

GrahAM Research Group Newsletter



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Welcome from Group Leader



David Graham

I want to welcome you to our newly established newsletter series. Our goal is to release newsletters semi-regularly that highlight the group's research efforts, which will complement our research website that becomes public early in the New Year. We have been doing cutting-edge research for some time, but have not focused enough on getting a condensed version of our work to our funders, research partners, university colleagues, alumni etc. As a result, we hope the newsletter can provide bite-size summaries of some of our work, highlighting some team successes. I apologise this first newsletter is a bit long, but 2019 was a very good year, with several key projects coming to close. Therefore, it is a nice place to draw attention to past activity and future work.

Introducing Group Members

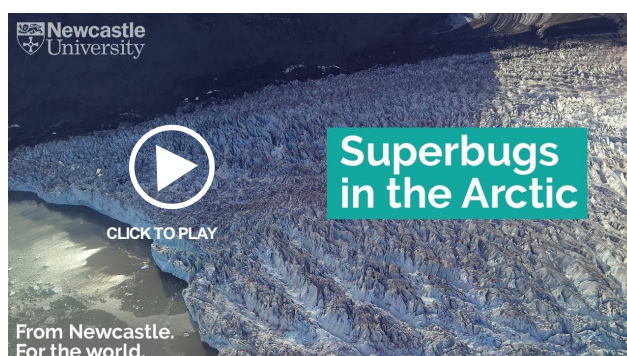
We currently have four post-doctoral researchers (PDRA), including Dr Marcos Quintela Baluja, Dr Myra Giesen, Dr Kelly Jobling, and Dr Andrew Zealand. Our Research Technician is Adrian Blackburn. We started the year with five PhD candidates: Panagiota (Pani) Adamou, Marcos Quintela Baluja, Joshua (Josh) Bunce, Florence Jong, and Amelie Ott. Both Marcos and Josh have both graduated, and Florence defended successfully and will graduate in January 2020. Josh is now working for UK DEFRA; whereas, Florence is working as a PDRA at the National University of Singapore (NUS) on projects related to micro-plastic pollution. Pani is in her final stretch, having finished all her fieldwork, with her viva planned for Spring 2020. In 2019, we had four MSc students, including Arabella Budge, Jiaqi Chen, Katie Robins, and Dan Sun. We are happy to say that Katie has since joined the group as a PhD candidate in September. She will perform landscape antimicrobial resistance (AMR) work sponsored by DEFRA and the Environment Agency, initially finalising the Arctic work (see below) and studying sources and sinks across Cumbria and Northumberland.

Highlighted Publication

Of our fifteen 2019 publication, '[Understanding drivers of antibiotic resistance genes in High Arctic soil ecosystems](#)' in *Environment International* deserves highlight. It was co-authored by Clare McCann, Beate Christgen, Jennifer Roberts, Jian-Qiang Su, Kathryn Arnold, Neil Gray, Yong-Guan Zhu and **David**, and received much attention, including coverage in >400 media outlets within three days of release and an interview on BBC World News. The university produced a [video](#) to promote this work, while **David** wrote short pieces for [The Conversation](#) and [Newsweek](#).

Key 2019 Group Impacts

1. Work reported and published in 2019 by Marcos, Florence, and Pani showed "old" views of AMR fate mechanisms in wastewater treatment plants (WWTPs) are probably not correct. AMR to and from WWTPs is primarily driven by ecological and operating factors, and less associated with horizontal gene transfer in WWTPs.
2. Our work in the Arctic has shown that AMR spread is now global, almost certainly migrating in the gut of humans and wildlife. Local factors select for AMR, such as antibiotic use and pollution, but diffuse environmental pathways drive globalisation.
3. Various international agencies, including the World Health Organisation (WHO), have recommended our strategic approach for prioritising sanitation interventions to reduce AMR spread. The approach suggests implementation of WASH and decentralised sanitation as the "best buys" for reducing AMR. Guidance that will become public in 2020.



Prizewinning presentations and more



Congratulations to **Pani**, who won the Best Oral Presentation Award for her presentation on 'Using Fe-bearing clay minerals to remove antibiotic resistance genes from domestic wastewater' at the joint research meeting of the Clay Minerals Group of the Mineralogical Society & the Environmental Chemistry Group of the Royal Society of Chemistry. The meeting held at Newcastle University (05/19) was themed 'Clay Minerals in the natural and built environment: formation, chemistry & applications.'

Congratulations also to **Amelie** for her stop-motion film 'An antimicrobial resistance in the environment of emerging countries.'



It was awarded 3rd place the Institute for Social Science Postgrad Researcher Impact Award 2019. She also was awarded best presentation for 'Source Tracking of Antimicrobial Resistance in Emerging Countries' at the School of Engineering Postgrad Research Conference 2019.



