



20181030 Camera Workshop: U.S. Geological Survey – Wildlife Camera Workshop  
Title Slide

Carlton J. Rochester\* and Robert N. Fisher  
U. S. Geological Survey, San Diego, CA, U.S.A.

\*- US Geological Survey – BRD  
San Diego Field Station  
4165 Spruance Road, Suite 200  
San Diego, CA 92101  
Phone: (619) 225-6424  
E-mail: [crochester@usgs.gov](mailto:crochester@usgs.gov)

# Wildlife Camera Workshop

**Camera Workshop Agenda - 2016, October 24<sup>th</sup>**

**9:15 – 12:15 – Morning Session**

9:15 – 9:30 – Intro – T. Smith, C. Rochester and R. Fisher – welcome, logistics, goals and objectives of meeting

9:30 – 9:45 – MSP Goals – T. Smith (The Nature Conservancy), Management Strategy Plan and Camera

9:45 – 10:00 – Connectivity – C. Rochester (USGS), San Pasqual Valley Connectivity

10:00 – 10:15 – Human use – R. Gregory (Pine Point Conservancy), Human Impacts on Wildlife Activity Patterns in a Managed Open Pasture

10:15 – 10:30 – Biodiversity monitoring – B. Ortega (Duke), Varied Implementation of Game Cameras as a Tool

10:30 – 10:45 – Biodiversity monitoring and management – M. Spiegelberg (Center for Natural Lands Management), Wildlife Observation Enhancement Project at Carlsbad State North

10:45 – 11:00 – Break

11:00 – 11:15 – Biodiversity monitoring – L. Hargrove (San Diego Natural History Museum), Tracking Wildlife Use of Interior Wetlands in Southern California

11:15 – 11:30 – Target species inventories/communication – C. Wilmer (San Diego Zoo Institute for Conservation Research), Use of Remote Cameras for Monitoring, Surveying, and Habitat Ecology in San Diego County

11:30 – 11:45 – Target species inventories/communication – S. Strawn (Conservation Biology Institute), And Now for Something Completely Different: Using Drop Motion Photography to Monitor Quail Checkerspot Butterfly Larvae

11:45 – 12:00 – Biodiversity and connectivity monitoring – P. Van Heady (San Diego Tracking Team), San Diego Tracking Team Wildlife Camera Project

12:00 – 12:15 – Wildlife monitoring – A. Backer (USGS), Using Cameras to Monitor Stream Recovery Following a Wildfire at a High Elevation Site

12:15 – 1:15 – Lunch

1:15 – 1:30 – Larch colored leucocytes, chips, cookies, and pulltraps thanks to T. Smith, C. Lacey, and Z. Prince with The Nature Conservancy

1:30 – 1:45 – Afternoon Session

1:45 – 1:55 – Study Design – C. Bhatia (USGS), New Technology: Wildlife Cameras for Amphibians and Pacific Wetlands

1:55 – 2:05 – Invasive species surveillance – S. Strawn (USGS-APHS), San Diego Firewise Evolution Program Camera Management

2:05 – 2:20 – Invasive species – C. Brown (USGS), Camera Station Monitoring for Sensitive Resources

2:20 – 2:35 – Connectivity and management – M. Jennings (Institute for Ecological Monitoring and Management – USGS), Camera Tracking for Conservation Decision Making

## Introductions

9:15 – 10:45 Morning Presentations 1

10:45 – 11:00 Break

11:00 – 12:15 Morning Presentations 2

12:15 – 1:15 Lunch

1:15 – 2:35 Afternoon Presentations

2:35 – 2:50 Break

2:50 – 4:00 Discussion



20181030 Camera Workshop: U.S. Geological Survey – Agenda

# Wildlife Camera Workshop

## Wildlife Camera Research and Literature



The screenshot shows the Web of Science search interface. At the top, it says "Web of Science" and "Clarivate Analytics". Below that, there are navigation links: "Tools", "Searches and alerts", "Search History", and "Marked List". A "Select a database" dropdown menu is set to "Web of Science Core Collection". The search type is "Basic Search". The search terms are entered in a list of boxes, each with a "Topic" label and a "Search" button. The terms are: "wildlife camera", "camera trap", "remote camera", "camera trapping", "Motion triggered camera", "remote triggered camera", and "game camera". There are also "or" labels between the boxes. At the bottom, there is a "Timespan" dropdown menu set to "All years (1985 - 2018)" and a "More settings" link.

