Photo credit: Moon Creek Studios

Coastal Dune Lakes

Walton County, FL

sarah kalinoski

Choctawhatchee Basin Alliance

Northwest Florida State College

Overview

- What is a coastal dune lake?
- Are all dune lakes the same?
- Management challenges
- CBA's work on the coastal dune lakes
  Monitoring, Restoration, Education, Research
- Public access/use

Photo credit: Moon Creek Studios

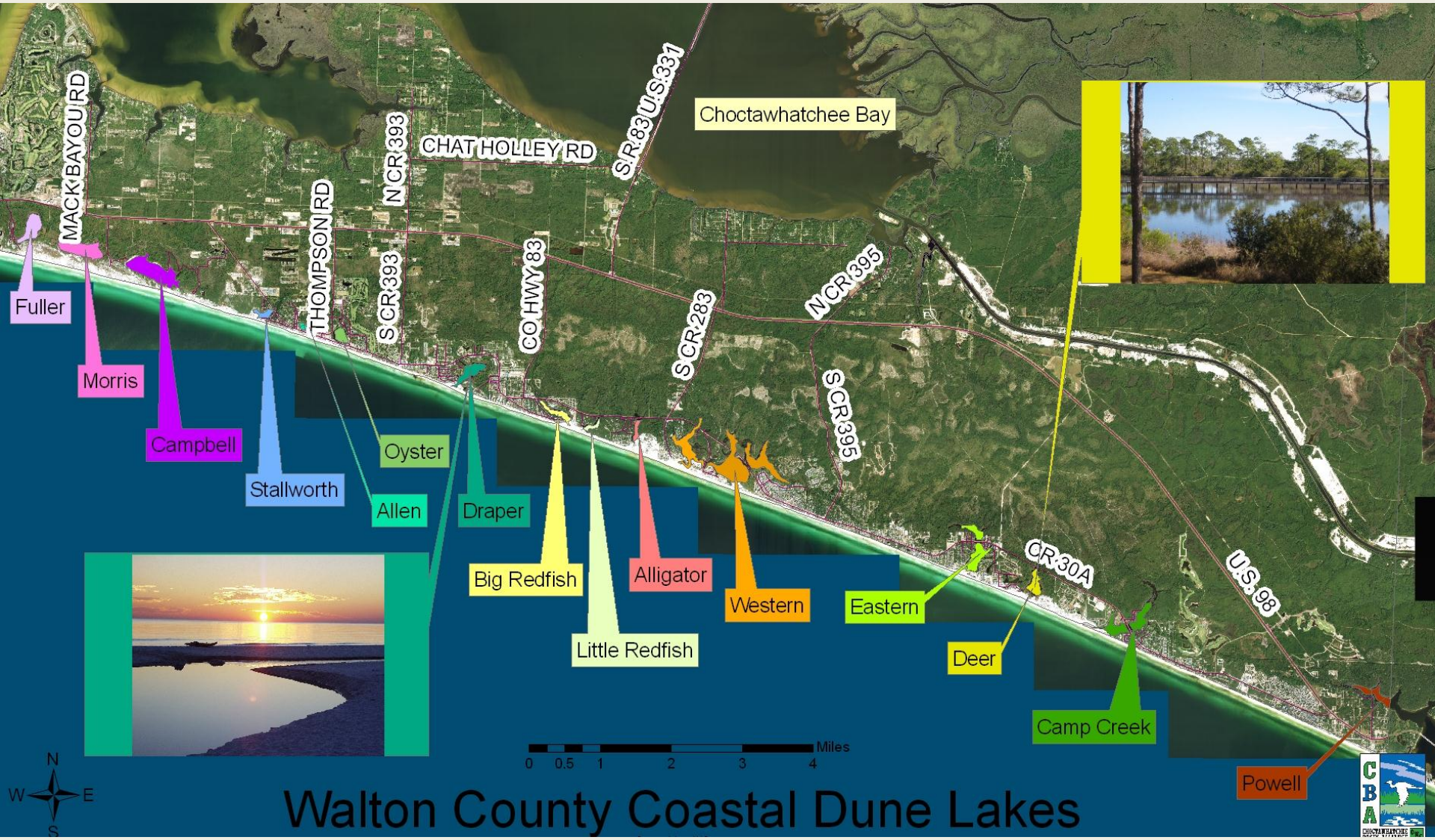
What IS a coastal dune lake?

Photo credit: Moon Creek Studios

What IS a coastal dune lake?

- Found within about 2 miles of the coast
- Shallow and irregularly shaped
- In Walton County, dune lakes are usually permanent water bodies, but water levels fluctuate substantially due to transitory interchanges with the Gulf of Mexico
- Lake-water composed of both fresh and saltwater that comes from tributaries, groundwater seepage (from uplands *and* from the Gulf), rainfall, exchange with the Gulf, and coastal storm surges
- Lake-water is generally colored (e.g., tea or black colored) due to the dissolved organic matter it contains
- Tremendously impacted by hurricane activity (i.e., storm frequency, strength, and duration)
- Slightly acidic, hard water with high mineral content, predominately sodium and chloride
- Salinity levels tend to vary greatly, depending on local rainfall and storms
- Generally oligotrophic to mesotrophic with low to medium nutrient levels
- Critical source of freshwater for wildlife, especially migratory species

- 15 lakes recognized by Walton County as coastal dune lakes
- Found within about 2 miles of the coast
- Shallow and irregularly shaped



Walton County Coastal Dune Lakes

Photo credit: Moon Creek Studios

- Found within about 2 miles of the coast
- Shallow and irregularly shaped
- Lake-water generally colored (tea/coffee/black) due to dissolved organic matter

- Walton County dune lakes have **outfalls**

- When lakes reach flood-level, water forms an **outfall**
- Water cuts through the dunes, across the beach, and into the Gulf of Mexico
- Tannic, tea-colored water

Eastern Lake Opening
2007 (SOWAL.com)

