Enabling authentic ecological inquiries using research data and imageries in large classrooms

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ESA Annual Meeting

August 8, 2017

- Bringing research data to **large** ecology classrooms

  (limited interaction, support, and student preparation and interest)
  - case studies
  - web-based authentic scientific inquiry projects
- High-impact learning experiences
  - promote engagement
  - develop essential competencies (critical thinking, etc.)
  - develop science literacy (NASEM 2016)
    - understanding of scientific practices
    - content knowledge
    - understanding of science as a social process
- Types of research data
  - structured data (research or monitoring datasets)
  - unstructured data/information (images, video, texts, etc.)

RENR 205 Fundamentals of Ecology

Students

- 450-500 students in 2 sections
- 60% U1/U2 and 40% U3/U4; 30-59 majors

Outside class (online)

- SimUText Ecology and additional online modules
- Authentic ecological inquiry projects

In-class

- Peer instruction/think-pair-share
- Case studies
- Mini-lectures

Assessment for and of learning

- Frequent formative and summative assessments, with both self-reflections and direct assessments

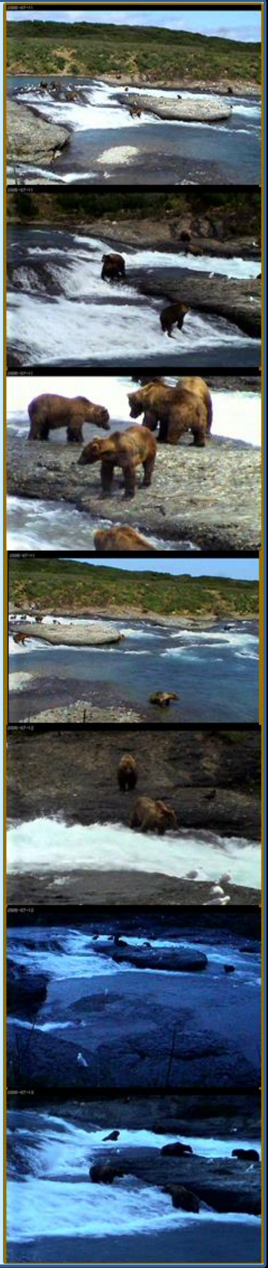
Authentic Ecological Inquiry Projects

- 3 alternative inquiry projects
  - BearCam (grizzly bear behavior), F06-F16
  - VEI (virtual inquiry; vegetation ecology), F11-F16
  - CBC (bird abundance and land cover change), F16
- Develop understanding of the nature and process of science (scientific practices and science as a social process)
- Enhance skills of critical thinking and communication

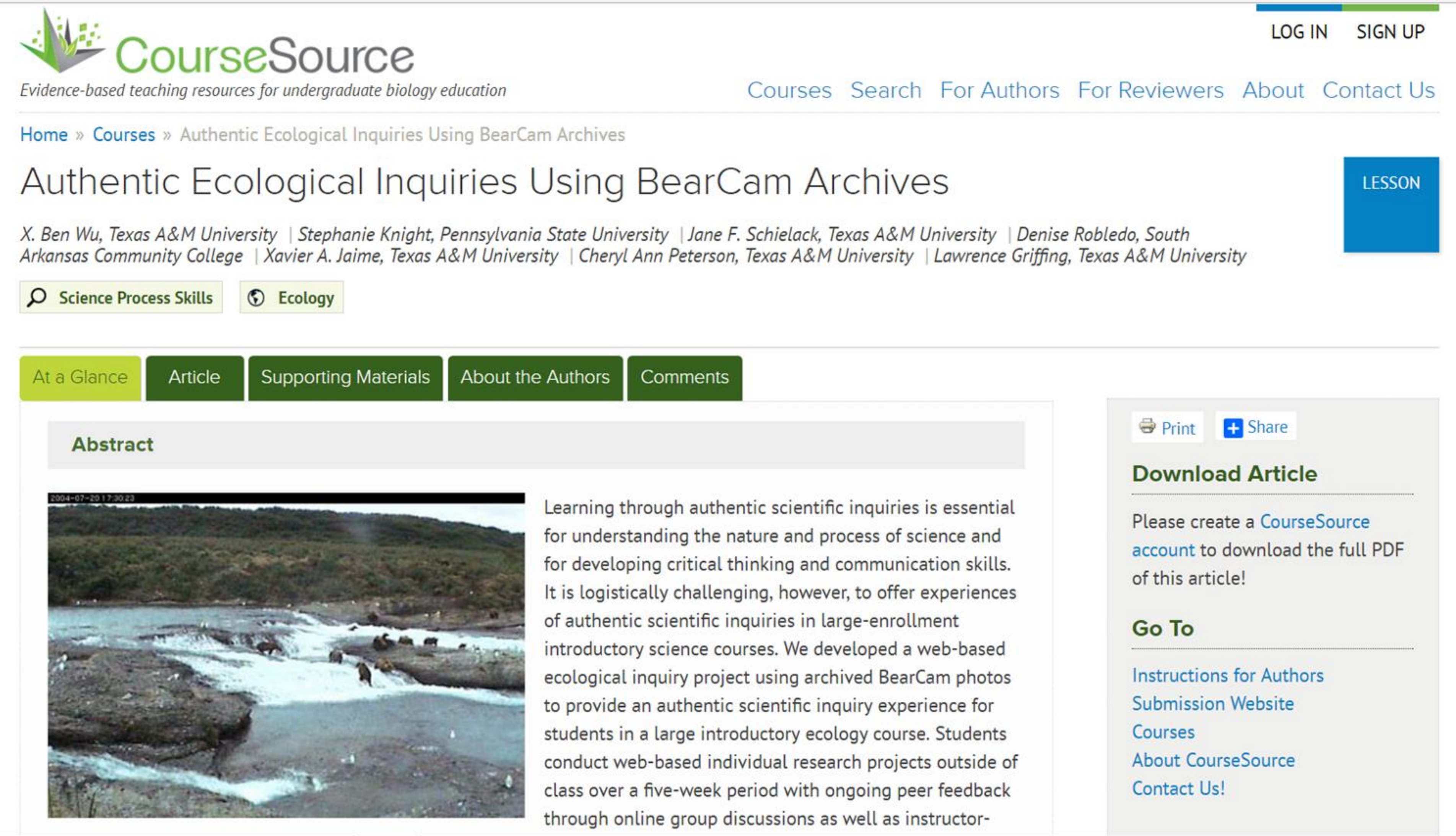
INQUIRY PROJECT - Bear Cam

Web-based authentic ecological inquiries using BearCam archives

Individual inquiry process	Collaboration
1. Background exploration and share	Online group discussions and feedback throughout the inquiry project
2. Observing bear behavior and interactions using BearCam stills	
3. Developing and refine research hypothesis and design	
4. Collecting and analyzing data and interpreting results	
5. Writing inquiry report	
6. Conduct Calibrated Peer Review (CPR) using a rubric	
7. Revising the report based on peer review feedback	



