California State Parks

Video Transcript

Strange Waters: Mono Lake Tufa Walk at Mono Lake Tufa State Reserve

Welcome, everybody, to Mono Lake. My name is Janet. I work for State Parks. What we're going to do this morning is take a little stroll through the tufa, which are the rocks you can see down there. We'll talk about the creatures that live here, the flies and the shrimp, the birds that nest here and migrate through. But, really, our main theme is going to be the water story at Mono Lake. I don't know if everybody realizes this isn't just any old lake, this lake is a really special place. There was a water war that raged here for sixteen years over the inflow streams to Mono Lake, and we have a solution to that, it came in 1994, a decision, and I'll tell you all about that.

Let me just briefly tell you what happened with the water situation. Back in 1941, the City of Los Angeles started diverting water from the Mono basin. Now, a lot of people think that the water came right out of the lake, went in the aqueduct, and went down south to Los Angeles. But the lake water is three times as salty as the ocean, so, for obvious reasons, they didn't want that coming out of their pipes in Los Angeles. What they did is they took the streams that flow in from the mountain snow, that flow into Mono Lake, and took the freshwater streams, put those in the aqueduct and diverted the water before it ever got into the salty lake. As a result, the lake, that was up here in the parking lot back in the 1940s, started shrinking and getting saltier and saltier and smaller and smaller. And you can see where the lake is today—we have quite a walk to get down there. This went on for several years. They increased the capacity of the aqueduct in the 1970s, and the drop happened even faster.

Finally, in the late 1970s, a group of students from U.C. Davis, which is by Sacramento, came to study the lake, and they said "What's going on here? How come nobody knows about this? This is such a special place, and it's so threatened. Somebody should do something." They thought about it for about a year and they said, "Well, might as well be us." And they founded the Mono Lake Committee, which is celebrating their 25th anniversary this year in 2003. They really brought attention to the situation at Mono Lake. They got the State Park and the Forest Service here. They got a lot of lawyers to work for free, and there was a sixteen-year battle over the inflow streams to Mono Lake.

Finally, in 1994, a decision was reached based on the public trust, which says that places like this belong to all the people in California. We all have an interest in what happens here, not just the people with the water rights down south. This was a very landmark decision for California water policy. The state water board agreed to re-evaluate the water rights, and in 1994 a decision was reached to bring the lake back to where it was in 1963. It's about half-

way back up to where it was in 1941, and we'll see that 1963 level as we walk down. So that's it in a nutshell. We'll talk about it more, and, for now, let's go on down to the next stop.

This is one of our beautiful desert flowers here in the Great Basin. It's called a blazing star. We're really lucky to see it. It's open in the morning; in the afternoon it closes up in the heat of the day. It's pollinated by moths, so when you see it open, it's either in the late evening, early morning—but really a spectacular desert bloom, blazing star.

People always ask us, "Why is Mono Lake salty?" If you've been in the area at all you know that most of our lakes here are freshwater lakes. But this particular lake is a salty lake. It's in a basin, which is a closed system, so those freshwater creeks that melt out from the snow come into the lake with a small amount of salts and minerals. They dump into this basin, and all the salts and minerals sit here. There's no outlet; there's no way for the water to get out. This is also a very old lake, possibly three million years old. So there's been a lot of time for the salt and minerals to accumulate. The lake's actually three times as salty as the ocean and about eighty times as alkaline. There's lots of baking soda stuff in the lake, and that comes into play when we talk about the tufa.

Now, take a look behind us, and you'll see there's two islands in the lake, a black one and a white one. They're actually two separate islands. The black island traditionally has been where the California gulls have nested, which is our biggest nesting species. When the lake dropped so much, a land bridge actually connected the black island with the mainland. The problem with that was that predators, mostly coyotes, could just trot across the land bridge and eat the chicks and the eggs. People could see this was a problem right around 1980, and they were wondering what to do about it, so the first thought was "Let's blow up the land bridge." They brought out the National Guard and they blew it up not once but twice. The mud went up in the air and pretty much came down where it was before. So the next idea was to build a fence, and they did build a very nice fence out there, but by this point, we think, the birds figured out, "Well, we're not on a island; we don't really feel safe." And the birds retreated to some smaller islets behind the black island where most of the nesting, even now with the lake higher, is continuing to happen. But one of the goals of bringing up the lake was to cover up the land bridge and make it safe for the gulls to nest again.