Western Lake at Grayton Beach

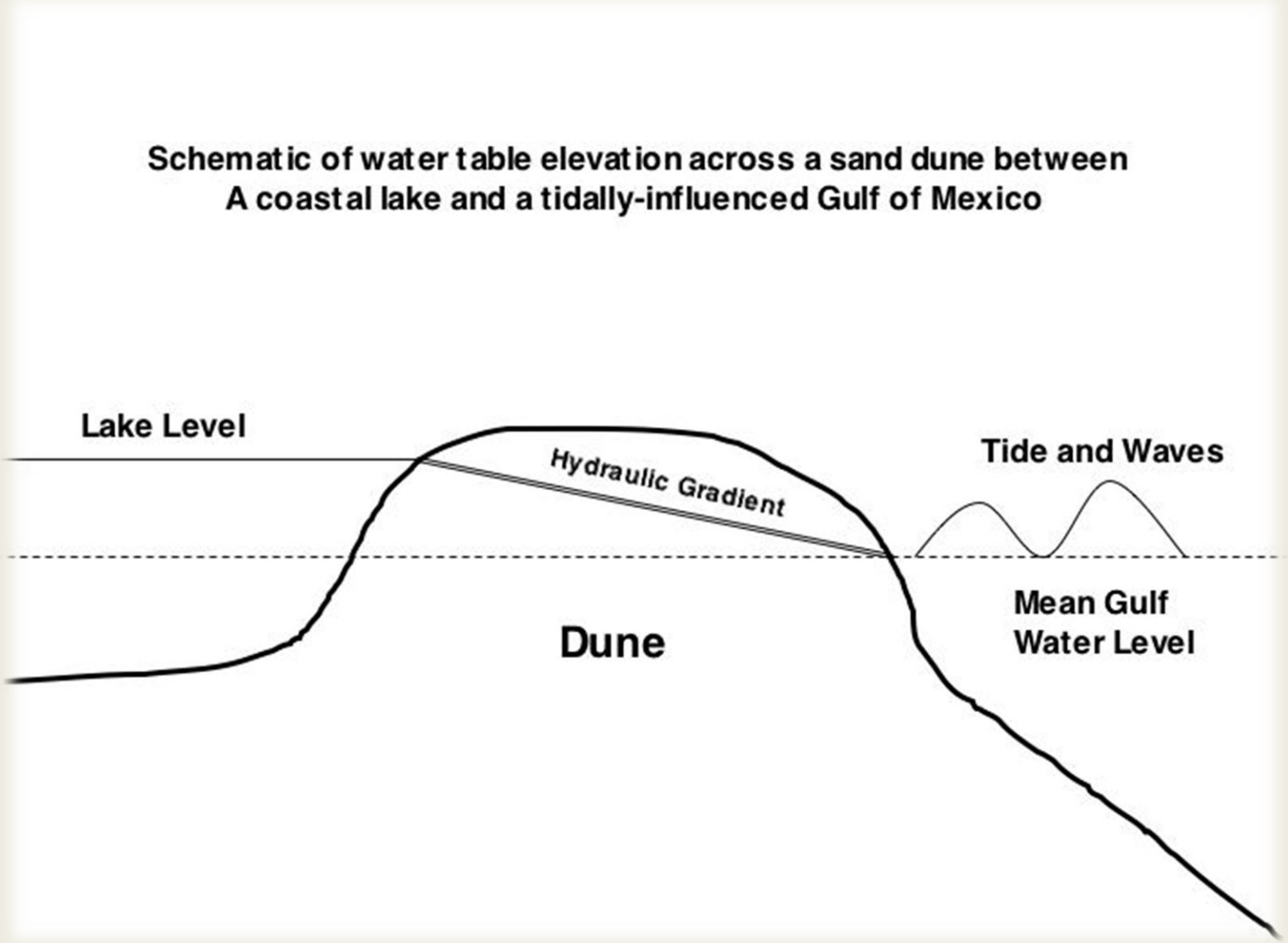
April 2010

February 2004

Photo credit: Moon Creek Studios

Stallworth Lake

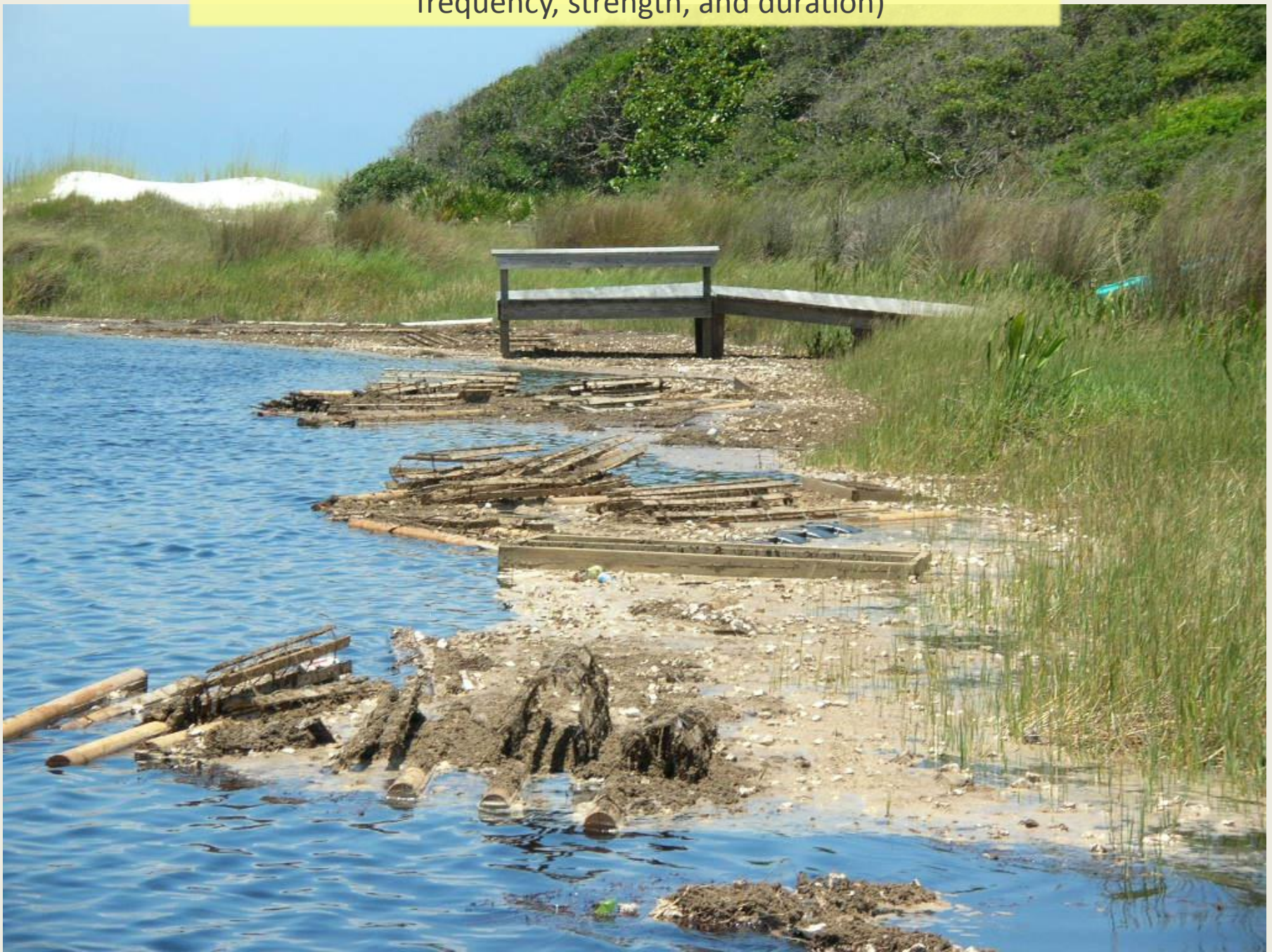
January 2012



- Lake-water composed of both fresh and saltwater that comes from tributaries, groundwater seepage (from uplands *and* from the Gulf), rainfall, exchange with the Gulf, and coastal storm surges

- Tremendously impacted by hurricane activity (i.e., storm frequency, strength, and duration)

- Tremendously impacted by hurricane activity (i.e., storm frequency, strength, and duration)



- Tremendously impacted by hurricane activity (i.e., storm frequency, strength, and duration)

Florida Natural Areas Inventory:

