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Editor's Note

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You are invited to submit stories for this newsletter to Stanley Anderson, National Soil Survey Center, Lincoln, Nebraska. Phone—402-437-5357; FAX—402-437-5336; email—stan.anderson@lin.usda.gov.

NPS Park Spotlight: Joshua Tree National Park, California

By Susan Southard, National Liaison to the National Park Service, and David W. Smith, California State Soil Scientist/MO2 Leader.

Soil mapping at Joshua Tree National Park (JOTR) is well underway with an enthusiastic crew willing to brave the harsh climate and terrain of this southern California desert park (fig. 1). This park soil survey is led by Carrie-Ann Houdeshell, MLRA Soil Survey Leader, with mapping performed by Peter Fahnestock, Area Soil Scientist; Soil Scientists Stephen Roecker, Paul Rindfleisch, and Judith Ball; and Rangeland Management Specialist Allison Tokunaga (fig. 2). Ed Tallyn, Soil Data Quality Specialist of the Davis Pacific Southwest Soil Survey Region Office (MO2), is the review leader for the project, and Kendra Moseley, California State Rangeland Ecologist, is overseeing the development of Ecological Site Descriptions (ESDs).

Soil mapping of JOTR is part of the Natural Resource Challenge of the United States Department of the Interior, National Park Service, being managed by Pete Biggam of the NPS Soil Resource Inventory office in Lakewood, Colorado. JOTR is one of 32 U.S. parks currently under agreement with the NRCS for development of soil survey data. David Smith, California State Soil Scientist and M02 Leader, in Davis, California, is directing soil survey program management of JOTR as well as nine other California parks that will eventually all be mapped as part of the NPS Natural Resource Challenge.

The southern and eastern parts of Joshua Tree National Park include the Sonoran Desert extension of the Lower Colorado Desert (MLRA 31), in

Figure 1.—Landscape of Joshua Tree National Park.

Figure 2.—From left to right, Allison Tokunaga, Judith Ball, Peter Fahnestock, Stephen Roecker, Carrie-Ann Houdeshell, and Paul Rindfleisch.

the Imperial Valley, and the northern part of the park is in the Mojave Desert (MLRA 30). Of minor extent, at the higher elevations, are oak woodlands characteristic of the Southern California Mountains (MLRA 20). The interesting landscapes of Joshua Tree National Park result partly from weathering of a monzogranitic pluton. Rectangular jointing caused by vertical and horizontal fracturing coupled with ground-water intrusion has resulted in massive toppled piles of monzonite. Also in the park are what visitors often think are “broken terrace walls,” which are really weathered dikes. Natural palm oases are along active fault lines in the park and offer a cool and shady respite from desert winds and the sun. The park’s namesake, the Joshua Tree (*Yucca brevifolia*), a giant member of the lily family, occurs at elevations of more than 4,000 feet.

Figure 3.—Kendra Moseley, NRCS, listens to Brandon Bestelmeyer, ARS, as he makes a point about soil and ecological site correlation.

Biologic soil crusts in JOTR help to stabilize the park soils, making them resistant to wind erosion and water erosion. The crusts also increase the water-holding capacity of the soils and contribute nitrogen and organic matter to the fragile desert ecosystem. The soil crust, or “desert glue,” is formed by cyanobacteria (blue-green algae) as well as lichens, mosses, green algae, microfungi, and bacteria.

Figure 4.—Lyn Townshend of the West National Technical Support Center discusses site index measurements of desert tree species while standing in front of toppled monzonite.

Recently, all California NRCS soil scientists and rangeland management specialists were fortunate to have a 3-day training session in JOTR that focused on concepts of Ecological Site Descriptions. The training focused on soil-site correlation, mapping concepts, and the development of ecosite state and transition theory. The ESD training session was coordinated by Kendra Moseley. Assistance was provided by Pat Shaver, Rangeland Management Specialist, and Lyn Townshend, Forester, both of the NRCS West National Technical Support Center, Portland, Oregon, and by Brandon Bestelmeyer with ARS at the Jornada Station, Las Cruces, New Mexico (figs. 3, 4, and 5).

