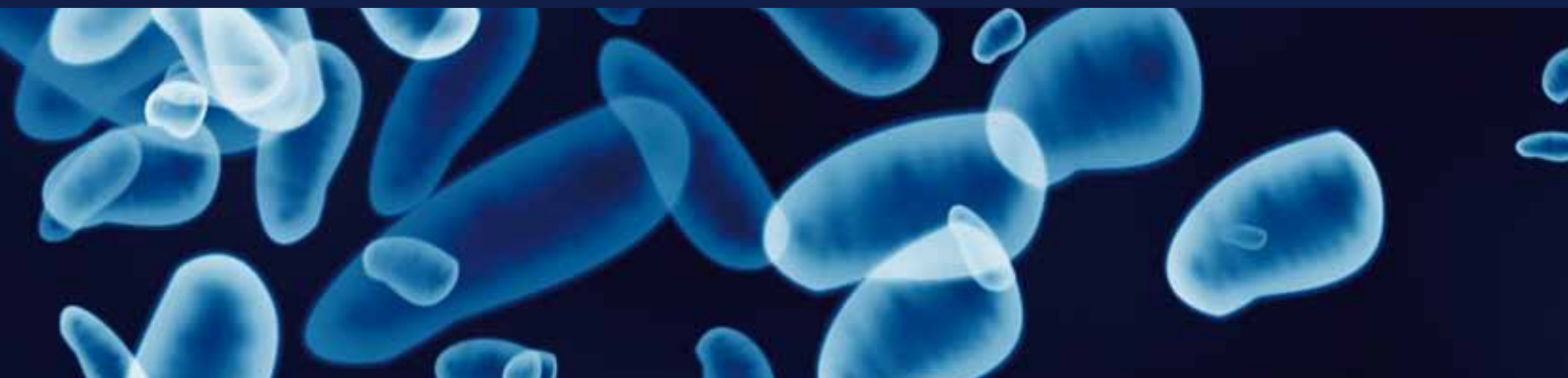




**Centre for
Ecology & Hydrology**
NATURAL ENVIRONMENT RESEARCH COUNCIL

Environmental Research and Human Health



Enlarged bacteria illustration.
(Photograph - Shutterstock)

CEH's role

CEH (the Centre for Ecology & Hydrology), part of the Natural Environment Research Council, is responsible for more than 60% of the freshwater and terrestrial monitoring undertaken in the UK; it also conducts fundamental and applied research.

The environment in which we live is inextricably linked to our health. CEH's research helps make the connections between the underlying environmental causes of health issues, and provides evidence to support policies which seek to mitigate adverse impacts and contribute to an improved quality of life in the UK.

Research and Monitoring by CEH

CEH research relating to human health focuses on:

- Air quality monitoring, and the correlation between poor-quality air and respiratory diseases such as asthma
- Investigating real-time monitoring of pandemic flu, and the adverse effects of antivirals
- Monitoring of environmental pollutants - understanding the fate and effects of nanoparticles, rat poisons and other pollutants
- Connecting pathogen-induced animal diseases with human health problems
- Developing land-management strategies following radioactive contamination
- Monitoring and modelling the extending ranges of disease carriers due to climate change, and providing evidence to policy-makers

Much of CEH's research is carried out in partnership with, or funded in conjunction with, other organisations.



Monitoring air quality at Auchencorth Moss.
(Photograph - CEH)

Background

Air quality and human health are inextricably linked. Although a healthy person is unlikely to experience any adverse impacts in the short term, there can be times when levels are high enough for most people to be affected. People with heart diseases or severe lung diseases might be more sensitive than others - not just to immediate impacts but also to less-well defined, longer-term effects. It is suggested that cutting long-term exposure to fine particles could increase life expectancy by up to 11 months. Because air pollution is no respecter of national boundaries there are international agreements on limiting its levels. Consequently, a wide range of pollutants is monitored routinely in the UK, work overseen and partly funded by Defra (the Department for Environment, Food and Rural Affairs) under its Air Quality and Industrial Pollution Programme.

