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Intelligence Squared U.S.

Don't Bring Extinct Creatures Back To Life

For the Motion: Dr. Ross MacPhee, Dr. Lynn J. Rothschild

Against the Motion: Stewart Brand, Dr. George Church

Moderator: John Donovan

AUDIENCE RESULTS	
Before the debate:	After the debate:
31% FOR	48% FOR
48% AGAINST	44% AGAINST
21% UNDECIDED	8% UNDECIDED

00:00:00

[applause]

John Donovan:

Remember “Jurassic Park?” Amazing movie where science brings dinosaurs back from extinction. Okay, that film took sides; the experiment blows up; people get hurt. But not before actor Jeff Goldblum declares, "Scientists were so preoccupied with whether or not they could that they didn't stop to think if they should." And then, a dinosaur eats Jeff Goldblum.

[laughter]

Well, we do not take sides at Intelligence Squared U.S. That is what the debaters are here to do. But we are taking sides on the fantasy at the heart of that movie because the science is now getting real. Right now, some very smart scientists and thinkers are working on a way to revive, not dinosaurs, but other extinct species or near replicas of them, or animals that have those traits, like the woolly mammoth, using the gene editing technology known as CRISPR.

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To paraphrase Jeff Goldblum, should they? What are the risks? But also, what are the benefits?

We think this has the makings of a debate, so let's have it. Yes or no to this statement: don't bring extinct creatures back to life. I'm John Donovan, and I stand between two teams of two, experts in many aspects of this topic for and against that resolution. As always, our debate will go in three rounds, and then our audience, here at the Kaye Playhouse at Hunter College in New York City, will choose the winner. As always, if all goes well, civil discourse will also win. Our resolution, don't bring extinct creatures back to life, let's meet the team arguing for that resolution. Please first welcome Dr. Ross MacPhee.

[applause]

Ross, welcome to Intelligence Squared. You can stay seated there for this conversation. You're a paleomammalogist and a curator at the Department of Mammalogy at the American Museum of Natural History.

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You are also the author of the new book, "The End of the Megafauna: The Fate of the World's Hugest, Fiercest, and Strangest Animals." Help us out here. What do we mean by "megafauna," and what is the fate of the megafauna?

Ross MacPhee:

Thank you, John. Well, megafauna just means big animals.

[laughter]

John Donovan:

That was so easy.

[laughter]

Ross MacPhee:

This is clearly an educated audience. So it also includes things that we're going to be talking about tonight, like woolly mammoths, which are extinct. But I want to draw a line under the fact that there are still surviving megafauna, rhinos, elephants, hippos, and others, who are, in many cases, in very dire circumstances.

John Donovan:

Thank you, Dr. Ross MacPhee.

[applause]

And, of course, you have a great partner. Please, ladies and gentlemen, welcome Dr. Lynn Rothschild.

[applause]

Lynn, welcome to Intelligence Squared. You are an -- you are an evolutionary biologist, and you're an astrobiologist like everybody else in the room.

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You are also a professor of molecular biology at Brown. You've been the faculty advisor to the award-winning Stanford-Brown iGEM team. That team has been pioneering the use of synthetic biology to accomplish human settlements on Mars. Can you tell us a little bit about what that means?

Lynn Rothschild:

Absolutely. What you didn't mention is that I also am a scientist at NASA. And our big problem --

John Donovan:

That's on Thursdays I guess, right?

[applause]

Lynn Rothschild:

[laughs] Thank you. I was told by my siblings that's all I need to say.

[laughter]

Really, our big problem at NASA is to launch things into space. That's what's expensive, is to fight earth's gravity. And if you start to use biology as a technology, a technology that can do things that no other technology can do, like self-repair and reproduce and so on, that computers can only dream about, I believe that you can solve the problem of human exploration.

John Donovan:

Absolutely fascinating. And this is the team arguing for the resolution, don't bring extinct creatures back to life.

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[applause]

And now we have a team arguing against the resolution, which means they do want to do this work. Please first welcome Stewart Brand.

[applause]

Stewart, you are a true legend and an icon. You founded the award-winning Whole Earth Catalog. You cofounded the Long Now Foundation and Revive & Restore. That's a movement that is facilitating the revival of extinct species. You have written tech books. You have written science books. You are credited with helping to found the Environmentalist Movement. There

is a famous quote attributed to you, Stewart, "We are as gods and might as well get good at it." What did you mean by that?

Stewart Brand:

Well, that was 1968 in the Whole Earth Catalog. And I was talking about personal power of man. But it still sort of applies now when we're realizing that we're the most powerful species on the planet. And now, I think it's -- we are as gods and have to get good at it, given climate change and everything else.

00:05:03

John Donovan:

All right. Thank you very much. Ladies and gentlemen, Stewart Brand.

[applause]

And an extremely esteemed partner you have on your team arguing against the motion. Ladies and gentlemen, please welcome Dr. George Church.

[applause]

George, welcome to Intelligence Squared. You are a professor of genetics at Harvard Medical School. You are a professor of health sciences and technology at Harvard and MIT. That doesn't say half of what you're known for. You have earned dozens of awards and honors including Time magazine's 100 Most Influential People. You developed the first direct genomics sequencing method. That resulted in the first genome sequence ever. In all of this that you've been doing all your life, what inspires your work?

George Church:

Well, I'm inspired by my students who go on and do things for society. I'm inspired by all the things -- all the opportunities in medical research to help people live healthier lives.

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John Donovan:

That's a lot of inspiration. Thank you very much for joining us. George Church.

[applause]

And the team arguing against the resolution, don't bring extinct creatures back to life. Now we move on to the debate proper. We go in three rounds. Round one will be opening statements by each debater in turn. Up speaking first for the resolution, don't bring extinct creatures back to life, is Dr. Lynn Rothschild, evolutionary biologist and astrobiologist. Ladies and gentlemen, Lynn Rothschild.

[applause]

Lynn Rothschild:

Thank you very much. Well, I'm going to be honest with you. I'm not really as involved in this field as some of the other distinguished people on this stage. In fact, any of the other people on this stage. In fact, because of the double negative, when I was first invited, I actually thought I'd been invited to speak on the other side. And so, I already knew what the killer argument was, and that was, if coffee, tea, or, God forbid, chocolate went extinct, that would be an international priority.

Billions would be put into it. You know, forget the wall. We're making chocolate back.

[laughter]

So, you know, that was going to be it.

00:07:00

We could end the debate, I win, all over. And then I discovered that actually, I was on the other side. And so, [laughs] I thought about that for a moment. I said, "Well, what do you mean, then, by "creatures?" Because I already had the argument for plants. And went to the dictionary, and both the American and the English dictionaries define "creatures," really, as moving animals so that we're starting to talk about something very far from chocolate or coffee or something like that. And what we're really going to be discussing tonight are a few apex species such as the woolly mammoth, a few birds, passenger pigeon, heath hen, probably, and the odd giant tortoise.

So I took a deep breath, because I did definitely want to say I wanted to be here tonight, and said, okay, let me delve into the literature. And so what I'm hoping to do today is take you along on the journey that I've been through for the last two months and convince, as I've managed to convince myself, that we don't want to bring back these extinct creatures.

In fact, what I don't believe is that it's a problem of the technology. What I don't want to do is get into the position where we're saying, "Oh, yeah, in 10 years, we're going to be fine," and I'll come back and I'll sit with my distinguished colleagues on the other side of the aisle.

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But, in fact, I could say that these arguments are going to hold. It doesn't matter how crisp or even "CRISPR" your arguments --

[laughter]

-- we're still right. So, now, as an evolutionary biologist, obviously, it would be amazing to bring back extinct creatures. You poke and you prod them and you study them. But that's not really what this field's about. What we're really talking about here is some kind of mixture, because there's only one creature that I can think of you actually could bring back from the dead, and it's been done, and that's a virus. The horsepox actually has been brought back. It's been de-extincted. Now, I don't need to give you a lecture on viruses for you to imagine how horribly wrong that de-extincting viruses can go. So, at the other extreme, we could talk about de-extincting individual genes.

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For example, there is a very sad disease where people do not have the genes to be able to repair damage in the UV radiation, in the sun, and they have to stay inside all day and so on. Now, if the whole human population lost that ability to go outside, we would say we need to de-extinct these genes immediately. But that's not what we're talking about with de-extincting creatures. I would like to call that therapeutic de-extinction. We're talking about one or two genes. So that's not it. So let's now speak really about what the issues are. And as I started to think of them, most of them started to start with the letter E, and so I'm now going to call these like the seven Es. The first one is for extinction. We have to think, why did these creatures go extinct to begin with? And is there any reason to think it would be different a second time?

And even if you start to bring them back, you're going to have real problems, inbreeding depression, just as we've done with the domestic dogs. Think about what's happened with the English bulldog. It's been a terrible, terrible situation.

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So, if you really want to bring back extinct creatures, you better be prepared to bring back over 100, so you have the genetic diversity. In fact, the only organism I know that doesn't have this kind of, what we call, inbreeding depression, is bed bugs and, you know, we -- let's not go there.

Evolution, second E, even if we bring these back to life, we're not going to be able to control how they evolve in the future. And with the severe inbreeding, I don't think they will have a future. Ecology; no man is an island, and neither is any other creature. We need an ecosystem in order to survive. So we can think a lot about the examples of reintroducing species into environments, like the gray wolf into Yellowstone. There were all sorts of downstream effects. But ecology's very complicated, and it certainly wasn't so trivial when we reintroduced or introduced rabbits into Australia. It was a total disaster. But we also have an internal ecology, our microbiome. And if we even bring back something like an extinct mammoth, it's not going to have a mammoth microbiome.

