

# Growing Up: From AutoCAD to ArcGIS

**Ericka Witcher**



**MONTGOMERY BOTANICAL CENTER**

Advancing Research, Conservation and Education through Scientific Plant Collections





# MONTGOMERY BOTANICAL CENTER

- Non-profit research center
- 12,000 plants on 120 acres in Miami, Florida
- Sub-tropical zone





- MBC specializes in growing palms...



...and cycads



- tropical conifer collection is growing, too



# Focus on wild-collected plants

- MBC uses population-based sampling to build collections
- 74% of our palms and 85% of our cycads are known wild-collected
- Stringent about permits
- 26% of our taxa are IUCN red-listed

# Ex-situ conservation

- Botanical collections have become very important for ex-situ conservation

- 
- Extinct in the wild
  - only 20 known plants worldwide
  - MBC has 13

*Corypha taliera* - India






- Widespread devastation due to cycad aulacaspis scale (CAS)
- MBC has representatives from many different populations

## *Cycas micronesica* - Guam

# Ex-situ conservation

- Botanical collections have become very important for ex-situ conservation
- In-situ conservation isn't always likely or possible

- 
- Found in only one known location

*Hemithrinax ekmaniana* - Cuba

# Ex-situ conservation

- Botanical collections have become very important for ex-situ conservation
- In-situ conservation isn't always likely or possible
- Recent paper contributed to by MBC demonstrated that a sample size of 15 can have a very high allelic capture

# Generally speaking...

- We're looking to maximize survival rates with analysis of current collections and records, both spatial and temporal

# Data

- MBC maintains meticulous records



# Data

PLANTS (BG-BASE) - 4 pages - (PLANTS ENTRY: 1 / Copernicia tectorum)

File Edit View Options Database Search Help Favorites

MSA 00 MAY 04 08:13 AM

Copernicia tectorum

Accession: 94853 (Parent of, also provided) SEC 2001

Quantity: 0 (5 seedling, also known to) (Fruit, CLIMBER, STURDY?)

Barcode: (optional) (for use with barcode) (Barcode)

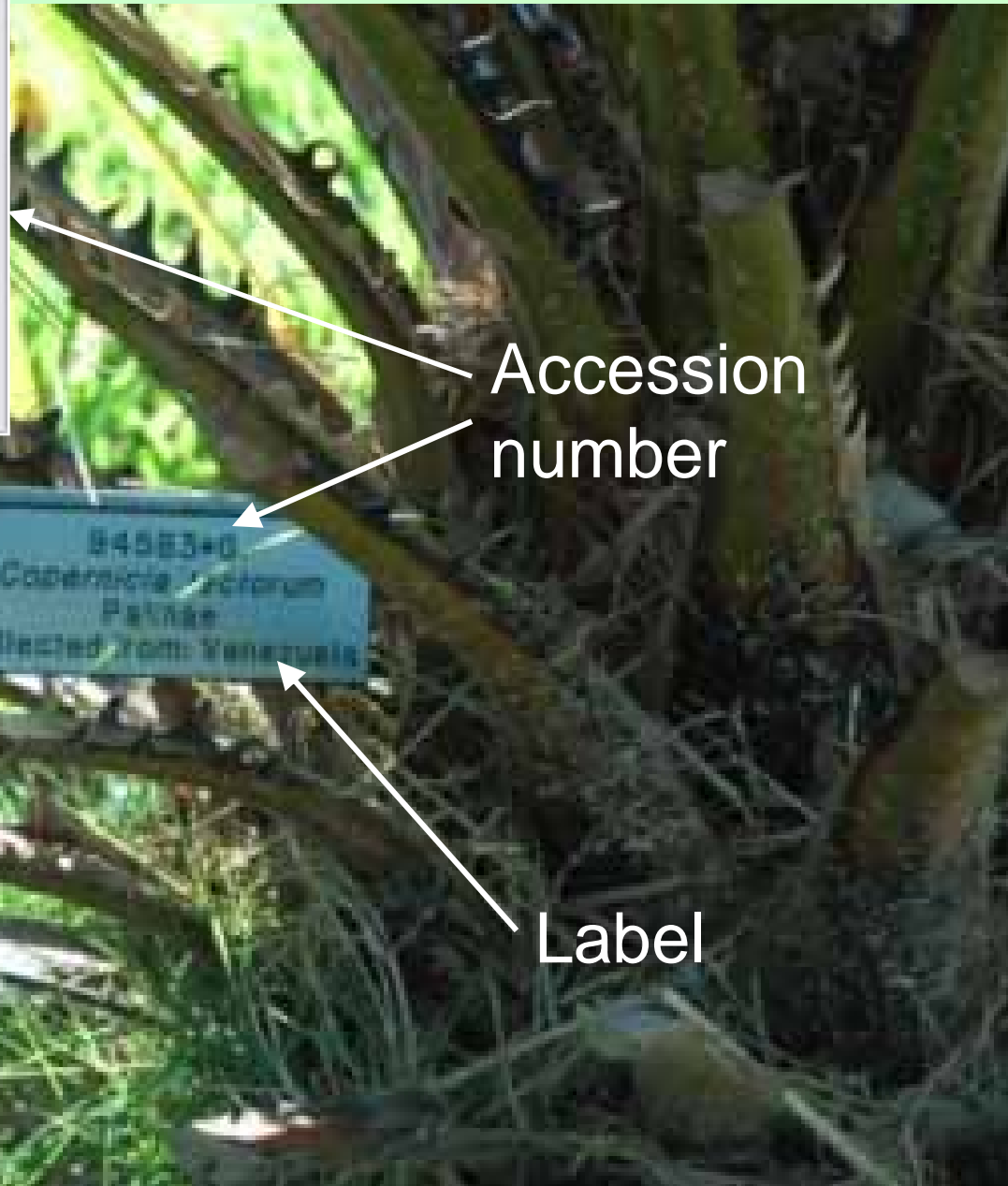
Number: (Number)

Location: (optional) (check and add) (check and add) (check and add) (check and add)

Code	Country	Site	U	V	W	X	Y	Z	Accession	Q	Barcode	date	
94853	Venezuela	HC							sec 2001	D		27 Aug 2001	1
94854	Venezuela	HC							sec 2001	D		6 May 2001	1

Field observations: (check and add) (check and add) (check and add) (check and add) (check and add) (check and add)

Code	Condition	Q	Observed	Observed	Observed	Observed	Observed	Observed	Observed	Observed
A	site	D	1 Dec 2000						Herbar 2001-0000	Gaudin P. Galin
A	site	D	21 Jan 2000						Herbar 2001-0000	Etienne L. Wicher
A	site	D	6 May 2000						Herbar 2001-0000	Gaudin P. Galin
A	site	D	11 Feb 2000						Herbar 2001-0000	Gaudin P. Galin
A	site	D	6 May 2000						Herbar 2001-0000	Bertram A. Datta
A	site	D	1 Dec 2000						Herbar 2001-0000	Bertram A. Datta



Accession number

Label

# BG-Base

ACCESSRONS - [ACCESSRONS\_IHTDY\_TA] - [ACCESSRONS\_IHTDY\_TA]

File Edit Home Contents Materials Window Stat Reports Help

STR 26 FEB 95 LTR 06 MAR 99

Accession #  *Adalea crassipatha*

Acc date  PALMAE

Name num  3 other accessions of this name 2 records in PLANTS table

Lineage num  accepted name PWBE

Material received

Recd as

Recd how   name changed

Recd dt  Recd size

Recd notes

Prov type  collected directly from wild; origin known

Seed source

Source information (first value is current) (use Ctrl-N to create a blank line)

Source # (1)	Source name	Source acc #
1	Fairchild Tropical Botanic Gan	

Accessions 1    Hort\_1

Procurer 1    Vendor

PLANTS (BG-BASE) - 4 pages - [PLANTS\_IHTDY\_T / Adalea crassipatha]

File Edit Home Contents Materials Window Stat Reports Help

STR 26 JUN 97 AAS 13 JAN 98

*Adalea crassipatha*

Acc num  PWBE, 1 pL, alive, checked 08 DEC 2006

Qualifier  2 editing qualifiers: A D

Barcode  collected directly from wild; origin known PALMAE

Herbarium

Location (first line is most recent) (when adding a new location, use Ctrl-N to create a blank line)

Code> (2)	Location	Grid	X	Y	Z	C t>	Change type	Q>	Plant date	#Pls
PWBE	Palm/WaldEast	Hll				R	remapped	D	18 Jul 1997	1
Hll						P	planted	D	25 Jun 1997	1

Field checks (observations) (first line is most recent) (when adding a new observation, use Ctrl-N to create a blank line)

Code> (1)	Condition	Q>	Check dt	Res >	Yeg >	D>	C>	Check note	Check by >
A	alive	D	8 Dec 2006					Noted in 2006 inventory	Claudia P. Calon
A	alive	D	28 Jan 2008					Noted in 2008 inventory	Erica L. Wicher
A	alive	D	8 Nov 2007					Noted in 2007 inventory	Sandra S. Rignotti
A	alive	D	19 Oct 2006					Noted in 2006 inventory	Sandra S. Rignotti
A	alive	D	2 May 2006					1 leaflet collected by Dr. Alan Meerow, of UI	Larry Nodárik
P	poor	D	28 Oct 2005					Hurricane Wilma, 24OCT05 - Bud damage,	Leslie Daniels

