

# Superimposed Image Description and Retrieval for Fish Species Identification

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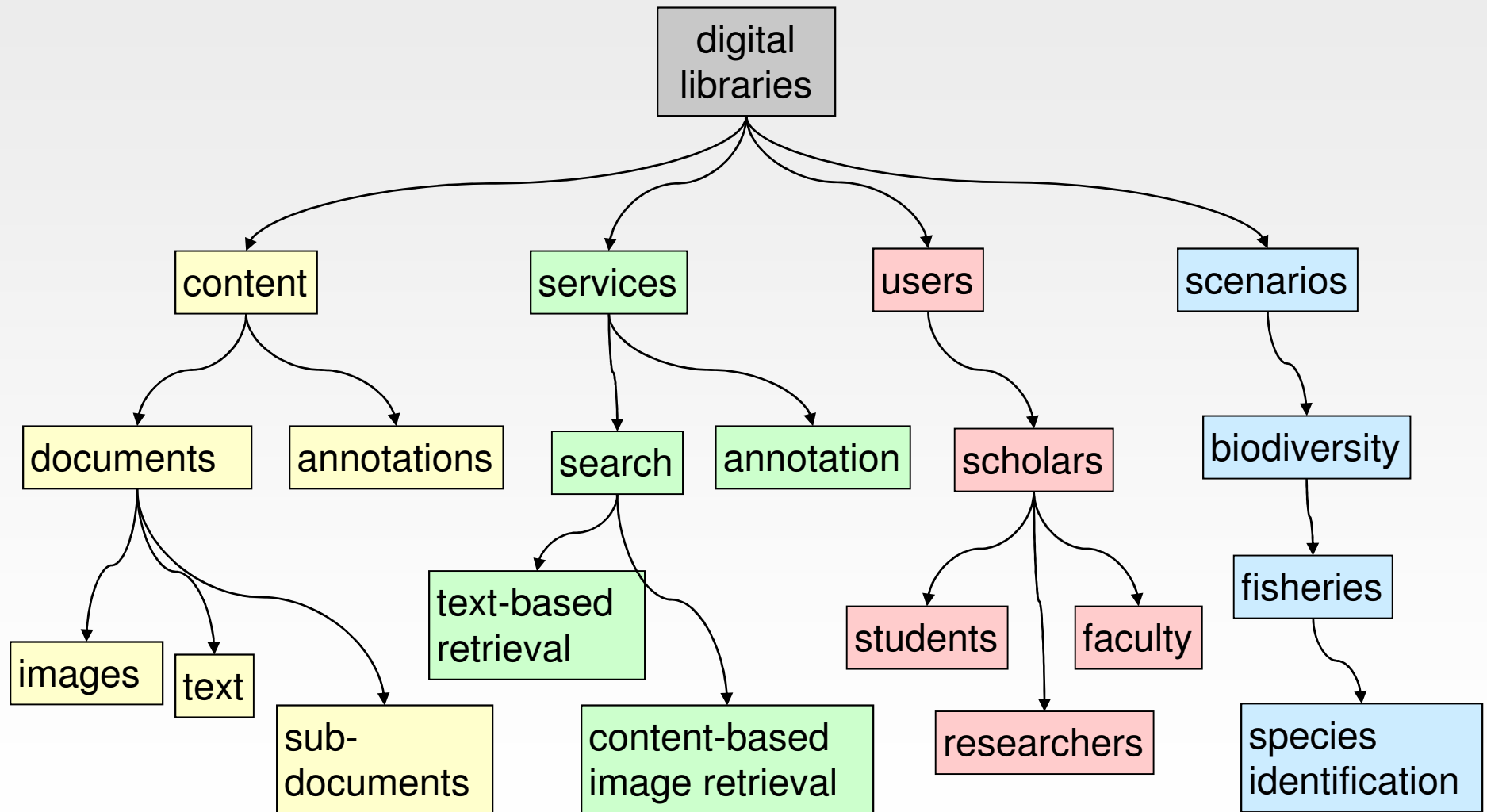
**Ricardo Torres**, Evandro Ramos,  
& Tiago Falcão

