Homer Soil & Water Conservation District

Fox River Cattlemen's Association

NRCS CIG NR200150XXXXG001

Field testing GPS tracking of cattle in the Fox River Flats state grazing lease

AT RIGHT: Green pins show GPS locations for two cows from June to November 2021 in the grazing area. These data were collected with direct-to-satellite (DtS) units from Smarter Technologies.

Moving cattle in the Fox River–Sheep Creek grazing area

Installing ear tags on three cows; the back of the tag (photo below) is a solar panel charging the battery.

BELOW: Yellow tracks and squares on the map show GPS data for the movements and locations of 14 cows in the grazing area from May through June 2022. Data were collected using direct-to-satellite ear tags from Ceres Tags (see photos at left).

January 2024

CHAPTER 1: Introduction – (a) selecting GPS systems for testing, (b) overview of the Fox River Flats state grazing area

Overview

This report describes a project undertaken to test equipment that could enable livestock managers in Alaska to track the location of their animals on remote rangelands. Systems were field tested in order to determine how effective, useful, reliable, and user friendly they were in sending real-time global positioning system (GPS) data about cattle locations to online mapping applications. Three kinds of GPS tracking systems were tested by members of the Fox River Cattlemen's Association (FRCA). In early May (after green-up), these four cattlemen turn their herds out on the Fox River Flats (FRF) state grazing lease at the head of Kachemak Bay. As shown in maps later in this chapter, this grazing lease area is remote and relatively inaccessible, particularly areas on the far side of Fox River. Cattlemen gather their herds in October and drive or haul them to overwinter at their ranches.

Funding for this project was provided through a Conservation Innovation Grant (CIG) from the USDA Natural Resources Conservation Service (NRCS) (grant award #NR200150XXXXG001). Work was accomplished over 3 years by a collaborative team consisting of Natural Resource Specialist Devony Lehner from the Homer Soil and Water Conservation District (HSWCD) and the four "EQIP[1]-eligible" ranchers who make up the FRCA: Otto Kilcher, current FRCA president; Chris Rainwater, current FRCA secretary; Mark Marette, current FRCA treasurer; and Akaky Martushev. Karin Sonnen, NRCS State Range Management Specialist, located in the NRCS Homer Field Office, provided technical guidance and oversight. Kyra Wagner, HSWCD District Manager, provided administrative oversight. Devony Lehner worked with cattlemen and wrote progress reports and this final report.

The CIG proposal was titled: *Field testing GPS tracking of cattle in the Fox River Flats state grazing* lease. As that proposal outlined:

> Innovative technologies can significantly improve the management of livestock grazed on remote rangelands in Alaska. The issue is how to identify, demonstrate, and field test technology that can be both effectively operational in a particular area and sufficiently user-friendly and useful to local ranchers given the conditions and challenges they face. This project is designed to develop, demonstrate, and field test GPS tracking systems suitable for real time remote tracking of the movements of cattle grazed on the Fox River Flats (FRF) state grazing lease at the head of Kachemak Bay.

Ultimately, three types of IoT[2] (internet of things) GPS systems were selected to track cattle in the Fox River Flats. It's important to understand that even in the short time since these technologies were acquired and tested, the products and services offered by the manufacturers selected have changed significantly. Rapid change is inherent in technologies that are part of the internet of things. This includes GPS tracking systems, which collect location data on everything from packages to pets and transmit this data to the internet for retrieval. Data are often retrieved using online mapping applications.

What's in this chapter

This chapter begins by outlining tasks performed to initiate this study, a few lessons learned as potential GPS tracking systems were researched, and describes a system tested in 2021 that could not be made operational. Chapters 2 and 3 describe in some detail the two GPS systems that were successfully tested and the kinds of locational data acquired. Chapters 2 and 3 also illustrate how GPS cattle tracking data were accessed via online maps representing two different mapping applications, each associated with one of the systems tested. The latter section of this chapter provides an overview of the Fox River Flats state grazing lease area through maps, photos, and other introductory information.

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1 EQIP is the NRCS Environmental Quality Incentives Program. The link to Alaska EQIP is: https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives/alaska/alaska-eqip. Links to all Alaska NRCS programs can be found at: https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/alaska#programs.

2 "The Internet of things (IoT) describes devices with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks." (Internet of Things, Wikipedia.)

Initiating the study – selecting GPS tracking systems for testing

The first step in this project was to identify GPS tracking systems potentially useful in the Fox River Flats state grazing lease area. To do this, a variety of cattle tracking systems were researched on the internet during winter 2020-2021. To be considered for testing, tracking systems had to be:

- commercially available,
- off-the-shelf,
- affordable,
- able to provide GPS information in real time,
- user friendly, and
- able to work in remote areas of extensive rangeland.

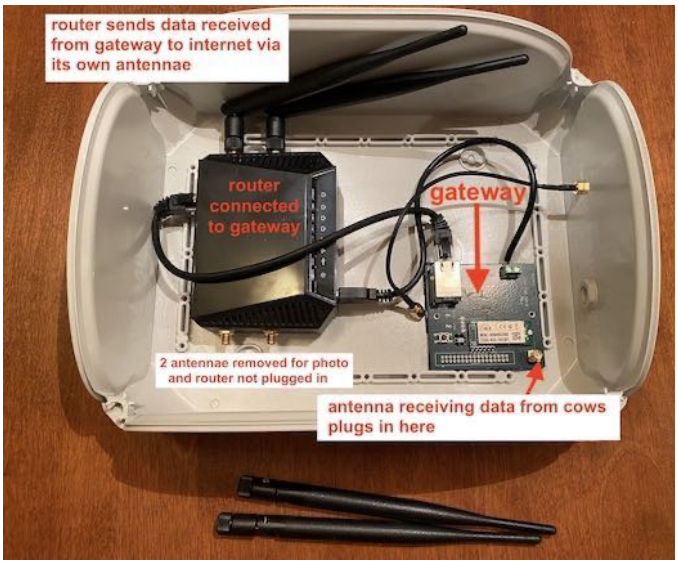
Online research quickly made it clear that the GPS system would represent an example of the internet of things (IoT), as mentioned above. Because IoT technology is evolving so rapidly, we discovered that there's often a large lag time between when a manufacturer develops a new product and when updated product information is posted online. Alternatively, sometimes manufacturers post information online about a new product well before that product is actually available. As a result, it was critical to talk directly with any vendors that offered products of potential interest, and many were contacted. This was often difficult for three main reasons. In most cases vendors request potential customers fill out an online contact form rather than providing a direct phone number. Reaching someone who can answer even basic questions can be difficult and time consuming. Secondly, in 2020/2021 (at least), most of the IoT products of greatest interest were manufactured overseas, which further complicated direct communication with vendors. Thirdly, research for this project was conducted during the first winter of the COVID-19 pandemic; as a result, many businesses were not operating or were understaffed.

Once several potential GPS tracking systems were identified, Fox River cattlemen met on April 13, 2021, to review, discuss, and select systems to purchase for testing. Three systems were selected, two collar-mounted systems from Smarter Technologies in England and one ear tag system from Ceres Tag in Australia. Webpage graphics for two of these systems are shown below. Note, these graphics are from early 2021; because IoT technology changes so fast, these tracking systems have already evolved significantly since then. Current models offer a variety of additional features, including the capacity to provide "virtual fencing" of collared or tagged animals.

At right: Tracking collar from Smarter Technologies, England

Below: Tracking ear tag from Ceres Tag, Australia

The first two GPS tracking systems selected for testing were from Smarter Technologies (see also https://smartertechnologies.com/smarter-products/gps-cattle-collar/). The first system arrived spring 2021 and is here called **the gateway system**. Components of that system are shown on this page.



Collar-mounted gateway GPS units transmit a cow's location to a local antenna every 15 minutes. These GPS transmitters contain a battery reported to last about 2 years. The units came in two shapes: tubes and black boxes (see middle photo at right). Each cattleman received four GPS units and collars—either three black boxes and one tube or two black boxes and two tubes. Collars were placed on cows in early May 2021.

GPS units (tubes and black boxes) transmit a cow's location via the antenna to a receiver in a junction box (shown below and upper right). The receiver (gateway) connects to a router, also in the junction box. The router then transmits GPS data via Wi-Fi to the internet. The junction box with its components was set up in a cabin on the grazing lease (bottom photos). Two 6-volt batteries, charged by a solar panel on the south-facing wall of the cabin, powered the gateway and router via a controller. The antenna was mounted on the cabin and was plugged into the gateway. Cost of gateway system with 16 units was $4781 with shipping.

Photos below show cows wearing GPS units for the collar-mounted gateway system. The photo below on the right shows cattleman Mark Marette attaching one of the tube-shaped GPS units.

Collar-mounted GPS units in the "gateway" system mounted on cows: black box-shaped GPS unit on left, tube-shaped GPS unit on right.

While installing the gateway system at the cabin, a diode in the router burned out when the router was connected to the controller and powered on. The router was brought back to Homer and then repaired by Jason Sodergren, an electrical engineer who volunteered his time; he also provided a wiring diagram and instructions to ensure that the router was re-connected correctly. After considerable delays in arranging transport back to the remote cabin, two attempts were made to connect the router correctly. Despite these efforts, the gateway system could not be made operational though the system had worked when tested at Otto Kilcher's ranch. Difficulties were anticipated in setting up at a remote cabin an antenna-based GPS system powered by batteries recharged by a solar panel, but it was considered important to try out a system reflecting a common approach to livestock tracking.

The second GPS tracking system acquired from Smarter Technologies was a small white unit that transmitted twice daily directly to satellites (DtS) and then to the internet. This is here called **the DtS system** and is described in Chapter 2. The unit can be seen in the photo at right on the top of the collar held by cattleman Otto Kilcher. A gateway black box is hanging at the bottom of the collar. Because the four DtS units requested by Homer Soil and Water had not been shipped in the original order, Smarter Technologies generously provided these units "on the house" and without charging for their shipping.

The third GPS system selected for testing was a solar-powered **ear tag unit** acquired from Ceres Tag in Australia. These direct-to-satellite ear tags only became commercially available in early summer 2021 and could not be acquired before cattle were released on to the grazing lease. Permission was requested from the NRCS to extend this study for an additional grazing season, with no additional funding, to allow the Ceres tags to be tested. This request was approved, and a box of 24 Ceres tags was ordered. These units were attached to cows during the 2022 grazing season, as described in Chapter 3; a few Ceres tags remained functional into at least the 2023 grazing season.

Public outreach

Public outreach has been an important part of this project. As further described in Chapter 2, a variety of media were used to inform the public of this study. Information was shared via

- posts on a Facebook page called "Fox River Flats and Beyond,"
- articles in the Homer Soil and Water newsletter,
- interviews on KBBI with Fox River cattlemen (see end of Chapter 2),
- informal discussions with a variety of individuals and user groups, and
- a storyline broadcast on a national TV show (*Alaska, The Last Frontier*) about the benefits of using GPS units to track cattle on the Fox River Flats (see end of Chapter 2).

A glimpse at the future

Application of study results has already begun: Updates of the FRF Grazing Management Plan (and the NRCS conservation plan on which it builds) were initiated by the Fox River cattlemen in November 2023 and involve Homer Soil and Water, the Natural Resources Conservation Service, the Alaska Department of Fish and Game, and the Alaska Department of Natural Resources—both the Division of Mining, Land and Water and the Division of Agriculture. Outreach and information sharing will continue as results of this study, and other information, are applied to improve management in the Fox River Flats grazing lease area. Throughout this process, public involvement will be critical and will be solicited by entities involved in planning efforts.

During future decision-making affecting the Fox River – Sheep Creek valleys, larger statewide (and national) issues may come into play in significant ways—including lessons learned from the Covid pandemic. For example in February 2022, Governor Dunleavy signed Administrative Order 331 promoting instate food security. The order opened as follows:

> *I, Mike Dunleavy, Governor of the State of Alaska, under the authority of Article III, Sections 1 and 24 of the Alaska Constitution, establish the Alaska Food Security and Independence Task Force (Task Force) to recommend policies and measures to enhance Alaska's food security, increase the amount of locally grown and consumed food, wild seafood, and mariculture products, and ensure State agencies are leveraging all available resources to promote, purchase, and advance the growth of Alaska's food system.*

A year later, in March 2023, the Alaska Food Security and Independence Task Force published its Food Security Task Force Final Report. That report addresses seven core subtopics related to the critical issue of food security in Alaska: (a) Wild Foods, (b) Production, (c) Processing, (d) Distribution and Aggregation, (e) Access, (f) Preparation and Consumption, and (g) Waste and Recovery. Under Production opportunities (page 48), the following "opportunity" highlights the significant role that grazing areas such as the Fox River Flats could play in the future, for example, as "regional food reserves" or other kinds of food security resource and production areas.

- **Our state agriculture leases and grazing leases can serve as a guarantee of food production; a sort of cache of food on the hoof or being grown yearly. With strategic planning and specific growing requirements, such leases could be regional food reserves.**

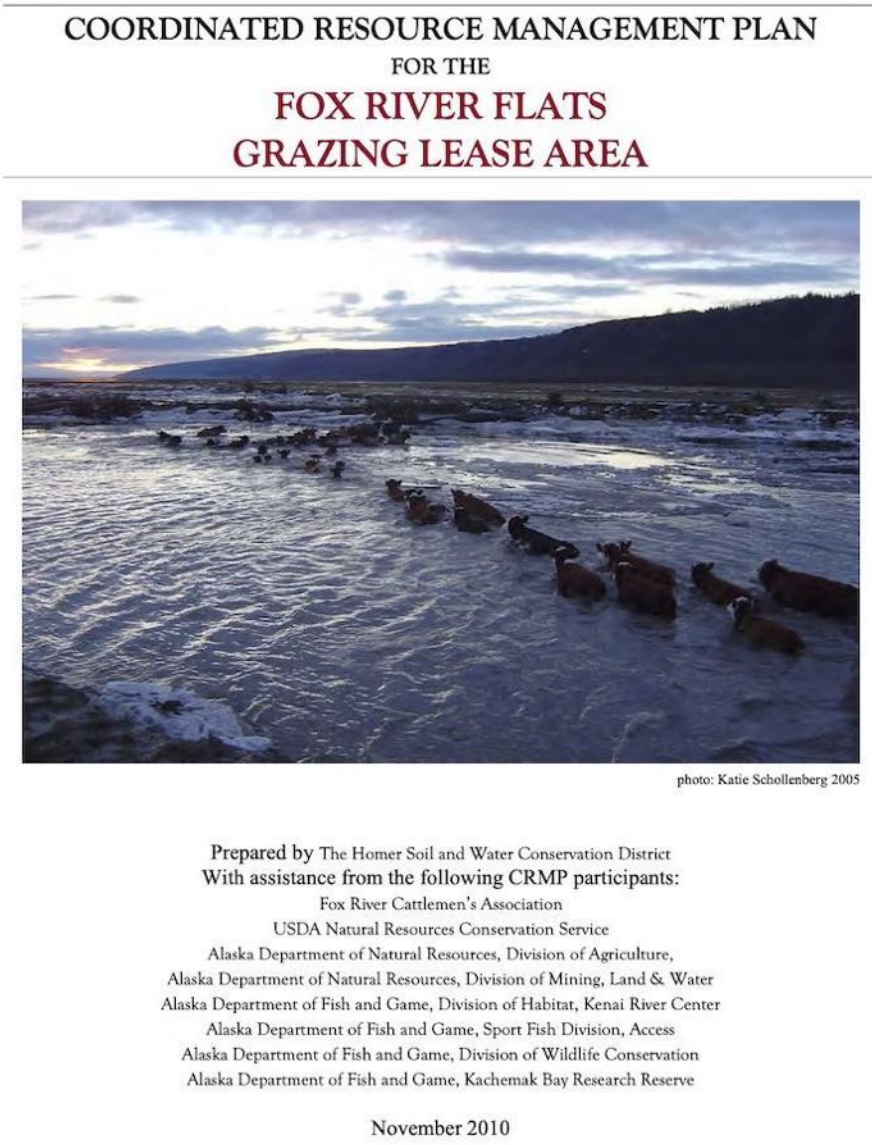
Whatever the future of grazing areas in Alaska, ongoing awareness and use of innovative technologies can contribute in critical ways to the value of these lands and the benefits they provide. Technologies such as those tested in this study can promote long-term environmental quality and sustainability of pastures and rangelands while improving health and productivity of animals—both domestic and wild—that live on these lands and waters.

Overview of the Fox River Flats state grazing lease area

The maps, other graphics, and supplemental information that follow are intended to familiarize readers with the Fox River Flats grazing lease area—easily one of the most productive, beautiful, and unique grazing areas in Alaska. Additional information about local cultural resources is found at the end of this overview.

Readers are also directed to other sources of information about Fox River–Sheep Creek valley and its colorful history. One useful source is the 2010 edition of the *Coordinated Resource Management Plan for the Fox River Flats Grazing Lease Area* (the CRMP). This and the earlier (first) CRMP were developed in accordance with terms of the state grazing lease held by the Fox River Cattlemen's Association. The 2010 CRMP is available on Homer Soil and Water's publications webpage.

Chapter 8 of the CRMP represents the "Grazing Management Plan" required for the lease, and an excerpt from Chapter 8 is found on the following page. The CRMP also provides regulatory and ecological information about the lease area and discusses other factors relevant to its management.



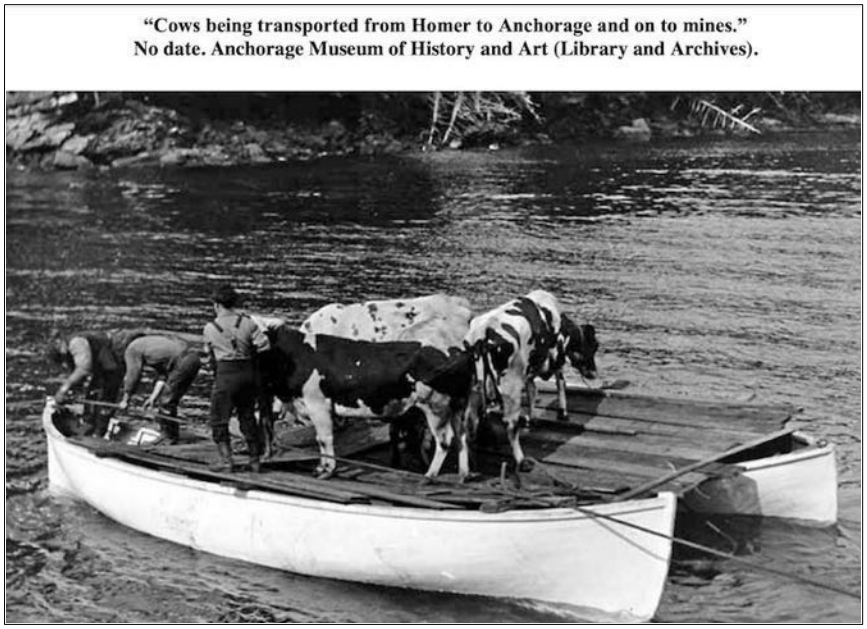
COORDINATED RESOURCE MANAGEMENT PLAN
FOR THE
FOX RIVER FLATS
GRAZING LEASE AREA

photo: Katie Schollenberg 2005

Prepared by The Homer Soil and Water Conservation District
With assistance from the following CRMP participants:
Fox River Cattlemen's Association
USDA Natural Resources Conservation Service
Alaska Department of Natural Resources, Division of Agriculture,
Alaska Department of Natural Resources, Division of Mining, Land & Water
Alaska Department of Fish and Game, Division of Habitat, Kenai River Center
Alaska Department of Fish and Game, Sport Fish Division, Access
Alaska Department of Fish and Game, Division of Wildlife Conservation
Alaska Department of Fish and Game, Kachemak Bay Research Reserve

November 2010

Photo below is from CRMP Chapter 3, a brief history of livestock use at the head of the bay.

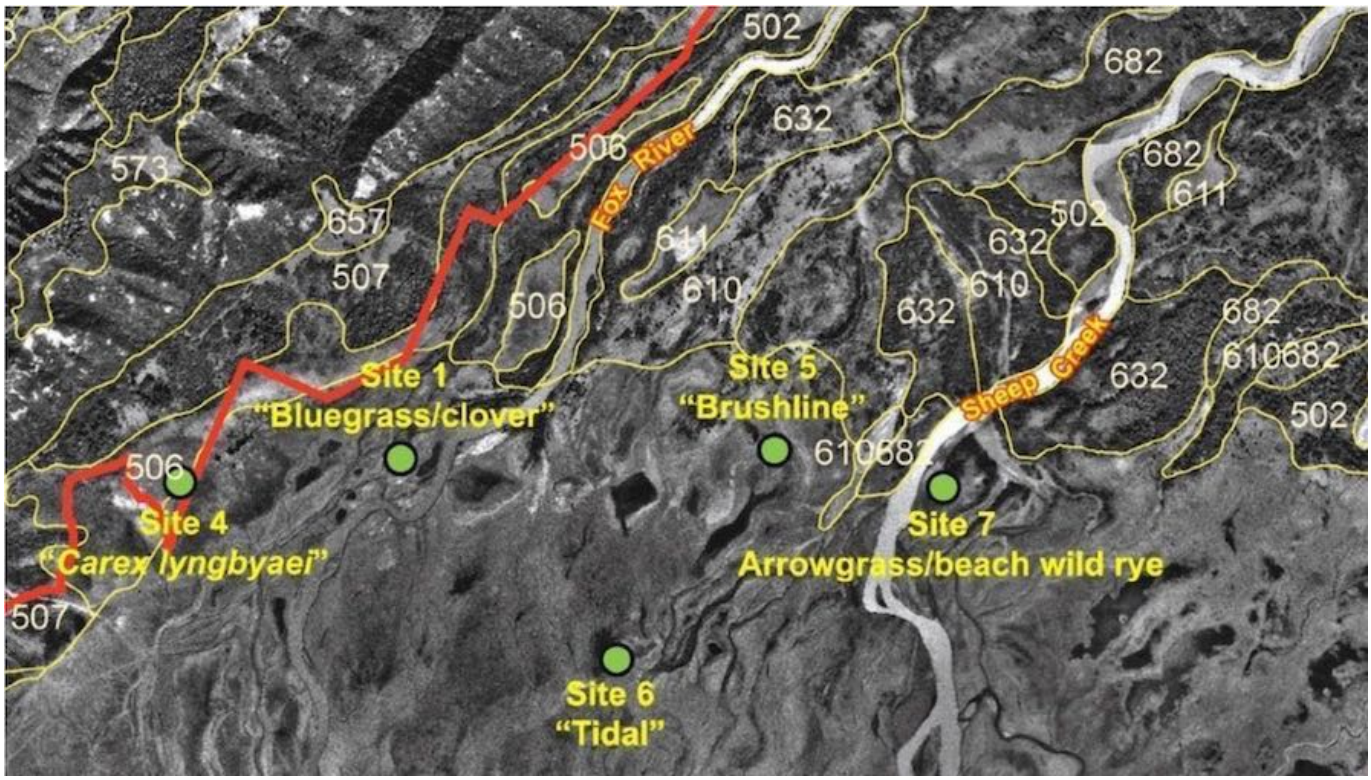


"Cows being transported from Homer to Anchorage and on to mines."
No date. Anchorage Museum of History and Art (Library and Archives).

Many useful sources of information have been published by the Kachemak Bay National Estuarine Research Reserve (KBNERR). KBNERR information can be accessed at: https://accs.uaa.alaska.edu/kbnerr/. Information summaries include *Kachemak Bay Ecological Characterization* (2003) and KBNERR's *Management Plan 2021-2026*.

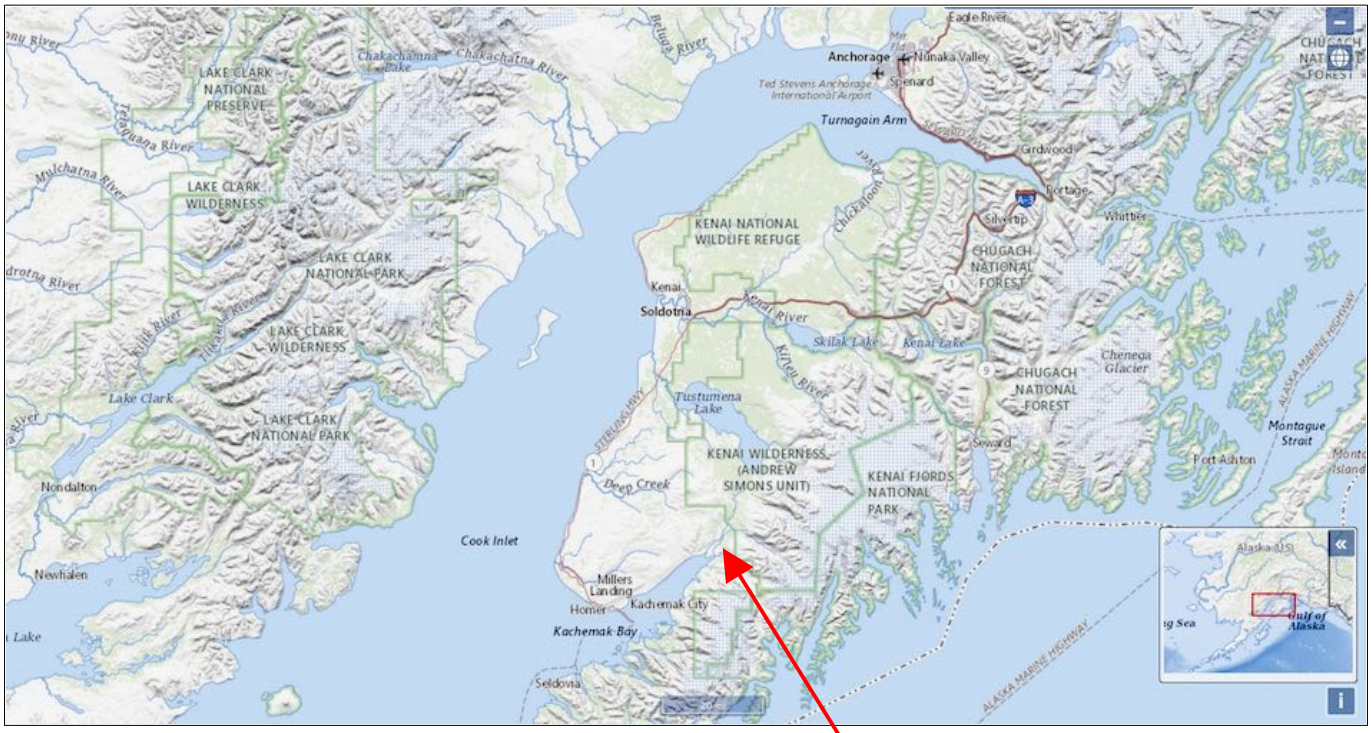
Text below is excerpted from Chapter 8, Fox River Cattlemen Grazing Management Plan, from the *Fox River Flats Coordinated Resource Management Plan*, 2010 (http://www.homerswcd.org/user- files/pdfs/CRMP-3chapters8-10.pdf). The map shows exclosures monitored for many years by the NRCS to assess grazing pressure and impacts.

In 1994, NRCS began long-term monitoring to measure grazing pressure and impacts over time. Four permanent 8-ft x 8-ft exclosures or "cages" were installed in the western and central flats above the high tideline, where cattle have grazed seasonally for over 50 years. Exclosures were located in areas predicted to have the highest probability of grazing impacts. Some of these locations have proven to be among the most heavily utilized areas on the lease. Exclosures prevent cattle from grazing plants within the caged area. One cage was removed in 1998 by winter ice scour. In 1999, all four cages were replaced to ensure that cattle continued to be excluded. A fifth exclosure was constructed in 2003. These sites are evaluated annually. The map below shows the location of the five monitoring sites. Numbers on the map identify soil map unit soil types.

