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Looking through the microscope: Microbes as a challenge for theorising biocentrism within environmental ethics

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ABSTRACT

While in the humanities and social sciences at large we can observe posthumanist developments that engage with the microbiome, microbes are still not a major topic of discussion within environmental ethics. That the environmental ethics literature has not engaged extensively with this topic is surprising considering the range of theoretical challenges (and opportunities) it poses for environmental theorising. So, this paper is 'looking through the microscope' from an environmental ethics angle in order to see how these little beings challenge what we consider to be ethically relevant and how we conduct moral theorising. Especially interesting is how a focus on microbes can simultaneously support and challenge individualist biocentric intuitions and theories, which attribute moral standing to (some) microbes. Accordingly, the main aim of this paper is to lay out crucial aspects of these challenges and present some initial arguments about why not all of them pose a serious threat to biocentric theorising—including biocentric theories of interspecies justice. The three challenges discussed are (1) the moral significance challenge, (2) the self-defence predicament, and (3) undermining individualist biocentric intuitions.

Introduction

While in the humanities and social sciences at large we can observe posthumanist and 'probiotic' developments that engage with the microbiome (e.g., Lorimer, 2020), microbes are still not a major topic of discussion within environmental ethics, in which I include individualist and holistic accounts (with exceptions such as Cockell, 2004, 2005). In the everyday discourse we can also observe an increased attention paid to microorganisms. On the one side, the importance of bacteria for the human microbiome is gaining more and more traction, and fermented and probiotic foods are being promoted as being important for human health. On the other side, there is increasing general awareness about pathogens such as bacteria that cause disease, and accordingly it comes with a heightened awareness of the importance of hygiene. However, most kinds of microbes are neither pathogens nor useful inhabitants of the human microbiome. Instead, many microbes are important contributors to ecological processes that sustain life on Earth, while others might be neither important for human life nor do they negatively interfere with our wellbeing. I aim to shed some light on these (highly simplified) human-microbe relationships and their moral relevance, if these relationships are deemed morally relevant at all.

That the environmental ethics literature has not engaged extensively with this topic is to a degree surprising considering the range of theoretical challenges (and opportunities) it poses for environmental theorising.[1] Having said that, the biocentrism literature, which I will focus on in this paper, does usually consider microbes to be holders of moral standing (that is, as entities that matter in themselves) and, therefore, includes microorganisms in its theoretical analysis. Yet microbes are often only implicitly included in these theories without necessarily receiving much explicit theoretical consideration. That might be a problem in so far as it seems warranted from within biocentric approaches to pay considerable attention to the differences between morally considerable entities with distinct kinds and ways of life and what challenges these differences might generate for environmental theorising.

So, I will 'look through the microscope' from an environmental ethics angle in order to see how these little beings challenge what we consider to be ethically relevant and how we conduct moral theorising. Especially interesting is how a focus on microorganisms can simultaneously support and challenge *biocentric* intuitions and theories, which attribute

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[1] I am working from within a Western analytical environmental ethics approach which limits and frames what I consider to be relevant considerations. Needless to say, that also other philosophical traditions have reflected on this topic.

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moral standing to living beings including (some) microbes.[2] On the one hand, taking microorganisms into consideration appears to open up *more inclusive and ecological ways of 'seeing'* that do more justice to each kind of living being than perspectives that only account for the immediately observable Other. In the following, I will briefly sketch this 'opportunity' for environmental theorising. On the other hand, the human microbiome as well as microorganisms more generally pose a *range of challenges* for individualistic biocentric positions as well as biocentric theories of justice, more specifically. That is because they challenge their theoretical plausibility and foundation in our moral intuitions, in so far people share biocentric intuitions that make us presume that all living beings are morally considerable in the first place.

The main aim of this paper is to lay out crucial aspects of these challenges and present initial thoughts about why not all of these challenges might pose a serious threat to biocentric theorising. Section one will start with a brief overview of biocentric perspectives on microbes and introduces a range of challenges—of theoretical, intuitive and practical nature—posed by microorganisms. The three challenges discussed are (1) the moral significance challenge, (2) the self-defence predicament, and (3) undermining individualist biocentric intuitions. The second through fourth sections are dedicated to each of these challenges in turn, while the final section concludes. The upshot is that the existence of microbes adds an additional layer of complexity for theories of environmental ethics that consider these little beings to be morally considerable. While biocentric theories already face a range of challenges that require convincing argumentative answers, the *additional* theoretical challenges brought about by microbes might not be as tricky as they seem on the first view.

Introducing biocentric perspectives on microbes

For the following, it suffices to define a microbe (or microorganism) as a small living being, that is so small that (usually) only modern implements such as microscopes allow us to visualise their existence (see Cockell, 2005). Bacteria constitute probably the most well-known instance of microbes, which are also the most discussed example within biocentric theories. However, other kinds of very small living beings also fall into this category, such as different types of fungi, animals and plants for example. Of course, the adjective 'living' can be contested for some entities that fall into this category, specifically because the concept of 'life' is contested in itself (see Agar, 2001, Machery, 2012). For example, there is disagreement on the question of whether viruses count as living beings, because they cannot replicate on their own and are in need of a host, which puts them in a 'grey area' by not sharing some common features of living organisms such as a certain level of 'biochemical autonomy' (Villarreal, 2008). Bacteria, in contrast, are considered to be alive by fulfilling such criteria. Yet, while there is not necessarily agreement between all accounts of life (each of which aims to explain a different kind of phenomenon) on the matter which entities count as being alive, the important inquiry for moral philosophers usually centres around the question about in virtue of which considerations—usually a set of capacities or features—an entity is considered to be morally considerable. That is, being regarded as an entity that matters morally in itself and therefore ought to be taken into consideration in the moral decision-making process.

Biocentric approaches (among others Schweitzer, 1923, Goodpaster, 1978, Attfield, 1981, Varner, 1998, Sterba, 1998, Agar, 2001, Baxter, 2005, Taylor, 2011) explicitly attribute moral considerability to living beings and therefore make an argumentative connection between being alive and being morally considerable, while disagreeing (to an extent) on the grounds for attributing moral considerability (and consequently, on what counts as a morally considerable entity).[3] This is due, for instance, to differing concepts of wellbeing, interests or needs, and the reasons for why these should matter; as well as the related difficulty of determining what is 'good' or 'bad' for a living entity. The most well-known iteration of a biocentric position is Paul Taylor's assertion that in his biocentric outlook "[e]ach [individual organism] is seen to be a teleological (goal-oriented) centre of life, pursuing its own good in its own unique way" (Taylor, 2011, p. 45). Of course, most living beings and particularly microorganisms do not pursue this good in any sentient way. They are not (self)aware, but the argument rather is that unconscious organisms can also strive towards their own good and be harmed when prevented in doing so.