*Institute of Computing*

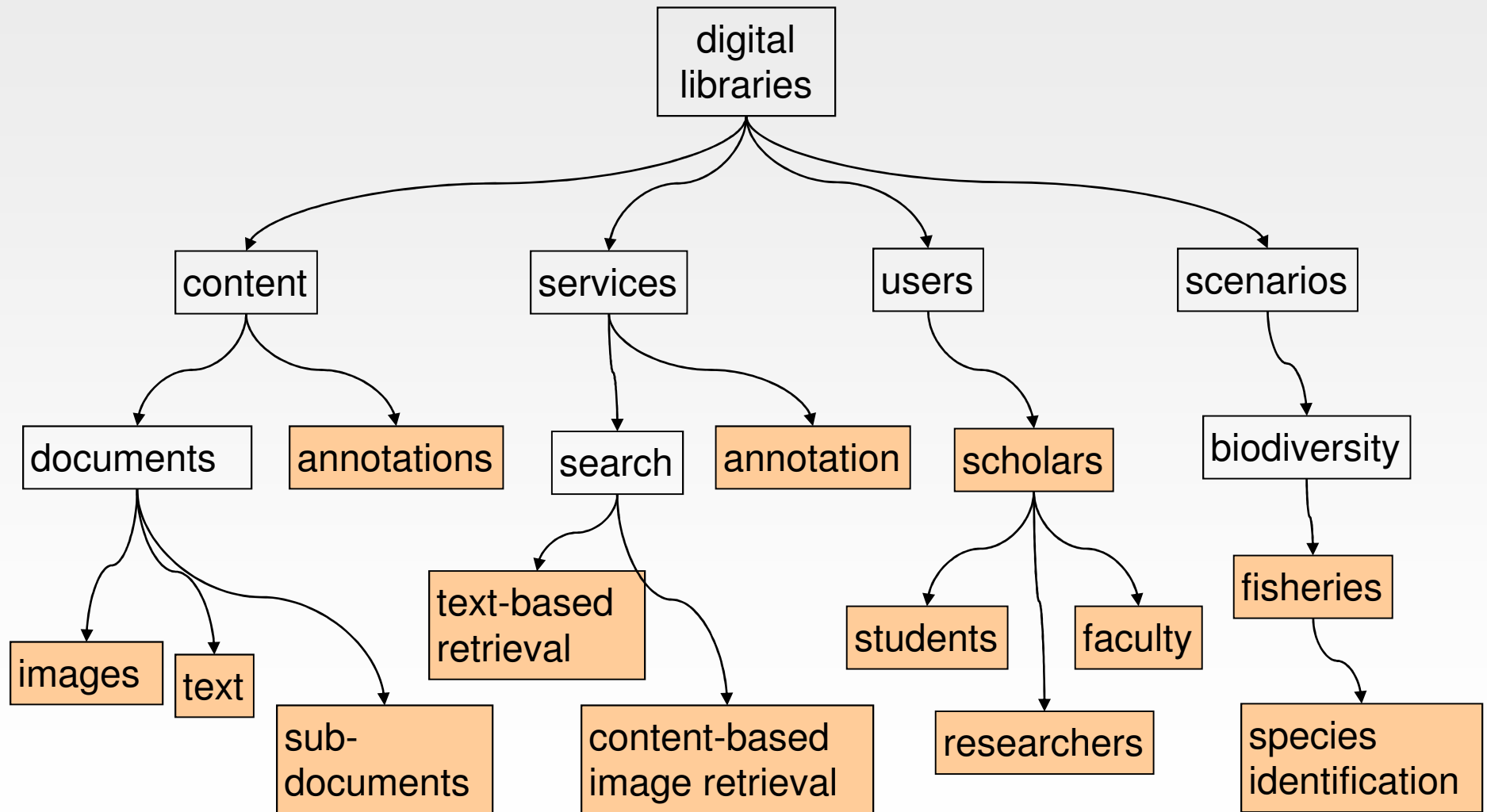


**UNICAMP**

# Context of this work



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# Motivation

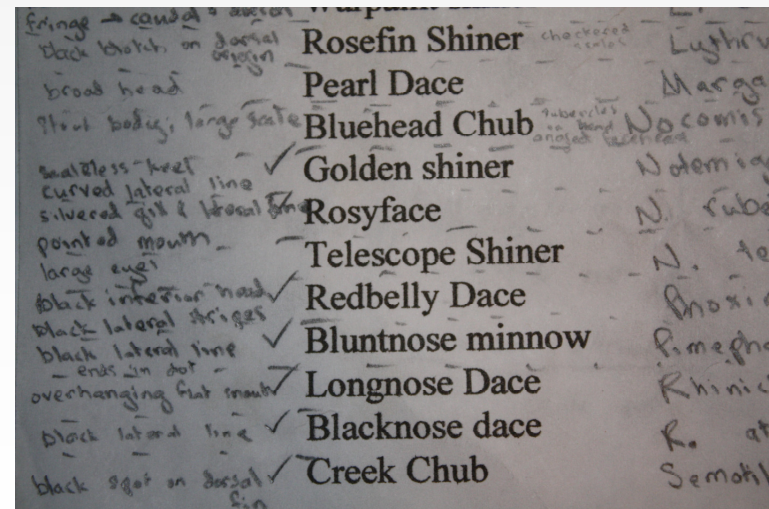
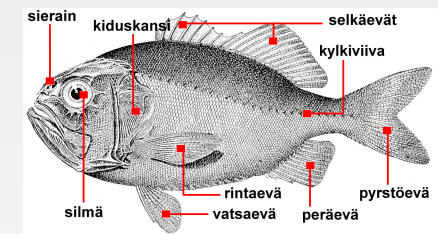
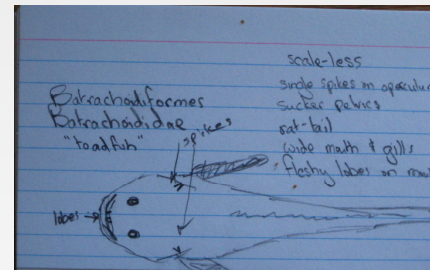
- Many scholarly tasks involve working with images with significant number of details
  - Species identification, analyzing paintings, studying architecture styles, analyzing medical images, etc.
- Scholars combine paper-based and electronic methods/tools
  - Tools are not well-integrated, information is fragmented and tedious to access → ineffective and inefficient task execution

