

Beach sand as a source of faecal indicator organisms.

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FAQ: Can sunlight clean up?

No!

- ♦ **2009 Mika *et al.*** showed that irradiation during day time doesn't help reducing *E. coli* in the sand
- ♦ **2012 Heaney *et al.*** showed positive relationship between sand-contact activities and enteric illness
- ♦ Fungi are very resilient, even in drier climates and bacteria lurk under the surface

World Health Organization, 2003, in “Guidelines for safe recreational water environments”, p118.

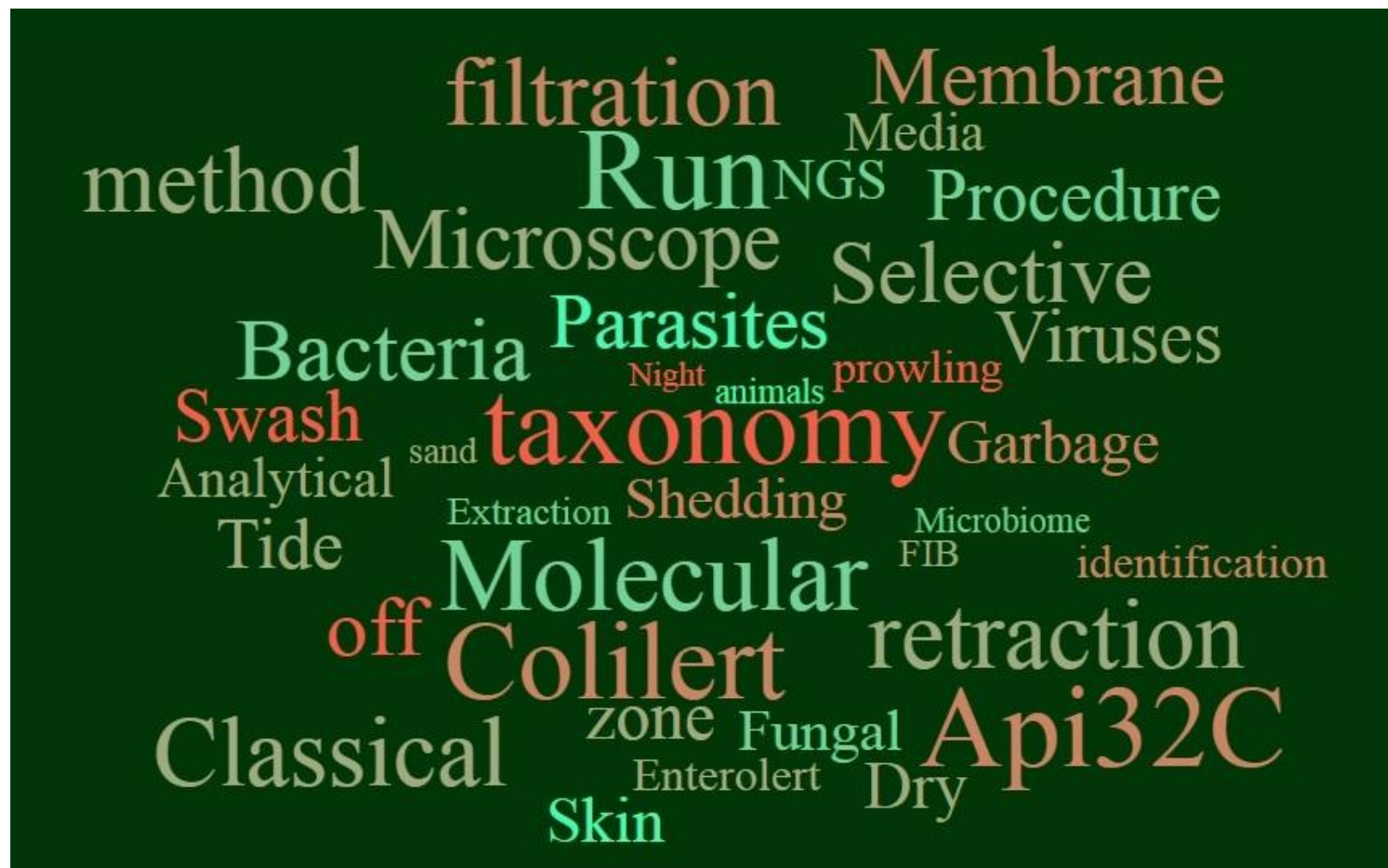
- “From a recreational viewpoint, sand beaches are sought after. Especially in higher latitudes, a significant percentage of time is spent on the beach itself rather than in the water.”
- “A number of genera and species that may be encountered through contact with sand are potential pathogens. Accordingly concern has been expressed that beach sand may act as reservoir of vectors of infection.”

