Interview with Dr. Douglas Altshuler by Elizabeth Bassett and Christina Mantey, UBC.

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DA: My name is Douglas L. Altshuler, or Doug. I am a professor in the Department of Zoology, and I study bird flight. And, the main animals we tend to work on are hummingbirds and zebra finches, but we also do some work, these days especially, on pigeons and starlings.

EB: Thanks for doing this interview with us today.

DA: My pleasure.

EB: Our first question is: If you were a hummingbird, how would you describe an average day?

DA: Well, I would wake up quite hungry, and so it would be very important to have a meal as soon as I wake up, and to tank up for a bit. Then throughout most of the day, what I would try and do is find a good resource that I could protect, that I could feed from slightly, but mainly have available to me both at the end of the day and, ideally, the next morning as well. Those are the two most important times for me to feed, if I was a hummingbird. And so I'd want to—if I don't have a resource like that, or the resource that I had, say, drained out, I'd be looking for a new one. And then, once I found one, I would either try and fight the bird that was guarding it, or if I found one that was unguarded, or taking it over, then I'd be guarding it myself. And so, this would involve a fair bit of flying when intruders appeared, but the rest of the time I'd actually be perched and resting. So, I would probably spend about 70% of my day resting. And again, the other bits would be feeding, chasing others away, and maybe finding a new resource.

DA: I should actually add one other thing to that, which is, that's assuming that hummingbirds are really only eating nectar. They also have to get some protein. And so, it is important to do some foraging for small arthropods, maybe small spiders, things like that. So, they do actually spend some time gleaning insects along tree bark, out of spider webs, if there are spiders, or in the air, things like fruit flies.

EB: What is your favourite thing about hummingbirds?

DA: Well, that would have to be their flight. I find it very magical just to watch a hummingbird hovering in mid-air, when they're curious, say, checking you out. **[02:00]** I find that quite magical to see this animal that just looks like it's floating. It almost looks like a spacecraft. It's in a way that we don't

really—we're not used to seeing animals that are that large just being able to float in space. And, it's an amazing thing about them.

EB: Could you give us a summary of your early work on evolution of hummingbird flight performance and elevation?

DA: Absolutely. Again, the purpose of that study was to understand what are the limits to flight performance at high elevation? That was at least how it started out. Okay, so what I found from that research was that the maximum performance, the total power that a hummingbird can generate, significantly declined as they went to higher and higher elevation. So, they lost the ability to generate additional power. But the interesting thing was that if you looked at just their power consumption, or the power generation that they could produce during hovering flight, that actually didn't change across elevations. So, that meant that it essentially cost a hummingbird the same amount to fly at very high elevations, at least to hover, as it did at low elevations.

DA: So, you might ask, how on earth did that—how did they do that? Well, it turned out they had—there was really two key adaptations that allowed them to fly essentially like—you could think of it as more efficiently, as they get to higher elevation. The first one is that they had larger wings. In addition to having larger wings, they also flapped those wings at a larger amplitude. So, if you think of the amplitude as—imagine you're making a snow angel in the snow, right? So, you're lying back in the snow, in fresh snow, and you wave your arms up and down, and by doing that, you're sweeping out an angle that becomes the angel's wings in the snow. Well, in a similar way, a hovering hummingbird flaps its wings back and forth, and makes a pie out of its wings. And that's the—what we call the stroke amplitude of the wingbeat. And as you go from low elevations to high elevations, that pie slice, that stroke amplitude, increases. **[04:00]** And so, by having a wider stroke amplitude and larger wings, the birds are actually expending the same amount of power to fly at high elevations as they are at low elevations. So, that's kind of the cool part, right? They actually—they have this very efficient flight at high elevations. The difference between the power they produce during hovering and the most power that they can produce actually gets smaller and smaller. So, another way to say that is that their hovering flight power gets closer and closer to their maximum power, as you get at the higher elevations.

