

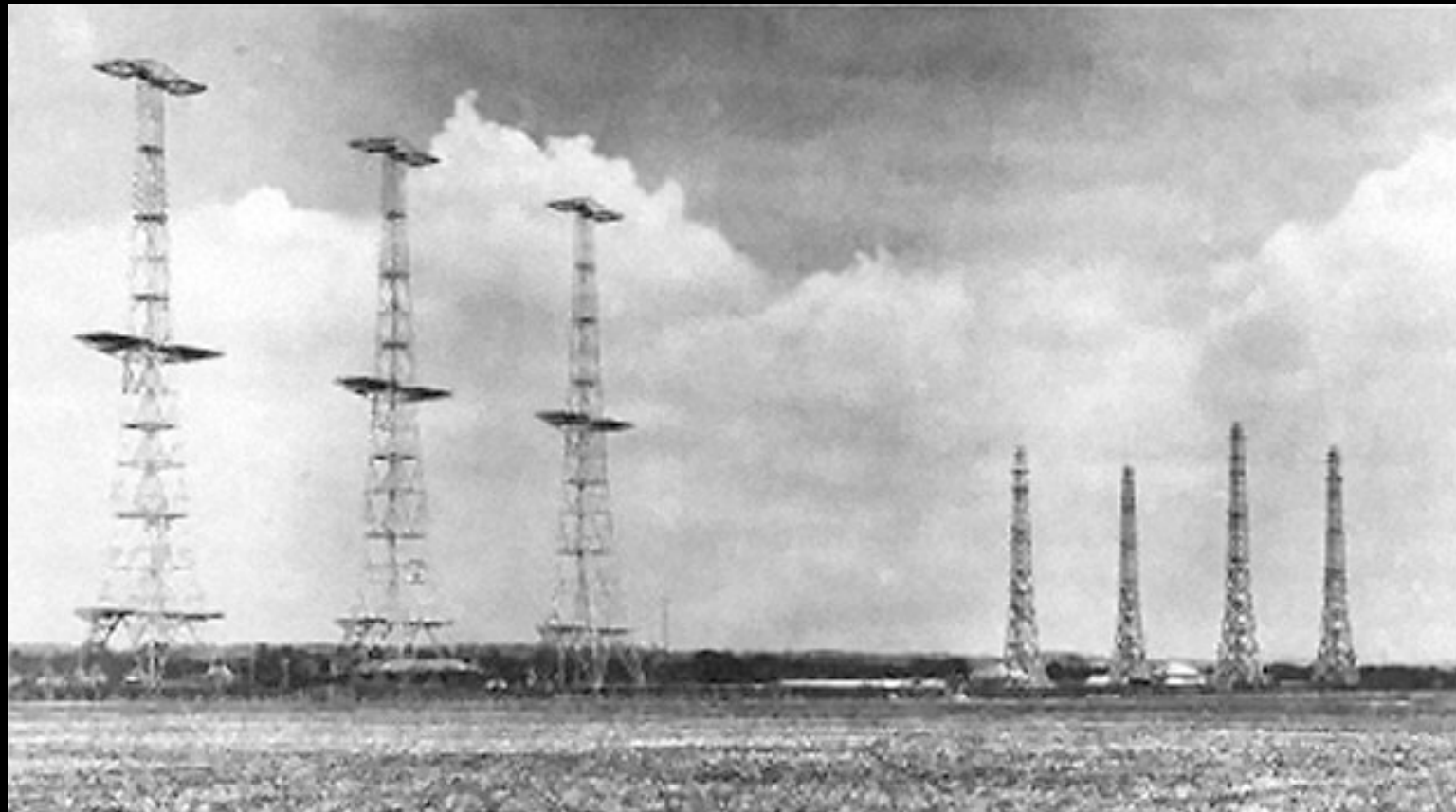


*Science During Crisis:*  
An Introduction to  
the Strategic Sciences Group

12 July 2012

G.E. Machlis

DOI Strategic Sciences Working Group

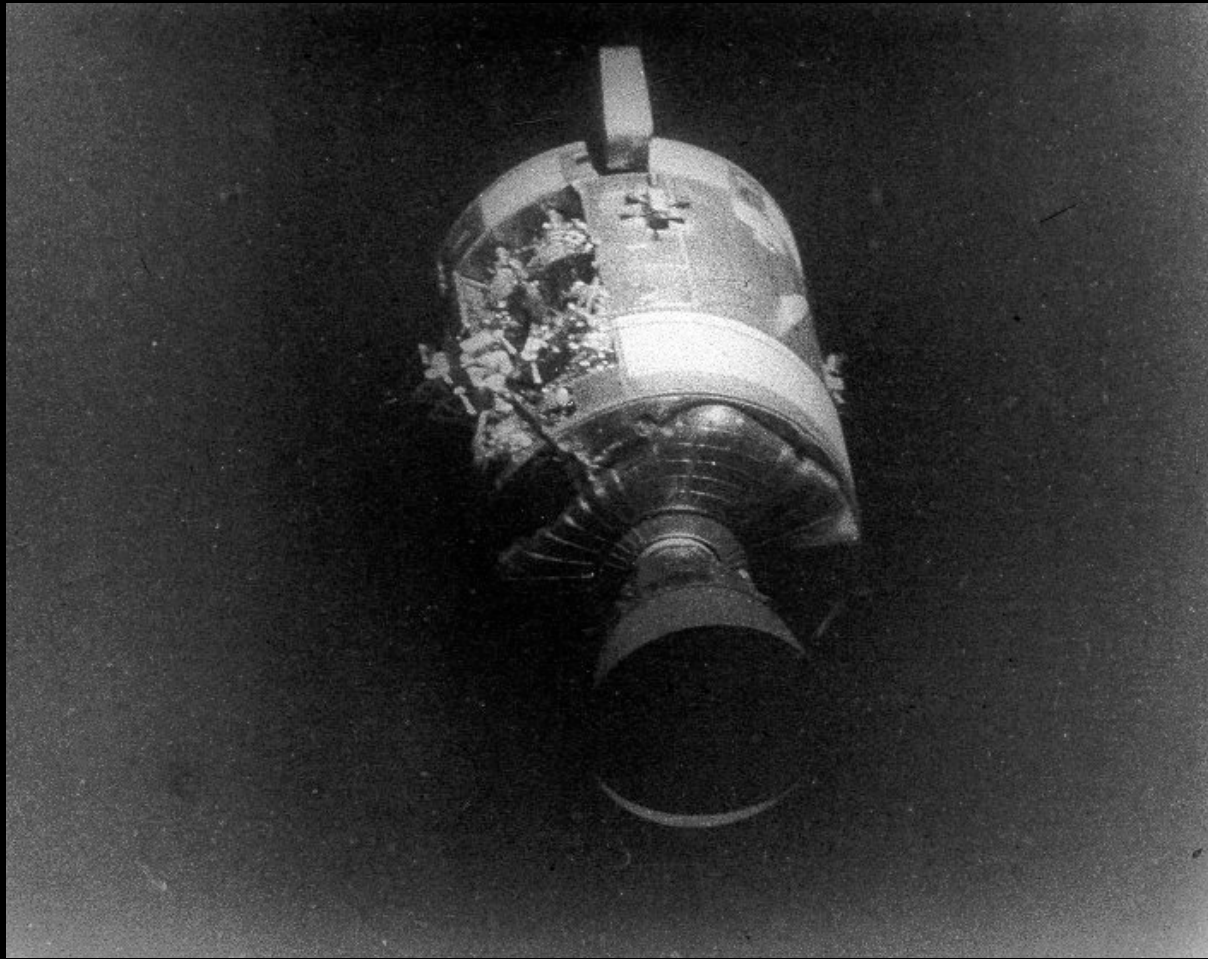


# Radar R&D, 1938





Manhattan Project, 1945



# Apollo 13, 1970







Ebola Epidemic, Zaire,  
1976





Deepwater Horizon, 2010

# The Challenge



- The Deepwater Horizon oil spill involved the application of science during crisis
