ENHANCING LEARNING THROUGH ASSESSMENT: A CASE STUDY USING FEEDBACK FROM A HUMAN DIMENSIONS SURVEY

A Thesis

by

MARIAN KRYSTAL WINDHAM

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2009

Major Subject: Wildlife and Fisheries Sciences

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Approved by:

Chair of Committee,	Frances Gelwick
Committee Members,	Selma Glasscock
	Tim Murphy
Head of Department,	Thomas Lacher

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ABSTRACT

Enhancing Learning Through Assessment: A Case Study Using Feedback from a Human Dimensions Survey. (August 2009)

Marian Krystal Windham, B.S., Texas A&M University

Chair of Advisory Committee: Dr. Frances Gelwick

The Department of Wildlife and Fisheries Sciences at Texas A&M University is in the process of developing an assessment plan for measuring and evaluating each academic degree program (including student learning outcomes) in order to achieve objectives for institutional effectiveness. Assessment is a necessary component of any truly dynamic and progressive educational program. Assessment by evaluation can enhance student learning as well as augment instruction given by the professor. It also allows professors to determine which students reach or exceed learning targets and inform them so students can work to improve their weaknesses. Because there is no assessment plan currently in place for Texas A&M University's Department of Wildlife and Fisheries Sciences, I evaluated results from a previously developed survey that had been given in multiple years to students enrolled in Wildlife Conservation and Management (WFSC 201), an entrance level course of the department. In 2008 I administered the survey to students enrolled in WFSC 201 and to senior-level students enrolled in Conservation Biology and Wildlife Habitat Management (WFSC 406), an upper level course, to evaluate undergraduate students' beliefs on various wildlife issues, interest in animals, and knowledge status of endangered species.

The research presented in this thesis contributes a general overview of assessment as it relates to undergraduate degree programs in wildlife and fisheries sciences. The focus was in particular to the evaluation of student conservation issues, animal interest, and species knowledge as it relates to student background (student classification, gender, hometown population size, and participation in youth groups. The results from analyses of responses to specific questions from a survey administered to undergraduates in the Department of Wildlife and Fisheries Sciences at Texas A&M University suggest that conservation beliefs and animal interest were highly correlated with gender and hometown population size. Students responding as males and having small hometown population size were more concerned about issues related to land or wildlife usage by humans and students responding as females and having large hometown population sizes were more concerned about issues related to habitat degradation and species viability. Males were also interested in mostly game species and females were interested in those of conservation, domestic, and herptiles. Lastly, the results from the knowledge question suggest that males attain and retain more knowledge of endangered species over females, and this relationship remains the same in non seniors and seniors. These results should be useful to the faculty currently and in the future as they develop an effective departmental assessment plan for the Department of Wildlife and Fisheries Sciences at Texas A&M University.

DEDICATION

To my dad, who was the true inspiration behind this thesis. He is the foundation of my hard work and dedication to education.

To my mom, my best friend, who was always there in the background pushing me, encouraging me, and loving me.

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I would like to thank my committee chair, Dr. Frances Gelwick, and my committee members, Dr. Tim Murphy and Dr. Selma Glasscock, for their guidance and support throughout the course of this research.

Thanks also to my friends, colleagues and the department faculty and staff for making my time at Texas A&M University a great experience. I also want to extend my gratitude to Dr. Grant and his lab for allowing me to be a part of their family and providing me with an office, computer, and assistantship. I would also like to thank Dr. Slack and Rob Powell, who provided the survey instrument and ideas about research. Thanks to all the professors that administered the survey, and a big thanks to all the WFSC students who were willing to participate in the survey. I want to give a special thanks to Todd Swannack for his guidance and mentoring through my entire graduate research, curriculum, and every day progressions.

Finally, thanks to my grandma, granddad, sisters (Kamie and Kerri), and brother (Jim) for their encouragement, patience, and love.

NOMENCLATURE

BD	Breslow-Day Test
CANOCO	Canonical Community Ordination
CCA	Canonical Correspondence Analysis
CMH	Cochran-Mantel Haenszel
df	Degree of Freedom
DCCA	Detrended Canonical Correspondence Analysis
OAC	Outcomes Assessment Committee
NAEP	National Assessment of Educational Progress
RENR	Department of Rangeland, Ecology, and Natural Resources
SAS	Statistical Analysis System
TIMSS	Third International Mathematics and Science Study
VIF	Variance Inflation Factor
WFSC	Department of Wildlife and Fisheries Sciences

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1. INTRODUCTION

1.1 Assessment overview

Assessment is a necessary component of any truly dynamic and progressive educational program. Incorporating assessment, and adaptations made based on the results of that assessment, can improve the quality of service to students by keeping education programs relevant. The Department of Wildlife and Fisheries Sciences wants to ensure its students receive a high quality of service in support of their education, so an assessment plan is in progress. Assessments enhance student learning as well as augment instruction given by the professor. Assessment of student learning is important because professors need to know who reaches or exceeds learning targets (Tomlinson, 2008). It also provides feedback to students on their individual learning and level of achievement (Boud and Falchikov, 2006; Ross et al., 2002). Combs et al. (2008) claim that "student evaluations have the potential to have a significant impact on improving courses and increasing student learning and satisfaction," but also agree that university-wide evaluations taken by students at the end of the semester do not inform the professor specifically enough about the effectiveness of their course. It is because of these gaps in evaluation that governments throughout the world are making changes to improve the direction of student learning (Black and William, 1998). National, state, and district

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This thesis follows the style of North American Colleges and Teachers of Agriculture.

standards are being implemented to learn more about student performance. The NAEP (National Assessment of Educational Progress), TIMSS (Third International Mathematics and Science Study) were survey initiatives designed to improve school planning and management. Weave Online ® and Way Point ® are examples of commercially available evaluation and assessment tools that are being tested for use in assessment at Texas A&M University. These initiatives, combined with more frequent inspections, are means of raising standards of learning in education to achieve a national priority (Black and William, 1998). If, as a national priority, these standards of learning become refined through such surveys, inspections, and management, then improved teaching and learning will be positive outcomes. Student perceptions about assessment and evaluation via instruments such as essays or multiple choice tests significantly influence their approaches to learning; students seem to perform better when they know they are being evaluated (Struyven et al., 2005).

1.2 Past methods of assessment

In the past, the most commonly used tool of teaching was lecture, emphasizing content and basic facts; and the most common tool used to assess student performance was an examination, which focused on gathering evidence in order to measure the student's retention of that content (Sternberg, 2008). This lecture and exam type of assessment omits other important aspects of learning that may not be revealed with a simple examination. The problem with this form of assessment has brought about a current focus of assessment research to determine if historic evaluative criteria (i.e., exams over fact-based lectures) measure the student's actual success in the course and in their future endeavors. Assessment should focus on skills, such as problem solving, that will be more likely to contribute to successful outcomes in real world experiences (Sternberg, 2008). Because society and culture change, teaching needs to respond and evolve in order to prepare students for a dynamic future. Traditional psychometrically driven (aptitude) testing is simply not effective enough to describe human growth and achievements in complex domains because learning objectives have multiple targets (Cummings et al., 2008). Complex domains can be considered as complex systems with dynamic feedback mechanisms among its elements, nonlinearity of outcomes, and uncertainty of effects (Bertalanffy, 1969). The study of complex systems focuses on how elements, such as students, interact with the other elements within the system (Bertalanffy, 1969). This complexity is what keeps professors from departing from old forms of assessment in the classroom today. It is very hard to convince professors to use new methods to assess the progress or digression of their students, when the old forms are easy to develop and alter year to year as they teach. Most professors assume that if they are doing their best to teach, the students are automatically learning (Wirth and Perkin, 2009). This does not take into account that everyone learns differently, and has different backgrounds of knowledge that could either enhance or hinder their learning. Professors presumptions that all students learn if they are taught, allows them to believe that older forms of evaluation are satisfactory and keeps them believing that the new forms are too complex and time consuming to change over (Francis, 2008;

Garfield, 1994). Thus they continuously reject the change despite evidence that the new methods of assessment help professors track student learning, and provide mechanisms that increase student satisfaction with their education programs and environments (Francis, 2008; Garfield, 1994). If professors develop and implement an evaluation and assessment tool, it is expected that adaptation will become more focused and the results will allow professors to modify their curriculum and techniques to meet the needs of contemporary as well as future students, beyond what ordinary examinations and quizzes once provided.

1.3 New look at assessment

The fundamentals in education to be assessed have grown since "student learning" is now viewed more closely and has prompted the development of new assessment and evaluation methods. These methods of assessment and evaluation are expected to provide students with a foundation on which a lifetime of learning can be built (Boud and Falchikov, 2006; Wirth and Perkins, 2009). Assessment and evaluation lead professors to believe that students will be prepared to continue to learn beyond the time spent in academia, where current instructional practices are not working (Fink, 2003; Wirth and Perkins, 2009). Boud (2000) described a new philosophy about assessment and suggested that current assessments did not measure whether students were equipped for a lifetime of learning, and recommended that all new assessment tools be judged so that they provide these elements to students. The current belief (Boud and

Falchikov, 2006) is that assessments should not only provide immediate feedback to students about their current learning, but should also contribute to or enhance achievement of future learning and skills that will help students develop their careers. During their academic tenure, students should learn from assessment and be able to apply that learning process to evaluate themselves and their performance in the workforce.

Previous assessments have used examinations and quizzes to measure primarily one outcome of student learning in a program, whereas Young et al. (2003) and Sternberg (2008) recommend measuring multiple outcomes to ensure representation of the various goals and dimensions of learning needed for success during their lifetime. Use of multiple outcomes leads to a more fully developed curriculum that is relevant to students interested in a wide variety of careers. The concept that "…what gets measured gets attention" seems to apply. However, it is impossible to measure everything professors consider important for student retention. Therefore, in order to get a wide selection of measurable outcomes for a department, it is very important that each professor set specific learning objectives for their course. These should encompass various measurements of learning that prepare students for numerous job opportunities. The use of multiple measurements does not mean that professors must evaluate every decision, answer, thought, and move by a student in order to evaluate their performance; there is a limit to assessment (Fitzpatrick et al., 2004). In order to effectively progress in assessing students, professors will have to prioritize student learning objectives (Young et al., 2003), and develop clearly-defined outcomes that will help to advance understanding of pedagogies. Some professors of conservation and the environmental prioritize affective and behavioral outcomes as important as cognitive goals (Barney et al., 2005). Once these outcomes are developed, whatever they may be, the next step is to measure them to see if students are achieving them. With the results of assessment sounding so laudable, one would think the actual process to achieve them has received the same amount of attention, but it has not (Baume et al., 2004). As observed in most classes, there are usually some objectives listed in the syllabi, but rarely are they measured to evaluate actual student learning outcomes. More work is needed to develop tools that are reliable, valid, and sensitive to true changes in outcomes (Summerfelt, 2003), and future progress will lend increased proficiency in measurement of learning outcomes. Once a plan is developed, and students are assessed throughout the course, the curriculum will be assessed as a result. This results in a more profound knowledge base to deal with an increasingly uncertain future that lies ahead for them.

1.4 Key to faculty motivation

Faculties complain about the difficulties of assessment and evaluations, specifically that these new tools comprise too many “hard-to-understand” concepts, procedures, and steps to follow, and lack a clear rationale behind some actions or procedures in the process (Dodeen, 2004). In addition, assumptions about faculty understanding of what is being proposed and awareness of the ‘big picture’ of the assessment process are often incorrect. These concerns prompted the Outcomes

Assessment Committee (OAC) at the United Arab Emirates University to renovate their approach to assessment by focusing only on the main steps of the process.

Simplification of the process also provides the flexibility to accommodate people from different backgrounds and experiences (Dodeen, 2004). For example, when the OAC asks for a program assessment report, plan, or schedule, it does not expect to get an exact replica from each of the multiple programs. Rather, OAC realizes that departments in each school are at different stages in their development of an assessment plan. Another simplification is removal of restrictive guidelines, thus allowing each department to select assessment tools, outcomes, schedules, and targets for results, as long as the rationale for decisions and actions is justified (Dodeen, 2004). It seems logical that such freedom of choice should enhance participation. Given that there is a considerable amount of time spent to develop and then evaluate results of an assessment, there should be at least as many benefits to be gained and appreciated. An essential prerequisite for successful assessment is faculty participation (Dodeen, 2004), and to achieve this, simplification is the key.

Given that both professors and students can achieve extensive advances through assessment, it should be an important criterion in every school's learning program. There are many outcomes of a productive learning program, one of which is teaching methodology that effectively opens the door to discovery for all students (Brewer, 2004). Assessment is one way to monitor and assure that such discovery occurs.

1.5 Assessing a program that has no formalized assessment plan

The Department of Wildlife and Fisheries Sciences (WFSC) is an academic department at Texas A&M University with a full staff, comprised of academic advisors, faculty, and students. The Department was recently ranked second nationally among Wildlife Biology academic programs and fifth among Fisheries Sciences programs in the United States (Fogg, 2007) and continues to aspire to preeminence among academic programs focused on ecology, management, and conservation biology (Texas A&M Univeristy, 2009). The faculty is dedicated to science-based research and dissemination of knowledge in the disciplines of conservation of biodiversity, natural resources management, and sustainable use of natural resources. The Department discovers and communicates knowledge relevant to the conservation and management of wildlife and fisheries and the ecosystems that sustain them through integrated academic instruction, research, and extension programs. At the end of each undergraduate student's non-senior year, and after consultation with an advisor, the student chooses a course of study from among department options. The relative abundance of students enrolled in each of the department's options is 3% in Aquatic Ecology and Conservation, 66% in Wildlife Ecology and Conservation, 9% in Vertebrate Zoology, 16% undecided, and 2% other (Figure 1). Students must successfully complete courses from the Departmental Core Curriculum, which is intended to enrich and broaden each student's knowledge and application of ecological theory and principles of management in preparation for the Bachelor of Science Degree. The Wildlife and Fisheries Sciences Department at Texas

A&M University has a diverse faculty and staff, including ecologists, aquaculturists, conservation biologists and natural resource managers, who prepare students for a wide variety of career opportunities. The faculty and staff of WFSC are in the process of developing an assessment plan for measuring and evaluating each academic degree program, including student learning outcomes in order to achieve objectives for Institutional Effectiveness Plan (Prior, 2007). The Institutional Effectiveness Plan organizes prospective students' information and materials, acts as a catalyst in identifying those who are admitted, and is responsible for promoting the visibility of the University to others. In general, schools that develop a clear vision of teaching and defined learning goals will help students and professors to be more productive (Abrantes et al., 2007). Although a broad body of knowledge is transmitted to students through the act of teaching, an actual measurement of student learning is necessary (Abrantes et al., 2007), and an evaluation of student learning requires an assessment plan. Because there is no assessment plan currently in place for WFSC, I used previous and current student survey instruments administered to students in select WFSC courses to evaluate students' conservation beliefs, animal interest and endangered species knowledge, in relation to some surveyed background variables. When WFSC develops assessment plans for evaluating each academic degree program, knowledge gained from my study should help the department determine which components of the WFSC 201 survey tool were valuable, and which components were limited in their usefulness and need revision in or omission from future evaluations.

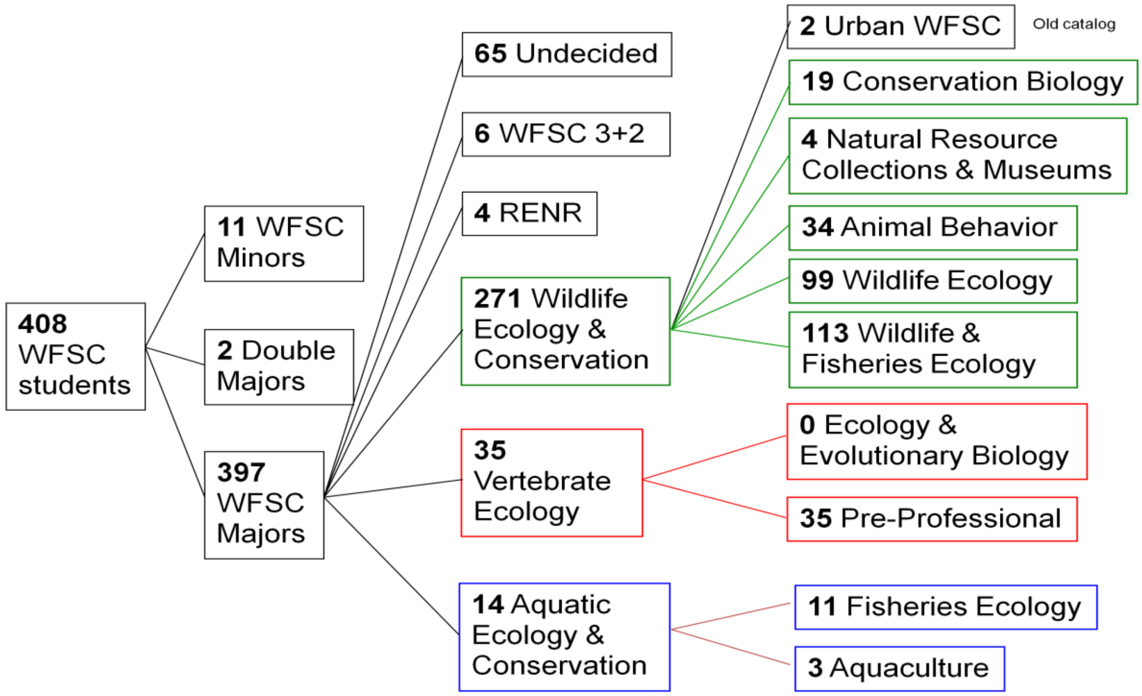


Figure 1. Student degree options within the department and student enrollment in each (Schwede, 2008).

1.6 Research objectives

To begin assessing the Wildlife and Fisheries Science Undergraduate Bachelor's Degree Program and to preview assessment plan potentials, I analyzed the only departmental survey that has been administered to undergraduates over the past ten years. This survey asked for student responses to basic background questions and their current knowledge and attitudes about various aspects of wildlife and fisheries sciences. Although the survey was not administered consistently over all years, as describe later in this thesis, Dr. R. D. Slack and his graduate students conducted the survey early in the semester each year in order to familiarize themselves with the students enrolled in Wildlife Conservation and Management (WFSC 201), a mandatory entry-level course. I continued administering this survey to students enrolled in WFSC 201 in spring and fall of 2008, and also to senior-level students enrolled in the upper level course Conservation Biology and Wildlife Habitat Management (WFSC 406).

Through survey responses, I intended to evaluate student beliefs about conservation issues and interests in several animal taxa and groups, as well as knowledge about wildlife and fisheries sciences. I also planned to compare these beliefs, interest, and knowledge to particular learning outcomes and to other survey responses related to student background variables (student classification, gender, hometown population size, past youth group participation) on the table on page 17. I assumed that the survey responses could be used to measure the change in conservation beliefs on the table on page 16 and animal interests on the table on page 19 of students in WFSC from entrance to graduation, and that the survey responses reflected relationships among background, conservation issues, and animal interests of students. I also assumed that the survey responses could be used to measure change in student knowledge from entrance to graduation, and whether student gender had any effect on responses to the knowledge questions in the survey.

1. The first objective of my research was to test for trends in student responses on survey question 12 in 2000 and 2008 (Appendix B & C), a multiple answer question focused on the relative importance students placed on conservation issues, and relationships of their responses to their student classification (non-senior or senior), gender (male or female), home town population size (five categories), and previous participation in youth group activities (two categories; written answers) (see tables on pages 16 and 17; different among each year).
2. The second objective of my research was to test for trends in student responses to survey question 19 in 2000 and 2008 (Appendix B and C), which asked about their relative interest in certain animals or animal groups, and the relationships of their responses to student classification, gender, home town population size and previous participation in youth group activities (see tables on pages 17 and 19; different among each year).

3. My third research objective was to analyze responses from survey question 13 in 1998, 2000, and 2008 (Appendix A, B, and C), which asked students to select endangered species from a list of animals, to determine if student knowledge was related to their grade-level student classification or gender. I also evaluated the responses to this question independently for each of the four taxanomic groups (i.e., birds, fish, herptiles, and mammals).

This information could inform WFSC faculty about the background and experiences that influence and shape the learning experiences of WFSC students and guide program adaptations that will enhance student learning in the future. The methodology for objective 3 allowed me to detect possible taxonomic bias among student groups based on their other survey responses. I wanted to be able to determine whether certain student groups are more likely to correctly identify the status of a specific taxon dependent on their interest in certain animal groups based on their response to question 19. Survey question 13 was the only question that could be used to directly measure change in student knowledge and contributed to assessment of specific learning outcomes. This assessment measure could be further developed to help professors better understand specifically what their students are learning. Professors could then adapt their teaching methods regarding knowledge of wildlife and fisheries to students in the WFSC population at Texas A&M University.

2. METHODS

2.1 Subjects

In my analysis, I used responses to surveys administered by Dr. R.D. Slack and his graduate teaching assistants to undergraduate students enrolled in WFSC 201 in 1998, 2000, and 2008 (Appendix A, B, and C). In the 2008 spring semester, the survey was administered at the beginning of the semester to students enrolled in WFSC 201, now WFSC 301, Wildlife Conservation and Management; and I also administered it to students enrolled in WFSC 406 (Conservation Biology and Wildlife Habitat Management), which requires senior-level student classification. Although participation in the survey was not mandatory, respondents were allowed to remain anonymous in order to encourage factual responses. I compiled all surveys in a database to analyze.

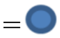
2.2 Focus questions of the survey and analyses

The survey questions of interest and analyses used to evaluate student responses were as follows:

1. Question 12, "How important are the following issues to you?" had response choices of *not an issue, important issue*, and *extremely important issue*. These responses were coded as three categorical response variables for each of the 11 issue statements (see Table 1 for statements and symbols). I also used responses to five survey questions (1, 5, 9, 10, and 11) that included

student classification (non-senior, senior), gender (female, male), hometown population size (<5,000, 5,001-25,000, 25,001-100,000, 100,001-500,000, >500,000), and previous participation in listed youth groups (e.g., 4H, boy scouts, or others written in by student) as my independent (explanatory) variables (Table 2). These responses gave me information about various factors that have been shown to influence attitudes, beliefs, and early interest in conservation (Kellert and Berry, 1987). Analyses were done using software for canonical community ordination, CANOCO version 4.5 (ter Braak, 2002) for years 2000 and 2008.

