

Oceans, Health and Wellbeing: the Next Frontier

IOC Bruun Memorial Lecture
June 2015

Professor Lora E Fleming MD PhD MPH MSc
*European Centre for Environment and Human Health
University of Exeter Medical School*





Anton Frederick Bruun (1901-1961)

The Anton Bruun Memorial Lecture Series is dedicated to the memory of the noted Danish oceanographer and first chairman of the Commission, Dr Anton Frederick Bruun.

The “Anton Bruun Memorial Lectures” were established in accordance with Resolution 19 of the Sixth Session of the IOC Assembly in 1970, in which the Commission proposed that **important intersession developments be summarized by speakers in the fields of solid earth studies, physical and chemical oceanography and meteorology, and marine biology.**

Why Oceans and **Human Health?**

Outline

- **Oceans and Human Health**
 - Overview
 - US
 - Europe
- **New Focus: Health and Wellbeing at the Coasts**
 - Beyond “Blue Gym”: the evidence base
- **Future Challenges and Opportunities**



Oceans and Human Health

Context and Principles

- **Interconnections/Interdependence** between Health of Humans and the Oceans/Seas
- **Complexity** of the science, challenges, contexts
- **Multi/Inter** Disciplinary, Institutional, Sector
- **Benefits, Opportunities, and Risks**
- **Time is NOW**





Interconnections: Environment ↔ Human Health



Linking Oceans & Human Health:

A Strategic Research Priority for Europe

Position Paper 19

European
MARINE BOARD
Advancing Ocean & Health Science

www.marineboard.eu

International Need:

- **To Increase Understanding of Human and Ecosystem Interactions with the Seas and Oceans**
- **Both Risks AND Benefits/Opportunities**



Linking Oceans & Human Health:

A Strategic Research Priority for Europe

Position Paper 19

European
MARINE BOARD
Advancing Oceans & Human Health Science

www.marineboard.eu

Risks:

- **Storms, Climate Events**
- **Harmful Algal Blooms (HABs) & Other Toxins**
- **Infectious Diseases**
- **Anthropogenic Chemicals**
- **Fisheries Destruction**



THE LANCET

Volume 373 - Number 9675 - Pages 1653-1734 - May 15-22, 2009

www.thelancet.com

“Climate change is
the biggest global
health threat of the
21st century.”

(See The Lancet Commissions page 169)

Comment

Compensation for brain drain
from developing countries
(see page 1616)

Correspondence

Anemia from cerebral tumor?
(see page 1621)

Articles

RECORD4: rivaroxaban for
thromboprophylaxis after
total knee arthroplasty
(see page 1623)

Articles

TACT: sequential docetaxel as
adjuvant chemotherapy for
early breast cancer
(see page 1681)

The Lancet Commissions

Management of health effects
of climate change
(see page 169)

£5.00 Registered as a newspaper - ISSN 0140-6736
Founded 1823 - Published weekly

May 2009

Natural Events/Global Climate Change

Increased CO₂ and Sea Surface Temperature (SST)

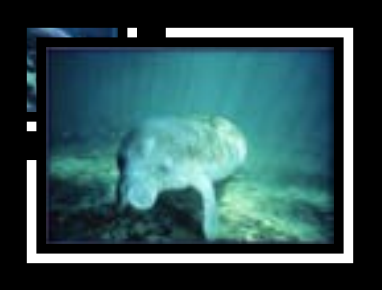
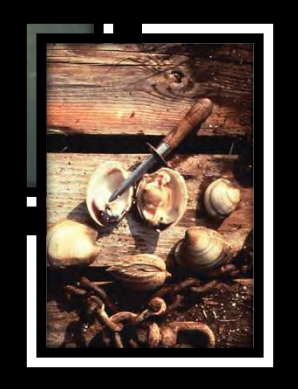
- Sea Level Rise & Increased Temperatures & Ocean Acidification
- Extreme Weather
- **Human Health Impacts?**
 - Drowning, trauma, migration
 - Infectious & Vectorborne Diseases
 - Threat to Fisheries & Agriculture, Food Security
 - Marine Microbial
 - Harmful Algal Blooms (HABs), Other Microbes
 - ?Depression, Mental Illness
 - ?"Distal" and Complex Effects
 - ?Chemicals, Ocean Acidification, Mixtures
- **Most Vulnerable are the Developing Nations!**



Harmful Algal Blooms (HABs)



**Florida Red
Tide
One Health**



Microbes & Infectious Diseases





BEACHES Study



Randomization

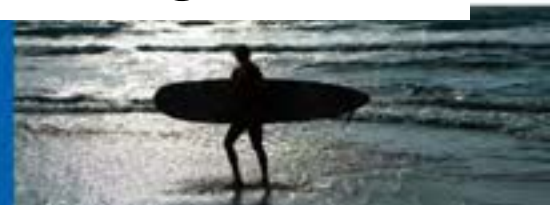


Anthropogenic Pollution



Mixtures!!!

Chemicals, HABs, Microbial Pollution, Climate Change, Acidification, Ocean Currents, Demographic Change, etc



Seafood Depletion



“**Seafood** (fish and shellfish harvested from capture fisheries and aquaculture production in marine and freshwater environments) contributes at least **15% of average animal protein consumption** to 2.9 billion people” (Smith 2010)



***!@# OVERFISHING!**
***!@# WATER POLLUTION!!**
!?!# GLOBAL WARMING!!!!
***!@# REEF DESTRUCTION!**



'NOT SO FUN LISTENING TO THE OCEAN, THESE DAYS..'

Linking Oceans & Human Health:

A Strategic Research Priority for Europe

Position Paper 19

European
MARINE BOARD
Advancing Oceans & Human Science

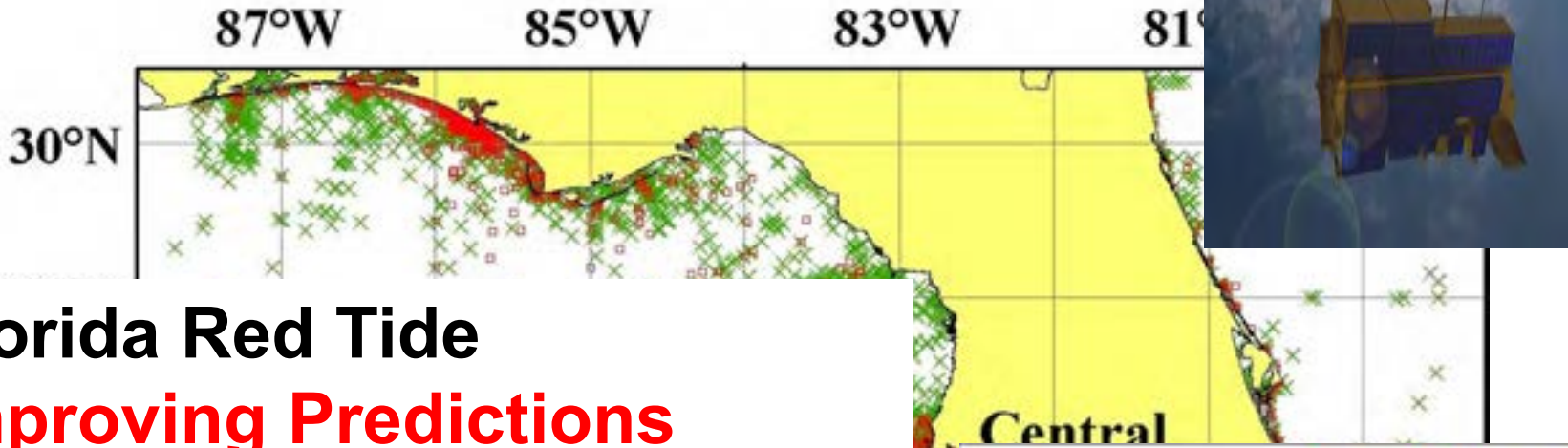
www.marineboard.eu

Benefits & Opportunities:

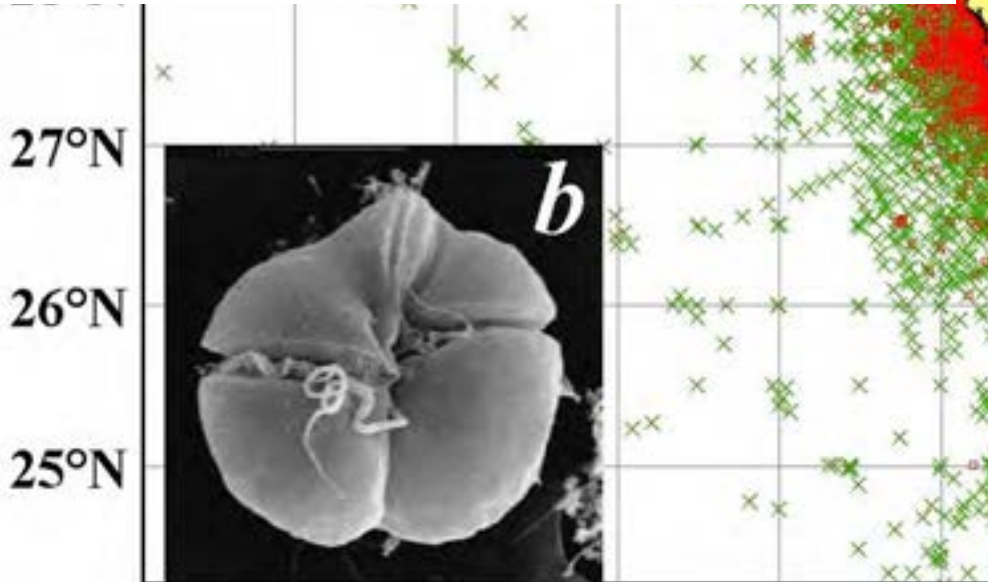
- Modelling/Forecasting
- Pharmaceuticals & Other Bioactive Compounds & Biotechnology
- Marine Organisms as Biomedical Models
- **Coastal Living/Blue Gym**



Florida



Florida Red Tide Improving Predictions



Gulf of Mexico Harmful Algal Bloom Bulletin
1 January 2010
Water Quality Division
Water Quality and Information Services
Last Revision: August 1, 2009

Conditions Report
A harmful algal bloom (HAB) identified in Monroe County Florida has impacted sea products for the gulfwide Lower Keys and has the potential to impact sea products Florida and elsewhere. No impacts are expected elsewhere in the Florida through January. Dead fish have been reported between Key West and Marathon in the past few days. Dead fish would, with exception, does not produce the same symptoms associated with HAB.

Analysis
The bloom near the Lower Keys continues present. Chlorophyll levels are consistently elevated north and south of the Lower Keys, with levels highest north and westward of Big Middle Key (24°17'N, 81°34'W and 24°14'N, 81°37'W), north of the Mosquito Keys, and northwest of the Florida Key (24°40'N, 81°38'W). Elevated chlorophyll levels along the outer edge of the Lower Keys, east to approximately 7 miles from shore. The bloom complex is available for this area. A fish kill was reported on 1/1 at Upper Lane west of Marathon. Sampling is highly recommended throughout this area. Continued sampling around the Lower Keys is possible throughout the winter. Any change in the bloom pattern may be the transport of additional HAB species through the Lower Keys' major passages on Florida and elsewhere with the appearance of rising levels in eutrophic waters.

Sampling events indicate the bloom is no longer present at the 100 Florida coast, although background levels continue present in Big and Middle Key of Monroe and Monroe County (FWRI, FTS). Elevated chlorophyll levels continue offshore Collier and Monroe Counties east 23°30'N, 82°17'W, and offshore Lee and Collier Counties at 26°30'N, 82°17'W. Sampling is preferred in recommended coastal waters, but has been limited. The bloom will likely continue until conditions are improved. (Water, Florida)

Notes on this report:
1. This is a summary of the information available on the HAB. It is not a prediction of the bloom's future.
2. This report is for informational purposes only. It is not a forecast.
3. Sampling stations are indicated by green 'x' markers on the map. Sampling stations are indicated by green 'x' markers on the map.

Wind speed and direction are averaged from 12-hour time-series measurements. Length of the red tide bloom is shown in the map. The map shows the most likely location of the bloom. The map shows the most likely location of the bloom. The map shows the most likely location of the bloom.

