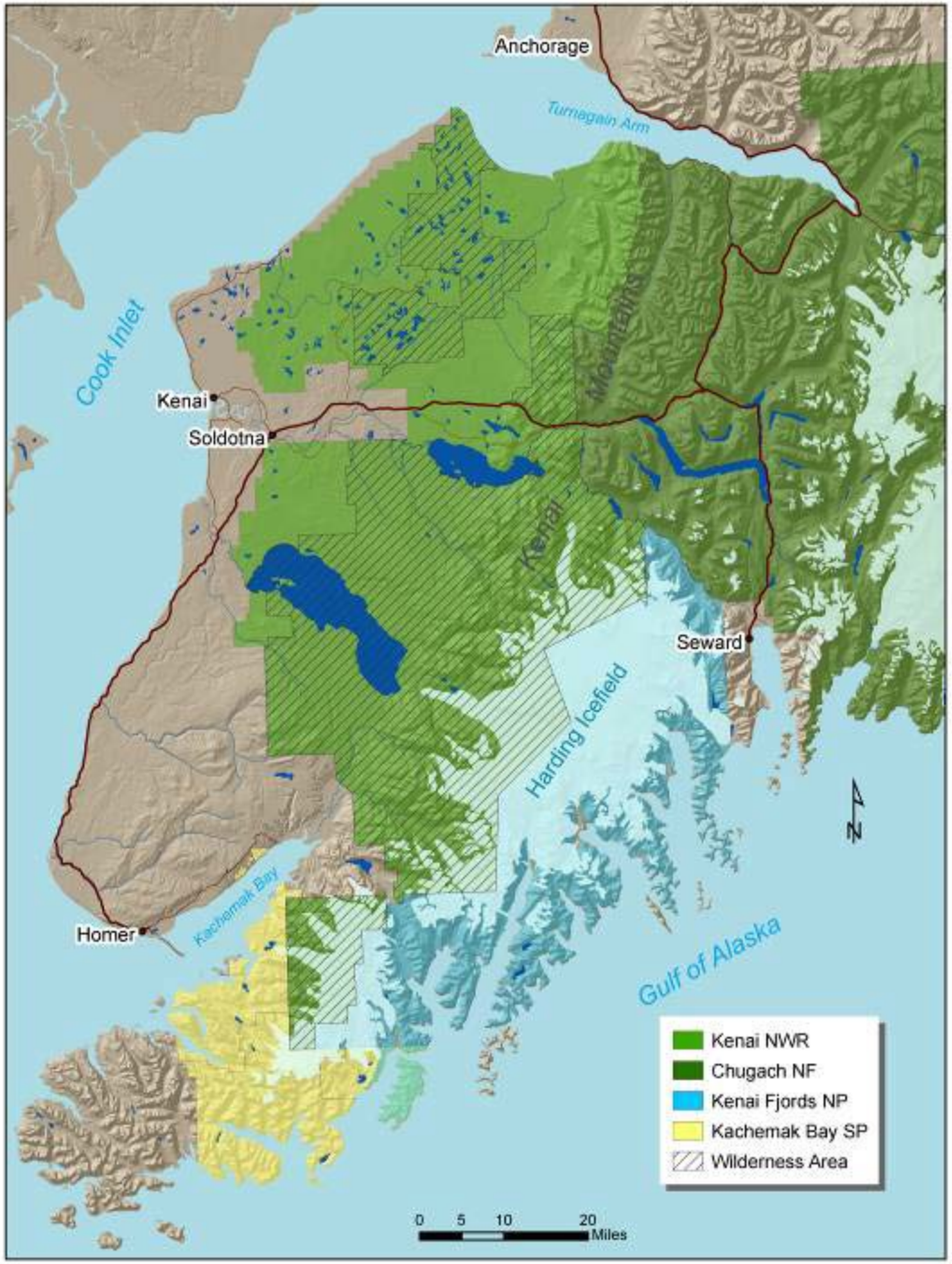
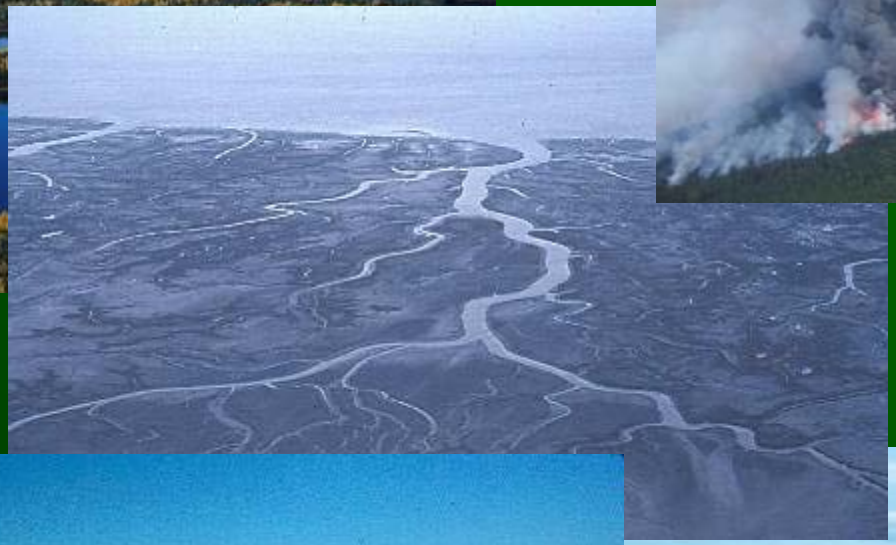
Long Term Ecological Monitoring Program on Kenai National Wildlife Refuge: an FIA adjunct inventory

John M. Morton, Matthew Bowser, Ed Berg,
Dawn Magness, Todd Eskelin & Mark Laker


Anchorage
Turnagain Arm
Cook Inlet
Kenai
Soldotna
Kenai Mountains
Seward
Harding Icefield
Homer
Kachemak Bay
Gulf of Alaska
Kenai NWR
Chugach NF
Kenai Fjords NP
Kachemak Bay SP
Wilderness Area
0 5 10 20
Miles


ALASKA


Kenai
National
Wildlife
Refuge




6/14/2004 9:36

ENLIGHTENED MANDATE!

"To conserve fish & wildlife populations and habitats in their natural diversity…."