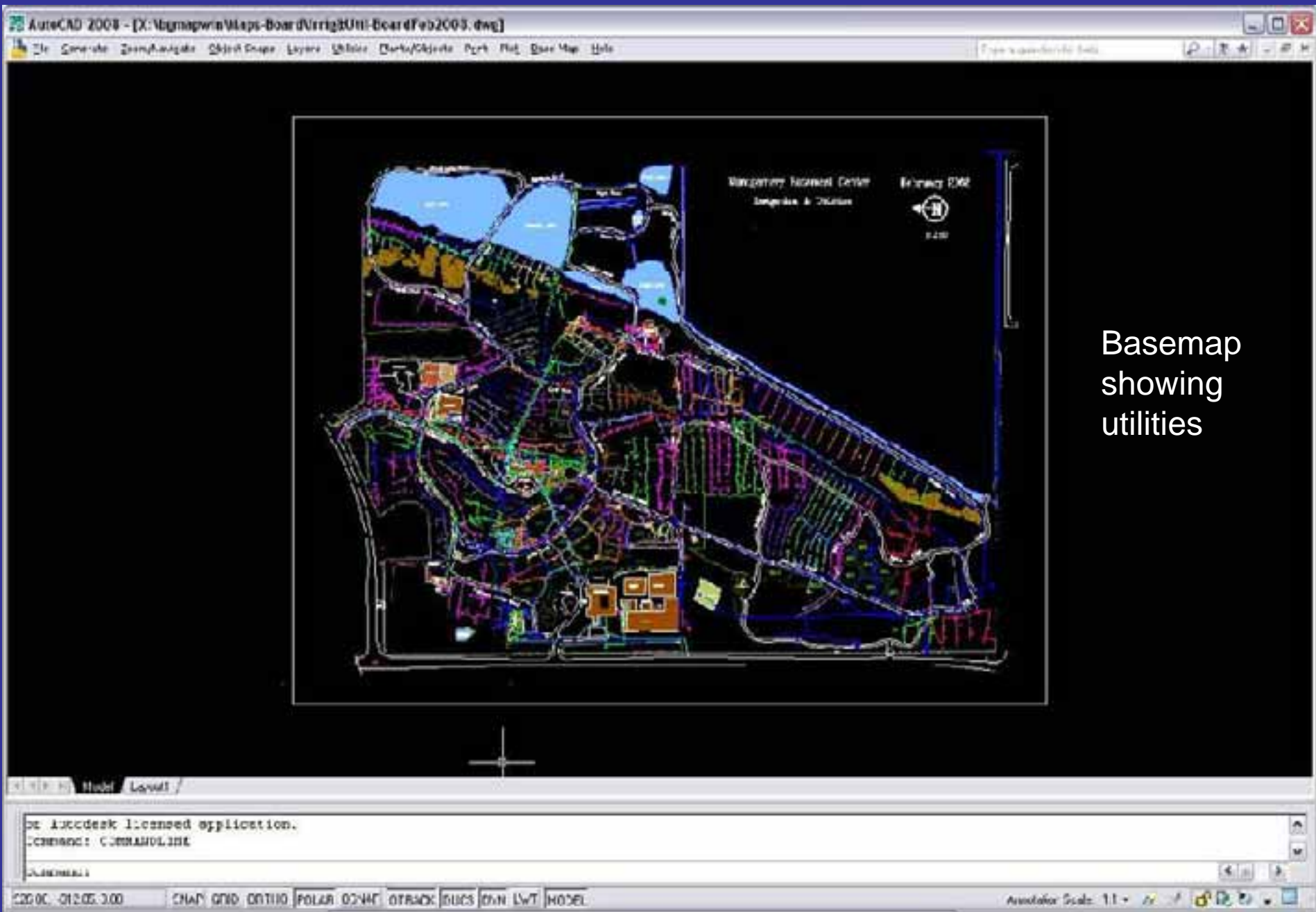


# How we began – AutoCAD maps and tables

- a catalog of who was where, but not much more info
- within the map itself, the lines and symbols had no meaning
- maps for display, locating plants or utilities