- Much of the science was *tactical*; there was an additional need for *strategic* science focused on response, mid-term, and long-term recovery scenarios
- The DOI stood up an experimental project for strategic science.....



# A Pilot Test: The DOI Strategic Sciences Working Group

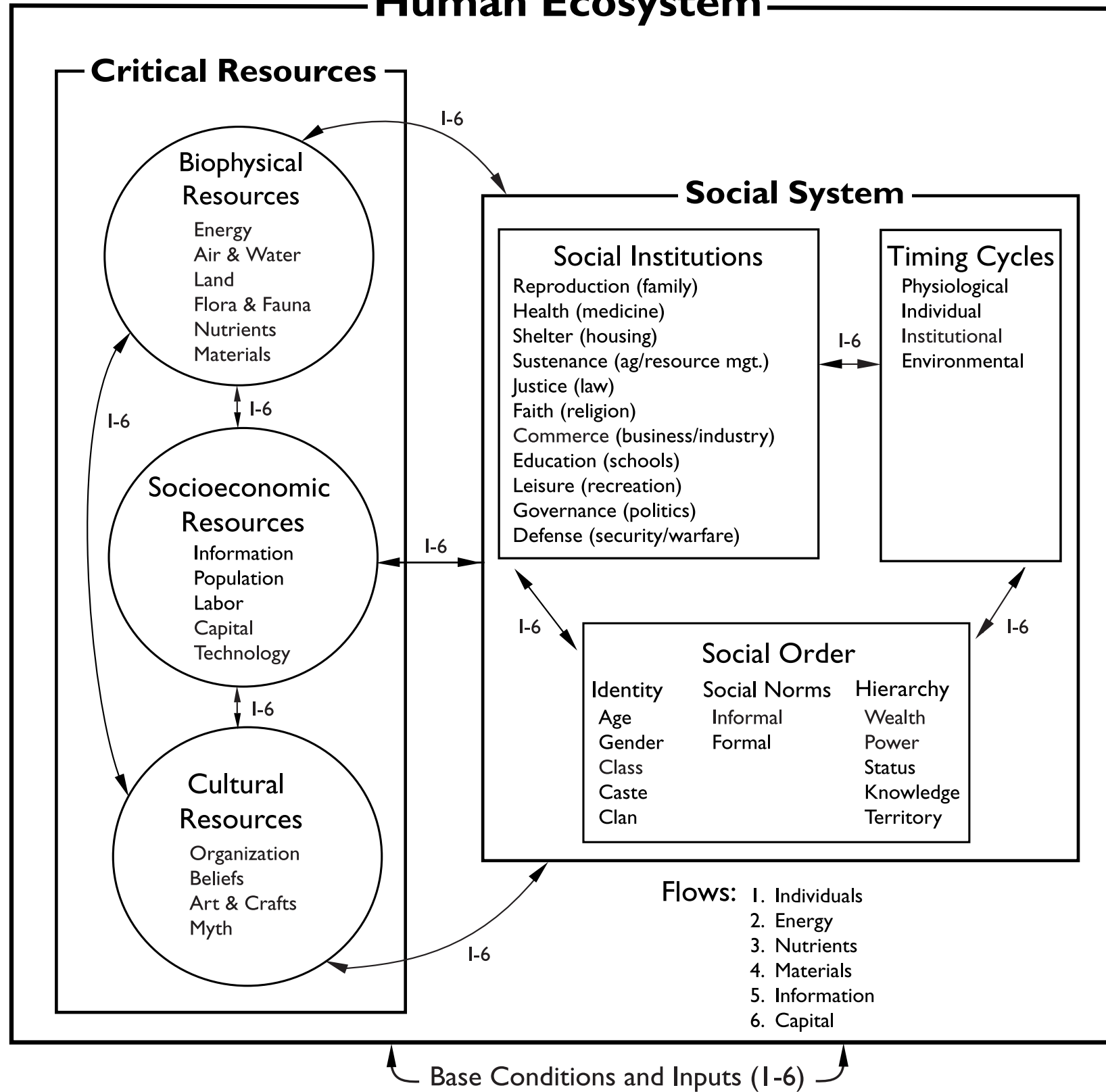
- Established May 2010, the DOI Strategic Sciences Working Group (SSWG) was tasked with developing science-based scenarios for the human/natural systems in the Gulf of Mexico



