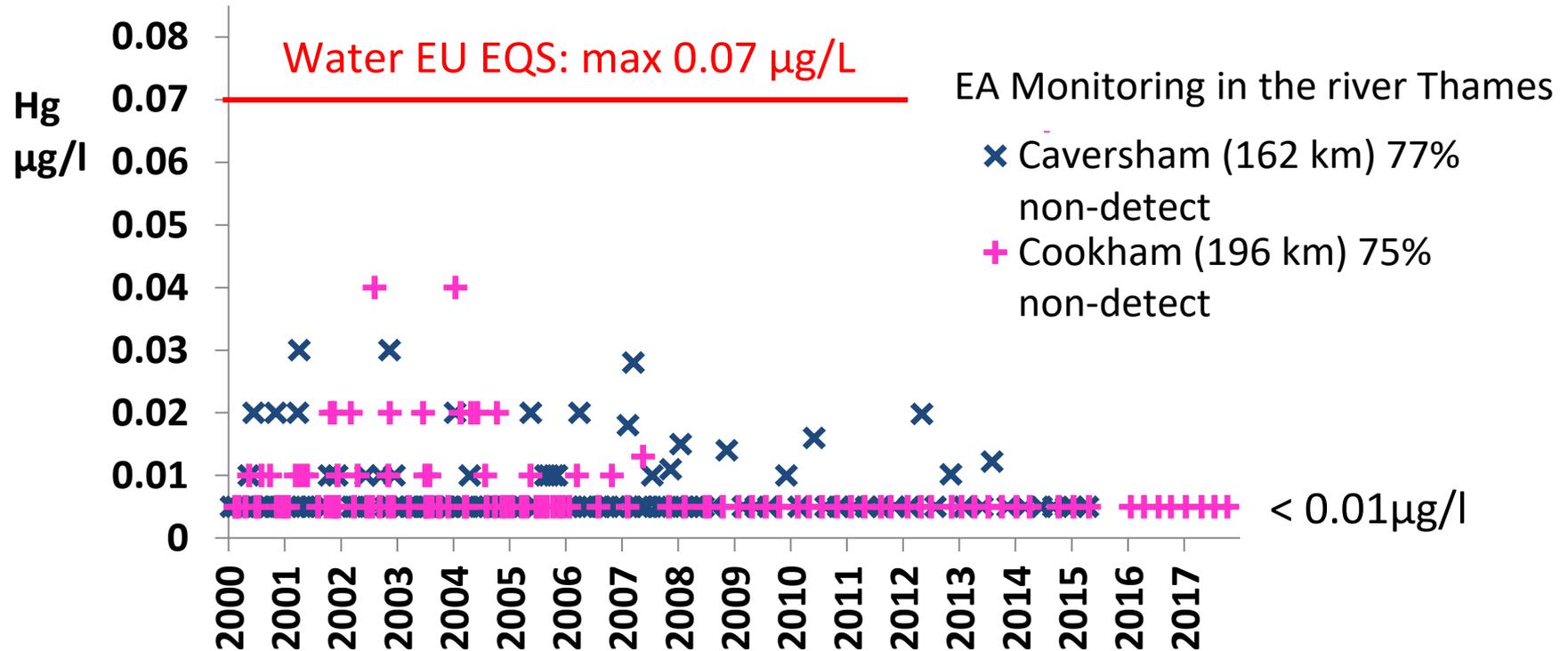
# Some results



# Mercury



# Mercury in water – no problem ?

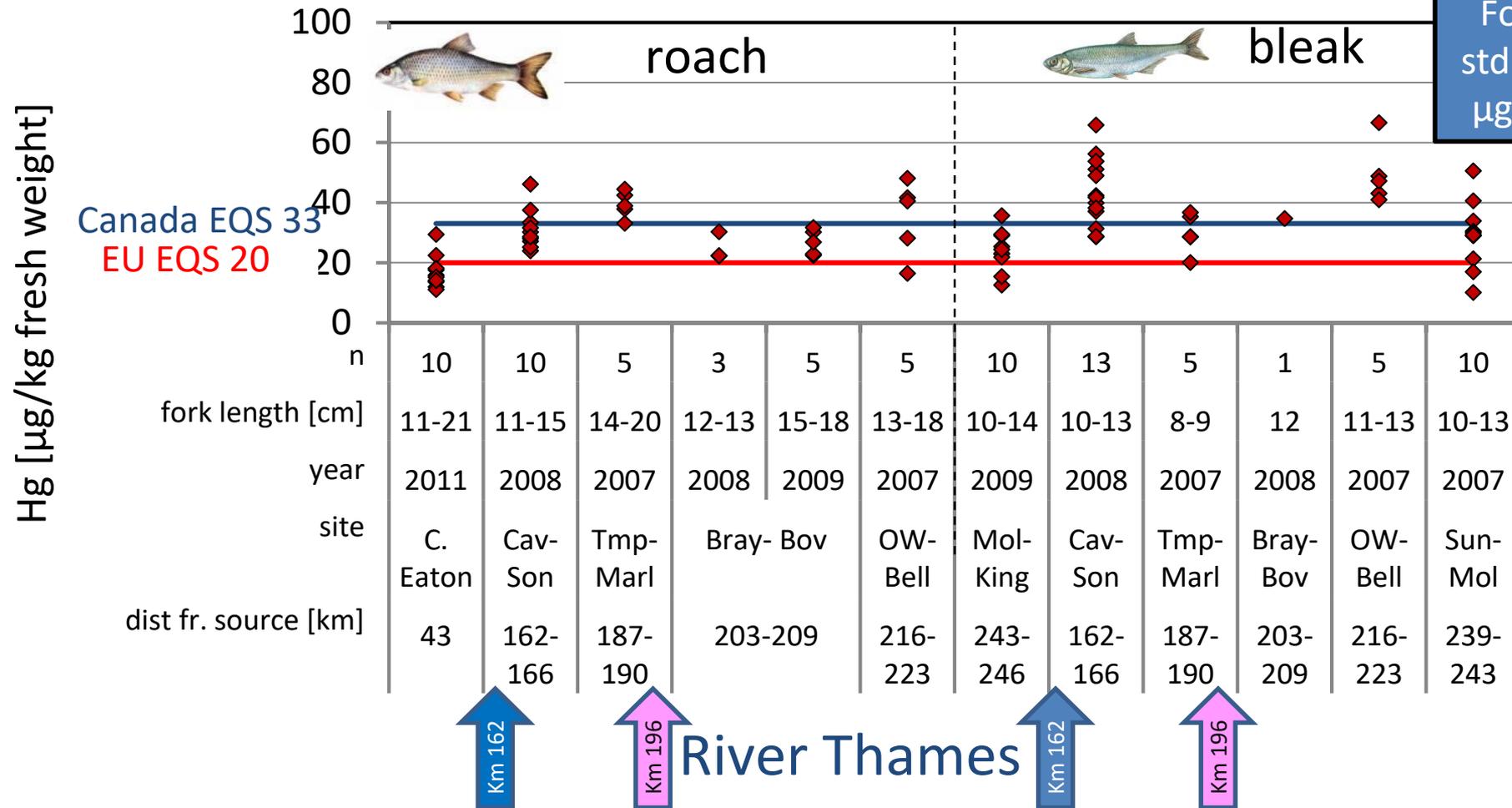


Water concentrations mostly < limit of quantification and always < Environmental Quality Standard (EQS)  
→ so no problem?



