

# Fisheries Then & Now:

A 60-year comparison of lake  
fish assemblages in Maine.

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*Maine Water Conference 2007*



Oquoss trout; blueback trout; quack; *Salvelinus fontinalis* (Girard). Breeding female, 15 inches long. From Kaughey Stream, Oquossoc, Me.



*Please note:*

*This document is derived from a slideshow that was originally prepared for a presentation made at the 2007 Maine Water Conference.*

*In order to make the material more self-explanatory (i.e. without the original narration), we now include text boxes to further clarify some of the graphics. These additions appear as red text on a light blue background.*

*None of the original data & analyses have been updated.*

*PDV. October 2020*

- We know that Maine's freshwater fish fauna has been modified by legal and unauthorized stocking over the past 150+ years.
- We know that unauthorized stocking continues to increase homogeneity in the composition of fish assemblages.
- We know that this process is insidious – it's going on all the time, but often is poorly documented.
- *What can historical lake surveys tell us about changes in Maine's freshwater fish assemblages?*

*We compared fish data from historical surveys with more contemporary data from IF&W. The historical surveys were conducted by Gerald Cooper (later joined by John Fuller) from the University of Maine, primarily between 1938 and 1944. (A few lakes and many streams were surveyed in 1937) Their primary focus was to evaluate lakes from the perspective of fish stocking.*

*Fish species*

*Fish size structure*

*Fish age/growth*

*Fish diets*

*Water quality*

*Benthos*

*Phytoplankton*

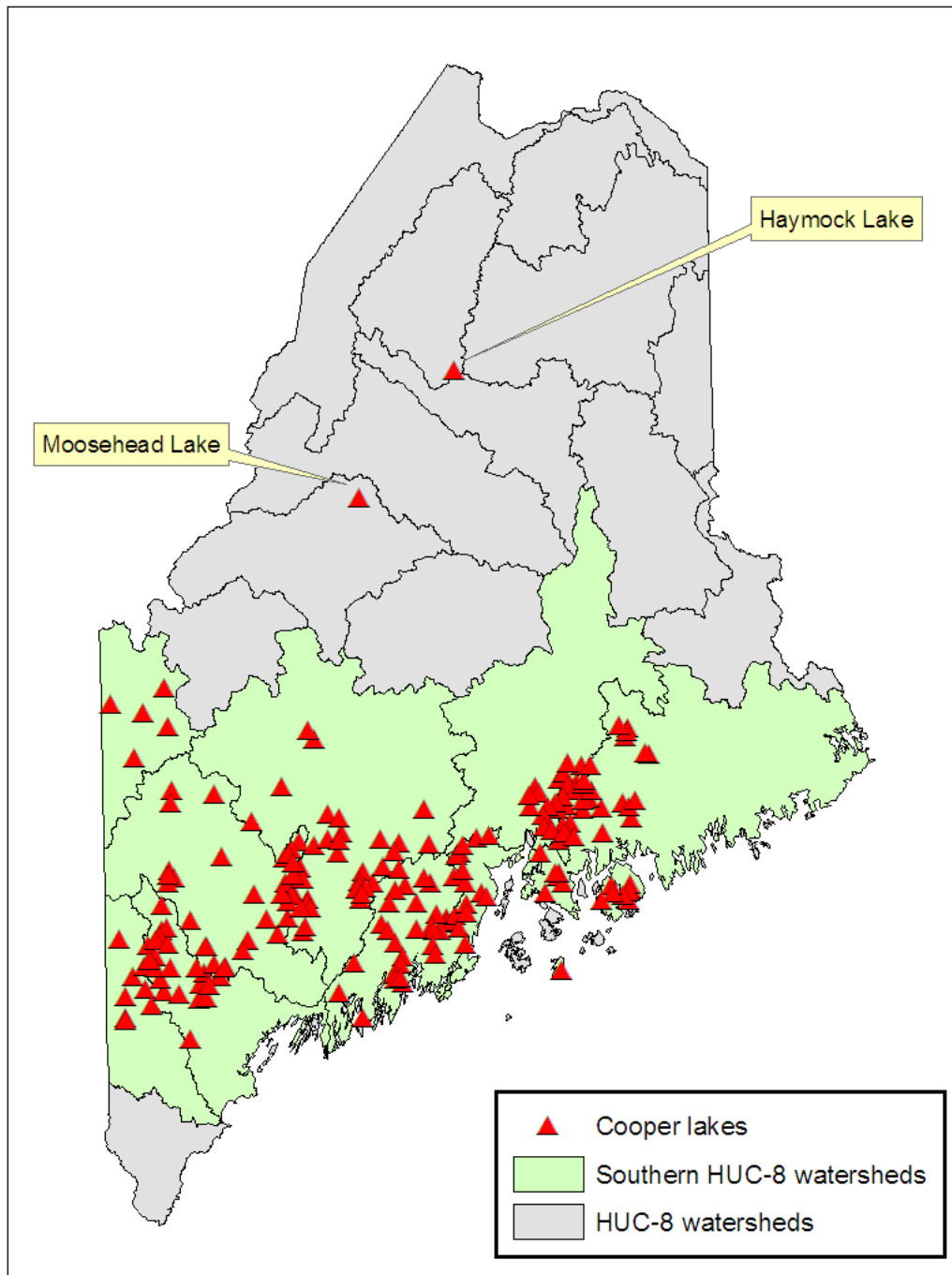
*Zooplankton*

*Lake depth maps*

*Fish sampling with  
gill nets and  
seines + warden  
reports of species  
presence.*



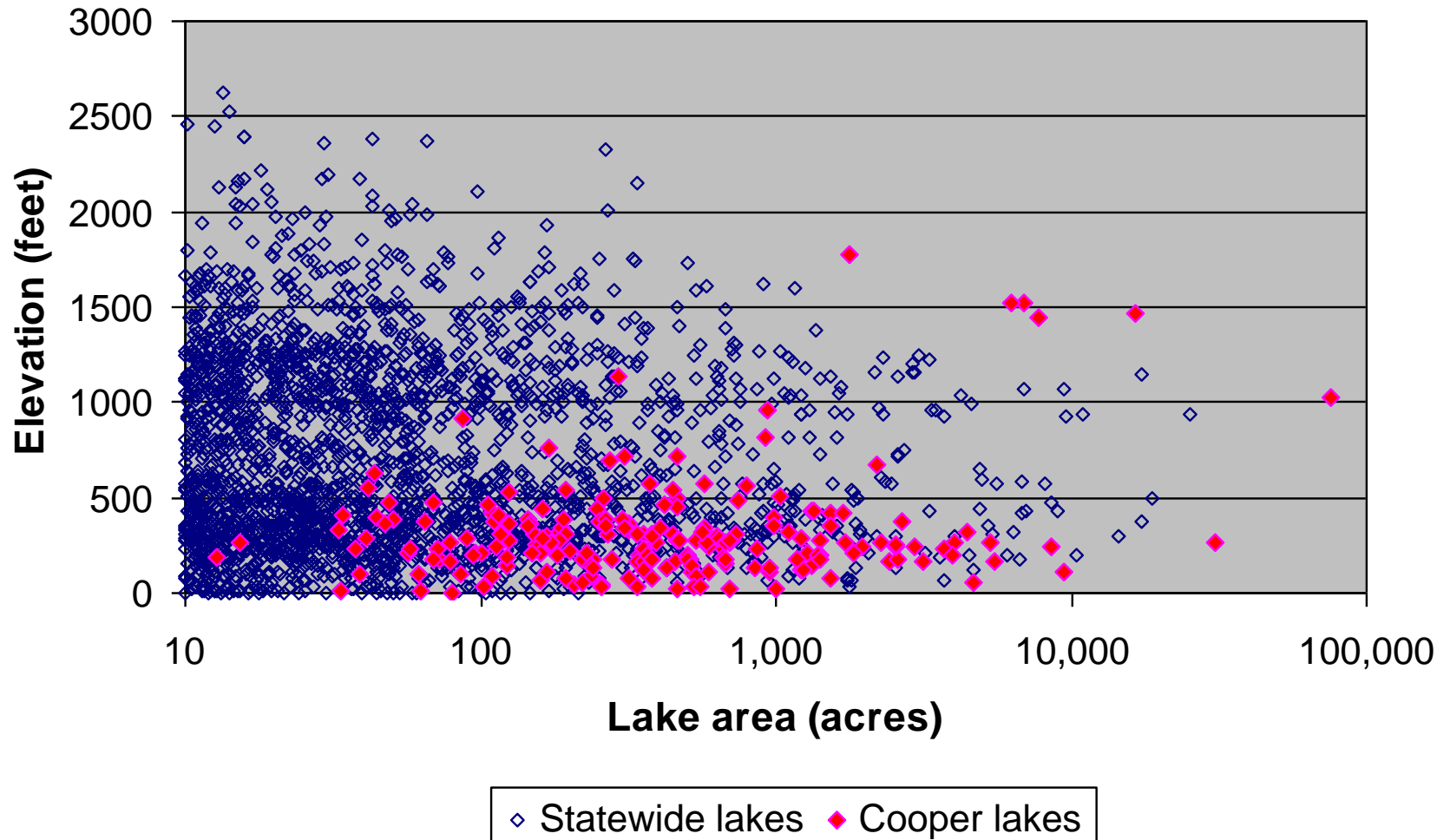
## **Cooper and Fuller surveys of Maine lakes: 1938 - 1944**



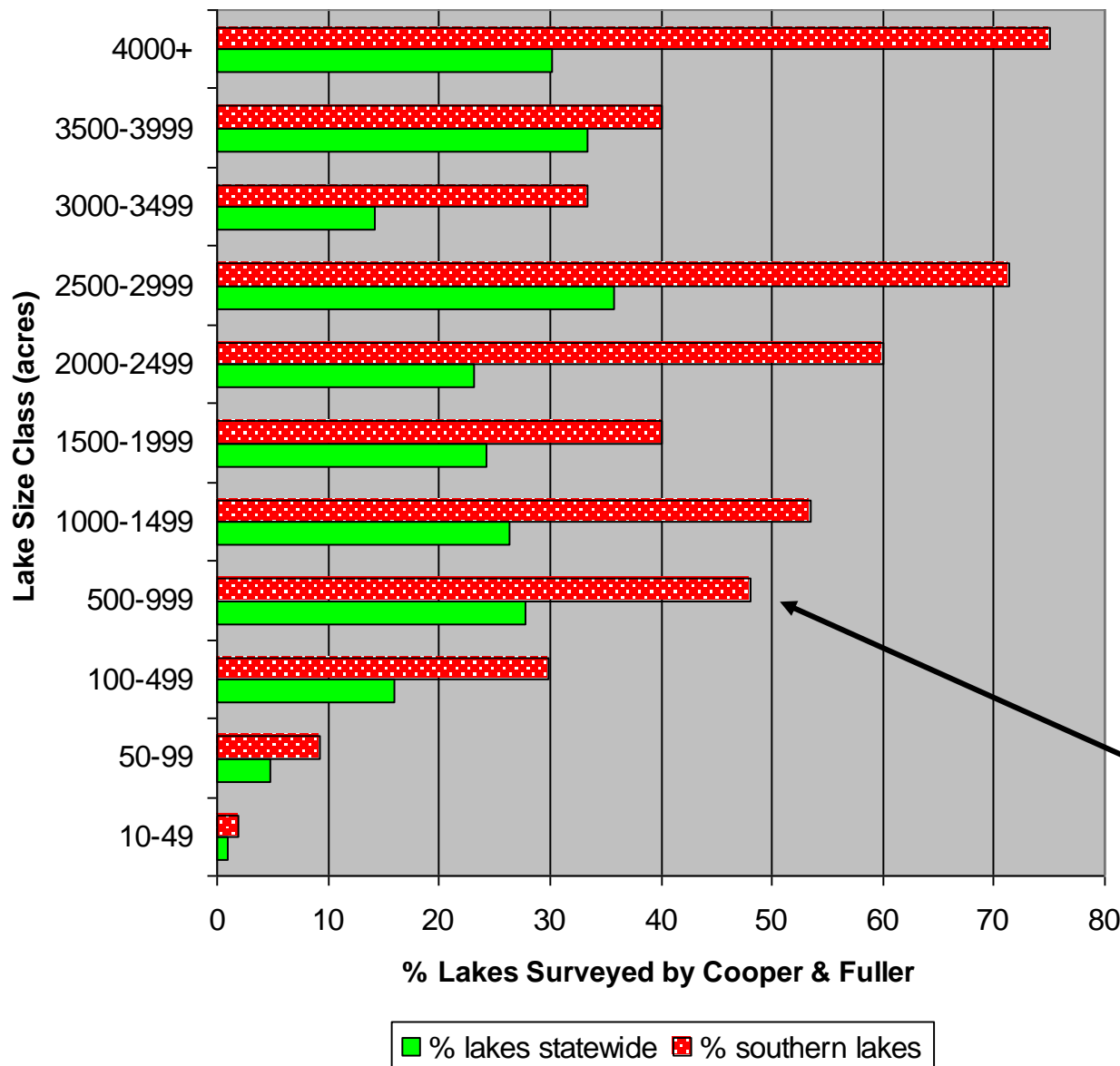
**Most of the 206 Cooper lakes are in the southern half of the state.**

