

U.S. Geological Survey

*The Heat Is On:
Desert Tortoises and Survival*

Program Requirements

Purpose:

To highlight USGS scientists' research and build support for the work being done to help with desert tortoise recovery.

To educate people about desert tortoises, their habitat needs, and what people might do to help.

Audience: General public, middle school age to adult.

Target venues:

1. The web.
2. DVDs for distribution and library.
3. Television

Length: 30 minutes

Scientists:

Roy Averill-Murray, (USFW)

Kristin Berry, (USGS)

Kristina Drake (USGS)

Todd Esque , (USGS)

Becky Jones, (Cal F&G)

Larry LaPre, (BLM)

Phil Medica, (USGS)

Ken Nussear, (USGS)

Steve Schwarzbach, (USGS)

Production:

Producer/Director: Steve Wessells, USGS, (702) 564-4626, swess@cox.net

The Heat Is On: Desert Tortoises and Survival

Fade in:

An amazing sequence of a baby tortoise hatching.

For example:

1. ECU of cracked egg with some reptile-y moving inside. [Hatching video, :52 or :58]

MUSIC: Lively, "welcoming" sound, more world beat than symphonic UP AND UNDER

SFX: if accompanying scene—crunch of shell breaking, possibly tortoise sounds, etc.

2. The baby tortoise's head breaks through the shell [HV 1:12]

NARRATOR: (voiceover)

Hello, newborn desert tortoise!

3. Absolutely marvelous ECU of the tortoise in its shell, looking right at the camera and looking around. At first one foot is out, then it gets the other one out. It looks curious and is pushing at the shell with its leg. [HV 2:05]

Welcome to your world.

Look around.

Break out of your shell
and explore what lies ahead.

Stretch your legs.

Feel the desert soil.

One thing for sure, though—
it won't be easy.

superimpose title:

4. *The Heat Is On: Desert Tortoises and Survival*

MUSIC UP AND OUT

**[Music will be incorporated as appropriate
throughout the production]**

dissolve to:

An intriguing montage of "blips" from the science stories—engaging scenes with voiceovers indicating that the desert tortoise is in trouble. Pick up scientists' dialogue as appropriate and available.

For example:

5-A. Man and woman with tortoise

Man / Woman exchange: (on camera)
**And this is a male? Yes. Oh yeah look
at that tail...yes.**

5-B. A woman is walking through scrub all rigged up with transmitter and antenna; see her from behind walking in lovely desert. [Thermoregulation video, 2:33]

Becky Jones: (voiceover)

**"...it appears that the desert tortoise is
in trouble." [BJ1, 1:13]**

6. She slows down and picks up a tortoise, wearing gloves on her hands.

7. Male scientist in red T-shirt is kneeling in the dirt, with his hand deep in a tortoise burrow. [B-roll X-rays, 25:28]

Ken Nussear: (voiceover)

"At, I think, eight or nine study sites we say declines between 30 and 50 percent." [KN, 9:45]

8. CU of scientist rummaging around in the dirt. She or he finds an egg, moves dirt from around it and very gently lifts it up. [B-roll X-rays, 27:37]

Larry LaPre: (voiceover)

"The tortoise has started having severe population declines in about 1989...."
[LL1, 1:12]

9. Tilt down from electrical tower to see three small tortoise carcasses with shells with holes pecked in. [DVD3, :05+]

Becky Jones: (voiceover)

"... very few of the small tortoises survive. There's about a 95% mortality rate within the first five years." [BJ1, 15:04]

10. Closeup of drawing blood from a tortoise. [Ft. Irwin blood draw, 11:31]

Ken Nussear: (voiceover)

"We're seeing declining populations due to a variety of factors. Not just disease

not just predation, not just habitat loss but I think a mix of all those things

11. Closeup of vials going into holes in a centrifuge. [Ft. Irwin blood draw, 16:33]

.... are really causing some declines that
i hope we can reverse." [KN,4:20]

12. Same scientist from Scene 7, a fellow in red T-shirt. [B-roll X-rays, 5:54+]

He reaches way down into the tortoise burrow.

He pulls the tortoise out of the hole. He lifts her up and blows off the dirt. A female scientist comes over to see. She picks up a clipboard.

Male scientist: voice over

"1-4-7-2-3."

dissolve to:

A sequence of some of the most delightful and fascinating desert tortoise footage. For example:

13. Charming shot of baby tortoise with its feet in front of its face. It moves its feet out of the way and sticks its head out. [DVD 4, 3:45]

14. A scientist is holding a baby tortoise. It moves its feet like it's trying to swim. [DVD 4, 20:06]

15. Collage from standard-def scenes: A great side shot ECU of a tortoise face. [Mojave Desert DVD] A close-up of a tortoise walking. [Mojave Desert DVD]

16. An adult tortoise looks over and up at the camera, comes close and just about puts its nose on the lens. [DVD 4, 22:00]

17. Two tortoises are very close to the camera. One has its nose to the camera, which pans left to the other. This one puts its nose right up there to the camera. [B-roll, X-ray, 5:28]

NARRATOR: (voiceover)

Desert tortoises have lived across
this southwest landscape for more
than
thousands of years.

