

# The devil is in the detail; the impact of invasive shrimps on the reliability of biotic indices used to assess water quality in Isle of Man rivers



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# Overview

1. Background on Isle of Man river systems
2. How the Isle of Man (+UK) assesses river quality using biotic indices based on macroinvertebrates.
3. How invasive shrimps can impact on the reliability of these indices to reflect changing water quality in two ways;
  - (a) Biotic – invader being more predatory/aggressive than the native
  - (b) Abiotic – invader being more tolerant of poor water quality than the native
4. Brief example of a way forward to account for the presence of invaders during routine water quality assessment.





# Isle of Man

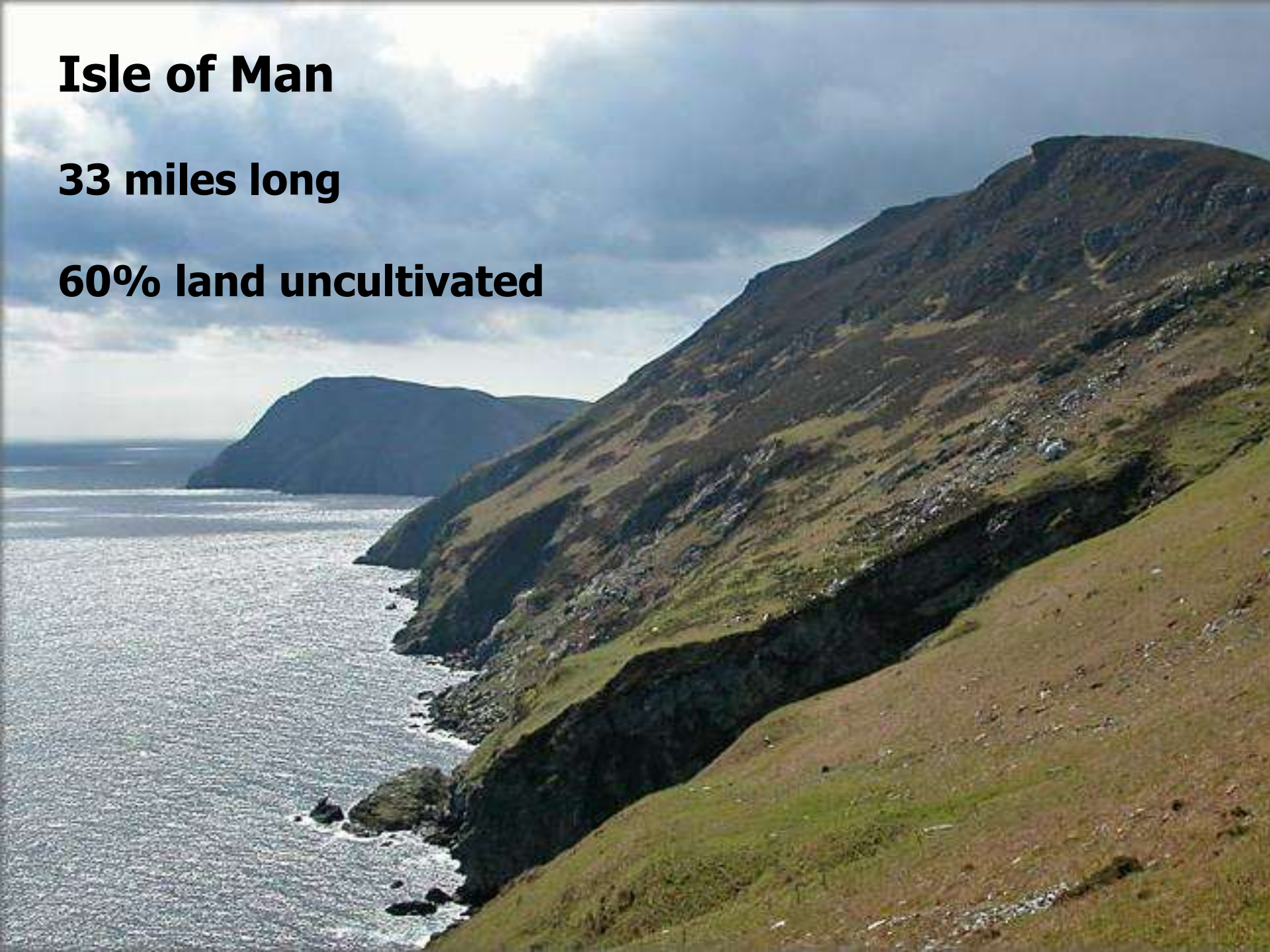
(572 km<sup>2</sup> )