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Oh, yes, there are examples of doing microbiome transplants and so on, but your microbiome affects what you can eat. It affects your immune system, your attitudes, your emotions, and so on. And so, again, what are we really doing? We're creating some kind of hybrid ecosystem.

Ethology, the science of behavior; all these things like birds and mammals have to learn from their parents. And what parents are going to be around to teach them? Again, we have examples where, for example, in California, we've had the reintroduction of the condors. There was the passive breeding program with very few condors, and what they tried to do is to feed these -- the little hatchlings using a mother condor puppet. And that was better than having them imprint on the humans, but still, when these poor creatures were released into the wild, they had an unnatural affinity for humans. They didn't behave the way they should, for condors. Another E - the fifth E is economics.

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According to Performing Animal Welfare Society, a healthy elephant costs about \$70,000 per year to care for, and an elderly elephant costs a good deal more. And, of course, we're not talking about one. We're talking about many, many creatures.

Emotions; we may have this feeling that this would be a great thing, and we feel this sense of loss when we lose a species, and I know, if you remember on New Year's day, the last of a certain species of snail, with the cuddly name of George, died. And we all felt bad, but really, look at yourself in the mirror. Was that really important to you that George died, that the one last snail of some species -- I don't even remember the name -- died? Is that a reason for de-extinction?

And finally, the last E is ethics, which Ross will pick up on. And here, we're talking about things like restorative justice, animal welfare, but we have to also think, "What are we doing? What is restorative justice? Are we making ourselves feel better because our ancestors way back years ago may have been involved in the extinction of this creature, or maybe 100 years ago?"

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Do we have the right to create individual suffering in order to assuage our guilt or maybe take this blood libel of our ancestors off of our hands?

John Donovan:
Lynn Rothschild, I --

Lynn Rothschild:
And I would argue that's not right.

John Donovan:
I'm sorry, you're time is up.

Lynn Rothschild:
Okay, I would just like to say that I wish my opponents the best of luck, and I hope that if they convince me, that I will encourage you to vote for them, and conversely, if we convince them, they encourage you to vote for us.

John Donovan:
Thank you, Lynn Rothschild.

[applause]

Our resolution is don't bring extinct creatures back to life. And here to be making his opening statement against the resolution -- in other words, he supports bringing these creatures back to life -- here is Stewart Brand, founder of the Whole Earth catalogue, and cofounder of Revive & Restore. Ladies and gentlemen, Stewart Brand.

[applause]

Stewart Brand:

I'll give you a little context why I think de-extinction's a good idea. I've been a conservationist since I was 10, which is 70 years ago.

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And when I went to Stanford, I got my degree in biology and evolutionary biology and ecology. Then, later on, thanks to Ryan Phelan here, my wife, we cofounded Revive & Restore, whose function is genetic rescue, basically bringing biotech to wildlife conservation.

The idea that has changed everything is what we've been learning about in terms of biotech, which is that you can now sequence extinct species from museum specimens, and find out exactly what their genome was. You can sequence closely related species and compare their genomes, and then look at what's different, and then move what's different that's important through George Church's technique from the extinct genome into the living genome, and start to recreate the extinct genome and the extinct animal.

This requires having a related species, and so with the mammoth, it's the Asian elephant, which is closer to the mammoth than it is to the African elephant.

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There's the passenger pigeon on the west coast; there is the band-tailed, really closely related. Here on the east coast, the heath hen is very close to the greater prairie chicken, and sequencing that we did proved that it was not a sub-species; it's a different species and worth bringing back.

There was a penguin of the North Sea called a great auk, which is an entire penguin-like pelagic bird that lived in the sea, in the entire North Atlantic, from here to England. And there's even the dodo, which has been sequenced. And where the great auk has the razorbill as the closest living species, there's actually -- the dodo is a big pigeon. And so, the Nicobar pigeon is really close to it.

What we usually have is people go, "Oh, de-extinction, cool idea. It's so cool, there must be something wrong with it [laughs]." And then, they start trying to find things. And then, next thing you know, it's "de-extinction is controversial." It's -- people made up problems.

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What you wish is that maybe an umbrella organization, like the IUCN -- the International Union for Conservation of Nature, which main-changed the red list of endangered species and extinct species -- if they could just put together some kind of group that would figure out, "Is this practical?" and "What would be the guidelines to do de-extinction properly?" That would really help. Well, it happens, five years ago, that group came together, and two years later, they came up with the IUCN Guiding Principles on Creating Proxies of Extinct Species for Conservation Benefit.

And what's interesting is they're saying, "Look, most of this is the same as what we already know

and we already do that, which is re-introduction of species in places where they haven't been in a while, transportation of species from where they've gotten to now back to where they used to be, and even ecological replacement of one species for another, to serve the same ecological function."

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The protocols and the practices are all in place. They've been there increasingly over 200 years. So, you know how to do captive breeding. You know how to do a soft release; you do these various things that have worked very well. They're just saying that de-extinction of the species are in that category; they just happen to be getting there by new technique.

So, they're basically referring to the wolves in Yellowstone that Lynn talked about, that were brought in as an apex predator, and actually moved the whole ecosystem back to a better condition. You know, bringing beavers back to Sweden, and now to Scotland, and even to England. And they're ecosystem engineers that are very important for making the whole landscape much richer for more kinds of creatures. The condors that Lynn mentioned. There were just 27 left when they went into captive breeding. There's now nearly 500. Half of them are in the wild, and they're having progeny in the wild.

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There's a black-footed ferret that we work with, America's most endangered animal -- mammal. And we're working on helping make it resistant to diseases killing it. Right here in New York, you had American chestnuts that were one quarter of all trees. And just 100 years ago, the chestnut blight came through, killed 4 billion trees, made them functionally extinct. But thanks to genetic engineering by Bill Paulette, SUNY, they're now coming back. We're just going through the process of getting the regulations squared away because they're a food plant, and they will come back and providing great chestnuts soon enough. But most interesting is the peregrine falcon, which went extinct in the east, so it's the eastern peregrine falcon back in the DDT days, in the '70s -- they were gone. Ornithologists started hybridizing various other kinds of peregrine falcons, including some in the Mid-East. They started releasing these mixed birds. And those mixed birds prospered, and that's why you have peregrine falcons in New York now, helping keep pigeons at bay.

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[laughter]

That was kind of a generalized hybridization. What we can now do with biotech and with CRISPR is what you might call precision hybridization, so you can get exactly what you want, pretty directly. Tested in the labs. They already know that it's viable and then move on. So the main event, really, is bringing biotech tools to the problem of human health, that George's worked in, to ecological health. And you can see that we're not just -- we're not just curing extinction. The technology that de-extinction is leading the way in is now being used by us and by others to prevent extinction. And that's what I hope you'll vote in favor of. Thank you.

John Donovan:

Thank you, Stewart Brand.

[applause]

And a reminder of where we are: we are halfway through the opening round of this Intelligence Squared U.S. debate. I'm John Donovan. We have four debaters, two teams of two, arguing it out over this resolution: don't bring extinct creatures back to life.

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That's the resolution. And here to make his opening statement to make that argument -- don't bring extinct creatures back to life -- please welcome to the lectern Dr. Ross MacPhee; Ross MacPhee, who is --

[applause]

-- mammalogy here at the American Museum of Natural History. Ladies and gentlemen, Ross MacPhee.

[applause]

Ross MacPhee:

Thank you, John, and thank you, audience, for coming out on a night like this. It's definitely a night that only a woolly mammoth would love.

[laughter]

So it's 2019. And ready or not, de-extinction is becoming a thing. But what kind of thing is it? Since there aren't any truly de-extincted creatures yet, despite what Stewart just said, tonight's proceedings are going to be mostly about hypotheticals, about things that may or may not happen, sort of the natural history equivalent of waiting for Godot, for a character that may come with tusks and a trunk, but may not come at all.

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As Lynn has already noted, de-extinction is not really about bringing back completely extinct species. That is species whose phylogenetic twig has been broken off at the base, and there's no way of bringing that link back. Instead, it's, from my point of view, a form of genetic cosmetic surgery. Using sophisticated hybridization techniques, as George is going to tell us about, we turn -- or hope to turn Asian elephants into mock mammoths and band-tails into Ersott's [spelled phonetically] passenger pigeons.

Now, as Lynn made clear, we're not against synthetic biology, absolutely the opposite. It has a great contribution to make to conservation biology. At the same time, we disagree with our opponents concerning the role of de-extinction, of trying to bring back species and plant them into ecosystems which they have not been in before.

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Now, I try to think of myself as a practical sort of fellow, so here are some issues that occurred to me that are important to talk about. There is no track record yet of de-extincted individuals being successfully raised from zygotes to adults and then generation after generation, so that we can be sure that there are no hidden disasters, epigenetic, genomic, what have you, lurking in your manufactured genomics. There is no methodology that's in place to gauge in advance how de-extincted creatures are going to impact other species that are in the environments that they've been introduced into. And there is no surety at the end of the day that the new life thus created -- if the experiment fails, what happens to them? And what happens when interest lags?

