Climatic Envelope Modeling using BIOCLIM (through the DIVA-GIS interface) and a Comparison of the Number of Environmental Variables Used in the Modeling Process (tuturial, no points; assigned 9 mar 2009)

A. Import and view data.

- 1) Open DIVA-GIS.
- 2) Add data layers (here, shapefiles, .shp) for the following:

North American administrative boundaries (i.e., countries), US states, and US counties.

In the table of contents (left side in DIVA), rename these layers as above.

- 3) Make a copy (copy and paste) of the Lycopodiella.csv file you used for the MAXENT procedure.
- Open this file using DATA>Import points to shapefile. Double click on this layer and alter properties (take points to size 6, change the color of the points to your liking).
- 5) You have just created a map displaying the distribution of specimens from our herbarium.

From which state(s) are our specimens?

From which PA counties are our specimens?

What is the PA county with the most specimens?

B. Model the distribution (climatic envelope).

1. With the occurrence records layer active and using the menu option MODELING>Bioclim/Domain, open the following window:

	You will be using the climate
Distribution Modeling	data contained in
Input Frequency Outliers Histogram Envelope Predict	"worldclim_5m.clm" (which is
	at 5 min resolution; use the 10
Points c:\program files\diva-for-class\aster.shp	min resolution climate model if
	the 5 min one is not available).
	· · · · · · · · · · · · · · · · · · ·
DIVA Climate data <u>iworldclim_10m</u>	How many degrees does this
C Stack	represent?
	How many degrees wide is PA^{9}
	How many degrees while is I A:
De la la la Elizabene en diseben El Francesco sidente	Therefore to what reachesting
Remove duplicates: M With same coordinates 1 From same grid cell	I herefore, to what resolution
One Class C Many Classes	should you be able to model the
	actual range of your genus?
Apply	

2. Select the "Predict" tab on the far right of this window to bring up the following window:

Distribution Modeling		
Input Frequency Outliers Histogram Envelope	Predict	
Output Grid Dimensions		
MinX -112.418 MinY 32.509 MaxX -74.783 MaxY 40.964 Climate database (outnut) worldclim 10m Image: Select variables Image: Select variables Image: Select variables Image: Annual Mean Temperature Range [2] Isothermality (2/7) (* 100) [3] Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image: Select variables Image:	Read from layer Adjust Draw Rectangle Maximum e	The default is to make a range prediction restricted to a bounding box defined by the geographical limits of your specimen records. However, use this button, followed by click-and-dragging the mouse to define a rectangle encompassing North America
 Mean Temperature of Wettest Quarter [8] Mean Temperature of Driest Quarter [9] Mean Temperature of Varmest Quarter [10] Mean Temperature of Coldest Quarter [11] Annual Precipitation [12] Precipitation of Wettest Month [13] Precipitation of Driest Month [14] Precipitation of Vettest Quarter [15] Precipitation of Wettest Quarter [16] Precipitation of Wettest Quarter [17] Precipitation of Warmest Quarter [18] Precipitation of Coldest Quarter [19] 	 Change Climate Change Climate Temperature Z.6 Precipitation Z.9 	only. DO NOT yet press "Apply".
	₽ , <u>C</u> lose	

3. In the window below, clear all climatic variables except for the same climate variables used for MAXENT (see the MAXENT procedure and that procedure's Table 1).

On your folder on the desktop, Save output gridfile as

"BIOCLIM-Ly-appressa-6variables.grd". Click APPLY. You've just predicted the possible range for this genus based on these climatic variables.

Distribution Modeling	
Output Grid Dimensions	
MinX -112.418 MinY 32.509 MaxX -74.783 MaxY 40.964	Read from layer Adjust Draw Rectangle Maximum extent
Climate database (output) worldclim_10m	🔽 🔽 Same as input
- Select variables	Lower Upper TAILS
 Annual Mean Temperature [1] Mean Monthly Temperature Range [2] Isothermality (2/7) (* 100) [3] Temperature Seasonality (STD * 100) [4] Max Temperature of Warmest Month [5] Min Temperature of Coldest Month [6] Temperature Annual Range (5-6) [7] Mean Temperature of Vettest Quarter [8] Mean Temperature of Driest Quarter [9] Mean Temperature of Varmest Quarter [10] Mean Temperature of Coldest Quarter [11] Annual Precipitation [12] Precipitation of Driest Month [13] Precipitation of Driest Quarter [16] Precipitation of Vettest Quarter [17] Precipitation of Varmest Quarter [18] Precipitation of Coldest Quarter [19] 	All V Clear V
Type output Bioclim Output C:\Program Files\diva-for-class\GENU:	S-YOURNAME-prediction01.grd
	Lose

BIOL 471.02 – Comp. Methods in Systematics Spring 2009

4. Modify the PROPERTIES of this new layer using the following box.

Remove the rows for NOT SUITABLE, LOW, and MEDIUM. Change the color of all others (i.e., high to excellent) to <u>red</u>. Click OK. You've just produced a color map of the predicted range, showing all areas with high probability of occurrence in red.

Properties							
Label genus-yourname-prediction01							
Filename c:\program files\diva-for-class\genus-yourname-prediction01.grd							
Lege	gend Info History						
Color	From	То	Label	Auto complete			
	0	0	Not suitable	Edit values			
	1	25	Low (0-2.5 percent	Classify			
	26	50	Medium (2.5-5 perc				
	51	100	High (5-10 percenti	Select color scheme			
	101	200	Very High (10-20 p				
	201	429	Excellent (20-43 pe	😁 Bamp 🔤			
	Nodata		No data	Read From File			
				Add or Remove Row			
NoData Transparent							

After moving the state and country boundary layers on top, your map should look something like this:



BIOL 471.02 – Comp. Methods in Systematics Spring 2009

What are some of the states predict for your taxon to occur in that we do not have records for?

5. Now, with the original "genus" layer active, do steps C1-C4 again, only this time use ALL CLIMATIC VARIABLES, and make the predicted High probability range <u>blue</u>. Name this new layer appropriately.

Is the distribution predicted now larger, smaller, or about the same area as that the first time around?

Is this expected? Explain. _____

6. Zoom in to PA. Make the county boundaries layer visible again.

Based on the climate predictions made using all climatic variables, what counties is your taxon predicted to occur in for which we do not currently have specimens?

7. Summary Questions: How could this procedure be used to monitor and manage the health of rare species in Pennsylvania?

Describe some of the limitations of our predicted ranges? Think about limitations in the datasets (occurrences, environmental data) we used.

What is the effect of the number of environmental variables used on the predicted size of the distribution? How do you think you might choose which is an appropriate number of variables?