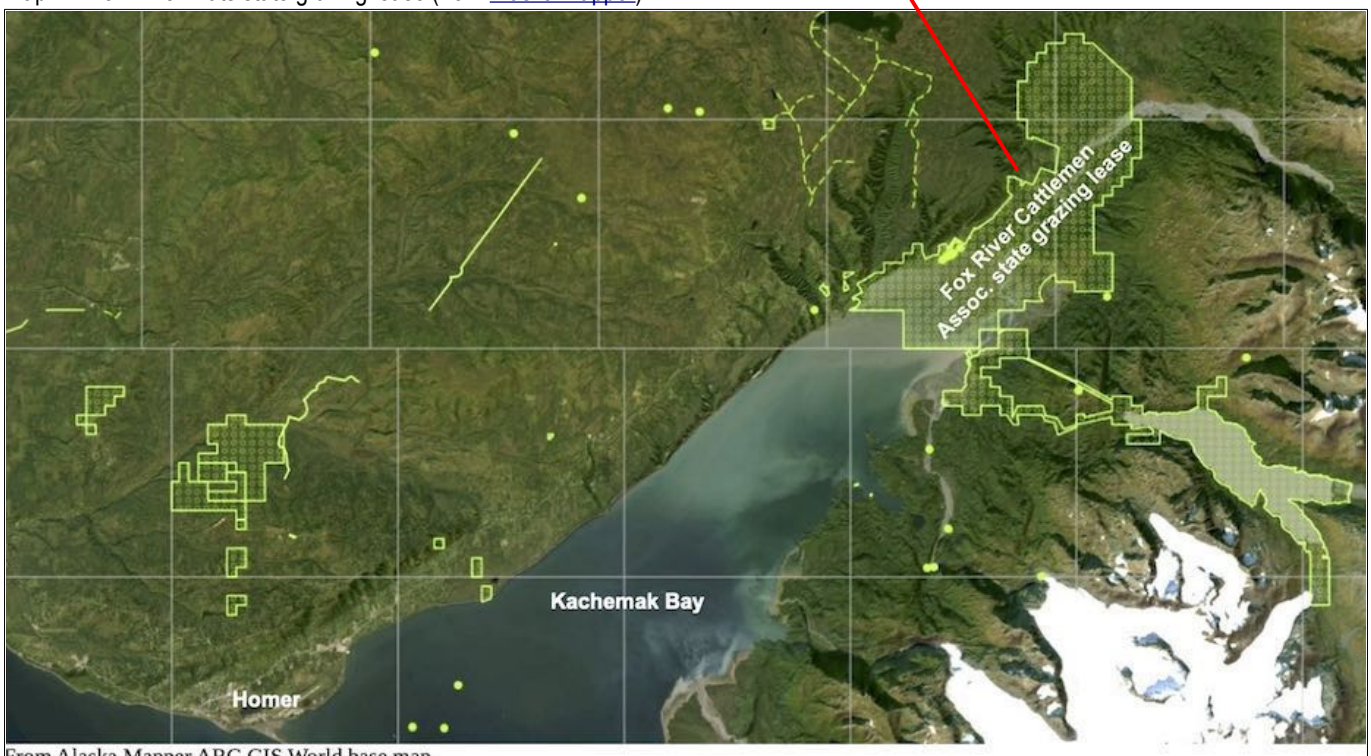


As noted above, a variety of maps are included in this section of Chapter 1. The two maps below show the location of Kachemak Bay in Southcentral Alaska and the boundaries of the grazing lease at the head of Kachemak Bay.

Map 1 – The Kenai Peninsula is located on the east side of Cook Inlet and south of Turnagain Arm (from Alaska Mapper)

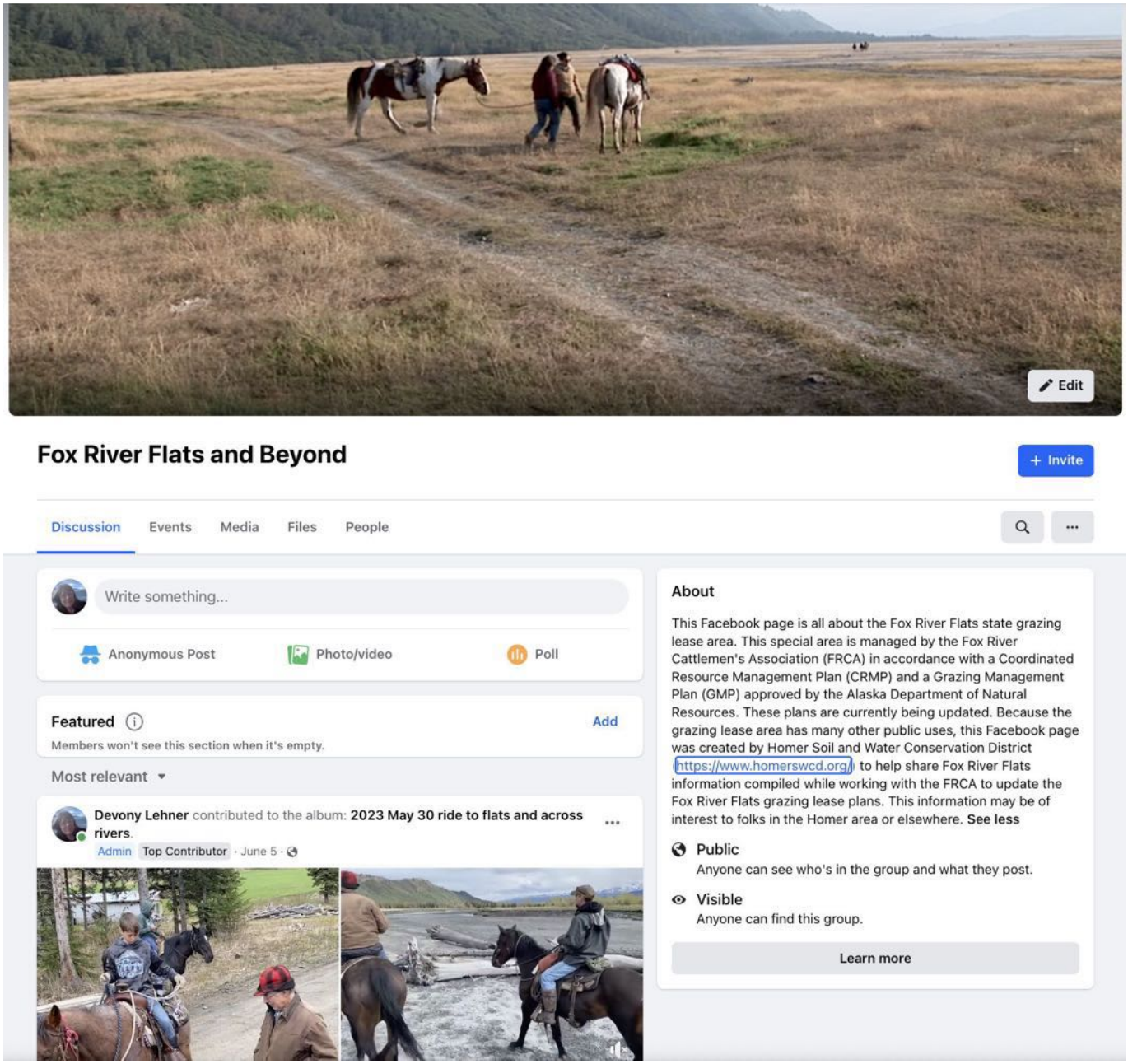


Map 2 – Fox River Flats state grazing lease (from Alaska Mapper)

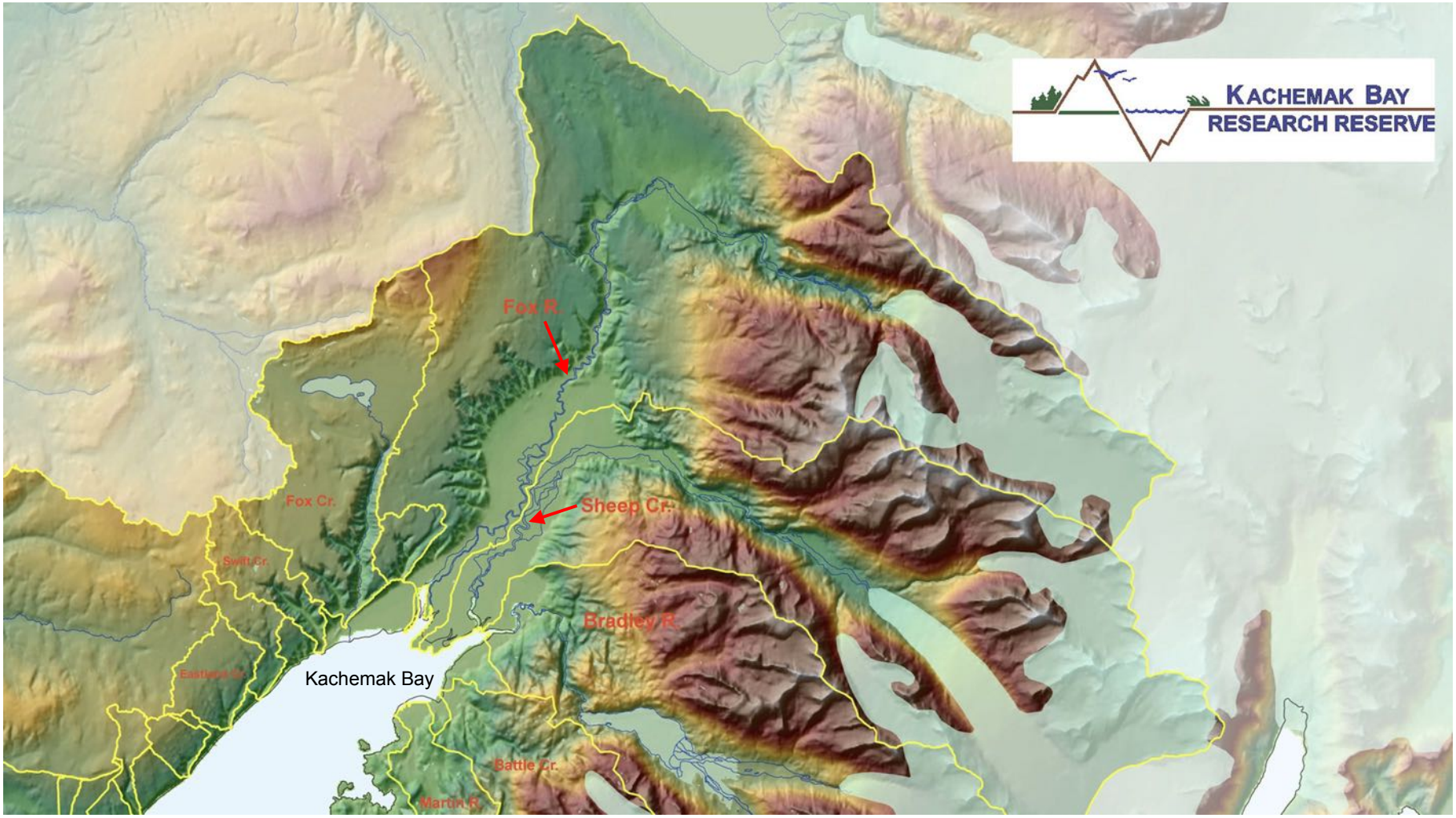


From Alaska Mapper ARC GIS World base map

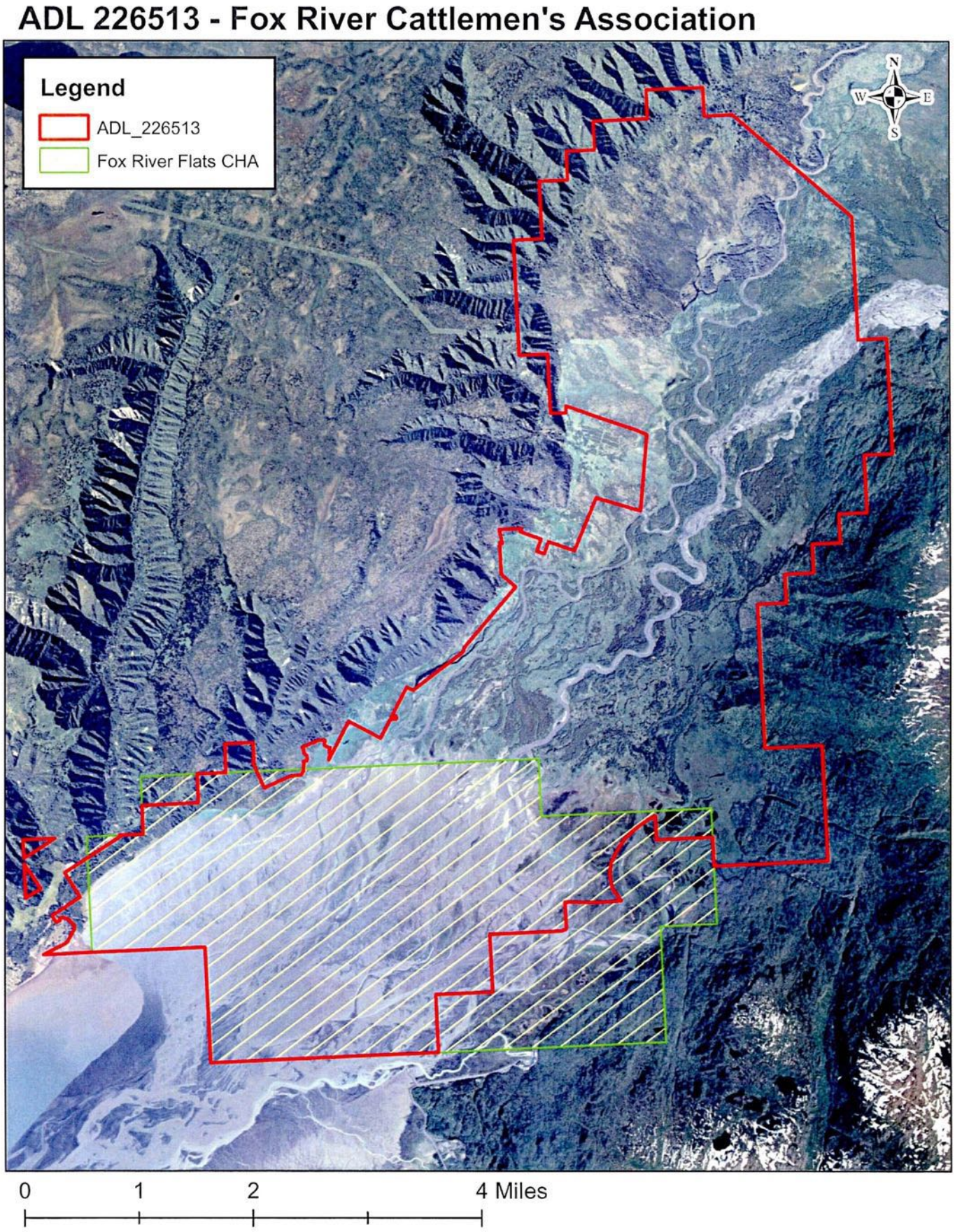
Image 1 – Homer Soil and Water's Facebook page "Fox River Flats and Beyond" is used to share information about the grazing area



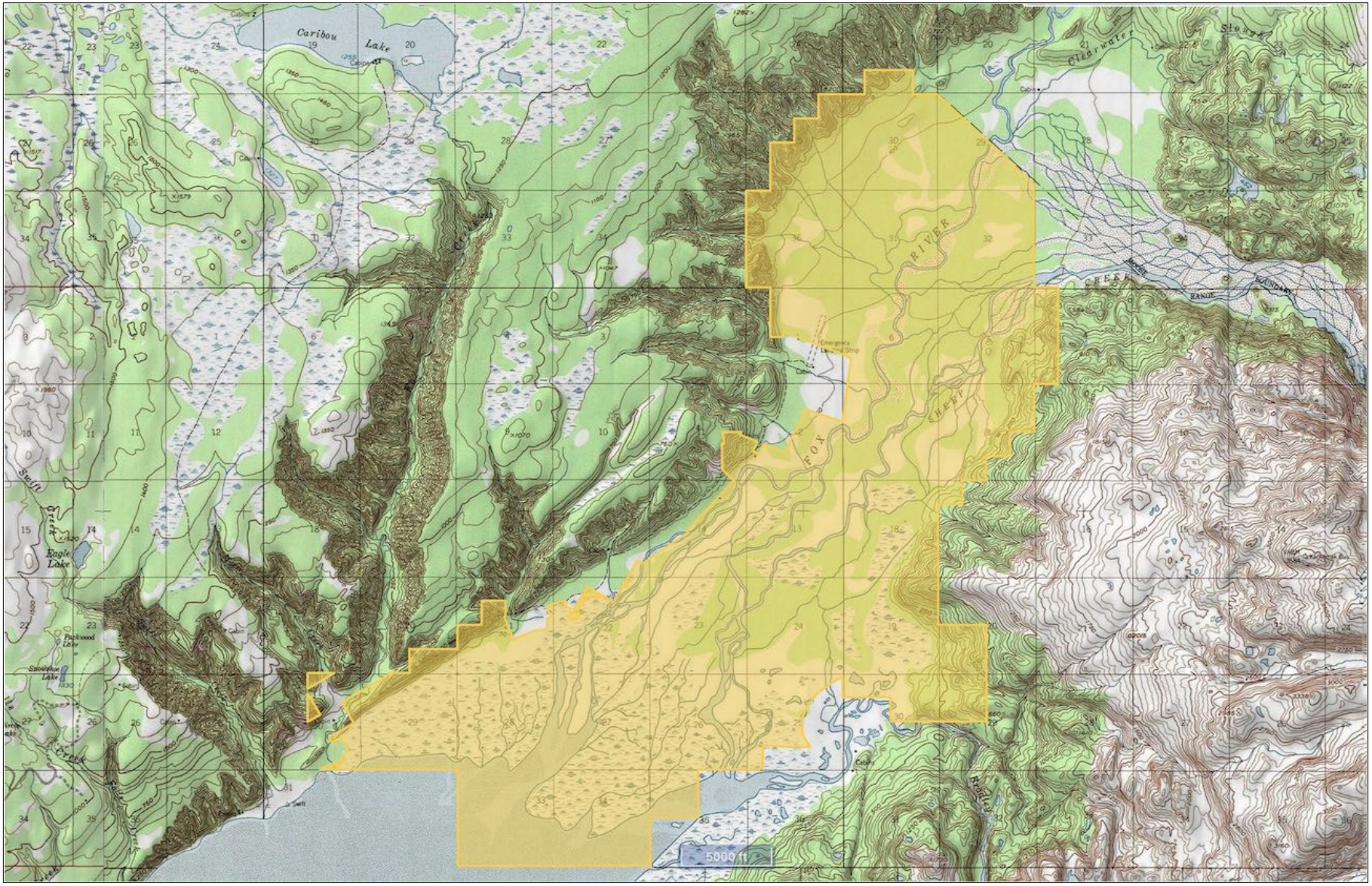
Map 3 – Map of watersheds at the head of Kachemak Bay (from UAA KBNERR); note, both Fox River and Sheep Creek headwater in glaciers and have dynamic braided river channels



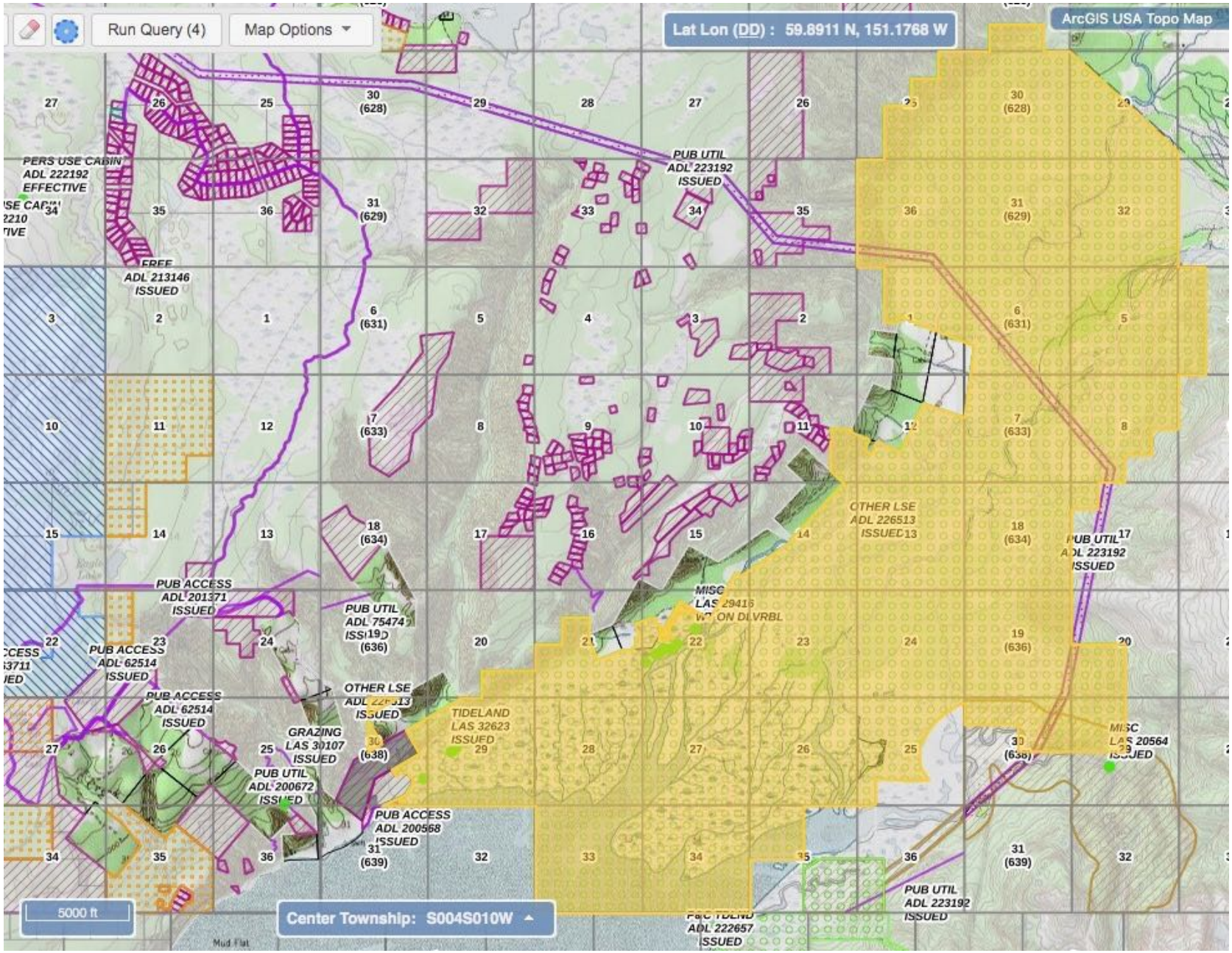
Map 4 – Outline of FRCA state grazing lease, ADL 226513, and Fox River Flats Critical Habitat Area (from Alaska Division of Agriculture)



Map 5 – Fox River Flats state grazing lease (yellow) overlaid on USGS topographic map (from Alaska Mapper)



Map 6 – Fox River Flats state grazing lease area (yellow) and state land disposals and easements (purple); areas with no overlay are other private lands (from Alaska Mapper)



Map 7 – Fox River Flats Critical Habitat Area; the CHA was overlaid on the pre-existing grazing lease originally granted by BLM to the Fox River Cattlemen's Association

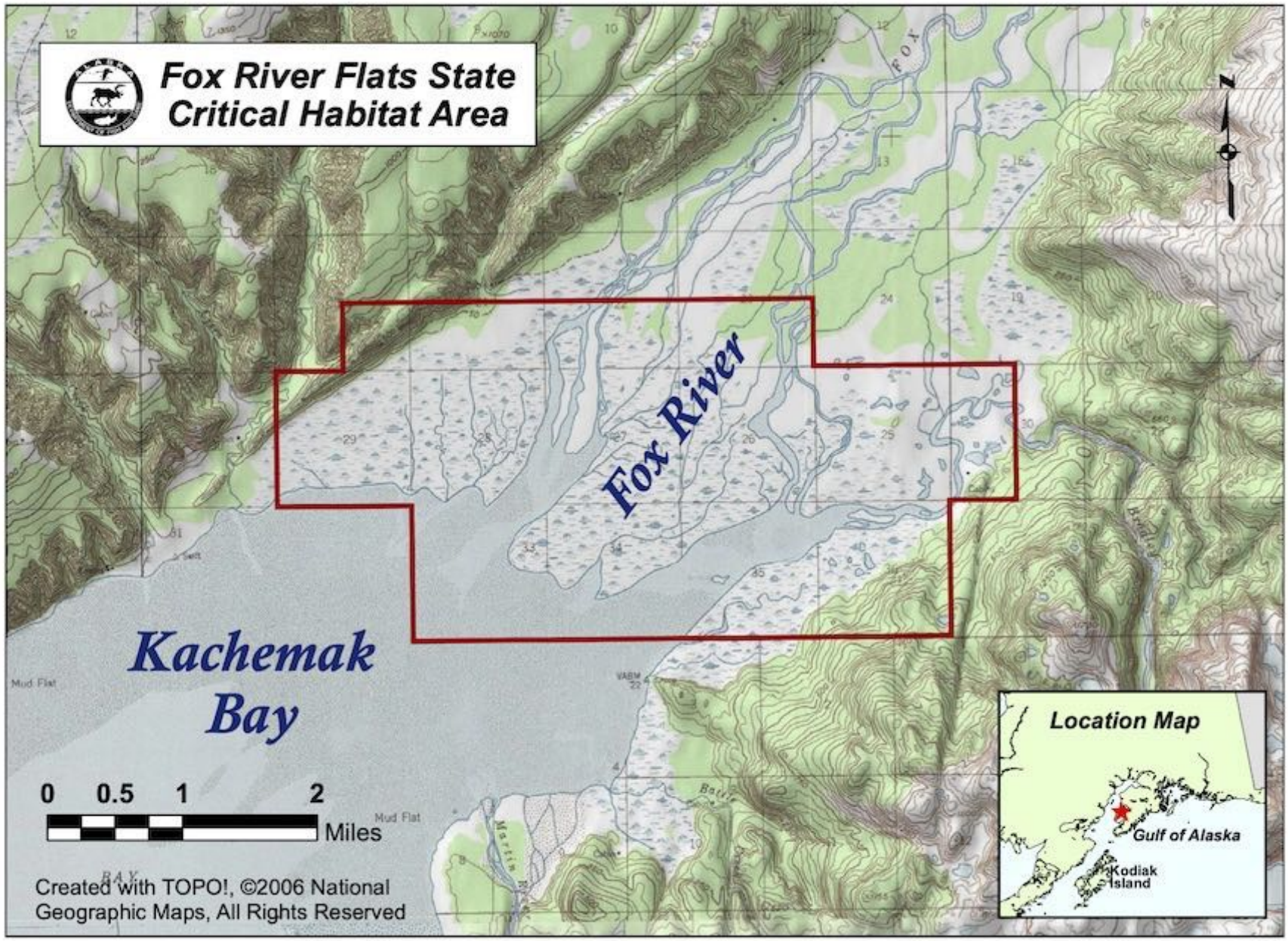


Image 2 – Views of the grazing lease area

2a, top left: Looking east up the Fox River – Sheep Creek valley June 2009; Fox River is on the left, Sheep Creek on the right (from Alaska Shorezone, see below).