*When we use the term “Cooper lakes” or Cooper surveys” this is simply for brevity – the reference is always to the full set of lakes surveyed by Cooper and Fuller.*

**Most Cooper lakes are at lower elevations  
( $< 500$  ft. above sea level)**



**Cooper  
surveyed  
relatively few  
small lakes  
(<100 acres)**

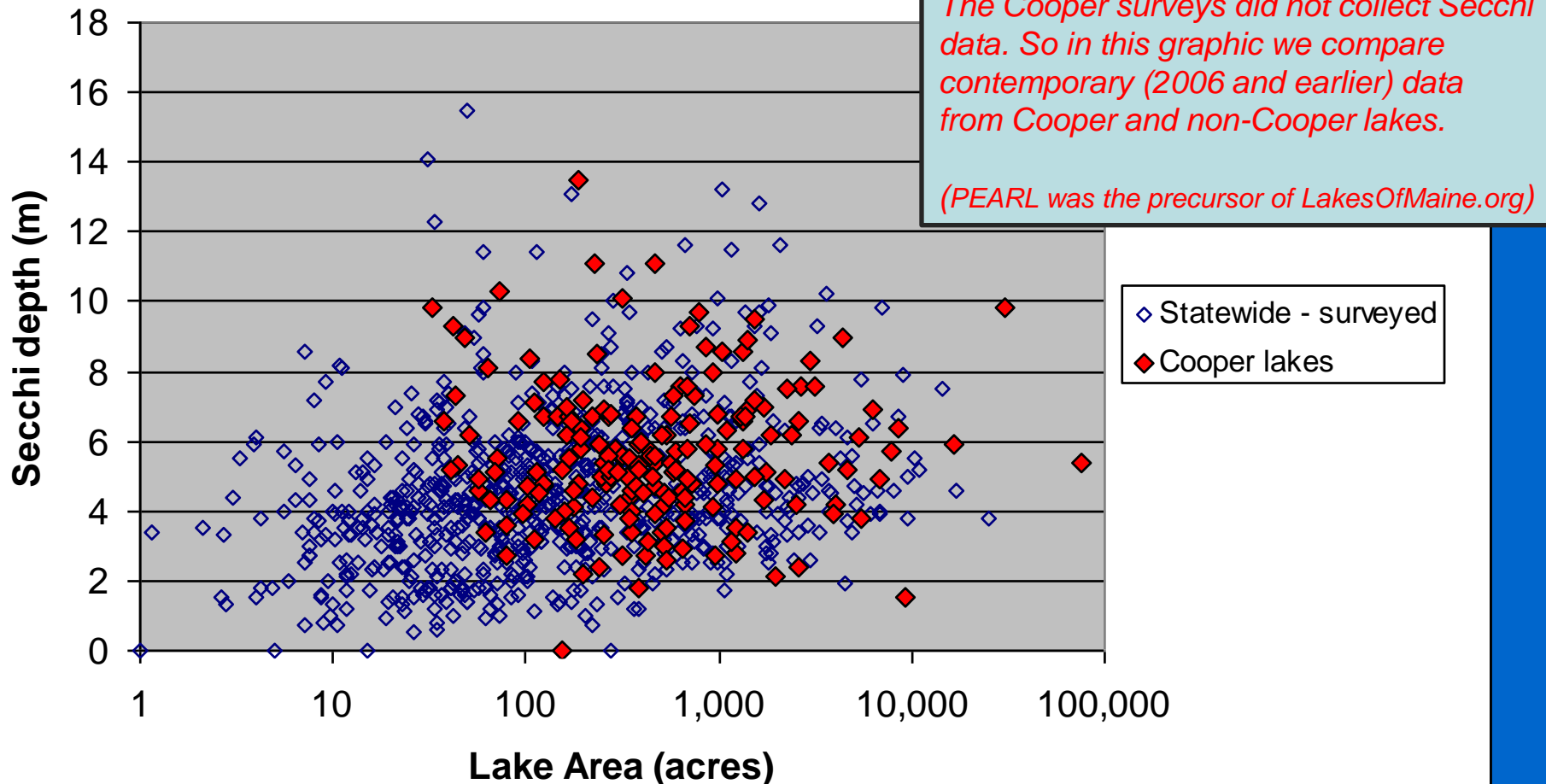


*This graphic shows the number of lakes surveyed by Cooper & Fuller, expressed as a % of the total number of lakes, by size class, (A) statewide (green bars), and (B) in the southern part of the state (green bars).*

*Thus, for the 500-999 acre size class, Cooper & Fuller surveyed approximately 28% of the statewide total, or 49% of the number of lakes in the southern part of the state.*



# Water transparencies in Cooper lakes are similar to values statewide (contemporary data)



Graph shows overall mean Secchi depth for all surveyed lakes by lake area. (Data source: DEP/VLMP via PEARL)



## Approach for this analysis:

1. For each of the Cooper survey lakes, develop species lists from (i) the 1930-40s surveys, and (ii) the IF&W 2004 lake fish inventory.

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2. For comparative purposes, focus on 22 species that are readily detected - i.e. likely to appear in snapshot-type sampling (e.g. gamefish spp. and other larger-bodies spp. Ignore most minnow species). Use EMAP repeat-sampling data to identify readily detectable species.

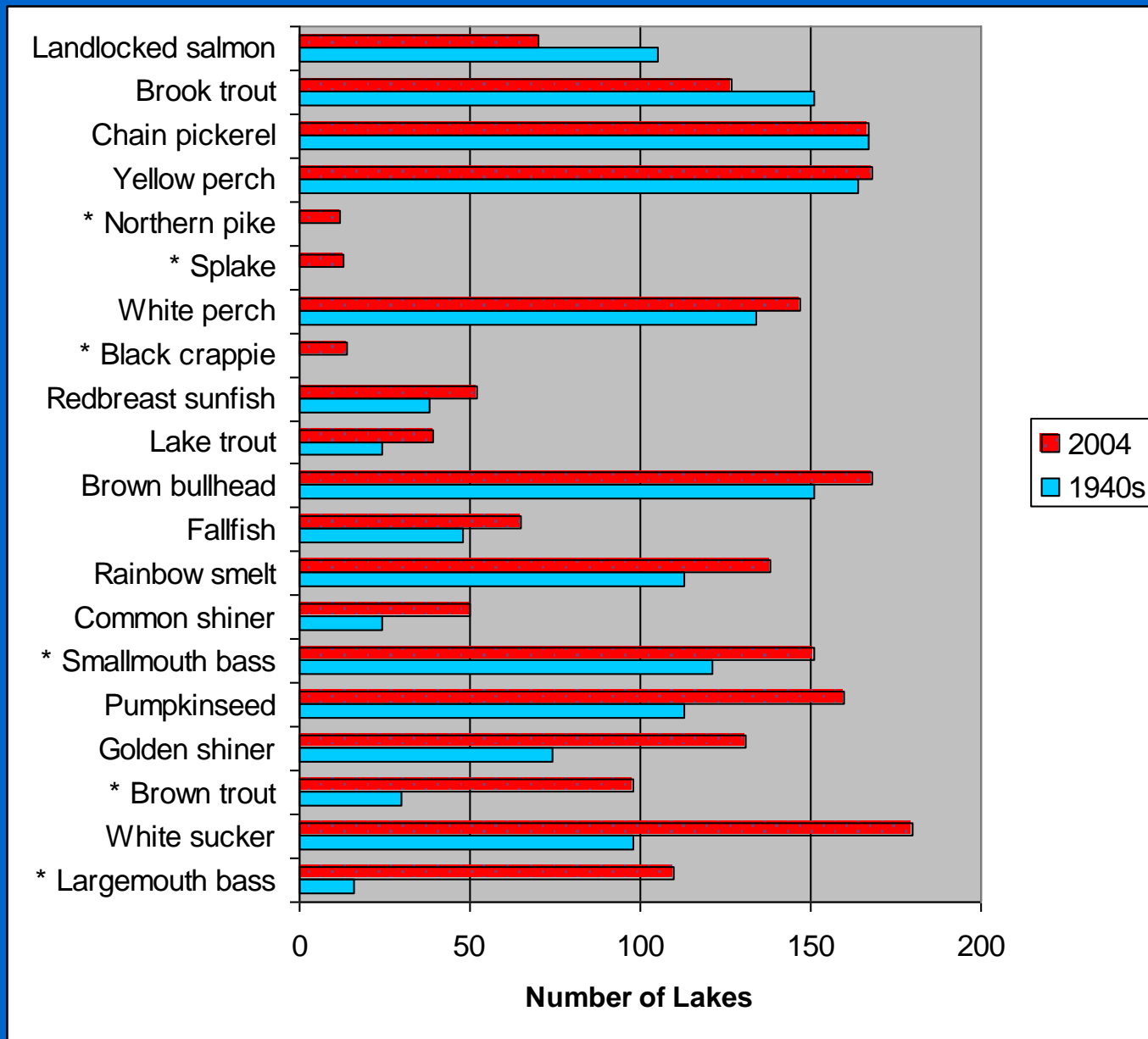
*EMAP was a nationwide program designed to sample water quality, fish, benthos and plankton in a statistically-derived 'population' of lakes across the US.*

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3. For these readily detectable taxa, assume that species present in a lake in 2004, but not recorded in the 1930-40s, derived from legal or illegal stocking, or 'natural' colonization.

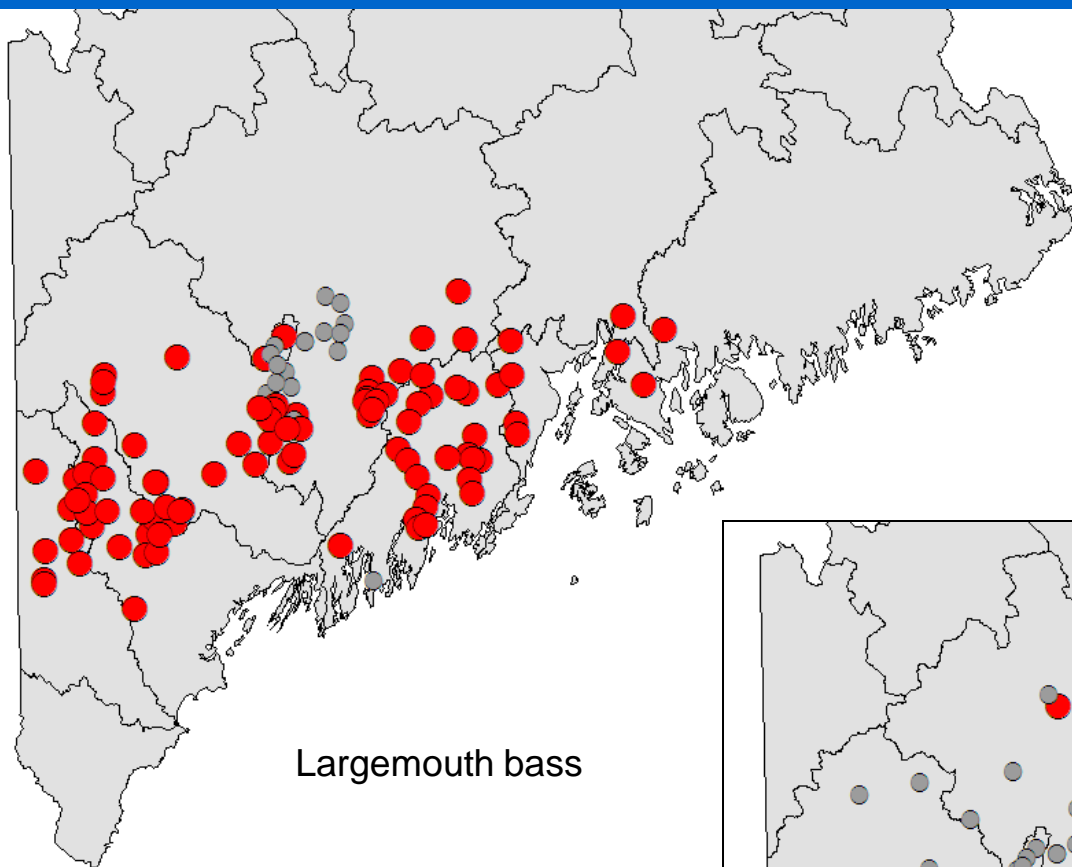
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3. For these readily detectable taxa, assume that species present in a lake in 2004 but not recorded in the 1930-40s derived from legal or illegal stocking, or 'natural' colonization.
4. Use IF&W stocking records to compare legal vs. illegal stocking and/or colonization.