There is no legislation or regulation in Europe or elsewhere in the world!

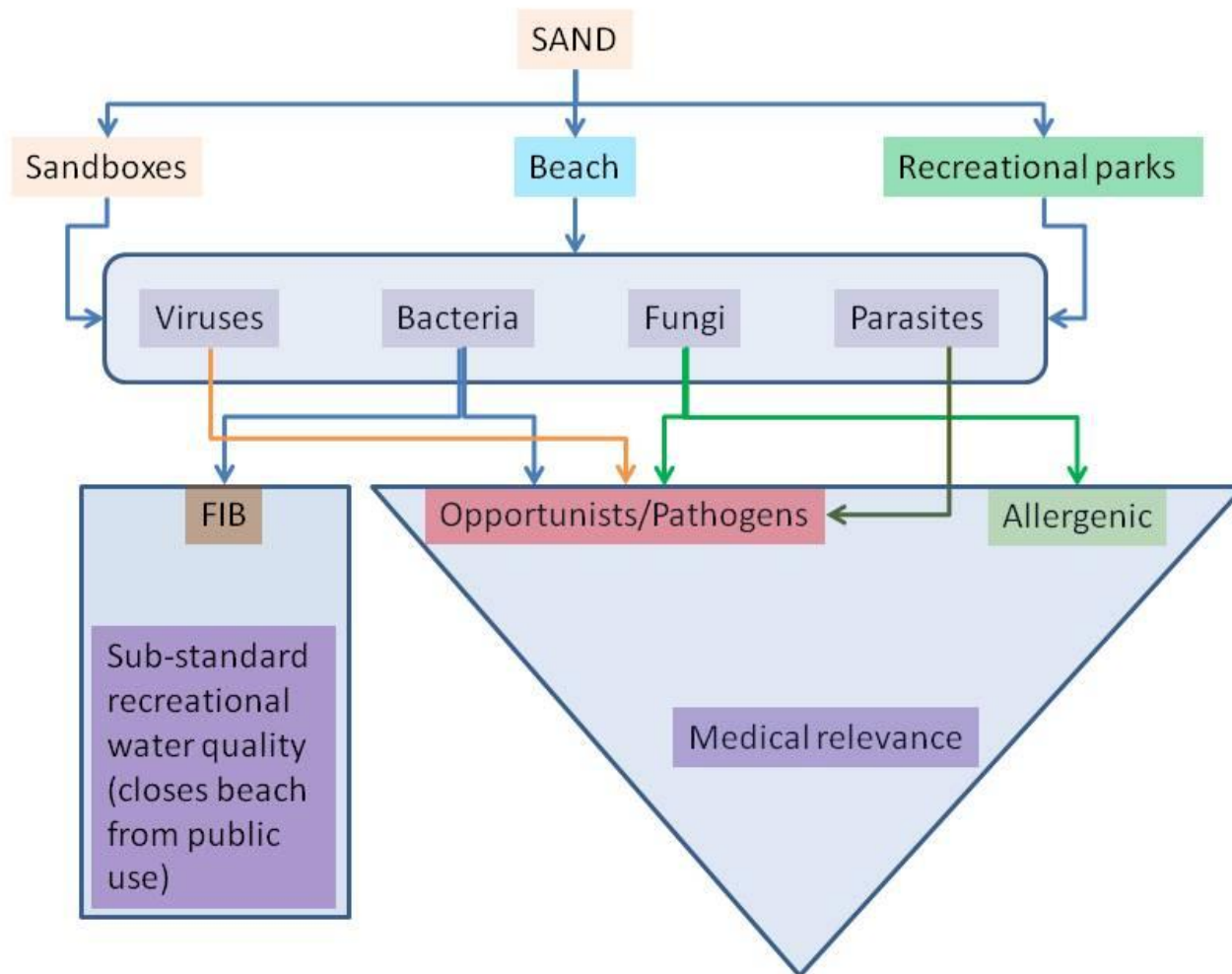
- ◆ The European Bathing water Directive contemplates surrounding areas to bathing waters because those may influence water quality but....
- ...Doesn't specify sand-specific contaminants or sand as its own entity.