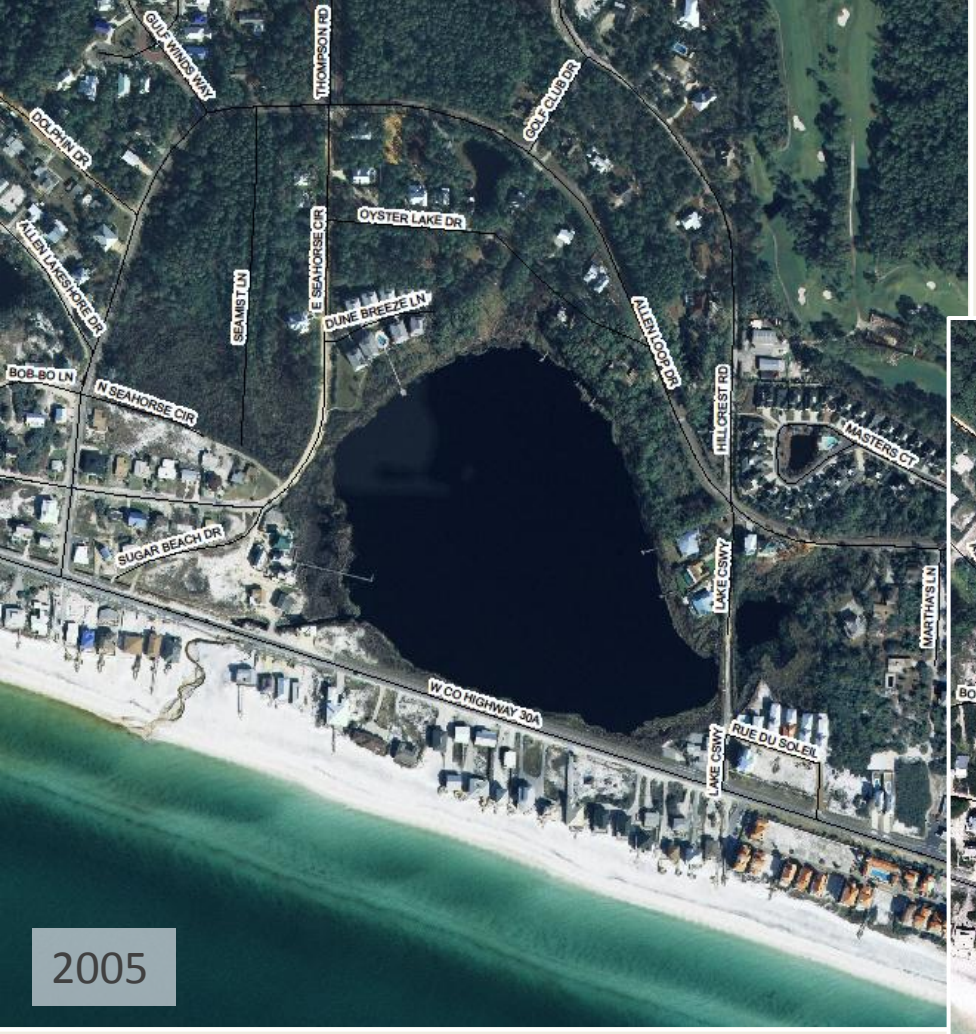
Coastal Dune Lakes are extremely vulnerable to hydrological manipulations. Excessive withdrawals of ground water could lower local water tables or increase salt water intrusion and, thus, induce successional responses in the lake basin.

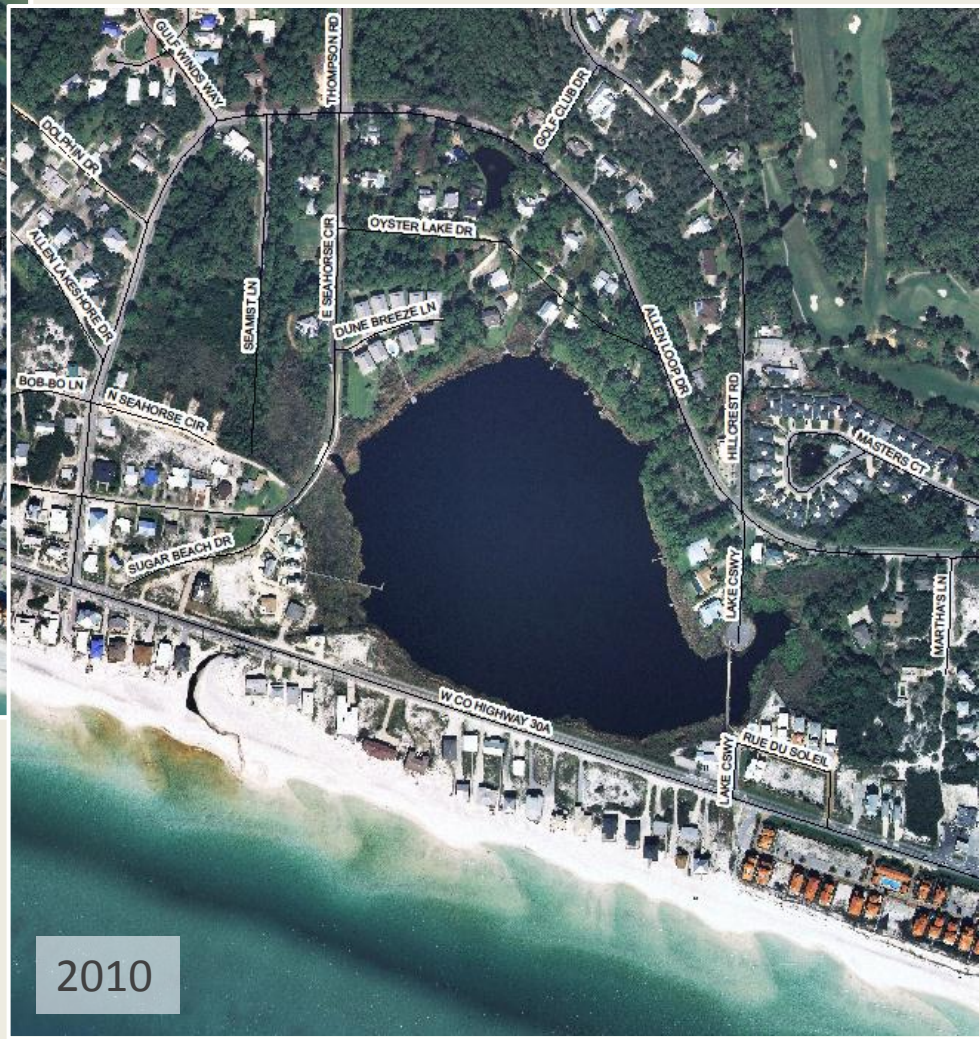
Groundwater pollution, especially from misapplications of chemicals on the surrounding coastal communities, could significantly alter the nutrient balance and produce devastating effects on the fauna and flora.

Florida Natural Areas Inventory (FNAI). 2010. Guide to the natural communities of Florida: 2010 edition. Florida Natural Areas Inventory, Tallahassee, FL.

Photo provided by Aerial Photography: FLORIDA A State University System of Florida PALMM Project, http://web.uflib.ufl.edu/digital/collections/FLAP/ (1941)

Photo provided by Aerial Photography: FLORIDA A State University System of Florida PALMM Project, http://web.uflib.ufl.edu/digital/collections/FLAP/ (1949)





Photos provided by Walton County GIS

"Globally rare and critically imperiled . . . "

Global and State Ranks: G2/S1

G2 = Imperiled globally because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.