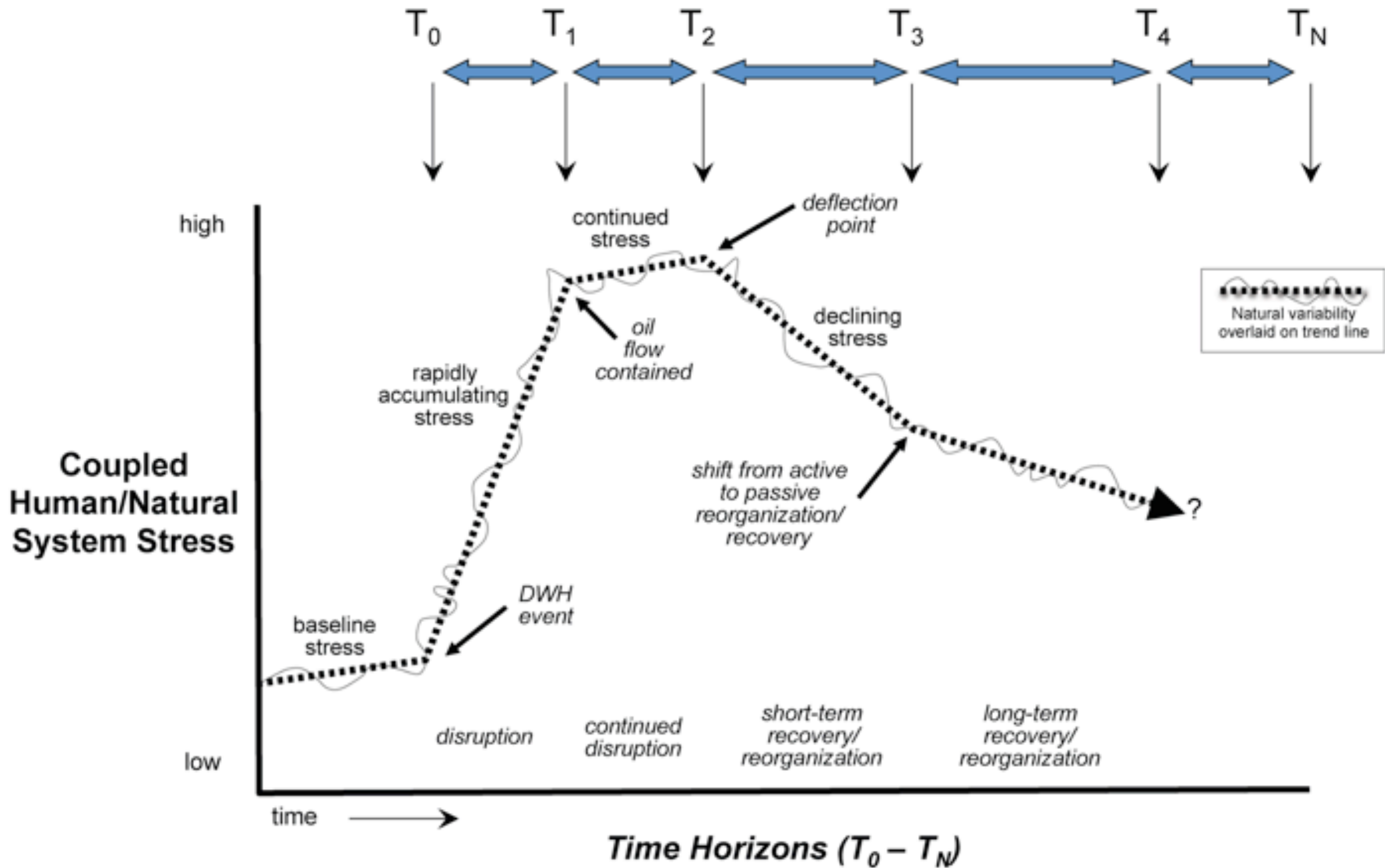


# Human Ecosystem

Flows from other human ecosystems



Flows to other human ecosystems



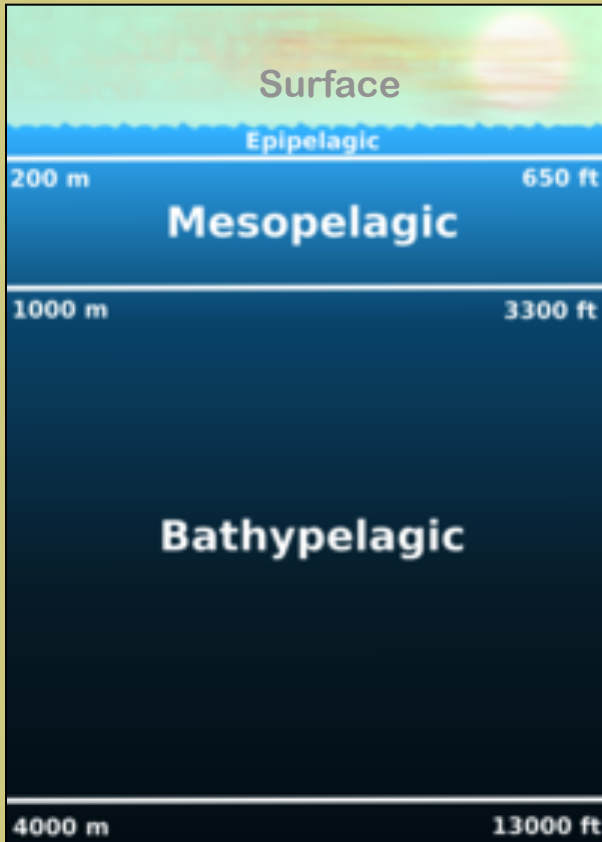
# Levels of Scientific Uncertainty<sup>1</sup>

<b>5</b>	Certain
<b>4</b>	Reasonably Certain
<b>3</b>	Probable
<b>2</b>	Plausible
<b>1</b>	Unlikely
<b>0</b>	Not Possible
<b>NK</b>	Not Known

<sup>1</sup> Adapted from Weiss, C. 2003. Expressing scientific uncertainty. Law, Probability and Risk, vol. 2, pages 25-26.



