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Introducción a la sección monográfica / Introduction to the Monographic Section

What is the Philosophy of Organismal Biology?

¿Qué es la filosofía de la biología organismal?

Alejandro FÁBREGAS-TEJEDA

Department of Philosophy I, Ruhr University Bochum, Bochum, Germany; Konrad Lorenz Institute for Evolution and Cognition Research (KLI), Klosterneuburg, Austria
Alejandro.FabregasTejeda@rub.de
https://orcid.org/0000-0002-1797-5467

Mariano MARTÍN-VILLUENDAS

Departamento de Filosofía, Lógica y Estética. Universidad de Salamanca, España
Instituto Universitario de Estudios de la Ciencia y la Tecnología, Salamanca, España
marianomv@usal.es
https://orcid.org/0000-0002-6814-7346

1. Introduction. What is the philosophy of organismal biology? What are its contours and what justifies this designation?

According to a growing number of historians and philosophers of biology, in recent years we have witnessed a "return of the organism" as a fundamental analytical, epistemic, and ontological category through which to approach and rethink some of the major theoretical discussions and empirical investigations that have articulated the field (see, for example, Huneman, 2010; Nicholson, 2014; Walsh, 2015; Fábregas-Tejeda and Vergara-Silva, 2018a; Baedke, 2019; McLoone, 2020; Gambarotto and Nahas, 2022). Within the multiple disciplines and areas of research that structure biological practice, organisms have begun to be considered as causally efficacious, active ontogenetic units whose conceptualization cannot be approached solely through the isolated study of the activities and properties of their parts (e.g., their genes or cells). Gone seems to be the idea that organisms are mere "bags of genes" or simple passive vehicles whose only evolutionary function is to ensure the replication and propagation of certain alleles over generations (for illustrative examples of this trend, see Fisher, 1936; Trivers, 1971; Wilson, 1975, p. 3; Dawkins, 1976, p. 82; for a historical reappraisal of the heuristic power and

epistemic limits of this view of evolution, see Ågren, 2021). Biologists and philosophers alike have argued, in marked opposition to the genetic program metaphor (see recent critiques in Martín-Villuendas, 2021a; McKenna et al., 2022; see also Moss, 2003), that organisms are in close interdependent relationship with their environments throughout development. This has led to the conclusion that organisms must play a crucial and active role in determining their ontogenetic and evolutionary trajectories by responding to, integrating, and modifying signals from their surroundings and by marshalling a diversity of developmental resources and scaffolds (Griffiths and Stotz, 2013, pp. 134-140; Stotz, 2017; Chiu and Gilbert, 2015).

In line with these considerations, multiple authors have proposed understanding developing organisms as agents constitutively open to environmental influences, recognizing the important role that plasticity and flexibility play in their material configurations, responses, and actions (see, for example, Sultan, 2015; Newman, 2022; Gilroy and Trewavas, 2022). This has paved the way for a substantial reconceptualization of the processes that structure organismal development, as well as the potential role that the latter could play in determining the *tempo* and *direction* of evolutionary processes. Instead of conceptualizing development through an internalist view, where selected genetic variation does all the work in explaining the unfolding of phenotypes, it has been proposed to recognize development as a constructive process (Laland et al., 2015): organisms have the capacity to shape their own developmental trajectories by responding to, modifying, and altering their internal and external states (for discussion, see Fábregas-Tejeda and Vergara-Silva, 2018b). This constructive view, which rejects a linear, bijective relationship between genotype and phenotype, has called into question two of the fundamental principles on which evolutionary biology has been founded over the last decades: (i) the idea that genetic change always causes and precedes phenotypic change; and (ii) the conception that variation subtending the evolutionary process is isotropic. Studies in epigenetics and evolutionary developmental biology (particularly in its 'devo-evo' branch) have shown how the organism is able to impose biases on the generation of phenotypic variation, either by modifying the connections and regulation established between the components that structure ontogenetic processes (see Gehart and Kirschner 2007, 2010) or by integrating environmental signals through epigenetic regulatory mechanisms (for examples, see Young and Badyaev, 2010; Herrera and Bazaga, 2012; for discussion, see Brun-Usan et al., 2022). In accordance with these musings, studies framed by niche construction theory have shown that organisms are capable of exerting substantive changes in their environments, being able to bias, accordingly, their own selective pressures, as well as those of their conspecifics and those of other organisms from different species with which they are linked by sustained ecological interactions (Odling-Smee et al., 2003; Schwab et al., 2019; for discussion, see Baedke et al., 2021; Fábregas-Tejeda and Baedke, 2023). Some authors have even argued that studying organisms in their

environmental and ontogenetic contexts, foregrounding their agential activities, could help bridge some of the explanatory gaps left by traditional evolutionary perspectives (Sultan et al., 2021).