Research and Monitoring by CEH

Just to the south of Edinburgh, on Auchencorth Moss, CEH runs one of two UK air quality monitoring supersites on behalf of Defra. Controlled air pollutants such as ozone, nitrogen dioxide, mercury and fine particles that are hazardous to health are monitored and measured. The measurements are used to show UK compliance with international conventions and for models. One such model, EMEP4UK, has been developed by the University of Edinburgh in collaboration with CEH and funded by Defra. It predicts concentrations and sets them into a context across the whole country. This allows policy-makers to make decisions on the basis of solid evidence. Other projects include EDPHiS, led by the Institute of Occupational Medicine, which seeks to support the Scottish Government's strategy, 'Good Places, Better Health'. CEH aims to combine data and modelling in order to quantify impacts on human health, and on asthma in children in particular. CEH is also using measurements taken at Edinburgh's Calton Hill to investigate whether the chemical composition of air pollution is more or less important compared to total mass.

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Real time monitoring of Pandemic Flu



Antiviral drugs may affect the performance of sewage-treatment plants, which use microbiologically 'activated sludge'. (Photograph - Shutterstock)

Background

In order to make sound decisions, policy-makers need to know how deadly a pandemic influenza virus is, and how fast it spreads. For the latter, in the UK, the system relies on modelling confirmed clinical cases, although this only measures cases in which people visit their doctor. It takes up to two weeks to obtain confirmed results, and so information is out of date by the time it is needed. One possible policy reaction is the widespread use of antiviral medications, but this may mean that high concentrations of powerful drugs are released into waste water. In turn, this may cause undesired effects in the environment, and might hasten the generation of antiviral resistance. Antiviral drugs may also affect the performance of sewage-treatment plants, which use microbiologically 'activated sludge'. Thus, the flu treatment could itself endanger health because the effectiveness of the sewage treatment is compromised.

Research and Monitoring by CEH

Research at CEH seeks to determine the basis for a real-time, unbiased assessment of the number of influenza-infected people within a population. Unlike seasonal influenza, pandemic influenza virus can have more severe physiological effects, which can lead to the release of the virus into faeces. Viruses can be transported into the sewage-treatment system, where they can be quantified, thereby providing a rapid and cost-effective method of determining the extent of infection within populations in real time. Year-round monitoring of other gastrointestinal viruses could also help estimate the prevalence of other serious diseases in the community. CEH's methods could provide better evidence for policy-makers at local and national levels, and allow better targeting of treatment and greater restraint in the use of antivirals - thus limiting potential dangers.

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Pathogens in the Environment & Human Health



Johne's disease is caused by a bacterium that affects the small intestine mainly of ruminants (cattle, sheep) but also of primates. *(Photograph - Shutterstock)*

Background

Recent outbreaks of Avian Flu and Swine Flu have raised public awareness of the ability of pathogens to cross from the environment to humans. Avian Flu and Swine Flu are viruses but many other pathogens (including microbes and fungi) also have an environmental source. The pathogens do not necessarily need to be new in order to cross over; there may be existing diseases for which the connection between animal and human health has yet to be recognised. In order to help develop effective treatments and preventative strategies in humans, it is useful to study the source and routes of transmission of these pathogens from the environment to man.

Research and Monitoring by CEH

Researchers at CEH are investigating the links between birds and the pathogens that they carry. Recent work has identified a fungus associated with seabirds that can cause fatal systemic disease in humans with compromised immune systems. Other research by CEH is looking at a possible connection between Johne's disease in animals and Crohn's disease in humans. Johne's disease is caused by a bacterium that affects the small intestine mainly of ruminants (cattle, sheep) but also of primates. Crohn's disease also occurs in the gastrointestinal tract, has similarities to Johne's disease and is now significantly associated with the Johne's disease pathogen. Recent evidence across the world suggests that there is a five-fold increase per decade in the incidence of Crohn's disease particularly in children. CEH is carrying out environmental studies on the sources of the bacterium and investigating the possible exposure routes to humans, through air, rain runoff into rivers, and milk. It is intended that the results of this research and the evidence obtained will help policy-makers determine the action needed to reduce environmental exposure routes and ultimately lower instances of Crohn's disease in humans.

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The Predatory Bird Monitoring Scheme monitors birds of prey for pollutants in order to determine a UK fingerprint of exposure. *(Photograph - Shutterstock)*

Background

Every year, tonnes of man-made substances are released into the environment. Some are deliberate: for example, 80-90% of UK farms use poison to keep down rat populations, vermin that would otherwise eat our cereal grains or defecate on them. Predators, such as birds of prey, eat the rats (and other non-target animals) and are gradually poisoned themselves. Other substance releases are inadvertent: many modern sunscreens contain titanium dioxide, a nanoparticle. When sunscreen is washed off in the shower, the nanoparticles go down the drain. Currently it is not clear what effect they may have in the environment. In order to mitigate the risk to human health for all types of releases, it is necessary to understand and monitor these substances in the environment.