# Vertical Life Zones



Epibenthic

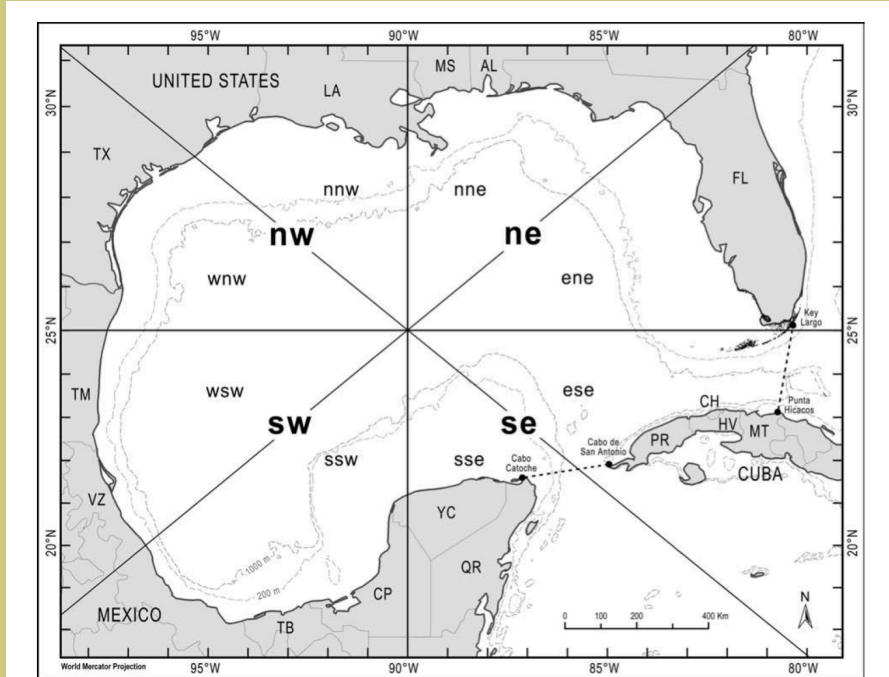
Benthic

Underlying Geology

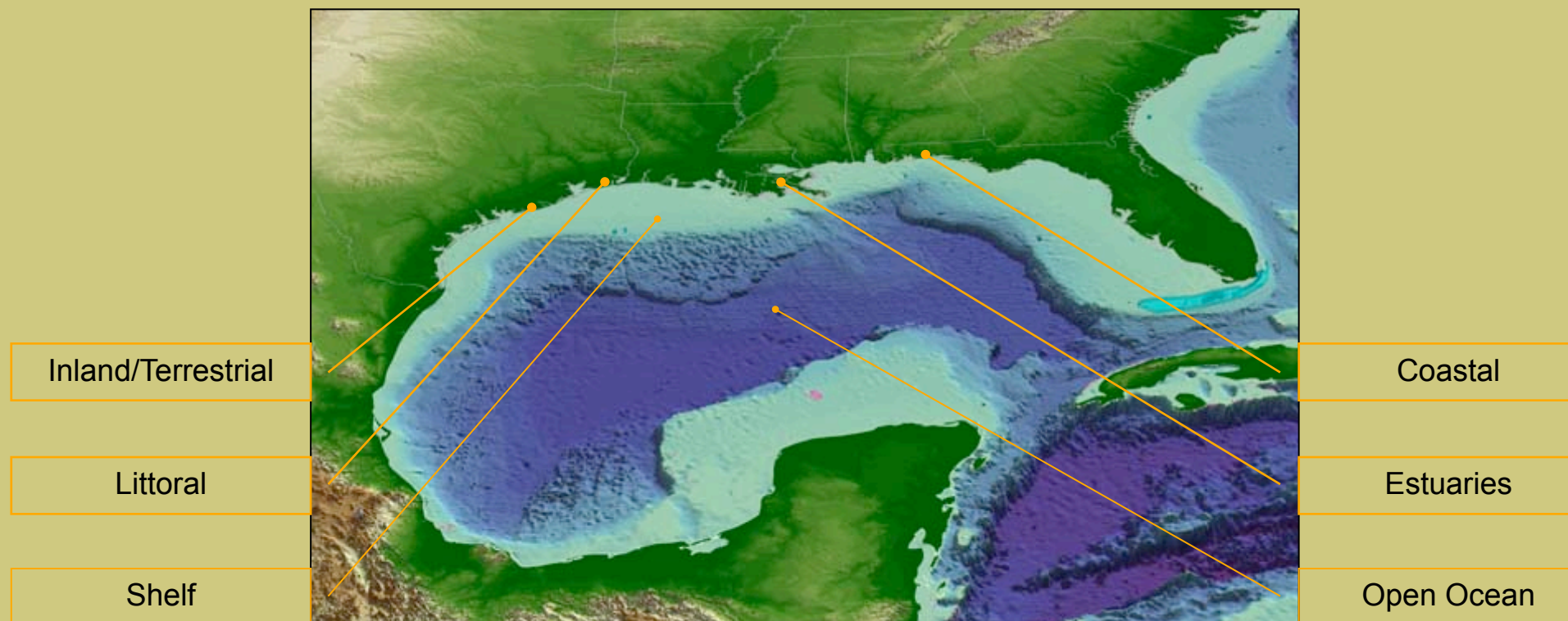
# Administrative Boundaries



# Gulf of Mexico Biodiversity Quadrants



# Major Ecosystem Types



# Session 1 (May 2010): S<sub>2</sub>

- Scenario Parameters:
  - Flow Rate: 40k bbl/day
  - Time to Containment: 100 days (July 29)
  - Time Horizon: T<sub>2</sub>-T<sub>4</sub>
  - Geographic/Spatial Unit: Major Ecosystem Types (Coastal), GoM North
- Assumptions
  - Oil release was relatively constant and associated with gases and dispersants.
  - Skimming, burning, collecting, etc. is an ongoing activity.
  - During T<sub>2</sub>-T<sub>4</sub>, a hurricane will make landfall in the GoM North.



