This course introduces the science of conservation biology. The first half of the course focuses on biodiversity patterns and threats. The second half covers applications and problem solving.

Instructor: Dr. Michael Reed   TA: Jessica Cañizares

Class hours: Anderson 206, Mon, Wed, 1:30-2:45

Office hours: Reed: Mon 3-4:30, or by appointment, Robinson 360 (go through Robinson 359), michael.reed@tufts.edu
Cañizares: Mon, Wed 12:30-1:30, Robinson 350, Jessica.rozek@tufts.edu

Your emails to us should contain “Bio 144” in the subject line; emails received without it, may get treated as SPAM and be deleted without being read.

Text: ESSENTIALS OF CONSERVATION BIOLOGY, 6th ed., Primack

Reading assignments: Chapters from the text, plus readings from the primary literature (on Canvas), associated with each lecture are listed below.

Videos: There are some videos to watch as supplemental material that complement the lecture.

Optional reading that might be helpful: If you are really interested in a particular topic from class, if you ask me or the TA, we can provide more reading on it.

Questions: Please ask lots of them! Class is much more interesting (for me and you) when people ask questions. You can send us questions over email; we might post them (anonymously) along with the answers on Canvas, so that everyone can read the responses.

Course objectives and expectations: My goal is to provide you with a basic understanding of the scientific field of conservation biology and the application of science to solving conservation problems. My primary goal is for you to learn and understand basic concepts and general ideas, although to get an A or a high B, you will need to know plenty of details too. I will expect you to know examples relating to each major concept, so that you can relate theory to practical, real-world situations. I won’t expect you to memorize all the minutia in my notes or the text; for example, I wouldn’t ask you exactly how many species have gone extinct in the last 500 years. But, I will expect you to have a solid understanding of the core information that would be required of you in a job in this field; for example, I would expect you to know whether the number of extinctions this decade is likely to be closer to 6 or 20,000. The text book readings are intended to complement the lectures, and material from both could appear on exams.

If you are just taking this course out of general interest, then hopefully it will provide you with a sense of how the biological sciences is applied to protection of the natural world, and it will give you a better understanding of the main issues in conservation biology. For those of you wishing to pursue a career in conservation biology, I hope that this course will give you a solid foundation on which to build with future courses and research.
Specific things that I hope you will learn include:

- to understand the basic issues that define the field of conservation biology;
- specific factual information about major issues in conservation biology;
- specific examples of important concepts, problems, and solutions;
- to use general principles to think about ways to solve specific conservation problems;
- to extrapolate from examples I provide in class to other cases with similar characteristics (e.g., that I may ask about in exams!);
- to acknowledge scientific uncertainty, to recognize when it hampers understanding and management actions, and when it does not;
- to read scientific papers and understand the main points that they make;
- to interpret graphs, tables, and simple statistics presented in the scientific literature;
- to present scientific information to your peers in a format commonly used by scientists;
- to think about the work of others and provide constructive feedback.

Students with disabilities: If you have a disability that requires reasonable accommodations (as assessed by the university), please contact the Student Accessibility Services office at Accessibility@tufts.edu or 617-627-4539 to make an appointment with an SAS representative to determine appropriate accommodations. Please be aware that accommodations cannot be enacted retroactively, making timeliness a critical aspect for their provision.

Grading

1) Two mid-term exams (100 points each, total 50% of final grade) [there is no final exam]

2) Management Plan poster and associated materials (120 points, 30% of final grade)
   - Topic approved & 5 annotated citations from the scientific literature turned in by October 21 (10% of the points); first come, first choice
     - For each citation, include a sentence (= annotation) about the relevance of the paper to your management plan
     - Points for citations are all or nothing – 0 or 12 – and being in the correct format (see below) is part of the requirement. Lists that fall short of 5 from the scientific literature, and/or in incorrect format will be returned to give you the opportunity to revise. Final citations also need to meet format requirements.
   - About 30% of your poster grade will be determined by peer evaluation (your fellow students)
   - Part of your poster grade will be based on the degree to which you followed format instructions (below)

3) Evaluation of 3 other students’ Management Plan posters (20 points; 5% of final grade) – your evaluations will be confidential to the students being evaluated.

