

Harmful Algal Bloom Community Ecology Project



Aabir Banerji

Office of Research and Development
Ecosystems Services Branch
US Environmental Protection Agency

Disclaimer: the views expressed in this presentation are those of the presenter(s) and do not necessarily reflect the views or policies of the U.S. Environmental Protection Agency.



EPA Federal & Regional Offices

Office of the Administrator (AO)

Office of Air and Radiation (OAR)

Office of Chemical Safety and Pollution Prevention (OCSP)

Office of the Chief Financial Officer (OCFO)

Office of Enforcement and Compliance Assurance (OECA)

Office of General Counsel (OGC)

Office of Inspector General (OIG)

Office of International and Tribal Affairs (OITA)

Office of Land and Emergency Management (OLEM)

Office of Mission Support (OMS)

Office of Research and Development (ORD)

Office of Water (OW)

Region 1 / Boston

Serving CT, ME, MA, NH, RI, and VT

Region 2 / New York

Serving NJ, NY, Puerto Rico, and the U.S. Virgin Islands

Region 3 / Philadelphia

Serving DE, DC, MD, PA, VA, and WV

Region 4 / Atlanta

Serving AL, FL, GA, KY, MS, NC, SC, and TN

Region 5 / Chicago

Serving IL, IN, MI, MN, OH, and WI

Region 6 / Dallas

Serving AR, LA, NM, OK, and TX

Region 7 / Kansas City

Serving IA, KS, MO, and NE

Region 8 / Denver

Serving CO, MT, ND, SD, UT, and WY

Region 9 / San Francisco

Serving AZ, CA, HI, NV, American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Marshall Islands, and Republic of Palau

