Ecosystem Management

General Goals

"Ecosystem management integrates scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting native ecosystem integrity over the long term." (The greatest good, for the greatest number, for the longest time?)

- Overall, ecosystem management has many of the same features and criticisms of collaborative policy.
- Other labels include watershed management, adaptive management, sustainable development, integrated resource planning

Subgoals

- Viable populations of native species
- Represent ecosystem types
- Manage over long enough period of time to maintain evolutionary potential
- Allow for human use and occupancy (which generally means multistakeholder negotiations)

Dominant Themes

- Hierarchical context: Cannot work on just one level (e.g., species, population, landscape)
- Ecological boundaries: Management must span administrative units
- Ecological integrity: Native species and ecological processes for biodiversity (including natural disturbance regimes)
- Data collection: Habitat and species inventories; baseline characterizations
- Monitoring: Using data to track changes in key indicators over time.
- Adaptive Management: Decisions must allow learning from mistakes
- Interagency cooperation: Ecological boundaries requires integrating goals and procedures
- Organizational change: Land management agencies need to change procedures and norms
- Humans embedded in nature: Humans have a fundamental influence on ecological processes
- Values: Human values and resolving value conflict is a central task

Science and Water Policy

Science and Ecosystem Management

- Ecosystem management built on scientific recommendations
- Science clarifies policy choices
- Science can reduce conflict—but not always
- National Research Council as conflict mediator

Problems with Science

- Conflicts not always scientific; value differences
- Value differences disguised with scientific terminology
- Scientific uncertainty generally aggravates conflict
- Scientific uncertainty doesn’t fit with politics (error terms vs. point estimates)
- Science is often long-term; politics short

When does Science Work(Debatable!)?

- Simple, sound, and peer-reviewed science
- Complex interests/environments and scientific uncertainly hurt
- Open discussion of values and goals
- Science should identify the effects of various proposals, not try to choose one

Chesapeake Bay Watershed

Watershed Characterization

Structure

- Largest estuary in US at 64,000 square miles, six states
- The claim it is the most biologically diverse estuary in the US (I've heard that claim many times now!)
- Watershed encompasses six states
- Very high land-water ratio; land-use decisions have huge impact
- Between 1980-1990, 11% increase in population and 17% increase in households
- At same time, average lot size expands from .42 to .57 acres; in MD, 22% increase in population has 47% increase in developed acres

Problems

- Overharvesting in fisheries; blocked migration routes for anadromous fish (shad, stripers, blue crabs)
- Point and non-point source pollution
- Urbanization and habitat destruction
- Disappearance of submerged aquatic vegetation (by 1978—41,000 acres, down from 600,000 historically)
- Toxic pollution

Chesapeake Bay Commission

Overview

- Founded in 1980; EPA study as catalyst
- Three states as member: PA, MD, VA
- Legislative advisory commission; recommends legislative action to member states for protecting Chesapeake Bay
- Serves as state-level liaison (I.e., lobbyist) to U.S. Congress and Fed gov’t
- Composed of seven-member delegations from each of the three states
- Delegations are 5 elected legislators, Governor (usually represented by Secretary of Natural Resources), and one citizen

Activity Examples (implemented through state legislation)

- 1984: Ban use of phosphate detergents in all three states
- 1985: 5-year moratorium of on taking striped bass (major population rebound)
- Pushing through state land-use laws that protect Bay resources
- 1994: Legislation in PA to requires certain animal operations to implement nutrient BMP
- Creation of Bi-State Blue Crab Advisory Committee to make fishery recommendations (e.g., 15% reduction in fishing efforts starting 2001, establishment of target harvest levels; disbanded in 2003)

Chesapeake Bay Program

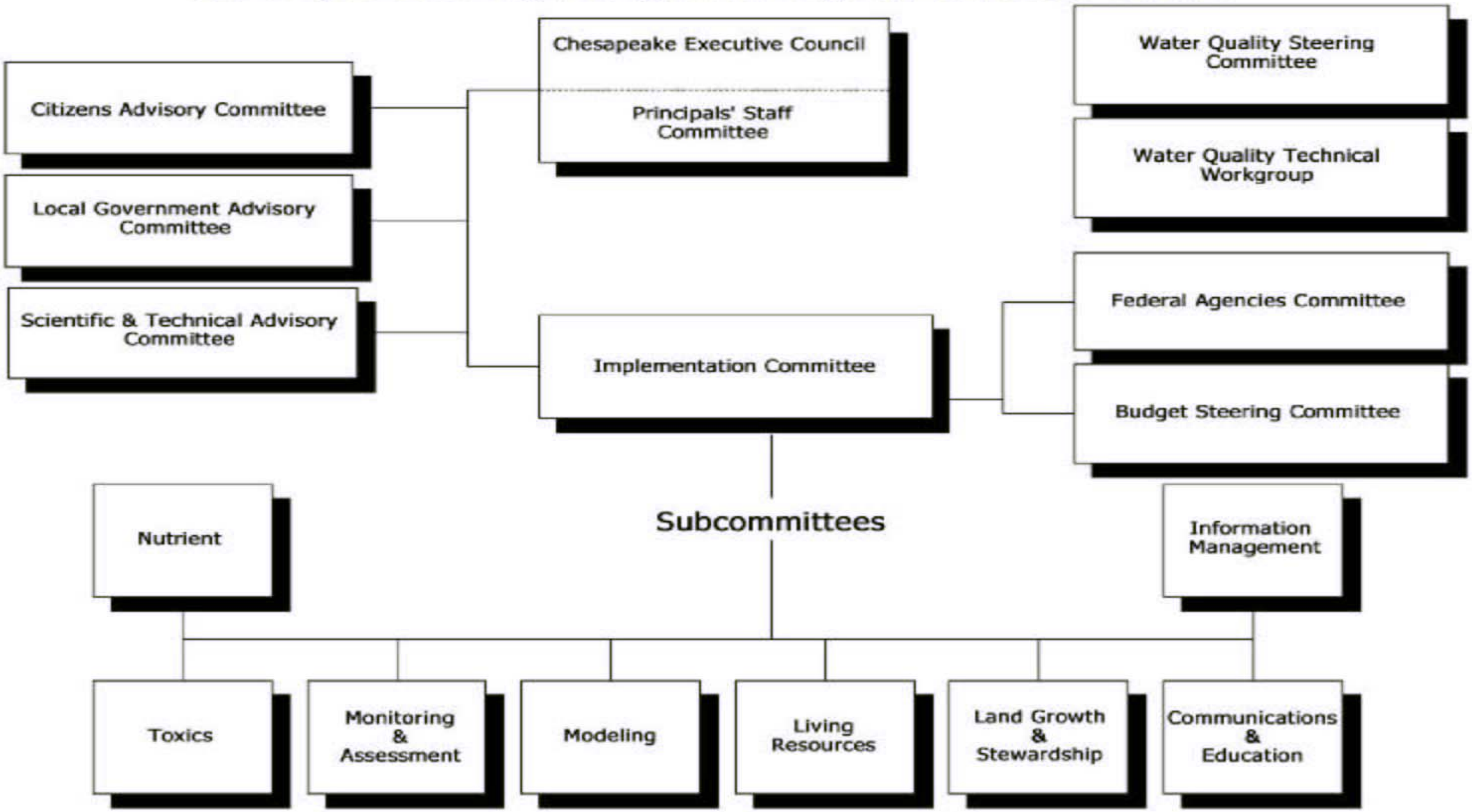
Structure

- Built on interstate Chesapeake Bay Commission
- Chesapeake Bay Agreement of 1983(1987, 1992, and 2000 amendments)
- Sets goals, objectives, and commitments for Bay restoration
- Partners include EPA, Chesapeake Bay Commission, state governors, other agencies, academic institutions, interest groups
- Chesapeake Bay Executive Council oversees partnership
- Also includes Implementation Committee, Local Government Committee, and Citizens Advisory Committee
- Chesapeake Bay Monitoring Program collects and analyzes environmental data