# Mercury in fish tells a different story

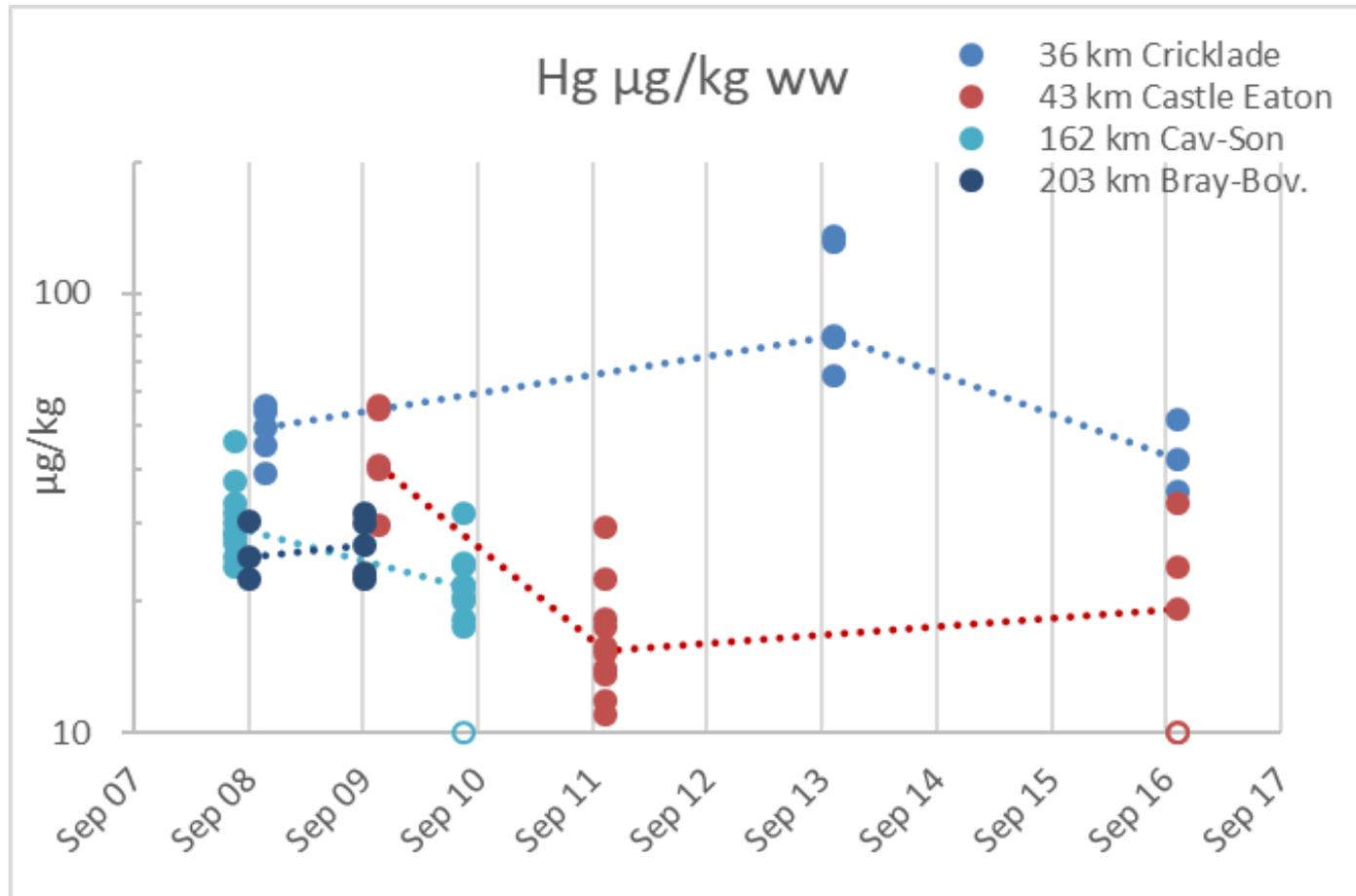
Food  
std 500  
µg/Kg



- Hg in fish is always detectable
- Mostly > EU EQS → possible risk for fish eating birds



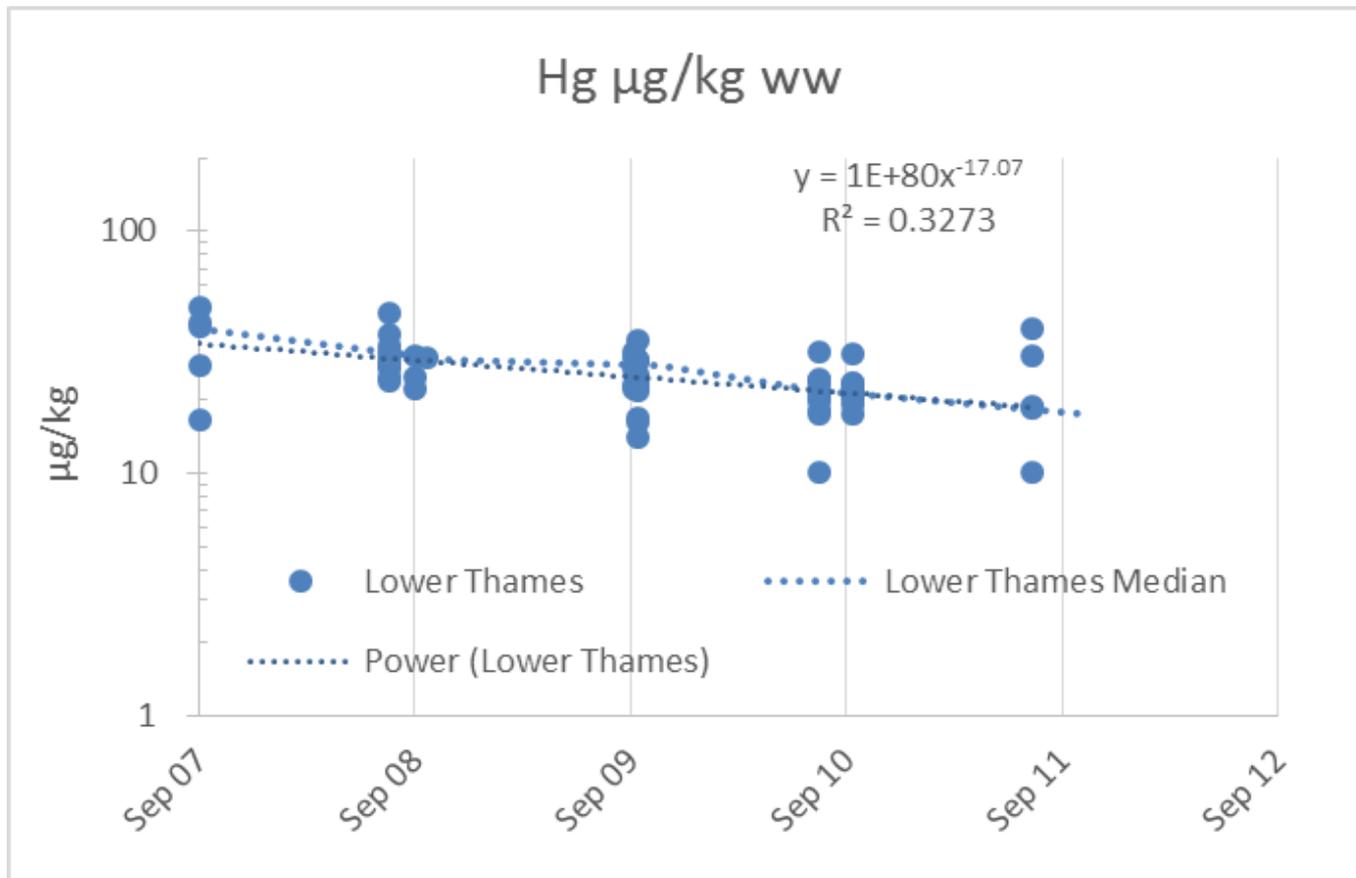
# What about temporal trends ?



