Linking Science and Management

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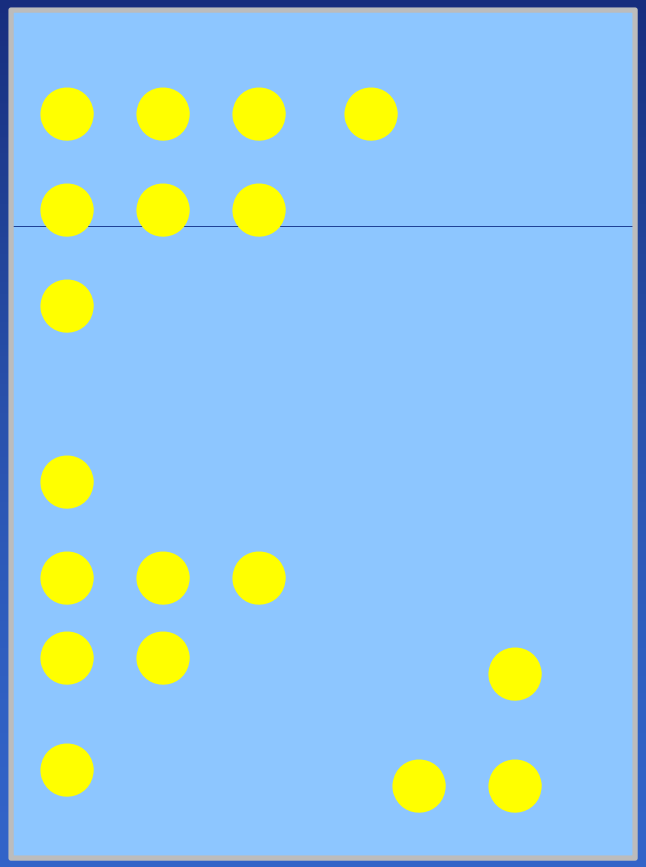
Challenges and Opportunities

- The scientific uncertainty associated with the ecological response of the ecosystem to restoration programs and projects must be addressed by linking the scientific process with program management
- The two processes are very different and linking them presents special challenges
- A focused effort to produce science synthesis that is useful to managers is the key to being able to link science with program management
- Science synthesis is useful to managers when it is:
  - communicated in a way that is understandable
  - related to management actions i.e. program/project design or operation

Scientific Method

Science
Science



Scientific Method

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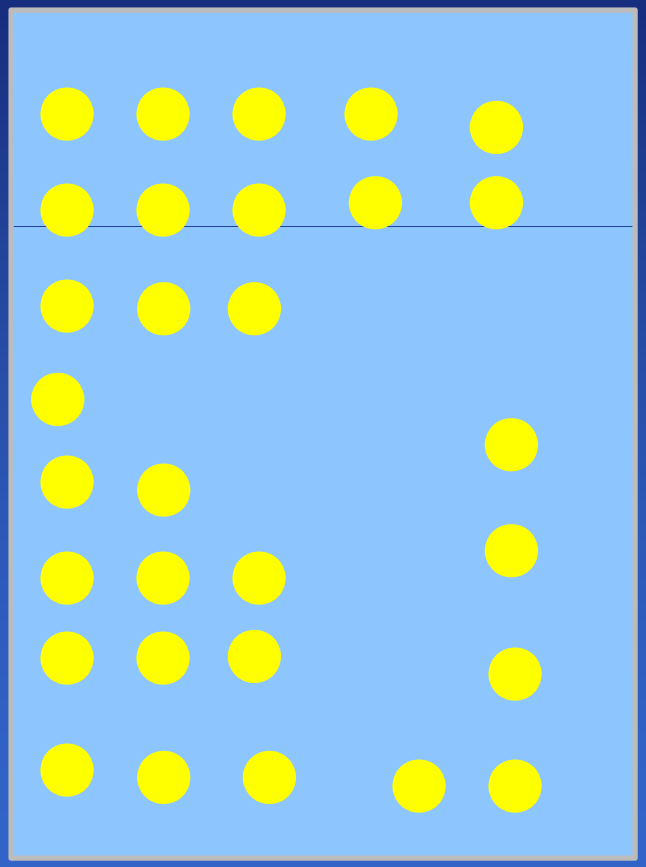

