

Jastro & Shields Graduate Award Application – Graduate Group in Ecology

Student name: Katherine Lauck

UC Davis student identification number: 917812967

Email: kslauck@ucdavis.edu

Telephone number: 5409230228

Degree sought (M.S. or Ph.D.): PhD

Major professor and their home department and college (your major professor's home department must be in the College of Agricultural and Environmental Sciences): Daniel Karp; WFCB in CAES

Year of entry into the GGE: 2019

Have you advanced to candidacy? If so, when? Yes, 2/1/2022

Cumulative grade point average (must be 3.30 or greater): 4.0

Have you previously received a Jastro & Shields Award? If yes, for which academic years, and for what amount per year? (individuals may not receive more than \$18,000 in Jastro & Shields awards during their tenure at UC Davis): Yes - 2020-21: \$3854 research, 21-22: \$3000 research, \$3000 support

If you previously received a Jastro & Shields Award, have all funds from that award been expended? If not, what is your balance? Yes, all funds have been expended

Abstract. Provide an extended abstract of your thesis or dissertation research. Include a title; introduction; methods; description of anticipated scientific advances; description of applicability to management, education, or other practical purposes (if relevant); and literature cited. The abstract should address the scientific novelty and rigor of the research. The abstract, not including literature cited, may not exceed 500 words. Use 12-point font and 1” margins, number your pages, and double-space the abstract.

Attached

Applicability to California. Provide a statement of 100 words or fewer that explains whether your research is conducted in California or, if not, how it is applicable to California. Per CAES rules, this relevance is a requirement for receipt of Jastro & Shields awards.

This study will be conducted along Putah Creek, CA and adjacent agricultural areas. In this ecosystem, warm temperatures during nesting are associated with lower nestling growth (and survival in some species)¹. Furthermore, conversion of natural lands to agriculture may exacerbate these effects². Native species in California’s Central Valley and other agricultural areas may thus be especially vulnerable to population decline as climate change-driven warming progresses. This project will explore the mechanisms driving reduced nestling growth and survival in temperature spikes so that managers can modify working landscapes to better accommodate cavity-nesting birds and the ecosystem services they provide to farmers.

Literature Cited

1 Riggio *et al.* (2023) Long-term monitoring reveals the impact of changing climate and habitat on the fitness of cavity-nesting songbirds. *Biological Conservation* **278**: 109885.

2 Lauck et al (In Revision) Agriculture and hot temperatures interactively erode avian nest success across the United States. *Science*.

Contribution of the requested research funds to the thesis or dissertation. Provide a statement of 100 words or fewer than explains how the Jastro & Shields funds will advance the scientific objectives of your thesis or dissertation.

My dissertation explores the mechanisms driving community and population change under climate change and land use change. The first chapter uses existing data from a network of sites in Costa Rica to model the consequences of forest cover, precipitation, and drought for survival and colonization rates of bird species. The second uses Cornell’s NestWatch dataset to demonstrate that negative consequences of temperature spikes on nestlings are exacerbated by agriculture and urban land uses. This proposed project extends the second chapter by exploring the mechanisms that underpin its results and is likely to be my only experimental or field-based chapter.

Statement from major professor. Attach a signed statement from your major professor indicating that they support your application and will assist with budget administration and management as needed. This is a simple statement only, not a letter of recommendation.

Attached

BUDGET

CAES requires that support funds (\$1000–3000 per student), which may be used for stipends, tuition, and fees, be awarded only after research funds (\$1000–3000 per student) have been awarded to eligible students. Given the GGE’s Jastro budget and the number of students who usually apply for Jastro awards, it is highly unlikely that the GGE will be able to award support funds. You may apply for support funds, but please be aware of these constraints.

Research budget. Per CAES rules, research funds must be used for purposes vital to the success of the student’s research. This budget may not be less than \$1000 or exceed \$3000. Research awards shall be administered as an account by the student’s home department. GGE approval shall be required for among-category transfers that exceed 10% of the budgeted amount.

Research Budget Category	Amount (total must be \$1000–3000)
Wages	
Purpose of wages (e.g., for undergraduate or other research assistants)	
Travel	\$2,319
Purpose of travel (e.g., field research, registration for a professional conference at which research will be presented). If multiple purposes, explain each.	Registration & travel expenses for ESA 2023 at which I will present the results of this research
Estimated travel expenses, itemized (e.g., airfare, mileage, lodging)	Registration: \$230 registration + \$39 membership fee Airfare: Round trip ticket SMF to PDX, 8/6-8/11. Est \$400 Food: Per diem est \$25/meal * 3 meals * 6 days = \$450 Lodging: \$200/night * 6 nights = \$1,200
Materials and supplies. Please itemize in general categories (e.g., GPS units, reagents). Per CAES rules, computers must be returned to the university upon graduation.	New GPS unit for navigation of new field sites: \$300 Corticosterone Multi-Format ELISA Kits, (Strip Wells) 1 Plate for measuring corticosterone content of nestling blood: \$324
Other. Explain and itemize.	

Total (must be \$1000–3000)	\$2,943

Including but not limited to Jastro funds, what is the total cost of your thesis or dissertation research?

