Linking Remote Sensing and Bird Behavior Data to Understand the Impacts of Drought on Waterfowl

John Ossanna: I'd like to welcome everyone from the US Fish & Wildlife Service's National Conservation Training Center in Shepherdstown, West Virginia. My name's John Ossanna. I'd like to welcome you to our webinar series held in partnership with the US Geological Survey's National Climate Adaptation Science Center.

Today's webinar is titled, "Linking Remote Sensing and Bird Behavior Data to Understand the Impacts of Drought on Waterfowl." We're excited to have Michael Casazza with us today. Michael is from the USGS. We have Abby Lynch who is also with the US Geological Survey. She will be introducing our speaker today. Abby?

Abigail Lynch: Thanks. Thanks for the opportunity. I'm with the National Climate Change & Wildlife Science Center. It's my pleasure to introduce Michael Casazza. Just as a brief introduction to him and his team, which includes Cory Overton and Eliott Matchett. They are wildlife biologists at the USGS Western Ecological Research Center in Dixon, California.

They, and others, conduct a variety of research on the ecology, population biology, disease and habitats of wildlife in California and western North America. The team's research provides species information to land managers responsible for maintaining diverse and healthy wildlife population while trying to help recover special-status species.

A primary focus of their work include the study of waterfowl movement across multiple species using cutting edge tracking devices. This research is being used to understand waterfowl migration, movement patterns, distribution, and habitat use , which can inform management from the local to flyway level. We're looking forward to your presentation today, Mike.

Michael Casazza: Thank you very much for the introduction and the opportunity to share some of our research with everyone. I'd just like to acknowledge my coauthors also. Josh Ackerman and Susan De La Cruz of USGS. Matt Rider, who is really the architect behind a lot of the water mapping products that you're going to see in the presentation. He's with the Point Blue Conservation Science.

In general, just a couple of brief descriptions about the project before we get into the details. The opportunity that we're taking advantage of is we had these two distinct projects at the time going on where Point Blue and some other partners were mapping water-flooded habitats across the landscape in the Central Valley.

We were involved in this intense radio telemetry work using radio transmitters on multiple species of waterfowl. We partnered with the Southwest Climate Adaptation Science Center to try and integrate those two ongoing projects and basically leverage that work.

With a little bit of funding from the Science Center, we were able to just try and maximize what each project is getting out of the data set. From the mapping aspect, just being able to evaluate how well the water mapping relate to waterfowl habitat.

From the telemetry aspect, we were really looking forward to seeing how does this water map help us interpret the birds' behavior and how they respond to water on the landscape. Those are both critical things to have to be able to know when you want to evaluate something like drought and especially in California.

When we were doing this project, we were starting in the middle of a pretty extreme drought situation. The timing was great. We really appreciate the support from everybody.

Just a little bit about the Central Valley. The Central Valley of California is a critical wintering area for waterfowl in the Pacific Flyway with up to 12 million waterfowl spending some portion of their winter time period here.

Over 85 different species of waterbirds....the landscape is a mix of private lands, agriculture, duck clubs providing about 85 percent of the current habitat.

The Central Valley have a joint venture with Fish and Wildlife Service led is a great private public conservation team that is dedicated to maintaining waterfowl and water blue populations throughout the Central Valley.

It's really important given that only 10 percent of historic wetlands are remaining in this area. We're in a highly urbanized and agricultural landscape with remnant and fragmented areas of wetlands.

In California, water is the real gold. It's the currency that drives our state. This is just a slide that demonstrates where that water is distributed on the landscape. How it's doled out under current...this is from a 2011 publication where you see the cities are getting about 15 to 16 percent of the water available.

Farms and industry are up there in the 60 to 65 percent. Fish and flows somewhere around 20 percent and waterfowl somewhat meager 2 percent of the water allocation in the state is going to support waterfowl-related habitat.

When we look at those numbers, we think it's really critical that we do the best we can managing that small amount of water available to support 12 million waterbirds.

The water tracker product is really developed. It's a product that Point Blue has developed which matched the probability of surface water using Landsat imagery and Landsat basically on a 16-day cycle. They integrate the imagery every two weeks and get a water map of surface water across the entire Central Valley or most of the Central Valley every two weeks.

