Multi-species Baseline Initiative
Project Report: 2010-2014

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September, 2016
Coeur d'Alene, Idaho

Multi-species Baseline Initiative Partner Organizations

Washington Department of Fish and Wildlife

Forest Service U.S. Department of Agriculture

Forest Service U.S. Department of Agriculture Rocky Mountain Research Station

U.S. Fish & Wildlife Service Department of the Interior

Vandals University of Idaho

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Potlatch

Scotchman Peaks Wilderness

Idaho Department of Lands

Idaho Governor's Office of Species Conservation

Kalispel Tribe of Indians

Hancock Forest Management®
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Coeur d'Alene Tribe

Idaho Conservation League

Climate Impacts Group

British Columbia The Best Place on Earth Ministry of Environment

U.S. Department of the Interior Bureau of Land Management

Multi-species Baseline Initiative Funding Organizations

MBI OVERVIEW. Multi-species Baseline Initiative

Preface

All I ever really wanted from life was to be a dirtbag field biologist. As it turned out, as long as I was willing to forgo money, comfort, and a personal life, it wasn't that hard to pull off. I was beside myself with excitement when I got my first job after college working with mountain lions. By University of Utah requirements, I was paid minimum wage for 40 hours per week. By requirement of my graduate student supervisor, I 'volunteered' an additional 40 for the lions. And so my career went. Spotted owls, bald eagles, deer mice, wolves...I dove in and worked hard. One species at a time.

This was a great way to live but I began wondering if it might be possible to manage wildlife more efficiently. My opportunity came when the Idaho Panhandle National Forest partnered with us on a wolverine survey. By choosing a multi-species survey method, we were able to collect solid data on many data-deficient species, not just the one.

Back then, when we had a hard day, we would borrow from Doug Chadwick's description of the pine-cone-shitting-badass and say we were doing things the 'Wolverine Way'. As our project grew, our 'Wolverine Way' morphed into the 'MBI Way'.

At first, the MBI Way referred to perseverance and suffering - mostly in the field. And there was certainly plenty of bushwhacking and frozen beaver hauling to go around. But the hardest parts of this project happened far from the field and looking back over the last 6 years, I realize now the MBI Way is much more than hard field work. From learning completely new (to me) taxonomic groups to trying out citizen science the MBI Way required not just visiting the area outside of my comfort zone, but *living* there. In the end, it pushed me to be a better biologist and broadened my perspective to think about ecosystems rather than species.

As MBI comes to a close, I've finally realized the MBI Way is really about growing out of being a biologist focused on a single species and becoming an ecologist studying the bigger picture. I hope this project inspires other dirtbag field biologists to become ecologists too.

Michael Lucid
16 September, 2016
Bonners Ferry, Idaho

Project Summary
The occurrence data required to develop the species of concern lists which drive many conservation programs are usually not available. This forces practitioners to develop and implement conservation actions without accurately assessing conservation need. We are left with a conservation system which is assumption based rather than data driven. Often modeled, but rarely measured, the data necessary to appropriately inform adaptive natural resource management may seem too difficult to obtain, but they are within reach.

Our tradition of single species management is a primary reason these data are not available but attempting to inventory wildlife one species at a time is akin to trying to understanding the galaxy with a pair of binoculars. Even when projects do encompass multiple species, the focus rarely extends beyond class. The path forward requires inventory and monitoring programs that maximize field survey resources to effectively encompass multiple broad taxonomic groups in single field efforts.

Complicating matters, climate change is increasing the rate of ecosystem composition change and it is unclear what capacity wildlife may possess to adapt. A minimum of 2 data types are necessary to develop wildlife management actions in the context of climate change: 1) species occurrence and 2) species climate requirements. Accurate sets of either of these data types are unavailable for almost all species. This presents an urgent problem which cannot be solved on a per species basis. Thoughtfully designed and implemented inventory programs that target multiple taxonomic groups and their climatic requirements are needed over large spatial scales.

To begin addressing this need in northern Idaho and adjoining mountain ranges, we selected 19 Species of Greatest Conservation Need (SGCN) which were identified by the 2005 Idaho or Washington State Wildlife Action Plans (SWAP) as "lacking essential information." We used this multi-taxa group of amphibians, forest carnivores, and terrestrial gastropods as the centerpiece of an inventory designed to collect data on baseline occurrence and micro-climatic associations for 182 species of animals and plants.

Our study area centered on the Panhandle Administrative Region of the Idaho Department of Fish and Game (IDFG), but also included portions of Washington, Montana, and British Columbia. We overlaid a grid on our 22,975km^2 study area which divided it into 920 5x5 km cells. We conducted surveys for terrestrial gastropods, pond breeding amphibians, and/or forest carnivores and their associates at 2,315 survey sites stratified within the cells. We co-located 1,169 micro-climate data loggers with wildlife survey sites where we collected 1-4 years of air or water temperature data.

Our central funding source was a $950,000 Competitive State Wildlife Grant and we were awarded 5 additional federal grants. We leveraged over 1 million dollars in non-federal matching funds which included 2 non-federal grants but was largely partner contributions. Our total budget was 2.6 million dollars. We built a coalition of 18 partner groups representing state, tribal, and federal agencies, universities, non-governmental organizations, and private corporations. Our partners enabled over 500 individual people, including about 200 volunteer citizen naturalists, to contribute to various aspects of the project.

Together, we demonstrated the feasibility of collecting a regional multi-taxa species occurrence dataset along with survey site level micro-climate measurements. Our micro-climate inventory identified species which may be cool air associates and pinpointed areas which could be used as cool air conservation reserves. Our species occurrence data changed our understanding of the distribution and abundance for each target species. Vertebrates tend to be less well distributed than previously thought and most invertebrates were more abundant and more widely distributed than previously thought. Without this inventory, management actions developed for our target species would have been based on incorrect assumptions.

Data driven adaptive management is needed but is only achievable when adequate data collection tools are in place. The time frame is too short for single species inventories to realistically provide the information we need to manage wildlife during climate change. Through partnerships and thoughtful study design, we leveraged a workforce of hundreds to implement SWAP identified actions within a multi-taxa inventory framework. We called our project the Multi-species Baseline Initiative and from 2010-2014 we set forth into northern Idaho's mountains, forests, and swamps with one simple goal: to see what's out there...

Key Findings

- Standardized surveys at 2,315 sites detected 182 species.
- From 2005 to 2015 the mean NatureServe Idaho subnational conservation status rank (S-rank) of target species increased by 1.4 (Table 1-1).
- From 2005-2015 our understanding of landscape level species occurrence changed for each of the 19 target SGCN (Table 1-2).
- From 2005 to 2015 the mean Idaho S-rank of target invertebrate increased by 2.3 (Table 1-1, 1-3).
- From 2005 to 2015 mean Idaho S-rank of target vertebrates decreased by 0.4 (Table 1-1, 1-3).
- Invertebrate status tended to increase with additional survey effort and vertebrates either stayed the same or decreased slightly.

Table 1-1. Mean NatureServe Idaho subnational conservation status rank (S-rank) changes from 2005-2015. SH (possibly extinct) = 0, SNA/R (Species Not Applicable/Ranked) = removed from calculation

	2005	2015	Change
Invertebrates (*n* = 10)	1.4	3.7	+2.3
Vertebrates (*n* = 5)	2.6	2.2	-0.4
All Species	1.8	3.2	+1.4

- *Cryptomasitx mullani blandi*: We provide evidence this trinomial should never have been considered a distinct taxonomic unit.
- *Cryptomastix sanburni* and *Magnipelta mycophaga*, both considered possibly extinct (SH) in 2005, were detected at multiple sites.
- Evidence supporting a new species of *Hemphillia* is provided.
- Wood frogs (*Rana sylvatica*) were never extant in Idaho.
- Northern leopard frogs (*Rana lithobates*) are native to northern Idaho and appear to be extirpated.
- Western toads (*Anaxyrus boreas*) within the study area are appropriately taxonomically classified.
- Western toads were more abundant in the Selkirks than other portions of the study area.
- Tiger salamanders (*Ambystoma tigrinum*) were likely never extant in northern Idaho.
- Chytrid fungus (*Batrachochytrium dendrobatidis*) is widespread at low concentrations across the study area.
- We detected 46 individual fishers (25 males, 20 females, 1 unknown gender).
- Fishers (*Pekania pennanti*) are more abundant in the West Cabinet Mountains than the remainder of the study area.
- The 'native' fisher Haplotype 12 was not detected.
- 5 individual (2 male, 3 female) Canada lynx (*Lynx canadensis*) were detected.
- 3 individual male wolverines were detected.
- Arboreal mammal species richness, particularly American marten (*Martes americana*), is lowest in the Coeur d'Alene Mountains.

- Mean 2013 annual air temperature of survey sites in was 6.17°C.
- Mean 2013 annual wetland water temperature was 5.88°C.
- A cool air refugium is identified in the Selkirk Mountains.
- Four terrestrial gastropods are associate with cooler than average mean air temperatures.
- The majority of terrestrial gastropods are found across a wide range of mean air temperatures.
- Most target 'rare' terrestrial gastropods were relatively abundant with 4 of the 8 most commonly detected gastropods being target 'rare' species (Fig. 1-1).

Table 1-2. Differences in target species status within study area before and after MBI survey.

Common Name	Pre-MBI Status	MBI Survey Results
Gastropods		
Thinlip Tightcoil (*Pristiloma idahoense*)	Critically imperiled[a]	Relatively common and well distributed
Lyre Mantleslug (*Udosarx lyrata*)	Critically imperiled[a]	Relatively common with restricted range
Pale Jumping-slug (*Hemphillia camelus*)	Imperiled[a]	Relatively common and well distributed
Pygmy Slug (*Kootenai burkei*)	Imperiled[a]	Common and well distributed
Humped Coin (*Polygyrella polygyrella*)	Imperiled[a]	Locally common with limited distribution
Smoky Taildropper (*Prophysaon humile*)	Imperiled[a]	Common and well distributed
Fir Pinwheel (*Radiodiscus abietum*)	Imperiled[a]	Common and well distributed
Sheathed Slug (*Zacoleus idahoensis*)	Imperiled[a]	Common and well distributed
Blue-gray Taildropper (*Prophysaon coeruleum*)	Occurs in study area[b]	Uncommon with restricted range
Kingston Oregonian (*Cryptomastix sanburni*)	Possibly extinct[a]	Locally abundant with limited distribution
Magnum Mantleslug (*Magnipelta mycophaga*)	Possibly extinct[a]	Widespread with patchy distribution
An Oregonian (*Cryptomastix mullani blandi*)	Critically imperiled[a]	Inappropriate taxonomic designation
Amphibians		
Wood Frog (*Rana sylvatica*)	Possibly extinct[a]	Never extant
Northern Leopard Frog (*Lithobates pipiens*)	Possibly extinct[a]	Presumed extinct
Western Toad (*Anaxyrus boreus*)	Widely distributed[c]	Locally abundant but poorly distributed
Tiger Salamander (*Ambystoma tigrinum)*	Unverifiable historic detections[d]	Likely not native and currently not extant
Mammals		
Wolverine (*Gulo gulo*)	All modeled habitat occupied[e]	Little modeled habitat occupied
Canada Lynx (*Lynx canadensis*)	Occasional individuals[f]	Resident individuals
Fisher (*Pekania pennanti*)	Few well distributed individuals[fg]	Locally abundant but poorly distributed

[a] IDFG 2005
[b] Ovaska et al. 2004
[c] Groves et al. 1997
[d] Slater 1937 and IFWIS, accessed April 3,2016
[e] USFWS 2013
[f] Albrecht and Heusser 2009
[g] Knetter and Hayden 2008

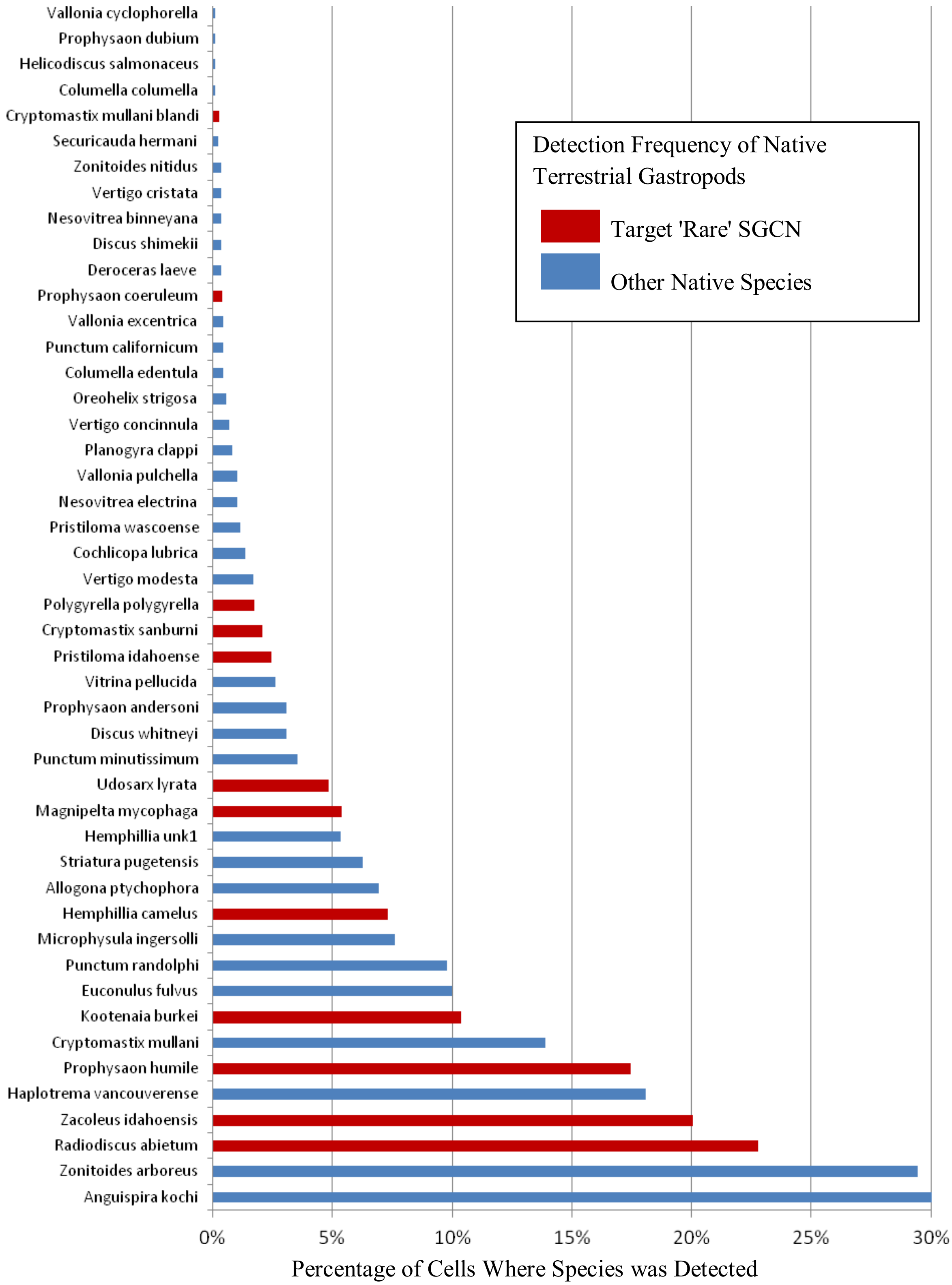

Figure 1-1. Percentage of surveyed cells (*n* = 879) where target 'rare' and other native terrestrial gastropods were detected.

Table 1-3. Target SGCN 2005 and 2015NatureServe Idaho subnational conservation status rank conservation status rank (S-rank) and Idaho SGCN status.

Common Name	2005 ID S-rank	2015 ID S-rank	2005 ID SGCN	2015 ID SGCN
Gastropods				
Thinlip Tightcoil (*Pristiloma idahoense*)	S1	S4	Y	N
Lyre Mantleslug (*Udosarx lyrata*)	S1	S3	Y	N
Pale Jumping-slug (*Hemphillia camelus*)	S2	S2	Y	Y
Pygmy Slug (*Kootenai burkei*)	S2	S5	Y	N
Humped Coin (*Polygyrella polygyrella*)	S2	S4	Y	N
Smoky Taildropper (*Prophysaon humile*)	S2	S4	Y	N
Fir Pinwheel (*Radiodiscus abietum*)	S2	S5	Y	N
Sheathed Slug (*Zacoleus idahoensis*)	S2	S5	Y	N
Blue-gray Taildropper (*Prophysaon coeruleum*)	SNR	S1	N	Y
Kingston Oregonian (*Cryptomastix sanburni*)	SH	S3	Y	Y
Magnum Mantleslug (*Magnipelta mycophaga*)	SH	S2	Y	Y
An Oregonian (*Cryptomastix mullani blandi*)	SNR	SNA	Y	N
Amphibians				
Wood Frog (*Rana sylvatica*)	SH	SNA	Y	N
Northern Leopard Frog (*Lithobates pipiens*)	S2	S2	Y	Y
Western Toad (*Anaxyrus boreus*)	S3	S2	N	Y
Tiger Salamander (*Ambystoma XX)*	S5	S4	N	N
Mammals				
Wolverine (*Gulo gulo*)	S2	S1	Y	Y
Canada Lynx (*Lynx canadensis*)	S1	SNA	Y	N
Fisher (*Pekania pennanti*)	S1	S2	Y	Y

S1: Critically Imperiled, S2: Imperiled, S3: Vulnerable, S4: Apparently Secure, S5: Secure, SH: Possibly Extinct, SNR: Species Not Ranked, SNA: Species Not Applicable

Acknowledgements

Partnerships were the foundation of this project and 18 organizations worked together (Table 1-4) to form the collaborative which was MBI. We thank employees of the following organizations for field assistance: Bureau of Land Management, Coeur d'Alene Tribe of Indians, Grylloblatta Ecological Consulting, Idaho Department of Lands, Idaho Panhandle National Forest, Kalispel Tribe of Indians, Seepanee Ecological Consulting, and Washington Department of Fish and Wildlife. We are grateful for collaboration with the British Columbia Ministry of Forests, Lands, and Natural Resource Operations. We thank Friends of Scotchman Peaks Wilderness, Idaho Conservation League, and Selkirk Outdoor Leadership and Education for facilitating the field work of hundreds of volunteer citizen naturalists. We thank the State of Idaho's Office of Species Conservation for their guidance and participation. We thank Potlatch Corporation, Hancock Forest Management, and over 100 other business and private individuals for allowing access to privately held land. Wildlife Genetics International performed outstanding laboratory work. Technical specialists provided essential assistance with a variety of technical analyses and questions. We are grateful to the journalists who provided excellent media coverage over the course of the project. We thank the many Idaho Department of Fish and Game (IDFG) employees who provided administrative, technical, and field assistance and the multiple IDFG wildlife technicians and interns for perseverance in the face of adversity. There was incredible interest and enthusiasm in participating in MBI and we are humbled by the nearly 500 individuals representing over 30 organizations who stepped up to contribute to this project. Thank you.

Table 1-4. MBI Partner Organizations

MBI Partner
Bureau of Land Management
British Columbia Ministry of Forests, Lands, and Natural Resource Operations
Coeur d'Alene Tribe of Indians
Friends of Scotchman Peaks Wilderness
Hancock Forest Management
Idaho Conservation League
Idaho Department of Lands
Idaho Department of Fish and Game
Kalispel Tribe of Indians
Idaho Office of Species Conservation
Idaho Panhandle National Forest
Potlatch Corporation
Selkirk Outdoor Leadership and Education
University of Idaho
University of Washington Climate Impacts Group
US Fish and Wildlife Service
US Forest Service Rocky Mountain Research Station
Washington Department of Fish and Wildlife

Table 1-5. Individual MBI contributors organized by affiliations. *Italicized names* indicate individuals who represented more than one group. Apologies for inadvertent omissions.

Arrowsandbullets.com
Mark Ullrich

British Columbia MFLNO[a]
John Krebs
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Bureau of Land Management
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Coeur d' Alene Tribe of Indians
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Gem Vision Productions
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Grylloblatta Ecological Consulting
Andrea Kortello

Hancock Forest Management
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Patrick Seymour

Laughing Dog Brewery
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Kootenai National Forest
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Montana Fish Wildlife and Parks
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Jim Williams

MT Natural Heritage Program
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Natural History Museum of LA Co.
Neftali Camacho
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Pend Oreille Master Naturalists
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Lynette Leonard
Valle Novak
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James Salminen
Clem Yonker

Potlatch Corporation
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Not named due to minor status (<18)

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Nicole Thomas
Leanne Harris

Vital Ground
Ryan Lutey

[a]Ministry of Forests, Lands and Natural Resource Operations

[b]Interagency Special Status / Sensitive Species Program Operations

Table 1-5 (continued). Individual MBI contributors organized by affiliations. *Italicized names* indicate individuals who represented more than one group. Apologies for any inadvertent omissions.

Idaho Department of Fish and Game

Administration	***Wildlife***	***MBI Field Technicians***	***MBI Field Technicians***	***IDFG Volunteers (cont)***
Eric Bjork	Miles Benker	***& Biologists***	***& Biologists (cont)***	Jeanine Fichea
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Charles Corsi	Brad Compton	Nicole Bilodeau	Rick Yates	Jenni Hook
Doug Fisher	Kathy Cousins	Chris Boulden	***IDFG Reservists***	Justus Hook
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Nancy Kasner	Jeff Gould	Casey Costello	Anthony Kastella	*Deborah Hunsicker*
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Michael Pearson	Chris Murphy	Adam Fuest	Lorenzo Elias	Zachary Jenner
Treva Pline	Britta Peterson	Connor Fuhrman	Dave Klaw	Zack Johnson
Jim Rice	Dr. Joel Sauder	Andy Gygli	Tom Price	Amelia Kafflen
Lori Thomson	Dr. Rex Sallabanks	Kim Hack	Gary Whitney	Karen Lamb
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Pete Gardner	Jim Teare	Amy List	Jaedyn Beatty	Shaun Leonard
Sue Nass	Colleen Trese	Brian Malloure	Hunter Beatty	Jethro Runco
Vickie Osburn	Wayne Wakkinen	Jason Massarone	Micah Beatty	Kirk Sehlmeyer
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Gina Hodge	Julie Bryant	Andrew Rivers	Dennis Braun	John Albi
Connie Thelander	Rick Bogar	Lisa Rosauer	*Kelsey Brasseur*	Daniel Haley
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Lorene Pennington	Dan Hislop	*Laine Smith*	Grace Clark	
Craig Potcher	Brian Johnson	Johanna Thalmann	Joy Clark	
Angie Schmidt	Robert Morris	Roger Tyler	Courtney Comer	
Brent Thomas	Mark Rhodes	Jamie Utz	Matthew Davidson	
	Robert Soumas	Leslie Van Neil	Tim Dorsey	
	Josh Stanley	Anna Walker	Greg Engel	
	Craig Walker	Drew Wickard	Gunner Fichea	
	Tom Whalen			

Table 1-5 (continued). Individual MBI contributors organized by affiliations. *Italicized names* indicate individuals who represented more than one group. Apologies for any inadvertent omissions.

Friends of Scotchman Peaks Wilderness

FSPW Staff	***FSPW Volunteers***	***FSPW Volunteers***	***FSPW Volunteers***	***FSPW Volunteers***
Kelsey Brasseur	Bob Lizotte	Eric Grace	Jacob Styer	Florence Lamothe
Sandy Compton	Randi Lui	Jake Hagadone	Kyle Tucker	Lindsey Larson
Phil Hough	Ron Mamajek	Miles Hansen	Victoria Wagner	Ciara Legato
FSPW Volunteers	Irv McGeachy	Susan Harbuck	Sandy Wall	Micheal Lowry
Lora Adams	Jim Mellen	Joa Harrison	Mark Waters	David Lux
Jody Aslett	Alan Millar	Jamie Heckmann	Neil Wimberley	Kieri McCommas
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Zach Hagadone	Lisa Veniscofsky	Mike Murray	Will Glenn	Mark Stockwell
John Harbuck	Kate Walker	Jake Ostman	Chuck Gross	Joe Sweeny
Isaac Harrison	Jan Wasserburger	Tim Patton	Perky Smith-Hagadone	Justin Urbantas
John Hastings	Jeff Wiley	Jeff Pennick	Brad Hanson	Erick Walker
Carolyn Hidy	Denise Zembryki	Matthew Phillipy	Nate Harrell	Steve Wall
City School	KC Chisley	Zack Porter	Geoff Harvey	Lex Whinery
Brett Hubbard	Mark Cochran	Jodi Prout	Hannah Hernandez	Annette Wimberley
Deborah Hunsicker	Kari Dameron	Rachel Reckin	Lloyd Hixson	
Stephen Johnson	Melissa Demotte	Rebecca Reynolds	Genny Hoyle	
Andrew Klaus	Susan Drumheller	Tom Riggs	Cate Huisman	
Dick Kramer	David Eberlein-Stephenson	Austin Russell	Jamie Jarolimek	
Tom Kuglin	Tory Fantozzi	Cheryl Schroder	Andy Kennaly	
Rich Landers	Wendy Framois	Amber Spinney	Jody Kramer	
John Latta	David Gilbert	Laurie Stockwell	Eric Krausz	

Table 1-6. Private individuals and groups that allowed access to privately held property to conduct wildlife surveys. *Italicized names* indicate individuals or groups who contributed to the project in addition to allowing access. Apologies for inadvertent omissions.

Private Landowners	**Private Landowners (cont)**	**Private Landowners (cont)**
Roberta Burnham & Terry Hale	William & Melody Martz	James V. & Cynthia A. White
Chris Ashenbritter	John D. & Mary Ann Mason	Doyle & Betty Whitney
Edward C. Atkins	Jessica Matheson	Rand Wichman
Shirley A. Barksdale	Harvey C. May	Nolan Wiley
Dennis C. & Mary Ellen Bartel	Larry H. McIntosh	*Jim Hayden*
David Berklund	Elsie V. Monroe	Conrad Lahr
Pamela Bertram	Curtis Nelson	**Businesses and Industry Land Access**
Jerry & Virginia Botts	Orren E. & Virginia Overland	Carlin Bay LLC
Marion Brendis	Beth Paragamian	Buell Brothers, Inc.
James & Zelma Brisboy	Sonny Poirier	BF Builders, Inc.
Julie Bryant	Carla Poole	Golf Club at Black Rock LLC
Kenneth Chausse	Robert & Renita Radmer	Deep Creek Resort
Foster Cline	Max Reininger	*Coeur d'Alene Tribe*
Scott Crane	Richard & Gloria Rios	Krimm Enterprises, Inc.
Patrick D & Robin M Crnich	Donald & Marlene Roberts	Prairie Falls Golf Association
Steve & Peggy Cuvala	Robert & Karen Roman	T & T Farms, Inc.
Tom & Anna Davidson	Gordon Sanders	Gozzer Golf and Lake Club
Dean Peterson	Bonnie Scott	Red Horse Mountain Ranch
Hart Family Trust	Donald & Barbara Scott	Elk Mountain Farms, Inc.
Edith L. (Ros) Ferguson	Gregory Sempel	Schweitzer Mtn. Facilities LLC
Michael Fish	Brian H. & Michele Shay	River Pine Estate Property Owners
Walter & Denise Floch	Jerome Smith	Association
Kevin Fuhr	Erik Smith	Sylte Ranch LLC
Clinton & Carolyn Fullmer	Warren Smith	Skookum Rendezvous RV Resort
John & Karen Ganley	Roberta Smits	Pillar Rock and Boulder LLC
Gene B. Glazier	Sterling & Marilynn Snyder	CDS Stoneridge Assoc. Golf LLC
Daniel & Linda Green	*Robert Soumas*	Selle Valley Carden School
Daniel Hagman	Jeannine A. Spear	Twin Lakes Village Homeowners
Richard C. & Lois I. Hamacher	Gordon Stanley	Hecla Limited
Eric Hautala	James F. & Margaret Stevens	Molpus Woodlands Group;
Bernard & June Heinemann	Lennart M. Thorell	Carmona Tristar LLC
John Hudspeth	Jack & Marly Tibbitts	Inland Empire Paper Company
Guy Hulquist	Roger Titus	*Potlatch Corporation*
Jeff Hutchins	Timothy P. & Pamela Trimble	*Hancock Forest Management*
John Harbuck	Kehler Trust	Stimson Lumber Company
Michael & Joan Kerttu	Nancy Turley	
Vaughn & Natalie Leatherman	David P. Wenk	

Funding and Match

In the early 2000's, the U.S. Congress created two new funding mechanisms for non-game wildlife: the Wildlife Conservation and Restoration Program (WCRP) and the State and Tribal Wildlife Grants Program (STWGP). In 2001, Congress directed each U.S. state and territory to develop a State Wildlife Action Plan (SWAP) which would provide a list of Species of Greatest Conservation Need (SGCN) and describe Recommended Conservation Actions (RCA) for each of those species. In 2002, the WCRP and STWGP were merged into a single funding source, State Wildlife Grants (SWG) (Cook, M.T. 2008). SWG funds are independent of all other funding sources and are derived in part from offshore oil lease receipts (U.S. Fish and Wildlife Service Wildlife and Sport Fish Restoration Program 2015). By 2005, each state and territory had submitted a SWAP to the U.S. Fish and Wildlife Service which would guide the distribution of SWG funds and outline RCAs which would prevent SGCN being listed under the Endangered Species Act (ESA). Collectively, these plans represent a national action plan to prevent species from being classified as threatened or endangered under the ESA (Cook, M.T., 2008).

The USFWS requires each state to revise SWAPs on a decadal basis and all states were required to have submitted SWAP revisions to the USFWS by September, 2015. All states and territories receive an annual allotment of SWG dollars; however, this usually is not sufficient to implement all RCAs in the SWAP. To help bridge this gap, a portion of the national allotment is set aside each year and distributed through an annual competition for the Competitive State Wildlife Grant (C-SWG) fund. In 2012, the Idaho Department of Fish and Game (IDFG) and Washington Department of Fish and Wildlife (WDFW) were awarded a $950,000 C-SWG to implement the Multi-species Baseline Initiative (MBI) (Table 1-7, Appendix I).

This award formed the core (73%) of our cash funding and allowed us to build on previous and concurrent grants. In total, we operated on 7 grants totaling $1,297,697 from Idaho fiscal year 2010-2015 (Table 1-7). Five of our grants were from federal sources and 2 were from zoo conservation funds. We matched these federal dollars with $1,289,927 of cash and in kind contributions from 14 organizations and 1 private individual (Table 1-8).

Table 1-7. MBI funding and match sources for state of Idaho fiscal years 2010-2015 (all figures in US$).

Grant Source	Title	Agreement #	FY10	FY11	FY12	FY13	FY14	FY15	Total Indirect[a]	Grant Total[a]	Match Total	Match Source	Grant + Match[a]
RMRS[b]	ID Panhandle Biodiversity Initiative	10-JV-11221633-100	60,925	50,000	72,570			30,000	38,338	213,495	112,372	IDFG[g]/FSPW[h]	325,867
RMRS	WA Forest Carnivores	08-CS-11221633-194	16,556	26,511	61	21,261			5,637	64,389	98,528	FSPW	162,917
IPNF[c]	ID Panhandle Forest Carnivores	10-CS-11010400-023		2,143	23,544				3,925	25,687	85,064	IDFG	110,751
FWS-SWG[d]	SGCN Gastropod Surveys	T-3-17		13,994	6,878				3,877	20,872	20,872	IDFG	41,744
Oregon Zoo	Wolverine Survey	NA		4,400					709	4,400	0	NA	4,400
FWS-Sec.6[e]	Panhandle Forest Carnivores	E-64-TW-1			18,854				2,871	18,854	63,110	FSPW/ICL[i]/ZB[j]	81,964
FWS-cSWG[f]	MBI	F12AP01101				348,000	348,000	254,000	140,189	950,000	909,981	MBI Partners[k]	1,859,981
Total			**77,481**	**97,048**	**121,907**	**369,261**	**348,000**	**284,000**	**195,547**	**1,297,697**	**1,289,927**		**2,587,624**

[a] Indirect is included in FY, grant, and grant+match totals.
[b] US Forest Service Rocky Mountain Research Station.
[c] Idaho Panhandle National Forest.
[d] US Fish and Wildlife Service State Wildlife Grant.
[e] US Fish and Wildlife Service Section 6.
[f] US Fish and Wildlife Service Sport Fish and Wildlife Restoration Fund competitive state wildlife grant.
[g] Idaho Department of Fish and Game (IDFG).
[h] Friends of Scotchman Peaks Wilderness (FSPW).
[i] Idaho Conservation League.
[j] ZooBoise Conservation Fund.
[k] British Columbia Ministry of Forests Lands and Natural Resource Operations, Coeur d'Alene Tribe of Indians, FSPW, Hancock Forest Management, Idaho Conservation League, Idaho Department of Lands, IDFG, Kalispel Tribe of Indians, Idaho Office of Species Conservation, Potlatch Corporation, Private Donation (S. Cushman), Selkirk Outdoor Leadership and Education, University of Idaho, Washington Department of Fish and Wildlife.

Table 1-8. Sources of MBI cash and in kind matching funds (all figures in US$).

Matching Organization	Federal Grant Matched						
	10-JV-11221633-100	08-CS-11221633-194	10-CS-11010400-023	T-3-17	E-64-TW-1	F12AP01101	Total
British Columbia MNRO[a]						328,240	328,240
Coeur d'Alene Tribe of Indians						40,365	40,365
Friends of Scotchman Peaks Wilderness	52,416	98,528			16,705	136,172	303,821
Hancock Forest Management						1,156	1,156
Idaho Conservation League					16,705	8,051	24,756
Idaho Department of Lands						12,882	12,882
Idaho Department of Fish and Game	59,956		85,064	20,872		218,980	384,872
Kalispel Tribe of Indians						91,647	91,647
Idaho Office of Species Conservation						5,095	5,095
Potlatch Corporation						3,000	3,000
Private (S. Cushman)						17,396	17,396
Selkirk Outdoor Leadership and Education						23,525	23,525
University of Idaho						19,875	19,875
Washington Department of Fish & Wildlife						3,597	3,597
Zoo Boise Conservation Fund[b]					29,700		29,700
Total	**112,372**	**98,528**	**85,064**	**20,872**	**63,110**	**909,981**	**1,289,927**

[a] Ministry of Forests Lands and Natural Resource Operations
[b] Awarded directly to Friends of Scotchman Peaks Wilderness who used the grant for operating and personnel expenses related to MBI participation

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CHAPTER 1. Overview - Multi-species Baseline Initiative

Introduction

The world is changing fast, especially for wildlife. In order to implement meaningful actions that will effectively inform conservation efforts of the future, we need baseline knowledge of species' status and distribution at the landscape level. Such snapshots would allow us to pinpoint and act upon current conservation problems and allow future workers to adaptively manage species distribution and abundance over time. Our success in this endeavor rests on our ability to merge established techniques, partnerships, and funding mechanisms into creative new programs that allow us to move wildlife conservation forward at a pace that remains abreast of global change.

The most basic biological information is lacking for most species in most ecosystems. This information is often simple to collect and could often be gained in single field efforts. But due to lack of funding and interest, Recommended Conservation Actions (RCA) such as 'basic species inventory' for species listed in SWAPs often fall by the wayside.

Terrestrial gastropods are a case in point. Of the 229 SGCN listed in the 2005 Idaho SWAP (ISWAP), 49 were terrestrial gastropods. This was the second largest taxa group in the 2005 ISWAP, second only to the 54 bird SGCNs. While the RCAs listed for birds tended to be very specific recommendations on how to improve the status of the species (such as habitat manipulation), almost all of the terrestrial gastropods in the SWAP were identified as lacking basic occurrence data. Basic inventory was listed as a RCA for only one bird species in the 2005 ISWAP. In contrast, basic inventory was the primary RCA for 82% of terrestrial gastropods. Inventory was critical as we lacked sufficient knowledge of these species to know if they were truly rare, truly habitat specialists, or if there was just a lack of survey effort (IDFG 2005).

Given the general lack of human connection to invertebrates, it comes as little surprise that there is not a sufficient knowledge base for invertebrates. Even species with general public appeal, such as amphibians and mammalian carnivores, suffer from a lack of basic information. For example, wood frogs (*Rana sylvatica*) were listed in the 2005 ISWAP based on decades-old observations for which the taxonomy of available museum specimens was never verified. In another case, without a single field survey, the USFWS presumed all modeled wolverine (*Gulo gulo*) habitat within the MBI study area was occupied by that species (USFWS 2013).

Computer modeling and management plans are essential pieces of the conservation puzzle. However, both are of limited value without an inflow of sufficiently accurate data to validate models and add the "*adaptive"* portion to management plans. Our national strategy for wildlife conservation focuses on identifying and funding programs for species at risk. The process basically boils down to this: 2) make a list of species we are concerned about 3) develop management plans to conserve said species, 4) implement those actions on the ground, and 5) monitor those species to make sure the first steps worked.

Makes sense, right? Except there is a step missing. The first step should be 1) Develop a monitoring program that assesses the range, distribution, and abundance of species in multiple taxonomic groups. This would allow us to assess which species are truly at risk so that conservation dollars and efforts are most appropriately allocated.

One of the most basic aspects of human endeavor, to assess where we are before we move forward, is missing from our process. A field biologist or manager may see the need to collect distribution data on many species, but directives from the highest levels of government or available funding may concentrate on only a few species.

This is where we found ourselves in 2010. Our first partner, the Idaho Panhandle National Forest approached us with a need and funding to conduct wolverine (*Gulo gulo*) surveys. This fit well within the 2005 ISWAP RCAs and we accepted the project. However, instead of choosing a technique such as snow-tracking (Ulizio et al. 2006), which would only detect wolverines, we chose to further develop an existing technique that had potential to detect many species in multiple taxa groups. Bait stations (Robinson et al. *in prep*) not only allowed us to implement 2005 ISWAP RCAs for two additional SGCN but allowed us to collect a standardized data set for 28 species representing 12 families.

The absence of even basic information about the occurrence, distribution, and rarity of species makes it challenging to assess their vulnerability to current or future habitat conditions. Climate change is expected to drive large-scale shifts in ecological conditions as well as geographic dislocation of species' ranges (McCarthy 2001). It is essential to provide managers with solid information on how the dominant factor of human land use will interact with a changing climate and other factors to impact SGCN across their ranges.

In 2010 and 2011, Multi-species Baseline Initiative (MBI) partners implemented 2005 SWAP RCAs for 14 SGCN at 402 sites in a 10,171 km^2 study area spanning portions of Idaho, Washington, and Montana. During this time the project was called the Inland Maritime Initiative (Lucid et al. 2011). In 2012 the project name was changed to MBI when we were awarded a $950,000 Competitive State Wildlife Grant and we added 5 SGCN to our target list and expanded our study area to 22,975km^2.

Thanks to our collaborative approach, MBI has exceeded expectations. IDFG developed and expanded partnerships with adjoining state and provincial governments, federal agencies, Native American tribes, universities, private corporations, and non-governmental organizations. Our large community of partners pooled resources to implement the project. This included financial contributions and in-kind contributions of personnel time, operating expenses, and thousands of donated hours by hundreds of volunteer citizen naturalists. Our results demonstrate the feasibility of MBI and projects like it to maximize efficiency by surveying multiple taxonomic groups in single large-scale field efforts and to provide the most appropriate and current scientific knowledge for SWAP revisions.

MBI is a collaborative of organizations which, from 2010-2014, co-located micro-climate monitoring stations with multi-species wildlife surveys across the Idaho Panhandle and adjoining mountain ranges. Our goals were to: 1) assess the range, distribution, and S-Ranks of 19 SGCN listed in the 2005 ISWAP and WSWAP, 2) collect air and water temperature datasets at wildlife survey sites, 3) develop community, corporate, and agency partnerships to more efficiently implement RCAs, and 4) to develop and implement Phase I of a regional multi-taxa monitoring program.

Methods

Study Area

The project area consists primarily of IDFG's Panhandle Administrative Region (Panhandle) which stretches from the Clearwater Divide north to the Canadian Border. The study area encompasses portions of five mountain ranges; Saint Joe, Coeur d'Alenes, West Cabinets, Purcells, and Selkirks (Figure 1-2). The northern portion of the Panhandle narrows into a 70km wide strip of land which contains portions of the West Cabinet, Purcell, and Selkirk Mountains. To maintain ecological relevancy and build partnerships we expanded the study area west and east to the next major drainage to include portions of Washington and Montana. We expanded the study area north into British Columbia in order to most effectively implement the forest carnivore portion of the project and further develop international relationships with Canadian partners.

The U.S. portion of the study area consists of 22,975km^2 and ranges in elevation from 525-2350 meters. Flat glacial valleys are used by humans primarily for urban and rural settlement and contain small portions of remnant or reconstructed forested wetland habitat. Mountain ranges, which are used by humans for logging, mining, and recreation, rise steeply from valley floors to abundant sub-alpine and limited alpine habitat where the dominant human use is recreation.

The study area is a relatively wet area in the Inland Pacific Northwest averaging 100.3 cm of precipitation per year (PRISM Climate Group, Accessed May 27, 2016). Summers are typically short and hot with a drier period from July-September. Winters are moderate in temperature with heavy precipitation which currently falls primarily in the form of snow. One drainage in the study area, Lightning Creek, is thought to be the wettest drainage in Idaho receiving 229 cm of precipitation annually (https://www.nationalforests.org/who-we-are/our-impact/idaho Accessed 18 April, 2016).

The merging of Maritime, Rocky Mountain, and Boreal Forest ecological divisions results in the study area being on the fringe of many native species' ranges. The influence of different ecosystems, low elevation, and heavy precipitation make the study area a favorable location for high levels of temperate biological diversity.

The study area hosts one of the more diverse assemblages of coniferous trees in North America including grand fir (*Abies grandis*), western red cedar (*Thuja plicata*), subalpine fir (*Abies lasiocarpa*), Douglas fir (*Pseudotsuga menziesii*), western and mountain hemlock (*Tsuga heterophylla*, *Tsuga mertensiana*), lodgepole pine (*Pinus contorta*), western larch (*Larix occidentalis*), Engelmann spruce (*Picea engelmannii*), ponderosa pine (*Pinus ponderosa*), whitebark pine (*Pinus albicaulis*), and Western white pine (*Pinus monticola*). It also hosts at least some individuals of every native meso to large native mammalian carnivore including marten (*Martes americana*), fisher (*Pekania pennanti*), wolverine, bobcat (*Lynx rufus*), Canada lynx (*Lynx canadensis*), mountain lion (*Puma concolor*), coyote (*Canis latrans*), grey wolf (*Canis lupus*), black bear (*Ursus americanus*), and grizzly bear (*Ursus arctos*). Few species are confirmed to have been completely extirpated from the study area since pre-European settlement.

This biologically rich landscape presents an opportunity to understand a region where biological diversity remains largely intact and to develop a monitoring program to evaluate and potentially assist the adaptation of wildlife species to global change.

Study Design
We employed a systematic stratified sampling design by overlaying the study area with a 5x5km grid. We used ArcGIS 10.1 (Environmental Systems Research Institute, Redlands, CA) to build the grid (Figure 1-2).

We developed protocols for primary surveys at three types of sites: 1) terrestrial (gastropods), 2) wetland (amphibians), and 3) winter bait stations (forest carnivores). Our goal was to conduct one terrestrial invertebrate survey in all cells (n = 920) and a wetland amphibian survey in all cells in Idaho and Washington (n = 849) regardless of land ownership. We also aimed to conduct winter forest carnivore surveys in each high elevation cell (mean cell elevation >1,000m, n = 457 cells). We conducted all three types of survey in 43% (n = 392) of the cells in our study area.

We co-located terrestrial micro-climate data loggers at 90% (n = 894) of all terrestrial invertebrate survey sites. These data loggers recorded air temperature (n = 746) or air temperature and relative humidity (n = 148) for 1 (n = 493), 2 (n = 27), 3 (n = 290), or 4 (n = 84) years. We co-located terrestrial air and relative humidity data loggers at 50 of 424 wetland pond sites and aquatic water temperature data loggers in 131 ponds for one year (Table 1-9).

Table 1-9. Summary of surveys conducted 2010-2014 by type.

Year[a]	**Terrestrial Gastropod**		**Wetland Amphibian**		**Carnivore Bait Station**	
	Cells	Sites	Cells	Sites	Cells	Sites
2010	172	172			15	16
2011	318	322			17	17
2012					74	86
2013	497	498	641	659	97	97
2014			161	167	280	281
Totals	879[b]	992	802	826	457[b]	497

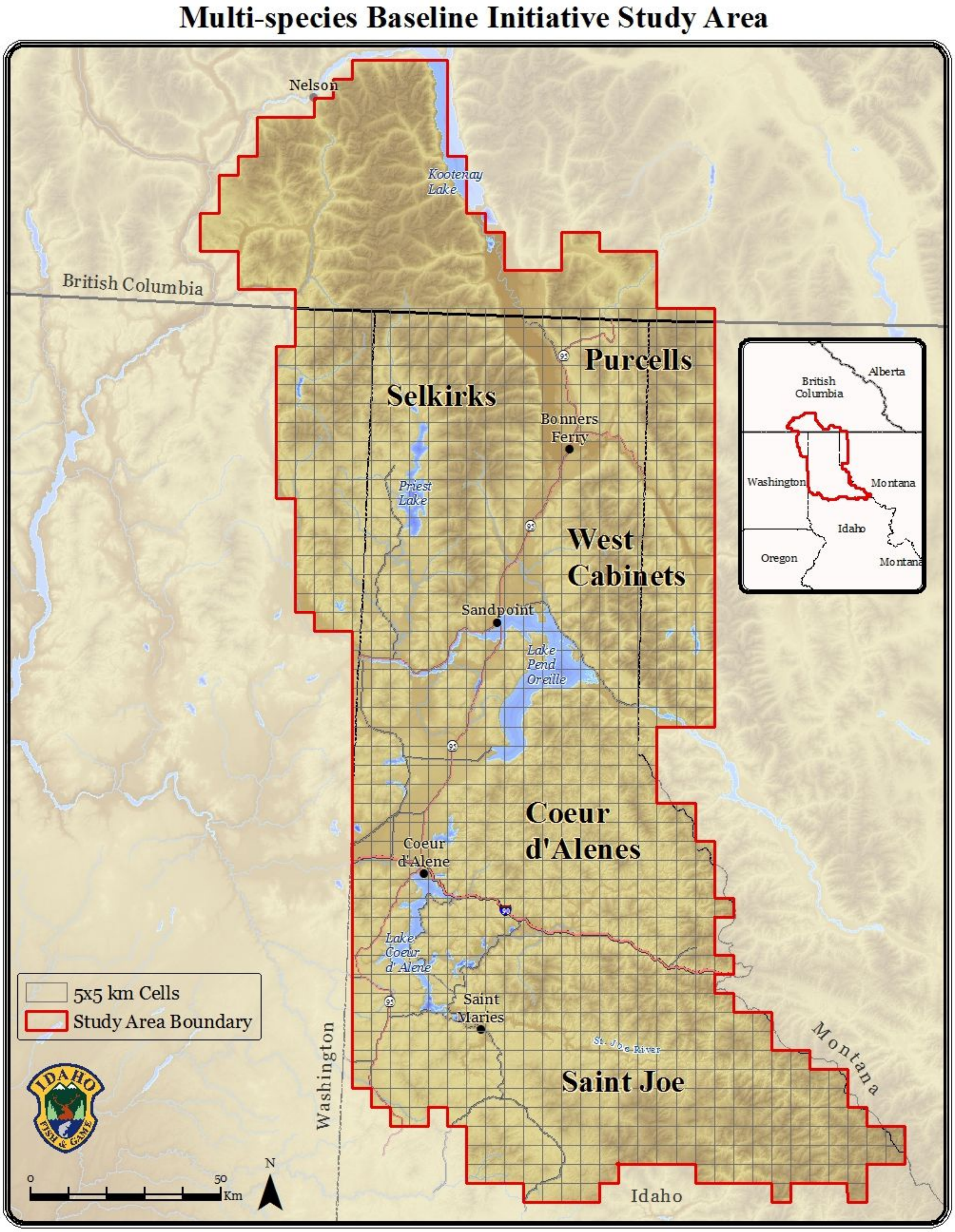
[a] Year refers to the first year of the winter season. A bait station associated with 2012 was run in the winter of 2012-13

[b] Some cells received multiple surveys across different years so column sum is greater than total number of cells surveyed.

We designed the three primary surveys to focus on our funded taxonomic groups: amphibians, terrestrial gastropods, and forest carnivores. For all surveys, we chose techniques which would enable reliable detection of all species within that taxa group, not just the funded SGCNs. At terrestrial gastropod survey sites, we deployed traps to collect ground and flying beetles. We also recorded occurrence data for a variety of other species which are easily detected and identified by field technicians at terrestrial plots (n = 16 species) and wetland plots (n = 14 species). In addition to forest carnivores, bait station cameras allowed for the detection of small mammals, ungulates, and birds.

Conclusions

In this report we summarize the current status of 19 target SGCN funded by the Competitive State Wildlife Grant we were awarded in 2012. We present the first comprehensive inventory of terrestrial gastropods and pond breeding amphibians with co-located micro-climate surveys in the study area. We also detail the most comprehensive forest carnivore survey in the study area to date. When combined with opportunistically collected species data, we provide standardized survey data for 182 species representing 8 taxonomic classes from 2,315 survey sites across our study area. This baseline inventory sets the stage for long term species occurrence and micro-climate monitoring which we recommend be implemented to assess changes in species abundance and distribution over time.



Map 1-1. MBI study area with overlay of 5x5 km grid. The 5 mountain ranges are labeled.

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CHAPTER 2. Gastropods - Multi-species Baseline Initiative

Introduction

A humped coin (*Polygyrella polygyrella*) does not generate the same level of human passion as a wolverine (*Gulo gulo*), underscoring the markedly different conservation challenges faced by invertebrates and vertebrates. Incomplete species lists, complex and specialized taxonomy, and a relative lack of human interest all lead to poor information on invertebrate distribution, abundance, and basic ecology. Nevertheless, a majority of the 56 U.S. state and territory State Wildlife Action Plans (SWAPs) created in 2005 classified invertebrates as Species of Greatest Conservation Need (SGCN). Specifically, 80% (n = 45) of 2005 SWAPs included insects and 44% (n = 25) included terrestrial gastropods (http://www.usgs.gov/core_science_systems/csas/swap/sgcn/state_list.html. Accessed June 11, 2015).

Terrestrial gastropods perform a suite of ecosystem functions including fuels reduction, disease vectoring, soil building, nutrient cycling, and providing a prey base for multitudes of other species (Jordan and Black 2012). As a group, they are thought to be sensitive to a variety of human and natural influences including fire, silviculture, and habitat fragmentation (Jordan and Black 2012). Mollusks (terrestrial and aquatic) represent 37% of known animal extinctions since 1600 A.D. and currently represent 20% of species considered threatened globally (Dunk et al. 2004, Seddon 1998). Terrestrial gastropods are represented by about 1,200 North American species and an estimated 150-300 new North American species await description (Nekola 2014). The group is well described at a coarse level in North America but limited inventory data often lead to misperceptions regarding how abundant or at risk terrestrial gastropod species might be.

Collection of terrestrial gastropod data from the Idaho Panhandle and adjoining mountain ranges began in earnest in the late 1800s (Pilsbry 1940). Original collections, not without scientific merit, were at least partly driven by commercial motives. This led to data with extremely vague or inaccurate georeferencing and taxonomic designations that were monetarily motivated (Coan and Roth 1987). A handful of museum vouchered specimens are available from over the course of the 1900s (IFIWS accessed April 10, 2016) but standardized attempts to scientifically describe unoccupied areas did not occur until the end of that century (Frest 1999). Since 2000, surveys have been conducted in British Columbia (Ovaska and Sopuck 2007, Nekola et al. 2012), western Montana (Hendricks, 2003, Hendricks 2005, and Hendricks 2012), and the Idaho Panhandle (Hendricks et al. 2007) and predictive models for multiple species were developed for western Montana (Hendricks et al. 2008). Publications compiling observational records have also recently become available for the Idaho Panhandle (Bosworth 2012, Burke 2013), northeastern Washington, and northwestern Montana (Burke 2013). Two new genera have been described from the study area since 2000 (Leonard et al. 2003, Leonard et al. 2011).

Frest (1999) described a somewhat dire situation for many Idaho terrestrial gastropods and when the 2005 I-SWAP was written, many species were only known from a handful of localities (I-SWAP 2005). Despite somewhat extensive work in and adjacent to our study area, uncertainty remained as to the abundance and distribution of many terrestrial gastropod species. It was clear that an extensive standardized terrestrial gastropod survey was needed for our study area. Gastropods are far from being the only taxonomic group lacking basic inventory data and we chose to implement a multi-taxa inventory approach by collecting opportunistic field observations for species which are easy to collect or identify in the field.

Our goals were to 1) provide distribution and occurrence data for 12 SGCN gastropods to inform the 2015 S-ranks and SWAP revisions, 2) co-locate micro-climate data loggers with terrestrial gastropod surveys, 3) co-locate terrestrial gastropod surveys with Forest Inventory and Analysis (FIA) plots which provide detailed habitat data, 4) collect opportunistic field observations for 17 species of plants, mammals, reptiles, and bees and 5) collect beetle, millipede, and shrew samples.

Methods

Study Design

We stratified our 23,000 km^2 study area into 920 5x5 km sampling cells and successfully conducted at least one terrestrial survey in 879 (96%) cells. We did not conduct surveys in 41 (4%) cells because we were unable to gain access to privately owned land (Map 2-1). Our survey sites were selected by technicians in the field (n = 172), randomly but biased to roads and trails (n = 670), and sub-selected from randomly selected FIA plots (n = 150) based on site characteristics. We biased sampling to roads and trails to increase field efficiency. Detailed site characteristic data is available for FIA plots and we conducted a sub-set of surveys on FIA plots to enable future habitat association analyses.

Basic Survey Site Selection - In 2010, field technicians selected survey locations (n = 172) in relation to bear hair snare corrals (Woods et al. 1999). Technicians traveled to an assigned grid and selected a location for a bear hair snare corral 50-150 meters from a road or trail based on landscape features such as trail and road junctions. Technicians then used a GPS unit to walk perpendicular to the road or trail 300 meters to a location where they established the invertebrate transect.

In 2011, we used ArcGIS 10.1 (Environmental Systems Research Institute, Redlands, CA) to generate a buffer around each road and trail from 50-150 m. We then generated a random point within this buffer for the survey location (n = 322). This resulted in survey sites that were randomly located, but biased to roads and trails. In 2013 we used the same technique for the remaining unsurveyed cells (n = 324) with the exception of cells where we conducted surveys at FIA plots.

FIA Survey Site Selection - We established a Memorandum of Agreement (MOU) with the US Forest Service (USFS) Rocky Mountain Research Station (RMRS) which allowed access to the locations of 150 FIA plots on public land. We were unable to finalize the MOU until 2013 after we had already sampled 477 cells. In order to distribute the FIA plots evenly across the study area, we stratified our survey points by mountain range. We chose 150 points from the 293 available from the USFS (Table 2-1).

Table 2-1. Site Characteristics of available FIA plots (*n* = 293)

Mountain Range	Number of sites provided by FS	Number of sites selected by MBI	Stand Age[a]			Elevation[b]			Road Distance[c]		
			Old	Mature	Young	High	Medium	Low	Far	Mid	Close
Cabinets	28	15	7	13	8	6	18	4	16	9	3
Coeur d' Alenes	84	48	6	48	30	0	55	29	15	50	19
Purcells	15	15	1	6	8	0	10	5	1	10	4
Selkirks	74	32	21	20	33	16	32	26	27	29	18
St. Joe	92	40	6	42	44	11	66	15	35	39	18
Total	**293**	**150**	**41**	**129**	**123**	**33**	**181**	**79**	**94**	**137**	**62**

[a] Stand age: Old (126-300 years), Mature (76-125 years), or Young (0-75 years)
[b] Elevation: High 1677-2303 m), Medium (1067-1676 m), or Low (457-1066 m)
[c] Road Distance: Far (> 1 mile), Mid (305 m - 1.59 km), or Close (0-304 m)

We limited the number of FIA plots to one per cell. From the 293 available FIA plots, we selected all plots which fell within Idaho Department of Fish and Game (IDFG) Wildlife Management Areas (WMA) (*n* = 6). To ensure a diversity of plot conditions, we then selected plots based on three characteristics: stand age, elevation, and distance to road (in order of priority). Within each mountain range, sites were first selected to achieve equal number of old, mature, and young stand sites. In the case of the Coeur d' Alenes and St. Joe mountain ranges, all of the old stand sites (except those in duplicate cells) were selected since there were few available. We sampled 2 FIA plots in St. Joe cell 1539 because one plot fell within a WMA and another was an old stand site. There were limited sites provided within the Purcell mountain range, therefore all of the sites within that range were selected regardless of site characteristics (Table 2-2).

Table 2-2. Site characteristics of selected FIA plots (*n* =150)

Mountain Range	Number of sites required by MBI	Stand Age[a]			Elevation[b]			Road Distance[c]		
		Old	Mature	Young	High	Medium	Low	Far	Mid	Close
Cabinets	15	5	5	5	3	8	4	9	3	3
Coeur d' Alenes	48	6	22	20	0	26	22	14	23	11
Purcells	15	1	5	8	0	10	4	1	9	4
Selkirks	32	11	10	11	9	15	8	12	12	8
St. Joe	40	5	18	18	9	20	12	18	12	11
Total	**150**	**28**	**60**	**62**	**21**	**79**	**50**	**54**	**59**	**37**

[a] Stand age: Old (126-300 years), Mature (76-125 years), or Young (0-75 years)
[b] Elevation: High 1677-2303 m), Medium (1067-1676 m), or Low (457-1066 m)
[c] Road Distance: Far (> 1 mile), Mid (305 m - 1.59 km), or Close (0-304 m)

Field Methods
At each site we deployed a survey transect (Fig. 2-1) which used a combination of techniques to collect arthropods. Gastropods were targeted with cardboard cover board traps (Hawkins 1998), leaf litter collection, and timed visual searches. We used pitfall traps to collect gastropods, ground beetles, and shrews. We recorded visual and audible opportunistic detections of plants, mammals, and reptiles. We opportunistically photographed bumblebees. We deployed a microclimate data logger at each site which recorded air temperature at basic sites (83%, n = 746) and air temperature and relative humidity at FIA sites (17%, n = 148). We used Lindgren Funnel traps (Lindgren 1983) at all FIA sites to collect flying insects.

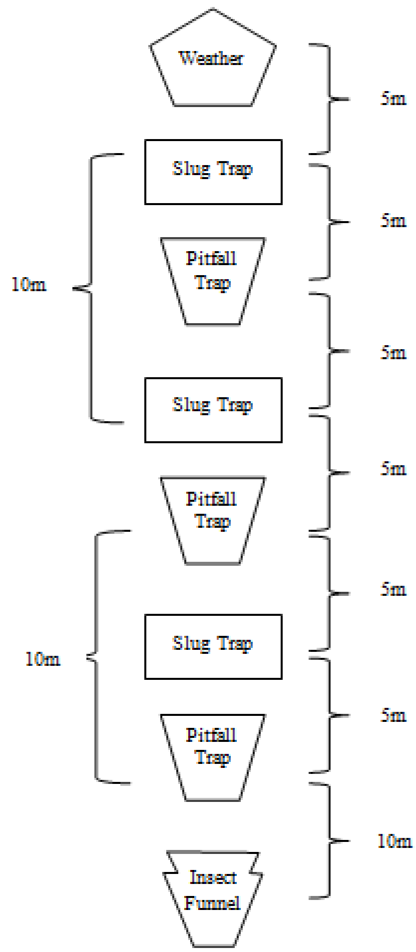


Figure 2-1. Terrestrial Transect

Microclimate data logger – A data logger was attached with nails to a conifer tree >30 cm in diameter within 40 m of the assigned point (see Chapter 5 for more detail). Beginning at the data logger, an observer used a compass to set a 45° bearing on which to set up the survey transect.

Cardboard cover boards - Three cardboard cover board traps were placed 5 meters apart from each other (Appendix II-a). In 2010 traps were initially deployed dry and un-baited (6%, *n* = 63 transects). After the first round of trapping, we began baiting traps to improve capture rates. Gardeners have long considered beer to be an effective slug attractant. Beer has been shown to be a more effective slug attractant than water (Piechowicz et al. 2014) and some commercially available molluscicides (Dankowska 2011). We tested the effectiveness of dry, water baited, and beer baited traps.

The majority of transects deployed in 2010 (11%, *n* = 109) had one dry control trap, one trap baited with 12 oz. of water, and one trap baited with 12 oz. of Natural Ice® beer. In 2011 all transects (32%, *n* = 322) had one trap each baited with 12 oz. of water, Natural Ice® beer, or Laughing Dog microbrew beer. In 2013 each of the three traps in all transects (50%, *n* = 497) were baited with 12 oz. of Natural Ice® beer. We chose Natural Ice® beer because it was the cheapest commercially available. We are grateful to Laughing Dog Brewery for graciously donating surplus beer in 2011. While there were differences in the attractiveness of differently baited traps, transect types showed little difference in effectiveness (Lucid et al. in prep.).

Traps were baited in the field by placing the trap and bait in a two gallon zip top bag and allowing the cardboard to become saturated. Traps were placed 5 m apart along the transect. Leaf litter was moved aside, the trap was placed directly on the soil, any remaining bait was poured on the trap, and the trap was covered with leaf litter to slow drying. Traps were re-visited after approximately 14 days when an observer used a magnifying glass to view the trap and remove all gastropods.

Leaf litter - Leaf litter was collected during the second visit to the survey transect. We sampled the top 10 cm of leaf litter where leaf litter associated gastropods are found (Hawkins et al. 1982) at three locations five meters perpendicular to each trap. We collected 333 mL of leaf litter from each of the three locations for a total of one liter of leaf litter from each transect. When leaf litter was not 10 cm deep we brushed adjoining litter together to collect a large enough sample. Leaf litter samples remained in the field with observers for 1-8 days and were then frozen upon return from the field. Samples were later removed from the freezer and placed in paper bags which were stapled shut to prevent contamination by other organisms while they dried at room temperature. Litter was then sifted through a series of three filters (Appendix II-a) by biological science technicians (38%, *n* = 374 samples), paid workers from a temporary job service (18%, *n* = 179 samples), college students (6%, *n* = 57 samples) and volunteer citizen naturalists (39%, *n* = 382 samples). Gastropod shells and millipedes were preserved in separate dry vials.

Timed searches - During each site visit an observer conducted at least one gastropod timed search (GTS). Beginning at the climate station, one observer spent 15 minutes searching under rocks and logs for gastropods, traveling no farther than 50 m from the climate station. FIA sites received two additional GTS in the fall of 2014.

Pitfall traps - Three 8 oz. plastic cups with a 4 cm^2 piece of Hot Shot® No-Pest fumigant strip (Spectrum Brands, Middletown, WI) were placed 5 meters apart along the transect to act as pitfall traps. A trowel was used to dig a small hole and then the rim of the cup was placed level with the ground.

During subsequent visit(s), collected rainwater was poured from the trap (amount of water was measured in 2013) through a strainer. Gastropods were handpicked from the strainer, placed in a vial, and the remaining sample (which consisted of beetles, other species, and debris) was placed into a manila coin envelope. Samples were dried in the field. Shrews (*Sorex* spp.) were occasionally captured in pitfall traps. Dead shrews were collected and preserved in 95% ethanol.

Lindgren funnel traps - We deployed un-baited Lindgren-8 funnel traps (Lindgren 1983) with dry collection cups at 148 of 150 FIA survey sites and Lindgren-8, 12, or 16 funnel traps (n = 135, 17, 31 respectively) at 22%, (n = 183) of basic survey sites. We placed a 4 cm^2 piece of fumigant strip in each collection cup. Samples were collected during each re-visit and stored in manila coin envelopes.

Opportunistic Observations - In 2013, we created a list of easily identifiable species of reptiles, mammals, invasive plants, native plants, and bumblebees which observers might encounter while working on transects. We provided training in species ID and a field identification guide. Observers recorded visual and audio detections while at the survey site and took photographs of bumblebees and one plant [rare moonwort (*Botrychium* spp.)] for later species ID verification.

Specimen Euthanasia and Storage
Gastropods - Gastropods collected on traps and by GTS were euthanized in the field by drowning. Specimens were then stored in 70% ethanol until they were identified at which point they were transferred to 95% ethanol for long term storage. Gastropods and other invertebrates collected with leaf litter were frozen and then stored in paper bags at room temperature until leaf litter was sorted. Sorted specimens were stored in dry plastic vials at room temperature. Gastropods which were sub-sampled for genetics work were either dried whole (specimens < 1 cm) or a sub-sample was dried and stored in a manila coin envelope at room temperature until laboratory work was performed.

Millipedes remained part of the leaf litter sample until the sorting process. At this time millipedes were separated from gastropod specimens and stored in dry vials at room temperature. Beetles were euthanized at the time of capture with fumigant strips. Beetles were stored in dry manila coin envelopes. Shrews expired in pitfall traps in the field. Shrew carcasses were stored in 95% ethanol until a tissue sub-sample was taken from the tail. Each tail sub-sample was dried and stored in a manila coin envelope at room temperature.

Gastropod Taxonomy
We conducted taxonomy work days ("gastropodys") where a taxonomic expert oversaw less experienced biologists and technicians in specimen identification. Bill Bosworth (Bosworth 2012) oversaw two early work events and Tom Burke (Burke 2013) oversaw a three week work period in 2014 in which we identified the majority of specimens (71%, n = 3056). Less experienced observers typically learned to identify easier specimens quickly and had an expert on hand to consult with questions. Difficult taxa groups (in particular *Cryptomastix* spp. and *Punctum* spp.) went directly to the expert for identification. We used characters defined in Bosworth (2012) and Burke (2013) to identify specimens. Characters used identify select similar species are outlined Appendix II-c.

A sub-group of slugs (7%, *n* = 312) including all *Hemphillia* spp. were sent to WGI for molecular species ID. We sub-selected all slugs we identified morphologically as *Hemphillia* spp. from the 2013 and 2014 collections for laboratory analysis at WGI. WGI developed a species test for this group of organisms using a portion of the 16S RNA gene. WGI downloaded 16S sequences from Genbank (http://www.ncbi.nlm.nih.gov/genbank/) for *Hemphillia dromedarius*, *H. camelus* and *Kootenaia burkei*. Using these sequences, they designed primers for DNA sequences which were conserved across a range of slug species, and that were located on either side of the highly variable portion of the 16S gene that WGI typically targets for species identification of mammals and birds. DNA was extracted using QIAGEN DNeasy Blood & Tissue Kits, and following QIAGEN's instructions. They then used PCR and electrophoresis conditions to produce sequence profiles of the 16S region which were compared to reference data from Genbank, as well as a profile produced by a *H. danielsi* sample which Bill Leonard provided.

We held several "gastropodys" (taxonomy work days) where a taxonomic expert oversaw less experienced biologists and technicians in specimen identification.

We morphologically identified 177 specimens as *Hemphillia* spp. in 2014 and performed the 16S species test on them. Ninety percent (*n* = 159) of samples produced sequence profiles suitable for species ID. Morphological ID matched the *Hemphillia* spp. genus for 98% (*n* = 156) of samples (*H. camelus n* = 88, *H.* unk1 *n* = 68). Three samples produced profiles consistent with *Zacoleus idahoensis* (*n* = 1), *Prophysaon* spp. (*n* = 1), and a profile which did not match available GenBank sequences (*n* = 1). Therefore, we were 98% accurate in morphologically identifying the *Hemphillia* genus. Recognizing different genera possess different levels of taxonomic difficulty, this suggests defensibility of our morphological taxonomic identification system.

Results and Discussion

Microclimate and opportunistic species results are detailed in Chapters 5 and 6 respectively.

Summary

We detected terrestrial gastropods at 86% (*n* = 851) of sites surveyed and 86% (*n* =773) of 897 cells surveyed. We collected 9,193 terrestrial gastropod specimens representing 25 families, 35 genera, and 56 species (Table 2-3). Additionally, we collected aquatic gastropods at 1% of sites (*n* = 10) representing 3 families, 2 genera, and 2 species. We detected 16 terrestrial gastropod species which were listed as SGCN in 2005 SWAPs for Idaho (*n* = 28) or Washington (*n* = 4). We detected 11 of our target SGCN terrestrial gastropods and provide evidence the 12th *(Cryptomastix mullani blandi*) should not be recognized at the sub-specific level. Non-native species tended to be located in valley bottoms with native species being found across all elevations and habitat types (Maps 2-3-5). Four of our 8 most commonly detected native terrestrial gastropods were categorized as 'rare' species and we were funded to look for them. Only 1 target 'rare' species (*Prophysaon coeruleum*) was actually rarely found in our surveys. (Figure 2-2).

**Non-native species such as giant garden slugs (*Ariolimax columbianus*)
were found more often in valley bottoms than higher elevations.**

**Robust lancetooth (*Haplotrema vancouverense*)
was the 5th most commonly detected gastropod in our survey.**

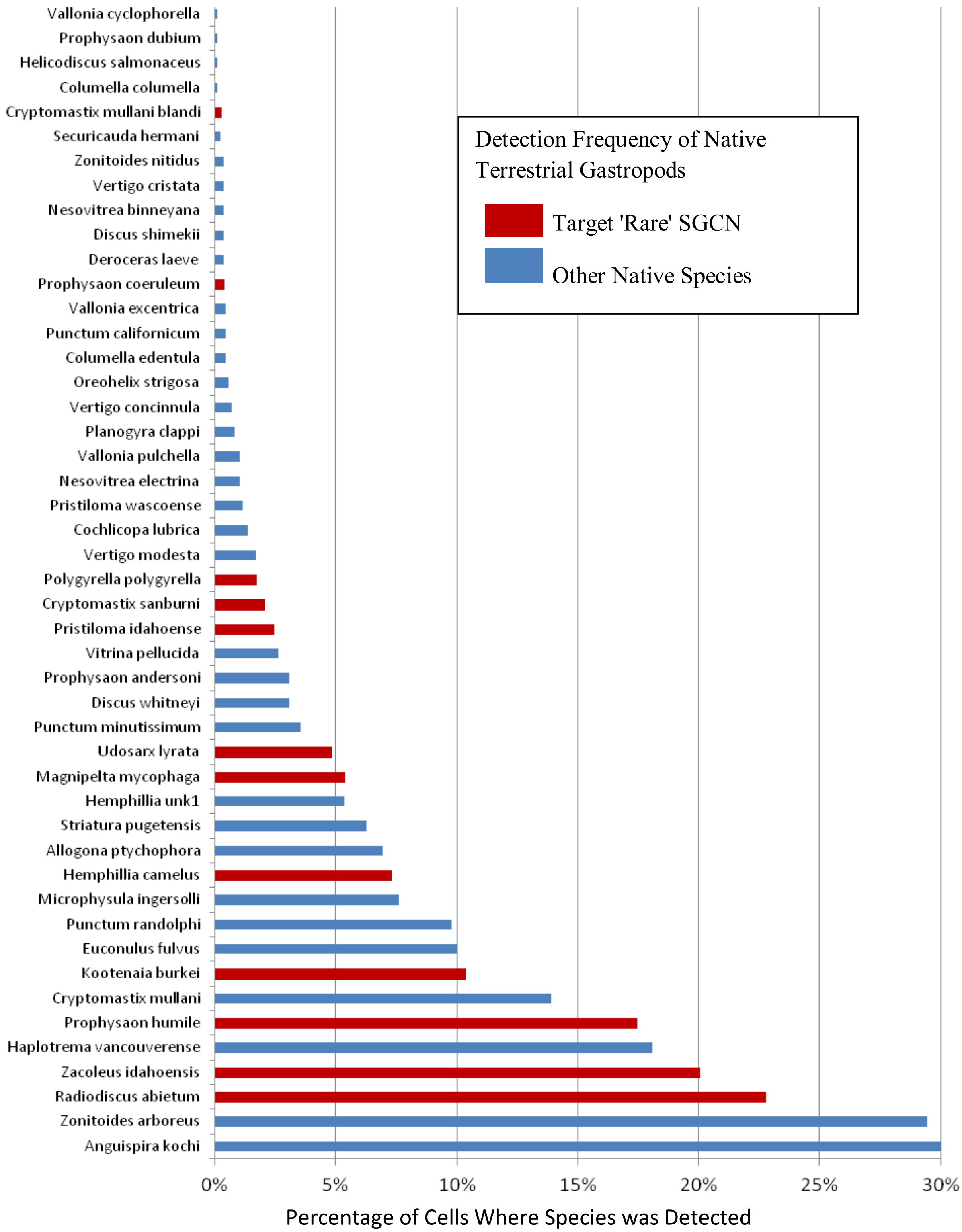


Figure 2-2. Percentage of surveyed cells (n = 879) where target 'rare' and other native terrestrial gastropods were detected.

Species Accounts

<u>*An Oregonian (Cryptomastix mullani blandi) (Table 2-3, Map 2-16)*</u>

Since the time of Henry Hemphill's 1892 description of this trinomial (Vagvolgyi 1968), 108 years passed before MBI's first gastropod survey in 2010. We are aware of only 2 reports of this sub-species in that time period. L.E. Daniels collected several specimens near Como Lake in Ravalli County Montana in 1913 (ANSP 107298 and 107330; Burke, 2013, Pilsbry 1940, Frest and Johannes 1999). Frest and Johannes (1999) examined the Ravalli specimens and determined they actually represent *C. mullani mullani* (Frest and Johannes 1999). Frest and Johannes claim to have collected *C. m. blandi* in the Coeur d' Alene River Corridor in 1990 (Frest and Johannes 1999) near the 'Post Falls' 1892 collection locality (Vagvolgyi 1968). They base their identification on several shell characteristics including dentition.

Using shell characters to differentiate polygyrid species can be exceptionally difficult (Perez 2014) as shells tend to be highly variable within species (Emberton 1995) and the use of denticles for gastropod classification can be unreliable (Tongkerd et al. 2004). Hemphill made at least part of his livelihood from selling shells commercially. He had a propensity for naming sub-specific 'varieties' and it has been suggested he may have been monetarily motivated to create more products for his sales catalogues (Coan and Roth 1987). Many of Hemphill's trinomials have not withstood taxonomic scrutiny and are currently recognized as intra-populational variants (Coan and Roth 1987). Perez et al (2014) found no support for sub-specific designation *C. m. olneyae, C. m. hemphilli*, and *C. m. latilabris* and described an urgent need for a revision of Polygyrida taxonomy.

During our surveys, we detected 2 individual snails which morphologically keyed out to *C. m. blandi* (See Table II-c-1 in Appendix II-c) on the eastern and western edges of the Selkirk Mountains. However, we believe there are little data available to continue sub-specific recognition of *C. m. blandi* for the following reasons: 1) Many of Hemphill's trinomials have not withstood systematic scrutiny (Coan and Roth 1987), 2) Hemphill may have been commercially motivated to 'create' additional varieties (Coan and Roth 1987), 3) only 2 observations, both un-substantiated, were reported from 1892-1990 (Frest and Johannes 1999), and 4) other *C. mullani* trinomials have not been supported by molecular analysis (Perez et al. 2014).

We conclude:
1) The 2 snails in our survey should simply be considered *C. mullani.*
2) The detection maps we provide of sub-specific *C. mullani* trinomials should be interpreted with skepticism until molecular evidence are shown to support the designations.
3) Taxonomic classification of this complex beyond the specific level should not be used to inform prioritized species conservation lists.

<u>*Kingston Oregonian (Cryptomastix sanburni) (Table 2-3, Map 2-21)*</u>

We collected 32 Kingston Oregonian specimens at 18 sites in 18 cells. Most detections clustered in the northern portion of the Coeur d' Alene Mountains and only 1 detection occurred outside of the Coeur d' Alenes, in the Saint Joe.

Until recently the Kingston Oregonian was considered extremely rare in Montana and possibly extinct in Idaho (http://explorer.natureserve.org/ accessed April 8, 2016). Recent museum database searches, however, have revealed specimens from 17 different collection events (IFWIS accessed April 7, 2016) the earliest of which was in 1891 (ASNP 62377, 62262). The majority of historic records are from the Coeur d' Alene Mountains with the remainder located south of the Coeur d' Alenes. The most southerly museum record is near Winchester, Idaho (ASNP 338741).

The clustering of MBI locations in the Coeur d' Alenes suggests the species could potentially be limited to that mountain range. Given the difficulty of polygyrid morphological identification (Perez et al. 2014), we recommend molecular comparison of specimens collected within and outside of the Coeur d' Alene mountains to verify Kingston Oregonian is not a Coeur a' Alene Mountain endemic.

<u>*Pale Jumping Slug (Hemphillia camelus) and Hemphillia unk1 (Table 2-3, Map 2-31-33)*</u>
The *Hemphillia* genus is endemic to the Pacific Northwest and the majority of *H.* spp have coastal distributions. Two species, Pale (*H. camelus*) and marbled (*H. danielsi*), have inland distributions (Burke 2013). *H. camelus* was our target SGCN, but we also expected to find *H. danielsi* toward the southern end of our study area (Bosworth 2012, Hendricks 2012). We did not detect *H. danielsi*. Only 2 records exist of this species in Idaho. One is an unverified museum specimen from 1960 and the other is a 2013 observation with no voucher (IFWIS accessed April 8, 2016). The 1960 voucher should be examined for taxonomic accuracy and surveys should be conducted further south on the Idaho side of the Montana border where the species range abuts with Idaho (Burke 2013) to determine if it actually occurs in Idaho. We collected 156 *H. camelus* specimens from 64 cells. We collected 91 specimens of an un-described *Hemphillia* (*H.* unk1) species from 47 cells.

Pale jumping slugs (*Hemphillia camelus*) (MBI#s OMG13L10, OMG13L11)

We identified samples to species with the partial sequence test and then produced full sequences of a 417 basepair region of 16S RNA for *H. camelus* (*n* = 33) and *H.* unk1 (*n* = 21). *H. camelus* samples yielded 3 haplotypes with 3 polymorphic sites and 0-2% divergence from most similar *H. camelus* sequence available on GenBank (accession # AY382639.1). *H.* unk1 samples yielded 8 haplotypes with 4 polymorhpic sites. *H.* unk1 samples diverged 9-10% from the *H. camelus* GenBank sequence and 12% from a GenBank *H. malonei* (a coastal species) sequence (accession# AY357656.1).

H. unk1 does appear slightly smaller than *H. camelus* but we were unable to determine a definitive external morphological character to differentiate the two species. Dr. Lyle Chichester examined the reproductive tract of specimens which had been identified genetically as *H. camelus* (*n* = **15**) and *H.* unk1 (*n* = 5). Only 5 mature *H.* unk1 specimens were available because both *H. camelus* and *H.* unk1 appear to be annual species which do not reach sexual maturity until the end of the growing season in late summer or fall. Sexually mature individuals are necessary to differentiate the species with reproductive morphology. We found 4 distinct characters to differentiate the species (Figure 2-3).

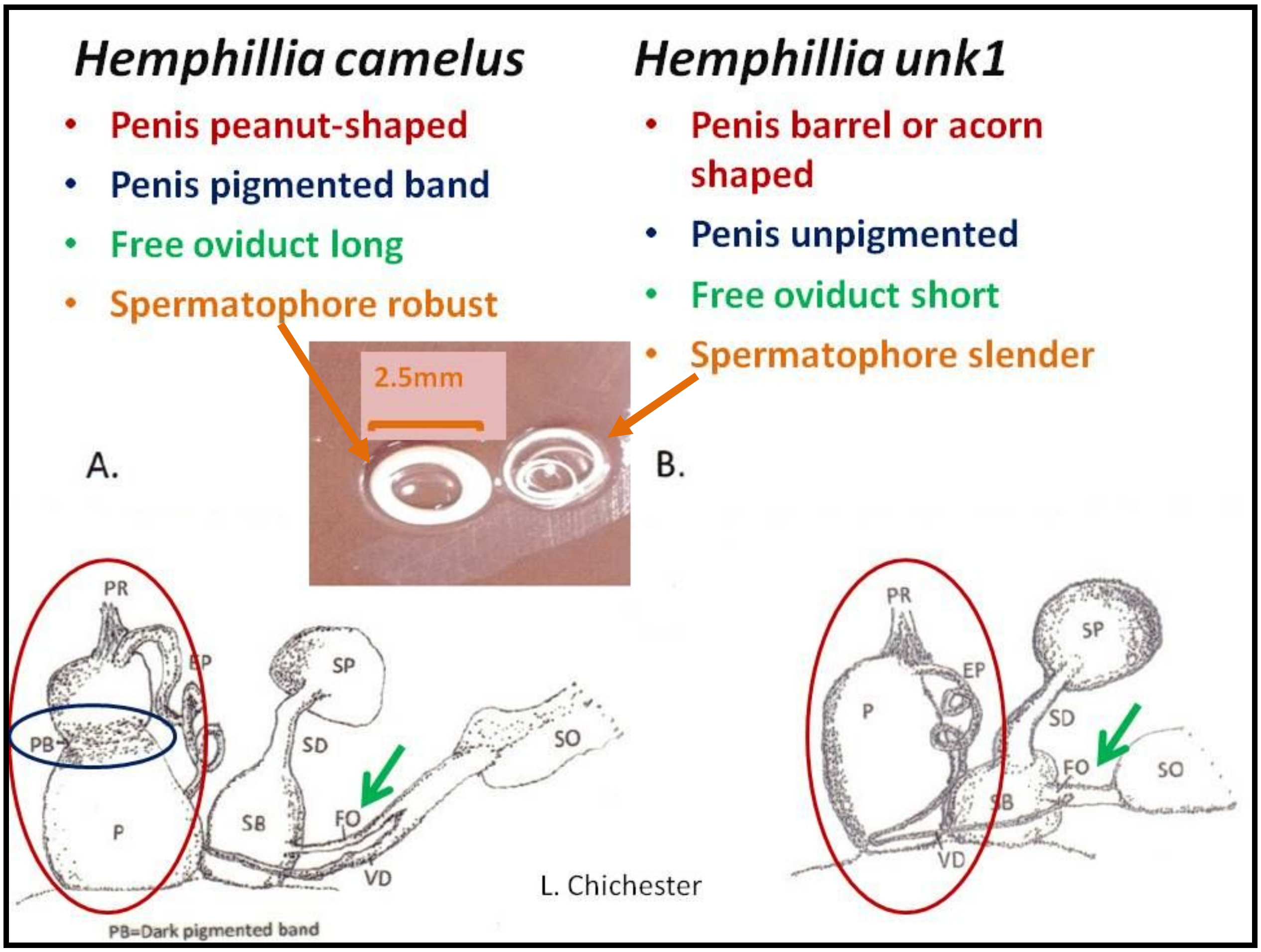


Figure 2-3. Morphological character differences of *H. camelus* and *H.* unk1 genetailia. Dissections, diagrams, and photographs by Dr. Lyle Chichester.

These two species have an interesting distribution with *H. camelus* 'ringing' the distribution of *H.* unk1. From south to north, *H. camelus* is dominant in the majority of the St. Joe and *H.* unk1 is the only of the two species detected in the Coeur d' Alenes and West Cabinets. Farther north, *H. camelus* only is in the Purcells and both species are sympatric in the Selkirks with a contact zone in the Priest Lake Basin. In the Selkirks both species were found at the same survey sites and in one case both species were captured on the same trap. Both species show associations with cooler and higher conditions than survey site averages. Future work should address ecological requirements for these species and a formal description of *H.* unk1.

Pygmy Slug (Kootenaia burkei) (Table 2-3, Map 2-34)
This little slug was only known to science for 7 years before the first 2010 MBI surveys (Leonard et al. 2003). The first specimens were described from a northern Idaho locality within the MBI study area (Leonard et al. 2003) and it was subsequently detected in Montana in 2005 (Hendricks et al. 2006) and British Columbia in 2007 (Ovasak 2007). To our knowledge, our surveys represent the first occurrence records of this species in Washington State.

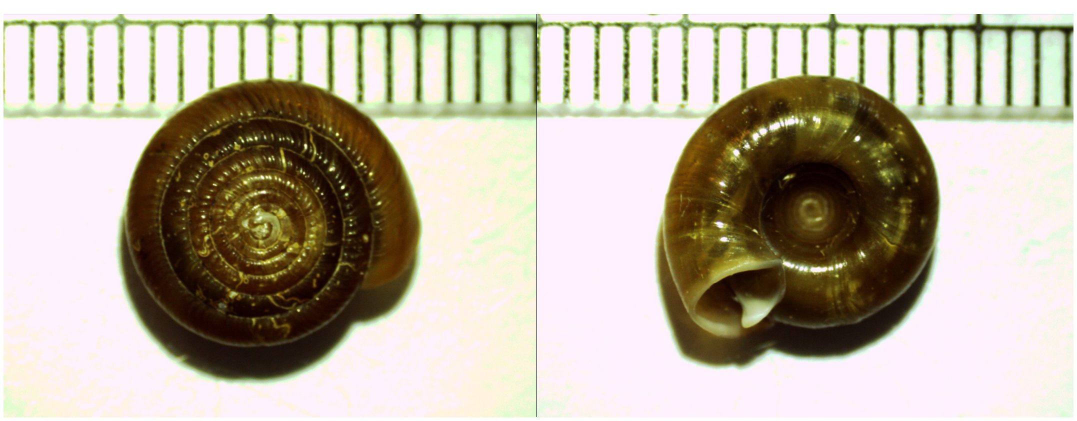
This species was initially thought to be quite rare (G2) with state ranks of S1 (BC, MT) or S2 (ID) (http://explorer.natureserve.org/ accessed 8 April, 2016). However, we found pygmy slugs to be relatively abundant and well distributed across the study area. We collected 158 specimens from 91 cells. This species was found across elevation and air temperature gradients. We recommend this species not receive special conservation status within our study area.

Pygmy slug (*Kootenaia burkei*)

Magnum Mantleslug (Magnipelta mycophaga) (Table 2-3, Map 2-36)
Pilsbry (1953) first described this "peculiar" genus and species from a single specimen collected in 1948 by Robert and Margaret Orr near Lolo Pass, Idaho approximately 60 km southeast of the MBI study area (Pilsbry 1953). There was not a subsequent verified detection of this species in Idaho for another 62 years until the MBI surveys began in 2010. Verified Washington observations did occur in that time frame (Burke 2013) and multiple post-2000 observations occurred in Montana (Hendricks 2012) and British Columbia (Ovasak and Sopuck 2007). Although this species was ranked as possibly extirpated (SH) (http://explorer.natureserve.org/ accessed 8 April, 2016) from Idaho when our surveys began, given the known records from adjacent states, it should not be surprising that we collected 69 specimens from 47 cells in Idaho, Washington, and Montana. This species is patchily distributed across all mountain ranges in the study area. It tends to be more strongly associated with higher elevations cooler mean annual air temperatures than other gastropod species (see Chapter 5 for more detail). We recommend additional work be done to determine ecological requirements of this species.

Magnum mantleslug (*Magnipelta mycophaga*) (MBI# OMGPS913)
Photo credit: Doug Albertson

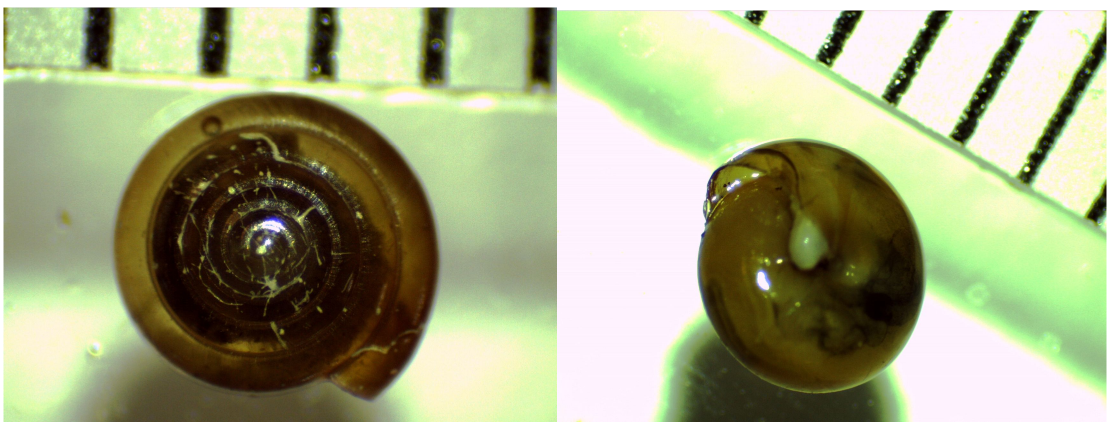
Humped Coin (Polygyrella polygyrella) (Table 2-3, Map 2-44)
Humped coins have been documented in the Blue Mountains in Oregon and Washington (Burke 2013), in northern Idaho (Bosworth 2012), and western Montana (Hendricks 2012). We collected 42 specimens from 15 cells in the Coeur d' Alene and Saint Joe Mountains. We did not detect this species in the Selkirks, West Cabinet, or Purcell Mountains. This species was associated with higher elevations and lower mean annual air temperatures than survey site averages.



Humped coin (*Polygyrella polygyrella*) (MBI# FIA1213GTSV1D) on a mm scale.

Thinlip Tightcoil (Pristiloma idahoense) (Table 2-3, Map 2-45)

This species ranges primarily from northern to central Idaho (Bosworth 2012) and has been documented in Washington and Oregon (Burke 2013). It has not been documented in Montana (Burke 2013). We collected 57 thinlip tightcoil specimens from 21 cells which were well distributed across the Saint Joe, Coeur d' Alene and Selkirk Mountains in Idaho and Washington. The Selkirk detections, including 1 detection about 1.5 km from the International Border, suggest this species likely occurs in British Columbia. We did not detect it in the Purcell Mountains. Although we did not detect the species in Montana, we did collect 1 individual from the West Cabinet Mountains about 10 km from the state line, which suggests the species could occur in the Montana portion of that mountain range. This species was associated with higher elevations and lower mean annual air temperatures than survey site averages.



Thinlip tightcoil (*Pristiloma idahoense*)
(MBI#s FIA1392GTSV1A, FIA1118GTSV1B)
on a mm scale.

Blue-grey Taildropper (Prophysaon coeruleum) (Table 2-3, Map 2-48)

Taildroppers are so named because they can dislocate a portion of their tail as a predatory defense strategy. Blue-grey taildroppers are primarily a coastal species which extend from northern California to Vancouver Island (Burke 2013). A disjunct population with genetic (Wilke and Duncan 2004) and morphologic (Ovaska et al. 2004) differences from the coastal population occurs in the Idaho portion of our study area (Bosworth 2012). We collected 4 individuals from 3 cells from the Coeur d' Alene River Corridor and Mountains, the same general area where the species has been previously reported (Ovaska et al. 2004). We do not have reason to suspect this species would be more difficult to detect than other, smaller, slugs such as pygmy slugs which were commonly detected. Therefore, we conclude this species is relatively rare and conservation efforts should be applied to known populations.

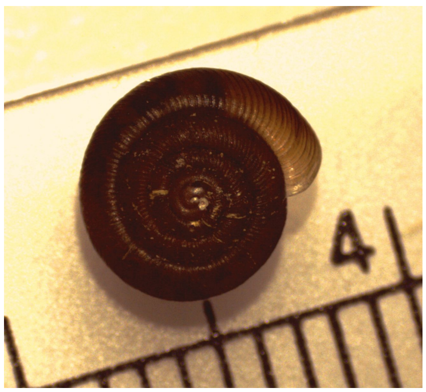
<u>Smoky Taildropper (Prophysaon humile) (Table 2-3, Map 2-50)</u>

Smoky taildroppers are known to occur in Idaho and Montana (Burke 2013) and our collection of 376 specimens from 153 cells provides confirmation of an Idaho-Montana distribution which does not include Washington or British Columbia. We did not detect this species in the Purcell or Selkirk Mountains indicating a biogeographic barrier which prevents expansion from the West Cabinet Mountains and subsequently into adjoining British Columbia or Washington. Rocky mountain tailed frogs (Nielson et al. 2001) and Coeur d' Alene salamanders (Wilson et al. 1997) show similar distributional patterns. Smoky taildroppers are associated with slightly higher elevations and slightly lower mean annual air temperatures than survey site averages. This common species appears to be an Idaho-Montana endemic. The shared distributional pattern may provide unique opportunities to investigate co-evolution and multi-taxa phlyogeographic patterns which could provide important information for landscape conservation within the study area.

Smoky taildropper (*Prophysaon humile*) (MBI# OMGPS1013)
Photo credit: Doug Albertson

Fir Pinwheel (Radiodiscus abietum) (Table 2-3, Map 2-54)

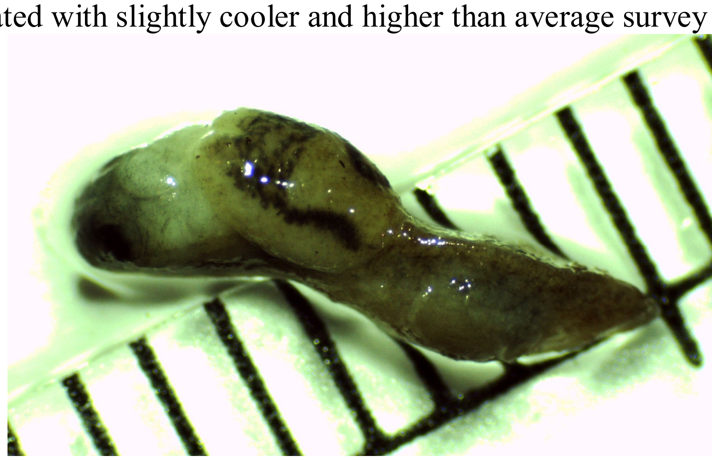
Fir pinwheels occur in Idaho, Montana, Oregon, Washington (Burke 2013) and British Columbia (Nekola 2012). This species was considered an S2 imperiled species in 2010 at the beginning of the MBI surveys (http://explorer.natureserve.org/ accessed 8 April, 2016). Since that time, both our work and others (Hendricks 2012) have demonstrated this species is much more common than previously thought. In fact, we detected this 'imperiled' species more commonly than all but 2 other terrestrial gastropod species (Figure 2-2). We collected 505 specimens from 200 survey cells at sites which tended to be slightly cooler and higher elevation than survey site averages. This species should not be considered a candidate for species of conservation concern lists and emphasizes the need for accurate and current inventory data to make such decisions.



Fir pinwheel (*Radiodiscus abietum*) (MBI# FIA1371T1V3B) on a mm scale.

Lyre Mantleslug (Udosarx lyrata) (Table 2-3, Map 2-57)

Named for the hourglass-shaped shading on their mantle, lyre mantleslugs are another species which emphasize the importance of accurate and current inventory data. Classified as critically imperiled (S1) (http://explorer.natureserve.org/ accessed 8 April, 2016) when this project began, our data and others (Hendricks 2012) have demonstrated this species to be much more common than previously thought. We collected 109 specimens from 42 cells primarily in the Saint Joe Mountains. Lyre mantleslugs were identified from 3 widely spaced cells north of the Joe. We confirmed species ID morphologically and plan to conduct genetic analyses to determine if the more northern samples are appropriately taxonomically assigned. Documented occurrences remain only in Montana (Hendricks 2012) and Idaho but the proximity of our detections to Washington suggest lyre mantleslugs may be detected in that state in the future. This species was associated with slightly cooler and higher than average survey sites.



Lyre mantleslug (*Udosarx lyrata*) (MBI# FIA1064GTSVA) on a mm scale.

<u>Sheathed Slug (Zacoleus idahoensis) (Table 2-3, Map 2-67)</u>

Prior to MBI, sheathed slugs were documented to occur in Montana (Hendricks 2012, Burke 2013) and Idaho (Bosworth 2012, Burke 2013). We found this species to be well distributed across all mountain ranges and states in our study area. We collected 385 specimens from 176 cells and it was the 4th most common terrestrial gastropod in our survey (Figure 2-2). To our knowledge, we provide the first state records for Washington. Our detections adjacent to the international border suggest likely occurrence in British Columbia. The heaviest concentrations of this species were in the West Cabinet and Purcell Mountains. Detections decreased in the southern portions of the study area with fewer detections in the Coeur d' Alenes and Saint Joe. The species was common in the Selkirks but was nearly absent from the Priest Lake Basin. A similar pattern of non-detection in this basin was observed for *Allogona ptychophora* (Map 2-6) and *Anguispira kochi* (Map 2-7). Future work should investigate if this is a natural biogeographic or, rather, an anthropogenic influenced pattern. This species showed no association with a temperature or elevational gradient and should not be considered for special status.

Sheathed slug (*Zacoleus idahoensis*) (MBI# OMGPS613)
Photo credit: Doug Albertson

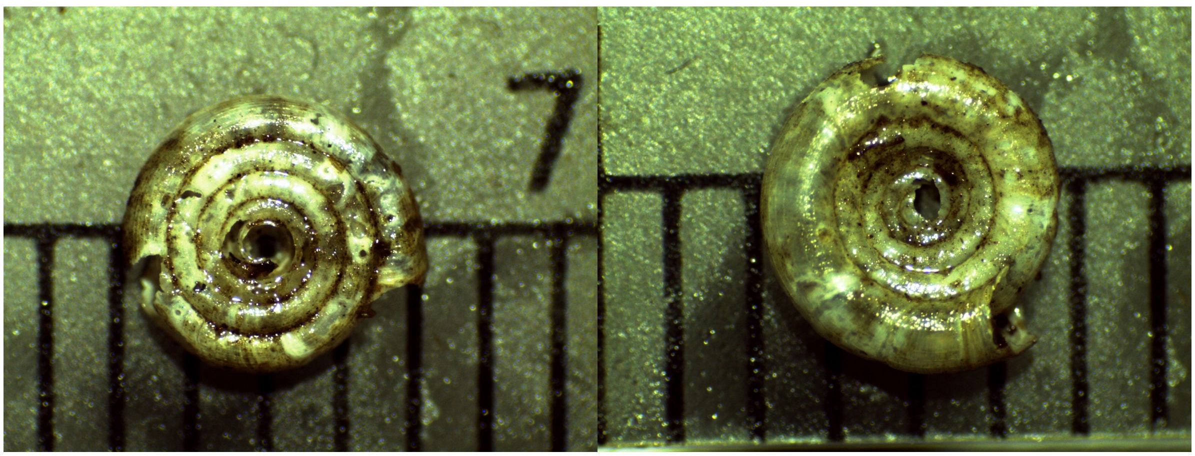
2005 Idaho SGCN Maintaining SGCN Status in 2015

Western Flatwhorl (Planogyra clappi) (Table 2-3. Map 2-43)

This species was listed as an I-SGCN in 2005 and 2015. We detected 11 specimens from 7 sites. All detections were from the Selkirks with 1 Idaho specimen and 10 Washington specimens. Our Washington detections are not surprising but are the first verified occurrences in the eastern half of that state (Burke 2013).

Salmon Coil (Helicodiscus salmonaceus) (Table 2-3, Map 2-30)

This distinctive species was listed as an I-SGCN in 2005 and 2015. The single specimen we collected in 2013 was the first record in our study area since 1931 (IFWIS accessed September 8, 2016). Our surveys suggest the current global imperiled status (GS2) is warranted and this species should be a priority for conservation resources.



Salmon coil (*Helicodiscus salmonaceus*) (MBI# C727GTSV2B) on a mm scale.

Species Without 2005 SGCN Status Upgraded to SGCN Status in 2015

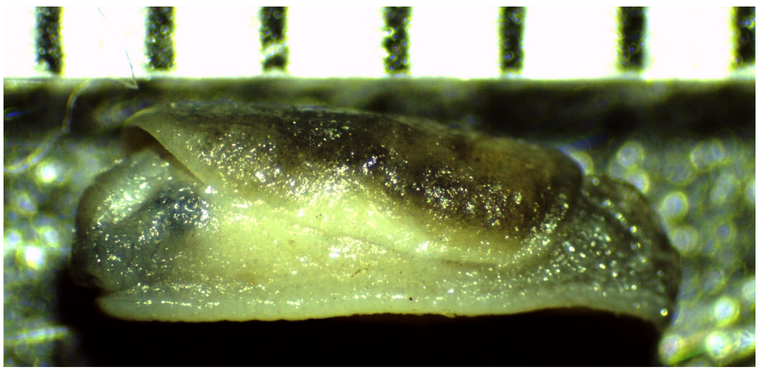
Shiny Tightcoil (Pristiloma wascoense) (Table 2-3, Map 2-46)

This species was not an I-SGCN in 2005. We collected 13 specimens from 10 cells in widely distributed sites across the study area including Washington, Idaho, and Montana and all mountain ranges except the Purcells. It was listed as I-SGCN in 2015 because it is a cool air associate (See chapter 5 for more details).

Prophysaon dubium (Table 2-3, Map 2-49)

This species was not an I-SGCN in 2005. We collected 2 specimens from 1 Idaho site near the Saint Joe River. It was listed as an I-SGCN in 2015 because it is a regional endemic which appears to be uncommon and is known only from limited sites.

Rocky Mountain Axetail (Securicauda hermani) (Table 2-3, Map 2-55)
S. hermani was not yet known to science when the 2005 SGCN list was created (Leonard et al. 2011) and was therefore not included in the 2005 I-SWAP. We collected 1 specimen near where the original specimens were described (Leonard et al. 2011) and 1 specimen from the Purcell Mountains in Montana. Both specimens key out morphologically to *S. hermani*. It should be kept in mind that another axetail species, Cascades Axetail (*Carinacauda stormi*), has nearly identical external morphological features to *S. hermani* but differs distinctly in internal anatomy (Leonard et al. 2011, Burke 2013). The *S. hermani* designation of the Montana specimen should be viewed with caution until further taxonomic work can be completed.



Rocky mountain axetail (*Securicauda hermani*) (MBI# C1204GTSV1) on a mm scale.

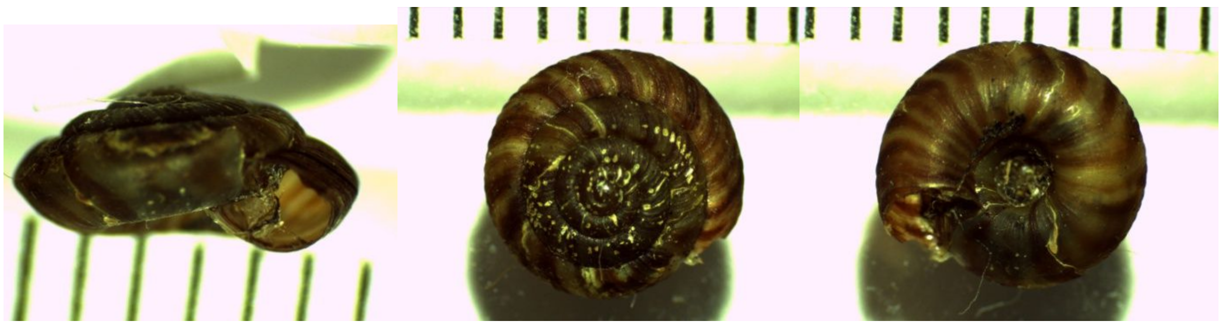
Other Notable Detections
Columbia Oregonian (Cryptomastix hendersoni) (Table 2-3, Map 2-15)
Although this species supposedly only occurs in the Columbia and Snake River areas of Washington, Oregon, and Idaho (Burke 2013), the 4 shells we collected from 2 localities fit the description of only *C. hendersoni.* Although the shells characteristics of *Crptomastix* spp. can be quite variable with continual intergrades between them (Burke 2013, Perez et al. 2014), of the many *Cryptomastix* identified during this project, these shells alone had the distinct appearance of *C. hendersoni*. We recommend caution in definitive range expansion of this species until a thorough molecular analysis of the genus in Idaho is complete.

Mountainsnails (Oreohelix spp.) (Table 2-3, Map 2-15)
This genus displays remarkable diversity and hosts many species and subspecies which occur in extremely limted geographic areas (Burke 2013). This diverse speciation is more typical of dryer areas and not likely a major evolutionary factor within our mesic study area. Regardless, taxonomy of this group remains difficult and we did not feel we could definitively identify the majority of our *Oreohelix* spp. specimens beyond genus by morphological characters alone. Based on distribution and expected abundance, most *Oreohelix* in our collection are likely *O. strigosa*. It is possible we misidentified some *Oreohelix* spp. specimens as *Anguispira kochi* as these two genera are similar (Burke 2013).

Ribbed Spot (Punctum californicum) (Table 2-3, Map 2-51)
We collected 4 specimens from 4 well distributed Idaho cells. This is the first verified Idaho occurrence of this species. Its range is primarily the southwestern United States, but it has been collected in Glacier National Park (Burke 2013). Our detections fill in a hole in this disjunct distribution but we recommend molecular analysis to investigate taxonomic accuracy of the southwestern and northwestern collections.

Vertigos (Vertigo spp.) (Table 2-3, Maps 2-60-65)
We were surprised we did not detect this genus more frequently as they are widespread and thought to be common in North America (Burke 2013). We do not believe this is due to the small size of the genus as we detected smaller species such as *Punctum* spp. regularly. However, vertigos may have a tendency to be annual species which would mean very small juveniles may not have been detected earlier in the survey season.

'New' Non-native Records
Rotund Disc (Discus rotundatus) (Table 2-3, Map 2-25)
This European species (Kerney and Cameron 1979) is introduced to North America. We collected 3 specimens of this distinctive snail in 3 cells in Washington and Idaho. We believe these are the first detections of this species in both states (Burke 2013).



Rotund disc (*Discus rotundatus*) (MBI# FIA62GTSV3B) on a mm scale.

Pacific Bananaslug (Ariolimax columbianus) (Table 2-3, Map 2-8)
Frest (1999) described this well known coastal species as "fairly common" in the northern third of Idaho. We collected 20 specimens from 3 cells, but it remains unclear if the species is truly native (Bosworth 2012). Genetics work may elucidate the source of Idaho populations (i.e., native or introduced).

Pacific bananaslugs *(Ariolimax columbianus)* (MBI# C844GTSV2)

Conclusions
Our surveys represent the first comprehensive inventory of terrestrial gastropods in the Idaho Panhandle and adjoining mountain ranges. This baseline inventory sets the stage for long term monitoring which we recommend be implemented to assess changes in species abundance and distribution over time.

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Table 2-3. Terrestrial gastropods detected during primary surveys and 2005 and 2015 S rank and SGCN status

Common Name	Latin Name	% cells detected (*n*)	cells detected *n* (%)	2005 ID S Rank	2015 ID S Rank	2005 ID SGCN	2015 ID SGCN
		MBI Target Species					
Thinlip Tightcoil	*Pristiloma idahoense*	2.39% (21)	21 (2)	S1	S4	Y	N
Lyre Mantleslug	*Udosarx lyrata*	4.78% (42)	42 (5)	S1	S3	Y	N
Pale Jumping-slug	*Hemphillia camelus*	7.28% (64)	64 (7)	S2	S2	Y	Y
Pygmy Slug	*Kootenai burkei*	10.35% (91)	91 (10)	S2	S5	Y	N
Humped Coin	*Polygyrella polygyrella*	1.71% (15)	15 (2)	S2	S4	Y	N
Smoky Taildropper	*Prophysaon humile*	17.29% (152)	152 (17)	S2	S4	Y	N
Fir Pinwheel	*Radiodiscus abietum*	22.64% (199)	199 (23)	S2	S5	Y	N
Sheathed Slug	*Zacoleus idahoensis*	19.91% (175)	175 (20)	S2	S5	Y	N
Blue-gray Taildropper	*Prophysaon coeruleum*	0.34% (3)	3 (0)	SNR	S1Q	N	Y
Kingston Oregonian	*Cryptomastix sanburni*	2.05% (18)	18 (2)	SH	S3	Y	Y
Magnum Mantleslug	*Magnipelta mycophaga*	4.89% (43)	43 (5)	SH	S2	Y	Y
Cryptomastix mullani blandi	*Cryptomastix mullani blandi*	0.23% (2)	2 (0)	SNR	S2	Y	N*
Common Name	**Latin Name**	**% cells detected (n)**		**2005 ID S Rank**	**2015 ID S Rank**	**2005 ID SGCN**	**2015 ID SGCN**
		MBI Detected Species					
Western Flat-whorl	*Planogyra clappi*	0.80% (7)	7 (1)	S1	S1	Y	Y
Salmon Coil	*Helicodiscus salmonaceus*	0.11% (1)	1 (0)	S2	S2	Y	Y
Columbia Oregonian	*Cryptomastix hendersoni*	0.23% (2)	2 (0)	SNR	S3	N	N
Shiny Tightcoil	*Pristiloma wascoense*	1.14% (10)	10 (1)	SH	S2	Y	Y
Idaho Forestsnail	*Allogona ptychophora*	6.83% (60)	60 (7)	SNR	S4	N	N
Banded Tigersnail	*Anguispira kochi*	29.92% (263)	263 (30)	SNR	S5	N	N
Pacific Bananaslug	*Ariolimax columbianus*	0.34% (3)	3 (0)	Exotic			
Brown-banded Arion	*Arion circumscriptus*	0.11% (1)	1 (0)	Exotic			

Chocolate Arion	*Arion rufus*	0.80% (7)	7 (1)	Exotic			
Dusky Arion	*Arion subfuscus*	0.57% (5)	5 (1)	Exotic			
Columella columella	*Columella columella*	0.11% (1)	1 (0)	SNA	S3	N	N
Toothless Column snail	*Columella edentula*	0.46% (4)	4 (0)	SNA	S3	N	N
Glossy Pillar	*Conchlicopa lubrica*	1.37% (12)	12 (1)	SNR	S3	N	N
Cryptomastix mullani hemphilli	*Cryptomastix mullani hemphilli*	5.80% (51)	51 (6)	?	S4	N	N*
Coeur d' Alene Oregonian	*Cryptomastix mullani mullani*	4.66% (41)	41 (5)	?	S4	N	N*
Cryptomastix mullani olneyae	*Cryptomastix mullani olneyae*	4.10% (36)	36 (4)	?	S4	N	N*
Meadow Fieldslug	*Deroceras laeve*	0.34% (3)	3 (0)	SNA	S3	N	N
Longneck Fieldslug	*Deroceras panormitanum*	0.23% (2)	2 (0)	Exotic			
Gray Fieldslug	*Deroceras reticulatum*	2.05% (18)	18 (2)	Exotic			
Rotund Disc	*Discus rotundatus*	0.34% (3)	3 (0)	Exotic			
Striate Disc	*Discus shimekii*	0.34% (3)	3 (0)	SNR	S3	N	N
Forest Disc	*Discus whitneyi*	3.07% (27)	27 (3)	S4	S4	N	N
Brown Hive	*Euconulus fulvus*	10.01% (88)	88 (10)	S4	S4	N	N
Robust Lancetooth	*Haplotrema vancouverense*	17.97% (158)	158 (18)	SNR	S5	N	N
Hemphillia unk1	*Hemphillia unk1*	5.12% (45)	45 (5)	ND	S2Q	NA	Y
Giant Gardenslug	*Limax maximus*	1.71% (15)	15 (2)	Exotic			
Spruce Snail	*Microphysula ingersolli*	7.62% (67)	67 (8)	SNR	S4	N	N
Blue Glass	*Nesovitrea binneyana*	0.34% (3)	3 (0)	SNR	SNA	N	N
Amber Glass	*Nesovitrea electrina*	1.02% (9)	9 (1)	SNR	S3	N	N
Oreohelix spp.	*Oreohelix spp.*	2.28% (20)	20 (2)	NA			
Oreohelix strigosa	*Oreohelix strigosa*	0.57% (5)	5 (1)	SNR	SNR	N	N
Garlic Glass-snail	*Oxychilus alliarius*	0.11% (1)	1 (0)	Exotic			
Reticulate Taildropper	*Prophysaon andersoni*	3.07% (27)	27 (3)	SNA	S4	N	N
Papillose Taildropper	*Prophysaon dubium*	0.11% (1)	1 (0)	SNR	S2Q	N	Y
Punctum californicum	*Punctum californicum*	0.46% (4)	4 (0)	SNR	SNR	N	N
Small Spot	*Punctum minutissimum*	3.53% (31)	31 (4)	SNR	S4	N	N
Conical Spot	*Punctum randolphii*	9.78% (86)	86 (10)	SNR	S5	N	N
Rocky Mountain Axetail	*Securicauda hermani*	0.23% (2)	2 (0)	ND	S1	NA	Y
Northwest Striate	*Striatura pugetensis*	6.26% (55)	55 (6)	SNA	S4	N	N

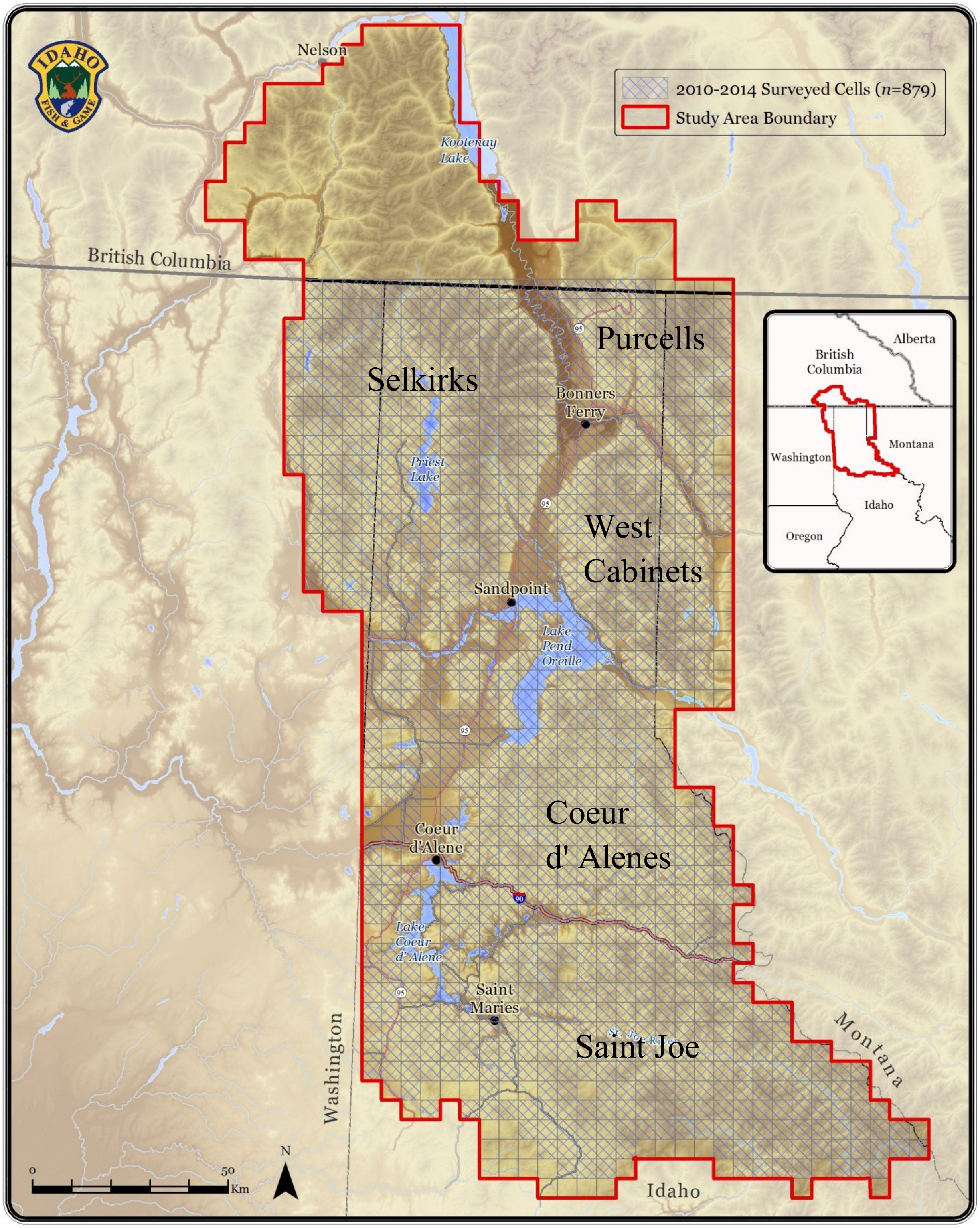
Silky Vallonia	*Vallonia cyclophorella*	0.11% (1)	1 (0)	SNR	S4	N	N
Iroquois Vallonia	*Vallonia excentrica*	0.46% (4)	4 (0)		S4	N	N
Lovely Vallonia	*Vallonia pulchella*	1.02% (9)	9 (1)	SNR	S3	N	N
Vertigo concinnula	*Vertigo concinnula*	0.68% (6)	6 (1)	SNR	SNR	N	N
Crested Vertigo	*Vertigo cristata*	0.34% (3)	3 (0)		SNR	N	N
Cross Vertigo	*Vertigo modesta*	1.25% (11)	11 (1)	SNR	S4	N	N
Vertigo modesta parietalis	*Vertigo modesta parietalis*	0.57% (5)	5 (1)				
Vertigo modesta sculptilis	*Vertigo modesta sculptilis*	0.34% (3)	3 (0)				
Western Glass-snail	*Vitrina pellucida*	2.62% (23)	23 (3)	SNR	S4	N	N
Quick Gloss	*Zonitoides arboreus*	29.35% (258)	258 (30)	SNR	S5	N	N
Black Gloss	*Zonitoides nitidus*	0.34% (3)	3 (0)	SNR	S5	N	N

[a] S-rank averages calculated only from numberical S-ranks. SH (possibly exitrpated), SNR (species not ranked) are not included in calclulation.

*Trinomial ranked as SGCN at specific epithet level.

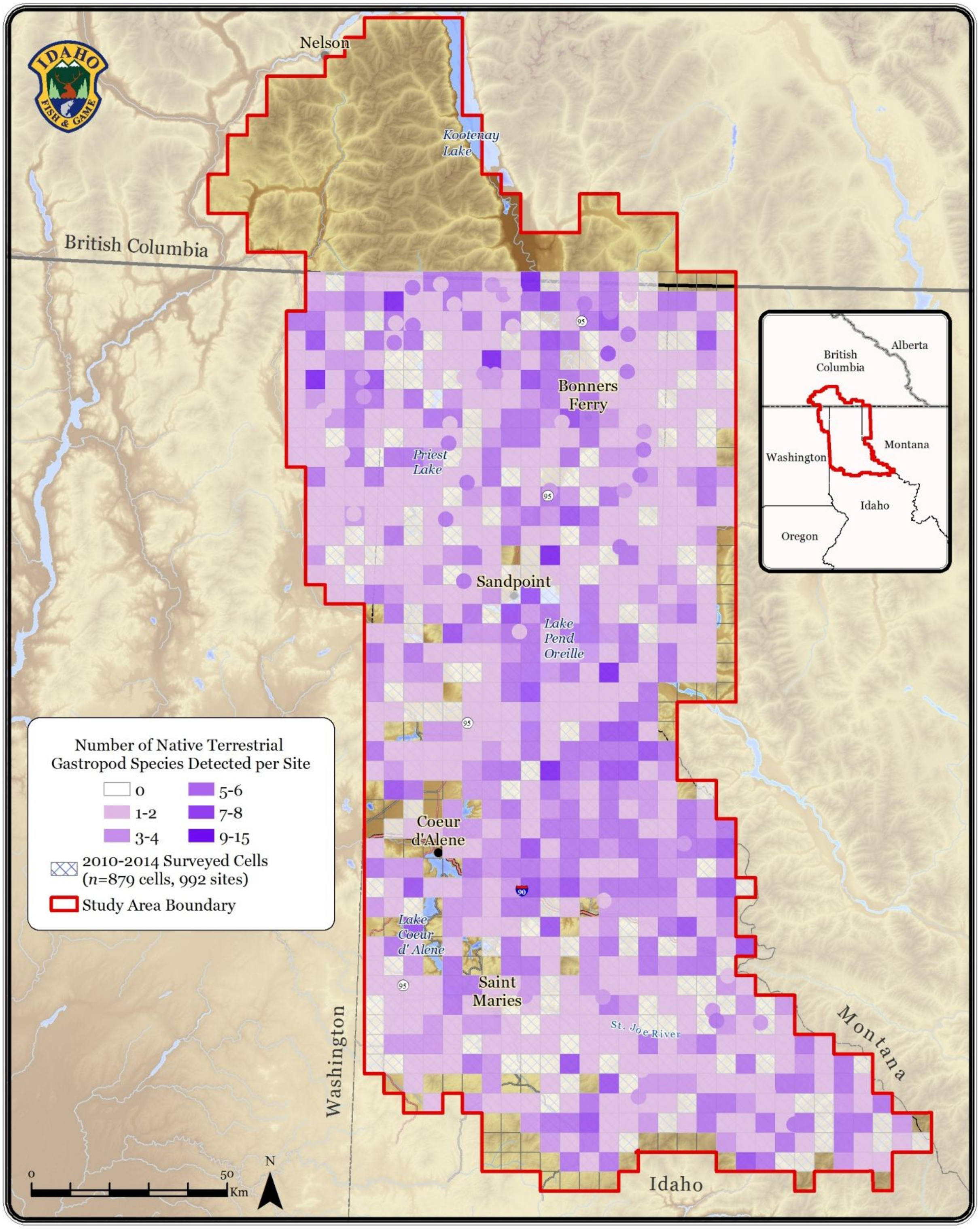
ND: Not Described

Multi-species Baseline Initiative: Gastropod Survey Overview



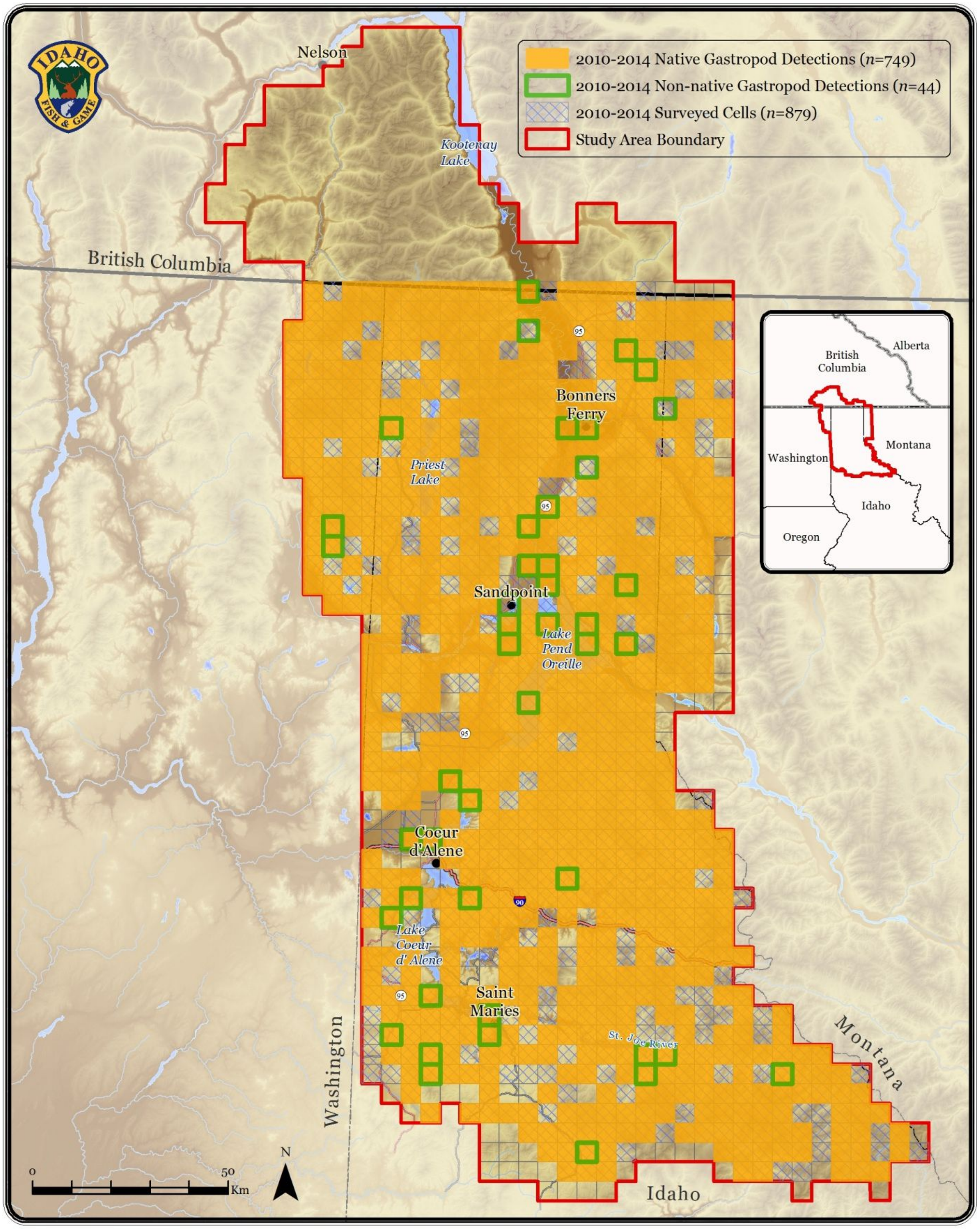
Map 2-1. 879 5x5 km cells surveyed for gastropods from 2010-2014.

Multi-species Baseline Initiative: Native Terrestrial Gastropod Species Richness



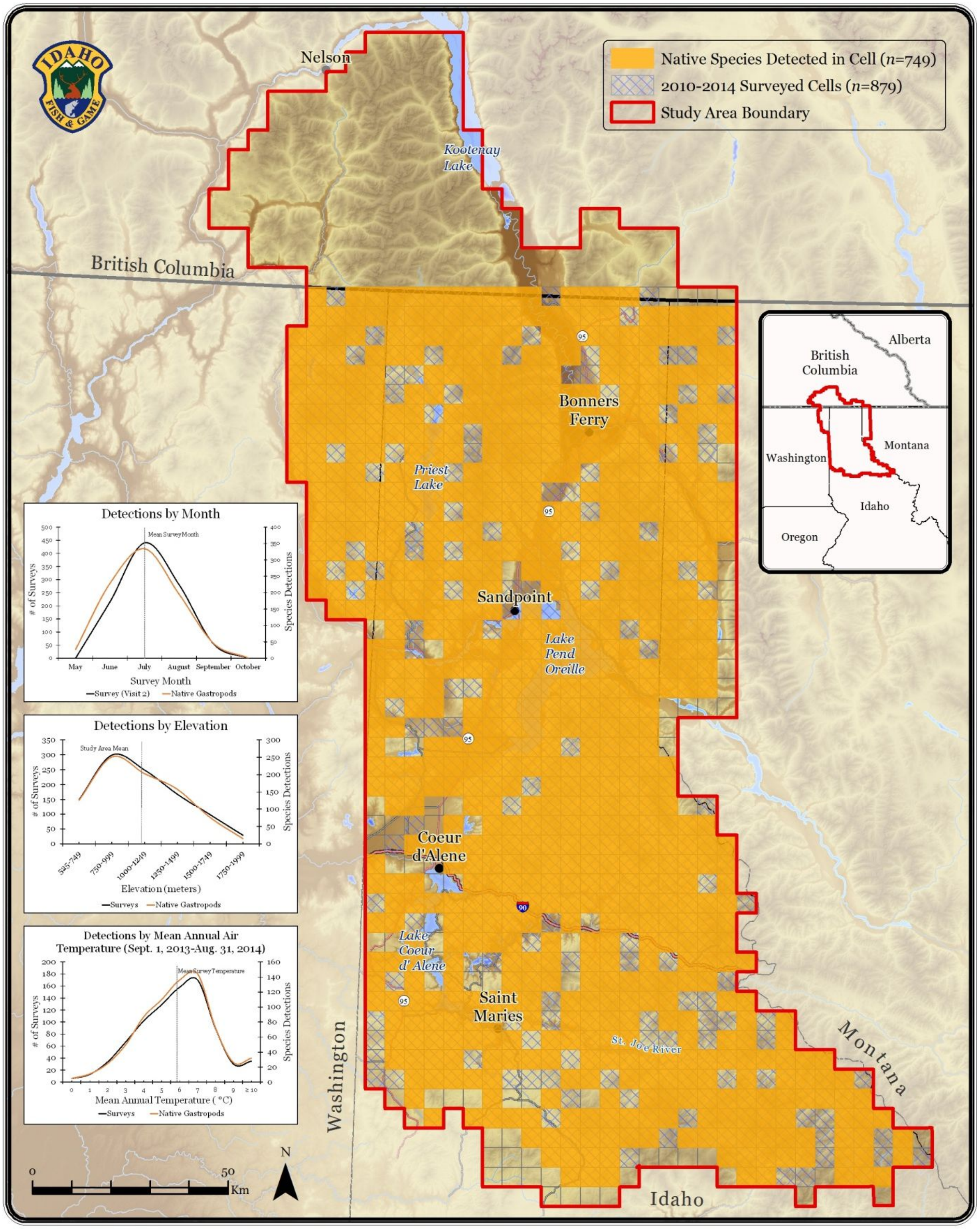
Map 2-2.

Multi-species Baseline Initiative: Native and Non-native Gastropod Detections



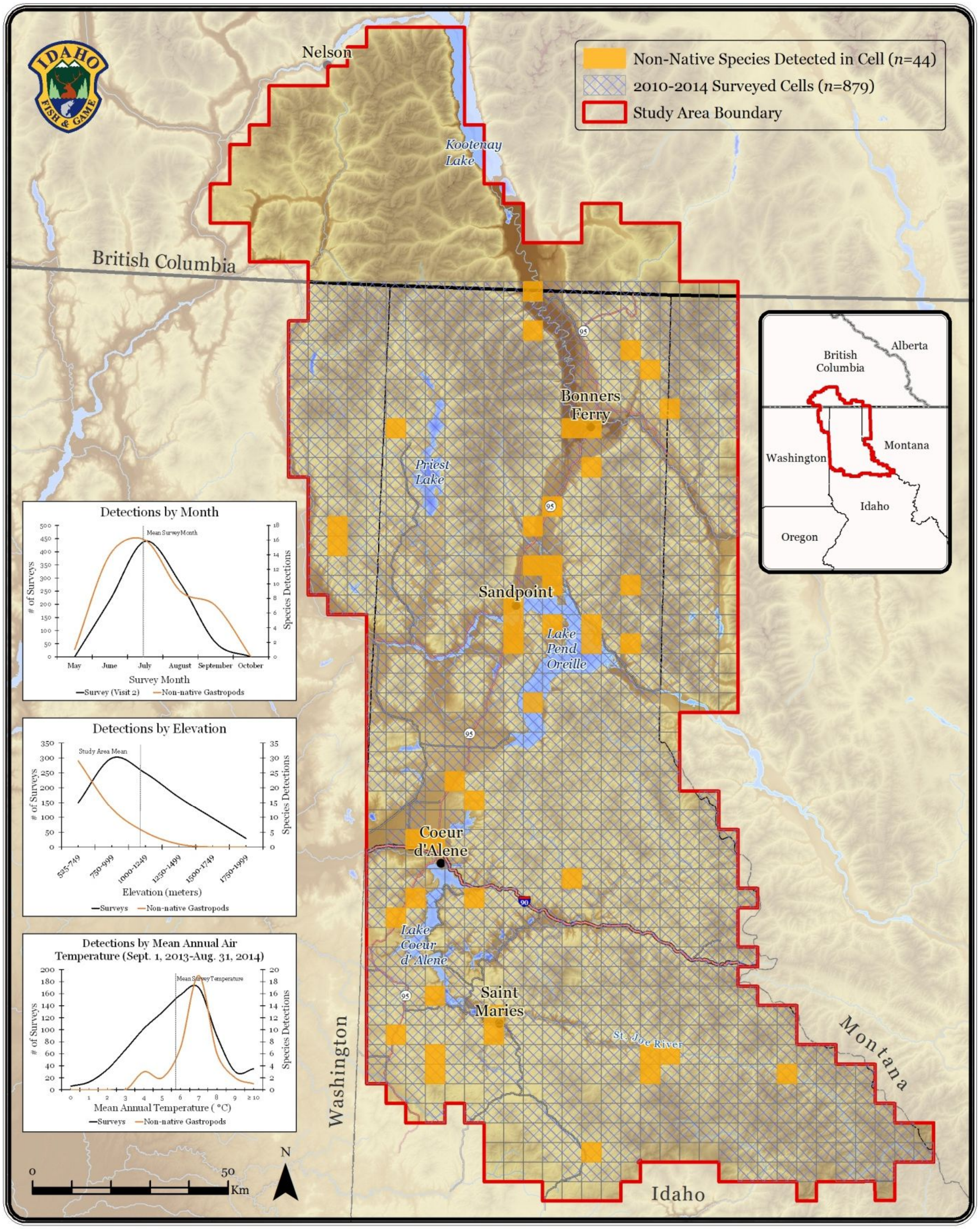
Map 2-3.

Multi-species Baseline Initiative: Native Gastropod Detections



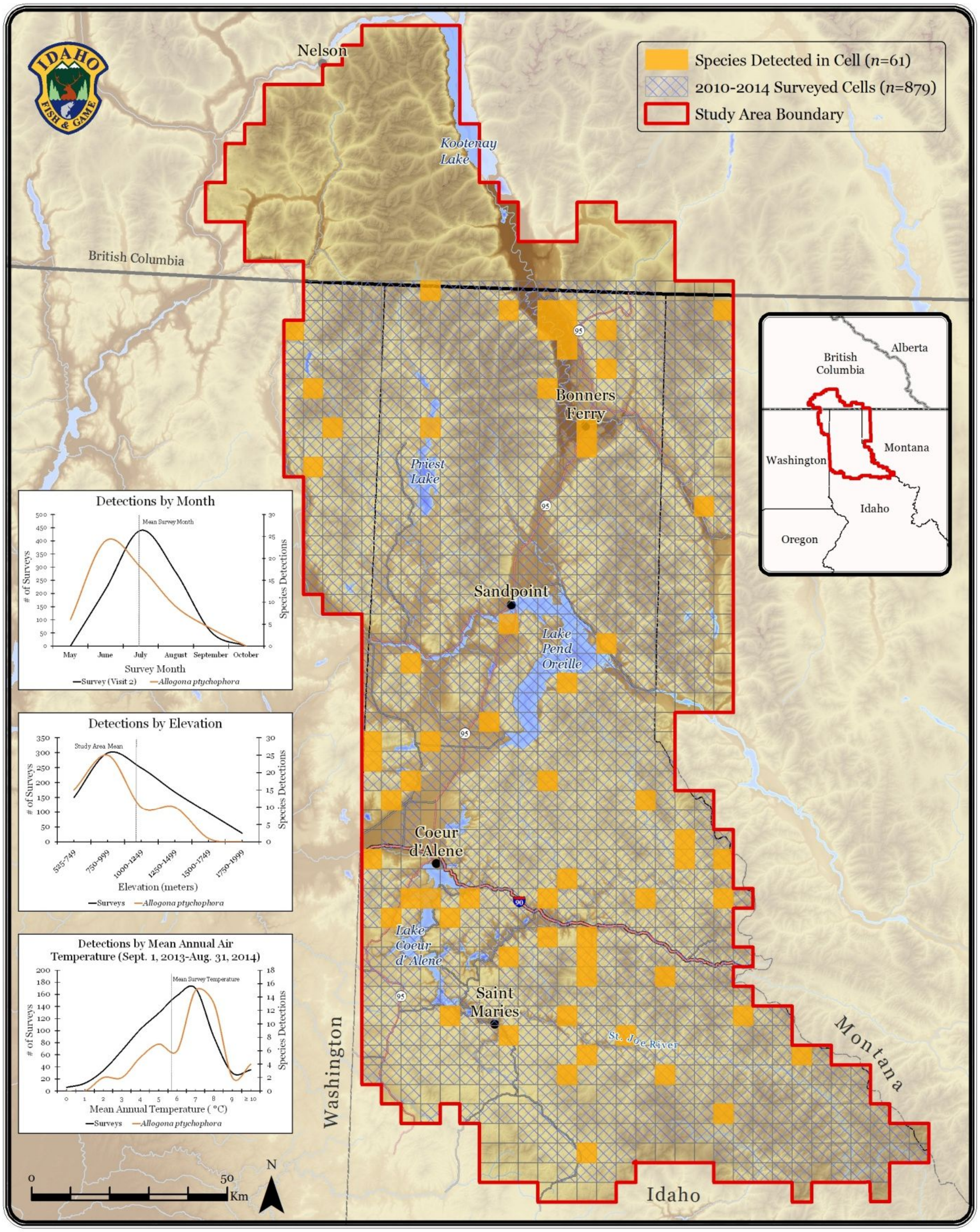
Map 2-4.

Multi-species Baseline Initiative: Non-native Gastropod Detections



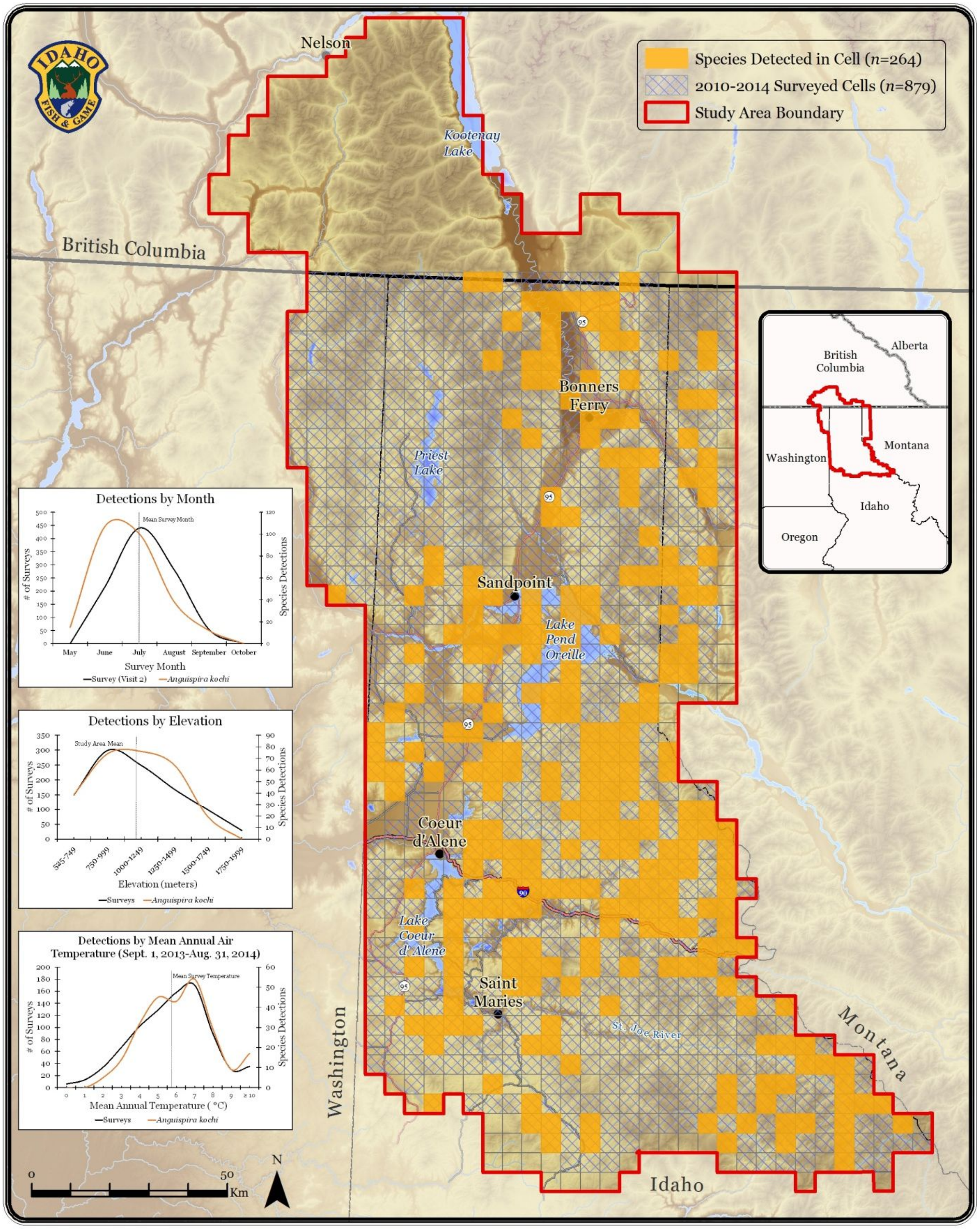
Map 2-5.

Multi-species Baseline Initiative: Idaho Forestsnail (*Allogona ptychophora*) Detections



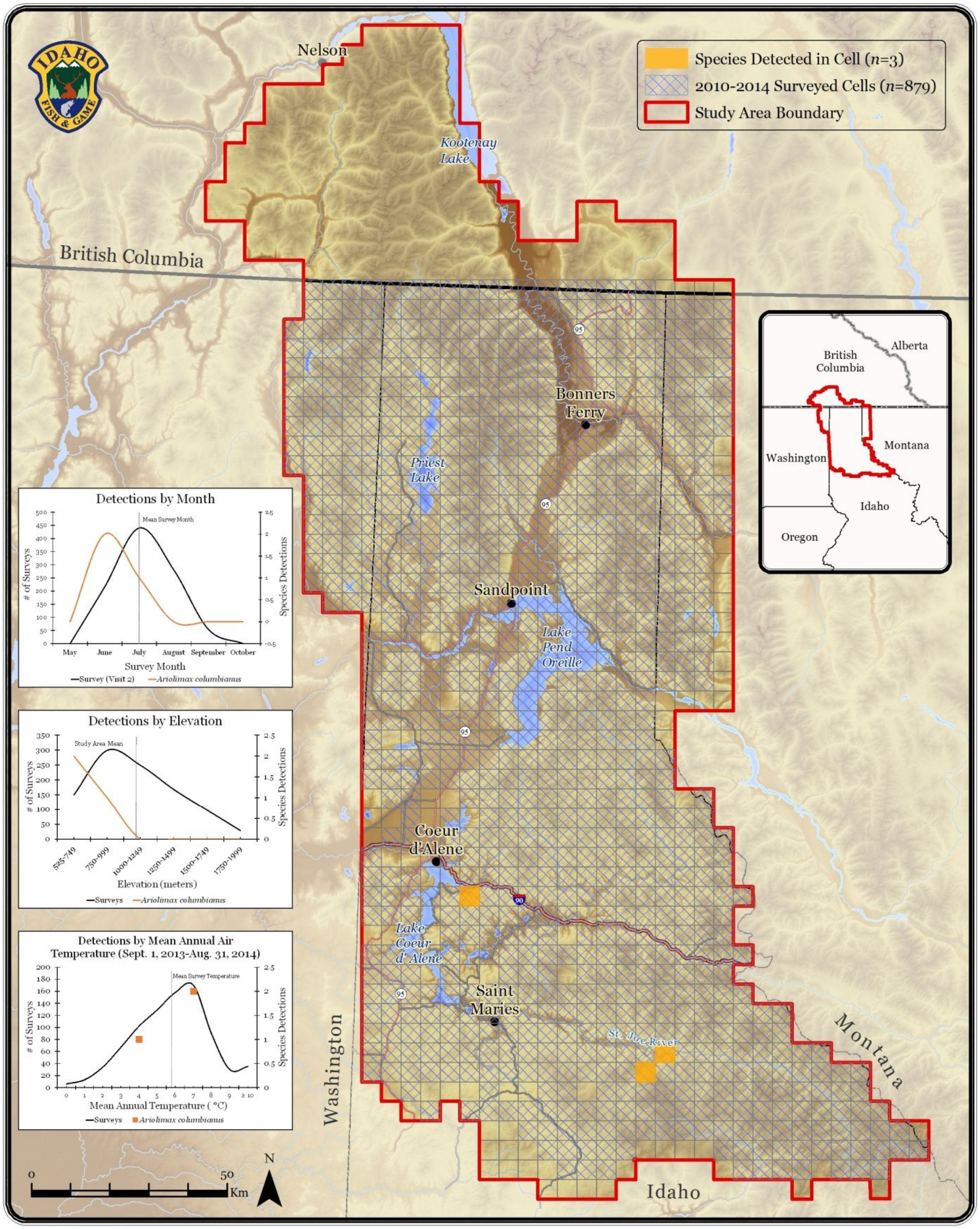
Map 2-6.

Multi-species Baseline Initiative: Banded Tigersnail (*Anguispira kochi*) Detections



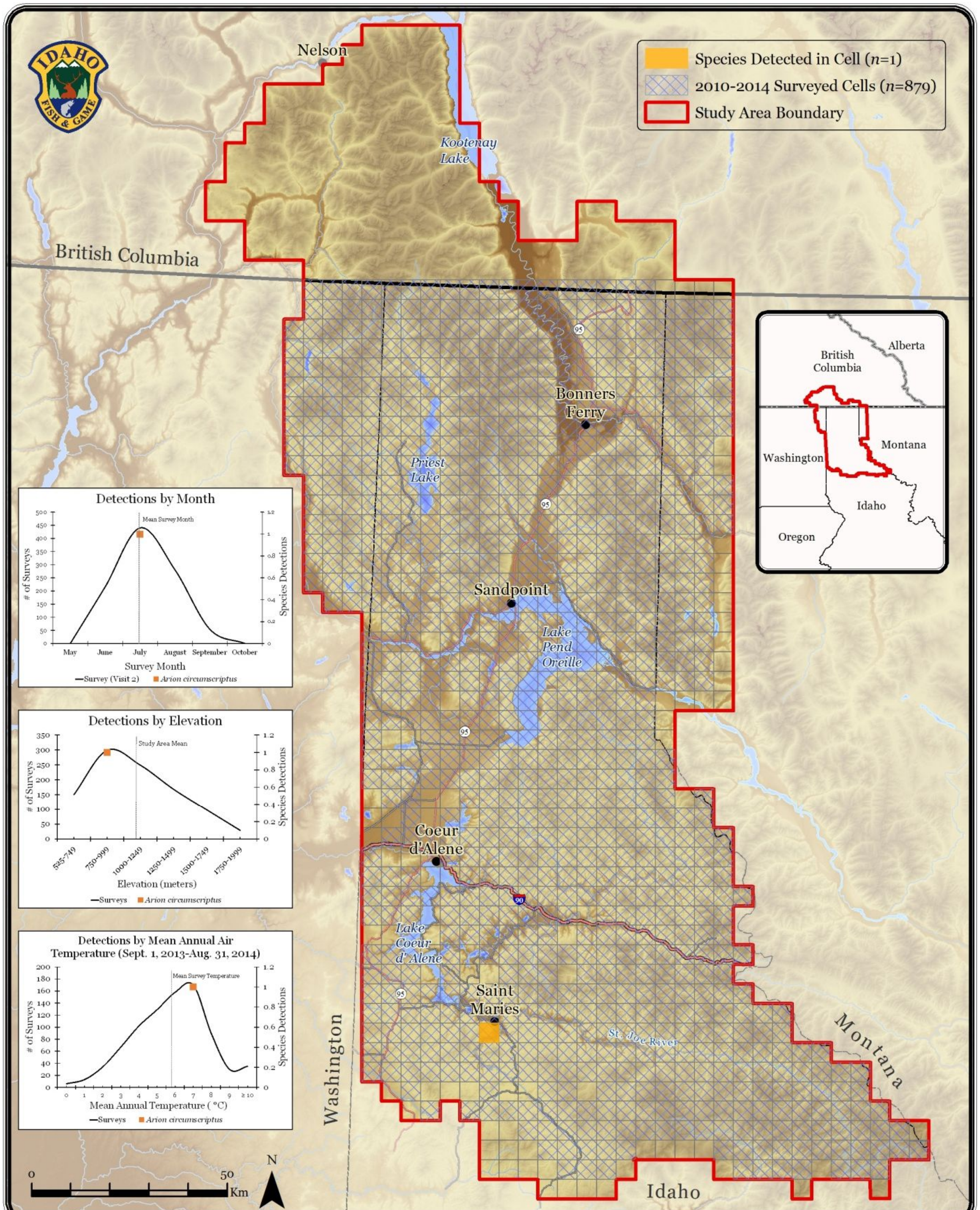
Map 2-7.

