

Enteric viruses in shellfish

What, how, where?

Kata Farkas, PhD, Bangor University, North Wales
Vanessa Kienmoser, Shelagh K Malham, Davey L Jones

Enteric viruses in the environment



- Contaminated humans are supershedders
 - 10^5 - 10^{11} norovirus particles/g stool
 - Probability of infection: 0.3-0.4 / norovirus particle
- Released daily in treated wastewater
 - 10^2 - 10^6 norovirus particles/litre
- Seawater contamination
 - Persistent for up to 1-2 years
- Accumulation in sediment
- **Shellfish contamination**





Norovirus outbreak from B.C. oysters makes dozens sick

Vancouver oyster bar owner expects his business to take a hit, as health officials issue warning

By Rafferty Baker, CBC News

[Services](#) [Contact](#)

MARLER CLARK
THE FOOD SAFETY LAW FIRM

Raw Oyster Norovirus Outbreak in Seattle

By [Anthony Marangon](#) on January 31, 2017

POSTED IN [FOOD POISONING INFORMATION](#)

Public Health recently investigated a cluster of norovirus-like illness associated with consuming raw oysters. Norovirus is the name of a group of viruses that cause viral gastroenteritis. Norovirus is found in the stool and vomit of infected people and is usually spread person-to-person or by contaminated food. Consuming raw or undercooked shellfish, particularly raw oysters, also increases the chances of becoming ill with norovirus. Symptoms of norovirus include nausea, vomiting, watery diarrhea, stomach cramps, fever, chills, headache, and body aches. Norovirus illnesses typically last 12-60 hours.



On 1/9/17, Public Health was notified of 4 cases of norovirus-like illness from the same meal party who had consumed raw oysters at Taylor Shellfish (located at 124 Republican St in Seattle) on 1/4/17. Two females and two males became ill 20-29 hours after consuming

Oysters behind norovirus outbreak in New Zealand



By Joe Whitworth+ [✉](#)

07-Feb-2017

Last update

Norovirus Causes Outbreak Linked to Oysters

April 19, 2017

By: James Peacock

The Washington State Department of Health announced recently that it was investigating an outbreak of Norovirus associated with people eating raw oysters. These reports come from all over the state, though it is unknown exactly just how many cases of Norovirus are being reported. As number of reported illnesses has increased, it has become more and more clear where the contamination is coming from. Having tracked down the harvest areas responsible for the contamination, there were several small recall associated with this outbreak. Shellfish that were harvested from the closed areas were recalled on March 2, April 4, and April 5.



What?

- RNA viruses

- Norovirus GI and GII
- Hepatitis A virus
- Hepatitis E virus
- Sapovirus
- ...

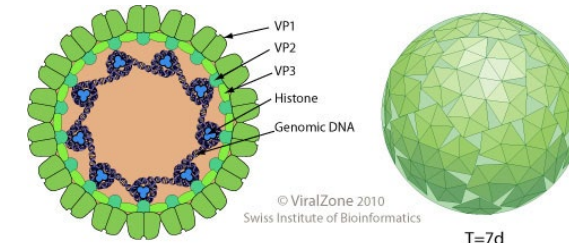
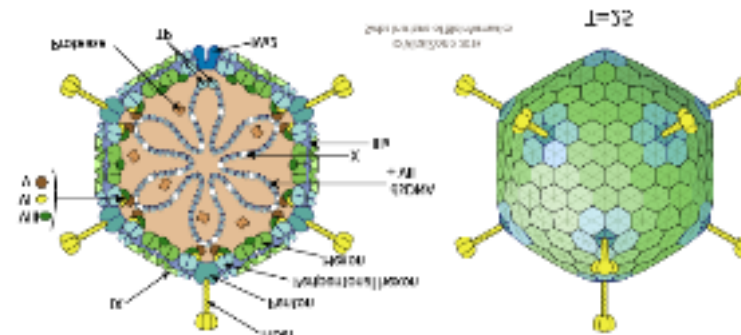
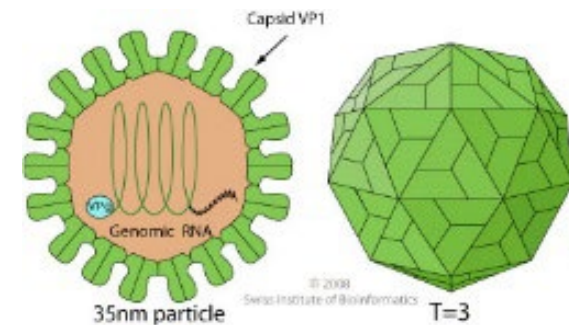
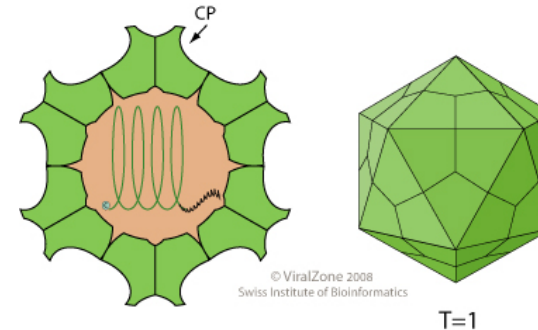
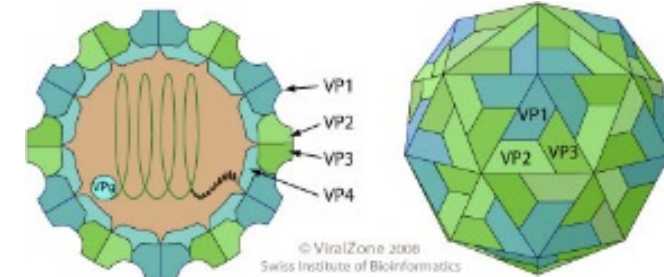
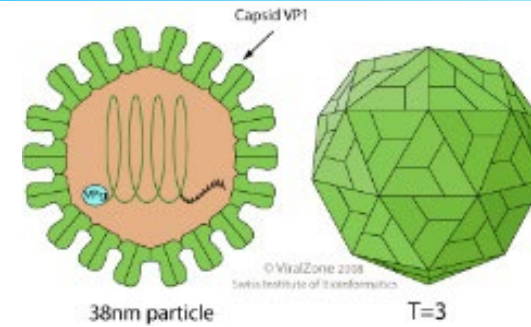
COMMON

