Diagnosing declining numbers.

We're still following the text, though we're bouncing in and out of chapters 8 and 9 and looking at things in a slightly different order.

A lot of the material in chapter 8 was already covered, though the text emphasizes on how to determine the cause a bit more than we did (an important point, and what we're starting with).

A review of what we've done so far in this class:

1. Discussed the problem, generally by using examples of animals in trouble.

2. Examined the causes (in general) of declining species (e.g., habitat loss, deforestation, introduced species, etc.)

3. Done some math that is important because:

a) it lets us get population parameters (which help in diagnosis)

b) it allows us to examine the effect of genetics on populations (and get a better handle on the extent of this problem).

c) it allows us to get initial estimates of required reserve sizes (should this be required - note that this is only one "solution" or "treatment" available).

In summary, it lets us use analytical tools to get at the problems and solutions.

Now what we need to do is take some if this information and start using it to try and figure out how to help species that are in trouble.

We'll follow the generally suggested outline in the text:

1) Determine that the species is in trouble.

This can be more difficult than it appears.

- if data is only available for a one or two years, this does not confirm that the species is in trouble.

- for example, we measure the current population of banana slugs and find 5000 individuals. Does this mean anything? Not unless we have other data to suggest that the number of banana slugs used to be far higher.

- if we do have data on consecutive years (e.g., 10,000 banana slugs in 1995 and 8,000 banana slugs in 1996), does this mean anything? Maybe, but not necessarily. It could just be a dry year and banana slugs are having a hard time, but are in general doing just fine (a wet year in 1997 might show 12,000 banana slugs).

- To do this correctly requires data for more than just a few years.

- Some points:

    - Don't let this dictate what you're doing. Sometimes it's obvious a population is in trouble, and waiting around to measure population data for several years might mean watching it go extinct!

    - If all else fails, use whatever data there is, including local information such as "it used to be much more common".

    - Even if data is available for several years, analyzing a decline may depend on the method used to analyze the data! You've got to know what you're doing, if you don't, talk to someone like a statistician.

        - Example in text shows a declining population, but the methods illustrated give two very divergent views as to how long this population will survive (if nothing is done).

        - One estimate shows this population of Caribou going extinct in 1984 (actual data shows 1917 animals in 1986!), another estimate indicates 2063.

        - Some statistical comments:

            - Neither regression is significant at 5%. But what happens if we say "we have no evidence to show that this population is declining?"

                - We may well have made a Type II error (fail to reject if H_0 is false). In this case the cost of making a Type II error is serious and could lead to extinction.

            - Once we're outside the range of our data, we have no idea what will happen. "2063" is way outside of our range of data, so who knows how good it is? If we could predict what would happen on tomorrow's stock market....

- If you haven't had statistics, the r^2 that is mentioned has NOTHING to do with r = rate of increase (it's a measure of how good our regression is, though you need to be very careful in using it).

- Estimating the trend in a population becomes more difficult if there is a lot of environmental fluctuation that affects the population (e.g., my slug example).

- There are other ways of determining trend:

  - One could estimate survival and birth rates (usually more difficult in the field).

  - Failing all else, one needs to rely on the knowledge of locals (as mentioned above). Do not ignore this, it may be the best information available.

Contraction of range:

- If a species disappears from a part of its range, this is often a sign that the species is in trouble.

  - Careful - this might be just a temporary contraction of the range due to social, environmental or other reasons.

  - But usually this is a sign that something is wrong.

  - Often the only sign - population data is sometimes difficult to get. The figure on page 8.3 emphasizes this.

    - For about 320 - 330 species of endangered birds in the Americas, we have population estimates on only 90.

2) Natural history.

To really know what to do, we need to know a little about the biology of the organism we're looking at.

- An absurd example: suppose that we decided that the reason the elephant was in trouble was that there were not enough lions around for the elephant to feed on. This is really stupid, but the point is that if we don't know even the basics about an organism, how can we hope to deal with conserving the species?

- The text makes the point that nothing helped the Big Blue Butterfly until the ecology was finally understood.

- Don't go overboard either. If a species is in trouble, we need to know enough biology so that we can construct hypotheses about why the species is in trouble. We don't necessarily need to start "banding everything in sight,...estimating age-specific rates of fecundity and mortality", to quote the text.

  - Save that up for when we've managed to stabilize things a bit.

3) Diagnosing the problem.

Once we've got some idea of the natural history, what can we do next? Come up with a list of possible causes for the decline of the species (this will often include a lot of the factors we discussed previously (or specific examples of each)).

Example: The brown tree snake

- We've already discussed this, but notice that the problem was elucidated, then several possible causes were considered and rejected. Finally, the snake was blamed as a possible cause of the disappearance of birds. This was tested by developing three predictions and verifying these.

  - It's not always that easy!

Example: Palila

- A honeycreeper (small bird) from Hawaii. Only partial progress had been made by the time the book was published. This pointed to low breeding success as being the culprit. Unfortunately, predation as a factor in causing low breeding success has been ruled out (unfortunate because that is the only thing tried so far). Food availability or other resource might be the problem, but we don't know.

[Note: The book presents an outline right at the start of the chapter, and then proceeds to go through these points one at a time. However, #'s 4 & 5 in the outline are part of (3) as the book proceeds. According to the outline, 3, 4 & 5 are:

3) List all possible factors that might cause the decline

4) Measure the level of each factor

5) Test thy hypothesis developed by 4 & 5 to verify.]

The rest of this part of the book covers material we've already discussed.

- Some of it has already been used in lecture.

- Some came from a different text.

- The book concentrates on tying together the specific causes and effect (so, when the text talks about overharvesting, it picks specific examples and discusses how we know that this is the problem). Some brief examples:

Graphs showing the relationship between harvesting and population numbers for various seals (all show a decline in numbers as harvest increased, and sometimes a recovery as harvest ceased.

Habitat - kind of obvious. Even with something like the woodhen, where pigs were to blame - but they were to blame because they kept the woodhen out of its preferred habitat!

Habitat fragmentation - New England Cottontail rabbits are in trouble due to habitat fragmentation - a nice little study tests predictions and verifies this as the cause.

Introduced animals/plant - numerous examples of a decline in local populations coinciding with the introduction of an animal. We've had numerous examples in class and the text gives some more (e.g., mongooses and cowbirds island hopping and driving local populations down).

Pollution - egg shells/birds of prey, etc.

- Again, an emphasis is made on showing cause and effect.

To conclude this section:

Establishing a cause and effect is critical if a decline is to be reversed. Establishing a reserve is totally useless, for example, if the reserve includes an introduced predator that is causing the problem!

It is sometimes difficult to separate out the exact cause of the problem. Often there are confounding effects, and even if a study is planned, unless one can separate out, for example, different predators (e.g., pigs vs. rats), it's hard to know how to move forward.

Don’t get bogged down in this - if a species is in real trouble, then all that may be possible is to capture them to try and ensure their survival in captivity and then worry about the causes at a later date.

- Still, we’ve seen several examples where this has backfired and actually caused the extinction of species.