Exploring the interconnections between the environment, health and wellbeing.

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• An international centre-of-excellence for research addressing the *interconnections* between the Environment and Human Health.

• Through knowledge transfer, catalysing the further development of *business activity* in the “environment and human health service sector”

• *Promote understanding* of the interconnections between environment and human health among policymakers, politicians, leaders in society and the public.
Research Agenda

- Climate change, weather, and human health (including oceans and human health)
- Environmental chemicals and vulnerable populations.
- Pharmaceuticals in the environment.
- Biodiversity and Health (incl. pathogen biodiversity)
- Environmental triggers of disease (UV, arsenic, radon)
- Health and wellbeing from the Environment (including environmental psychology and qualitative research)
- Citizen sensors and tele-health (tele-wellbeing).
- Sustainable Healthcare systems
- Public Policy Initiatives (novel communication strategies).
- Global outreach.
Health and wellbeing in past ecosystems.
Interconnections between humans and the environment: a historical perspective
The “Great Acceleration”
Our changing relationship with Death
The Global Population

YEARS WHEN WORLD POPULATION REACHED INCREMENTS OF 1 BILLION

The rapid growth of the world population is a recent phenomenon. About 2,000 years ago, the population of the world was about 300 million. It took more than 1,600 years for the world population to double to 600 million. The rapid growth of the world population started in 1950, with reductions in mortality in the less developed regions, resulting in an estimated population of 6.1 billion in the year 2000, nearly two-and-a-half times the population in 1950. With the declines in fertility in most of the world, the global growth rate of population has been decreasing since its peak of 2.0 per cent in 1965-1970.

Source: Population Division of the United Nations Department of Economic and Social Affairs.

WILL MY GRANDCHILDREN LIVE IN A WORLD OF 10 BILLION?
Economic History of the World

World GDP (trillion 1990 dollars)

Year

$1 trillion in 1900

$10 trillion in 1967

$52 trillion in 2003

Source: DeLong 1998
More people are alive today than ever before
More goods are being moved around the World
More impacts of humans on the Earth’s ecosystems and climate
More frequent and intense storms
More heatwaves and ice vortices
More sea level rise and flooding
More icecap melting
More chemical contaminants
More particulate air pollutants
More biodiversity losses
More invasive species
More pathogens (and potentially antibiotic resistant pathogens)
More extensive agriculture and aquaculture (GMOs)
More depletion of non-renewable mining resources
More exploitation of non-renewable energy resources (e.g. fracking).
More extensive knowledge of how our planet works
More detailed knowledge of how humans work
More detailed knowledge of potential threats to, and opportunities for
the future of humanity.
More inertia?
Anthropogenic Chemicals

- **Pesticides** (DDT, organophosphates, carbamates, etc.)
- **Fertilizers** (phosphates, nitrates)
- **Industrial chemicals**
  - Heavy metals and metalloids.
  - Organics (PCBs, PAHs, BPA, PFs, Dioxins, BFRs, etc).
  - Nanomaterials.
- **Pharmaceuticals** (antibiotics, analgesics, cardiovascular and respiratory drugs, contraceptive pills, chemotherapy agents, etc.)
- **Gases** (carbon dioxide, carbon monoxide, methane, etc.)
- **Particulates**
We have always been exposed to a wide variety of chemicals so what’s the problem?

Global Population (1804) = 1 billion
British Population (1804) = 10.5 million

Today = 7.2 billion
Today = 63.7 million

World Production of Industrial Chemicals has increased by ca. 2500% in just the last 75 years
Dioxin TEQ levels by age: 4 studies
Human Demographics
Population ageing e.g. USA

From Ed Stephan, Global Health Network

http://www.ac.wwu.edu/~stephan/Animation/pyramid.html
Body burdens of contaminants with age

Depledge et al. (2013) Marine Environmental Research, in press
Are environmental chemicals altering the incidence and pattern of diseases?

Association of Urinary Bisphenol A Concentration With Medical Disorders and Laboratory Abnormalities in Adults

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Bisphenol A (BPA) is one of the world’s highest production-volume chemicals, with more than 2 million metric tons produced worldwide in 2003 and annual increase in demand of 6% to 10% annually. Bisphenol A is used extensively in epoxy resins lining food and beverage containers and as a monomer in polycarbonate plastics in many consumer products. Widespread and continuous exposure to BPA, primarily through food but also through drinking water, dental sealants, dermal exposure, and inhalation of household dusts, is evident from the presence of detectable levels of BPA in more than 90% of the US population. Most studies of the health effects of BPA have focused on well-documented

Context Bisphenol A (BPA) is widely used in epoxy resins lining food and beverage containers. Evidence of effects in animals has generated concern over low-level chronic exposures in humans.

