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The Science of Bee Collapse and an Emerging Knowledge for Sustainability

Elsa Coimbra, *The Department of Human Geography and Human Ecology, Lund University and Centre for Research and Studies in Sociology (CIES), University Institute of Lisbon, Email: elsa.coimbra@keg.lu.se*

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The following text addresses the threats affecting the honey-bee, and which are manifesting through the unusual death rates of bee colonies. Focus is placed in reviewing the scientific knowledge that concerns the honey-bee by discussing its cognitive and ethical categories and its influence in nature conservation, mainly centred in the EU. Results indicate that scientific knowledge plays a fundamental role in defining what the problems are, as well as their degree of urgency and holds the greatest legitimacy in informing policy-making. Further results reveal that research is dominated by STEM fields of science, and is largely conveying a dichotomized and utilitarian viewpoint of human-nature relationships. The concluding section argues for a transition towards transdisciplinarity and social learning. It emphasises a science that is able to integrate a social-ecological understanding of the value of bees as the world's common good, together with a praxis that effectively promotes sustainable change.

Keywords: Honey-bee collapse; nature conservation; science; transdisciplinarity.

1 Introduction

The following text is based on research underway about the life and death of the honey-bee understood within the dynamic wholeness of Earth's human-environmental relationship. In this research I set out to understand the significance of the threats affecting the honey-bee, and which are becoming apparent through the unusual and sometimes drastic death rates of bee colonies (Potts et al., 2010; William, 2010) [1] [2].

Science points to the demise of the honey bee as one instance of a larger picture, in which fellow insect pollinators are reported to be in decline in many regions of the world (Potts et al., 2010; Vanbergen, 2013) [1] [3]. It has been estimated that 87.5% of flowering plants are pollinated by animals. This covers both crop and wild plants, and points to the crucial importance of bees – as one of the chief global pollinators – to the maintenance of food production and wild plant ecosystems (Ollerton, 2011) [4]. Not surprisingly, the past decade has seen a considerable amount of research conducted on the collapse of bee colonies. Despite a variety of inquiries, unanswered questions and blank spaces, scientists agree that the syndrome has a *multifactorial nature and anthropogenic* origin.

My research also points to a maze of multi-

dimensional aspects that compose a remarkably complex tapestry. Its strands involve not only the ecological intricacies of the biosphere, of which bees are fundamental attendants, but also the impact of a plethora of human ideas and practices. These encompass conservation policies and regulations, apiculture, agro-chemical corporative manoeuvres and scientific models of understanding the natural world. This article mainly addresses the latter, through a critical review of scientific knowledge concerning and affecting bees.

In nature conservation, scientific knowledge plays a fundamental role in defining what the problems are, as well as their scale and their degree of urgency. The case of the honey-bee is no exception. Science holds the greatest legitimacy in informing policy making, ranging from regulatory frameworks to the implementation of protective measures. For example, the European Commission's recent attempt to remove certain pesticides from the market was based on large amounts of scientific research demonstrating their negative impact on the honey-bee (CFP, 2009; EFSA, 2013; UNEP, 2010) [5] [6] [7]. Scientific research also has a large influence on modern apiculture: 'good' beekeeping practices and technologies get promoted through different venues, and beekeepers are increasingly dependent on pharmaceutical products to ensure the livelihood of their colonies.

The collapse of bees seems to have become a vortex around which a series of key pressure factors revolve. One of the main factors is land-use, which includes growing urbanization. This fragments and destroys many natural habitats that bees, like other pollinators, rely on for their livelihood (Garibaldi et al., 2011) [8]. Agricultural intensification often leads to the use of pesticides that harm bees. In addition to the use of pesticides, various modern beekeeping practices cause stress and malnutrition. For example, continually relocating beehives and the increasing use of sugar, instead of honey, to feed colonies. Other stressors include the practice of selective breeding with its related problematic consequences (Tarpy, 2003; Meixner et al., 2010) [9] [10]. There is also the rampant pressure produced by pathogens, such as the notorious parasitic mite Varroa destructor. As a consequence of the ubiquitous presence of pathogens, beekeepers often resort to chemotherapy (Johnson et al., 2009) [11]. Managed honey-bees are thus chronically exposed to a cocktail of different chemicals that can interact, sometimes synergistically, with detrimental effects on their behaviour, immunology and ultimate survival (Vanberg, 2013) [3].