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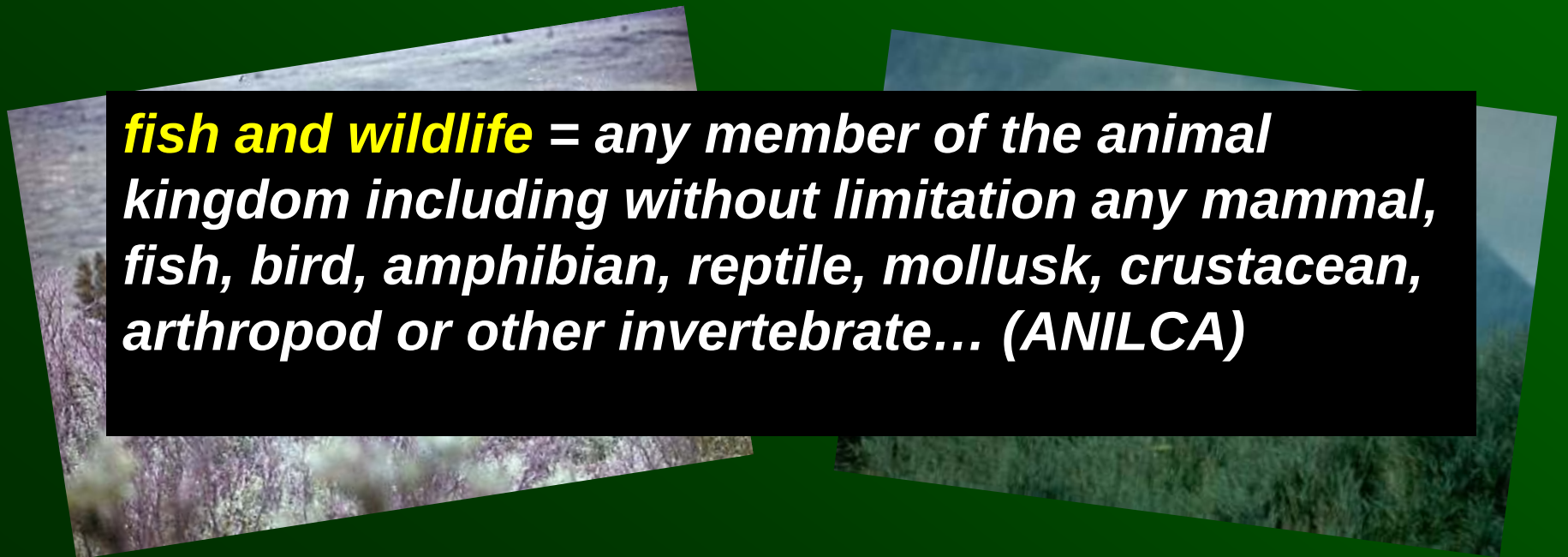
"To conserve fish & wildlife populations and habitats in their natural diversity…."



***fish and wildlife** = any member of the animal kingdom including without limitation any mammal, fish, bird, amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate… (ANILCA)*

"… resource managers do not have sufficient site-specific information to plan for and manage the effects of climate change on the federal resources they oversee. [They] generally lack detailed inventories and monitoring systems to provide them with an adequate baseline understanding of the plant and animal species that currently exist on the resources they manage."

GAO Aug 2007

Climate Change: Agencies Should Develop Guidance for Addressing the Effects on Federal Land and Water Resources

"Few DOI land management units have complete biological inventories of species. Additionally, DOI has no cohesive, systematic program for monitoring change over time in the distribution of species and communities. Inventories will be critical to assessing climate change impacts and to developing management responses to those impacts…"

DOI Climate Change Task Force

Feb 2008 Pre-decisional draft

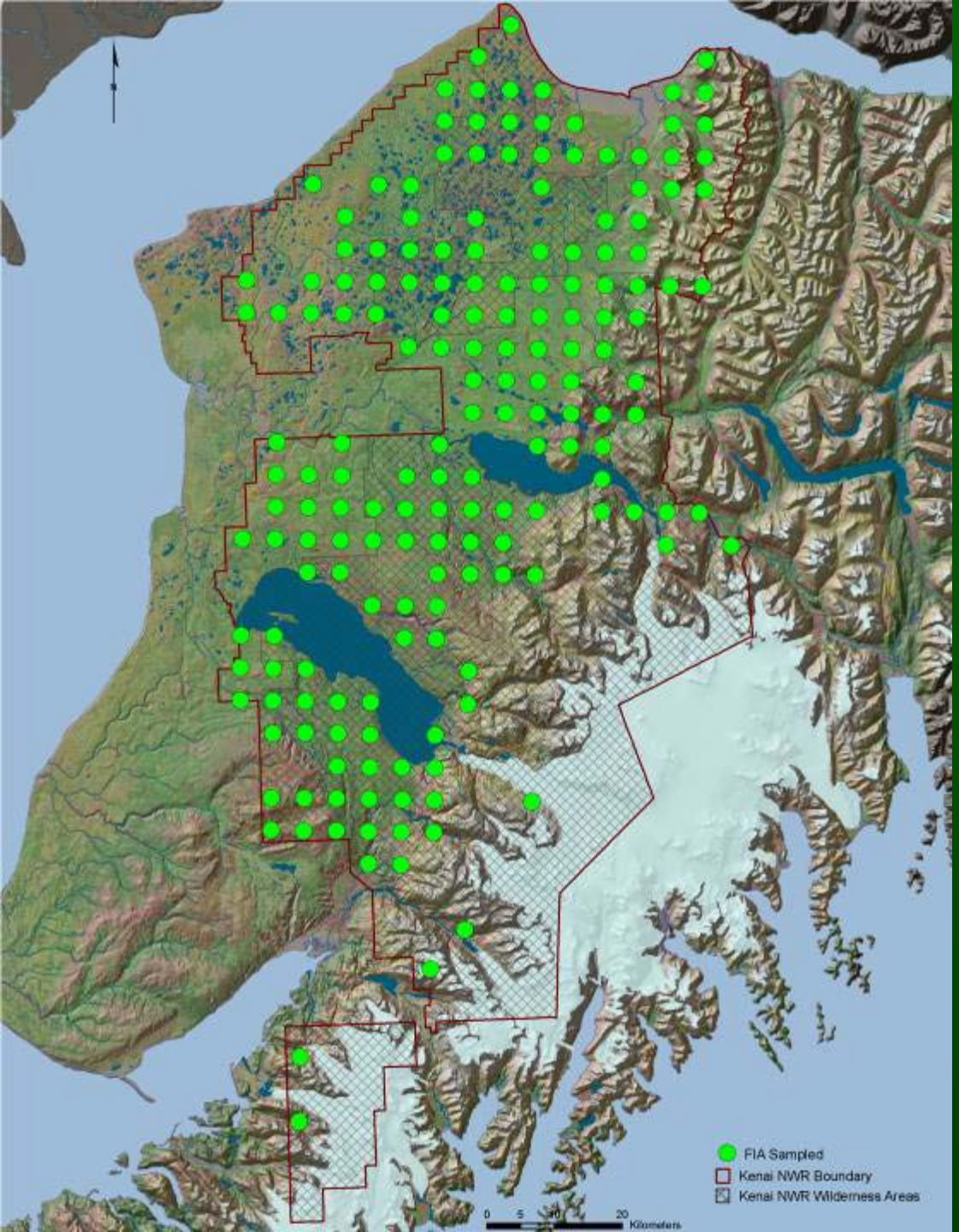
"The USFWS has an extensive inventory and monitoring program…However, inventory and monitoring plans often have little programmatic or geographic integration. The effects of climate change on Alaska flora and fauna are predicted to be far-reaching, and the Service's ability to modify its management objectives and strategies in response to these changes may require a reconsideration of current inventory and monitoring efforts… "