This reconsideration of the potential role that organisms might play in improving our understanding of evolutionary processes has been driven by conceptual and empirical contributions from a diversity of disciplines and areas of study: evolutionary developmental biology (Evo-Devo; Arthur, 2004, chapter 7; Casanueva, 2014; Petino Zappala and Barberis, 2018; Müller, 2021; Nuño de la Rosa and Villegas, 2022), niche construction theory (Odling-Smee et al., 2003; Barahona et al., 2021; Aaby and Desmond, 2021), epigenetics (Baedke, 2018; Veigl, 2022), phenotypic plasticity research (West-Eberhard, 2003), microbiome and holobiont research (Skillings, 2016; Baedke et al., 2020a; Triviño and Suárez, 2020; Suárez and Stencel, 2020), immunology (Pradeu, 2010; Zach and Greslehner, 2023), the study of extra-genetic inheritance (Jablonka and Lamb, 2018; Bonduriansky and Day, 2020; Martín-Villuendas, 2021b), the contextual and social examination of organismal behavior (Gomez-Marin and Ghazanfar, 2019; Kohn, 2019), the debate surrounding the so-called 'Extended Evolutionary Synthesis' (Laland et al. , 2015; Baedke et al., 2020b), cancer research in systemic contexts (Soto and Sonnenschein, 2021), and developmental systems theory (Oyama, 2000; Andrade, 2017), among other converging strands of theorization.

The advances made in these fields have brought the 'organism' concept back into the focus of analysis as an explanatory category in its own right. That is, as a legitimate explanandum that cannot be subsumed entirely under a molecular-genetic perspective, and as part of the explanantia of many other biological phenomena. This epistemic undertaking demands that philosophers, historians and biologists alike face the challenging task of redefining the semantic contours that structure this concept on the basis of the results revealed by the different disciplines and areas of research alluded to above. In general, reflections traversed by this concept promise to offer new tools through which to rethink various debates that articulate biology and the philosophy of biology in the 21st century (see, among others, Ruiz-Mirazo et al., 2000; Bateson, 2005; Pepper and Herron, 2008; Nicholson, 2014; as an antecedent, see, for example, Wake, 1984).

The theoretical centrality of the 'organism' concept has even transcended the frontiers of scientific debates, permeating and involving disciplines such as philosophy. Philosophers of biology have begun to pay attention to organisms and to the study of organisms as productive *loci* of analysis in relation to other epistemic and ontological problems of the life sciences. For example, in recent years there have been many philosophical discussions on the concept of organism and the importance of organismal organization and regulative control (see, e.g., Nuño de la Rosa, 2010; Soto et al., 2016; Shields, 2017; Bich and Bechtel, 2022; for discussion on the complex historical itineraries of the concept of organism, see