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So what, if anything, justifies de-extinctions? Supporters say that we can undo the harm caused by human over many millennia, or we can restore diminished ecosystems. And certainly, at some point, we may see, emerging from George's lab, some curious looking Asian elephants that will have long hair and curvy tusks and small ears and that sort of thing, and their genomes will perhaps be around 1 percent mammoth. But these creatures won't be anything, and that's the point. They won't constitute a natural evolutionary species until and unless there is a real wild herd made up of multiple individuals living in and adapted to their place on Earth just like real species. George and Stewart agree, and in fact argue, that a good place for their restored woolies would be high latitude Siberia.

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And in addition to that, they could help solve a real-world problem and at the same time restore a lost ecosystem. So, let's look at that. The idea's that the engineered elephants would act as sort of combination earth movers and gardeners. They'd turn up the ground, the tundra while foraging. They would keep tree growth down as a result. They would be manuring all over the place with the feces and therefore creating the kinds of soil conditions which would be appropriate to grow grasses and forests. You keep that up long enough, and you get what's called the mammoth steppe, which used to exist at high latitudes back in the Pleistocene.

And as a bonus, you would slow down global warming. How would you do that? By decreasing the albedo, which is the reflection of solar energy, in these areas, getting the snow to linger on the ground longer and thereby reduce the amount of carbon dioxide and methane being degassed into the atmosphere.

00:25:07

So this seems totally win, right? Jumbo gets a job. That's nice. And the planet will be saved. It's a great storyline, but it's an objective fantasy, and that's the point about the extinction. Permafrost takes about 2 million square miles on the planet now, about 17 percent of the total surface. If you had only one mammoth per square mile, you can do the math. The numbers really don't matter because it would take years and years and even centuries in order to bring back ecological conditions of the sort that we're talking about here, a grassland. And meanwhile, you'd have to provision your mammal fence at the rate of 300 to 500 pounds per day per animal because elephants don't live on sphagnum moss and pine needles.

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It is said that you can't walk twice in the same stream. Where can you solve engagement by plugging de-extincted species or replicas or proxies or looky-likeys, or whatever you want to call them into ecosystems where they have no meaningful role to play and where their roles have been taken over by others? You don't rejuvenate degraded environments by coming up with implausible jobs for genetically engineered animals whose connection with any real ecosystem either never existed or was severed thousands of years ago.

George and Stewart are well-intentioned, brilliant visionaries, but they are on sort of a nostalgia tour, sort of a bringing "Back to the Future," an adventure where the means become the ends. To which I can only say, "Hubris, hubris, hubris." Thank you.

[applause]

John Donovan:
Thank you, Ross MacPhee.

00:27:00

The resolution, once again, don't bring extinct creatures back to life. And here is our final debater making his opening statement against that resolution, Dr. George Church, geneticist and professor at Harvard and at MIT. Ladies and gentlemen, George Church.

[applause]

George Church:
So the phrase, "Don't bring back extinct creatures to life -- back to life," isn't about technical feasibility. And it gets mixed up a little bit like saying that we can only get to 1 percent is about whether we could, not whether we should. So, I'm going to make some assumptions that we could. I am happy to talk about the details, though we're having this happen.

Is there no circumstances under which we should bring back any extinct creature? Should we -- or should we at least see if there is some value and is there some cost effective roots of that? Should we do some experiments?

00:28:00

It's not about all sorts of things we wouldn't want to happen. It's what the ones -- small number of things we would want to happen. So what are the top concerns? We've heard a number of them already: the environment is no longer adequate. That is, there are 17 million square kilometers of Arctic, and it is still quite cold. The cost will take away from other conservation projects. We can -- we have made a business, my lab has, of bringing down costs. And we've seen these costs come down as much as 10 million-fold for reading and writing DNA. Doesn't guarantee that will happen. But the interesting aspect is that, if we can endow these creatures with new capabilities, derived from ancient, we might make the conservation practices on living species more suitable.

00:29:02

So at this point, I think there is this component of purity. It has to be a pure species. But we know that many species are hybrids. And I think to some extent, when -- I had a problem that Lynn had, which was I was -- I wasn't that fond of marrying back extinct species. Oh, I want to bring back -- I want to make new species. I want to make species that are more adapted to the modern world. But if we can use ancient DNA to do that, should we? That's the question. The extinct animals could be lonely. There could be behavioral issues. The answer is, bring back a herd. And diversity is certainly an issue. If we can bring back one, why can't we bring back hundreds? In fact, the diversity could be even higher than it's ever been because we have -- we can draw from many different eras which were not -- as long as we loosen ourselves up a little bit about this idea of hybrids.

00:30:03

There's a lot of hybridization that occurs in mammals. I can say this -- I have to admit, I am a hybrid, that I am partially Neanderthal.

[laughter]

So let's get loose about that and embrace this diversity. I think it's certainly an excellent point that has been made here. Do we -- is this just something that we're doing as a stunt, or we're feeling guilty for our ancestors having killed these things off? I think that's almost irrelevant. The question is, "Do these species have something to offer us? Do we have something to offer modern species like the Asian elephant, which is endangered?" It's endangered both because it is living in a land that in conflict with humans, and there's a serious herpes virus to which it is succumbing. Maybe 25 percent of the offspring are getting this herpes virus.

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Can we create a new homeland for them, which is -- does -- occupied by some of their hybridizing friends, the mammoths, and get them away from humans to this vast territory which they could help in all the ways that Ross mentioned? They could help us with our problems, where we don't want 1,400 gigatons of carbon to be released in the form of methane and carbon dioxide. And if they could be part of the solution of keeping that cold and causing grasses to be better at carbon sequestration, there's a positive argument there. I don't think this is cosmetic surgery. I do believe that, you know, it -- our -- what is it that we're really worried about? Are we arguing against rewilding? I don't think so. Are we arguing against introducing a few genes -- or sorry, changing a few base pairs because mammoths and Asian elephants are extraordinarily closely related.

00:31:58

Not only is there plenty of evidence for hybridization, but they're more closely related to each other than they are to the African elephant, which has hybridized with the -- with Asian elephants. Are we worried -- are we worried about the microbiome or the viruses? We've shown that we can eliminate the endogenous viruses from a species, the first of such with the pig. We've done that. We now have living pigs, showing we can do quite a bit of engineering on

a species, and it's going through multiple generations. So we're doing some of the things that Ross asked us to do.

Where the microbiome is going to be a combination of the microbiome of a living fauna that are being brought back into this land by the Zilmals [spelled phonetically], for example, in Pleistocene Park in Siberia, and the microbiome of the closely related Asian elephants.

00:33:00

The behavior is something that can -- that I think that if we keep putting lines to, we can handle as well. These are technologies. So the question is not whether we can, it's whether we should. So please vote that we should bring them back.

[laughter and applause]

John Donovan:

Thank you, George Church. Our resolution again is don't bring extinct creatures back to life, and that concludes round one of this Intelligence Squared U.S. Debate. Now we move on to round two. Round two is the round where the debaters address one another directly, and they also take questions from me and from you, members of our live audience here at the Kaye Play House in Hunter College in New York City. The team arguing for the resolution, Dr. Ross MacPhee, Dr. Lynn Rothschild, we have heard them say that their opponents, those who want to pursue this practice are on a nostalgia tour. They refer to the work they're doing as genetic cosmetic surgery. They point out, and everyone here agrees, we're not talking about having these creatures pop back into life full from the past.

00:34:05

What everyone understands is that we're talking about using the technology to amend the genome of existing creatures using ancient DNA. So, that's just to clarify what it is we're talking about. But the side that's opposing this, which is the for side of the resolution, argues that there is no track record to talk about the -- to reveal the hidden disasters that could go wrong. And they listed a number of them, including the fact that these creatures would not have parents to teach them how to be: if they're birds, how to fly; if they're animals, how to forage. That they would be introduced into environments, that they may not be suited for, causing harm to themselves or possibly also causing harm to the environment itself. They talk about how we couldn't really be able to control how they evolved. They talked about the economic costs of this.

00:35:00

And they also make a point that their opponents are getting carried away with sentimentality, that there's a sense of guilt about having allowed certain creatures to go extinct, perhaps at the hands of humankind, and that this is emotionally driven. And they point out that you can bring back a snail, but nobody really loves a snail.

[laughter]

Now, on the other side of the resolution, the team arguing against the resolution, don't bring extinct creatures, which means that they support the idea; they're interested in this idea. They, too, make it clear that they're not -- that they're talking about using ancient DNA to amend present-day creatures. And they say two things. One is, look, first of all, look at the potential benefits. These creatures can be endowed with new capabilities. They can enhance conservation. They can -- some creatures that are under threat now may be given traits that will allow them to survive. That diversity can -- it's something that can be engineered, that you can bring back hundreds; you can bring back herds; that would solve some of the problems of these animals having company, having teachers, having parents -- not being inbred. The economic costs are going down, they say.

00:36:08

And as far as the alarm bells that their opponents are ringing, they say there are guidelines in place. There is experience already with what they are defining as hybridization, that, in fact, we're already -- for centuries have been mixing the genes of creatures, and that this, frankly, is nothing new; that we know how to do it; and that there's a very conscious decision to lay out guidelines for this practice, that -- both its morality and its ethics. So, they're saying, you know, "Let's not be too frightened about where we're going. Let's think about the good that can come out of it." So, there is a lot -- there is a lot there. Some of it is about the science and some of it is about the philosophy. I find interesting the claim that your opponents made -- I'm talking now to the side -- to Stewart Brand and George Church; your opponents are saying that you're being nostalgic and somewhat acting out of guilt, and wanting a sense of restorative justice. And Stewart, you've spoken about that.