2. Question 19, "How interested are you in the following animals (animal groups)?" had response choices of *no interest, a little,* or *a lot* to each item. The responses were coded as three categorical response variables for each item (see Table 3 for statements and symbols). I again used responses to the five survey questions (1, 5, 9, 10, and 11) as my independent (explanatory) variables, and CANOCO version 4.5 (ter Braak et al., 2002) for analyses in year 2000 and 2008 (Table 2).
3. Question 13,"From the list below, which species do you believe are endangered?" had seven response choices: mountain lion, white-tailed deer, American alligator, channel catfish, whooping crane, red-cockaded woodpecker, and wolf. These responses were coded as categorical dependent variables with 1 representing yes and 0 representing no for each species. I

Table 1. List of conservation issues the students were given and asked to show scale of importance in survey question 12 and symbols used to label plots in the ordination analysis (0 = *not an issue* = , 1 = *important issue* = , 2 = *extremely important issue* = ).

Conservation Issue	**Abbreviation**
Endangered Species	ESImp
Landowner Rights	LoRts
Water Availability	WtrAv
Over-Harvest of Marine Fish	OvHvMar
Habitat Distruction	HabDes
Water Pollution	WtrPol
High Fences	HiFen
Over-Hunting of Wildlife	OvHnWL
Access to Rivers	AccRv
Loss of Biodiversity	LoBioD
Invasive Species	InvSp

Table 2. List of explanatory variables (independent) that were used to study student relationships of conservation beliefs and animal interest. ( ) symbol used to label plots in the ordination analysis. *Variables varied per question: *2008 only*

Explanatory Variables	Abbreviation	Question on Survey
Student classification		
Non-Senior	NotAllSr	Dependent of class given
Senior*	AllSr	Dependent of class given
Gender		
Female	Female	#1
Male	Male	#1
Hometown population size		
Population Size < 5,000	Pop 1	#5
Population Size 5,001-25,000	Pop 2	#5
Population Size 25,001-100,000	Pop 3	#5
Population Size 100,001-500,000	Pop 4	#5
Population Size > 500,000	Pop 5	#5
Previous participation in youth groups		
4H Yes	4HY	#9
4H No	4HN	#9
Boy Scouts Yes	ScoutY	#10
Boy Scouts No	ScoutN	#10
Brownies*	Brownies	#11
Scout Ranch*	SctRnch	#11
Habitat for Humanity*	H for H	#11
FFA*	FFA	#11
Indian Princesses*	IndPrin	#11
Youth Sports*	YthSprts	#11

used responses to survey question 1 regarding gender (female or male) together with student classification as my categorical independent (explanatory) variables. Student classification allowed me to directly test this as a knowledge-based learning outcome for the Wildlife and Fisheries Sciences assessment program (see Table 4 for list of hypothesis). Analyses were all done using the Proc FREQ procedure of SAS (Statistical Analysis System).

Out of the three surveys, these dependent and independent variables were the only variables analyzed to test relationships of student classification, gender, population size of home town, and participation in youth groups (Appendix A, B, and C and Table 2). The responses to all survey questions were entered as categorical variables (coded as either 0 or 1) into a spreadsheet, and each student was treated as an independent observation. Since some questions were omitted in some years and some response options for questions were modified over time, data were missing for some questions and some response variables were missing in certain years. In other cases, students left questions blank or entered multiple responses where a single response was to be chosen. For variables or observations having missing or incorrectly answered responses, "NA" (not available) was entered in the spreadsheet cell. If a cell contained NA, either the observation or the individual response variable was omitted from the analysis, which ever was appropriate to maintaining the highest number of replicates for the particular

Table 3. List of animals provided to students in question 19, where students were asked to show scale of interest in survey question 19 and symbols used to label plots in the ordination analysis (0 = *no interest*=, 1 = *a little interest* = , 2 = *a lot of interest* =)

*Animal option varied by year: * 2008 only*

Animal of interest	**Abbreviation**
Fish	ItFsh
Songbird	ItSongB
Beaver	ItBvr
Snake	ItSnk
Deer	ItDeer
Ducks and Geese	ItDkGs
Dog	ItDog
Lizards	ItLiz
Squirrel	ItSquir
Butterfly	ItBfly
Mountain Lion	ItMtLio
Turtle	ItTurt
Bass	ItBass
Rabbit	ItRbt
House Cat	ItHCat
Frog	ItFrog
Turkey	ItTurk
Dolphin*	ItDolp
Chimpanzee*	ItChim
Blue Martin*	ItBlMrt
Wolf*	ItWolf
Whale*	ItWhale
Bat*	ItBat
Fox*	ItFox
Eagle Hawk*	ItEglHwk

Table 4. List of statistical analyses used to analyze the distribution of correct versus incorrect responses on the student knowledge question (identify endangered and non-endangered species) and relationships to survey-response variables (student background variables). Variables correspond to correct student responses to taxa overall (TaxaOA) or individual taxa (IndTaxa), and Gender and/or student classification (Class). *M= significant only for the taxon mammals **only listed for significant results

Test #	**Year**	**Contingency Table**	**Variables Available**	**Test of the independence of correct responses**	**Significant** *if* *P > 0.05* *(Yes or No)*	**Odds Ratio** Value	**95% Confidence Limits**	**(BD) Test** χ^2	*P-value*	**Chi-Square Test** χ^2	*P-value*	**(CMH) Statistics** χ^2	*P-value*
1	1998	χ^2 with 1 df	TaxaOA	Difference across all taxa?	Yes	--	--	--		37.88	< 0.0001	--	
2	1998	2x4	IndTaxa	Difference among some taxa?	Yes	--	--	--		114.138	< 0.0001	6.5450	0.0105
3	2000	2x2	Gender, TaxaOA	Difference between females and males across all taxa?	No	--	--	--		0.2965	0.05861	--	
4	2000	2x2x4	Gender, IndTaxa ,	Difference between females and males among some taxa?	No	--	--	0.2886	0.8656	--		--	
5	2008	2x2	Class, TaxaOA	Difference between non-seniors and seniors across all taxa?	No	--	--	--		0.0671	0.7956	--	
6	2008	2x2x2	Class, Gender, TaxaOA	Difference between non-seniors and seniors of different gender across all taxa?	No	--	--	--		0.1221	0.7268	--	
7	2008	2x2	Gender, TaxaOA	Difference between females and males across all taxa?	Yes	0.0615*	0.0221-0.1712*	--		38.034	< 0.0001	--	

Table 4 Continued.

Test #	**Year**	**Contingency Table**	**Variables Available**	**Test of the independence of correct responses**	**Significant** *if* *P > 0.05* *(Yes or No)*	**Odds Ratio** Value	**95% Confidence Limits**	**(BD) Test** χ^2	*P-value*	**Chi-Square Test** χ^2	*P-value*	**(CMH) Statistics** χ^2	*P-value*
8	2008	2x2	Gender, TaxaOA	Difference between **non-senior** females and males across all taxa?	Yes	0.0870*	0.0305-0.2480*	--		25.9022	< 0.0001	--	
9	2008	2x2	Gender, TaxaOA	Difference between **senior** females and males across all taxa?	Yes	0.1754*	0.0464-0.6638*	--		7.0585	0.0079	--	
10	2008	2x2x4	Class, IndTaxa ,	Difference between non-seniors and seniors, among some taxa?	No	--	--	0.5254	0.7690	--		0.2887	0.5910
11	2008	2x2x4	Gender, IndTaxa	Difference between females and males among some taxa?	Yes	M=0.0274*	M=0.0035-0.2133*	18.3149	< 0.0001	--			
12	2008	2x2x4	Gender, IndTaxa	Difference between **non-senior** females and males, among some taxa	Yes	M=0.5366*	M=0.4037-0.7131*	21.6668	< 0.0001	--		--	
13	2008	2x2x4	Gender, IndTaxa ,	Difference between **senior** females and males, among some taxa?	No	--	--	0.5967	0.7420	--		--	

test. After entering all these variables, the three survey questions listed above were the ones of most interest and most relevant to measure for student assessment.

2.3 Statistical analyses of WFSC student's conservation issue beliefs and animal interests as related to student classification, gender, hometown population size and youth group participation

Multivariate analysis provides an efficient statistical method for the study of the joint relationships of variables in datasets that contain inter-correlations, or multiple entries of zero (James and McCulloch, 1990). The multivariate statistical program Canonical Community Ordination (CANOCO) is designed mainly for data analysis in community ecology. CANOCO operates on observations of dependent variables and independent or explanatory variables in which ordination is applied simultaneously to the observations using reciprocal, weighted averaging and χ^2distance measures. Dependent variables are usually abundance or incidence, but can also be binary (0/1) variables (ter Braak, 2002). CANOCO contains four main ordination methods: 1) indirectly describe the structure in a single data set; 2) directly describe the structure in one data set by using another data set; 3) follow the first (indirect) method, but first account for (remove) variation explained by another data set (the covariables); and 4) directly describe the structure in a single data set using a third data set, after accounting for variation explained by the covariables in a second data set (ter Braak, 2002). For each of these methods, one must choose either a linear model (such as Principle

Components Analysis, PCA) or unimodal model (such as Correspondence Analysis, CA) to describe the structure of the common trends in the dependent variables (Leps and Smilauer, 2003). Preliminary analyses were run to quantify β diversity (using detrending to quantify turnover rate in standard deviation units, SD) across the length of the gradient representing first, the unconstrained common trends (detrended correspondence analysis; DCA), and then the constrained common trends (detrended canonical correspondence analysis; DCCA). A trend of 4-SD indicates a complete turnover in the dependent data across all observations (students). Trends < 3-SD are generally suitable for linear methods, and > 3-SD are suitable for unimodal methods. In addition, zero inflated data are generally better suited for unimodal methods. After preliminary testing, I found all gradients were > 3-SD; therefore, all analyses were run using unimodal methods of correspondence analysis in which distribution of responses are modeled as optima with respect to common trends and explanatory variables.

2.3.1 Multivariate analysis of student responses for question 12, importance of conservation issues

Using CANOCO method one, I first ran a detrended correspondence analysis (DCA) to indirectly describe the unconstrained relationships among student responses to the survey questions (i.e., the species data without explanatory variables) to quantify common trends (Leps and Smilauer, 2003). Using method two, I then quantified the relationships among the responses that could be predicted based on their correlation with responses to the five background (explanatory) questions (i.e., student classification, gender, hometown population size, and youth group participation) (Table 2). The final models were determined using two methods of selecting explanatory variables in order to evaluate alternative relationships among explanatory variables and student responses. The first method was forward selection of explanatory variables to successively include only those variables that explained (were correlated with) significant additional variance in the response database. The second method of variable selection was through backward elimination of variables that had high variance inflation factors (VIFs), which I considered as values > 5. The formula is

$$\text{var}(c_j) = \text{VIF (residual variance)}/(\text{n-q-1}),$$

where $\text{var}(c_j)$ is the variance explained by the environmental variable, n is the number of samples and q is the number of environmental variables in the equation. The VIF is related to the (partial) multiple correlation R_j between environmental variable j and the other environmental variables in the analysis (ter Braak and Smilauer 2002). If significant explanatory variables had high VIFs, they represented alternative explanations for the same trends. Removal of variables having high VIFs reduces inflation of significance tests of the multivariate relationships for canonical axis. To interpret the results, I created multiple relationships in several joint-plots of dependent and explanatory variables along the canonical axes (common trends). I used the Monte Carlo test to determine significance of canonical axes and to determine significant t-values of regression coefficients for each axis. Two models, on page 36 and 38, represented students in year 2000, and the other two models (Tables 4 and 5) represented students in 2008.

2.3.2 Multivariate analysis of student responses to question 19, interest in specific animals

Using CANOCO, I ran two canonical correspondence analyses (CCA) to describe relationships among student responses (three levels of interest in each listed animal) that could be predicted based on responses to the four background questions (i.e., student classification, gender, hometown population size, and youth group participation). The final models were determined, as for question 12, by using two methods of selecting explanatory variables. To interpret these results, I visualized multiple relationships and trends in joint-plots. I used the Monte Carlo test to determine significance of canonical axes and to determine significant t-values of regression coefficients for each axis. Two models, on page 45 and 47, represented students in year 2000, and the other two models, on page 49 and 51, represented students in 2008.

2.4 Statistical analyses of student knowledge about endangered species

The Statistical Analysis Systems program (SAS) is an integrated set of modules for manipulating, analyzing, and presenting data using programming language statements that specify how data will be processed and analyzed (Everitt, 2002). The

FREQ procedure (PROC FREQ) of SAS produces one-way to n-way frequency and contingency (cross tabulation) tables that can be used to statistically analyze data. When testing one-way frequency tables, PROC FREQ computes goodness-of-fit tests for equal proportions and it also provides confidence limits and tests for binomial proportions (noninferiority and equivalence). When testing a two-way table, PROC FREQ computes tests and measures of association between the responses of two variables. When testing n-way tables, PROC FREQ provides stratified analyses by computing statistics across, as well as within, strata (SAS Institute Inc., 2004). For contingency tables, PROC FREQ can compute multiple statistics to examine the relationships between multiple student classification variables. To determine if an association exists, chi-square tests are computed. The statistics for contingency tables include those for the following statistical tests: Chi square test, measures of association, risks (binomial proportions) and risk differences for tables, odds ratios and relative risks for tables, tests for trend, tests and measures of agreement, Cochran-Mantel-Haenszel statistics, and Breslow-day statistics (SAS Institute Inc., 2004).

Using SAS, I tested for independence of correct versus incorrect responses for knowledge question 13 to evaluate if the responses were different from random. In initial tests, I considered this question as a whole, such that a student had to correctly distinguish between endangered versus not endangered among all seven species listed in the question. I also repeated this test for each of the individual taxonomic categories (i.e., birds, herptiles, fish, and mammals), using a series of contingency tables (Table 4), to test combinations of my explanatory categorical variables (i.e., student classification and gender; Table 2). Due to the disparity among answer choices (different versions of the survey) across years for this question, as well as the lack of some student information among years, the survey results for each year were analyzed separately. I tested the 13 different hypotheses (Table 4) using the following methods:

(a) Using χ^2 goodness of fit tests for differences from random in frequency of correct student responses grouped by each explanatory categorical variable.

(b) Using odds ratios to test for conditional independence in distribution of correct student responses grouped by each explanatory categorical variable.

(c) Using the Cochran-Mantel-Haenszel (CMH) statistic to test if the conditional odds ratios for gender for each partial table (individual row and column combination controlling for all other combinations) of categorical variables equaled 1.0 (H_0: $\theta_{partial\ table\ 4} = \theta_{partial\ table\ 4} = \ldots\ \theta_{partial\ table\ 4} = 1$); rejecting H_0 indicated that there was not conditional independence among partial tables, and genders responded differently for some categories of taxa.

(d) Using the Breslow-Day (BD) statistic to test if the odds ratios among partial tables were equal (H_0: $\theta_{partial\ table\ 4} = \theta_{partial\ table\ 4} = \ldots\ \theta_{partial\ table\ 4}$); rejecting H_0 indicated that a common odds ratio could not be estimated for each table (i.e., odds ratios for gender differed for one or more categories of animal taxa).

Use of both BD and CMH statistics allowed me to compare the consistency of their results. The CMH statistic has low power for detecting association in which association for some strata are in the opposite direction to patterns for other strata, so a non-significant statistic suggests either no association or no pattern with strength or consistency to dominate another pattern, but also it does not depend on assumption of homogeneity of the odds ratios (Agresti, 1996). The BD statistic requires large sample size within each stratum. All statistical analyses were done using PROC FREQ in SAS 9.1 (SAS Institute Inc., Cary, NC, USA). SAS CODE is presented in Appendix D. For hypotheses that resulted in expected values in any cell of < 5, I re-coded the data by adding 5 to all cells in the contingency table (Agresti, 1996).

2.4.1 Methodology of tests in 1998

In 1998, responses for gender and student classification were not included so I tested for significant differences in the number of students that answered the entire question correctly using a χ^2 test, corrected for 1 *df* (Table 4, Test 1). In order to determine if students responded differently depending on taxa, I independently tested for significant differences in the numbers of students that correctly identified endangered status for each taxon using a χ^2 goodness of fit test (Table 4, Test 2).

2.4.2 Methodology of tests in 2000

In 2000, responses for gender were available, so I tested for the conditional independence of gender from correct responses for the entire question using a 2x2 contingency table. I calculated a CMH statistic to determine if the conditional odds ratios were equal to 1 (H_0: $\theta_{CORRECT.(females)} = \theta_{CORRECT.(males)} = 1$) (Table 4, Test 3). Rejecting H_0 indicated the correct responses to the entire question were not independent of gender in 2000. I used a 2x2x4 contingency table to test for non-independence of gender from correct responses for each taxonomic group (Table 4, Test 4). For this table, I calculated a BD statistic to determine if the odds ratios for gender were the same for each taxon (H_0: $\theta_{CORRECT.FEMALES(birds)} = \theta_{CORRECT.MALES(birds)} = \theta_{CORRECT.FEMALES(herptiles)} = \theta_{CORRECT.MALES(herptiles)} = \theta_{CORRECT.FEMALES(mammals)} = \theta_{CORRECT.MALES(mammals} = \theta_{CORRECT.FEMALES(fish)}) = \theta_{CORRECT.MALES(fish)}$). Rejecting H_0 indicated that a common odds ratio for gender could not be estimated across taxa (that is, females and males responded differently for some taxa in 2000). I also calculated a CMH statistic to determine if the odds ratios for each partial table were equal to 1 (H_0: $\theta_{CORRECT.FEMALES(birds)} = \theta_{CORRECT.MALES(birds)} = \theta_{CORRECT.FEMALES(herptiles)} = \theta_{CORRECT.MALES(herptiles)} = \theta_{CORRECT.FEMALES(mammals)} = \theta_{CORRECT.MALES(mammals} = \theta_{CORRECT.FEMALES(fish)}) = \theta_{CORRECT.MALES(fish)} = 1$). Rejecting H_0 also indicated differences in correct response due to gender for some taxa in 2000.

2.4.3 Methodology of test in 2008

In 2008, in addition to gender information being available, the survey was given to two classes, so I was able to analyze the survey responses considering both gender and student classification (non-senior and senior). I tested for the conditional independence of student classification from correct responses to the entire question using a 2x2 contingency table. I calculated a CMH statistic to determine if the conditional odds ratios were equal to 1 (H_0: $\theta_{CORRECT(non\text{-}seniors)} = \theta_{CORRECT(seniors)} = 1$) (Table 4, Test 5). Rejecting H_0 indicated differences in correct responses due to gender for some taxa in 2008. I also tested for the conditional independence of student classification from gender in correctly responding to the entire question using a 2x2x2 contingency table. I calculated a CMH statistic to determine if the conditional odds ratios were equal to 1 (H_0: $\theta_{CORRECT.NON\text{-}SENIORS(females)} = \theta_{CORRECT.SENIORS(males)} = 1$) (Table 4, Test 6). Rejecting H_0 indicated gender and student classification were not independent from the correct response to the question in 2008. I tested for the conditional independence of each gender (across both non-senior and senior classes) from the correct response to the entire question using a 2x2 contingency table. I calculated a CMH statistic to determine if the conditional odds ratios were equal to 1 (H_0: $\theta_{CORRECT(females)} = \theta_{CORRECT(males)} = 1$) (Table 4, Test 7). Rejecting H_0 indicated gender was not independent from the correct response to the question among all students in 2008. I also tested for the conditional independence of gender (using only seniors) from correct responses to the entire question using a 2x2 contingency table. I calculated a CMH statistic to determine if the conditional odds ratios were equal to 1 (H_0: $\theta_{CORRECT(females)} = \theta_{CORRECT.(males)} = 1$) (Table 4, Test 8). Rejecting H_0 indicated gender was not independent from correct responses to the question among seniors in 2008. I also tested for the conditional independence of gender (using only non-seniors) from correct responses to the entire question using a 2x2 contingency table. I calculated a CMH statistic to determine if the conditional odds ratios were equal to 1 (H_0: $\theta_{CORRECT(females)} = \theta_{CORRECT(males)} = 1$) (Table 4, Test 9). Rejecting H_0 indicated gender was not independent from correct responses to the question among non-seniors in 2008. I also created a 2x2x4 contingency table to determine if student classification was independent of correct responses for each taxa (Table 4, Test 10). For this table, I calculated a BD statistic to determine if the odds ratios for student classification were the same for each taxon (H_0: $\theta_{CORRECT.NON\text{-}SENIORS(birds)} = \theta_{CORRECT.SENIORS(birds)} = \theta_{CORRECT.NON\text{-}SENIORS(herptiles)} = \theta_{CORRECT.SENIORS(herptiles)} = \theta_{CORRECT.NON\text{-}SENIORS(mammals)} = \theta_{CORRECT.SENIORS(mammals)} = \theta_{CORRECT.NON\text{-}SENIORS(fish)} = \theta_{CORRECT.SENIORS(fish)}$. Rejecting H_0 indicated that a common odds ratio for student classification could not be estimated among taxa (that is correct responses across both, non-seniors and seniors differed among taxa in 2008). I also calculated a CMH statistic to determine if the odds ratios for each partial table were equal to 1 (H_0: $\theta_{CORRECT.NON\text{-}SENIORS(birds)} = \theta_{CORRECT.SENIORS(birds)} = \theta_{CORRECT.NON\text{-}SENIORS(herptiles)} = \theta_{CORRECT.SENIORS(herptiles)} = \theta_{CORRECT.NON\text{-}SENIORS(mammals)} = \theta_{CORRECT.SENIORS(mammals)} = \theta_{CORRECT.NON\text{-}SENIORS(fish)} = \theta_{CORRECT.SENIORS(fish)}$. Rejecting H_0 indicated that student classification was not independence of correct responses for each taxon in 2008. I also created a 2x2x4 contingency table to determine if gender (across both non-seniors and seniors) was independent of correct responses for each taxa (Table 4, Test 11). For this table, I calculated a BD statistic to determine if the odds ratios of each gender for each taxon were the same for each taxon (H_0: $\theta_{CORRECT.FEMALES(birds)} = \theta_{CORRECT.MALES(birds)} = \theta_{CORRECT.FEMALES(herptiles)} = \theta_{CORRECT.MALES(herptiles)} = \theta_{CORRECT.FEMALES(mammals)} = \theta_{CORRECT.MALES(mammals)} = \theta_{CORRECT.FEMALES(fish)} =$

$\theta_{CORRECT.MALES(fish)}$. Rejecting H_0 indicated that a common odds ratio could not be estimated across taxa (that is, males and females responded differently to some taxa). I also calculated a CMH statistic to determine if the odds ratios for each partial table were equal to 1 (H_0: $\theta_{CORRECT.FEMALES(birds)} = \theta_{CORRECT.MALES(birds)} = \theta_{CORRECT.FEMALES(herptiles)} = \theta_{CORRECT.MALES(herptiles)} = \theta_{CORRECT.FEMALES(mammals)} = \theta_{CORRECT.MALES(mammals)} = \theta_{CORRECT.FEMALES(fish)} = \theta_{CORRECT.MALES(fish)} = 1$). Rejecting H_0 indicated gender was not independent from class and correct responses for some taxa in 2008. Then, I created a 2x2x4 contingency table to determine how each gender, observing only seniors, responded to each taxon (Table 4, Test 12). For this table, I calculated a BD statistic to determine if the odds ratios for gender were the same for each taxon (H_0: $\theta_{CORRECT.FEMALES(birds)} = \theta_{CORRECT.MALES(birds)} = \theta_{CORRECT.FEMALES(herptiles)} = \theta_{CORRECT.MALES(herptiles)} = \theta_{CORRECT.FEMALES(mammals)} = \theta_{CORRECT.MALES(mammals)} = \theta_{CORRECT.FEMALES(fish)} = \theta_{CORRECT.MALES(fish)}$. Rejecting H_0 indicates that a common odds ratio could not be estimated across taxa (that is, gender was not independent from correct responses for some taxa). I also calculated a CMH statistic to determine if the odds ratios for each partial table were equal to 1 (H_0: $\theta_{CORRECT.FEMALES(birds)} = \theta_{CORRECT.MALES(birds)} = \theta_{CORRECT.FEMALES(herptiles)} = \theta_{CORRECT.MALES(herptiles)} = \theta_{CORRECT.FEMALES(mammals)} = \theta_{CORRECT.MALES(mammals)} = \theta_{CORRECT.FEMALES(fish)} = \theta_{CORRECT.MALES(fish)} = 1$). Rejecting H_0 indicates that gender of seniors was not independent from correct responses for some taxa in 2008. Lastly, I created a 2x2x4 contingency table to determine how each gender, observing only non-seniors, responded for each taxon (Table 4, Test 13). For this table, I calculated a BD statistic to determine if the odds ratios for gender were the same for each taxon (H_0: $\theta_{CORRECT.FEMALES(birds)} = \theta_{CORRECT.MALES(birds)} = \theta_{CORRECT.FEMALES(herptiles)} = \theta_{CORRECT.MALES(herptiles)} = \theta_{CORRECT.FEMALES(mammals)} = \theta_{CORRECT.MALES(mammals)} = \theta_{CORRECT.FEMALES(fish)} = \theta_{CORRECT.MALES(fish)}$. Rejecting H_0 indicates that a common odds ratio could not be estimated across taxa (that is, gender of non-seniors was not independent of correct responses to some taxa). I also calculated a CMH statistic to determine if the odds ratios for each partial table were equal to 1 (H_0: $\theta_{CORRECT.FEMALES(birds)} = \theta_{CORRECT.MALES(birds)} = \theta_{CORRECT.FEMALES(herptiles)} = \theta_{CORRECT.MALES(herptiles)} = \theta_{CORRECT.FEMALES(mammals)} = \theta_{CORRECT.MALES(mammals)} = \theta_{CORRECT.FEMALES(fish)} = \theta_{CORRECT.MALES(fish)} = 1$). Rejecting H_0 indicated that gender of non-seniors was not independent of correct responses for some taxa in 2008.

