ENDANGERED SPECIES RECOVERY COMMITTEE (ESRC) MEETING

January 24, 2019 MEETING MINUTES

Meeting Location: Department of Land and Natural Resources, Division of Forestry and Wildlife, 1151 Punchbowl Street, Honolulu, Hawai'i 96707

MEMBERS: Scott Fretz (DLNR), Loyal Mehrhoff (At-Large), Lisa Spain (At-Large), Kim Burnett (UH), Kawika Winter (At-Large)

STAFF: DOFAW: David Smith, James Cogswell, Katherine Cullison, Glenn Metzler, Lauren Taylor, Lainie Berry, Fern Duvall

DLNR: Linda Chow

OTHERS: Shahin Ansari, Mitchell Craig, Lily Henning, Alicia Oller, Marie VanZandt, George Akau, Dave Johnston, Maxx Phillips, Ron Duke, Kristin Jonasson, Brad Yuen, Lesley Davidson, Tiffany Agostini

AGENDA

ITEM 1. Call to order.

FRETZ: Good morning, let's come to order. We have a quorum today. Not present are USGS and USFWS due to the Federal shutdown.

ITEM 2. Announcements.

FRETZ: This will be a short meeting. Is everyone good with the agenda? Yes. Anything else?

WINTER: Yes, I would like to add something about the O'ahu distribution study. I never got a response back from my email. They didn't report on some methods I think are very important to report on, so I asked for an amended report, but I haven't gotten a response from the contractor. Glenn said he'd send them an email and they'd reply directly and they haven't and it's been a month.

FRETZ: Is there a report coming for that project, and is that where we would like that to go? I want to arrange for that to get handled.

WINTER: I don't think the final report will be complete without that information.

FRETZ: Kate, can you follow up and let us know that got communicated?

KATHERINE CULLISION: Yes.

MEHRHOFF: Does the proposal have that kind of methodology?

WINTER: I didn't look but it is standard methods to report on. I'm just asking for more specifics on their methods.

FRETZ: When is that report due, Kate? It's a two year study and we get an annual review?

KATHERINE CULLISON: We plan to have a bat-focused meeting for the reports.

LINDA CHOW: That reply should only go to Kawika, not to the entire Committee.

ITEM 3. Request to schedule the annual Habitat Conservation Plan review meetings.

FRETZ: I'm going to move this item to later.

ITEM 4. Request to hold limited meetings for site visits pursuant to HRS §92-3.1 at Kawailoa Wind Farm, O'ahu, and Auwahi Wind Farm, Maui.

FRETZ: These site visits are considered to be a limited meeting under the Sunshine Law because the attendees from the public will have to sign a liability waiver?

LINDA CHOW: That, and because attendees will have to attend the initial safety briefing as well.

FRETZ: For that reason the Committee must vote that these limited meetings be held?

LINDA CHOW: Yes.

FRETZ: I move that the Committee approve to hold these limited meetings. A second?

SPAIN: I second.

FRETZ: Any discussion? Seeing no discussion all in favor say aye.

COMMITTEE: Aye.

FRETZ: Approved.

ITEM 5. Ecological Studies of the Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) on Maui: An Update, presented by Dave Johnston, Kristin Jonasson, and Brad Yuen of H.T. Harvey

FRETZ: Item 5 is an update from H.T. Harvey presented by Dave Johnston, Kristin Jonasson, and Brad Yuen.

DAVE JOHNSTON: Thank you Scott. I want to thank the ESRC for inviting us today. We've had an opportunity to put a very large team together with specific expertises and I've very proud of our team, so very quickly I will introduce Kristin Jonasson, Brad Yuen, and our president, Ron Duke.

We came up with several hypotheses, but to keep this presentation to about 30 minutes, I would have to say that the greatest risks to this population are complex. We took several approaches. Right away it

looked like availability of prey could be a serious constraint for this species. This was after spending a week here and on other islands. In the end we decided to use a study area where there was a known population of bats, fairly easy access that had roads going through it. I worked with our statistician to develop a robust acoustic monitoring program and telemetry: where the bat is spending time. We caught bats mist-netting, then used radio telemetry to track them down, catch them, collect guano or fecal samples and analyze with DNA barcoding.

Our study area is upcountry Maui. After we started radio tracking bats we found many were using the outside areas of our study area, so part way into our study we increased that size. We settled on nine habitats and added one, gulches. I have also seen bats foraging for insects at Kawailoa. The habitats are patchy and mixed. We separated the upper forest area from the lower forest area, and developed areas. Bats seemed to use low development areas a lot, more than highly developed or urbanized areas.

Though there isn't equal amounts of each habitat, we sample equal amounts for each habitat. Someone at the HCC said this project wasn't worth anything because we hadn't said what was available. In fact, the way we sample, it doesn't matter how big the habitats are because we sample each one the same. Every other month we have nine bat detectors out, the SM4s, the newer ones, that rotate every three days. One bat detector for one habitat. Five repetitions each night. Each month we have 45 samples: five replicates of nine habitats. We have 316 samples.

Here's a figure that shows our grids. Arbitrarily I used 250 meters squared a grid, based on what we know about how the bat forages. I didn't know if that would be significant so we did a test run in July 2017 and did a power analysis which showed it was. There are 3400 grids total. Some areas were not available for us to set equipment, such as Haleakala Ranch which did not allow access, or access was inaccessible for hiking. Brad and Kristin did an incredible job of keeping up our contacts in the community so we could continue access to various lands.

