Salguero-Gómez Rob (Orcid ID: 0000-0002-6085-4433)
Lancaster Lesley (Orcid ID: 0000-0002-3135-4835)
Sanders Nate J (Orcid ID: 0000-0001-6220-6731)
Meyer Jennifer Alice (Orcid ID: 0000-0002-0366-6348)

Conceptualising ecology to support more theory-driven research

A manuscript in consideration as an *Editorial* for *Journal of Animal Ecology*

Roberto Salguero-Gómez[1,*], Darren M. Evans[2], Jean-Michel Gaillard[3], Lesley T. Lancaster[4], Nate Sanders[5], Milly Ivy Briden[6], Jennifer Meyer[6]

1 Department of Biology, University of Oxford, Oxford, UK;

2 School of Natural and Environmental Sciences, Newcastle University, Newcastle-upon-Tyne, UK;

3 Mixed Research Unit (UMR 5558) "Biometry & Evolutionary Biology", University Claude Bernard Lyon 1, Campus de la Doua, Bâtiment Mendel, Villeurbanne Cedex, France;

4 School of Biological Sciences, University of Aberdeen, Aberdeen, UK;

5 Department of Ecology and Evolutionary Biology, University of Michigan, Ann Arbor, Michigan, USA; and

6 British Ecological Society, London, UK

* Correspondence: rob.salguero@biology.ox.ac.uk

Author Manuscript

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/1365-2656.14206

This article is protected by copyright. All rights reserved.

Author Manuscript

1. What are ecological concepts, and why are they important?

Concepts are abstract ideas that describe processes of interest. As such, concepts are the backbone to theories in any science. Concepts and theories are related in that novel theories cannot emerge without the existence of the solid concepts that underpin them. Indeed, Einstein and Darwin would not have been able to put forward their respective theories of relativity (Einstein 1918) and evolution (Darwin 1859) without the concepts of 'gravity' and 'natural selection'. Concepts are not necessarily empirically testable, while theories must be.

Concepts are particularly useful to investigate and understand ecological systems because nature is complex. The development of concepts has historically enabled ecologists to better understand the interactions between organisms and their environments, as well as their underlying mechanisms. Indeed, ecological concepts encapsulate key processes such as energy transfer (*e.g.*, 'energy flows', Lindeman 1942), self-regulation (*e.g*, 'density dependence', Nicholson and Bailey 1935), species interactions (*e.g*, 'competition', Volterra 1927; 'facilitation', Clements 1916), or evolutionary dynamics (*e.g.*, 'fast evolution', Reznick, Bryga, and Endler 1990; 'eco-evolutionary dynamics', Pelletier, Garant, and Hendry 2009). By providing a consistent structure to study ecological systems, ecological concepts allow researchers to classify life history strategies (Stearns 1983; Stott et al. 2024), predict behaviours (Hamilton 1964), quantify the stability and resilience of systems (Van Meerbeek, Jucker, and Svenning 2021), or identify key drivers of biodiversity (McArthur and Wilson 1970). These foundational concepts integrate biology, evolution, environmental sciences, and conservation, enabling us to address global challenges such as resource depletion, climate change, and biodiversity loss.

To further fuel the development and implementation of concepts in ecology, in 2020 *Journal of Animal Ecology* added a seventh Article Type to its publishing portfolio: 'Concepts'.

Author Manuscript

The goal of Concept articles is to challenge existing paradigms or to introduce novel ideas that may guide the field of animal ecology in fresh directions and ultimately support more theory-driven research. Here, we provide some key examples of concepts that have helped advance ecology. In doing so, we also highlight contributions published in *Journal of Animal Ecology*, and provide suggestions to authors interested in submitting Concept articles to the Journal.

2. Conceptual landmark contributions

Journal of Animal Ecology has published a myriad of foundational studies that continue to shape our ecological thinking. Concepts published in our Journal come from authors at all career stages, from students to retirees, thus demonstrating the importance of a fresh perspective as well as experienced insights. Indeed, ecology is a global science made of many perspectives, and we are keen to receive concepts that represent and celebrate this diversity. Authors considering submitting a Concept article might find some additional inspiration from both the content and the format of some of the research areas we highlight below. We note these are not comprehensive, with many others not covered here. Concept articles can also be found in the following live link of our Journal's website: https://besjournals.onlinelibrary.wiley.com/hub/journal/13652656/features/concepts_in_animal_ecology.