S1 = Critically imperiled in Florida because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.

Florida Natural Areas Inventory (FNAI). 2010. Guide to the natural communities of Florida: 2010 edition. Florida Natural Areas Inventory, Tallahassee, FL.

"Globally rare and critically imperiled . . . "

- Similar ecosystems found in Madagascar, New Zealand, Australia and USA Pacific Coast

- However, **Rosalie Shaffer** of the **National Oceanic and Atmospheric Administration** states:

"The others are usually freshwater lakes in coastal areas with no outlet to the sea, or are coastal lagoons with a permanent connection. I have never found dune lakes with an intermittent outfall anywhere but in Northwest Florida."

Formation Theories

- Relic lagoons shaped by wind and rain – closed by sand filling the inlets
- Humate impervious layer creating troughs behind dunes
- Continuous dune build-up at end of a watershed

Are all dune lakes the same?

Photo credit: Moon Creek Studios

Are all coastal dune lakes the same?

No!

Dune Lakes around the world

- Rare
- Within two miles of the coast
- Shallow and irregular
- Fluctuating water levels

vs.

Walton County Dune Lakes

- Fresh to brackish – varying salinity
- Multiple water sources
- Create outfall to the Gulf of Mexico
- Highly dynamic

Even in **Walton County**,
every lake is different:

Size • Shape • Outfall • Salinity • Watershed

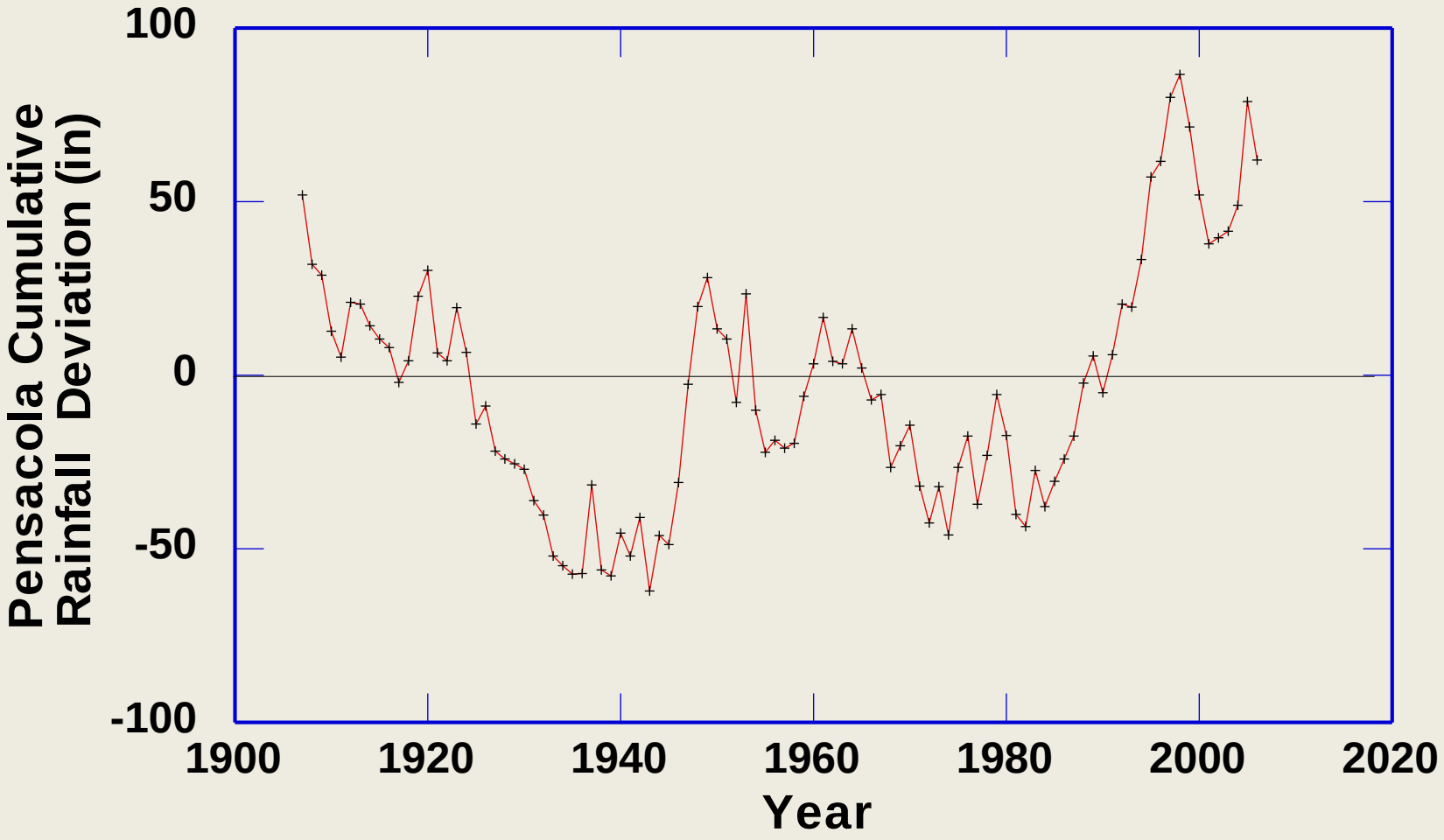
Outfall Openings

- Yearly openings vary between 0.1-18.9 times a year

Many environmental and physical factors contribute to outfall openings:

- Rainfall and water table (groundwater) elevation
- Watershed area, lake morphometry (e.g., lake area, mean depth, volume), and hydrology (e.g.,water level and flushing rate)
- Outfall sweep distance (S) and separation distance (D)
- Tidal elevation and frequency of storm surges

Cumulative Rainfall



- Rainfall and water table (groundwater) elevation

Watershed =

the area of land from which all surface waters drain toward a common destination, such as a river system or other common body of water