They've been able to do that going back with historic imagery and we particularly focusing on data from 2013 to present.

One of the things you can do when you have a map of water across time and space, you can assist the impacts of drought on various habitat types. Here, we're just looking at the types that are important to waterfowl especially dabbling ducks that we have with radio transmitters.

On the agricultural side, you have corn and rice which contribute a lot to waterfowl habitat in the region. What we see is that yes during severe drought in the pinkish salmon-color. You see some pretty serious declines in the proportion of flooded corn and rice during drought periods.

You see similar response looking at the water tracker and how mapping surface water are flooded seasonal marshes and semi-flooded marshes during those periods of extreme drought as well.

The water trackers, it seems to be doing a good job of tracking these types of habitats during various periods of normal to drought in California.

Another area we wanted to investigate was just how drought affected the acres of rice planted. We looked at some USDA crop data and basically indicated through that data that...you see about a 20 to 25 percent reduction in fallowing of rice during these extreme periods of drought.

Now, the drought started a little early on the graph there. It takes a few years of drought in California before water supplies are diminished and the allocations for rice farms are dropped down to where it actually impacts the acres planted.

This can affect the habitat on the landscape. Given that a big portion of the Central Valley habitat available for waterfowl is agriculture. In the Sacramento Valley, some are normally in a normal year about 550,000 acres of rice which a significant portion of that gets flooded, it's important to know that impact of drought on that as well.

We looked at the water tracker, how well it maps different habitats during different years. Basically, it matched up really well where you see the proportion of open water higher during the non-drought years.

The drought years slightly less and then in extreme drought quite a bit less. The water tracker seemed to be doing a good job of capturing what we would expect based on precipitation.

Another feature of the water tracker that we think is really quite useful and maybe not as intuitive is the ability to detect irrigations on the landscape.

With some previous work through UC Davis, John Eadie, some of the students there, they looked at the impact of irrigating seasonal moist soil managed seasonal wetlands and the impact of irrigation on the productivity of those wetlands.

What they found was one or two irrigations produced significantly greater yield of moist soil seed. We could use a water tracker -- it's what we did -- to evaluate the probability of wetland irrigation in various regions in the Sacramento Valley based on drought.

What they found was during drought, the probability was lower particularly in some areas. I think where water supplies became more limited and perhaps ground water was not available.

What this can do, you can map where those irrigations are taking place and you can estimate that the joint venture is using some estimates of production and food availability. Those estimates could be modified based on the water trackers indexing of those irrigations and we get a better idea of food abundance across the landscape.

This is just a couple of different scenarios. This is the basic A scenario is where your food supply the red curve is very sufficient and well above the demand curve below in blue. You have lots of food in supply over the course of the winter and demand does not exceed supply.

That's what you want to see. That's the goal of the joint venture and the habitat plan is to have that blue curve in that condition.

Scenario B is potentially detecting what you would maybe expect in a drought condition. Where you have at the beginning, potentially, an adequate food supply but as the winter wares on the demand increases.

You reach a period of food deficit where the red line and blue line intersect and your demand is exceeding your supply and the birds have to do something either leave, go find some other areas to feed, or perhaps are impacted in terms of their body condition.

There are several studies that show that the body condition of waterfowl leaving the wintering area is directly related to reproductive output on the breeding ground. There are some potential impacts that you could see with that.

Here, this is some work done. This is actually a paper from Mark Petri in a joint venture where they actually looked at and modeled some real data in terms of the true meant model. When you're focusing on that purple line is under the drought conditions and this is just for ducks.

Under drought conditions for ducks, they predicted that towards the end of December, early January that we actually could reach a deficit. This condition would be in play under certain severe drought conditions.

We look at that same modeling effort for geese. We see that there is a deficit that occurs much later. Really, this comes into play with the feeding behavior of differences between ducks and geese.

Whereas ducks will primarily just for feeding in flooded habitats, whereas geese will take advantage of both flooded and dry habitats. They have the ability to exploit habitat in the drought that ducks might not, but still, under drought conditions would be facing a potential deficit late in the winter period.