- Population Ecology: Understanding and predicting population dynamics has been central to the field of Ecology since its inception. Nicholson's (1933) publication in our Journal on the regulatory mechanisms of animal population dynamics was fundamental for population ecology. Similarly, Elton and Nicholson's (1942) work also in *Journal of Animal Ecology* on the long-term population cycles of the Canada lynx (*Lynx*

Author Manuscript

canadensis) and its prey significantly contributed to our understanding of predator-prey dynamics. Further conceptual developments published by *Journal of Animal Ecology* in this area include the application of prediction intervals for more accurate population forecasts (Asbjørnsen et al. 2005), or the formalisation of population responses to disturbances (Benton, Cameron, and Grant 2004).

- Niche Theory: Hutchinson's (1957) "n-dimensional niche" concept helped re-define how ecologists think about species' roles in ecosystems. *Journal of Animal Ecology* has published subsequent works examining how species partition resources and space to coexist. This theory continues to shape research, with further conceptual advances in this area including the integration of individual sociality (Webber and Vander Wal 2018) and individual heterogeneity across space (Costa-Pereira et al. 2018).

- Trophic Interactions and Food Webs: Elton, the founding editor of *Journal of Animal Ecology*, pioneered the concept of food-chains and food-webs (Elton 1927), organising species into functional groups. In recent years, the development and application of network science to ecological systems is helping to resolve previously intractable questions in ecology and evolution, allowing the study of multiple interaction types (Pocock, Evans, and Memmott 2012), 'multilayer' networks (Pilosof et al. 2017) and the resilience of entire communities of interacting species to environmental change (Maia et al. 2021). Two recent Concept articles published in *Journal of Animal Ecology* on this topic expand network ecology in freshwater ecosystems (Windsor 2023), and show how nutrients could be integrated into network analyses (Cuff et al. 2024).

- Life History Strategies: Life history theory examines the optimal strategies of organisms given their trade-offs between survival, development, and reproduction under different environmental conditions (Stearns 1999, 1977). This body of theory

Author Manuscript

has been vastly expanded in recent decades, with key contributions in *Journal of Animal Ecology* shaping our understanding of senescence and fitness (Žák and Reichard 2021), the evolutionary underpinnings of life-history variation in birds (Culina et al., n.d.), mammals (Coulson, Tuljapurkar, and Childs 2010), and other taxa (Žák and Reichard 2021), and delivering direct applications to genetics (Coulson, Tuljapurkar, and Childs 2010) and conservation (Morrison and Hero 2003).

- Metapopulation Dynamics: The metapopulation framework, developed by Levins (1969) and advanced by Hanski (1991), describes populations as networks of smaller populations connected by dispersal. This framework has informed conservation efforts by helping ecologists understand how species persist in fragmented habitats (Nonaka et al. 2019). *Journal of Animal Ecology* has published key contributions on, for instance, butterfly metapopulations, showing how species survive despite frequent local extinctions (Hanski, Saastamoinen, and Ovaskainen 2006).

- Ecosystem Services: The concept of ecosystem services (*sensu* LaBastille 1985), while initially developed outside of *Journal of Animal Ecology*, has been expanded through studies on the role of animals in ecosystems. Research published in this Journal on pollinators (Minachilis et al. 2023), seed dispersers (Naniwadekar et al. 2019), and vertebrates (Luck et al. 2012) has emphasised their role in providing essential ecosystem services, from crop pollination (Minachilis et al. 2023) to nutrient cycling (Del Toro, Ribbons, and Ellison 2015). Such work has crucial implications for biodiversity conservation and sustainability.

- Molecular Ecology: Increasingly available molecular genetic data are helping to unravel fundamental ecological questions related to biogeography, genomics, conservation genetics, and behavioural ecology. Recent research published in this

Author Manuscript

Journal has used environmental DNA to examine the temporal dynamics and functional stability of arthropod communities (Thomassen et al. 2024), and DNA metabarcoding to study species-interaction networks (Lucas et al. 2018) through to test the niche variation hypothesis (Jesmer et al. 2020). Still, there is considerable scope to use advances in this field to either tackle previously intractable questions in ecology, or define new eco-evolutionary Concepts afforded by the technology, particularly in the context of climate change (Layton and Bradbury 2022).