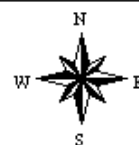
# **Isle of Man**

**33 miles long**

**60% land uncultivated**



# RIVERS OF THE ISLE OF MAN



Address: Gazetteer  
 Mainframe Original  
 Primary  
 Updated  
 Deleted

Point Detail

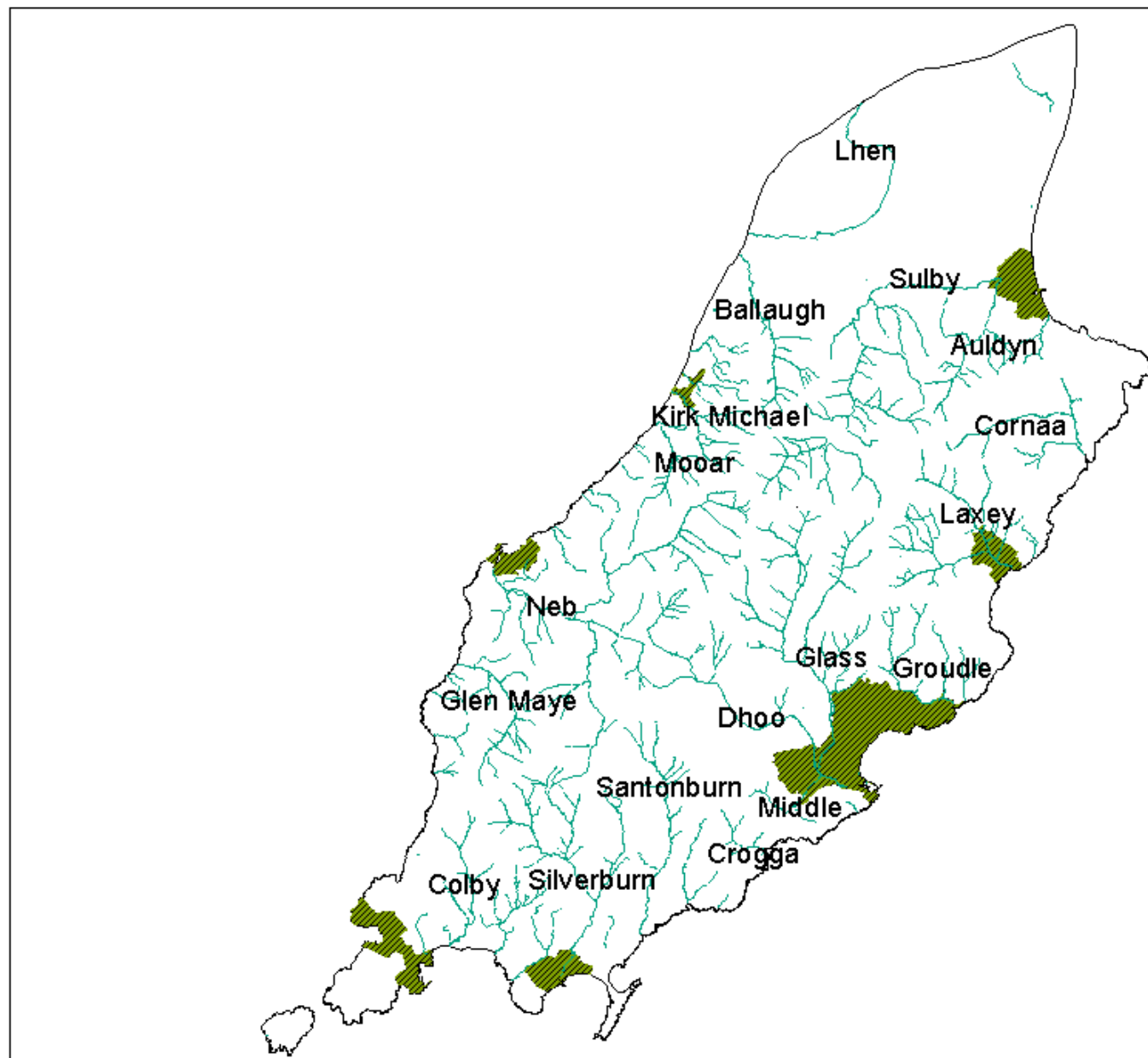
- Boundary Post
- Boundary Marking
- Trig Point
- Bench Mark
- Surface Level
- Pylons
- Miscellaneous Points
- Row Arrow
- Building Seeds
- Glasshouse seed
- Barriers
- Coniferous Trees
- Coppice / Gales
- Marsh/Saltmarsh/Roads
- Non-Coniferous Trees
- Orchard
- Heath
- Rock
- Rough Grassland
- Scrub
- CIP
- Slope
- Water
- Scree
- Positioned Boulder