USFWS R7 Climate Change Forum

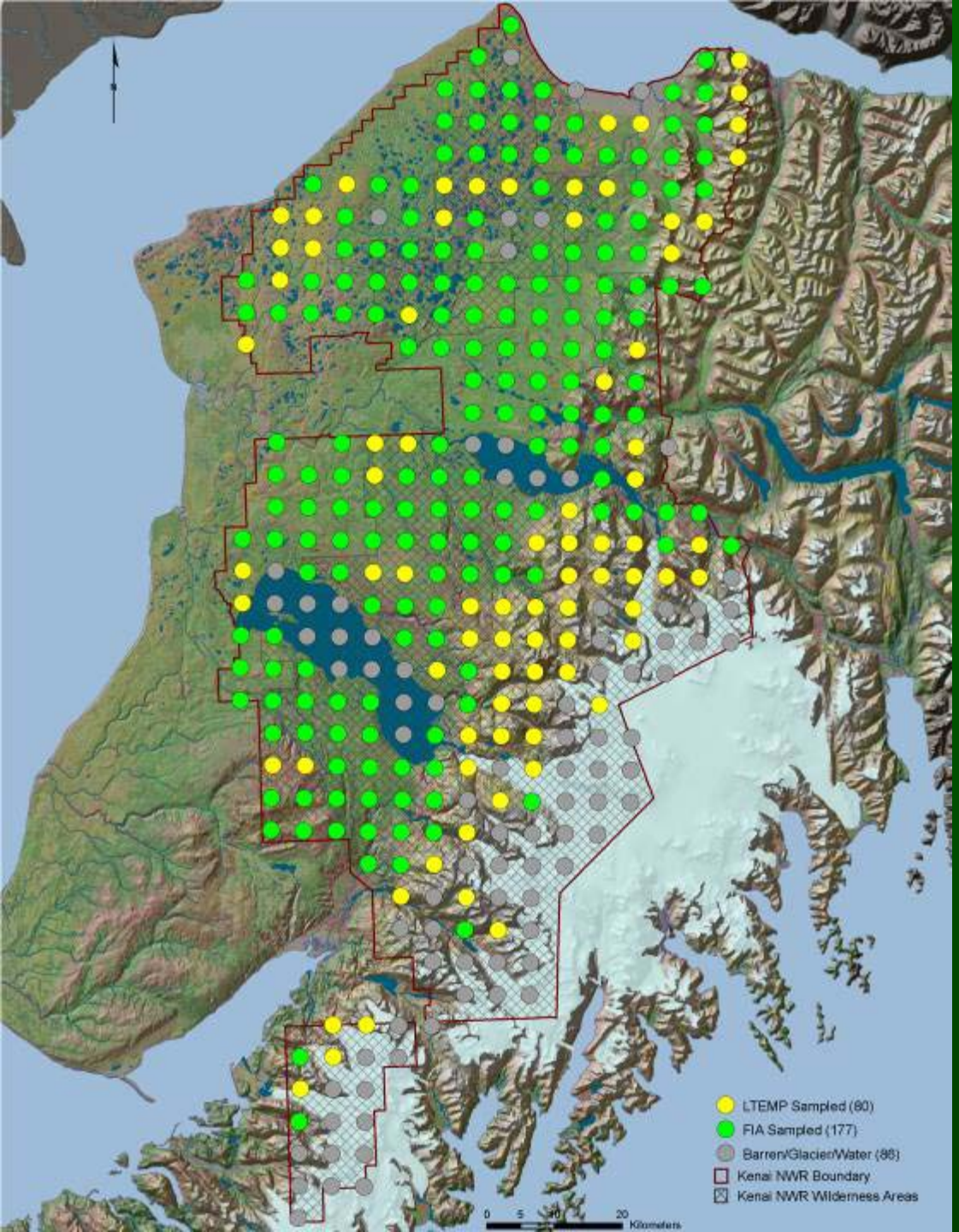
Inventory & Monitoring Breakout Group, Feb 2007

Long Term Ecological Monitoring Program

- Determine the occurrence and distribution of selected terrestrial flora & fauna (inventory)
- Assess trends in occurrence and distribution of selected terrestrial flora & fauna (monitoring)
- Develop explanatory statistical models to assess effects of physical, biological, and anthropogenic factors on distributions



175 FIA plots in forests at 5-km intervals

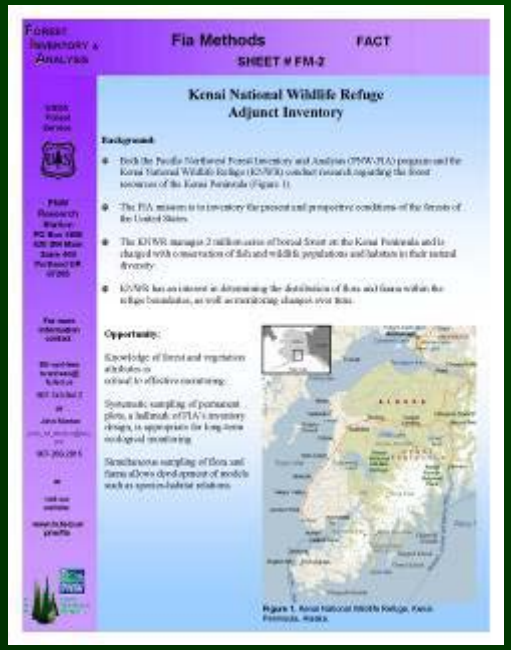


Another 80 plots in nonforested habitats

LTEMP

255 permanent plots systematically arrayed at 5-km intervals sampled cooperatively with FIA

2004 MOU designated LTEMP as FIA adjunct inventory



Fia Methods FACT

SHEET # FM-2

Kenai National Wildlife Refuge
Adjunct Inventory

Background:

Opportunity:

Kenai
Soldotna
Seward
Homer
LTEMP Grid
Kenai NWR
Miles
0 5 10 20

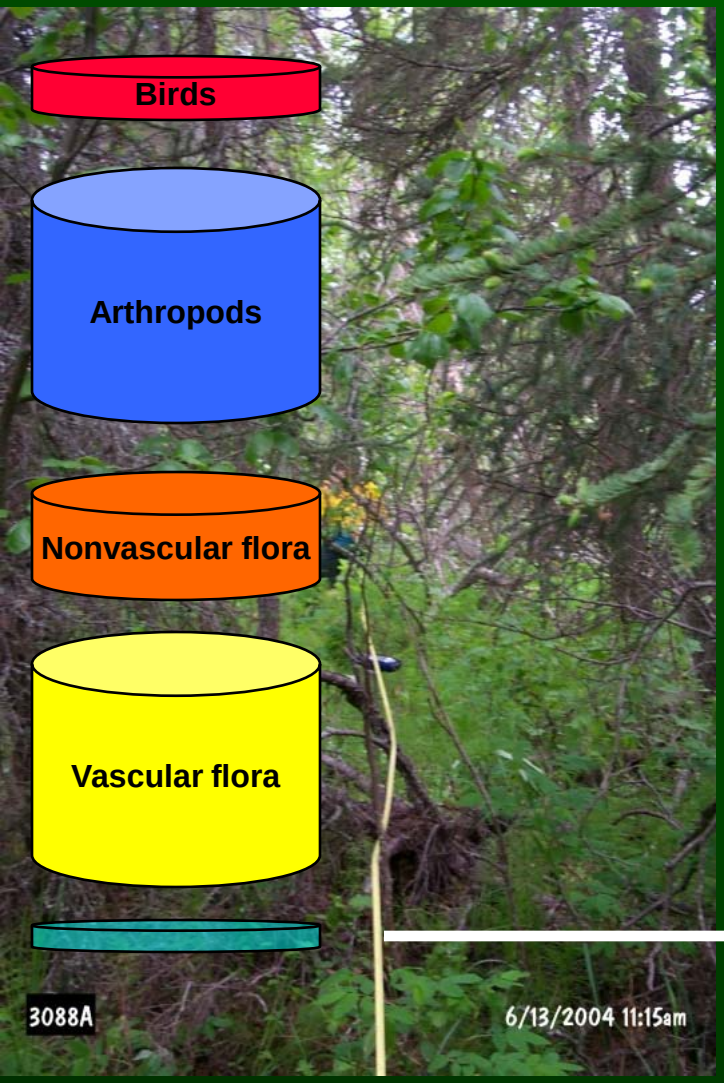
Although regionally scaled, data from LTEMP are representative of Kenai NWR…