That's an example of how we would use the water tracker information to try and relate it to what's going on on the landscape and what we think is going on with birds, but then we want to just see where we have actual data on these birds and what they're doing in relationship to that water on the landscape. We combine that.

We have these solar-powered backpack GPS transmitters. They just fit on like a backpack. We have about approximately 550 different individuals, 7 different species marked. The transmitters can collect data.

Actually, this is a little bit of an old slide, that anywhere from a one-minute interval to a six-hour interval. One minute would be basically getting a location every minute for the day. They can't do that for more than 36 hours. They'll use up their charge but they are solar-powered so they will recharge.

We can get this varying high frequency relocation data with an accuracy of a normal handle GPS somewhere around 5 or 10 meters. Sometimes a lot better. To date, we have well over 650,000 data points that we can apply to these different questions in evaluation of the water tracker.

Primarily, the data I'm presenting today is from the ducks but we are also marking geese. We'll be looking at how they're using dry and wet habitats going forward.

They basically have the same type of transmitter. The transmitter communicates through the cell phone network, through the GSM network. As long as it's in cell phone range, we're getting the data and when it's not, it stores the data onboard and we download the data.

Currently, we're getting lots of data from migrating geese coming back from the Arctic. They're downloading many, many megabytes of data every day from the storage onboard the transmitter.

For the geese, we have several species marked as well. Lesser snows, ross greater white-fronts as well as truly white-fronted geese now as well.

For the Central Valley, just as we already talked about its importance in the Pacific Flyway is a major wintering area for up to 12 million birds. Almost all the birds that we've marked have been in the Central Valley and primarily in Sassoon Marsh which is right on the edge of the Central Valley.

You can see from some of this, this is an example of some of the locations that we've gotten from the birds that we've released. Pretty much the Central Valley is blacked out there, yellowed out with a myriad of thousands and thousands of points.

The birds spread out all across North America. We've even had to interchange between different flyways. Now with the geese that we're marking, many are going into Russia. The importance of the Central Valley really can't be overstated. It's a real critical area for all North America. Being able to track the water and the birds within the Central Valley we feel it's a game changer for some of the management questions that are being put forward.

Primary study area in the Central Valley, the nexus, it's got some our bird locations, our duck locations overlaid there. You can see the Suisun Marsh. It's on that western edge. It's on the confluence of Sacramento and San Joaquin Rivers as they flow into the San Francisco Bay estuary.

The habitat associated with the Central Valley in the Sacramento Valley, if you'd look at the figure on the left, the Sacramento Valley to the North of the Central Valley, the bird habitat would be primarily consisting of wetlands and rice agriculture, with the wetlands in blue and rice agriculture in green. A little bit of corn in other habitats mixed in.

Primarily, that's rice built up in the north. The Sacramento-San Joaquin River Delta, a lot of corn, a little bit of rice and wetlands, but primarily a corn-centric area. The Suisun Marsh

wetland, almost all wetlands, either mostly seasonal wetlands with a little bit of tidal wetlands as well.

The San Joaquin Valley to the south, the primary bird habitat to the wetland units down there. Agriculture in the San Joaquin Valley is shifted over the past 30 years, where you see a shift away from rice or grain crops to nut crops, almonds, vineyards and cotton. Depending on those wetlands down in the south, either duck clubs or refuge areas.

When you overlay the bird locations on the habitat, they really line up pretty well. What the birds are focusing in on, these are duck locations, they're focusing in on the same habitats when they're flooded.

As those habitats flood, drain and become available when they flood to ducks, the ducks respond, and we see a large overlap of bird use right over the top of those wetland and agricultural habitats.

To give you an example, we have different species in different colors. These are 20-day intervals, just the bird locations over through the course of the winter. Essentially, that breaks down the previous slide you saw with all these points.

You can see how the various species distribute themselves over the winter. We really get nice mix of locations and distributions of waterfowl across the Central Valley, especially in the Sacramento Valley.

At the more regional scale, we're focusing in here, the bottom right of the picture there is the Sutter Buttes, if you're familiar with the Sacramento Valley at all. This is the Sacramento National Wildlife Refuge here.

We can look at the bird points at the more regional level, and then look at the distribution. Pretty much most of the green habitat that you see surrounding the refuge or the Sutter Buttes, which we shouldn't see too many duck points up there. The green is primarily rice agriculture.