Road Classification

- No
- "A" Road
- "B" Road
- "C" Road
- "D" Road
- "E" Road
- "F" Road
- Unclassified

Line Detail

- Building Outline
- Building Fenced
- Parish Boundary
- District Boundary
- Island Boundary
- Electoral Boundary
- Railway
- Road Marking
- General Detail
- General Fick Detail
- Underground Detail
- Veg/Landform Limit
- Overhead Detail
- Minor Detail
- Water Feature
- Mean High Water
- Mean Low Water
- Top of Slope
- Top of CIP
- Bottom of Slope or CIP



1 0 1 2 3 4 5 Kilometers











# IOM Farming industry = main polluters

**Two new dairy farms  
every year**

**Organic pollution,  
nitrates and phosphates**





# Biological water quality monitoring

'Kick samples are fun'



cheap, low-tech, reliable,  
gives very quick 'feel' for  
state of a site

## BMWP

\*each type of macroinvertebrate given a score  
(1-10) based on tolerance /sensitivity  
to organic pollution + all scores added up

## ASPT

\*the average score for animal in that site

10



Mayfly

2



Chironomid

1

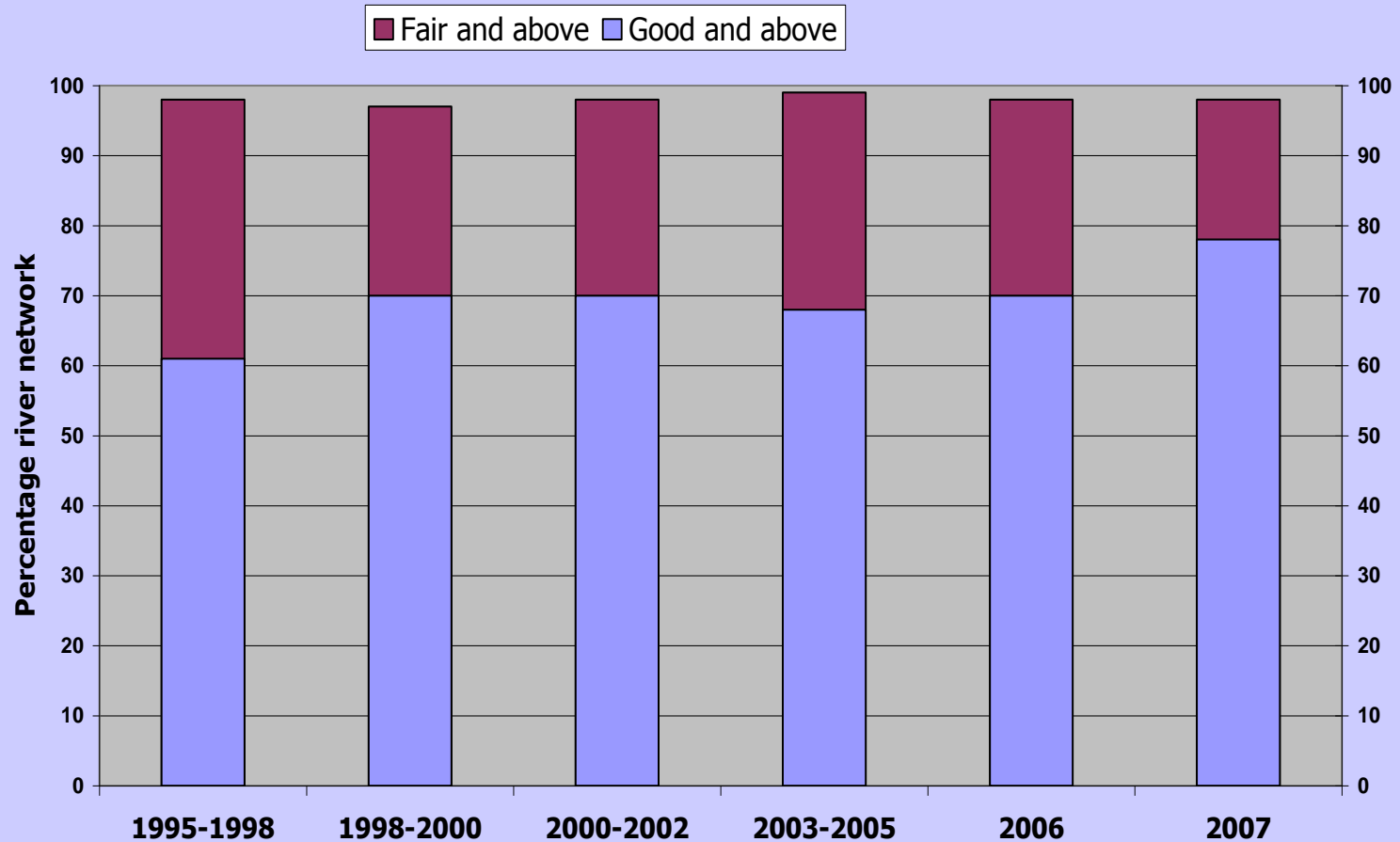


Worms



# Government key performance indicator - Biological river quality

Chart showing percentage of monitored river length achieving fair or above biological quality 1995 – 2007 as measured by river water analysis.





# All shrimps are equal



*Gammarus duebeni celticus* native to Ireland + Isle of Man (16-18 mm)



*Crangonyx pseudogracilis* invasive to British Isles (4-8 mm)



*Gammarus pulex* – invasive to Ireland + Isle of Man (15-17mm)



*Dikerogammarus villosus*  
'The Killer Shrimp'  
1<sup>st</sup> detected in U.K. in 2010  
(25-30 mm)





*Crangonyx pseudogracilis*



The Isle of Man

1980s

N. Ireland

H. B. N. Hynes as 'experiment'!

1940s

English fishermen as 'fish food'!