Objective To examine associations between urinary BPA concentrations and adult health status.

Design, Setting, and Participants Cross-sectional analysis of BPA concentrations and health status in the general adult population of the United States, using data from the National Health and Nutrition Examination Survey 2003–2004. Participants were 1455 adults aged 18 through 74 years with measured urinary BPA and urine creatinine concentrations. Regression models were adjusted for age, sex, race/ethnicity, education, income, smoking, body mass index, waist circumference, and urinary creatinine concentration. The sample provided 80% power to detect unadjusted odds ratios (ORs) of 1.4 for diagnoses of 5% prevalence per 1-SD change in BPA concentration, or standardized regression coefficients of 0.07 for liver enzyme concentrations, at a significance level of P<.05.

Main Outcome Measures Chronic disease diagnoses plus blood markers of liver function, glucose homeostasis, inflammation, and lipid changes.

Results Higher urinary BPA concentrations were associated with cardiovascular diagnoses in age-, sex-, and fully adjusted models (OR per 1-SD increase in BPA concentration, 1.39; 95% confidence interval [CI], 1.18-1.63; P=.001 with full adjustment). Higher BPA concentrations were also associated with diabetes (OR per 1-SD increase in BPA concentration, 1.39; 95% confidence interval [CI], 1.21-1.60; P<.001) but not with other studied common diseases. In addition, higher BPA concentrations were associated with clinically abnormal concentrations of the liver enzymes γ-glutamyltransferase (OR per 1-SD increase in BPA concentration, 1.29; 95% CI, 1.16-1.46; P<.001) and alkaline phosphatase (OR per 1-SD increase in BPA concentration, 1.48; 95% CI, 1.18-1.89; P=.002).

Conclusion Higher BPA exposure, reflected in higher urinary concentrations of BPA, may be associated with avoidable morbidity in the community-dwelling adult population.

JAMA. 2008;300(11):1303-1310


Melzer D, Rice N, Depledge MH, Henley WE, Galloway TS 2010. Association Between Serum Perfluorooctanoic Acid (PFOA) and Thyroid Disease in the NHANES Study. Environ Health Perspect --. doi:10.1289/ehp.0901584
Most cancer types “just bad luck”

The results, in the journal Science, showed two thirds of the cancer types analysed were caused just by chance mutations rather than lifestyle.

There were 161,823 deaths from cancer in the UK in 2012. About 53,900 deaths were lifestyle related. Causes of mutations in the remaining 2/3’s were unidentified (Radiation? Chemical ? Other?)
MED MI

Medical and Environmental Data Mash-up Infrastructure
Chemical Pollution and Climate Change

- Alters local environmental conditions including temperature, salinity, oxygen concentrations.
- Influences the bioavailability of environmental pollutants (persistence, toxicity, transformations, breakdown)
- Affects the distribution and lifecycles of organisms (including humans) – and hence the pollutants that they encounter.
- Results in acute exposures after extreme events
Managing pharmaceuticals in the environment

Annual prescribing rates by therapeutic group
Males, England & Wales, 1998

Data source: Department of Health, 1998
Pills for Everyone

ACE INHIBITOR
STATIN
ASPIRIN
METFORMIN

Times

Get The Times delivered free

Alzheimer’s could be stopped by ‘statin’ pill

European Centre for Environment & Human Health
Deaths attributable to AMR every year compared to other major causes of death

- AMR in 2050: 10 million
- AMR now: 700,000 (low estimate)

- Tetanus: 80,000
- Cancer: 8.2 million
- Road traffic accidents: 1.2 million
- Measles: 130,000
- Cholera: 100,000 - 120,000
- Diarrhoeal disease: 1.4 million
- Diabetes: 1.5 million

Sources:
- Diabetes
- Cancer
- Cholera
- Measles
- Road traffic accidents
- Tetanus
- Diarrhoeal disease
Resistance to antibiotics is one of the greatest threats to modern health, experts say.

The chief medical officer, Prof Dame Sally Davies, said: "Antibiotics are losing their effectiveness at a rate that is both alarming and irreversible - posing a threat similar to global warming".
Novel Materials in the Environment: The case of nanotechnology

Nanotechnology and human health:
Scientific evidence and risk governance

Report of the WHO expert meeting
10–11 December 2012, Bonn, Germany
Benefits of New Technologies

Nanotechnology & the Life Straw

Plus thousands more!

e.g. Sunscreen, fuel additives, antiseptics, medicines, novel electronics, paints, decontaminating of land, water and air, fabrics...
Do some nanomaterials pose new threats to human health and our ecosystems?