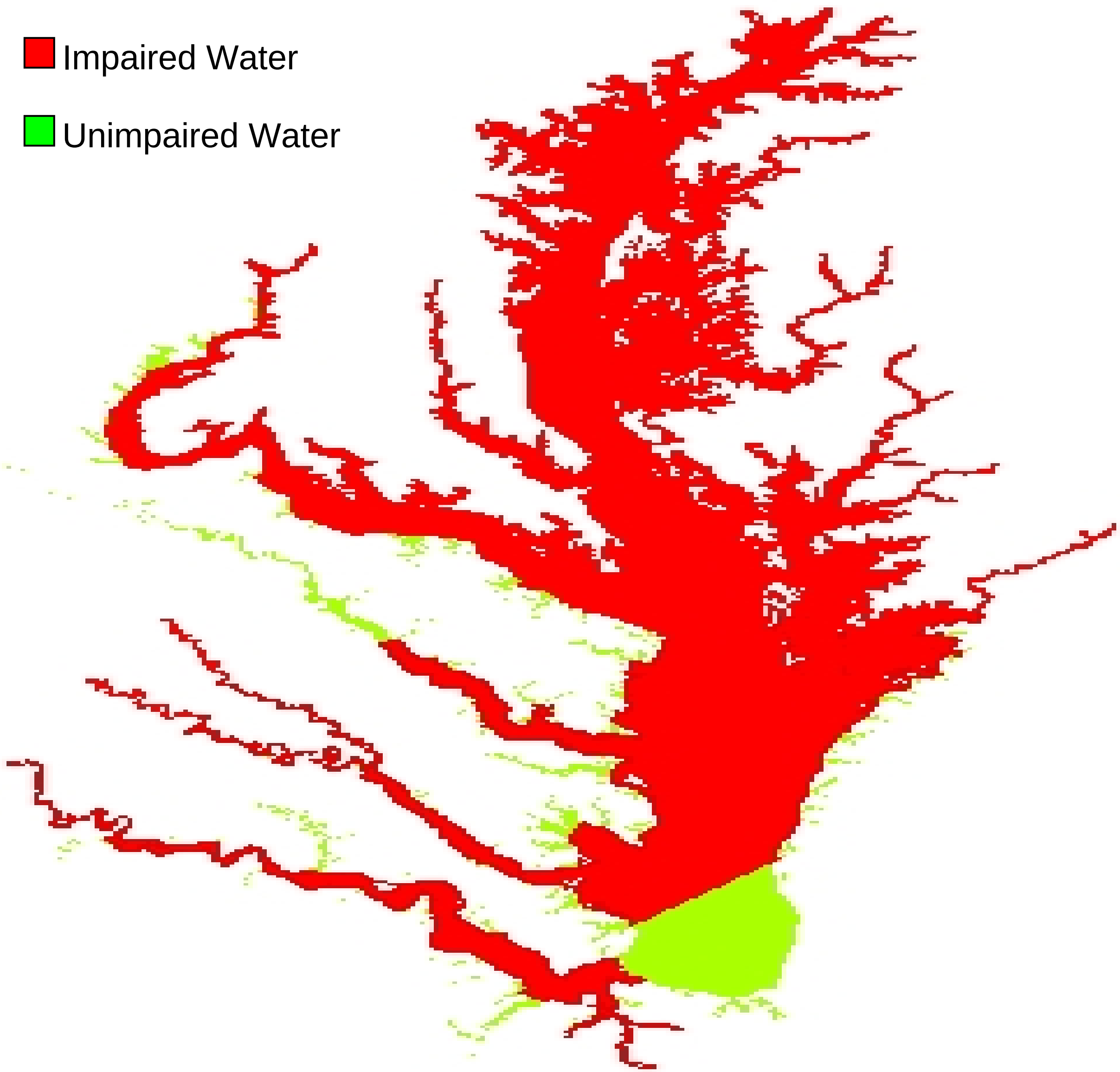
Primary Goals

- Living resource protection and restoration
- Vital habitat protection and restoration
- Water quality protection and restoration
- Sound land use
- Stewardship and community engagement

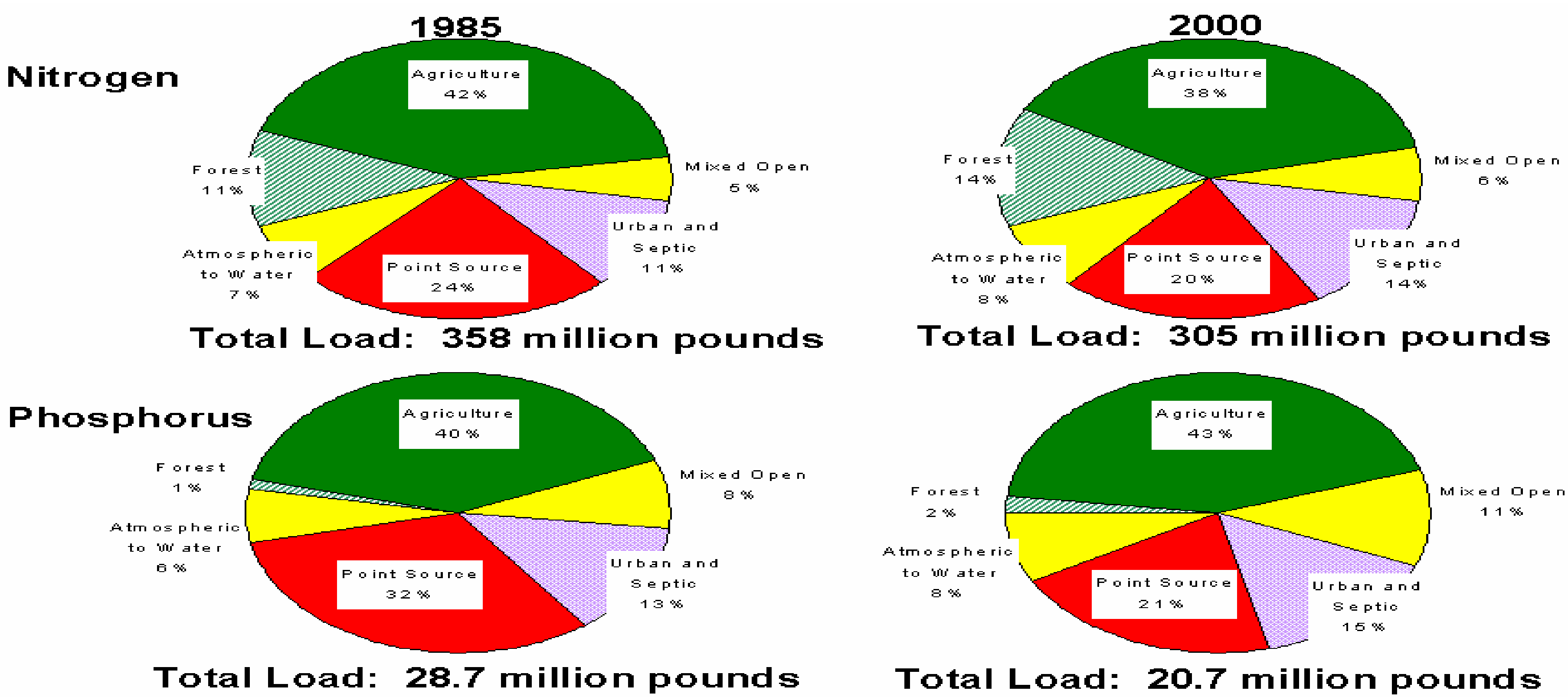
Chesapeake Bay Program Organizational Chart



Chesapeake Bay and Tidal Tributary
Nutrient and/or Sediment Impaired Waterbodies



Chesapeake Bay Nutrient Sources



Don't forget atmospheric deposition: 8% of total nitrogen deposited in water; 24% of total nitrogen deposited on land

Who should be targeted for atmospheric deposition?

Water Quality Efforts

- Chesapeake 2000 identifies improving water quality as most important component
- Goal is by 2010 to remove bay from 303(d) impaired list (will avoid formal TMDL development in 2011)
- Nutrient reduction goal: 40% reduction from 1985 baseline
- Development of common water quality standards for dissolved oxygen, chlorophyll *a*, and clarity
- Integration with TMDL and state water quality standards
- Tributary strategy focuses on allocating nutrient and sediment “caps” to nine major and 37 sub-basins
- Estimated costs: $28 billion in capital costs; $2.7 billion annually
- Is it working? Chesapeake Trends

Tributary Strategies are Written for these Basins

The new nutrient reduction goals, or allocations, call for Bay watershed states to reduce the amount of nitrogen from the current 285 million pounds to no more than 175 million pounds per year, and phosphorus from 19.1 million pounds to no more than 12.8 million pounds per year. When coordinated nutrient reduction efforts began in 1985, 338 million pounds of nitrogen and 27.1 million pounds of phosphorus entered the Bay annually.

The allocations for the 13 Watershed Team areas and for point source dischargers are listed on Table 2.A.

Table 2.A.

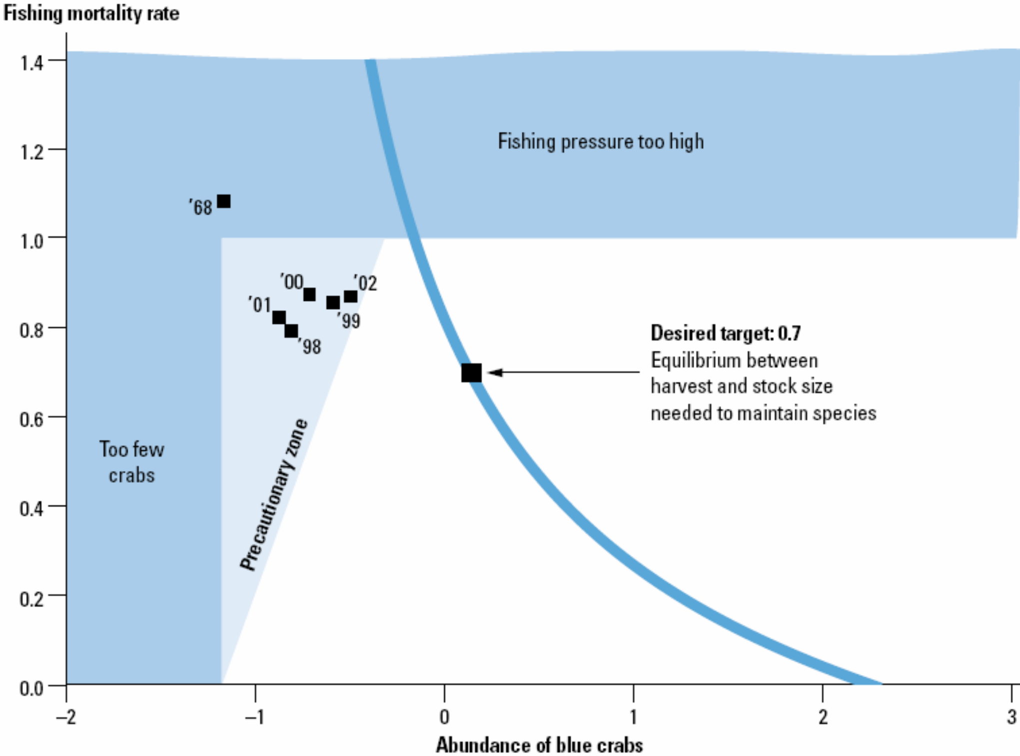
Watershed Team Area Cap Load Allocations