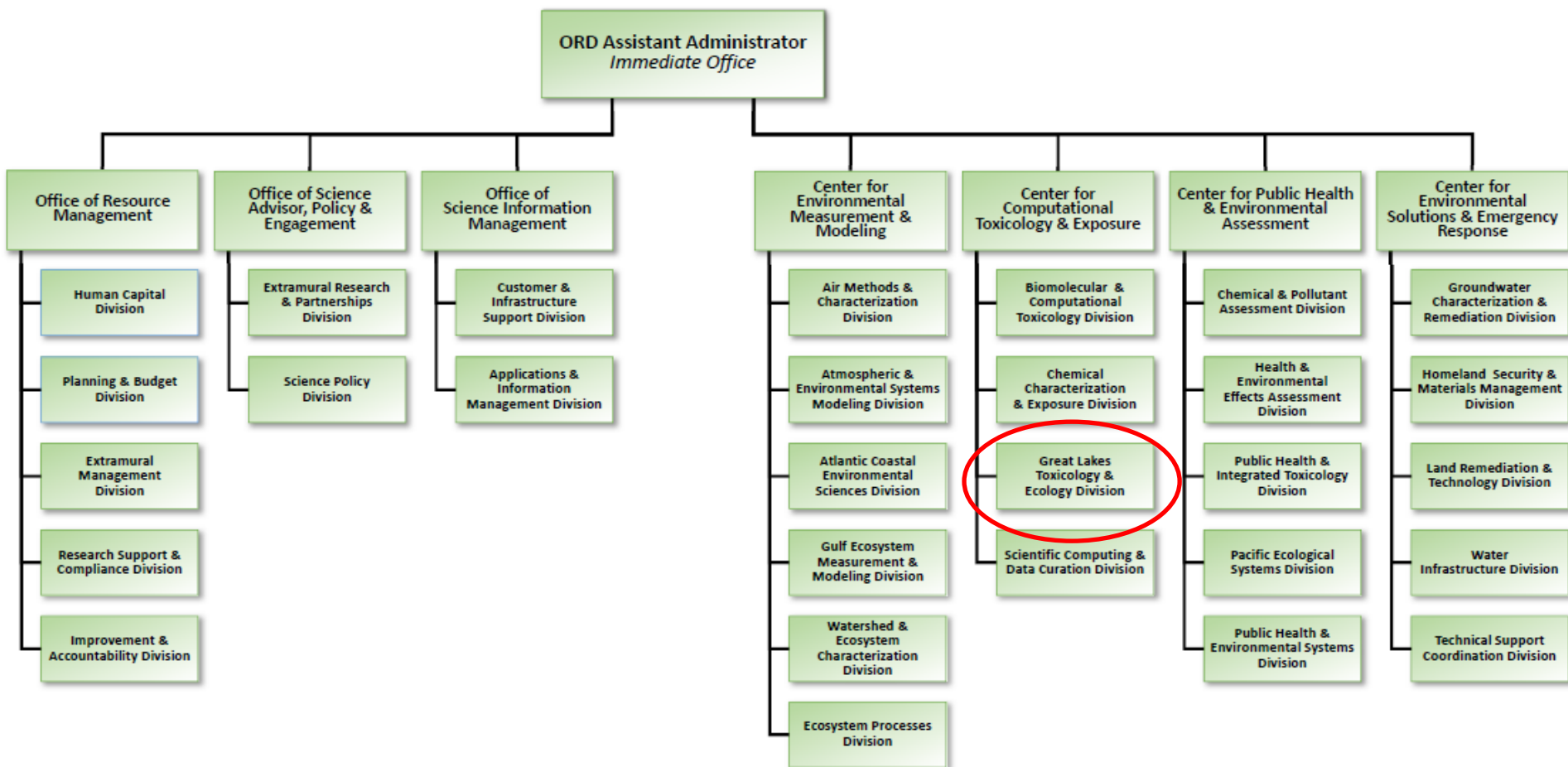
Region 10 / Seattle

Serving AK, ID, OR, and WA

<https://www.epa.gov/aboutepa/>



Office of Research & Development





Great Lakes Toxicology & Ecology Division

GLTED focuses on freshwater ecotoxicity and freshwater coastal ecology. The Division employs traditional and predictive toxicology with advanced scientific tools to inform ecological risk assessments of chemicals by EPA's Program Offices and Regions.





Harmful Algal Blooms (HABs)



HABs: dense assemblages of phytoplankton (drifting photoautotrophic microbes or seaweeds) that pose threats to human health/well-being and to the environment.

- These “threats” include:
 - Toxins (e.g., neurotoxins and hepatotoxins)
 - Hypoxia
 - Biofouling and taste/odor issues
- In freshwater systems, **cyanobacteria** such as *Dolichospermum* spp. are the most common HAB constituents.



HABs Management

Mitigation



- GAC and TiO₂ filters
- Algaecide
- Cavitation & ultrasound
- Gene silencing agents
- Manual harvesting

Monitoring & Prediction



- Rapid detection
- Early warning
- Risk assessment

Prevention



- Overwintering disruption
- Global climate change mitigation
- Curbing of nutrient inputs

Especially **nitrogen (N)**
and **phosphorus (P)**!



Disclaimer

- Any mention of trade names or commercial products in the following analogy does not constitute endorsement or recommendation for use.
- The opinions expressed via this analogy are those of the presenter and do not necessarily reflect the views of the Agency; therefore, no official endorsement should be inferred.
- Be advised that, if you are not already a vegan, this analogy may inspire you to become one.



Fuss about [Beef] & [Cheese]