That makes individualist biocentrism particularly interesting, because while there might be disagreement on whether certain 'grey zone' instances of microbes are alive and morally considerable, biocentric reasoning sets the scene for deeming (at least some) microorganisms to be morally considerable which, in turn, ultimately influences how we ought (and ought not) to act. However, microorganisms are usually not extensively discussed in this literature (and the environmental ethics literature more broadly) and if they are mentioned, the focus tends to lie on bacteria (such as they are briefly mentioned in Taylor's [2011] seminal biocentric theory).[4] For my purposes here, it will suffice to assume that most biocentric positions consider at least *bacteria*—e.g. due to being teleological centres of life—to be morally considerable, despite different theories differing on what this means in practice. Although this inclusion could be contested, I am not aware of any theory that is termed biocentric and which provides a detailed argument with the effect of explicitly excluding *all* microbes from being attributed moral considerability (which would lead to a 'curtailed' version of biocentrism that does not consider all life forms morally considerable; see section two).[5]

In contrast, *viruses* (such as SARS-CoV-2) have received even less attention than bacteria by biocentric approaches, as far as I am aware (with exceptions such as being mentioned in Monaghan, 2018). This will be due to several reasons, such as they might be considered lacking some morally relevant features regarding what it means to be a living entity in a morally relevant sense (by falling into the above-mentioned grey area

[2] Moral intuitions are an important 'tool' in moral philosophy. For instance, when employing the method of a 'reflective equilibrium' the aim is to reach a coherent theory where our intuitive judgements about a problem are consistent with moral principles that we consider to be justified. When a principle or an intuition does not fit, it prompts us to consider whether the intuition or the principle needs to be revised. For a good overview of methodology in environmental ethics see the relevant chapter in Newman, Varner and Linquist (2017).

[3] See Palmer (2016) for a concise overview of the literature on biocentrism.

[4] While many works from a biocentric angle within environmental ethics have explicitly considered (some) microorganisms, they have often done this in passing. However, a few authors with an interest in microbiology have put them into the focal point of attention in their discussions of environmental ethics (e.g., Cockell, 2004, 2005). Moreover, biocentrism can also be applied to the field of synthetic biology (see Deplazes-Zemp, 2012) where, for example, bacterial synthetic biology focuses on this particular kind of microorganisms. In this article I will set the latter literature aside, despite that it is highly relevant for analysing the human-microbe relationship.

[5] Their absence from theoretical deliberations—in so far as microbes are notable by their absence—will be due to a range of reasons. For example, the literature on plant ethics (e.g., Kallhoff, 2007, 2014) has a narrower focus than biocentrism but is situated within biocentrism's broader remit of theoretical interest. That microorganisms are not discussed in this context—as far as I am aware—might be due to simple omission or by not constituting an entity of theoretical interest for these theories which focus particularly on plant life (bearing in mind that also microscopically small plants fall into the above-mentioned definition of microorganisms).

of definitions of life).[6] I will not provide an answer to this issue here and just take it as a given that viruses are usually not attributed moral standing as a living entity.[7] This premise is, however, not crucial for what follows and my conclusions also remain valid for perspectives that would be more inclusive in this regard. Nevertheless, this pragmatic premise aids to focus the following discussion by explicitly setting questions about the current COVID-19 pandemic aside which introduces a further range of issues to consider. So, when it comes to microbes, it is better to think of bacteria as a typical example of an entity which is attributed moral considerability by biocentric theories for the purpose of this paper.

Besides the question about what makes an individual living entity moral considerable, different biocentric approaches also differ along other axes. Two of these will be relevant for what follows. For one, within moral philosophy one can distinguish between three primary theoretical approaches. Theories either constitute *deontological* accounts that focus on what is morally required of us in terms of moral duties. That also includes, for example, rights theories and accounts of interspecies justice that will become relevant in the section about individualist biocentric intuitions.[8] Alternatively, theories constitute *consequentialist* accounts, which is a position that ethically evaluates the consequences of an action. Or finally, one can take a *virtue ethics* approach to moral theorising that emphasises an agent's moral character. Because of that, different biocentric theories differ in their evaluation of what would constitute a 'right' or 'good' action in a specific situation event if they largely agree on the question of moral considerability.

Secondly, despite that biocentric theories tend to largely agree on which entities are morally considerable, they do not necessarily agree on how much weight that should be given in our moral deliberations (that is, their *moral significance* with respect to one another; see Goodpaster, 1978). As I will elaborate on this in more detail in the next section, this is a further axis along which different biocentric approaches differ regarding how important they deem the interests, needs or wellbeing of microbes for our moral deliberations.

Moreover, biocentrism stands in contrast with perspectives, for instance, that (only) attribute moral considerability to some living beings such as all sentient animals (sentientism) or only humans (anthropocentrism). While these perspectives can also invoke a range of moral reasons to argue for the protection of a species of bacteria by arguing for their instrumental value in terms of being beneficial for the wellbeing of humans, for example, biocentric theories have the theoretical tools to also argue in favour of protecting an *individual* bacterium based on its own moral considerability. That makes biocentrism a promising theoretical lens for any 'microbe advocate.'

Despite that I am primarily focusing on this particular perspective in this paper, there are certainly also alternative (complementary) argumentative routes open for illustrating the moral relevance of microorganisms that deserve more consideration. For example, some pluralist ecocentric theories attribute moral standing to all living beings in this sense in addition to collective entities such as ecosystems. Such theories acknowledge a range of entities with moral status also *beyond and in addition to* living beings (among others see Gorke, 2018). So, one possibility is to focus on the moral considerability or more generally the value of microbial communities or of ecosystems more broadly where microbes are acknowledged as important members of the system. Moreover, certain ecocentric perspectives also attribute (objective) intrinsic value to species themselves, which would give individual microbes a derivative protection via their species membership. For instance, Holmes Rolston III (1995) has argued that species hold objective value in this sense (for a critique see Sandler, 2012, chap. 2).