\$38,718 this includes 80 temperature loggers, 16 humidity and temperature loggers, 24 cameras, physiology reagents for 1,160 samples, 90 nest boxes and poles, transportation for three field seasons, plus the needs outlined in the Jastro budget above.

Other secured sources of research support (e.g., major professor's grant funds, other extramural grants and contracts). Per CAES rules, if the student's thesis or dissertation research costs more than \$3000, the graduate group must be assured that other sources of support are or will be available.

Source	Amount
Horodas Foundation (Departmental Fund)	\$5,000
Selma Herr (Departmental Fund)	\$11,000
Daniel Karp's startup fund	\$6,200
Jastro 2020 & 2021	\$9,854
Museum of Fish and Wildlife Biology volunteer donation	\$2,100
Total	\$34,154

Support budget. Per CAES rules, the support budget may not be less than \$1000 or exceed \$3000. Jastro & Shields awards do not support non-resident tuition and fees. Funds awarded for tuition and fees are paid directly by the GGE. Stipends are disbursed to students, are taxable income, and may affect financial aid awards.

Support Budget Category	Amount (total must be \$1000–3000)
Tuition and fees	
Stipend	\$3000
Total (must be \$1000–3000)	\$3000

Why do the effects of temperature on nestling growth and survival vary across land uses?

The interactive effects of climate change and habitat conversion to agriculture constitute the primary threat to terrestrial wildlife.¹ As climate change progresses, human-dominated landscapes may expose birds to new temperature extremes because converting forested land to agriculture removes trees that insulate the understory from temperature spikes.^{2,3} In hot ecosystems, climate change-driven temperature spikes can induce nest failure and drive population collapse.⁵ For example, my results from an analysis of Cornell University's NestWatch database show that, across North America, temperature spikes lower nesting success in agriculture and urban environments but not in forests (Lauck *et al* in review at *Science*).

For this project, I will investigate the two main mechanisms that could underlie the negative effects of temperature spikes in agricultural landscapes: direct thermoregulation challenge for nestlings and food availability. Nestlings can survive heat waves by using more energy to thermoregulate, but this may decrease growth and lead to lower survival.⁶ Furthermore, heat waves may reduce food provisioning to nestlings, either by forcing adults to spend more energy thermoregulating or by reducing prey availability.⁷ Here, I propose to investigate the relative contributions of thermoregulation challenge and food provisioning to reduced nestling growth under temperature spikes across four land uses: natural open canopy (grassland), natural closed canopy (riparian forest), agricultural open canopy (row crop), and agricultural closed canopy (orchard).

To do so, I will monitor Tree Swallow and Western Bluebird nest boxes in these land uses at 12 sites ($N = 3 \text{ sites/land use} \times 4 \text{ land uses}$). To date, we have monitored XXX nests and I plan on monitoring an additional 72 nests this season. At each nest box, after the start of incubation, I will place one HOBO temperature logger outside and one inside to measure nest

temperature. To quantify nestling growth, I will measure mass and morphometrics of each nestling three times during the nestling period and paint the toenails of the chicks to track individual growth until banding. To quantify parental food provisioning rates, I will use motion-activated cameras (Phillips et al. in review) that save footage 30 seconds before and after motion activation. I will use image classification software to determine which videos contain footage of birds and calculate the hourly feeding rate. To measure thermoregulation challenge, I will use ELISA assays to measure blood cortisol concentrations of nestlings. I will use GLMMs to compare effects of provisioning rate and nestling cortisol concentration on nestling growth and survival rates among land uses.

The results of this project will provide crucial insight into the mechanisms by which climate change may affect the ability of birds to survive in human-dominated habitats. They will also provide concrete avenues through which working landscapes could be modified to better accommodate cavity-nesting birds. If the direct effects of heat are more important than food-mediated effects, nest boxes could be modified to reduce their internal temperature. If food-mediated effects predominate, then maintaining patches of non-crop habitats in working landscapes to support food resources may be more effective.

Literature Cited

- 1 Travis, J. M. J. *Proc. R. Soc. Lond. B Biol. Sci.* 270, 467–473 (2003)
- 2 Suggitt, A. J. *et al. Oikos* 120, 1–8 (2011)
- 3 De Frenne, P. *et al. Nat. Ecol. Evol.* 3, 744–749 (2019)
- 4 Dunn, E. H. *Wilson Bull.* 91, 455–457 (1979)
- 5 Socolar, J. B. *et al. Proc. Natl. Acad. Sci.* 114, 12976–12981 (2017)
- 6 Wingfield, J. C. *et al. Philos. Trans. R. Soc. B Biol. Sci.* 372, 20160140 (2017)
- 7 Forister, M. L. *et al. Science* 371, 1042–1045 (2021)



Selection Committee
Graduate Group of Ecology
Davis, CA 95616

Re: Letter of support for Katherine Lauck

Dear Selection Committee,

I am writing enthusiastically support Katherine Lauck's application for the Henry A. Jastro Research Award. If awarded, I commit to both assisting with budget administration/management, as well as support her throughout the duration of the project.

Please feel free to contact me with any questions or concerns.

Sincerely,

A handwritten signature in blue ink, appearing to read "D. Karp", is written over a horizontal line.

Daniel S. Karp
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Wildlife, Fish, and Conservation Biology
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