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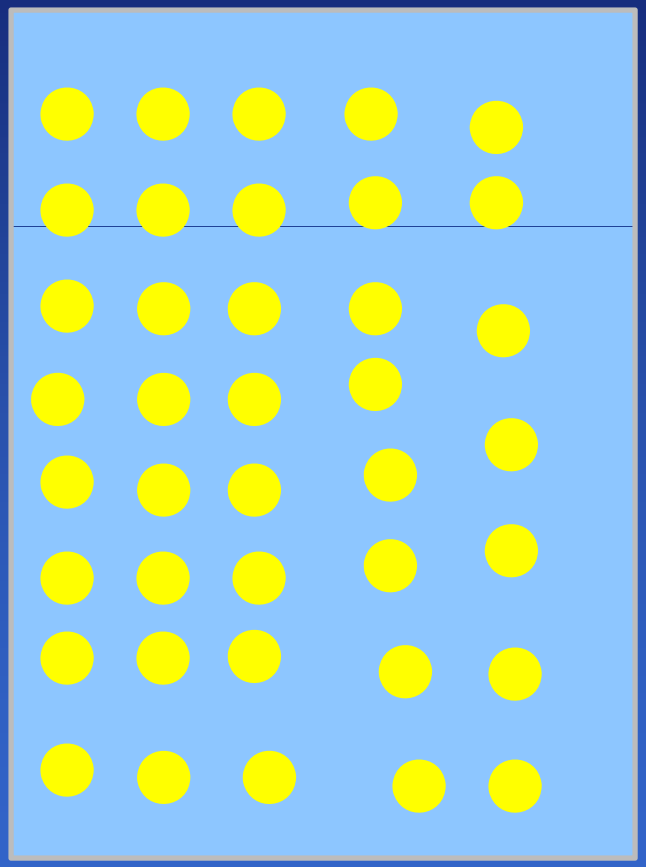
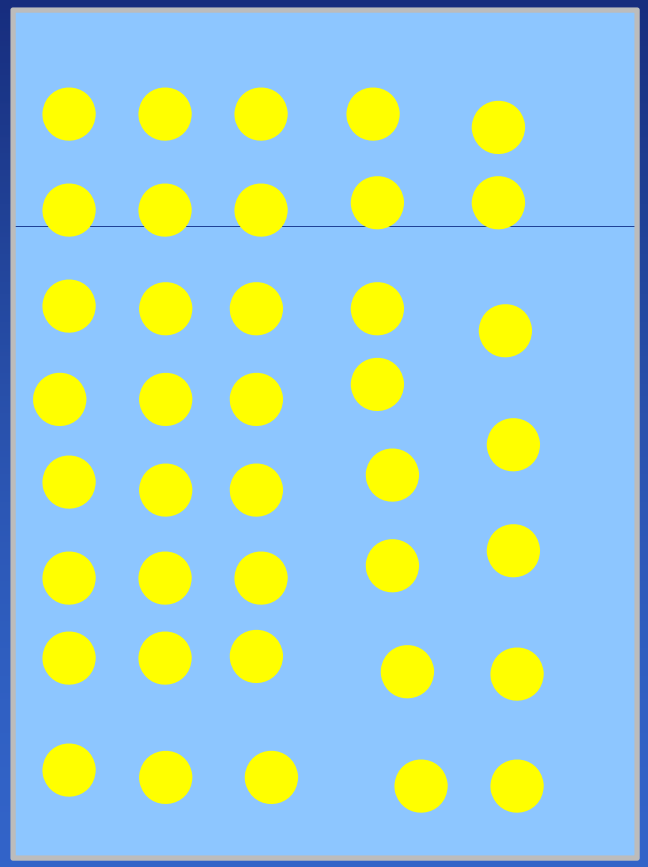
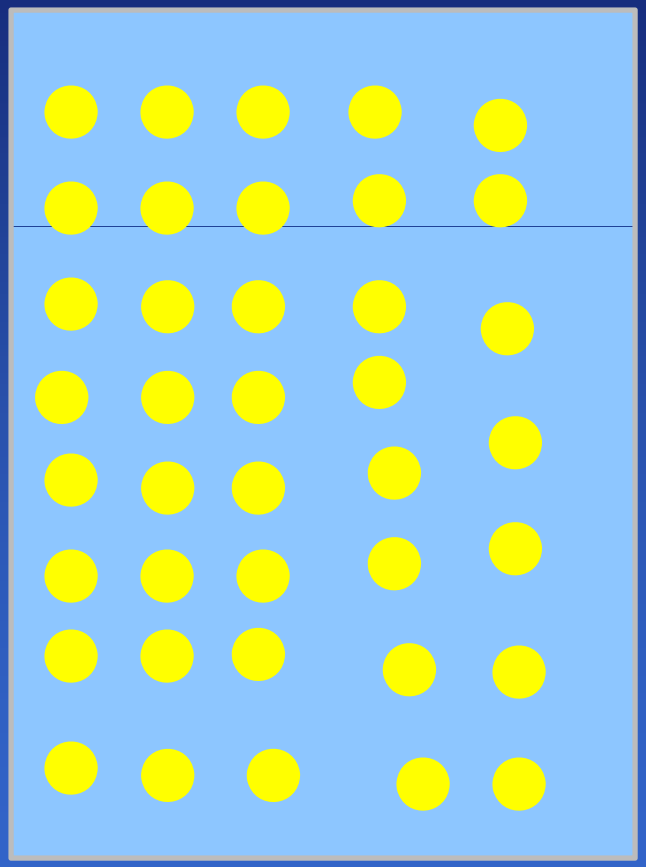


