Human-Cougar Interactions: A Literature Review Related To Common Management Questions

Human-Cougar Interactions Science Review Team

Department of Fish and Wildlife

Overarching Context

Objective - Manage cougars while being trusted to take action to help people feel safe

OUTREACH	RESPONSIVE TO PUBLIC	SCIENCE INFORMS DECISIONS	PARTNERSHIPS
Refine communication strategies and provide information and tools those who live and/or recreate in cougar country	Refine internal protocols, improve communication, and continue to improve incident tracking and agency response	Continue to support and engage in research to inform management. Continue to communicate findings and integrate science into policy discussions.	Build partnerships with NGOs, local governments, and the general public. Form a working group with partners to help inform agency discussions

Science Informing Decisions

Human-Cougar Interactions Science Review Team

WDFW Team Members

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Dr. Bruce Johnson - Wildlife Research Scientist, Oregon Department of Fish and Wildlife (retired)

Dr. Glen Sargent - Research Wildlife Biologist, USGS Northern Prairie Research Center

Science-Policy Interface

- Science as cornerstone
- What is the question?
- What do we know?
- Research, expertise, and experience
- Communication & integration
- Diverse team
- Broad expertise
- Humility
- Iterative process
- Mutual learning

Why is the Scientific Method Important in this Process?

- Framework for learning
- Promotes objective reasoning
- Rigorous assessment vs. opinion
- Repeatable

How Knowledge Advances

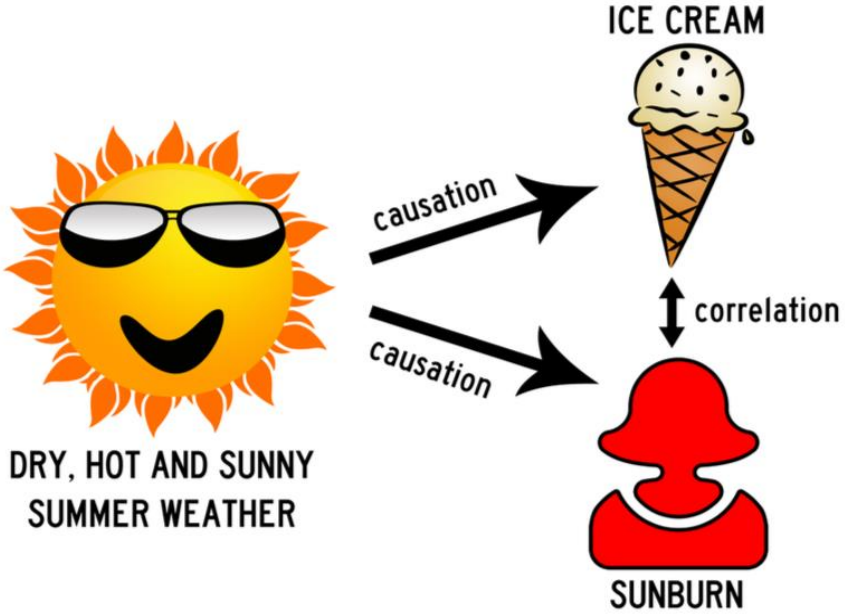
- Knowledge advances incrementally
- Critical review of published work is expected
- Prevailing theory emerges from replicated published work with consistent findings from others
- Body of science on human-cougar interactions still in early stages compared to natural history

Ecology *In Situ*

- Complex natural environment
- Data collection
- Variability
- Separating actual variable of interest from system noise/masking
- Analytical constraints (e.g., sample size)
- Other plausible explanations

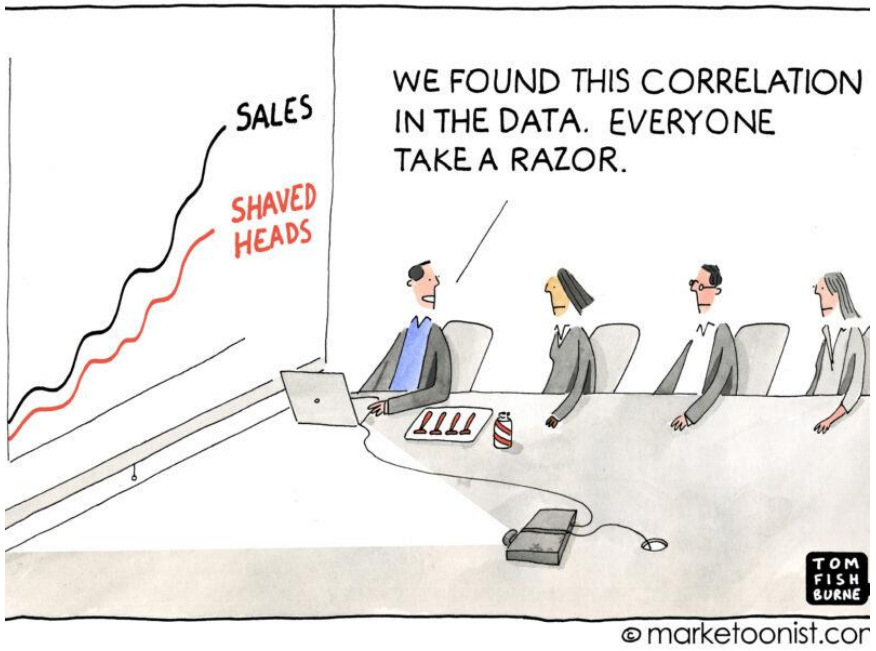
Holy Grail – Cause and Effect

- What drives a system or outcome?
- Typically evaluated in a control-treatment experiment
- Incredibly challenging in environmental sciences
- Seeking the signal in a world of noise