HABITAT	PLOTS (%)	ACRES (%)
Forest	161 (47)	945,896 (48)
conifer	105 (31)	550,996 (28)
deciduous	12 (4)	72,805 (4)
mixed	44 (13)	322,095 (16)
Shrub/grass	26 (7)	141,819 (7)
Barren/sparsely vegetated	60 (18)	329,293 (17)
Wetlands	20 (6)	122,292 (6)
Snow/ice	51 (15)	289,974 (15)
Water	25 (7)	159,242 (8)
Σ	343 (101)	1,988,516 (101)

Data collected in 2004 and 2006

- Vascular (including exotics) & nonvascular flora on nonforested points (**modified line intercept**)
- Breeding bird densities (**VCP**)
- Insect relative abundance (**sweep nets**)
- Sound meter readings
- Rose galls as disturbance index

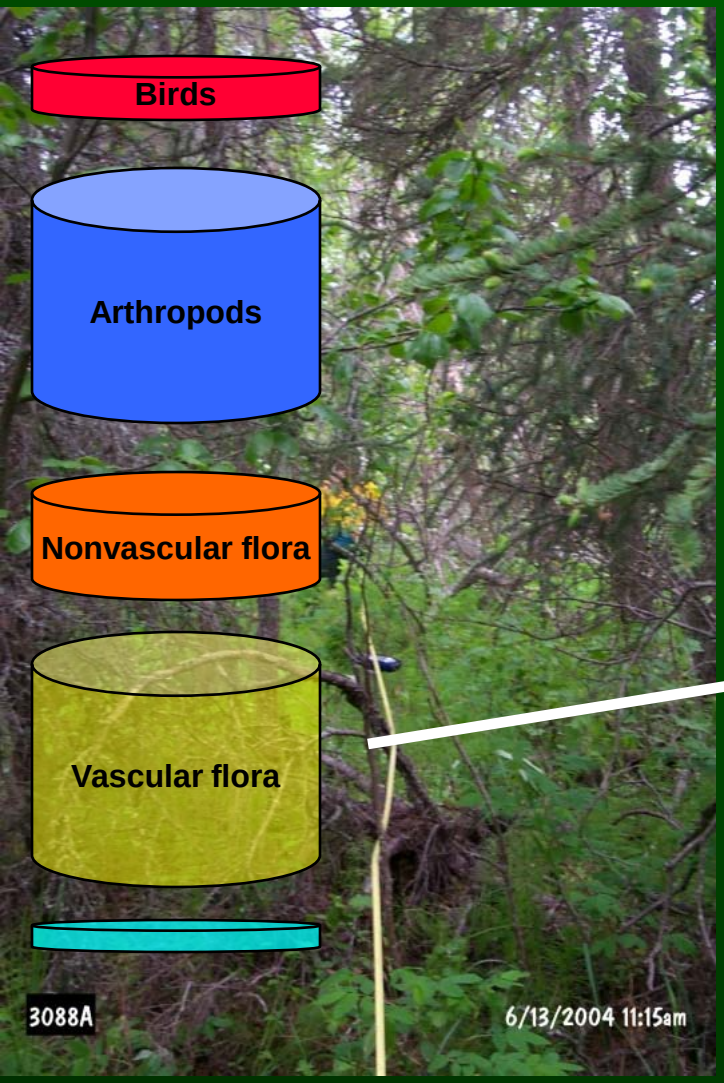
LTEMP site 3088



GIS derived data

Black spruce (IA2F), 40 years old
Elevation = 20 m
Patch size = 57 ha
Nearest stream = 105m
Nearest road = 2725 m
Nearest border = 1119 m
Leq = 46.4 dBa
Rose galls = 0

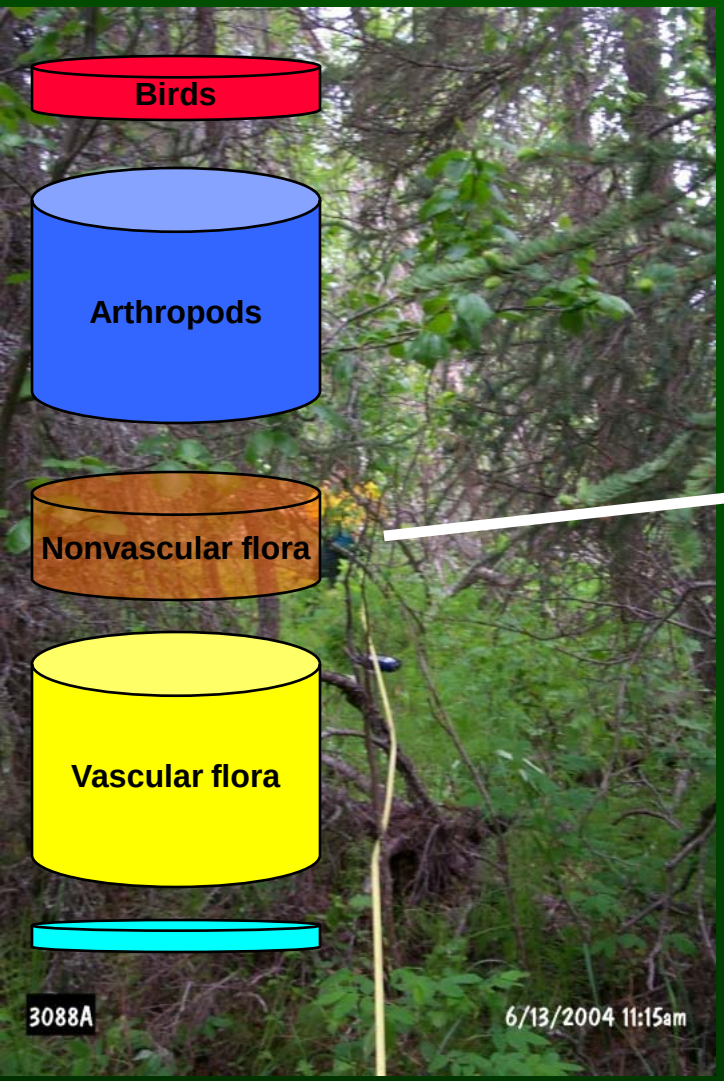
LTEMP site 3088



26 species of vascular plants

Alanus incana
Athyruium filiz-femina
Betula nana
Calamagrostis candadensis
Chamerion angustifolium
Cornus canadensis
Dryopteris expansa
Empetrum nigrum
Equisetum sylvaticum
Equisetum arvense
Gymnocarpium dryopteris
Linnaea borealis
Mertensia paniculata
Picea mariana
Pyrola minor
Ribes glandulosum
Ribes hudsonianum
Ribes triste
Rosa acicularis
Rubus arcticus
Saliz pulchra
Sanguisorba candadensis
Spiraea stevenii
Trientalis europaea
Vaccinium uliginosum
Vaccinium vitis-idaea