Science Synthesis

Science

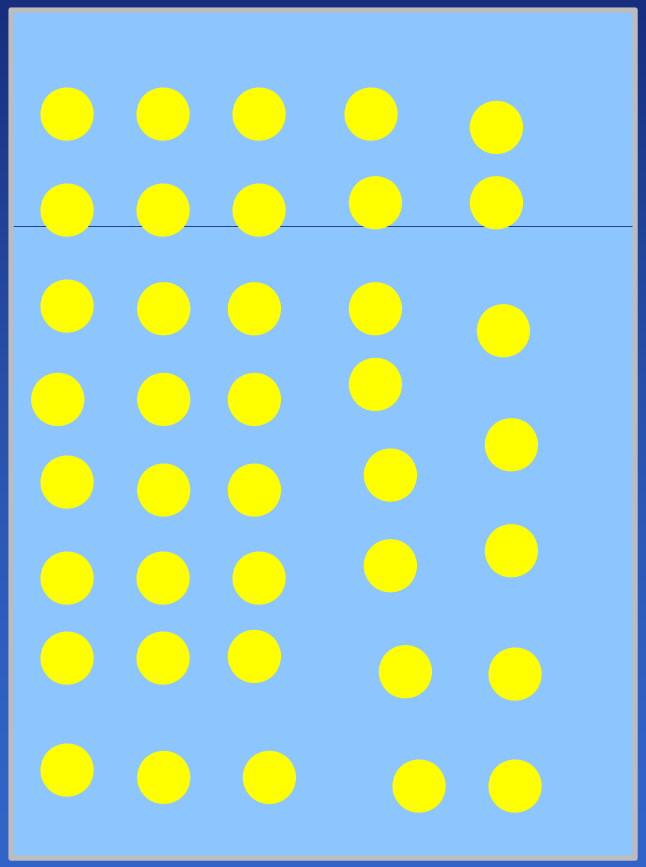


Science Synthesis

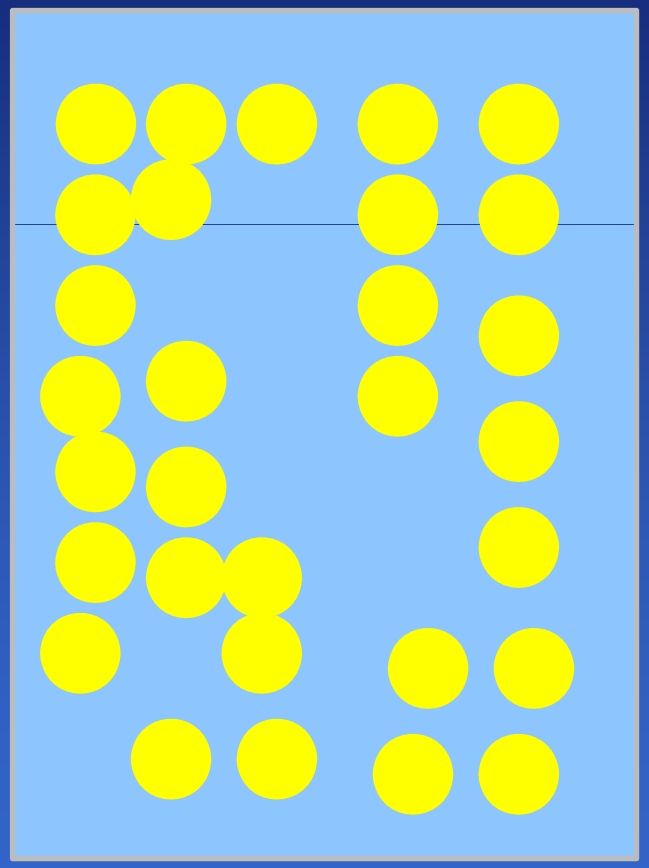


Science Synthesis

Science

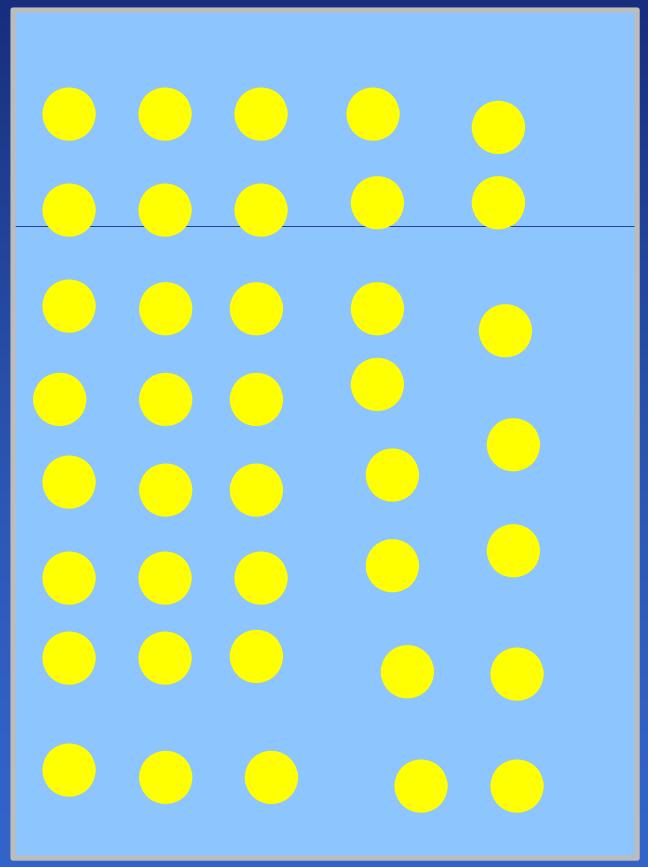


Science Synthesis

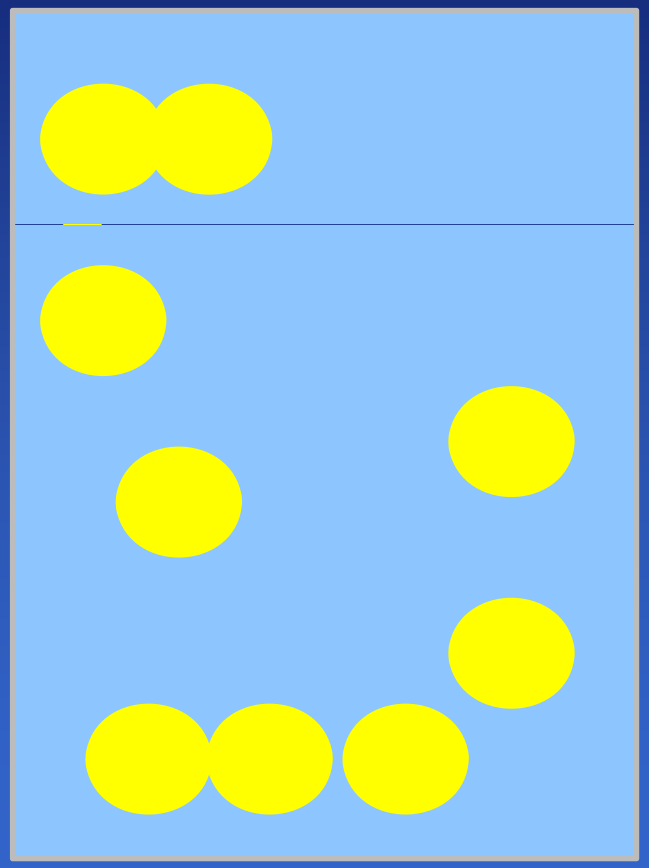


Science Synthesis

Science

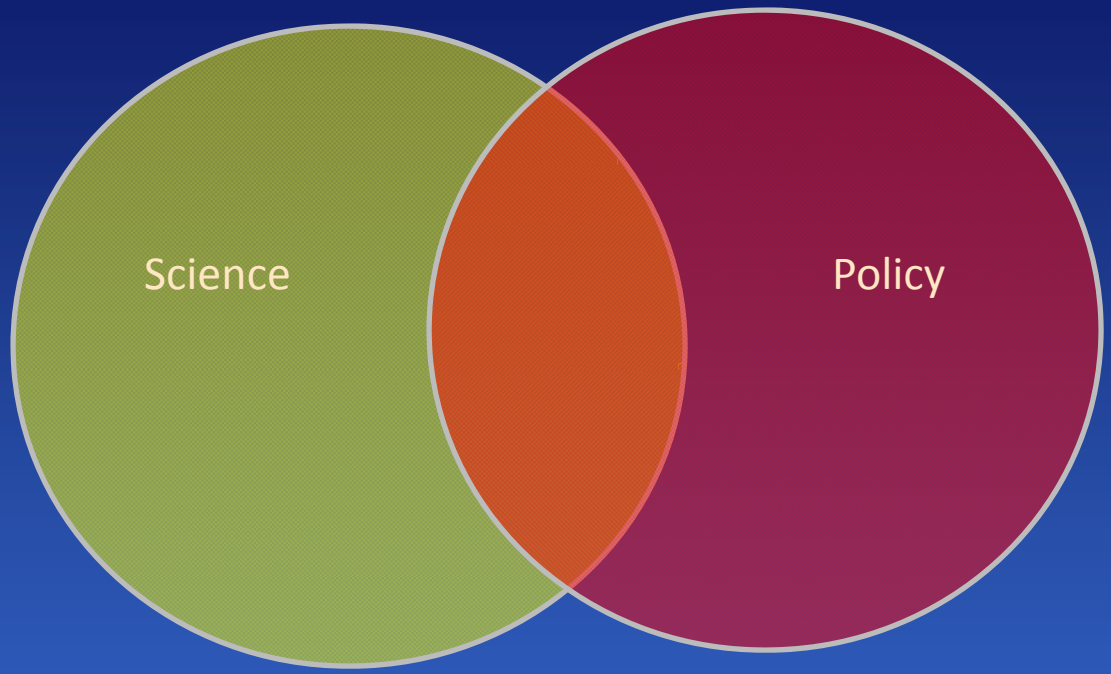


Science Synthesis

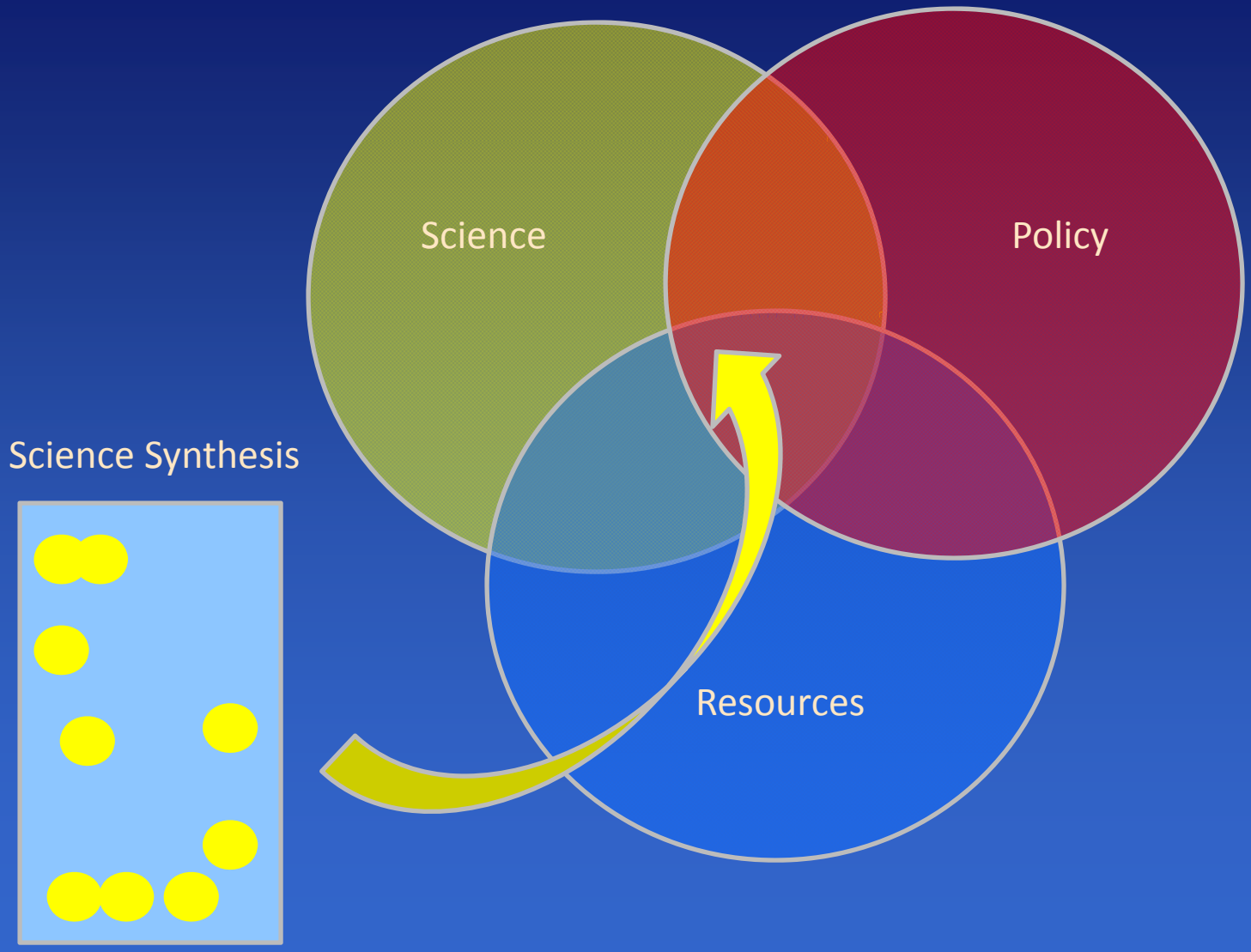


Program Management

Program Management



Program Management



Linking Science and Management

- Observation: because of the complex nature of subtropical systems and substantial alterations, the response of these systems are difficult to predict with high levels of certainty
- Hypothesis: carefully defined systems that link science and management are necessary to help reduce uncertainty
- Prediction: over time system-wide ecological indicators, and other tools, can help reduce current levels of scientific uncertainly and improve our confidence in the correctness of restoration plans