Common Errors in Complex Analytical Approaches

- Inappropriate tests
- Autocorrelation
- Inferring causation from correlation
- Spurious correlations
- Prediction beyond the range of supporting data
- Variable trending in time
- Data dredging
- Mismatch the scale of the data



•Sound scientific and analytic principles
•Recognizes the difficulty in studying animals like cougars

Our Review

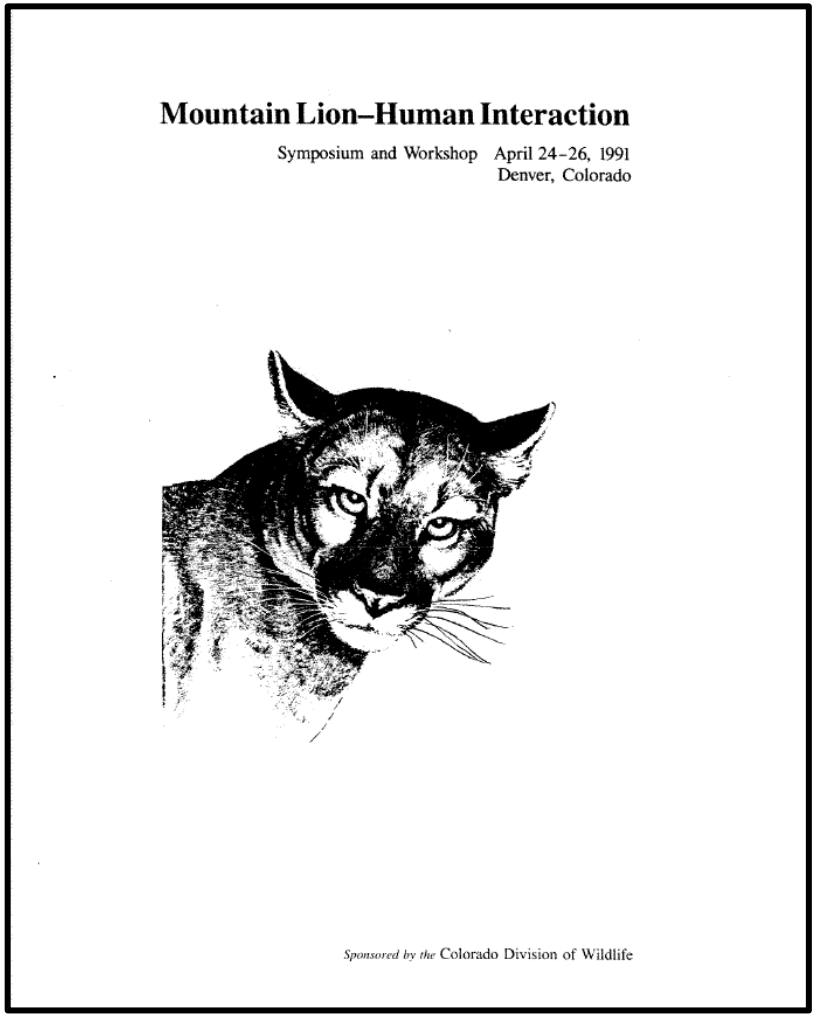
- Thorough, reasoned, and objective
- Sound scientific and analytic principles
- Recognized the difficulty in studying animals like cougars

Human-Cougar Interactions

- Management challenge
- Four categories:
  - -Sightings
  - -Encounters
  - -Depredations
  - -Attacks
- Source of frequent debate
- Minimizing is a priority

Human-Cougar Interaction Science

- Relatively new – 4th MLW
- Diverse landscapes
- Policy challenges:
  - -Number
  - -Complexity
  - -Translation
  - -Public interest
- Commission interest

