Validation, values and vision: ways early career researchers can help propel the field of conservation physiology

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The pressures created by population growth, conversion of natural landscapes and resource extraction are steadily increasing and the world is facing a growing need for efficient and pragmatic conservation (Marvier and Kareiva, 2014). Both as a group and individually, young conservation professionals are faced with the question of how to tangibly contribute to our field and generate lasting results (Chapman et al., 2015). In the case of conservation physiology, many of the tools and theories that comprise the sub-discipline are not new, but the moniker itself is a relatively recent addition (Wikelski and Cooke, 2006). As a result, we are just beginning to see the first generation of scientists who have self-identified with the field of conservation physiology throughout their entire training experience. This puts us in a unique position when establishing our research programmes; we are at the forefront of a rapidly accelerating, nascent discipline where we have the power to help shape the way forward. As an early career scientist hoping to establish a research programme that can not only make contributions to the growth of conservation physiology, but also to conservation science as a whole, I offer a few suggestions for where we might profitably place some of our effort. Specifically, I outline the importance of targeted validations, valuing application and collaboration, and appreciating that conservation may require diverse and changing tactics.

Validation: ensuring the toolbox is accessible

The physiological toolbox is becoming impressively well-stocked. We have the ability to measure immune function,
stress levels, metabolism, nutrition, ion and water balance, sensory physiology, reproduction and many other traits (Cooke et al., 2013). However, when we specifically strive to measure these variables in conservation settings, there are a number of considerations that must come into play. Some of these are logistical: how do we best collect, store, transport and analyse our samples, and how much will all of this cost? Other considerations are tied to the interpretation of the physiological metrics themselves: when and why does physiology change, does it do so in a predictable way, and can it help us understand disturbance and population persistence? Will a single trait provide us with the information we need to make conservation decisions? The onus is on those with a background in physiology to investigate these questions. Doing so will be necessary to determine the limitations of each tool and the likely scenarios where they will be most useful.

The importance of validating traits is well-illustrated by the vast literature focusing on glucocorticoids as indicators of disturbance and ‘stress’ in wildlife. My own work has focused primarily on the utility of baseline plasma levels of stress hormones in conservation settings. I performed my validation studies in a migratory bird, the tree swallow (Tachycineta bicolor), and as a whole, stress hormones performed poorly at reflecting components of environmental quality, showing repeatability and predicting fitness both at the individual and population level (Madliger et al., 2015; Madliger and Love, 2016a, 2016b). Even more importantly, others studying the same species, in some cases even within the same geographic area, have found different patterns (e.g. Patterson et al., 2011). The obvious question is why, and we do not have a particularly good answer yet. Opposing results could be due to differences in weather, age structure, density of nesting sites, other year-related effects, or habitat, among many other factors. This ambiguity makes on-the-ground application of this trait as a biomarker of disturbance potentially problematic.

For some physiological traits, like plasma- and faecal-based stress hormones, the literature is substantial enough to perform meta-analyses that can help elucidate how to best move forward, and which types of validations we still need to complete (e.g. Dantzer et al., 2014). In other cases, traits are still largely being developed in the context of conservation (e.g. oxidative status; Beaulieu and Costantini, 2014) so we are often looking at patterns across studies that were not designed to explicitly test the utility of a trait in a conservation setting. Here, we should not only investigate the logistical and theoretical relevance of each physiological metric, but also make every effort to publish non-significant results whenever we have confidence in the statistical power of our investigations. This approach will take dedication on our part because validations and non-significant findings are often less ‘sexy’ and more methodological. However, if the budding generation of conservation physiologists include validations as part of their research program it will help us build an accessible toolbox and fully articulate the pros and cons of each physiological technique.