Research and Monitoring by CEH

CEH carries out a broad range of environmental monitoring. For the examples mentioned here it has specific projects.

Operating for over 40 years, the Predatory Bird Monitoring Scheme monitors birds of prey for pollutants in order to determine a UK fingerprint of exposure. Many are exposed - 70% of red kites have detectable levels of rat poison. This sort of evidence is used to help determine policies, such as the banning of the pesticide DDT. Other substances currently under examination include flame-retardants.

CEH scientists are also researching the fate and effects of nanoparticles in the environment, a question of key concern to governments and health authorities. Research by CEH has shown that most titanium dioxide is taken out in sewage-treatment plants as sludge and then enters the environment via soil. Tests have also shown that earthworms are not harmed, a finding which could be used as a sentinel for humans. Current research by CEH is looking at nanoparticle fuel additives and the silver nanoparticles released through their use as antibacterial treatments (e.g. deodorants, anti-odour socks and coated washing machines).

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Following a nuclear accident issues such as the recovery of contaminated land need to be addressed. (Photograph - Shutterstock)

Background

Following a nuclear accident, two levels of response can be expected: immediate, short-term action, when the emergency services are at the fore; and medium- and long-term action, when issues such as the recovery of contaminated land need to be addressed. In the latter case, both urban and rural land might be involved and we need to try and ensure that acceptable living and working conditions are sustained by using practical, cost-effective and acceptable restoration strategies for the different types of environment and land use.

Research and Monitoring by CEH

The approach taken by STRATEGY, a European project, led by CEH, was based on the use of datasheets for a wide range of countermeasures combined with a model. This enabled users to select optimal remediation strategies for the long-term sustainable management of

contaminated areas. The datasheets incorporated a wide range of different factors which might affect the acceptability, effectiveness and practicality of each countermeasure. The datasheets now form part of the UK Radiation Recovery Handbook, which is partly-funded by the Food Standards Agency (FSA). The handbook, produced by the Health Protection Agency, is intended to provide management and mitigation information for the recovery of contaminated land once an incident has occurred. "The work is considered to be very high in importance," according to Andy Dugdale of the FSA. "Recent emergency exercises have focused on recovery issues and the role of the handbook during discussions on options post-acute phase of an accident has been invaluable."

One example scenario considered a hypothetical nuclear incident in Cumbria. The optimal combination of countermeasures suggested by the model resulted in a decrease in collective population exposure dose of over 90% while maintaining practical land use over a 10-year period. The optimised approach could reduce the costs of applying countermeasures from £2,300 million to £160 million by banning contaminated food.

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Mosquito-borne diseases that are present in Western Europe could conceivably be transmitted by British mosquitoes. (Photograph - Shutterstock)

Background

Recent (2009) UK government climate change scenarios have predicted changes in rainfall patterns and an average increase in UK summer temperatures of between 3-5°C. In the event of such environmental change, vectors of disease (including mosquitoes) will alter their ranges and there may be an increased risk of outbreaks of disease. This would have a direct impact on human health in this country. Mosquito-borne diseases that are present in Western Europe that could conceivably be transmitted by British mosquitoes include West Nile Virus and heartworm. To develop effective mitigation strategies we need to understand and monitor the changes taking place, and create models to predict future trends.

Research and Monitoring by CEH

The Biological Records Centre (BRC) is hosted by CEH and co-funded with the Joint Nature Conservation Committee. It holds data on species distributions in Britain and works with the National Biodiversity Network to make these records accessible to the research community and environmental practitioners. Many of the datasets are collected by voluntary schemes and societies. The BRC links these data and undertakes meta-analyses to identify and interpret trends which show, for example, how different species ranges are changing over time and what might cause these changes. Through the BRC, CEH is involved in or linked to a number of schemes in collaboration with the Health Protection Agency and Chartered Institute of Environmental Health to record distributions for species such as ticks and mosquitoes. One project, EMMPOWER, seeks to understand environmental parameters that explain mosquito population abundance in UK wetlands. Six of the 34 species of UK mosquitoes feed on both humans and animals, and nine species have been linked to West Nile Virus. Only through the work of these and similar projects can we improve our understanding of the processes underlying disease-vector dynamics and disease transmission. Once we have this deeper understanding, we can then contribute to the development of targeted and cost-effective intervention strategies.

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