EMERGING

- DNA viruses

- Adenoviruses
- Polyomaviruses

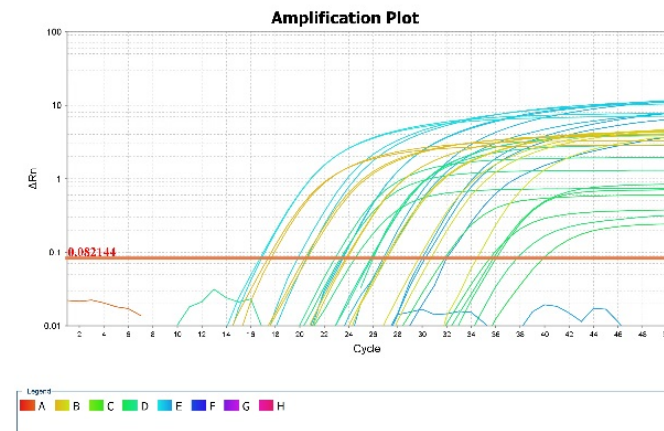
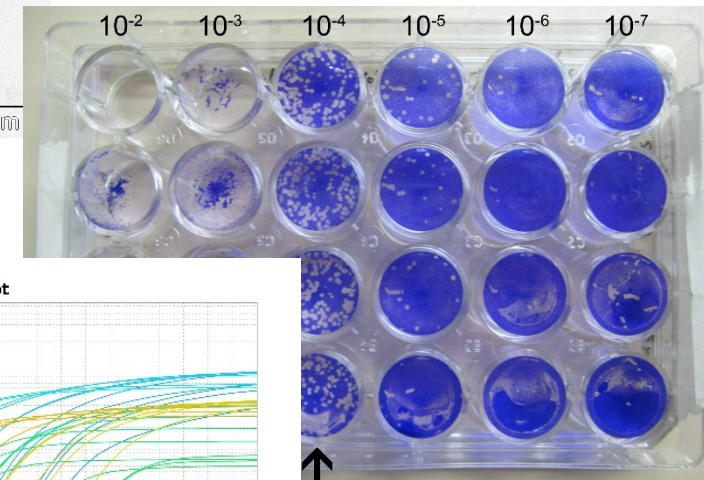
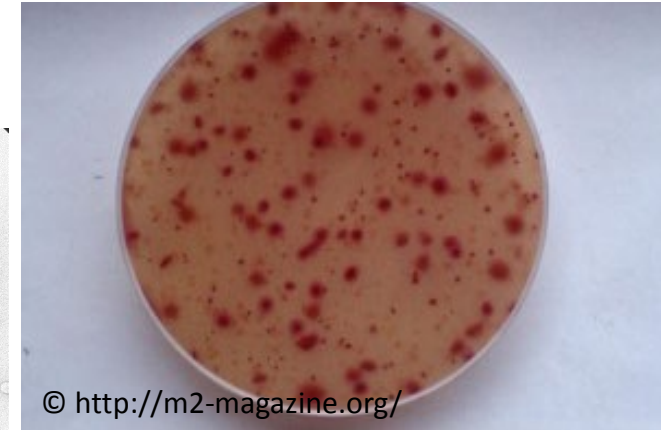
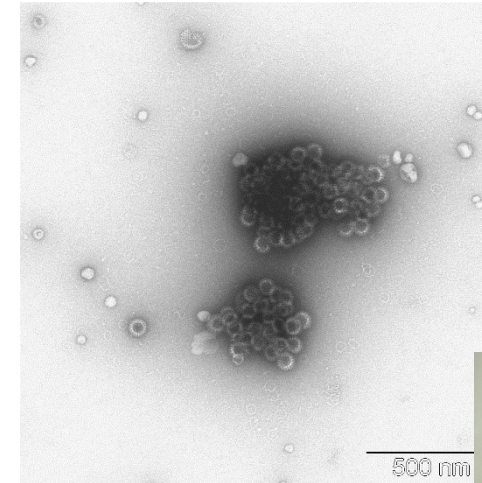
INDICATOR



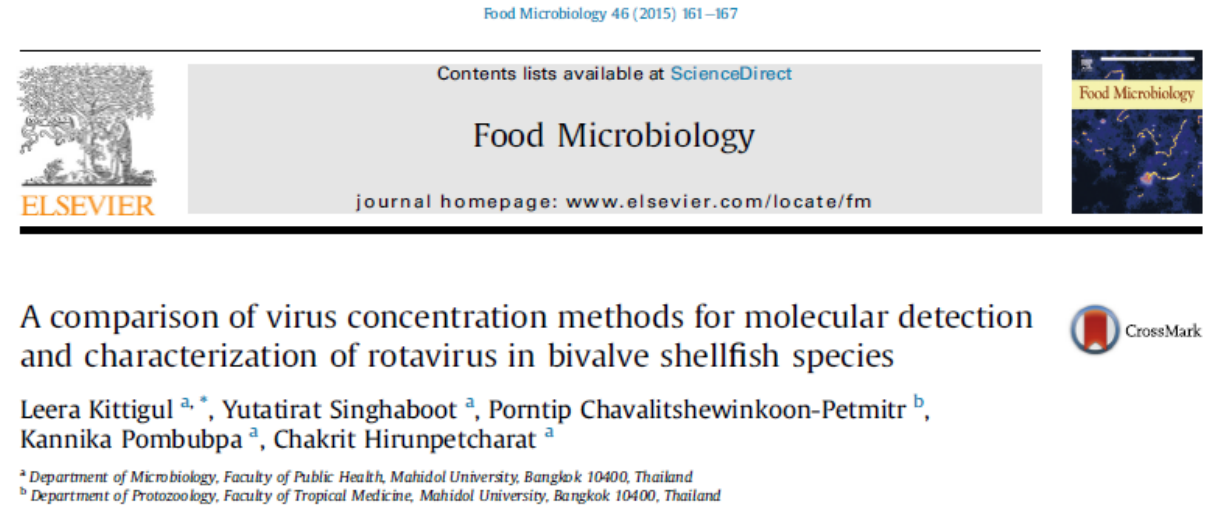
How?

Detection and quantification

- Cell/tissue culture
- Electron microscopy
- ELISA
- q(RT-)PCR vs dPCR
- Sample process?
- Infectivity?
- Inhibition?



- ISO/TS 15216-1:2013 standard
 - Elution with proteinase K
- Elution with alternative buffer
 - PBS
 - SM
 - Beef extract (hydrophobicity)
- Adsorption-twice-elution-extraction (Kittigul et al, 2015)
 - tryptose phosphate broth, pH 9 – arginine, pH 7.5 – chloroform



Quantification



- TaqMan qPCR – Adenovirus
- Multiplex qRT-PCR – RNA viruses

Food Environ Virol
DOI 10.1007/s12560-017-9293-5

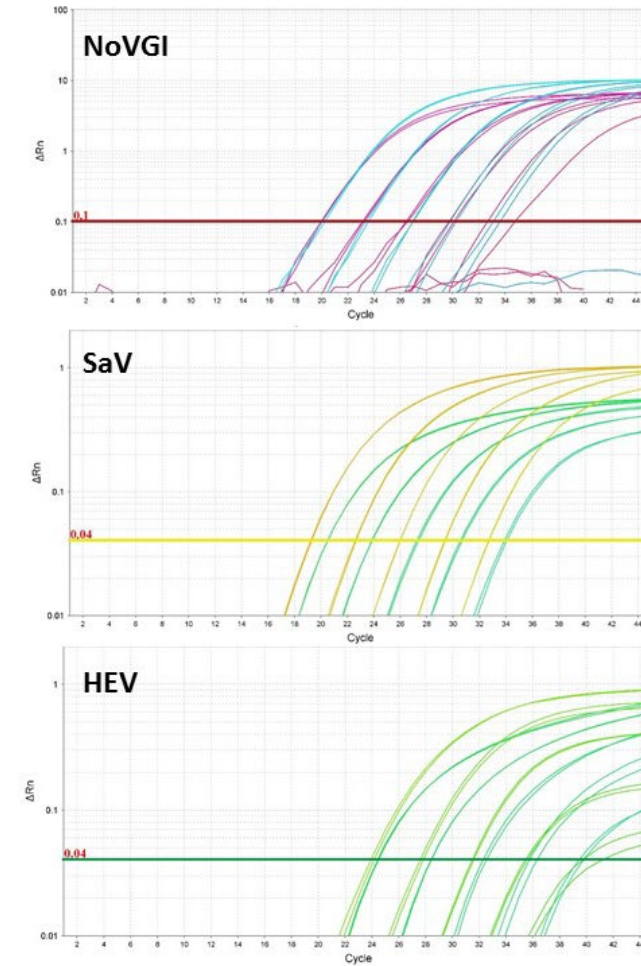
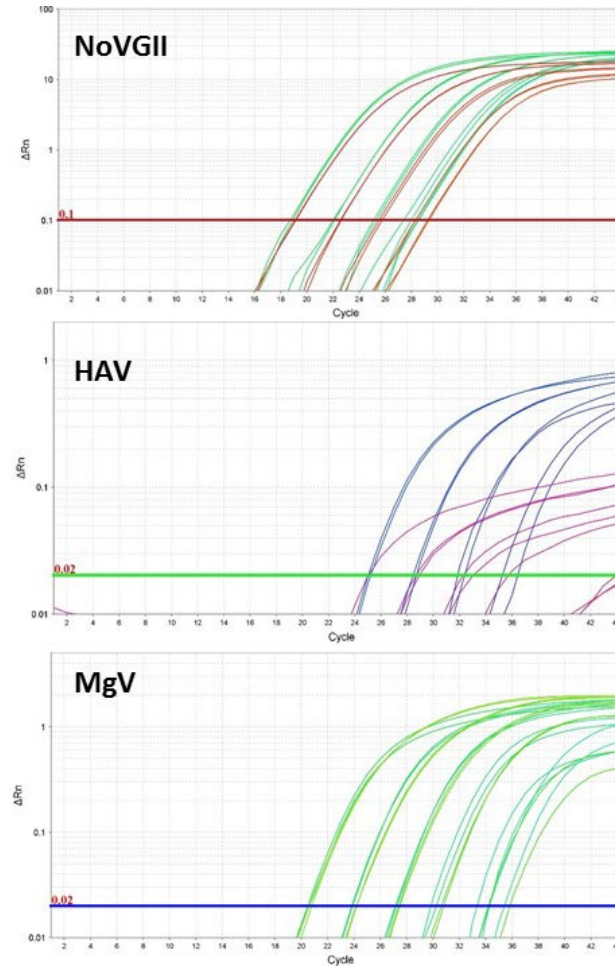