Multi-species Baseline Initiative: Pacific Bananaslug (*Ariolimax columbianus*) Detections



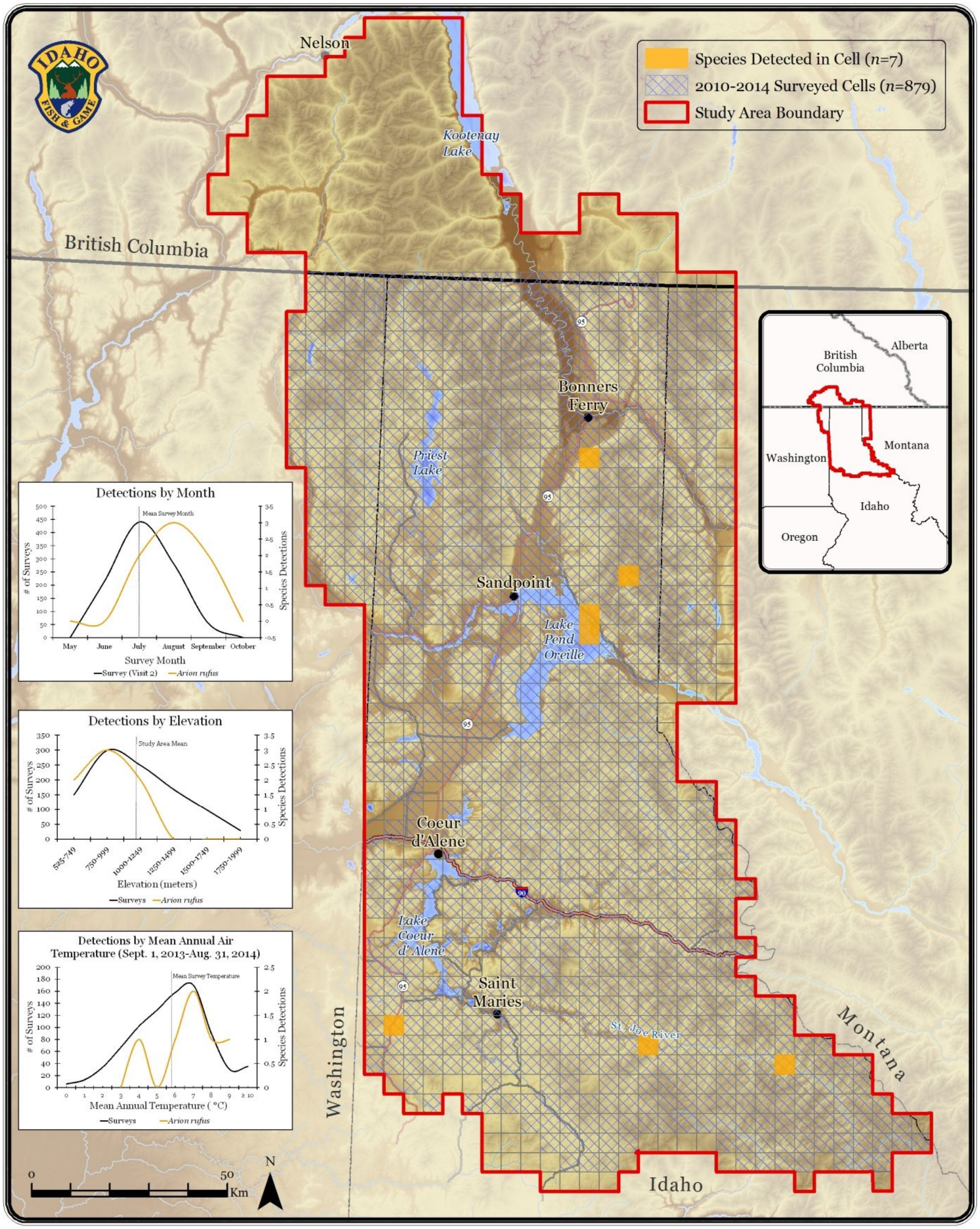
Map 2-8.

Multi-species Baseline Initiative: Brown-banded Arion (*Arion circumscriptus*) Detections



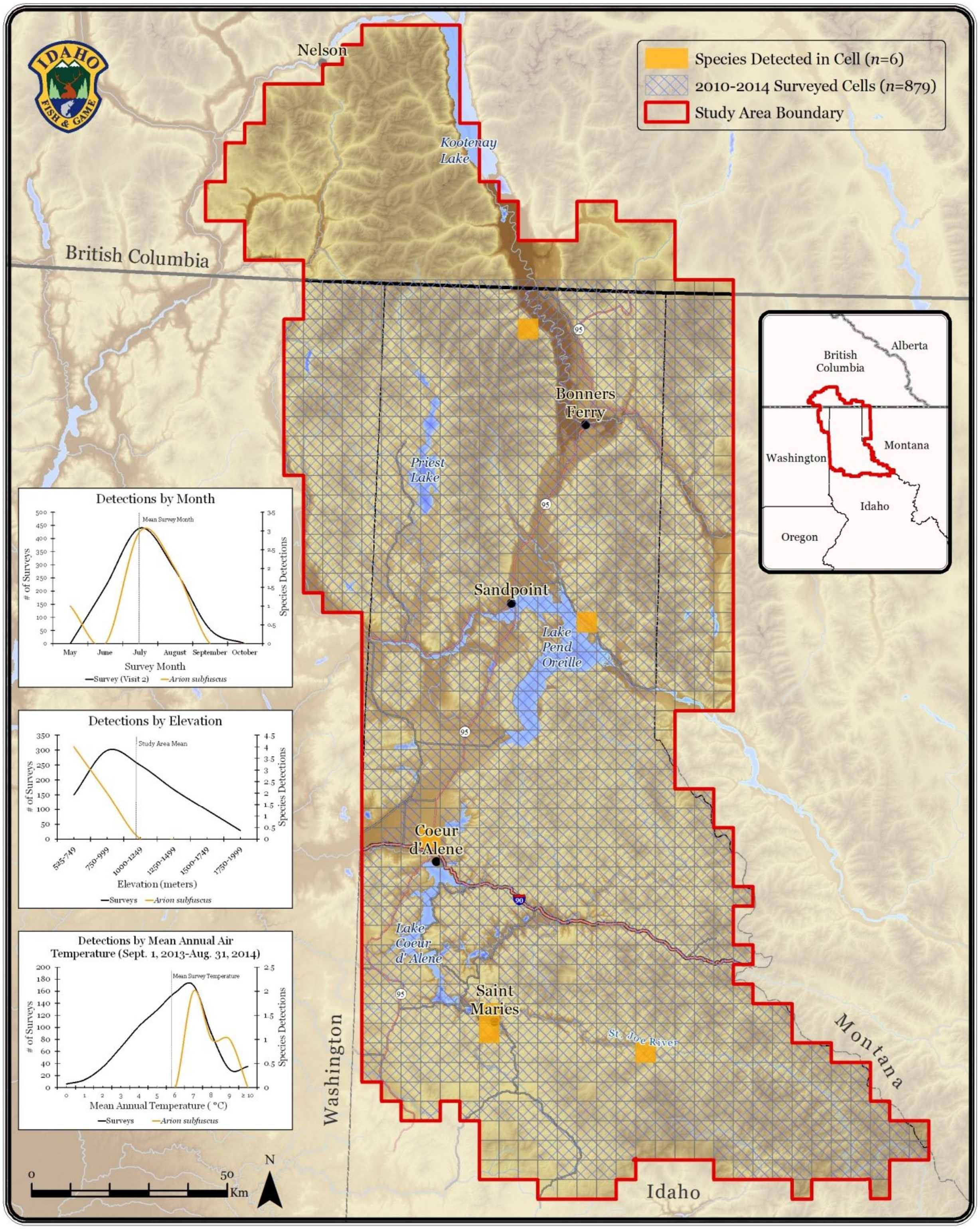
Map 2-9.

Multi-species Baseline Initiative: Chocolate Arion (*Arion rufus*) Detections



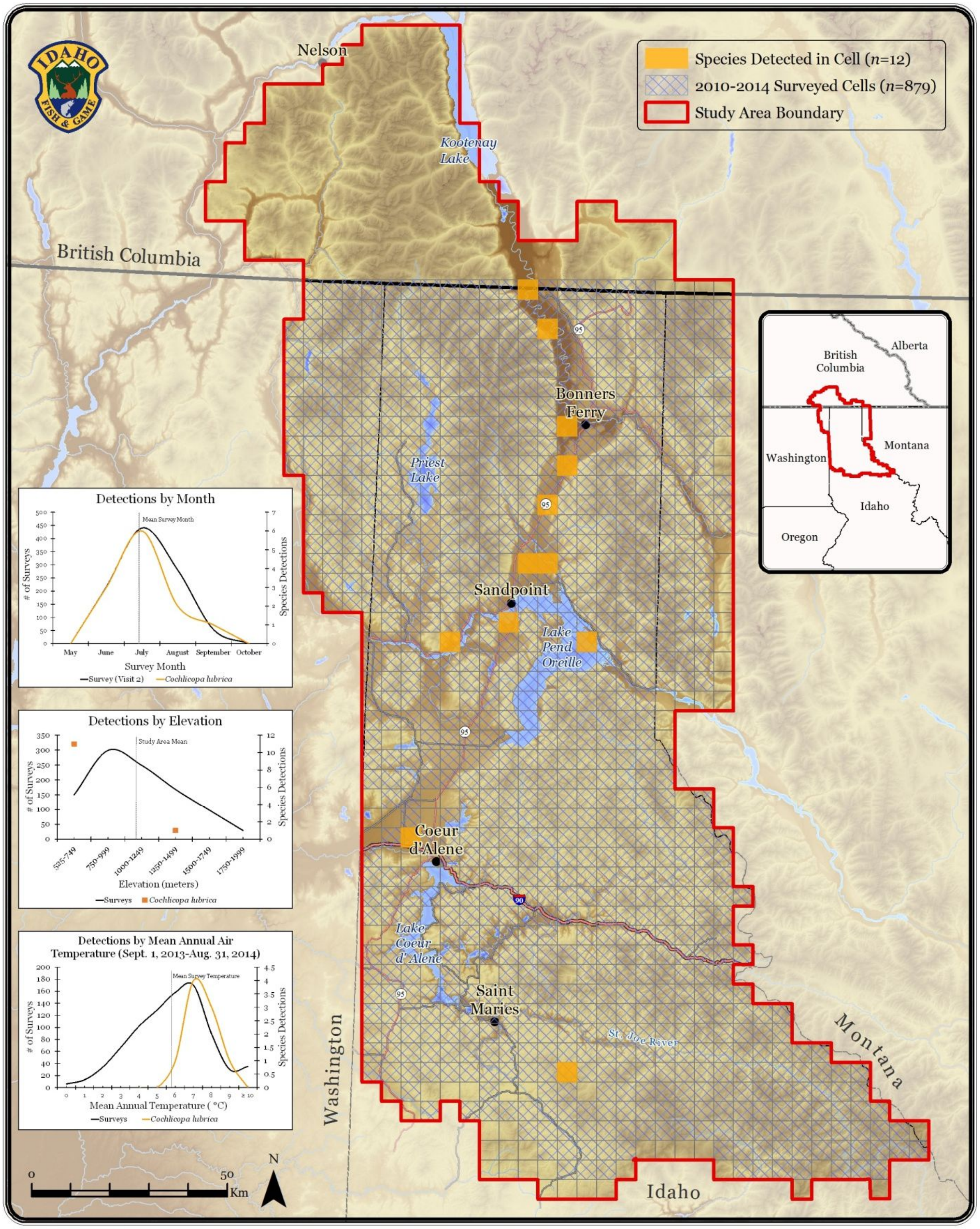
Map 2-10.

Multi-species Baseline Initiative: Dusky Arion (*Arion subfuscus*) Detections



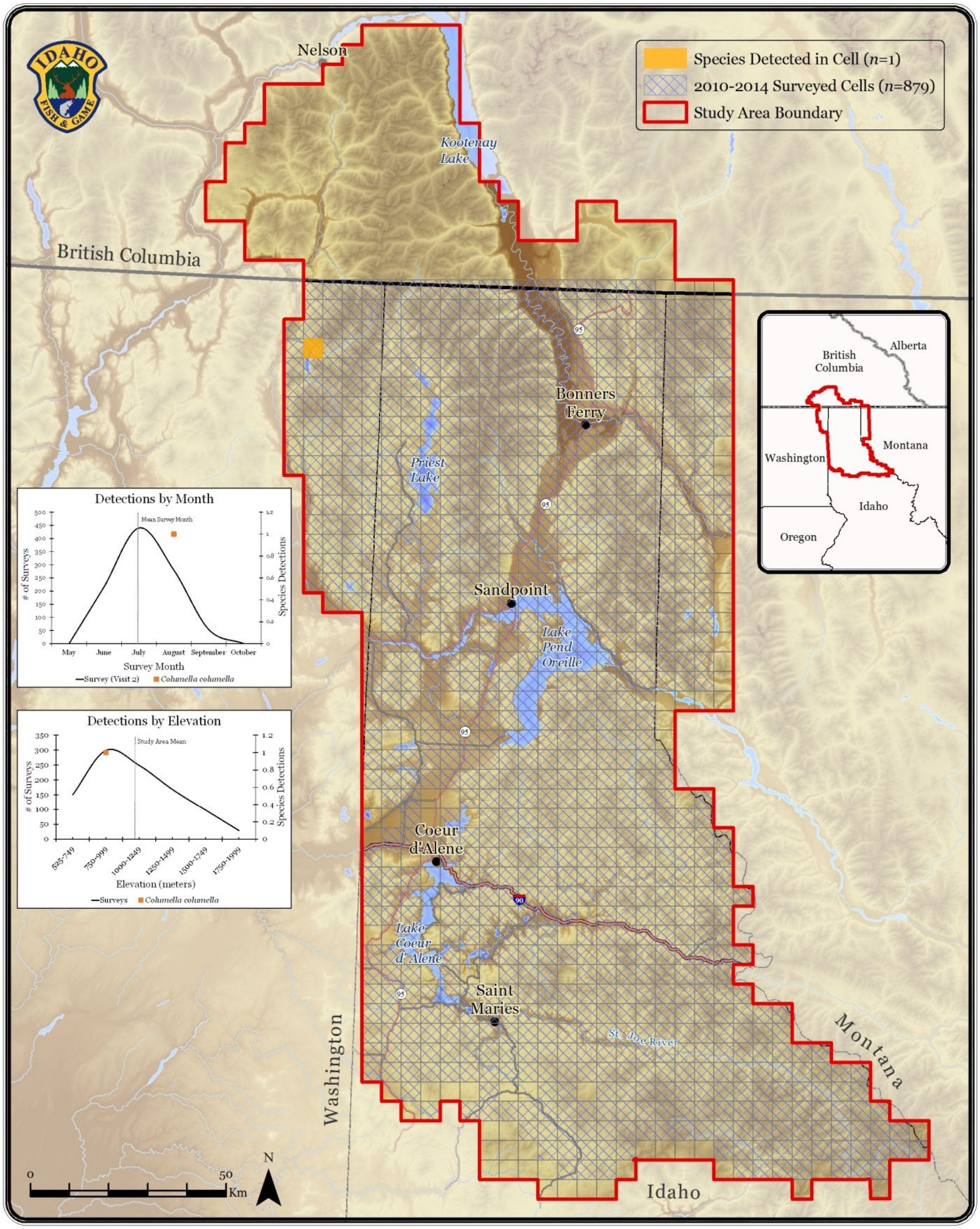
Map 2-11.

Multi-species Baseline Initiative: Glossy Pillar (*Cochlicopa lubrica*) Detections



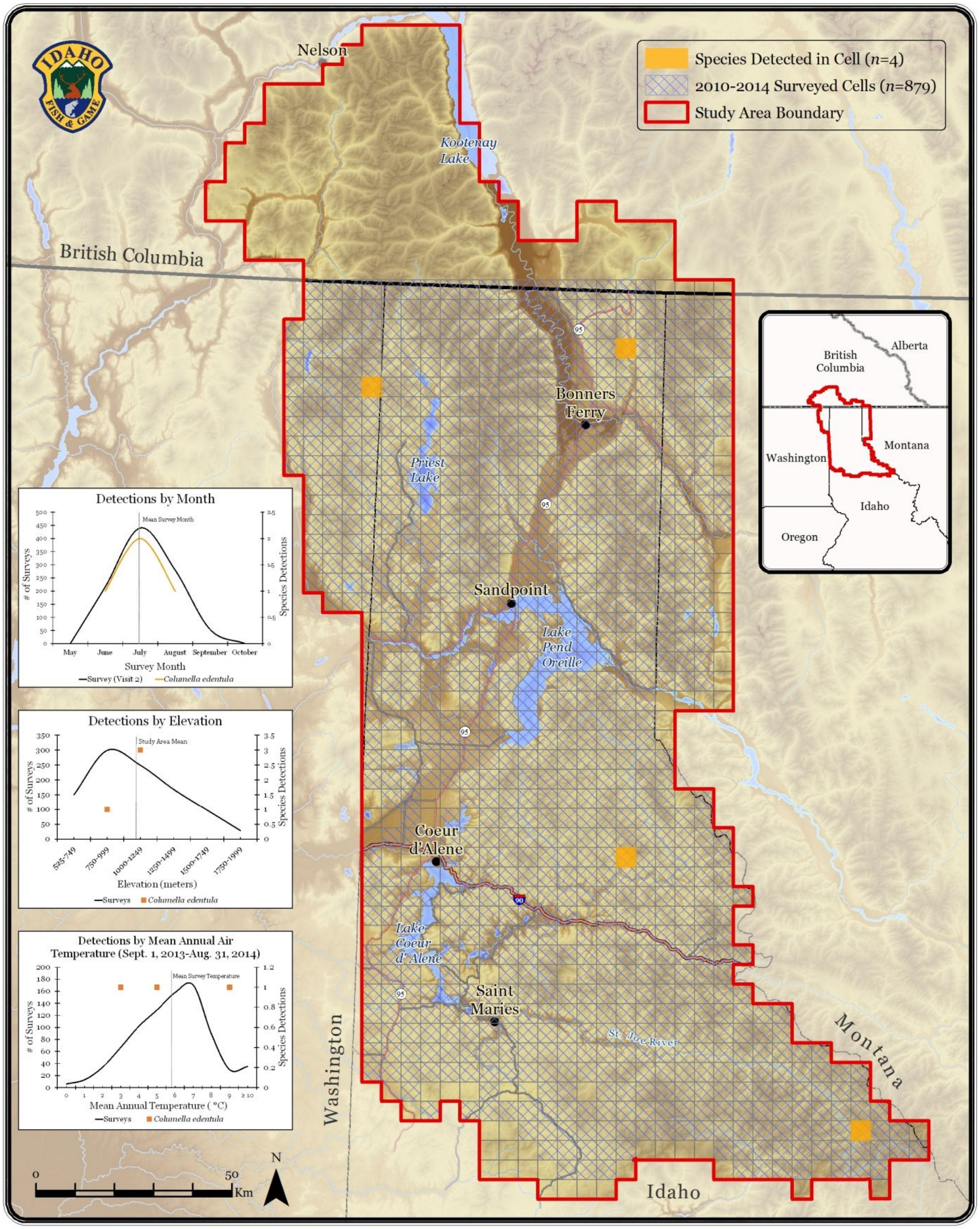
Map 2-12.

Multi-species Baseline Initiative: *Columella columella* Detections



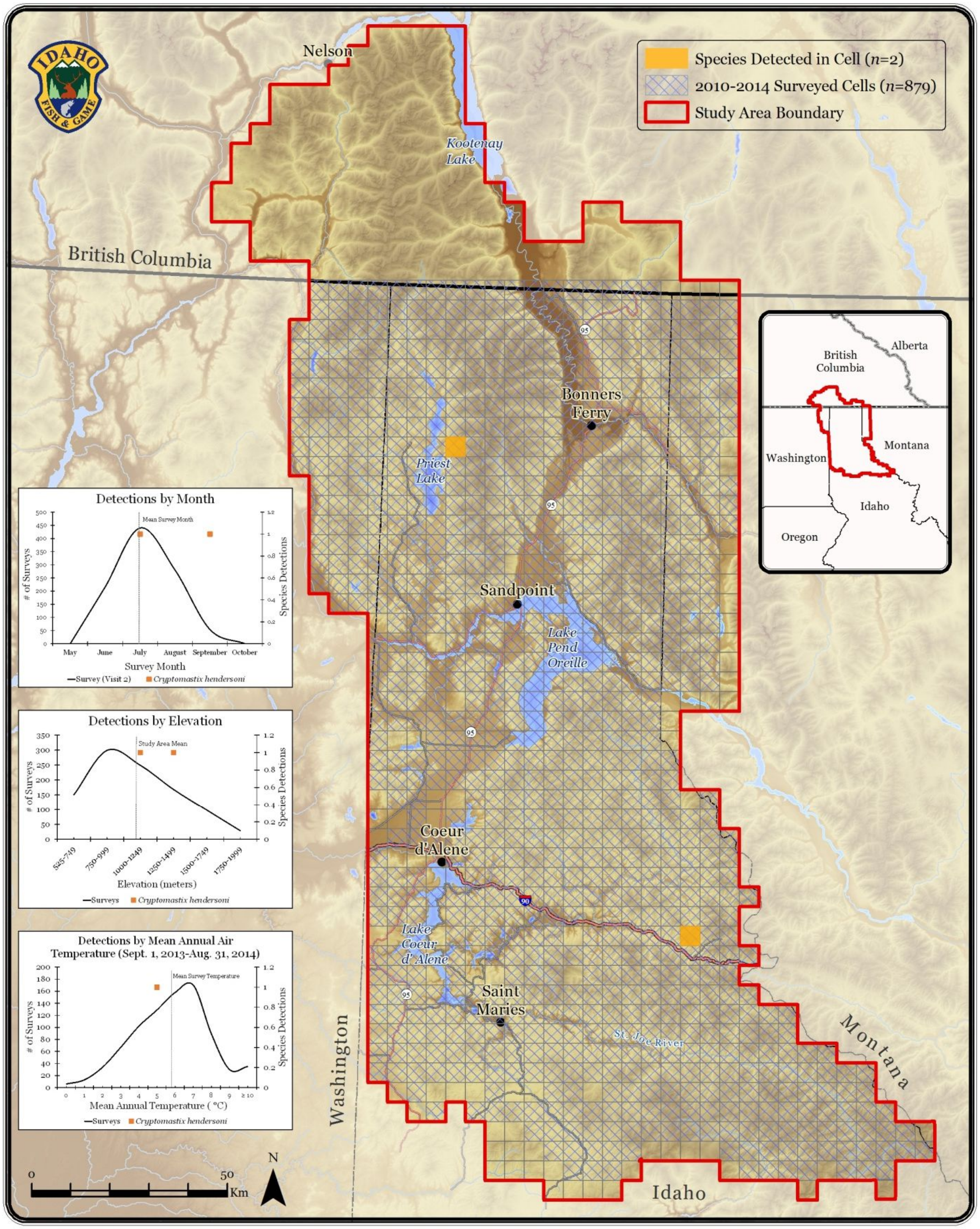
Map 2-13.

Multi-species Baseline Initiative: Toothless Column snail (*Columella edentula*) Detections



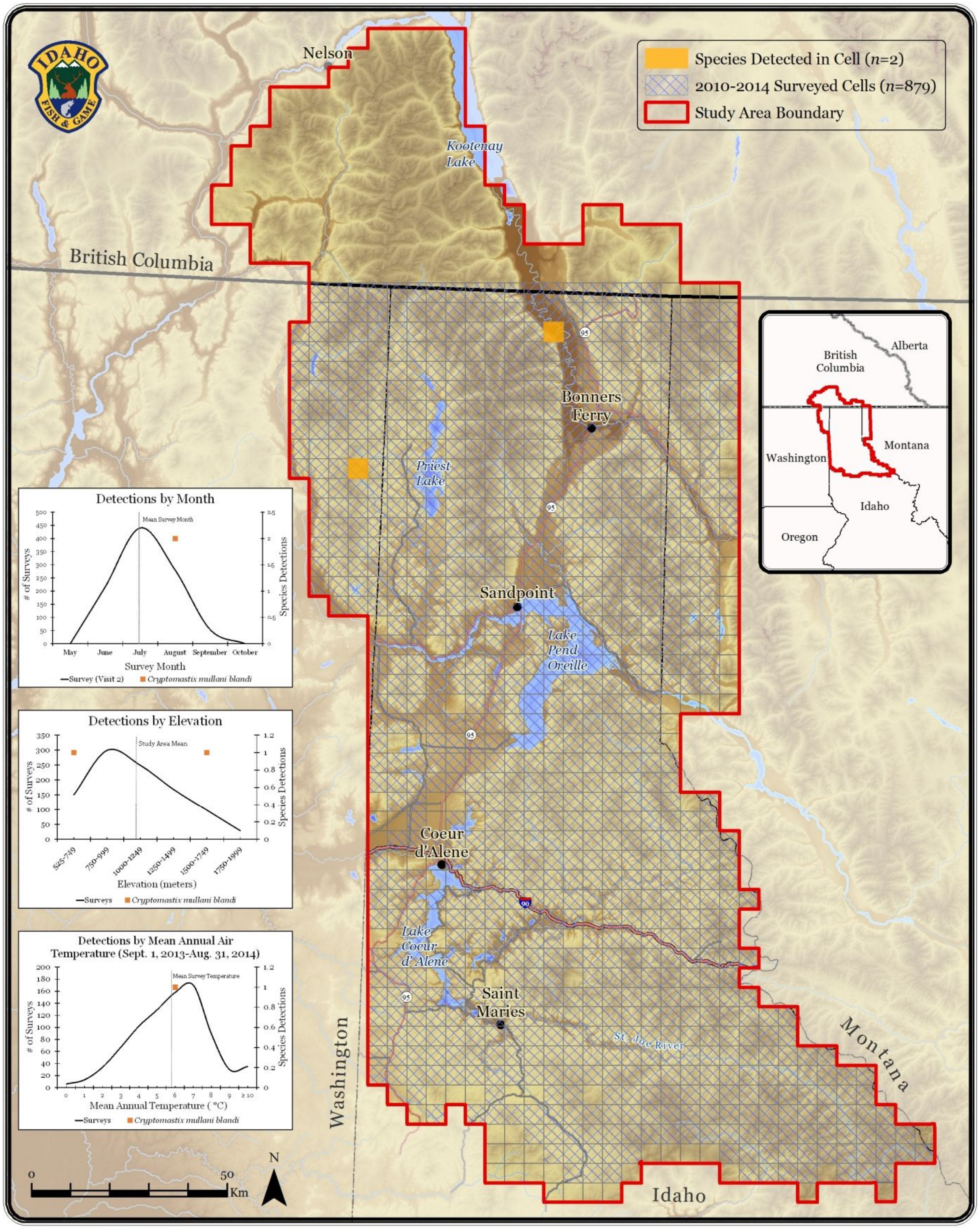
Map 2-14.

Multi-species Baseline Initiative: Columbia Oregonian (*Cryptomastix hendersoni*) Detections



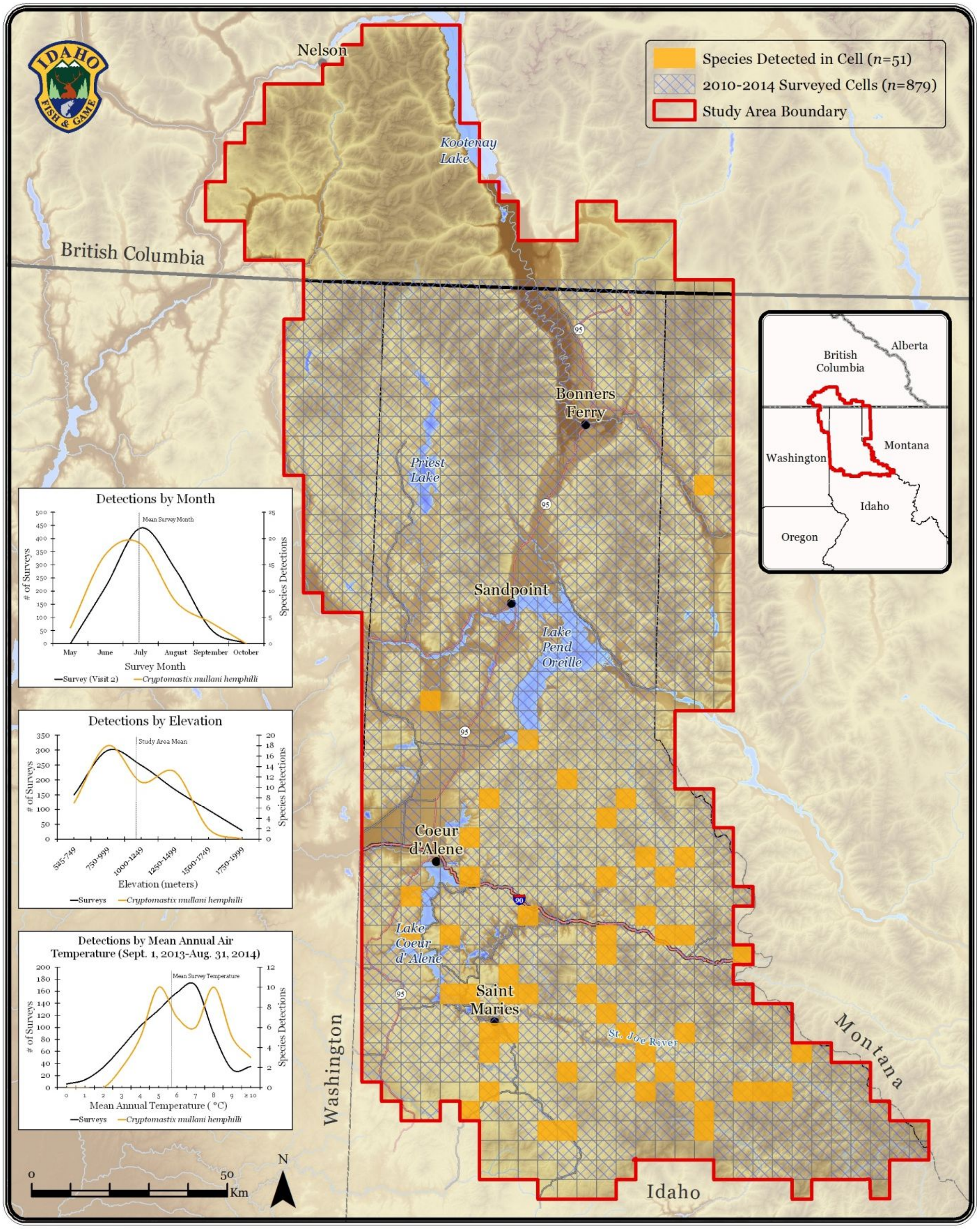
Map 2-15.

Multi-species Baseline Initiative: *Cryptomastix mullani blandi* Detections



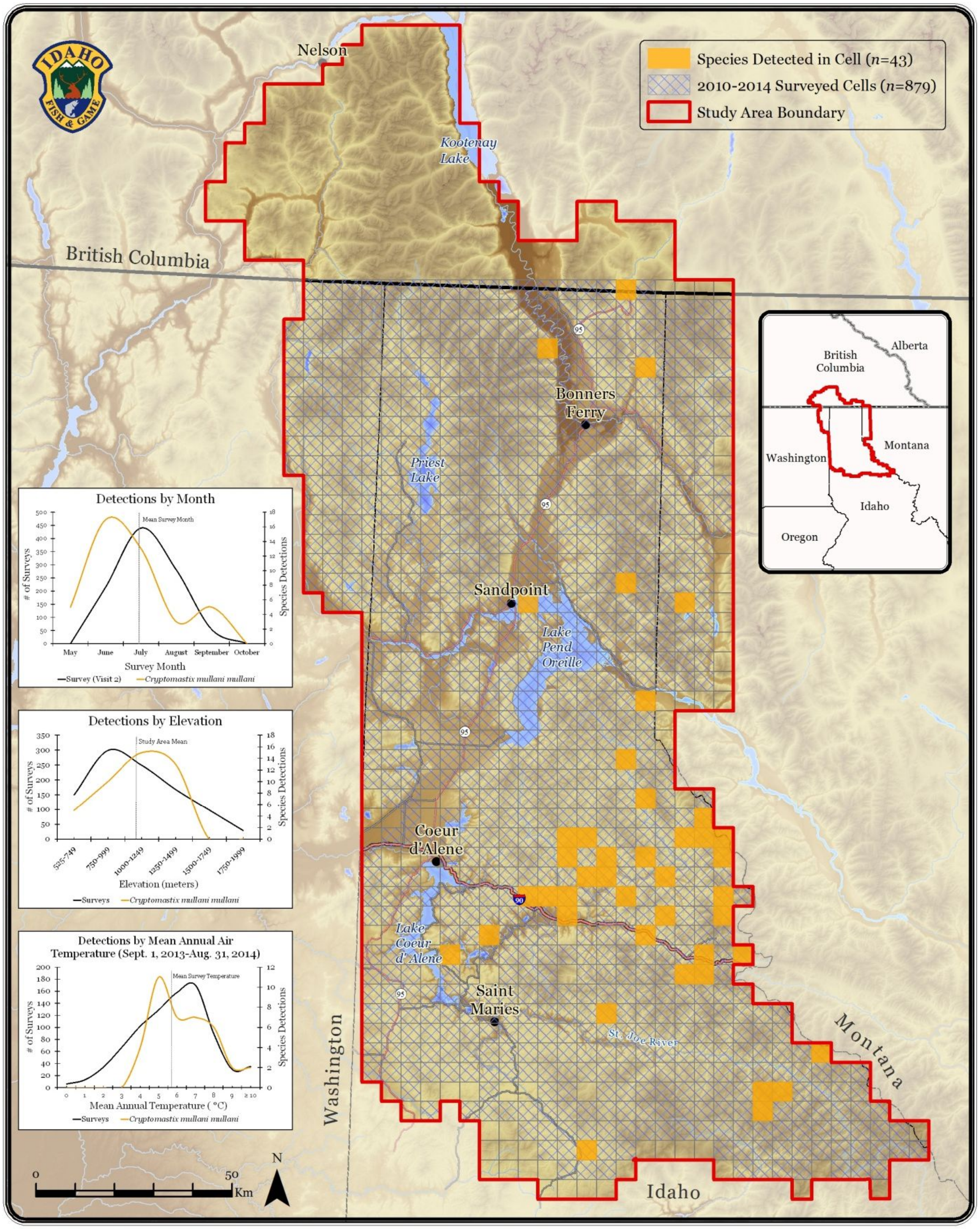
Map 2-16.

Multi-species Baseline Initiative: *Cryptomastix mullani hemphilli* Detections



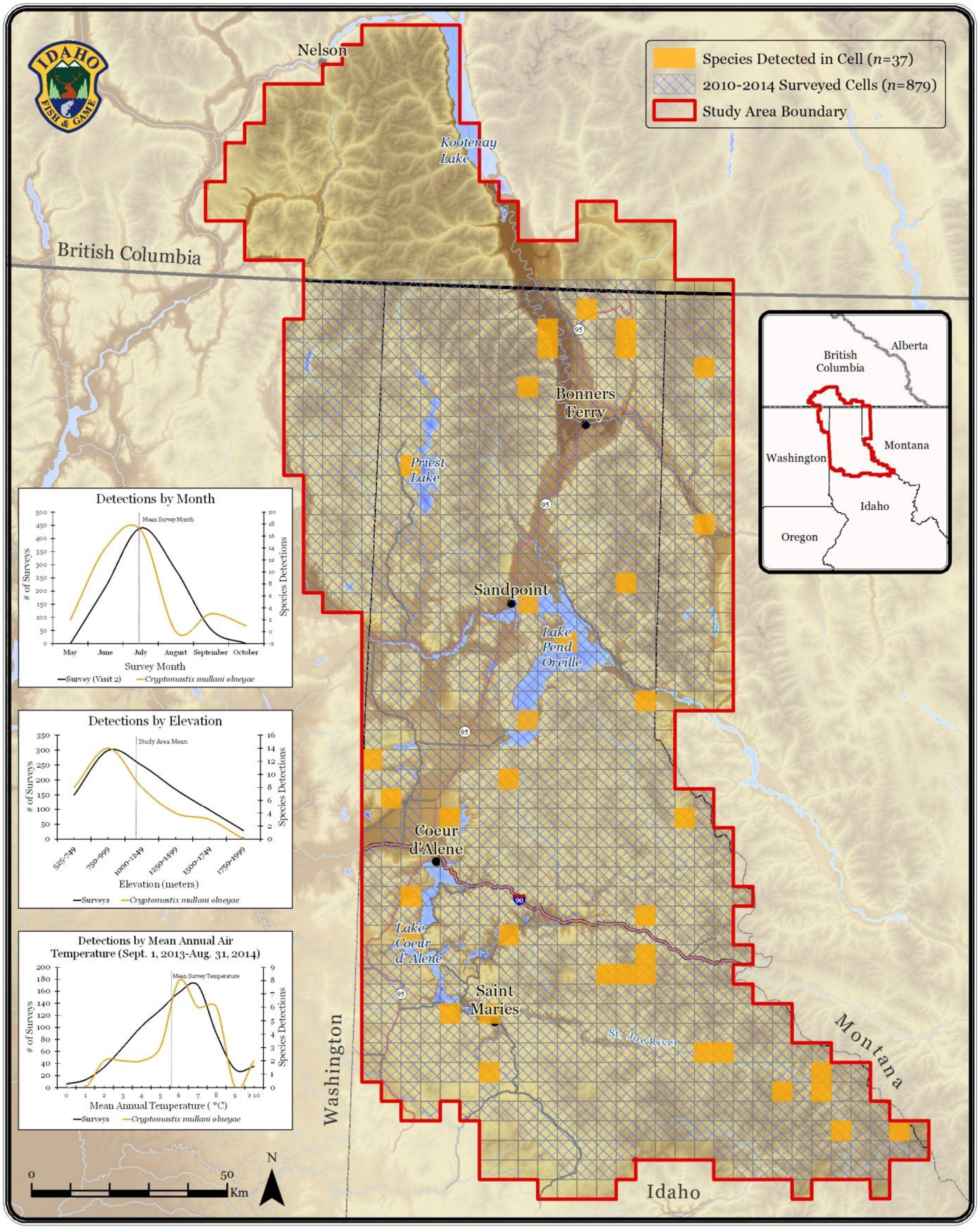
Map 2-17.

Multi-species Baseline Initiative: Coeur d' Alene Oregonian (*Cryptomastix mullani mullani*) Detections



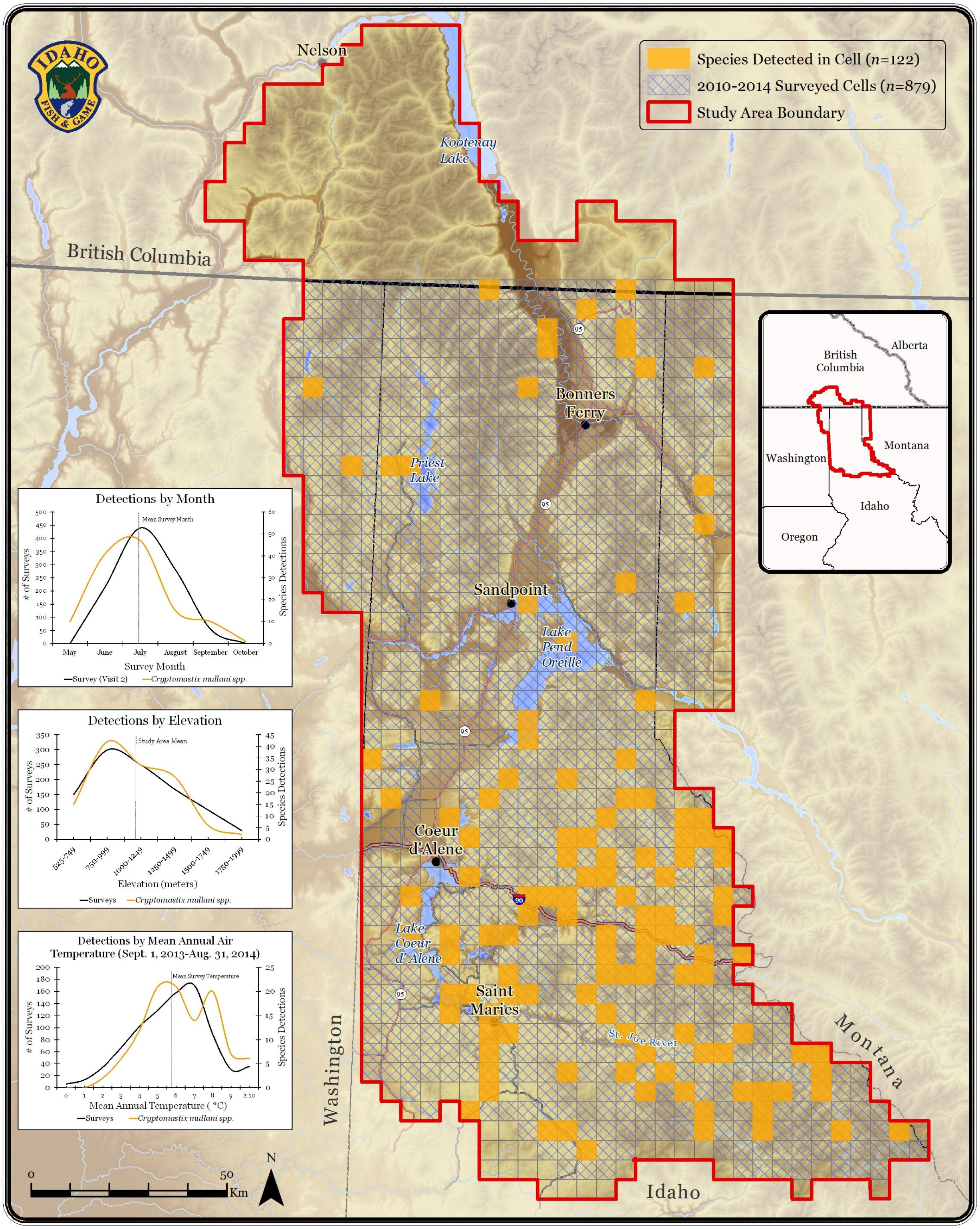
Map 2-18.

Multi-species Baseline Initiative: *Cryptomastix mullani olneyae* Detections



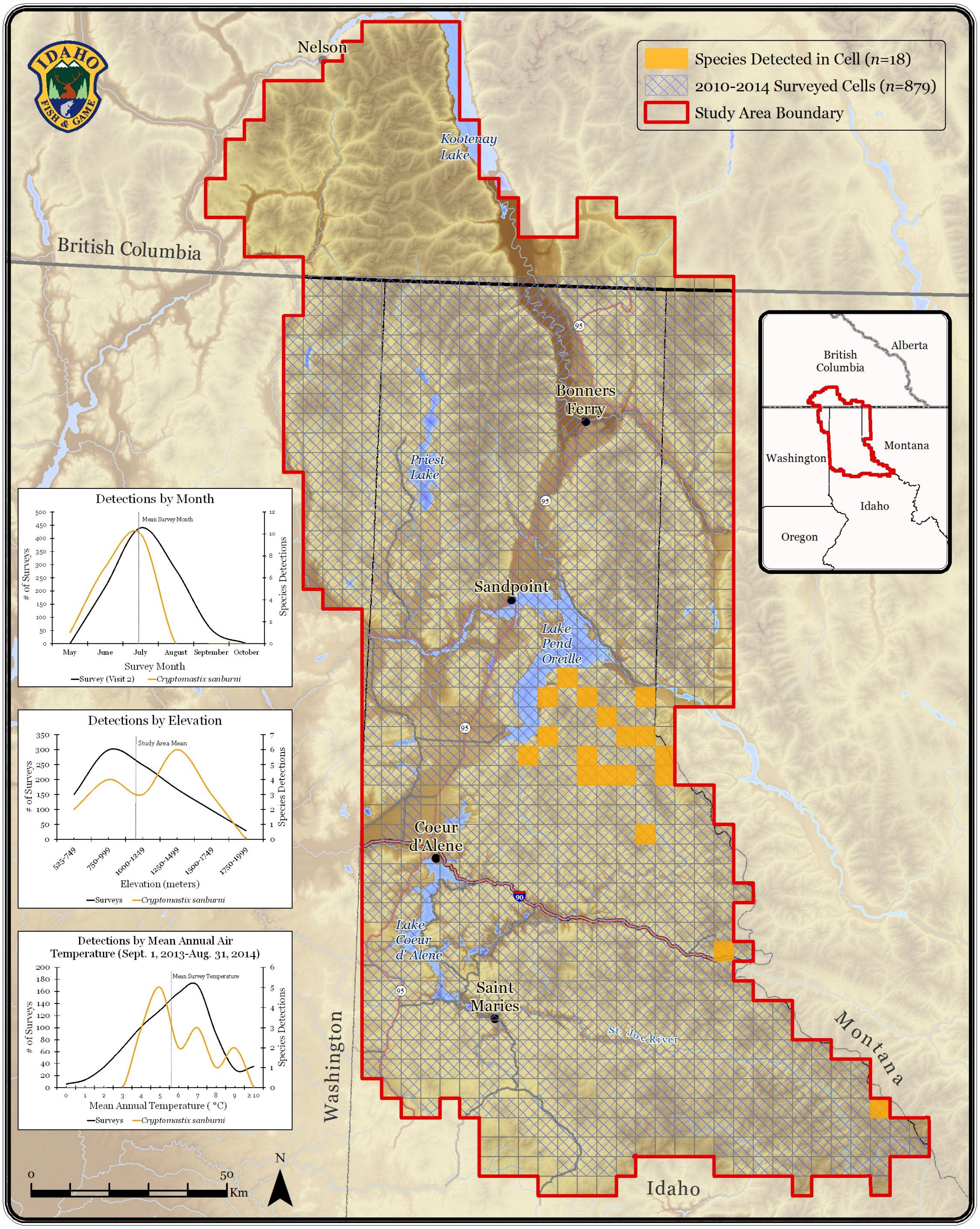
Map 2-19.

Multi-species Baseline Initiative: The *Cryptomastix mullani* complex Detections



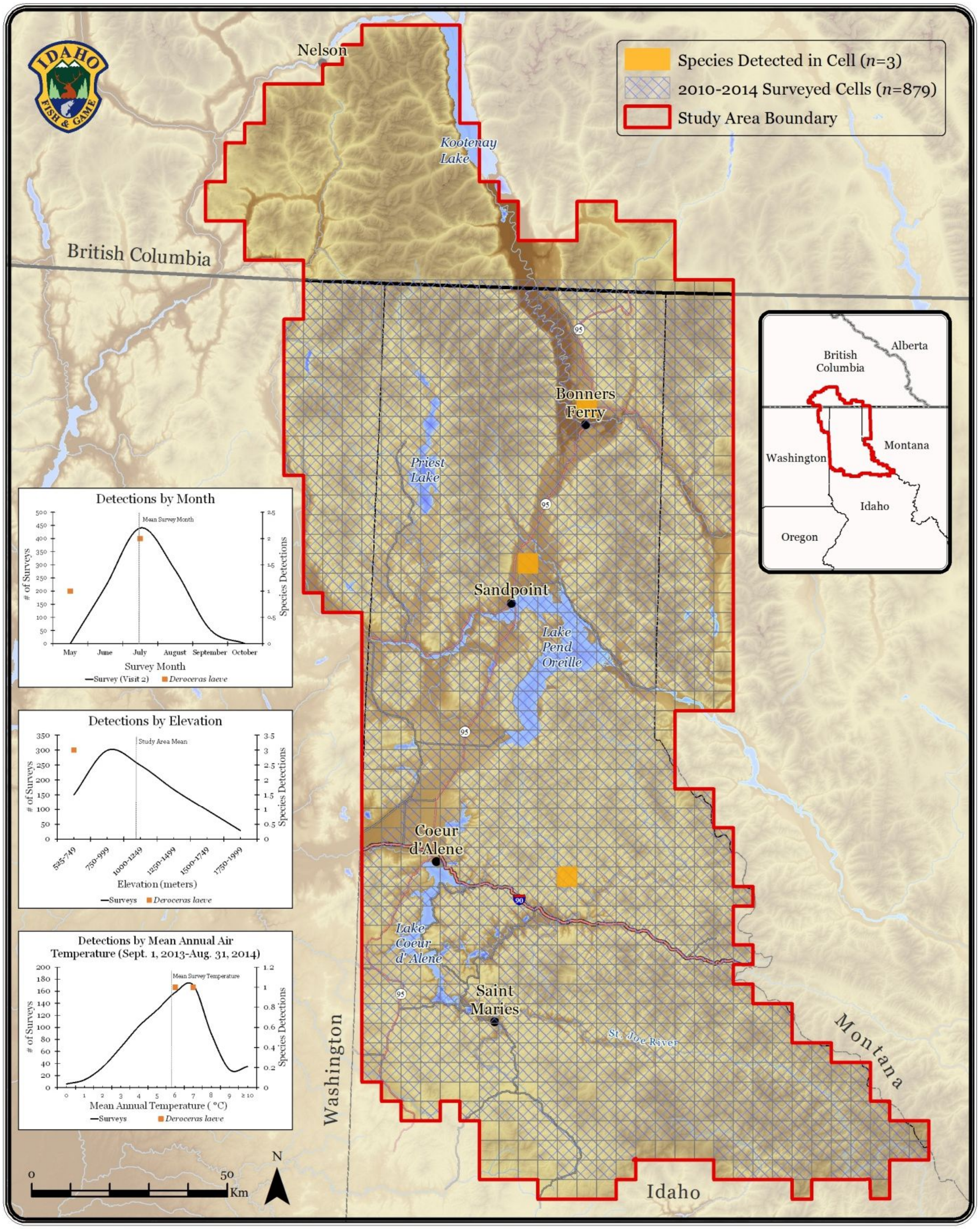
Map 2-20. All *C. mullani* detections including all subspecies.

Multi-species Baseline Initiative: Kingston Oregonian (*Cryptomastix sanburni*) Detections



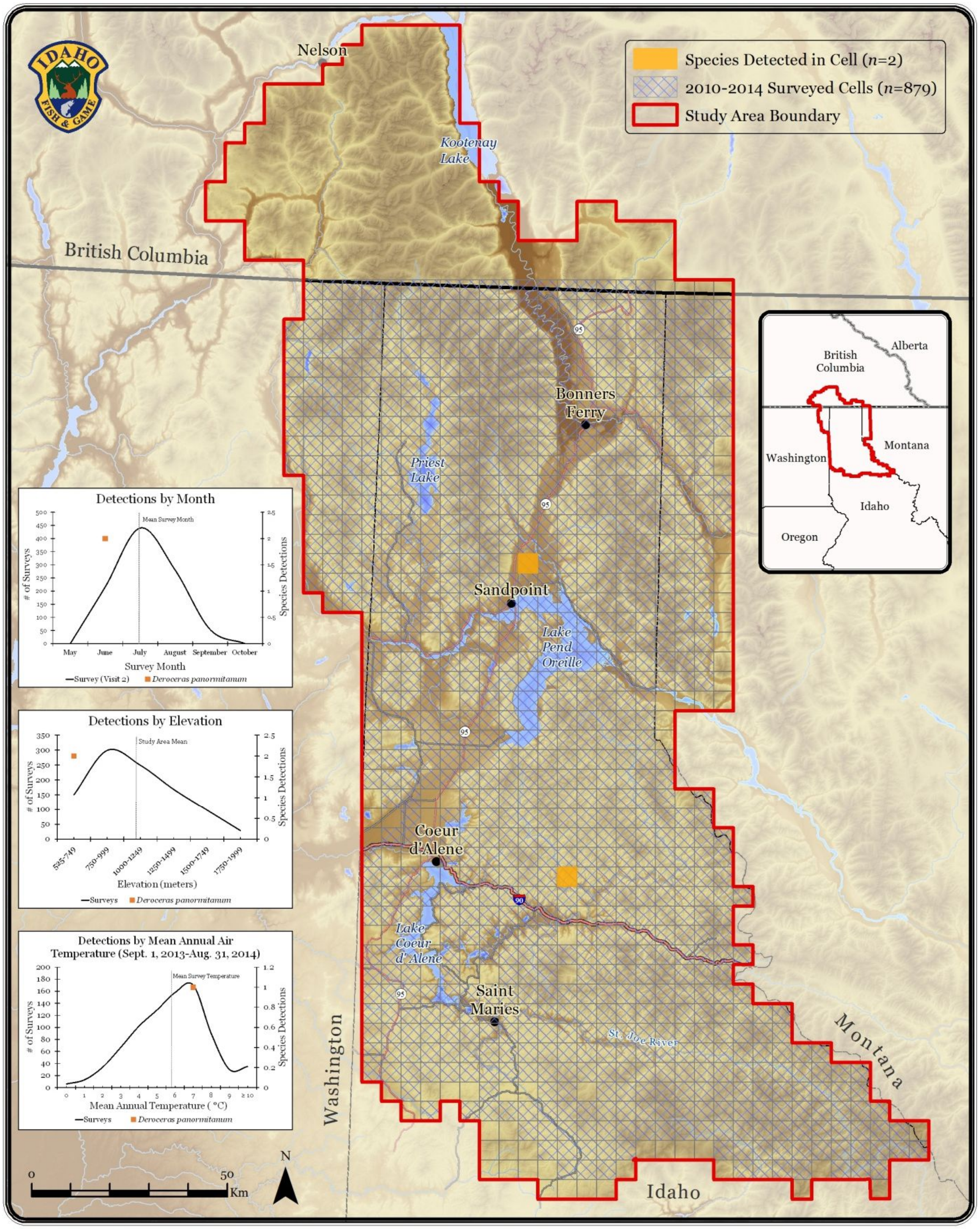
Map 2-21.

Multi-species Baseline Initiative: Meadow Fieldslug (*Deroceras laeve*) Detections



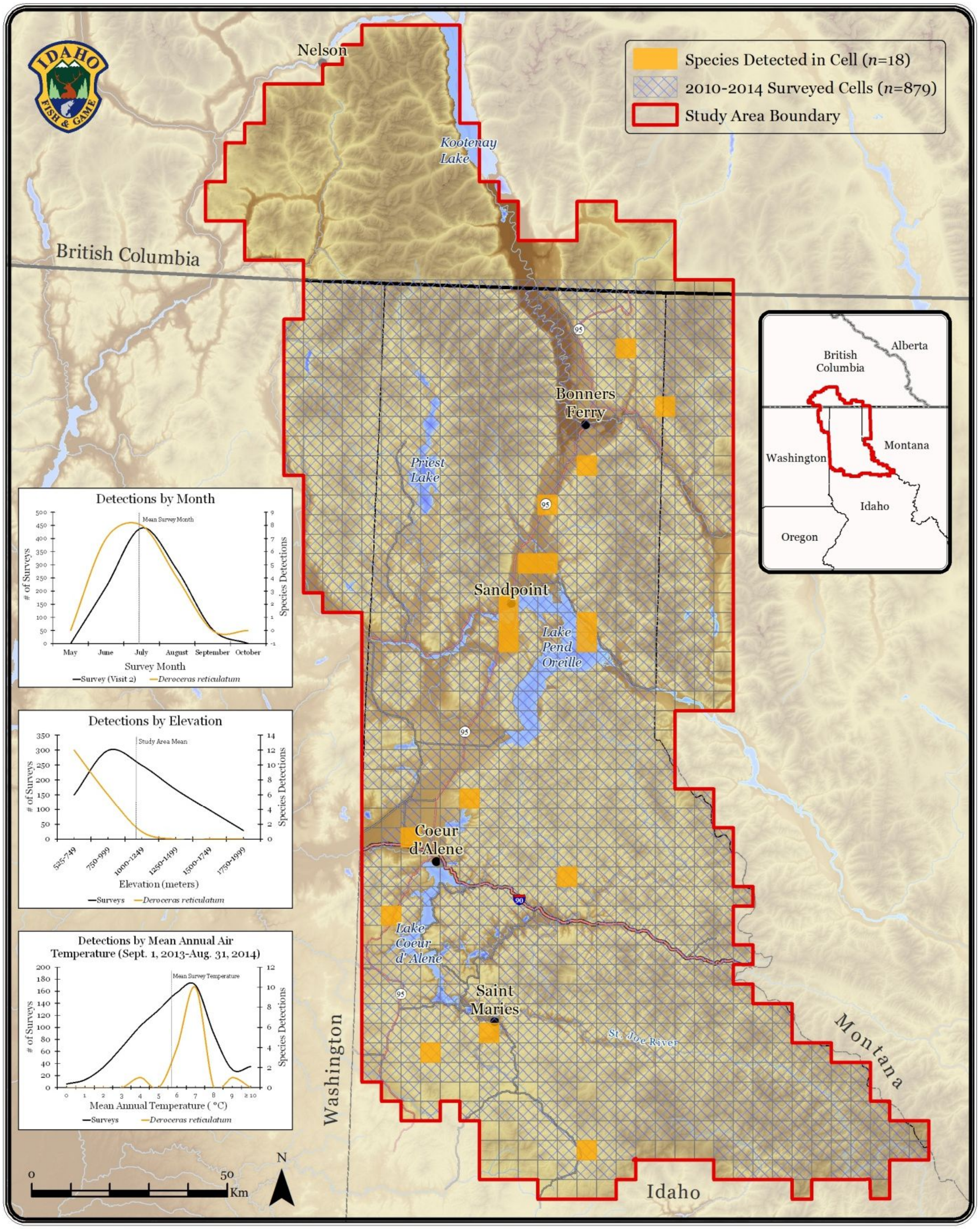
Map 2-22.

Multi-species Baseline Initiative: Longneck Fieldslug (*Deroceras panormitanum*) Detections



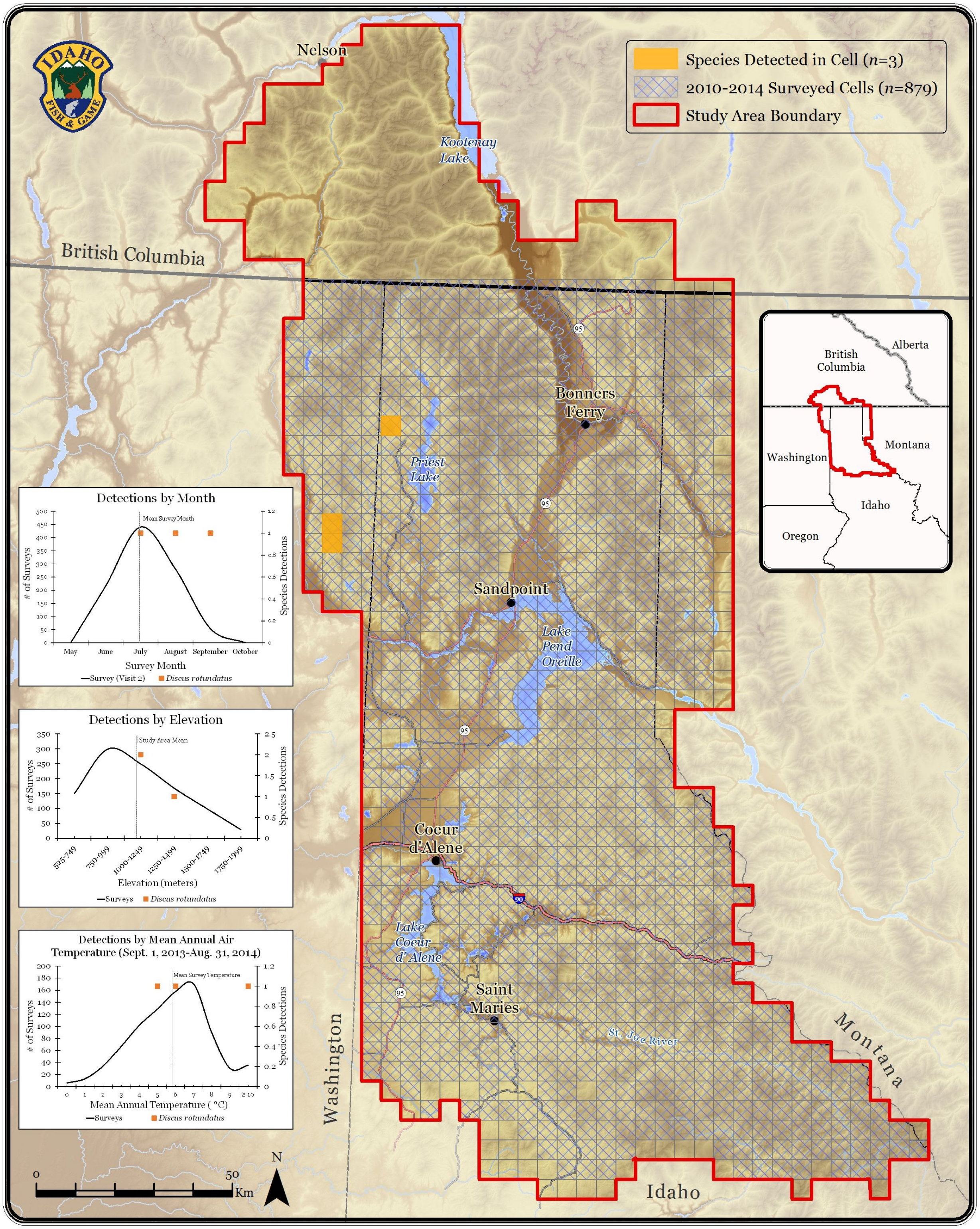
Map 2-23.

Multi-species Baseline Initiative: Gray Fieldslug (*Deroceras reticulatum*) Detections



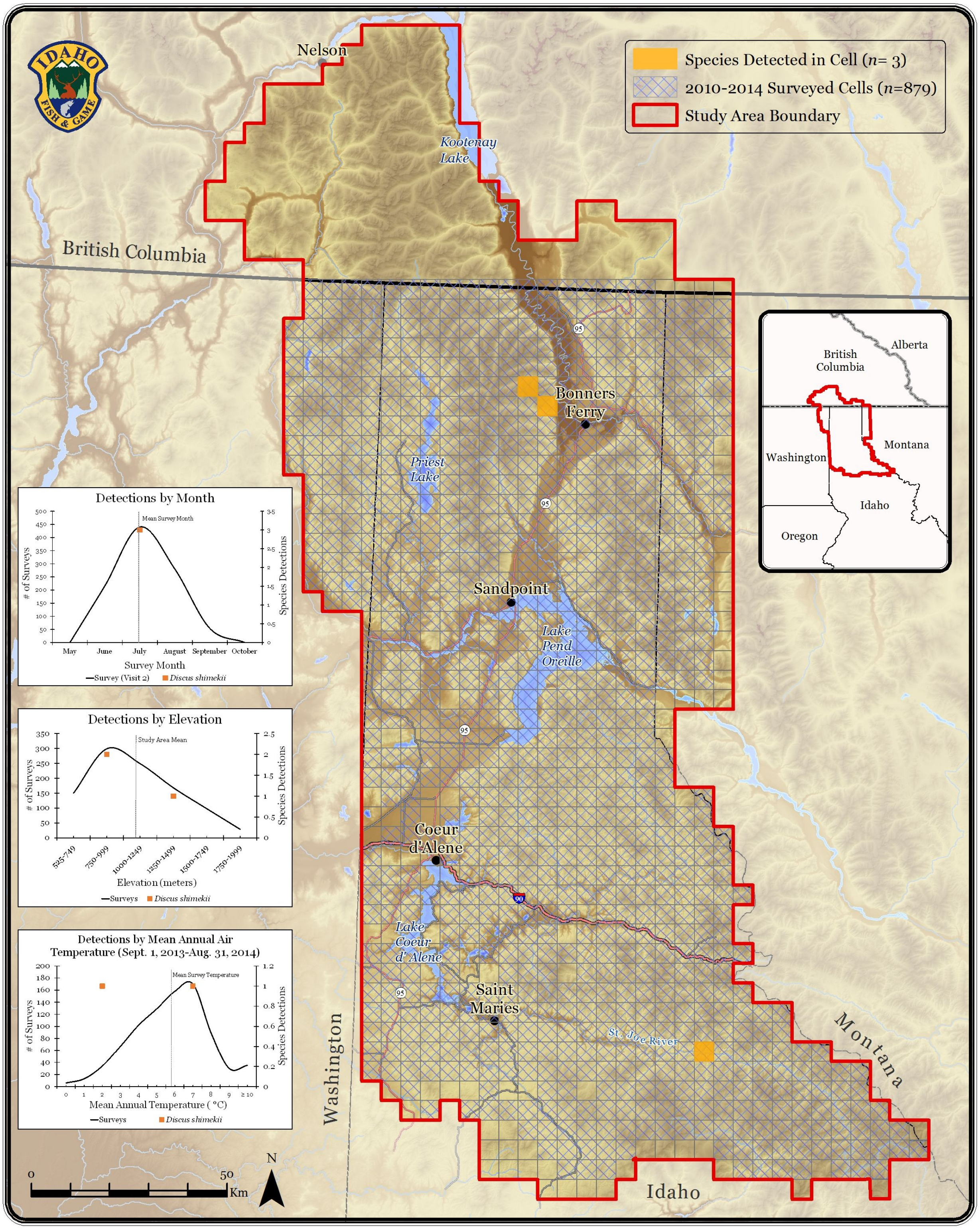
Map 2-24.

Multi-species Baseline Initiative: Rotund Disc (*Discus rotundatus*) Detections



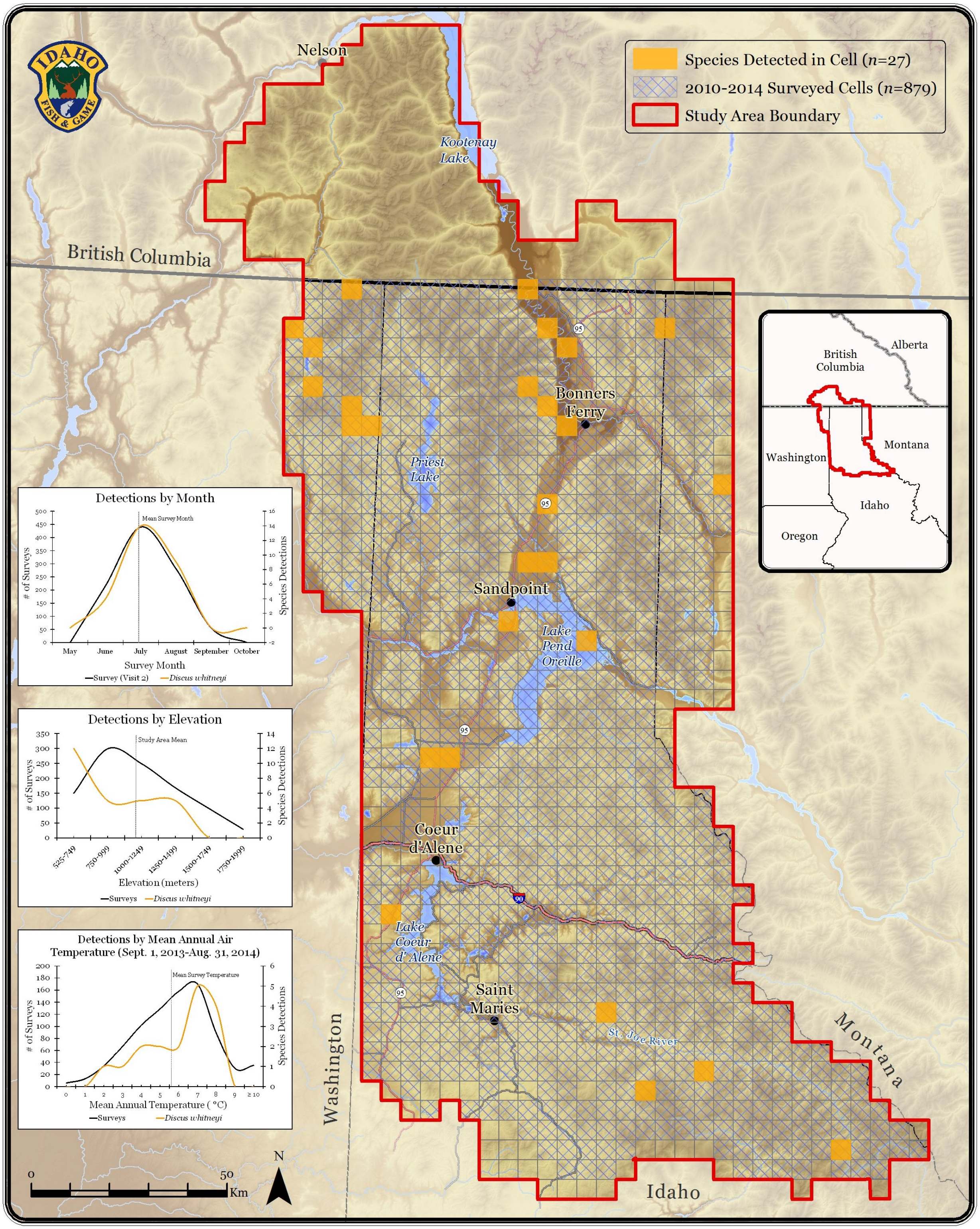
Map 2-25.

Multi-species Baseline Initiative: Striate Disc (*Discus shimekii*) Detections



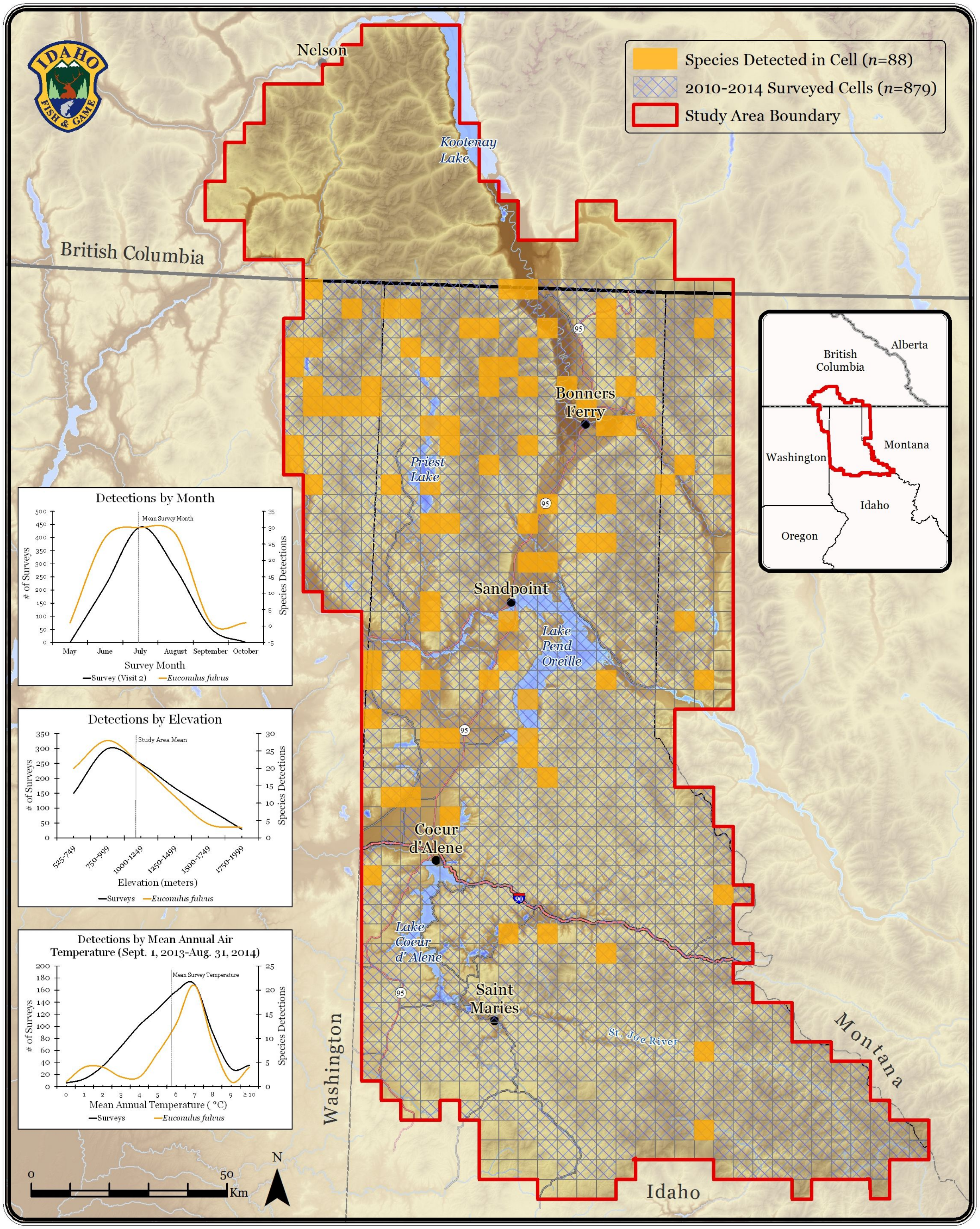
Map 2-26.

Multi-species Baseline Initiative: Forest Disc (*Discus whitneyi*) Detections



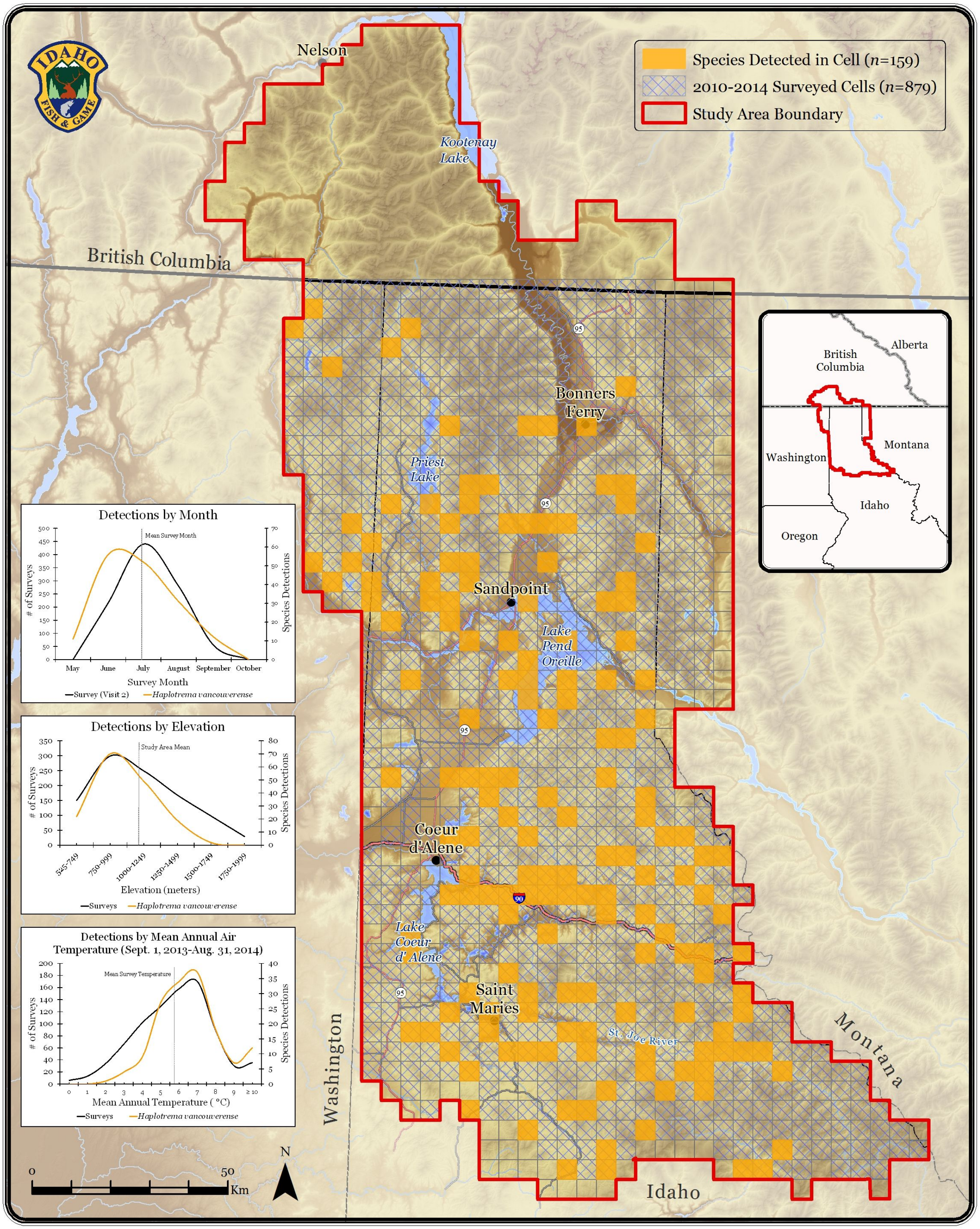
Map 2-27.

Multi-species Baseline Initiative: Brown Hive (*Euconulus fulvus*) Detections



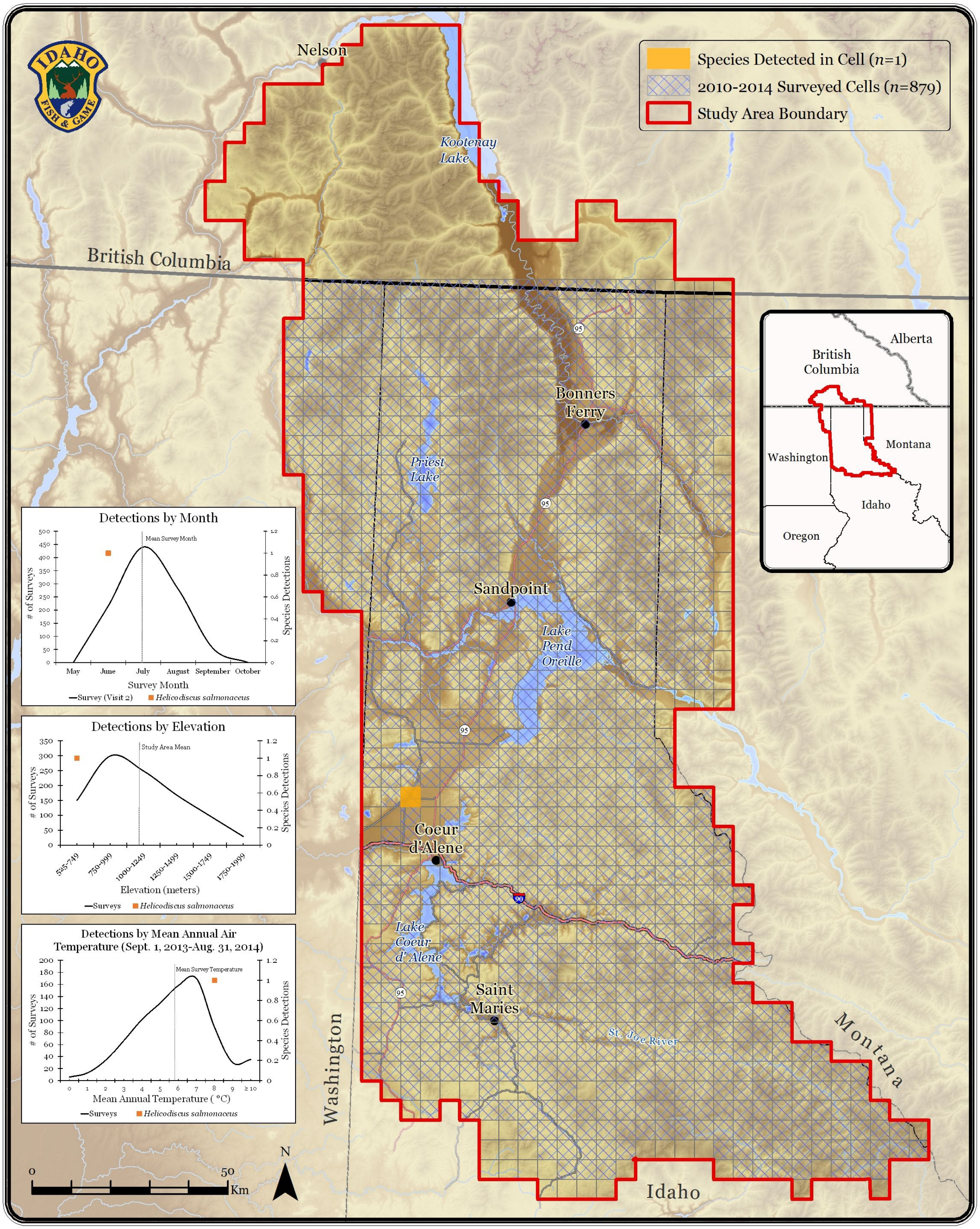
Map 2-28.

Multi-species Baseline Initiative: Robust Lancetooth (*Haplotrema vancouverense*) Detections



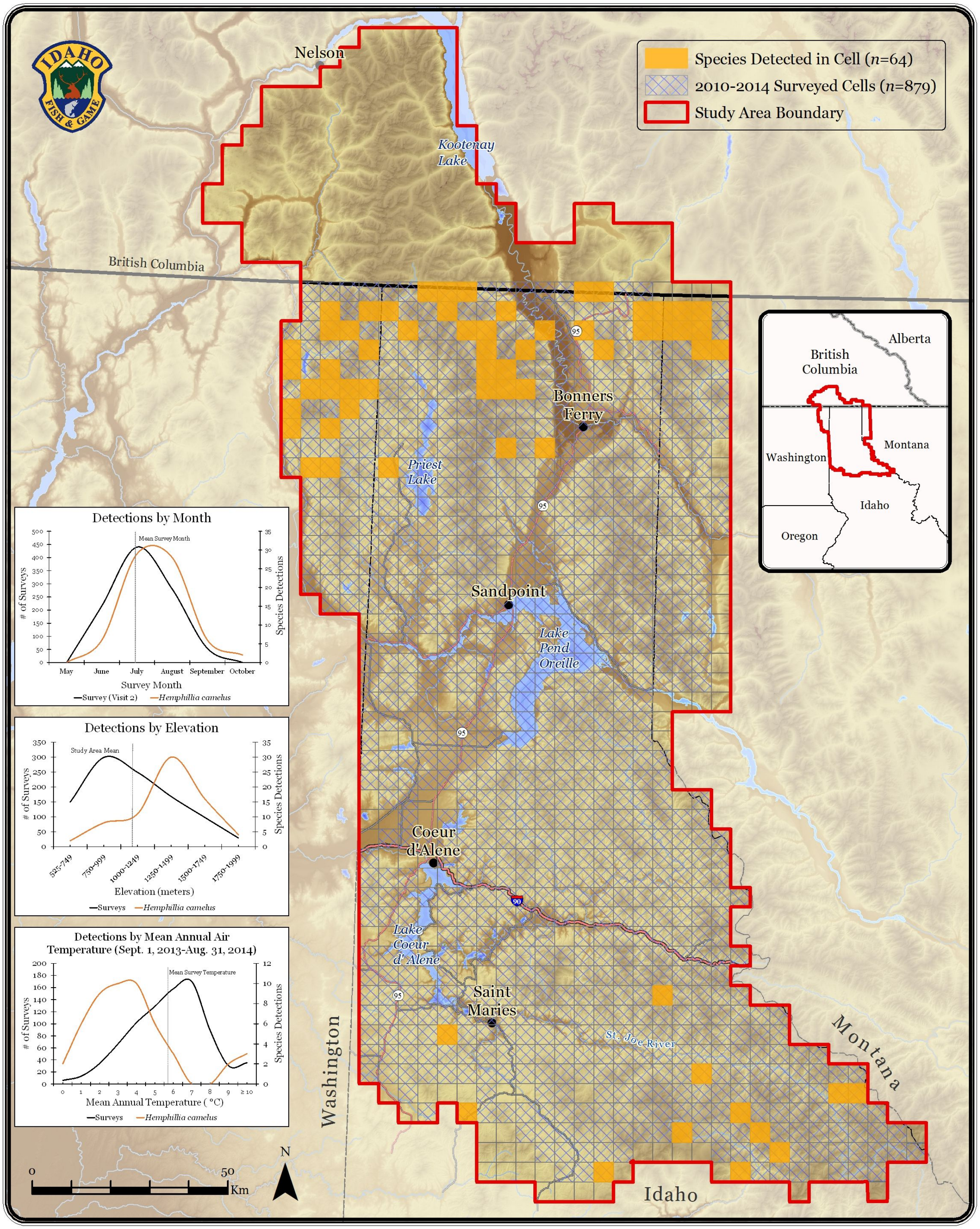
Map 2-29.

Multi-species Baseline Initiative: Salmon Coil (*Helicodiscus salmonaceus*) Detections



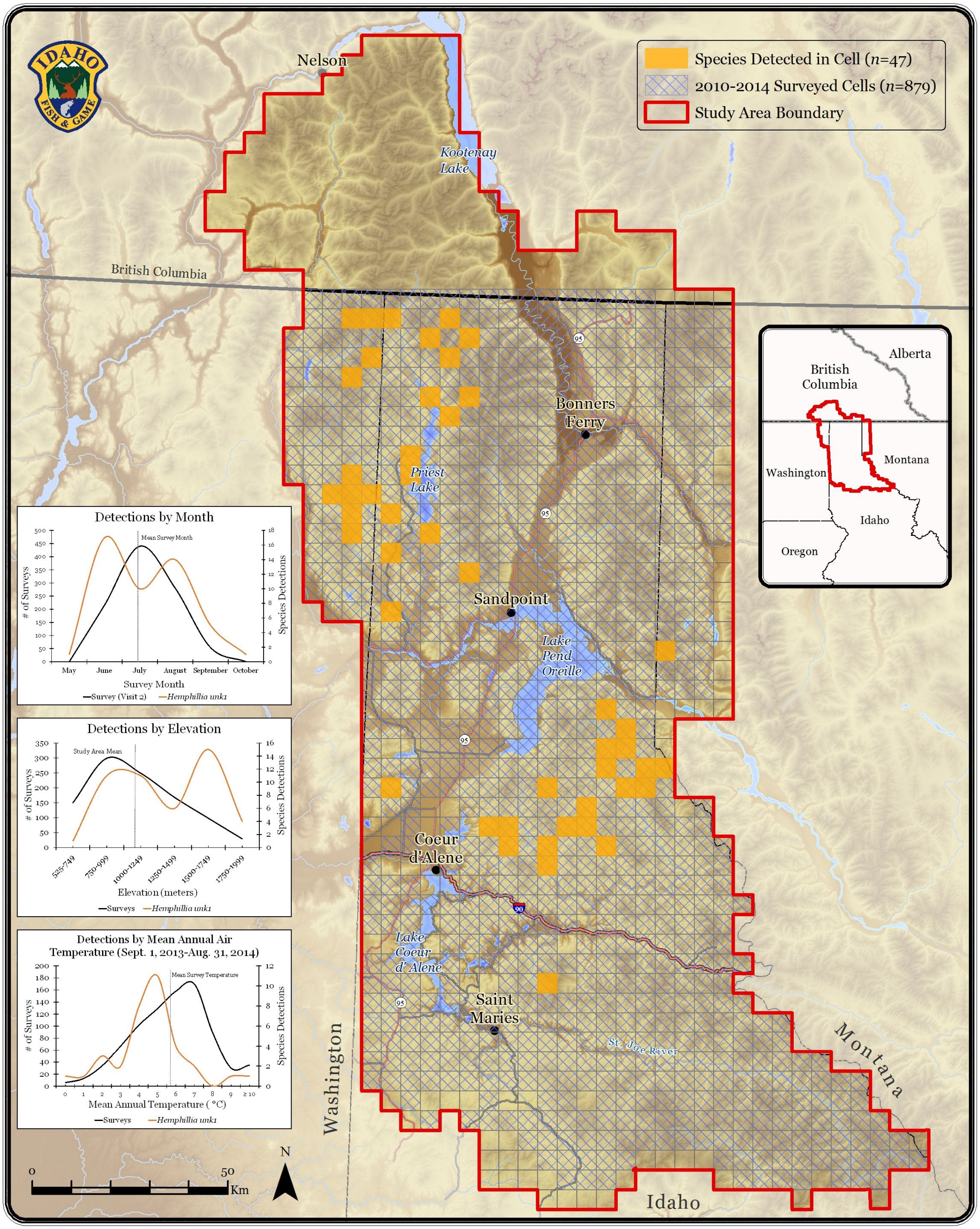
Map 2-30.

Multi-species Baseline Initiative: Pale Jumping-slug (*Hemphillia camelus*) Detections



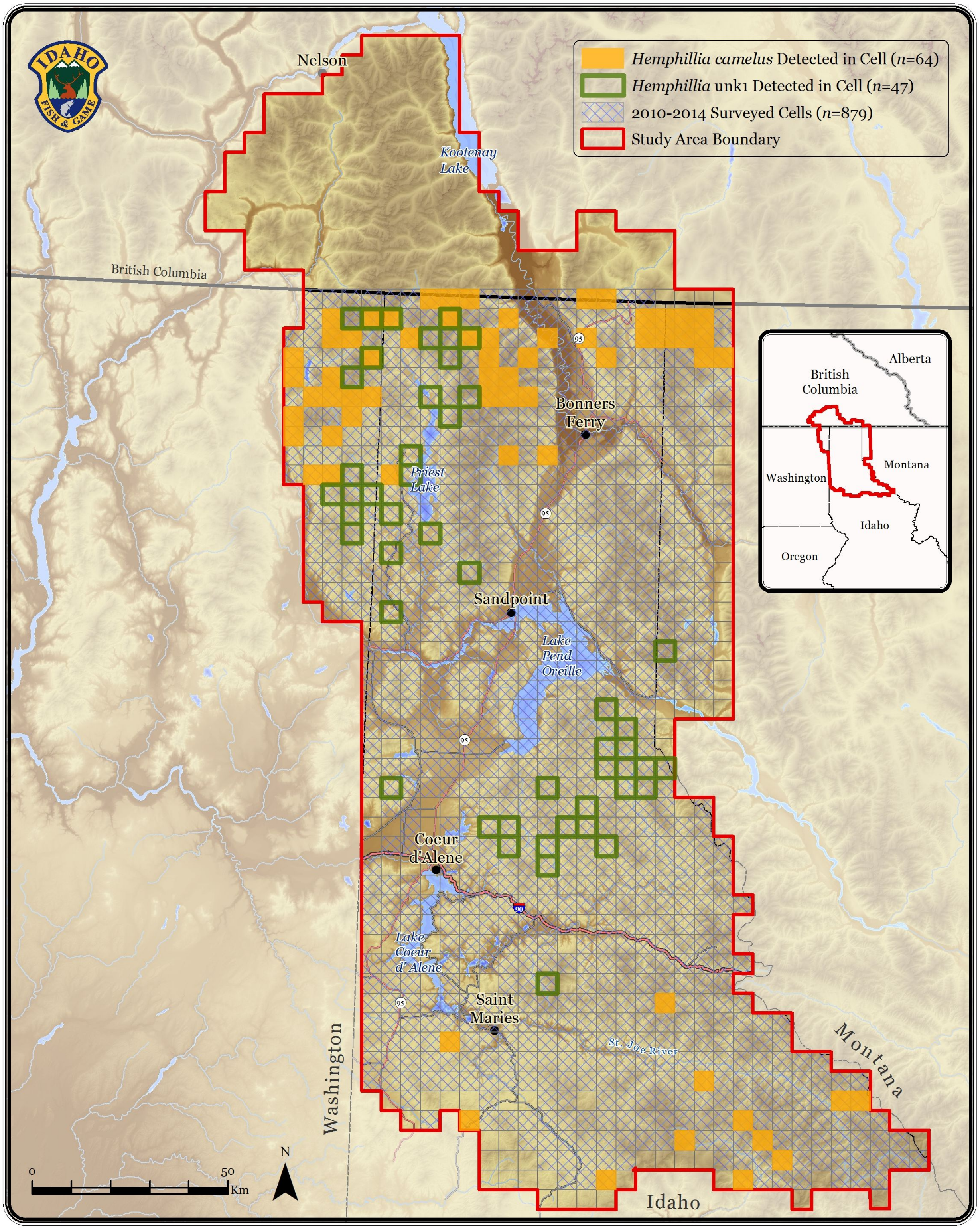
Map 2-31.

Multi-species Baseline Initiative: *Hemphillia* unk1 Detections



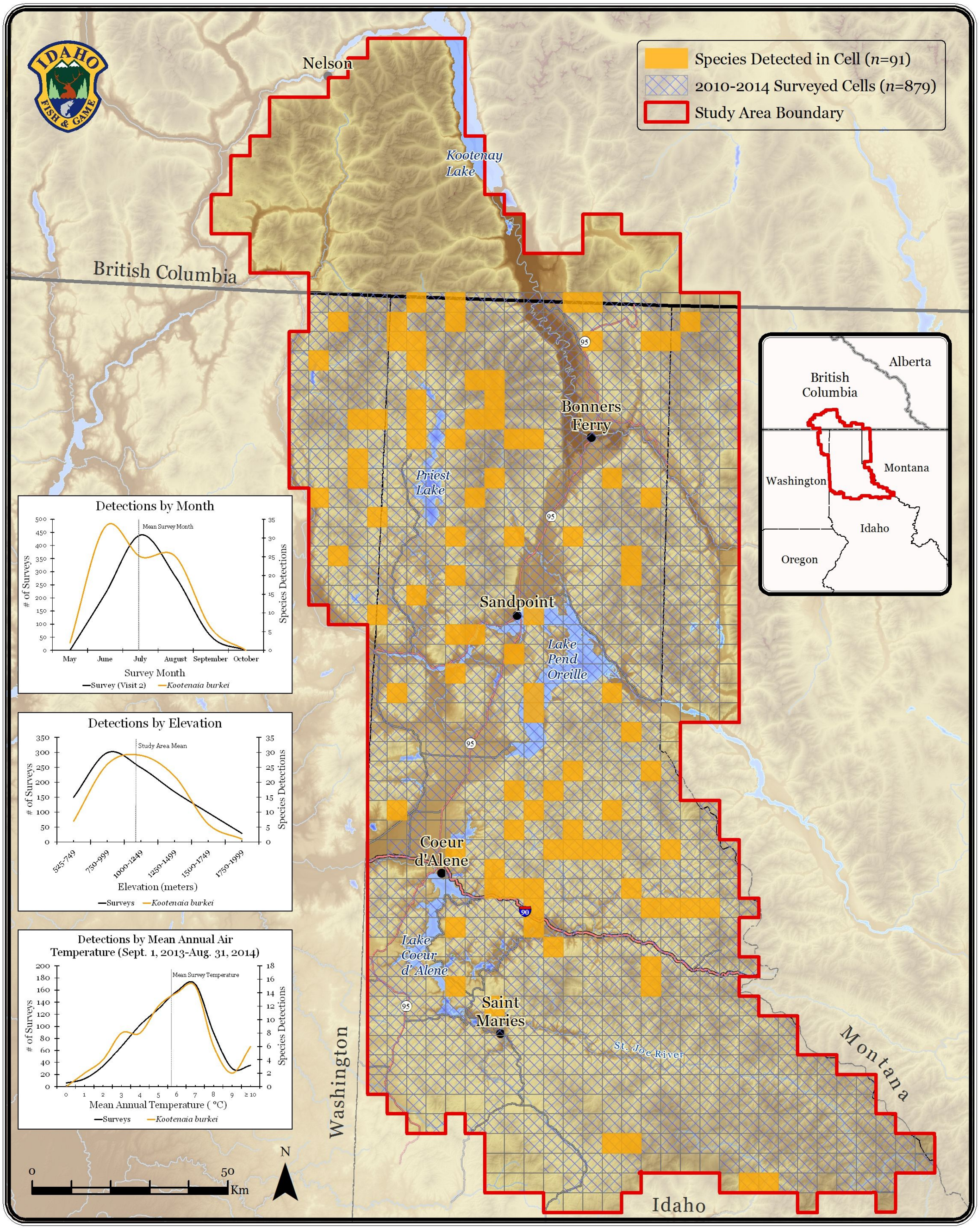
Map 2-32.

Multi-species Baseline Initiative: *Hemphillia* spp. Detections



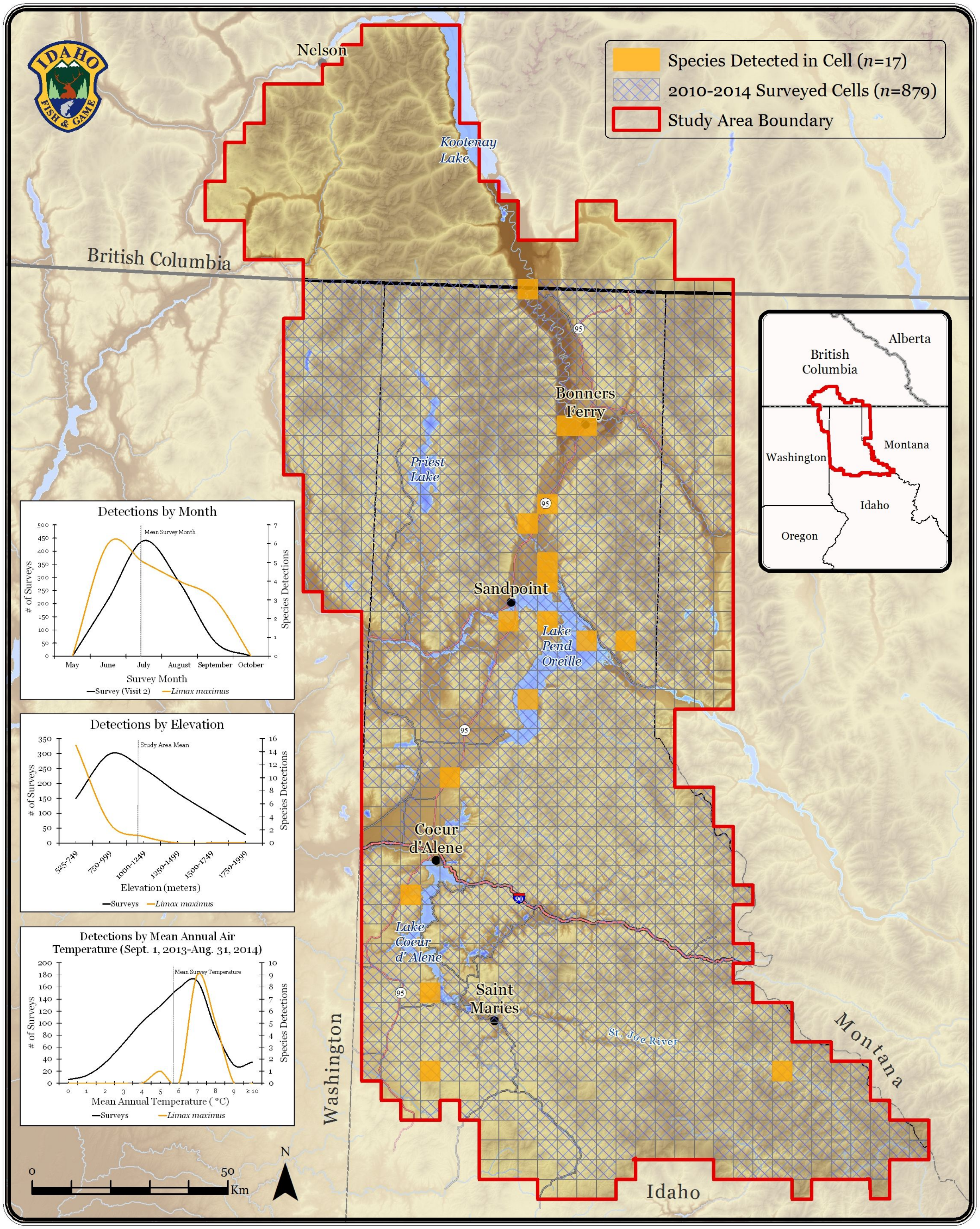
Map 2-33.

Multi-species Baseline Initiative: Pygmy Slug (*Kootenaia burkei*) Detections



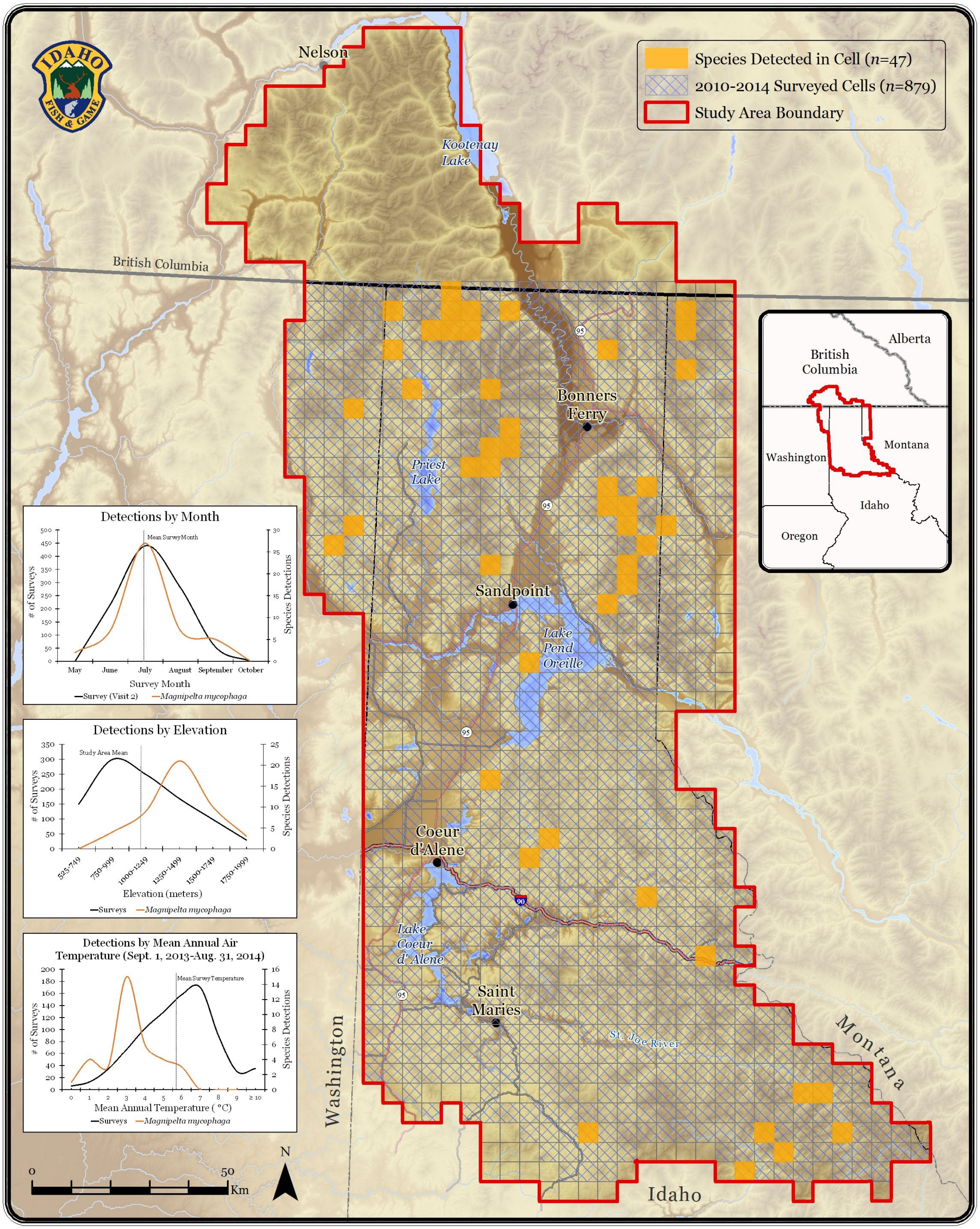
Map 2-34.

Multi-species Baseline Initiative: Giant Gardenslug (*Limax maximus*) Detections



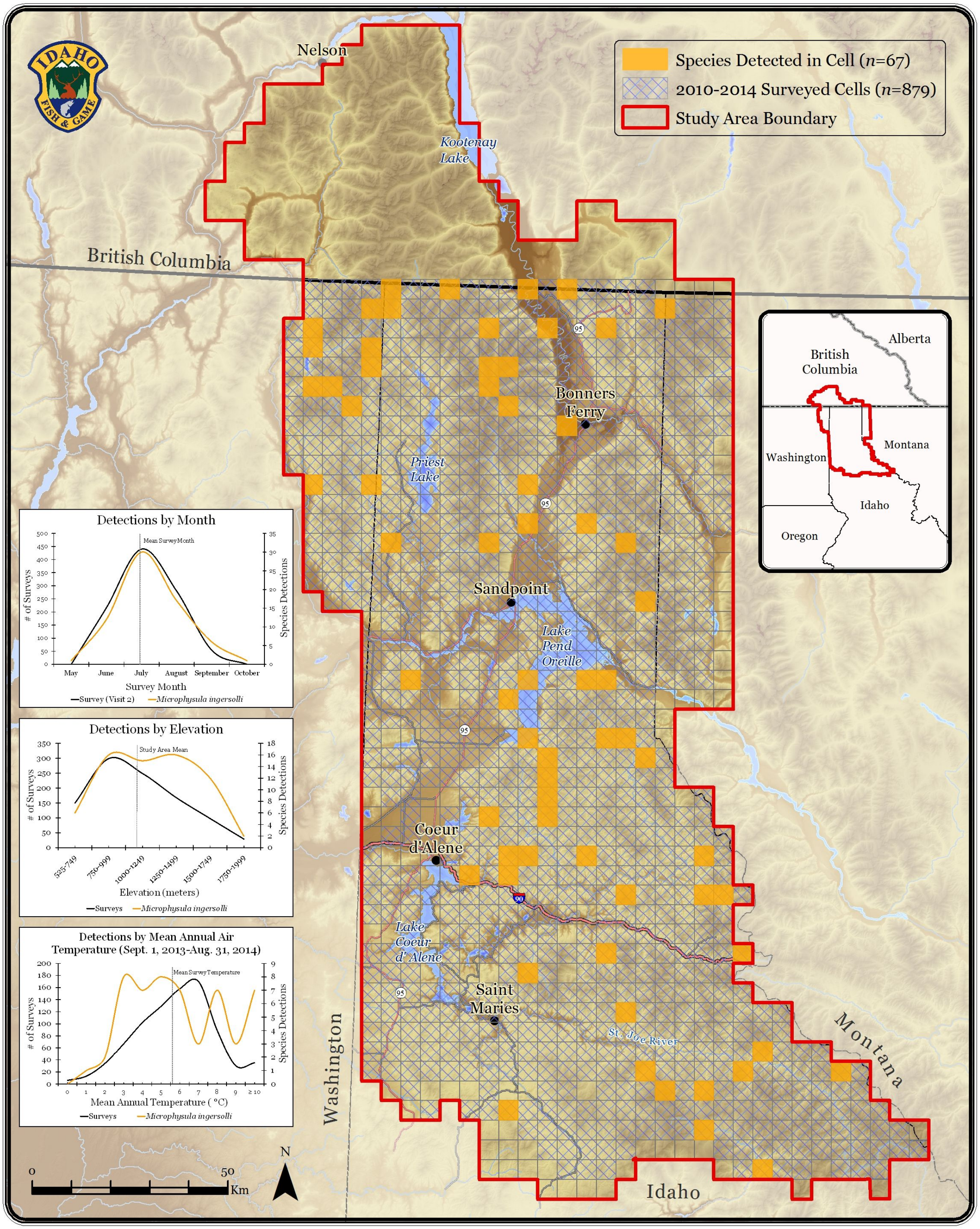
Map 2-35.

Multi-species Baseline Initiative: Magnum Mantleslug (*Magnipelta mycophaga*) Detections



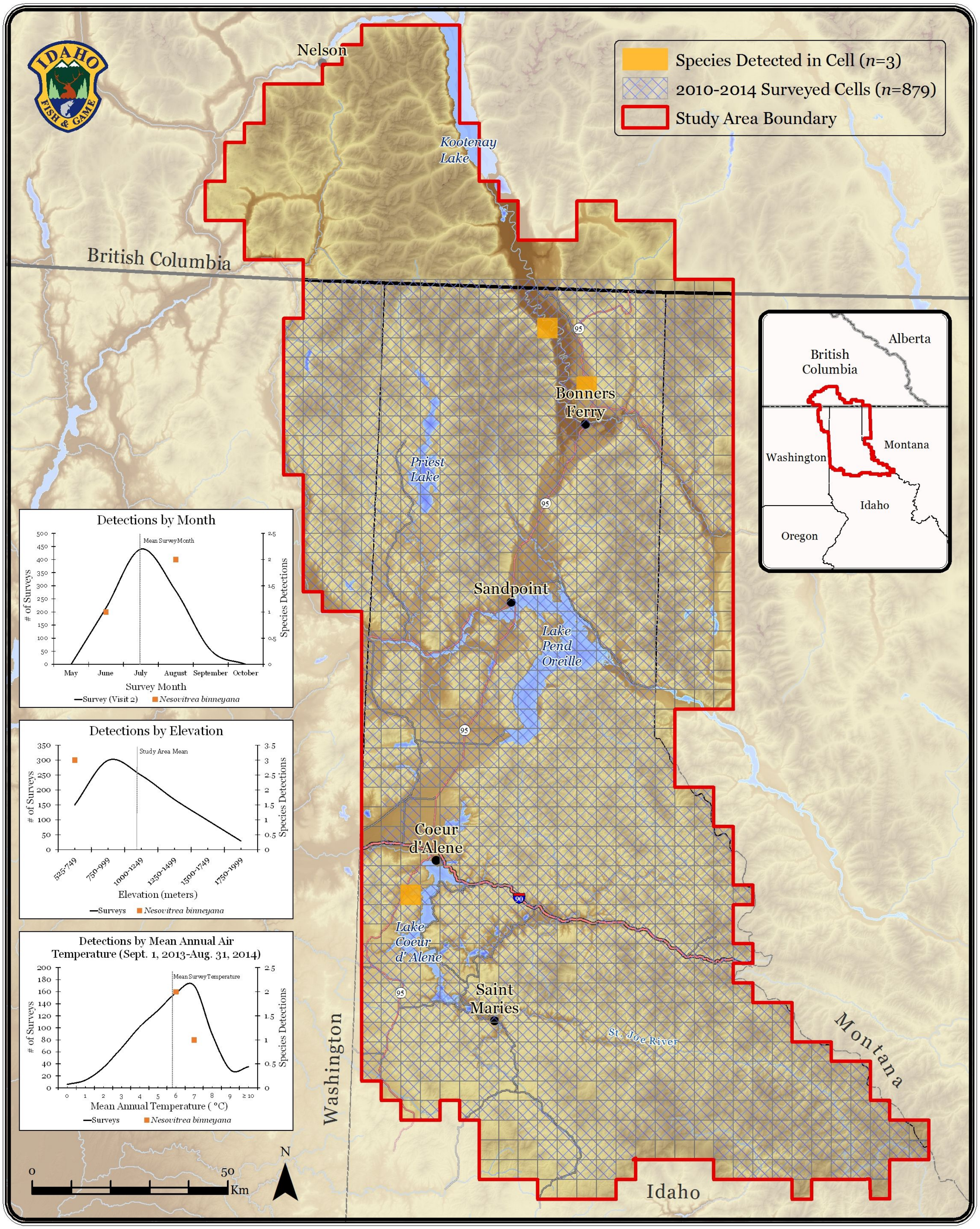
Map 2-36.

Multi-species Baseline Initiative: Spruce Snail (*Microphysula ingersolli*) Detections



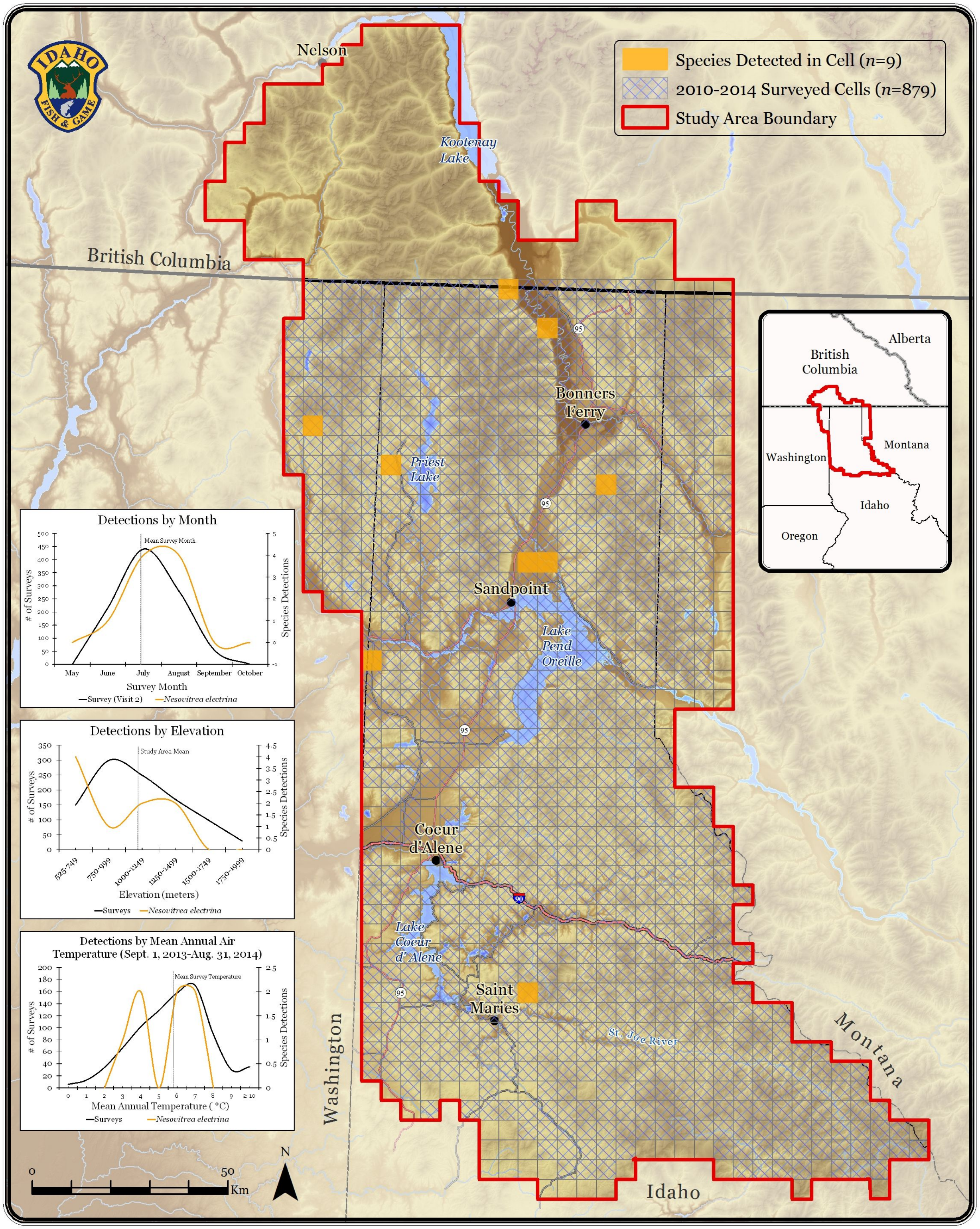
Map 2-37.

Multi-species Baseline Initiative: Blue Glass (*Nesovitrea binneyana*) Detections



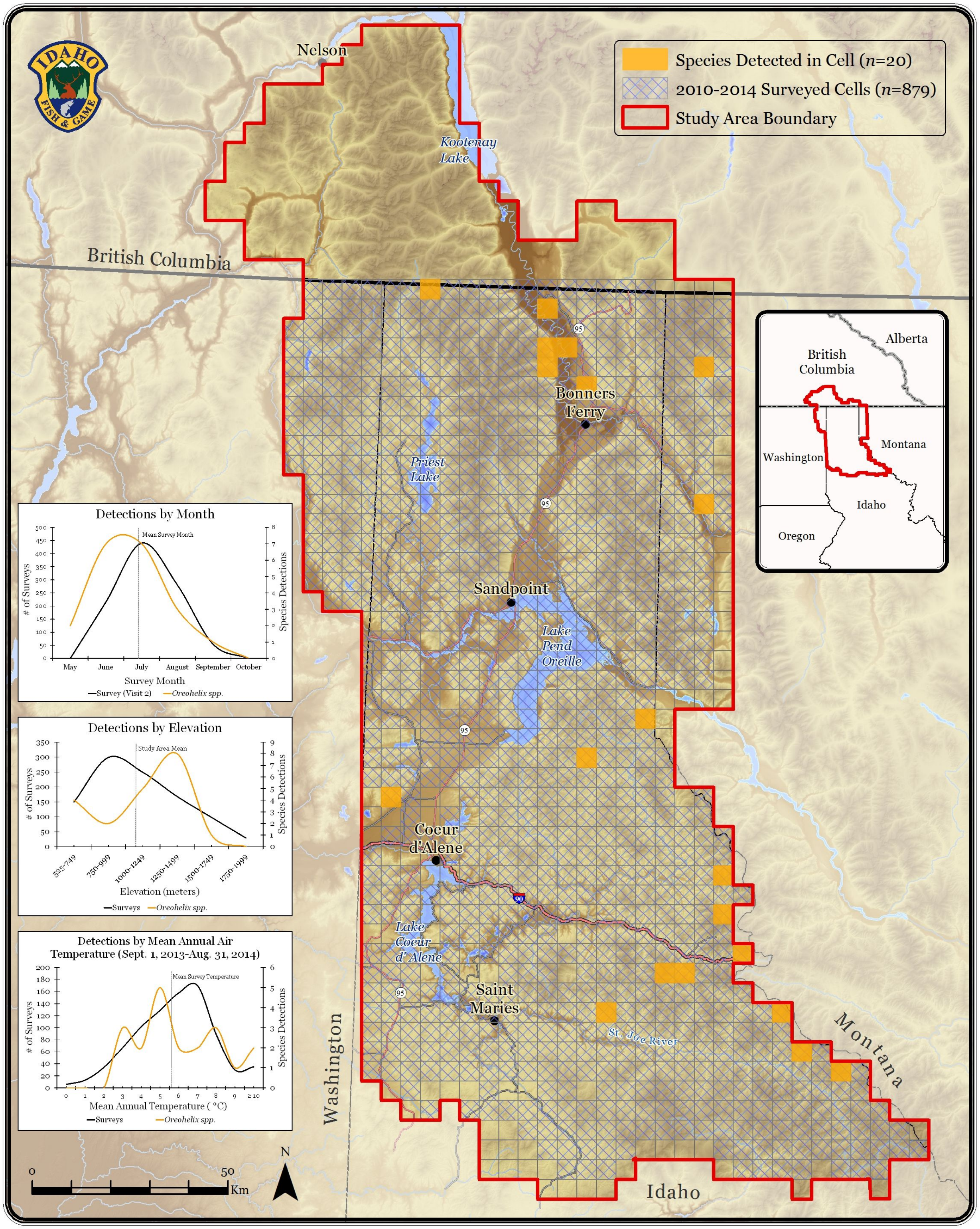
Map 2-38.

Multi-species Baseline Initiative: Amber Glass (*Nesovitrea electrina*) Detections



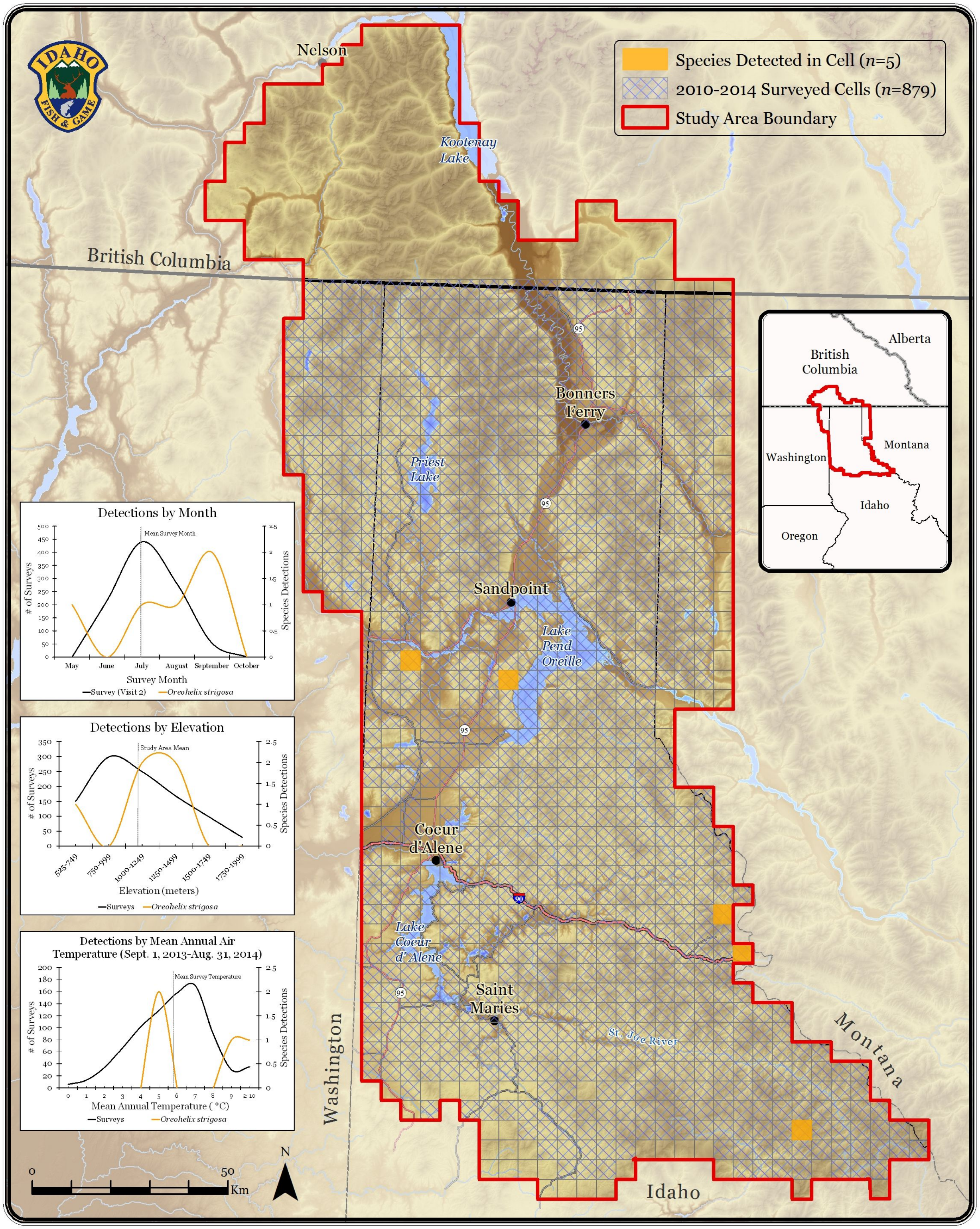
Map 2-39.

Multi-species Baseline Initiative: *Oreohelix* spp. Detections



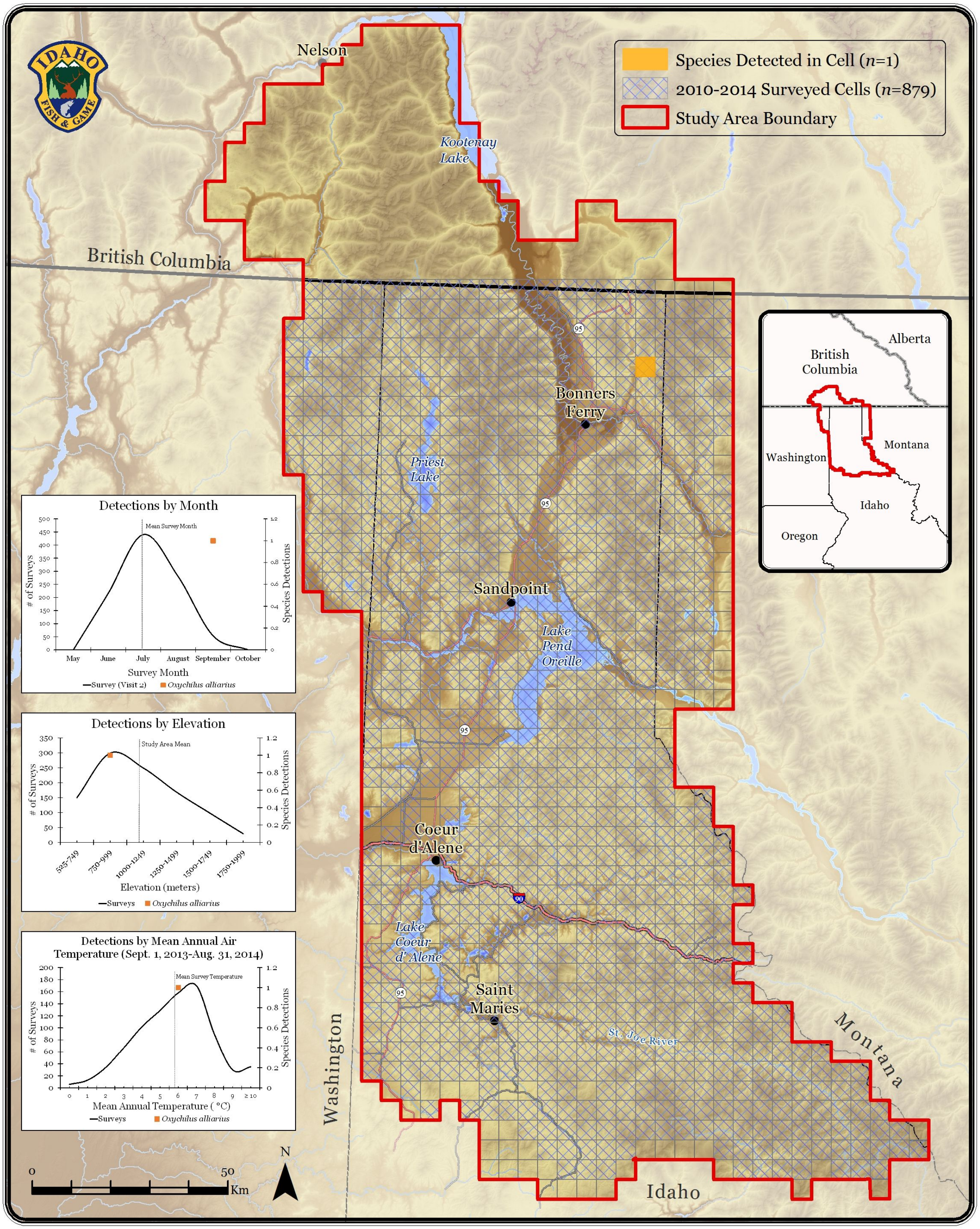
Map 2-40.

Multi-species Baseline Initiative: Rocky Mountainsnail (*Oreohelix strigosa*) Detections



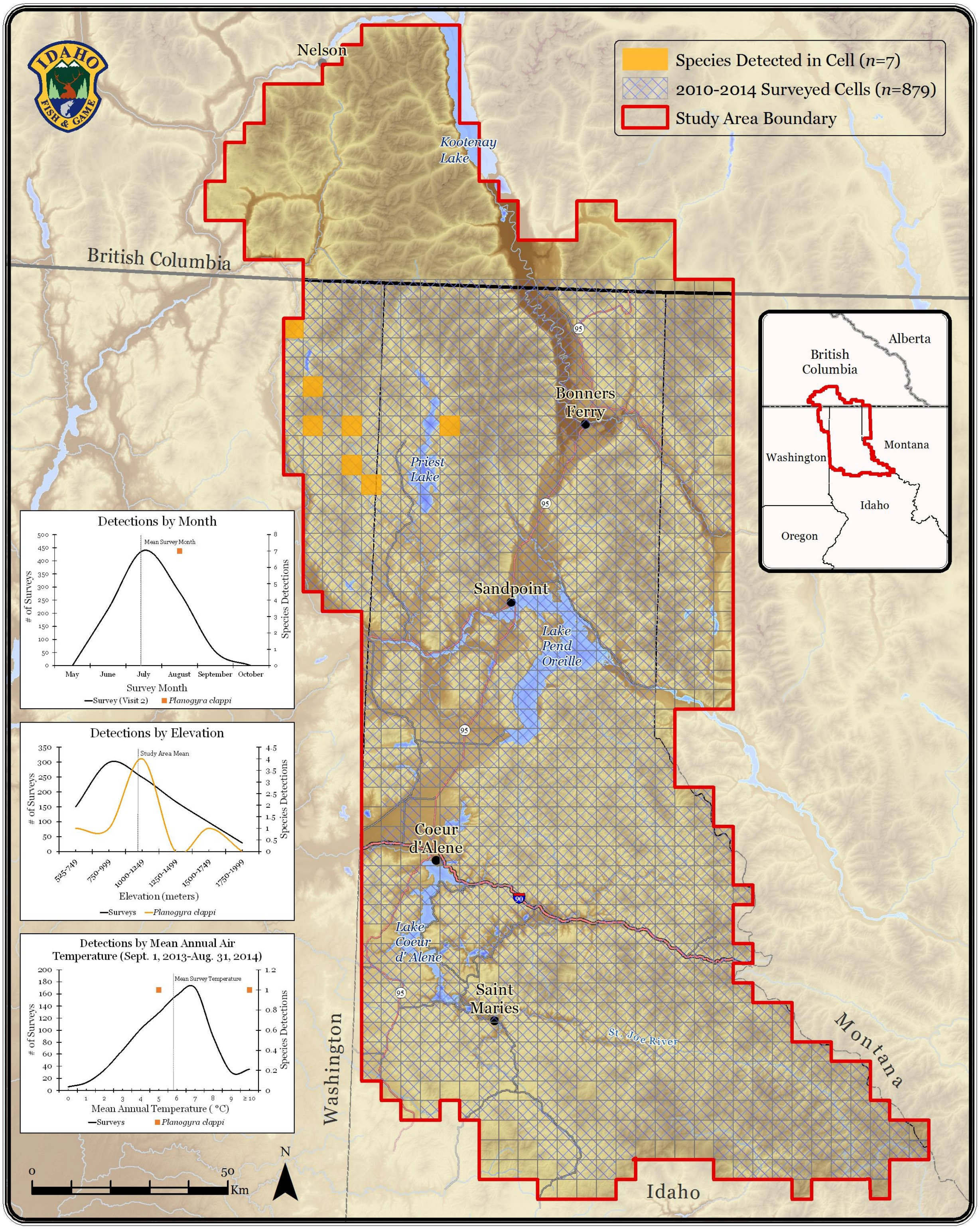
Map 2-41.

Multi-species Baseline Initiative: Garlic Glass-snail (*Oxychilus alliarius*) Detections



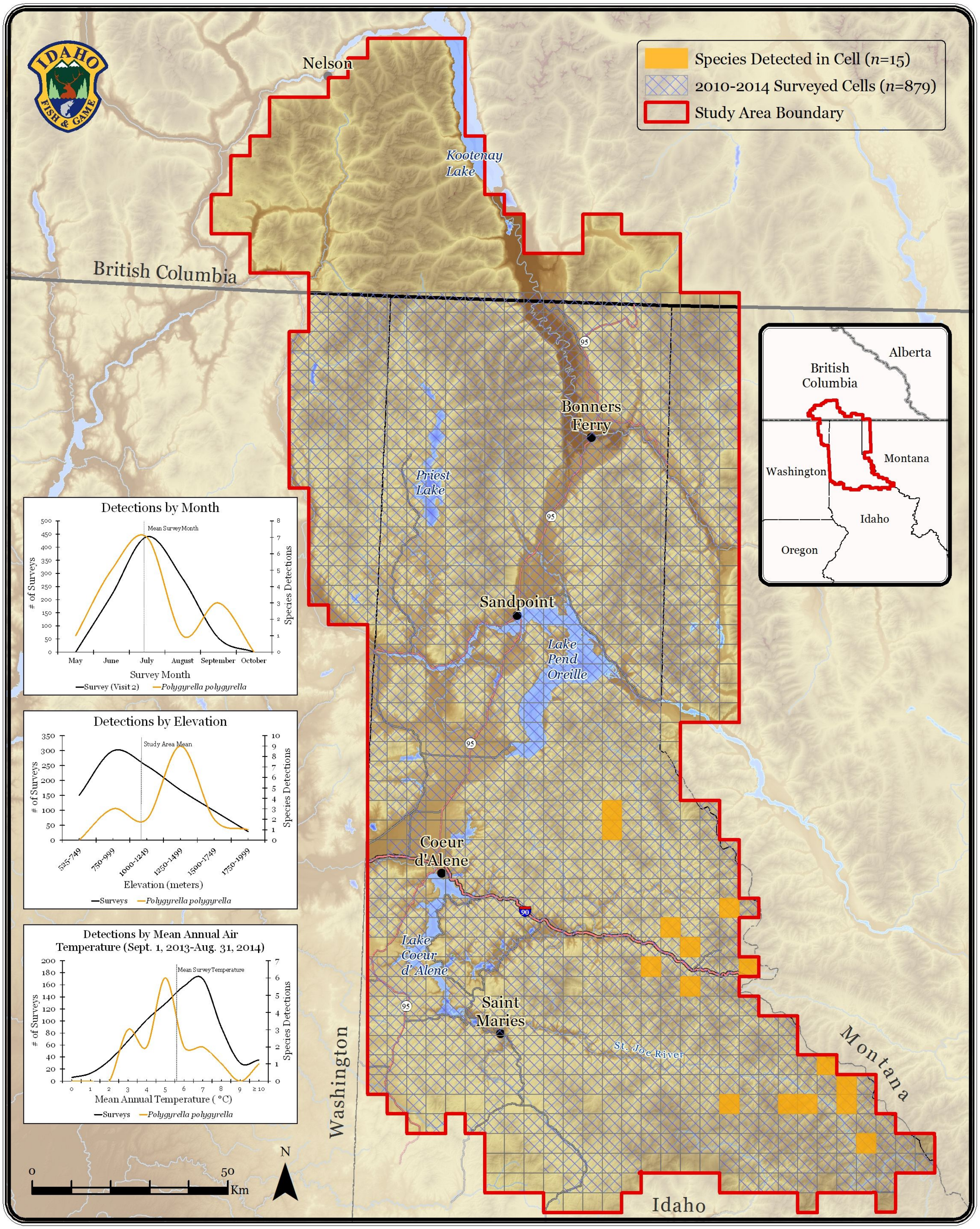
Map 2-42.

Multi-species Baseline Initiative: Western Flatwhorl (*Planogyra clappi*) Detections



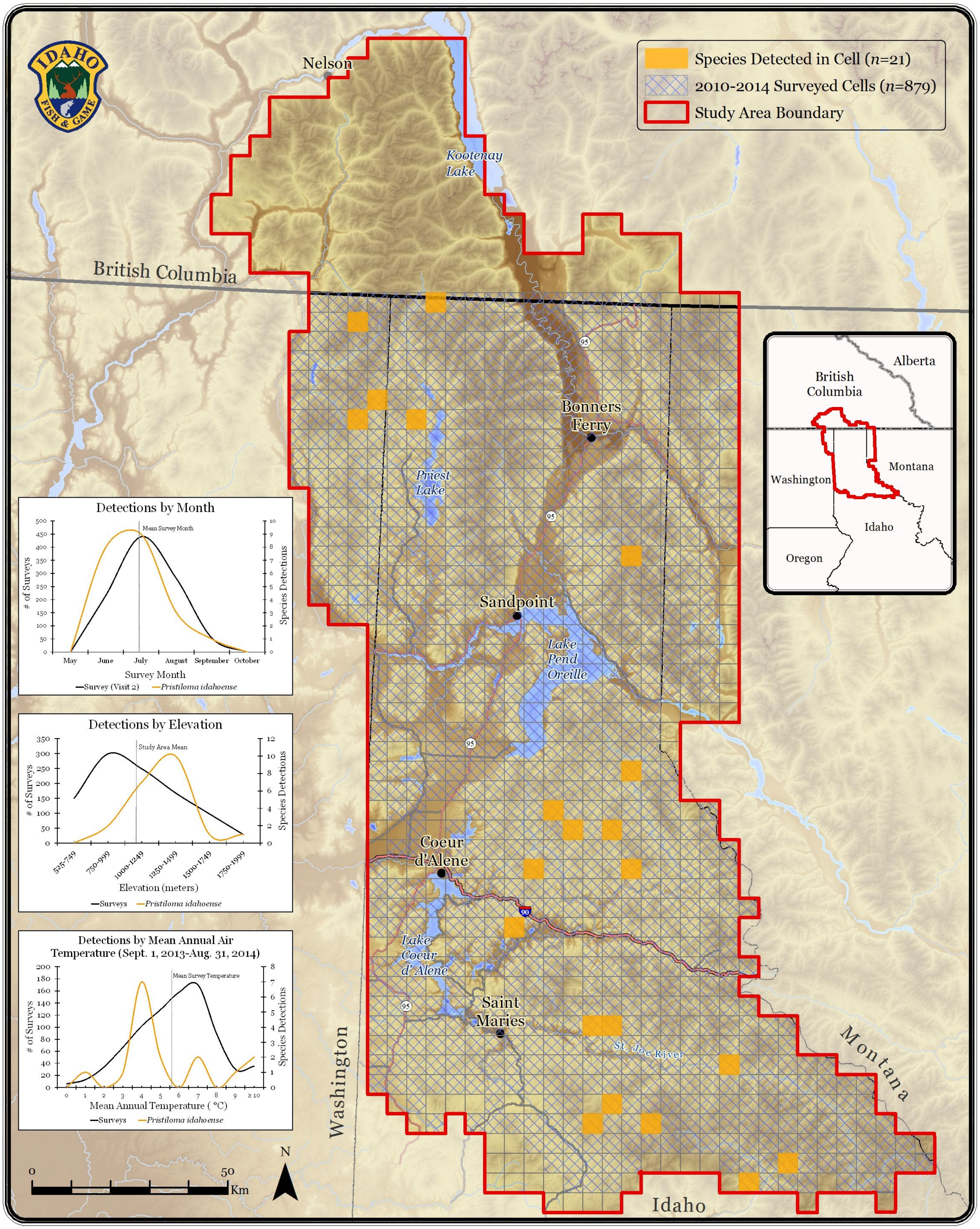
Map 2-43.

Multi-species Baseline Initiative: Humped Coin (*Polygyrella polygyrella*) Detections



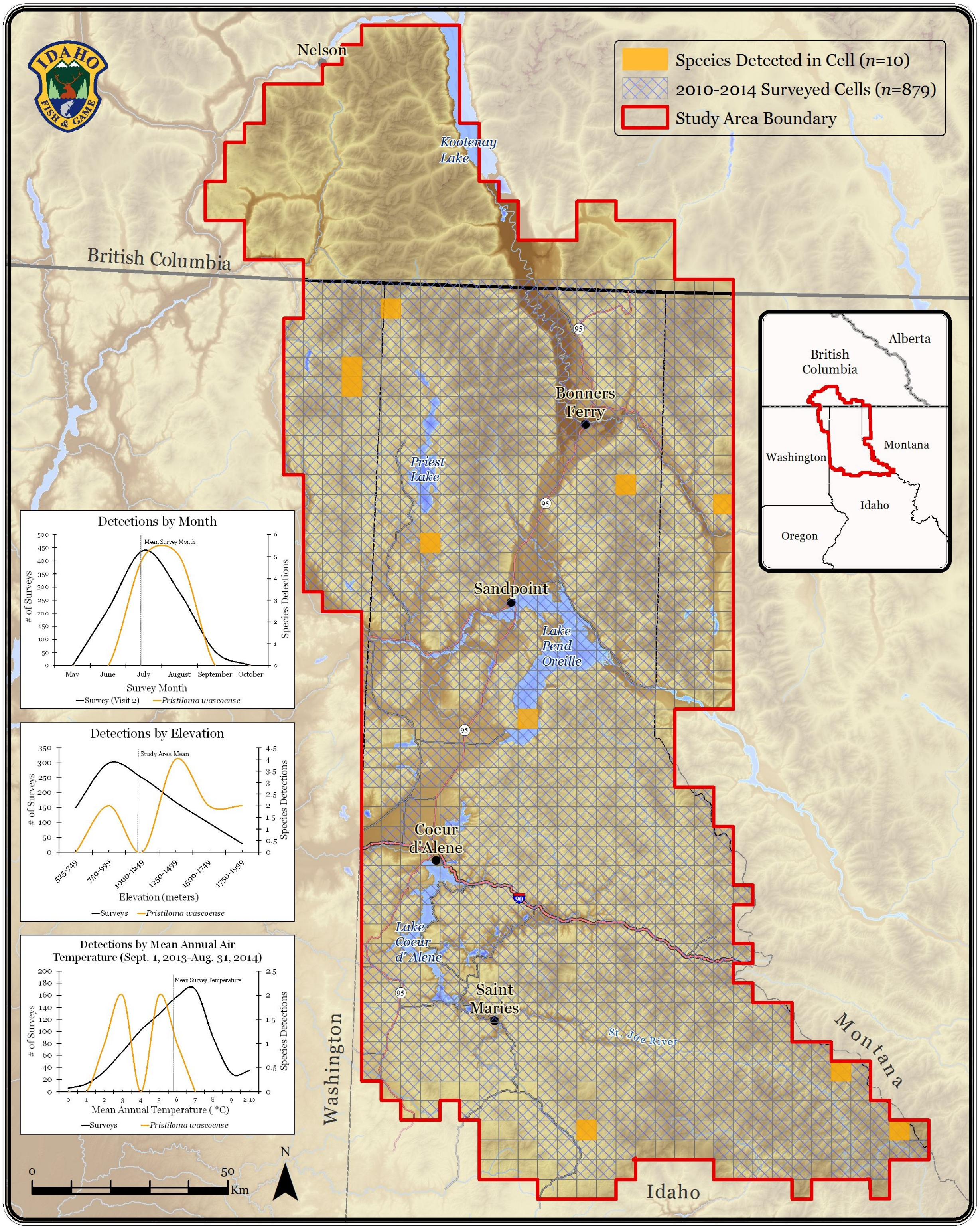
Map 2-44.

Multi-species Baseline Initiative: Thinlip Tightcoil (*Pristiloma idahoense*) Detections



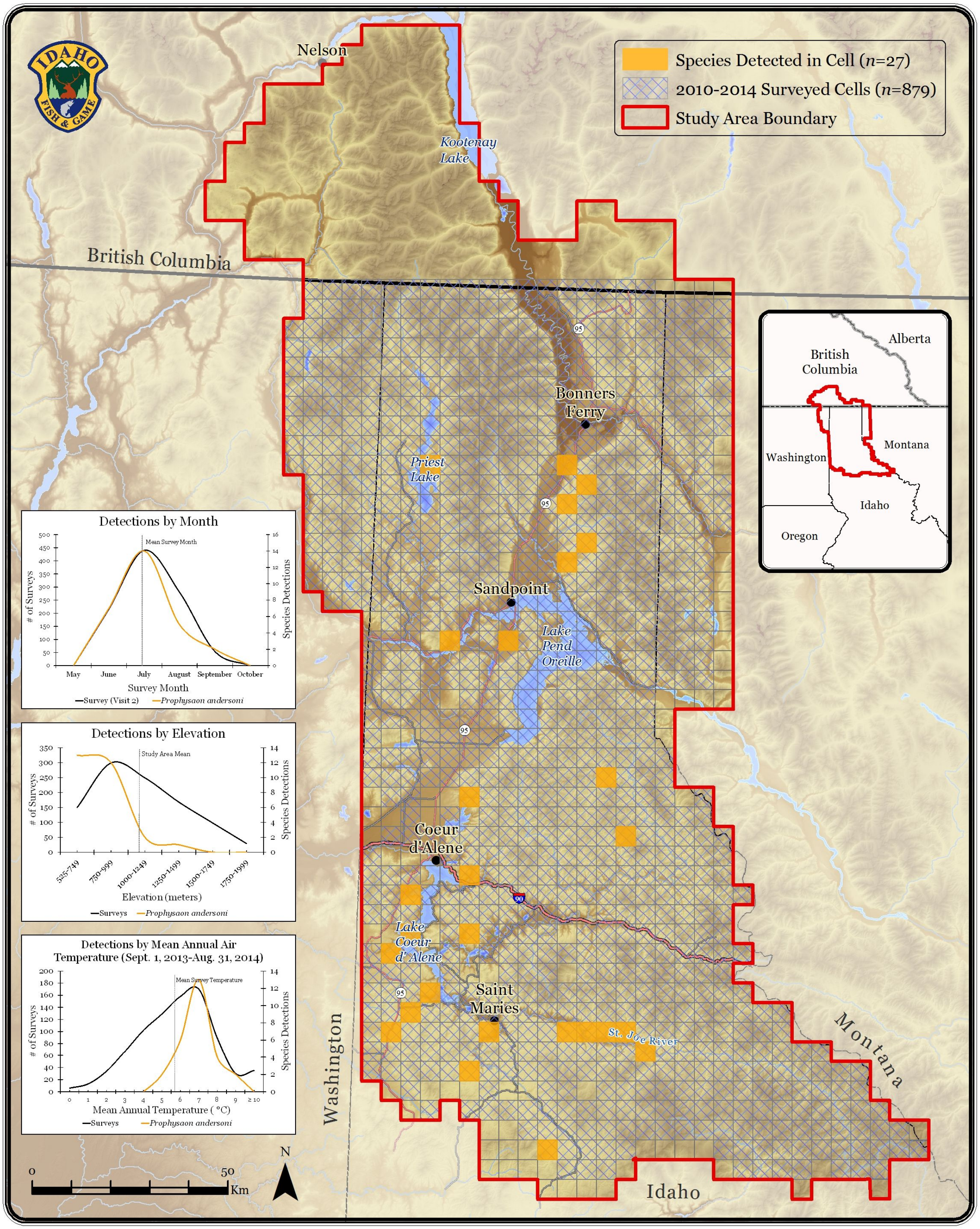
Map 2-45.

Multi-species Baseline Initiative: Shiny Tightcoil (*Pristiloma wascoense*) Detections



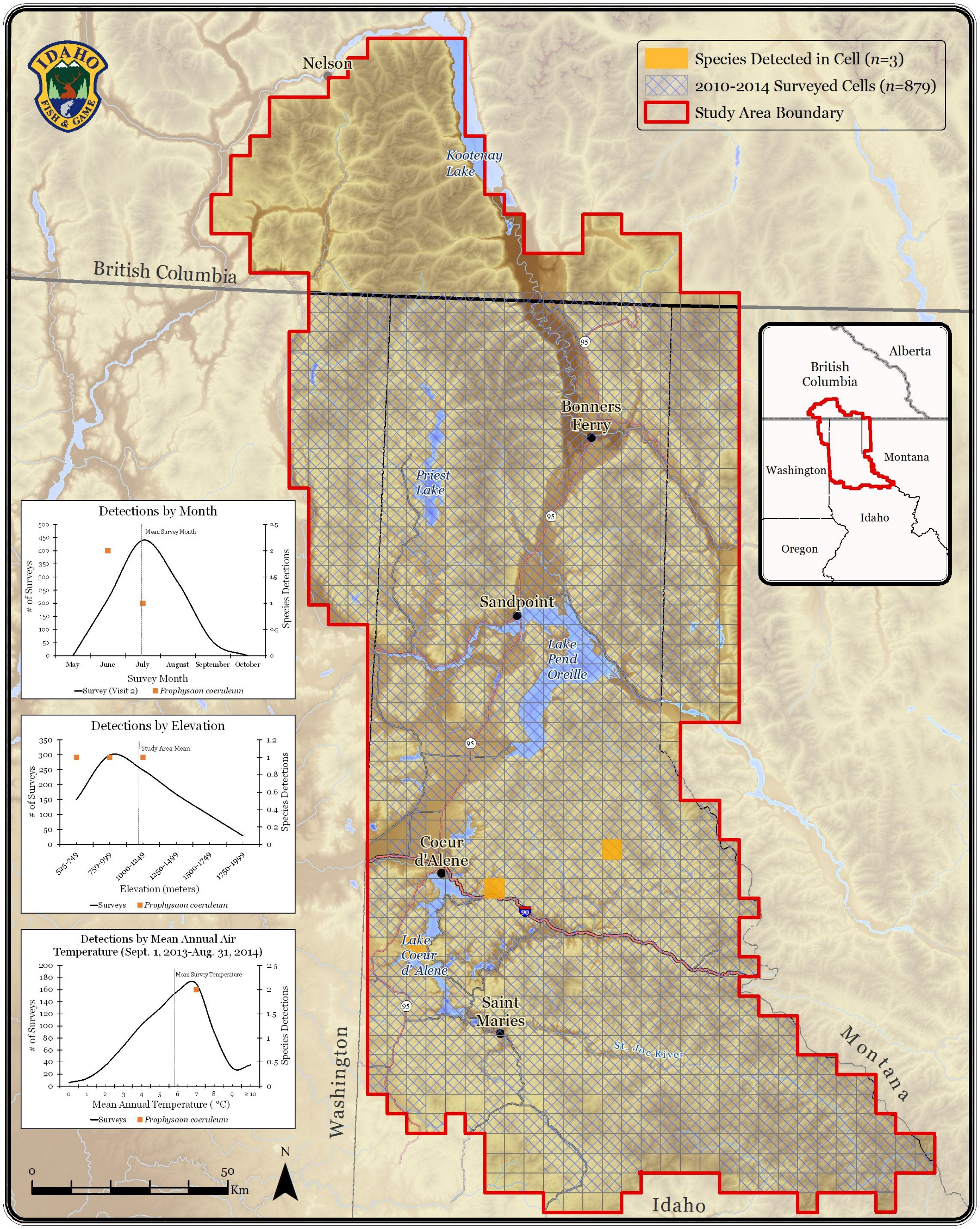
Map 2-46.