DA: And another way to say that is that while they do have this very efficient flight at high elevations, there is, in a sense, a cost to it. Which is that they essentially don't have a lot of extra power. And so

that—this solicited a new question that I also addressed during my PhD, which is that given that the hummingbirds have less extra power to do things above and beyond hovering, when they're at high elevations, how does that affect their ecology? And I did a number of other behavioural studies, and it suggested two main things. One of them is, is that they tend to produce less diverse behaviours as you get to higher elevations. But the other thing is that that competitive ability, the ability they need to be able to chase off other birds that are trying to get into their territories, that actually declines as they get to higher and higher elevations.

EB: Humans get a lot of joy from attracting hummingbirds to their yards with feeders and flowers. Could you tell us about this in relation to Anna's hummingbird specifically, and how it came to be Vancouver's official bird?

DA: The Anna's hummingbird had a northern range-limit that was quite a bit south of where it is now. Just a couple decades ago, they were—I think it was Oregon, or southern Washington, or somewhere around there was where this northern range-limit was. And then, in the 2000s, they started showing up more and more around Vancouver, and now they're here year-round. Which is quite extraordinary. So that's a really massive increase in range—of northern range-limits, from the Oregon-Washington boundary all the way up to Southern BC. **[06:00]** And that is not—that's too much of a range expansion, I think, to really be explained by climate change. Instead that's more likely due to the availability of resources to them. So, ornamental flowers probably came first in gardens, and now people hanging up feeders. All of those things allow them to exist in an environment where they didn't thrive not that long ago. So, I do think it's probably likely that human activity has caused this northern range expansion. But I don't necessarily think that's a bad thing. I think that the birds are here. They also—I should say, this is an important thing about hummingbirds—if you give them a choice between a flower and a feeder, a full flower and a feeder, they seem to always prefer the full flowers. So, while they do feed from feeders, it doesn't seem that feeders are actually drawing them away from flowers. It goes in the other direction. If flowers are available, they prefer those.

EB: Some human behaviour seems to be beneficial for hummingbirds.

DA: Yeah.

EB: Are there downsides to this?

DA: Up here, in North America, there doesn't seem to be. And the reason for that is that the North American hummingbirds seem to be very good at moving into new habitats, and basically, if there are flowers, they move into those habitats and feed from those flowers. And again, if there is also more availability of insects, they seem to move into those habitats and feed from those insects. There are a small number of endangered hummingbird species. We know that—there is something called the [International Union for Conservation of Nature's] "Red List," which basically tells us whether hummingbirds are extinct, endangered—or actually, all organisms, I should say, that have been characterized in this way. Not all organisms are known. But it's a list, essentially, of what organisms are threatened, extinct, endangered, et cetera. And there are twenty or so hummingbird species that are basically on the "Red List." And those all seem to exist in very—relatively restricted drainages in the Andes. Like in Columbia, where there's one valley in the Andes where that species exists. **[08:00]** And those hummingbirds, the ones that are endangered, seem to be very dependent on specific plant species or possibly specific insect species. And in those cases, what we think is going on is that habitat destruction of these really specialized and relatively small habitats is actually leading to decline of those hummingbird populations. So, I do think that for the hummingbirds that don't adapt easily to human habitats, they are very adversely affected by human habitat development. But most hummingbirds seem to be the opposite, which is that they actually thrive with humans as we develop land, and plant ornamental flowers, and hang up feeders, and things like that.

EB: Are hummingbirds affected by climate change? And, if so, what are the ramifiI think cations and potential outcomes?

DA: So, we don't have a lot of good evidence for that. I actually did participate in a study once that looked at a little bit of this with respect to elevational range. And, basically, what we concluded was that while climate change should cause range shifts—elevational range shifts—in hummingbirds, that it looked like at least the cost of flight would be relatively modest. And at least for the foreseeable future, the habitat changes would not be all that traumatic. So it does seem like, while they will be affected by climate change, and they will have to move around somewhat, there's not a lot of good evidence, at the moment, that they are one of the more sensitive species to climate change—groups to climate change. I think there are plenty of animals that are—amphibians come to mind. But hummingbirds don't seem to be one of them that are especially sensitive to climate change.

EB: What would you say are the biggest threats to hummingbird populations?