Other key concepts in ecology published by the Journals of the British Ecological Society can be found in this link: https://www.britishecologicalsociety.org/learning-and-resources/career-development/key-concepts-in-ecology/.

3. Ten tips for writing a strong Concept article in *Journal of Animal Ecology*

Here, we provide some tips to help interested authors properly showcase the concept at the heart of their manuscript submissions:

1. **Focus on novelty**: Introduce a new or significantly revised concept that advances ecological theory or addresses a current gap in the literature. Concepts articles should clearly state how they differ from established concepts in the area of interest. We welcome submissions of classical concepts that may be in need of a good 'dust off', but we caution authors against re-branding well-established concepts that are still relevant nowadays in their original definitions.

2. **Theoretical foundation**: Situate your concept within the broader literature, making connections to existing theories while highlighting your key contribution and how it

Author Manuscript

could help develop extensions and new theories. Authors are encouraged to do so by contextualising the broader ecological literature.

3. **Testable predictions**: If pertinent, ensure your concept offers a theoretical framework that can be empirically tested or used to predict ecological patterns. In doing so, we encourage authors to provide specific ways of applying the concept and testing predictions that will emerge from its usage.
4. **Relevance to animal ecology**: Focus on the ecology of animals, emphasising how the concept relates to animal-animal or animal-other kingdom interactions, population dynamics, or physiological, evolutionary, biogeographical, or ecosystem processes. Naturally, though, we encourage authors to detail whether and how their concept may apply to other kingdoms.
5. **Provide empirical examples**: Consider supporting your concept with empirical evidence when possible. Case studies or data-driven examples from diverse taxa can strengthen the argument.
6. **Incorporate interdisciplinary perspectives**: Consider integrating concepts from related fields such as anthropology, economics, mathematics, sociology, geology, computer science, climatology, *etc*. to offer a broader perspective.
7. **Not just one's own views**: Do not constrain the concept to your own work. Instead, Concept articles should provide thought-provoking, novel, or controversial perspectives on a concept related to animal ecology, which consider multiple views.
8. **A picture is worth a thousand words**: Include well-designed, clear, and informative figures, diagrams, infographics, *etc.* that support your concept. Infographics can be particularly effective, as they can convey abstract ideas to our broad readership.
9. **Format:** Use a format that works for you and your ideas. The standard "Introduction - Methods - Results - Discussion" format of Research Articles does not typically result

in effective Concept papers. For once, Concept papers do not need to be supported by data and analyses. We invite authors to provide an early section on 'history' of the concept. Likewise, authors should consider a final section where they highlight opportunities for future studies, suggesting testable hypotheses, new applications for their concept, and synergies with emerging areas of research.

10. **Follow journal guidelines**: Ensure your manuscript adheres to the specific formatting and stylistic guidelines of *Journal of Animal Ecology*, including citation styles, figure presentation, and structure, as well as word count. Concepts are limited to 3,000 words (including title page, abstract, and references list) and up to four tables or figures. The word limit is deliberate and *not* flexible. We want to provide our authors with the platform to communicate said concepts in a concise and streamlined manner. Concepts are *not* reviews of a topic in ecology. Indeed, for reviews, authors should consider our *Review* article type, which offers a substantially greater word count limit (https://besjournals.onlinelibrary.wiley.com/hub/journal/13652656/author-guidelines).

Authors wishing to submit a *Concepts in Animal Ecology* article are encouraged to contact the commissioning editor of *Journal of Animal Ecology* (rob.salguero@biology.ox.ac.uk) to discuss the idea prior to submission.

4. Conclusion: Areas of focus for future concepts

As the field of animal ecology continues to evolve, several emerging areas offer exciting opportunities for conceptual development. We are particularly keen to continue to receive concepts that help our discipline overcome said challenges.

One of the most promising areas is Artificial Intelligence (AI) in ecology. AI has already drastically transformed how ecologists collect and analyse data, from enhanced field

Author Manuscript

Author Manuscript

monitoring (Shermeister, Mor, and Levy 2024), to automating species identification (Blair et al. 2024), to bridging lab and field pipelines (Harrison, Mohr, and van de Waal 2023), and expediting predictive analytics (Windsor 2023). AI applications allow ecologists to handle vast datasets more efficiently (Smith and Pinter-Wollman 2021), offering unprecedented opportunities to monitor ecosystems in real time. However, with the potential to access and analyse more data, new challenges too are starting to emerge, including the choice of approach and the reproducibility of the research.