3 RESULTS

3.1 Multivariate analysis results of student responses to conservation issues in the survey

Together all canonical axes testing the relationship between conservation issue beliefs of students in year 2000 and background variables explained 14.5% of the total variance (F-ratio = 1.308, $P = 0.0360$) in student responses to the conservation issues in the survey (Figure 2). The first canonical axis represented the strongest trend (axis 1; eigenvalue = 0.099 F-ratio = 3.317, $P = 0.0200$), explaining 5.8% of the total variation of student beliefs in conservation (Figure 2). The second canonical axis represents a second trend, and explained an additional 3.4% of the variation, the third explained an additional 1.7%; and the forth explained an additional 1.4%.

Axis 1 shows that student responses to conservation issues were associated with a combination of related factors. Students responses that identified endangered species, water pollution, loss of biodiversity, and habitat destruction as *extremely important* were correlated with responses of no participation in 4H or boy scouts, responses by females, and large student hometown population sizes (Pop 4 and 5) (Figure 2, left side). Student responses to high fences, landowner rights, access to rivers, water availability, over harvesting of marine fishes, over hunting of wildlife as *extremely important* were more highly correlated with participation in 4H, and in boy scouts, responses by males, and small hometown population sizes (Pop 1, 2, and 3) (Figure 2, right side)

Axis 2 depicts student responses of *extremely important* for issues of landowner rights, access to rivers, water availability, water pollution, habitat destruction, low biodiversity, and over hunting of wildlife. These responses were correlated with responses of previous participation in boy scouts, small hometown population sizes (Pop 1 and 2), and by male students (Figure 2, top portion). On the opposite side of the second trend (Figure 2; negatively correlated with responses plotted at the top of axis 2) are student responses of *an important* issue to habitat destruction, low biodiversity, access to rivers, and water availability (Figure 2, bottom portion). These student responses were correlated with no previous participation in boy scouts, responses by females, and large hometown population sizes (Pop 3, 4, and 5).

Axis 3 depicts student responses of *an extremely important* issue to over harvesting of marine fish, habitat destruction, low biodiversity, water availability, and over hunting of wildlife (Figure 3, left side). These student responses were correlated with no previous participation in boy scouts or 4H, responses by males, and medium hometown population sizes (Pop 2, 3, and 5). On the opposite side (Figure 3; negatively correlated with responses plotted at the left of axis 3) are student responses of *extremely important* for issues of landowner rights, access to rivers, water availability, water pollution, habitat destruction, low biodiversity, endangered species, and high fences. These responses were correlated with responses of previous participation in boy scouts,

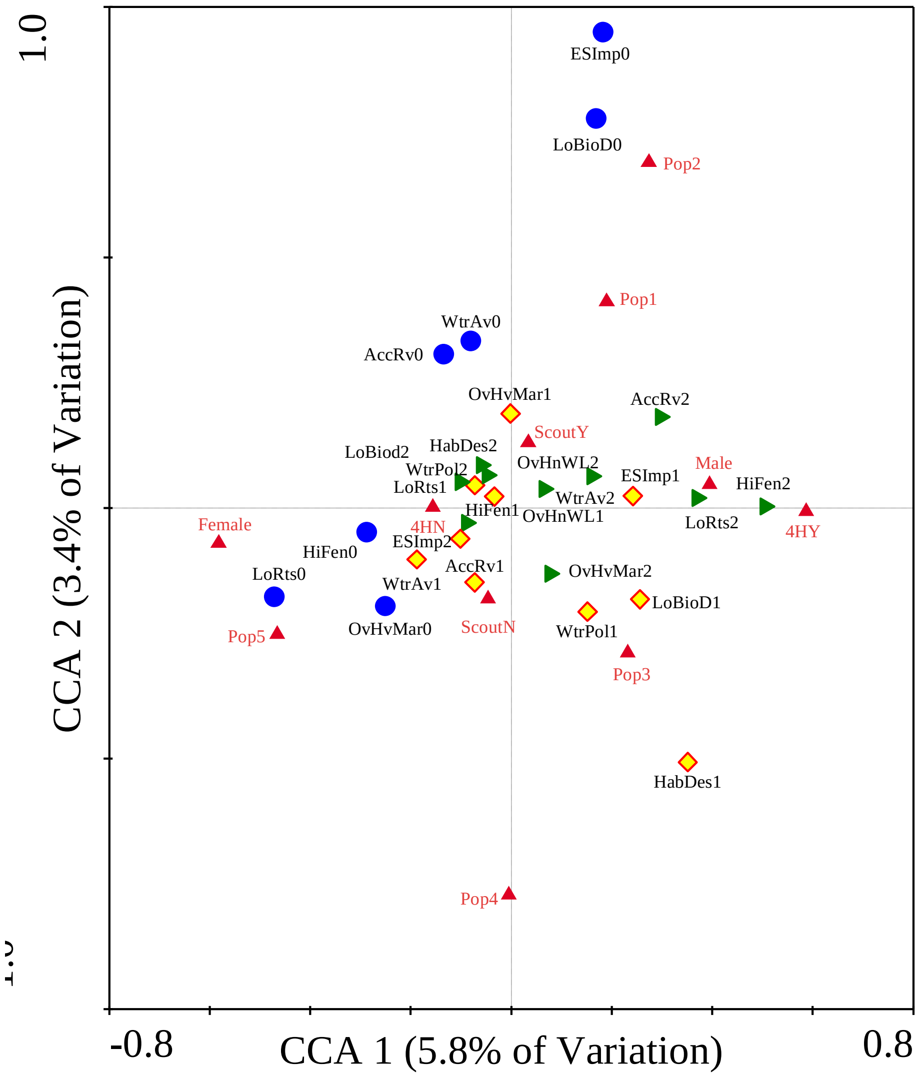


Figure 2. Joint plot showing the relationship between student responses in year 2000 on the 1st and 2nd axis, ranking importance of conservation issues as *not an issue* (blue circles), *important issue* (yellow diamond), *extremely important issue* (green right triangle) and background explanatory variables (student classification, gender, hometown population size, and youth group participation) shown with red upright triangles.

small hometown population sizes or very large hometown population sizes (Pop 1 and 5), and by female students (Figure 3, right side).

Axis 4 depicts student responses of *extremely important* for issues of landowner rights, access to rivers, low biodiversity, and endangered species. These responses were correlated with responses of previous participation in boy scouts and 4H, medium hometown population sizes (Pop 2, 3, and 4), and by female students (Figure 3, top portion). On the opposite end of axis 4, student responses of *extremely important* for issues on water availability, water pollution, habitat destruction, over hunting of wildlife, over harvesting of marine fish, and high fences. These responses were correlated with responses of no previous participation in boy scouts or 4H, small hometown population sizes or very large hometown population sizes (Pop 1 and 5), and by male students (Figure 3, bottom portion).

Together all canonical axes testing the relationship between conservation issue beliefs of students in year 2008 and background variables explained 12% of the total variance (F-ratio = 1.037, P = 0.3760) in student responses to the conservation issues in the survey (Figure 4). The first canonical axis represented the strongest trend (axis 1; eigenvalue = 0.065 F-ratio = 3.836, P = 0.3880), explaining 3.6% of the total variation of student beliefs in conservation (Figure 4). The second canonical axis represents a second trend, and explained an additional 2.9% of the variation, the third explained an additional 1.7%, and forth explained an additional 1.0%.

Axis 1 shows that student responses to conservation issues were associated with a combination of related factors. Students' responses that identified landowner rights,

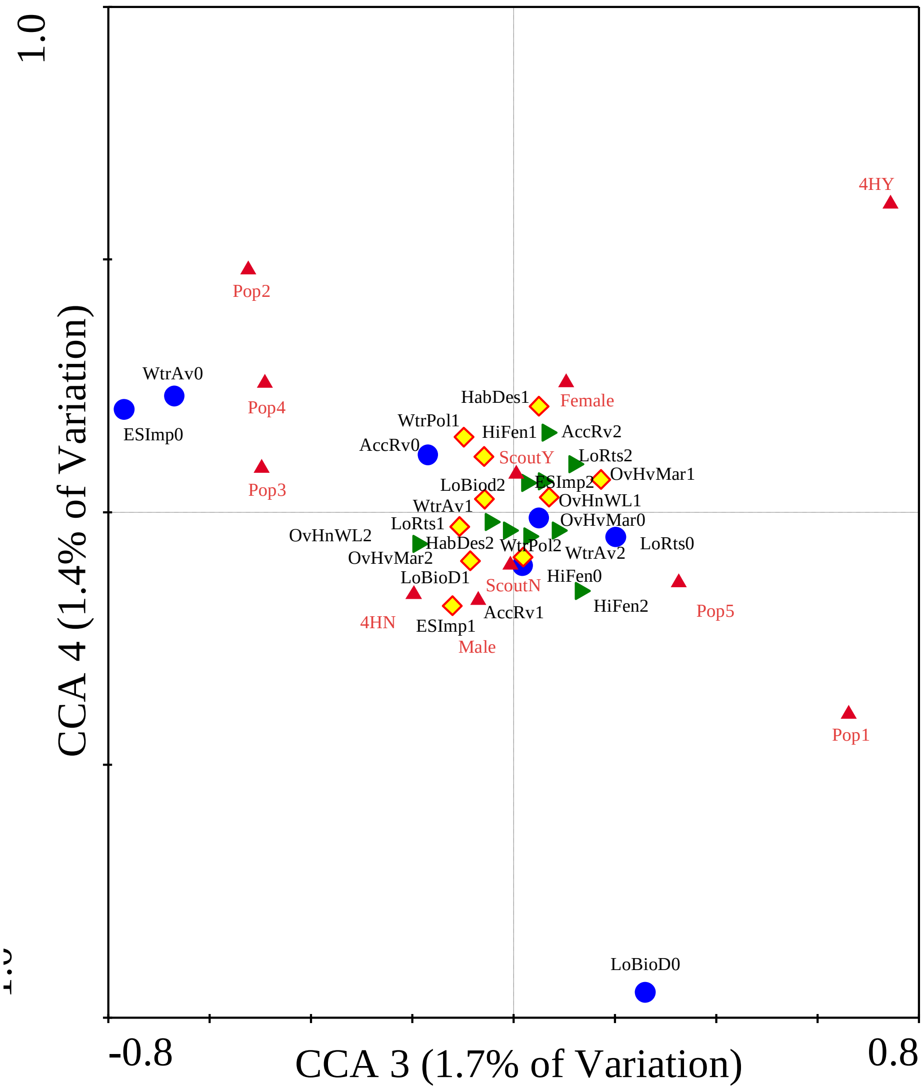


Figure 3. Joint plot showing the relationship between student responses in year 2000 on the 3rd and 4th axis, ranking importance of conservation issues as *not an issue* (blue circles), *important issue* (yellow diamond), *extremely important issue* (green right triangle) and background explanatory variables (student classification, gender, hometown population size, and youth group participation) shown with red upright triangles.

access to rivers and high fences as *extremely important* were correlated with responses of participation in 4H, youth sports, scout ranch, brownies or boy scouts, responses by males, and small student hometown population sizes (Pop 1 and 2) (Figure 4, left side). This does not mean that boys were participating in brownies, but that there is some variable highly correlated with males, that participating in brownies is highly correlated with, possibly hometown population size. Student responses to habitat destruction, water pollution, over harvesting of marine fishes, endangered species as *extremely important* were more highly correlated with no participation in 4H, and in boy scouts. These students did however participate in Indian princesses and Habitat for humanity, and were responding as mostly males, and as coming from medium to large hometown population sizes (Pop 3, 4, and 5) (Figure 4, right side)

Axis 2 depicts student responses of *an important* issue to habitat destruction, low biodiversity, access to rivers, and water pollution, endangered species, water availability, high fences, and over harvesting of marine fish (Figure 4, top portion). These student responses were correlated with no previous participation in boy scouts, responses by males, small hometown population sizes, and as being not all seniors (Pop 1 and 2). On the opposite side of the second trend (Figure 4; negatively correlated with responses plotted at the top of axis 2) are student responses of *extremely important* for issues of landowner rights, access to rivers, water availability, water pollution, high fences, habitat destruction, low biodiversity, and over hunting of wildlife. These responses were correlated with responses of previous participation in boy scouts, 4H, youth sports, scout

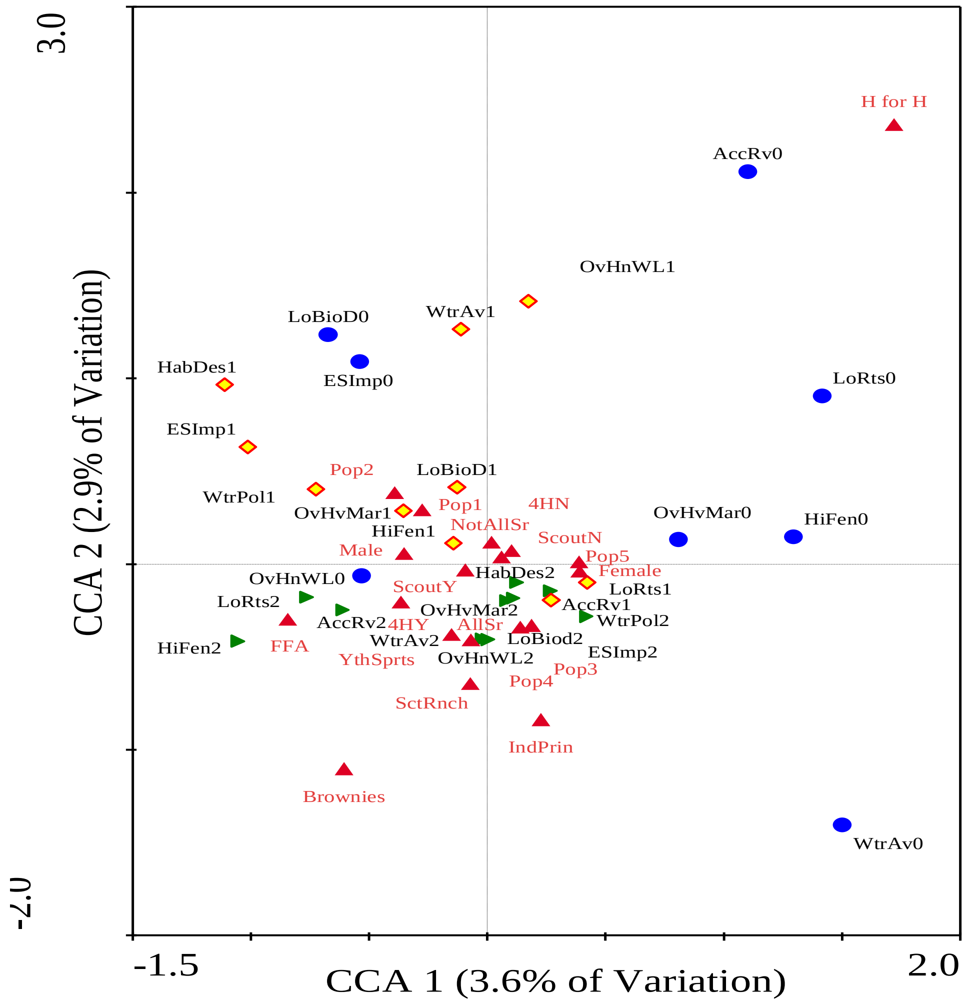


Figure 4. Joint plot showing the relationship between student responses in year 2008 on the 1st and 2nd axis, ranking importance of conservation issues as *not an issue* (blue circles), *important issue* (yellow diamond), *extremely important issue* (green right triangle) and background explanatory variables (student classification, gender, hometown population size, and youth group participation) shown with red upright triangles.

ranch, brownies, Indian princesses, and medium hometown population sizes (Pop 3 and 4), and by male students (Figure 4, bottom portion). The largest trend I see on this axis is that all seniors are plotted on the bottom of the axis where all conservation issues are considered *extremely important.* On the opposite end (top portion of axis 2) the responses are from not all seniors and tended to relate to conservation issues that were responded to as *not an important issue*, or *important issue*.

Axis 3 depicts student responses of *an extremely important* issue to over harvesting of marine fish, habitat destruction, water availability, and landowner rights (Figure 5, left side). These student responses were correlated with no previous participation in boy scouts or but participated in 4H. These students also responded as being males, not all seniors, and being from medium or large hometown population sizes (Pop 2, and 5). On the opposite side (Figure 5; negatively correlated with responses plotted at the left of axis 3) are student responses of *extremely important* for issues of access to rivers, habitat destruction, low biodiversity, endangered species, and high fences. These responses were correlated with responses of no previous participation in boy scouts, but previous participation in 4H, Scout ranch, FFA, habitat for humanity, or brownies, Theses students were also from small or medium hometown population sizes (Pop 1 and 3), and were female senior students (Figure 5, right side).

Axis 4 depicts student responses of *extremely important* for issues of water availability, landowner rights, over harvesting of marine fish, high fences, landowner rights, access to rivers, low biodiversity, and endangered species. These responses were correlated with responses of previous participation in boy scouts, FFA, habitat for humanity, brownies, and being from small or medium hometown population sizes (Pop 1 and 3), and by female students (Figure 5, top portion). On the opposite end of axis 4, student responses of *important* for issues on habitat destruction, over harvesting of marine fish, access to rivers, low biodiversity, endangered species, and high fences. These responses were correlated with responses of no previous participation in boy scouts or 4H, medium hometown population sizes (Pop 3 and 4), and by male students who answered as not all seniors (Figure 5, bottom portion).

3.2 Multivariate analysis results for student survey question of animal interests tested in two different years (2000 and 2008)

Together all canonical axes testing the relationship between animal interest of students in year 2000 and background variables explained 15.7% of the total variance (F-ratio = 1.441, $P = 0.004$). The first canonical axis represented the strongest trend (axis 1; eigenvalue = 0.137, F-ratio = 3.976, $P = 0.002$), explaining 6.9% of the total variation in student responses about animal interests (Figure 6). The second canonical axis explained an additional 2.6% of the total variation, the third explained an additional 2.0%, and forth explained an additional 1.6%.