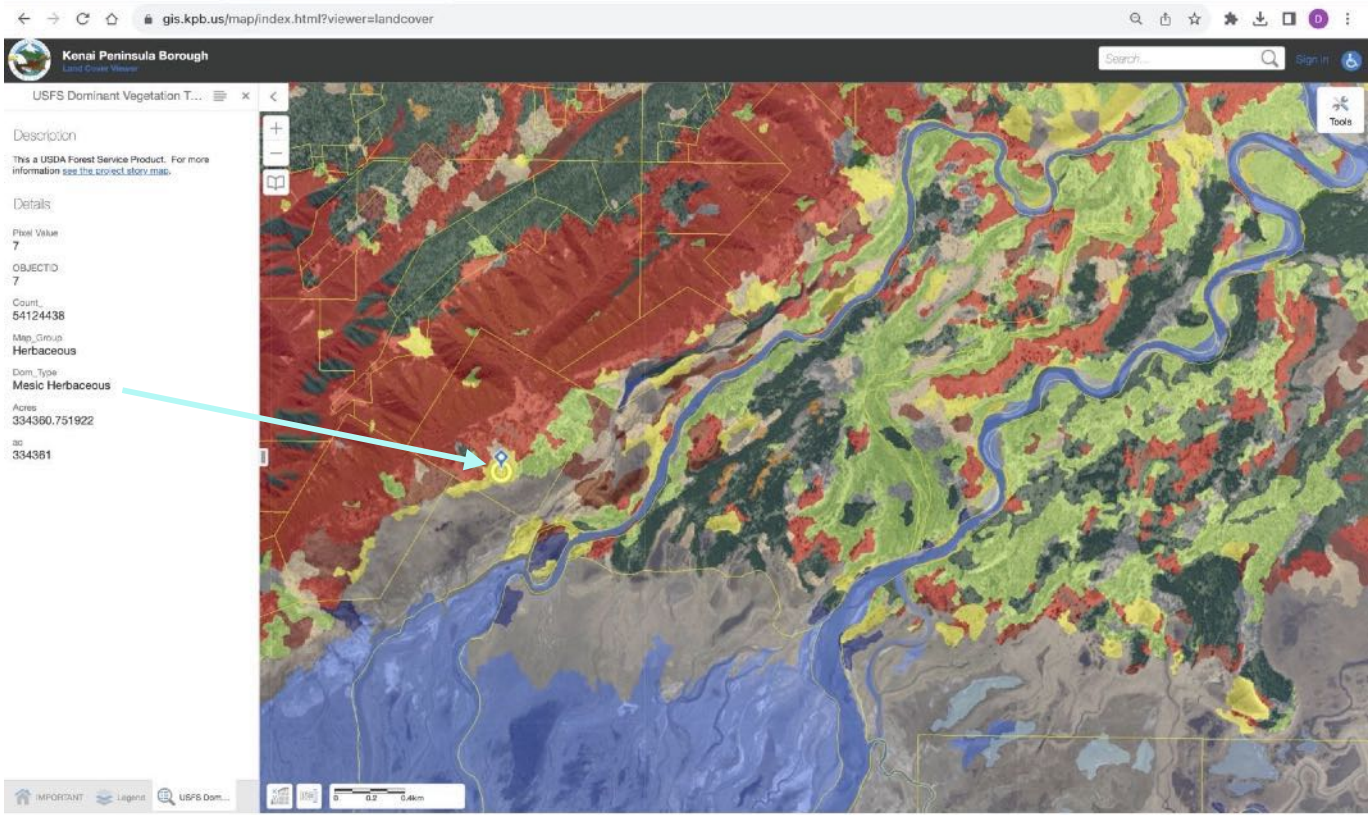
2b, bottom left: Looking east up the Fox River – Sheep Creek valley August 26, 2019; Fox River is visible on photo left (from UAA KBNERR).

2c, bottom right: Fox River cattlemen's corral and fenceline at western edge of grazing lease (from Alaska Shorezone, see below).

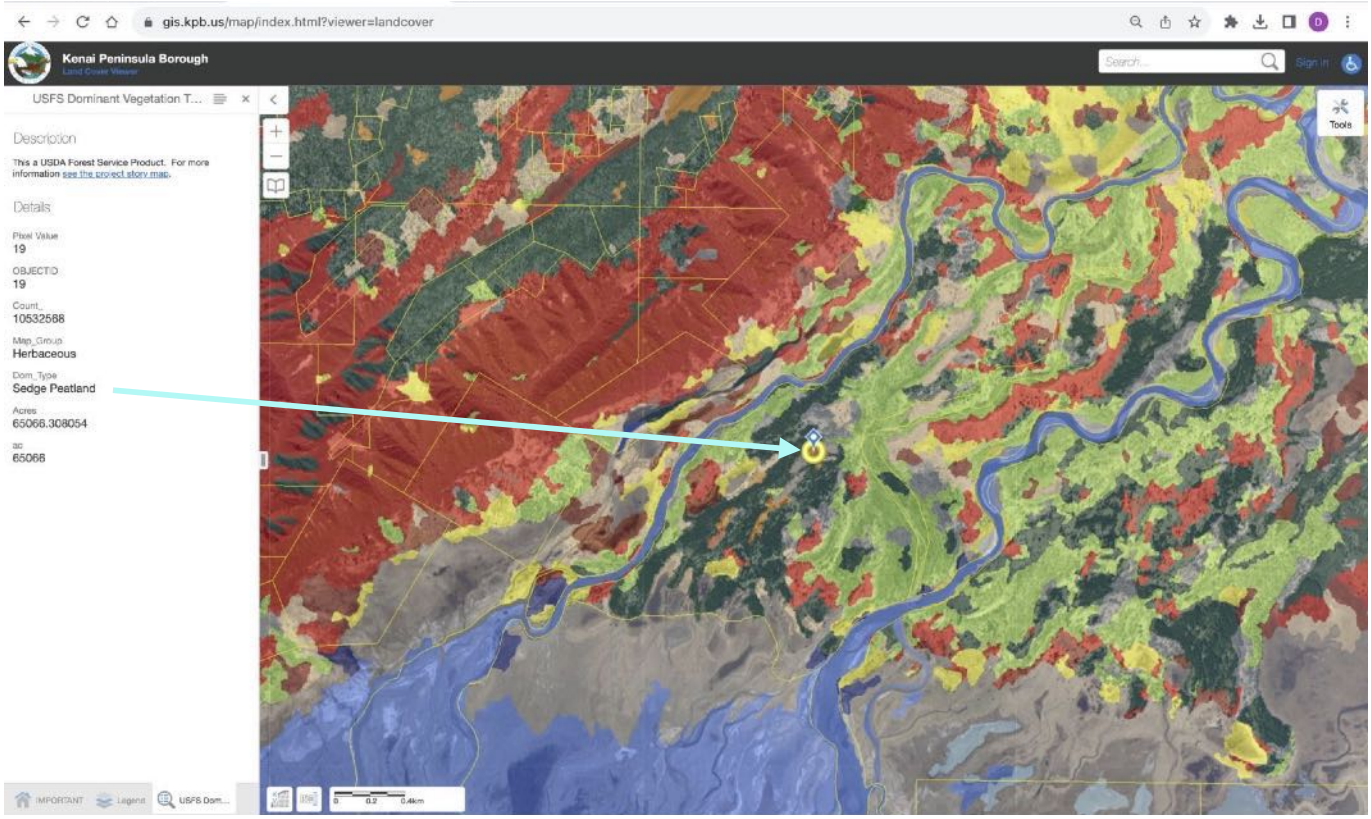
Images are from NOAA's Alaska ShoreZone Mapping Website and are dated June 2009, see https://alaskafisheries.noaa.gov/mapping/sz/.

Map 8 – Examples of Fox River Flats vegetation maps with color codes (available from KPB GIS USFS veg layer)

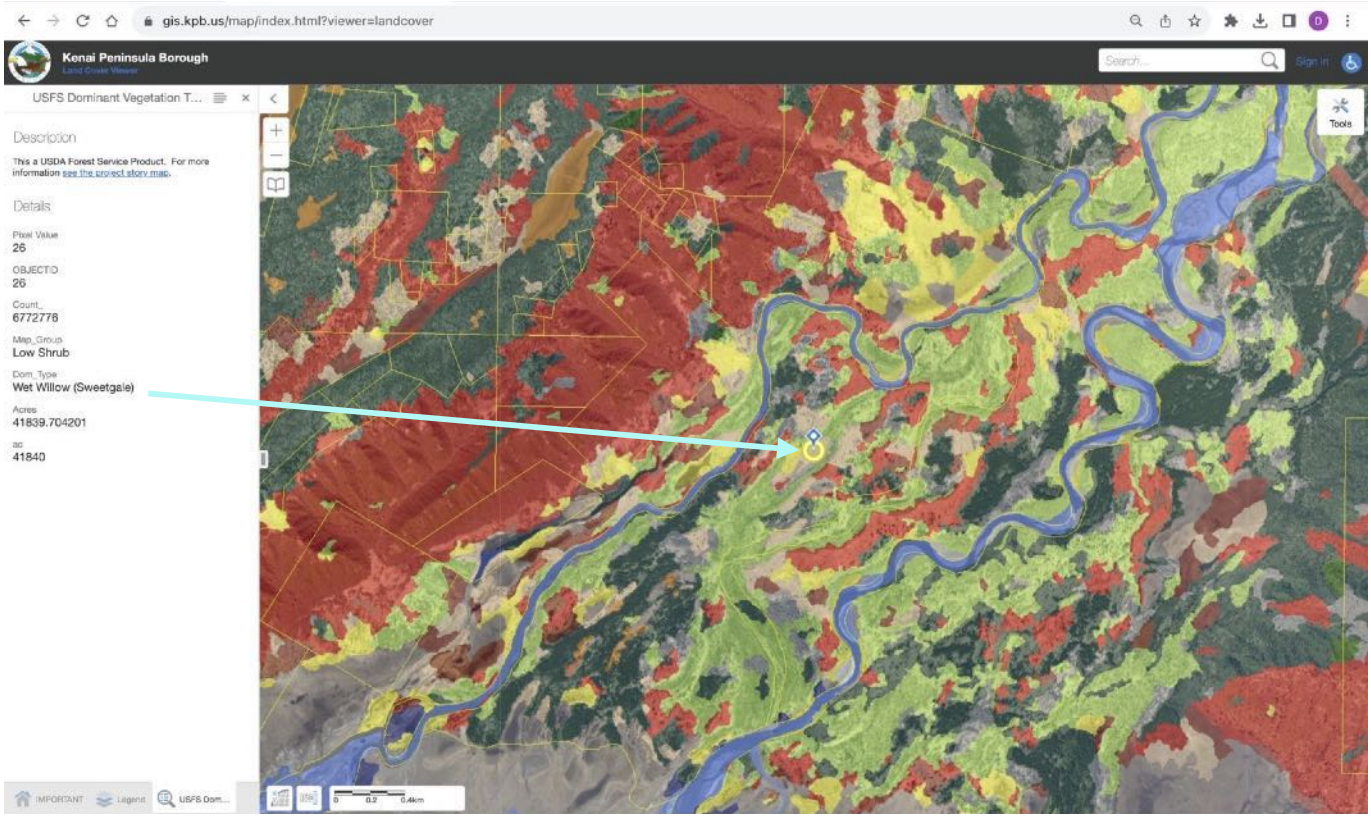
8a – Herbaceous, mesic herbaceous



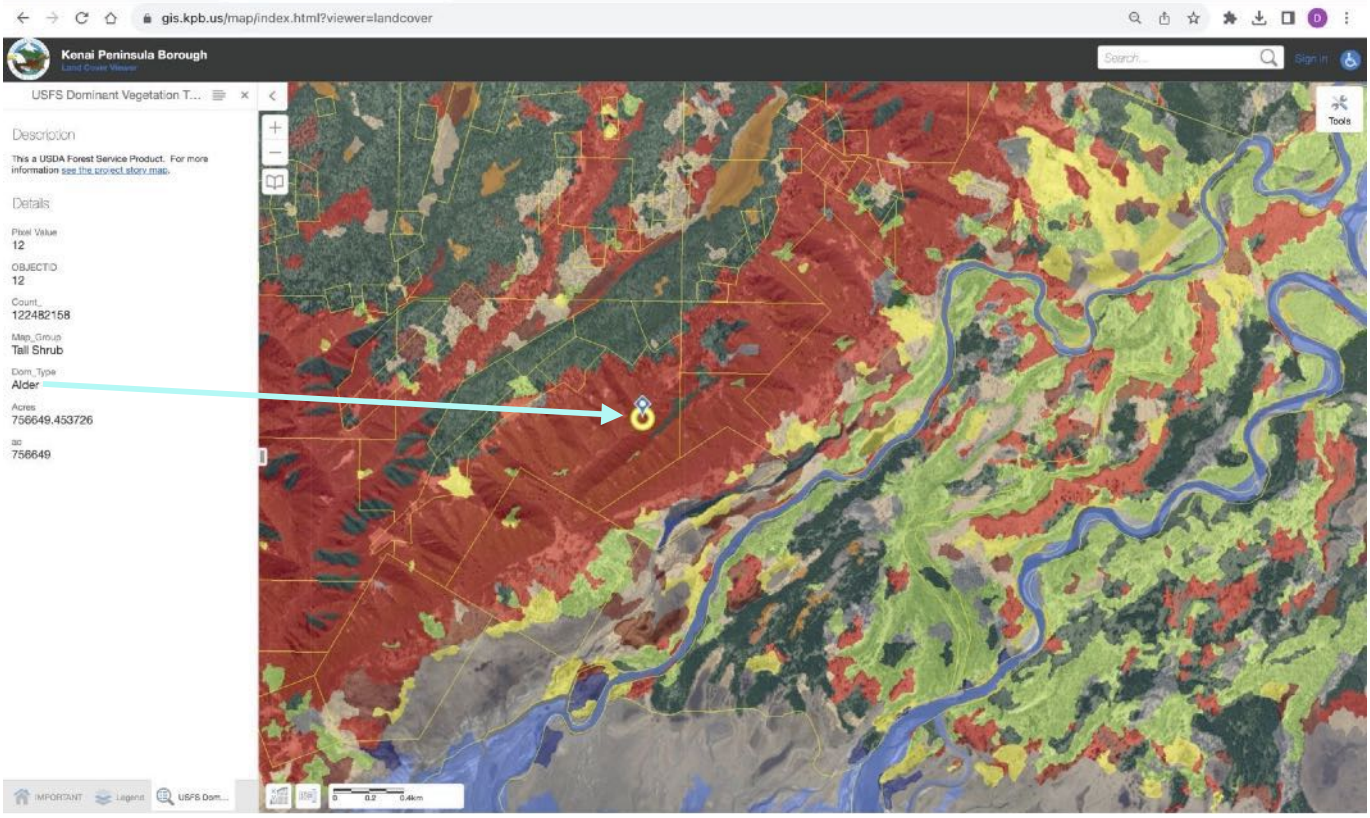
8b – Herbaceous, sedge peatland



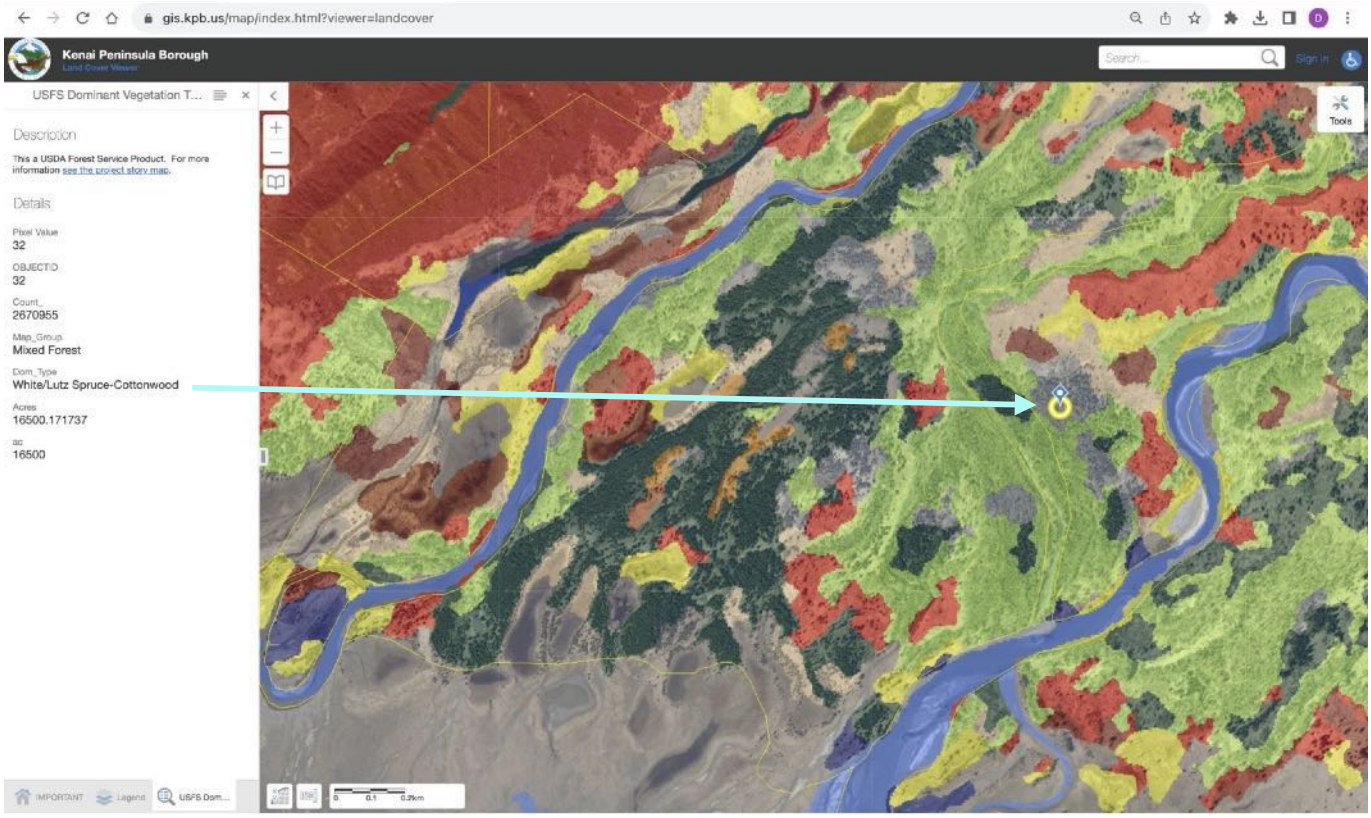
8c – Low shrub, wet willow (sweetgale)



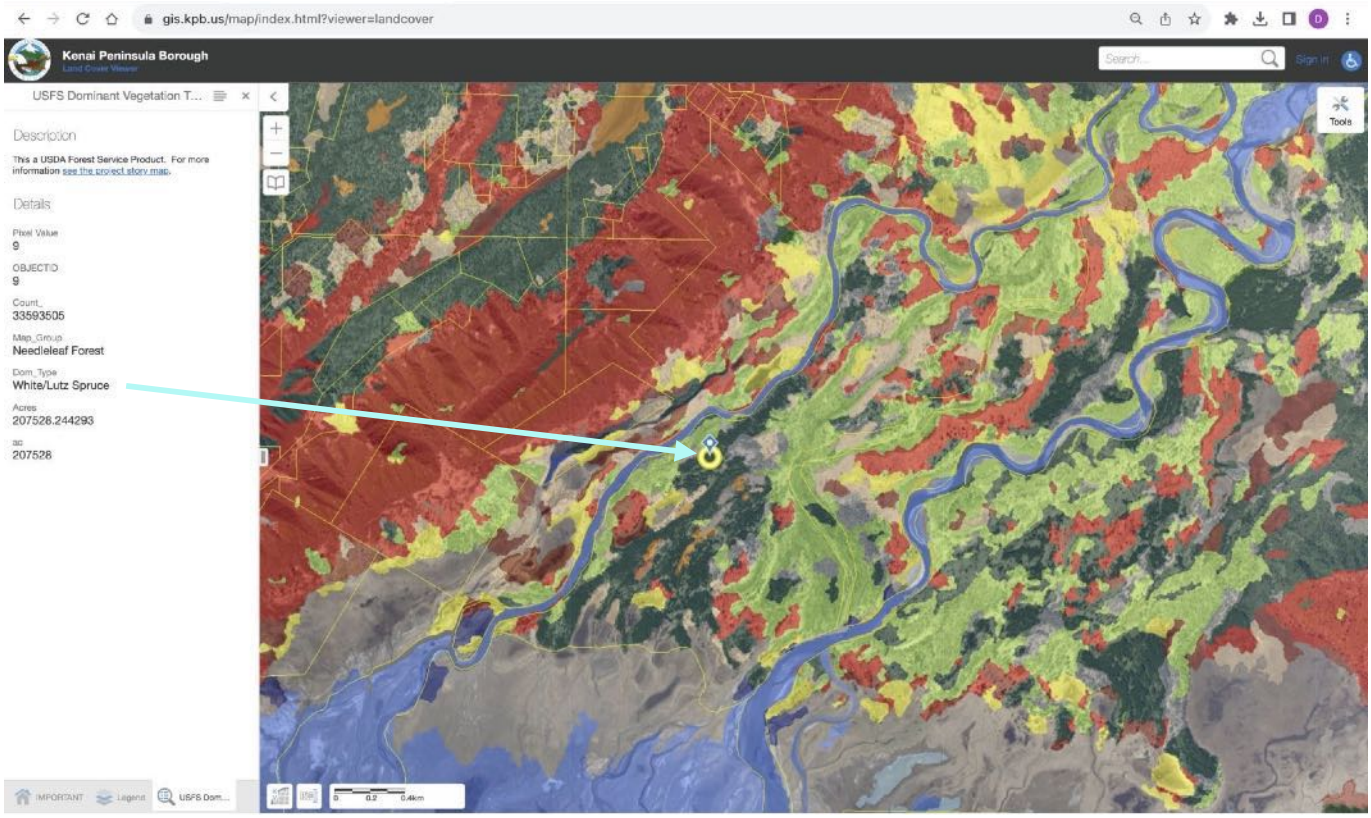
8d – Tall shrub, alder



8e – Mixed forest, white/Lutz spruce – cottonwood



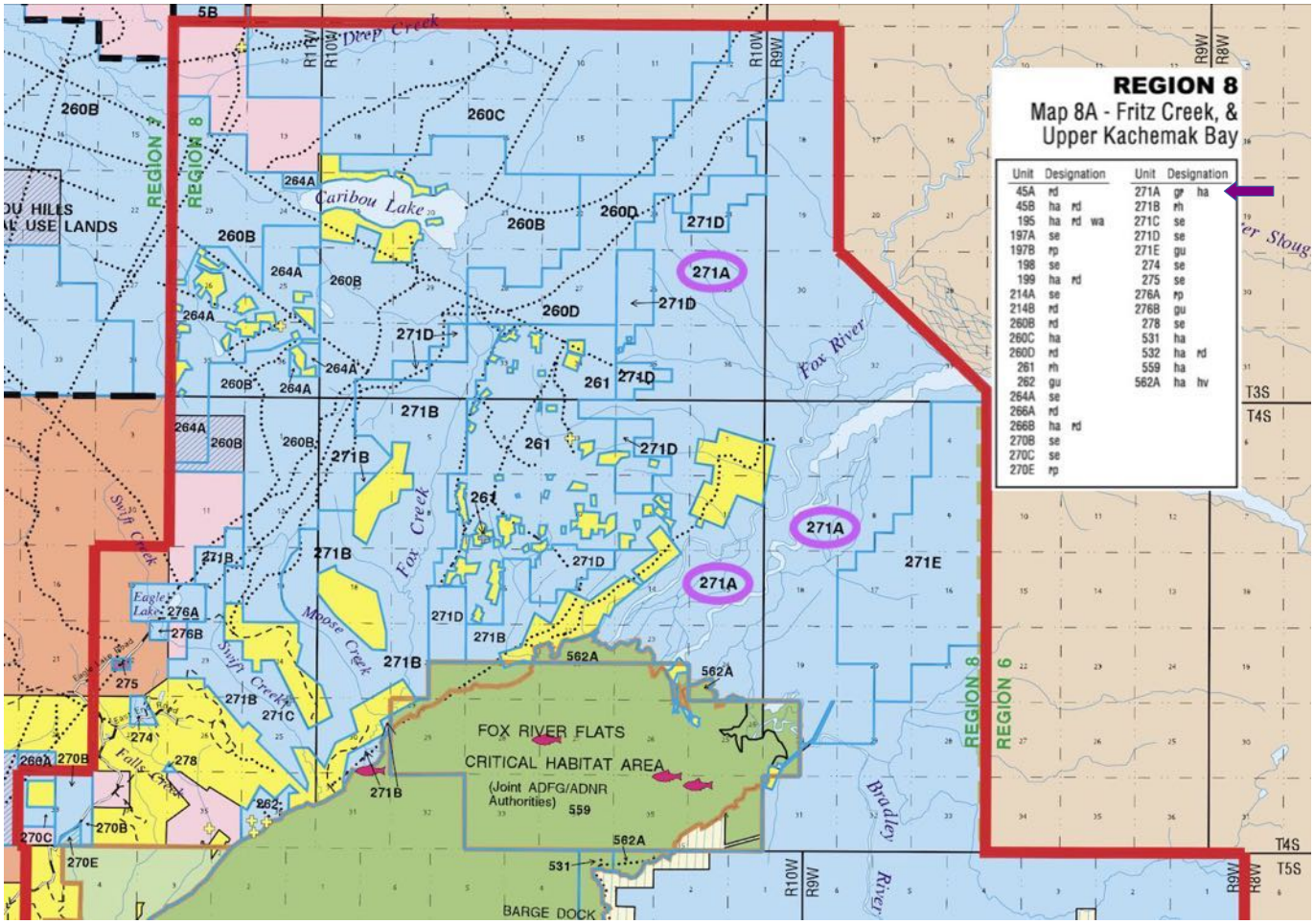
8f – Needleleaf forest, white/Lutz spruce



Map 9 – Map and legend from State of Alaska Kenai Area Plan (KAP) Region 8. KAP Unit 271A encompasses state land at the head of Kachemak Bay that is designated both "grazing" (gr) and "habitat" (ha). The Alaska Department of Natural Resources adopted the Kenai Area Plan in 2001; the KAP provides land use designations and management guidelines for all state lands on the Kenai Peninsula.

KENAI AREA PLAN

Alaska Department of Natural Resources
DIVISION OF MINING, LAND AND WATER

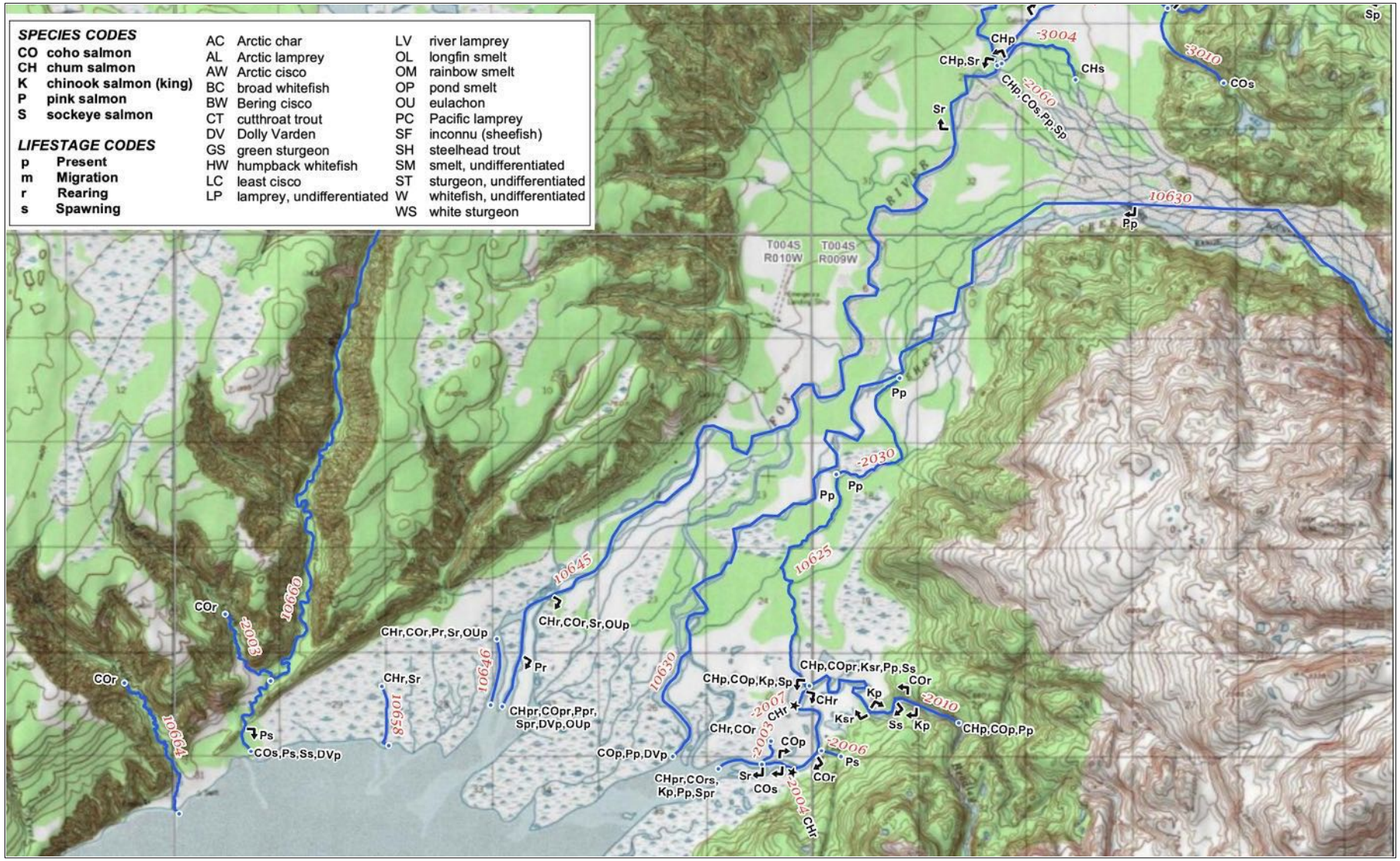


ag Agriculture
co Coal
fo Forestry
gr Grazing
gu General Use
ha Habitat
hv Harvest
hr Heritage
ma Materials
pr Public Facilities - Retain
pt Public Facilities - Transfer
rd Public Recreation and Tourism- Dispersed Use
rp Public Recreation and Tourism - Public Use Site
rh Resource Management - High Value
se Settlement
sh Shoreline Use
tr Transportation
wa Water Resources and Uses
wd Waterfront Development

Grazing
gr Land that is appropriate for grazing and that is suitable, in the cultivated or uncultivated state, for supporting domestic livestock. These lands will be managed in a manner that supports the sustained production of forage needed for raising livestock while providing for other public uses and minimizing impacts on habitat, recreation, water quality, and other values. This land may be conveyed only to municipalities. It may not be sold to individuals.