Another promising area in ecological research is the refinement of methodological pipelines. New tools, such as remote sensing (Davison et al. 2023), genetic techniques (Li et al. 2021), and integrative modelling (Zhao et al. 2019), provide ecologists with more accurate and scalable approaches for studying ecosystems. We are also keen to receive submissions in these areas, as the further development of pipelines requires the formalisation of concepts therein.

Ecological concepts are also key in applied contexts such as wildlife management, environmental policy, and sustainability efforts. The frameworks that ecological concepts sustain inform ecological restoration projects (Elliot Noe et al. 2022), guide rewilding strategies (Burgos et al. 2022), and help assess the effectiveness of protected areas (Wood et al. 2013). Ultimately, the ability to accurately model ecosystems and predict responses to environmental pressures underpins conservation efforts globally. We welcome more concepts and theoretical frameworks in this area.

We are excited to receive submissions that revisit ecological concepts that have evolved over time. Ideas such as niche theory (Grinnell 1917; Dussault 2022), metapopulation dynamics (Levins 1969; Hanski, Saastamoinen, and Ovaskainen 2006), and trophic cascades (Hairston, Smith, and Slobodkin 1960; Katano, Nakamura, and Yamamoto 2006) have

transformed as new technologies and data sources have expanded our understanding of ecosystems (Koger et al. 2023; Leach et al. 2023). Revisiting these concepts can provide fresh perspectives, especially in the context of climate change, habitat fragmentation, and rapid species loss (Lustenhouwer et al. 2023; Sánchez-Hernández 2023; Reed, Visser, and Waples 2023; Layton and Bradbury 2022).

As the future of ecology is shaped by these and other emerging areas, the *Journal of Animal Ecology* will continue to welcome contributions that push the boundaries of our knowledge. By embracing technological advances, refining methodologies, rethinking established concepts, testing old theories, and proposing new ones, we will deepen our understanding of the natural world and address the pressing environmental challenges of our time.

In this piece, we have highlighted some key concepts published in *Journal of Animal Ecology* and other journals that, with time, have become staples of our ecological thinking. While some of the on-going Concept submissions will no doubt reach those heights, we encourage our authors to not let that thought be their ultimate goal. Rather than receiving only Concepts that have the potential to become heavily cited, we are more interested in receiving a wide diversity of concepts, with a special emphasis on ECRs and under-represented groups and sub-disciplines of ecology. Researchers are welcome to approach us to obtain initial feedback on their ideas for concepts and to receive suggestions on further development. We look forward to your Concepts!

Author Manuscript

Acknowledgements:

We stand on the shoulders of giants. We acknowledge the myriad of seminal conceptual works published in *Journal of Animal Ecology* and other Journals, which have shaped our understanding of the natural world. RSG was supported by a NERC Pushing the Frontiers grant (NE/X013766/1).

Author contributions:

Conflict of interest:

The authors are Editors of *Journal of Animal Ecology*, but took no part in the peer review or decision-making process for this paper.

Data Availability:

This manuscript does not use data.

References

Asbjørnsen, E. J., Sæther, B.-E., Linnell, J. D. C., Engen, S., Andersen, R., and Bretten, T. 2005. Predicting the growth of a small introduced muskox population using population prediction intervals. *The Journal of Animal Ecology* 74 (4): 612–18.

Benton, T. G., Cameron, T. C., and Grant, A. 2004. Population responses to perturbations: Predictions and responses from laboratory mite populations. *The Journal of Animal Ecology* 73 (5): 983–95.

Author Manuscript

Author Manuscript

Jarrett, B. D., Gaynor, K. M., Palmer, M. S., and Marshall, K. E. 2024. A Gentle Introduction to computer vision-based specimen classification in ecological datasets. *The Journal of Animal Ecology* 93 (2): 147–58.