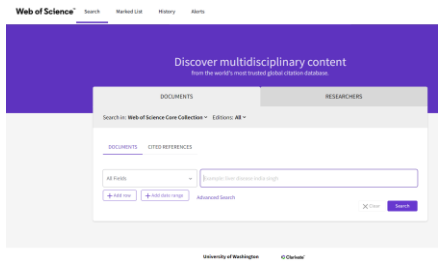


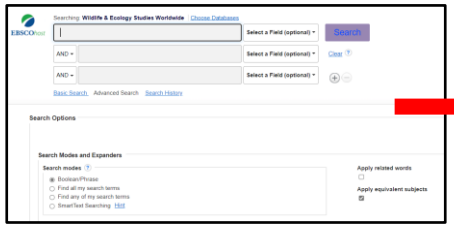
Science Panel Objective

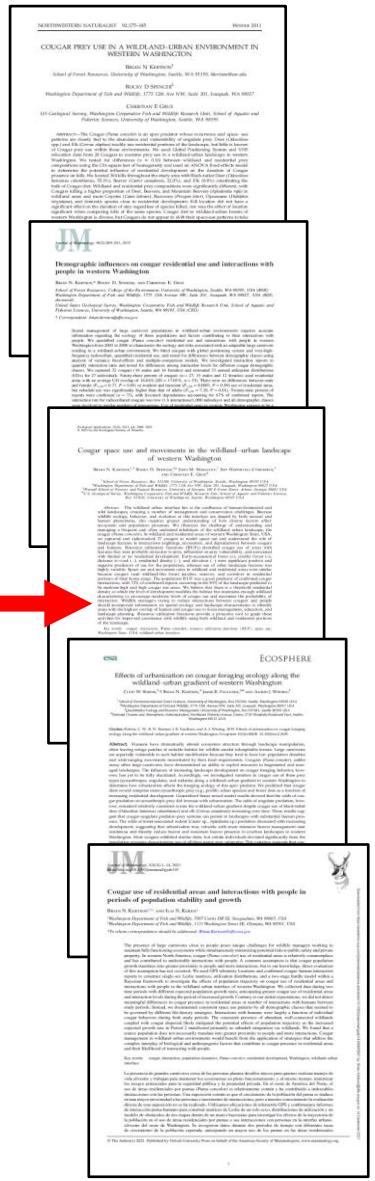
- Conduct a systematic review
- Current state of knowledge
- No management recommendations
- No policy assessment
- Research recommendations

Literature Search

- Bibliographic lists
- Research databases
- “Snowballing”
- 96 studies/papers
  - -87 ecology
  - -9 human dimensions
- Categorized







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Guiding Questions

- Needed to focus and organize review
- Common questions about factors that may or may not contribute to interactions
- 8 questions - considered both cougar and human-centric factors

The Review Process

- Initial review and assignment to question
- Standardized framework
- Analytical:

  -Assumptions, scale, sampling, data, and analysis
- Ecological:

  -Cougar ecology and behavior
- Limitations, issues, fatal flaws
- Discussed as a group
- Determine if conclusions supported

41 Studies

Data Sources: The IUCN Red List of Threatened Species. Version 2017-3. <www.iucnredlist.org> Downloaded on 11 March 2017. Western hemisphere country boundaries obtained from ESRI online. Northern range limit approximated from Hornocker and Negri (2010). Florida range boundary obtained from FWC.

Question 1

Do cougar removals through recreational hunting and/or agency conflict response affect the number or probability of cougar-human interactions?

Question 1

- **7 papers:**
  - -WDFW 2008 (-)
  - -Kirsch et al. 2009 (n/e)
  - -Peebles et al. 2013 (+)
  - -Hiller et al. 2015 (-)
  - -Teichman et al. 2016 (+)
  - -Laundr*é* and Papouchis 2020 (+)
  - -Dellinger et al. 2021 (+)
- **Inconclusive**