4) Reading & computer assignments, attend and comment on 2 seminars (15% of final grade). Assignments due by next class; late assignments penalized 10% / day.
- Reading assignments – due dates the syllabus. I have posted papers on Canvas from
the primary literature to read before a particular lecture. Before the start of class, post
document on Canvas – of one thing that surprised you about the paper – with regards
to the Methods, Analysis, Results, or Interpretation of the results – and why you were
surprised. It helps a lot if you have in your statement sentences that includes the
phrase “I was surprised by”, and another that includes “I was surprised because” (or
something else this obvious).

- Attend 2 seminars during the semester – either Biology Dept (Fridays at 4 p.m.), or
Environmental Studies Lunch and Learn (Thursdays at noon). For each, post on
Canvas the name of the speaker(s), the date you attended, and 2 sentences about
something new you learned, or what surprised you.

- 2 computer assignments – discussed below

<table>
<thead>
<tr>
<th>Item</th>
<th>Total Points</th>
<th>% of Final Grade</th>
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<tbody>
<tr>
<td>Midterm 1</td>
<td>100</td>
<td>25%</td>
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<tr>
<td>Midterm 2</td>
<td>100</td>
<td>25%</td>
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<tr>
<td>Management Plan assignments</td>
<td>120</td>
<td>30%</td>
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<tr>
<td>Evaluation of posters</td>
<td>20</td>
<td>5%</td>
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<tr>
<td>Reading, computer exercises,</td>
<td>60 (10 x 6 pts/each)</td>
<td>15%</td>
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<td>seminar attendance</td>
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<td><strong>Total</strong></td>
<td><strong>400</strong></td>
<td><strong>100%</strong></td>
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**Notes about grading**

- Grades tend to be straight percentages (e.g., 80-83% B-, 83-88% B, 88-89% B+) unless I
see a need to curve.

- Exams are not cumulative, except when material is repeated in the new examination
period.

- Make up exam policy: NO make-up exams (except for documented medical problem, or
extraordinary circumstance)

- Late assignments will be penalized

- You must be present for both days of poster presentations.

- NO, there is no extra credit – please don’t ask.

- If you have a question regarding how an exam question was graded, after reviewing the
exam key please submit in writing why you think your answer might be correct, along
with your exam. This must be done within 7 days of our returning the exam to the class
(5 days for the 2nd exam). Exam keys will be posted on Canvas.