Habitat
ha Valuable habitat is defined as: limited, concentrated-use area for fish and wildlife species during a sensitive life-history stage where alteration of the habitat or human disturbance could result in a permanent loss of a population or species' sustained yield. This land will remain in state ownership.

Map 10 – Anadromous species codes and lifestage codes for anadromous fish streams in the Fox River – Sheep Creek valley (from ADF&G Anadromous Waters Catalog)



Map 11 – Access to the Fox River Flats is via the steep Switchback “road” or along the beach (base map from Kenai Peninsula Borough Geohub, https://geohub.kpb.us/ or viewKPB)

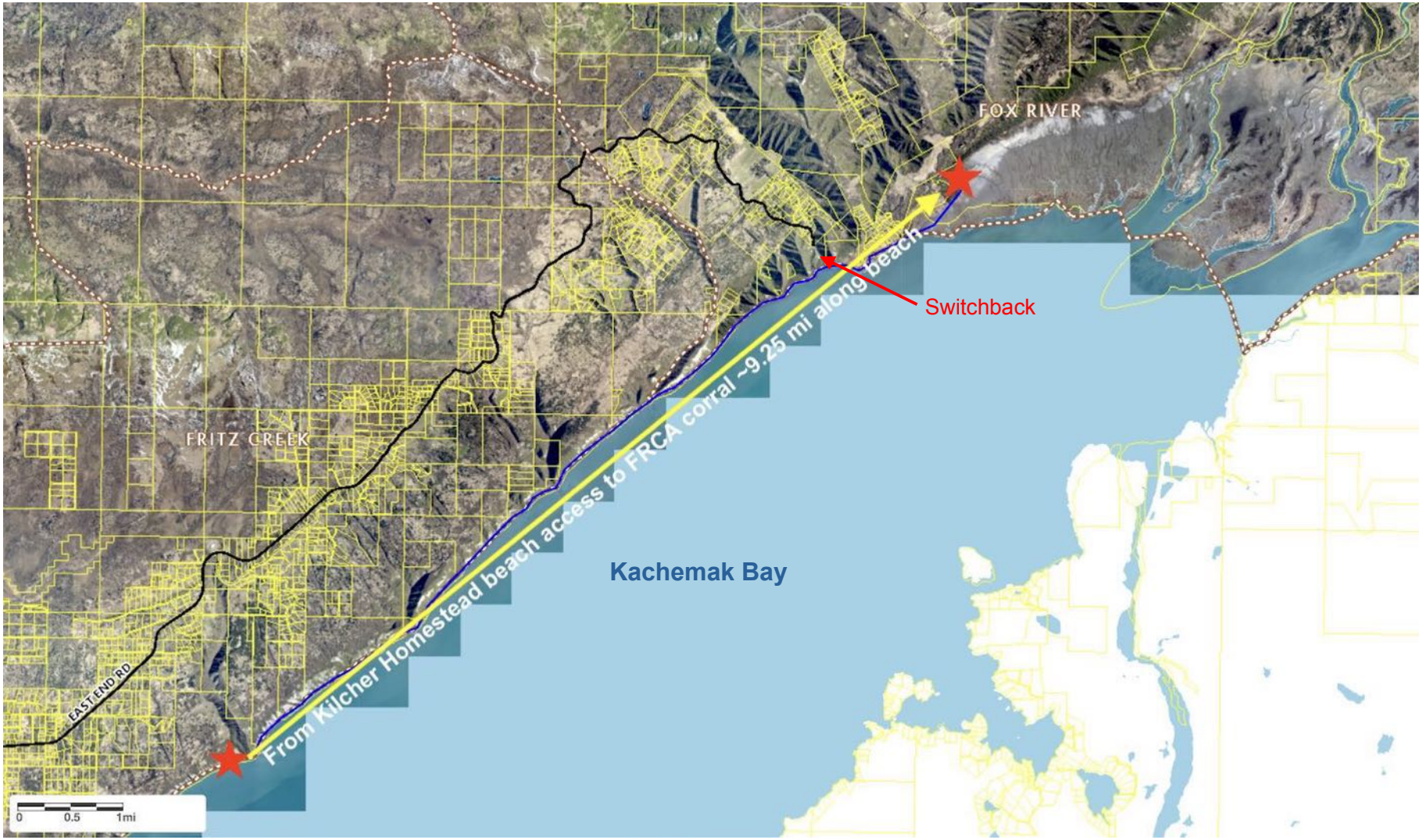
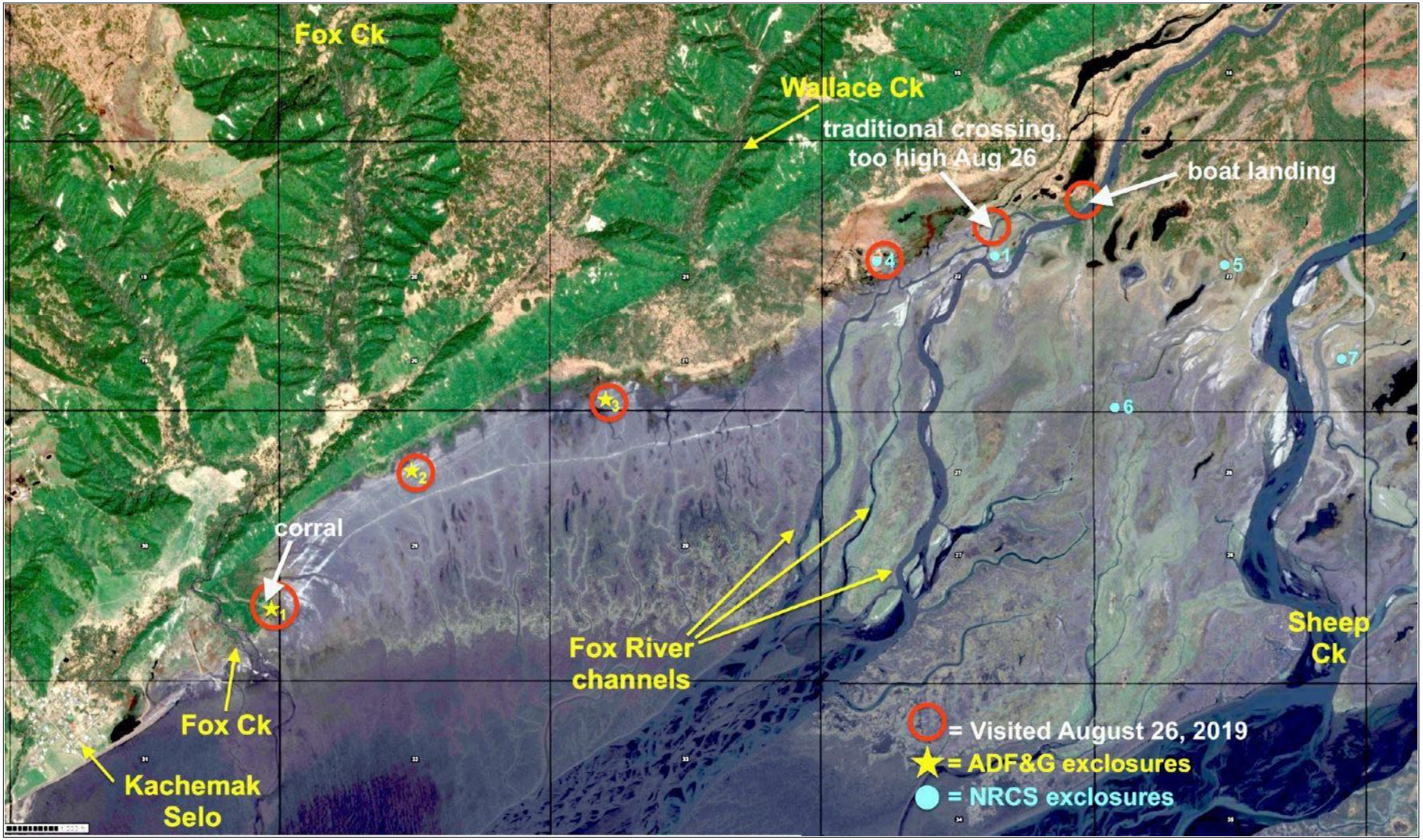


Image 3 — Two views of the Switchback “road” beyond the end of East End Road
The Switchback is used by hikers, bikers, cars and trucks, OHVs, horseback riders, and others. At the bottom of the Switchback, trails follow the beach both east and west. The bottom photo shows a white vehicle on the beach traveling west towards the Switchback.

Map 12 – Landmarks and sites relevant to August 26, 2019, collaborative interagency field trip – see description below map



This map was developed by Homer Soil and Water in August 2019 to orient participants in a collaborative field trip to the flats. Five participants traveled on horseback and five used 4-wheelers. Both groups met at exclosures and other selected sites on the nearside of Fox River to discuss conditions and ideas for improved management. Participants represented Homer Soil and Water, Natural Resources Conservation Service, Fox River Cattlemen's Association, Alaska Department of Fish and Game, Kachemak Bay National Estuarine Research Reserve, Kachemak Heritage Land Trust, and a university graduate program. Base map is imagery then available on NRCS's online Web Soil Survey (colors were enhanced by HSWCD).

Cultural Resource information relevant to the head of Kachemak Bay

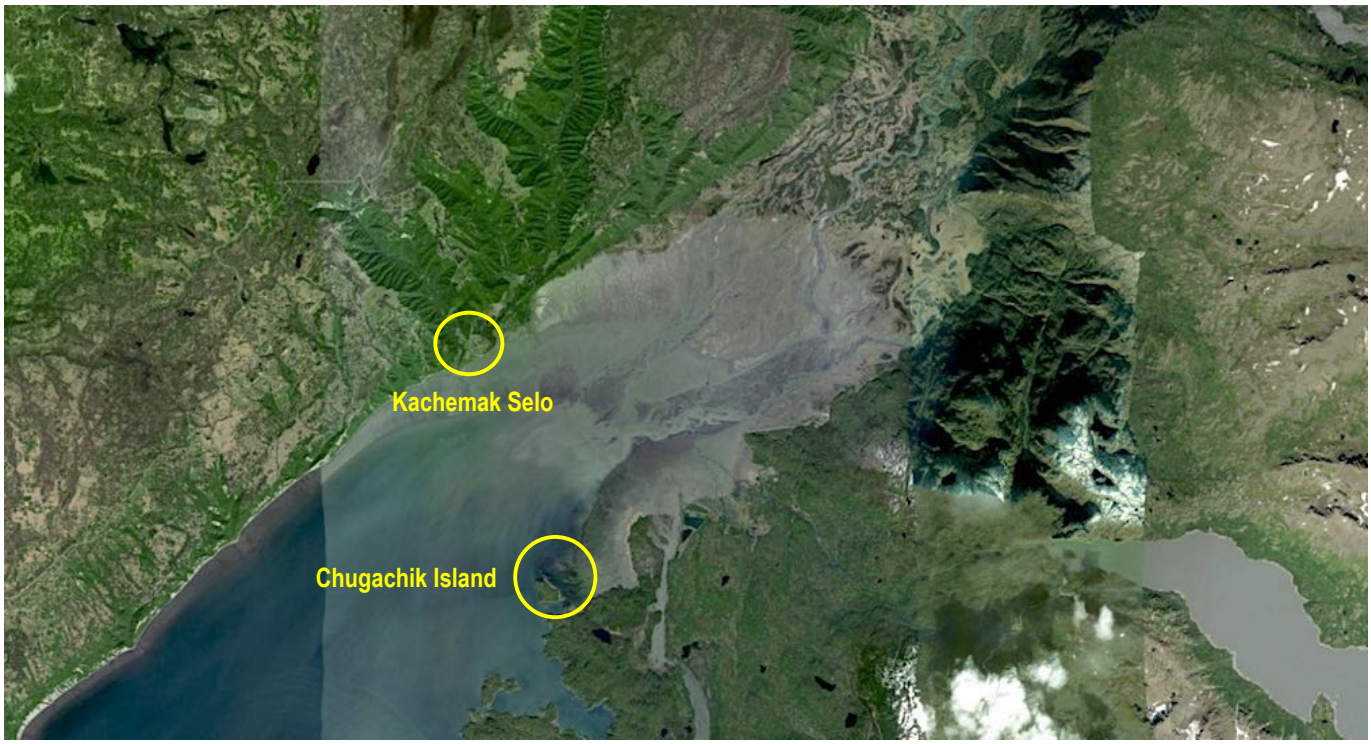
The Fox River–Sheep Creek valley is subject to many powerful natural processes, from the braiding of river channels, to flooding from glacial meltwater and storms, to winter icing, mass wasting and other forms of erosion, to sediment deposition, earthquakes, and more. As a result, signs of prehistoric and historic human uses in the valley are unlikely to survive for many decades, much less centuries. Nonetheless, it's important to be aware of the archeological and historical richness of the area. This section offers a brief overview of cultural resources near the Fox River Flats and surrounding areas. A recent history of livestock use of the area is provided in Chapter 3 of the Coordinated Resource Management Plan mentioned earlier in this overview.

Humans have used lands around Kachemak Bay for millennia, settling for various periods in areas offering shelter and good access to preferred foods. So far, six or seven discontinuous cultural traditions have been identified around Kachemak Bay. The table below briefly summarizes identified traditions.

Along the steep, rocky fjords on the south (or east) side of the bay, cultures tended to focus on marine resources. Foods hunted or harvested included harbor seals, porpoise, sea otters, ocean fish, seabirds (including eggs, chicks, and adults from rocky rookeries), and intertidal plants and animals. South of Sheep Creek, harbor seals still haul out on beaches and mudflats at the head of the bay to rest, pup, molt, interact, and escape aquatic predation (NOAA Alaska Harbor Seal Aerial Survey Unit IF28).

The maritime culture best studied so far is the Kachemak Tradition, "...a complex tradition of marine mammal hunters and fishermen who occupied primarily coastal sites on the islands and fringes of the rugged and geologically complex south shore of Kachemak Bay (Workman 1992)" (see main reference in the table below).

Common forms of archeological evidence from marine coastal traditions include shell middens, ash layers from hearths, ground and chipped stone tools, bone points, harpoons, fishing gear such as sinkers, carvings, personal adornments such as labrets, as well as human remains and funerary objects. Chugachik Island, near the southeast corner of the Fox River Flats (and 3 miles south of Kachemak Selo)—see map below—was inhabited by the Kachemak Tradition between 2400 to 1500 years ago and has produced a rich assemblage of artifacts. About 3.3 miles southwest of Chugachik Island, along the shores of Aurora Lagoon, radiocarbon dates associated with earlier human occupation go back at least 8,200 years (see table below). Other key archeological sites have been excavated at Cottonwood Creek—on the north shore of the bay—and on Yukon Island.



The earliest Kachemak Bay residents arrived by kayaks or larger umiaks, and their cultures show ties to coastal Kodiak and Aleutian traditions. For these small-craft seafarers, accessing the Fox River Flats area would have been easy at high tides. At the time when these earliest inhabitants arrived, overland travel onto the peninsula from the mainland to the north—e.g., through Turnagain Pass—was only just becoming feasible as glaciers retreated. Food resources on land were initially very limited until peninsula lowland vegetation shifted from periglacial hebaceous communities to shrublands, which were followed by spruce and deciduous forests favorable to larger mammals and more diverse species of birds. Over time, the rolling lowlands and hillslopes on the north side of Kachemak Bay came to be dominated by cultures reflecting Athabaskan traditions focused on hunting moose, caribou, bear, furbearers, onshore birds, and salmon swimming upstream to spawn. These Dena'ina Natives used many kinds of food and fiber resources from upland and wetland peninsula plant communities north of Kachemak Bay; they developed a unique culture that combined hunting traditions of Interior Alaska Indians with adaptations enabling them to procure coastal resources around Cook Inlet, including, for example, beluga whales, which had also been hunted by coastal maritime traditions.

Summary of Kachemak Bay cultural traditions (most recent to oldest)

(Much of this table is based on *Expanding the radiocarbon chronology of Kachemak Bay, Kenai Peninsula, Alaska*, Klein and Zollars. 2008)

Cultural tradition	Brief description, comments	Approximate dates in Kachemak Bay
Sugpiaq – see https://alutiiqmuseum.org/learn/the-alutiiq-sugpiaq-people	Sugpiaq (Alutiiq) people have inhabited coastal environments of Southcentral Alaska for over 7,500 years. Traditional homelands include Prince William Sound, the outer Kenai Peninsula, the Kodiak Archipelago, and the Alaska Peninsula. Sugpiaq lived in coastal communities and hunted sea mammals from skin-covered boats.	From roughly 500 AD to the present; now represented by communities of Port Graham and Nanwalek on the south (east) shore of Kachemak Bay
Athabascan (Dena'ina) see: http://sites.kpc.alaska.edu/anthropology/files/2014/08/Overview-of-Denaina-Prehistory-2.pdf	Both Homer Spit and Bishop's Beach have Dena'ina place names; Dena'ina called the Spit Uzintun, meaning "extends out into the distance," and Bishop's Beach was called Tuggeght, meaning "at the water." Dena'ina also no doubt used resources along Kachemak Bay out into the Fox River Flats area and beyond. Although related to inland upland/riverine Athabaskans, the Dena'ina adopted a maritime hunter/fisher subsistence culture as they adapted also to use coastal resources.	From roughly 500 AD to present; now represented by Kenaitze, Salamatof, and Ninilchik Natives of the Dena'ina tradition
Kachemak Tradition – see: https://www.jstor.org/stable/25780687 and http://www.alaskaanthropology.org/wp-content/uploads/2017/08/akanth-articles_258_v6_n12_Klein-Zollars.pdf	By 3000 years ago a coastal marine Kachemak Tradition was established and spreading. The tradition had close connections with Kodiak Island, from which pioneer settlers probably derived. On the peninsula, a Riverine Kachemak variant developed that included adaptations for harvesting salmon and terrestrial resources.	1000 BC to 600 AD (3000 to 1400 years ago); Riverine Kachemak has been placed at ca. 1000 B.P., at which time it was apparently replaced by in-migrating groups ancestral to Dena'ina Athabaskans.
on Yukon Island, "eclectic artifact assemblage" predating Kachemak Tradition	These oldest dates from Yukon Island predate the onset of the Kachemak Tradition by hundreds of years when using Frederica de Laguna's incipient date of 883 BC, and they postdate the ASTt in Kachemak Bay by roughly a millennia: 3100–2450 BC and 2900–2200 BC… The meaning of the unusual combination of lithics, artifacts, and dates remains a mystery.	A sample of bark was dated at 2015–1670 BC, and a piece of wood at 1450–930 BC.
Arctic Small Tool tradition (ASTt)	About 4000 years ago (2000 BC), a technology related to Arctic Small Tool tradition of the Alaska Peninsula appeared in Kachemak Bay.	~ 2000 BC (4000 years ago)
eastward across Aurora Lagoon from Aurora Spit,	artifact assemblage with a radiocarbon date of 3059 BC; may represent late Ocean Bay tradition coming from the Alaska Peninsula; how this site relates to the earlier site on Aurora Spit is unknown	Radiocarbon date of 3059 BC
on Aurora Spit, earlier site of unknown culture,	Located on Aurora Spit; due to an absence of diagnostic materials, Klein and Zollars were unable to suggest an ethnic affiliation for the occupants and identified the site simply as early Holocene in age (...dates are from the Early Holocene Component of a Stratified Site," Klein and Zollars 2004:121).	Radiocarbon dates ranging from 6220 to 5470 BC

By the time Russian explorers arrived in the mid-to-late 1700s, Dena'ina Athabaskans were the dominant culture on the north side of Kachemak Bay and northwards up the peninsula, while the Sugpiaq coastal tradition dominated on

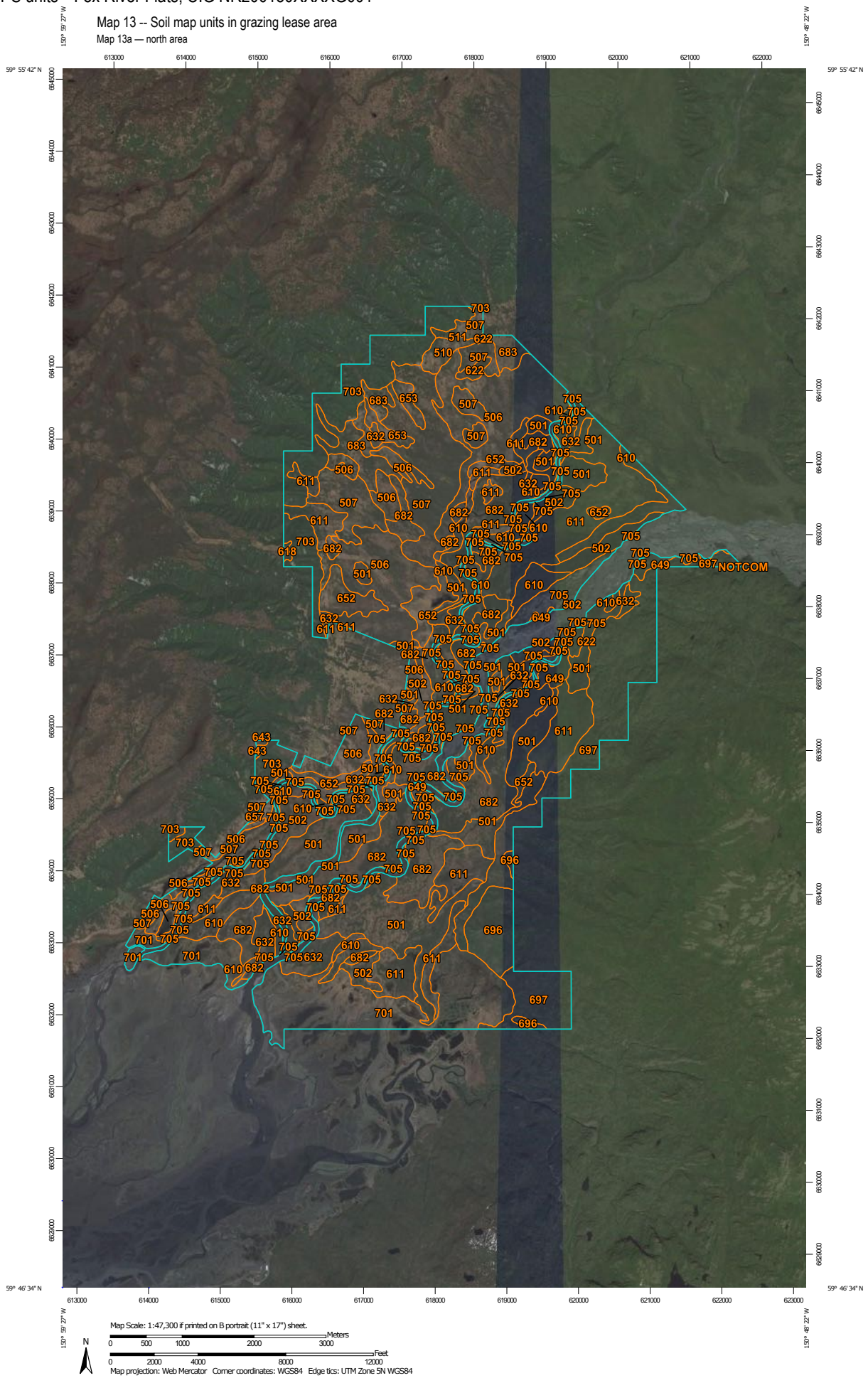
the southern coast of the bay. After Russia sold Alaska to the U.S. in 1867, American and European explorers, trappers, miners, settlers, and others began arriving in greater numbers. For an overview of these periods in peninsula history, see *A Timeline of Kenai Peninsula History* by Alan Boraas (November 2001).

The 1886 gold rush to Hope probably brought the first livestock to Fox River Flats. Homer was the farthest north ice-free port, and the Fox River valley provided an overland route to goldfields at Tustumena Lake and north to Hope. The value of Fox River Flats rangelands was recognized by miners, trappers, and other travelers.

Shortly after the turn of the 20th century, a group of Finlanders established a livestock operation between the mouths of Swift and Fox Creeks and ran a small herd of Durham cattle to sell to fishing-based settlements around the bay (Chris Rainwater, personal communication). Homesteaders arrived next, particularly after World War II, and began staking out homesteads in the flats and up the Fox River–Sheep Creek valley. While Alaska was still a Territory, the Fox River Cattlemen's Association was formed at the request of the U.S. Bureau of Land Management in order to accommodate all current users of grazing lands at the head of the bay. The founding members of the FRCA were Charlie Rainwater, Kunz, Matt Mattox, and Yule Kilcher. As outlined in this report, the current members of the FRCA were essential partners in this project to test GPS systems potentially useful to track cattle movements in the Fox River–Sheep Creek valley.

Map 13 -- Soil map units in grazing lease area

Map 13a — north area



Map Scale: 1:47,300 if printed on B portrait (11" x 17") sheet.