Criteria	3	2	1	0
Objective	The objective (1) is clear, (2) is reasonably specific, and (3) explains the purpose of the study.	Met 2 of 3	Met 1 of 3	Met none
Hypothesis	The hypothesis is (1) logical, (2) testable, and (3) nontrivial.	Met 2 of 3	Met 1 of 3	Met none
Sampling	The number of samples is (1) reported and (2) sufficient, and (3) with sufficient description for sample selection.	Met 2 of 3	Met 1 of 3	Met none
Data Collection	(1) The variables collected are appropriate for testing the hypothesis and (2) there are sufficient description for data collection and (3) and data analysis.	Met 2 of 3	Met 1 of 3	Met none
Data Display	The data display (1) is in an appropriate form, (2) represents appropriate variables, and (3) addresses the hypothesis.	Met 2 of 3	Met 1 of 3	Met none
Results	Results (1) are presented in the text, (2) are specific, and (3) correspond to the variables specified in the methods section.	Met 2 of 3	Met 1 of 3	Met none
Conclusions	Conclusions (1) are based solely on results, (2) are sufficiently developed based on the results, and (3) correspond to the hypothesis.	Met 2 of 3	Met 1 of 3	Met none
Discussions	Discussions include (1) interpretations of the results, (2) limitations of the study, and (3) suggested future studies/new questions.	Met 2 of 3	Met 1 of 3	Met none
Organization	The (1) Introduction, (2) Methods, and (3) Results & Discussion sections, respectively, are free of other contents.	Met 2 of 3	Met 1 of 3	Met none
Report	The report is (1) written in grammatically correct sentences, (2) written in a succinct, technical style, and (3) free of unnecessary repetition.	Met 2 of 3	Met 1 of 3	Met none



Authentic Ecological Inquiries Using BearCam Archives

X. Ben Wu, Texas A&M University | Stephanie Knight, Pennsylvania State University | Jane F. Schielack, Texas A&M University | Denise Robledo, South Arkansas Community College | Xavier A. Jaime, Texas A&M University | Cheryl Ann Peterson, Texas A&M University | Lawrence Griffing, Texas A&M University

Abstract

Learning through authentic scientific inquiries is essential for understanding the nature and process of science and for developing critical thinking and communication skills. It is logistically challenging, however, to offer experiences of authentic scientific inquiries in large-enrollment introductory science courses. We developed a web-based ecological inquiry project using archived BearCam photos to provide an authentic scientific inquiry experience for students in a large introductory ecology course. Students conduct web-based individual research projects outside of class over a five-week period with ongoing peer feedback through online group discussions as well as instructor-

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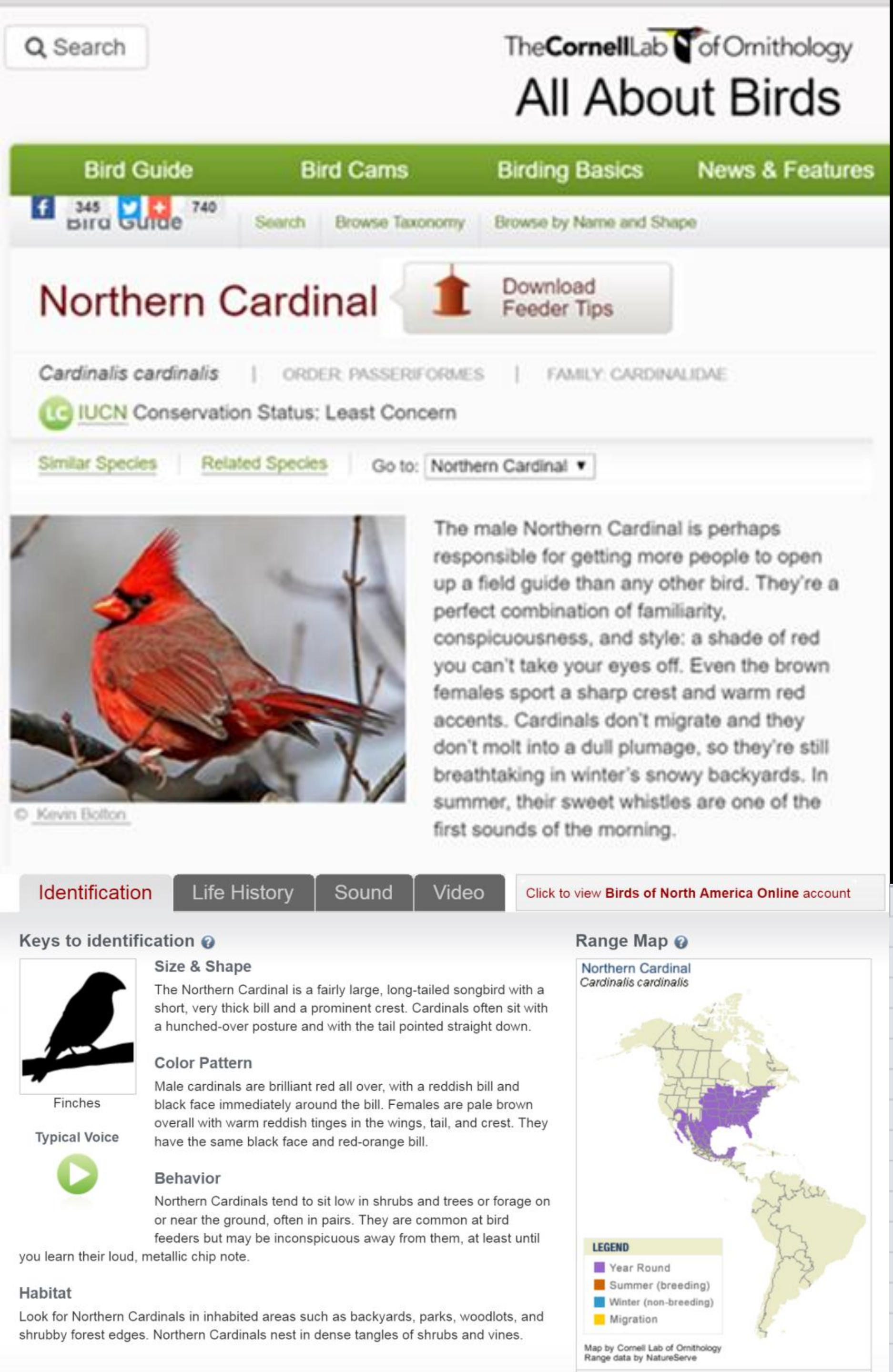
Wu, X.B., Knight, S.L., Schielack, J.F., Robledo, D.C., Jaime, X.A., Peterson, C.A., and Griffing, L.R. 2016. Authentic Ecological Inquiries Using BearCam Archives. *CourseSource*. https://doi.org/10.24918/cs.2016.22