Burgos, T., Fedriani, J. M., Escribano-Ávila, G., Seoane, J., Hernández-Hernández, J., and Virgós, E. 2022. Predation risk can modify the foraging behaviour of frugivorous carnivores: Implications of rewilding apex predators for plant-animal mutualisms. *The Journal of Animal Ecology* 91 (5): 1024–35.

Clements, F. E. 1916. Plant Succession: Analysis Development Vegetation. *Carnegie Institution Washington Publication Sciences* 242:1–512.

Costa-Pereira, R., Rudolf, V. H. W., Souza, F. L., and Araújo, M. S. 2018. Drivers of individual niche variation in coexisting species. *The Journal of Animal Ecology* 87 (5): 1452–64.

Coulson, T., Tuljapurkar, S., and Childs, D. Z. 2010. Using evolutionary demography to link life history theory, quantitative genetics and population ecology. *The Journal of Animal Ecology* 79 (6): 1226–40.

Cuff, J. P., Evans, D. M., Vaughan, I. P., Wilder, S. M., Tercel, M. P. T. G., and Windsor, F. M.. 2024. Networking nutrients: How nutrition determines the structure of ecological networks. *The Journal of Animal Ecology* 93 (8): 974–88.

Culina, A., F. Adriaensen, L. D. Bailey, M. D. Burgess, A. Charmantier, E. F. Cole, T. Eeva, et al. n.d. 2021. Connecting the data landscape of long-term ecological studies: The SPI-Birds Data Hub. *The Journal of Animal Ecology*, 90 (9): 2147-2160.

Darwin, C. 1859. On the Origin of Species by Means of Natural Selection; Or, the Preservation of Favoured Races in the Struggle for Life. John Murray, London.

Davison, C. W., Assmann, J. J., Normand, S., Rahbek, C., and Morueta-Holme, N. 2023. Vegetation structure from LiDAR explains the local richness of birds across denmark.

Author Manuscript

The Journal of Animal Ecology 92 (7): 1332–44.

Del Toro, I., Ribbons, R. R., and Ellison, A. M.. 2015. Ant-mediated ecosystem functions on a warmer planet: Effects on soil movement, decomposition and nutrient cycling. *The Journal of Animal Ecology* 84 (5): 1233–41.

Dussault, C. 2022. Functionalism without selectionism: Charles Elton's 'functional' niche and the concept of ecological function. *Biological Theory* 17 (1): 52–67.

Ehrlich, P., and Ehrlich, A. 1985. Extinction: The Causes and Consequences of the Disappearance of Species. New York: Ballantine Books.

Einstein, A. 1918. Prinzipielles Zur Allgemeinen Relativitätstheorie. *Annalen Der Physik* 360 (4): 241–44.

Noe, E., Innes, J., Barnes, A.D., Joshi, C., and Clarkson, B. D. 2022. Habitat provision is a major driver of native bird communities in restored urban forests. *The Journal of Animal Ecology* 91 (7): 1444–57.

Charles, E. 1927. Animal Ecology. *Sidgwick & Jackson, LTD, London*.

Charles, E., and Nicholson, M.. 1942. The ten-year cycle in numbers of the lynx in Canada. *The Journal of Animal Ecology* 11 (2): 215.

Grinnell, J. 1917. The niche-relationships of the California thrasher. *The Auk* 34 (4): 427–33.

Hairston, N. G., Smith, F. E., and Slobodkin, L. B. 1960. Community structure, population control, and competition. *The American Naturalist* 94 (879): 421–25.

Hamilton, W. D. 1964. The genetical evolution of social behaviour. *Journal of Theoretical Biology* 7 (1): 1–16.

Hanski, I. 1991. Single-species metapopulation dynamics: Concepts, models and observations. *Biological Journal of the Linnean Society. Linnean Society of London* 42 (1-2): 17–38.

Author Manuscript

Hanski, I., Saastamoinen, M., and Ovaskainen, O. 2006. Dispersal-related life-history trade-offs in a butterfly metapopulation. *The Journal of Animal Ecology* 75 (1): 91–100.

Harrison, R. A., Mohr, T., and van de Waal, E.. 2023. Lab cognition going wild: Implementing a new portable touchscreen system in vervet monkeys. *The Journal of Animal Ecology* 92 (8): 1545–59.