Their adaptation to its extreme
harsh environment is amazing:

... surviving ground temperatures
greater than 130 degrees
Fahrenheit.

... and able to live a year, or even two, without water.

But now, the desert tortoise is in danger of extinction.

dissolve to:

An animated mapping sequence that shows the dramatic decline of the tortoise population in the Sonoran and Mojave deserts.

18. Perhaps this sequence begins with a Google Earth zoom from planet-scale to these southwest locales.

19. Animation shows the area with symbols or otherwise representing the thousand tortoises per square mile.

In the 1920s, there were hundreds of desert tortoises per square mile in parts of the Mojave desert.

20. The same area, but with almost no tortoises. Perhaps this can evolve as a sequence, showing the numbers dwindling over time.

Now, in those same areas there may be fewer than a dozen per square mile ...

21. Mapping depicts the Red Cliffs Desert Reserve. This is 62,000 acres. The tortoise population dropped from 3,200 in 2000 to 1,700 in 2008.

Tortoise extinction would have a ripple effect across the desert.

As tortoise numbers drop so too do the numbers of underground burrows that they dig.

A wide host of animals depend upon these burrows from shelter from extreme summer heat and the cold of winter.

Even in a protected Critical Habitat area like the Red Cliffs Desert Reserve, in southern Utah, the tortoise population dropped nearly 50% since 2000.

22. [A graphic element that is a creative transition.]

But perhaps science can yet turn the tide.

dissolve to:

23. Becky Jones on camera. [BJ2, 1:53]

Super title: *Becky Jones, Desert Tortoise Coordinator, California Department of Fish and Game*

Becky Jones: (on camera)

"Science can give us a lot of information on how best to manage populations and areas on which the tortoises live."

[BJ 2, 1:53]

24. Roy-Averill Murray on camera. [RA-M2, 5:27]

Super title: *Roy-Averill Murray, Desert Tortoise Recovery Coordinator, U.S. Fish and Wildlife Service*

Roy-Averill Murray: (on camera)

"... I work with the Desert Tortoise Recovery Office, our job is to facilitate recovery efforts for the species. [RA-M2, 5:27]

cutaway to:

A scene with a lot of scientists. Perhaps:

25. Three people are in a contained area that seems to have dividers; a city is visible in the background. One person has a large tortoise. [B-roll, X-rays, 00:40]

Roy-Averill Murray: (voiceover)

"There's four states, three Fish and Wildlife Service regions, countless agencies and stakeholders and interest groups and researchers..." [RA-M1, :10+]

26. A scientist putting lids on bins that each have two to four tortoises in them. [B-roll blood testing, 5:23]

NARRATOR: (voiceover)

Much of the research guiding the recovery effort is being carried out by ecologists and biologists with the Department of the Interior, U.S. Geological Survey.

27. Todd Esque on camera. [[YouTube 1:10+ tortoise DVD]

Super Title: *Todd Esque, Research Ecologist, U.S.G.S.*

Todd Esque: (on camera)

"USGS researchers are conducting a really great variety of research - including tortoise physiology, general ecology, their responses to fires ...

28. Outside, a long shot with two women carrying three each of these bins, with a fellow at the back of a van, loading the bins inside. [B-roll blood testing, 8:25]

**Todd Esque: (voiceover)
"disease and health... hibernation, reproduction, all aspects of their ecology..."**

29. A closeup of a tortoise (following from Scene 25) with its neck extended, with almost a haunting look as it looks directly at the camera. [B-roll, X-rays, 2:16+]

**Roy-Averill Murray: (voiceover)
"What works? What doesn't work?"
[RA-M2, 6:30+]**

30. Closeup of Becky Jones' hand holding a baby desert tortoise in her palm. [BJ1, 11:50]

**Becky Jones: (voiceover)
"The more we can learn about the tortoise, the better chance we have to bring it back." [BJ 2, 46:09]**

31. ECU of desert tortoise face and shell [Sonoran DVD]

**NARRATOR: (voiceover)
Because the Mojave desert tortoise is listed under the Endangered Species Act, there is a federal mandate to restore the populations.**

32. A tortoise with a radio collar on top. It moves through rough shrubs toward the camera, moving slowly, and then stops for a bit. [Paula video 10:23]

SFX: beeping sounds (associated with the radio collar)

The tortoise is among the top recipient of federal dollars— because their decline has been quite sudden and wide ranging.

33. A tortoise scratches dirt with its feet, then is digging, digging, digging with the left foot, then digging, digging with its right foot. [Paula video, 12:55+]

... and because they are so long-lived it takes years to know which recovery efforts are working or not.

dissolve to:

x. Mojave Map

NARRATOR: (voiceover)

The Mojave Desert covers some 25,000 square miles.

It is a part of Utah, Arizona, Nevada and California.

Over 30 years ago, USGS researcher Kristin Berry set up 27 study plots in the Mojave and adjoining Colorado Deserts.

These plots were designed to help understand how tortoise populations and their habitats might be changing over time.

Kristin Berry: (voiceover)

“The long term study plots provide a substantial amount of data on the status and trends in tortoise populations. They are places one can return to year after year, decade after decade and find out how tortoise populations are doing.