Sites where metals have been measured in several years



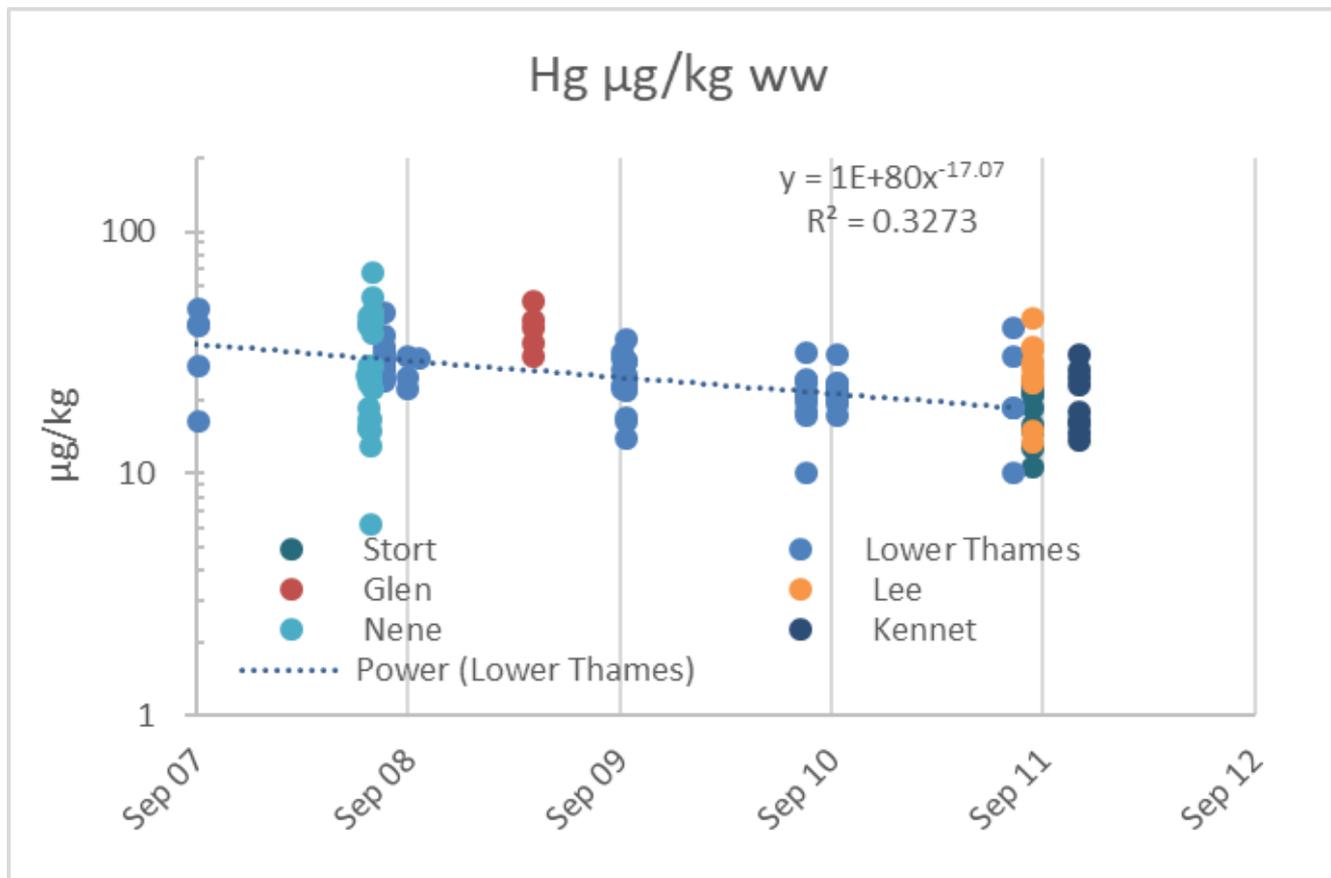
# What about temporal trends ?



Only Lower Thames samples lumped together



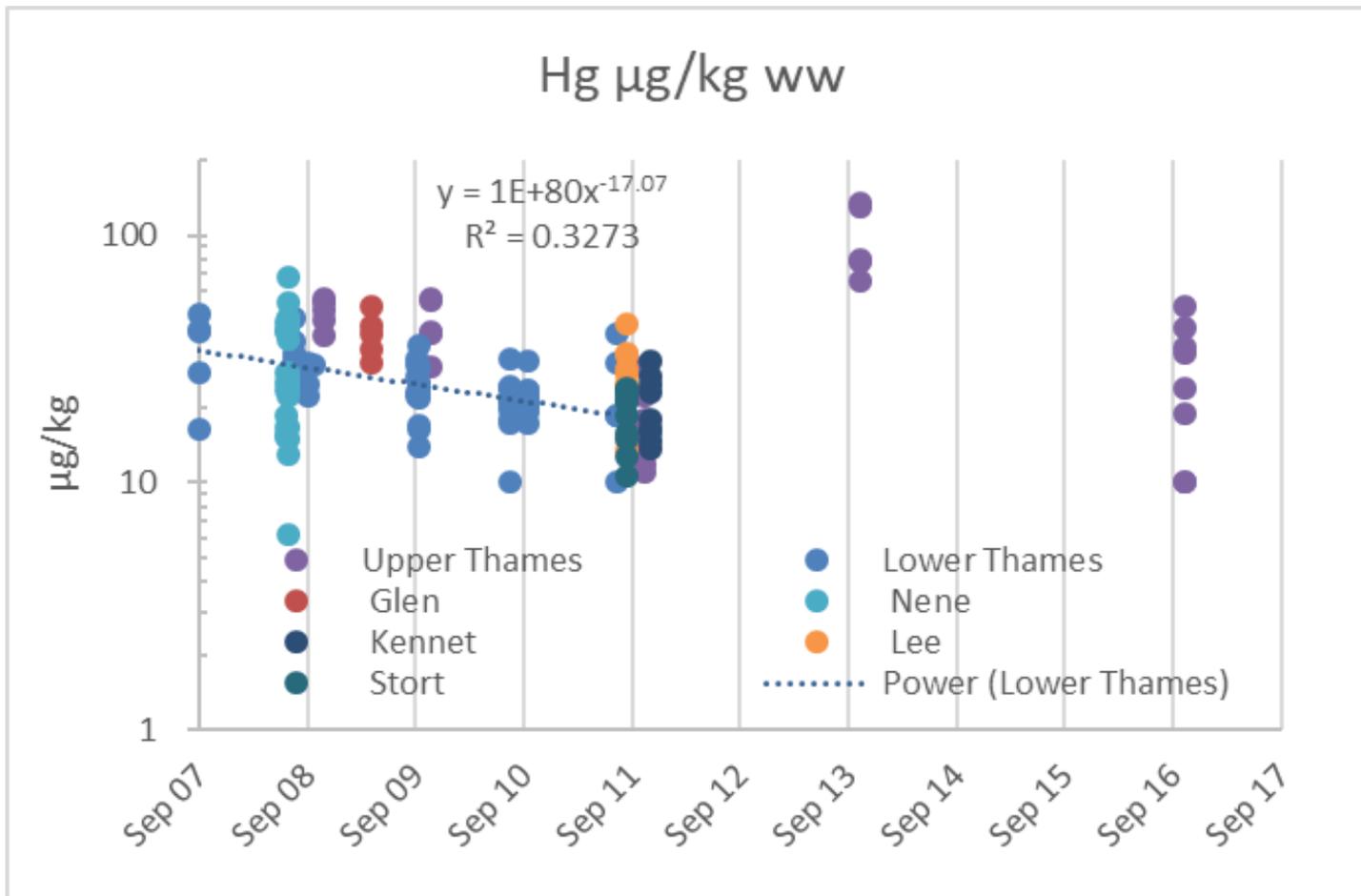
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Lower Thames samples lumped together