Two places visited in JOTR during the training were the Pinto Basin and the Covington Flats. In the Pinto Basin, areas mapped and correlated with different ecological sites were reviewed as part of the training exercises. Soil properties and slight landscape position differences with different flooding frequencies resulted in different ecosite assignments. On the Covington Flats, the role that invasive plants play in the fire regimes of the desert and the resulting impact on native vegetation were investigated. Some good discussions on measurement of site index for desert tree species took place. An interesting example was offered by Lyn Townsend, who compared the productivity rates of redwood trees in Redwood National Park that can reach 550 cubic feet per acre per year with the rates of the singleleaf pinyon of Joshua Tree National Park at 2 to 3 cubic feet per acre per year!

In the next couple of years, a soil survey of Joshua Tree National Park (CA794) will be completed with correlated ecological site descriptions that will help park managers to understand the roles that soils play in their park ecosystem and that will allow better natural resource management. ■

Figure 5.—Pat Shaver of the West National Technical Support Center discusses ESD state and transition theory on a field trip to Joshua Tree National Park.

EMI Survey in a CEAP Project in the Caribbean Area

By Jorge L. Lugo-Camacho, MLRA Soil Survey Leader, USDA, NRCS, Mayagüez, Puerto Rico

From February 18 to 26, 2009, the Caribbean Area soils staff received technical support from the National Soil Survey Center with an electromagnetic induction (EMI) survey. The survey was completed on 260 acres of agricultural fields where NRCS has established a Conservation Effects Assessment Project (CEAP) at Jobos Bay Watershed, Salinas, Puerto Rico (fig. 1). The Jobos Bay Watershed is an NRCS Tropical Special Emphasis Watershed.

Figure 1 .—Location map of the Conservation Effects Assessment Project (CEAP) at Jobos Bay Watershed, Salinas, Puerto Rico.

The purpose of the CEAP project is to identify and reduce the causes of soil contamination. Maps of apparent conductivity (ECa) identified spatial patterns related to physical and chemical properties of the soils. These maps were used to develop an optimal soil sampling plan.

Jim Doolittle, research soil scientist, and Wes Tuttle, soil scientist, provided training to the MLRA 15–9 staff in the use of an EM38 meter. This meter was used to conduct the electromagnetic induction surveys (fig. 2). Measured ECa was found to be relatively high across the surveyed area and representative of the fine-textured and sodic soils recognized in the *Soil Survey of Humacao Area of Eastern Puerto Rico* (Boccheciamp, 1977). Based on 50,636 measurements, ECa values ranged from 8 to 301 mS/m with a mean of 89.1 mS/m. Higher ECa values are associated with higher amounts of soluble salts and with Cartagena soils (fine, mixed, superactive, isohyperthermic Sodic Haplusterts) (Beinroth et al., 2003).

Using the Response Surface Sampling Design (RSSD) of the USDA–ARS ESAP Software Suite, an optimal soil sampling plan was developed.

Figure 3 provides a comparison of the soils map and the ECa map. The study demonstrated that maps of apparent conductivity can be used to correlate ECa with soil patterns and to determine map unit composition and soil boundaries. In many instances, zones on ECa maps correspond with soil polygons, as shown in figure 3. According to Shaner et al. (2008), if transition zones are avoided, ECa-directed zone sampling is a cost-effective alternative method to grid soil sampling.

Figure 2.—Samuel Ríos-Tirado, soil scientist from MLRA–SSO 15–9, conducting an EMI survey in a sorghum field.

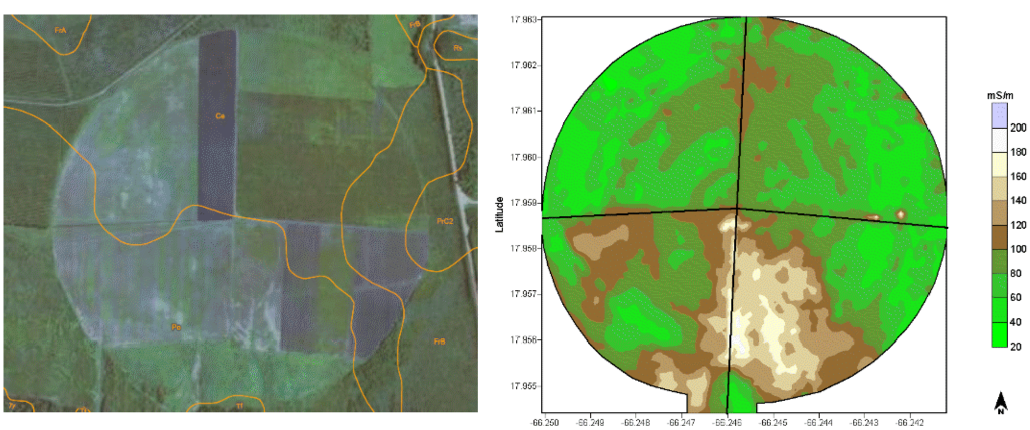

Figure 3.—Soil survey map (left) compared to EMI survey map.