I selected for longterm study 15 of the plots that had an adequate sample size of at least 20 to 30 tortoises per square mile.

NARRATOR: (voiceover)

These plots have all experienced declines in tortoise numbers. ..and have helped identify some of the causes behind that decline.

Woman counting:

"..18, 19, 20....."

Narrator

In this particular plot near Needles, California the scientists are counting the numbers of the invasive plant Saharan Mustard. It is one of several invading plant species causing widespread change to southwest deserts.

Kristin Berry: (voiceover)

... there are 6,000 approximately in this group on the same transect where there was a handful in 1999." [KB2,2:00]

"...the proportion of plants that we have now ten years later is just enormous. It's been major change"

[KB2, 3:05+]

NARRATOR: (voiceover)

Exact impacts of this invasion are being assessed. The invaders take up precious water and nutrients. If the trend continues there's likely to be a profound effect on native creatures such as the desert tortoise.

Invasive plants pose other dramatic threats as well.

34. A raging desert fire.

SFX: Fire sounds, crackling and sizzling, trees falling over, wind whooshing, etc.

Roy Averill-Murray: (voiceover)

"One of the threats facing the desert tortoise today are increasing wildfires. Because of the invasion of exotic grasses and things which perpetuate a fire cycle that is not historically present in the Mojave Desert. [RAM1, 7:47]

NARRATOR: (voiceover)

The dry stems of spreading invasive grasses fuel devastating backcountry fires.

35. Another raging desert fire scene. [stock footage?]

Tens of thousands of acres of critical tortoise habitat have burned in one year.

36. A fire aftermath scene, showing scorched blackened earth and a dearth of vegetation. [stock footage?]

Native plant foods disappear.

Shrub and shade covers are eliminated.

Some tortoises have been burned to death.

37. Perhaps a scene where invasive grasses are starting to grow again amid the burned land,

Roy Averill-Murray: (voiceover)

"It looks like this is going to be a recurring risk for a long time, at least until we figure out how to deal with invasive grasses." [RAM1, 7:47+]

45. Pan across sign, "Desert Tortoise Conservation Center." [B-roll, blood and release, 00:10]

Narrator:

The Desert Tortoise Conservation Center was originally established as a way-station for tortoises displaced by Las Vegas development.

46. A wide shot of a person with a tortoise in hand; she turns around and hands the tortoise to another person. The camera moves in to a closeup of the tortoise in the person's hand. [B-roll blood and release, 4:17]

Narrator:

Today, with the expertise of management by the San Diego Zoo and the U.S. Fish and Wildlife Service...it will fill a key role by providing a base for applied

research, training and community support.

47. [Inside the Center] a side view of fingers holding a tiny tortoise; its little feet are sticking out. [B-roll, blood and release, 2:32]

Narrator:

One of the U.S.G.S. studies underway at the Center involves a promising Head-starting program.

NARRATOR: (voiceover)

Head starting is taking place at several locations across the Mojave. It is a technique where captive tortoises lay eggs in pens with the young being raised and later released so that researchers can better learn about their survival.

48.

cutaway to:

49. Tortoises are in cement block enclosures. From ground level, see three, then four tortoises moving around over rocks. [B-roll X-rays, 3:50]

NARRATOR: (voiceover)

Since females lay the eggs deep in burrows, how do scientists know when the eggs are laid ... so they can get the eggs to incubate them?

dissolve to:

50. A scientist is next to a female tortoise in the dry-looking and rocky cement block enclosure. [B-roll, X-ray, 1:18]

Scientist: (on camera)

"1-4-7-2-7"

51. Phil Medica on camera. [PM, :30+]

Super title: *Phil Medica, Biologist, , U.S.G.S., Las Vegas Field Station*

Phil Medica (USGS): (on camera)

"...so we're in the process now of every two weeks we X-ray the female tortoises ... [PM, :30+]

52. A fabulous closeup of the tortoise; it looks at the camera. [B-roll, X-ray, 2:05]

Phil Medica: (voiceover)

"..put the tortoise on the plate...and I'm going to shoot the x-ray now." [X-rays found tape, 3:59]

53. The scientist is wearing gloves holding the tortoise. He or she picks it up and moves it into a plastic bin. [B-roll, X-ray, 1:41]

54. Phil Medica holds the bin, then sets it down, puts on an X-ray apron, walks a little distance away and takes the X-ray. [B-roll, X-ray, 13:13]

Phil Medica: (on camera)

" Okay, stay back. Done."

dissolve to:

55. A woman is seated at a laptop with a round image on the computer screen. [X-rays found tape, 00:10]

Kristina Drake: (on camera)

"So this is one of the X-ray images we shot about 5 minutes ago. And this is tortoise 1-4-9-9-8 ...

56. ECU so that the eggs are visible on the X-ray. [X-rays found tape, 17:19]

... and you can see five visible shelled eggs on the x-ray here."

57. A different angle of the woman at the laptop. Another woman in a hat is taking notes. [X-rays found tape, 13:44+]

dissolve to:

58. A woman is laying on the ground, feeling deep into a hole. Another person is in the background. [B-roll, X-rays, 25:38]

Phil Medica: (voiceover)

"... and subsequently, if they lay eggs, based on the weight change, we know that at least the 6 eggs that we xrayed last week have been deposited somewhere inside the enclosures.