**Number of lakes in which species are found: 1940s vs. 2004**

\* = non-Maine native

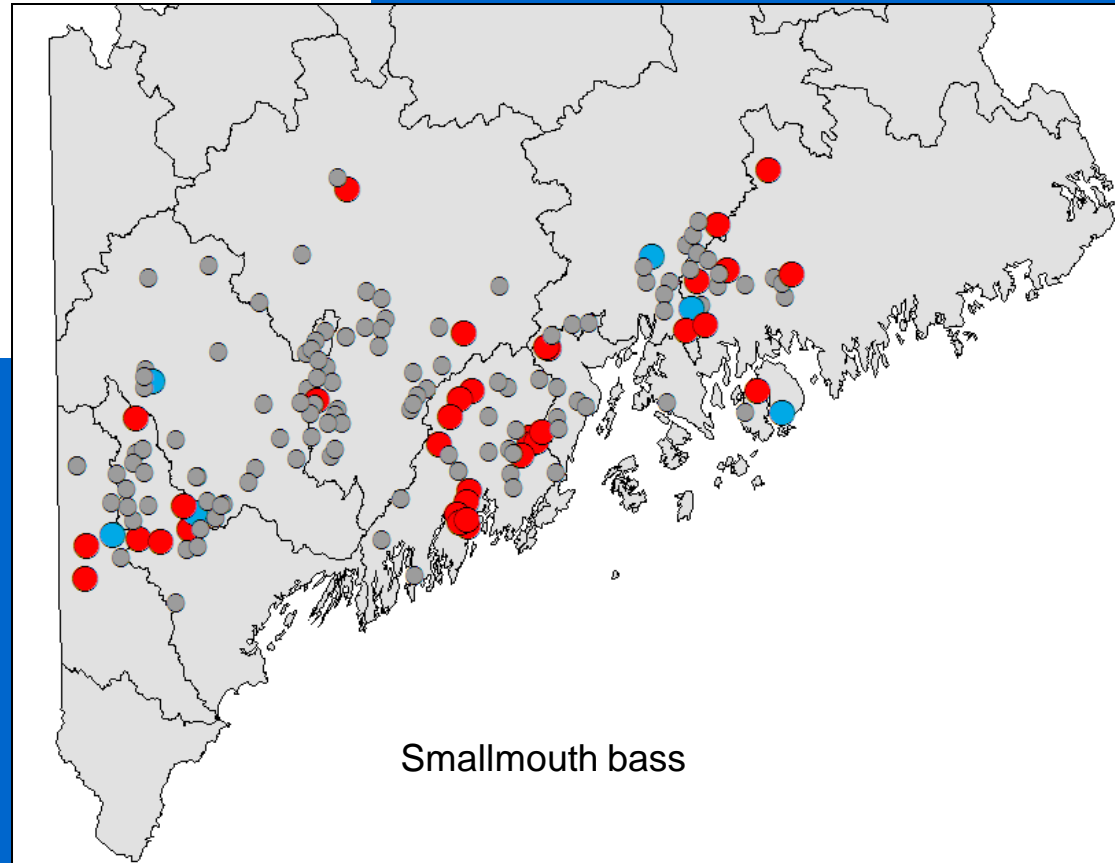


Largemouth bass

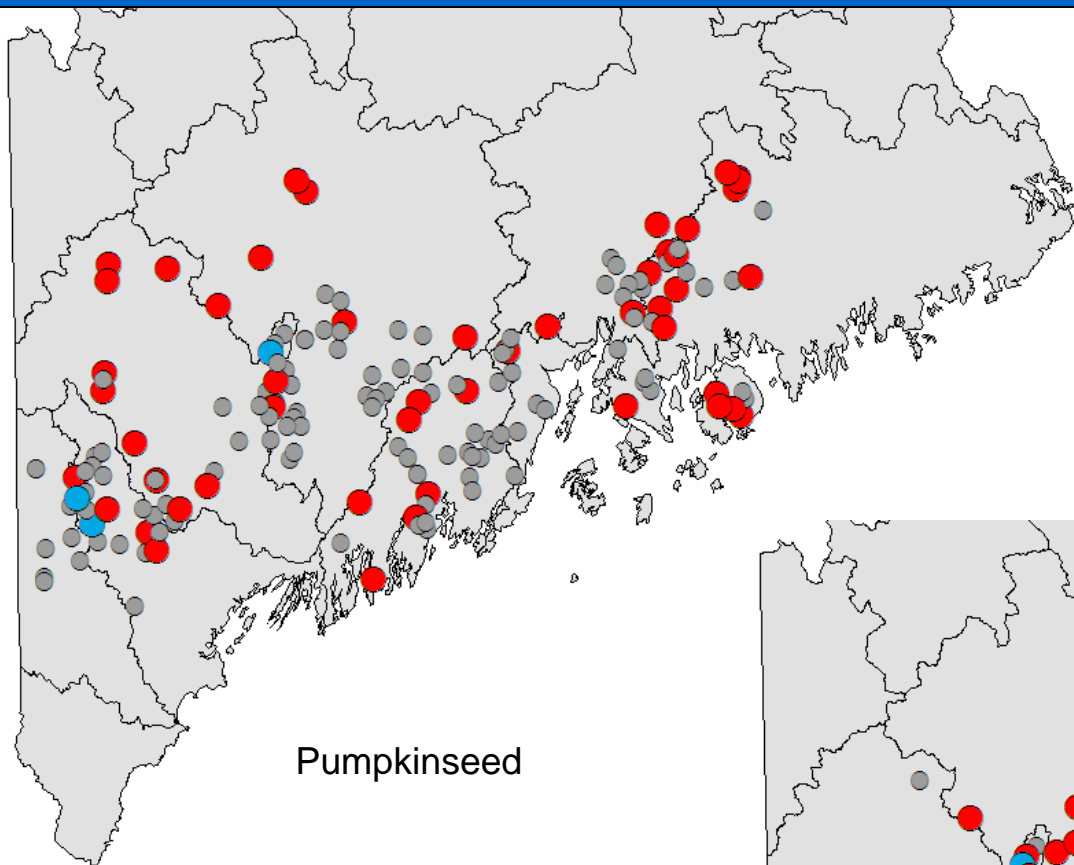
*In this and the following 4 graphics, we show lakes in which a species was present: in the 1930s-40s only\* (blue dots), 2004 only (red dots), and in both time periods (grey dots).*

*\* Many of these graphics refer to "1940s lakes" – this is for clarity only; these lakes were actually sampled between 1938 and 1944.*