ORIGINAL PAPER

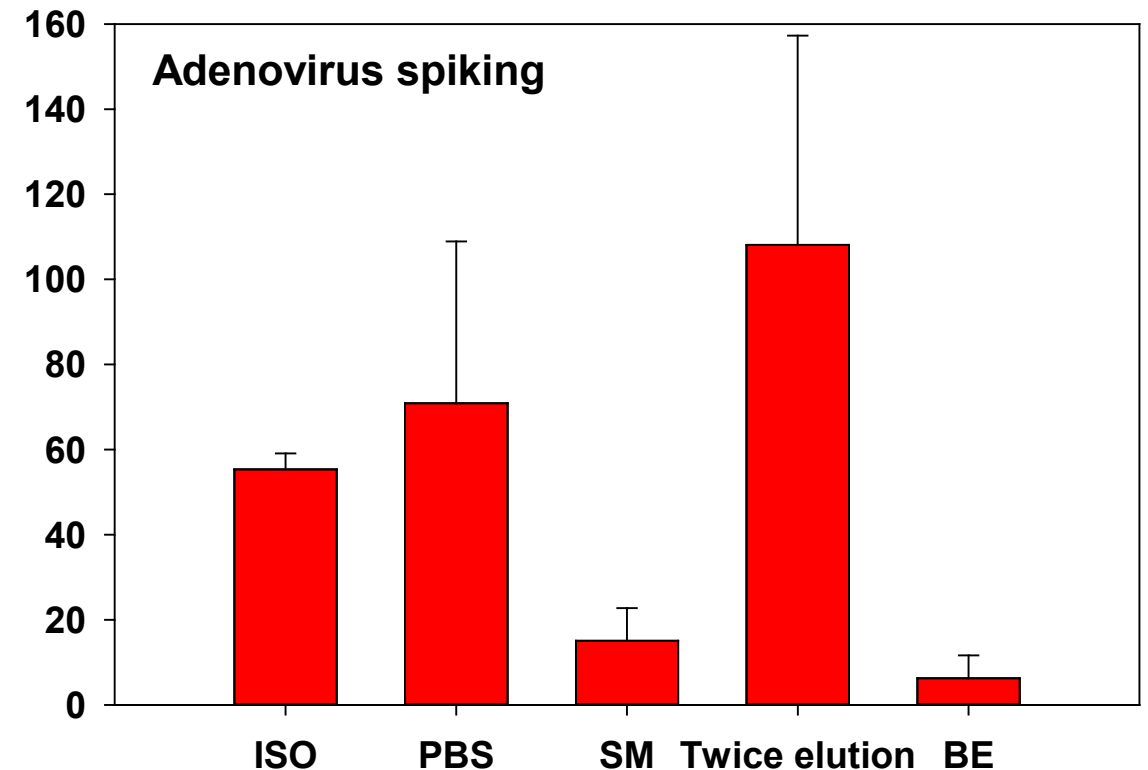
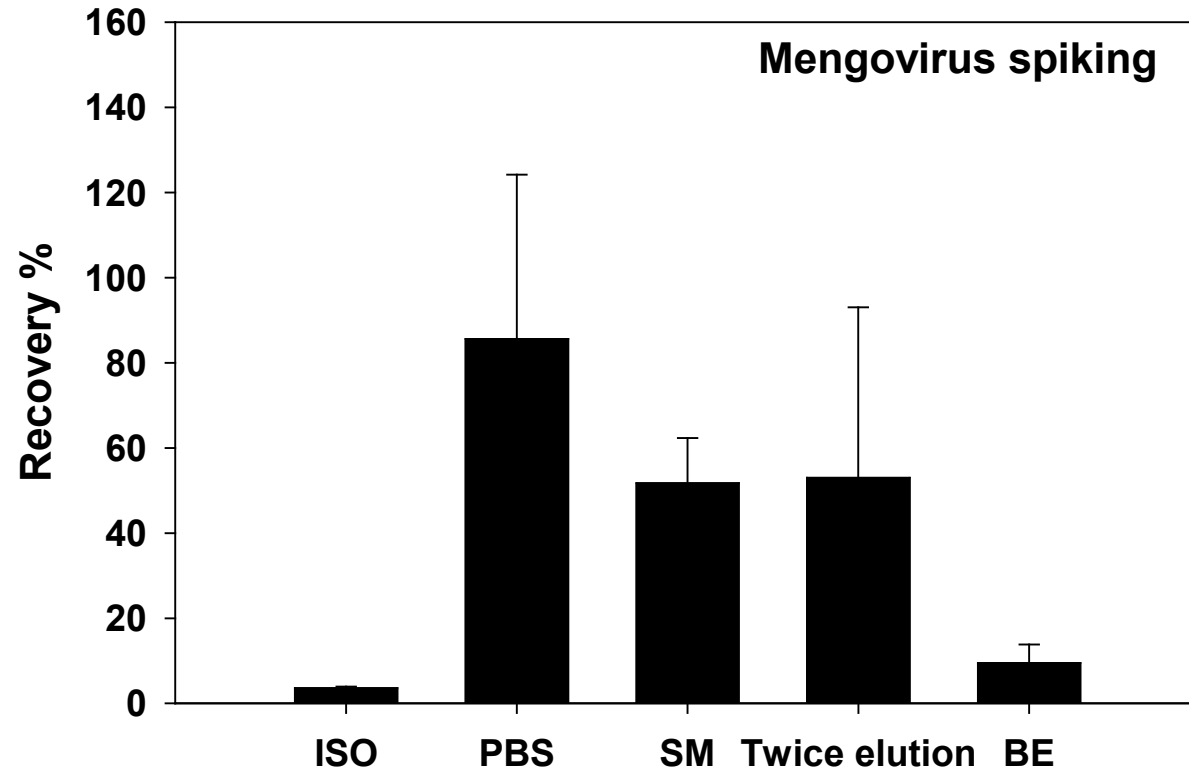
Evaluation of Two Triplex One-Step qRT-PCR Assays for the Quantification of Human Enteric Viruses in Environmental Samples

Kata Farkas¹ · Dafydd E. Peters² · James E. McDonald³ · Alexis de Rougemont^{4,5} · Shelagh K. Malham⁶ · Davey L. Jones¹

