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sDiv working group meeting summary

”sPrint”

This sPRINT working group stems from initial discussions that took place in 2019 between some of the current members of the group, as well as other researchers. The impetus from the previous meeting was to capitalize on the publication of the article by Portalier et al (2019), which reported a first attempt at the explicit inclusion of mechanical factors into the mathematical modelling of predator-prey interactions in specific environments, namely pelagic and aerial habitats. The main discussion from that preliminary meeting formed the basis for the aims and scope of the current sDiv meeting.

Thus, this first gathering of the sPRINT group members aimed at:

1) Working on the generalization of the approach initially built only on mechanical factors (gravity, viscosity and density), to other important physical factors (temperature, light, turbulence, etc.), perhaps even factors largely ignored in the current field of ecology (electromagnetism, texture, etc.).
2) Working on the generalization of the approach initially built only for pelagic and aerial predators and prey, to other important habitats (benthic, ground) and predation strategies (sit-and-wait, filter-feeders, etc.).
3) Working on scaling from physics-based derivations of single predator-prey interactions to the building of whole food web architectures.

Before Portalier et al’s article (2019), only a handful of papers ever tried to quantify the effect of a physical factor on one or more aspect of predator-prey interactions. Moreover, effects of any physical factor on predation have rarely if ever been comprehensively reviewed in the past. As exciting as the exploration of largely uncharted scientific territories is, the other side of the coin is that no member of the group can claim expertise in the overall theme of the workshop. Hence, a large part of the meeting consisted in doing the groundwork and deciding on the methods and approaches worth pursuing. As a consequence, the co-organizers of the meeting decided to forgo the classical arrangement of workshops into alternations of oral presentations and brainstorming sessions. Rather, the group members were divided into open breakout groups, decided as their need arose from the whole group discussions.

In that manner, after the first day during which the aims and scope of the workshop were presented by the co-organizers, followed by a first whole-group discussion, it was decided to devise three breakout groups:

1) Group 1 worked on the outline of a review that would fulfil two objectives: present evidence for the important role of physical factors in shaping predation in various environments; and simultaneously outline a framework for the explicit inclusion of such factors in models of predation.
2) Group 2 worked on the definition of a list of traits and parameters that will need to be measured by ecologists and food-web empiricists, in order to collect the data necessary for the build-up and testing of the theory.

3) Group 3 worked on the interface between predictions at the trophic interaction level and food web models. How can one scale from predicting the occurrence probabilities and net energy gains of pairwise interactions under a given physical regime, to estimations of interaction strengths and energy flows within food webs?

Brainstorming within each of the groups produced substantial progress on the conceptual level. For example, it was decided that the movement ecology paradigm, as first defined in Nathan et al (2008), will be the focal point in the framework at which level the inclusion of physical factors have to be acted. Movement in relation to the surrounding medium is an unavoidable component of predator-prey interactions, and is the ecological process that is most affected by physical factors. Moreover, the movement ecology paradigm includes not only the mechanical aspect of locomotion, but also its physiological, behavioral and evolutionary components.

It was also deemed that the conceptual description of the predation sequence by Wootton et al (2021) is the appropriate approach to use in the task of scaling up from the interaction level to the food web level. Indeed, this approach is comprehensive, since it applies to any kind of predation strategy. It is also mathematical, presenting a formalism that leads to an explicit derivation of the functional response from the detailed description of the various stages that compose the predation sequence. From the functional response, energy flows and interaction strengths can then easily be derived, for their use in state-of-the-art models that describe the architecture of food webs, such as the ADBM model (Thierry et al 2011). Work on the generation of empirical data and patterns for theory development proved less conclusive. There is unfortunately a lack of comprehensive databases available with relevant data. It was agreed, however, that the best approach was to rely on GATEWAy, a database of realized predator-prey interactions, since it is the largest database of its kind, and it already contains information of the body size of species, their habitat and locomotion mode. The idea is to try to aggregate external data on movement-related traits (velocities, accelerations, turning rates, etc.) and physical senses (vision, hearing, electroreception, etc.) into GATEWAy. Debates around the nature of the traits to be collected yielded a useful distinction between intrinsic traits (mostly morphological and cognitive), that are not affected by the physical factors per se, and realized traits (mostly behavioural), which are the result of the interaction between the usage of the intrinsic traits in a given environment, and the physical conditions of that environment.

At the conclusion of the workshop, it was decided that the progress on the conceptual front warranted starting on writing the planned review on a framework for the inclusion of physical factors into the study of food webs. Decisions on the traits to select for a literature search and for recommendations to provide to field ecologists for data collection are left to the next sDiv workshop planned for 2021. Advancement on the review will make the other half of this coming meeting.

In summary, although this sDiv workshop took place entirely on-line (the first of its kind), the technical support offered by the institution, and the dedication of most participants resulted in significant advances towards the framing of a theory for the explicit inclusion of physical factors in the prediction of the structure of food webs.

References:

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