Wolfe, 2010; Cheung, 2014). In the same vein, the question of what, if anything, differentiates an organism from a machine has resurfaced (e.g., Nicholson, 2013; Esposito, 2019; Bongard and Levin, 2021). On the other hand, philosophers have scrutinized the processes through which organisms sculpt, select, and adapt to various aspects of their environments, and how natural scientists approach studying these phenomena (see, for example, Trappes et al., 2021; Aaby and Ramsey, 2022). Similarly, the relationship between organism and environment, arguably one of the most important bonds investigated within biology, has become important for philosophical disquisitions. Various scholars have attempted to address the conceptual problems underlying the idea of reciprocal causation between organisms and environments (see, for example, Baedke et al., 2021; Baedke and Buklijas, 2022; Pontarotti et al., 2022; Prieto and Fábregas-Tejeda, 2022; Saborido and Heras-Escribano, 2023) and its possible theoretical extensions in domains such as human health (e.g., through the notion of 'adaptivity'; see Menatti et al, 2022) or the study of cognition as a biological phenomenon that is widely distributed and needs to be understood beyond computational-representational frameworks (see, e.g., Corris, 2020; Feiten, 2020; Sims, 2021). In fields such as behavioral ecology, intra-populational variation at the organismic (and not just genetic) level has been given increased attention, especially the ecological and phenotypic singularities of *token* organisms that have important consequences for evolutionary paths (for a philosophical analysis of these developments, see Trappes, 2022). In general, the uniqueness of *token* organisms and the temporal dimensions of ontogenetic processes are becoming fertile topics of inquiry that open unexplored questions for philosophers of biology interested in the controversy over what constitutes 'biological individuality' (see Kaiser and Trappes, 2021). Additionally, important philosophical papers have been put into circulation that contribute to organism-centered evolutionary perspectives, from explorations of the evolution of pregnancy in eutherians (Nuño de la Rosa et al., 2021) to the scholarly discussion of possible intersections between Humberto Maturana and Francisco Varela's theory of autopoiesis and the idea of 'natural drift' to account for some evolutionary dynamics (see Raimondi, 2021; Mpodozis, 2022; Etxeberria and Cortés-García, 2022). This renewed interest in whole organisms, in how they develop and interact with their environments in ecologically and evolutionarily meaningful ways, in how they are studied and conceptualized by scientists, and in how they fit into the broader theoretical edifice of biology and other neighboring sciences such as medicine and biomedicine, calls for novel and penetrating philosophical analyses that address these problems from a variety of angles.

We propose to adopt the label 'philosophy of organismal biology' to refer to this heterogeneous, though partially overlapping, set of debates currently taking place within the broad disciplinary orientation of the philosophy of biology (see, for example, recent treatments of the scope of the latter in Pradeu, 2017; Prieto, 2021; contrast this with the overview of the discipline outlined in Ruse, 1989).

Despite their close link with advances made in the various branches that make up biological research, these discussions have often been addressed in parallel and independently in the philosophical literature (for instance, discussions concerning 'biological individuality' in contrast to 'organismality,' the distinction between organisms and machines, the metaphysics of symbiosis and holobionts, arguments highlighting the role of organisms as agents in ecology and evolution, controversies about the boundaries between 'development' and 'reproduction,' the organism-environment relationship or discussions concerning levels of organization, cancer research in organismic and not exclusively molecular contexts, extended immunology, ecological epigenetics, evolutionary and variational dispositions of organisms, developmental scaffolding, phenotypic plasticity, etc.). The common denominator of all these philosophical debates (plural in their approaches and methods, from classical conceptual analysis and the philosophy of explanation, passing through the metaphysics of biology and including the inspection of concrete scientific practices) has been, we believe, in one way or another, their anchoring in the concept of 'organism,' as well as the existing relationship between all the phenomena of study previously referred to with salient organismal contexts that are scientifically investigated through experimental interventions, the construction of models with different degrees of idealization and abstraction, and the renewed recognition of the importance of having theories able to frame these phenomena and that seek to explain them. Thus, the philosophy of organismal biology intersects in various ways with the philosophy of Evo-Devo, the philosophy of ecology, the philosophy of immunology and multispecies studies, the philosophy of medicine and biomedicine, the philosophy of the cognitive sciences, the philosophy of developmental biology, the philosophy of cancer research, and the philosophy of evolutionary biology. This overlap notwithstanding, the philosophy of organismal biology is not interchangeably synonymous with these, nor is it completely subsumable to any of them, since under these diverse headings many other topics are investigated that are not directly related to organisms as integrated units of analysis. Moreover, none of these orientations in a unitary manner can grasp the breadth and scope of the questions raised by placing organisms at the forefront of the present-day biological arena. We consider that the appellation 'philosophy of organismal biology' allows us to account for the patent family resemblance that underlies the various debates already reviewed.

We should emphasize that debates with organisms as their focal points have a long pedigree in the history and philosophy of biology, especially in the first decades of the twentieth century in multiple corners of the globe where holistic and organicist positions thrived (see, as a sample of recent historiographical research on this period, Haraway, 1976; Etxeberria and Umerez, 2006; Umerez, 2013; Nicholson and Gawne, 2014, 2015; Esposito, 2016, 2017; Peterson, 2016; Rieppel, 2016; Shields, 2017; Brooks, 2019; Herring and Radick, 2019; Sprenger, 2019; chapters in Michelini and Köchy, 2019; Fábregas-Tejeda et