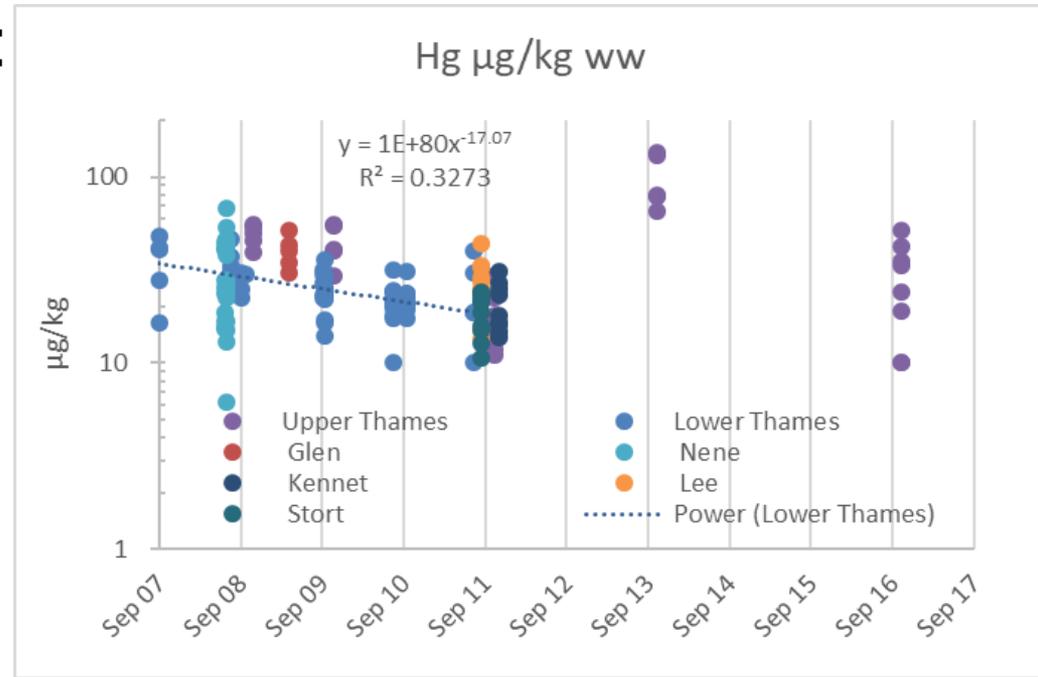


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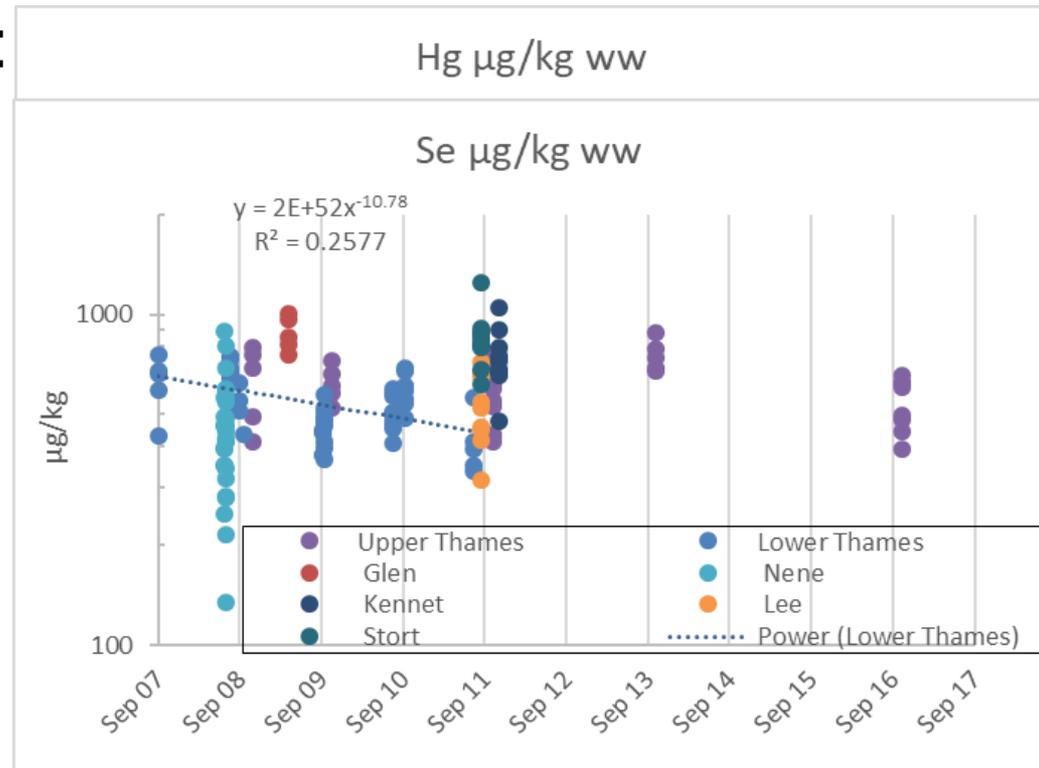
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- Similar to mercury (Hg):



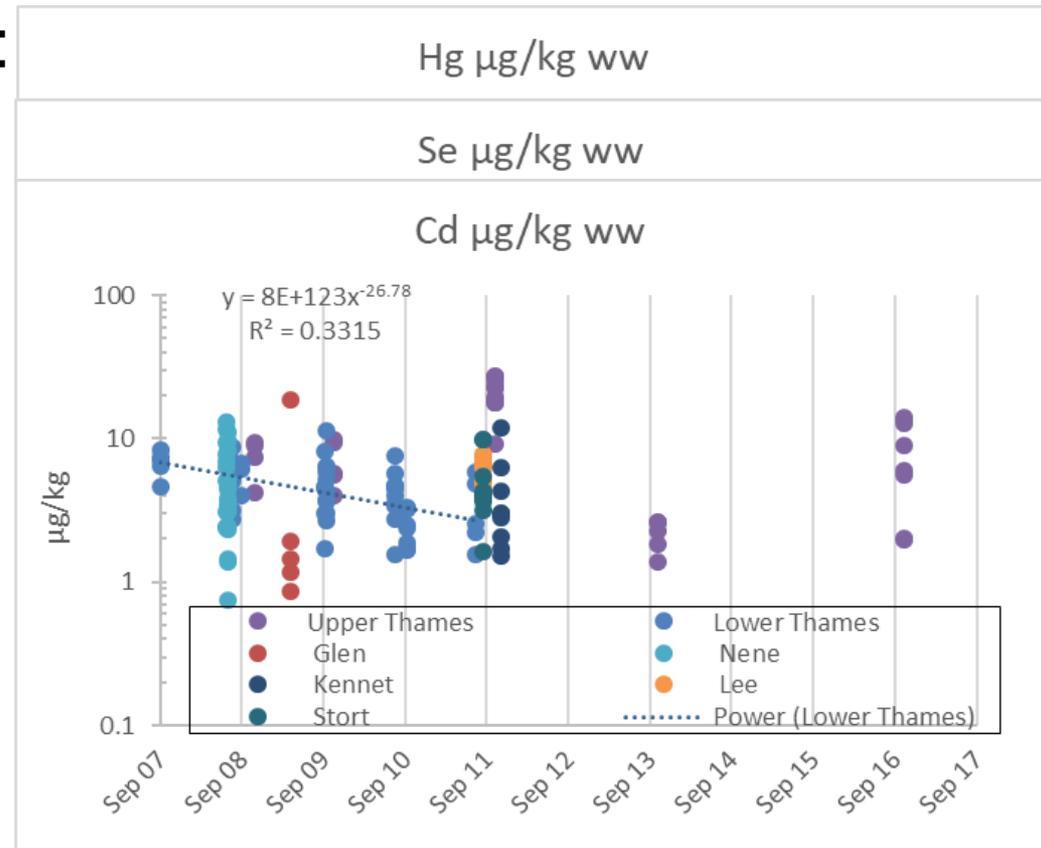
# What about temporal trends

- Similar to mercury (Hg):
  - Selenium (Se)