Systems for Integrating Science Synthesis are Evolving

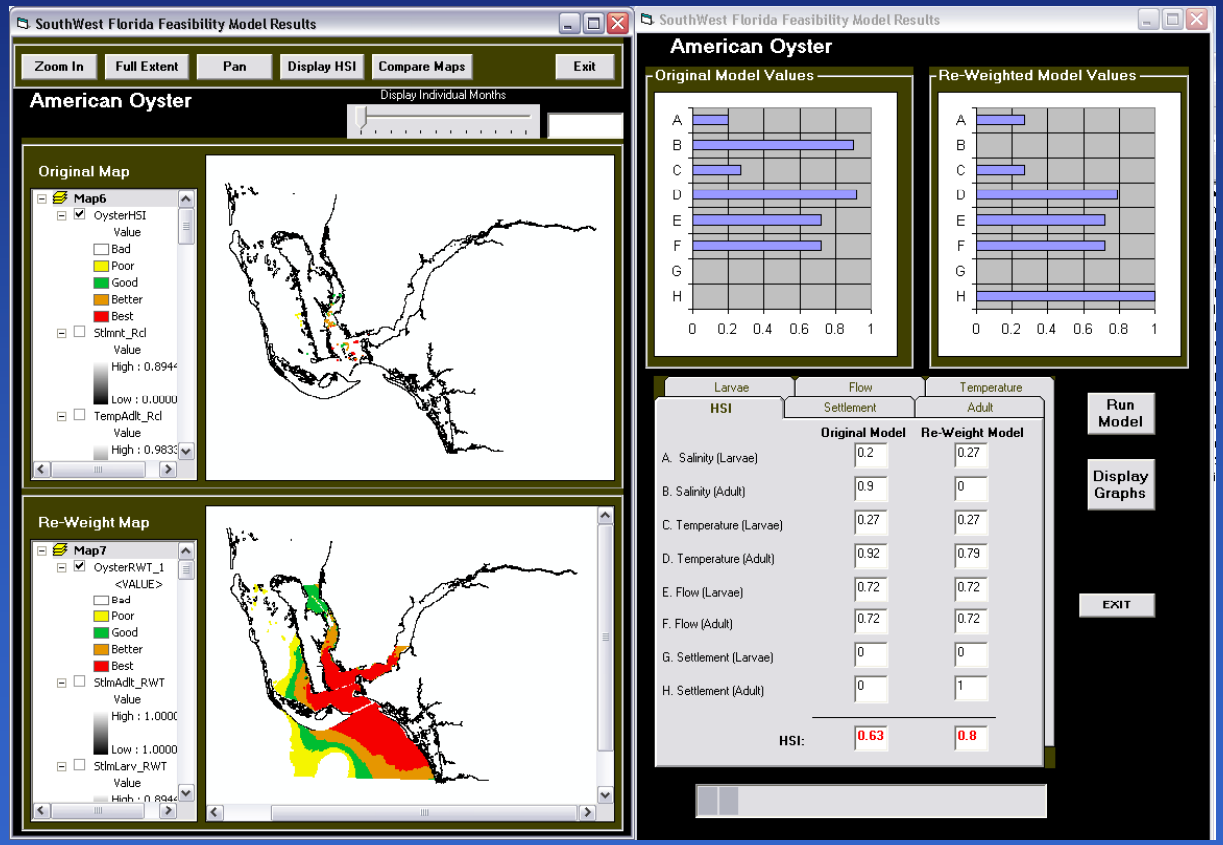
- Scales
  - Project Planning
    - Oyster HSI metric – predict suitable oyster habitat based on different flow/salinity scenarios from various management actions
  - System-wide Planning
    - System-wide Ecological Indicators – provide current status, directionality, responses to the suite of restoration projects and system operational changes

Oyster HSI

Application of MAP as it relates to project planning and implementation

Oyster Performance Measure

HSI to predict suitable Oyster Habitat based on differing flow/salinity scenarios that will occur as an outcome of implementation



Linkage of oyster HSI metrics to management actions

Stressor metric	Target	Management Action OPTION 1	Management Action OPTION 2	Management Action OPTION 3
Salinity	Salinity range of 10-25 ppt	Change operations to meet flows		
Recruitment	Presence Absence adults and larvae	Stock larvae	Stock adults	Operations to avoid too much or too little flow in key months
Substrate	Acres of Suitable habitat	Add oyster shell cultch	Try different substrate e.g., concrete	Dredge muck