1950s



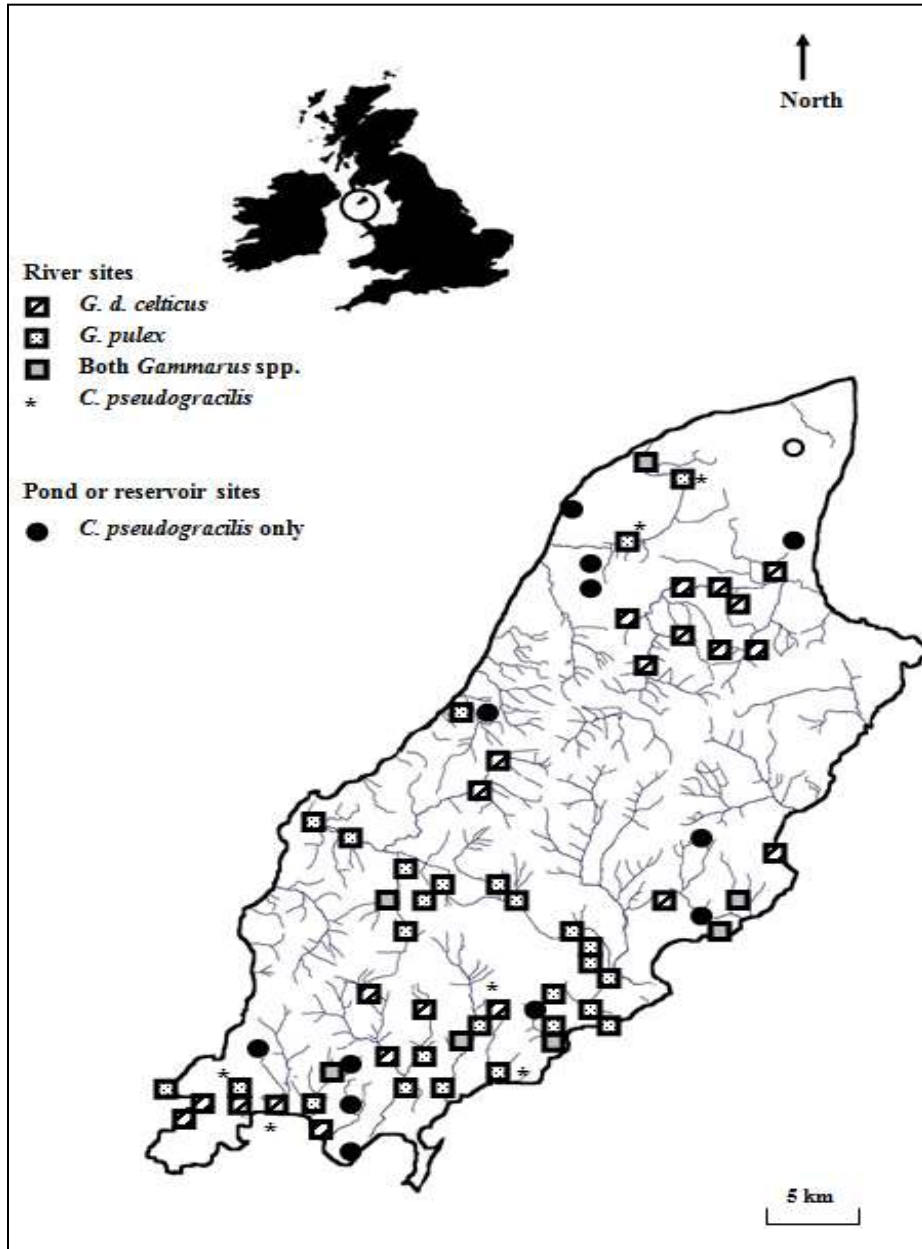
*Gammarus pulex*

**Some shrimps are more equal than others ! – IGP in action**





# Some shrimps are more equal than others



*G. pulex* in 3 minute kick sample for routine biological water quality monitoring, Middle River



# The Monks' Bridge, Isle of Man – native : invader stasis ?

Hynes in 1949 - 'part of the structure of the Monks' bridge (1136 AD)..is probably an effective barrier to *G. pulex*'