Amelie also was awarded the Society for Applied Microbiology (Sfam) President's Fund, a travel fund of £1200 to attend the EDAR conference in Hong Kong. In addition, Amelie was awarded the International Water Association Young Water Professionals Scholarship at the 20th International Symposium on Health Related Water Microbiology in Vienna (09/19) based on her conference abstract. While in Vienna, she presented a poster on 'Source tracking of antimicrobial resistance in emerging countries.'

Andrew was awarded £500 by the Federation of European Microbiological Societies towards presenting 'Low-energy Wastewater Treatment for Removing Antibiotic Resistant Bacteria' at the 8th Microbial Ecology in Water Engineering Specialist Conference in Hiroshima (11/19).

Out and about

Amelie participated in the Science Policy Workshop organised by Sfam & the Microbiology Society in London (11/19). Whereas, both

Amelie and **Katie** attended also the Royal Society of Chemistry Water Science Forum in London on 'Antibiotics in the Water Environment: Occurrence, Detection, Fate' (11/19).



Pani presented 'Fate of AMR in Wastewater Treatment' at the 7th UK Wastewater Network Conference, with co-researchers A Neumann, S Andrews, J-Q Su, B Martin, E Germain, & **David** (11/19). **Andrew**, **Amelie**, & **Pani** all presented posters at 20th International

Symposium on Health Related Water Microbiology in Vienna (09/19). **Amelie** presented 'Source Tracking of Antimicrobial Resistance in Emerging Countries' at the 5th International Symposium on the Environmental Dimension of Antibiotic Resistance in Hong Kong, with co-researchers G O'Donnell, NH Tran, MR Haniffah, J-Q Su, K Y-H Gin, M Goodson, Y-G Zhu, & **David** (06/19).

David did a lecture tour last Spring as part of the UK/Israel Science Lectureship Scheme. His talks included 'Using terrestrial metagenomes around the world to characterise antibiotic resistance migration' at Hebrew University, Faculty of Agriculture, Department of Plant Pathology and Microbiology, and 'Microbial ecology controls on antibiotic resistance fate in water, wastewater, and environmental systems,' provided to the Agricultural Research Organization, Institute for Soil, Water and Environmental Sciences. 'Assessing cost-benefits of different mitigation options for reducing global antibiotic resistance' was presented to the Ben Gurion University, Desert Research Center.



In April, **Adrian** visited Bangkok as part of Prof David Werner's team to attend a meeting at KMUTT University and to provide fieldwork and training support in using Minion sequencing to investigate the water quality of aquaculture sites.

Out and about continued ...



Finally, **David** and Prof Werner hosted a highly successful two-day workshop, entitled 'Mitigating Antimicrobial Resistance in the Water Cycle: Analytical Methods and Improving Water Quality' in Bahir Dar, Ethiopia. Special thanks to Prof Mulugeta Kibret at Bahir Dar University and CultivAid for hosting the event, and our other speakers, Mr Tenaw Tadege (FAO), Dr Eddie Cytryn (Volcani Institute), & Prof Edouard Jurkevitch (Hebrew University). Colleagues attended the workshop from IMWI, WLRC, Gondar University, the University of Addis Ababa, & various water utilities in Ethiopia. We are now planning a Welcome Trust proposal.

Influencing policy

We have had some unique opportunities to promote the group work at top-level policy meetings, slowly moving our work into national and international guidance documents. In 2019, we presented our work on the cost-benefit of different AMR mitigation actions, including low-tech sociotechnical solutions, at several high-profile meetings in Spain, the UK, USA, Israel, Sri Lanka, and other locations. Example recent talks include:

'Current sanitation and WASH practices for mitigating AMR,' presented at the Decentralized WASH Systems to combat Antimicrobial Resistance (AMR) workshop at the IWA Sustainable Development Congress & Exhibition; Colombo, Sri Lanka (12/19).



'Antimicrobial resistance: Are wastewater treatment plants a problem or a solution?' Antibiotics in the Water Environment: Occurrence, Detection, Fate workshop, organised by SCI's Environment, Health & Safety Group and the RSC Water Science Forum. Royal Society of Chemistry; London, UK (11/19).

'Complexities in understanding antimicrobial resistance across animal and environmental systems,' Antibiotics in Animal Agriculture: What You Need to Know meet-

ing; sponsored by The New York Academy of Sciences, New York City, NY, USA (04/19).



Towards successful international research collaborations

'Newcastle University & IIT, Delhi: Successes and Challenges in Collaborations.' Hamied Foundation UK-India Antimicrobial Resistance Meeting; Academy of Medical Sciences; London, UK (02/19); talk is available [online](#).