DA: Well, that's a very interesting question. The Rufous hummingbird is in British Columbia, and has been throughout human recorded history. They seem to be in decline quite a bit. Their population in BC is definitely **[10:00]** declining, and I don't think we really know exactly why. There's been some investigation of pesticides. There's some other hypotheses as to what is driving it, but I would say, at the moment, we don't really know. But it is very troubling that one of the hummingbird species we have here does seem to be declining somewhat dramatically.

EB: What can the average person do to support hummingbird species?

DA: Well, in terms of the cause of Rufous decline, because we don't know what it is, we actually don't know what we can tell people to do. So, I would be very hesitant to do that. I would say, if you enjoy hummingbirds—what I'm about to say would not necessarily help the species—but if you enjoy them, you are, of course, most welcome to hang up hummingbird feeders, to plant ornamental flowers that hummingbirds like, and then you'll have them in your garden and you can enjoy watching them. But whether or not that actually is helping—we don't really have good evidence that that is especially helping or hurting them at the moment.

DA: I should say, one thing that probably is useful, if you really love hummingbirds, is to be mindful of them in the winter during the weeks when it freezes. That is probably—we suspect—is a very, very vulnerable time for hummingbirds because if you leave your feeder out, and it gets so cold that it can freeze overnight— And I should also say, hummingbird sugar water doesn't actually freeze at zero [degrees]. It freezes a little bit below because the sugar actually slightly lowers the freezing temperature. But if it's getting much below negative one [degree], or negative two [degrees] especially, then that sugar water will be frozen in the morning. And remember I told you that it's very important that the hummingbird gets a good meal right when it first wakes up? So, if you do keep hummingbird feeders, for those months where it's really, really cold—or weeks, say, when it's really, really cold and the sugar water is freezing, it's probably best if you bring the feeder in at night, after dark. Ideally, **[12:00]** and I know this is a bit of a heavy ask, is that you actually put it up in the morning right at dawn. And if you do that, you're basically going to be able to provide the hummingbirds that use your feeder with a reliable meal right when they wake up and need it most.

EB: Can you tell us about the hummingbird banding network, and how people have been working together in this collaborative research effort?

DA: I can't tell you a lot about it other than the fact that I've always been very impressed with them. So, there's a hummingbird banding network that exists throughout BC. There's a number of volunteer banders, and they do an amazing job of collecting data. They have a lot of respect for the birds. They really love them. They really care about them, and they also get together at least once a year and share knowledge. And they also contribute all of their data. It's going into this North American database on migratory movements for all birds. I think that they are really doing a lot to educate people about hummingbirds—some of the most important science about hummingbird natural history, biology, movement patterns, and things like that. It's a group that—they've invited me to speak to them a few times, and last year when I was with them in the spring, I spent a day with them. And I've always just been very, very impressed with the knowledge that this group has, and the efforts that they're making on behalf of hummingbirds in British Columbia.

EB: What would you want future generations to know about hummingbirds if you could record it now? Do they have a smell? A feeling? A special quality? Is there anything about them that is special and not articulated by scientific research?

DA: Well, again, I think to me it does keep coming back to hovering flight. That's the most magical thing about them. I also think their maneuverability is something that is a corollary of that. The ability to fly slow, it turns out, is also something that tends to confer the ability to fly fast, which I know is a bit counterintuitive. But they are **[14:00]** really—they do have this just absolutely magical flight ability. But at the same time, I think that's probably fairly well captured by the literature. The thing that maybe isn't captured—people do sometimes report it—but I think is an experience that many of us have had that I hope future generations can understand, is that the birds are also very curious, and they turn out to be very curious about humans. So I can't tell you how many people have told me a story of they were walking through the forest and a hummingbird just came up to them and basically hovered right in front of them—maybe just 20-30 centimeters away—staring at them, and they seem to come right up next to them, almost just looking around their face, studying their face, or their hat, or their backpack, or something like that before they flew away. And I think they have this really—they almost seem like you're touching nature when they come in and they're that curious about you and the things you're carrying. I hope that that experience is something that future generations can appreciate as well.

[15:01]