We can see a little more local regional scale bird movement across time and space over the winter. Again, 20-day intervals of distribution of points. Using that entire landscape with the primary driver of whether they're using it is whether there's flooding or not.

To take it down a notch and scale, this is just an example of one bird. It was a Northern Pintail marked in the Suisun Marsh down in the central part of the Central Valley. This does a good job of depicting many of the birds that we have marked and their behavior.

Of course, in the winter time, there's a hunting season going on. They tend to congregate at their daytime location at some sanctuary area. At night, they go out and feed, and distribute themselves from those sanctuaries.

You can see this bird is in Suisun. Probably using a couple of different sanctuaries and then feeding off into the duck clubs around it. It moves into the old bypass area in the Central Valley there just south of Sacramento. It does the same thing. It sets up on the sanctuary during the day, and then goes out into the adjacent rice field and duck clubs, and feeds.

It does that in a couple of other spots over the American Basin, and then up around some of the refuges up to the North Sac refuge and Delevan refuge, it looks like there.

That's just a typical example of the entire winter scale. There's a lot of points overlaid on top of the one another there. It gives you a feel for what an individual duck is doing in the Central Valley, what it's looking for on a daily basis. I want to get into that here. I'm going to show you.

On a daily basis, this is basically the locations from a couple of days for an individual Pintail. Again, this is in Suisun Marsh. It's really primarily spending it's day on this...this is a sanctuary on Joice Island there on the south part of the screen, then feeding out into the private duck clubs at night and utilizing those wetland habitats there during the night time.

Doing that over and over again day after day until it moves into a new area sets up, follows at a similar pattern in a new area. Just to get in a more detail, this is a night time feeding track of a radio-marked Northern Pintail with GPS location at two-minute intervals.

To me, every time I look at this, it's a huge game-changer. When we first started doing telemetry on Pintails, this is back in the late '80s in this region in Suisun Marsh, we would be lucky to get one, maybe two locations on any given bird or on any given day. You'd have to get within a kilometer of the bird to triangulate it from three different spots.

It was very, very labor intensive. The point had an accuracy of 200 to 300 meters linear distance from wherever you determined it was. The level and the amount of data is somewhat staggering that we can gather now.

This is about an eight-hour period. We got locations every two minutes. You can follow the bird as it flies in at night into this duck club. It starts feeding here in this very localized area of probably about a 15-meter radius of that spot right there, and then heads over to an adjacent duck club and feeds in a couple of spots there as well.

It just opens up a whole ability for us to go out, and do a lot more reconnaissance and get a much greater understanding how birds are using the actual specific vegetation types, the habitat types, the water depths, all those things at that very local scale.

The telemetry data is giving us data from the regional, the valley-wide, continent-wide scale all the way down almost to the sub-meter scale.

We can combine those two, the water tracking and telemetry data, to start to try and address questions like California's winter waterfowl habitat. One question is, "Is it drought-proof?" We would sure like it to be drought-proof. We'd love to be able to say that we can sustain a population given periods of drought which we would like to occur.

When we looked at that at some previous analysis, we looked pre-joint venture conditions. We'll look at habitat during those conditions, and then post-joint venture. Also, during drought. What we see is pre-joint venture projects in a lot of restoration efforts and the work that's going on.

We see that there was just about half as much as managed wetlands available flooded for waterfowl, and a little bit of flood rice and a lot of burned rice, which if it wasn't flooded, it wasn't really accessible to the ducks.

Post-joint venture, you have increase in managed wetlands. You also have an increase of flooded rise because that lack of burning led to strong management for the rice fields by actually incorporating into the soil and flooding. It's really a boon to the waterfowl management of the straw in terms of more flooded rice available.

During drought, what do we see? We see some reduction in managed wetlands, but still maintaining a decent level. We do see a significant reduction in the amount of flooded rice available. There's still the question of whether we're drought-proof or not, I think we're not there yet. Maybe we're moving in that direction. We can still keep evaluating that.

Then we want to look at how the winter precipitation, how it gets tracked by the water tracker, what that looks like and what it means. Does it all make sense in terms of interpreting our waterfowl data.