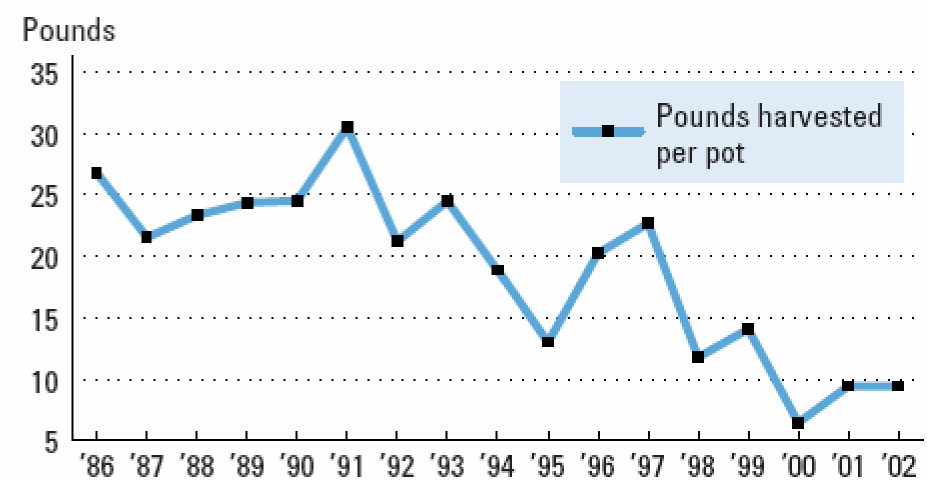
	Nitrogen	Phosphorus	Sediment
Susquehanna Basin			
Central Penn	3,851,000	96,700	29,320
Upper West Branch	4,087,000	58,500	20,230
Susquehannock	6,835,000	95,800	45,610
Lower North Branch	3,373,000	107,900	27,120
Big Bend	5,032,000	153,200	49,470
Bradford/Tioga	4,518,000	145,500	37,300
Upper Susquehanna	2,735,000	74,400	20,170
Wyoming Valley	1,813,000	43,000	12,480
Lackawanna	787,000	14,900	4,820
Lower Susquehanna East	9,259,000	367,500	104,770
Lower Susquehanna West	7,264,000	261,200	85,700
Juniata	8,522,000	235,900	84,220
Susquehanna Basin NPS Total	58,076,000	1,654,400	521,210
Point Source dischargers	7,892,000	477,100	0
Susquehanna Basin Total	65,968,000	2,131,500	521,210
Susquehanna Basin Allocation	67,874,000	2,131,500	797,850
Potomac Basin NPS	3,280,000	251,600	127,270
Potomac Basin PS	407,000	24,600	0
Potomac Basin Total	3,687,000	296,800	127,270
Potomac Basin Allocation	4,021,000	329,500	196,800
Pennsylvania Total	69,656,000	2,455,000	648,480
Pennsylvania Total Allocation	71,895,000	2,461,000	995,000

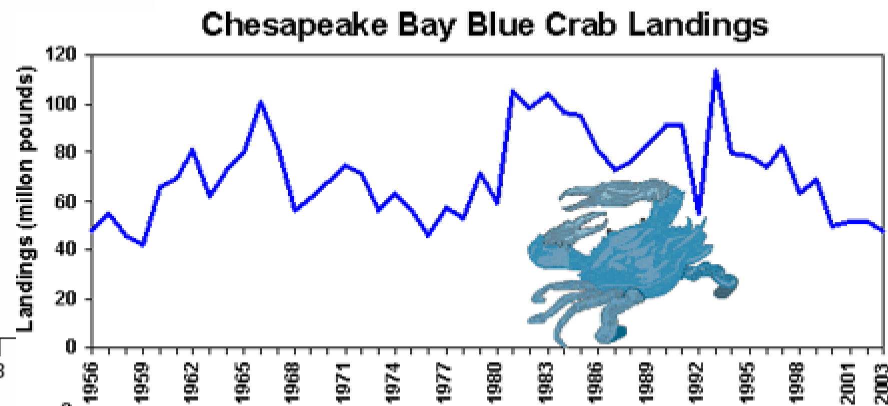
2005: PA estimates they still need to reduce Nitrogen at 37 million lbs/year; Phosphorous 1.1 million; Sediment 116,000 million tons per year!

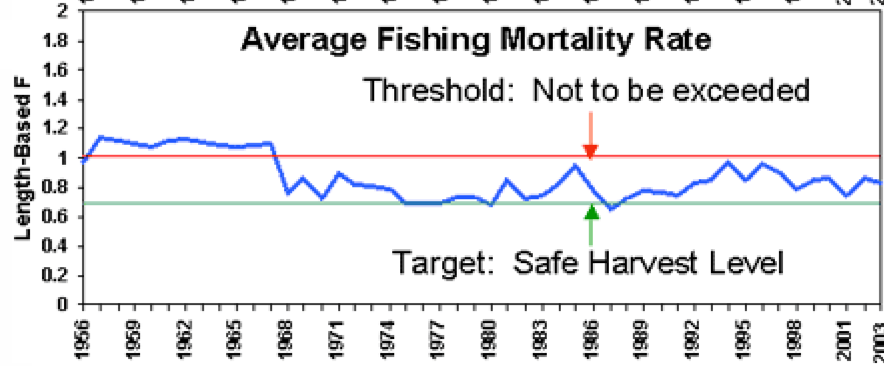
Tributary Strategies implemented by watershed teams in each sub-basin

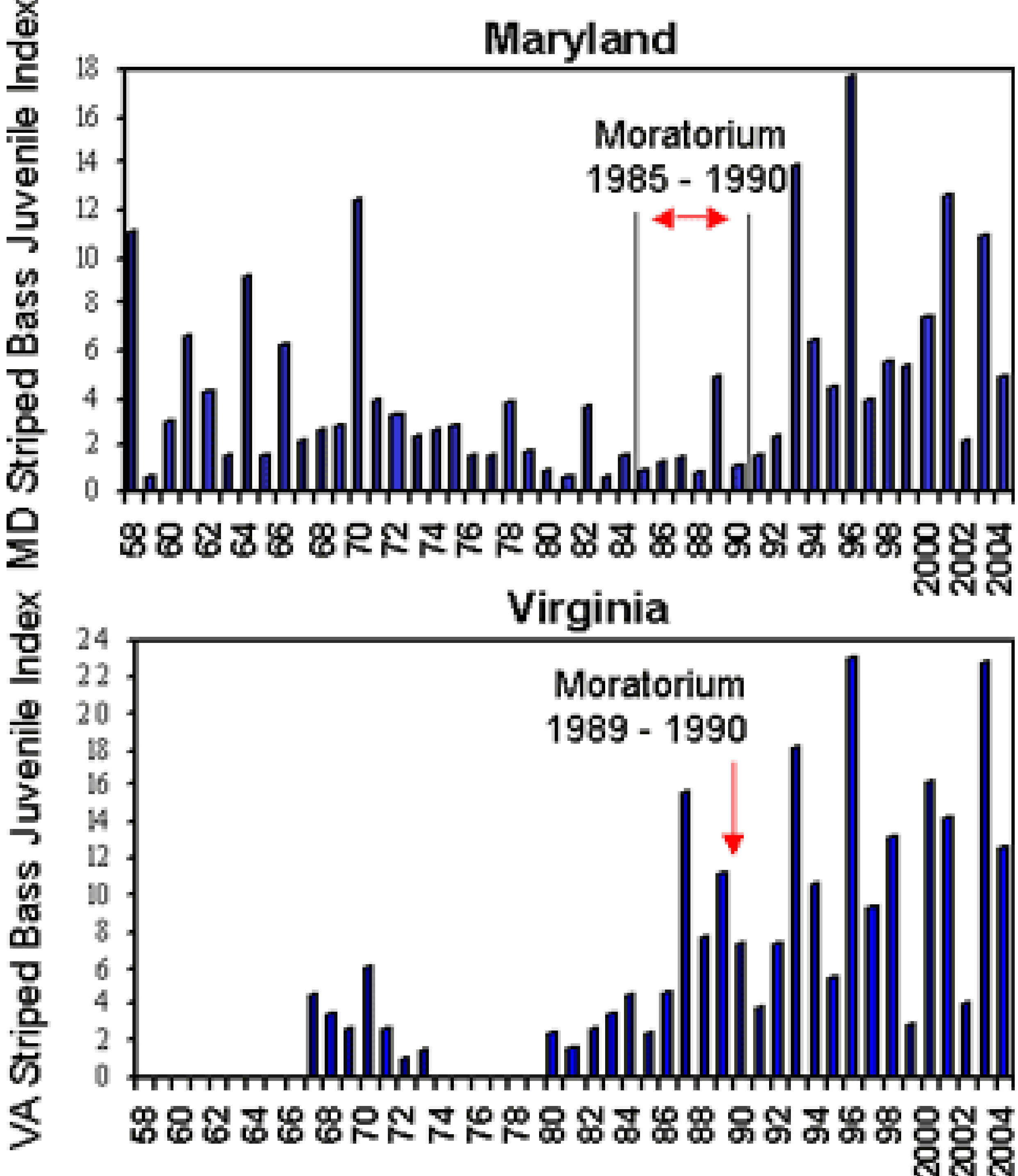
FIGURE 1
Fishing Pressure on the Blue Crab











Maryland
MD Striped Bass Juvenile Index
Moratorium
1985 - 1990
0
2
4
6
8
10
12
14
16
18
58
60
62
64
66
68
70
72
74
76
78
80
82
84
86
88
90
92
94
96
98
2000
2002
2004
Virginia
VA Striped Bass Juvenile Index
Moratorium
1989 - 1990
0
2
4
6
8
10
12
14
16
18
20
22
24

The End of Cooperation in the Chesapeake?

