# **Symbolizing Features**

- Create a folder called **Symbology**. On DIA 322 computers, you might want to create this folder in your user Documents folder (e.g. C:\Users\jdoe\Documents\Symbology). On the DIA 222 computers, you might want to create this folder on the D: drive under D:\course number\user name\ (e.g. D:\ES212\jdoe\Symbology).
- 2. <u>Download the data</u> for this exercise and <u>extract the files</u> from the Symbology.zip file to your newly created **Symbology** directory.

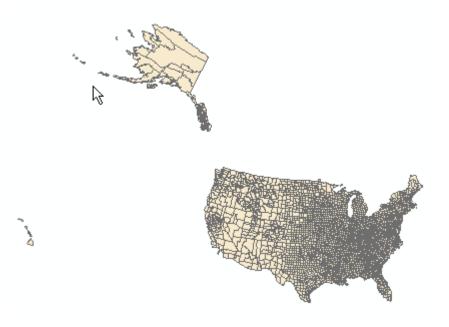
In this exercise, you will learn how to symbolize features based on their geometric characteristics and their attribute type. You will also learn how to add data frames, modify their coordinate systems and generate a final map layout.

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- Step 4: Add state boundaries
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# Step 1: Open Map document

Navigate to your **Symbology** folder and open the map document **Symbology.mxd** in ArcMap.



The map document is made up of a single data frame called "Layers".

The data frame contains four layers: Cities, Rivers, States and Counties.



Next, you will create a choropleth map based on cropland distribution.

Step 2: Symbolize counties by farm acreage

Right-click on Counties layer and select Open Attribute Table.

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		×	Remove	
			Open Attribute Table	
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There is a field called CROP\_MI07 that lists the total surface area of croplands within each county (units are in square miles). You will symbolize the counties using this field.

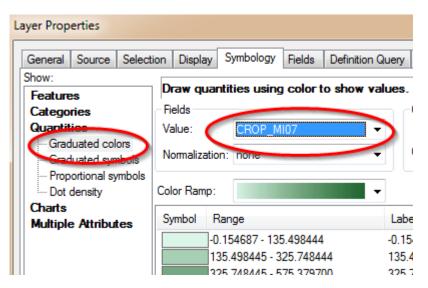
Close the attribute table.

Right-click on **Counties** layer and select **Properties**.

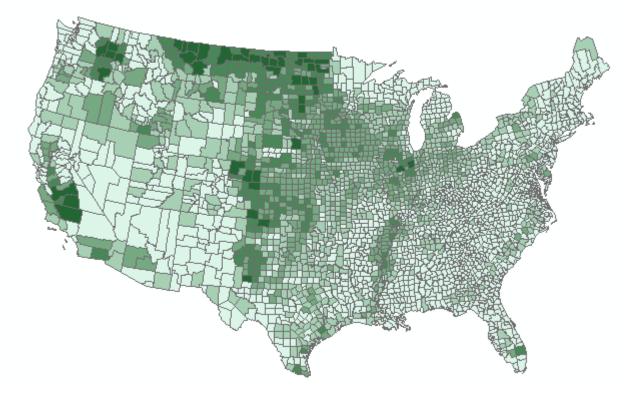
```
Select the Symbology tab Display Symbology Fields
```

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Select **Quantities** in the left window pane then select **CROP\_MI07** in the *Value* field. Choose a **green** color ramp.



Click **OK** to accept the symbology changes and close the Layer Properties window.



Note the distribution of "high" values around Montana and the Dakotas. Remember that we are looking at **total** acreage within each county. Also note that each county has **different** total area and shape. Symbolizing heterogeneous polygons using 'count' or 'enumerated' data can mislead the intended audience. It is therefore best to *normalize* such data by polygon surface area. The field that lists total county area in square miles is **SQMI**.

Open the Counties Properties window again (right-click Counties and select Properties).

Make sure that the **Symbology** tab is selected.

Under Normalization, select SQMI.

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	Draw quantities using color to show values								
	- Fields								
	Value:		CROP_MI07 -						
ls	Normaliza	ation:	none 🔽						
ols	Color Ram	p:	none <percent of="" total=""> <log></log></percent>	Ĺ					
	Symbol	Ran	POP2010 NO_FARMS07	Lał					
		-0.15	AVG_SIZE07	-0.1					
		135.4	CROP_ACR07	135					
		325.	Shape_Length	325					
		575.3	Shape_Area	575					

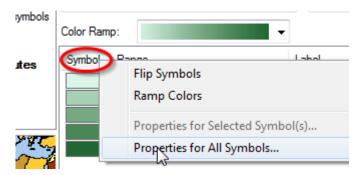
This instructs ArcMap to divide all crop area values (CROP\_MI07) by the total area of each county polygon (SQMI).

Before we accept the changes, we will make a few changes to the symbols. We will remove the dark outline from each polygon to emphasize the distribution of cropland across the US and we will increase the number of classes to 7.

## Change the number of classes from 5 to 7.

•	Classification Natural Breaks (Jenks)
•	Classes: 🚺 🔻 Classify
•	2

Click on the header **Symbol** (the column name just above the list of symbol swatches) and select **Properties for All Symbols**.



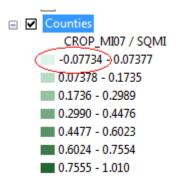
In the Symbol Selector window change the **Outline Color** to **No Color**. Be careful **not** to change the color settings for *Fill Color*!