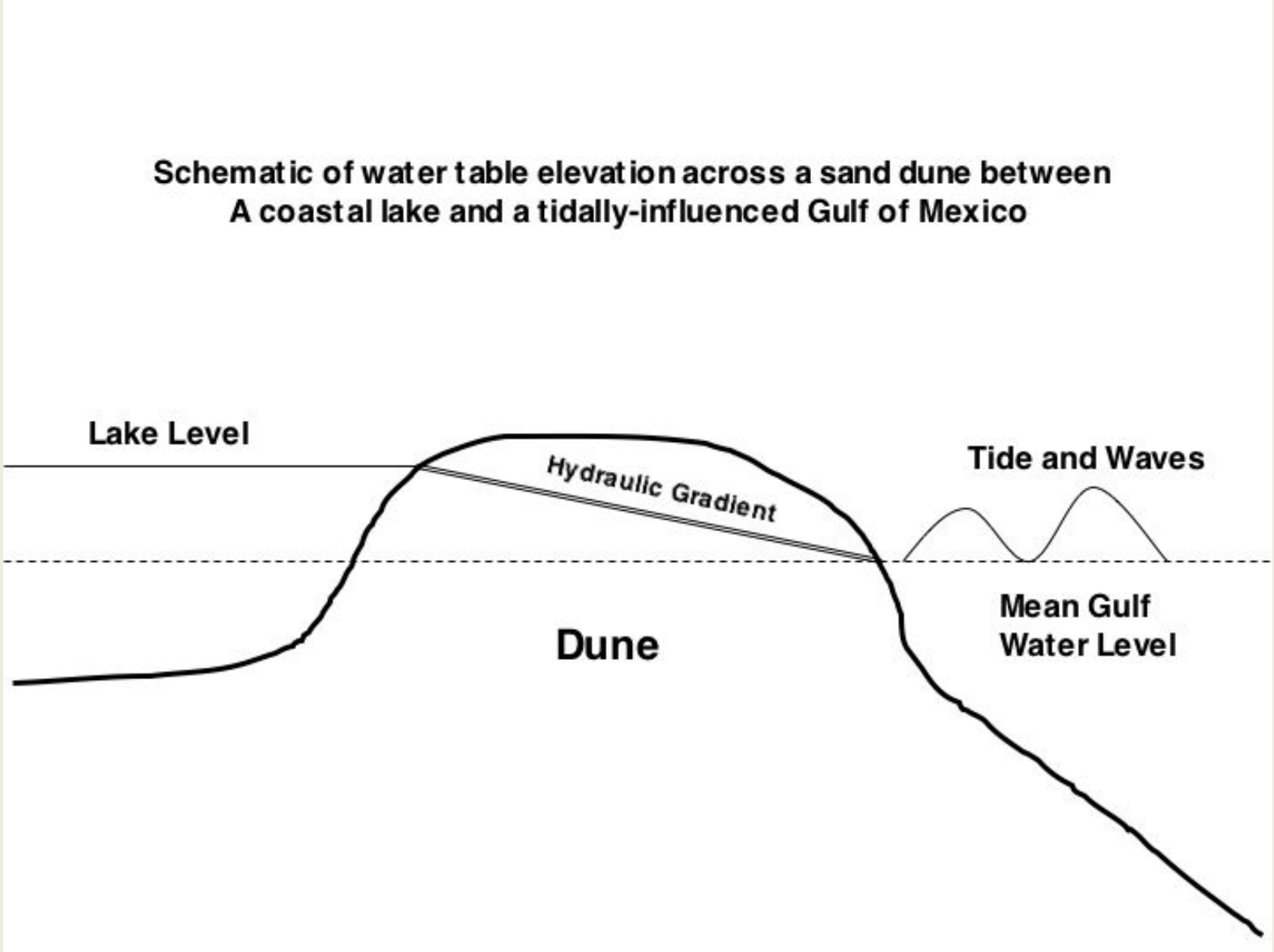
- Watershed area, lake morphometry (e.g., lake area, mean depth, volume), and hydrology (e.g.,water level and flushing rate)

Lake	Watershed Area (the area of land where all of the water that is under it or drains off of it goes into the same place) (acres)	Lake Area (acres)	Mean Depth (ft)	Flushing Rate (# of times per year entire lake volume is exchanged) for 62 in/yr rainfall	Outfall Opening (%)
Allen	175.4	17.6	3.6	14.3	.
Alligator	95.0	15.9	4.8	6.5	62
Big Red Fish	294.5	22.8	5.2	12.8	51
Camp Creek	526.5	57.7	5.2	9.1	37
Campbell	20.9	109.9	11.6	0.1	7
Deer	341.7	41.8	9.3	4.5	38
Draper	476.9	28.3	4.6	18.9	22
Eastern	379.5	62.8	6.9	4.5	43
Fuller	107.0	49.5	5.5	2.0	52
Morris	214.0	78.3	10.1	1.4	21
Oyster	138.8	22.0	5.7	5.7	44
Powell	1804.1	258.0	6.6	5.5	20
Stallworth	212.7	12.9	5.0	17.0	28
Western	679.7	171.0	7.1	2.9	52
Average	390.5	64.1	6.4	7.5	32%
Maximum	1804.1	258.0	11.6	18.9	62%
Minimum	20.9	12.9	3.6	0.1	7%

S = Sweep Distance

D = Separation Distance

- Tidal elevation and frequency of storm surges



CDL Variability compared to other Florida lakes

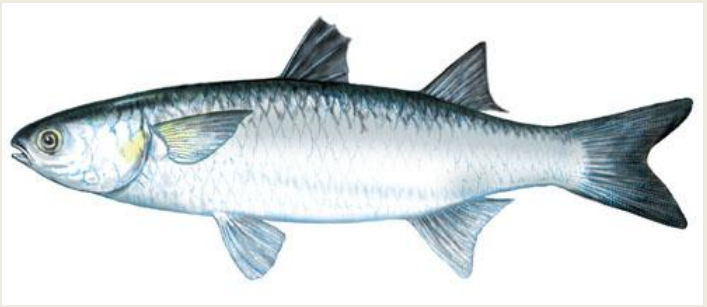
County	N Lakes within each County	Mean CV TP (µg/L)
Holmes	2	25
Gulf	2	27
Bradford	10	28
Jackson	4	29
Taylor	2	29
Highlands	67	29
Polk	111	29
Union	2	31
Washington	6	31
Hillsborough	171	31
Sarasota	8	32
Hernando	7	32
Walton	14	33
Orange	175	33
Volusia	42	33
Seminole	101	33
Miami-Dade	33	34
Escambia	4	34
Osceola	34	34
Pinellas	27	35
Hamilton	4	35
Charlotte	21	35
Columbia	3	36
Pasco	41	36
Indian River	4	36
Lake	121	36
Marion	34	37
Jefferson	4	38
Santa Rosa	4	38
Wakulla	3	39
Leon	69	39
Flagler	30	39
Broward	31	40
Gadsden	4	40
Suwannee	3	41
Okaloosa	10	41
Brevard	11	41
Putnam	85	41
Clay	29	42

County (Continued…)	N Lakes within each County	Mean CV TP (µg/L)
Palm Beach	17	44
Duval	4	44
Bay	4	45
Walton-CDL	17	46
Citrus	27	47
Alachua	37	49
St Lucie	19	50
Lee	17	57
Collier	2	62

Out of 48 Counties Sampled

- CDL # 43 for TP
- CDL # 41 for TN
- CDL # 40 for CHL
- CDL # 43 for Secchi

Fish



FISH SPECIES	OYSTER LK	STALLWORTH LK
FRESHWATER FISH		
Largemouth bass (Micropterus salmoides)	X	
Bluegill (Lepomis macrochirus)	X	
Redear sunfish (Lepomis microlophus)	X	
Eastern Mosquitofish (Gambusia affinis)	X	X
Sailfin molly (Poecilia latipinna)	X	X
SALTWATER FISH		
Striped mullet (Mugil cephalus)	X	X
Sheephead minnow (Cyprinodon variegatus)		X
Gulf killifish (Fundulus grandis)		X
Bay anchovy (Anchoa mitchille)		X
Red drum (Sciaenops ocellata)		X
Silver perch (Bairdiella chrysura)		X
Gulf flounder (Paralichthys albigutta)		X
Pinfish (Lagodon rhomboide)		X
Gray snapper (Lutjanus griseus)		X