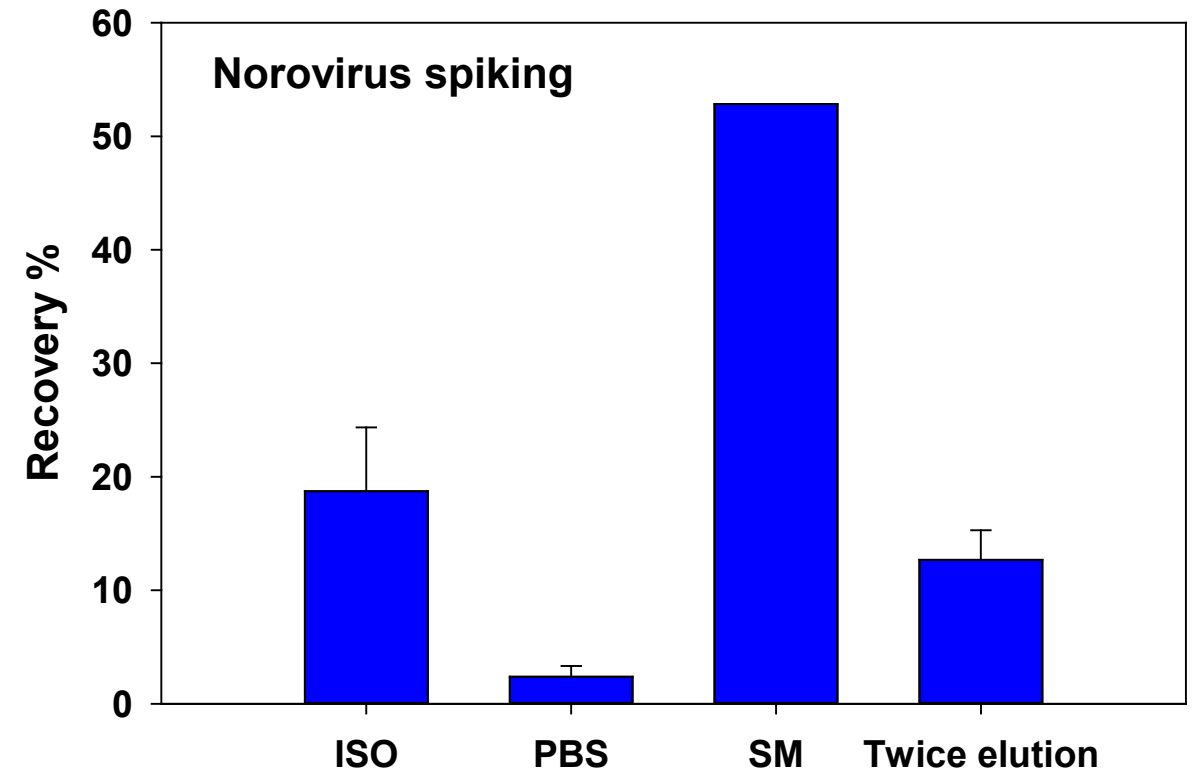
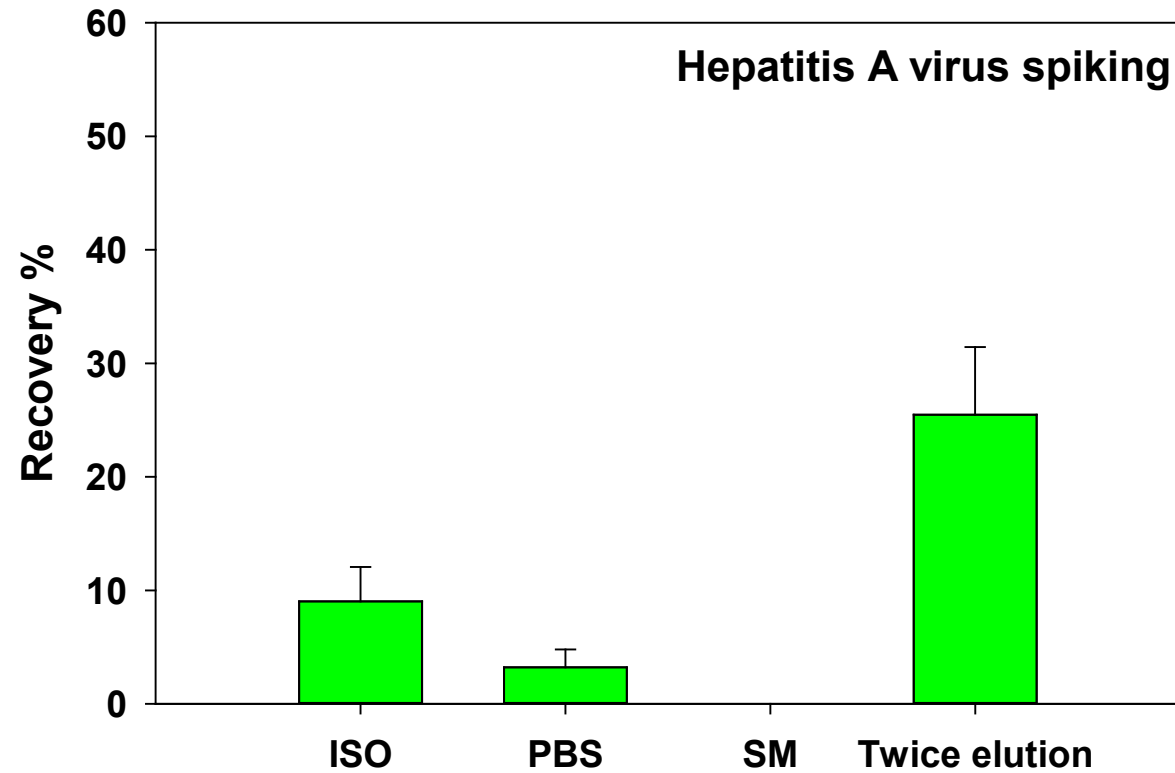
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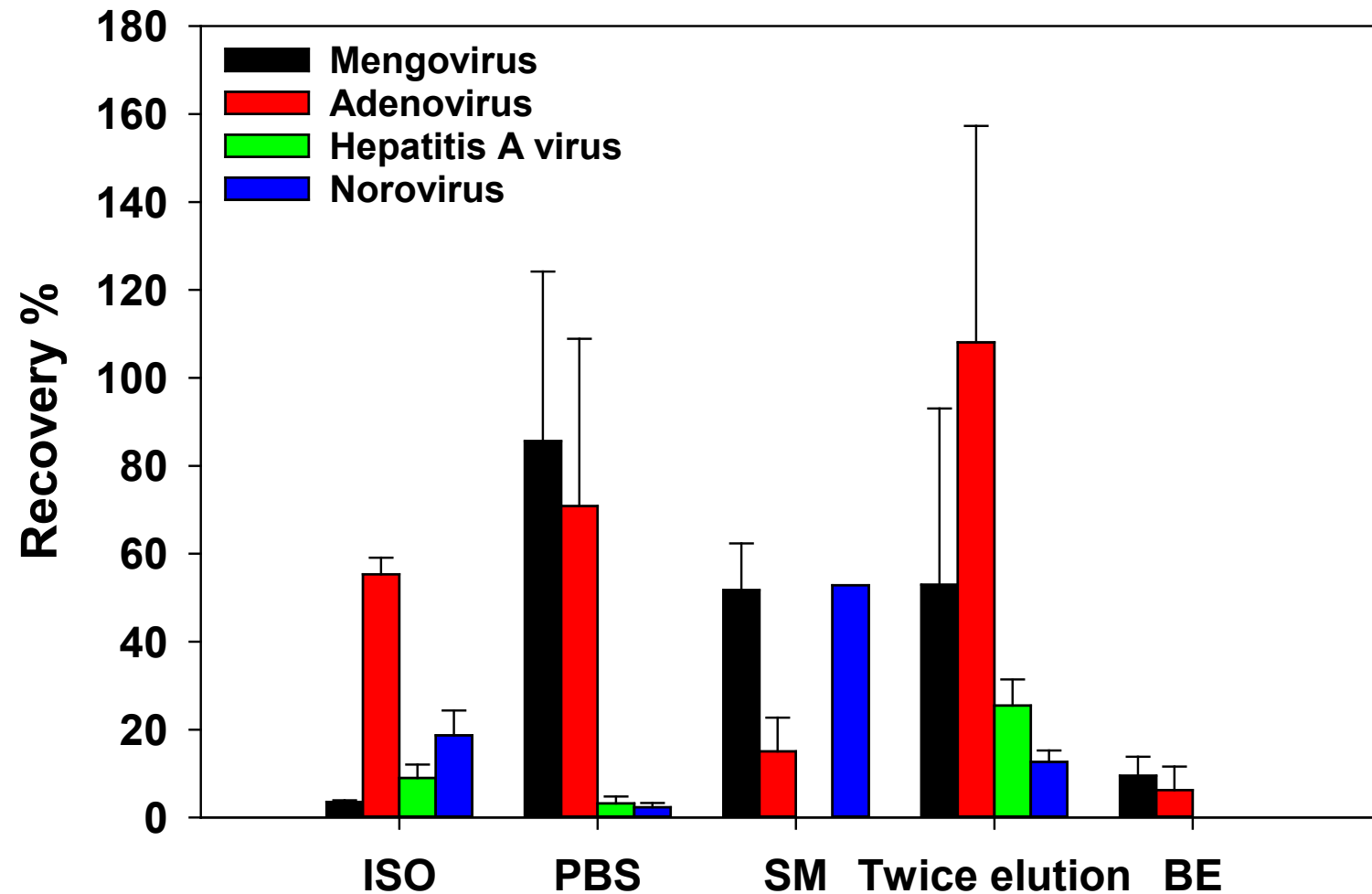
Virus recovery from mussels