Fill Color:	
Outline Width: 0.40	Ids Definition Query
Outline Color: 🔘	lor to show values.
	No Color

Click OK to close the Symbol Selector window.

#### Click OK to close the Properties window.

Looking at the legend, we notice some oddities in the range of values. The range starts off with a negative value (-0.077) but it's clear that we cannot have 'negative' area!



#### Open the **Counties** attribute table.

Looking a bit more closely at the data in the attribute table, we spot many '-99' values under the **CROP\_ACR07** field. Why does this matter? Well it turns out that **CROP\_MI07** was calculated from the **CROP\_ACR07** field by multiplying the CROP\_ACR07 by 0.0015625 (conversion coefficient from acres to square miles). This explains the -0.1547 values found in the CROP\_MI07 attribute field. Of course, this is information you could not glean from the data. This is something you obviously were not expected to know unless documentation for the data was readily available. This is an example why data documentation (metadata) is critical!

NO_FARM S07	AVG_SIZE07	CROP_ACR07		SQMI	Shape_Length	Shape_Area	CROP_MI07
-99	-99		-99	92.1	70344.420091	221284462.529141	-0.154687
-99	-99		-99	9.3	20873.824737	29340220.566434	-0.154687
-99	-99		-99	68.3	62127.765176	171102766.55341	-0.154687
-99	-99		-99	2	12182.30288	9132810.581329	-0.154687

So what does the -99 value represent? Fortunately, this bit of information is documented in the Counties layer's metadata.

You may need to change the view settings for your metadata window by accessing **ArcMap Options** from the **Customize** pull-down menu, then selecting the **Metadata** tab, and choosing the **FGDC CSDGM Metadata** style.

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ArcMa	p Options			-			2	
	Raster			CAD		-	Display	Cache
G	ieneral	Data	View	Layo	ut View	Metadata		Table
T V	letadata Sty he style det alidated, ar Item Descri FGDC CSDG INSPIRE Me ISO 19139 I Item Descri North Amer an be upda	termines d which p ption M Metad etadata D Metadata ption ican Prof	ata irective Impleme	ntation Sp 19115 200	editing me	etadata.		

Click OK to close the ArcMap Options window.

Right-click **Counties** and select **Data** >> **View Item Description**.

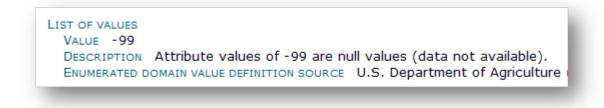
Under the ArcGIS Metadata tag, scroll down (about <sup>3</sup>/<sub>4</sub>'s of the way down) to the Fields section.



Then look for the attribute field CROP\_ACR07.



Looking at the list of values for the field CROP\_ACR07, we discover that **-99** is a placeholder for **no data**. Therefore we should change the map symbology such that counties with no data are indicated as such in the map.



#### Close the Metadata window.

Also note that at the other end of the Counties layer range of values, we spot a value greater than 1.0 (which implies that there is more cropland area than county area). This is obviously an anomaly most likely due to error in measurements (i.e. crop area was probably computed at a different scale). Fortunately, only a single polygon (county) has a value greater than 1. Looking at an aerial view of the aforementioned county, it's clear that the majority of that county is under cropland.



We will change the classification scheme to symbolize -99 as no data and round the value of 1.01 down to 1.

Open Counties' properties window.

Make sure that the **Symbology** tab is selected.

Click on the Classify button.

Classification							
Natural Breaks (Jenks)							
Classes:	7	•	Classify				
			1				

By default, ArcMap chooses a Natural Breaks classification scheme. We will change it to an equal interval scheme.

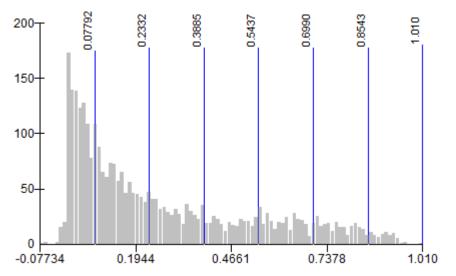
Select Equal Interval as the Classification Method type.

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Symbology

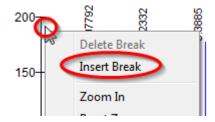
Classification							
Classification							
Method:	Natural Breaks (Jenks)						
Classee	Manual						
	Equal Interval						
<ul> <li>Data Exclusion</li> </ul>	Defined Interval	45					

This ensures that intervals between each classification break are equal.



Next, you will add another classification break for all -99 crop land area features.

Right click somewhere on the far left side of the graph and select Insert Break.



With the new break line still active (it should be colored red), type 0.0 in the Break Values window.



Click OK to close the Classification window.

In the Layer Properties window, click in the **Label** column header and select **Format Labels** from the pull-down option.

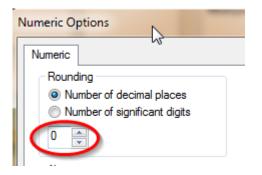
#### Classes: 7 Classify... Click anywhere on the Label header tab Label **Reverse Sorting** -0.d 24 34 0.0 Format Labels... 15 0.1 Edit Description... 78 0.2 34 0.4477 - 0.6023

Change the category to **Percentage** and select the '...number represents a fraction...' option.

lumber Format	2 X
Category: None Currency Numeric Direction Percentage Custom Rate Fraction Scientific Angle	<ul> <li>The number already represents a percentage</li> <li>The number represents a fraction. Adjust it to show a percentage.</li> </ul> <u>Numeric Options</u>
	Numorio Ontinno

Click on the Numeric Options \_\_\_\_\_\_ button.