Question 1

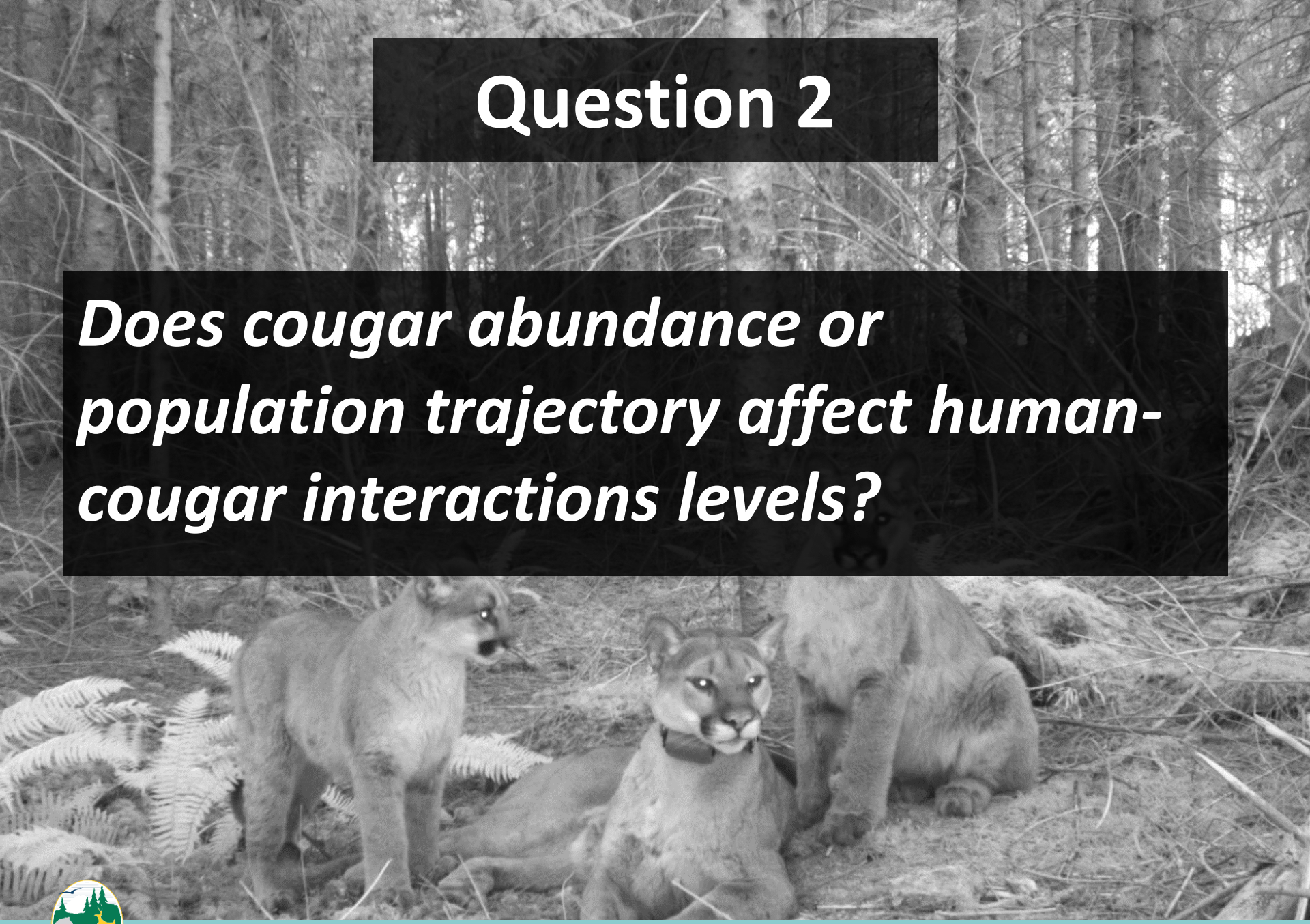
- 5 of 7 papers – *post hoc* regressions
  - -Faulty assumptions
  - -Convenient, but questionable data
  - -Did not directly measure cougar populations
  - -Did not account for variables trending in time
  - -Scale too coarse or mismatched
  - -Confounding variables
- Present hypotheses to be tested

Question 1

- **WDFW 2008:**
  - -Agency legislative report, not peer-reviewed
  - -Entirely descriptive, mismatched scales, not supported
- **Kirsch et al. 2009:**
  - -Agency report, not peer-reviewed
  - -Rigorous design: control-treatment design w/ replicates
  - -Did not account for confounding variables
  - -Removals – effect size?
  - -Logistical issues

Question 2

Does cougar abundance or population trajectory affect human-cougar interactions levels?



Question 2

- **5 papers:**
  - -Aune 1991 (+)
  - -Torres et al. 1996 (+)
  - -Lambert et al. 2006 (-)
  - -Hiller et al. 2015 (+)
  - -Kertson and Keren 2021 (n/e)
- **Inconclusive, some insights**

Question 2

- **Aune; Torres et al.; Hiller et al.:**
  - -Descriptive analysis (Aune)
  - -*Post hoc* regressions deficiencies (Torres et al., Hiller et al.)
  - -Did not directly quantify population (all)
  - -Data dredging (Hiller et al.)
- **Lambert et al. 2006:**
  - -Population growth directly quantified, interactions were not
  - -Mismatched scales of inference

Question 2

- **Kertson and Keren 2021:**
  - -Quantified both cougar population and interactions
  - -Accounted for potential confounding factors
  - -Small sample sizes, uncertainty, population change
- **Two key takeaways:**
  - -Growth ≠ more interactions; emigration via wildlands
  - -Effects of growth mediated or mitigated by ecological or anthropogenic factors; Torres et al., Hiller et al.

Question 3

Does the abundance, diversity, and/or distribution of prey affect human-cougar interaction levels?

Question 3

- 2 papers:
  - -Polisar et al. 2003
  - -Burgas et al. 2014
- South America
- Inconclusive

Question 3

- **Polisar et al. 2003:**

  -Depredations despite readily available prey

  -Management recommendations may have some utility

  -Descriptive analysis and biased prey estimates

- **Burgas et al. 2014:**

  -Differences between ranches?

  -Differences in puma population size or use?

  -Unreliable prey survey techniques, secondary prey

  -Relied upon P-values without effect sizes.

Question 3

- More expansive body of literature on diet/foraging ecology in wildland-urban landscapes
- Three studies fit with Question 5
- Others: kill rates, handling time, prey use
- Domestic prey used infrequently

Question 4

Do preventative measures, such as nonlethal deterrence, quality husbandry, and outreach/education/information sharing affect the level of cougar interactions with people?

