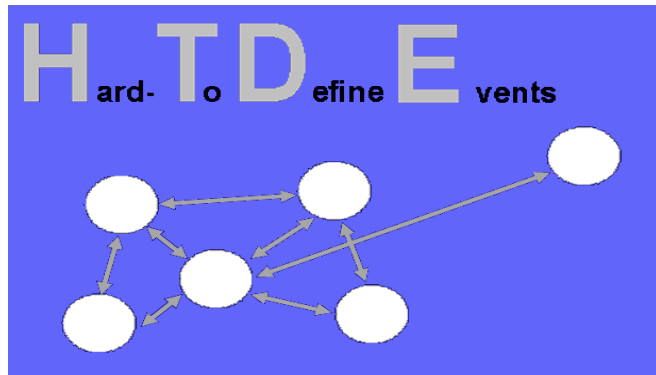


Drawing Conclusions From Drunk Fish in Dynamic Environments



Presented at the HTDE (Hard-to-Define Events) Workshop 2012,
Artificial Life XIII, East Lansing, MI USA

Nicholas Keeney
Louisiana State University
<http://www.ocean.lsu.edu/>

DRAWING CONCLUSIONS FROM DRUNK FISH IN DYNAMIC ENVIRONMENTS

**NICHOLAS KEENEY
DEPARTMENT OF OCEANOGRAPHY
AND COASTAL SCIENCES
LOUISIANA STATE UNIVERSITY**

THE LOUISIANA COAST



<http://www.nps.gov/miss/photosmultimedia/upload/watershedBG.jpg>

<http://www.adammandelman.net/tag/mississippi-river-delta/>

NATURAL RESOURCES



<http://www.tripsmarter.com/videos/uploads/thumbs/QeiJc20uYc2DpibqbNI.jpg>

<http://www.zimbio.com/pictures/3Ojo5R9ACqa/First+Shrimping+Season+Begins+Louisiana+Since/CQGETlcBgNN>

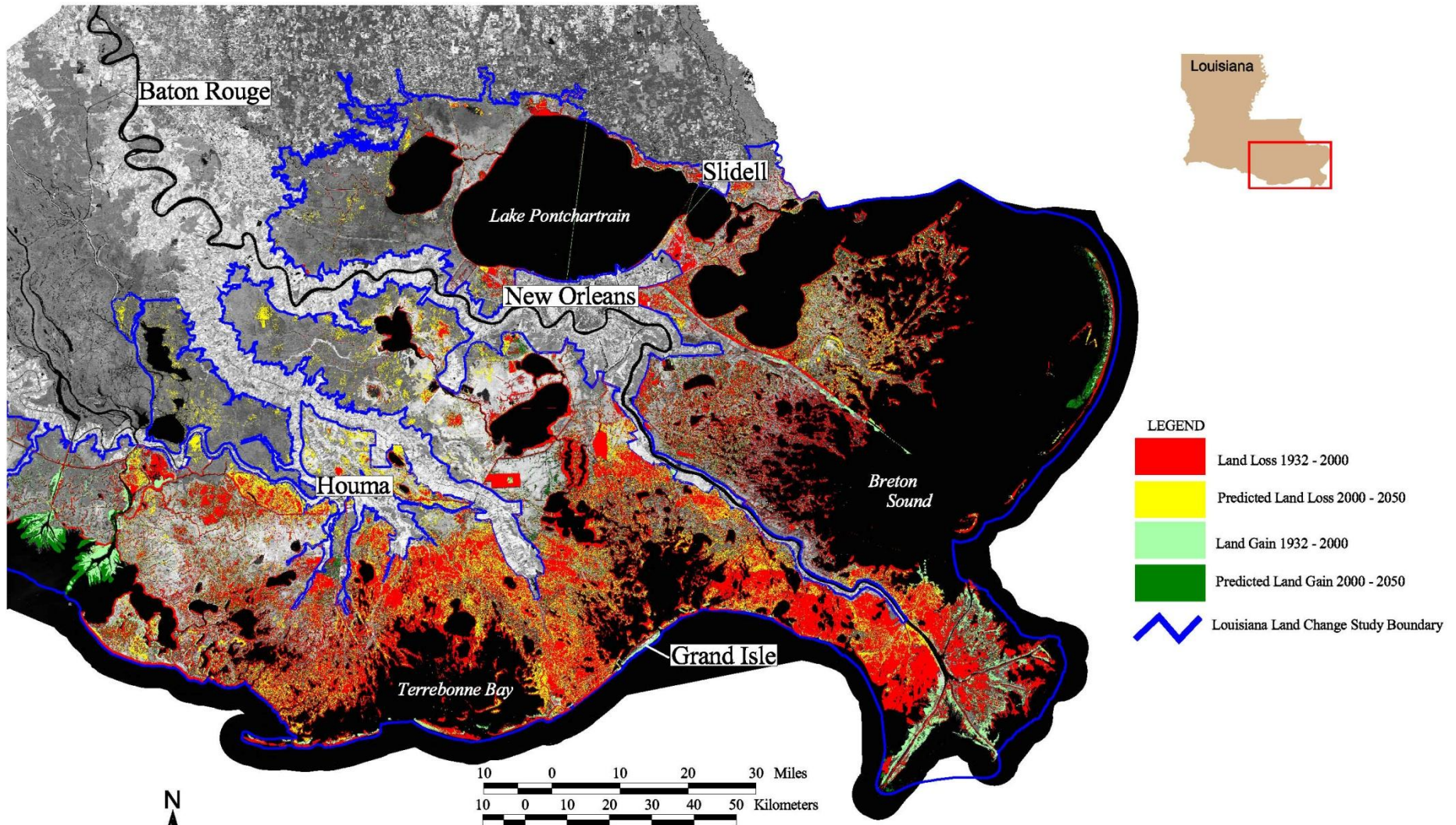
http://www.igfa.org/Images/SpeciesID/Images/bass_black_sea.png