00:37:01

I mean, they're -- you've written, saying it would be, you know -- we kind of owe it to some of these creatures to bring them back. And yet, I didn't hear that work into your argument tonight. Is that because you've backed off that, or --

Stewart Brand:

I --

John Donovan:

Go for it.

Stewart Brand:

Yeah. I mentioned the sort of retribution, getting it back redemption aspect because some people buy that. I don't. I think the -- what happened in the past was done for its own reasons. That's long ago. Those animals are all gone. We -- you know, we owe them a lot; we can't do anything for them.

John Donovan:

I just want to encourage you all to talk out to the audience, because --

Stewart Brand:

So -- thank you.

John Donovan:

-- they're the ones you want to persuade. Sure.

Stewart Brand:

And I think what we're talking about is the present and the future. In the present, we are losing fauna like mad. We're losing wild animals like mad. And we need more bio-abundance, more of the populations we have, and more kinds of populations. Some of them, we know, are particularly affected in the past -- this is not nostalgia; it's just science.

00:38:02

And the same reason you brought wolves back to Yellowstone, because it needed that apex predator, and Yellowstone was improved when they were brought back. That's the same with all of the extinct species we're talking about bringing back. You know, they're either an ecosystem engineer -- like passenger pigeons were -- changed the forest; we made it a mosaic; or they were a keystone species. Mammoths were in several respects. Or they're umbrellas species, like the heath hen, which will encourage conservationists on the east coast to make it more of a mosaic, like you see when they prospered here. The dodo especially, Mauritius wants the bird back because it will change Mauritius as a nation, as an island, if they have that bird back. They completely go into conservation. So, that's why.

John Donovan:

All right. Let me take that to Lynn Rothschild. What I think I hear Stewart saying is that what they're talking about is really not new territory, that almost -- that the vast majority of what they're proposing, we're already doing; we have experience in it. There have been a lot of good outcomes. What's your response to that?

00:39:01

Lynn Rothschild:

Well, first of all, when you talk about something like wolves in Yellowstone, wolves have not gone extinct. They had not been out of Yellowstone all that long. And it was more predictable, what was going to happen. And actually, it hasn't been great for the elk and the deer. It's great for the other species. But as you get farther and farther away from a natural ecosystem, you're going to have more and more unintended consequences, whether they're viruses or bacteria there that are waiting to be revived, or there are other creatures that have come into fill these niches and so on -- there are too many things. In fact, I didn't become an ecologist academically because it is so complicated.

Stewart Brand:

Yes.

Lynn Rothschild:

You just can't predict what's going to happen.

John Donovan:

[affirmative]

Lynn Rothschild:

I think we're all sort of in agreement that, if you can assist these endangered species, maybe, as I called it before, with therapeutic de-extinction, maybe allow them to live at a little bit colder temperature, a little warmer temperature, whatever -- that could be a very good thing. But that's not what we signed up for. It was bringing extinct creatures back to life, and that's where I still find that the arguments are not persuasive.

00:40:05

John Donovan:
George Church?

George Church:

Yeah. I think these are -- that's complicated for me too. [laughs] It's complicated for us all. But just -- medicine is very complicated, and that's why you do clinical trials, is you prove safety and efficacy; you take cautious baby steps and see what happens. I totally buy your -- both of your economic arguments; I don't want to be provisioning them that \$70,000 a year, either. I know that they would not love a diet of moss and pines. But they're not going to be alone. They're going to -- there are going to be caribou and elks and a variety of other things that do eat moss and pines. And the elephants are the few things that will knock down trees with abandon, in about 15 seconds, and they'll back off, and they'll eat the grass while the other species come in and eat the needles and pines.

00:41:00

You just need to distribute them so that they each have their square kilometer that they're responsible for, which won't take them that long to clear the trees.

John Donovan:
Ross MacPhee.

Ross MacPhee:
That's great, George. I like that.

[laughter]

Okay, so let's have a little tundra reality. I work at high latitude in both polar regions, so I know a thing or two. The tundra is not all the same. It varies greatly over distances. The problem that our opponents took up is the idea that, if you could convert what is there now to a productive grassland, you would reduce albedo and, therefore, reflect more heat energy from the sun, which would prevent carbon being released into the atmosphere, dot, dot, dot. But here's the real problem with these scantily explored issues. The average albedo is around 30 as the mark, 30 percent reflectance.

00:42:03

Grasses are about 35, which means that they're more reflective. So what's there now with the

mosses? It's around 30, or 25 to 30. It's only bad when you get down into trees where it's going to be 15 to 20. So if you look at those percentages, and you think about the enormous effort for these animated machines, the bison and the horses and the elephants that they want to adapt for northern conditions, does this make any sense? Wouldn't you just send out a bunch of guys with chainsaws, some caterpillars, if this was something that would really work in order to turn over the tundra so that you get the kind of grassland that you want? I want to make another point. And I thought that Lynn did express this, but I'm going to underline it.

John Donovan:

Ross, could you hang on? I --

Ross MacPhee:

Yeah.

John Donovan:

-- do want you to get to that second point. I don't want what you just said to get by without a response from the other side, and I will remember to come back to that.

00:43:05

I'd just like Stewart to respond to what we just heard from Ross.

Stewart Brand:

Just a month ago, George and I were Pleistocene Park in northeastern Siberia. First time for me in the Arctic. You as well, I guess. And what we saw is that they were indeed using, in their case, caterpillar tractors to knock down trees. They would rather have mammoths, but they don't have them yet. They have a lot of other grazing animals like the musk oxen and the Yakutian horse and so on. And those creatures are making grassland. Grassland fixes carbon. They are replacing tundra, just themselves, without mammoths, with some tractors. And it's not just the albedo effect. When the animals are there trampling, getting down to the grass in the winter, they trample snow, and by reducing the snow load, the soft snow load on the ground, they are measuring the temperature of the permafrost.

00:43:59

The ground gets colder with thinner snow layer, same as if we went outside right now with ordinary clothes instead of what we've been wearing. And that is just one of many long-term beneficial aspects, I think, for a climate. And basically, you're moving in the direction of, as you have the grasslands in Africa, of a very rich abundance of wildlife. The -- Sergei Demoff [spelled phonetically] has basically studied -- done the statistics from the bones in the ground. There used to be 100 times more bio mass of animals in that whole biome than there is now.

John Donovan:

Lynn, is that something that you can take on? And, Ross, I will keep the note of that.

Lynn Rothschild:

That's marvelous. But there's nothing that you said that convinced me that you now need to add

a mammoth to the equation. You can trample all you want with the elk or the deer or whatever that are coming in, and you can increase the albedo, and you can do all this stuff. You've done it all without the mammoth. You do not need to bring that into the equation.

Stewart Brand:

I agree.

John Donvan:

Okay, Ross.

[laughter]

Lynn Rothschild:

Oh, thank you.

00:45:00

[applause]

Ross MacPhee:

So, let's start with a simple question. What is the size of Pleistocene Park?

George Church:

Sixteen square kilometers. So, yes, we've done it, but only for 15 square kilometers.

Ross MacPhee:

Well, do the math. You've got 2 million square miles to deal with if you really wanted to make a dent. And the dent that you're going to make, given that the albedo differences are not that extreme in any case, just doesn't warrant, in my view, creating animals for this purpose. I'm going to go off in another direction. You know, there was huge reaction to the Chinese scientist, Hu Jung Qui [spelled phonetically], who decided that what he wanted to do was, using CRISPR, get some zygotes that were not going to probably suffer from HIV if they got infected because they'd have the right genotype.

00:46:00

The reaction to that was so enormous all over the planet because he got no permission for it, no real permission for it. It was the wrong thing to do. So why do we think we can do this with elephants? Elephants are sentient creatures. They have self-awareness. Human babies, until they're 6 months or a year or so, are not self-aware. Your dog isn't self-aware. So why are we considering them the kind of property that we can mess with to take an Asian elephant, which is not adapted to the polar extremes at all, punch in a few genes that'll give it more body fat and hair and all the rest of it, and then set them loose. Is that really their job?

John Donvan:

Okay, that's a perfectly phrased question I want to bring to George Church.

George Church:

Excellent point. And I sympathize. However, they are currently not having such a happy life going extinct.

00:47:01

[laughter]

And faced with elephant endothelial herpes virus. So if we can -- I agree that we should be humane. We should do something that's to their benefit, not just the benefit of the planet and our selfish needs for a slightly warmer, colder planet --

Stewart Brand:

George, tell them what we discovered in Florida when we went down to the Ringling Brothers Elephant Center, and they told us the worst problem they had with Asian elephants is herpes virus. And we'd never heard this before. One quarter of all young Asian elephants are dying from this virus that they can't reproduce in the lab. What did you say?

George Church:

Well, it immediately struck me as an opportunity to make the virus and make a resistance to it. And that has been -- it's also benefited our work on herpes viruses for humans. So there will be spinoffs, but there will be spinoffs for the elephant species as well if we are thoughtful about it.

00:48:02

John Donovan:

So --

George Church:

-- which I think you're encouraging us to be.

John Donovan:

But you are saying the end, in terms of the treatment of the animals in the process of making this discover, is the end would justify the means?

George Church:

I think the ends and the means should be humane. Both should be humane. Every stage, we should be evaluating very it carefully with the kind of agreements that are represented at IUCN.

John Donovan:

Okay.