Question 4

- 5 papers:
  - -Gonzalez et al. 2012
  - -Zarco-Gonzalez and Monroy-Vilchis 2014
  - -Guerisoli et al. 2017
  - -Alldredge et al. 2019
  - -Ohrens et al. 2019
- S. America studies concluded effective
- Alldredge et al., ineffective
- Situation-specific evidence

Question 4

- **Ohrens et al. 2019:**
  - -2x2 crossover, control-treatment design - rigorous
  - -Flashing lights (Foxlights®) reduced depredations
  - -Applicability of findings outside of unique setting?
- **Remaining South American studies:**
  - -Confounding variables
  - -Questionable depredation data
  - -Small sample sizes with descriptive comparisons
  - -Ranch characteristics, cougar pop. size, use

Question 4

- **Alldredge et al. 2019:**
  - -Different study – setting and techniques evaluated
  - -Opportunistic, small sample sizes, descriptive
  - -Logistical considerations for future work
- **Community engagement in SA studies:**
  - -Improved trust
  - -Access to sites and data
  - -Scientific literacy and application of protocols

Question 5

Do landscape characteristics (e.g., residential development levels and/or pattern, habitat type, connectivity) affect cougar-human interaction levels?

Question 5

- 22 papers, 7 core:
  - -Kertson et a. 2011
  - -Zarco-Gonzalez et al. 2013
  - -Blecha et al. 2018
  - -Alldredge et al. 2019
  - -Guerisoli et a. 2020
  - -Klees van Bommel et al. 2020
  - -Riley et al. 2021
- Most studied, best understood - yes

Question 5

- **Benefited from extensive empirical history:**
  - **-Used vs. unused/available, used more vs. less**
  - **-Logistic or multiple regression framework**
  - **-Models validated**
- **Diverse methods and locations with consistent findings:**
  - **-De facto replicates**
  - **-Increased certainty**

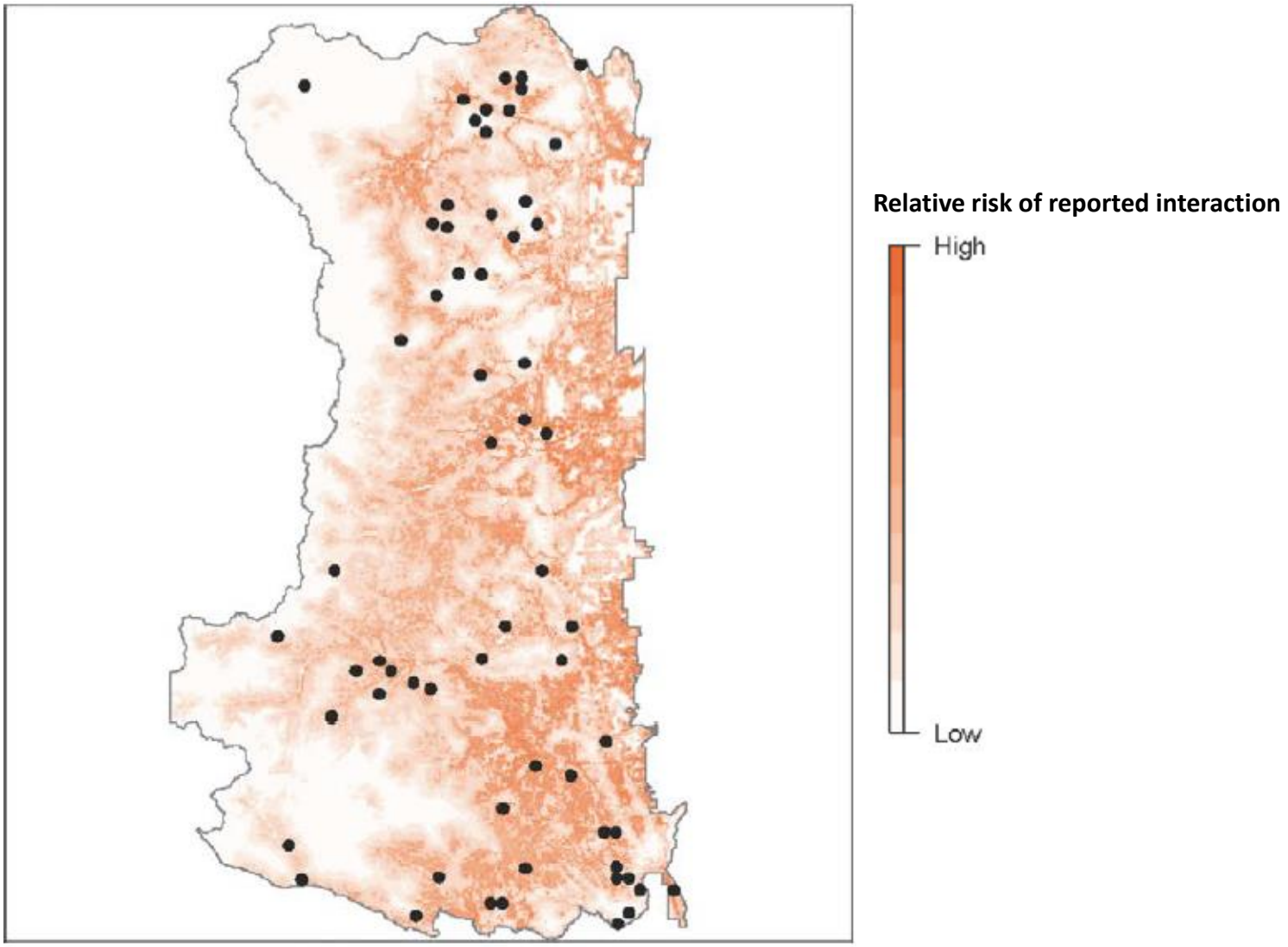
Question 5

- Use common, interactions infrequent
- WUI, adjacent exurban and rural:
  - -Abundant prey (deer) and stalking cover (WUI)
  - -Native landcover, prey, and connectivity, but not too many people (exurban, rural)
  - -Maximizes spatial-temporal overlap
- Landscape, prey, and movement linked