WETLAND LOSS

- **Levees built 1930s**
- **Subsidence**
- **100 km² annually**



100+ Years of Land Change for Southeast Coastal Louisiana



SUMMARY

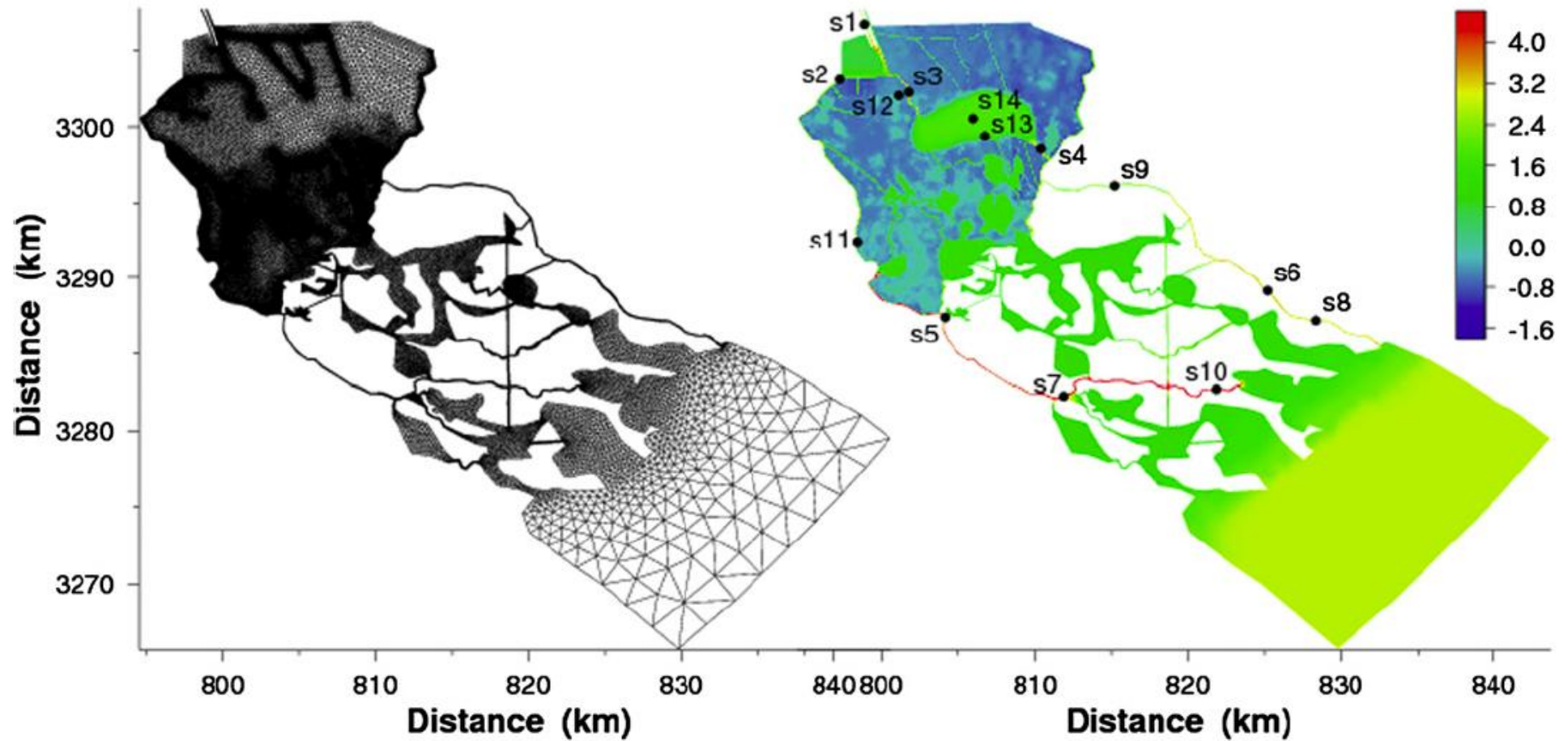
Coastal Louisiana has lost an average of 34 square miles of land, primarily marsh, per year for the last 50 years. From 1932 to 2000, coastal Louisiana has lost 1,900 square miles of land, roughly an area the size of the state of Delaware. If nothing is done to stop this land loss, Louisiana could potentially lose approximately 700 square miles of land, or about equal to the size of the greater Washington D.C.-Baltimore area, in the next 50 years. Further, Louisiana accounted for an estimated 90 percent of the coastal marsh loss in the lower 48 states during the 1990s. The area shown on this map represents over 75 percent of the total land loss for coastal Louisiana. Backdrop is 2000 TM panchromatic band.