We just pulled this example in. The left panel, the 2016-2017 winter, October, we got an amazing amount of rain. We got about four inches of rain in October, which is unusual for us here. It's usually very dry. You can see the light color green is basically a normal rainfall year. Anything in dark green would be when you're above normal rainfall.

2017-2018, light color green...

There's the flooding map of depicting what was the rainfall. We had that early rainfall event on October. What we have here is just the water map from a satellite imagery depicting that increase rainfall on October '16 as opposed to the normal pattern of flood up in October '17 which our normal dry fall...Most of the flooding there is due to management as opposed to on the left where you have a culmination of management and rainfall to provide a much more wet landscape for the waterfowl.

That's the satellite drive imagery. It's basically an example of what the water tracker spits out. It's a slightly different image, but it's the same idea. We just used it as an example. We can look at that across time and space. You can see the satellite imagery provides you the opportunity to map this water across the landscape.

You can see in the October image what we just talked about. You can see the difference in the regions. That's primarily we would touch base on precipitation. December is, sometimes, a peak time of flooding. We have flooded habitats throughout our landscape which you can still see differences between years.

Some of that is due to management. Some of that is due to precipitation. The imagery and the water tracker does a good job of picking out both the rainfall and management-related water availability on the landscape.

One of the key things we wanted to look at was the performance of the final map that the water tracker put out for flooded habitats. In general, it performed pretty well. We expect almost all, almost a hundred percent of our duck locations to come up as being within flooded habitat.

When we intersected the points directly with the open water habitat classified by water tracker, we've got about 75 percent overall across all species. We were pretty happy with that.

We thought it was pretty good, but then we realized a lot of our birds are perhaps on the edge of ponds associated. Some species tend to be in much smaller waterbird, like mallards maybe like to...they use a lot of ditch habitat, a little linear habitat. It may not show up that well on the water tracker.

We thought, "Well, it's doing a good job, but if we can do a couple of iterations and take the pixels identified as water with water tracker and run a couple of tweaks to the iterations on those, maybe we could do a little better."

The first thing we did was say, "OK, well, if it's within a hundred meters of water, we'll buffer anything classified by water tracker as water and buffer by a hundred meters and then see how that does." That did really great. We've got over 90 percent of our birds showed up as being in flooded habitat which made a lot of sense except that it over-classified things.

At some point, we were getting anywhere between 5 and 85 percent of the habitat in the Central Valley coming up as flooded. What was happening was there was a lot of very small pixels, two or three pixels, that would be classified as open water habitats, but that was more of an artifact of just interpreting satellite imagery.

We did another iteration where we did a buffering, but then we actually shrunk it back down. If it wasn't more than about a hectare of well we shrunk it back down to zero. It was a pretty simple iteration.

We were able to capture about 87 percent of our points would be classified in waterfowl habitat using the water tracker output with a range between 2 and 46 percent flooded in the valley at any one time. That made a lot more sense. It got rid of a lot of extra water that was an artifact. It was just these little isolated pixels. We're really happy with that.

Then we also thought bird biology comes into play here. Certain species should be much better tracked by open water flooded habitats than others. We looked at each individual species. What we found was, sure enough, mallards, the ubiquitous duck that most people are familiar with, use a lot of different habitats.

They like a lot of emergent marsh. It wouldn’t necessarily classify at all as open water habitat and only 76 percent of the time will they classify in the habitat. Which is not unexpected.

This is really mapping these more open water habitats. The open water species like Northern Pintail, Northern Shoverler and Gadwall, blue winged teal, those species really came up strong and did a great job of capturing the habitats that those species were using.

Water tracker was in concert with, in our iteration that we did to produce our new habitat map from the water tracker, we were pretty confident that it was really actually quite good at predicting waterfowl habitat.

When we look at the distance that birds fly from roost to feed, I talked about that briefly with the one Pintail showing that example basically spreading out from roost areas and going out to feed.

What we looked at this in particular over different periods of the winter and different years to try to assess, do we see differences across seasons and across years with varying levels of water availability on the landscape.