- July 7, 2004: Chesapeake Bay Foundation launches Litigation Project
- Litigation focuses mostly on integrating specific nitrogen reduction goals into NPDES permits

"Pollution is killing our streams, rivers and the Chesapeake Bay," said CBF President William C. Baker. "While years of sound science have provided a roadmap to restoring the Bay, the politics of postponement have produced few significant improvements in water quality or actions by state and federal governments to enforce existing laws to reduce pollution. We will continue efforts to educate and build broad public support for legislative and regulatory change. But in the final analysis, when government is unwilling or unable to enforce the law, the only recourse remaining is legal action.“ (2004 press release)

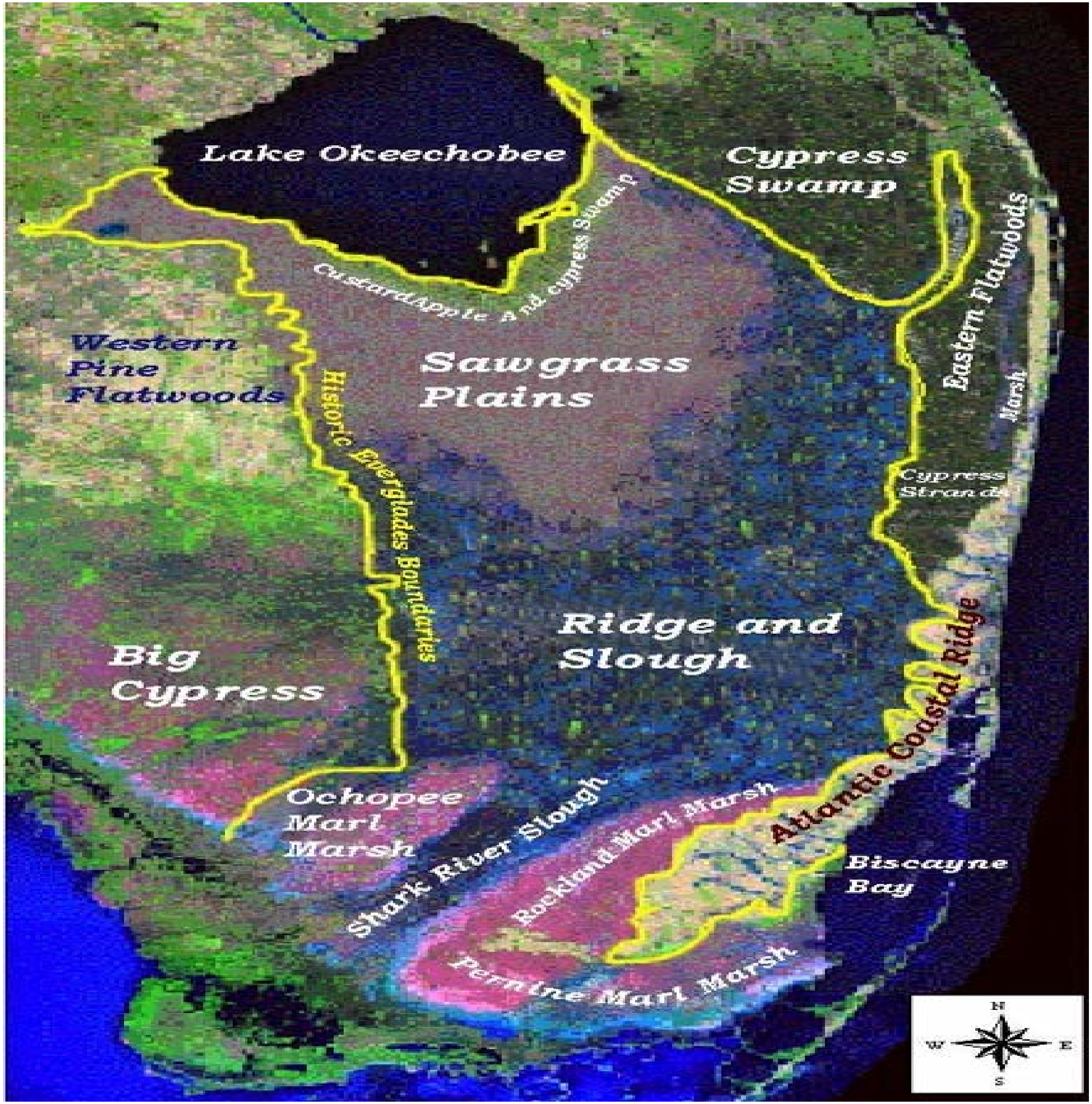
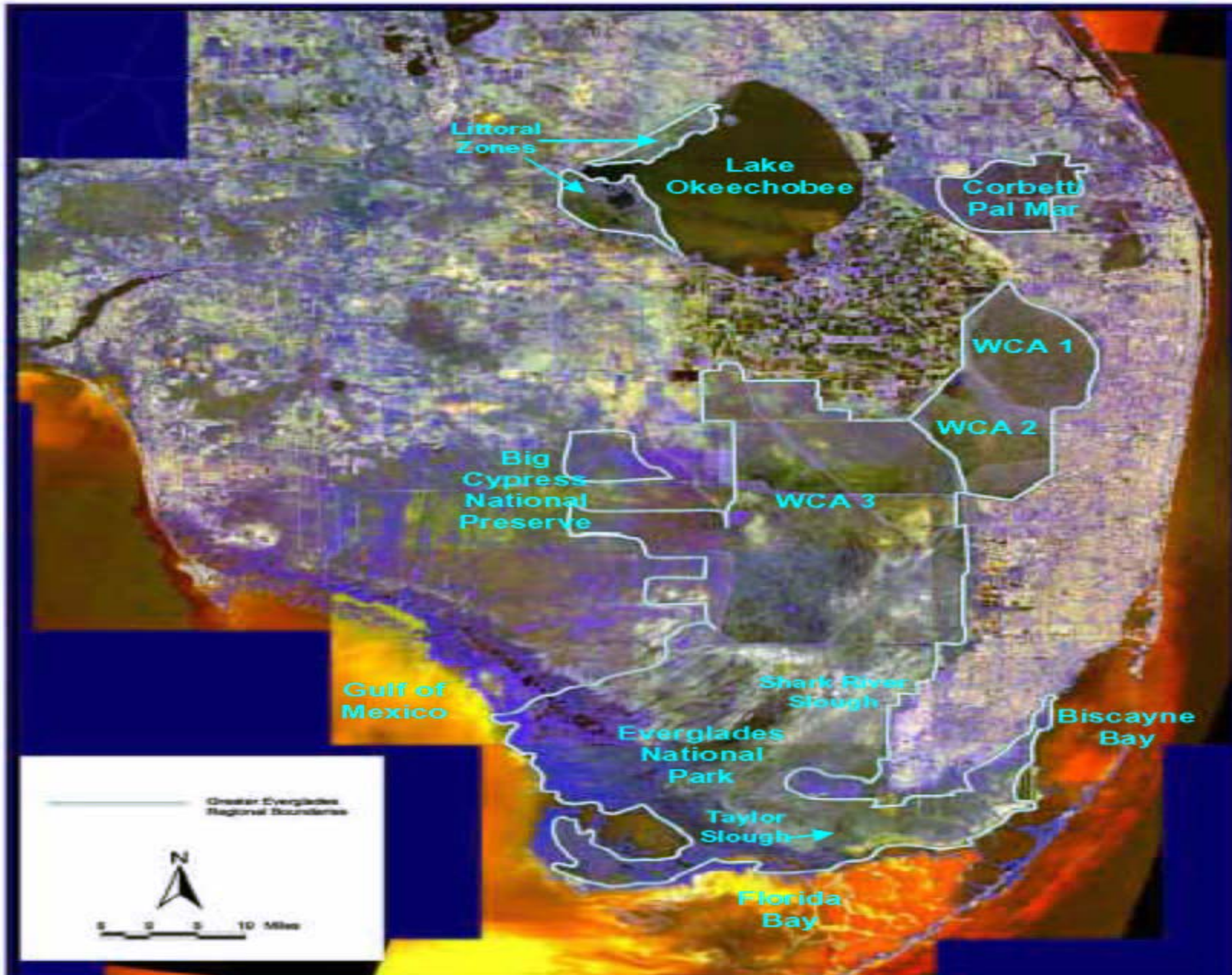

Lake Okeechobee
Cypress Swamp
CustardApple And cypress Swamp
Eastern Flatwoods
Marsh
Western Pine Flatwoods
Sawgrass Plains
Historic Everglades Boundaries
Cypress Strands
Ridge and Slough
Big Cypress
Atlantic Coastal Ridge
Ochopee Marl Marsh
Shark River Slough
Rockland Marl Marsh
Biscayne Bay
Perrine Marl Marsh
N
W
E
S

Figure 3-1: Greater Everglades Wetlands Areas Within The Influence Of CERP



Historic Everglades Ecosystem: Three Defining Features

Hydrologic regime featuring dynamic storage and sheet flow

- "River of Grass": Downward gradient of 1-2 inches per mile
- Sand, limestone aquifers, vegetation, Lake Okeechobee: natural storage system
- Result: Very slow sheet movement of water, heavily supported by groundwater
- Even in dry years, dynamic storage kept freshwater moving through system

Large spatial scale

- Everglades itself, 3 million acres historically
- Entire set of South FL wetland ecosystems, 18 million acres