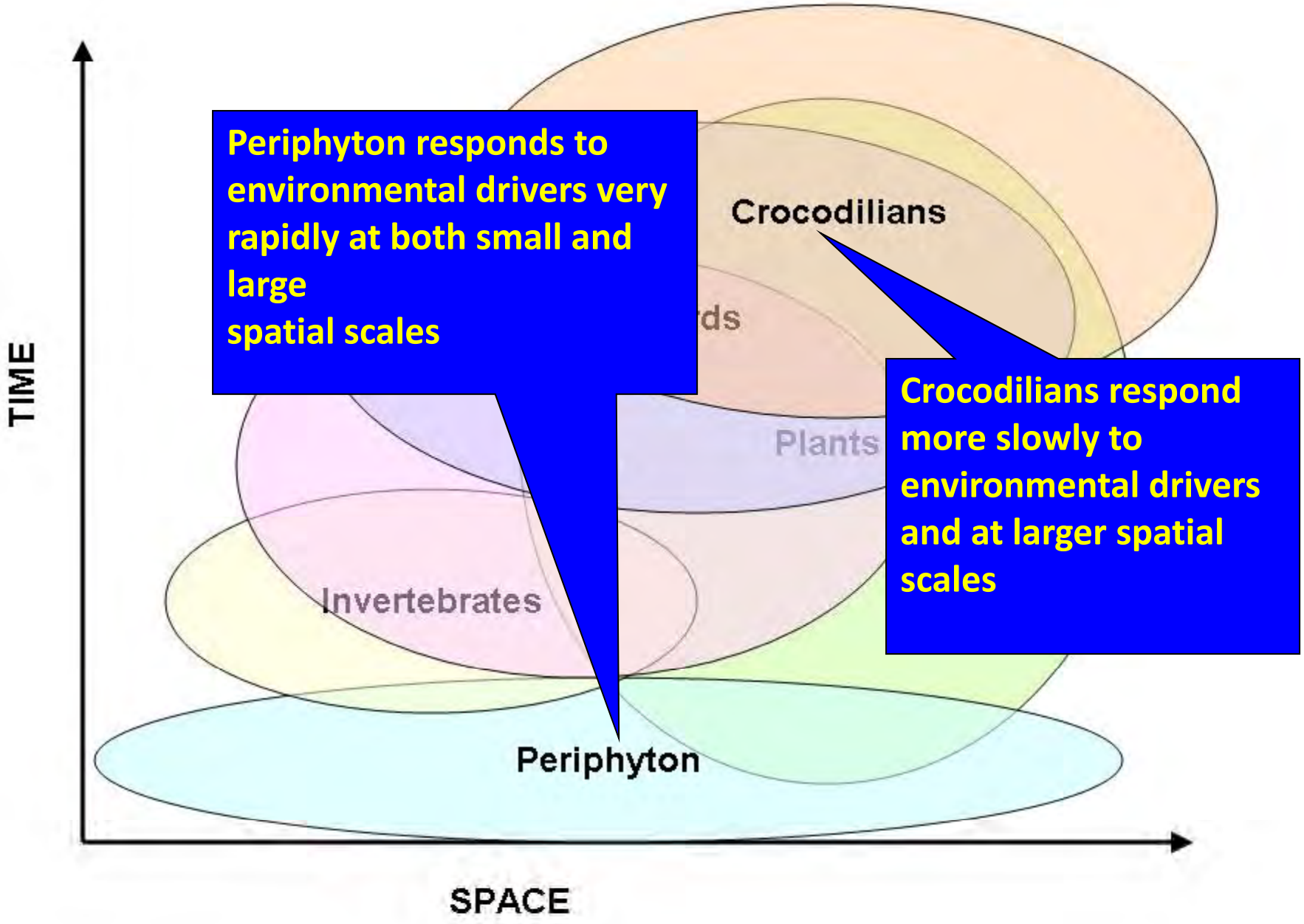
Linkage of oyster HSI metrics to management actions

Stressor metric	Target	Management Action OPTION 1	Management Action OPTION 2	Management Action OPTION 3
Oyster reef development	Presence / absence of 1 m2 reefs	Add additional cultch		
Juvenile growth and mortality	Attain natural levels of growth and mortality	Adjust operations to eliminate or minimize events	Adjust flows to attain salinities similar to creeks where oyster growth is optimal	Excessive predation may require salinity adjustments through operations
Disease	Elimination	Operate flows to maintain salinity below maximum threshold	Lower salinity threshold and adjust operations	

System-wide Ecological Indicators

Application at the system-wide planning level

“System-wide” (a spatial and temporal context)

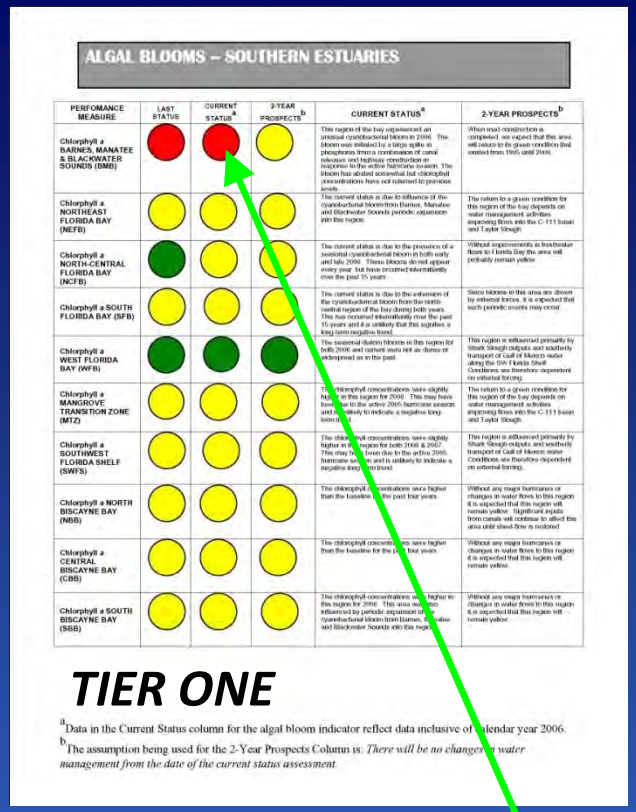


Science Report

provides direct and transparent links from the data to the stoplights

GOAL IS TO:

- **Develop Stoplights that are empirically based**
- **Develop <u>performance measures</u> that are dynamic & reflect natural variation**
- **Distinguish between natural and management effects on <u>targets</u> where possible**