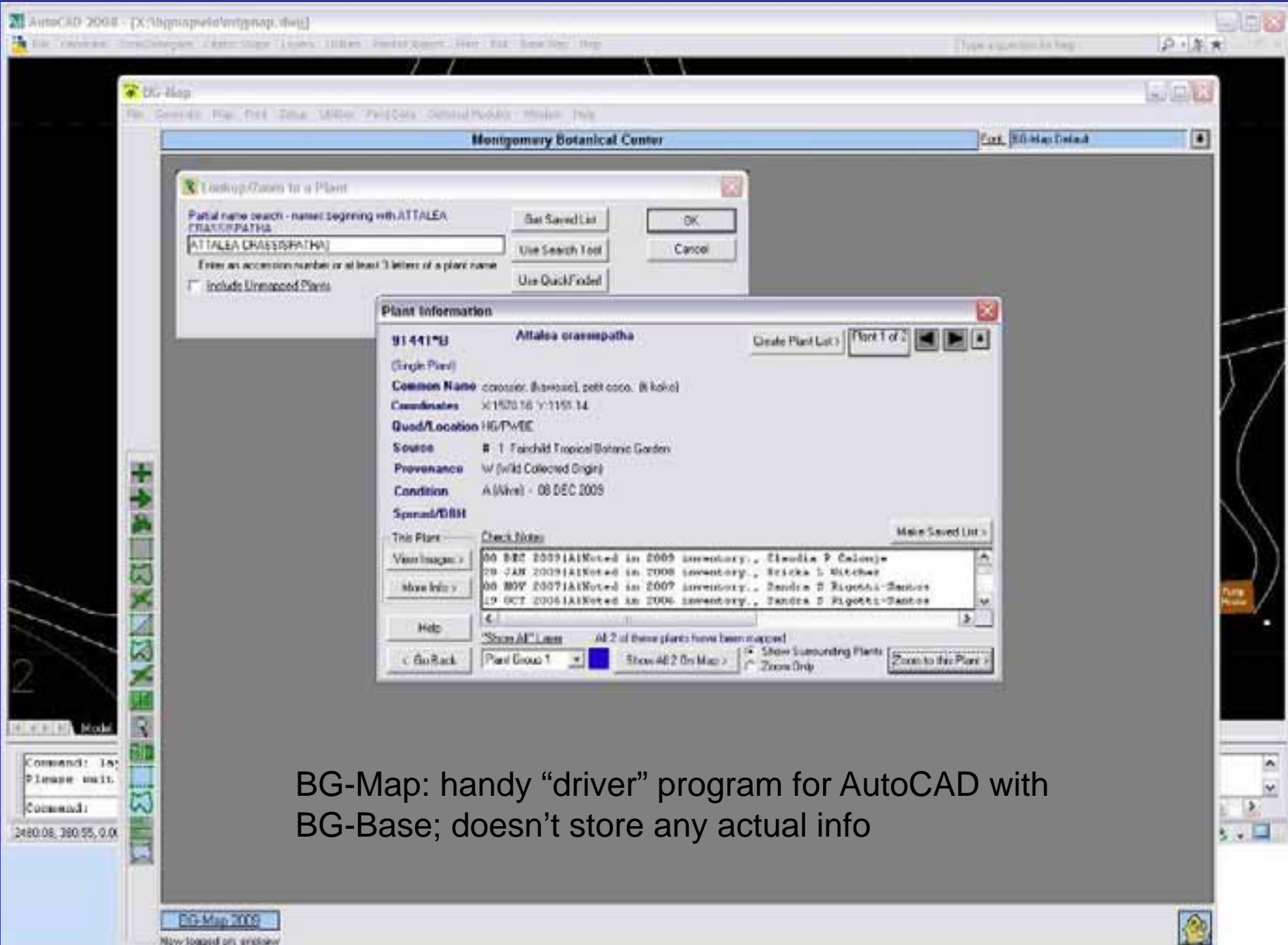
Basemap showing plant locations



Basemap showing utilities

# How we began – AutoCAD maps and tables

- basic integration of database (BG-Base) with AutoCAD through BG-Map

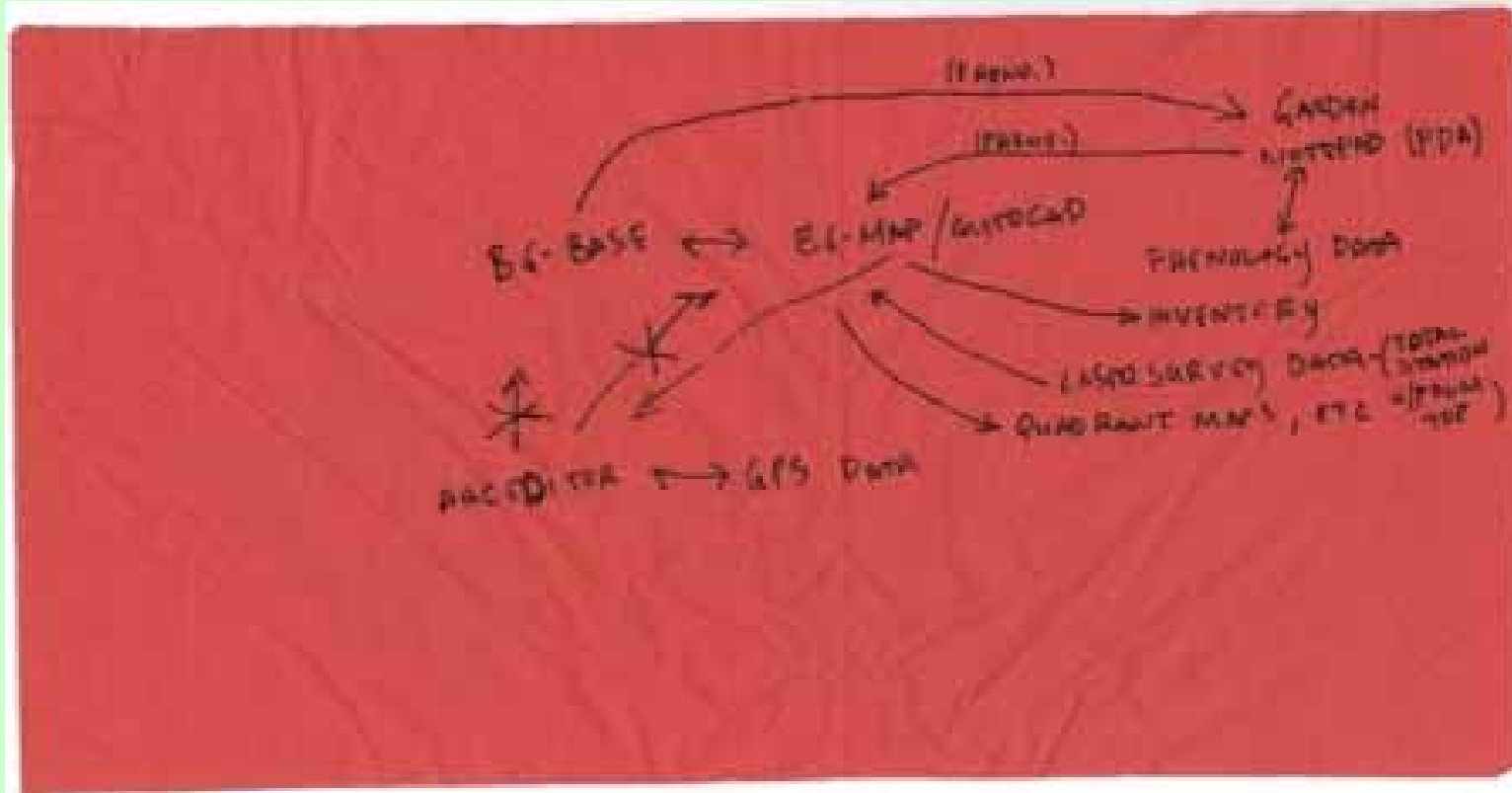


BG-Map: handy "driver" program for AutoCAD with BG-Base; doesn't store any actual info

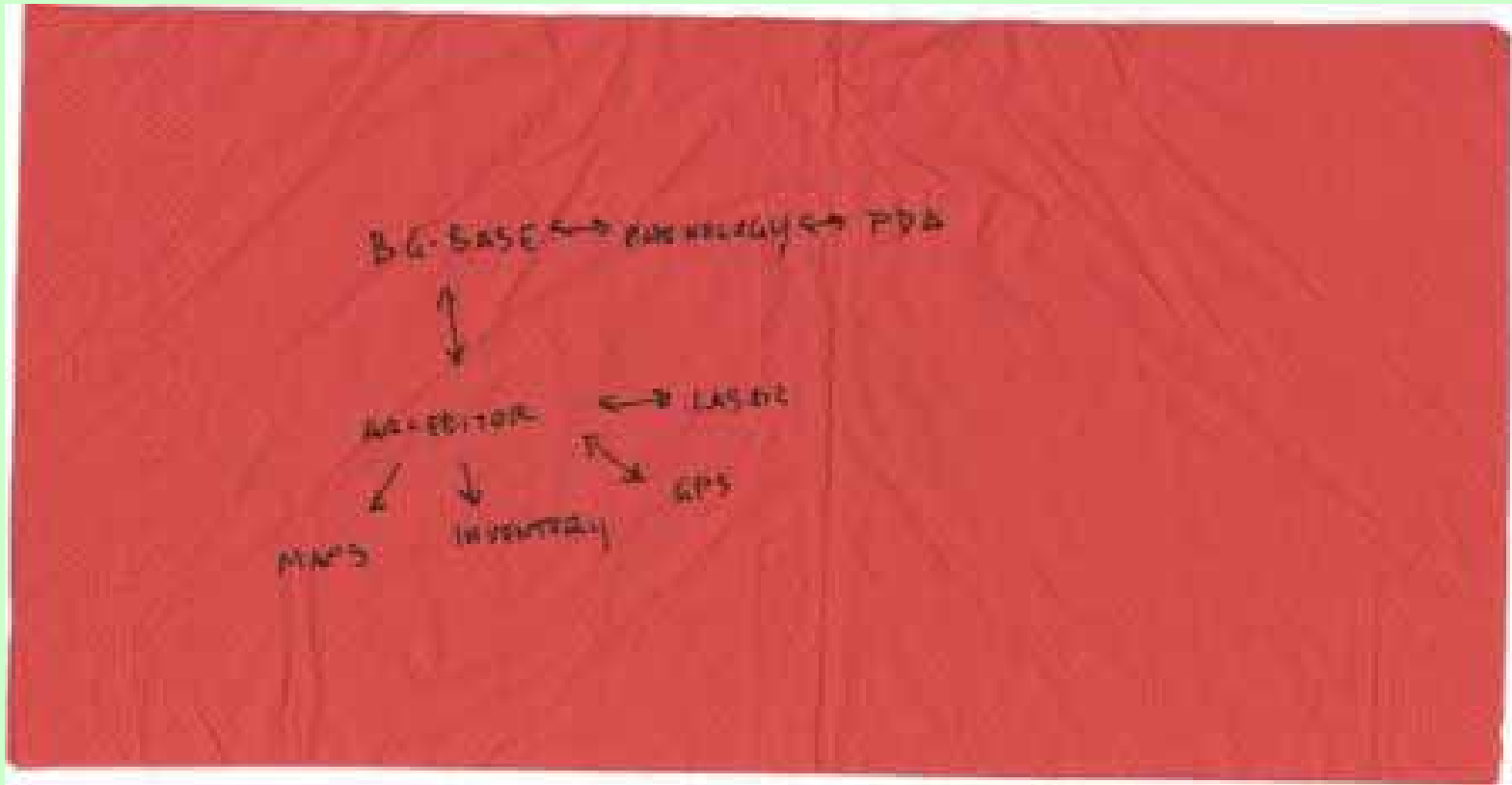
# How we began – AutoCAD maps and tables

- desire for something more powerful
- easy to use with a GPS unit
- myself and Michael's previous experience
- ESRI Botanical Garden and Zoological Park (BGZP) grant
- TopCon TotalStation breaking clinched it – had to do a complete conversion