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Shaner, D.L., R. Kosla, M.K. Brodahl, G.W. Buchleiter, and H.J. Farahani. 2008. How well do zone sampling based soil electrical conductivity maps represent soil variability? Agronomy Journal 100(5): 1472–1480. ■

Publication of a Soil Change Guide

By Stanley P. Anderson, Editor, USDA, NRCS, National Soil Survey Center, Lincoln, Nebraska.

The Natural Resources Conservation Service recently published *Soil Change Guide: Procedures for Soil Survey and Resource Inventory*. Cooperating Federal agencies included the Agricultural Research Service, the National Park Service, the Bureau of Land Management, and the Forest Service. The publication was written by Arlene J. Tugel and Skye A. Wills, soil scientists with the Natural Resources Conservation Service, and by Jeffrey E. Herrick, research scientist with the Agricultural Research Service Jornada Experimental Range in Las Cruces, New Mexico.

The following passage from the Foreword explains the intent of the publication:

> Soil survey can meet emerging needs related to the protection, long-term management, and ecological function of soil. It will meet these needs by providing data and information about how soils change. Data about dynamic soil properties, in combination with existing soil survey information, will be used to interpret and predict the effects of human activities and management on soil function within the human time scale.
>
> Soil survey customers can use information about dynamic soil properties and ecosystem change in order to:
>
> - Plan for long-term productivity and sustainability,
> - Protect and restore ecosystem functions and services provided by soil,
> - Design monitoring plans and interpret assessments of resource conditions,

- Predict land use and management effects on soil, and
- Adjust management practices for changes in near-surface conditions.

Capturing information about these changes and communicating it to a wide variety of audiences will require new procedures and new technologies for soil survey. This Guide lays out key concepts and protocols that will enable soil scientists and other resource specialists to examine and quantify changes that affect soil and its ability to function.

The main parts of this publication are:

Chapter 1.—Using This Guide
Chapter 2.—Measuring Soil and Ecosystem Change
Chapter 3.—Managing Comparison Studies
Chapter 4.—Planning and Conducting a Comparison Study
    Step 1.—Project Scope
    Step 2.—Sampling Design
    Step 3.—Sampling Requirements
    Step 4.—Field Work
    Step 5.—Data Preparation
    Step 6.—Data Analysis and Reports
Chapter 5.—Interpreting Soil Change and Soil Function

The publication is available on the Internet (http://soils.usda.gov/technical/soil_change/index.html). CDs are available at the National Soil Survey Center (402-437-5499). Two printed copies were distributed to each NRCS State Office. Also, copies were distributed to the National Park Service, the Bureau of Land Management, and the Forest Service. No other printed copies will be distributed. The publication will be periodically updated on the Web as the need arises. ■

Soil Inference Engine Software

By Jon Hempel, Director, USDA, NRCS, National Geospatial Development Center, Morgantown, West Virginia, and Robert Long, NRCS, MLRA Soil Survey Project Leader, St. Johnsbury, Vermont.

Over the past 3 years, the National Geospatial Development Center (NGDC) has provided funding for the continued development of Soil Inference Engine (SIE) software, a knowledge-based, automated soil mapping tool. Over the years, Dr. Xun Shi of Dartmouth College has programmed a wide variety of added-value products into SIE, including the following tools:

- DEM spike shaving, which removes artifacts and other noise from high-resolution elevation data
- Multipath flow accumulation, which improves representation of water movement over a surface
- Multipath wetness index, which improves representation of predicted soil wetness
- Smoothed, multipath wetness index, which lessens the sensitivity of the wetness index algorithm to slight differences in elevation
- Auto-iterative sliver removal, which aggregates individual raster values to map units of a specified area
- Diversity calculator, which calculates the percent of each component in a map unit
- Vectorization, which converts raster results to polygons for SSURGO

As part of the research, NGDC purchased high-resolution (1 M horizontal) LiDAR elevation data to support the project. These data were delivered in 2006.