Multi-species Baseline Initiative: Reticulate Taildropper (*Prophysaon andersoni*) Detections



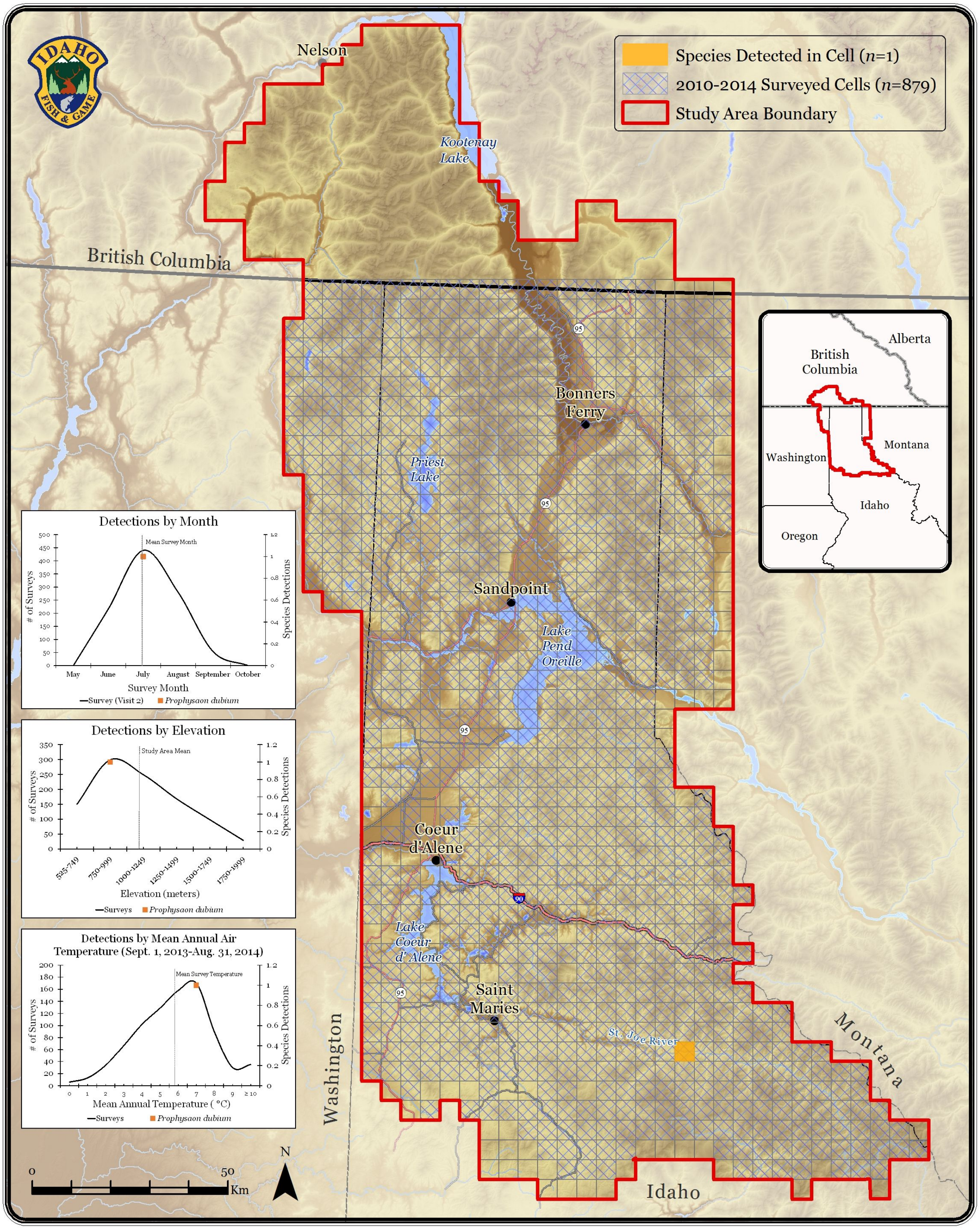
Map 2-47.

Multi-species Baseline Initiative: Blue-gray Taildropper (*Prophysaon coeruleum*) Detections



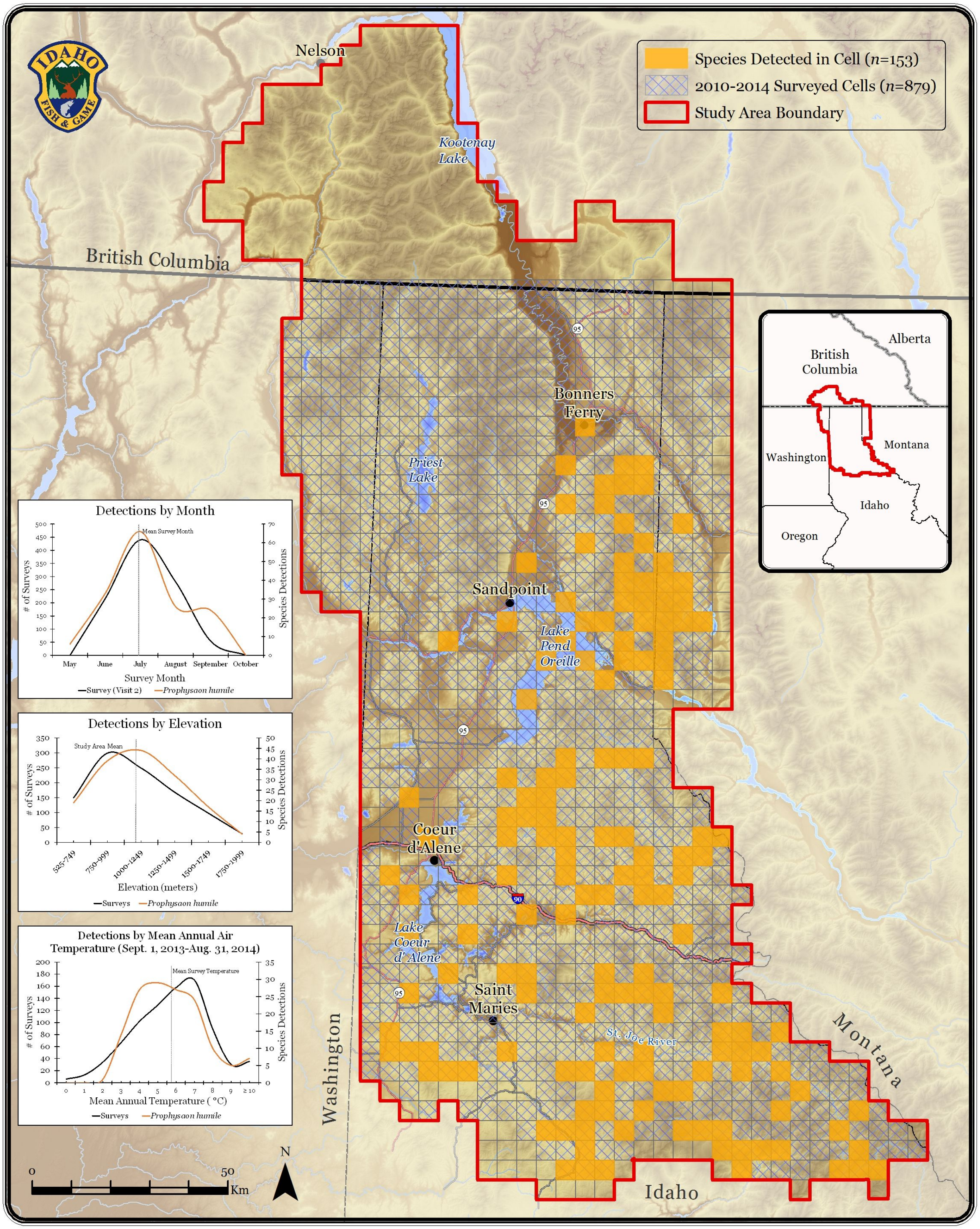
Map 2-48.

Multi-species Baseline Initiative: PapilloseTaildropper (*Prophysaon dubium*) Detections



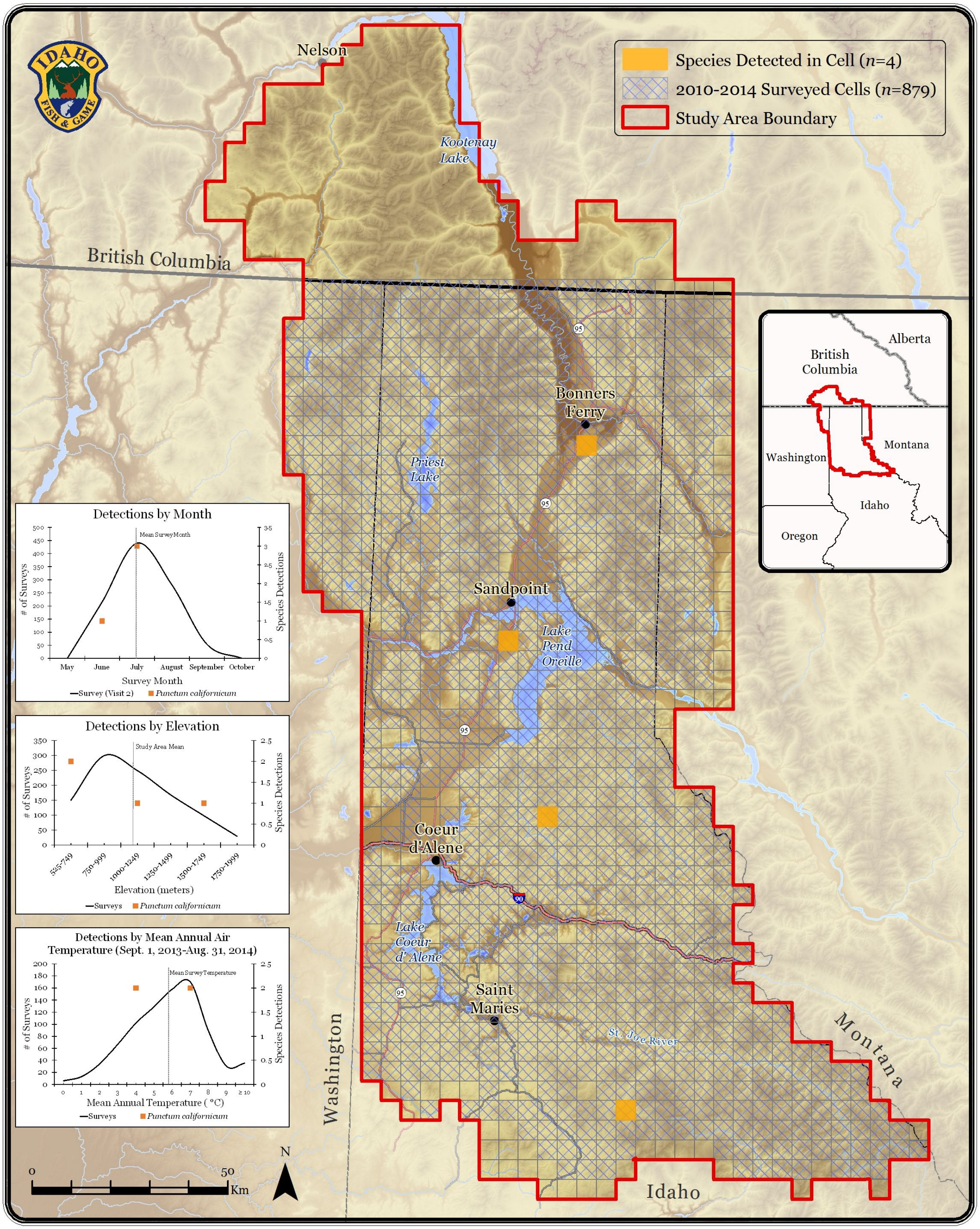
Map 2-49.

Multi-species Baseline Initiative: Smoky Taildropper (*Prophysaon humile*) Detections



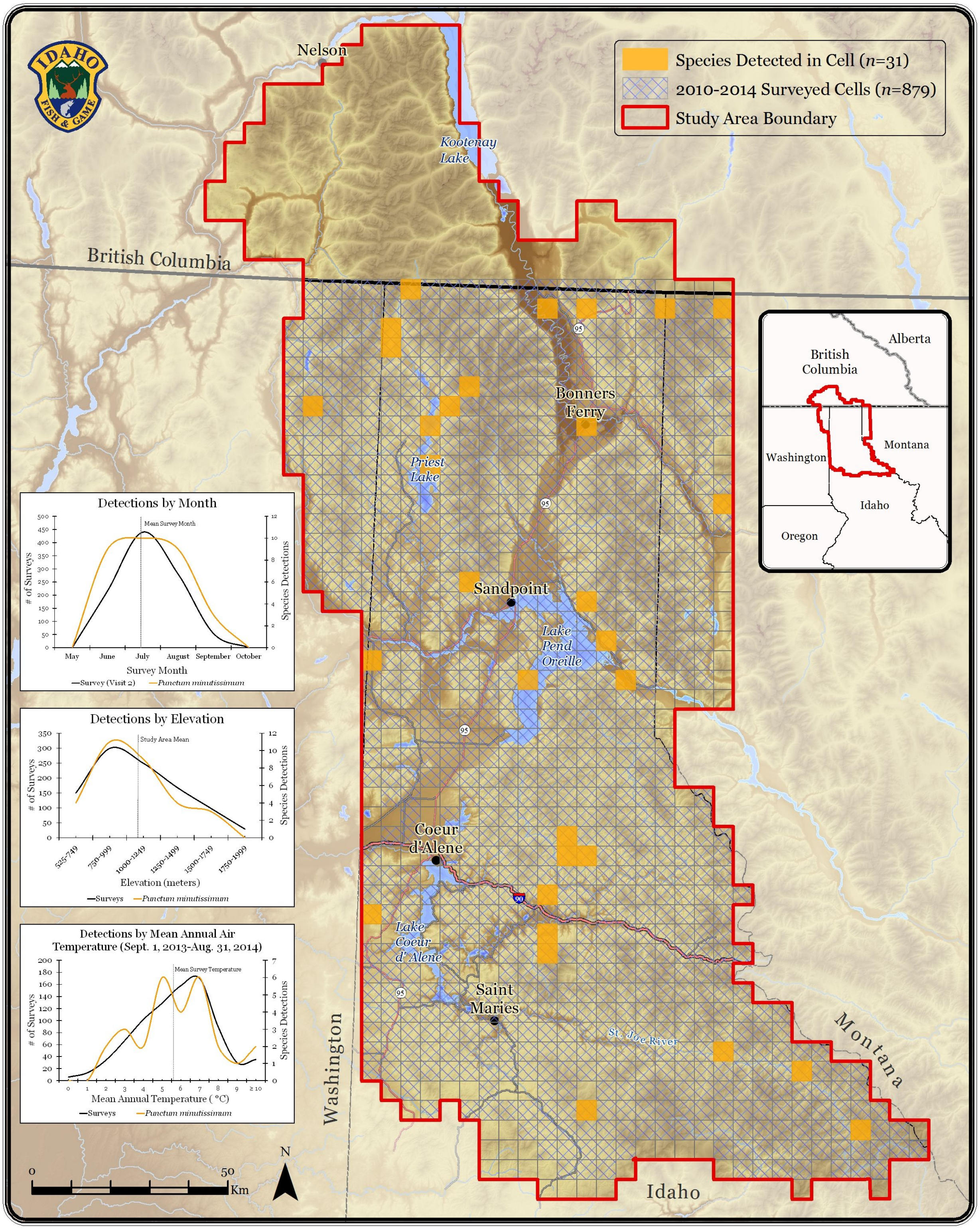
Map 2-50.

Multi-species Baseline Initiative: Ribbed Spot (*Punctum californicum*) Detections



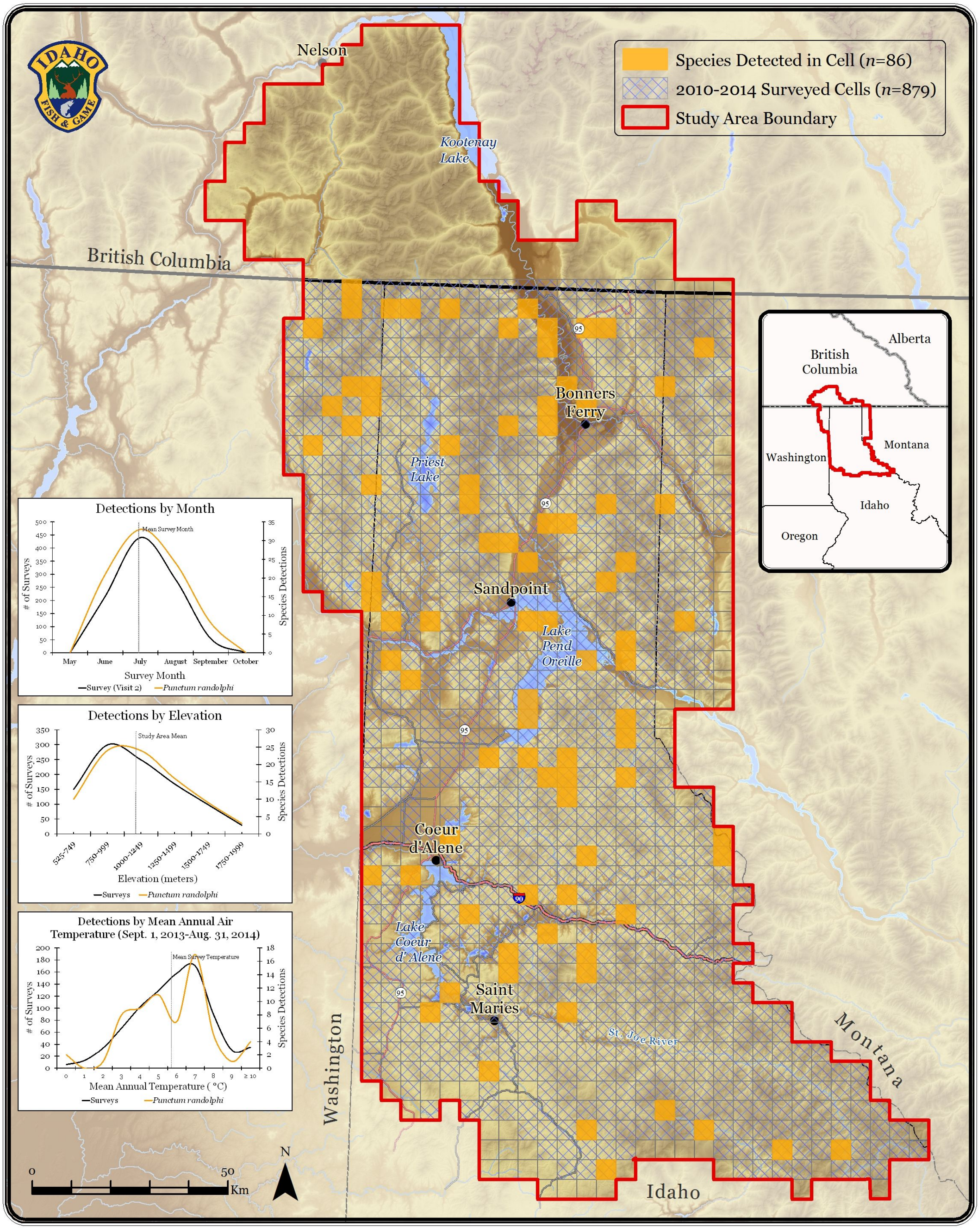
Map 2-51.

Multi-species Baseline Initiative: Small Spot (*Punctum minutissimum*) Detections



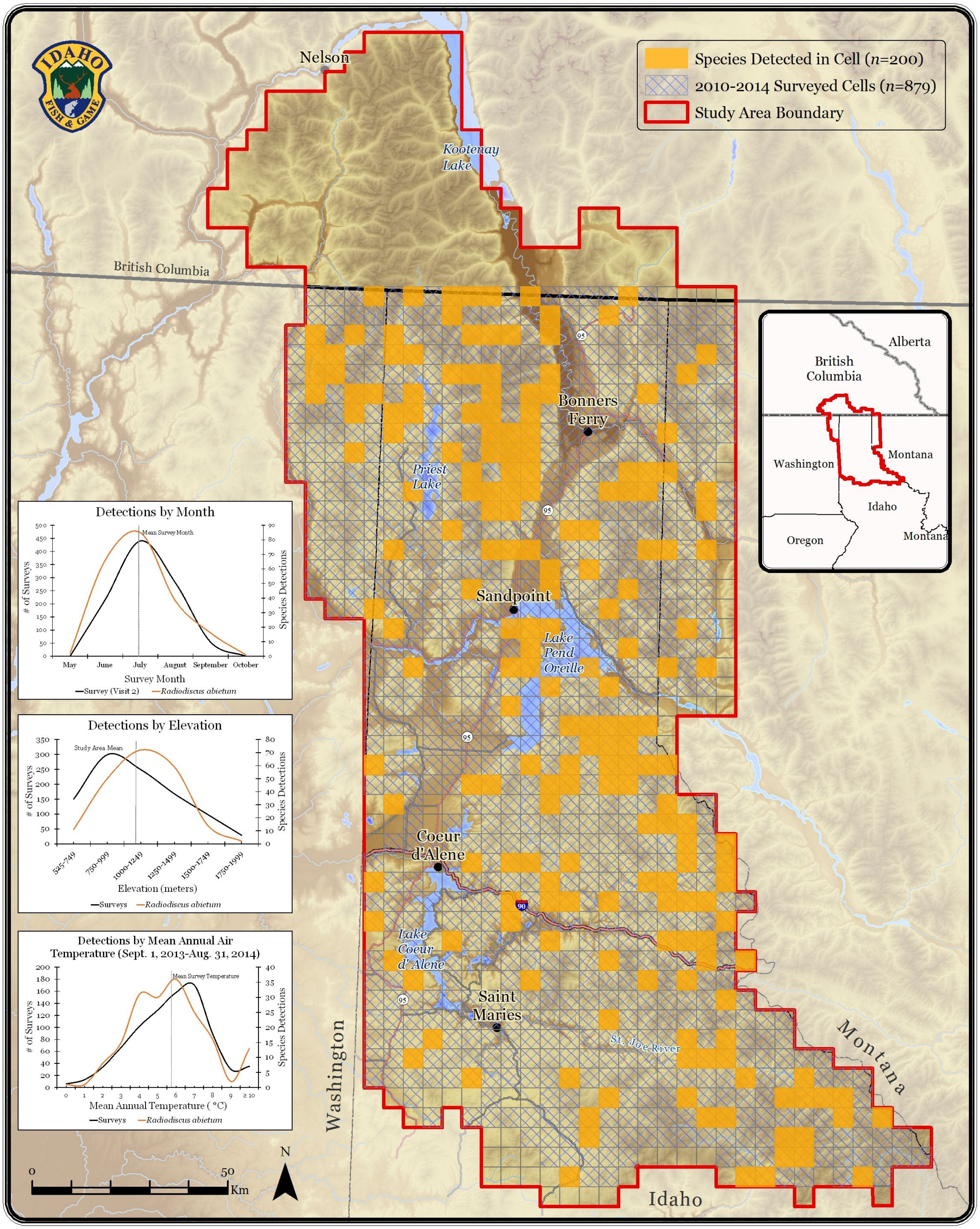
Map 2-52.

Multi-species Baseline Initiative: Conical Spot (*Punctum randolphi*) Detections



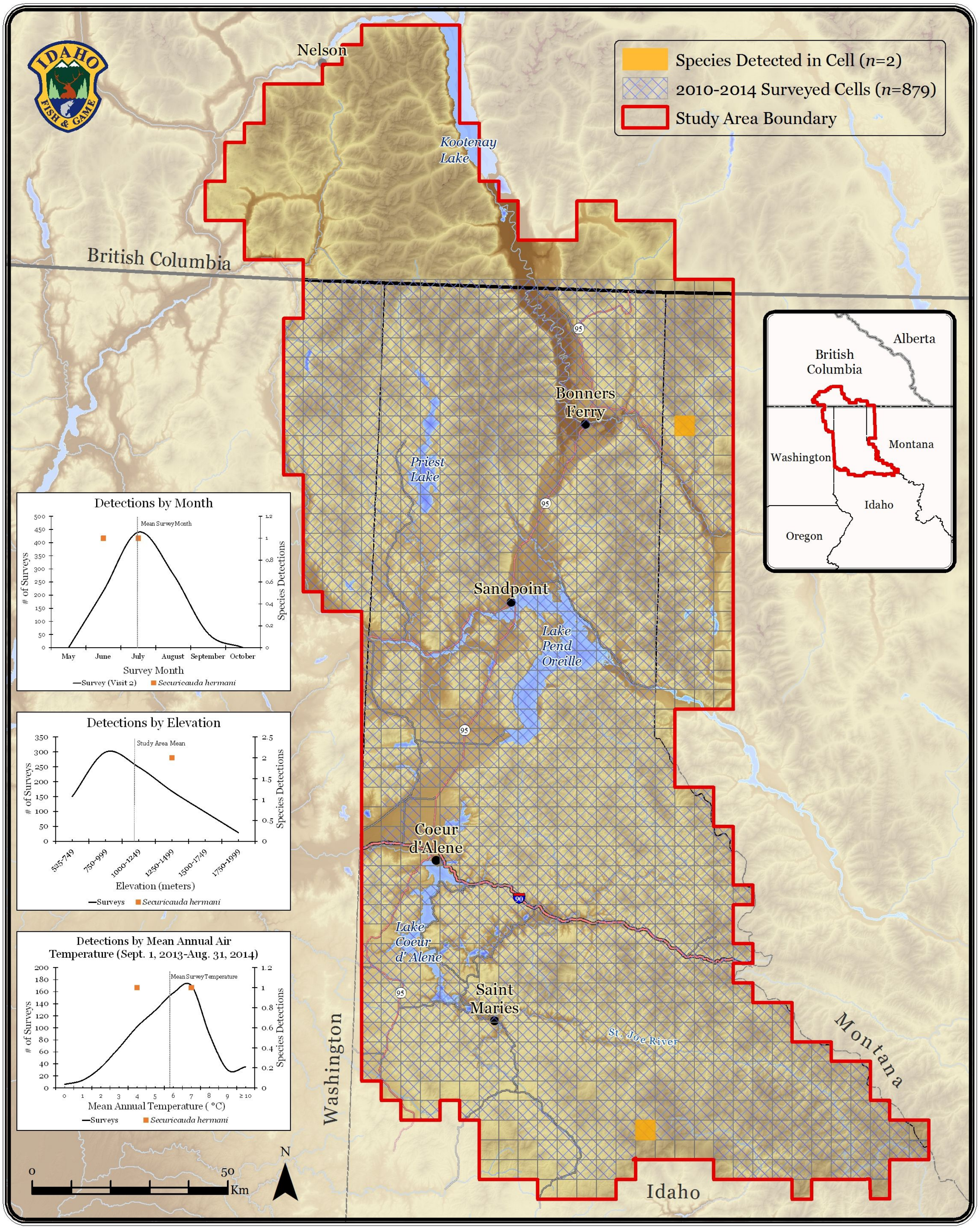
Map 2-53.

Multi-species Baseline Initiative: Fir Pinwheel (*Radiodiscus abietum*) Detections



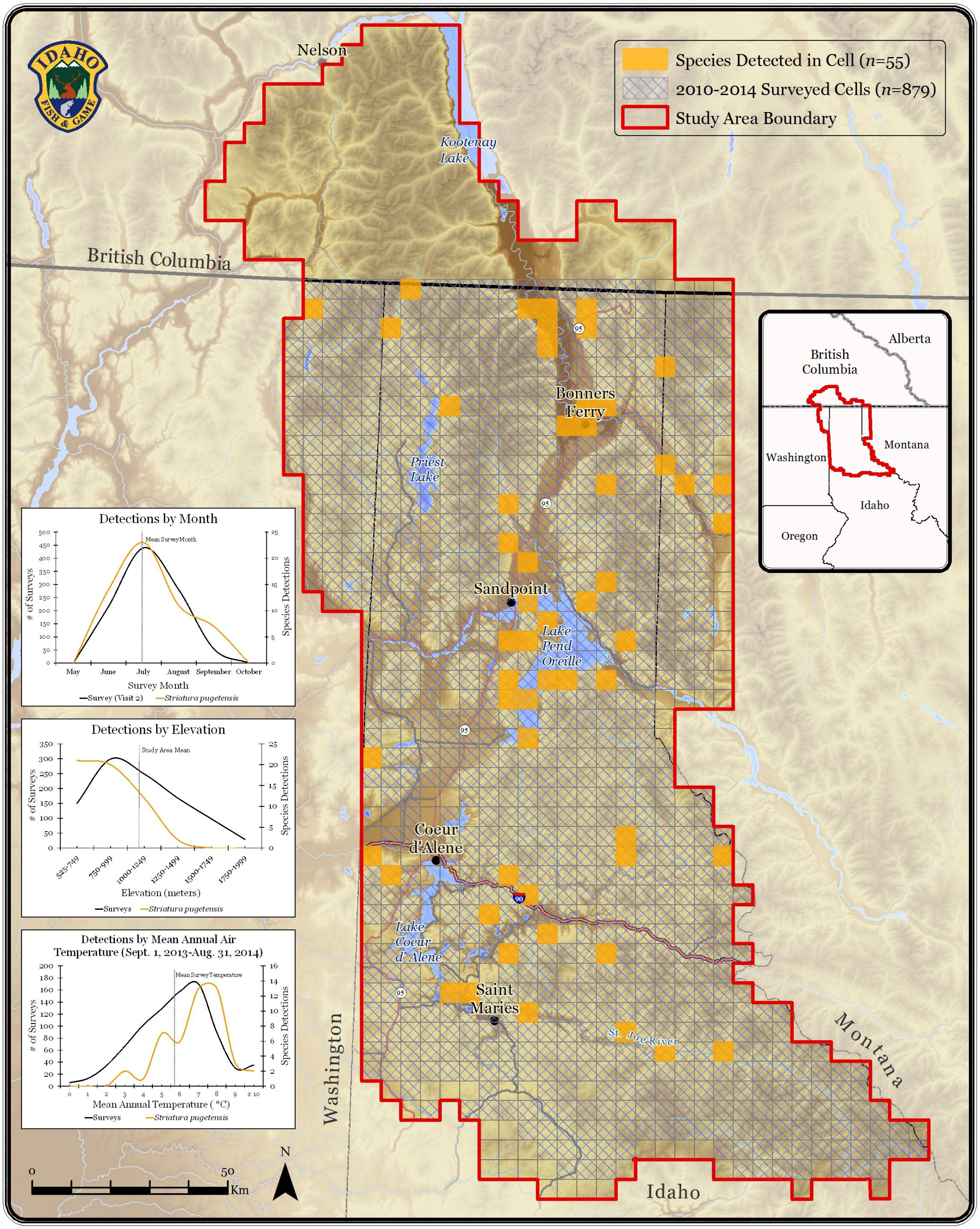
Map 2-54.

Multi-species Baseline Initiative: Rocky Mountain Axetail (*Securicauda hermani*) Detections



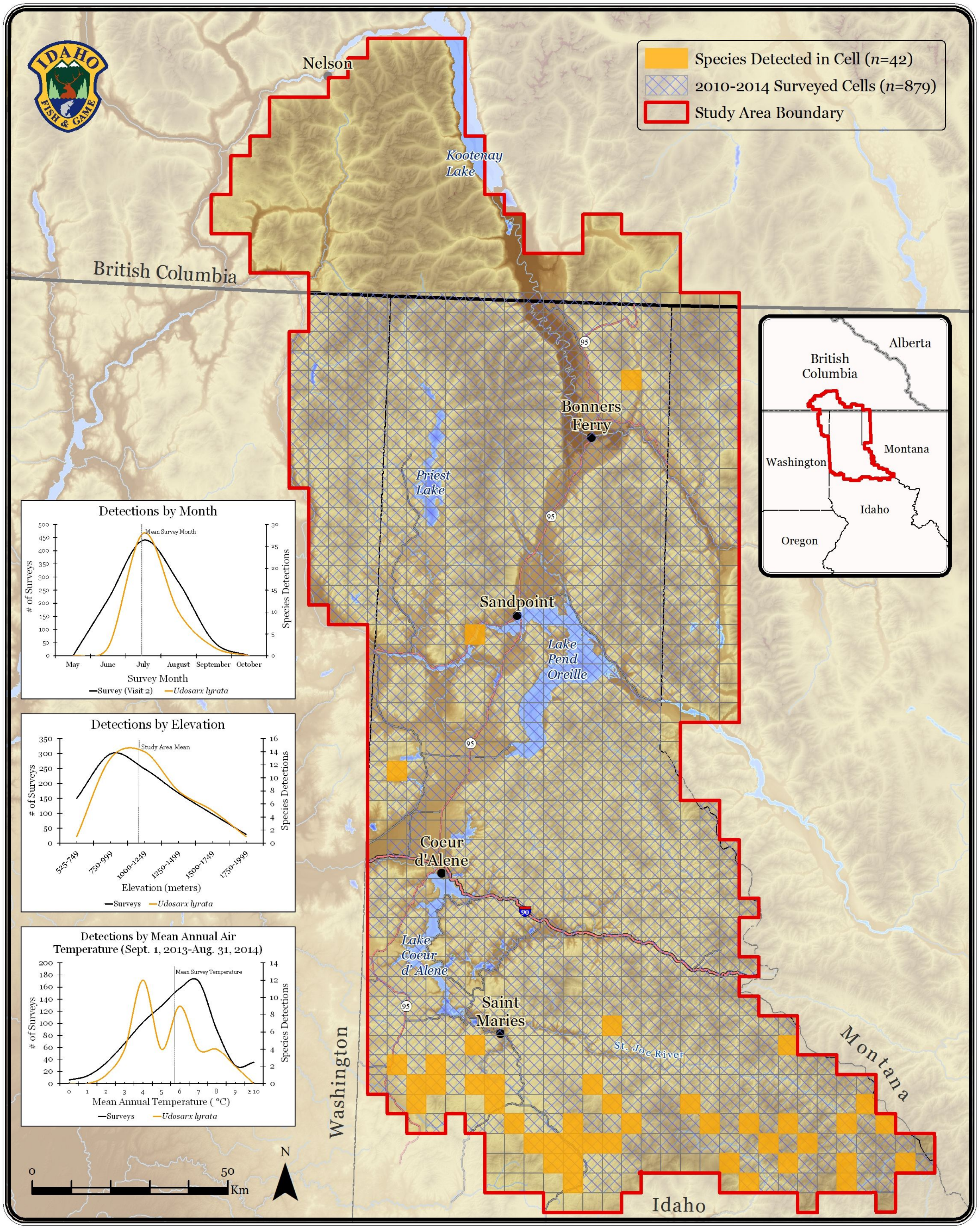
Map 2-55.

Multi-species Baseline Initiative: Northwest Striate (*Striatura pugetensis*) Detections



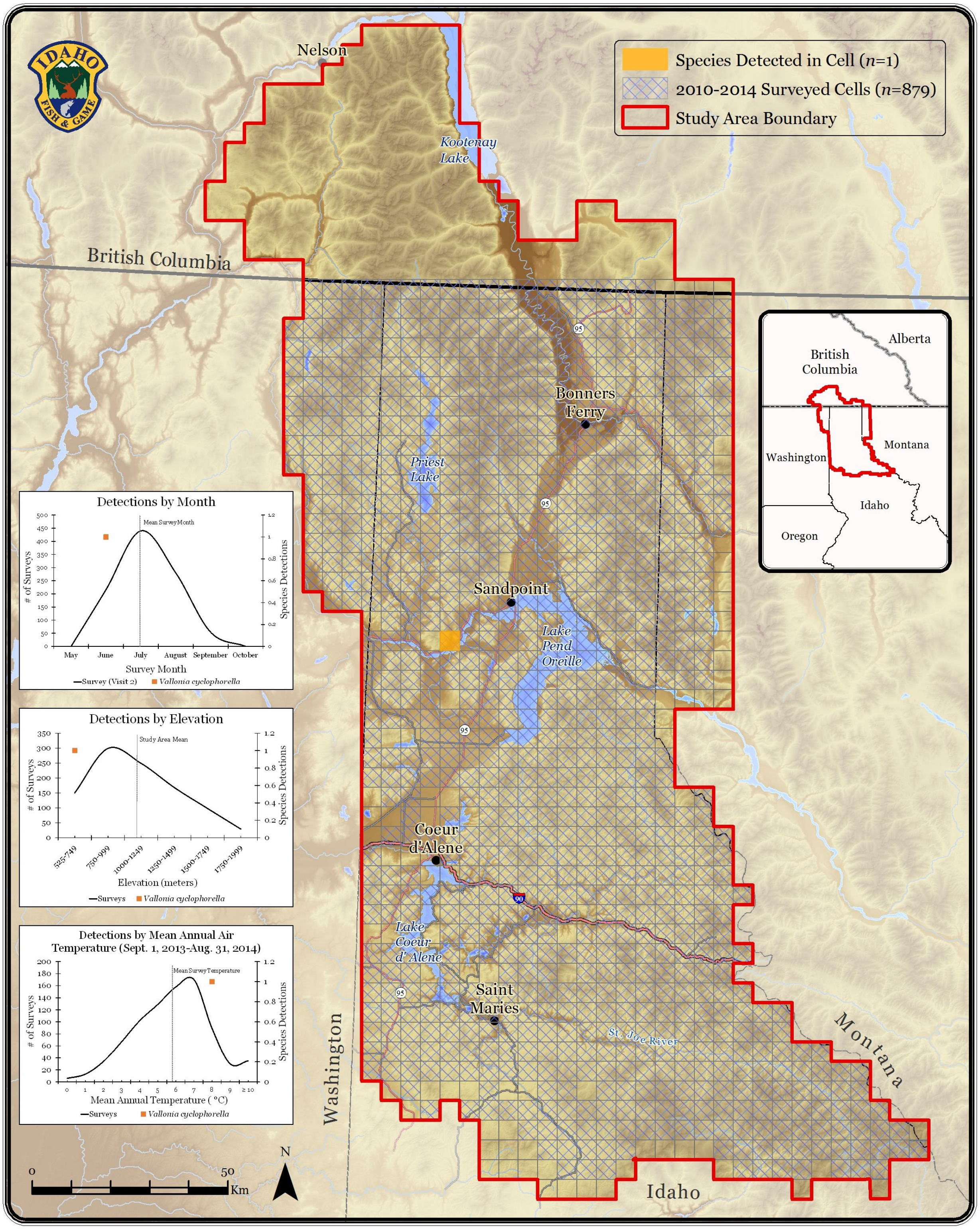
Map 2-56.

Multi-species Baseline Initiative: Lyre Mantleslug (*Udosarx lyrata*) Detections



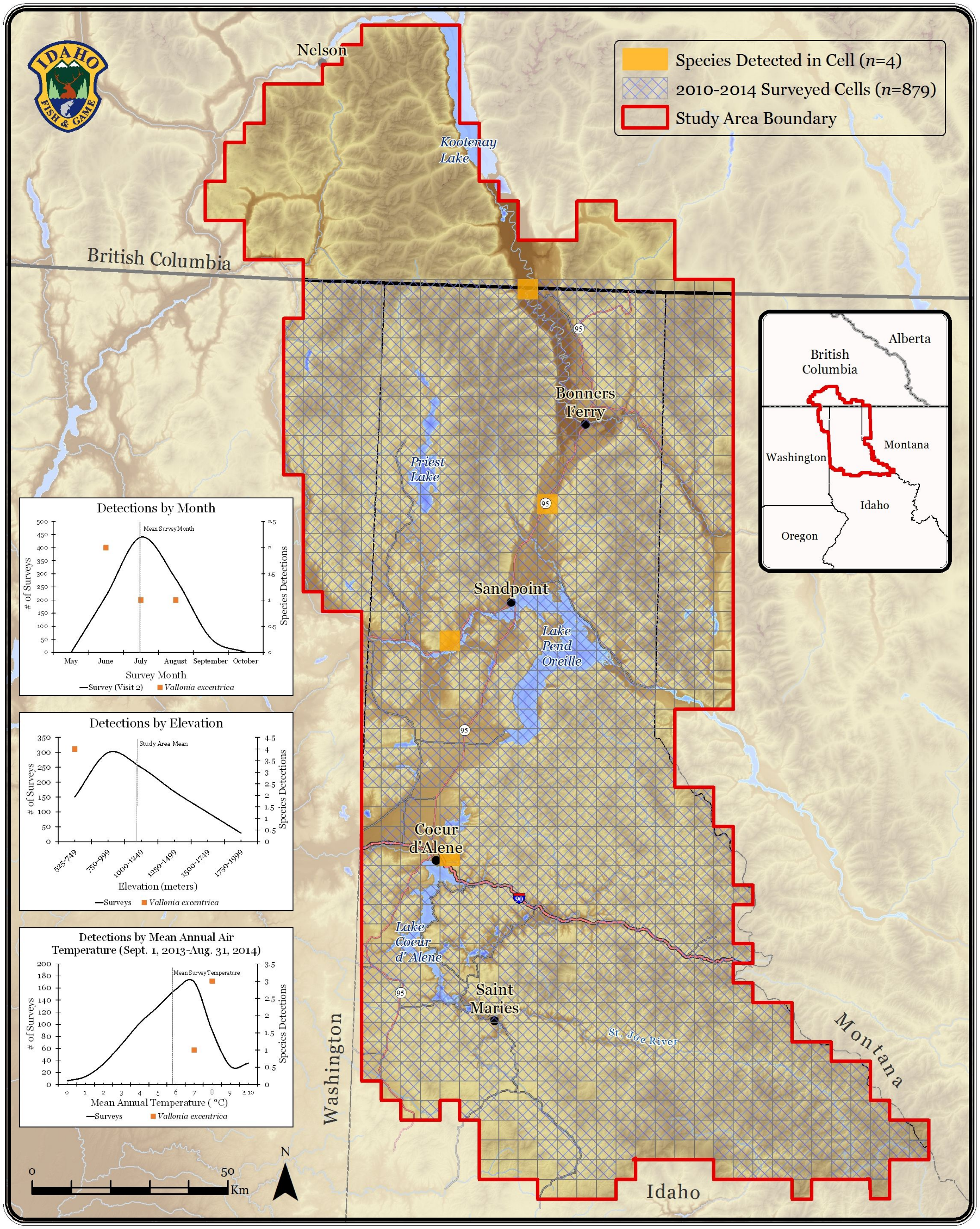
Map 2-57.

Multi-species Baseline Initiative: Silky Vallonia (*Vallonia cyclophorella*) Detections



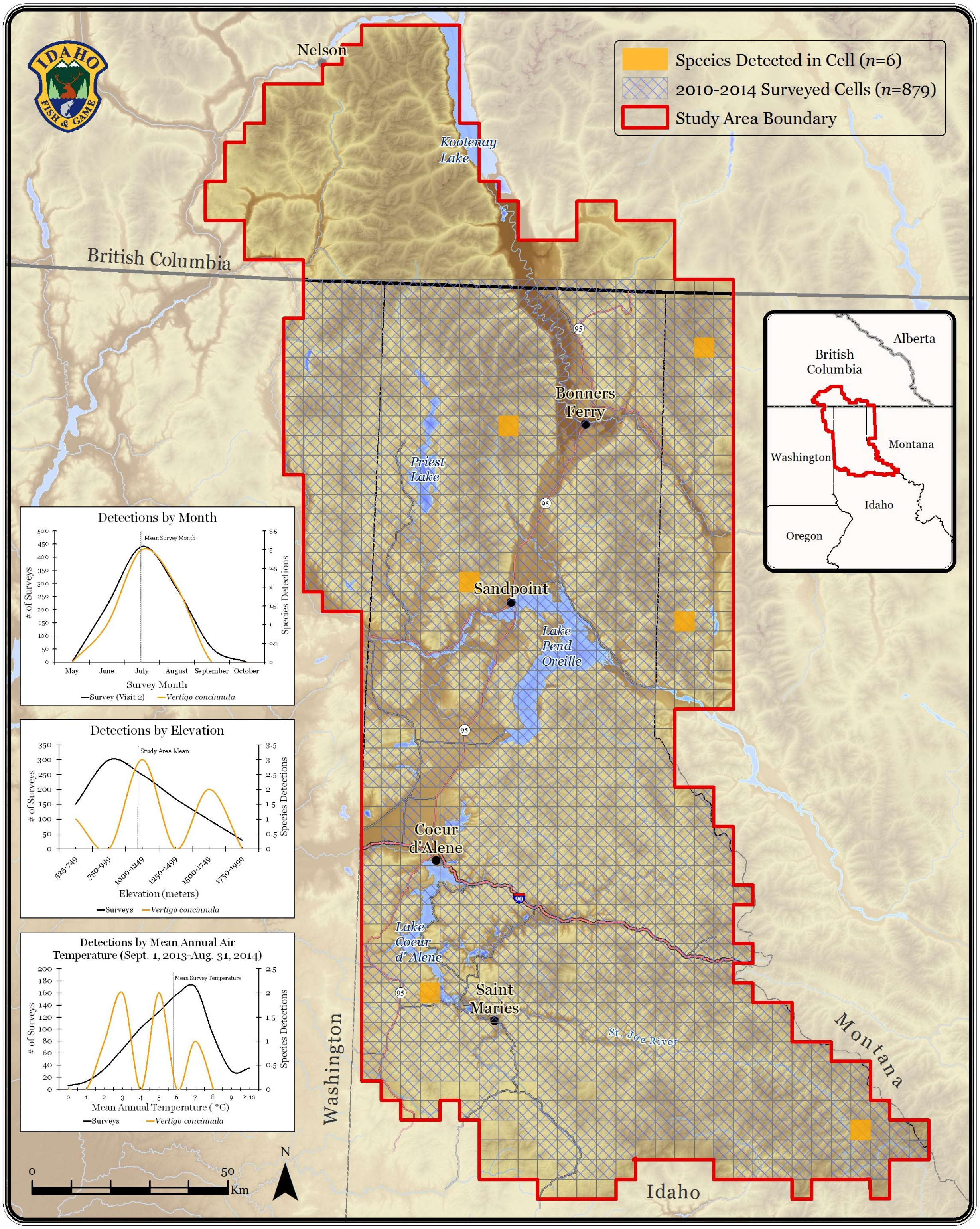
Map 2-58.

Multi-species Baseline Initiative: Iroquois Vallonia (*Vallonia excentrica*) Detections



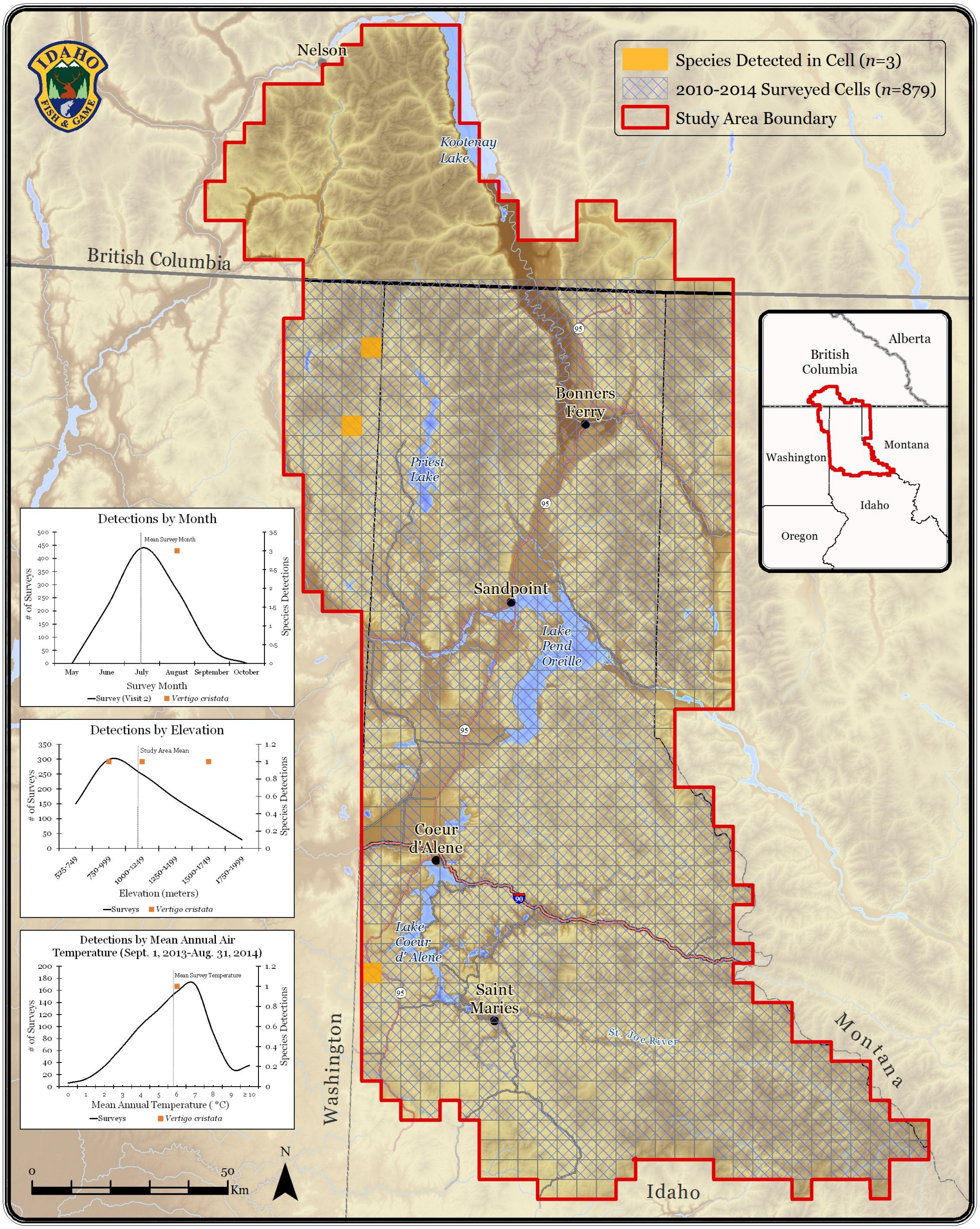
Map 2-59.

Multi-species Baseline Initiative: Mitered Vertigo (*Vertigo concinnula*) Detections



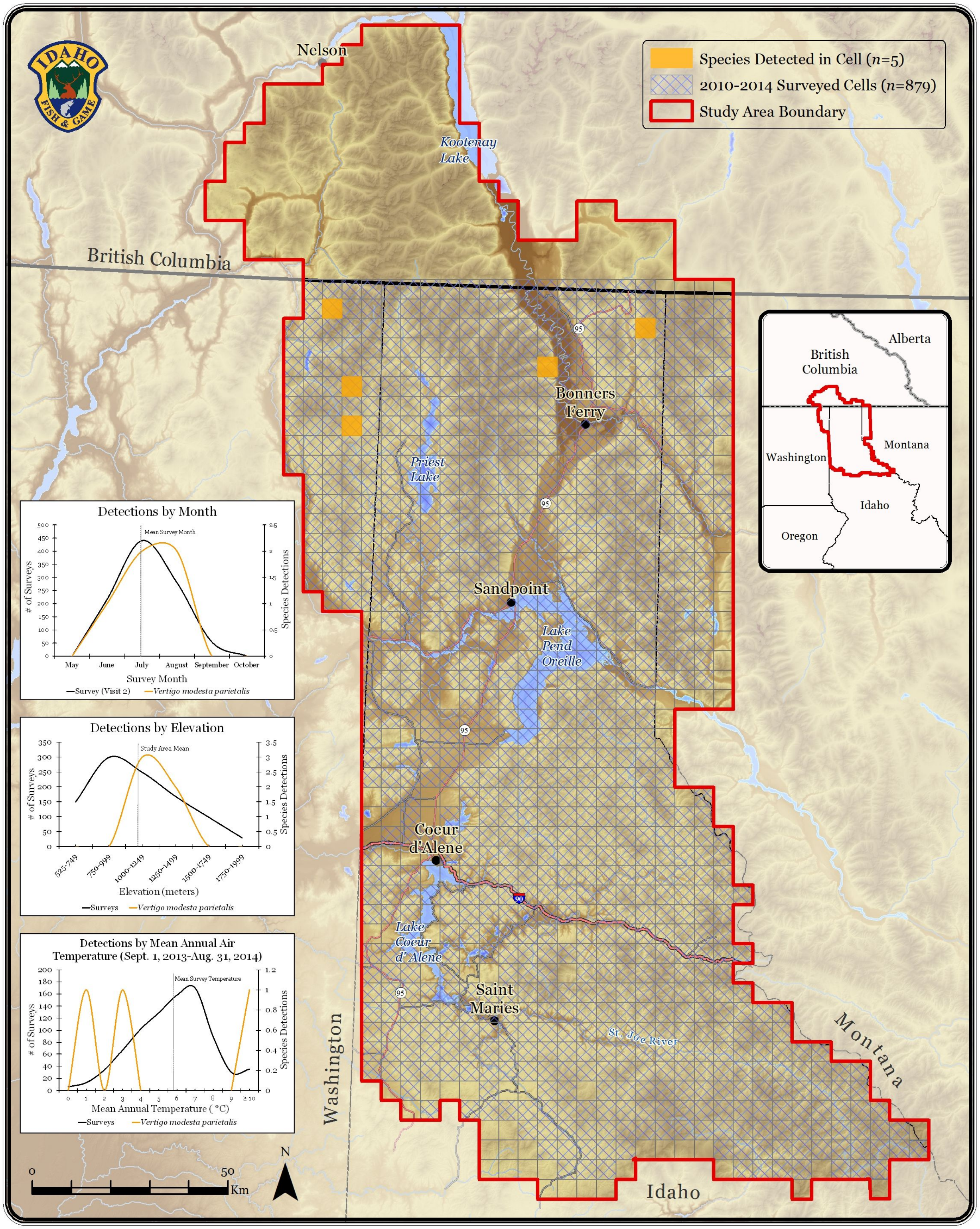
Map 2-60.

Multi-species Baseline Initiative: Crested Vertigo (*Vertigo cristata*) Detections



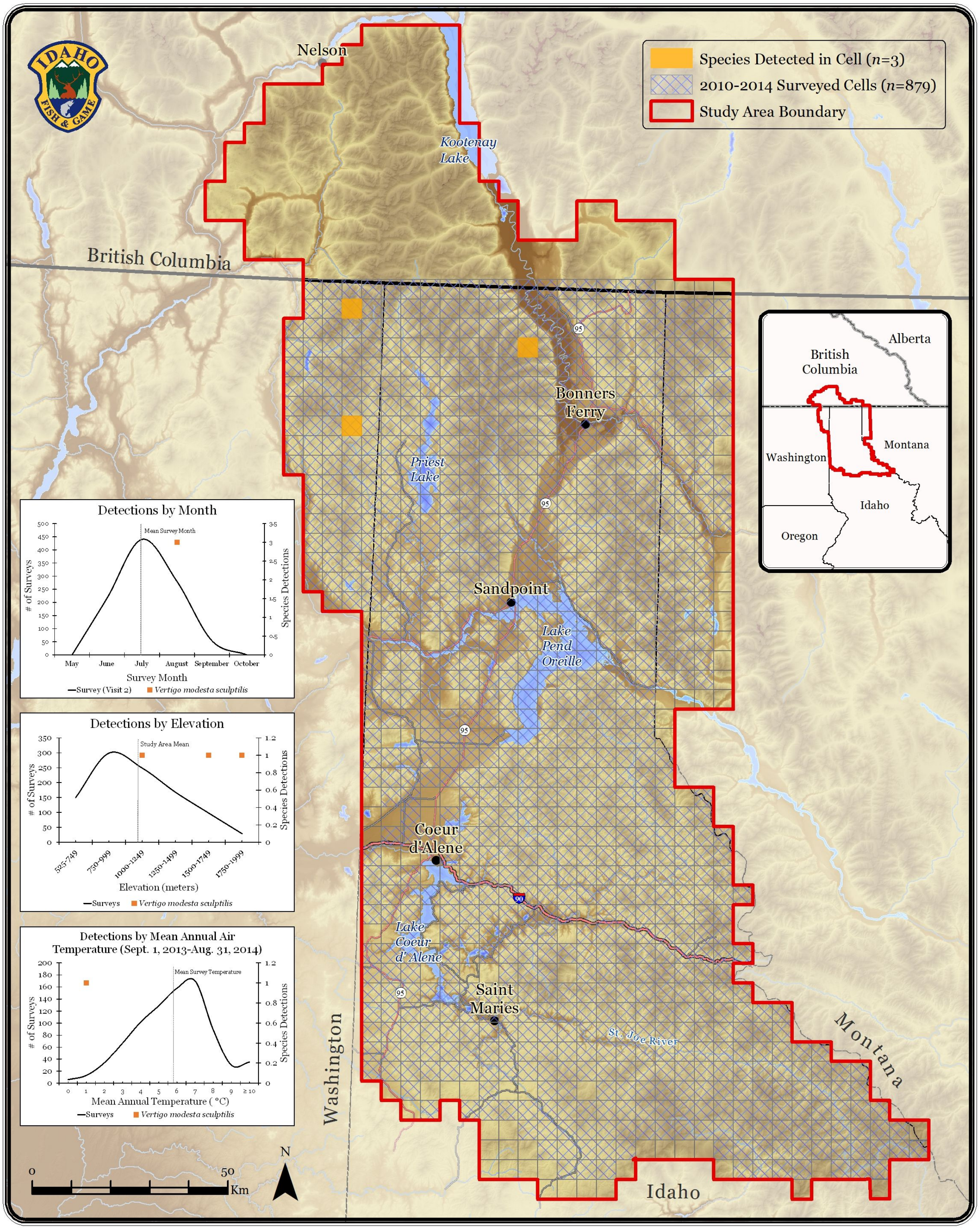
Map 2-61.

Multi-species Baseline Initiative: *Vertigo modesta parietalis* Detections



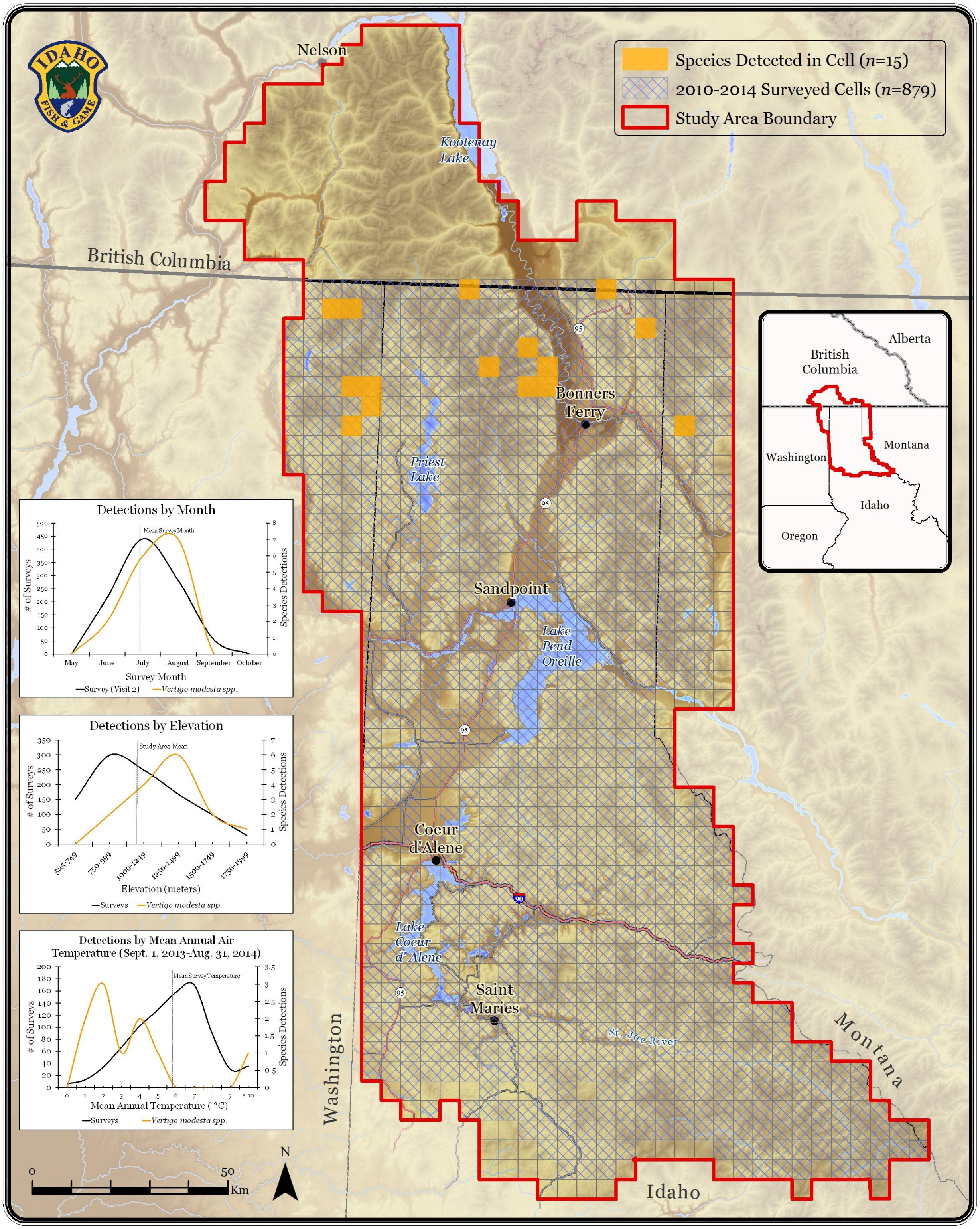
Map 2-62.

Multi-species Baseline Initiative: *Vertigo modesta sculptilis* Detections



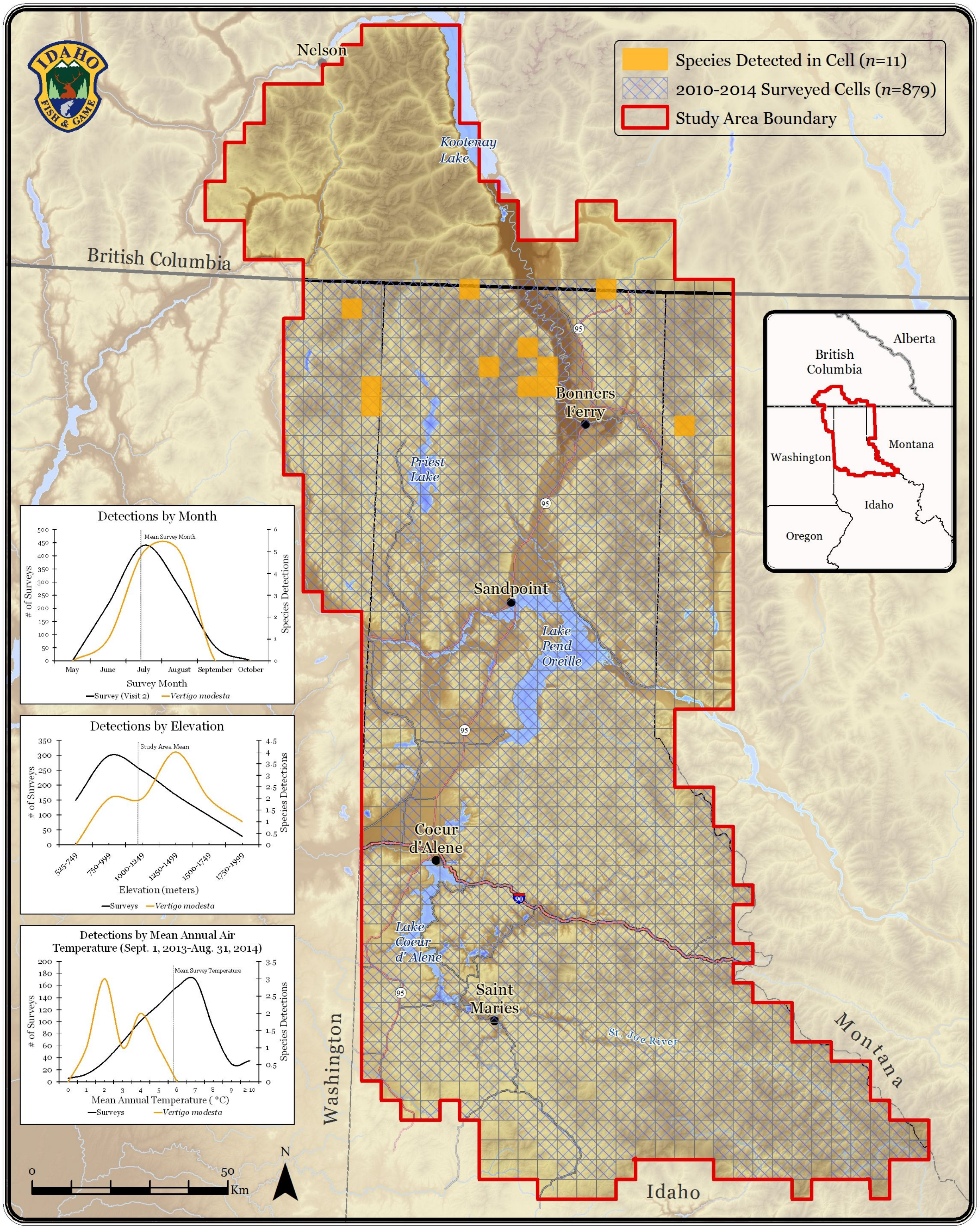
Map 2-63.

Multi-species Baseline Initiative: *Vertigo modesta* complex Detections



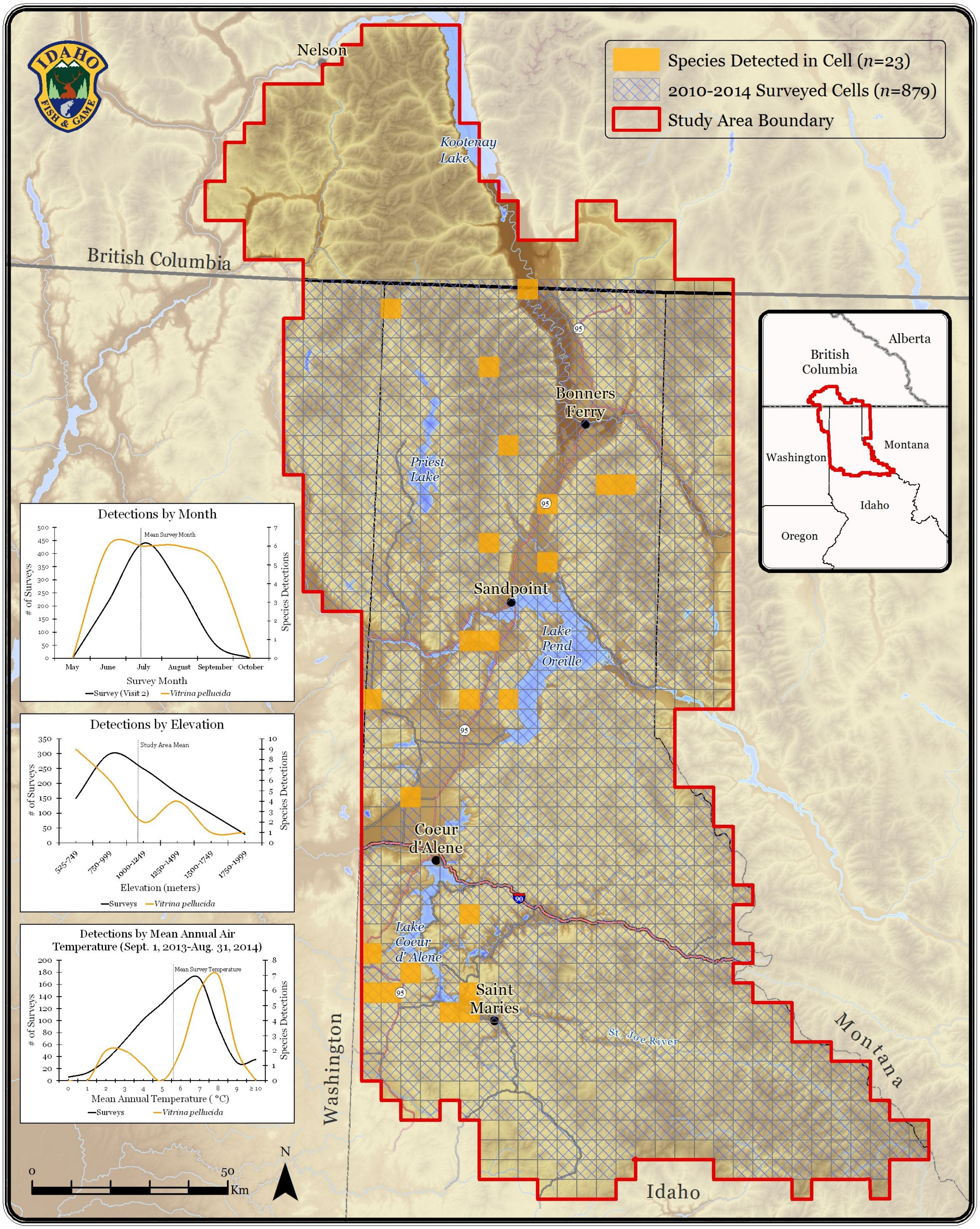
Map 2-64.

Multi-species Baseline Initiative: Cross Vertigo (*Vertigo modesta*) Detections



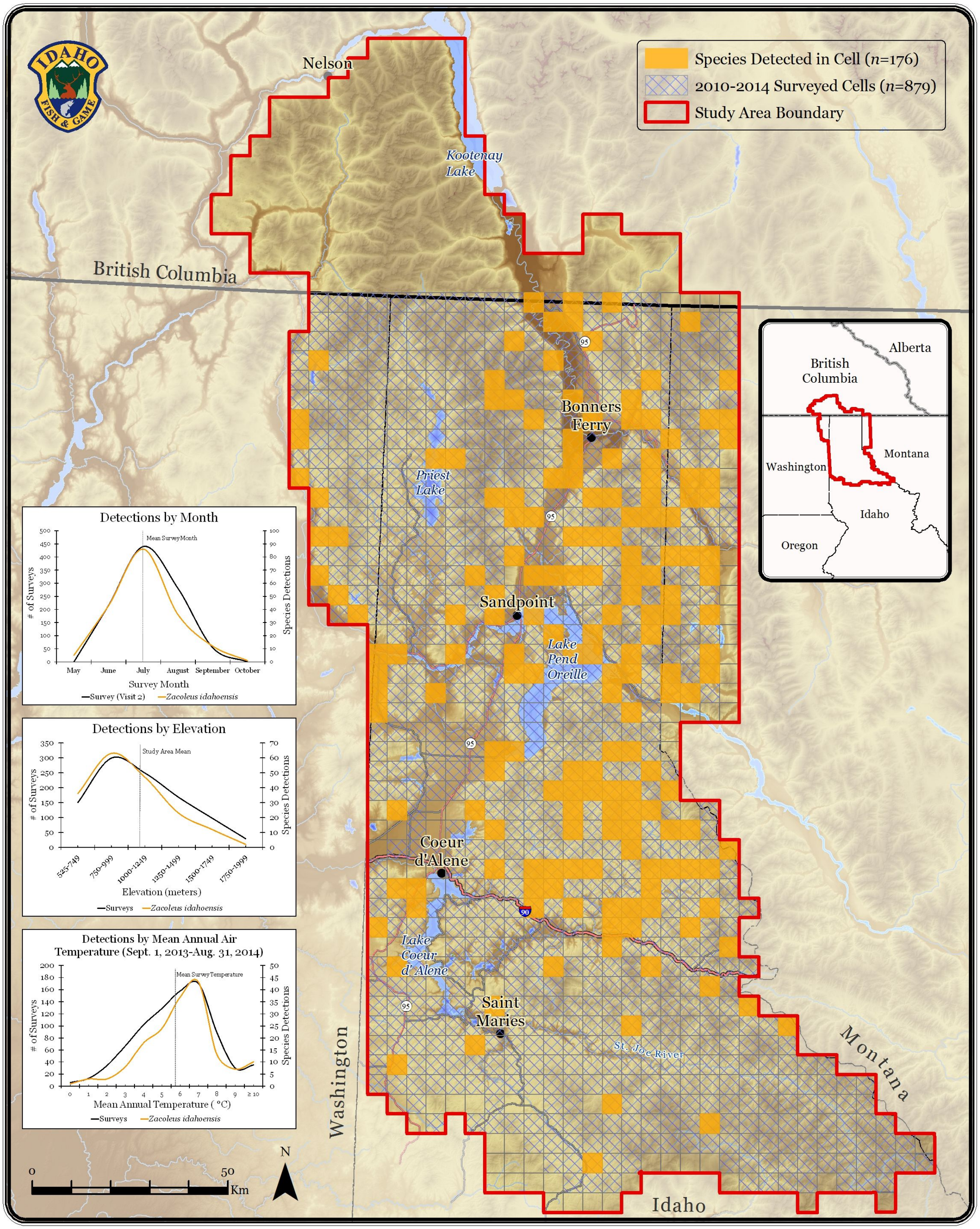
Map 2-65.

Multi-species Baseline Initiative: Western Glass-snail (*Vitrina pellucida*) Detections



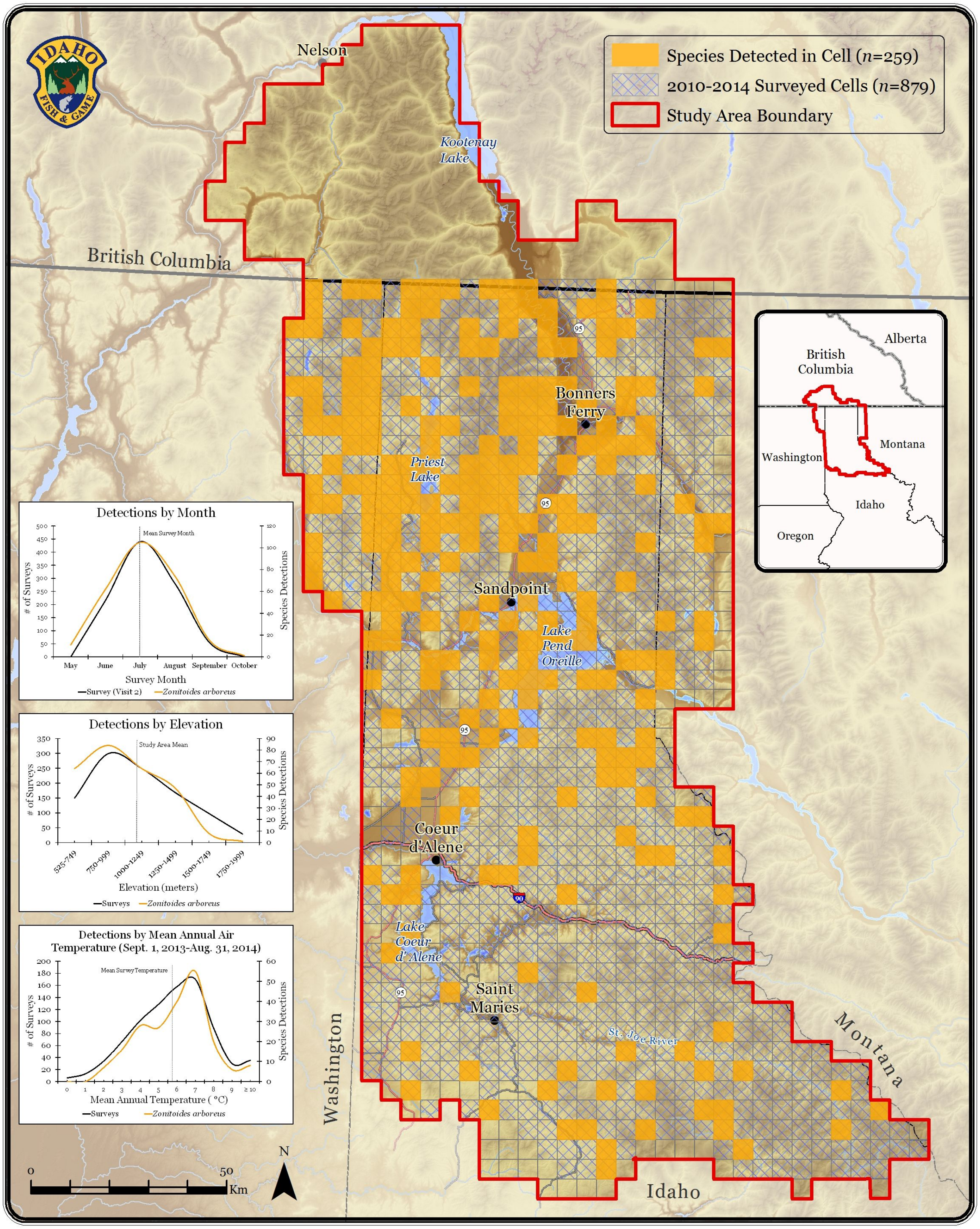
Map 2-66.

Multi-species Baseline Initiative: Sheathed Slug (*Zacoleus idahoensis*) Detections



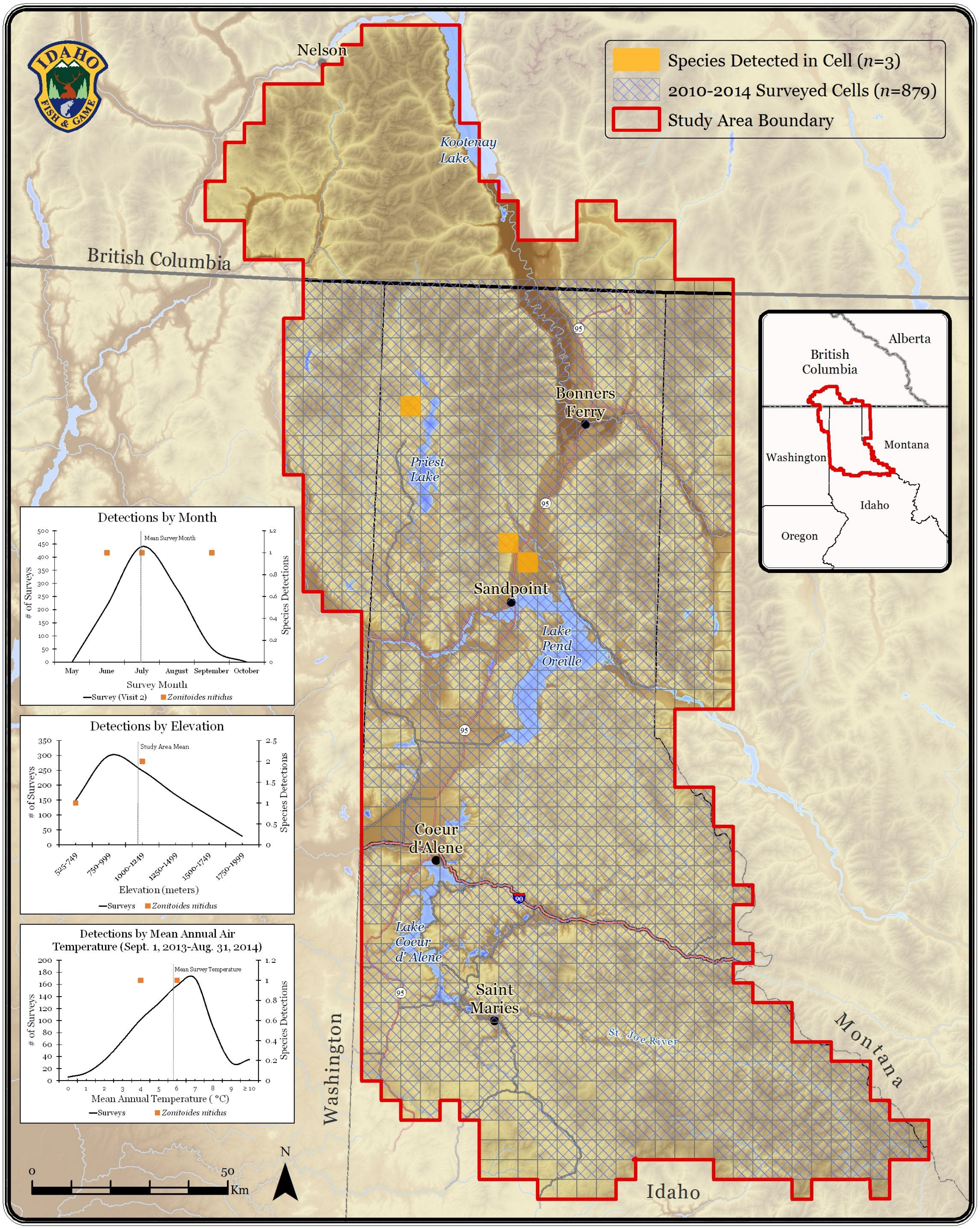
Map 2-67.

Multi-species Baseline Initiative: Quick Gloss (*Zonitoides arboreus*) Detections



Map 2-68.

Multi-species Baseline Initiative: Black Gloss (*Zonitoides nitidus*) Detections



Map 2-69.

CHAPTER 3. Amphibians - Multi-species Baseline Initiative

Introduction

Amphibian populations have been declining world-wide for decades (Houlahan 2000) as a result of pathogens, climate change, environmental pollution, ultraviolet-b exposure, and invasive species (Bridges and Semlitsch 2000, Cushman 2006, Kiesecker et al. 2001, Stuart et al. 2004). Amphibians have relatively low vagilities (Bowne and Bowers 2004, Cushman 2006), often have narrow habitat requirements (Cushman 2006), and declines can occur rapidly in seemingly pristine environments (Stuart et al 2004). The majority of amphibian research and monitoring is conducted on a site specific level. But to address the threats to amphibian populations, landscape level monitoring and conservation programs for both common and rare species are needed (Cushman 2006).

Prior to the beginning of the MBI project, the Idaho Fish and Wildlife Information System (IFWIS) contained 868 amphibian observations from the Idaho portion of the study area consisting of 77% (*n* = 671) incidental and 23% (*n* = 197) standardized survey observations. Standardized amphibian surveys in portions of the Multi-species Baseline Initiative (MBI) study area have occurred sporadically since at least the mid-1990s (Beck et al. 1998). The first standardized surveys available in IFWIS were conducted in 2002 [Beck et al. (1998) data are not included in the IFWIS database]. The first incidental IFWIS observations occurred in the 1800s.

Only six of these 868 IWFIS observations were of Northern leopard frogs (*Rana pipiens*). The most recent Northern leopard frog observation in the Idaho portion of the study area occurred in 1955 (IFWIS, accessed April 3, 2016). Although this species is one of the most widely distributed amphibians in North America, it has been declining in the western portion of its range since the 1960s (Gibbs et al 1971, McAllister et al 1999). Because a standardized amphibian survey or monitoring program never existed in our study area, we are forced to wonder if this species was historically common and widely distributed throughout the study area or if it occurred patchily or in small numbers. What happened to this species since it was last detected over 50 years ago? This knowledge is lost for Northern leopard frogs but opportunity remains for currently common species such as Columbian spotted frogs (*Rana luteiventris*). Here we present the first step in the path toward a regional amphibian monitoring program.

MBI was funded to conduct surveys for five amphibians classified as Species of Greatest Conservation Need (SGCN). Northern leopard frogs, wood frogs (*Rana sylvatica*), and Coeur d'Alene salamanders (*Plethodon idahoensis*) are SGCN listed in the 2005 Idaho State Wildlife Action Plan (I-SWAP). Tiger salamanders (*Ambystoma tigrinum*) and western toads (*Anaxyrus boreas*) are SGCN listed in the 2005 Washington State Wildlife Action Plan (W-SWAP). All but Coeur d'Alene salamanders breed in ponds. Therefore we focused our efforts primarily on potential pond breeding habitat. To obtain the maximum data return for our survey effort, we tested new and existing techniques to develop protocols which enable detection of rare and common amphibians and other co-occurring species.

In addition to native species occurrence data, we designed our protocols to detect potential physical and biological threats to native amphibians. At all wetlands, we recorded bullfrog (*Rana catesbeianus*) detections and fish presence, and at a subset of wetlands, we collected micro-climate data (water temperature, air temperature, and relative humidity) and sampled for chytrid fungus (*Batrachochytrium dendrobatidis;* BD).

In order to set the stage for landscape level amphibian monitoring and conservation strategies, we set out with the following goals: 1) develop distribution maps of target SGCN, 2) develop distribution maps of other pond breeding amphibians and other species found at ponds, 3) develop distribution maps of potential biological threats to native pond breeding amphibians (e.g., bullfrogs, BD, and fish), 4) determine micro-climate associations for pond breeding amphibians, 5) assess the proper phylogenetic clade and taxonomic classification for western toads in our study area, and 6) provide information on current phenological patterns of pond breeding amphibians.

Methods

Study Design

We stratified our 22,975 km^2 study area into 920, 5x5 km sampling cells and attempted to conduct a pond survey in each Idaho and Washington cell (*n* = 849). We did not conduct surveys in 68 (8%) cells because we were either unable to gain access to private lands or we were unable to identify a potential wetland (Map 3-1). To increase our sampling effort, we added 21 additional cells in the Saint Joe and Coeur d'Alene Mountains. This left us with a total of 870 cells we attempted to conduct amphibian surveys in. Of those 870 Idaho and Washington cells we successfully conducted surveys at 826 sites within 802 cells between April 22 and September 17 in 2013 and 2014. Of the 826 sites, 665 were publicly owned and 161 were privately owned. Our survey sites were selected in four ways in the following order of preference: 1) from the National Wetland Inventory [NWI (U.S. Fish and Wildlife Service, 2013)] (*n* = 559), 2) visually selected from maps (*n* = 74), 3) technicians on the ground (*n* = 59), and from the Wetlands Assessment Tool (WAT) (*n* = 134) (Table 3-1).

We defined a pond as a lentic body of water ≤500 meters in perimeter. We attempted to survey 870 wetlands consisting of one pond in Idaho (*n* = 800) and Washington (*n* = 70) cells.

Terrestrial invertebrate survey plots were chosen prior to wetlands. Terrestrial plots were primarily randomly chosen with bias to roads and trails or random Forest Inventory and Analysis (FIA) plots (see Chapter 2 for details). We selected the wetland nearest the terrestrial survey plot in an effort to improve field efficiency. If more than one terrestrial plot occurred in a cell, we preferentially selected the FIA terrestrial plot over the basic terrestrial survey plot.

Wetland photographs are archived on IDFG servers.

Site Selection (Table 3-1) -

2013 - The majority of wetlands were selected using NWI http://www.fws.gov/wetlands/Data/State-Downloads.html, Accessed April 3, 2013), which is based on aerial imagery, collateral data sources, and field work (U.S. Fish and Wildlife Service, 2013). We then used ArcGIS 10.1 (Environmental Systems Research Institute, Redlands, CA) to clip the wetland layer to the Idaho Fish and Game (IDFG) Region 1 shapefile and calculated a perimeter for all of the wetlands in the Idaho Panhandle. We removed any wetland with a perimeter ≥ 500 meters. If a small enough wetland was not available, we made exceptions up to 700 meters in perimeter. We also removed wetlands that were categorized as "Riverine."

We then generated the centroid coordinates for each wetland and produced a point shapefile based on those coordinates. In Geospatial Modeling Environment (http://www.spatialecology.com/gme/, Accessed January 21, 2013) we used the "Distance to Points" function to produce a list of the 4 closest wetlands to the terrestrial survey site. We eliminated any wetlands outside the cell of interest then selected the closest wetland classified as a pond. If a pond was not available, we preferentially selected an emergent wetland followed by a forested-shrub wetland. We preferentially selected wetlands on public land if available.

The NWI did not cover all of the study area, in particular, Shoshone County. We used a variety of digital (National Hydrography Dataset, IDFG Region 1 Lakes.shp, GoogleEarth) and non-digital (Forest Service Maps, private landowners) sources to find additional ponds.

After the first two steps, we were left with 151 cells in which we had yet to identify a pond, primarily in the Saint Joe and Coeur d'Alene Mountains. In an attempt to identify ponds in these 151 cells, we used WAT, which was developed by Chris Murphy (IDFG) and models wetland locations based on NWI and gap analysis. To select wetlands using WAT, we eliminated any polygons which were > 500 meters in perimeter. Wetlands were displayed as either squares or polygons with a more 'natural' appearance but no other information such as wetland type was available about the polygons. We selected the 'natural' appearing polygon closest to the terrestrial survey location.

2014 - There were 208, mostly privately owned, un-surveyed cells remaining to be surveyed. We had already identified wetlands within these cells. However, we modified the wetland identification methodology and re-ran the selection process for these cells in order to: 1) increase our success in identifying ponds (over other types of sites) prior to field visits and 2) to prioritize private ponds or wetlands which had higher likelihood of gaining access permission. As in the 2013 method, the NWI dataset was utilized and wetlands with a perimeter ≤ 500 meters were selected. Wetlands categorized as "Riverine" were eliminated. We converted the filtered shapefile into a .kmz and then visually confirmed the presence of a wetland in Google Earth. In cells with no digitized source of wetland information, we visually scanned Google Earth for any sign of ponds or wetlands in the Landsat image. Wetlands identified using this method were digitized for inclusion in the overall survey shapefile. Because access to privately owned wetlands was dependent on landowner permission, we prioritized private wetlands with publically available landowner contact information. We did not use WAT in 2014.

Of the 826 sites we surveys we found ponds at 338 (41%) NWI selected sites, 6 (0.73%) WAT model selected sites, 29 (4%) sites field-selected by technicians and 60 of other selection type sites (7%). Overall, we successfully detected ponds at 433 (52%) of 826 sites visited. (Table 3-1)

Table 3-1. Data sources used to identify wetlands.

Data Source	# Surveys	Wetland Type					
		Pond/Lake[a] #(%)		Other Wetlands[b] #(%)		Dry Sites[c] #(%)	
National Wetland Index	559	338	(40.92)	133	(16.10)	88	(10.65)
Wetland Assessment Tool	134	6	(0.73)	100	(12.11)	28	(3.39)
National Hydrography Dataset(Shoshone County)	26	18	(2.18)	7	(0.85)	1	(0.12)
Region 1 Lakes layer	7	6	(0.73)		(0.00)	1	(0.12)
Forest Service Map	5	3	(0.36)	1	(0.12)	1	(0.12)
Google Earth™	34	32	(3.87)	2	(0.24)		(0.00)
Private Landowner	2	1	(0.12)		(0.00)	1	(0.12)
Technician Selected in Field	59	29	(3.51)	27	(3.27)	3	(0.36)
Total Wetlands	826	433	(52.42)	270	(32.69)	123	(14.89)

[a] Includes ponds, beaver ponds, lakes, emergent wetlands, puddles, vernal pools, wet meadows
[b] Includes streams, channels near streams, puddles, springs, road ditches
[c] Includes any wetland or non-wetland site that did not have any water

Obtaining Private Land Access - The majority of privately owned wetlands surveyed in 2013 were either located on timber properties (for which we obtained access through a MOU) or were properties for which IDFG had existing access. In 2014, however, 83% (*n* = 247) of wetlands surveyed were privately owned. We used a variety of resources to determine land ownership. During February of 2014, we sent initial contact letters to landowners asking for permission to access their property to conduct amphibian surveys (Appendix III-c). We provided a postage paid card with which the landowner could respond either granting or denying access to their property. Landowners who did not return the postcard were contacted by telephone in April 2014. Landowners granting access were called prior to the field survey and provided with written survey results in January 2015.

Of the 265 privately owned wetlands we requested access to, we were granted access to 161 (61%). Of the 193 postcards we sent, 53 (27%) were returned, the majority of which (*n* = 41) granted access. Follow-up calls yielded access to an additional 43 wetlands (Table 3-2).

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Table 3-2. Number of publicly and privately owned wetlands surveyed. Success obtaining access to privately held wetlands

	# (%)			
	Cells (*n* = 802)		Surveys (*n* = 826)	
Completed in 2013	641	(80)	659	(80)
Public wetlands	599	(75)	617	(75)
Private Wetlands	42	(5)	42	(5)
Private Individual	11	(1)	11	(1)
Business/Industry	31	(4)	31	(4)
Completed in 2014	161	(20)	167	(20)
Public Wetlands	48	(6)	48	(6)
Private Wetlands (see below)	113	(14)	119	(14)
Cells with no wetland identified	51	(6)		
Cells with no access	17	(2)		
Wetland Selection 2014				
	# (%)			
Private Wetlands Identified in 2014	247			
1st Attempt access request (postcard)	193			
Total Returned	53	(27)		
Access granted	41	(21)		
Access denied	12	(6)		
2nd Attempt Access request (phone call)	98			
Access granted	43	(44)		
Access denied	42	(43)		
Unable to contact landowner	13	(13)		
Postcard returned after phone call	26[a]	(60)		
Business/Industry Access Requests	30			
Access granted	21	(70)		
Access denied	9	(30)		

[a] Three people returned a card denying access after saying yes on the phone

Ponds vs. Other Survey Sites - Our goal was to survey for pond breeding amphibians. However, only 433 (52%) surveyed sites met 'pond' criteria (lentic water body ≤500 m diameter). It was often not possible to determine from maps if a site was a pond, different type of wetland, or a dry site.

Field Methods

At each survey site we conducted a dip net survey or timed search for amphibians. We recorded observations of amphibian life stages as well as opportunistic species. We deployed water temperature data loggers at 131 ponds. At 50 ponds we deployed air temperature and relative humidity data loggers. We sampled fully formed spotted frogs for BD at 153 (18%) ponds.

Environmental DNA vs. Dip Netting Field Assessment - When we proposed this project, we initially planned to use environmental DNA (eDNA) techniques (e.g. Pilliod 2012) to detect amphibians. In 2012 we conducted a field trial to compare the eDNA technique to traditional dip net larval surveys (Heyer et al 2014). We determined we would need to collect eDNA at a minimum of three locations per pond to assess amphibian species composition. Because we could test for only four species at one time using eDNA, at least six laboratory tests would have been necessary to survey each pond. Using eDNA was therefore cost prohibitive and we made the decision to use traditional dip netting, a cheaper and more efficient technique for our purposes (Appendix III-d).

Dip Net Surveys (tissue sampling and photos) - At each pond ≤500 meters in perimeter (*n* = 354), we conducted a full perimeter dip net survey. At ponds and lakes >500 meters in perimeter (*n* = 60), we conducted a dip net survey along a section of shoreline either 100 m (2013) or 500 m (2014) long (Table 3-9). We used 12" deep, 3/16" mesh dip nets (Forestry Suppliers, Jackson, MS; Appendix III-a) and sampled all microhabitats along the shoreline. Technicians visually estimated 50 m shoreline sections and counted each amphibian species by life stage (egg, no legs, 2 legs, 4 legs and tail, or fully formed; Table 3-5). Exact quantities were recorded for 0-10 individuals per section. If there were more than 10 individuals per section, quantities were estimated by order of magnitude to the nearest 10, 100, or 1000.

Dip net survey on private land.

Timed Search Surveys - When we were unable to find a pond or lake at an assigned site (n = 412), observers conducted a 30 minute timed visual encounter search for amphibians (*n* = 412). Non-pond sites included stream channels, emergent wetlands, puddles, dry meadows, and talus fields; observers classified conditions as wet (*n* = 302) or dry (*n* = 110) (Table 3-1) and recorded opportunistic observations of target plants, mammals, reptiles, and insects as they conducted the amphibian timed search.

Temporal Surveys - In temperate mountain environments amphibians tend to distribute breeding activity temporally along elevational gradients and some species may take more than one summer breeding season to complete metamorphosis. Determination of phenological patterns allows both the ability to develop study-area-specific development timeframes to inform amphibian survey protocols and provides baseline knowledge for which to compare potential comparative phenological changes over time during climate change. To delineate current phenological patterns and assess amphibian detectability across the survey season, we conducted temporal surveys at 7 ponds in 2014. We selected ponds from the 2013 survey season which had high species diversity (2-4 species per pond) and provided the maximized pond sample size for each species (3-5 ponds per species). Pond elevations ranged from 538-1,763 m. Beginning May 29, 2014, we conducted full perimeter dip net surveys at approximate 20-day intervals throughout the season until larval amphibians had fully metamorphosed, were no longer detected, or an active dispersal was detected during the survey. This resulted in 6-7 surveys per pond with higher elevation ponds receiving more surveys.

Temporal surveys began in early June 2014. Amphibians were not detected until July at high elevation ponds like W1188.

Table 3-3. Temporal Wetland Locations

Wetland ID	Elevation	Latitude	Longitude
W1057	538	***48.90364**	**-116.38901**
W1001	630	48.30135	-116.42580
W930	643	48.29160	-116.55321
W67	899	48.87775	-117.00529
W48B	1070	48.77481	-117.04884
W148	1711	48.65950	-116.59918
W1188	1763	48.37906	-116.13732

* **Bold** locations are fuzzed within 500 meters.
All other locations are precise.

Water Temperature Data Loggers - We originally planned to deploy a water temperature monitor at all survey ponds. However, quality data loggers cost more than anticipated and we chose instead to monitor fewer ponds with higher quality data loggers. We modified Isaak et al.'s (2013) stream temperature water monitoring protocol slightly and in 2013, deployed one Onset® HOBO® TidbiT® v2 Submersible Temperature Loggers (MA, USA) in 131 ponds. In 2014, we deployed 3-4 loggers in different locations in the seven temporal ponds to compare variability in temperature readings throughout the pond. See chapter 5 for further details and results.

Air and Relative Humidity Data Loggers - At 50 ponds, we co-located HAXO8 LogTag® Transit HAXO-8 Temperature and Relative Humidity Data Loggers (UT, USA) with water temperature data loggers. HAXO-8 loggers were placed in a radiation shield according to Holden et al. (2013) and attached to the north side of a conifer tree >30 cm in diameter within 100 meters of the pond. See Chapter 5 for more details and results.

Photographs and Tissue Samples - We captured 2 individuals of each amphibian species detected in addition to 2-3 fully formed spotted frogs. We held each animal individually in plastic zip top bags with water in a shady location until sampling occurred. We placed each animal in a plastic 'photo booth' (small plastic terrarium with marked measurements) to take a ventral, lateral, and dorsal photograph (2014 only). We then used scissors to collect a toe or tail clip from each animal. We wiped scissors with bleach between individuals to destroy residual DNA on scissors. We preferentially selected fully formed individuals and when sampling them, clipped the second or third toe from the back foot in order to avoid adversely affecting nuptial pads on front feet. When only larval specimens were captured we removed a small portion of tail tissue.

Amphibians were placed in 'photo booths' (small plastic terrariums) and lateral, dorsal, and ventral photographs were taken.

BD Sampling - We selected spotted frogs to test for BD for 2 reasons: 1) we expected spotted frogs or long-toed salamanders (*Ambystoma macrodactylum*) to be the most commonly detected species in our study area and 2) spotted frogs carry heavier BD zoospore loads than long-toed salamanders (Goldberg et al. in prep). This maximized our chances of detecting BD and producing the most accurate BD distribution map in our study area.

In 2013 we sampled only designated 'intensive' sites. In 2014 we sampled spotted frogs for BD at all wetlands where fully formed individuals were detected. We sampled up to 3 spotted frogs at each sampling site. We used buccal swabs (MW fine-tipped plastic DrySwab; Medical Wire and Equipment, Wiltshire, England) to swab the underside of the animal back and forth 15 times (30 total swipes). New vinyl gloves were used to handle each animal. Swabs were stored in 95% ethanol until extracted. We sent swabs to the San Diego Zoo Amphibian Disease Laboratory where they used PCR to determine the number of BD zoospores for 3-8 replicates of each sample. We use the mean number of zoospores detected in all replicates of each sample to quantify the BD present on each animal.

Swabbing spotted frog (*Rana luteiventris*) for BD testing.

Animal Handling, Hygiene, and BD Decontamination - When we arrived at the wetland, we dug a small hole at least 100 feet from the wetland and washed our hands with biodegradable soap over the hole. We did not use sunscreen or bug spray during sampling in order to keep hands free of chemicals. Except spotted frogs (which were handled with gloves for BD sampling), we handled fully formed amphibians with wet bare washed hands. We observed tadpoles in plastic zip-top bags or 'photo booths' and did not handle them unless necessary for tissue sampling.

After each survey, we cleaned mud, snails, and plants from equipment with stiff brush at the site. We rinsed the net in the wetland. When back at the field vehicle we sprayed all equipment (e.g., boots, waders, and dip nets) with a 10% bleach solution. We allowed equipment to dry while traveling to next site.

Opportunistic Observations - We created a list of easily identifiable species (including reptiles, mammals, invasive plants, native plants, and bumblebees) which observers might encounter at survey sites. We provided training in species ID and a field identification guide. Observers noted visual and audio detections of opportunistic species while at the survey site. Bumblebees were photographed for later verification. If fish were observed in the wetland, observers recorded species if known. See Chapter 6 for additional detail and results.

Sample Handling and Storage
Amphibian tissue samples were placed in coin envelopes and dried in the field. BD samples were stored in 95% ethanol. Samples were stored at room temperature at a climate controlled storage unit. Photographs were labeled and archived on IDFG servers.

General Taxonomy
Taxonomy was conducted in the field by paid wildlife technicians and biologists. Each staff member completed an amphibian identification training course. We modified dichotomous keys from Corkran and Thoms (2006) with information in Amphibians and Reptiles of Montana

(Werner et. al, 2014) and Storm et al. (1995). Ten specimens were identified in the field as salamander (*n* = 9) or wood frog (*n* = 1) and tissue samples from these individuals were sent to the University of Idaho for genetic confirmation of species ID. Sections of 16SRNA, D-loop, or ND2 were sequences and a BLAST (http://blast.ncbi.nlm.nih.gov/) search was performed to determine which species each sequence represented.

Western Toad Taxonomy
We used dried toe or tail clips collected from extracted DNA and sequenced a 269 base pair section of the mitochondrial cytochrome oxidase (COI) gene. We accessed GenBank to obtain sequences of the same region from additional toads representing the major clades identified by Goebel et al. (2009). We used PAUP* (Swofford 2002) to build a Neighbor-Joining tree from maximum likelihood distances calculated using a HKY+I model. The work described in this paragraph was performed or supervised by Dr. Jack Sullivan at the University of Idaho and we are grateful for his assistance.

Verifying Historic Specimens
In 2012 we reviewed the IFWIS database for historic wood frog and northern leopard frog observations. We visited each location where a wood frog had been reported in Idaho (*n* = 4) and each location where a leopard frog had been reported in the Idaho Panhandle IDFG administrative region (*n* = 6). We conducted a visual inspection, timed search, or dip net survey at these locations. Survey type was dependent on conditions at sites (privately owned, developed since report was made, etc). All locations had poor accuracy and were estimated to be within 5 miles of the original collection site.

We queried museum collection databases to confirm IFWIS records and searched for additional records. We requested collection loans of all available museum specimens and specimens were examined by taxonomic experts.

Results and Discussion
Microclimate and opportunistic species results are detailed in Chapters 5 and 6 respectively.

Summary
We detected amphibians at 48% (*n* = 397) of 826 sites surveyed. We detected amphibians in 49% (*n* =390) of 802 cells surveyed (Table 3-4). We identified 9 amphibian species representing 7 families and 7 genera. We detected amphibians at 70% (*n* = 303) of ponds, 33% (*n* = 89) of other wetlands, and 4% (*n* = 5) of dry sites surveyed (Table 3-4). Most commonly detected were spotted frogs (47% of ponds), long-toed salamanders (36% of ponds) and Pacific tree frogs (*Pseudacris regilla*) (20% of ponds). The maximum number of species detected in one pond was 4. (Map 3-2). Playa Lake, WA was the most diverse and the only pond to host 4 species of breeding amphibians (spotted frogs, long-toed salamanders, tree frogs, and western toads). We detected 1 of 4 target SGCN amphibians. We provide evidence the 3 of the undetected species were either extirpated (leopard frog) or never occurred (wood frog and tiger salamander) in the Idaho and Washington portion of the study area. We occasionally detected rocky mountain tailed frogs (*Ascaphus montanus*) (*n* = 33 cells) and Idaho giant salamanders (*Dicamptodon aterrimus*) (*n* = 2 cells) at mostly non-pond survey sites (Map 3-12). Our results should not be considered a comprehensive survey for these 2 species.

Table 3-4. Detections by species and wetland type.

Species	# Detections (% of wetland type)							
	Ponds/Lakes (*n* = 433)		Other Wetlands (*n* = 270)		Dry (*n* = 123)		Total (*n* = 826)	
All Species	302	(70)	90	(33)	5	(4)	397	(48)
Wood Frog[a]	0		0		0		0	
Northern Leopard Frog[a]	0		0		0		0	
Western Toad[a]	22	(5)	3	(1)	0		25	(3)
Columbia Spotted Frog[a]	205	(47)	35	(13)	2	(2)	242	(29)
Pacific Tree Frog	88	(20)	12	(4)	2	(2)	102	(12)
Long-toed Salamander	158	(36)	10	(4)	0		168	(20)
American Bullfrog	23	(5)	2	(1)	0		25	(3)
Tiger Salamander[a]	0	(0)	0	(0)	0		0	(0)
Non-target species[b]	22	(5)	42	(16)	1	(1)	65	(8)
Total Detections	518		104		5		627	

[a] Species of Greatest Conservation Need

[b] Includes Rocky Mountain tailed frog[a], Idaho giant salamander[a] and unidentified species

We detected tree frogs consistently throughout the mountain ranges in our study area except the Coeur d'Alene Mountains where they were only found on the fringes (Map 3-8). This mirrors the pattern seen in marten and other mammals described in chapter 4. The IFWIS database does not contain records of tree frogs nor are we aware of pre-MBI amphibian surveys in the Idaho Coeur d'Alene Mountains as we define the range geographically (but see Beck et al. 1998 for close proximity surveys). However, tree frogs have been reported at locations immediately adjacent to the Idaho Coeur d'Alene's since 2009 (http://fieldguide.mt.gov, Accessed April 2, 2016). We currently lack the data necessary to determine if tree frogs were extirpated from the Idaho Coeur d'Alene’s or if they are not native to the mountain range.

Pacific tree frog (*Pseudacris regilla*) in the West Cabinet Mountains.

Left: Rocky mountain tailed frog (*Ascaphus montanus*)
Right: Idaho giant salamander (*Dicamptodon aterrimus*)

Temporal Surveys
In this section we define pond survey sites by elevation as low (<1,100 m) or high (>1,100 m). This criteria is based on timing of 2014 detected amphibian activity in temporal ponds (n = 7). We classified ponds as low elevation (n = 5) if amphibians were detected during both June visits. We classified ponds as high elevation (n = 2) when amphibians were not detected until the July 8-10 visit (Table 3-12).

Most tree frog detections occurred from June 1-June 29 indicating an early burst of breeding. BL tadpoles were detected at the higher elevation tree frog pond (48B) during the August 13 survey. This species was not detected at all at low elevation pond 1001 until NL tadpoles were detected during the September 3 survey. Long-toed salamanders were detected consistently at all three ponds where they occurred until the August 13 survey. They were detected in LEGS phase during the 3 September survey at the highest elevation salamander pond 48B. Bullfrogs were detected consistently across the survey period from June 1 to September 3 (Tables 3-5, 3-6, 3-7, and 3-11).

Long-toed salamander (*Ambystoma macrodactylum*)

Table 3-5. Amphibian life stages.

Code	Life Stage
EGG	egg
NL	no legs
BL	2 legs
LEGS	4 legs and a tail
AJ	fully formed

Table 3-6. Reliable breeding detection dates of pond amphibians at low (< 1,100 m) and high (> 1,100 m) elevation sites between June 1-September 25, 2014.

Western Toad < 1100 m	1 June-13 August
Western Toad > 1100 m	9 July-3 September
Spotted Frog < 1100 m	17 June-13 August
Spotted Frog >1100 m	29 July-3 September
Long-Toed Salamander	1 June-13 August
Tree Frog <1000 m	1 June-29 July
Tree Frog > 1000 m	1 June-29 July
Bullfrog	1 June-3 September

Western toads and spotted frogs were detected at low elevation sites from June 1 to August 13 and dispersed between August 13 and September 3. These species were not detected at high elevation sites until the July 9 survey. Spotted frogs were not detected at high elevation sites during the September 25 survey and western toads appeared ready to disperse (indicated by masses of near completely metamorphosed toadlets) by the September 25 survey. Although breeding was delayed by about 4 weeks at higher elevations, spotted frogs at both low and high elevation sites completed their life cycle in approximately 10 weeks. This suggests the spotted frog breeding cycle occurs later at higher elevations but is not shortened. However, western toad breeding at high elevation sites was delayed by approximately 6 weeks and life cycles appeared to be shortened at high elevations being completed in 8 weeks, which is 2 weeks shorter than their lower elevation western toad counterparts (Table 3-14).

Western toad (*Anaxyrus boreas*) eggs, tadpoles, and toadlet. Temporal surveys tracked amphibian development at 7 ponds for the 2014 breeding season.

Our temporal surveys generally mirrored patterns we saw in the larger dataset and July 9-July 29 was the portion of the season in which we detected all species across all elevations. This window would be the most productive to conduct multi-species surveys across elevational gradients. However, our approach of beginning with low elevation surveys in early June, surveying higher elevations in early July (or when snow melt allows access), and finishing surveys by early September also appears to have been effective. For landscape scale multi-species pond breeding amphibian surveys in our study area we recommend completing low elevation surveys during June and July and high elevation surveys between mid-July and early September.

Table 3-7. Developmental stage (see Table 3-5 for abbreviations) of amphibians detected at temporal wetlands. Dates are accurate within 1 day. Actual survey dates occurred +/- 1 day indicated in this table.

	1-Jun	17-Jun	9-Jul	29-Jul	13-Aug	3-Sep	25-Sep
Western Toad							
WT EGG	■						
WT NL		■	■	■			
WT BL				■	■	■	
WT LEGS				■	■	■	
WT AJ	■		■		■	■	■
Spotted Frog							
SF EGG							
SF NL		■	■	■			
SF BL			■	■	■	■	
SF LEGS			■		■	■	■
SF AJ	■	■	■	■	■	■	■
Long-toed Salamander							
LTS EGG	■	■	■				
LTS NL	■	■					
LTS BL			■				
LTS LEGS	■	■	■	■	■	■	
LTS AJ	■						
Pacific Tree Frog							
TREE EGG	■						
TREE NL	■	■	■		■		
TREE BL		■	■	■	■		
TREE LEGS			■				
TREE AJ	■		■				
Bull Frog							
BF EGG			■				
BF NL	■						
BF BL	■	■					
BF LEGS			■	■	■		
BF AJ	■		■	■	■	■	

Beginning surveys in June does have the drawback of missing the early and probably biggest breeding period of tree frogs from April-May. However, we consistently detected larval stages of this species throughout June. Additionally, conducting surveys in June rather than April-May allows for the collection of tree frog tadpoles which are much easier to identify than the eggs which would be detected more often in the April-May window. Tree frog detections occurred less frequently as the summer progressed and our late season surveys were less likely to detect tree frogs. Nevertheless, we detected larvae in various stages of development for most of the summer and early NL tadpoles as late as mid-August. The early burst of tree frog breeding is followed by production of occasional egg clutches throughout the summer.

Columbia spotted frog (*Rana luteiventris*)

Wood Frogs (Map 3-11)

The potential occurrence of wood frogs in northern Idaho has been a curiosity for naturalists and natural resource professionals since Dumas (1955) first reported the capture of a single specimen in 1955. Nearly 6 decades later we were funded to determine the status of this species under the guidance of the I-SWAP. Through a combination of visiting historic observation sites, examining museum specimens, reviewing published literature, and conducting extensive field surveys we conclude wood frogs are not native to, and were never extant in, northern Idaho or northeastern Washington and historic records are erroneous. We support this conclusion as follows:

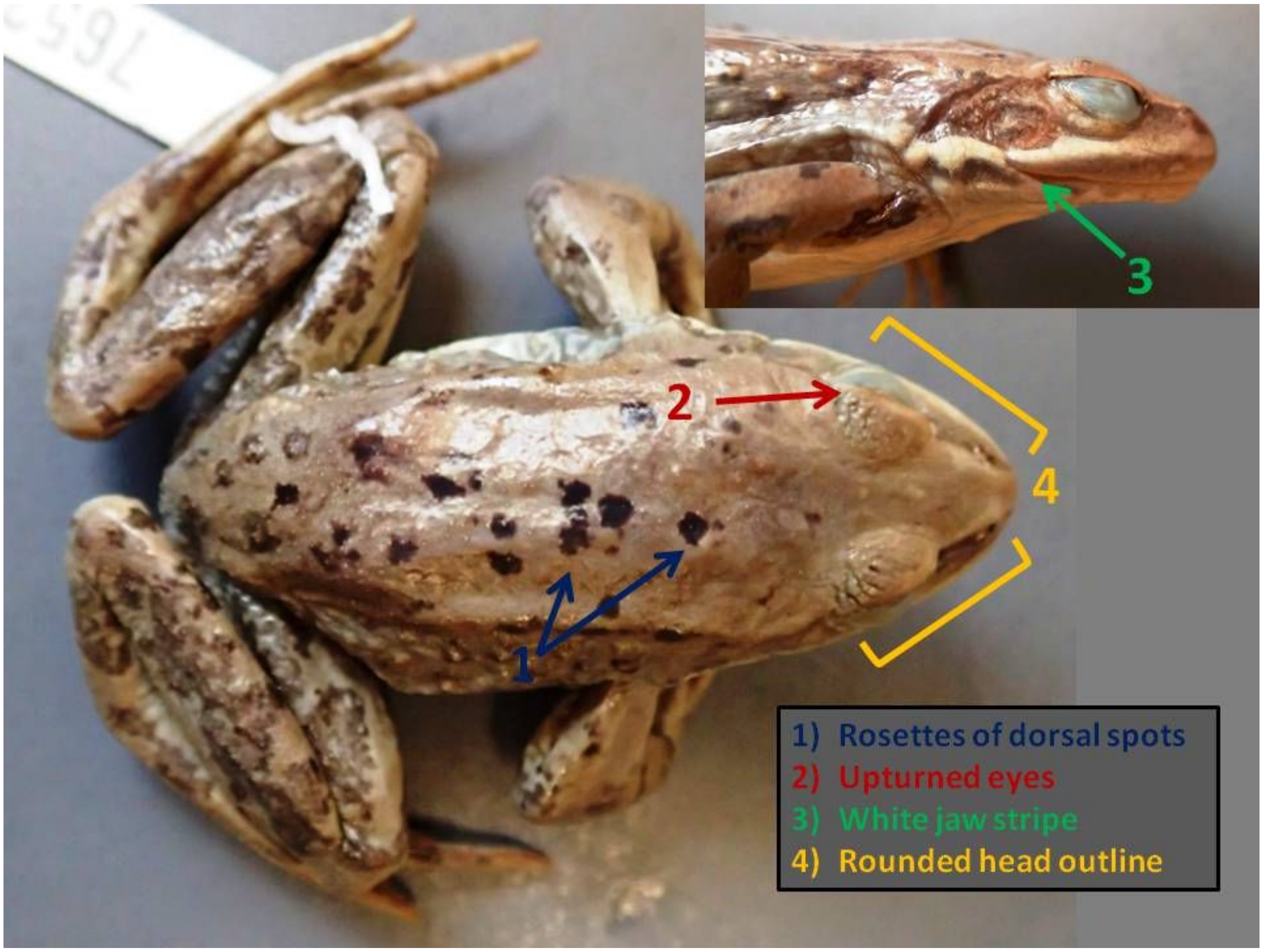

Figure 3-1. Museum specimen LACM76527 with characters used to re-classify it from *R. sylvatica* to *R. luteiventris*.

Genetic analysis revealed the 1 specimen our field crew morphologically identified as wood frog was actually a tree frog. This is not surprising as observers inexperienced with wood frogs commonly make this mistake in northern Idaho.

The 4 IFWIS wood frog records indicated specimens had been curated at the Los Angeles County (LACM) and University of Idaho Museums (UIM). We queried both collection databases and found records of 3 additional specimens at LACM for a total of 7 historic wood frog observations in the state of Idaho from 1955, 1956, and 1970. The sample archived at UIM had been lost and one observation did not have a corresponding museum record. The 5 remaining specimens were archived at LACM. We obtained all 5 LACM specimens. Dr. David Green (McGill University) examined the specimens and classified each as *R. luteiventris* based on the following characters: 1) rosettes of dorsal spots, 2) upturned eyes, 3) white jaw stripe, and 4) rounded head outline (Corkran and Thoms 1996, Dr. David Green, personal communication) (Figure 3-1).

Dumas (1957) reported collecting 2 female wood frog specimens from the northern Idaho Panhandle in 1955 and 1956. The 1956 specimen was collected from, "a small pond by the Kootenai River approximately one mile west of Bonners Ferry, Boundary County, Idaho.".

Dumas provides no more detail in his report other than, "pattern and coloration were typical of the species [wood frog]". The specimen was archived at the UIM and subsequently misplaced. Therefore, it was not available for examination.

The 1955 Dumas specimen was collected 2 miles east of Coolin, Idaho and, to our knowledge, not archived in a museum. However, Dumas does provide more character details describing it as intermediate in character between *R. sylvatica* and *R. pretiosa* (*R. pretiosa* is now classified *R. luteiventris*). He describes the "undersides of the hind legs and toes and the lateral margins of the abdominal region" as orange-pink. This orange-pink ventral coloration would be inconsistent with *R. sylvatica* classification but is a character of mature *R. luteiventris* (Corkran and Thoms 1996).

The only other Idaho *R. sylvatica* records are from July 6 and 8, 1970. Because we examined these specimens and determined they represent *R. luteiventris*, we are left with only Dumas's (1957) 2 records as potential markers of this species' historic occurrence in Idaho.

If wood frogs were a native Idaho species, they would exist disjunctly from the majority of their conspecifics within their vast North American range (Muths et al. 2005). This is not unusual for this species as disjunct populations are thought to occur in Oklahoma, Missouri, and Arkansas (Muths et al. 2005). Regardless, the only occurrence record we cannot definitively dispute is Dumas (1955) for which he provides no description of identifying characters. We do not believe this single record provides adequate evidence that this species ever occurred naturally within the political bounds of the state of Idaho or northeastern Washington east of the Pend Oreille River. We conclude wood frogs are not native to Idaho or northeastern Washington east of the Pend Oreille River.

Northern Leopard Frogs (Map 3-7)

We conclude northern Leopard frogs are native to at least the northern portion of our study area and were likely extirpated from the Idaho and northeastern Washington portions of the study area. We support this conclusion as follows:

We found 11 historic records of *R. pipiens* in our study area in addition to the 6 IFWIS records for a total of 17 historic records in the study area from 1892-1955. Specimens were available for 15 of the observations. We examined the 15 specimens identified each as *R. pipiens* based on the following characters: 1) light dorsolateral folds, 2) smooth dark oval dorsal patches, and 3) long legs (lower leg >1/2 snout to vent length) (Corkran and Thoms 1996) (Figure 3-2).

Confirmed leopard frog detections occurred sporadically in the Idaho Panhandle from the late 1800s to 1955. Historic northern Idaho occurrence records spanned from near the Canadian border south to Lake Cocolalla. These confirmed records indicate *R. pipiens* is a native species which occurred, at a minimum, in the northern portion of our Idaho study area. We did not detect this species during our extensive Idaho and Washington surveys. Because 60 years have passed since the last confirmed leopard frog detection, we conclude this species is likely extirpated from the Idaho and Washington portions of the study area.

MBI surveys detected breeding populations of non-native bullfrogs within 16 km of the CWMA, where bullfrogs are not currently known to be extant. The potential northward expansion of bullfrogs may pose an additional threat to the native leopard frog colony. A collaborative trans-boundary working group was formed which will be important in addressing bullfrog expansion issues and facilitating potential leopard frog re-colonization of northern Idaho.

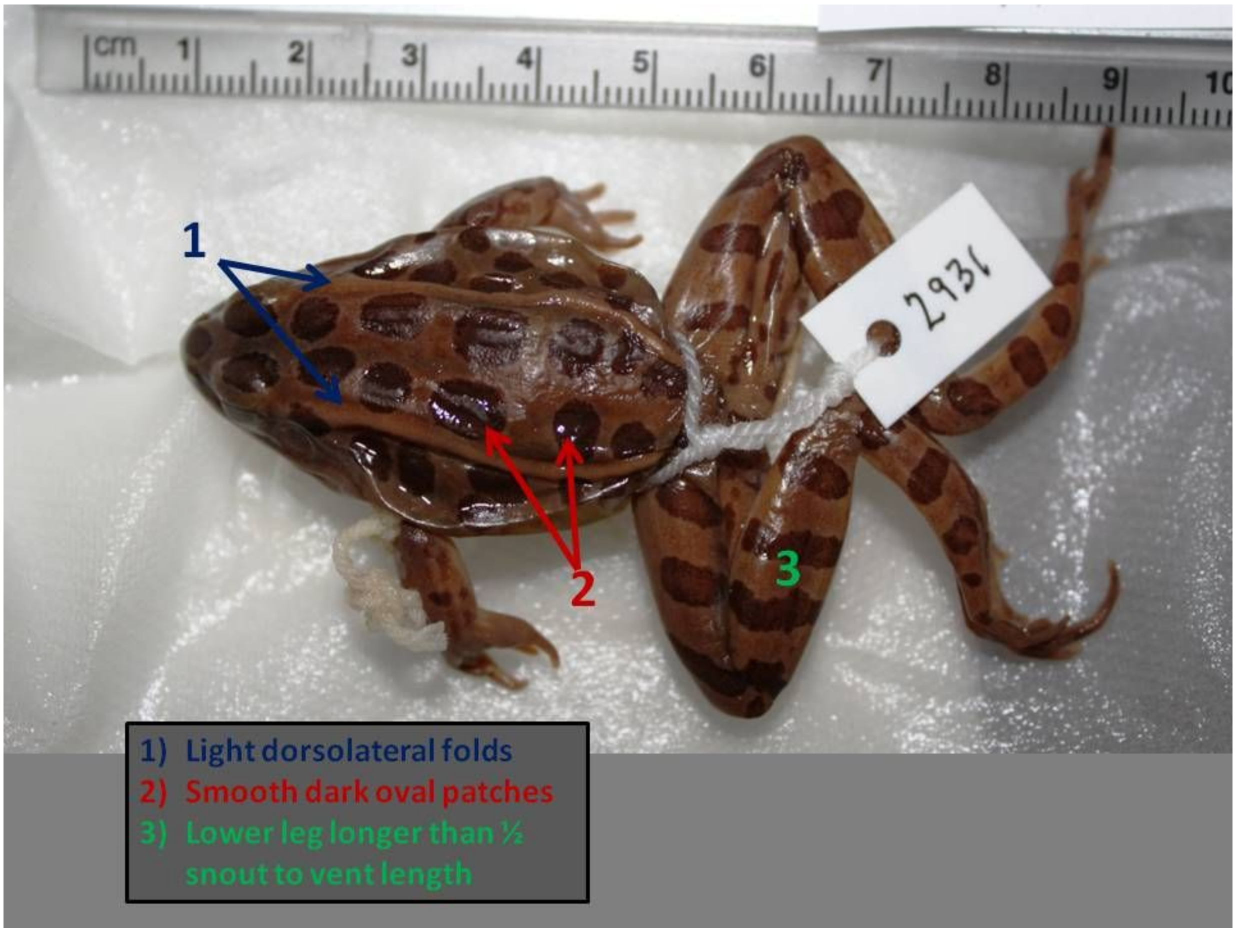

Figure 3-2. Museum specimen PSM2931 with characters used to confirm museum classification of *R. pipiens*.

Western Toads (Map 3-6)

We detected western toad breeding activity at 62% (n = 16) of the 26 sites where we detected toads. Toad detections occurred primarily north of Interstate-90 with a majority of detections in the Selkirks (Map 3-6). Toads were not detected in the Coeur d'Alene Mts. and were only detected at 1 location in the Saint Joe Mts.

The Sullivan Lab at University of Idaho successfully generated sequences from 47 individual toads representing 17 survey sites. MBI sequences formed 7 groupings within the Goebel et al. (2009) Northwest Clade (Fig. 3-3). The Goebel et al. (2009) northwest coastal and central sub-clades formed independent clades in our analysis. However, Goebel et al. (2009) middle rocky mountain and northern sub-clades were not supported by our analysis. The 7 MBI sub-clades were well distributed across the study area.

Western toads do not breed exclusively in ponds. They breed in many small bodies of water such as puddles or ruts in roads and can experience reproductive bursts after disturbance events (Dr. Chuck Peterson, personal communication). Although we targeted ponds for inventory, we did survey a substantial number of other wetland types, and we expected to find toads to be more numerous in the southern portion of the study area. Our survey protocol, that focuses only on the edges of ponds, may have resulted in fewer detections. For example, the wet meadows near W1247 (Copper Lake, ID) are a major toad breeding site. The observer followed the protocol to survey the shore of the pond but did not explore the nearby wetlands. Therefore, breeding activity was not detected, although a single adult toad was documented. This suggests we may have missed breeding activity at sites where we detected only fully formed toads.

Western toad (*Anaxyrus boreas*)

Our geographical sampling was less broad continentally but more intense locally than Goebel et al. (2009). DNA sequences from our study area fell within the Northwest clade and support toads in our study area being considered part of the Northwest clade (Goebel et al. 2009). We found less support for the sub-clades identified by Goebel et al. (2009). The middle rocky mountain

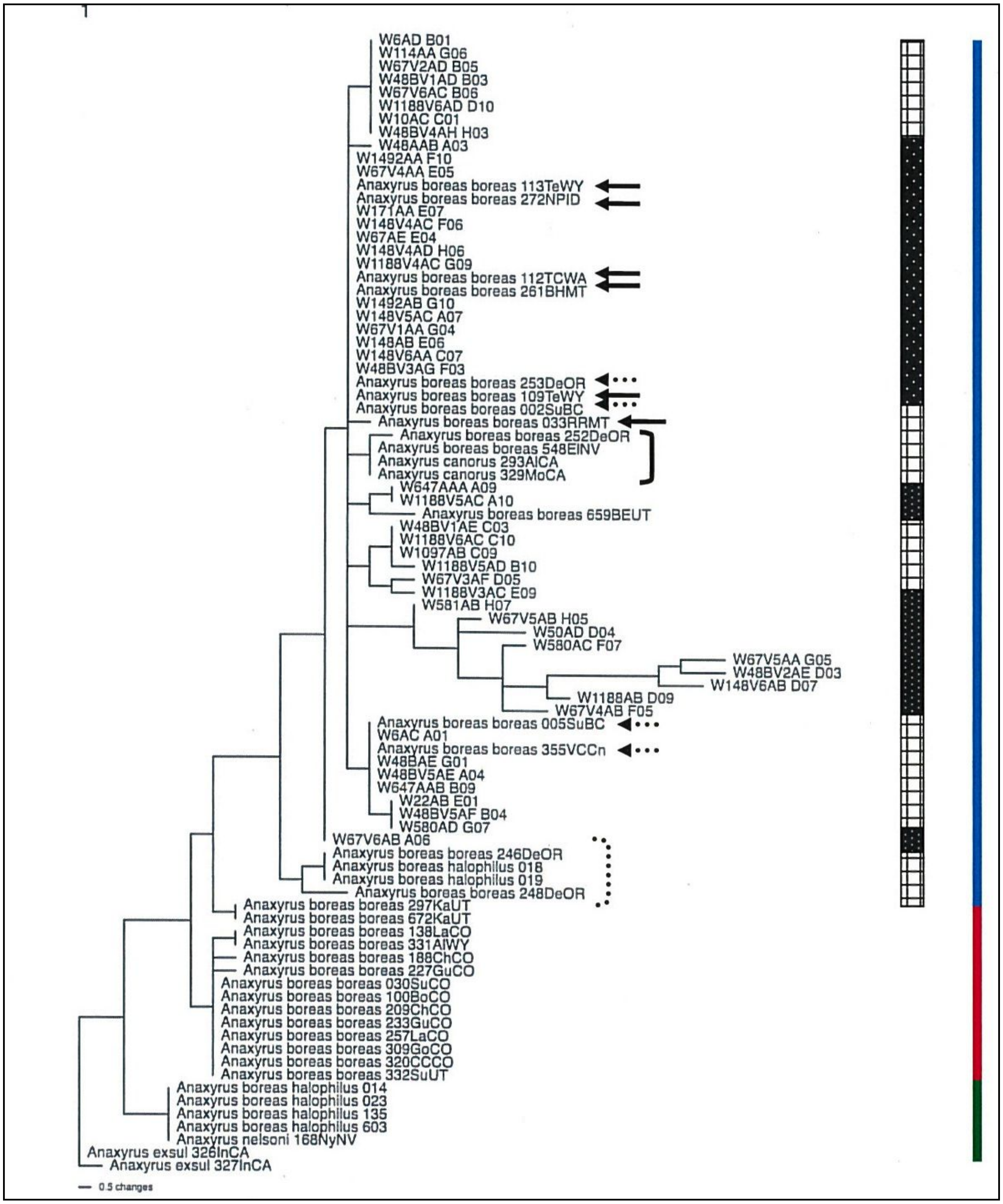

Figure 3-3. Neighbor-joining tree showing relationship of MBI toad tissues (sample name starts with W) with Goebel et al. (2009) toad samples (sample name starts with *Anaxyrus*). Black and white bar indicates MBI sub-clades. Colored bar indicates Northwest (blue), East (red), and Southwest (green) clades identified by Goebel et al. (2009). Arrows and brackets indicate Goebel et al. (2009) Northwest sub-clades: Middle Rocky Mountains (solid arrow), Central (solid bracket), Northern (dashed arrow), and Coastal (dashed bracket).

and northern sub-clade sequences showed no independence from our MBI sequences. Although the central clade did form an independent clade, it showed little independence from the MBI sequences. The coastal clade did show independence from MBI samples (Figure 3-3).

We found no evidence of genetic structure of toad populations within our study area. This is supported by our clades being well distributed across the study area and mountain ranges. The one toad population we found in the Saint Joe Mountains (W1492), which was separated from all other samples by a dearth of toad detections in the Coeur d'Alene's, phylogenetically groups with toads from the Selkirks and Cabinets. The one Cabinet population we detected is well represented among 5 of our 7 sub-clades. This suggests two possibilities: 1) We did not detect toads which were present between the southern and northern portions of our study area or 2) there has been a recent decline in toad populations in the central and southern portion of our study area.

Regardless, all toads examined in our study area appear to be appropriately assigned to *A. boreus* and show no evidence of distinct evolutionary lineages to be prioritized for conservation.

Tiger Salamanders (Map 3-5)
Our field crews identified 9 tiger salamander specimens from 5 sites. However, genetic analyses confirmed each of the 9 specimens were long-toed salamanders. We are aware of two historic records of this species in our study area. Dr. Gordon D. Alcorn was reported to have taken several 7-8 inch larvae from Lake Chatcolet, Idaho on April 19, 1936 (Slater 1937). To our knowledge these specimens were not archived in a museum. Based on this record and reports from other areas in Idaho, Slater and Brown (1941) postulated the species occurred statewide. D. Gayman was reported to have collected one specimen from Black Lake, ID on July 4, 1966 (IFWIS, accessed April 3, 2016). We were unable to locate the D. Gayman specimen which was purportedly submitted to a museum at the University of Idaho. Adjacent to our study area, tiger salamanders have historically been reported from Medical Lake, WA and Colville, WA (Slevin 1928). Based on the lack of unverifiable historic specimens and our non-detection of this species we conclude this species is likely not native to our study area.

Potential Threats to Native Amphibians (BD, Bullfrogs, and Fish) (Maps 3-3, 3-9, 3-13)
We detected BD on spotted frogs at 80% (n = 123) of 153 wetlands sampled. Of the 399 spotted frogs tested, 65% (n = 261) tested positive, 29% (n = 115) negative, and 6% (n = 23) equivocal. The median zoospore count was 1.3 ranging from 0.03 to 5023. BD is well distributed across the landscape and was detected more frequently later in the survey season. BD was detected less frequently at mid-elevation sites than low or high elevation sites (Map 3-3, Appendix III-b).

Western toads and bullfrogs were detected more often in ponds with fish than without. Spotted frogs, tree frogs, and long-toed salamanders were detected more often in ponds without fish (Table 3-8). Comprehensive fish surveys were not conducted; observers simply noted any fish observations during the course of the survey. Therefore, fish likely occurred at some sites where they were not detected.

Table 3-8. Amphibian detections in ponds with and without opportunistic fish detections.

Species	All Pond/Lakes Surveyed	Ponds with fish detected (n=93)	Ponds with no fish detected (n=310)
	# Detections		
All Species	302	48	233
Western Toad	22	8 (9%)	12 (4%)
Columbia Spotted Frog	205	36 (39%)	147 (47%)
Pacific Tree Frog	88	10 (11%)	77 (25%)
Long-toed Salamander	158	9 (10%)	139 (45%)
American Bullfrog	23	7 (8%)	16 (5%)

BD was well distributed across the study area occurring at a majority of sites and on a majority of frogs at very low intensities (Map 3-3, Appendix III-b). The patterns we found are similar to Goldberg et al. (*In Prep*) who tested spotted frogs for BD in a study area which overlapped the southern portion of the MBI study area. The zoospore levels we detected were very low-intensity and generally too low to be likely to cause deformities (Allan Pessier, personal communication). Climate change is expected to alter conditions favorably for BD while at the same time improving conditions for bullfrogs (Goldberg et al. *In Prep*) which are known to be resistant carriers of the fungus. Monitoring programs should continue over time to assess the status of BD and the distribution of bullfrog populations in the study area.

American bullfrog (*Rana catesbeianus*)

Conclusions

Our wetland surveys represent the first comprehensive inventory of pond breeding amphibians in the Idaho Panhandle and adjoining mountain ranges. This baseline inventory sets the stage for long term monitoring which is needed to assess changes in species abundance and distribution over time.

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Tables and Maps

Table 3-9. Wetland surveys by survey and wetland type.

Wetland Type	Survey Type									
	Full Perimeter		100-meter		500-meter		30-minute Timed Search		Total Survey	
	#	(%)	#	(%)	#	(%)	#	(%)	#	(%)
Pond/Lake[a]	187	(23)	35	(4)	2	(0)	20	(2)	244	(30)
Natural Pond/Lake	24	(3)			1	(0)			25	(3)
Ephemeral Natural Pond	5	(1)							5	(1)
Modified Natural Pond	6	(1)			1	(0)			7	(1)
Constructed Pond	65	(8)			2	(0)			67	(8)
Beaver Pond	5	(1)							5	(1)
Puddles	4	(0)					20	(2)	24	(3)
Emergent Wetland	32	(4)					38	(5)	70	(8)
Channels near Stream	11	(1)	1	(0)			38	(5)	50	(6)
Stream	1	(0)	16	(2)			190	(23)	207	(25)
Meadow	10	(1)	1	(0)			34	(4)	45	(5)
Dry-No wetland	1	(0)					70	(8)	71	(9)
Other[b]	3	(0)	1	(0)			2	(0)	6	(1)
Total	**354**	(43)	**54**	(7)	**6**	(1)	**412**	(50)	**826**	

[a] Category could include natural, ephemeral, modified, and constructed ponds. Used primarily in 2013.

[b] Includes rivers, vernal pools, road ditches, forested wetlands, and springs

Table 3-10. Western toad detections by wetland site. Temporal sites were surveyed once in 2013 and repeatedly in 2014.

Wetland ID	Survey Date	Breeding Detected?	Abundance**	Latitude	Longitude
W6	08/19/13	No	10	48.6670	-117.271367
W10	08/08/13	Yes	1000	48.8378	-117.260317
W22	07/02/13	No	2	48.3094	-117.095367
W35	07/25/14	No	2	48.9130	-117.16507
W48A	08/30/13	Yes	300	48.7425	-117.06126
W48B	Temporal	Yes	2000	48.7741	-117.04978
W50	07/12/14	Yes	100	48.8341	-117.04068
W580	07/25/13	Yes	4	48.3937	-117.17862
W581	06/27/13	Yes	100	48.4412	-117.20027
W67	Temporal	Yes	1600	48.8779	-117.00529
W76	07/18/13	No	2	48.5630	-116.94733
W96	07/21/13	Yes	1000	48.9293	-116.84659
W109	08/13/13	Yes	3	48.7791	-116.77924
W114	07/05/13	No	2	48.9968	-116.82925
W121	08/15/13	Yes	2	48.5705	-116.72315
W148	Temporal	Yes	600	48.6597	-116.59933
W171	08/10/13	No	2	48.8316	-116.43779
W645	06/15/14	Yes	1000	***47.6795**	**-117.02486**
W647A	06/13/14	No	4	**47.7892**	**-116.97322**
W731	06/04/14	No	3	47.9824	-116.89313
W964	06/18/13	Yes	100	48.2373	-116.49515
W1057	Temporal	No	2	48.9036	-116.38901
W1097	06/22/13	Yes	2	48.5709	-116.32872
W1188	Temporal	Yes	400	48.3778	-116.13695
W1247	08/08/13	No	2	48.9938	-116.10632
W1492	08/22/13	Yes	100	47.2369	-115.63681

* **Bold** locations are fuzzed within 500 meters. All other locations are precise.

**If >10, abundance indicates an estimate in the 10s, 100s, or 1000s.

Table 3-11. Bullfrog detections by wetland site. Temporal sites were surveyed once in 2013 and repeatedly in 2014.

Wetland ID	Survey Date	Breeding Detected?	Abundance**	Latitude	Longitude
W156	7/2/2014	Yes	20	***48.4948**	**-116.47588**
W645	6/15/2014	Yes	10	**47.6795**	**-117.02486**
W652	6/3/2014	No	20	**48.0063**	**-116.99474**
W653	6/3/2014	No	5	**48.0333**	**-117.02763**
W656	6/13/2013	Yes	40	48.1740	-117.01009
W657	7/1/2014	Yes	4	**48.1955**	**-117.03132**
W691	7/11/2014	Yes	70	**47.9948**	**-116.98153**
W711	7/15/2014	Yes	50	**47.1016**	**-116.85449**
W802	6/16/2013	Yes	6	47.4789	-116.73676
W814	8/20/2013	No	2	**48.0045**	**-116.72745**
W838	8/14/2013	No	15	47.3375	-116.61890
W839	8/20/2013	Yes	10	47.3558	-116.68524
W854	8/24/2013	No	6	**48.0542**	**-116.70102**
W856	6/3/2014	No	1	**48.1397**	**-116.71170**
W908	7/25/2014	No	4	**47.2940**	**-116.53454**
W909	6/28/2014	No	5	**47.3295**	**-116.49332**
W930	Temporal	Yes	200	48.2916	-116.55319
W931A	6/4/2014	Yes	600	**48.3028**	**-116.56934**
W968	6/13/2014	Yes	10	**48.4169**	**-116.51068**
W1001	Temporal	Yes	100	48.3015	-116.42539
W1005	7/1/2014	No	1	**48.4698**	**-116.46614**
W1043	6/29/2014	No	2	**48.2793**	**-116.37933**
W1044	6/18/2013	Yes	8	48.3322	-116.38375
W1057	Temporal	Yes	2000	**48.8989**	**-116.38508**
W1147	6/14/2014	Yes	2	**48.6183**	**-116.36089**

* Bold locations are fuzzed within 500 meters. All other locations are precise.

**If >10, abundance indicates an estimate in the 10s, 100s, or 1000s.

Table 3-12. Detections of amphibians by life stage [EGG (eggs), NL (no legs), BL (beginning legs), LEGS (4 legs and tail), AJ (fully formed adult or juvenile)] during 2014 temporal wetland surveys Dates are within 1 day of actual survey date.

Wetland ID	Elevation	1-Jun	17-Jun	9-Jul	29-Jul	13-Aug	3-Sep	25-Sep
Western Toad								
W1057	538	0	0	0	0	0	0	~
W1001	630	0	0	0	0	0	0	~
W930	643	0	0	0	0	0	0	~
W67	899	EGG/AJ	NL	NL	BL	LEGS/AJ	AJ	AJ
W48B	1070	EGG	NL	NL	NL	BL/LEGS	0	~
W148	1711	0	0	AJ	NL	BL/LEGS	BL	0
W1188	1763	0	0	AJ	NL AJ	BL/LEGS	BL/LEGS	0
Tree Frog								
W1057	538	0	BL	LEGS/AJ	0	0	0	~
W1001	630	0	0	0	0	0	NL	~
W930	643	NL	NL/BL	NL/BL/LEGS	BL	0	0	~
W67	899	EGG AJ	0	NL	0	0	0	~
W48B	1070	EGG	0	NL	BL	BL	0	~
W148	1711	0	0	0	0	0	0	0
W1188	1763	0	0	0	0	0	0	0
Bullfrog								
W1057	538	AJ	0	EGG/AJ	AJ	AJ	AJ	~
W1001	630	NL/BL	BL	LEGS/AJ	AJ	LEGS/AJ	0	~
W930	643	NL/AJ	BL	AJ	LEGS/AJ	LEGS/AJ	AJ	~
W67	899	0	0	0	0	0	0	~
W48B	1070	0	0	0	0	0	0	~
W148	1711	0	0	0	0	0	0	0
W1188	1763	0	0	0	0	0	0	0
Spotted Frog								
W1057	538	AJ	0	LEGS	0	AJ	AJ	~
W1001	630	0	0	0	0	0	0	~
W930	643	0	0	0	0	0	0	~
W67	899	0	0	0	0	0	AJ	AJ
W48B	1070	AJ	NL/AJ	NL/BL/LEGS	BL/AJ	BL/LEGS/AJ	AJ	0
W148	1711	0	0	AJ	NL/AJ	BL/AJ	AJ	0
W1188	1763	0	0	AJ	NL/AJ	BL/AJ	BL/LEGS/AJ	LEGS
Long-toed Salamander								
W1057	538	0	0	0	0	0	0	~
W1001	630	0	0	0	0	0	0	~
W930	643	LEGS	LEGS	LEGS	LEGS	LEGS	0	~
W67	899	EGG/NL	LEGS	LEGS	LEGS	LEGS	0	~
W48B	1070	EGG/NL/AJ	EGG/NL	EGG/BL	LEGS	LEGS	LEGS	~
W148	1711	0	0	0	0	0	0	0
W1188	1763	0	0	0	0	0	0	0

Table 3-13. Historic records of wood frog and northern leopard frog from the Idaho portion of the MBI study area.

IFWIS #	Museum #	Museum	Specimen Status	Database Spp.	MBI Spp.	Identifier	Life Stage	Field ID	MBI ID	Field Observer	Latitude	Longitude	Reference
81925	LACM76527	LAC	Photographed	*R. sylvatica*	*R. luteiventris*	Green, D.	Adult	6-Jul-70	12-Mar-15	Howell, D.B.	48.63477	-116.99098	Peterson 1999
NA	LACM76528	LAC	Photographed	*R. sylvatica*	*R. luteiventris*	Green, D.	Juvenile	6-Jul-70	12-Mar-15	Howell, D.B.	48.63477	-116.99098	www.portal.vertnet.org
NA	LACM76529	LAC	Photographed	*R. sylvatica*	*R. luteiventris*	Green, D.	Adult	6-Jul-70	12-Mar-15	Howell, D.B.	48.63477	-116.99098	www.portal.vertnet.org
81924	LACM76532	LAC	Photographed	*R. sylvatica*	*R. luteiventris*	Green, D.	Juvenile	8-Jul-70	12-Mar-15	Howell, D.B.	48.64013	-116.87786	Peterson 1999
NA	LACM76533	LAC	Photographed	*R. sylvatica*	*R. luteiventris*	Green, D.	Juvenile	8-Jul-70	12-Mar-15	Howell, D.B.	48.64013	-116.87786	www.portal.vertnet.org
81922	UIM246	UI	Lost	*R. sylvatica*	NA	NA	NA	14-Apr-56	12-Mar-15	Dumas, P.C.	48.69287	-116.33095	Dumas 1957
81923	NA	NA	NA	*R. sylvatica*	NA	NA	NA	2-Aug-55	12-Mar-15	Dumas, P.C.	48.49244	-116.90220	Dumas 1957
82269	CRCM48-25	CRCM	Photographed	*R. pipens*	*R. pipens*	DN[b]	Adult	30-Jul-47	8-Feb-14	Jones, G.	48.13921	-116.17637	Peterson 2000
82266	USNM39706	SNMNH	Not Verified	*R. pipens*	NA	NA	NA	1-Jul-1896	NA	Unknown	48.25113	-116.31445	Peterson 2001
82264	USNM20922	SNMNH	Not Verified	*R. pipens*	NA	NA	NA	20-Sep-1892	NA	Unknown	48.29212	-116.55162	Peterson 2002
82268	PSM2931	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	11-Sep-39	8-Feb-14	Slater, J.R.	48.32579	-116.49292	Peterson 2003
82273	PSM2924	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	11-Sep-39	8-Feb-14	Slater, J.R.	48.91255	-116.44860	Peterson 2004
82273	PSM2927	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	11-Sep-39	8-Feb-14	Slater, J.R.	48.91255	-116.44860	Peterson 2005
82270	NA	NA	NA	*R. pipens*	*NA*	NA	Larva[a]	17-Jun-55	NA	Keating, J.	48.10842	-116.62265	Peterson 2006
NA	PSM2931	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	11-Sep-39	8-Feb-14	Slater, J.R.	48.32780	-116.47660	www.portal.vertnet.org
NA	PSM2932	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	11-Sep-39	8-Feb-14	Slater, J.R.	48.32780	-116.47660	www.portal.vertnet.org
NA	PSM10775	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	11-Sep-39	8-Feb-14	Slipp, J.W.	48.85917	-116.33526	www.portal.vertnet.org
NA	PSM10770	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	19-Aug-39	8-Feb-14	Slipp, J.W.	48.35550	-116.48195	www.portal.vertnet.org
NA	PSM10767	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	19-Aug-39	8-Feb-14	Slipp, J.W.	48.18326	-116.26907	www.portal.vertnet.org
NA	PSM10773	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	11-Sep-39	8-Feb-14	Slipp, J.W.	48.95035	-116.58417	www.portal.vertnet.org
NA	PSM10769	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	19-Aug-39	8-Feb-14	Slipp, J.W.	48.35550	-116.48195	www.portal.vertnet.org
NA	PSM10771	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	19-Aug-39	8-Feb-14	Slipp, J.W.	48.35550	-116.48195	www.portal.vertnet.org
NA	PSM10772	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	19-Aug-39	8-Feb-14	Slipp, J.W.	48.35550	-116.48195	www.portal.vertnet.org
NA	PSM10774	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Juvenile	11-Sep-39	8-Feb-14	Slipp, J.W.	48.85917	-116.33526	www.portal.vertnet.org
NA	PSM10768	SMNH	Photographed	*R. pipens*	*R. pipens*	DN	Adult	19-Aug-39	8-Feb-14	Slipp, J.W.	48.35550	-116.48195	www.portal.vertnet.org

[a] Life stage not confirmed by MBI

[b]DeLima A., Neider J.

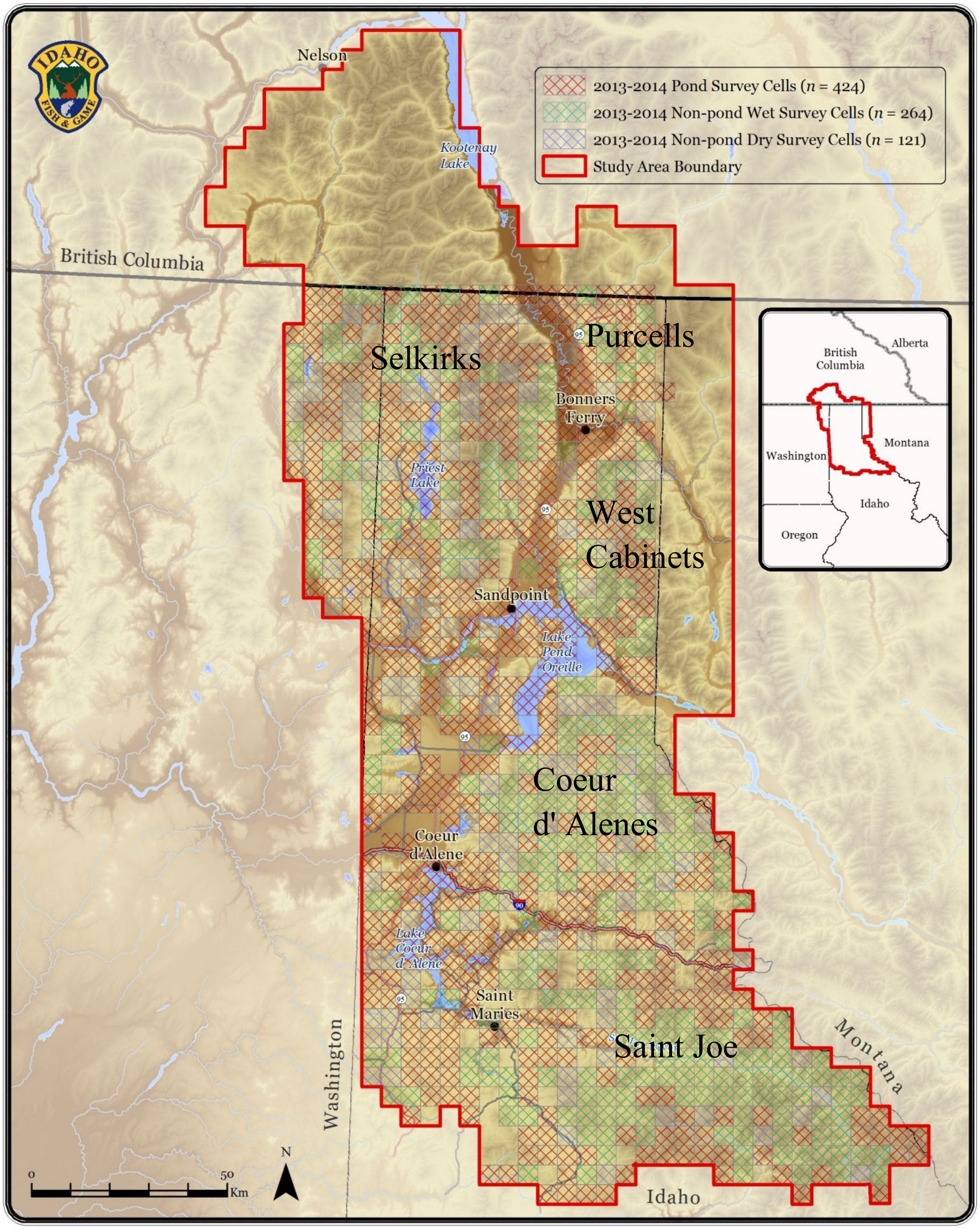
LAC: LA County Museum, UI: University of Idaho Museum, CRCM: Charles R. Conner Museum, SNMNH: Smithsonian National Museum of Natural History, SMNH: Slater Museum of Natural History

Table 3-14. Development of western toads (WT) and spotted frogs (SF) at high and low temporal wetlands. Development stages: EGG (eggs), NL (no logs), BL (beginning legs), LEGS (4 legs and tail), D (animals not detected or in process of dispersing when surveyed). Dates are accurate within 1 day.