In the following, I will focus on how microorganisms *as individuals* challenge environmental theorising and particularly biocentric positions which are committed to attributing them moral considerability. As I will explain further in the penultimate section, how an 'individual' is conceptualised is contested, but there are good reasons for taking individualist perspectives seriously. Importantly, it is not warranted to assume that within intra-human moral relations our moral concern lies on the wellbeing of individual humans, while in interspecies moral relations the non-human individual—such as an individual microorganism—is simply assumed to be subordinated to the moral importance of species or populations or even dismissed entirely. For reasons of theoretical consistency, the individual moral considerability of microbes needs to be *at least* considered and its dismissal requires a convincing argument.[9] The three challenges discussed below consider some potential argumentative grounds for such a dismissal.

However, I *neither* aim for a complete survey of the relevant ethical literature on microorganisms *nor* am I providing a detailed discussion—let alone defence—of biocentrism as an axiological position.[10] Whether some form of biocentrism is ultimately a coherent and convincing theory is a question that I cannot answer in this paper (despite that I take a position in its favour, notwithstanding some caveats, see Wienhues, 2020, chap. 2). The following deliberations that I will introduce about microbes take place against the background that biocentric theories are also more generally a subject of contention. So, even without taking the specific questions generated by microbes into consideration, biocentrism has been met with criticism since its first iterations in environmental ethics (such as recently Basl, 2019; for a reply see McShane, 2021) which has led some of its original proponents (such as Varner, 1998) to retreat from their biocentric position in favour of sentientist arguments (as elaborated in Newman, Varner, & Linquist, 2017). For example, can we really distinguish between (morally considerable) living beings, on the one side, and non-living artefacts, on the other side, in a satisfactory manner? If we can, why is the wellbeing of an insect, plant etc. supposed to be morally relevant?

So, individualist biocentrism *might* fail on more general terms (which would make some of what I discuss below irrelevant for ethical deliberations), but I will assume that it has at least the potential to be a coherent theory for the purpose of this paper. In contrast, anyone that does not consider such an inclusive perspective on moral considerability as intuitively appealing as myself, will not be troubled very much by most of the microbes-specific challenges that I will discuss. Nevertheless, in addition to such questions about the theoretical feasibility of

[6] On several levels, it is important to distinguish between the moral and ecological relevance of microbes, on the one hand, and the dangers posed by the current virus pandemic, on the other hand. As Jamie Lorimer (2020, p. x) nicely puts it, 'Covid-19 certainly needs fighting, but it would be a shame if the necessary push for antiviral control results in an amplified fear of nonhuman life and collateral damage to ecological diversity and health'.

[7] Of course, that does not preclude the possibility that some viruses (as individuals or species) are attributed other kinds of moral value (such as instrumental value).

[8] As biocentric accounts of interspecies (or ecological) justice (e.g., Baxter, 2005, Wienhues, 2020) I understand specific theories that do not only attribute moral considerability to all living beings (a necessary but not sufficient condition for generating demands of justice), but additionally identify a global interspecies justice-relationship. Based on that, such accounts claim that nonhuman beings do not merely demand consideration in our moral deliberations, but also hold entitlements of justice that ought to be respected. In terms of distributive justice that would mean that nonhuman beings hold entitlements to environmental resources or land, for example.

[9] That is particularly relevant, because the assumption that an individual non-human being does not matter morally in itself leads to the question about why one does not apply the same logic to humans. Obviously, any such position should be deemed morally repugnant and would have to face the charge of totalitarianism. Thanks to Leonie Bossert for prompting me to make this point explicit.

[10] Accordingly, the argumentative routes suggested here should not be taken as exhausting all possibilities.

biocentrism more generally that I will set aside, microbes add *additional issues* that might undermine the biocentric theoretical project due to its inclusion of microorganism within the scope of moral considerability (which further challenges the acceptability of biocentrism as a theoretical basis for environmental ethics) that I will turn to now.

Challenges posed by microbes

A range of challenges for non-anthropocentric theories of environmental ethics, particularly biocentric positions, are being posed by microbes. These can take the form of theoretical challenges that question the *theoretical viability* of attributing microbes moral standing; challenges that contest the *intuitive appeal* of positions that deem microbes to be morally considerable; or challenges that question the *practical feasibility* of including microbes into our moral deliberations. In the following, I will focus on central (non-exhaustive) aspects that any position that considers microbes—or at least certain kinds of microbes—to be holders of moral considerability has to answer. Based on my analysis of the subject matter, I have identified the following three central challenges:

1. The moral significance challenge: Microbes put pressure on how different biocentric positions theorise moral standing.
2. The self-defence predicament: If considered to be morally considerable, microbes challenge the viability of relying on analogy arguments (such as the self-defence case) in environmental theorising.
3. Undermining individualist biocentric intuitions: Microorganisms challenge common assumptions regarding what constitutes a (human and non-human) individual entity.

The moral significance challenge

The first challenge has a dual nature. On the one side, it constitutes a theoretical challenge to how we theorise moral significance in non-anthropocentric accounts of environmental ethics. On the other side, it also constitutes a challenge to how many people intuitively think about how to weigh the moral worth of individuals (or groups and collectives) against each other.

To clarify, as introduced earlier it is usually taken as given that a useful distinction can be made between moral considerability and moral significance, as originally proposed by Kenneth Goodpaster (1978). Moral considerability refers to the question about whether an entity directly matters at all in our moral deliberations (usually as a so-called 'moral patient'; see Regan, 1984). This is a simple yes or no question. So, biocentric theories argue that microbes (at least of the 'living' variety) are morally considerable. But that does not tell us much about how important they are for our moral deliberations. That is the subject of moral significance, which is often also discussed as moral worth or moral weight. Simply put, it might be that microbes are morally considerable but that their moral significance is so little in comparison with the moral significance of a human or chimpanzee, that their moral considerability becomes practically meaningless in most moral decision-making situations.