George Church:

And I totally agree that we should be -- the elephants should be part of the equation, not for nostalgia, but for their sake, modern elephants today.

John Donovan:

Lynn Rothschild, does that pledge assuage some of your concerns?

Lynn Rothschild:

I mean, I -- it doesn't assuage any of my concerns about de-extinction, but it's exactly what I said I think is a good idea, that we are really talking about gene therapy. And maybe that involves de-extincting individual genes, going back to an ancestral type of resistance to something or use the example of DNA damage or whatever. That's perfectly fine.

00:49:03

But we're just talking about a couple of genes. And I think George or Stewart mentioned earlier, we're, what? People from European ancestry are roughly 1 or 2 percent Neanderthal, and we're talking about woolly mammoths being, you know -- it's about the same percent elephant, but I don't walk around calling myself a de-extincted Neanderthal because I've got 2 percent Neanderthal.

[laughter]

George Church:

Well, we actually share --

[laughter]

I'm 3 percent Neanderthal, but even the part that's not Neanderthal shares a lot with the Neanderthal, okay? So, I mean, we're basically so similar that we apparently got along.

[laughter]

Stewart Brand:

Very well.

George Church:

Very well.

John Donvan:

Ross?

Ross MacPhee:

I think something needs to be very clearly stated. The motion is about de-extincting completely extinct species. And what -- the examples that you've talked about are examples of facilitated adaptation for living species.

00:50:03

And we are completely in complete agreement. The idea now that, with synthetic biology, you can help a species -- endangered species that are having a problem so that they get more competitive, so that they survive and so forth, is great, but the point is they're living. When we're talking about reaching back in time 10,000 years because we can now with ancient DNA and get genomic sequence for something like a woolly mammoth, that's a different thing. These are

huge mega beasts. Where are you going to put them? Siberia? That's the best place? That's what they would like, if you could ask them? I don't think so.

So here's my point; the de-extinction agenda, the real de-extinction agenda, which is bringing back completely extinct species is really more of the same thing, which is utilizing the planet, its resources, asset-stripping it for our purposes.

00:51:02

It's not for repairing ecosystems that, in a sense, don't need repairing anymore because we're already 10,000 years down the pike from what they were. The planet's getting warmer. Whether or not we get elephants up into northern Siberia is not going to change the equation sufficiently to turn the whole process back. The real problem, as usual, is us.

John Donovan:
Stewart, response?

[applause]

Stewart Brand:

Ross, you're sort of saying that this might take two centuries is a problem. I see that as a solution. I think that taking on these long-term, multi-generation, multi-century conservation projects is exactly what civilization needs to be doing. It's the kind of scale that we need to think about in terms of climate change and dealing with climate change. Woolly mammoths and the mammoth stuff are not going to fix climate change.

00:52:03

But they could be, over the long term, part of the stabilization employment by replacing what is falling with what is -- what could fix carbon. As far as it being a habitat, the mammoth steppe was once the world's largest biome. There's a lot of landmass in the northern hemisphere, and it is now -- I just saw a map today on Twitter -- the largest, in-tact wilderness is the north of Canada, Alaska, and all of Russia. That is a great place for elephants. Elephants used to be everywhere, including right here. We had Columbian elephants here. The new standard breed was woolly mammoths back in the day, as you know. And to get them back in that environment is probably a great place to start. If we're getting them back, lots of places in the world, they don't have to be restricted to Africa or Southeast Asia anymore.

John Donovan:

Lynn, I wanted to -- bouncing off of what Stewart just said, you said in your opening, the issue for you is not whether the technology can be improved, but that there are larger philosophical and statistical issues --

00:53:05

Lynn Rothschild:
Absolutely.

John Donovan:

-- that will persist, so if -- I -- on the one hand, Stewart is just positing something, a positive impact on the environment and potentially climate change through the reintroduction of an amended elephant that acts and functions and looks like a woolly mammoth. Now, I'm not asking you, "Do you believe that can happen?" I'm ask -- I'm putting it in the terms you did. If it could happen, would that beneficial outcome justify what they're talking about?

Lynn Rothschild:

Well, I think that there's a very big temptation to personify the idea of a species. Species are these abstractions that don't have feelings. It's the individual organisms do. We don't have feelings as humans. We have feelings as individual creatures, and what I worry about a lot here is what's going to happen. There have been attempts at de-extinction. No one's mentioned it yet, but the Bucardo, for example, and so on. And you have to go through an awful lot of pain and suffering, and attempts to get a single one that might live for a few minutes.

00:54:06

But even if you pull off all the technology, it doesn't matter, because then you've got the inbreeding depression. You've got all the problems of not having a mom, and not having people -- other organisms to learn from, and not having the right microbiome and so on. And so, each of these individuals, I believe, will be suffering for something that we could be solving a different way.

John Donovan:

Okay, so in other words, the answer is, "No." Even if -- even if that vision were to work, you're saying, "That's not the way to get it done; that's not the way to address climate change?"

Lynn Rothschild:

That's correct.

John Donovan:

Okay, I want to go to audience questions in just a minute, but I'd like to let George Church respond to that last point.

George Church:

Yeah, I agree that if we're talking about, "Could we do it?" you may be right. Maybe we can't do it, okay?

Lynn Rothschild:

Yeah.

George Church:

But the question is, "Should we do it?" right, if we can? And I think we have to disentangle those a little. I completely sympathize that I believe we can do it, but that's not what's at debate here.

00:55:01

I think they can -- we can find intermediates where they can be trained by current elephants, and then those intermediates can train the next generation of elephants, okay? And it's not a guarantee, but if we take causative steps, the question is, "Should we?" And if we can -- if we can show along the way -- can show that, then I think we should.

John Donovan:

And if we can't show it, do we stop?

George Church:

Well, that's not what the debate is about.

[laughter]

Yes, we should stop.

John Donovan:

Thank you. There was should in there. All right. I would like to go to audience questions now.

Female Speaker:

Hi, yes. Thank you very much. I'm a big fan of your work, George Church and Stewart. So, thank you. I'm from Africa -- I'm from South Africa, and I'm very involved with wildlife conservation and the fact that we're losing rhinos at a hugely exponential rate; we've lost the last northern rhino in Kenya.

00:56:03

And we're looking at potentially the wipeout of rhino in our lifetimes. So, de-extinction, to me, is probably the only thing that we can do to rectify what we're currently doing. And so, my question to the panel is, do we not actually have an ethical obligation to fix up what we are currently destroying in the environment?

John Donovan:

Using the methods of de-extinction?

Female Speaker:

Yes. Correct.

John Donovan:

Okay. All right. I know that, George, you've actually made that argument. I've read that you've made that argument, that the moral -- it's immoral not to do these things, in light of something that the questioner is asking about. I will come back to you, but I would like to let your opponents respond to that question first, either Ross or Lynn.

Ross MacPhee:

I'd like to ask the person who asked the question -- since she's from South Africa -- you know there are game farms there, and you know that lions in particular are raised for hunting purposes --

Female Speaker:
Right.

00:57:03

Ross MacPhee:

-- so that wealthy North Americans can come in and shoot them in a barrel. That's not de-extinction. Once again, we have the living species, but it's the same thing, when you think about it. It's using nature for our own ends because the means doesn't -- the means are the ends, as usual. So, when you tell me that we should bring rhinos back, I think -- northern rhino sub-species back, I think that's a great idea. But then what happens? Who's going to take care of them? Who's going to ensure, for as long as it takes -- indefinitely -- that nobody is going to go in there and, you know, destroy them once more? None of these safeguards are recognized at the time that they need to be, which is what this debate should be all about -- that the safeguards need to be in place, discussed, ironclad, before we undertake any of these de-extinction experiments.

John Donovan:

Stewart Brand, respond to the same question.

Stewart Brand:

The northern white rhino is a wonderful example, sort of in our direction.

00:58:00

Ryan and I have met some of the last northern white rhinos at the San Diego Zoo before they died. And there is a biotech workaround -- which is now in progress -- to basically use cryopreserved tissue from the last of the northern white rhinos -- and they have a variety of them so there's genetic diversity there -- to basically plant embryos from them in southern white rhinos, which there are quite a lot of, and to restore the northern white rhino population. And there is desire in Kenya to get them back; the last one died a while ago. There's a whole support group there for making that happen. So, this is an actual case of, right now, happening, with an African megafauna, biotech being applied to bring back an extinct species.

John Donovan:

Lynn?

Lynn Rothschild:

Yeah. I'd like to say that working at NASA, I often hear people say, "Well, if we screw up the Earth, we can always go to Mars as Plan B." And this, to me, is the same sort of argument.

00:59:01

"Well, if we kill off the rest of them, we can always de-extinct them." What you should be doing is conserving the last of the ones that are there. And if you can't do that, de-extinction is not Plan B.

John Donovan:

Yes. George, I --

[applause]

-- the moral hazard argument has been made a lot. If we truly get to the point where we can de-extinct, at the -- you know, at will, then we would let species come and go, as we feel like it. But that's a thing that we, as humans, would probably end up doing. Can you take on that thought and also address the -- use the opportunity to address the question that the audience member raised?

George Church:

I agree that we should not be using this as Plan B. But the technology that we're developing for de-extincting genes and species is exactly the technology that we need for conserving the living species. And that's why I'm excited about it; not nostalgia, not so we can shoot at them, but so that we can help living species, especially those living species that are important for our survival.

01:00:04

That's the selfish part.

John Donovan:
Stewart.