Male responses, plotted on the first axis on the far left, were negatively correlated with responses by females, plotted on the far right (Figure 6). Small hometown population sizes (Pop 1 and 2) were highly correlated with responses by males, and also

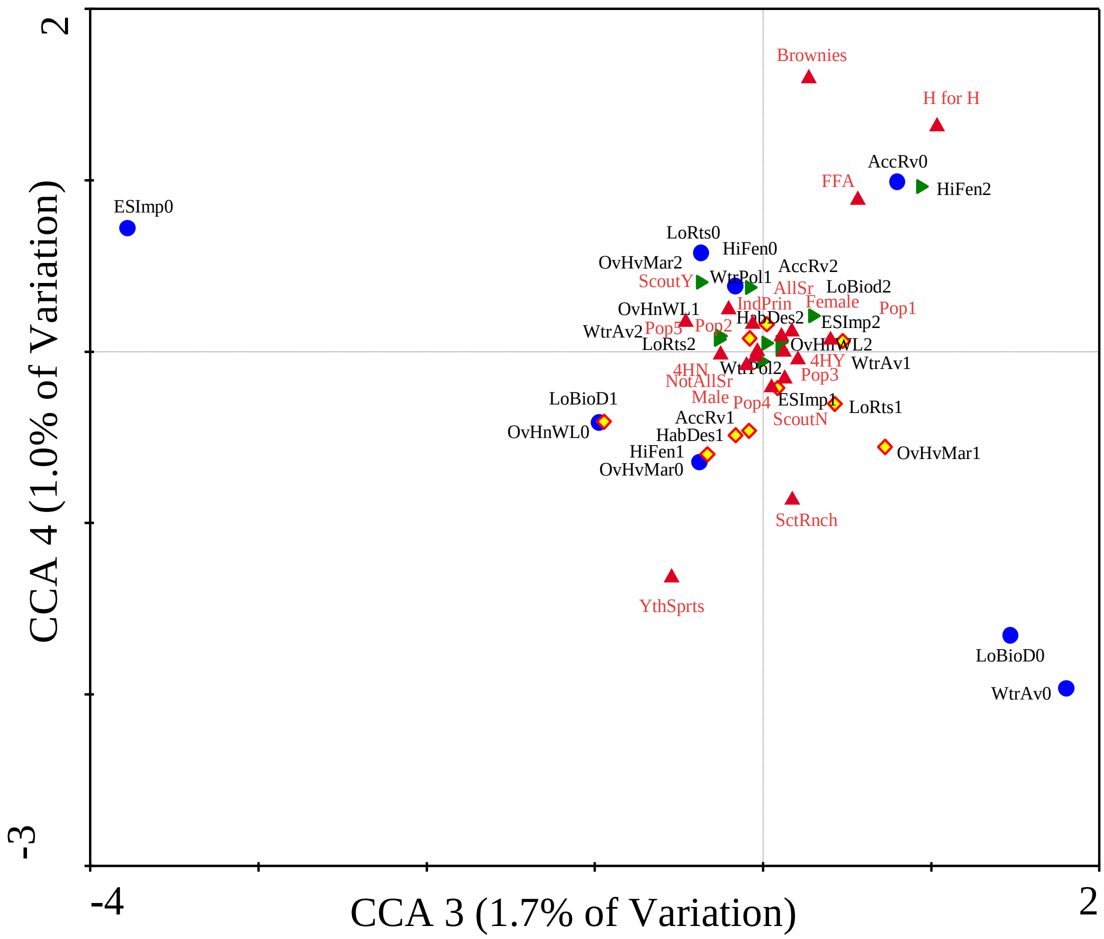


Figure 5. Joint plot showing the relationship between student responses in year 2008 on the 3rd and 4th axis, ranking importance of conservation issues as *not an issue* (blue circles), *important issue* (yellow diamond), *extremely important issue* (green right triangle) and background explanatory variables (student classification, gender, hometown population size, and youth group participation) shown with red upright triangles.

with participation in 4H and *a lot* for interest in game animals (i.e., fish, bass, turkey, deer, ducks and geese). These student responses also were correlated with responses of *no interest* in *conservation animal*s (songbirds, turtles, butterflies, mountain lions, frogs, rabbits, and turtles) and the *domestic animal* (house cats) and negatively correlated to responses by females, no participation in 4H, and medium to medium-large hometown population sizes (Pop 3 and 4). Females were also correlated with greater interest (response 1 and 2) in *conservation animal*s (mountain lions, turtles, frogs, lizards, snakes) and *domestic animal*s (house cats and dogs) (Figure 6, right side).

On the second axis, student responses were *a lot* for interest in fish (bass, more specifically), dogs, snakes, and house cats (top portion of Figure 6). These students also had participated in 4H, scout, and had medium to large hometown population sizes (Pop 3, 4, and 5). Also, student responses in this region of the plot included interest in *domestic animal*s (house cats), but *no interest* in game animals (fish, bass, and turkey) (top half of Figure 2). Students' responses on the opposite side of this trend (bottom portion of Figure 6) indicated no participation in 4H or boy scouts, but were from small hometowns (Pop 1 and 2). These students also responded *a lot* for interest in game animals (deer and turkey) and *conservation animal*s (songbirds, frogs, butterflies, lizards, mountain lions, frogs, and turtles), but were correlated with *no interest* in house cats and squirrels.

On the third axis, as on axis 1, student responses by males were negatively correlated with responses by females (left versus right respectively on Figure 7). Population sizes were not highly correlated with this axis. Student responses by males

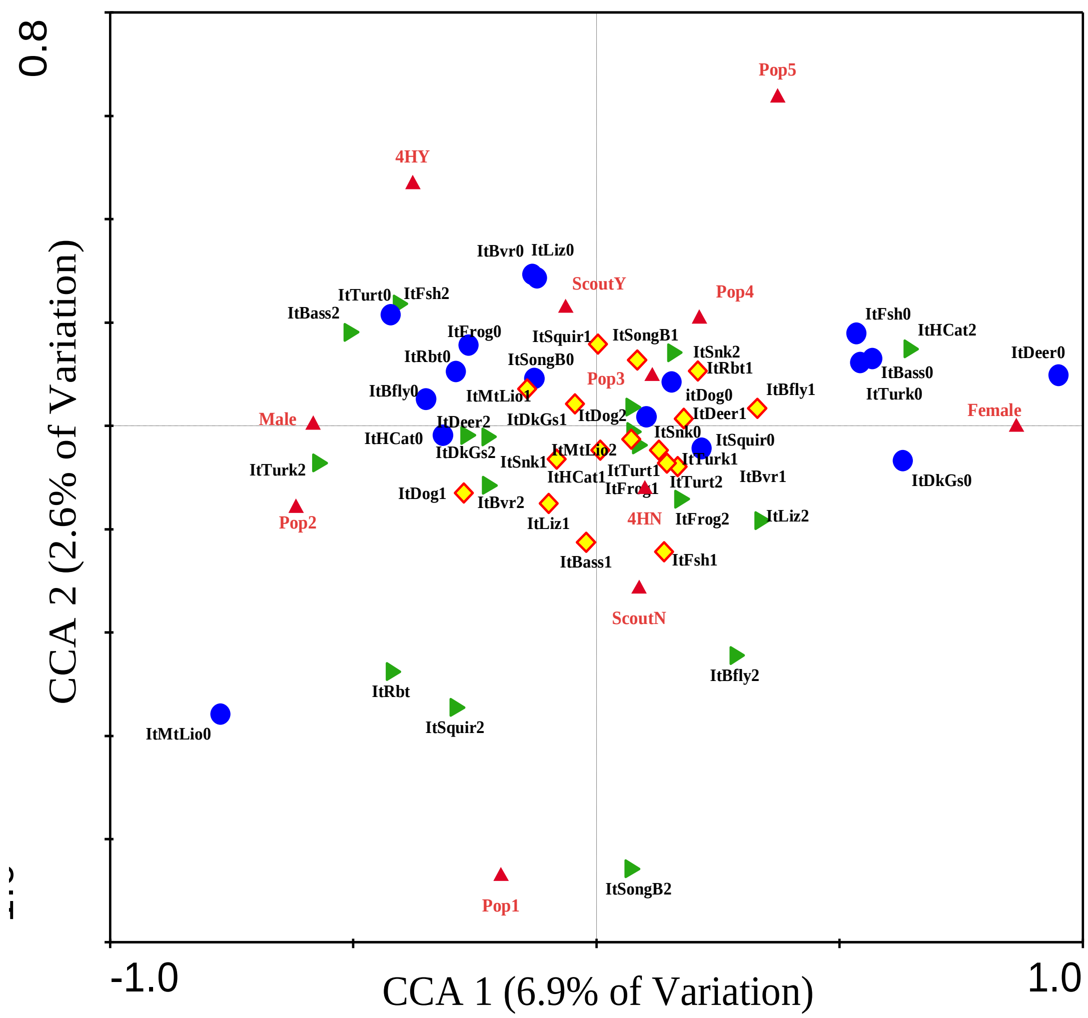


Figure 6. Joint plot on the 1st and 2nd axis showing the relationship between student responses in year 2000 ranking animal interests as *no interest* (blue circles), *a little interest* (yellow diamonds), *a lot interest* (green right triangles) and background explanatory variables (student classification, gender, hometown population size, and youth group participation) shown with red upright triangles.

were highly correlated with participation in boy scouts; however, on this axis, they are correlated with not participating in 4H. These responses were correlated with *a lot* for interest in *conservation animal*s (snakes, songbirds, and squirrels), *domestic animal*s (dogs), and game animals (turkey). These student responses also were correlated with *no interest* in another group of *conservation animal*s (butterflies, lizards, snakes, beavers, songbirds) and game animals (bass, deer, ducks and geese). Student responses by females (Figure 7, right side) were correlated with no participation in boy scouts, and *a lot* for interest in *conservation animal*s (mountain lions, frogs, fish, butterflies, lizards, beavers, and turtles) and game animals (deer, ducks and geese). These student responses also were correlated with responses of *no interest* in another group of *conservation animal*s (fish and turtles), *domestic animal*s (house cats), and game animals (turkey).

On the fourth axis, student responses were *a lot* for interest in *conservation animal*s (frogs, mountain lions, snakes, and songbirds), game animals (deer), and *domestic animal*s (house cats) (top portion of Figure 7). Participation in boy scouts was the only youth group correlated with these student responses on the fourth axis. These student responses also were correlated with responses of *no interest* in butterflies, lizards, snakes, fish and turtles. Students responses on the opposite side of this trend (bottom portion of Figure 7) indicated no participation in 4H and *a lot* for interest in *conservation animal*s (turtles, squirrels, fish, lizards), game animals (bass, ducks and geese), and *domestic animal* (dogs). These student responses also were correlated with responses of *no interest* in a *conservation animal* (songbirds), game animals (bass, deer, turkey, beavers, ducks and geese) and *domestic animal*s (house cats).

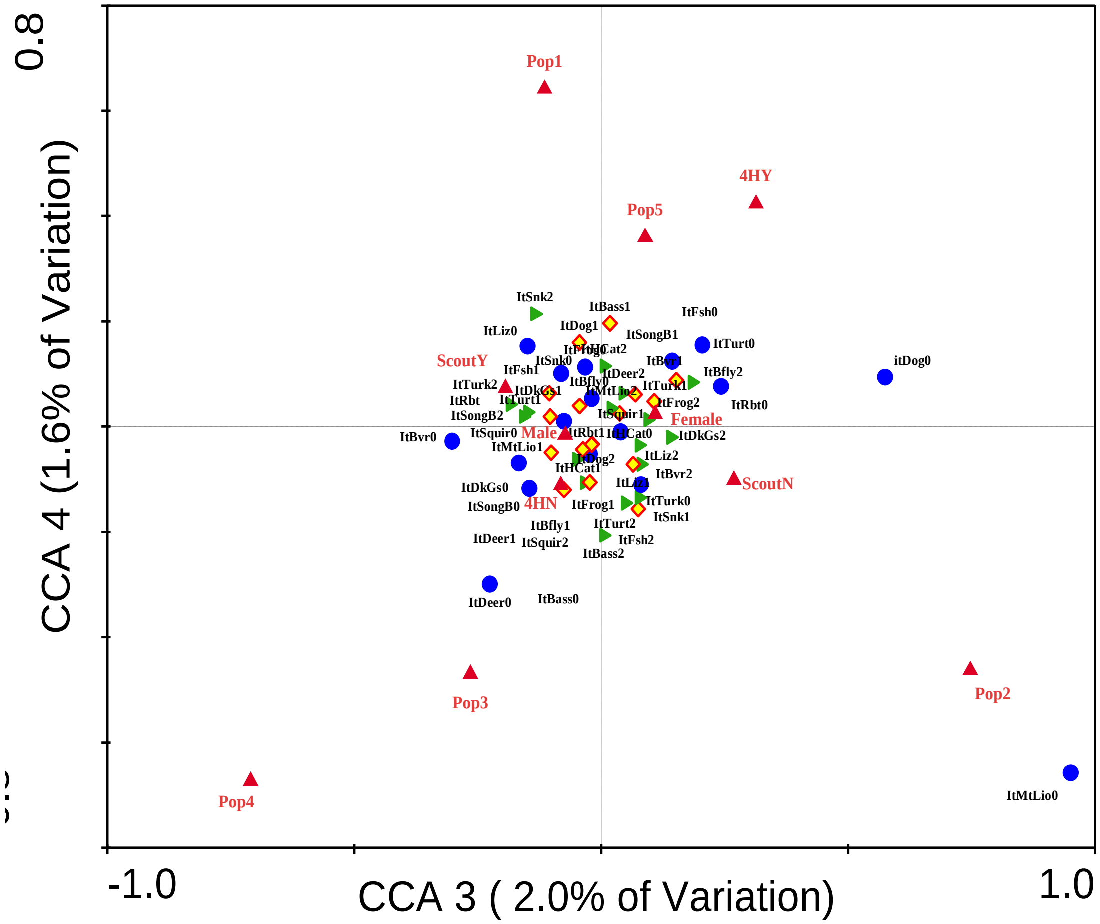


Figure 7. Joint plot on the 3rd and 4th axis showing the relationship between student responses in year 2000 ranking animal interests as *no interest* (blue circles), *a little interest* (yellow diamonds), *a lot interest* (green right triangles) and background explanatory variables (student classification, gender, hometown population size, and youth group participation) shown with red upright triangles.

Together all canonical axes testing the relationship between animal interest of students in year 2008 and background variables (Figure 8) explained 14% of the total variance (F-ratio = 1.291, $P = 0.006$). The first canonical axis represented the strongest trend (axis 1; eigenvalue = 0.111, F-ratio = 6.051, $P = 0.002$), explaining 6.9% of the total variation in student responses about animal interest (Figure 8). The second canonical axis explained an additional 1.5% of the total variation. The third explained an additional 1.1% of the variation and the fourth explained an additional 1.0% of variation.

Axis 1 shows that most male students (Figure 8, left side) were from small hometown population sizes (Pop 1 and 2), and participated in 4H and FFA, but not in Boy scouts. Similar to the students that were not seniors surveyed in 2000, responses by males also indicated *a lot* of interest in the game animals (turkey, deer, fish, ducks, and geese, and bass). These student responses also were correlated with responses of *no interest* in the *conservation animal*s (fox, turtles, butterflies, songbirds, chimpanzees, and rabbits), and *domestic animal*s (house cats, and dogs). On the opposite end of this trend (negatively correlated) were responses by mostly females (right side of Figure 8), who were from hometowns having larger population sizes 4 and 5, and had participated in boy scouts. These students responded as *a lot* for interest in *conservation animal*s (bats, dolphins, chimpanzees, whales and songbirds) along with *domestic animal*s (house cats and dogs), and herptiles (frogs, turtles, and lizards). These student responses also were correlated with *no interest* in *conservation animal*s (mountain lion and fish) or game animals (bass, turkey, deer, ducks and geese).

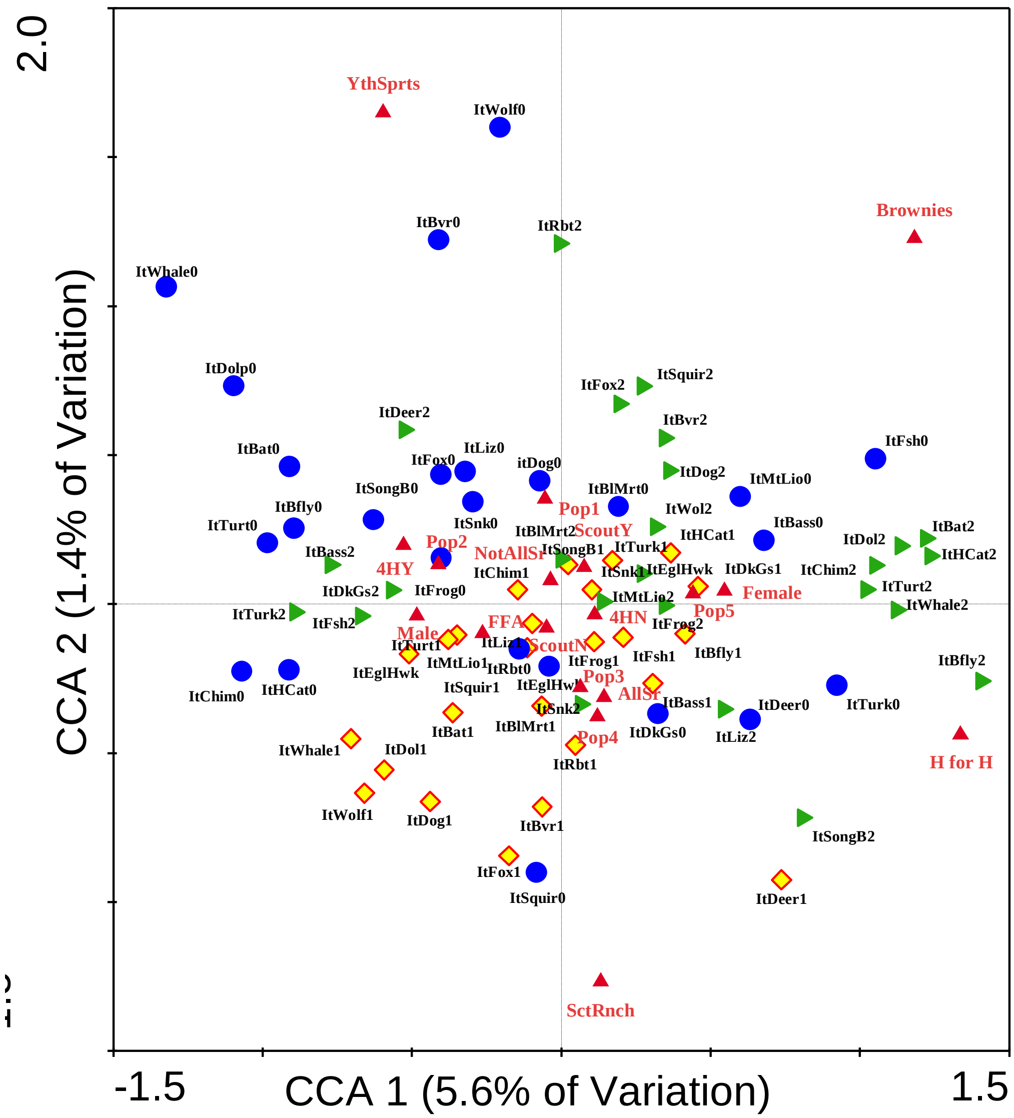


Figure 8. Joint plot on the 1st and 2nd axis showing the relationship between student responses in year 2008 ranking animal interests as *no interest* (blue circles), *a little interest* (yellow diamonds), *a lot interest* (green right triangles) and background explanatory variables (student classification, gender, hometown population size, and youth group participation) shown with red upright triangles.

On axis 2, (top portion of Figure 8) responses show a relationship between responses by students who were classified as non seniors, being from both small and large hometown population sizes (Pop 1, 2, and 5), and who also participated in 4H and boy scouts. These responses were also correlated with greater interest in game animals (deer, bass, turkey and ducks and geese) and *domestic animal*s (house cats and dogs), as well as *conservation animal*s (dolphins, whales, fish, chimpanzees, wolves, and bats). Negative correlations with the previous responses (bottom portion of Figure 8) were by students who were seniors and from medium to medium-large hometown population sizes (Pop 3 and 4). These students had not participated in 4H or boy scouts, but had participated in FFA. Interestingly, all seniors showed *a lot interest* turkey, fish, snakes, lizards, songbirds, butterflies, whales, and mountain lions. This shows that seniors, males and females, are broadening their interest in animals as they finish their education in the department.

On the third axis, most male students (left side in Figure 9) were from a small hometown population size (Pop 1), medium hometown population size (Pop 3), or a very large hometown population size (Pop 5), and did not participate in 4H, but did participate in boy scouts. Responses by males also indicated *a lot* for interest in house cats, fish, and frogs, and game animals (bass, ducks, and geese). On the opposite end of this trend (negatively correlated) were responses by females (Figure 9, right side), who were from medium hometown population sizes 2 and 4, and had participated in 4H. These students responded *a lot* for interest in *conservation animal*s (bats, turtles, squirrels, and lizards) and game animals (deer and turkey).

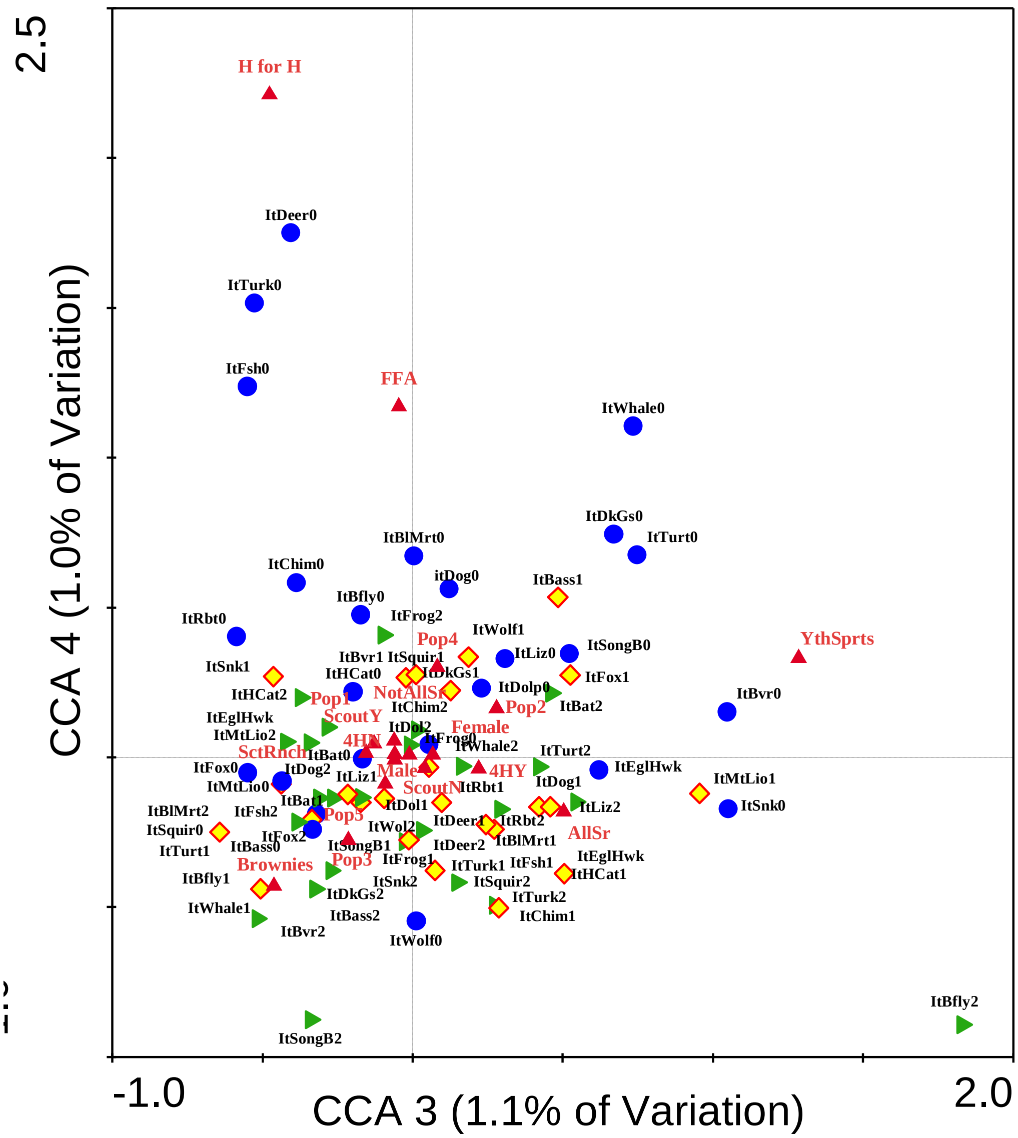


Figure 9. Joint plot on the 3rd and 4th axis showing the relationship between student responses in year 2008 ranking animal interests as *no interest* (blue circles), *a little interest* (yellow diamonds), *a lot interest* (green right triangles) and background explanatory variables (student classification, gender, hometown population size, and youth group participation) shown with red upright triangles.

