**Annual Call - 2021**

**SELMA HERR FUND FOR ORNITHOLOGICAL RESEARCH**

**Deadline:** The application and supporting documents (thank-you letter and summary, for continuing applications) must be submitted as a PDF via email to Dirk Van Vuren ([dhvanvuren@ucdavis.edu](mailto:dhvanvuren@ucdavis.edu)), Chair of the Endowment Committee, by:

**5:00 pm, 12 March (Friday).**

**Proposal Preparation**—Proposals are limited to two pages (1” margins, Times New Roman 12 point font; literature cited and budget not included), and should include:

* 1. Title
  2. Investigators (the PI must be a WFCB faculty member)
  3. Background summary, concluding with objectives or hypotheses
  4. Methods summary
  5. Justification summary
  6. Budget, with justification and explanation of other funds available for the project
  7. Written agreement, signed by the PI, that 1) all funds awarded will be expended by 1 March 2022, and that 2) a thank-you letter to the Selma Herr family, explaining the project’s results and value, and 3) a project summary, including accounting of funds expended, will be submitted to the Endowment Committee Chair by 1 March 2022.

*Please use the form on the following page as a template for your proposal.*

**Supporting Documents**—Include project summaries and Herr family thank-you letters for continuing projects.

**Award Guidelines**:

Proposals should be *tightly* focused on ornithological research.

Awards will normally not exceed $3000.

Other funds available for the project will be considered.

Highest consideration will be given to WFCB students (grad or undergrad).

**Selma Herr Fund for Ornithological Research – Proposal**

**Project Title:**

**Applicant (WFCB PI Status): Daniel Karp**

**Participants (degree objective if student): Katherine Lauck (PhD student)**

**Total Request: New /Continuing Funding Request (circle one)**

***Background***

The interactive effects of climate change and habitat conversion to agriculture constitute the primary threat to terrestrial wildlife (Travis 2003). Efforts to increase biodiversity in agricultural landscapes, such as installing nest boxes for cavity-nesting birds, may allow more species to thrive in human-dominated landscapes [CITE working lands conservation specifically re: birds??]. However, as climate change progresses, human-dominated landscapes may expose birds to new temperature extremes because converting land to agriculture removes trees that insulate the understory from ambient temperature (Suggitt et al. 2011, De Frenne et al. 2019). In bird species with altricial young, nestlings are ectothermic, so both low and high temperatures divert energy from growth to thermoregulation (Dunn 1979). The lethal effects of cold are well-documented (Shipley et al. 2020). But in the future, climate change will drive temperature increases globally and exacerbate the intensity of short-term temperature spikes [CITE climate modeling showing this]. Especially in hot ecosystems, climate change-driven temperature spikes often induce nest failure and drive population collapse (Socolar et al. 2017). For example, in the Putah Creek ecosystem near Davis, CA, warm temperatures during nesting are associated with lower nestling growth (and survival for some species) (Riggio *et al.* in prep). Furthermore, our preliminary results from an analysis of Cornell University’s NestWatch database (N= 152,863 nesting attempts across 58 species) show that, across North America, temperature spikes lower nesting success in agriculture and urban environments. However, nesting success remains stable in grassland and increases in forested areas following temperature spikes.

WFCB undergraduate Katia Goldberg has proposed a project to the Swift Endowment seeking to compare nest temperatures between multiple land uses, determining whether closed canopies buffer nests from temperature spikes. For this project, I will investigate the two main mechanisms that could underlie the effects of heat waves: direct thermoregulation challenge for nestlings and food availability. Nestlings can survive heat waves by using more energy to thermoregulate, but this may increase stress, decrease growth, and lead to lower survival (Wingfield et al. 2017). Alternatively (or additionally), heat waves may reduce food provisioning to nestlings, either by forcing adults to spend more time/energy thermoregulating or by reducing prey availability. For example, warming temperatures are driving lepidopteran declines across the U.S. (a key resource for young birds) [CITE]. Here, I propose to investigate the relative contributions of thermoregulation challenge and food provisioning to nestling growth under temperature spikes, with the goal of understanding how they operate differently in a two-factor cross of land use types: natural open canopy (grassland), natural closed canopy (riparian forest), agricultural open canopy (row crop), and agricultural closed canopy (orchard).

***Questions***

*Question 1.* How do ambient temperature and land use affect food provisioning for nestlings?

*Hypothesis 1.* Temperature spikes will be more frequent and more severe in open lands (i.e., grassland and row crop), decreasing provisioning rates. Parents may decrease foraging time to meet thermoregulatory demands or lower insect availability may increase search effort.