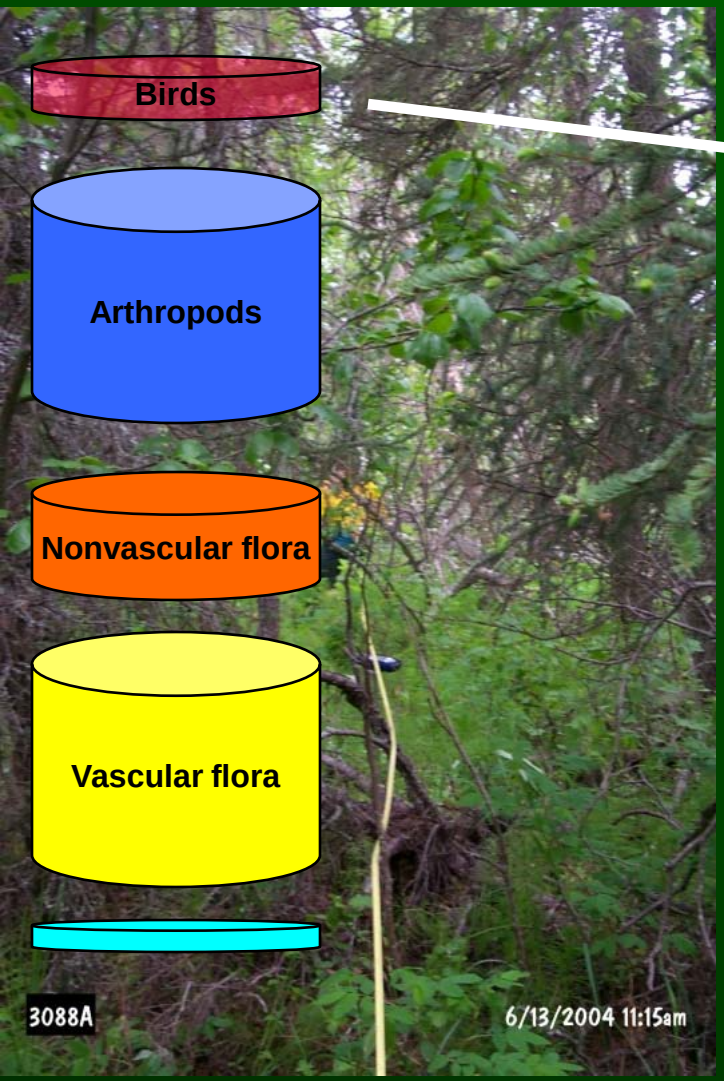
LTEMP site 3088



9 species of nonvascular plants and counting

Ptilidium ciliare
Drepanocladus uncinnatus
Stereocaulon alpinum
Aulacomnium palustre
Cladonia umbricola
Parmelia sulcata
Pleurozium schreberi
Rhizomnium nudum
Brachythecium sp.

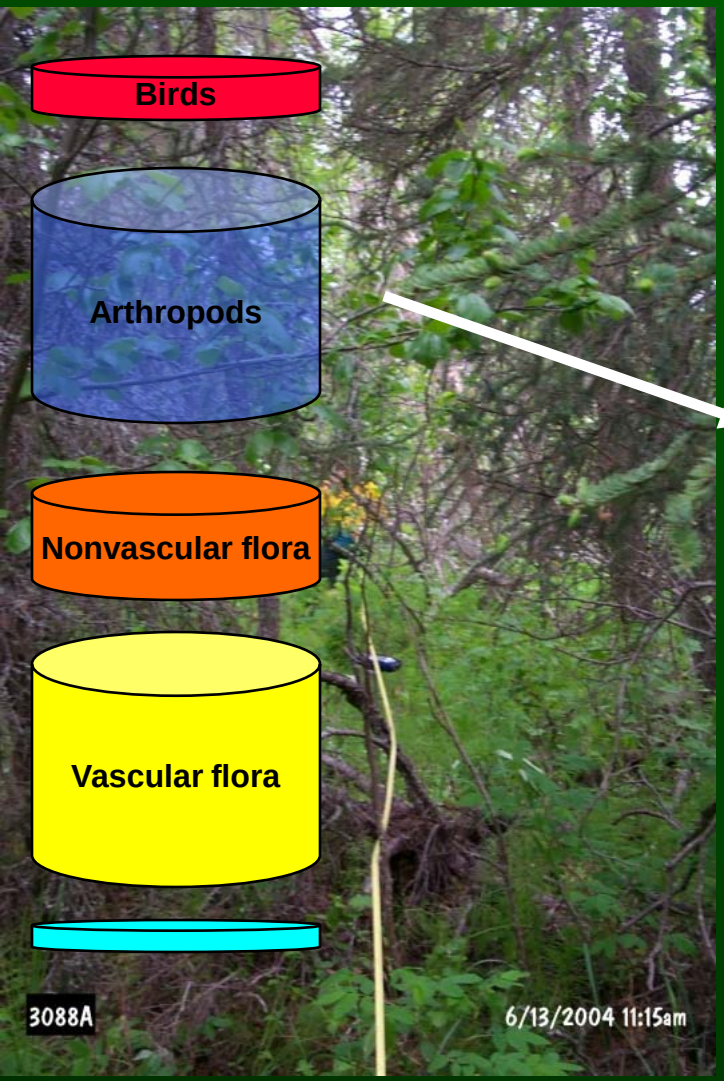
LTEMP site 3088



7 bird species

Alder flycatcher
Cliff swallow
Orange crowned warbler
Ruby-crowned kinglet
Swainson's thrush
White-winged crossbill
Wilson's snipe

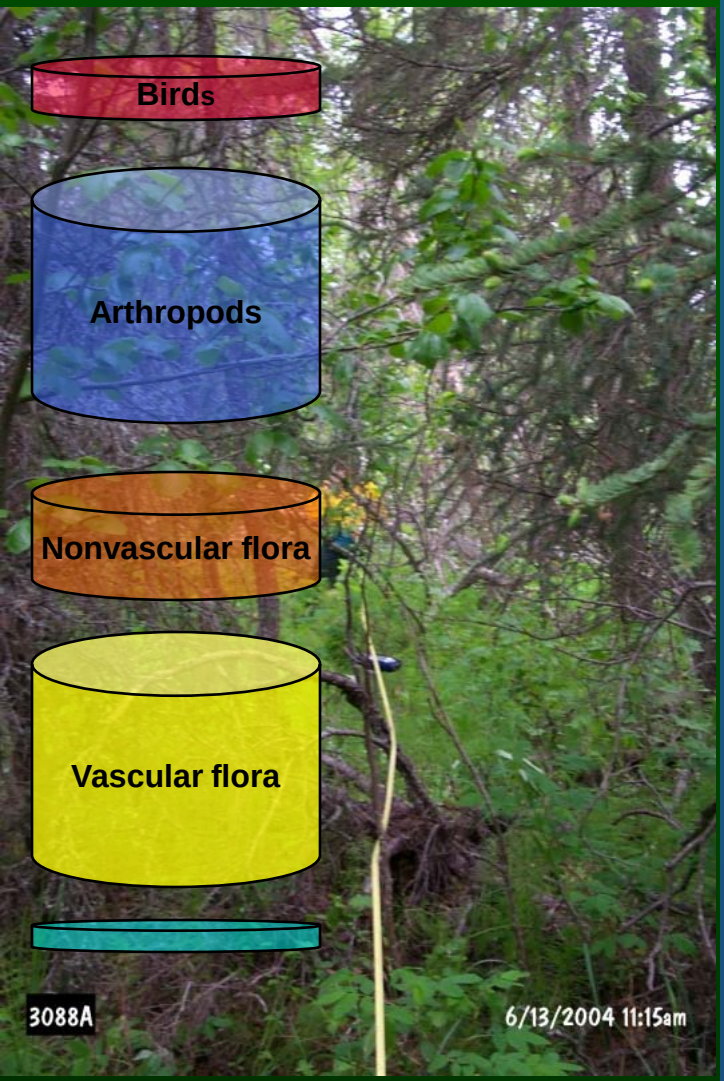
LTEMP site 3088



Aphididae
Aphidius
Araneae
Braconidae
Cicadellidae
Culicidae
Diptera
Dismodicus alticeps
Empididae
Ephedrus lacertosus
Fannia serena
Fannia brevicauda
Hemerobiidae
Ichneumonidae
Javesella pellucida
Lepidoptera
Melanostoma mellinum
Muscidae
Mycetophilidae
Phaenoglyphis
Podabrini
Pseudocalliope
Psyllidae
Simuliidae
Sminthurus