# The napkin: what I had THEN (ca. ESRI UC 2008)



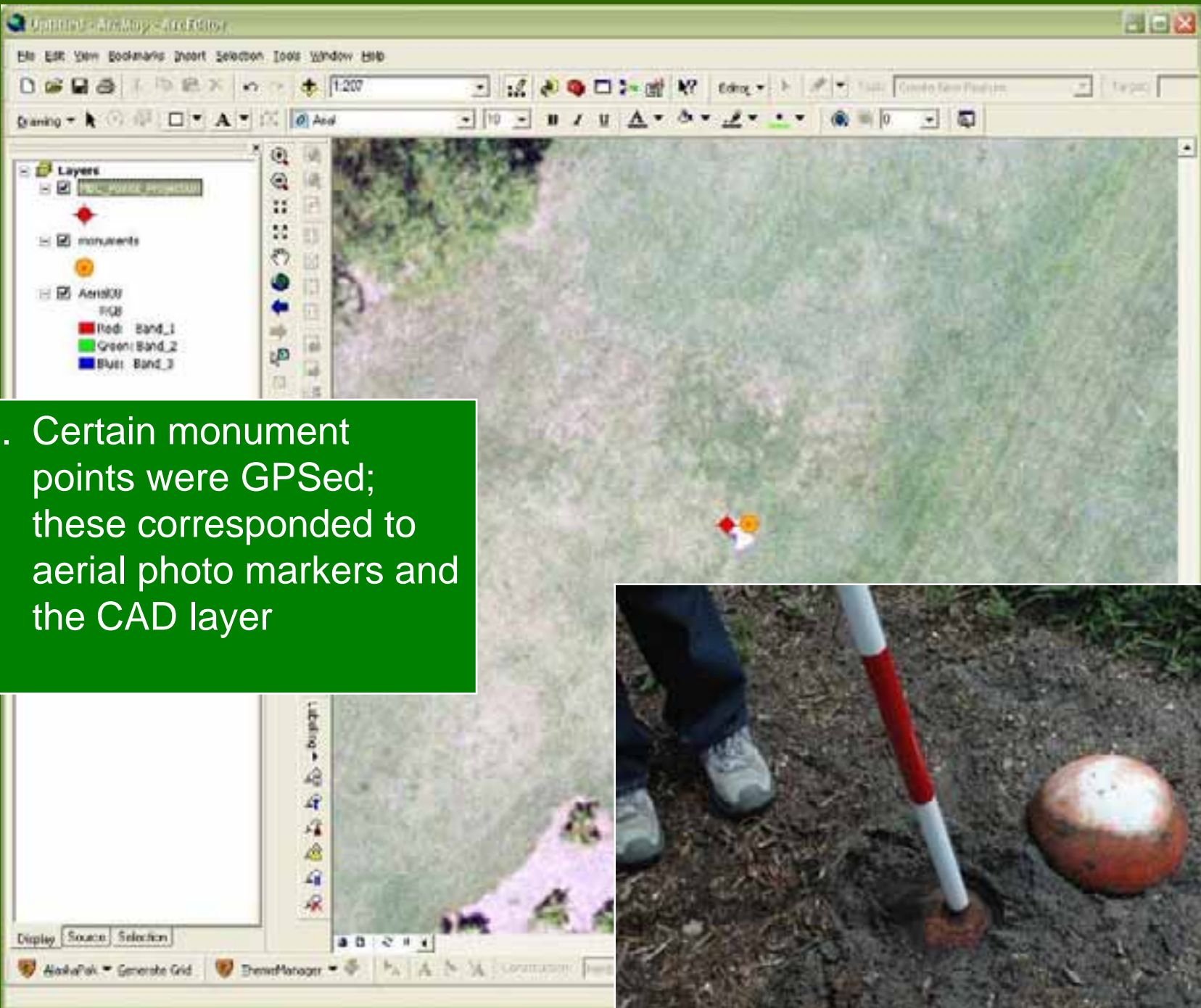
# The napkin: what I wanted



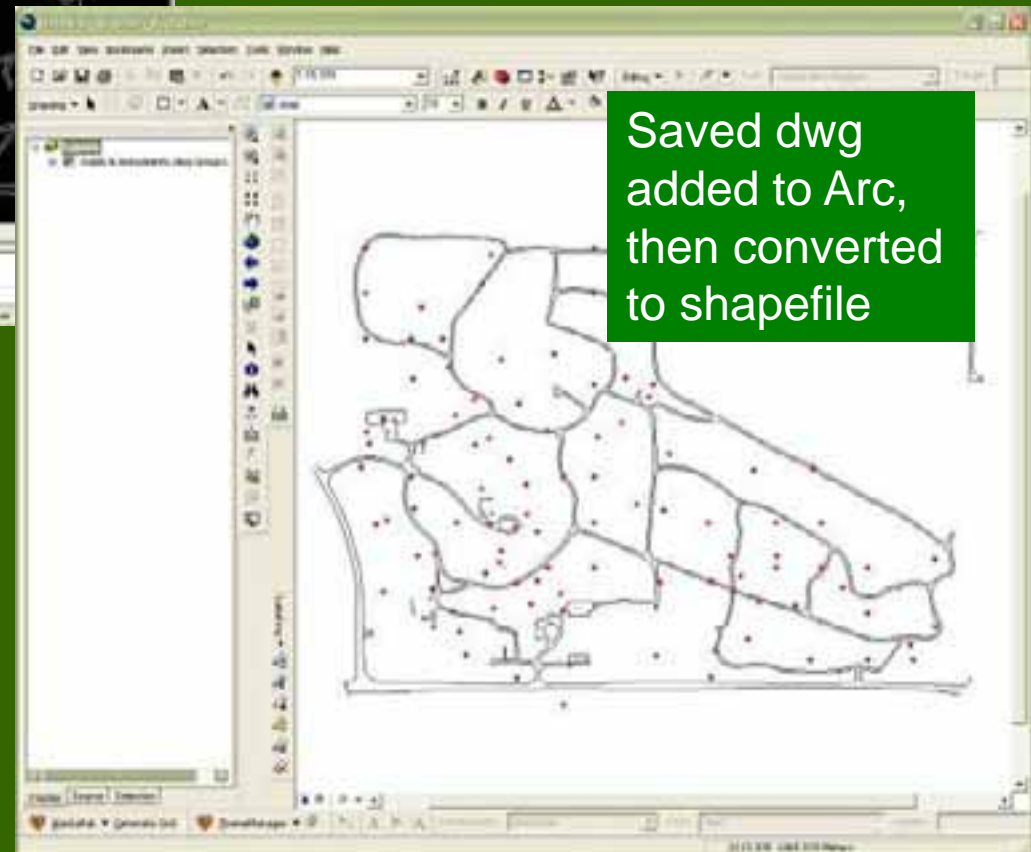
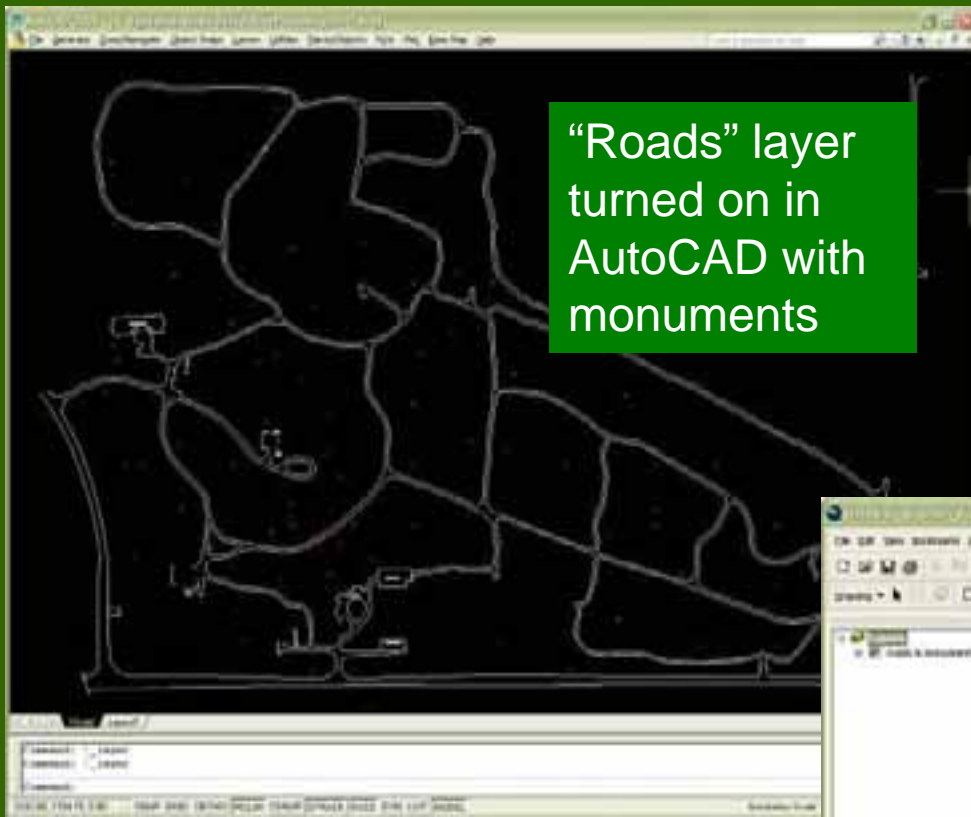


A large, ancient tree with many buttresses and aerial roots, possibly a banyan tree, in a natural setting. The tree is the central focus, with its thick, gnarled trunk and numerous aerial roots hanging down. The background shows a dense forest with green foliage and a path leading through the trees. The overall scene is a natural, outdoor environment.