It's a mess right now!



Different perspectives



What's missing?

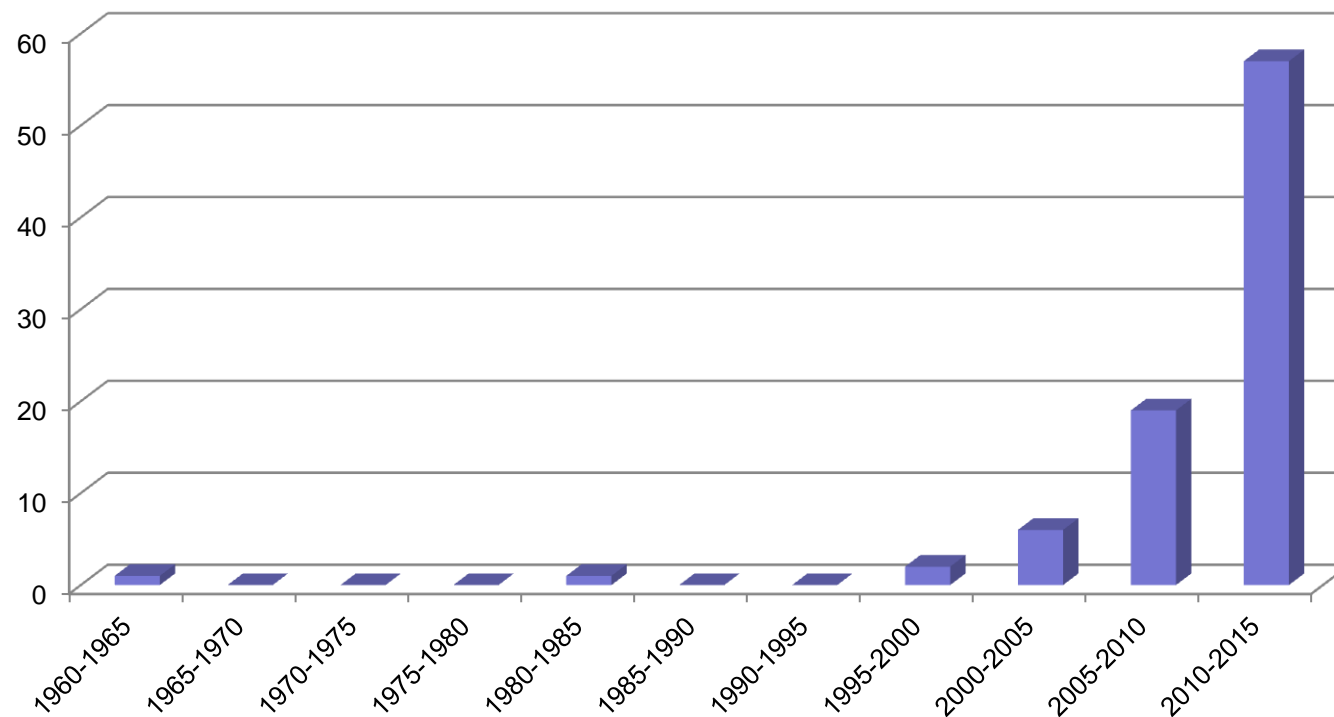
Time



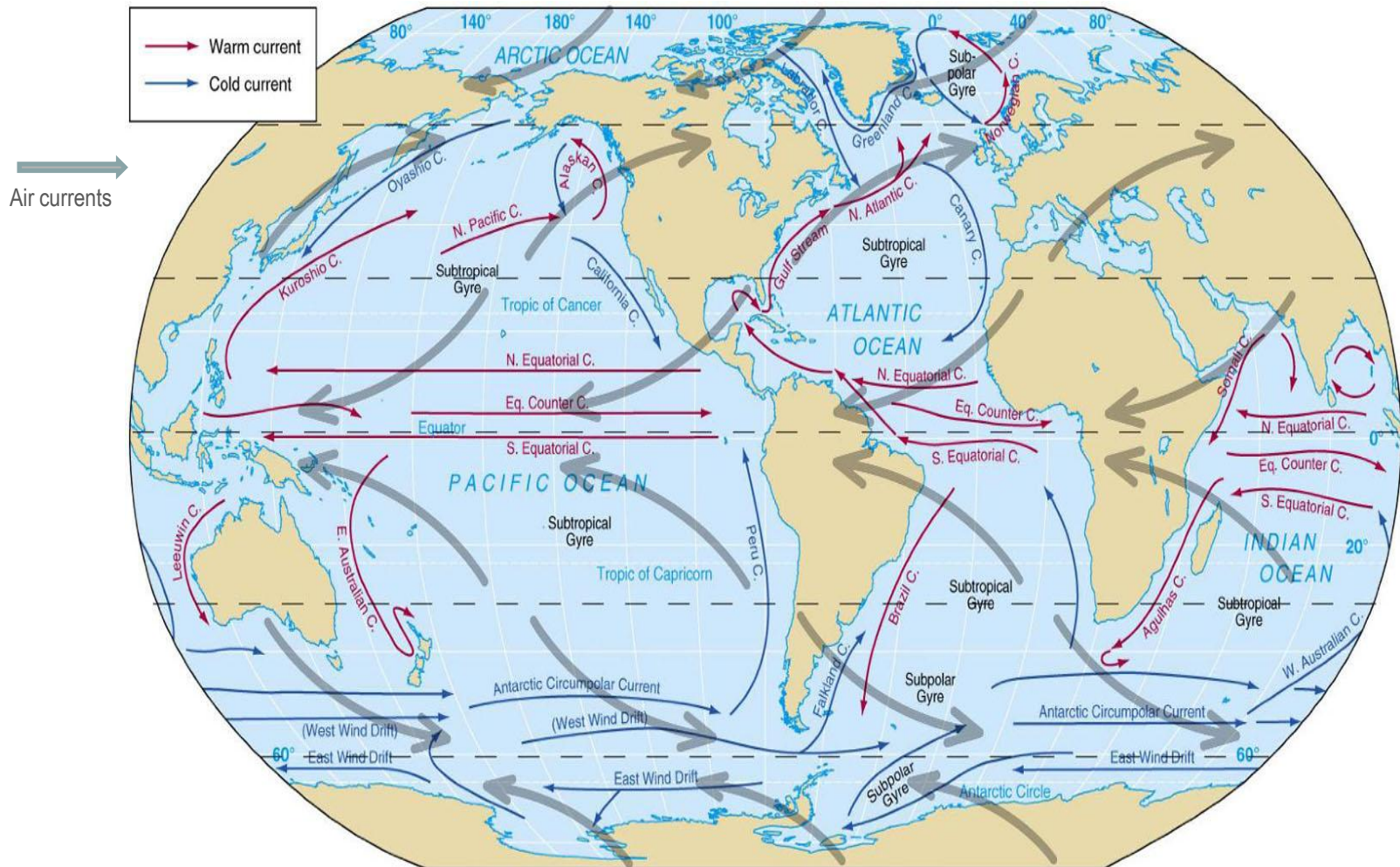
1. A **consensus** in methods and parameters based on a wide review proposal of papers on sand contaminants
2. More epi studies to demonstrate the need to regulate
3. Regulation
4. Confirm efficiency of regulation