Remedies from the Seas

Current successful examples:

- **Bryostatin 1** (potent anticancer agent from marine invertebrate);
- **Ecteinascidin 743** (potent anti cancer drug from the Caribbean sea squirt);
- **Discodermolide** (potential anti cancer drug from a marine sponge)
- **Brevenal** (possible cystic fibrosis agent from Florida Red Tide brevetoxin natural derivative)

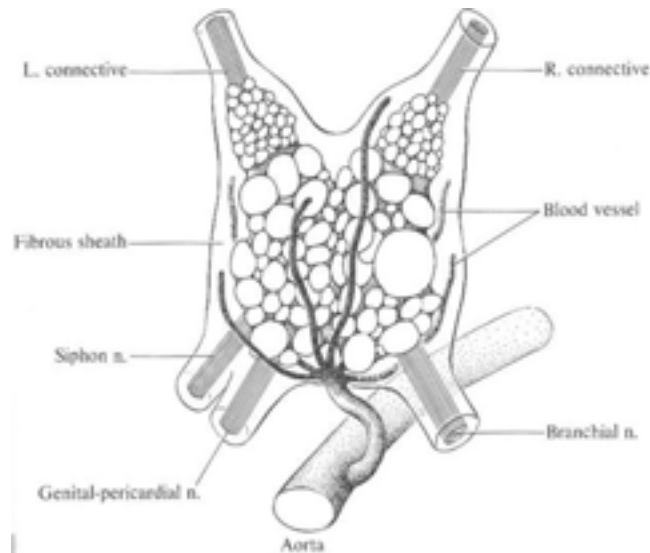
Bourdelais, Baden, Abraham et al



Example: Aquatic Animal Model

Aplysia (Sea Hare)

Simple Brains Enabled Nobel Award Winning Studies of Memory & Learning





European Centre for
Environment & Human Health

A relationship between environmental degradation and mental health in rural Western Australia (Speldewinde 2009)



- An association was detected between **dryland salinity** and **depression**, indicating that **environmental processes** may be driving the degree of **psychological ill-health** in these populations.

Blue Gym = Campaign + Research



Rockpool rambles



Sailing



Rigorous scientific studies

(Secondary Data, Intervention & Mechanistic studies)

Coastal walks

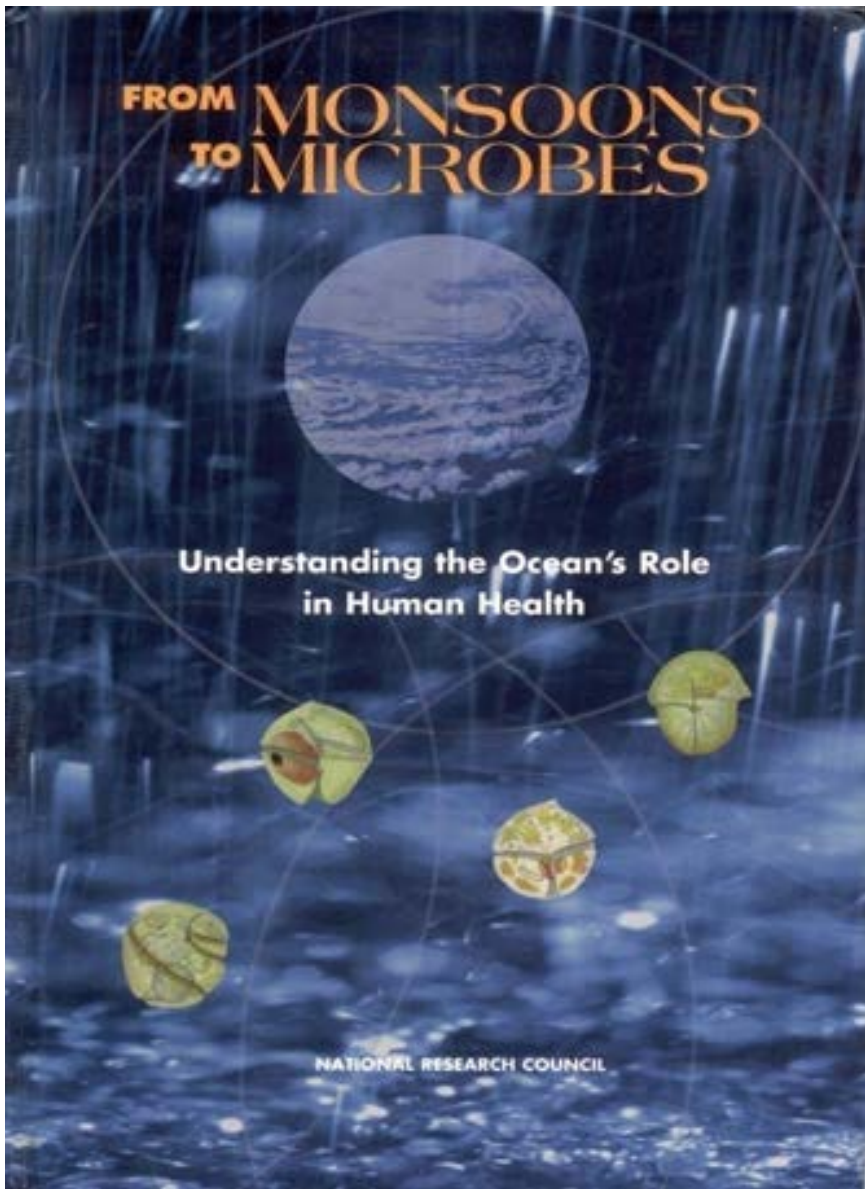
Kayaking



Mike Depledge PhD et al

Swimming

Diving



2005



2006



2007

1999 United States

2012

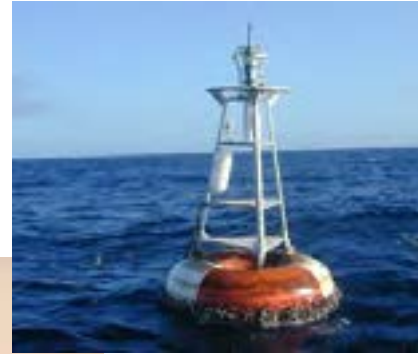
2004

4 NSF NIEHS OHH Centers

3 NOAA OHH Centers



Oceans & Human Health Centers: Inter-disciplinary Research, Training, Pilot Projects, Facilities Cores, Shiptime



2015

2 NSF NIEHS OHH Centers + 11 RO1s

3 NOAA OHH Centers + Training Grants



OHH New Series

 Gordon Research Conference

Gordon Conference in **OCEANS & HUMAN HEALTH**

- June 2008
- June 2010
- June 2012
- June 2014



Oceans and Human Health
Implications for Society and Well-Being

Robert E. Bowen, Cinnamon P. Carlisle, Michael H. Depledge, Lora E. Fleming

This remarkable volume brings experts from diverse disciplines and builds a workable understanding of breadth and depth of the processes – both social and environmental – that will help us to limit future costs and enhance the benefits of sustainable marine systems. In particular, the authors have developed a shared view that the global coastal environment is under threat through intensified natural resource utilization, as well as changes to global climate and other environmental systems. All these changes contribute individually, but more importantly cumulatively, to higher risks for public health and to the global burden of disease.

This pioneering book will be of value to advanced undergraduate and postgraduate students taking courses in public health, environmental, economic, and policy fields. Additionally, the treatment of these complex systems is of essential value to the policy community responsible for these questions and to the broader audience for whom these issues are more directly connected to their own health and well-being.


"The following pages in this volume are written in a lucid and very readable style, and provide a wealth of knowledge and insightful analysis, which is a rare amalgam of multi-disciplinary perspectives and unique lines of intellectual inquiry. It is valuable to get a volume such as this, which appeals as much to a non-specialist reader as it does to those who are specialists in the diverse but interconnected subjects covered in this volume." From the "Forward" written by, R.K. Pachauri, Director General, TERI and Chairman, IPCC

Hardcover | 328 Pages | June 2014 | ISBN: 978-1-119-94131-6
USD \$80.00 / £50.00 / €65.90

EARTH & ENVIRONMENTAL SCIENCES

WILEY

Connect with US:

 [facebook.com/earthandenvironmental](#)

 [@earth_wiley](#)

 [wiley-pages.com](#)

How to order:


EUROPE, MIDDLE EAST & AFRICA John Wiley & Sons Ltd Baffins Lane, Chichester, West Sussex PO19 1UD, UK Tel: +44 (0)1243 779777 www.wiley.com	US, CANADA & SOUTH AMERICA John Wiley & Sons Inc 111 River Street, Hoboken, NJ 07030, USA Tel: +1 (201) 748 6000 www.wiley.com	GERMANY, SWITZERLAND & AUSTRIA WILEY-VCH Verlag GmbH Boschstr. 12, D-69469 Weinheim, Germany Tel: +49 (0)6201 606-0 www.wiley-vch.de
--	---	---

Europe – a Maritime Continent

- 4 seas & 2 oceans
- 91,000km coastline (EU + Norway)
 - **50% EU population lives within 50km of coastline**
 - 50% EU territory underwater
- Trade: **90% external, 40% internal**
 - 40% World's Merchant Fleet
- **5.4 M jobs**
- **GVA > €500 Billion/year**



EU Strategies, Policies and Directives

EU Aquaculture Strategy	Habitats & Birds Directives	Water Framework Directive
Common Fisheries Policy	Integrated Maritime Policy	Marine Strategy Framework Directive
Blue Growth		Floods Directive
REACH Directive (chemicals)		Bathing Water Directive
EU Biodiversity Strategy 2020	Shellfish Waters Directive	EU Climate and Energy Package
Convention on Biological Diversity	London Convention (Dumping at Sea)	Stockholm Convention (POPs)



EU Blue Growth Strategy

Goal to reach 7 million jobs by 2020 with 5 Sectors

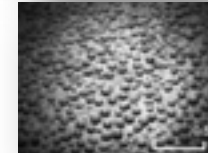
Blue energy



Aquaculture



Marine mineral resources



Maritime tourism



Marine biotechnology



European MARINE BOARD

Advancing Seas & Oceans Science



Linking Oceans & Human Health:

A Strategic Research Priority for Europe
Position Paper 19



Moore, McDonough et al 2014

www.marineboard.eu

European
MARINE BOARD
Advancing Seas & Oceans Science

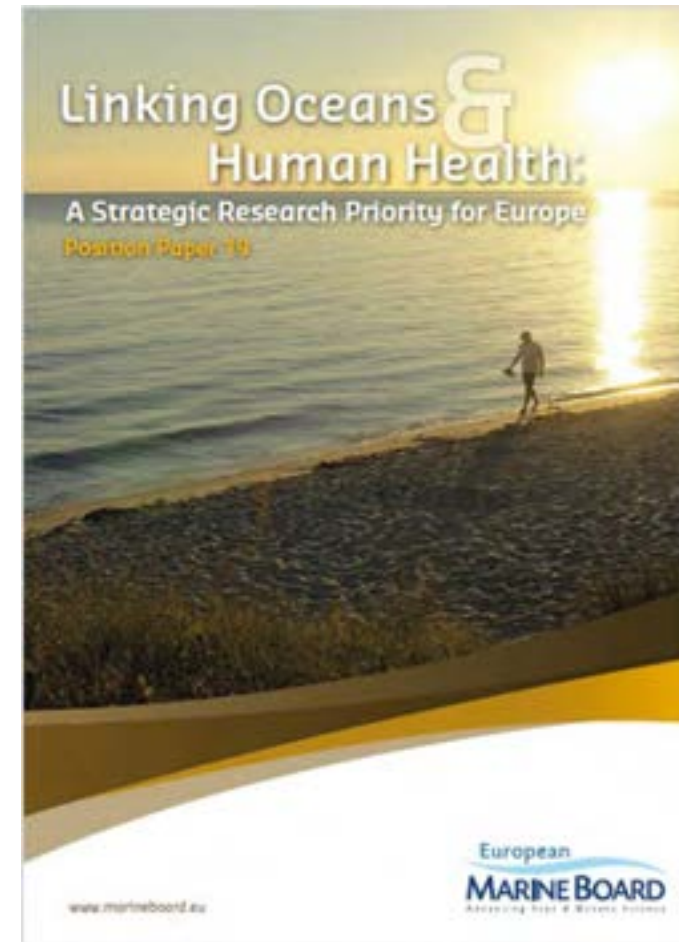
EMB Position Paper 19 (2014). Linking Oceans and Human Health: A Strategic Research Priority for Europe.