Jesmer, B. R., Kauffman, M. J., Murphy, M. A., and Goheen, J. R. 2020. A test of the niche variation hypothesis in a ruminant herbivore. *The Journal of Animal Ecology* 89 (12): 2825–39.

Katano, O., Nakamura, T., and Yamamoto, S. 2006. Intraguild indirect effects through trophic cascades between stream-dwelling fishes. *The Journal of Animal Ecology* 75 (1): 167–75.

Koger, B., Deshpande, A., Kerby, J. T., Graving, J. M., Costelloe, B. R., and Couzin, I. D. 2023. Quantifying the movement, behaviour and environmental context of group-living animals using drones and computer vision. *The Journal of Animal Ecology* 92 (7): 1357–71.

Layton, K. K. S., and Bradbury, I. R. 2022. Harnessing the power of multi-omics data for predicting climate change response. *The Journal of Animal Ecology* 91 (6): 1064–72.

Leach, C. B., Weitzman, B. P., Bodkin, J. L., Esler, D., Esslinger, G. G., Kloecker, K. A., Monson, D. H., Womble, J. N., and Hooten, M. B. 2023. Revealing the extent of sea otter impacts on bivalve prey through multi-trophic monitoring and mechanistic models. *The Journal of Animal Ecology* 92 (6): 1230–43.

Levins, R. 1969. Some demographic and genetic consequences of environmental heterogeneity for biological control. *Bulletin of the Entomological Society of America* 15 (3): 237–40.

Author Manuscript

Lindeman, R. L. 1942. The trophic-dynamic aspect of ecology. *Ecology* 23 (4): 399–417.

Li, W., Hou, X., Xu, C., Qin, M., Wang, S., Wei, L., Wang, Y., Liu, X., and Li, Y. 2021. Validating eDNA measurements of the richness and abundance of anurans at a large scale. *The Journal of Animal Ecology* 90 (6): 1466–79.

Lucas, A., Bodger, O., Brosi, B. J., Ford, C. R., Forman, D. W., Greig, C., Hegarty, M., Neyland, P. J., and de Vere, N. 2018. Generalisation and specialisation in hoverfly (Syrphidae) grassland pollen transport networks revealed by DNA metabarcoding. *The Journal of Animal Ecology* 87 (4): 1008–21.

Luck, G. W., Lavorel, S., McIntyre, S., and Lumb, K. 2012. Improving the application of vertebrate trait-based frameworks to the study of ecosystem services. *The Journal of Animal Ecology* 81 (5): 1065–76.

Lustenhouwer, N., Moerman, F., Altermatt, F., Bassar, R. D., Bocedi, G., Bonte, D., Dey, S., et al. 2023. Experimental evolution of dispersal: Unifying theory, experiments and natural systems. *The Journal of Animal Ecology* 92 (6): 1113–23.

Maia, K. P., Marquitti, F. M. D., Vaughan, I. P., Memmott, J., and Raimundo, R. L. G. 2021. Interaction generalisation and demographic feedbacks drive the resilience of plant-insect networks to extinctions. *The Journal of Animal Ecology* 90 (9): 2109–21.

Mac Arthur, R. H., and Wilson, E. O. 1970. The Theory of Island Biogeography. Princeton, New Jersey: Princeton University Press.

Minachilis, K., Kantsa, A., Devalez, J., Vujic, A., Pauly, A., and Petanidou, T. 2023. High species turnover and unique plant-pollinator interactions make a hyperdiverse mountain. *The Journal of Animal Ecology* 92 (5): 1001–15.

Morrison, C., and Hero, J.-M. 2003. Geographic variation in life-history characteristics of amphibians: A review. *The Journal of Animal Ecology* 72 (2): 270–79.

Author Manuscript

Naniwadekar, R., Chaplod, S., Datta, A., Rathore, A., and Sridhar, H. 2019. Large frugivores matter: Insights from network and seed dispersal effectiveness approaches. *The Journal of Animal Ecology* 88 (8): 1250–62.

Nicholson, A. J. 1933. Supplement: The balance of animal populations. *The Journal of Animal Ecology* 2 (1): 131.

Nicholson, A. J., and Bailey, V. A. 1935. The Balance of Animal Populations.—part I. *Proceedings of the Zoological Society of London (1944)* 105 (3): 551–98.