25 arthropod taxa and counting

LTEMP site 3088



Alder flycatcher
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Aphididae
Aphidius
Araneae
Braconidae
Cicadellidae
Culicidae
Diptera
Dismodicus alticeps
Empididae
Ephedrus lacertosus
Fannia serena
Fannia brevicauda
Hemerobiidae
Ichneumonidae
Javesella pellucida
Lepidoptera
Melanostoma mellinum
Muscidae
Mycetophilidae
Phaenoglyphis
Podabrini
Pseudocalliope
Psyllidae
Simuliidae
Sminthurus

Ptilidium ciliare
Drepanocladus uncinnatus
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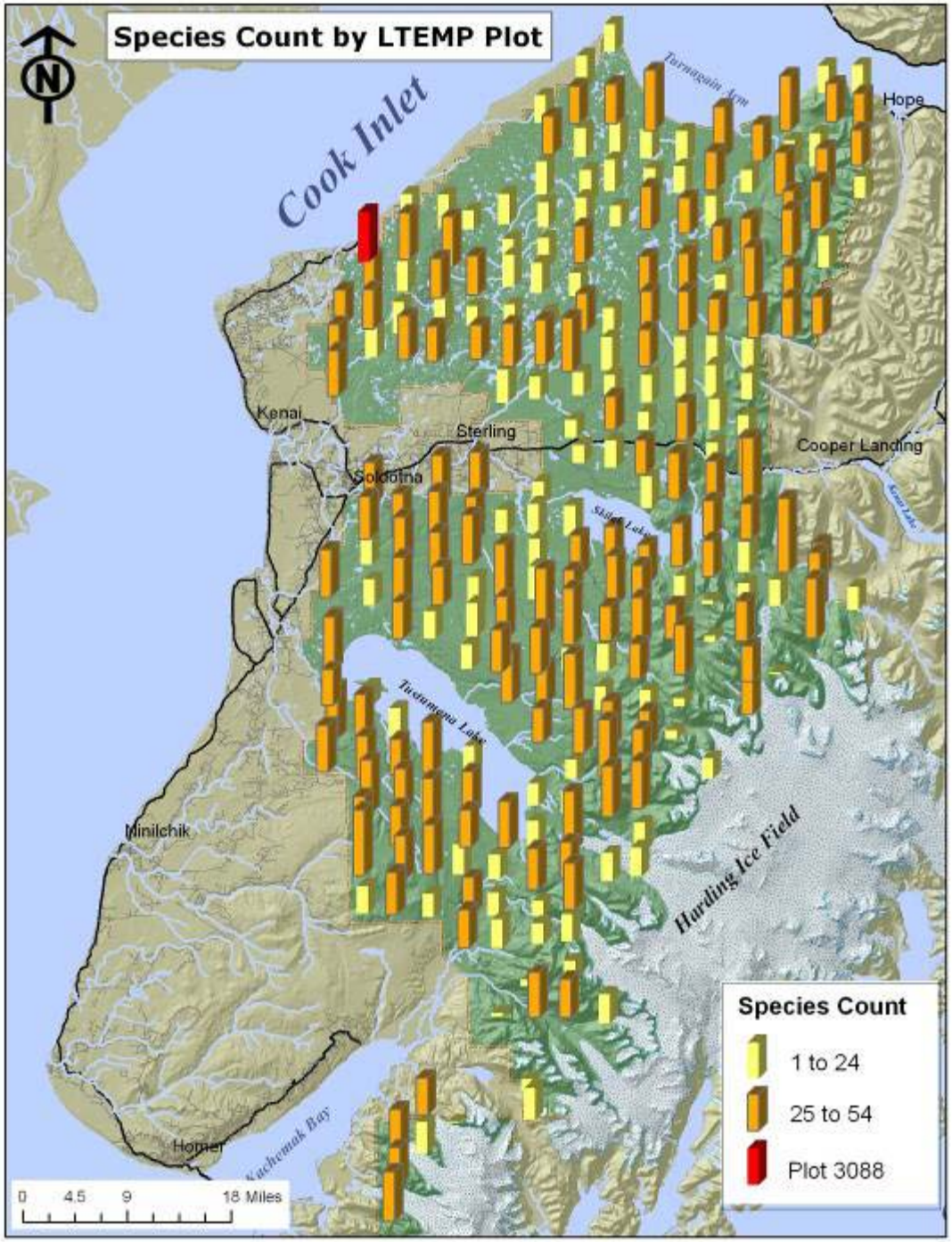
682 species to date!

86 birds
333 vascular plants
78 nonvascular plants
44 lichen/fungi
141 arthropods

species assemblages
spatial distribution
temporal change
explanatory models



- 2 insect species new to science!!
- 1 insect species new to the Nearctic
- 1 insect order new to Alaska
- 1 insect family new to Alaska
- 7 insect species new to Alaska
- 2 new sedges for KENWR (*Carex* spp.)
- range expansion for Hammond's flycatcher

A Brand New Species Discovered in Alaska

Three arthropod species never before reported in Alaska have been discovered at Kenai National Wildlife Refuge. A scarab beetle and an alpine bristletail are new to Alaska and a harvestman – better known by the name "daddy long-legs" among laypeople – is new to science.

Dominique Collet, a local entomologist, found the bristletail. While biological technician Matthew Bowser was collecting more bristletails, he found the harvestman. The scarab beetle was collected in a separate activity.

Kenai Supervisory Biologist John Morton is quite excited about the discoveries, which are an important part of the refuge's Long Term Ecological Monitoring Program, in which sweep net samples are taken periodically following a grid that covers the entire 2 million-acre refuge. "In Alaska," he said, "we always start with the big charismatic animals and have to work our way down the chain. Nobody has been looking at insects." The monitoring program will provide a fairly complete picture of the insect fauna of the refuge.

Bowser first worked at Kenai Refuge as a biological technician in 2004. He grew up in Florida, where he became interested in insects even as a youngster. When he was a young soccer player, he spent more time looking at the bugs on the ground than the ball. "I could go out in my yard every day and find something I hadn't seen before," he recalls. At the University of Florida, he discovered entomology as a career and then he discovered Alaska, where he is now a graduate student at the University of Alaska – Fairbanks. As part of his master's thesis, Bowser will help develop new methods for monitoring and modeling arthropod populations on the refuge.

"Entomology is really a frontier in Alaska," says Bowser. "Compared with most of North America, the insects of Alaska are poorly known because there have not been many people here studying them, and there has not been a great agricultural pest problem to push their study forward."

The alpine bristletail looks like a silverfish but has large eyes and an ability to jump. Bristletails live among rocks and feed on algae and lichens. After the first one was discovered, Bowser and a colleague covered headlamps with red cellophane and headed out at night to find dozens of them crawling around on lichen-covered rocks despite a strong wind and a temperature of eight degrees Celsius.

With the help of professional literature and Internet searches, Bowser discovered that the world's foremost expert on bristletails is an elderly scientist in Germany. He is now deciding if the bristletail is actually a new species – or just new to Alaska.