*“...many of our perceptions of the relationships between the marine environment and human health are limited and still relatively unexplored, leaving **critical knowledge gaps** for those seeking to develop effective policies for the sustainable use of marine resources and environmental and human health protection.”*



Recommendations

- Interdisciplinary collaboration
- Transmission processes
 - **Ocean Literacy**
- Valuation methods
- Causal relationships
- Monitoring and surveillance
- Indicators
- Environmental modelling



Message from Bedruthan



“...Unanimous call for a coordinated trans-national and interdisciplinary *oceans and human health* research programme in Europe..”

- engaging with stakeholders; and
- managing effective knowledge transfer and science policy interfaces.

The Bedruthan workshop unanimously called for a coordinated, transnational and interdisciplinary Oceans and Human Health research programme in Europe. Research should be solutions-oriented, supporting health and wellbeing promotion and disease treatment, and informing maritime, environment, public health and innovation policy.

European Marine Board (EMB) position paper

The Message from Bedruthan follows publication of EMB position paper 19, **“Linking Oceans & Human Health: A Strategic Research Priority for Europe”**. The EMB is a partnership of 95 major national research institutes and funding agencies from 19 European countries. The paper represents a compelling endorsement from this large European research network of the societal importance for Europe of supporting coordinated interdisciplinary OHH research.

Download at www.marineboard.eu



3. Strategic Analysis

Analyse the current OHH research effort and state-of-the-art in Europe, including research capacities and infrastructures, and identify research gaps and needs. Identify mechanisms to collate existing evidence and data currently dispersed across many different fields.

4. Human Capacities

Improve training and researcher mobility, and promote interdisciplinary expertise in OHH.

5. Policy Assessment and Support

Analyse the current EU policy framework, identifying policy gaps and making recommendations in support of evidence-based policy which takes account of marine environment and human health interactions.

6. Stakeholder Engagement

Improve the pathways for knowledge transfer and uptake across key OHH areas, linking with current ocean literacy developments in Europe, to achieve stakeholder and community engagement.

For more information, contact:

Professor Iain Fleming, Director, European Centre for Environment & Human Health, University of Exeter (i.fleming@exeter.ac.uk)
 Dr Neil McDonough, Executive Scientific Secretary, European Marine Board (neil.mcdonough@emb.org)
 Reference: Fleming et al. 2014. Message from Bedruthan. A statement from the participants of the Oceans & Human Health workshop. A rising tide of challenges and opportunities in Europe. Bedruthan, Cornwall, UK, 20-22 March 2014.
 Further information at: www.marineboard.eu/links/oceans-human-health & www.ecceh.eu

Image credits: Page 2 from top: coast (Shutterstock); sea (Fleming, Alan Stockley 1992); Page 2 from top: Ocean (Shutterstock); diver (Shutterstock); beach (Shutterstock); litter (Shutterstock).

6 Essential Areas to Build OHH Capacity

1. Community building
2. International cooperation
3. Strategic analyses
4. Human capacities
5. Policy assessment
6. Stakeholder engagement and knowledge transfer
 - **Knowledge Gap: Interconnections**



Rome Declaration Goals

Oct 2014

- 1. Valuing the ocean**
- 2. Capitalizing on European leadership**
- 3. Advancing ocean knowledge**
- 4. Breaking barriers**

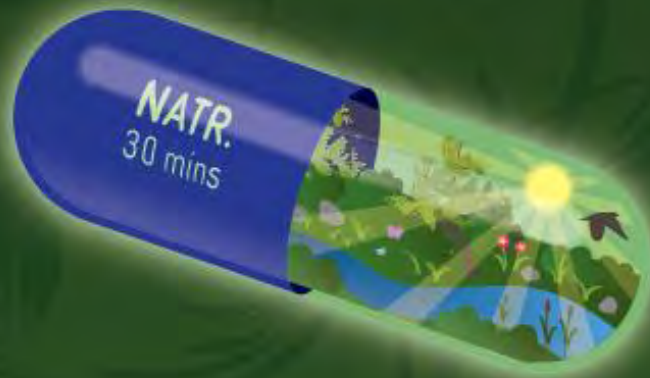


Rome Declaration Goals

Oct 2014

“A coordinated, cross-disciplinary and integrated programme on ***Oceans and Human Health***, targeted at understanding and managing the risks and benefits to human physical and mental wellbeing from interactions with the seas.”





Salutogen[©]

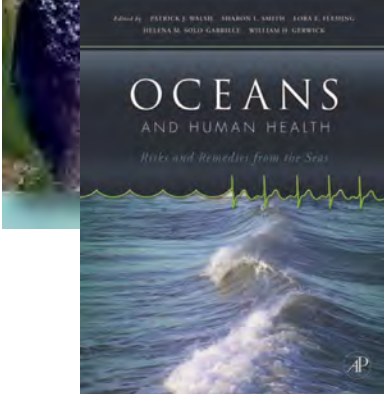
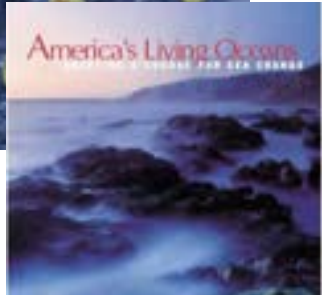
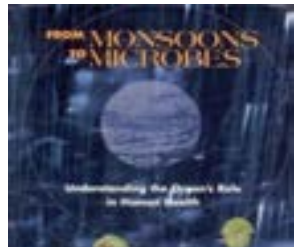
- Lowers blood pressure
- Lowers heart rate
- Promotes wellbeing

Available from all parks, seashores,
forests or countryside near you.

Dr Will Stahl-Timmins
Prof Michael Depledge



Oceans & human health: A rather negative focus



HABs & Other Toxins



Fisheries Destruction



Storms, Floods & Climate Change



Man-made Chemicals

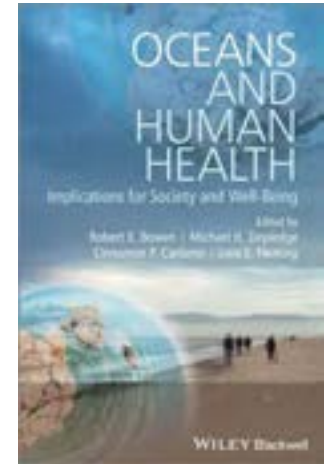


Microbial pollution

RISKS



Rich History of Oceans & Human Health



Dr Edouard Delcroix (1891-1973)
Thalassotherapy



Dr Richard Russell (1687– 1759)



Dr Fortescue Fox (1934 & 1938 Lancet)



Royal Sea Bathing Hospital (Est.1791)



Charlier & Chaineux (2009) Thalassotherapy



The “Blue Gym” Team



Michael Depledge



Lora Fleming



Sabine Pahl



Ben Wheeler

Ian Alcock, Kat Ashbullby, Debbie Cracknell, Lewis Elliot, Bonny Hartley, Andrea Harvey, Ian Frampton, Sahran Higgins, Amanda Hignett, Julie Hollenbeck, Rebecca Jenkin, Rebecca Lovell, Cassie Phoenix, Karin Tanja-Dijkstra, Tim Taylor, Kayleigh Wyles.



mathew.white@exeter.ac.uk

www.ecehh.org.uk



< Stress



> Social



> Environ.





Every methodology has its pros and cons!

Method	Pros (inc.)	Cons (inc.)	Our studies
Qualitative interviews	In-depth understand of people's motives & beliefs	Unrepresentative samples Demand characteristics	- Parent interviews - Child interviews
Visitor surveys	Big numbers / Multiple environments (controls) Voluntary/chosen	Memory biases, selection effects	- MENE (N = 142,000) - Wembury surveys - Surfing / sailing studies
Where people live	Representative samples Some longitudinal data	Causality? Multiple confounders	- Census (N = 48 million) - BHPS (N = 12,000 x 18 yrs)
Field experiments	Realistic exposure conditions with some control	Hard to randomise/blind to condition	- Marine Aquarium - Dental surgeries - Volunteering studies
Lab experiments	Reduced confounds & selection effects. Increased understanding of underlying processes (e.g. physiological, emotional, cognitive).	Small Ns (convenience samples); non-ecological e.g. may miss synergistic effects	- Videos/photos/sounds - Attention processes - Delay of gratification - Risk taking - Pain



Health & Wellbeing in the Natural Environment Across the Life Course

Transitions into Retirement

**Young Adults & Outdoor Physical Activity
(ESRC/National Trust)**

**“Stories of the Sea”
Exploring *Embedment* in Deprived Coastal Communities**

Marine access and understanding in a disadvantaged, urban coastal community: Implications for health, well-being and ecosystem management

Julie Hollenbeck¹, Cassandra Phoenix², Lora Fleming², Katrina Wyatt³, Angela Clark⁴, Ray Trujillo, Jr.⁴

¹European Centre for Environment and Human Health, University of Exeter & Oceans and Human Health, University of Miami; ²European Centre for Environment and Human Health, University of Exeter; ³University of Exeter; ⁴Rosenstiel School of Marine and Atmospheric Science, University of Miami

BACKGROUND

There is mounting evidence that access to the marine environment contributes to human health and well-being, and may provide greater health benefits for deprived coastal communities than non-deprived ones. However, research suggests that marginalized populations are underrepresented in marine engagement activities, issues, literacy and policy. Against this backdrop, this ongoing PhD study investigates the socio-cultural factors influencing marine access and understanding in a disadvantaged, urban coastal community in Miami, Florida, from the perspective of current/former community members.



Liberty City, Miami, FL



STUDY SITE

Liberty City,
Miami, Florida, USA



AIMS

Explore how social and cultural factors influence marine access & understanding in a disadvantaged, urban coastal community.

OBJECTIVES

1. To explore subjective experiences of marine access within a disadvantaged African-American coastal community.
2. To examine participants' awareness and understanding of the interconnections between marine environments and human health.
3. To investigate how the participants' marine access and understanding is shaped by knowledge management systems.
4. To understand the extent to which 'stories of the sea' transcend and/or are constrained by regional and cultural parameters.



METHODS

Qualitative – Narrative Inquiry & Framework Analysis

A number of qualitative data collection methods were used in Wave 2, including focus group discussions and individual interviews with participants who self-reported non-engagement with the marine environment. Participants were asked to share their own experiences and insights about accessing and understanding the ocean, and discuss their perceptions and beliefs about marine-derived human health threats/benefits. Focus group discussions were recorded and transcribed, followed by independent thematic coding conducted by two project members. Wave 3 data, derived from one on one interviews with participants who reported regular marine recreational engagement, is currently being analyzed. The data collected during both waves will be managed and analyzed using Framework analysis, a transparent, matrix-based data management & analysis method that allows for inter and cross-case analysis while retaining context of the participants views.

- Wave 2: Focus Groups with non-marine environ. engagers (natural) – Liberty City (n=31)
- Wave 3: In depth 1-on-1 interviews with marine environ. engagers – Liberty City (n= 10)

PRELIMINARY WAVE 2 RESULTS (Participant quotes in yellow)

"Tell me what the marine environment means to you?"

- Freedom
- Liberation
- Peace
- Tranquillity
- Stress Reliever
- Joyful
- Therapeutic
- Reset
- Comfort
- Soothing
- Spiritual

"Why didn't you or your parents visit the marine environment?"

- "It just never came up."

EMERGING THEMES AND QUOTES:

Themes and subthemes derived from Wave 2 data were grouped into five key constraint themes and subthemes.