# Paper-based methods for fish identification

## Dichotomous keys

- 1a Paired fins absent; jaws absent, mouth in an oral disk (the disk mostly surrounded by a fleshy hood in larvae); 7 external gill openings present in row behind eye ..... Lampreys - Petromyzontidae p. 000
- 1b Paired fins present (at least 1 set); jaws present; 1 external gill opening per side ..... 2
- 2a Caudal fin heterocercal or abbreviate heterocercal (Figure 5) ..... 3
- 2b Caudal fin protocercal (Figure 13, Part 2, upper left) or homocercal (Figure 5) ..... 6

## Personal Notes



# Popular electronic methods

[fishbase.org](#) [fishbase.it](#) [fishbase.de](#) [fishbase.fr](#) [fishbase.es](#) [fishbase.ru](#) [fishbase.cn](#)  
[fishbase.gr](#)  
[English](#) [Español](#) [Português \(Br, Pt\)](#) [Français](#) [Deutsch](#) [Italiano](#) [Nederlands](#) [简体中文](#) [繁體中文](#)  
[More...](#)

**FishBase** (31100 Species, 276100 Common names, 47400 Pictures, 42700 References, 1660 Collaborators, 33 million Hits/month) (02/2009)

[Home](#) | [FishBase Book](#) | [FishBase Tour](#) | [Best Photos](#) | [Hints](#) | [Guest Book](#) | [Download](#) | [Links](#) | [Fish Forum](#) | [Fish Quiz](#) | [Fish Watcher](#) | [Ichthyology Course](#) | [LarvalBase](#) | [Team](#) | [Identification](#)

**Common Name**  
 contains   (e.g. rainbow trout)  
[ABCDEFGHIJKLMNOPQRSTUVWXYZ](#)  
[中文](#) [العربية](#) [Русский](#) [日本語](#) [हिन्दी](#) [Ελληνικά](#) [More scripts...](#)

**Scientific Name**  
 Genus   (e.g. Rhinodon)  
 Species  (e.g. typus)  
 Genus + Species  (e.g. Tor soro)  
[ABCDEFGHIJKLMNOPQRSTUVWXYZ](#)








**FISHBASE:** Image collection with browsing, field-wise searching and use of forums

**EFISH:** Organization and browsing based on taxonomy

**EFISH:**  
 The Virtual Aquarium  
 The Department of  
 Fisheries & Wildlife Sciences  
 **Virginia Tech**  
 Virginia Polytechnic Institute & State University


Credits: Dr. Lou Helfrich, Dr. Tammy Newcomb, Dr. Eric Hallerman, & Dr. Ken Stein  
 Contact: [Dr. Lou Helfrich](#)

**Aquarium!** Please click on fish thumbnails or select fish from the family list below to go to the re habitats, distribution in Virginia, food and reproductive habitats for each species are provide

				
Lampreys	Paddlefishes	Sturgeons	Gars	Bowfins
				
Freshwater Bels	Cavefishes	Catfish	Trout-Perches	Trout

**EKEY - The Electronic Key for Identifying Freshwater Fishes**  
[EKey Home](#) | [Browse by Taxon](#) | [Dichotomous Key](#) | [Text-Based Search](#) | [Shape and Text Search](#) | [Credits](#) | [Glossary](#)

Help IconNote: Words in italics (other than the Scientific Name) are glossary terms. Click the term to see its definition; move the mouse over the definition to dismiss it. You can view the glossary as a [MS Word document](#) or as a [webpage](#).

<b>Common Name:</b> Pirate Perch	<b>Scientific Name:</b> <i>Aphredoderus sayanus</i>
<b>Family Name:</b> Aphredoderidae	
<b>Physical Description:</b> "Drab, dark, stout-bodied fish" "Anus located behind the head in the jugular" "Compressed body, arched back" "Rounded snout with a terminal or supraterrminal mouth" "Single dorsal fin" "Slightly indented tail fin" "Cheek area iridescent silver-blue"	
<b>Similar Species:</b> Only living species in this family	
<b>Mean Body Size:</b> "Adults are 45-90 mm standard length"	
Click the image to check for a higher-resolution version.	
	

**EKEY:** Text search and shape-based image retrieval on predefined shapes

# Requirements of a new system

- Incorporate more visual and descriptive information
  - Ability to add user content
- Improve information management access to heterogeneous information
  - Images, textual descriptions, notes, image markings, etc.
- Provide well-integrated functionalities to support task execution
- Provide capability to share content

# The Superimposed Image Description and Retrieval Tool (SuperIDR)

## **Superimposed information**

*subdocuments  
annotations  
new structure*

## **Content-based image retrieval (CBIR)**

*description and retrieval of images using image features such as shape, color, etc.*

## **Text-based image retrieval**

*description and retrieval of images using text*

## **Digital library services**

- *searching, browsing, indexing, etc.*
- *Managing documents, collections, metadata, etc.*