Arguably, the death of bees is a fundamentally radical case for Nature Conservation. Firstly, on account of its impacts on the biophysical level. Because the life of bees provides the foundation for a most intricate web of relations in the planet, the risk of their demise points to a most colossal collapse. Secondly, because solutions involve seeing the complexity of a much larger set of human-environmental relations, and involve changes in deeply entrenched institutions and their functions.

The most radical problems naturally call for far-reaching answers, which I argue require moving beyond the death of bees as a collective bio-physical threat to an understanding of the life of bees as a common good. This change presupposes a considerable paradigmatic leap in the way science and knowledge is used in the pursuit of sustainability. The challenge of this paradigm shift lies at the core of effective Nature Conservation and its failure to respond to the situation at hand. In the next section I address some of the key challenges of this transition. In the last section I argue for a new model and praxis that recognizes that the complexity and urgency posed by the fate of bees demands an integration of science and social transformation.

2 Challenges of Transition

2.1 Taking on Board the Human Dimension

The key pressure factors identified in relation to the collapse of bees, such as land-use intensification or particular models of agriculture, point to multiple human-environmental aspects, thus naturally calling for interdisciplinary approaches. Nevertheless, an overview of research reveals that the understanding of the collapse, like other problems in environment and nature conservation, is largely dominated by the natural sciences and STEM fields of research[1]. However, the question remains whether it is possible to understand the collapse outside of its actual social fabric and bypass sourcing its anthropogenic roots.

In effect, the death of bees is immensely and unavoidably political. One has only to place research

[1]It is revealing that the two latest scientific events on Bees in Europe have no formal participation from the social sciences, vide http://coloss.org/home/conference/ and http://eventos.um.es/event_detail/592/sections/166/symposia.html (Accessed 11 August 2014)

developed on bee collapse in its social context, and consider the thought-provoking fact that pesticides, the most researched and 'objectively' established factor of risk is also one of the most energetically refuted. The solidity of such findings informed the recent restriction adopted by the Commission, but this political decision was soon to be counteracted by two large companies with agribusiness interests, Syngenta and Bayer, who have sued the EU[2].

These legal actions, in turn, have to resort to scientific data that sheds doubt on previous research. Doubt, instrumental to science's method, can also become a powerful weapon. Anyone who has followed the Climate Change saga may well find in this new collapse saga remarkable similarities.

Furthermore, the production of knowledge on the life and death of bees is no longer confined to public bodies. Nowadays, large corporations like Monsanto are buying entire research institutions, promoting networking events, and forming new influential bodies, such as the Honey Bee Advisory Council, an alliance comprised of Monsanto executives, researchers and beekeepers[3]. These developments eloquently reveal how the death of bees can only be fully understood and addressed in the meeting of science, politics, and corporate economic power.

A transition towards a science for sustainability supposes not so much taking on board the human dimension – because it was never absent in the first place – but promoting thorough awareness and reflexivity amongst researchers in regard to mutual influences and potential impacts of such triangulation.

2.2 Science in culture

Research announces the ecological value of bees as veritable pillars of biodiversity. However, very often this ecological, instrumental value, is translated into a social value with apparent naveté as to its canons and potential consequences. Reports, particularly those with outreach ambitions into civil society, frequently convey information in this fashion:

"The Food and Agriculture Organization of the United Nations (FAO) estimates that of the 100 crop species that provide 90% of food worldwide, 71 are pollinated by bees. The majority of crops grown in the European Union depend on insect pollination. Beyond the essential value of pollination to maintaining biodiversity, the global annual monetary value of pollination has been estimated at hundreds of billions of euros. In view of the important ecological and economic value of bees, there is a need to monitor and maintain healthy bee stocks"[4] .

The life of bees and its value is consequently being associated with food production, and its corresponding monetary value. Indeed, this translation accurately expresses a powerful trend in the management of Nature Conservation known as Ecosystem Services.