	1-Jun	17-Jun	9-Jul	29-Jul	13-Aug	3-Sep	25-Sep
WT <1,100m	EGG	NL	NL	BL/LEGS	LEGS	D	
WT >1,100m			AJ	NL	BL	BL/LEGS	D
SF <1,100m	ADULTS	NL	NL/BL	BL	BL/LEGS	D	
SF >1,100m			AJ	NL	BL	BL/LEGS	LEGS/JUVYS
W67 (899m)							
WT EGG	1000s	0	0	0	0	0	0
WT NL	0	100s	30s	0	0	0	0
WT BL	0	0	0	1000s	0	0	0
WT LEGS	0	0	0	0	3000s	0	0
WT AJ	2	0	0	0	0	2	1
SF EGG	0	0	0	0	0	0	0
SF NL	0	0	0	0	0	0	0
SF BL	0	0	0	0	0	0	0
SF LEGS	0	0	0	0	0	0	0
SF AJ	0	0	0	0	0	1	1
W48B (1,070m)							
WT EGG	1000s	0	0	0	0	0	~
WT NL	0	2000s	1	1000s	0	0	~
WT BL	0	0	0	0	1000s	0	~
WT LEGS	0	0	0	0	100s	0	~
WT AJ	0	0	0	0	0	0	~
SF EGG	0	0	0	0	0	0	0
SF NL	0	5	30s	0	0	0	0
SF BL	0	0	30s	70s	9	0	0
SF LEGS	0	0	0	0	10s	0	0
SF AJ	8	50s	10s	8	7	1	0
W148 (1,711m)							
WT EGG	0	0	0	0	0	0	0
WT NL	0	0	0	200s	0	0	0
WT BL	0	0	0	0	500s	50s	0
WT LEGS	0	0	0	0	0	0	0
WT AJ	0	0	3	0	0	0	0
SF EGG	0	0	0	0	0	0	0
SF NL	0	0	0	1	0	0	0
SF BL	0	0	0	0	1	0	0

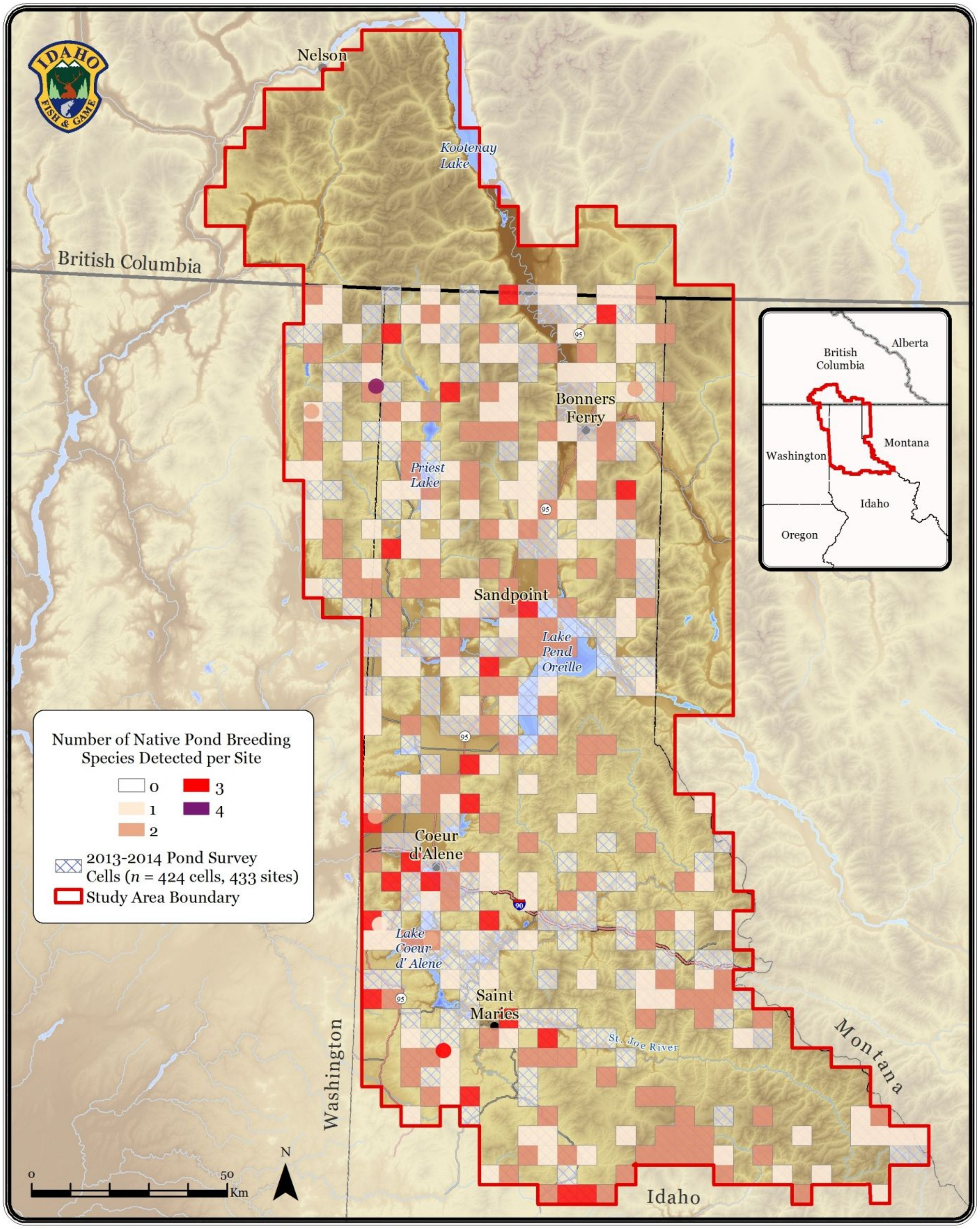
SF LEGS	0	0	0	0	0	0	0
SF AJ	0	0	4	4	3	1	0
W1188 (1,763m)							
WT EGG	0	0	0	0	0	0	0
WT NL	0	0	0	200s	0	0	0
WT BL	0	0	0	0	100s	50s	0
WT LEGS	0	0	0	0	0	20s	0
WT AJ	0	0	10	1	0	0	0
SF EGG	0	0	0	0	0	0	0
SF NL	0	0	0	60s	0	0	0
SF BL	0	0	0	0	60s	10s	0
SF LEGS	0	0	0	0	0	3	8
SF AJ	0	0	10s	10s	6	10s	10s

Multi-species Baseline Initiative: Wetland Survey Overview



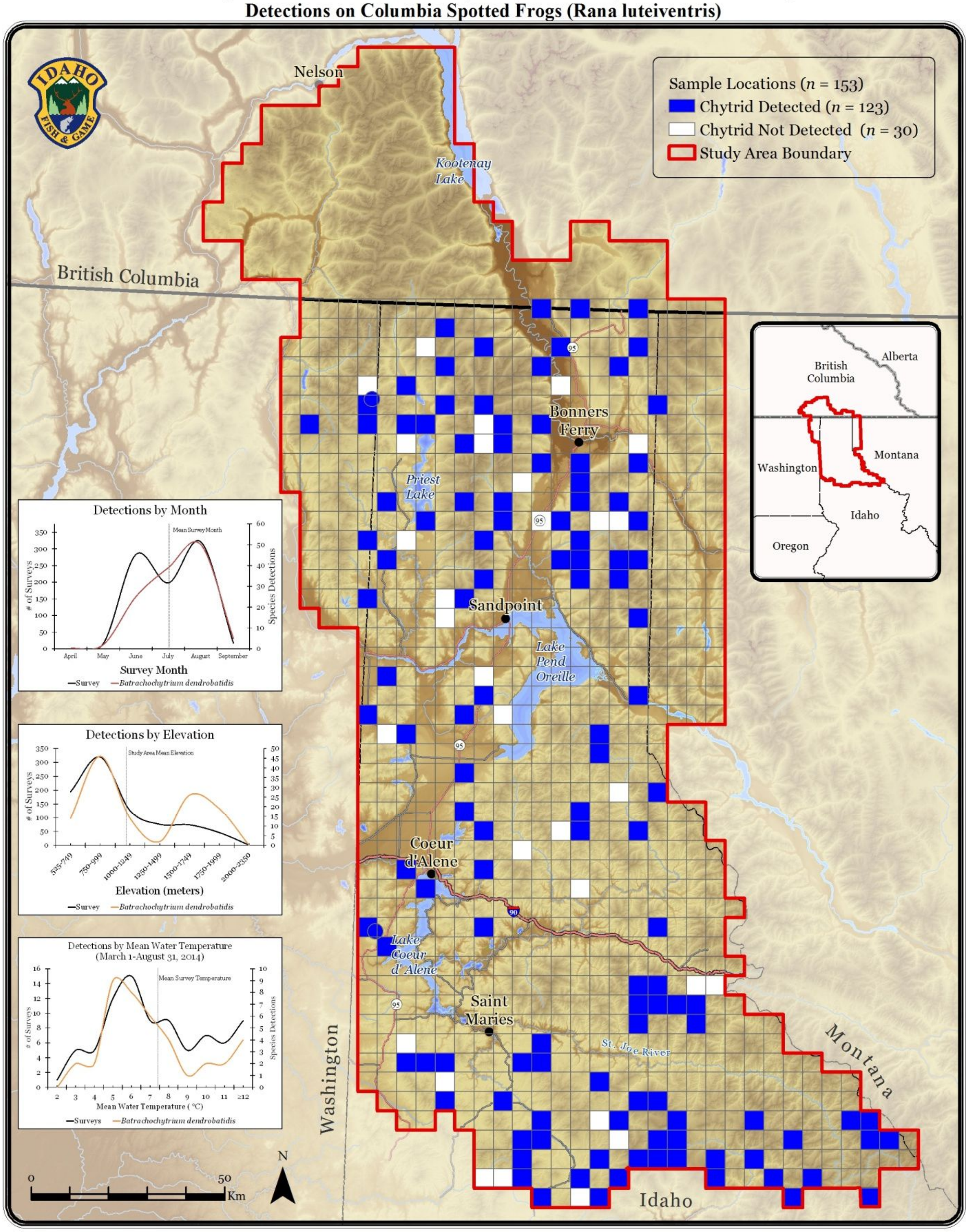
Map 3-1. 802 5x5 km cells surveyed for amphibians in 2013 or 2014. Legend numbers add up to >802 because multiple sites were surveyed within some cells.

Multi-species Baseline Initiative: Native Pond Breeding Amphibian Species Richness



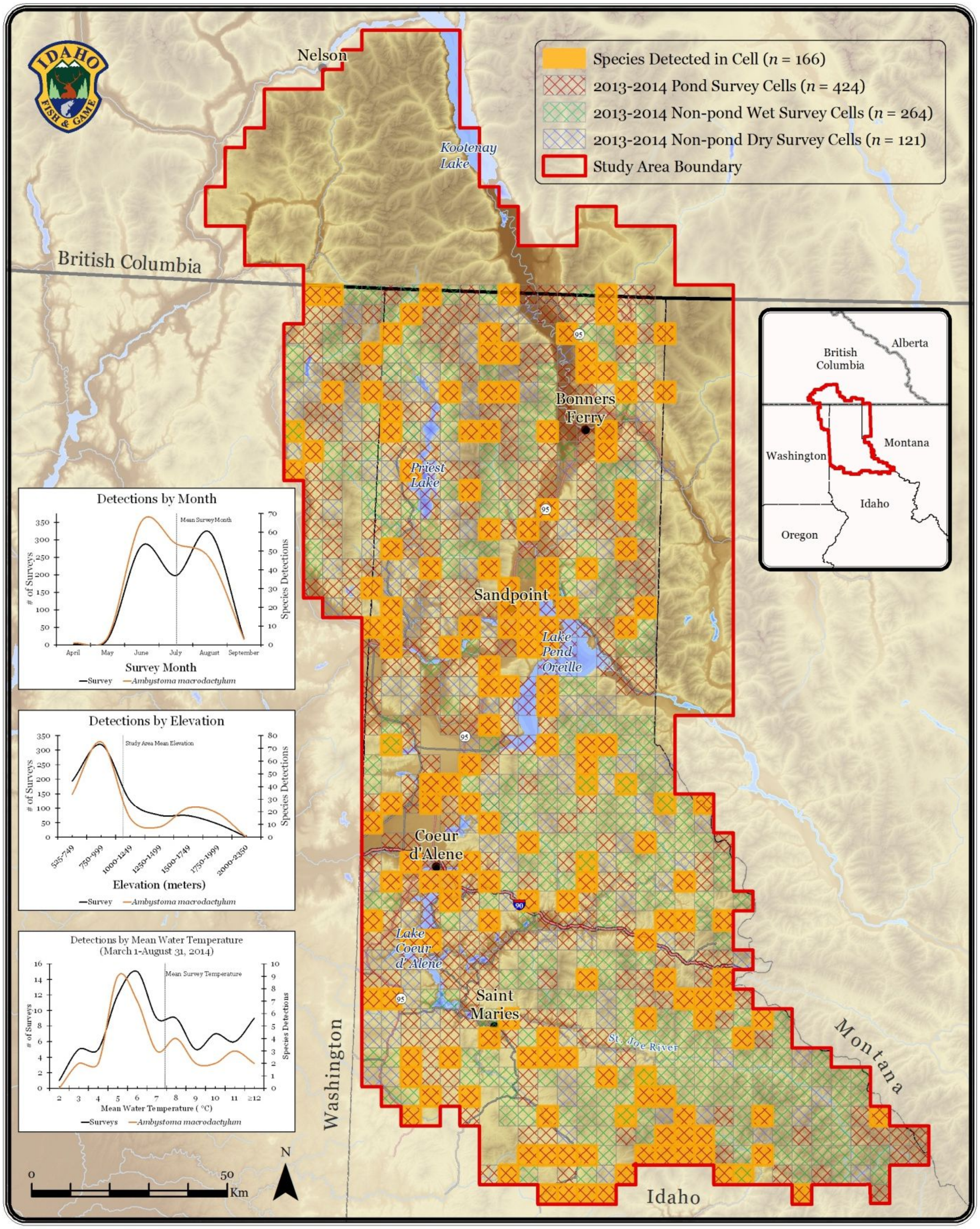
Map 3-2. Number of amphibian species detected during 2013-2014 surveys.

Multi-species Baseline Initiative: Chytrid (Batrachochytrium dendrobatidis) Detections on Columbia Spotted Frogs (Rana luteiventris)



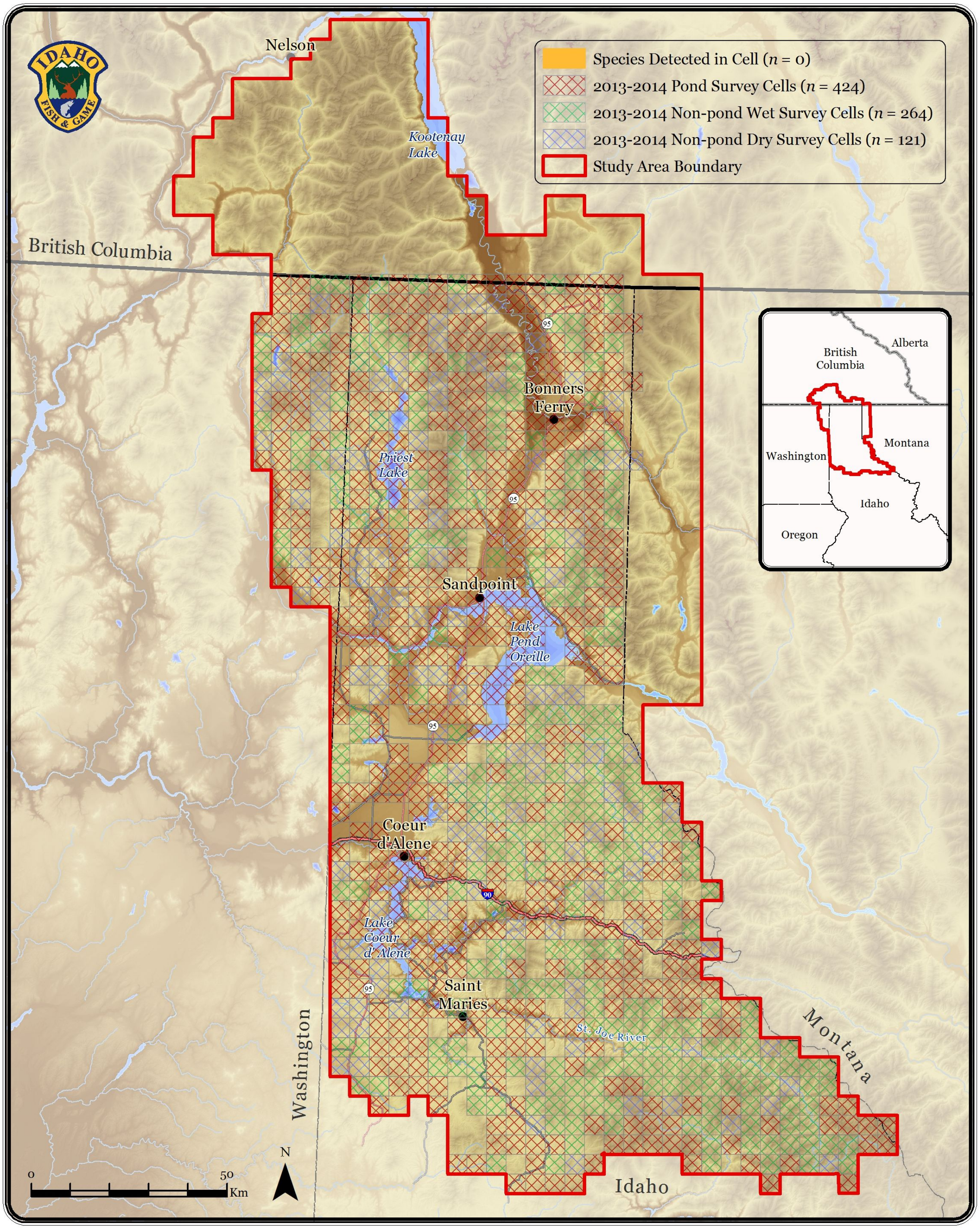
Map 3-3.

Multi-species Baseline Initiative: Long-toed Salamander (*Ambystoma macrodactylum*) Detections



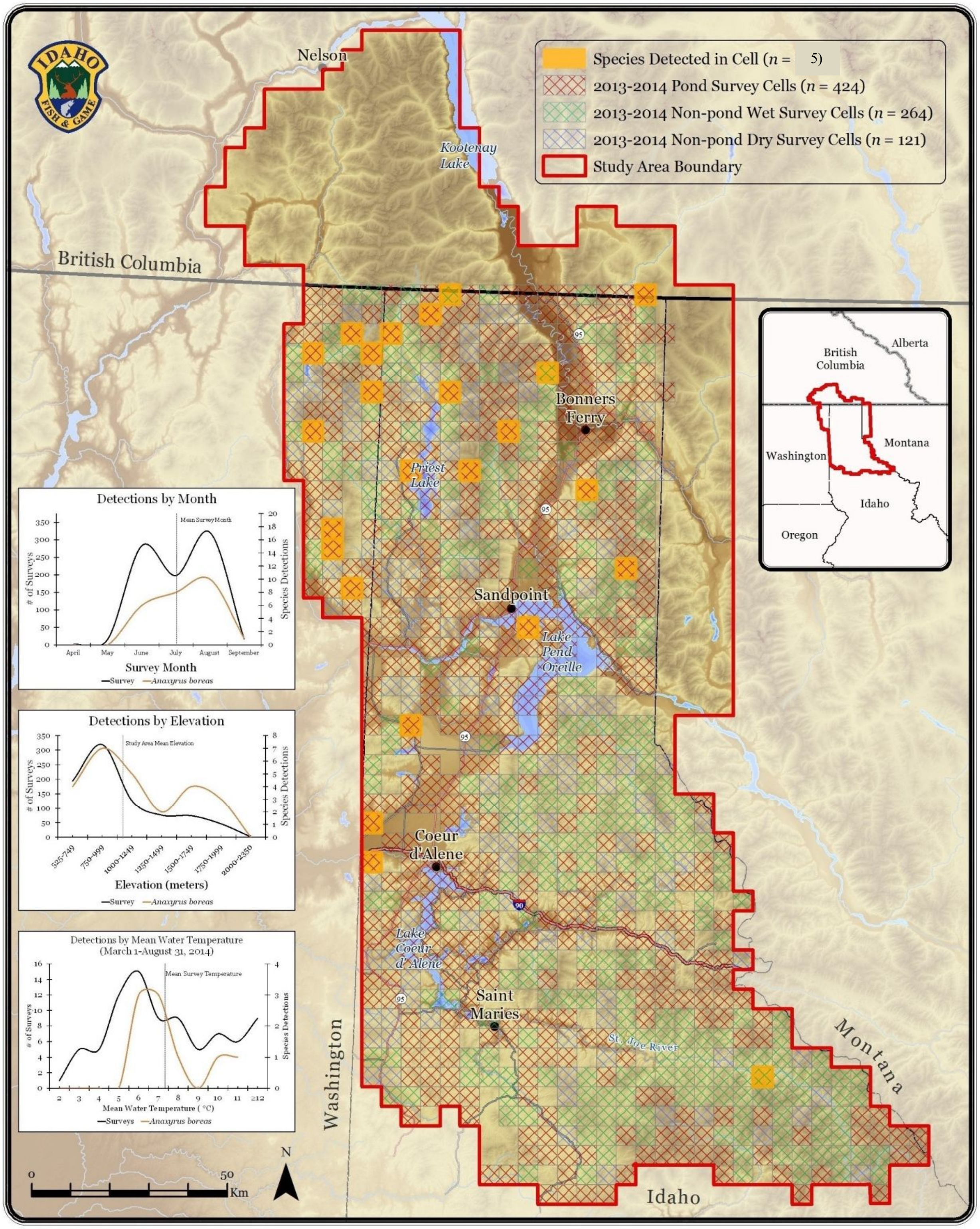
Map 3-4.

Multi-species Baseline Initiative: Tiger Salamander *(Ambystoma tigrinum)* Detections



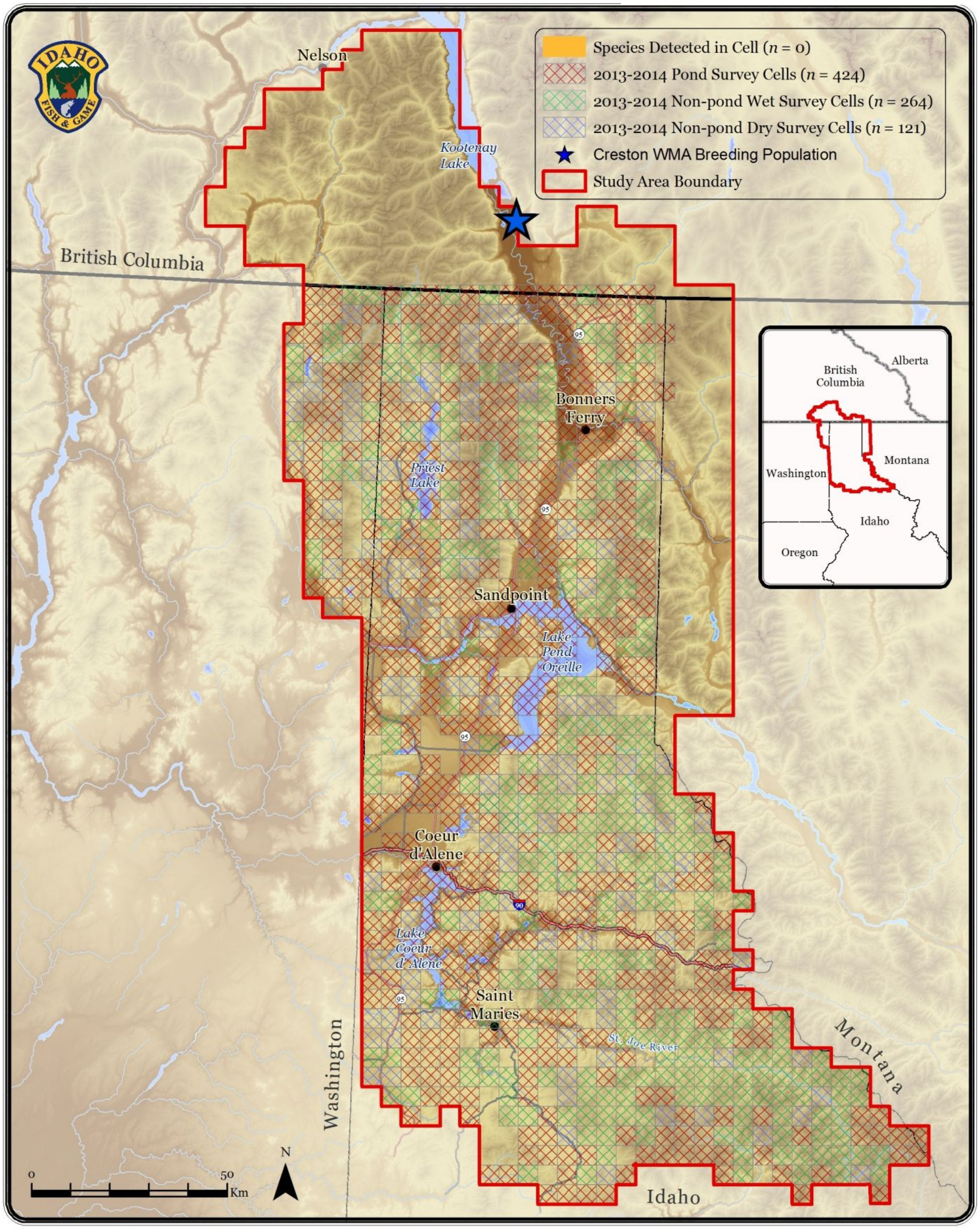
Map 3-5.

Multi-species Baseline Initiative: Western Toad (*Anaxyrus boreas*) Detections



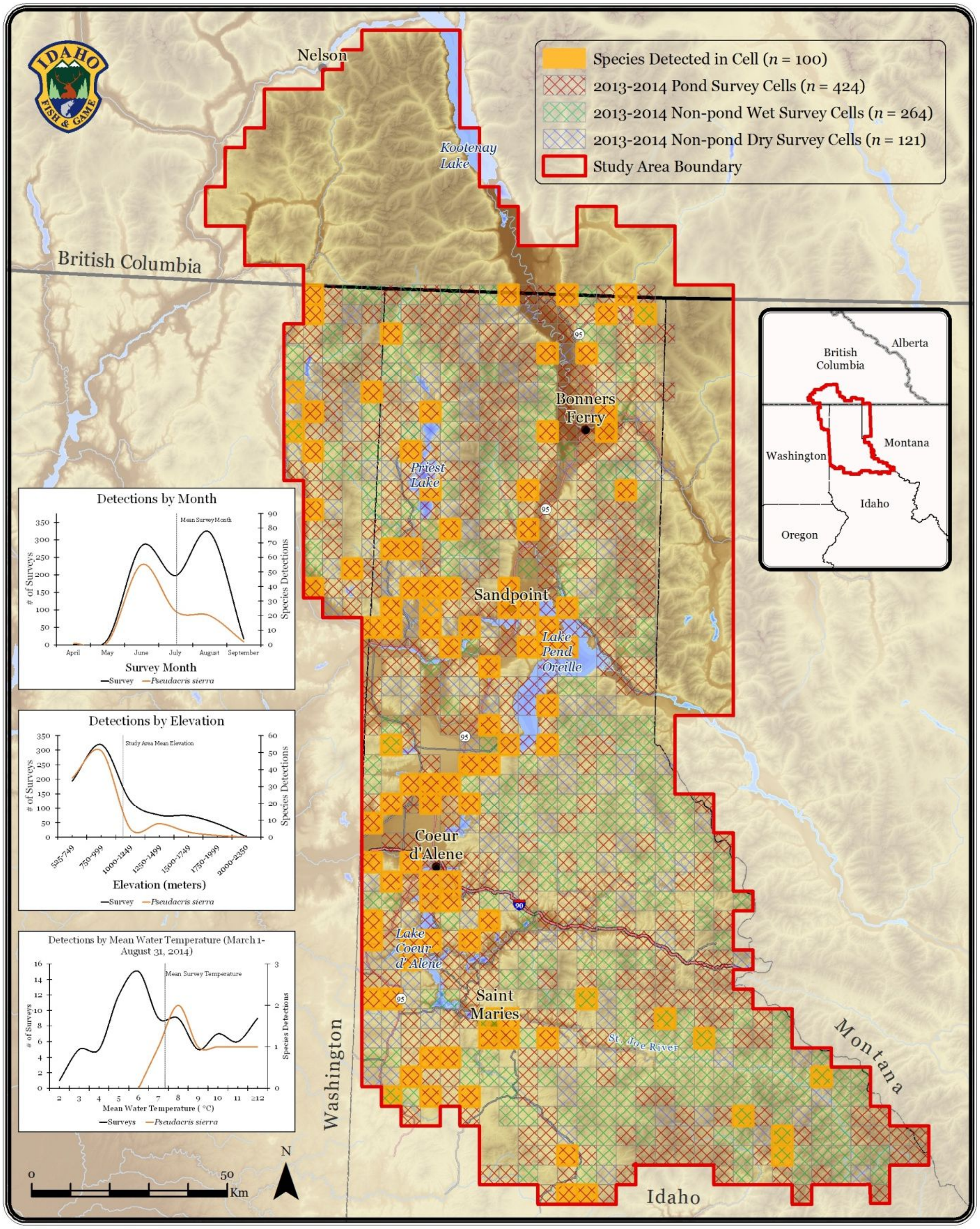
Map 3-6.

Multi-species Baseline Initiative: Northern Leopard Frog ***(Rana pipiens*) Detections**



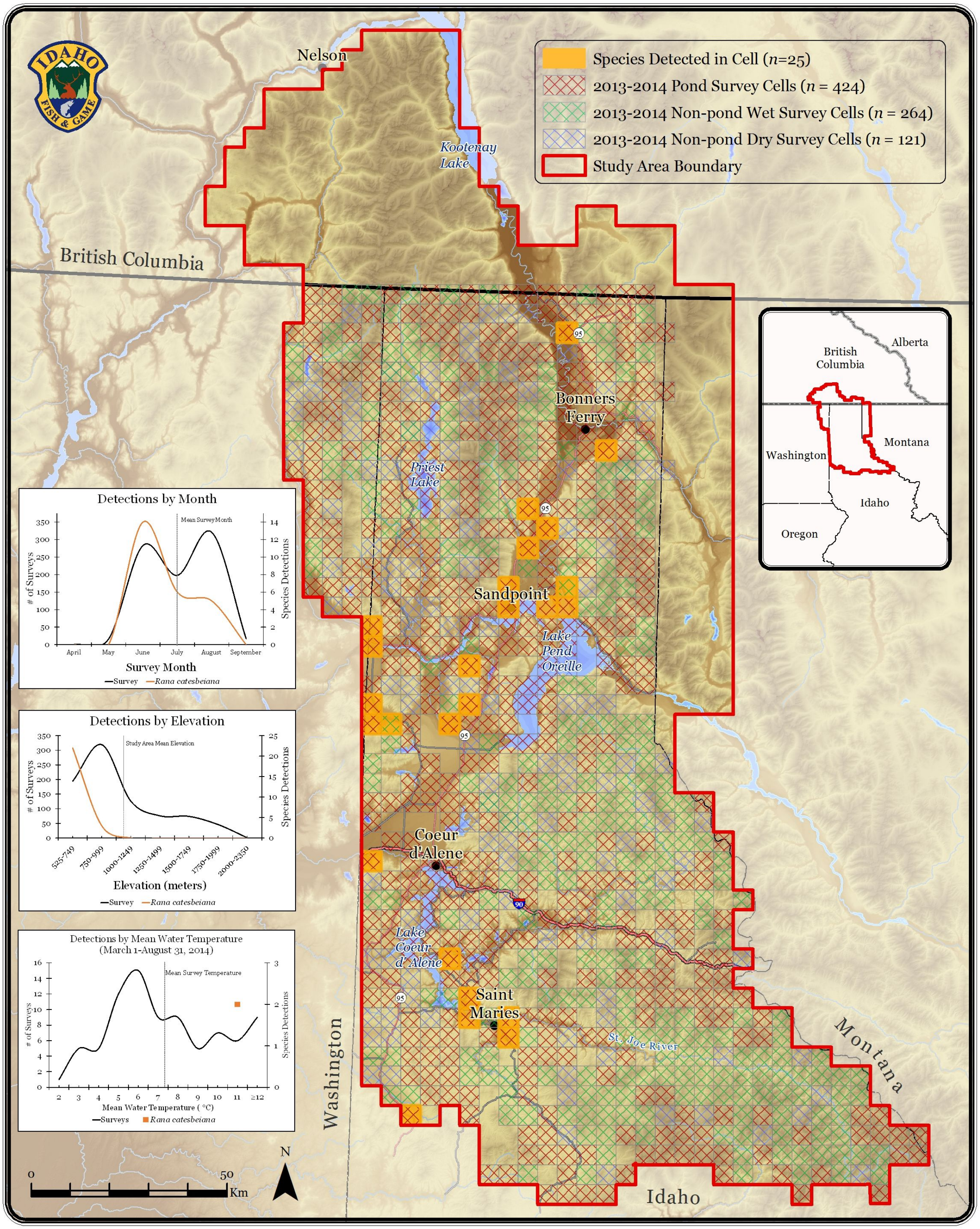
Map 3-7.

Multi-species Baseline Initiative: Pacific Treefrog (*Pseudacris regilla*) Detections



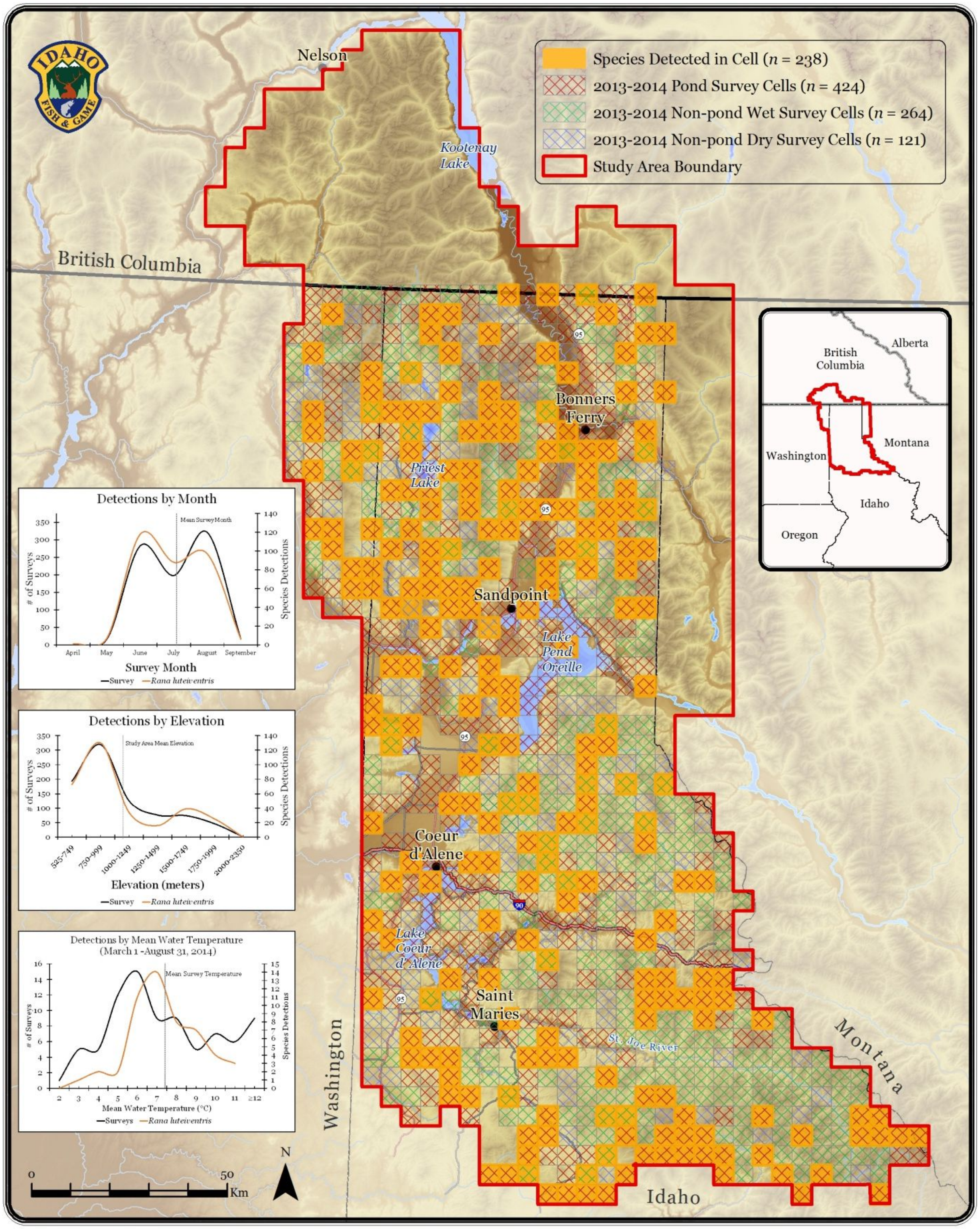
Map 3-8.

Multi-species Baseline Initiative: American Bullfrog (*Rana catesbeiana*) Detections



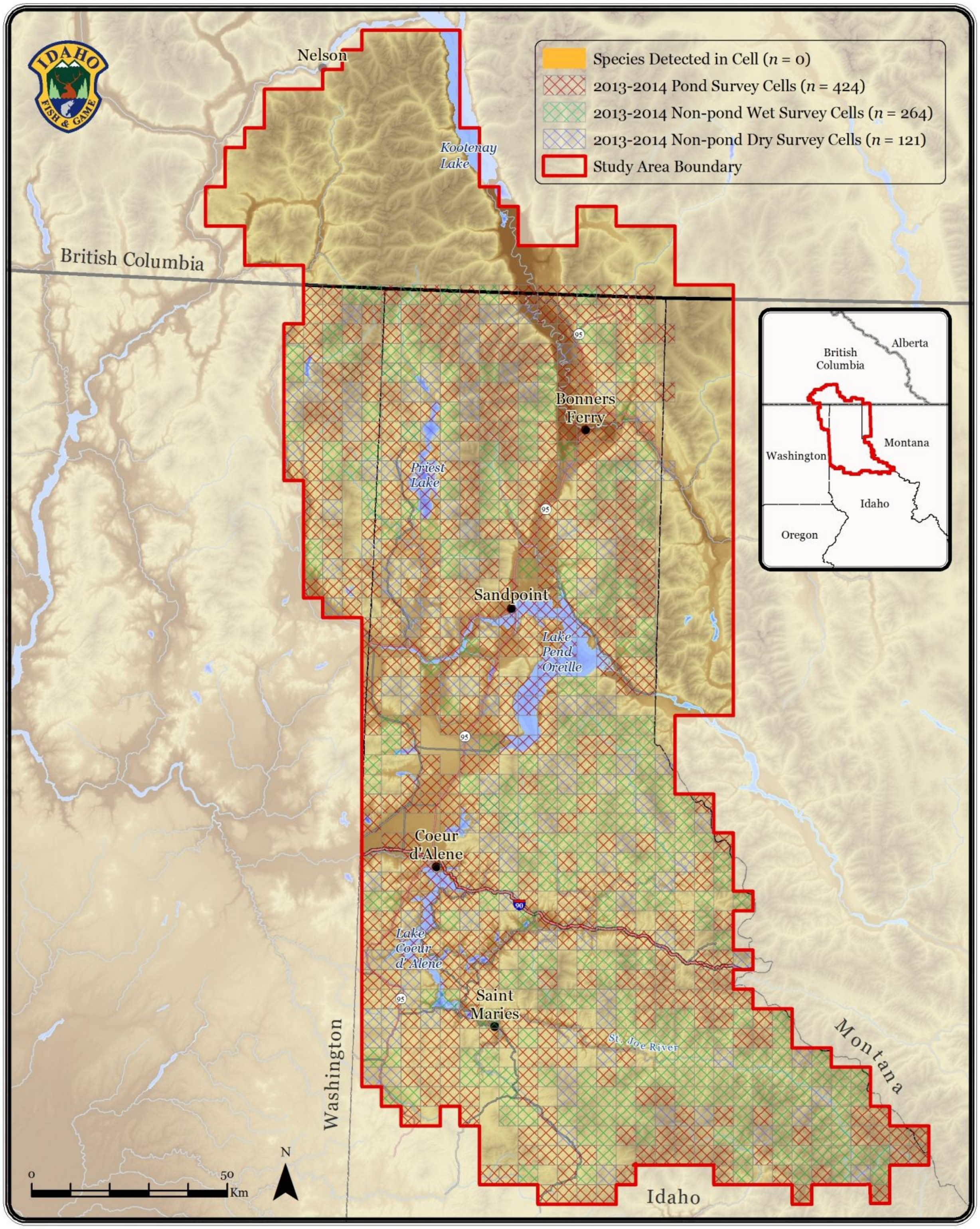
Map 3-9.

Multi-species Baseline Initiative: Columbia Spotted Frog (*Rana luteiventris*) Detections



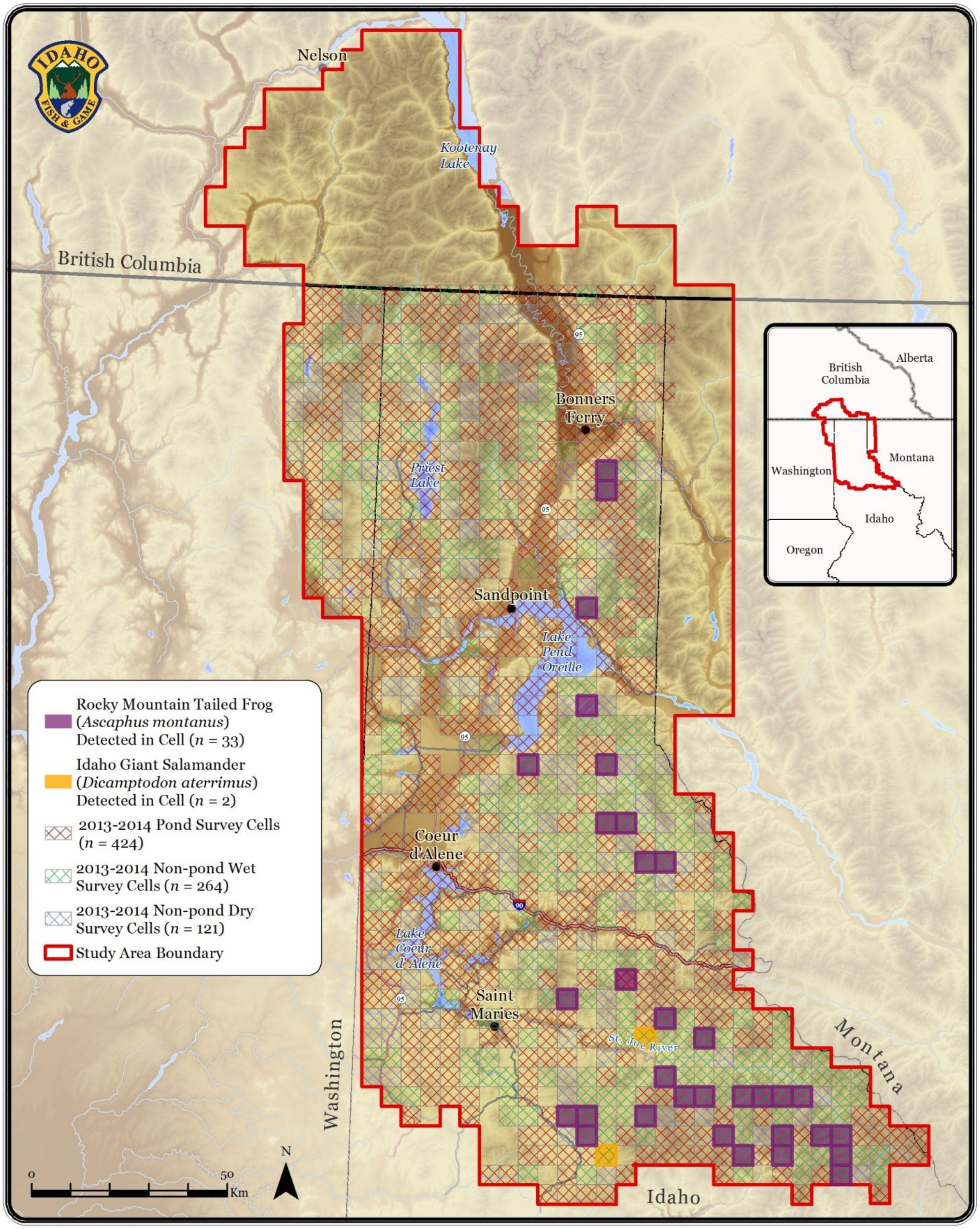
Map 3-10.

Multi-species Baseline Initiative: Wood Frog (*Rana sylvatica*) Detections



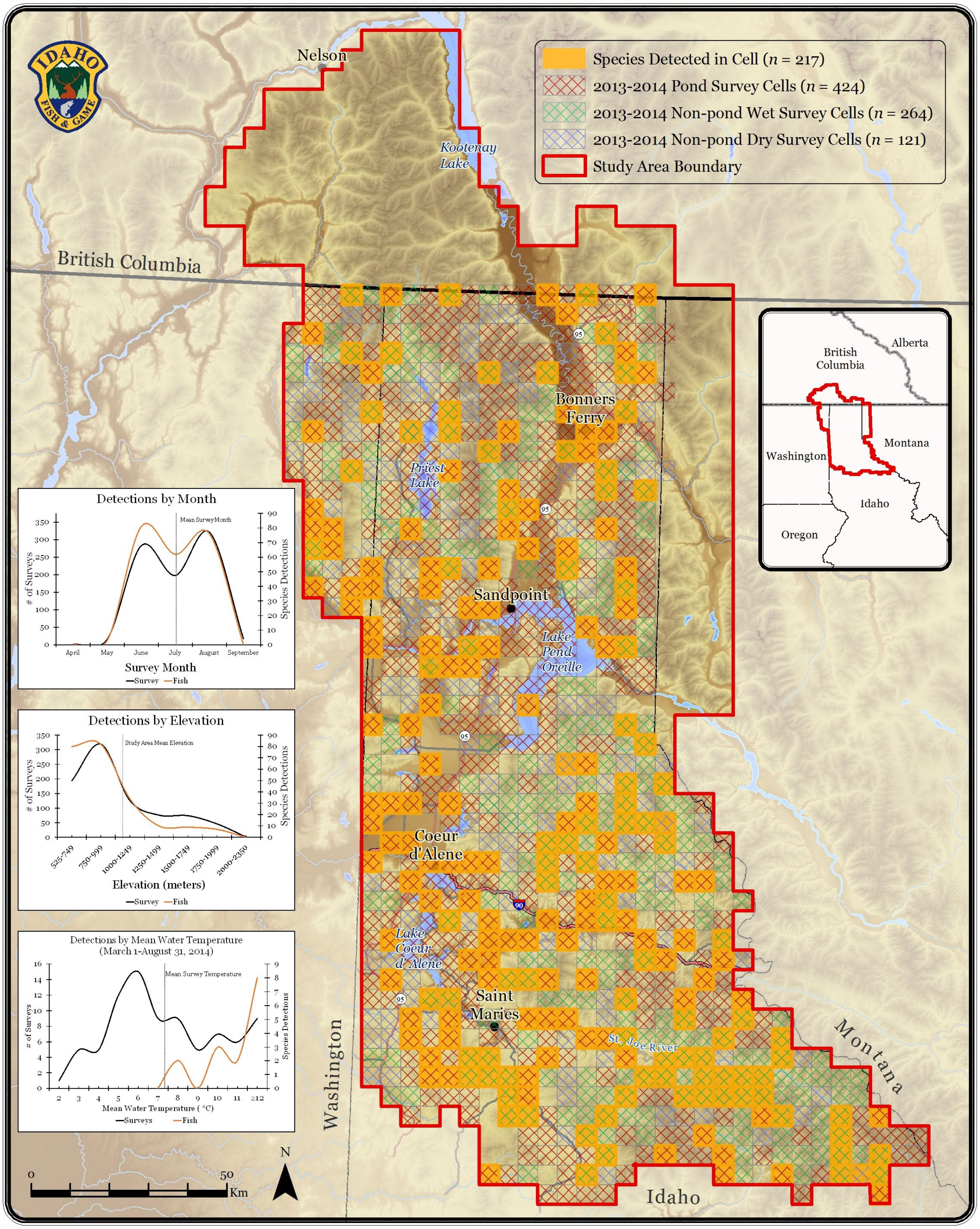
Map 3-11.

Multi-species Baseline Initiative: Stream Amphibian Detections



Map 3-12.

Multi-species Baseline Initiative: Fish Detections



Map 3-13.

CHAPTER 4. Carnivores - Multi-species Baseline Initiative

Introduction

Large mammals have relatively low reproductive rates, large home range requirements, and low natural population densities (Noss et al. 1996) making their populations more responsive to changing human land use practices and environmental conditions than many other species. This can lead to conservation challenges for some mammals (Noss et al. 1996) but also allows wildlife management programs to maintain stable to growing populations of species such as elk (*Cervus elaphus*), white-tailed deer (*Odocoileus virginianus*), and black bears (*Ursus americanus*) with harvestable surpluses (Ackerman 2013).

Such game species are typically allotted a relatively large portion of the conservation dollar and our knowledge base of their ecological requirements and status is subsequently greater than for non-game species. The term 'forest carnivore' generally refers to mammals with regulated fur trapping seasons but much inventory and research effort is spent on 'rare' forest carnivores such as wolverine (*Gulo gulo*), Canada lynx (*Lynx canadensis*), and fisher (*Pekania pennanti*) which are generally thought to not be abundant enough for populations to withstand regulated harvest in the western contiguous 48 U.S. Rare forest carnivores are charismatic and often receive disproportionately more conservation resources than other non-game taxa such as amphibians and gastropods. Regardless, forest carnivores have historically been targeted for human use and land management for their benefit remains contentious.

In the U.S. Rocky Mountains, forest carnivores have long been the subject of conservation efforts ranging from suggestions to make them a conservation 'umbrella' for other species (Noss et al. 1996) to using wolverine, lynx, fisher, and grizzly bears (*Ursus arctos*) as focal species for conservation planning (Carroll et al. 2001). Lynx (USFWS 2014b) and grizzly bears (USFWS 1999) are currently classified as 'threatened' under the U.S. Endangered Species Act and wolverine (USFWS 2014a) and fisher (USFWS 2011) have been considered for listing by the U.S. Fish and Wildlife Service (USFWS).

'Rare forest carnivores' is a catch-all term often applied to wolverine, fisher, and lynx in the northern Rocky Mountains. Despite broad interest in managing for these wide ranging species, inventory and conservation projects exist with little spatial or temporal continuity. For example, in the late 1980s and early 1990s, a fisher augmentation was implemented in the West Cabinet Mountains straddling the Idaho-Montana border. The project ended without a follow-up monitoring program (but see Vinkey 2003) leaving managers with no real information as to the success of the program or status of the fisher population. Since the 1990s a variety of forest carnivore inventories and other research efforts have occurred in the Idaho Panhandle and adjoining mountain ranges (Hayden et al. 2001, Bowers et al. 2002, Bowers et al. 2003, Vinkey 2003, McCall et al. 2006, Patton 2006, Wik 2006, Cushman et al. 2008, Knetter and Hayden 2008, Ulizio et al. 2007, Albrecht and Heusser 2009, Hausleitner and Kortello 2014). Lacking is synergy to coalesce such efforts to better understand species’ status across space and time.

Multi-species Baseline Initiative (MBI) Forest Carnivores was funded primarily to develop a baseline occurrence and distribution dataset of wolverine, fisher, and lynx in the Idaho Panhandle and adjoining mountain ranges. In 2010 we received funds to conduct a summer grizzly bear, lynx, and fisher survey in the Selkirk Mountains. After 2010 we shifted our focus to winter forest carnivore surveys for three reasons: 1) other research groups were already focused on grizzly bear monitoring, 2) no group in our study area was working to fill wolverine, lynx, or fisher information gaps identified in Idaho and Washington State Wildlife Action Plans (SWAP), and 3) because summer hair snaring seemed a less effective survey tool than emerging winter bait station techniques. To obtain the maximum data return for our survey effort, we tested existing techniques and refined emerging techniques to develop protocols that enabled detection of rare and common forest carnivores and other co-occurring species. We conducted field work from 2010-2014 with the objective of developing distribution maps and baseline datasets of target SGCN and co-occurring species to inform the 2015 Idaho and Washington SWAP revisions.

Methods

In summer 2010, we conducted bear, fisher, and lynx surveys at 172 sites in 172 survey cells in the Selkirk Mountains. In summer 2011, we conducted surveys in 175 cells for lynx in the Selkirk, Purcell, and West Cabinet Mountains. We used remote cameras to conduct lynx surveys during the summers of 2012 (4 sites) and 2014 (8 sites). From 2010-2014, we deployed 497 multi-species winter bait station surveys in 457 cells in the Selkirk, Purcell, West Cabinet, Coeur d'Alene, and Saint Joe Mountains (Map 4-1). During the winters of 2011, 2012, and 2014 we ran wolverine traps at 2, 3, and 15 sites in the Selkirk and Purcell Mountains.

Summer Fisher and Lynx Hair Snares

In 2010, we deployed fisher and lynx hair snares 300 m from bear hair snare corrals and approximately 100-150 m from a road or trail. In 2011, only lynx hair snares were deployed. Lynx hair snares were deployed in relation to the invertebrate survey location which was randomly placed within a 50-150 m buffer near a road or trail. Lynx hair snares were placed along the road or trail associated with the invertebrate survey.

To survey for fishers, we used the triangular style fisher hair snare box described in Schwartz et al. (2006). Two sides of the hair snare consisted of corrugated plastic sheeting. These two sides were nailed to a tree at a height of approximately 3 ft above the ground. Each side of plastic sheeting had one .30-caliber gun brush bolted to its walls; a third was nailed to the tree in between the first two to make a triangular shaped enclosure. Another triangular shaped piece of plastic sheeting forms the top of the snare. A piece of chicken was wired to the "roof" of the snare and a dab of Gusto (Caven's Lures, Minnesota, USA) call lure was applied to a branch above the snare. We deployed fisher hair snare boxes only in the winter of 2010 ($n = 25$) and in the summer of 2010 with one box per grid cell ($n = 172$).

To survey for lynx, we used the lynx rub pad style hair snare described in McKelvey et al. (1999). Rub pads consisted of a 3 in. x 3 in. square of carpet or sponge with four .30-caliber gun brushes arranged around the edges. Carpet squares were soaked in castor oil and liquid catnip and nailed to the base of trees at a height of 25 cm above the ground. As a visual attractant, we hung a pie plate on a wire leader attached to a swivel and bent to facilitate spinning in light breezes. We deployed one lynx hair snare per grid cell in 2010 ($n = 172$) and 2011 ($n = 175$). In 2010, snares were placed 100-150 m from a road or trail. In 2011, snares were place within view of a road or trail.

Fisher boxes and rub pads were visited three times in 2010. The first visit was to deploy the box or pad. On the second and third visits we collected any gun brushes with hair and stored them in coin envelopes. The fisher box, rub pad, and associated hardware were removed on the final visit. In 2011, lynx rub pads were visited only twice (once to deploy and once to retrieve) at approximately 14 day intervals.

Lynx rub pad (left) and fisher box (right).

Summer Remote Cameras
Remote cameras (Reconyx™ PC800 or PC900) were deployed specifically to detect lynx during the summer months of 2012 and 2014. Camera locations were chosen in the field in areas where lynx presence had previously been documented by project personnel.

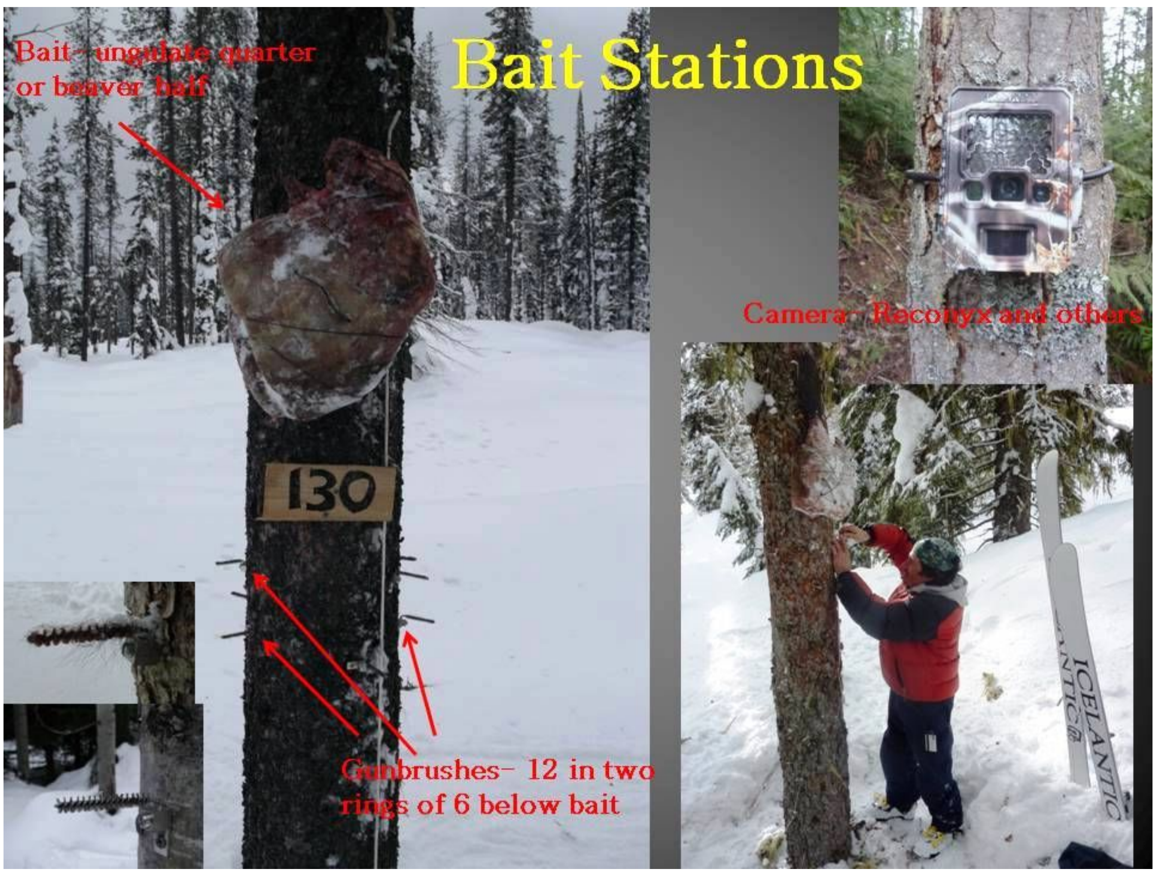
Opportunistic Observations
We occasionally had the opportunity to collect samples from target species incidental to our regular field work. We collected scat, hair, and track observations of target species (lynx, wolverine, fisher, grizzly bear) while in the field conducting carnivore surveys. Scats and hair were submitted to Wildlife Genetics International (WGI; Nelson, BC) for DNA analysis. From 2010-2014, we collected hair or scat samples from grizzly bear (n = 2), lynx (n =3), and wolverine (n = 1). We report only observations which are verifiable by photograph or DNA.

Winter Bait Stations
Winter bait station sites were selected prior to visiting the field with the use of topographic maps (Garmin BaseCamp and GoogleEarth) and field crews deployed stations within 200 m of the assigned location. Cells with a mean elevation of >1000 m were prioritized for survey (median elevation = 1310 m) and at least one bait station was deployed in each selected cell. Sites with high likelihood to be used by fisher, lynx, or wolverine were prioritized such as road intersections, saddles, ridges, and drainage intersections. We alternated site selection between ridges and drainage bottoms in adjacent cells.

Bait stations were established over five winters (2010-2014) with a January 25 median setup date (earliest was October 30) and a March 14 median takedown date (latest was June 30). Stations were deployed for a median of 39 days (range of 12-162 days). Surveys were conducted during the winter months to avoid destruction of stations and removal of bait by bears.

Most stations (n = 439) were visited once and 58 stations were revisited 1 to 3 times for a total of 567 sampling sessions (Table 4-3). Mean deployment length of revisited stations was 25 days for the first sampling period (n = 58), 36 days for the second sampling period (n = 58), and 29 days for the third sampling period (n = 12). When revisiting stations, field personnel collected hair samples, downloaded pictures, replaced camera batteries, and replaced bait if needed.

We selected live bait trees >30 cm in diameter which were isolated from other trees by at least 1.5 m (to prevent animals from jumping onto bait from neighboring trees and avoiding gun brushes). We used annealed wire to attach a skinned and frozen beaver carcass or skinned ungulate quarter to the bait tree approximately 6 ft above snow level. To ensure bait was firmly attached to the tree, we pre-wired the frozen bait by drilling holes on either side of the spinal column or leg bone (4 total holes). We then tightly wrapped annealed wire around the bone to ensure that even after the meat was removed, the bone would still be attached to the tree. As a scent attractant, we hung a sponge soaked in Gusto (Caven's lures, Minnesota, USA) within 20 m of the bait tree. For a size reference, we attached a rope with reflective tape every foot below the bait.



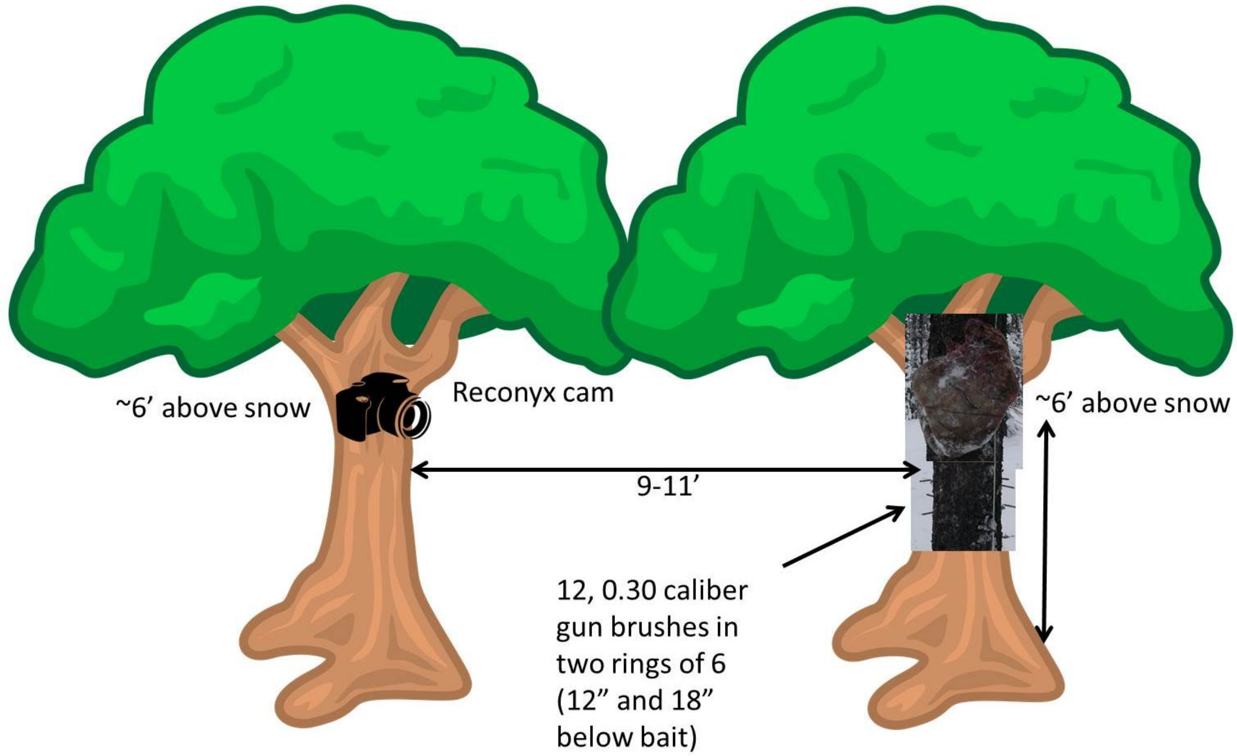
Bait station technique

We used aluminum terminal lugs to affix 12, .30 caliber gun brushes below the bait in 2 concentric rings of 6 at 30 and 45 cm below the bottom of the bait. To reduce bait contamination of hair samples we avoided placing gun brushes directly below the bait. Hair samples were dried and stored in paper coin envelopes at room temperature.

We deployed one remote camera on a tree adjacent to the bait tree. We primarily used Reconyx™ cameras (Wisconsin, USA) but also cameras produced by other manufacturers (Table 4-2). We equipped all cameras with ≥ 4GB memory cards and rechargeable NiMH batteries.

Distance between bait and camera tree was dependent on camera model due to varying trigger sensitivities and fields of view. We placed Reconyx™ cameras 9-11 ft from the bait, but other models needed to be placed closer (approximately 8 ft from bait). Reconyx™ cameras were set on high sensitivity to take 3 rapidfire pictures with no delay between triggers; night mode was set to "balanced" (for complete protocol, see Appendix IV).

All images collected by remote cameras (n = 722,435) were reviewed independently by two wildlife biologists to identify species.



Wolverine Traps
We selected 15 sites in the Selkirk and Purcell Mountains where we had either documented wolverine activity or felt wolverine activity was likely given historical observations or predicted wolverine habitat (Map 4-9). We pre-selected specific trap sites using Garmin BaseCamp and GoogleEarth software.

We used stationary round log (n = 2) and portable wooden (n = 13) wolverine traps (Lofroth et al. 2008). The baited traps were monitored via satellite trap transmitter (Vectronic Aerospace, Germany). Daily satellite transmissions were received via email; additionally, we conducted an in-person check every third day. During the in-person checks, snow was removed from the trap and traps were re-baited if necessary.

Stationary log (left) and portable wooden (right) wolverine traps.

Incidental Trapping Captures
Licensed trappers are required by Idaho state law to turn in incidentally captured fisher carcasses to IDFG. We collected DNA samples from all fisher carcasses turned into IDFG personnel. We conducted a follow-up phone interview to determine the location of the trapped fisher.

Licensed trappers are also required to report lynx incidentally captured to legal trapping activity to IDFG personnel. All trappers (*n* = 3) reporting incidentally captured lynx during the course of the project participated in in-person interviews with IDFG staff.

Sample Storage
Hair and tissue samples were placed in coin envelopes and then dried and stored at room temperature. Scats were sampled by swiping both sides of a flat toothpick across the outside of the scat. Toothpicks were then placed in a coin envelope and dried and stored at room temperature.

Taxonomy
Image Review - Each remote camera image was reviewed independently by two different biologists with extensive experience identifying Northern Rockies mammals. Each biologist maintained a spreadsheet of identifications. Spreadsheets were compared after each review and, when necessary, images were reviewed a third time to resolve discrepancies.

Genetic Species Identification - Samples were analyzed for species and individual identification at WGI which extracted DNA from hair samples by clipping up to 10 guard hair roots, as available, or up to 30 underfur hairs if needed to supplement guard hairs. Samples were processed with QIAGEN DNeasy Blood and Tissue Kits, using QIAGEN's protocol for tissue. The species test was a partial sequence analysis of the mitochondrial 16S rRNA gene.

Individual ID
After successful species identification, samples of target species (lynx, wolverine, and fisher) were submitted for genotyping, which used a microsatellite array to distinguish individuals (Paetkau 2004). WGI used microsatellite markers to determine individual identification and

gender of fisher (*n* = 12 markers), grizzly bear (*n* = 8 markers), lynx (*n* = 11 markers), and wolverine (*n* = 13 markers).

Fisher Haplotypes

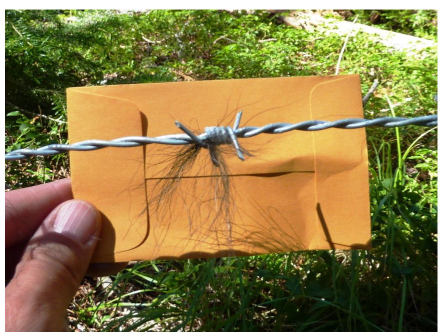
We sent samples from each individual fisher detected from 2010-2012 from WGI to the USFS Rocky Mountain Research Station Genetics Laboratory in Missoula, MT. There samples were analyzed using a 300bp region of the control region previously used to evaluate fisher (Drew et al. 2003, Vinkey et al. 2006).

Bear Hair Corrals

Technicians were assigned grid cells and selected bear corral locations in the field. All sites were ≥100 m from a road or trail. Sites with high likelihood to be used by bears were prioritized including saddles, ridges, and drainage intersections.

Following Woods et al. (1999), we used Gaucho® style barbed wire to establish bear corrals. Wire was strung around 3-4 trees approximately 50 cm above the ground and pulled tight. A duff pile of bark, logs, and moss was built in the center of the corral and baited with a mixture of cow blood and ground fish.

Corrals were revisited twice at approximately 14 day intervals for a total of three visits. Corrals were re-baited on the second visit. On the second and third visits, each barb was examined for hair. Hair was removed from each barb with tweezers and placed in a coin envelope. Tweezers were exposed to flame for 5 seconds between each hair sample to destroy any DNA. The corral was dismantled on the third visit.



Bear hair collected on barbed wire.

Results and Discussion

We documented 28 species and genera during our bait station surveys (Table 4-1; Maps 4-3 through 4-28). We detected fisher at 59 bait stations in 47 different cells (Map 4-3). Eight incidental trapping mortalities were reported in our study area from 2010-2014. We detected 46 individual fishers in our study area (25 males, 19 females, 2 unknown gender; Table 4-4). We detected lynx at 16 sites (2 bait stations, 3 incidentally trapped, 7 remote cameras, and 4 opportunistic scats; Table 4-5; Map 4-5). DNA analysis identified 5 individuals (2 males and 3 females). We detected wolverines at 13 sites in 13 different cells (Table 4-6; Map 4-7). Genetic analysis identified a total of 3 individual males. We detected grizzly bears at 6 sites in 6 different cells in the Selkirk Mountains (Table 4-7; Map 4-11). Genetic analysis identified 4 individual grizzly bears (3 males, 1 female).

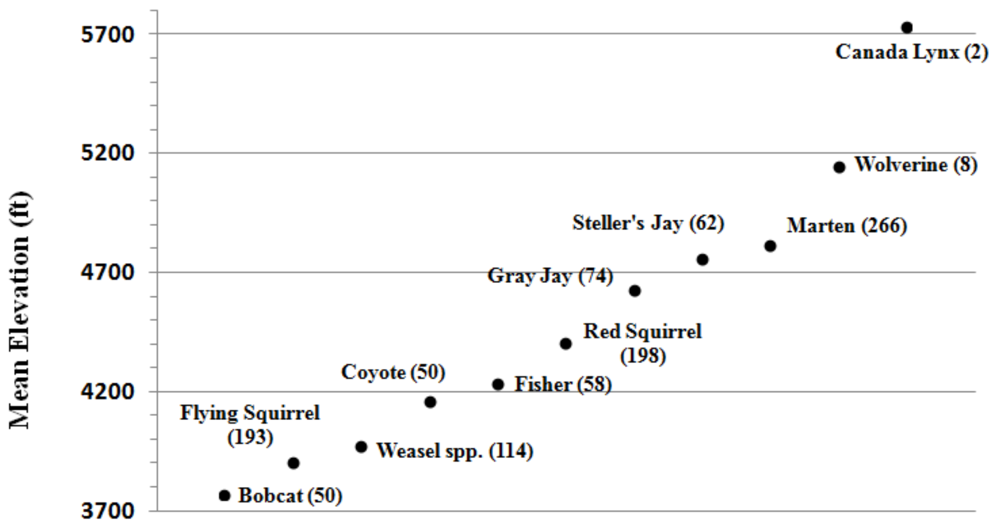


Figure 4-1. Mean elevation of stations detecting species visiting 497 forest carnivore bait stations in the Idaho Panhandle and adjoining mountain ranges during the winters of 2010-2014. Numbers in parentheses represent number of stations detecting species.

Species Richness

We detected 28 species and genera at all bait stations (Table 4-1). We detected an average of 2.8 species per bait station across the study area (range= 0-11 species; Map 4-2). We found relatively low species richness in the Coeur d'Alenes (1.9 species per station). Marten (*Martes americana*) and red squirrels (*Tamiasciurus hudsonicus*) in particular had lower detection rates in the Coeur d'Alenes when compared to the rest of the study area. Marten were detected at 54% of overall stations, 12% of Coeur d'Alene stations, and 63% of all stations outside the Coeur d'Alenes. Red squirrels were detected at 40% of overall stations, 21% of Coeur d'Alene stations, and 45% of all stations outside the Coeur d'Alenes.

Species richness is a fundamental measure of biological diversity and is often used to assess ecosystem health and develop conservation strategies (Gotelli and Colwell 2001). The Coeur d'Alenes have a long history of mining, timber harvest, and road development (IPNF 2012) and at first glance, the lower rates of marten and red squirrel detections and overall species richness may seem related to anthropogenic factors. However, other inherent variabilities need to be considered and, unlike the other mountain ranges, all of the Coeur d'Alene sites were surveyed during one field season (2014). This could have influenced results although we do not see similar species richness reductions in surveys conducted in other mountain ranges in 2014.

Few data are available to compare the species richness levels we found to historic levels and the disparity does not hold for all taxonomic groups. Terrestrial gastropods have higher species richness in the Coeur d'Alenes compared to other mountain ranges in our study area. With low mobility and permeable skin, it would seem reasonable that terrestrial gastropods would be more sensitive to anthropogenic influences than the highly mobile animals which visit bait stations. It is not possible to know whether gastropod disparity represents natural richness levels or is a remnant of historically higher levels of biodiversity. Regardless, priority should be given to investigating the low vertebrate richness levels in the Coeur d'Alenes.

Selkirk Mountain marten (*Martes americana*)
Photo credit: Lacy Robinson

Fisher Results

Fisher Summary (Table 4-4) - Forty-six individual fisher (25 males, 20 females, 1 unknown gender) were detected in our study area. We detected 1 individual female in the Coeur d'Alenes, 9 individuals in the Saint Joe (5 males, 4 females), 1 individual male in the Selkirks, and 35 individuals in the West Cabinets (19 male, 15 female, 1 unknown gender). Fisher not identifiable to individual were detected in the Coeur d'Alenes (n = 2 detections), Saint Joe (n = 4 detections), and West Cabinets (n = 10 detections). Fisher were not detected in the Purcells.

Summer Fisher Hair Snares - We detected 0 fisher using the summer hair snare method.

Incidental Fisher Trapping Captures - Eight fisher mortalities (3 males, 5 females) incidental to licensed public trapping were recorded within the study area from 2010-2014 (Table 4-4; Map 4-3). One male fisher was captured in a MBI wolverine live trap on March 29, 2011. This animal was released unharmed after a hair sample was collected.

Bait Stations (Fisher) - We detected fishers at 58 bait stations in 46 cells (Map 4-3). We detected a total of 39 individuals through DNA analysis (22 males, 16 females, 1 unknown gender). Fisher were detected in the Selkirks (n = 1), West Cabinets (n = 33), Coeur d'Alenes (n = 1), and Saint Joe. (n = 4) (Table 4-4; Map 4-3). Fisher were not detected in the Purcells. Over five survey seasons, we recaptured a total of 8 fisher from previous Years at bait stations, all in the West Cabinets.

Fisher Mitochondrial DNA Haplotypes - Control region mtDNA haplotypes were determined for 19 individual fishers. Mid-western origin haplotypes 5 (n = 9) and 10 (n = 6) and British Columbia origin haplotype 4 (n = 4) were found (Drew et al. 2003, Vinkey et al. 2006) (Table 4-4; Map 4-4).

Fisher (*Pekania pennanti*) at bait station in West Cabinet Mountains.

Fisher Status

Fisher were sparsely distributed across the southern portion of the study area and, consistent with other recent surveys (Knetter and Hayden 2008, Albrecht and Heusser 2009), less abundant in the Coeur d'Alenes than Saint Joe Mountains.

West Cabinet Fisher - The relatively high West Cabinet fisher concentration is likely the result of the augmentation effort that occurred in the late 1980s and early 1990s when 110 fisher were released in both the East and West Cabinet mountains (Vinkey et al. 2006). Subsequent West Cabinet surveys detected fisher (Knetter and Hayden 2008, Vinkey 2003) in portions of the range. MBI surveys were the first comprehensive fisher survey of the West Cabinets since the augmentation.

The majority of West Cabinet haplotypes were of mid-western origin (Haplotypes 5 and 10: Drew et al. 2003). This would be expected as that was the source population for the augmentation (Vinkey et al. 2006). However, fisher of British Columbia origin (Haplotype 4; Drew et al. 2003) were also detected. Although the occurrence of Haplotype 4 indicates at least some genetic in-flow to the West Cabinets, the paucity of fisher in adjoining mountain ranges suggests the West Cabinets have limited connectivity with adjoining mountain ranges. Our results suggest the augmentation was successful in establishing a West Cabinet fisher population but obstacles remain to connectivity with other mountain ranges.

Selkirk Fisher - Hair snare surveys reliably detected small numbers of fisher in the Selkirks in the first decade of the 2000's (Cushman et al. 2008, McCall et al. 2006, Knetter and Hayden 2008). The 1 Selkirk male we detected was first detected during a previous project (K. Pilgrim, U.S. Forest Service, personal communication) in 2005. The MBI project detected this male in 2010 approximately 2 km from the 2005 detection. In 2011 we captured this male in a wolverine trap 23 km north of the 2010 detection well outside of what would be the limits of the mean northern Rockies male fisher home range of 98.2km^2 (Sauder and Rachlow 2014).

We were surprised to detect only 1 fisher in the Selkirks for 3 reasons: 1) recent detections of multiple fisher individuals by other surveys, 2) abundant modeled suitable Selkirk habitat (Olson et al. 2014), and 3) the well forested MacArthur wildlife corridor is thought to provide a means of gene flow for wildlife between the Selkirk and West Cabinet Mountain Ranges (Davidson 2003, Cushman et al. 2006, Schwartz et al. 2009). Possible reasons for low Selkirk fisher numbers include: 1) an unidentified mortality source in the Selkirks, 2) modeled habitat is not actually suitable (Olson et al. 2014), 3) the West Cabinets fisher population is not at carrying capacity and surplus individuals are not available to disperse, and 4) the MacArthur corridor or other potential corridors are not permeable to fisher. Examining these scenarios would be the next logical step in Selkirk fisher conservation.

Lynx Results
Lynx Summary (Table 4-5) - Five individual lynx (2 males, 3 females) were detected in our study area. We detected 1 individual male in the Selkirks, 3 individuals (1 male, 2 females) in the Purcells, and 1 individual female in the West Cabinets. Lynx not identifiable to individual were detected in the Purcells (n = 18 detections) and West Cabinets (n = 1 detection). Lynx were not detected in the Coeur d'Alenes or Saint Joe.

Summer Lynx Hair Snares - We detected 0 lynx using the summer hair snare method.

Canada lynx (*Lynx canadensis*) at bait station in Purcell Mountains.

Incidental Lynx Trapping Captures - From 2010-2014, 3 lynx were incidentally captured by licensed trappers targeting other species. On December 12, 2012, a juvenile female was captured approximately 9 miles northeast of Bonners Ferry, ID. The trapper mistakenly identified the animal as a bobcat and shot her in the trap. One lynx was captured near Naples, ID in January 2014 and was released alive by the trapper. One adult female was captured near Naples on January 29, 2014. The trappers called IDFG and she (LF1) was fitted with an ARGOS satellite collar and released. In July, 2015, LF1's collar released as programmed, and we lost contact with her.

Opportunistic Lynx Observations - We collected 3 lynx scats opportunistically during field work. One scat was collected February 4, 2011 and DNA analysis matched this scat to a male detected in 2012 at a bait station in the Purcell Mts. The remaining two scats were collected in December, 2013 and were identified as a new female individual and as a female with DNA not of high enough quality to identify her to individual (Table 4-5).

Bait Stations (Lynx) - Lynx were detected at two different bait stations: one in the Selkirks in 2010 and the second in 2012 in the Purcells (Map 4-5). Both lynx were genetically identified as males and the male detected in 2012 was also detected from a scat sample collected in 2011.

Summer Lynx Remote Cameras - During the summer of 2012, we deployed 4 cameras from July 27-September 11 in the Purcells (180 trap nights). We detected lynx 7 times during 6 different 24 hour periods on 3 different cameras. In 2014, we deployed 4 cameras from June 19-September 22 and 4 additional cameras from July 26-September 22 in the West Cabinets (612 trap nights). We detected the radio-collared lynx, LF1, on August 10 and July 2, 2014 on two different cameras.

LF1 was travelling without kittens each time she was photographed (n = 2) by remote cameras in 2014. This lynx is identified as LF1 because it is wearing a radio-collar.

LF1 Reproductive Assessment - We used remote cameras to obtain images of LF1 during the summer of 2014 to determine if she was travelling with kittens. In 2014 and 2015, we mapped LF1's ARGOS locations to determine if location clustering indicative of denning activity (Olson et al. 2011) had occurred. We obtained 2 images (July 2 and August 10, 2014) of LF1, neither of which showed kittens travelling with her. LF1's collar released as scheduled in summer 2015 and no cameras were deployed in the area to determine if she was with kittens before she could have been photographed with the collar which would positively identify her. Clusters indicating denning were not observed in either 2014 or 2015 and we therefore did not initiate follow-up field efforts to confirm reproduction. The ARGOS collar LF1 was fitted with did not collect locations as often or of as high quality as the GPS collars used in Olson et al. (2011) and may not have indicated denning activity had it occurred. Regardless, we found no evidence that LF1 produced viable kittens in 2014 or 2015.

Lynx Parent-offspring Relationships - All 3 female lynx shared alleles at each of 10 micro-satellite markers. Although 10 loci do not give us enough power to definitively assess parentage, this would be consistent with a parent and offspring relationship. The 2 male lynx did not have genetic structure consistent with a parent offspring relationship with each other or the 3 females.

Lynx Status
We consistently detected lynx within designated critical habitat (USFWS 2014b) in the Purcell Mountains. The home range of radio-collared lynx, LF1, in the West Cabinets was entirely outside of designated critical habitat (Map 4-6). Occasionally, we detected lynx outside of critical habitat in the Purcells and Selkirks.

Our project is the first comprehensive lynx survey across the Idaho Panhandle, although more limited surveys have also detected lynx in the Coeur d'Alene and Saint Joe Mountains from 2006-2007 (Albrecht and Heusser 2009) or failed to detect lynx from 2004-2006 (Patton 2006).

Although bait stations have proven effective at detecting lynx (SCCM 2014) in areas of high lynx density, our bait stations only detected 2 of 5 MBI individuals. Bait stations and other methods appear less likely to detect lynx in areas of lower density and it was only through a combination of detection tools that we were able to identify 5 individuals. Consistent with other studies (Long et al. 2007), rub pads (McKelvey 1999) performed particularly poorly, detecting 0 lynx (and only 4 bobcats; Map 4-22) in areas of confirmed lynx occurrence. We did not detect lynx at bait stations in areas of confirmed lynx occurrence in the West Cabinets possibly due to fisher presence. Fisher are a primary lynx predator (Augusta et al. 2012) and we suspect lynx might avoid bait stations used by fisher. Un-baited remote cameras detect lynx consistently in areas of confirmed occurrence and we suggest bait station surveys which detect fisher, but not lynx, be followed up by un-baited trail camera surveys (Weingarth et al. 2015) to further evaluate lynx presence in an area.

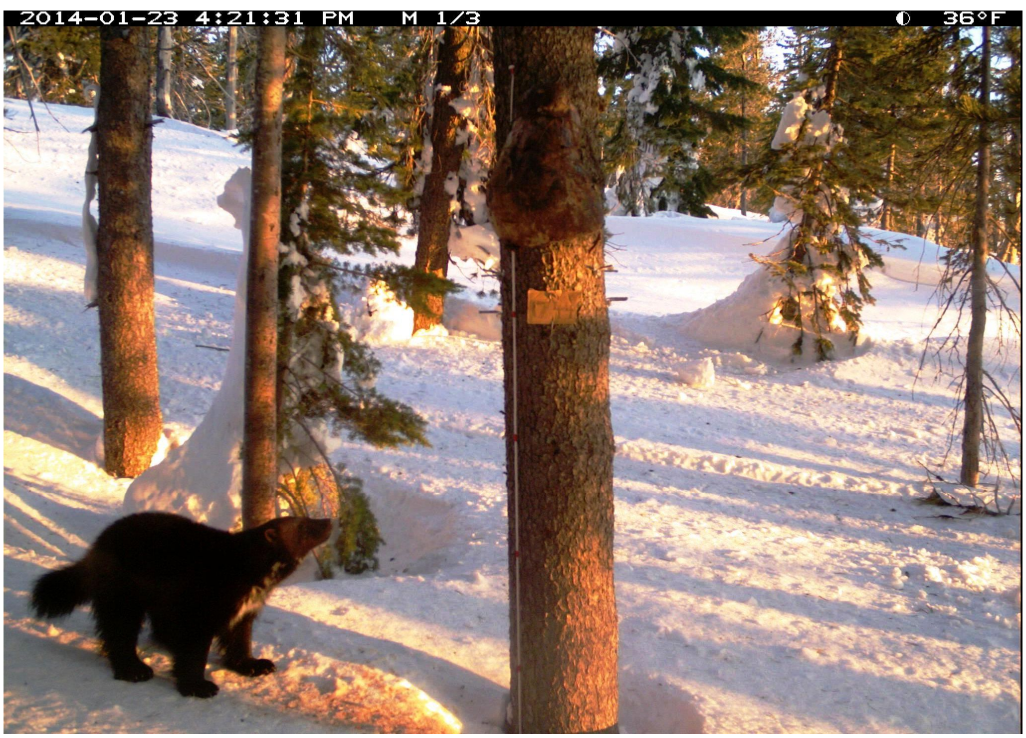
Wolverine Results
Wolverine Summary (Table 4-6) - Three individual male wolverine were detected in our study area. We detected 1 individual male in the Selkirks and 2 individual males in the Saint Joe. Wolverine not identifiable to individual were detected in the Selkirks (n = 1 detection), Saint Joe (n = 3 detections), and West Cabinets (n = 2 detections). Wolverine were not detected in the Coeur d'Alenes or Purcells.

Opportunistic Wolverine Observations - We collected one wolverine scat sample in 2011, which was identified to L11S1, the resident male detected at 3 bait stations. Five sets of wolverine tracks were observed during the 2010-2011 winter season: 2 sets in the Selkirks and 3 sets in the West Cabinets (Table 4-6).

Opportunistically detected wolverine (*Gulo gulo*). Selkirk Mountains.
Photo credit: Lydia Allen, IPNF

Wolverine Trapping Effort - Wolverine traps were deployed for a total of 1,058 trap nights over the three seasons of trapping: 2011 (2 traps, 82 trap nights), 2012 (3 traps, 142 trap nights), and 2014 (15 traps, 834 trap nights; Map 4-8). No wolverines were trapped over these 3 seasons. Incidental captures include 1 fisher (2014), 3 bobcats (*Lynx rufus*) (2014), and 3 martens (1 in 2011, 2 in 2014). We obtained a hair sample from all non-target animals using a gun brush taped to a stick. They were all released unharmed.

Bait Stations (Wolverine) - We detected wolverines at 8 bait stations in 8 survey cells (Map 4-7). The three most northern detections in the Selkirks were of the same male, L11S1 (Table 4-6). These detections occurred in 2010, 2012, and 2013 and we therefore conclude that this was a resident animal. The remaining 2 detections were both identified through DNA analysis as two different males and they occurred in 2014 in the Saint Joe. An additional 3 bait stations in the Saint Joe detected wolverine by camera but DNA samples failed to produce an individual genotype.



Wolverine (*Gulo gulo*) at bait station. Saint Joe Mountains.

Wolverine Parent-offspring Relationships - None of the 3 wolverine identified showed a genetic pattern of parent-offspring relation.

Wolverine Status
A substantial portion of our study area has been identified as wolverine habitat (Copeland et al. 2010, Inman et al. 2013; Map 4-9) and the USFWS considers all modeled wolverine habitat within the study area to be occupied (USFWS 2013). Our field surveys documented only 3 unrelated males and a handful of detections of unknown individuals scattered across the landscape (Table 4-6). These findings are consistent with more limited wolverine surveys on the Coeur d'Alene-Saint Joe divide (Hayden et al. 2001, Bowers et al. 2003, Bowers et al. 2003).

Despite the scarcity of actual wolverines on the landscape, a large portion of the study area has been identified as important for wolverine conservation. The MacArthur Corridor was identified as a wolverine dispersal pathway (Schwartz et al. 2009) and a majority of the IDFG Panhandle Administrative Region is designated as wolverine priority conservation areas (IDFG 2014). We conclude there are fewer wolverines within the study area than estimated carrying capacity (Inman et al. 2013) and we found no evidence of reproduction within the study area.

Grizzly Bears
Grizzly Bear Summary (Table 4-7) - We conducted targeted grizzly bear surveys in the Selkirks only. Four individual grizzly bears (3 males, 1 female) were detected in the Selkirks. Grizzly bears not identifiable to individual were detected in the Selkirks (n = 1 detection) and Purcells (n = 1 detection).

Grizzly Bear Hair Snare Corrals - During the summer of 2010, we detected grizzly bears at 2 (1%) and black bears at 125 (73%) of 172 bear hair snare corrals (Map 4-10). Of 1,142 hair samples submitted from bear corrals, 766 (67%) successfully produced a species identification. Seven (1%) samples identified as grizzly bear, 718 black bear (94%), and 41 (5%) were from non-bear mammals. The 7 grizzly bear samples represent 2 individual males and a sample from an unknown individual from 2 different cells (Table 4-7; Map 4-11). We also collected hair from a grizzly bear in a third cell at a fisher hair snare box. The sample was high enough quality to identify the species but not the individual. Black bears were not genotyped to individual.

Black bears were consistently detected at hair corrals across the study area but grizzly bears were detected at only 2 corrals. A comparable US Selkirk study detected grizzly bears at < 1% of bear hair corrals in 2003 and 2004 (S. Cushman, US Forest Service, personal communication). Similarly, our 2010 survey detected grizzly bears at 1% of stations, indicating this species occurs in low numbers in the US Selkirks.

Grizzly bear (*Ursus arctos*) at Selkirk Mountain hair snare corral. Selkirk Mountains.

Opportunistic Grizzly Bear Observations - We collected two grizzly bear hair samples opportunistically (Table 4-7; Map 4-11). Both were genotyped and represented two male individuals, one of which was previously detected at a bait station. We also obtained one image of a grizzly bear on a trail camera.

Bait Stations (Grizzly Bears) - We detected grizzly bears at 2 bait stations. One was genotyped a female and DNA was not collected from the other (Table 4-7; Map 4-11).

Grizzly Bear Parent-offspring Relationships - Two of the 4 grizzly bears we detected were placed in a parent (father, C134B2V2) offspring (daughter, BronsonV2K) relationship.

Conclusions
Our bait station surveys represent the first comprehensive inventory of forest carnivores and their associates in the Idaho Panhandle and adjoining mountain ranges. This baseline inventory sets the stage for long term monitoring which we recommend be implemented to assess changes in species abundance and distribution over time.

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Table 4-1. Species and genera detected by remote camera and DNA analysis at forest carnivore bait stations in the Idaho Panhandle and surrounding drainages during the winters of 2010-2014.

Species	Latin Name	Camera Only	DNA Only	Camera+DNA	DNA Total	Camera Total	Total # of Stations detecting species by either camera or DNA (% of total stations surveyed))	median days to first detection*	Mean elevation of species detected (m)**
Marten	*Martes americana*	49	10	207	217	256	266 (54)	7.0	1467
Red squirrel	*Tamiasciurus hudsonicus*	193	1	4	5	197	198 (40)	19.0	1342
Flying squirrel	*Glaucomys sabrinus*	183	1	9	10	192	193 (39)	13.0	1189
Weasel	*Mustela spp.*	108	2	4	6	112	114 (23)	10.5	1209
Gray jay*	*Perisoreus canadensis*	74	0	0	0	74	74 (15)	12.5	1410
Snowshoe hare*	*Lepus americanus*	70	0	0	0	70	70 (14)		
Steller's jay*	*Cyanocitta stelleri*	62	0	0	0	62	62 (12)	15.5	1450
Fisher	*Pekania pennanti*	9	1	48	49	57	58 (12)	12.0	1289
Moose*	*Alces alces shirasi*	55	0	0	0	55	55 (11)		
Coyote*	*Canis latrans*	50	0	0	0	50	50 (10)	27.0	1267
Bobcat	*Lynx rufus*	21	2	27	29	48	50 (10)	19.0	1148
White-tailed deer*	*Odocoileus virginianus*	37	0	0	0	37	37 (7)		
Elk*	*Cervus elaphus*	33	0	0	0	33	33 (7)		
Raven*	*Corvus corax*	23	0	0	0	23	23 (5)		
Human*	*Homo sapiens*	22	0	0	0	22	22 (4)		
Wolf*	*Canis lupus*	16	0	0	0	16	16 (3)		
Black bear	*Ursus americanus*	14	1	1	2	15	16 (3)		
Clark's nutcracker*	*Nucifraga columbiana*	13	0	0	0	13	13 (3)		
Mouse	*Peromyscus spp.*	10	0	0	0	10	10 (2)		
Mink	*Mustela vison*	2	0	7	7	9	9 (2)		
Raptor*	*Accipitridrae*	9	0	0	0	9	9 (2)		
Wolverine	*Gulo gulo*	2	0	6	6	8	8 (2)	29.0	1567
Red Fox	*Vulpes vulpes*	4	0	2	2	6	6 (1)		
Mule deer*	*Odocoileus hemionus*	5	0	0	0	5	5 (1)		
Raccoon	*Procyon lotor*	2	0	1	1	3	3 (1)		
Cougar	*Puma concolor*	3	0	0	0	3	3 (1)		
Canada lynx	*Lynx canadensis*	0	0	2	2	2	2 (0)	43.0	1747
Grizzly bear	*Ursus arctos*	1	0	1	1	2	2 (0)		
Striped skunk	*Mephitis mephitis*	0	0	1	1	1	1 (0)		
Total		1070	21	321	342	1391	1412		

Table 4-2. Camera failures experienced at forest carnivore bait stations in North Idaho and surrounding drainages, winters 2010-2014.

Camera Model	# of Stations Deployed	Camera not triggering for all detections	Technical failure of camera	IR failed	Possible battery failure (pics end for no reason)	Pics start late or very few pics for no reason	Total Camera-related failures (% of total deployed)
Reconyx PC800	156	2			5	2	9 (6)
Reconyx PC900	141	5	2	2	7	1	17 (12)
Reconyx RC55	90		1		2	3	6 (7)
Reconyx RM45	30			1	1		2 (7)
Reconyx HC600	7					1	1 (14)
All Reconxy models	424	7	3	3	15	7	35 (8)
Moultrie M-80xt	63	24			4	1	29 (46)
Trailwatcher	3			1		1	2 (67)
Bushnell Trophy Cam	2	1					1 (50)
Total- All Models	497	32	3	4	19	9	67 (13)

Table 4-3. Success of DNA analysis for samples collected at forest carnivore bait stations in North Idaho and surrounding drainages, winters 2010-2014.

year	# of stations surveyed	mean # days deployed	# of stations revisited	mean # days between revisits	Total # sampling sessions	total # samples collected	total # samples submitted for species ID	total # samples producing species ID	% of successful species ID brushes	total # samples submitted for genotype	total # samples producing genotype	% of successfully genotyped brushes
2010	16	89	16	44	32	124	124	104	84	21	10	48
2011	17	34	12	18	29	337	184	161	88	132	86	65
2012	86	54	24	29	122	1037	216	201	93	80	61	76
2013	97	45	6	27	99	703	139	125	90	13	7	54
2014	281	46	0	-	281	1744	348	310	89	56	37	66
Total	497				563	3945	1011	901		302	201	

Table 4-4. Individual fishers detected at forest carnivore bait stations and opportunistically in the Idaho Panhandle and adjacent mountain ranges during 2010-2014 field surveys. Reported coordinates are accurate to within 500 meters of actual location.

Individual	Gender	Mt. Range	Date	ID Method	Latitude	Longitude	Haplotype
R11H1	M	Selkirks	1/21/10	Bait Station (Photo+DNA)	48.72342	-116.74145	5
R11H1	M	Selkirks	3/29/11	Incidental Research Capture (Live Animal)	48.92077	-116.76647	5
SparV1K	M	W. Cabinets	1/22/11	Bait Station (Photo+DNA)	48.27466	-115.96271	4
BlueV1G	M	W. Cabinets	1/23/11	Bait Station (Photo+DNA)	48.11129	-116.01456	5
AuxorV1E	M	W. Cabinets	1/25/11	Bait Station (Photo+DNA)	48.27590	-116.25230	5
RossV1A	F	W. Cabinets	1/30/11	Bait Station (Photo+DNA)	48.19604	-115.95999	10
RossV1A	F	W. Cabinets	1/14/12	Bait Station (Photo+DNA)	48.19406	-115.96034	10
RossV2A	F	W. Cabinets	1/30/11	Bait Station (Photo+DNA)	48.19604	-115.95999	10
RossV2A	F	W. Cabinets	1/23/12	Bait Station (Photo+DNA)	48.27494	-115.96325	10
RossV2J	F	W. Cabinets	1/30/11	Bait Station (Photo+DNA)	48.19604	-115.95999	10
RossV2J	F	W. Cabinets	1/17/12	Bait Station (Photo+DNA)	48.20489	-115.95380	10
KeelerV2A	F	W. Cabinets	2/2/11	Bait Station (Photo+DNA)	48.31671	-116.08524	Unknown
KeelerV2A	F	W. Cabinets	12/26/11	Bait Station (Photo+DNA)	48.26618	-116.07237	Unknown
RattleV1E	F	W. Cabinets	2/3/11	Bait Station (Photo+DNA)	48.33088	-116.17650	5
RattleV2D	M	W. Cabinets	2/3/11	Bait Station (Photo+DNA)	48.33088	-116.17650	10
SmithV1F	F	W. Cabinets	2/3/11	Bait Station (Photo+DNA)	48.47427	-116.14400	5
SmithV1F	F	W. Cabinets	2/3/12	Bait Station (Photo+DNA)	48.47532	-116.14540	5
SmithV1F	F	W. Cabinets	1/22/13	Bait Station (Photo+DNA)	48.46008	-116.11545	5
SmithV2D	F	W. Cabinets	2/3/11	Bait Station (Photo+DNA)	48.47427	-116.14400	5
W3IV2	M	W. Cabinets	2/3/11	Bait Station (Photo+DNA)	48.47427	-116.14400	Unknown
W3IV2	M	W. Cabinets	11/11/11	Bait Station (Photo+DNA)	48.54221	-116.22678	Unknown
W3IV2	M	W. Cabinets	11/15/11	Bait Station (Photo+DNA)	48.50131	-116.30313	Unknown
EastforkV1A	M	W. Cabinets	2/3/11	Bait Station (Photo+DNA)	48.24739	-116.11533	4
EastforkV1A	M	W. Cabinets	12/26/11	Bait Station (Photo+DNA)	48.24763	-116.11041	Unknown
EastforkV1C	M	W. Cabinets	2/3/11	Bait Station (Photo+DNA)	48.24739	-116.11533	5
EastforkV2E	M	W. Cabinets	2/3/11	Bait Station (Photo+DNA)	48.24739	-116.11533	Unknown
IT20142	M	Saint Joe	11/7/11	Incidental Trapping (Carcass)	47.40821	-116.31457	Unknown
W1DV2	F	W. Cabinets	11/11/11	Bait Station (Photo+DNA)	48.48549	-116.24255	5
W3LV2	F	W. Cabinets	11/11/11	Bait Station (Photo+DNA)	48.54221	-116.22678	10

Individual	Gender	Mt. Range	Date	ID Method	Latitude	Longitude	Haplotype
W3LV2	F	W. Cabinets	11/16/11	Bait Station (Photo+DNA)	48.51083	-116.19703	10
W2DV2	M	W. Cabinets	11/14/11	Bait Station (Photo+DNA)	48.49114	-116.36652	5
W70MV2	M	W. Cabinets	12/29/11	Bait Station (Photo+DNA)	48.29664	-116.17377	4
W74IV3	F	W. Cabinets	12/29/11	Bait Station (Photo+DNA)	48.27121	-116.12864	Unknown
W66AV2	F	W. Cabinets	1/7/12	Bait Station (Photo+DNA)	48.28778	-116.25527	Unknown
W66AV2	F	W. Cabinets	1/7/12	Bait Station (Photo+DNA)	48.31066	-116.26239	Unknown
W67EV3	M	W. Cabinets	1/7/12	Bait Station (Photo+DNA)	48.31066	-116.26239	5
W72KV2	F	W. Cabinets	1/28/12	Bait Station (Photo+DNA)	48.19401	-116.10147	Unknown
W33GV2	M	W. Cabinets	2/3/12	Bait Station (Photo+DNA)	48.39905	-116.09369	5
W31LV2	M	W. Cabinets	2/3/12	Bait Station (Photo+DNA)	48.53761	-116.05778	10
W50CV2	U	Saint Joe	2/8/12	Bait Station (Photo+DNA)	47.04797	-115.35403	4
W83AV2	M	W. Cabinets	2/11/12	Bait Station (Photo+DNA)	48.30344	-115.98667	Unknown
W90DV2	M	W. Cabinets	2/13/12	Bait Station (Photo+DNA)	48.07405	-115.86283	Unknown
W85FV2	M	W. Cabinets	2/24/12	Bait Station (Photo+DNA)	48.13863	-115.88323	Unknown
FC1092CV2	F	W. Cabinets	1/18/13	Bait Station (Photo+DNA)	48.33277	-116.27469	Unknown
FC1142AV2	M	W. Cabinets	1/27/13	Bait Station (Photo+DNA)	48.40229	-116.22906	Unknown
C097875(A)	M	Saint Joe	2/4/13	Incidental Trapping (Carcass)	47.41841	-116.27443	Unknown
87-87208(A)	M	Saint Joe	10/31/13	Bait Station (Photo+DNA)	47.01850	-115.36867	Unknown
87-87208(A)	M	Saint Joe	12/26/13	Incidental Trapping (Carcass)	47.02351	115.45968	Unknown
C112713(A)	F	Saint Joe	12/9/13	Incidental Trapping (Carcass)	47.40821	-116.31457	Unknown
FC1097_2014BIV2	M	W. Cabinets	12/20/13	Bait Station (Photo+DNA)	48.58676	-116.15149	Unknown
FC1097_2014BIV2	M	W. Cabinets	2/15/14	Bait Station (Photo+DNA)	48.55119	-116.27912	Unknown
87-87208(C)	F	Saint Joe	12/26/13	Incidental Trapping (Carcass)	47.03988	-115.92804	Unknown
FC1236IV2	F	W. Cabinets	12/29/13	Bait Station (Photo+DNA)	48.52174	-116.12420	Unknown
IT20141(A)	M	Saint Joe	1/3/14	Incidental Trapping (Carcass)	47.39755	-116.34831	Unknown
FC1390DV2	F	Saint Joe	1/16/14	Bait Station (Photo+DNA)	47.15188	-115.78327	Unknown
C112795(A)	F	W. Cabinets	1/19/14	Incidental Trapping (Carcass)	48.55607	-116.23504	Unknown
FC990BV2	F	Coeur d'Alenes	1/24/14	Bait Station (Photo+DNA)	47.78701	-116.38300	Unknown
FC1071BV2	M	Saint Joe	2/1/14	Bait Station (Photo+DNA)	47.39184	-116.08433	Unknown
FC1071BV2	M	Saint Joe	2/25/14	Bait Station (Photo+DNA)	47.37755	-116.28125	Unknown
87-87811	F	W. Cabinets	2/4/14	Incidental Trapping (Carcass)	48.33003	-116.30069	Unknown

Individual	Gender	Mt. Range	Date	ID Method	Latitude	Longitude	Haplotype
FC1097_2014ADV2	M	W. Cabinets	2/17/14	Bait Station (Photo+DNA)	48.53858	-116.28409	Unknown
Unknown	U	W. Cabinets	12/9/11	Bait Station (Photo)	48.21837	-116.02788	Unknown
Unknown	U	W. Cabinets	12/29/11	Bait Station (Photo)	48.29664	-116.17377	Unknown
Unknown	U	W. Cabinets	1/16/12	Bait Station (Photo)	48.24708	-115.96315	Unknown
Unknown	U	W. Cabinets	2/3/12	Bait Station (Photo)	48.39905	-116.09369	Unknown
Unknown	U	W. Cabinets	1/19/13	Bait Station (Photo)	48.46054	-116.30167	Unknown
Unknown	U	W. Cabinets	1/21/13	Bait Station (Photo)	48.27810	-116.07384	Unknown
Unknown	U	W. Cabinets	1/30/13	Bait Station (Photo)	47.13044	-115.79146	Unknown
Unknown	U	Saint Joe	1/30/13	Bait Station (Photo)	47.13071	-115.72313	Unknown
Unknown	U	Saint Joe	2/6/13	Bait Station (Photo)	47.13246	-115.98778	Unknown
Unknown	U	W. Cabinets	12/29/13	Bait Station (Photo)	48.63536	-116.17251	Unknown
Unknown	U	Saint Joe	1/12/14	Bait Station (Photo)	47.38331	-115.98754	Unknown
Unknown	U	Saint Joe	1/14/14	Bait Station (Photo)	47.13013	-115.83683	Unknown
Unknown	U	W. Cabinets	2/2/14	Bait Station (Photo)	48.24970	-116.19186	Unknown
Unknown	U	Coeur d'Alenes	3/1/14	Bait Station (Photo)	47.60283	-115.86463	Unknown
Unknown	U	Coeur d'Alenes	3/6/14	Bait Station (Photo)	47.60510	-116.13650	Unknown
Unknown	U	W. Cabinets	3/7/14	Bait Station (Photo)	48.56473	-116.17202	Unknown

Table 4-5. Individual lynx detected at forest carnivore bait stations and opportunistically in the Idaho Panhandle and adjacent mountain ranges during 2010-2014 field surveys. Reported coordinates are accurate to within 500 meters of actual location.

Individual	Gender	Mt. Range	Date	ID Method	Latitude	Longitude	Elevation (m)
Shorty2C	M	Selkirks	2/21/2010	Bait Station (DNA + Photo)	48.96050	-116.67960	1751
W12AV2	M	Purcells	2/6/2012	Bait Station (DNA + Photo)	48.99714	-116.03759	1650
W12AV3	M	Purcells	2/6/2011	Scat (DNA)	48.94313	-116.09629	1686
LF2	F	Purcells	12/29/2012	Incidental Trapping (Carcass)	48.81653	-116.27998	1011
OMG20141B	F	Purcells	12/18/2013	Scat (DNA)	48.98565	-116.06906	1321
OMG20141B	F	Purcells	3/21/2014	Scat (DNA)	48.97482	-116.07157	1365
LF1	F	W. Cabinets	1/29/2014	Incidental Trapping (Live Animal)	48.54283	-116.32148	1118
LF1	F	W. Cabinets	8/10/2014	Trail Camera	48.59039	-116.26870	1666
LF1	F	W. Cabinets	7/2/2014	Trail Camera	48.59040	-116.29497	1313
Unknown	U	Purcells	8/13/2012	Trail Camera	48.99570	-116.06813	1284
Unknown	U	Purcells	8/14/2012	Trail Camera	48.93629	-116.05739	1573
Unknown	U	Purcells	8/15/2012	Trail Camera	48.90287	-116.05258	1835
Unknown	U	Purcells	8/15/2012	Trail Camera	48.99570	-116.06813	1284
Unknown	U	Purcells	8/22/2012	Trail Camera	48.90287	-116.05258	1835
Unknown	U	Purcells	9/6/2012	Trail Camera	48.93629	-116.05739	1573
Unknown	U	Purcells	9/11/2012	Trail Camera	48.93629	-116.05739	1573
Unknown	U	W. Cabinets	Jan. 2014	Incidental Trapping (Photo)	48.57275	-116.35091	835
Unknown	U	Purcells	1/14/2014	Trail Camera	48.98565	-116.06906	1318
Likely OMG20141B	U	Purcells	1/19/2014	Scat (DNA)	48.95089	-116.06996	1414
Unknown	U	Purcells	1/23/2014	Video at Wolverine Trap	48.98565	-116.06906	1318
Unknown	U	Purcells	1/26/2014	Video at Wolverine Trap	48.98565	-116.06906	1318
Unknown	U	Purcells	1/27/2014	Video at Wolverine Trap	48.98565	-116.06906	1318
Unknown	U	Purcells	2/5/2014	Trail Camera	48.98565	-116.06906	1318
Unknown	U	Purcells	2/10/2014	Video at Wolverine Trap	48.98565	-116.06906	1318
Unknown	U	Purcells	2/14/2014	Trail Camera	48.98565	-116.06906	1318
Unknown	U	Purcells	2/17/2014	Trail Camera	48.98565	-116.06906	1318
Unknown	U	Purcells	3/21/2014	Trail Camera	48.98565	-116.06906	1318
Unknown	U	Purcells	7/31/2014	Photo, USFWS Bear Survey	48.96891	-116.09999	1854

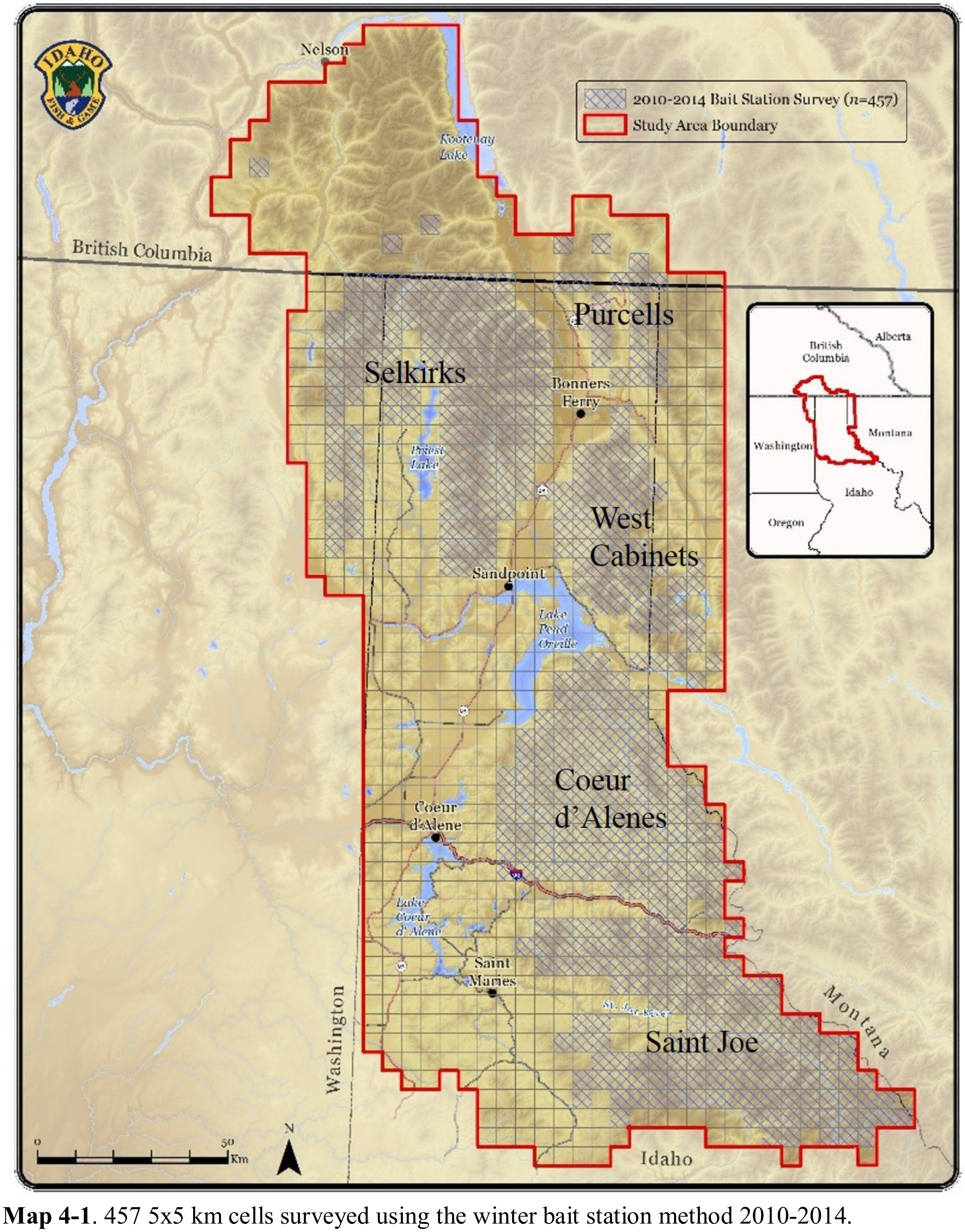
Table 4-6. Individual wolverines detected at forest carnivore bait stations and opportunistically in the Idaho Panhandle and adjacent mountain ranges during 2010-2014 field surveys. Reported coordinates are accurate to within 500 meters of actual location.

Individual	Gender	Mt. Range	Date	ID Method	Latitude	Longitude	Elevation (m)
LS11	M	Selkirks	1/27/11	Anal Secretion (DNA)	48.93619	-116.66917	1467
LS11	M	Selkirks	2/28/10	Bait Station (Photo)	48.88303	-116.80922	1447
LS11	M	Selkirks	3/14/11	Photo at Wolverine Trap	48.94954	-116.65305	1607
LS11	M	Selkirks	3/20/11	Photo at Wolverine Trap	48.94954	-116.65305	1607
LS11	M	Selkirks	12/13/11	Bait Station (Photo+DNA)	48.94582	-116.74344	1555
LS11	M	Selkirks	3/6/13	Bait Station (Photo+DNA)	49.09972	-117.02512	1588
FC1744AV2	M	Saint Joe	1/23/14	Bait Station (Photo+DNA)	47.22868	-115.30809	1764
FC1444CV2	M	Saint Joe	4/8/14	Bait Station (Photo+DNA)	47.36151	-115.70045	969
Unknown	U	W. Cabinets	1/15/11	Track (Photo)	48.23926	-116.11302	828
Unknown	U	W. Cabinets	3/24/11	Photo at Carcass	48.49971	-116.39590	882
Unknown	U	Selkirks	9/28/11	Photo at IPNF Bear Survey	48.78878	-116.60885	1848
Unknown	U	Saint Joe	11/20/13	Bait Station (Photo+DNA)	47.00672	-115.21117	1888
Unknown	U	Saint Joe	11/27/13	Bait Station (Photo)	47.07653	-115.16167	1595
Unknown	U	Saint Joe	4/10/14	Bait Station (Photo+DNA)	47.30472	-115.65991	1732

Table 4-7. Individual grizzly bears detected at forest carnivore bait stations and opportunistically in the Idaho Panhandle and adjacent mountain ranges during 2010-2014 field surveys. Reported coordinates are accurate to within 500 meters of actual location.

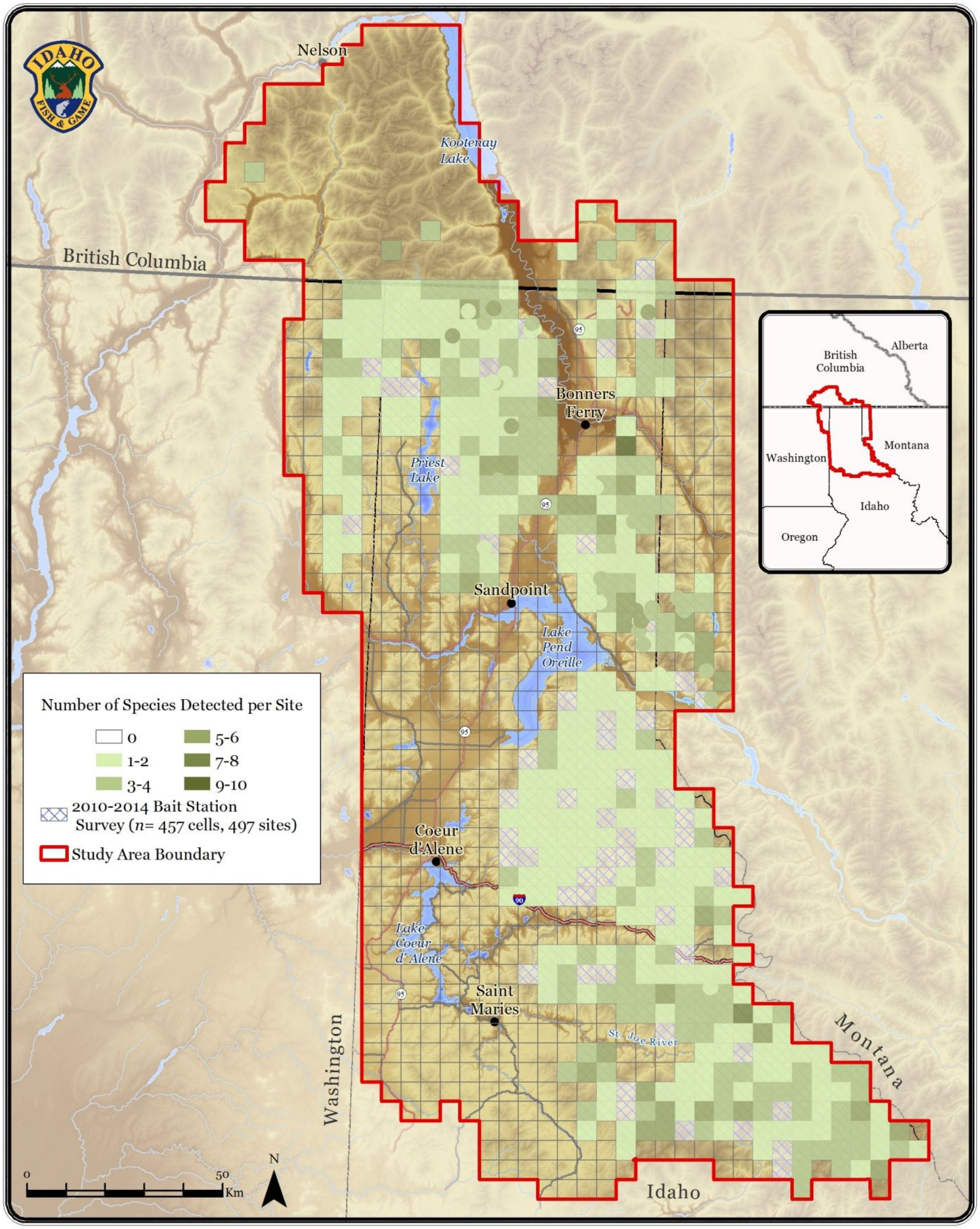
Individual	Gender	Mt. Range	Date	ID Method	Latitude	Longitude	Elevation (m)
C134B2V2	M	Selkirks	7/4/10	Bear Corral (DNA)	48.64205	-116.62307	1375
C134B2V2	M	Selkirks	4/12/12	Opportunistic Hair (DNA)	48.67865	-116.57740	1350
C81B10V1	M	Selkirks	7/16/10	Bear Corral (DNA)	48.82047	-116.94496	766
BronsonV2K	F	Selkirks	4/12/11	Bait Station (DNA+Photo)	48.92823	-116.51243	702
OMGR112	M	Selkirks	4/7/12	Opportunistic Hair (DNA)	48.95316	-116.55853	608
Unknown	U	Selkirks	8/1/10	Fisher Box (DNA)	48.81108	-117.24235	1240
Unknown	U	Purcells	9/10/12	Trail Camera	48.93629	-116.05739	1573
Unknown	U	Selkirks	5/22/14	Bait Station (Photo)	48.98668	-116.94183	976

Multi-species Baseline Initiative: Cells Surveyed With Winter Bait Stations



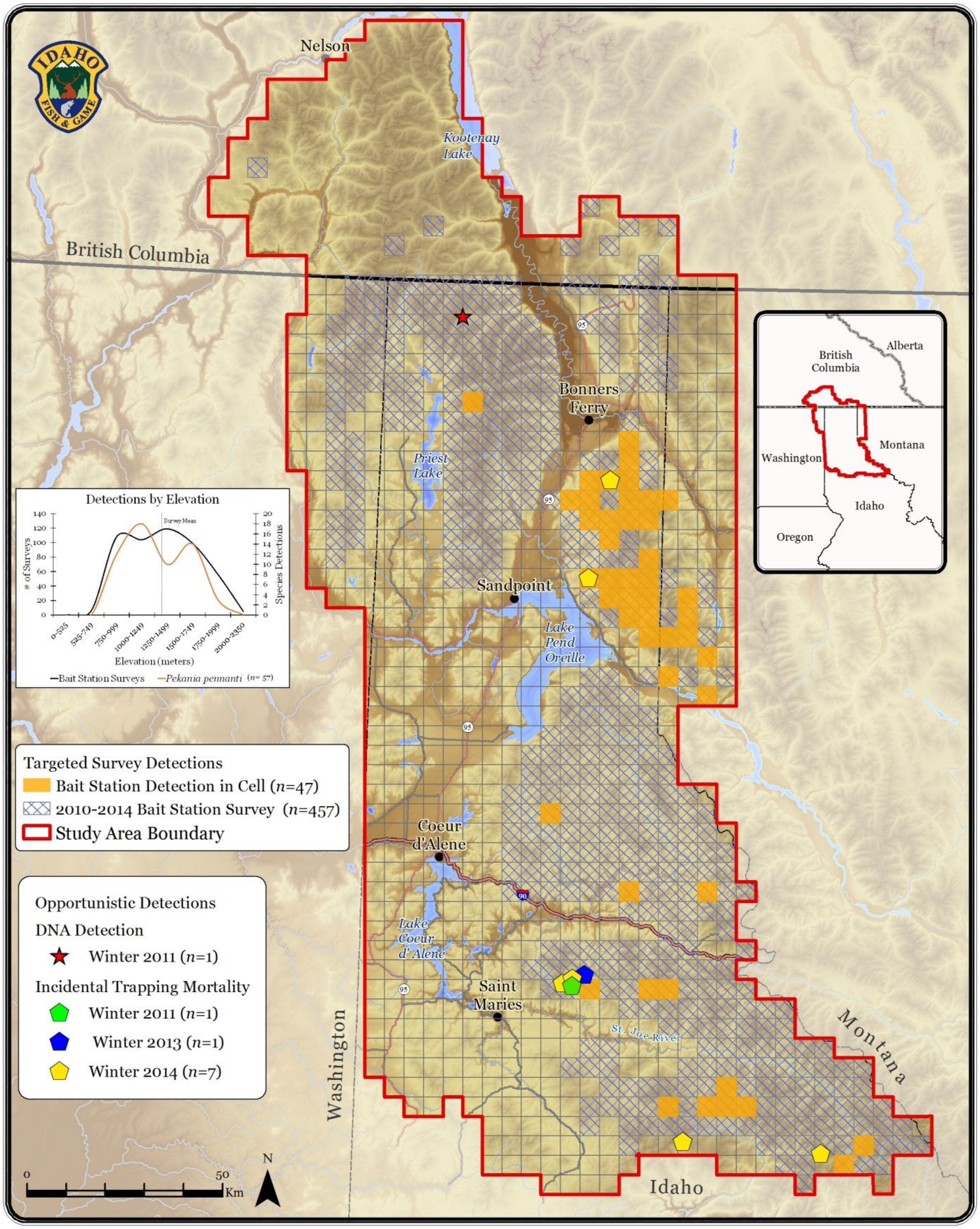
Map 4-1. 457 5x5 km cells surveyed using the winter bait station method 2010-2014.

Multi-species Baseline Initiative: Bait Station Species Richness



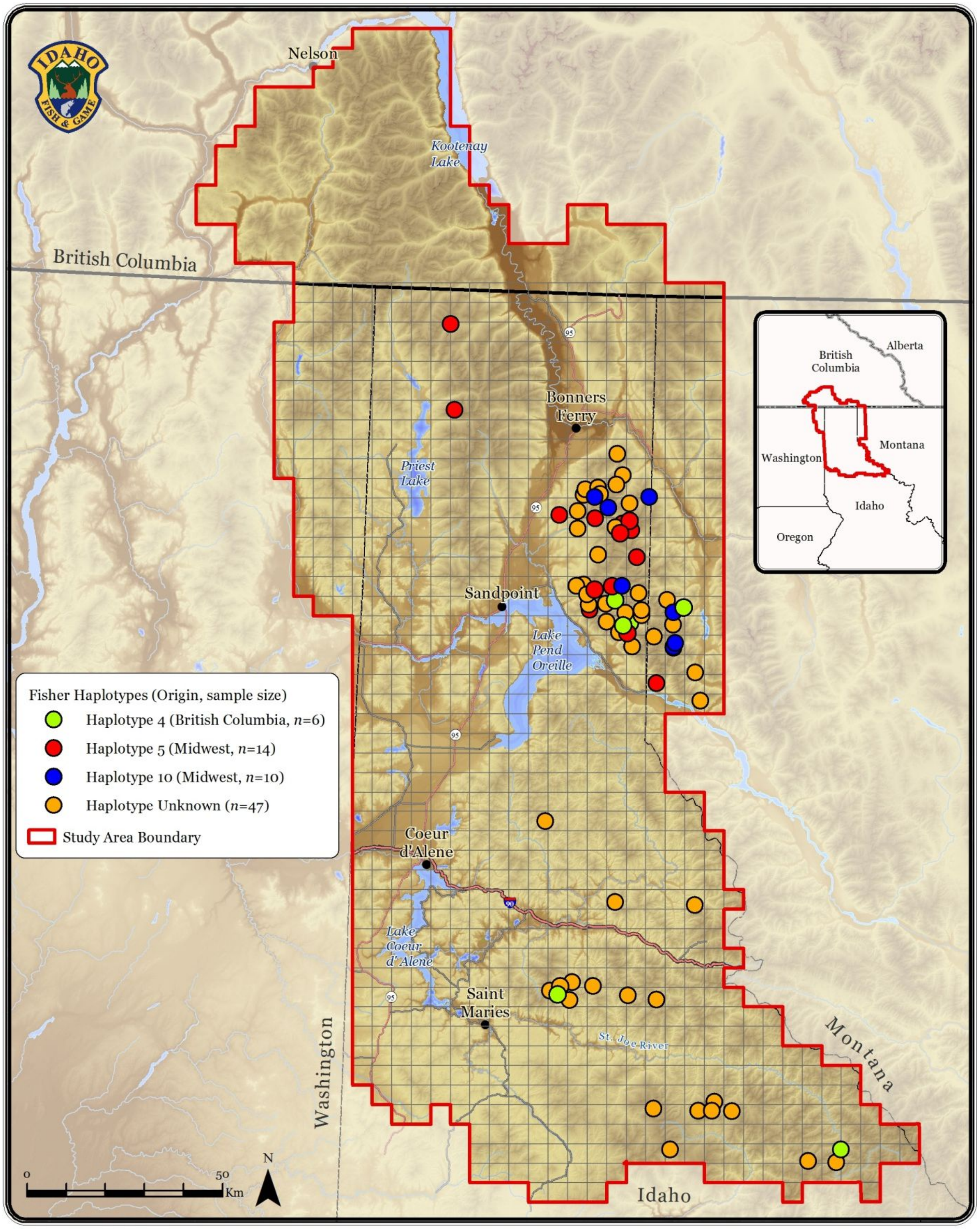
Map 4-2. Number of species detected during bait station surveys conducted from 2010-2014.

Multi-species Baseline Initiative: Fisher (*Pekania pennanti*) Detections



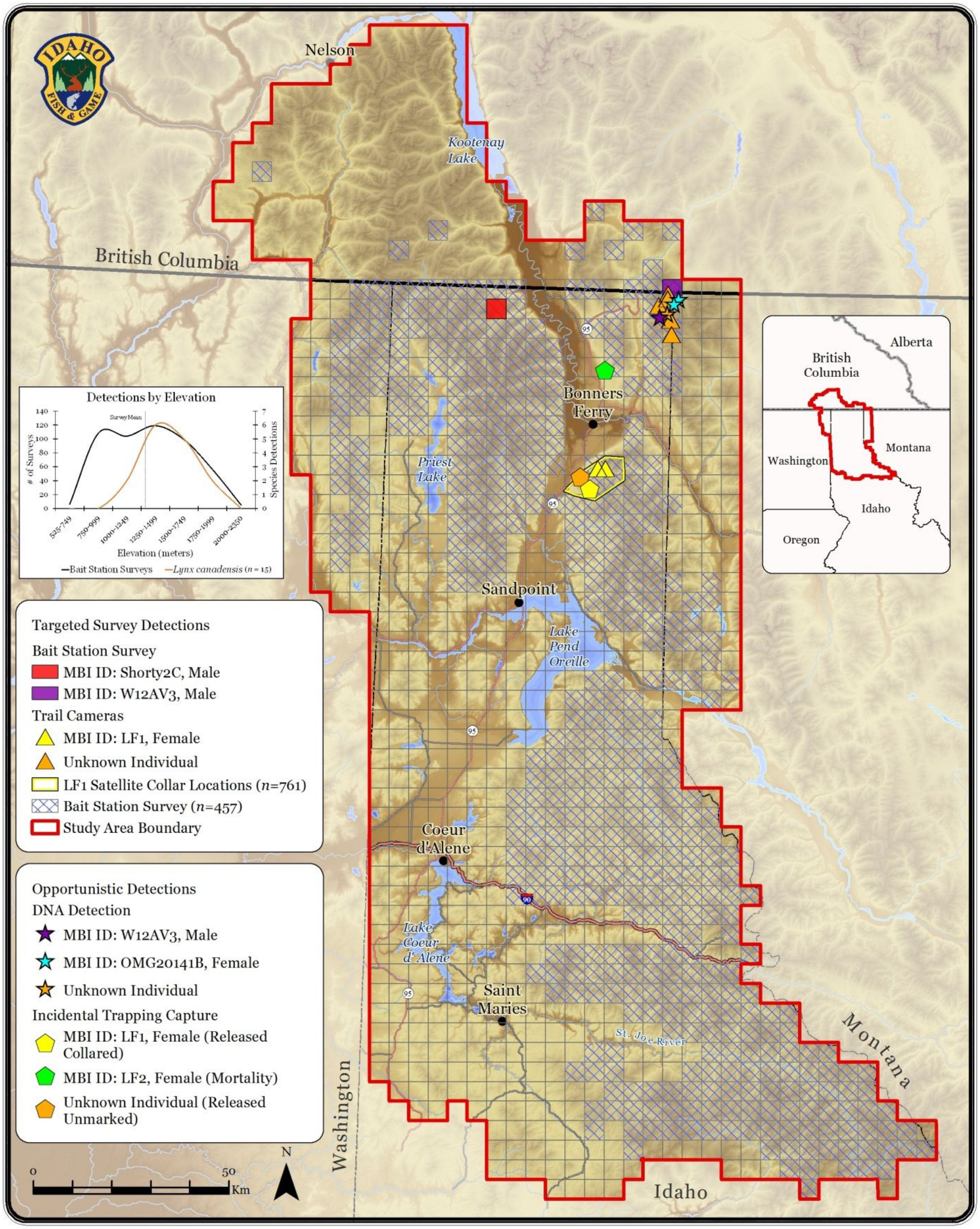
Map 4-3.

Multi-species Baseline Initiative: Fisher (*Pekania pennanti*) Control Region mtDNA Haplotypes



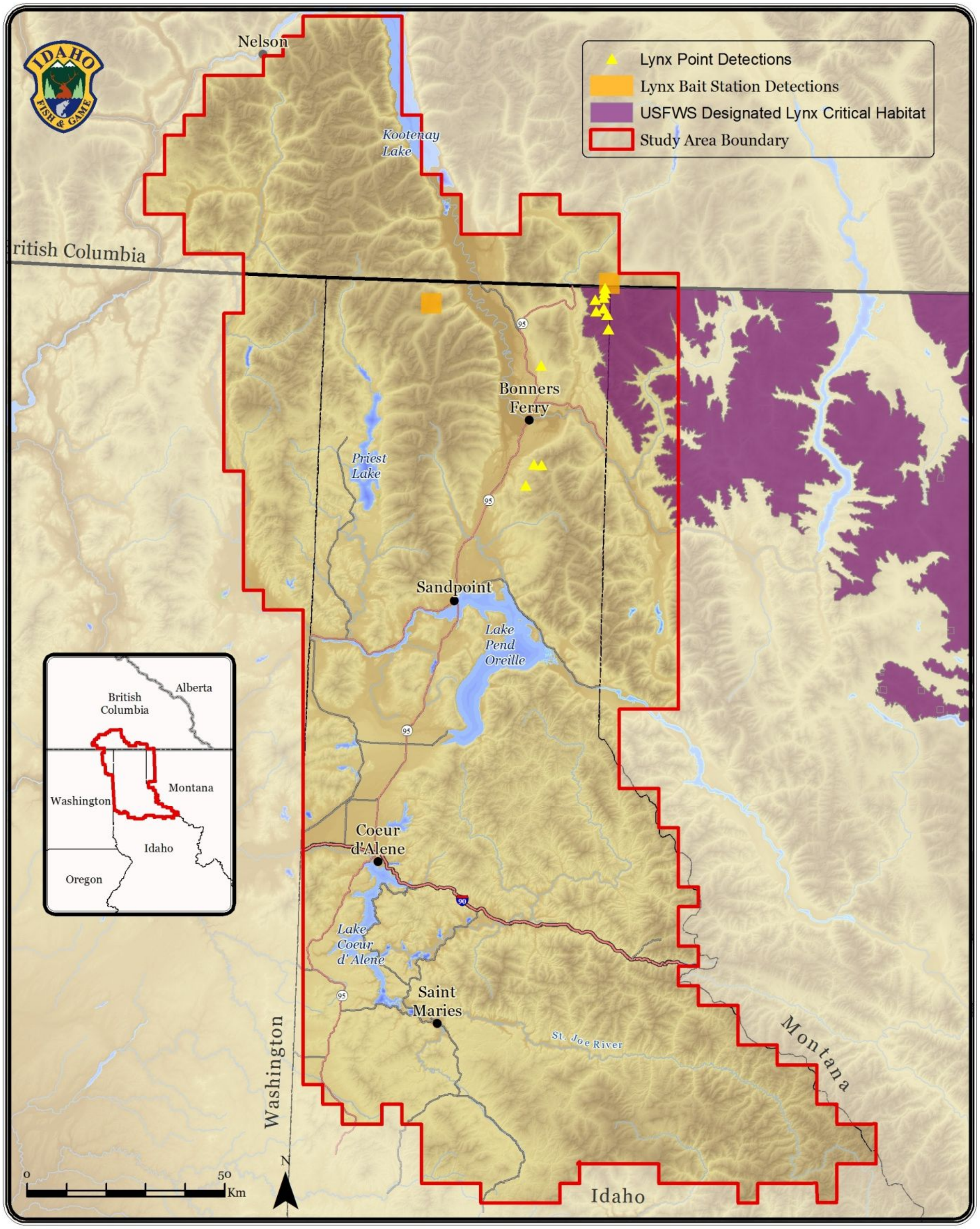
Map 4-4.

Multi-species Baseline Initiative: Canada Lynx (*Lynx canadensis*) Detections



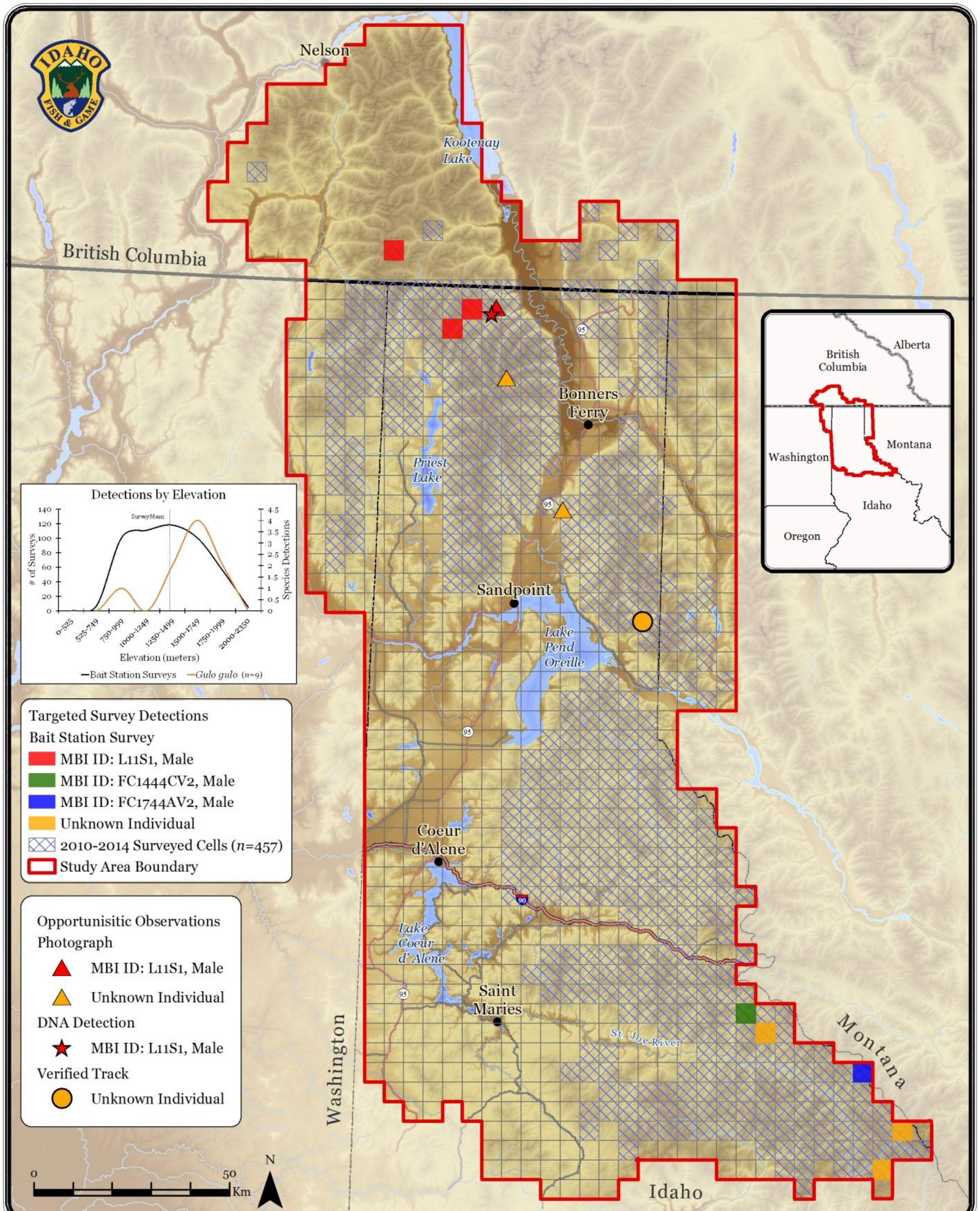
Map 4-5.

Multi-species Baseline Initiative: Lynx Detections and Critical Habitat



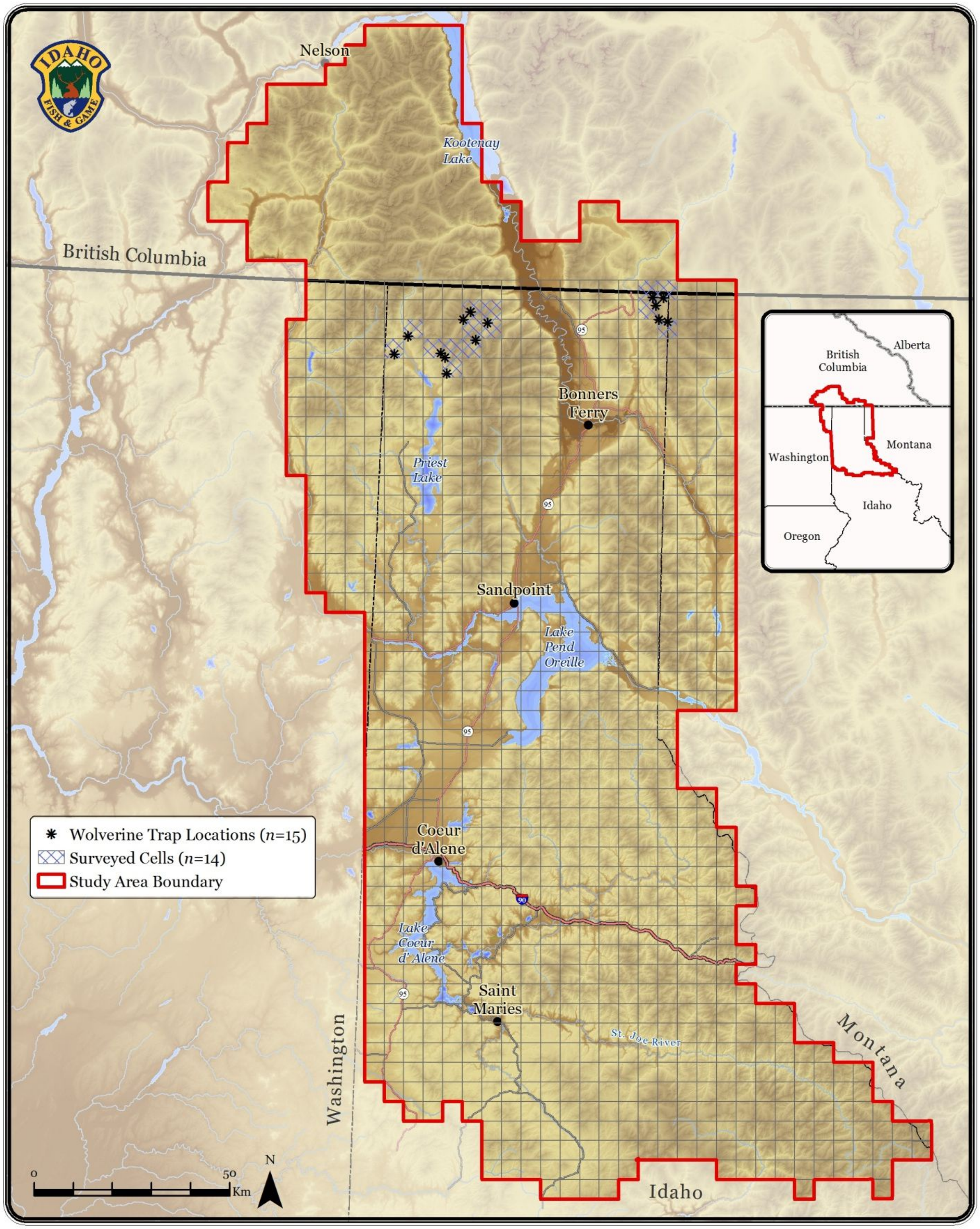
Map 4-6. USFWS designated critical lynx habitat and lynx detections in the Idaho Panhandle and adjacent mountain ranges from 2010-2014.

Multi-species Baseline Initiative: Wolverine (*Gulo gulo*) Detections



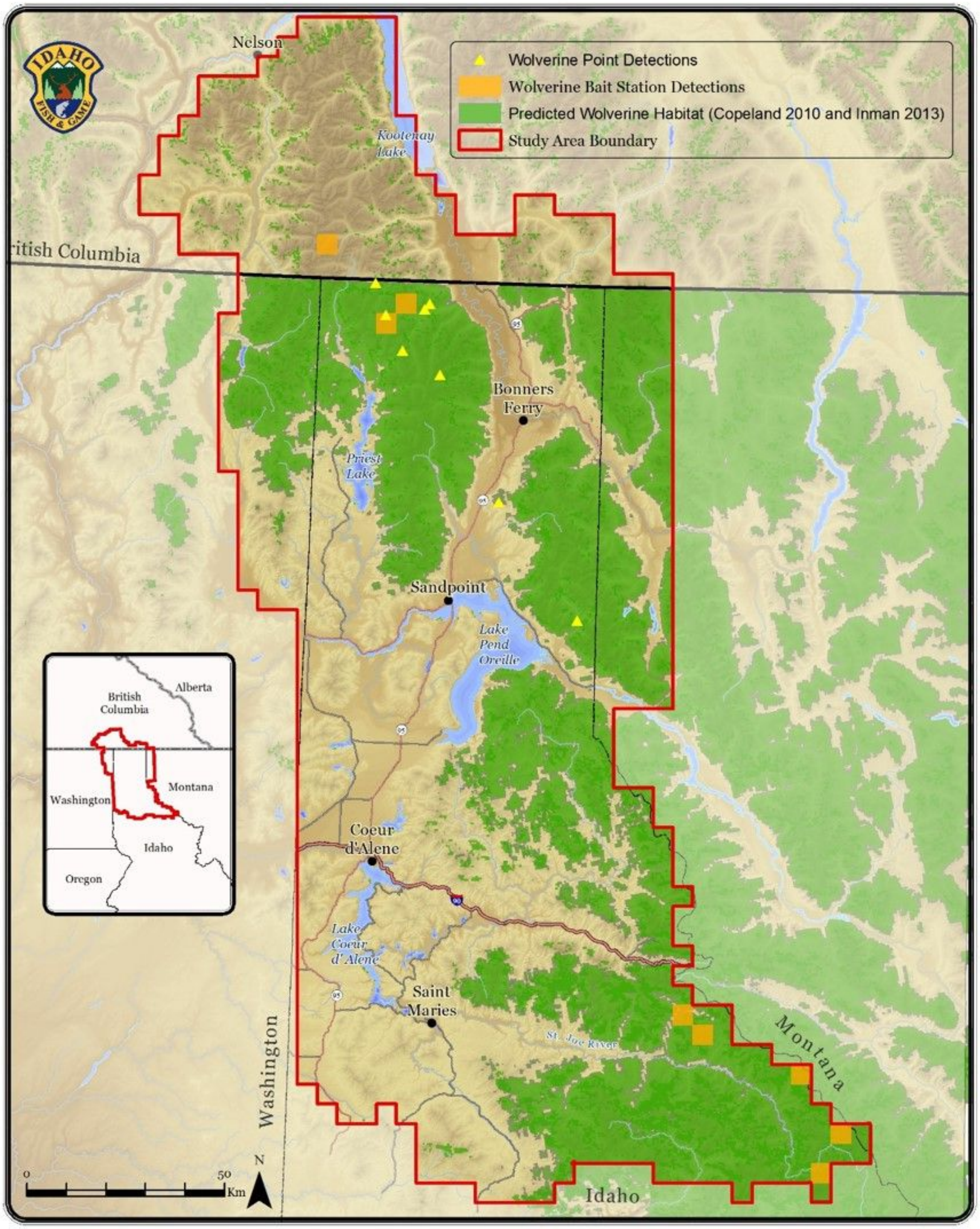
Map 4-7.

Multi-species Baseline Initiative: Wolverine (*Gulo gulo*) Trap Locations



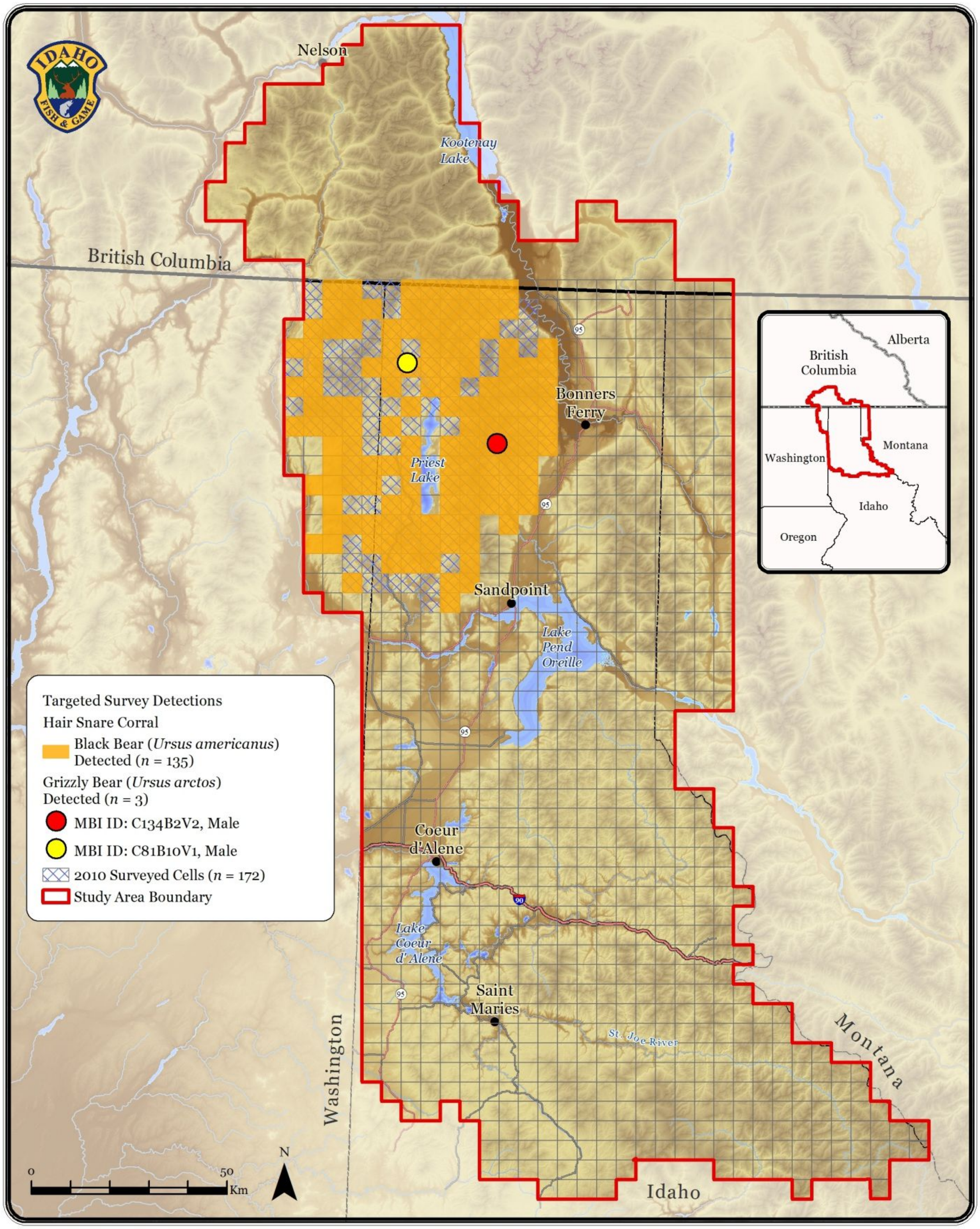
Map 4-8.