I will show you a sample of what these data look like. This is the upper forest woodland habitat. Elevation and temperature is different and there's quite a bit of activity there. We're still working on modelling these using a range of variables like lunar phase, temperature, rainfall, elevation. Since the Committee has interest in grasslands, grasslands are being modelled. They're pretty busy. Looking at the data, lower grassland tends not to be well used. Gulches are important to the species on Maui.

You can clearly see there is a big difference in the modelling in the habitats. Very little in forest woodland low, forest woodland upper elevation. Why is that? When we're trying to catch bats, the forests are very dense. The Hawaiian Hoary Bat wants openness, it is an open aerial forager and likes to be up high. We often saw bats fly over the forest but less situations in which they are foraging inside the forest.

In low developed areas, like Kula and outlying areas of Makawao, rural areas where people have big yards, fruit trees, compost bins. We caught a bat foraging for soldier flies over a compost bin when it was just getting dark. Rural areas presumably have more prey, they have heterogeneity and structure. Grasslands are interesting because they are variable, as are gulches. The more we model this data though, the bars are shrinking. There are two ways to model the data. We can run the data with raw data, or more complicated with the range of data such as precipitation, etc. If you look at grassland, we see more bats in the fall, as seen throughout the Northern Hemisphere. In the Southern Hemisphere it's probably the opposite. But after babies are born, they need to move somewhere so it is a very high

activity time for bats, which is probably why it is the highest time they are hit by wind turbines. We are also looking at feeding buzzes. As a bat is flying through space, it sends out signals faster and faster, like how a ping pong ball drops, so you hear a succession of buzzes in the recorder as the distance between the bat and the prey is shortening. Other activity could be the bat foraging but not locating prey, or community. We don't know which is which.

Take homes for the activity: most dense are grasslands, gulches, and low density developed. That looks like where they're spending the most time foraging. In all locations we found a good relationship between temperature, the insects flying, and the bats foraging. However, when we saw bats flying from Makawao up to the crater, because these bats move around a lot, we saw a lot in bloom in January and December and a lot of insects there. Finally, modelling this has not been easy. And on mist netting, when we first started we introduced acoustic lures and they were very effective in the fall. The bats didn't pay much attention to them in the winter. Also, these are big nets. These are over 100 foot nets and these bats are still hard to catch.

As a summary, we've caught 20 bats, after 78 nights of work. I'd like to catch more sub-adults which seem to have huge ranges. I'm going to turn this over to Kristin.

KRISTIN JONASSON: Thanks Dave. This is what radio telemetry tracking looks like on Haleakala. The first thing I want to describe is the difference between how we collected our radio telemetry and the data that was previously collected by the USGS study that our core use area recommendations are based on. The USGS wanted to be able to collect data using one person at a time. That was part of their objective and they calibrated their radio telemetry for a distance of up to 300 meters, based on signal strength. I calibrated that for different habitat types, but the limitation of that study was that if the bat flew past 300 meters from the person tracking, it could no longer be detected or quantified and that data wasn't collected. We were fortunate enough that Brad Yuen was collecting data both on that project and on our project and was able to contrast those methods. The thing is, bats fly. There aren't always ways for us to follow. So to cover a huge swath of upcountry Maui with two people, we triangulated our bats and used the intersection of both of our antennae at the same time, which required a lot of conversation really quickly where we focused on getting the bat at the exact same instant, I would say within one second of getting the signal. Because bats move so rapidly, we wanted to make sure those points were very accurate. There were times we detected bats up to ten miles away from the observer. Another time there was a bat roosting in lower Haiku and we had lost it for three days and were trying to find it everywhere, and 9,000 feet up on Haleakala, we found the signal. We then spend all day tracking down that signal to find where the bat was roosting. So we do know we are able to track bats at large distances and this gave us the ability to track bats with long ranges, but it was still highly challenging.

We radio tagged 16 bats. The majority were adult males. We were able to map 11 ranges. Five of those bats we radio tagged, we never found again. One bat we couldn't find for several nights, and eventually Brad went to Wailuku and pointed back to Haleakala, the other side, and said he's at Thompson Ranch. So I went to Thompson Ranch and we were able to drive and chase. Once we started to figure out a bat's pattern, next night we would stage at Thompson Ranch and the road, and find the bat travelling down the slope of Haleakala.

What I want to emphasize is we tracked bats for snapshots. We got on average five nights of data. We may have tracked a bat for greater total time, but there were nights when there was lightning and we

decided not to run around with lightning rods, or weather conditions were not good and the bats weren't out. But we got on average 5.3 nights of data from the bats. This is a subset from the best bats. So we wanted to show you the most robust data from the bats we collected for the most information.

The first thing I want to point out is the white dot is the 40 acres, the current recommended core use area. The other shapes are the core use areas of what our bats were using. You can see the orders of magnitude difference. The first bat, we first captured him in lower Kula—that was the bat that we lost. The green range is the core use area where he spent 50% of his time, but there is a larger area. I want to emphasize that the areas where we radio tracked didn't always include where we captured the bat, so we know that we weren't capturing all of what they did. And that was only for a few nights, for a few hours. Some bats had regular routines each night which included moving outside the range that we could track. Sometimes the bats used larger ranges but we were limited in our ability to chase them.

Bats E and F we captured ten days apart and it looks like they're segregating space. Both bats foraged heavily in gulches. This you can see with the radio signal where you have strong, constant signal and then it's gone, and then reappears quickly. Likely what's happening is there's insects coming off the edges of the gulches, creating three edges in space, and they have a linear flight corridor where there's easy, obvious to catch prey.

