The restoration of gray wolves in Yellowstone Park: Conservation Genetics

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Bob strode towards the south end of the conference room. It was now afternoon. The Endangered Species Act discussion had taken the most of the morning, and the short lunch that Secretary of the Interior Bruce Babbitt's office had served had done nothing to satisfy his hunger. However, the morning's doughnuts hadn't been depleted, and there was an apple fritter with his name on it.

"Bob, I'm going to need a lot of help with the next couple of discussions." It was Secretary Babbitt. "I've got to admit, I know next to nothing about genetics. So, let's sit down before the meeting starts up again, and see if I understand the conservation genetics issues involved with our wolves."

"Nuts," thought Bob. "There goes my apple fritter."

"You're right, sir," he responded to Secretary Babbitt. "The theories involved with the population genetics can be kind of tricky. But, it was a topic that came up more than once in our hearings, and there are a couple of concerns."

Sitting down to the table, Bob pointed to the map of the proposed reintroduction areas.

"As you can see," Bob motioned, "we have three main reintroduction areas. It is good to have three zones of introduction, as it may prevent a stochastic extinction event occurring." Bob was watching the Secretary's eyes, and when he said "stochastic" he could see them start to glaze over. "Keep it simple, stupid," Bob thought to himself.

"You see, it's kind of like investing in the stock market. If you diversify, like investing in three different stocks, there are fairly good odds that at least one of them will do well. Your total returns might be a little lower, but in the end it is a safer policy. However, if you buy one stock, and it does well, then you are pretty happy. On the other hand, it that stock starts heading south, you're in a world of hurt."

"OK, I can see that," Secretary Babbitt replied. "But tell me what that has to do with population genetics of our wolves."

"Well, having 3 populations, at first, is good for preventing random mortality events, like winter storms or disease, from killing all of the wolves. And, we'll get back to this when we talk about the population viability of each population," Bob said. "But, having 3 smaller founder populations may be bad in terms of genetics. In the beginning, each population will probably be somewhat isolated from the other 2. That creates problems, because there may be a lack of gene flow between the populations."

"Also, in smaller populations, a condition called genetic drift can occur." The Secretary's eyes were really glazing over now. "Think of this as just a random loss of genetic variability," continued Bob. "So, we start small, which means each population may have limited variability, and the genetic variability may get worse over time. For example, one of our initial populations may not have genetic resistance to a disease that we haven't even thought about--and, it's just by dumb luck, because their population is so small. Or, if a few members of the population do have the genetic resistance, it can be lost over time if they don't mate, or if they fail to pass on that gene to their offspring--again, just because of dumb luck."

"I thought we were talking about putting 100 animals in each area," responded the Secretary. "That sure seems like a big wolf population to me!"

"That is a lot of wolves," agreed Bob, imagining what it was going to be like to capture and transport that many wolves over a period of a few years. "But, it isn't as straightforward as that. The effective population size may be much lower than 100 wolves, and again, these wolves won't be having contact with the other reintroduced populations for some time."

"I thought the biggest genetic question," interrupted the Secretary, "was the problem of hybridization with coyotes. You biologists can figure out the math on the effective population size--I just want to make sure we put enough wolves out there that they don't disappear in 20 years or less. But, one of my aides tells me there is a really good chance that in a few years we'll have spent millions of dollars on this reintroduction to find out that all of our wolves have mated with coyotes. That's just crazy--is he right?!"

Bob was spared answering the question immediately, as the rest of the group had re-entered the room from lunch break.

All eyes were on Mollie Beattie, Director of the U.S. Fish and Wildlife Service. "We have some good news," she reported to the group. "I've just heard from the Senate appropriations committee. They are giving us more money than we thought for the research portion of the reintroduction. If this thing ever gets of the ground, it looks like we'll have some money to do some post-release genetic analyses of the wolf populations as they begin to grow. I think we'll all be anxious about the potential for inbreeding to hurt the reintroduction--we should probably start making contacts with University research teams interested in submitting pre-proposals for the money."

"Bob, I've heard that Mike Quince at the University of Minnesota has done some analyses of the Isle Royale wolf population. I think he is using new mitochondrial DNA techniques."

"Mitochondrial?" huffed Bob. "You're past my expertise there. The last study I looked at used allozyme data from red blood cells. I'll have to defer to one of our lab techs on this question!"

LEARNING ISSUES: What information do you need to determine how many wolves should be released?

LEARNING ISSUE REPORTS: your assignment

Group assignment.--Explore the discussion questions and learning issues. As you are given more information, continue your discussion of these issues. Your group is assigned to compile a short summary of answers to the learning issues that we develop. These should be succinct paragraphs. Include citations for material that requires citing.

Individual assignments.--You will be given three assignments to complete individually. You may work together on the assignments, but each individual will turn in their own assignment. First, you will write a 2-page pre-proposal for a post-release genetic research project as described in the problem. See below for a link to the RFP for this pre-proposal. Second, we will conduct a laboratory electrophoresis genetics experiment, which will require a short individual report on your group's analyses. Third, you will be given your classmates pre-proposals, anonymously; you will rank the proposals as if you were on the committee making the funding decisions.

The group learning summary and the pre-proposal are both due in class on Feb. 19th. Your evaluation of the pre-proposals is due in class on Feb. 26th.

Questions for Discussion:

1. What factors could potentially make the effective population size less than the actual number of introduced wolves?

2. Is Bob's stock market analogy a good one for describing the benefits of a sub-divided population, or metapopulation?

3. If genetic variability in the populations is low, or becomes low, how might the population suffer?

4. What are "stochastic" events? How are they different than "deterministic" events?

5. What landscape features might impact the dynamics of the metapopulation of wolves?

6. Why might wolves be able to hybridize with coyotes? What ramifications does this have for concept of "species"?