Constraint Theme	Subtheme	Participant Quote
Exposure: Avenues of Experience	Access to the beach	"When I was growing up, we actually had Caucasian friends that came into our lives, took us outside of where we were, brought us somewhere we've never been, to the beaches, wherever. And it was like wow, that's how they live? To us that was luxury. I gotta do this all the time. I gotta get somebody that has that experiences because if I'm bound in it, how can I get out of it? Somebody has to take the chains off of me, and be like come on."
	Access to marine resources	"I got out of it? Somebody has to take the chains off of me, and be like come on."
	Access to marine education	"I got out of it? Somebody has to take the chains off of me, and be like come on."
Accessibility: Fears/Threats	Police presence	"You have a lot of police officers and a lot of harassment, a lot of discrimination going on. A lot of racial profiling going on. We have it in the back of our minds, like we really want to keep ourselves under the radar, and not be at those scenes, to not be a target in the eyes of the police."
	Harassment	"You have a lot of police officers and a lot of harassment, a lot of discrimination going on. A lot of racial profiling going on. We have it in the back of our minds, like we really want to keep ourselves under the radar, and not be at those scenes, to not be a target in the eyes of the police."
	Discrimination	"You have a lot of police officers and a lot of harassment, a lot of discrimination going on. A lot of racial profiling going on. We have it in the back of our minds, like we really want to keep ourselves under the radar, and not be at those scenes, to not be a target in the eyes of the police."
Identity: Class and Character	Survivor mode	"A child growing up in complicated situations, at that time you're not thinking of no beach, you just pretty much in survivor mode."
	Class and character	"A child growing up in complicated situations, at that time you're not thinking of no beach, you just pretty much in survivor mode."
Value: Social Benefits	Therapy	"That therapy, I felt when I was in that water. And I think that if somehow somehow we can bring that to the school, and have the kids experience that, it could be therapy for them. They might not come up robbing, stealing and killing. And then dealing, and stuff like that. That might just be therapy for them, because they are enjoying something new."
	Social benefits	"That therapy, I felt when I was in that water. And I think that if somehow somehow we can bring that to the school, and have the kids experience that, it could be therapy for them. They might not come up robbing, stealing and killing. And then dealing, and stuff like that. That might just be therapy for them, because they are enjoying something new."

Exposure: Avenues of Experience

"When I was growing up, we actually had Caucasian friends that came into our lives, took us outside of where we were, brought us somewhere we've never been, to the beaches, wherever. And it was like wow, that's how they live? To us that was luxury. I gotta do this all the time. I gotta get somebody that has that experiences because if I'm bound in it, how can I get out of it? Somebody has to take the chains off of me, and be like come on."

-24-year old rapper, husband and father

Accessibility: Fears/Threats

"You have a lot of police officers and a lot of harassment, a lot of discrimination going on. A lot of racial profiling going on. We have it in the back of our minds, like we really want to keep ourselves under the radar, and not be at those scenes, to not be a target in the eyes of the police."

-23-year old male activist

Identity: Class and Character

"A child growing up in complicated situations, at that time you're not thinking of no beach, you just pretty much in survivor mode."

-17-year old pastor and wife

Value: Social Benefits

"That therapy, I felt when I was in that water. And I think that if somehow somehow we can bring that to the school, and have the kids experience that, it could be therapy for them. They might not come up robbing, stealing and killing. And then dealing, and stuff like that. That might just be therapy for them, because they are enjoying something new."

-36-year old husband

DISCUSSION

- While focus group participants generally believed the marine environment offered mental/physical human health benefits, emerging results from thematic data analysis shows that access and understanding in this community may be negatively impacted by a legacy of historic racial segregation, generational differences, cultural identity, little culturally-relevant marine outreach, perceived threats, socio-economic limitations, and top-down beach management policies.
- Results from this project may provide insight into how participants make sense of marine issues and the environment; identify barriers and facilitators to coastal access; and offer new avenues to engage disadvantaged communities in marine environmental health-related behaviors.

ACKNOWLEDGEMENTS: Support for this project is provided by the Peninsula College of Medicine and Dentistry, and the ERDF (European Regional Development Fund) Convergence Programme. Support for this project was also provided by the National Science Foundation (NSF) and the National Institute of Environmental Health Sciences (NIEHS) Oceans and Human Health Center at the University of Miami Rosenstiel School, (NSF OCE0432366/0911373) and (NIEHS P50 ES12736)



“There's no sunbathing sort of thing we don't have time for that...it's all kind of up and about and making up games and playing with sandcastles and things” (Father, Family 2)



“Instead of the adults just sitting somewhere on a bench while the kids do activities, they get up and they play Frisbee or cricket and football and sometimes go swimming with them.” (Boy aged 11, Family 6).”

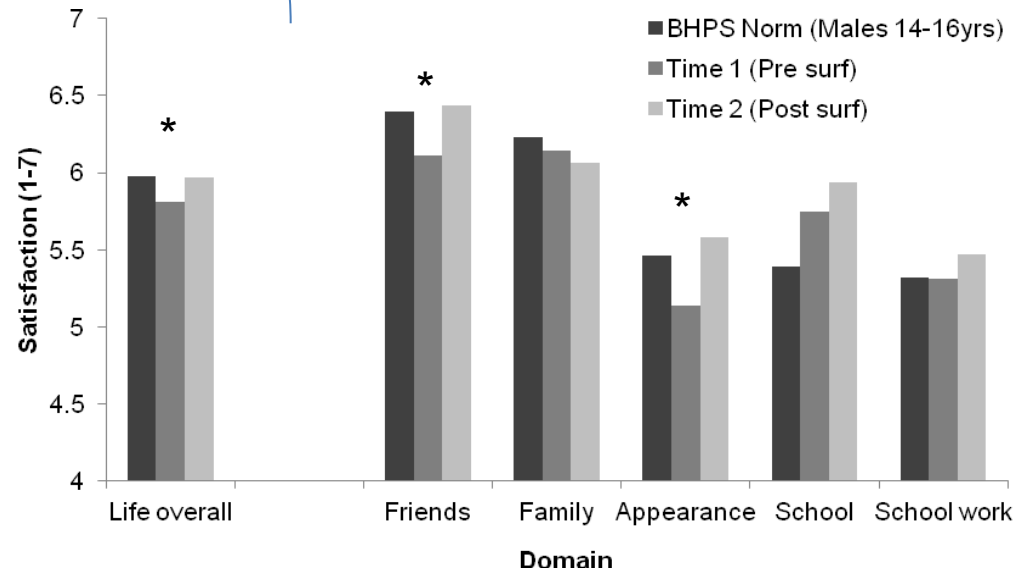
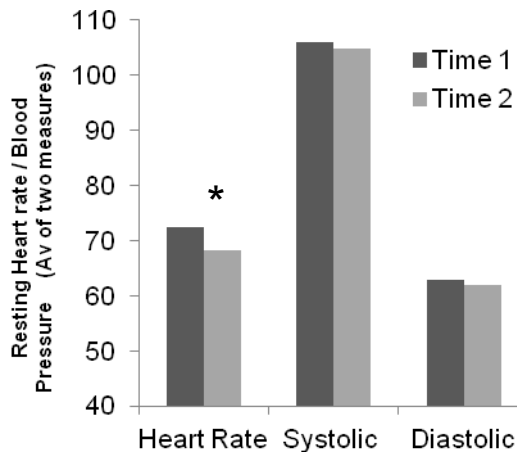
- The coast encourages families to play actively together



“If I lived closer to the beach I would probably do it more often but the whole packing up the car with all the kids' stuff and the food and the picnic from here would be an absolute nightmare.” (Mother, f5).



Vulnerable Communities



Choosing a hotel room.....



European Centre for
Environment & Human Health

All 3 rooms are identical (2-3 star, size, furniture, en-suite, price) except view from the balcony

A



£60.81

B



£72.85

C



£47.96

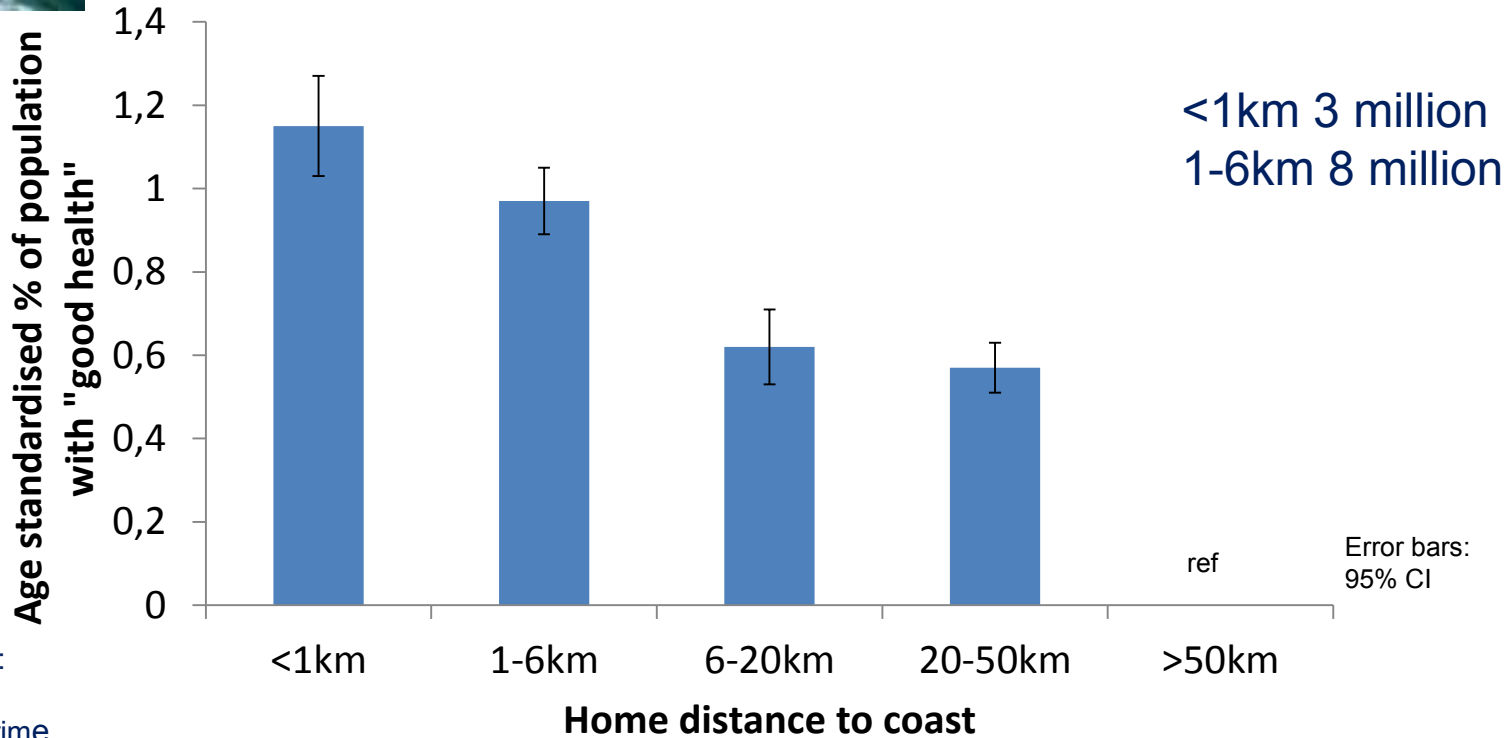
Mean Willingness to Pay (per night)

White *et al.*, 2010, J Environ Psych



Self-Reported Health

Census Data (England, n = 48 million)