- Although there is no grade for class participation, if your final grade is on a threshold
between grades, notable student engagement in the classroom, and participation in in-
class Q&A using Poll Everywhere will decide whether to bump up the grade.
<table>
<thead>
<tr>
<th>Date (day)</th>
<th>Topic</th>
<th>Text Chapter</th>
<th>Primary Literature</th>
<th>Supplemental videos</th>
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</thead>
<tbody>
<tr>
<td>Sept. 4 (1)</td>
<td>What is Conservation Biology?</td>
<td>1; 6</td>
<td></td>
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<tr>
<td>9 (2)</td>
<td>Types of biodiversity</td>
<td>2</td>
<td></td>
<td>Biodiversity</td>
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<tr>
<td>11 (3)</td>
<td>Patterns of biodiversity</td>
<td>3</td>
<td></td>
<td>new species</td>
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<td>16 (4)</td>
<td>Extinction rates</td>
<td>7</td>
<td>Ceballos et al. 2015</td>
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<td>18 (5)</td>
<td>Vulnerability to extinction</td>
<td>8</td>
<td></td>
<td>extinction overview</td>
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<tr>
<td>23 (6)</td>
<td>Habitat loss &amp; degradation</td>
<td>9</td>
<td></td>
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<tr>
<td>25 (7)</td>
<td>Overexploitation</td>
<td>10</td>
<td></td>
<td>bushmeat; illegal trade</td>
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<td></td>
<td><strong>Excel assignment given</strong></td>
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<tr>
<td>30 (8)</td>
<td>Exotic, invasive species, &amp; disease</td>
<td>10</td>
<td></td>
<td>IPANE</td>
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<td>Oct. 2 (9)</td>
<td>Climate change</td>
<td>pp. 205-214</td>
<td>Freeman et al. 2018</td>
<td>Global change; Time Machine</td>
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<td>7 (10)</td>
<td>Problems of small populations, &amp; role of behavior</td>
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<td>9 (11)</td>
<td>Conservation genetics</td>
<td>11</td>
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<td>15</td>
<td><strong>EXAM 1</strong></td>
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<td>16 (13)</td>
<td>Population viability analysis</td>
<td>12</td>
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<td><strong>Vortex assignment given</strong></td>
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<tr>
<td>21 (14)</td>
<td>Establishing new populations</td>
<td>13</td>
<td>Neff &amp; Larson 2014</td>
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<td><strong>Management plan / citations due</strong></td>
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<td>23 (15)</td>
<td>Surveying &amp; monitoring</td>
<td>12</td>
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<tr>
<td>28 (16)</td>
<td>Ex situ approaches</td>
<td>14</td>
<td>Seddon et al. 2014</td>
<td>Frozen Ark Project</td>
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<td>30 (17)</td>
<td>Protected areas &amp; protected areas networks; <strong>poster best practices</strong></td>
<td>15; 16</td>
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<td>Nov. 4 (18)</td>
<td>Managing protected areas</td>
<td>17</td>
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<td>6 (19)</td>
<td>Habitat restoration</td>
<td>19</td>
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<tr>
<td>13 (20)</td>
<td>Managing the matrix</td>
<td>18</td>
<td></td>
<td>matrix management</td>
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<tr>
<td>18 (21)</td>
<td>Economics of conservation</td>
<td>4; 5</td>
<td>Lindsey et al. 2018</td>
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<tr>
<td>20 (22)</td>
<td>Ecosystem services</td>
<td>20</td>
<td>Silvertown 2015</td>
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<td>25 (23)</td>
<td>Sustainability</td>
<td>21</td>
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<tr>
<td>Dec. 2</td>
<td><strong>EXAM 2</strong></td>
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<tr>
<td>4 &amp; 9</td>
<td><strong>Poster presentation &amp; evaluation (all posters due Dec 4 at start of class)</strong></td>
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Excel & Vortex exercises
There are 2 homework assignments where you use computational software – one requires Excel, one requires Vortex – assignments are due by the start of the class following their assignment. **Recommend you work in groups of 2-3, but turn in separate answer files.** Assignments will be on Canvas, and assignments will be to use the software to answer some questions. If you want a brief introduction to using Excel or Vortex beyond what I talk about in class or have in the assignment handout, come see me or the TA (after you have tried it yourself).

- If you do not have Excel on your computer, you can get it for free – all students have access to Microsoft Office 365 for PC or Mac, which includes Excel: [https://it.tufts.edu/sw-office365-pp](https://it.tufts.edu/sw-office365-pp). If you have questions about this download, contact the TTS help desk (617-627-3376 or it@tufts.edu).

- Vortex (& user’s manual): free download at [https://www.cpsg.org/download-vortex](https://www.cpsg.org/download-vortex) – NOT FOR MACS – I will find a solution

Poll Everywhere
I am experimenting this semester with Poll Everywhere, a free app that lets students answer questions posed during class. You will need to download the app onto some device you have that accesses the internet. Student download and use instructions: [http://tuftsedtech.screenstepslive.com/s/19028/m/73482/l/915631-poll-everywhere-student-instructions](http://tuftsedtech.screenstepslive.com/s/19028/m/73482/l/915631-poll-everywhere-student-instructions)


Note: when you respond to questions in class via Poll Everywhere, I can see a record of who participates; if I ask a potentially sensitive question, I’ll disable this function and alert you to it.

Note: If you participate and are not in class, and I notice it, your grade will be penalized.