If one takes such a position, it would be consistent to argue, for example, that in order to increase the wellbeing of a group of wild chimpanzees it is legitimate to eradicate all of the individual bacteria that currently make up a species that cause a non-fatal disease in this chimpanzee population. Based on such a position, the chimpanzees are just so much more important morally than the bacteria in question that this measure to increase their welfare by a small amount is—at least on the first view—justified.[11]

Robin Attfield, who defends a consequentialist biocentric position, adopts a *hierarchical* position and makes a clear distinction between having moral considerability and moral significance. According to Attfield, bacteria "[…] could have a moral standing and yet have an almost infinitesimal moral significance, so that even large aggregations of them did not outweigh the significance of sentient beings in cases of conflict" (Attfield, 2011, p. 154).

On the one hand, this statement nicely summarises what many people who are inclined to agree with biocentric positions seem to intuitively think when it comes to bacteria. Maybe attributing to bacteria such a very minimal moral significance is all that can be done without leading to intuitively and theoretically implausible and unwanted results. On the other hand, it also raises the question of what attributing moral considerability is supposed to do in the context of microbes, if the moral significance is so small that it becomes theoretically as well as practically irrelevant—collapsing individual biocentrism into something closer to (but not identical with) a sentientist position that attributes moral standing only to sentient animals. That is, resulting in practice in a 'curtailed' version of biocentrism.

Addressing this worry, John Nolt (2017) analysed Attfield's statement in detail with a focus on how 'almost infinitesimal moral significance' could be understood within a consequentialist framework. Nolt concludes that after argumentatively dismissing the possibility of *almost* infinitesimal moral significance, it "follows—however discomforting—that the overall welfare of a bacterium is not infinitesimal relative to the overall welfare of a human being," because it is implausible (due to a range of considerations) that there are "infinite welfare differences among living things." However, in the end Nolt sides with Attfield when concluding that the welfare of a bacterium "is indeed miniscule" and even a very large number of bacteria could not surpass jointly a "healthy" human's overall welfare (Nolt, 2017, p. 88).[12]

Creating a hierarchy of moral significance, which is either attached to different amounts of welfare value (such as in consequentialist accounts) or attributed to the living beings themselves due to a range of capacities that are considered to be of moral relevance (as generally seen in deontological accounts), is the most common argumentative route taken. In addition to other theoretical pitfalls[13] that such theories need to address, the *specific challenge* posed by the existence of microbes demands an account of how individual biocentrism amounts to more than

[11] That also depends on, among other things, whether one deems such interventions into 'nature' justifiable in the first place, which is a separate question.

[12] Nolt's analysis focuses on comparing welfare values (differentiated between biotic and experiential welfare) of different living beings which asks for comparisons between different welfare gains and losses for moral decision-making within a consequentialist framework. This is situated against the background that bacteria welfare can be aggregated (that is, adding up all welfare attributed to each single living being) and then, figuratively speaking, put on a pair of scales with the welfare of a human on the other side. Yet, Nolt argues that this picture gets more complicated: "if (as is most plausible) biotic and experiential welfare are incommensurable, then there is no number of bacteria whose aggregate welfare exceeds the overall welfare of a healthy human. But there is some very large number of bacteria whose aggregate welfare is not less than—though it may be incomparable with—your overall welfare and mine" (Nolt, 2017, p. 88).

[13] These go beyond the question of whether individualist biocentrism is tenable when taking microbes into account. Some authors also question the normative appropriateness of 'hierarchical' accounts more generally (e.g., Plumwood, 2002). Of course, there are good theoretical and pragmatic reasons that explain why the majority of biocentric accounts can be considered hierarchical in one way or another. In addition, considerations about hierarchical accounts of moral significance are also related to debates about value trade-offs, more generally, on which distinct theories also differ and which further complicate ethical decision-making.

a curtailed version of biocentrism in theory and practice.[14]

The most obvious alternative is to regard microbes to be equally morally significant to all life. That is taking an *egalitarian* perspective on moral significance.[15] Yet, if one wants to make this argumentative move one steps into a serious problem of intuition (while also generating some practical questions that need answering). Based on their moral intuitions, many (or very likely most) people simply do not think that microbes—particularly disease-causing organisms to which we will return later—have as much moral worth as a tree or fox, let-alone a human being. Of course, intuitions must not be decisive. After all, when taking all our moral commitments and beliefs into consideration we might have to end up accepting that this is a wrong intuition that does not fit into what we would consider a coherent theory of environmental ethics. Maybe then it is just an anthropocentric or sentientist bias, for instance, that leads us to believe that microbes do not have equal moral significance.

Having said that, most theoretical perspectives come to the opposite conclusion. That is that *even if* one sympathises with the view that biocentric egalitarianism is the appropriate way to theorise the moral weight of microbes, this intuition has to be dropped because it is not workable within a coherent non-anthropocentric theory. For instance, if each bacterium counts as much, morally speaking, as an elephant, does that mean that an environmental ethic would just collapse into a 'microbe ethic' because their large numbers would always tilt decision-making in their favour? Especially for consequentialist positions (but also all theoretical approaches more generally) this is a problem. That partially explains why theorists like Attfield are very committed to a hierarchical biocentrism to avoid such a conclusion which would take non-anthropocentric environmental ethics *ad absurdum*. Because of that and in addition to the fact that most people do not share such an intuition in the first place, most environmental ethicists agree with Clare Palmer and colleagues (2014, p. 427) that it is "absurd to think that we must take the welfare of bacteria into account—in particular if of equal significance" and that an "ethic that maintains it is no worse to kill a wolf than an *E. coli* must surely be misguided."[16].

Microbes and the incommensurability of moral significance

In order for biocentrism to answer this particular microbe challenge, *at least* two argumentative routes are open. Either one that accepts the necessity of a hierarchical version of biocentrism—with its related problems—or one takes a third argumentative route and argues for the incommensurability of moral significance. In other words, the moral significance of different living beings is neither equal nor can it be ranked hierarchically. There are different versions of this position that differ in several respects. For example, Nolt (2017) argues for a position to such an effect within a consequentialist framework (see footnote 12 above) and adds the additional possibility of incomparability. I have argued for a version of this position from a deontological perspective (Wienhues, 2020, 2021b).