Set the Number of decimal places to 0.



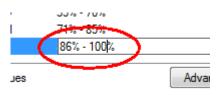
Click **OK** to close the Numeric Options window.

Click **OK** to close the Number Format window.

Change the first label name to **No Data** (just select the field to edit it).



#### Likewise, change the last label to 86% - 100%.

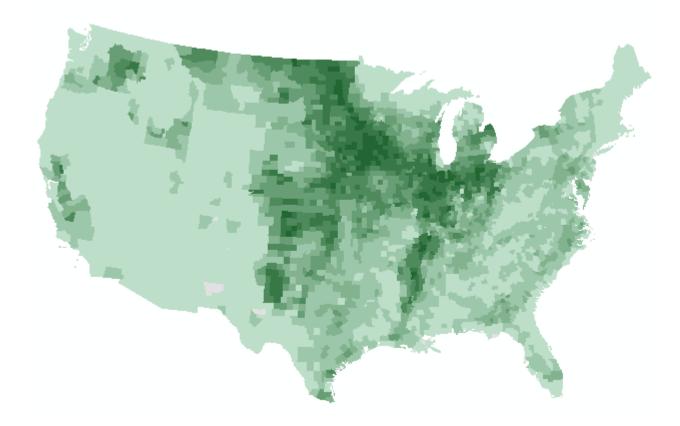


To isolate the No Data symbol, you will change its color to a more neutral color.

Double-click on the No Data symbol and change its color to 10% gray.

	Color Ramp:	]
	Symbol Range	Label
	-0.0 7343747 - 0.000000000	No Data
	0.00000000 - 0.073770224	1% - 7%
	0.073770225 - 0.173467904	8% - 17%
_	0 173467905 - 0 298941415	18% - 30%

Click **OK** to close the Layer Properties window.



# Step 3: Add river features and labels

Turn on the **Rivers** layer in the TOC.

Open Rivers' properties window.

# Make sure that the **Symbology** tab is selected.

You will symbolize all river features with the same symbol type.

# Click on the **symbol**.

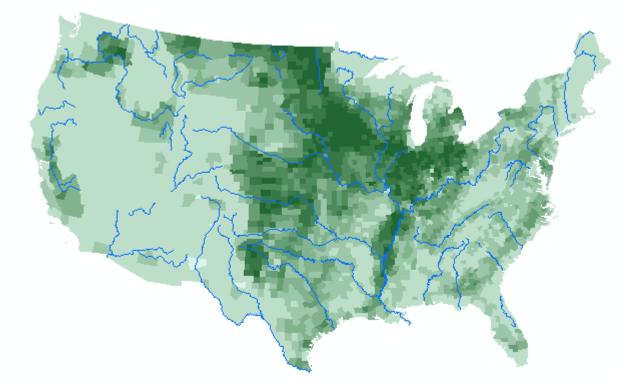
Symbol		
	6	

# Change the color to Cretan Blue.

Color:	•		8 23
Width:		No Color	pup
Edit Save As			Cretean Blue

Click **OK** to close the Symbol Selector window.

Click **OK** to close the Layer Properties window.



Next, you will have ArcMap automatically place the river labels.

Open the Rivers' properties window.

Click on the Labels tab

Labels Joins & Relat

Check off the Label features box.

Select Name as the Label field.

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	General	Source	Selection	Display	Symbology	Fields	Definition Query	Labels	J
	Dabe	el features	in this layer						
	Method	:	Label	all the fea	tures the sam	e way.		•	
	All fea	itures will t	be labeled u	ising the o	ptions specifi	ed.			
		t String el Field:	NA	ME				•	

Click on the **Placement Properties** button.

Placement	Properties

# Select Curved orientation.

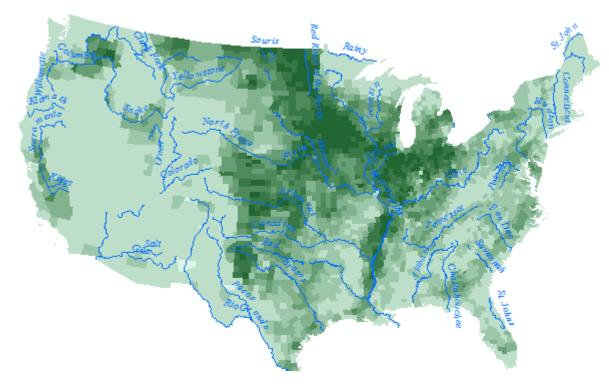
Text Symbol	Placement Properties
AaBbYyZz	Placement Conflict Detection
Other Options	Orientation
Placement Properties	Horizontal
Ť Ť	Parallel
	Curved
	Perpendicular

Click **OK** to close the Placement Properties window.

Change the label font to Times New Roman, Italic and Cretan Blue.

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	B	Ι	Ū		Symbol	

Click **OK** to close the Layer Properties window.



# In the next step, you will add States outline.

Step	4:	Add	state	bour	ndaries
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# Turn on the **States** layer.



The States layer is masking out the farm cropland layer. Since we only want to display the boundaries, we will remove the fill color.

# Open the States' Properties window.

https://mgimond.github.io/ArcGIS\_tutorials/Symbolizing\_features.htm

Select the Symbology tab.

Click on the Symbol.

# For Fill color, select No Color.

Fill Color:	
Outline Width:	No Color

Click OK to close the Symbol Selector window.