RIVER DIVERSIONS

- **Supply sediment**
- **Filter nutrients**
- **Control salinity**
- **Increase production**



BRETON SOUND ESTUARY

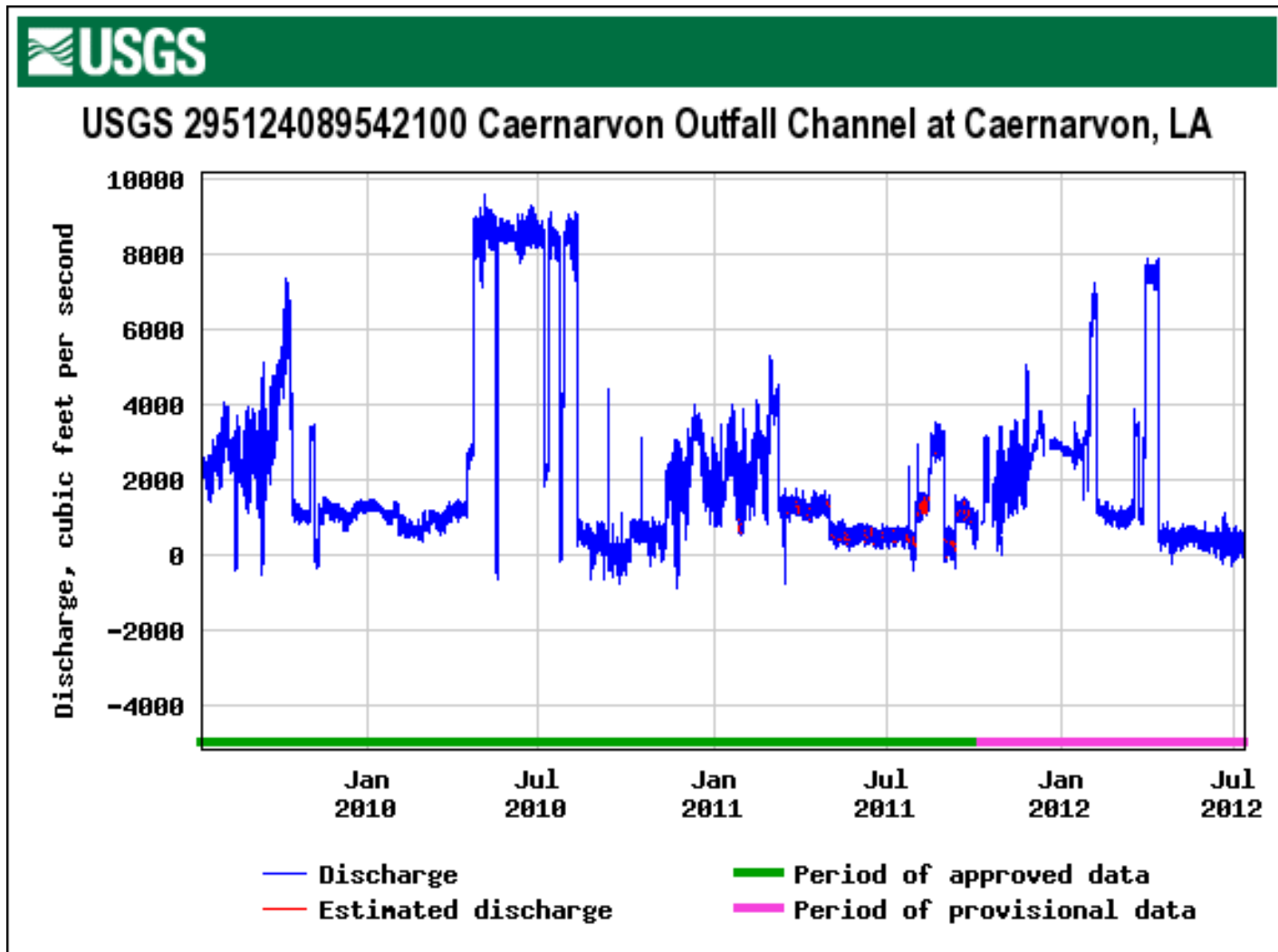


CAERNARVON

- **Transport x10 in Spring**
- **Completed 1991, 227 m³/s**
- **St 10-15 km**



CAERNARVON



VIRTUAL FISH

- **Self-propelled particles**
- **Respond to environmental cues**
 - **Salinity**
 - **Food availability**
- **Bioenergetics**

MOVEMENT ALGORITHMS

- **Random walk: poor approximation**
- **Kinesis: local conditions only**
- **Taxis: directional, need spatial information**