Virus recovery from mussels



Virus recovery from mussels



Where?

Source of contamination

- Treated wastewater
- Untreated wastewater, CSO



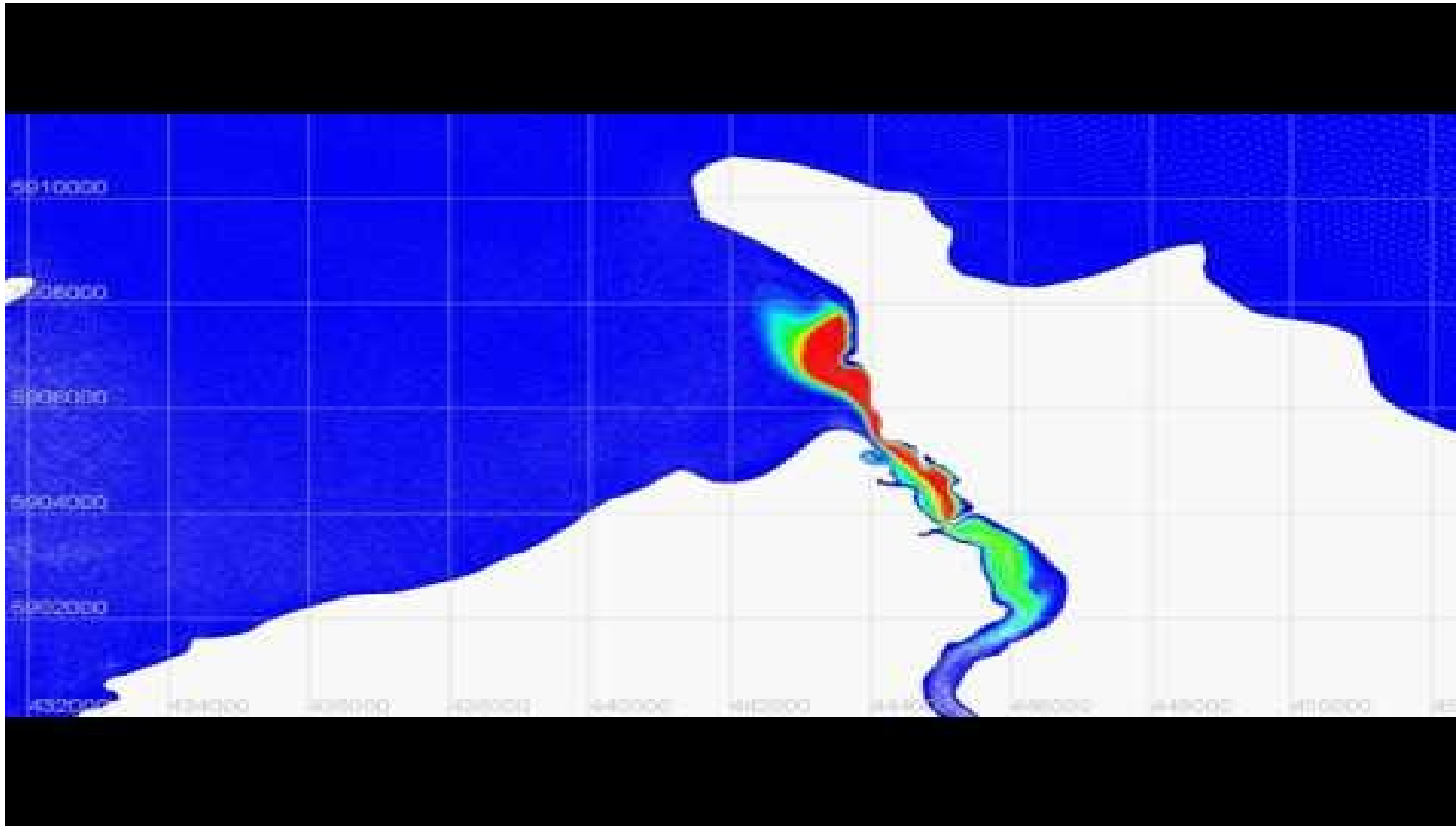
Ganol WWTP
82,000 inhabitants

Tal-y-Bont WWTP
1,000 inhabitants

Llanrwst WWTP
4,000 inhabitants