Stewart Brand:

Thirty-five years ago, when the frozen zoo started up in the San Diego Zoo, the moral hazard argument was brought that you should not do this. It's going to make people feel relaxed, if you're just being able to cryopreserve viable DNA and viable cells --

John Donovan:
Sorry, I'm unfamiliar with what was happening at the San Diego Zoo.

Stewart Brand:

The frozen zoo was where they were going to do cryopreservation of tissue samples from living species that were endangered, with the idea of keeping those at hand just in case. Animals -- so for study. And it was -- careers were broken because of people complaining that it's a moral hazard here that's going to make people relaxed about extinction and, therefore, don't do it. One, no such thing happened. Extinction worries continue, and they will continue, and they should continue. Two, an enormous -- a whole domain of really important scientific research opened up because you can study the entire genome of the species.

01:01:05

At Revive & Restore, the reason we're able to go in and think about and act on bringing back basically extinct alleles and, frankly, we're going to clone back into life the twin of one of the black-footed ferrets that died 35 years ago. When we bring it back to life in the next few months, it will add genetic diversity to the inbred population of Fort Collins, Colorado of the captive-bred animals that are there. Instead of having seven founders, they will move up to eight

and maybe nine. So already, you've got a benefit happening there.

John Donovan:

Ross, the last point on this one, and I think we'll move to another question.

Ross MacPhee:

This is not the subject of the debate. It isn't.

[applause]

This is about bringing back -- read the motion. It's about bringing back extinct species. Both of you have talked about woolly mammoths and to a lesser degree, passenger pigeons.

01:02:00

What you're talking about is something that we, all four of us, fundamentally agree about, that the value of synthetic biology for conservation is doing exactly what you're talking about. But that is not bringing back completely extinct species.

Stewart Brand:

Well, it --

[applause]

-- but it is. There is no other white Rhino. They're gone, they're dead.

Lynn Rothschild:

Could I just add one other point? You're talking about adding an eighth creature there, which is certainly better in terms of its population dynamics than seven. But when you're talking about something like a dog, you're not even a viable population until you have a diversity of at least 100 individuals. And so, imagine how much more difficult it would be. And I think you said earlier, well, we could engineer in that diversity. I'm sure that people like George have enough trouble coming up with one mammoth without having to have 100 different genetically diverse mammoths that then could interbreed.

John Donovan:

George, what is your mammoth capacity?

[laughter]

George Church:

I just personally dissected six the last time I was in Siberia.

01:03:01

There are hundreds that are, unfortunately, being exposed at a rapid rate now because of the melting -- the rapid melting of the permafrost. So, unfortunately -- and the Russian government's quite excited about helping people come in and characterize them. So I don't think there'll be a

loss.

Lynn Rothschild:

But even if you -- but think of the challenge of a hundred different ones at the same time that can then start interbreeding.

Stewart Brand:

I don't think that's challenging enough to say that it can't be done.

John Donovan:

Let's go to another question, please.

Male Speaker:

Hi, guys. First of all, thank you for being here. This has been a really fascinating and awesome debate. My name is Warren [spelled phonetically]. I just wanted to bring up the question of intellectual property, which I think might inform this debate, or at least lead it in a new direction, as John pointed out. I want to know everyone's thoughts on how existing rules surrounding the ownership of genes and genomes might influence whether or not we should undertake this endeavor. I'll leave it at that.

01:04:06

John Donovan:

So I want to see if we can phrase this within the framework of the debate.

Male Speaker:

Yes.

John Donovan:

Could I say whether -- would you mind rephrasing your question to say, did the existing rules argue for or against the extinction argument? Is that fair enough? Is that what you're saying? Because otherwise, I want to pass on it because I really want --

Male Speaker:

That's okay. I mean, I guess this is a debate about what we should do. Fundamentally, the word "should" keeps coming back here. So, let me rephrase into something I'm more interested in pursuing, and you can pass if you want. What should the existing laws on the ownership -- or what should the laws on the ownership of genes and genomes be in the context of de-extincted species?

John Donovan:

I think that's -- I think that's relevant, and I'd like to bring either Lynn or Ross to that.

Lynn Rothschild:

My understanding, and certainly, you know, others like George can correct me, but that the Supreme Court case ruling with BRCA is that if it's a natural genome, there's no ownership. Only if there's been some human intervention, for example.

01:05:05

You've -- it's a result of CDNA or something. So I don't think that there is an ownership issue. But --

John Donovan:

An ownership issue that acts on its curve of being able to do this, which is where --

Lynn Rothschild:

No, no. Ownership issue owning extinct genomes. Is that -- that was the question I think.

John Donovan:

Yeah, I think, actually, we're kind of getting off the "should" question, so I'm going to pass on that. But thanks very much. Can I take another question from right here on the corner?

Cathy Sorov:

Hi, Cathy Sorov [spelled phonetically]. The issue of should and could, with every invention and discovery, there's a good use and a bad use. And whether or not we legislate, oh, you can or cannot do it, somewhere, someone is going to do it whether you should or not. And it's up to each of our societies to decide --

John Donovan:

So what would be --

Cathy Sorov:

-- what is good and bad. So I wanted to find out, is -- isn't there an individual situation with each species that we might consider, and considering it in terms of whether or not it's beneficial for human beings and it matters, and if it's cost effective.

01:06:13

John Donovan:

Okay, let me -- can I rephrase your question --

Cathy Sorov:

Yes.

John Donovan:

-- to the side arguing for the resolution, which means they're against de-extinction --

Cathy Sorov:

Okay.

John Donovan:

-- to say -- I think what you're saying is, shouldn't this be taken on a case-by-case basis --

Cathy Sorov:

Yes.

John Donovan:

-- rather than a blanket, "Don't do it?"

Cathy Sorov:

Yes.

John Donovan:

Let me take that to Lynn or Ross.

Ross MacPhee:

Well, I take your point, but it appears to me that, you know, if you've got nuclear bombs, and you've got nuclear power plants. One is, by design, a weapon. The other isn't, although bad things can happen. What I don't get from this kind of argument, that it's good and bad, is that it's always framed in terms of what's good and bad for people and people's interests, so that the inquiry over here about whose property is it, this is us.

01:07:06

This is all we think of. If we invent it, then it's ours. It doesn't exist apart from us. And if it's not ours personally, then it's the state's or something like that. So these animals being brought back that we're talking about, I don't know whether George would patent them. Maybe he would. But somebody somewhere is certainly going to do precisely that. But by virtue of becoming property, they can be sold, bought, auctioned, and what have you. Is that what we want? Is that really the way to bring back ecosystems, to have business interests, capitalism unleashed, in order to recover them in the way that's being talked about? I don't think so. I think that's a misappropriation of the idea for, in this case, facilitated adaptation. You want to bring species back to the degree that you can by intervening very carefully in their lives with some sort of genetic repair mechanism.

01:08:00

John Donovan:

Stewart.

Ross MacPhee:

And then you leave them alone.

John Donovan:

Let's let Stewart respond.

Stewart Brand:

Well, that was a great issue with "Jurassic Park," which was a commercial operation. And the reason it became crazy is they were trying to protect their intellectual property, and then it got stolen, and various bad things happened. There is exactly nothing going on with the extinction or genetic rescue that I know has any commercial aspects at all. That's one of the reasons it's hard to raise money for it because nobody's going to get any feedback. It's pure philanthropy. Conservation has that quality. Nobody gets rich in conservation, so there's not any private issues

involved here. Furthermore --

Ross MacPhee:

You don't think there's a future in having sabre tooth lookey-likeys that you can use for hunting purposes?

Stewart Brand:

If you want to do it, go for it. Nobody I know is lining up to do that sort of thing. What they are doing is what they're doing in conservation generally, which is begging for money to make a good thing happen for the common wheel of species and the common wheel of humans. And it is totally transparent. It's the opposite of what was the problem with "Jurassic Park."

01:09:02

There's no secret IP involved here. Even CRISPR, they're fighting over the patents, everybody's using CRISPR while they fight off the patents. So, it's not -- it's a non-problem I think.

Ross MacPhee:

I have to say, Stewart, that I'm very pleased that I am not the most naive person on the panel tonight.

[laughter]

John Donovan:

All right. We try not to make it personal. I think --

[laughter]

I'm trying to think of "not naive" that's not that cutting, but -- but it was there, so let's try to keep it above board. I want to get farther in the back. Young man.

Male Speaker:

So, my question for the side negating the resolution is that, do you think that the issues of sort of ecological instability or instability in ecosystems for both the species being brought back to life and the organisms already living in those ecosystems should be taken into account?

George Church:

Yes.

[laughter]

01:10:01

I think that, you know, Ross brought this up at the very beginning, that there could be consequences for the ecosystem, in fact, for the elephant mammoths, that's the whole point, is to have consequences on the ecosystem. Now, whether we could calculate that in advance, probably not. But can we, by trial and error, get there? That's a "can" question, not a "should."

John Donovan:
I think it was Lynn who brought that up in the opening.

George Church:
Oh, was it? Yeah.

John Donovan:
You know, Lynn, why don't you jump in on this conversation?

Lynn Rothschild:
[laughs] No, and I get back to the point that it's going to create a lot of individual suffering on the way, and is that right for our ultimate goal? Is that goal worth enough to be forcing these creatures to suffer the way they're going to, and all the trials and so on?

John Donovan:
Okay.

Male Speaker:
Hi, my name is Jeff. I have a question, basically.