# The Process: from AutoCAD to ArcGIS

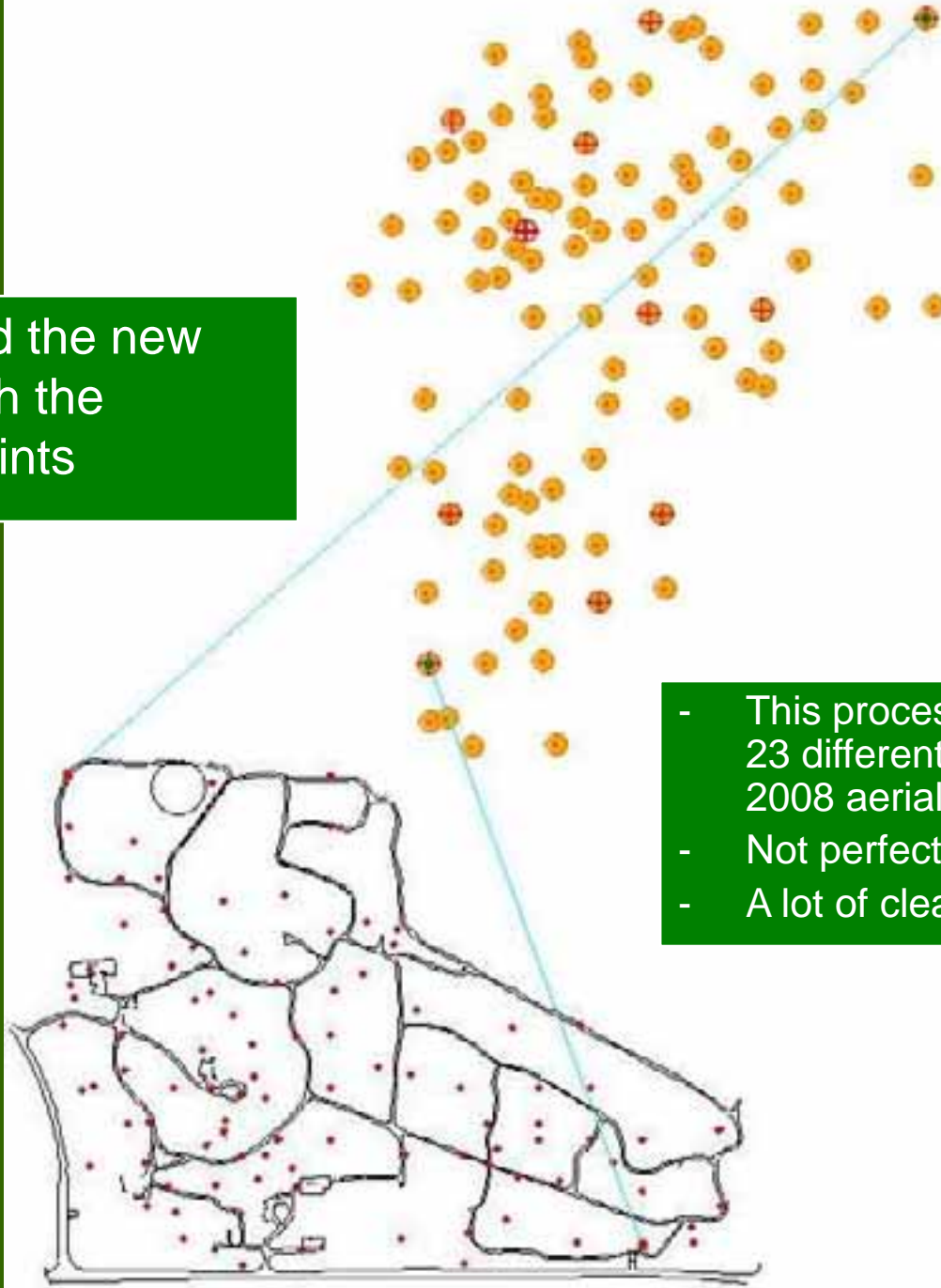


1. Certain monument points were GPSed; these corresponded to aerial photo markers and the CAD layer



2. Once in Arc,  
exported individual  
CAD layers into  
shapefiles with same  
monument points

### 3. Georeferenced the new shapefiles with the monument points



- This process was repeated for 23 different CAD layers and the 2008 aerial photo
- Not perfect, some skewing
- A lot of clean-up

# The Process: from AutoCAD to ArcGIS

- GPSed/digitized other new things (eg. new utilities, expanded rock areas, turf areas)
- Soon able to make up-to-date, basic new maps quickly for staff, researchers, etc

# Protocols: new methods

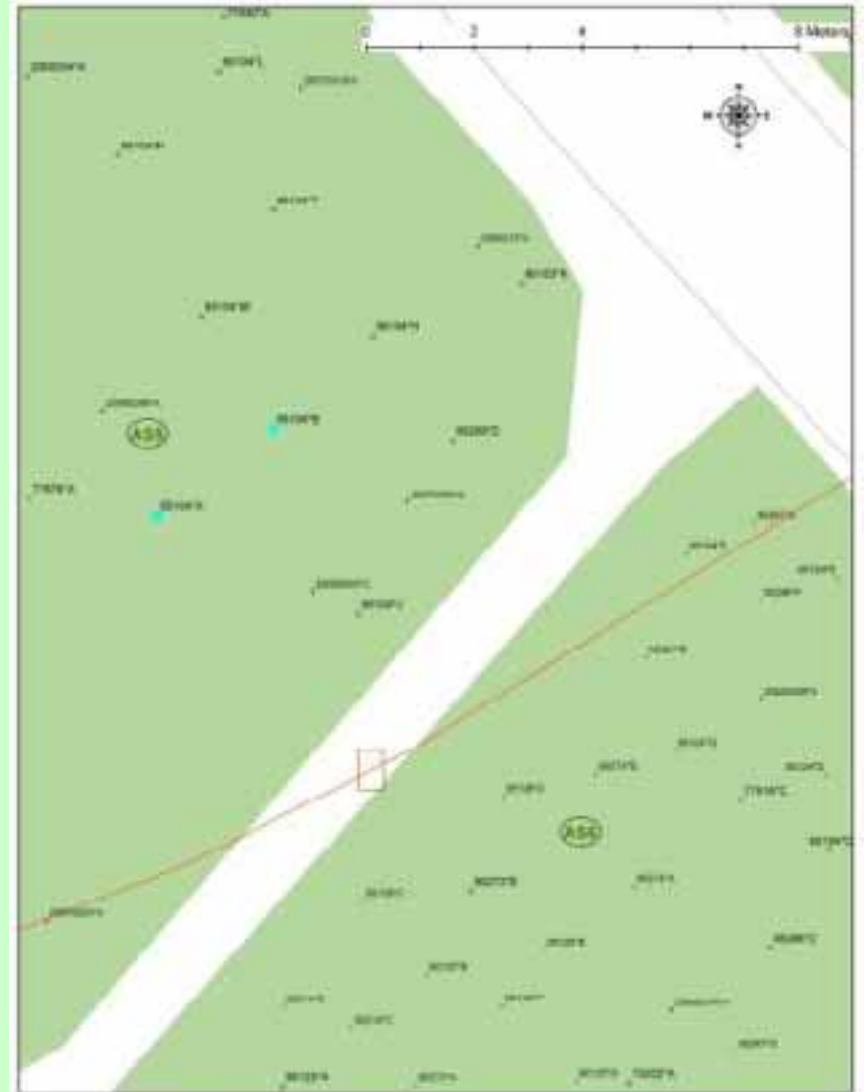
how to do what we did before, but in Arc?

- Finding plants, etc for staff and others



Visiting Researcher

vs.



Curatorial Staff

# Protocols: new methods

how to do what we did before, but in Arc?

- Finding plants, etc for staff and others
- Large format maps
- Inventory – process and maps



The screenshot shows the ArcGIS Desktop interface. The main map area displays the Montgomery Botanical Center with several layers visible in the Layers panel on the left. A context menu is open over the map, and a data table window is also open, showing a table with columns for FID, Shape, OBJECTID, Accession#, Species Name, Area Code, and Date GPS.

**Layers Panel:**

- GPS
- Features In Progress
- GPS missions
  - Correction Type
    - Corrected
    - Uncorrected
- 08/2009
  - Type
    - cycad
    - palm
    - conifer
    - other
- 08/2009 names
- 08/2009 plants
  - Type
    - leafed
    - palm
    - conifer
    - other
- plant names
- monuments
- hardware
- grid
- island
- escarpment
- water
- hammock out
- cycad beds
- buildings

**Data Table:**

FID	Shape	OBJECTID	Accession#	Species Name	Area Code	Date GPS
10804	Point	0	2004045571	Ataxa cuneata	PVCW	8/4/2009
10805	Point	0	2004045572	Ataxa cuneata	PVCW	8/4/2009
10806	Point	0	2004045573	Ataxa cuneata	PVCW	8/4/2009
3782	Point	0	9618179	Louisa spirosea	JT	8/4/2009
3786	Point	0	96227E	Psychopoma elegans	JT	8/4/2009
3784	Point	0	96227S	Psychopoma elegans	JT	8/4/2009
3796	Point	0	96227C	Psychopoma elegans	JT	8/4/2009
3797	Point	0	96227D	Psychopoma elegans	JT	8/4/2009
3802	Point	0	96227R	Psychopoma elegans	JT	8/4/2009
3003	Point	0	36228S	Psychopoma elegans	JT	8/4/2009

Don't need too many layers - just enough to locate plants when printed in B&W

Only need 'Acc#', 'Sp. Name', and 'Type' fields for each quad report

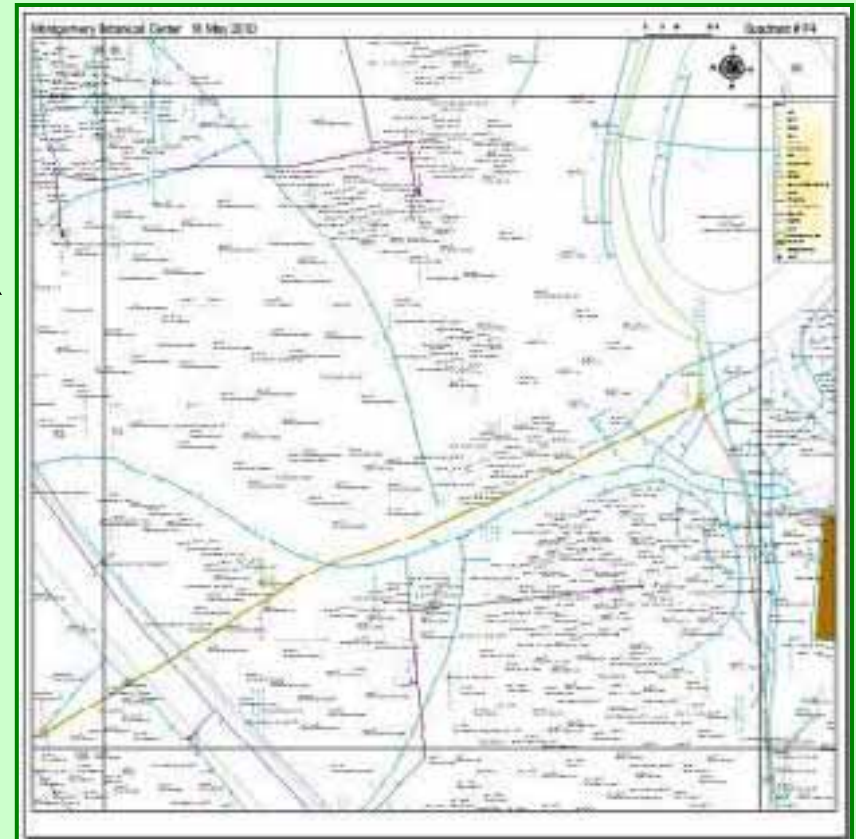
# Protocols: new methods

how to do what we did before, but in Arc?