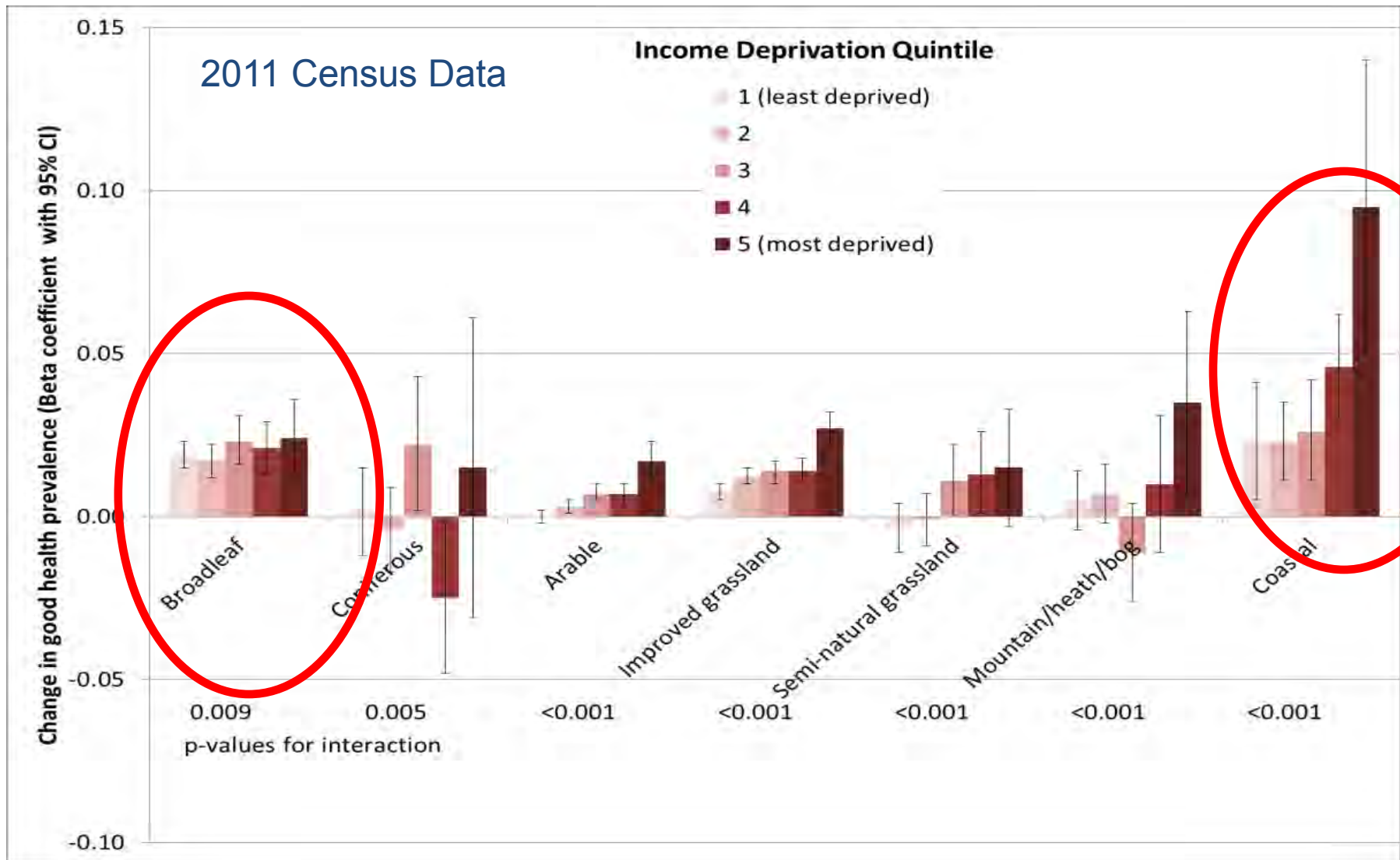
Controlling for area:
income, education,
unemployment & crime

The effects are strongest in poorer communities ^a

We see the same pattern when people move home ^b



Health inequalities are lower in coastal regions





NATURAL
ENGLAND

MENE Subset (n = 4,255)
asked about experiences in

- a) Urban green space
- b) Rural green space
- c) Coast

Stress reduction: To what extent
did they feel 'x' after the visit:

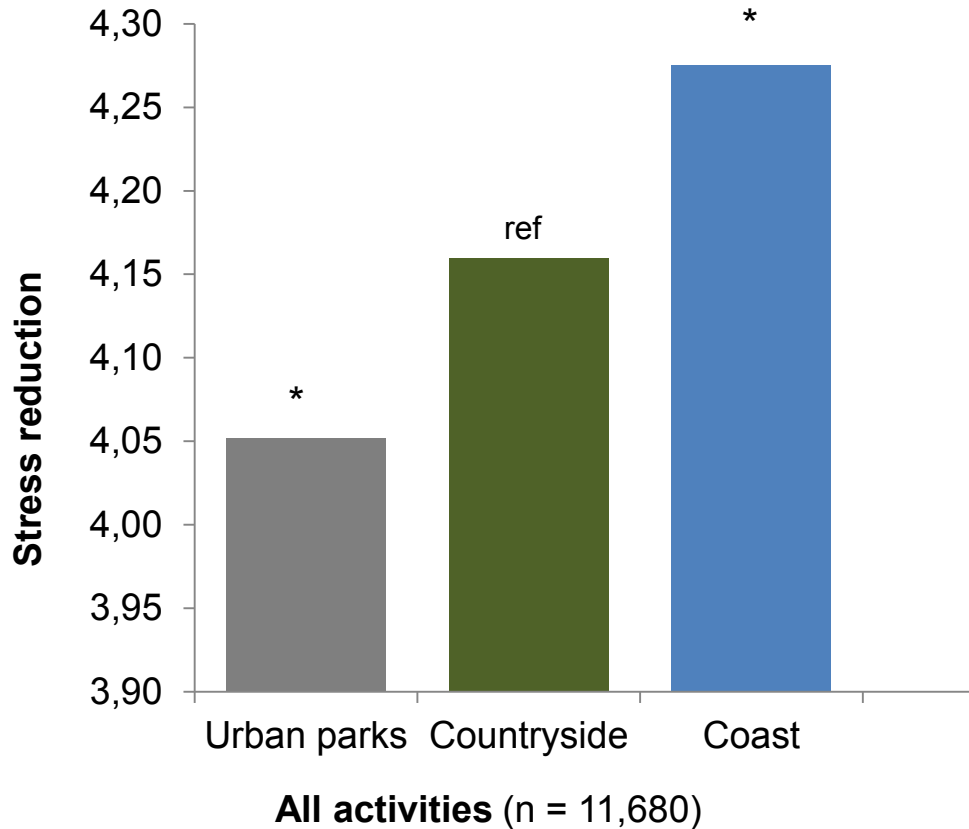
- 1) *Relaxed*
- 2) *Calm*
- 3) *Refreshed*
- 4) *Revitalised*





NATURAL
ENGLAND

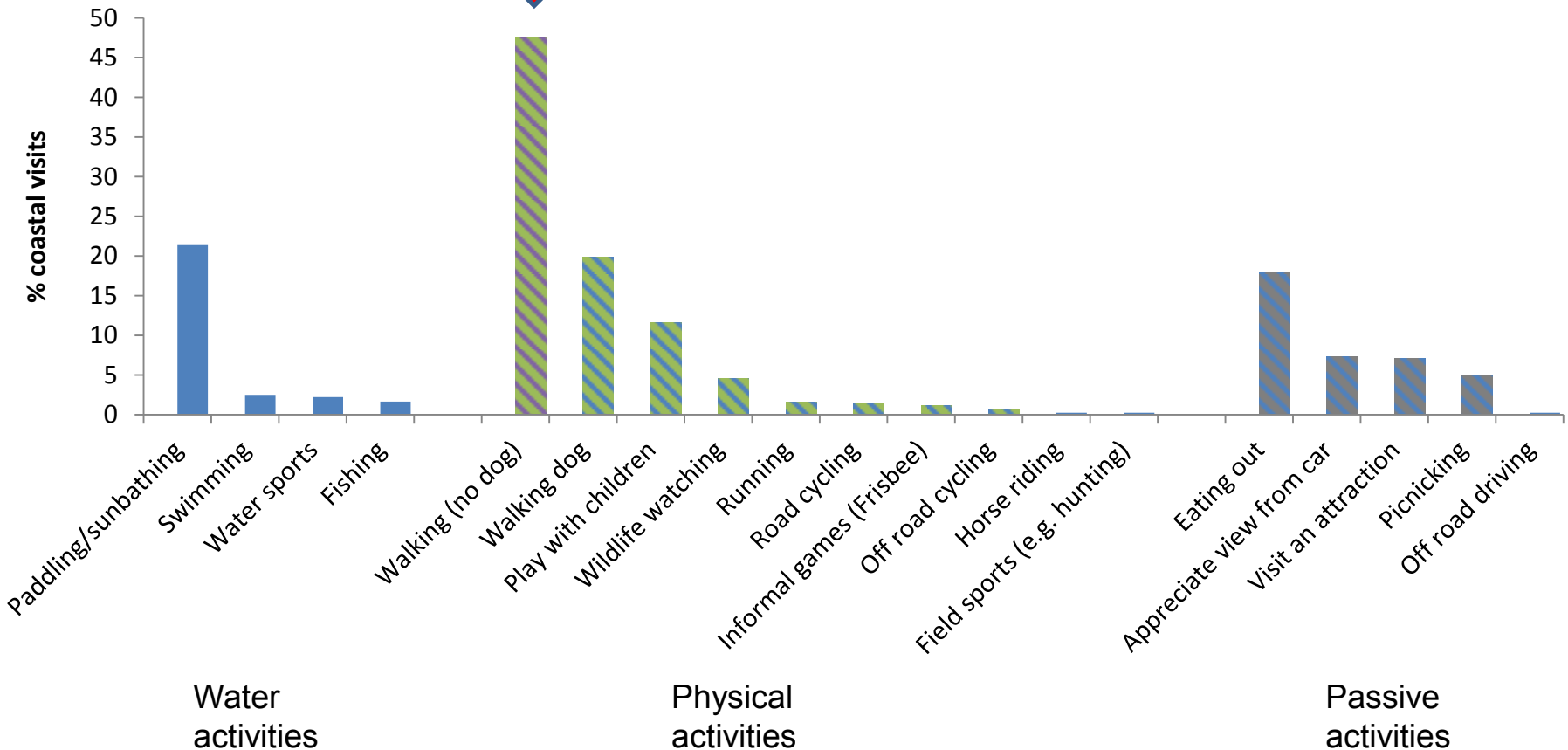
Monitor of Engagement with the Natural Environment [MENE] (Visits n = 11,680)



Controlling for: Age, gender, SES, activity type, visit duration, companions, distance travelled & mode of transport

