Jastro & Shields Graduate Award Application – Graduate Group in Ecology

Student name: Katherine Lauck

UC Davis student identification number: 917812967

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Telephone number: 5409230228

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

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

Year of entry into the GGE: Fall 2019

Have you advanced to candidacy? If so, when? Not yet: planned Winter 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, in Summer 2020; research funds; $3,854.50

Abstract. Attach 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.

Applicability to California. Attach 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.

Contribution of the requested research funds to the thesis or dissertation. Attach a statement of 100 words or fewer than explains how the Jastro & Shields funds will advance your research program as a whole.

Contribution of the requested award to achieving degree objective (optional). If applicable, attach a statement of 100 words or fewer that explains how the Jastro & Shields funds will allow you to complete your degree.

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.

BUDGET

You may apply for research funds ($1000–3000), support funds ($1000–3000), or both. Requests for research and support funds may be evaluated separately.

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**
Wages	**$3000**
Purpose of wages (e.g., for undergraduate or other research assistants)	Partial funding for 2 undergraduate research assistants during field season 2022: 15 weeks (Early April-mid-July) * 20 hours/week, paid at the UC Davis rate of $15/hour, plus benefits of 2.1% * 2 people = $9189
Travel	
Purpose of travel (e.g., field research, registration for a professional conference at which research will be presented). Itemize as relevant.	
Estimated travel expenses, itemized (e.g., airfare, mileage, lodging)	
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.	
Other. Explain and itemize.	
Total	$3000

Estimated total cost of thesis or dissertation research (from all sources):

$26,669: this includes 80 temperature loggers, 12 humidity and temperature loggers, 24 cameras, salary for 2 field assistants in summer 2022, physiology reagents for 432 samples, 50 nest boxes and poles, and transportation for two field seasons.

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 requires more than $3000, the graduate group must be assured that other sources of support are or will be available.

Source	**Amount**
Horodas	$5000
Selma Herr	$6792
Daniel Karp's startup fund	$6200
Jastro 2020	$3854.50
Museum of Fish and Wildlife Biology volunteer donation	$2100
Total	$23,946.5

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**
Tuition and fees	
Stipend	$3000 (partial Summer 2022, remainder covered by Daniel Karp's startup funds)
Total	$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 ambient temperature.[2,3] In hot ecosystems, climate change-driven temperature spikes often induce nest failure and drive population collapse.[5] For example, my preliminary 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.

For this project, I will investigate the two main mechanisms that could underlie the consequences of temperature spikes: 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 sites/land use * 4 land uses). This season we expect to monitor 72 nests. 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 individuals 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 and place a camera on two boxes per site for a total of 24. I will use image recognition 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)

This study will be conducted in and near Putah Creek, Davis, CA. In this ecosystem, warm temperatures during nesting are associated with lower nestling growth (and survival in some species).[1] Furthermore, conversion of natural land cover to agriculture may exacerbate these effects.[2] Native species in the Central Valley and other agricultural areas of CA may 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.

Literature Cited

1 Riggio *et al.* in prep.
2 Lauck et al in prep.

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.

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Re: Letter of support for Katherina Lauck

Dear GGE Awards Committee,

This letter is to affirm that I support Katherine Lauck's application for the Jastro Shields award and will help her with budget administration and management, as needed.

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

Sincerely,

Daniel S. Karp
Assistant Professor
Wildlife, Fish, and Conservation Biology
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