On the fourth axis, students responded *a lot* for interest in *conservation animal*s (frogs, chimpanzees, and dolphins) (top portion of Figure 9), which were correlated with participation in boy scouts, scout ranch, and being classified as non seniors. These students were also from a range of hometown population sizes (Pop 1, 2, and 4). Student responses on the opposite side of this trend (bottom portion of Figure 9) indicated most were seniors and had no participation in boy scouts. These students also responded *a lot* for interest in *conservation animal*s (whales, turtles, squirrels, lizards, beavers, and fish) and game animals (turkey, bass, deer, ducks and geese). These students were also from medium and large hometown population sizes (Pop 3 and 5).

3.3 Results of contingency table analyses for student knowledge survey questions

3.3.1 Results for 1998

For responses in 1998 to the entire endangered-species question (Figure 10), significantly more students answered incorrectly than correctly ($\chi^2 = 37.8788$, $P < 0.0001$) (Table 4, Test 1). When considering individual taxa (Table 4, Test 2), students tended to respond correctly for birds, herptiles, and mammals, and incorrectly for fish ($\chi^2 = 141.1382$, $P < 0.0001$) (Figure 11).

3.3.2 Results for 2000

For responses in 2000 to the entire endangered-species question males and females answered similarly ($\chi^2 = 0.2965$, $P = 0.5861$) (Table 4, Test 3). Likewise, when considering individual taxa (Table 4, Test 4), the Breslow-Day test ($\chi^2 = 0.2886$, $P = 0.8656$) indicated that a common-odds ratio could be estimated across all four taxa, and this showed no significant difference between responses by females and males. Fish were removed from statistical analyses because no student responded incorrectly for that taxonomic group. The difference between responses by females and males were not significant, but were greatest for herptiles (more correct responses by females) and mammals (more correct responses by males) (Figure 12).

3.3.3 Results for 2008

In 2008, responses were similar between non-seniors and seniors ($\chi^2 = 0.0671$, $P = 0.7956$) (Table 4, Test 5). For both male and female students, responses to the entire question (Table 4, Test 6) were similar between non-senior and seniors ($\chi^2 = 0.1221$, $P = 0.7268$). Across all student classifications, more males than females responded correctly to the entire question ($\chi^2 = 38.0335$, $P < 0.0001$), and the odds of correct responses were 94% less for females than males (Table 4, Test 7). Among non-seniors, more males than females responded correctly to the entire question ($\chi^2 = 25.9022$, $P < 0.0001$), and the odds of getting the entire question correct were 91% less for females than males (Table

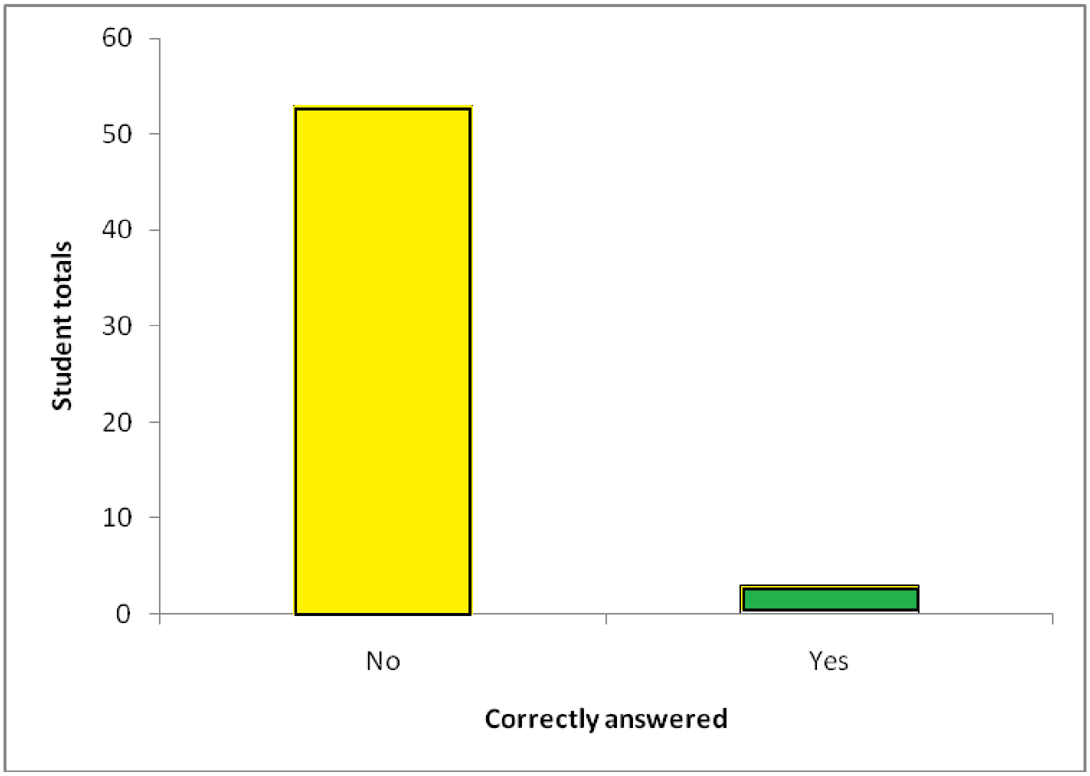


Figure 10. Total number of students in 1998 that responded correctly and incorrectly to all endangered species across all four taxonomic groups.

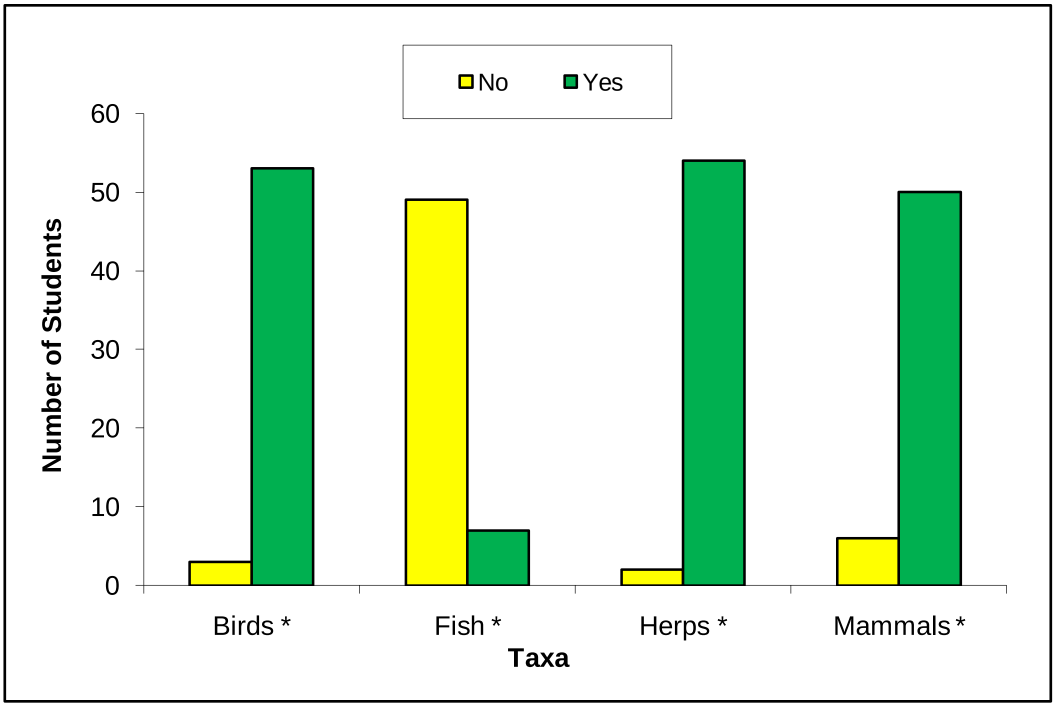


Figure 11. Student responses to the endangered species survey question divided into four main taxa in 1998. Bars represent number of correct versus incorrect responses by students asked to identify endangered status of species within the various taxa (i.e., birds, fish, herptiles, and mammals). ** indicates significant difference.*

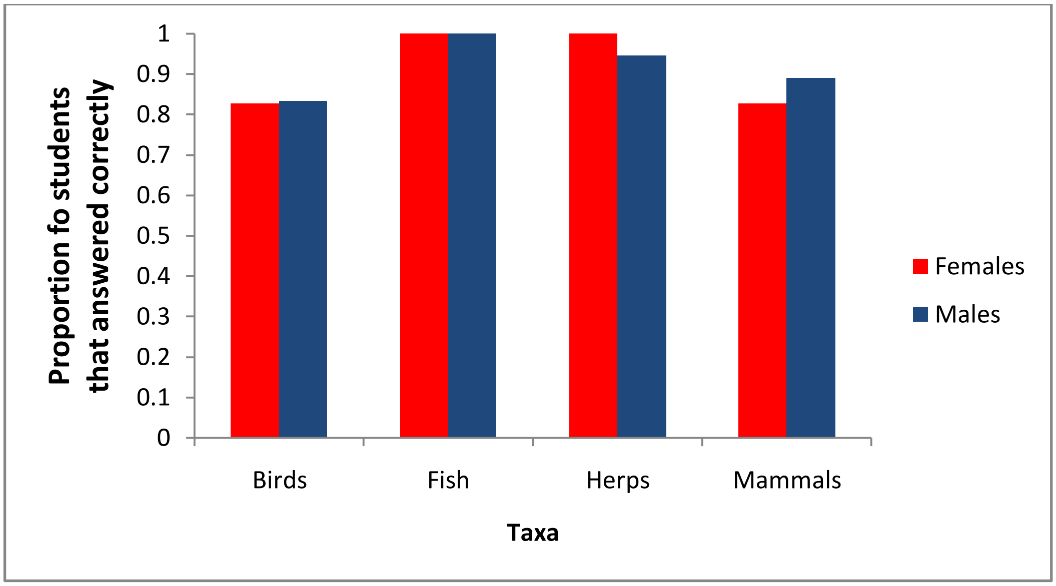


Figure 12. Proportion of females and males in 2000 that responded correctly to The question regarding endangered species status of animals among four taxa.

4, Test 8). For seniors, significantly more males than females answered the entire question correctly ($\chi^2 = 7.0585$, $P = 0.0079$), and the odds of getting the entire question correct were 82% less for females than males (Table 4, Test 9). Also in 2008, a common-odds ratio could be estimated across all four taxa as indicated by the Breslow-Day test ($\chi^2 = 0.5254$, $P = 0.7690$), and there was no significant difference between non-seniors and seniors as to their responses among the four taxa, as indicated by the Cochran-Mantel-Haenszel test ($\chi^2 = 0.2887$, $P = 0.5910$) (Table 4, Test 10). Next, for responses among all taxa except fish (removed due to incorrect answers by all students), considering all females and all males in 2008 (Table 4, Test 11), the Breslow-Day test indicated a common-odds ratio could not be estimated across all four taxa ($\chi^2 = 18.3149$, $P < 0.0001$) because females and males responded differently to some taxa (Figure 13). There was no difference between responses by females and males for birds ($\chi^2 = 0.4858$, $P = 0.4864$) or herptiles ($\chi^2 = 1.2382$, $P = 0.2658$); however, there was a significant difference for mammals ($\chi^2 = 24.8116$, $P < 0.0001$), and the odds of correct responses to the mammal taxa were 97% less for females than males. A common-odds ratio could not be estimated across all four taxa for non-seniors (Table 4, Test 12) as indicated by the Breslow-Day test ($\chi^2 = 21.6668$, $P < 0.0001$). There was no significant difference between non-seniors females and males as to their responses for the taxa birds ($\chi^2 = 0.3353$, $P = 0.5626$) or herptiles ($\chi^2 = 0.7869$, $P = 0.3750$). There was a difference for mammals ($\chi^2 = 30.7831$, $P < 0.0001$), and the odds of getting mammal taxa correct were 46% less for non-senior females than males (Figure 14). However, for seniors, differences between female and male responses for each taxa (except fish) (Table 4, Test

16) on the Breslow-Day Test indicated a common-odds ratio could be estimated across all four taxa ($\chi^2 = 0.5967$, $P = 0.7420$) indicating that females and males responded similarly to question 13 on survey pertaining to endangered species taxa..

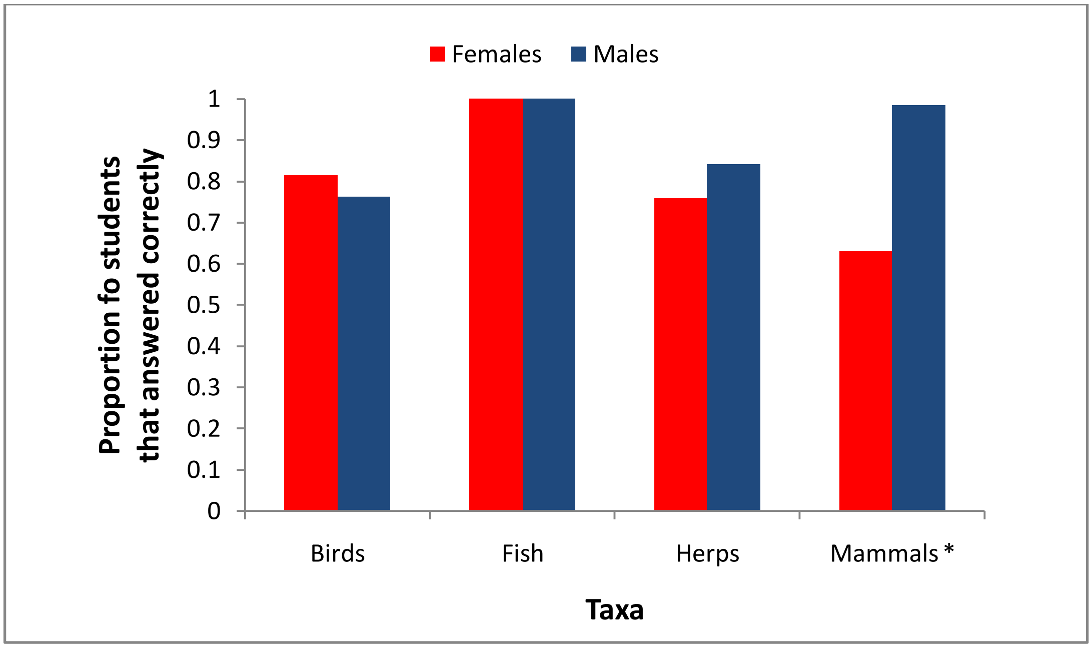


Figure 13. Proportion of both non-senior and senior students added together (females and males) in 2008 that responded correctly to all endangered species divided among four taxa. * indicates significant difference.

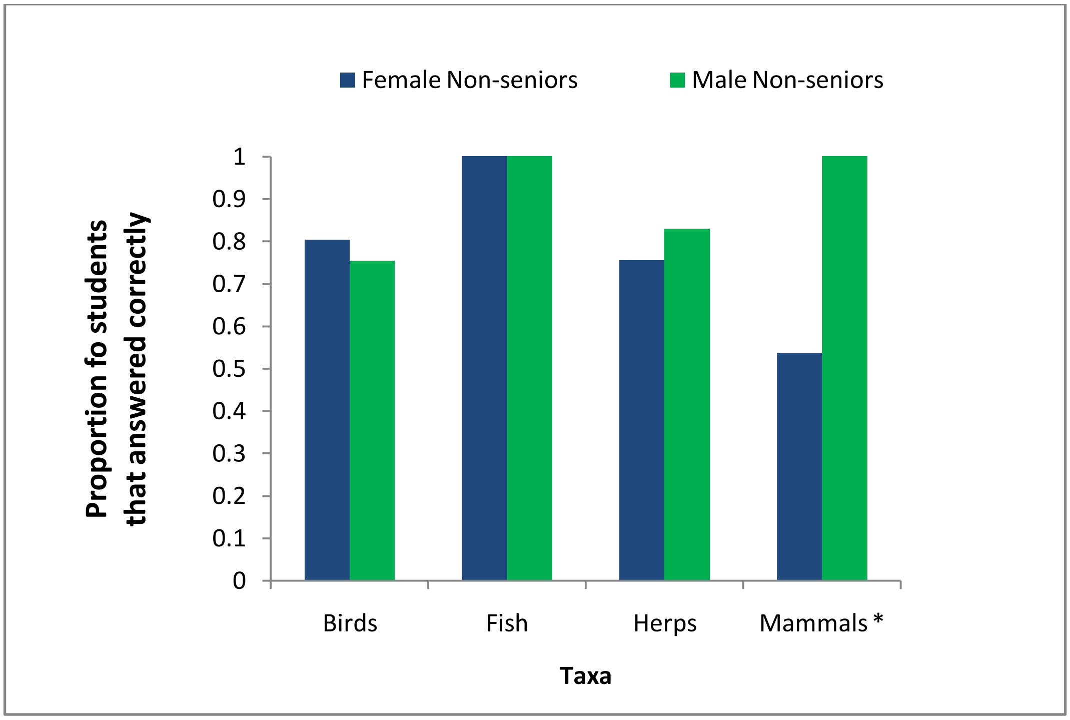


Figure 14. Proportion of non-senior students (female and male) that responded correctly to the endangered species survey question divided into four main taxa in 2008. * indicates significant difference.

4. DISCUSSION AND CONCLUSIONS

4.1 Conservation issues

My results indicated that students involved in youth groups had more interest in conservation issues related to land or use of wildlife by humans than students who were not involved in youth groups. Students concerned about conservation issues were from small to medium hometown population sizes and were mostly males (Figure 15 and 16). This is contrary to previous studies arguing that environmental concerns are higher in cities and perception of these problems increase with population size (Berenguer et al., 2005). Urban residents are more concerned with these issues because they are more directly exposed to environmental degradation than rural residents (Hampel et al., 2008; Hunter and Brehm, 2004).

Gender was the main indicator reflecting differences in importance among various conservation issues in the models; however, I believe large versus small hometown population sizes influenced aspects of conservation among WFSC students. Gender tended to be correlated with certain population sizes, so it was difficult to distinguish between the effect of hometown population size and gender on their influence on student opinions of conservation issues. The WFSC female students were from larger hometown population sizes and, unlike males from small towns, they had different conservation issues of concern. Females were more concerned with conservation issues related to habitat degradation and the continuing viability of all species, rather than those targeted for human use (Figure 15 and 16). Kellert and Berry

(1987) suggested similar findings; males were more concerned about conserving wildlife species and habitats, while females cared more about the individual welfare of animals. Researchers of national surveys feel that gender is among the most important demographic factors determining attitudes about animals and conservation issues (Kellert and Berry, 1987), and my study also reveals gender as a significant explanatory variable for conservation issues and animal interest, although hometown size was somewhat confounded with gender. Female students in WFSC 201 considered endangered species an *extremely important issue*. Multiple studies, including mine, show more females than males around the nation are concerned about preservation of animals (Czech et al, 2001; Kellert and Berry, 1987). In this study, however, males show more knowledge about endangered species than females.

When focusing on changes that are seen from students classified as all seniors, I conclude that there was a dramatic change in conservation beliefs throughout education in the department. All seniors responded *extremely important issue* to all issues listed. This means that absent of gender, seniors tailored their beliefs and considered all conservation issues *extremely important issue.*

From this research, we can conclude that survey questions similar to these can be used to assess students' beliefs about conservation and monitor how their beliefs change throughout their higher education career. Initial surveys should relate background variables to beliefs and thereafter, the only variables that will be changing is the influence from education they receive from different classes they take throughout the

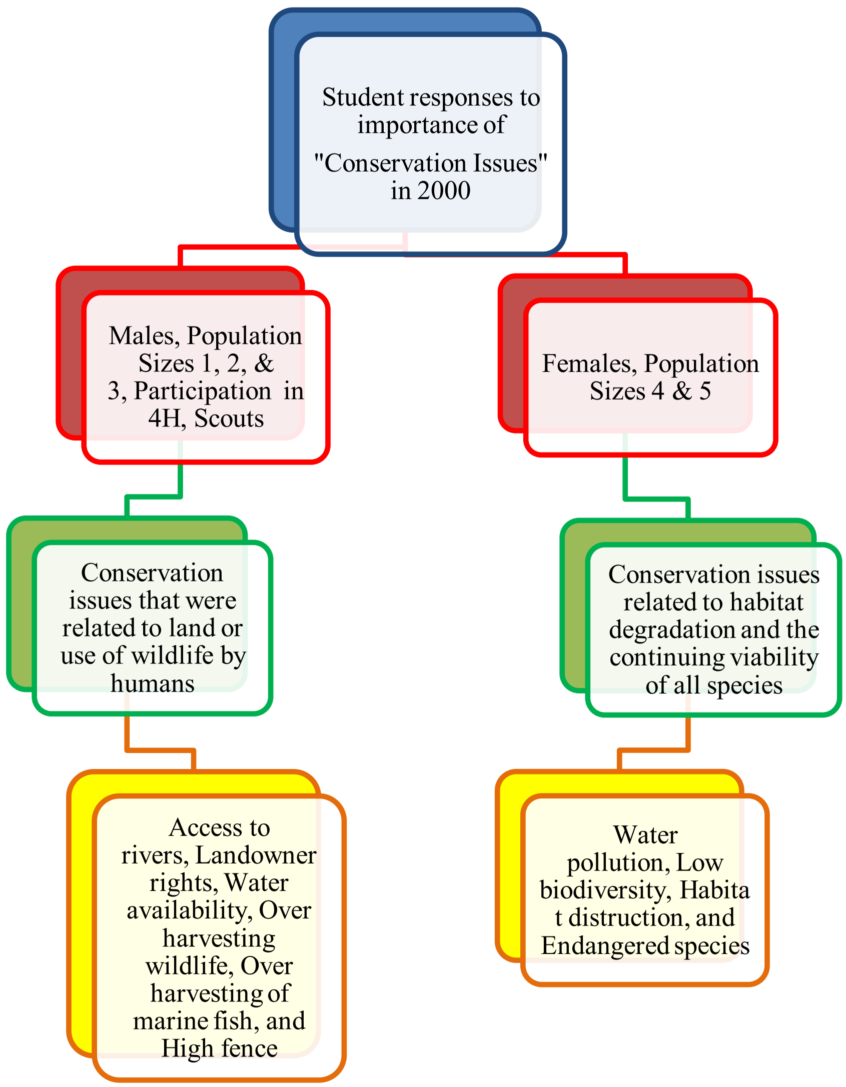


Figure 15. Student responses in 2000 to importance of conservation issues in question 12 on the survey. Table displays the dependent variables (responses to importance of conservation issues as “2- important issue” and “3-extremely important issue”) that correlated with the specific explanatory variables (gender, hometown population size and youth group participation).