al., 2021; Fábregas-Tejeda and Vergara-Silva, 2022; chapters in Donohue and Wolfe, 2023). It is no coincidence that the organism concept has been referred to by some authors as 'biology's phoenix,' given that its importance has waxed and waned throughout various periods of its history (see Benson, 1989). In becoming aware of this rich history of scientific and philosophical appraisals of organisms, we propose the name 'philosophy of organismal biology' rather than 'philosophy of organismic biology' because we believe that the emerging configuration of the former has more similarities with discussions that took place within organicist biology at the beginning of the last century (which primarily focused on the analysis of organisms as integrated and organized units).[1] In contrast, 'organismic biology' nowadays refers to an institutional classification scheme, mainly driven and exported from US-American universities (see Milam, 2010), which encompasses various disciplines (e.g., systematics, morphology, zoology, botany, mycology, ecology, paleobiology, and evolutionary population biology) that, although deal with organisms as raw material in their everyday practices, do not necessarily emphasize them as central epistemic or ontological units, or ask how their constitution and agential activities impact the construction of models and theories in biology. In this sense, we cannot ignore the fact that the notion of 'organismic biology' was a banner adopted by authors such as Ernst Mayr and Theodosius Dobzhansky in 1960s to demarcate and legitimize their naturalistic orientations in the face of the unstoppable influx of molecular biologists that were filling the universities of the United States, and not, as its *prima facie* name might suggest, to emphasize the importance of organisms as central units of biology or agents of evolution and development (for a reconstruction of the historical details of this conflict, see Beatty, 1990, 1994; Milam, 2010).[2]

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[1] At the same time, we choose not to christen this approach under the label 'philosophy of organicist biology,' as not all philosophers who could currently be framed as participants, in one sense or another, in the collective discussion on 'philosophy of organismal biology' necessarily uphold and revive the theoretical and epistemic-ontological principles of organicism *qua* movement in biological science of the interwar period (for a discussion of these, see Nicholson and Gawne, 2015; Baedke, 2019; Baedke and Fábregas-Tejeda, 2023). In that sense, to limit the considerations and reflections made to organicist biology would be akin to narrowing their scope and theoretical focus. Organismal biology, we judge, is broader than organicist biology.

[2] There is a general sense, which will not be alien to practicing scientists, according to which it can be said that, distinctively, biology (*sensu lato*) is the science that studies organisms from different perspectives and at different levels of organization; however, that generic assertion (which has also been popular within the philosophy of science, see, for example, Strong, 1980) does not capture the nuances that we want to recover in designating the space of an 'organismal biology.' In particular, at the juncture we live at the onset of the 21st century and regardless of what may have been the *ethos* of this science in the past, not all biology today is *de facto* organismal (think, for instance, of bioinformatics or omics approaches that only work with molecular preparations and extracts, such as metagenomics), since organismal contexts can easily be obviated or taken for granted (which is in fact often the case in experimental laboratories). Even the practice of traditional organismic biology, especially those disciplines that continue the valuable legacies of natural history, has been overtaken by these new developments (for a problematization, see

In sum, there is both a meta-philosophical justification (i.e., bringing together and juxtaposing a set of related discussions that are being waged in parallel by several communities of scholars and that could be enriched by this grouping movement and invitation to collaboration) and a historiographical-sociological one (i.e., the historical background of related scientific-philosophical discussions that took place in the interwar organicist movement and the coeval coexistence of 'organismic biology' in university contexts) to recognize 'philosophy of organismal biology' as a distinct sector within the confines of the philosophy of biology.[3]

This special issue of *ArtefaCToS. Revista de Estudios sobre la Ciencia y la Tecnología* seeks to take the first steps towards this recognition and, at the same time, to advance some seminal discussions related to organisms and their place in the life sciences. In these pages, the philosophy of organismal biology is conceived from a broad perspective that takes into account its ontogenetic, ecological and evolutionary dimensions, as well as its interfaces with other disciplines of scientific relevance such as medicine and biomedicine. With this initiative, we sought (1) to establish bridges and connections between the various debates that potentially structure the current philosophy of organismal biology, and (2) to publish contributions, mainly by authors from Ibero-America, that delve into some of its sub-themes, thus helping to further our understanding of this field of inquiry. In order to fulfill these objectives, we have collected seven contributions from some of the main active contributors to the debates that articulate what we have decided to call here 'philosophy of organismal biology.'