- 1940s only
- 2004 only
- Both periods

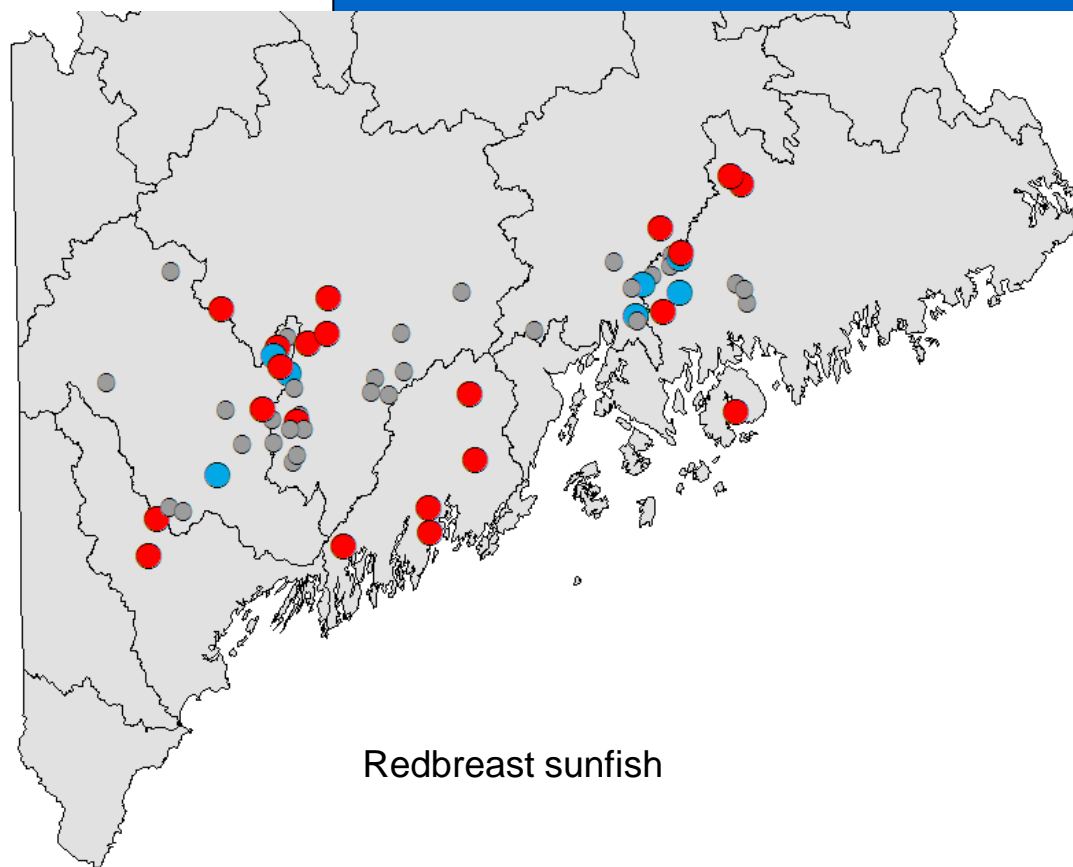


Smallmouth bass



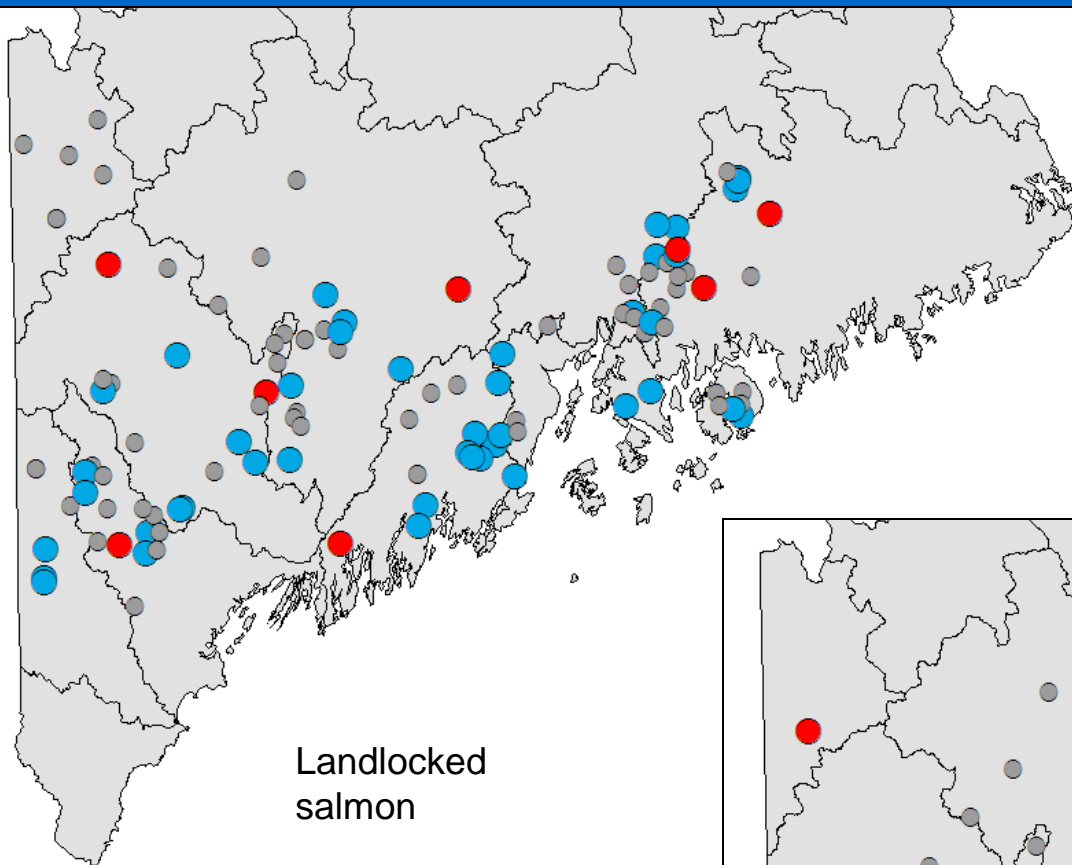
Pumpkinseed

- 1940s only
- 2004 only
- Both periods



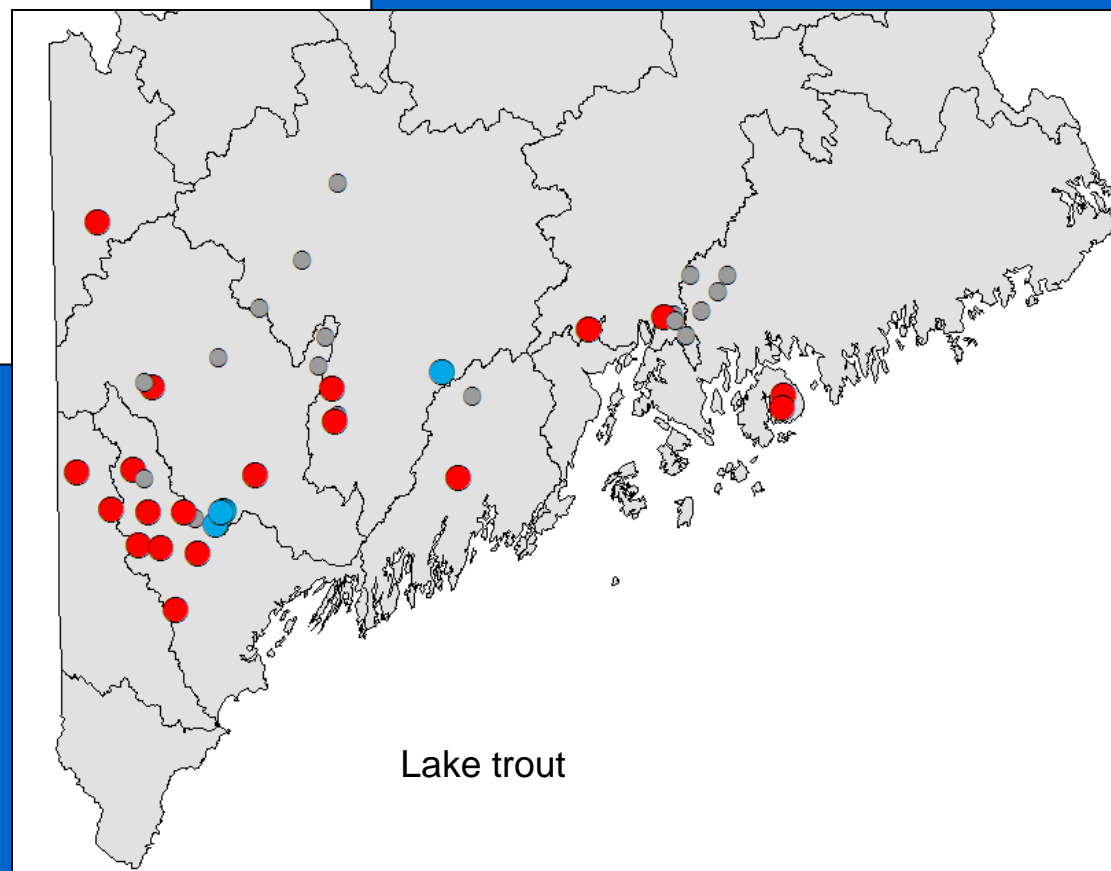
Redbreast sunfish



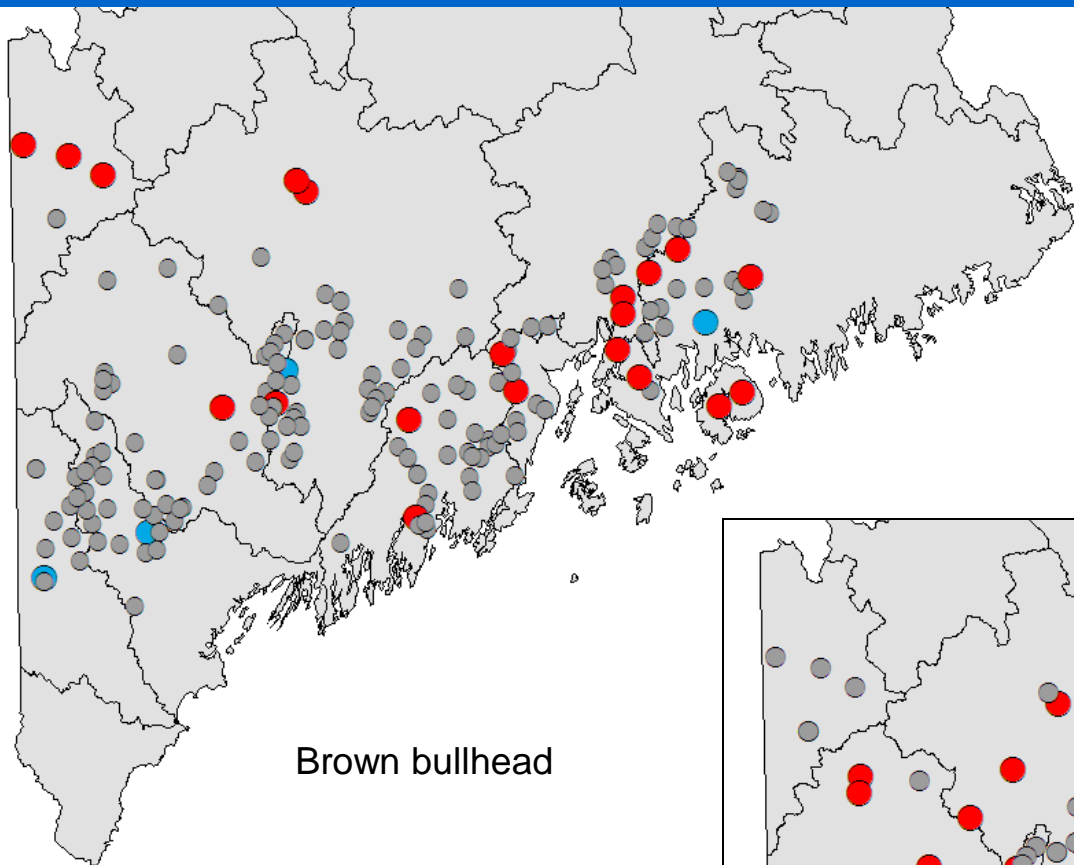


Landlocked  
salmon

- 1940s only
- 2004 only
- Both periods

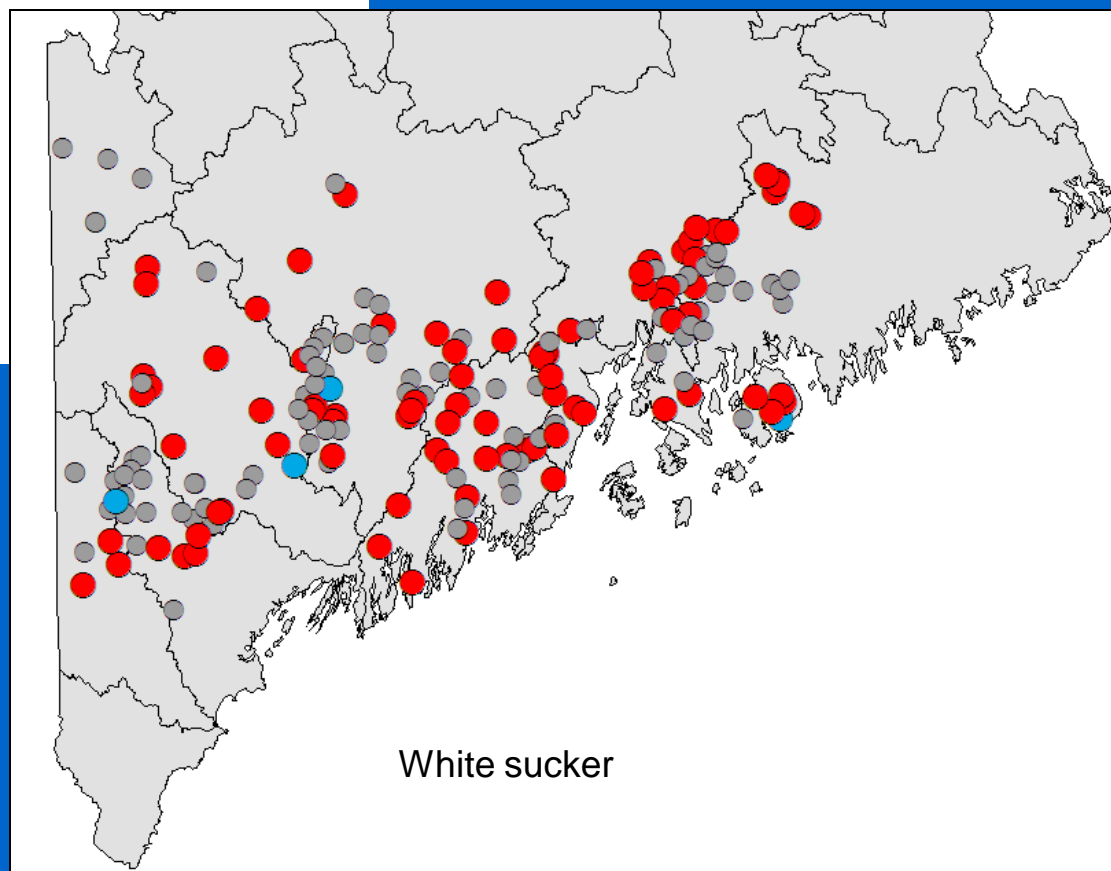


Lake trout

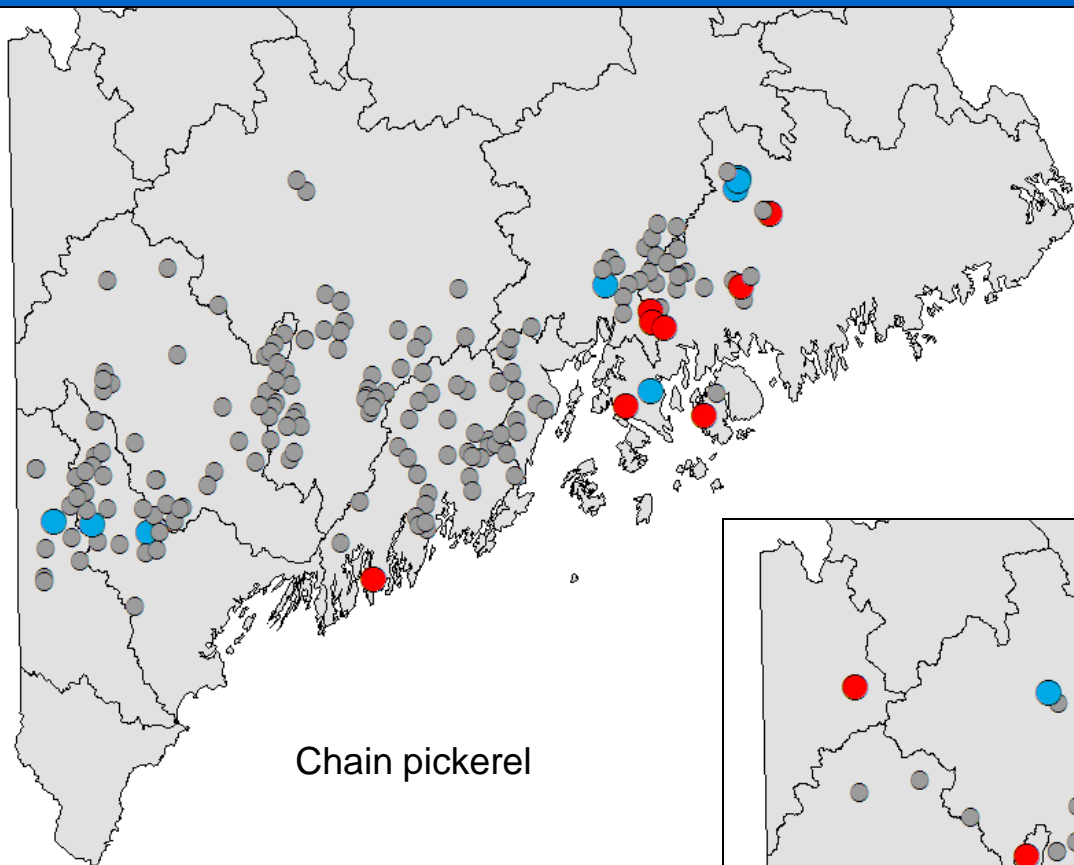


Brown bullhead

- 1940s only
- 2004 only
- Both periods

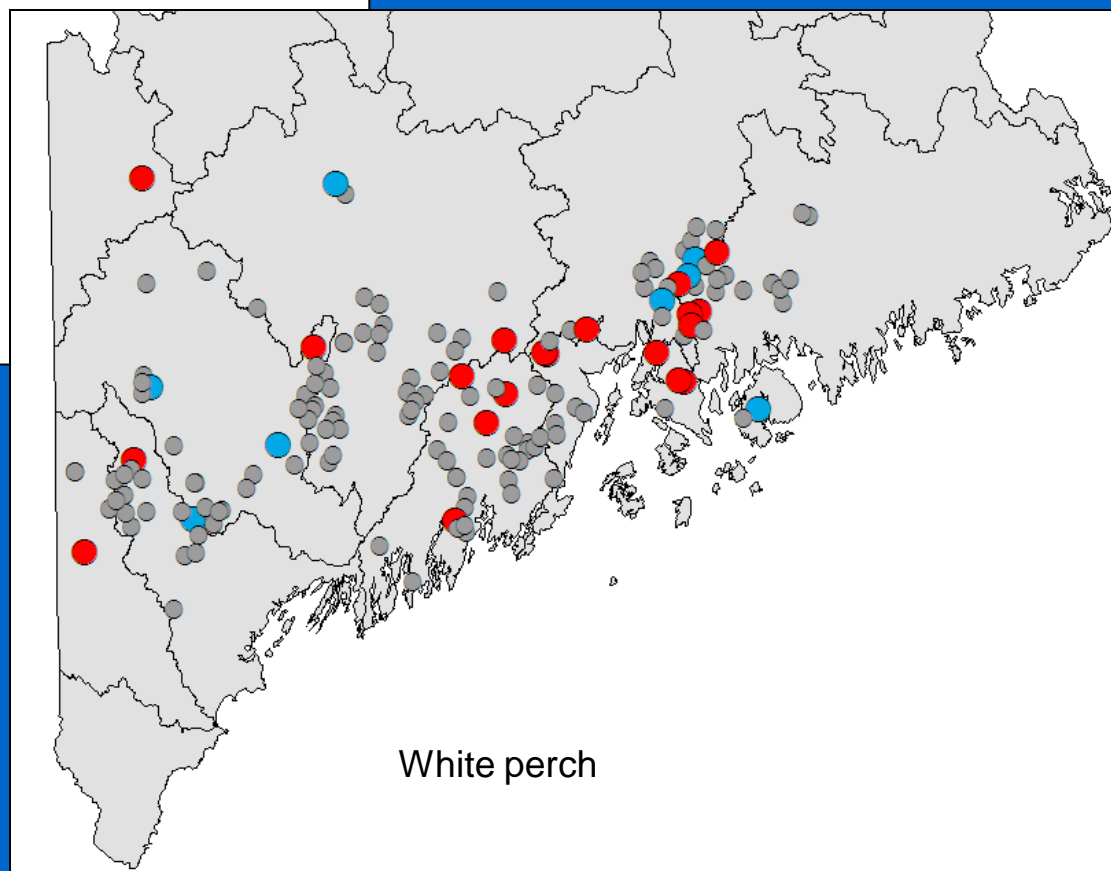


White sucker



Chain pickerel

- 1940s only
- 2004 only
- Both periods



White perch

| <b>Species</b>    | <b># Lakes Stocked</b> |
|-------------------|------------------------|
| Brook trout       | 1152                   |
| Landlocked salmon | 307                    |
| Brown trout       | 298                    |
| Lake trout        | 135                    |
| Splake            | 101                    |
| Largemouth bass   | 90                     |
| Rainbow trout     | 73                     |
| Smallmouth bass   | 52                     |
| Atlantic salmon   | 31                     |
| White perch       | 29                     |
| Bass (sp.)        | 28                     |
| Chinook salmon    | 19                     |
| Arctic char       | 12                     |
| Chum salmon       | 10                     |