We need to think about how bats are partitioning their space. We did observe aggressive interactions between bats, and it's possible they are competitively excluding each other at a larger scale, but we need a better understanding of that. These ranges did overlap a little bit, but they may not overlapping at the same time of night or at the same altitude.

SPAIN: Those were all males?

KRISTIN JONASSON: Yes.

FRETZ: All adults?

KRISTIN JONASSON: Yes.

Each bat we tracked used massive areas, and used that whole massive area in a night. And the bats are using areas with varied levels of human impact. Bats don't need pristine forest that is completely removed from humans. If we can get them the food resources, bats are effective in fragmented landscapes, a huge advantage that we have. We need to think about the ephemerality and abundance of insects, how they aren't constant but occur in blooms, and the bats' diets need to encompass a variety of insects that occur in different habitat types at different times of the year and different times of the night. We don't know what resources the bats captured at times of day we weren't monitoring, for instance, dawn.

DAVE JOHNSTON: I can't emphasize enough the importance of knowing what bats eat and where they eat it. This is a plate of one of our samples. We were overwhelmed by the number of insects, mostly moths. There were tens of 1000s of insects in the samples. For DNA sampling, first you build a DNA barcode dictionary; for us, this meant collecting insects in all habitats, spatial and temporal, over the course of a year. Like the bat detectors, we would move the insect collectors. Then we mist net the bat, collect guano, extract the DNA from that, and run it through two primers. We are duplicating how USGS does this. Finally, we analyze and interpret the data to determine the species present. It is complicated.

Apparently you determine a moth species by dissecting their genitalia, and we have many undescribed species. Because we won't have time to identify all of the species, we're grouping them to the genus level, in many cases. After we build our DNA barcode dictionary, Beth Clare, an expert in this from Bristol University in the United Kingdom, will read them and we will combine the data with USGS data to get a better picture of what the bats are eating. We still need more guano to do a good job. We will also identify wasps and other like taxa. Some species we won't identify, such as very tiny insects, as our experience and the literature suggests hoary bats don't eat very tiny insects.

We need 24 useable guano samples. We split the samples in two so we can run them twice, with each primer. So a full plate takes 96 samples. We need three more samples to get a full plate.

I think we should start examining the bat's ecology on an island by island basis. My other take home message is I think hoary bats will skip huge expanses of area to go to a known foraging site. My colleagues and I recently came out with a paper on social foraging of bats. Some of these bats will fly for miles to specific sites habitually, not defending the area in between, while defending those specific sites fiercely.

Here's our thank you slide. Many people and organizations have helped contribute to our work. Questions on the study to date?

FRETZ: Thank you.

MEHRHOFF: I have a number of questions. You hypothesize there is a link between bat activity and insect abundance, but I didn't see any data on that.

KRISTIN JONASSON: One of the challenges of bat biology is quantifying insect abundance and what is available in a standardized way. So our goal was not so much to quantify that, but to quantify that bats were foraging, and relate feeding buzzes to what bats do when they encounter insects. Bats make buzzes in response to water, or if another bat was in the area, so we wanted to be able to correlate buzzes in our acoustic data with when bats were foraging. We didn't quantify insects because we do not have good methods to do so.

DAVE JOHNSTON: When we set out our specific tasks, we didn't say that we were going to test that specific hypothesis. What we want to propose, with what may be the best insect sampling collection on Maui ever because it is so robust and spread over such a period of time, is to map those samples temporally and by habitat. Then we could test that relationship knowing what the prey species are for the bats, and knowing where the insects occur at what time of year. Does that make sense?

MEHRHOFF: No, because you still need an abundance range in order to get any correlation between the abundance of the insects. Not just presence-absence of the species, but your abundance tied to the activity of the species.

DAVE JOHNSTON: I believe we'll have that. We have hundreds of the same species in some samples. That would suggest an ephemeral bloom going on with a particular species of prey.

MEHRHOFF: You've tried to be somewhat definitive in saying there is a relationship between abundance of insects and activity of bats, and I haven't seen that with the data. Somewhere in your study you need to produce a quantitative, or otherwise persuasive, reason you're making that statement.

DAVE JOHNSTON: I agree with that. Again, this has evolved over time. These are our thoughts now. We didn't propose that in the beginning but we would like to test that now.

FRETZ: I think where we want to go from this is to tie insects with habitat types that had higher bat activity. You identify gulches as important. So what is it in gulches that makes it important for bats to be there?

KRISTIN JONASSON: One thing we get out of our data is the acoustics show some commonalities. For instance, we were measuring temperature at our sites. There's a clear relationship between insect activity and temperature. The literature shows there's a trend that flying insects are more active in warmer temperatures. There's less bat activity at some of the higher sites where there tends to be less warmer temperatures, but also at sites where bat activity makes it difficult to forage due to the site structure. So we want to try to establish those direct links. Bats may be foraging in gulches for entirely different reasons.

DAVE JOHNSTON: A feeding buzz is accepted in the literature as an indication a bat is eating. In our data the gulches had the highest number of feeding buzzes. We're proposing using this sample set of insects to identify abundance of specific insects in a habitat, like gulches, that the bats are eating large numbers of through DNA barcoding. This is the next step.

FRETZ: The original proposal was to tie the habitat type to feeding buzzes and bat activity? But I thought I remembered insect sampling in there.

DAVE JOHNSTON: Correct. We wanted to know what the bat ate to determine what host plant species should be planted in restoration sites so the bats would have something to forage on.

FRETZ: Do we know that yet from your results?