We will go and find the nest and collect the eggs and then put them in incubators to hatch, hatchlings. [PM, 5:13+]

59. Four people are in the area; one is shoveling dirt. A fellow is scraping dirt. Two other people in the background are moving dirt with their feet. [B-roll, X-rays, 25:49]

Scientist: (voiceover)

"You guys...I found an egg!"

60. A close up of an egg. Hands move dirt from around the egg and very gently lift it out. [B-roll, X-rays, 27:37]

Scientist: (voiceover)**"Got one? Alright!** [B-roll, X-rays, 26:29]

61. A person puts the egg gently into a plastic bin and moves dirt around it. [B-roll, X-rays, 28:16]

62. A bin with six eggs is on the ground. A fellow picks it up and carries it. [B-roll, X-rays, 29:50]

63. The fellow is holding the bin, talking to a fellow sitting in a car. [B-roll, X-rays, 30:04]

dissolve to:

64. Inside the conservation center, the fellow writes with magic marker on the bin, then puts it inside an incubator. [B-roll, X-rays, 30:23]

53. Pan around the room that is full of incubators. [B-roll, X-rays, 31:05]

dissolve to:

65. Five eggs with Xs in a plastic bin. [Hatching video, 3:13]

Kristina Drake: (voiceover)

Once the egg's laid in the ground, the temperature in which the eggs are incubated will determine the sex of the offspring. Warmer temperatures are going to produce females, cooler temperatures are going to produce males.

match dissolve to:

66. Five tortoises moving around the plastic bin. [Hatching video, 3:14]

... Once the eggs hatch in the incubators, one of the first things we're going to do is remove them from the incubator. Put them in some sort of out door enclosure, allowing them to get the natural sunlight and hopefully the natural vegetation that they would normally be eating. And then just

monitor these animals and try to ensure survival as best we can.

68. A wider shot of two plastic containers.

69. An engaging tortoise shot. Perhaps: Two tortoises are clambering on rocks; one is looking at the camera. He opens his mouth and yawns. [DVD4, Paul shots, 00:05]

NARRATOR: (voiceover)

For the desert tortoise to be taken off the Endangered Species List, populations must increase or remain stable for 25 years.

70. An engaging tortoise/scientist shot. Perhaps: Scientist at cages for the tortoises. She opens a bin, puts a tortoise in and gives it a little shove. [B-roll blood test and release, 10:34]

Fade to Black then up

71. Marvelous ECU of hatchling tortoise in its shell, looking right at the camera then looking around. [Hatching video, 1:29]

NARRATOR: (voiceover)

Hey, baby tortoise.

You're beginning an amazing life.

"match" dissolve to:

Desert Tortoise Lifecycle animation—For example:

72. The animation begins with an illustration that matches the hatchling in Scene

71. With a desert scene as background, animation shows other reptiles moving in and out of frame, all smaller than a mature desert tortoise. Maybe somewhere here we see its scientific name, *Gopherus agassizii*.

The desert tortoise is the largest reptile in the Mojave Desert.

73. Phil has a graph with data from NTS that can be used here. Perhaps it shows something like age 1-50, with some comparison with humans.

The life span is a bit like humans:
Young are soft-shelled and vulnerable.

74. Maybe the animation imitates the footage where one male tortoise is ramming the other. [DVD4, Paula shots, 4:30]

Sexual maturity arrives around age 15.

75. Animation of whatever their courting looks like.

Males and females court...

76. Animation of digging a nest and then the eggs appearing.

... and the female digs a nest for the four to eight eggs, each about the size of a ping-pong ball.

77. Animation that illustrates the two layers. Maybe somewhere in here we can also add on the screen some general statistics that we don't want to take the time to mention, like weight at maturity (8-15 pounds), carapace length (9-15"), height (4-6").

The shell, called a carapace, has two layers:
bone underneath,

...and on top: “scutes”-made of keratin, like fingernails.

78. Animation can show a network of small and long burrows across a landscape.

Desert tortoises spend 90% of their time in underground burrows— which can be shallow, or as long as 30 feet.

79. Animation can illustrate a thermometer with temperature ranges above and below ground.

There they hibernate in winter and stay cool in summer ... when the burrow temperature may be 40 degrees cooler than the searing heat above.

80. Perhaps animation of a wrinkle-faced tortoise match dissolves back into live footage.

Desert tortoises can live to be over 50 years old.

81-A. A close shot of a raven.. It opens its mouth and lets out a caw, then flies off. [DVD3, 7:53+] Or: Looking toward the camera almost inquisitively. It flaps one wing and turns its head. [DVD3, 7:07]

SFX: The raven's low, drawn-out croak

Brian Jacobs: (voiceover)

We're tapping him out with the hopes that when he hears noise he's going to come charging out of the burrow, right on cue.

.....ready?

81-B.....

Narrator:

While deaths from upper respiratory tract disease triggered the endangered species listing...additional threats are multiplying.

Ravens have become an increasingly deadly predator of young tortoises.