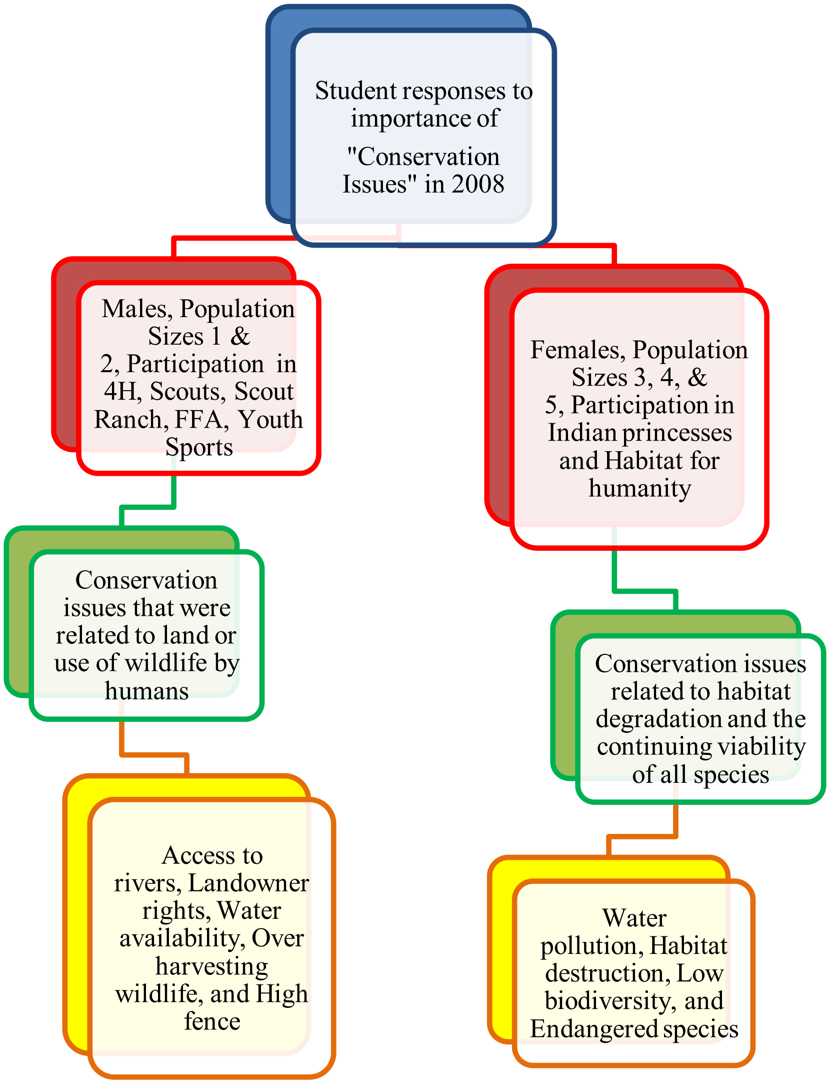


Figure 16. Student responses in 2008 to importance of conservation issues in question 12 on the survey. Table displays the dependent variables (responses to importance of conservation issues as “2- important issue” and “3-extremely important issue”) that correlated with the specific explanatory variables (gender, hometown population size and youth group participation).

department. Future assessments might look at changes in students' conservation beliefs effected by the different paths of study they choose while in the department.

4.2 Animal interests

Responses from undergraduate male students in 2000 demonstrated high interest in game animals. These students reported small hometown population sizes and were involved in 4H and boy scouts (Figure 17). Cauley and Groves (1975) found that these youth groups are directly related to conservation knowledge and interest among young adults. Also, males could be more interested in *game species* because these species can be harvested to yield food or trophies, whereas the *domestic animal*s and herptiles categories were animals of no interest and are not generally harvested for food. This again emphasizes utilitarian attitudes of males (Czech et al., 2001; Hampel et al., 2008; Kellert and Berry, 1987). Kellert and Berry (1987) showed that on a like-dislike scale of animal preferences, males awarded a more positive (like) rating to predatory animals, invertebrates, or game animals.

Among WFSC students, and negatively correlated with responses by males, females responded as *extremely interested* in *domestic animal*s, esthetically attractive animals or *conservation animal*s, and *herptiles* and *no interest* in *game animals* (Figure 17). This association has been reported in previous research, in which females have a stronger attachment or preference to the aforementioned animal categories especially *domestic animal*s (Kellert and Berry, 1987). Females were also from larger hometown population sizes, and as shown for conservation issues, gender and hometown population size could be confounded. Students from larger and urban populations may have a different attitude towards animals than those from smaller and rural areas that might associate some animals with their use to humans (Kellert and Berry, 1987; Hampel et al, 2008). Czech et al. (2001) states that "most hunters are and have been men" and "women reflect a more ecologistic perspective than men," which could also be interpreted from my study results since animal interests differed between *game species* for males and conservation type charismatic animals for females.

My results indicate that in 2008 male students were similar to those in 2000 because their responses were highly correlated with *extremely interested* for *game animals* even though more *conservation animal*s were listed in 2008. As in 2000, these students in 2008 were also from small hometown population sizes and involved in 4H, FFA and boy scouts (Figure 18). Males are 89% more likely than are women to be involved in an animal-related organization and 62% more likely to be involved in an environmental protection organization (Kellert and Berry, 1987). My results indicate negative correlation of responses by male and female students in both 2000 and 2008; female students were *extremely interested* in *domestic animal*s, aesthetically attractive animals or *conservation animal*s, and *herptiles* and had *no interest* in game animals were also from larger hometown population sizes, and involved previously in boy scouts and habitat for humanity (Figure 17 and 18). Kellert and Berry (1987), reported females are 80% more likely to be in a humane organization than are males, which are similar to my findings of females participating in habitat for humanity.

Results from surveys of WFSC undergraduate students in both 2000 and 2008 agree with previous research that animal interest is related to *game species* for males and conservation type aesthetically attractive animals for females (Czech et al., 2001; Kellert and Berry, 1987). The difference between the 2000 and 2008 survey was that in 2008, there were two student classifications when seniors were added. My results showed that the senior students were more interested in *conservation animal*s whereas non-seniors were more interested in game or *domestic animal*s. Females and males with higher education project more knowledge and appreciation and a greater protectionist sentiment towards animals (Czech et al., 2001). Similarly, students in the WFSC completed the curriculum with a more conservation-oriented viewpoint or at least a broader range of animal interests. Using questions similar to this for an assessment plan could allow the department to evaluate interest in animals in a way similar to conservation issues. The animal interest can be initially evaluated using background variables, but as the students progress through the curriculum, the department can evaluate the changes of interest and relate it to their education and path of study.

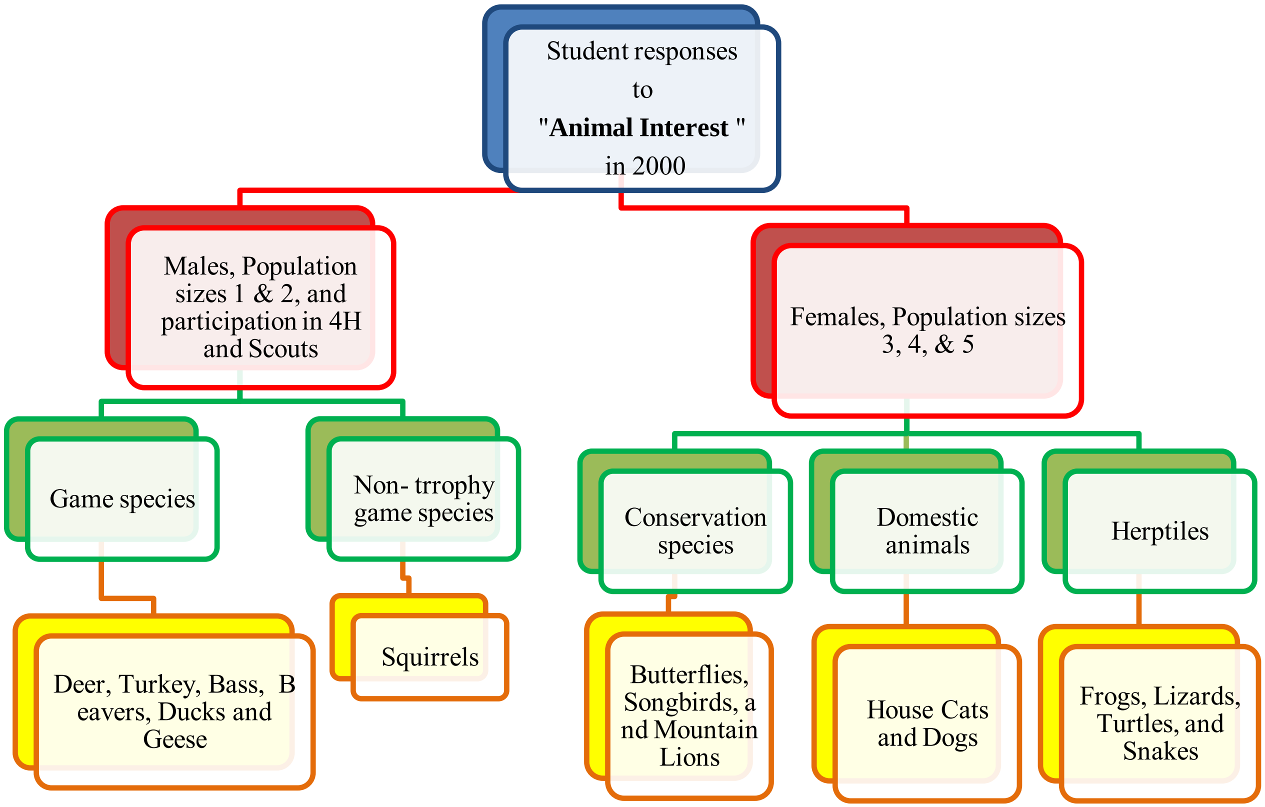


Figure 17. Student responses in 2000 to animal interest in question 19 on the survey. Figure displays the dependent variables (responses to animals of "*a little interest*" and "*a lot interest*") that correlated with the specific explanatory variables (gender, hometown population size and youth group participation).

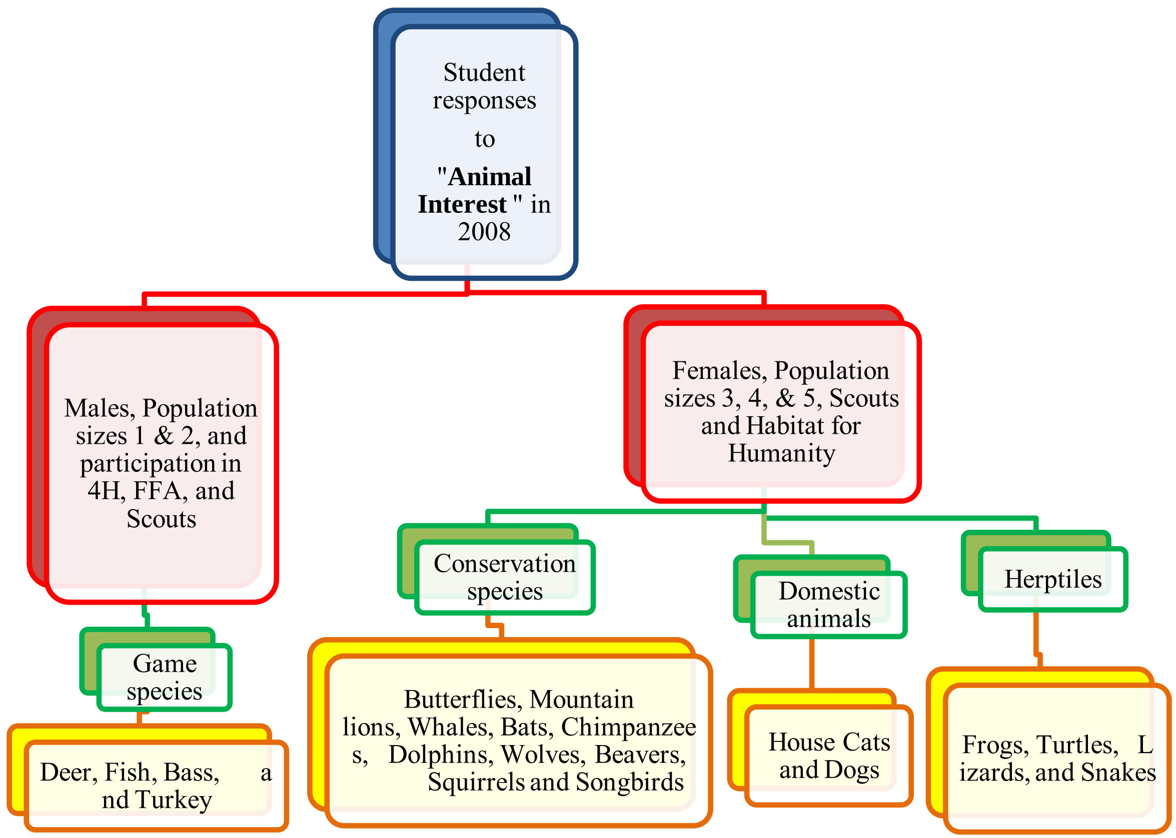


Figure 18. Student responses in 2008 to animal interest in question 19 on the survey. Figure displays the dependent variables (responses to animals of "*a little interest*" and "*a lot interest*") that correlated with the specific explanatory variables (gender, hometown population size and youth group participation).

4.3 WFSC students' knowledge

My results indicate varied levels of knowledge about endangered species listed in the survey question. In 1998, there was a significant difference in number of students who answered the entire endangered species question correctly versus incorrectly, although this was likely confounded with the fact that most non-seniors responded incorrectly and only the 2008 survey included both student classifications. This large number of incorrect responses also may be because of the constraint that the endangered status of all taxa in the question had to be answered correctly for the whole question to be considered correct. To learn if there was a specific taxon that was consistently mislabeled by the students, which in turn would cause them to miss the complete question, I evaluated the responses for individual taxon. Overall, most students incorrectly identified the status for the fish taxon, resulting in a large number of total incorrect responses. This discrepancy begs the question as to whether or not there is a knowledge gap due to teaching, learning, or interest, or if the species listed for particular taxon were confusing or difficult to qualify. Women and men value the preservation of mammals and birds, which suggests that efforts to protect other taxonomic groups like fish has less public support, resulting in less knowledge (Czech, 2001) (Figure 11) . The 1998 survey did not include gender so I could not compare them for analysis, but previous studies relating gender and fishing activities show small differences, which lead researchers to believe that in comparison to hunting and trapping, females sense a different capacity of fish to experience pain than mammals and birds (Kellert and Berry, 1987). This perceived reduced of emotional connection to fish among females may allow them to be more involved with activities concerning fish because they are not biased by their emotions. The disconnection between emotion and partaking, allow females to participate in activities such as fishing, which in some cases harms fish but allows females to gain knowledge. If males are in fact gaining knowledge about fish through these activities, then females could be gaining it the same way. This idea leads to why both genders may have answered similarly to questions pertaining to the classification of fish as endangered or not (Figures 12, 13, and 14).

In 2000 and 2008, the survey incorporated gender and there were no significant differences between males and females in their response to the entire question; however, males in 2008, both non-seniors and seniors, were 94% more likely than female non-seniors and seniors to respond correctly to the entire question. When focusing on only non-seniors in 2008, 91% more males than females answered correctly. Among seniors, males were 84% more likely than females to answer correctly. These results indicate that student classification is not as defining as gender in determining whether which students respond correctly to some questions. Interestingly, in these surveys males answer correctly more frequently than females by over 80% regardless of student classification. If males are providing a greater number of correct responses to endangered species questions, it begs the question as to why females are not. The results of my research are similar to those of Kellert and Berry (1987), Czech et al. (2001), and Tikka et al. (2000). Czech et al. (2001) states that males have more knowledge about wildlife through hunting experiences, and utilitarian and dominionistic pursuits that incidentally builds knowledge, whereas most women lack this experience.

Throughout the survey of WFSC undergraduate students, student classification and gender were both considered, again when evaluating the question in regard to evaluating each taxon separately in 2000 and 2008. Students in the 2000 survey did not show a significant difference in responses to any of the four individual taxonomic groups (birds, fish, herptiles, or mammals); however the largest difference was between females and males for the taxon herptiles. Females answered correctly more often to herptiles, which is highly correlated with females interest in herptiles summarized in Figure 16 and 17 In 2008, male differed by being 97% more knowledgeable about mammals than females (Figure 12). Again for only non-seniors, males were 46% more likely to respond correctly to questions about mammals than females, but were similar in the responses about other taxa (Figure 13). The disparate frequency of incorrect responses by females for mammals was unexpected based on previous studies showing that female's knowledge, attitude, stronger emotional attachment is stronger for domestic and aesthetically appealing animals (Kellert and Berry, 1987). There was not a significant difference between male and female seniors in their response to mammals, which suggest that by the time females completed their curriculum in the WFSC, their knowledge of endangered species improved. Or more specifically, knowing that white-tailed deer and wolves are not endangered became apparent when responding to the survey. Higher education has previously been correlated with improved knowledge of endangered animals in a national survey (Kellert and Berry, 1987) indicating senior

WFSC females were similar to females in other departments across universities. Another reason their knowledge may have improved is that these species, especially the wolf are seen as “charismatic megafauna,” and are highly displayed in television, magazines, on the web, and even on food boxes; so education is being directed towards these species as a mechanism to conserve the environment (Barney et al., 2005). Throughout the 2008 survey, males in the department were consistently knowledgeable about all taxa as non-seniors and seniors. This was similar to three other educational institutions surveyed studies showing greater knowledge by males when considering wildlife sciences (Dahlgren et al., 1977; Kellert and Berry, 1987; Tikka et al., 2000).

If viewed as an outcome of assessment, my results could assist WFSC faculty and students with modifying teaching and studying methods in response to trends in knowledge differences among WFSC undergraduate students. Since females seem to be less knowledgeable of endangered species in my study and others, I think looking at a variety of places knowledge can be gained besides the educational institute should be investigated. Knowledge could be gained through, television, zoos, amusement parks, clubs, and various societies (Barney et al., 2005), and this could be the reason males are retaining it more females. This can help guide the WFSC Department toward achieving its goals for the undergraduate program by monitoring responses to surveys, content knowledge gained in formal courses, and other measures of student learning outcomes (Poulos and Mahony, 2008).

4.4 Relationship between endangered species knowledge and perceived importance to the student

My results indicate males were far more knowledgeable about the endangered species status of several animal taxa; however, when comparing these responses to survey question 12 “How important is the following issue to you… *not an issue*, *important issue*, and *extremely important issue*,” the majority of females ranked endangered species as *extremely important*, whereas males ranked it as *important* (Figure 19). Similarly, others have found an important contrast between genders with respect to protectionist sentiments toward animals (Czech et al., 2001; Kellert and Berry, 1987). Czech et al. (2001) found that females and males valued the preservation of mammals and birds more than of preservation of other taxa. The disconnection for females between thinking an issue is important and having knowledge about the issue is a problem that needs further research. I suggest that the WFSC department obtain and utilize more knowledge-based questions as a tool to evaluate students as a of their assessment plan. The department can develop such knowledge based questions by gathering course goals from professors, and then logically organizing outcomes out of what students should be able to do or know as a result of meeting these goals (Feldman, 1998). Depending on when the survey questions will be asked to students, the questions can be broken into groups that are relevant to student progress through the curriculum, then sophomores are not asked questions that are from a four hundred-level course.

4.5 Suggestions to improve the survey

Results from my study provide some outcomes the WFSC would perceive as useful data for an assessment plan. This survey evaluation could be composed as a summative type of evaluation and is appropriately targeted as an initiation for assessing a program. Summative evaluation looks at more than one learners' performances to see how well a group learns task that utilize specific materials and methods or any assessment that looks at what a student learned or did not learn (Linn and Gronloud, 2000). The survey could be improved to make it a more useful tool for assessing by adapting specific objectives set by the department. If the objective needs to be improved and evaluated in a specific course, then I suggest a formative evaluation, but this is more specific and only necessary if a professor wants to assess students individually in his/her course (Scriven, 1991). If the department just wants to assess an entire range of outcomes over a period of time (degree option) and assess student mastery of those specific skills (Bloom et al., 1971) then summative evaluation is suffice. Both forms of collecting assessment data are important means to improving learning outcomes (Fuchs and Fuchs, 1986; Fuchs, Fuchs, Hamlett and Allinder, 1991a; Fuchs, Fuchs, Hamlett and Stecker, 1991b; Salvia et al., 2007).