You can also see a low black hill across the lake; that's called Black Point. That's a volcano that was underneath the ice age Mono Lake when the lake was much higher 13,000 years ago. You can also get a nice view of the Sierra Crest and the Mono Crater chain here—there's about twenty cones behind us. In fact, this area is full of volcanoes. If you don't count the tufa or the Sierra Crest, all these hills you see around us are all volcanic. We're going to talk more about volcanoes later, too. I also wanted to point out these small tufas here. They don't look like much yet, but remember what these look like. I'm going to refer to them in a bit as we get to the tufas that are closer to the lake.

Next I'm going to show you the 1963 lake level where we're hoping the lake will be brought back up to before too long, and we'll talk about how tufas formed. This is the '63 level. This is where the lake was in 1963. The decision that they reached in 1994 said that this is where the goal is, to bring the lake back up here. The lake will hopefully be managed, and it will stay in a range somewhere around this level. So, as you come down here, this is where you'd start

getting your feet wet. And you can see the trail changes to a boardwalk with the idea that as the lake rises, we can pull the boardwalk out.

So, the main things that they considered were it was very important to reduce how salty the lake was. The brine shrimp in particular were really being impacted by the increasing salinity—it was really important to get the lake a bit fresher for them. Another thing was the land bridge that we talked about for the gulls—it was important to bring the lake up to cover up that land bridge and make the island secure again. Another thing was the dust, and on a clear day like today I know it's hard to imagine a really dusty happening here. But when the lake was much lower, there was all this exposed salt flat all around the lake, and on a windy day the dust would be in the air. It was regularly exceeding the standards for dust control, and that was really one of the main things that brought this level up higher than some of us were expecting to see. I could go on for a week about all of the intricacies of the water board decision, but I just want to leave you with the thought that this was really a precedent-setting decision in California water policy. It was one of the first times that an environment got water from a municipality instead of the other way around, and that's why it's so important. Mono Lake has really been an inspiration to people struggling with these environmental issues all over the world. These were just young people without a lot of money or experience that got the whole thing rolling to preserve Mono Lake, and it took sixteen years, but we have a success story to tell you about.

So, let's go on, and talk about how tufas formed. This is tufa. The important thing to remember about tufa is that it doesn't just pop up out of dry ground. All the tufa grew in Mono Lake. A lot of people think they're salt towers because it's a salty lake, but if they were salt towers, they would have dissolved a long time ago. It's actually limestone—the same stuff you see in a coral reef or in a cave formation. Now remember those other ones we saw, those small ones I pointed out. That was up where the water was shallower, and the tufa was only able to get this tall. Here the lake was much deeper, now that we're closer to the water, and the water at one time was way up there, allowing the tower to get that tall. You need two things to make a tufa—you need the lake, which provides not the salt but the baking soda, the carbonates. So the carbonates come from the lake itself. The other thing you need is freshwater that comes out of the springs underneath the lake, comes in in little cracks and crevices and brings in a small amount of calcium. So the calcium and the carbonate mix, and that's were you get the limestone. That's why there isn't tufa everywhere, there's only tufa where we have this freshwater source coming up into the lake. Everywhere you see a tufa, at some point in time there was a freshwater spring coming into the lake. Now I know it's kind of hard to visualize two waters in a lake mixing into a stone, and so what we're going to do when we get to the lake is make some tufa before your very eyes.

So, what we're going to do is make some tufa. This is just freshwater I brought from town. We're going to put some freshwater in here, and does anybody remember what is in the freshwater that makes the tufa form? Calcium, right. Bert, you want to help me out? So this is the freshwater that we're going to put the calcium chloride in to make it like a spring at Mono Lake. Put a little calcium, and if you'll put your hand over the top and just shake that up and down, and I'm going to get some water out of the lake, which has salt and also carbonates, baking soda. So, let's get some lake water. And if you'll stand right next to me, Bert, and hold your hands really flat, that's fine. Okay, can everybody see? So what we're going to do is mix the salty lake water with the spring water and see if we get a reaction. You can see we got

that immediate mixing of the two chemicals—this is called precipitation, and this is what's happening in the lake. Now to make a tufa form, this has to be in pretty deep, calm water where it's not going to get influenced by the waves, and you can see we're getting little globs of stuff. Everybody see? It's thickening up, and that's how the tufa reaction happens. This gradually settles out around the mouth of the spring, and the towers can get taller and taller as time goes by. We think the tufas right here in this area are about a 1,000 years old, but we do have tufa at the lake that goes back to the ice ages, 13,000 years ago. So, Bert, if you wouldn't mind holding this for me for a few minutes, and we'll watch that settle out.