- Finding plants, etc for staff and others
- Large format maps
- Inventory – process and maps
- Quadrant maps – the doozy



- MBC has 127 quadrants with plants, utilities, etc

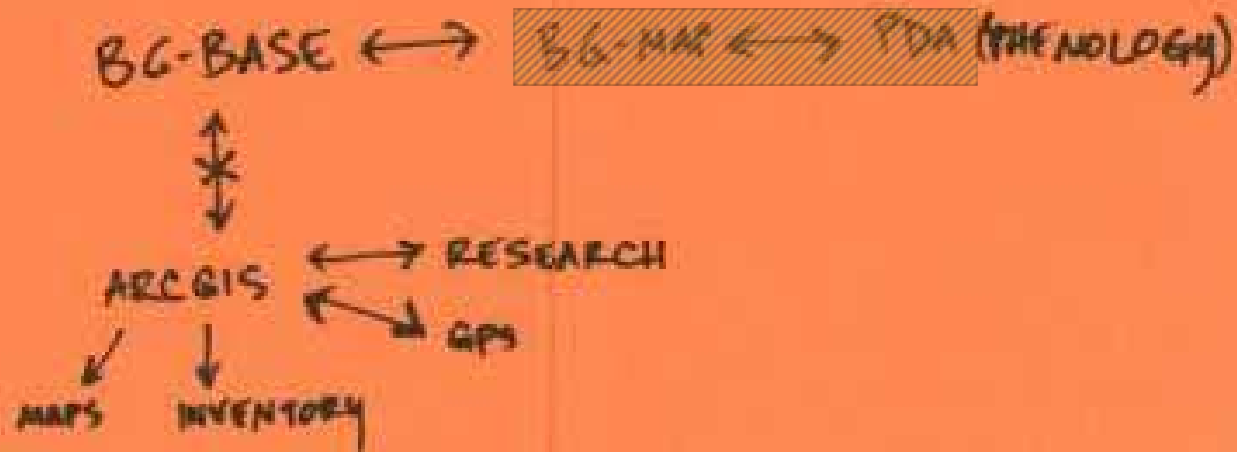


# more about the Quadrant Map

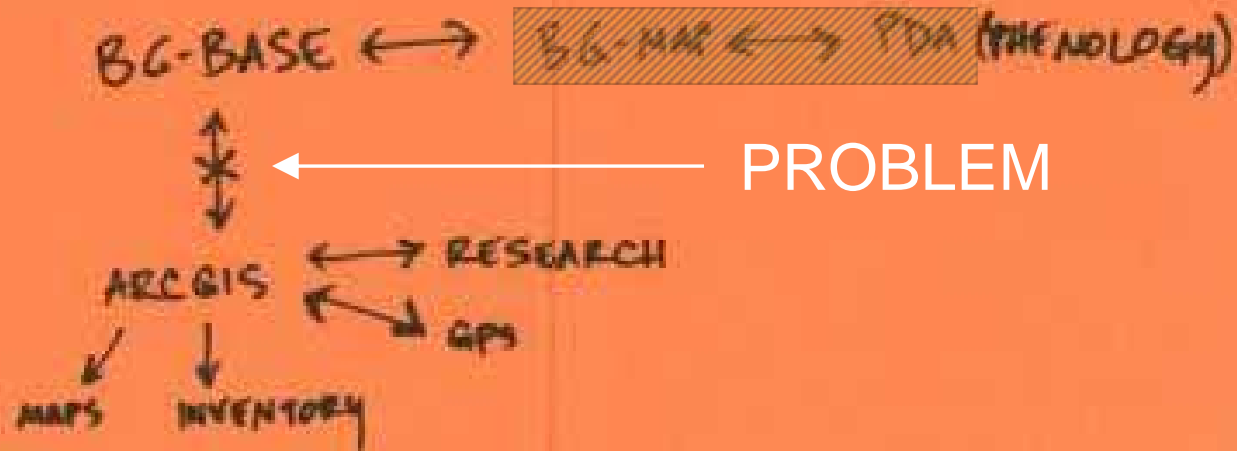
- Quad maps are used for all field operations
- Lots of visual information must be displayed at once
- Text notes stored in AutoCAD map are essential: represent former and current employee knowledge about an area, guide decisions about everything



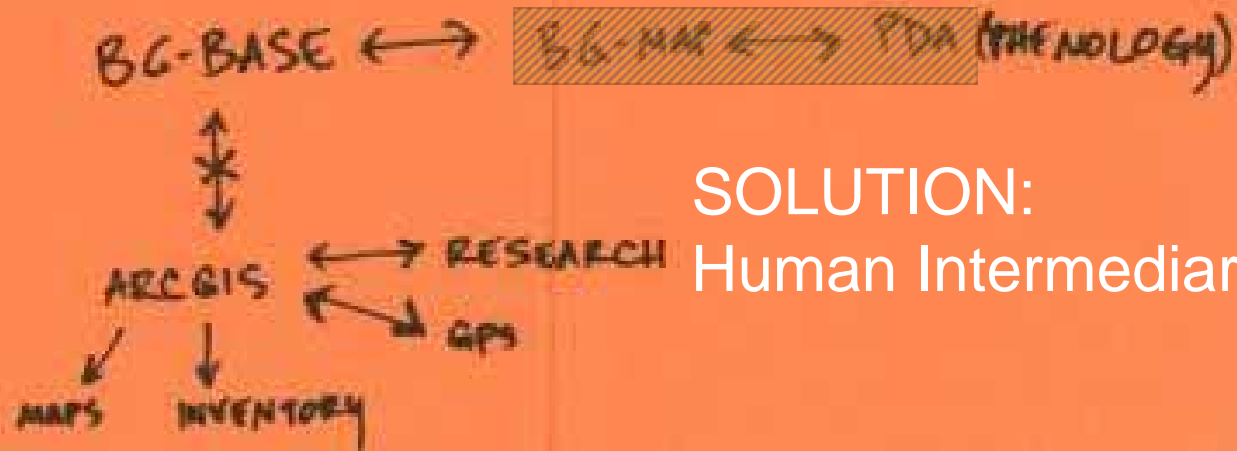
# New napkin: what I have now (2010)



# New napkin: what I have now (2010)



# New napkin: what I have now (2010)



SOLUTION:  
Human Intermediary

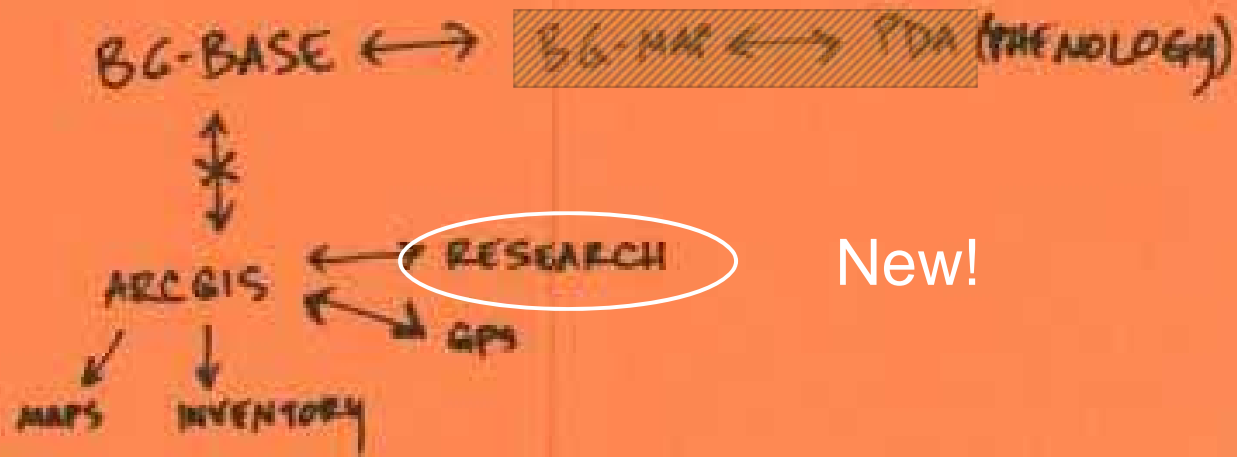
(i.e., I do double-data entry)