Simply put, and taking into account that incommensurability is understood differently by different authors, for me that means that instead of arguing that all living beings have the same moral worth (egalitarianism) or that we can compare and rank the moral worth of different living beings along a linear scale (the most common form of hierarchical biocentrism), this third perspective claims that it is not possible to rank the moral significance of different living beings in such a manner—it is incommensurable. Using Val Plumwood's (2002) terminology that would constitute a 'non-hierarchical' perspective. Drawing on her work, I employ this label here as an alternative to hierarchal perspectives that 'rank' different beings according to their moral worth. Such a ranking can be 'hierarchical' but also 'equal', because also ranking as equals presupposes commensurability. Ultimately that means that we cannot say that different non-human living beings are equally, or more or less morally significant from a human perspective. Their moral significance is simply incommensurable.[17]

Taking this third route as a perspective on axiology (that is, value theory) within a deontological framework has as the consequence, that matters become more complicated because this perspective makes it impossible to claim, for instance, that a few billion bacteria add up to the same moral worth of a wolf. Rather, this position considers such statements not very meaningful. So, it requires other theoretical tools in decision-making situations instead of providing a ranking of moral worth, for instance, and instead gives more emphasis on contextual and relational factors. For example, it would put more emphasis on the question about what relationship we have with the microorganism in question (something we will return to in the following sections). Moreover, the wolf and a bacterium clearly have different needs and interests at stake. To argue that the wolf has certain interests that ought to be taken into account which, in turn, the bacterium lacks, is consistent with additionally arguing that, ultimately, their context-independent moral significance is incommensurable. The wolf's complex cognitive abilities provide us with reasons to treat it in certain ways that do not come into play when we deliberate how to treat microbes with respect. Similarly, other considerations will be relevant with respect to bacteria that are not relevant for the wolf in question. But for me, these are judgments about what we ought to do that can be made independently from weighing their respective moral worth against each other on a scale.

This brief outline is meant to illustrate that some peoples' intuitions, like mine, rather deem bacteria and wolves to be just *so different forms of life* that a non-hierarchical perspective seems to be able to account best for the intuitive force of biocentrism from this perspective. Arguably it does so without falling into some of the pitfalls to which egalitarian and hierarchical perspectives are vulnerable, such as the intuition problem of egalitarian perspectives when it comes to how to treat microbes, or the problem of attributing microbes so little moral significance in hierarchical accounts that their moral standing becomes meaningless in practice.[18] So instead of claiming implausibly that (1) the moral worth of the wolf and an *E. coli* bacterium are identical or that, as implausibly,

[14] Related to that worry, Alan Carter introduces the 'Minimax Implication' arising from what he calls the inegalitarianism (that is, what I termed here a hierarchical position) in addition the premise of attributing moral considerability to 'possible persons' (that is, persons not yet in existence) in Attfield's work (2005, p. 64). According to Carter, this implication of Attfield's position results in the conclusion that "we ought, *ceteris paribus*, to bring about the lowest acceptable level for the greatest number of human beings" and furthermore "that we ought, *ceteris paribus*, to bring about the lowest acceptable level of such capacities for the greatest number of human beings at the expense of other living entities" in so far as these are understood as inessential for human wellbeing (2005, p.65, italics in original). So, the issue presented by Carter concerns the worry, that such an inegalitarian consequentialist biocentrism—as defended by Attfield—might lead to an outcome that does not resemble a biocentric *environmental ethic* very much in practice. However, for a response see Attfield (2005).

[15] Without necessarily using the above introduced terminology, authors whose accounts fall into the category of 'egalitarian biocentrism' are Taylor (2011) and Schweitzer (1923).

[16] Of course, this matter is more complex and authors such as Taylor (2011) have provided a theoretical decision-making framework that builds on the egalitarian starting point.

[17] This is not the place to go into further details, but it should be said that such a position presupposes, of course, that biocentrism has potential to be a defensible account of moral standing in the first place. This rough sketch of this position is only meant to show that there are a range of ways to try to answer the challenge posed by microbes.

[18] To be fair, taking a non-hierarchical perspective, as I see it, does not 'solve' the latter problem on its own terms but rather questions the relevance of thinking in terms of moral significance in the first place.

(2) it is actually possible to meaningfully rank their moral significance in a non-arbitrary way, the moral significance challenge seems to point us to the third option. That is, in order to make biocentrism (at least in *this aspect*) initially plausible, a non-hierarchical route to moral significance needs to be taken.[19] The specific challenge (or 'opportunity' for further theorising) posed by microbes in this context is that it puts the limelight on this question because these microscopic living beings test our intuitions when it comes to moral standing more than other problem cases for biocentric theorising.

To summarise, the seriousness of the 'moral significance of microbes' challenge depends on the particular version of biocentrism that one prefers. Especially egalitarian accounts seem counterintuitive and hierarchal accounts that only attribute very minimal moral significance to microorganisms beg the question when it comes to the moral relevance of the assertion that microorganisms are also attributed moral standing. That is because such moral significance is attributed to a very small degree in comparison to larger living beings that are regarded, for example, as having more complex aspects to their wellbeing (e.g., sentience) and which are attributed more potential for welfare based on their complexity. Yet, arguably, an alternative would be to take the position that microbial life is so different to other forms of life (as well as what we as humans can relate to) that it might be more appropriate in terms of moral inclusivity (and importantly less arbitrary) to argue that the moral significance across different forms of life is incommensurable.

The self-defence predicament

Microorganisms are mainly paid attention in the public discourse in health contexts—ranging from interspecies cooperation to disease. Either because they are beneficial to human health—such as the fermented foods trend—or when they are dangerous by causing disease. Whereas only a very small number of microorganisms is actually detrimental to human health, the danger that some of them pose for humans is an issue for which biocentric accounts need to be able to provide answers. More specifically, that is the challenge that I call the self-defence predicament because it ultimately questions a common methodological approach to this issue.

When is killing of billions of microorganisms, and even entire species, morally justified given that these beings are considered to have moral standing? Here it should be noted again that we are standing in different relationships to different microbes for which this question takes slightly different forms. For instance, we have mutually beneficial relationships. A good example of this is bacteria in our gut that are essential for digesting food. On the other hand, there is also a range of microorganisms that can severely affect human health up to being deadly.[20] So, the relevant microbes in this dangerous category are for example disease-causing bacteria that cause infections of different kinds—for instance, bacteria affecting the lung by causing pneumonia.