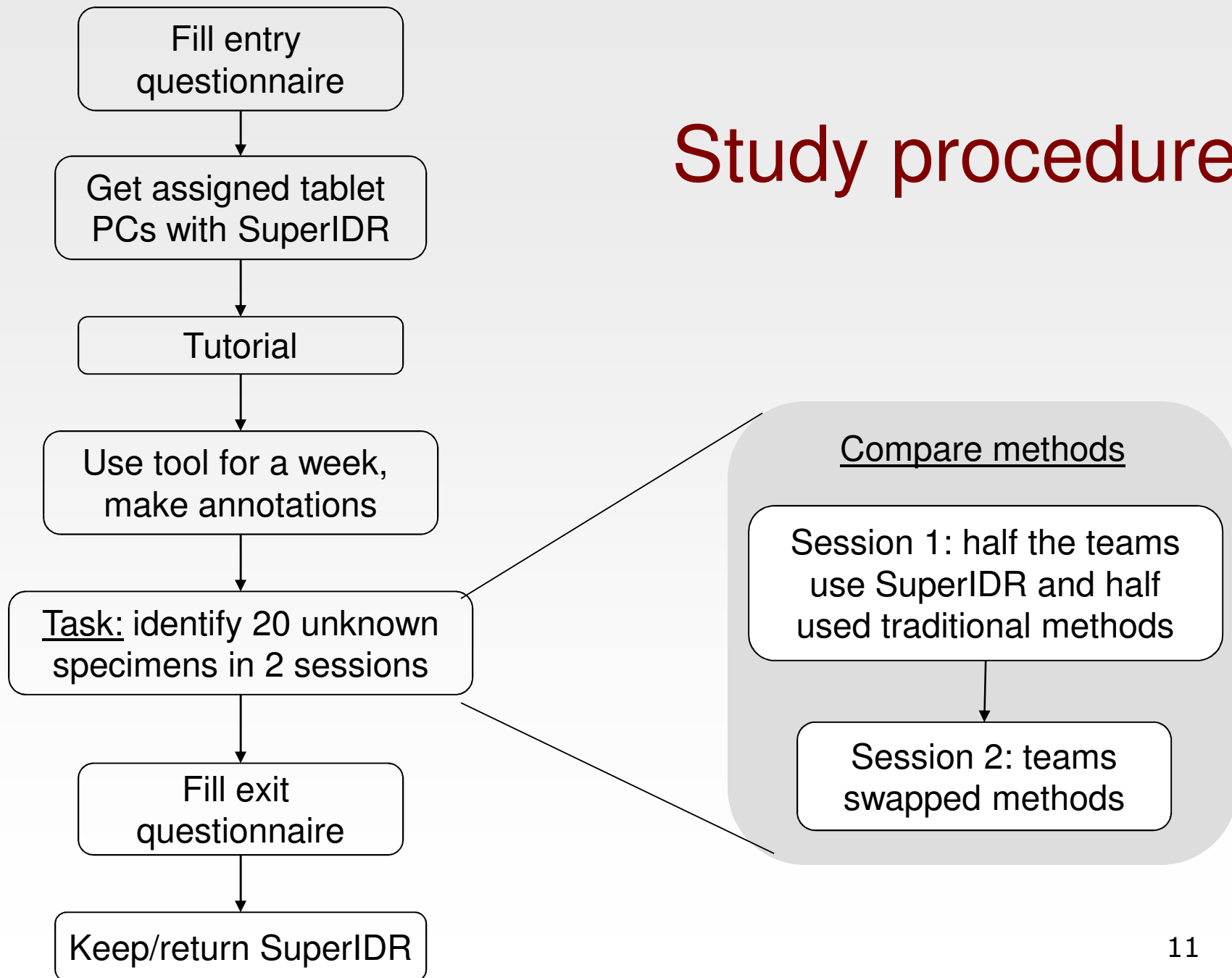


<<Demo>>

## User study in an UG Ichthyology class (Spring 2008) – 1/2

- Goal: to assess the usefulness of SuperIDR in fish species identification
- Participants: 28 undergraduates, working in teams of two with a tablet PC

# Study procedure



# Summary of results (1/2)

- Method had a significant impact on task outcome (p-value=0.015), with higher likelihood of success in using SuperIDR than traditional methods
- In general, students were interested in using SuperIDR for species identification
  - Positive comments by students
  - Six teams chose to keep the tool

# Comments

“it was very helpful”

“very helpful for taxonomy but need better photos”

“very neat but might take a while to master all the key concepts”