Management Plan Poster
Posters are one of the primary methods people in the scientific community communicate research results at conferences. You and your partner will devise a management plan to solve any particular species or ecosystem-oriented problem: recovery of a threatened or endangered species or ecosystem, control an exotic invasive species or emerging disease whose invasion is causing biodiversity problems, reducing human-wildlife conflicts, adaptive management for climate change, etc. Treat the management action as a hypothesis to test, and your plan as an experiment.

Team: Students will work in teams of 2 to prepare a management plan and present it as a poster.

Selecting a Topic: Management plans already exist for many species or ecosystems – your selected project may **not** be a repeat of an already proposed or completed project. If you select a species or ecosystem with an existing management plan, you need to (1) propose something that goes beyond the existing plan, (2) make it clear in your poster what is new to you and what is not, and (3) include as one of your references the existing plan.

Your proposed Management Plan topic must be cleared with me or the TA before you start work, and the latest you can clear a topic is **October 21**. By this date, you also must provide at least 5 citations from the primary literature (= scientific journal articles). Submit topics and citations
and/or come talk to us about possible topics AS EARLY AS POSSIBLE to avoid being scooped – only one group per species / problem, so first come first served. Before you select a species/ecosystem you should do a literature search to make sure there is sufficient information to tackle the project. Do \textbf{not} cite articles that you did not read (we have a great interlibrary loan service).

\textbf{Lazy team member:} If you believe your partner is not being productive, and you cannot get that person to be productive, come talk to me.

\textbf{Deliverables:} Each team will prepare 1) a \textbf{poster}, and 2) turn in a \textbf{separate annotated bibliography} (hard copy) of materials used in developing your management plan.

\begin{enumerate}
\item \textbf{Poster:}
\end{enumerate}

\textbf{Required Poster information} [note: example posters from past classes are on Canvas]

\begin{itemize}
\item \textbf{Title \& presenter names:} Names under the title in large font
\item \textbf{Abstract:} In 350 words or less, summarize your management plan. State the problem, why it is a problem, where it is a problem, and the major findings and recommendations of your management plan. No citations appear in the abstract.
\item \textbf{Introduction:} Introduce the general conservation/management problem, then narrow the focus of the introduction to your specific management problem. Give the location, interested parties (for many projects this will include who is in conflict), and state your specific goals for the project. By the end of the section a reader should know what you are doing and why.
\item \textbf{Background:} A brief review of the location and species involved. If your management plan focuses on a single species, give me a summary of its pertinent natural history, ecology, and behavior. If it is an ecosystem, tell me about the ecosystem (biome, primary species, etc).
\item \textbf{Proposed management plan:} This is the bulk of your project. What do you propose to do? What is your reasoning? Design your management plan as an experiment (= adaptive management). That is, you plan to do “x”, and you expect “y” to occur. This means you should state your plan as a \textit{hypothesis}, or set of hypotheses, or predictions. Include predictions – what specifically should result from your management plan?
\item \textbf{Quantifying success:} How does your management plan address and solve the problem? What were you not able to deal with? Define “success” for your management plan, and provide criteria for assessing success (or failure).
\end{itemize}

\textbf{PROOFREAD YOUR POSTER.} I guarantee that if you wait to the last minute to do this project it will show in the quality of your work.

\textbf{Poster format and design:} [see also ‘How to make a Good Poster’: Canvas, Files, Poster resources] Also, we will cover this in the class sometime after the first exam.

Your goal for a poster is to distill the information for your management plan into short, clear statements, illustrations, and/or tables

\begin{itemize}
\item Requirements:
\begin{itemize}
\item Cite ideas not your own
\end{itemize}
\end{itemize}
o Size: no smaller than 36 x 36 inches, no larger than 36 in tall x 48 in wide.

o Text & Font
  ▪ Abstract & Headings: minimum 36 pt;
  ▪ Body Text: minimum 32 pt;
  ▪ Title: 72-80 pt;
  ▪ Recommendation: Arial font is easy to read.

o Everything should be easily readable from 2 meters away.

2. Bibliography:

Citations in the bibliography should be mostly from the primary scientific literature, and must
include at least 5 sources from the primary literature. The bibliography should be typed in the
form of the journal Conservation Biology. If you do not know what constitutes primary
literature, see me, the TA, or Nicole Bookout (your science librarian).