Given the social legitimacy of science in describing the world 'as it is', the idea of anchoring the life of bees in its instrumental value – widespread in the media and used as the main rationale by policy makers – runs the risk of becoming 'natural' and of hiding the fact that it carries an ideological assertion.

When instrumentality is the main operative standpoint of value, solutions and problems become strangely similar. At present, laboratories in Europe are dedicated to reducing potential sources of honey contamination caused by both foraging contaminated nectar and chemotherapy of honey-bee diseases. One of the strategies to address these problems involves genetic manipulation, that is, selecting and breeding "disease resistant stock". This is made possible "because the complete honey-bee genome (Apis mellifera) has become available, establishing this economically and ecologically essential organism as a model system for genomic research" (my italics)[5].

This solution poses two problems. One expresses the typical environmental 'technofix' whereby a counter-technology is developed to oppose and neu-

[2]http://www.europeanvoice.com/article/2013/august/syngenta-challenges-eu-pesticide-ban/78075.aspx (Accessed 11 August 2014)

[3]Monsanto acquisition: http://naturalsociety.com/monsanto-bee-collapse-buys-bee-research-firm/#ixzz1swcD6H4T; http://www.huffingtonpost.com/richard-schiffman/the-fox-monsanto-buys-the_b_1470878.html?view=print&comm_ref=false. Monsanto's advisory council: http://news.monsanto.com/press-release/sustainability/monsanto-company-forms-honey-bee-advisory-council-pledges-support-honey (Accessed 11 August 2014)

[4]In EFSA website: http://www.efsa.europa.eu/en/topics/topic/beehealth.htm (Accessed 11 August 2014).

[5]http://www2.biologie.uni-halle.de/zool/mol_ecol/bee-shop/behav_genet.html (Accessed 11 August 2014). The opening of the genetic research field covers other aspects beyond those of food production. For example, the case of the honey-bee being re-designed to serve military purposes (see Kosek, 2010) [12].

tralize the negative effects created by other technologies. In such an approach the habitual pattern is to overlook the unintended consequences, in this case, of genetic manipulations which are eloquently captured in the second law of thermodynamics: "Each technology always creates a temporary island of order at the expense of greater disorder in the surroundings" (Huesemann and Huesemann, 2011, p. 19)[13]. Such fixes commonly bypass the dire need for "a conscious effort to direct technological innovation toward the achievement of clearly defined societal goals that reflect shared values" (Ibidem:116)[13].

The second problem with the solution relates to its unexamined ideological nature. Framing the existence of bees as producers of ecological services is tacitly in line with the representation of the biophysical world as reservoirs and stocks of 'capital' and therefore to be part of the market.

Once particular conditions of production are colonized in this way, it becomes possible to justify their management by economic rationale. That is, environmental degradation and resource exhaustion are being seen as management problems rather than a civilization crisis. Such narratives steers us away from the difficult politics of solving structural inequalities and differentiated interests, in favour of "technomanagerialist remedies, preferred (and constituted) by elite, scientists and bureaucrats" (Goldman and Schurman, 2000, p. 567) [14]. In sum, the prospects of such solutions are set within the commodification of nature in which species become alienable market goods, a solution that seems to be in collusion with the very problem to start with (Kosoya and Corbera, 2010) [15].

A transition is underway insofar as there are signs of awareness of the serious consequences of what could be called an epistemological short-sightedness. This awareness comes from different sources (Suryanarayanan and Kleinman, 2012; Matthews, 2010) [16] [17] including the most reflexive quarters of those advocating economic values of ecosystem services' (Kumar, 2012) [18]. A cultural analysis of science stresses the fact that all human understandings of nature are crucially mediated by social and cultural practices, assumptions, and belief systems. Moreover, such understandings have different impacts and consequences in our relationship with other beings, such as bees. Therefore, there is a need to question science on account of its virtually invisible cultural constructions. "The point of such an interrogation is not to debunk scientific knowledge, but rather to expose its unspoken social and moral commitments" (Wynne, 1994, p. 188)[19]. Yet, hardly any such self-reflexivity transpires in mainstream research dedicated to the collapse of the honey-bee. Moreover, the exceptions to this trend seem to play a negligible role in informing nature conservation management.