2. The special issue "Philosophy of Organismal Biology: From Ontogeny to Ecology and Evolution"

In his article, Guido I. Prieto offers a systematization of different perspectives available on the distinction between 'organisms' and other 'biological individuals,' identifying eight ways in which the two terms have been juxtaposed in the philosophical literature (some advocating for the elimination of one of the two *designata*, others arguing for full equivalence between them and, finally, others that draw out a specific difference that makes organisms a

Shanker and Guttal, 2021).

[3] As far as our knowledge goes, the only published mentions of the expression 'philosophy of organismal biology' can be found in Maienschein (2009, ix) and Fulda (2017, p. 70), although in both cases this notion is used in passing and without further substantive explication. Both omissions are fully justified within the frameworks of the specific problems addressed in their respective texts. For example, in the second case, the philosopher Fermín Fulda does not devote much commentary to the idea of 'philosophy of organismal biology' because the theoretical target that concerns him in that piece is the putative link between cognition and the agency of organisms such as bacteria (and not the meta-philosophical distinction of a research area that can be circumscribed within the philosophy of biology).

special kind of biological individuals). Prieto argues that this whole range of positions faces conceptual challenges in delimiting the organism from other biological individuals, from imprecision to conceptual narrowness and the risk of eliminativism, and suggests some promising ideas on how to move forward with the debate.

From the standpoint of inductive metaphysics, Javier Suárez approaches the problem of biological individuality by focusing his analysis on one of the most controversial case studies of recent times: the conglomerates formed by individuals of multiple symbiotic species. To this end, he points out the limitations of a shared whole-dependent ontology and advocates the adoption of a part-dependent ontology. Suárez argues that the relations of biological dependence between the parts of a set can be asymmetric without this compromising the attribution of individuality of the conglomerate.

Contributing to recent discussions of organismal perspectives on the problem of phenotypic trait origination (see, for example, McLoone, 2020), the article by Cristina Villegas and Vanessa Triviño addresses the characterization of homologous traits, as well as their variational tendencies, in the organicist approach of evolutionary developmental biology. In their contribution, Villegas and Triviño argue that a deep understanding of the causal and explanatory role of these traits requires metaphysical consideration. More specifically, they propose a metaphysical characterization of the variational tendencies of traits as dispositional properties, conceptualizing homologous traits as dispositional natural kinds. They conclude by highlighting the need to reorient the approach through which existing debates in biology have traditionally been addressed. To this end, they propose to adopt an innovative meta-scientific framework that considers new interactions and interanimation between metaphysics and biology: metaphysics *from* biology (see also Triviño, 2022).

Moving on to another subject, as the article by Alfredo Marcos shows, the philosophy of organismal biology can also dialogue with "bio-philosophy" (see, for example, Köchy, 2008) and with what has recently been called "continental philosophy of biology," under which the reflections on organisms and the phenomenon of the living by authors such as Georges Canguilhem, Maurice Merleau-Ponty, Helmuth Plessner, Kurt Goldstein and Hans Jonas, among others, are emphasized (see the chapters in Bianco et al. , 2023, e.g., Gandolfi, 2023; see also Michelini et al., 2018). Marcos focuses on the concept of "organism" in the work of Hans Jonas, exploring the existing connections with other areas that structure the influential work of this German philosopher.

In his article, James Marcum makes use of reflections coming from the organicist tradition to face a problem of extraordinary practical relevance: the articulation of a biomedical framework that allows to overcome the conceptual and experimental limitations inherent to the currently accepted model (see also Soto and Sonnenschein, 2018, 2021, 2023). To this end, Marcum performs

a characterization and critical analysis of the reductionist medical model that has predominated to the present day, dissecting the conceptual assumptions on which it is founded. Through two case studies, hemostasis and the carcinogenic process, Marcum exemplifies the main shortcomings of this classical framework. As an alternative, he proposes to articulate a novel biomedical framework with organicist and holistic underpinnings: an organismal systems biology. Marcum discusses how this new framework has the potential to solve the problems bequeathed by the old mechanistic-reductionist framework. This is proof that the philosophy of organismal biology constitutes an extremely fertile field through which to structure philosophical reflections that allow us to confront pressing problems of our present juncture.