The first year (2005) was spent refining the mapping process and developing a very detailed case study to validate the inference in a small watershed. From this study, a production plan was developed. The Vermont staff has been actively using the process to produce information for the initial soil survey of Essex County, Vermont.

The software has matured into a CCE-certified ArcGIS extension and has a well defined user manual. Several States are using the process, including Alabama, Texas, Missouri, and Illinois. The process is most mature in Vermont.

With the assistance of Dr. Shi, MLRA Soil Survey Office (SSO) staff has created a completely digital soil survey and a variety of soil survey products, including raster component maps (fig. 1) and SSURGO-certifiable traditional polygon maps (fig 2). These side products, particularly the raster component, increase the utility of the data for use and interpretation. The raster presentation shows the spatial distribution of components and provides a model for how soils occur in a continuous fashion across the landscape. The SSO staff also has developed an advanced process that takes full advantage of the high-resolution elevation LiDAR data for use in creating soil survey information from both modeling and more traditional approaches.

Steve Gourley, State Soil Scientist in Vermont, estimates that this process has increased production by 20 percent. In my view, the transparency as to how the information is produced is unequalled by anything that has been done in the past. ■

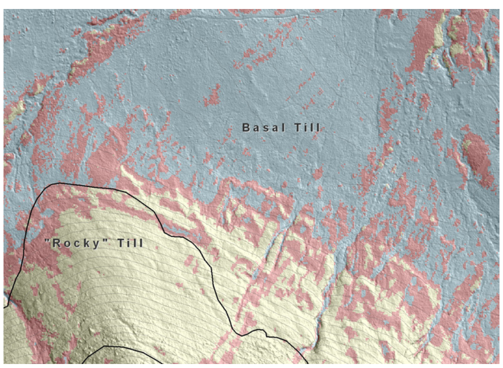

Figure 1. —Raster component soil map, with a distinctive landform delineated.

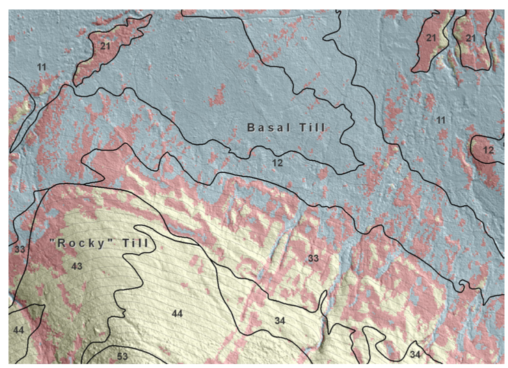

Figure 2. —Raster component soil map, with SSURGO polygons developed.

National Cooperative Soil Survey Conference

From the Soil Survey Division Weekly Report, May 18, 2009.

The National Cooperative Soil Survey (NCSS) Conference was held in Las Cruces, NM. Maxine Levin, Ken Scheffe, and Curtis Monger did an excellent job in organizing the conference. Several international guests, including keynote speaker Alex McBratney from the University of Sydney in Australia, participated in the conference. The conference focused on ecological relationships and soil change and on digital soil mapping tools. There were three tours: 1) geomorphic tour of White Sands Missile Range; 2) Dynamic soils and Ecological Site tour of Jornada Experiment Range Field Station; and 3) Agronomy and Soil Assessment tour to a pecan orchard on the NM/TX border. ■

Swimming With the Deer at Zachar Bay, Kodiak Island

By Mark Clark, Soil Scientist, USDA, NRCS, Sutton, Alaska

I was drawn to Alaska in 1982 to pursue my career as a Soil Scientist and to enjoy outdoor activities, such as hunting, fishing, rafting, and hiking. I spend my summers working and recreating in remote parts of Alaska where encounters with wildlife, including bears, are common. I have learned to carry two forms of bear deterrent with me in the field, usually a handgun or shotgun and bear spray, and consider an understanding of bear behavior as important to safety as a weapon is for protection. During my 26 summers, I have had many close interactions with bears but managed to avoid using a weapon in defense of life until November 2, 2008 while archery hunting for Sitka blacktail deer on Kodiak Island.

