IQCB Seminar

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IQCB — Institute for Quantitative & Computational Biosciences

Lecture Hall (00.187) at BioZentrum I, Hanns-Dieter-Hüsch-Weg 15, 55128 Mainz

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Ecology needs a causal overhaul

Ecology has yet to embrace causal inference, yet most questions in ecology are causal. Despite the common use of terms that imply causation, such as "shapes," "drives," or "impacts," many studies shy away from directly acknowledging their causal ambitions. This avoidance not only obscures the true intent of research but also underpins a broader challenge within the field's approach to science. Ecology heavily relies on observational data, and so the necessity for robust causal inference becomes paramount. However, causal methods are also needed for non-randomized experiments. We critique the predominance in ecology of scientifically-empty statistical procedures that lack scientific clarity and value. We advocate for a shift towards explicit causal inference, arguing that understanding causality is not confined to randomized controlled trials but can also be enriched through observational data when paired with rigorous causal inference methodologies. The paper elucidates the common pitfalls in ecological studies, such as throwing all variables into an analysis, use of AIC for model selection, the 'Table 2 Fallacy' and the misuse of controls: all of which can lead to misleading scientific understanding. The good news is that causal inference is not primarily a statistical problem, but rather a scientific one that is accessible to all ecologists. We can get reasonably far continuing to use many ecologists' familiar standard statistical toolbox based around regression models paired with causal diagrams. When it comes to regression, causal inference is about understanding what we should condition on (good controls) and what we should not condition on (bad controls). We provide not only a critique but a constructive guide, aiming to demystify causal inference and encourage its adoption in ecological studies using familiar approaches. By doing so, we seek to elevate the quality and impact of ecological research, moving beyond routine convenient statistical procedures and towards a more scientifically sound and insightful understanding of ecology.

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