← *Dolichospermum*

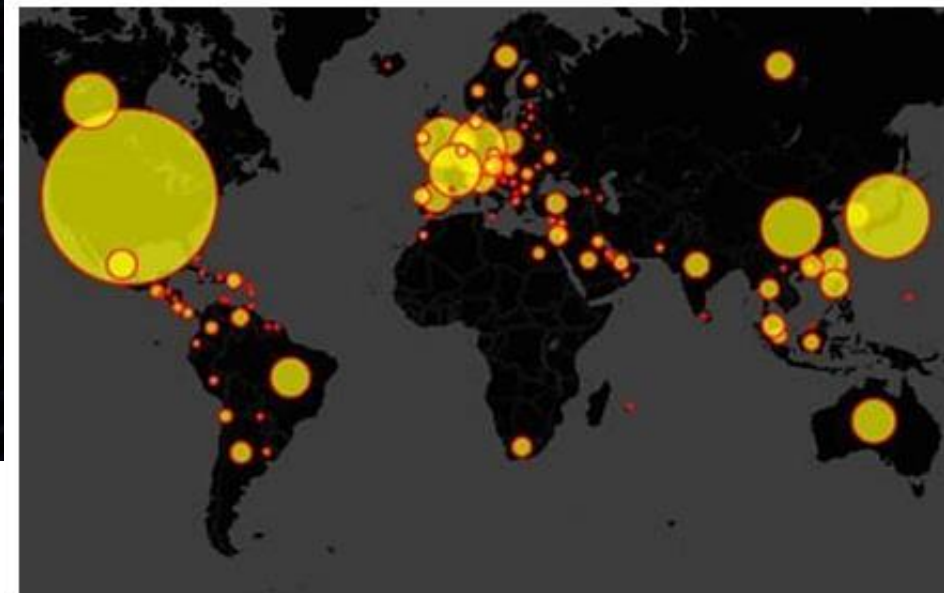


IMAGE: Number of McDonald's by country at the end of 2012, from an interactive infographic showing expansion from 2007, built by The Guardian.

<https://www.ediblegeography.com/mapping-mcdonalds/>

<http://www.datapointed.net/visualizations/maps/distance-to-nearest-mcdonalds/>



Competition (“Paradox of the Plankton”)

Cyanobacteria



(*Dolichospermum*)



(*Aphanizomenon*)



(*Microcystis*)



(*Planktothrix*)

Other Phytoplankton



(Green Algae)



(Diatoms)



(Dinoflagellates)

Other Plankton



(Heterotrophic Bacteria)



(Fungi)



(Oomycetes)



Other Species Interactions



- *McNuggets*
- *Egg McMuffin*
- *Crispy Chicken Sandwich*
- *Mayonnaise*
- *Public Relations*



Potential Adverse Outcomes



ARTICLE

Mycotoxins: the biggest challenge present in the food and beverage sector?

Mycotoxins are responsible for millions of human deaths each year and may be more present than one thinks, but how can the food and beverage industry, as well as consumers, avoid contact with these toxic organic compounds? Kate Harveston takes a look...

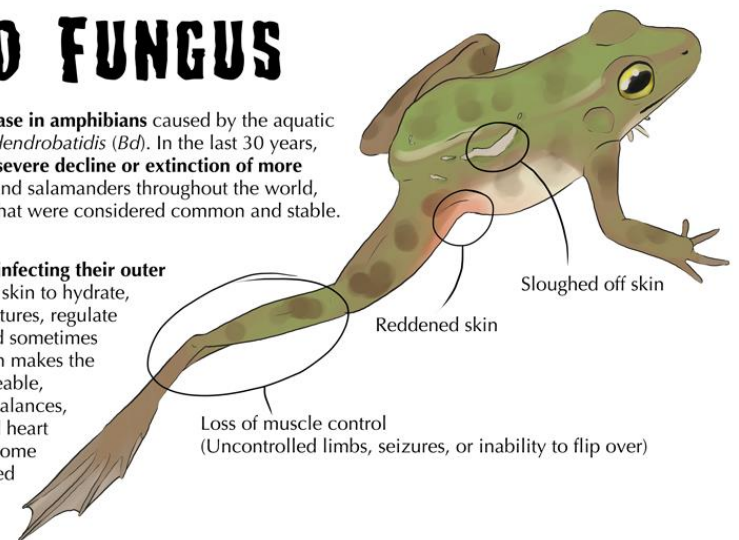
<https://www.newfoodmagazine.com/article/99722/mycotoxins-the-biggest-challenge-present-in-the-food-and-beverage-sector/>