In the case of disease-causing microbes, humans engage in a variety of different self-defence practices, which are—on most accounts—justified. Simply put, while most people would consider it morally justified to defend themselves (even with force) against a violent human attacker, by analogy we would think that it is at least as much justified, if not even more, if the attacker constitutes a group of disease-causing bacteria. Such types of analogies are commonly found in biocentric theories for justifying certain acts of killing (despite that here again microbes have not received much attention). So, the justifiability of self-defence by taking antibiotics, for instance, does not rely on the fact that the aggressor is a being with moral standing, but rather on the act of aggression. Having said that, there are *at least* the following four issues that have to be taken into account to see whether the analogy holds.

Firstly, as already discussed, the moral standing of a human is usually considered to be much larger than the moral standing of bacteria, according to hierarchical biocentric positions. As a consequence, one could argue that in the non-human aggressor case, self-defence is even *easier to justify* because the moral standing of the 'aggressors' (even when added together) does not carry much moral weight (Monaghan, 2018). Biocentrists that have such a position (particularly of the consequentialist variety) will find Shelly Kagan's (2019) detailed hierarchical sentientist analysis of different human-non-human self-defence scenarios instructive in order to apply his line of thinking to self-defence cases involving also non-sentient beings like microbes. For example, Kagan (2019, chap. 10) discusses a range of different versions of a few cases such as a lion coming into a village and attacking unprovoked a nearby person. The purpose of engaging with different versions of each case is to highlight each time different (potentially morally relevant) features of the scenario. For instance, whether it makes a difference to the justifiability of self-defence of the attacked person whether the attack was unprovoked or not.

Generally, biocentric positions—despite otherwise sometimes diverging commitments—tend to agree that killing in self-defence is justified (Sterba, 1998, 2005; Taylor, 2011; Monaghan, 2018).[21] For example, similarly to Taylor, James Sterba argues for a "Principle of Human Defense." According to this principle, it is morally permissible to defend oneself against "harmful aggression" when required, even if that entails killing individual animals or an entire species (Sterba, 2005, p. 295). If it is permissible to defend myself against a tiger when attacked for example, most people will hold that it is also permissible to defend myself against disease-causing bacteria. Jake Monaghan summarises this point nicely using the example of the virus that causes AIDS, but for the reasons mentioned above, one might want to replace this with a case of disease-causing bacteria. However, Monaghan's general point remains the same:

> Perhaps we have a pro tanto reason not to violate the interests of a virus. But just as we have a pro tanto reason to refrain from violating the interests of persons that can be overridden or outweighed, the reason can be outweighed or overridden by other moral considerations. If a person is an unjust or even innocent aggressor, we are permitted to kill him. Similarly, if a virus is an innocent threat, we are permitted to kill it (Monaghan, 2018, p. 131).

Yet, such biocentric accounts of self-defence demand a certain level of precaution that prevent the pervasiveness of self-defence scenarios. That is, if I bring myself into a situation by pure recklessness—for example, by traveling to the North Pole with the sole purpose of petting a polar bear and then being taken by surprise that this wild animal does not appreciate the attention—then I would create a situation in which the permissibility of my self-defence becomes more difficult to justify. So, for permissible self-defence to apply, one has to take "reasonable care" (Taylor, 2011, p. 265). Of course, if I would live in a rural area

[19] Of course, a *fourth option* would be to take this as a ground to reject the moral standing of microbes all together, with the effect of creating the above-mentioned 'curtailed' version of biocentrism (at a high theoretical price by loosening the close connection between moral considerability and the criterium of being alive) or even reverting to a more restrictive position such as sentientism.

[20] Because viruses are usually not covered by biocentric theories (see the question about what is alive mentioned above), that means that their eradication would not require a justification that would have to take their moral standing into account.

[21] Even authors like Cockell (2005, p. 388) that do not frame it as a matter of self-defence but rather as an "avoidable" as opposed to unavoidable ground for killing microbes agree that population control for certain harmful microbes is acceptable. Or even egalitarian biocentrist Albert Schweitzer, who sees humans to be in a constant ethical dilemma when it comes to conflict situations between different kinds of life, seems to take it as given that killing bacteria for saving human lives is necessary (see Engels, 2016).

where some large predators or disease-carrying mosquitoes are native species, taking reasonable care will not be enough to avoid self-defence scenarios, which then would be morally permissible according to this line of thought.

However, secondly, the harmful microbes case appears to be of a different quality than more common examples of self-defence in environmental ethics. That is, the conflict is *endemic*. I mean by that, that most people will never be in a situation that puts them at danger from a tiger or shark. For most people it is possible to avoid to be in contact with such nonhuman animals and even people that share their homeland with such predators can avoid conflicts in some instances.[22] Co-living is not intrinsically impossible, despite that it is often difficult in practice. That does not apply to the relationship between humans and microbes that are classified as pathogens. Here the conflict is endemic to the relationship by being an inherent feature of the relationship itself. How do we apply 'reasonable care' in such a situation? Hygiene is precaution against disease, but that also already implies—by definition—the killing of microbes. Here taking precautions against avoiding cases of self-defence (such as by taking antibiotics) already entail acts of self-defence (such as washing our hands) in themselves. That makes the case of disease-causing microbes different from self-defence against other non-human beings as well as different from the initial case of a human attacker.

Thirdly, what also changes the analogy in a relevant way is that it involves little beings that are missing moral agency, intentionality and so on. Of course, that is also the case for the sentient animal cases that Kagan (2019) discusses. Yet, as Kagan also points out, this circumstance makes a theoretical difference for theorists that see a morally relevant difference between 'innocent' and non-innocent threats. The microbes would constitute innocent threats in this context because they are missing moral agency and, thus, cannot be morally blamed for their actions, for instance. Based on this, some might argue that it is *conceptually* inappropriate to speak of self-defence in this scenario, which would mean that the analogy would not hold and we would need a different route to justify our actions. Others, like Monaghan (2018) argue that self-defence against innocent threats can be justified within a biocentric theory of environmental ethics.