| Alewife, searun   | 6                      |
| Sockeye salmon    | 4                      |
| Lake whitefish    | 4                      |
| Coho salmon       | 3                      |
| Rainbow smelt     | 1 (?)                  |
| Chain pickerel    | 1                      |

**Number of lakes stocked by IF&W between 1937 and 2003, by species.**

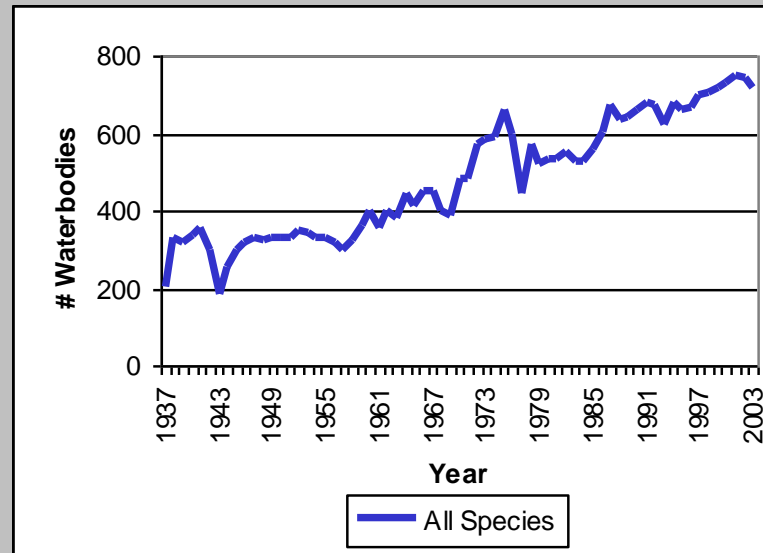
**(period of stocking varies by species)**

**Number of lakes and  
streams stocked  
by IF&W  
1937-2003:**

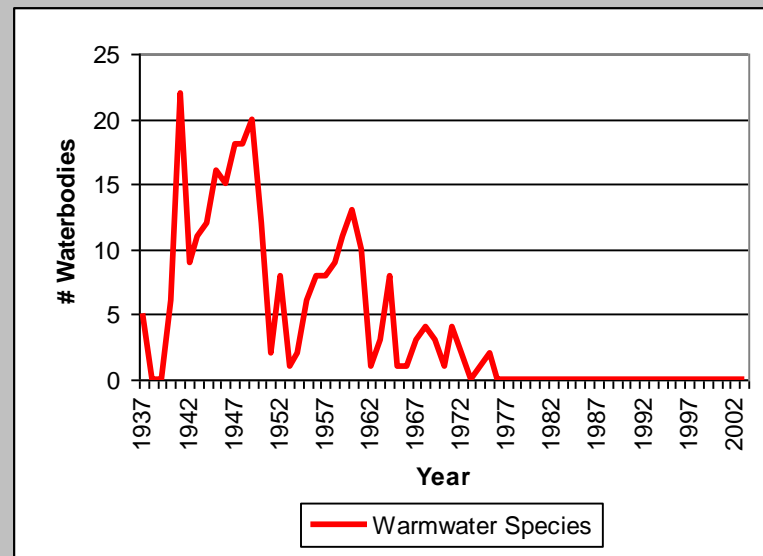
**(A) all fish species,**

**(B) smallmouth/  
largemouth bass.**

*In the 1970s, IF&W ceased  
stocking largemouth &  
smallmouth bass in Maine  
waters. These black bass  
species are NOT Maine-natives.*



**(A)**



**(B)**

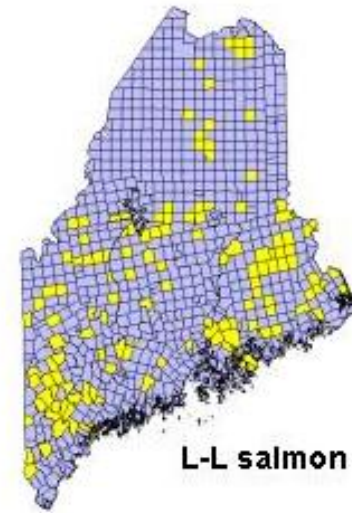
*This graphic shows counties where each species was stocked (in one or more waterbodies) during the period 2000-2003.*



**Brook trout**



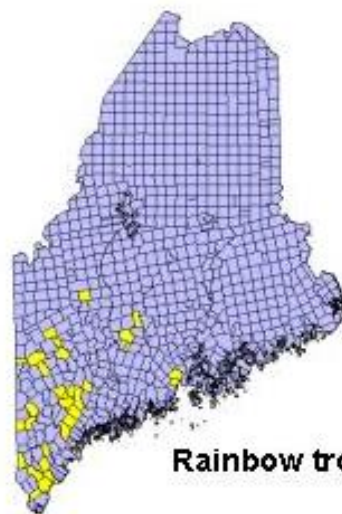
**Brown trout**



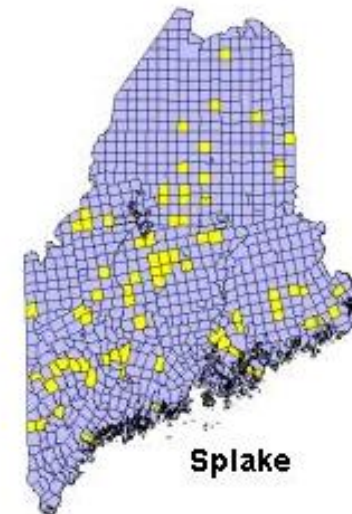
**L-L salmon**



**Lake whitefish**

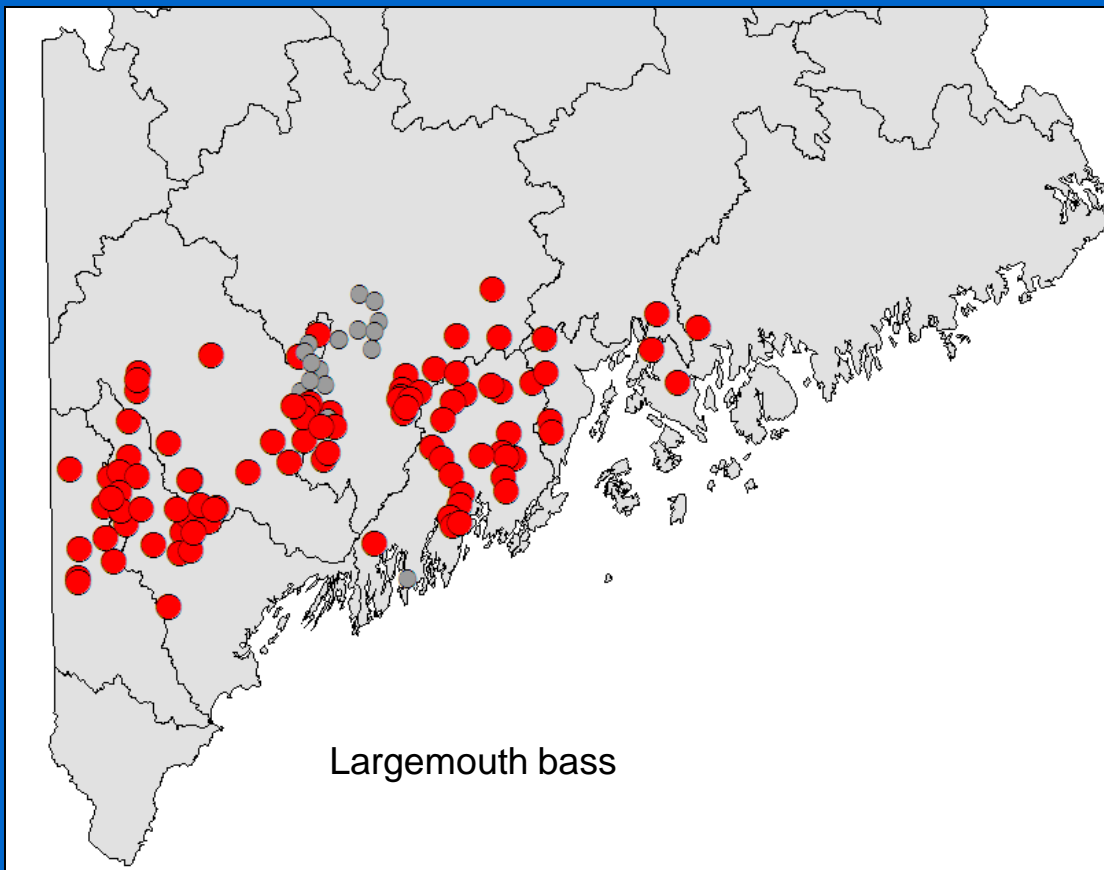


**Rainbow trout**



**Splake**

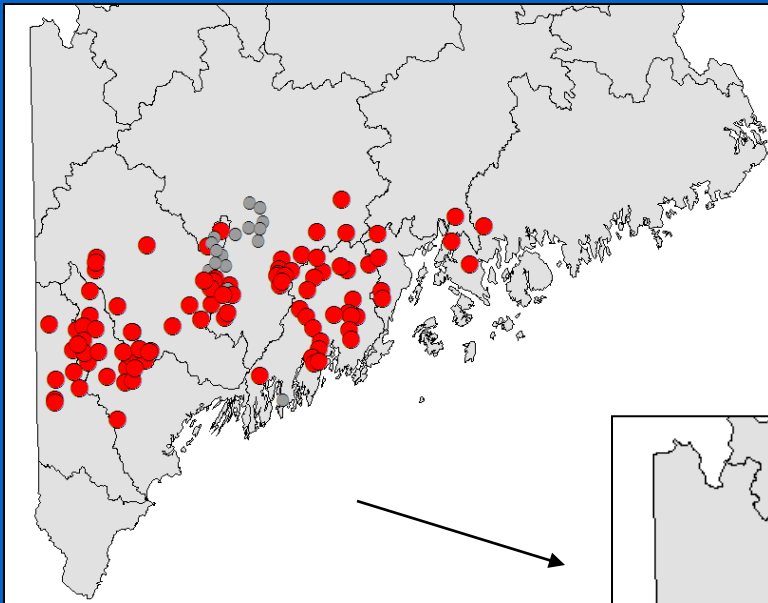
## Fish stocking: 2000-2003



- 1940s only
- 2004 only
- Both periods

*Use the IF&W stocking database (1937-present) to identify which of the new 2004 records (●) may have resulted from legal stocking.*

