A Simple and Reliable Index for Characterizing and Ending Drought Severity in the Big Cypress Swamp and Everglades

Bob Sobczak, Hydrologist
Big Cypress National Preserve
Signs of drought?
Marl chips are especially crunchy
Overwhelming sense of **vertigo**
along Tamiami Canal
Unable to *reasonably* paddle down Turner River
Ultimate Litmus Test:

Walk through Sweetwater Culverts
My point:

“We know drought when we see it ...”,

But how do we define it?
1. A long period with little or no rain. 2. A shortage or dearth.
“Drought is a period of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance.”
Drght is not inherently a dirty word ...

- South Florida has a **seasonal** drought each winter
- **Native** flora and fauna require seasonal drought
  - Wading birds forage on recession
  - Exotic fish flourish in overly wet areas

But self-inflicted drought is **vulgar**.

- Over drainage, i.e. canals and levees
- Global climate change, i.e. drier winters
What Do the experts Say?

“Drought is a deficiency of moisture that results in **adverse impacts** on people, animals, or vegetation over a sizeable area.

**NOAA** together with its partners provides short- and long-term Drought Assessments.”

**NOAA**: National Weather Service’s On-line Glossary
The data cutoff for Drought Monitor maps is Tuesday at 7 a.m. Eastern Standard Time. The maps, which are based on analysis of the data, are released each Thursday at 8:30 a.m. Eastern Time.

NOTE: To view regional drought conditions, click on map below. State maps can be accessed from regional maps.

U.S. Drought Monitor

April 9, 2013
Valid 7 a.m. EDT

Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
- Delineates dominant impacts
- S = Short-Term, typically <6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/

Released Thursday, April 11, 2013
Author: David Miskus, NOAA/NWS/NCEP/CPC
## Drought Categories

<table>
<thead>
<tr>
<th>Drought Severity</th>
<th>Return Period (years)</th>
<th>Description of Possible Impacts</th>
<th>Drought Monitoring Indices</th>
<th>NDMC Drought Category</th>
<th>Palmer Drought Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor Drought</td>
<td>3 to 4</td>
<td>Going into drought; short-term dryness slowing growth of crops or pastures; fire risk above average. Coming out of drought; some lingering water deficits; pastures or crops not fully recovered.</td>
<td>-0.5 to -0.7</td>
<td>D0</td>
<td>-1.0 to -1.9</td>
</tr>
<tr>
<td>Moderate Drought</td>
<td>5 to 9</td>
<td>Some damage to crops or pastures; fire risk high; streams, reservoirs, or wells low; some water shortages developing or imminent; voluntary water use restrictions requested.</td>
<td>-0.8 to -1.2</td>
<td>D1</td>
<td>-2.0 to -2.9</td>
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<tr>
<td>Severe Drought</td>
<td>10 to 17</td>
<td>Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.</td>
<td>-1.3 to -1.5</td>
<td>D2</td>
<td>-3.0 to -3.9</td>
</tr>
<tr>
<td>Extreme Drought</td>
<td>18 to 43</td>
<td>Major crop and pasture losses; extreme fire danger; widespread water shortages or restrictions.</td>
<td>-1.6 to -1.9</td>
<td>D3</td>
<td>-4.0 to -4.9</td>
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<tr>
<td>Exceptional Drought</td>
<td>44+</td>
<td>Exceptional and widespread crop and pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells creating water emergencies.</td>
<td>less than -2</td>
<td>D4</td>
<td>-5.0 or less</td>
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</tbody>
</table>