There's a couple of things that stood out. Suisun stood out as being the odd place out. In essence maybe more drought-proof because Suisun has a really reliable water supply. It's a tidal area. It's an estuary. Water is fresh and the salinity waxes and wanes through the course of the winter depending on fresh water inputs.

You have this foot print of flooded habitats in Suisun is very stable from year to year. The distances the birds travel, the graph on the left, very stable between year to year and between time period to time period.

Where as the rest of California, the Central Valley outside the Suisun Marsh, we see a little bit more availability and we see, and I'll just focus in a little bit here. There you see in Suisun you see there's a moderate increase in distance from roost just in one of the time periods.

It's in the late-season during the drought of '15-'16. I wouldn't call it a significant change in flight distances, but there's something a little bit different about that and it was during the drought of 2015-2016.

In the Sacramento Valley and outside of Suisun Marsh we do see some interesting patterns. The decrease distance during the early season of 2017-2018 we had a lot of water on the landscape. It translated into birds flying less. They had more choices most likely within that landscape to choose from and didn't fly as far from their roost to feed.

Then in the drought period, mid-season of '15 and '16 you see the orange line, you see the exact opposite of a lot father distances flown from roost to feed and in the general trend.

We do see evidence for that. Why is that flight distance important? We just think it translates into a couple of things. Both impact for survival and energetics and reproduction.

The farther they have to fly, the more they're looking around for food the more energy they're expending to get that. Then, in additional to that, the farther they fly from roost potentially could and we're going to be looking at this too, is likely has some survival implications.

More exposure to predation or hunting pressure. Really trying to minimize those flight distances is a good thing and it looks like they are related to the distribution of water on a landscape.

We go back to our supply and demand curves for food. That's where that would come into play. If you go to that drought period and you have basically what we talked about in the bottom of the scenario be, you could be looking at a drought where you've had fewer irrigations.

The quality of your wetlands is lower and you have less habitat on the landscape. Then, now we add in this other factors increased demand by geese. They alone could potentially create a drought like situation with the supply of food demand curves.

Knowing where to put the water [laughs] and when on a landscape can become more and more critical as we have the tools to get at where the limitations might be on the landscape.

Sort of a proof of concept, we have done a lot of work on just measuring birds at hunter check stations. As the hunters comes out, we take some morphometric measurements which we developed, a body condition index based on those measurements.

In that index we use different species, the sex of the bird, and where they were collected, where they were shot to come up with that index and look and see if we can measure that potential impact of drought or poor habitat conditions.

What we see, actually body condition is a nice check of that. In the '80s body condition was significantly lower prior to a lot of the winter flooding of rice, the joint venture restoration work. Body condition in general was quite low. It started off OK and just deteriorated through the winter and actually was quite low by January.

Then when we look in the 2000s where we had good conditions, we had a lot of restoration, a lot of flooded rice, no drought. Body condition was good, and the birds more or less, maintained body condition over winter. Definitely ended up in good condition compared to the '80s at the end of winter.

Then when we look at 2014, which was a drought year, we see a similar pattern to what we see in the 2000s, the non-drought, except they start off good. They maintained for a while, but then the slope of body condition, the slope increases downward.

We see an intermediate body condition. still significant and greater than it was in the '80s, not too bad. Almost, you might say, almost drought-proof potentially, but really reliant, again, on lots of rice and those stable habitats provided by wetlands and for hunting and recreation that are a big part of the habitat component that are, maybe, a little bit more drought-proof than, say, the agricultural habitats.

Then this is just more reinforcement of that, the slopes of those lines, the decrease is obviously more significant pre-joint venture. The drought, they started off good, ended up not as bad, but not as good in the non-drought years.

We get back to that question about drought, waterfowl, and winter habitat. Is it drought-proof? What we see is a trend towards some positive numbers and some indication that the wetland restoration efforts and the work of the network of private and public lands supporting waterfowl in the Central Valley are doing a pretty good job.

We are still heavily dependent on the agricultural landscape. That can go up and down with economics and a variety of other reasons, especially water availability. Drought-proof is probably too strong a term for now.

In certain areas like the San Joaquin where we've seen a lot of conversion, we're starting to see more and more conversion to nut crops, a lot of almonds, they make a pretty picture, but the waterfowl tend not to get a lot of benefits from those habitat types.