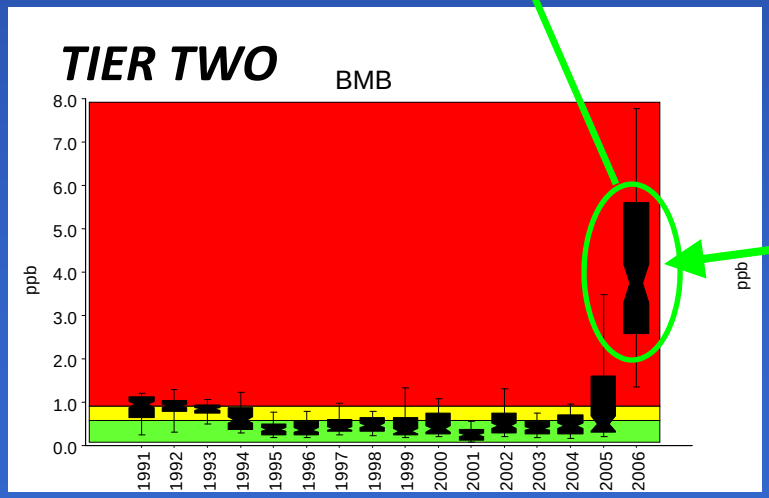
ALGAL BLOOMS – SOUTHERN ESTUARIES

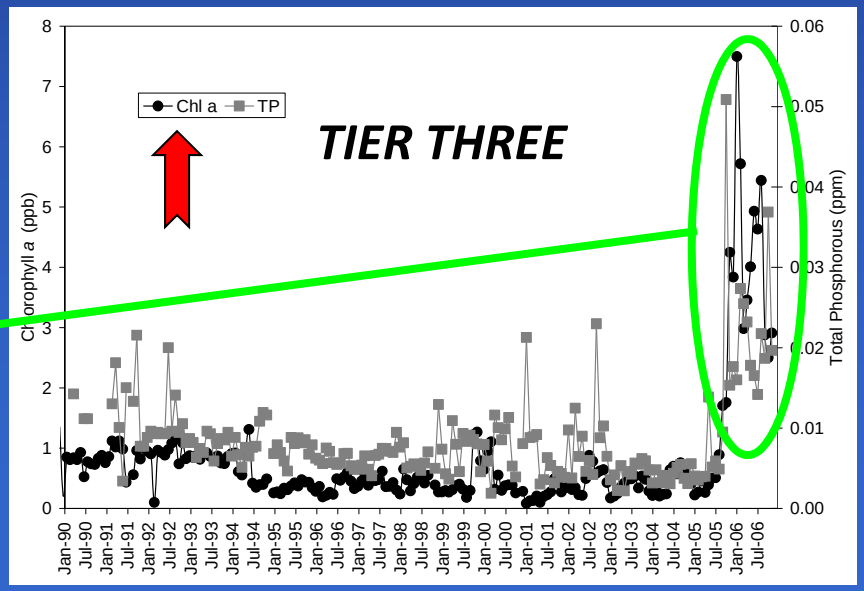
PERFOMANCE MEASURE	LAST STATUS	CURRENT STATUS[a]	2-YEAR PROSPECTS[b]	CURRENT STATUS[a]	2-YEAR PROSPECTS[b]
Chlorphyll a BARNES, MANATEE & BLACKWATER SOUNDS (BMB)	Red	Red	Yellow	This region of the bay experienced an unusual cyanobacterial bloom in 2006. The bloom was initiated by a large spike in phosphorus from a combination of canal releases and highway construction in response to the active hurricane season. The bloom has abated somewhat but chlorophyll concentrations have not returned to previous levels.	When road construction is completed, we expect that this area will return to its green condition that existed from 1995 until 2006.
Chlorphyll a NORTHEAST FLORIDA BAY (NEFB)	Yellow	Yellow	Yellow	The current status is due to influence of the cyanobacterial bloom from Barnes, Manatee and Blackwater Sounds periodic expansion into this region.	The return to a green condition for this region of the bay depends on water management activities improving flows into the C-111 basin and Taylor Slough.
Chlorphyll a NORTH-CENTRAL FLORIDA BAY (NCFB)	Green	Yellow	Yellow	The current status is due to the presence of a seasonal cyanobacterial bloom in both early and late 2006. These blooms do not appear every year, but have occurred intermittently over the past 15 years.	Without improvements in freshwater flows to Florida Bay the area will probably remain yellow.
Chlorphyll a SOUTH FLORIDA BAY (SFB)	Yellow	Yellow	Yellow	The current status is due to the extension of the cyanobacterial bloom from the north-central region of the bay during both years. This has occurred intermittently over the past 15 years and it is unlikely that this signifies a long term negative trend.	Since blooms in this area are driven by external forces, it is expected that such periodic events may occur.
Chlorphyll a WEST FLORIDA BAY (WFB)	Green	Green	Green	The seasonal diatom blooms in this region for both 2006 and current years did as dense or widespread as in the past.	This region is influenced primarily by Shark Slough outputs and southerly transport of Gulf of Mexico water along the SW Florida Shelf. Conditions are therefore dependent on external forcing.
Chlorphyll a MANGROVE TRANSITION ZONE (MTZ)	Yellow	Yellow	Yellow	The chlorophyll concentrations were slightly higher in this region for 2006. This may have been due to the active 2005 hurricane season and is unlikely to indicate a negative long-term trend.	The return to a green condition for this region of the bay depends on water management activities improving flows into the C-111 basin and Taylor Slough.
Chlorphyll a SOUTHWEST FLORIDA SHELF (SWFS)	Yellow	Yellow	Yellow	The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. This may have been due to the active 2005 hurricane season and is unlikely to indicate a negative long-term trend.	This region is influenced primarily by Shark Slough outputs and southerly transport of Gulf of Mexico water. Conditions are therefore dependent on external forcing.
Chlorphyll a NORTH BISCAYNE BAY (NBB)	Yellow	Yellow	Yellow	The chlorophyll concentrations were higher than the baseline for the past four years.	Without any major hurricanes or changes in water flows to this region it is expected that this region will remain yellow. Significant inputs from canals will continue to affect this area until sheet-flow is restored.
Chlorphyll a CENTRAL BISCAYNE BAY (CBB)	Yellow	Yellow	Yellow	The chlorophyll concentrations were higher than the baseline for the past four years.	Without any major hurricanes or changes in water flows to this region it is expected that this region will remain yellow.
Chlorphyll a SOUTH BISCAYNE BAY (SBB)	Yellow	Yellow	Yellow	The chlorophyll concentrations were higher in this region for 2006. This area may also be influenced by periodic expansion of the cyanobacterial bloom from Barnes, Manatee and Blackwater Sounds into this region.	Without any major hurricanes or changes in water flows to this region it is expected that this region will remain yellow.

TIER ONE

[a] Data in the Current Status column for the algal bloom indicator reflect data inclusive of calendar year 2006.