Betws-y-Coed WWTP
1,200 inhabitants

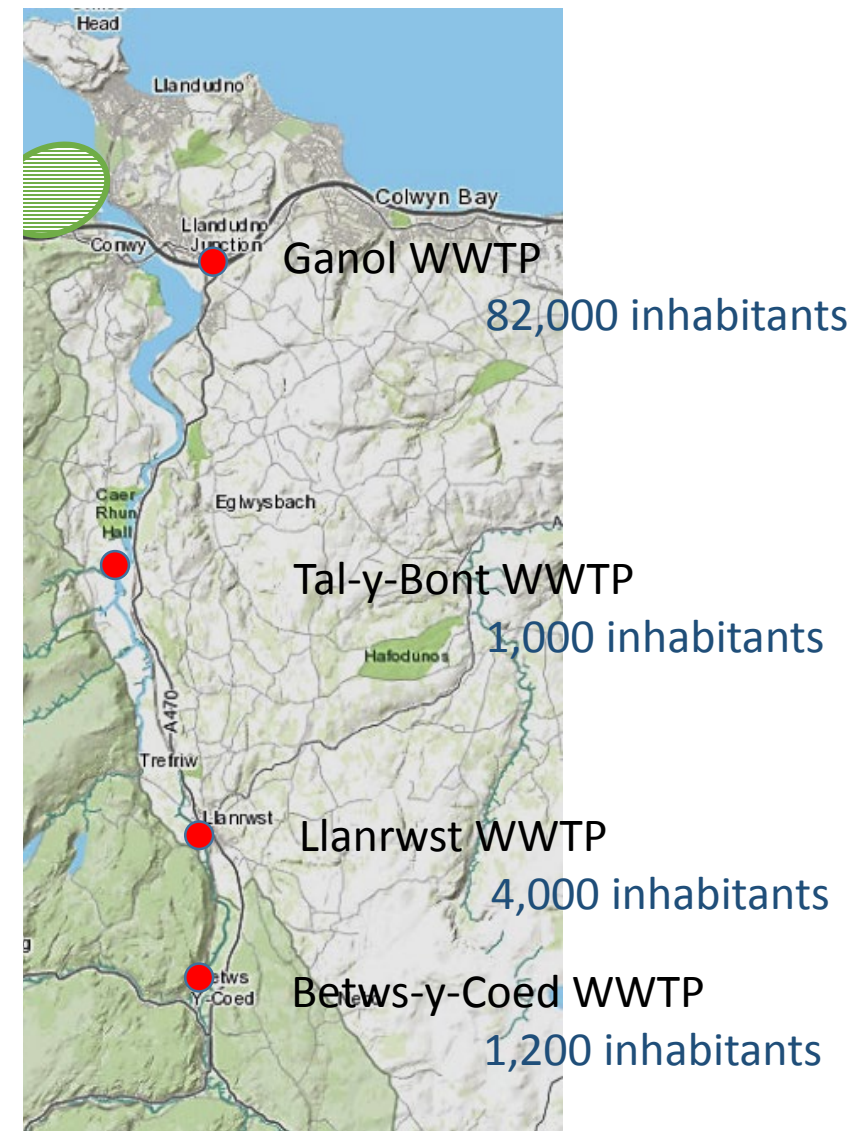
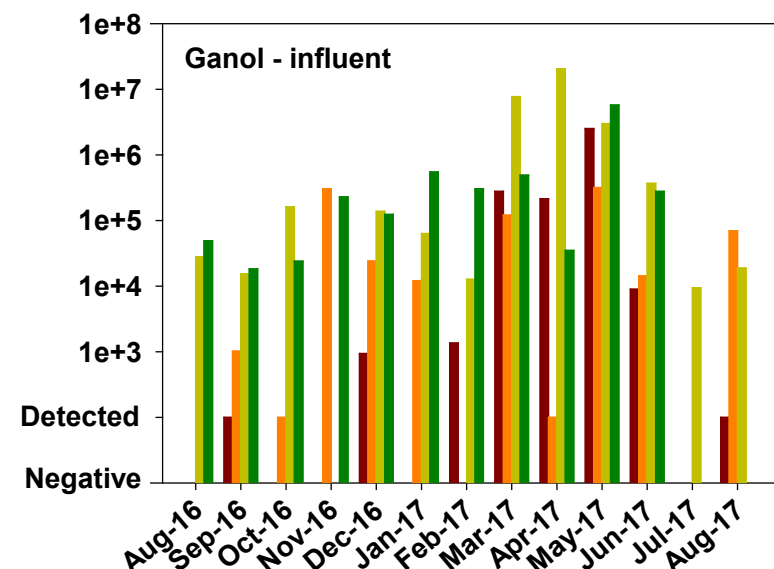
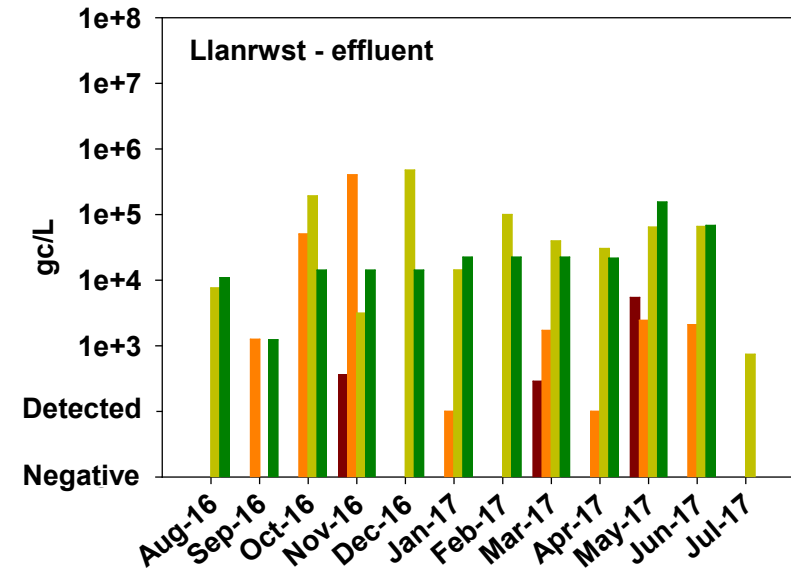
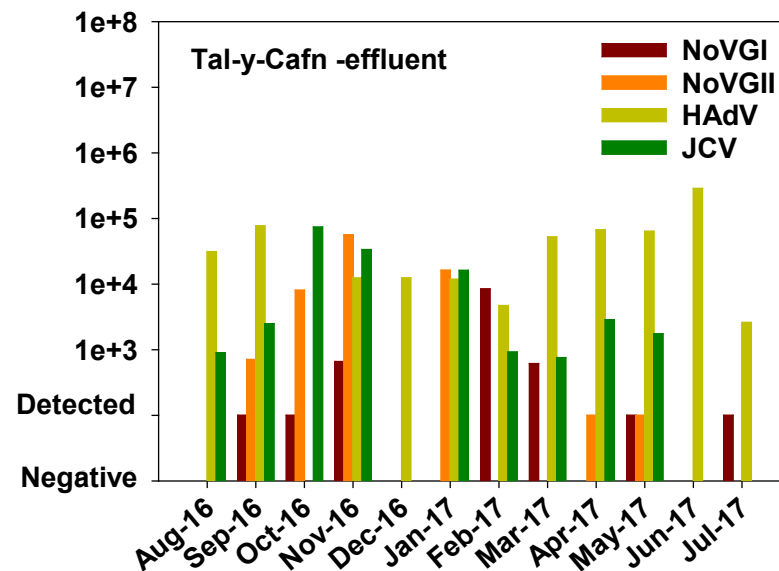
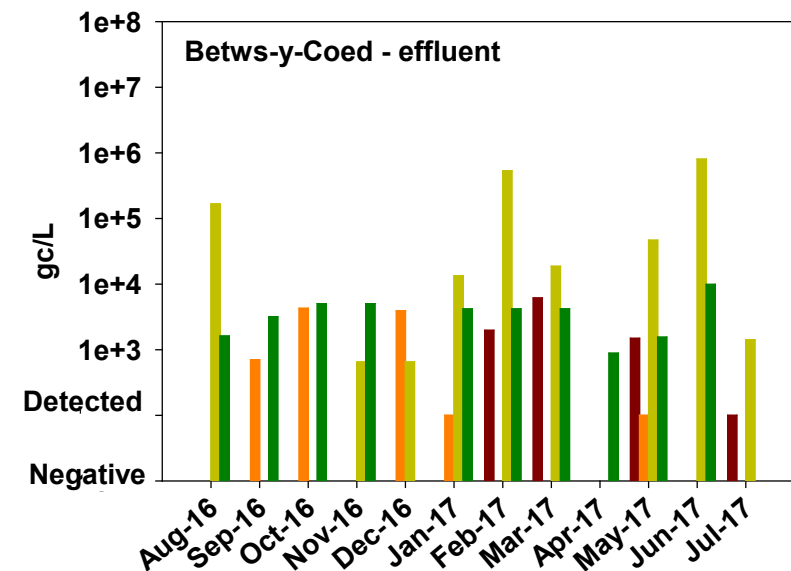
Modelling the fate of viruses from source to coast