# Onward & Upward

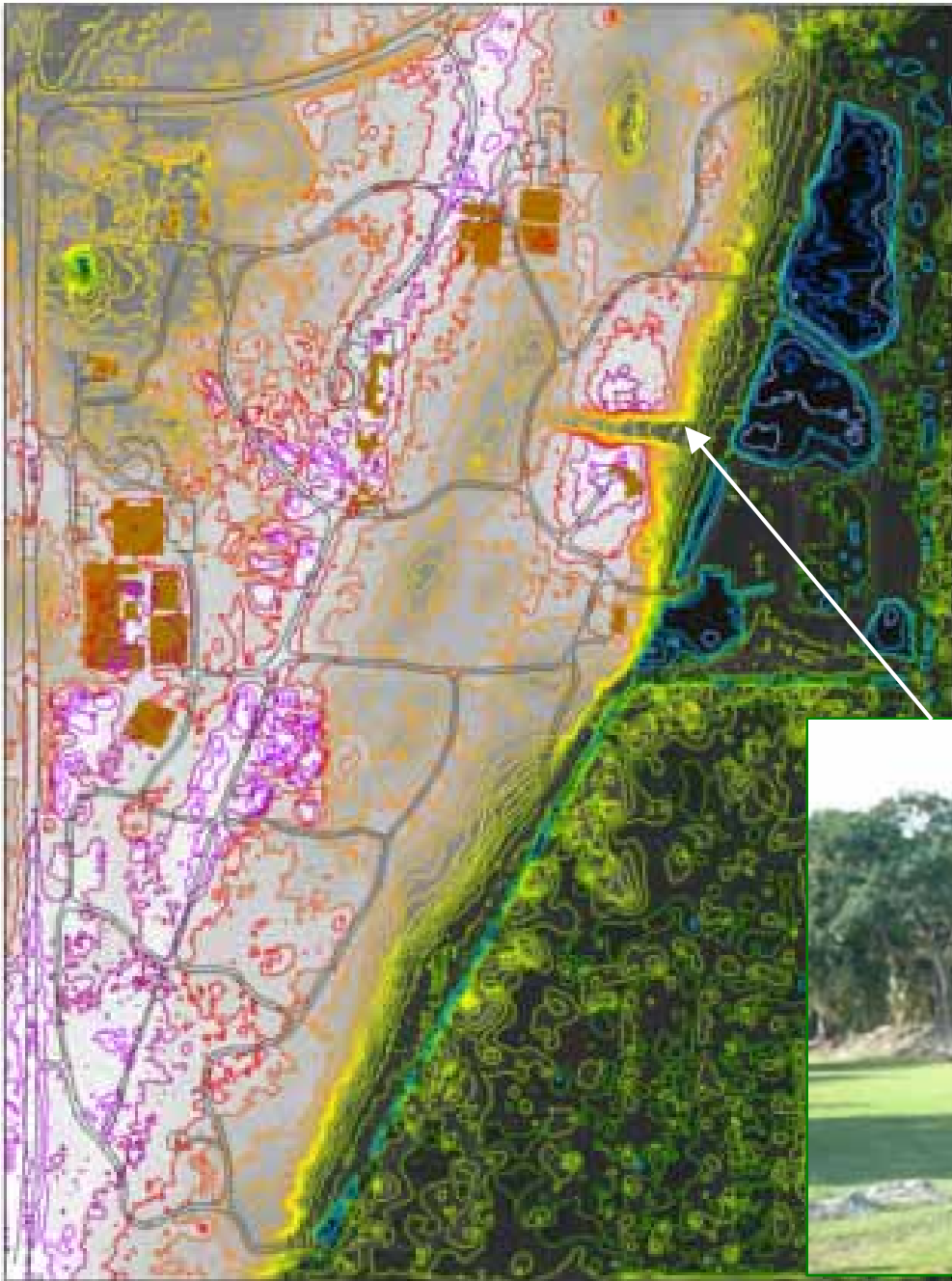


# Onward & Upward



# Onward & Upward

- Many different study and assessment options now available
- Spatial: analysis with imagery, proximity studies
- Temporal: phenology data projection

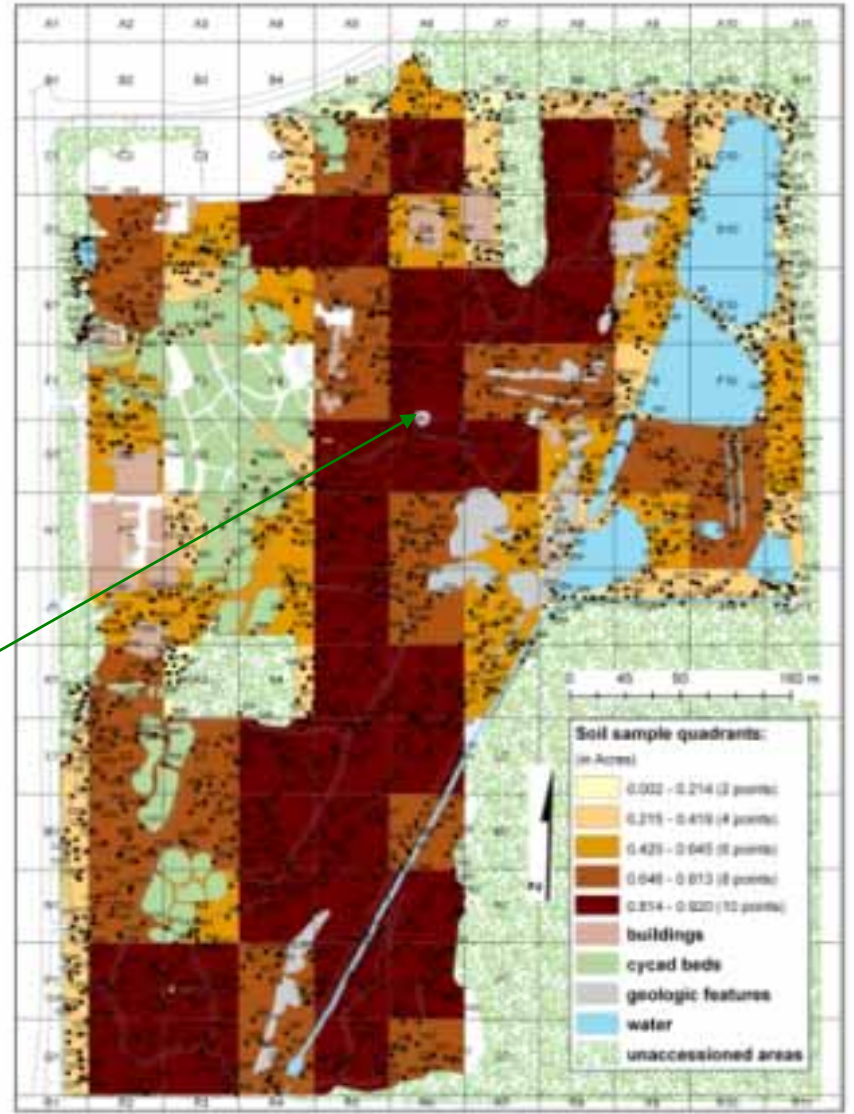


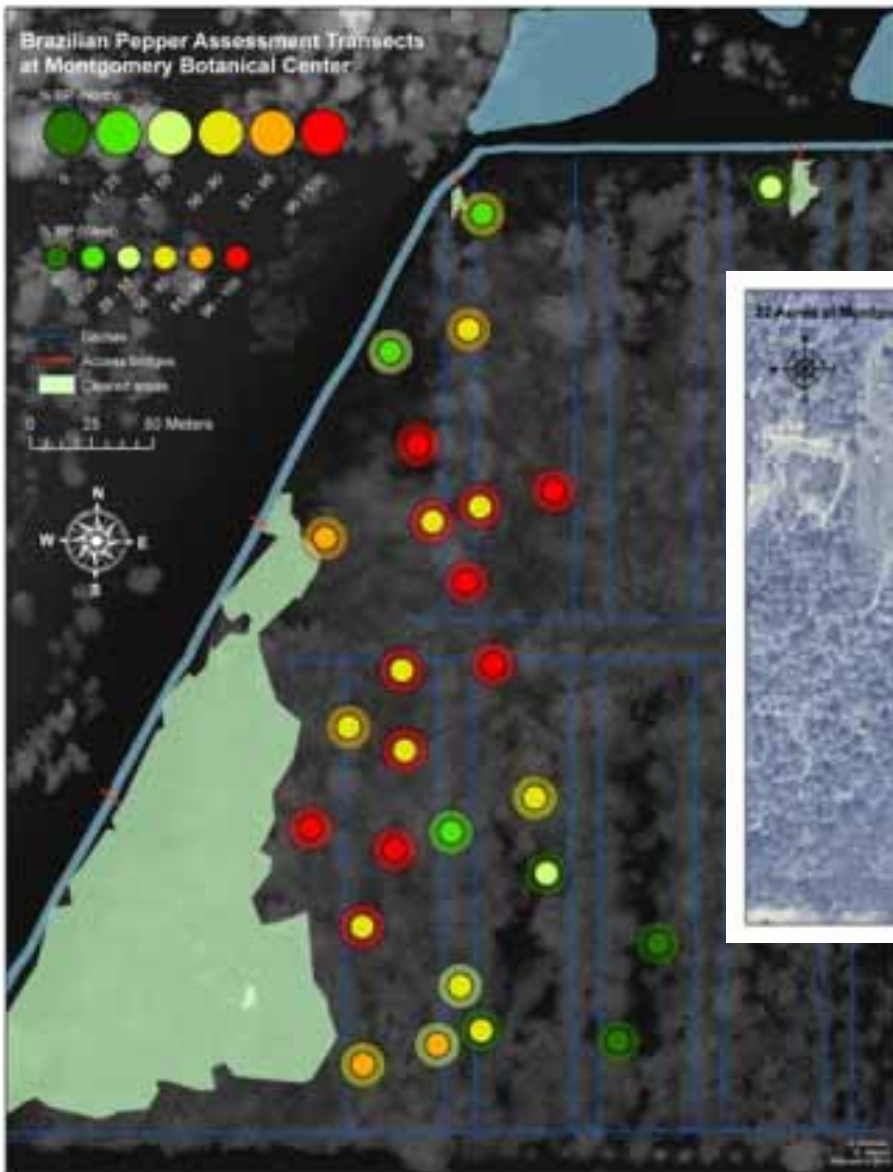
- LiDAR provides clues for planting locations