Habitat/species mosaics

- Mosaics of vegetation regimes
- Naturally low nutrient (oligotrophic)
- Ridge and slough sawgrass system, tree islands, alligator holes
- Habitat mosaic, hydropatterns, and sub-tropical/temperate mixing zone produces high biodiversity and rates of endemism

Current Everglades Ecosystem

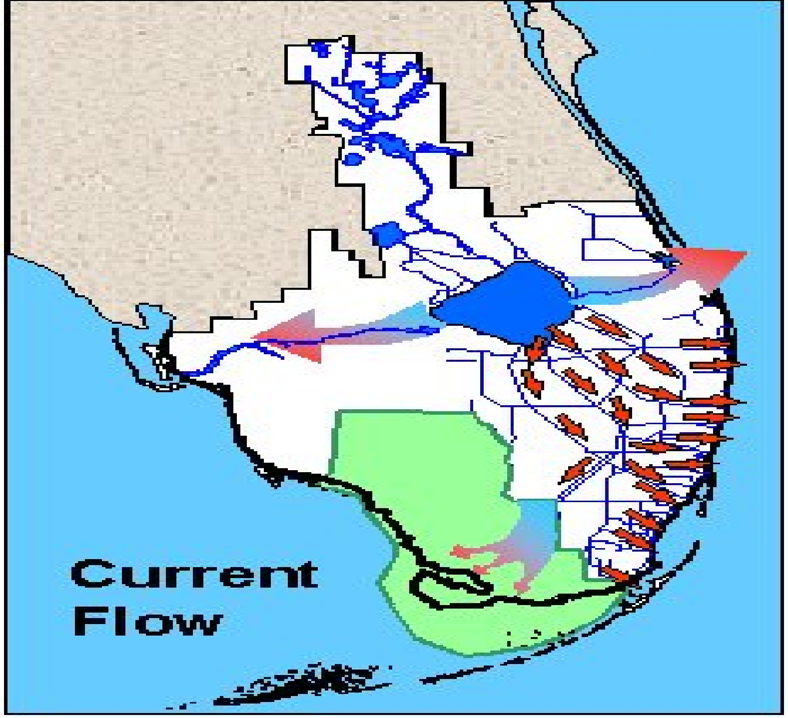
Flow Patterns

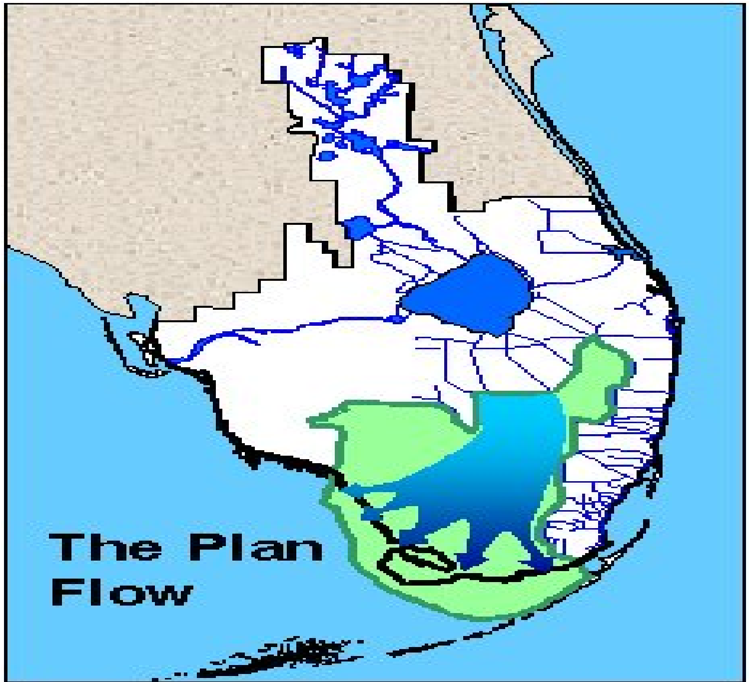
- Draining of Everglades with canals started in 1890s
- Lake Okeechobee diked by early 1900s
- 1948 Central and South Florida Project (Army Corp)
- Water control system takes out too much water; flow is lost
- Not enough freshwater to estuaries; increasing salinity
- Area of Everglades wetlands reduced 50% by draining, urban and agricultural development; 70% reduction in water flows

Habitat/Species Mosaic

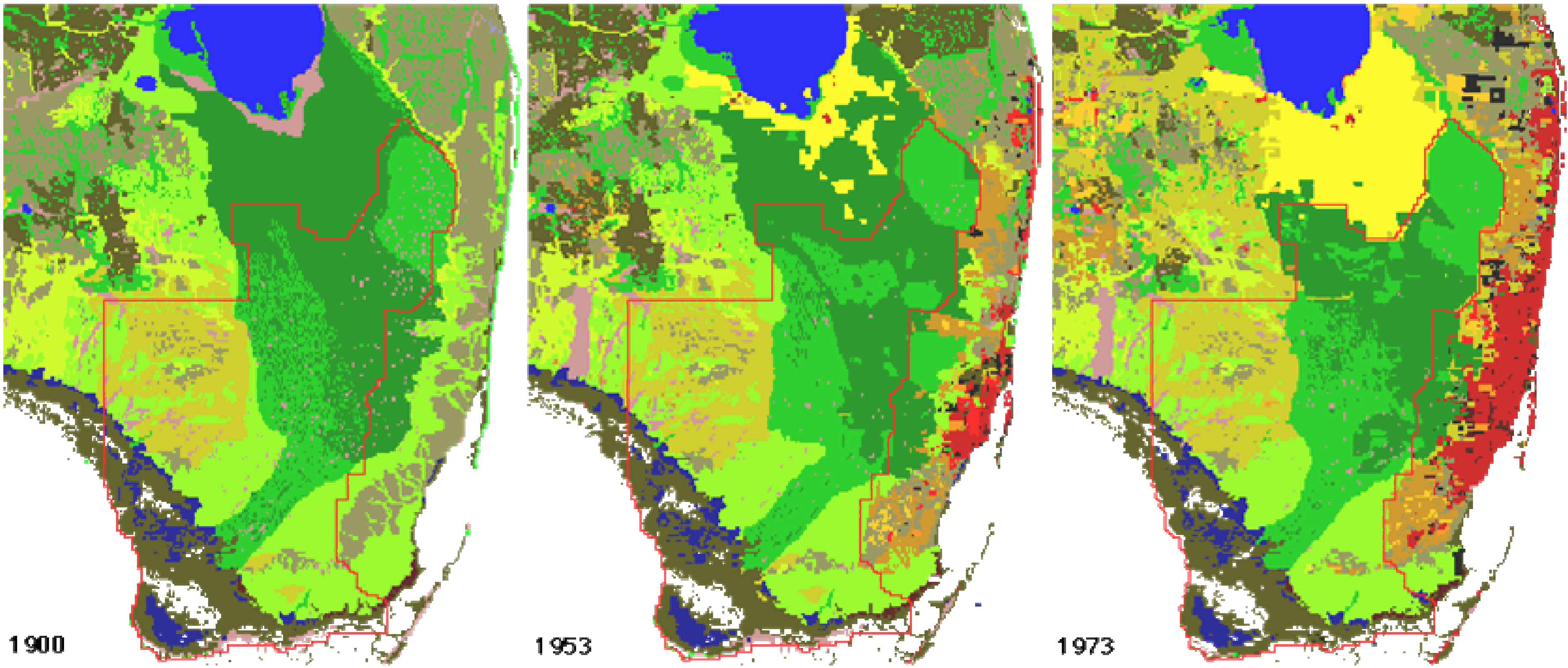
- Lost of slough and ride landscape; replaced by random sawgrass ridges; some places cattails
- Tree islands becoming smaller
- Reduction of uninterrupted flooding from 15 years to 2 years eliminates middle trophic level (small fishes)
- Increased salinity in estuaries reduces food base for wading birds; 90% decrease in wading bird population
- 69 endangered or threatened species
- Decreased water clarity and sea grasses in estuaries
- Water quality degraded; too many nutrients