*NDMC - National Drought Mitigation Center

**D0 to D4**
# U.S. Drought Monitor

## Southeast

### Drought Conditions (Percent Area)

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>D0-D4</th>
<th>D1-D4</th>
<th>D2-D4</th>
<th>D3-D4</th>
<th>D4</th>
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<tbody>
<tr>
<td><strong>Current</strong></td>
<td>66.99</td>
<td>33.01</td>
<td>13.39</td>
<td>1.23</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td><strong>Last Week</strong></td>
<td>63.62</td>
<td>36.38</td>
<td>19.16</td>
<td>1.23</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>(04/02/2013 map)</td>
<td></td>
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</tr>
<tr>
<td><strong>3 Months Ago</strong></td>
<td>28.57</td>
<td>71.43</td>
<td>44.97</td>
<td>20.40</td>
<td>9.51</td>
<td>2.10</td>
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<tr>
<td>(01/08/2013 map)</td>
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<tr>
<td><strong>Start of Calendar Year</strong></td>
<td>29.15</td>
<td>70.85</td>
<td>45.65</td>
<td>20.64</td>
<td>9.58</td>
<td>2.10</td>
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<td>(01/01/2013 map)</td>
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<td></td>
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<tr>
<td><strong>Start of Water Year</strong></td>
<td>66.49</td>
<td>33.51</td>
<td>17.18</td>
<td>11.50</td>
<td>8.53</td>
<td>3.52</td>
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<td>(09/25/2012 map)</td>
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<td></td>
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<tr>
<td><strong>One Year Ago</strong></td>
<td>22.46</td>
<td>77.54</td>
<td>58.79</td>
<td>36.74</td>
<td>20.92</td>
<td>3.32</td>
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<td>(04/03/2012 map)</td>
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</tbody>
</table>

### Intensity:
- **D0 Abnormally Dry**
- **D1 Drought - Moderate**
- **D2 Drought - Severe**
- **D3 Drought - Extreme**
- **D4 Drought - Exceptional**
Tools to control drought are limited,

But we should be able to:

1. Short term – Assess severity of drought for management applications, i.e. fire

2. Long-term – Plan and implement hydrologic restoration to dampen incursions into deep drought
What’s the best way to track drought?
All sorts of Indices

- Drought Monitor Index (D0-4)
- Palmer Drought Index
- Standardized Precipitation Index
- NOAA Drought Severity Classification
- Fire metrics (100 hr, 1000 hr, etc)
- Keetch Byram Drought Index
- Bass pond behind Bubba’s place

... The List goes on
Current KBDI Readings

Problems with KBDI:

- Varies across Florida
- Doesn’t show trends
- Not 100 percent suitable for south Florida

Why?
Note of Interest:

North Florida has a wetter winter than south Florida, but late spring drought severity actually surpasses south Florida.
Florida’s KBDI annual cycle 2000-2011
Collier County’s KBDI statistics 2000-2012

**KBDI Graph for Collier County**

Statistical overview of Keech Byram Drought Index for Collier County, Florida. Data source: Florida Forest Service

**Color Coding** as seen on KBDI maps

- 300-399
- 200-299
- 100-199
- 0-99
- 550-599
- 500-549
- 450-499
- 400-449
- 650-699
- 600-649
- +750

**Shading Coding** 10-year KBDI statistics

- max
- 90th %tile
- 66th %tile
- median
- 33rd %tile
- 10th %tile
- min

KBDI Value

2011

2012

2013
### KBDI Summary Table

**Florida-wide**

<table>
<thead>
<tr>
<th>Regions</th>
<th>KBDI Value</th>
<th>long term daily mean</th>
<th>one month ago</th>
<th>one year ago</th>
<th>Period of Record Calendar</th>
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<tbody>
<tr>
<td><strong>FLORIDA</strong></td>
<td>390</td>
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<tr>
<td><strong>PANHANDLE</strong></td>
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<tr>
<td>Blackwater</td>
<td>104</td>
<td>↓-141</td>
<td>↓42</td>
<td>↓205</td>
<td>PQR</td>
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<tr>
<td>Chipola</td>
<td>154</td>
<td>↓-79</td>
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<td>Tallahassee</td>
<td>186</td>
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<td>↑130</td>
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<td>Perry</td>
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<td>Suwannee</td>
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<td>↓273</td>
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<td><strong>NORTH PENINSULA</strong></td>
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<td>Jacksonville</td>
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<td>Withlacooche</td>
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<td>Orlando</td>
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<td>↓67</td>
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<td>Lakeland</td>
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<td>↑100</td>
<td>↓75</td>
<td>↓132</td>
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<td><strong>SOUTH PENINSULA</strong></td>
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<tr>
<td>Mulakka River</td>
<td>430</td>
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<td>Okeechobee</td>
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<td>↓11</td>
<td>↓31</td>
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<tr>
<td>Caloosahatch</td>
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<td>↑37</td>
<td>↓42</td>
<td>↓177</td>
<td>PQR</td>
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<tr>
<td>Everglades</td>
<td>512</td>
<td>↑36</td>
<td>↓28</td>
<td>↓141</td>
<td>PQR</td>
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<tr>
<td>Collier</td>
<td>486</td>
<td>↑35</td>
<td>≥-5</td>
<td>↓140</td>
<td>PQR</td>
</tr>
</tbody>
</table>