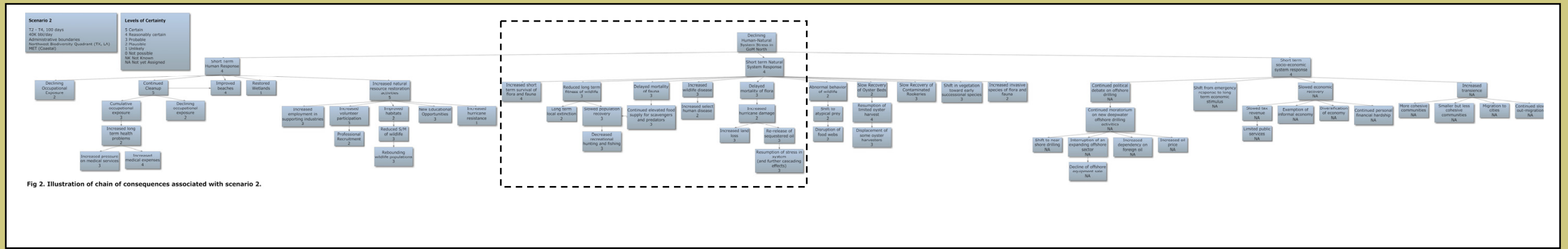
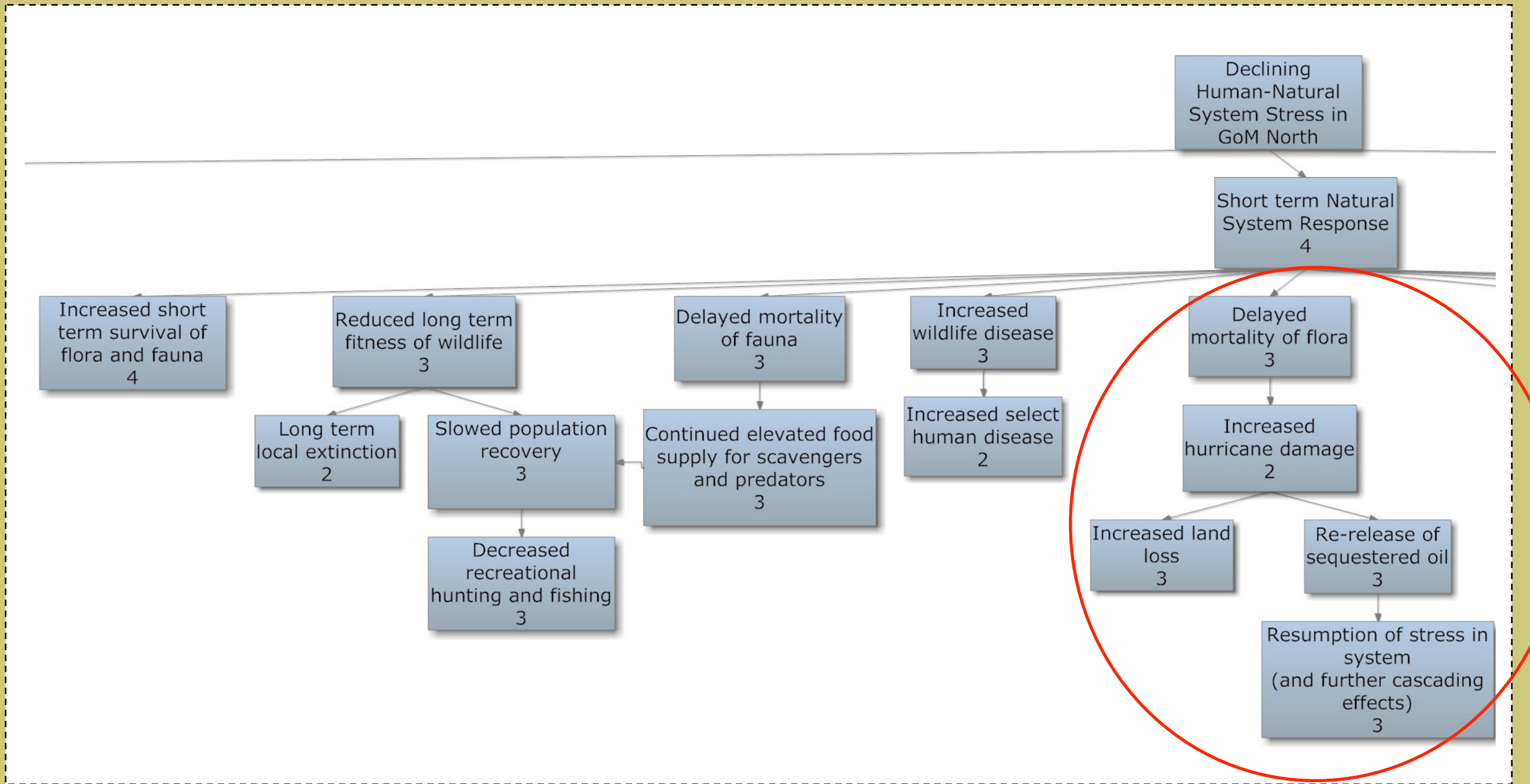