New to Science

When Bowser brought a colony of bristletails home for further observation, he also brought some of the arthropod's associates, including a harvestman. As he began keying the arachnid, he realized it didn't belong to any other species in North America. The foremost expert on harvestmen, James Cokendolpher at Texas Tech, has confirmed that the Kenai species is indeed new to science. Bowser and Dr. Cokendolpher will co-author a description of the new species in a professional journal.

Now in addition to his graduate studies and his employment at the refuge in the Student Temporary Employment Program, Bowser expects to apply for funding to survey other parts of the Kenai Mountains, the location of the Skyline Trail where the new species were found. Bowser will try to determine "if these are common arthropods that have been just overlooked or if this mountain is special and needs to be protected." ◆

A scarab beetle and an alpine bristletail, new to Alaska, were found at Kenai National Wildlife Refuge on into a harvestman new to sci

(USFWS)

FIRST NEW WORLD RECORD FOR *BADONNELIA TITEI* (INSECTA: PSOCOPTERA: SPHAEROPSOCIDAE)

Edward L. Mockford[1]

ABSTRACT

Badonnelia titei Pearman (Psocoptera: Sphaeropsocidae) was found in a laboratory building at Soldotna, Kenai Peninsula, Alaska. This is the first Western Hemisphere record of this domestic (i.e. dwelling in human habitations) species. The history of knowledge of this species is reviewed.

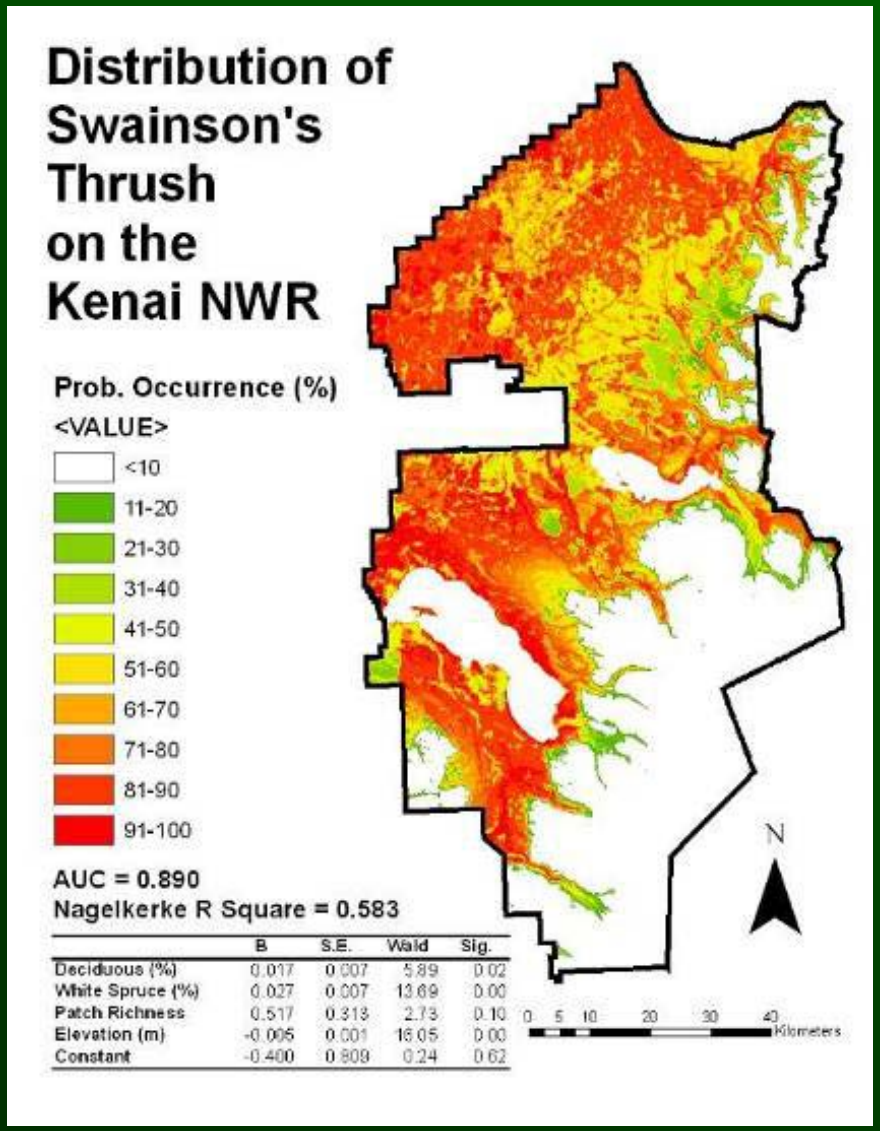
This note reports the first discovery of *Badonnelia titei* Pearman (Psocoptera: Sphaeropsocidae) in the Western Hemisphere. Data for the find are as follows: USA: ALASKA: Soldotna (N 60.461°, W 151.073°). Ski Hill Road, Kenai National Wildlife Refuge headquarters building. Crawling on floor of laboratory. 12 December 2005. M.L. Bowser. The material consists of a single well-colored female agreeing in form and color with prior published descriptions (Pearman 1953, 1958; Günther 1974a, 1974b; Lienhard 1998).

Badonnelia titei is in the psocopteran family Sphaeropsocidae, which is unique in that females have olytriform forewings and lack hindwings, while males are completely wingless. Thus, the females resemble minute beetles, while the males look like book-lice of the closely-related family Liposcelididae. Sphaeropsocidae is represented by three genera and 15 extant species (Lienhard and Smithers 2002). Only *B. titei* is domestic in the sense of being known only from human habitations.

Knowledge of this species has had an interesting history. The original description (Pearman 1953) was based on a single female kept alive in the hope that it would reproduce and augment the sample. It was found in the back binding of the loose cover of an atlas in the Zoological Museum, Tring, England. Subsequently, additional specimens were found in the same museum and a more detailed description, including both sexes, was published (Pearman 1958). Günther (1974a, 1974b) recorded the species from Belgium, Germany, France, and Switzerland, and noted that it is univoltine. By examination of digestive tract contents, he found that it feeds on fungal spores and body parts of (presumably) dead arthropods. Lienhard (1998) summarized the known distribution at the time, noting that it had been found in ten European countries (in addition to the five already noted, they were Finland, Ireland, Luxembourg, Norway, and Sweden).

The European records of this species are mostly northern (see references listed by Lienhard and Smithers 2002). The southernmost record is from Geneva just north of 46° N lat. From there it ranges north into Norway and Finland [illegible] of 60° N lat. Although it is not clear how to interpret these [illegible] species in a biologically meaningful way, they [illegible] domestic situations in Canada and