Nonaka, E., Sirén, J., Somervuo, P., Ruokolainen, L., Ovaskainen, O., and Hanski, I. 2019. Scaling up the Effects of Inbreeding Depression from Individuals to Metapopulations. *The Journal of Animal Ecology* 88 (8): 1202–14.

Pelletier, F., Garant, D., and Hendry, A. P. 2009. Eco-evolutionary dynamics. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences* 364 (1523): 1483–89.

Pilosof, S., Porter, M. A., Pascual, M., and Kéfi, S. 2017. The multilayer nature of ecological networks." *Nature Ecology & Evolution* 1 (4): 101.

Pocock, M. J. O., Evans, D. M., and Memmott, J. 2012. The robustness and restoration of a network of ecological networks. *Science* 335 (6071): 973–77.

Reed, T. E., Visser, M. E., and Waples, R. S. 2023. The opportunity for selection: A slippery concept in Ecology and Evolution. *The Journal of Animal Ecology* 92 (1): 7–15.

Reznick, D. A., Bryga, H., and Endler, J. A. 1990. Experimentally induced life-history evolution in a natural population. *Nature* 346 (6282): 357–59.

Sánchez-Hernández, J. 2023. Fresh perspectives on the river continuum concept require trophic ecology approaches focussed on food web structure and energy mobilisation routes. *The Journal of Animal Ecology* 92 (5): 957–64.

Author Manuscript

Shermeister, B., Mor, D., and Levy, O. 2024. Leveraging camera traps and artificial intelligence to explore thermoregulation behaviour. *The Journal of Animal Ecology* 93 (9): 1246–61.

Smith, J. E., and Pinter-Wollman, N. 2021. Observing the unwatchable: integrating automated sensing, naturalistic observations and animal social network analysis in the age of big data. *The Journal of Animal Ecology* 90 (1): 62–75.

Stearns, S. C. 1977. Life-history tactics: A review of the ideas. *The Quarterly Review of Biology* 51 (1): 3–47.

———. 1983. The influence of size and phylogeny on patterns of covariation among life-history traits in the mammals. *Oikos* 41 (2): 173–87.

———. 1999. *The Evolution of Life Histories*. New York, USA: Oxford University Press.

Stott, I., Salguero-Gómez, R., Jones, O. R., Ezard, T. H. G., Gamelon, M., Lachish, S., Lebreton, J.-D., Simmonds, E. G., Gaillard, J.-M., and Hodgson, D. J. 2024. Life histories are not just fast or slow. *Trends in Ecology & Evolution*, July. https://doi.org/10.1016/j.tree.2024.06.001.

Thomassen, E. E., Sigsgaard, E. E., Jensen, M. R., Olsen, K., Hansen, M. D. D., and Thomsen, P. F. 2024. Environmental DNA metabarcoding reveals temporal dynamics but functional stability of arthropod communities in cattle dung. *The Journal of Animal Ecology* 93 (8): 1003–21.

Van Meerbeek, K., Jucker, T. and Svenning, J. C. 2021. Unifying the concepts of stability and resilience in ecology. *The Journal of Ecology* 109 (9): 3114–32.

Volterra, V. 1927. Fluctuations in the abundance of a species considered mathematically. *Nature* 119 (2983): 12–13.

Webber, Q. M. R., and Vander Wal, E. 2018. An evolutionary framework outlining the

integration of individual social and spatial ecology. *The Journal of Animal Ecology* 87 (1): 113–27.

Windsor, F. M. 2023. Expanding network ecology in freshwater ecosystems. *The Journal of Animal Ecology* 92 (8): 1575–88.

Wood, C. L., Micheli, F., Fernández, M., Gelcich, S., Castilla, J. C., and Carvajal, J. 2013. Marine protected areas facilitate parasite populations among four fished host species of central Chile. *The Journal of Animal Ecology* 82 (6): 1276–87.

Žák, J., and Reichard, M. 2021. Reproductive senescence in a short-lived fish. *The Journal of Animal Ecology* 90 (2): 492–502.

Zhao, Q, Arnold, T. W., Devries, J. H., Howerter, D. W., Clark, R. G., and Weegman, M. D. 2019. Land-use change increases climatic vulnerability of migratory birds: Insights from integrated population modelling. *The Journal of Animal Ecology* 88 (10): 1625–37.

Author Manuscript