Multi-species Baseline Initiative: Wolverine Detections and Predicted Wolverine Habitat



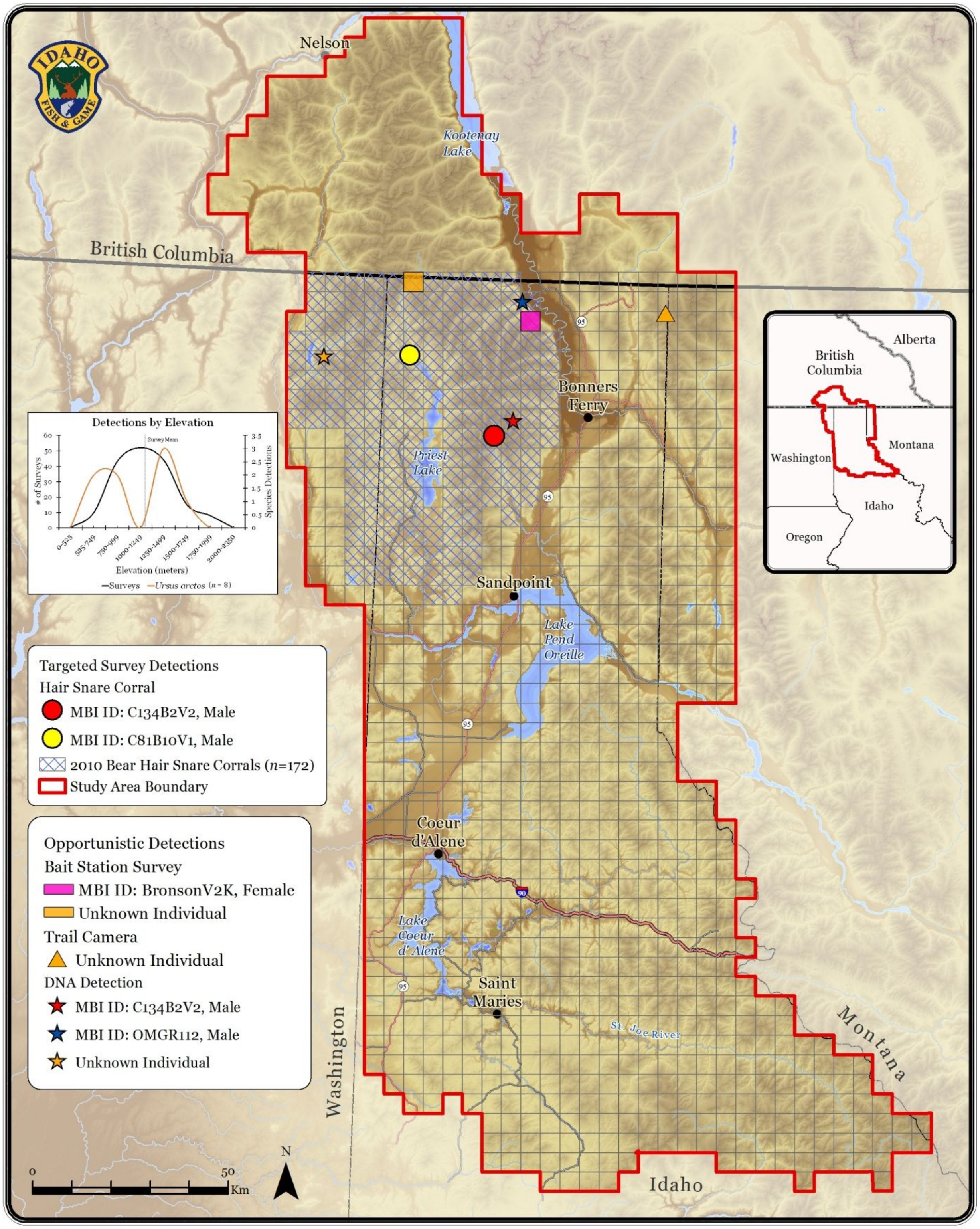
Map 4-9. Predicted wolverine habitat (Copeland 2010, Inman 2013), which is considered occupied by USFWS (USFWS 2013), and wolverine detections in the Idaho Panhandle and adjacent mountain ranges from 2010-2014.

Multi-species Baseline Initiative: Bear Hair Snare Corral Detections



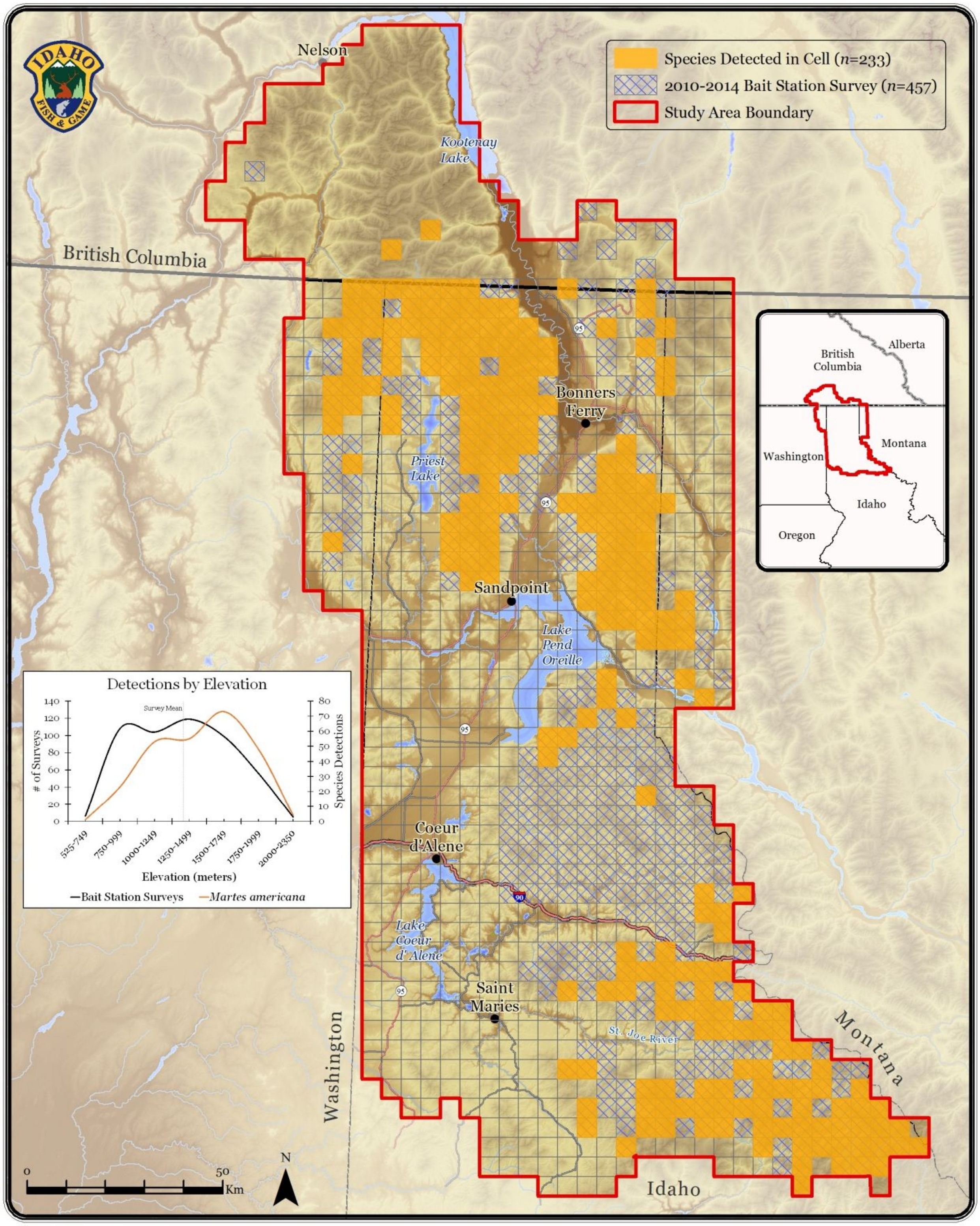
Map 4-10.

Multi-species Baseline Initiative: Grizzly Bear (*Ursus arctos*) Detections



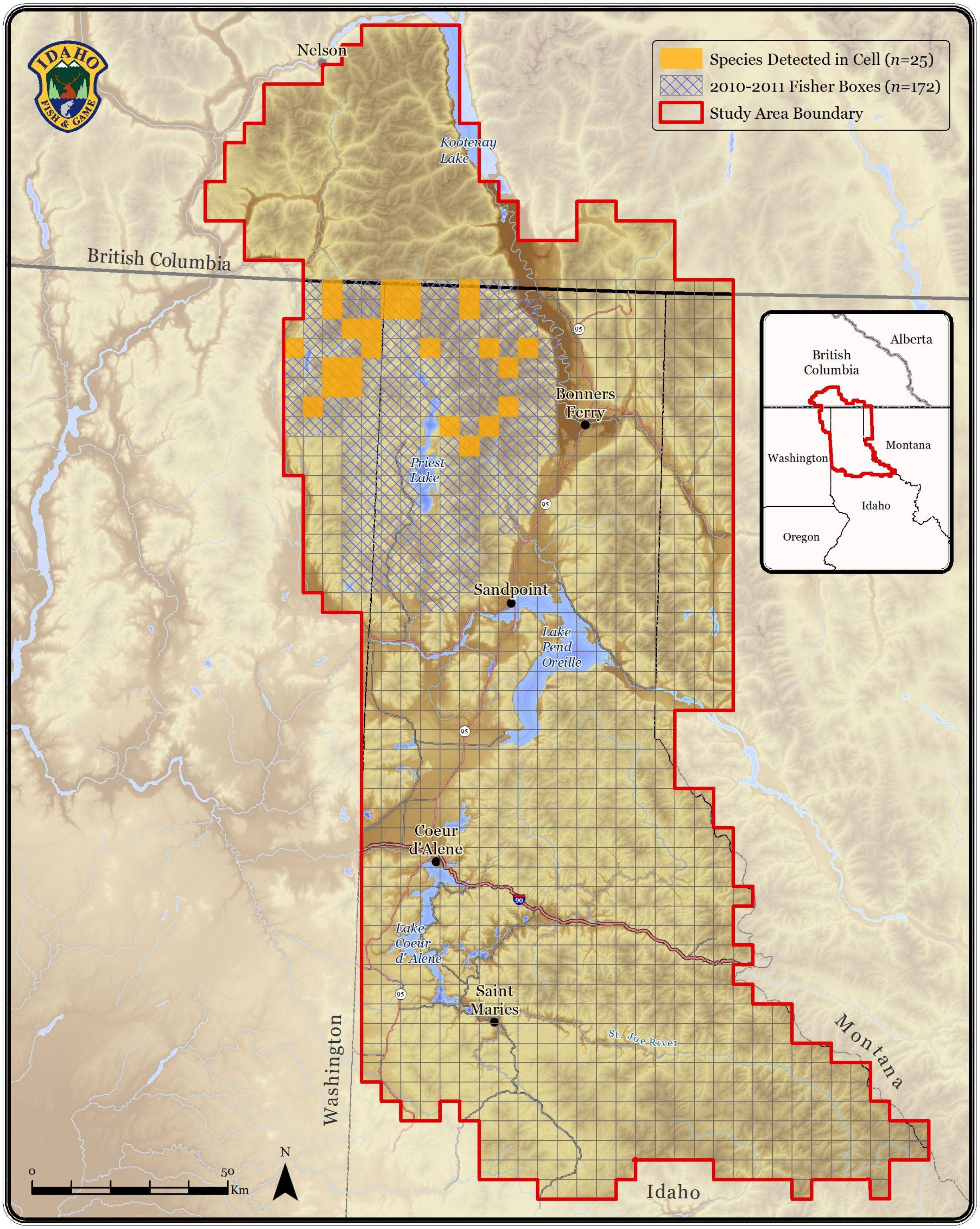
Map 4-11.

Multi-species Baseline Initiative: Marten (*Martes americana*) Detections



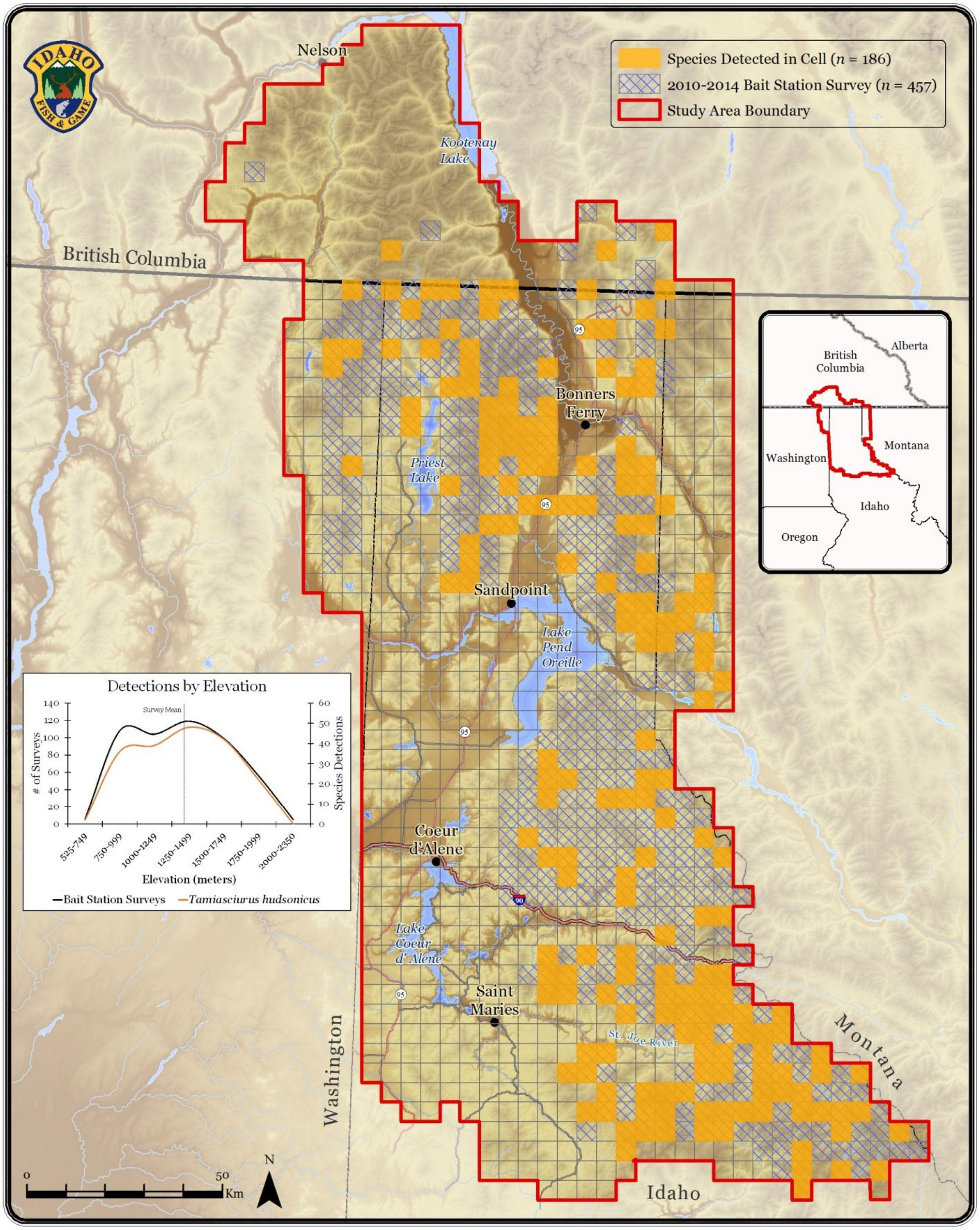
Map 4-12.

Multi-species Baseline Initiative: Marten (*Martes americana*) Detections in Summer Fisher Boxes



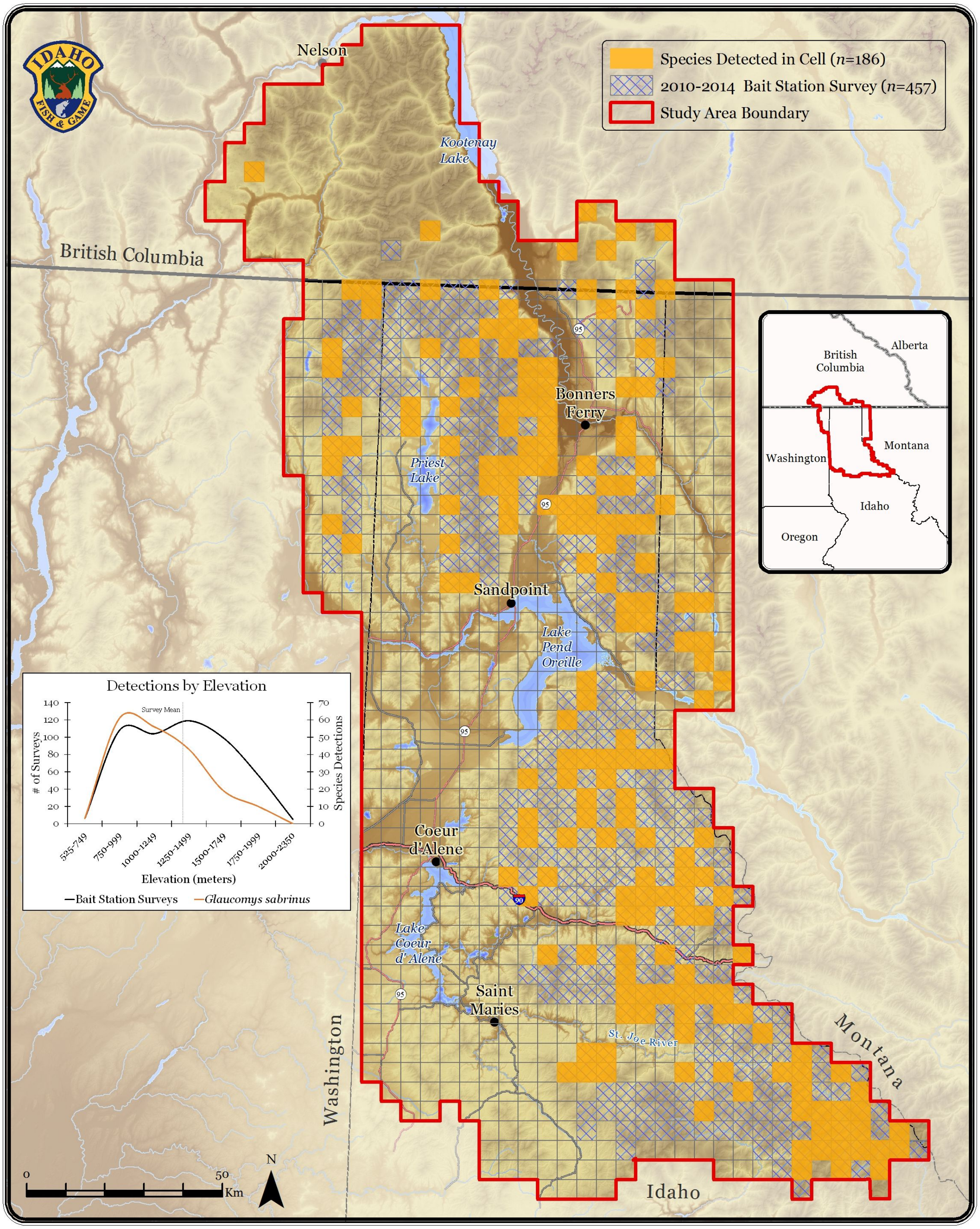
Map 4-13.

Multi-species Baseline Initiative: Red Squirrel (*Tamiasciurus hudsonicus*) Detections



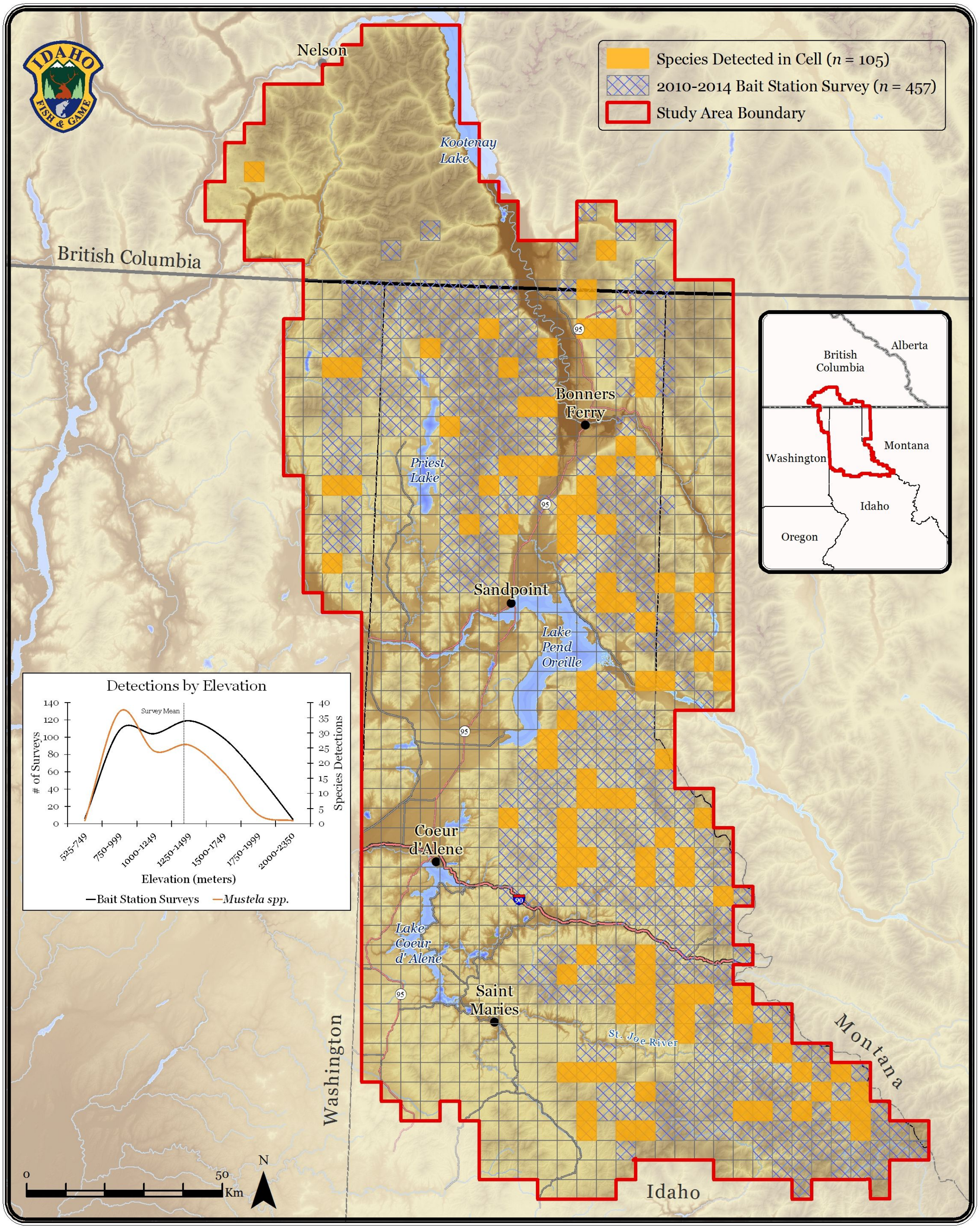
Map 4-14.

Multi-species Baseline Initiative: Northern Flying Squirrel (*Glaucomys sabrinus*) Detections



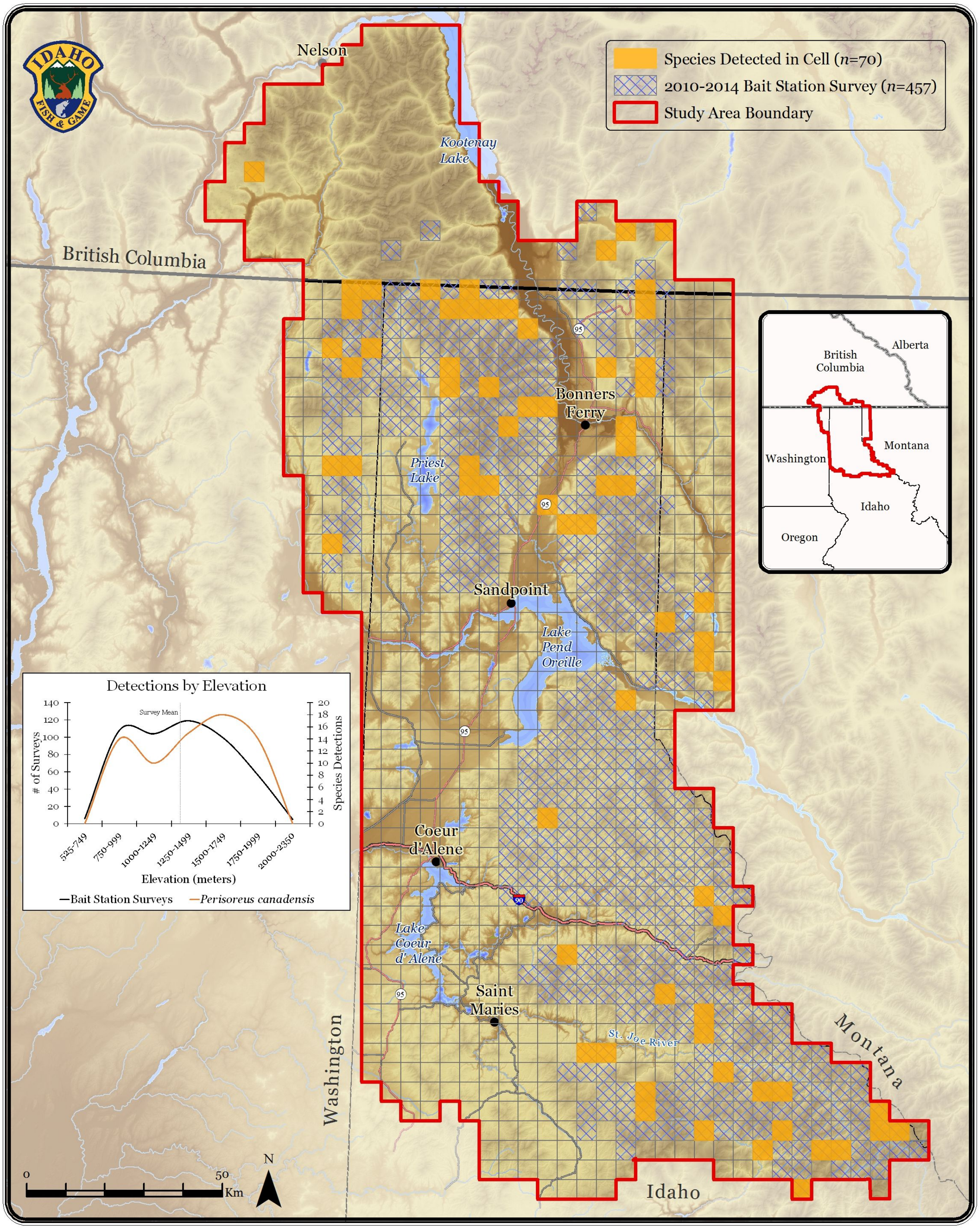
Map 4-15.

Multi-species Baseline Initiative: Weasel (*Mustela* spp.) Detections



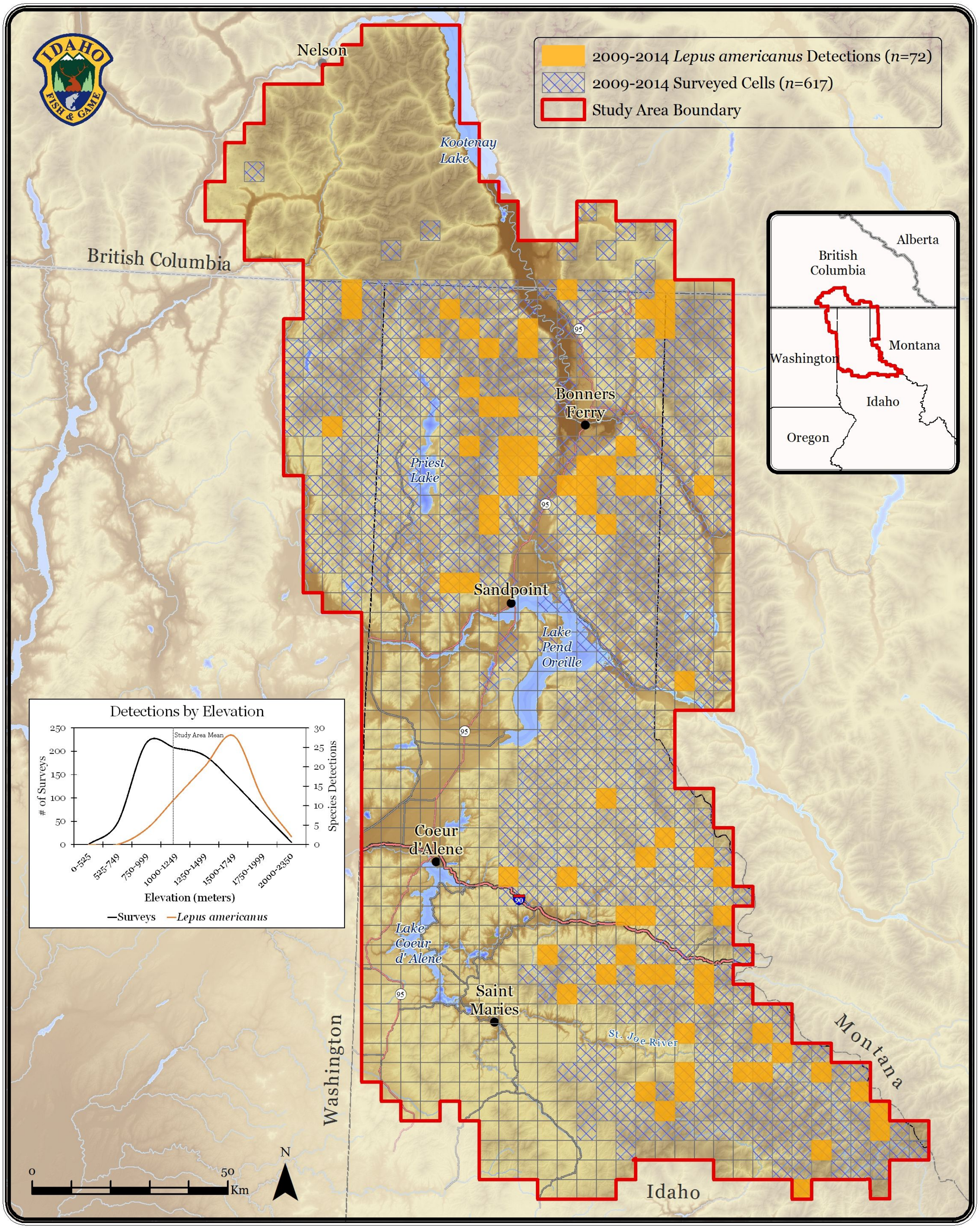
Map 4-16.

Multi-species Baseline Initiative: Gray Jay (*Perisoreus canadensis*) Detections



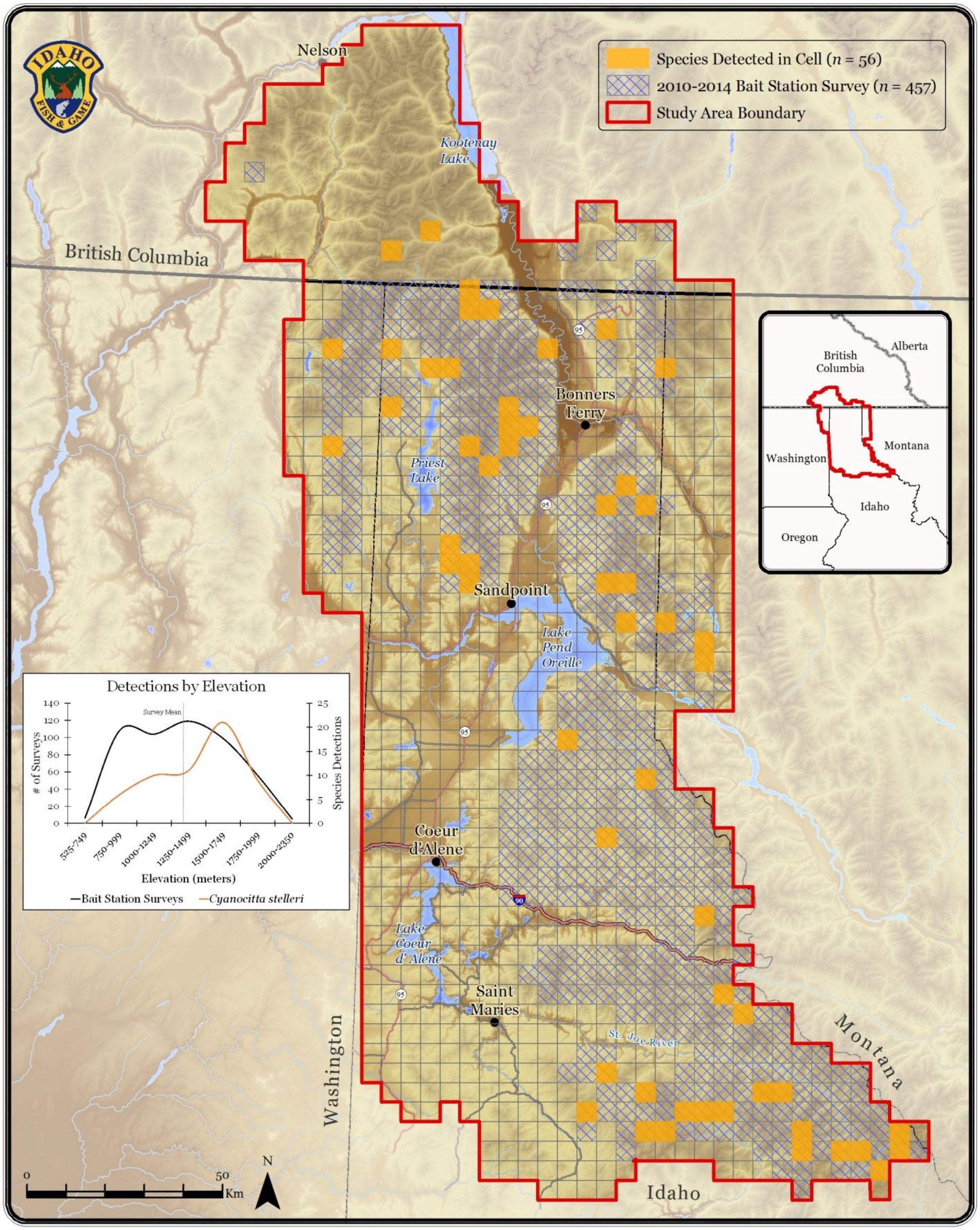
Map 4-17.

Multi-species Baseline Initiative: Snowshoe Hare (*Lepus americanus*) Detections



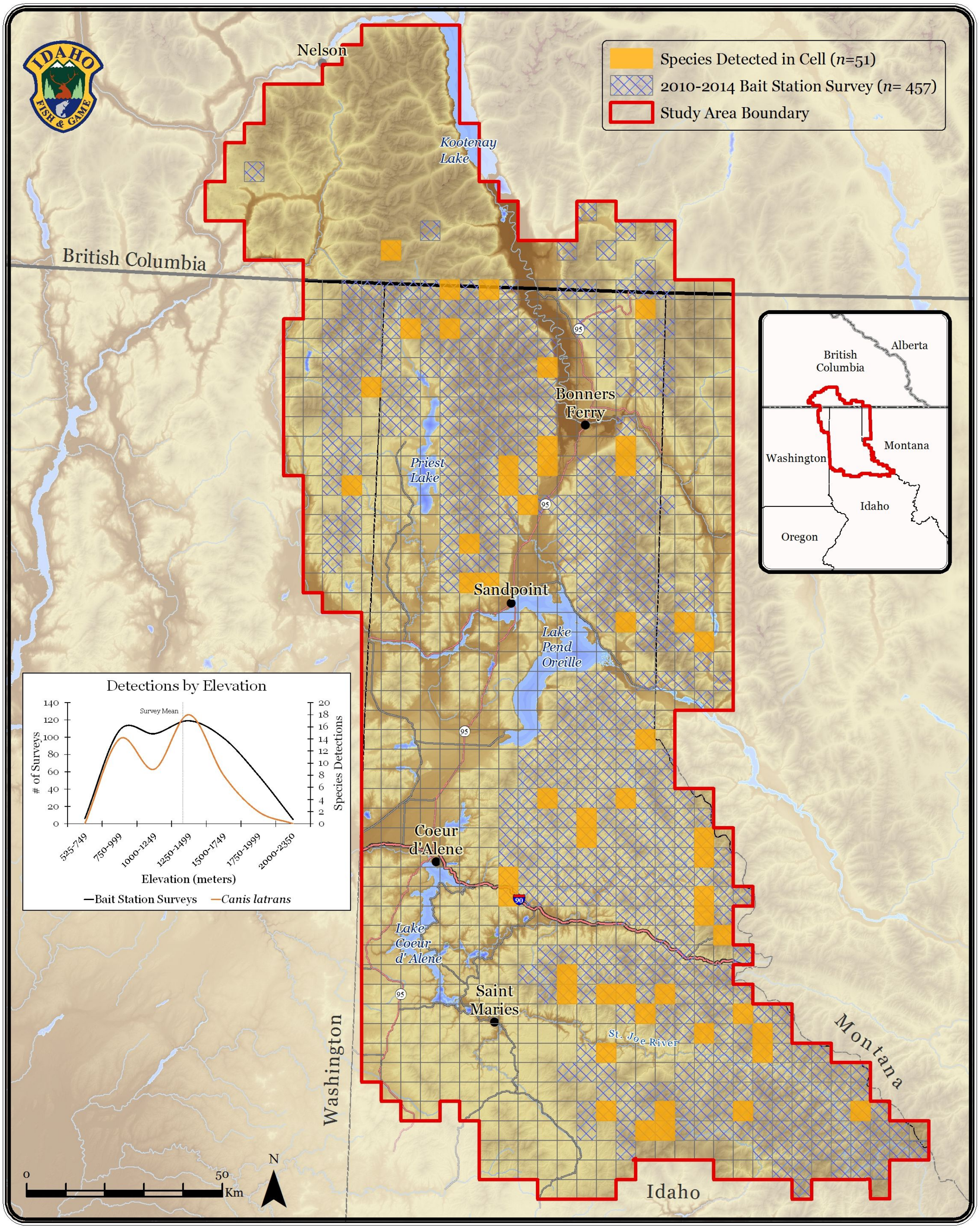
Map 4-18.

Multi-species Baseline Initiative: Steller's Jay (*Cyanocitta stelleri*) Detections



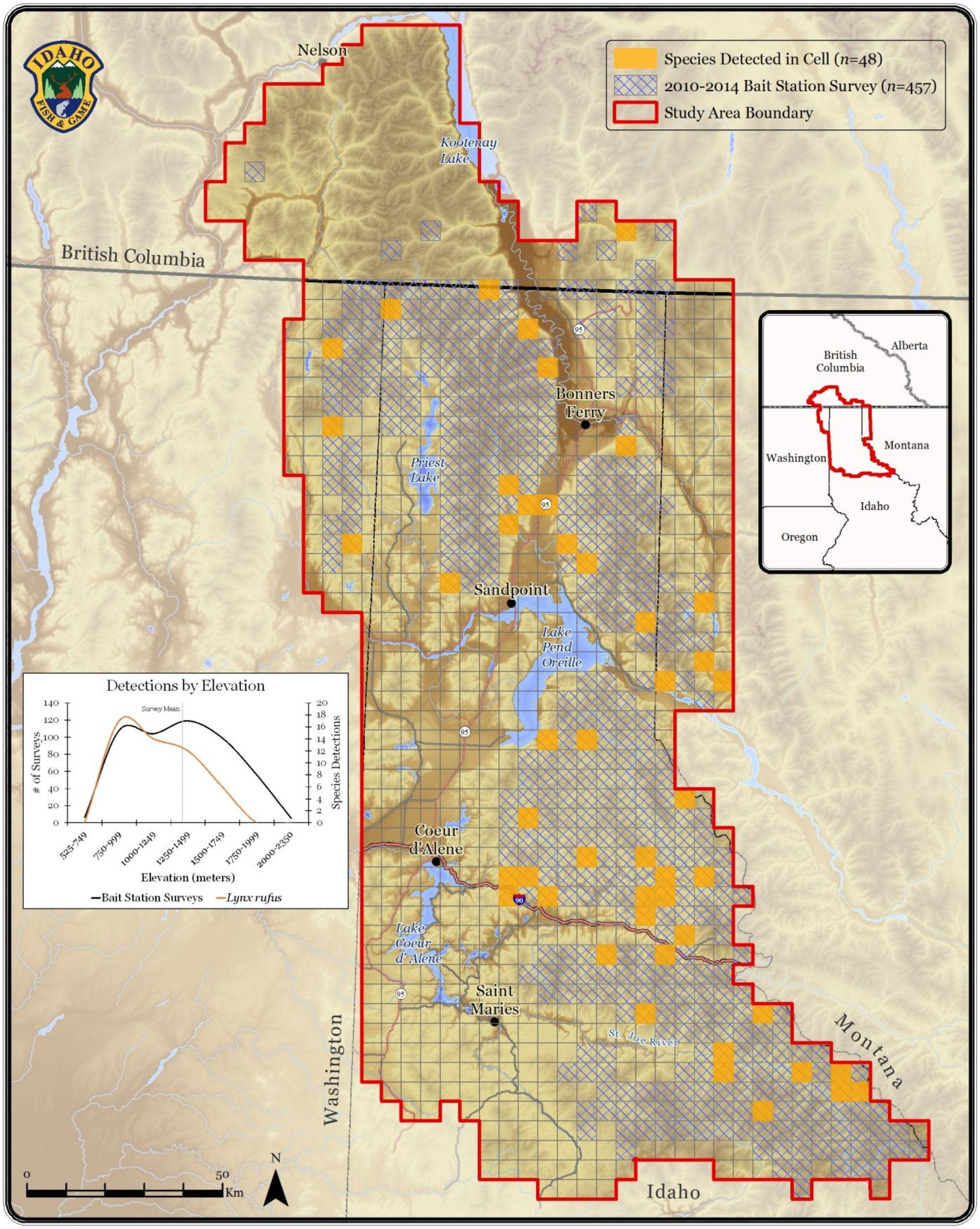
Map 4-19.

Multi-species Baseline Initiative: Coyote (*Canis latrans*) Detections



Map 4-20.

Multi-species Baseline Initiative: Bobcat (*Lynx rufus*) Detections



Map 4-21.

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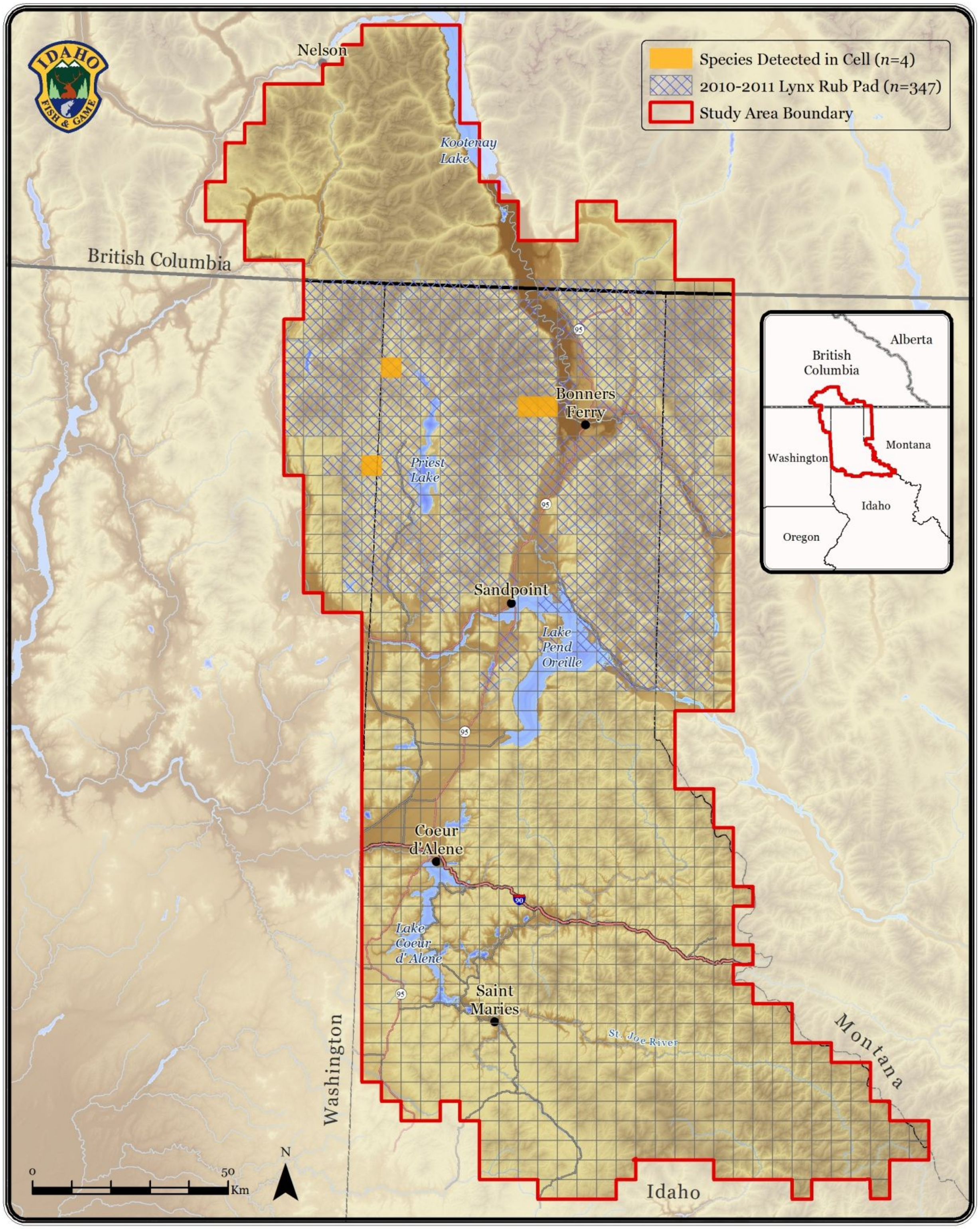
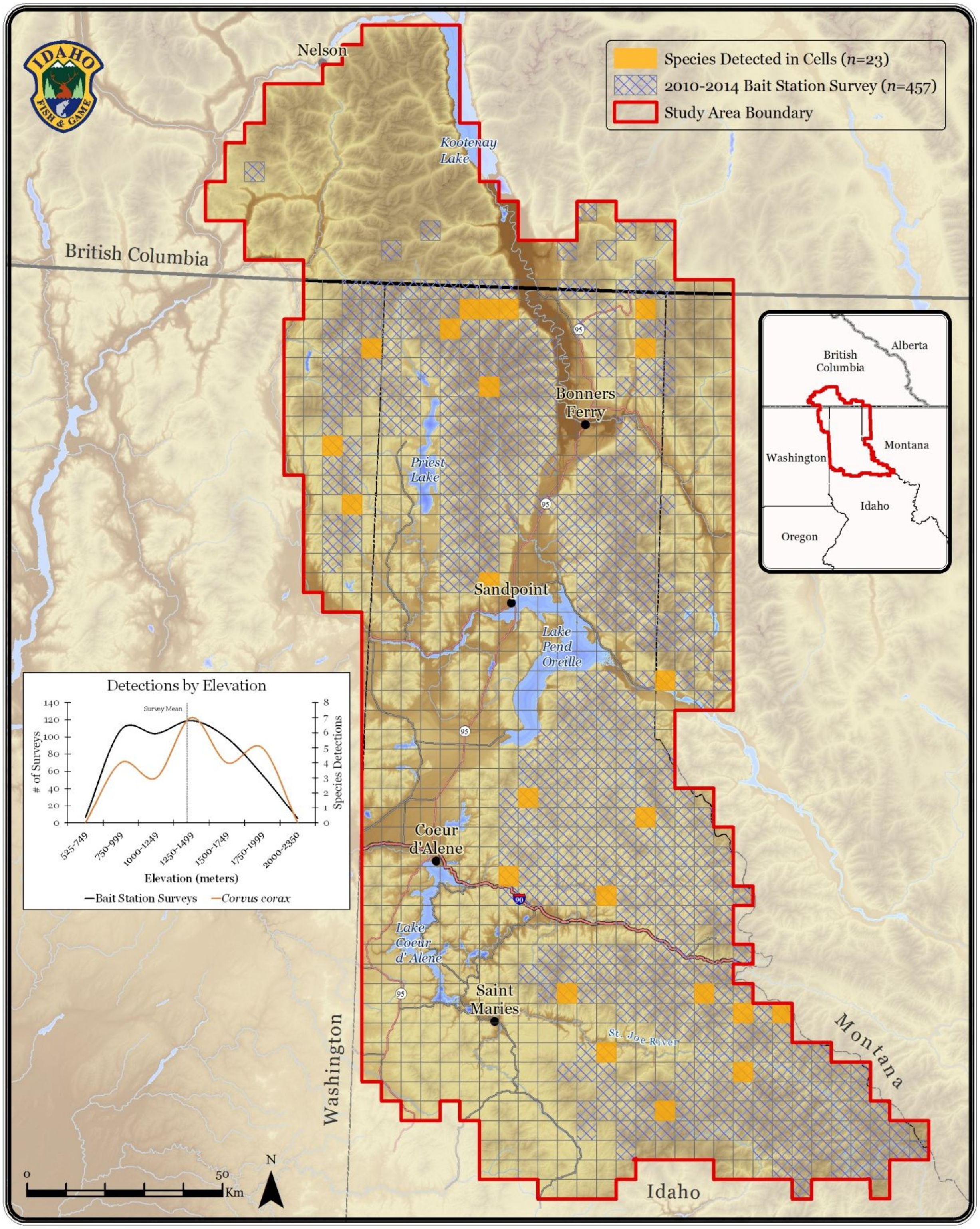
Multi-species Baseline Initiative: Bobcat (*Lynx rufus*) Detections at Summer Lynx Rub Pads



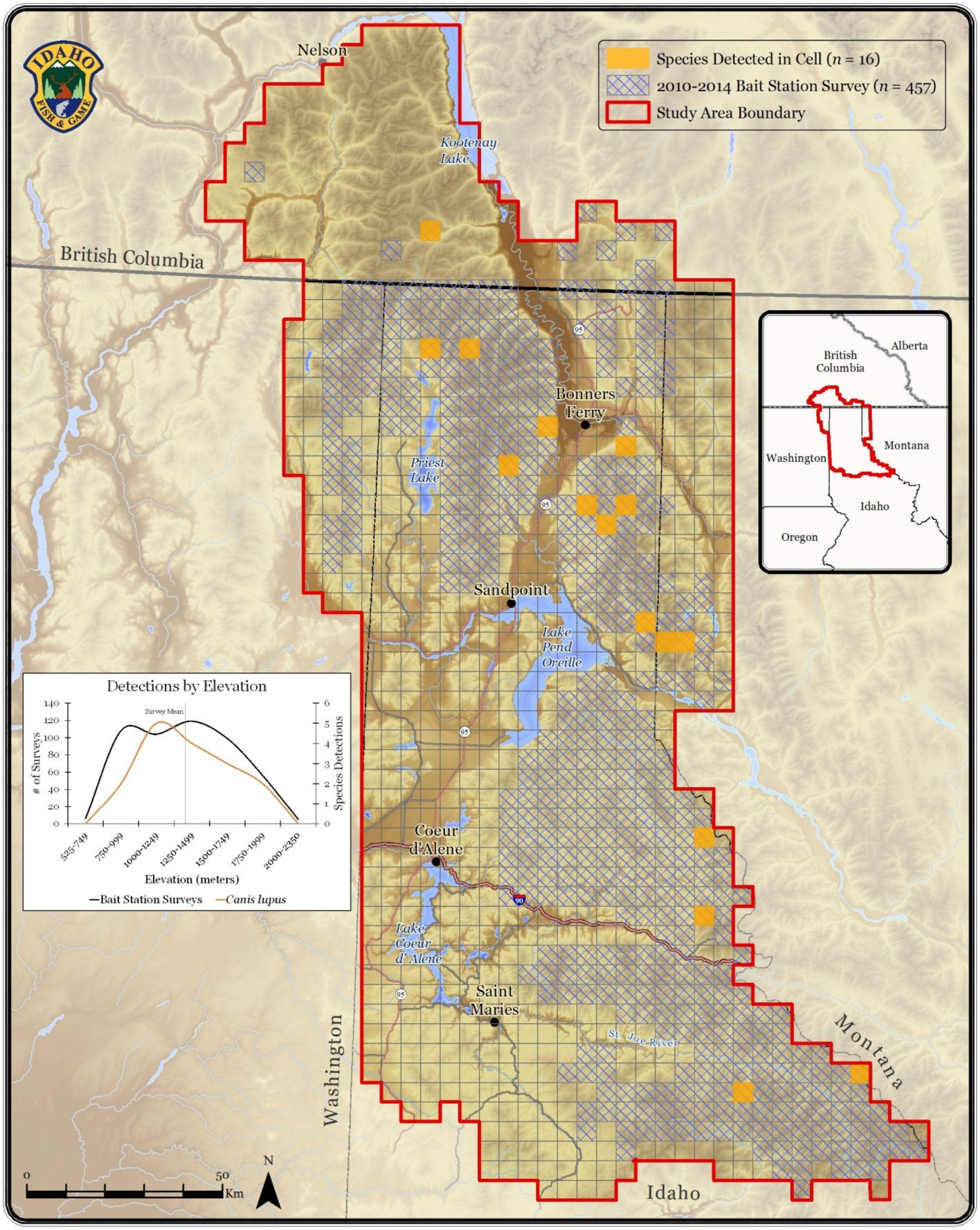
Map 4-22.

Multi-species Baseline Initiative: Common Raven (*Corvus corax*) Detections



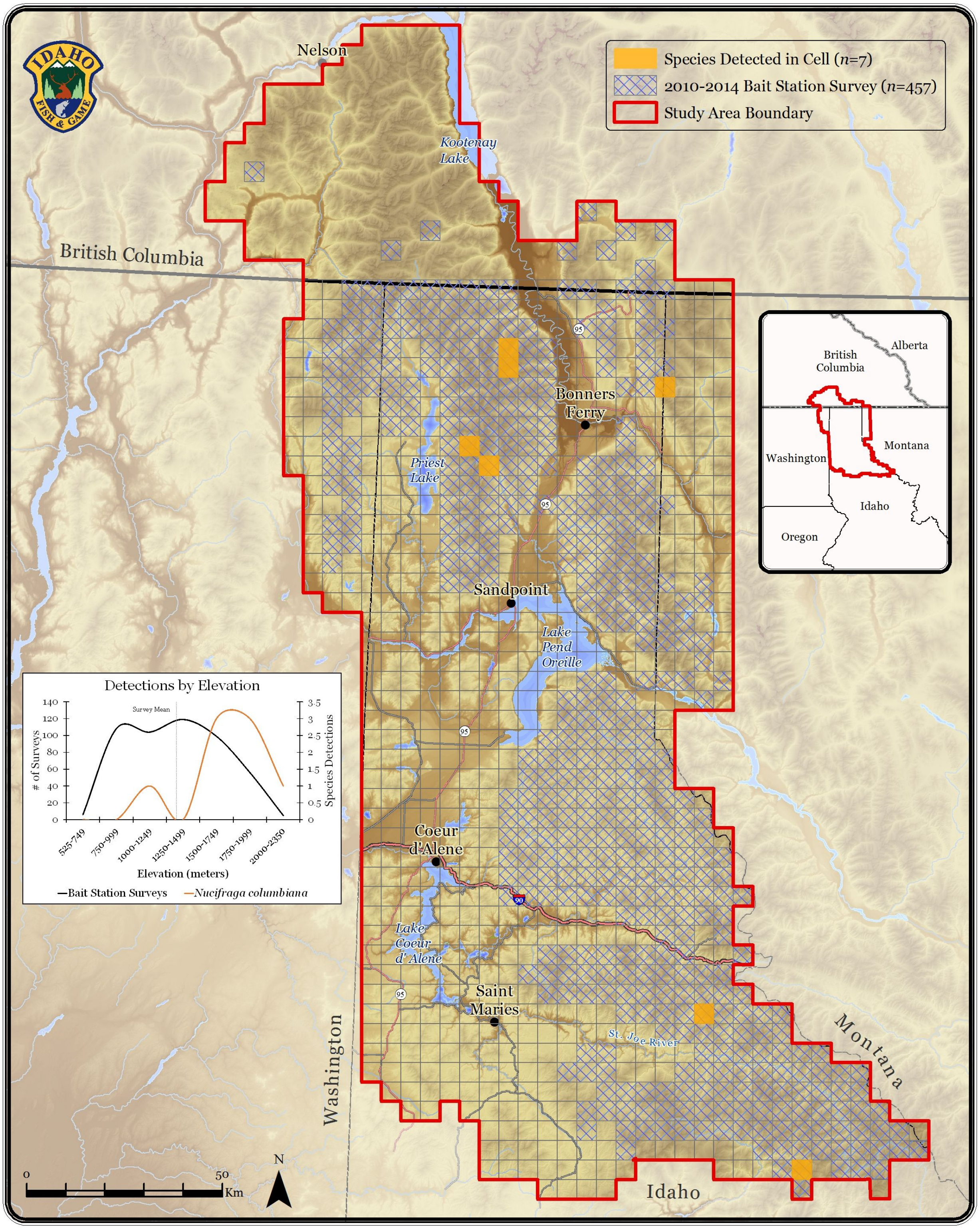
Map 4-23.

Multi-species Baseline Initiative: Wolf (*Canis lupus*) Detections



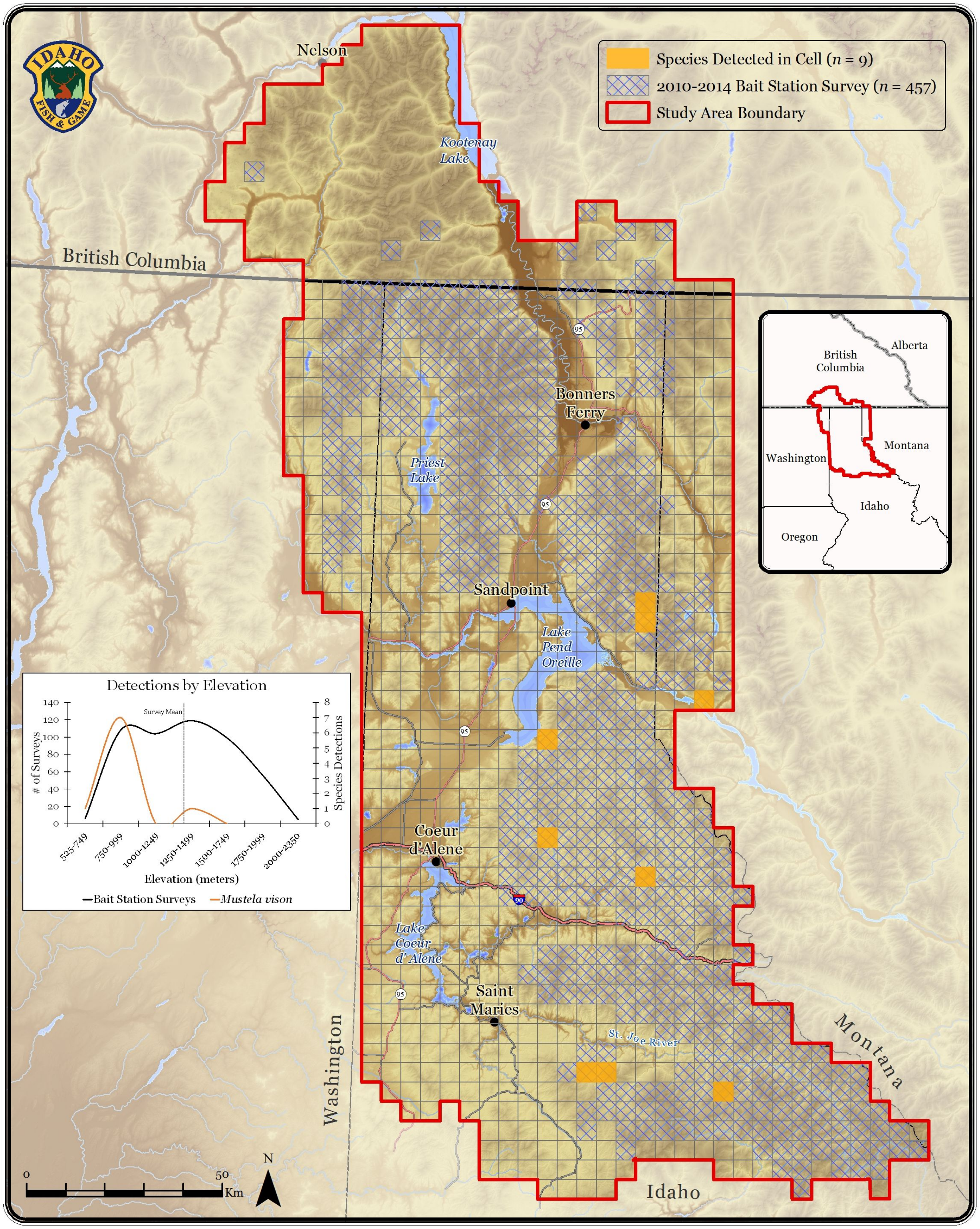
Map 4-24.

Multi-species Baseline Initiative: Clark's Nutcracker (*Nucifraga columbiana*) Detections



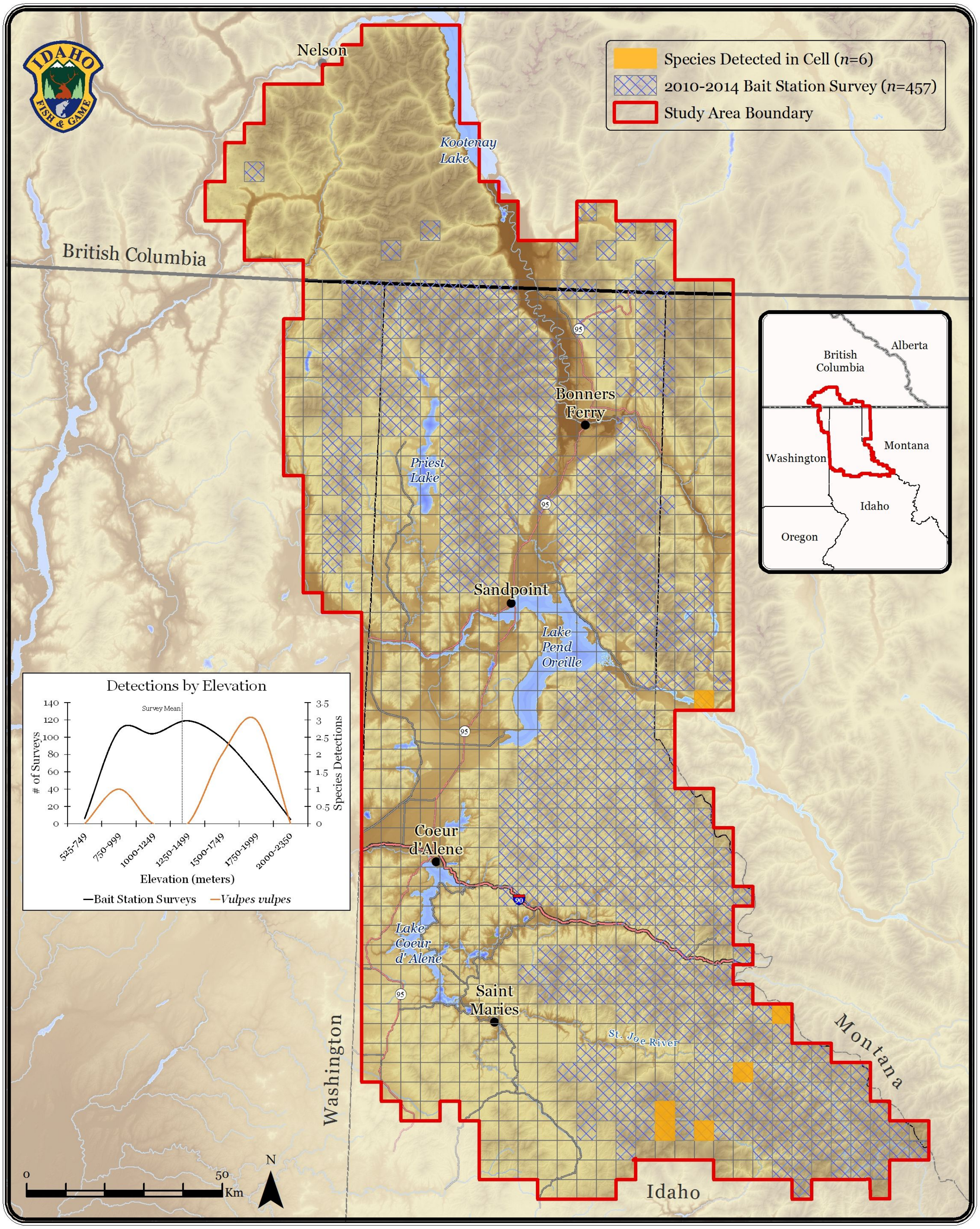
Map 4-25.

Multi-species Baseline Initiative: Mink (*Mustela vison*) Detections



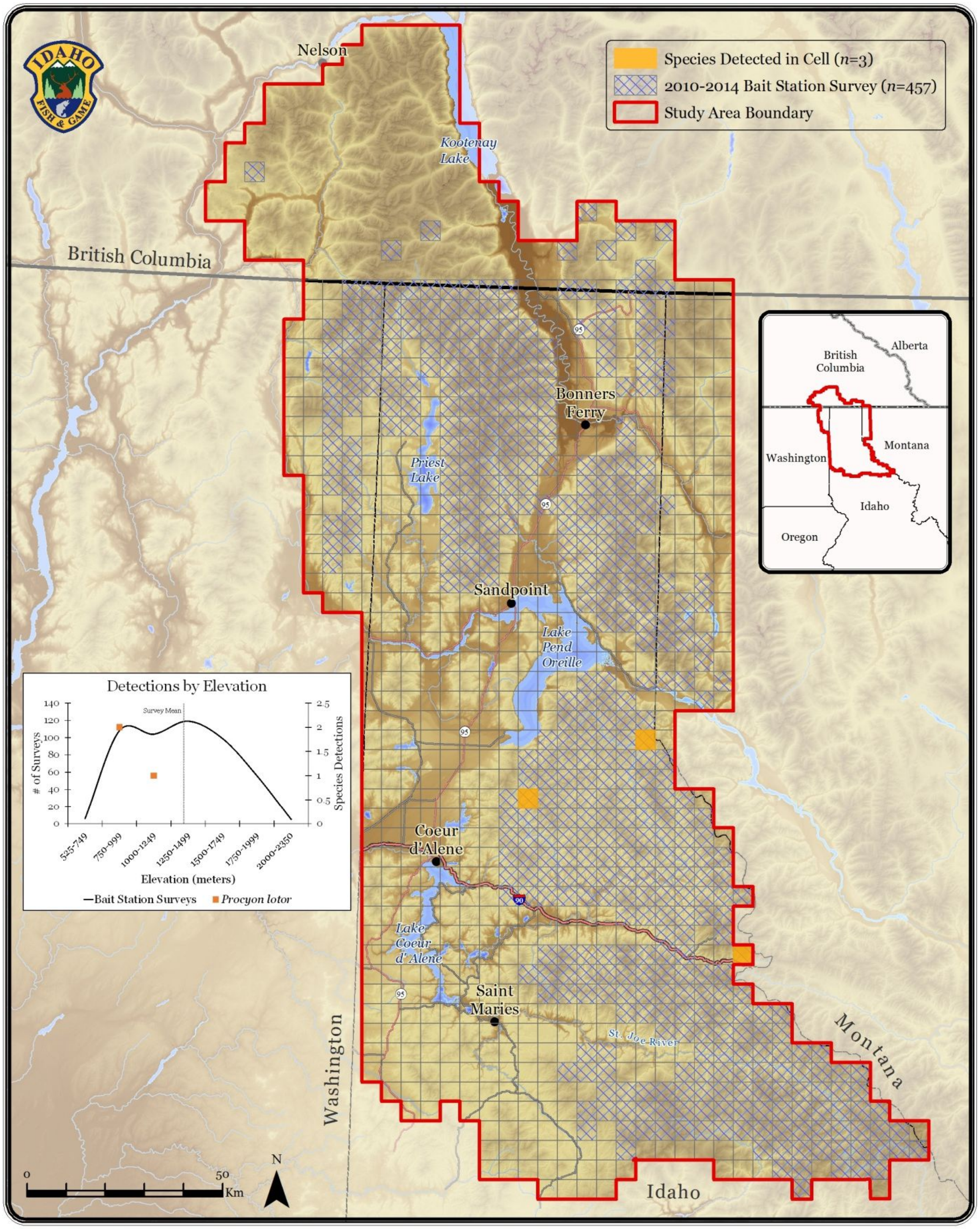
Map 4-26.

Multi-species Baseline Initiative: Red Fox (*Vulpes vulpes*) Detections



Map 4-27.

Multi-species Baseline Initiative: Raccoon (*Procyon lotor*) Detections



Map 4-28.

CHAPTER 5. Microclimate - Multi-species Baseline Initiative

Introduction

Global climate change is expected to have widespread effects on temperature and precipitation regimes worldwide and mean annual global air temperatures are predicted to rise 2-4.5°C by the end of this century (Meehl et al. 2007). Conditions in the Pacific Northwest are expected to trend toward hotter drier summers and warmer wetter winters (Karl 2009). How wildlife populations will respond to these changes is uncertain. A clear understanding of local climatic landscapes and climatic requirements of wildlife species is the first step toward managing landscapes to reduce potential climatic stressors on wildlife species but empirical data to evaluate basic climatic requirements for most species are lacking (Mawdsley 2009).

Delineating climatic requirements for species will inform landscape management on multiple spatial scales. On the macro-scale, a regional air temperature map could pinpoint cooler sections of the landscape which may be more important to species dependent on late spring snowpacks such as wolverines (*Gulo gulo*) (Inman et al. 2012). These areas may become more important both for wolverines and winter recreationists and careful planning now could help prevent future conflicts. Data collection for regional maps can be done simultaneously with the collection of micro-climate data for less vagile species such as terrestrial gastropods. The identification of species with specific climatic requirements may allow implementation of micro-habitat management techniques which could reduce the effects of climate change at micro-sites.

Available micro-climate data from our study area are limited. Several networks of micro-climate data loggers and weather stations have been deployed in portions of our study area in recent years (Holden et al. 2011, Holden et al. 2015). Additionally, a variety of stream water temperature data loggers (Isaak 2015) and 15 Snowtel sites also occur within our study area. Lacking completely from our study area are water temperature data for small (≤500 meter diameter) lentic ponds. To our knowledge, micro-climate data loggers have never been co-located with wildlife survey locations within our study area.

The Idaho (2005) and Washington (2005) State Wildlife Action Plans did not address climate change. Because Idaho and Washington both planned to incorporate climate change into the 2015 SWAP revisions, the MBI Competitive State Wildlife Grant was funded in part to address the emerging issue of climate change. Our goals were to 1) develop an air temperature map of the study area, 2) delineate air or water temperature envelopes for individual species 3) develop a baseline micro-climatic data set including air temperature, water temperature, and relative humidity variables to be available for use by other researchers and resource managers.

Methods

Study Design

We stratified our 22,975km^2 study area into 920 5x5km sampling grids (Map 5-1) and deployed at least one air temperature data logger for a minimum of twelve months in 803 cells. We did not install air temperature loggers in 116 cells because we were unable to gain access to privately owned land or lacked a suitable location for the logger at the survey site. We selected our terrestrial survey sites in 3 ways (see Chapter 2, Invertebrates for more detail): 1) technicians selected sites while in the field (*n* = 172), 2) randomly but biased to roads and trails (*n* = 670), or

3) sub-selected from randomly selected Forest Inventory and Analysis (FIA) plots (*n* = 150). We attempted to deploy water temperature data loggers at ponds which fell in the same survey cell as the 150 FIA plots. However, we were only able to successfully find ponds in 55 (37%) FIA cells. Therefore, we deployed the remaining water temperature loggers as ponds became available.

In total, we deployed air temperature data loggers at 951 sites for 1 (*n* = 549), 2 (*n* = 27), 3 (*n* = 290), or 4 (*n* = 85) years. We deployed relative humidity data loggers at 200 sites and 151 water temperature data loggers at 133 ponds. All data loggers were synchronized to collect a data point every 90 minutes. This document provides a summary of climate data collected from September 1, 2013-August 31, 2014. Data collected prior to September 1, 2013 will be used for future analyses.

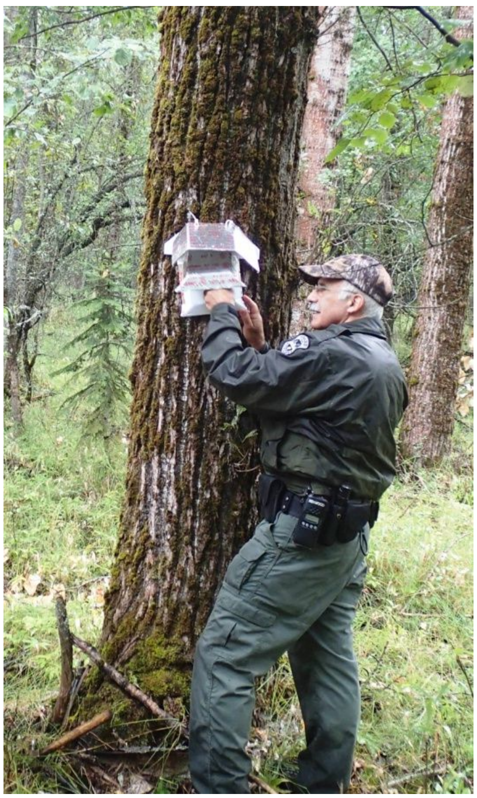
Field Methods
Air Temperature and Relative Humidity - We used TRIX8 or TRIX16 LogTag® Transit data loggers to collect air temperature data and HAXO8 LogTag® Transit data loggers to collect air temperature and relative humidity data concurrently. TRIX8 and HAXO8 loggers can store 8,000 readings and were collected after approximately one year of deployment. TRIX16 loggers store up to 16,000 readings and were collected after a two year deployment.

Air temperature data loggers were placed in radiation shields to avoid direct sunlight and subsequent temperature bias.

We built radiation shields as described by Holden et al. (2013) and nested the data logger within the radiation shield. We selected the nearest >12" diameter conifer tree to the assigned waypoint and used nails to attach the radiation shield to the north side of the tree. In compliance with Section 6 of the Endangered Species Act, if the nearest tree was a whitebark pine (*Pinus albicaulis*), we did not attach hardware to the tree but selected the nearest conifer of a different species. If no conifer trees were present we mounted the radiation shield on a post. We then photographed the radiation shield.

The latest air temperature data logger deployment date was August 27, 2013 and the latest water temperature deployment date was September 5, 2013. All air and relative humidity data loggers were removed from the field between September 4 and October 31, 2014. Therefore, air temperature data were collected from each survey site in the study area (*n* = 941) for a continuous 12 month period (September 1, 2013-August 31, 2014).

When loggers were removed in 2014, we took a photograph of each radiation shield and three site photographs facing 45°, 180°, and 315° from the radiation shield tree. Radiation shield height (bottom of shield) from ground was measured and a shade index was estimated: 1- completely open (clear cut or field), 2- some direct sun but not completely open, 3- mostly shade, 4- completely shaded. Observers noted if the logger was on the ground and if any obvious recent landscape changes (clear cut, forest fire, etc.) had occurred.



Idaho Fish and Game Conservation Officers assisted with micro-climate monitoring.

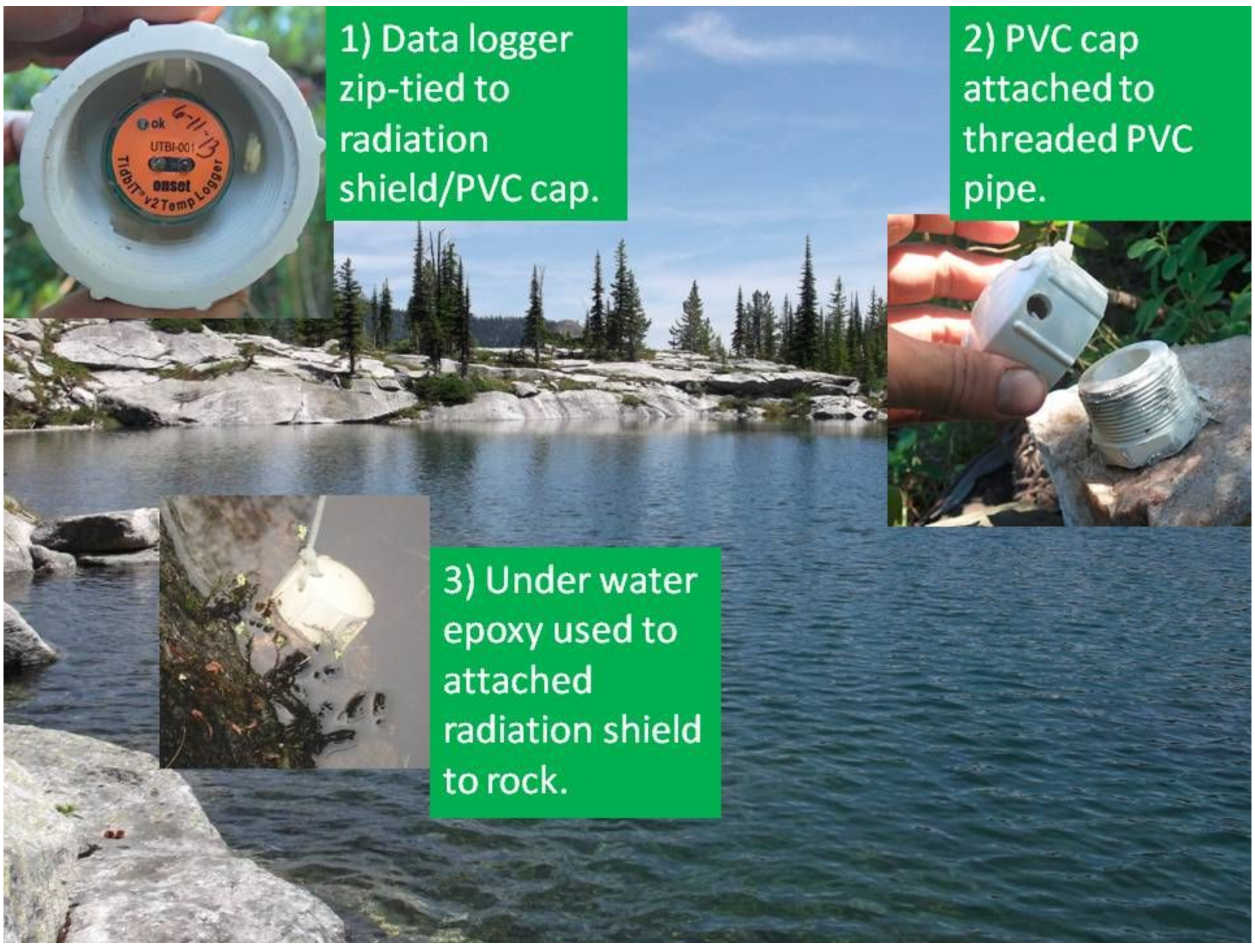
Water Temperature - We deployed 151 of Onset® HOBO® TidbiT® v2 Submersible Temperature Loggers at 133 of ponds. We deployed one data logger at 131 ponds in 2013 and an additional 2-3 data loggers at the seven 2014 temporal wetlands (Chapter 3, Amphibians). Data loggers were deployed at depths ranging from 4 – 140 cm (mean = 37 cm).

We built PVC radiation shields as described by Isaak et al. (2013), zip-tied the logger to the cap of the radiation shield and attached the radiation shield to an anchor using underwater epoxy (Isaak et al. 2013). We attempted to attach radiation shields to large boulders at the shore line.

However, pond conditions sometimes dictated we attach loggers to smaller rocks which were deployed either near the shoreline or toward the center of the pond depending on pond depth. Occasionally radiation shields were zip-tied to logs in the pond if no rocks were available.

Data loggers were re-visited at least 12 months after initial deployment and data were downloaded with an Onset® HOBO® Datalogger Waterproof Shuttle and downloaded to a computer using Onset® HOBO® HOBOware® Pro Software. The radiation shield was photographed and depth was measured during the revisit.

Data loggers were left in the field retaining the battery life and memory to log data until summer 2019.



Water temperature data loggers were protected by PVC radiation shields and attached to rocks in lentic wetlands with underwater epoxy.

Analysis

Erroneous Air Temperature Data - We encountered two situations in which data loggers collected erroneous data: sunlight directly hitting the radiation shield and the radiation shield being buried by or otherwise affected by snow. We worked with Andrew Shirk of the University of Washington Climate Impacts group to develop an algorithm to weed out erroneous data points and impute small data gaps
(Appendix 5-c).

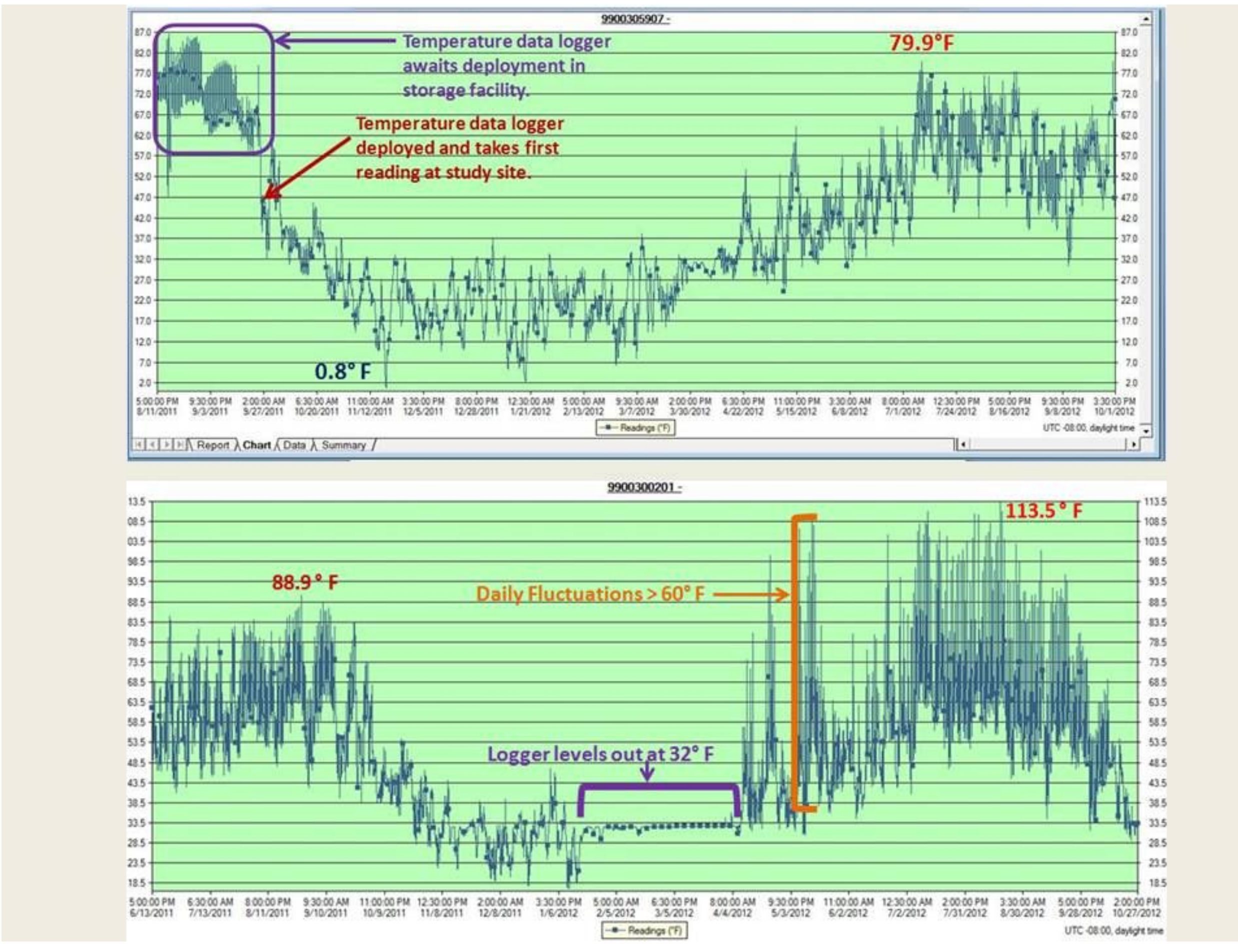


Figure 5-1. Accurate (top) and erroneous data (bottom) air temperature data logs.

Table 5-1. Erroneous Air Temperature Algorithm Rules

Maximum allowed daily temperature	38.8°C
Minimum allowed daily Temperature	-30.0°C
Minimum min-max daily temperature range	2.0°C
Maximum temperature anomaly threshold	2.5°C
Maximum allowed missing observations per day	2
Maximum allowed interpolated observations per day	2

Missing Relative Humidity Data - Relative humidity data did not appear to be affected by sunlight. However, loggers did not collect data when snow covered. We used the algorithm to calculate a variety of relative humidity variables and to describe the percentage of missing data for each logger.

Erroneous Water Temperature Data - Pond hydrology was dynamic and some loggers were exposed to air as pond depth decreased over the course of the summer. If the radiation shield was covered by water when we downloaded data in September 2014, we assumed the logger was continuously under water from March-August. We used Onset® HOBO® HOBOware® Pro Software to visualize pond data to further determine if loggers had been exposed to air. If loggers recorded a temperature below 0°C we assumed the logger was exposed to air from that point forward. If the radiation shield was exposed to air during the September data download we examined pictures of the logger and viewed the data to make a conservative estimate of when the logger was exposed to air. We visually estimated which month the logger was exposed to air and removed that entire month of data and all subsequent months of that year.

Mean Annual Air Temperature - We calculated the mean annual air temperature for each survey site (n = 905) for the period of September 1, 2013-August 31, 2014. We used the algorithm to remove erroneous data and calculate the percentage of missing data. We removed sites which had ≥75% missing data (n = 12). An additional 14 loggers were removed from the analysis due to an algorithm error which was later fixed. These loggers had missing data ranging from 24-71%. A total of 26 loggers were removed from the analysis and we used the remaining sites (n = 879) for the analyses described in this report.

March-August Mean Water Temperature - We calculated the mean March-August temperature for data loggers which were not exposed to air (n = 83) and used this variable for the analyses described in this report (Map 5-3).

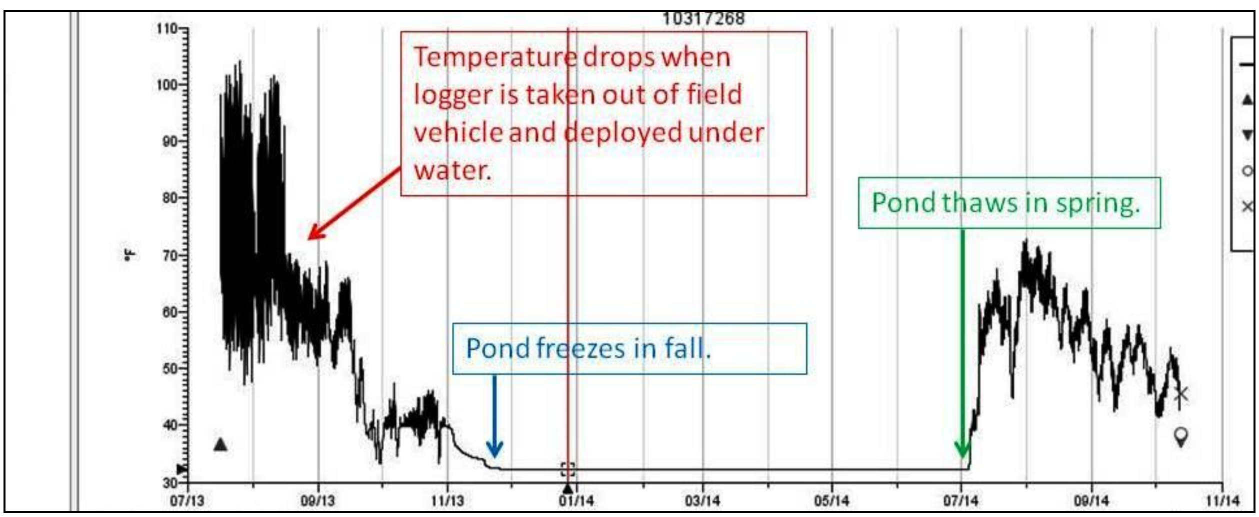


Figure 5-2. Read out from water temperature data logger. Vertical maroon line is a selection tool which is part of the software.

Other Air Temperature Variables - We calculated monthly and quarterly mean, minimum, and maximum temperatures for each logger. We calculated annual variables for both the calendar year (January 1-December 31) and for the period in which we had loggers at each survey site (September 1-August 31). Annual variables included mean warmest month temperature (MWMT), mean coldest month temperature (MCMT), temperature difference between warmest and coldest months (TD), degree days < 0C (DDLT0), degree days < 18C (DDLT18), degree days > 5C (DDGT5), degree days > 18C (DDGT18), number of frost free days (NFFD), julian day beginning the frost free period (bFFP), julian day ending the frost free period (eFFP), and days in the frost free period (FFP).

Additionally, we calculated variables directly related to our survey period including mean, minimum, and maximum temperatures for the 48 hours immediately following each visit and 14 days following the first visit to terrestrial sites. This will allow for future analysis of the air temperature variable in relation to gastropod survey data.

Relative Humidity Variables - We calculated monthly and quarterly mean, minimum, and maximum temperatures for each logger. Additionally, we calculated variables directly related to our survey period including mean, minimum, and maximum relative humidity for the 48 hours immediately following each visit and 14 days following the first visit to terrestrial sites. This will allow for future analysis of the relative humidity variable in relation to gastropod survey data.

Other Water Temperature Variables - We calculated pond freeze dates by calculating the first date after a 48 hour period when the standard deviation of pond temperature was ≤0.05 for a 48 hour period. We calculated pond thaw dates by determining the first date after a 48 hour period when the pond temperature standard deviation remained ≥0.05. We then calculated number of days frozen and number of days open.

We calculated annual, quarterly, and monthly mean, minimum, and maximum temperatures. We determined the warmest month and calculated its mean. Starting at midnight the night of the survey we calculated the mean, minimum, and maximum temperatures for the 48 hours period following the survey.

Temperature Associations - We calculated mean temperature and temperature envelopes (site air or water temperature ranges where a certain proportion of species detections) occur for all species with ≥15 detections, all SGCN, and several additional species. We calculated these values for all pond breeding amphibians both for individual species and as a group. We calculated 50%, 80%, and 95% temperature envelopes by proportionately selecting the coolest annual mean temperature sites for each species and determining the temperature range.

Results
This document provides a summary of climate data collected from September 1, 2013-August 31, 2014. Data collected prior to September 1, 2013 will be used for future analyses.

Air Temperature
During fall 2014, we successfully collected 899 of 941 air temperature data loggers that were deployed at the time. Forty-two loggers were not found or collected because they were removed by animals, lost in clear-cutting operations, stolen, or not found for other reasons. Data from 26 (2.7%) of the 899 collected loggers were excluded from this analysis as described in the

methods. Therefore, data from 873 data loggers were used for this analysis. The remaining 873 loggers had an average of 11.5% (3 – 72.3%) of data excluded. Imputed data averaged 0.14% (0-6.2%) per logger with 644 (73.2%) loggers having 0 imputed data.

Mean annual air temperature for the study area was 6.17°C (-1.90-14.17°C). Additional variables are reported in Table 5-2. The majority of cooler sites clustered in the northern Selkirk Mountains with other clusters forming in the Purcell and St. Joe Mountains (Map 5-2).

Table 5-2. Annual air temperature variables September 1, 2013- August 30, 2014

Variable	Description	Mean	Min	Max
T	mean annual temperature (°C)	6.17	-1.90	14.17
TD	temperature difference between warmest and coldest month (°C)	53.87	31.78	65.39
DDGT18	degree days > 18° C	104.22	0.00	463.32
DDGT5	degree days > 5° C	1428.28	293.22	2345.94
DDLT0	degree days < 0° C	458.58	0.00	1290.06
DDLT18	degree days < 18° C	3941.92	598.50	5970.36
NNFD	number of frost-free days	186.95	53.00	267.00

Relative Humidity
During fall 2014, we collected 191 (96%) of the 200 relative humidity data loggers deployed. Nine loggers were not found. We calculated monthly mean, minimum, and maximum relative humidity for each site for the months of September, October, and November 2013 and June, July, and August 2014. We removed loggers from the analysis if ≥20% of data were missing (n = 121 sites), or if a 0% relative humidity reading was recorded (*n* = 5 sites) for the month in question (Table 5-3). 98% (*n* = 118) of months missing ≥20% data were November. This is likely because snow covered the sensors and why we do not report values for December-May.

Table 5-3. Monthly Relative Humidity Values

Month	Year	Mean	Min	Max	*n* (sites)
June	2014	73.98	9.3	99.3	188
July	2014	61.70	10.1	99.2	189
August	2014	68.37	7.6	99.5	189
September	2013	78.55	13.6	99	187
October	2013	82.97	18.7	99.1	186
November	2013	87.76	29.7	98.1	67

Water Temperature
During September and October of 2014, we visited 151 data loggers (138 ponds) and successfully downloaded data from 125 (83%) loggers. We were unable to find 26 (19%) loggers. Data downloads were successful for all loggers found. Variables calculated had different sample sizes due to loggers being exposed to air for varying amounts of time. March-August mean temperature was the variable with the largest number of available loggers (*n* = 83) and

therefore was the variable we used to calculate temperature envelopes. March-August mean temperature was 8.03° C (2.88 – 15.67°C) and annual mean temperature was 5.88° C (2.39 – 10.52°C) (*n* = 73) (Table 5-4).

Table 5-4. Water Temperature Variables

Variables	Mean	Min	Max	*n*
Annual Mean	5.88	2.39	10.52	73
Mean for March, April, May	3.09	-0.02	9.74	83
Mean for June, July, August	13.02	3.58	21.63	83
Mean for March-August	8.03	2.88	15.67	83
Days Frozen	160.69	0	261	59
Days Open	204.30	104	365	59

Temperature Associations

Gastropods - Of species with sample size ≥15 sites, magnum mantleslugs (*Magnipelta macrophaga*) (*n* = 38) had the lowest mean annual temperature (4.17°C) and *Limax maximus* (*n* = 15) had the highest mean annual temperature (7.79°C). *L. maximus* also had the narrowest 50% temperature envelope (0.69°C) and *Microphysula ingersolli* had the widest 50% temperature envelope (4.05°C) (Table 5-5, Fig. 5-3).

Twenty-one of the 31 species analyzed had mean temperatures which fell within 1°C of the annual study area mean of 6.17°C. Magnum mantleslug, *Pristiloma wascoense, Hemphillia camelus,* and *Hemphillia* unk1 all were associated with mean temperatures of at least 1°C less (2.71-1.01°C) than the mean annual study area mean of 6.17°C. Magnum mantleslugs were associated with cooler temperatures than other species. A majority of magnum mantleslug detections occurred within a temperature envelope of 2-4°C (Fig. 5-4). *Striatura pugentensis, Prophysaon andersoni, Prophysaon coeruleum, Planogyra clappi,* and *L. maximus* were all associated with mean annual temperatures of at least 1°C above (1.23-1.57°C) the mean annual study area mean of 6.17°C. However, *P. coeruleum* and *P clappi* had sample sizes of only 2 each. *Heliodiscus salmonaceus* had a mean annual temperature 2.68°C greater than the study area mean but had a sample size of just one. Non-native gastropods tended to be more associated with warmer temperatures but this may be an artifact of their association with human development which is biased to lower elevations.

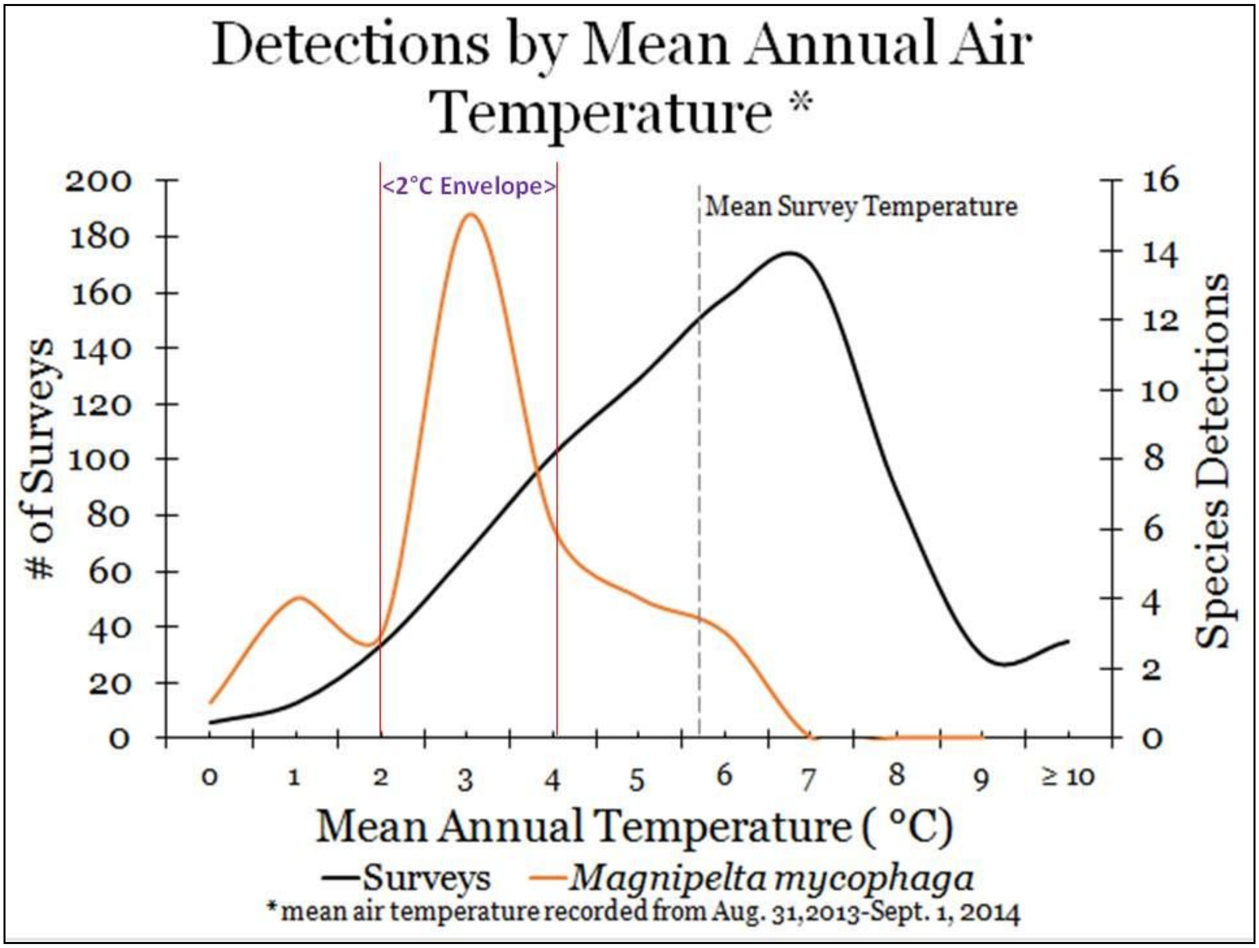


Figure 5-4. Magnum mantleslug detections by temperature.

Magnum mantleslug (*Magnipelta macrophaga*)

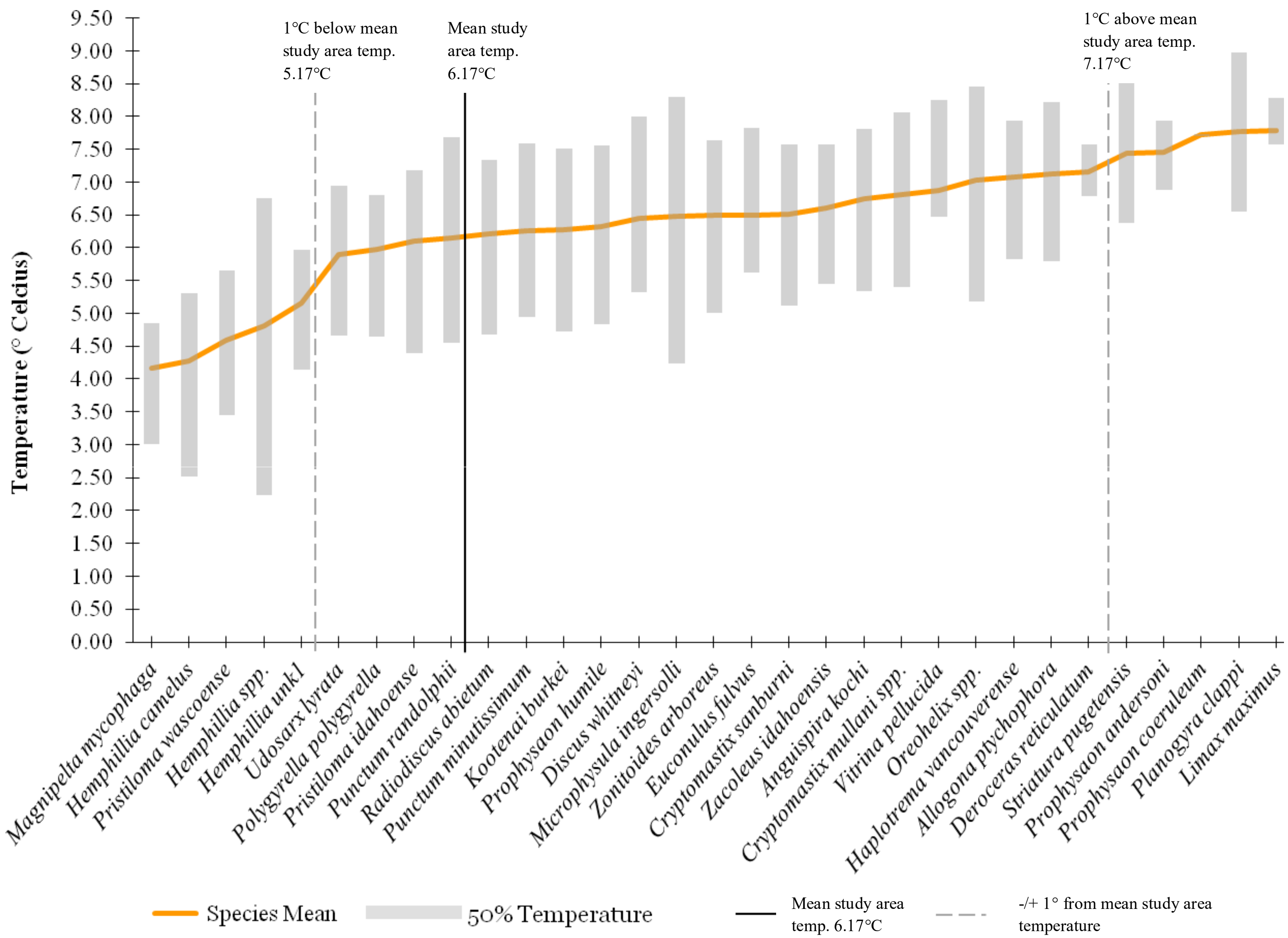


Figure 5-3. Mean annual air temperature and 50% temperature envelopes for selected gastropod species. Temperature envelopes were calculated by proportionately selecting the coolest mean temperature sites for each species and determining the temperature range.

Amphibians - Mean March-August temperature of western toad (*Anaxyrus boreas*) (*n* = 5) and American bullfrog (*Rana catesbeianus*) (*n* = 2) breeding ponds were both >1°C different than the mean March-August water temperature for all ponds (*n* = 83). Western toad breeding ponds averaged 6.84°C (1.19°C < mean all pond temperature) and bullfrog breeding ponds averaged 14.61°C (8.03°C > mean all pond temperature) (Table 5-6).

Mean March-August breeding pond temperature of the other 3 species detected fell within 1°C of mean all pond temperature. Columbian spotted frogs (*Rana luteiventris*) (mean 7.13°C, *n* = 33) and long-toed salamanders (*Ambystoma macrodactylum*) (mean = 7.43, *n* = 32) were detected at ponds cooler than mean all-pond temperature. Pacific treefrogs (*Pseudacris regilla*) (mean = 9.00°C, *n* = 5) were detected at ponds warmer the mean all-pond temperature.

Mean March-August temperature of all amphibian breeding ponds (7.70°C, *n* = 55) was 0.97°C cooler than non-breeding ponds (8.67°C, *n* = 28) (Table 5-6).

Western toad
(*Anaxyrus boreas*)

Discussion

We explore only two micro-climate variables, annual and March-August mean temperature, in relation to species occurrence. However, mean temperature may not be the most important variable in describing species response to climate change. Climatic variables such as minimum and maximum daily temperatures may change at different rates (Karl et al. 1993) and non-climatic variables may have a greater effect on species occurrence than temperature. Adaptive capacity influences climate change vulnerability and is not addressed in this report. We plan to conduct more in depth analyses to elucidate which climatic and other variables may drive species distribution and persistence potential. The associations of species occurrence and micro-climate presented herein should be viewed as preliminary assessments.

The temperature data we collected adds to growing networks of northern Rockies air (eg Holden et al. 2015) and water (Isaak 2015) temperature data loggers. Our water temperature sensors are unique in that they monitor small lentic waters instead of streams (Isaak 2015) and, to our knowledge, our data loggers are the first in our study area to be co-located with terrestrial gastropod and amphibian surveys.

In addition to species specific air and water temperature envelopes, our data delineate both macro and micro-sites that are relatively cool and may serve as cool-air refugia during climate warming (Dobrowski 2011, Greenwood et al. 2016). The largest congregation of cool air sites occurs in the Selkirk Mountains (Map 5-2). This is likely due to this mountain range having a combination of relatively higher elevation and steeper topography, which protects air from solar warming, than much of the study area.

This presents an opportunity to manage a macro-level area for cool temperatures but potential micro-refugia were also documented across the study area. Micro-refugia are sites that support favorable climate conditions within a larger landscape of unfavorable conditions (Dobrowski 2011). Cool air micro-site management is a relatively new concept and the effectiveness of various management techniques is still unclear. Regardless, several techniques have proven to be at least moderately successful in maintaining cooler air temperatures than the surrounding landscapes including afforestation, reduced or removal of grazing, slope creation or protection, and woody debris addition (Greenwood et al. 2016).

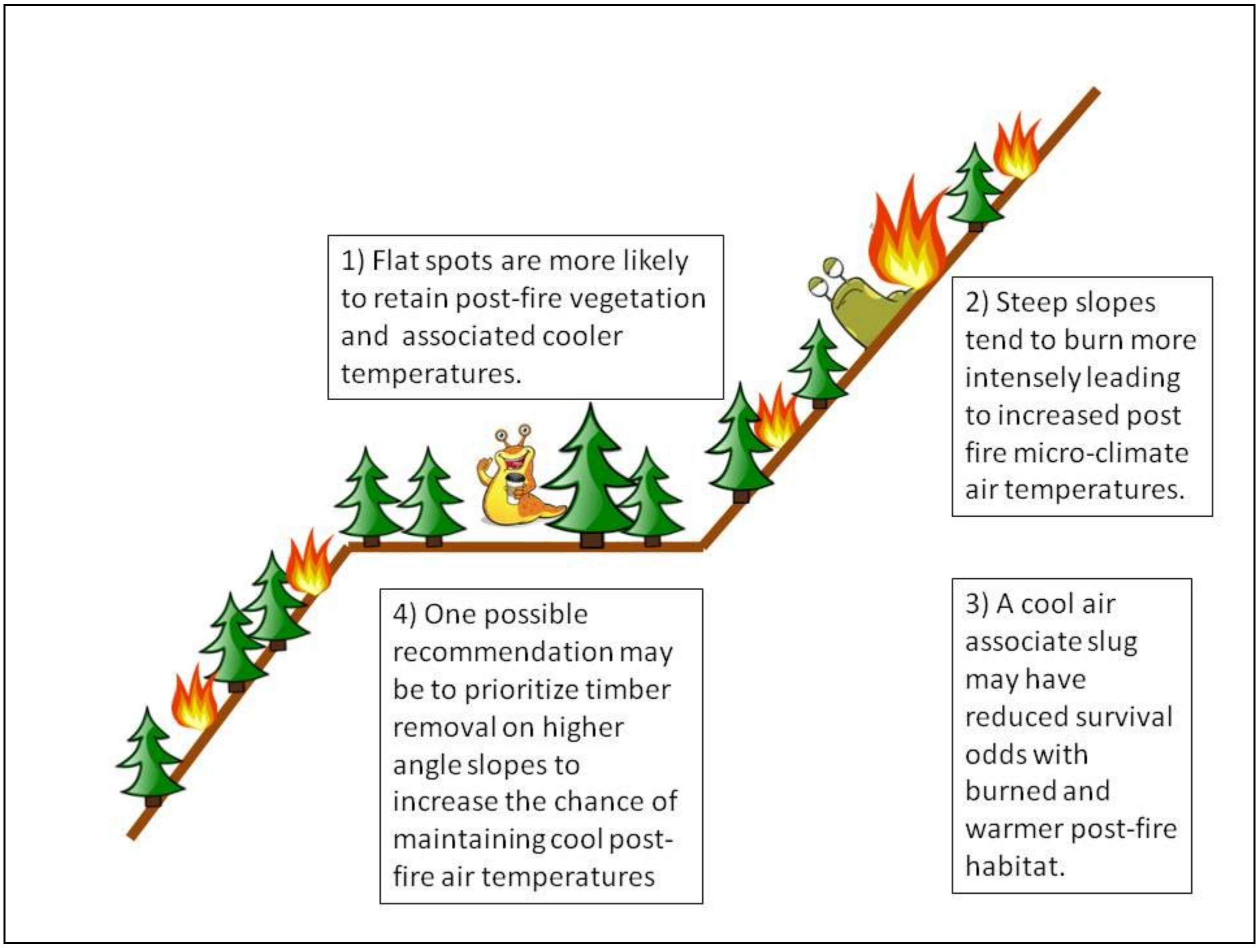


Figure 5-5. An example of how micro-climate planning might be incorporated into a management plan.

Fire planning and management is one example of how we might manage for cool air temperatures at key micro-sites. Magnum mantleslug was our most strongly cool-air associated species with the majority of detections occurring within a 2-4°C temperature envelope >2°C below the mean study area temperature (Fig. 5-4). Because increased vegetative cover buffers against temperature extremes and reduces maximum temperatures (Greenwood et al. 2016) a magnum mantleslug management plan would likely include recommendations to maintain vegetative cover at sites where the species is known to occur. If we were selecting sites of known species occurrence to prioritize maintenance of vegetative cover and associated cooler air temperatures, we would want to choose sites less likely to be affected by outside forces such as fire.

Imagine a timber sale is being planned in an area of late seral forest with two sites where magnum mantleslugs are known to occur. The nature of the sale requires one of the two sites be clear-cut and the other to not be managed. If one site is flat and another is a steep slope, we would recommend the flat spot not be harvested because, in the event of a stand altering fire, the flat location would be more likely retain vegetative cover and, thus, more protection from extreme temperatures (Jaiswal et al. 2002) (Fig. 5-5).

Conclusions

Our micro-climate surveys represent the first effort in our study area to co-locate micro-climate data loggers with amphibians and terrestrial gastropod surveys. Five species are associated with air (magnum mantleslug, *P. wascoense, H. camelus,* and *H.* unk1) or water (western toad) mean temperatures ≤1°C than study area mean. However, *P. wascoense* (n = 6) and western toads (n = 5) were represented by small sample sizes. The Selkirk Mountains contain the largest area suitable for macro-cool air refugia but multiple micro-cool air refugia are located across the study area. Data presented in this report are a summary of results and further analyses are needed to more firmly associate 'cool' or 'warm' species within temperature envelopes, to determine if temperature is a limiting factor for these species, and determine species adaptive capacity to micro-climatic changes. We encourage managers to consider air and water temperature as an important factor when managing natural resources at the macro or micro scale.

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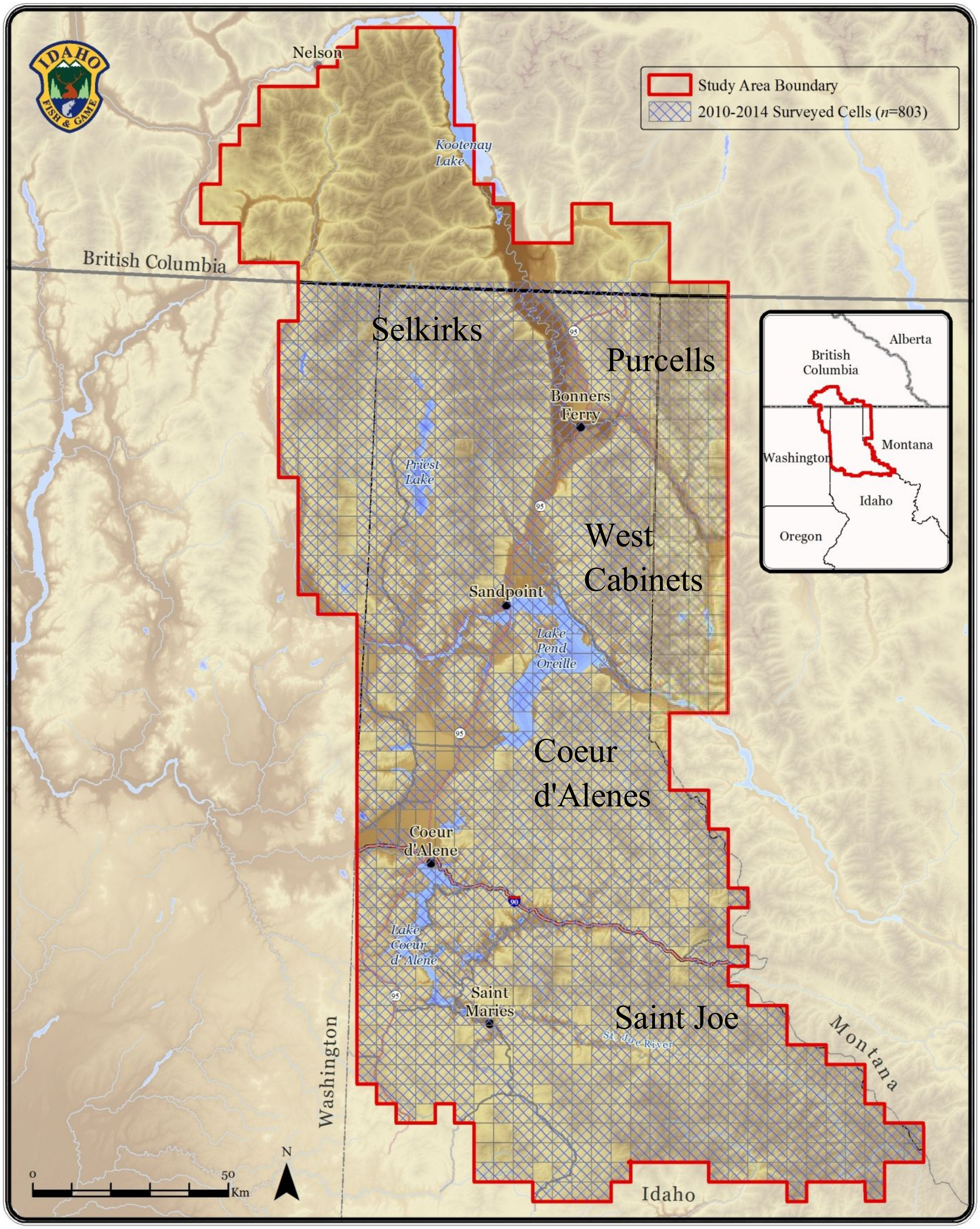
Table 5-5. Terrestrial gastropod air temperature associations. 50%, 80%, and 95% temperature envelopes were calculated by proportionately selecting the coolest mean temperature sites for each species and determining the temperature range. Mean temperature is annual mean of all sites where species was detected.

Species	95% low	95% high	Range	80% low	80% high	Range	50%low	50% high	Range	Mean	*n*
Allogona ptychophora	3.16	11.45	8.29	4.07	9.17	5.10	5.81	8.21	2.40	7.12	56
Anguispira kochi	3.31	11.65	8.34	4.15	9.07	4.92	5.35	7.81	2.46	6.75	248
Cryptomastix hendersoni										5.92	1
Cryptomastix mullani blandi										6.75	1
Cryptomastix mullani spp.	3.15	11.37	8.22	4.35	9.11	4.76	5.42	8.07	2.65	6.81	109
Cryptomastix sanburni	4.64	9.79	5.16	4.76	9.05	4.28	5.14	7.58	2.44	6.51	16
Deroceras reticulatum	5.40	8.63	3.24	6.43	7.80	1.37	6.81	7.57	0.77	7.16	16
Discus whitneyi	3.00	8.44	5.45	4.16	8.23	4.07	5.34	7.99	2.65	6.44	17
Euconulus fulvus	1.69	10.64	8.95	2.52	8.63	6.11	5.63	7.82	2.19	6.50	68
Haplotrema vancouverense	3.89	11.49	7.60	5.03	9.48	4.45	5.83	7.94	2.10	7.08	149
Heliodiscus salmonaceus										8.89	1
Hemphillia camelus	0.68	10.43	9.75	1.90	6.75	4.85	2.53	5.30	2.77	4.28	51
Hemphillia spp.	1.79	10.50	8.71	1.92	10.30	8.38	2.25	6.76	4.50	4.81	20
Hemphillia unk1	1.40	9.54	8.14	2.71	7.50	4.79	4.16	5.96	1.80	5.16	34
Kootenai burkei	2.04	11.25	9.21	3.55	8.92	5.37	4.74	7.51	2.77	6.28	77
Limax maximus	6.16	8.82	2.66	7.09	8.56	1.47	7.59	8.29	0.69	7.79	15
Magnipelta mycophaga	1.72	11.22	9.50	1.99	6.55	4.55	3.02	4.85	1.83	4.17	38
Microphysula ingersolli	2.16	12.07	9.91	3.49	10.33	6.85	4.25	8.30	4.05	6.48	53
Oreohelix spp.	3.87	11.91	8.05	3.98	10.51	6.53	5.19	8.45	3.26	7.03	22
Planogyra clappi	5.49	10.06	4.57	5.85	9.70	3.85	6.57	8.97	2.40	7.77	2
Polygyrella polygyrella	3.80	10.43	6.63	3.95	7.80	3.85	4.67	6.80	2.13	5.98	15
Pristiloma idahoense	2.61	12.34	9.73	3.94	10.26	6.32	4.41	7.18	2.77	6.10	16
Pristiloma wascoense	2.92	6.37	3.45	3.08	6.13	3.05	3.46	5.65	2.19	4.59	6
Prophysaon andersoni	5.80	9.11	3.31	6.54	8.80	2.26	6.90	7.93	1.03	7.46	27
Prophysaon coeruleum	7.72	7.74	0.03	7.72	7.74	0.02	7.72	7.74	0.01	7.73	2
Prophysaon humile	3.40	10.97	7.58	3.94	8.71	4.77	4.84	7.55	2.71	6.32	144
Punctum minutissimum	2.49	10.33	7.84	3.75	8.68	4.92	4.95	7.60	2.64	6.26	28
Punctum randolphii	1.54	10.92	9.38	3.49	8.54	5.05	4.57	7.68	3.12	6.15	65
Radiodiscus abietum	2.50	12.35	9.86	3.66	8.72	5.05	4.68	7.34	2.66	6.21	178
Striatura pugetensis	3.98	10.62	6.63	5.54	8.99	3.46	6.39	8.60	2.21	7.44	47
Udosarx lyrata	3.00	9.03	6.03	3.95	8.55	4.61	4.67	6.95	2.27	5.90	40
Vitrina pellucida	2.30	9.36	7.06	3.20	8.98	5.78	6.49	8.26	1.76	6.87	22
Zacoleus idahoensis	2.10	10.74	8.64	4.14	8.88	4.73	5.47	7.57	2.10	6.60	167
Zonitoides arboreus	2.90	10.78	7.88	3.92	8.54	4.62	5.02	7.64	2.61	6.49	207

Table 5-6. Amphibian water temperature associations. 50%, 80%, and 95% temperature envelopes were calculated by proportionately selecting the coolest mean temperature sites for each species and determining the temperature range. Mean temperature is March-August mean of all sites where species was detected. All pond sites include any pond where species was detected. Breeding ponds are only ponds where breeding activity was detected.

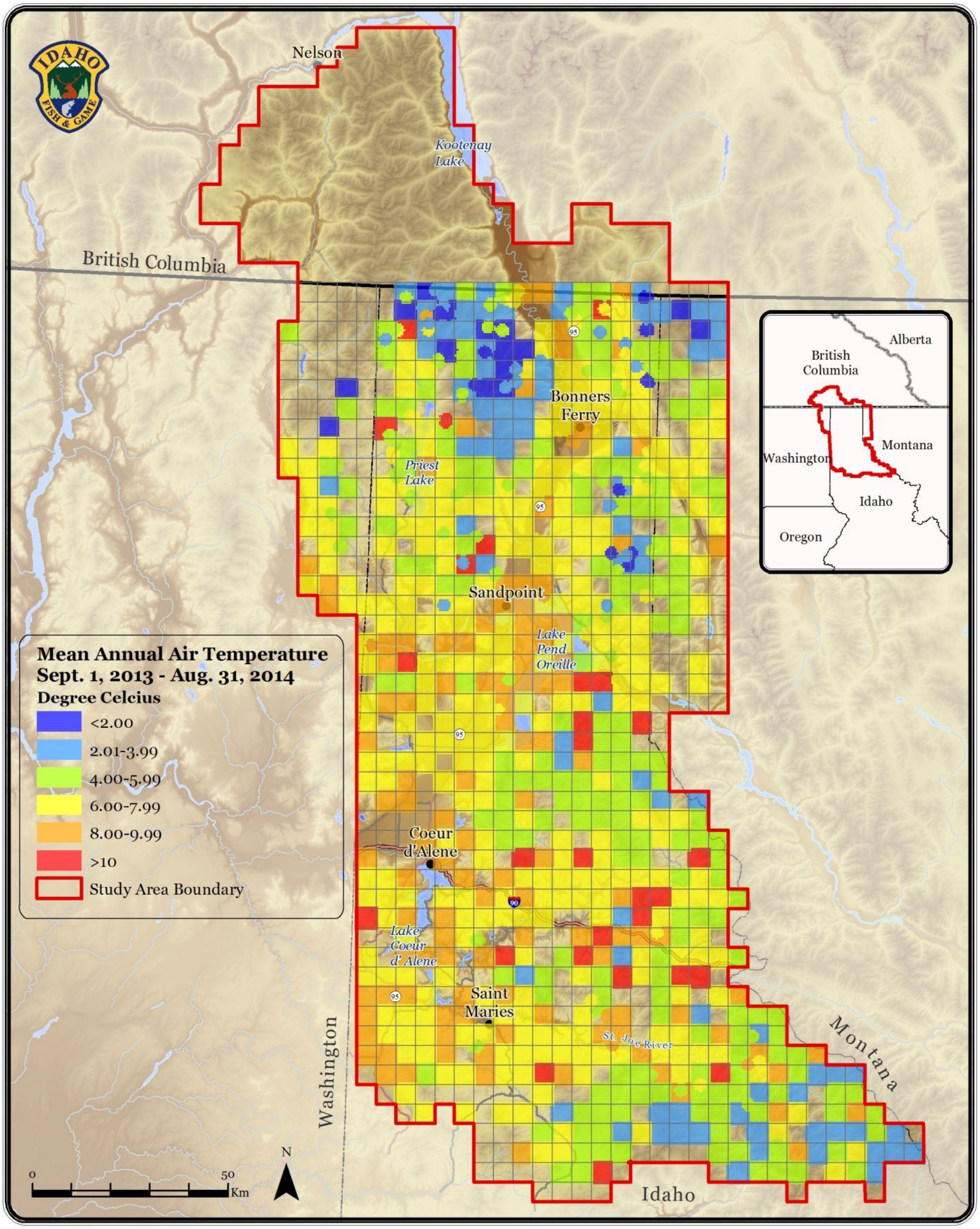
Species	95% low	95% high	95% Range	80% low	80% high	80% Range	50% low	50% high	50% Range	Mean	*n*
					All Ponds						
Long-toed Salamander	3.89	13.36	9.47	4.90	11.40	6.49	5.64	9.07	3.43	7.42	36
Columbia Spotted Frog	3.88	13.60	9.71	5.04	11.71	6.66	5.86	9.44	3.59	7.65	65
Western Toad	5.33	10.00	4.67	5.68	9.59	3.91	5.86	7.75	1.90	7.01	9
Sierran Treefrog	6.21	12.80	6.59	6.75	11.85	5.10	7.74	10.43	2.69	9.25	8
Amercian Bullfrog	13.64	20.40	6.75	13.96	19.65	5.69	14.61	18.16	3.55	16.62	3
					Breeding Ponds						
Long-toed Salamander	3.89	13.50	9.61	4.80	11.46	6.66	5.64	9.07	3.43	7.43	32
Columbia Spotted Frog	3.67	12.18	8.51	5.26	10.02	4.76	5.86	8.26	2.40	7.13	33
Western Toad	5.87	9.19	3.31	5.93	8.37	2.45	6.03	6.75	0.72	6.84	5
Sierran Treefrog	6.22	11.19	4.97	6.81	10.84	4.04	7.97	10.14	2.17	9.00	5
Amercian Bullfrog	13.59	15.62	2.03	13.75	15.46	1.71	14.07	15.14	1.07	14.61	2
					All Species Combined						
Breeding Ponds	3.88	14.21	10.34	5.04	11.92	6.88	5.82	9.18	3.36	7.70	55
Non Breeding Ponds	3.52	13.47	9.95	4.13	12.92	8.79	6.15	11.00	4.86	8.67	28
All Ponds	3.69	14.18	10.49	4.57	12.61	8.04	5.82	10.21	4.38	8.03	83

Multi-species Baseline Initiative: Microclimate Survey Overview



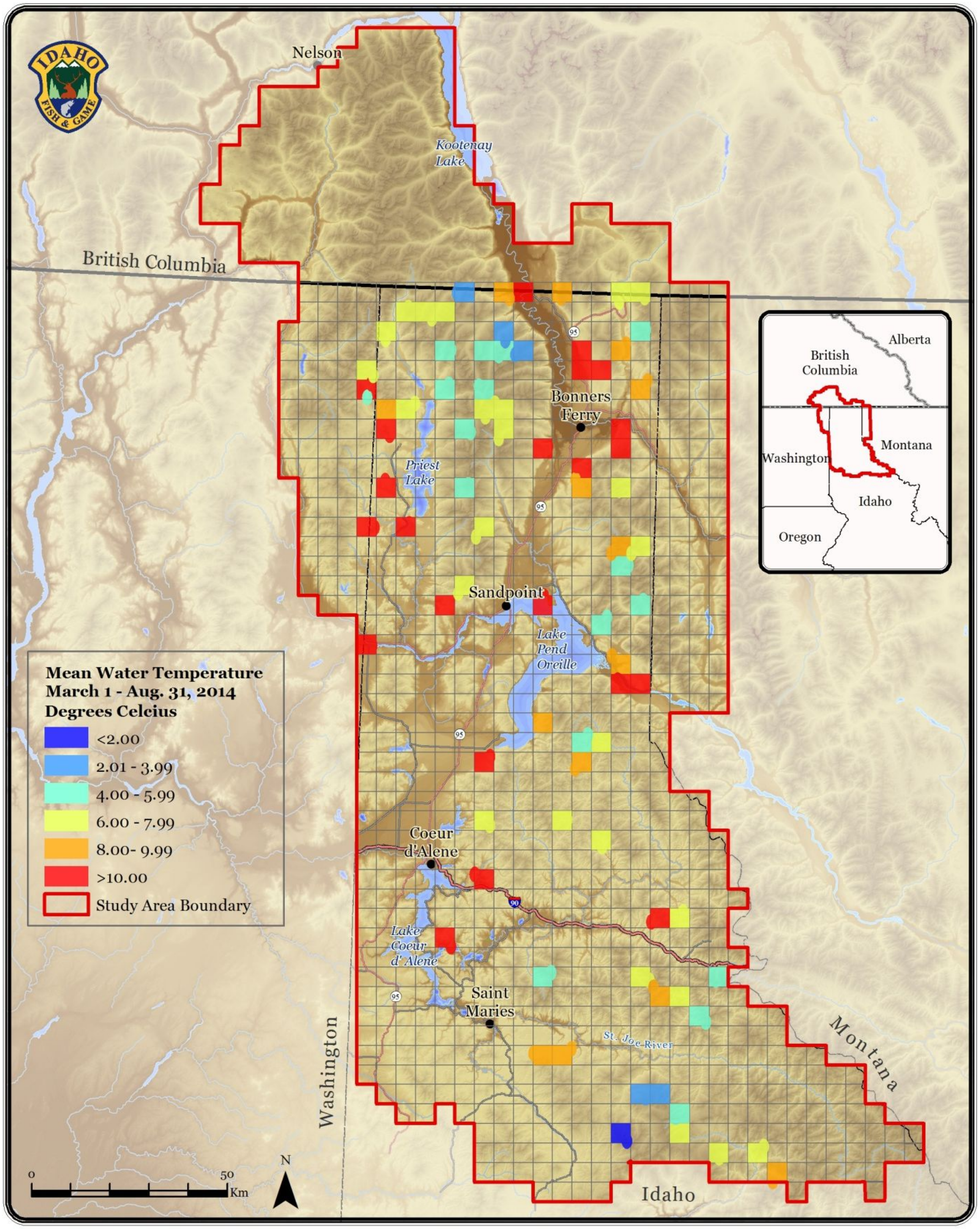
Map 5-1. 803 5x5 km cells where micro-climate data was collected between 2010-2014.

Multi-species Baseline Initiative: Mean Annual Air Temperature Sept. 1 2013 - Aug. 31, 2014



Map 5-2.

Multi-species Baseline Initiative: Mean Water Temperature



Map 5-3.

CHAPTER 6. Opportunistic Species - Multi-species Baseline Initiative

Incorporating opportunistic observations into standardized field protocols is a cost and time effective means of developing datasets for species that may be common and therefore unlikely candidates for inventory funding. It also presents the opportunity to collect data on species which may be rare or in decline without specific funding. Resulting opportunistic datasets may be of lower quality than surveys for targeted species, but in many cases, provide vastly more information than was previously available.

Although opportunistic observations were collected according to standardized protocols the observations were collected ad hoc to surveys which were designed for other species (with the exception of carabids). Therefore, the results in this section should be interpreted with some caution and should not be considered comprehensive surveys. For example, our detection of only 1 western skink (*Plestiodon skiltonianus*) (Map 6-51) is more suggestive that our surveys are not well designed for skinks than that skinks are rare. Nevertheless, our skink observation is 1 of only 5 reported to the state of Idaho during the 2010-2014 study period (IFWIS accessed June 28, 2016) and worthy of note. In this section, species we felt had reasonable detection probabilities are mapped individually (Maps 6-1-37, 52, 54-60). Those, such as skink, that we felt we were less likely to detect when present are mapped in groups of species and displayed with dots (Maps 6-38-48, 49, 51, 53).

Beetles (Tables 6-1-2, Maps 6-1-48)

Coleoptera is the largest family of insects (Gaston 1991) and carabids (ground beetles, Coleoptera: Carabidae) in particular may have some usefulness as bioindicators (Rainio and Niemelä 2003). We invested a small amount of extra effort in our field surveys to collect carabids for these reasons in addition to partner interest. We deployed beetle traps at all terrestrial gastropod survey sites in 2010, 2011, and 2013. Carabids were collected in pitfall traps. We ran Lindgren funnel traps (Lindgren 1983) to capture flying beetles and other insects.

Pitfall traps - Three 8 oz. plastic cups with a 4 cm^2 piece of Hot Shot® No-Pest fumigant strip (Spectrum Brands, Middletown, WI) were placed 5 meters apart along each gastropod transect to act as pitfall traps. A trowel was used to dig a small hole and then the rim of the cup was placed level with the ground. All material in the traps, including leaf litter and other species, was collected, dried, and stored in coin envelopes at room temperature. Beetles were sorted from the samples in a laboratory environment.

Lindgren funnel traps - We deployed unbaited Lindgren-8 funnel traps (Lindgren 1983) with dry collection cups at 148 of 150 FIA survey sites and Lindgren-8, 12, or 16 funnel traps (n = 135, 17, 31 respectively) at 22%, (n = 183) of basic survey sites. We placed a 4 cm^2 piece of fumigant strip in each collection cup. Samples were collected at each site revisit and stored dry in manila coin envelopes. All arthropods in the trap were collected and beetles were separated from other arthropods in a laboratory environment.

Preliminary identification of the 364 beetle samples (each sample was a coin envelope with 0-many individual beetles) collected from 2010-2011 was led by University of Idaho graduate student Laine Smith who was overseen by Dr. Steve Cook. We detected beetles at 74% (n = 271) of the 2010-2011 sites. The preliminary identification of the 2010-2011 collection yielded 5,196 beetle specimens representing 12 families and 69 species. The 2013 pitfall or Lindgren funnel samples have not been sorted to determine beetle detection. Contingent on funding, beetle taxonomy may be completed at a later date.

We mapped carabid species detections on a per species basis because we conducted targeted surveys for that family. Non-carabid detections are mapped in groups because we did not conduct targeted surveys and results should not be considered a comprehensive survey. Because taxonomy is either not verified or not complete, beetle occurrence data contained in this report should be considered preliminary. Pinned specimens of the 2010-2011 sampling are available for examination upon request.

Aquatic Gastropods (Map 6-49)
We occasionally collected aquatic gastropod at very wet terrestrial sites. We identified them to family, genus, or species as our level of expertise allowed.

Fish (Table 6-3, Map 6-50)
Observers recorded fish if they detected them visually or in amphibian dipnets. We provided no training or identification guides for fish taxonomy, but the observer recorded the fish to species if known. More details are provided in chapter 3.

Western Bumblebee (*Bombus occidentalis*) (Table 6-3, Map 6-51)
We recorded western bumblebee observations because this species is thought to be in decline (Cameron et al. 2011) and because it is easily identified. In 2013 and 2014, observers attempted to photograph bumblebees if they were observed at terrestrial or wetland sites. If a bumblebee was detected, observers spent 5 minutes attempting to photograph it. We detected *B. occidentalis* at 3 survey sites and detections were verified by examination of photographs. Photos were verified as *B. occidentalis* if distinctive white 'hairs' were observed on metasomal tergum 4 and sometimes on terga 5 and 6 (Koch et al. 2012). Observers reported unverified *B. occidentalis* detections at additional survey sties. Our surveys were not designed to detect bumblebees and our detection of *B. occidentalis* at only 3 sites should not be used to interpret species status.

Western bumblebee collects pollen from Saint John's Wort (*Hypericum perforatum*)
Photo credit: Shannon Ehlers

Mammals

Alpine Mammals (Table 6-3, Maps 6-51-52) - We recorded detections at 2013 and 2014 wetland and terrestrial sites for a group of easily identified alpine mammals. American pikas (*Ochotona princeps*) were recorded if the species was detected visually or audibly during terrestrial or wetland surveys. Visual observations of golden mantled ground squirrel (*Callospermophilus lateralis*) were recorded. Hoary (*Marmota caligata*) and yellow-bellied (*Marmota flaviventris*) marmots were sometimes first detected audibly but only identified to species by visual characters. We detected 40 pikas, 10 golden mantled ground squirrels, and 3 of each marmot species.

Tree Squirrels (Table 6-3) - We recorded 184 visual or audible red squirrel (*Tamiasciurus hudsonicus*) detections at 2013 terrestrial sites. We chose this ecologically significant common species because it is easy to identify and little standardized data exist for this important component of the prey base of two target SGCN, Canada lynx (*Lynx canadensis*) and fisher (*Pekania pennanti*). We do not provide a map of opportunistic detections in this chapter because a map of standardized bait station detections is provided in chapter 4. The map in chapter 4 does not include these 184 opportunistic detections.

Shrews (Table 6-3, Map 6-53) - We collected 78 shrews incidental to pitfall trapping. Shrews expired in the traps. We stored the carcasses in 95% ethanol until we clipped and dried a small section of tail tissue. Wildlife Genetics International conducted a sequence style species ID test using 16S RNA and mitochondrial gene cytochrome oxidase subunit 1(COI). We detected American pygmy (*Sorex hoyi*;*n* = 8), masked (*Sorex cinereus*;*n* = 41), montane (*Sorex monticolus*;*n* = 4), vagrant (*Sorex vagrans*;*n* = 24), and unknown (*n* = 1) shrews. It is perplexing that we did not detect shrews south of I-90 or in the Priest Lake Basin. Although this was not a targeted shrew survey, we would have expected to detect shrews in those areas since our shrew detections are well distributed throughout the remainder of the study area.

Millipedes

We often found desiccated millipedes while doing timed gastropod leaf litter searches. We detected millipedes at 8% (*n* = 80) of sites surveyed and 8% (*n* = 72) of 879 cells surveyed. We archived specimens and, contingent of funding, taxonomy may be completed at a later date. See chapter 2 for details on leaf litter searching methods.

Plants

We recorded opportunistic observations of 7 easily identified species of plants which were of conservation concern, noxious weeds, or common. Field observers completed a field identification course and were provided field ID keys for the 7 species.

Conservation Concern Plants (Table 6-3, Maps 6-51, 57) - We targeted whitebark pine (*Pinus albicaulis*) during 2013 terrestrial sites because it is a candidate for federal listing under the Endangered Species Act. We targeted sundews (*Drosera* spp.) and rare moonworts (*Botrychium* spp.) at 2013 and 2014 wetland sites based on recommendations of IDFG's botany program because they are considered rare species.

We detected whitebark pine at 13 of the 2013 terrestrial sites. The 13 sites were higher in elevation and had cooler annual mean air temperatures than study area means. The majority of whitebark pine detections were in the Selkirk Mountains in or near the area identified as a potential cool air conservation refugium in chapter 5.

We detected one of our target rare plants, long leaf sundew (*Drosera anglica*), only once. However, this result should not be interpreted as target species rareness. These species are easy to identify but difficult to see and field observers only recorded observations if they happened to observe the species.

Whitebark pine (*Pinus albicaulis)* in the Selkirk Mountains.

Noxious Weeds (Table 6-3, Maps 6-54-55) - We selected 2 easily identified common noxious weeds to include in our surveys because standardized survey data for these species are uncommon and we are unaware of other studies co-locating micro-climate data loggers with surveys. We found tansy (*Tanacetum vulgare*) (*n* = 133 cells) and spotted knapweed (*Centaurea maculosa*;*n* = 131 cells) at sites which tended to be warmer and lower elevation than study area means. This is suggestive that a warming climate may favor further expansion of these species.

Common Plant (Table 6-3, Map 6-54) - Devil's club (*Oplopanax horridus*) is found at moist sites and we hypothesized this species would be a cool air associate. Our data indicate this species is found across the majority of the study area's elevational gradient and is found at sites with cooler air temperatures than the study area mean (Fig. 6-1). Future analyses could tease out possible variables, including air temperature, which may affect devil's club occurrence.

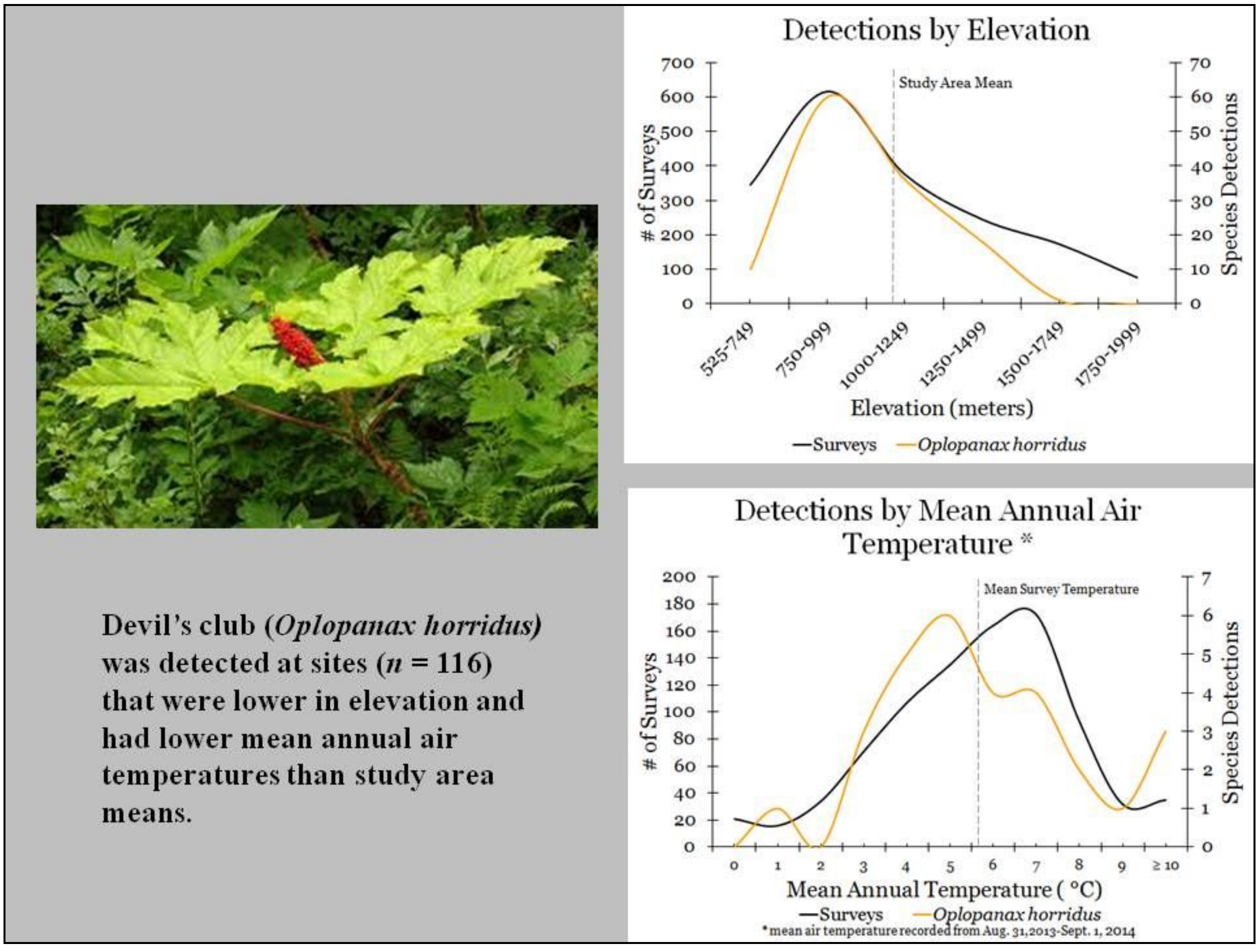


Figure 6-1. Devil's club detections by elevation and air temperature.

Reptiles

We recorded detections of all reptile species known to occur in the study area at terrestrial and/or wetland sites.

Lizards (Table 6-3, Map 6-51) - We detected only 1 western skink and did not detect a single northern alligator lizard (*Elgaria coerulea*). This should not be interpreted as a scarcity of lizards in the study area but rather that our survey techniques are not well designed for lizard detection.

Turtles (Table 6-3, Map-6-58) - We surveyed for turtles by approaching wetlands slowly and scanning for turtles as we approached. We also scanned for turtles as we dip-netted and sometimes caught turtles in dipnets. We detected painted turtles (*Chrysemy picta*) in 22 lower elevation cells. Although painted turtles seem to be readily detectable during dipnet surveys is should be kept in mind that our surveys were conducted during all weather conditions and turtles would not be likely to be detected during cold or cloudy conditions.

Snapping turtles (*Chelydra serpentina*) are not native to our study area and the first verified observation of this species in the Idaho portion of the study area was reported from the Pend d'Oreille River in 2012 (IFWIS accessed June 28, 2016). From 2012-June 28, 2016 there were 2 photo verified and 2 unverified reports of this species in Lake Pend Oreille or its immediate tributaries (IFWIS accessed June 28, 2016). We did not detect this species during MBI surveys.

Snakes (Table 6-3, Maps 6-59-60) - Several racer (*Coluber constrictor*) records occur in Kootenai County, ID (www.explorer.natureserve.org accessed June 28, 2016) and the Montana portion of the study area (www.fieldguide.mt.gov accessed June 28, 2016). The first verified record in Boundary County, ID occurred near Bonners Ferry in 2011. An additional, unverified, Boundary County report occurred near MacArthur Lake in 2015 (IFWIS accessed June 28, 2016). We did not detect this species, but that result should not be interpreted as species rarity as our surveys were not designed to detect racers.

We did not detect a rubber boa (*Charina bottae*) but this should not be interpreted as a scarcity of rubber boas in the study area but rather our survey techniques are not well designed for rubber boa detection.

Garter snakes, on the other hand, were readily observed while conducting dipnet surveys in warm sunny conditions. We recorded garter snake observations because amphibians are an important prey source for garter snakes (Fitch 1965, Matthews et al. 2002) and garter snake populations have been documented to track amphibian declines in other study areas (Matthews et al. 2002).

We detected common garter snakes (*Thamnophis sirtalis*) in 26 cells and western terrestrial garter snakes (*Thamnophis elegans*) in 60 cells. Terrestrial garter snakes were detected at some terrestrial (n = 6) but mostly at wetland sites (n = 20). Common garter snakes were detected almost exclusively at wetlands, with only 1 terrestrial detection. This should not be interpreted as a comment on garter snake habitat preference as they are generalists (Fitch 1965), but as an indication that opportunistic detection is more reliable during wetland amphibian surveys than during terrestrial surveys. This is likely because garter snakes can switch to amphibian larvae as a primary prey source during metamorphosis (Gregory 1984, Kephart and Arnold 1982) and tadpoles on pond edges can attract garter snakes. It was not uncommon for us to observe garter snakes eating tadpoles during our surveys.

We used red spots between yellow dorsal stripes as a diagnostic character to distinguish the two species. We identified garter snakes with the red spots as *T. sirtalis* and those without as *T. elegans.* We recognize there are color forms of *T. sirtalis* which do not have red coloration and that our taxonomic differentiation of these 2 species is imperfect (Werner et al. 2004). We also recognize our surveys were conducted in all weather conditions and garter snakes are less likely to be encountered during the cold, wet conditions in which some of our surveys occurred.

Common garter snake (Thamnophis sirtalis) preys on non-native American bullfrog (Lithobates catesbeianus). ***Photo credit: Andy Gygli***

Conclusions
Our study design allowed for opportunistic yet standardized detection of 89 species and associated microclimate data across a large study area. Most of the 89 species would be unlikely candidates for a successful inventory funding proposal. Although our surveys had varying levels of detection imperfection, they represent the most comprehensive inventory of these species to date in the Idaho Panhandle and adjoining mountain ranges.

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Table 6-1. Carabid (ground beetle) species detected during 2010-2011 MBI surveys

Latin Name[a]	# Cells Detected[b]	Latin Name[a]	# Cells Detected[b]
Agonum errans	1	*Harpalus seclusus*	9
Agonum quadratum	1	*Loricera decempunctata*	2
Amara discors	2	*Microlestes major*	1
Amara latior	1	*Notiophilus aquaticus*	2
Amara obesa	2	*Poecilus laetulus*	1
Blethisa oregonensis	1	*Pterostichus castaneus*	7
Calosoma cancellatum	5	*Pterostichus ecarinatus*	4
Calosoma moniliatum	3	*Pterostichus herculaneus*	63
Calosoma wilkesi	3	*Pterostichus laetulus*	2
Carabus granulatus	5	*Pterostichus melanarius*	12
Carabus nemoralis	21	*Pterostichus neobrunneus*	1
Carabus taedatus	51	*Pterostichus oregonus*	4
Cicindela longilabris	3	*Pterostichus pumilus*	5
Cychrus hemphilli rickseckeri	5	*Pterostichus sphodrinus*	92
Diplocheila impressicollis	1	*Scaphinotus marginatus*	58
Elaphrus clairvillei	1	*Scaphinotus merkelii*	27
Harpalus affinis	1	*Scaphinotus relictus*	87
Harpalus nigritarsus	1	*Zacotus matthewsii*	83
Harpalus rufipes	1		

[a] Species ID should be considered preliminary. Pinned specimens are available for examination.
[b] 357 cells were surveyed with unbaited pitfall traps.

