WEEG NEWSLETTER November 2019

The newsletter is published monthly by the University of Southampton's Water and Environmental Engineering Group WEEG, and reports things of interest in this field worldwide, as well as ongoing undergraduate student and research work in WEEG itself.

We believe that water and energy are the most important topics worldwide for the next decades. Our work covers river and coastal engineering, water and wastewater and energy related to water.

Editorial: Today's editorial, on a topic important for hydraulic engineering, focusses on - well, goats. Feral goats, to be more accurate. And the effect of European Union subsidies. Goats, you might ask? What do goats have to do with hydraulic or environmental engineering? Well, read on...

Hydraulic Engineering International: *island ecosystems and goats.*

The Greek island of Samothraki in the Aegean Sea is a beautiful place, with an area of 180.6 km^2 and a population of 2,900 - humans, that is. Plus around 50,000 goats.

Fig. 1: Samothraki Island

The goats are semi-feral, grazing everywhere, and eating practically everything. In doing so, they have destroyed most of the vegetation, to the point where the total number of goats has reduced from 75,000 in 2003 to 50,000 today because there simply is not enough grazing for them. Today, most of the goats are too malnourished even to be of value to the farmers.

The excessively high number of goats was induced by EU subsidies for goat farmers.

The effects of the reduction in vegetation are severe: water retention is reduced, and water resources are decreasing, Soil erosion due to the removal of vegetation has increased to the point where in 2017 many roads and the City Hall were destroyed by mud slides.

The problem of goats literally destroying island ecosystems is of course not new. In the absence of predators, goats can become the ecologically dominant species. Their activities lead to the extirpation of many local plants, increased erosion through over-grazing and defoliation and a reduction in water retention, to the point where there is no longer enough vegetation for the goat population. Such problems occurred e.g. on Hawaii, where many local plant species disappeared; and on the Galapagos islands, the Baja California Islands etc. More recently, eradication programmes have cleared more than 120 islands of their feral goat populations in order to rescue the ecosystems. The after-effects of large numbers of feral goats in the absence of predators are longer lasting, however, since significant erosion has occurred, and the accompanying adverse impacts can remain for a long time.

Fig. 2: Denuded landscape and soil erosion

Back to Samothraki. Fig. 2 shows a denuded landscape. Erosion of the soil and effects of immediate run-off of rainwater are clearly visible. The retention of water is minimal, which will have a profund effect on groundwater levels and vegetation.

Fig. 3: Soil erosion and incised channels

Figure 3 shows another defoliated landscape where plants have mostly disappeared due to

goats. The soil erosion is clearly visible, rain run-off has created deeply incised channels, groundwater levels are lowered and so on.

On the Galapagos Islands, three goats were released on the island of Pinta by fishermen in 1957. In the 1970s, the goat population was around 40,000, and the vegetation cover was pitiful. In 1997 the number of goats reached six figures. A large eradication programme was then launched to rescue the ecosystem, and by 2005 no goats were left. This appears to be the only solution to the problem.

However, despite the fact that goats on islands are always an invasive species, the local population often considers them as part of their environment and does not connect the island's ecosystem status with the goats. As on Samothraki, where the goat farmers are unaware of the chain of consequences. Restoration of ecosystems and of a sustainable water supply is therefore often problematic, since it involves not just the environment itself, but also educational, economic, political, social and emotional aspects. All need to be combined to find a successful solution.

Lastly, it should be remembered that even the eradication of the goats will probably not lead to complete restoration of the ecosystem since many plant species will have disappeared, soil has been washed away, streams are incised and so on. Further intervention may be needed - and maybe our artificial beaver dams can be of use here as well...

Year 3 Individual Projects: the methane-based biorefinery

For his Year 3 Individual project, Adil Khan has chosen to look at the feasibility of the methane-based biorefinery. The idea is based on the fact that certain microorganisms can use gaseous feedstocks to create other products. In particular, microbes known as hydrogenotrophic methanogens consume H_2 and CO_2 to create CH_4, while others known as methanotrophs or methylotrophs can use CH_4 and O_2 and produce a range of potentially useful products including e.g. organic acids lipids and PHA (a basis for bioplastic),.

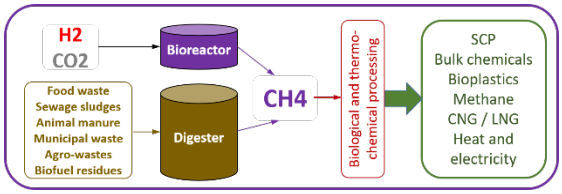

Fig. 4: Methane-based biorefinery

They also just produce more methanotrophs, and this is important because these too are actually a product, known as single-cell protein or SCP, which is likely to become increasingly valuable in a protein-hungry world. It is already being produced at commercial scale for aquaculture and animal feeds (see e.g. http://calysta.com/feedkind/product).

Adil's project aims to focus on the engineering feasibility of these systems in terms of potential sources of feedstock, energy and other inputs, and likely outputs to assess the potential for and impact of full-scale operation.

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Have you ever thought of doing a PhD?

We are looking for highly talented students to work on cutting-edge research across a range of topics in water and environmental engineering.

If you are graduating with a 1st or 2:1 degree, you can apply for a fully-funded studentship that will cover the fees and stipend for the 3.5 years of a PhD. If you would like to discuss PhD opportunities available or to know more about what a PhD is, talk to academics working in your area of interest, or contact our Gradschool representative: Dr Gustavo de Almeida, G.deAlmeida@soton.ac.uk. And come along to the Civil, Maritime and Environmental Engineering Postgrad Research Showcase at Boldrewood on 24 January 2020!

Jobs in water engineering:

This section gives you an idea of the type of work you can do when working in industry.

Advert: An example of a senior post in process engineering for water treatment - one of many interesting jobs currently advertised by Southern Water

Water Process Discipline Manager

www.southernwater.co.uk/careers/job-details?autoReqId=6385BR

Civil and Environmental Engineering at Southampton University:

WEEG: the Civil and Environmental Engineering pathway offers the chance to deepen your knowledge in water-related areas, and gives you a better preparation for environmental engineering projects.

Contact: Dr Sonia Heaven, s.heaven@soton.ac.uk, Bldg 178, Room 5015

Further information:

We have two Facebook pages, which provide a logbook of our laboratory activities:

www.facebook.com/Hydraulicslaboratory/

www.facebook.com/environmental.lab.university.of.southampton/

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