82. Larry LePre walks into the scene under two power tower legs; he reaches down. [LLP B-roll, 9:08]

Super title: *Larry LePre, Desert District Biologist, Bureau of Land Management*

Larry LePre: (on camera)

"The easiest place to find Raven nests is underneath power towers.

Yep, they're back for a visit.

Sticks blown off the nest ... "Ooooh, here's a tortoise."

83. A closeup of the pecked tortoise shell. Larry picks it up and holds it in his hand. [LLP B-roll, 10:03]

Larry LePre: (on camera)

"... that's been eaten by a raven. its characteristic [sign] ...

84. [Yet to be filmed — ravens pecking at desert tortoise shells and eating what's inside.]

Larry LePre: (voiceover)

... that they'll peck a hole in the top to kill it.."

[LLP B-roll, 10:03]

85. Raven flies across a road and lands. [DVD3, 6:09]

"..., in northern forests such as Maine, ravens are still a wilderness bird. In the Mojave Desert, which has had urban sprawl and so many human modifications, ravens have increased up to 1,000% in the last 50 years. [LLP1, 9:09]

86. Raven on the ground eating something. Trucks go by in the distance. More vehicles pass by. [DVD3, 6:16] Wind ruffles its feathers a little bit. It looks at the cars, looks back toward the camera. [DVD3, 7:53]

"and the availability of food has just caused this huge population increase." [LLP1, 7:11]

87. [Some image of a landfill or other human-induced location where ravens are getting food.]

"...they're social birds and they congregate around landfills, around sewage ponds, around fast food restaurants, cattle yards, horse properties, anywhere there's easy food."

88. Looking up to large nest on power tower. [DVD3, 4:37]. Closer shot of nest. [DVD3, 5:12]

"But the ones who have learned to eat juvenile tortoises they can decimate a

generation of tortoises right around the nest. So, those ravens are targeted, and if they find evidence of tortoise predation under a raven nest, then the Bureau of Land Management calls the Wildlife Services of the U.S.D.A and they come out and kill the raven... The power company comes out and knocks down the nest. [LLP2, 1:10+]

89. Larry LePre looks around with binoculars and spots a raven flying above. [LLP B-roll, 00:18]

Larry LePre: (voiceover)

"They're just so adaptable." [LLP1, 8:01]

90. Continuation of Scene 61: [Yet to be filmed—ravens pecking at desert tortoise shells and eating what's inside.]

"and then they teach the young that tortoises are good eatin', and so the next generation becomes a tortoise predator, too." [LLP1, 3:04+]

NARRATOR: (voiceover)

Desert tortoise recovery is enormously complicated because there is so much that scientists need to learn.

91. CU of hand with vials, pouring one thing into another. Pull back to see the vial being put into a tray of vials with blue caps. [B-roll, blood and release, 2:54]

For instance, just with the exotic,
non-native plants:

What happens to tortoises who eat
them?

92. Closer shot of looking down into plastic bins with baby tortoises in them. [B-roll, blood and release, 4:52]

Or, if spraying herbicides is used
to control the invasive plants –
and the tortoises eat them... what
then?

93. Woman at Coyote Springs Desert Management Area being interviewed. [B-roll, blood and release, 11:39+]

Kristina Drake: (on camera)

**"We're studying the nutritional ecology of
tortoises in relation to wildfires of 2005."**

Coyote Springs scientist: (voiceover)
[not fully transcribed]

**"..but the pens are so armored to keep
the predators from eating them ...**

[B-roll, blood and release, 13:01+]

94. A closeup of a hand holding a young tortoise, setting it down at the entrance of a hole. The tortoise is slowly moving into the hole. There is a tiny yellow flower there. [B-roll, blood and release, 17:59+]

[

...about 25 of them are actually progeny from adults that were removed from this property when the housing development started to go in ...so we xrayed those adult females, collected the eggs – incubated the eggs and then raised them at the Desert Tortoise Conservation Center throughout the last 6 months... "

95. [Note: I can't tell from my logs where in the sequence of shots the samples are taken, but the vials begin at 2:54, so it would be before then.][B-roll, blood and release, :46-2:54.]

Today we were taking our first blood samples. We have plans to take blood samples 3 times per year for all the animals that went into this project and with the blood we're going to study a variety of parameters...mostly parameters that will help us understand their metabolic fitness that would again to some of the various treatments and their diet. [B-roll, blood and release, 14:42]

96. Roy Averill-Murray on camera. [RAM1, 15:20]

Roy Averill-Murray: (on camera)

"So, the nutrition study is asking primarily – do tortoises on a native diet perform better, grow better, survive better than tortoises on an exotic, unnatural diet?"

dissolve to:

97. A close shot of the back of a tortoise at a burrow entrance. Close of tort rear end at hole entrance. It is moving a bit of dirt with its feet. [Ft. Irwin blood draw, 5:31]

NARRATOR: (voiceover)

So much about the life of the
reclusive tortoise is a mystery—
that scientists are beginning to
solve with
21st century technology.

98. Wide shot across expanse of desert landscape. [Sonoran DVD]

For example, a customized GPS
logging system collects
more data, over the vast desert
landscape, than ever would be
possible with field crews.