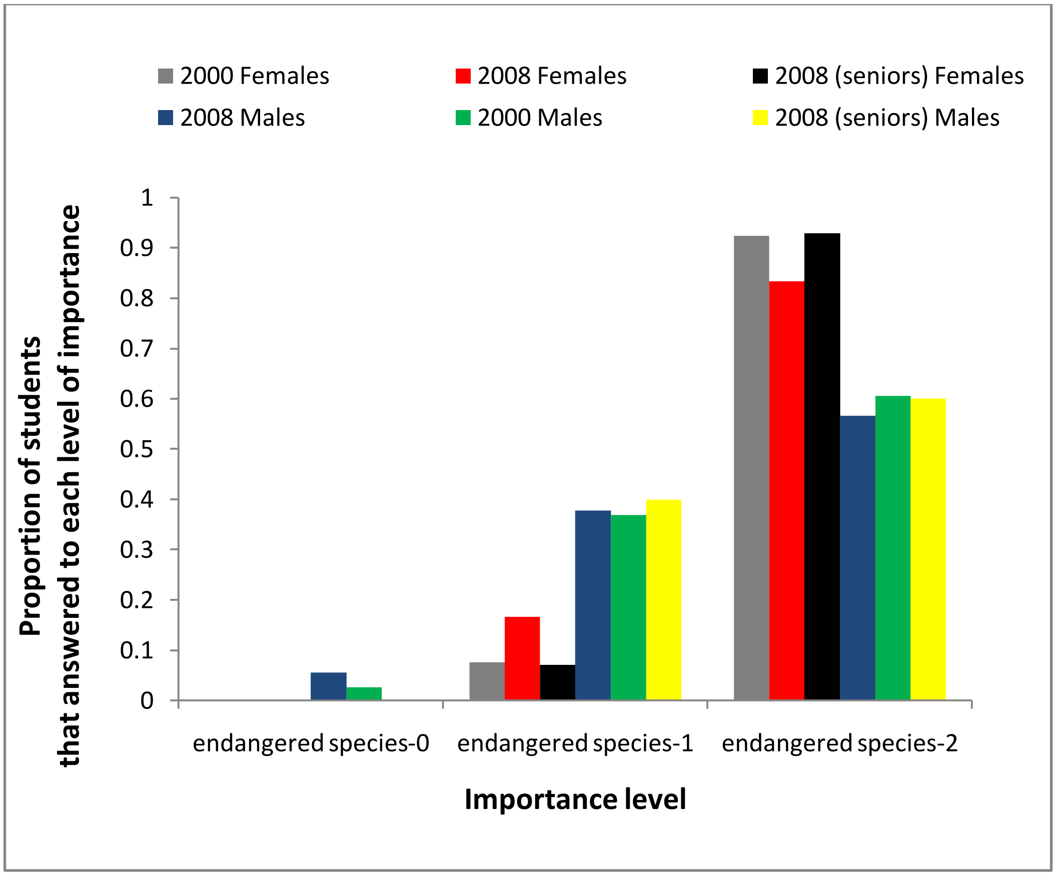


Figure 19. Proportion of students based on student classification and gender regarding the importance of endangered species as *not an issue, important issue,* and *extremely important.*

If this survey is to be used as a means to assess student knowledge of content areas within to WFSC curriculum, I believe it should include more knowledge-based questions, which would help determine students' ability to reach competencies in the department. Knowledge of one's field is a secondary competency (Appendix E) compiled by Neill (2001) and revised by him and Slack (2004). Most survey-based research projects are done to investigate how much people know about certain issues (Nardi, 2005). I recommend using the endangered species survey question to evaluate WFSC students' knowledge of wildlife and fisheries, but it could be better structured for evaluation purposes.

I would construct the survey to evaluate the students' specific knowledge, but each question should provide the same number and type of answer choices, with the same degree of specificity (e.g., catfish was listed as a choice of an animal that the students were suppose to define as endangered or not, I think the survey could make it more challenging by specifying a single species, such as channel catfish). This suggestion applies to all questions across the survey because analysis of results will be easier and less subjective. The survey is mostly composed of closed-ended questions that display response options on an intensity scale. This was a good way to gauge WFSC students' conservation beliefs and the animals of interest to them because they did not have to answer in a dichotomous way like, "yes or no," or "true or false," but had a range of responses from which to choose (Nardi, 2005). It would be better if the survey questions presented a broader array of responses than just three, to discriminate against neutral answers (Nardi, 2005).

Another format change I would suggest to lessen students' fear of being identified is to structure the survey so that all demographic questions or background questions are at the end of the survey (Giles and Field, 1978; Nardi, 2005). Wilson and Rosen (1975) suggest deleting all demographic questions to make respondents feel anonymous. This fear of identification might not be a problem in the department, but could be tested on some surveys and compared for verification.

4.6 Suggestions for a new survey

I would develop and administer surveys to students at three different time periods: upon entry into the department, at a midway point through the curriculum, and near the end of their tenure. Survey questions should be developed by WFSC professors who are teaching classes at the time of these three points of evaluation. This will give the department a better idea of student learning because the students will be evaluated on what they are actually presented with the breadth of the material around each period of review (Knipp, 2001; Nuhfer, 1993). My study cannot measure improvement because I was unable to identify whether any of the non-senior respondents were also surveyed during their senior year. Therefore, I could only measure knowledge by evaluating whether seniors as a whole answered the questions correctly more often than non-seniors, and in my study student classification was not as significant as evaluating gender. Overall, I believe that monitoring progress of students in the department with three surveys that are periodically given throughout their tenure at the university is one way to begin assessing the department's students.

If evaluation is going to be given periodically, class order is very important. Assuming that students do not always take courses in the same chronological order, advising could be used to enforce this aspect of the assessment to make evaluation format easier. If classes continue to be taken by students at different points of their curriculum, then student learning will continue to be hard to measure. This would eliminate any conglomerated evaluation at various times because there will not be any set objectives that a student could be assessed against.

To effectively evaluate student learning and knowledge over a period of time, the survey format should remain constant over time. I had to exclude many questions from the survey analyses because of inconsistency in questions and answer choices. With the results showing that males' knowledge of endangered species and previous research showing males overall wildlife knowledge is greater than females, I think some specific contributions need to be made to increase female knowledge and awareness of wildlife and fisheries to prepare for the future (Dahlgren et al., 1977; Kellert and Berry, 1987). The prediction of future increase in the number of women in the wildlife and forestry profession is suggested by the present enrollment of 25% females in the field nationwide (Kellert and Berry, 1987).

Lastly, I believe the survey should be administered to other departments at Texas A&M University, to broaden the results about the differences and similarities that students possess regarding conservation issues, animal interest, and knowledge about endangered species in different departments. I believe that the survey should be given to other wildlife and fisheries departments in different universities across Texas and in other states to evaluate the differences and similarities in their wildlife students based on demographics and academic institutions. Even, if my overall results on conservation beliefs, animal interest, and endangered species knowledge closely parallel two other studies done evaluating people around the nation, it would be informative to evaluate more studies on this subject (Czech et al., 2001; Kellert and Berry, 1987). In conclusion, willingness of the faculty and staff to unite for the good of the department and students will result in a sophisticated education system primed for the advancement of the university curriculum as a whole.

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APPENDIX A

1998 SURVEY FOR INITIAL ASSESSMENT

INFORMATION SURVEY

DEPARTMENT OF WILDLIFE AND FISHERIES SCIENCES

Circle your responses or fill in appropriate blanks.

1. I am a student in which of the following departments:

   a. WFSC   b. RLEM
   c. RPTS   d. FRSC
   Other ____________________

2. For students in WFSC, I am most interested in which of the following curriculum options:

   a. Aquaculture
   b. Fisheries Ecology and Management
   c. Conservation Biology
   d. Natural Resource Collections and Museum Science
   e. Teaching
   f. Urban Wildlife and Fisheries Management
   g. Vertebrate Zoology
   h. Wildlife Ecology and Management
   i. Natural Resources Conservation Option

3. I entered my current department as a:

   a. Freshman
   b. Transfer from another department at TAMU
   c. Transfer from another College or University

4. The population of my hometown is:

   a. less than 5,000
   b. 5,001 – 25,000
   c. 25,001 – 100,000
   d. 100,001 – 500,000
   e. >500,000

5. Did you grow up living on a ranch or farm? _______yes ________no

6. While you were in high school how often did you watch a nature program, such as those on the Discovery Channel or those sponsored by National Geographic, on TV?

   a. more than 2 times per week
   b. once a week
   c. once a month
   d. seldom

7. While growing up, which of the following activities did you often participate in (often enough to develop competence in the activities)? [choose as many as appropriate]

   a. camping
   b. fishing
   c. bird watching
   d. golf
   e. hiking
   g. swimming
   h. hunting
   i. photography
   j. boating
   k. insect collection

8. Did you participate in a 4-H program while grwoing up? ________yes _______no

9. How important are the following issues to you? [choose 0 = not an issue, 1 = important issue, 2 = extremely important issue] Rate each issue.

Issue	Rating		
a. endangered species	0	1	2
b. landowner rights	0	1	2
c. water availability	0	1	2
d. overharvest of marine fishes	0	1	2
e. habitat destruction	0	1	2
f. water pollution	0	1	2
g. high fences	0	1	2
h. over hunting of wildlife	0	1	2
i. access to rivers	0	1	2
j. loss of biodiversity	0	1	2

10. Which of the following species do you believe is endangered?

a. mountain lion
b. white-tailed deer
c. American alligator
d. channel catfish
e. whooping crane

11. Do you plan to attend graduate school, or other professional school, after finishing your B.S. degree? ________yes ______no

12. At this time which of the following careers are you most interested in?

a. fisheries biology
b. conservation officer (game warden)
c. wildlife biology
d. park interpretation
e. ranch management (wildlife)
f. museum education
g. private consulting
h. aquaculture
i. conservationist with a non-governmental organization
j. water quality technician
k. urban wildlife or fisheries biologist
l. nature center education
m. undecided

13. My favorite class in high school was:

a. chemsitry
b. physics
c. biology
d. agricultural science
e. math
f. literature
g. history
h. physical education
i. other ______________________________

14. Who, or what, influenced you the most in choosing Wildlife and Fisheries Sciences as an academic department? [non-WFSC choose N/A]

a. high school guidance counselor
b. parent (s)
c. friend
d. TV program (s)
e. agricultural extension agent
f. Recruiting by TAMU
g. WFSC professor
h. wildlife or fisheries biologist
i. conservation officer (game warden)
j. Texas Parks & Wildlife Dept. programs
k. past interest in outdoor activities
l. recruiting by College of Agriculture & Life Sciences
m. other ________________________________

15. How interested are you in the following animals? [For each animal circle the appropriate interest level: A lot, A little, No interest]

Animal	Interest level		
a. fish	A lot	A little	No interest
b. song birds	A lot	A little	No interest
c. beaver	A lot	A little	No interest
d. snakes	A lot	A little	No interest
e. deer	A lot	A little	No interest
f. ducks and geese	A lot	A little	No interest
g. dogs	A lot	A little	No interest
h. lizards	A lot	A little	No interest
i. squirrels	A lot	A little	No interest
j. butterflies	A lot	A little	No interest
k. mountain lions	A lot	A little	No interest
l. turtles	A lot	A little	No interest
m. bass	A lot	A little	No interest
n. rabbits	A lot	A little	No interest
o. house cats	A lot	A little	No interest
p. frogs	A lot	A little	No interest
q. turkeys	A lot	A little	No interest

16. Do you agree or disagree with the following statements?

A D

___ ___ a. Hunting is a necessary means of managing wildlife populations.

___ ___ b. Hunting is cruel and should be illegal.

___ ___ c. Wildlife on private land should belong to the landowner.

___ ___ d. The state and/or federal government should regulate hunting, even on private land.

___ ___ e. Water in ponds and lakes on private land should belong to the landowner.

___ ___ f. Water in aquifers below private land should belong to the landowner, and he/she should be allowed to pump all the water he/she wants.

___ ___ g. If a stream flows through a person's land, he/she should be allowed to use all that he/she wants.

___ ___ h. Owners of private land should be allowed to erect 10' fences to fence wildlife in or out.

___ ___ i. Endangered and/or threatened species should be protected by the federal government.

___ ___ j. Landowners should be reimbursed for any costs or economic losses due to complying with the law protecting endangered species.

___ ___ k. Animals have rights, just like people.

___ ___ l. People have the right to manage wildlife populations.

___ ___ k. Wildlife belong to all of the people, even if found on private land.

___ ___ l. It is OK to breed and raise wildlife (deer, ducks, quail) to release for hunting.

___ ___ m. The fish and shrimp in the ocean belong to everyone, and the government has the right to regulate recreational and commercial harvest.

___ ___ n. It is a good idea to have some "wilderness or sanctuary areas" for wildlife, protected by the government where no hunting or camping is allowed.

APPENDIX B

2000 SURVEY FOR INITIAL ASSESSMENT

INFORMATION SURVEY
DEPARTMENT OF WILDLIFE AND FISHERIES SCIENCES

Circle your responses or fill in appropriate blanks.

1. ____ Female ____ Male

2. I am a student in which of the following departments:

   a. WFSC c. RLEM
   b. RPTS d. FRSC
   Other _______________

3. I am most interested in which of the following curriculum options (choose 1):

   a. Aquaculture
   b. Fisheries Ecology and Management
   c. Conservation Biology
   d. Natural Resource Collections and Museum Science
   e. Teaching
   f. Urban Wildlife and Fisheries Management
   g. Vertebrate Zoology
   h. Wildlife Ecology and Management
   i. Natural Resources Conservation Option
   j. Not applicable (not a student in WFSC)
   k. Undecided

4. I entered my department (all majors) as a:

   a. Freshman
   b. Transfer from another department at TAMU
   c. Transfer from another College or University

5. The population of my hometown is:

   a. less than 5,000
   b. 5,001 - 25,000
   c. 25,001 - 100,000
   d. 100,001 - 500,00
   e. >500,000

6. Did you grow up living on a ranch or farm? _____ yes _____ no

7. While you were in high school how often did you watch a nature program, such as those on the Discovery Channel or those sponsored by National Geographic, on TV?

   a. more than 2 times a week
   b. once a week
   c. once a month
   d. seldom

8. While growing up, which of the following activities did you often participate in (often enough to develop competence in the activities)? [choose as many as appropriate]

a. camping
b. freshwater fishing
c. saltwater fishing
d. bird watching
e. golf
f. hiking
g. swimming
h. hunting - big game
i. hunting - small game
j. hunting - waterfowl
k. photography
l. boating
m. insect collection

9. Did you participate in a 4-H program while growing up? _____ yes _____ no

10. Did you participate in a Boy Scout or Girl Scout program? _____ yes _____ no

11. How important are the following issues to you? [choose 0 = not an issue, 1 = important issue, 2 = extremely important issue] Rate each issue.

Issue	Rating		
a. endangered species	0	1	2
b. landowner rights	0	1	2
c. water availability	0	1	2
d. over harvest of marine fishes	0	1	2
e. habitat destruction	0	1	2
f. water pollution	0	1	2
g. high fences	0	1	2
h. over hunting of wildlife	0	1	2
i. access to rivers	0	1	2
j. loss of biodiversity	0	1	2

12. Which of the following species do you believe is endangered (choose 1)?

a. mountain lion
b. white-tailed deer
c. American alligator
d. channel catfish
e. whooping crane

13. Do you plan to attend graduate school, or other professional school, after finishing your B.S. degree?
_____ yes _____ no _____ undecided

14. At this time which of the following careers are you most interested in (choose 1)?

a. fisheries biology
b. conservation officer (game warden)
c. wildlife biology
d. park interpretation
e. ranch management (wildlife)
f. museum education
g. private consulting
h. aquaculture
i. conservationist with a non-governmental organization
j. water quality technician
k. urban wildlife or fisheries biologist
l. nature center education
m. undecided
n. public school teacher
o. other (identify) _______________________

15. My favorite class in high school was (choose 1):

a. chemistry	e. math
b. physics	f. literature
c. biology	g. history
d. agricultural science	h. physical education
	i. other (identify) ____________________

16. Who or what influenced you the most in choosing Wildlife and Fisheries Sciences as an academic department? (choose 1)

a. high school guidance counselor	i. wildlife or fisheries biologist
b. parent(s)	j. conservation officer (game warden)
c. friend	k. Texas Parks & Wildlife Dept. programs
d. TV program(s)	l. past interest in outdoor activities
e. agricultural extension agent	m. recruiting by College of Agriculture & Life Sciences
f. recruiting by TAMU	n. other (identify) ____________________
g. WFSC professor	
h. WFSC student	

17. How interested are you in the following animals? [For each animal category circle the appropriate interest level: 0 = no interest, 1 = a little, 2 = a lot]

Animal	Interest Level		
a. fish	0	1	2
b. song birds	0	1	2
c. beaver	0	1	2
d. snakes	0	1	2
e. deer	0	1	2
f. ducks and geese	0	1	2
g. dogs	0	1	2
h. lizards	0	1	2
i. squirrels	0	1	2
j. butterflies	0	1	2
k. mountain lions	0	1	2
l. turtles	0	1	2
m. bass	0	1	2
n. rabbits	0	1	2
o. house cats	0	1	2
p. frogs	0	1	2
q. turkeys	0	1	2

18. Do you agree or disagree with the following statements? Place an x on the appropriate blank for each statement.

Agree	Disagree	No Opinion		
_____	_______	__________	a.	Hunting is a necessary means of managing wildlife populations.
_____	_______	__________	b.	Hunting is cruel and should be illegal.
_____	_______	__________	c.	Wildlife on private land should belong to the landowner.
_____	_______	__________	d.	The state and/or federal government should regulate hunting, even on private land.
_____	_______	__________	e.	Water in ponds and lakes on private land should belong to the landowner.
_____	_______	__________	f.	Water in aquifers below private land should belong to the landowner, and he/she should be allowed to pump all the water he/she wants.
_____	_______	__________	g.	If a stream flows through a person's land, he/she should be allowed to use all that he/she wants.
_____	_______	__________	h.	Owners of private land should be allowed to erect 10' fences to fence wildlife in or out.
_____	_______	__________	i.	Endangered and/or threatened species should be protected by the federal government.
_____	_______	__________	j.	Landowners should be reimbursed for any costs or economic losses due to complying with the law protecting endangered species.
_____	_______	__________	k.	Animals have rights, just like people.
_____	_______	__________	l.	People have the right to manage wildlife populations.
_____	_______	__________	m.	Wildlife belong to all of the people, even if found on private land.
_____	_______	__________	n.	It is OK to breed and raise wildlife (deer, ducks, quail) to release for hunting.
_____	_______	__________	o.	The fish and shrimp in the ocean belong to everyone and the government has the right to regulate recreational and commercial harvest.
_____	_______	__________	p.	It is a good idea to have some "wilderness or sanctuary areas" for wildlife, protected by the government where no hunting or camping is allowed.
_____	_______	__________	q.	Individuals should be allowed to have wild animals as pets.
_____	_______	__________	r.	Fishing is cruel and should be illegal.

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APPENDIX C

2008 SURVEY FOR INITIAL ASSESSMENT

Human Dimensions Survey for Introductory Wildlife and Fisheries Conservation

Circle your responses or fill in appropriate blanks.

1. ____ Female ____ Male

2. I am a student in the department of ______________________________

3. I am most interested in the following curriculum options or areas of concentration (choose 1):

   a. Aquaculture
   b. Fisheries Ecology and Management
   c. Conservation Biology
   d. Taxonomy/Natural Resource Collections and Museum Science
   e. Teaching
   f. Urban Wildlife and Fisheries Management
   g. Vertebrate Zoology
   h. Wildlife Ecology and Management
   i. Natural Resources Conservation Option
   j. Natural Resources and Economic Policy
   k. Other__________________
   l. Undecided

4. I entered my department as a:

   a. Freshman
   b. Transfer from another department at this College or University
   c. Transfer from another College or University

5. The population of my hometown is:

   a. Less than 5,000
   b. 5,001 - 25,000
   c. 25,001 - 100,000
   d. 100,001 - 500,00
   e. >500,000

6. Did you grow up living on a ranch or farm? _____ yes _____ no

7. While you were in high school how often did you watch a nature program, such as those on the Discovery Channel or those sponsored by National Geographic, on TV?

   a. more than 2 times a week
   b. once a week
   c. once a month
   d. seldom
   e. never

8. While growing up, which of the following activities did you often participate in (often enough to develop competence in the activities)? (Choose as many as appropriate)

   a. camping
   b. freshwater fishing
   c. saltwater fishing
   d. bird watching
   e. golf
   f. hiking/backpacking
   g. swimming
   h. hunting - big game
   i. hunting - small game
   j. hunting - waterfowl
   k. nature photography
   l. boating
   m. insect collection

9. Did you participate in a 4-H program while growing up? _____ yes _____ no

10. Did you participate in a Boy Scout or Girl Scout program? _____ yes _____ no

11. Did you participate in other outdoor youth groups? If so, which?________________________________

12. How important are the following issues to you? [Rate each issue: 0 = not an issue, 1 = important issue, 2 extremely important issue]

Issue	Rating		
a. endangered species	0	1	2
b. landowner rights	0	1	2
c. water availability	0	1	2
d. over-harvest of marine fishes	0	1	2
e. habitat destruction	0	1	2
f. water pollution	0	1	2
g. high fences	0	1	2
h. over-hunting of wildlife	0	1	2
i. access to rivers	0	1	2
j. loss of biodiversity	0	1	2
k. Invasive species	0	1	2

13. From the list below, which species do you believe are endangered? (Circle as many as appropriate)

a. mountain lion
b. white-tailed deer
c. American alligator
d. channel catfish
e. whooping crane
f. red-cockaded woodpecker
g. wolf
h. redfish
i. painted bunting
j. striped bass
k. snapping turtle
l. red-tailed hawk
m. box turtle
n. ocelot
o. gopher tortoise
p. fox squirrel

14. After finishing your B.S. degree do you plan to attend:

a.) graduate school _____ yes _____ no _____ undecided
b.) health related professional school _____ yes _____ no _____ undecided
c.) professional (law) school _____ yes _____ no _____ undecided

15. At this time which of the following careers are you most interested in (choose 1)?

a. government fisheries biologist
b. conservation officer (game warden)
c. government wildlife biologist
d. park interpretation
e. ranch management (wildlife)
f. museum education
g. private consulting
h. aquaculture
i. conservationist with a non-governmental organization
j. water quality technician
k. urban wildlife or fisheries biologist
l. nature center education
m. public school teacher
n. college teacher
o. research scientist
p. Industry Fisheries Biologist
q. Industry Wildlife Biologist
r. other (identify)________________________
s. undecided

16. My favorite class in high school was (choose 1):

a. chemistry
b. physics
c. biology
d. agricultural science
e. math
f. literature
g. history
h. physical education
i. other (identify) ________________________

17. Who or what influenced you the most in choosing your academic department? (choose 1)

a. high school guidance counselor
b. parent(s)
c. friend
d. TV program(s)/ other media
e. agricultural extension agent
f. University or College professor
g. University or College student
h. wildlife or fisheries biologist
i. conservation officer (game warden)
j. State Natural Resources Dept. programs
k. past interest in outdoor activities
l. recruiting by University or College
m. other (identify) ______________________

18. How important do you feel the following topic areas are to your field of study? [choose 0 = not important, important, 2 = extremely important issue]

Topic Areas	Rating		
Biology	0	1	2
Zoology	0	1	2
Math	0	1	2
Statistics	0	1	2
Ecology	0	1	2
Economics	0	1	2
Chemistry	0	1	2
English (writing)	0	1	2
Communication (oral)	0	1	2
Literature	0	1	2
Agricultural Sciences	0	1	2

19. How interested are you in the following animals (animal groups)? [For each animal category circle the appropriate interest level: 0 = no interest, 1 = a little, 2 = a lot]

Animal	Interest Level		
a. fish	0	1	2
b. song birds	0	1	2
c. beaver	0	1	2
d. snakes	0	1	2
e. deer	0	1	2
f. ducks and geese	0	1	2
g. dogs	0	1	2
h. lizards	0	1	2
i. squirrels	0	1	2
j. butterflies	0	1	2
k. mountain lions	0	1	2
l. turtles	0	1	2
m. bass	0	1	2
n. rabbits	0	1	2
o. house cats	0	1	2
p. frogs	0	1	2
q. turkeys	0	1	2
r. dolphins	0	1	2
s. chimpanzee	0	1	2
t. blue marlin	0	1	2
u. wolves	0	1	2
v. whales	0	1	2
w. bats	0	1	2
x. foxes	0	1	2
y. eagles/hawks	0	1	2

20. Do you agree or disagree with the following statements? Place an x on the appropriate box for each statement.

Agree	Disagree	No Opinion		
			a.	Hunting is a necessary means of managing wildlife populations.
			b.	Hunting is cruel and should be illegal.
			c.	Wildlife on private land should belong to the landowner.
			d.	The state and/or federal government should regulate hunting, even on private land.
			e.	Water in ponds and lakes on private land should belong to the landowner.
			f.	Water in aquifers below private land should belong to the landowner, and he/she should be allowed to pump all the water he/she wants.
			g.	If a stream flows through a person's land, he/she should be allowed to use all that he/she wants.
			h.	Owners of private land should be allowed to erect 10' fences to fence wildlife in or out.
			i.	Endangered and/or threatened species should be protected by the federal government.
			j.	Landowners should be reimbursed for any costs or economic losses due to complying with the law protecting endangered species.
			k.	Clearcutting is an important technique for wildlife habitat management.
			l.	People have the right to manage wildlife populations.
			m.	Wildlife belong to all of the people, even if found on private land.
			n.	It is OK to breed and raise wildlife (deer, ducks, quail) to release for hunting.
			o.	The fish and shrimp in the ocean belong to everyone and the government has the right to regulate recreational and commercial harvest.
			p.	It is a good idea to have some wilderness or sanctuary areas for wildlife, protected by the government where no hunting or camping is allowed.
			q.	Individuals should be allowed to have wild animals as pets.
			r.	Fishing is cruel and should be illegal.
			s.	Animals have rights, just like people.
			t.	Prescribed fire is an important technique for wildlife habitat management.