# The Monks' Bridge, Isle of Man – native : invader stasis ?

*G. d. celticus*

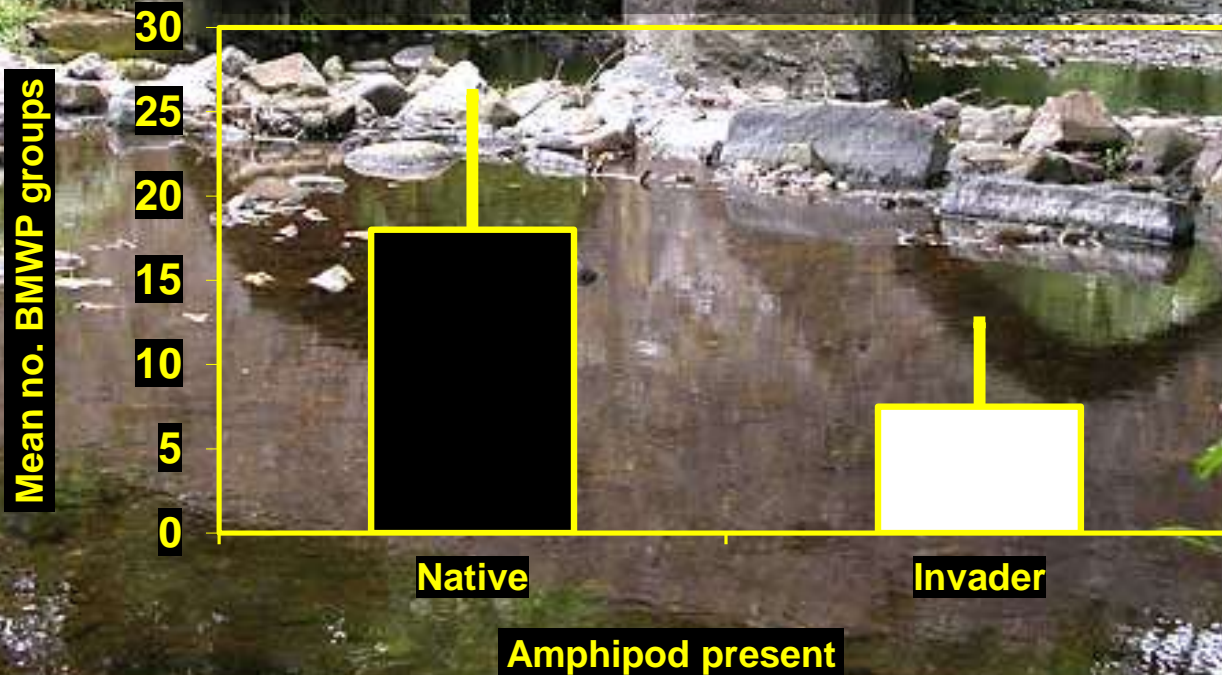
12% rel. abundance

ASPT = 4.8

*G. pulex*

82%

3.2