Now I need another helper to do the pH paper, and pH paper tells us if something is acid or alkaline. If we put this in an orange, it would turn red because it's acid. So why don't you dip that in the lake, and we'll see what we get. You can see we did get quite a reaction on our scale. It's about an 11, which is right up there with baking soda, milk of magnesia, things like that, extremely alkaline.

This is not easy water to live in, and everything that lives here has to be able to deal with this kind of a chemistry, so the food chain is fairly simple. There's a green algae that lives in the water. There's two things that eat the algae—this fly we've seen on the beach is the alkali fly, and there's a little shrimp in the water about as big as your thumbnail that also eats algae, the brine shrimp. And the birds are eating the shrimp and the flies. So, not a lot of diversity, but every one of those things occurs in tremendous numbers—millions of flies, trillions of brine shrimp, and millions of birds—so an incredibly rich ecosystem.

The brine shrimp have the ability to either lay eggs or have a live birth—it all depends on what's happening in the lake. If it's like it is now, there's long days, the weather's warm, the water's warm, there's lots to eat, they'll have a live birth. They'll hatch the eggs in their little bodies and release the nauplii, which is the baby shrimp. If it's getting cold and the days are getting short, they'll lay eggs, and that's how they survive our cold winters, the eggs sit in the mud all through winter and then hatch out in the spring. This shrimp is *artemia monica*. It's only found in Mono Lake in the whole world, that's why there was a lot of concern about this species when the lake was getting so low. In fact, this species was really what brought a sense of urgency to try to do something about the lake dropping. The scientists were telling us we had two more feet to go in a drop and the shrimp eggs weren't going to hatch because of the increased salinity. The lake gets up to about 70 Fahrenheit, is about as warm as it gets. It's down below 60, it's about 58 today, about 13 Celsius, so it has cooled off a bit from the summer high, which was around the end of July.

Notice this orange color here on the shore. This is freshwater, and the orange is an iron-fixing bacteria that lives in the freshwater. So when you see orange on the shore, you know that this is a freshwater seep and right here in the zone where the freshwater and the lake are mixing—you can see it looks a little bit white. A lot of times you'll get little tufa crystals settling out right here in the mixing zone. Okay, let's go down here and we'll talk about flies.

These little worm-like guys are the fly larvae. The larvae hatch out of the egg into a little worm-like creature that actually lives in the water. When they're ready to turn into a fly, they pupate into these darker ones that aren't moving, and that is like the cocoon stage that sticks to the rock. You can see we have quite a few here on the rock. The rocks are real important to give the pupae a place to stick to. If they didn't have anything to stick, they would dry up and get

thrown up on the beach or they'd just get eaten by the birds if they're floating around on the water. Now the Paiute Indians actually collected the pupae stage as a food source, and there's thirteen calories in each of these, so they're pretty rich in protein and fat. They kind of have a peanut butter-bacon bits kind of taste, and if anybody wants to try one this is our snack time. You might say, "It would take a lot of these little guys to make a meal." But in the right conditions you can practically shovel them up off the beach when the wind blows them off the rocks and up onto the beach. Would you like to try one? Marilyn? We have lots more here if anybody else wants to try one. So what do you think everyone? Protein? And, you know, there's lots of food value here; they're very rich in fat and protein. So a lot of the birds, if they had their choice over flies or shrimp, they'll go for the flies because there's so much more food value.

So that's the pupae, and a lot of this went over to Yosemite Valley as a trade item and acorn came back, which we don't have here on the east side, which was a big staple food of the California Indians. The fly also gave Mono Lake its name. The Yokut Indian word for the people here at Mono Lake was Monachi, which means "fly-eater people." So you're all honorary Monachi, and that got shortened eventually to Mono, and that's where Mono Lake got its name. So we're going to put these back in the water where they'll be happy, and I'm going to introduce you to a little friend of mine.