How would we know?
Nanomaterials: Regulatory Challenges

- Exposure? - too small to detect
- Toxicity? - altered chemistry, nano-toxicology
- Persistence? - lack of monitoring tools
- Current regulatory protection - do production volumes trigger action? Weight vs numbers?
- Regulation? - can exposure to nanomaterials in the environment be regulated effectively?

http://news.softpedia.com/
From innovation to regulation...
Emergence of Nanotechnology Products

Emerging nano-products
Generated EHS data
EHS data analyzed by regulatory agencies

Volume
Time
Gap

from Linkov and Satterstrom, 2008
Chemicals Policy in Europe

One Integrated Policy!

Industrial
Chemicals,
Pesticides,
Plastics,
Pharmaceuticals,

Air
Pollutants,
Fertilizers,
Radioisotopes,
Nanomaterials,

Other emerging chemicals.
Global Urbanization Trends

The chart illustrates the global urbanization trends from 1950 to 2050, broken down by region: World, Africa, Asia, Europe, Latin America and Caribbean, and Oceania. The bars represent the percentage of the population living in urban areas for each region in different years:

- **1950**
- **1980**
- **2010**
- **2050**

The data shows a significant increase in urbanization across all regions, with the highest increase expected in Latin America and the Caribbean, followed by Oceania and Europe.
The way we were.....
The way we are........
Four key behaviours

• Smoking.
• Non-adherence to guidelines on fruit and vegetable consumption.
• Excessive consumption of alcohol.
• Low levels of physical activity.

What’s missing from our lives?
Urbanisation: Living without Nature
Global Trends in Obesity

- % Obese (BMI ≥ 30 kg/m²)
- Year (1970-2005)

Lines represent:
- England
- Finland
- Norway (Tromsø)
- Sweden (Goteborg)
- Australia
- Japan
- Brazil
- USA

European Centre for Environment & Human Health
Diseases associated with Obesity

- Arthritis
- Breast Cancer
- Heart Disease
- Colorectal Cancer
- Type 2 diabetes
- Endometrial Cancer
- End Stage Renal Disease
- Gall bladder Disease
- Hypertension (x5)
- Liver Disease
- Low Back Pain
- Stroke
- Urinary Incontinence
Disease patterns by 2030

1. Aids
2. Depression
3. Stroke

1. Depression
2. Heart Attack
3. Alzheimers

1. Aids
2. Depression
3. Stroke

1. Aids
2. Infant Mortality
3. Depression

1. Depression
2. Heart Attack
3. Alzheimers

Source: NASA & WHO
Responses to isolation from Nature?

Excessive Feeding

Behavioural abnormalities
What can the outdoors do for you?

- Increased energy use (standing, walking, running, etc.).
- Mental stimulation (reduced risk of psychiatric disorders, improved sense of wellbeing).
- Long term motivation and beneficial habits.
- Increased social cohesion.
- Something EVERYONE can do.
Green spaces boosts wellbeing of urban dwellers - study

22 April 2013 Last updated at 01:55

Parks, gardens and green space in urban areas can improve the wellbeing and quality of life of people living there, says a University of Exeter study.

Using data from 8,000 UK households over 17 years, researchers found...
Mechanisms

Fig. 4. Immunological and psychological explanations for the health benefits derived from contact with the natural environment. (NO, nitric oxide). There are many studies of exposures during the perinatal period that point to the immunological mechanisms, whereas most studies in adult life have been orientated toward psychological explanations, and have not included investigation of the immunoregulatory aspects.

G. A Rook (2013)
Does water make a difference?
Does living by the sea improve your health and wellbeing?

Blue Gym = Campaign + Research

Rigorous scientific studies (RCT, intervention & mechanistic studies)

Rockpool rambles
Sailing
Coastal walks
Kayaking
Surfing
Swimming
Diving
3 rooms are identical except view from the balcony

- Room A: $91.22
- Room B: $109.28
- Room C: $71.94

White et al, 2010
Quality Values *(non-economic valuation)*

What would diminish your life? What would you miss?

- Access to natural settings?
- Nature and your senses?
- Charismatic megafauna and flora?
- Imagined nature?
- Vastness?
- Diversity of species?
- The security of nature?
- Moral and ethical wellness?
- Shared pleasures and concerns?
- Exploring the unknown?

How can these considerations be used to modulate economic drivers?
Environmental Inequality: Unequal access to green and blue space
Joining up health, wellbeing and environmental sustainability issues
Salutogen®

- Lowers blood pressure
- Lowers heart rate
- Promotes wellbeing

Available from all parks, seashores, forests or countryside near you.
A Culture of Health and Environmental Sustainability