CHYTRID FUNGUS

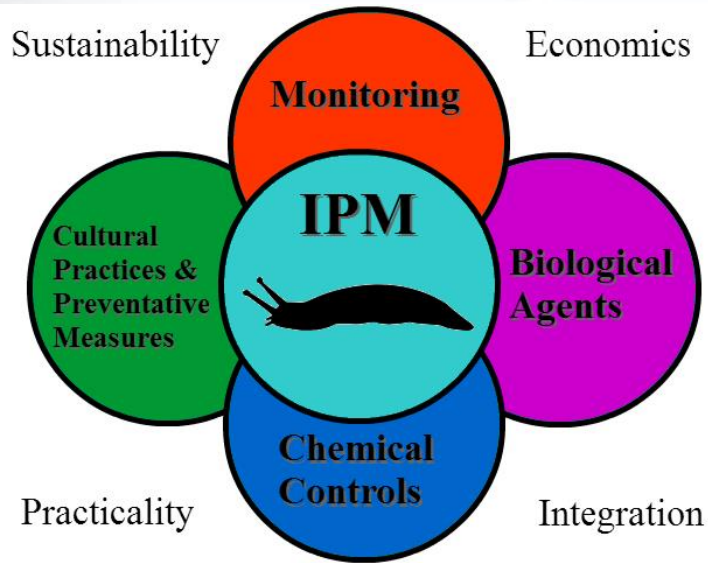
Chytridiomycosis is a disease in amphibians caused by the aquatic fungus *Batrachochytrium dendrobatidis* (Bd). In the last 30 years, Bd has been linked to the **severe decline or extinction of more than 200 species** of frogs and salamanders throughout the world, including several species that were considered common and stable.

Bd attacks amphibians by **infecting their outer skin layers**. Frogs use their skin to hydrate, control their body temperatures, regulate minerals and nutrients, and sometimes even breathe. The infection makes the skin thicker and less permeable, resulting in electrolyte imbalances, loss of muscle control, and heart failure. Frogs may also become lethargic and have reddened or sloughed off skin.

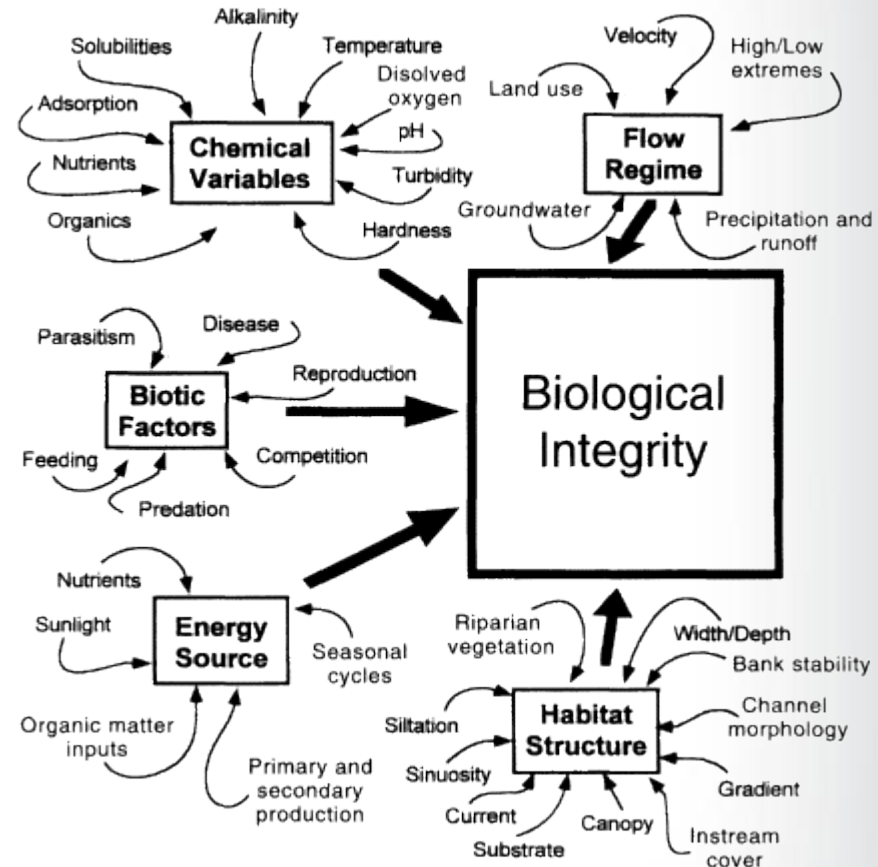
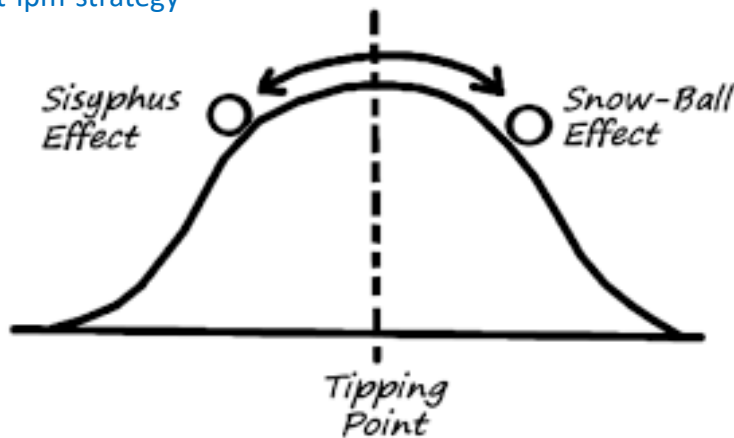