Now Albertina's a little shy. They're nice people, Albertina. This is Albertina the alkali fly, and she came with me today to show you how she gets her eggs into Mono Lake because the flies have to be laid in the lake because the little larvae need to be in the water. So, when Albertina is ready to lay eggs, she actually walks into the lake with her hairy, waxy little body. As she walks in, she traps air around herself in kind of an air bubble affair, like so, and then she can be underwater for about 10 to 15 minutes. She can eat algae, she can lay her eggs, breathing the air in this bubble. Then gradually she uses up the air supply, and then she'll pop up "as dry as a patent office report" as Mark Twain said. You'll also see the flies sitting on the surface of the water tension of the lake, so you'll see flies out on the water a lot, too.

Let's all go and see if we can find some flies underwater in their little air bubbles. They're pretty small, so you have to get up close. Okay, this is the fly under water, eating algae or laying eggs. You can see that shininess is the air bubble, and they can stay under for quite a while, ten to fifteen minutes. Mark Twain talked about poking them, and watching them pop up "as dry as a patent office report," which I guess was very dry and very boring. Reliable people have seen flies down twenty feet deep, which is pretty amazing, as dense as this water is, that these little guys can go down that deep.

This little blackbird here is pecking at flies. You can see that we have quite a good population of flies here. Notice how they just fly up when I go through, and some of the birds have figured out that if they just run through the flies, they'll come up in the air and they can just run through with their mouths open and suck up the flies like a vacuum cleaner, which is a much more efficient way to feed than picking them up one at a time.

Good job, Bert. Thanks for being the tufa monitor. You can see how we did indeed get the solid settling out in the beaker. That's what's happening in the lake. Over time the calcium and the carbonate will precipitate out and make the solid, which becomes the tufa towers.

Also there's a beautiful view behind me of the tufa in front of the Sierra Crest, which is one of my favorite views at the lake, so we'll all enjoy that for a minute.

What we're going to do next is go and look at the osprey nest. We have an osprey baby, which is kind of getting big. Hopefully he's there today. So the nest tufa is that single one—does everyone see the nest? Look at the pointy brown one, and then it's right to the left. There's two osprey on it, I think that's the mother and the chick. The chick was born about six weeks ago or so. So it's pretty grown up. We have six nests that we know about around the lake, all on top of tufas. What's interesting is that an osprey is a fish-eating bird, and this is a lake with no fish, so it's kind of ironic that we have so many nests. What the birds do is they fly to the nearby creeks, they catch fish and they bring them back to the nest.

Just a bit about the main birds that pass through Mono Lake. Pretty much everybody's heard about the California gulls at Mono Lake, and there's about 50,000 adult gulls that come here every year. Right now there's about 30,000 babies that were just fledged that are out swimming around and eating. Notice that this gull looks very different—this is a juvenile that was just born this year in late June, and now it's fledged and is out on its own, but this is this year's baby gull. Notice it's just about as big as the adults by now. It has this grayish-brown plumage that's going to take about four years to evolve into the full adult plumage of the gray and the white. The estimate is that one gull eats about 7,000 shrimp or flies a day. That gives you an idea of how much food is in this lake. It's kind of like a big bowl of shrimp and fly soup right now.

I wanted to show you a picture of the islands. I mentioned the land bridge; this is the black island right about here. Right about here is where the land bridge was. The gulls retreated to these little islets back here, and that's where most of the nesting is continuing to happen. The scientists tell us that the birds like to go back to the same place every year, and probably they're going to stay there until these nest sites flood and they'll almost be forced to moved back to their ancestral nesting ground.

Now the other bird, this is a little phalarope that actually is here at the lake. We have about, probably, close to 100,000 of them at the lake right now, but unfortunately they're not right here where we're standing. The little phalarope nests up on the tundra, up on the high plains in Alaska, comes here for about six weeks, and in six weeks they double their body weight from one ounce to two ounces, drop their flight feathers, grow new feathers, and get ready to fly non-stop down to South America, between 2,000 to 3,000 miles non-stop. They go down to lakes in Bolivia, Peru, Argentina, Chile. It's one of the longest migrations we know of in the bird world. This is a small bird—it will fit in the palm of your hand. These are not big birds. They're beautiful little birds that all turn and fly together. It's interesting that when they were having the water board hearings in Sacramento, a film crew from Chile actually showed up at the hearings and said, "You better take care of *our* birds." I think the decision makers understood it's not just about California, this is a hemisphere kind of issue where the birds go back and forth from such great distances.