DAVE JOHNSTON: No, because we haven't done any of the DNA barcoding. We need three more guano samples. Then we have enough to collaborate with the USGS data to run the barcoding.

FRETZ: You are aware of the proposals and management needs we're looking at and where we want to go with this information.

DAVE JOHNSTON: When the data is complete, restoration ecologists can look up the species of insect the bat chooses to eat. If the data of what the insect feeds on are also available, then there can be a determination of what plants to use. There may be assumptions by using some plants used by similar insects, and there may be some direct links.

KRISTIN JONASSON: We're also identifying what good habitats look like. There was a time we thought forests were good habitats for restoration, now we're looking at gulches.

BURNETT: Do these gulches have water moving through them, or have water in them at some point?

DAVE JOHNSTON: Typically not.

KRISTIN JONASSON: I'd say half were usually dry. It's more about the physical structure of that landscape. And the wind moving through the gulches. There's insect traps at the edge of gulches. It was talking to local people who saw bats in gulches and informed us that gulches were something we needed to pay attention to.

DAVE JOHNSTON: I noticed in Kawailoa, the wind was strong on the plateau between the gulches, and that's why there are turbines there. But when you drive into the gulches the wind is calm. When the wind is coming straight across perpendicular to the gulch, the gulches often become quiet areas filled with insects. Flying insects use that as a refuge. Most insects can't fly faster than five miles per hour. They are completely at the whim of wind. If they can get out of the wind, that's good for them. A hoary bat typically forages about 12 meters off of a forest edge. That's an area insects will collect if there is wind coming across presumably. So I think bats will use those areas in gulches where insects are collecting.

MEHRHOFF: How did you parametrize the different habitats? The boundary at the forest's edge: did you call that grassland?

DAVE JOHNSTON: That's a good question. The sampling was by randomly selected. So we have within that 250 meters squared area to place the detector. Rather than put it in a forest edge area, it was put clearly inside the grass. But that's potentially a problem. Is 100 meters from a forest still grassland, or forest edge?

MEHRHOFF: I wonder if there should be a category called edge. Did you note if the plots were grazed?

DAVE JOHNSTON: We did not, but it's been in our discussions.

FRETZ: But you could go back to your data and look at this edge question?

DAVE JOHNSTON: Absolutely. We have a lot of detail. But we did not design this to test edge. To determine the amount of edge that would be beneficial we'd need to know the precise location of the bat. You can try to do that with light tags, but unfortunately the bat moves so fast you get maybe a minute of data, if you're lucky. We're also limited by our line of sight. Now there are brand new tags available that allow us to collect data we could not collect before because the tags were too heavy and exceeded the 5% rule. These are roughly ten times stronger and have a microphone that will allow us to record interactions. The other tough thing about hoary bats is it is so rare to recapture them. Bats are smart. We are waiting for our turn to access the tags. They're being used on the east coast currently for another endangered species. They won't be available commercially for a few years, but because we worked with the DOE on the proposal for these tags, they worked with the manufacturer to produce prototypes which we will be able to use.

WINTER: You mentioned open forest habitat seems important. Could you go into some detail about the community structure that you think is ideal for foraging?

BRAD YUEN: This wasn't something that we designed the study to test for, but in the places where we've had success catching bats, the structure is open areas within a larger tract of forest.

KRISTIN JONASSON: In general our forested landscapes were some of the least used.

DAVE JOHNSTON: On Maui these are dense forests generally, in cases where no light is passing through and there is allelopathy. I don't think bats use those forests. They're not easy to fly through. They may use the edge where the branches hang over, but not the inside of the forest. On the Big Island, where the forests are multi-storied and fairly open, I have seen bats.

FRETZ: What about the gulches?

DAVE JOHNSTON: The gulches have different structures with a mixture of species, depending on where you are. I'm not sure I can answer that question.

WINTER: What about roosting habitat? Could a denser forest be important for roosting, and then the bats fly to open areas for foraging?

KRISTIN JONASSON: In our study the bats were not picky about where they roosted. In Kula they roosted in a mango tree, an African tulip. One bat loved a silky oak patch. It roosted there every day and night and there were no leaves covering him! We could see him swinging in the breeze. We didn't find roosting habitat to be highly limiting.

WINTER: Let me stop there because I understand that they can roost in any species of tree. My question was related to community structure and roosting habitat.

KRISTIN JONASSON: Half of our bats roosted in people's yards next to streets in fairly disturbed areas, and the other half roosted in forests or gulches that were inaccessible to us.

DAVE JOHNSTON: They can't roost in any tree. Often they like to roost in trees with clusters of leaves. But they're looking for free space underneath them where they can take off. In a dense forest they may not be able to see.

WINTER: Thank you.

SPAIN: I'm a little concerned that most of these studies are indicating where bats are because that's where people can get. I think about forest structure on Hawai'i Island, or what I would consider the east side of Maui, and there are high levels of complexity in native forest where you have a stand, and then a bog and then a gulch that creates heterogeneity.

DAVE JOHNSTON: The key point is this study was conducted on Maui. There is very little native forest. I agree, in a native ʻōhiʻa forest there is a lot of heterogeneity and I would expect a reasonable amount of activity there, assuming there is something for bats to eat in time and space.

FRETZ: Committee, you will get a report from the USGS project that is ongoing on the Big Island, and it's a completely different habitat, and a lot of it native, I think.

DAVE JOHNSTON: And your point that it would easier to put a bat detector by a road: we used this random sampling method and that meant in a lot of cases hiking for hours to place the detector. I went on one of these jaunts with Brad and it took five hours to put this bat detector out, going in, and coming out. We were cognizant of that issue and we didn't want to be sampling roadsides.