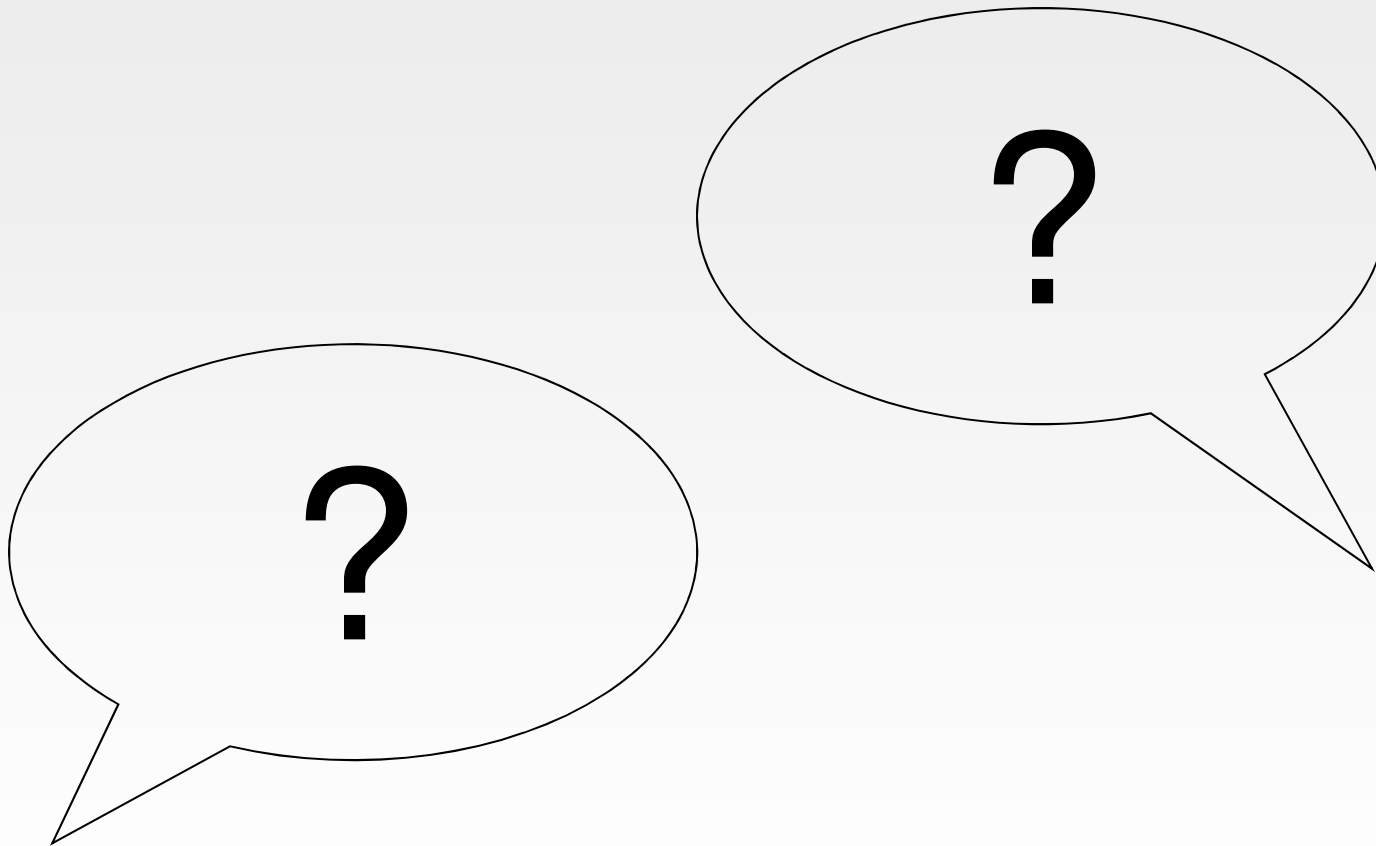
## Summary of results (2/2)

- No significant evidence to show that annotation or search on parts of images is useful
  - Possibly due to timing and duration of the study

# Conclusion

- Developed SuperIDR that combines text- and content-based image description, retrieval, and browsing, including for parts of images
- Ichthyology students performed better with SuperIDR than with traditional methods in fish species identification
- Current/future work
  - Conduct further experiments to test retrieval effectiveness and usefulness of combined search (text + CBIR) on parts of images
  - Make SuperIDR available for download
  - Connect with Flickr to enable information sharing and to leverage existing Flickr collection