We will also have ArcMap label the States.

In the Properties window, select the Labels tab.

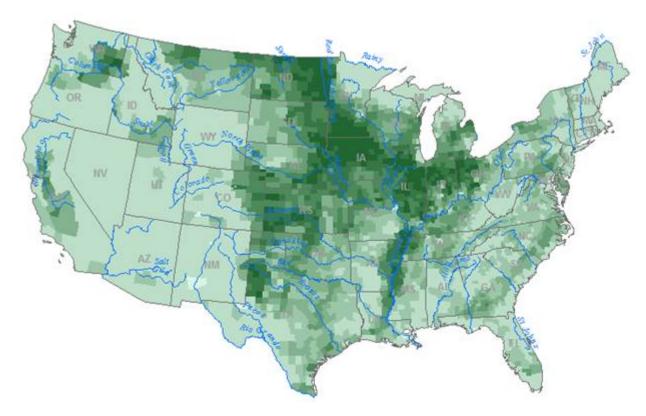
Set the label properties as follows (use Gray 40%).

abel features in th	nis layer	
Method:	Label all the features the same way.	•

All features will be labeled using the options specified.

Text String Label Field:	STATE_A	BBR		•	Expression
Text Symbol					
	AaBbYyZz	$\langle$	Arial     B	• • ⊻	Symbol

Click **OK** to close the Layer Properties window.



Next, you will symbolize cities by population count.

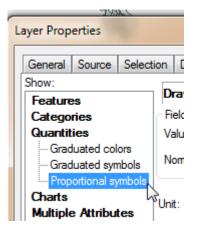
**Step 5:** Symbolize cities by population

Turn on the **Cities** layer.

Open Cities' properties.

Select the **Symbology** tab.

Select Quantities >> Proportional symbols.



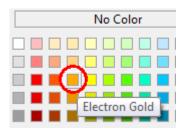
Use the **POP2007** value to define the symbol sizes.

Fields Value:	POP2007 🗸			
Normalization:	none	•		

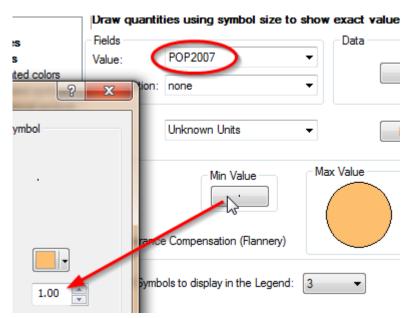
Click on the Min value button.

Value	
•	
	Value -

#### Set the color to **Electron Gold**.

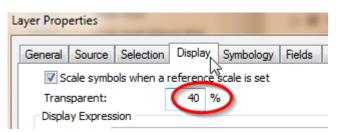


#### Set the minimum value circle size to 1.00

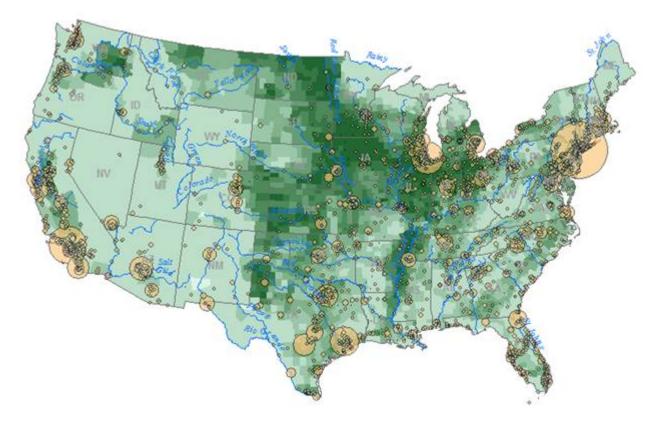


Click OK to close the Symbol Selector window.

Click on the **Display** tab and set the **transparency** value to **40%**.



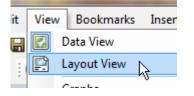
Click **OK** to close the Layer properties window.



# Next you will setup the map layout.



# From the View pulldown menu, select Layout View.



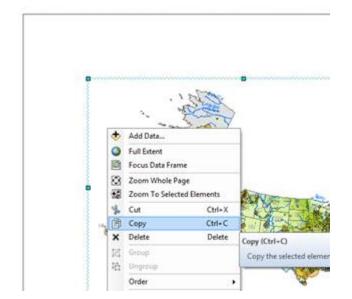
One challenge in displaying all 50 states is dealing with the vast amount of empty space between Hawaii, Alaska and the 48 contiguous states.



To resolve this issue, you will create three *separate* data frames: one for **Hawaii**, one for **Alaska** and one for the **48 states**.

So as not to have to recreate all the layer symbols for each data frame, you will copy and paste the existing data frame twice.

**Right-click** anywhere on the **data frame** in the TOC and select **Copy** (make sure that you are in layout mode!).



From the Edit pulldown menu, select Paste.

You should now see a duplicate of the original data frame in the TOC and in the map layout.

Rename the new data frame Hawaii.

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Cities	🖃 🗹 Cities					
POP	2007					
· 1,000						
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10,00	0,000					

You will now paste another copy of the data frame for Alaska.

From the Edit pulldown menu, select Paste.

Rename the new data frame Alaska.

Rename the original data frame 48 States.

Collapse all data frames in the TOC.