BRAD YUEN: There weren't trails for a lot of this. They were random points.

DAVE JOHNSTON: But some bats do love roads. Think about a road: it's open, it's edge. Another thing. We assumed that the bat that we caught would be using the habitat we caught it in. That's a reasonable assumption, but it was wrong. A lot of bats would be caught in a particular area and moved quite a distance before they were regularly foraging. Where you catch a bat doesn't mean a lot in the end. It just means that bat was at that point at that time.

WINTER: I understand you will have more information once you do your DNA analysis, but do results elucidate a preference for native or non-native insects thus far?

DAVE JOHNSTON: We don't have any data to address that yet. Chris Todd did his Master's thesis on that, and it doesn't look like bats have a preference. These species have evolved to eat certain groups of insects, and we may think this is simple, but they have very complex natural histories. Some moths can hear a hoary bat and they have a number of defenses. One is to fly away from the bat as soon as they hear the bat, and if the bat is very close, it will start flying erratically. Some moths produce sounds that can jam the bat's sonar. You can probably predict, by family, which species or groups the bats are going to eat, as opposed to native or non-native.

WINTER: What about termites?

DAVE JOHNSTON: Bats love termites.

MEHRHOFF: When obtaining the guano sample, what time period does that involve insects? Is that a day, a minute, ten minutes?

KRISTIN JONASSON: Several hours. They can produce multiple fecal samples in a night. They have a quick gut through time.

DAVE JOHNSTON: Like birds, they want to process insects quickly because it's weight. But that's a good question, because the bat could be caught in one place but hunting insects in another place. That's why we can't make assumptions based on where we caught the bat.

RON DUKE: That's part of why we're here today. We have an opportunity through our client to continue our work. We're done with our contract. So we wanted to tell you what we've done so far, and what more things we can do over the next part of the year.

FRETZ: We plan to take that up. Any more questions?

WINTER: Are your telemetry methods novel or established?

BRAD YUEN: These are established methods that were the best for our study area.

DAVE JOHNSTON: They're long established. Over 20 or 30 years. The technology is very old though and I've been trying to get the manufacturers to use newer technology than that from the 20th century. We should be using cell phone technology in these radio tags, but they don't because it's such a tiny market.

MEHRHOFF: Did you quantify the overlap in the core areas?

KRISTIN JONASSON: No. We had some bats with overlap but a lot of our bats were captured at separate periods.

DAVE JOHNSTON: But easy to do.

BRAD YUEN: I'm guessing you want that because that was done in the previous telemetry study? The bats that overlapped the core areas were caught one after the other, within two days. All of the other bats were further apart temporally so we they could have moved in that time. We can't be sure of overlap.

DAVE JOHNSTON: Core use areas shift. They are not stable. I think there is some competition. On the mainland, and I would be surprised if our hoary bats don't exhibit the same, bats make quiet calls, stealth calls, around conspecifics. It might be bats trying to detect an insect without alerting other bats.

Most researchers have seen bats in some sort of tangle or seemingly aggressive behavior, but we don't really understand it.

MEHRHOFF: Can you elaborate? It seems like the home ranges you're showing are so big that if they're excluding each other from those, there's not that many bats.

KRISTIN JONASSON: It may be at different time frames. With those microphone tags maybe we can hear a bat's calls and locate its conspecifics, and see how often a bat encounters other bats and what happens when it does. It may not be how capable a bat is of defending an area, but the spatial and temporal overlap of those areas and so when it has to defend that aerial space.

DAVE JOHNSTON: Their landscape is clearly three dimensional. Some territories may be spatially separated in altitude. Or if they are separated temporally, one bat may forage early evening and one in the early morning, and they may never see each other. Or they're not excluding each other at all. Sex and age may contribute to those factors.

FRETZ: If you continue the study, would you be tagging more bats in those same areas? I see the importance of linking the prey to the habitat features, but also considering the issue of core use area, you'd be catching more bats in the same area.

DAVE JOHNSTON: I think our best plan would be to work in those same areas. Catching the bats is one of the most difficult parts of this and we've found specific places where it's easier to catch them, and we're getting better at it. We'd try to catch as many as we could at the same time with the new technology to be better able to answer that question. But in the past we catch a bat and then we spend all our energy radio tracking the bat, rather than catching more bats.

KRISTIN JONASSON: Our detection is limited by whether the transmitter sticks to the bat, and the bat staying in an area. We're working on better adhesion and attempting to catch more bats at the same time. But there's no guarantee the bats will be near each other so we can determine if they're excluding each other.

FRETZ: How long does the transmitter last?

KRISTIN JONASSON: On the bat, about a week.

DAVE JOHNSTON: There is no battery commercially available today that will last more than three weeks. But the new nano battery transmitter will last almost a year.

KRISTIN JONASSON: Another study sutured the tags on the bats and they lasted a year, but those were GPS transmitters.

DAVE JOHNSTON: And that was a mainland hoary bat, which is not endangered. The suturing is very invasive and may not work out well for the bat. I've successfully put collars on Mexican Fishing Bats with GPS data loggers.

FRETZ: Have you considered doing aerial surveys by helicopter or something like that for when your bat goes out of range?

KRISTIN JONASSON: In principle I would love that.

DAVE JOHNSTON: You'd have to test if the helicopter would make too much high frequency sound that could drown out the transmitters.

FRETZ: We've tracked birds this way.