2.3 Responding to Uncertainty and the Unknown

Uncertainty is commonly identified as one of the central aspects of human-environmental systems and indeed comes as one of the main aspects that research on bee collapse refers to. As we meet some of its empirical instances, it becomes apparent that the way we respond to uncertainty and the unknown expresses different modalities of knowing which in turn suggest different ways of relating to nature. Concerning the collapse of colonies, uncertainty starts with the very definition and criteria of what constitutes the problem, as "there are many inconsistencies in the ways in which 'colony losses' are defined" (Hendrikx, 2009)[20]. From here on, uncertainty spreads to any "exact reasons" that link to recent increases in bee mortality (Tabajdi, 2011) [21].

The importance of defining the problem is worth considering. Here Einstein's famous quote gives us the clue when he reportedly stated that if he had an hour to solve a problem, and his life depended on the solution, he would spend the first 55 minutes determining the proper question to ask.

In social sciences, the importance of such procedure has been identified as framing, here understood as the interpretation process through which individuals, groups, and societies organize, perceive, and communicate about reality.

It is clear, therefore, that in a science for sustainability, where research aims to answer not only biophysical but social and political relevant matters, there is the need to share and agree on how problems are framed. This is crucial, as it influences the way in which research will be carried out and communicated, as well as its potential outputs to be used in decision-making processes. Even though it is unusual for research questions to be framed jointly with other stakeholders, some transition steps are being taken in that direction in nature conservation (Young et. al., 2014, p. 392)[22]. Given its novelty and uncertainty, the case of colony collapse seems most apt to be framed and reframed in and outside

academia. For researchers this implies sharing not only their expertise but also their uncertainties in a wider pool of knowledge that includes a range of social actors, such as bee-keepers, farmers, activists and policy makers.

In understanding the demise of bees, uncertainty is also related to empirical intricacies, particularly the need to carry out an extensive and thorough monitoring of what is happening to the honey-bee as well as the need to further articulate this information. Yet – and taking the European case as an example – researchers report that there is a general weakness and high variability in most of the surveillance systems (Hendrikx et. al., 2009; Potts et al., 2010) [20] [1] and therefore a lack of "reliable and comparable data on the number of hives, beekeepers and colony losses in the EU" (Tabajdi et al., 2011) [21].

The challenges of uncertainty are being addressed by researchers, policy and funding bodies in different ways. One approach favours the daunting task of fostering converging platforms across Europe. This approach involves managing the immense plurality and fragmentation that is inherent in diverse socio-economic and political contexts in which the monitoring takes place. One example is the implementation of the pan-European epidemiological study on honeybee colony losses (EPILOBEE, 2012–13). Because the focus of such survey is centred in ecotoxicological aspects, there is nevertheless ample room for knowledge to be produced also on social, political and ethical variables. In addition, methodologies for building knowledge that include participation and communication should be encouraged, albeit being resource intensive and hard to impress upon funding bodies (Wals et al., 2009)[23].

Other approaches seem to prefer bypassing the development of social-oriented approaches in favour of using technology as a panacea. Perhaps that is why in a FAO report concerning pollination services, the development of a new radical solution is expressed in enthusiastic terms: "DNA barcoding works for bees (...) the long term objective of the barcoding enterprise is to have almost all organisms on the planet identifiable with a hand-held device that can generate a DNA sequence and communicate with a global database through wireless technology" (FAO n/d, p. 5) [24].

This radical codification measure against the uncertain and the unknown brings the promise of shedding light on the obscurity of bee collapse by creating an understanding that thoroughly computes the life of bees. But will such sweeping profiling bring greater acumen in humans' relationship to bees and ultimately nature conservation?

As we have seen, techno-fixes need careful reflection, not least because they spring from a tradition that has concocted objectification and control as key ingredients in addressing nature's mysteries. Many argue, and convincingly so, that these ingredients mark the onset of modern science. Some of its illustrious fathers, such as Francis Bacon and René Descartes, made clear secular confessions concerning the intercourse between knowledge of nature and the will to power (Coimbra, 2006; Merchant, 2006)[25] [26].