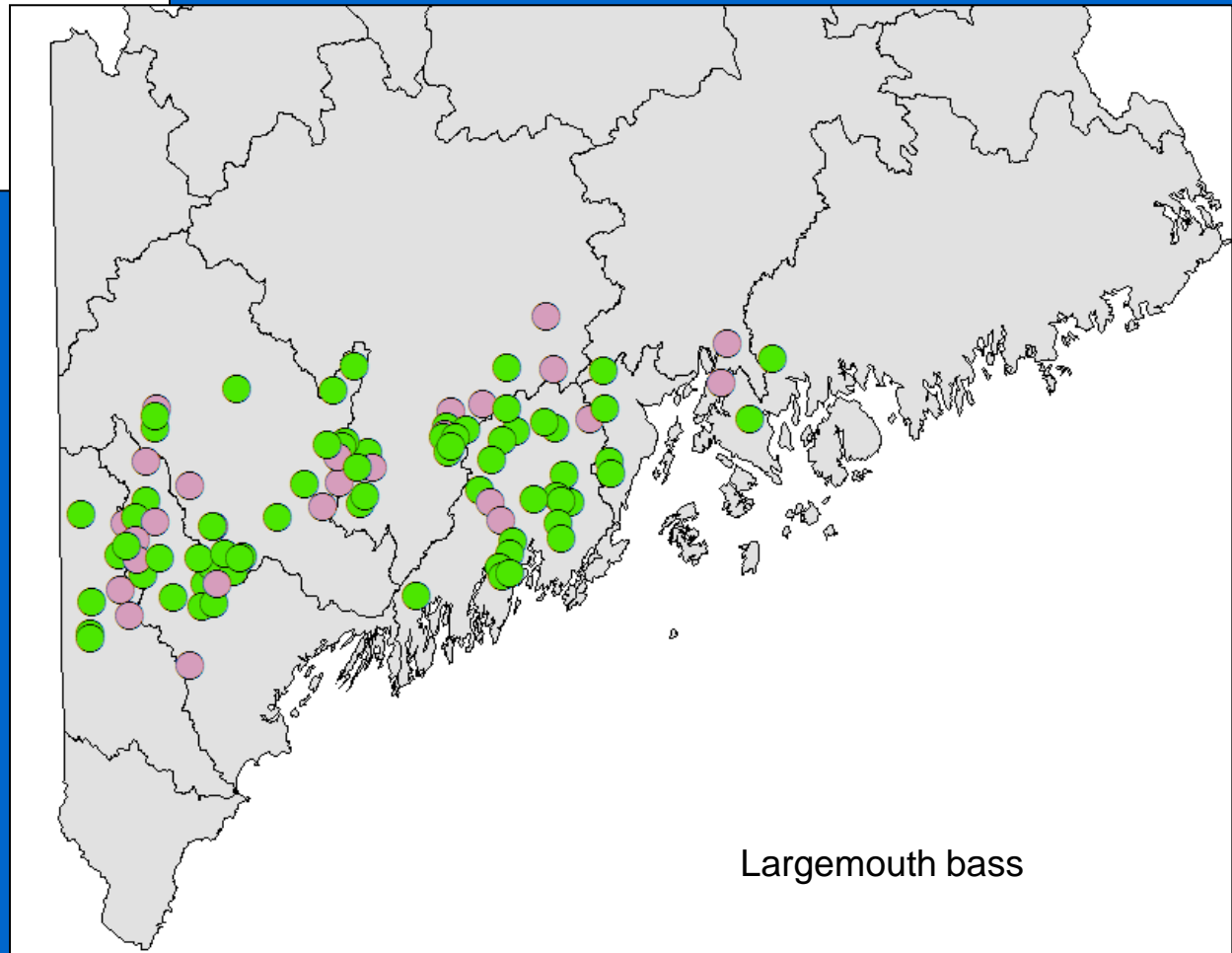




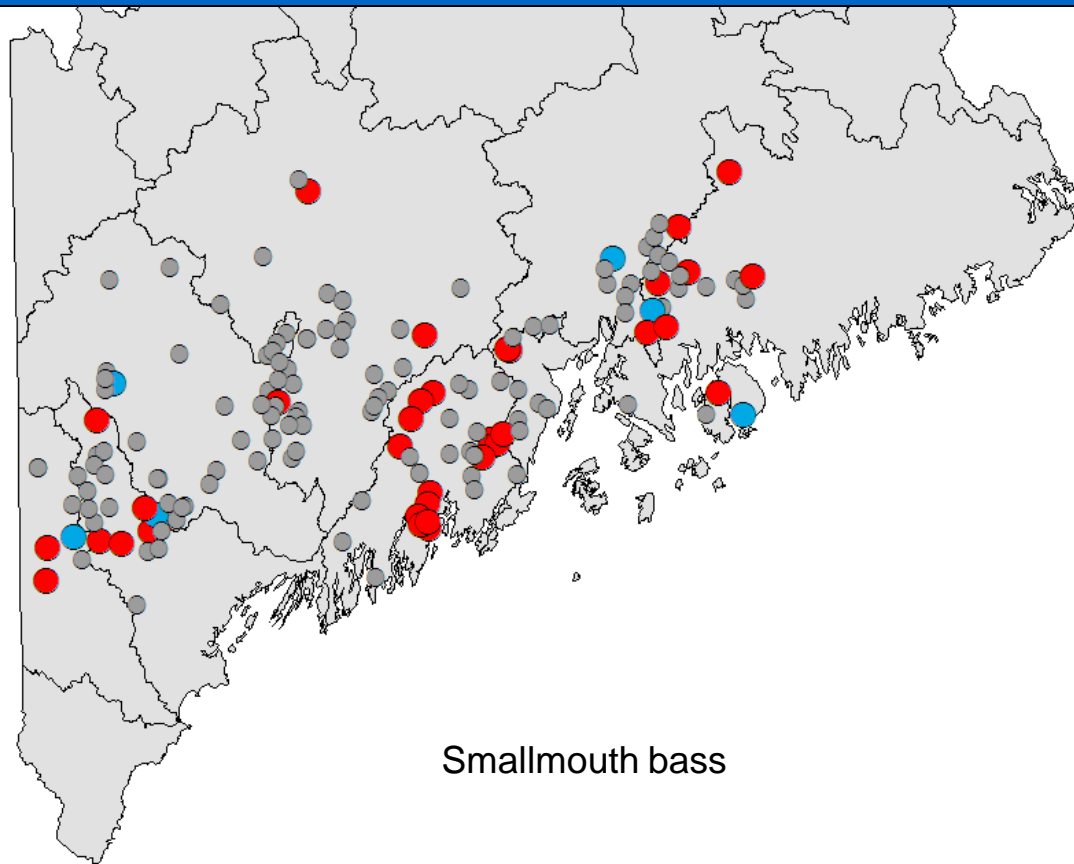
*In this slide for Largemouth bass, and the subsequent slide for Smallmouth bass, the red-dot lakes depicted in the smaller panel (top left) are the same lakes depicted in the larger panel (bottom right). It is just the symbology that changes between the 2 panels, to indicate illegal vs. legal stocking.*

*Conclusion:* Most of the lakes in which Largemouth bass were found in 2004, but NOT in the 1930s-40s, resulted from illegal stocking / colonization, not from legal stocking.

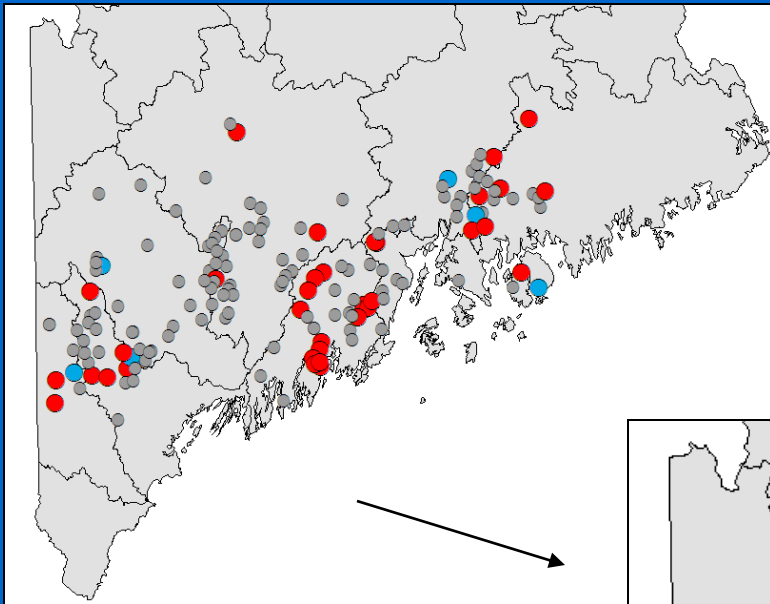
- Illegal stocking/colonization
- Legal stocking (IF&W)