DAVE JOHNSTON: If we could figure out where more of them roost or where they relocate to when they're out of range that would help.

MEHRHOFF: When I was in Panama, my friends banded bats. Can you band bats?

KRISTIN JONASSON: Yes, we band our bats. You have to be careful in placement not to limit their movement. We use very small bands that have to cut through the wing membrane, but we are limited by the number of colors—if we find a Big Island bat on Maui, we'd never know. We should push to use PIT tags with numbers so we can get more long term data collection. I think as more projects start working on this species it will be more important to capture this data, particularly inter-island movement. It may be very rare, but we want to be able to capture it if it happens.

MEHRHOFF: How about their feet?

KRISTIN JONASSON: The feet are too tiny. The band would go right over their feet. And their leg bones are very tiny, close in size to their finger bones.

FRETZ: Do you have to capture a bat again to read a PIT tag, or can you read it from a distance?

KRISTIN JONASSON: A short distance, depending on the antennas.

FRETZ: Public comments for the presenters?

FERN DUVALL: I was wondering about one aspect of the population which hasn't been mentioned. What happens with pups— pups would determine temporality of what they're feeding on, beetles or moths, and might have something to do with where the bats are and when pupping versus not pupping.

DAVE JOHNSTON: What the females are eating while they're nursing?

FERN DUVALL: There may be selectivity, like birds.

DAVE JOHNSTON: Yes, I suspect it may be different judging by other mammals. We would need to collect a lot more bats to get a robust enough data set, and for whatever reason, we're biased for catching males. On O'ahu, we caught one lactating female and one male. On Maui, we've caught an assortment, including sub adults. But most data is male biased and it may be because of the lure. There may be some social interaction we don't understand, but we know it attracts bats that are investigating.

FERN DUVALL: Over the years that I've every now and then gotten bat pups, some have been in Kihei down at sea level, some at Makawao, other times Pukalani, so these low density type areas. I was thinking using these nano tags, catch the female and track as it comes to the pup. These are roosts brought to my attention by homeowners who saw the pups in the trees. In one case, a cat being interested in the pups.

DAVE JOHNSTON: By all means let Kristin and Brad know.

KRISTIN JONASSON: That would be super informative. We've only had one lactating female sample. If we had a known roost, I would try to put bedsheets underneath and collect some guano.

FRETZ: Were you able to analyze the prey in the one sample you have?

DAVE JOHNSTON: Not yet. It's better to process all the samples and DNA at one time. But we have started processing the insect data in our collection. We did record a lot of social calls between the mother and the pups with the female coming in and leaving the pups.

FERN DUVALL: When we do forest bird work in closed canopy native forests, or seabird work at night, we often detect bats in and over forested areas, either with night vision or thermal imagery. I would say it's a normal occurrence on the Hana side.

DAVE JOHNSTON: Native forests have much better structure for bats than what I'm seeing in these non-native forests.

FERN DUVALL: Another thing. I wonder if the gulches where you've been working recently, because they are predominantly eucalyptus trees which have been dying off due to beetles, are attracting bats because of the confluence of beetles, compared to a normal gulch?

DAVE JOHNSTON: How big are the beetles?

FERN DUVALL: At least the size of souring beetles or larger.

DAVE JOHNSTON: I bet there's a DNA barcode already for those, so we could determine if they're taking them.

MARIE VANZANDT: For your acoustic analysis you used something called "call minutes" for your metric. I've seen "bat passes". Maybe you could explain how those are related and why you chose that?

DAVE JOHNSTON: I like call minutes because a bat detector doesn't tell you how many bats; it only records the call. Some prefer using "pulses"—that is, the number of pulses that are recorded—not a full call, but that's a really tiny metric. A lot of people use "number of calls" and they define a call as more than two pulses. Bruce Miller wrote a paper in 2001 about the bias involved in just talking about the number of calls per night. The issue is one bat can go around this microphone a hundred times, say it's a swarm of insects, and then it leaves, is that the same thing as one hundred different bats going by that microphone? Your data will show the same thing: one hundred bats on that day. And that's a big difference. So to buffer that Bruce's suggestion is to only count calls that occur within one minute as one call, or one "call minute". So if the bat went past one hundred times and took three minutes to do that, you would only call that three call minutes. When different bats fly past presumably they won't all do so at the same time, they will be independent rare events over the course of the night. So each pass will be one call minute.

MARIE VANZANDT: It's hard because most of the projects use bat calls, so it's hard to compare data. It seems like we should all be using the same metric.

DAVE JOHNSTON: I would highly recommend going by call minutes as more meaningful metric. And it's easy to tell you how many calls there are. We have to count the number of calls before we go to call minutes.

FRETZ: Are you able to compare the occupancy of these sites and the occupancy of completely different habitats in the Big Island studies? That would be important to land managers.

DAVE JOHNSTON: Yes, they need only to look at their data, assuming they saved their data with a time stamp on it, there is a fairly quick analysis script that will produce that for them. I would recommend people use this other metric, but we always report both.

TIFFANY AGOSTINI: What is the minimum insect size you will be looking at for the diet analysis?

DAVE JOHNSTON: I can't exactly remember, nothing smaller than either four or six millimeters. There was a paper published about 20 years ago, by Jim Ford and another author that examined Hawaiian Hoary Bat prey and found about six to 21/22 millimeters was their prey size. The bats were from one site though, and to some degree what they feed on will be opportunistic. And they can eat larger prey when they're available—they love dragonflies.

TIFFANY AGOSTINI: What I've heard from the entomologist is that the smaller size insects are more challenging to identify in the samples, but the bat biologists seem to agree on the smaller size cut off.