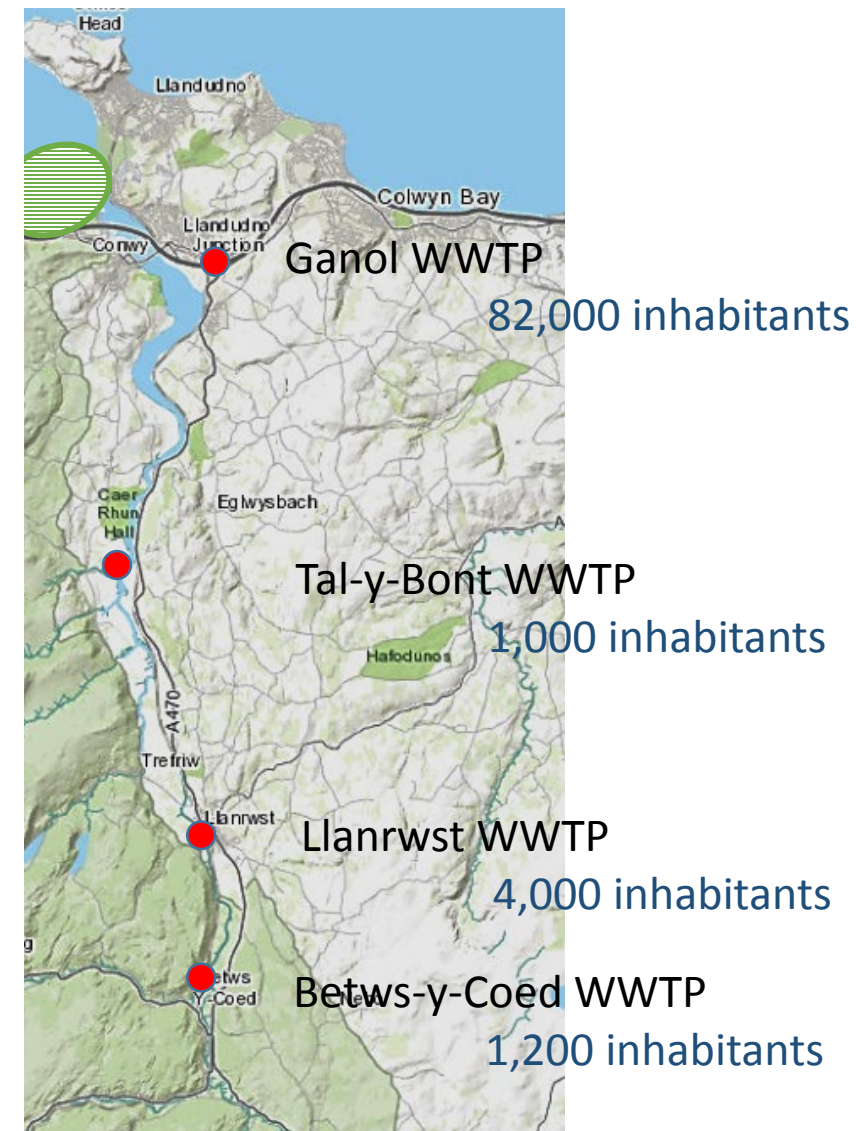
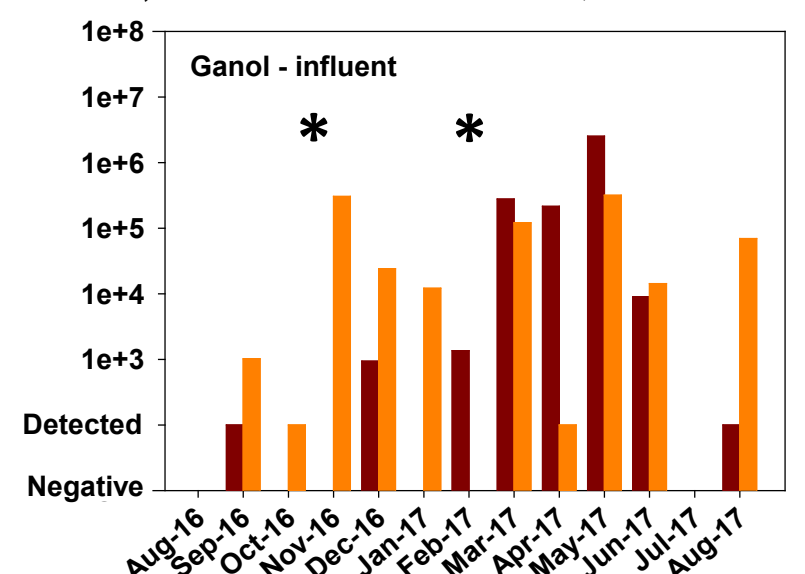
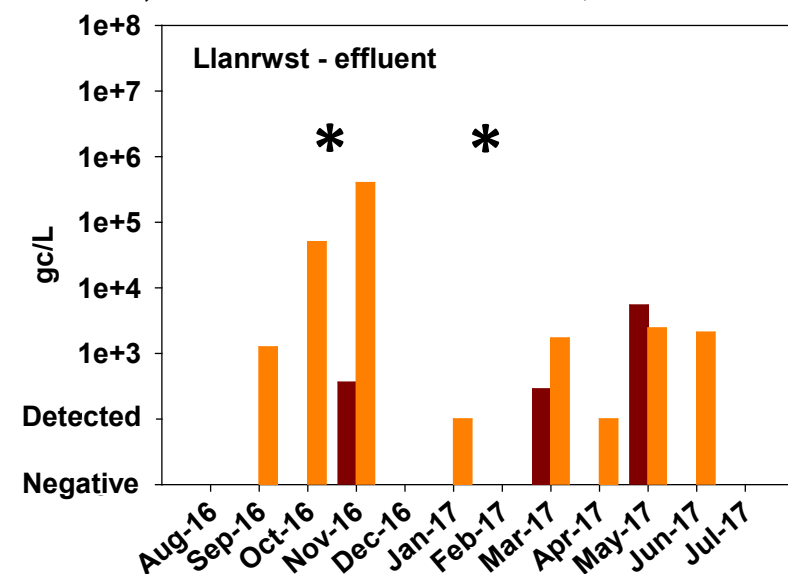
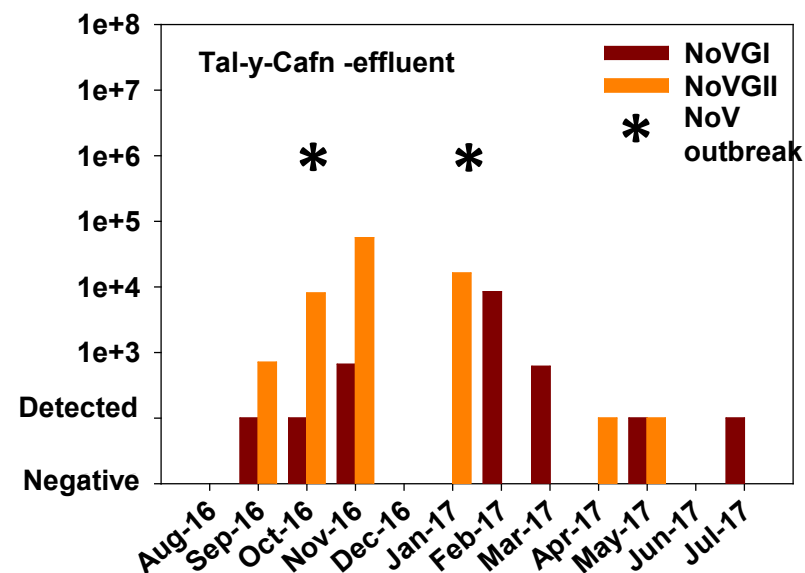
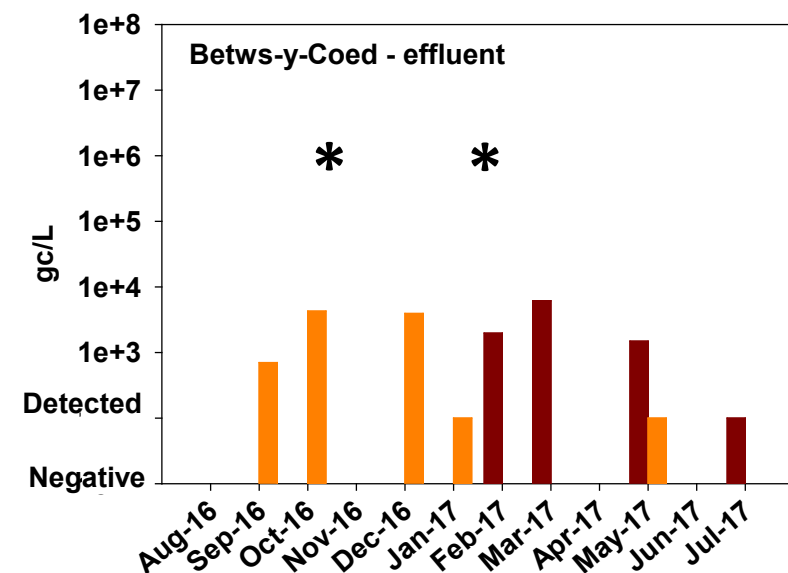
Peter Robins, SOS, Bangor University