You searched for:

- TOPIC: (wildlife and camera) OR
- TOPIC: ("camera trap") OR
- TOPIC: ("remote camera") OR
- TOPIC: ("camera trapping") OR
- TOPIC: ("Motion triggered camera") OR
- TOPIC: ("remote triggered camera") OR
- TOPIC: ("game camera")

Timespan: All years (1985 – present)

Date of Search: 2018, October 26  
Results = 1,900 unique records  
(2018, October 28 = 1,902 results)



20181030 Camera Workshop: U.S. Geological Survey – Literature Review\_01

We searched the Web Of Science for literature related to wildlife camera research using several criteria to try and capture as many variations as possible. The search returned 1,900 unique articles.

# Wildlife Camera Workshop

## Search Topics (n=101):

Africa	demography	lizard	restoration
alligator	density	machine learning	rhino
amphibian	density	mammal	rural
Antarctica	detection probability	mark	salamander
artificial intelligence	dispersal	model	salmon
Asia	disturbance	modeling	shark
Australia	diversity	moth	snake
automation	eagle	mouse	South America
barrier	elephant	natal dispersal	species richness
bear	europe	neural network	stressors
biodiversity	exotic	nonnative	suburban
bird	extinct	non-native	threats
butterfly	extinction	North America	tiger
<i>Canis familiaris</i>	<i>Felis catus</i>	occupancy	toad
<i>Canis lupus</i>	fish	owl	tortoise
<i>Canis lupus familiaris</i>	fragmentation	phenology	transportation
capture	frog	pig	tree
caterpillar	geology	plant	trout
community	habitat	population	tuna
connectivity	hawk	rattus	turtle
conservation	honey bee	recapture	urban
crocodile	human	recover	vegetation
decline	insect	recovery	wilderness
deep learning	invasive	recreation	
deer	leopard	reproduction	
demographic	lion	reptile	

**Author:** Ordenana, MA; Crooks, KR; Boydston, EE; Fisher, RN; Lyren, LM; Sludyla, S; Haas, CD; Harris, S; Hathaway, SA; Turschak, GM; Miles, AK; Van Vuren, DH

**Title:** Effects of urbanization on carnivore species distribution and richness

**Authors Keywords:** camera trap; mammalian carnivores; richness; southern California; species distribution; urbanization

**Web of Science Keywords:** SOUTHERN CALIFORNIA; HABITAT FRAGMENTATION; GRAY FOXES; MESOPREDATOR RELEASE; AVAILABILITY DATA; VIRGINIA OPOSSUM; NATIONAL-PARK; RURAL ZONES; URBAN; BOBCATS

**Abstract:** Urban development can have multiple effects on mammalian carnivore communities. We conducted a meta-analysis of 7,929 photographs from 217 localities in 11 camera-trap studies across coastal southern California to describe habitat use and determine the effects of urban proximity (distance to urban edge) and intensity (percentage of area urbanized) on carnivore occurrence and species richness in natural habitats close to the urban boundary. Coyotes (*Canis latrans*) and bobcats (*Lynx rufus*) were distributed widely across the region. Domestic dogs (*Canis lupus familiaris*), striped skunks (*Mephitis mephitis*), raccoons (*Procyon lotor*), gray foxes (*Urocyon cinereoargenteus*), mountain lions (*Puma concolor*), and Virginia opossums (*Didelphis virginiana*) were detected less frequently, and long-tailed weasels (*Mustela frenata*), American badgers (*Taxidea taxi*), western spotted skunks (*Spilogale gracilis*), and domestic cats (*Felis catus*) were detected rarely. Habitat use generally reflected availability for most species. Coyote and raccoon occurrence increased with both proximity to and intensity of urbanization, whereas bobcat, gray fox, and mountain lion occurrence decreased with urban proximity and intensity. Domestic dogs and Virginia opossums exhibited positive and weak negative relationships, respectively, with urban intensity but were unaffected by urban proximity. Striped skunk occurrence increased with urban proximity but decreased with urban intensity. Native species richness was negatively associated with urban intensity but not urban proximity, probably because of the stronger negative response of individual species to urban intensity. DOI: 10.1644/09-MAMM-A-312.1.