Table 6-2. Non-carabid beetle species detected during 2010-2011 MBI surveys

Family	Latin Name[a]	# Cells Detected[b]
Buprestidae (Jewel Beetles)	*Buprestis aurulenta*	1
	Buprestis lyrata	1
	Chalcophora angulicollis	1
	Dicerca tenebrosa	1
Cerambycidae (Long Horned Beetles)	*Evodinus monticola*	1
	Judolia montivagans	1
	Leptura obliterata	2
	Megasemum asperum	1
	Monochamus oregonensis	1
	Neanthophylax mirificus	1
	Stictoleptura canadensis	3
	Trachysida aspera	1
	Xestoleptura crassipes	2
	Xestoleptura tibiolis	1
	Xylotrechus longitarus	1
Cucujidae (Flat Bark Beetles)	*Cucujus clavipes*	2
Curculionidae (True Weevils)	*Lepesoma verrucifera*	2
Elateridae (Click Beetles)	*Ctenicera bombycina*	1
	Ctenicera resplendens	1
	Ctenicera semimetallica	2
	Danosoma brevicornis	3
	Hemicrepidius morio	1
Geotrupidae (Earth Boring Dung Beetles)	*Odonteus obesus*	6
Pyrochroidae (Fire-Colored Beetles)	*Ischalia vancouverensis*	2
Silphidae (Carrion Beetles)	*Heterosilpha ramosa*	8
	Nicrophorus defodiens	16
	Thanatophilus coloradensis	3
Tenebrionidae (Darkling Beetles)	*Coelocnemis californica*	11
	Upis ceramboides	1
Trogossitidae (Bark-gnawing Beetles)	*Temnoscheila chlorodia*	1
Zopheridae (Ironclad Beetles)	*Phellopsis porcata*	12

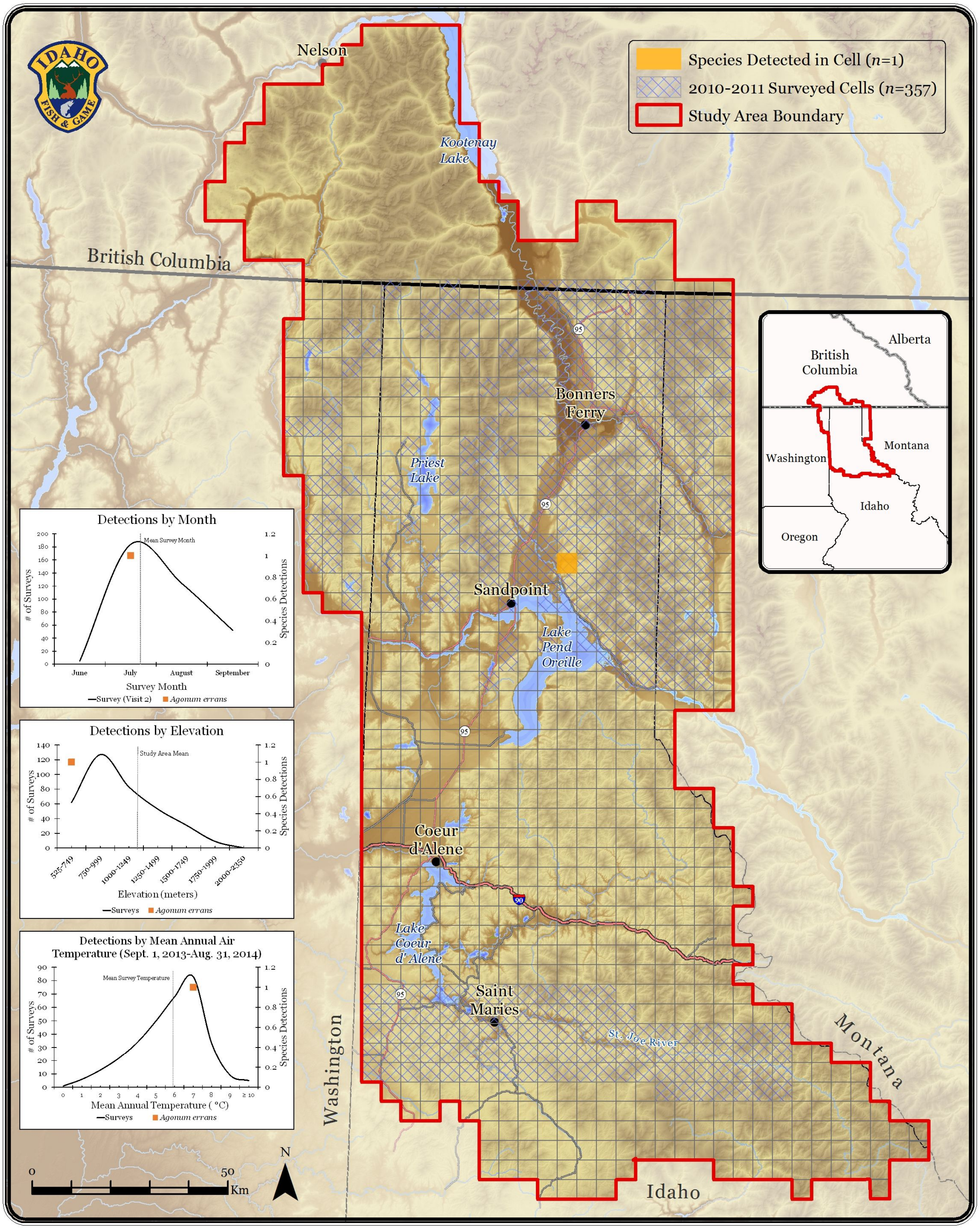
[a] Species ID should be considered preliminary. Pinned specimens are available for examination.
[b] 357 cells were surveyed with un-baited pitfall traps. 183 of those cells were also surveyed with unbaited 4-16 funnel Lingren traps

Table 6-3. Opportunistic detections at terrestrial and wetland survey sites during 2013-2014 MBI surveys

Common Name	Latin Name	Terrestrial[a]	Wetland[a]	# Cells Detected
Fish[b]				
Any Fish Species		No	Yes	217
Insect[c]				
Western Bumblebee	*Bombus occidentalis*	Yes	Yes	5
Mammals[b]				
American Pika	*Ochotona princeps*	Yes	Yes	40
Golden Mantled Ground Squirrel	*Callospermophilus lateralis*	Yes	Yes	10
Hoary Marmot	*Marmota caligata*	Yes	Yes	3
Red Squirrel	*Tamiasciurus hudsonicus*	Yes	No	184
Yellow-bellied Marmot	*Marmota flaviventris*	Yes	Yes	3
Mammals (Shrews)[d]				
American Pygmy Shrew	*Sorex hoyi*	Yes	No	8
Masked Shrew	*Sorex cinereus*	Yes	No	41
Montane Shrew	*Sorex monticolus*	Yes	No	4
Vagrant Shrew	*Sorex vagrans*	Yes	No	24
Millipedes[e]				
Any Millipede Species	Diplopoda	Yes	No	72
Plants[b]				
Devil's Club	*Oplopanax horridus*	Yes	Yes	116
Long Leaf Sundew	*Drosera anglica*	No	Yes	0
Rare Moonwort	*Botrychium spp.*	No	Yes	0
Round Leaf Sundew	*Drosera rotundifolia*	No	Yes	1
Spotted Knapweed	*Centaurea maculosa*	Yes	Yes	131
Tansy	*Tanacetum vulgare*	Yes	Yes	133
Whitebark Pine	*Pinus albicaulis*	Yes	Yes	13
Reptiles[b]				
Common Garter Snake[f]	*Thamnophis sirtalis*	Yes	Yes	26
Northern Alligator Lizard	*Elgaria coerulea*	Yes	No	0
Northern Rubber Boa	*Charina bottae*	Yes	No	0
Painted Turtle	*Chrysemys picta*	No	Yes	22
Racer	*Coluber constrictor*	Yes	No	0
Snapping Turtle	*Chelydra serpentina*	No	Yes	0
Western Skink	*Plestiodon skiltonianus*	Yes	No	1
Western Terrestrial Garter Snake[f]	*Thamnophis elegans*	Yes	Yes	60

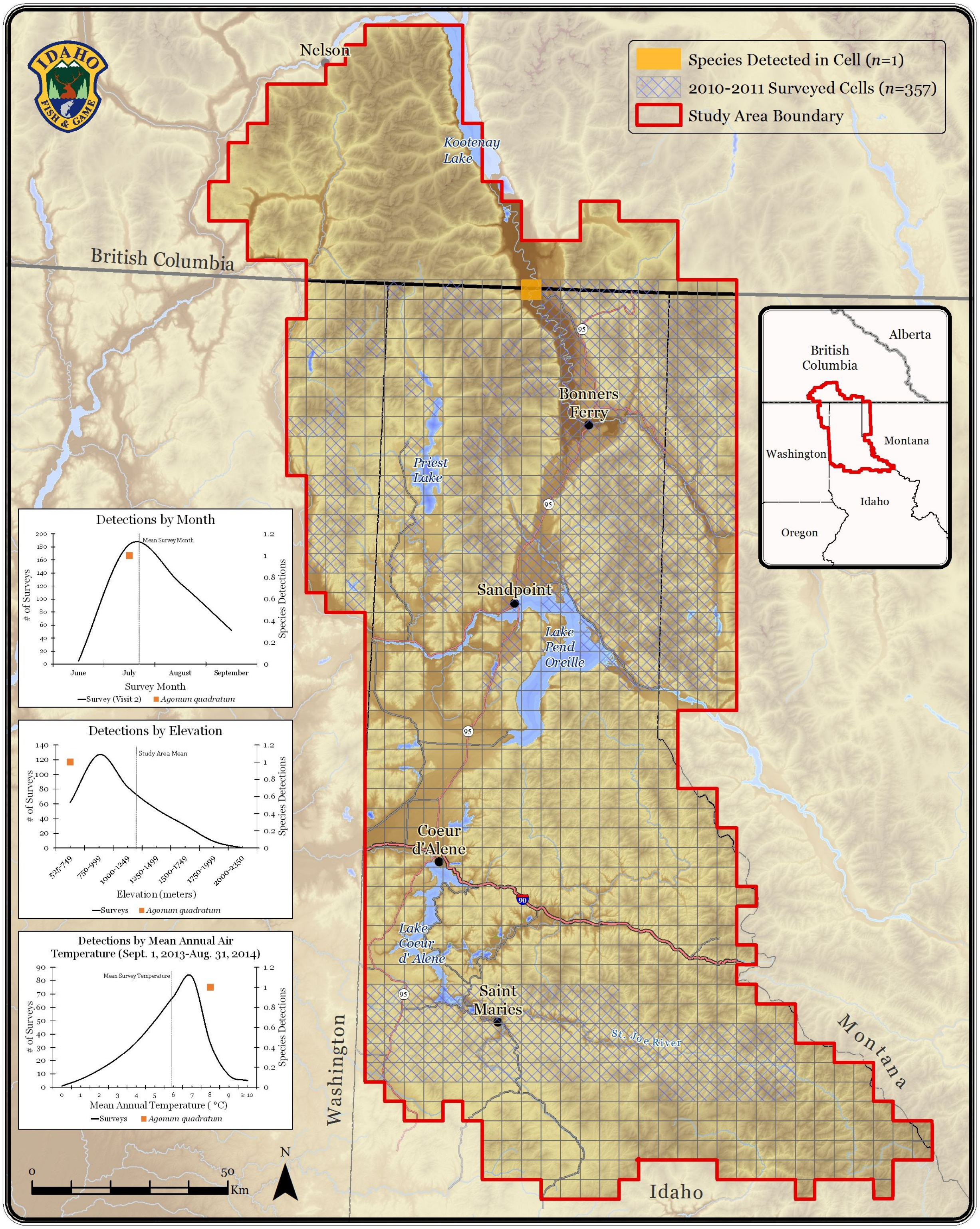
[a] Detection/no-detection box provided on terrestrial or wetland datasheet
[b] 3Visual or audible field identification
[c] Observations verified via photograph
[d] Observations verified genetically
[e] Specimens collected from leaf litter
[f] Garter snake species ID should be interpreted cautiously as species were differentiated in the field by presence (*T. sirtalis*) or absence (*T. elegans*) of red dorsal markings.

Multi-species Baseline Initiative: *Agonum errans* Detections



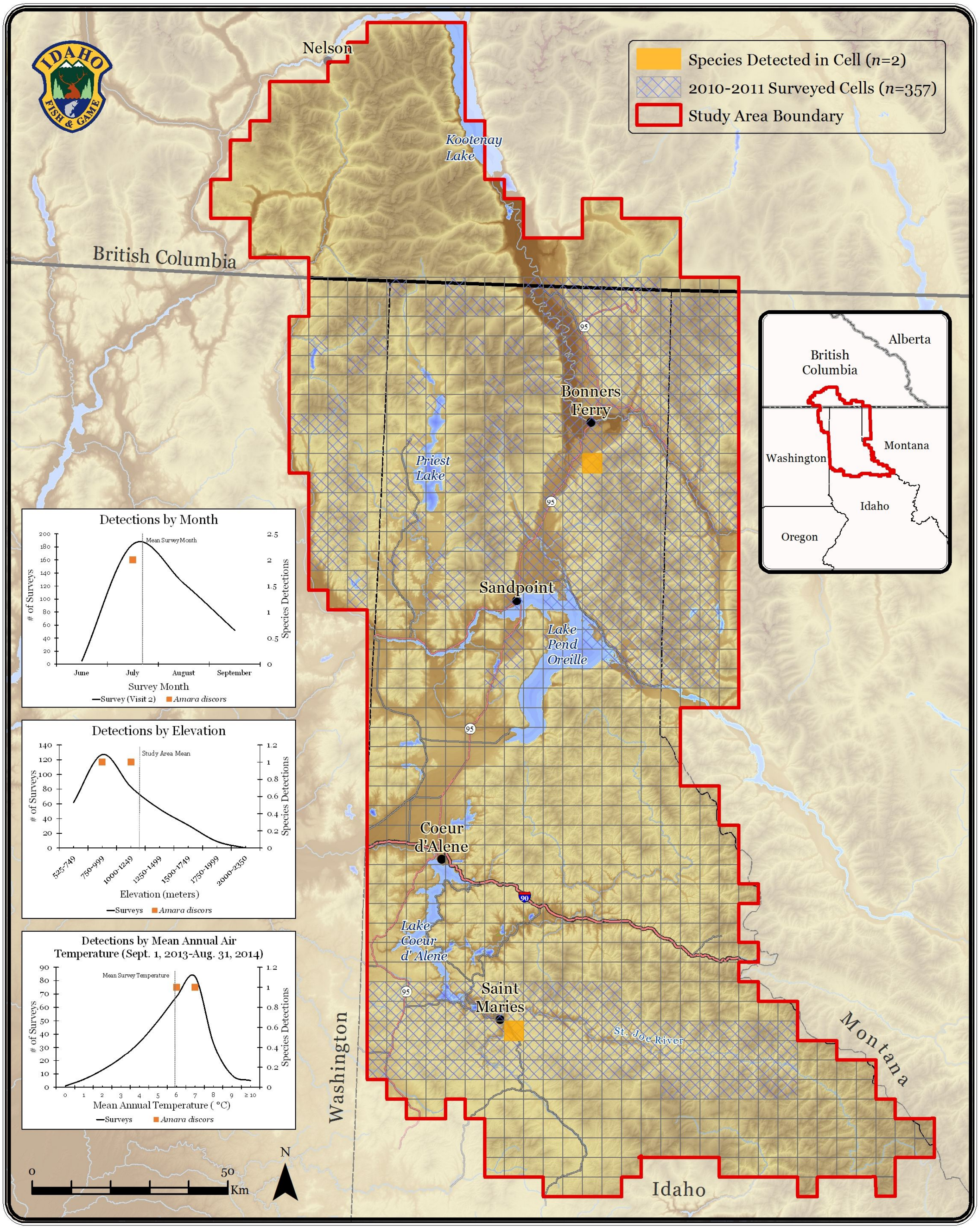
Map 6-1.

Multi-species Baseline Initiative: *Agonum quadratum* Detections



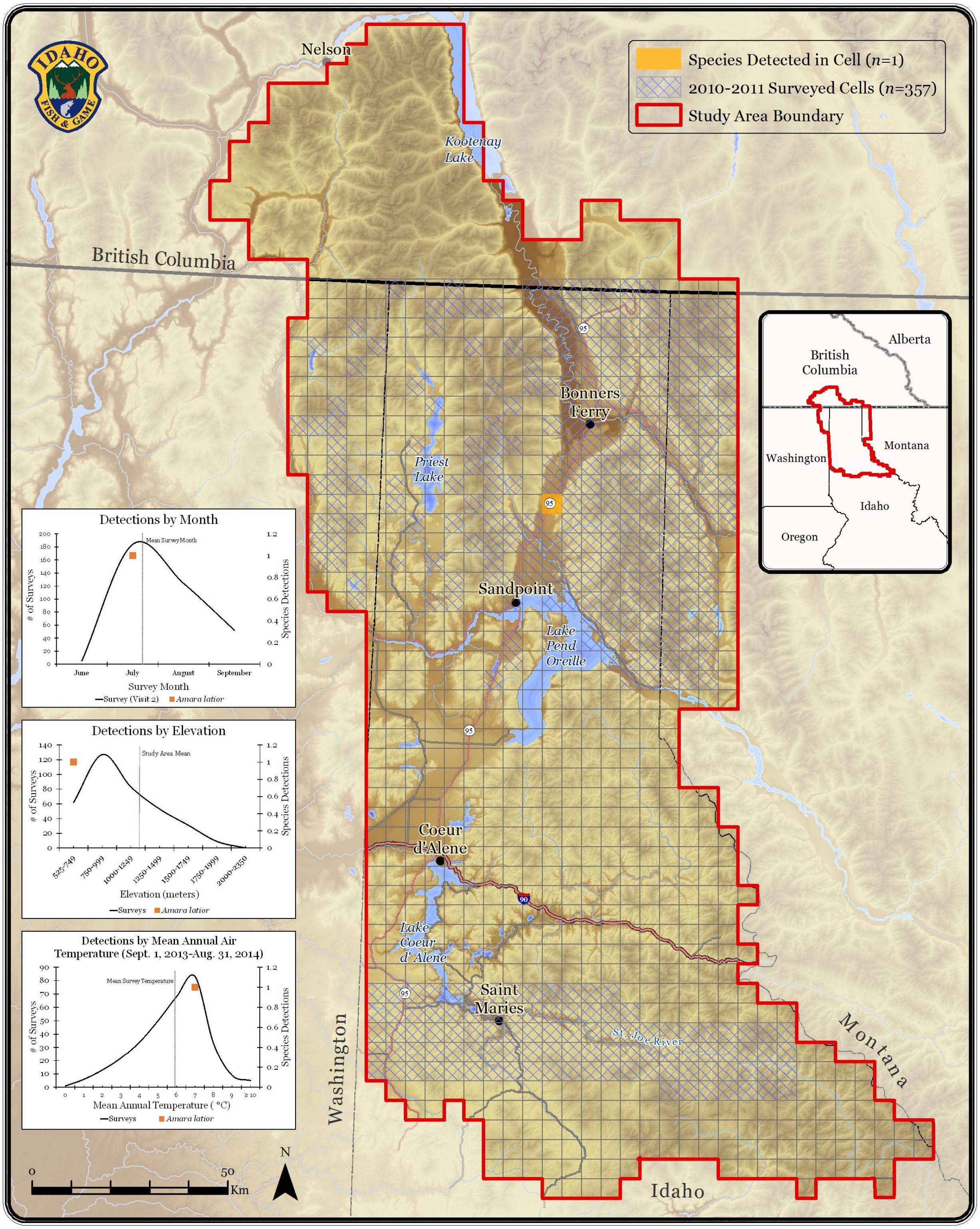
Map 6-2.

Multi-species Baseline Initiative: *Amara discors* Detections



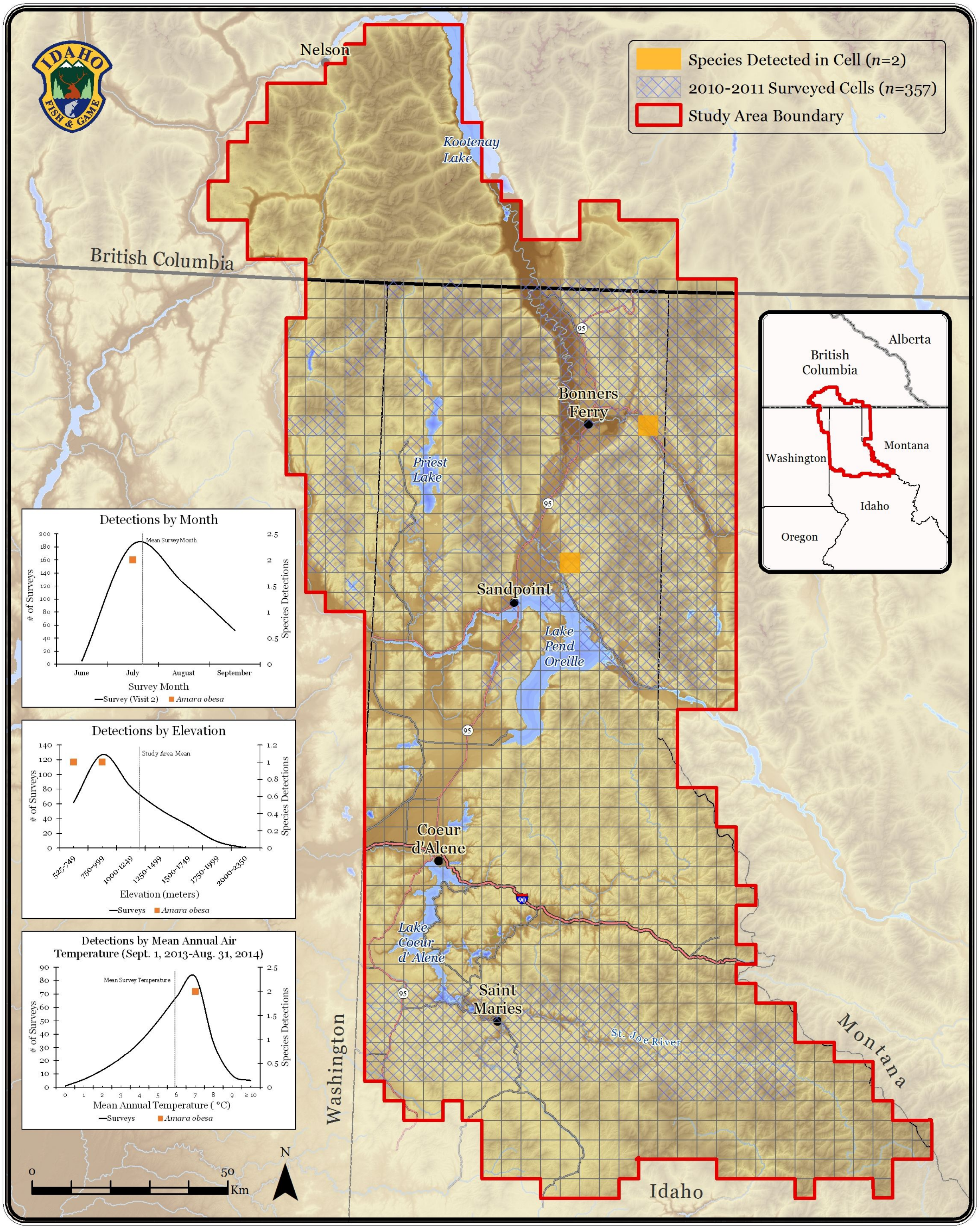
Map 6-3.

Multi-species Baseline Initiative: *Amara latior* Detections



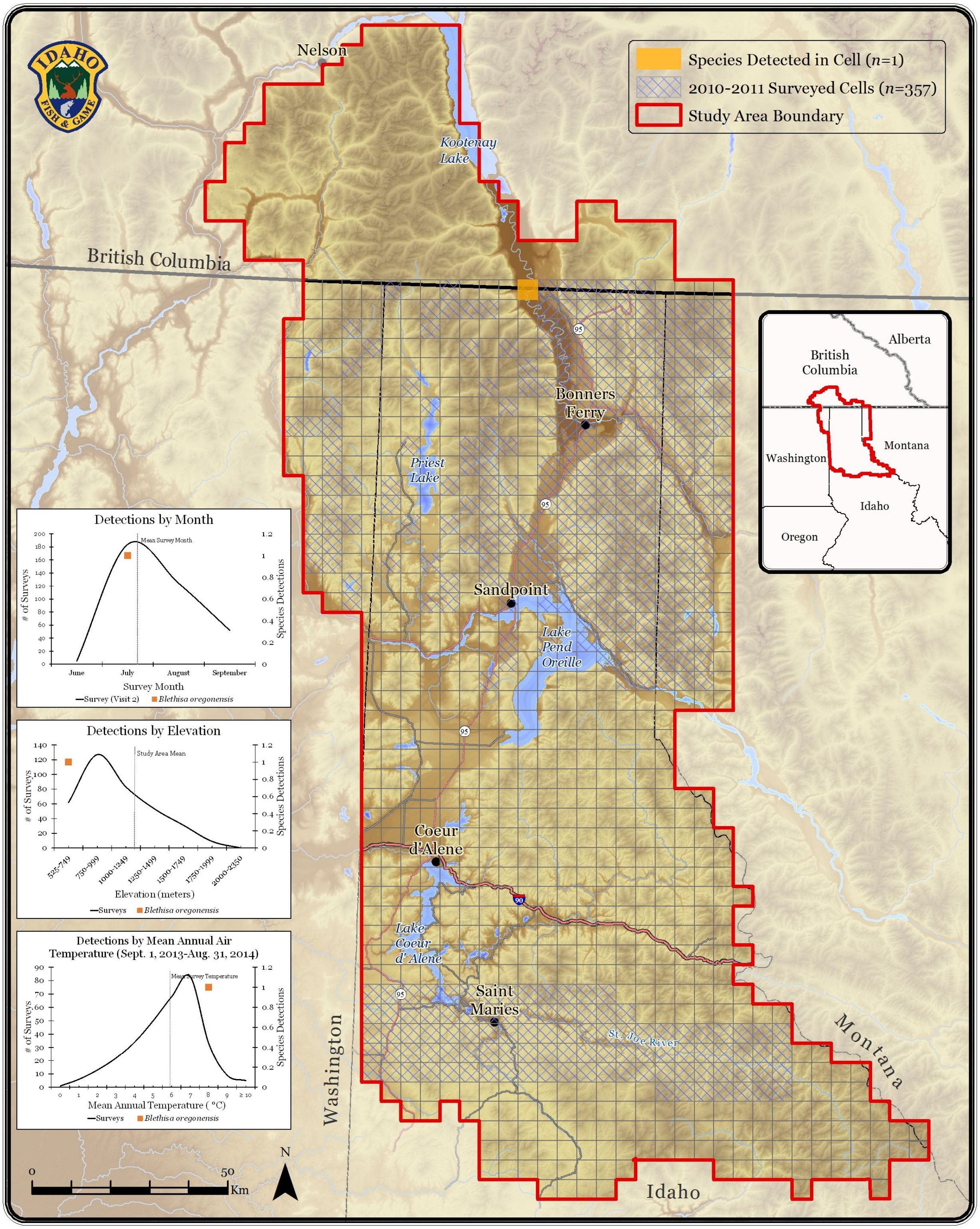
Map 6-4.

Multi-species Baseline Initiative: *Amara obesa* Detections



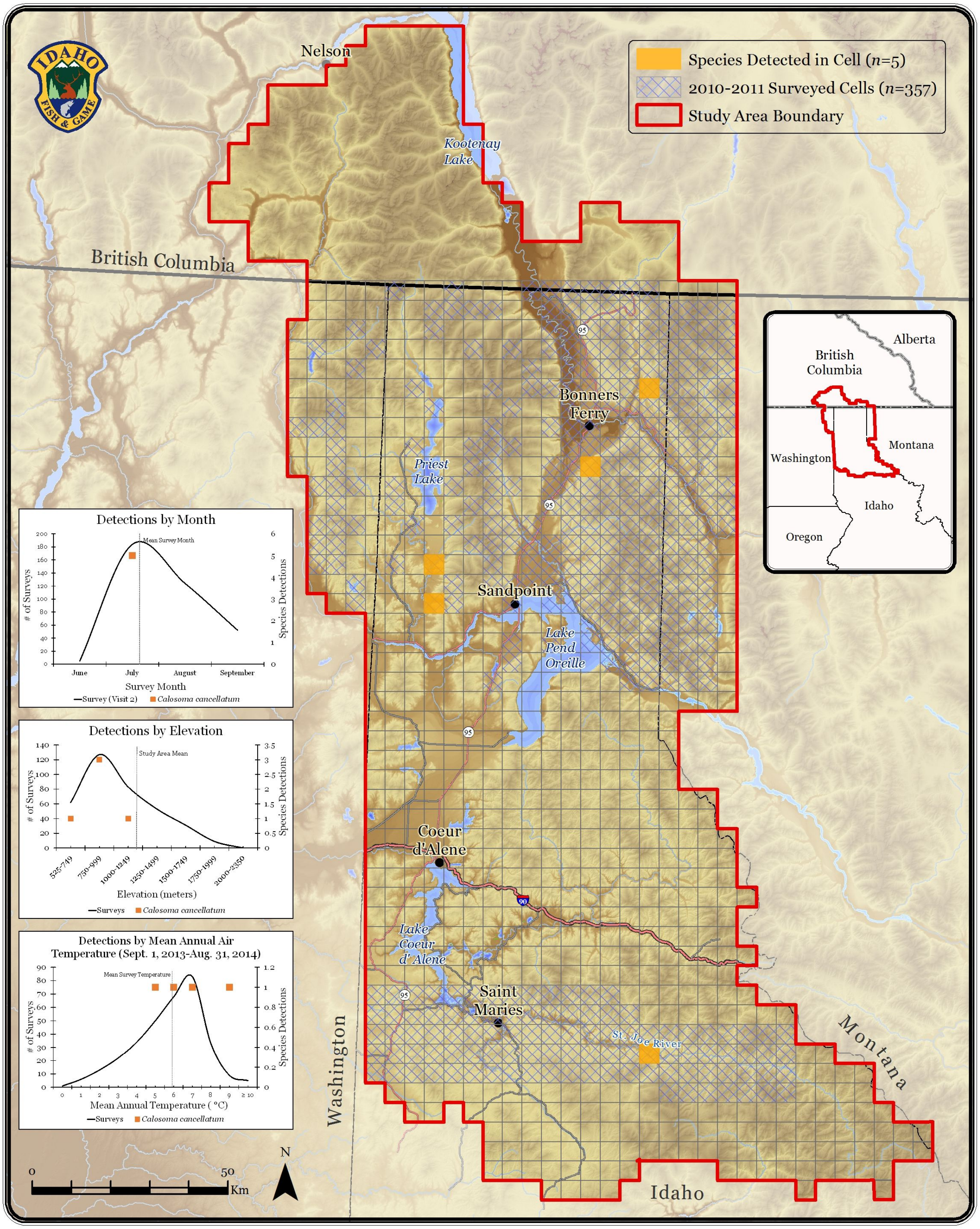
Map 6-5.

Multi-species Baseline Initiative: *Blethisa oregonensis* Detections



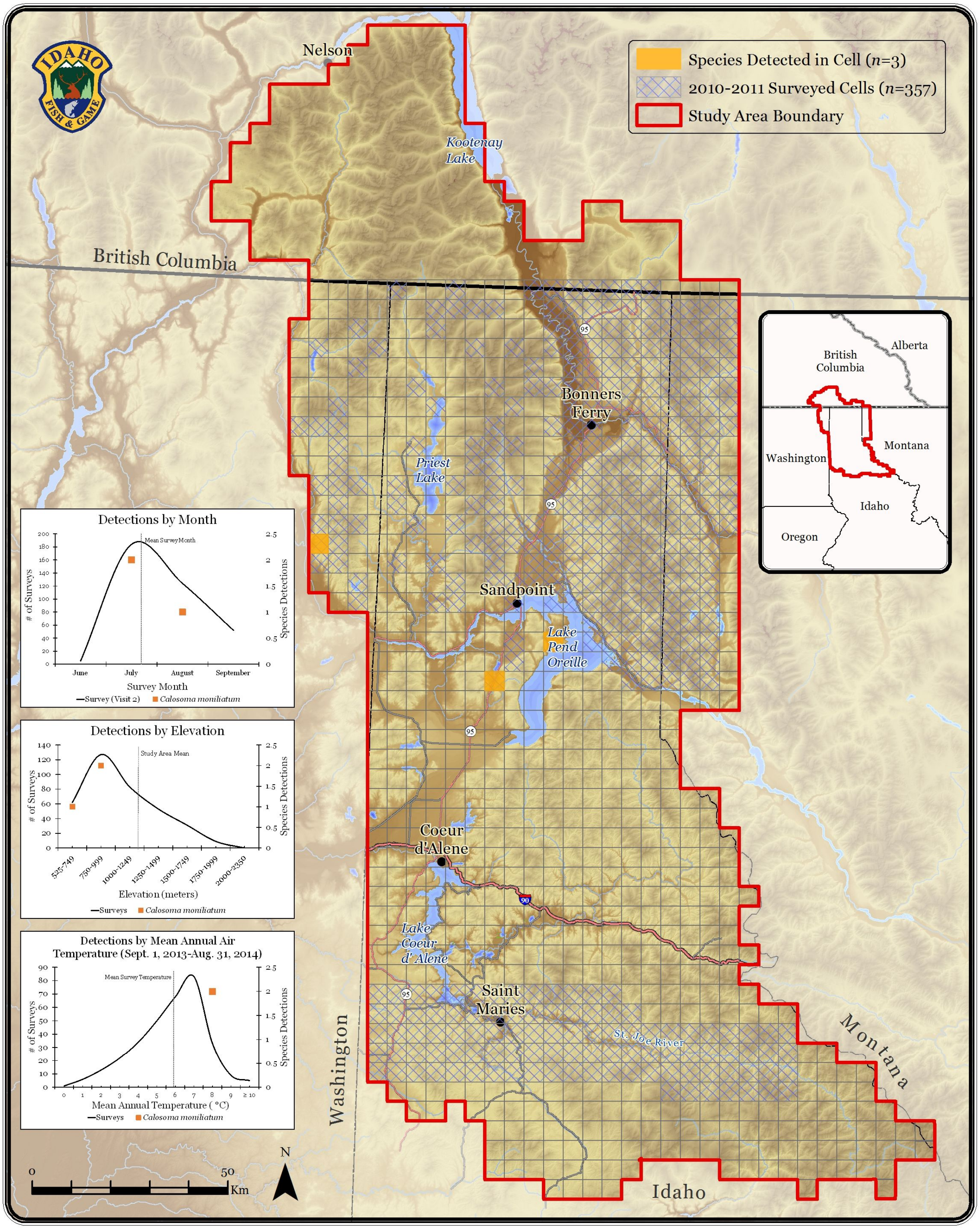
Map 6-6.

Multi-species Baseline Initiative: *Calosoma cancellatum* Detections



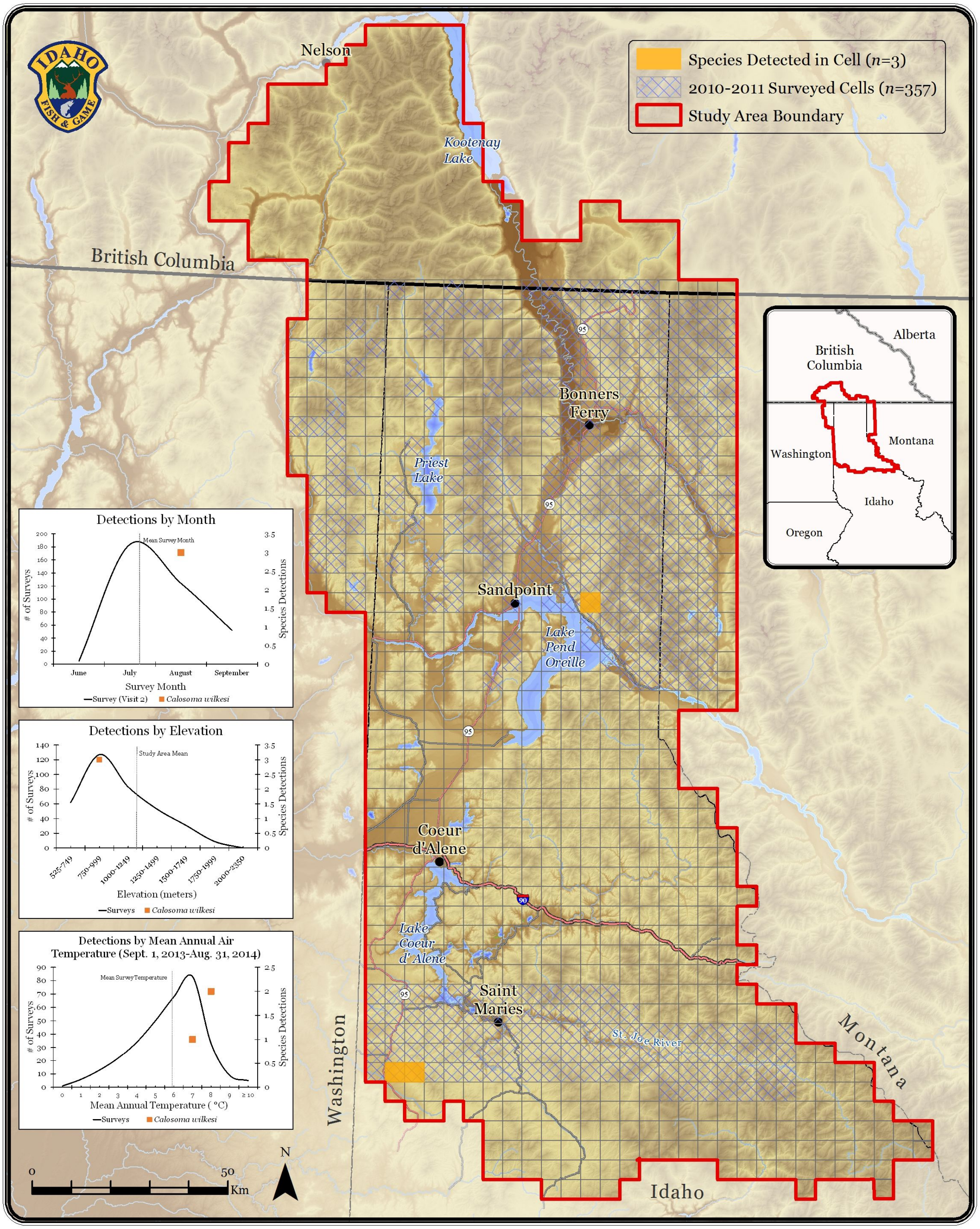
Map 6-7.

Multi-species Baseline Initiative: *Calosoma moniliatum* Detections



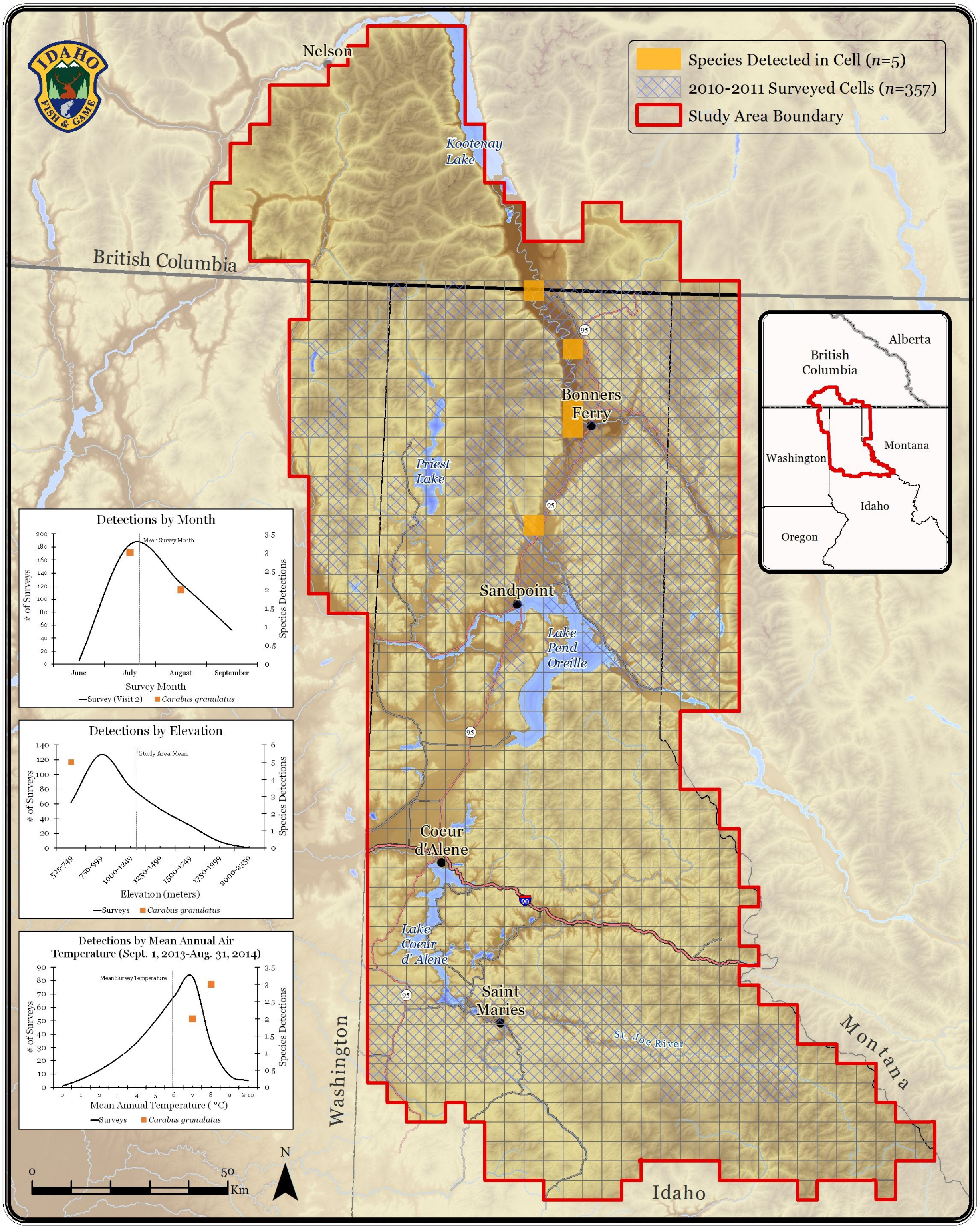
Map 6-8.

Multi-species Baseline Initiative: *Calosoma wilkesi* Detections



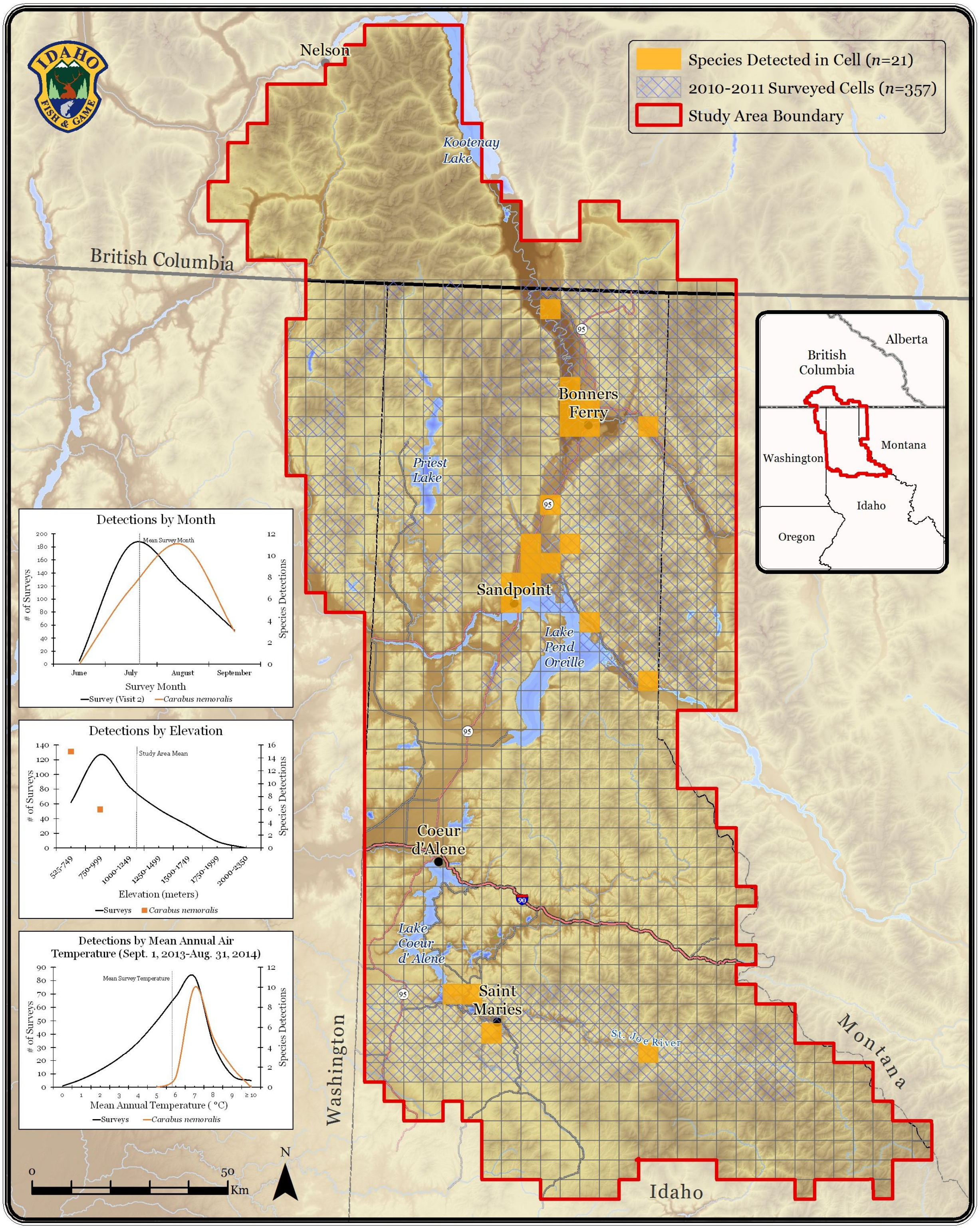
Map 6-9.

Multi-species Baseline Initiative: Granulated Carabid (*Carabus granulatus*) Detections



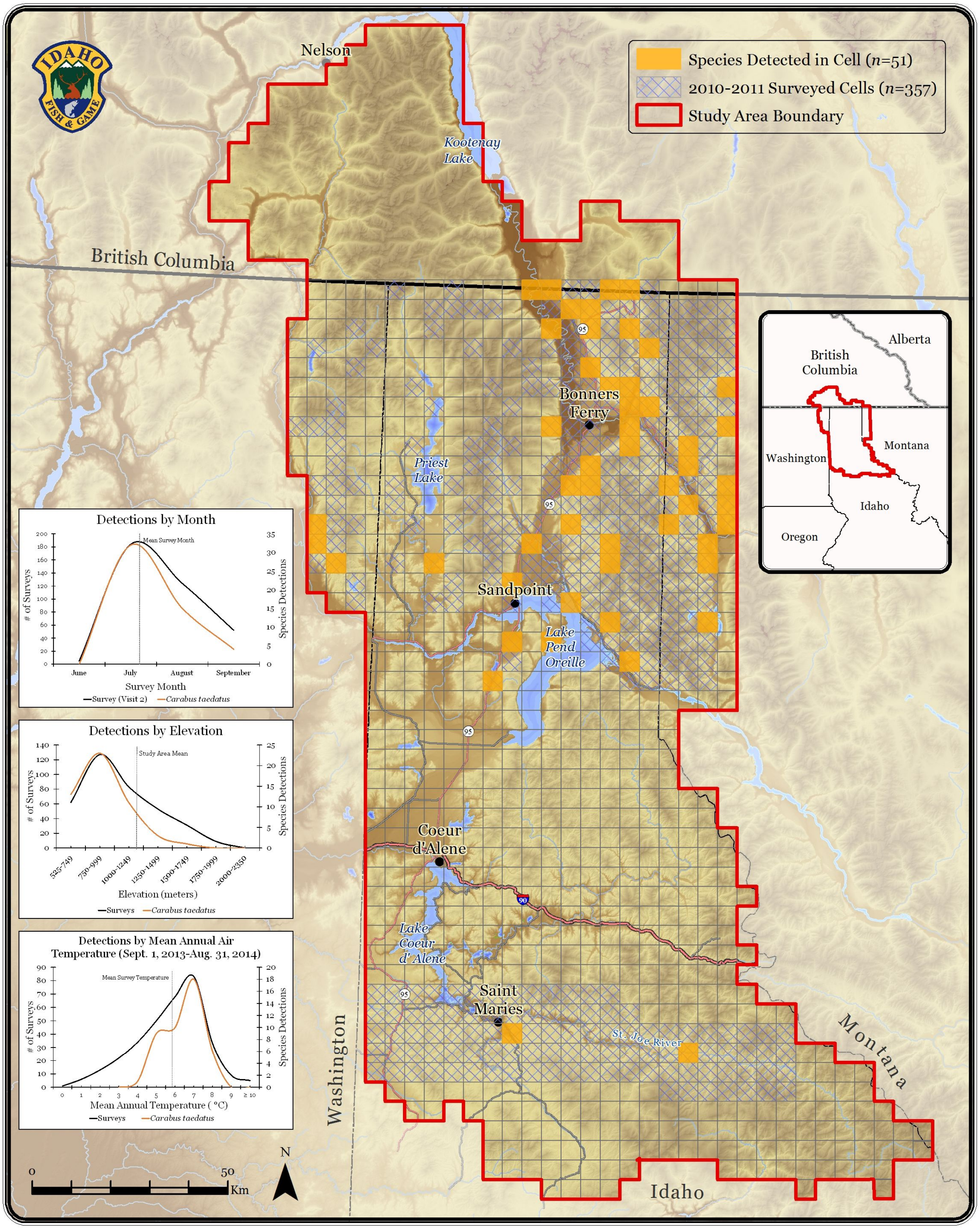
Map 6-10.

Multi-species Baseline Initiative: Bronzed Carabid (*Carabus nemoralis*) Detections



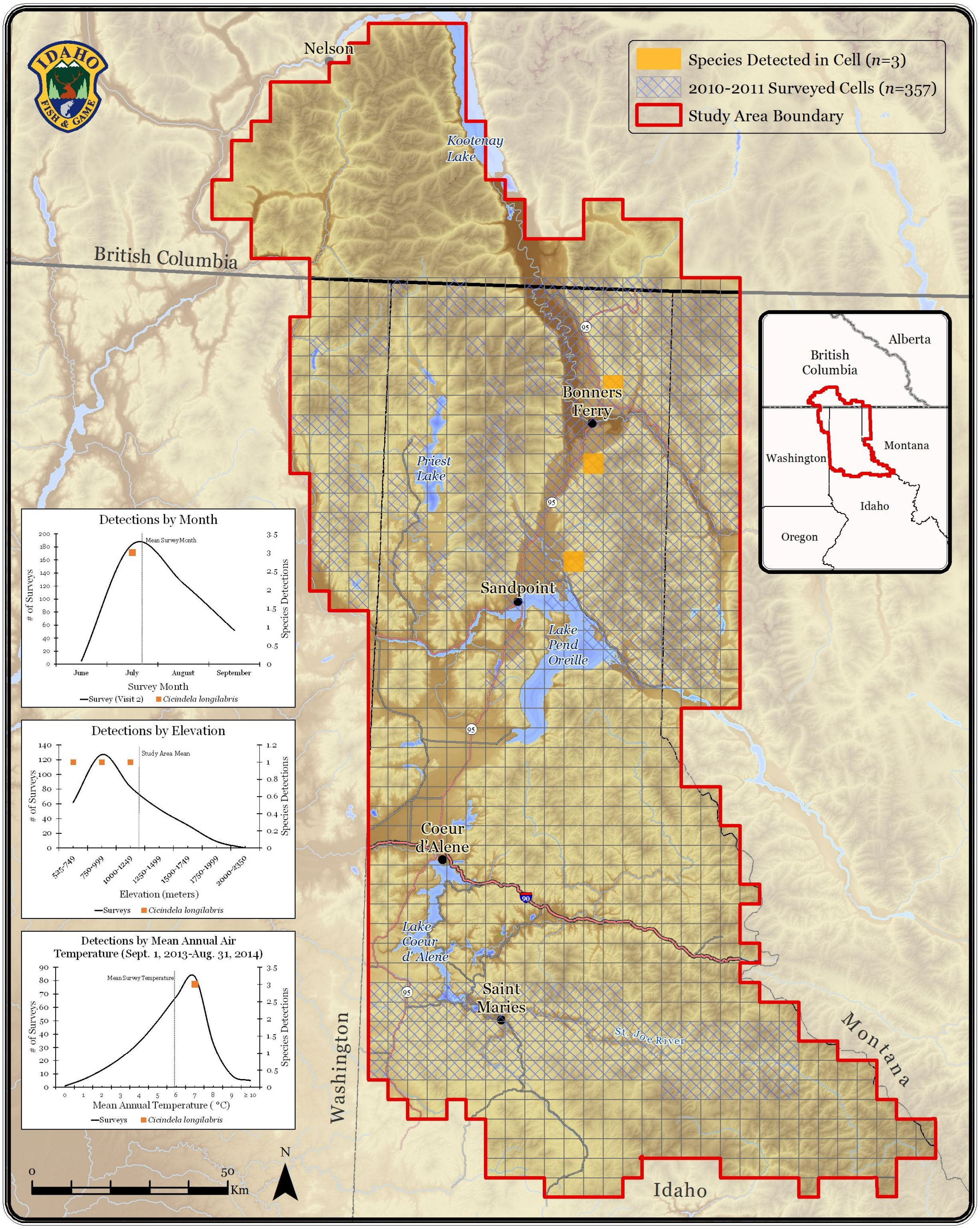
Map 6-11.

Multi-species Baseline Initiative: *Carabus taedatus* Detections



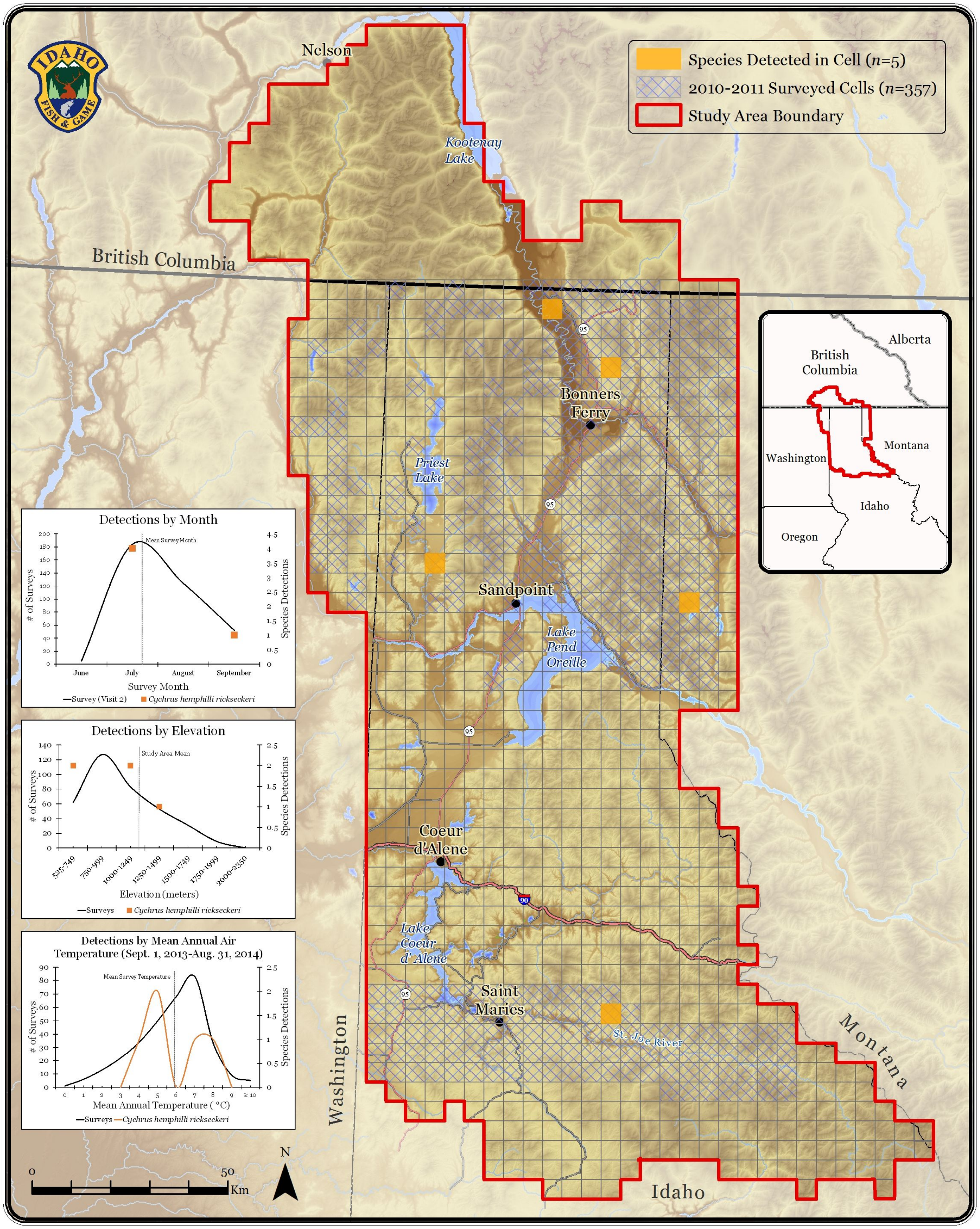
Map 6-12.

Multi-species Baseline Initiative: Boreal Long-lipped Tiger Beetle (*Cicindela longilabris*) Detections



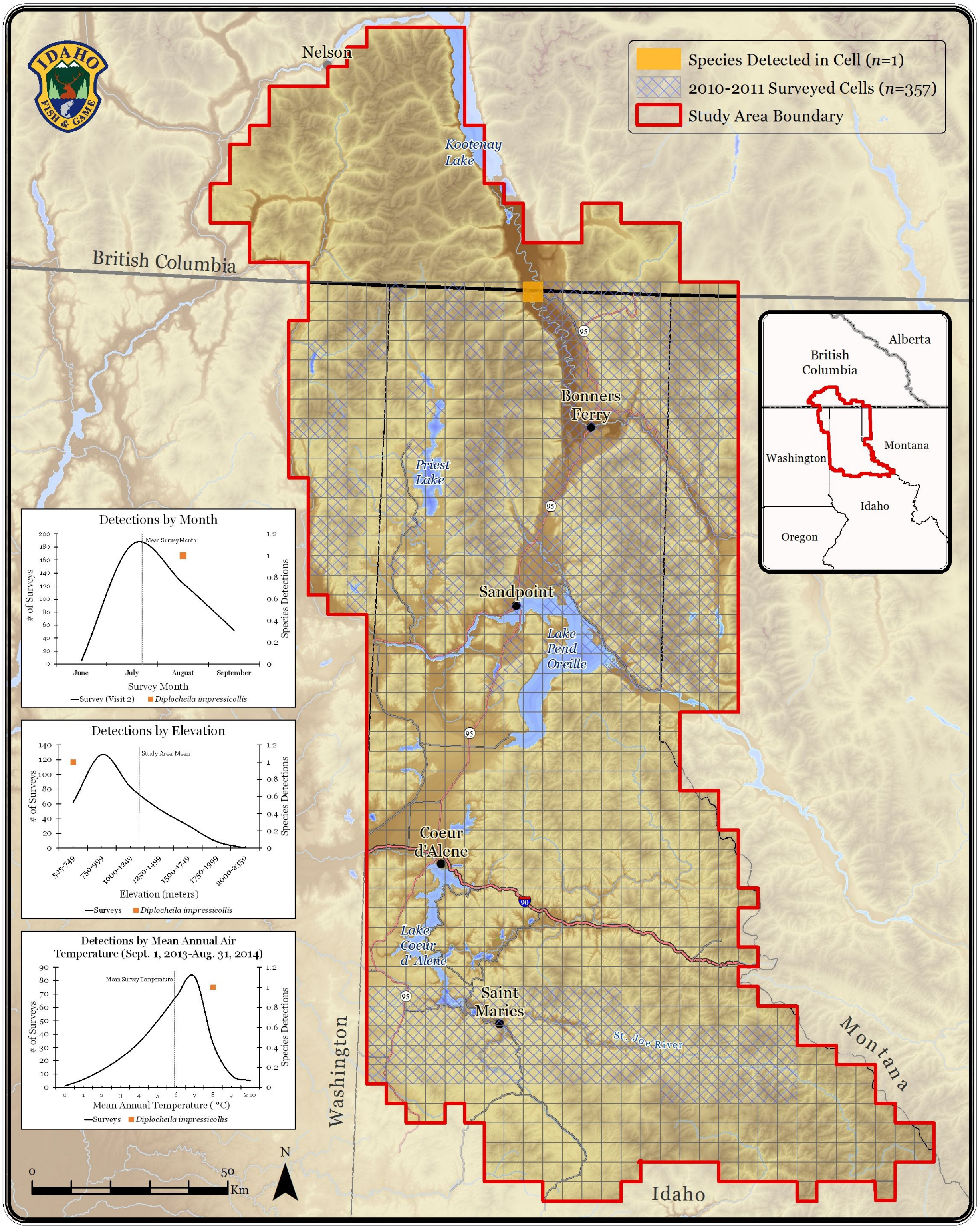
Map 6-13.

Multi-species Baseline Initiative: *Cychrus hemphilli rickseckeri* Detections



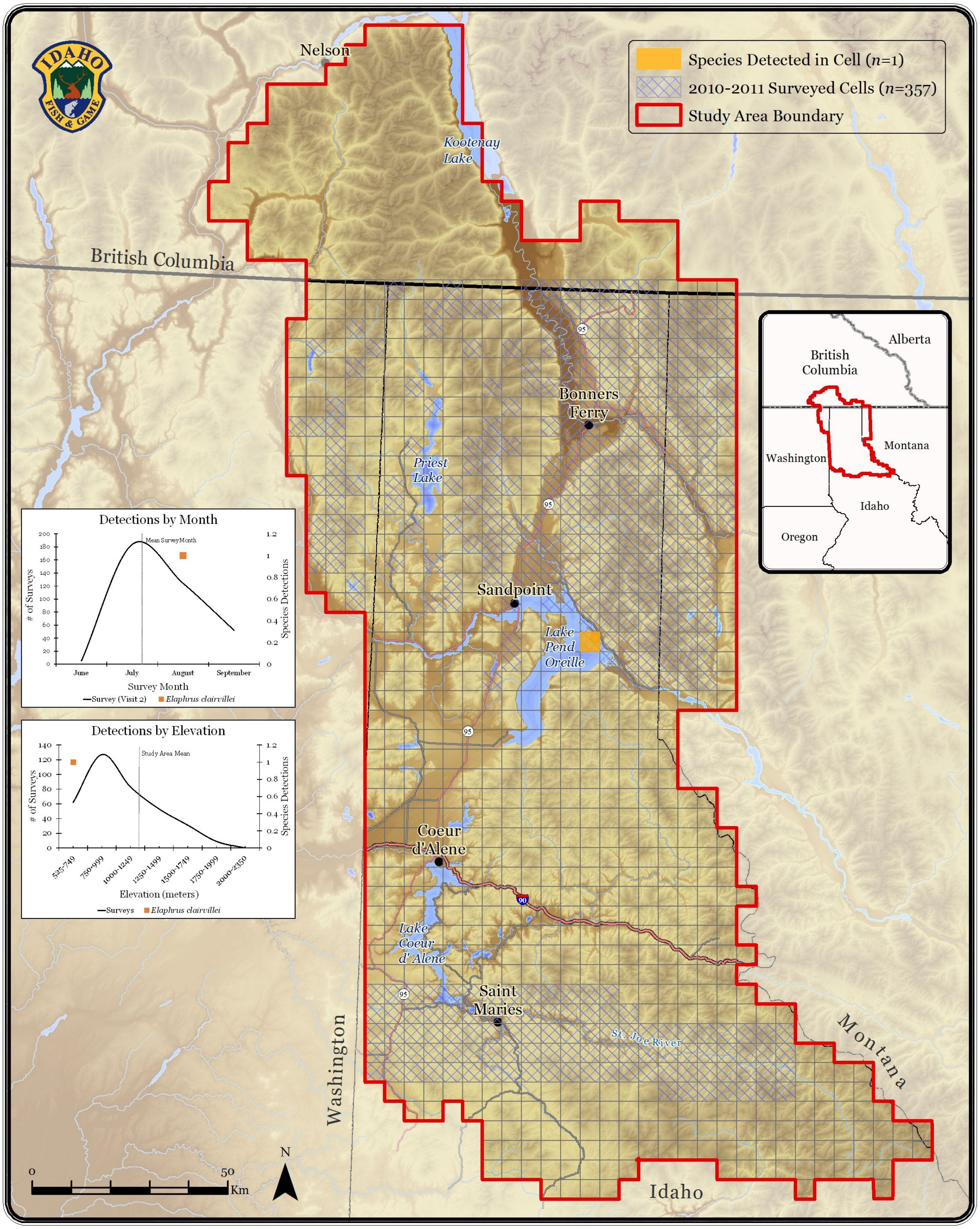
Map 6-14.

Multi-species Baseline Initiative: *Diplocheila impressicollis* Detections



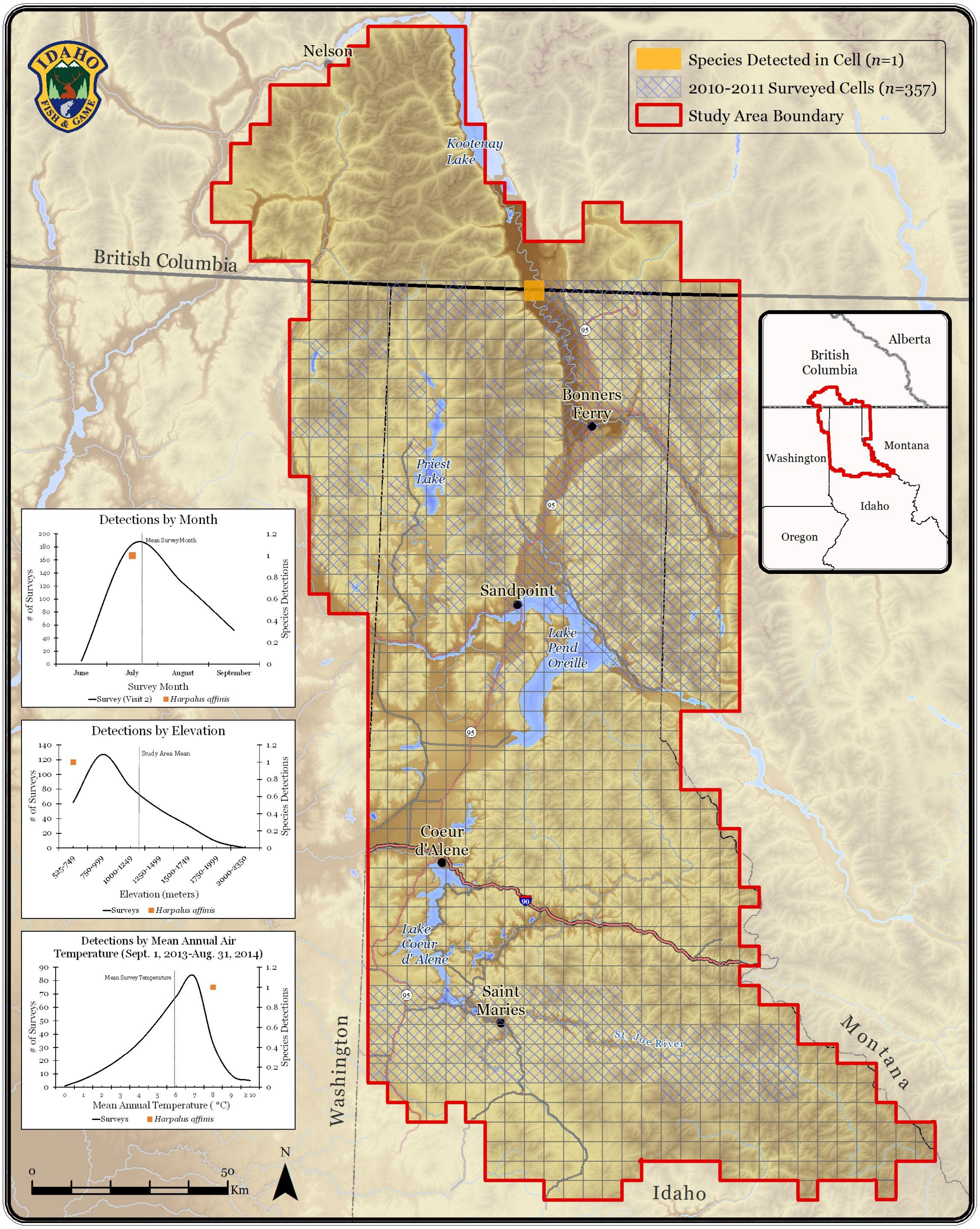
Map 6-15.

Multi-species Baseline Initiative: *Elaphrus clairvillei* Detections



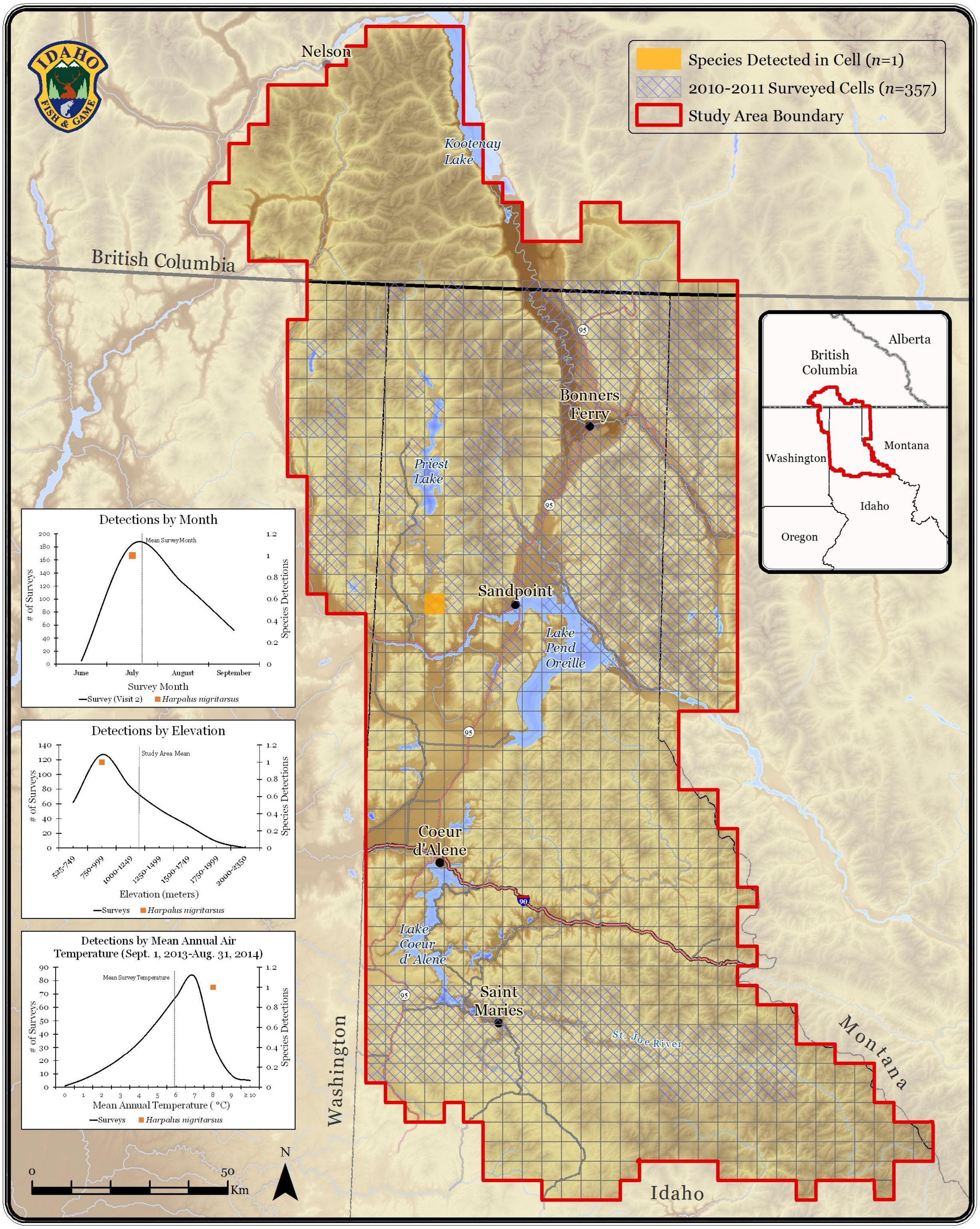
Map 6-16.

Multi-species Baseline Initiative: *Harpalus affinis* Detections



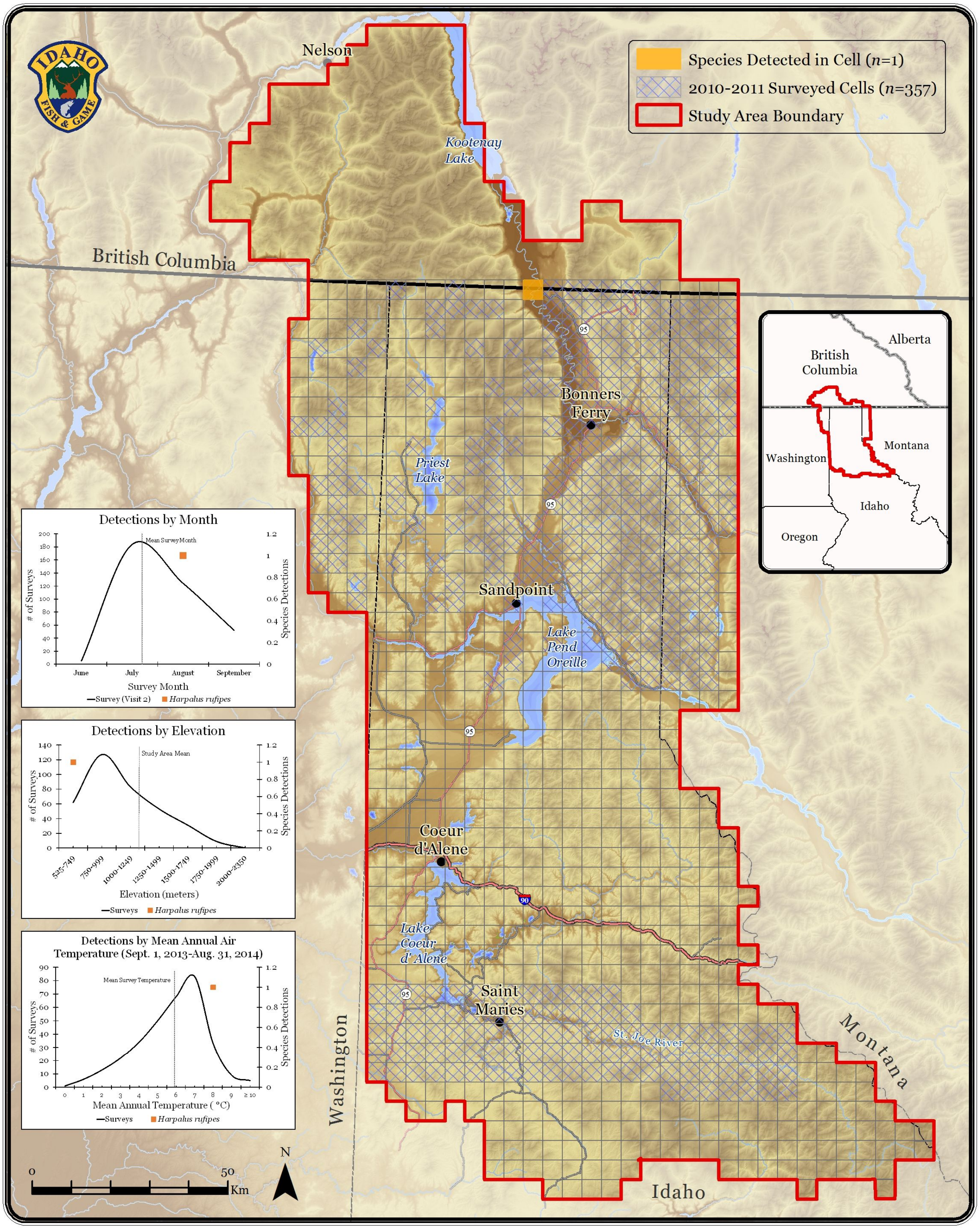
Map 6-17.

Multi-species Baseline Initiative: *Harpalus nigritarsus* Detections



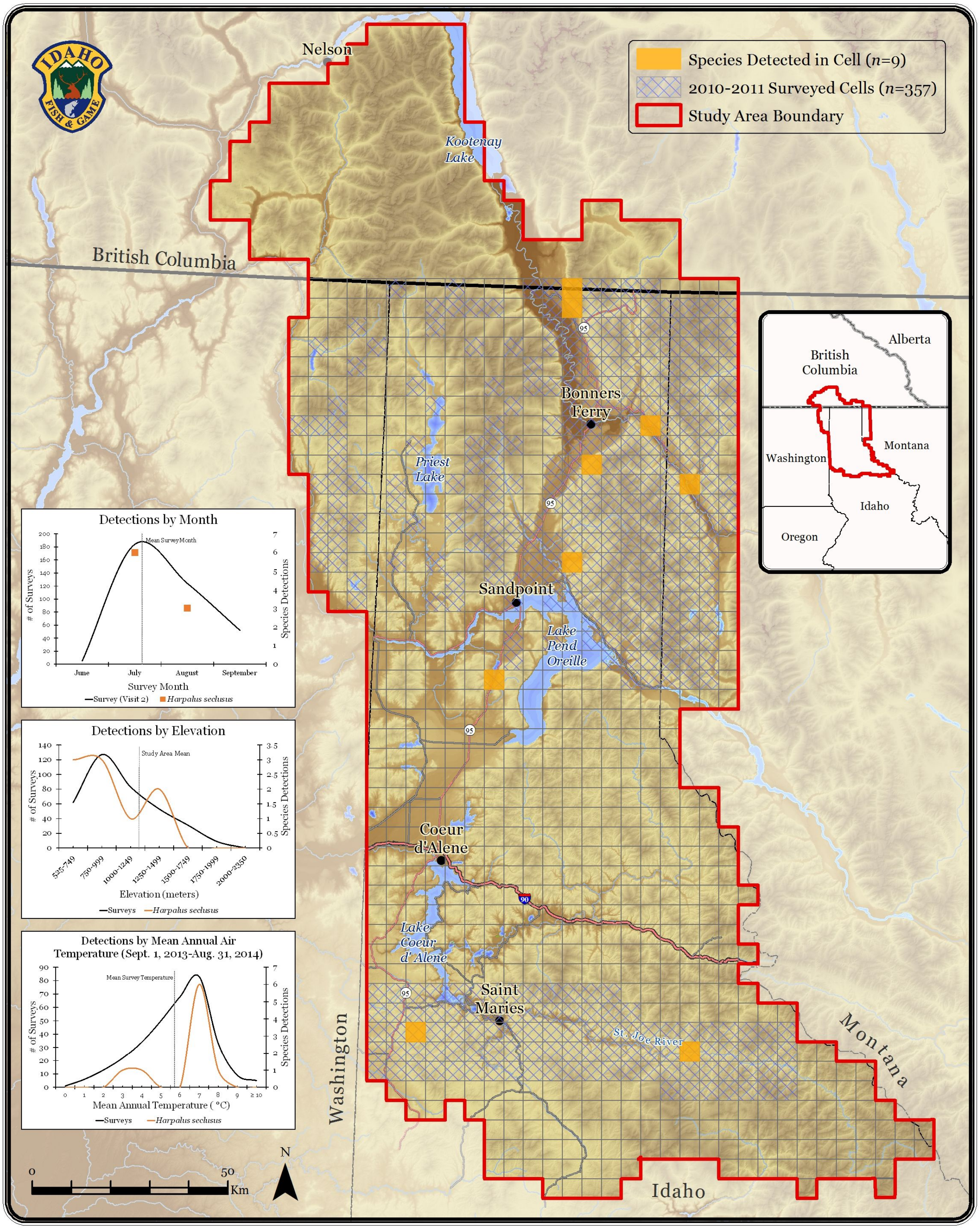
Map 6-18.

Multi-species Baseline Initiative: *Harpalus rufipes* Detections



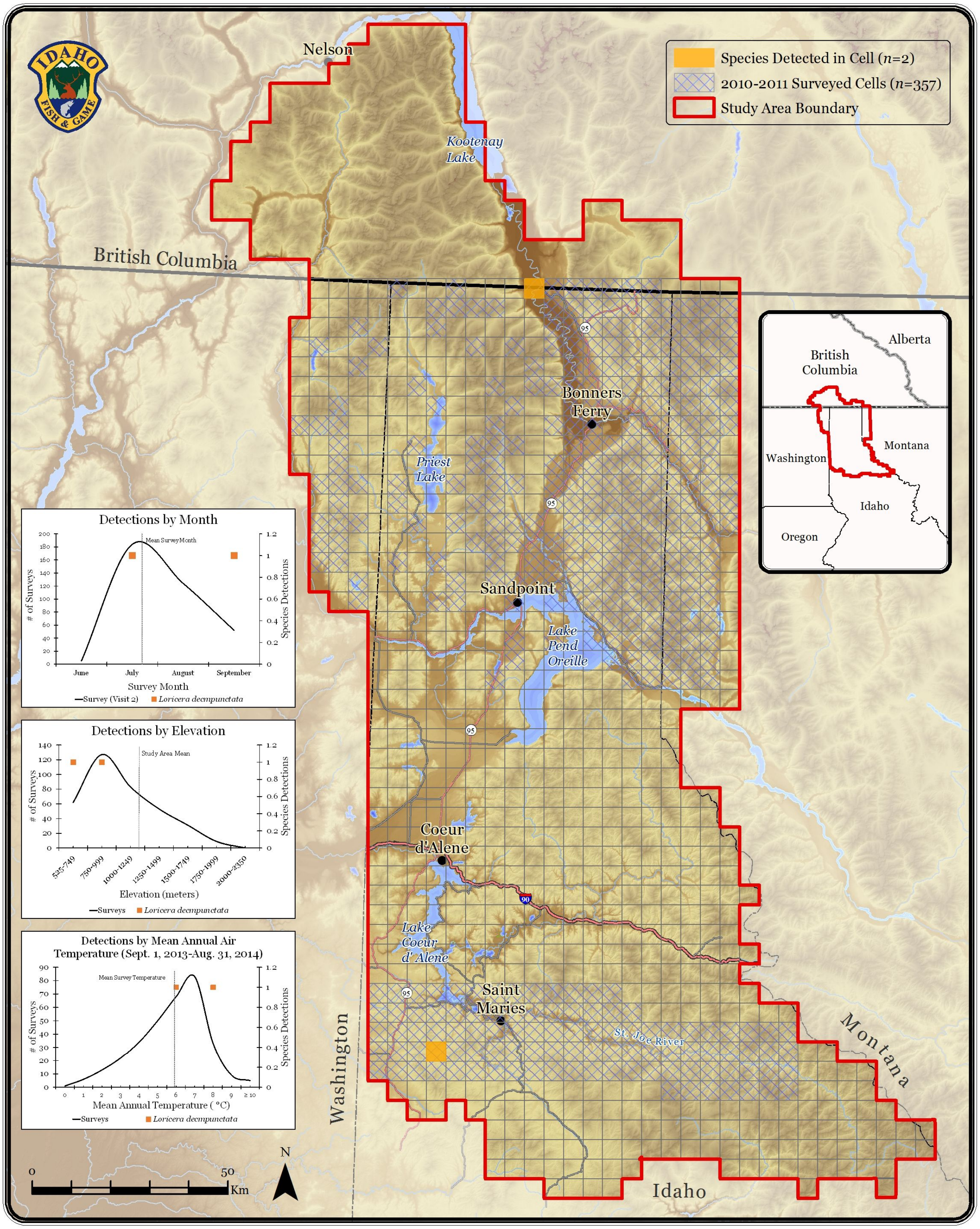
Map 6-19.

Multi-species Baseline Initiative: *Harpalus seclusus* Detections



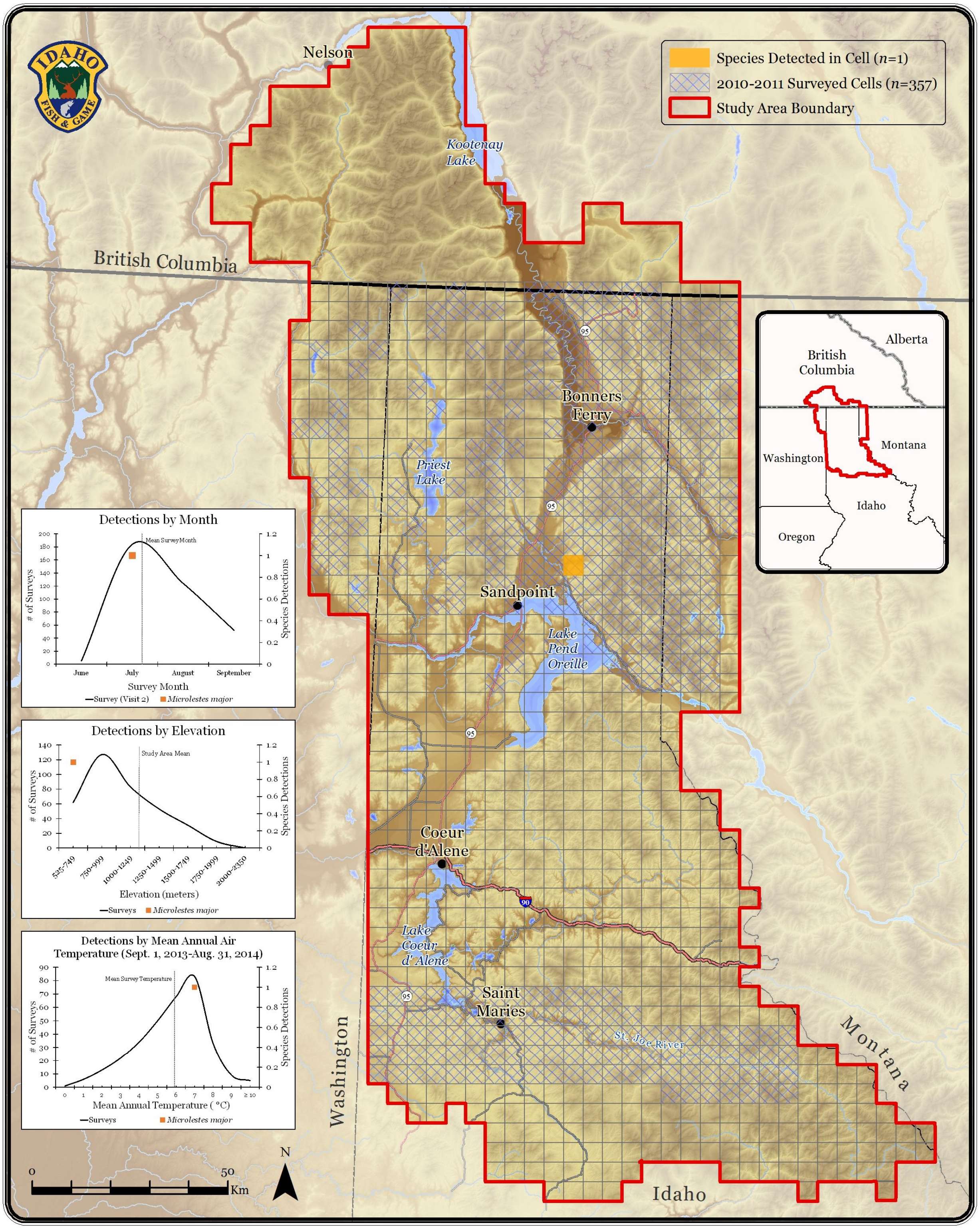
Map 6-20.

Multi-species Baseline Initiative: (*Loricera decempunctata*) Detections



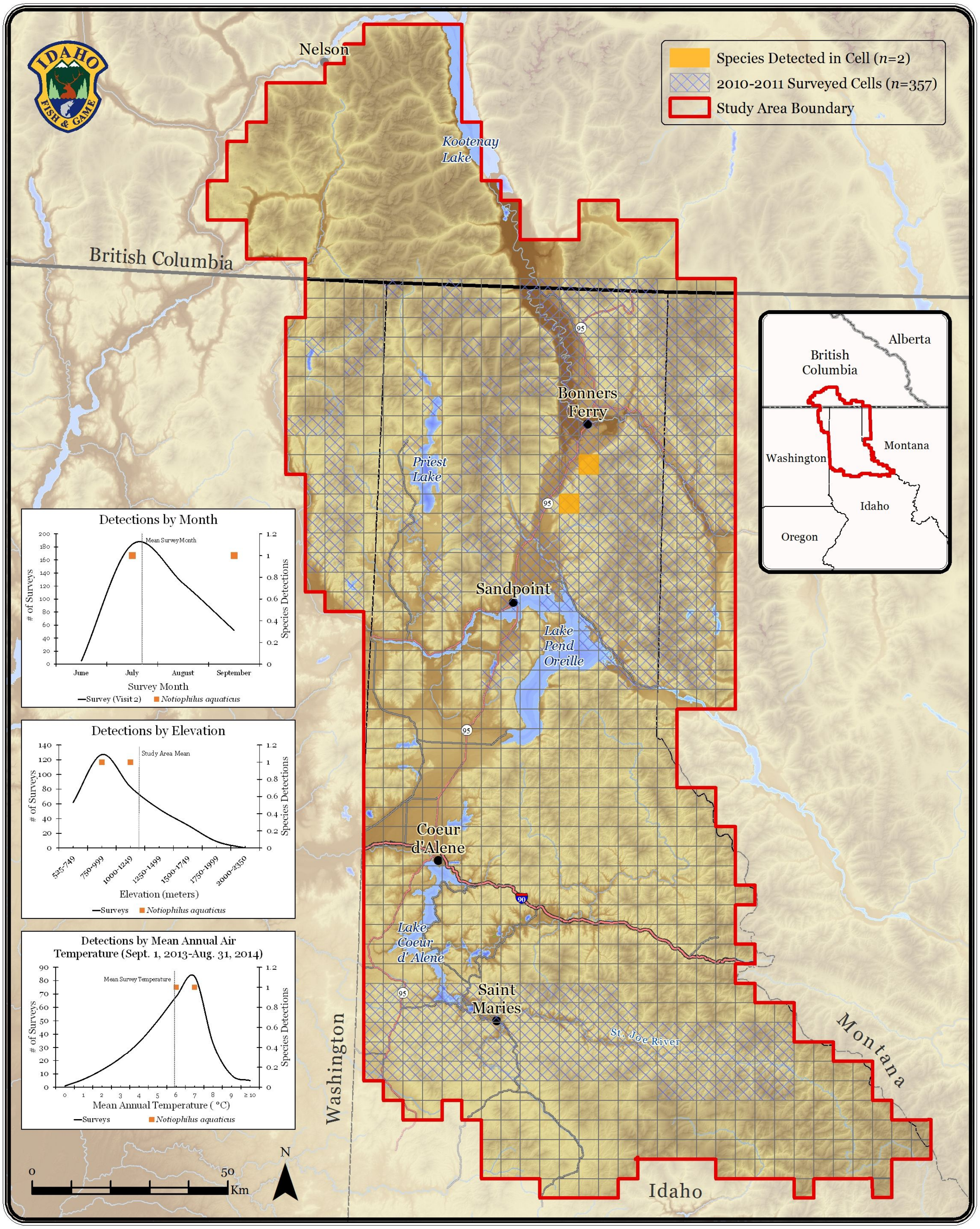
Map 6-21.

Multi-species Baseline Initiative: *Microlestes major* Detections



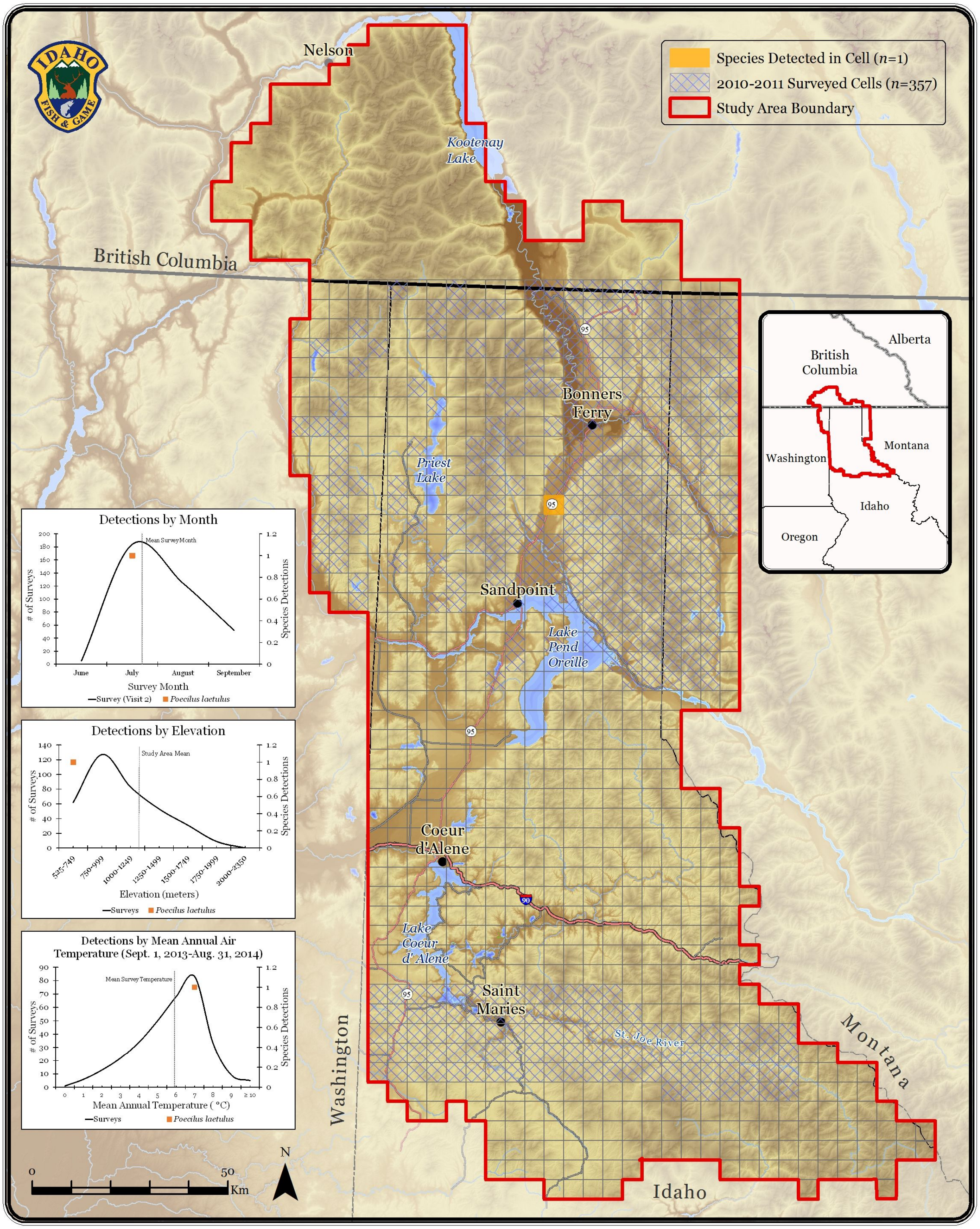
Map 6-22.

Multi-species Baseline Initiative: *Notiophilus aquaticus* Detections



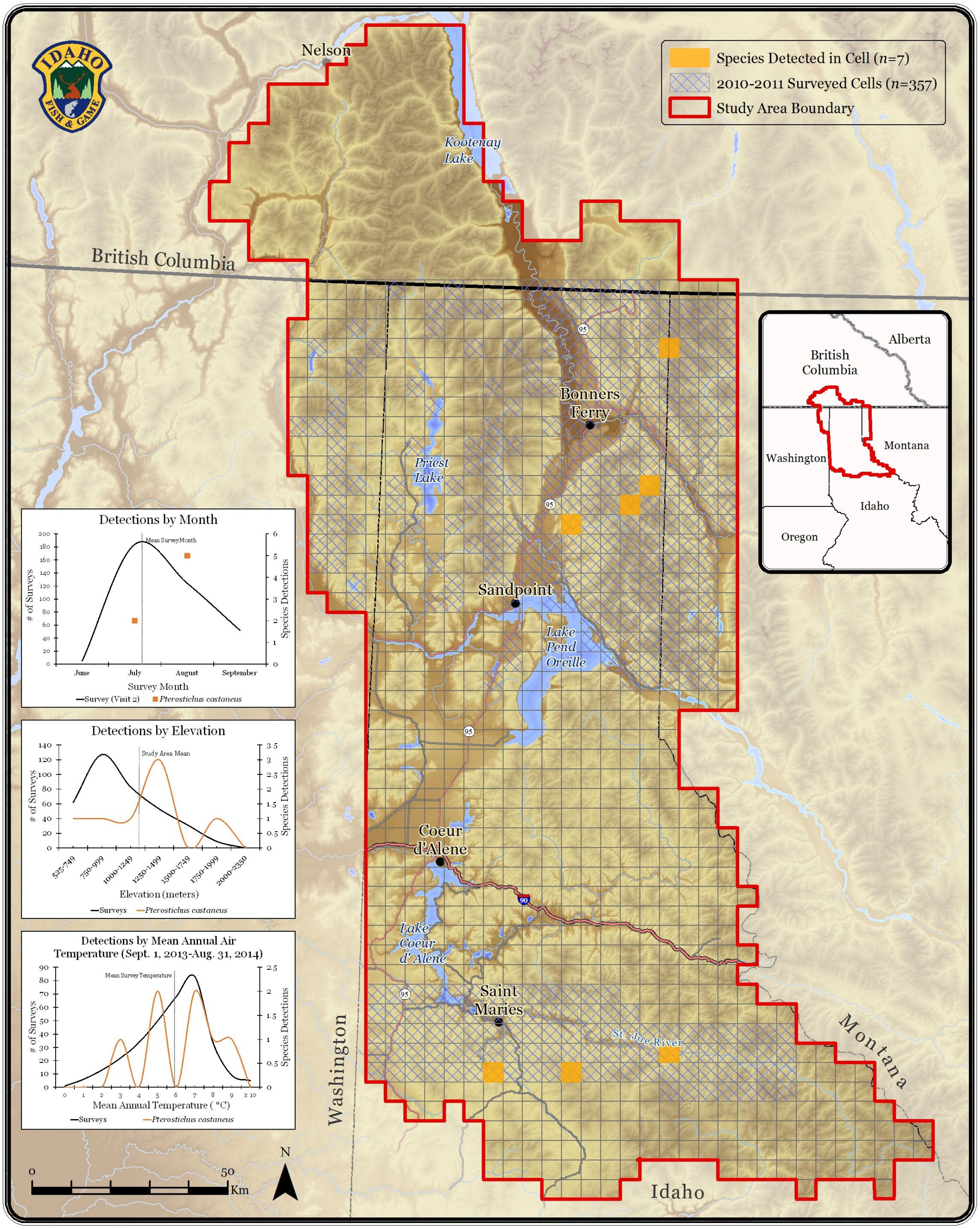
Map 6-23.

Multi-species Baseline Initiative: *Poecilus laetulus* Detections



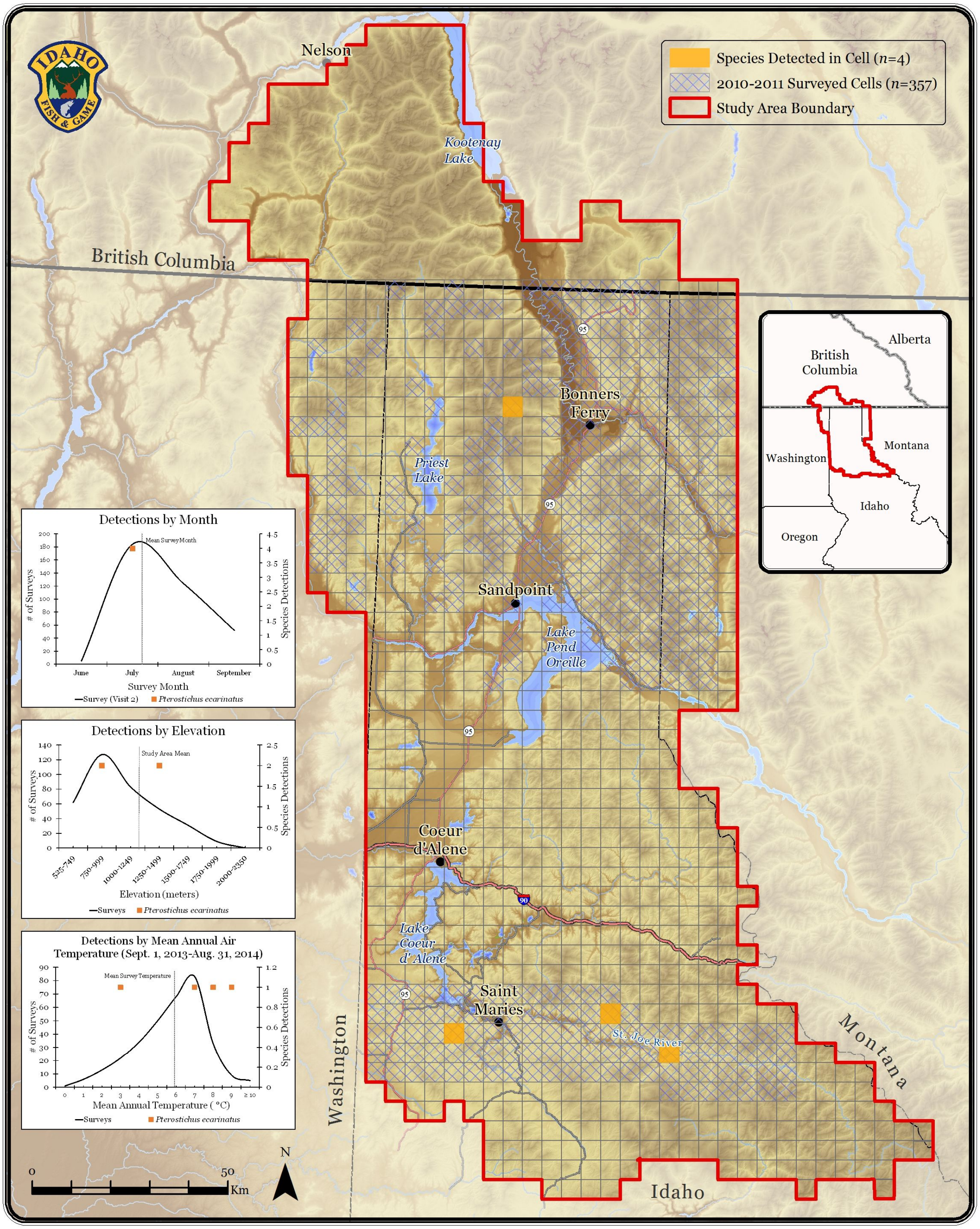
Map 6-24.

Multi-species Baseline Initiative: *Pterostichus castaneus* Detections



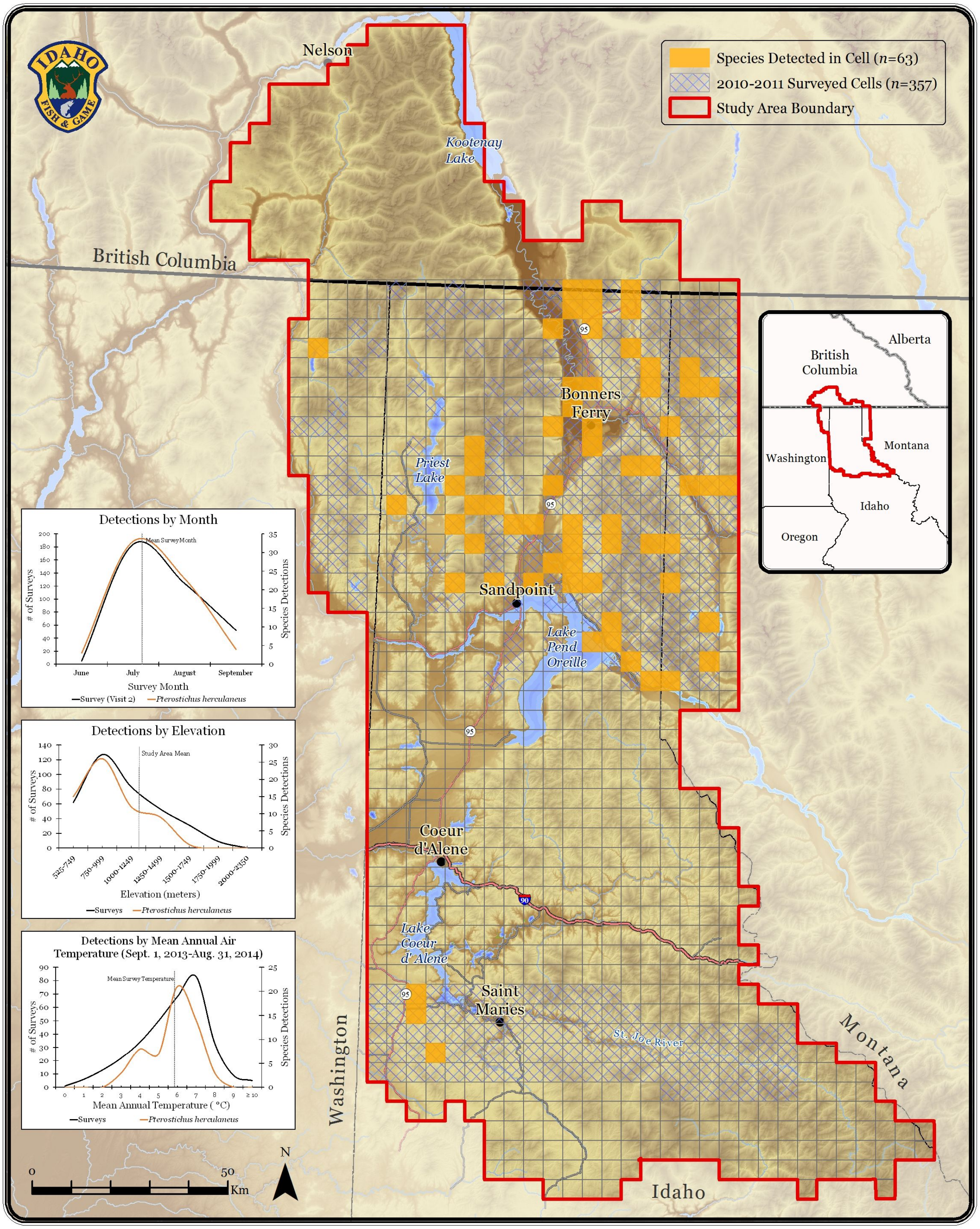
Map 6-25.

Multi-species Baseline Initiative: *Pterostichus ecarinatus* Detections



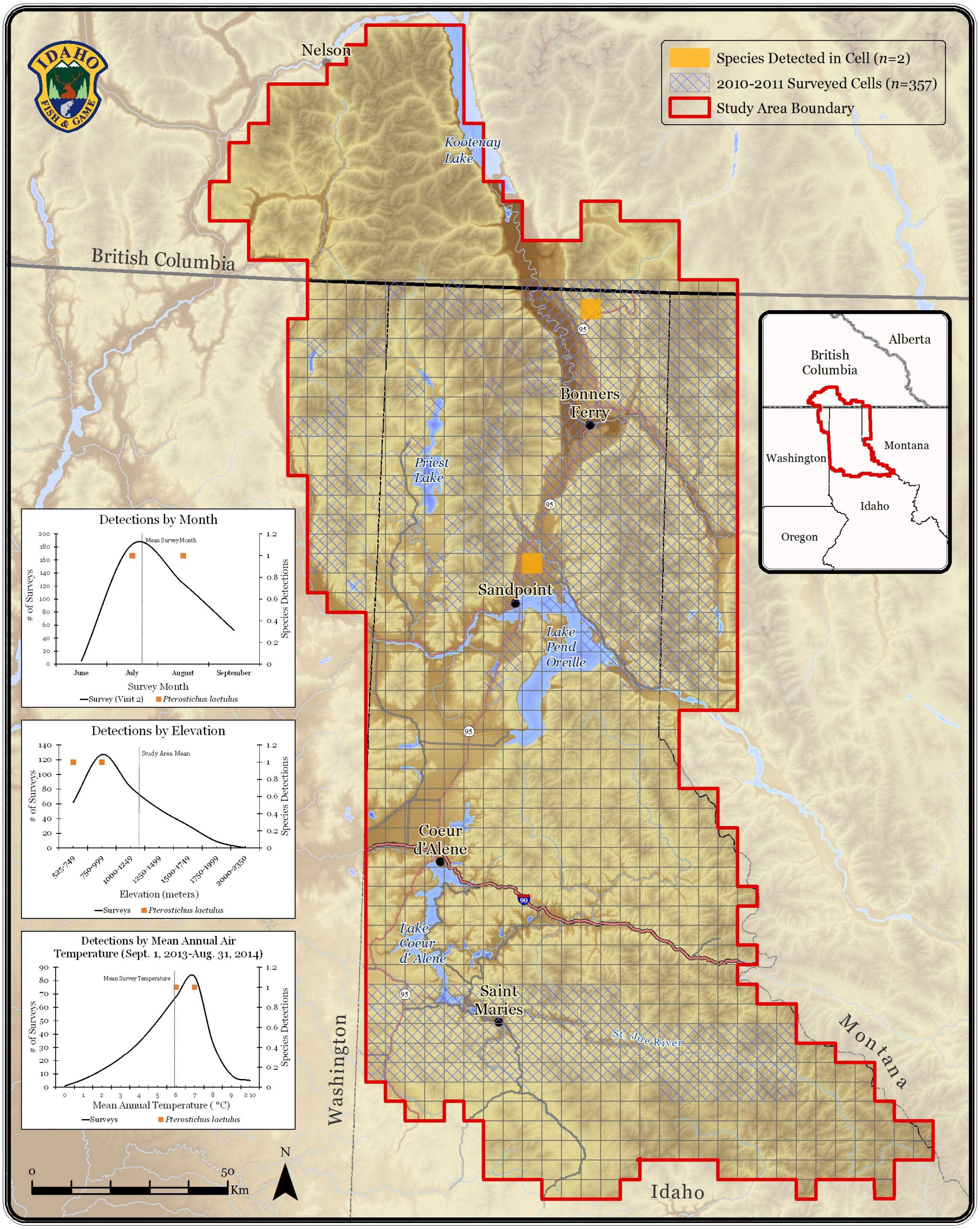
Map 6-26.

Multi-species Baseline Initiative: *Pterostichus herculaneus* Detections



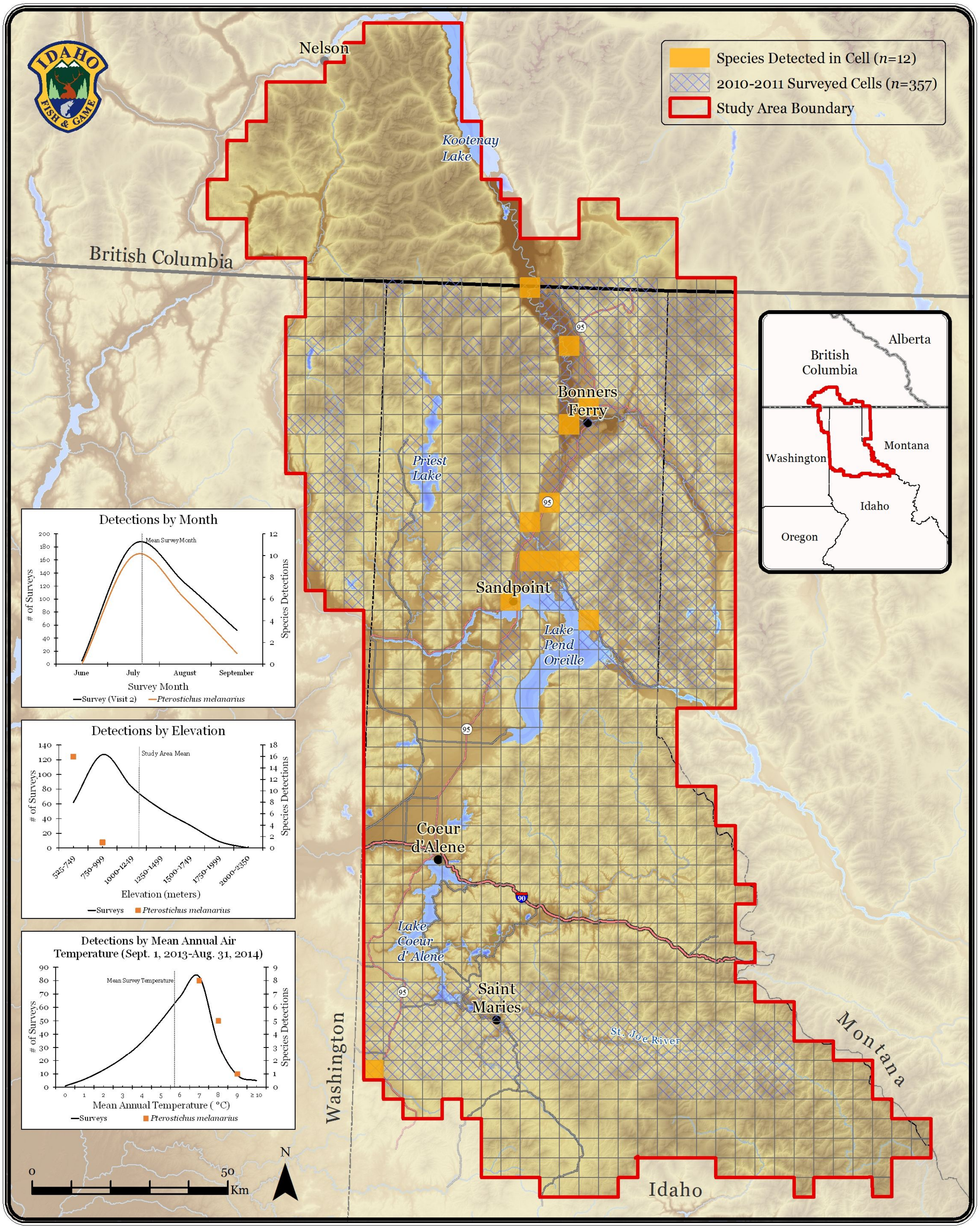
Map 6-27.

Multi-species Baseline Initiative: *Pterostichus laetulus* Detections



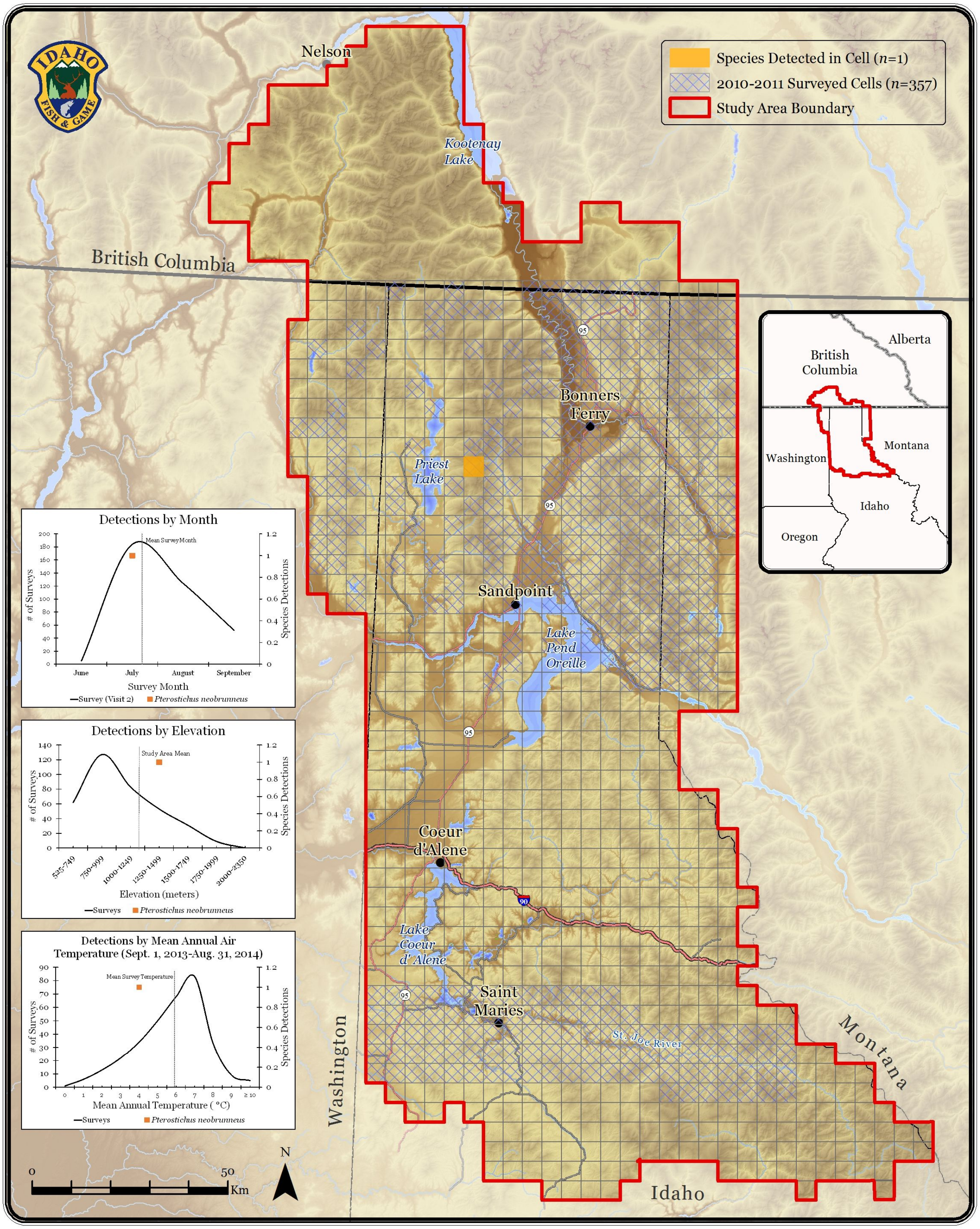
Map 6-28.

Multi-species Baseline Initiative: *Pterostichus melanarius* Detections



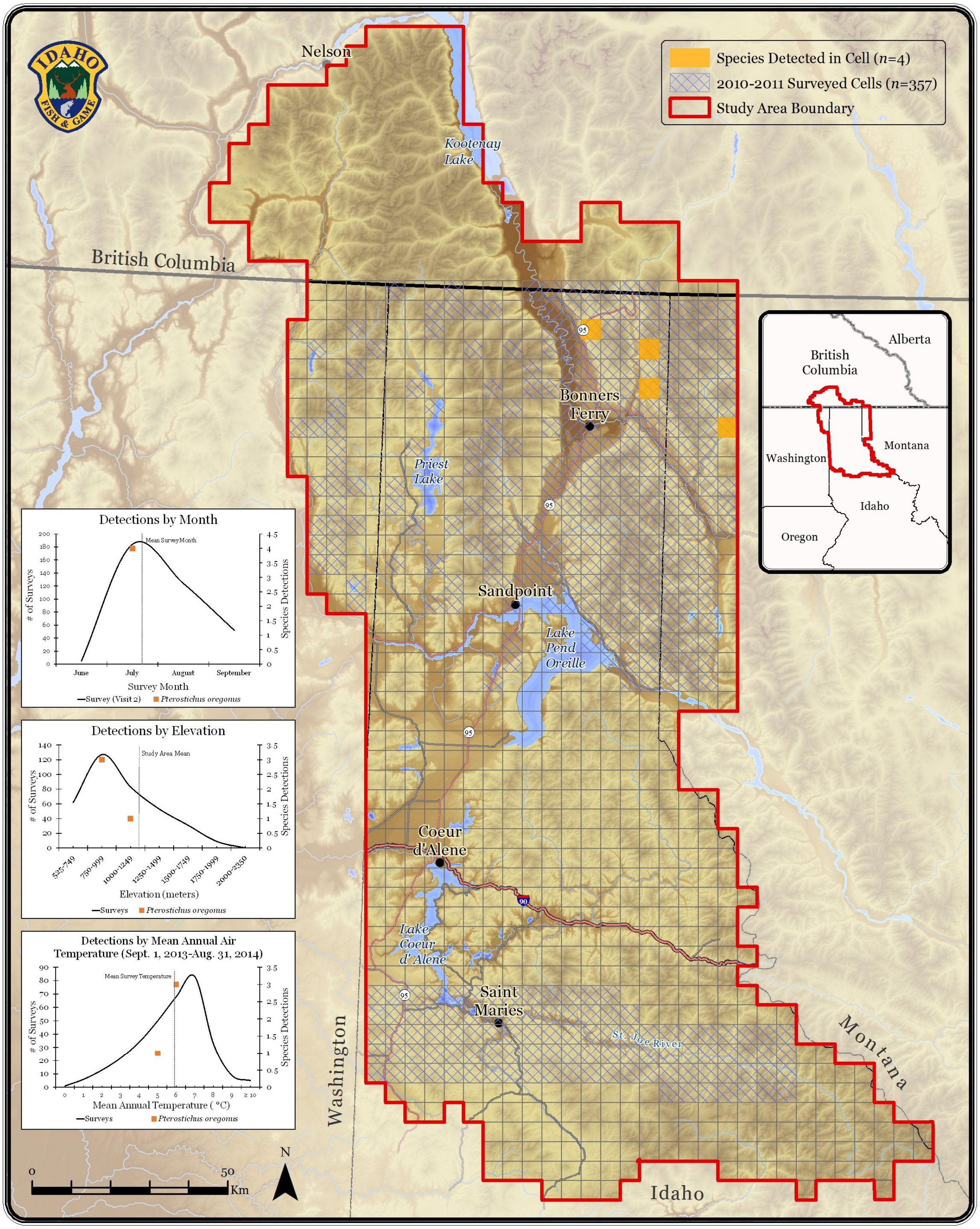
Map 6-29.

Multi-species Baseline Initiative: *Pterostichus neobrunneus* Detections



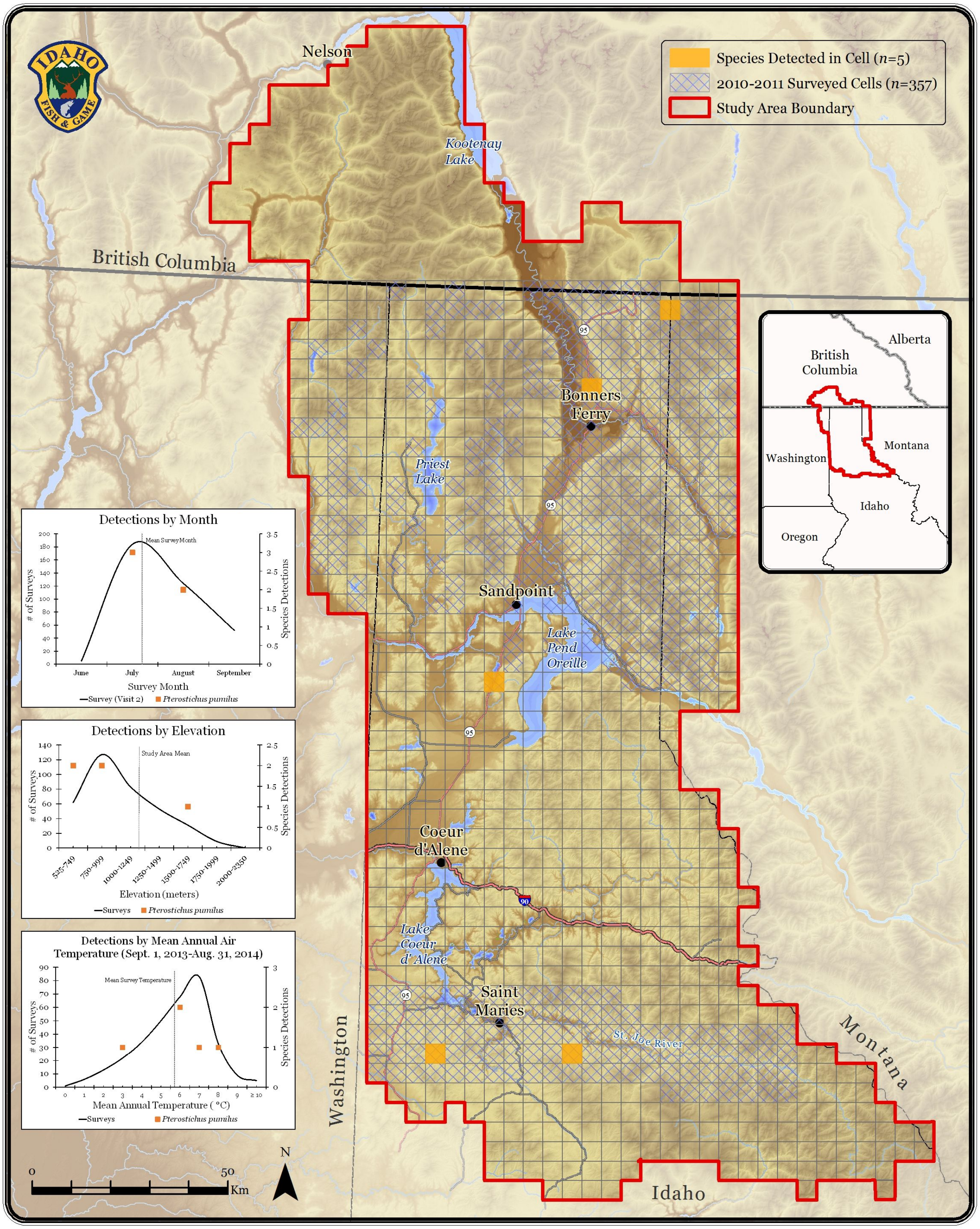
Map 6-30.

Multi-species Baseline Initiative: *Pterostichus oregonus* Detections



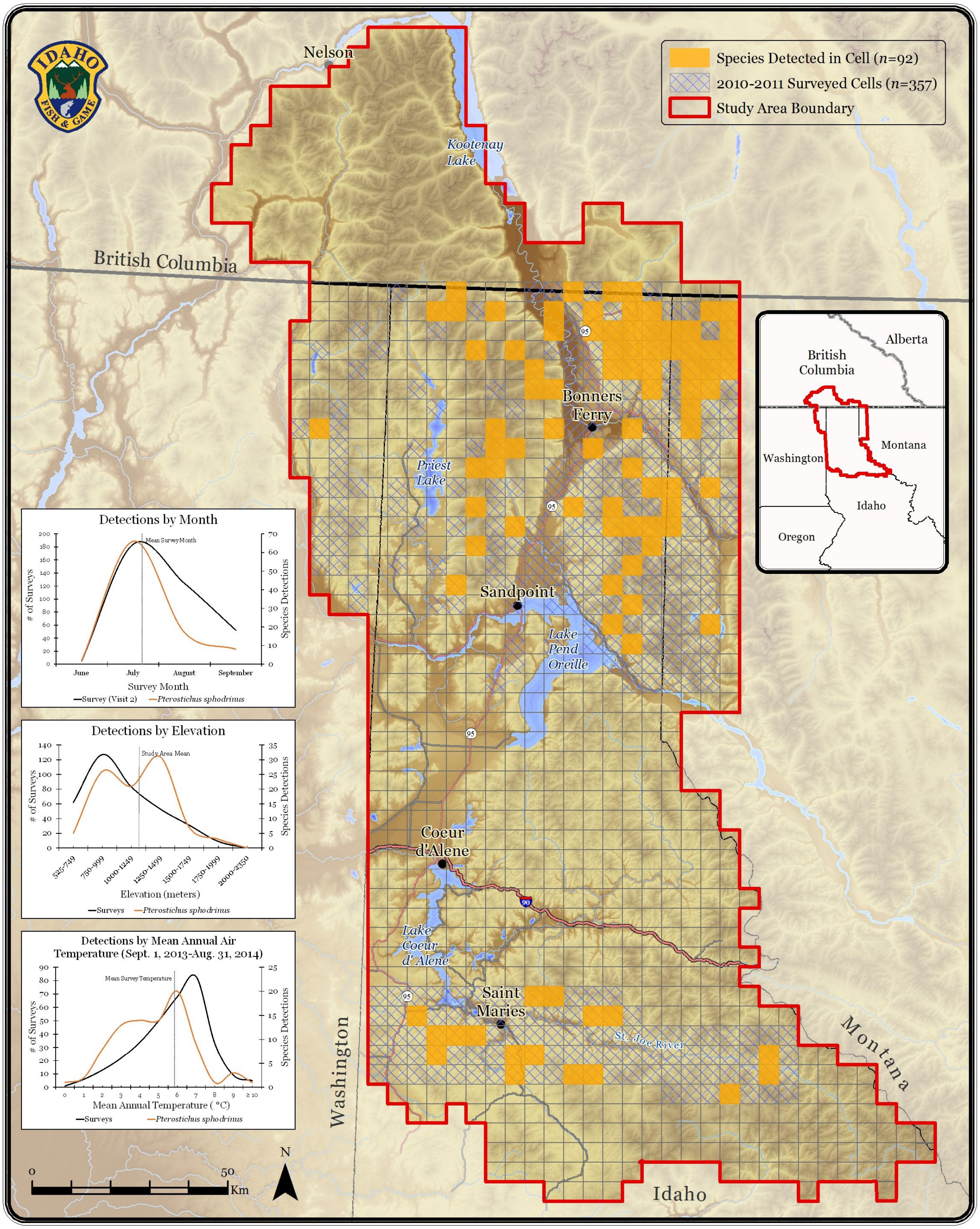
Map 6-31.

Multi-species Baseline Initiative: *Pterostichus pumilus* Detections



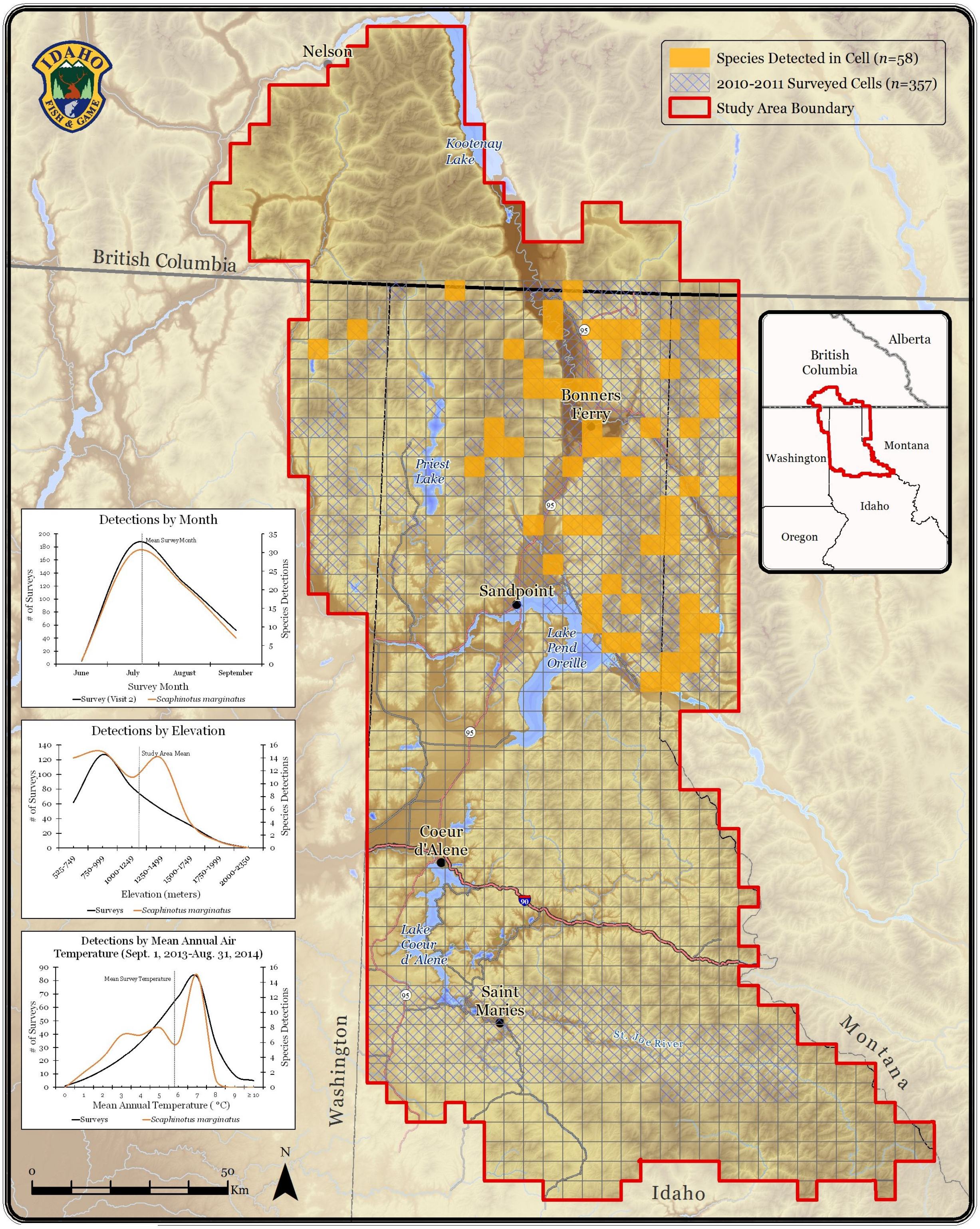
Map 6-32.

Multi-species Baseline Initiative: *Pterostichus sphodrinus* Detections



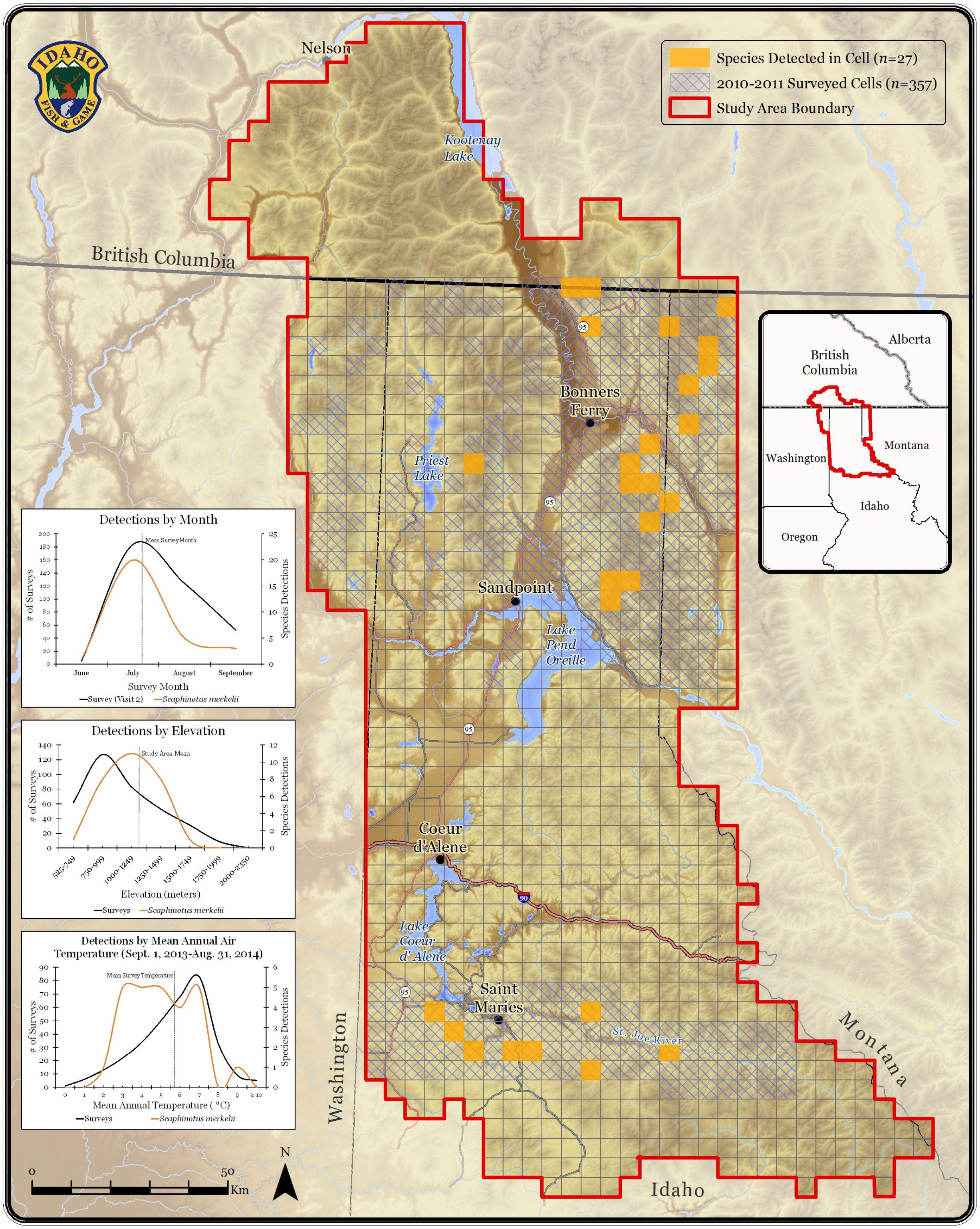
Map 6-33.

Multi-species Baseline Initiative: *Scaphinotus marginatus* Detections



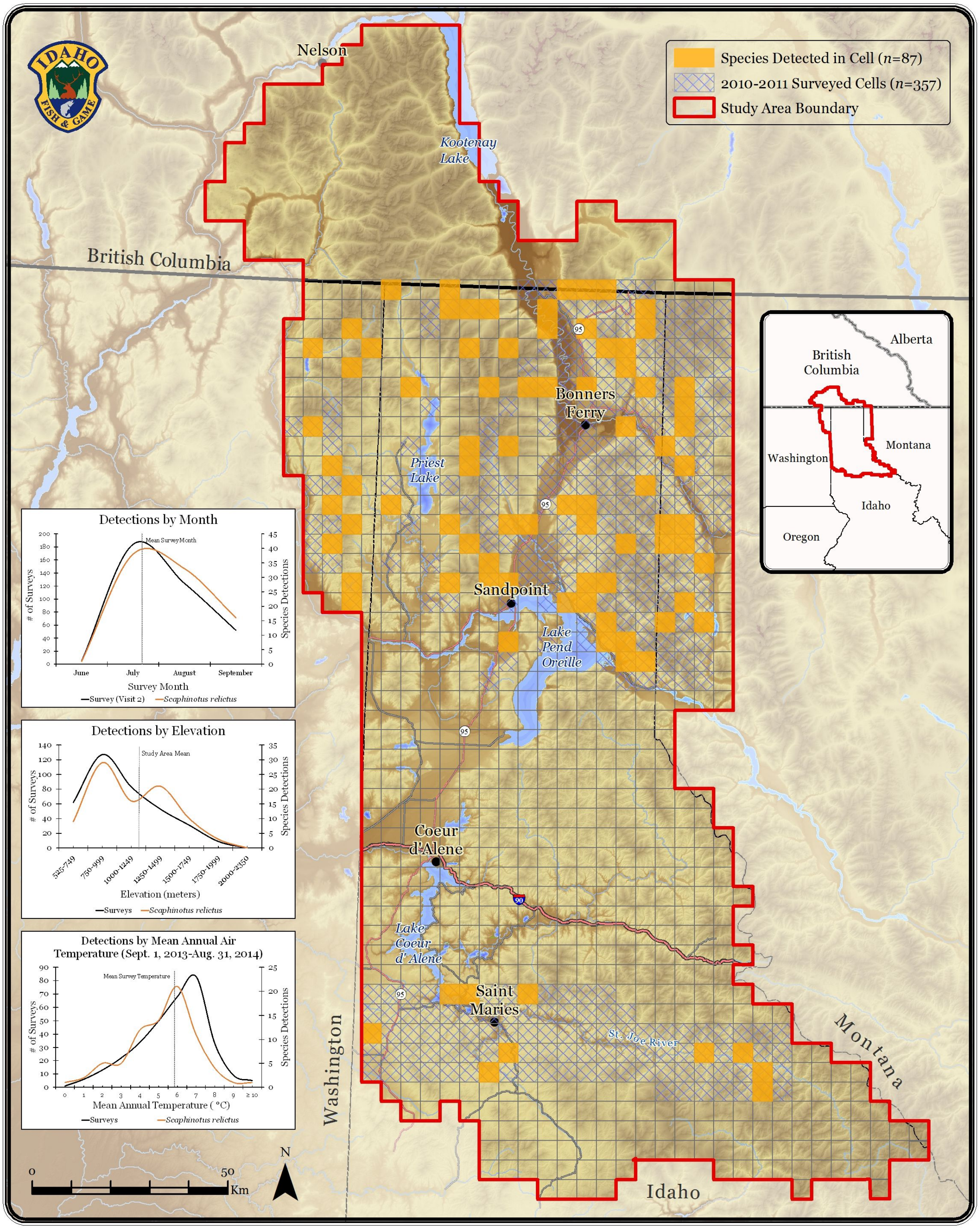
Map 6-34.

Multi-species Baseline Initiative: *Scaphinotus merkelii* Detections



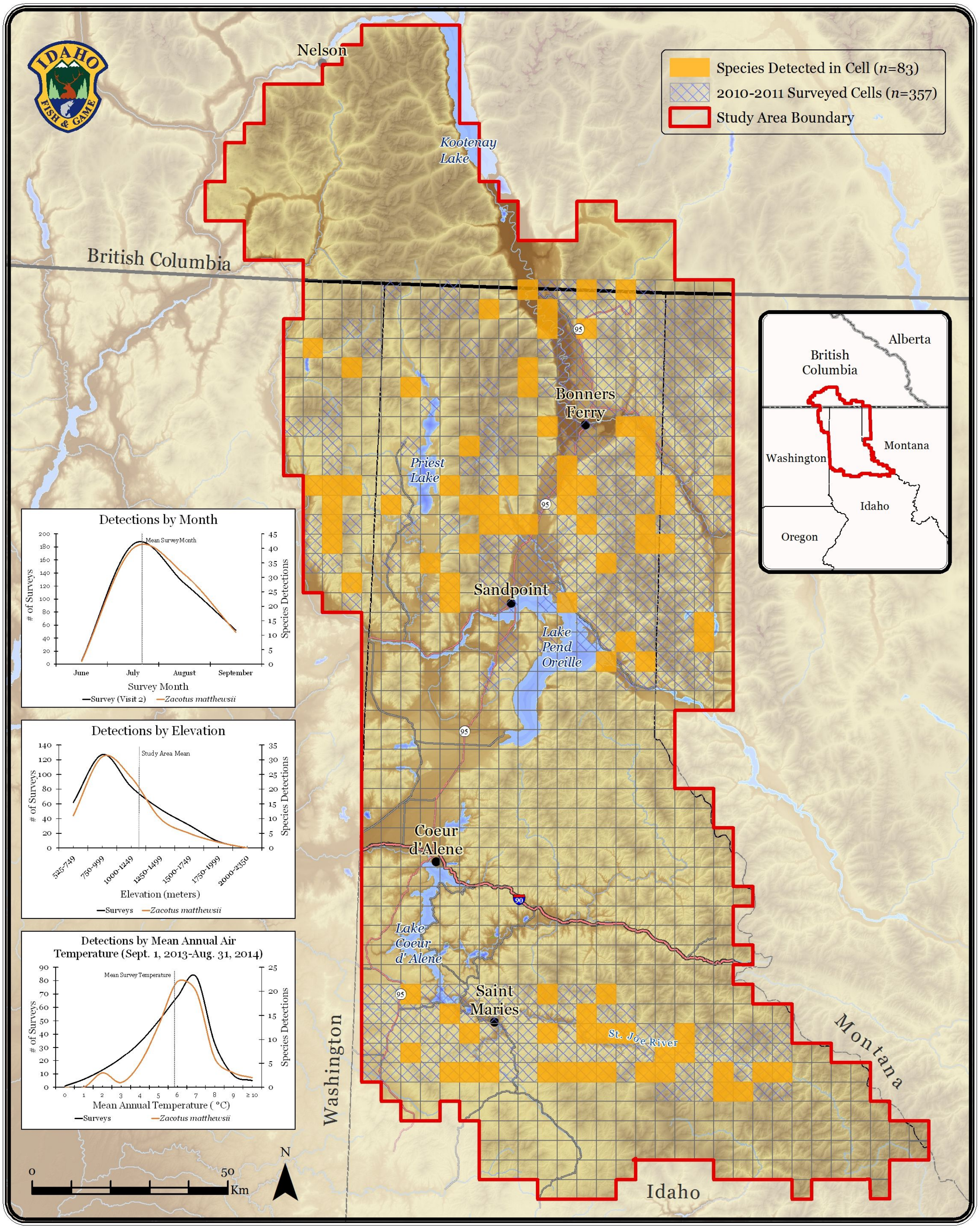
Map 6-35.

Multi-species Baseline Initiative: *Scaphinotus relictus* Detections



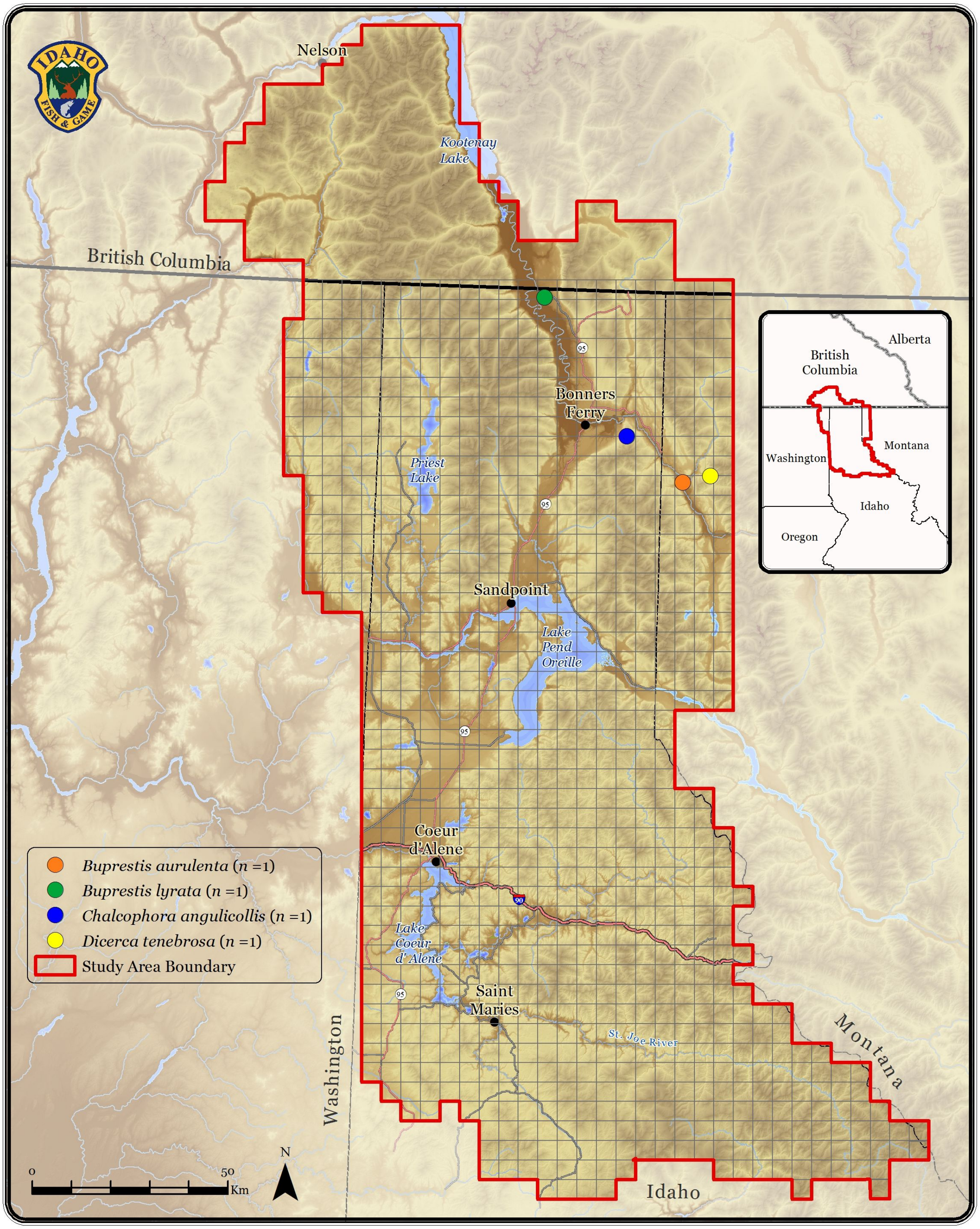
Map 6-36.