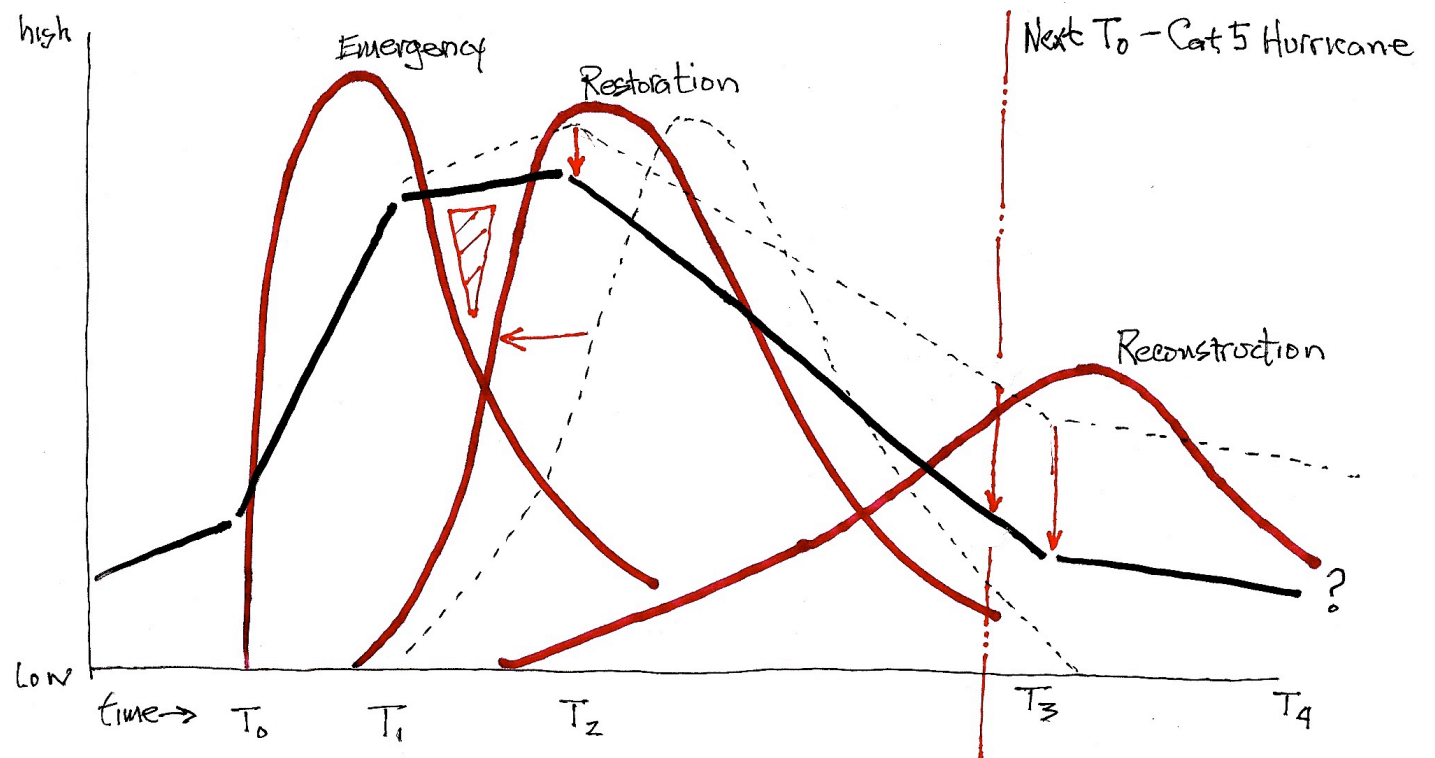
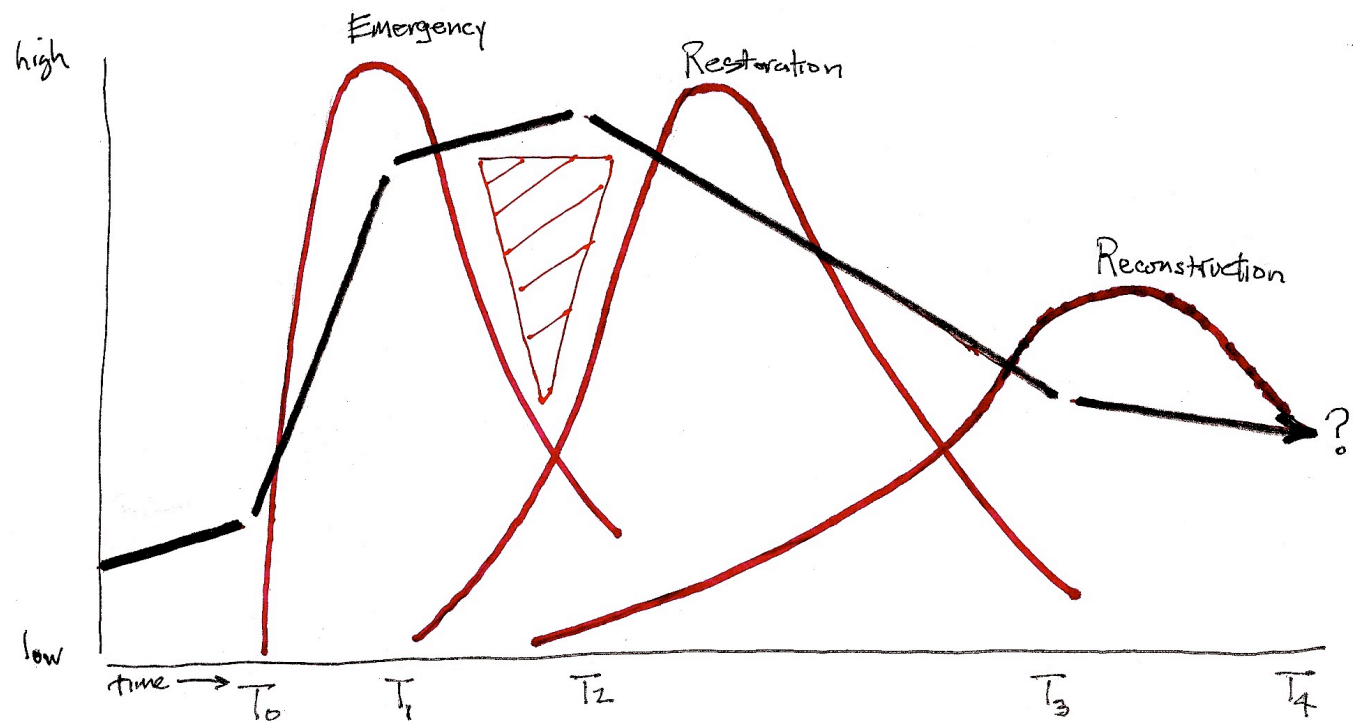