From [Drought Tab in Go Hydrology! website](http://example.com)
But core problem remains:

KBDI is an **imperfect** index for landscape susceptibility to drought in large wetland areas
Why is this?

- Predicts deep spring drydown too early

- Thus, it gets the fall, winter and early spring wrong

Comparison of median water levels and Keech Byram Drought Index for Big Cypress National Preserve, 2000-2011

*Upper and lower values for both vertical axes are drawn to match the historic range
Better word to replace drought?

1. Don’t scare public
2. Advertising friendly
3. Ecosystem relevant
4. Anything but drought
Short list of entries

1. Apocolypse of aridity Index
2. “End of water cycle” cataclysm Index
3. Devestation of drynessness Index
4. Popcorn Index
Very saturated
(crackers recommended)

Mostly moist

Supposed to be moist

Mostly dry with small pool
of rapidly vanishing salsa

Extreme drought
(very large soda recommended)
Parchedness

1. To make extremely dry, especially by heat. 2. To make thirsty. 3. To dry or to roast (corn, for example) by exposing to heat 4. Index for explaining drought severity in large wetland environments
Best place to predict Parchedness in the swamp?

Answer: pond apple forest
Best place to predict Parchedness in the swamp?

Answer: pond apple forest
Relationship between Hydrology and Parchedness in Big Cypress National Preserve

Hydrology

Water level
Staff Gage in feet

Parchedness

P0 Very Saturated
P1 Saturated
P2 Flooded Peat
P3 Patchy Peat
P4 Dry Peat
P5 Dry Refugia

Proportion of habitats in Big Cypress National Preserve (as percent)

Expansion potential of wildlands fire

negligible moderate high extreme

50 25 0
Landscape based, not just meteorologic
Define probability of parchness by **month**

**Monthly Drought Severity**

![Diagram showing monthly drought severity with colors representing different probabilities (P0, P1, P2, P3, P4, P5) and a legend indicating percent of occurrence and months per year.](image-url)
When did management burns occur in Big Cypress National Preserve?

relative to calendar year
What was the KBDI index and **water level** index during the management burns, 2000-2011?

Comparison of KBDI and Water levels as a Suitability Index for Management Burns

- Poor correlation, management burns occur over a wide range of KBDI values

- Stronger correlation, management burns occur between 0 and 2.0 ft
Application of Water-Level based Drought Index Across Everglades

From Side Bare of Go Hydrology! website
Water Conservation Area 1
Loxahatchee

Historical Calendar showing
Wetland Parchness Severity
in Water Conservation Area 1
using Regulatory Stage
1963 to present

Lowest → wildfire severity → Highest

very wet
prescribed
very saturated
flooded
P0
P1
Saturated

transition

dry peat
P2
P3

suppression

Refugia

water depth (in feet) in marsh
Advantages of Parchedness

• Simple to convey
• Practical to use
• Historically comparable
• Geographically precise

But how do we prevent it?
New Paradigm for Preventing Wildfires: Add Water To Ecosystem
What’s **wrong** with this picture?

- Wet season storage **escaping** to tide
- Water not getting into wetlands **across** road
- Legacy and **derelict** infrastructure
Cost to fight wildfires over past 8 years

But $0 long-term benefit towards increasing swamp’s natural resilience to fight wildfire
Hydrologic restoration is actually a cheap and high return investment
Next Steps

**How do we adopt the parchedness Index?**

**How do we prolong non-parchedness in the swamp?**

Photo of *non* parchedness