

Tracing the fate and infectivity of human pathogenic viruses through the environment

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## Final year focus...

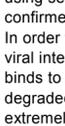
By Professor Davey Jones, Bangor University

The NERC and FSA funded VIRAQUA project is now in its final year and continues to push forward our understanding of how pathogenic viruses behave in our rivers and coastal waters. A key focus of the work now is to bring the project together to develop robust risk management systems. The aim of this will be to devise an early warning system to minimise the likelihood of getting ill from eating contaminated shellfish (e.g. raw oysters) or from coming into contact with contaminated recreational waters. We are also making excellent progress towards our aim of proposing new viral markers which better represent sewage contamination of freshwaters, rather than relying on short lived indicators like norovirus. Furthermore, we will be looking into how viruses interact with particles and how they are deactivated by exposure to sunlight in an effort to improve the predictive modelling of viral flow in estuaries (e.g. how viruses interact with particles and how they are deactivated by exposure to sunlight). This will help our modelling of viral discharges and dispersal from wastewater treatment plants and combined sewer overflows. Lastly, the planning for the final dissemination workshop in London has started, so save the date for this forum to be held on 14th March 2018.

## Reminder – Save the date!

The VIRAQUA and RESERVOIRS teams are jointly hosting the **NERC-EMHH Environmental Microbiological Risk Symposium 2018. This will take place at the Royal Geographical Society on Wednesday 14th March, 2018. We will provide a forum for the discussion of viruses and antimicrobial resistant bacterial in UK waters. More details will be circulated closer to the event.**

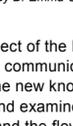
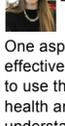
## Viraqua news from the University of Liverpool



By Dr Evelien Adriaenssens, University of Liverpool

Dr Evelien Adriaenssens received a Johnston Postdoctoral Fund grant of the Institute of Integrative Biology (University of Liverpool) to attend the VEME viral bioinformatics workshop in Lisbon, Portugal (27th Aug - 1st Sep 2017). During this weeklong, intensive training course, she learned about the use of Bayesian methods in phylogenetics and their uses in the analysis of viral evolution and geographic spread of pathogens. She will be implementing these newly learned methods in the analysis of sequence data of the Summer 2017 sampling campaign and any future sampling missions. She also presented a poster of her metaviromics work on the Viraqua project (see photo), which was very well received by the international audience.

## Update from Bangor University

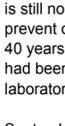


By Dr Kata Farkas and Dr Peter Robins Bangor University

Over the summer our research team at Bangor University investigated the survival of enteric viruses in the River Conwy. Our thorough investigation using several viral strains and different approaches for enumeration confirmed the extreme stability of enteric viruses in environmental water. In order to investigate survival, a novel method was validated to study viral integrity. Using magnetic beads coated with porcine, a protein that binds to norovirus particles, we are able to distinguish between intact and degraded norovirus particles in a variety of samples. This method will be extremely useful for the surveillance of norovirus and for the refined modelling and risk assessment of enteric viruses in the water environment.

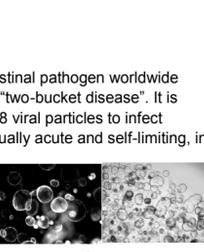
Also, catchment modelling has enabled one year of rainfall and virus sampled data to be routed through the river system (including CSO inputs) to reproduce estuarine and coastal dispersal patterns of the virus. A striking result, in terms of viral exposure risk to shellfish beds and bathing waters, is the strong dependence on rainfall events – with tidal phasing being a secondary control. Although more work is needed to determine the relative importance of event-scale viral concentrations and decay rates within the estuarine system. All the animations produced by the project showing simulations and predicted transit of viruses can be viewed on our  channel and website [www.viraqua.ac.uk](http://www.viraqua.ac.uk).

## Perception and effective communication of environmental microbiological risk



By Dr Emma Green, Bangor University

One aspect of the NERC-EMHH programme looks at the perception and effective communication of environmental microbiological risk. We hope to use the new knowledge generated by VIRAQUA to protect human health and examine how stakeholder groups understand the flow of microbiological contaminants in the environment and the communication of issues for risk management and mitigation. In order to address this we've been collaborating with Professor Dan Rigby, who's based at the University of Manchester, to produce on social science survey to quantify perceived risk of enteric viruses by the general public in the context of other risks.



The survey will be focused upon shellfish eaters and beach users, who can be directly affected by the risk. Risk perception is defined as the subjective perception of the danger; not necessarily correlated with actual risk and can therefore be a tricky thing to assess. We're in the final stages of developing an online survey using best-worst scaling. This is used to obtain preference/importance scores for multiple items using social survey research. We've chosen to look at two risk fear and control. We've also included risk items pertaining to the other project within the EMHH programme in the best worst scaling exercise.