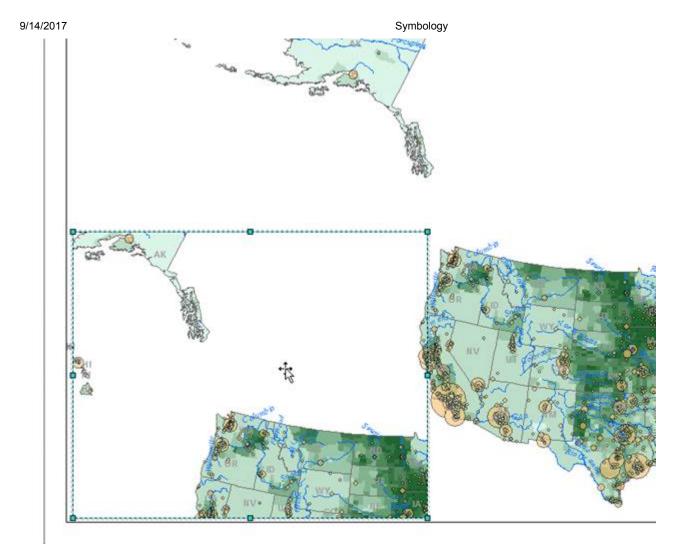
Table Of Contents
🖹   🤩 🥪 📮
🕀 🍠 48 States
🗄 🥌 Hawaii
🗄 <i>i S</i> Alaska

Right-click the Alaska data frame and select Activate.

This action make the Alaska data frame active in the Layout view.

Resize the Alaska data frame to about a quarter of the page.

Move it to the lower left hand corner of the map layout.



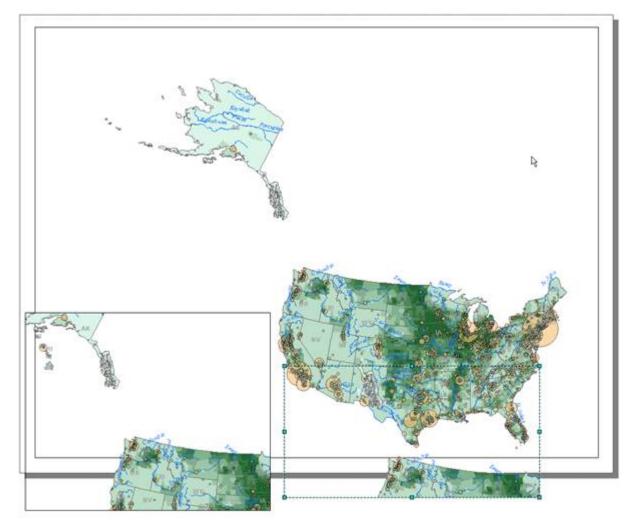
Next, you will resize and reposition the Hawaii data frame.

Selecting the correct data frame in a map layout when data frames overlap can be challenging. To ensure that you have selected the proper data frame, use the space bar.

Holding down the **space bar**, select a data frame in the data view window. Keep clicking on the overlapping data frames until you see **Hawaii** '**bolded**' in the **TOC**. (Alternatively, you could have **right-click** the **Hawaii** data frame in the **TOC** and selected **Activate**).



**Resize** the **Hawaii** data frame and **relocate** it to the bottom of the map layout (you will refine the positioning later).

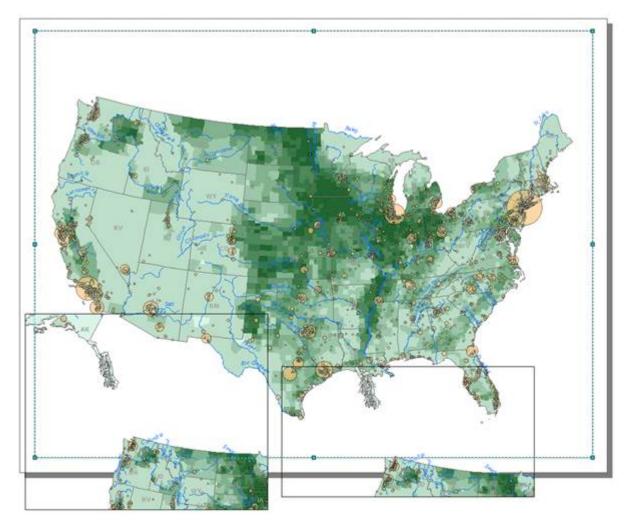


Activate the 48 States data frame (right-click on the data frame and select activate).

From the **Tools** toolbar, select the **Zoom In** icon (be careful <u>not</u> to select the Zoom In icon from the layout toolbar).

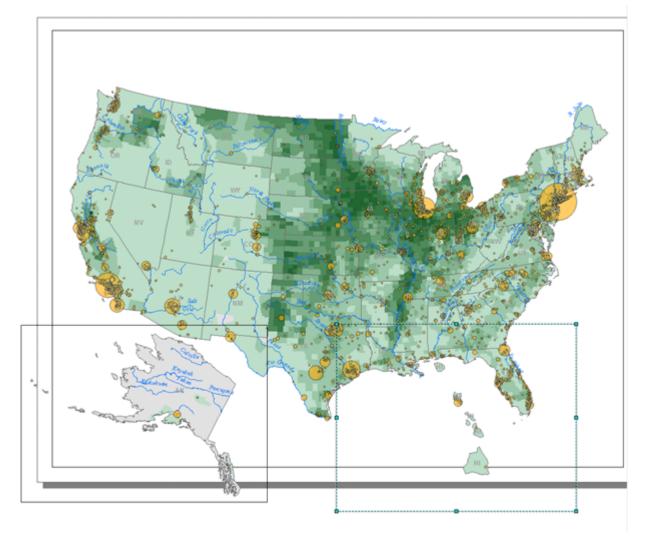


In the 48 States data frame, zoom in on the 48 States.