Meters 0 500 1000 2000 3000

Feet 0 2000 4000 8000 12000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 5N WGS84

USDA Natural Resources Conservation Service

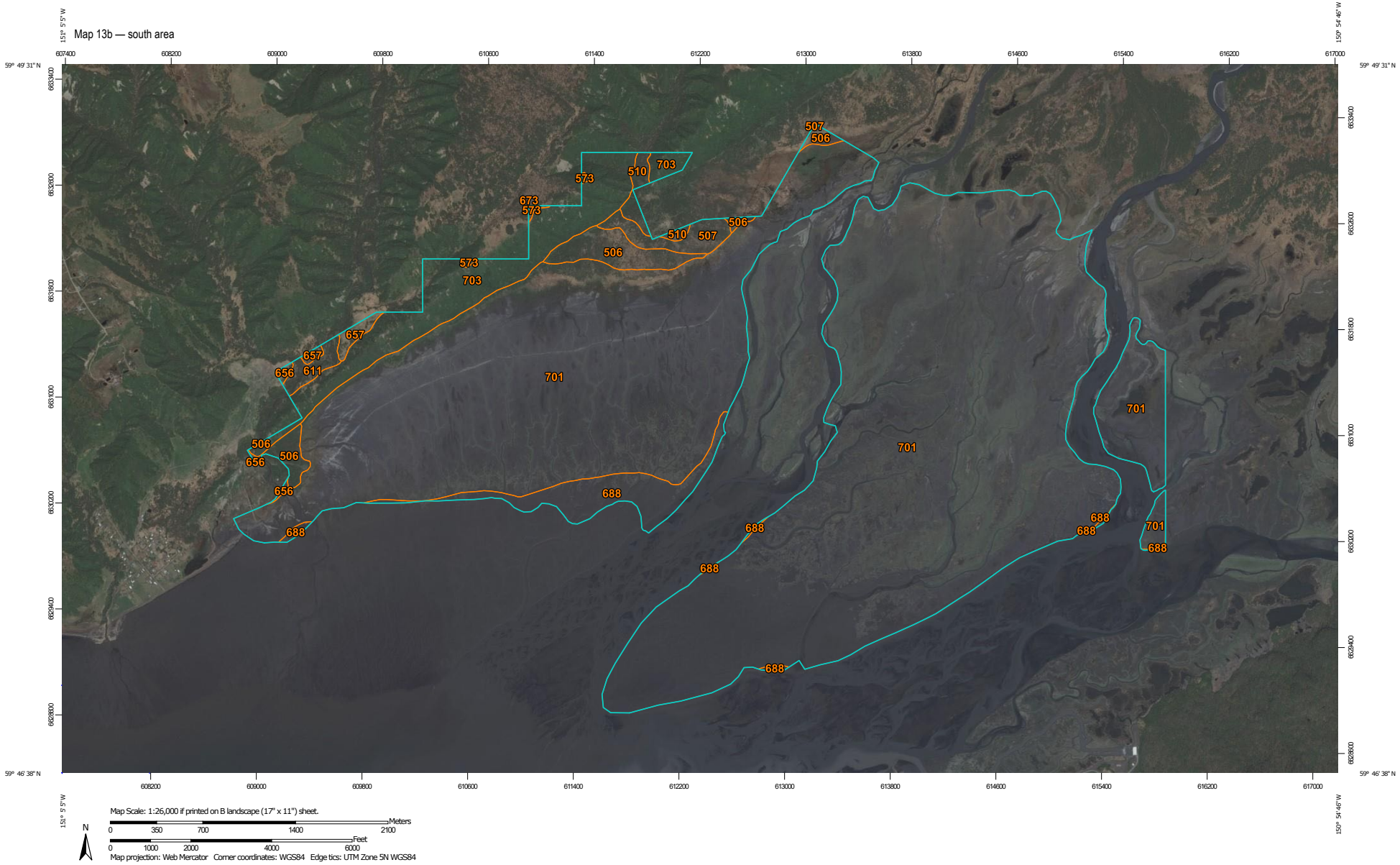
Web Soil Survey
National Cooperative Soil Survey

Map Unit Legend north area

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
NOTCOM	No Digital Data Available	0.0	0.0%
Subtotals for Soil Survey Area		**0.0**	**0.0%**
Totals for Area of Interest		**9,704.3**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
501	Aquic Cryofluvents, 0 to 2 percent slopes	1,064.0	11.0%
502	Aquic Cryofluvents, shallow, 0 to 2 percent slopes	437.9	4.5%
506	Beluga silt loam, 0 to 4 percent slopes	1,013.9	10.4%
507	Beluga silt loam, 4 to 8 percent slopes	705.9	7.3%
510	Beluga-Smokey Bay complex, 4 to 8 percent slopes	48.1	0.5%
511	Beluga-Smokey Bay complex, 8 to 15 percent slopes	16.5	0.2%
584	Kachemak silt loam, forested, 8 to 15 percent slopes	7.6	0.1%
610	Kidazqeni silt loam, 0 to 2 percent slopes	703.9	7.3%
611	Killey and Moose River soils, 0 to 2 percent slopes	984.3	10.1%
618	Mutnala silt loam, 4 to 8 percent slopes	5.9	0.1%
622	Mutnala silt loam, 45 to 60 percent slopes	40.4	0.4%
632	Niklason very fine sandy loam, 0 to 2 percent slopes	308.8	3.2%
643	Redoubt silt loam, 0 to 4 percent slopes	3.7	0.0%
649	Riverwash	92.9	1.0%
652	Slikok peat, 0 to 4 percent slopes	245.6	2.5%
653	Slikok peat, 4 to 8 percent slopes	62.1	0.6%
657	Smokey Bay silt loam, 8 to 15 percent slopes	0.8	0.0%
682	Susitna silt loam, 0 to 2 percent slopes	1,270.0	13.1%
683	Susitna silt loam, 4 to 8 percent slopes	162.9	1.7%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
696	Tutka-Kasitsna-Rock outcrop complex, very steep	175.9	1.8%
697	Tutka-Portgraham complex, hilly to steep	766.9	7.9%
701	Typic Cryaquents, 0 to 2 percent slopes	783.2	8.1%
703	Typic Cryorthents, 100 to 150 percent slopes	553.1	5.7%
705	Water, fresh	250.0	2.6%
Subtotals for Soil Survey Area		**9,704.3**	**100.0%**
Totals for Area of Interest		**9,704.3**	**100.0%**


Map 13b — south area
507
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688
688
688
688
688
701
688
688
688
150° 5' 5" W
150° 54' 46" W
59° 49' 31" N
59° 46' 38" N
607400
608200
609000
609800
610600
611400
612200
613000
613800
614600
615400
616200
617000
6634400
6633400
6632400
6631400
6630400
6629400
6628400
Map Scale: 1:26,000 if printed on B landscape (17" x 11") sheet.
N
Meters
0 350 700 1400 2100
Feet
0 1000 2000 4000 6000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 5N WGS84

Map Unit Legend south area

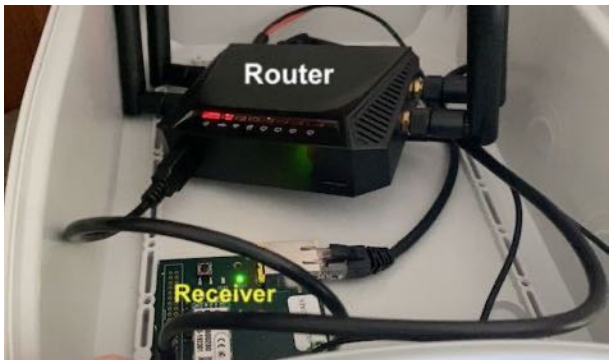
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
506	Beluga silt loam, 0 to 4 percent slopes	78.9	2.1%
507	Beluga silt loam, 4 to 8 percent slopes	35.3	0.9%
510	Beluga-Smokey Bay complex, 4 to 8 percent slopes	18.4	0.5%
573	Kachemak silt loam, 4 to 8 percent slopes	3.3	0.1%
611	Killey and Moose River soils, 0 to 2 percent slopes	18.4	0.5%
656	Smokey Bay silt loam, 0 to 4 percent slopes	4.0	0.1%
657	Smokey Bay silt loam, 8 to 15 percent slopes	12.9	0.3%
673	Spenard peat, 0 to 4 percent slopes	0.0	0.0%
688	Tidal flats	103.9	2.8%
701	Typic Cryaquents, 0 to 2 percent slopes	3,249.6	86.7%
703	Typic Cryorthents, 100 to 150 percent slopes	223.2	6.0%
Totals for Area of Interest		**3,748.0**	**100.0%**

CHAPTER 2: 2021 Grazing Season – testing collar-mounted DtS tracking system

Introduction: As introduced in Chapter 1, in 2021 cattlemen in the Fox River Cattlemen's Association (FRCA) attached two types of collar-mounted GPS tracking units from Smarter Technologies on cattle released onto the Fox River Flats state grazing lease for summer grazing—a "gateway" GPS tracking system described in Chapter 1 and a direct-to-satellite (DtS) system. This chapter discusses the collar-mounted DtS system.

During the grazing season, FRCA releases four herds totaling about 300 cattle on the lease. The 2021 grazing season extended from mid May—when range readiness was collaboratively determined by NRCS and FRCA—through early November, when FRCA removed cattle from the lease.

As noted, Chapter 1 discussed the first type of GPS tracking units—gateway GPS units attached to bright green plastic collars (see photos on right). These units were placed on 16 animals—four cattle from each of the four herds. Gateway units were expected to send GPS cattle locations to an antenna mounted on a remote cabin (top photo below). Inside the cabin, a receiver was wired to both the antenna and a router designed to send GPS data to the internet (bottom photo below). A router diode blew out during initial set up in the cabin; and despite returning to the cabin twice to re-connect the repaired router, FRCA and Homer Soil and Water were unable to get the gateway system operational.



Fortunately, the small, white, direct-to-satellite (DtS) collar-mounted units (from Smarter Technologies) were also tested in 2021. As noted in Chapter 1, because these units were not included in the original order, Smarter Technologies provided and shipped four at no charge. Delay in receiving these units meant that some previously collared cattle needed to be recaptured to add a DtS unit to their collars, and three cattle were recaptured in mid June.

In order to communicate with low-earth orbiting satellites, the DtS units must face skyward. Mark Marette noted that if the DtS units were mounted opposite the heavy, black gateway boxes, they were counterweighted on the collars and always faced the sky. On July 26, Matt Walker at Smarter Technologies activated an online mapping application called "activeherd" so cattlemen could access location data from the DtS units. Two of the units worked well from the time they were activated to the time cattle were taken off the lease and collars were removed. These DtS devices sent GPS coordinates every 12 hours, and each unit provided about 180 locational data points during the grazing season, as shown on maps that follow.

DtS technology such as tested in this project can offer significant benefits to livestock managers. An article titled "Uplink Transmission Probability Functions for LoRa-Based Direct-to-Satellite IoT: A Case Study" explains:

> Direct-to-Satellite IoT [Internet-of-Things] allows devices on the Earth surface to directly reach Low-Earth Orbit (LEO) satellites passing over them… The so-called Direct-to-Satellite IoT (DtS-IoT) paradigm constitutes the holy grail of satellite-based IoT. The core idea is to succeed in connecting resource-constrained devices on ground directly to LEO satellites without relying on intermediate gateways. DtS-IoT is particularly attractive in regions where deploying infrastructure is difficult...[1]

Putting DtS GPS units on livestock on a remote Alaskan rangeland to track animal movements is a good example of "...connecting resource-constrained [IoT] devices on ground...where deploying infrastructure is difficult." The maps on the following pages illustrate GPS data available during 2021 using the DtS GPS units tested by Fox River cattlemen.

For those interested, a brief report supplements 2021 GPS maps: a summary of mostly texted communications among cattlemen and Homer Soil and Water during the 2021 grazing season. These communications illustrate issues discussed and actions taken, particularly related to attempts to make the gateway system operational in the cabin. That document is called "Selected messages with Fox River Cattlemen's Association members."

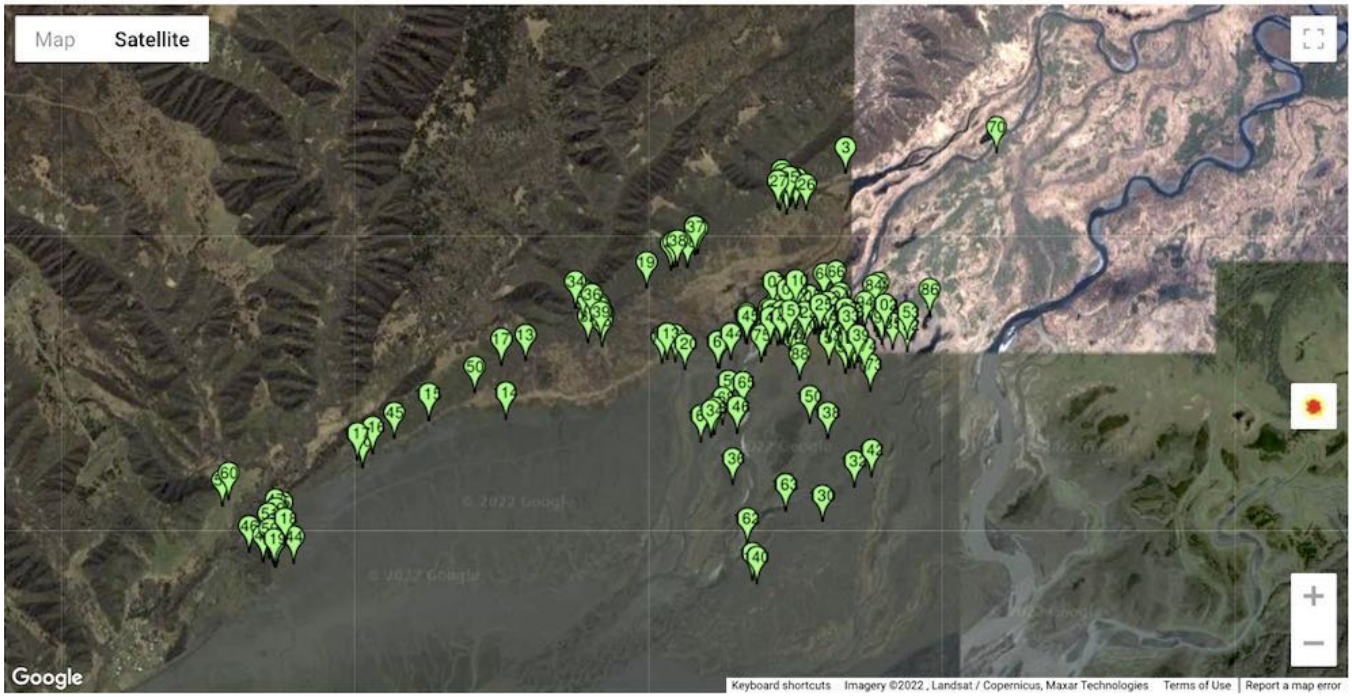
In addition, information about public outreach in 2021 is provided at the end of this chapter, after the map compilation.

Maps and the "activeherd" application: Maps on the following pages show examples of data available from the battery-operated DtS units introduced above. Data displayed below were accessed using an online application from Smarter Technologies called "activeherd." Maps show selected GPS data from July 26 to about October 25 for each of the two cattle whose DtS devices remained operational for much or all of the grazing season. The following pages also describe steps involved in using the activeherd application.

1 Kai Vogelgesang, Juan Andrés Fraire, Holger Hermanns. Uplink Transmission Probability Functions for LoRa-Based Direct-to-Satellite IoT: A Case Study. GLOBECOM 2021 - IEEE Global Communications Conference, Dec 2021, Madrid, Spain. pp.1-6. ffhal-03494140f, accessed at HAL Id: hal-03494140 https://hal.archives-ouvertes.fr/hal-03494140 on February 8, 2022.

Map below: Location data from July 26 to October 25, 2021, for cow wearing DtS GPS tag 0-4347998; this cow was part of the herd that generally remained close to and often west of Fox River.

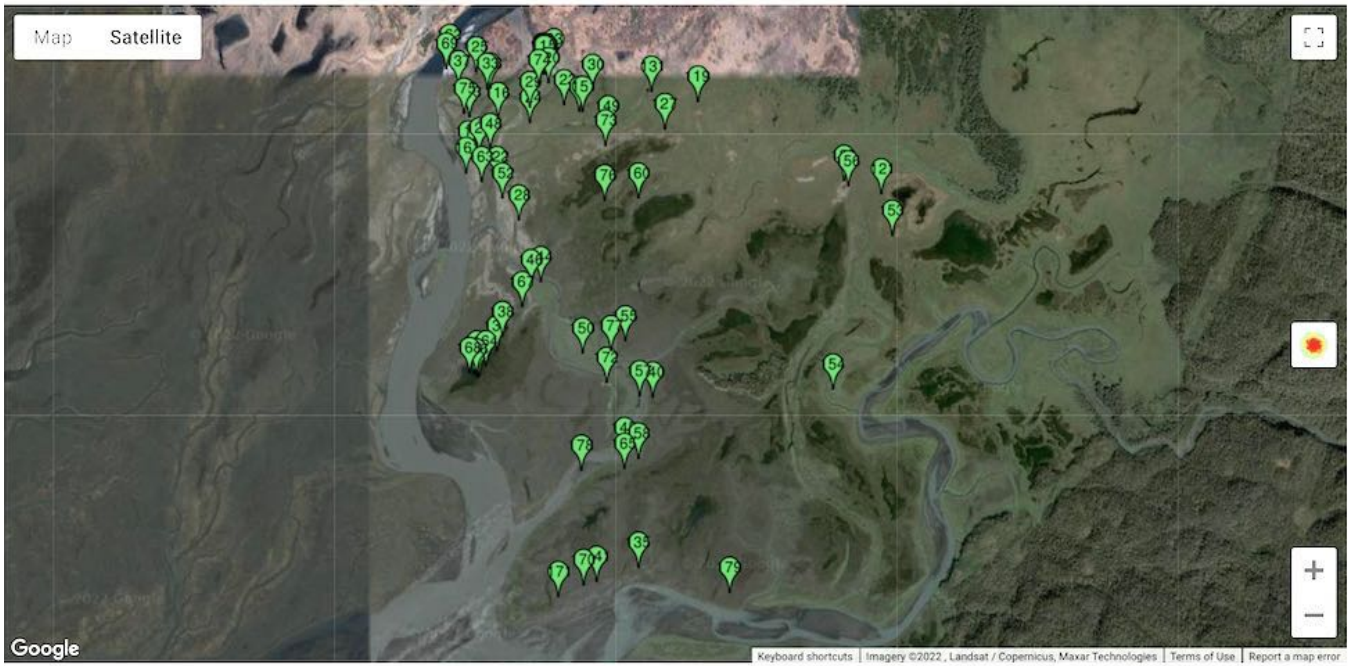
180 locations have been recorded Between 01 June 2021 and 25 October 2021 Change Date Range



Map below: Location data from July 26 to October 25 for cow wearing DtS GPS tag ID: 0-4347104; this cow was part of the herd that generally remained east of Sheep Creek.

Note, in late August, the DtS device shown below was found cracked and hanging under the neck of the collared cow wearing it. The unit was removed and left on a fencepost facing skyward to see if it still worked. As a result, a tight cluster of data points occur in one location from late August onward. These can be seen clearly on the "Heatmap view" discussed later in this report.

179 locations have been recorded Between 26 July 2021 and 26 October 2021 Change Date Range



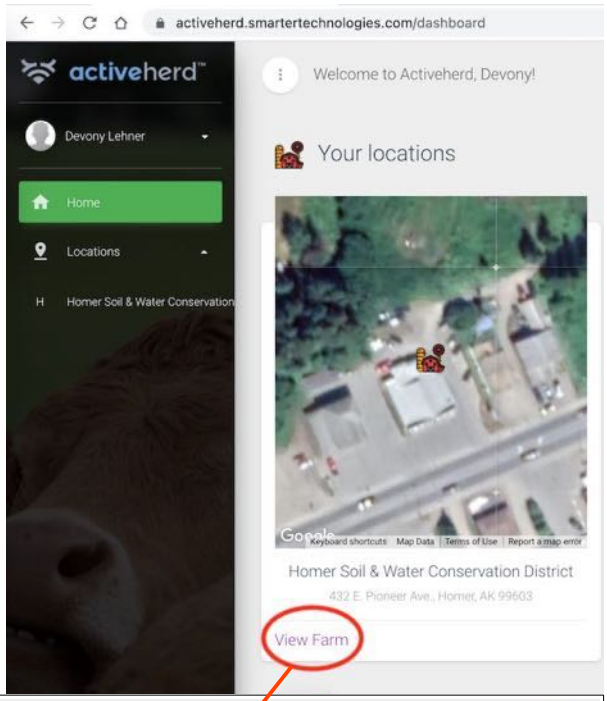
How data were accessed

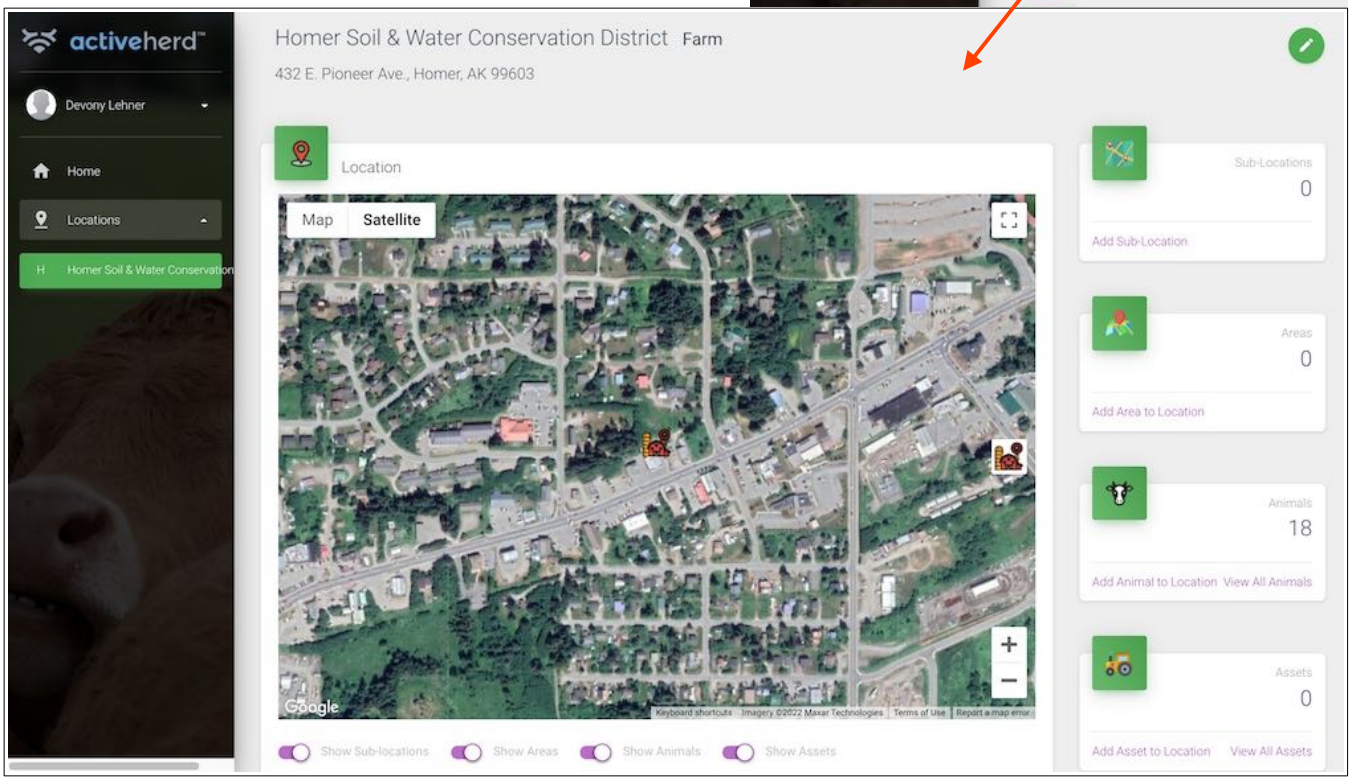
Smarter Technologies uses an application called *activeherd* to access data from the GPS units it provided to the FRCA and Homer Soil and Water. Data from DtS devices became accessible online via activeherd on July 26, and access was provided at no charge to Devony Lehner (Homer Soil and Water) and Hannah Bradley (one of the cattlemen's partners). Accessing activeherd data required a two-step authorization: first, the confirmation of an activeherd login and associated password and, second, entry of a code received through an app called "Okta Verify." Devony made her login information available to the cattlemen if they wanted to access the data directly but they chose not to. Steps to access data are outlined below.

Step 1: At an online search engine, enter activeherd's url: https://activeherd.smartertechnologies.com/dashboard. In this case, the default "farm" location that appears is the Homer Soil and Water office in Homer.

Step 2: Click View Farm (see image at right, area circled in red at bottom left).

Clicking View Farm opens a google map like that shown below. This map can be zoomed in and out and moved around.

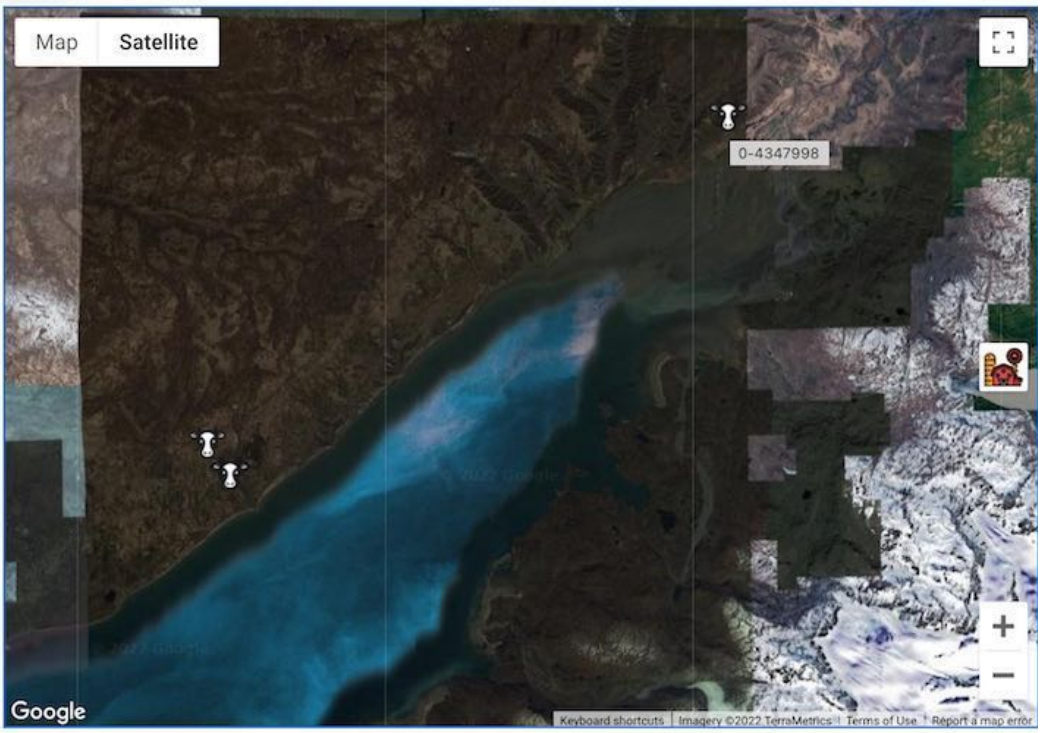




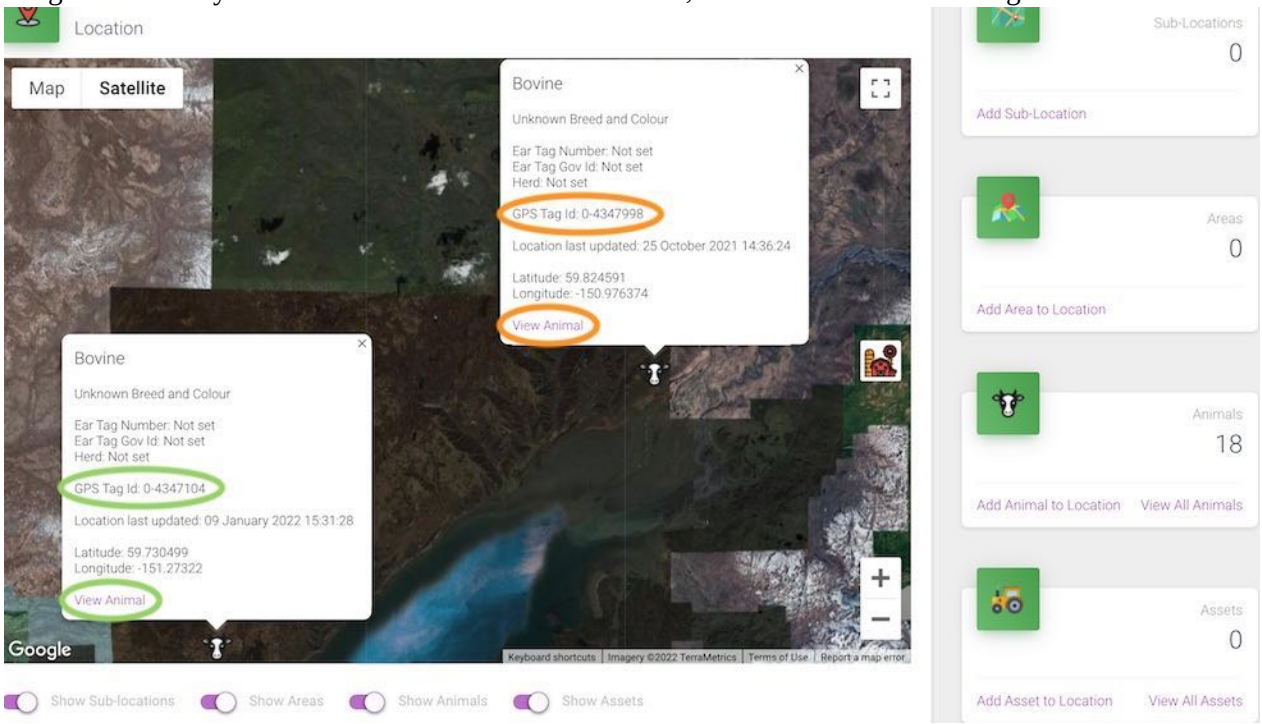
Step 3: Zoom the map in or out until cow heads appear on the map. Three cow heads are shown below, corresponding to last recorded locations of GPS units at the time this map was accessed in early February 2022.