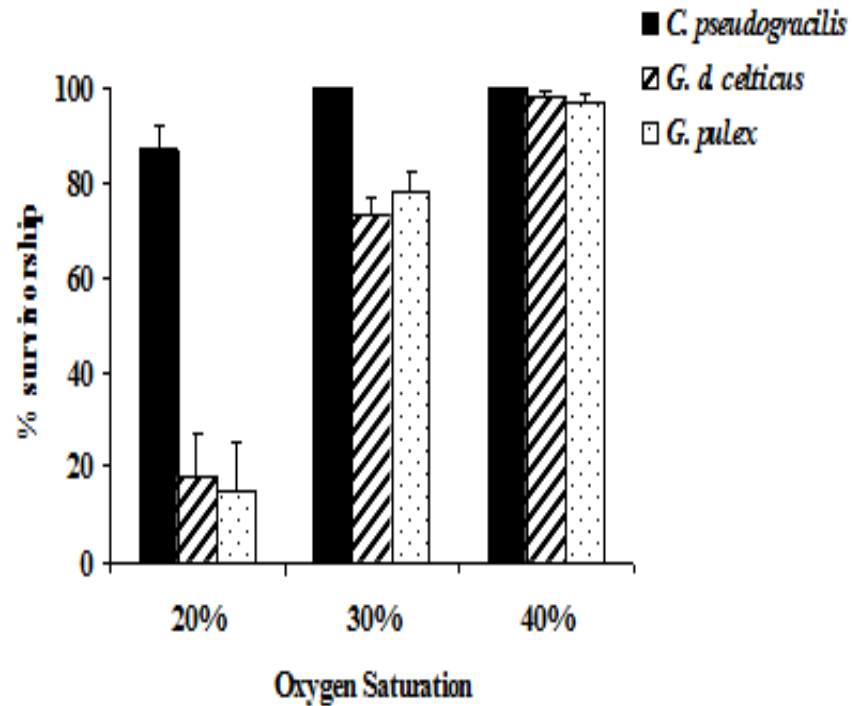


# *Crangonyx* v. *Gammarus*

Dissolved oxygen expts



Single amphipod species  
after 24 hrs

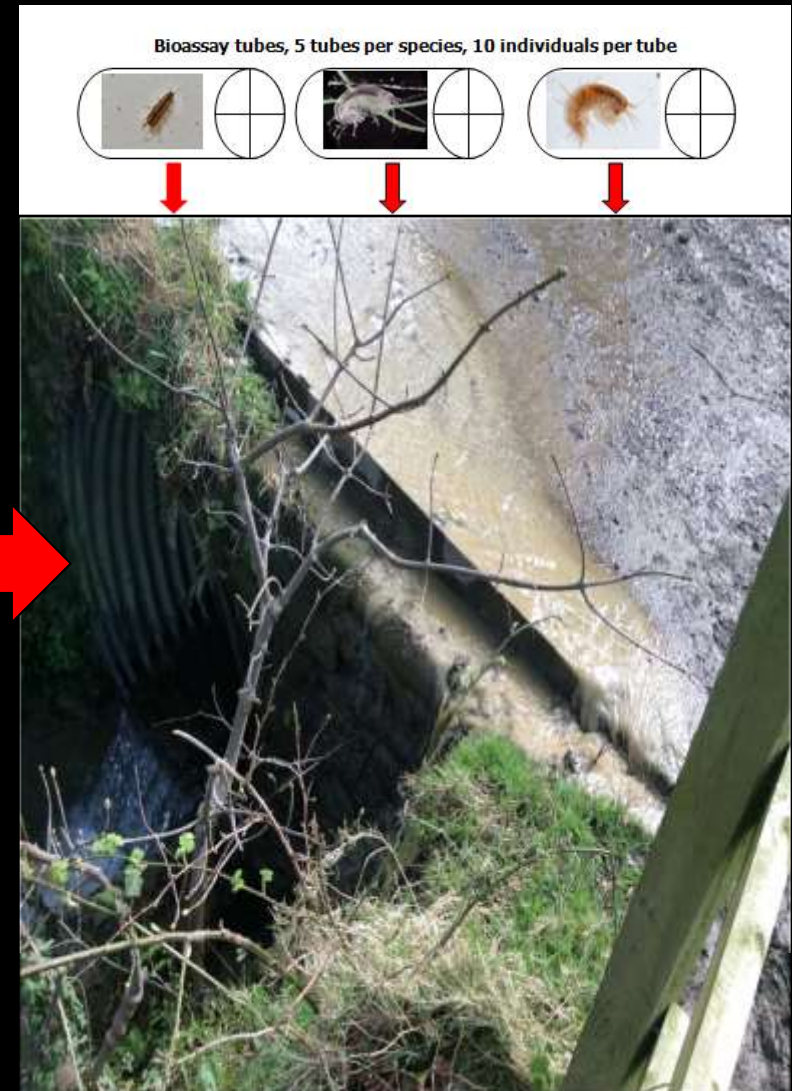




# Barnell stream, Isle of Man – major pollution incident 2015



# Transplantation / bioassay expt.





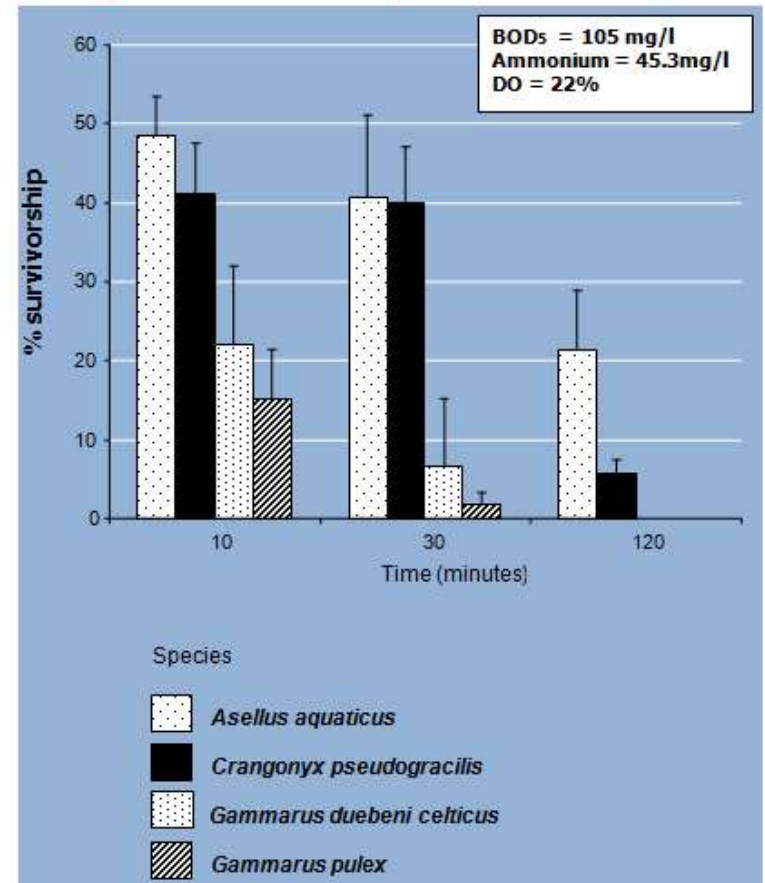
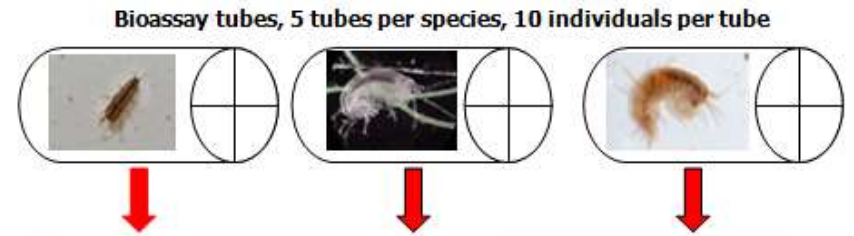
# Immediate aftermath of slurry spill