Multi-species Baseline Initiative: *Zacotus matthewsii* Detections



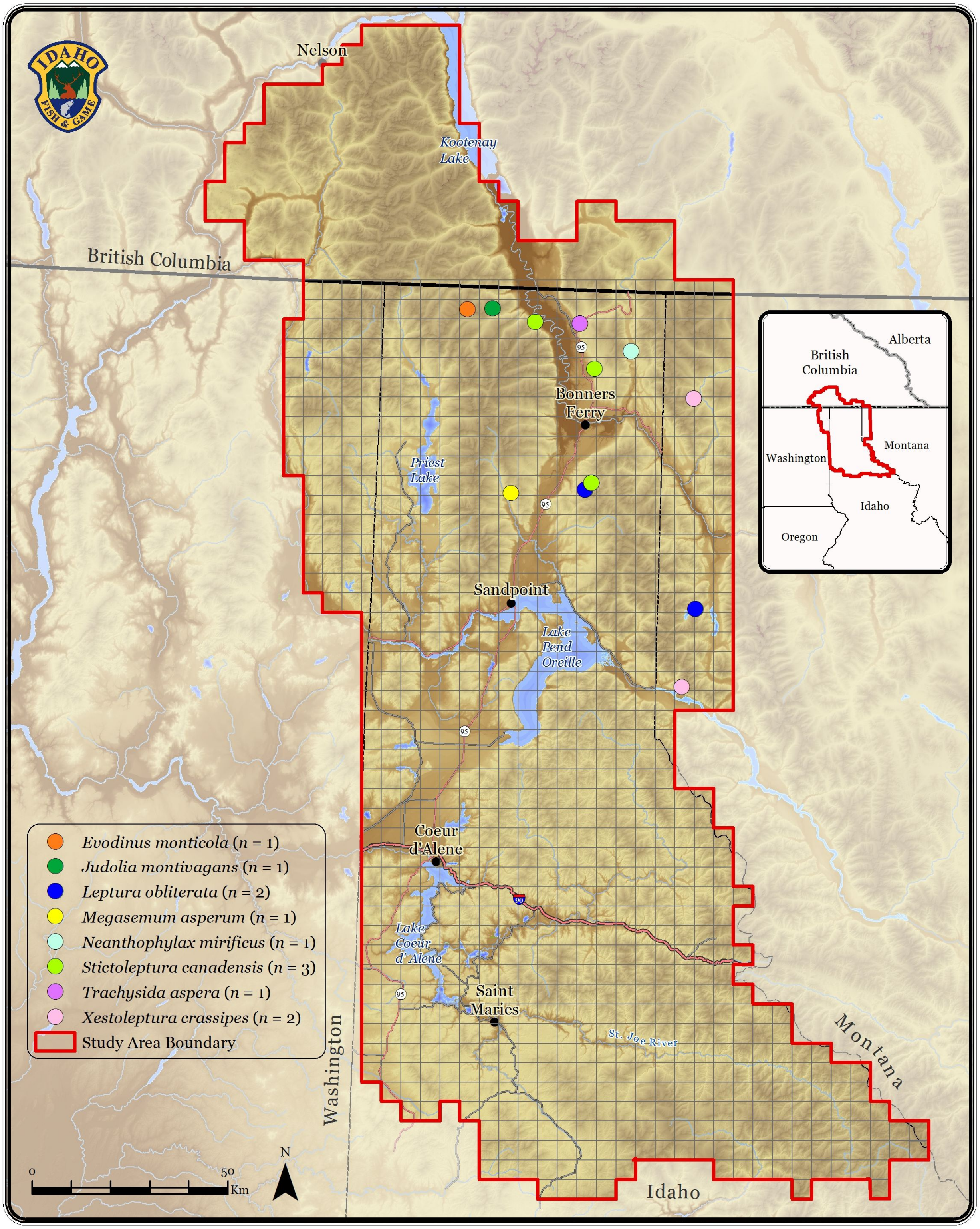
Map 6-37.

Multi-species Baseline Initiative: Jewel Beetles (Buprestidae)



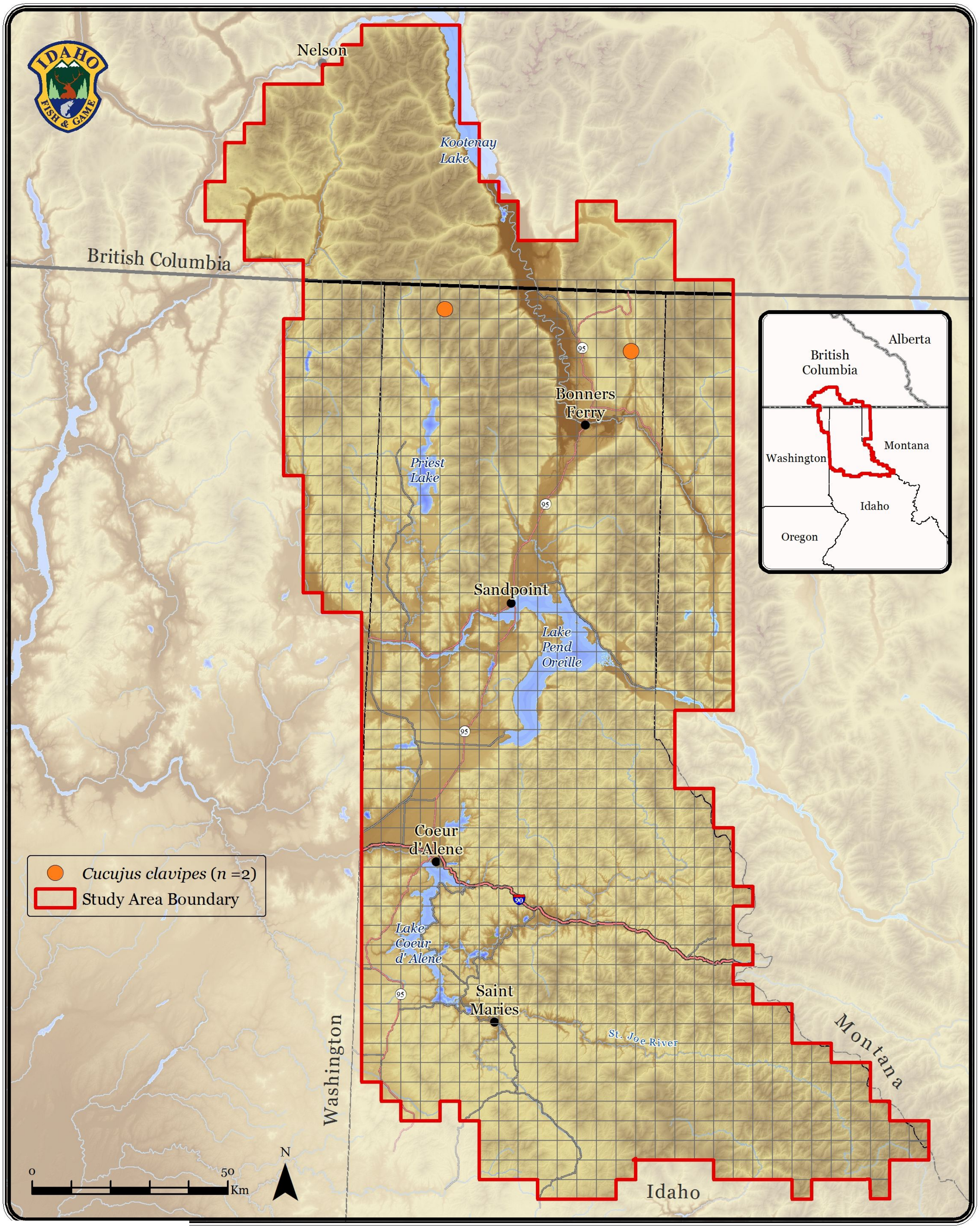
Map 6-38.

Multi-species Baseline Initiative: Long Horned Beetles (Cerambycidae)



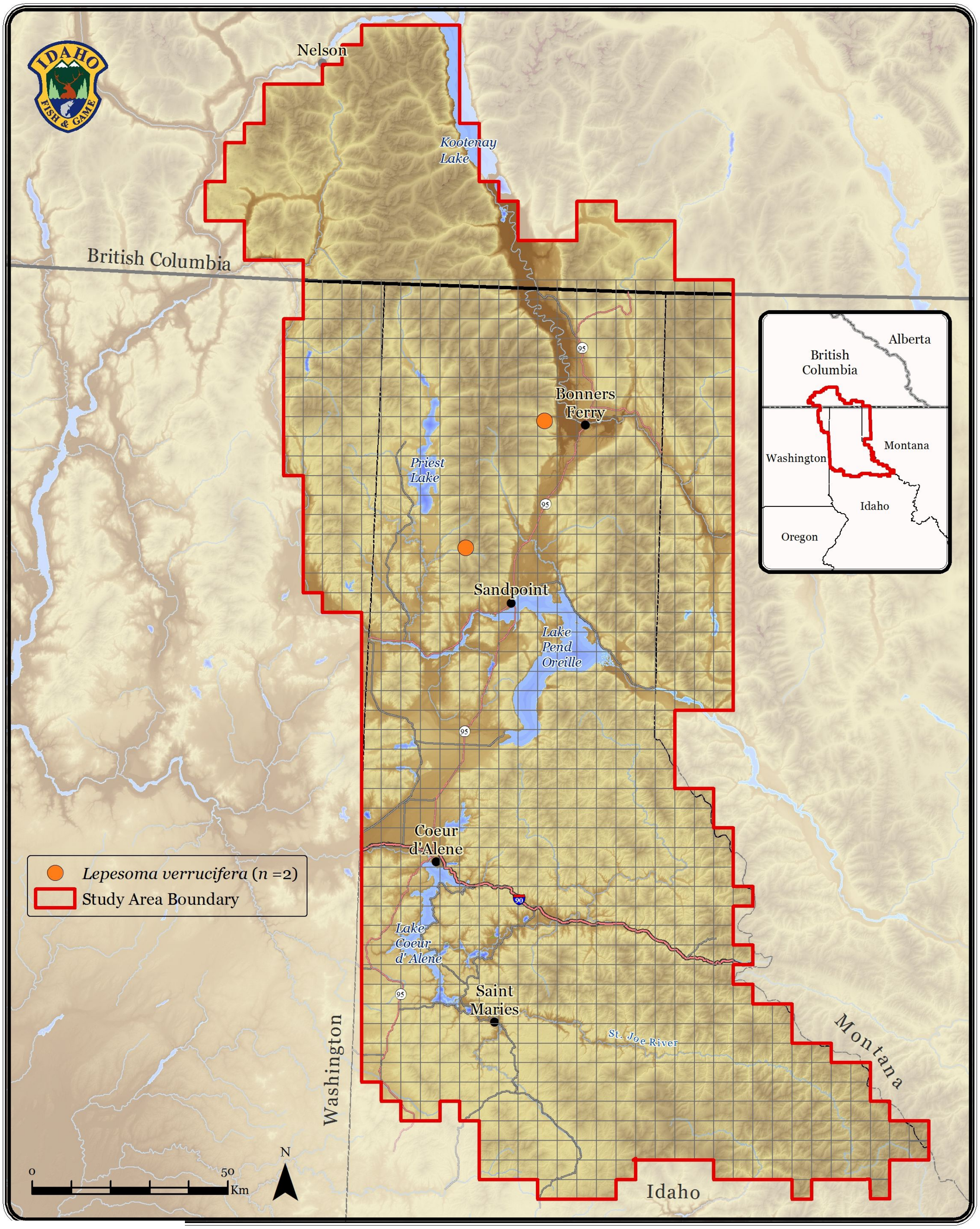
Map 6-39.

Multi-species Baseline Initiative: Flat Bark Beetles (Cucujidae)



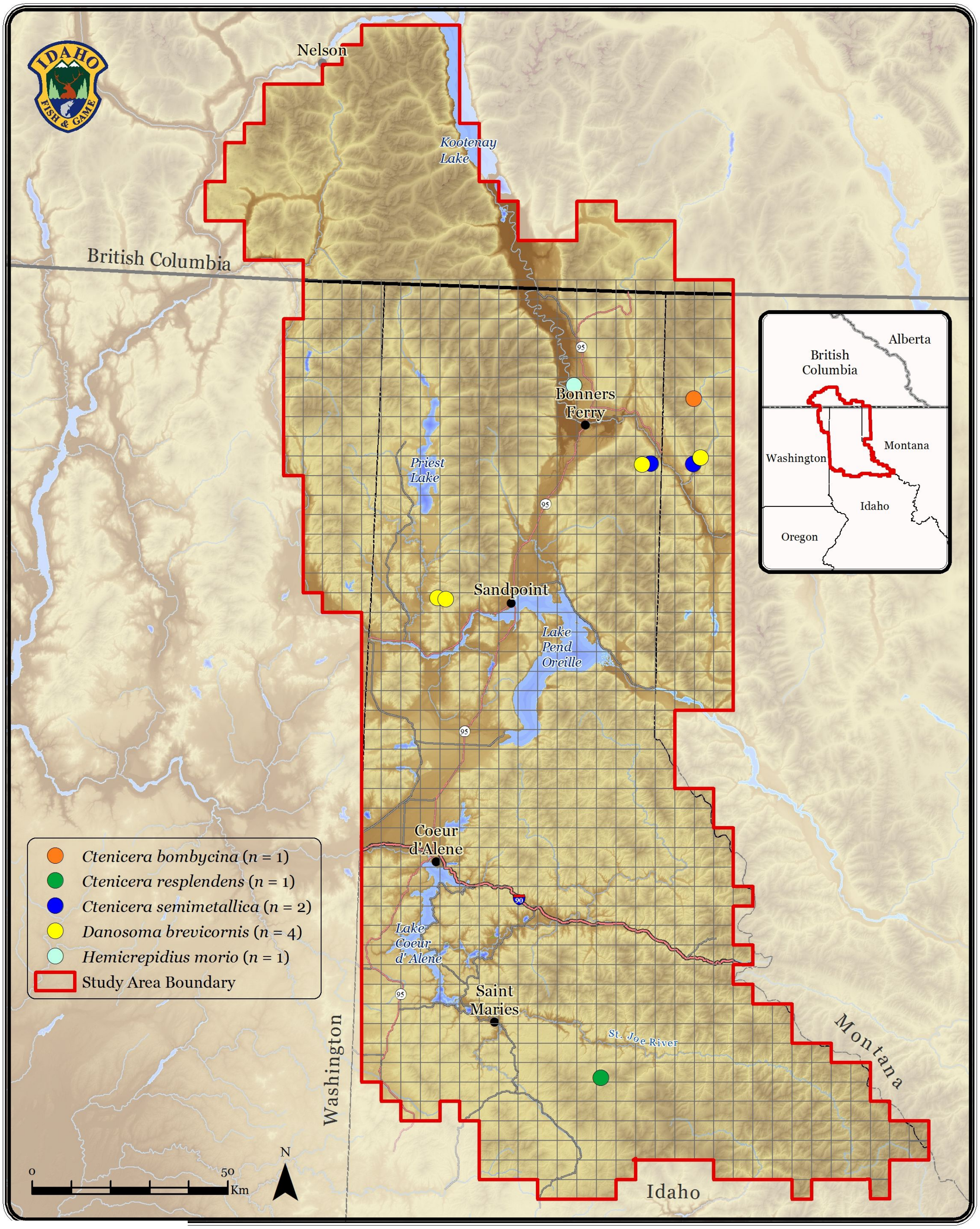
Map 6-40.

Multi-species Baseline Initiative: True Weevils (Curculionidae)



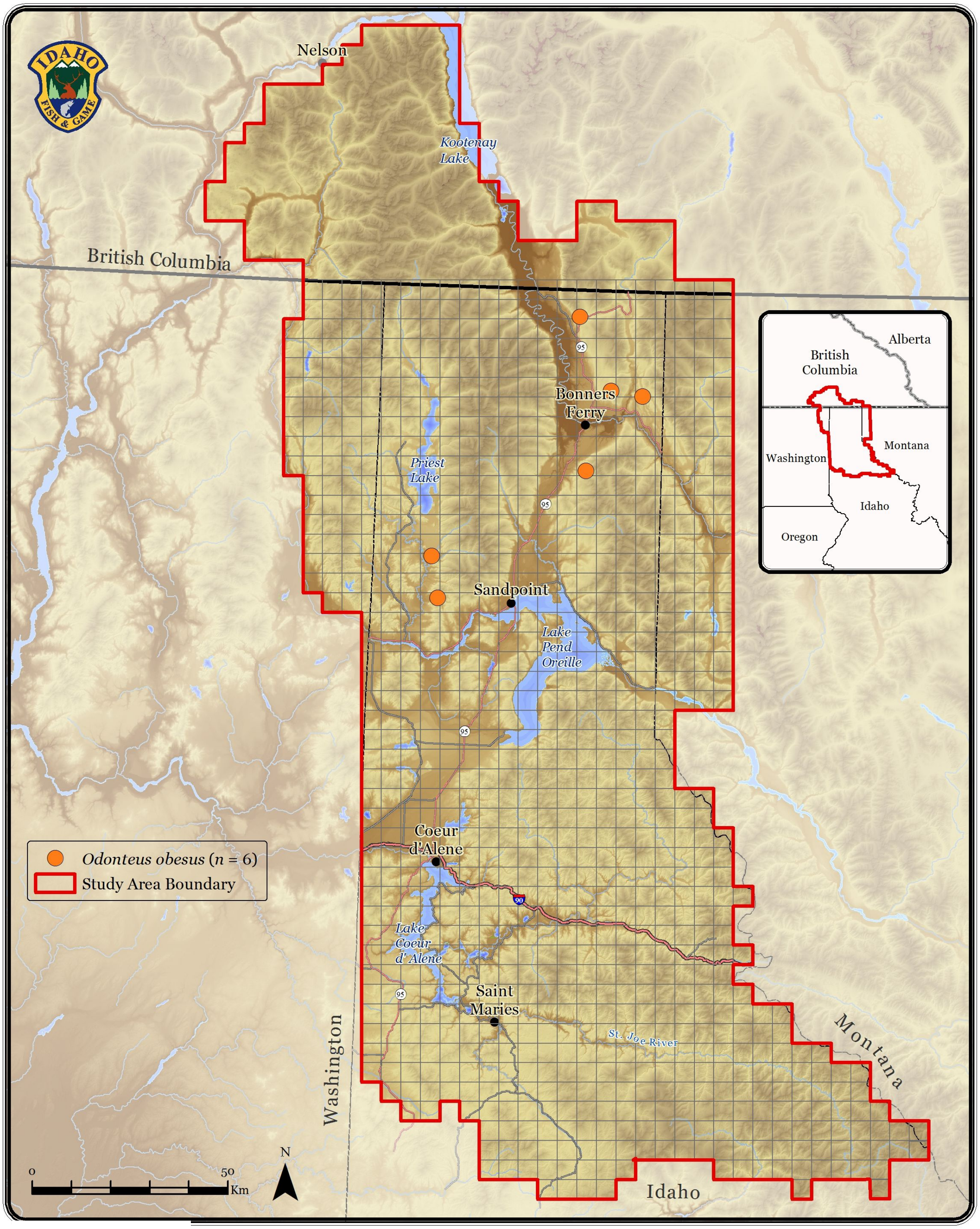
Map 6-41.

Multi-species Baseline Initiative: Click Beetles (Elateridae)



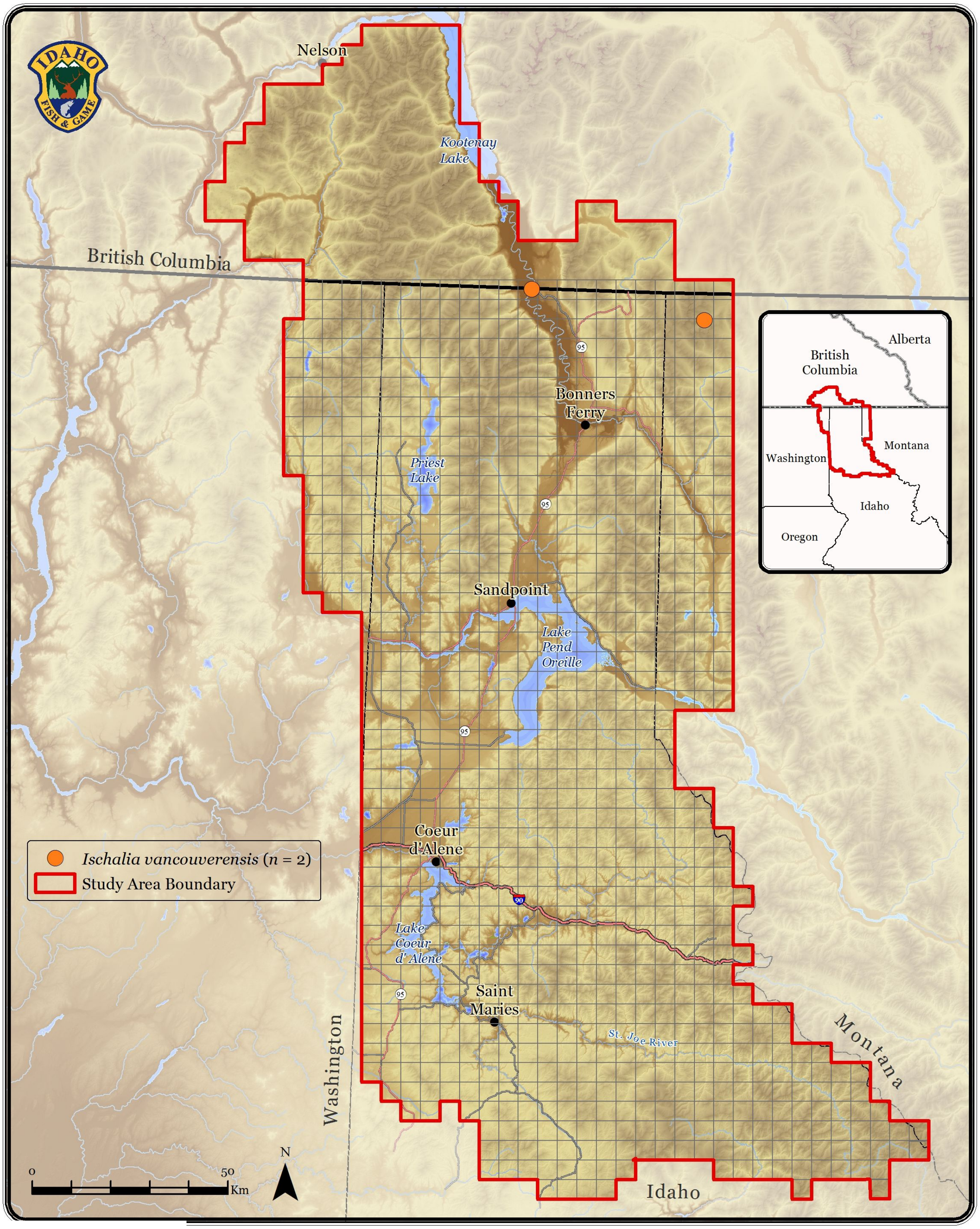
Map 6-42.

Multi-species Baseline Initiative: Earth Boring Dung Beetles (Geotrupidae)



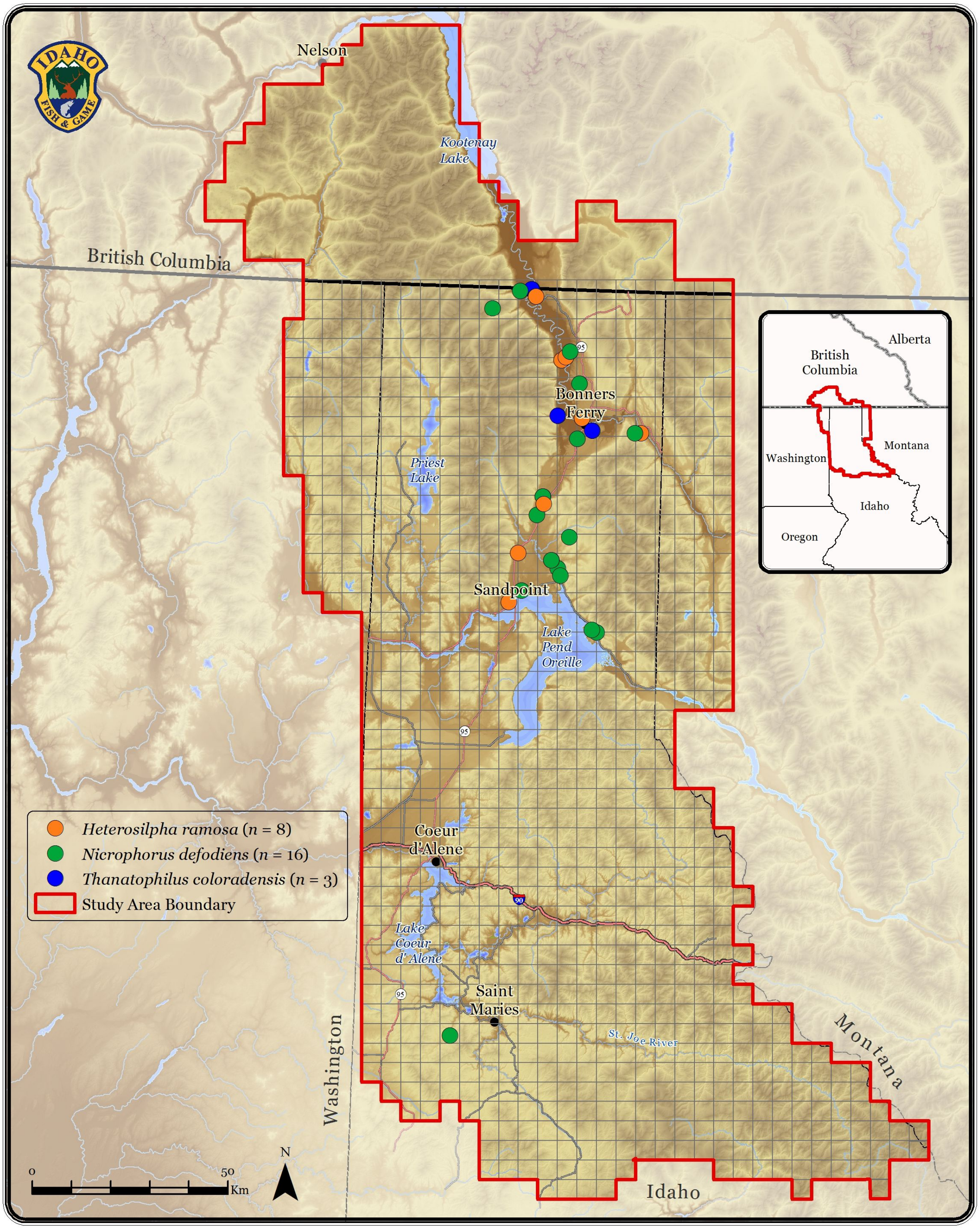
Map 6-43.

Multi-species Baseline Initiative: Fire-Colored Beetles (Pyrochroidae)



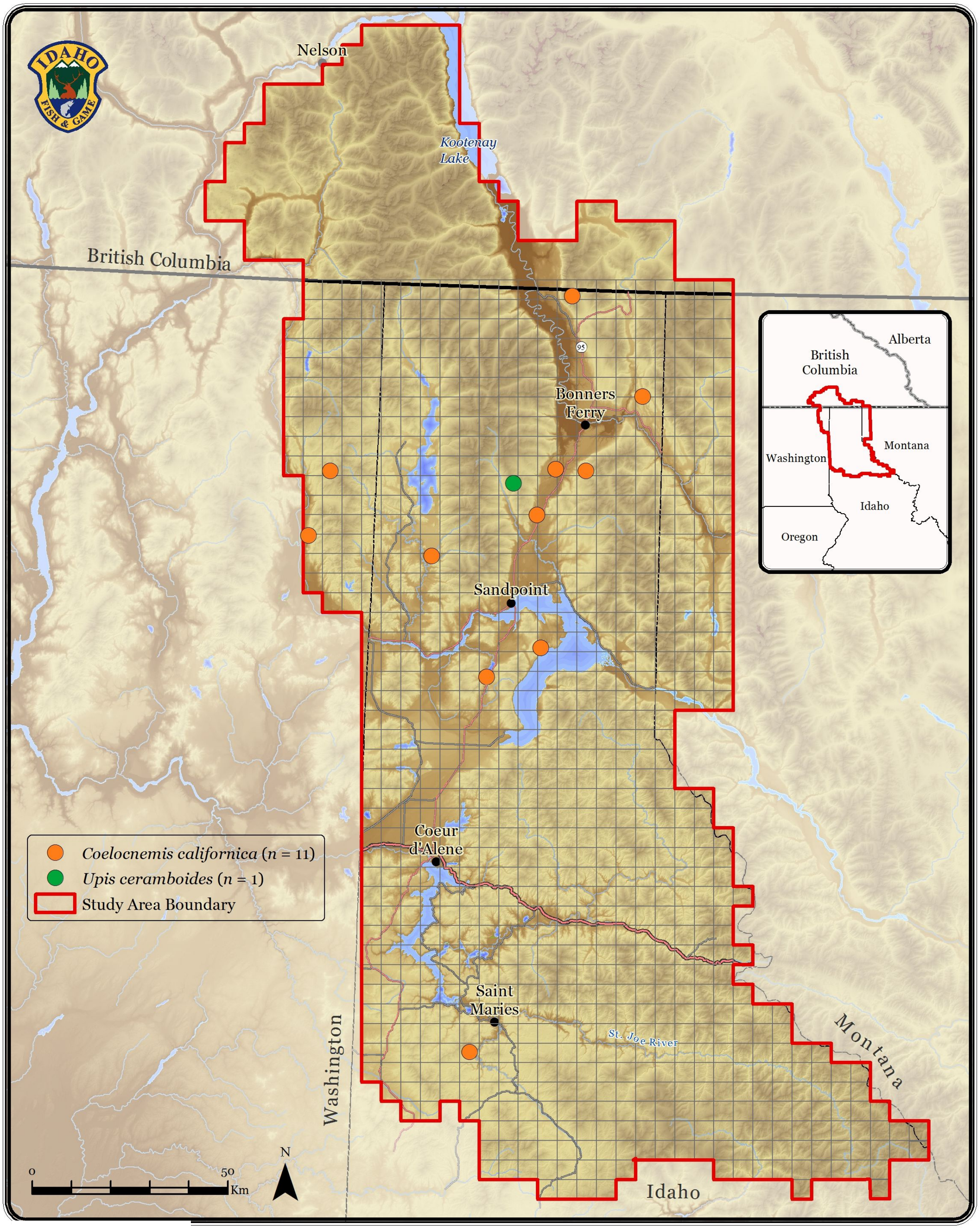
Map 6-44.

Multi-species Baseline Initiative: Carrion Beetles (Silphidae)



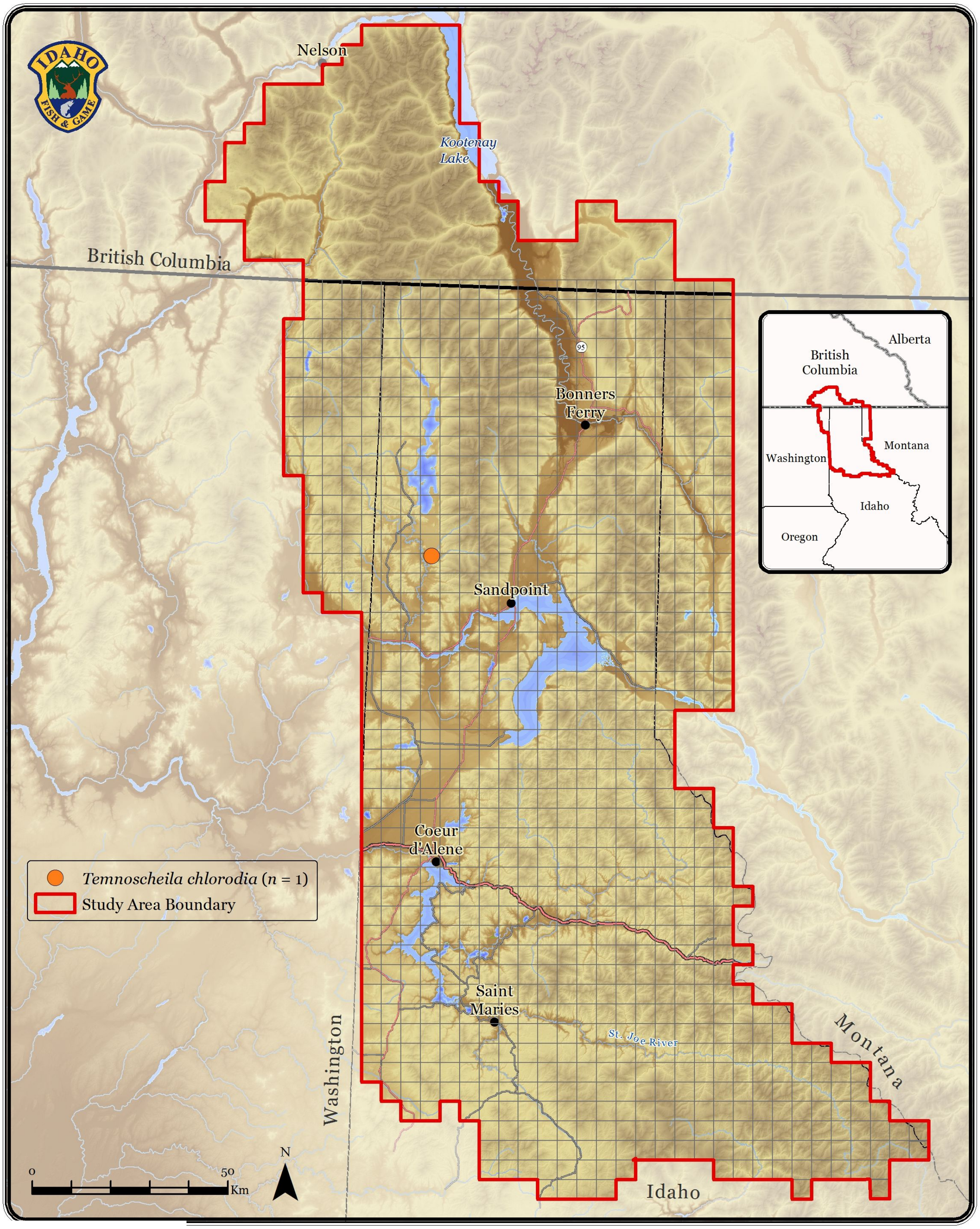
Map 6-45.

Multi-species Baseline Initiative: Darkling Beetles (Tenebrionidae)



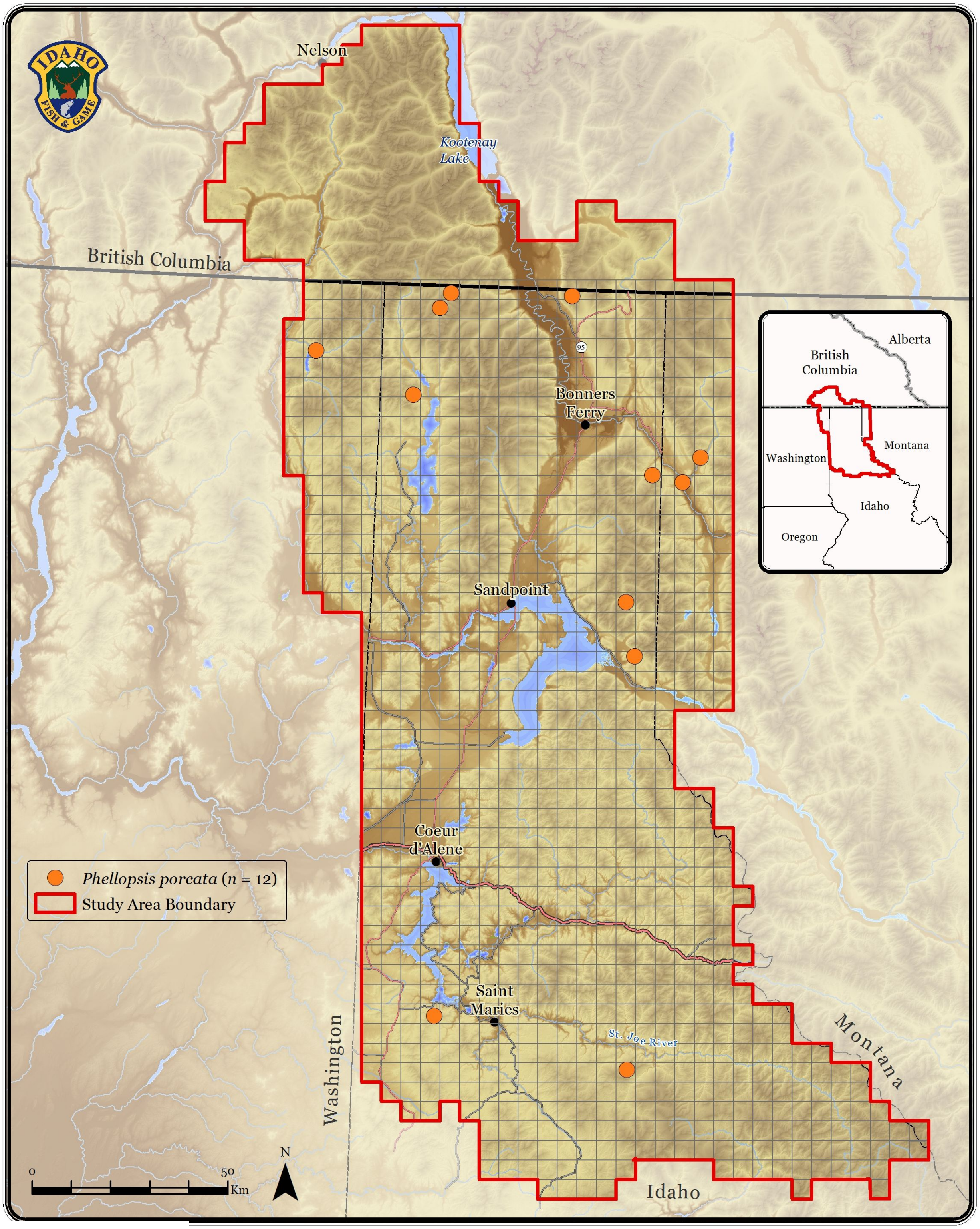
Map 6-46.

Multi-species Baseline Initiative: Bark-gnawing Beetles (Trogossitidae)



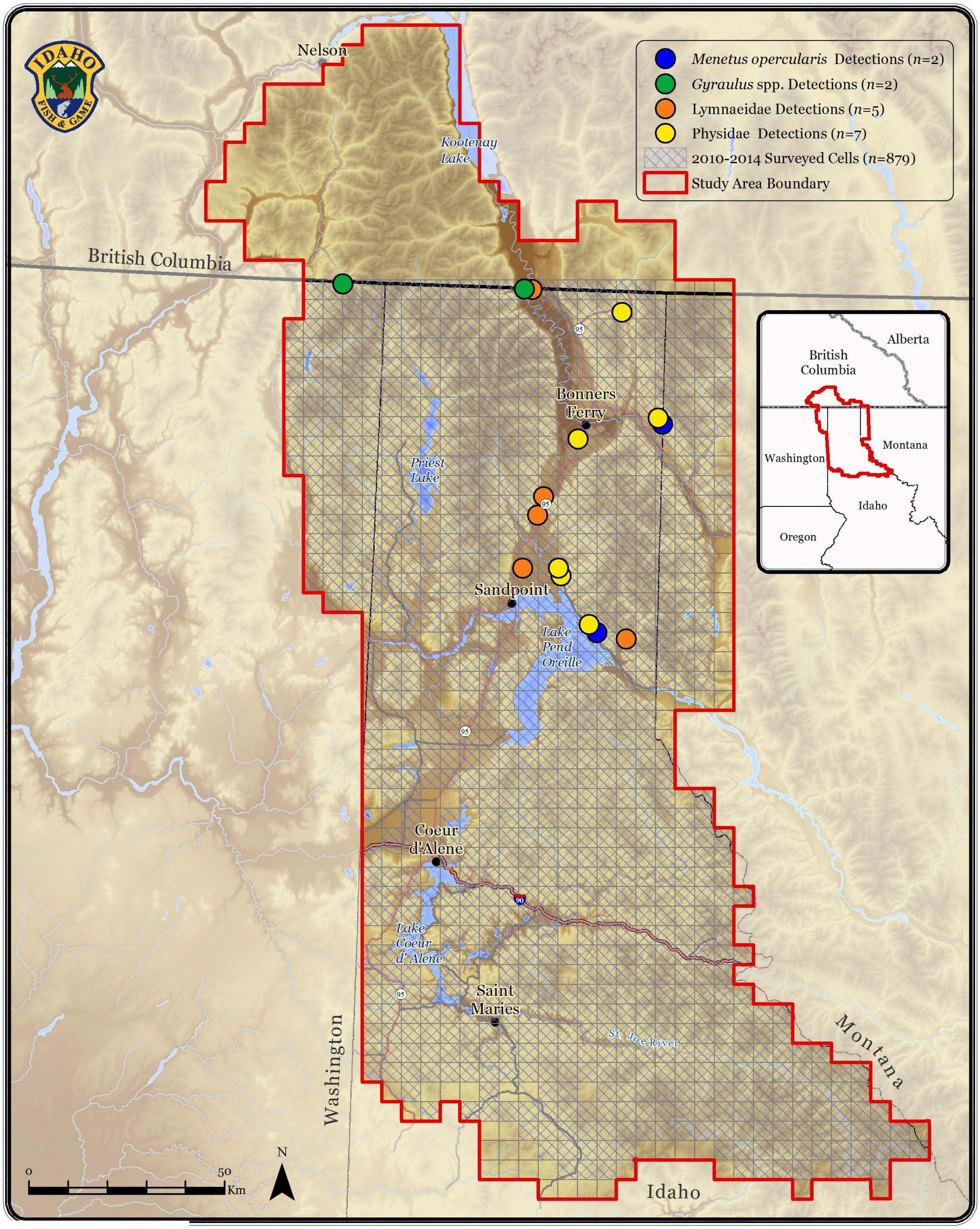
Map 6-47.

Multi-species Baseline Initiative: Ironclad Beetles (Zopheridae)



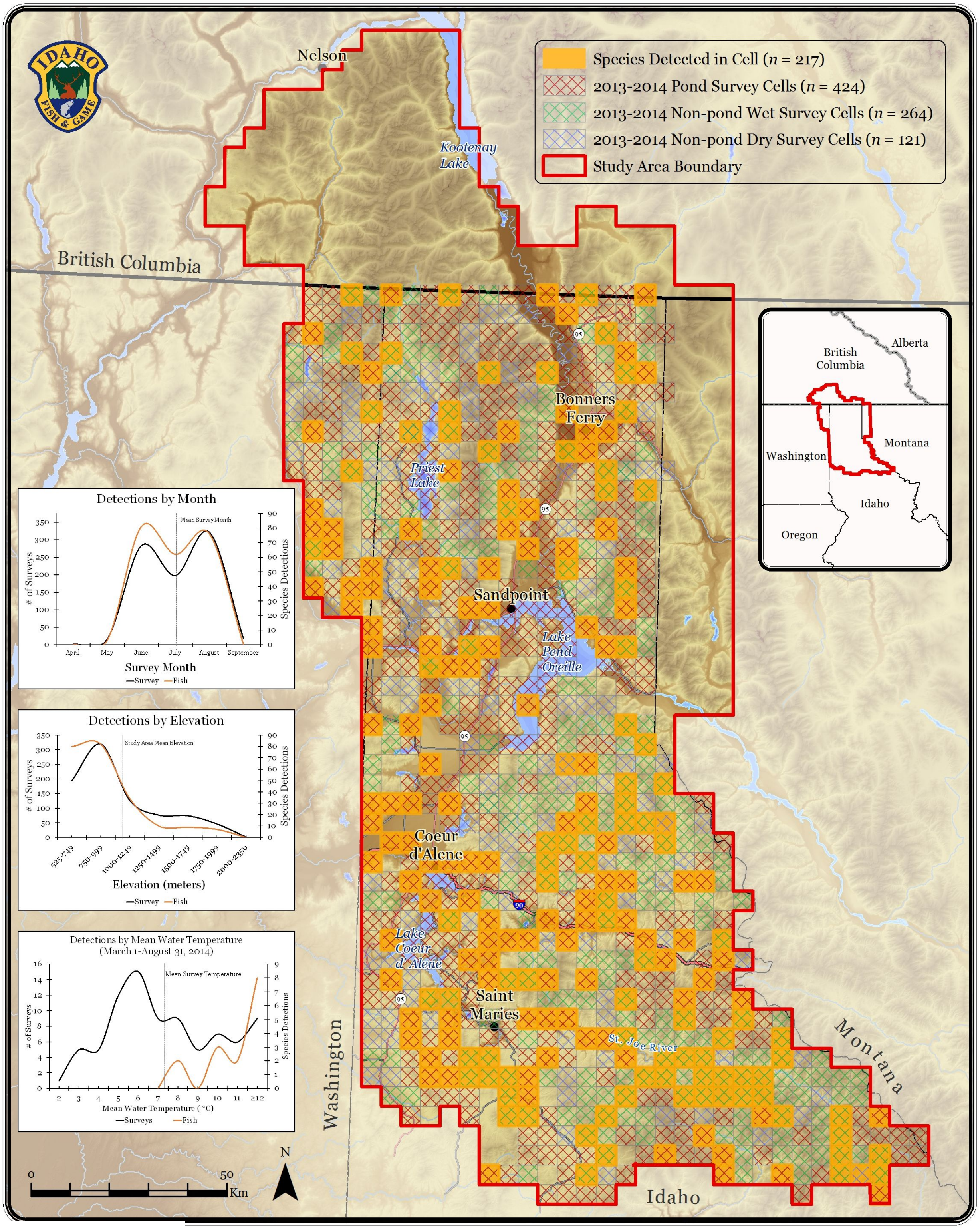
Map 6-48.

Multi-species Baseline Initiative: Aquatic Snail Detections



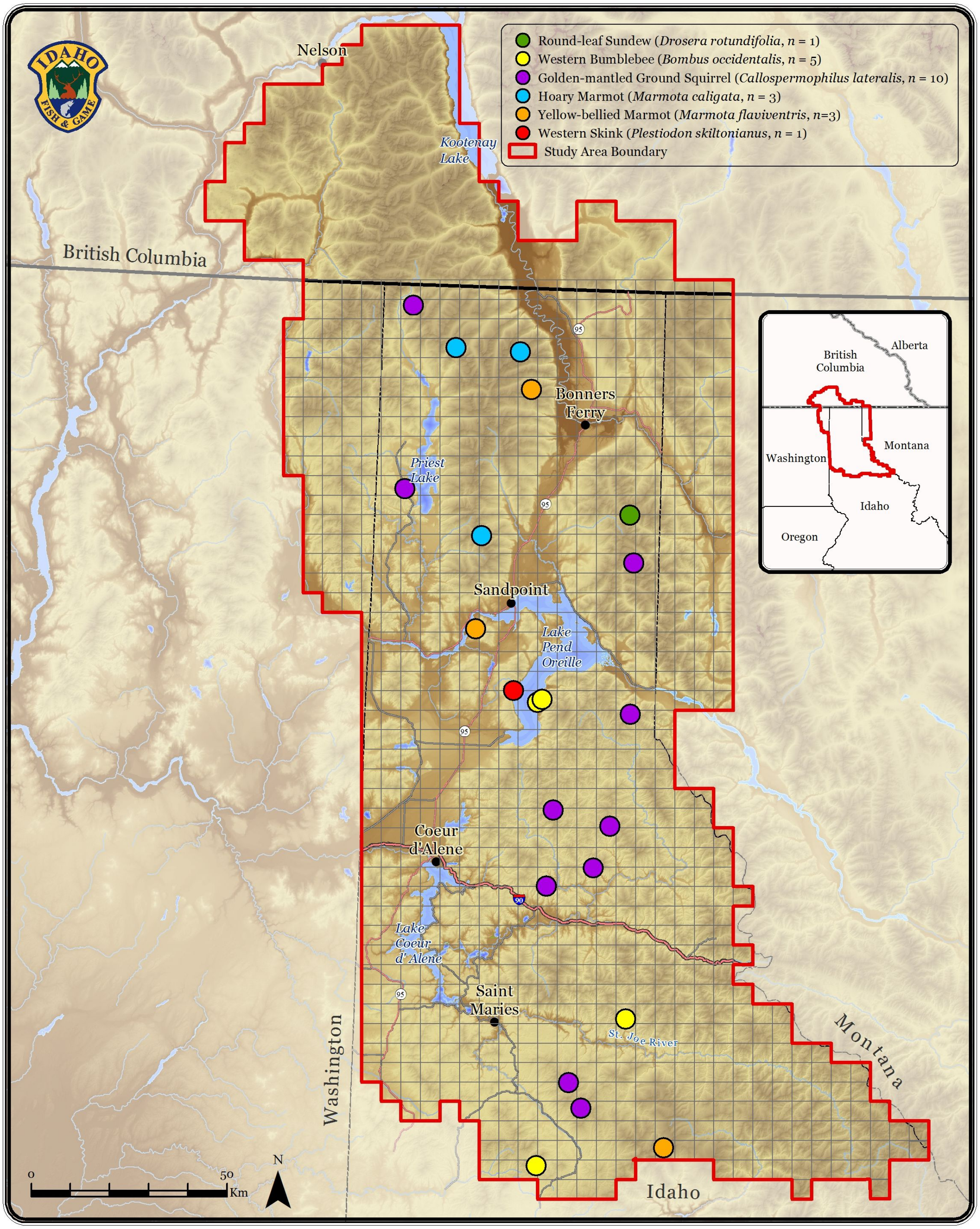
Map 6-49.

Multi-species Baseline Initiative: Fish Detections



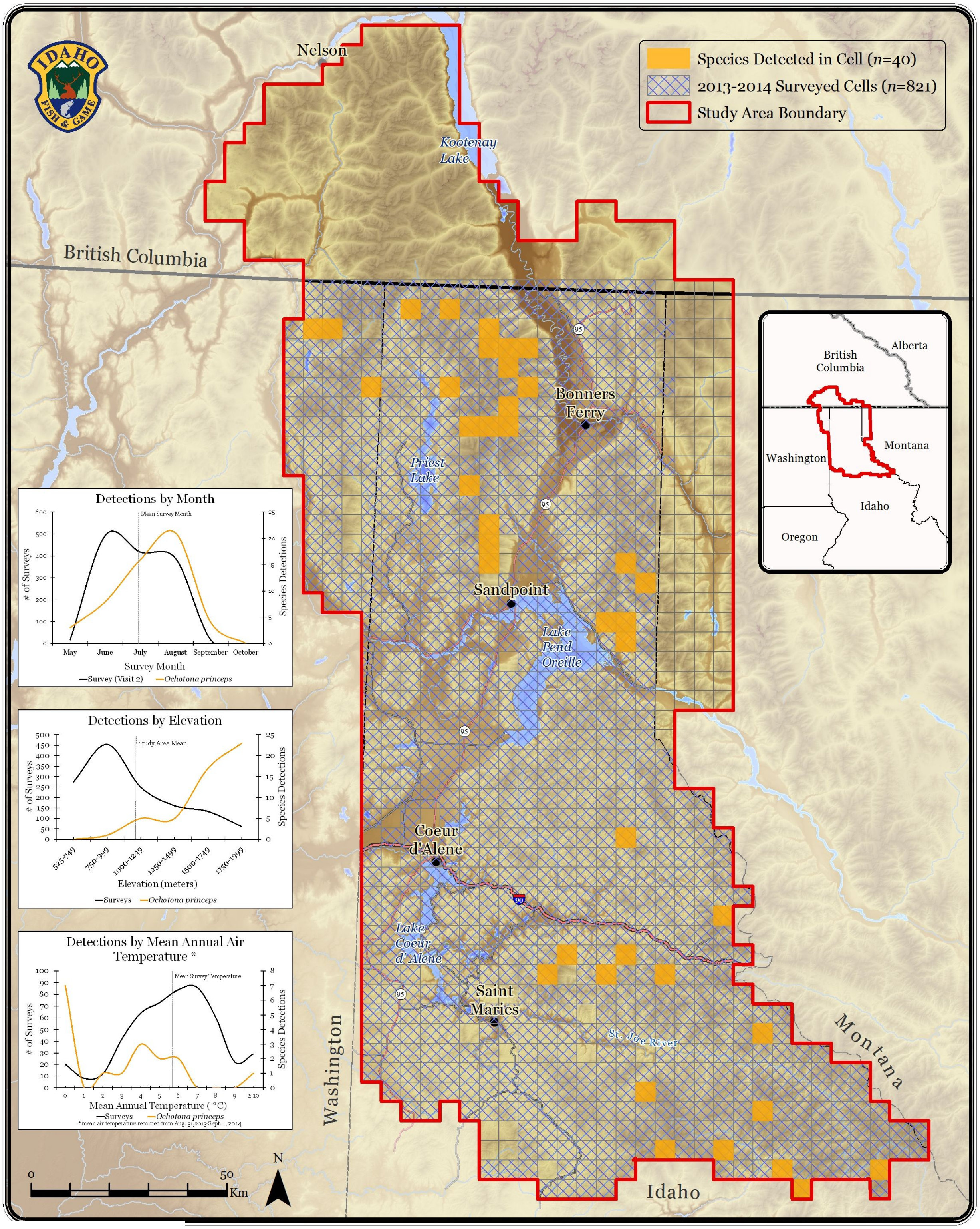
Map 6-50.

Multi-species Baseline Initiative: Opportunistic Detections



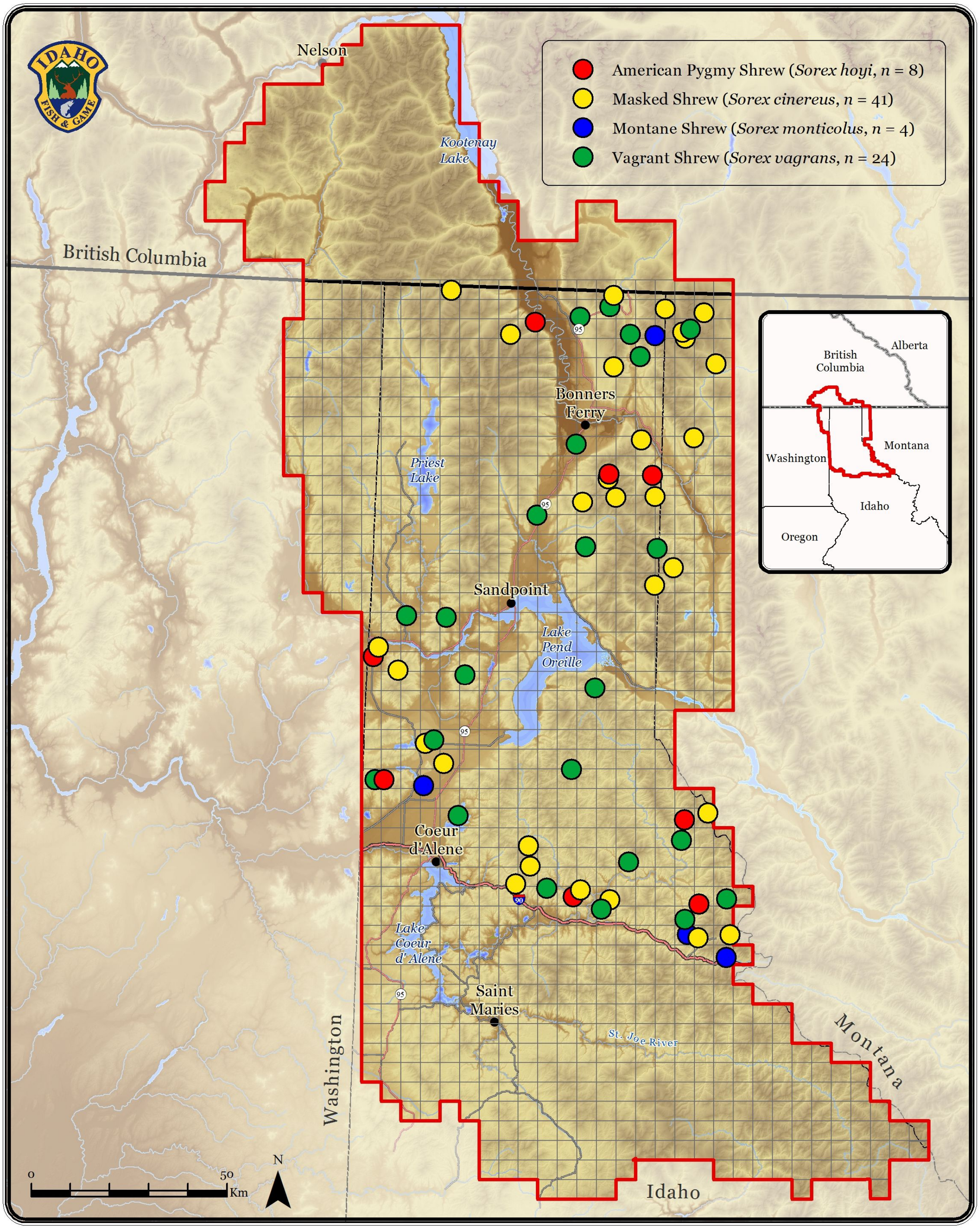
Map 6-51.

Multi-species Baseline Initiative: American Pika (*Ochotona princeps*) Detections



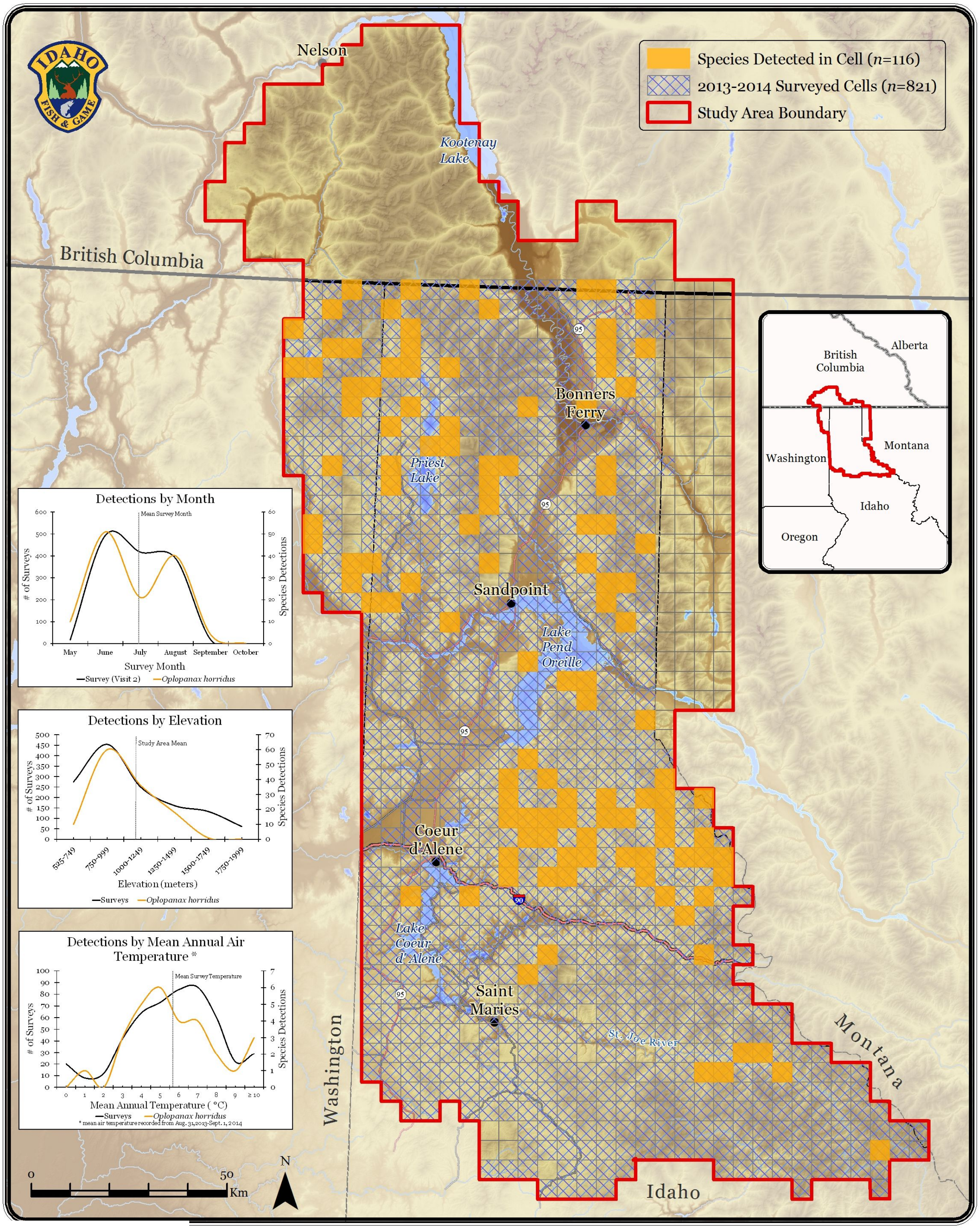
Map 6-52.

Multi-species Baseline Initiative: Shrew (*Sorex* spp.) Detections



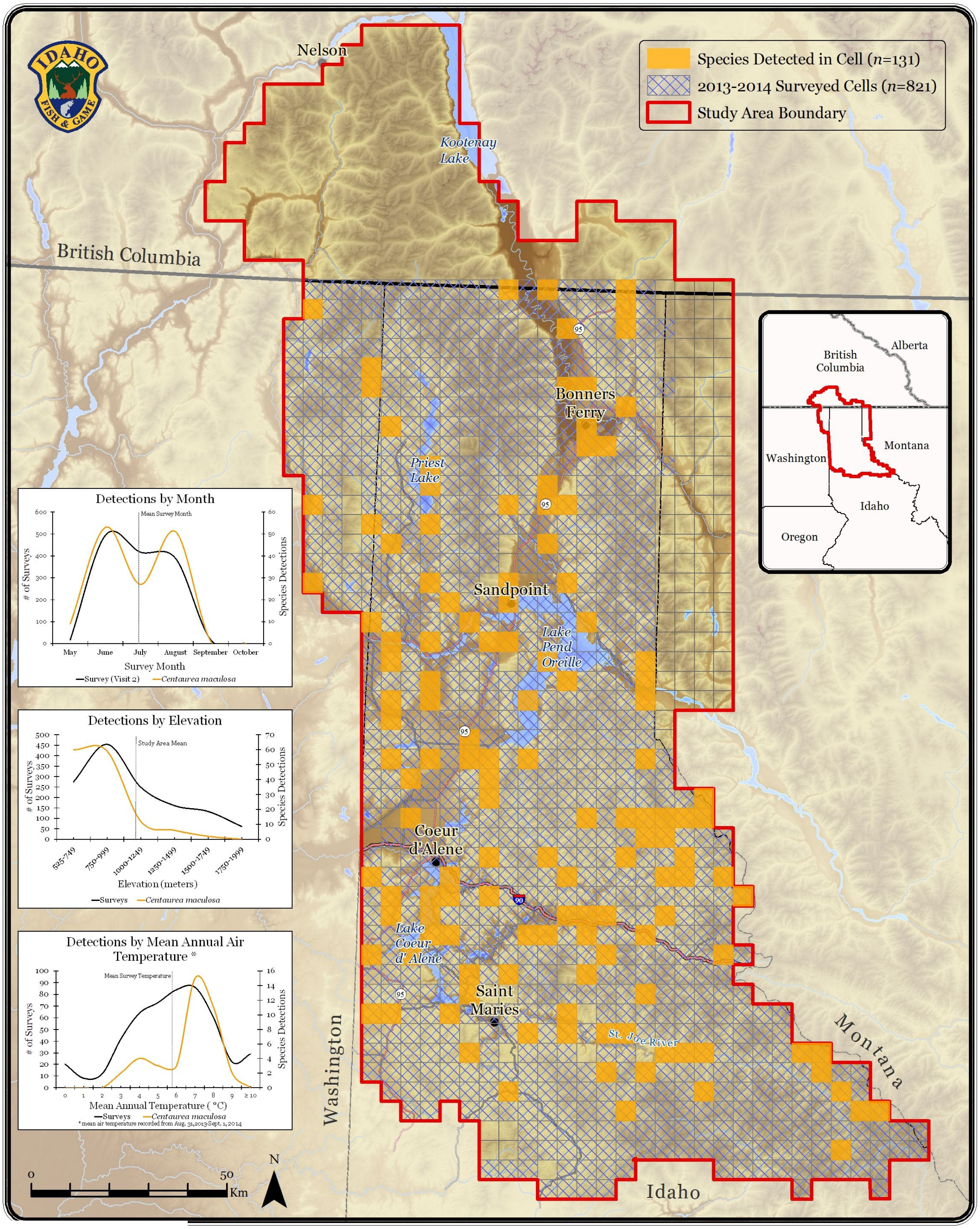
Map 6-53.

Multi-species Baseline Initiative: Devil's Club (*Oplopanax horridus*) Detections



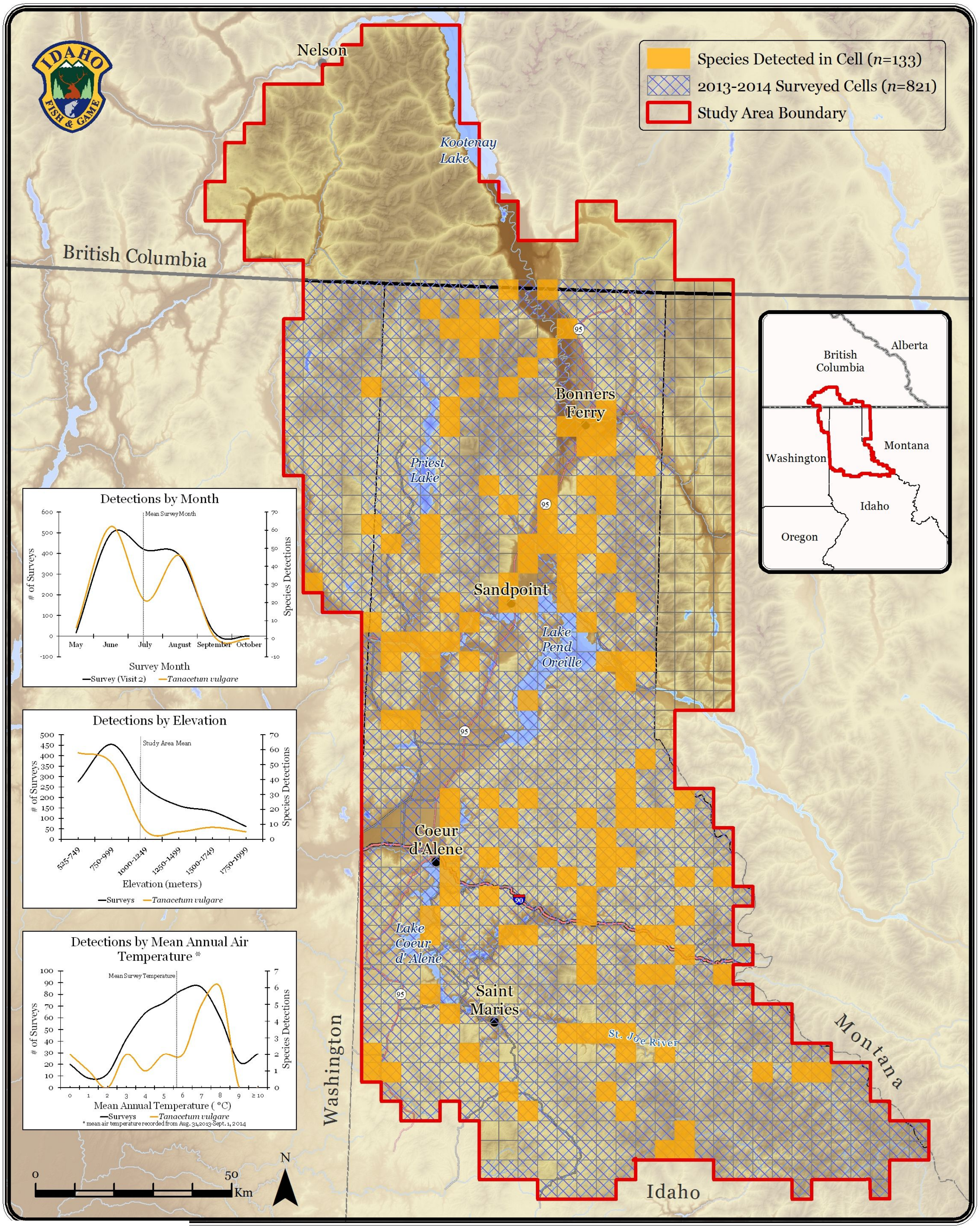
Map 6-54.

Multi-species Baseline Initiative: Spotted Knapweed (*Centaurea maculosa*) Detections



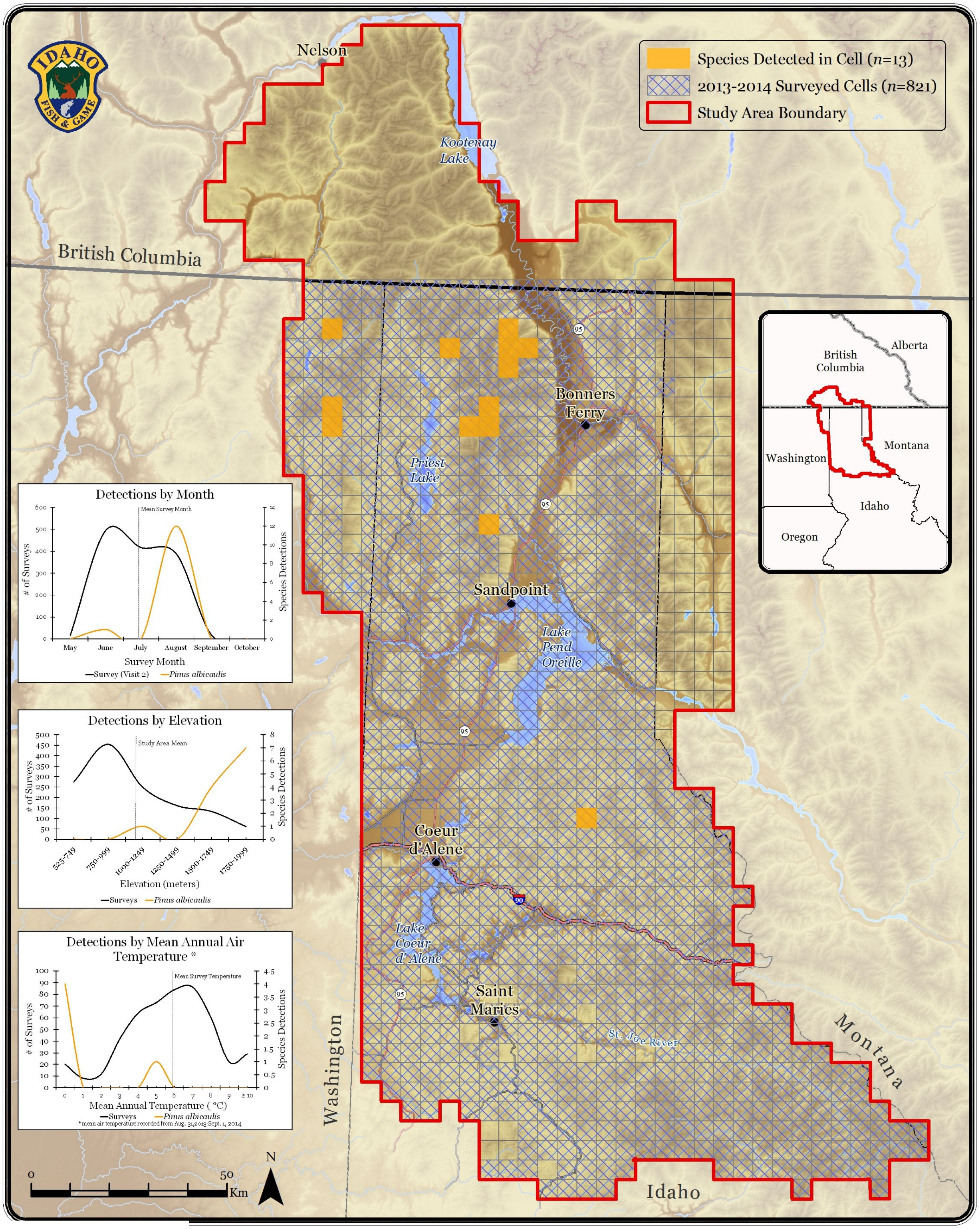
Map 6-55.

Multi-species Baseline Initiative: Tansy (*Tanacetum vulgare*) Detections



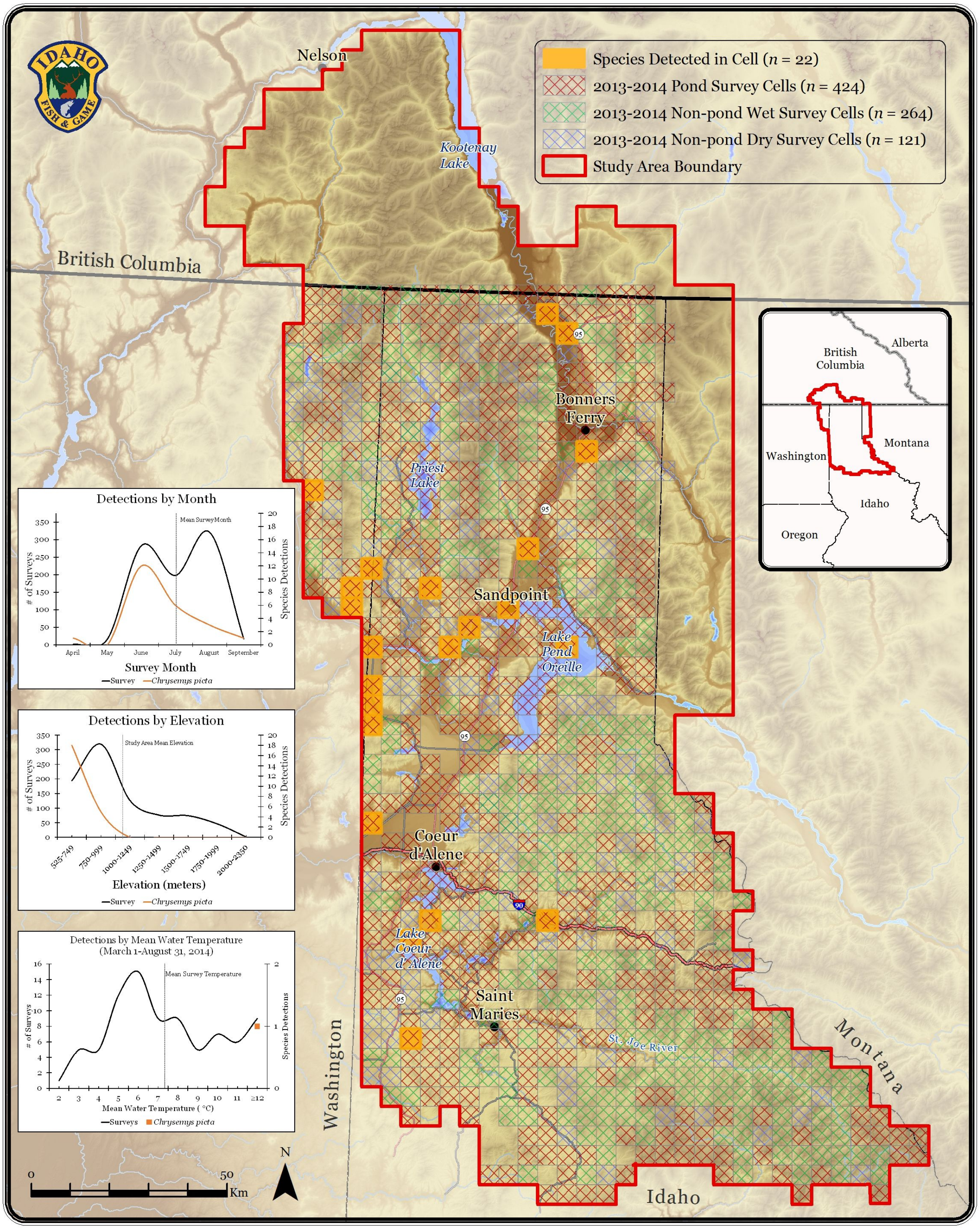
Map 6-56.

Multi-species Baseline Initiative: Whitebark Pine (*Pinus albicaulis*) Detections



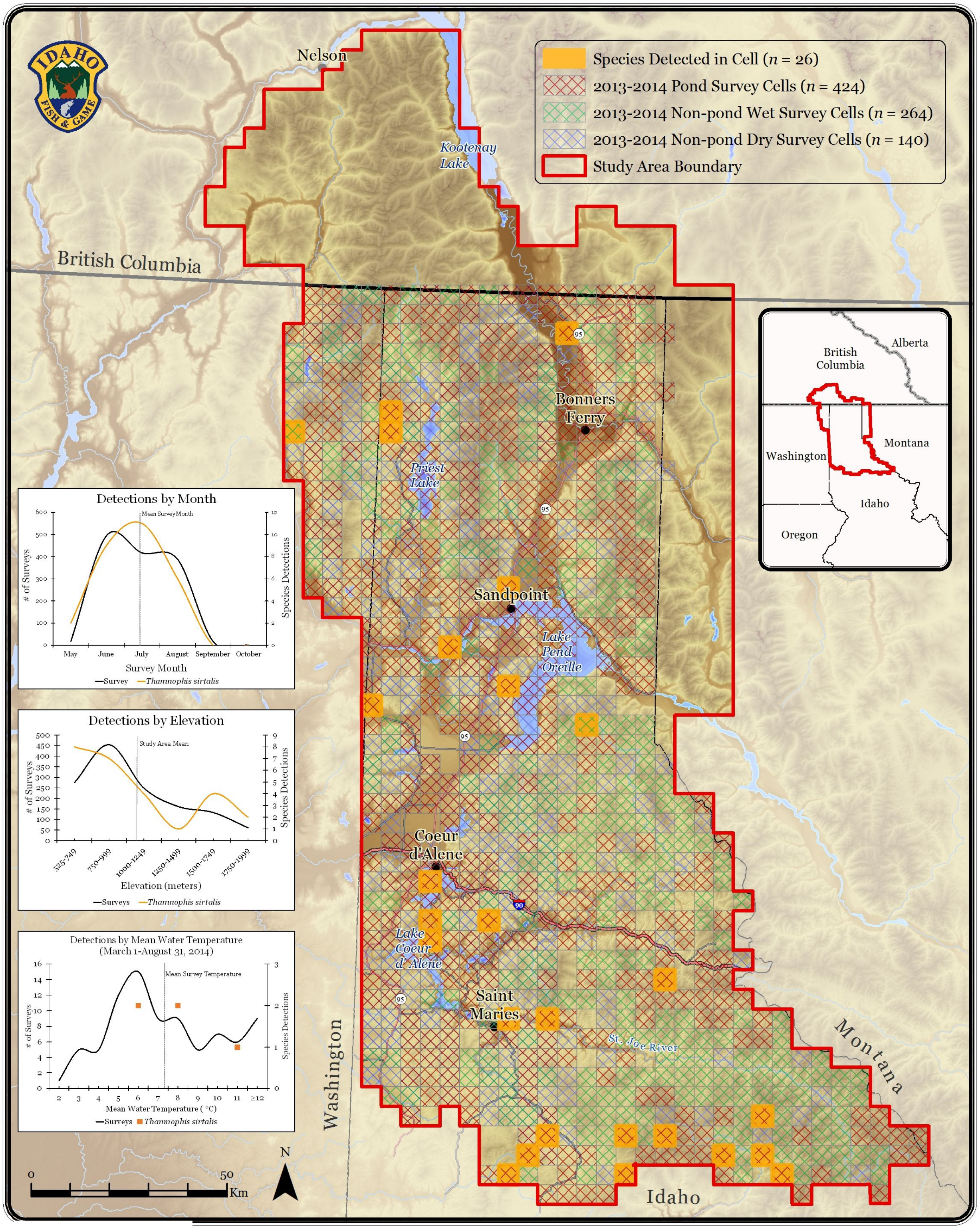
Map 6-57.

Multi-species Baseline Initiative: Painted Turtle (*Chrysemys picta*) Detections



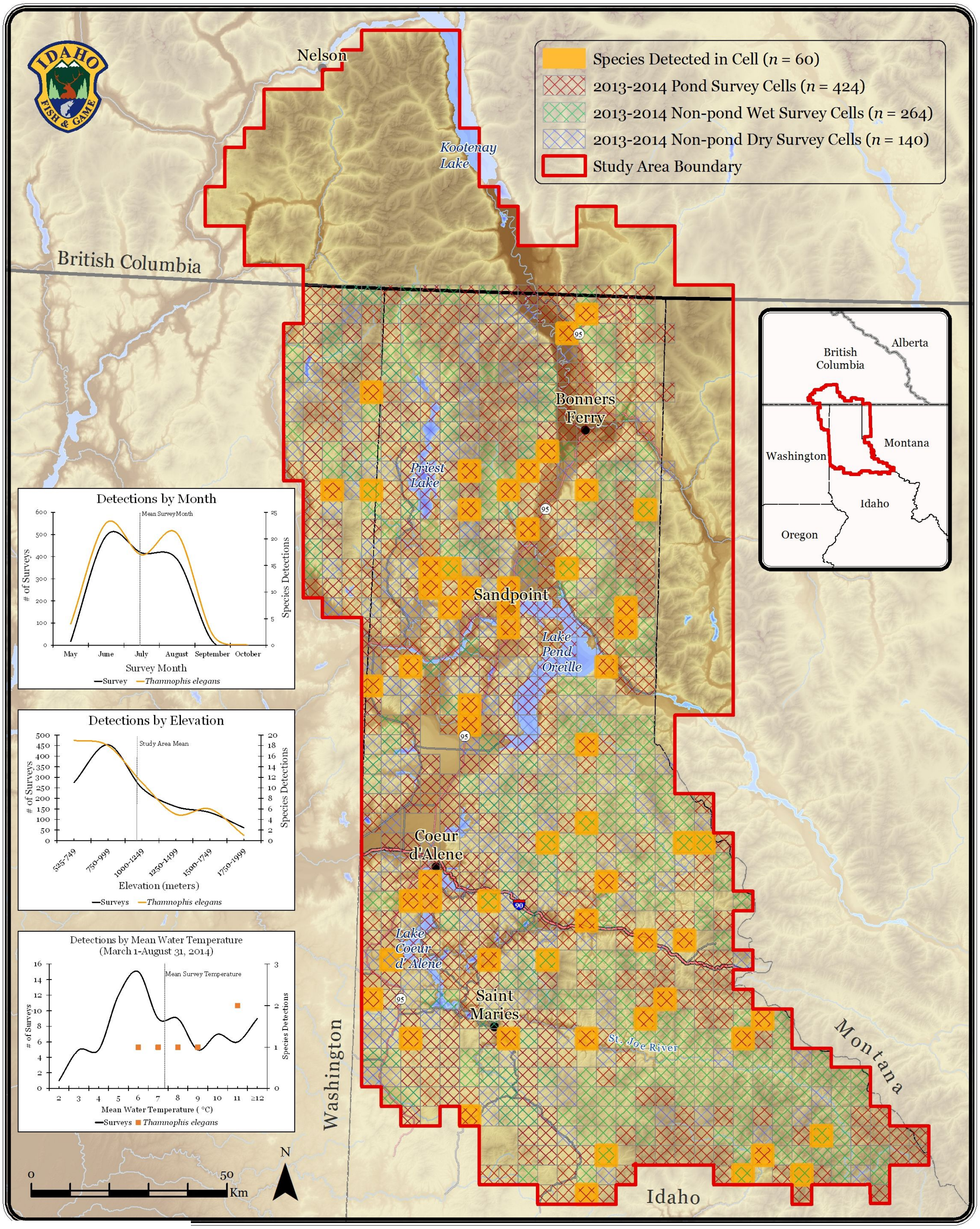
Map 6-58.

Multi-species Baseline Initiative: Common Garter Snake (*Thamnophis sirtalis*) Detections



Map 6-59.

Multi-species Baseline Initiative: Western Terrestrial Garter Snake (*Thamnophis elegans*) Detections



Map 6-60.

Appendix I. Competitive State Wildlife Grant Reporting: F12AP01101- Multi-species Baseline Initiative

Appendix Ia: Competitive State Wildlife Grant (F12AP01101) US Fish and Wildlife Service Project Reports

2015: Final
2014: Interim
2013: Interim

Appendix Ib: Competitive State Wildlife Grant (F12AP01101) Match Reports

FY15
FY14
FY13

This appendix addresses only reporting requirements of State Wildlife Grant F12AP01101: Multi-species Baseline Initiative.

This appendix does not include reports to other funding sources.

IDAHO DEPARTMENT OF FISH AND GAME

Virgil Moore, Director

State Wildlife Grant
F12AP01101

Multi-Species Baseline initiative

Final Performance Report

Performance Period
July 1, 2012 through July 1, 2015

Compiled and edited by: Michael Lucid

September 2015
Boise, Idaho

Findings in this report are preliminary in nature and not for publication without permission of the Director of the Idaho Department of Fish and Game.

COMPETITIVE STATE WILDLIFE GRANT
FINAL PROJECT PERFORMANCE REPORT

1. **State**: Idaho and Washington

   Grant number: F12AP01101

   Grant name: Multi-species Baseline Initiative

2. **Report Period**: July 1, 2012-July 1, 2015

   Report due date: September 30, 2015

3. **Location of work:** Idaho Counties: Boundary, Bonner, Kootenai, Shoshone, and Benewah, Washington County: Pend Oreille.

4. **Costs:** Final costs will be provided in a separate SF425.

5. **Objectives**: **Performance measures:**
   1) Location data of 17 Idaho Species of Greatest Conservation Need (SGCN) and 7 Washington SGCN will be provided to IDFG and WFDW by winter 2015 for inclusion in Idaho's State Wildlife Action Plan revision.
   2) Partnership development performance can be measured in number of partners and level of match support. At a minimum, success would be measured in keeping the current 12 partners and match levels.
   3) Completion of amphibian surveys in 849 survey cells.
   4) Completion of gastropod surveys in 402 survey cells.
   5) Completion of forest carnivore surveys in 364 survey cells.
   6) Provide all available data on wolverine to Idaho Panhandle National Forest (IPNF).
   7) One map showing locations of "native" versus "introduced" fisher haplotypes.
   8) One map showing locations of "native" tiger salamanders.
   9) Collection and data download of 402 CMS in 2012. Deployment of 1,291 CMS in summer 2013 and collection and data download in summer 2014.
   10) By September 30, 2015 data collected from project will be available on-line: http://fishandgame.idaho.gov/ifwis/observation

6. **If the work in this grant is part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.**

   This grant builds on and provides the majority of funding for work which began in 2010. This project allowed for completion of target species surveys across the entire study area. A final comprehensive report of all work performed will be available in the fall of 2015.

7. **Describe how the objectives are being met and what has been accomplished to date.** Progress towards performance measures (as of September 30, 2015):

1) Location data of 17 Idaho SGCN and 7 Washington SGCN will be provided to IDFG and WFDW by winter 2015 for inclusion in Idaho's State Wildlife Action Plan revision.-**Complete**.

2) Partnership development performance can be measured in number of partners and level of match support. At a minimum, success would be measured in keeping the current 12 partners and match levels.
   - *July 1, 2012-June 30, 2013:*
     Annual MBI coordination meeting held in Coeur d'Alene November, 2012.
     Annual MBI coordination meeting is being planned for fall 2013.
     Current 12 partners still actively involved in project.
     Bi-monthly project updates emailed to partners.
   - *July 1 2013-June 30, 2014:*
     Annual MBI coordination meeting held in Coeur d'Alene November, 2013.
     Annual MBI coordination meeting is being planned for fall 2014.
     Current 12 partners still actively involved in project.
     Bi-monthly project updates emailed to partners.
   - July 1 2015-June 30, 2015:
     Annual MBI coordination meeting held in Coeur d'Alene November, 2014.
     All 12 partners remained engaged for project duration.
     Project updates emailed to partners as necessary.

3) Completion of amphibian surveys in 849 survey cells.
   - *October 1, 2012-September 30, 2013:*
     Surveys conducted at 659 sites in 641 unique cells.
   - *October 1, 2013-September 20, 2014:*
     Surveys conducted at 167 sites in 161 unique cells.
   - *Project Total:* Amphibian surveys were conducted at 871 sites in 802 unique cells.

4) Completion of gastropod surveys in 402 survey cells.
   - *October 1, 2009-September 30, 2010:*
     Surveys conducted at 172 sites in 172 unique cells.
   - *October 1, 2010-September 30, 2011:*
     Surveys conducted at 322 sites in 318 unique cells.
   - *October 1, 2011-September 30, 2012:*
     Surveys conducted at 1 site in 1 unique cell.
   - *October 1, 2012-September 30, 2013:*
     Surveys conducted at 498 sites in 497 unique cells.
   - *October 1, 2013-September 30, 2014:*
     Surveys conducted at 135 sites in 134 unique cells.
   - *October 1, 2014-September 30, 2015:*
     Surveys conducted at 12 sites in 12 unique cells. All surveys during this time period were conducted in from October 1, 2014-October 11, 2014.
   - *Project Total:* Gastropod surveys were conducted at 992 sites in 879 unique cells. During the period funded by F12AP01101 (October 1, 2012-September 30, 2015) gastropod surveys were conducted at 498 sites in 497 unique cells.

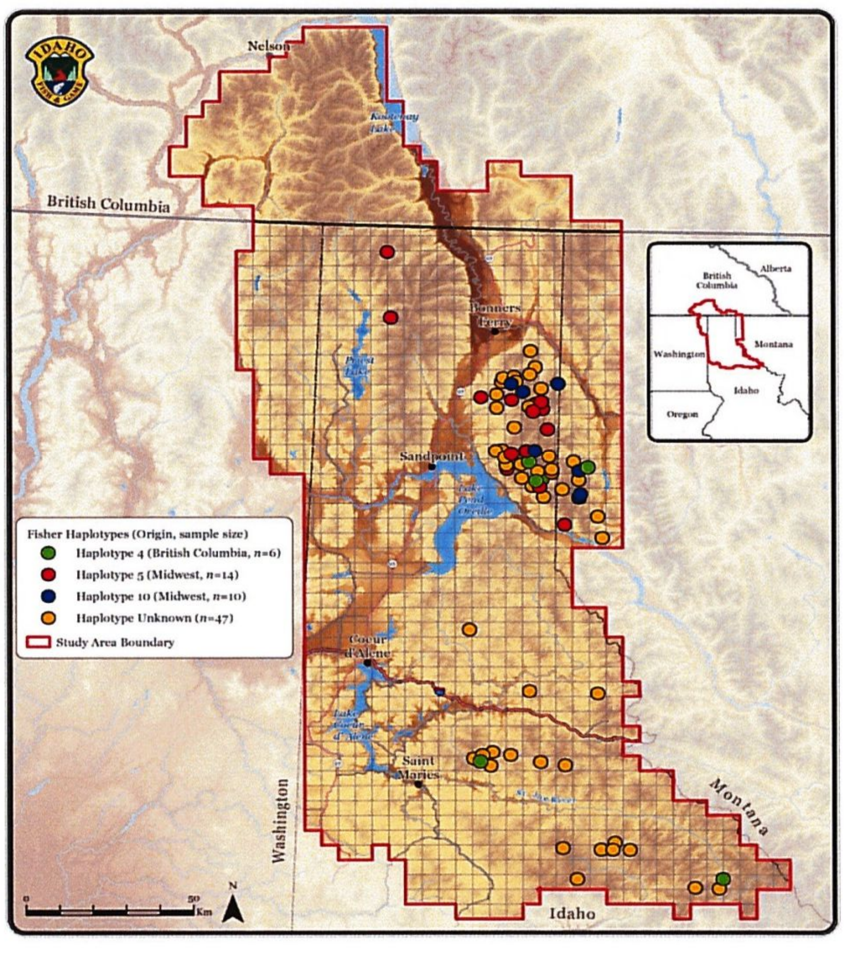
5) Completion of forest carnivore bait station surveys in 364 cells.
   - *October 1, 2009-September 30, 2010:*
     Surveys conducted at 16 sites in 15 unique cells.

> ➢ *<u>October 1, 2010-September 30, 2011:</u>*
> Surveys conducted at 17 sites in 17 unique cells.

- ➢ *October 1, 2011-September 30, 2012:*
  Surveys conducted at 86 sites in 74 unique cells.
- ➢ *October 1, 2012-September 30, 2013:*
  Surveys conducted at 97 sites in 89 unique cells.
- ➢ *October 1, 2013-September 30, 2014:*
  Surveys conducted at 281 sites in 280 unique cells.
- ➢ *Project Total:* Bait station surveys were conducted at 497 sites in 457 unique cells. During the period funded by F12AP01101 (October 1, 2012-September 30, 2015) bait station surveys were conducted at 378 sites in 368 unique cells.

6) Provide all available data on wolverine to IPNF. **Complete**.
7) One map showing locations of "native" versus "introduced" fisher haplotypes.
   -We detected introduced haplotypes 4, 5, and 10. Native haplotype 12 was not detected in samples collected from 2010-2015.

Multi-species Baseline Initiative: Fisher (*Pekania pennanti*) Control Region mtDNA Haplotypes



8) One map showing locations of "native" tiger salamanders.
   We did not detect this species during the course of the study.

9) Collection and data download of 402 CMS in 2012. Deployment of 1291 CMS in summer 2013 and collection and data download in summer 2014.
   - *<u>October 1, 2009-September 30, 2010:</u>*
     98 CMS deployed. 0 CMS collected.
   - *<u>October 1, 2010-September 30, 2011:</u>*
     416 CMS deployed. 94 CMS collected.
   - *<u>October 1, 2011-September 30, 2012:</u>*
     303 CMS deployed. 294 CMS collected.
   - *<u>October 1, 2012-September 30, 2013:</u>*
     1022 CMS deployed. 363 CMS collected.
   - *<u>October 1, 2013-September 30, 2014:</u>*
     28 CMS deployed. 85 redeployed. 762 CMS collected.
   - *<u>October 1, 2014-September 30, 2015:</u>*
     0 CMS deployed. 33 redeployed. 250 CMS collected. All work done during this time period was conducted from October 1, 2014-October 11, 2014.
   - *<u>Project Total:</u>* 1867 CMS deployed, 1763 CMS collected.

10) By September 30, 2015 data collected from project will be available on-line:
   http://fishandgame.idaho.gov/ifwis/observation

   Idaho Fish and Wildlife Information System staffing is not sufficient to complete this task by September 30, 2015. However, the data will be incorporated into the online accessible database as staff is available.

8. Discuss differences between work anticipated in the approved grant and that actually carried out with WSFR grant funds; include differences between expected and actual costs.

Amphibian surveys were only conducted in 802 of the 849 planned cells because:

a) In some cells suitable habitat (pond) is not available or
b) We were unable to obtain permission to access private land in a cell where habitat (pond) occurs

Instead of conducting surveys in 849 cells we conducted surveys at 871 sites in 802 cells.

We were unable to make data available online by the September 30, 2015. However, we will continue to work with Idaho Fish and Wildlife Information Service staff to make the data available online as soon as practical.

9. List (and attach) any deliverables, publications, or in-house reports, appendices, photos, etc. resulting from this grant.

Ehlers, S., M. Lucid, L. Robinson. 2013. Multi-species Baseline Initiative - Surveying for 17 Species of Greatest Conservation Need that are Under-represented, Misunderstood, and Sometimes Slimy. Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d'Alene, Idaho.

Lucid, M. L. Robinson, and S. Ehlers. In Prep. The MBI Way. Multi-species Baseline Initiative Project Report. Idaho Department of Fish and Game, Coeur d'Alene, Idaho.
Lucid, M. 2015. Multi-species Baseline Initiative Preliminary Results. Presentation at 2015 Idaho Chapter of the Wildlife Society Meeting. Pocatello, Idaho.
Lucid, M. and L. Robinson. 2014. Multi-species Baseline Initiative: A collaborative to implement State Wildlife Action Plans and develop a regional biodiversity monitoring program. Presentation at 2014 North American Chapter of the Society for Conservation Biology Meeting. Missoula, Montana.
Lucid, M.K., L. Robinson, S. Cushman, M. Schwartz, K. Pilgrim, L. Allen. 2013. Status of Fisher in Northern Idaho. Presentation at 2013 Idaho Chapter of the Wildlife Society Meeting: Fisher Symposium. Coeur d'Alene, Idaho.
Lucid, M.K., L. Chichester, L. Robinson, B. Bosworth, S. Cushman. 2013. A new slug species in Idaho? Exciting the public with exceptionally large genetialia! Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d'Alene, Idaho.
Hough, P. 2013. Panhandle Wolverine/Rare Forest Carnivore Study, A Citizens' Science Project. Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d'Alene, Idaho.
Robinson, L. and M. Lucid. 2014. Multi-species Baseline Initiative Preliminary Bait Station Results. https://fishandgame.idaho.gov/content/post/preliminary-2010-14-bait-station-results
Robinson, L. and M. Lucid. 2014. Assessing forest carnivore status across the Idaho Panhandle and adjoining mountain ranges using winter bait stations. Presentation at 2014 North American Chapter of the Society for Conservation Biology Meeting. Missoula, Montana.
Robinson, L. M. Lucid, S. Cushman, L. Allen. 2013. Using Winter Bait Stations to Detect Forest Carnivores in the Idaho Panhandle. Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d'Alene, Idaho.
Witt, C. 2013. Using Forest Inventory Data for Wildlife Applications in Idaho. Poster at 2013 Idaho Chapter of the Wildlife Society. Coeur d'Alene, Idaho.
Van Niel, L., M. Lucid, L. Robinson, S. Ehlers. 2013. Using Citizen Naturalists to Implement the Multi-species Baseline Initiative. Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d'Alene, Idaho.

Name, title, phone number, and e-mail address of person compiling this report:

Michael Lucid. Regional Wildlife Diversity Biologist.
Panhandle Region (208) 830-1451. michael.lucid@idfg.idaho.gov

Submitted by:

Bradley B. Compton
Federal Aid Coordinator

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Jeff Gould, Chief
Bureau of Wildlife

FEDERAL AID IN WILDLIFE RESTORATION

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sale of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program then allots the funds back to states through a formula based on each state's geographic area and the number of paid hunting license holders in the state. The Idaho Department of Fish and Game uses the funds to help restore, conserve, manage, and enhance wild birds and mammals for the public benefit. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes necessary to be responsible, ethical hunters. Seventy-five percent of the funds for this project are from Federal Aid. The other 25% comes from license-generated funds.

IDAHO DEPARTMENT OF FISH AND GAME

Virgil Moore, Director

Project F12AP01101

Multi-Species Baseline Initiative

Interim Report

July 1, 2013 to June 30, 2014

Insert Prepared By: Michael Lucid, Wildlife Diversity Biologist

Compiled and edited by: Rex Sallabanks , Statewide Wildlife Diversity Manager

September 2014
Boise, Idaho

STATE WILDLIFE GRANT
INTERIM PROGRESS REPORT

1. **State**: Idaho and Washington

   Grant number: F12AP01101

   Grant name: Multi-species Baseline Initiative

2. **Report Period**: July 1, 2013-June 30, 2014

   Report due date: September 28, 2014

3. **Location of work:** Idaho Counties: Boundary, Bonner, Kootenai, Shoshone, Benewah, Washington and: Pend Oreille

4. **Costs:** Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are "Actual" or "Estimated"

Source	Budgeted	Actual ___ or Estimated ____
Federal :_____________	$400,000	$400,000 (estimated)
State	$14,993	$14,993 (estimated)
Other: Non-federal In Kind Match	$265,534	$265,534 (estimated)
Non-federal Cash Match	$105,043	$105,043 (estimated)
____________________		
Total Federal	$400,000	$400,000 (estimated)
Total match	$370,577	$370,577 (estimated)
Total project:	$770,577	$770,577 (estimated)

5. **Objectives**:
   a) Location data of 17 Idaho SGCN and 7 Washington SGCN will be provided to IDFG and WFDW in by winter 2015 for inclusion in SGCN revision.
   b) Partnership development performance can be measured in number of partners and level of match support. At a minimum, success would be measured in keeping the current 12 partners and match levels.

c) Completion of amphibian surveys in 849 survey cells.
d) Completion of gastropod surveys in 402 survey cells.
e) Completion of forest carnivore surveys in 364 survey cells.
f) Provide all available data on wolverine to Idaho Panhandle National Forest (IPNF).
g) One map showing locations of "native" versus "introduced" fisher haplotypes.
h) One map showing locations of "native" tiger salamanders.
i) Collection and data download of 402 CMS in 2012. Deployment of 1,291 CMS in summer 2013 and collection and data download in summer 2014.
j) By September 30, 2015 data collected from project will be available on-line: http://fishandgame.idaho.gov/ifwis/observation

6. If the work in this grant is part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This work is not part of a larger undertaking.

7. Describe how the objectives are being met and what has been accomplished to date.
Progress towards performance measures (as of 31 August, 2014):

a) Location data of 17 Idaho SGCN and 7 Washington SGCN will be provided to IDFG and WFDW in by winter 2015 for inclusion in SGCN revision.

-In progress.

b) Partnership development performance can be measured in number of partners and level of match support. At a minimum, success would be measured in keeping the current 12 partners and match levels.

1 July 1 2013-30 June, 2014:
-Annual MBI coordination meeting held in Coeur d' Alene November, 2013.
-Annual MBI coordination meeting is being planned for fall 2014.
-Current 12 partners still actively involved in project.
-Bi-monthly project updates emailed to partners.
-Partners and IDFG have contributed $370,577 in non-federal match. This is 53% of the $702,290 match requirement.

Total as of 30 June, 2014:
-Partners and IDFG have contributed a total of $768,871 in non-federal match and exceeded the $702,290 match requirement.

c) Completion of amphibian surveys in 849 survey cells.

1 July 2013-3o June, 2014: Amphibian surveys conducted in 611 cells. An additional 35 surveys were conducted at 7 temporal wetlands to assess amphibian detectability.

Total as of 30 June, 2014:
837 Amphibian surveys were conducted in 802 of the 849 planned cells. .

d) Completion of gastropod surveys in 402 survey cells.

1 July 2013-June 30, 2014: Gastropod surveys conducted in 222 unique cells. Duplicate gastropod surveys were conducted in 65 cells for a total of 287 gastropod surveys.

Total as of August 31, 2014: Gastropod surveys were conducted in 431 unique cells and a total of 496 gastropod surveys were completed.

e) Completion of forest carnivore surveys in 364 survey cells.

1 July 2013-30 June, 2014: Forest carnivore surveys conducted in 281 survey cells.

Total as of 30 June, 2014: Forest carnivore surveys were conducted in 370 cells.

f) Provide all available data on wolverine to IPNF.

-All proofed wolverine data to date has been provided to IPNF.

g) One map showing locations of "native" versus "introduced" fisher haplotypes.

-Haplotypes were sequenced for 25 individual fisher. All 25 were "introduced" haplotypes. Haplotypes were mapped and presented at the Fisher Symposium at the 2013 Idaho Chapter of the Wildlife Society Meeting.
-Genetics material from additional fisher have been submitted to Wildlife Genetics International for analysis.
-Map will be produced when laboratory work is complete.

h) One map showing locations of "native" tiger salamanders.

-Possible tiger salamander tissue samples have been submitted to Wildlife Genetics International. If species is positively identified as tiger salamander an analysis will be conducted to determine if the populations are "native" or not and a map will be produced.

i) Collection and data download of 402 CMS in 2012. Deployment of 1,291 CMS in summer 2013 and collection and data download in summer 2014.

1 July 2013-30 June, 2014: 263 CMS retrieved, 683 CMS deployed.

Total as of 30 June, 2014: 263 CMS retrieved, 935 CMS deployed.

j) By 30 September, 2015 data collected from project will be available on-line: http://fishandgame.idaho.gov/ifwis/observation

8. Discuss differences between work anticipated in the approved grant and that actually carried out with WSFR grant funds; include differences between expected and actual costs.

Amphibian surveys were only conducted in 802 of the 849 planned cells because:
a) In some cells suitable habitat (pond) is not available or
b) We were unable to obtain permission to access private land in a cell where habitat (pond) occurs

The deployment goal of 1,291 CMS was not met because water temperature data loggers were more expensive ($100 instead of $30 each) than expected and project budget could not support goal. All CMS currently deployed (1,069) will be collected and downloaded in September and October, 2014.

496 gastropod were conducted. This is 94 more than the goal of 402. Additional surveys were conducted (multiple surveys in the same cell) in order to sample FIA plots which had gastropod surveys in the same survey cell, but at a different location, in previous years.

9. List (and attach) any deliverables, publications, or in-house reports, appendices, photos, etc. resulting from this grant.

Ehlers, S., M. Lucid, L. Robinson. 2013. Multi-species Baseline Initiative - Surveying for 17 Species of Greatest Conservation Need that are Under-represented, Misunderstood, and Sometimes Slimy. Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d' Alene, Idaho.

Lucid, M. and L. Robinson. 2014. Multi-species Baseline Initiative: A collaborative to implement State Wildlife Action Plans and develop a regional biodiversity monitoring program. Presentation at 2014 North American Chapter of the Society for Conservation Biology Meeting. Missoula, Montana.

Lucid, M.K., L. Robinson, S. Cushman, M. Schwartz, K. Pilgrim, L. Allen. 2013. Status of Fisher in Northern Idaho. Presentation at 2013 Idaho Chapter of the Wildlife Society Meeting: Fisher Symposium. Coeur d' Alene, Idaho.

Lucid, M.K., L. Chichester, L. Robinson, B. Bosworth, S. Cushman. 2013. A new slug species in Idaho? Exciting the public with exceptionally large genetialia! Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d' Alene, Idaho.

Hough, P. 2013. Panhandle Wolverine/Rare Forest Carnivore Study, A Citizens' Science Project. Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d' Alene, Idaho.

Robinson, L. and M. Lucid. 2014. Multi-species Baseline Initiative Preliminary Bait Station Results. https://fishandgame.idaho.gov/content/post/preliminary-2010-14-

bait-station-results

Robinson, L. and M. Lucid. 2014. Assessing forest carnivore status across the Idaho Panhandle and adjoining mountain ranges using winter bait stations. Presentation at 2014 North American Chapter of the Society for Conservation Biology Meeting. Missoula, Montana.

Robinson, L. M. Lucid, S. Cushman, L. Allen. 2013. Using Winter Bait Stations to Detect Forest Carnivores in the Idaho Panhandle. Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d' Alene, Idaho.

Witt, C. 2013. Using Forest Inventory Data for Wildlife Applications in Idaho. Poster at 2013 Idaho Chapter of the Wildlife Society. Coeur d' Alene, Idaho.

Van Niel, L., M. Lucid, L. Robinson, S. Ehlers. 2013. Using Citizen Naturalists to Implement the Multi-species Baseline Initiative. Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d' Alene, Idaho.

Additional reports and publications are pending.

Name, title, phone number, and e-mail address of person compiling this report:

Michael Lucid. Regional Wildlife Diversity Biologist.
(208) 830-1451. michael.lucid@idfg.idaho.gov

INTERIM Performance Report

1. State: Idaho and Washington

Grant number: F12AP01101

Grant name: Multi-species Baseline Initiative

2. Report Period: July 1, 2012-June 30, 2013

Report due date: September 30, 2013

3. Location of work:

Idaho Counties: Boundary, Bonner, Kootenai, Shoshone, and Benewah

Washington County: Pend Oreille

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are “Actual” or “Estimated”

Source	Budgeted	Actual ___or Estimated____
Federal :______________	$300,000	$285,000 (estimated)
State	$14,993	$14,993 (actual)
Other: Non-federal In Kind Match	$280,521	$280,521 (actual)
Non-federal Cash Match	$102,780	$102, 780 (actual)
_______________________		
Total Federal	$300,000	$285,000 (estimated)
Total match	$398,294	$398,294 (actual)
Total project:	$698,294	$683,294

5. Objectives:

Performance measures:

1) Location data of 17 Idaho SGCN and 7 Washington SGCN will be provided to IDFG and WFDW in by winter 2015 for inclusion in SGCN revision.
2) Partnership development performance can be measured in number of partners and level of match support. At a minimum, success would be measured in keeping the current 12 partners and match levels.
3) Completion of amphibian surveys in 849 survey cells.
4) Completion of gastropod surveys in 402 survey cells.
5) Completion of forest carnivore surveys in 364 survey cells.
6) Provide all available data on wolverine to Idaho Panhandle National Forest (IPNF).
7) One map showing locations of "native" versus "introduced" fisher haplotypes.
8) One map showing locations of "native" tiger salamanders.
9) Collection and data download of 402 CMS in 2012. Deployment of 1,291 CMS in summer 2013 and collection and data download in summer 2014.
10) By September 30, 2015 data collected from project will be available on-line: http://fishandgame.idaho.gov/ifwis/observation

6. If the work in this grant is part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This work is part of, but the primary funding source, of the Multi-species Baseline Initiative which began in 2010.

7. Describe how the objectives are being met and what has been accomplished to date.

Progress towards performance measures (as of June 30, 2013):

1) Location data of 17 Idaho SGCN and 7 Washington SGCN will be provided to IDFG and WFDW in by winter 2015 for inclusion in SGCN revision.

   -In progress.

2) Partnership development performance can be measured in number of partners and level of match support. At a minimum, success would be measured in keeping the current 12 partners and match levels.

   -Annual MBI coordination meeting held in Coeur d' Alene November 2012.
   -Annual MBI coordination meeting is being planned for fall 2013.
   -Current 12 partners still actively involved in project.
   -Bi-monthly project updates emailed to partners.
   -Partners and IDFG have contributed $398,294 in non-federal match. This is 60% of the $700,000 match requirement.

3) Completion of amphibian surveys in 849 survey cells.

   -Amphibian surveys conducted in 191 cells.

4) Completion of gastropod surveys in 402 survey cells.

   -Gastropod surveys conducted in 209 cells.

5) Completion of forest carnivore surveys in 364 survey cells.

   -Forest carnivore surveys conducted in 89 survey cells.

6) Provide all available data on wolverine to IPNF.

   -All proofed wolverine data to date has been provided to IPNF.

7) One map showing locations of "native" versus "introduced" fisher haplotypes.

   -Haplotypes were sequenced for 25 individual fisher. All 25 were "introduced" haplotypes. Haplotypes were mapped and presented at the Fisher Symposium at the 2013 Idaho Chapter of the Wildlife Society Meeting. Haplotypes for additional fisher will be developed as genetic material is obtained.

8) One map showing locations of "native" tiger salamanders.

   -Not yet available.

9) Collection and data download of 402 CMS in 2012. Deployment of 1,291 CMS in summer 2013 and collection and data download in summer 2014.

   -0 CMS retrieved.
   -252 CMS deployed.

10) By September 30, 2015 data collected from project will be available on-line: http://fishandgame.idaho.gov/ifwis/observation

8. Discuss differences between work anticipated in the approved grant and that actually carried out with WSFR grant funds; include differences between expected and actual costs.

-Progress towards performance measures is proceeding as expected.

9. List (and attach) any deliverables, publications, or in-house reports, appendices, photos, etc. resulting from this grant.

Ehlers, S., M. Lucid, L. Robinson. 2013. Multi-species Baseline Initiative - Surveying for 17 Species of Greatest Conservation Need that are Under-represented, Misunderstood, and Sometimes Slimy. Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d' Alene, Idaho.

Lucid, M.K., L. Robinson, S. Cushman, M. Schwartz, K. Pilgrim, L. Allen. 2013. Status of Fisher in Northern Idaho. Presentation at 2013 Idaho Chapter of the Wildlife Society Meeting: Fisher Symposium. Coeur d' Alene, Idaho.

Lucid, M.K., L. Chichester, L. Robinson, B. Bosworth, S. Cushman. 2013. A new slug species in Idaho? Exciting the public with exceptionally large genetialia! Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d' Alene, Idaho.

Hough, P. 2013. Panhandle Wolverine/Rare Forest Carnivore Study, A Citizens' Science Project. Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d' Alene, Idaho.

Robinson, L. M. Lucid, S. Cushman, L. Allen. 2013. Using Winter Bait Stations to Detect Forest Carnivores in the Idaho Panhandle. Presentation at 2013 Idaho Chapter of the Wildlife Society. Coeur d' Alene, Idaho.

Witt, C. 2013. Using Forest Inventory Data for Wildlife Applications in Idaho. Poster at 2013 Idaho Chapter of the Wildlife Society. Coeur d' Alene, Idaho.

Van Niel, L., M. Lucid, L. Robinson, S. Ehlers. 2013. Using Citizen Naturalists to Implement the Multi-species Baseline Initiative. Presentation at 2013 Idaho Chapter of the Wildlife Society. CDA, ID.

Additional reports and publications are pending.

Name, title, phone number, and e-mail address of person compiling this report:

Michael Lucid. Regional Wildlife Diversity Biologist. (208) 830-1451. michael.lucid@idfg.idaho.gov

Multi-species Baseline Initiative

Non-Federal Match Report - State of Idaho Fiscal Year 2015

Compiled by Michael Lucid
Regional Wildlife Diversity Biologist
Idaho Department of Fish and Game
2885 Kathleen Avenue, Coeur d' Alene, Idaho 83815

This document summarizes $141,110 ($5,850 Cash, $135,260 In Kind) in non-federal contributions to the Competitive State Wildlife Grant project 'Multi-species Baseline Initiative' for the State of Idaho's 2015 fiscal year (1 July, 2014 - 30 June, 2015).

This is the final match report for the project. Project partners have collectively provided a total of $909,981 in non-federal matching dollars from FY13-15. This exceeds the required $702,290 match amount by $207,691.

Contained herein are:
1) Summary table of match contributions by partner organization.
2) Letters from each partner organization which summarize match contributions.

Non-federal match summary.

Idaho Fiscal Year	Non-federal Match
FY13	$398,294
FY14	$370,577
FY15	$141,110
Total	**$909,981**

Please see FY13 and FY14 reports for detailed reporting on each fiscal year.

Cash and in-kind contributions to the Multi-species Baseline Initiative during Idaho FY15.

Organization	Cash	In Kind	Total
Idaho Office of Species Conservation	$0	$1,410	$1,410
Idaho Department of Lands	$0	$425	$425
Potlatch Corporation	$0	$1,000	$1,000
Friends of Scotchman Peaks Wilderness	$0	$2,219	$2,219
Coeur d' Alene Tribe	$0	$14,544	$14,544
Hancock Forest Management	$0	$592	$592
British Columbia Ministry of Forests, Lands, and Natural Resource Operations	$0	$86,505	$86,505
Washington Department of Fish and Wildlife	$0	$772	$772
Kalispel Tribe	$0	$12,800	$12,800
Idaho Department of Fish and Game	$5,850	$14,993	$20,843
Total	$5,850	$135,260	**$141,110**

OFFICE OF SPECIES CONSERVATION

C.L. "BUTCH" OTTER
Governor

DUSTIN T. MILLER
Administrator

P.O. Box 83720
Boise, Idaho 83720-0195

304 North Eighth Street, Suite 149
Boise, Idaho 83702

May 7, 2015

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

Dear Michael,

This letter is to document non-federal match contributed by the Idaho Office of Species Conservation towards the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2014 to April 30, 2015.

The following list summarizes our In-kind contributions:

Personnel Costs:	$980
Operating Costs:	$430
Total:	$1,410

Sincerely

Dustin T. Miller

Dustin T. Miller
Administrator

• (208) 334-2189 • Fax (208) 334-2172 •

TECHNICAL SERVICES BUREAU
Coeur d'Alene Staff Office
3284 W. Industrial Loop
Coeur d'Alene, Idaho 83815
Phone (208) 769-1525
Fax (208) 769-1524

IDAHO DEPARTMENT OF LANDS

TOM SCHULTZ, DIRECTOR
EQUAL OPPORTUNITY EMPLOYER

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

Dear Michael,

This letter is to document the non-federal match the Idaho Department of Lands has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2014 to April 30, 2015.

The following list summarizes our In-Kind contributions:

Item	Amount
Personnel	$424.81

Please let me know if any additional information is required.

Sincerely,

Patrick Seymour
Endangered Species Program Manager

"Trusted Stewards of Idaho's Resources, from Main Street to Mountaintop"

Potlatch

Potlatch Forest Holdings, Inc.

A WHOLLY OWNED SUBSIDIARY OF POTLATCH CORPORATION

301 D Street
Lewiston, ID 83501

www.potlatchcorp.com

May 5, 2015

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

Dear Michael,

This letter is to document non-federal match contributed by Potlatch towards the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2014 to May 5, 2015.

The following list summarizes our In-kind contributions:

Personnel Costs: $1000.00

Sincerely,

T.W. Cundy

Terrance W. Cundy
Manager – Silviculture, Wildlife and Environment
Potlatch Forest Holdings, Inc.
301 D Street
Lewiston, ID 83501

208-748-2032
208-301-0410 cell
Terry.Cundy@potlatchcorp.com

www.ScotchmanPeaks.org

Friends of Scotchman Peaks Wilderness

FSPW
PO Box 2061
Sandpoint, ID 83864

May 12, 2015

Michael Lucid
Idaho Department of Fish and Game
Via email: michael.lucid@idfg.idaho.gov

Dear Michael,

This letter is to document the non-federal match the Friends of Scotchman Peaks Wilderness has contributed to the Competitive State Wildlife Grant Project ***"Multi-species Baseline Initiative"*** from July 1, 2014 to May 12, 2015.

The following list summarizes our In-Kind contributions:

Contribution	Number	Unit Value	Total Value
Volunteer Hours At Biologist rate	0	37.85	$ -
Vol Hours at Tech Rate	0	24.08	$ -
FSPW Staff Hours	80	26.5	$ 2,120.00
Car Miles	180	0.55	$ 99.00
Day Use of Ski Package	0	26	$ -
Day Use of Snowshoe Package	0	12	$ -
Day Use of Avalanche Safety Equipment	0	32	$ -
Total			$ 2,219.00

Please let me know if I can provide any other information,

Best Regards,

Philip J. Hough

Phil Hough
Executive Director

COEUR D'ALENE TRIBE
850 "A" STREET
P.O. BOX 408
PLUMMER, IDAHO 83851
(208) 686-1800 FAX (208) 686-1182

REFERENCE:

May 14, 2015

Michael Lucid
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d'Alene, ID 83815

Dear Michael,

This letter is to document the non-federal match the Coeur d'Alene Tribe has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2014 to December 31, 2014. The following list summarizes our In-Kind contributions:

Labor Cost:	$10,944
Use of 4WD vehicle:	$3,600
Total:	**$14,544**

Please let me know if you have any questions. We have enjoyed the opportunity to work with your agency on this project, and look forward to continued cooperation in the future.

Sincerely,

Cameron Heusser
Wildlife Program Manager, Coeur d'Alene Tribe

Hancock Forest Management

A Division of Hancock Timber Resource Group, A Manulife Asset Management Company

May 22, 2015

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Fish and Game
2885 W. Kathleen Avenue
Coeur d'Alene, ID 83815

RE: IDFG Multi-species Baseline Initiative project- summary of in-kind contributions

Dear Michael,
This letter is to document non-federal match contributed by Hancock Forest Management towards the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2014 to May 15, 2015.

The following list summarizes our in-kind contributions:

Personnel costs:	$ 532.00
Operating costs:	$ 60.00
Total:	$ 592.00

Sincerely,

Gretchen Lech
Wildlife Biologist

Hancock Forest Management
3918 N. Schreiber Way, Suite 100
Coeur d'Alene, ID 83815
(208) 292-2462 x105
(208) 660-3340 (mobile)

cc: David Gabrielsen, HFM
Scott Ketchum, HFM

BRITISH COLUMBIA

File #: 78640-01

May 25, 2015

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Avenue
Coeur d' Alene ID 83815

Dear Michael:

RE: Competitive State Wildlife Grant Project

This letter is to document the non-federal match that BC Fish & Wildlife Branch and our partners have contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2014 to May 1, 2015."

Central Selkirks Wolverine inventory:

Cash contribution from Fish and Wildlife Branch = $14,000.00
Government in-house costs (salary, vehicles, etc) = $12,000.00
Columbia Basin Trust Environmental Initiatives Grant = $20,100.00
Fish and Wildlife Compensation Program = $40,405.00

Total contribution for July 1 2014 and May 1 2015 = $86,505.00 CDN

Sincerely,

Garth Mowat
Head-Natural Resource Science & Stewardship Section

GM:ar

Ministry of Forests, Lands and Natural Resource Operations
Resource Management Kootenay-Boundary
Mailing/Location Address: #401 333 Victoria Street Nelson BC V1L 4K3
Telephone: 250 354-6142
Facsimile: 250 354-6332
Website: www.env.gov.bc.ca/fw

State of Washington
DEPARTMENT OF FISH AND WILDLIFE
2315 N. Discovery Place • Spokane Valley, WA 99216-1566 • (509) 892-1001 • (509) 921-2440 FAX

July 27, 2015

Michael Lucid
Regional Wildlife Biologist
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d'Alene, ID 83815

Dear Michael,

This letter is to document the non-federal match the Washington Department of Fish and Wildlife has contributed to the Competitive State Wildlife Grant Project "Multi-species Baseline Intitiative" from July 1, 2014 to June 30, 2015.

The following summarizes our In-Kind contributions:

WDFW participation in Annual MBI meeting
Regional Wildlife Program Manager Kevin Robinette, Spokane, WA
Salary and Benefits (1 day): $421.33
Assistant District Wildlife Biologist Annemarie Prince, Colville, WA
Salary and Benefits (1 day): $263.45
State Vehicle Mileage ($208 mi @ $0.42/mi): $87.36

Total Contribution: $772.14

Sincerely,

Kevin Robinette
Regional Wildlife Program Manager

KALISPEL TRIBE OF INDIANS

Kalispel Tribe of Indians
P.O. Box 39
Usk, WA 99180

(509) 445-1147
(509) 445-1705 fax
www.kalispeltribe.com

August 30, 2015

Michael Lucid
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

RE: MBI Match Letter

Dear Michael,

This letter is to document the non-federal match the Kalispel Tribe has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2014 and August 30, 2015.

The following list summarized our In-Kind contributions:

Salary and Fringe	$10,800
Travel	$2,000
Total	**$12,800**

Please let us know if there is anything else we can help you with.

Sincerely,

Ray D. Entz

Ray Entz
Deputy Director of Terrestrial Resources
Kalispel Tribe of Indians

IDAHO DEPARTMENT OF FISH AND GAME
PANHANDLE REGION
2885 West Kathleen Avenue
Coeur d'Alene, Idaho 83815

C.L. "Butch" Otter / Governor
Virgil Moore / Director

This letter is a summary of the non-federal match contributed by the Idaho Department of Fish and Game (IDFG) to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' (MBI) during the State of Idaho Fiscal Year 2015 (July 1, 2014-June 30, 2015).

A non-federal cash contribution of $14,993 dollars was made from IDFG budget 48112.

Item	Type	Unit Type	Quantity	Unit Value	Total Value
Budget 48112	Cash		1	$14,993.00	$14,993
Waterlife Discovery Center:Office Space	In Kind	Month	6	$750.00	$4,500
Waterlife Disc. Center:Trailer Hook-up	In Kind	Month	4	$450.00	$1,350
Total					**$20,843**

One IDFG property, which was not purchased with federal funds, was used to support the project. The Waterlife Discovery Center was used as office space and assigned a value of $750. This value was determined by searching Craigslist for office space in the local area and picking an average price for a similar size office. The Waterlife Discovery Center was also used as employee housing in the form of a house-trailer hook-up site. The $450 hook-up fee is the same rate charged for a hook-up at the Hi Dee Ho Trailer Park in Ponderay, Idaho.

The total non-federal match for this agreement for Idaho Fiscal Year 2014 is **$20,843.**

Sincerely,

Michael Lucid
Regional Wildlife Diversity Biologist
michael.lucid@idfg.idaho.gov
(208) 830-1451

Multi-species Baseline Initiative

Non-Federal Match Report - State of Idaho Fiscal Year 2014

Compiled by Michael Lucid
Regional Wildlife Diversity Biologist
Idaho Department of Fish and Game
2885 Kathleen Avenue, Coeur d' Alene, Idaho 83815

IDFG wildlife biologiy interns contributed 3,379 hours of labor to the project. Photo credit: Toren Johnson

This document summarizes $370,577 ($105,043 Cash, $265,534 In Kind) in non-federal contributions to the Competitive State Wildlife Grant project 'Multi-species Baseline Initiative' for the State of Idaho's 2014 Fiscal Year (July 1, 2013-June 30, 2014).

When combined with FY13 $398,294 non-federal contributions we have provided a total of $768,871 in non-federal matching dollars in FY13 and FY14. This exceeds the $702,290 match requirement.

FY14 Contributions made from 12 partner organizations include personnel time, property use, vehicle use, and 4,506 hours of labor contributed by project volunteers.

Contained herein are:
1) Summary table of match contributions by partner organization or individual.
2) Letters from each partner organization or individual which summarize match contributions for those entities.

Individual time cards which document volunteer hours worked and personal gear used by volunteers directly supervised by Idaho Department of Fish and Game personnel are available upon request.

Partner	Cash	In-Kind	Total
British Columbia MNRO			
Cash	$90,050		$90,050
In-Kind		$24,905	$24,905
Kalispel Tribe			
Personnel		$30,360	$30,360
Travel		$2,224	$2,224
Equipment		$4,300	$4,300
Idaho Fish and Game			
Personnel	$7,497		
Operating	$7,497		
Volunteers		$81,366	
Equipment Use		$8,592	
Office Space		$4,500	
Cold Storage		$2,250	
Employee Housing		$25,350	
Friends SP Wilderness			
Personnel		$10,060	$10,060
Volunteers		$26,702	$26,702
Vehicle Miles		$1,562	$1,562
Equipment		$16,740	$16,740
SOLE			
Volunteers		$10,447	$10,447
Vehicle Miles		$232	$232
Equipment		$192	$192
Idaho Conservation League			
Personnel		$240	$240
Other		$1,538	$1,538
Washington DFW			
Personnel		$948	$948
Travel		$169	$169
CDA Tribe			
Personnel		$3,850	$3,850
Vehicle Miles		$450	$450
Office of Species Conservation			
Personnel		$940	$940
Operating		$441	$441
Idaho Department of Lands			
Personnel		$611	$611
Sam Cushman			
House Donation		$4,000	$4,000
Hancock Corporation			
Personnel		$510	$510
Operating		$54	$54
Potlatch Corporation			
Salary and Benefits		$2,000	$2,000
Total = $370,577	**$105,043**	**$265,534**	**$370,577**

Table 1. Cash and In-Kind contributions to the Multi-species Baseline Initiative during Idaho fiscal year 2014.

File #: 78640-01

July 14, 2014

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Avenue
Coeur d' Alene ID 83815

Dear Michael:

RE: Competitive State Wildlife Grant Project

This letter is to document the non-federal match that BC Fish & Wildlife Branch and our partners have contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from November 1, 2013 and June 1, 2014."

Central Selkirks Wolverine inventory:

Cash contribution from Fish and Wildlife Branch = $32,000
Government in-house costs (salary, vehicles, etc) = $22,500
Columbia Basin Trust Environmental Initiatives Grant = 24,905
Fish and Wildlife Compensation Program = 35,550

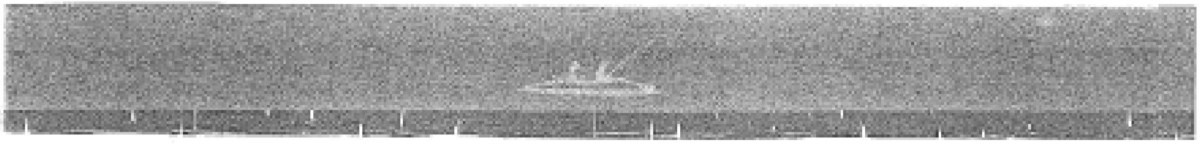
Total contribution for July 1 2012 and June 1 2013 = $114,955.00 CDN

Sincerely,

Garth Mowat
Head-Natural Resource Science & Stewardship Section

GM:ar

Ministry of Forests, Lands and Natural Resource Operations
Resource Management Kootenay-Boundary
Mailing/Location Address: #401 333 Victoria Street Nelson BC V1L 4K3
Telephone: 250 354-6142
Facsimile: 250 354-6332
Website: www.env.gov.bc.ca/fw



Kalispel Tribe of Indians
P.O. Box 39
Usk, WA 99180

(509) 445-1147
(509) 445-1705 fax
www.kalispeltribe.com

July 18, 2014

Michael Lucid
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

RE: MBI Match Letter

Dear Michael,

This letter is to document the non-federal match the Kalispel Tribe has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2013 to June 1, 2014.

The following list summarizes our In-Kind contributions:

Salary and Fringe	$30,360
Travel	$2,224
Equipment	$4,300
Total	**$36,884**

Please let us know if there is anything else we can help you with.

Sincerely,

Deane Osterman
Executive Director of Natural Resources
Kalispel Tribe of Indians

IDAHO DEPARTMENT OF FISH AND GAME
PANHANDLE REGION
2885 West Kathleen Avenue
Coeur d'Alene, Idaho 83815

C.L. "Butch" Otter / Governor
Virgil Moore / Director

This letter is a summary of the non-federal match contributed by the Idaho Department of Fish and Game (IDFG) to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' (MBI) during the 2014 State of Idaho Fiscal Year 2014 (July 1, 2013-June 30, 2014).

A non-federal cash contribution of $14,993 dollars was made from IDFG budget 48112.

Seven volunteer interns contributed 3,379 hours of labor at the wildlife technician level. Duties included participating in training, conducting forest carnivore surveys, building forest carnivore traps, deploying forest carnivore traps, and maintaining forest carnivore traps. Volunteer hours were calculated at the mid-line level for a paid IDFG wildlife technician: $24.08 per hour (salary plus benefits). Signed volunteer time cards are available upon request.

Item	Type	Unit Type	Quantity	Unit Value	Total Value
Budget 48112	Cash		1	$14,993.00	$14,993
Volunteer Carl Nelson	In Kind	Hour	247.25	$24.08	$5,954
Volunteer Torren Johnson	In Kind	Hour	432.5	$24.08	$10,415
Volunteer Casey Costello	In Kind	Hour	489	$24.08	$11,775
Volunteer Brian Malloure	In Kind	Hour	494	$24.08	$11,896
Volunteer Casey McCormack	In Kind	Hour	584	$24.08	$14,063
Volunteer Benjamin Goodheart	In Kind	Hour	588	$24.08	$14,159
Volunteer Elizabeth Hurkes	In Kind	Hour	544.25	$24.08	$13,106
Backcountry Ski Package	In Kind	Day	125	$36.00	$4,500
Avalanche Safety Package	In Kind	Day	186	$22.00	$4,092
Waterlife Discovery Center:Office Space	In Kind	Month	6	$750.00	$4,500
Waterlife Disc. Center:Trailer Hook-up	In Kind	Month	3	$450.00	$1,350
Thompson Lake Housing	In Kind	Month	36	$500.00	$18,000
Bismark Cabin Housing	In Kind	Month	12	$500.00	$6,000
Mullan Freezer	In Kind	Month	9	$250.00	$2,250
Total					**$137,051**

Volunteers used their own backcountry skiing equipment to access survey locations. Local rental rates from the North Idaho College Outdoor Pursuits Rental Program <www.nic.edu/op/> were used to calculate the daily value of a backcountry ski set-up and the value of an avalanche safety gear package. Each ski set-up includes daily rental rates for telemark or AT skis ($16), telemark or AT boots ($10), climbing skins ($8), and ski poles ($2) for a total match value of $36 per day of use of a backcountry ski set-up. Avalanche safety gear includes the use of a transceiver, shovel, and probe for a total daily rental value of $22. Volunteer time cards which document gear use are available upon request.

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http://fishandgame.idaho.gov

IDAHO DEPARTMENT OF FISH AND GAME
PANHANDLE REGION
2885 West Kathleen Avenue
Coeur d'Alene, Idaho 83815

C.L. "Butch" Otter / Governor
Virgil Moore / Director

Several IDFG properties, which were not purchased with federal funds, were used to support the project. The Waterlife Discovery Center was used as office space and assigned a value of $750. This value was determined by searching Craigslist for office space in the local area and picking an average price for a similar size office. The Waterlife Discovery Center was also used as employee housing in the form of a house-trailer hook-up site. The $450 hook-up fee is the same rate charged for a hook-up at the Hi Dee Ho Trailer Park in Ponderay, Idaho. The Thompson Lake House and Bismark Cabin were used as employee and volunteer housing. It would cost approximately $500 per month to rent local housing for each personnel so a value of $500 was assigned for each month an employee or volunteer used one of the units. The Mullan Freezer was used as cold storage for beaver carcasses and assigned the value it would cost to rent a cold storage unit: $250 per month.

The total non-federal match for this agreement for Idaho Fiscal Year 2014 is **$137,051.**

Sincerely,

Michael Lucid
Regional Wildlife Diversity Biologist
michael.lucid@idfg.idaho.gov
(208) 830-1451

Friends of Scotchman Peaks Wilderness

www.ScotchmanPeaks.org

FSPW
PO Box 2061
Sandpoint, ID 83864

Aug 1st, 2014

Dear Michael,

This letter is to document the non-federal match the Friends of Scotchman Peaks Wilderness has contributed to the Competitive State Wildlife Grant Project ***"Multi-species Baseline Initiative"*** from June 2, 2013 and June 30, 2014.

The following list summarizes our In-Kind contributions:

Contribution	Number	Unit Value		Total Value
Volunteer Hours At Biologist rate	451	37.85	$	17,070.35
Volunteer Hours at Tech Rate	400	24.08	$	9,632.00
FSPW Staff Coordination	430	16	$	6,880.00
FSPW Staff Planning and Supervisory	120	26.5	$	3,180.00
Car Miles	2663	0.55	$	1,464.65
Snowmobile Miles	65	1.5	$	97.50
Day Use of Ski Package	34	26	$	884.00
Day Use of Snowshoe Package	75	12	$	900.00
Day Use of Avalanche Safety Equipment	8	32	$	256.00
Value of Camera Gear for Stations	21	700	$	14,700.00
Total			**$**	**55,064.50**

Please let me know if I can provide any other information,

Best Regards,

Philip J. Hough

Phil Hough
Executive Director

Michael Lucid
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d'Alene, Idaho 83815

Dear Michael,

This letter is to document the non-federal match Selkirk Outdoor Leadership and Education (SOLE), Inc. has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2013 and June 1, 2014.

The following list summarizes our In-Kind contributions:

Contribution	Number	Unit Value	Total Value
Volunteer Hours	276	37.85	10,446.60
Car Miles	424	0.55	232
Snowmobile Miles	0	1.5	0
Day Use of Ski Package	0	26	0
Day Use of Snowshoe Package	16	12	192
Day Use of Avalanche Safety Equipment	0	32	0
Dennison Webb Salary	0	0	0
Dennison Webb Benefits	0	0	0
Total			10870.60

Sincerely,

Dennison Webb, M.A.
Executive Director

www.idahoconservation.org

Idaho Conservation League

PO Box 2308, Sandpoint, ID 83864
208.265.9565

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

July 24, 2014

Subject: In-Kind Contributions to the Multispecies Baseline Initiative

Dear Mr. Lucid:

This letter is to document the non-federal match the Idaho Conservation League has contributed to the Competitive State Wildlife Grant Project "Multi-species Baseline Initiative" from July 1, 2013 through June 1, 2014.

The following list summarizes our in-kind contributions:

- Staff time - $240
- Other - $1,538
- **Total - $1,178**

It has been our pleasure to partner with the Idaho Fish and Game on the Multispecies Baseline Initiative. We look forward to future opportunities to work together.

Sincerely,

Brad Smith
Conservation Associate

State of Washington
DEPARTMENT OF FISH AND WILDLIFE
2315 N. Discovery Place • Spokane Valley, WA 99216-1566 • (509) 892-1001 • (509) 921-2440 FAX

July 22, 2014

Michael Lucid
Regional Wildlife Biologist
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d'Alene, ID 83815

Dear Michael,

This letter is to document the non-federal match the Washington Department of Fish and Wildlife has contributed to the Competitive State Wildlife Grant Project "Multi-species Baseline Intitiative" from June 2, 2013 to June 30, 2014.

The following summarizes our In-Kind contributions:

WDFW participation in Annual MBI meeting
Regional Wildlife Program Manager Kevin Robinette, Spokane, WA
Salary and Benefits (1 day): $421.33
Assistant District Wildlife Biologist Annemarie Prince, Colville, WA
Salary and Benefits (1 day): $263.45
State Vehicle Mileage ($208 mi @ $0.42/mi): $87.36

WDFW Participation in Field Activities with Kalispel Tribe
Assistant District Wildlife Biologist Annemarie Prince, Colville, WA:
Salary and Benefits (1 day): $263.45
State Vehicle Mileage (195 mi @ $0.42/mi): $ 81.90

Total Contribution: $1117.49

Sincerely,

Kevin Robinette
Regional Wildlife Program Manager

COEUR D'ALENE TRIBE
850 "A" STREET
P.O. BOX 408
PLUMMER, IDAHO 83851
(208) 686-1800 FAX (208) 686-1182

REFERENCE:

July 16, 2014

Michael Lucid
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d'Alene, ID 83815

Dear Michael,

This letter is to document the non-federal match the Coeur d'Alene Tribe has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from June 2, 2013 to June 30, 2014. The following list summarizes our In-Kind contributions:

Labor Cost:	$3,850
Use of 4WD vehicle:	$450
Total:	**$4,300**

Please let me know if you have any questions. We are looking forward to the continued cooperation between the Tribe and IDFG on this valuable project.

Sincerely,

Cameron Heusser
Wildlife Program Manager, Coeur d'Alene Tribe

OFFICE OF SPECIES CONSERVATION

C.L. "BUTCH" OTTER
Governor

DUSTIN T. MILLER
Administrator

P.O. Box 83720
Boise, Idaho 83720-0195

304 North Eighth Street, Suite 149
Boise, Idaho 83702

July 15, 2014

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

Dear Michael,

This letter is to document non-federal match contributed by the Idaho Office of Species Conservation towards the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2013 to June 30, 2014.

The following list summarizes our In-kind contributions:

Personnel Costs:	$940
Operating Costs:	$441
Total:	$1381

Sincerely

Dustin T. Miller
Administrator

• (208) 334-2189 • Fax (208) 334-2172 •

COEUR D'ALENE ADMINISTRATION
3284 W Industrial Loop
Coeur d'Alene ID 83815
Phone (208) 769-1525
Fax (208) 769-1524

IDAHO DEPARTMENT OF LANDS

TOM SCHULTZ, DIRECTOR
EQUAL OPPORTUNITY EMPLOYER

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Ben Ysursa, Secretary of State
Lawrence G. Wasden, Attorney General
Brandon Woolf, State Controller
Tom Luna, Supt. of Public Instruction

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

Dear Michael,

This letter is to document the non-federal match the Idaho Department of Lands has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from June 1, 2013 to June 30, 2014.

The following list summarizes our In-Kind contributions:

Item	Amount
Personnel	$610.79

Please let me know if any additional information is required.

Sincerely,

Patrick Seymour
Endangered Species Program Manager

Dear Michael,

I am pleased to report the donation of the use of my house at 629 Smith Creek Road in Bonners Ferry, Idaho for use at no charge as in-kind non-federal match to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative'. I report the value of this donation as the following:

Housing for two employees (John and Amanda) for four months (June to October 2013) at $500 each per month for a total of $4000.

Total value of the contribution is $4,000.

Best of luck getting this exciting field season completed

Cheers

Sam Cushman
629 Smith Creek Rd
Bonners Ferry, ID
83805

Hancock Forest Management
A Division of Hancock Timber Resource Group, A Manulife Asset Management Company

July 30, 2014

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Fish and Game
2885 W. Kathleen Avenue
Coeur d'Alene, ID 83815

RE: IDFG Multi-species Baseline Initiative project- summary of in-kind contributions

Dear Michael,
This letter is to document non-federal match contributed by Hancock Forest Management towards the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2013 to June 30, 2014.

The following list summarizes our in-kind contributions:

Personnel costs:	$ 510.30
Operating costs:	$ 54.00
Total:	$ 564.30

Sincerely,

Gretchen Lech
Wildlife Biologist

Hancock Forest Management
3918 N. Schreiber Way, Suite 100
Coeur d'Alene, ID 83815
(208) 292-2462 x105
(208) 660-3340 (mobile)

cc: David Gabrielsen, HFM
Scott Ketchum, HFM

Potlatch

Potlatch Forest Holdings, Inc.

A WHOLLY OWNED SUBSIDIARY OF
POTLATCH CORPORATION

301 D Street
Lewiston, ID 83501

www.potlatchcorp.com

July 22, 2014

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

Dear Michael.

This letter is to document non-federal match contributed by Potlatch towards the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from June 2, 2013 to June 30, 2014.

The following list summarizes our In-kind contributions:

Personnel Costs: $2000.00

Sincerely,

T. W. Cundy

Terrance W. Cundy
Manager – Silviculture, Wildlife and Environment
Potlatch Forest Holdings, Inc.
301 D Street
Lewiston, ID 83501

208-748-2032
208-301-0410 cell
Terry.Cundy@potlatchcorp.com

1

Multi-species Baseline Initiative

Non-Federal Match Report

Fiscal Year 2013

Compiled by Michael Lucid Regional Wildlife Diversity Biologist
Idaho Department of Fish and Game
2885 Kathleen Ave. Coeur d' Alene, Idaho 83815

Volunteer Citizen Naturalists contributed 2190.5 hours and 10,781 vehicle miles the project during FY13.

This document summarizes $398,294 in non-federal contributions to the Competitive State Wildlife Grant project 'Multi-species Baseline Initiative' for Idaho Fiscal Year 2013 (July 1, 2012-June, 30 2013).

Contained herein are:
1) Summary table of match contributions by partner organization or individual.
2) Letters from each partner organization or individual which summarize match contributions for those entities.

Individual volunteer time cards and mileage reports for volunteers directly supervised by Idaho Department of Fish and Game personnel are available upon request.

Partner	Cash	In-Kind	Total
British Columbia MNRO			
Cash	$102,780		$102,780
In-Kind		$24,000	$24,000
Kalispel Tribe			
Salaries+Benefits		$32,845	$32,845
Travel		$5,646	$5,646
Equipment		$3,472	$3,472
Idaho Fish and Game			
Salaries	$7,493		$7,493
Operating	$7,500		$7,500
Volunteers		$22,402	$22,402
Vehicle Miles		$3,640	$3,640
Office Space		$4,500	$4,500
Storage		$3,600	$3,600
Cold Storage		$1,750	$1,750
Employee Housing		$10,200	$10,200
Friends SP Wilderness			
Salaries		$9,228	$9,228
Volunteers		$43,751	$43,751
Vehicle Miles		$4,367	$4,367
Equipment		$21,544	$21,544
SOLE			
Volunteers		$12,112	$12,112
Vehicle Miles		$302	$302
Equipment		$240	$240
Idaho Conservation League			
Salaries		$1,540	$1,540
Volunteers		$2,464	$2,464
Vehicle Miles		$240	$240
Equipment		$156	$156
Other		$1,873	$1,873
Washington DFW			
Salaries and Benefits		$1,194	$1,194
Travel		$514	$514
CDA Tribe			
Salaries and Benefits		$17,328	$17,328
Vehicle Miles		$4,193	$4,193
University of Idaho			
Salary and Benefits		$13,076	$13,076
Tuition Waiver		$4,690	$4,690
Equipment		$2,109	$2,109
Office of Species Conservation			
Salary and Benefits		$909	$909
Operating		$1,395	$1,395
Idaho Department of Lands			
Salary and Benefits		$8,930	$8,930
Vehicle Miles		$1,495	$1,495
Travel		$1,197	$1,197
Equipment		$224	$224
Sam Cushman			
House Donation		$13,396	$13,396
Total = $398,294	$117,773	$280,521	$398,294

Table 1. Cash and In-Kind non-federal contributions during Fiscal Year 2013.

Kalispel Tribe of Indians
P.O. Box 39
Usk, WA 99180

(509) 445-1147
(509) 445-1705 *fax*
www.kalispeltribe.com

June 17, 2013

Michael Lucid
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

RE: MBI Match Letter

Dear Michael,

This letter is to document the non-federal match the Kalispel Tribe has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2012 and June 1, 2013.

The following list summarizes our In-Kind contributions:

Salary and Fringe	$32,845
Travel	$5,646
Equipment	$3,472
Total	**$41,963**

Please let us know if there is anything else we can help you with.

Sincerely,

Deane Osterman
Executive Director of Natural Resources
Kalispel Tribe of Indians

BRITISH
COLUMBIA

File: 78640-35/Wolverines

June 7, 2013

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene ID 83815
USA

Dear Michael:

This letter is to document the non-federal match that BC Fish & Wildlife Branch and our partners have contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from November 1, 2012 and June 1, 2013.

South Purcell and South Selkirks Wolverine inventory:

Cash contribution from Fish and Wildlife Branch = $46,000
Grant from The Wolverine Foundation = $7,600
Government in-house costs (salary, vehicles, etc) = $24,000
Columbia Basin Trust Environmental Initiatives Grant = 49,180

Total contribution for July 1, 2012 and June 1, 2013 = $126,780.00 CDN

Sincerely,

Garth Mowat

Garth Mowat
Head-Natural Resource Science & Stewardship Section
Ph. (250) 354 6142
Email: garth.mowat@gov.bc.ca

Ministry of Forests, Lands and Natural Resource Operations
Resource Management Kootenay-Boundary
Mailing/Location Address: #401 333 Victoria Street Nelson BC V1L 4K3
Telephone: 250 354-6333
Facsimile: 250 354-6332

IDAHO DEPARTMENT OF FISH AND GAME
PANHANDLE REGION
2885 West Kathleen Avenue
Coeur d'Alene, Idaho 83815

C.L. "Butch" Otter / Governor
Virgil Moore / Director

This letter is a summary of the non-federal match contributed by the Idaho Department of Fish and Game (IDFG) to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' (MBI) during the 2013 Idaho Fiscal Year 2013 (July 1, 2012-June 30, 2013).

Seventy IDFG volunteers contributed 705.5 hours to MBI. Their hours were valued at the cost a benefitted IDFG employee would be compensated for work of a similarcomplexity at the technician, utility craftsman, regional biologist, or staff biologist level. The $80 per hour rate is for complex morphological taxonomy work. This value is equivalent to what commercial laboratories charge for similar work. Vehicle miles are valued at the IDFG re-imbursement rate. Volunteer time sheets and mileage reports are included in the FY13 MBI Match Report.

IDFG facilities were used for the project for employee housing, office space, storage, and cold storage. Values were calculated by comparing to rates charged by local businesses for similar products.

Item	Type	Unit Type	Quantity	Unit Value	Total Value
Budget 48112	Cash		1	$14,993.00	$14,993.00
Volunteer Time	In Kind	Hour	388	$24.08	$9,343.04
Volunteer Time	In Kind	Hour	166.5	$30.65	$5,103.23
Volunteer Time	In Kind	Hour	34	$37.85	$1,286.90
Volunteer Time	In Kind	Hour	71.5	$42.36	$3,028.74
Volunteer Time	In Kind	Hour	45.5	$80.00	$3,640.00
Vehicle Miles	In Kind	Mile	2659	$0.55	$1,462.45
Employee Housing	In Kind	Month	24	$425.00	$10,200.00
Monthly Office Space	In Kind	Month	6	$750.00	$4,500.00
Mullan Freezer	In Kind	Month	7	$250.00	$1,750.00
Smith Creek Storage	In Kind	Month	12	$300.00	$3,600.00
Total					**$58,907.36**

Please feel free to contact me if there are any questions.

Sincerely,

Michael Lucid
Regional Diversity Biologist
(208) 830-1451, michael.lucid@idfg.idaho.gov

Keeping Idaho's Wildlife Heritage

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www.ScotchmanPeaks.org

FSPW
PO Box 2061
Sandpoint, ID 83864

Friends of Scotchman Peaks Wilderness

June 24th, 2013

Dear Michael,

This letter is to document the non-federal match the Friends of Scotchman Peaks Wilderness has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2012 and June 1, 2013.

The following list summarizes our In-Kind contributions:

Contribution	Number	Unit Value		Total Value
Volunteer Hours At Biologist rate	1140	37.85	$	43,149.00
Vol Hours at Tech Rate	25	24.08	$	602.00
FSPW Staff Coordinator	320	16	$	5,120.00
FSPW Staff Planning and Supervisory	155	26.5	$	4,107.50
Car Miles	7580	0.55	$	4,169.00
Snowmobile Miles	132	1.5	$	198.00
Day Use of Ski Package	48	26	$	1,248.00
Day Use of Snowshoe Package	95	12	$	1,140.00
Day Use of Avalanche Safety Equipment	8	32	$	256.00
Value of Camera Gear for Stations	27	700	$	18,900.00
Total			**$**	**78,889.50**

Please let me know if I can provide any other information,

Best Regards,

Philip J. Hough

Phil Hough
Executive Director

Selkirk Outdoor Leadership & Education
Immersing individuals in their natural learning environment!

Michael Lucid
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d'Alene, Idaho 83815

Dear Michael,

This letter is to document the non-federal match Selkirk Outdoor Leadership and Education (SOLE), Inc. has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2012 and June 1, 2013.