The article by Jorge Luis Hernández-Ochoa, Melina Gastelum-Vargas, Agustín Fuentes and Francisco Vergara-Silva shows that organismal biology can have fruitful crossings with embodied cognitive sciences and philosophical reflections from conceptual frameworks such as enactivism. The authors propose to analyze play behavior in *Homo sapiens* from an ontogenetic-constructivist perspective, a case study so far underexplored that could simultaneously enhance our understanding of evolutionary processes and shed light on how we perceive, inquire, know, transform and interact in the world as situated organisms. They focus on exploring the importance of play in the processes of cultural, selective and ontogenetic niche construction, and in the dynamic emergence of human cognition. Play, according to their examination, could strengthen and expand a vast network of evolutionary and enactivist concepts in various disciplines that draw from them.

Finally, the work of Arantza Etxeberria Agiriano, David Cortés-García and Mikel Torres Aldave explores the evolutionary significance of collaborative relationships between organisms. To do so, they propose an innovative conceptual strategy that transgresses the traditional boundaries on which reflection on the concept of organism has pivoted: starting from the ideas outlined in the theoretical work of Pyotr Kropotkin. Combining both historical and philosophical aspects, the authors demonstrate to what extent the ideas of intraspecies relationships and altruism outlined by Kropotkin allow us to rethink crucial aspects of the evolutionary process, including the importance of inter-organismic collaborative interactions and inter-dependencies in development and in the formation of new evolutionary individuals. To exemplify these reflections, they analyze case studies that deal with symbiosis and viviparous reproduction in eutherian mammals.

Overall, the agenda of the philosophy of organismal biology points to an extremely lively field whose contours are just beginning to be delineated and re-negotiated. Therefore, the contributions to this special issue only constitute a small sample of the possible philosophical discussions and thematic connections that can be addressed within it (see the introductory section of this article). Some

of the potential meta-scientific extensions that remain to be addressed could be: assessing the role given to organisms within scientific explanations and theories in the various fields that make up the contemporary research landscape in biology and biomedicine; envisioning the need for a methodological restructuring of modeling practices in order to more accurately reflect the epistemically central role of organisms and their activities in our understanding of the phenomena studied (e.g., the case of model organisms; see Ankeny and Leonelli, 2021); examining the place of organismality within current debates on individuality in the biological and biomedical sciences; discussing how organismal agency might fit into naturalist positions and debates on life-mind continuity (see Gambarotto and Nahas, 2023); rethinking some bioethical debates, for instance, on the value of life or the notion of 'death,' that arise from distinct concepts of 'organism' (see Rendón and Klier, 2017; Nowak and Stencel, 2022); and becoming aware of the possible conceptual and epistemological limitations of a scientific practice based on the organism as the central epistemic and ontological unit of biology, thus avoiding falling into a reification regime similar to that committed by population thinking. In short, multiple epistemological, ontological, heuristic, methodological, pragmatic and axiological issues related to organisms as *loci* of analysis in the life sciences remain to be thoroughly articulated and linked.

Furthermore, some of the possible debates that could structure the field in direct connection with scientific work include: the agency of organisms in development, ecology and evolution;[4] critical analyses of the variational and dispositional properties of organismal development; studies of the boundaries of organisms in the context of development, reproduction and interactions with their environments; the relationship between 'organisms' and 'holobionts' in development and evolution; the possibility of structuring an inclusive notion of inheritance that detaches from the germline condition and captures the constructive ecological activities of organisms; the conceptualization of an idea of plasticity that picks up the intuitions underlying the notion of 'constructive development,' leaving aside the traditionally adopted genocentric view based on the idea of reaction norms; and the articulation of connections with developments in 4E cognition, basal cognition studies, the free energy principle, and embodied robotics and artificial intelligence studies (for propitious contributions to build these bridges, see, among others, Castro Garcia, 2011; Colombo and Wright, 2021; Heras-Escribano *et al.*, 2022; Hernandez-Ochoa and Vergara-Silva, 2022; Harrison et al., 2022).

We would like to conclude this introduction by remarking that, although the philosophy of organismal biology constitutes a burgeoning area of academic discussion within Anglo-Saxon and Ibero-American communities (as this bilingual issue

[4] For example, the study of organisms as active, responsive entities to their changing environments could have implications for how species conservation initiatives are framed (see Feiner et al., 2021).

of *ArtefaCToS* purports to show), it also manifests itself in additional philosophical communities that perhaps have not received the consideration they should (see, for example, Yılmaz, 2022). We hope that the contributions published here will serve as an encouragement to consolidate in the future the philosophy of organismal biology as a valid, vivid and nurturing orientation within contemporary philosophy of science on an international scale.

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