Authentic inquiry project using CBC and NLCD data

Individual Inquiry Process	Collaboration
1. Explore and share background information on bird biology and ecology	Online group discussion and feedback throughout the inquiry process
2. Generate hypothesis based on exploration of spatial pattern and change in bird abundance and possible relationship with spatial pattern and change in land cover	
3. Design investigation, collect and analyze data, and develop research report	
4. Conduct Calibrated Peer Review (CPR)	
5. Revise report based on peer review feedback	



Search

The Cornell Lab of Ornithology

All About Birds

Northern Cardinal

Cardinalis cardinalis | ORDER: PASSERIFORMES | FAMILY: CARDINALIDAE

LC IUCN Conservation Status: Least Concern

© Kevin Bolton

The male Northern Cardinal is perhaps responsible for getting more people to open up a field guide than any other bird. They're a perfect combination of familiarity, conspicuousness, and style: a shade of red you can't take your eyes off. Even the brown females sport a sharp crest and warm red accents. Cardinals don't migrate and they don't molt into a dull plumage, so they're still breathtaking in winter's snowy backyards. In summer, their sweet whistles are one of the first sounds of the morning.

Keys to identification

Size & Shape

The Northern Cardinal is a fairly large, long-tailed songbird with a short, very thick bill and a prominent crest. Cardinals often sit with a hunched-over posture and with the tail pointed straight down.

Color Pattern

Male cardinals are brilliant red all over, with a reddish bill and black face immediately around the bill. Females are pale brown overall with warm reddish tinges in the wings, tail, and crest. They have the same black face and red-orange bill.

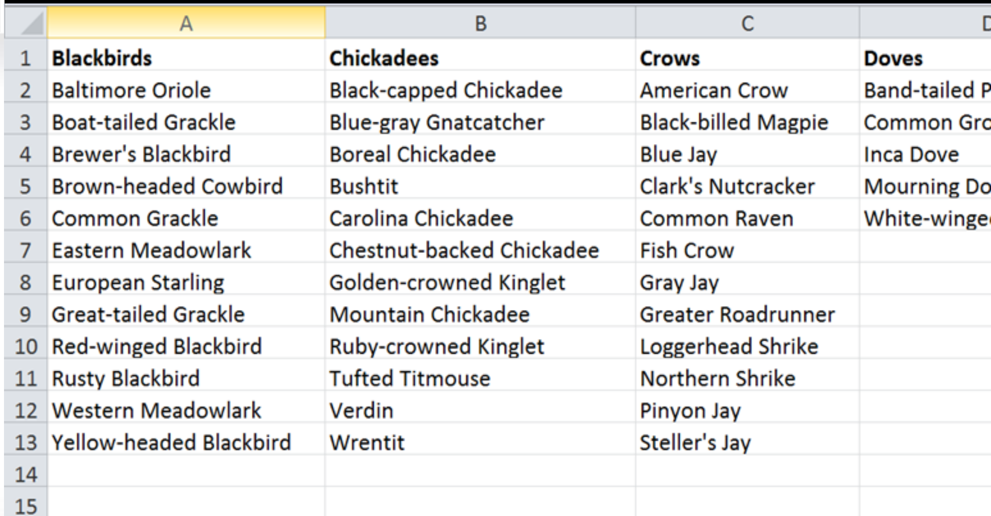
Behavior

Northern Cardinals tend to sit low in shrubs and trees or forage on or near the ground, often in pairs. They are common at bird feeders but may be inconspicuous away from them, at least until you learn their loud, metallic chip note.

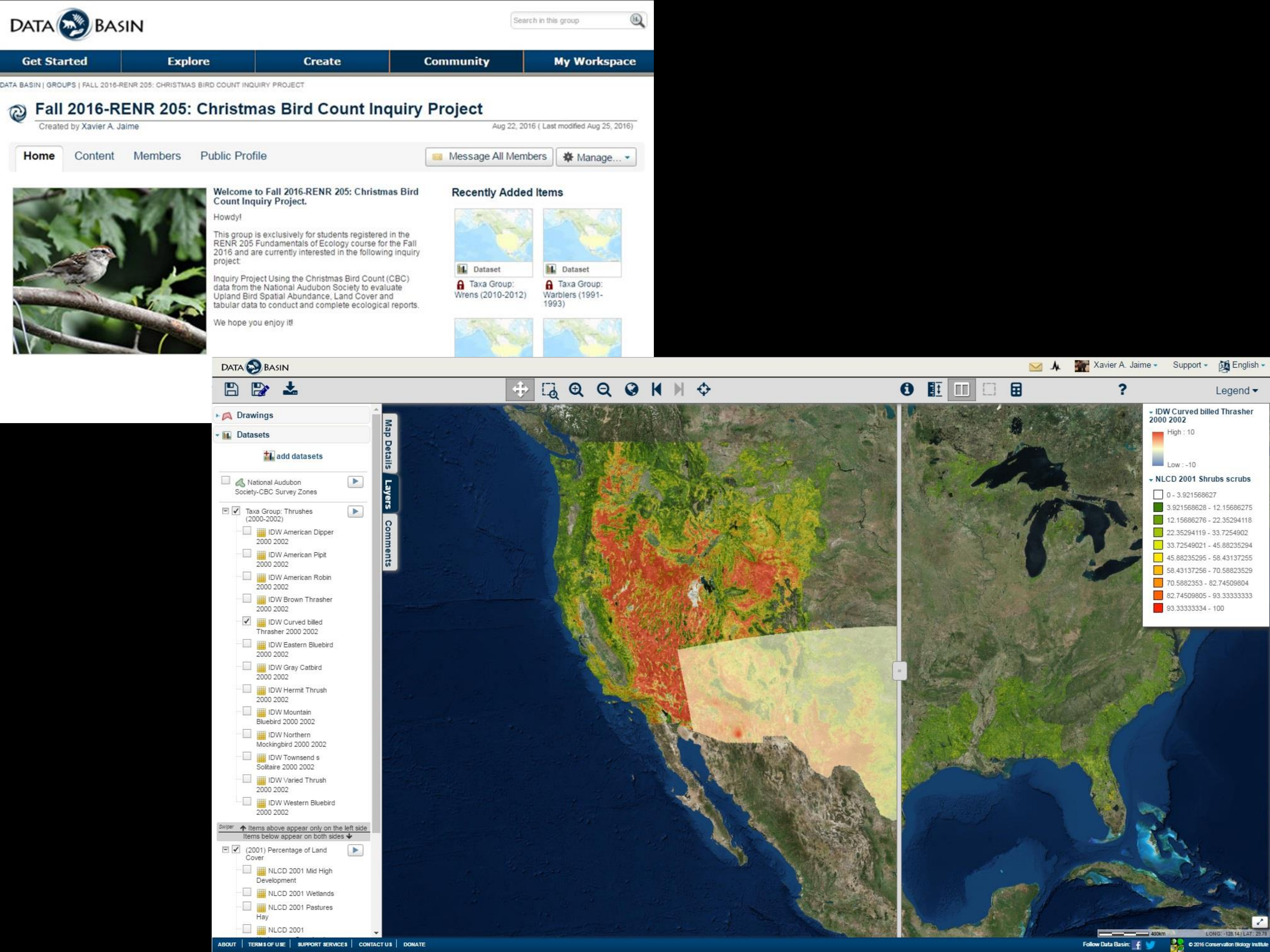
Habitat

Look for Northern Cardinals in inhabited areas such as backyards, parks, woodlots, and shrubby forest edges. Northern Cardinals nest in dense tangles of shrubs and vines.