Scientific community is waking up

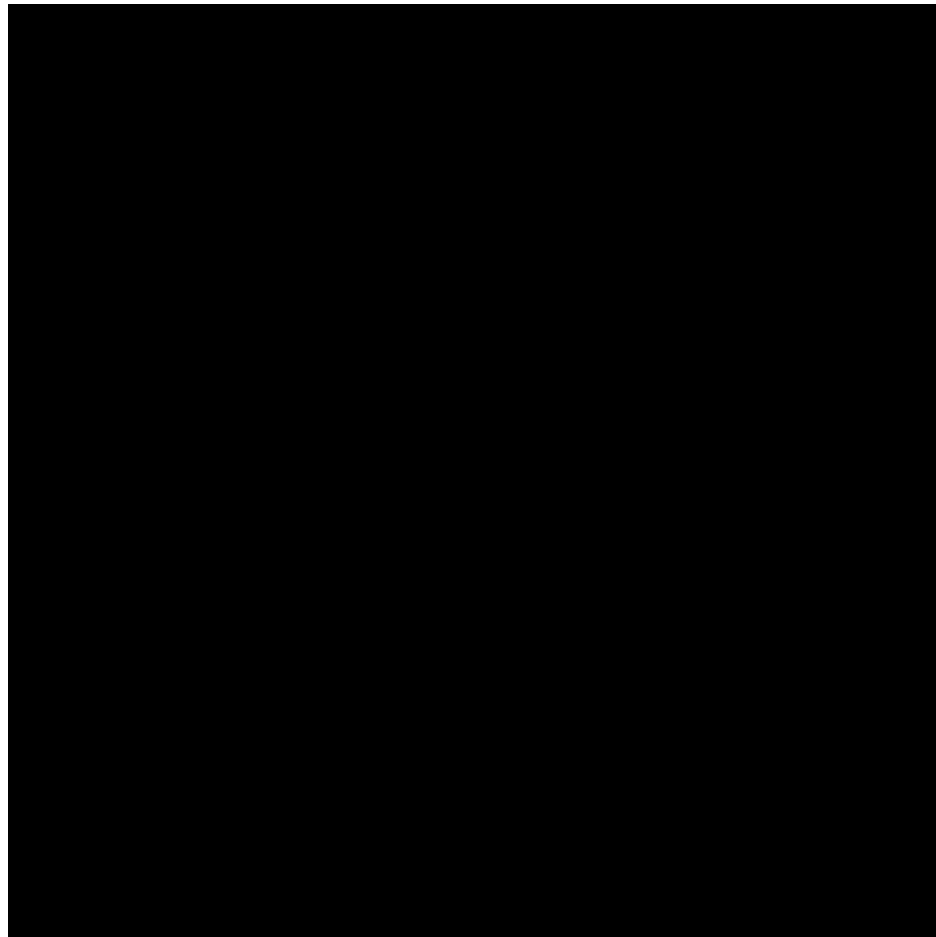
Publications on Sand Contaminants



Air and water currents of the world



Temperature anomalies arranged by country 1900 – 2016



by [Antti Lipponen](#)
(Finnish Meteorological
Institute) @ Kuopio -
2017



Climate change is generating changes in microbial communities... reports

- *Vibrio spp* in Europe
- *Vibrio vulnificus* infections in florida
(<http://www.floridahealth.gov/newsroom/2015/06/061215-fl-beaches.html>)
- *Cryptococcus gattii* is being found all over europe
- Blackmould is becoming a major indoor contaminant in developed regions
- *Cladophialophora bantiana* is now a pathogen (BSL3)
- 1st case of non-imported infection by *Conidiobolus spp* in europe reported!!
(<http://www.sciencedirect.com/science/article/pii/S1198743X17303348>)
- Canine cyano-intoxication reports increasing in the USA (see next slide)

Canine cyano-intoxication reports increasing in the USA

PubMed Central, Figure 1: Toxins (Basel). 2013 Sep; 5(9): 1597–1628. Published online 2013 Sep 24. doi: 10.3390/toxins5091597 - Google Chrome

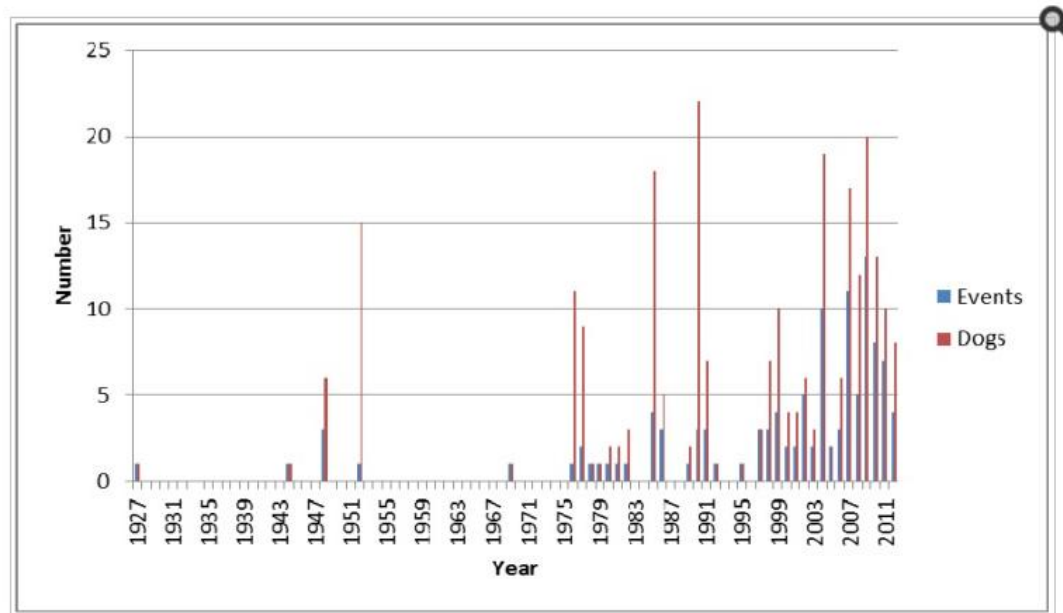
Seguro | <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3798876/figure/toxins-05-01597-f001/>