# Thank you



<http://si.dlib.vt.edu/superidr>

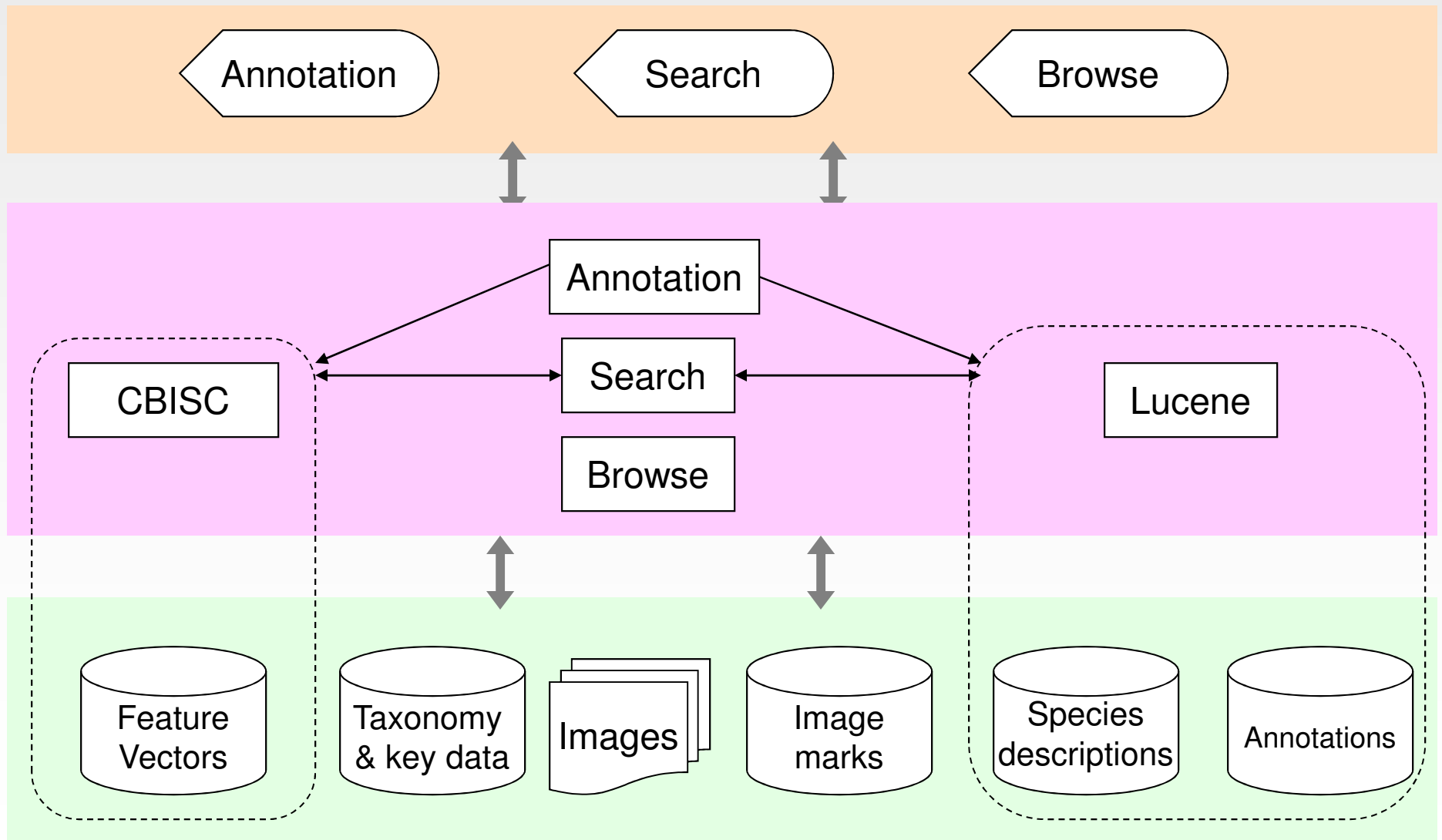


# Back-up slides

# Acknowledgements

- Dr. Orth, Ryan McManamay, Lindsey Pierce, and others at the Fisheries and Wildlife Sciences department
- Microsoft (tablet PC grant)
- Jason Lockhart for loaning tablets
- NSF (DUE-0435059)

# SuperIDR architecture



# SuperIDR: species organization

Tablet PC Image Description and Retrieval Tool - [TaxonomyBrowser]

Annotate Search by Image Search by Text Browser Help

Simple Navigation TreeView Navigation

Select the Family name:

- Acipenseridae
- Amblyopsidae
- Amiidae
- Anguillidae
- Aphredoderidae
- Atherinidae
- Catostomidae
- Centrarchidae**
- Clupeidae
- Cottidae
- Cyprinidae
- Esocidae
- Fundulidae
- Gasterosteidae
- Ictaluridae
- Lepisosteidae
- Moronidae
- Percidae
- Percopsidae
- Petromyzontidae

Select the Genus name:

- Acantharchus
- Ambloplites
- Centrarchus
- Enneacanthus
- Lepomis**
- Micropterus
- Pomoxis

Select the Specie name:

- Lepomis macrochirus
- Lepomis cyanellus
- Lepomis auritus
- Lepomis megalotis
- Lepomis gibbosus
- Lepomis auritus
- Lepomis microlophus**
- Lepomis gulosus

**Family Name:** Centrarchidae **Genus Name:** Lepomis **Specie Name:** [Lepomis microlophus](#)

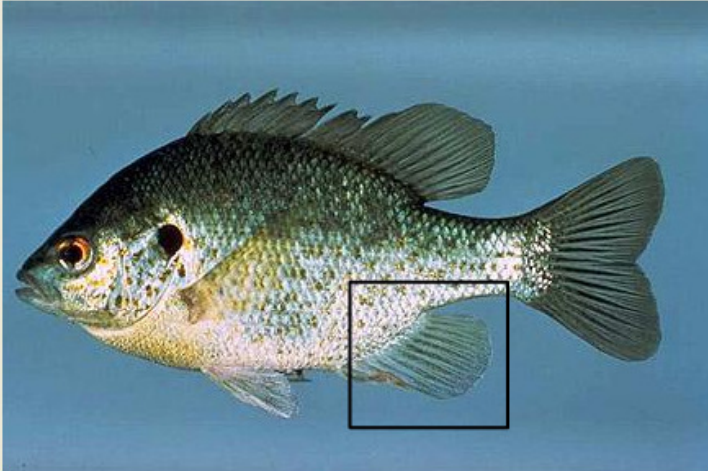
**Common Name:** Sunfishes **Common Name:** Lepomis Sunfishes **Common Name:** Redear Sunfish

**Description:** Not Available **Description:** Not Available

# SuperIDR: species description

Redear Sunfish

Redear Sunfish



Description

Similar Species

[Pumpkinseed\(Lepomis gibbosus\)](#)  
[Redbreast Sunfish\(Lepomis aurtus\)](#)

Mean Body Size

"Adults are 130-240 mm total length "

Habitat

"Clear, vegetated ponds and lakes and pools in streams"

Food Habit

"Insects, snails, mussels, and fish"

Reproductive Habit

"Mature at age 1 or 2 " "Spawning occurs spring to mid-summer " "Nest in colonies near vegetation in shallow water"  
"Fecundity is 15,001-30,144 eggs per female per year"  
"Hybridizes with other sunfish "