Range Map



	A	B	C	D
1	**Blackbirds**	**Chickadees**	**Crows**	**Doves**
2	Baltimore Oriole	Black-capped Chickadee	American Crow	Band-tailed P
3	Boat-tailed Grackle	Blue-gray Gnatcatcher	Black-billed Magpie	Common Gro
4	Brewer's Blackbird	Boreal Chickadee	Blue Jay	Inca Dove
5	Brown-headed Cowbird	Bushtit	Clark's Nutcracker	Mourning Do
6	Common Grackle	Carolina Chickadee	Common Raven	White-winge
7	Eastern Meadowlark	Chestnut-backed Chickadee	Fish Crow	
8	European Starling	Golden-crowned Kinglet	Gray Jay	
9	Great-tailed Grackle	Mountain Chickadee	Greater Roadrunner	
10	Red-winged Blackbird	Ruby-crowned Kinglet	Loggerhead Shrike	
11	Rusty Blackbird	Tufted Titmouse	Northern Shrike	
12	Western Meadowlark	Verdin	Pinyon Jay	
13	Yellow-headed Blackbird	Wrentit	Steller's Jay	
14				
15				



Fall 2016-RENR 205: Christmas Bird Count Inquiry Project

Created by Xavier A. Jaime

Aug 22, 2016 (Last modified Aug 25, 2016)

Welcome to Fall 2016-RENR 205: Christmas Bird Count Inquiry Project.

Howdy!

This group is exclusively for students registered in the RENR 205 Fundamentals of Ecology course for the Fall 2016 and are currently interested in the following inquiry project:

Inquiry Project Using the Christmas Bird Count (CBC) data from the National Audubon Society to evaluate Upland Bird Spatial Abundance, Land Cover and tabular data to conduct and complete ecological reports.

We hope you enjoy it!

Taxa Group: Wrens (2010-2012)

Taxa Group: Warblers (1991-1993)

☐ National Audubon Society-CBC Survey Zones

☑ Taxa Group: Thrushes (2000-2002)
- ☐ IDW American Dipper 2000 2002
- ☐ IDW American Pipit 2000 2002
- ☐ IDW American Robin 2000 2002
- ☐ IDW Brown Thrasher 2000 2002
- ☑ IDW Curved billed Thrasher 2000 2002
- ☐ IDW Eastern Bluebird 2000 2002
- ☐ IDW Gray Catbird 2000 2002
- ☐ IDW Hermit Thrush 2000 2002
- ☐ IDW Mountain Bluebird 2000 2002
- ☐ IDW Northern Mockingbird 2000 2002
- ☐ IDW Townsend s Solitaire 2000 2002
- ☐ IDW Varied Thrush 2000 2002
- ☐ IDW Western Bluebird 2000 2002

Swiper ↑ Items above appear only on the left side
Items below appear on both sides ↓

☑ (2001) Percentage of Land Cover
- ☐ NLCD 2001 Mid High Development
- ☐ NLCD 2001 Wetlands
- ☐ NLCD 2001 Pastures Hay
- ☐ NLCD 2001