Hovering the cursor over a cow head shows the number of the GPS unit for that cow, as shown below near the upper right of the image.

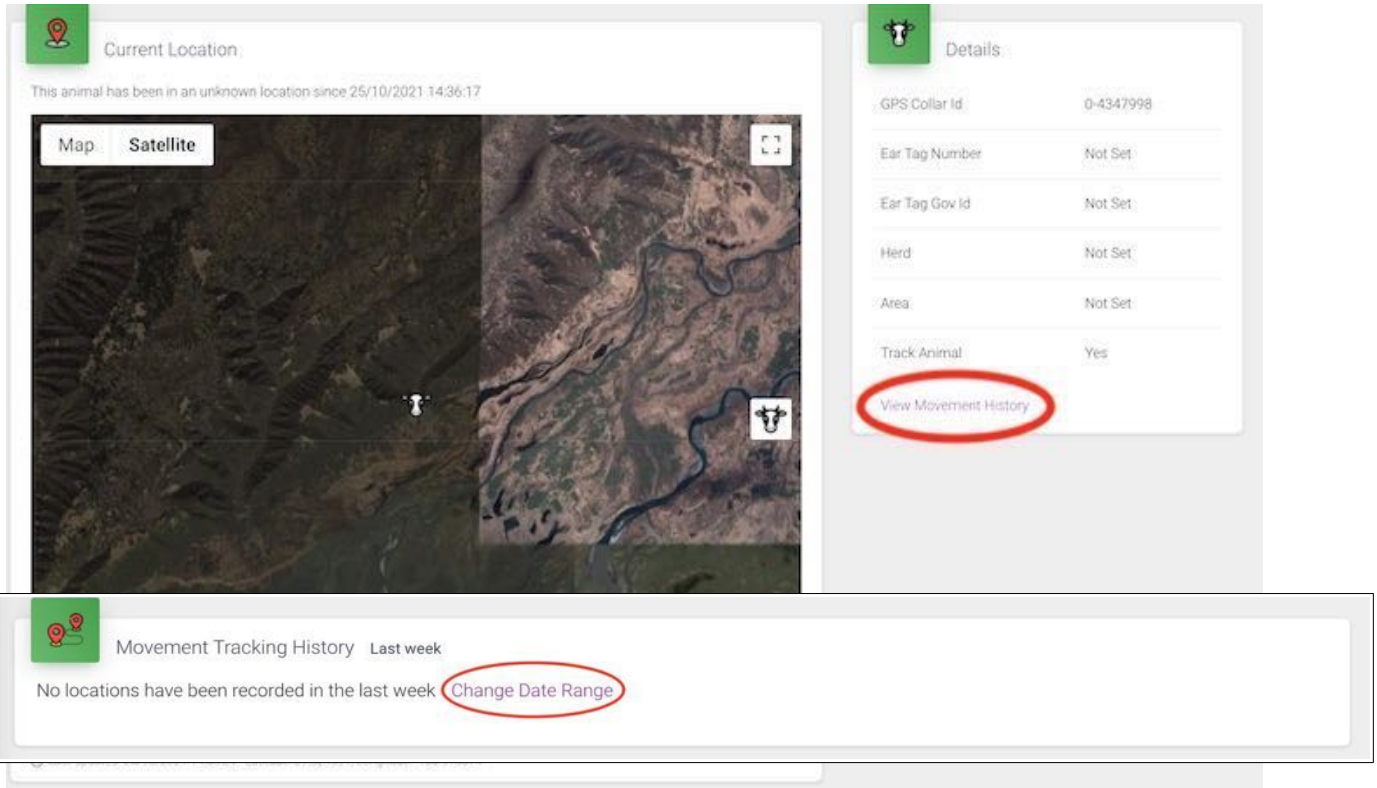
Clicking on the cow head provides additional information. The information in the dialogue box that opens —shown in the top map on the next page— includes the latitude and longitude of the unit's last location reading and the time of that reading. Time data are referenced to GMT (Greenwich Mean Time).



Step 4: Choose the animal whose movements you want to view and click "View Animal," shown circled in the image below. As you can see from the screen that follows, the animal chosen wore tag ID 0-4347998.



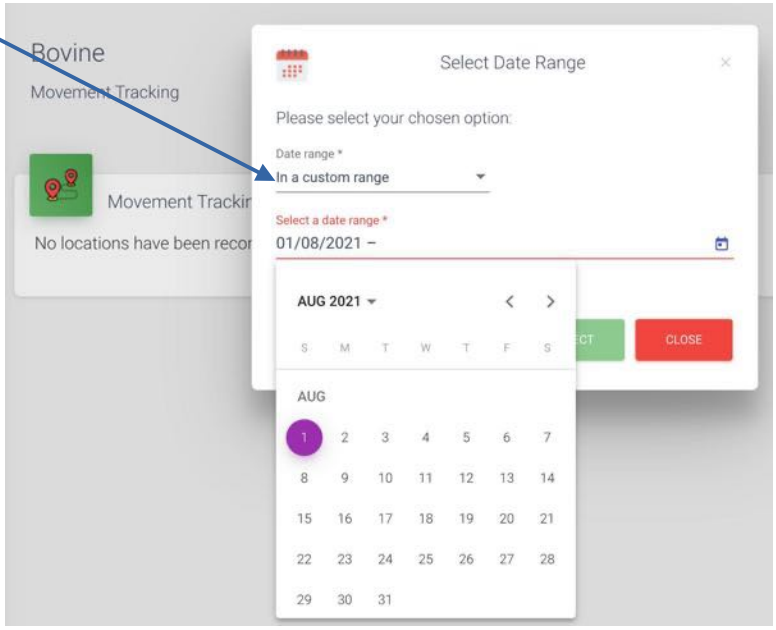
Step 5: Click "View Movement History," shown circled in the right dialogue box on the screenshot below. Note, the screenshot also shows the information that can be set and edited about any cow wearing a GPS unit tracked by activeherd, for example, the ear tag number of the cow and the herd to which it belongs.



Clicking "View Movement History" opened the dialogue box above but no map. The default date range is "Last Week," during which no locations were recorded. To access location data, it is necessary to enter dates in "Change Date Range."

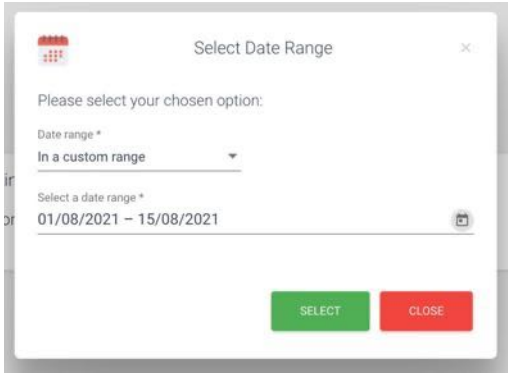
Step 6: Click on Change Date Range and choose a range of interest. Choices in activeherd are: "in the last 24 hours," "in the last 48 hours," "in the last week," "in the last 2 weeks," and "in a custom range."

The screenshot at right shows that a custom date range is being selected. Note that because activeherd is a European product, calendar dates are written in European order (date/month/year) rather than in American order (month/date/year). As a result, we found it less confusing to insert dates using the calendar window than to type in a date in the European order.



The image at right shows that a start date of August 1, 2021, has been selected using the calendar window.

The middle image at right shows that an end date of August 15 has been selected.
(For the average American, the date range shown at right will look strange—it looks like the first date is January 8 and the last date is the 8th day of a 15th month. Using the calendar to set dates will address this sort of confusion.)



Step 7: Click on SELECT to access GPS data for the date range.

Wait a few seconds while the software reports that it's "Loading Movement History," and then a map will appear.

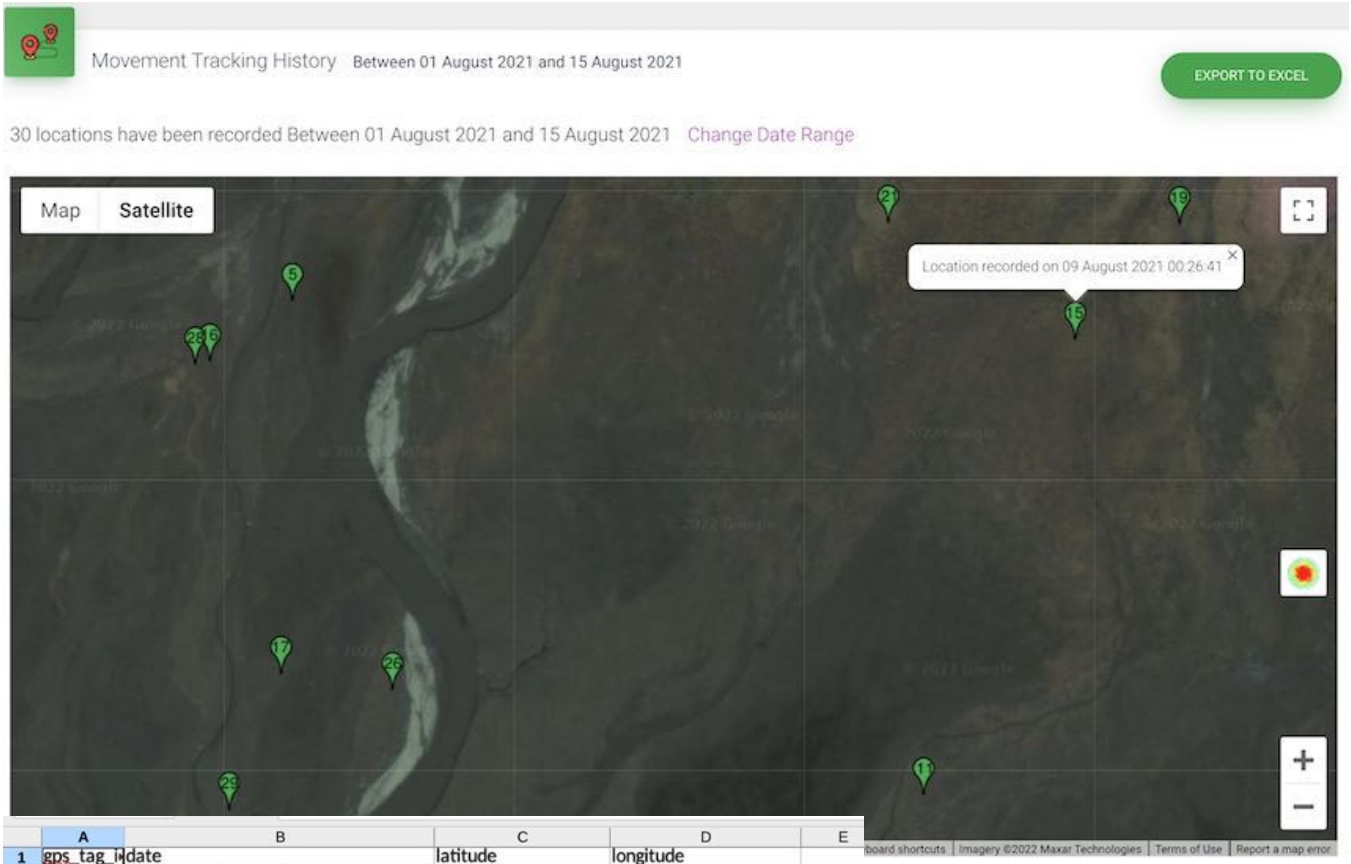
The first map that appears is a "Heatmap view," as seen below. You can toggle to a "Marker view" with the icon on the right, middle of the map.

Clicking on a heatmap point does not provide additional information.

The Marker view is illustrated by the map on the following page and provides access to more information.

Below is a Marker view of the date range from August 1 to 15, 2021, for the cow wearing ID 0-4347998. Note, the map reports that 30 locations were recorded in that period (every 12 hours, or 2 times/day, for 15 days). When the map opened, not all 30 locations were visible, but more became visible by zooming out.

Note, the date range is shown at the top of the map, the Change Date Range button is readily available, and location data for this date range can be exported to an excel spreadsheet by clicking the green button labeled EXPORT TO EXCEL. Excel data from the 30 locations between August 1 and 15 are shown in the table below the map. Clicking on a marker (a green pin) will provide the date and time that location was recorded. The pin that has been clicked near the upper right of the map below shows that that location was recorded on August 9.

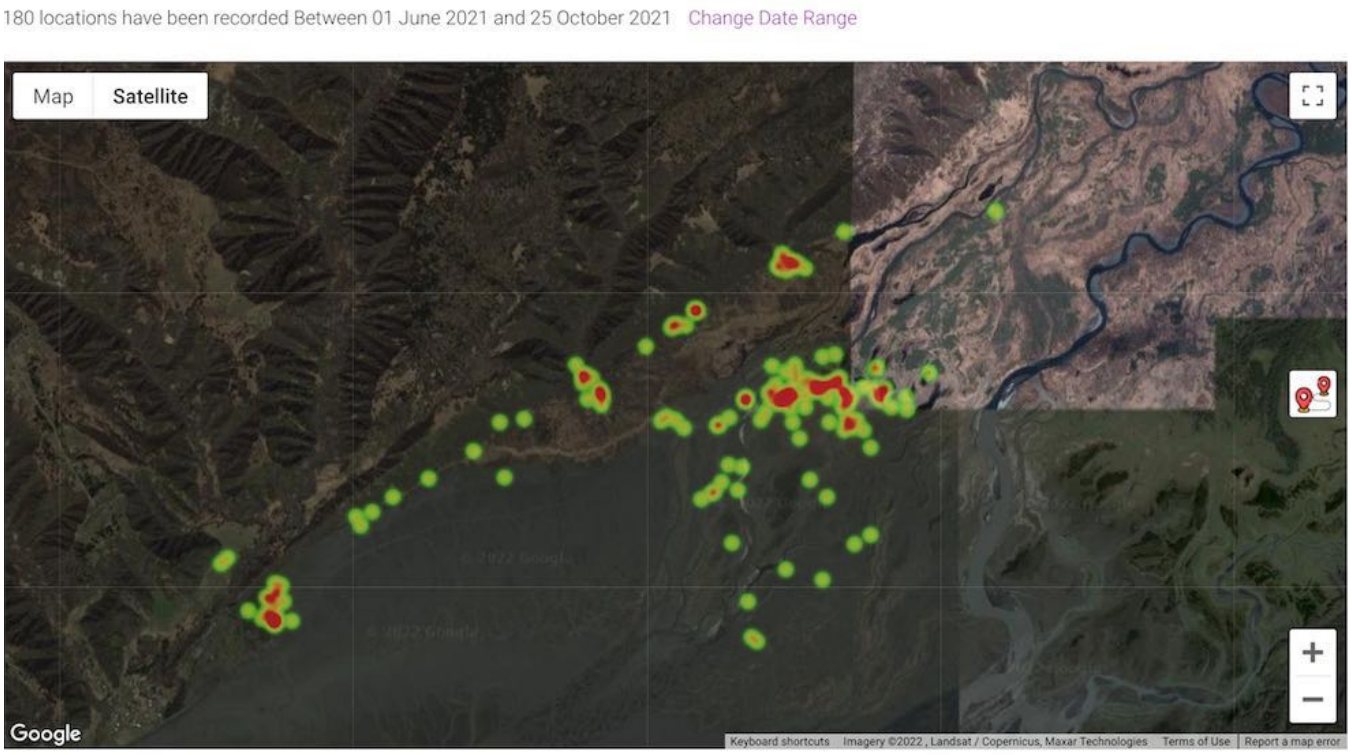


	A	B	C	D	E
1	gps_tag_id	date	latitude	longitude	
2	0-434799	2021-08-15T23:54:25.000Z	59.796535	-150.979722	
3	0-434799	2021-08-15T12:12:29.000Z	59.814838	-150.975602	
4	0-434799	2021-08-15T00:04:34.000Z	59.804571	-150.962684	
5	0-434799	2021-08-14T12:06:37.000Z	59.814645	-150.981374	
6	0-434799	2021-08-14T00:07:29.000Z	59.81339	-150.983799	
7	0-434799	2021-08-13T11:57:36.000Z	59.814677	-150.981374	
8	0-434799	2021-08-12T23:51:28.000Z	59.807929	-150.982704	
9	0-434799	2021-08-12T11:48:35.000Z	59.815128	-150.975988	
10	0-434799	2021-08-11T23:34:28.000Z	59.814624	-150.977705	
11	0-434799	2021-08-11T11:34:27.000Z	59.814656	-150.976095	
12	0-434799	2021-08-10T23:27:27.000Z	59.80868	-150.971847	
13	0-434799	2021-08-10T11:28:27.000Z	59.815096	-150.975001	
14	0-434799	2021-08-09T23:27:36.000Z	59.81398	-150.957298	
15	0-434799	2021-08-09T11:33:36.000Z	59.814956	-150.957341	
16	0-434799	2021-08-08T23:26:41.000Z	59.813025	-150.968971	
17	0-434799	2021-08-08T11:18:36.000Z	59.812821	-150.985365	
18	0-434799	2021-08-07T23:14:36.000Z	59.809839	-150.984013	
19	0-434799	2021-08-07T11:21:46.000Z	59.814699	-150.981481	
20	0-434799	2021-08-06T23:18:53.000Z	59.814119	-150.966997	
21	0-434799	2021-08-06T11:27:54.000Z	59.814795	-150.975752	
22	0-434799	2021-08-05T23:35:55.000Z	59.81413	-150.972512	
23	0-434799	2021-08-05T11:37:55.000Z	59.815664	-150.96998	
24	0-434799	2021-08-04T23:43:00.000Z	59.799539	-150.981116	
25	0-434799	2021-08-04T11:45:58.000Z	59.801985	-150.975494	
26	0-434799	2021-08-03T23:35:54.000Z	59.796857	-150.980558	
27	0-434799	2021-08-03T11:38:56.000Z	59.809688	-150.98191	
28	0-434799	2021-08-02T23:29:56.000Z	59.807231	-150.988133	
29	0-434799	2021-08-02T11:23:56.000Z	59.812789	-150.985644	
30	0-434799	2021-08-01T23:23:59.000Z	59.80854	-150.985	
31	0-434799	2021-08-01T11:15:59.000Z	59.814838	-150.976074	
32					

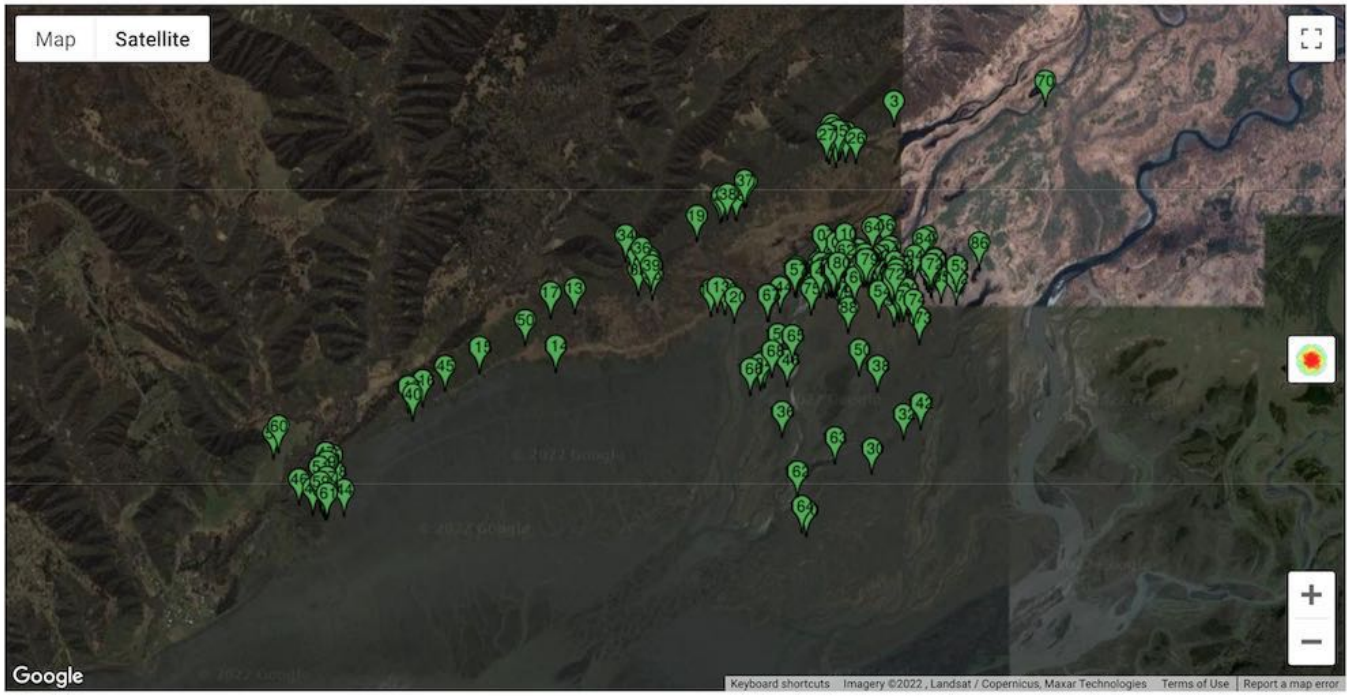
The maps that follow provide a few examples of information available through activeherd.

Three months of data recorded every 12 hours for just two cows provides a lot of information to analyze and a lot of food for thought. The goal of this project was to test GPS devices, but analysis of locational data received—particularly in relationship to mapped plant communities and other geospatial features—is the next logical step.

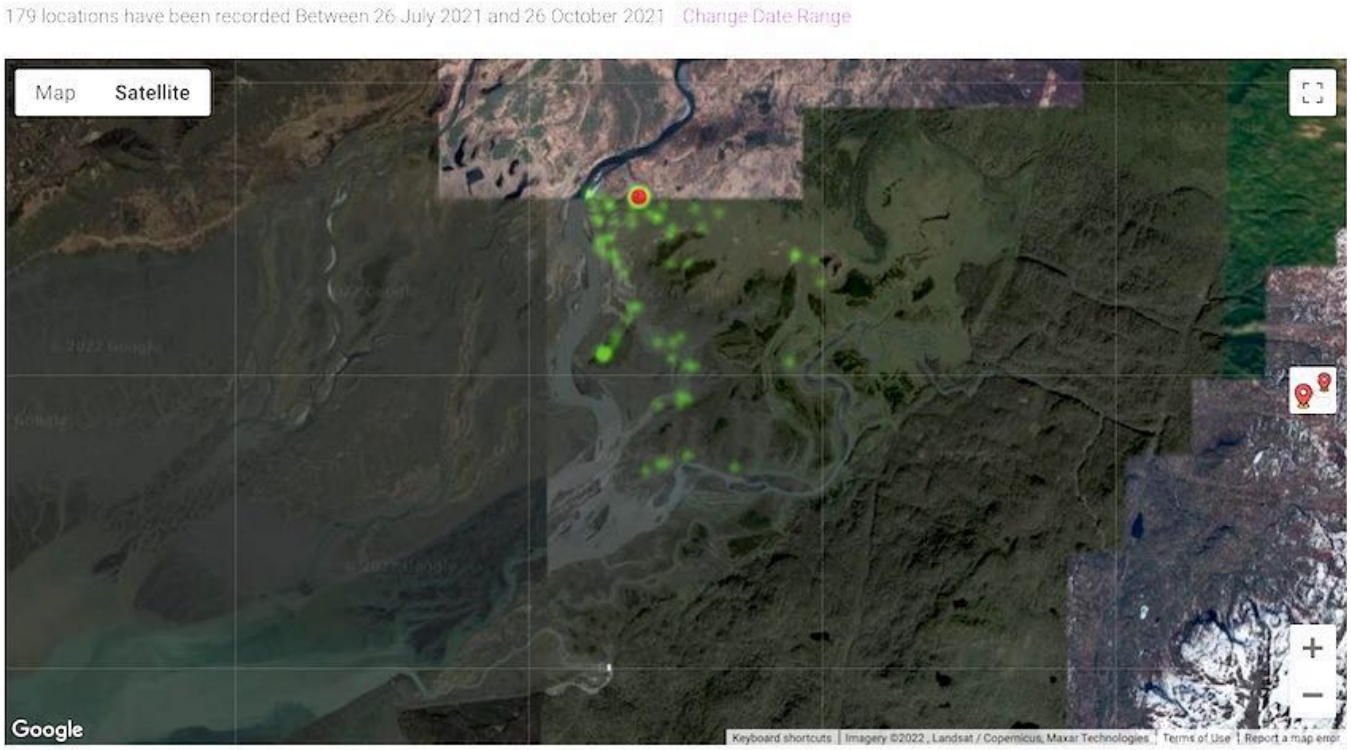
Heatmap view for July 26 through October 25 for cow wearing GPS tag ID 0-4347998. Larger red heatmap clusters show locations reflecting more DtS data points—namely, locations where the cow spent more time.



Marker view for the same period and same cow as map above: July 26-October 25



Although the Marker view allows retrieval of more information by clicking on the green pins, the Heatmap view can be useful in seeing clearly where a cow's locations are concentrated. As mentioned earlier, the DtS device for GPS tag ID: 0-4347104 was found cracked and hanging under the neck of the cow in late August. The unit was removed and left on a fencepost facing skyward to see if it still worked. The tight cluster of data points is easier to see using Heatmap view—where the bright red dot shows the cluster—than using Marker view—where data points become stacked on top of one another, making the lower data points invisible. (In Marker view, the most recent pin within a specified date range will have the lowest number.)