This last bird is actually the most numerous bird at Mono Lake. This is the eared grebe, and they're just starting to come in. We have about 75,000 of them on the lake right now, the scientists are telling us. We'll have between one and two million in the fall. It's called an eared grebe because it has this yellow crest on the side of its head, and it actually builds a floating

nest because it has little legs way back on its body. It's a really great swimmer, and it can't walk at all. So it has to build a nest out on the water. The reason they don't nest at Mono Lake is because of this wind. In about a week the nest would probably be flooded and that would be the end of the eggs. They need quiet water, like bays and protected waters. When they're here at the lake, they look like kind of a little gray duck with a skinny neck. And in the fall we have between one and two million of them. It's quite a sight to see when the grebes are in here. They'll stay until the shrimp are gone from the cold. They stay here throughout the fall and then they go down to the Salton Sea and Baja for the winter.

This is a freshwater spring coming out of the ground like we talked about. This is what makes the tufa form. Remember that orangey color? You can see that here, that's the iron-fixing bacteria that lives in the freshwater. Right in here you can see the freshwater flowing down and meeting the lake, and we have that point of mixing, and that is where we're likely to get tufa crystals. There's a small freshwater spring coming in. The water is so much less dense that you can see kind of a cloudy look where the freshwater is coming in to the lake water. That's the point where tufa would form. In fact that's what we're standing on, this sandy surface. I call it "tufa sidewalk." It's actually caliche, which is a kind of sand tufa. It's lake bottom sand that's actually been hardened by the limestone, and that's why it's here, because there's this freshwater source. Right behind you there, this big tower was probably created because this freshwater spring is here. That's what made that tufa happen right there. If the lake was a bit higher, the spring would be right up there by Marilyn's foot and it would be much higher.

Now I mentioned that this area is very active volcanically. There really is the potential for some kind of an event to happen here, the best estimate is the next two weeks to fifty years. But we were just hanging out on the beach, me and Joan, and Mount Mono emerged out of the sand, and I think, didn't we feel a little tremor, Joan? A little earthquake—we thought we felt something. So we think something may be about to happen here at Mount Mono. Now when you get an eruption, you're left with a hole, that's a cauldera or a crater. That's usually not the end of the story. There's usually more energy that makes kind of a dome, and sometimes there's more than one dome depending on where the energy is—they'll even sometimes take out part of the original rim. Now you see this in real life behind us. This is Panum Crater, which is the youngest of the Mono Craters chain, and that sagebrush-covered hill is the rim of that original explosion, that bump on the top is the dome, and that's your classic Sierra plug dome volcano.

Another big volcanic rock that's very common, was, you saw this one, Bert, what's this one? Obsidian, volcanic glass. Obsidian was used by the Native Americans to make arrowheads and scrapers. This source of obsidian was very important to the Yosemite Miwok. They don't have a lot of obsidian right in Yosemite Valley so a lot trading went on. You'll see a lot of this dark black obsidian in the Yosemite Indian Museum. So those are our two main volcanic rocks. In fact this beach we're standing on is mostly pumice.

Well, we're going to wrap things up, and I always hope after we do a walk on a beautiful day like today that people are thinking to themselves, "Okay, I see what all the fuss was about this place." It really is a unique and special landscape, it was very threatened, and a lot of people worked really hard to protect it. I think that we can all feel proud that California set a trend, really, nationwide to do these balancing acts with environmental problems. There still is some

water going to Los Angeles, but it has been greatly reduced to bring the lake up to a healthier level. The lake's already up about seven or eight feet from where it was in 1994. We've got about another nine feet to go, and right in here behind us that level would be about half-way up these tufas, so that gives you an idea of how much further we have to go. We're about half-way to the management level. If you come back again, you might be swimming here. We're in a time of change, and hopefully Mono Lake will continue to be healthier and higher as we move into the future. We'll see if Mother Nature provides some good snowy years coming up.

Running Time: 29:07