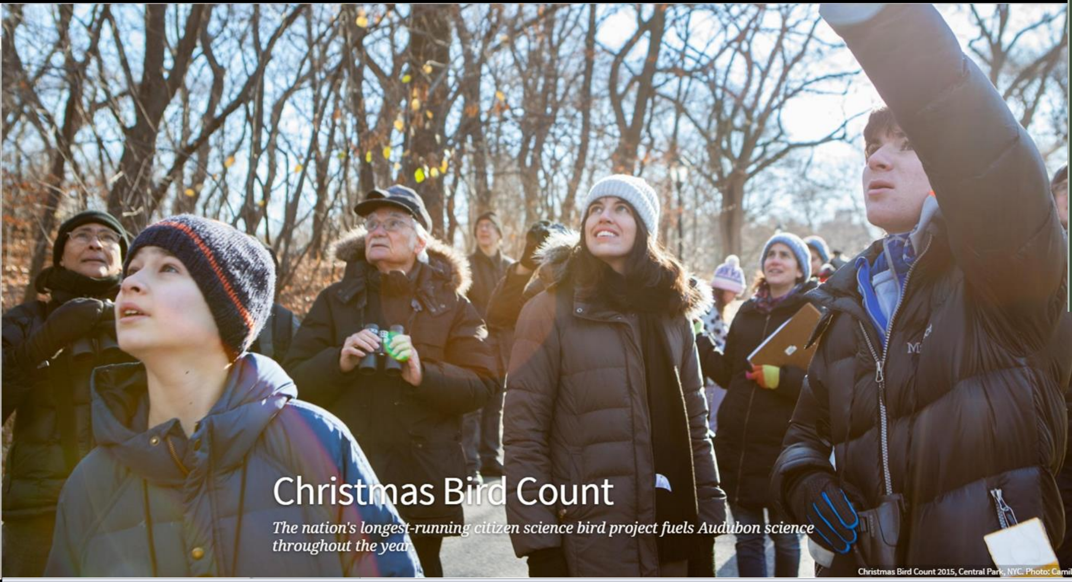
IDW Curved billed Thrasher 2000 2002

High : 10

Low : -10

NLCD 2001 Shrubs scrubs

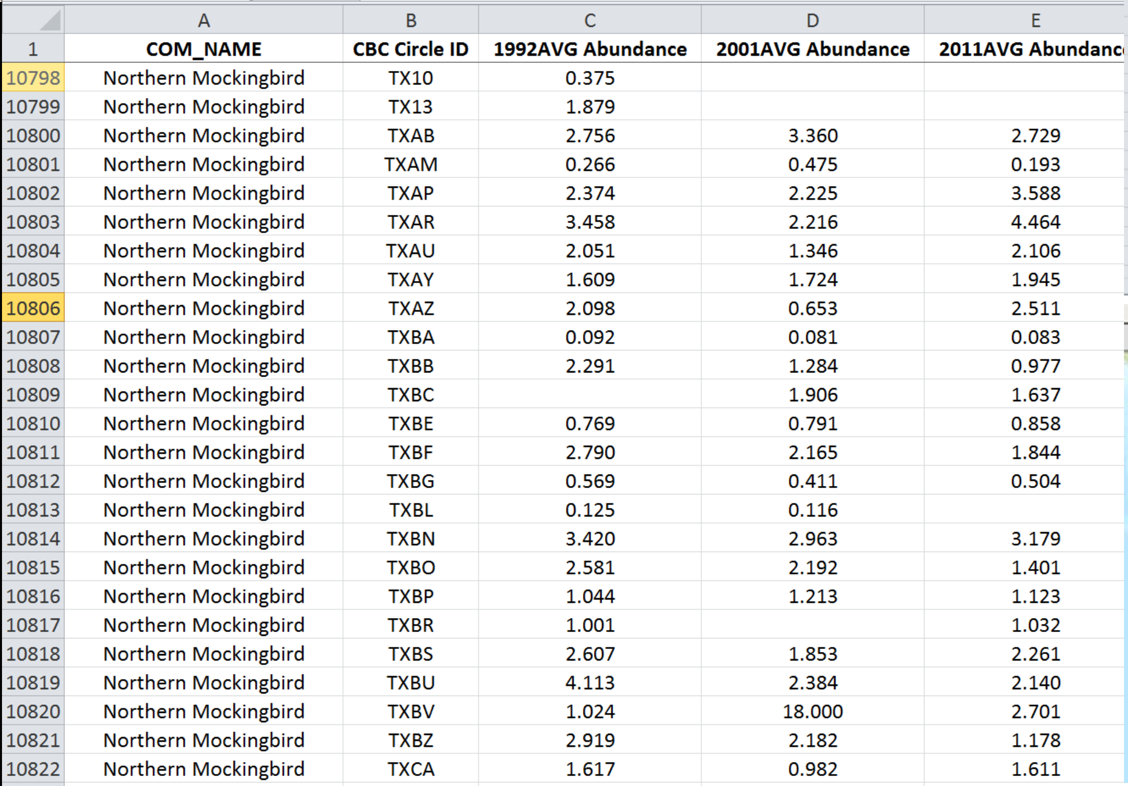
- ☐ 0 - 3.921568627
- 🟩 3.921568628 - 12.15686275
- 🟩 12.15686276 - 22.35294118
- 🟩 22.35294119 - 33.7254902
- 🟨 33.72549021 - 45.88235294
- 🟨 45.88235295 - 58.43137255
- 🟧 58.43137256 - 70.58823529
- 🟧 70.5882353 - 82.74509804
- 🟧 82.74509805 - 93.33333333
- 🟥 93.33333334 - 100



Christmas Bird Count

The nation's longest-running citizen science bird project fuels Audubon science throughout the year

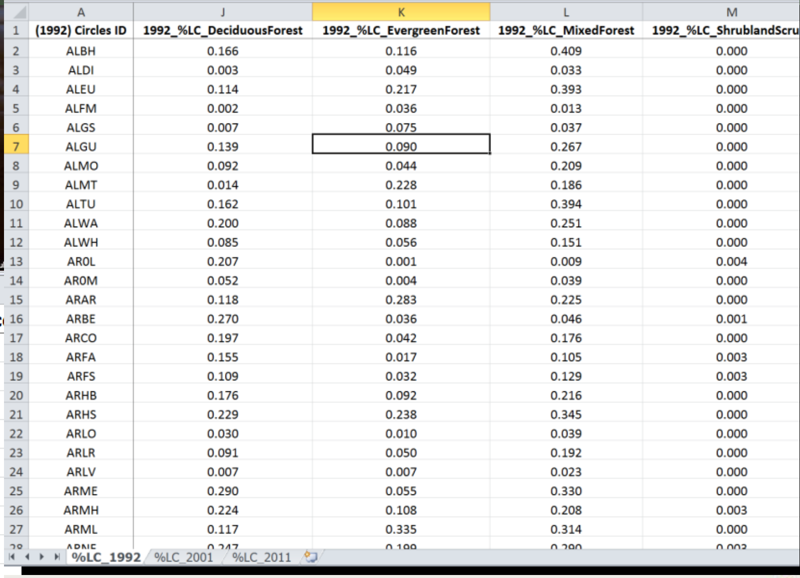
Christmas Bird Count 2015, Central Park, NYC. Photo: Camilla Cerea/Audu



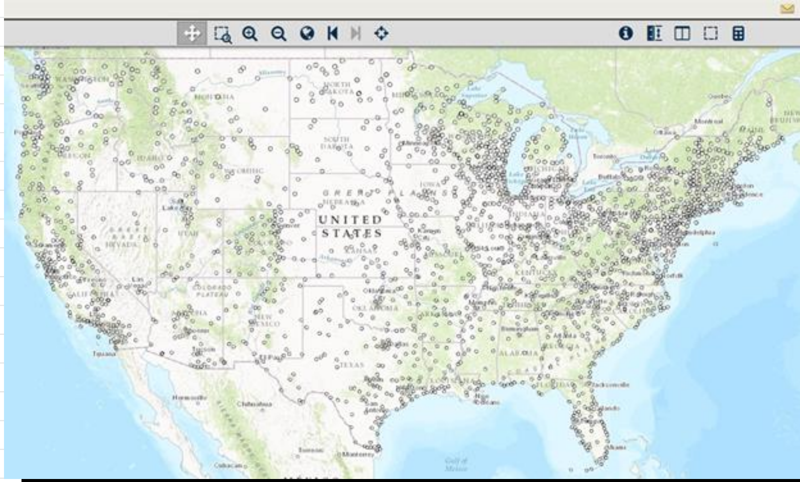
	A	B	C	D	E
1	**COM_NAME**	**CBC Circle ID**	**1992AVG Abundance**	**2001AVG Abundance**	**2011AVG Abundanc**
10798	Northern Mockingbird	TX10	0.375		
10799	Northern Mockingbird	TX13	1.879		
10800	Northern Mockingbird	TXAB	2.756	3.360	2.729
10801	Northern Mockingbird	TXAM	0.266	0.475	0.193
10802	Northern Mockingbird	TXAP	2.374	2.225	3.588
10803	Northern Mockingbird	TXAR	3.458	2.216	4.464
10804	Northern Mockingbird	TXAU	2.051	1.346	2.106
10805	Northern Mockingbird	TXAY	1.609	1.724	1.945
10806	Northern Mockingbird	TXAZ	2.098	0.653	2.511
10807	Northern Mockingbird	TXBA	0.092	0.081	0.083
10808	Northern Mockingbird	TXBB	2.291	1.284	0.977
10809	Northern Mockingbird	TXBC		1.906	1.637
10810	Northern Mockingbird	TXBE	0.769	0.791	0.858
10811	Northern Mockingbird	TXBF	2.790	2.165	1.844
10812	Northern Mockingbird	TXBG	0.569	0.411	0.504
10813	Northern Mockingbird	TXBL	0.125	0.116	
10814	Northern Mockingbird	TXBN	3.420	2.963	3.179
10815	Northern Mockingbird	TXBO	2.581	2.192	1.401
10816	Northern Mockingbird	TXBP	1.044	1.213	1.123
10817	Northern Mockingbird	TXBR	1.001		1.032
10818	Northern Mockingbird	TXBS	2.607	1.853	2.261
10819	Northern Mockingbird	TXBU	4.113	2.384	2.140
10820	Northern Mockingbird	TXBV	1.024	18.000	2.701
10821	Northern Mockingbird	TXBZ	2.919	2.182	1.178
10822	Northern Mockingbird	TXCA	1.617	0.982	1.611