Nonetheless, from the onset of modern science other voices sustained alternative viewpoints. Notably, within the Romantic Movement, nature was a privileged field of knowledge precisely because it stood as the realm of reality less explicated by humans and as such it constituted the best choice for the Romantic experiment. Claiming that important facts of nature are lost when we reduce them to quantities and tangible surfaces, the Romantics were not so much nature poets as reality-experimenters, seeking to reconstitute the wholeness of knowledge by adding their experience of value as a feature of reality [6] (Everden, 1993)[27]. Later, scientist and environmentalist Aldo Leopold also re-envisioned the enterprise of science through similar lines, by questioning the meaning of perception, of our experience of the 'other,' and of the dichotomy of 'subjectivity' and 'objectivity'. This re-envisioning was carried through within the field of ethology by Jakob von Uexkll. He introduced the concept of *Umwelt*, proposing to understand how the world exists for the animal, given its own particular characteristics. Such perspective sustained that animals too live in meaningful worlds, and that meaning is bestowed by the organism-subject on its environment (Uexkll, 1957)[29]. Contributions such as these have had a

[6] It is worth noting that the Romantic Movement, like other major movements, has had both a shallow and a deep side. Unfortunately Romantics became known as utopian, sentimental and regressive. Our reference here, however, takes into account the intellectual and artistic stature of representatives such as Novalis and Schiller. The latter envisioned the relation of humans to nature through a culture which "does not bring back man to Arcadia, but leads him to Elysium" (Schiller, 2006)[28].

far-reaching influence on alternative worldviews in science and environmental philosophy and still hold great potential for future exploration (Bartof, 1996; Bateson, 1972; Nss, 1989) [30] [31] [32].

Science demands to be understood as part of our history and cultural development. The commodification strategies and unrevised techno-solutions as answers to the death of bees are just new avatars of a form of knowledge that is still anchored in seeing nature and its subjects as objects to be probed and controlled, thus obstructing real innovation and new forms of relation that are conducive to sustainability.

In summary, an analysis of research on bees reveals the possibility of having a change which fittingly agrees with what has been called the transition from Mode 1 to Mode 2 Science (Nowotny et al., 2003) [33]. In the case of colony collapse, research seems mostly centred in the first modality, which emphasizes objective and value-free science, preference for technical solutions, and interrogation of conventionally defined natural 'others'. A transition towards a second modality entails giving further steps into complexity's pool of knowledge, by including the interaction between actors, structures and phenomena and the related convolution of managing human-environmental systems throughout uncertainty and epistemological creativity.

Given the dominant role of science in shaping nature conservation, it follows that different modalities of knowledge have a large impact in decision-making and ultimately on the life and death of bees. The actual transition from a traditional mode of science to a new paradigm seems at least as central to the fate of bees as producing more research per se. But the buzz in concepts like 'interdisciplinarity' or 'participation' should not blind us to the fact that such transition knows many covert obstacles, not least the inertia of cognitive conformism, particularly when this rests on extremely powerful and deeply seated institutions, and so business runs on, despite stern messages that business as usual is not an option.

3 A way Forward

The death of bees is showing us that the mainstream model of Nature conservation is not endowed, conceptually and practically, to deal with the complexity and urgency it entails. The solutions it engenders – at their root – often seem to collude with the problems to begin with.

According to such a model, the demise of bees is often understood and communicated as an environmental risk with ominous economic consequences. The value of bees reaches civil society and the political sphere through ecological and economic rationality, wrapped in the fear of impending catastrophe. It seems indubitable to assume that the death of bees serves no interest on Earth and inversely, that the flourishing of their life is to everyone's interest, and can therefore be understood as a common good. But what is common, and moreover good?