**Web of Science Categories:** Zoology

**Research Areas:** Zoology



## 20181030 Camera Workshop: U.S. Geological Survey – Literature Review\_02

Using a list of 101 search topics, we evaluated the subject of each article based on the authors keywords, the Web of Science keywords, the abstract, the categories assigned by Web of Science, and the research area.

# Wildlife Camera Workshop

## Wildlife Camera Research and Literature



Category	Year							Grand Total
	1985	1990	1995	2000	2005	2010	2015	
Connectivity	Natal Dispersal	0	0	0	0	0	2	2
	Transportation	0	0	0	0	2	7	9
	Barrier	0	2	0	1	3	11	14
	Connectivity	0	0	0	1	4	25	43
	Dispersal	0	0	0	1	9	31	48
	Fragmentation	0	0	2	5	13	35	94
Invasive	Nonnative	0	0	0	0	0	1	1
	Non-Native	0	0	0	1	1	5	8
	Exotic	0	0	0	0	2	12	21
	Invasive	0	0	1	1	7	62	112
Diversity	Species Richness	0	0	0	4	5	35	69
	Community	0	0	0	2	11	50	133
	Diversity	1	1	5	27	81	249	419
Human	Suburban	0	0	0	0	2	9	14
	Recreation	0	0	1	1	3	5	17
	Rural	0	0	0	1	4	10	23
	Disturbance	0	0	1	3	11	45	113
	Urban	0	0	1	4	16	66	168
	Human	0	0	1	6	29	108	247
Vegetation	Vegetation	0	0	1	4	18	44	82
	Habitat	0	0	3	20	80	252	465
		1	3	16	82	301	1061	2102

### Search Topics Summary:

Workshop themes by 5-year time bin

- From 2000 forward, results almost double every step
- Of 1,900 unique results, more between 2015 – 2018 (n = 1,001) than previous 30 years (n = 899)



### 20181030 Camera Workshop: U.S. Geological Survey – Literature Review\_03

The year of publication for each article was grouped into 5-year bins, starting on the indicated year. We grouped several of the search categories into the general themes of the workshop to show how the use of wildlife cameras has dramatically increased within the last decade. It is important to keep in mind that this is a summary of the search categories and that the whole article may not be focused on that specific word or phrase. For example, there were 465 articles between 2015 and 2018 with the word “Habitat” somewhere in the five fields we searched and not that each of these was wholly about habitat.

# Wildlife Camera Workshop

## Wildlife Camera Research and Literature

Category	Taxa Group						Grand Total
	Amphibian	Insect	Fish	Reptile	Bird	Mammal	
Connectivity	Natal Dispersal	0	0	0	0	0	1
	Transportation	0	0	0	1	2	10
	Barrier	1	1	0	2	0	13
	Connectivity	0	1	3	3	10	42
	Dispersal	0	1	2	0	17	42
	Fragmentation	1	3	1	4	20	92
Invasive	Nonnative	0	0	0	0	0	0
	Non-Native	1	1	1	2	6	12
	Exotic	0	1	0	0	5	23
	Invasive	4	5	11	9	26	65
Diversity	Species Richness	0	3	0	5	22	94
	Community	1	3	2	1	27	122
	Diversity	5	7	17	22	99	386
Human	Suburban	0	0	3	1	5	13
	Recreation	0	0	3	0	0	14
	Rural	0	0	1	2	5	17
	Disturbance	1	4	3	4	21	83
	Urban	2	5	8	8	38	123
	Human	1	6	18	8	44	180
Vegetation	Vegetation	0	4	2	4	28	76
	Habitat	3	10	19	22	96	380
Total		20	55	94	98	471	1788