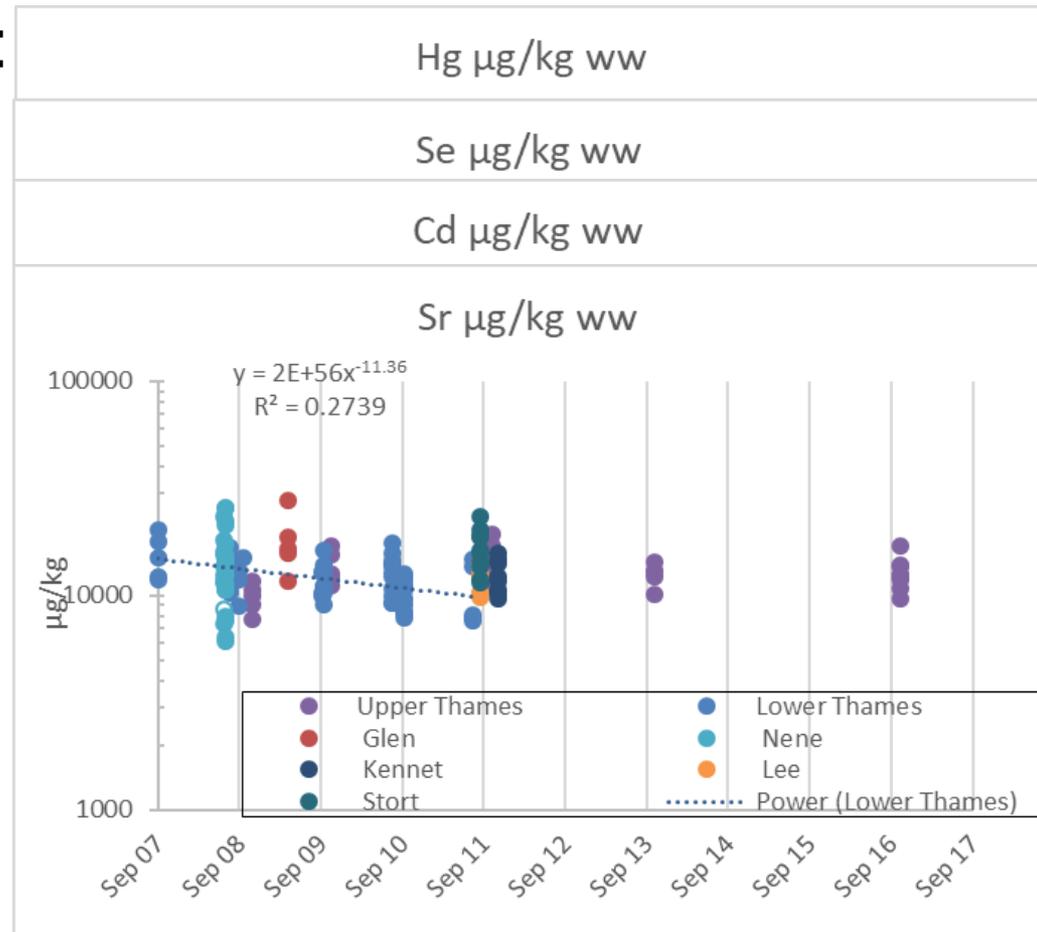
# What about temporal trends

- Similar to mercury (Hg):
  - Selenium (Se)
  - Cadmium (Cd)