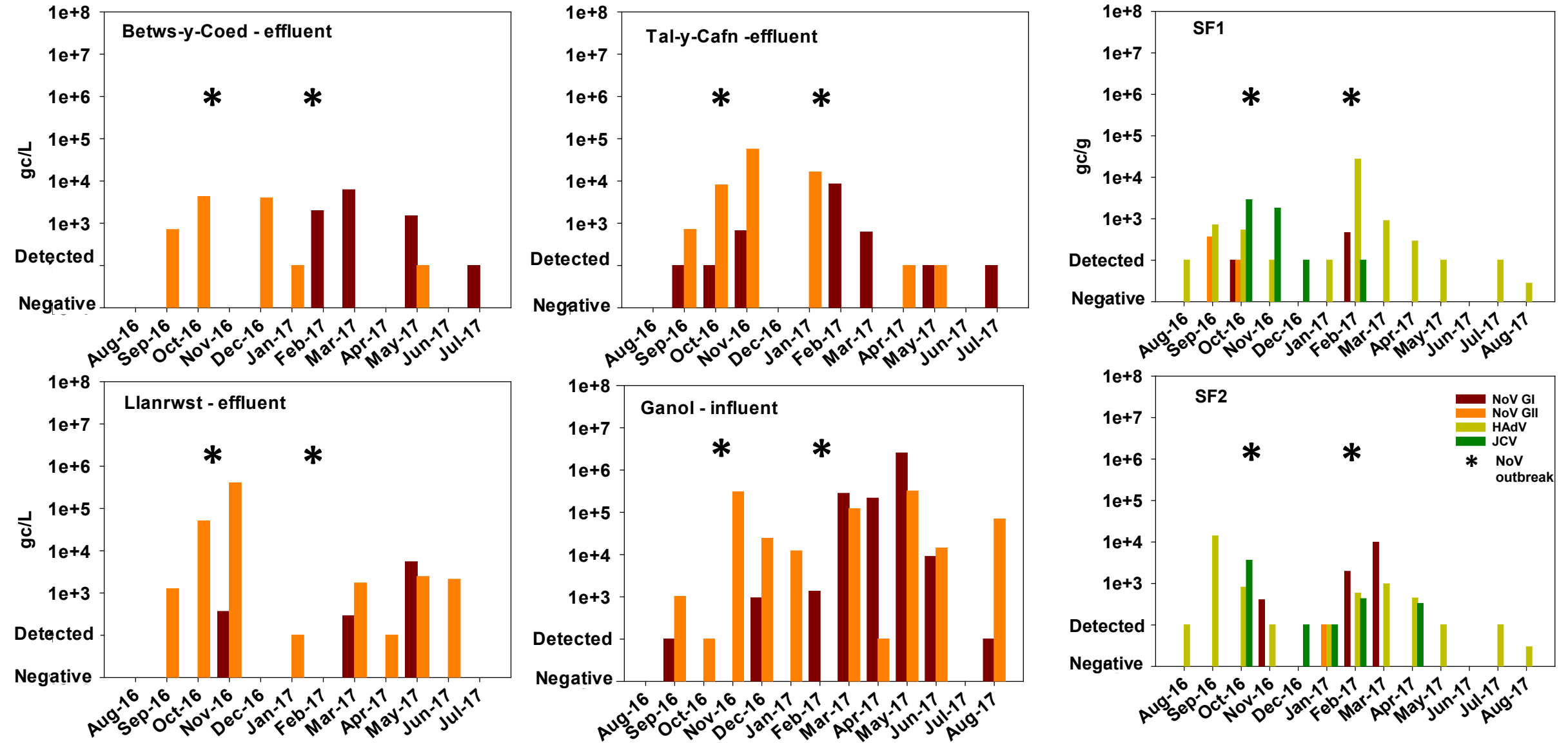
Viral input - wastewater



Viral input - wastewater

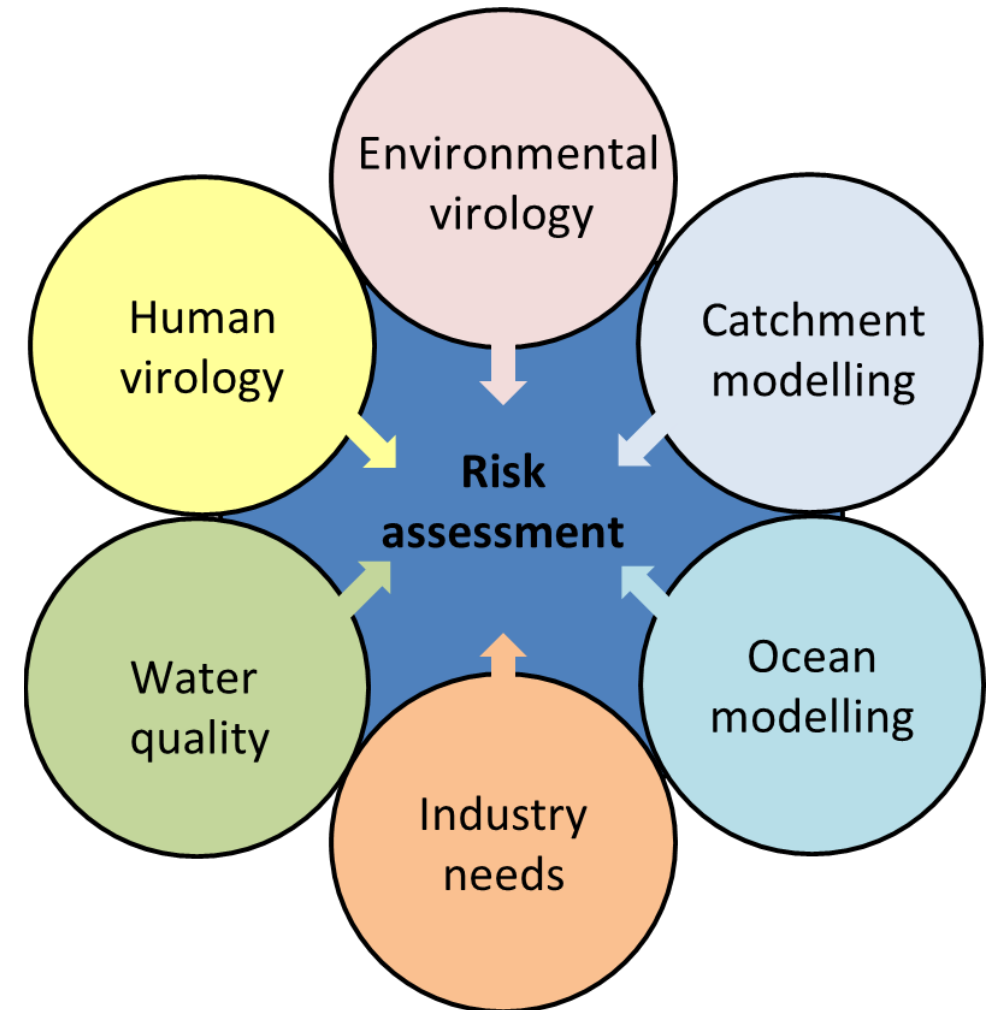


Viral input – wastewater vs shellfish



Conclusions

- Virus recovery from shellfish is strain and method dependent
The use of process controls, e.g. mengovirus is essential
- Indicators viruses, e.g. adenovirus, may be more reliable than bacterial indicators
- More information on input is essential



- Investigate viral integrity and infectivity
 - Adenovirus culture
 - Norovirus capsid integrity assay
 - Human norovirus infectivity
 - human intestinal organoid culture

RESEARCH ARTICLE

Replication of human noroviruses in stem cell–derived human enteroids

Khalil Ettayebi^{1,*}, Sue E. Crawford^{1,*}, Kosuke Murakami^{1,*}, James R. Broughman¹, Umesh Karandikar¹, Victoria R. Teng...

+ See all authors and affiliations

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www.viraqua.uk

k.farkas@bangor.ac.uk
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