DAVE JOHNSTON: Different bats will eat different things. It's not true that bats never eat mosquitos, but most bats don't eat mosquitos because it's too small a mass to be worth eating, unless there is a dense cloud. One study found that bats eat 600 mosquitos an hour. In that study the researchers captured a brown bat and held it overnight, and the next day put that very hungry brown bat in a small tent filled with mosquitos and counted how many were left after one hour. What is wrong with this science? But you will read that cited in a lot of books, and online. I don't think they eat a lot of tiny moths. If I thought they did, I would figure out how they could be identified and by whom.

WINTER: You mentioned you statistically analyzed the influence of the lunar cycle. Did you see any correlations or trends?

DAVE JOHNSTON: We're still looking at that.

WINTER: Could you pull up the slide that had the bar graphs for habitat types and seasonality over the year? Was I correct in the inference that in the pupping season the mothers are foraging more?

DAVE JOHNSTON: I think a lot of things are going on there. They're foraging more in July—they pup in June—when they are lactating. The big activity period is usually September but it can vary.

WINTER: When do the pups first fly?

DAVE JOHNSTON: Sometime in August. By September they are fully flying and foraging.

WINTER: So what habitat type is high in August or September?

DAVE JOHNSTON: We didn't collect data in August because we do this every other month. In September, gulch and grassland were very high.

WINTER: Thank you.

TIFFANY AGOSTINI: Were the habitat types defined by existing data?

DAVE JOHNSTON: The habitats were defined by a State-owned data set that we accessed. Gulch we had to hand map out of that.

FRETZ: You will be able to go back after determining what the bats eat and look at prey abundance of certain insect species in different habitat types? In other words, tying the use of that high activity area to prey availability?

DAVE JOHNSTON: I believe so. But there will be some variability within those habitats and their composition and seasonally, and we didn't test microhabitats in this study within the habitat, say edge of forest versus within the forest. That will all be "forest".

FRETZ: Do you have any information on value, attractiveness, or use of water features?

KRISTIN JONASSON: I would be very interested to put up some bat detectors at some of these features.

DAVE JOHNSTON: We had water as a habitat feature in the beginning and we weren't getting any calls. The question is how important are water sources, and where? They may be more important in a drier habitat. In a wet situation without open sources of water, they may not be drinking surface water, but in a drier landscape it makes sense they're drinking surface water.

KRISTIN JONASSON: The time for a bat to commute to a water source is probably not very important because they spend so much time flying and foraging.

DAVE JOHNSTON: We caught a bat just inside Haleakala National Park at a water feature and presumably it was coming to drink, but I agree with Kristin, I don't think they need a pond close by. It's probably not a big issue.

MEHRHOFF: That's interesting because I thought the water was important not because of needing to drink, but because you'd get higher insect populations there.

KRISTIN JONASSON: When reservoirs are treated for drinking water that can reduce the insect populations there.

DAVE JOHNSTON: It depends on the specific water source.

BRAD YUEN: In our telemetry work, we would have expected that if the bats were continually foraging over a body of water, which is usually quite small, that we would have had a small core use area, but we did not see that. We did not record any bats using water to forage on.

FRETZ: Any more questions? No. Okay, the submittal is they're requesting to extend this research and they're asking for the Committee's recommendation on that. Mitch, is this connected to a particular HCP or set of funds?

MITCHELL CRAIG: Yes. We're about "half" a bat or less away from needing to plan and fund Tier 2 at Kahuku. That's eight bats. If it were a research project at $50,000 a bat that allows $400,000. We've already committed $100,000 to finish the USGS contract, partly out of KWP I and KWP II mitigation funds.

FRETZ: This Tier 2 at Kahuku funds… was this part of the original funds that had been identified as going towards research funds?

MITCHELL CRAIG: Probably not. It wasn't something we were expecting at that time.

KATHERINE CULLISION: I don't know if we can agree to additional research without checking with USFWS. I thought we'd fully obligated the funds at the time.

FRETZ: That's the technical side of this. Committee, do you think this is something we can support, that we should go and explore the possibility of if and how we could continue this?

WINTER: Dave, do you have more slides on how you suggest you could continue this?

DAVE JOHNSTON: We have some goals or tasks we'd like to look at, but we would be completely open to the Committee's interests. Our top priority would be to collect more guano because that would really help the restoration ecologists and managers. Until we know what they're eating, and when and where, it is difficult to restore an area. We need just three more samples to run the full sheet. We don't know what the bats are doing at night because we catch them early evening, so because of the bat's ability to process food quickly, if you want to know what bats are eating in the middle of the night and early morning, we would have to start catching bats then. Finally, we have few data from females, and winter and spring. We don't know much about what they're eating then.

Second, we would like to generate a report on the insect resources of the study area. If we used a GIS format we could see how these changed over time.

Third, the bat research community is just learning about the bat's social interactions. For instance, we've just identified the stealth calls. If we could put a microphone on them, we could learn about this. If we attached altimeters we could learn if bats use a three dimensional space in core use area. If we used regular transmitters with super strong batteries we could get data for closer to a year and learn if the core use area changes or not.

FRETZ: Is there somewhere in your goals and tasks that will help us as managers understand how to change a habitat to improve its suitability for bats?

DAVE JOHNSTON: We could certainly do that. It's a little different from this. Part of the answer to that will be to finish the DNA barcoding, and we have the data to mine to answer that question, about what is so important about a habitat that bats are attracted to it, for example, why some grasslands are more productive than others. We're just beginning to look at that, but we've run out of money to do special analysis like that. We're just finishing our obligation.