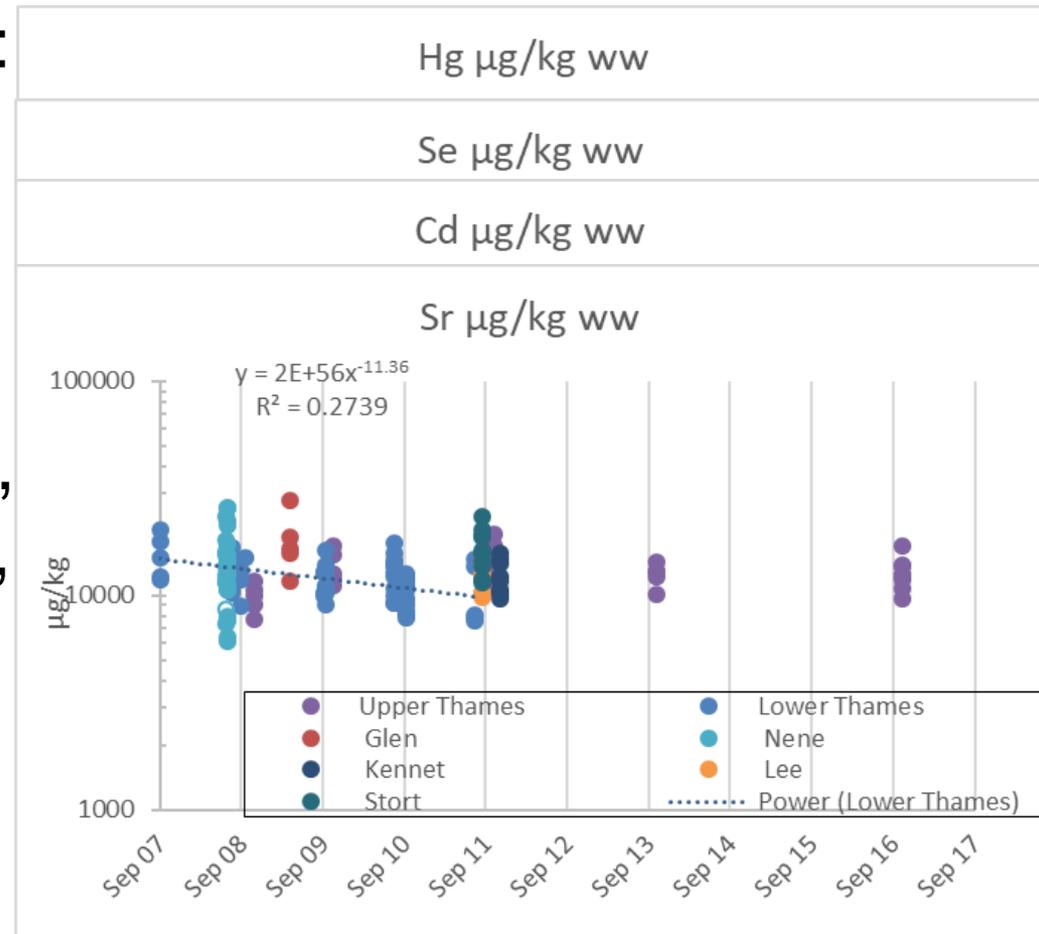
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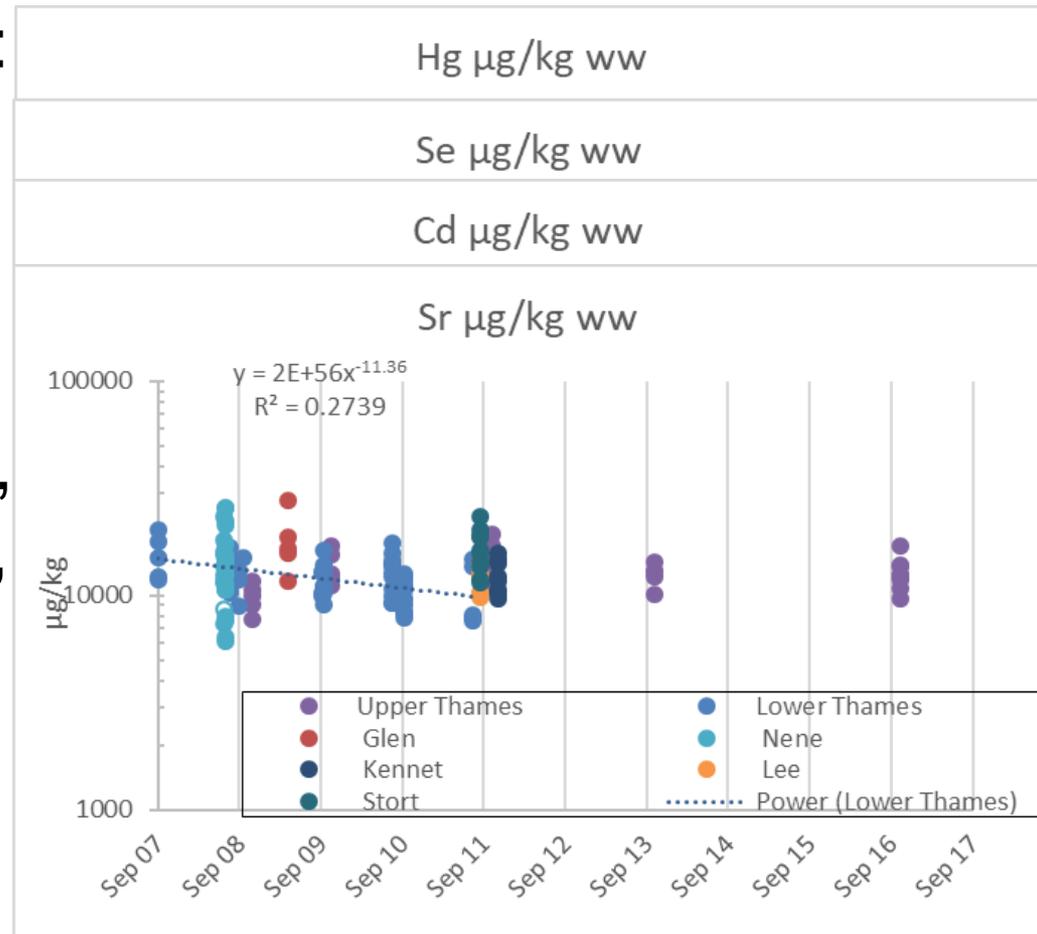
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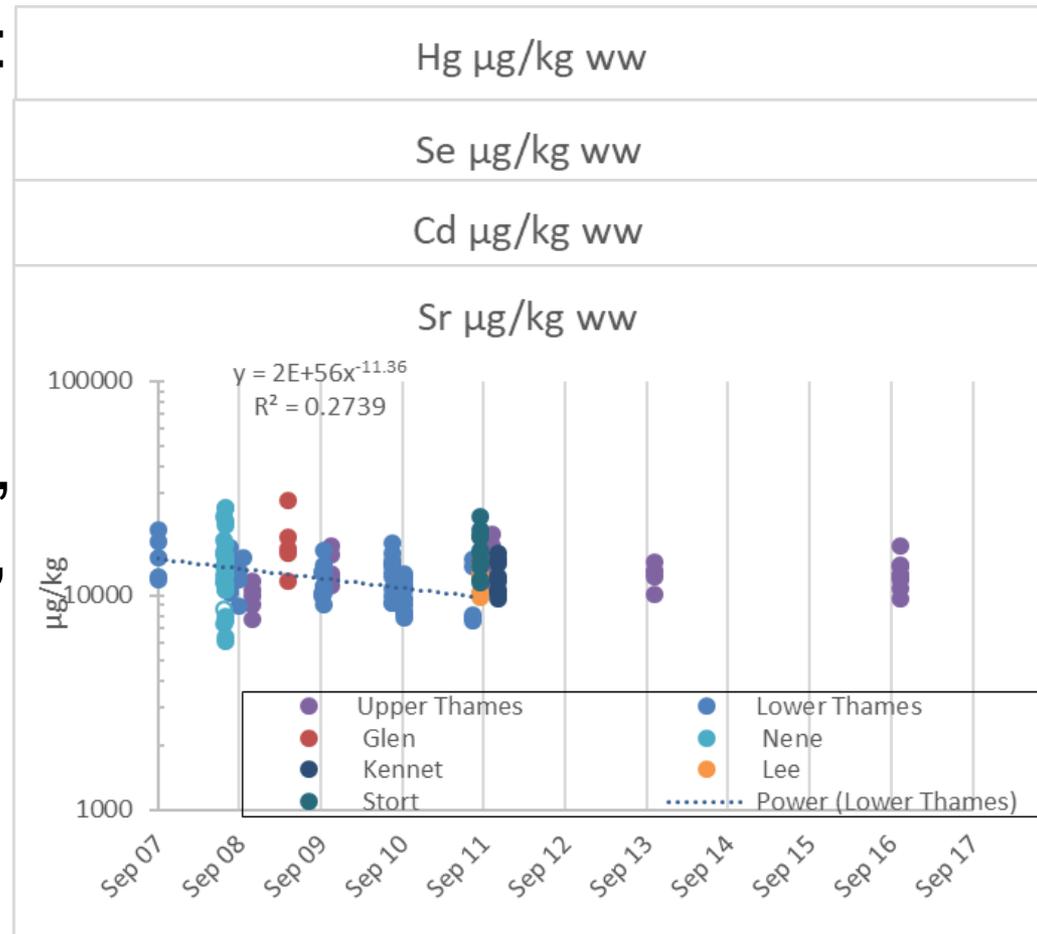
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Contents lists available at [SciVerse ScienceDirect](http://SciVerse ScienceDirect)

# Science of the Total Environment

journal homepage: [www.elsevier.com/locate/scitotenv](http://www.elsevier.com/locate/scitotenv)



## The presence of EU priority substances mercury, hexachlorobenzene, hexachlorobutadiene and PBDEs in wild fish from four English rivers



Monika D. Jürgens <sup>a,\*</sup>, Andrew C. Johnson <sup>a</sup>, Kevin C. Jones <sup>b</sup>, David Hughes <sup>b</sup>, Alan J. Lawlor <sup>c</sup>

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### HIGHLIGHTS

- A fish tissue archive was set up to monitor persistent pollutants in English rivers.
- The chemicals with EU EQS for biota (Hg, HCB, and HCBd) were measured in some fish.
- Hg concentration was size dependant and exceeded EQS of 20µg/kg in 79% of samples.
- HCB and HCBd were always below their standards of 10 and 55µg/kg.
- A proposed PBDE EQS of 0.0085µg/kg was exceeded more than 200 times in every fish.