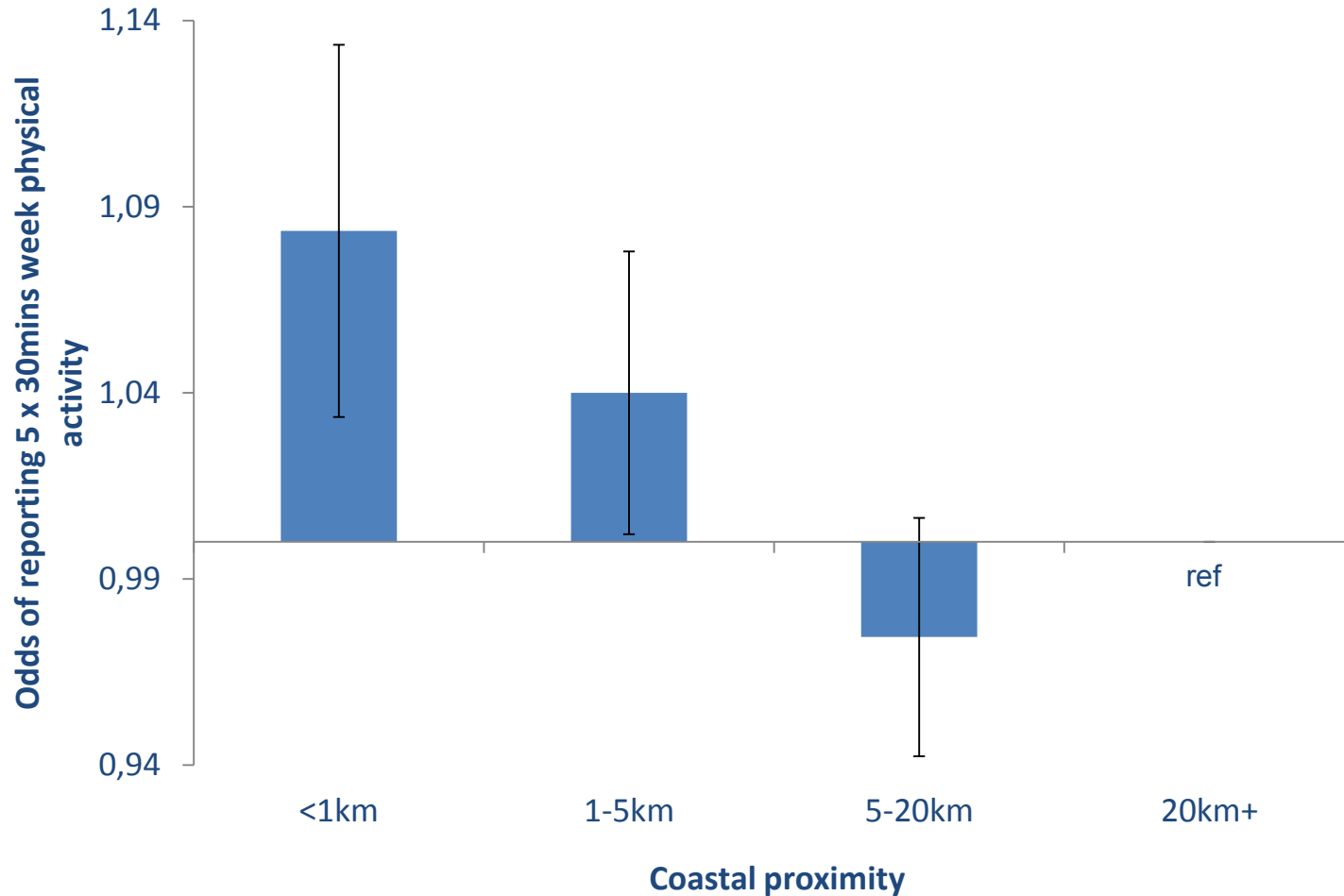


UK MENE (n = 10,529) coastal visit activity details





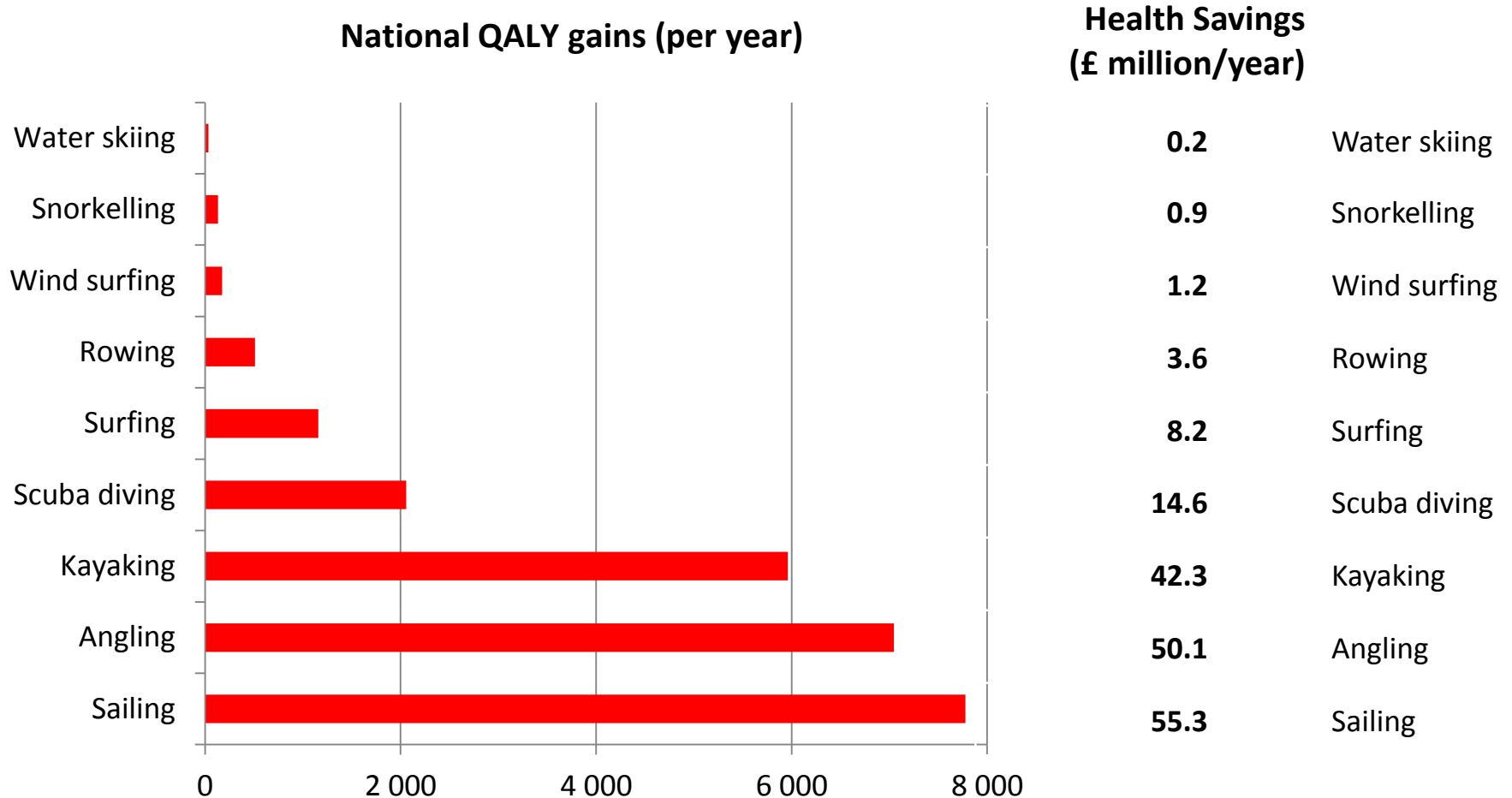
Do people who live near the coast exercise more?



N = 183,755, controlling for area green space, & deprivation (IMD) + individual age, gender, SES, marital status, employment status, children, ethnicity, disability, car ownership, dog ownership, year and season.



Energy Expenditure, QALY gains, Health Service Savings from engaging with the marine environment



^a Papathanasopoulou, E., White, M., Hattam, C., Lannin, A., Harvey, A., Spencer, A. "Valuing the health benefits of physical activities in the marine environment and their importance for marine spatial planning" (submitted). [Health Survey for England]

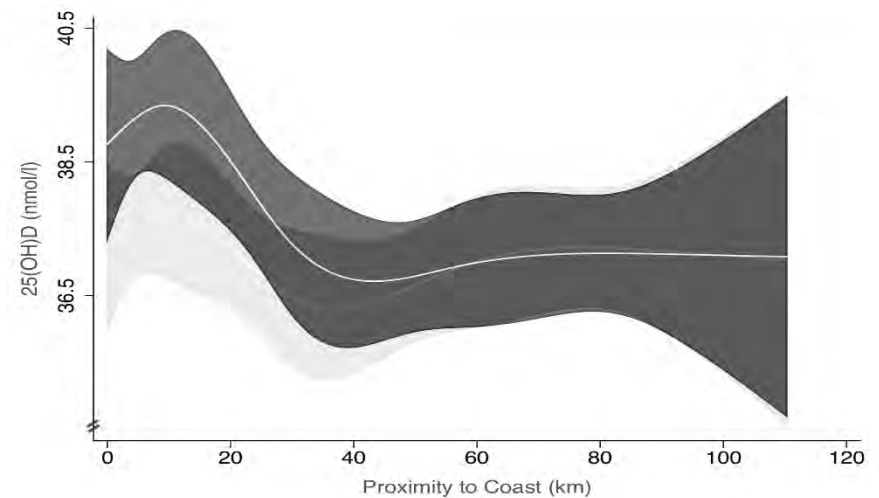
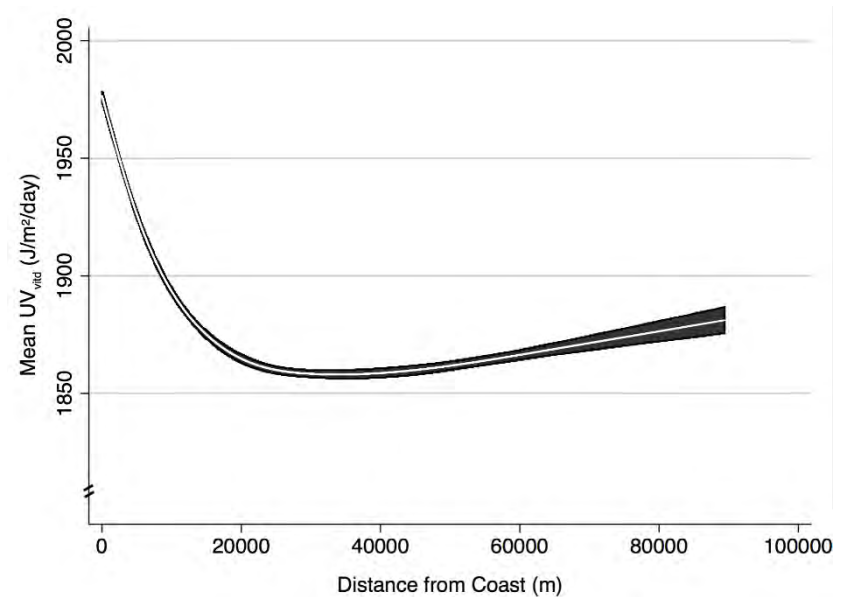


Low Vitamin D associated with auto-immune, cardio-vascular diseases, cancer, possibly poor mental health

UV Radiation exposure 
Vitamin D

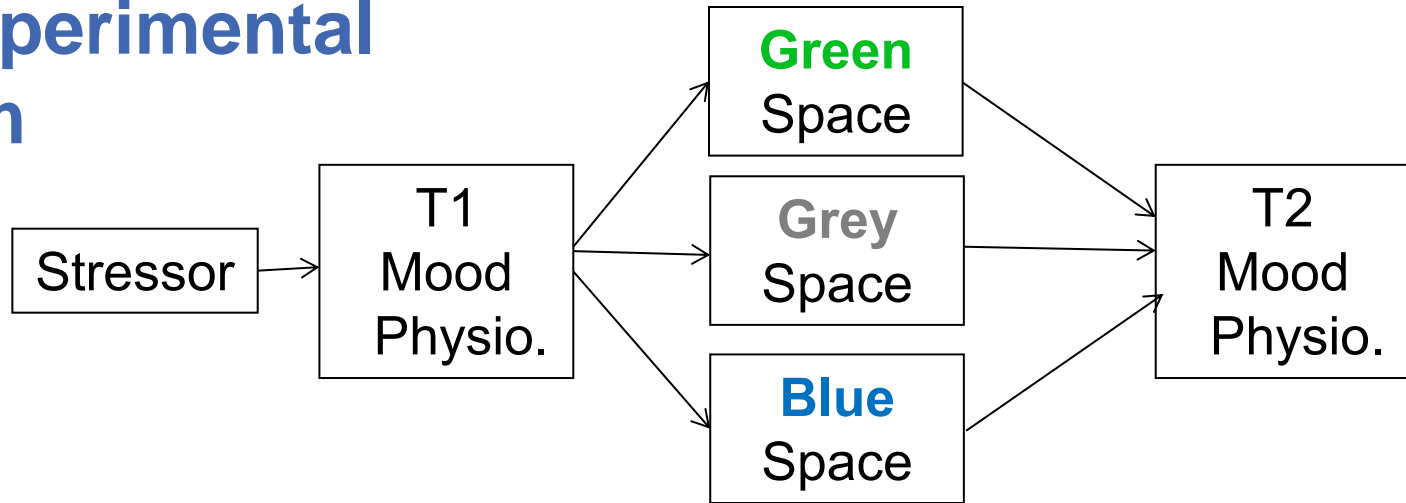
- **Higher UV near coast**
- **Higher Vitamin D levels among coastal dwellers***

*1958 Birth Cohort





Basic Experimental Paradigm



Lab work:

(Films, Sounds, +
During Exercise)



Applied Settings & Different Populations



Dental surgeries (+ VR)



White, Pahl, et al



Thick-lipped grey mullet (*Chelon labrosus*)



Thornback ray (*Raja clavata*)



Flounder (*Platichthys flesus*)

Condition 1: Nothing! (“**No fish**”; $n = 29$)