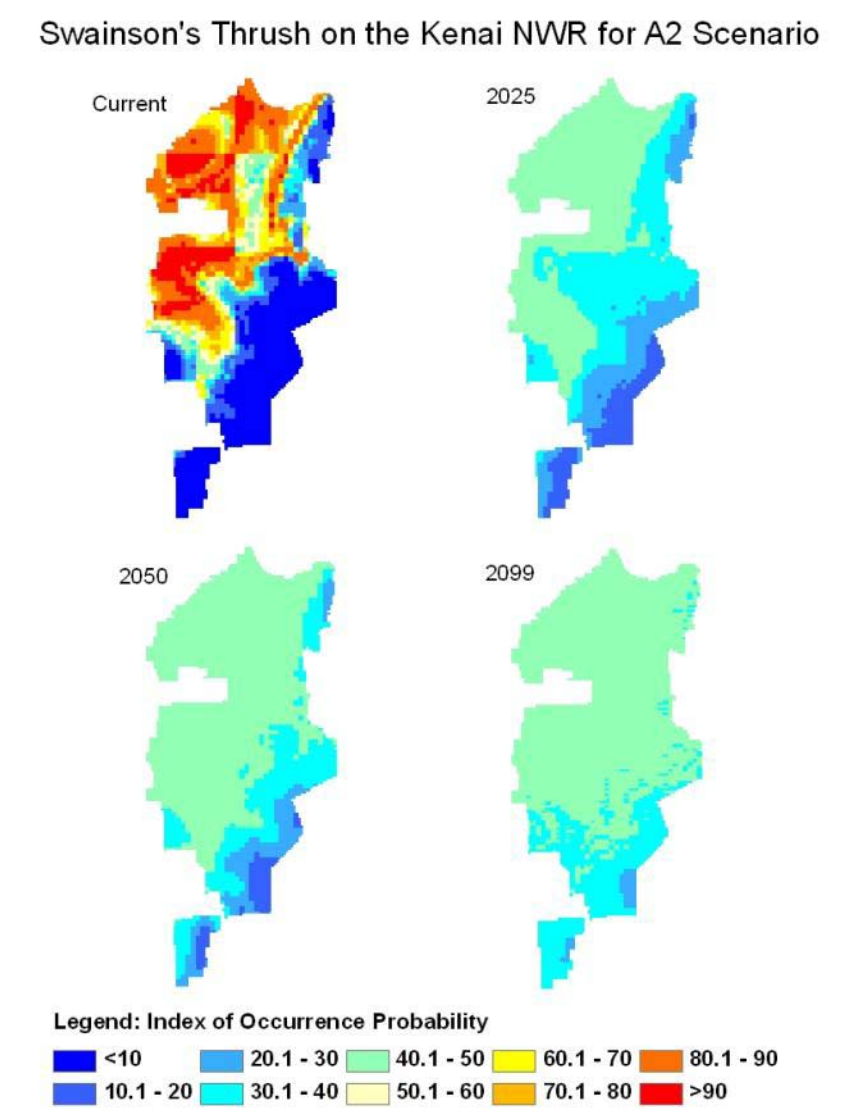
Explanatory modeling using GLM approach



- **focus on explanatory modeling**
- **60-80% accuracy**
- **computationally intensive**
- **incorporate climate variables**
- **management application**

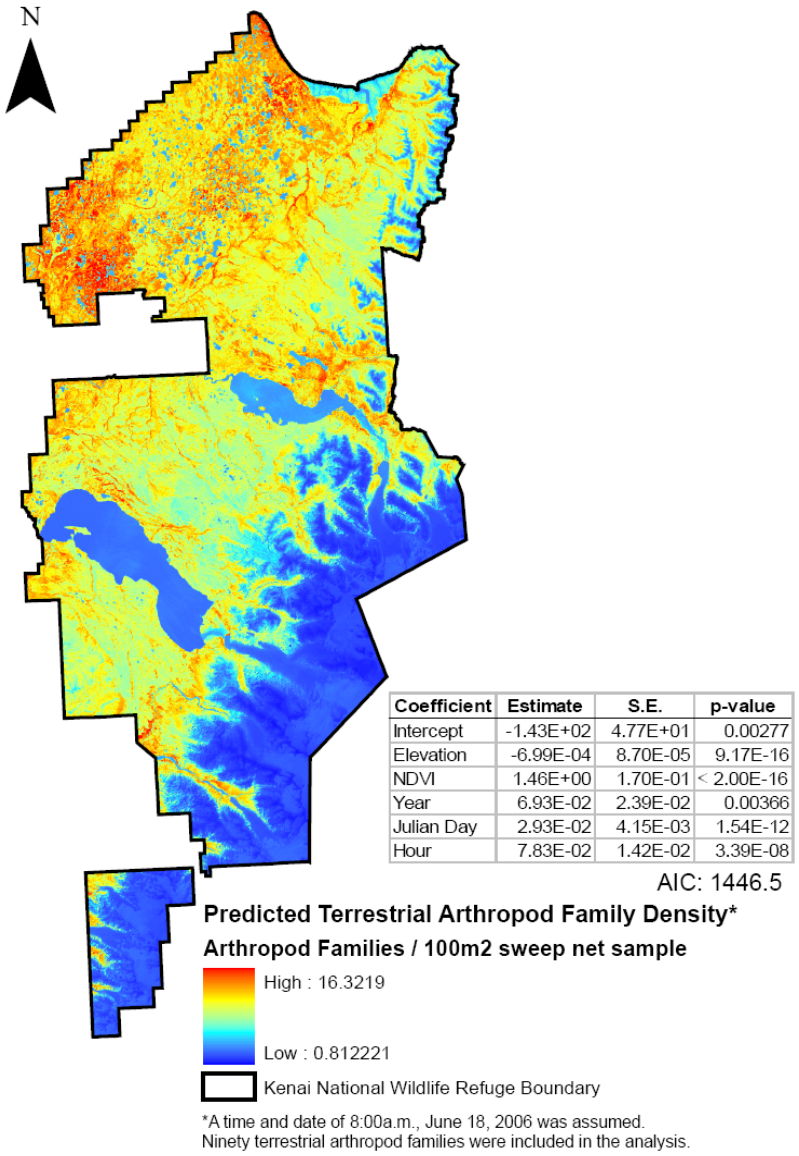
Dawn Magness
Managing the NWRS with climate change: The interaction of policy perceptions and ecological knowledge. PhD dissertation, UAF

Predictive modeling using Random Forests



- **focus on predictive modeling**
- **>90% accuracy**
- **computationally easy**
- **pixel-by-pixel change analysis**
- **easy to incorporate climate data**

Magness, Huettmann & Morton (2008) *Using Random Forests to provide predicted species distribution maps as a metric for ecological inventory & monitoring programs.* In: Applications of Computational Intelligence in Biology (Springer-Verlag)



We can also model diversity metrics!

Matt Bowser (2009)
Modeling and monitoring terrestrial arthropod diversity on the Kenai National Wildlife Refuge
MS thesis, UAF

PANEL	N		SAMPLING YEAR						
	FIA	OTHER	2004/2006		2008	2010	2012	2014	2016
			FLORA	BIRDS INSECTS	ALL	ALL	ALL	ALL	ALL
1	35			X	X				
2	35			X		X			
3	35			X			X		
4	35			X				X	
5	35			X					X
∑	175								
1		16	X	X	X				
2		16	X	X		X			
3		16	X	X			X		
4		16	X	X				X	
5		16	X	X					X
∑		80							

Why have we stalled on monitoring?

- Complete taxonomic work (arthropods)
- More inventories (heavy metals, mammal tracks)
- Monitoring metric (occupancy)
- Power analyses, detection estimation (single visit)
- Refine objectives, methods (inventory ≠ monitor)

What makes LTEMP work?

- Permanent sampling sites to measure change
- Statistically robust sampling frame (systematic) to survive planned and unplanned habitat changes
- Data are representative of the land (i.e., refuge) unit
- Co-location of biotic & abiotic sampling (modeling)
- All sampling methods are passive, nondestructive (to habitat) and inexpensive
- Multi-taxa sampling and interagency cost-share

…develop a national, integrated inventory and monitoring partnership to monitor continental changes in biological diversity. The Service efforts will focus principally on NWRS lands and priority species, but will build upon existing Federal monitoring programs with proven track records and relevancy to climate change (e.g., the Forest Service's FIA Program…)

Crisis, Challenge, and Opportunity: The USFWS Strategic Plan for Responding to Accelerating Climate Change in the 21st Century

USFWS Climate Change Strategic Plan Team

15 October 2008