Values: committing to application and collaboration

The validations I describe above necessitate a commitment to application-driven research. In a time characterised by rapid human-induced environmental change (including climate change), it is not overly challenging to identify the general conservation implications of physiological studies in free-living plants and animals. While there are countless ways that physiology can potentially benefit conservation (Cooke et al., 2013), success stories are scarcer than we might predict (Madliger et al., 2016). There are a whole variety of reasons why this might be the case. For example, lack of knowledge, training, or confidence in physiological tools could all contribute to a slower uptake by conservation professionals, and identifying these barriers will be the only way to understand how to dissolve them. Further, we can prove the value of our techniques by championing them at meetings and conferences, publishing in venues that have both an academic and non-academic readership, taking time to work outside of academia to connect with new collaborators, and inspiring a younger generation of scientists to join the field. When on-the-ground application becomes a focus, rather than an afterthought (i.e. through collaboratively formulating research agendas), the probability of creating a conservation success should skyrocket.

Vision: a diverse and evolving conservation mindset

The conservation community is comprised of individuals with a spectrum of beliefs and, as a result, we contribute to the field for diverse reasons and purposes. However, the need to prioritize our efforts and increase efficiency (i.e. solve as many conservation problems as possible) may come down to a willingness to step outside of our individual comfort zones. It may also sometimes require us to alter our vision of what conservation looks like. In some cases, the approach of directly targeting species, communities, or ecosystems will be best. It will involve tasks like field surveys, habitat restorations, reintroductions, tracking and modelling wildlife movements, captive breeding, etc. Physiology can play a key role in all of these tasks, as others have outlined in detail (Cooke et al., 2013). However, in other cases, the best approach may need to be augmented or tackled entirely with techniques unrelated to physiology, or the natural sciences in general (Marvier and Kareiva, 2014). Instead, it may best be accomplished through the direct targeting of humans to create a desired indirect effect on the environment. It may be providing fresh drinking water, alternative energy strategies, or food subsidies, or involve poverty alleviation, creative marketing strategies, engineering innovations, and cooperation with businesses. We need to view each conservation issue from the pragmatic perspective of how best to accomplish the goal, and this will require the courage to move on
to new systems or questions if physiology is not the best answer in a given situation.

A major advantage we have when envisioning the future of conservation physiology is the ability to harness a vast reservoir of knowledge and data from past conservation efforts and successes. It is our job to ask what has worked and what has not, why this is the case, and what characterizes successes versus challenges. Identifying patterns allows for the spread of evidence-based and predictive conservation techniques and provides the opportunity for continual innovation and creativity through integration with engineering and technology. It will tell us where physiology can help, and where it might not. Again, a caveat of pursuing this type of work is that we may need to reinvent our research programmes (i.e. reorient our vision of conservation physiology) if we find ourselves in the latter situation. Overall, we may be required to have an evolving research programme so we can continuously apply physiology in the places where it has the greatest chance to succeed.

Concluding thoughts

In a growing field such as conservation physiology, there are many opportunities to guide theoretical underpinnings or broader goals. Early career researchers often have a detailed knowledge of the literature base related to the topics covered by their PhD work. Indeed, graduate school is probably the time in a researcher’s career when they have the most time to read and keep abreast of new literature. As a result, this can be a worthwhile time to write perspectives that shine light on a gap and call other researchers to action. This can represent a worthwhile opportunity to share the vision of conservation physiology we see for the future.

As young conservation physiologists, we have the power to push for new approaches, employ them in our own endeavours, and allow them to govern the ways we accomplish conservation goals. I think we can make the best decisions if we ask ourselves two questions as we go forward. What is the purpose of conservation? And what is the future without realistic conservation? By being pragmatic, carefully validating our tools, and having an application-driven mindset, we can dissolve some of the barriers that still exist within conservation physiology, and more broadly, among social science, environmental science and conservation science. Overall, we can contribute to conservation physiology’s growth with broad brush strokes that guide the theoretical base of the field paired with detailed investigations that flesh out our toolbox. Our generation can be characterised by resourceful determination; let’s look back in 50 years not with pessimism, but knowing that we had the impetus to refine and adapt our approaches and tread in non-traditional waters to accomplish the most that we possibly could.

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