The following list summarizes our In-Kind contributions:

Contribution	Number	Unit Value	Total Value
Volunteer Hours	320	37.85	12,112.00
Car Miles	330	0.55	181.50
Snowmobile Miles	80	1.5	120.00
Day Use of Ski Package	0	26	0
Day Use of Snowshoe Package	20	12	240
Day Use of Avalanche Safety Equipment	0	32	0
Dennison Webb Salary	0	0	0
Dennison Webb Benefits	0	0	0
Total	750		12653.50

Sincerely,

Dennison Webb, M.A.
Executive Director

Explore > Achieve > Lead

Selkirk Outdoor Leadership & Education (SOLE), Inc. • 1255 Meadowood Road • Sandpoint, Idaho 83864
928.351.SOLE • info@soleexperiences.org • www.soleexperiences.org

www.idahoconservation.org

Idaho Conservation League

PO Box 2308, Sandpoint, ID 83864
208.265.9565

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

June 7, 2013

Subject: In-Kind Contributions to the Multispecies Baseline Initiative

Dear Mr. Lucid:

Since 1973, the Idaho Conservation League has been Idaho's voice for clean water, clean air and wilderness—values that are the foundation for Idaho's extraordinary quality of life. The Idaho Conservation League works to protect these values through public education, outreach, advocacy and policy development. As Idaho's largest state-based conservation organization, we represent over 25,000 supporters, many of whom have a deep personal interest in protecting human health and the environment.

This letter is to document the non-federal match the Idaho Conservation League has contributed to the Competitive State Wildlife Grant Project "Multi-species Baseline Initiative" from July 1, 2012 through June 1, 2013.

The following list summarizes our in-kind contributions:

- Staff time - $1,540
- Volunteer time - $2,464
- Travel - $325
- Snowmobile travel - $240
- Equipment - $156
- Other - $1,548
- **Total - $6,273**

It has been our pleasure to partner with the Idaho Department of Fish and Game on the Multispecies Baseline Initiative. We believe this endeavor will contribute greatly to the conservation of native wildlife in northern Idaho.

Sincerely,

Brad Smith
Conservation Associate

State of Washington
Department of Fish and Wildlife

Mailing Address: 600 Capitol Way N, Olympia WA 98501-1091, (360) 902-2200, TTY (800) 833-6388
Main Office Location: Natural Resources Building, 1111 Washington Street SE, Olympia WA

June 17, 2013

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

Dear Michael,

This letter is to document the non-federal match the Washington department of Fish and Wildlife has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2012 to June 1, 2013.

The following list summarizes our In-Kind contributions from July 1, 2012 to June 1, 2013:

WDFW participation in Annual MBI Meeting:

- Endangered Species Section Manager; Olympia, WA:
  - Salary & benefits (2 days): $798
  - Travel (flight, per diem & lodging): $400
  - Total = $1,198
- WDFW District Biologist Dana Base; Colville, WA:
  - Salary & benefits (1.5 days): $396
  - Travel (208 mi x $.55/mi, per diem): $114
  - Total = $510
- Total Contribution = $1,708

Sincerely,

Harriet Allen, Manager
Endangered Species Section

COEUR D'ALENE TRIBE
850 "A" STREET
P.O. BOX 408
PLUMMER, IDAHO 83851
(208) 686-1800 FAX (208) 686-1182

REFERENCE:

June 10, 2013

Michael Lucid
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d'Alene, ID 83815

Dear Michael,

This letter is to document the non-federal match the Coeur d'Alene Tribe has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2012 to June 1, 2013. The following list summarizes our In-Kind contributions:

Labor Cost:	$17,328
Use of 4WD vehicle:	$3,675
Use of snowmobiles:	$518
Total:	**$21,520**

Please let me know if you have any questions. We are looking forward to the continued cooperation between the Tribe and IDFG on this valuable project.

Sincerely,

Cameron Heusser
Wildlife Program Manager, Coeur d'Alene Tribe

University of Idaho
College of Agricultural and Life Sciences

Department of Plant, Soil, and
Entomological Sciences
PO Box 442339
Moscow, Idaho 83844-2339

Phone: 208-885-6274
Fax: 208-885-7760
www.ag.uidaho.edu/pses

Mr. Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815
(208) 830-1451

20 June 2013

Dear Michael,

This letter is provided as documentation of the non-federal, in-kind and cash dollars that can be provided through the University of Idaho's Natural Resource Entomology laboratory to the following project: Multi-species Baseline Initiative.

My student, Laine Smith, is participating in the project by assisting with insect and gastropod taxonomy work. This will directly implement recommended conservation actions for 11 species of gastropod listed in the Idaho State Wildlife Action Plan and 1 species of gastropod listed in the Washington State Wildlife Action Plan.

The Natural Resource Entomology Laboratory has contributed the following non-federal in-kind support:

1. Out-of-state tuition waiver for graduate student Laine Smith ($13,076 for the 2012-2013).
2. $4,690 in salary and fringe benefit dollars. This is equivalent to 2 weeks of salary and benefits for myself to advise and work with the student during the 2012-2013 academic year.
3. We have provided the use of 38 Lindgren funnel traps (valued at $55.50 each) for a contribution equivalent to $2,109.

Therefore, the total contribution to this project in non-federal dollars is $19,875.

Sincerely,
Dr. Stephen Cook

Associate Professor of Entomology
University of Idaho
208-885-2722
stephenc@uidaho.edu

OFFICE OF SPECIES CONSERVATION

C.L. "BUTCH" OTTER
Governor

DUSTIN T. MILLER
Administrator

P.O. Box 83720
Boise, Idaho 83720-0195

304 North Eighth Street, Suite 149
Boise, Idaho 83702

June 15, 2013

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

Dear Michael,

This letter is to document non-federal match contributed by the Idaho Office of Species Conservation towards the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2012 to June 30, 2013.

The following list summarizes our In-kind contributions:

Personnel Costs:	$909.38
Operating Costs:	$1,394.58
Total:	$2,303.96

Sincerely

Dustin T. Miller

Dustin T. Miller
Administrator

• (208) 334-2189 • Fax (208) 334-2172 •

COEUR D'ALENE ADMINISTRATION
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IDAHO DEPARTMENT OF LANDS

TOM SCHULTZ, DIRECTOR
EQUAL OPPORTUNITY EMPLOYER

Michael Lucid
Regional Wildlife Biologist
Wildlife Diversity Program
Idaho Department of Fish and Game
2885 Kathleen Ave.
Coeur d' Alene, ID 83815

Dear Michael,

This letter is to document the non-federal match the Idaho Department of Lands has contributed to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative' from July 1, 2012 to June 1, 2013. We did not document any expense prior to December 1, 2012.

The following list summarizes our In-Kind contributions:

Item	Amount
Personnel	$8,930.41
Travel and Lodging	$1,197.00
Vehicles	$1,495.04
Equipment purchase	$ 223.76
TOTAL	$11,846.21

Please see the attached Project Transaction Report for additional detail. Please let me know if any additional information is required.

Sincerely,

Patrick Seymour
Endangered Species Program Manager

Dear Michael,

I am pleased to report the donation of the use of my house at 629 Smith Creek Road in Bonners Ferry, Idaho for use at no charge as in-kind non-federal match to the Competitive State Wildlife Grant Project 'Multi-species Baseline Initiative'. I report the value of this donation as the following:

Housing for two employees (John and Amanda) for two months (April-May). $500 each per month= $2000.
Housing for 16 employees for a 9 night training session, at a rate of $79 per night per person. 16 peoplex9nightsx$79= $11,396

Total value of the contribution is $13,396.

Best of luck getting this exciting field season completed

Cheers

Sam Cushman

Sam Cushman
629 Smith Creek Rd
Bonners Ferry, ID
83805

Appendix II. Gastropods - Multi-species Baseline Initiative

Appendix IIa: Protocols, Datasheets, and Supply Lists
Appendix IIb: Target Species Detection Data
AppendixIIc: Character Key

Appendix IIa: Protocols, Datasheets, and Supply Lists

Terrestrial Survey Protocol: 1st Visit to Site

TRANSECT LOCATION/DIRECTION

1) Travel to the assigned waypoint for the grid. If it is impossible to set transect up at site (cliff face, in water) move 50 meters north. If you can't go north go east, south, then west. If you cannot setup the transect 50 meters from assigned point; move 50 meters again as above. Continue until suitable spot is located.
2) Find a suitable tree within 40 meters of assigned point for climate logger (>12" diameter, a conifer, not whitebark pine, and in shady location). Place logger on north side of this tree. *If no trees, do not deploy logger.*
3) Write cell number in dry erase marker on 'begin' card. Take a picture of the paper. While standing at climate logger tree take three pictures facing 45°, 180°, and 315°, including notecard with bearing (write cell # on card) in photo. Label pictures C, cell #, P, bearing.

CLIMATE DATA LOGGER

1) **Record 10 digit serial number of data logger. DO NOT PRESS START button**. **If no logger is to be placed, still attach plastic cup to tree.**
2) Use aluminum nails to attach radiation shield cover to north side of tree about 5 feet off the ground.
3) Use 4" zip tie to attach data logger to top of 2 plate shield fairly tight.
4) Use three 8" zip ties to suspend the 2 plate shield from cover.
5) Photograph the radiation shield. Photo should show the surroundings of the shield. Label photo: C, cell #, P, T.
6) Use aluminum nail to place 9oz plastic cup to tree immediately above radiation shield.
7) Waypoint station and tie flag around tree above it. Label flag with cell #.

GASTROPOD TRAPS

1) Use compass to face 45° and run transect along this bearing.
2) The gastropod transect will begin 5 meters from the assigned waypoint (unless moved, then from the new point).
3) Use a zip lock bag to soak each trap in 12 oz. of natural ice beer.
4) Place traps 10 meters apart, corrugation down.
5) Pull leaf litter from floor, place trap directly on soil, put litter back on trap to retain moisture. Do not move litter more than a few inches to place on top of trap.
6) Waypoint only the first trap in transect, but flag each set.

BEETLES

1) One pitfall between each gastropod trap (3 total), 10 meters from each other/5 meters from gastropod traps).
2) Ensure top of pitfall is level with leaf litter surface (not soil surface), place bug strip in each pitfall.
3) Hang size 8 funnel trap from tree at end of transect 10meters from last pitfall. Hang about 10 feet high & away from tree trunk. Place bug strip in white collection container of funnel trap. Note species of tree you hang it on. If you don't know the species write unknown. If you know it's a fir, but not what kind of fir, write 'fir'.
4) Flag each pitfall and the funnel trap. Waypoint the funnel trap (taxa abbreviation IF) but not the pitfalls.

TIMED SEARCH

1) Conduct search within 50 meters of temp logger.

2) Spend 15 minutes searching for gastropods. Collect all gastropods in one vial.
3) Use pencil and designated paper to create label: 'C, xxx, GTS, Visit #', Date, Observer ex: **C142GTSV1, 15 JUNE 13, JJJ** = cell142, GTS, collected on 15 June 2011 by Jim John Jones on the first visit to the cell.
4) Pour water into each vial and allow to stand for at least 1 hour or until samples are dead.
5) Pour water off, being careful not to lose specimens, and fill vial with enough 70% Ethanol to cover samples.
6) Collect a tissue sample from the first two individuals of each amphibian species you encounter. Clip one digit (digit 3 or 5 is best) from hind foot. <u>Between each sample wipe scissors with bleach. Use alcohol wipe to clean hands before handling amphibian.</u>

<u>INCIDENTAL OBSERVATIONS</u>

1) If bumblebees are encountered during survey spend 5 minutes attempting to photograph individuals. If *western* bumble bee is seen spend up to 15 minutes attempting to photograph.
2) Watch and listen for other target animals as you conduct the survey. Note as directed on data sheet.

AT END OF SURVEY WRITE THE CELL NUMBER ON 'END' LAMINATED CARD. TAKE A PICTURE. THIS SHOULD BE THE LAST PICTURE YOU TAKE AT THE CELL.

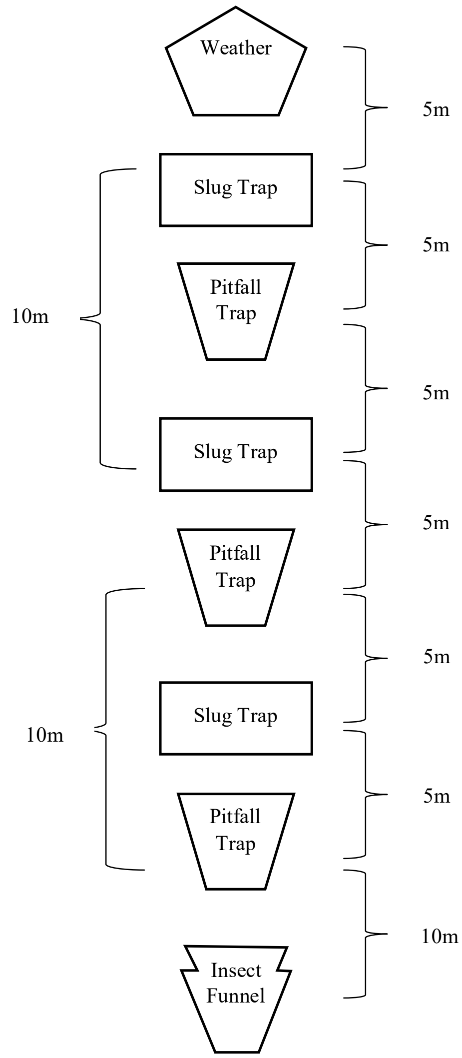


Figure 1: Schematic of Terrestrial Trap Transect

Terrestrial Survey Protocol: 2nd Visit to Site

CLIMATE STATION

1) Carefully remove cup from tree. Measure amount of water by pouring through strainer into graduated cylinder.

SLUG TRAP TRANSECT

1) Use hand lens to examine each trap. Remove all gastropods from each trap to a single glass vial.
2) Each trap gets its own vial. ***There will be up to 3 vials for the entire transect.***
3) Label vial twice. Use sharpie to label lid and glass.
   Label will be as follows: C, xxx, Gastropod, trap type (M = micro, Na = naty ice a, Nb = naty ice b), Date, observer. Ex: **C142GM, 15 JUNE 13, JJJ** = cell142, Microbrew trap, collected on 15 June 2013 by Jim John Jones
4) On data sheet, note if trap is missing/unusable.
5) Pour water into each vial and allow to stand until samples are dead (usually about 1 hour).
6) Pour water off, being careful not to lose specimens, and fill vial ¾ full with 70% Ethanol. Use slip of cotton paper and pencil to create label to be placed inside vial at this time.

PITFALL TRANSECT

1) Remove pitfalls from ground, remove bug strip (place in zip lock bag for future use), and pour all samples into strainer. Use tweezers to remove samples from pitfalls if necessary.
2) Place samples into a single envelope and name sample as follows:
   C, xxx, **P**itfall ex: **C142PB** = samples from the pitfalls from cell142
3) Complete all envelope blanks. Allow envelopes to dry quickly as possible, keep in rigid container while in field.
4) Place any mammals in a vial and label **C142PM.** Preserve in 70% ethanol.
5) Place any gastropods in a vial and label **C142PG.** Preserve in 70% ethanol.

FUNNEL TRAP

1) Remove white collection chamber from trap and place bug strip in zip lock bag for re-use.
2) Place samples into a single envelope and name sample as follows:
   a. FIA, xxx, Funnel ex: **FIA142IF** = samples collected from the funnel trap in cell 142
3) Fill in all blanks on envelope. Make sure to fill out Latitude and Longitude.
4) Allow envelopes to dry as quickly as possible and store in rigid container while in field.

LEAF LITTER SAMPLES

1) Sample 3 sites in the 5 meters adjacent to each slug trap.
2) Use trowel to dig 10cm into the leaf litter and put about 1/3 of a quart of litter into quart Ziploc.
3) Do **not** collect soil. If litter is not 10cm use trowel to scrape enough litter together to collect 1/3 quart.
4) After sampling 3 sites, you will have a nearly full ***QUART*** Ziploc bag, label it as follows:
   a. C, xxx, LL, Date, Observer, ex: **C142LL, 15 June 13, JJJ**
5) Write sample name ***directly on bag with sharpie and on piece of paper inside baggie***.
6) Keep protected from heat and sun while in field. Place in freezer when you return from the field.

TIMED SEARCH

1) Conduct search within 50 meters of temp logger.
2) Spend 15 minutes searching for gastropods. Collect all gastropods in vial.
3) Use pencil and designated paper to create label: 'C, xxx, GTS, Visit #', Date, Observer ex: **C142GTSV2, 15 JUNE 13, JJJ** = cell142, GTS, collected on 15 June 2013 by Jim John Jones on the second visit to the cell.

4) Pour water into each vial and allow to stand for at least 1 hour or until samples are dead.
5) Pour water off, being careful not to lose specimens, and fill vial with enough 70% Ethanol to cover samples. Use slip of cotton paper and pencil to create label to be placed inside vial at this time.
6) Collect a tissue sample from the first two individuals of each amphibian species you encounter. Wipe hands with alcohol before handling. Clip one digit (digit 3 or 5 is best) from hind foot. Between each sample wipe scissors with cotton (your shirt) then a bleach wipe.

INCIDENTAL OBSERVATIONS

1) If bumblebees are encountered during survey spend 5 minutes attempting to photograph individuals. If *western* bumble bee is seen spend up to 15 minutes attempting to photograph.
2) Watch and listen for other target animals as you conduct the survey. Note as directed on data sheet.

IF YOU TAKE PHOTOS AT THE SITE BEGIN AND END YOUR SERIES WITH A PHOTO OF A PIECE OF PAPER WITH: C, CELL NUMBER, BEGIN OR END.

Terrestrial Survey Data Sheet: 1st Visit to Site

Cell: ___________ Date (e.g. 15 June 2013):________________Start Time: _________ Observer(s):__________

Weather (circle one): Sunny Mostly Sunny Partly Sunny Overcast Light Rain Heavy Rain Snow

Plot Photo IDs (CxxxP bearing): 45°________ 180°_________ 315°__________

Directions to Plot:

____

____

____

Weather Station

Type of weather station (circle one): TRIX8 HAXO8 none

Waypoint Name (CxxxT): __________________ Weather Station Photo ID (CxxxPT):__________________

Lat. ___________________________ Long. ____________________ (WGS 84, decimal degrees)

Serial Number: _______________________________ **DO NOT PRESS START BUTTON!**

Logger Height (cm):______________ Shade metric (1-4):________

Slug n Bug Transect

	Waypoint ID (CxxG), (CxxIF)	Latitude (WGS 84, Decimal Degrees)	Longitude (WGS 84, Decimal Degrees)
1st Slug Trap:	______________________	______________________	______________________
Size 8 Funnel Trap:	______________________	______________________	______________________

Tree Species Funnel Trap Hung on ________________________

Type of Micro-brew ______________________

Slug traps placed in following order? Microbrew, Natural Ice, Natural Ice? □ 1st trap way-pointed? □

Pitfalls:
3 pitfalls placed 10 meters apart (in between slug traps)? □

15 Minute Timed Search

Sample name (CxxxGTSV1: write none if no sample collected) ____

Snails ___ # Slugs ___

Incidental Observations

Observed - Yes or No - do not take photo

Spotted Knapweed: ______

Tansy: ______ Devil's Club: _______

Whitebark Pine: ______

Observed - record number detected (0 if not detected) - do not take photo

E. Racer: ______ Rubber Boa: ______

W. Skink: ______ N. Alligator Lizard: ______

Red Squirrel: ________ T. Garter Snake: ______

C. Garter Snake: ______ Hoary Marmot: ____

Golden Mantled G.S.:_____

Yellow-bellied Marmot: ______ Pika: _________

Bumblebee Observed? (Y/N)_______

Western Bumblebee Observed? (Y/N)______
PhotoID: FIA, Cell# P, letter

Species	Photo ID

Observed - Yes or No

Rare Moonwort:______
Fill in table for each location species is observed.
PhotoID: FIA, Cell#, P, letter

Species	Latitude	Longitude	Photo ID

Amphibians Detected? Yes or No (circle one)

Tissue Samples
Sample ID: FIA, Cell#, T, Letter

Species	Stage	Sample ID

Terrestrial Survey Data Sheet: 2nd Visit to Site

Cell: ____________ Date (e.g. 15 June 2013):___________________Start Time: ______ Observer(s):__________

Weather (circle one): Sunny Mostly Sunny Partly Sunny Overcast Light Rain Heavy Rain Snow

Slug n Bug Transect

	Label*	OK? Y/N	# Slugs	# Snails
Slug A				
Slug B				
Slug C				
Pitfall - Bugs				
Pitfall - Gastropods				
Pitfall -Mammal				
Insect Funnel				
Time Search - Gastropod				
Time Search - Amphibian				
Tissue Sample				

*C, xxx, GM/GNa/GNb/PB/PG/PM/IF/GTSV2/T,letter, Date ex: **C142Ta, 15 JUNE 13, JJJ** = cell142, Tissue sample, first one, 6/15/2013 by Jim John Jones. Write NONE in label column if no specimens collected.

Leaf Litter

Ziploc Label: _______________ (C, xxx, LL, Date, Observer) ex: C142LL, 15 June 13, JJJ

Precipitation: ____________

Observed - Yes or No - do not take photo

Spotted Knapweed: ______

Tansy: ______ Devil's Club: _______

Whitebark Pine: ______

Observed - record number detected (0 if not detected) - do not take photo

E. Racer: ______ Rubber Boa: ______

W. Skink: ______

N. Alligator Lizard: ______ Red Squirrel: ________

T. Garter Snake: ______ C. Garter Snake: ______

Hoary Marmot: ____ Golden Mantled G.S._____

Yellow-bellied Marmot: ______ Pika: _________

Observed - Yes or No

Rare Moonwort: ______

Fill in table for each location species is observed.

Photo ID: C, xxx, P, letter

Species	Latitude	Longitude	Photo ID

Bumblebee Observed? (Y/N)_______

Western Bumblebee Observed? (Y/N)______

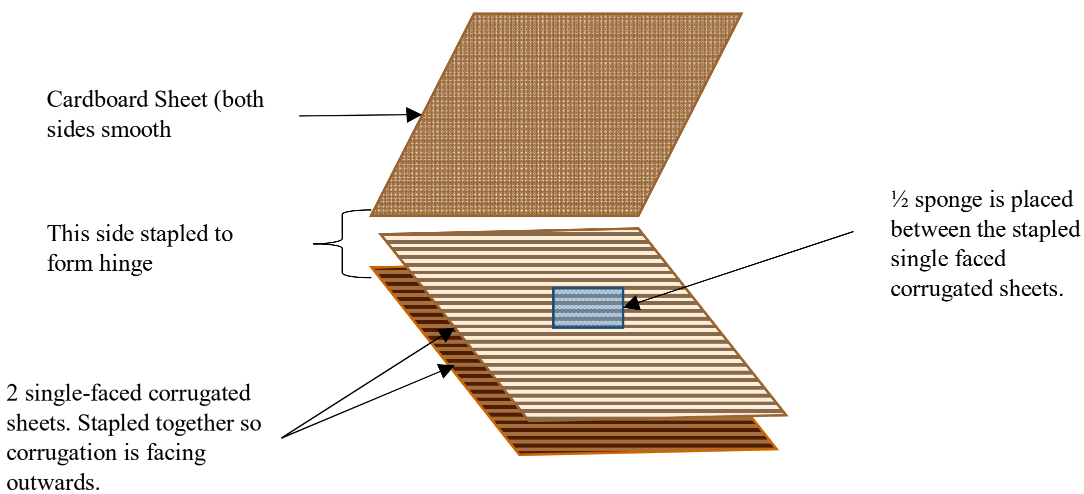
Photo ID: C, xxx, P, letter

Species	Photo ID

Terrestrial Survey Supply List

Cardboard Gastropod Traps

Item	Number/ trap	Supplier	Item #	Web Page
12x12 single wall corrugated cardboard	1	Boxforless	Css-1212	http://www.boxforless.com/
12x12 single face corrugated cardboard	2	Papermart	2631212	http://www.papermart.com/HOME
Sponges	½ sponge	Buythecase		Out of Business
2 Gallon zip top bags	1 per site	StockPkg	3675A	https://stockpkg.com/
Beer	1 (12 oz)			
Stapler/staples				



2 Diagram of Gastropod Cardboard Trap
Adapted from: Hawkins, J. W., M. W. Lankester, and R. R. A. Nelson. "Sampling terrestrial gastropods using cardboard sheets." Malacologia 39, no. 1-2 (1998): 1-9.

Pitfall Traps

Item	Number/trap	Supplier	Item #	Web Page
9oz plastic cups	1	Buythecase		Went out of business
No Pest Fumigant strip	1/8	Bioquip	1196	https://www.bioquip.com
Trowel	1 per person			

Insect Funnels

Item	Number/ site	Supplier	Item #	Web Page
Lindgren Funnel Trap 8 unit	1	Contech, Forestry Distributing		https://www.contech-inc.com/, http://www.forestrydistributing.com/en/v

Other Supplies for terrestrial surveys

Item	Number/ site	Supplier	Item #	Web Page
2 oz. glass vials	6	Carolina Biological Supply		http://www.carolina.com/
Vial Lids	6	Carolina Biological Supply		http://www.carolina.com/
Ethanol Laboratory grade 70%		Carolina Biological Supply	861285	http://www.carolina.com/
Cloth Paper (labels)				

Appendix II-b. Target Terrestrial SGCN Locations by Site. Location precision in meters. 1000 meter precision sites were fuzzed to comply with Memorandum of Agreement with US Forest Service. All detections occurred from 2010-2014. *OMG: Oh My Gastropod incidental detection.

State	Site ID	Latitude	Longitude	Precision
Cryptomastix mullani blandi				
ID	C1009	48.9239	-116.50269	10
WA	C28	48.5769	-117.09885	10
Kingston Oregonian *(Cryptomastix sanburni)*				
ID	C957T	47.9147	-116.46076	10
ID	C994T	47.9737	-116.41179	10
ID	C996T	48.0469	-116.44926	10
ID	FIA1039T	48.9747	-116.387862	1000
ID	FIA1082T	47.9872	-116.265985	1000
ID	C1083T	47.9086	-116.27842	10
ID	FIA1086T	48.2543	-116.262228	1000
ID	C1130T	47.8885	-116.22249	10
ID	C1133T	48.0274	-116.19963	10
ID	C1177T	47.8655	-116.16472	10
ID	C1179T	47.9884	-116.17278	10
ID	C1219T	47.7468	-116.09742	10
ID	C1224T	47.9513	-116.10488	10
ID	C1226T	48.0783	-116.10866	10
ID	C1267T	47.8657	-116.02312	10
ID	C1268T	47.9290	-115.99995	10
ID	C1397T	47.4766	-115.78541	10
ID	C1787T	47.1511	-115.27139	10
Pale Jumping Slug *(Hemphillia camelus)*				
ID	C60	48.5688	-116.98012	10
ID	C68	48.9474	-117.01467	10
ID	FIA83T	48.8878	-116.93711	1000
ID	C97	48.9961	-116.83905	10
ID	C113	48.9455	-116.81918	10
ID	CBIRDA	48.9585	-116.80732	10
ID	C114	48.9833	-116.79994	10
ID	C128	48.9175	-116.72707	10
ID	C130	48.9926	-116.70847	10
ID	C137	48.7682	-116.62206	10
ID	C138	48.8376	-116.63816	10
ID	C139	48.8617	-116.63552	10
ID	FIA140T	48.8868	-116.663248	1000
ID	C147	48.6504	-116.55515	10

State	Site ID	Latitude	Longitude	Precision
Fir Pinwheel (*Radiodiscus abietum*)				
ID	FIA56T	48.3928	-117.002243	1000
ID	FIA62T	48.6624	-116.997219	1000
ID	FIA63T	48.7081	-117.002552	1000
ID	FIA66T	48.8465	-116.999516	1000
ID	FIA67T	48.8916	-116.996843	1000
ID	C67	48.9033	-116.97359	10
ID	FIA75T	48.5310	-116.935999	1000
ID	FIA79T	48.7072	-116.927113	1000
ID	CBIRDD	48.7462	-116.91903	10
ID	C82	48.8675	-116.95735	10
ID	FIA85T	48.9747	-116.942999	1000
ID	FIA102T	48.4447	-116.797587	1000
ID	FIA106T	48.6193	-116.797559	1000
ID	C110	48.8239	-116.82346	10
ID	C113	48.9455	-116.81918	10
ID	C114	48.9833	-116.79994	10
ID	C115	48.3074	-116.71515	10
ID	FIA120T	48.5306	-116.728839	1000
ID	C121	48.5798	-116.74548	10
ID	C124	48.7090	-116.7362	10
ID	C126	48.8008	-116.74927	10
ID	C128	48.9175	-116.72707	10
ID	C130	48.9926	-116.70847	10
ID	C131	48.5157	-116.61585	10
ID	C132	48.5577	-116.62994	10
ID	C134	48.6485	-116.62385	10
ID	C135	48.6673	-116.62968	10
ID	C136	48.7304	-116.63422	10
ID	FIA137T	48.7830	-116.683394	1000
ID	C137	48.7682	-116.62206	10
ID	C138	48.8376	-116.63816	10
ID	C140	48.9147	-116.64793	10
ID	C142	48.9660	-116.64256	10
ID	C144	48.5163	-116.5836	10
ID	CBIRDH	48.5292	-116.56847	10
ID	C146	48.5764	-116.60416	10

ID	C150	48.7780	-116.5812	10
ID	C151	48.8051	-116.59937	10
ID	C154T	48.9663	-116.62474	10
ID	CBIRDF	48.7925	-116.52968	10
ID	C164	48.8428	-116.51527	10
ID	C167	48.6317	-116.46842	10
ID	C798	47.2795	-116.71259	10
ID	C833T	47.0849	-116.65096	10
ID	C1009	48.9239	-116.50269	10
ID	FIA1105T	48.9509	-116.341147	1000
ID	C1107	48.9911	-116.32935	10
ID	C1110T	46.9743	-116.18865	10
ID	FIA1152T	48.9346	-116.25041	1000
ID	C1152	48.8509	-116.23873	10
ID	C1155	48.9910	-116.23191	10
ID	C1245	48.9083	-116.12762	10
ID	C1246	48.9461	-116.09825	10
ID	C1256T	47.3666	-116.00431	10
ID	C1290	48.9009	-116.08475	10
ID	C1291	48.9634	-116.05133	10
ID	FIA1294T	47.1732	-115.947742	1000
ID	FIA1343T	47.3342	-115.835433	1000
ID	FIA1436T	47.1317	-115.743606	1000
ID	FIA1439T	47.4923	-115.745087	1000
ID	C1489T	47.0888	-115.65327	10
ID	FIA1539AT	47.0360	-115.554751	1000
ID	FIA1539BT	47.0769	-115.551759	1000
ID	C1693T	47.1595	-115.3912	10
ID	C1743T	47.1730	-115.32325	10
ID	OMG	48.9733	-116.56651	10
ID	OMG	48.8846	-116.75512	10
ID	OMG	48.9733	-116.56651	10
WA	C1B	48.6838	-117.29301	10
WA	C2	48.7118	-117.31126	10
WA	C4	48.7958	-117.32204	10
WA	C5	48.8394	-117.32135	10
WA	C8	48.7662	-117.25974	10
WA	C14	48.6774	-117.21956	10
WA	C16	48.7497	-117.20182	10
WA	C17	48.8197	-117.18701	10
WA	C19	48.8777	-117.18568	10
ID	C147	48.6504	-116.55515	10
ID	FIA148T	48.6634	-116.593183	1000
ID	C148	48.6816	-116.57518	10
ID	C153	48.9083	-116.59852	10
ID	C157	48.5712	-116.49681	10
ID	C158	48.6024	-116.49074	10
ID	C159	48.6330	-116.4845	10
ID	C160	48.6870	-116.54466	10
ID	C161	48.7229	-116.535	10
ID	C162	48.7894	-116.54322	10
ID	C170	48.7581	-116.46786	10
ID	C171	48.8258	-116.47504	10
ID	C658T	48.2721	-117.01922	10
ID	C679T	47.4620	-116.92207	10
ID	C687T	47.8255	-116.95383	10
ID	C696T	48.2027	-116.96566	10
ID	C714	47.2439	-116.83273	10
ID	C718T	47.3964	-116.883	10
ID	C734T	48.1403	-116.92153	10
ID	C755	47.2827	-116.80269	10
ID	C803T	47.5257	-116.72869	10
ID	C835	47.1754	-116.61438	10
ID	C846T	47.6946	-116.6487	10
ID	C850T	47.8516	-116.65674	10
ID	C885T	47.8603	-116.58985	10
ID	FIA897T	48.3961	-116.661916	1000
ID	C914T	47.5662	-116.54099	10
ID	FIA915T	47.5874	-116.533017	1000
ID	C917G	47.6956	-116.53991	10
ID	FIA925T	48.0382	-116.536107	1000
ID	C927	48.1451	-116.52519	10
ID	C929T	48.2278	-116.56417	10
ID	C933	48.4721	-116.6181	10
ID	FIA946T	47.4089	-116.471491	1000
ID	FIA952T	47.7211	-116.467897	1000
ID	C957T	47.9147	-116.46076	10
ID	C962T	48.1570	-116.5023	10
ID	C963T	48.1842	-116.47749	10
ID	C964T	48.2505	-116.50533	10
ID	C968T	48.4226	-116.53223	10
ID	C970	48.9992	-116.5194	10

WA	C20	48.9508	-117.21635	10
WA	C31	48.7320	-117.08286	10
WA	C32	48.7798	-117.09828	10
WA	C32T	48.7627	-117.10503	10
WA	C35	48.8863	-117.14512	10
WA	C48	48.7677	-117.06012	10
WA	C50	48.8546	-117.08501	10
WA	C52	48.9185	-117.05728	10
WA	C541T	48.5838	-117.26717	10
WA	C584	48.5648	-117.19656	10
WA	C584B	48.5873	-117.1638	10
MT	C1335	48.9102	-115.98798	10
MT	C1336	48.9783	-116.01607	10
MT	C1380	48.8791	-115.90718	10
MT	C1381	48.9392	-115.91329	10
MT	C1382	48.9566	-115.91598	10
MT	C1428	48.8929	-115.83614	10

Pygmy Slug (*Kootenaia burkei*)

ID	C67	48.9033	-116.97359	10
ID	C68	48.9474	-117.01467	10
ID	C70	48.3189	-116.91289	10
ID	C78	48.6826	-116.90975	10
ID	FIA79T	48.7072	-116.927113	1000
ID	CBIRDD	48.7462	-116.91903	10
ID	C82	48.8675	-116.95735	10
ID	FIA83T	48.8878	-116.93711	1000
ID	C85	48.9750	-116.93735	10
ID	C100	48.3726	-116.79894	10
ID	FIA102T	48.4447	-116.797587	1000
ID	C107	48.6922	-116.78345	10
ID	CBIRDA	48.9585	-116.80732	10
ID	C114	48.9833	-116.79994	10
ID	FIA120T	48.5306	-116.728839	1000
ID	C124	48.7090	-116.7362	10
ID	C126	48.8008	-116.74927	10
ID	C133	48.6038	-116.643	10
ID	C136	48.7304	-116.63422	10
ID	CLONG	48.7820	-116.64278	10
ID	C138	48.8376	-116.63816	10
ID	C143	48.4675	-116.59398	10
ID	FIA984T	47.6241	-116.401276	1000
ID	C986T	47.6027	-116.38471	10
ID	FIA987T	47.8054	-116.387315	1000
ID	FIA991T	47.8564	-116.404743	1000
ID	FIA992T	46.9931	-116.277376	1000
ID	C997T	48.1015	-116.42627	10
ID	C1000T	48.2544	-116.43076	10
ID	C1002	48.3045	-116.42525	10
ID	C1003	48.3777	-116.41978	10
ID	C1009	48.9239	-116.50269	10
ID	C1010	48.9153	-116.48537	10
ID	FIA1014T	47.1794	-116.34097	1000
ID	C1019	47.1895	-116.32082	10
ID	C1028T	47.6062	-116.30997	10
ID	C1030T	47.7027	-116.30411	10
ID	FIA1034T	47.9982	-116.339345	1000
ID	C1035T	47.9018	-116.31297	10
ID	C1037T	47.9987	-116.33989	10
ID	C1047	48.4688	-116.34369	10
ID	FIA1064T	47.6717	-116.257195	1000
ID	C1065T	47.1207	-116.26398	10
ID	FIA1084T	48.0791	-116.266486	1000
ID	C1085T	48.0226	-116.29716	10
ID	C1088T	48.1290	-116.25661	10
ID	C1093	48.3582	-116.31252	10
ID	FIA1095T	48.5686	-116.317224	1000
ID	C1114T	47.1477	-116.18073	10
ID	C1118	47.3384	-116.15659	10
ID	C1121T	47.4663	-116.17677	10
ID	C1124T	47.6023	-116.18623	10
ID	C1130T	47.8885	-116.22249	10
ID	FIA1131T	48.2607	-116.191294	1000
ID	C1132T	47.9822	-116.20507	10
ID	C1133T	48.0274	-116.19963	10
ID	C1135T	48.1076	-116.23762	10
ID	FIA1139T	48.5485	-116.229559	1000
ID	FIA1145T	48.8386	-116.253738	1000
ID	FIA1154T	47.0373	-116.07569	1000
ID	C1177T	47.8655	-116.16472	10
ID	FIA1178T	48.0293	-116.133979	1000

ID	C148	48.6816	-116.57518	10	ID	C1179T	47.9884	-116.17278	10
ID	C160	48.6870	-116.54466	10	ID	FIA1180T	48.2128	-116.124813	1000
ID	C658T	48.2721	-117.01922	10	ID	FIA1184T	48.3941	-116.192476	1000
ID	C687T	47.8255	-116.95383	10	ID	C1184	48.2114	-116.12885	10
ID	C693T	48.0792	-116.94012	10	ID	FIA1192T	48.7977	-116.185529	1000
ID	C801T	47.4312	-116.69407	10	ID	C1193	48.5983	-116.18767	10
ID	C804T	47.5350	-116.72623	10	ID	FIA1202T	47.1325	-116.077887	1000
ID	C808T	47.7338	-116.72274	10	ID	C1202	48.9863	-116.20116	10
ID	C817T	48.1387	-116.73561	10	ID	C1212T	47.4406	-116.06655	10
ID	C819T	48.2396	-116.77639	10	ID	FIA1217T	47.7006	-116.045439	1000
ID	C858T	48.2129	-116.6684	10	ID	FIA1220T	48.0329	-116.060846	1000
ID	C874	47.3654	-116.5549	10	ID	C1223T	47.9380	-116.07764	10
ID	C880T	47.6280	-116.58997	10	ID	FIA1225T	48.3026	-116.125201	1000
ID	C881T	47.7006	-116.62127	10	ID	FIA1234T	48.6187	-116.120983	1000
ID	C916T	47.6322	-116.5072	10	ID	C1237	48.5799	-116.08052	10
ID	C919T	47.7672	-116.51242	10	ID	C1237T	48.5603	-116.13025	10
ID	C921T	47.8536	-116.52312	10	ID	FIA1238T	48.6609	-116.121494	1000
ID	C928	48.1637	-116.54263	10	ID	FIA1242T	48.8407	-116.107903	1000
ID	C949T	47.5526	-116.45592	10	ID	FIA1259T	47.6752	-116.002594	1000
ID	C950T	47.6011	-116.48174	10	ID	C1261T	47.6029	-116.00623	10
ID	C951T	47.6690	-116.45661	10	ID	FIA1262T	47.0849	-115.881463	1000
ID	C955T	47.8269	-116.46606	10	ID	C1265T	47.7855	-116.02386	10
ID	C960T	48.0502	-116.45396	10	ID	C1266T	47.8504	-115.98571	10
ID	C961T	48.1178	-116.4933	10	ID	C1268T	47.9290	-115.99995	10
ID	C965T	48.2620	-116.49352	10	ID	C1283	48.6014	-116.06094	10
ID	FIA984T	47.6241	-116.401276	1000	ID	C1296	47.1736	-115.9111	10
ID	C989T	47.7408	-116.4172	10	ID	C1298	47.2747	-115.93307	10
ID	FIA992T	46.9931	-116.277376	1000	ID	C1299	47.3124	-115.92746	10
ID	C1031T	47.7216	-116.31543	10	ID	C1302T	47.4178	-115.90134	10
ID	FIA1032T	47.8996	-116.329311	1000	ID	C1304T	47.5275	-115.91911	10
ID	C1035T	47.9018	-116.31297	10	ID	C1306T	47.6228	-115.90109	10
ID	C1047	48.4688	-116.34369	10	ID	FIA1308T	47.1311	-115.879618	1000
ID	C1059	48.9861	-116.37689	10	ID	C1309T	47.7440	-115.94732	10
ID	FIA1079T	47.8130	-116.270498	1000	ID	C1310T	47.7909	-115.93855	10
ID	FIA1105T	48.9509	-116.341147	1000	ID	FIA1341T	47.2216	-115.877568	1000
ID	C1107	48.9911	-116.32935	10	ID	C1344	47.2509	-115.83355	10
ID	C1112T	47.0634	-116.18683	10	ID	C1349T	47.4713	-115.88203	10
ID	FIA1127T	47.9435	-116.197681	1000	ID	C1350T	47.5204	-115.88264	10
ID	C1129T	47.8317	-116.19109	10	ID	C1352T	47.5979	-115.88216	10
ID	C1135T	48.1076	-116.23762	10	ID	C1389T	47.1224	-115.75038	10
ID	C1146	48.5810	-116.23035	10	ID	FIA1392T	47.3112	-115.821424	1000

ID	FIA1159T	47.8509	-116.133505	1000
ID	C1172T	47.6591	-116.15993	10
ID	FIA1180T	48.2128	-116.124813	1000
ID	FIA1188T	48.4384	-116.193092	1000
ID	FIA1189T	48.5239	-116.183467	1000
ID	C1212T	47.4406	-116.06655	10
ID	FIA1213T	47.5864	-116.082996	1000
ID	FIA1216T	47.6737	-116.071336	1000
ID	C1223T	47.9380	-116.07764	10
ID	C1237	48.5799	-116.08052	10
ID	C1245	48.9083	-116.12762	10
ID	C1261T	47.6029	-116.00623	10
ID	C1264T	47.7341	-115.98169	10
ID	C1290	48.9009	-116.08475	10
ID	C1306T	47.6228	-115.90109	10
ID	C1352T	47.5979	-115.88216	10
ID	FIA1436T	47.1317	-115.743606	1000
ID	C1487T	46.9871	-115.67793	10
WA	C10	48.8391	-117.26163	10
WA	C20	48.9508	-117.21635	10
WA	C28	48.5769	-117.09885	10
WA	C29	48.6335	-117.10287	10
WA	C31	48.7320	-117.08286	10
WA	C42	48.4978	-117.05083	10
WA	C47	48.7198	-117.0612	10
WA	C540	48.5469	-117.24764	10
WA	C580T	48.3994	-117.17341	10
MT	C1336	48.9783	-116.01607	10

Magnum Mantleslug (*Magnipelta mycophaga*)

ID	C66	48.8277	-116.98394	10
ID	C68	48.9474	-117.01467	10
ID	CBIRDD	48.7462	-116.91903	10
ID	C95	48.9181	-116.85373	10
ID	C112	48.9163	-116.77692	10
ID	C113	48.9455	-116.81918	10
ID	FIA121T	48.5744	-116.732293	1000
ID	C128	48.9175	-116.72707	10
ID	C129	48.9475	-116.74129	10
ID	C133	48.6038	-116.643	10
ID	C134	48.6485	-116.62385	10
ID	FIA137T	48.7830	-116.683394	1000
ID	FIA1393T	47.4149	-115.786339	1000
ID	C1393	47.2883	-115.7742	10
ID	C1395T	47.3840	-115.75822	10
ID	FIA1399T	47.7422	-115.805664	1000
ID	C1401T	47.6732	-115.79839	10
ID	C1402T	47.7076	-115.82514	10
ID	FIA1403T	46.9887	-115.695993	1000
ID	FIA1436T	47.1317	-115.743606	1000
ID	C1441T	47.2289	-115.69434	10
ID	FIA1447T	47.0378	-115.624768	1000
ID	C1487T	46.9871	-115.67793	10
ID	FIA1539BT	47.0769	-115.551759	1000
ID	FIA1540T	47.0298	-115.478148	1000
ID	C1542	47.1508	-115.56616	10
ID	FIA1589T	47.0618	-115.506545	1000
ID	FIA1590T	47.1739	-115.545041	1000
ID	FIA1592T	46.9852	-115.284586	1000
ID	C1593T	47.1977	-115.51135	10
ID	C1642T	47.1572	-115.47832	10
ID	C1692T	47.1433	-115.40511	10
ID	C1693T	47.1595	-115.3912	10
ID	FIA1739T	47.0360	-115.293171	1000
ID	C1787T	47.1511	-115.27139	10
ID	OMG	48.3273	-116.17237	10
ID	OMG	48.8846	-116.75512	10
WA	C8	48.7662	-117.25974	10
WA	C9	48.8148	-117.23873	10
WA	C10	48.8391	-117.26163	10
WA	C11	48.8685	-117.28815	10
WA	C17	48.8197	-117.18701	10
WA	C18	48.8372	-117.19253	10
WA	C29	48.6335	-117.10287	10
WA	C31T	48.7187	-117.09787	10
WA	C32	48.7798	-117.09828	10
WA	C35	48.8863	-117.14512	10
WA	C48	48.7677	-117.06012	10
WA	C53	48.9830	-117.06632	10
WA	C642T	47.5681	-116.98241	10
WA	C644T	47.6382	-117.02593	10
WA	C650T	47.9202	-117.02599	10
MT	C1273	48.1766	-115.98653	10

ID	CLONG	48.7820	-116.64278	10
ID	C147	48.6504	-116.55515	10
ID	FIA148T	48.6634	-116.593183	1000
ID	C154T	48.9663	-116.62474	10
ID	C580	48.3975	-117.13629	10
ID	C885T	47.8603	-116.58985	10
ID	C896T	48.3695	-116.66483	10
ID	FIA952T	47.7211	-116.467897	1000
ID	C989T	47.7408	-116.4172	10
ID	FIA1064T	47.6717	-116.257195	1000
ID	C1139	48.2835	-116.20629	10
ID	C1144T	48.5273	-116.20406	10
ID	FIA1145T	48.8386	-116.253738	1000
ID	FIA1152T	48.9346	-116.25041	1000
ID	FIA1188T	48.4384	-116.193092	1000
ID	C1190	48.4700	-116.13657	10
ID	FIA1191T	48.5547	-116.153473	1000
ID	FIA1216T	47.6737	-116.071336	1000
ID	FIA1234T	48.6187	-116.120983	1000
ID	C1237	48.5799	-116.08052	10
ID	C1349T	47.4713	-115.88203	10
ID	FIA1436T	47.1317	-115.743606	1000
ID	C1489T	47.0888	-115.65327	10
ID	FIA1539AT	47.0360	-115.554751	1000
ID	FIA1592T	46.9852	-115.284586	1000
ID	C1691T	47.0887	-115.36108	10
ID	OMG	48.1318	-116.49004	10
ID	OMG	48.3273	-116.17237	10
ID	OMG	47.1577	-115.47729	10
WA	C25	48.4590	-117.11486	10
WA	C31T	48.7187	-117.09787	10
MT	C1280	48.4492	-116.04379	10
MT	C1333	48.8251	-115.94769	10
MT	C1335	48.9102	-115.98798	10
MT	C1336	48.9783	-116.01607	10
Humped Coin (*Polygyrella polygyrella*)				
ID	C1128T	47.7915	-116.1981	10
ID	C1129T	47.8317	-116.19109	10
ID	FIA1213T	47.5864	-116.082996	1000
ID	C1260T	47.5687	-115.99232	10
MT	C1279	48.4224	-116.02926	10
MT	C1285	48.6926	-116.02207	10
MT	C1320	48.2428	-115.96619	10
MT	C1333	48.8251	-115.94769	10
MT	C1364	48.1590	-115.90681	10
MT	C1370	48.4316	-115.84741	10
MT	C1372	48.5324	-115.91415	10
MT	C1373	48.5819	-115.87946	10
MT	C1380	48.8791	-115.90718	10
Lyre Mantleslug (*Udosarx lyrata*)				
ID	C674	47.2376	-116.8829	10
ID	C689T	47.8886	-116.97224	10
ID	C712T	47.1555	-116.85187	10
ID	C713	47.1870	-116.85194	10
ID	C753	47.1917	-116.76272	10
ID	C754	47.2515	-116.75932	10
ID	C835	47.1754	-116.61438	10
ID	C837	47.2839	-116.67767	10
ID	C858T	48.2129	-116.6684	10
ID	C869G	47.1577	-116.59408	10
ID	C870	47.1948	-116.56056	10
ID	FIA904T	47.0876	-116.48072	1000
ID	FIA938T	47.0439	-116.421016	1000
ID	C973T	47.0075	-116.38773	10
ID	C974T	47.0694	-116.34711	10
ID	FIA1014T	47.1794	-116.34097	1000
ID	C1015T	47.0087	-116.28539	10
ID	C1016T	47.0503	-116.28071	10
ID	C1017T	47.1136	-116.29388	10
ID	FIA1064T	47.6717	-116.257195	1000
ID	C1067	47.2107	-116.27134	10
ID	C1112T	47.0634	-116.18683	10
ID	C1114T	47.1477	-116.18073	10
ID	FIA1118T	47.5800	-116.213552	1000
ID	C1160T	47.1263	-116.12373	10
ID	C1198	48.8387	-116.1681	10
ID	FIA1296T	47.7153	-115.946517	1000
ID	FIA1341T	47.2216	-115.877568	1000
ID	C1387T	47.0172	-115.7489	10
ID	FIA1436T	47.1317	-115.743606	1000

ID	C1302T	47.4178	-115.90134	10
ID	C1304T	47.5275	-115.91911	10
ID	C1390	47.1702	-115.7882	10
ID	C1400T	47.6106	-115.78926	10
ID	FIA1447T	47.0378	-115.624768	1000
ID	C1542	47.1508	-115.56616	10
ID	FIA1592T	46.9852	-115.284586	1000
ID	C1644T	47.2474	-115.48832	10
ID	C1693T	47.1595	-115.3912	10
ID	C1694T	47.2005	-115.38288	10
ID	C1741T	47.0660	-115.31906	10
Thinlip Tightcoil (*Pristiloma idahoense*)				
ID	FIA79T	48.7072	-116.927113	1000
ID	C97T	48.9850	-116.84513	10
ID	C914T	47.5662	-116.54099	10
ID	FIA952T	47.7211	-116.467897	1000
ID	FIA991T	47.8564	-116.404743	1000
ID	FIA1032T	47.8996	-116.329311	1000
ID	C1065T	47.1207	-116.26398	10
ID	C1070	47.3457	-116.23877	10
ID	C1114T	47.1477	-116.18073	10
ID	FIA1118T	47.5800	-116.213552	1000
ID	C1128T	47.7915	-116.1981	10
ID	C1173T	47.6904	-116.12543	10
ID	FIA1178T	48.0293	-116.133979	1000
ID	FIA1189T	48.5239	-116.183467	1000
ID	FIA1205T	47.4907	-116.069193	1000
ID	FIA1392T	47.3112	-115.821424	1000
ID	FIA1436T	47.1317	-115.743606	1000
ID	FIA1539BT	47.0769	-115.551759	1000
WA	C31T	48.7187	-117.09787	10
WA	C36	48.9194	-117.14945	10
WA	C48	48.7677	-117.06012	10
Blue-grey Taildropper (*Prophysaon coeruleum*)				
ID	C720T	47.5210	-116.85044	10
ID	C880T	47.6280	-116.58997	10
ID	FIA1127T	47.9435	-116.197681	1000
Smokey Taildropper (*Prophysaon humile*)				
ID	C674	47.2376	-116.8829	10
ID	C675	47.3013	-116.8946	10
ID	FIA1439T	47.4923	-115.745087	1000
ID	C1489T	47.0888	-115.65327	10
ID	FIA1539AT	47.0360	-115.554751	1000
ID	C1541T	47.1318	-115.58344	10
ID	C1545	47.3142	-115.5918	10
ID	FIA1590T	47.1739	-115.545041	1000
ID	C1689T	47.0021	-115.35719	10
ID	C1690T	47.0572	-115.35349	10
ID	C1692T	47.1433	-115.40511	10
ID	C1743T	47.1730	-115.32325	10
ID	C1787T	47.1511	-115.27139	10
ID	C1816T	47.0484	-115.18311	10
Sheathed slug (*Zacoleus idahoensis*)				
ID	C98	48.2784	-116.79324	10
ID	FIA106T	48.6193	-116.797559	1000
ID	C106	48.6273	-116.80315	10
ID	FIA116T	48.3491	-116.72512	1000
ID	C132	48.5577	-116.62994	10
ID	CLONG	48.7820	-116.64278	10
ID	C138	48.8376	-116.63816	10
ID	C144	48.5163	-116.5836	10
ID	CBIRDH	48.5292	-116.56847	10
ID	FIA150T	48.7525	-116.594798	1000
ID	FIA153T	48.8934	-116.588304	1000
ID	C153	48.9083	-116.59852	10
ID	C156	48.5157	-116.48119	10
ID	C161	48.7229	-116.535	10
ID	C172T	48.8733	-116.44377	10
ID	C674	47.2376	-116.8829	10
ID	C679T	47.4620	-116.92207	10
ID	C683T	47.6394	-116.908	10
ID	C687T	47.8255	-116.95383	10
ID	C695T	48.1969	-116.97225	10
ID	C722T	47.5961	-116.86637	10
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AppendixIIc: Character Key
Author: Tom Burke

The following tables were prepared by Tom Burke who worked as a gastropod taxonomy specialist on the MBI project. The characters detailed in the tables indicate characters he used to differentiate selected similar species. Characters used to differentiate additional species can be found in Burke 2013.

Table II-c-1. Characteristics of North Idaho Cryptomastix

Species	Width (Whorls)[a]	Proportion Umbilicus Covered	Apertural Lip[b]	Apertural Teeth (Parietal; Basal; Outer or Palatal)	Notes
C. mullani mullani	13-15	> ½ cov.	revolute	P, B, & small outer	outer tooth may be quite small
C. mullani hemphilli	13-17	Mostly to nearly cov.	revolute	P, B, no outer	
C. mullani olneyae	11-19	≤ ½ cov.	revolute	P, B, no outer	
C. mullani blandi	13-13.5 (very low spire)	About ½ cov.	narrow revolute	small P & very small mid-basal cusp	
C. magnidentata[c]	10.8 (4¾ W)	About ½ cov.	revolute	P, B, O; teeth very large	strong dark brown; more loosely coiled
C. sanburni	10-12 (5¼-6 W)	Little to < ½ cov.	reflected & recurved	P, B, O; teeth very large	buff to medium brown; more tightly coiled
C. hendersoni[c]	14.5-16 (5½ W)	About ¼ cov.	reflected & recurved	no teeth or only a very small parietal	
C. populi[c]	To 17 mm wide	< ½ cov.	revolute	no teeth	glossy shell w/ wide aperture

[a] Number of whorls is significant for *C. magnidentata* and *C. sanburni*. *C. sanburni* is more tightly coiled and has more whorls on a shell of similar size.

[b] There is sometimes little distinction between a revolute lip and one that is strongly recurved at its edge. The revolute or recurved edge may be broken away, so close examination may be required.

[c] Species not known to occur in the MBI study area, but occur farther south in Idaho.

[d] Shells which keyed out to this species were identified during the MBI study. See chapter 2 for details.

Table II-c-2. Characteristics of North Idaho Microsnails

Species	Whorls	Size[a]	Umbilicus	Aperture	Spire	Ribs
Planogyra clappi	~3 ½	2x1.1-1.2	funnelform	slightly higher than wide	nearly flat	high, well spaced cuticular ribs
Paralaoma servilis	4¼	1.5-2.1x0.9-1.3	¼+ D; expanding regularly	slightly wider than high	low to moderate	moderately high, well-spaced cuticular ribs w. ribs between
Punctum californicum	3½-4⅓	1.5-1.9x1.05-1.25	larger ¼ to ⅕ D; expanding rapidly	roundly lunate	low to moderate	fine, close-set rather solid riblets
Punctum minutissimum	~4	1.1-1.5x0.7-0.95	medium ¼ to ⅓D; expanding near aperture	roundly lunate	low to moderate	uneven, closely spaced riblets
Punctum randolphi	~4	1.1-1.4x0.73-0.95	smaller ¼ to ⅕ D; expanding little	obovately lunate (not distinctly)	moderate to domed	closely-spaced cuticular riblets with radial & spiral striae between

[a] Shell width range x height range (mm)

Table II-c-3. Sole Characteristics of Pacific Northwest Slugs

Tripartite Soles	Undivided Soles
Limax maximus	*Prophysaon* spp.
Deroceas spp.	*Ariolimax* spp.
Arion spp.[a]	*Hemphillia* spp.
Arion subfuscus (faintly tripartite)	
Udosarx lyrata	
Zacoleus idahoensis	

[a] *Arion subfuscus* is only faintly tripartite.

A tripartite (divided in three parts) or undivided sole characterizes genera and species as describe above.

Table II-c-4. Characteristics Used to Differentiate *O. strigosa* and *A. kochi*

Oreohelix strigosa	*Anguispira kochi*
Shell usually heavier, more calcareous.	Shell thinner, not as calcareous.
Periostracum usually light brown when present; often quite thin or lacking.	Periostracum usually dark brown, covering entire whorls, sometime sloughing off in patches.
Dark peripheral bands usually present, sometimes lacking: Lower band just below the periphery, Upper band near mid-dorsally. The area between the bands may the normal color of the shell or it may be distinctly white.	Dark peripheral bands sometimes appear as those of Oreohelix, but they are usually wider and the lower band is usually on or just above the periphery. The norm is a yellowish band just above the periphery with dark areas above and below it that may be distinct bands or may extend onto the dorsal and/or basal whorl.
The aperture nearly round, slightly wider than high; the outer insertion attached to the penultimate whorl at an approximate right angle or slightly descending; the columellar insertion approximately vertical.	The Aperture is obliquely obovate; the outer insertion entering the penultimate whorl at an upward angle; the columellar insertion approximately vertical.
Whorls of young sharply angled at the periphery; the angle often still apparent in front of the aperture on mature or near mature specimens.	Whorls of young somewhat shouldered but not sharply angular. Periphery is round on nearly mature specimens.
Umbilicus narrowly tapering funnelform descending at a slight angle to the apex.	The umbilicus narrowly tapering funnelform descending straight toward the apex.
Sculpturing around the apex is very fine, sharp, rib-like collabrally arranged (at the angle of the aperture). However, the early whorls may be badly eroded so the sculpturing may not be discernible.	Apex sculpturing may be wider, wave-like ribbing, either collabral or more radially arranged. However, the early whorls may be badly eroded so the sculpturing may not be discernible.

Appendix III. Amphibians - Multi-species Baseline Initiative

Appendix IIIa: Protocols and Datasheets
Appendix IIIb: Chytrid Fungus Detection Data
AppendixIIIc: Landowner Letter and Postcard
Appendix IIId: Environmental DNA vs Dipnetting Field Assessment
Appendix IIIe: Photographs of Examined Historic Record Museum Specimens of Rana pipiens and Rana sylvatica

Amphibian Survey Protocol

SURVEY

1) Locate wetland. If there is not a wetland at the point you were assigned conduct a 30-minute timed search for amphibians and complete the remainder of this protocol.
2) Approach wetland quietly and scan for turtles as you approach.
3) Write the wetland number and 'begin' on the laminated card. Photograph wetland from aspect which best shows its character. This point will also be the start of the transect. Record waypoint.
4) While at the wetland keep an eye out for, and take note of, target non-amphibian species.
5) Use a 50-meter section of rope to measure your first transect. You should survey the wetland in a clockwise fashion. If two observers are available, survey the transect at the same time with one observer going clockwise and the other going counter-clockwise. Only use the rope for the first transect and estimate the distance for the remaining transects.
6) Dip-net each 50-meter section and record each amphibian species and development stage you detect. Estimate abundance in each section. If <10 individuals, count each one. If 10-100 individuals estimate to the nearest 10 (i.e. 20, 30, 40...). If there are more estimate '100s' or '1000s'. Don't just count what's in the net, count all the amphibians you see.
7) Repeat until entire shoreline has been surveyed or up to 500 meters.
8) Collect a tissue sample from and photograph the first **two** individuals of each common amphibian species you encounter. Photograph and collect tissue samples from **5** each of tiger salamander, n. leopard frog, or wood frog. Samples from adults are preferred (record life stage).
   a. Clip one digit (digit 3 or 5 is best) from hind foot of adult, collect whole small tadpoles, clip tail from large tadpole, or collect single egg. *Fill sample envelopes out completely (including life stage).* **Between each sample wipe scissors with cotton (your shirt) then with a bleach wipe.**
   b. Take three photographs of each animal sampled (tissue or Bd). Place animal in photo container and take a dorsal, ventral, and lateral view.
9) **If adult spotted frogs are present, swab the first 3 captured according to BD protocol (below).**
   a. Only collect tissue from 2 of the spotted frogs. There should be 2 tissue samples and 3 Bd samples if there are adult spotted frogs at wetland.
10) Draw a diagram of the wetland which includes relevant habitat: submerged logs, emergent vegetation, talus slopes, cliffs, inlet, outlet, and transect locations.
11) If bumblebees are encountered during survey spend 5 minutes attempting to photograph individuals. If *western* bumble bee is seen spend up to 15 minutes attempting to photograph.
12) Write the wetland number on laminated 'end' card.

Labeling

Photo ID

Wetland: W, cell #, P: The photo of the wetland from wetland 867: **W867P**
Tidbit: W, cell #, PTidbit: The photo of the tidbit from wetland 867: **W867PTidbit**
Plant/Bee: W, cell #, P, letter: bee photo after pictures have been taken of two plants wetland 867: **W867PC**
Amphibian: W, cell #, A, Sample ID, P_L: The fourth amphibian to be sampled at wetland 867 lateral view: **W867ADP_L**

Sample ID

Tissue: W, cell #, A, letter: The fourth amphibian to be sampled at wetland 867: **W867AD**
BD: W, cell #, BD, letter: second frog swabbed at wetland 867: W867BDB

Photo ID and Sample ID letters should correspond.

HYGIENE, ANIMAL HANDLING, AND EQUIPMENT CLEANING

1) When you arrive at the wetland use a plastic bag to get some water from wetland. Dig a small hole about 75 paces from wetland and wash hands with biodegradable soap over hole. Fill hole in. Do not apply additional sunscreen or bug spray unless you wash your hands again.
2) Handle adult amphibians with clean wet hands. Observe tadpoles and transport other amphibians in plastic zip lock bags. Do not handle tadpoles directly unless collecting tissues. Discard bags after one use.
3) Clean mud, snails, and plants from equipment with stiff brush at site. Rinse in wetland.
4) At truck spray all equipment which touched wetland with 10% bleach. Spread equipment out to dry in back of truck while traveling to next site.
5) Soak rope in 10% bleach solution.

BD SAMPLING

Sample only the first three adult spotted frogs captured. Do not sample if spotted frogs not present.

1) Start the swabbing procedure as soon as possible after capture, without putting amphibians in a container together or in water that another amphibian has just been held in.
2) Wear a fresh vinyl glove for each amphibian handled to prevent transfer of chytrid to the swab sample between amphibians or from stream water, etc.
3) Open the swab package and tube on a stable surface if working alone, or have another person handle them. Do not touch or get water onto swab tip or inside of tube during handling.
4) Pick up the amphibian from the top and try to minimize touching the animal's underside during handling.
5) Swab the underside of the amphibian from just below throat to rear toe tips and back 15 times. Alternate legs each time. Apply some pressure while swabbing, but don't squash the animal. Do not contaminate the swab by setting down or touching something with it before or after you swab the animal.
6) Place swab inside tube without brushing it against the outside or rim of the tube. After swab tip is about half way inside tube, bend swab handle against rim of tube to snap it off.
7) Screw the cap on the tube firmly (but do not over tighten).
8) Label the side and top of the tube with sample ID. Place tube in coin envelope and *fill envelope out completely.*
9) To prevent spreading disease, dispose of swab stick and glove in a designated, sealed bag.
10) Do not let sample get extremely hot (like in the cab of your truck). Store at room temperature away from light when you return from the field.

WETLAND SURVEY DATASHEET

Wetland ID: _________ Cell: ______ Date (e.g. 15 June 2014):_____________ Start Time: _______ Observer(s):______

Weather (circle one): Sunny, Mostly Sunny, Partly Sunny, Overcast, Light Rain, Heavy Rain, Snow

Wetland Type (circle one): Natural Pond, Ephemeral Natural Pond, Constructed Pond, Modified Natural Pond, Lake, Stream , Channels Near Stream, Puddles, Emergent Wetland, Meadow, Forest-No Wetland, Not-Forested-No Wetland, Beaver Pond, Other: _____________

Site is (circle one): Wet or Dry Search Type (circle one): Full Perimeter, 500 Meter Shoreline, 30 Minute T.S.

Wetland Waypoint: _________Lat:___________ Long: ______________ Wetland Photo ID: (W, cell#, P) ___________

TidBit: Yes or No TidBit Waypoint: _____________ Lat: ___________Long:______________ TidBit SN: ___________

Wetland Diagram

Last Section (m): ___________

Total Perimeter (m): _________

Tidbit Diagram

Tidbit Photo ID: ___________________________

Tidbit Depth (cm):____

Distance to shore (cm):______

Directions to plot:

Directions to tidbit:

Landowner name:

Landowner phone:

Observed- Yes or No –do not take photo

Spotted Knapweed: ____ Devil's Club: _____

Whitebark Pine: ______ Tansy: ______

Amphibians by 50m Section

Species	Stage	Abundance	Section

Stages
EGG: Eggs
NL: No Legs
BL: Beginning Legs
LEGS: 4 legs + Tail
AJ: Fully formed juvy or adult.
AJF: AJ Fledging - only use when mass of juvys is leaving pond. Usually late summer.

Abundance Categories
1, 2, 3, 4, 5, 6, 7, 8, 9
10s (estimate to nearest 10, 20, 30, 40...
100s
1000s

Observed - Yes or No_______
Round Leaf Sundew: ______ Long Leaf Sundew: ____
Rare Moonwort: ______
Fill in table for each location species is observed.
Photo ID: W, Cell#, P, letter

Species	Latitude	Longitude	Photo ID

Observed - record number detected (0 if not detected) - do not take photo

Painted Turtle______ Snapping Turtle______

T. Garter Snake: ______ C. Garter Snake: ______

Hoary Marmot: ____ Golden Mantled G.S._____

Yellow-bellied Marmot: ______ Pika: _________

Bumblebee Observed? (Y/N)_______

Western Bumblebee Observed? (Y/N)______
Photo ID: W, Cell# P, letter

Species	Photo ID

Fish Observed? Fish Species (if known):

Y/N: _________ ___________________

Samples: Adult Spotted Frogs Present? __________
Sample ID: W, Cell#, A, Letter
Photo ID: W, Cell#, BD, Letter

Species	Stage	(T)issue or (Bd)	Sample ID	Photo ID

SUPPLIES

Item	Number/ survey	Supplier	Item #	Web page
12" deep, 3/16" mesh Dip Net	2/person	Forestry Suppliers	77609	www.forestry-suppliers.com
Waders				
Quart zip top bags	10	StockPkg	3630A	https://stockpkg.com/
Parachute cord5/32"	2			
4 ½" Stainless-steel surgical scissors	2	Carolina Biological Supply	622505	http://www.carolina.com/
Disposable latex gloves (powder-free)	6	eSafety Supplies	20010FIT	https://www.esafetysupplies.com
MW fine-tipped plastic DrySwab, peel	3	Lakewood Biochemical, Co.	Mw113	http://www.lakewoodbio.com/
Screw top tubes with ethanol	3			
Plastic aquarium-small (photos)	1			
Bleach **Spray bottle**				

Appendix IIIb. Chytrid detection and zoospore count for swabbed Columbia spotted frogs.

Animal ID	Date Collected	Latitude	Longitude
W007ABDA	8/31/2013	48.7101	-117.27100
W7ABDB	8/31/2013	48.7101	-117.27100
W38BDA	6/4/2014	***48.3044**	**-117.01311**
W38BDB	6/4/2014	**48.3044**	**-117.01311**
W38BDC	6/4/2014	**48.3044**	**-117.01311**
W41BDA	8/19/2013	48.4443	-117.01783
W41BDB	8/19/2013	48.4443	-117.01783
W41BDC	8/19/2013	48.4443	-117.01783
W47BBDA	7/18/2013	48.7015	-117.03170
W48ABDA	8/30/2013	48.7425	-117.06126
W48ABDB	8/30/2013	48.7425	-117.06126
W48BBDA	9/4/2013	48.7741	-117.04978
W48BBDB	9/4/2013	48.7741	-117.04978
W48BBDC	9/4/2013	48.7741	-117.04978
W48BV1BDA	5/30/2014	48.7741	-117.04978
W48BV1BDB	5/30/2014	48.7741	-117.04978
W48BV1BDC	5/30/2014	48.7741	-117.04978
W48BV2BDA	6/17/2014	48.7741	-117.04978
W48BV2BDB	6/17/2014	48.7741	-117.04978
W48BV2BDC	6/17/2014	48.7741	-117.04978
W48BV3BDA	7/11/2014	48.7741	-117.04978
W48BV3BDB	7/11/2014	48.7741	-117.04978
W48BV3BDC	7/11/2014	48.7741	-117.04978
W48BV4BDA	7/29/2014	48.7741	-117.04978
W48BV4BDB	7/29/2014	48.7741	-117.04978
W48BV4BDC	7/29/2014	48.7741	-117.04978
W48BV5BDA	8/13/2014	48.7741	-117.04978
W48BV5BDB	8/13/2014	48.7741	-117.04978
W48BV5BDC	8/13/2014	48.7741	-117.04978
W48BV6BDA	9/4/2014	48.7741	-117.04978
W49BDA	8/30/2013	48.7930	-117.04305
W49BDB	8/30/2013	48.7930	-117.04305
W56BDA	6/14/2013	48.3912	-116.96167
W56BDB	6/14/2013	48.3912	-116.96167
W56BDC	6/14/2013	48.3912	-116.96167
W59BDA	7/31/2013	48.5531	-116.98752
W67V6BDA	9/4/2014	48.8778	-117.00529
W67V7BDA	9/26/2014	48.8778	-117.00529
W78ABDA	8/16/2013	48.6690	-116.93479
W78ABDB	8/16/2013	48.6690	-116.93479
W95BDA	8/5/2013	48.9032	-116.85519
W98BDA	8/17/2013	48.2725	-116.76801
W98BDB	8/17/2013	48.2725	-116.76801
W98BDC	8/17/2013	48.2725	-116.76801

W99BDA	8/17/2013	48.2994	-116.74477
W109BDA	8/13/2013	48.7791	-116.77924
W109BDB	8/13/2013	48.7791	-116.77924
W109BDC	8/13/2013	48.7791	-116.77924
W111BDA	8/12/2013	48.8588	-116.77599
W111BDB	8/12/2013	48.8588	-116.77599
W113BDA	8/6/2013	48.9417	-116.78936
W113BDB	8/6/2013	48.9417	-116.78936
W113BDC	8/6/2013	48.9417	-116.78936
W115BDA	6/5/2013	48.3018	-116.72021
W115BDB	6/5/2013	48.3018	-116.72021
W120BDA	8/15/2013	48.5509	-116.69915
W123BDA	8/31/2013	48.6714	-116.69757
W123BDB	8/31/2013	48.6714	-116.69757
W123BDC	8/31/2013	48.6714	-116.69757
W135BDA	8/13/2013	48.6988	-116.65073
W135BDB	8/13/2013	48.6988	-116.65073
W135BDC	8/13/2013	48.6988	-116.65073
W136BDA	8/13/2013	48.7080	-116.64771
W137BDA	8/3/2013	48.7776	-116.67493
W140BDA	7/18/2013	48.9030	-116.63202
W140BDB	7/18/2013	48.9030	-116.63202
W140BDC	7/18/2013	48.9030	-116.63202
W144BDA	8/20/2013	48.5114	-116.57792
W145BDA	8/26/2013	48.5513	-116.55980
W148BDA	8/27/2013	48.6595	-116.59918
W148BDB	8/27/2013	48.6595	-116.59918
W148V3BDA	7/11/2014	48.6595	-116.59918
W148V3BDB	7/11/2014	48.6595	-116.59918
W148V3BDC	7/11/2014	48.6595	-116.59918
W148V4BDA	7/30/2014	48.6595	-116.59918
W148V4BDB	7/30/2014	48.6595	-116.59918
W148V4BDC	7/30/2014	48.6595	-116.59918
W148V5BDA	8/13/2014	48.6595	-116.59918
W148V5BDB	8/13/2014	48.6595	-116.59918
W148V5BDC	8/13/2014	48.6595	-116.59918
W149BDA	8/10/2013	48.7395	-116.61693
W149BDB	8/10/2013	48.7395	-116.61693
W149BDC	8/10/2013	48.7395	-116.61693
W158BDA	8/27/2013	48.6092	-116.52594
W158BDB	8/27/2013	48.6092	-116.52594
W158BDC	8/27/2013	48.6092	-116.52594
W167BDA	9/3/2013	48.6435	-116.42785
W167BDB	9/3/2013	48.6435	-116.42785
W167BDC	9/3/2013	48.6435	-116.42785
W169BDA	9/2/2013	**48.7417**	**-116.41412**
W169BDB	9/2/2013	**48.7417**	**-116.41412**
W169BDC	9/2/2013	**48.7417**	**-116.41412**

W172BDA	6/15/2014	**48.8750**	**-116.42736**
W172BDB	6/15/2014	**48.8750**	**-116.42736**
W172BDC	6/15/2014	**48.8750**	**-116.42736**
W642ABDA	7/2/2014	**47.5251**	**-117.00643**
W642ABDB	7/2/2014	**47.5251**	**-117.00643**
W642ABDC	7/2/2014	**47.5251**	**-117.00643**
W642BBDA	6/29/2014	**47.5347**	**-116.96253**
W642BBDB	6/29/2014	**47.5347**	**-116.96253**
W642BBDC	6/29/2014	**47.5347**	**-116.96253**
W653BDA	6/3/2014	**48.0333**	**-117.02763**
W653BDB	6/3/2014	**48.0333**	**-117.02763**
W653BDC	6/3/2014	**48.0333**	**-117.02763**
W680BDA	6/29/2014	**47.5059**	**-116.95135**
W680BDB	6/29/2014	**47.5059**	**-116.95135**
W680BDC	6/29/2014	**47.5059**	**-116.95135**
W691BDA	7/11/2014	**47.9948**	**-116.98153**
W691BDB	7/11/2014	**47.9948**	**-116.98153**
W694BDA	6/4/2014	**47.9948**	**-116.98153**
W694BDB	6/4/2014	**48.1384**	**-116.98236**
W694BDC	6/4/2014	**48.1384**	**-116.98236**
W714BDA	7/12/2014	**47.2296**	**-116.85555**
W714BDB	7/12/2014	**47.2296**	**-116.85555**
W714BDC	7/12/2014	**47.2296**	**-116.85555**
W715BDA	7/16/2014	**47.2765**	**-116.85729**
W724BDA	6/15/2014	**47.6654**	**-116.87930**
W724BDB	6/15/2014	**47.6654**	**-116.87930**
W724BDC	6/15/2014	**47.6654**	**-116.87930**
W731BDA	6/4/2014	47.9824	-116.89313
W731BDB	6/4/2014	47.9824	-116.89313
W731BDC	6/4/2014	47.9824	-116.89313
W73BDA	8/16/2013	48.4560	-116.89911
W754BDA	7/13/2014	**47.2473**	**-116.75713**
W763BDA	5/1/2014	**47.6202**	**-116.76163**
W763BDB	5/1/2014	**47.6202**	**-116.76163**
W763BDC	5/1/2014	**47.6202**	**-116.76163**
W777BDA	8/15/2013	48.4984	-116.82166
W777BDB	8/15/2013	48.4984	-116.82166
W777BDC	8/15/2013	48.4984	-116.82166
W795BDA	7/14/2014	**47.1582**	**-116.68570**
W795BDB	7/14/2014	**47.1582**	**-116.68570**
W795BDC	7/14/2014	**47.1582**	**-116.68570**
W796BDA	7/16/2014	**47.2114**	**-116.67783**
W797BBDA	7/13/2014	**47.2508**	**-116.73061**
W797BBDB	7/13/2014	**47.2508**	**-116.73061**
W797BBDC	7/13/2014	**47.2508**	**-116.73061**
W79BDA	8/16/2013	48.7323	-116.89452
W79BDB	8/16/2013	48.7323	-116.89452
W79BDC	8/16/2013	48.7323	-116.89452

W81BDA	8/3/2013	48.8283	-116.94142
W81BDB	8/3/2013	48.8283	-116.94142
W81BDC	8/3/2013	48.8283	-116.94142
W849BDA	6/15/2014	**47.8331**	**-116.68495**
W851BDA	6/15/2014	**47.8889**	**-116.66737**
W851BDB	6/15/2014	**47.8889**	**-116.66737**
W851BDC	6/15/2014	**47.8889**	**-116.66737**
W854BDA	8/24/2013	**48.0542**	**-116.70102**
W854BDB	8/24/2013	**48.0542**	**-116.70102**
W854BDC	8/24/2013	**48.0542**	**-116.70102**
W878BDA	6/29/2014	**47.5397**	**-116.57151**
W878BDB	6/29/2014	**47.5397**	**-116.57151**
W881BDA	6/13/2014	47.6915	-116.60610
W883BDA	5/26/2013	47.7709	-116.58474
W883BDB	5/26/2013	47.7709	-116.58474
W883BDC	5/26/2013	47.7709	-116.58474
W890BDA	6/3/2014	**48.0846**	**-116.58562**
W890BDB	6/3/2014	**48.0846**	**-116.58562**
W891BDA	8/14/2013	48.1332	-116.63739
W896BDA	7/23/2014	**48.3779**	**-116.62206**
W896BDB	7/23/2014	**48.3779**	**-116.62206**
W898BDA	8/15/2013	48.4322	-116.66645
W898BDB	8/15/2013	48.4322	-116.66645
W898BDC	8/15/2013	48.4322	-116.66645
W905BDA	8/19/2013	**47.1486**	**-116.48734**
W905BDB	8/19/2013	**47.1486**	**-116.48734**
W905BDC	8/19/2013	**47.1486**	**-116.48734**
W91BDA	8/20/2013	48.7134	-116.87742
W91BDB	8/20/2013	48.7134	-116.87742
W91BDC	8/20/2013	48.7134	-116.87742
W925BDA	7/1/2013	48.0387	-116.57018
W925BDB	7/1/2013	48.0387	-116.57018
W938BDA	8/19/2013	**47.0544**	**-116.40897**
W938BDB	8/19/2013	**47.0544**	**-116.40897**
W942BDA	7/16/2014	**47.2337**	**-116.43912**
W942BDB	7/16/2014	**47.2337**	**-116.43912**
W953BDA	6/8/2013	47.7217	-116.46562
W953BDB	6/8/2013	47.7217	-116.46562
W974BDA	7/15/2014	**47.0606**	**-116.34051**
W974BDB	7/15/2014	**47.0606**	**-116.34051**
W974BDC	7/15/2014	**47.0606**	**-116.34051**
W975BDA	7/16/2014	47.1297	-116.38735
W975BDB	7/16/2014	47.1297	-116.38735
W978BDA	8/18/2013	**47.2462**	**-116.40868**
W978BDB	8/18/2013	**47.2462**	**-116.40868**
W979BDA	6/30/2014	**47.2760**	**-116.40935**
W1006BDA	6/18/2013	48.5004	-116.46627
W1011BDA	6/16/2014	**48.9898**	**-116.44654**

W1032BDA	6/9/2013	47.7887	-116.32120
W1046BDA	8/11/2013	48.4333	-116.38947
W1046BDB	8/11/2013	48.4333	-116.38947
W1048BDA	8/12/2013	48.5074	-116.35610
W1055BDA	7/10/2013	48.8261	-116.41749
W1057V1BDA	5/31/2014	48.9036	-116.38901
W1057V5BDA	8/13/2014	48.9036	-116.38901
W1062BDA	8/15/2013	46.9987	-116.22641
W1062BDB	8/15/2013	46.9987	-116.22641
W1062BDC	8/15/2013	46.9987	-116.22641
W1077BDA	6/11/2013	47.6747	-116.24615
W1080BDA	6/9/2013	47.8074	-116.27443
W1081BDA	6/28/2013	47.8253	-116.26785
W1081BDB	6/28/2013	47.8253	-116.26785
W1081BDC	6/28/2013	47.8253	-116.26785
W1093BDA	6/16/2014	**48.3541**	**-116.29257**
W1093BDB	6/16/2014	**48.3541**	**-116.29257**
W1093BDC	6/16/2014	**48.3541**	**-116.29257**
W1094BDA	8/11/2013	48.4336	-116.30891
W1094BDB	8/11/2013	48.4336	-116.30891
W1094BDC	8/11/2013	48.4336	-116.30891
W1095BDA	6/17/2013	48.4557	-116.30756
W1095BDB	6/17/2013	48.4557	-116.30756
W1095BDC	6/17/2013	48.4557	-116.30756
W1097BDA	6/22/2013	48.5709	-116.32872
W1098BDA	9/3/2013	48.6030	-116.32495
W1098BDB	9/3/2013	48.6030	-116.32495
W1099BDA	8/20/2013	48.6599	-116.34177
W1107BDA	8/9/2013	48.9835	-116.34006
W1111BDA	8/15/2013	47.0315	-116.14223
W1111BDB	8/15/2013	47.0315	-116.14223
W1111BDC	8/15/2013	47.0315	-116.14223
W1113BDA	7/30/2013	47.1316	-116.14650
W1113BDB	7/30/2013	47.1316	-116.14650
W1115BDA	8/19/2013	**47.1991**	**-116.20605**
W1115BDB	8/19/2013	**47.1991**	**-116.20605**
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W1132BDB	6/27/2013	47.9740	-116.20650
W1133BDA	6/27/2013	47.9993	-116.22366
W1133BDB	6/27/2013	47.9993	-116.22366
W1144BDA	8/6/2013	48.5258	-116.21066
W1159BDA	8/16/2013	47.0543	-116.08841
W1159BDB	8/16/2013	47.0543	-116.08841
W1159BDC	8/16/2013	47.0543	-116.08841
W1160BDA	8/18/2013	47.1310	-116.10364
W1160BDB	8/18/2013	47.1310	-116.10364
W1160BDC	8/18/2013	47.1310	-116.10364
W1177BDA	6/30/2013	47.8854	-116.16144

W1188BDA	8/9/2013	48.3791	-116.13732
W1188BDB	8/9/2013	48.3791	-116.13732
W1188BDC	8/9/2013	48.3791	-116.13732
W1188BDD	8/9/2013	48.3791	-116.13732
W1188V3BDA	7/11/2014	48.3791	-116.13732
W1188V3BDB	7/11/2014	48.3791	-116.13732
W1188V3BDC	7/11/2014	48.3791	-116.13732
W1188V4BDA	7/30/2014	48.3791	-116.13732
W1188V4BDB	7/30/2014	48.3791	-116.13732
W1188V4BDC	7/30/2014	48.3791	-116.13732
W1188V5BDA	8/13/2014	48.3791	-116.13732
W1188V5BDB	8/13/2014	48.3791	-116.13732
W1188V5BDC	8/13/2014	48.3791	-116.13732
W1188V6BDA	9/4/2014	48.3791	-116.13732
W1188V6BDB	9/4/2014	48.3791	-116.13732
W1188V6BDC	9/4/2014	48.3791	-116.13732
W1188V7BDA	9/24/2014	48.3791	-116.13732
W1189BDA	8/10/2013	48.4047	-116.19664
W1189BDB	8/10/2013	48.4047	-116.19664
W1189BDC	8/10/2013	48.4047	-116.19664
W1191BDA	7/5/2013	48.5202	-116.17390
W1191BDB	7/5/2013	48.5202	-116.17390
W1192BDA	8/1/2013	48.5494	-116.17631
W1192BDB	8/1/2013	48.5494	-116.17631
W1192QCBDA	8/13/2013	48.5494	-116.17631
W1192QCBDB	8/13/2013	48.5494	-116.17631
W1192QCBDC	8/13/2013	48.5494	-116.17631
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W1206BDB	8/18/2013	47.1548	-116.02982
W1206BDC	8/18/2013	47.1548	-116.02982
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W1211BDA	8/25/2013	47.3884	-116.07006
W1211BDB	8/25/2013	47.3884	-116.07006
W1211BDC	8/25/2013	47.3884	-116.07006
W1212BDA	8/17/2013	47.4251	-116.02680
W1212BDB	8/17/2013	47.4251	-116.02680
W1212BDC	8/17/2013	47.4251	-116.02680
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W1220BDB	7/1/2013	47.8078	-116.07093
W1220BDC	7/1/2013	47.8078	-116.07093
W1227BDA	6/26/2013	48.1036	-116.10139
W1227BDB	6/26/2013	48.1036	-116.10139
W1227BDC	6/26/2013	48.1036	-116.10139
W1231BDA	9/5/2013	48.2977	-116.08228
W1231BDB	9/5/2013	48.2977	-116.08228
W1231BDC	9/5/2013	48.2977	-116.08228

W1234BDA	8/10/2013	48.4054	-116.12784
W1234BDB	8/10/2013	48.4054	-116.12784
W1234BDC	8/10/2013	48.4054	-116.12784
W1236BDA	8/25/2013	48.5045	-116.11859
W1236BDB	8/25/2013	48.5045	-116.11859
W1236BDC	8/25/2013	48.5045	-116.11859
W1239BDA	8/12/2013	48.6581	-116.10069
W1239BDB	8/12/2013	48.6581	-116.10069
W1239BDC	8/12/2013	48.6581	-116.10069
W1240BDA	6/15/2014	48.6807	-116.11752
W1245BDA	8/8/2013	48.9199	-116.09908
W1245BDB	8/8/2013	48.9199	-116.09908
W1247BDA	8/8/2013	48.9938	-116.10632
W1247BDB	8/8/2013	48.9938	-116.10632
W1247BDC	8/8/2013	48.9938	-116.10632
W1249BDA	7/15/2013	47.0869	-115.96252
W1249BDB	7/15/2013	47.0869	-115.96252
W1249BDC	7/15/2013	47.0869	-115.96252
W1251BDA	8/19/2013	47.1598	-116.00684
W1251BDB	8/19/2013	47.1598	-116.00684
W1256BDA	8/17/2013	47.4095	-116.01257
W1256BDB	8/17/2013	47.4095	-116.01257
W1256BDC	8/17/2013	47.4095	-116.01257
W1257BDA	8/16/2013	47.4257	-116.00834
W1257BDB	8/16/2013	47.4257	-116.00834
W1257BDC	8/16/2013	47.4257	-116.00834
W1260BDA	7/9/2013	47.5599	-116.02542
W1260BDB	7/9/2013	47.5599	-116.02542
W1260BDC	7/9/2013	47.5599	-116.02542
W1267BDA	7/12/2013	47.8657	-116.00220
W1267BDB	7/12/2013	47.8657	-116.00220
W1287BDA	7/28/2014	48.7784	-116.05181
W1287BDB	7/28/2014	48.7784	-116.05181
W1287BDC	7/28/2014	48.7784	-116.05181
W1294BDA	8/19/2013	47.0733	-115.91806
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W1294BDC	8/19/2013	47.0733	-115.91806
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W1295BDC	7/29/2013	47.1120	-115.92621
W1301BDA	8/24/2013	47.3921	-115.91964
W1301BDB	8/24/2013	47.3921	-115.91964
W1301BDC	8/24/2013	47.3921	-115.91964
W1346BDA	8/24/2013	47.3324	-115.83236
W1346BDB	8/24/2013	47.3324	-115.83236
W1346BDC	8/24/2013	47.3324	-115.83236
W1347BDA	8/24/2013	47.3996	-115.84660
W1347BDB	8/24/2013	47.3996	-115.84660

W1347BDC	8/24/2013	47.3996	-115.84660
W1348BDA	8/24/2013	47.4349	-115.82944
W1348BDB	8/24/2013	47.4349	-115.82944
W1348BDC	8/24/2013	47.4349	-115.82944
W1387BDA	7/29/2013	47.0216	-115.77673
W1387BDB	7/29/2013	47.0216	-115.77673
W1387BDC	7/29/2013	47.0216	-115.77673
W1396BDA	8/16/2013	47.4299	-115.80214
W1396BDB	8/16/2013	47.4299	-115.80214
W1488BDA	7/14/2013	47.0489	-115.62781
W1488BDB	7/14/2013	47.0489	-115.62781
W1488BDC	7/14/2013	47.0489	-115.62781
W1490BDA	7/29/2014	**47.1136**	**-115.63075**
W1490BDB	7/29/2014	**47.1136**	**-115.63075**
W1490BDC	7/29/2014	**47.1136**	**-115.63075**
W1538BDA	7/27/2013	46.9693	-115.59433
W1590BDA	7/26/2013	47.0793	-115.48946
W1742BDA	7/25/2013	47.1078	-115.30518
W1742BDB	7/25/2013	47.1078	-115.30518
W1742BDC	7/25/2013	47.1078	-115.30518
W1786BDA	7/25/2013	47.0983	-115.28540
W1786BDB	7/25/2013	47.0983	-115.28540
W1786BDC	7/25/2013	47.0983	-115.28540
W1787BDA	7/26/2013	47.1389	-115.28151
W1787BDB	7/26/2013	47.1389	-115.28151
W1817BDA	7/25/2013	47.0916	-115.16090
W1817BDB	7/25/2013	47.0916	-115.16090
W1817BDC	7/25/2013	47.0916	-115.16090
W1924BDA	7/15/2014	**46.9663**	**-116.56323**
W1924BDB	7/15/2014	**46.9663**	**-116.56323**
W1932BDA	7/14/2014	**46.9717**	**-116.48843**
W1932BDB	7/14/2014	**46.9717**	**-116.48843**
W1938BDA	7/14/2014	**47.0097**	**-116.45627**
W1939BDA	7/14/2014	46.9856	-116.40910
W1939BDB	7/14/2014	46.9856	-116.40910
W1939BDC	7/14/2014	46.9856	-116.40910
W1946BDA	7/14/2014	46.9529	-116.34484
W1946BDB	7/14/2014	46.9529	-116.34484
W1956BDA	7/13/2014	**46.9121**	**-116.24325**
W1956BDB	7/13/2014	**46.9121**	**-116.24325**
W1956BDC	7/13/2014	**46.9121**	**-116.24325**
W1961BDA	7/25/2014	**46.9175**	**-116.16200**
W1961BDB	7/25/2014	**46.9175**	**-116.16200**
W1961BDC	7/25/2014	**46.9175**	**-116.16200**
W1966BDA	7/26/2014	46.9612	-116.11333
W1966BDB	7/26/2014	46.9612	-116.11333
W1972BDA	7/25/2014	47.0353	-116.02062
W1972BDB	7/25/2014	47.0353	-116.02062

W1972BDC	7/25/2014	47.0353	-116.02062
W1979BDA	7/24/2014	47.0356	-115.98238
W1979BDB	7/24/2014	47.0356	-115.98238
W1979BDC	7/24/2014	47.0356	-115.98238
W1986BDA	7/24/2014	47.0306	-115.88182
W1986BDB	7/24/2014	47.0306	-115.88182
W1986BDC	7/24/2014	47.0306	-115.88182
W2000BDA	7/26/2014	46.9891	-115.80888
W2000BDB	7/26/2014	46.9891	-115.80888
W2000BDC	7/26/2014	46.9891	-115.80888
W2021BDA	7/28/2014	46.9561	-115.51434
W2021BDB	7/28/2014	46.9561	-115.51434
W2021BDC	7/28/2014	46.9561	-115.51434
W2026BDA	7/28/2014	46.9819	-115.43272
W2026BDB	7/28/2014	46.9819	-115.43272
W2026BDC	7/28/2014	46.9819	-115.43272
W2042BDA	7/25/2014	46.9681	-115.27082
W2042BDB	7/25/2014	46.9681	-115.27082
W2042BDC	7/25/2014	46.9681	-115.27082

***Bolded** locations fuzzed within 500 m because survey was conducted on private property.

AppendixIIIc: Private Land Request and Return Postcard

We requested permission to access privatley owned wetlands with a written letter. We asked landowners who were willing to allow access to fill out and return a postcard providing written permission.

Return Card

Please fill out this card and drop in the mail

1. I grant permission for 1-2 Idaho Fish and Game employees to conduct a survey for frogs and salamanders on my property Yes____No____ (If No for #1, please the drop card in mail)
2. Is there a wetland or "wet area" on your property? Yes___No___
3. If Yes to #2, approximately how big is your wetland (ie. acres, distance around, or length) and what is it made up of (ie. Cattail swamp, pond, spring/seep, wet field, etc.). Size:___________ Type of wetland:____
4. Have you ever heard or seen any amphibians there before and if you know, what are they?
    a. Amphibians present? Yes:___No:___ What kind: ____________________________
5. Are you interested in receiving a species list based on our findings of your wetland? Yes __No __

Printed Name: ______________________________
Signature: ________________________________
Date: ____________________________________

Thank you for taking the time to fill this out and send it back to us!

IDAHO DEPARTMENT OF FISH AND GAME
PANHANDLE REGION
2885 West Kathleen Avenue
Coeur d'Alene, Idaho 83815

C.L. "Butch" Otter / Governor
Virgil Moore / Director

Dear Landowner,

During the spring and summer of 2014 Idaho Fish and Game will be conducting surveys for frogs and salamanders across the Idaho Panhandle. Our goal is to determine how widespread and abundant each species of frog and salamander is in the region.

The information collected will be used in the next revision of Idaho's State Wildlife Action Plan (Plan), which will be published in 2015. The goal of the Plan is to prevent federal listings of species and maintain state authority of wildlife by determining which species of wildlife may be at risk of being listed under the Endangered Species Act. Once we decide which species may be at risk, we develop actions which will help conserve these species and avoid ESA listing.

Our efforts can only be successful if landowners are willing to allow us to conduct surveys, thus we are seeking your permission to conduct a survey for frogs and salamanders on the property indicated on the enclosed maps. Any pond, marsh, or wet area that may or may not have these animals is a potential survey site. We will do whatever we can to accommodate any concerns you may have about where, how, and when we would conduct the survey. We would greatly appreciate your return of the enclosed, postage paid card with the information filled out at your earliest convenience.

If you grant permission to conduct a survey:

- We will contact you within the next several weeks with more information
- We will contact you before we conduct the survey
- We would conduct the survey in the spring/summer of 2014
- If you wish, we will be happy to provide you the results of our survey of your wetland

If you have any specific questions about this project we would appreciate a call or email, anytime.
We truly appreciate whatever help you can provide us in accomplishing this project.

Sincerely,

Shannon Ehlers
Wildlife Research Biologist
(208)659-9229
shannon.ehlers@idfg.idaho.gov

Keeping Idaho's Wildlife Heritage

Equal Opportunity Employer • 208-769-1414 • Fax: 208-769-1418 • Idaho Relay (TDD) Service: 1-800-377-3529 •
http://fishandgame.idaho.gov

AppendixIIId: Environmental DNA vs. Dipnetting Field Assessment

eDNA Tools for Monitoring Amphibians

12-JV-11221633-112

Final Report

Caren S. Goldberg, University of Idaho/Washington State University

31 March 2014

Introduction

The goal of this pilot project was to determine detection probabilities and most efficient sampling design for using environmental DNA (eDNA) methods to monitor amphibian populations in north Idaho.

Field sampling methods

Four lakes were sampled by Michael Lucid and Idaho Fish and Game staff in June and July of 2012. At each lake, three 250 mL water samples were collected and filtered through 0.45 µm pore size cellulose nitrate filters in disposable filter funnels (Whatman) at approximately every 50 m around the perimeter (Figure 1). Field negatives (distilled water) were filtered at the beginning of each sampling session and after every 5 sampling sites. Locations of amphibians detected visually while collecting water samples were recorded. Water sample collection was followed with a dip-net survey where locations of all detected amphibians were recorded.

eDNA assay development

After sampling, collaborators on this project (Michael Lucid, Sam Cushman, and Caren Goldberg) decided that analysis should focus on the species identified through field surveys: long-toed salamanders (*Ambystoma macrodactylum*), western toads (*Anaxyrus boreas*), Columbia spotted frogs (*Rana luteiventris*), and American bullfrogs (*Lithobates catesbeianus*). I developed a species-specific qPCR assay for each species using previously developed genetic data (Austin et al. 2004, Funk et al. 2008, Goebel et al. 2009, Lee-Yaw and Irwin 2012) with Primer Express software (Life Technologies) and PrimerBLAST (NCBI), except for Columbia spotted frogs, where the test is only for the northern clade. I validated each assay using tissue samples from all north Idaho amphibians (except Coeur d'Alene salamanders, which I do not have tissue samples for). This consisted of 10 of each of the target species and 5 each of the following: Pacific treefrog (*Pseudacris sierrae*), Rocky Mountain tailed frog (*Ascaphus montanus*), and Idaho giant salamander (*Dicamptodon aterrimus*). Reactions were run using Quantitect Multiplex PCR Mix (Qiagen, Inc.) with recommended multiplexing concentrations (1X QuantiTect Multiplex PCR mix, 0.2 µM of each primer, and 0.2 µM of each probe) on an Applied Biosystems 7500 Fast Real-Time PCR System. Reactions were 15 µl in volume and each included 3 µl of sample. Cycling began with 15 min at 95°C followed by 50 cycles of 94°C for 60 s and 62°C for 60 s and went for 50 cycles. All of the samples from the target species tested positive and all of the samples from non-target species tested negative.

Sample analysis

DNA was extracted from filters with the Qiashredder/DNeasy method described in Goldberg et al. (2011). All filter sample extractions and qPCR reaction preparations were conducted in a lab dedicated to low-quantity

DNA samples. Researchers are required to shower and change clothes before entering this room after being in a high-quality DNA or post-PCR laboratory, and no amphibian tissues have been handled in this room. A negative extraction control was included with each set of extractions and an additional negative qPCR control was run with each plate of samples. We used a multi-tube approach for analysis, where multiple reactions were conducted for each sample, to increase the probability of detecting each species (Taberlet et al. 1999). We analyzed each sample in triplicate in 1 – 3 reactions (i.e. in 3-9 wells) and included an internal positive control (IC; Qiagen) in each well. A positive sample was defined as any sample that showed exponential amplification in all three wells from one run or in one or more wells from two separate reactions (samples were rerun whenever triplicate wells within a reaction yielded inconsistent results). Quantitative standards consisted of diluted skin tissue derived DNA quantified on a Nanodrop spectrophotometer and diluted 10^{-3} through 10^{-6}, run in duplicate.

We compared results of eDNA sampling with field sampling to evaluate detection probabilities of target species with eDNA sampling.

Results

All negative controls tested negative. Detection probabilities of all species were high with one exception: at Dennick Lake, many samples failed to detect any species, indicating an issue with sample preservation or eDNA degradation due to water chemistry at that site.

Long-toed salamanders were detected with eDNA at every segment where they were detected with field methods, with an overall detection probability per sample of 0.92 given that it was in the segment. The per sample probability of detection given that long-toed salamanders were in the lake was 0.64 for Playa, 1 for Copper, 0.96 for Long Mountain, and 0.08 for Dennick. At Dennick, the one observation of a long-toed salamander was made halfway between two eDNA sampling points; long-toed salamander eDNA was detected at one of these sampling points but not the other.

Western toads were also detected with eDNA at every segment where they were detected with field methods, with an overall detection probability per sample of 0.66 given that it was in the segment. The per sample probability of detection given that western toads were in the lake was 0.21 for Playa and Copper and 0.04 for Long Mountain (no evidence of western toads was found at Dennick Lake). At Playa Lake, western toad eDNA was detected 21 m in one direction from an egg mass but not 28 m in the other direction. Additionally, new larvae were detected at a site where no western toad eDNA was detected, indicating either misidentification or low detection probability. At Copper Lake, western toad eDNA was detected 61 m from the nearest observed toad, and at Long Mountain Lake western toad eDNA was detected at only one location.

Columbia spotted frogs were detected with eDNA at all sites at Copper Lake and most sites at Playa Lake where they were detected with field methods. No evidence of Columbia spotted frog presence was detected at Long Mountain Lake, and many sites at Dennick Lake where the species was detected by field crews were not detected using eDNA. At Copper and Playa Lakes, Columbia spotted frogs had an overall detection probability per sample of 0.91 given that it was in the segment. For Dennick, this estimate was 0.37. The per sample probability of detection given that Columbia spotted frogs were in the lake was 0.66 for Playa, 1.0 for Copper, and 0.21 for Dennick. At Playa Lake, there was one sampling site where an adult spotted frog was seen at the sampling site but not detected in the eDNA sample (although western toads were detected in the eDNA sample at this site), but at another sampling site, spotted frog eDNA was detected with the nearest field observation at 85 m.

Bullfrog eDNA was not detected during this study. Bullfrogs were only seen at Dennick Lake, where eDNA samples had very low overall detection. However, Columbia spotted frogs were detected in the area of the lake where bullfrog observations where noted. There is some possibility that field identification was incorrect, although the unexplained low detection of eDNA at this site may also have reduced detection of this species.

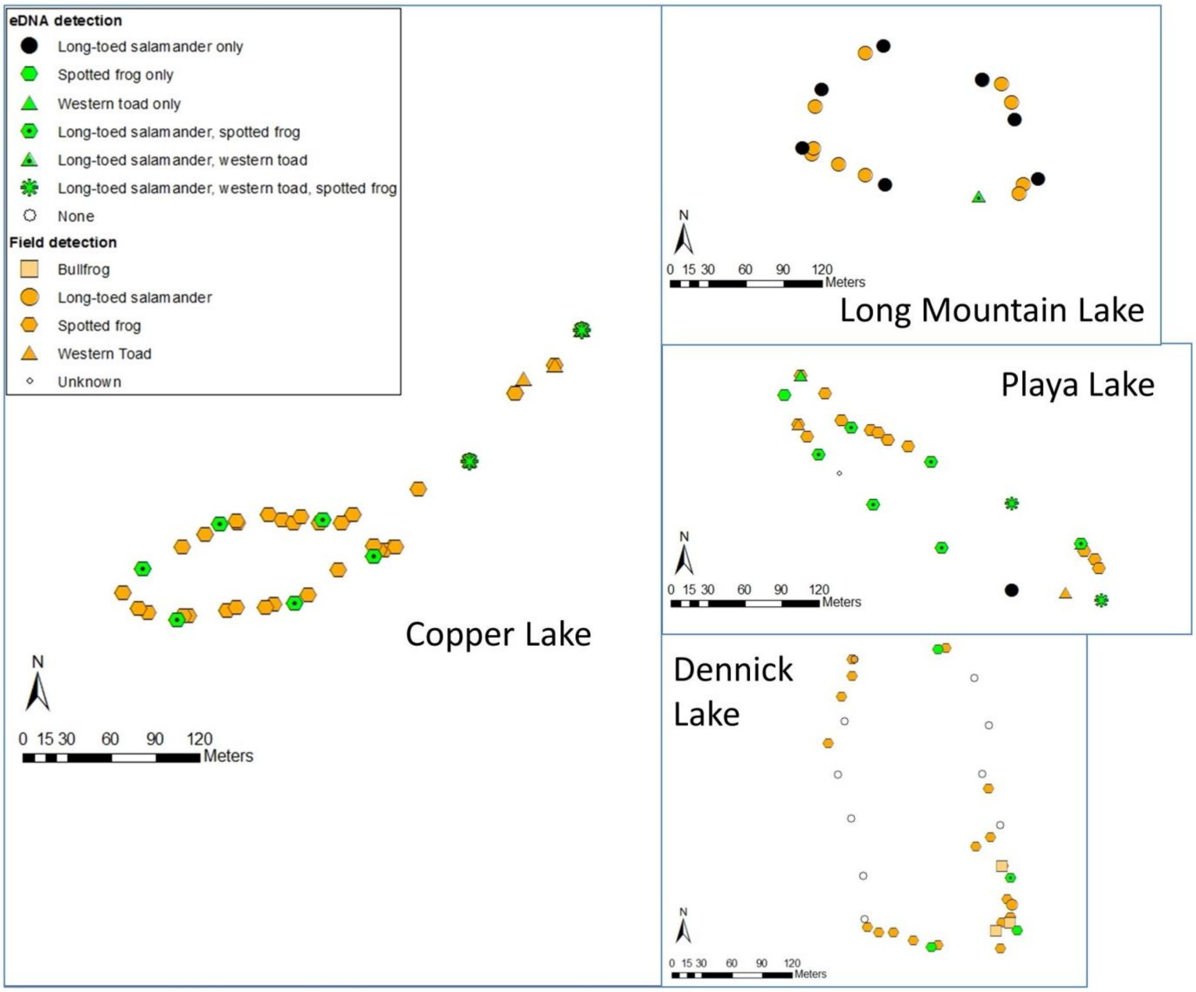

Figure 1. Field observations and environmental DNA sampling results from 4 lakes in northern Idaho. Environmental DNA samples were taken in triplicate from each location.

Conclusions

Environmental DNA showed very high detection probabilities for long-toed salamanders and Columbia spotted frogs and slightly lower detection probabilities for western toads given that they were within 50 m of the sampling site. For >95% probability of detection of these species, two samples need to be taken in a segment for long-toed salamanders and Columbia spotted frogs and three for western toads. At the scale of the lake, we found that some sites <25 m away from an observation (and some right at an observation, if field identification was accurate) did not detect the species using eDNA. Overall lake detection probabilities indicate that for average lakes, 3 samples in a lake (evenly spaced) is enough to detect long-toed salamanders and Columbia spotted frogs with >95% certainty. However, for western toads, this number may range from

13 for breeding populations to 74 for individual adults passing through (one adult western toad was found 200 m from Long Mountain Lake).

Environmental DNA results found species in areas of the lakes where they were not detected with visual sampling, and also detected species that were missed in surveys of the whole lake with visual and dipnet sampling (long-toed salamanders at Copper and Playa Lakes, western toads at Long Mountain Lake). This indicates a complementary role for eDNA in detecting and monitoring amphibian species in northern Idaho, even those that appear to have high detection probabilities. To conduct this complementary sampling, water samples would be taken before dipnet surveys begin and placed in the shade during field surveying. If all target species are detected during the survey, the water is discarded. However, if not all target species are detected, the water can be filtered and the filter preserved for later analysis.

Finally, the low detection probabilities at Dennick Lake demonstrate that there are additional factors to be considered in the collection and preservation of eDNA samples. This site should be further investigated and resampled to try and determine why eDNA sampling showed such low detection at that site compared with the other sites from this study and similar studies with eDNA throughout the area and globally.

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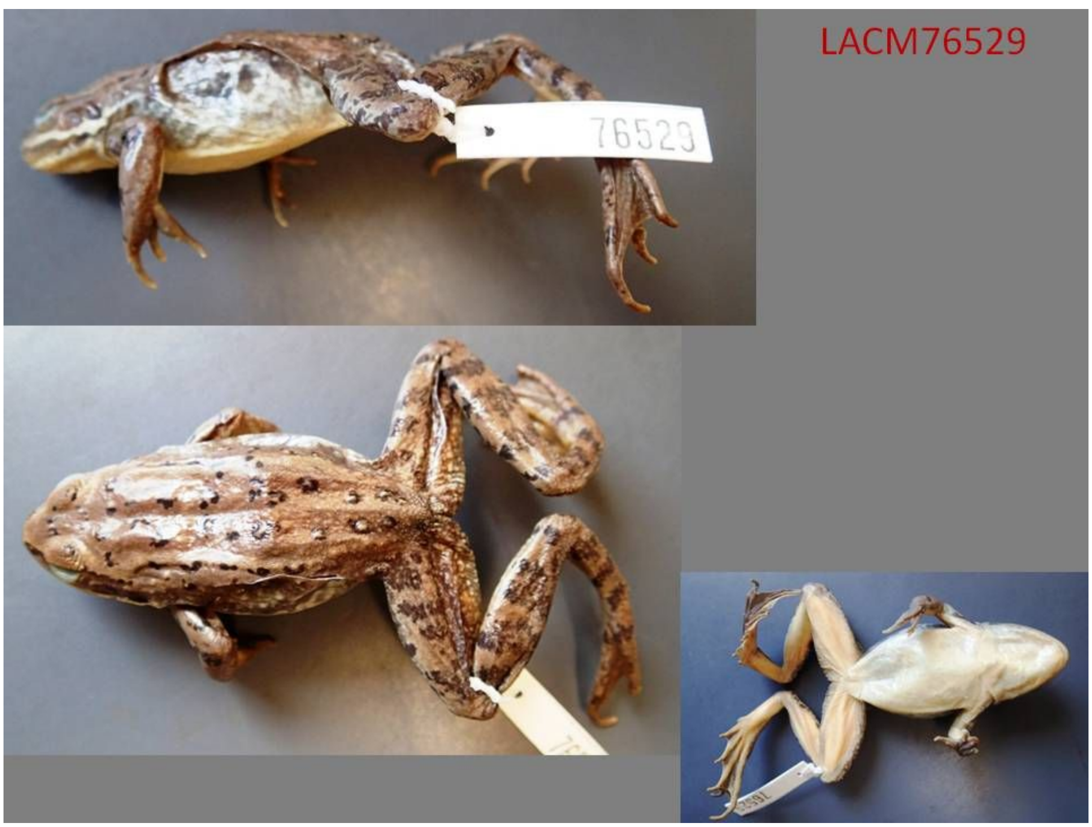
AppendixIIIe: Photographs of Purported *Rana sylvatica* and Confirmed *Rana pipiens* Museum Specimens

Taxonomy was confirmed for all historic observations of *Rana pipiens* for which specimens were available. Taxonomy was not confirmed for all historic observations of *Rana sylvatica* for which specimens were available. All purported *R. sylvatica* specimens were determined to be *R. luteiventris*.

Columbia spotted frogs (Rana luteiventris) samples which had been misidentified as wood frogs (Rana sylvatica) when collected:


LACM76528
76528
76528


LACM76529
76529


LACM76532
765


LACM76533
LAC
76533
765

Confirmed northern leopard frog (Rana pipiens) Museum Specimens:

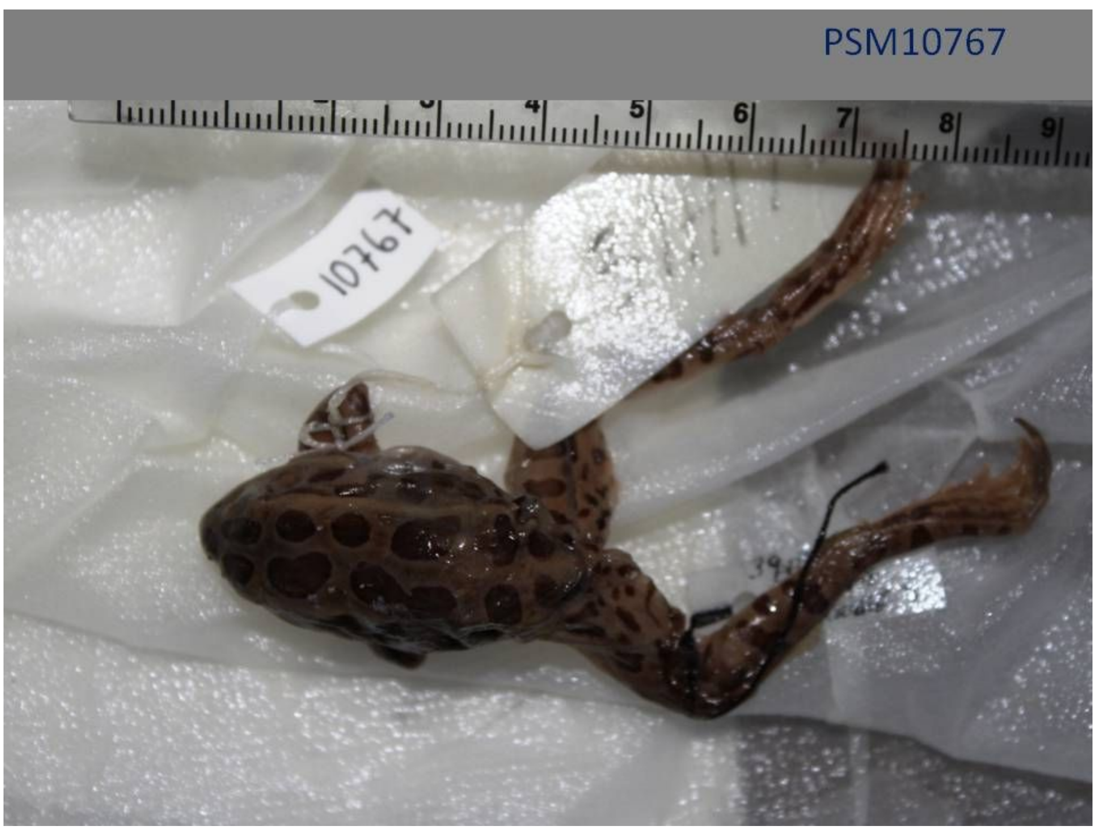
CRCM48-25

PSM2924

PSM2927

PSM2931


PSM2932
2932


PSM10767
10767

PSM10768

PSM10769

PSM10770

PSM10771
PSM10772

PSM10773

PSM10774


PSM10775
cm

Appendix IV. Carnivores - Multi-species Baseline Initiative

Appendix IVa: Protocols, Datasheets, Supply Lists, and Whitebark Pine Field ID Guide

Multi-species Baseline Initiative (MBI) Forest Carnivore Bait Stations: Protocols for Setup, Rebait, and Removal

Lacy Robinson and Michael Lucid, Idaho Department of Fish and Game

January 21, 2013

BAIT STATION SETUP

Choose a Station Location

Within each survey cell, bait stations should be located in places likely to be frequented by forest carnivores. Choose sites where carnivores are likely to travel, including saddles, heads of drainages, ridges, and drainage bottoms.

Once the general area for the bait station is chosen, pick a location that has good exposure to wind for distributing scent or is located along a likely travel route for animals. Place stations at least 50 meters from any road or snowmobile trail and avoid areas likely to be used by winter recreationists. Carnivores may become habituated to the bait station location. For that reason, do not place bait stations near any human dwelling or structure (even if it is not in use during the winter) nor near any road that may be heavily used in the summer. Avoid other areas of high summer use such as camp grounds and popular trailheads.

Choose a Bait Tree and Camera Tree

Trees should be:

- 9 to 11 feet apart from each other (measure the distance between the camera and bait trees).
- >12" diameter.
- Alive.
- NOT Whitebark Pine!
- Bait tree should not have neighboring trees within 4 feet (to prevent animals from jumping on the bait from a nearby tree instead of climbing the bait tree).
- Waypoint the camera tree. Use the WGS84 datum and decimal degree format (e.g., 48.1234, 116.12345).

Site Prep

- Remove all brush or small trees in between bait tree and camera tree that may inadvertently obscure the camera or trigger the camera when blown by the wind.
- Remove any branches near the bait (above or below) that might allow animals to “rest” on them.

Fisher resting on an improperly prepared bait tree. Notice how the fisher is resting on the branch well above the gunbrushes. These branches should have been removed upon set-up.

- Remove any branches above the camera that might collect snow and droop into the field of view, thereby obscuring pictures.

Wire Bait to the Bait Tree

- Any wild game meat can be used for bait. A front or hind quarter of a roadkilled ungulate works well. We prefer beaver carcasses. Frozen adult beavers can be cut in half easily with an axe. Juvenile beavers can be used whole. 10-15 pounds of meat is a good bait size.

SKIN YOUR BAIT! Un-skinned bait will result in ungulate or beaver hair spread all over your gunbrushes, contaminating your forest carnivore DNA samples!

- Use a 12" spike or a power drill to make four holes in the beaver carcass or bait: 2 on either side of the spinal column (or bone) about 3-4"apart.

- Wrap wire through these 4 holes and around the spinal column several times.  
- Use a spike or screwdriver to tighten the wire around the carcass- especially if you are wiring it when it is frozen (as the meat thaws, the wiring will loosen up).
- Leave wire tails 3-4 feet long on both ends of the wire.

Hint: wire your beaver *before* heading out in the

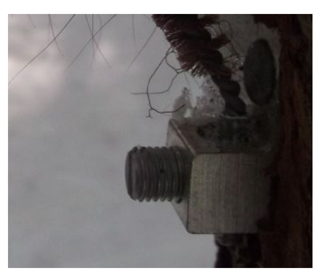
- Place bait 6-7 feet off the ground facing the camera tree (remember, it will snow more!).
- Place a large nail in the carcass or tail to hold the beaver up while you wire it to the tree.
- Place another large nail on the backside of the tree at the same height as the bait.
- Place 2 double headed nails on either side of the beaver about 4 inches away from the bait at the top and bottom of the bait (for a total of 4 nails).
- Take the tails of the wire and wrap them around the tree, wrapping the wire around the nails in the tree.
- Wrap 2-3 more long pieces of wire around the whole carcass, using the nails as anchor points. Try to create several angles of wire around the bait so that the carcass is VERY securely attached to the tree.
- Use a fencing tool to tighten the wire around the bait by creating loops in the wire in several spots.

Notice the well constructed 'harness' on the left hand beaver which will keep it attached to the tree as mustelids attempt to remove the carcass. However, this beaver's tail has obviously not been 'nailed' to the tree. 'Nailing the tail' often results in the tail being left behind after a mustelid does remove the carcass. On the right a fisher comes back to a tree to try and retrieve a tail. A combination of securely wiring the beaver to the tree and 'nailing the tail' makes the bait station effective for the longest time period possible.

Make sure you point the narrowest end of the bait up. This 'front half' of a beaver should have been oriented facing up the tree so there wasn't a nice resting platform for this bobcat. The goal is to force the animal to spend time touching the gunbrushes.

Attach the Gunbrushes and Accessories to the Bait Tree

- Use a short wood screw to attach 12 connectors (terminal lugs) to the bait tree.
- Connectors should be placed in two rings (6 connectors per ring) below the bait.
- The first ring should be 12” below the bottom of the bait.
- The second ring should be 18” below the bait.
- Connectors in the two rings should be offset so that no connectors are directly above or below another.
- Connectors should NOT be placed directly underneath the bait or anywhere where the bait will likely drip on the gunbrushes (causing contamination of the DNA sample).
- Orient the connectors so that the tab (screw side) is facing down.
- Make sure the connectors are firmly in place and do not swivel.
- Once the connectors are in place, use the screw in the connectors to attach the gunbrush to the connector.
- Use latex gloves or bare hands to handle the gunbrush. Fleece or wool gloves are more likely to have hairs pets or humans stuck to them which could contaminate the DNA samples.
- Make sure the gunbrush is firmly attached, but do not over tighten the screw as it can rust in the elements and become difficult to unscrew during station removal.
- When gunbrush is in place, bend it forward so that the brush is oriented at a 90 degree angle to the trunk of the tree. Make sure not to damage the bristles of the brush when you bend it.



Orient connectors so the side with the tab faces up. Insert the gunbrush from above. This reduces your chance of dropping it in the snow when you take it down.

- Use a lighter to sterilize each gunbrush for at least 5 seconds.
- Move the lighter up and down the gunbrush. This destroys any DNA that may be lingering on the brush (this is especially important if you own a cat!).

- Attach the criminal tape to the bait tree with two staples. Rope should extend at least 6" above the top of the bait and should be in view of the camera.

The 'criminal tape' is a rope with reflective tape wrapped around it every 12 inches. This helps give a size estimate for difficult to identify animals.

- Attach station sign to bait tree with a double headed nail. Sign should be placed about 6 inches below the bait and should be labeled with the station ID ("W" plus cell #).

The station sign should have large, easily read, block letters.

Hang Gusto Sponge

- Before heading out to the field, soak sponges in gusto and a little water (to moisten sponge).
- Transport gusto sponge to the field in a ziploc bag.
- At the bait station, poke the end of a 2 foot long piece of annealed wire through the middle of the sponge.
- Choose a place to hang the sponge that will facilitate the spread of scent from the lure (e.g., open areas, areas higher up that will catch the wind). The sponge should be located within 50 feet (preferably within sight) of the station.
- Wrap the wire around the sponge.
- Hang the other end of the wire from a nearby tree as high as you can reach.

- Flag the tree or branch with the sponge on it so that it can be recovered when the station is removed.

Set up Camera Tree

- Use lock or bungee cord to attach the camera to the camera tree at the same height as the bait.
- Point the camera toward the bait. If necessary, shove small sticks behind the top or bottom of the camera to get the view angle right.
- If needed, shove sticks in between the lock and the tree to prevent the lock from slipping down the tree.
- Use the 'walktest' function on the camera to make sure that it is oriented correctly and that it will trigger when animals approach the bait.
- If using a Reconyx PC800 or PC900, camera settings should be as follows:

  Under Main Menu>Change Setup>Advanced>Trigger>:
  Motion Sensor: ON
  Sensitivity: High
  Pics Per Trigger: 3
  Picture Interval: Rapidfire
  Quiet Period: No Delay
  Main Menu>Change Settings>Advanced>
  Resolution: 3.1 MP
  Night Mode>Night Mode: Balanced
  Night Mode>Illuminator: ON
- Use an 8GB memory card or larger.
- Use NiMH batteries and make sure this is reflected in the main menu>battery type (if this option is present).
- Arm the camera and take several pics of you walking toward the bait.
- Use a handheld digital camera to review the pics and make sure you have the right field of view.

This camera has a poor field of view. It should be aimed lower so the entire bait and the ground are captured in the image.

- Field of view should include 6-12” of space above the top of the bait, but not much more than that as you will not be able to see animals that do not climb the tree but do approach the bait (wolves and coyotes).

This camera has a proper field of view which allows capturing images of non-tree climbing animals like this coyote.

- Erase test pics from card.
- If using a lock, make sure to record the key# and remove the key from the lock.
- **Arm the camera!**
- Make sure to record at least one picture of yourself (hand wave in front of the camera is fine) before you leave the station so that we have a record of when the camera was set.
- Before leaving the site, make sure you have recovered all tools and gear from the ground.

BAIT STATION REBAIT

- Make sure to record at least one picture of yourself (hand wave in front of the camera is fine) so that we have a record of when the station was rebaited.
- Turn off the camera.
- Replace memory card and batteries.

Sample Collection

- Examine each gunbrush closely for hair
- Only collect gunbrushes that have visible hairs present (not lichens!)

Hint: To help see hair, put an envelope behind the gunbrush.

- Label sample envelopes with:
  - Sample ID: W, cell number, sample letter (A-L), V, visit number (The first visit is the setup. There will be no samples ending in V1)
  - (Example: The fifth gunbrush collected on the third visit to cell 125 will be called **W125EV3)**
  - Observers
  - Date
  - Waypoint in decimal degrees latitude/longitude (WGS84)
  - Cell #
  - Sample type= FC bait station
- Use a screwdriver to loosen the screw holding the gunbrush in place
- Without touching the gunbrush, cover the gunbrush with the sample envelope and remove the gunbrush (inside the envelope) from the connector. You do not have to collect the samples in any particular order.
- Place all sample envelopes in a Ziploc bag.
- Once home for the day, take samples out of the Ziploc bag and spread them out to dry. Moisture can cause the envelopes to rip and can damage DNA! Be sure to keep pets away from your samples, drying them in a drawer works great and keeps pet hair away from them.

Replace Gunbrushes and Bait

- Place new gunbrushes in the connectors that you removed samples from. See protocols in the station setup section. Gunbrushes that did not have hair on them should be left untouched.
- Replace the bait. See protocols in the station setup section.
- **Re-arm the camera!**
- Make sure to record at least one picture of yourself (hand wave in front of the camera is fine) before you leave the station so that we have a record of when the camera was reset.
- Before leaving the site, make sure you have recovered all tools and gear from the ground.

BAIT STATION REMOVAL

- Make sure to record at least one picture of yourself (hand wave in front of the camera is fine) so that we have a record of when the station was removed. Be sure to keep pets away from your samples, drying them in a drawer works great and keeps pet hair away from them.
- Turn off the camera.

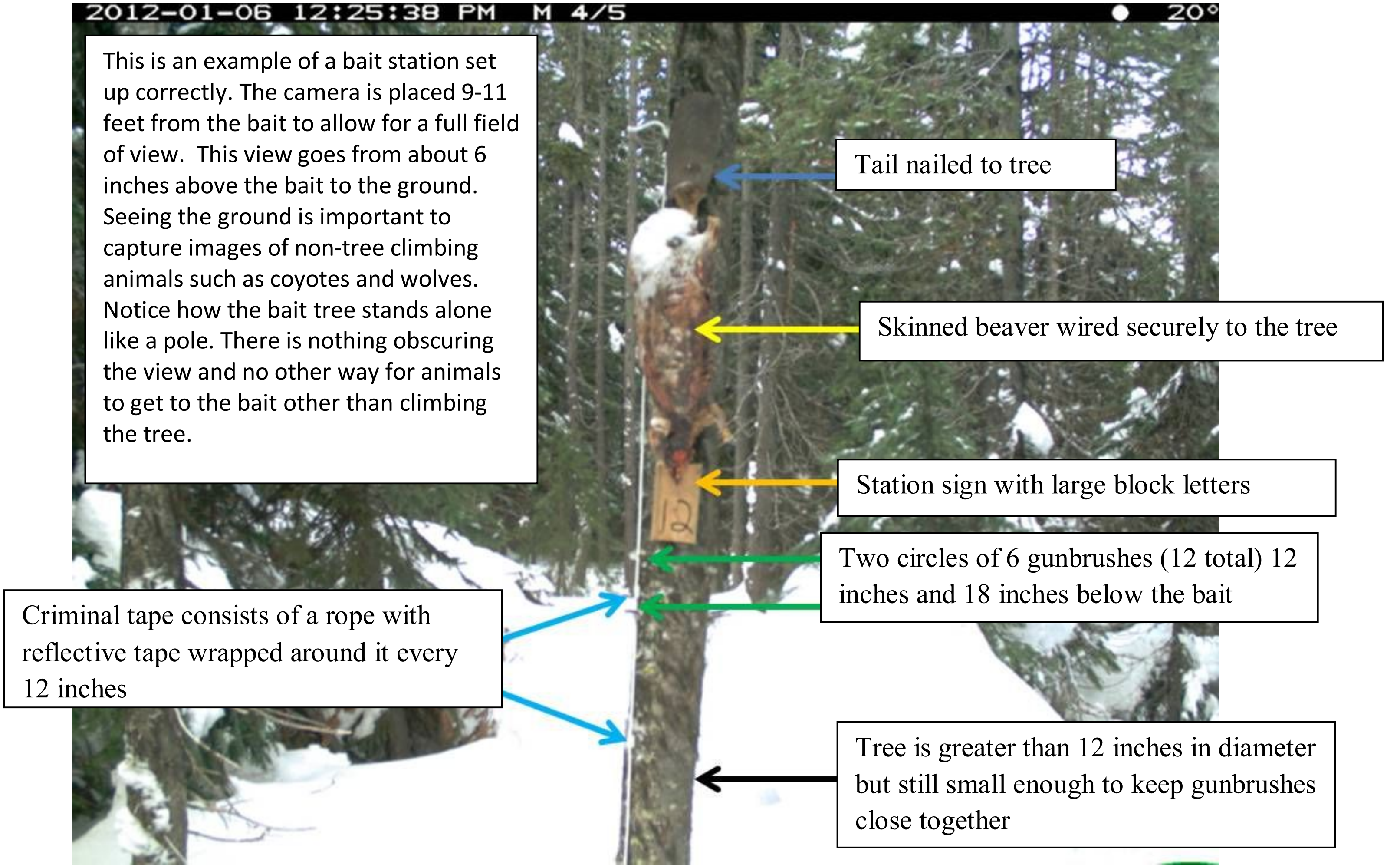
Sample Collection

- Examine each gunbrush closely for hair.
- Only collect gunbrushes that have visible hairs present (not lichens!).
- Label sample envelopes with:

  Sample ID: W, cell number, sample letter (A-L), V, visit number (The first visit is the setup. There will be no samples ending in V1)
  (Example: The fifth gunbrush collected on the third visit to cell 125 will be called **W125EV3)**
  Observers
  Date
  Waypoint in decimal degrees latitude/longitude (WGS84)
  Cell #
  Sample type= FC bait station
- Use a screwdriver to loosen the screw holding the gunbrush in place.
- Without touching the gunbrush, cover the gunbrush with the sample envelope and remove the gunbrush (inside the envelope) from the connector. You do not have to collect the samples in any particular order.
- Place all samples in a ziploc bag.
- Once home for the day, take samples out of the Ziploc bag and spread them out to dry. Moisture can cause the envelopes to rip and can damage DNA!

Remove Hardware and Camera

- Use fencing tool to remove all wire and bait from the bait tree.
- Toss remains of bait into the woods. Make sure there is no wire left in the bait that you toss in the woods.
- Remove all connectors, station sign, criminal tape, and nails from bait tree.
- Remove camera.
- Remove gusto sponge and all flagging.
- LEAVE NO TRACE! Make sure ALL hardware and gear is removed from the station site.



IDFG training video can be found at:
http://www.youtube.com/watch?v=b_D0XsTKWn4&feature=youtu.be

Forest Carnivore Bait Station Setup **Station (W,Cell#):______**

Observers:____________________________ _______ Date: _______________

Lat: ________________ Long:______________________ Datum: __________

Distance between bait and camera trees (96-144 inches): ______________inches

Camera model: ReconyxRM45 ReconyxRC55 ReconyxPC800 Other____

Camera serial number: ___________________ Camera lock key number ______

□ Pick bait tree (≥12" diameter), apart from other trees (so animal can only access bait from bottom).
MAKE SURE BAIT AND CAMERA TREES ARE **NOT** WHITEBARK PINE!!!!!
□ Pick camera tree 8-12' from bait tree. Make sure camera tree is small enough so lock will fit around it.
□ Measure and record distance between camera and bait tree in inches.
□ Take waypoint of camera tree in WGS84, average 80 time if GPS allows.
□ Remove all 'resting' branches from bait tree.
□ Remove any branches on both trees which may potentially block camera view or trigger camera.
□ Wire beaver securely to bait tree (bottom of beaver 6' off ground) - nail the tail!
□ Screw 12 gunbrush holders to bait tree in two concentric circles.
First circle will be 12" below beaver, second circle 18" below beaver.
Do not place gunbrush holders directly below beaver (so blood doesn't drip on gunbrushes).
□ In each holder, place one gunbrush from above and tighten.
□ Attach criminal tape to bait tree, in view of camera, extending from beaver to snow.
□ Nail station name placard below beaver.
□ Confirm memory card and charged batteries are in camera.
□ Lock camera to tree making sure camera is at same height as beaver.
□ Remove key from lock and record key number.
□ 'Walktest' camera.
□ Flag camera tree (do not block camera view!).
□ Hang and flag gusto sponge (≤10meters from bait).

Forest Carnivore Bait Station Follow-up   Visit#_________   Station (W, Cell#):_________

Observers:_________________________   Date: _________________

Bait status (circle one): untouched   partially consumed   skeleton   all gone

Action taken (circle one):   station removed   station re-baited

Camera batteries replaced (circle one):   yes   no

Sample IDs:____   _____________

SAMPLE CARE: As soon as you are out of the field take all envelopes out of Ziploc bags. Lay them out where they will dry and will not be accessible to pets. A drawer works great. SAMPLES NEED TO BE DRY FOR DNA TO REMAIN VIABLE.

DO NOT EVER TOUCH DNA SAMPLES!!

IF RE-BAITING STATION:

□ Turn off camera.
□ Replace batteries if level is below 80%.
□ Replace memory card.
□ Examine each gunbrush closely for hair.
□ Without touching hair, place each gunbrush with hair in a separate envelope (1 per envelope) and label:
    W, station number, sample letter (A-L), V, visit number
    Example: The fifth gunbrush collected on the third visit to station 25 will be called: **W25EV3**
    The first visit is the setup. There will be no samples ending in V1.
□ Seal all envelopes in a Ziploc bag (one Ziploc per station).
□ Replace gunbrushes taken as samples with clean gunbrushes, leave gunbrushes with no hair untouched.
□ Account for all 12 gunbrushes.
□ Hang new beaver.
□ **Re-arm camera!!**

IF REMOVING STATION:

□ Collect and name samples as above.
□ Place gunbrushes without hair into a Ziploc bag. Return these for cleaning.
□ LEAVE NO TRACE:
    □ remove all hardware and flagging from tree
    □ collect gusto sponge and flagging.
    □ remove all wire from beaver carcass before discarding in woods.

Bait Station Supplies and Tools Needed:

Part	Cost	Number Needed	Total Cost	Source
.30 caliber rifle brush	0.75	12	$9.00	ATK Security and Sporting
14-2 ALCU Terminal Lug	0.73	12	$8.76	Idaho Electric Supply
sample envelope	0.08	12	$0.96	envelopesuperstore.com
wood screw		12		
criminal tape	.08/ft	6	$0.48	
large staples		2		
large nail		1		
contractor bag	0.5	1	$0.50	
station sign		1		
sponge	0.46	1	$0.46	buythecase.com
gusto				Minnesota Trapline Products
form/annealed wire				
flagging				
1/2 beaver	6	0.5	$3.00	
Total			**$23.16**	

Tools Needed:

Phillips head screwdriver
Flathead screwdriver
Fencing tool
Hammer
GPS unit
Data sheet
Pencil/pen
Bait gloves
Measuring tape
Folding brush saw

WHITEBARK PINE IDENTIFICATION

Whitebark pine (*Pinus albicaulis*) is a candidate for listing under the Endangered Species Act. The U.S. Fish and Wildlife Service has directed Multi-species Baseline Initiative partners to mitigate any potential harm to individuals of this species by instructing field personnel (this includes employees and volunteers) as follows:

DO NOT ATTACH HARDWARE (screws, beavers, cameras, etc) OR OTHERWISE ALTER WHITEBARK PINE TREES (cut branches etc).

Whitebark pine is typically found at higher elevation sites. Young whitebark pines have greyish white to chalky white bark while older trees have brown scaly plates with narrow fissures. Whitebark pines can be confused with Lodgepole pines (*Pinuscontorta*) or Western White pine (*Pinusmonticola*). Cones and needles are the best way to tell the two species apart.

Count the number of needles per fascicle:
Whitebarkpines have five needles per fascicle (bundle), which range in length from 2- 3 inches. If there are fewer than five needles per fascicle, then the tree is not a Whitebarkpine. Lodgepolepines have two and sometimes three needles per fascicle, so this is a good way to distinguish between the two species.

If there are five needles per fascicle:
The other trees species in Northern Idaho that has five needles per fascicle is Western White pine, whose needles tend to have a blue-green appearance and range in length from 2-5 inches. Whitebark pine is most easily distinguished from Western White Pine by its cones, which are MUCH smaller (2-3 inches long) than those of Western White pine 5-10 inches long).

Whitebark Pine	Lodgepole Pine	Western White Pine
Cones: **Small 2-3 inches long**, broadly ovoid, purplish brown when mature, blunt triangular tips that lack prickles	Cones: **Small 0.5-2 inches long**, asymmetrical and lop-sided, cylindrical with prickles	Cones: **Large 5-10 inches long**, slender and slightly curved, flat and lack prickles, hanging
Needles:**Bundles of 5**, stiff, dull to bluish green, **1-3 inches long**	Needles: **Bundles of 2**, yellow green, stiff and twisted, **0.5-3 inches long**	Needles: **Bundles of 5**, thin, soft, bluish green,**2-5 inches long**

Photo: Richard Sniezko, USFS

Photo: USFS

Photo: BC Ministry of Forestry

IF IN DOUBT, CHOOSE ANOTHER TREE!

Appendix V. Microclimate - Multi-species Baseline Initiative

Appendix Va: Air Temperature/Relative Humidity Protocols and Data Sheets
Appendix Vb: Water Temperature Protocols and Data Sheets
Appendix Vc: Air Temperature Algorithm

Appendix Va: Air Temperature/Relative Humidity Protocols and Data Sheets

Protocol adapted from:
Holden, Z.A., A. Klene, R. Keefe and G. Moisen 2013. Design and evaluation of an inexpensive solar radiation shield for monitoring surface air temperatures. Agricultural and Forest Meteorology 180: 281-286

Logger Installation

TEMPERATURE LOGGER LOCATION

1) Travel to the assigned waypoint for the grid. Find a suitable tree within 40 meters of assigned point for climate logger (>12" diameter, a conifer, not whitebark pine, and in shady location). Place logger on **north** side of this tree. *If no trees, do not deploy logger.*
2) Write cell number in dry erase marker on 'begin' card. Take a picture of the paper. While standing at climate logger tree take three pictures facing 45°, 180°, and 315°, including note card with bearing (write cell # on card) in photo. Label pictures C, cell #, P, bearing.

CLIMATE DATA LOGGER

1) **Record 10 digit serial number of data logger. DO NOT PRESS START button**.
2) Use aluminum nails to attach radiation shield cover to north side of tree about 5 feet off the ground.
3) Use 4" zip tie to attach data logger to top of 2 plate shield fairly tight.
4) Use three 8" zip ties to suspend the 2 plate shield from cover.
5) Photograph the radiation shield. Photo should show the surroundings of the shield. Label photo: C, cell #, P, T.
6) Measure distance in centimeters from the ground to the bottom of the radiation shield.
7) Determine the amount of shade using the following metric:
    - 1: Completely open (clear cut or field).
    - 2: Not completely open but looks like it would probably get some direct sun.
    - 3: Looks pretty shady but might be some sunlight getting thorough.
    - 4: Completely shaded, not hit by direct sunlight all year.
8) Waypoint station and tie flag around tree above it. Label flag with cell #.

Logger Takedown/Replace

TEMPERATURE LOGGER LOCATION

1) **Travel to Waypoint with GPS**
2) **Find Logger:** Once you reach the waypoint, spend 30 minutes searching for logger.
    a. If you find a tree with pink flagging tied around the trunk you have found the logger tree (but the rad shield and logger are gone). Search the ground for the logger and rad shield.
3) **Note on Data Sheet if Not Found**

CLIMATE DATA LOGGER

1) **Photograph***:* Take four photographs. One photograph of the logger tree, then three photos at 45°, 180° and 315° of the surrounding vegetation. Include a card that has the photo ID in each photo (example: CXXXP45)
2) **Shade Metric***:*
    a. 1: Completely open (clear cut or field).
    b. 2: Not completely open but looks like it would probably get some direct sun.

c. 3: Looks pretty shady but might be some sunlight getting thorough.
d. 4: Completely shaded, not hit by direct sunlight all year.

3) **Height:** Measure distance (centimeters) from the ground to the bottom of the rad shield.
4) **Habitat Changes:** Note any major habitat changes (i.e. clear cut, fire) that appear to have occurred since logger was deployed.
5) **Logger on Ground?** Note on data sheet if logger was found on the ground.
6) **Rad Shield Damage:** Note any damage or anything unusual about radiation shield.
7) **Take Logger Out:** Use knife to cut zip-ties and remove data logger. **Do not push START button!!!**
8) **Write Data on Back of Logger with Sharpie:** Date (e.g. 9 Sept 2014) - Military Time - Waypoint ID - Your 3 initials

REPLACING CLIMATE LOGGER

1) Repair any damage to the radiation shield. Add more aluminum tape to the top shield.
2) **Record 10 digit serial number of the new data logger. DO NOT PRESS START button.**
3) Use 4" zip tie to attach data logger to top of 2 plate shield fairly tight.
4) Use three 8" zip ties to suspend the 2 plate shield from cover.

TAKE DOWN CLIMATE LOGGER

1) **Take RAD SHIELD Down With Hammer**
2) **Leave No Trace!** Make sure to take all flagging, nails, and other hardware out of the woods.

Logger Installation Data Sheet

Cell: ________ Date (e.g. 15 June 2013):________________Start Time: ______Observer(s):__________

Plot Photo IDs (CxxxP bearing): 45°________ 180°_________ 315°__________

Directions to Plot:

____
____
____
____

Weather Station

Type of weather station (circle one): TRIX8 HAXO8 none

Waypoint Name (CxxxT): __________________ Weather Station Photo ID (CxxxPT):______________

Lat. __________________________ Long. ____________________ (WGS 84, decimal degrees)

Serial Number: _____________________________ **DO NOT PRESS START BUTTON!**

Logger Height (cm):______________ Shade metric (1-4):________

Logger Takedown/Replace Datasheet

Front of datasheet

Waypoint ID	Cell #	Takedown Date (M/D/YY)	Takedown Time (Military time)	OBS	Pictures				Logger height (cm)
					Logger (CXXXPT_2014)	45 CXXXP45_2014	180 CXXXP180_2014	315 CXXXP315_2014	
					Tidbit WXXXTidbitP_2014	Wetland WXXXP_2014			Tidbit Depth (cm)

Back of datasheet

Waypoint ID	Shade Metric	Logger on ground?	Logger Serial #	Habitat changes(i.e. fire, clear cut)	Damage (i.e. tape rip, logger above water?)	New Logger Serial #	Comments

Radiation Shield Construction Supplies

Item	Number/ site	Supplier	Item #	Web Page
4mm corrugated white plastic (48x96)	1-12x12” 2-8x8”	Laird Plastic	110143	https://www.lairdplastics.com
2 ½” x 60 yds. 324A-Premium Cold Weather HVAC Foil Tape		Home Depot		http://www.homedepot.com/
Heavy Duty Plier Stapler	1	Salco	P694STD	https://www.stapleheadquarters.com
3/8” staples	8	Salco	PSTCR5019/10	https://www.stapleheadquarters.com
Utility knife	1			
8” Zip Ties	6			
4” Zip Ties	1			
Aluminum nails	3			
LogTag Temperature Recorders (TRIX8, TRIX16, or HAXO8)	1	ThermoWorks		http://www.thermoworks.com/
LogTag USB Interface Cradle	1	ThermoWorks		http://www.thermoworks.com/

Radiation Shield Construction Video:

https://www.youtube.com/watch?v=LkVmJRsw5vs

Appendix Vb: Water Temperature Protocols and Data Sheets

Protocol Adapted from:
Isaak, D. J., D.L. Horan, and S.P. Wollrab 2013. A Simple Protocol Using Underwater Epoxy to Install Annual Temperature Monitoring Sites in Rivers and Streams**.** Gen. Tech. Rep. RMRS-GTR-###. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Available online: http://www.fs.fed.us/rm/boise/AWAE/projects/stream_temp/downloads/2013_StreamSensorEpoxyProtocol_RMRS_GTR.pdf

The ideal time to install data-loggers in small ponds is late summer or early fall when water levels are lowest. This allows the logger to be placed in a location where it is most likely to remain underwater for the entire year.

Water Data Logger Installation

1) Select a rock in secluded and shady location. A large boulder on the north side of the wetland would be ideal. If no rocks are present you may transport a rock to the site and attach the logger to it.
2) Use wire brush to clean rock of any debris or algae. If no rock available use re-bar.
3) Rub a half golf ball size of each epoxy together for one minute (wear gloves!). Place around rim of male portion of rad shield. Attach to rock.
4) Zip-tie Tidbit to female portion of rad shield (write down serial number!). Make sure the side that says, 'Tidbit' faces out. Use teflon tape and screw female part on male part.
5) Measure the distance between the surface of the water and the top of the logger shield in centimeters
6) Measure the distance between the water's edge and the logger in centimeters
7) Take excellent waypoint and draw diagram of tidbit location. Take photo showing tidbit and surroundings.
8) Flag the nearest location to the tidbit and label flag with cell #.

Water Data Logger Download

1) Locate data logger (Tidbit). Spend at least 1 hour searching for the tidbit. Make sure to bring a trowel and chisel. The housing may have been buried in silt or the cap may have been epoxied.
2) Once the logger is located, take a photograph of the logger. Also take a photograph of the wetland.
3) Measure the logger depth (centimeters)
4) Measure the distance the logger is located from the water's edge (centimeters).
5) Unscrew the PVC cap and snip the zip tie holding the tidbit in place
6) Ensure the LED bulbs are still attached on the front of the tidbit and that the sensor is still blinking.
a. If the bulbs are broken or missing, collect the tidbit to bring back to the office. Remove all other materials from the field (leave no trace). **Do not throw the tidbit away!**
7) Press the tidbit firmly into the shuttle coupler with the LED lights facing down and squeeze the black lever. Press hard enough that the lever bends.
a. An amber light will blink if the data is downloading. **Do not remove the tidbit from the coupler during the download.**

b. A red light will blink on the shuttle if it is not properly engaged. Remove the logger and gently clean the tidbit with the kimwipes and try again.
c. A green light will blink when the data is done downloading. It will blink for 15 minutes. It is safe to remove the tidbit from the shuttle at this time. Press the black lever again to stop the green light from blinking.

8) Record the serial number of the tidibit on your datasheet.
9) Redeploy the tidbit by securing it in the PVC cap with a zip tie. Make sure the LED lights are facing outwards.
10) Screw the cap back into the base.
11) Mark the nearest spot on land with pink flagging. Make sure to label the flagging with a waypoint ID.

Water Temperature Data Logger Data Sheets (See Appendix IIIa for complete amphibian datasheet)

Water Data Logger Installation (most often in conjunction with an amphibian survey)

Wetland ID: _________ Cell: ______ Date (e.g. 15 June 2014):_____________ Start Time: _______ Observer(s):______

Weather (circle one): Sunny, Mostly Sunny, Partly Sunny, Overcast, Light Rain, Heavy Rain, Snow

Wetland Type (circle one): Natural Pond, Ephemeral Natural Pond, Constructed Pond, Modified Natural Pond, Lake, Stream , Channels Near Stream, Puddles, Emergent Wetland, Meadow, Forest-No Wetland, Not-Forested-No Wetland, Beaver Pond, Other: _____________

Site is (circle one): Wet or Dry Search Type (circle one): Full Perimeter, 500 Meter Shoreline, 30 Minute T.S.

Wetland Waypoint: _________Lat:___________ Long: ______________ Wetland Photo ID: (W, cell#, P) ___________

TidBit: Yes or No TidBit Waypoint: _____________ Lat: ___________Long:______________ TidBit SN: ___________

Wetland Diagram

Last Section (m): ___________

Total Perimeter (m): _________

Tidbit Diagram

Tidbit Photo ID: ____________________________

Directions to Plot:

Directions to Tidbit:

Landowner Name: _________________________________

Landowner phone: _________________________________

Tidbit Depth (cm):____

Distance to shore (cm):______

Water Data Logger Download (in conjunction with Air Temperature Logger takedown/replace)

Front of datasheet

Waypoint ID	**Cell #**	**Takedown Date (M/D/YY)**	**Takedown Time (Military time)**	**OBS**	**Pictures**				Logger height (cm)		
					Logger (CXXXPT_2014)	45 CXXXP45_2014	180 CXXXP180_2014	315 CXXXP315_2014			
					Tidbit WXXXTidbitP_2014	Wetland WXXXP_2014			Tidbit Depth (cm)	Distance to water edge (cm)	

Back of datasheet

Waypoint ID	Shade Metric	Logger on ground?	Logger Serial #	Habitat changes(i.e. fire, clear cut)	Damage (i.e. tape rip, logger above water?)	Comments

SUPPLIES

Item	Number/ site	Supplier	Item #	Web Page
1 ½” x ¾” Schedule 40 Reducer Bushing	1	PVC Fittings Online	439210	http://www.pvcfittingsonline.com/
1 ½” Schedule 40 Threaded cap	1	PVC Fittings Online	448015	http://www.pvcfittingsonline.com/
FX-764 Hydro-Ester Splash Zone & Underwater Paste (Fox Industries)		Simpson Strong-Tie		http://www.strongtie.com/
Plumber’s tape				
4” Zip Tie	1			
Vinyl gloves	2			
Containers for epoxy	2/person			
Wire Brush	1/person			
TidbiT V2 Water Temperature Logger	1	Onset Computer Co.	UTBI-001	http://www.onsetcomp.com/
Hobo Underwater Data Shuttle	1	Onset Computer Co	U-DTW-1	http://www.onsetcomp.com/
Chisel	1/person			

Radiation Shield Construction Instructions:

http://www.fs.fed.us/rm/boise/AWAE/projects/stream_temperature.shtml

Appendix Vc: Air Temperature Algorithm

Andrew Shirk (University of Washington) developed and wrote the algorithm code with input from Michael Lucid (Idaho Department of Fish and Game) and Dr. Sam Cushman (US Forest Service Rocky Mountain Research Station)

We developed an algorithm which enforced the following 6 rules to determine if air temperature data was accurate or erroneous.

1) Maximum allowed daily temperature: 38.8°C

This was the maximum temperature recorded at SNOWTEL stations located within the study area from 2010-2014.

2) Minimum allowed daily Temperature: -30.0°C

3) Minimum min-max daily temperature range: 2.0°C

We assumed if the min-max daily temperature range was <2.0°C the data logger was affected by snow pack.

4) Maximum temperature anomaly threshold: 2.5°C

We assumed if the temperature spiked ≥2.5°C and the logger was affected by direct sunlight.

5) Maximum allowed missing observations per day: 2

Data for the entire 24 hour period was removed if >2 data points were not recorded by the data logger.

6) Maximum allowed interpolated observations per day: 2

If one data point was missing or determined erroneous by the algorithm, but was bounded by 2 acceptable data points, a mean of the 2 bounding points was calculated to replace the erroneous point. Only 2 interpolated points were allowed be 24 hours period or the entire period was deleted.