Historic
Flow

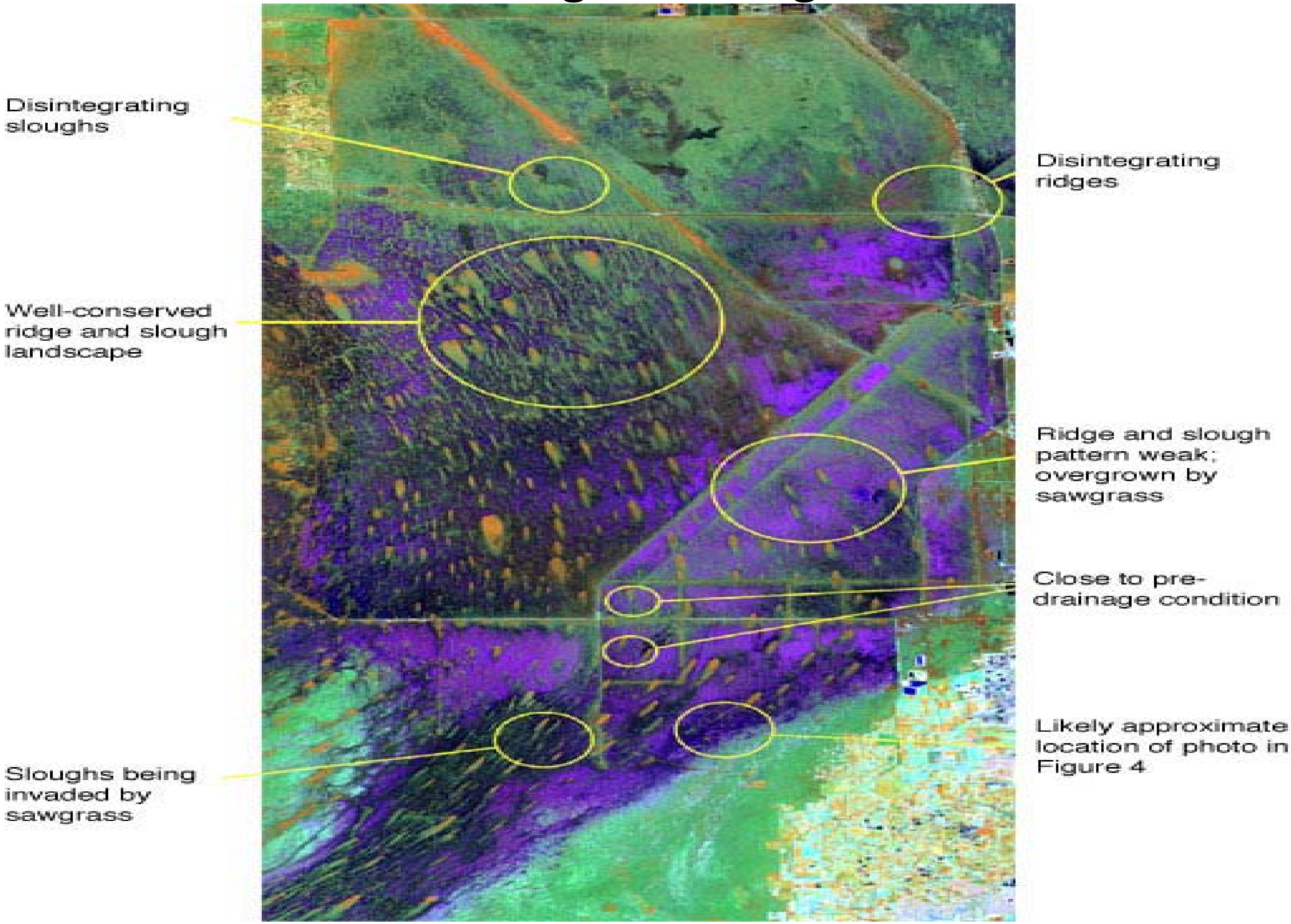

Current
Flow


The Plan
Flow

Land-Use Changes



Ecological Changes



Central and Southern Florida Project

Background

- First authorized in 1948; in the wake of two big hurricanes in 1947
- Built by the Army Corp of Engineers
- 1000 miles of canals, 720 miles of levees, almost 200 water control structures
- Owned by Army Corp; operated mostly by South Florida Water Management District under contract

Historical Purposes

- Reduce flood damages and open land for development
- Control groundwater levels for ag.
- Store excess flood water for beneficial use
- Reduce salt water intrusion in coastal well-fields
- Preserve fish and wildlife
- Enhance navigation

Major Accomplishments

- Channelize Kissimmee River
- Dikes on Lake Okeechobee
- Drain Everglades Ag. Area
- Make Water Conservation Areas for storage

U.S. vs South Florida Water Management District, 1988

- 1988: Federal government sues South Florida Water Management District and Florida Department of Environmental Regulation
- Alleges state failing to enforce water quality standards for discharges into Everglades National Park
- National Park and Loxahatchee NWF visible proponents of suit; lots of political implications (change in governor; SFWMD board appointments)
- Reached a settlement agreement requiring clean-up of agricultural discharge into Everglades
- Leads to 1994 Everglades Forever Act, which mandates BMP in Everglades Agricultural Area
- Construction of Stormwater Treatment Areas by SFWMD
- These settlement agreements involved a lot of conflict resolution and mediation; helped establish the idea of multi-stakeholder negotiations, ecosystem thinking; also showed worst-case conflict

South Florida Ecosystem Task Force

- Task Force first developed as Federal interagency working group in 1993
- Water Resources Development Act of 1996 gives Task Force statutory authority, defines duties
- Advisory role to Army Corp of Engineers development of Restudy and eventually CERP
- Supported by Governor's Commission for a Sustainable South Florida
- Governor's Commission creates a "conceptual plan" directly integrated into CERP; integration required by WRDA of 1996
- The "Working Group" does policy implementation
- Working Group consists of members from many different federal and state agencies; also Native Americans
- Main goal of Task Force is to provide a forum and support for Everglades restoration
- A collaborative process; individual agencies are not legally committed to Task Force strategic plan
- CERP is largest component; but many other state and federal agencies have projects (e.g., multi-species recovery plan by FWS; land acquisition under Florida Forever Act).

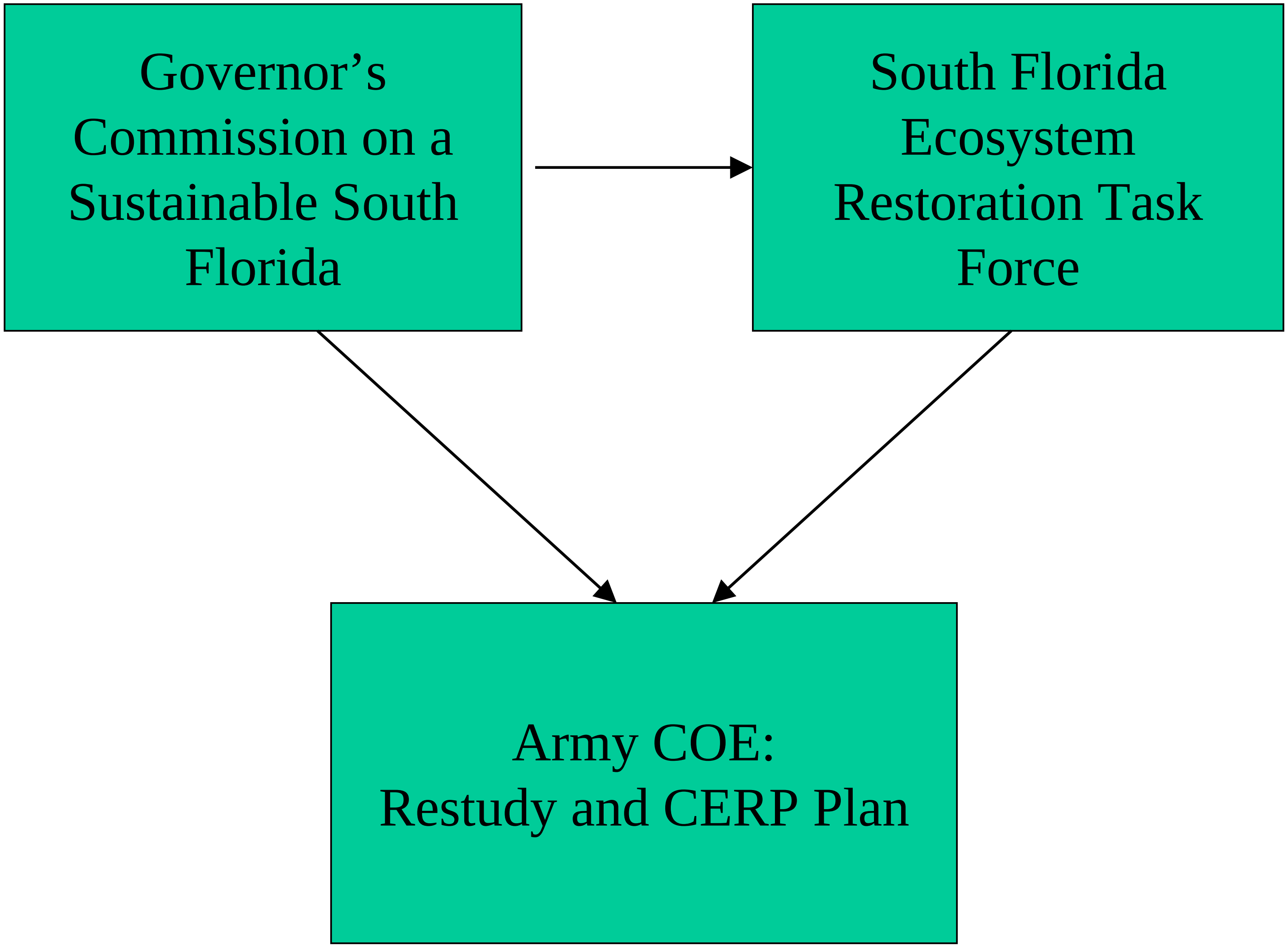
Comprehensive Everglades Restoration Plan

Background

- Water Resources Development Acts 1992: Authorizes the Army Corp to conduct a feasibility study (RESTUDY) about re-plumbing CSFP
- WRDA 1996; ACOE directed to develop restoration plain in consultation with Task Force and Commission
- WRDA 2000: CERP plan becomes law, receives Federal dollars
- CERP really focuses on all of South Florida, starting at Kissimmee river and going to Florida Bay and Ten Thousand Islands

Some Details

- Cost: $7.8 billion; $182 million in annual operating expenses
- 50% Federal/50% state cost-share
- "Getting the water right":Main goal is to restore the hydropattern in Everglades to as close to original conditions as possible
- Based on 13 broad-scale concepts (e.g., Lake Okeechobee operational plan) and over 60 specific projects
- 20-year implementation time table, with Design Agreements between Army Corp and SFWMD for construction
- RECOVER teams track implementation through development of success indicators; adaptive management


Governor's Commission on a Sustainable South Florida
South Florida Ecosystem Restoration Task Force
Army COE:
Restudy and CERP Plan