99. Ken Nussear on camera. [KN 5:05+]

Ken Nussear: (on camera)

**"One of the things we've been kind of on the
leading edge of for a long time is to get some
technology to do a difficult job.**

100. A close shot of the front of a tortoise. It blinks. See the radio receiver on its shell. [Ft. Irwin blood draw, 13:41]

Ken Nussear: (voiceover)

**"Just the act of putting a radio
transmitter on a tortoise, means that
we've got to have people out there on a**

monthly or sometimes weekly basis monitoring tortoise activity to get data on how they're using habitat and kinds of body temperatures they're achieving.

101. A close shot of one of the GPS logger devices. [have not seen such footage]

Ken Nussear: (on and off camera)

"We got a company to help us miniaturize GPS's and actually now we have GPS loggers that are as small as the radio transmitters we were using ten years ago. And now it has a radio transmitter and a GPS and a data logger all in the same package so we're pretty happy about being able to work with technology companies to get the kinds of things that you have in your cell phone working for us on tortoises to help us understand how they're using habitat.

102. Maybe this is a composite image of a graphic that depicts following one or more tortoises over space and time

NARRATOR: (voiceover)

... the GPS logger can follow and monitor the tortoise all day, every day, and everywhere it moves.

Ken Nussear: (voiceover)

"So if I want to know for example are tortoises using burned habitat or not after a wildfire and I only

get one picture of each tortoise a day it takes me a lot longer to achieve the information than if I get detailed information about every day how much time is that animal spending in or out of the burned areas.

So, we're getting all of this now with people watching tortoises but I think in the future we can get a lot more detailed information and be able to put a better picture together of what they're doing.

103. Todd Esque on camera. [TE, 3:12]

Todd Esque: (on camera)

"... we've been watching tortoise populations for the desert tortoise for a little over 30 years in the desert, almost 40 years in some areas. And everything indicates to us that there has been a steady decline in populations over that time. Until recently, that was kind of a mystery.

cutaway to:

104. Collage from standard-def scenes: Flying over the landscape of Joshua Tree Forest. [Mojave Desert DVD] Closeup of buckhorn cholla. [Mojave Desert DVD] Beauty shot of Creosote Basin. [Mojave Desert DVD]

Todd Esque: (voiceover)

"... we knew that it was lots of influences but only recently have we had the ability to get on the ground and collect massive amounts of information across the entire Mojave Desert and then put it all into analysis so that we can start to understand the pattern for the Mojave. And we're starting to pin down pieces of that story about why we are having these declines."

105. Catherine Nolte**Catherine Nolte: (on-camera)**

"and then did you say that number two is the one without the transmitter?
...(mumble)"

105. Ken Nussear on camera. [KN 7:59]**Ken Nussear: (on camera)**

"Over the last five years we've been working with a team of scientists, including biologists, but also ecologists, plant ecologists, people who do GIS remote sensing hydrologists, geologists and geographers to put together a desert tortoise habitat model."

dissolve to:

106. Animated Mojave Desert Tortoise Habitat model, depicting in 3-D numerous variable layers such as precipitation, vegetation, topography, geology, groundwater, likely predators. Model will expand and contract revealing individual layers and the combined overall habitat model.

[over animation sequence]

Ken Nussear: (voiceover)

“So looking at different elevations, different rock types, vegetation associations, different precipitation and temperature regimens...and how those all come together to influence what we know as the current desert tortoise distribution.”

[KN, 7:59+]

NARRATOR: (voiceover)

Shades from yellow to orange then red show good to ideal tortoise habitat...while dark blue is not tortoise habitat.

Ken Nussear: (voiceover)

“So here in the Mojave Preserve you can see we have areas of high tortoise concentration and predicted high suitable habitat and also areas like these blue ones where we predict that it would be low suitable habitat.

Narrator:

The model's ability to predict habitat type is proving to have wide applications across the Mojave and into the future.

It's an invaluable tool for guiding the search for best locations to site new green energy projects.

And the model can project us into the future, helping to clarify possible impacts of climate change. Model components such as rainfall totals and temperature can be adjusted to show how habitats will shift as the climate changes.

The model helps scientists understand the desert tortoise on a range-wide scale over millions of acres.

It has the potential to make a huge difference in desert tortoise recovery ... helping to insure that critical habitats will be suitable into the future.

107. An engaging tortoise shot. Perhaps: A female scientist is holding a baby tortoise.
[DVD4, Paula shots, 17:14]

Female scientist: (on camera)

"... a beauty, ~~a male~~, just a little runny nose ..."

NARRATOR: (voiceover)

There's no one thing killing off the desert tortoises; a multitude of threats are interacting. Scientists must prioritize which are the most important and which problems can be solved.

Fade to black then up

Fade in:

109. ECU of hatchling tortoise struggling to get out of its shell.

NARRATOR: (voiceover)

Hey, baby tortoise,
the heat is on.