For the Hawaii and Alaska data frames zoom in on Hawaii and Alaska, respectively (don't forget the **activate** the proper data frame).

Note: you will probably need to use the **Pan tool** 1 to move around within each data frame.



Clearly the orientation of both Hawaii and Alaska are not ideal. Also, you might note some slight distortion in their shapes. This is because they inherited a projected coordinate system best suited for the 48 states. To resolve this, you will define different coordinate systems for Hawaii and Alaska.

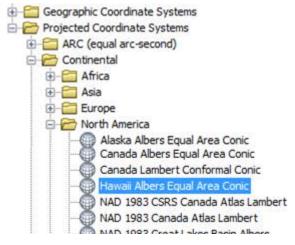
Right click on the Hawaii data frame and select Properties.

Select the Coordinate System tab.

Select the following predefined coordinate system:

Projected Coordinate Systems >> Continental >> North America >> Hawaii Albers Equal Area Conic

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## Click **OK** to close the Data Frame Properties window.

## Click Yes to close a Warning window if it pops-up.

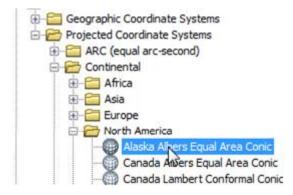
Warning:
This coordinate system has a geographic coordinate system that differs from one or more data sources in the map. Alignment and accuracy problems may arise unless there is a correct transformation between geographic coordinate systems. Use the Transformations button to specify or modify the transformation(s) used by this data frame.
Do you wish to use this coordinate system anyway?
Don't warn me again in this session
🔲 Don't warn me again ever

Right click on the Alaska data frame and select Properties.

Select the Coordinate System tab.

Select the following predefined coordinate system:

Projected Coordinate Systems >> Continental >> North America >> Alaska Albers Equal Area Conic



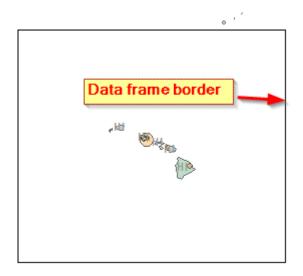
Click OK to close the Data Frame Properties window.

Next, you will set the scale to all three data frames so that they match (this is important if you are to place a scale bar in the final map layout).

For **each** data frame, set the **scale** to **1:25,000,000** (don't forget to activate the data frame before changing the scale).

Selection	Geoprocessing	Customize
×   🔶 -   🚺	25,000,000	

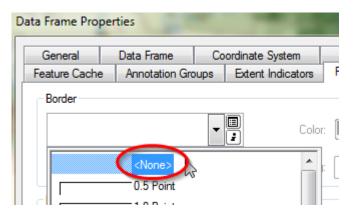
Next you will remove the data frame borders for all data frames.



Open the Hawaii data frame Properties window.

Select the Frame tab.

Under the Border option, select None.

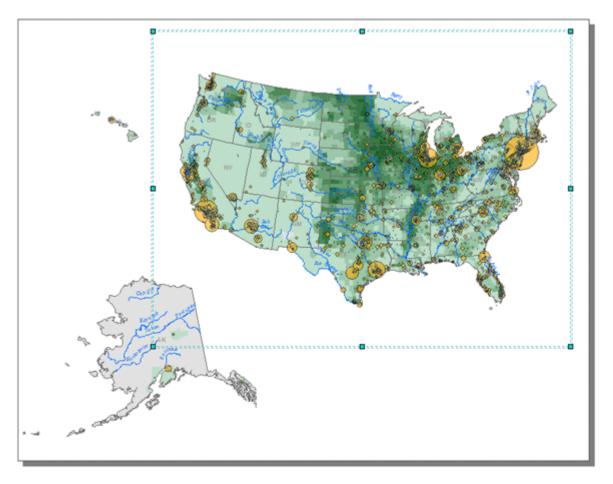


Click **OK** to close the Data Frame Properties window.

Using the procedure just outlined, remove the Alaska and 48 States data frame border.

Rearrange the three data frames to match the following graphic.

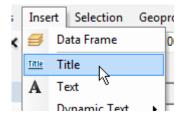
Feel free to pan the maps within each data frame as needed but **do not** change the scales (they should all remain at 1:25,000,000). For example, make sure that the southern tip of Alaska does not show up in the **48 States** data frame.



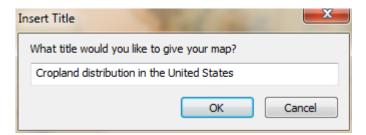
# Step 7: Adding additional elements to the map document

Next, you will add a title, legend and scale bar.

## From the **Insert** pulldown menu, select **Title**.



In the Insert Title window type Cropland distribution in the United States.



#### Click OK.

Move the title to the top of the page.

You can change the text properties by accessing its properties menu.

Right-click on the title and select Properties.

In the Properties window, click on the Change Symbol button.

In the Symbol Selector window, change the font size to 24, bold and color to 60% Gray.

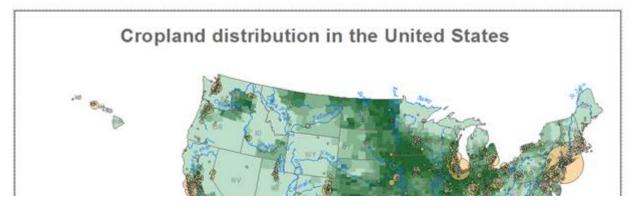
Current Symbol
bution in the
Color:
Size: 24 - Style: <b>B I</b> <u>U</u> <del>ST</del>
Edit Symbol

Click **OK** to close the Symbol Selector window.