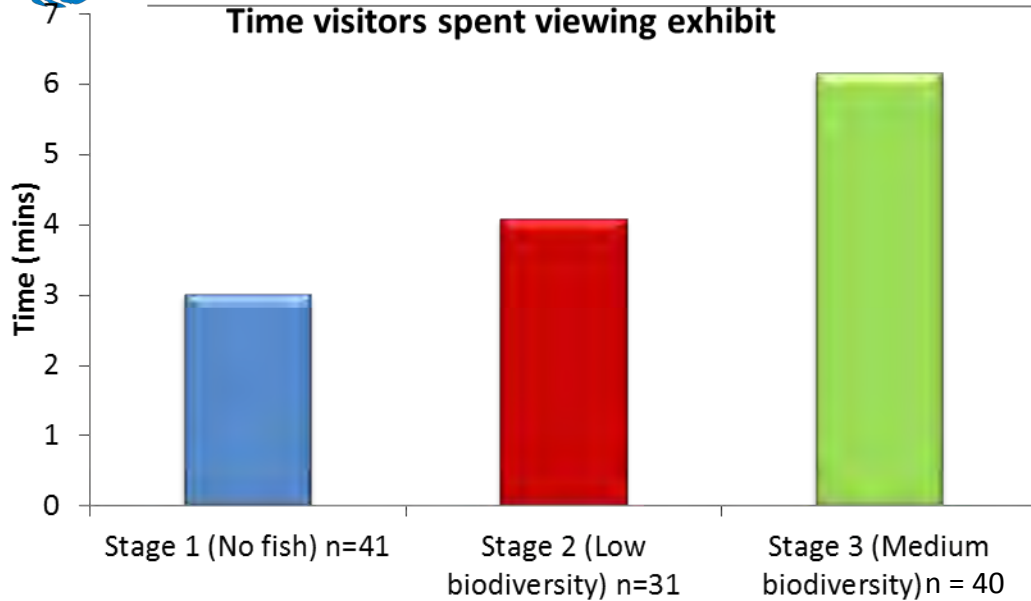
(water and tank decoration - no fish or invertebrates)

Condition 2: Small number of fish (“**Low**” **biodiversity**; $n = 26$)

(2-10 fish species; 45-80 individuals)

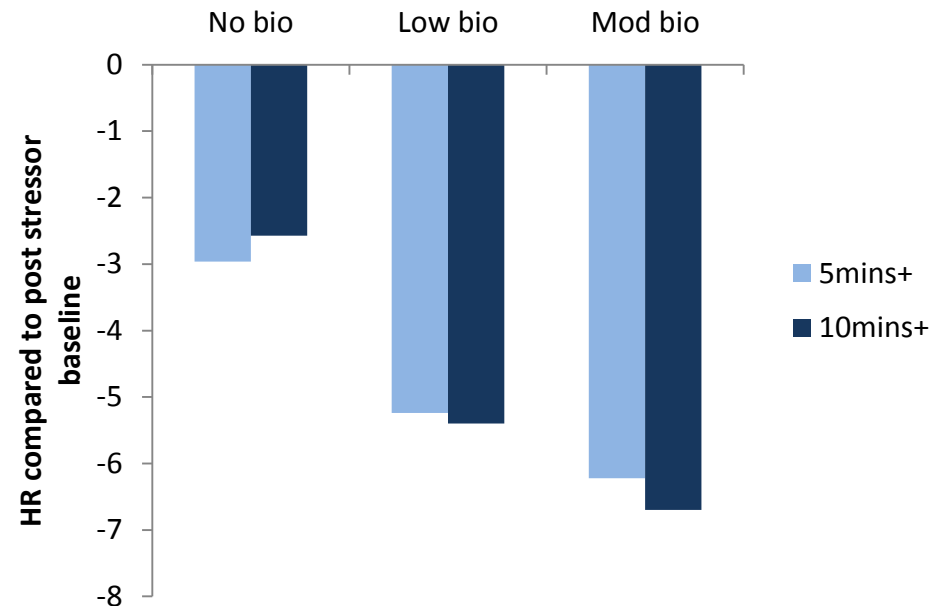
Condition 3: Additional number of fish (“**Medium**” **biodiversity**; $n = 29$)

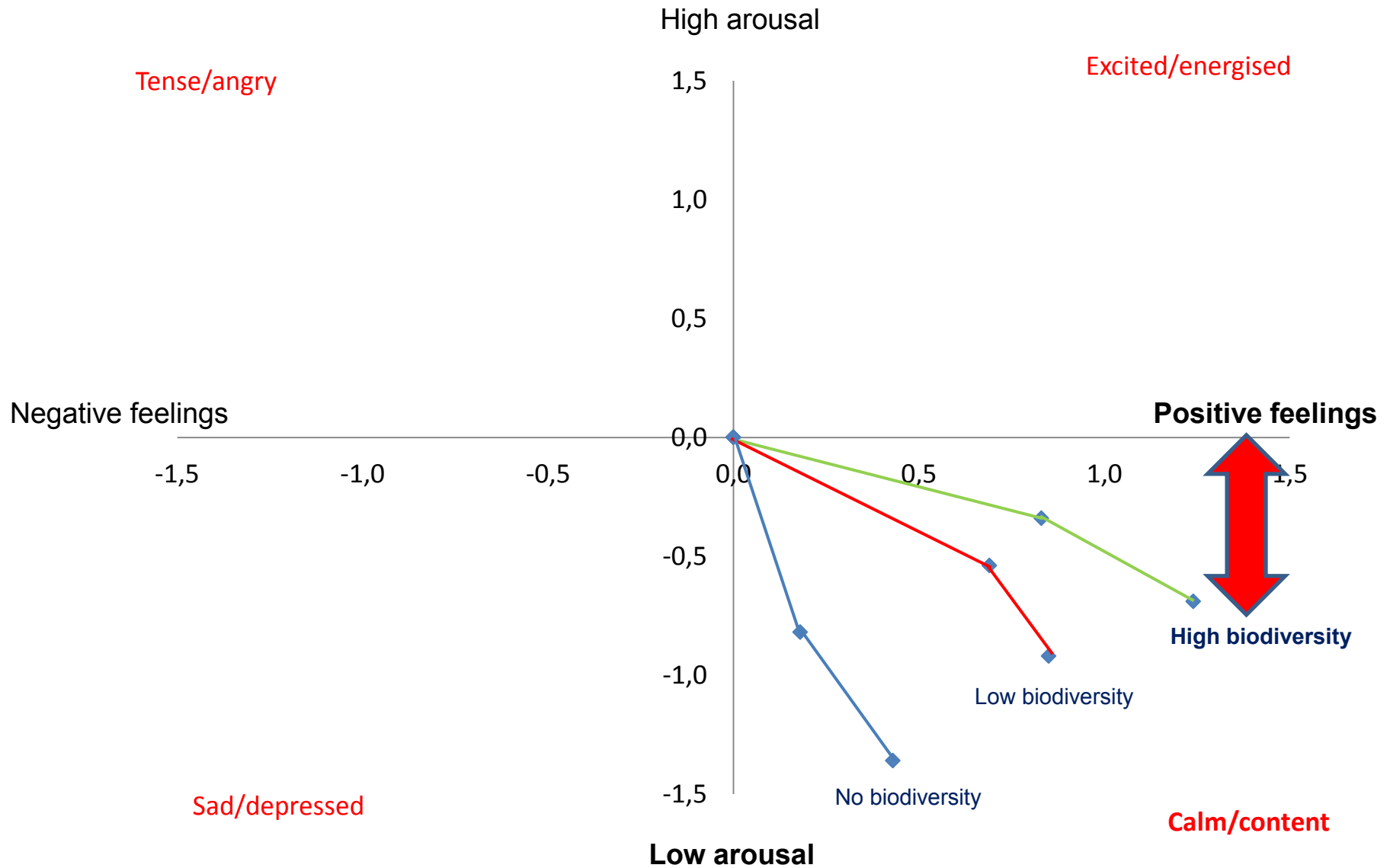
(Total of 19 fish species; 138 individuals (9 additional species, 58 extra fish))



Visitor observation data

- Participant heart rate
 - Significant drop in all conditions:
 - **Mod>Low>No**
 - No dose-response pattern for time spent







Impacts on the Environment and Human Wellbeing?



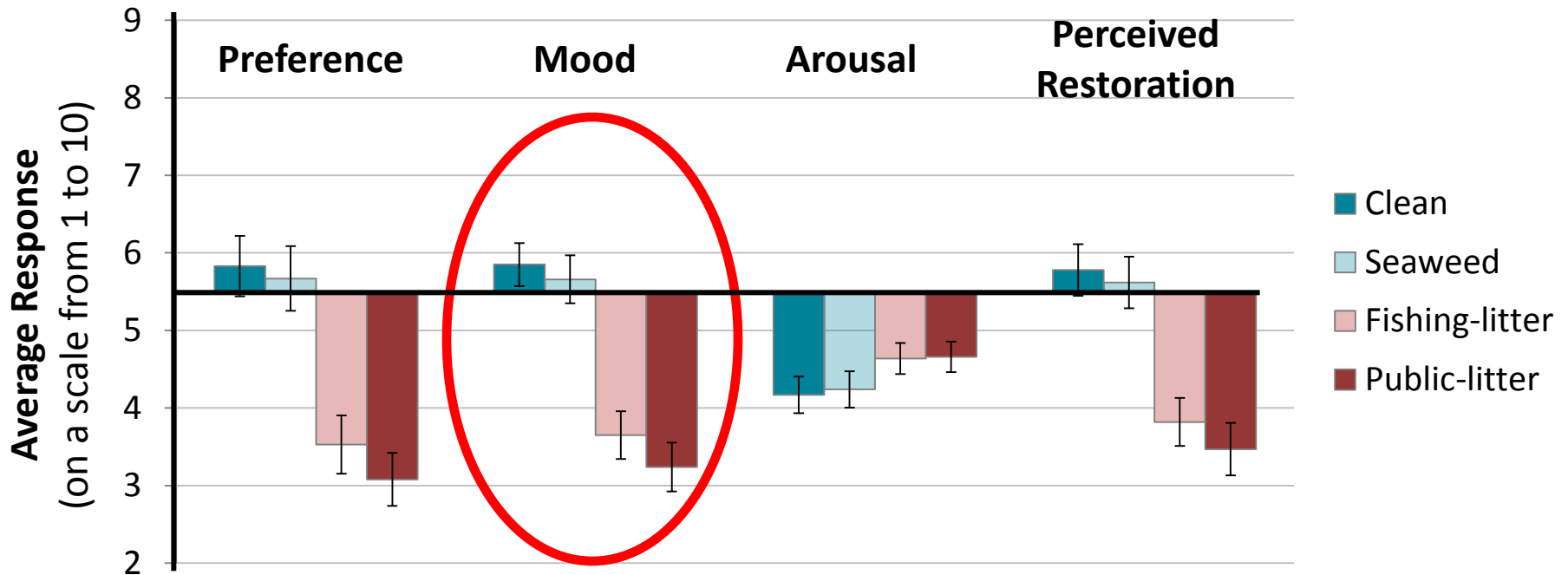
**DISCOVER
WITH
PLYMOUTH
UNIVERSITY**

**E · S · R · C
ECONOMIC
& SOCIAL
RESEARCH
COUNCIL**

**NERC
SCIENCE OF THE
ENVIRONMENT**



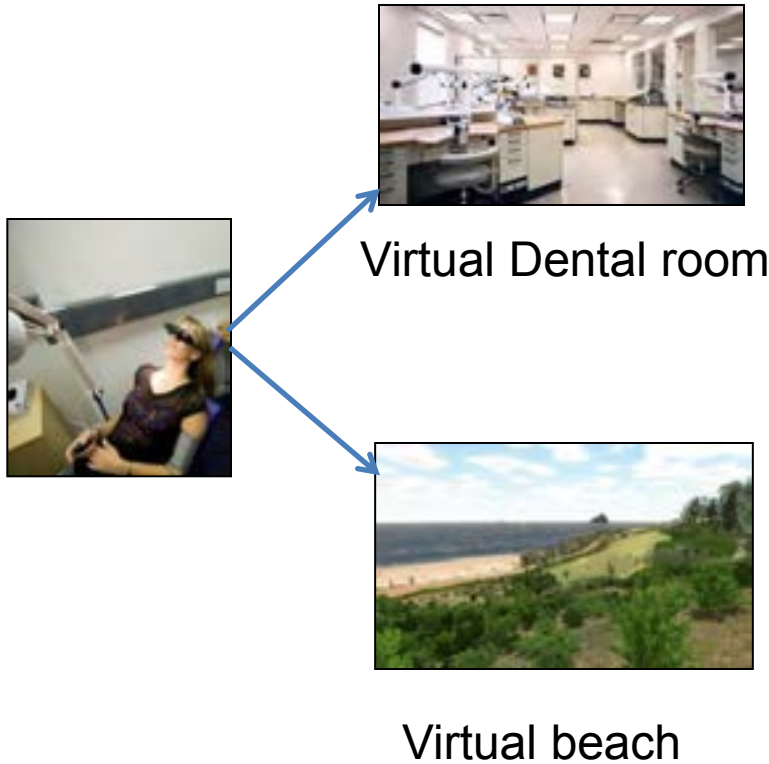
Impacts on the Environment and Human Wellbeing