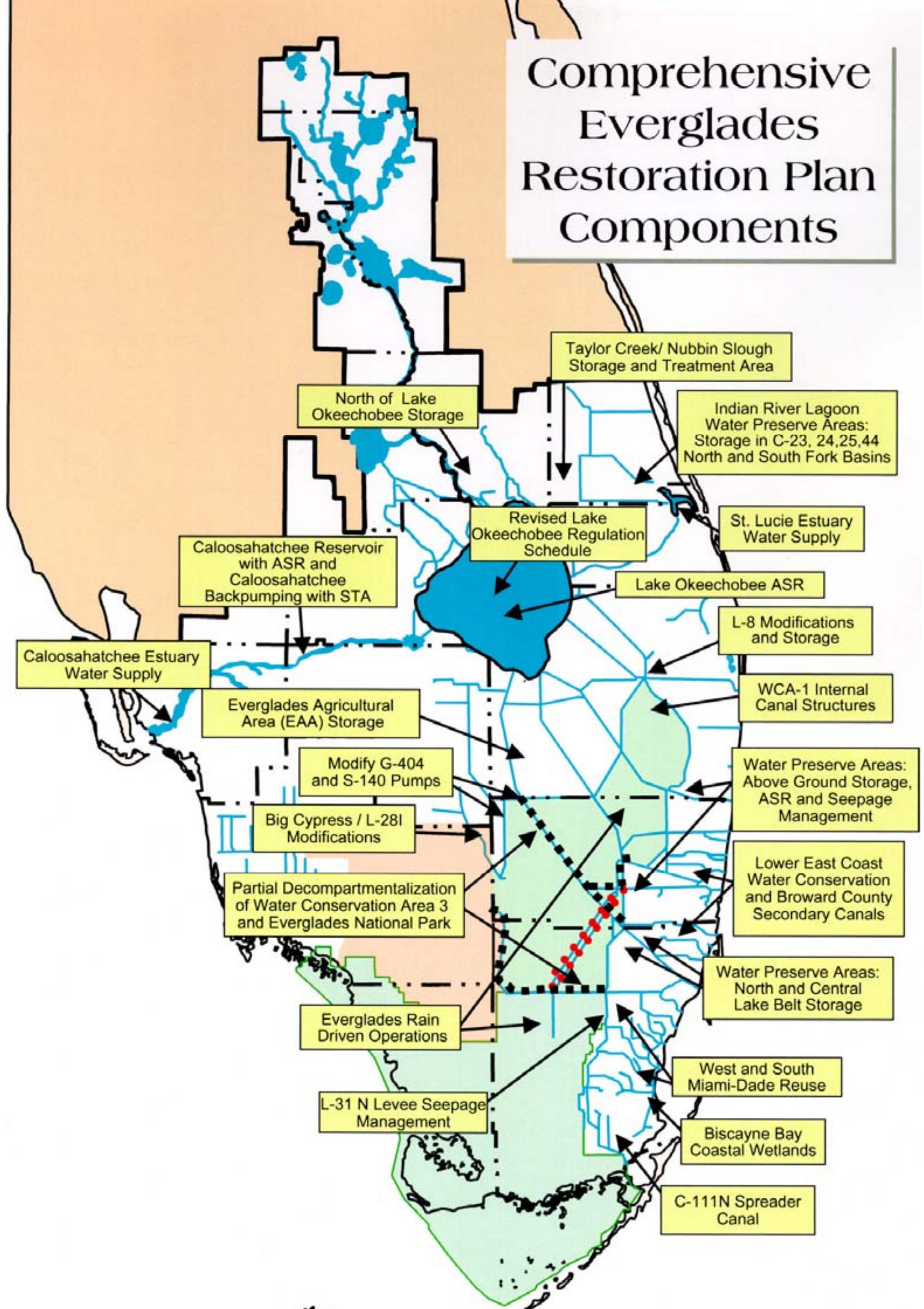
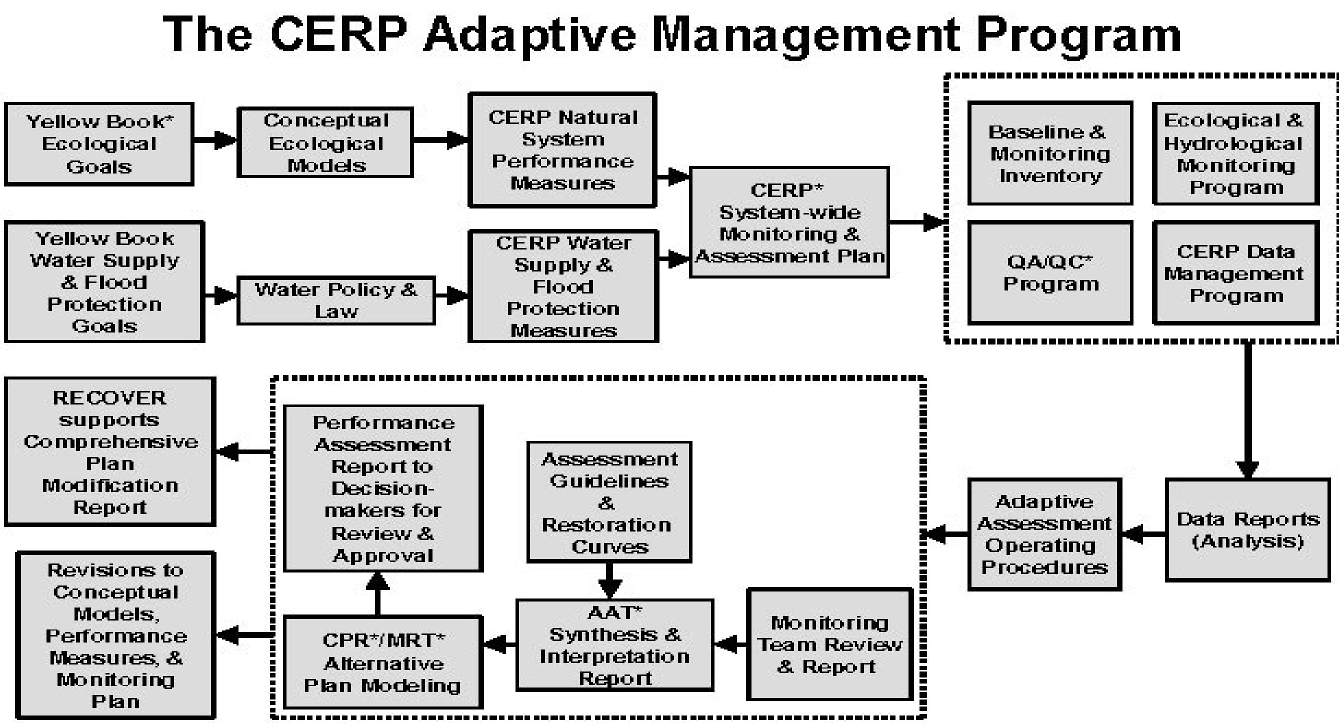
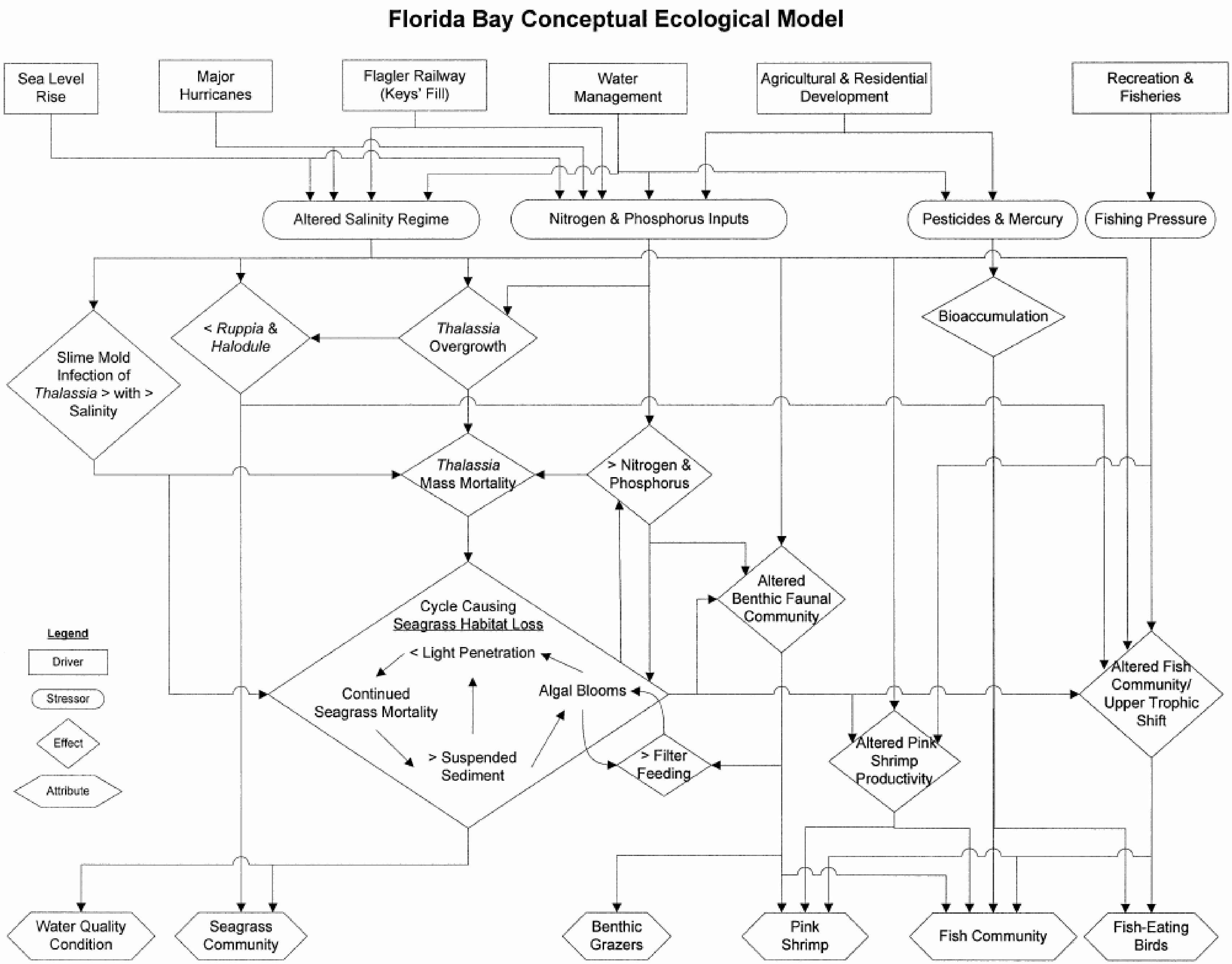