## Mini-intestines being used for the growth of norovirus



By Dr Myra Hosmillo, Cambridge University

Human norovirus is the leading viral gastrointestinal pathogen worldwide causing diarrhoea and vomiting, known as the "two-bucket disease". It is highly contagious and it only takes as few as 18 viral particles to infect another person. While norovirus infection is usually acute and self-limiting, in children and immunocompromised patients, the disease can be chronic which can last from days and months. Despite these, there is still no available vaccine or drugs to prevent or cure norovirus infection. For over 40 years since its discovery in 1972, studying the biology of human norovirus had been challenging because of our inability to grow the virus in the laboratory.



September 2016, human norovirus was first successfully cultured using a stem-cell derived three-dimensional (3D) organoid system. Organoids or enteroids are mini-organs that can be grown in the laboratory that resemble tissues from the body. They can be generated using cells from the eye, gut, liver, kidney, pancreas, prostate, lung, breast and intestine. Organoids are good model for studying infectious diseases including noroviruses.

The discovery of organoid culture system is a major step forward for the study of human norovirus and in developing drugs to prevent and treat norovirus infection. We have established the organoid culture system for norovirus, here in Cambridge. We will use it as part of the VIRAQUA project to examine norovirus persistence in the environment.

## Reducing the risk of viral contamination of the UK's food and water supply



By Luke Hillary, Bangor University

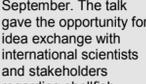
While viruses can escape wastewater treatment plants through treated water, this is not their only route to freedom. Sludge is the solid waste produced from our sewage system and this is often used on agricultural land to improve soil quality. As part of the multidisciplinary STARS soil science PHD programme funded by NERC/ BBSRC, I will examine how sludge treatments affect the viral communities of soil. At present, we know that human pathogenic viruses such as hepatitis A and E and norovirus can be detected in both sewage sludge and soil. However, we know little of how long these viruses persist in the soil and what affects this persistence. By combining metaviromics with PCR and infectivity studies, I am aiming to increase our understanding of the flow of viruses from sludge through soil to the aquatic environment, and address the possible policy implications for sludge disposal as part of food production. For updates on the progress of my research, follow me on Twitter @lukehillary.

To unsubscribe please contact [emma.green@bangor.ac.uk](mailto:emma.green@bangor.ac.uk)

## November 2017

The VIRAQUA Project Newsletter is a quarterly publication offering partners and stakeholders an insight into the impact of the project and findings to date.

For more frequent updates, please visit our website [www.viraqua.ac.uk](http://www.viraqua.ac.uk) or connect with us on social media:



## NEWS:

### We welcome interns!

We can offer an exciting opportunity to join VIRAQUA as a science intern, to gain biological and environmental science experience within an active research team. Please note, the placement would be unpaid. For more details please contact [emma.green@bangor.ac.uk](mailto:emma.green@bangor.ac.uk)

### International Oyster Symposium

Dr Kata Farkas presented our latest finding on the fate of enteric viruses in shellfish at the 7th International Oyster Symposium 2017 held in Bangor, Wales in September. The talk gave the opportunity for idea exchange with international scientists and stakeholders regarding shellfish hygiene.

### Welcome, good bye and good luck

Ronan Barry, a third year Honours student from the University of Liverpool, has joined the VIRAQUA group at the Institute of Integrative Biology in October 2017. He will be working on the metaviromics part of the project under the supervision of Prof Alan McCarthy and Dr Evelien Adriaenssens. His main research focus will be mining the sequencing data for viruses of interest and validating their presence using PCR-based approaches.

Miles Marshall, who has been with the project since the beginning has now left to join a brand new distillery in the Bangor area and will be making gin and whiskey. We welcome David Norris to the VIRAQUA team, from the Centre of Ecology and Hydrology to the project.

### Congratulations!

Congratulations to Christian Harrison on obtaining his BSc Honours in Microbiology at the University of Liverpool. Christian was part of the VIRAQUA project for his Honours project and worked on the validation of RNA extraction methods, using the single-stranded RNA virus mengovirus as a positive control.

### Cross project meetings



The second annual NERC-EMHH PIG conference took place in Birmingham on the 28th September. All four projects were present and gave updates on progress and Rob Kinnersley from the EA and James Lowther from CEFAS provided a point of view from the regulators. The conference finished with round table discussions on impact, future opportunities and the way forward.

### Get in touch:

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