Fourthly, one last aspect that changes the analogy are the *negative-side effects* that are involved when defending ourselves against harmful microbes. While we are always killing microorganisms accidentally (which is an issue to that I will return below), it is also the case that in each instance of self-defence we are killing a large number of microbes that are not targeted by our actions. For example, antibiotics do not only kill harmful bacteria but also have a detrimental impact on the beneficial bacteria in our intestine, or when washing our hands, we do not only wash off *E. coli* bacteria, but also other kinds of bacteria that live on our skin. Such negative side effects cannot be avoided when dealing with microbes, but they are not present or at least rare (harming an innocent bystander, for example) when one considers self-defence scenarios against sentient animals or even in the initial case of the human attacker.

A particular sub-case of the negative side effects problem are vector-borne diseases, which come with a very large health burden (see WHO, 2020). For example, this includes a range of different disease-carrying mosquito species that transmit disease-producing micro-organisms—such as viruses and bacteria—from one host to another. While biocentric theorists seem to agree on this case that killing disease-carrying mosquitoes is a permissible form of self-defence (see Sterba, 1998), it is also the case that this scenario moves further away from the initial analogy with the human attacker because the target of defence is not the mosquito in itself, but the diseases causing pathogen that it carries (Wienhues, 2021a). To be clear, that does not mean that such self-defence is not permissible. On the contrary, I cannot see any good reasons to argue against the need to curb the global health burden brought on by vector-borne diseases despite that some methods will be clearly morally preferable to others.[23]

Rather, what this means—in conjunction to the other three points mentioned above—is that the analogy with the human aggressor does not hold particularly well in the case of disease-causing microorganisms, because this case is even further removed than examples involving sentient animals.[24] That is why the case of disease-causing microorganisms prompts us to be careful when theorising self-defence, because their case is different to how we think about the permissibility of self-defence in the intra-human context. Maybe self-defence is even an inappropriate framing of the problem in the first place by not reflecting appropriately the different human-microbe relationships which are relevant in this context.

More generally, the case of microbes prompts us to be careful when employing analogy arguments in environmental ethics. While analogy arguments (that is, comparing cases of intra-human ethics with cases in the human-nonhuman context and drawing ethical conclusions from that comparison based on their similarities) are a common methodological 'tool' in this literature (and particularly the sub-literature on animal ethics; see footnote two on methodology), their employment becomes less argumentatively robust when we consider forms of life which are simply very different from ourselves.[25] That does not only apply to microorganisms but they are a good example for this point. Analogies drawing on intra-human ethics might simply be an inappropriate way taking such life forms (and our relationship to them) into account *on their own terms*, which is related to the point about incommensurable moral significance discussed in the previous section.

Undermining individualist biocentric intuitions

Microbes in general, and the human microbiome in particular, constitute a challenge to the concept of the human individual or human self (see Gilbert et al., 2012, Rees et al., 2018) moving further away from atomist accounts of the human self to understanding the human as "a multispecies chimera that is kept alive, sane, and rational by its microbes" (Lorimer, 2020, p. 4). Microbes as 'collaborators' in the human body challenge the concept of the human self as well as how we perceive a moral agent as an individual decision-maker. For example, some initial evidence suggests that there is a link between the makeup of the gut microbiome, on the one side, and human behaviour and neural activity, on the other side (Bagga et al., 2018). This of course also poses additional complexities for ethical theorising in several respects and its implications also matter for environmental ethics. While that is nothing new to other disciplines or fields within philosophy, applied and

[22] Having said that, human-wildlife conflicts are a more and more common occurrence due to pressures on habitats and these come with serious problems to address. A convincing account of conservation ethics does not merely give an answer to why and how 'nature' ought to be protected but also addresses the question about how conservation policies and practices can be just towards the local community that is affected by them.

[23] For an analysis of the case of malaria transmitting mosquitos see Callies and Rohwer (2022).

[24] As already mentioned, the set of relevant considerations exceeds the four dimensions that I presented here which makes matters even more complex. For example, while some microbes might be harmful, they might also simultaneously have beneficial effects. Or another relevant consideration is that one needs to take into account how a microbe becomes an 'aggressor' that is harmful to human health. For this to be the case a range of factors need to be in place and some of this will be due to human actions and human-caused environmental changes, which in turn will require reflections about moral responsibility. Thanks to Davina Höll for prompting me to mention this additional level of complexity.

[25] I would go even that far to say that the 'natural otherness' of all non-human life forms makes a strong reliance on analogy arguments problematic in many cases—even when it comes to life forms that are more familiar to us (e.g., other species of mammals).

normative environmental ethics broadly within the 'analytical tradition' have been less quick in taking up this challenge, as far as I am aware.

On the first view, this challenge does not necessarily give reason to deeply question prevalent forms of moral theorising that start with the human as a moral agent that constitutes an individual of some sort in a relevant way. So, while I would argue that it remains appropriate to understand ourselves as individual moral agents, this should have nevertheless an impact on our self-image and understanding of our place in the world. That is, what this points towards are more inclusive and ecological ways of 'seeing' ourselves as humans as part of and within 'nature'.[26] For example, I would argue that seeing ourselves as 'ecological space'—that is, partly, as a resource and habitat for other life such as a variety of microorganisms—is not itself necessarily relevant to the content of a biocentric theory (e.g., in terms of our duties and responsibilities), but it aids to make such a theoretical perspective more intelligible within a moral philosophy tradition that has remained normatively anthropocentric in its core assumptions until very recently. It does that by helping us to see ourselves *situated within* a web of ecological relations, instead of assuming a detached 'outsider' perspective on ecological systems and processes.[27]

Additionally, moving the focus of attention to the microbes themselves, a range of further aspects need to be considered by individualist biocentric theories that attribute moral standing to (some) microbes. Many people find it already intuitively challenging to speak of the wellbeing of one single bacterium, to which individualist biocentrism is committed as I have taken as given. Moreover, also conceptually it is not easy to determine what constitutes the wellbeing of one single bacterium and then, in turn, to illustrate what makes this wellbeing morally relevant.

To put it concisely, the existence of microbes and their relationship to human beings makes us ask—at least—the following questions about the relevance of individuality:

1. How do we define what constitutes an individual living entity?[28]
2. Does the human microbiome make a difference to how we conceptualise the human self as well as human moral agency?
3. Is there a difference if we morally theorise about macro and micro worlds?[29]
4. In how far can we—and should we—differentiate between different kinds of microbes?[30]
5. Does it make sense to speak of an individual microbe being owed anything?