*Question 2****.*** How do next box temperature and land use affect nestling stress physiology?

*Hypothesis 2.*Temperature spikes will be more frequent and more severe in open land uses (i.e. row crop and grassland systems) which will increase nestling stress (*i.e.,* cortisol levels). Indeed, high temperatures may cause hyperthermia, which can elevate cortisol in nestlings [CITE – ask Paulina].

*Question 3.* How does land use affect the dominance of physiological effects of heat (Q2) versus food-mediated effects (Q1) on the growth and fledging success of nestlings?

*Hypothesis 3.* In open land uses (i.e., grassland and row crop), the direct effects of heat on nestlings will dominate. Hyperthermia will drive cellular damage, forcing nestlings to expend more energy on maintenance, lowering their growth (Wingfield et al. 2017). However, because hyperthermia may also cause adults to decrease provisioning during temperature spikes, food-mediated effects may also be important. In agricultural lands, low resource (*i.e.,* insect) availability will cause food-mediated effects to dominate [CITE same as in previous hypothesis].

***Methods***

To address these questions, I will monitor Tree Swallow and Western Bluebird nest boxes in four land use treatments: row crops, orchards, grasslands, and high canopy cover riparian forests. I will partner with the Museum of Wildlife and Fish Biology (MWFB) to access their ‘Putah Creek Nest Box Highway,’ a network of 169 nest boxes along Putah Creek. However, the Nest Box Highway does not include any nest boxes in row crop agriculture. It also does not include sufficient numbers of orchard or grassland sites. Thus, I am in the process of securing landowner permissions to expand the network. In early April, we will begin monitoring 36 boxes (N= 3 nests/site, 4 sites/land use, 4 land uses). After chicks fledge, we will move on to new nests: we expect to complete 3 rounds of sampling for a total of 108 nests monitored.

I propose monitoring the same nest boxes that Katia Goldberg (see above) will use to explore temperature differentials between land-use types. She will place HOBO loggers inside boxes to measure nest temperature following egg-laying. To quantify parental food provisioning rates, I will use Raspberry Pi-based motion-activated cameras [CITE Emily’s paper] that will record 30 seconds before and after motion activation. I will use generalized linear mixed models (GLMMs) to compare the effect of temperature on provisioning rates across the four land use types (Question 1). Starting in March 2022, I will additionally partner with Dr. Paulina Gonzalez to collect blood samples from nestlings and then use ELISA assays [CITE – ask Paulina] to measure cortisol concentrations. Again, I will use GLMMs to compare effects of temperature on nestling cortisol concentrations among land uses (Question 2).

To address question 3, I will partner with the MWFB to monitor nestling growth and survival. Within their current nest box network, project scientist Hanika Cook and her team will record mass, tarsus length, bill length, and wing chord of nestlings twice during the nestling period and band them at the appropriate time. I will be trained to handle, measure, and band nestlings according to their protocol. I will then monitor the additional boxes I place in row crops, orchards, and grasslands. Again, I will use GLMMs to compare effects of provisioning rate and nestling cortisol concentration on nestling growth and survival rates among land uses.

***Justification***

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. In doing so, it 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 increase nesting success; for example, by adding white paint or solar shields to roofs, or by installing boxes in more shaded areas. In contrast, if food-mediated effects predominate, then it may be necessary to maintain patches of non-crop habitats in working landscapes to support more diverse and abundant food resources for birds (*i.e.,* insects).

***Literature cited***

De Frenne, P., F. Zellweger, F. Rodríguez-Sánchez, B. R. Scheffers, K. Hylander, M. Luoto, M. Vellend, K. Verheyen, and J. Lenoir. 2019. Global buffering of temperatures under forest canopies. Nature Ecology & Evolution 3:744–749.

Dunn, E. H. 1979. Age of Effective Homeothermy in Nestling Tree Swallows According to Brood Size. The Wilson Bulletin 91:455–457.

Shipley, J. R., C. W. Twining, C. C. Taff, M. N. Vitousek, A. Flack, and D. W. Winkler. 2020. Birds advancing lay dates with warming springs face greater risk of chick mortality. Proceedings of the National Academy of Sciences 117:25590–25594.

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Travis, J. M. J. 2003. Climate change and habitat destruction: a deadly anthropogenic cocktail. Proceedings of the Royal Society of London. Series B: Biological Sciences 270:467–473.

Wingfield, J. C., J. H. Pérez, J. S. Krause, K. R. Word, P. L. González-Gómez, S. Lisovski, and H. E. Chmura. 2017. How birds cope physiologically and behaviourally with extreme climatic events. Philosophical Transactions of the Royal Society B: Biological Sciences 372:20160140.