01:10:53

I think it builds on the question she was asking, which was that: given that new precedents in science basically set -- or open the door for future work in that field, how can you be sure that bringing back extinct creatures would not then open the door, bringing back extinct Neanderthals, and that -- given that people would have patents over those creatures, that that would not then open the door for all kinds of strange things to happen?

John Donovan:
So you're talking about the slippery slope potential, that after going for the mammal animals, they would start going for the mammal hominids, I guess?

Male Speaker:
Who knows?

John Donovan:
I guess it's a, who knows, question; it's a little bit hard to answer because it's, "Who knows?" but I actually want to put it to the panel that's being decided -- the panel that's being challenged.

George Church:
Well, I would say that there's a pretty steep gradient between humans and other animals, whether we think there should be or not. Chimpanzees get a lot of rights. It's very hard to do experiments on them, at this point. I think Neanderthals are humans. They're modern -- they're just like modern humans.

01:12:03

You know, like I said, my ancestors got along, and I think they would be respected as such. You

can patent human cells. You can engineer human cells, but that doesn't mean you own the human being.

Stewart Brand:

I would make the point this is not a slippery slope. This is a very high-friction, shallow slope with arguments and --

John Donovan:

That's a nice coinage. I've never heard the non-friction shallow slope, but I think that's a very useful term.

[laughter]

Stewart Brand:

And there's argument every step of the way, as there should be. Science is argument. That's what it's made of, and it's, you know, organized skepticism. And so, the thing that we're waiting for -- and both of you were right about this. This is all conjecture, at this point. We're just talking fantasy. Until there is actual beginnings of the process that we're trying to send a notion, we don't have data to argue with. All we have is sort of dueling conjectures, and that's fine for now.

01:13:02

And I don't think it's going to stop the people who are trying to do the experiments that will actually prove -- they'll get us some data and start to get these things in the field, building what we already know from conservation biology with various kinds of reintroductions and so on. That part is pretty predictive. Even though ecosystems are not totally predictive, there's a lot of experience to draw on, on how to bring species in, and that's what we're going to be working with. And we can argue every step of the way, I think.

Lynn Rothschild:

I'm sorry, I'd like to get back to Neanderthals, because I thought this would come up, so I made a point of looking at the exhibits at the museum yesterday, and staring these exhibits in the eye. And I believe people have talked about de-extincting Neanderthals, and possibly some people on the other side of the stage, and I just want to say that I believe equivocally that is absolutely wrong. It is morally repugnant. We have enough trouble with humanity recognizing that we have roughly equal intellects across the races. And to purposefully recreate a species that we know is going to be inferior in some way is just asking for enormous trouble.

01:14:08

And so I'd just like to be on the record in saying that I find that whole idea morally off the table.

Stewart Brand:

So back in the day when --

[applause]

-- the homo sapiens was interbreeding with Neanderthals, you would have discouraged that?

John Donovan:
She did not say that.

Lynn Rothschild:
I cannot help what my ancestors did.

Ross MacPhee:
I'd like to respond to this, too.

John Donovan:
Sure, go ahead.

Ross MacPhee:
Because these are ethical questions, right? And the thing about ethical philosophy is that it's always framed, the good and the bad, as it affects humans. There isn't really an ethical philosophy for animals, although there should be. And the trouble with that is that we inevitably end up with an anthropogenic perspective -- or anthropocentric perspective. So, we can say on the one hand, as Lynn just did, that it's absolutely repugnant to consider the idea of bringing back Neanderthals.

01:15:00

But it is perhaps not so repugnant to think about bringing back woolly mammoths. Now, why should that be? One has personhood and the other doesn't, as a matter of law. But for ethics, for thinking about what is proper for the planet, I put it to you that we shouldn't be thinking like there's a divide between them and us, that we're somehow different from everything else. We're not. And the same kinds of ethical questions that arise in thinking about bringing back human ancestors that are no longer with us should apply in the same way to bringing back completely extinct species.

[applause]

John Donovan:
Let's go on to another question there -- yes.

Female Speaker:
Hi. My name is Aylin [spelled phonetically]. So, the conflation of gene therapy versus returning a fully extinct animal aside, you know, if we're talking about bringing back woolly mammoths versus kicking up Asian elephants with a small percentage of mammoth DNA, would both sides of the argument acknowledge the fact that if you bring back a Pleistocene creature to the Anthropocene, despite the fact that they have the same DNA, by default, make it a different creature than it was.

01:16:11

So, I'm basically talking about how we compare modern day hunter-gatherer societies to our

hunter-gathering Neanderthal ancestors.

Lynn Rothschild:
Can I --

John Donovan:
Sure.

Lynn Rothschild:
I actually --

John Donovan:
Oh.

Lynn Rothschild:
-- often answer sort of a variation of it when I'm talking about astrobiology, that if you took DNA to another planet, and then you brought something back to life, is that still the same? And the -- my answer is that we have this idea that there has to be an evolutionary continuity, but we've broken that using molecular biology. So, my students -- George's students -- if someone sits behinds computers, they come up with DNA sequences; they push send; it goes to a company. And those zeros and ones become actual DNA that's sent back. We no longer need to have that physical continuity.

01:17:01

So, I believe that they still would be the same species. I don't know the vast majority of people in this room, and I don't know if you were made in the basement this morning, if they were worried that no one would come out in the cold, and so, they make you in the back room --

[laughter]

You sure all look like humans to me.

John Donovan:
George?

[laughter]

George Church:
Yeah. I'd agree.

[laughter]

John Donovan:
Okay.

Male Speaker:
Hi, my name is Cameron. Thanks for doing this debate. A question a friend and I were thinking

of was, is there an ethical difference between natural selection and humans deciding what happens? So, if this happens naturally, is there really a difference between humans taking the reins and --

John Donovan:
I like that question.

Male Speaker:
-- what you guys thought about that.

John Donovan:
If it can happen --

Ross MacPhee:
Oh, there's -- you know, there's a lot of difficult questions about this. This is very clear. The thing about natural selection is the word "natural," the idea that all species, including ours, is the product of eons of selection by natural forces that shaped us.

01:18:09

We wouldn't be around unless we were successful in that. Nature doesn't like weak throw-offs. You would have gone extinct, is the problem. So, when it becomes artificial selection, which is what humans do in particular with other species, it's a different situation, isn't it? It's no longer just allowing nature to take its course, so to speak. It's our intervening and, who breeds with whom, who gets selected for whatever desirable set of traits, who survives, and who doesn't? And I see that as a dramatic difference. So, to bring it back to the point of the debate here, we're not talking -- when we are talking, in fact, about bringing back extinct species -- we're not talking any longer about natural selection. That's out of the picture.

01:19:05

We're talking about something we as humans can do; perhaps should do, under circumstances. But in any case, we just want to do, and that's the difference.

John Donovan:
Stewart, I can give you 20 seconds to wrap this round.

Stewart Brand:
Those extinct alleles were arrived at by natural selection. There's, you know, on the order of 4 billion years of evolution behind their equality, and that they got eliminated is a loss to, in a sense, the global gene pool. And getting those genes back in place seems like a perfectly natural thing to do.

John Donovan:
And that concludes round two of this intelligence Squared U.S. Debate --

[applause]

-- where our resolution is, "don't bring extinct creatures back to life." Now we move on to round three, and round three will be brief closing statements by each debater in turn. They will be two minutes each. Here to make his closing statement in support of the resolution is Dr. Ross MacPhee, mammalogy curator at the American Museum of Natural History.

01:20:08

[applause]

Ross MacPhee:

Thank you, John. So we've spent a lot of time tonight on what we might call taxonomic trivia, quibbling over whether an Asian elephant infused with a certain number of mammoth genes can be regarded as a pretty good replica, real enough to pass, or just a poseur. That's for you to decide. For me, the issue isn't what you call these creatures; it's why you do what you do in the first place. What's the objective? And let's get very real. Synthetic biology is the thing that could help to solve huge ecological problems; there's no doubt about that -- real ones, life changing ones. For example, we raise billions of meat and dairy animals across the planet every year on millions of grassland, feedlots, factory farms.

01:21:02

They contribute hugely to methane production, a far more potent greenhouse gas than carbon dioxide. So could we even fractionally reduce that particular problem and free up all that land for other purposes? And I say, "Yes, we can." Consider slaughter-less meat? What is slaughter-less meat? This is meat tissue that is derived from cattle stem cells. There's no harm to the animal that provides the cells, and there's no significant thereafter production of greenhouse gas emission. So, why would we bother with this? What's the objective? Because everything is interrelated. This is what ecosystem biology is all about, reducing the number of meat animals and the land needed to grow them may allow, eventually, for forests to come back in Amazonia, stop destructive burning in Madagascar, end the dumping of huge quantities of agricultural chemicals, hormones, and other forms of chemical pollution into our water systems and, ultimately, the ocean.

01:22:09

This would be truly transformative and very different from misdirected efforts to try to recreate the past in the present. If you agree that science, ethically and imaginatively applied, is the only long-term fix for trying to conserve nature, not bringing back the dead, please vote for the motion. Thank you.

[applause]

John Donovan:

Thank you, Ross MacPhee. And that resolution, again, don't bring extinct creatures back to life. And here making his closing statement against the resolution, Dr. George Church, geneticist and professor at Harvard and MIT.

[applause]

George Church:

I really love the arguments that Ross and Lynn have made. I agree that there could be harm along the way, and we should avoid it as much as possible. In fact, we should reduce the total amount of harm that occurs in the wild right now. That is something, if we can do it, we should do it.