Search Topics Summary:  
Workshop themes by Taxa Group

- Targeted at mammals and birds
- First amphibian paper 2010
- First insect paper 2002
- First fish paper 1994
- First reptile paper 2004
- First bird paper 1995
- First mammal paper 1994



20181030 Camera Workshop: U.S. Geological Survey – Literature Review\_04

Summarizing the literature search results by general taxonomic group and workshop theme, we see that wildlife camera research has focused mainly on mammal species. This would be expected based on the triggering mechanism of most wildlife cameras and the larger body size and warm bodies of mammals. Keep in mind that an article may be counted in multiple search topics depending on the nature of the article.

# Wildlife Camera Workshop

## Wildlife Camera Research and Literature

Category	Amphibian					Insect					Fish					Reptile					Bird					Grand Total
	Toad	Honey Bee	Tuna	Snake	Eagle	Rat	Rhino	Mouse	Cat	Dog	Elephant	Pig	Lion	Bear	Tiger	Leopard	Deer									
Natal Dispersal	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1				
Transportation	0	0	0	0	0	0	0	0	0	0	1	1	1	5	0	0	0	9	0	0	0	17				
Barrier	0	0	0	1	0	0	0	0	0	0	1	0	4	1	1	1	4	12	0	0	0	4				
Connectivity	0	0	1	2	0	0	2	1	1	0	3	1	4	10	7	7	11	12	0	0	0	58				
Dispersal	0	0	2	0	1	0	1	1	0	1	3	6	2	8	12	9	12	12	0	0	0	58				
Fragmentation	0	0	1	0	0	0	3	4	6	1	4	2	8	13	12	19	17	10	0	0	0	100				
Nonnative	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Non-Native	0	0	0	0	0	1	0	1	1	0	0	0	1	0	0	0	0	3	0	0	0	7				
Exotic	0	0	1	0	0	1	0	1	2	5	0	1	0	0	0	0	5	7	0	0	0	23				
Invasive	3	1	5	5	0	7	4	6	14	7	0	10	5	19	17	14	20	13	0	0	0	137				
Species Richness	1	0	1	1	0	0	1	1	2	1	4	3	5	4	8	13	11	11	0	0	0	56				
Community	0	0	1	1	4	1	1	3	1	3	10	8	12	13	19	26	23	126	0	0	0	126				
Diversity	1	1	7	10	10	4	9	9	16	14	21	30	30	65	118	129	136	590	0	0	0	590				
Suburban	0	0	0	0	0	0	0	0	4	1	1	0	1	0	0	0	6	13	0	0	0	13				
Recreation	0	0	0	0	0	0	0	0	0	1	1	1	5	5	0	0	10	23	0	0	0	23				
Rural	0	0	2	0	1	0	0	0	5	4	0	0	2	4	0	3	3	24	0	0	0	24				
Disturbance	0	0	3	1	1	0	1	0	1	8	8	8	15	17	26	28	34	151	0	0	0	151				
Urban	0	0	4	3	3	0	1	1	10	10	8	18	20	26	29	49	192	326	0	0	0	326				
Human	0	0	5	1	5	0	2	5	5	18	12	12	24	40	56	80	61	326	0	0	0	326				
Vegetation	2	1	7	7	0	7	7	19	12	11	18	25	40	68	101	134	117	99	0	0	0	99				
Habitat	2	1	7	7	0	7	7	19	12	11	18	25	40	68	101	134	117	576	0	0	0	576				
<b>Total</b>	<b>7</b>	<b>3</b>	<b>41</b>	<b>34</b>	<b>26</b>	<b>21</b>	<b>32</b>	<b>53</b>	<b>82</b>	<b>87</b>	<b>103</b>	<b>124</b>	<b>177</b>	<b>308</b>	<b>416</b>	<b>529</b>	<b>538</b>									