Going forward, we're going to use that water tracker to help interpret our waterfowl data. We were impressed that it could be modified to be very highly predictive of waterfowl habitat.

The telemetry advancements are allowing for this regional/local pinpoint assessment of waterfowl habitat selection. We know that drought can impact waterfowl habitat quantity and quality. We can actually use the water tracker to even further define where and when those effects are taking place, and help guide and steer management.

Which leads to the bottom line of the more we can understand how our water use decisions can affect waterfowl populations, we can help improve conservation and recreational opportunities into the future.

It's a promising outlook. I'd like to thank all of our collaborators and funding partners, the Southwest Climate Adaptation Science Center for letting us pull these two disparate sources of information together and work together as a collaborative team. It was a great benefit.

From the Fish & Wildlife Service and USGS, our major funding. The telemetry work was from the California Department of Water Resources. A lot of help from our private landowners in the Suisun Marsh where we caught most of our birds.

With that, I'm not sure where we are time-wise. It seemed like it went fast.

John: I'd like to thank Mike. I'd like to thank Elda and everybody over at USGS that continue putting on this webinar. It looks like we actually have one person showing up right now. It's Leeanna. Actually I'll unmute you right now. Leeanna, you should be on the line.

Leeanna: Hi, there. This is Leeanna out at Forder Win. We're up in the desert, so we don't have a tremendous waterfowl management program. Thanks for the presentation. We do, however, put transmitters on lots of different types of birds.

I just wanted to find out the reasoning for putting the transmitters on geese on the neck as opposed to the backpack-type.

Michael: There's been a lot of research on attachment type for geese. There's been a lot over the years. The geese, they tend to with a backpack...we've done both. We started marking geese in the early '80s with backpacks.

Behaviorally, they have a real hard time. They just are constantly pulling and fussing with the backpack. They just don't seem to handle that very well. What we've seen with the collar, at least, we've had great success. We see an adjustment period no matter what the attachment method.

If they make it through the first couple weeks, they're probably going to do well with either one. Just the backpacks seem to have a lot more issues behaviorally with the birds.

These collars are quite light. They're 35 grams, the goose collars. The duck transmitters, we're down to 10 to 14 grams on some of the new ones. The goose collar's relatively light for a 3,000 gram bird. They're down around 35 grams.

Leeanna: Thanks very much.

John: We also have a question from Steve Jackson. Steve, you should be on the line now.

Steve Jackson: Can you hear me?

Michael: Yep, I can.

Steve: Hi, Mike. That was interesting. Thanks for doing this. I actually have two or three questions. First was just a general information thing. I was impressed by how few of the Central Valley birds are going up the Pacific Coast.

They're heading inland. It looks like their breeding territory is mostly the Prairie Potholes region. Is that correct? It looks like they're going to Manitoba and Saskatchewan for the summer.

Michael: In general, I would say the most common route that we're seeing for the ducks and the geese -- not all of them. The mallards and the gadwalls that we mark, we're marking those birds on nest in California.

You wouldn't see that migration. If you mark mallards in the wintertime, you'd see some of those would migrate probably to the prairies as well, just to preface that. The primary route has been through the Southern Oregon, Northeastern California. Then off from there, up to Malheur area and then headed towards the prairies.

Some birds will go straight across Nevada to Salt Lake and then up. We're not seeing a lot of coastal migration. We're having some birds come back now. Some of the geese actually flew up that interior route.

Some of these snow geese went to Malheur or Summer Lake. Then up into the prairies, then hung out around Edmonton until late April, early May. Then headed up towards the Arctic Circle. The Wrangel Island birds were over in an island off the coast of Russia. Then they came back via a more coastal route.

We've had a few that flew directly over the ocean, some down the coast from Vancouver. That's a good observation, Steve.

Steve: I just found it interesting. Not being a waterfowl person and having learned back in the '70s, the old Frank Bellrose flyway corridors. This was interesting. I want to think about this and maybe discuss it with you some more at some point. Second question is, is there historical information to the effect that the San Joaquin Valley was a more critical...

Sorry, not critical. That's got baggage, but that it was a much more widely-used winter habitat before the nut crop conversions? It'd be interesting to document that with whatever kind of data are available.