Question 5

- Landscape characteristics:
  - -% Forest (+)
  - -Distance to wildlands (-)
  - -Terrain complexity (+)
  - -Decreasing residential density (+)
  - -Distance to residential development (+/-)
- Can map/predict interactions hotspots

Alldredge et al. 2019



QUESTION 6

Does the number of people living, working, or recreating in cougar habitat affect the level of cougar-human interactions?

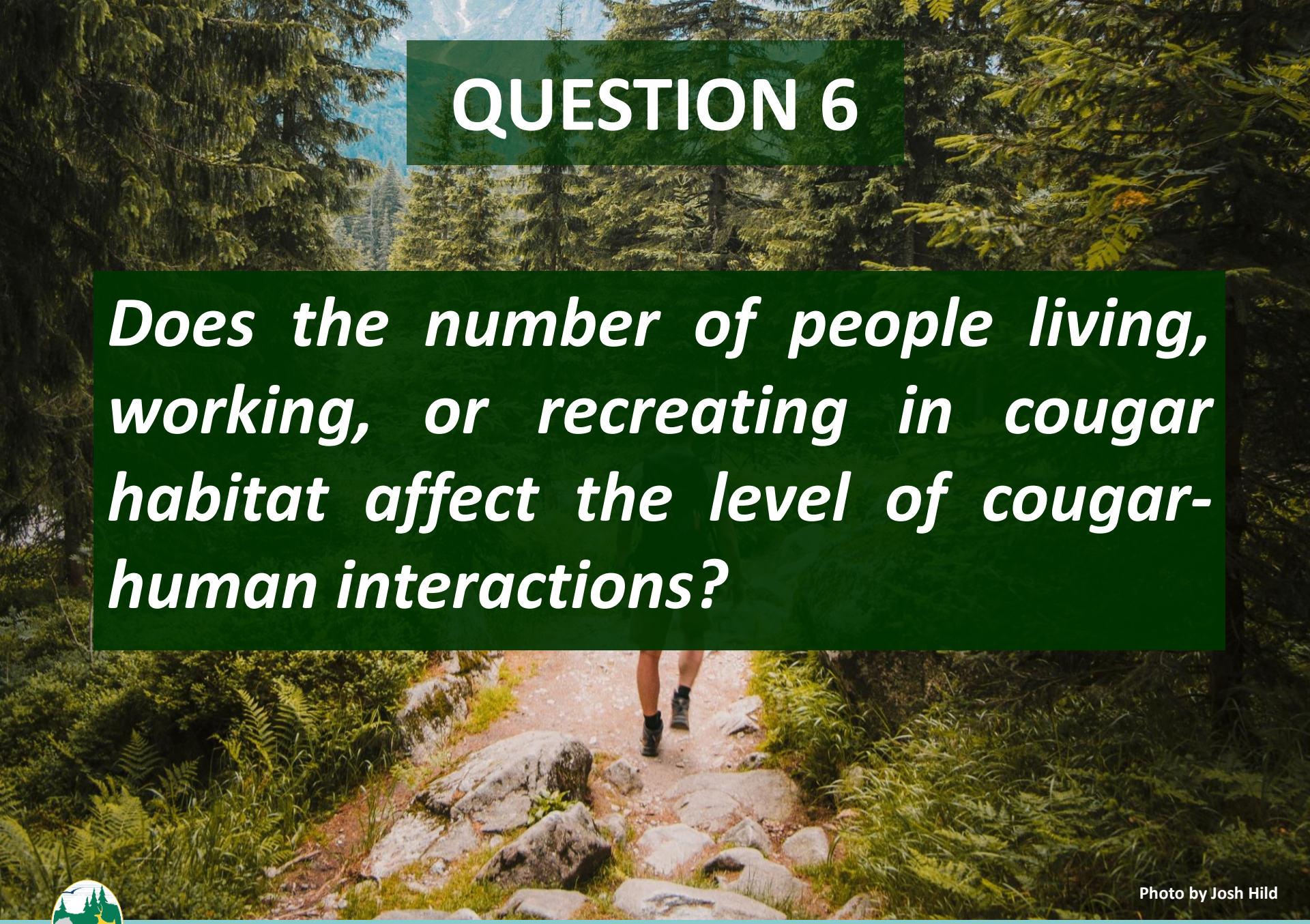


Photo by Josh Hild

Question 6

- 2 papers:
  - -Sweanor et al. 2008
  - -Penteriani et al. 2016
- Different designs; local vs. global
- Inconclusive