Almost a mini sabbatical

Marcos spent two months in Paraguay working with the National University of Asunción (UNA) on an innovative project that seeks to develop a new tool for rapid assessment of water quality through the use of multidimensional data models. Marcos, along with Dr Elias Berra, an expert in spatial information and remote sensors,

worked with other professionals from the Multidisciplinary Center for Scientific and Technological Research, the Faculty of Chemical Sciences, and the Faculty of Agricultural Sciences, at UNA. This interdisciplinary project aims to integrate new methods of massive se-



quencing and spatial information for the characterization of aquatic ecosystems. In this way, we can locate and identify environmental disturbances related to pollution, altered land use, overexploitation, invasions of microbial species, and the spread of pathogens.

Visitors

In late June, **Dr Julian Carrillo-Reyes**, from Universidad Nacional Autónoma in Mexico, visited the group to discuss new different AMR and related projects in Mexico with our group and the School. While here, he gave a talk the 'Microalgae-bacteria systems for wastewater treatment: potential and energetic valorization of bio-mass' in the Environmental Engineering Seminar series.

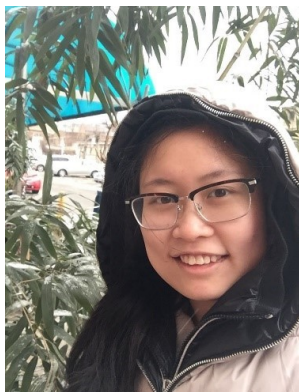
From **Claire Gibson**, one of our 2016 MSc graduates, who returned to Newcastle to gather data for her PhD student research at McGill Universi



Visitors continued ...

ty. Claire research interest is on the diverse microbial community found in biological wastewater treatment plants and the role of these systems in the dissemination of antibiotic resistance. During her visit, she hoped to investigate samples from Josh's fieldwork in Northumberland. However, this do not go according to plan, so Claire had to use shared samples from previous work.

We are pleased to host **Rui Xin**, a PhD student from the School of Marine Science and Technology at Tianjin University (China) visiting us. Rui is working closely with **Kelly** and **Marcos**, on assessing the prevalence and spread of different colistin resistance variants across an urban wastewater network. **Rui** will be with us until August 2020.



Ending Projects

In addition to **Josh** and **Florence's** PGR research ending, **Pani's** fieldwork on tertiary treatment technologies for reducing antibiotic resistance ended; now she only needs to write it up. We had two other projects end in 2019. One project, co-led by **Andrew** with York University, looked at whether antibiotics in wastewater used for agricultural irrigation impact soil health, antimicrobial resistance, and crop production. **Andrew** also co-leads a project comparing microbiomes and resistomes in infants and the environment in Bangladesh as well as a Newton-funded project with UTM in Malaysia comparing DHHS Bioreactors with Alternate Technologies for Decentralised Waste Treatment Commercialisation in SE Asia. This also has a completion workshop in Johor Bahru on March 10-11, 2020.

The New York Times

David received an unexpected gift before Christmas from in the New York Times. Despite being misquoted on the pollution state in India, the article '[DEADLY GERMS, LOST CURES: The Ganges Brims With Dangerous Bacteria](#)' by Donald G. McNeil Jr. showcases our long standing work with Shaikh Ziauddin (Zia) Ahammad, professor of biochemical engineering at the Indian Institute of Technology. It is a reminder that we need to move from the grim reality that AMR is endemic, global, and is and will continue to significantly effects public health and global economy to offering some sustainable and effective solutions to mitigating the problem. The good news is we also are working with the WHO and UN Environment to develop sustainable solution recommendations, which we expect to become public by March 2020.

On the horizon

Most group members will be attending, if not presenting, at the [Global Water Security Symposium \(H70\)](#) being held here at Newcastle University, January 23rd and 24th. Another meeting that will feature our research efforts is the [6th World One Health Congress](#) to be held in Edinburgh from 14-18 June 2020 in Edinburgh, Scotland (abstract deadline 15 January).

We anticipate getting our new perception surveys out early in the New Year, initially surveys on knowledge and perceptions/attitudes towards AR and AMR drivers, spread, and mitigation options in New Delhi slums. This work is in collaboration with Prof Pauline Dixon and Dr Steve Humble in the School of Education, Communication and Language Sciences at Newcastle University and CURE in Delhi. The initial work will extend to other cohorts, including medical practitioners and students; veterinarians; wastewater/sanitation professionals and students; and the public in the UK and then Israel.

David will speak at a special invited session [ECCMID](#) in Paris (18-21 April 2020) and at the Microbiology Society [annual conference](#) in Edinburgh (31 March to 3 April 2020). Both talks are on AMR in and out of WWTPs, highlighting the work of **Marcos**, **Florence**, **Pani**, and **Amelie**.

Group social events

The group had fewer social events this year as it has been in the past, given to projects coming to an end and thesis deadlines. This will be remedied in the New Year. We did have occasions to celebrate with each viva passed though.



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