In the Properties window, set the character **spacing** to **2.00**.

Properties	x
Text Size and Position	
Text:	
<pre><dyn property="title" type="document"></dyn></pre>	é.
Font: Arial 24.00	
Angle: 0.00 Character Spacing: 2.00	
Leading: 0.00	
About Formatting Text Change Symbol	
OK Cancel Apply	

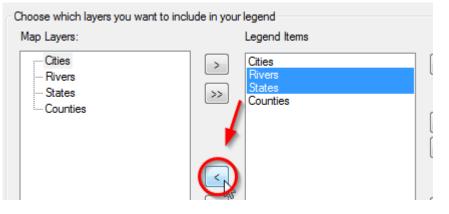
Click **OK** to close the Properties window.



Next, you will add a legend.

From the **Insert** pulldown menu, select **Legend**.

In the Legend Wizard window, **remove** *Rivers* and *States* from the legend list by selecting them (select both while holding down the control key) and clicking the single left arrow button



#### Click Next.

Remove the text Legend from the Legend Title (leave the field blank).

Legend	Wizard	1	
-Le	gend Title -		
Ī		 	

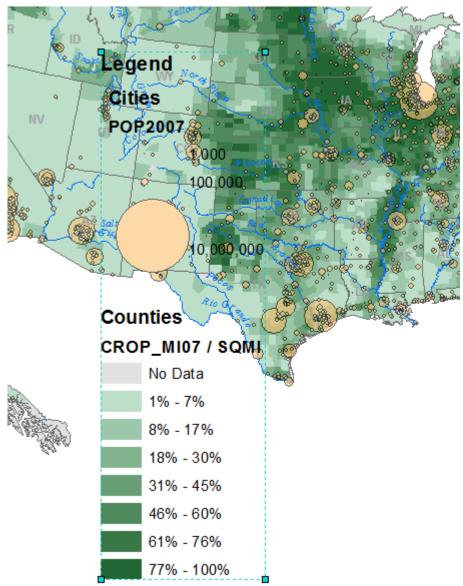
Click Next.

Click **Next** again.

And click **Next** one more time.

Click Finish to close the legend wizard window.

By default, the legend window is created as a single column. This will clearly not fit in our current map layout.



At this point you might be wondering which data frame's legend element was added. ArcMap will only add the legend element associated with the selected data frame. Since all three data frames in our map document share the exact same layers and associated symbology, it does not matter which data frame was selected when we added the legend element.

Like all map elements, we can access the legend element properties.

Right-click on the legend element and select Properties.

Select the Items tab.

In the Legend Properties window, select Counties and check off Place in new column.

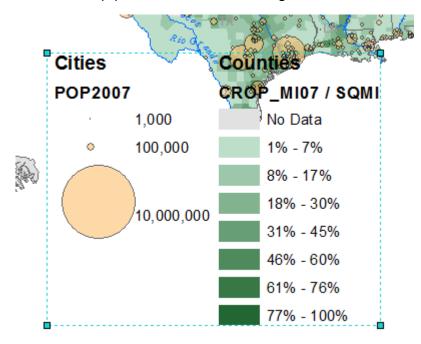
9/14/2017

Symbology

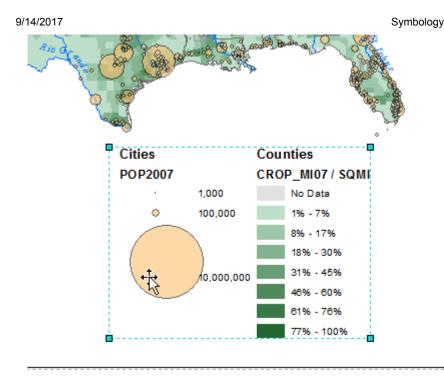
Legend Properties	
Legend Properties          General       Items       Layout       Frame         Apply settings to selected item(s)         Select <u>All</u> Select <u>None</u> Cities         Counties	Size and Position         Font         Apply to all labels         Image: B Image:
<u>S</u> tyle	Use current index feature as the map extent Item Columns Item Columns Column count for item(s) 1

## Click OK.

This last step placed the **Counties** legend element in a second column.



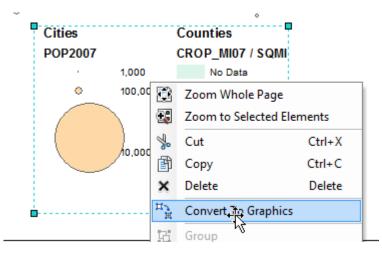
Resize the legend element so that it fits nicely under the 48 states data frame.



The legend elements are dynamically linked to the TOC. Therefore, to make changes to the legend labels/headers, one needs to change those items in the TOC.

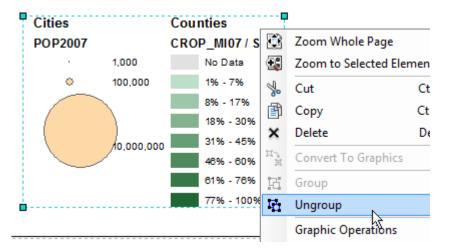
Another way to change legend elements is to convert them to 'graphic' elements and make the edits within the layout view window. This provides more control over the placement of the legend elements. However, once the legend elements are converted, the dynamic link between the legend's content and those inside the TOC is lost.