Largemouth bass

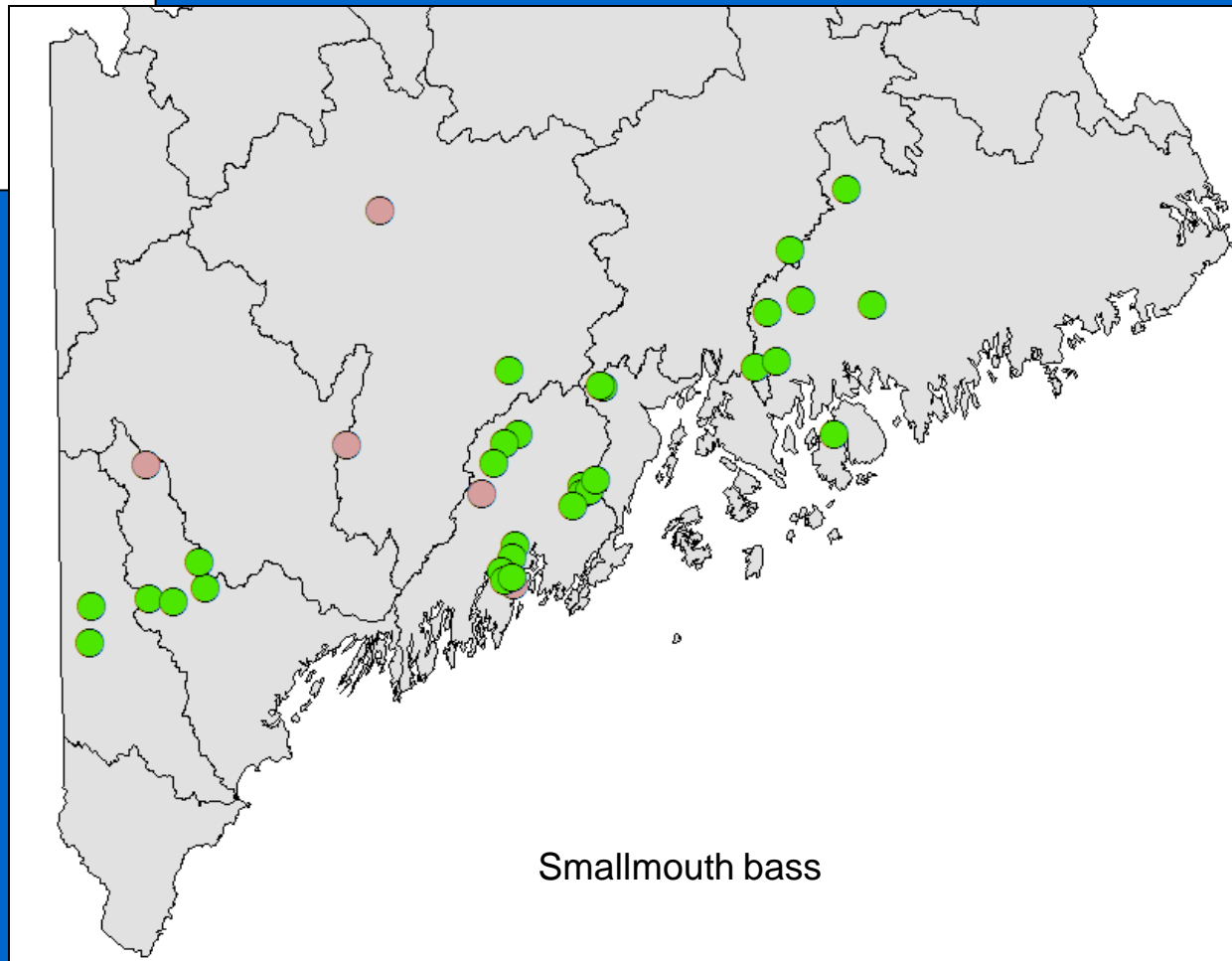


- 1940s only
- 2004 only
- Both periods



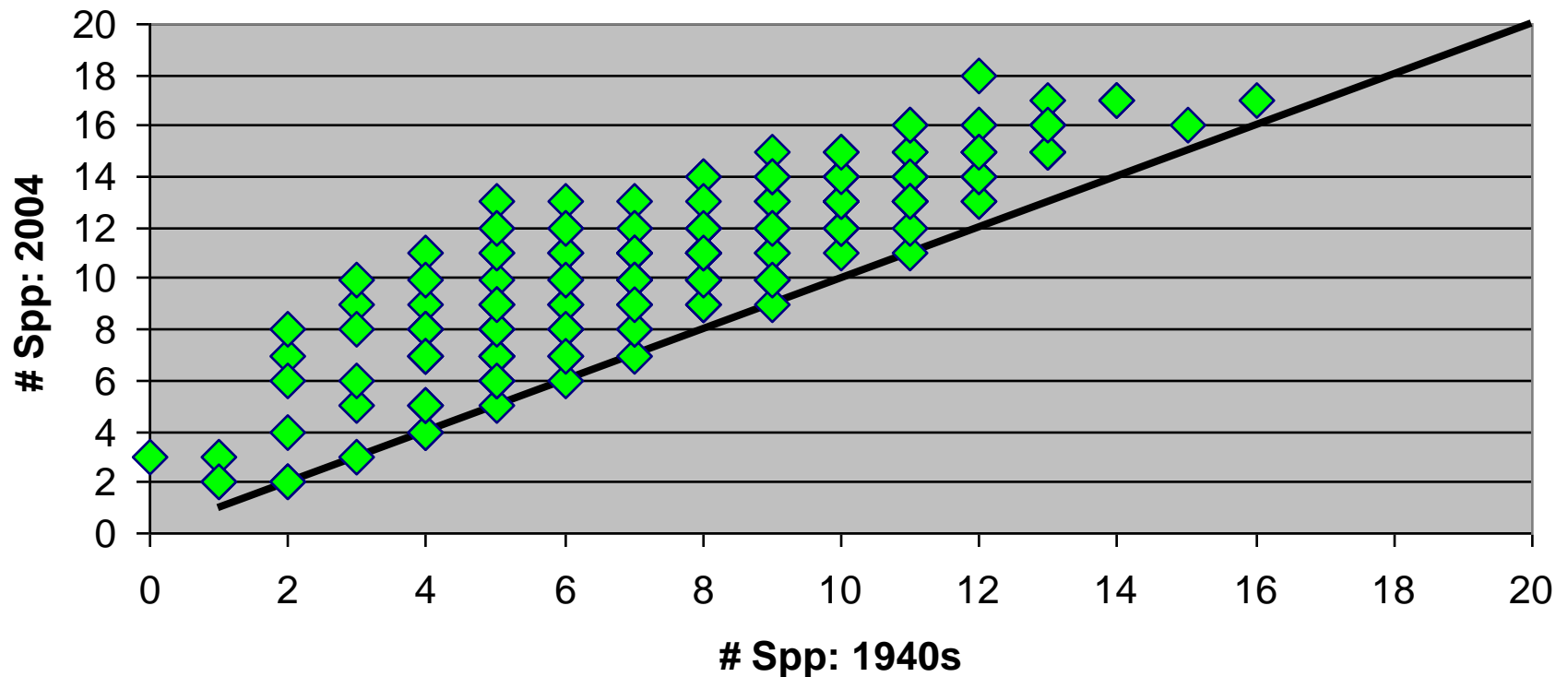
Conclusion: Most of the lakes in which Smallmouth bass were found in 2004, but NOT in the 1930s-40s, resulted from illegal stocking / colonization, not from legal stocking.

- Illegal stocking/colonization
- Legal stocking (IF&W)



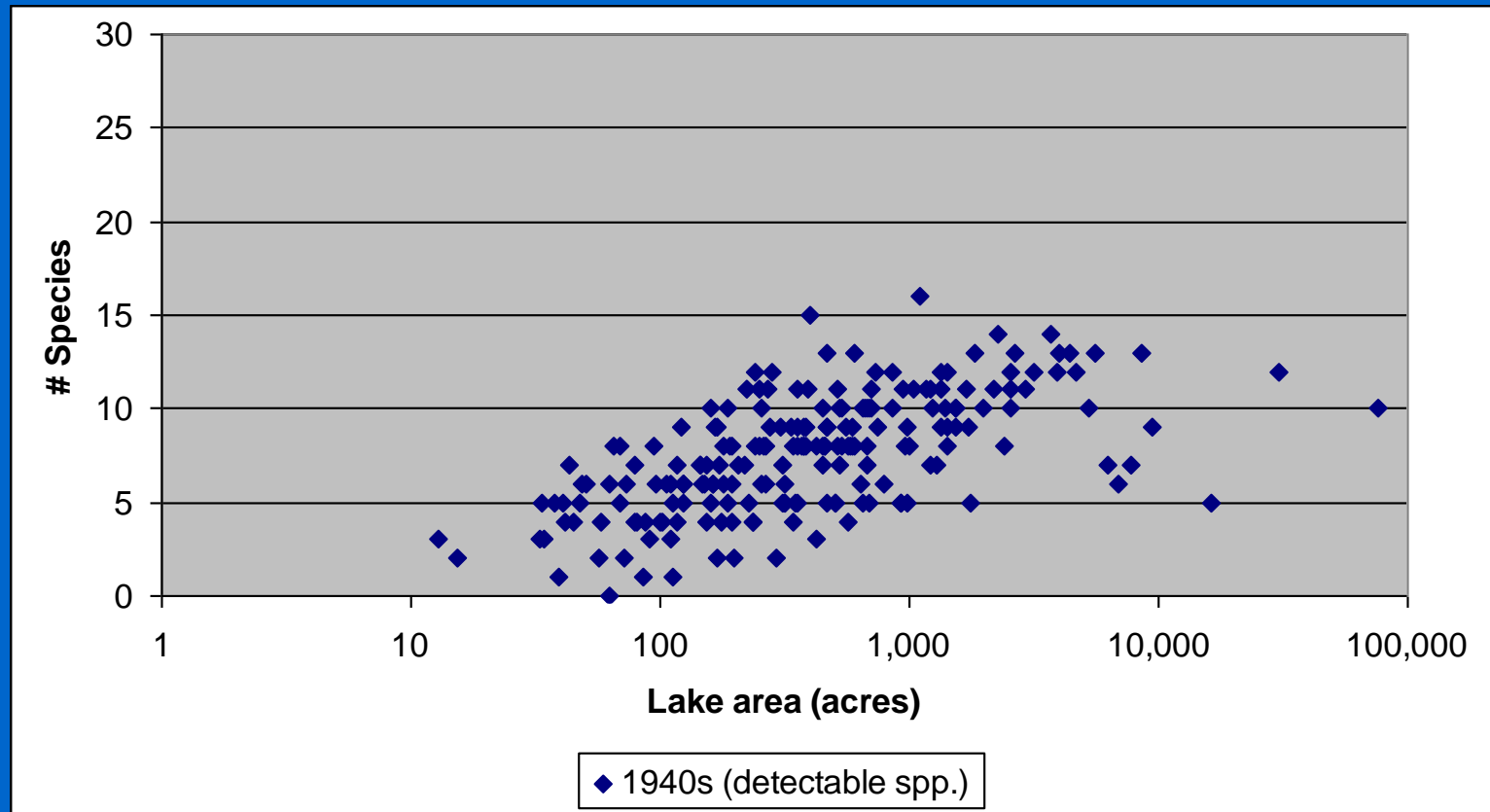
**What are the impacts on overall species richness in lakes from the changes in fish assemblages that have occurred in the past 60 years?**

**Lake fish species richness: numbers of "detectable" species,  
1940s vs. 2004**

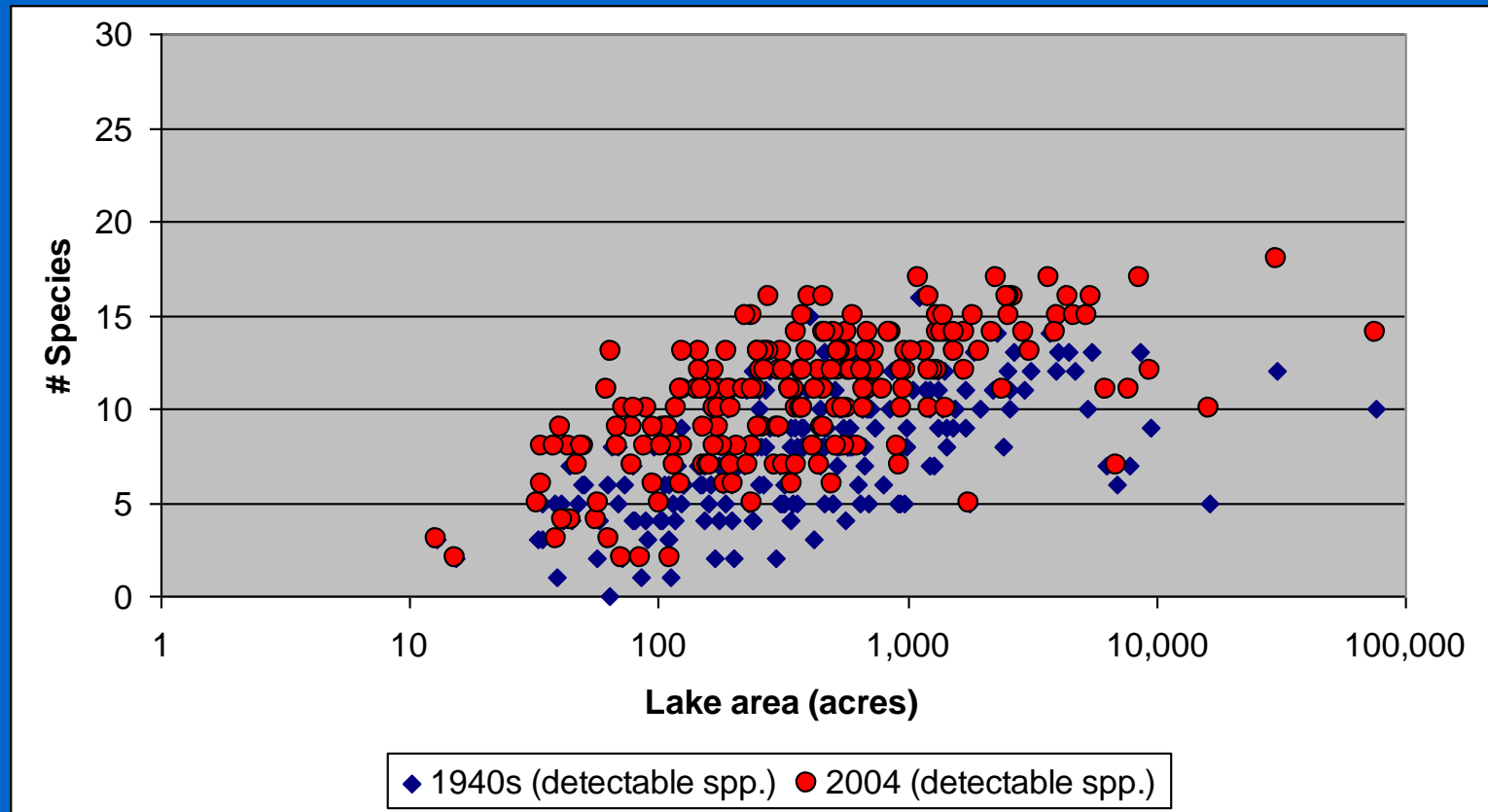


*Conclusion: It appears that lakes have more of the "detectable" species in 2004 than in the 1930s-40s. Each green dot represents one or more lakes.*

*(The black diagonal line is for reference, only, and simply depicts equal numbers of species in both time periods.)*