National Land Cover Database (NLCD)

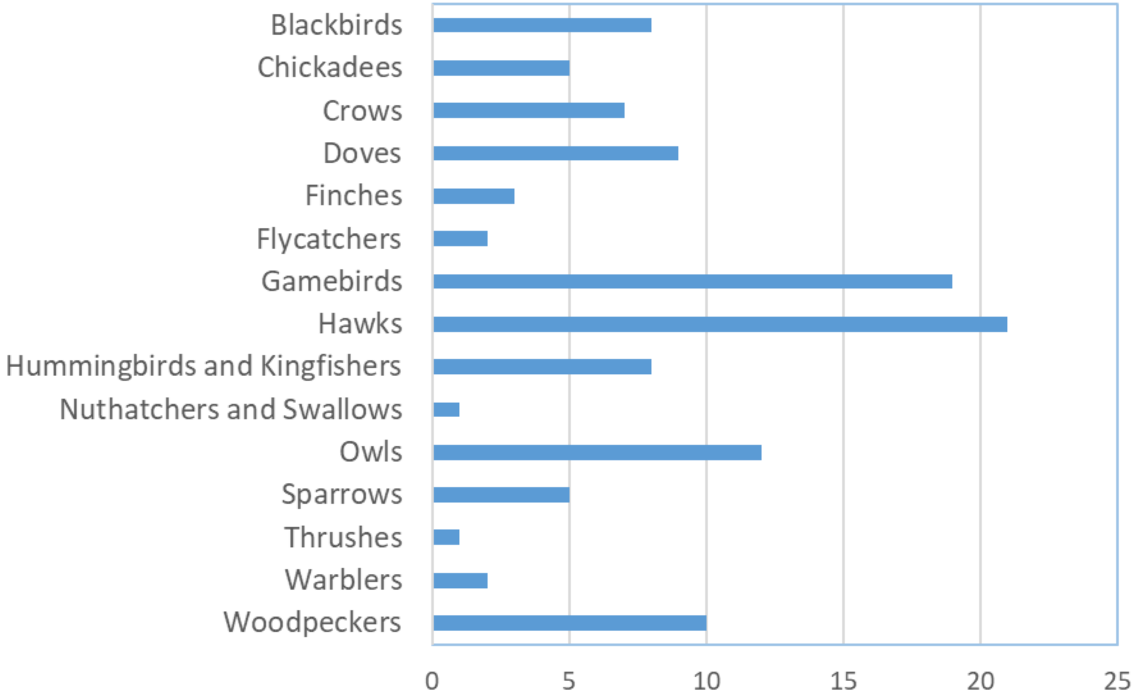
Land Cover 1992, 2001, 2006 & 2011



	A	J	K	L	M
1	(1992) Circles ID	1992_%LC_DeciduousForest	1992_%LC_EvergreenForest	1992_%LC_MixedForest	1992_%LC_ShrublandScru
2	ALBH	0.166	0.116	0.409	0.000
3	ALDI	0.003	0.049	0.033	0.000
4	ALEU	0.114	0.217	0.393	0.000
5	ALFM	0.002	0.036	0.013	0.000
6	ALGS	0.007	0.075	0.037	0.000
7	ALGU	0.139	0.090	0.267	0.000
8	ALMO	0.092	0.044	0.209	0.000
9	ALMT	0.014	0.228	0.186	0.000
10	ALTU	0.162	0.101	0.394	0.000
11	ALWA	0.200	0.088	0.251	0.000
12	ALWH	0.085	0.056	0.151	0.000
13	AR0L	0.207	0.001	0.009	0.004
14	AR0M	0.052	0.004	0.039	0.000
15	ARAR	0.118	0.283	0.225	0.000
16	ARBE	0.270	0.036	0.046	0.001
17	ARCO	0.197	0.042	0.176	0.000
18	ARFA	0.155	0.017	0.105	0.003
19	ARFS	0.109	0.032	0.129	0.003
20	ARHB	0.176	0.092	0.216	0.000
21	ARHS	0.229	0.238	0.345	0.000
22	ARLO	0.030	0.010	0.039	0.000
23	ARLR	0.091	0.050	0.192	0.000
24	ARLV	0.007	0.007	0.023	0.000
25	ARME	0.290	0.055	0.330	0.000
26	ARMH	0.224	0.108	0.208	0.003
27	ARML	0.117	0.335	0.314	0.000



59 of 182 upland birds studied in 113 projects



Northern Bobwhite (7)
Wild Turkey (7)

Anna’s Hummingbird (6)
Mourning Doves (6)

Scaled Quail (5)

Burrowing Owl (4)

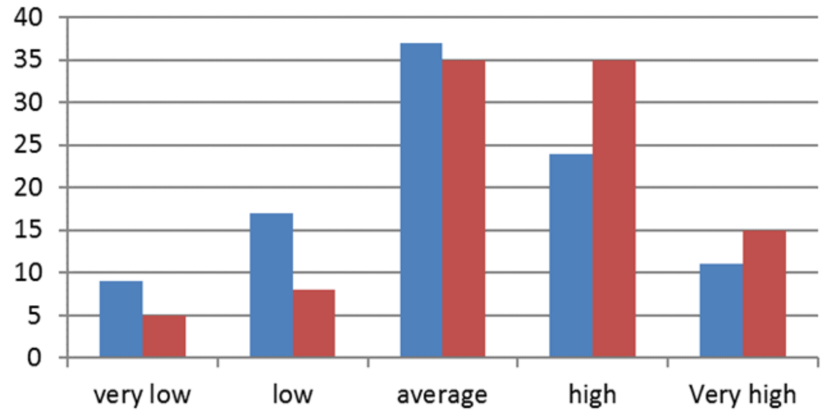
Bald Eagles (3)
Eastern Screech Owl (3)
Loggerhead Shrike (3)
Pileated Woodpecker (3)
Red-Headed Woodpecker (3)