### GRAPHICAL ABSTRACT

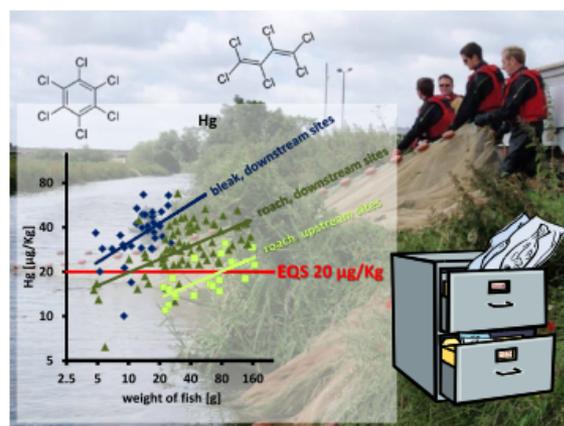




Photo - Heather Lowther, CEH

# Mercury is not the only interesting chemical in our fish ...

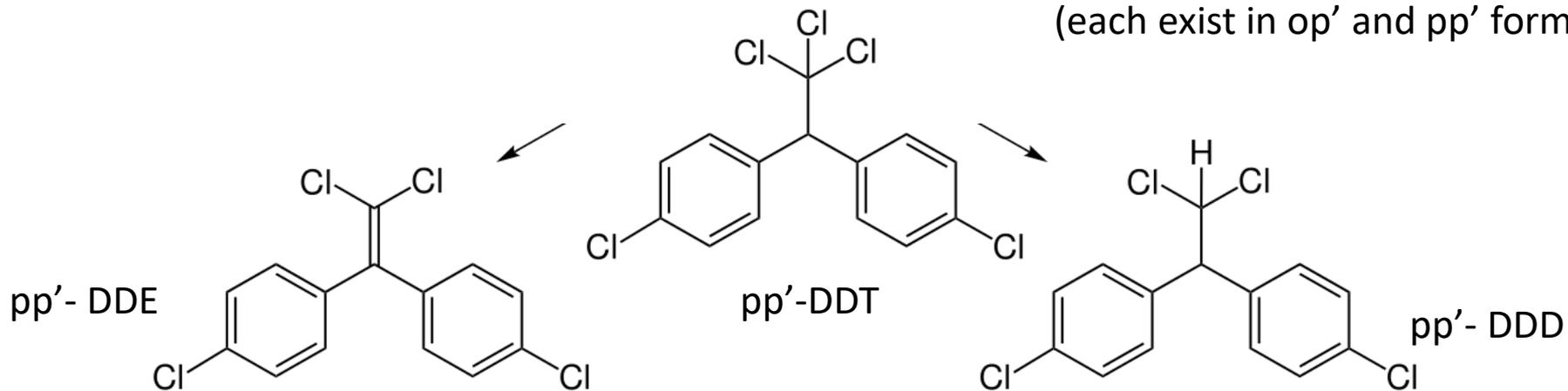


# DDT Dichlorodiphenyltrichloroethane

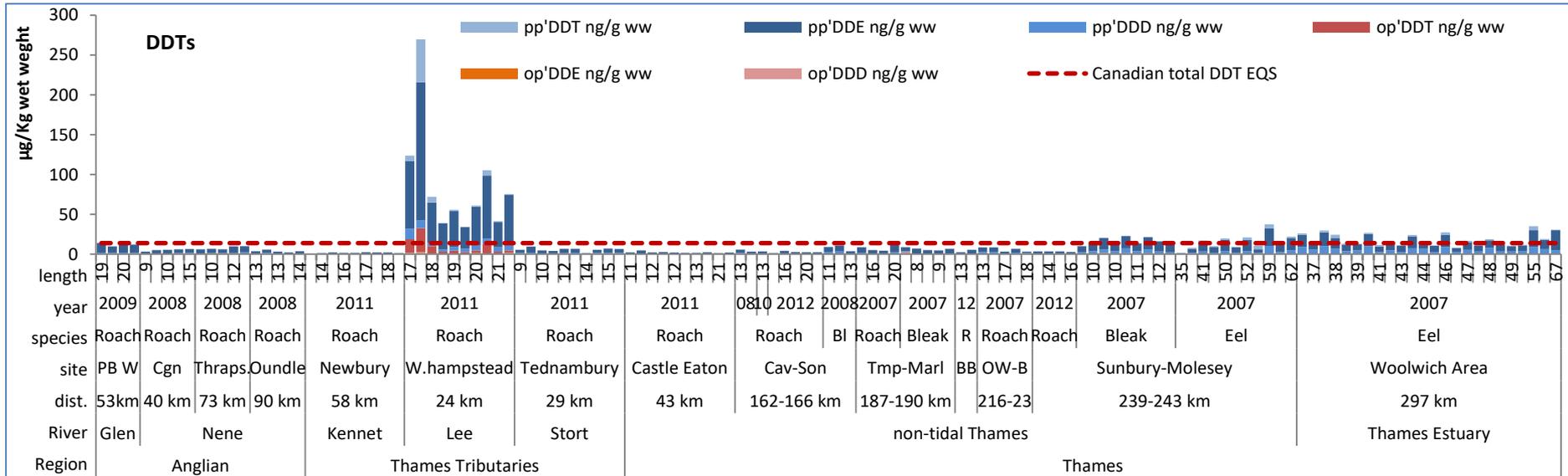


- Insecticide, widely used from the 1950s onwards
- Was banned in Europe in 1981, after it was discovered that it led to dangerous egg-shell thinning in birds
- Degrades to DDE or DDD:  $DDT + DDD + DDE = \Sigma DDT$

(each exist in *op'* and *pp'* forms)