Fig 2. Illustration of chain of consequences associated with scenario 2.





Early sketches,  
recovery scenario  
framework, July  
2011



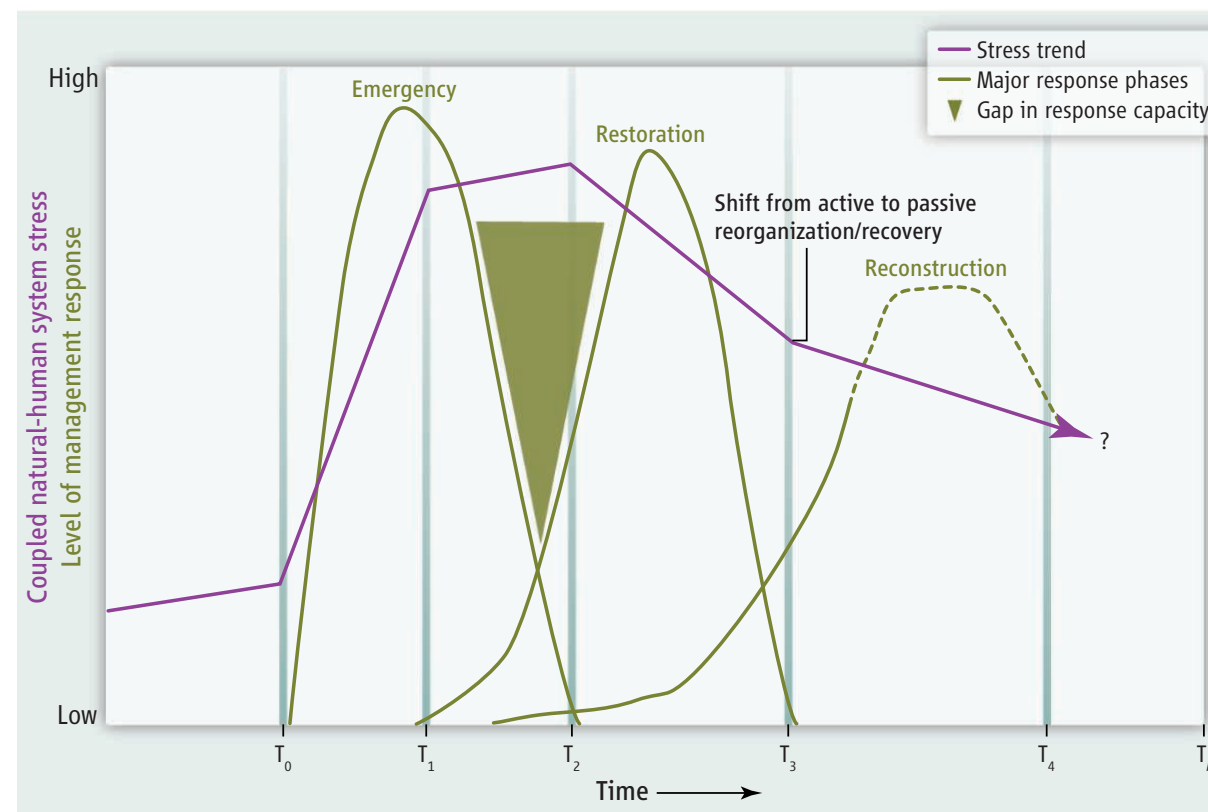
## DISASTERS

# Scenario-Building for the Deepwater Horizon Oil Spill

Gary E. Machlis<sup>1\*</sup> and Marcia K. McNutt<sup>2</sup>

In May 2010, the U.S. Department of the Interior (DOI) established a Strategic Sciences Working Group (SSWG) to assess how the Deepwater Horizon (DH) oil spill may impact the ecology, economy, and people of the Gulf of Mexico (GOM). It included scientists from diverse disciplines and federal, academic, and nongovernmental organizations. The SSWG was not to conduct a scientific investigation, but to provide rapid scientific assessment of potential consequences of the spill that could provide usable knowledge to decision-makers.

Such teams are not common to formal government response efforts. Most scientific activity at early stages of the spill was tactical, e.g., documenting preimpact conditions, monitoring oil transport, assessing resource damage, and supporting technical decisions associated with oil containment. Interdisciplinary and comprehensive analyses of consequences were not integral to these tactical efforts. The SSWG was a strategic and experimental response initiated by DOI, novel to the DH spill for its combination of (i) independence from standard response structures [e.g., the Incident Command System (ICS) and Natural Resource Damage Assessment (NRDA)]; (ii) collaborative engagement of federal and nonfederal scientists; (iii) rapid scenario-building within a interdisciplinary framework; (iv) assignment of scientific uncertainties; and (v) potential application to mid- and long-term recovery. The SSWG assembled in Mobile, Alabama, within 36 hours of establishment and developed initial scenarios 23 to 28 May 2010. A full descrip-



**Conceptual scenario framework.** This shows system stress, time horizons, major management response phases, and the potential gap in response capacity. [Adapted from (1)]

their requisite data may be unavailable, and many key factors are unknown. Scenario-building, originally developed for the military (2) and adapted by large-scale firms and others, offers several advantages, particularly its capacity to systematically examine possible futures and cascading consequences that are complex and uncertain (3, 4). Unlike quantitative modeling or risk assessment, scenarios identify alternative futures rather than predict new-state conditions. Limitations include constraints due to available expert opinion and lack of theory (4).