6 miles river impacted

800+ dead trout/salmon recovered

Macroinvertebrates at discharge point wiped out

$BOD_5 = 300 \text{ mg/l}$

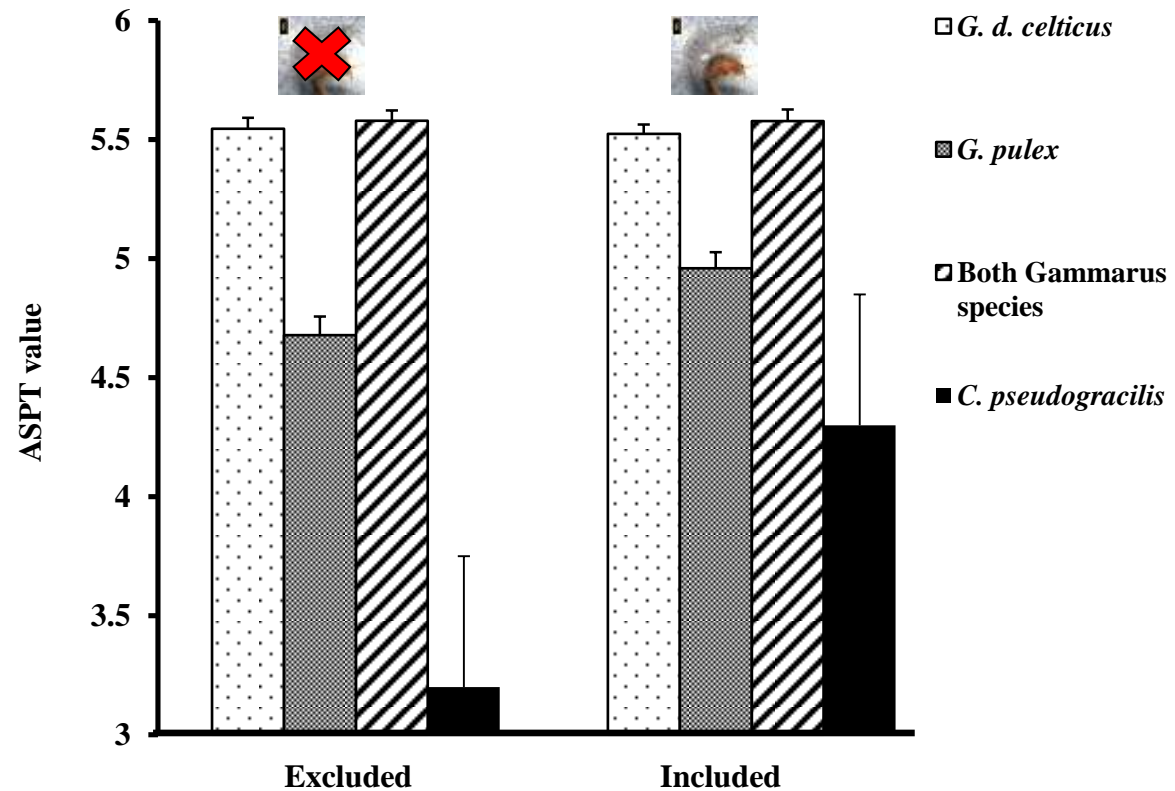


Mean survivorship ( $\pm$ SE) of an isopod and 3 amphipod species in bioassay tubes at site of slurry spill. Tubes transplanted into river site 24hrs after spill and survivorship of each species assessed after 10 minutes, 30 minutes and 120 minutes *in situ*.

# Problems of biotic indices when invader is more pollution tolerant than native

Invader falsely elevates biotic index score, while native does not 'over-inflate' score

119 sites





# Biocontamination – a way forward?

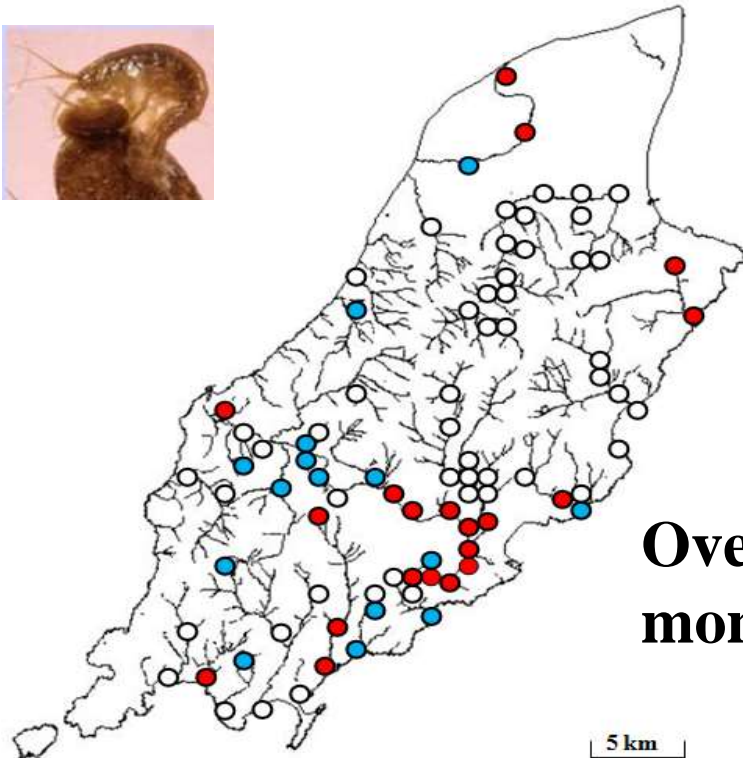
**Biological Contamination Index (BCI)** derived from two metrics

(Arbačiauskas et al. 2008) :

**ACI - Abundance** contamination index  
the number of specimens of alien  
species (AS) in a community.

**RCI - Ordinal richness** contamination index  
the proportion of alien orders within

## Biocontamination of Isle of Man routine water quality monitoring sites



- no invaders / natives only
- Low / moderate invasives less than 50%
- High / severe invasives more than 50%

**Over 1/3rd of Isle of Man routine  
monitoring sites = biocontaminated**

What next ?



“



Life is one damned thing after another  
*Elbert Hubbard*

”



**Thanks for listening**