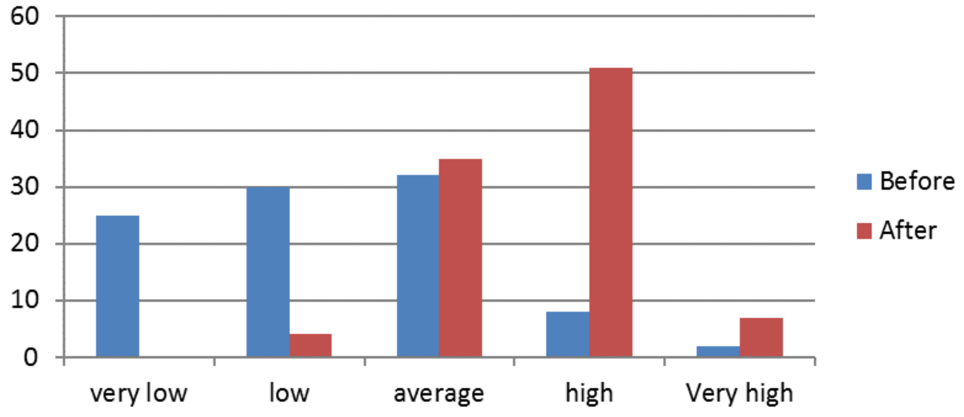
Barn Owl (2)
Belted Kingfisher (2)
Black Vultures (2)
Black-Capped Chickadee (2)
Cedar Waxwing (2)
Chestnut-backed Chickadees (2)
Eastern Meadowlarks (2)
European Starlings (2)
Golden eagles (2)
Golden-crowned sparrows (2)
Great Horned Owls (2)
Osprey (2)
Red-tailed Hawks (2)
Sharp-Shinned Hawks (2)
White-winged doves (2)

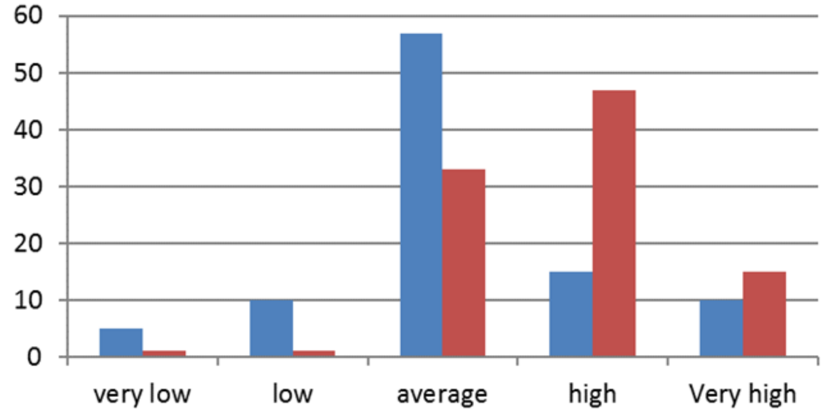
American crows (1)
American Kestrel (1)
Baltimore Orioles (1)
Barred owls (1)
Blue Jay (1)
Brown-Headed cowbird (1)
Bushtit (1)
Common Raven (1)
Crested Caracara (1)
Eastern Towhee (1)
Ferruginous Hawk (1)
Greater Roadrunner (1)
Harrier hawk (1)
House Sparrow (1)
Inca Dove (1)
Lark Sparrow’s (1)

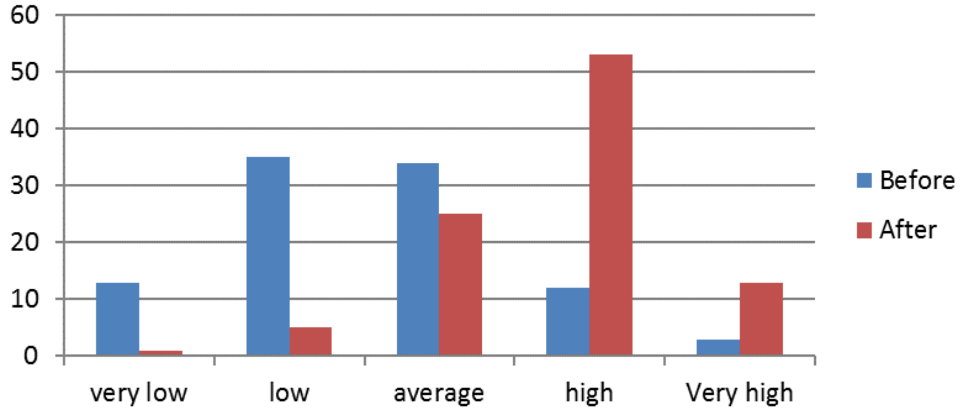
Lewis Woodpecker (1)
Mountain Bluebird (1)
Northern Cardinal (1)
Northern Flicker (1)
Northern Goshawk (1)
Ovenbird (1)
Prairie Warbler (1)
Purple Finch (1)
Pyrrhuloxia (1)
Red-Bellied Woodpecker (1)
Red-shouldered hawks (1)
Red-winged Blackbird (1)
Turkey Vulture (1)
Western Meadowlarks (1)
White Throated Swift (1)
White-tail Kites (1)

Student Self-reported Learning Gain through CBC Project (Fall 16)