Annotations

continuous spinous soft dorsal fin

somewhat pointed snout

clear fins no mottling or spots

small mouth

Annotation Menu

Add

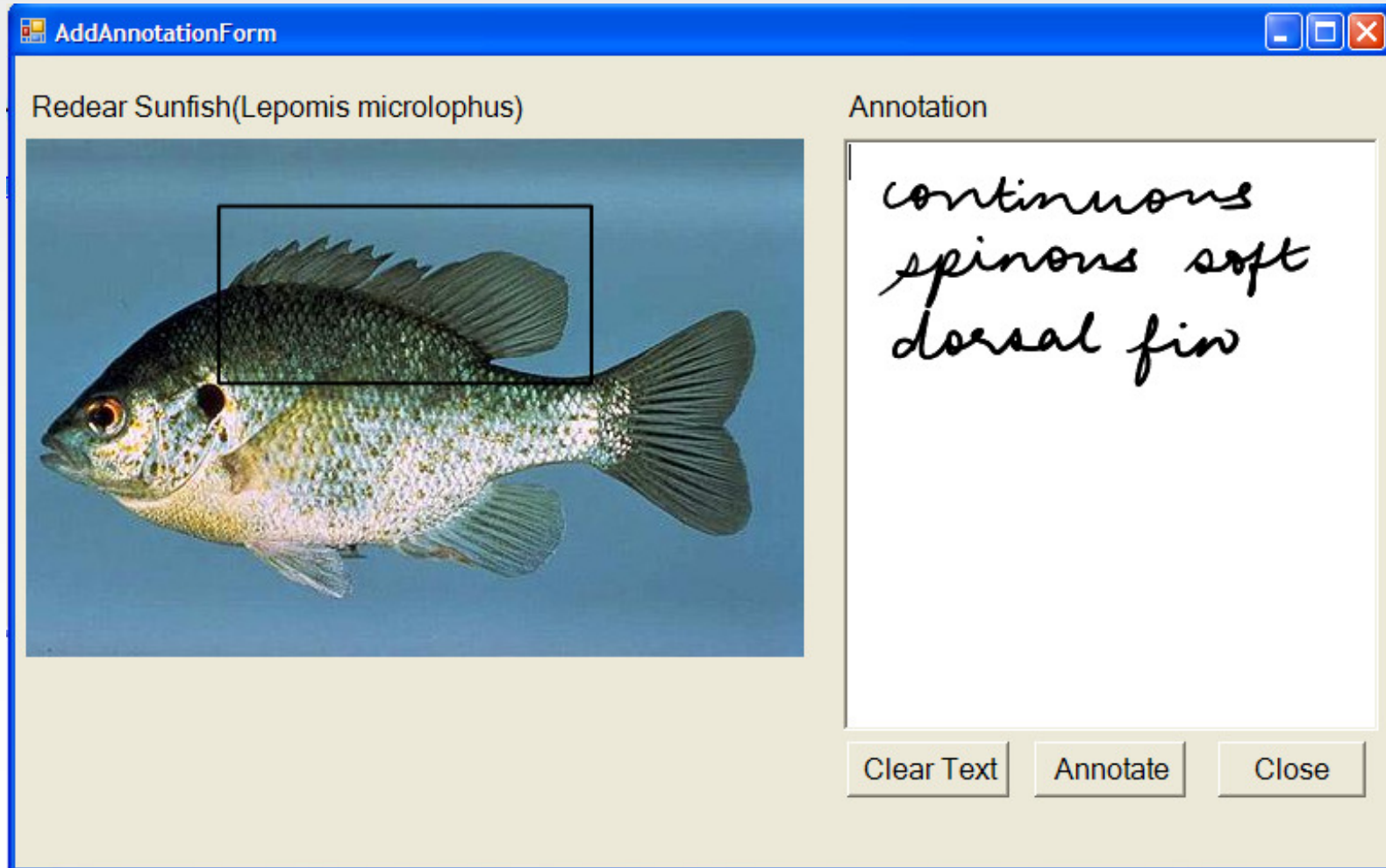
Modify

Delete

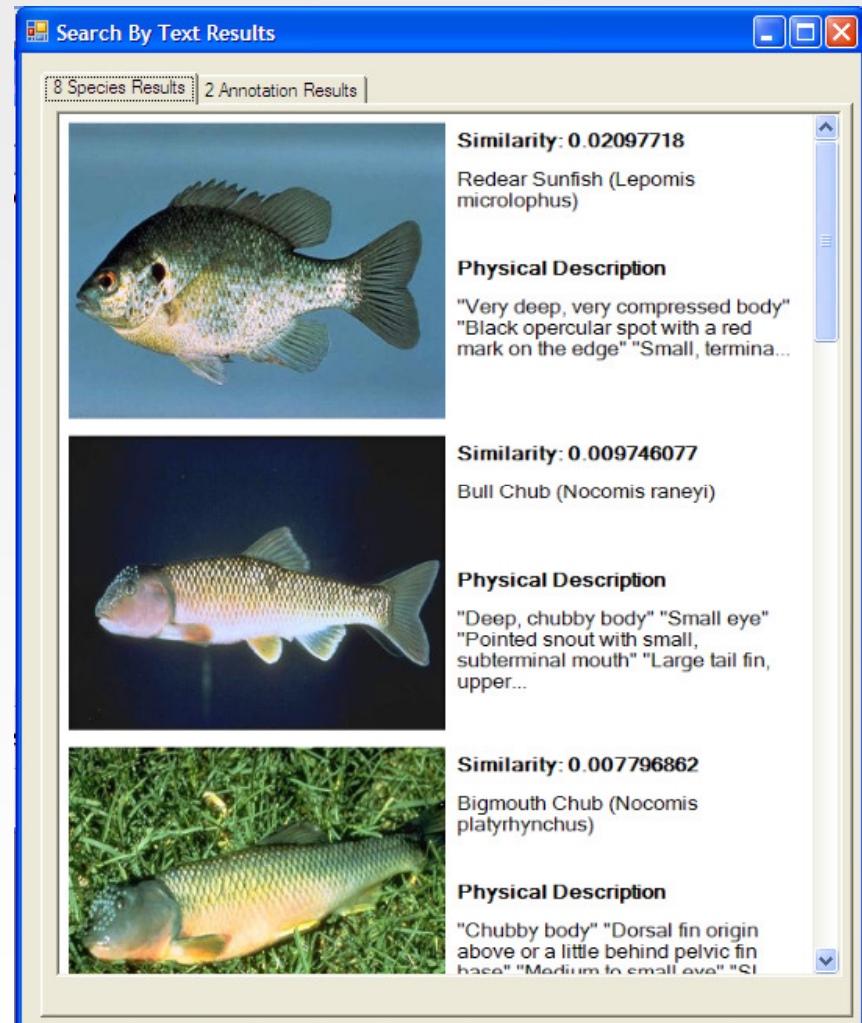
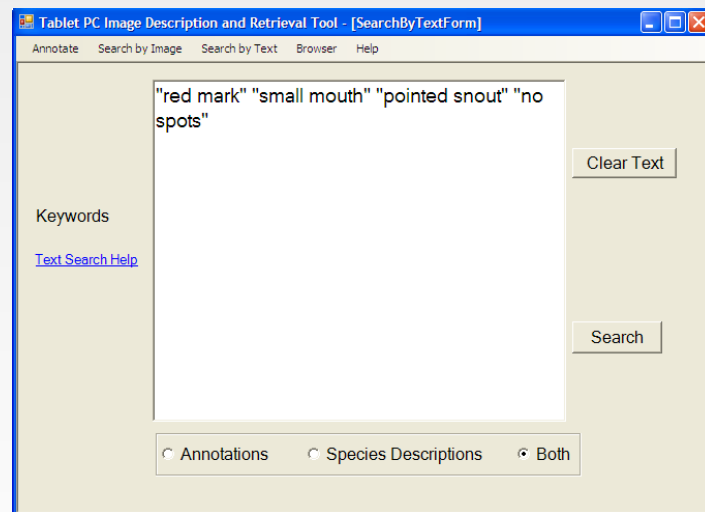
Reload

21

# SuperIDR: species image annotation



# SuperIDR: text- and content-based image retrieval

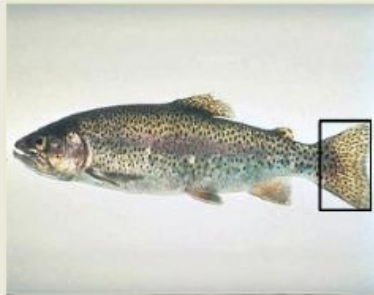






# SuperIDR: text- and content-based image retrieval



12 Image Results 3 Mark Results

	<p><b>Species</b> Rainbow Trout (<i>Oncorhynchus mykiss</i>)</p> <p><b>Annotation</b> broad forked tail fin</p>
	<p><b>Species</b> Rainbow Trout (<i>Oncorhynchus mykiss</i>)</p> <p><b>Annotation</b> moderate size dorsal fin centered on the body</p>
	<p><b>Species</b> Rainbow Trout (<i>Oncorhynchus mykiss</i>)</p> <p><b>Annotation</b> terminal mouth</p>



# Goal

Provide better support to work with images, parts of images, providing description through personal notes, linking related information, providing access to existing and new information easily, and being able to share all this information

# Species and image data

- 207 species of Virginia freshwater fishes
  - 25 families and 124 genera
- 213 images, mostly from Jenkins and Burkhead's *Freshwater Fishes of Virginia*

# Data collected in experiment

- Entry and exit questionnaire responses
- Species identification responses and time to identify
- Logs of user interaction with the tool