Comprehensive Everglades Restoration Plan Components
Taylor Creek/ Nubbin Slough Storage and Treatment Area
North of Lake Okeechobee Storage
Indian River Lagoon Water Preserve Areas: Storage in C-23, 24,25,44 North and South Fork Basins
Revised Lake Okeechobee Regulation Schedule
St. Lucie Estuary Water Supply
Caloosahatchee Reservoir with ASR and Caloosahatchee Backpumping with STA
Lake Okeechobee ASR
L-8 Modifications and Storage
Caloosahatchee Estuary Water Supply
WCA-1 Internal Canal Structures
Everglades Agricultural Area (EAA) Storage
Modify G-404 and S-140 Pumps
Water Preserve Areas: Above Ground Storage, ASR and Seepage Management
Big Cypress / L-28I Modifications
Lower East Coast Water Conservation and Broward County Secondary Canals
Partial Decompartmentalization of Water Conservation Area 3 and Everglades National Park
Water Preserve Areas: North and Central Lake Belt Storage
Everglades Rain Driven Operations
West and South Miami-Dade Reuse
L-31 N Levee Seepage Management
Biscayne Bay Coastal Wetlands
C-111N Spreader Canal

Figure 1-1: The CERP Adaptive Management Program



*Yellow Book – Central and Southern Florida Project Comprehensive Review Study (USACE and SFWMD, 1999);
CERP – Comprehensive Everglades Restoration Plan; CPR – Comprehensive Plan Refinement;
MRT – Model Refinement Team; AAT-Adaptive Assessment Team; QA/QC – Quality Assurance/Quality Control



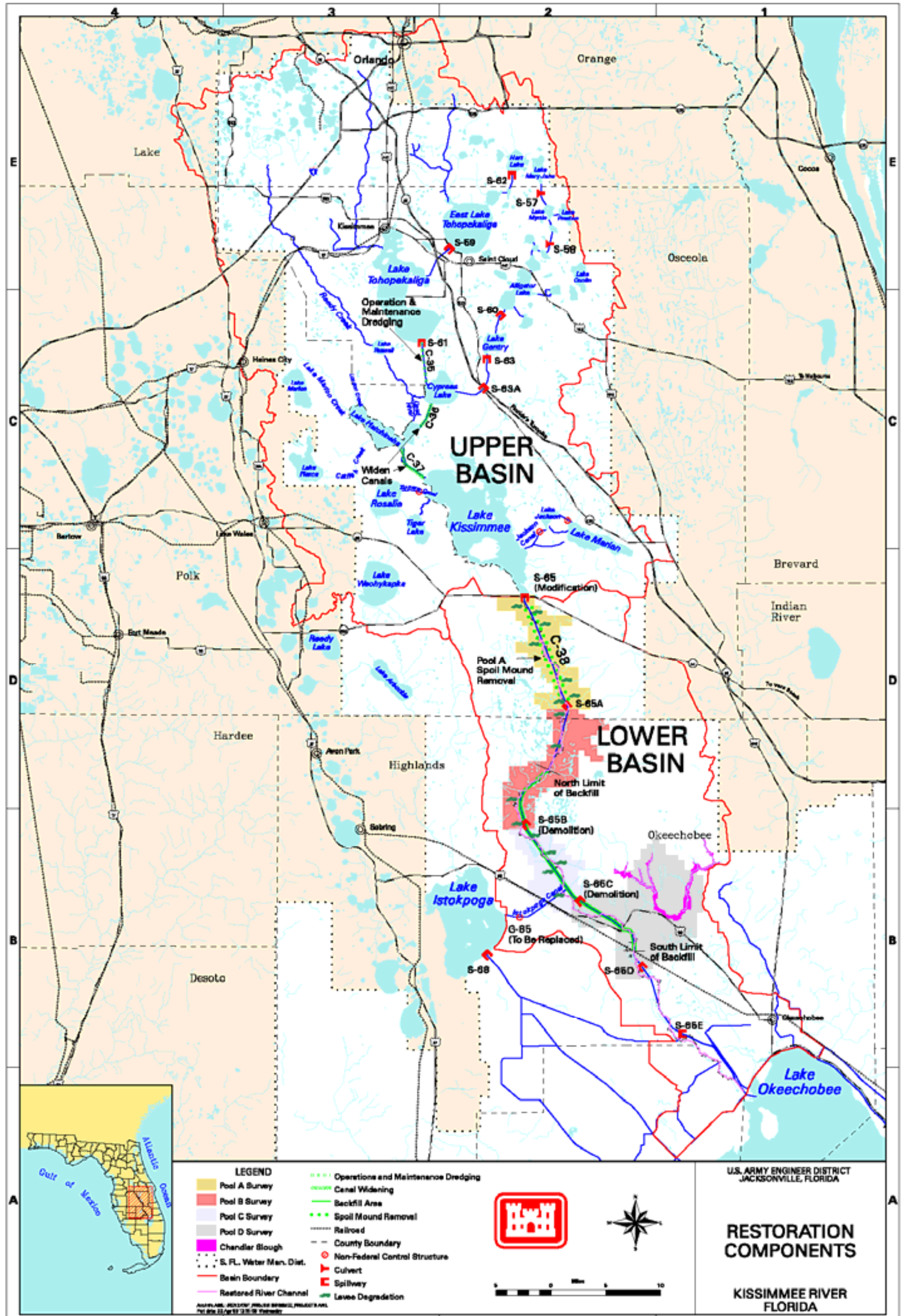
Florida Bay Conceptual Ecological Model
Sea Level Rise
Major Hurricanes
Flagler Railway (Keys' Fill)
Water Management
Agricultural & Residential Development
Recreation & Fisheries
Altered Salinity Regime
Nitrogen & Phosphorus Inputs
Pesticides & Mercury
Fishing Pressure
< Ruppia & Halodule
Thalassia Overgrowth
Bioaccumulation
Slime Mold Infection of Thalassia > with > Salinity
Thalassia Mass Mortality
> Nitrogen & Phosphorus
Altered Benthic Faunal Community
Cycle Causing Seagrass Habitat Loss
< Light Penetration
Continued Seagrass Mortality
Algal Blooms
> Suspended Sediment
> Filter Feeding
Altered Fish Community/ Upper Trophic Shift
Altered Pink Shrimp Productivity
Legend
Driver
Stressor
Effect
Attribute
Water Quality Condition
Seagrass Community
Benthic Grazers
Pink Shrimp
Fish Community
Fish-Eating Birds

Kissimmee River
Before 1961

Kissimmee River
After CS&F Project

Kissimmee River Restoration

- Historically, the Kissimmee River meandered approximately 103 miles within a one to two mile wide floodplain (35,000 acres of wetlands).
- The meandering river was transformed into a 56-mile-long, 30-feet-deep, 300-feet-wide canal.
- Approximately 26,000-31,000 acres of pre-channelized floodplain wetlands were drained, covered with spoil, or converted into canal.
- Dechannelization:
  1) Elimination of the flood control canal and reestablishment of the flow of water through the natural river channel and over its adjacent floodplain.
  2) Filling 22 contiguous miles of the 56 mile long flood control canal
  3) Removing two of the five water control structures within this reach of backfilled canal.
  4) Restore 27,000 acres of floodplain



Orlando
Orange
Lake
Osceola
Cocoa
S-62
S-57
East Lake Tohopekaliga
S-59
S-58
Saint Cloud
Lake Tohopekaliga
Operation & Maintenance Dredging
S-60
S-61
Lake Gentry
S-63
S-63A
C-35
C-36
Cypress Lake
Haines City
C-37
Widen Canals
UPPER BASIN
Lake Rosalie
Lake Kissimmee
Lake Marian
Bartow
Lake Wales
Polk
Lake Weohyakapka
Brevard
Indian River
S-65 (Modification)
C-38
Pool A Spoil Mound Removal
S-65A
LOWER BASIN
Hardee
Avon Park
Highlands
North Limit of Backfill
S-65B (Demolition)
Sebring
Okeechobee
S-65C (Demolition)
Lake Istokpoga
G-85 (To Be Replaced)
South Limit of Backfill
S-65D
S-68
Desoto
S-65E
Lake Okeechobee
Gulf of Mexico
Atlantic Ocean
LEGEND
Pool A Survey
Pool B Survey
Pool C Survey
Pool D Survey
Chandler Slough
S. FL. Water Man. Dist.
Basin Boundary
Restored River Channel
Operations and Maintenance Dredging
Canal Widening
Backfill Area
Spoil Mound Removal
Railroad
County Boundary
Non-Federal Control Structure
Culvert
Spillway
Levee Degradation
U.S. ARMY ENGINEER DISTRICT
JACKSONVILLE, FLORIDA
RESTORATION COMPONENTS
KISSIMMEE RIVER
FLORIDA