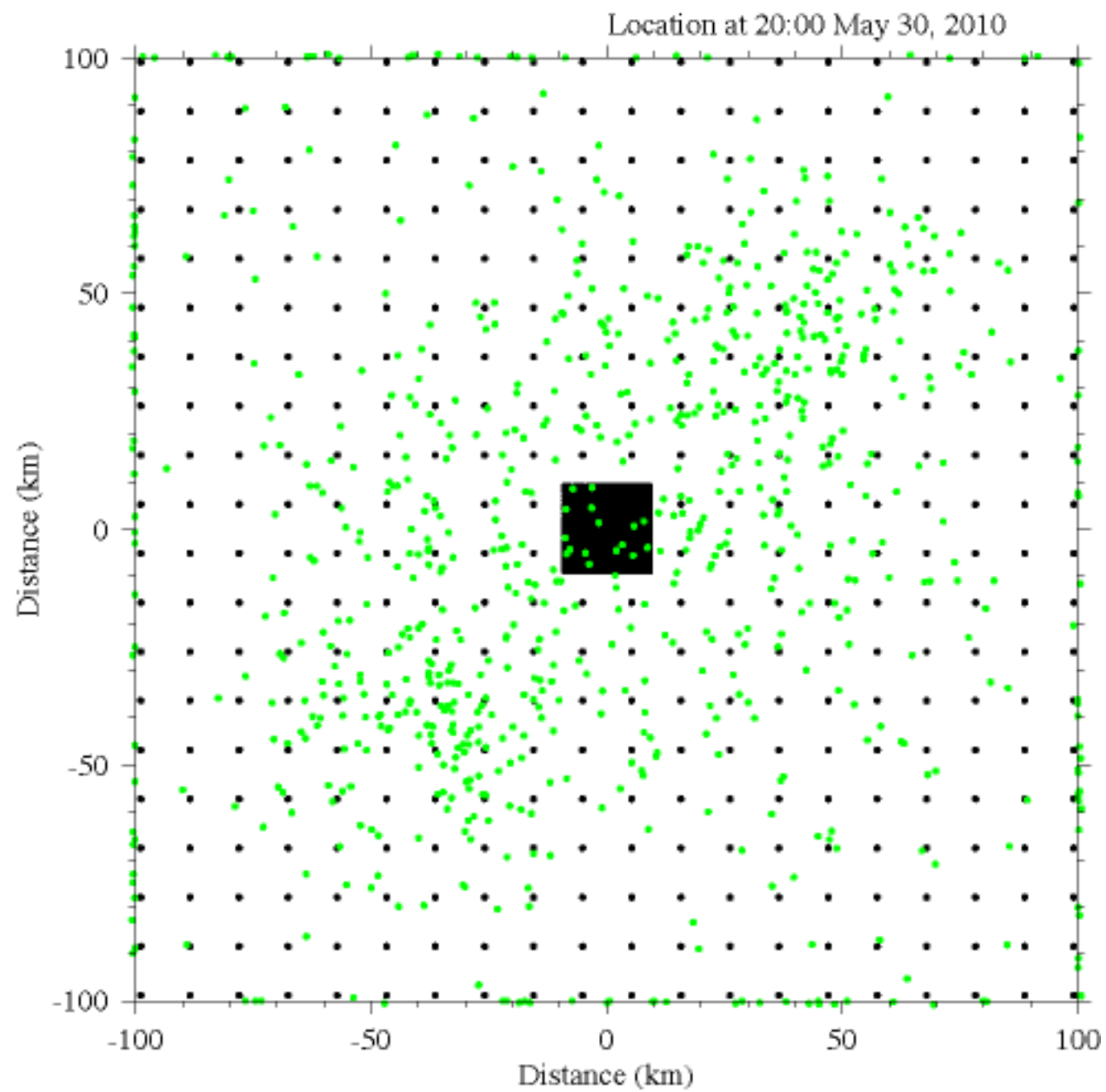
KINESIS

- **Inertial component:**

$$\text{velocity} * \exp(-0.5*((S-S_0)/\sigma)^2)$$

- **Stochastic component:**

$$\text{random} * (1 - \exp(-0.5*((S-S_0)/\sigma)^2))$$



CYANOBACTERIA

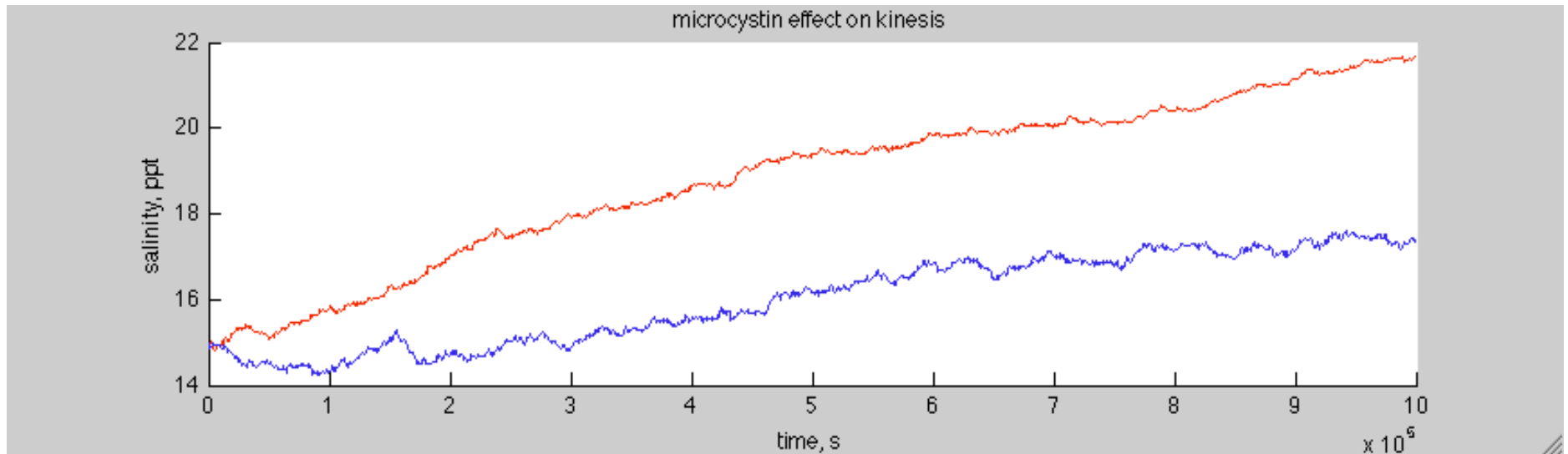
- *Anabaena sp.*
- Produces microcystin
 - Synthesized during growth
 - Released during crash
- Grow in 0.0-9.0 ppt salinity
- Toxins bioaccumulate



DRUNK FISH

- **Age dependent**
 - **Thin epithelium, high metabolism, surface area**
- **Effects**
 - **Development, growth, reproduction**
 - **Mobility**
 - **Osmoregulation**
 - **Internal clock (diel inversion)**

ANALYSING MOTION



- Profitable places
- Residence time

DRESSING IT UP

- **Genetic algorithms**
- **Toxin depuration and neurology**
- **Collective behavior**
- **Memory**