Management

Photo credit: Moon Creek Studios

Regulating the Coastal Dune Lakes

- County regulations
  - Coastal Dune Lakes Protection Zone:
    "All lands within an area beginning at the mean or ordinary high water line of the coastal dune lakes and their tributaries and extending 300 feet landward."
- No special restrictions under state or federal law
- Special designation (non-regulatory) passed by the BCC in 2011
- Coastal Dune Lakes Advisory Board
  - Coastal Dune Lakes Taskforce was initiated by Walton BCC in 2000
  - Transitioned into Coastal Dune Lakes Advisory Board (CDLAB) in 2002
  - The Coastal Dune Lakes Advisory Board is comprised of residents and partners with Walton County, to ensure the protection, health and environmental integrity of the county's globally rare and imperiled Coastal Dune Lakes and to provide sound recommendations to the Walton County Board of Commissioners.
  - Meets bi-monthly in District 5 Office
- CDLs included as a priority in Walton County Vision Plan

Summarized from the Walton County Land Development Code

Development in the Walton County Coastal Dune Lakefront Protection Zone shall be allowed with the following stipulations:

1. **Septic tanks:** Drain fields must be located 100 feet from the mean high water line.
2. **Stormwater management:** New lots shall be graded to ensure untreated stormwater runoff from fertilizers, pesticides, patios, driveway, etc. do not enter the lake.
3. **Erosion control:** Specific erosion control measures shall be utilized during construction activity, such as staked and staggered hay bales, siltation barriers, floating silt and filter berms.
4. **Hazardous wastes:** No land use shall be allowed within the zone which stores, handles or generates hazardous wastes.
5. **Seawalls, bulkheads, revetments and rip-rap are not permitted.**
6. **Endangered Species:** Native vegetative communities, including habitat for listed species, shall be protected.
7. **No new point or non-point sources of pollution** shall be discharged into the lakes.
8. **Setback:** All new development and redevelopment shall be set back from the mean high water line 100 feet.
9. **Open Space:** All new development and redevelopment shall preserve 75 percent of the portion of the parcel within the 300-foot protection zone as open space.

Management

- **A Management Plan for Walton County's Coastal Dune Lakes**
  - Collaborative effort initiated by CBA
  - Partners: CBA, UF Florida LAKEWATCH, Walton County citizens, key stakeholders
  - **TEAM** approach (developed by Dan Canfield, Florida LAKEWATCH)
    Together for **E**nvironmental **A**ssessment and **M**anagement
  - Public meetings
    - Individual lakes series, then collective
    - Identification of Management Issues
    - Pros & Cons document
    - Prioritization
    - "Final" Plan! (October 2008)
  - Adoption by the CDLAB and then by the BCC
  - Living document

Management Issues

1. Who is in Charge?
2. Outlet Management
3. Water Quality
4. Watershed/Inlet Management
5. Aquatic Plant Management
6. Education
7. Fish and Wildlife

Recommendations

CATEGORY I PRIORITIES
Designate the CDLAB as “who’s in charge.”
Expand ex-officio CDLAB membership and establish a TAG.
Plan and implement a comprehensive community education program for the coastal dune lakes.
Monitor outlet openings/closings, rainfall, water table level, watershed area, and lake morphometry.
Add CBA/LAKEWATCH volunteers on Stewart, Horseshoe, Tresca, and Little Deer.
Increase sampling on Oyster Lake to determine where nutrients are entering the system.
Begin a bacteria monitoring program.
Initiate bi-annual (once every two years) aquatic plant survey.
CATEGORY II PRIORITIES
Research storm water problems identified by Hartman & Associates and new ones in the field. Prioritize storm water problems and find cost-effective solutions.
Establish an aquascaping program to control exotic/invasive plants and revegetate with native plants.
Initiate monitoring program for fish communities.
CATEGORY III PRIORITIES
Begin comprehensive chemical, heavy metal and/or pesticide monitoring program and/or initiate chemical scanning of the fish population.
Remove obstructions to fish passage at Oyster Lake and other lakes and monitor the return of saltwater species.
Identify properties in the historical sweep distances of the lakes. Purchase and preserve.

Challenges

- Funding
- Transitory population
- Lots of record
- Inconsistent code enforcement
- Sea-level rise

CBA's Work on the Coastal Dune Lakes

Photo credit: Moon Creek Studios

Choctawhatchee Basin Alliance

of Northwest Florida State College

History:

- Watershed organization
- Created in 1996 by the FDEP Ecosystem Restoration Section due to concerns over local water quality
- Adopted as a program of Northwest Florida State College (NWFSC)
- Coverage:
  - Choctawhatchee Bay
  - Choctawhatchee River
  - Coastal Dune Lakes
  - Gulf of Mexico

Choctawhatchee Basin Alliance

of Northwest Florida State College

Mission:

CBA is committed to **sustaining** and providing **optimum utilization** of the Choctawhatchee Basin watershed. CBA provides opportunities for citizens, educators, and technical experts to promote the health of the Choctawhatchee Basin watershed.

Choctawhatchee Basin Alliance

of Northwest Florida State College

Programs:

- Monitoring
- Restoration
- Education
- Research

MONITORING

Monitoring

Water Quality Monitoring

- 61 stations on the lakes
- Sampled by volunteers every month
- Nutrients (Nitrogen, Phosphorus), Chlorophyll, Secchi depth, Color in cooperation with Florida LAKEWATCH
- Temperature, Specific Conductivity, Dissolved Oxygen (mg/L & saturation), pH, Salinity, Turbidity
- Part of a state-wide program (FL LW)
- Funded in part by Walton County
- Data acceptable for numeric nutrient criteria passed through the last legislative session
- Over 10 years of data

CR 30A

BETTY ST

OLD BEACH RD

DRAPER LAKE

RETREAT DR

1

2

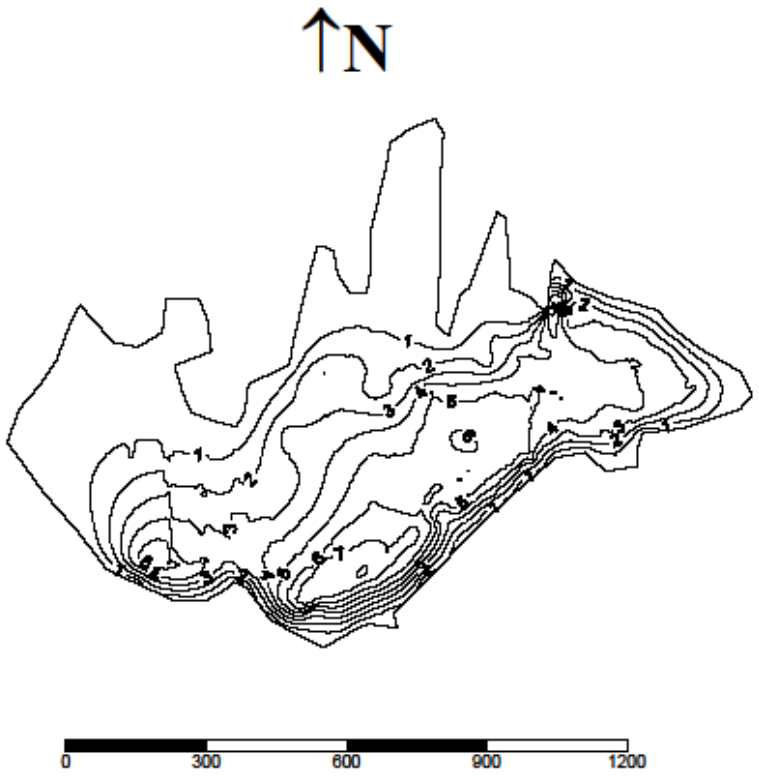
3

N

Draper / Walton

Monitoring

Allen (Walton County)
Florida LAKEWATCH Bathymetric Map



Florida LAKEWATCH personnel created this map using differentially corrected global positioning equipment (GPS). Data were collected May 14, 2009. Map contours are in 2-foot increments and were generated using kriging technique in Surfer® software package (Golden CO). The center of the lake is located at Latitude N 30° 21' 14.8" and Longitude W 86° 15' 7.3". On this date, the lake surface area was calculated at 16.1 acres (6.5 hectares) and the lake elevation was 3.08 feet above MSL. This is only an approximate bathymetric map and should not be used for navigation.