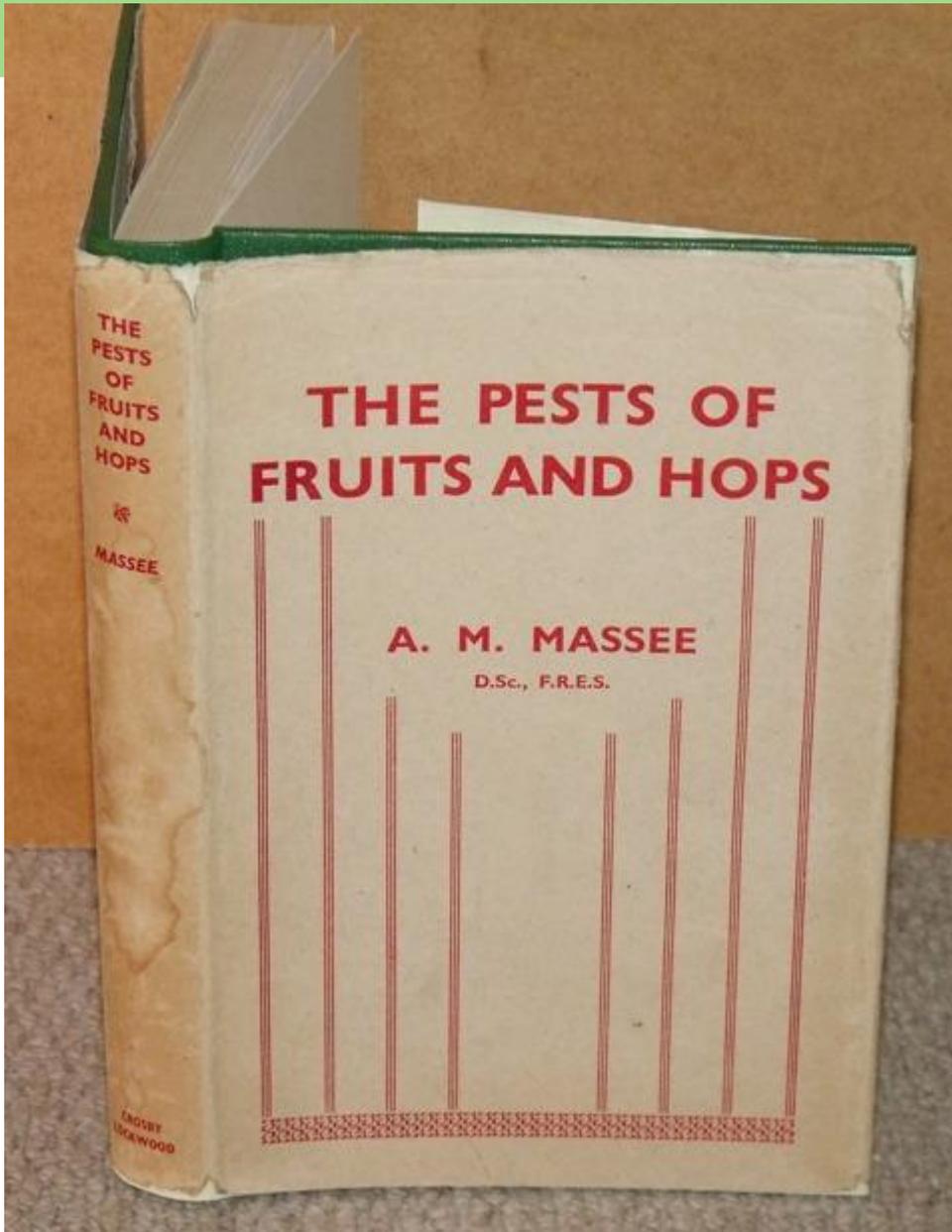


# Roach from one location are highly contaminated with banned pesticide DDT



Fish heavily contaminated at the River Lee at Wheathampstead in 2011!  
 These fish were only 6-8 years old.





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- Massee, A. M. (1946). The Pests of Fruit and Hops - second edition, revised.

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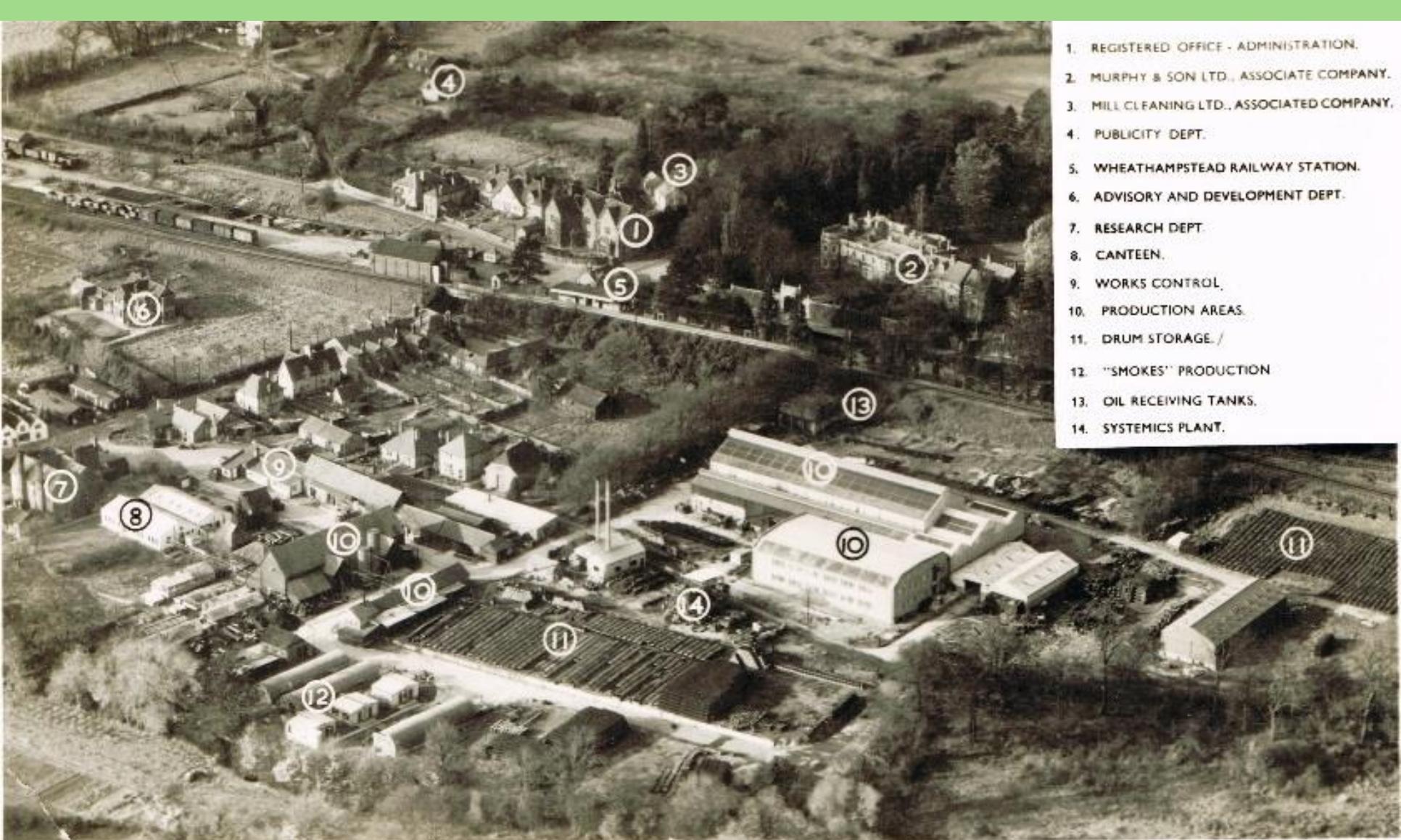
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AND  
HOPS

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# Murphy Chemical Company

- Former pesticide factory with R&D

- 200-400 m upstream of sampling site

Murphy & Son brewery supplies 1887-today (now in Nottingham)

Murphy Chemicals ca.1931-1982

reed beds

For treating contaminated groundwater

**DDT was banned in 1981 → Murphy closed 1982 → but high concentrations were found in 6-8 year old fish caught in 2011**



Contents lists available at ScienceDirect

Chemosphere

journal homepage: [www.elsevier.com/locate/chemosphere](http://www.elsevier.com/locate/chemosphere)



## The long shadow of our chemical past – High DDT concentrations in fish near a former agrochemicals factory in England



Monika D. Jürgens <sup>a,\*</sup>, John Crosse <sup>b</sup>, Patrick B. Hamilton <sup>c</sup>, Andrew C. Johnson <sup>a</sup>, Kevin C. Jones <sup>b</sup>

<sup>a</sup> Centre for Ecology and Hydrology, Wallingford OX10 8BB, UK

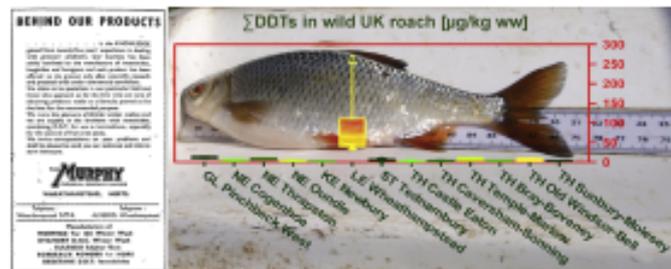
<sup>b</sup> Lancaster University, Lancaster Environment Centre, LA1 4YQ, UK

<sup>c</sup> University of Exeter, Biosciences, Exeter EX4 4QD, UK

### HIGHLIGHTS

- Roach (*Rutilus rutilus*) from 13 UK river sites were analysed for pesticides.
- Fish from one site had much higher  $\Sigma$ DDT content (DDT + DDE + DDD) than others.
- The explanation was found in a former pesticide factory nearby.
- A review found some similar hot-spots in recent European  $\Sigma$ DDT data in fish.
- Some fish contained levels of DDT harmful to them or their predators.

### GRAPHICAL ABSTRACT



**Any  
Questions**