Scientific knowledge has been the main player in framing, if not a common good, a common ground, on the implicit account that the biophysical objective reality is human's common ground. However, as innumerable research has demonstrated, nature cannot per se be a common ground because it is inextricably woven into culture and therefore is socially constructed, immensely plural and unequal. It follows that, in defining a common good, it is insufficient if not misleading to reduce it to an ecological and economic rationality. Such rationality cannot cover the full spectrum of value and meaningfulness embodied in the life of bees and, moreover, it hasn't been able to ignite the transformations urgently needed in order to recognize it and uphold it.

I argue, therefore, that a science for sustainability has the capacity to unleash a much more powerful social *understanding* of bees as the common good of humanity together with a social praxis that effectively promotes sustainable change. But in order to carry this through, science needs to embody the change it preaches, which means first and foremost to question some of its deeply seated assumptions. Otherwise, it will continue to be more part of the malaise than of the cure.

One foundational assumption rests on the dichotomy separating human subjectivity and objective nature. This division is becoming increasingly problematic as anthropogenic causes are becoming evident and acute. Yet, as we have seen, the knowledge production most dominantly working through Nature conservation is still entrenched in the "great Western paradigm," formulated by Descartes and imposed by developments in European history since the 17th century (Nicolescu, 2010)[34].

It is possible to overcome this dualism by purposely adopting a model that can reunite and integrate objective and subjective dimensions of knowl-

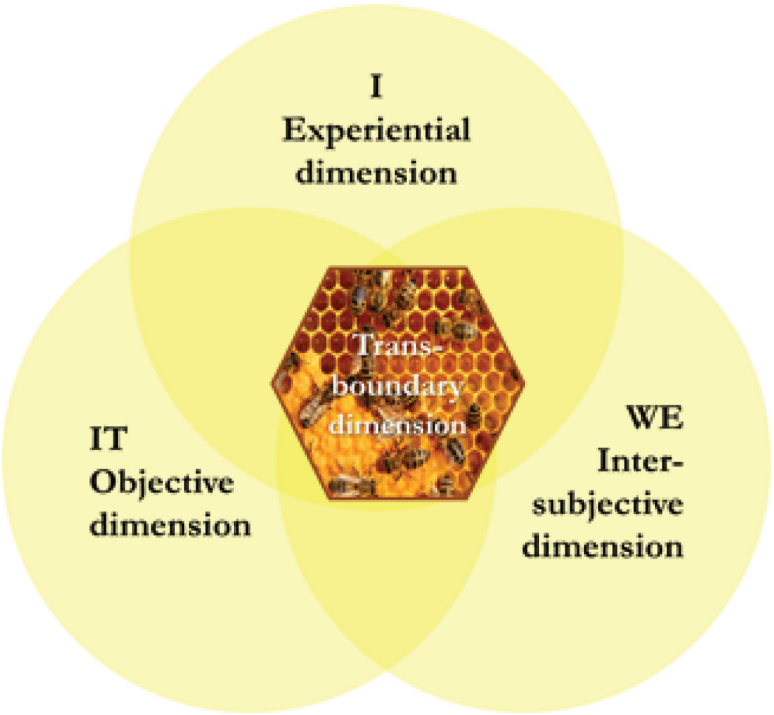

Figure 1: Trans-boundary model.

edge and in which multiple factors – ecological, economic, political, and normative – find their indelible correspondence. We have already very valuable contributions in this direction, namely in the development of a science animated by 'strong transdisciplinarity', such as proposed by Nicolescu (2010)[34], Max-Neef (2005) [35], and Morin (2005) [36]. Methodological contributions have been developed also in agreement with such epistemology and with effective capacity to create sustainable change (Scharmer et al., 2009; Wals et al., 2009) [37] [23].

The combination of these approaches, when applied to bee research, can be translated into a model and a method to address nature conservation. The model outlined here seeks to provide stakeholders with a learning, transformative process that is grounded in three main dimensions of knowledge – objective, inter-subjective and experiential (see Figure 1). Their intersection form a trans-boundary dimension where a pragmatic, real-life sustainability concern can be defined, designed and implemented. Simultaneously, it is also the podium from which the understanding of a common good may emerge.

