

Instructions & Example

Note: I developed this assignment for my ENVS 100 Ecology & Society sections during Winter 2025 at UC Santa Cruz. Drawing on my experience as a TA for this course in Winter 2024, I identified that students needed additional scaffolding between source synthesis and drafting their literature reviews. This outline assignment was not part of the original curriculum but has since been adopted by the course instructors for all future sections due to improved student outcomes in my sections. The assignment was adapted for asynchronous learning due to campus storm closures and power outages, with feedback provided through collaborative commenting by myself and peer groups.

Literature Review Outline Assignment

Outline due end of Thursday Lab 6b

Peer-feedback due Thursday 11:59pm

Instructions

1. Navigate to your name tab on the left of this document
2. Write your research question and thesis statement
3. Write your literature review outline **by the end of Thursday's lab 6b time**. Include specific evidence/examples from your papers with in-text citations
(*see example below for guidance*)
4. Make at least one comment on each of your group member's documents. You can comment on their question, thesis statement, and/or outline. You can tell them things you like or things you think they could improve on. Remember to leave kind and constructive feedback. **Please complete this by 11:59 pm Thursday night.**
5. Email me if power outages inhibit you from completing this assignment by the due dates
6. Once you've finished your outline, start turning your bullet points into complete sentences and paragraphs. Your complete rough draft is due Tuesday (lab 7a) at the start of lab.

Example

Research Question: How does solar energy development impact bird populations in California's deserts?

Thesis statement: We know that solar energy facilities installed in California's deserts cause avian deaths from impact collisions and from flying through concentrated solar beams, and that this impact is on the population level, but we still don't know how solar facility size or distance from water bodies is related to death counts.

Outline:

Introduction

- Broader topic: Human development is impacting wildlife (Author, Year)

- This is a problem because declining wildlife populations can interrupt key ecosystem processes and disrupt food chains (Author, Year)
- Specifically, human development impacts birds in a number of ways such as... (Author, Year)
- Losing birds means losing ecosystem functions such as seed dispersal (Author, Year)
- This is particularly significant in California's deserts where wildlife is already experiencing climate change stress (Author, Year)
- I ask, how does solar energy development impact bird populations in California's deserts?
 - This question is important to answer because renewable energy development is rapidly increasing (Author, Year)
 - We should know how this development impacts birds in fragile desert ecosystems so that we can minimize future development impacts
 - I reviewed 6 papers and found that:
 - Thesis statement: We know that solar energy facilities installed in California's deserts cause avian deaths from impact collisions and from flying through concentrated solar beams, and that this impact is on the population level, but we still don't know how solar facility size or distance from water bodies is related to death counts.

What we know

- We know that birds die from colliding with solar panels
 - We know this because Author (Year) found that....
 - Similarly, Author (Year) found that....
 - Both papers were located in the same place
 - Both papers had similar methods
 - Therefore, we know that birds fly into solar panels and die from their collision injuries
- We know that birds die from flying through concentrated solar beams
 - We know this because Author (Year) found that...
 - Similarly, Author (Year) found that...
 - Overlapping evidence
 - Overlapping evidence
 - Therefore....
- We know that this impact is on the population level not community level
 - We know this because Author (Year) found that...
 - Similarly....
 - Overlapping...
 - Overlapping...
 - Therefore....

What we don't know

- We don't know how solar facility size relates to number of bird deaths
 - We don't know this because facilities range in size (Author, Year)

- We don't know this because there have been no controlled experiments that look specifically at facility size (Author, Year)
- Author (Year) looked at facilities of X size while Author (Year) looked at facilities of Y size
- Therefore...
- We don't know how facility distance to water bodies relates to number of bird deaths
 - We don't know this because surrounding habitat differs between facility sites (Author, Year)
 - Author (Year) suggests that the closer a facility is located to a water body, the higher the bird deaths
 - In contrast, Author (Year) found the opposite
 - Therefore....

Conclusion

- Relate to broader topic: Understanding how human development impacts wildlife is important, especially in fragile desert ecosystems already threatened by climate change.
- Relate to question: I explored literature to understand how solar development impacts bird populations in California's deserts
- Summarize what we know: I found that overall, we know bird deaths are caused by colliding with solar panels and by flying through concentrated solar beams. We also know that these deaths impact the populations, not just local bird communities.
- Summarize what we don't know: We still don't know how facility size or location to water bodies is related to bird deaths. We don't know this because we lack controlled experiments and the solar facilities studied range in size and surrounding habitat.
- Why is it important: It is important that we still explore this because understanding size and location can help inform solar development policy in the desert to decrease bird population impact.
- Overall conclusion: Renewable energy development is important, but must be developed with ecosystems in mind.

Student Work Example

Note: This is an example of how one student completed this assignment.

Research Question: How does the warming of freshwater habitat affect salmon reproduction?

Thesis Statement: We know that climate change has been causing severe changes to the hydrology of freshwater systems and consequently affecting the reproduction patterns of salmon but we still don't know if these changes will permanently alter patterns in migration, reproduction, and growth and how such changes will affect population dynamics.