All ideas, data, information not your own must be cited, unless they are ideas common in the
literature (e.g., that plants photosynthesize). All citations must come from the scientific
literature. This includes scientific journals, symposia, and some government reports (but not all).
When in doubt, ask me. The literature cited section should contain all citations used, and no
extras.

**Format** for the literature cited section must follow format of the journal *Conservation Biology*;
see recent journal for format, or click on the link to ‘style guide to authors’ found here. It might
help to view [http://researchguides.library.tufts.edu/biology](http://researchguides.library.tufts.edu/biology)

**Citing Web pages:** **DO NOT**, unless it is an on-line journal. The only acceptable use of other
Web citations is if you want to document a popular interest in the topic.

**Presentation:** Posters will be on display on the dates listed in the syllabus; half the class will
present and answer questions one day and evaluate the posters the other; the next day, roles will
switch. **All posters must be completed and brought in by the first presentation date.** Both
members of each team will be expected to answer questions regarding management plans when
people come to view the posters.

Half the class will present on the first day – stand by your poster and wait for folks to come by –
and the other half of the class will evaluate; rolls will be reversed the second day. Be ready with
a short pitch (oral presentation) and engage people as they come to your poster – then walk them
through some of the details. Because of this, you do NOT need excruciating details in your
poster. The abstract should encapsulate your poster, but the rest of the poster is support for your
presentation. Note that the dynamic might be somewhat fluid – some folks will show up part
way through your presentation, and others (certainly at real conferences) will wander off when
you are only part-way through. So, you want to have a short pitch, then more details you can go
into if there is an opportunity. **Both presenters should talk.**

**Evaluation of Others’ Work:** Each student will formally evaluate 3 other groups’ posters in order
to practice thinking critically and assessing others’ work and your evaluation will be graded.
Your grade will be based on your doing a careful, constructive job of reviewing posters – if you
say a poster is great when it is not, your evaluation grade will go down. Also, students will
assign a grade to each poster they evaluate, and their grading will affect the poster’s final grade.
More Information on Selecting a Topic

The scientific literature, popular literature, news, personal experience, and the Internet are filled with examples of endangered or threatened species and ecosystems, and conflicts between environmental and other concerns. Talk with me or with your TA for ideas. You can use any of these sources for an initial selection of a problem to be addressed. Your next step is to search the scientific literature to see what information exists that could be used to develop a management plan for a specific area. Please come discuss ideas with me. Web of Science or Scopus are the best places for searches of primary literature, but Google Scholar is not bad.

Some scientific journals that focus on Conservation Biology:

- Animal Conservation
- Biodiversity & Conservation
- Biological Conservation
- Bird Conservation & Ecology
- Conservation Biology
- Conservation Ecology (on line)
- Conservation Letters
- Ecological Applications
- Invasion Biology
- Journal of Applied Ecology
- Journal of Wildlife Management
- Restoration Ecology

Some potentially useful web sites for getting ideas: (There are tons of them of varying quality. These sites are NOT scientific literature, but they might lead you to some.)

- The International Union on Conservation of Nature (IUCN) [www.iucn.org](http://www.iucn.org)
- The Society for Conservation Biology [http://conbio](http://conbio)

Other tips:

1. If you are having trouble making everything fit, you have too much stuff.
2. If you have long paragraphs, break them up with line spaces.
3. You can use bulleted points rather than paragraphs.
4. Each figure/table should be numbered and referred to in the text. Each should have a heading of one or more lines that provides a brief (one or two lines) “take home” message.
5. Choose fonts that are easy to read, don’t overuse bold or italics. Background colors or patterns can make text tough to read – use carefully.
6. Some relevant pictures can make the poster more aesthetically presentable, and easier to read.
7. Avoid unnecessary details in preparing figures, drawings or illustrations. Try to keep everything straight forward. If you are copying a figure and the font is too small, rewrite it!
8. Arrange material in columns rather than in rows. See example posters on Canvas.
9. Make sure your names appear on the poster under the title – in big letters!