01:23:03

That should not -- we should not be limited in what we can do. If it involves bringing back one or two extinct genes, I think we have -- we're converging on, that might be okay. If we can do one or two, why not do 100, 1,000, all 20,000 genes? It -- some of them may not have as big an effect, but we shouldn't be limited that we can't have that as part of our components that we want to do. I agree that we should try to be more animal centric in addition to being human centric on our ethics, and I think that this -- that allowing such technologies to take -- to bloom might be part of that argument or part of that discussion. I am a vegan, and I actually have -- I am an advisor for companies that make slaughter-less meat. So I totally agree with that, but we should not be limited in the technology that we can bring to bear on returning the Amazon to its status, and so forth.

01:24:04

I think we should be able to use anything that brings about humane treatment and better ecosystems. Thank you.

[applause]

John Donvan:

Thank you, George Church. Again, the resolution, don't bring extinct creatures back to life. Here making her closing statement in support of the resolution, Dr. Lynn Rothschild, evolutionary biologist and astrobiologist.

[applause]

Lynn Rothschild:

Thank you. I promised, when I started, that if my opponents convinced us that we were wrong, I would heartily encourage you to vote for them. Unfortunately, they haven't. And George, there is some kind of line in this slippery slope. As I told you before, I don't consider myself a de-extinction Neanderthal, and I suspect neither do you. As I said at the beginning, I really think that there are a whole bunch of reasons -- there are seven Es, as I call them -- that are both environmental and ethical reasons why you don't do this: that the reasons for extinction may not have gone away, that there are evolutionary reasons, ecologically, ethology, behavior, economics,

01:25:04

And not the economics of gene synthesis, or even somatic cell nuclear transfer or whatever, but of keeping these creatures. It's the 70,000 for a perfectly healthy elephant. If you need 100 of

them, and then they age eventually, and so on, the costs add up. History is littered with exotic zoos that the benefactor eventually decided he was no longer going to support. What happens to these poor creatures? You have a second extinction on your hands. The emotional arguments and the ethical arguments. But really, in the end, we've been dancing around this idea of, what is natural? Is it natural to have a woolly mammoth on the Siberian steppe, or is it more natural to have a sky filled with pterodactyls? Or maybe a sea filled with trilobites. Or actually an anaerobic earth, which is what it was like through much of evolution; or actually, if you want to take it back that far, the natural earth didn't have life here at all.

01:26:00

So, you can't just pick and choose, like a Chinese menu, and decide what's natural and what you're going to plug in and out of ecosystems. That's not the way it works. So, in sum, I would say these seven Es don't add up to EEE; they add up to "Uh-oh. Don't do it." So, no matter how cool this seems, or how our imaginations love the idea of time travel, we should not de-extinct creatures. "Jurassic Park" was a bad idea. Pleistocene Park is no better. Certainly, the Precambrian Park was a hellish place to live.

[laughter]

It's not the time to de-extinct these creatures, but rather to focus on conservation of the amazing creatures that evolution has wrought. So, therapeutic de-extinction, fine. De-extincting creatures -- no.

[applause]

John Donovan:

Thank you, Lynn Rothschild. And our final speaker of the evening, making his closing statement against the resolution and in support of bringing extinct creatures back to life, here is Stewart Brand, founder of the Whole Earth Catalog and co-founder of Revive & Restore.

01:27:00

[applause]

Stewart Brand:

Back in the 1970s, the big biotech issue was in-vitro fertilization, IVF. It was clearly going to be hubris; it was going to be playing God, that you're going to mess with human fertility in some strange and obviously against religion, way. It was obvious that the babies were probably going to be -- there was going to be something wrong with them. They would be impaired, and for sure, there was something wrong with the parents, that they would even want such a thing. In 1978, the first IVF baby, Luanne [sic] Brown, came along and people fell in love with that little girl. She was healthy. Her parents were ecstatic. There's probably IVF babies here in this audience. It became the norm. The controversy went away as soon as you saw what they've been shooting for all along. This is called the victory condition. What has -- what drove the doctors then and is driving us now is the potential victory condition of getting some species back.

01:28:03

Just here in New York State -- you will be having the chestnut trees coming back, raining down sweet nuts for wildlife and for humans for the rest of the century and for the next several million years. You will have passenger pigeons back, helping make the eastern forest -- which has grown back since they went extinct 100 years ago -- to be more of a mosaic, to get vast quantities of dung being laid down by these birds, enriching the whole system. You'll get heath hens back, which are these wonderful animals that were the greatest game bird, and that's why they were hunted to extinction. And you won't have to rely on extinct -- on an alien pheasants anymore; you can go out and get heath hens to feed. And in the ocean, just offshore here, great auks will be swimming around, taking up their old habitat, which is perfectly intact and waiting for them. And what you will see is greater biodiversity here and everywhere. So, a vote against the resolution is a vote for biodiversity, is a vote for more life.

01:29:11

John Donovan:
Thank you, Stewart Brand.

[applause]

And that concludes closing statements.

[applause]

The first thing I wanted to say is this was a really, really fascinating debate, and I found -- I found honorable the degree to which you all conceded points to one another. You were really listening to one another, and we're always wondering if our audience is willing to have their minds changed. And it seems to me that, even though, Lynn, you said in the end, you wouldn't vote for the other side, it sounds -- it seems as though you and your fellow debaters all heard things from your opponents that you respect and take seriously. And demonstrating that is the essence of what we want to do here, so the way that you conducted this honors us, so I want to thank you for the way that you all were here.

Stewart Brand:
Thank you.

[applause]

John Donovan:
And I also want to thank everybody who got up and asked a question. They were all pretty good, even the one that I think I manifestly did not understand.

01:30:03

I'm glad that our debaters did --

[laughter]

-- and that we went forward with it. I have a question that came up, you know, just in the minute or two that we have to wait. We've been talking about de-extincting creatures. What about extincting a creature? What about -- what about, you know, some disease-carrying mosquito which we could now -- we could now genetically make go away? Are -- is that -- are we talking about the same -- are we in the same realm ethically? What would you say, Ross?

Ross MacPhee:
Gracious.

[laughter]

I would say this -- and just to go back to natural selection for a second: we have our own rights, and part of our own set of rights is to live our lives free of disease to the extent possible. This is your example. And if it is the case like it is with malaria, right now, that there's mosquitos that carry it that can be caused to, within a few generations, consist exclusively of females using something called gene drive.

01:31:09

What that means is that that species possibly stops. Is that a bad thing? Well, yes and no, and that's what so many of these questions are like. We have a right not to suffer from disease. These mosquitos carry the disease. We have a right to fight back. To the level of extinction? I don't know. If there were a way with gene drive to make it less attractive for plasmodium, that would be the solution. As you can see, I'm just weaseling.

[laughter]

John Donovan:
How about on the other side?

Stewart Brand:
So there is a possibility. In effect, we're pursuing it, which is to get rid of the plasmodium and not the mosquito. Now, that's totally feasible, and I think desirable. There are some people who don't like getting bitten. That's another story. That's an inconvenience rather than 600,000 deaths per year.

01:32:03

There were -- we are -- we have extinct smallpox. We're on our way to polio, and the guinea worm is on its way out as well.

John Donovan:
So could we do a debate here called, "Kill the Mosquitos?"

[laughter]

I mean, we could get people up on -- arguing both sides of that?

George Church:

There is a project in Hawaii going ahead called, "Mosquito-Free Hawaii," and it's being driven by trying to protect the native birds there from avian malaria, but it would also protect the humans from, you know, all the issues that go with mosquitos. They're an invasive species there. Gene drive or whatever, the Wolbachia's the first approach they're taking, which is a sort of less objectionable like the gene drive effect. If they can get rid of mosquitos on the island, they really, really want to.

John Donovan:

Okay, well, I --

Lynn Rothschild:

With all due respect, I just want to point out again that viruses are the one thing that you can de-extinct, actually. So extinction is not forever with a virus, sadly.

01:33:00

Ross MacPhee:

And they're not really alive.

Lynn Rothschild:

Well, that's another debate, John.

[laughter]

John Donovan:

That's -- we'll do that debate. Okay. The results are in. You have voted twice on this resolution: don't bring extinct creatures back to life. You voted before hearing the arguments and again after hearing the arguments, and we give victory to the team whose numbers have changed the most in the upward direction between the two votes.

On the resolution -- don't bring extinct creatures back to life -- before the debate, in polling the audience, 31 percent of you agreed; that means you're against bringing extinct creatures back to life, but you agreed with the resolution, which has the word "don't" in it. 48 percent were against the resolution; that means they're in favor of the work being done or proposed work being done, which Stewart and George argued here tonight. And 21 percent were undecided.

So, remember, it's the difference between the first and second vote that determines our winner. On the second vote, the team arguing for the resolution, don't bring extinct creatures back to life, Lynn and Ross, their first vote, 31 percent. Their second vote, 48 percent.

01:34:00

They pulled up 17 percentage points. That's the number to beat. The team against the resolution, Stewart and George, their first vote, 48 percent. Their second vote, 44 percent. They lost four percentage points. That means the team goes to the side arguing for the resolution, don't bring extinct creatures back to life.

[applause]

Our congratulations to them. Thank you from me, John Donovan, and Intelligence Squared U.S. We'll see you next time.

01:34:29

[end of transcript]

This is a rough transcript. Please excuse any errors.