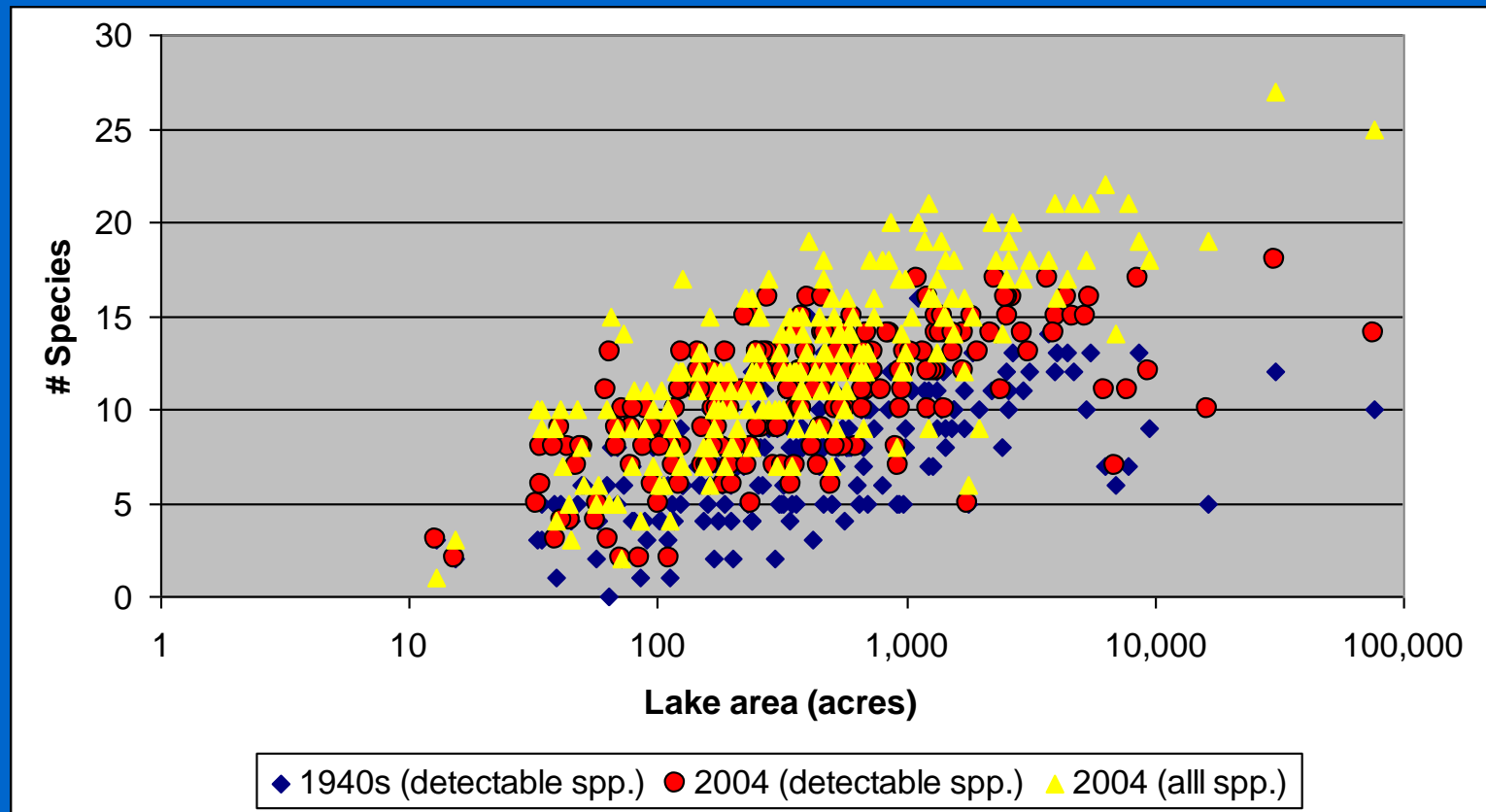


*This graphic shows the number of “detectable” fish species documented for the Cooper & Fuller lakes in the 1930s-40s, as a function of lake area. Note that the lake area axis is logarithmic.*



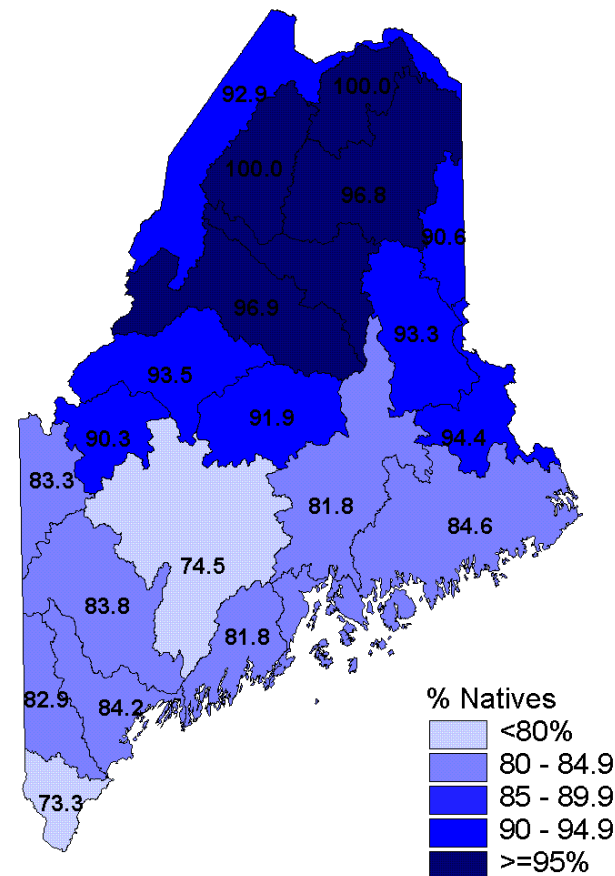
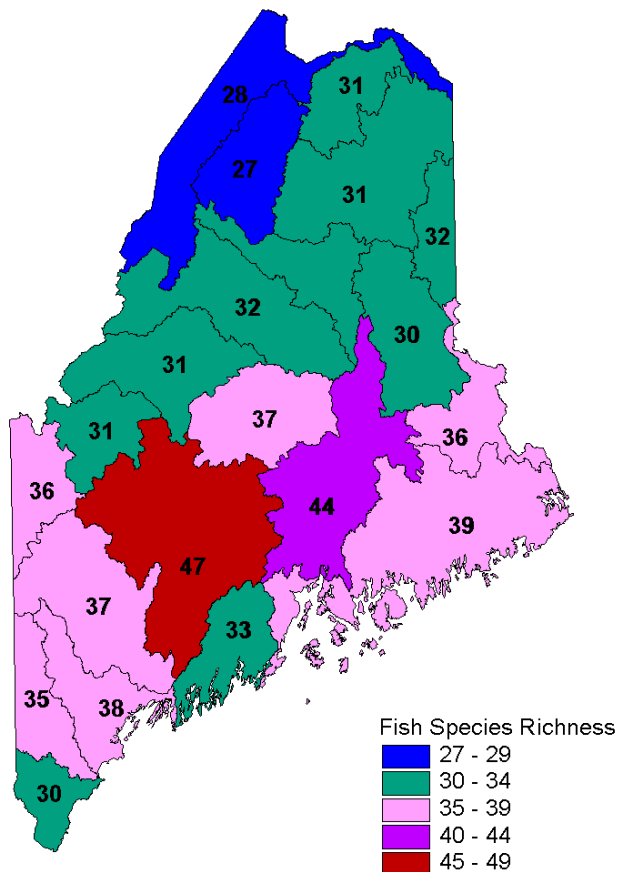
*This graphic is the same as the previous one, but now with the 2004 species records (IF&W) added (red dots).*





*This graphic is similar to the previous one, but now adds in – as yellow dots - the 2004 species totals for **all** species (i.e. both “detectable” and “less-detectable” species – for example minnows. See earlier slide for definition of “detectable”).*

**What has happened with the species  
that are less readily detectable – species  
that may have been missed in the  
Cooper surveys?**

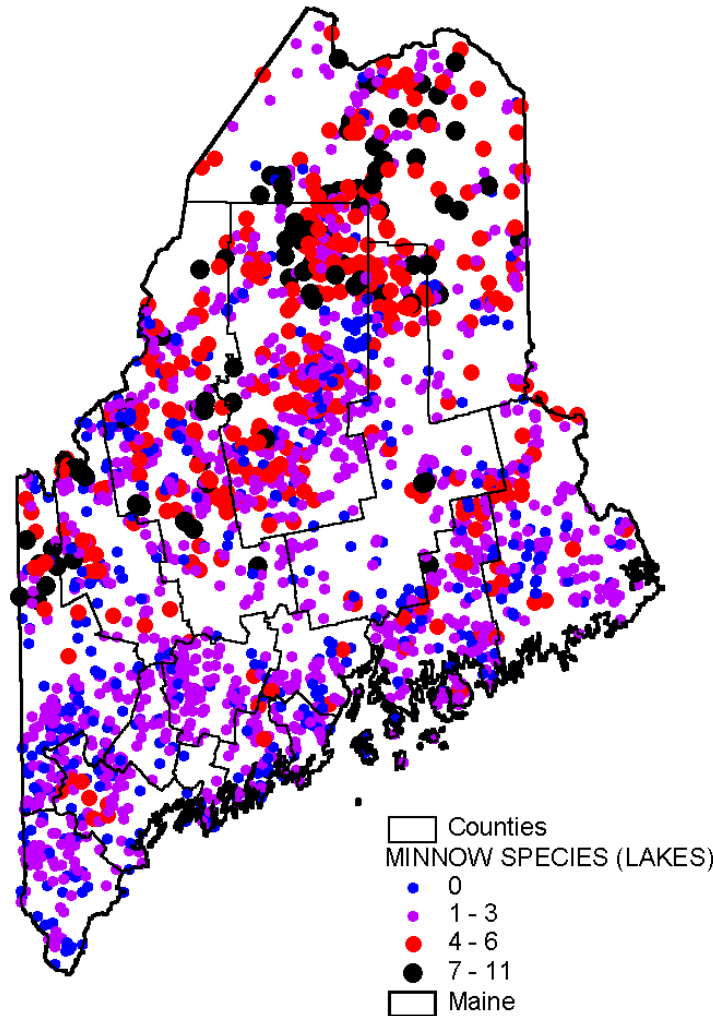


## Fish species richness by large watershed (HUC-8). (A) Total species, (B) % Maine natives.

Species totals are the cumulative number of species (lake or stream) in each watershed.

Conclusion: The number of minnow species (golden shiner excluded) is higher in lakes in northern and western parts of the state.

This may be associated with the fact that the number of littoral predator species, including largemouth & smallmouth bass, is often higher in lakes of the southern part of the state. Illegal stocking is part of the reason for higher predator numbers in the south.



For more information on the possible impact of littoral predator fish species on native minnows, see this journal article:

Whittier et al. 1997. [Cyprinid distributions in Northeast USA lakes: evidence of regional-scale minnow biodiversity losses.](#)

*Canadian Journal of Fisheries and Aquatic Sciences*: 54 : 1593-1607

## Minnow Species Richness

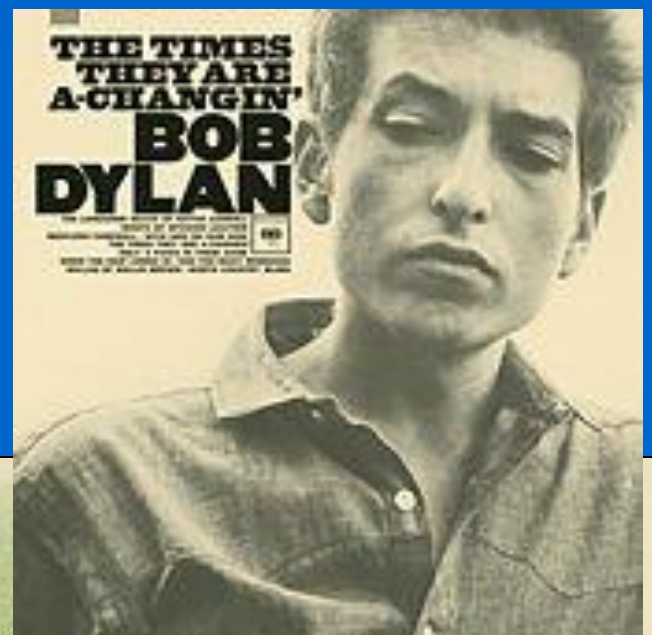
*To explore the distributions of Largemouth & Smallmouth bass in Maine lakes, click on the links below. These bring you to interactive maps in the Species Mapper feature of <http://www.lakesofmaine.org>.*

**LARGEMOUTH BASS**

**SMALLMOUTH BASS**

*Use the **Species Mapper** to map the distributions of other fish species in Maine.*

- We know that Maine's freshwater fish fauna has been modified by legal and unauthorized stocking.
- We know that unauthorized stocking is today continuing to increase homogeneity in the composition of fish assemblages.
- We know that this process is insidious – it's going on all the time, but often is poorly documented.
- We need to do whatever we can to document and publicize these changes so that they do not remain 'below the radar'.
- We also need to answer this question:  
***Why does it matter that the structure and character of Maine's freshwater fish assemblages do change over time?*** (Note that species additions are often Maine natives – just not native to the waterbody or watershed in question.)



Ogunassa trout; blueback trout; quasky, *Salvelinus aquaria* (Girard). Breeding female, 15 inches long. From Rangley Stream, Ogunssoc, Me.