

PANEL DISCUSSION (CONWAY, HEDRICK, O'BRIEN, SCHAAL)

George Amato: Thank you very much, Barbara. I invite the other members of this session to come up. We will have a couple of minutes for a brief panel discussion, to take just a couple of questions.

And, while they're coming up, a couple of announcements....

I'll start with one question here for the panel. And then, time allotting — we have about ten minutes — we'll take some questions from the audience.

As I've listened to people's discussions this morning, there seems to be sort of an interesting welcome to the notion that genomics and biotechnology may play some role in conservation. We had some good examples — we had some cautions. And I guess I would ask the panel: How do we marshal resources to explore these new technologies without distracting and taking away resources from other conservation strategies?... Bill, would you like to start?

William Conway: No. (Laughter). Marshalling resources for any sort of conservation effort today is an extraordinarily difficult job, particularly when we have a national administration which is directing resources originally intended for conservation for other kinds of activities.

The only way we can marshal resources in the long run is by convincing the public, in general, that what we intend to do is worthwhile, is inspiring, and can be done. In my view, genetics is such an extraordinarily exciting and dynamic science — so closely related to us as human beings — that it has a tremendous opportunity to do just that. So by relating ourselves to the problems of the creatures we share the earth with, we have an intellectual opportunity.

Going beyond that, I'm afraid that we come down to the basic rules of how we save endangered species: the four E's and an O. Why do you save an endangered species?

Ethics — there are those who would say it has a right to survive. Esthetics — it inspires us; it's beautiful. It's wonderful — it instructs us. Economics — it makes money for us. Ecology — it helps to sustain the earth, in which we live. And future opportunity — that's the O.

I'm sure that there are others here who can speak more succinctly, but there's a start, perhaps.

GA: Thank you. Steve, would you like to comment on this resources issue?

Steve O'Brien: Yes. I agree with what Dr. Conway has said. But I'm old enough to remember other competition for resources in biomedical sciences, and I think there are some lessons here to be learned. Twenty years ago there was something called a virus cancer program as part of NIH, and the people who weren't working on viruses criticized it a lot, because there weren't any human viruses that were causing cancers. And they pretty much closed it down, the year before the AIDS virus was discovered, which causes cancer and is a huge disease — and it's a retrovirus, and hepatitis, and other things. So that was really kind of a destructive argument between scientists in different disciplines, who were battling over the resources that were available.

When the Human Genome Project started out, there was a dialogue which got very bitter, where people were arguing that people who weren't going to sequence the human genome were doing, you know, monkey's work. And there was a lot of disagreement over that. When Tony Fauci asked for an extra \$100 million to fight AIDS, there were people who opposed that. And all those debates were useful — but in many ways, they were all simply because people were afraid that money from one discipline, that they were interested in — was going to be funnelled into another.

And I think that this can happen in conservation, too. That we have somebody who's interested in ecology, or in politics, or in management, or some aspect of conservation — see that genetics gets a lot of attention, and they might be tempted to criticize it.

But in each of the examples I've given, the money actually came from other places. It was developed explicitly because it was the right thing to do. And it actually made more money for the other fields — the people that the critics were coming from. They got more money as sort of overflow. Although the debates are important, we have to stop focusing on the competition and focus a little bit more on the partnerships and the complementarity of the different parts of conservation.

GA: Thank you. Phil or Barbara — would you like to comment? We can take a question from the audience? Yes.

Question: [Inaudible]

GA: If I could repeat the question, just so the audience knows: how do we really know whether what we're calling "neutral markers" are really neutral? And I'll let Barbara begin with the answer.

Barbara Schaal: Well, I think we make the assumption that many of our markers are neutral, or nearly neutral. I think for much of what we do, in my opinion, it doesn't make that much difference.

I'd like to go back historically. I'm old enough now that I remember the excitement when allozymes were first developed. And the reason that people were so excited about allozymes was because we could go out into native species and get some index of genetic variability.

Likewise with DNA markers. It allows us to actually assign genetic variability. These are characters that are under genetic control, unlike phenotypic characters, where there's a genetic basis. Often there's an environmental basis, and there's a gene-environment interaction — and epistasis, and all of the other lovely things that we study. So even if there are some limitations, neutral markers may not tell you phenotypic variation in some cases. But they do allow us to go out into any kind of species and to assay variability — and that's extremely important.

I think when you get to something like where you find no variation, and you are interested in phenotypic variation, then you have to do different kinds of studies. And maybe Steve or someone would like to comment on that. In spite of limitations-- they're better than not having them at all. And I think in so many cases they've been extraordinarily valuable. And I can't count on my hand the number of cases where they haven't been useful.

GA: Phil, would you like to comment on that?

Philip Hedrick: I was going to say, it would be wonderful if we could use neutral markers to assay population variation, individual value and so forth — and, in some cases, we probably can. You know, I think having many, many microsatellites — there's, you know, 6,000 microsatellites in humans. So you've got huge amounts of potential there for measuring variation. You might be able to get a very good assay of the level of inbreeding of a particular individual.

So it would be nice if they were correlated. I think we have to be careful about the exceptions. There are exceptions where populations, for example, may look identical for neutral markers, but may be very different for adaptive variants. Or vice versa. You may find important differences for neutral markers that may be statistically significant — but yet, there may be little difference in adaptive variation between these groups.

So I think — this may just be my academic caution here—I think you have to be careful about both of these situations, and think about it in that context. I think we would like to have neutral markers be a kind of diagnostic that we could use for adaptive differences or detrimental differences. Potentially, it tells us what could have happened — what adaptive differences could happen — but it may not always be that tight connection that we'd like to have.

BS: But you don't want to forego a study just because there might be a problem with the neutral marker.

GA: We have probably time for just one more question. Craig?

Q: [inaudible question from audience.]

BS: — salt cedar.

Q: Yes.

BS: I hate salt cedar, myself.

SO: People — people do well.

WC: Yes—as Steve says, people seem to have done rather well. (Laughter). There are an enormous number of introduced species that have done extremely well under remarkable conditions. I was amazed to find, down in the center of the wet part of the Andes last December, feral cattle in the most improbable place — if you know the history of cattle.

I'm not sure what this teaches us, except it does tell us a lot about the adaptability of particular species. There is more elasticity than we might have imagined. And sometimes when we deal with what we consider a very highly specialized species, we get surprises. But I'm not sure that there are generalizations we can make. We'll probably have to always approach each species rather carefully. And we have to remember that, whenever a species population becomes small, its ecological value becomes tiny. So that the reciprocal effects that it has in its environment — the effects it has on other species of plants and animals — gradually moves toward the vanishing point. And its environment then changes.

When we put a new species in that manages to adapt to an area — such as *Acridotheres*--the mynah that was introduced into Hawaii has had a *terrible* effect there. Because of the diseases it's brought in, and because of the way it has fed on local plants. No one could have anticipated that. I don't think we'll be able to anticipate what happens when climate changes to the environments that we have set up as reserves and parks — and we'll have to manage them, to some extent, as I said, as mega-zoos — which, I think, is terrible. But there it is.

GA: Well, in the interest of trying to stay on schedule, would you all please join me in thanking the speakers from this session, for their very interesting discussion.

(Applause)

GA: Thank you very much.... I'd like to introduce the moderator for our next session — Dr. Don Melnick. Don is the director of the Center for Environmental Research and Conservation at Columbia University, where he's also a professor in the anthropology and biology departments. Don has directed a significant major conservation genetics program for a great many years at Columbia University, and we're happy to have him moderating here today.

(Applause)