- Bathymetric Maps

Monitoring

- Plant surveys

Campbell / Walton

Aquatic plant data collected on May 3, 2011

Percent area covered with aquatic vegetation (PAC, %)	19.0
Percent of lake's volume filled with vegetation (PVI, %)	2.8
Average emergent plant biomass (kg wet wt/m^2)	1.9
Average floating-leaved plant biomass (kg wet wt/m^2)	0.6
Average submersed plant biomass (kg wet wt/m^2)	1.9
Average width of emergent and floating-leaved zone (ft.)	66.7
Average lake depth (m)	2.7

Frequency that plant species occur in 10 evenly spaced transects around the lake.
* Indicates non-native plant species

Common Name	Plant Species	Frequency (%)
little floating-heart	*Nymphoides cordata*	100
rush fuirena	*Fuirena scirpoidea*	90
purple bladderwort	*Utricularia purpurea*	90
Florida bladderwort	*Utricularia floridana*	90
red root	*Lachnanthes caroliniana*	80
variable-leaf milfoil	*Myriophyllum heterophyllum*	80
torpedograss*	*Panicum repens*	80
St. John's wort	*Hypericum spp.*	70
fragrant water-lily	*Nymphaea odorata*	60
buttonbush	*Cephalanthus occidentalis*	50
pipewort	*Eriocaulon spp.*	50
respuinata bladderwort	*Utricularia resupinata*	50
slender spikerush	*Eleocharis baldwinii*	40
common reed	*Phragmites australis*	40
sawgrass	*Cladium jamaicense*	30
haspan flatsedge	*Cyperus haspan*	30
water-pennywort	*Hydrocotyle umbellata*	30
southern cutgrass	*Leersia hexandra*	30
banana-lily	*Nymphoides aquatica*	30
red bay	*Persea borbonia*	30
dwarf arrowhead	*Sagittaria subulata*	30
horned bladderwort	*Utricularia cornuta*	30
lemon bacopa	*Bacopa caroliniana*	20
coinwort	*Centella asiatica*	20
jointed spikerush	*Eleocharis interstincta*	20
bacopa	*Bacopa monnieri*	10
water-shield	*Brasenia schreberi*	10
pink sundew	*Drosera capillaris*	10
spikerushes	*Eleocharis spp.*	10
myrtle leaved holly	*Ilex myrtifolia*	10
black rush	*Juncus roemerianus*	10
spatterdock	*Nuphar luteum*	10
duck-potato	*Sagittaria lancifolia*	10
sand cordgrass	*Spartina bakeri*	10
pond cypress	*Taxodium ascendens*	10

RESTORATION

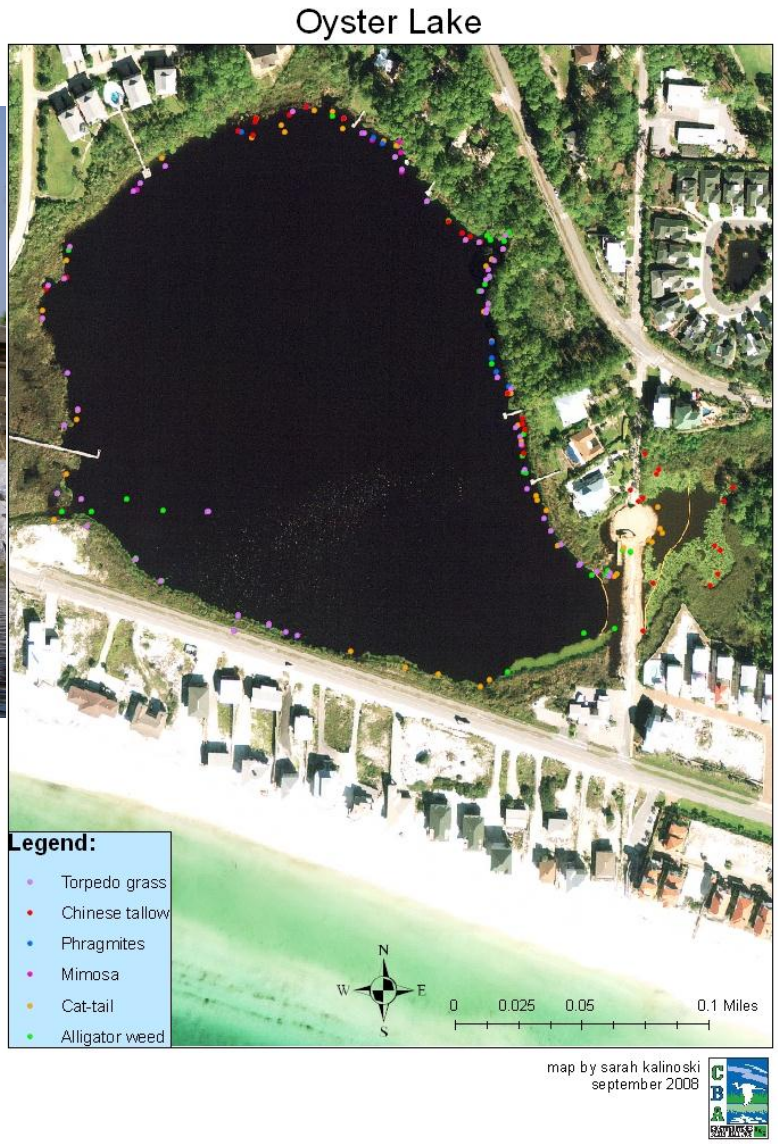
Restoration

- Exotic Invasive Program
  - Identification and mapping of invasive exotic plants
  - Treatment/Removal
  - Re-vegetation with native plants where indicated

Torpedograss on Stallworth Lake, January 2011

Restoration

- Students identified and mapped invasive species on the dune lakes
- Maps were subsequently used in permitting process for exotic treatments