FRETZ: Committee, technical issues aside. In concept, do you want to see if we can explore this?

WINTER: I recommend that we do so, but I think the research needs to be focused on informing mitigation strategies.

FRETZ: I'm a yes in concept too. But there's only five of us here, so we need to know from the other three of you.

BURNETT: I'm in agreeance with you that there's a lot that can be done with the data you have, by slicing those habitat types into structures and characteristics and looking at what's correlated with the activity levels, like water structures, densities, wind speeds, rainfall, distance to edge. Like you said, not every grassland is the same. So if you can splice up the data differently with what you already have, I think you can get a lot more information with what you already hold.

SPAIN: Looking at the big picture of what we have going on on O'ahu with the WEST study, the USGS study, and this study, I'm a numbers person, so I'd like to know that the effort and efficiency of the studies are comparable. I don't have a good sense of that and that's kind of on the staff. I want to be sure of where we're allocating dollars and the effort for the dollars is equal across the studies. That's a broader question. In concept I'm fine with moving along with research, but I just want to be sure the three entities that are getting these research dollars are using them efficiently.

FRETZ: Like Kim's comment, you would like to see a follow up set of information? There will be interim reports coming from the other two.

SPAIN: I would appreciate it, because I don't feel like I have much to hold on to. And to be sure all of the entities' data and mitigation is guiding us toward better mitigation decisions.

MEHRHOFF: From a concept perspective, an extension is fine. However, if these additional funds are going to go into research, I would like these ideas to compete with some of the other ideas we had for research before making a decision. I would also like more detail on the specifics, such as the hypothesis testing, how you were going to use the money and what your graphs and statistical tests were going to look like upfront, so I know we're going to answer a definitive question for management purposes.

FRETZ: Could you submit a proposal in writing that the Committee could look at? But we also have to talk to USFWS, because if they won't count it as mitigation, it leaves us stuck.

SPAIN: Do you need us to vote on a motion?

FRETZ: I think we should. But we need staff to talk to the USFWS, because we can't. But no applicant is going to want to commit money if they're not going to get credit for it.

MEHRHOFF: We can refer things to the Bat Task Force to start that process.

FRETZ: Glenn, can you schedule a Bat Task Force meeting? Committee, do you recommend in concept, with technical and other details to be worked out in the future, that this research project receive a proposal to continue, and we support its extension in concept?

WINTER: So moved.

FRETZ: Is there a second?

SPAIN: Second.

FRETZ: All in favor say aye.

COMMITTEE: Aye.

DAVE JOHNSTON: The other projects received quite a bit more money to do the same sort of thing but for a longer time. So on the broad stroke, it looks like the funding is similar. Ours is less because our timeline is shorter, but we'd like to continue on a parallel basis.

FRETZ: I really appreciate the work that you have done. I think it is great work of great value and you've made great progress. I'd be happy to support it and see it go forward. It's more of the practical issues we're facing.

DAVE JOHNSTON: Thank you.

ITEM 3. Request to schedule the annual Habitat Conservation Plan review meetings.

FRETZ: There is something else: to schedule the annual reviews. Is that a two day?

LAUREN TAYLOR: We're thinking two days to include the bat research that is coming as well as the reviews.

KATHERINE CULLISON: As soon as possible, as we had other things to get to we weren't able to schedule for this meeting.

FRETZ: You don't want to wait until the next quarterly meeting, right? March 6-7? Done.

MEHRHOFF: Are we going to have a meeting to review the incoming HCPs and amendment submittals?

FRETZ: Staff has to juggle this every time. Be conscious of the time it takes to go through these when you put them on the agenda. I'll help.

Any last comments or questions from the public?

MARIE VANZANDT: I'm trying to understand as the applicant, is there a new set of research that is being proposed for approval for mitigation, or this is just research that we all need? The direction we have been given from USFWS and DOFAW is there will be no more approval of research as mitigation. Trying to understand what the Bat Task Force is doing and how that is related to research as mitigation.

FRETZ: That reflects the technical issues that I was trying to get at. I don't think there's been anything formal from the Committee yet, but there has been an informal assumption that that round of research that was supported should go forward and we should wait until we get the results of that to see if there's other research needed. There was a Committee meeting in which the question was raised when to do more research, and the Committee created the Bat Task Force to review existing research to report back to this Committee if additional research is needed at this time, and the Bat Task Force hasn't finished that.

MARIE VANZANDT: As mitigation, or just research that is needed for the bat?

FRETZ: Research that mitigation dollars can support. We're aware that USFWS will not give credit, but I don't think that should stop the State and the ESRC from following up on interests and recommendations that they have.

MEHRHOFF: It wasn't clear last time I talked to USFWS whether it was an absolute, or whether it had to be highly tied to actually improving the mitigation for that project in the short term.

FRETZ: Whether we're talking about this small thing now or another round of research later, if this Committee and the State would like to explore this and come up with a recommendation it should do that, and then talk to USFWS about it. I don't think it would be right to say USFWS won't support this so we shouldn't look at it. That's why we're moving forward with the discussion on this.

SPAIN: The same could be said for deterrents.

GEORGE AKAU: Site visits for the 7th and 15th?

LAUREN TAYLOR: Yes, just pending OIP approval for the limited meeting aspect. I will send in the forms today and understand it will be a quick turnaround, so expect to hear from me shortly, hopefully next week.

FRETZ: Anything else? Adjourned.

ITEM 6. Adjournment.