Photo by Dmytro Matsiuk

Question 6

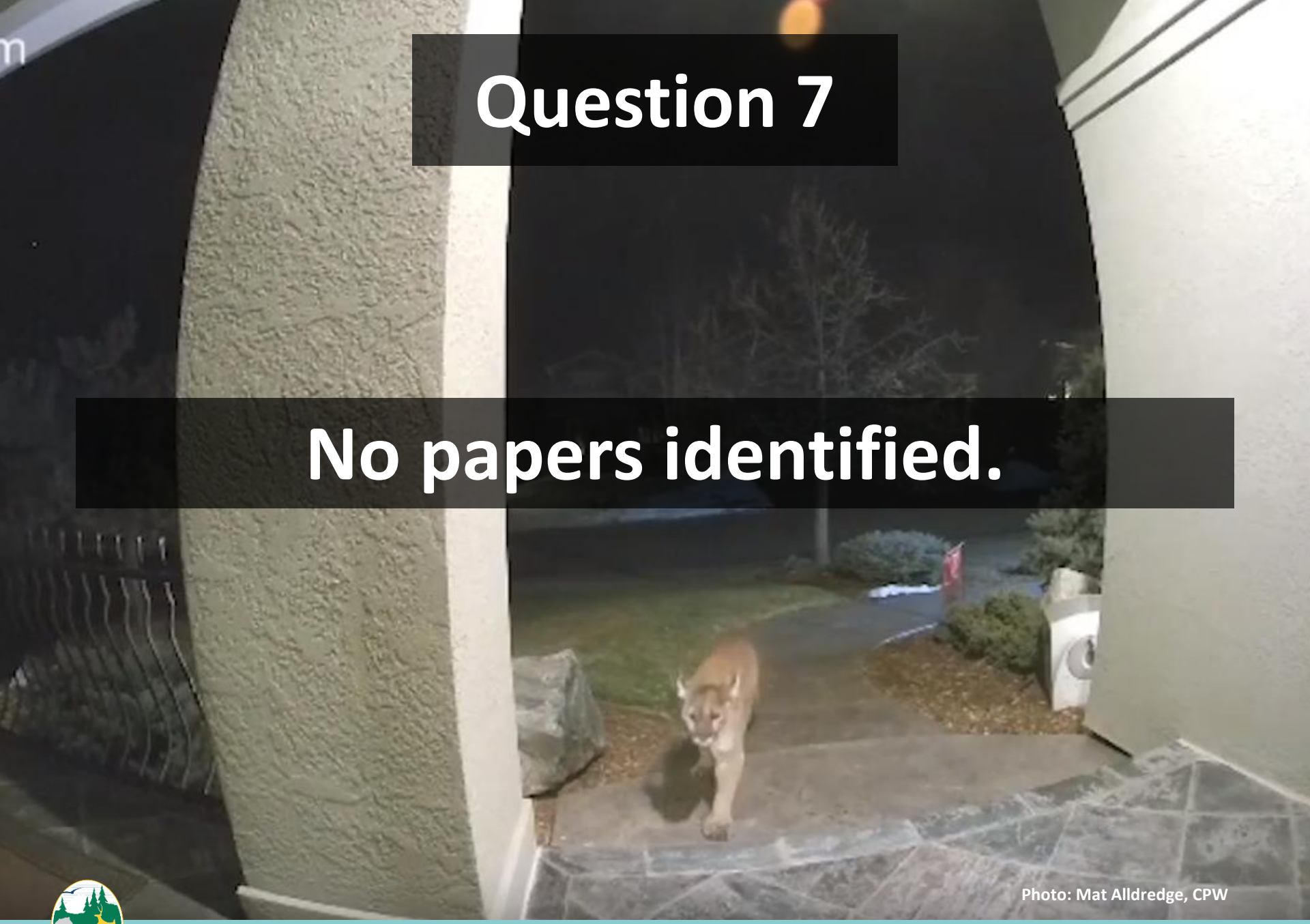
- **Sweanor et al. 2008:**
  - -Straightforward, ecologically relevant data
  - -Small sample sizes, confounding effects of mule deer, and a lack of explicit recreation and interaction data
- **Penteriani et al. 2016:**
  - -Did not account for trending recreation and attacks
  - -Mismatched scales
  - -*Post hoc* regression across multiple systems, continents

Photo by Frederico Almeida

QUESTION 7

Is the number of conflict reports correlated with the actual frequency of conflicts (i.e., the role of human attitudes and perceptions)?