Kodiak Island is known world-wide for its bears (fig. 1). According to the Alaska Fish and Game (http://wildlife.alaska.gov/index.cfm?adfg=bears.trivia), Kodiak bears are a unique subspecies of the brown or grizzly bear (*Ursus arctos middendorffi*). They live exclusively on the islands in the Kodiak Archipelago and have been isolated from other bears for about 12,000 years. There are about 3,500 Kodiak bears, occurring at a density of about 0.7 bear per square mile. Kodiak bears are the largest bears in the world. A large male can stand over 10 feet tall when on his hind legs and 5 feet when on all four legs. They weigh up to 1,500 pounds. Females are about 20 percent smaller and 30 percent lighter than males.

Sitka blacktail deer were transplanted to Kodiak Island from southeast Alaska. A population was established and grew, and legal hunting began in 1953, when 38 bucks were taken. By the late 1960s, the deer had moved to adjacent Afognak Island. Hunters harvest hundreds of deer each year, but these agile animals are difficult prey for the giant Kodiak bears during much of the year unless unusually deep snowpacks push starving deer onto the beaches, where they become easy prey. The behemoth bears scavenge deer carcasses whenever the opportunity presents itself.

From November 1 through 7, 2008, I made my fourth and much anticipated fall trip to Zachar Bay on Kodiak Island to archery hunt Sitka blacktail deer with a group of

Figure 1.—Bears feeding on a whale carcass on Kodiak Island.

friends from the Palmer-Anchorage area. Our party stays at the Zachar Bay Lodge, a private in-holding within the Kodiak National Wildlife Refuge. Marty Eaton and his family have owned and operated the lodge since he retired as an Alaska Fish and Game Biologist in 1985. Our party consists of 10 to 12 hunters.

Marty warned us that the bears were more aggressive this year. He attributed the increased aggression to a late and abbreviated silver salmon run. According to Andy, Marty's son, the run normally begins in late August and lasts well into September, for a duration of about 3 weeks. In 2008, the run was late and lasted only about a week. Andy speculated that the bears did not store sufficient fat reserves for winter and were more aggressive than normal. Previous hunters had observed bears chasing deer down onto the beaches, a relative rarity, and a deer hunter was mauled a week before at Viekoda Bay, north of Zachar Bay about 20 miles. A bear mauling is a rare event on Kodiak Island despite the number of hunters that visit the island each fall. During the previous decade of hunting at Zachar Bay, only two deer were lost to bears despite the fact that bear sightings by hunting parties are common.

The open grasslands and alpine slopes of the upper mountains are the habitats preferred by rifle hunters since visibility is good and deer tend to congregate there when the snowpack is low. The strategy for bow hunting is significantly different since cover is desirable for stalking purposes. I choose to hunt the mid mountain slopes, where dense alder and salmonberry provide good cover for stalking, but finding a clear shooting path with the bow in the often impenetrable brush is a challenge. Over the years, many apparently easy shots that I have taken ended in frustration when an unnoticed alder branch or salmonberry twig deflected the arrow. Since my hunting methods differ from those of the rifle hunters, I hunt by myself and carry a handgun for protection.

On November 2, 2008, I was waiting on one of the many protected beaches within the bay for the lodge skiff to pick me up at the end of an unsuccessful day. The boat and driver Andy Eaton had just passed about 50 yards offshore. They were going to pick up others in my party who were waiting in the next cove before returning to pick me up. As the boat passed by, a three-point buck ran out of a small slough and onto the beach about 40 yards away, stood on the beach for a few seconds, then jumped into the bay and started swimming.

I grabbed my bow and ran down the beach, hoping that the buck would swim ashore and I could get a shot. It then dawned on me that the kind of behavior the deer exhibited was far from normal, and I turned to head back up the beach to a safe point on a rocky island attached to the end of the beach. At that moment a flash of movement caught my eye as a large Kodiak bear ran down a 50-foot-high hill that ended at the beach. The bear was heading straight for me at a full run. I started yelling and waving my left arm while pulling my 44 magnum Super Black Hawk handgun out of the holster that I custom fit to my jacket pouch. I was wearing a yellow and blue raincoat that I had just put on over my camouflage jacket for the brisk boat ride back to the lodge, and I had a headlight strapped on to signal the boat in the afternoon's fading light. I momentarily lost sight of the bear behind the rise of the beach as it reached the bottom of the hill.