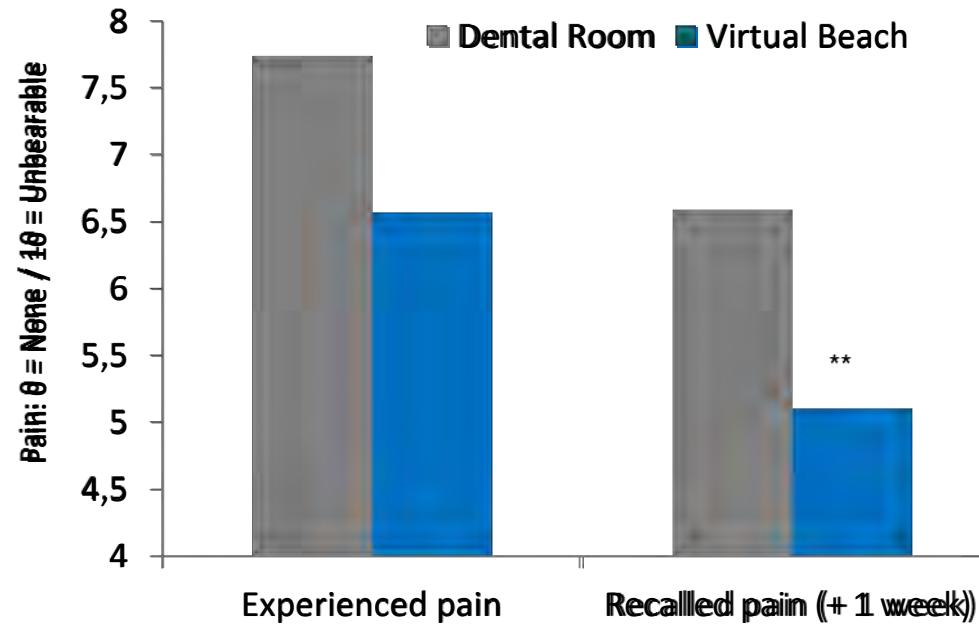
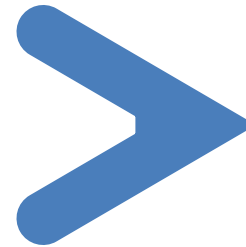
^a Wyles, K. J., Pahl, S., Thomas, K., & Thompson, R. C. (in press). *Environment & Behavior*



Using the “de-stressing” properties in health care



Iced water/
Tooth Extraction



People feel (& recall) less pain when “at” the virtual beach



Complex Mixtures?



> Environ.

Next steps

- What is the optimal dose?
- How long do effects last?
- Comparisons to/Synergy with drugs (e.g. depression)?
- What about children, other vulnerable populations?
- Other countries?
- Pro-Environmental Behaviors?
- Environmental impacts?





Salutogen[©]

- Lowers blood pressure
- Lowers heart rate
- Promotes wellbeing

Available from all parks, seashores,
forests or countryside near you.

Dr Will Stahl-Timmins
Prof Michael Depledge

EU Blue Growth Strategy

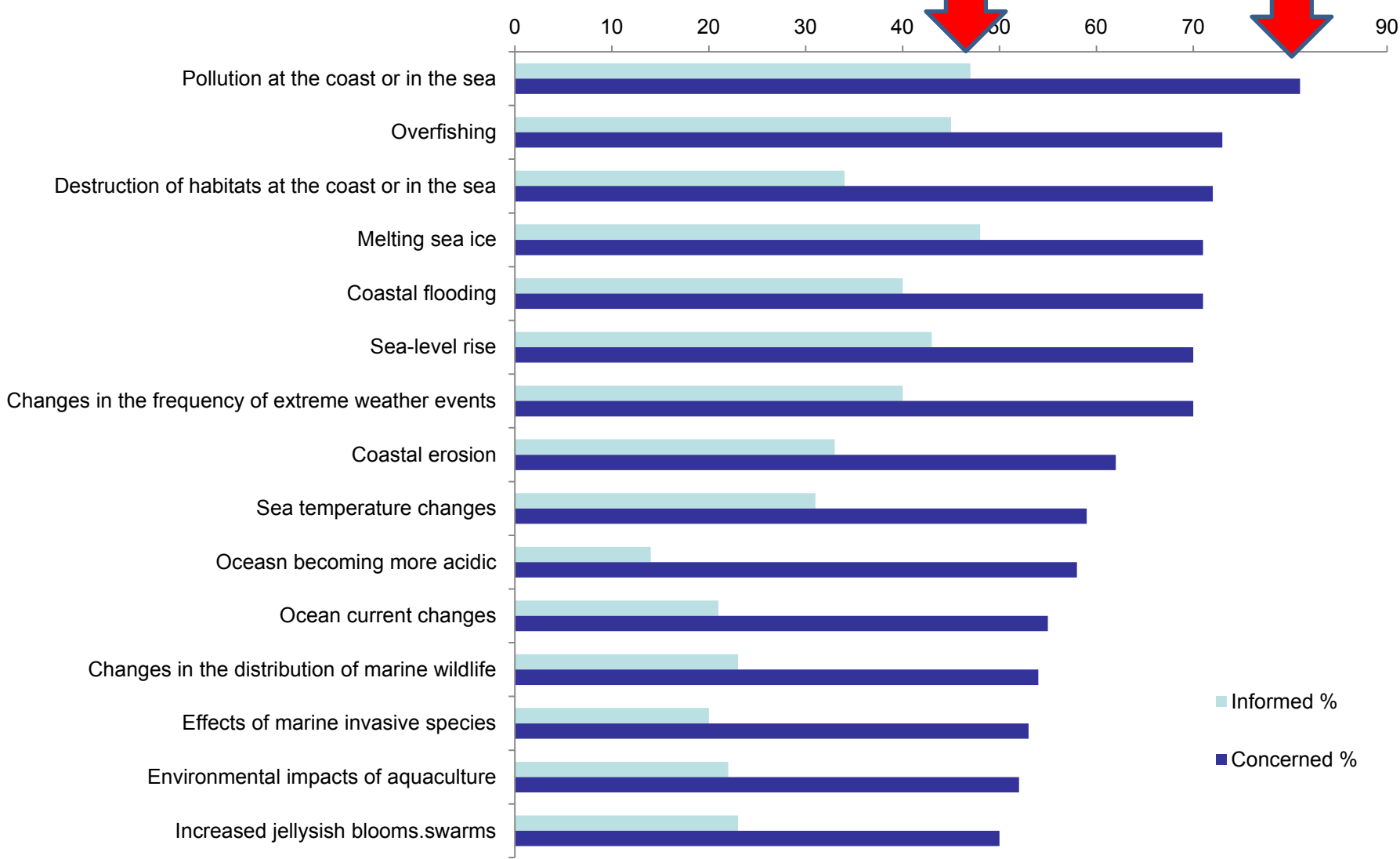
Risks, Benefits and Opportunities to Ocean and Human Health?



10,000 citizens from 10 EU countries (Clamer Survey)

1. How well informed?

2. Concern about 15 key marine environmental issues?





Rome Declaration: “Policy Goal 1: Valuing the Ocean”

- 1) A coordinated interdisciplinary and integrated programme on **Oceans and Human Health**, understanding and managing the risks and benefits of our interactions with the seas
- 2) Advanced and agreed mechanisms for attaching **monetary and non-monetary value** systems to marine ecosystem services and benefits for use in management and decision-making
- 3) A major increase in the promotion of **ocean education and literacy**, using best practice in communication, training and social marketing

Other Recommendations

- **Broad Definition of Oceans and Human Health**
 - Ocean Acidification
- **Inclusivity, Diversity & Collaboration = Creativity**
 - Oceanographic and Natural Sciences
 - Medical and Public Health Communities
 - Social Sciences
 - Governments, Businesses, NGOs, Communities, Citizens of All Ages
 - Equality & Access
- **Across the Atlantic**
 - Galloway Agreement
- **Around the World**
 - Hong Kong Example





Anton Frederick Bruun (1901-1961)

The Anton Bruun Memorial Lecture Series is dedicated to the memory of the noted Danish oceanographer and first chairman of the Commission, Dr Anton Frederick Bruun.

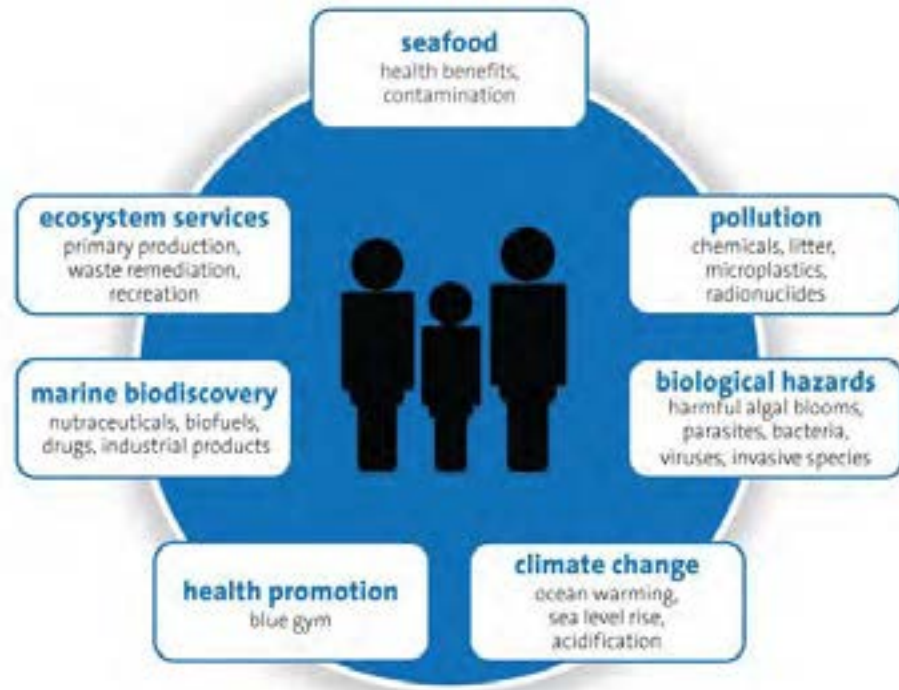
The “Anton Bruun Memorial Lectures” were established in accordance with Resolution 19 of the Sixth Session of the IOC Assembly in 1970, in which the Commission proposed that **important intersession developments be summarized by speakers in the fields of solid earth studies, physical and chemical oceanography and meteorology, and marine biology.**

And Medical, Public Health, Social Sciences, Governments, Businesses, NGOs, Communities, Citizens of all ages.....



European Centre for
Environment & Human Health

Thank You



L.E.Fleming@Exeter.ac.uk

With thanks to my current and future Oceans & Human Health Colleagues, including:

T Appleby, G Armbrust, M Austen, L Backer, D Baden, R Barciela, J Benson, E Berdalet, B Bowen, A Boxhall, J Brandão, R Caldwell, C Carlarne, Y Cheng, D Cracknell, K Davidson, M Depledge, J Doyle, S Dupont, W Elliot, S Elmir, H Enevoldsen, E Faustman, M Friedman, R Gabriel, T Galloway, W Gaze, MB Gidley, A Goksøyr, M Gribble, C Hadjichristodoulou, A Harvey, C Hattam, P Hess, P Hoagland, J Hollenbeck, A Ianora, K Irvine, K Jakobsson, C Janssen, B Kirkpatrick, K Kohler, E Laws, E Lewis, J Lloret, L Madson, N McDonough, D McGillicuddy, J Mees, M Moore, S Moore, K Olden, A Ortiz, S Pahl, E Papathanasopoulou, B Reguera, A Reich, K Rein, D Rice, D Sarigiannis, SL Smith, G Nichols, F Regoli, C Sinigalliano, A Smalley, H Solo Gabriele, W Stephan, R Stumpf, N Taylor, T Taylor, R Thompson, M Thorndyke, V Trainer, F Tyson, S Vardoulakis, V Vasconcelos, P Walsh, S Warber, M White, K Wyles, N Young