Interdisciplinary science-based scenarios can assist responses to the Gulf oil spill and similar environmental crises.

zons through recovery. Baseline stress in the GOM was treated as increasing before the DH oil spill, due to nutrient loading, expansion of the seasonal hypoxic area, wetland loss, land subsidence, invasive species, climate change, fishing pressures, effects of past hurricane damage, and national and regional economic recession (8–11). At the time of the DH explosion ( $T_0$ ; 20 April 2010), system stress began to rapidly accumulate. After oil flow containment ( $T_1$ ; well shut-in occurred 15 July 2010) system stress may continue to rise due to lagged effects, e.g., landfall of previously released oil

# Current Actions



- The Strategic Sciences Working Group has completed its technical reports
- DOI is responding to lessons learned from the DH oil spill and recommendations of National Commission related to strategic science
- The DOI is looking to the future.....



# The DOI Strategic Sciences Group



THE SECRETARY OF THE INTERIOR  
WASHINGTON

ORDER NO. 3318

Subject: Establishment of the Department of the Interior Strategic Sciences Group

Sec. 1 **Purpose.** This Order authorizes the establishment of the Strategic Sciences Group to: provide the Department of the Interior (Department) with science-based assessments and interdisciplinary scenarios of environmental crises affecting Departmental resources; rapidly assemble trained teams of scientists to conduct such work during environmental crises; and, provide the results of this work to the Secretary and Departmental leadership to support decision-making during crises.





Wildfires



Hurricanes



Dam failures



Drought





Arctic oil spills



Bioterrorist attack



Earthquakes



Megastorms





# The Need for Preparation

- The DOI Strategic Sciences Group is preparing for conducting science during crises
- Preparation includes organizational structures, rostering of scientists, and training
- Focus is on three key tasks: 1) interdisciplinary science assessments and scenarios, 2) actionable peer review, and 3) delivery of usable knowledge to decision makers
- Goal is to create capacity to respond to 2 major crises, and be operational within 36 hours

# Potential Benefits of the DOI Strategic Sciences Group



- DOI can expand role of science during future environmental crises and provide additional usable knowledge to decision makers
- DOI can lead efforts to engage external scientific community during crises
- DOI can increase preparation and capacity to respond to emergency response, recovery, and restoration planning/science needs