To pin a question onto that, is there risk of the rice fields in the Sacramento Valley undergoing similar conversion? The nut crops are so lucrative, and they're so water-intensive, of course. There's a lot of money being made, which is driving a lot of that conversion. Is it possible that that is a potential hazard for the waterfowl habitat over the coming decades?

Michael: That's a huge concern. Agronomics obviously drive what's out there, the growing conditions of the soils and such. They are finding some farmers are experimenting.

The common wisdom was that probably about 70 percent of that 550,000 acres of rice is a really heavy clay soil type. It was probably the old tule marsh from the past. It was thought, the common wisdom was, they can't really grow trees. The trees wouldn't do well in that soil. What they're finding is that they actually can.

Conversion is definitely a concern. Luckily, I think rice is still fairly...the economics of rice are still pretty good, too. Yeah, definitely a concern. We can see it going that way.

As far as the San Joaquin Valley, I think the San Joaquin Valley saw some initial hits to numbers. It was a death by...I wouldn't call it a million cuts. It was a couple big cuts.

One was once they stopped burning rice in the Sacramento Valley and started flooding the rice straw for decomp, it created so much more wetland habitat in the Sacramento Valley that I think the birds never even made it to the San Joaquin Valley. They just short-stopped. Then you add that to just a change in CropScape down there where there was some rice.

There was other crops that you could flood for. There was a lot of pasture and cattle ground. A lot of that cattle ground and pasture ground got converted to vineyards. Those habitats that were seasonally flooded, I think the Water Tracker would pick up a lot of water out on that landscape in the wintertime back in the '90s or '80s when it was that pasture or much more grassland-type habitat as opposed to vineyards and the orchards that are now replacing all of that. It's a combination there where the birds are stopping north. Some of the reduction is probably they're just not going down there.

The other is that then, when they do go down there, it's really the only wetland habitats remaining. It's much more of a postage-stamp habitat down there.

Steve: That transformation from burning to flooding may have offset some of the effects of what was going on further to the south. The final question is, to what extent are the managers, the people who are making the decisions on moving the water around at the refuges, duck clubs, and so forth, are they using Water Tracker at this point?

What's your thinking on how Water Tracker can and will be used by the management community in a direct way?

Michael: There's going to be an opportunity to apply it. It will provide an opportunity for certain groups in certain areas to take advantage of. The nice thing, and maybe I need to emphasize it, too, you update it every two weeks.

If you're really interested in what the landscape around the area that you're working with looks like, and you want to try and make some decisions on how you treat your land in relationship to what's around you, that's a tool that's really nice to have.

The Nature Conservancy is using that to manage some of their land, especially in the Delta. They're using the rice returns program that they're trying to look for opportunities for flooding up habitats for shore birds and spreading that habitat out across the landscape.

I know they're using it, and we've been meeting with the Sacramento National Wildlife Refuge Complex. We've met with them a couple times. They didn't really know what was available, but

we showed 'em their ability to look at the flooded habitats on a very timely basis and they were super-excited about that.

They were using it in a way I didn't expect. They were using it to...one of the water managers has said, "Oh yeah, I flooded that unit and I drained that unit in April." The biologist was saying, "That habitat looks like it got drained in February."

He went in and looked at the maps and it was very clear that it actually had been drained early. He was able to check what they had written down in their database for management versus what actually took place on the landscape. He thought that was great. He could check up and make sure that the management matched up to what the outcome was in terms of education.

As more and more people become aware of the tool, they'll probably start to use it. It'll really be helpful, especially as water becomes more and more limited, where you put those resources on the ground, really pretty critical.

Steve: I'll take this up with you offline or sometime later, but I'm eager to talk with you about how to accelerate and facilitate that whole process.

Michael: Matt Rider from Point Blue would be great to have in on that, obviously, because the water tracker's really his baby. We think it's a neat combination of combining the bird data and that product to try and make sure that it's useful and it's actually predicting what we think it's predicting.

John: Thank you, again, for attending and thank you, Mike, for the presentation. Thank you to USGS and Elda for continuing this series.

Michael: Thanks very much.

Steve: Thank you.

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