APPENDIX D

SAS CODE FOR INTERPRETING STUDENT KNOWLEDGE FROM SURVEY QUESTION 13 "FROM THE LIST BELOW, WHICH SPECIES DO YOU BELIEVE ARE ENDANGERED?"

```
*********************************************************************
options ls=95 ps=95 nocenter nodate;

ods html style=journal;
  ods graphics on;

*****************************************;
***TEST 1***;
*****************************************;
title 'Input data for Test 1';
*Input 2008 data to test for differences in non-seniors and seniors that answered entire
question correct;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student classification$ sex $ taxa $ Correct $ count;
data Test_1;

*INPUT ACTUAL DATA BELOW CARDS;
input Year $ Gender $ Student classification$ Correct $ count;
cards;
2008    Both   Non-seniors   Yes   30
2008    Both   Non-seniors   No    64
2008    Both   Seniors       Yes   7
2008    Both   Seniors       No    17
;
run;
*INSERT code for test 1 here;
title 'TEST 1: gets odds ratio for answered correctly for each age';
proc freq data=Test_1 order=data; weight count;
tables age*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;
```

```
****************************************;
***TEST 2***;
****************************************;
title 'Input data for Test 2';
*Input 2008 data to test for differences in non-seniors and seniors considering gender
that answered entire question correct;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student classification $ sex $ taxa $ Correct $ count;
data Test_2;

*INPUT ACTUAL DATA BELOW CARDS;
input Year $ Gender $ Student classification$ Correct $ count;
cards;
2008    Females  Non-senior  Yes  5
2008    Females  Non-senior  No   46
2008    Females  Seniors     Yes  5
2008    Females  Seniors     No   19
2008    Males    Non-senior  Yes  35
2008    Males    Non-senior  No   28
2008    Males    Seniors     Yes  12
2008    Males    Seniors     No   8
;
run;
*NOTE: ADDED 5 TO EACH CELL;
*INSERT code for test 2 here;

title 'TEST 2: gets odds ratio for answered correctly for each gender considering age';
proc freq data=Test_2 order=data; weight count;
tables gender*age*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;


****************************************;
***TEST 3***;
****************************************;
title 'Input data for Test 3';
*Input 2008 data to test for differences in all females (Soph & Sen) and all males(Soph
& Sen) that answered entire question correct;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student classification$ sex $ taxa $ Correct $ count;
```

```
data Test_3;
*INPUT ACTUAL DATA BELOW CARDS;
input Year $ Gender $ Student t classification$ Correct $ count;
cards;
2008	Females	both	Yes	5
2008	Females	both	No	60
2008	Males	both	Yes	42
2008	Males	both	No	31
;
run;
*INSERT code for test 3 here;
title 'TEST 3: gets odds ratio for answered correctly for gender';
*NOTE: Had to add 5 to each cell because of zero value;
proc freq data=Test_3 order=data; weight count;
tables gender*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;


****************************************;
***TEST 4***;
****************************************;
title 'Input data for Test 4';
*Input 2008 data to test for differences in female and male NON-SENIORS ONLY that
answered entire question correct in 2008;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;
data Test_4;
*INPUT ACTUAL DATA BELOW CARDS;
input Year $ Gender $ Student student classification$ Correct $ count;
cards;
2008	Females	Non-senior	Yes	5
2008	Females	Non-senior	No	46
2008	Males	Non-senior	Yes	35
2008	Males	Non-senior	No	28
;
run;
title 'TEST 4: gets odds ratio for answered correctly for gender for NON-SENIORS 2008
ONLY';
*INSERT code for test 4 here;
*NOTE: Had to add 5 to each cell because of zero value;
proc freq data=Test_4 order=data; weight count;
tables gender*correct/chisq expected norow nocol nopercent relrisk cmh1;
```

```
run;


****************************************;
***TEST 5***;
****************************************;
title 'Input data for Test 5';
*Input 2000 data to test for differences in female and male non-seniors that answered
entire question correct in 2000;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;
data Test_5;
*INPUT ACTUAL DATA BELOW CARDS;
input Year $ Gender $ Student student classification$ Correct $ count;
cards;
2000     Females     Non-senior     Yes     19
2000     Females     Non-senior     No      7
2000     Males       Non-senior     Yes     30
2000     Males       Non-senior     No      8
;
run;
title 'TEST 5: gets odds ratio for answered correctly for gender for NON-SENIORS 2000
ONLY';
*INSERT code for test 5 here;
proc freq data=Test_5 order=data; weight count;
tables gender*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;


****************************************;
***TEST 6***;
****************************************;
title 'Input data for Test 6';
*Input 1998 data to test for differences in total non-senior students that answered entire
question correct in 1998;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;
data Test_6;
*INPUT ACTUAL DATA BELOW CARDS;
input Year $  Student student classification$ Correct $ count;
```

```
cards;
1998            Non-senior      Yes         8
1998            Non-senior      No          58
;
run;
title 'TEST 6: Tests for statistical differences between number of correct and # incorrect
for 1998';
*INSERT code for test 6 here;
*NOTE: ADDED 5 to each cell;
proc freq data=Test_6 order=data; weight count;
tables correct/chisq expected norow nocol nopercent relrisk cmh1;
run;


****************************************;
***TEST 7***;
****************************************;
title 'Input data for Test 7';
*Input 2008 data to test for differences in non-seniors and seniors that answered certain
taxa correct;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;
data Test_7;
*INPUT ACTUAL DATA BELOW CARDS;
input Year $ taxa $ Student student classification$ Correct $ count;
cards;
2008      Birds          Non-seniors    Yes       73
2008      Fish           Non-seniors    Yes       94
2008      Herptiles      Non-seniors    Yes       75
2008      Mammals        Non-seniors    Yes       75
2008      Birds          Non-seniors    No        21
2008      Fish           Non-seniors    No        0
2008      Herptiles      Non-seniors    No        19
2008      Mammals        Non-seniors    No        19
2008      Birds          Seniors        Yes       19
2008      Fish           Seniors        Yes       24
2008      Herptiles      Seniors        Yes       19
2008      Mammals        Seniors        Yes       21
2008      Birds          Seniors        No        5
2008      Fish           Seniors        No        0
2008      Herptiles      Seniors        No        5
2008      Mammals        Seniors        No        3
```

```
;
run;
*INSERT code for test 7 here;
title 'TEST 7: for differences in non-seniors and seniors that answered certain taxa
correct for 2008';
proc freq data=Test_7 order=data; weight count;
tables taxa*age*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;


****************************************;
***TEST 8***;
****************************************;
title 'Input data for Test 8';
*Input 2008 data to test for differences in non-seniors and seniors considering gender
that answered certain taxa correct in 2008;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;
data Test_8;
*INPUT ACTUAL DATA BELOW CARDS;
input Year $  Gender $ taxa $ Student student classification$ Correct $ count;
cards;
2008    Females  Birds      Non-seniors  Yes  38
2008    Females  Fish       Non-seniors  Yes  46
2008    Females  Herptiles  Non-seniors  Yes  36
2008    Females  Mammals    Non-seniors  Yes  27
2008    Females  Birds      Non-seniors  No   13
2008    Females  Fish       Non-seniors  No   5
2008    Females  Herptiles  Non-seniors  No   15
2008    Females  Mammals    Non-seniors  No   24
2008    Females  Birds      Seniors      Yes  16
2008    Females  Fish       Seniors      Yes  19
2008    Females  Herptiles  Seniors      Yes  15
2008    Females  Mammals    Seniors      Yes  17
2008    Females  Birds      Seniors      No   8
2008    Females  Fish       Seniors      No   5
2008    Females  Herptiles  Seniors      No   9
2008    Females  Mammals    Seniors      No   7
2008    Males    Birds      Non-seniors  Yes  45
2008    Males    Fish       Non-seniors  Yes  58
2008    Males    Herptiles  Non-seniors  Yes  49
2008    Males    Mammals    Non-seniors  Yes  58
```

```
2008    Males   Birds       Non-seniors  No   18
2008    Males   Fish        Non-seniors  No   5
2008    Males   Herptiles   Non-seniors  No   14
2008    Males   Mammals     Non-seniors  No   5
2008    Males   Birds       Seniors      Yes  13
2008    Males   Fish        Seniors      Yes  15
2008    Males   Herptiles   Seniors      Yes  14
2008    Males   Mammals     Seniors      Yes  14
2008    Males   Birds       Seniors      No   7
2008    Males   Fish        Seniors      No   5
2008    Males   Herptiles   Seniors      No   6
2008    Males   Mammals     Seniors      No   6
;
run;
*INSERT code for test 8 here;
*NOTE: 5 has been added to each cell;

title 'TEST 8: test for differences in non-seniors and seniors considering gender for 2008
data';
proc freq data=Test_8 order=data; weight count;
tables taxa*gender*age*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;


****************************************;
***TEST 9***;
****************************************;
title 'Input data for Test 9';
*Input 2008 data to test for differences in all females (soph& sen) and all males (soph&
sen) that answered certain taxa correct in 2008;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;

data Test_9;
*INPUT ACTUAL DATA BELOW CARDS;
input Year $  Gender $ taxa $ Student student classification$ Correct $ count;
cards;
2008    Females   Birds       Both   Yes   44
2008    Females   Fish        Both   Yes   54
2008    Females   Herptiles   Both   Yes   41
2008    Females   Mammals     Both   Yes   34
2008    Females   Birds       Both   No    10
```

```
2008    Females    Fish         Both   No      0
2008    Females    Herptiles    Both   No      13
2008    Females    Mammals      Both   No      20
2008    Males      Birds        Both   Yes     48
2008    Males      Fish         Both   Yes     63
2008    Males      Herptiles    Both   Yes     53
2008    Males      Mammals      Both   Yes     62
2008    Males      Birds        Both   No    15
2008    Males      Fish         Both   No    0
2008    Males      Herptiles    Both   No    10
2008    Males      Mammals      Both   No    1
;
run;
*INSERT code for test 9 here;

title 'TEST 9: test for differences in females & Males considering taxa for 2008';
proc freq data=Test_9 order=data; weight count;
tables taxa*gender*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;
title 'delete FISH';
*no one answered Fish incorrectly, so we deleted it;
data test_9a; set test_9;
if taxa="Fish" then delete;
run;
title 'TEST 9a: NO FISH_test for differences in non-seniors and seniors considering
gender for 2008 data';
proc freq data=Test_9a order=data; weight count;
tables taxa*gender*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;


*****************************************;
***TEST 10***;
*****************************************;
title 'Input data for Test 10';
*Input 2008 data to test for differences in  female and male non-seniors that answered
certain taxa correct in 2008;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;
data Test_10;
*INPUT ACTUAL DATA BELOW CARDS;
input Year $  Gender $ taxa $ Student student classification$ Correct $ count;
```

```
cards;
2008    Females   Birds       Non-seniors   Yes   33
2008    Females   Fish        Non-seniors   Yes   41
2008    Females   Herptiles   Non-seniors   Yes   31
2008    Females   Mammals     Non-seniors   Yes   22
2008    Males     Birds       Non-seniors   Yes   40
2008    Males     Fish        Non-seniors   Yes   53
2008    Males     Herptiles   Non-seniors   Yes   44
2008    Males     Mammals     Non-seniors   Yes   53
2008    Females   Birds       Non-seniors   no    8
2008    Females   Fish        Non-seniors   no    0
2008    Females   Herptiles   Non-seniors   no    10
2008    Females   Mammals     Non-seniors   no    19
2008    Males     Birds       Non-seniors   no    13
2008    Males     Fish        Non-seniors   no    0
2008    Males     Herptiles   Non-seniors   no    9
2008    Males     Mammals     Non-seniors   no    0
;
run;
*INSERT code for test 10 here;
title 'TEST 10: test for differences in male and female non-seniors considering taxa 2008
data';
proc freq data=Test_10 order=data; weight count;
tables taxa*gender*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;


****************************************;
***TEST 11***;
****************************************;
title 'Input data for Test 11';
*Input 2000 data to test for differences in  female and male non-seniors that answered
certain taxa correct in 2000;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;
data Test_11;
*INPUT ACTUAL DATA BELOW CARDS;
input Year $  Gender $ taxa $ Student student classification$ Correct $ count;
cards;
2000    Females   Birds       Non-seniors   Yes   24
2000    Females   Fish        Non-seniors   Yes   28
2000    Females   Herptiles   Non-seniors   Yes   28
```

```
2000	Females	Mammals	Non-seniors	Yes	24
2000	Males	Birds	Non-seniors	Yes	35
2000	Males	Fish	Non-seniors	Yes	41
2000	Males	Herptiles	Non-seniors	Yes	39
2000	Males	Mammals	Non-seniors	Yes	37
2000	Females	Birds	Non-seniors	No	9
2000	Females	Fish	Non-seniors	No	5
2000	Females	Herptiles	Non-seniors	No	5
2000	Females	Mammals	Non-seniors	No	9
2000	Males	Birds	Non-seniors	No	11
2000	Males	Fish	Non-seniors	No	5
2000	Males	Herptiles	Non-seniors	No	7
2000	Males	Mammals	Non-seniors	No	9
;
run;
*INSERT code for test 11 here;

title 'TEST 11: test for differences in gender considering taxa for 2000 data';
proc freq data=Test_11 order=data; weight count;
tables taxa*gender*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;
title 'delete FISH';
*students answered all FISH correctly, so we deleted it;
data test_11a; set test_11;
if taxa="Fish" then delete;
run;
title 'TEST 11a: NO FISH_test for differences in gender considering taxa for 2000 data';
proc freq data=Test_11a order=data; weight count;
tables taxa*gender*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;


*****************************************;
***TEST 12***;
*****************************************;
title 'Input data for Test 12';
*Input 1998 data to test for differences in total non-senior students that answered certain
taxa correct in 1998;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;
data Test_12;
```

```
*INPUT ACTUAL DATA BELOW CARDS;
input Year $  taxa $ Student student classification$ Correct $ count;
cards;
1998        Birds       Non-seniors    Yes       53
1998        Fish        Non-seniors    Yes       7
1998        Herptiles   Non-seniors    Yes       54
1998        Mammals     Non-seniors    Yes       50
1998        Birds       Non-seniors    No    3
1998        Fish        Non-seniors    No    49
1998        Herptiles   Non-seniors    No    2
1998        Mammals     Non-seniors    No    6
;
run;
*INSERT code for test 12 here;
title 'TEST 12: test for differences in taxa answered correctly 1998';
proc freq data=Test_12 order=data; weight count;
tables taxa*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;



****************************************;
***TEST 13***;
****************************************;
title 'Input data for Test 13';
*Input 2008 data to test for differences in female and male SENIORS ONLY that
answered entire question correct in 2008;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;
data Test_13;
*INPUT ACTUAL DATA BELOW CARDS;
input Year $ Gender $ Student student classification$ Correct $ count;
cards;
2008        Females     Seniors        Yes       5
2008        Females     Seniors        No        19
2008        Males       Seniors        Yes       12
2008        Males       Seniors        No        8

;
run;
```

```
title 'TEST 13: gets odds ratio for answered correctly for gender for non-seniors 2008
ONLY';
*INSERT code for test 13 here;
*NOTE: Had to add 5 to each cell because of zero value;
proc freq data=Test_13 order=data; weight count;
tables gender*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;




****************************************;
***TEST 14***;
****************************************;
title 'Input data for Test 14';
*Input 2008 data to test for differences in female and male seniors that answered certain
taxa correct in 2008;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;
data Test_14;
*INPUT ACTUAL DATA BELOW CARDS;
input Year $  Gender $ taxa $ Student student classification$ Correct $ count;
cards;
2008    Females   Birds       Seniors   Yes   11
2008    Females   Fish        Seniors   Yes   14
2008    Females   Herptiles   Seniors   Yes   10
2008    Females   Mammals     Seniors   Yes   12
2008    Males     Birds       Seniors   Yes   8
2008    Males     Fish        Seniors   Yes   10
2008    Males     Herptiles   Seniors   Yes   9
2008    Males     Mammals     Seniors   Yes   9
2008    Females   Birds       Seniors   No    3
2008    Females   Fish        Seniors   No    0
2008    Females   Herptiles   Seniors   No    4
2008    Females   Mammals     Seniors   No    2
2008    Males     Birds       Seniors   No    2
2008    Males     Fish        Seniors   No    0
2008    Males     Herptiles   Seniors   No    1
2008    Males     Mammals     Seniors   No    1

;
run;
```

```
*INSERT code for test 14 here;
title 'TEST 14: test for differences in male and female seniors considering taxa 2008
data';
proc freq data=Test_14 order=data; weight count;
tables taxa*gender*correct/chisq expected norow nocol nopercent relrisk cmh1;
run;



****************************************;
***TEST 15***;
****************************************;
title 'Input data for Test 15';
*Input  data to test for differences in  interest levels of gender and age;
*TYPE EXTRA INFO HERE;

*COMPLETE INPUT LINE;
*input Year $ Gender $ Student student classification$ sex $ taxa $ Correct $ count;
data Test_15;
*INPUT ACTUAL DATA BELOW CARDS;
input Gender $ Student student classification$ Interest $  count;
cards;
Females    Non-senior     not        5
Females    Non-senior     import     12
Females    Non-senior     very       40
Males      Non-senior     not        8
Males      Non-senior     import     25
Males      Non-senior     very       35
Females    Seniors        not        5
Females    Seniors        import     6
Females    Seniors        very       18
Males      Seniors        not        5
Males      Seniors        import     9
Males      Seniors        very       11
Females    Non-seniors    not        5
Females    Non-seniors    import     7
Females    Non-seniors    very       29
Males      Non-seniors    not        6
Males      Non-seniors    import     19
Males      Non-seniors    very       28
;
run;
*INSERT code for test 15 here;
```

```
title 'TEST 15: test for differences in gender and student student classificationin response
to interest level';
proc freq data=Test_15 order=data; weight count;
tables age*gender*interest/chisq expected norow nocol nopercent relrisk cmh1;
run;
proc freq data=Test_15 order=data; weight count;
tables gender*age*interest/chisq expected norow nocol nopercent relrisk cmh1;
run;


******************************************;
ods graphics off;
  ods html close;
run;
***********************************************************************
```

APPENDIX E

COMPETENCIES OF WILDLIFE AND FISHERIES GRADUATES

Competencies of Wildlife and Fisheries Graduates

Primary competencies of a WFSC graduate: Ability (and will) to:

•think logically and creatively, working with and from appropriate knowledge bases (e.g., life experiences, the "core curriculum," discipline-focused courses).

•write and speak, skillfully and sensibly; and, otherwise present one's self as a well-informed and educated person.

•work effectively in multidisciplinary teams.

•use basic math concepts for computation and for problem-solving.

•use the Internet, e-mail, computer tools for text-processing and graphics.

Secondary competencies of a WFSC graduate: Ability (and will) to:

•understand and apply the scientific method.

•use computers for analysis of data via spread-sheets and statistical software, and for systems simulation.

•understand the basic principles of ecology, and appreciate their foundations in physics, chemistry, biology, geography, geology, etc.

•understand the need to balance use and preservation of natural resources. Our graduates must understand that we need to exploit land and sea to sustain human life, but we need to conserve resources, avoid pollution, find more efficient alternatives, recycle, etc.

•entertain a wise world view, whereby one strives to understand global impacts of humanity on the earth as a semi-closed system: human population growth, the AIDs epidemic, global warming and other pollution issues, socioeconomics, energy and food issues, destruction of rainforests, depletion of ocean fisheries, etc.

•command the technical knowledge in one's own field of specialization: concepts and "facts;" necessary tools (e.g., math); currently applied techniques and technology; the history of the field, including discredited theories and development of their successors; ethical practices and professionalism; practical experience via work-study and internships.

•be flexible: Attend to life-long learning, adjust with the times, change jobs when better opportunities present themselves, anticipate change (futuring), and adopt new technologies as they are developed. Learn even when there is little or no interest in the subject matter. Be prepared both for graduate school and for going to work.

•be resourceful, industrious and responsible. Have gumption.

–Suggestions compiled by
W.H. Neill, WFSC, 6 Feb. 2001;
Rvsd. by R.D. Slack & Neill, 4 May 2004

VITA

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