Right-click on the Legend element and select Convert to Graphics.

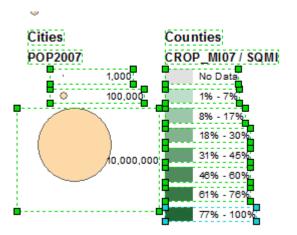


Next you have to ungroup the graphical elements.

Right click on the legend graphic and select **Ungroup**.



You can now edit the legend headings.



Right-click the Counties text graphic and select Properties.

In the Properties window, change the text to Percent cropland.

Properties	12
Text Size and Position	
Text:	
Percent cropland	

#### Click OK.

Select and delete the Crop\_MI07 / SQMI text.

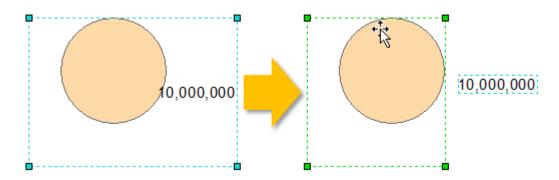


Likewise, rename the Cities text to City population and delete the POP2007 text.

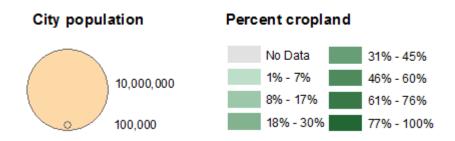


Now on your own, rearrange the legend elements as you see fit.

If you need to separate the text from the color swatch **right-click** the element and select **ungroup**.



You can use this graphic as inspiration (note that the 1000 population symbol was removed in this example):



If you have **overlapping** graphics and wish to move the 'front' graphic to the 'back', right click on the graphic and **select order >> Send to Back**.

		•	-	
ty	Order	۱.	Ъ	Bring to Front
	Nudge	•	8	Send to Back
	Align	+	<b>-</b>	Bring Forward
	Distribute	•	6	Send Backward

Next, you will add a scale bar.

Since all data frames inherent the same scale (1:25,000,000), it does not matter which data frame is selected when inserting a scale.

From the Insert pull-down menu, select Scale bar.

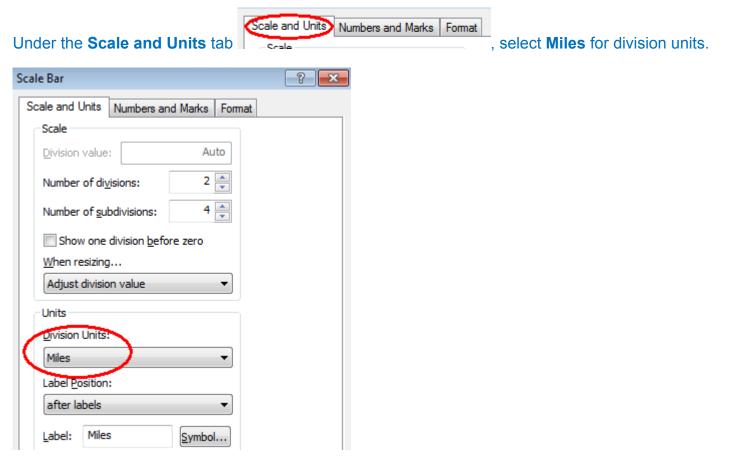
In the Scale bar Selector window, select Scale Line 1 (the top scale symbol).

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Symbology

0 50 100 200 Miles Scale Line 1 0 50 100 200 Miles
Scale Line 1
0 50 100 200 Miles
0 50 100 200 Miles
Scale Line 2
0 50 100 200 Miles
Scale Line 3

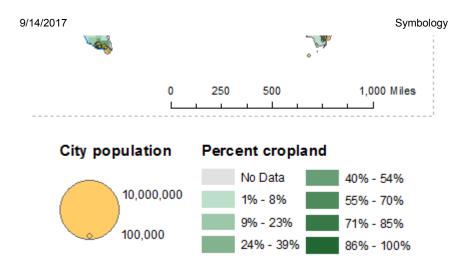
Click on the properties button.



Click **OK** to close the Scale bar window.

Click **OK** again to close the Scale Line properties window.

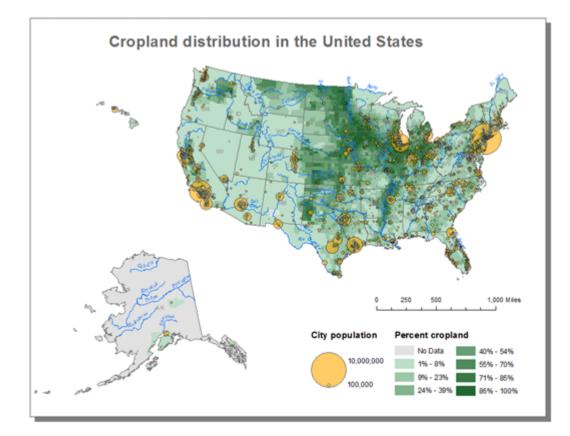
Move and resize the scale bar as needed.



We could add a north arrow indicator, but given that the coordinate system used does not do a good job in preserving north-south direction across the map's extent, we will opt not to add this graphic.

On your own, finalize the map by making any touch-ups you see fit.

Feel free to glean inspiration from the following graphic:



#### Save your map document.



Manuel Gimond, last modified on 8/24/2016