PMC full text: [Toxins \(Basel\). 2013 Sep; 5\(9\): 1597–1628.](#)
Published online 2013 Sep 24. doi: [10.3390/toxins5091597](#)
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Figure 1



Toxins (Basel)

Toxins (Basel)



Effects of a Changing Earth on Predicting Microbial Dynamics and Human Health Risks in the Beach Water/Sand Continuum

Outline and Team leaders

- **Introduction** lead by Jody Harwood and Mike Sadowski
- **Pathways to the Beach** lead by Thomas Edge and Erin Symonds
- **Moving Around** lead by Clare Robinson and Laura Vogel
- **Hangouts** lead by João Brandão and Helena Solo-Gabriele
- **Bummers** lead by Gregory Kleinheinz and Meredith Nevers
- **Putting It All Together (Modeling)** lead by Ali Boehm and Mantha Phanikumar
- **Effect of Climate Change on Microbial Fate and Transport (A changing world, e.g. temperature, precipitation, storm events, sea level rise, population increase, changing land use)** lead by Christopher Heany and Tarja Pitkänen
- **Discussion** lead by Chelsea Weiskerger and Richard Whitman

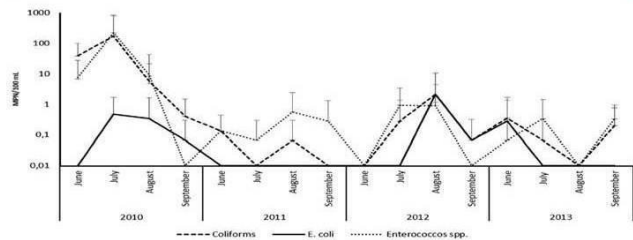
Madeira 2010 – Aftermath of flashfloods and mudslides on bathing water quality indicators and on sand microbial levels

- **20th of February 2010** - An active cold front combined with Atlantic low-pressure and temperature differences of the sea surface with unusually warm waters from West Africa, affected Portugal, Spain, Morocco and the Canary Islands, causing flooding, rain and strong winds. Madeira, has different types of beaches within a small coastline and severely affected. **Between 6 a.m. and 11 a.m., 108 mm** of rain were recorded at Funchal weather station and **165 mm at Pico do Areeiro** (1818m of altitude).
- The entire February's month average rainfall in Funchal is 88.0 mm. The South of the island was severely affected by flashfloods, originating mudslides that tore down everything along the way. Devastation was high and costly, both in lives and economically. The areas affected the most were Funchal, Ribeira Brava, Câmara de Lobos and Santa Cruz.
- The impact of this event in microbiological communities caused a **notorious peak of *Enterococcus spp.*, *E. coli* and sporulating fungi, both in sand and water until September** of the same year. Bathing water and sand quality monitoring revealed that both water and sand profiles were profoundly altered for months to follow.

Microbial fluctuation of FIB and Fungi in sand and in coastal water

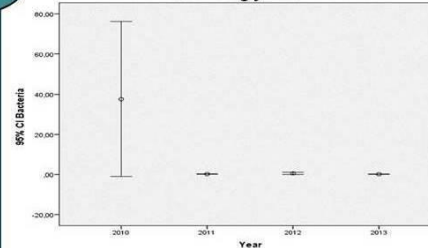
Bacteria: A story of ups and downs

SAND

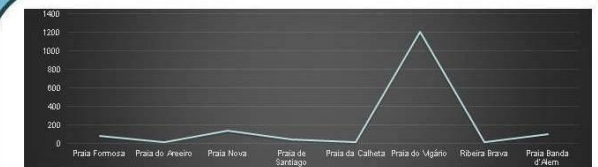


Annual trends showed high values in 2010, and a gradual decrease throughout the years, with a small occurrence for bacteria in the following years (2).