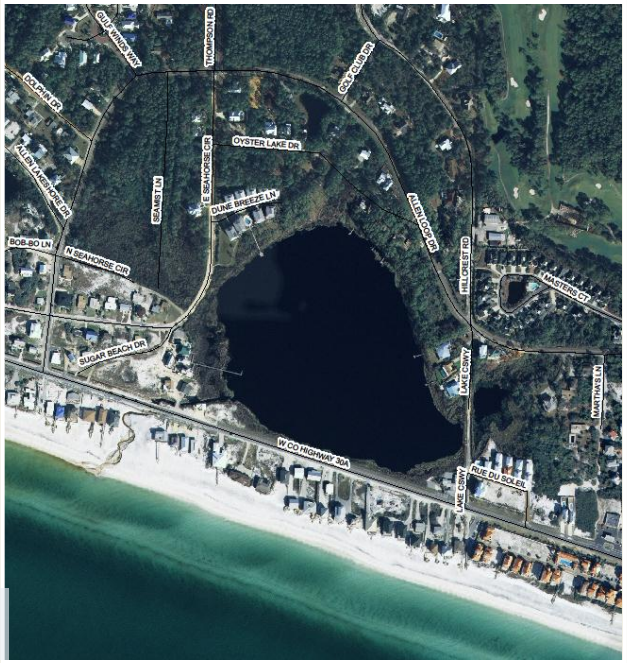
Restoration

BEFORE:
Torpedograss on Stallworth Lake, July 2011

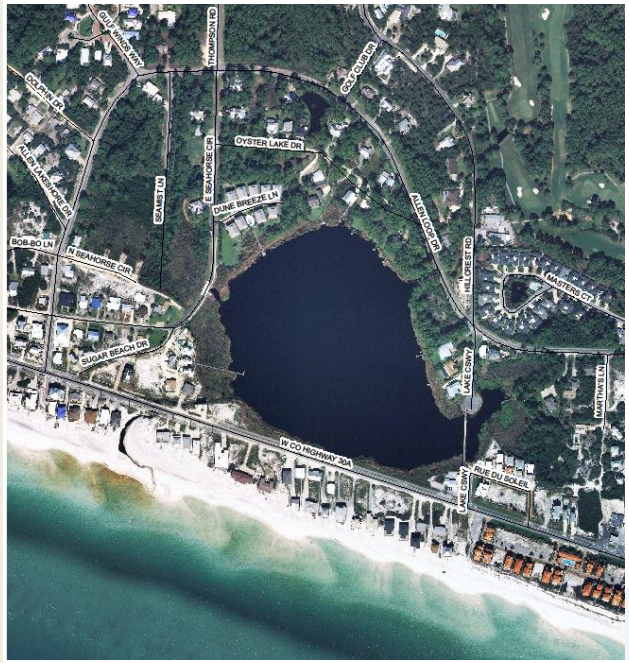
AFTER:
Dead Torpedograss on Stallworth Lake, February 2012

Restoration

- Oyster Lake Restoration Project
  - Water Quality Monitoring
  - Sediment Studies (Pre & Post)
  - Invasive plant control and re-vegetation
  - Educational Signage



2005



2010

Restoration

Educational Signage at Oyster Lake

EDUCATION

Education

- Produce and distribute publications
  - Dune Lakes rack cards
  - Homeowner's Guide
  - CBA media: website, Facebook, Twitter, newsletters
- Invasive/Exotic Program
  - South Walton High School and Walton Co. 4H – Mapping invasive plants and re-planting
  - Homeowner inquiries, public meetings, etc.
- Public Schools
  - AmeriCorps program in Okaloosa Public Schools
  - Butler Elementary – 5th Grade Filters for Florida
- Public Meetings/Homeowner inquiries/etc.
- Educational Signage
  - Oyster Lake Restoration Project
  - Along 30A in collaboration with TDC

RESEARCH

Research

- Hydrology Study (University of Florida)
- Sea-level Rise (Florida State University)
- Threats Assessment & Fish Surveys (USFWS & CBA)

Research

- UF: Hydrology Study

- Groundwater wells and lake level recorders installed on Campbell, Draper, and Camp Creek Lakes in 2007
- Compared nutrient data to open water sample data to examine land use and groundwater influence on lake water quality
- Documented tidal influence on lake levels
- Documented storm surge effects in 2008 (Fay, Gustav, Ike)

Research

- FSU: Investigation of the potential effects of accelerated sea-level rise and increased storminess over the next century on the NW Florida coastal region
  - Developing models for projecting potential effects of climate change on both man-made and natural components of the coast (groundwater, wetlands and barrier islands)
  - Model development calibrated with field data, including coastal dune lakes
  - Sediment cores analyzed to determine major storm occurrence prior to record-keeping era (i.e., the past approximately 150 years)
  - Preliminary results indicate that there is a record extending back at least 4000 years in the lake sediments, and that storm frequency in the geologic past was quite different than it has been in the past century

Public Access & Use

Photo credit: Moon Creek Studios

Public Access & Use

- No jet-propelled motors in Walton County
- Kayak, Stand-up paddle, Hike, Bike, Fish, Swim (at your own risk!), Boat, Camp, Bird-watch, People-watch
- Beach, Bike Path (Timpoochee Trail) & State Parks (Topsail Hill Preserve, Grayton Beach, Deer Lake)

Public Access Points on the Coastal Dune Lakes

Lake	Access	Allowed Uses
Fuller	Open to the public by reservation only: Call 850-622-3700	viewing from the dock or Memorial Grove
Morris	Topsail Hill Preserve State Park	hiking, bicycling, fishing, bird-watching, camping
Campbell	Topsail Hill Preserve State Park	hiking, bicycling, fishing, bird-watching, camping
Stallworth		bird-watching
Allen		bird-watching
Oyster		bird-watching
Draper		bird-watching
Big Redfish		bird-watching
Little Redfish		bird-watching
Alligator		bird-watching
Western	Grayton Beach State Park **Boat ramp**	hiking, bicycling, kayaking, boating, fishing, bird-watching, camping
	County access at the end of Hotz Avenue **Boat ramp**	kayaking, boating, fishing, YOLO boarding
Eastern	County park on Lakewood Drive **Boat ramp**	kayaking, boating, fishing, bird-watching
	County beach access at South Gulf Drive & Eastern Lake Road	kayaking, fishing, bird-watching
Deer	Deer Lake State Park	hiking, kayaking, fishing, bird-watching
Camp Creek	County easement off of Camp Creek Road North	kayaking, fishing, bird-watching
Powell	Camp Helen State Park	hiking, kayaking, fishing, bird-watching, camping
	County park, Walton County, N. Walton Lakeshore Dr.	kayaking, fishing, bird-watching
	Lake Powell Boat Ramp Park, Bay County **Boat ramp**	boating, jet-skiing, fishing, kayaking, bird-watching

All of the coastal dune lakes with the exception of Fuller are accessible from the beach. Lakes highlighted in blue have additional access points for public use.

The Timpoochee Trail is a wonderful way to see nearly all of the lakes – it is a multimodal trail which is great for hiking and biking. The trail runs along County Road 30A, providing stunning views of all of the coastal dune lakes from Stallworth to Camp Creek.

Guide available at www.basinalliance.org (FAQs)


Photo credit: Moon Creek Studios
Explore, Enjoy,
Appreciate, Share, Protect, Defend . . .

Get Involved!

- Join CBA
- Volunteer with CBA
- Attend and participate in public meetings
- Talk to neighbors, visitors, and government officials



Photo credit: Moon Creek Studios

Questions?

Choctawhatchee Basin Alliance
www.basinalliance.org

sarah kalinoski
850-200-4175
kalinoss@nwfsc.edu