# Soil Map

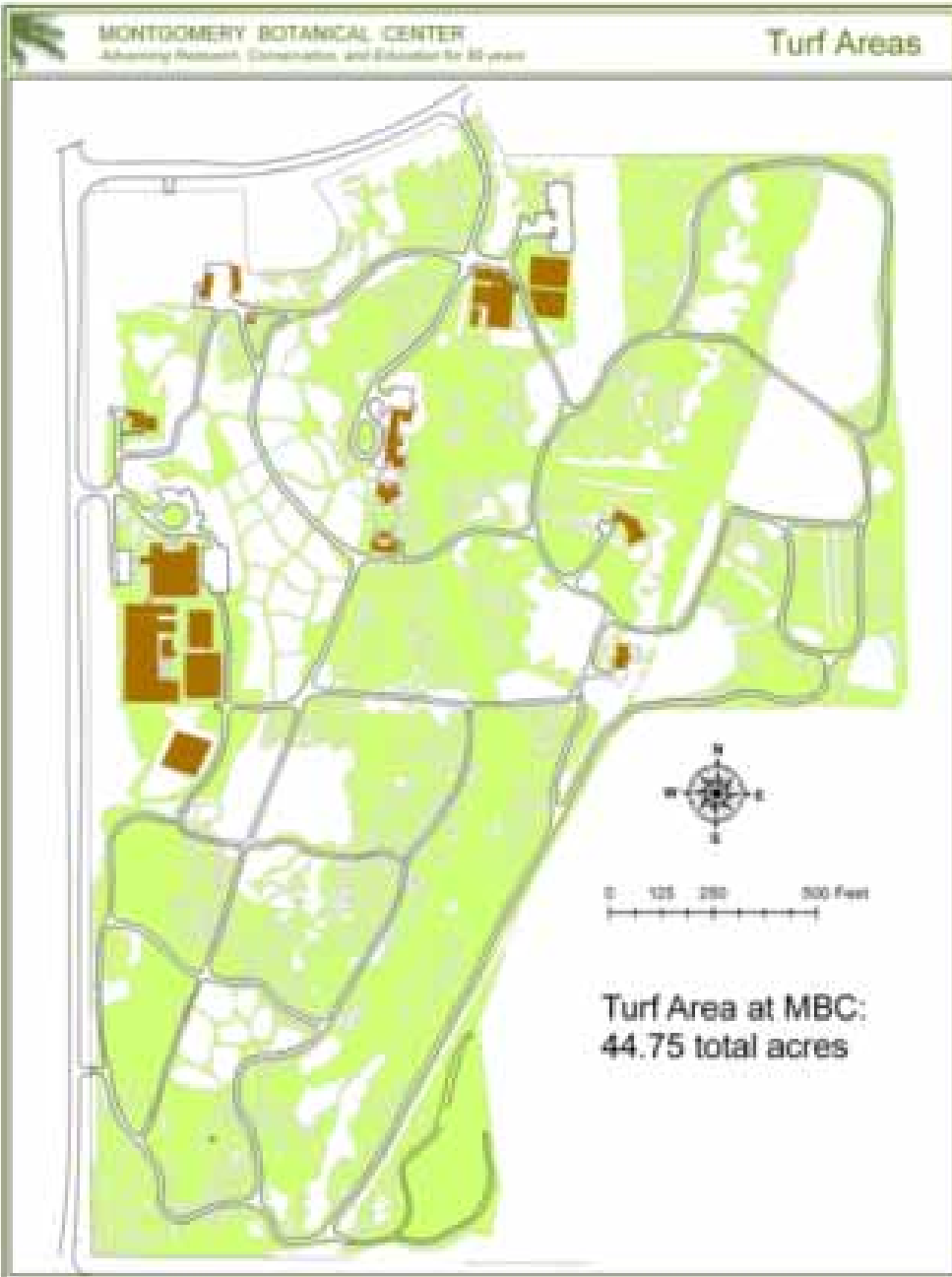
- Critical importance for plants
- What do we have and where? Deep soil layer? Sand?





Development or management?





# Resource allocation

- Determining investments of limited time and funds

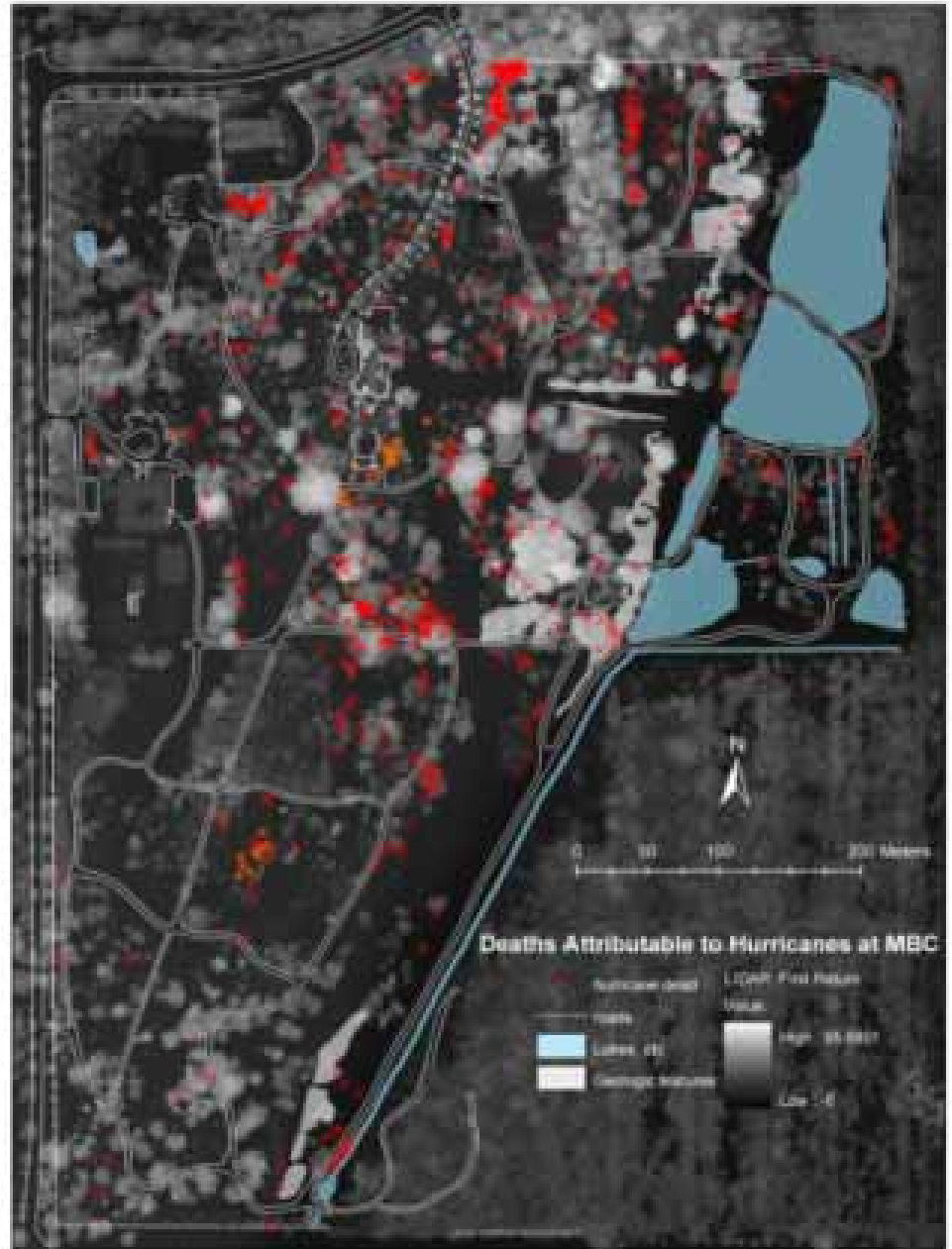


- Some projects can now be performed by volunteers



# In-depth scientific research: projection of data

- No direct link with database, so we query and export to an Excel table, then join in Arc
- Hope to do more with phenology data



# What's the point?

- It's all about maintaining and improving the health of current collections and preparing for future additions
- ArcGIS lets us do that better than ever

*Thanks*



**ESRI**  
Technology

**CONSERVATION**