The "IT" dimension, also known as 3rd person knowledge, is the sphere of data and analysis of objective and inter-objective realities. Here participants can identify relevant social and ecological variables correlating to bees, for example, in assessing the impact of GMOs or analysing EU conservation policies. So far, this has been the dominant, mostly exclusive sphere being developed in the case of bees.

The intersubjective sphere of "WE", concerns relational knowledge. It comprises an understanding of cultural plurality and the learning of communication and collaboration skills in the context of nature conservation.

The challenge here is to understand that pesticides, monoculture or malnutrition are only the downstream symptom of bees main problems, which in fact are the lack of mutual understanding and mutual agreement in the human sphere about how to proceed with these problems. 'Saving bees' thus depends primarily on human beings being able to reach mutual understanding and unforced agreement as to common ends. And that intersubjective accord occurs only in the cultural-communicative sphere.

Mutual understanding and agreement, however, can only be reached based on a moral, non-egocentric perspective concerning the global commons. And we reach such perspective through a challenging and laborious process of inner development that, even though it can be fostered by constructive communication, is ultimately an individual process.

Thus we reach the third, and less recognized sphere

Figure 2: Courtesy of Phillip Cairns.

of knowledge, the experiential dimension of the self. So far, in nature conservation, the individual human being is considered solely as part of a social system. Here, however, the individual – not reducible to the collective – figures as a defining feature of this new model.

The experiential sphere or 1st person knowledge is the core field of transformative learning and includes all manner of actors understood as knowledge producers and potential change makers: the beekeeper, the farmer, the scientist, the policy maker and the normal consumer, considering his/her daily choices of food and bee-related products.

A transformative learning process is capable of promoting autonomous thinking functions (revision of belief systems), feeling functions (revision of attitudes towards self and others) and willing functions (behavioural changes in lifestyle). In other words, it fosters self-awareness and social intelligence in the way we relate to others, human and non-human, like bees.

Beyond mainstream, a long standing tradition exists in science of anchoring self-reflexivity and experience, namely in the phenomenological tradition in which Johann Wolfgang von Goethe, a precursor, stated: "Insofar as he makes use of his healthy senses, man himself is the best and most exact scientific instrument possible" (Goethe, 2010) [38]. Grounded in the individual, the 'delicate empiricism' advocated by the Gothean science promotes a knowledge of relation, an intimacy that not only deepens intellectual understanding of animals and their life patterns but also strengthens empathy. This integration can have significant implications. Studies conducted on education based on such inclusive methods demonstrate that "students feel themselves to be more in harmony with the phenomenon, as if themselves were participating in it. This leads to an attitude towards nature more grounded in concern, respect and responsibility" (Bartof, 1996, p. 25) [30].

A science for sustainability is one that is able to engender such connection, in which the subject (observer) becomes the object (observed) and the object (bees) become a subject in their own right, collapsing the standard scientific divide between them. Such connection fosters an observation with a feeling for qualities that are to be found in the natural world, and by which it remains alive, dynamic, undivided and profoundly meaningful to the self. In short, a science of the wholeness of nature.

Such experiential knowledge, anchored in oneself, reunites fragmentation of thinking, feeling and willing. For we know more deeply by understanding what we know, through feeling what we have understood, and by putting into practice what we have understood and felt. Once found in the individual, the common good ceases to be an abstraction. Nevertheless, to be able to reach it we must, in the words of Gandhi, be the change we want to see in the world. And that, despite the buzz in the word change, seems to be remarkably challenging.

Yet, such integration must produce other ways

of understanding bees beyond seeing them as "economically and ecologically essential organisms", and consequently lead to other solutions which are more coherent to finding the common good for humans and bees alike.

In nature conservation it is imperative that before deciding on strategies and management plans, social actors decide upstream what the common good is. From a methodological perspective, this implies building a common frame of reference amongst different parties and working to reach agreements on a set of foundational values that are congruent with a desired direction of development in the thriving of the life of bees.