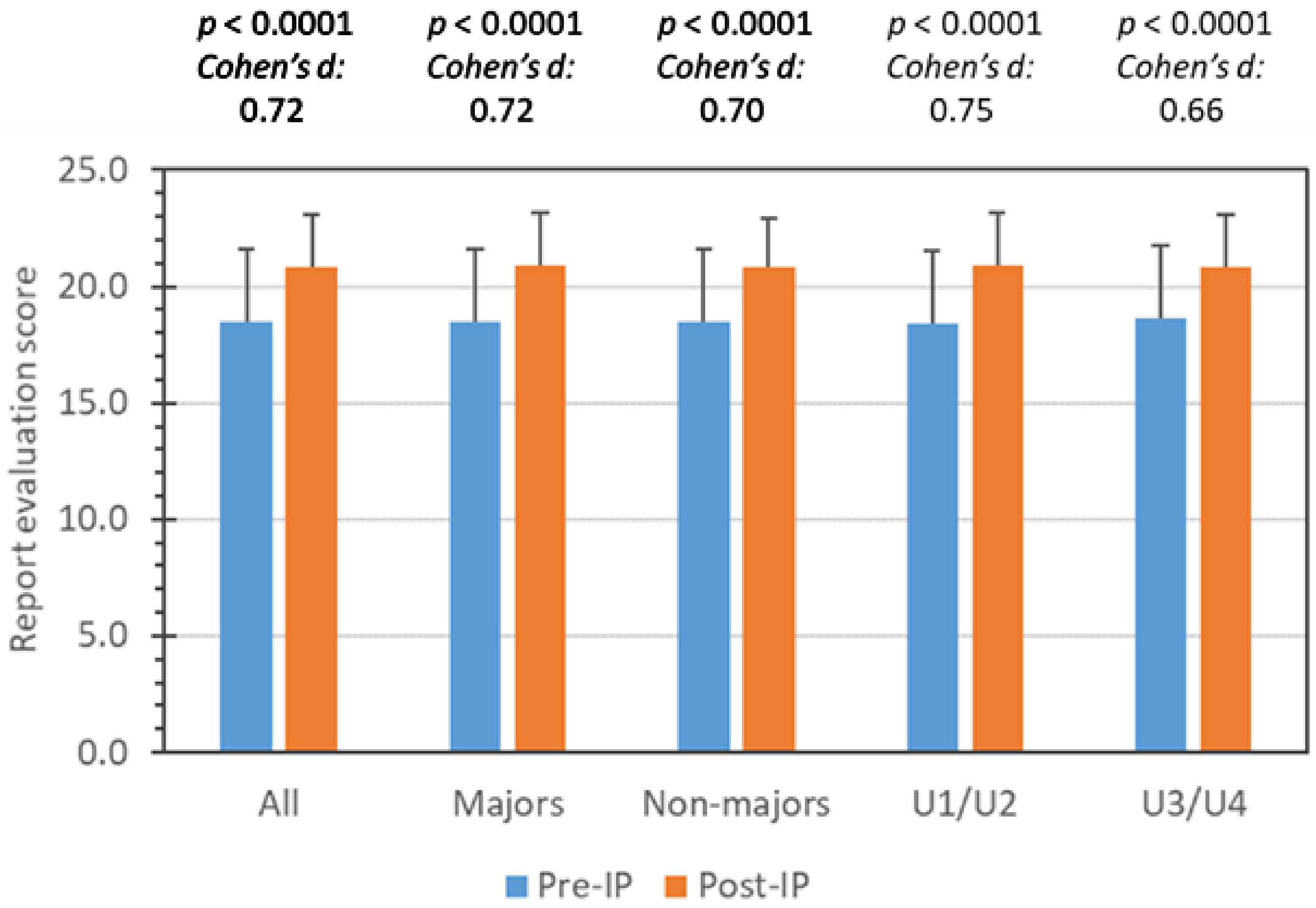

Rate your interest in ecology before/after the CBC project (p<0.001)


Rate your understanding of how ecologists conduct their research before/after the CBC project (p<0.001)

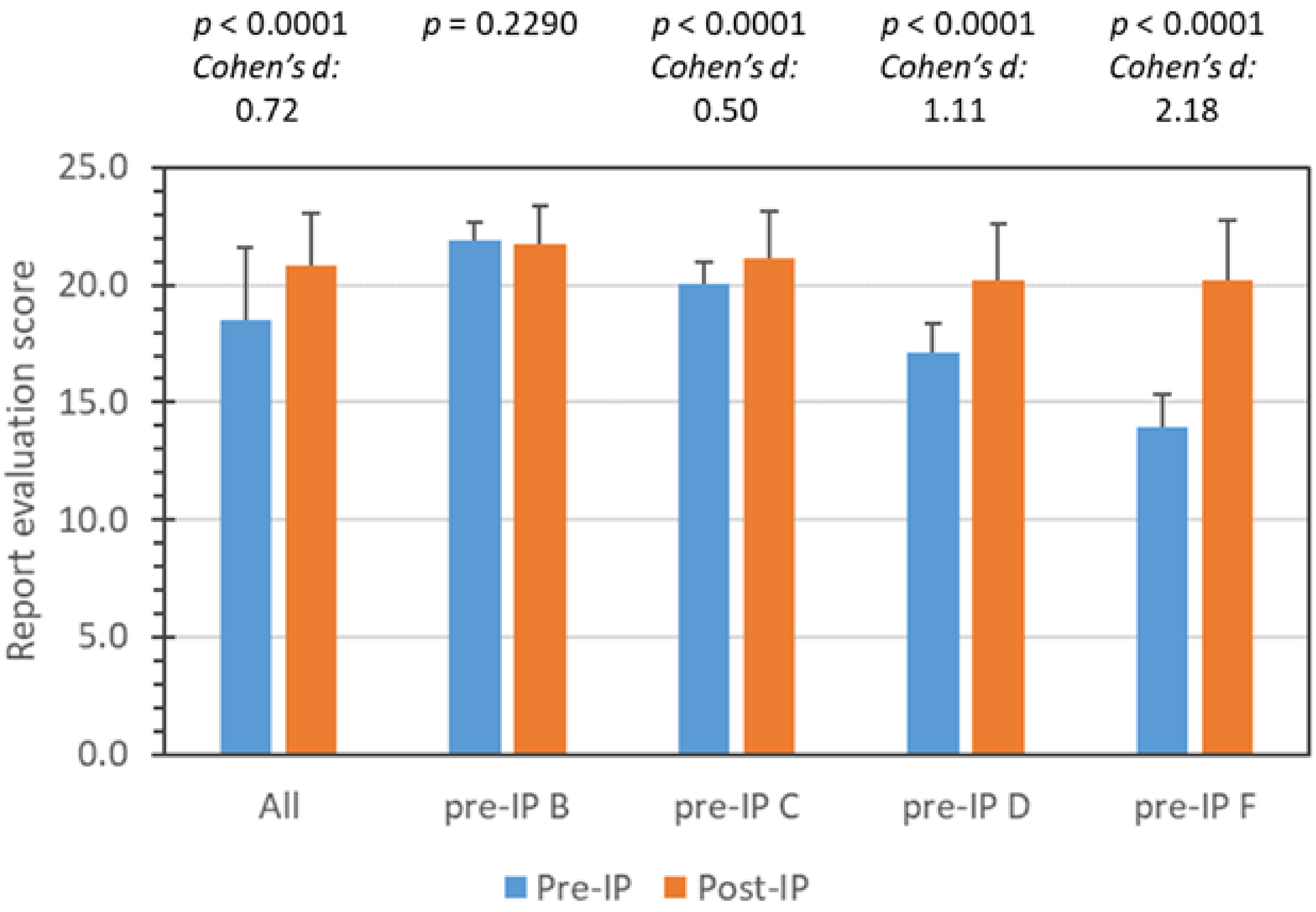

Rate your ability to formulate a testable hypothesis before/after the CBC project (p<0.001)


Rate your ability to evaluate the quality of a scientific report before/after the CBC project (p<0.001)

Direct assessment of ability to evaluate scientific report (BC F13-16)



Significant gain for all, both majors and non-majors, and both U1/U2 and U3/U4 students.



There was no statistically significant gain for pre-IP B group, but there were significant gains for the pre-IP C, D and F groups with increasing effect size.

Acknowledgements

- NSF (ESI 0083336 and DUE-0942715)
- Texas A&M University Core Curriculum Technology Enhancement Grant
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- National Audubon Society
- Multi-Resolution Land Characteristics Consortium
- Cornell Lab of Ornithology
- The thousands of undergraduate students and the TAs in our course over the years