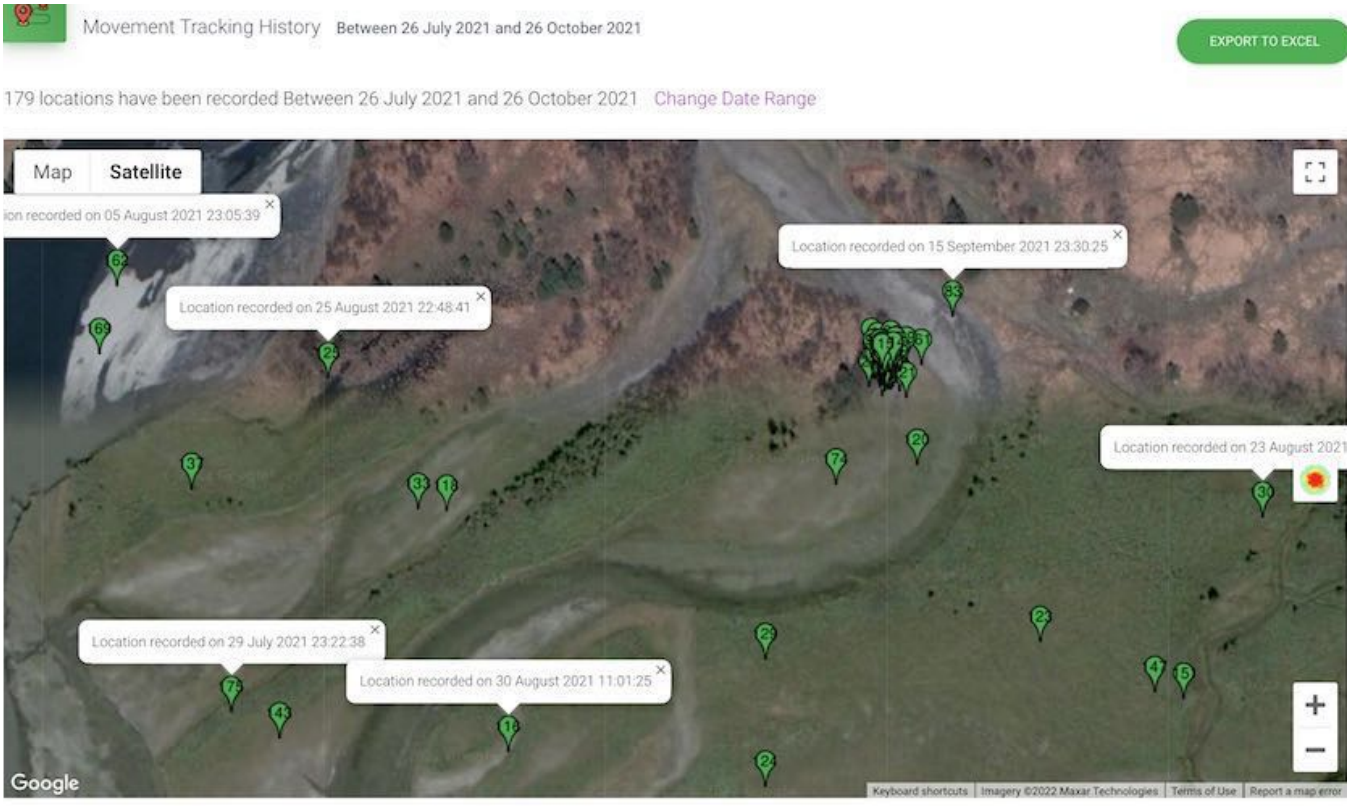
In comparison to the Heat-map view above, note how difficult the data cluster is to distinguish using the Marker view map at right.

Finally, the variability of satellite location data from a DtS device is suggested by the spatial extent of the cluster of locations from the fencepost.

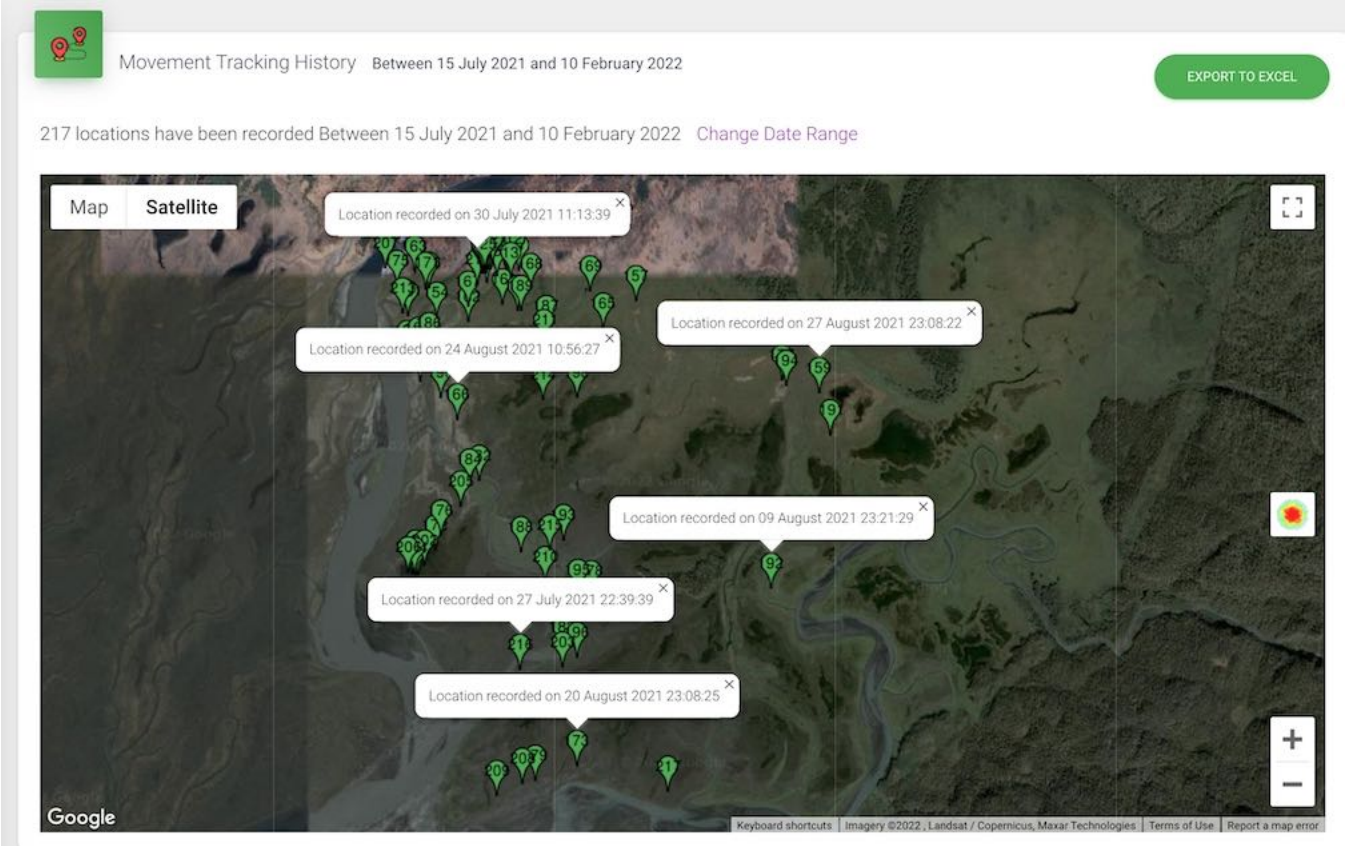
On the two maps on the following page, the fencepost data points are clustered, but some location variability is observable although all green pins reflect the same location—namely, the fencepost. It would be interesting to know the width of the fencepost data cluster and the various causes of data variability—such as weather conditions or satellite track.

The first map below is a zoomed-in view of the fencepost cluster as shown with Marker view. The second map shows dates of different locations where the cow was recorded while the DtS on its collar was still transmitting the animal's movements.

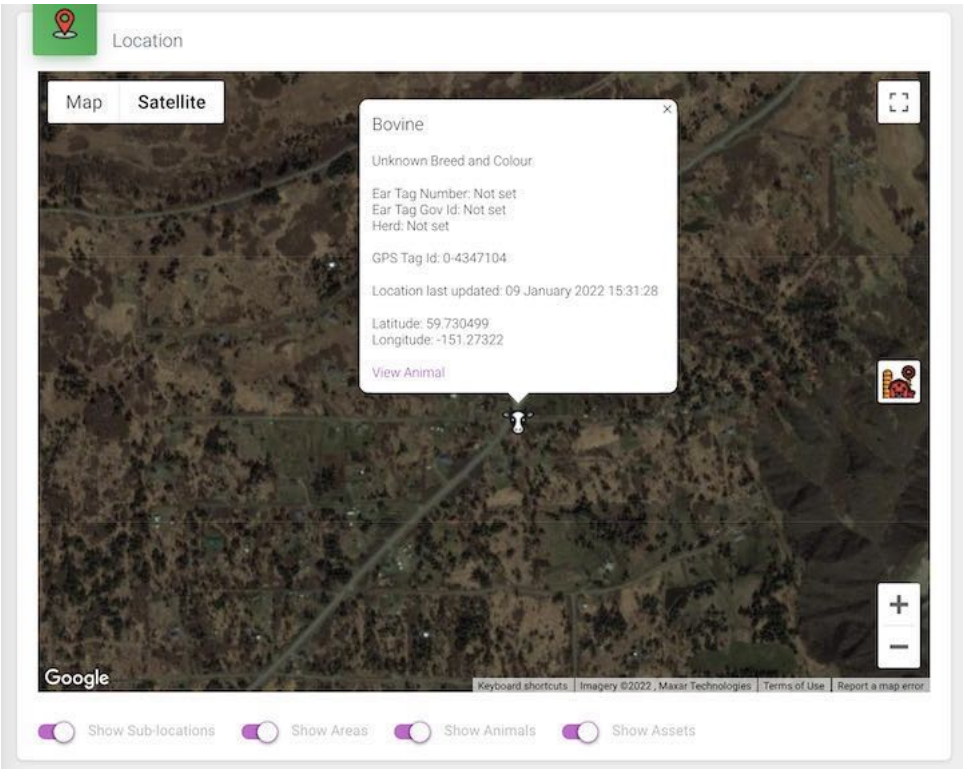
Below is a Marker view showing dates of different locations obtained by clicking on the green pins. The fencepost cluster is visible center-right of the image.



The map below shows selected dates from the dataset collected for cow wearing GPS tag ID: 0-4347104. Note that this DtS device also relayed data after it was relocated to a ranch near town—see image below.



The image below shows the same collar at its winter location on East End Road. The collar is not on a cow, but clicking on “View Animal” opens the dataset for this collar for the entire season—as illustrated in maps above.



Public outreach during the 2021 grazing season – radio interviews:

In late October and early November 2021, all four Fox River Cattlemen were interviewed on Homer radio station KBBI about grazing activities in the Fox River Flats.

Links below correspond to audio recordings of the KBBI interviews described below:

Part 1: https://www.kbbi.org/show/homer-grown/2021-10-27/fox-river-cattlemen-part-1
Part 2: https://www.kbbi.org/show/homer-grown/2021-11-10/fox-river-cattlemen-2
Part 3: https://www.kbbi.org/show/homer-grown/2021-11-22/fox-river-cattlemen-part-3

Fox River Cattlemen: Part 3

Desiree Hagen, November 22, 2021

For the final episode of Homer Grown's 2nd season, we interview the last member of the Fox River Cattlemen's Association, Mark Marette.

▶ LISTEN • 59:45

Fox River Cattlemen: Part 2

Desiree Hagen, November 10, 2021

Our second installment of Homer Grown's series on the Fox River Cattlemen features Otto Kilcher and Akaky Martushev. They discuss some of the challenges with raising cattle at the head of Kachemak Bay, "supernatural" qualities of cows and the pseudoscience of why ravens chase hawks. We had a long list of cattle-themed sequel names. The title of this episode is a reference to the 1984 movie Breakin'2: Electric Boogaloo. The Wikipedia entry for Breakin' 2 noted: 'the subtitle "Electric Boogaloo"... has entered the popular culture lexicon as a snowclone nickname to denote an archetypal sequel. '

▶ LISTEN • 57:07

Fox River Cattlemen: Part 1

Desiree Hagen, October 27, 2021

For this episode we interview Chris Rainwater for part one of a two part episode featuring the four members of the Fox River Cattlemen's Association. Chris about homesteading at the head of the bay (the land he refers to as "where god lost her shoes"), a history of the Cattlemen's Association, and some of the current struggles facing the cattlemen.

▶ LISTEN • 58:57

Public outreach during the 2021 grazing season – national TV coverage of GPS tagging project:

Cattleman Otto Kilcher and his son August were among characters featured on a reality TV show that aired for 11 years on the Discovery channel: *Alaska, the Last Frontier*. (Cattleman Mark Marette also appeared in some episodes.) Interest in this GPS project from the show's producers led to filming of project activities during the 2021 grazing season. Horseback travel across Fox River and Sheep Creek, collaring cattle, and setting up the gateway GPS system (described in Chapter 1) were filmed by Discovery on July 16, 2021. (Devony Lehner also filmed activities that day.) Segments from Discovery's footage began streaming October 2022 when Season 11 aired (the final season). A cattle GPS storyline was included in three episodes; the storyline credited August with the idea of using GPS collars to make it easier and safer for Otto, his father, to locate his cows. Season 11 episodes mentioning GPS collars were: Episode 2: *An Uncertain Recovery*, Episode 3: *Paying it Forward*, and the recap that opened Episode 5: *August's Choice*.

Three screenshots from the recap opening Episode 5 are shown here. The individual talking is August, and his comments are shown in the closed captions.

CHAPTER 3: 2022 Grazing Season – testing the Ceres GPS ear tag

During the 2022 grazing season, a third GPS tracking system was tested by the Fox River Cattlemen's Association (FRCA)—direct-to-satellite (DtS) Ceres ear tags acquired from Australia. As mentioned in Chapter 1, Ceres tags first became available to order in early summer 2021. In order to be able to test them in 2022, Homer Soil and Water and FRCA requested a 1-year, no-additional-funding extension of this CIG project, which was approved. A box of 24 Ceres tags was ordered in summer 2021, after cattle were out on the lease. Costs were as follows: 1 box of 24 Ceres tags = $3600, 1 applicator = $500 for attaching tags, shipping = $181, total AUD = $4281; US ~ $3300. (See Chapters 1 and 2 for GPS units tested during the 2021 grazing season.)

Distribution of Ceres ear tags

By May 2, 2022, each Fox River cattleman had received six Ceres DtS GPS ear tags. At a May 2, 2022, FRCA meeting at cattleman Mark Marette's operation on East End Road, each cattleman also received a printed table developed by Homer SWCD listing the unique numbers identifying the six tags distributed to each cattleman. The photo at right shows two of the six tags distributed to Otto Kilcher. The last four numbers on the bottom of the unit, below the solar panel, are most useful in identifying individual tags.

During this meeting, cattlemen reviewed written instructions that were included in the box with the 24 ear tags; these instructions are shown on the following page. As cattlemen discovered, these instructions were unclear about two key actions: first, being sure to charge tags before attaching them on an ear and, second, being sure tags were properly activated at the time of attachment.

Attachment of Ceres ear tags on livestock

As illustrated on pages 3 and 4, during the first week of May each cattleman began installing ear tags on six of his cattle. Each tag has a built-in solar panel that must be charged by sufficient exposure to sunlight before tags are inserted in an ear. In addition, it's critical to understand how to activate, and to check activation, during installation. The photo below left shows tags being charged in the sun once the importance of charging was learned.

Cattlemen learned from one another's experiences as each went through the process of charging, inserting, and activating Ceres ear tags. Cattleman Akaky Martushev at his ranch at the head of Kachemak Bay was the first to attach ear tags, and some of his tags were not properly activated during installation. He then spent considerable time online viewing instructional videos to find and review information needed to correctly charge and activate his tags, and he then shared this information to both Homer Soil and Water and the other cattlemen. Otto Kilcher tagged his cattle second; he then went to Mark Marette's ranch to show him how to avoid the mistakes he'd made. Chris Rainwater watched ear tags being put on cattle at Mark Marette's. Akaky Martushev ended up re-gathering and penning his tagged cows on May 15-16 so that he could make sure he had activated all ear tags. At most, 21 of the 24 ear tags operated during some or all of the 2022 grazing season. Some tags were still operational in 2023.

Instructions included in box of Ceres ear tags from Australia.

CERES
TAG

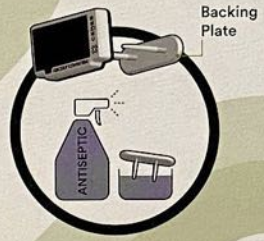
SMART APPLICATOR

Notice: Applicator pack includes a practice tag to enable applicator loading practice (steps 1 and 2 only).

1. Ceres Tag Smart Applicator: Ensure rubbers on both sides of applicator are firmly in place and adjust hand grip to ensure comfortable grip for the user.

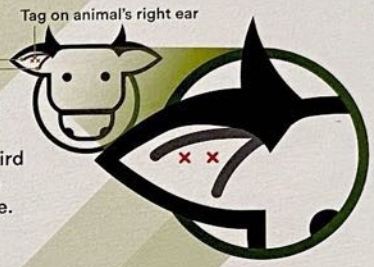
2. Slide the electronic tag (female) into the larger side of the applicator, ensuring the LED light can be seen flashing.

3. Dip or spray the backing plate (male) pins with sterilizing solution
   - Use antiseptic solution at recommended dilution. Failure to do so may cause irritation.

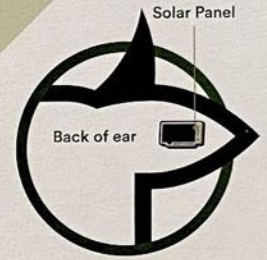


4. Slide backing plate into rubber in the applicator, ensuring the pins face towards the electronic side of the tag.
   - Ceres Tag Smart Applicator must be used when applying the tag.

5. On the right ear, locate the correct position to insert the tag. Inside third of the ear and between the two visible cartilage.



6. Once the correct position is located, pierce the ear making sure the solar panel is on the outside of the ear and the backing plate (male) is visible inside of the ear.



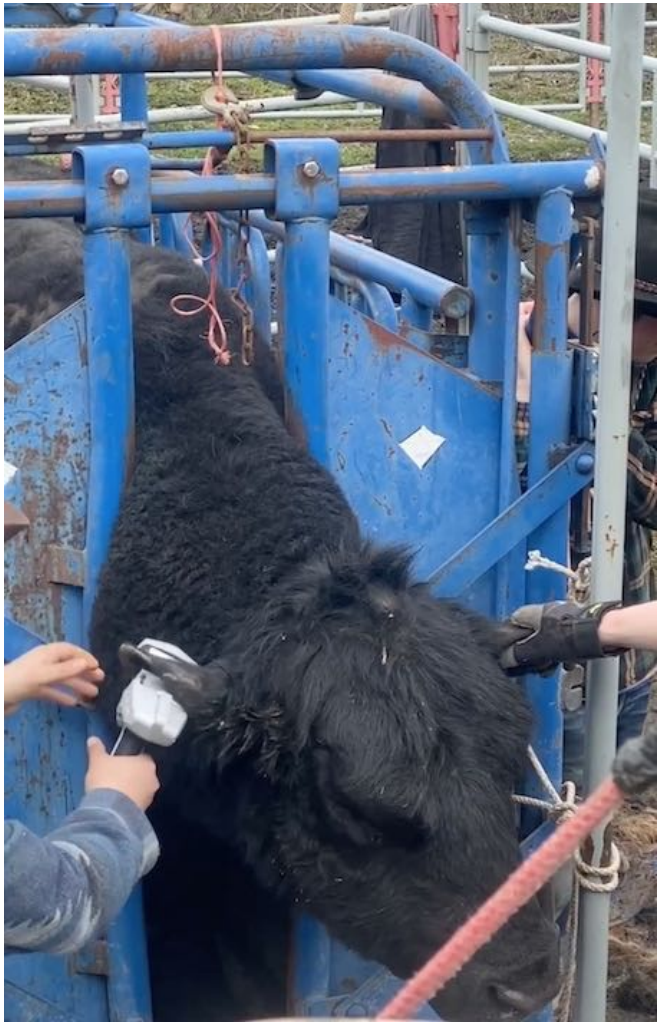
7. To release the Ceres Tag from the Applicator. Pull the Ceres Tag Smart Applicator straight down and away from the ear in one single motion. Do not release the applicator handles during this step.

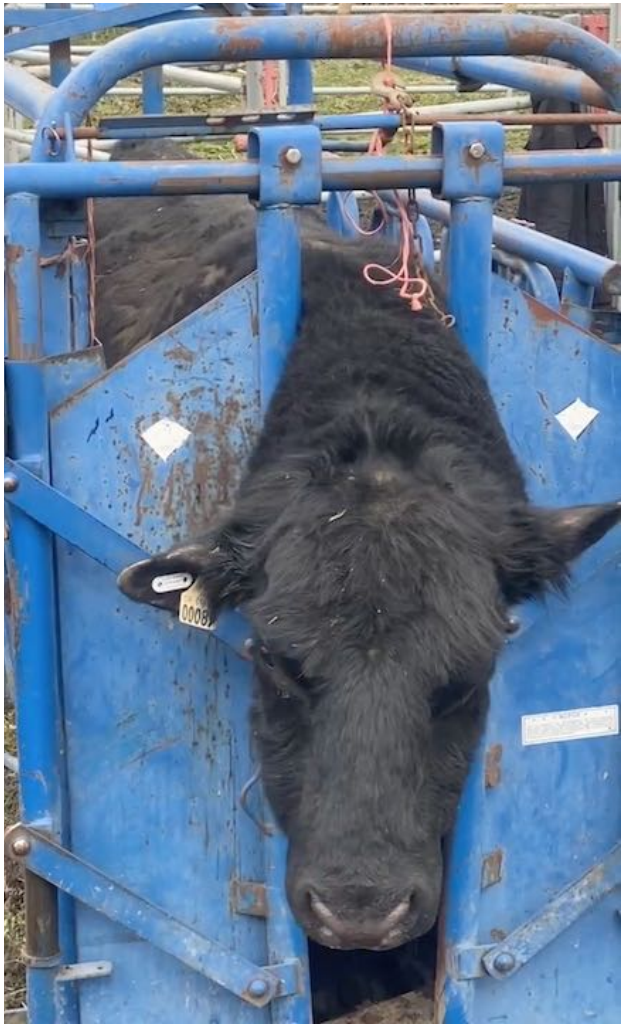
8. Congratulations your Ceres Tag is now applied and active. For details regarding software visualization please log in to your farm software.

Precautions

Do not use existing ear tag holes. Application of the Ceres Tag in these existing holes could lead to damaging of the ear.	Ceres Tags pins are sharp. Please exercise caution when handling.	Ceres Tag Smart Applicator is designed only for the use for the application of the Ceres Tag. It will not insert single pin button tags.	The Ceres Tag is a smart tag and requires the Ceres Tag Smart Applicator. The tag cannot be inserted via other means.	Please see the Ceres Tag Smart Applicator box notes for servicing

Cattleman Akaky Martushev attaching a Ceres direct-to-satellite GPS ear tag on one of his cattle, May 3, 2022. The tag is placed in an applicator/activator, as shown in instructions on page 2; the blinking pattern on the applicator changes when a tag has been properly activated. The operational portion of the tag rests against the backside of the ear, so that the solar panel will tend to point skyward.

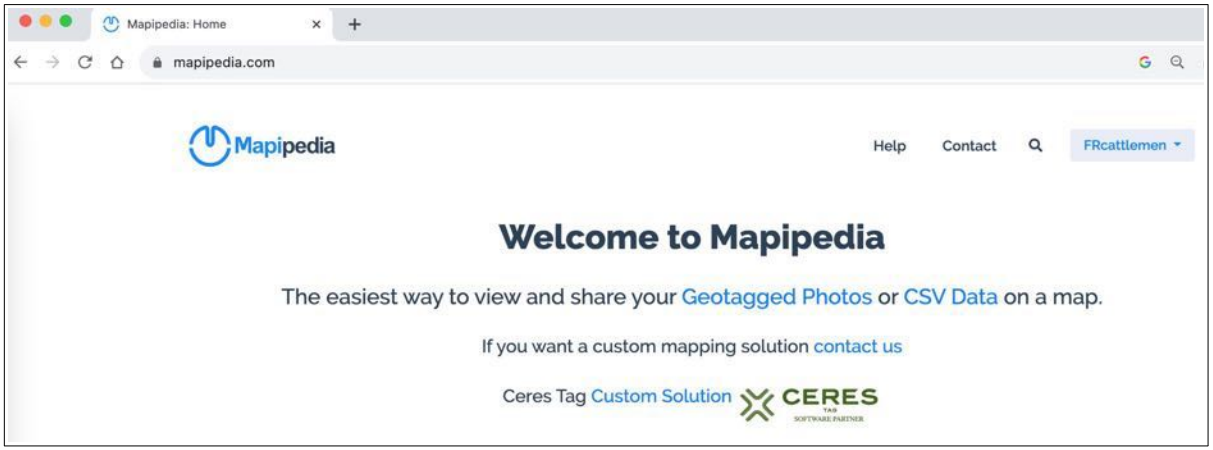


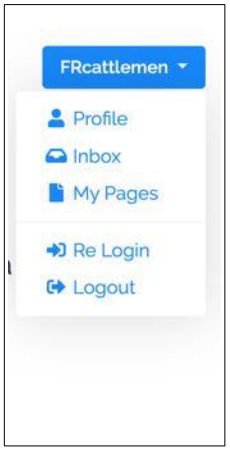


Cattleman Otto Kilcher attaching Ceres direct-to-satellite GPS ear tags on three of his cattle, May 5, 2022; his son August is helping.
The tag is placed in an applicator/activator, as shown in instructions on page 2. Photo on right shows the solar panel on the operational unit of the tag.
Photo at bottom of page shows an operational unit and the 2-pin backing plate.

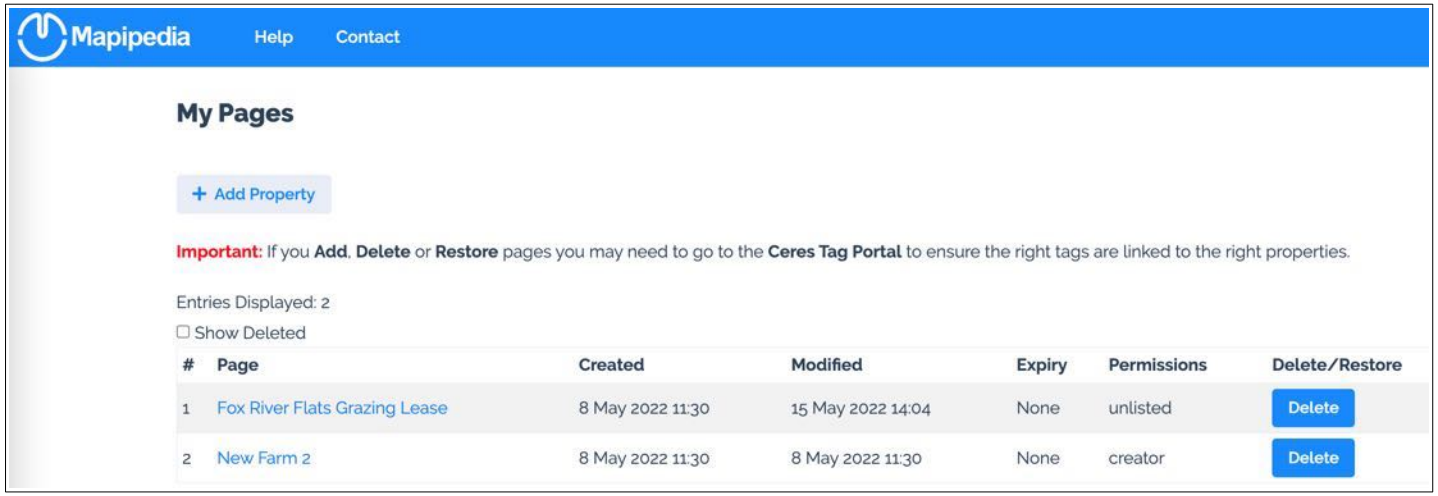
Mapipedia online mapping application to receive and track GPS location data from Ceres ear tags

Once cattlemen attached ear tags, Homer Soil and Water worked with David Philpot at Mapipedia in Australia to make sure tags were activated and reporting GPS locations online. Mapipedia is the Australian online mapping app selected by FRCA to track and record Ceres ear tag locations. David Philpot from Mapipedia assisted Devony Lehner in creating a Mapipedia login for the tags used by the cattlemen. Online instructions for using Mapipedia can be found at https://www.youtube.com/watch?v=xGzeABLWkQI. Once a Mapipedia account was set up and validated, going online to mapipedia.com opened the screen shown below left, and clicking on the FRcattlemen tab opened the dropdown menu shown below right.