A fraction of a second later, the Kodiak crested the beachhead about 15 yards from me, running full bore and grunting loudly. I made my stand on the beach gravel at the edge of the rising waterline of the incoming tide, hoping that the bear would finally identify me as human and abort the charge. I waved my left arm and yelled "Hey bear!" at the top of my lungs at least twice, but the bear failed to break stride and charged through the beach ryegrass and onto the open beach 10 yards away, the air expelled by the running bear sounding more and more like woofs than grunts. The large Kodiak had its full winter coat, which added to its size, and my only thought was, "What a massive animal!" As time went into slow motion, I aimed at the center of the bear's chest and fired at a distance of about 5 yards. The 44 magnum 320 grain bullet hit the bear just right of center in the chest, and the charging bear immediately began to spin to the right, at which point I fired again. I could not believe the bear's transition from a full-out charge to a spin in such a short distance and the fact that the bear's momentum from the charge did not carry it the final 4 yards into me.

Time resumed normal speed as I backed into the water a yard or two, trying to gain as much distance as possible between us. Shuffling backwards with the water now at knee level, I lost balance and fell backwards into the bay, submerging completely, sucking in a mouthful of Zachar Bay saltwater, and anticipating a salmon's-eye view of a bear's head reaching into the water for me as if I were a fall run silver salmon. To my amazement, as I gathered my feet under me and stood up in the gin-clear bay water, the bear continued to spin as it snapped repeatedly at its chest, emitted a growl verging on a roar, and threw gravel like a pinwheel with its paws. Assuming that the bear's attention would soon refocus on me, I prepared to fire the remaining four rounds. To my astonishment and relief, the bear abruptly turned directly up the beach and away from me, disappearing into the backwater slough behind the beach rise. In complete disbelief, I slogged to dry land and, while aiming my pistol in the direction of the departing bear, walked briskly along the beach to a safe rocky promontory.

The lodge boat piloted by Andy Eaton arrived from the adjacent cove a couple of minutes later. After I explained the circumstances, Andy suggested that we pick up my bow from the beach and take some measurements at the site of the shooting in case it became necessary to complete Alaska Fish and Game-Defense of Life or Property (DLP) paperwork. The following morning, I returned to the beach along with three other members of our hunting party to track the bear. The bear left a moderate blood trail that started about 50 yards back from the beach. We followed the trail through rolling hills of paper birch forest and alder thickets. About a half mile from the beach, we found a small bed where the bear had apparently sat down and cleaned the blood from its chest. The blood trail ended at that point. The lack of snow and blood made tracking the bear difficult, but we managed to find a couple of small spots of blood on a steep grassy slope above the bed and followed the trail a short distance farther before finally losing the trail. We continued searching for an additional 2 hours, trying to find a blood trail by searching in arcs of increasing distance from the last blood sign, but could not find the blood trail and ended the search around midday.

I believe that the bear did not have sufficient time to determine that I was not the deer that it chased out of the woods. The total elapsed time from when I saw the bear at the top of the hill until I fired my first shot was no more than five seconds, and the bear was out of my view for about two seconds as it reached the bottom of the hill and was momentarily hidden by the rise of the beach. I believe the incident was a case of mistaken identity. I was dazed after being so close to a charging bear and yet remaining unscathed.

Two weeks after I returned from my hunt, Linda Eaton at Zachar Bay Lodge informed me that a hunter had taken a bear that had a significant gunshot wound on the left shoulder. Linda said that she gave the hunters my email address and asked that they provide me the details. I was later contacted by Jaron Zollinger, a bear hunter from northern Utah who had drawn a nonresident bear permit and had recently returned from a bear hunt at Zachar Bay. Jaron verified harvesting a sow in the general area of my encounter and estimated that the bear was 8 feet tall. He reported that Alaska Fish and Game estimated the bear's age at 16 years. Jaron said that the bear looked healthy, except for the fact that it was limping on its left front leg. After shooting and skinning the bear, he discovered the gunshot wound to the left shoulder. He sent three photos (fig. 2) with the email, including one image of the bear's head in full frame with its mouth open. The caption, or quip, that Jaron included was, "This is probably the closest likeness of what you experienced." A reasonable assumption is that the bear would not have survived the winter, given the extent of the infection and gunshot wound described by Jaron.

Figure 2.—Hunter Jaron Zollinger with the bear that charged Mark Clark,

I wish to return to Kodiak Archipelago and Zachar Bay to hunt deer or explore and hope that all the elements that make the islands unique, including bears, salmon, and deer, remain healthy for generations. Hopefully, the political winds will start to favor a better balance between commercial and sport harvests and allow a higher escapement into the streams of Kodiak Island so that fish will remain plentiful for both humans and bears. ■