In practice, when bringing people together – like farmers, bee-keepers of different orientations, policy makers, and scientists – we come across the immense plurality of values, attitudes and belief systems that humans hold in relation to nature. As can be noted by any seasoned observer, this plurality often leads to fragmentation of multiple identity groups with few perceived shared interests. On a larger scale, "the association of multicultural policies and environmental conservation has set the stage for competing ownership to natural resources and knowledge systems" (Kumar, 2012, p. 159) [18]. In working with diverse groups, we typically tend towards extremes; either difference turns into conflict and there is a sliding back, or people reach agreements and solutions that are shallow or mediocre.

However, there has been considerable development in the creation and implementation of new social technologies geared into sustainable transformative processes. Such technologies are able to work with plurality and dissonance as a way of formulating innovative solutions (Wals et al., 2009) [23].

Epistemologically speaking, it is necessary to consider that convergence is not to be understood as dissolution. It is simply a steering away from the standard scientific principle of disconnection (between disciplines, subject and object) in favour of a principle that maintains the distinction of parts but that tries to establish their relation. As Nicolescu asserts, unity in diversity and diversity through unity is inherent to transdisciplinarity (2010) [34].

Further, reuniting multiple dimensions of knowledge in the understanding of the human-environment ecological system shows that our social and cultural constructions of nature may be relative but have different consequences – some ideas or attitudes are unsustainable and go against objective life principles. Therefore, the model here advocated seeks to go beyond worldviews that are seized between a reductionist rationalism or by what Bourdieu called nihilistic relativism, in which all is equivalent to all, a dissolution between knowledge and opinion.

4 Some Final Remarks

The collapse of bees is a typical 'wicked problem' in that the problem is not understood until after the formulation of a solution (Conklin, 2006) [39]. In our case, the collapse can only be understood once the common good as the underlying premise of the solution is to be established.

It is also apt to add the collapse to the family of "super wicked problems" because "those seeking to solve the problem are also causing it" (Levin et al., 2012) [40]. It is worth considering that while research concerned with sustainability struggles to establish the causes and hazards of bee collapse, an even more voluminous body of research is being produced that can be directly linked to threatening the life of bees and ecosystems at large. Products of this research include powerful synthetic pesticides, genetic manipulation beyond precautionary principles and in general the knowledge base for an agriculture still running under the auspices of the Green Revolution. But what kind of knowledge is thus being created and supported? A knowledge that celebrates the life of bees and strengthens appreciation for their existence or a knowledge that fosters their demise? Two irreconcilable strands of knowledge? Or a basic fragmentation of one knowledge? Yet there is only one planet, one life.

In this article, I have argued that the model of Nature Conservation, largely reliant on Science, is struggling to step into new modalities that are capable of dealing conceptually and practically with its multi-dimensional and interrelated facets. In the case of bee collapse, knowledge is still mainly reducing the human-environmental relation to its objective, biophysical aspects, thereby ignoring the profoundly woven political, cultural and experiential dimensions involved in the production of knowledge.

In order to respond to the great challenges invoked by the death of bees, a new approach is necessary, one that is able to understand and work through the complexity inherent in the human-environmental systems.

In the search for a common good, observation is inseparable from self-observation, criticism inseparable from self-criticism, processes of reflection inseparable from processes of objectification. This search requires developing integration of the observer-conceiver in the observation-conception and placing the observation-conception in its own cultural context (Morin, 1999) [41]. The sustainable common good embodied in the life of bees is, therefore, a matter to be situated in the integrity of epistemological pluralism, where the heights and depths of what we value need to be found and shared by means of quality communicative processes. No other field of human knowledge is more prepared to exert such systematic, uncompromising, critical pursuit, than a transdisciplinar science in service of sustainability.

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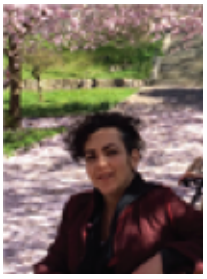
About the Author



Elsa Coimbra's research is dedicated to nature conservation. In the last years her work has been focused on the relation between humans and certain species, like wolves, and more recently the honeybee, mainly within the scope of Europe. She has experience in working within trans-disciplinary environments and enjoy developing new models for human-nature relationships alongside social technologies for transformative learning. She has been promoting these action-research approaches with students in international programmes related to development and sustainability.