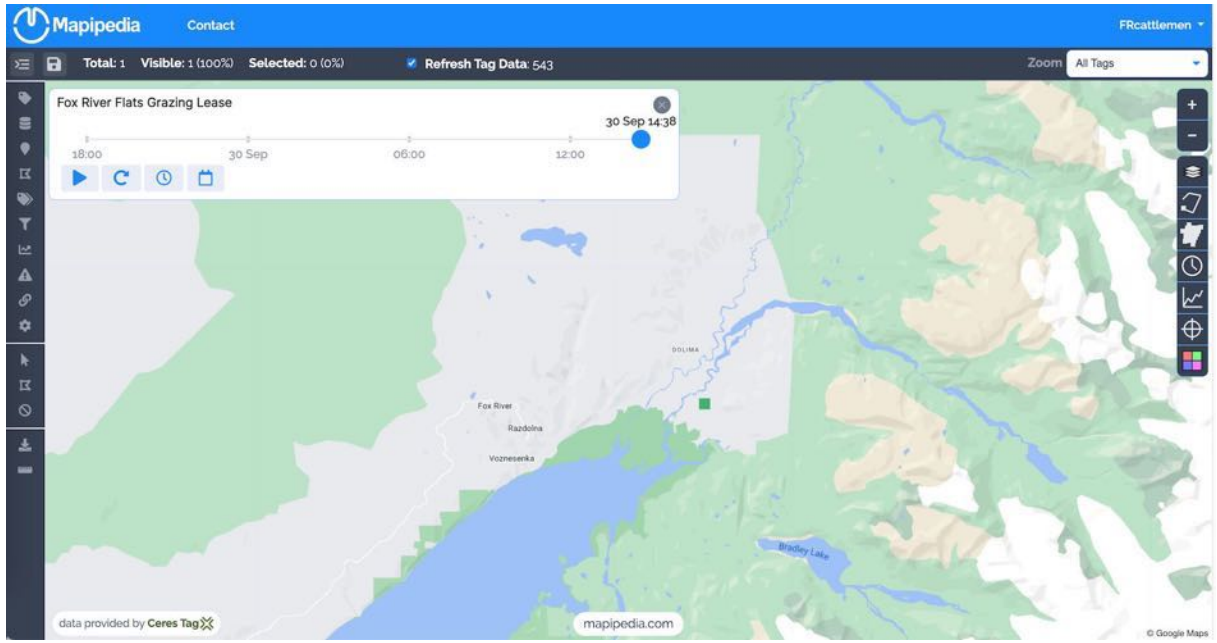


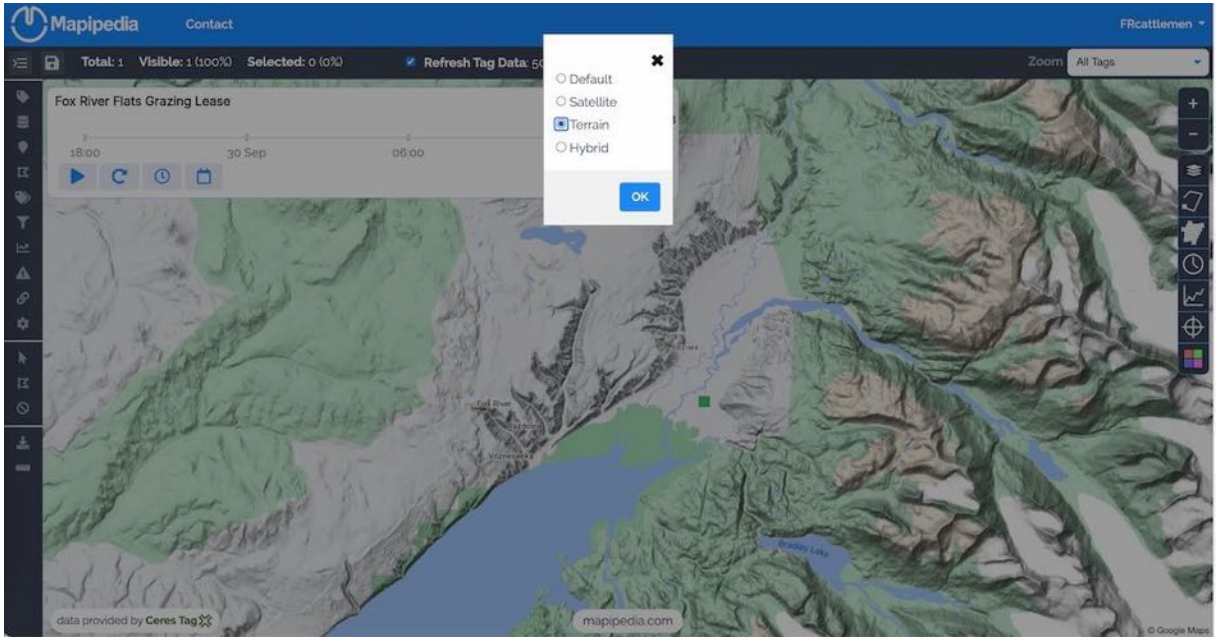


Clicking on My Pages in the dropdown menu opened the menu shown below, and clicking on Fox River Flats Grazing Lease opened the default interactive Mapipedia map shown on the following page. Each cattleman was added to a list of users authorized through Mapipedia to access Ceres tag data, and only authorized users could access mapped data. Once authorized, users did not need to provide a password to access the map, which was a significant convenience. The four FRCA cattlemen received authorizations; in addition, two family members of FRCA cattlemen were also authorized so that they could assist in accessing online digital data. Akaky Martushev accessed Mapipedia data frequently and actively, and he was able to do so using only his smartphone. Even though other cattlemen accessed the data less frequently, generally on their computers, all became familiar with what data were available.

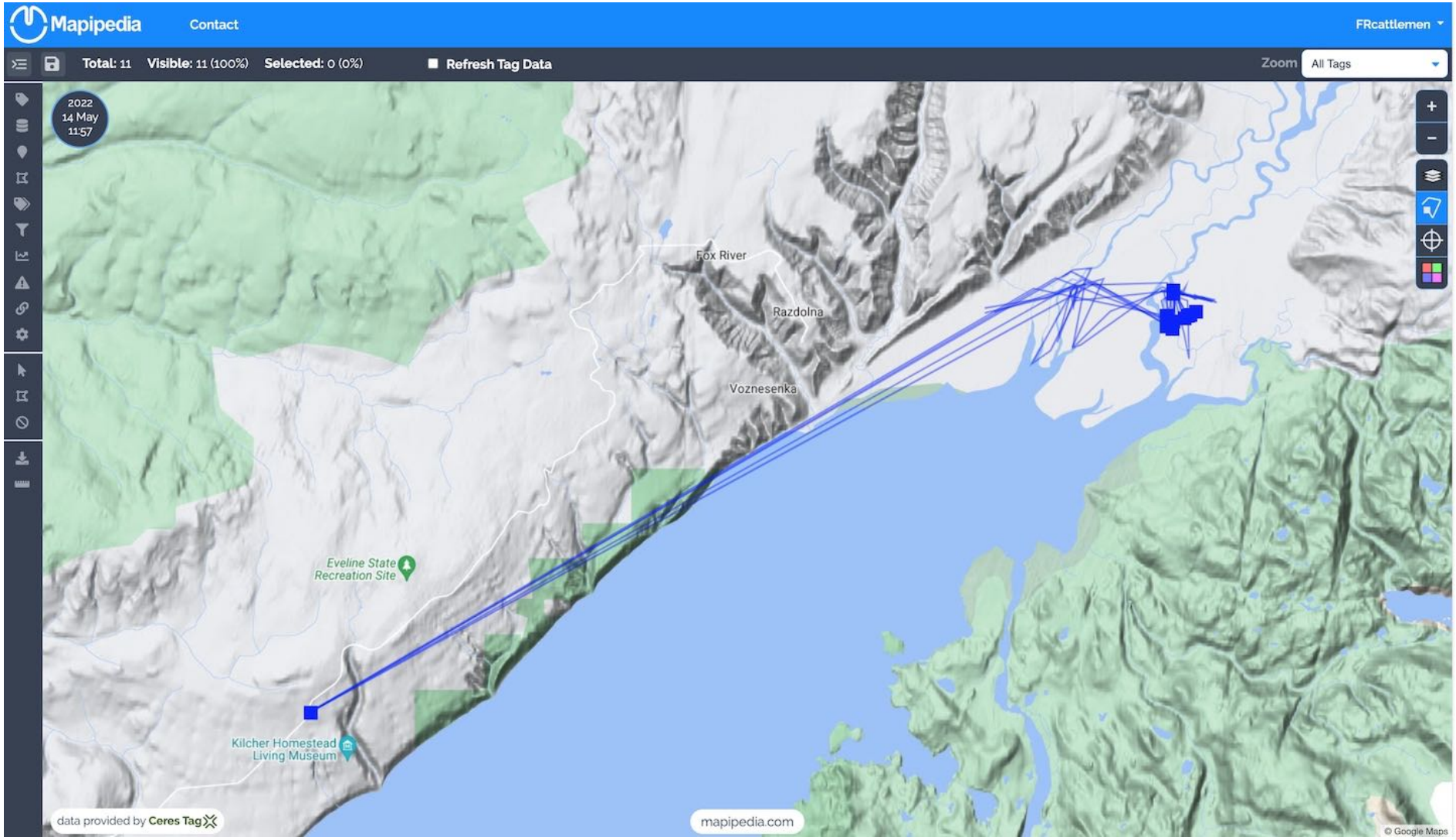


The top left map is the default map opened by using the steps outlined above. Alternative backgrounds can be chosen, and the bottom right map shows the Terrain background. A variety of tools are available via icons shown on screenshots below. The following pages provide a number of maps created to display GPS data from the 2022 grazing season.

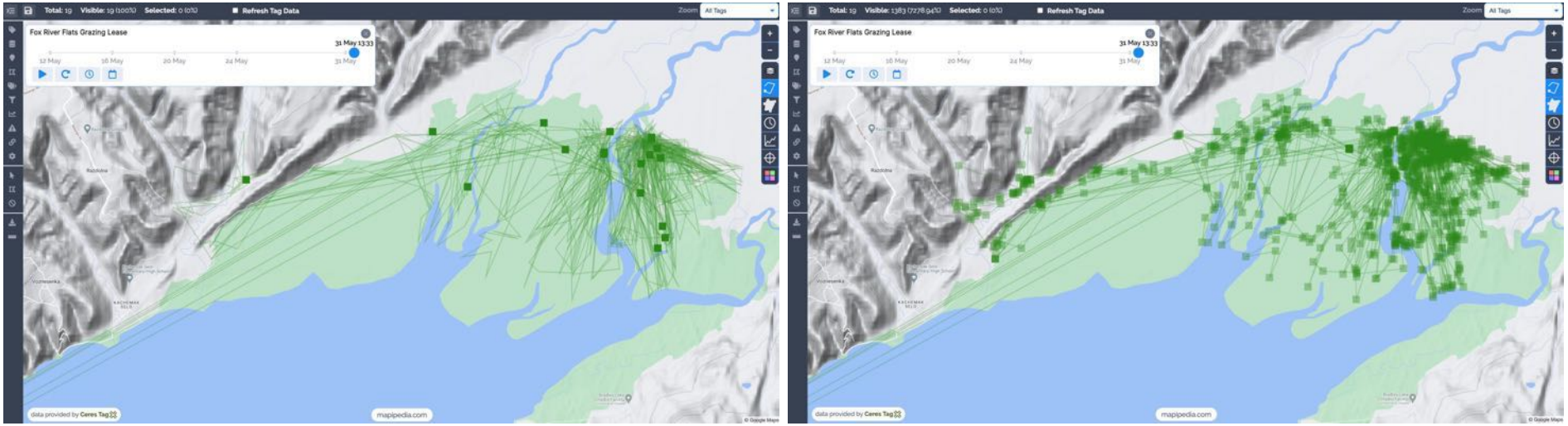




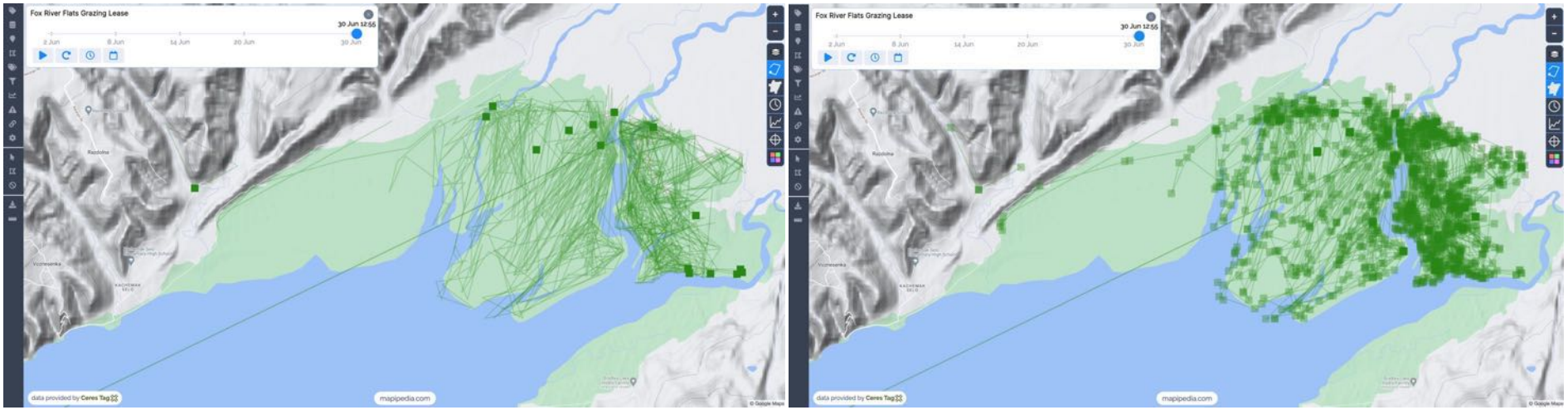
The map below shows locations of Ceres tags from initial activation in early May through May 14. The “track” tool is turned on (highlighted in blue on the right of the screen), so cattle can be tracked moving from ranches on East End Road out to the grazing lease at the head of Kachemak Bay. This period shows cattle from both Marette’s and Kilcher’s herds, which generally graze east of Sheep Creek, as seen here. Shortly after this (May 15-16), Martushev re-gathered his cows to re-activate his tags. His herd occupies the west side of the valley, on the near side of Fox River. The Rainwater herd tends to stay between Fox River and Sheep Creek, the two major rivers shown on the map. The following maps show tag locations month by month for all tags operating.



Ceres tag locations in 2022 for May (top two maps) and June (bottom two maps)

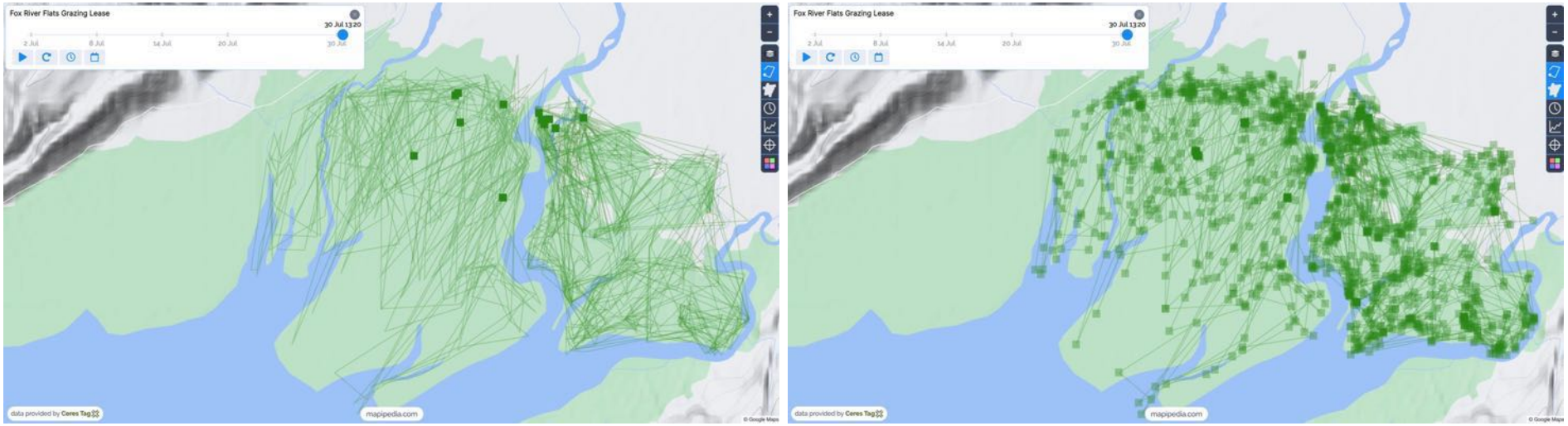


Above: May 1-31; **left** = track data shows each tagged cow's location on May 31 and the cow's movements to that location since release in early May; **right** = heat map showing the same tag locations; heat maps save locations of tag icons roughly every 4 hrs (~ 6 marked locations every 24 hours).

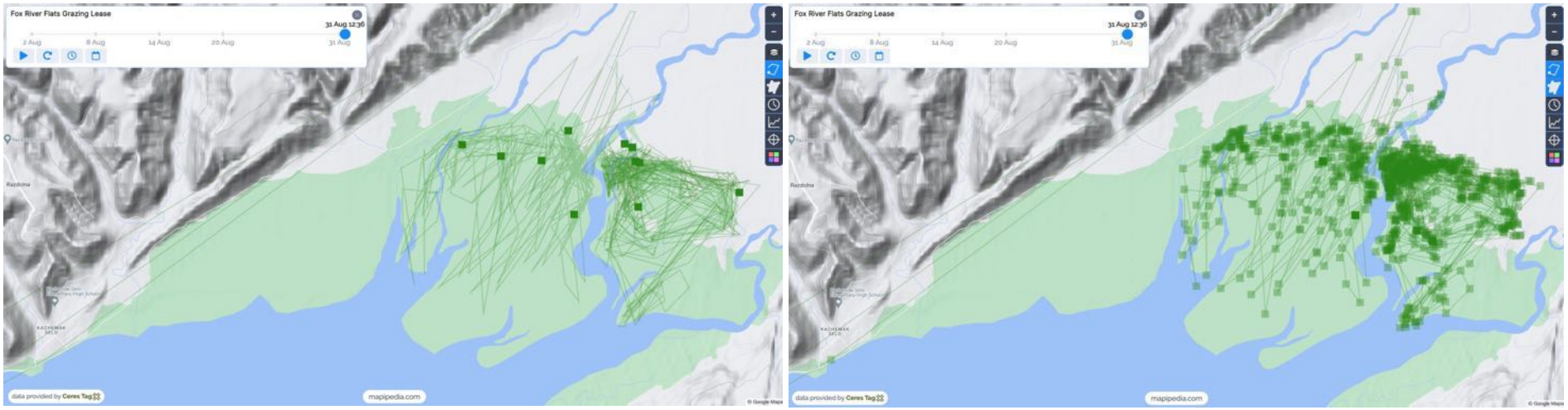


Above: June 1-30; **left** = track data shows each tagged cow's location on June 30 and the cow's movements to location since June 1; **right** = heat map showing the same tag locations; heat maps save locations of tag icons roughly every 4 hrs (~ 6 marked locations every 24 hours).

Ceres tag locations in 2022 for July (top two maps) and August (bottom two maps) – all operating tags

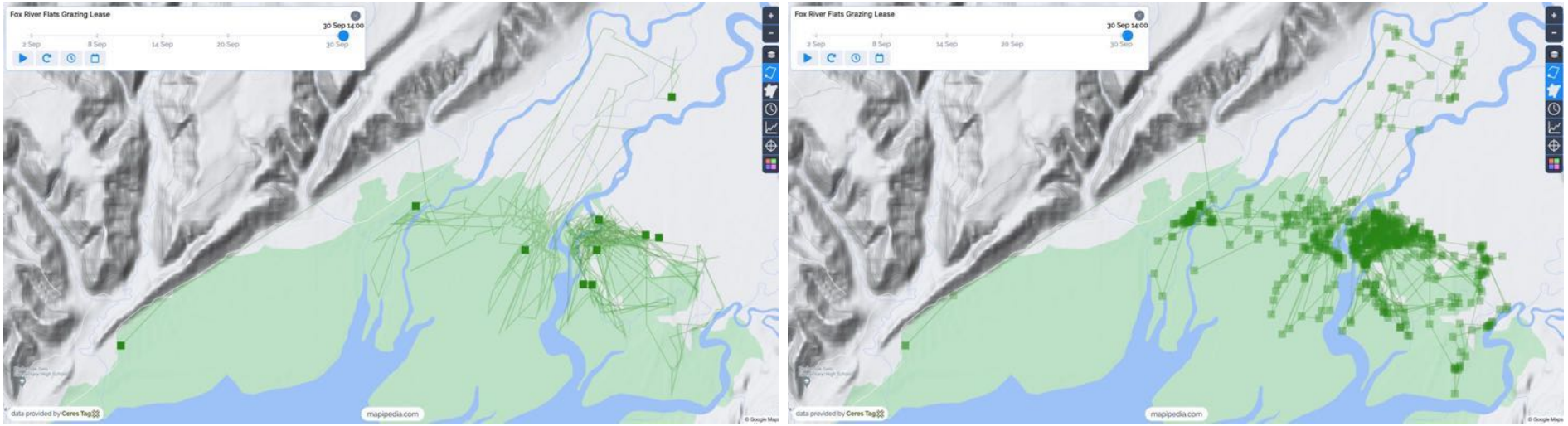


Above: July 1-31; **left** = track data shows each tagged cow's location on July 31 and the cow's movements to that point since July 1;
right = heat map shows tag locations roughly every 4 hrs for each cow with an operating tag during July (~ 6 marked locations every 24 hours).

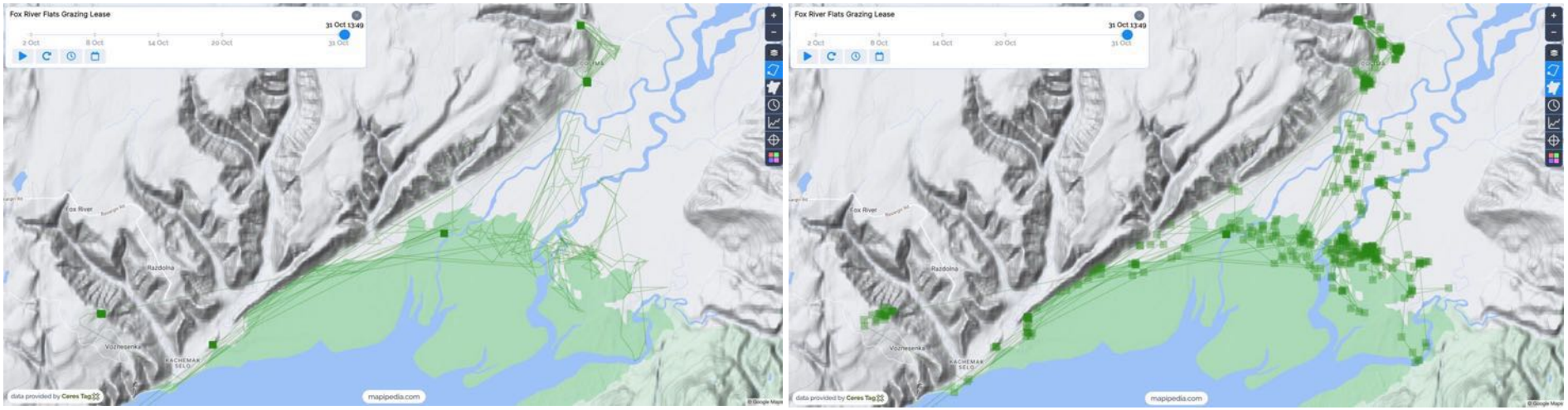


Above: August 1-31; **left** = track data shows each tagged cow's location on August 31 and the cow's movements to that point since August 1;
right = heat map shows tag locations roughly every 4 hrs for each cow with an operating tag during August (~ 6 marked locations every 24 hours).

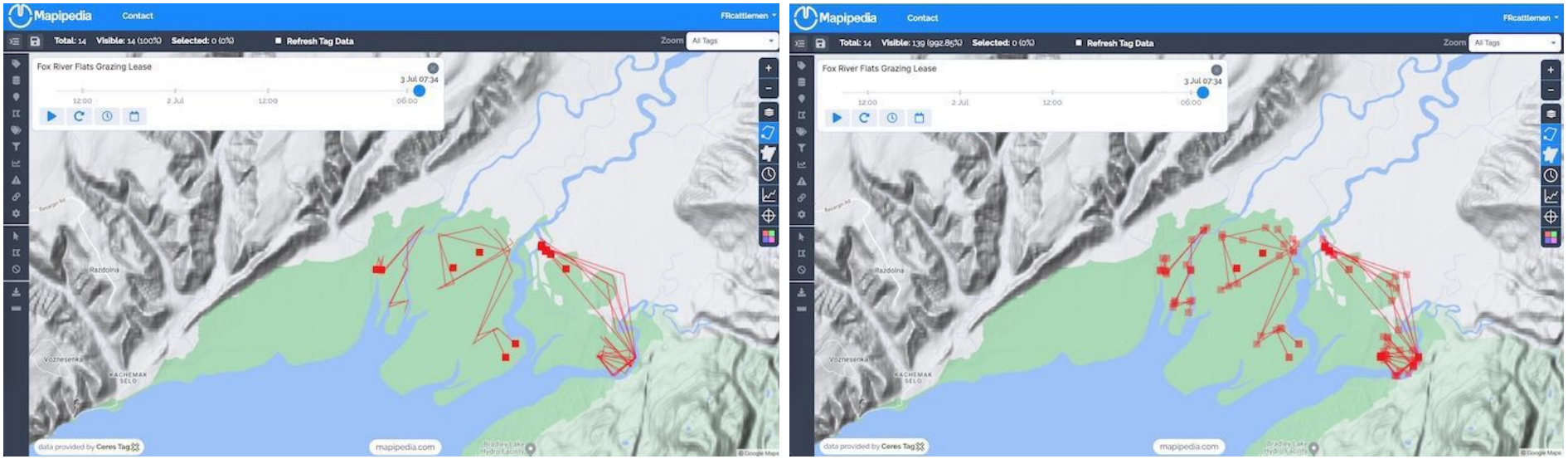
Ceres tag locations in 2022 for September (top two maps) and October (bottom two maps)



Above: September 1-30; **left** = track data shows each tagged cow's location on September 31 and the cow's movements to that point since September 1; **right** = heat map shows tag locations roughly every 4 hrs for each cow with an operating tag during September (~ 6 marked locations every 24 hours).



Above: October 1-31; **left** = track data shows each tagged cow's location on October 31 and the cow's movements to that point since October 1; **right** = heat map shows tag locations roughly every 4 hrs for each cow with an operating tag during October (~ 6 marked locations every 24 hours).



The duration of location data shown on a map can be set to any desired length of time. In the two maps above, a track map (left) and a heat map (right) show locations for 48 hours from about 8:00 am on July 1 to 8:00 am on July 3.

An animation of the 48-hour period from July 1 to July 3 can be viewed in the video linked below:
https://drive.google.com/file/d/1VkdtypjjVsXv2rx9OUymOrSsXKo1cyxU/view?usp=sharing

In general, cattlemen were very satisfied with the kinds of data they could access from Ceres tags using the Mapipedia app. Maps shown above just scratch the surface of the kinds of information that can be reviewed. Nevertheless, three kinds of problems were experienced with the tags during the 2022 grazing season.

- In three cases, tags simply failed to activate. The reason for this could not be determined. In total, 21 of 24 tags installed on cattle became operational for some period of time during 2022, and some of these ceased functioning for unknown reasons.

- In a few cases, Ceres tags came apart. The photo at right shows a tag on which the back of the operational portion of the unit came off during installation.

- In a number of cases, tags came off once animals were out on the lease. On June 1, 2022, Hannah Bradley texted the photo below to Devony Lehner. The accompanying text read: "You can see the tag dangling off the ear of the bull here (center)—it fell off the next day." A closeup of that tag is shown photo bottom right. One cattleman noted that it seemed to him that if the front and back portions of a tag in a cow's ear were squeezed together, the prongs inserted through the ear sometimes released.

  Hannah followed up with two additional comments, also on June 1:
  - They [the cattle] are definitely itchy right now; two [tags] were found near trees, like they itched them off.
  - The back of one was still in the cow's ear—retrieved—and found the other back, but I would say the backs dropping off and not found could be a concern—they're sharp.