Not only do you have all the struggles of life in the harsh desert, and dwindling habitat ... now there are new threats on the horizon.

dissolve to:

110. Todd Esque on camera. [TE, 6:25]

Todd Esque: (on camera)

".. I think uh, in pre-Western history of people moving out here, this was a giant wilderness.

cutaway to:

111. Pan across landscape of the Sonoran desert. [Sonoran desert DVD]

Todd Esque: (voiceover)

"It was a very hostile environment to humans.

112. Historic images of people living in the desert in a small shack. [Archival photos]

"And about just a little over a hundred years ago, the West began to be opened up with new trails for immigrants ... Those folks were sort-of eking out a living in the low desert areas.

113. Black/white footage of the new interstate highway from the 1950s. [Archival footage]

... Then, the highway system was put in. That opened up the area so people were moving through ... [TE, 7:35+]

114. Pan across a 1950s housing development in the desert. [Archival footage]

... And widespread availability of lots of electricity and air conditioning made it a less hostile place...

cut back to:

115. Todd Esque on camera. [TE 7:35+]

Todd Esque: (on camera)

"And what this all leads to is going from an area that was just little island of human habitat 80 years ago and 60 years to what is now becoming an area that is dominated by human influence with little tiny islands of open natural habitat left.

116. A medium shot of a tortoise as it walks slowly over rocks. [DVD4, Paula shots, :21]

Todd Esque: (voiceover)

"And that's where we still find the tortoises, in these little islands that are left."

dissolve to:

117. A "time lapse" series of six images that depicts the growth of the Las Vegas area, from 1984 to 2009. [<http://earthobservatory.nasa.gov/IOTD/view.php?id=37228>]



1984



2009

NARRATOR: (voiceover)

Not only has development encroached into the desert.

Scientists have recently found a pattern that shows human impacts extending beyond where people are living.

118. Animation or graphic that depicts the widening circle of predator range around the developed cities and towns.

There's a shadow that's much larger than the actual footprint of buildings and roadways ...

119. A coyote skulking across the landscape. [Sonoran DVD]

... it's created by predators such as coyotes and ravens, that are subsidized by human food and waste ...

120. Raven pecking in and pulling "food" out of a dead tortoise shell. [Footage to be shot]

... living outside the edge of these areas.

Others have their eye on the
desert, too.

dissolve to:

121. Roy Averill-Murray on camera. [RAM1, 19:16]

Roy Averill-Murray: (on camera)

**"There's a lot of sunshine in the Mojave Desert.
And there's a lot of open land that energy
developers and people who are really interested
in getting the country off fossil fuels look at and
say, 'Wow! Look at all that sun hitting the
ground..."**

122. Pan across expansive solar panel field in desert/or advertisement for one/or a few
examples already in existence.

Roy Averill-Murray: (voiceover)

**... We can put solar fields there.' Well,
that's also where the desert tortoise
lives, and other sensitive species."**

123. Larry LePre on camera. [LLP2, 8:42+=]

Larry LePre: (on camera)

**"I think it's important that you put these solar
projects and the windmill projects over at the
edge of the desert, the western edge, or maybe
the eastern edge or near major cities, but not in
the middle.**

124. Solar and the wind towers,

Larry LePre: (voiceover)

**"... then you're bringing an industrial
park into the middle of tortoise
habitat..."**

"So, siting of the energy projects is crucial, the first priority being to put them on lands already disturbed or where there is no tortoise habitat, and the second being to not fragment large areas that are a uniform block of habitat."

125. A close shot of a tortoise munching, munching on some branches. [DVD4, Paula shots, 14:32]

Roy Averill-Murray: (voiceover)

"The challenge is finding the right balance to be able to achieve our alternative energy goals while not sacrificing the native landscape and our natural heritage at the same time.

[RAM1, 19:16+]

SFX: Boom of thunder, sound of hard rainfall

dissolve to:

126. A collage of images

NARRATOR: (voiceover)

One definition of "desert" is a landscape that gets less than 10 inches of rainfall a year.

Todd Esque: (voiceover)

"When the desert gets a good year... maybe one in ten years we'll have a really good winter rain fall and in those years it's just unbelievably spectacular.... [TE, 20:21]

127. A collage of images of the gorgeous life in the desert.

[over sequence]

NARRATOR: (voiceover)

In the Mojave and Sonoran deserts, there live nearly 150 species of mammals... including mountain lions, ground squirrels and desert big horn sheep.

... along with 70 species of amphibians and reptiles, and more than 300 species of flowering trees, shrubs and wildflowers.

Larry LaPre: (voiceover)

"The desert grows on you ...

It's fabulous in the spring. The spring bloom is the most dramatic change of season of any other kind of ecosystem in the U.S. probably, from brown to green to color all within a month."

[LLP2, 16:02]

Todd Esque: (voiceover)

"This year was an above average year, it was great. We brought people out on a field trip from all over the world. Everywhere we went in the desert we

found 15 to 20 species of wildflowers growing...it was just a super abundance, just a month ago out here when things were a little bit fresher.... You just think, every time you go around a corner, you're walking up a wash you wonder what's going to be around the next corner. There might be a Gila Monster walking along or a tortoise or some kind of a snake ..you just never know what you're going to find so it makes it really fun to be out here when it's reasonable to walk around in the spring. [TE, 20:21]

128. Open Images: Climate Change

SFX: Natural sounds of these activities if available

NARRATOR: (voiceover)

These desert adapted plants and animals may hold some keys to human survival in a rapidly warming world.