Potential Opportunities



<https://agsci.oregonstate.edu/slug-portal/integrated-pest-management-ipm-strategy>



<https://www.nap.edu/read/5147/chapter/15#229>



Dispersal Component

How things are on-site might not be as important as how the critters get there.





Metapopulation Dynamics

Propagule Pressure

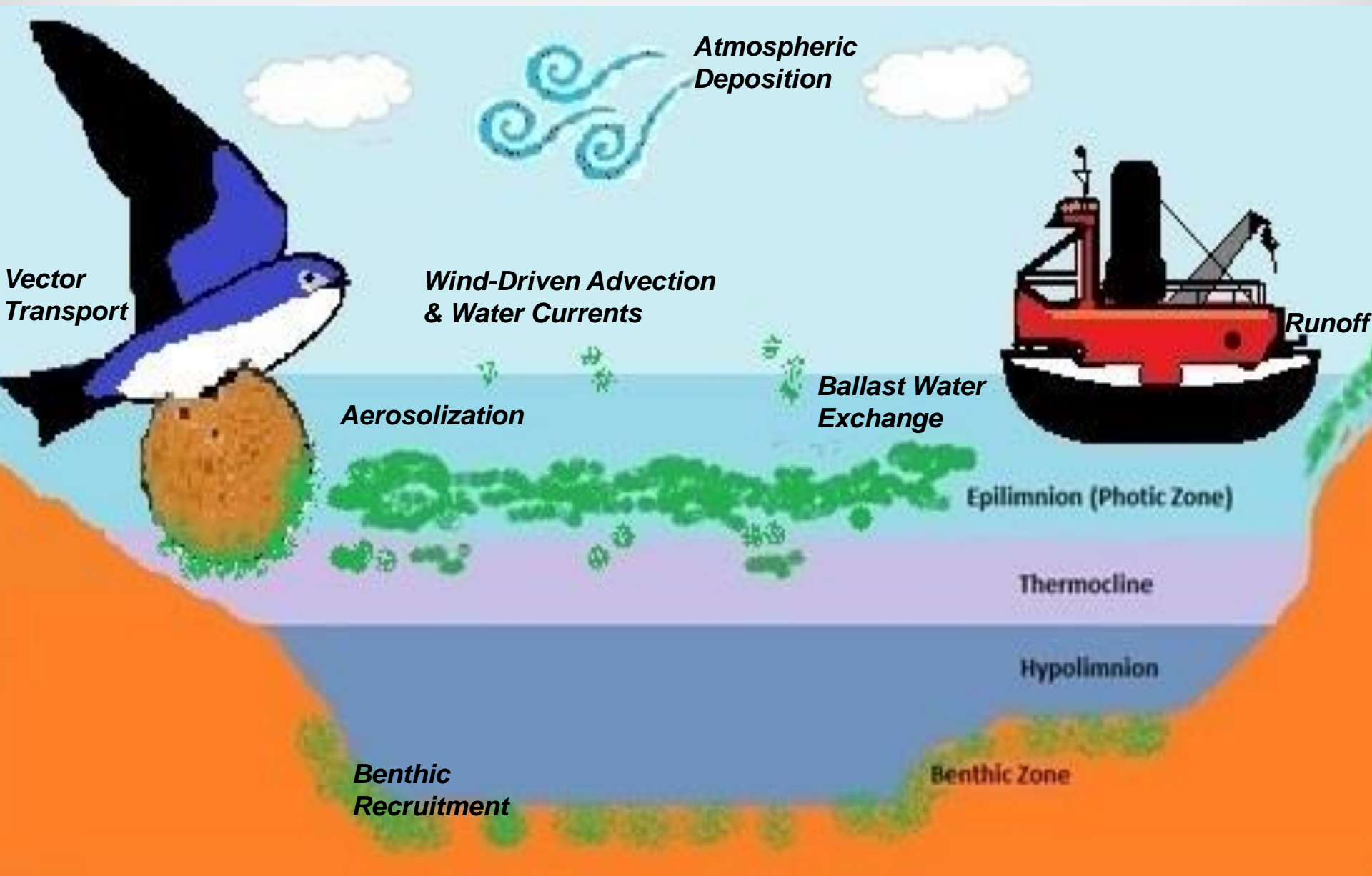


Landscape Linkages



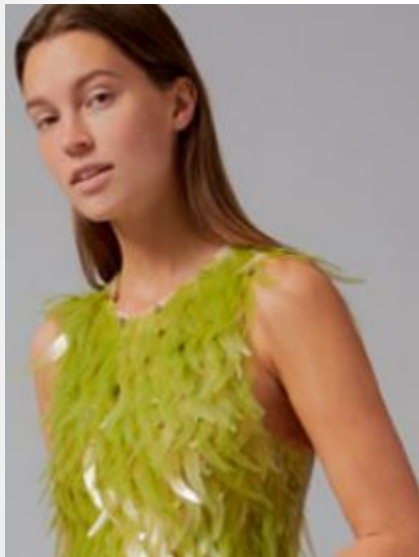
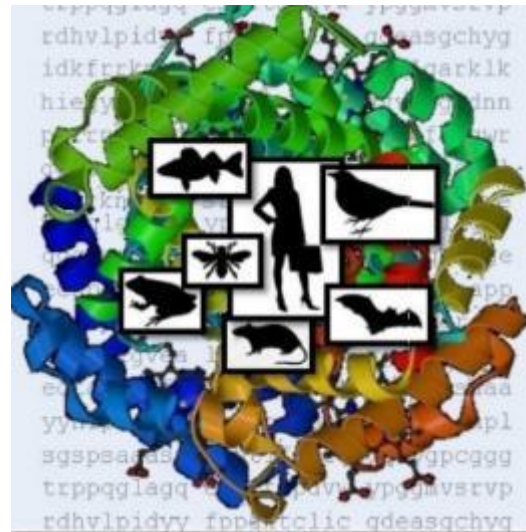
**Dormancy & Emergence
Patterns (Phenology)**







Tools & Approaches



(Modeling cyanobacteria.)
<https://onexone.earth/>





On the Back Burner

- How do HABs influence the presence and effects of co-occurring stressors/concerns such as **mercury** and **PFAS contamination**, **endocrine disruption**, and **antimicrobial resistance**?
- Where do **farm ponds**, **wetlands**, and **vernal pools** fit into the landscape of HAB dynamics?
- What are the **Environmental Justice** implications of where, when, and how HABs occur?
 - Do all people have equal access to safe drinking water and medical treatment for cyanotoxin exposure during HAB events?
- What are the best ways to **measure/monitor** cyanobacterial abundance?
 - Can one be converted into another?



Thank you for your attention!