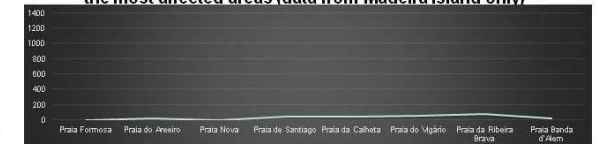
2010 shows higher variation when compared with following years



Madeira's geographic features outflows from damaged sewer lines, and stranded wreckages that resulted from the flash-flood event were responsible for high levels of FIB in 2010 (2).



Beach water *E.coli* profiling of 2010 shows that Praia do Vigário is one of the most affected areas (data from Madeira island only)

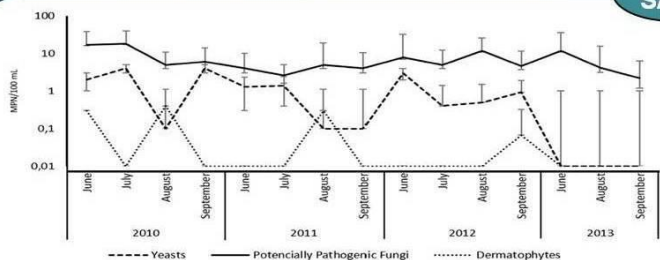


Beach water *E.coli* profiling of 2011 showing return to normality (data from Madeira island only)

WATER

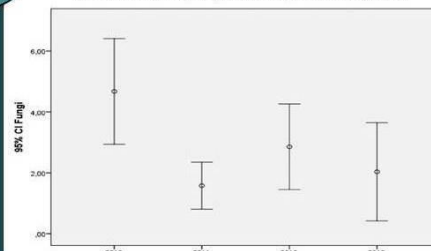
Fungi: A story of persistence

SAND



After experiencing high values in 2010, yeasts and dermatophytes tend to decrease whilst potentially pathogenic fungi seem to be persistent during the course of time (2).

2010 shows higher maximum values, but variation is continuously high throughout the years



Potential pathogenic fungi were the most common fungi detected. The extreme rainfall and flash flood event can be invoked to support this pattern of variation (2).



Beach water *Enterococci* profiling of 2010 shows that Praia do Vigário is one of the most affected areas (data from Madeira island only)



Beach water *Enterococci* profiling of 2011 showing return to normality (data from Madeira island only)

Conclusions

- Bacteria suffer a higher fluctuation, but fungi populations such as yeasts and dermatophytes are also affected.
- The only sand-renourished beach took more time to recover from the event, especially concerning fungi.
- The chemical composition and granulometry of sand were not influencing factors in the microbial load and survival, following the extreme weather event.
- Surveillance and rapid public health response can restrict infectious diseases from spreading but, knowledge of microbiological profiles of exposed, and therefore susceptible, environments can also help predict the emergence of potential pathogens

Exploring fungal contamination in the sand and water around the Mediterranean Sea and other water bodies of Europe

- **Project Leader:** Prof. Esther Segal; segale@post.tau.ac.il; Tel Aviv University, Sackler School of Medicine, Dep. of Clinical Microbiology and Immunology.
- Co-lead by [João Brandão](#)
- Promoted by the European Confederation of Medical Mycology ([ECMM](#))
- Parameters:
 - Dermatophytes – indicators of human/animal dermal contamination (including the *Arthroderma insingulare* complex, formerly known as *Trichophyton terrestre*)
 - *Candida albicans* –indicator of human fecal contamination,
 - Allergenic fungi – *Aspergillus*, *Penicilium*
- **Geo parameters:** Target is all of Europe, sectioned by climates, geological characteristics and fresh water and seawater. A strong participation of the Mediterranean coast, where tourists tend to congregate the most during warm months, is highly desired.
- **Methodology:**
 - Culture and quantification
 - Molecular methodology
- **Duration: one year** (tests will be carried out during all 4 seasons). After that year, data will be analyzed and decision will be made as to generate more data or to end the project and publish the results

Reference values for sand quality assessment based on national means

Mycology Parameters:

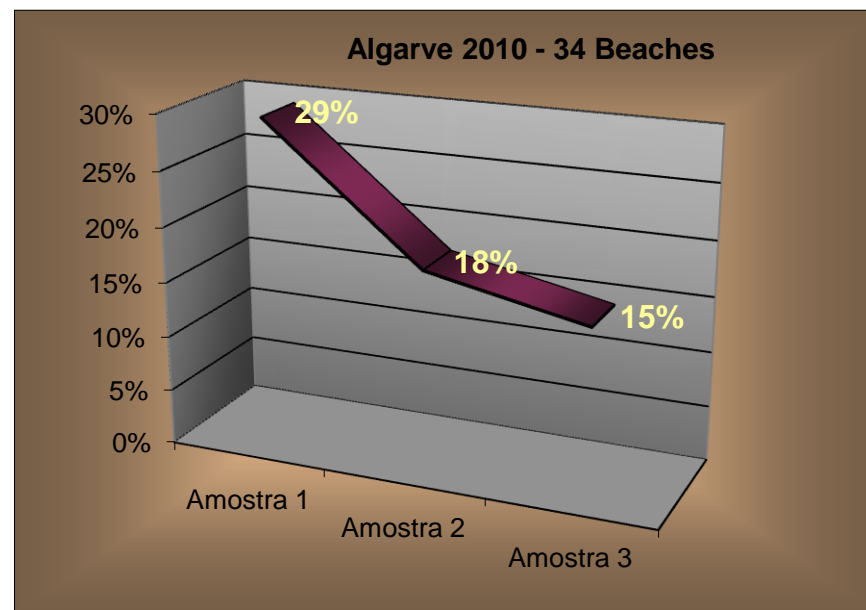
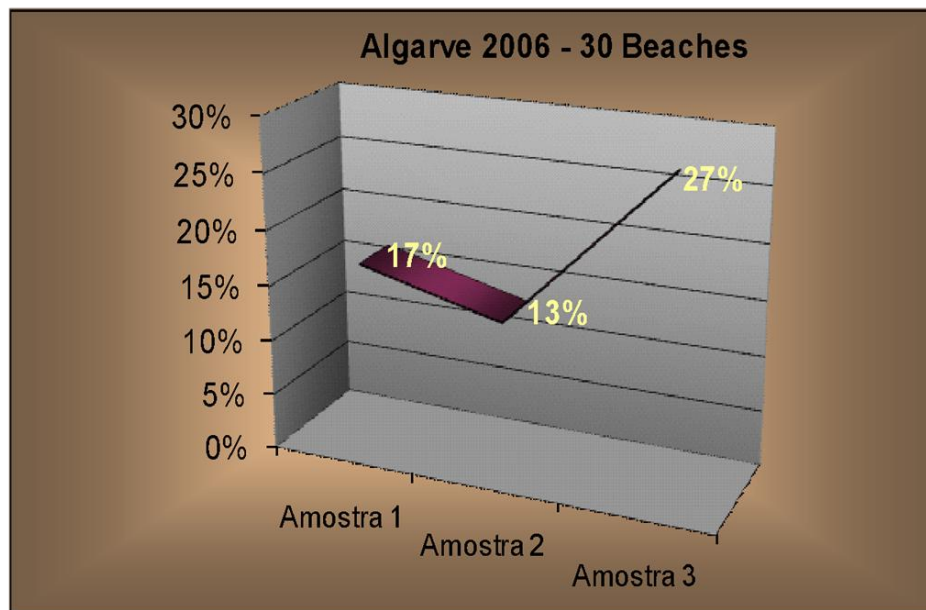
1. Yeasts	60 cfu/g
2. Potential pathogenic moulds (filamentous fungi)	85 cfu/g
3. Dermatophytes	15 cfu/g

Bacteriology Parameters:

1. Total coliforms	100 cfu/g
2. <i>E. coli</i>	20 cfu/g
3. <i>Enterococci</i>	20 cfu/g

Algarve 2006 x 2010

Samples that exceeded at least one of the Reference Values



Beach managers were instructed on how to control contaminant levels.

Result: Drastic reduction of contaminant levels from the first sampling (pre-bathing season) to the following two (during bathing season) after the first year of the project (2006)



AGÊNCIA
PORTUGUESA
DO AMBIENTE



Factors that positively influence the quality of beach sand

- **Garbage removal** - Frequent removal of litter and garbage from sand and neighbouring areas;
- **Garbage receptacles**- Number of garbage receptacles appropriate for the length of the beach;
- **Sand treatment** - based on experience of one region with weekly iodine spraying (this statement does not express the point of view of the authors);
- **Surroundings** - Identification and treatment of neighbouring contaminated areas

Factors that negatively influence the quality of beach sand

- Over-use of beach
- Admission of pets
- Accumulation of garbage
- Abandonment of remains from fishing
- Rodents and prowling animals

White Paper – ANNO 2015

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Beach sand and the potential for infectious disease transmission: observations and recommendations

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