The unique genetic make-up of desert plants and animals - is a sort of "resource for the future"- potentially crucial for developing

new crops, livestock and medicines as our climate warms.

Over the next 50 to 100 years temperatures in the Mojave are expected to rise between 5 and 10 degrees Fahrenheit. Rainfall is expected to decrease.

Will temperatures in some places be greater than tortoises or their eggs can tolerate? What will happen to the plants making up their diet? How will tortoise habitat change?

Science is the starting point for addressing these questions. There is already a foundation of scientific knowledge to build on. Tools such as the habitat model can help forecast some effects of climate change while guiding

management of habitat and species.

Narrator:

Mounting threats to the tortoise now include: invasive plants, disease, wildfires, roads, ravens, coyotes, off road vehicles, other predators and now climate change.

Narrator:

The question remains can the tortoise population stabilize and thrive?

Ken Nussear: (voiceover)

" people know about the tortoise, they care about the tortoise-- and I think that one thing may be the biggest thing that helps turns it around...

...and so we've gotta have people on our team and people that want to help and people that care and I think that's

coming around and that's a big positive thing.

[KN, 12:25]

Todd Esque: (voiceover)

"But in fact we're dealing with 60 million years of evolution here. Desert tortoises have been around for a very, very long time and people revere them for that reason. The general public wants to know that we have tortoises on the landscape that are not just being put there for their viewing, but they're existing out there in a natural habitat on their own.

129. A tiny tortoise on the edge of a rock. A person's foot walks past.

NARRATOR: (voiceover)

Humans collectively have had a big negative impact on desert tortoise habitat.

130. Tortoise eating the pink cactus flower. [YouTube 6:30 tortoise DVD]

But people individually can make a big positive difference, too.

131. A full shot of a side view of a tortoise walking; he continues over rocks, passes behind some grasses and continues on.

132. ECU of tortoise head as he reaches up and munches on some leaves.

133. A close side view of a tortoise on rocks, with blue sky in the background.

134. Close shot of two tortoises next to each other.

135. Extreme closeup of a baby tortoise.

Larry LaPre: (voiceover)

"If you see a tortoise in the wild, look at it and take its picture, see what it's doing ... Basically, it's something to appreciate but not to mess with. ... take a good look so you really can understand the essence of tortoise, half of which is pulling its head in its shell and stand like that for an hour." [LLP2, 12:00]

transitions to a montage of desert tortoise scientists at work

For example:

136. It is dark outside. A woman is at the back hatch of a white SUV and closes the doors and trunk. [Ft. Irwin blood draw, 6:50]

Narrator:

Before dawn, the scientists' work begins.

137. Continuing from Scene 136: A wide shot on a steep slope with a big tortoise sitting just in front of his burrow at first light with the two women scientists putting on their packs and walking off into the downhill distance. [Ft. Irwin blood draw, 8:21]

Roy Averill-Murray: (voiceover)

" Science is critical to desert tortoise recovery because there are a lot of uncertainties in how all the numerous threats ...

138. Five newly-hatched tortoises are in a plastic bin. One of them is moving around with shell still on its back. It tries to climb out of the bin and falls on its back and gets stuck. [Hatching video, 3:43]

... that face the tortoise interact and affect tortoise populations ... Without science we wouldn't be able to sort any of that out and anything we did on the ground would just be a crap shoot ... "

[RAM2, 16:32]

139. Continuing from Scene 136: The woman reaches down into the burrow, brings out a tortoise. The other woman picks it up and blows dirt off it. [Ft. Irwin blood draw, 9:05]

Becky Jones: (voiceover)

"I find the tortoise to be very fascinating because it seems like such a meek species but has been able to survive all these years out in the desert." [BJ1, 17:24]

140. One of the animation sequences of the modeling, from Scene 106.

Ken Nussear: (voiceover)

"I think more and more as we're facing bigger and bigger threats we need to use whatever science we can to understand how these animals are responding ." [KN, 8:22]

141. The scientist in the red T-shirt is holding a tortoise who's looking around, and moving its feet a bit as though it's trying to swim. [X-rays found tape, 5:56]

Scientist: (on camera)

**"Got the x-ray plates?
Let's go."**

Kristine Berry: (voiceover)

"The tortoise tells us so much about the health of the desert it's a very long lived animal it's a sentinel of the well

being of our environment and for that reason alone I think we should be very concerned about its well being and that it thrive..." [TE, 2:23]

142. Continuing from Scene 136: The scientist puts the tortoise down a little distance away from its burrow. See that it has a radio receiver. [Ft. Irwin blood draw, 13:24]

143. An extreme closeup of a baby tortoise in the scientist's fingers. [B-roll test and release, 3:50]

144. Day's end match to Scene 136. The two women scientists are walking, silhouetted in the dark pink/purple colors of sunset. [Ft. Irwin blood draw, 20:20]

NARRATOR: (voiceover)

Building on our knowledge of the tortoise, it's habitat and threats to its existence remains a key to Mojave Desert Tortoise survival into the future.

Fade out END