Outline:

Introduction

- 1) Broader topic: Climate change is causing a variety of changes in freshwater ecosystems (Elsner et al. 2010)
Elsner, M. Cuo, L. Voisin, N. Deems, J. Hamlet, A. Vano, J. Mickelson, K. Lee, S. Lettenmaier, D. (2010) Implications of 21st Century Climate Change of the Hydrology of Washington State. *Climate Change*, 102, 225-260.
<https://doi.org/10.1007/s10584-010-9855-0>
 - a) This is a problem because ecosystems support the natural world and support us! (Dobson et al. 2006)
Dobson, A. Lodge, D. Alder, J. Cumming, G. Keymer, J. Mcglade, J. Mooney, H. Rusak, J. Sala, O. Wolters, V. Wall, D. Winfree, R. Xenopoulos, M. (2006). Habitat Loss, Trophic Collapse, and the Decline of Ecosystem Services. *Ecology*, 8, 1915-1924.
[https://doi.org/10.1890/0012-9658\(2006\)87\[1915:HLTCAT\]2.0.CO;2](https://doi.org/10.1890/0012-9658(2006)87[1915:HLTCAT]2.0.CO;2)
 - i) Population dynamics collapse from top to bottom (prey-predator) by anthropogenic causes
- 2) Specifically, climate change can alter freshwater ecosystems that include currently endangered species like salmon and further decline the overall health of that species in a given region
 - a) Most significant driver being sea surface temperatures (Crozier et al. 2021)
Crozier, L. Burke, B. Chasco, B. Widener, D. Zabel, R. (2021) Climate Change Threatens Chinook Salmon Throughout Their Lifestyle. *Communications Biology*, 4: 222. <https://doi.org/10.1038/s42003-021-01734-w>
- 3) Your question: How does the warming of freshwater habitat affect salmon reproduction?
- 4) This question is important to answer because it is crucial to understand how climate change is altering systems to create the best measures of conservation, restoration, and preservation to protect salmon and their habitat as a resource.
- 5) I reviewed 6 papers and found that:
 - a) We know that there are severe changes to the hydrology of freshwater systems and consequently affecting the reproduction patterns of salmon but we still don't know if these changes will permanently alter patterns in migration, reproduction, and growth and how such changes will affect population dynamics.

What we know

- 1) We know that there are several changes underway regarding freshwater systems
 - a) We know this because Mantua et al. (2010) studied water temperature from historic data and predictions modeling and was able to provide proof that summertime streams in Columbia River Basin are warming (WA)
 - i) Significant warming in stream temps
 - ii) Modeling shows (in both emissions scenarios) increasing area of fatal water temps for salmon; decreasing area of favorable water temps in salmon
 - b) Similarly, Honea et al. (2016) focused on hydrology models that tracked historic data along with modeling future climate predictions (WA)
 - i) Increased mean and max water temperatures in all months
 - ii) Changes in precipitation
 - c) Both sources based in WA
 - d) Therefore, we know that climate change is altering freshwater systems and their characteristics, especially in Washington!
- 2) We know warmer stream temperatures are changing the timing of salmon migrations
 - a) We know this because Holtby et al. (1989) experiment showed that emigration (migration from freshwater to sea) timing for coho and chum salmon fry were temperature dependent
 - b) Similarly, Quinn (1997) found that sockeye salmon are migrating to spawning sites earlier across a 40 year period (1954-1994)
 - c) Therefore it's clear that salmon are changing migration patterns due to difference in thermal regimes
 - i) These two sources talk about two different periods in salmon life
- 3) We know that salmon characteristics are each impacted differently by warming river temperatures
 - a) We know this because Cline (2019) found that sockeye salmon are migrating younger to the ocean and then having longer residency in the ocean
 - i) Different life stages affected
 - b) Similarly, Honea et al. (2016) found that spawning life stage was most affected by warming river temps (predictions from modeling)
 - i) Warming river and higher flows increase scour (the removal of sediment by moving water)- crucial for in gravel spawning
 - c) Therefore warming river temperatures affects all of the life stages of a salmon, but do so in different ways

What we don't know, but need to

- 1) We don't know what species of salmon is greater impacted by warmer water temperatures
 - a) We don't know this because Lennox (2018) explained that Atlantic and Pacific salmon have different energetic depletion levels, connecting with their metabolism, and controlling their migration patterns
 - b) In contrast, Honea et al. (2016) researched chinook and was able to find their most vulnerable life stage but not in contrast/connection with other species
 - c) Therefore there has not been a study that compares different salmon species to

how they adapt to warming waters

- i) Limited information to generalize
- 2) We don't know how the severe changes will disrupt overall population dynamics
 - a) We don't know this because Quinn (1997) blankly stated that "The effects of the shift toward an earlier arrival in the upper Columbia River on survival and reproduction are unknown." (pg. 10)
 - b) In contrast, Cline (2019) stated for sockeye salmon that it could result in delayed maturation and increase the probability of spending 3 years in ocean before returning to spawning grounds
 - i) Could happen bc: improved growing seasons with ice free seasons and warmer lake conditions improving food availability
 - ii) Could help juvenile conditions as they leave freshwater but other factors need eval.
 - c) Therefore there needs to be more information done on the indirect effects of changing migration patterns

Conclusion

- Understanding how salmon are being affected by the change in hydrology to important to grasp the influence of climate change on natural systems
 - Overall, we know severe changes to the hydrology of freshwater systems and consequently affecting the reproduction patterns of salmon
 - But we still don't know if these changes will permanently alter patterns in migration, reproduction, and growth and how such changes will affect population dynamics.
- It is important that we still explore how changes in salmon ecology will affect populations in the future and permanently as a species, **because it matters??? (needs revision)**
- Climate change is shifting ecosystem regimes and causing animals to harshly adapt to be resilient. This needs to be studied in greater detail to create policies that effectively target root causes and mitigate effects felt by all living things.