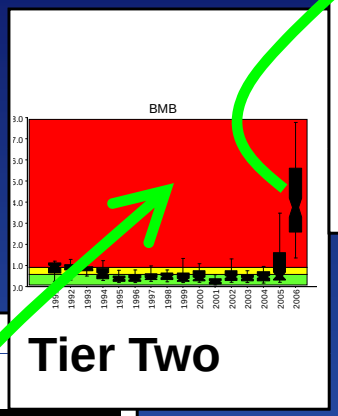
[b] The assumption being used for the 2-Year Prospects Column is: *There will be no changes in water management from the date of the current status assessment.*



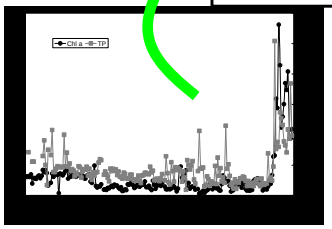


Science Report

Tier One



Tier Two

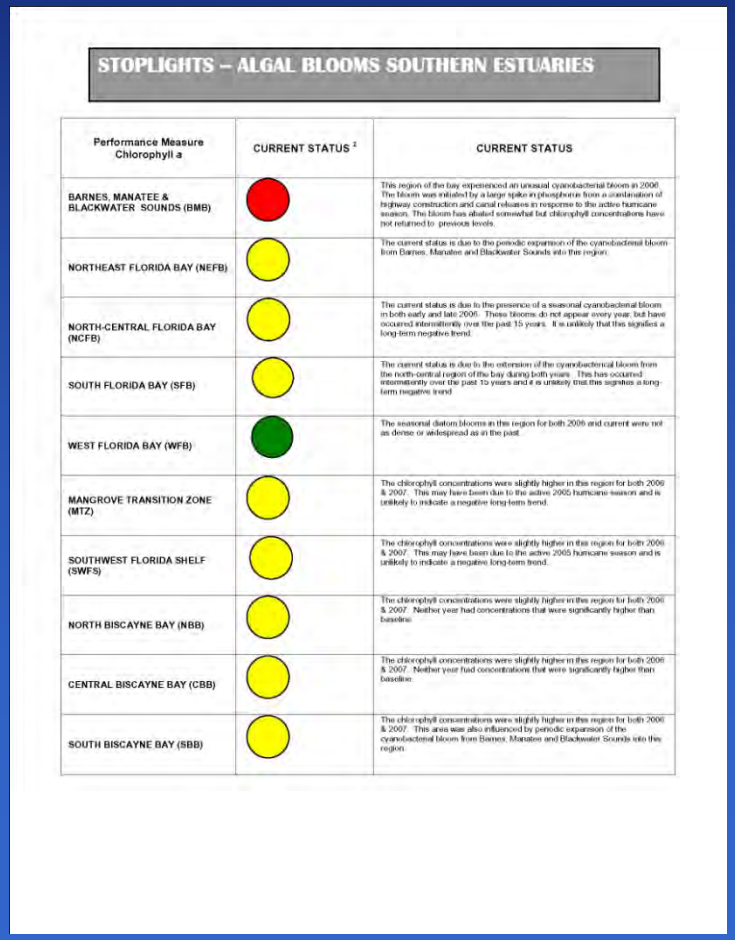


Tier Three

Linking data to the Stoplights

Tier 1. Stoplight Reports
Tier 2. Summary graphics and data charts
Tier 3. Detailed data, theory, and analyses

Task Force Biennial Report



STOPLIGHTS – ALGAL BLOOMS SOUTHERN ESTUARIES

Performance Measure Chlorophyll a	CURRENT STATUS [1]	CURRENT STATUS
BARNES, MANATEE & BLACKWATER SOUNDS (BMB)		This region of the bay experienced an unusual cyanobacterial bloom in 2006. The bloom was initiated by a large spike in phosphorus from a combination of highway construction and canal releases in response to the active hurricane season. The bloom has abated somewhat but chlorophyll concentrations have not returned to previous levels.
NORTHEAST FLORIDA BAY (NEFB)		The current status is due to the periodic expansion of the cyanobacterial bloom from Barnes, Manatee and Blackwater Sounds into the region.
NORTH-CENTRAL FLORIDA BAY (NCFB)		The current status is due to the presence of a seasonal cyanobacterial bloom in both early and late 2006. These blooms do not appear every year, but have occurred intermittently over the past 15 years. It is unlikely that this signifies a long-term negative trend.
SOUTH FLORIDA BAY (SFB)		The current status is due to the extension of the cyanobacterial bloom from the north-central region of the bay during both years. This has occurred intermittently over the past 15 years and it is unlikely that this signifies a long-term negative trend
WEST FLORIDA BAY (WFB)		The seasonal diatom blooms in this region for both 2006 and current were not as dense or widespread as in the past.
MANGROVE TRANSITION ZONE (MTZ)		The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. This may have been due to the active 2005 hurricane season and is unlikely to indicate a negative long-term trend.
SOUTHWEST FLORIDA SHELF (SWFS)		The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. This may have been due to the active 2005 hurricane season and is unlikely to indicate a negative long-term trend.
NORTH BISCAYNE BAY (NBB)		The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. Neither year had concentrations that were significantly higher than baseline.
CENTRAL BISCAYNE BAY (CBB)		The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. Neither year had concentrations that were significantly higher than baseline.
SOUTH BISCAYNE BAY (SBB)		The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. This area was also influenced by periodic expansion of the cyanobacterial bloom from Barnes, Manatee and Blackwater Sounds into this region.

Summary

- A focused effort to produce science synthesis that is useful to managers is the key to being able to link science with program management at various scales.
- System-wide ecological indicators are a means of accomplishing this at the ecosystem scale
- Presently system-wide ecological indicators and the stop light assessments provide a means of:
  - linking science and management
  - communicating complex scientific concepts and information in a way that is useful for policy makers
  - the current status of the ecosystem
- Over time system-wide ecological indicators and the stop light assessments will provide directionality in response to the suite of restoration projects and system operational changes