### Search Topics Summary:

#### Workshop themes by Species Group

- The top amphibian, insect, fish, reptile, bird “species” results barely approach the least reported mammal



- Lions, tigers, and bears . . . and leopards and deer



20181030 Camera Workshop: U.S. Geological Survey – Literature Review\_05

When we look at the literature search results by general species groups and workshop themes, mammals dominate the wildlife camera literature. Lions, bears, tigers, leopards, and deer are the most frequently reported species; with diversity and habitat the most common topic. Several of the presentations today will show how wildlife cameras are being used in new ways that may make wildlife camera research more applicable to smaller species.

# Wildlife Camera Workshop



- 9:15 – 9:30 Intro – **Trish Smith, Carlton Rochester and Robert Fisher**  
Welcome, logistics, goals and objectives of meeting
- 9:30 – 9:45 MSP Goals - **Trish Smith** (The Nature Conservancy):  
Management Strategic Plan and Cameras
- 9:45 – 10:00 Connectivity - **Carlton Rochester** (USGS):  
San Pasqual Valley Connectivity
- 10:00 – 10:15 Human use - **Nathan Gregory** (Irvine Ranch Conservancy):  
Human Impacts on Wildlife Activity Patterns in a Managed-Access Reserve
- 10:15 – 10:30 Biodiversity monitoring – **Brock Ortega** (Dudek):  
Varied Implementation of Game Cameras as a Tool
- 10:30 – 10:45 Biodiversity monitoring and management – **Markus Spiegelberg** (Center for Natural Lands Management):  
Wildlife Undercrossing Enhancement Project at Carlsbad Oaks North



# Wildlife Camera Workshop



- 11:00 – 11:15 Biodiversity monitoring – **Lori Hargrove** (San Diego Natural History Museum):  
Tracking Wildlife Use of Interior Wetlands in Southern California
- 11:15 – 11:30 Target species inventories/documentation - **Colleen Wisinski** (San Diego Zoo Institute for Conservation Research):  
Use of Remote Cameras for Monitoring Burrowing Owl Nesting Ecology in San Diego County
- 11:30 – 11:45 Target species inventories/documentation – **Spring Strahm** (Conservation Biology Institute):  
And Now for Something Completely Different: Using Stop Motion Photography to Monitor Quino Checkerspot Butterfly Larvae
- 11:45 – 12:00 Biodiversity and connectivity monitoring – **Phoenix Von Hendy** (San Diego Tracking Team):  
San Diego Tracking Team Wildlife Camera Project
- 12:00 – 12:15 Habitat monitoring – **Adam Backlin** (USGS):  
Using Cameras to Monitor Stream Recovery Following a Wildfire at a High Elevation Site



# Wildlife Camera Workshop



- 1:15 – 1:35 Study Design – **Cheryl Brehme** (USGS):  
New Technology - Wildlife Cameras for Amphibian and Reptile research
- 1:35 – 1:50 Invasive species surveillance – **Gary Brennan** (USDA-APHIS):  
San Diego Feral Swine Eradication Program Camera Management
- 1:50 – 2:05 Invasive species – **Chris Brown** (USGS):  
Camera Station Monitoring for Sensitive Resources
- 2:05 – 2:20 Connectivity and management – **Megan Jennings** (Institute for Ecological Monitoring and Management – SDSU):  
Camera Trapping for Conservation Decision Making
- 2:20 – 2:35 Study Design – **Tosha Comendant** (Pepperwood Preserve/Foundation):  
Mayacamas Wildlife Camera Grids & Bay Area Regional Network



20181030 Camera Workshop: U.S. Geological Survey – Afternoon Presentations