- Data from 9 teams (18 students) was considered in analysis
  - Others not present for both sessions
  - Incomplete species id. responses

# Species identification response summary

Traditional methods

Team ID	Session	# Correct (out of 20)
2	1	15
4	1	16
6	1	13
11	1	12
3	2	8
5	2	13
9	2	12
10	2	10
13	2	11
Mean		12.2

SuperIdR

Team ID	Session	# Correct (out of 20)
2	2	18
4	2	17
6	2	17
11	2	16
3	1	14
5	1	15
9	1	10
10	1	14
13	1	11
Mean		14.67

Method had a significant impact on outcome and students did better with SuperIDR

# Next steps

- Further evaluation to show that combining text- and content-based image retrieval on parts of images is effective and useful
- Explore use in other fields - art history, architecture, and other biology-based fields
  - Involving images with significant number of details

# Future experiments

- Three experiments focusing on combined text- and content-based image retrieval of parts of images
  - Identify good descriptors
  - Measure retrieval effectiveness
  - Get feedback on usefulness in species identification

# Flickr application

- Developing a Flickr application to benefit from existing Flickr features
  - Digital-library-like-system <need a better phrase>, providing many information management capabilities in one place
  - Notes feature
  - Several homogeneous collections (group pools)
  - Social network environment
  - Existing search capabilities (tag, full text) for more unbiased comparison