Question 7

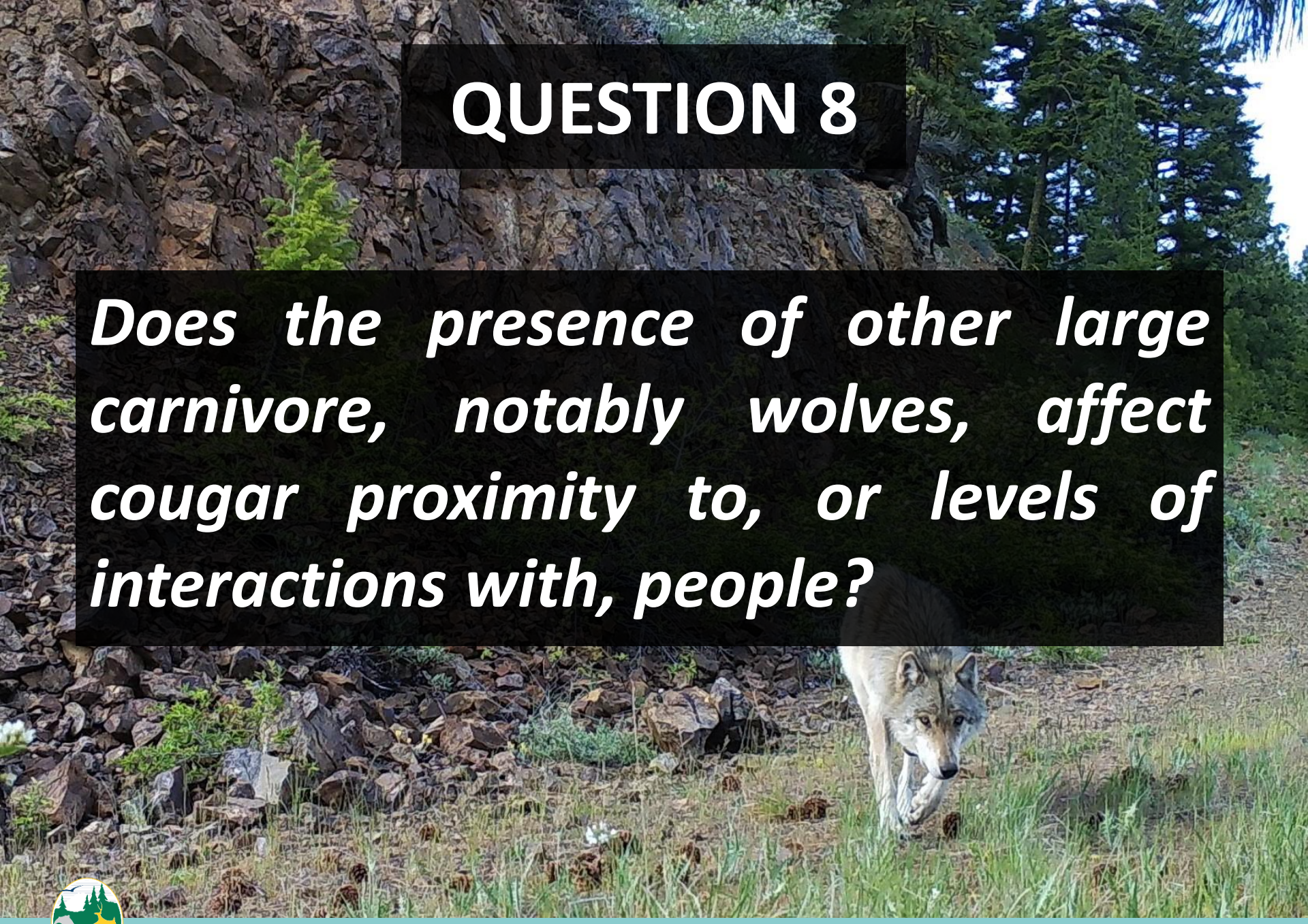


No papers identified.

Photo: Mat Alldredge, CPW

QUESTION 8

Does the presence of other large carnivore, notably wolves, affect cougar proximity to, or levels of interactions with, people?



Question 8

- Shores 2020 – UW dissertation
- Wolves increased temporal overlap
- Inconclusive

Question 8

- Wolf/no wolf design advantageous
- Camera grid too small:

  -~33-50% of single female, 10% of wolf pack

  -Detections incorrect sampling unit, few cougars
- Non-random sample
- Need to directly quantify responses and interactions

Research Summary

- Few studies with data collected after developing management-specific questions
- Questionable data, confounding variables, and alternate hypotheses
- Research in its infancy = information gaps
- Criticism is easy, research is hard

Cougar Research

- Small sample sizes
- Large scales required
- Extended time
- Open populations
- Labor intensive
- Expensive
- Lack of political and social consensus

Research Recommendations

- Research can address information needs
- *A priori* design accounting for other factors
- Data collection for objectives
- Complex system – cougars and people
- Control/treatment design

Information Needs

- **Mechanisms:**

  -Population characteristics, predator-prey, carnivores

  -Sprawl, recreation, human attitudes and knowledge

  -Mediation and mitigation

- **Strategies to reduce interactions:**

  -Lethal and nonlethal

  -Emphasis on reducing depredations

  -Economic costs

Research Moving Forward….

- Applied research objectives
- Control – treatment designs:

  -Long-term, multiple study areas

  -May require manipulation of cougar or ungulate pops

  -Resources, patience, and support
- Model validation
- Multi-disciplinary
- Collaborate across states


Questions?