What it means to respect individual microbes

I will put most of these extensive lines of inquiry aside and focus only on a few aspects regarding the fifth question that primarily asks to be considered by individualist biocentric theories that attribute moral standing to (some) microbes. So, for example, if bacteria are constantly replicating it raises the question of whether it makes sense to speak of a single bacterium being owed anything. That is, in a deontological framework being on the opposite end of moral duties and, in the strongest form, even being potentially a holder of moral rights for example, or whether—if at all—these could only be attributed to bacteria colonies. While most theories—even deontological biocentric theories (e.g., Taylor, 2011)—oppose the possibility that non-sentient living beings can be rights holders, there are exceptions. For instance, such conceptual and intuition challenges pose a problem especially for individualist biocentric theories of justice (that is, the above-mentioned accounts of interspecies justice which argue for a specific type of moral rights), if it turns out that it is inappropriate to speak of the wellbeing of one single bacterium.

For many people speaking of the wellbeing of a single bacterium may sound like an absurd suggestion. Even Charles Cockell, who puts forward a "microbe-centric ethic" (2004, p. 149), thinks that "the implementation of a microbial ethic that seeks to protect individual microbes is absurd and impractical. If implemented, we would descend into unsanitary conditions, indeed we could not even move or sit down in a chair" (2004, p. 146). From such practical considerations Cockell's argumentation directly derives a position that seems to attribute intrinsic value to "communities" and microbe species instead of individual microbes, claiming that "microbial communities are a textbook example of the environmental ethical importance of communities over individuals" (*ibid.*) and that an "intrinsic worth argument can be made that particular species of microbes have a right to live" (*ibid.*).

It should be made clear that it is *one* thing to argue that aggregate entities such as communities and species should be at the focal point of an environmental ethic, due to being the primary (or only) holders of (non-instrumental) intrinsic value besides humans. That is one possible variation of an ecocentric position. Alternatively, there are also biocentric accounts that distinguish between more or less 'individualised' beings and attribute claims as individuals to the former and claims as populations to the latter (e.g., Brian Baxter's [2005] biocentric theory of ecological justice). That means that a tiger would be attributed claims as an individual but microbes (Baxter discusses bacteria) are only attributed claims as populations, if at all.

But it is a *different* point to say that because it is impossible not to kill a large number of individual microbes by simple every-day acts such as cleaning our homes, that this tells us something about the moral standing held by these individual microorganisms. That would be an argumentative fallacy by drawing a conclusion (no moral standing as individuals) that does not follow (from the necessity of harming those individuals on a daily basis). Whether an entity is morally considerable or has intrinsic value is one factor that is part of broader moral deliberations about what is the 'right' or 'good' action in a certain situation. All-things-considered, there are many actions that will be morally permissible despite that they harm an entity with moral standing—such as a single microbe if one deems it morally considerable. Moreover, as we have already seen above, the respective moral worth can be understood in a variety of ways. Most positions that attribute moral considerability to microbes deem its moral significance miniscule in comparison to that of a human being, and *no* modern position to my knowledge argues that an individual microbe has the *same* moral

[26] That is one way of acknowledging at least some of the complexities of life in such a theoretical framework, without fully retracting from a way of moral theorising that starts with how many (although not all) humans perceive themselves and their environment.

[27] Moreover, more specifically regarding distributive interspecies justice I have argued that seeing ourselves as 'ecological space' aids making such accounts of interspecies justice intelligible within a political theory tradition which is built on normatively anthropocentric assumptions, which in turn obstruct non-anthropocentric theorising about justice (Wienhues, 2020, chap. 4).

[28] As already mentioned earlier, that is one of the points of contention in the debate about the form and viability of biocentrism. That is also closely related to the question about what counts as morally relevant wellbeing.

[29] This question is relevant in so far as it seems that our moral intuitions are not very reliable when it comes to moving from the macro sphere (that is, the realm which we can comprehend with our senses and where human social interactions are situated) to the micro sphere (that is, the scale of relevance for microbes) because it goes beyond our lived reality. Methodologically speaking, there seems to be a *pro tanto* reason to be more inclusive than exclusive about moral relevance, when in doubt.

[30] That is, is there something that ties all microbes together as a moral category, or should we rather focus on different kinds of microbes—bacteria, plants etc.? In this paper, as within the biocentric literature in general as far as I am aware, bacteria are discussed either on their own or as a paradigm case for microbes.

standing as a human being *all-things-considered.* So, it is consistent to say, for example, that microbes have moral standing but that they do not have the same moral rights as humans. It would also be consistent to say that microbes have more moral significance that it usually attributed to them, but that all-things-considered it is still permissible to clean our houses, bake bread with yeast and wash our hands, because pursuing our own wellbeing (within reasonable limits) is simply not compatible with the wellbeing of millions of microorganisms.[31]

Ultimately, there are different ways of conceptualising what it means to 'respect' microbes. For example, an environmental virtue ethics perspective on this example could be that living a life with the virtue of humility towards 'nature', in general, and microbes, in particular, would entail a certain awareness of the impacts of our actions—that is, maybe just being more aware about the existence of the microscopic lifeforms that are in our vicinity all the time—and refrain from actions that are detrimental to microbial life if there are simple alternatives.[32] Of course, often there are not. The purpose of washing our hands is to remove harmful microbes. Like the self-defence scenario described above, human-microbe relations are complex. While it is—in principle—possible to live a life that does not harm fellow human beings, it is not possible to live a life that does not harm microbes. That has an impact on how we theorise the moral human-microbe relationship but that does not presuppose that individual microbes cannot be holders of moral standing as individuals. That is a separate question that individualistic biocentric positions need to address.

The problem of individuation

Unfortunately, the concept of the individual is messier than we might wish. As suggested above, also the human case seems to hold more complexities than often acknowledged. The constantly replicating bacteria pose a challenge to the concept of the individual from the opposite end of the spectrum, despite that it makes sense on the first view to speak of one single bacterium. For instance, are bacteria ontologically 'separate' enough in order to count as individuals? That is the problem of individuation.[33] I cannot answer this question here, but one might also wonder about the importance of that question for normative and applied environmental ethics. Two considerations in this regard can help individualist biocentrism. Firstly, missing conceptual 'sharpness' about what it means to constitute an individual does not imply that the target concept lacks moral relevance. Secondly, what constitutes an individual can be defined in a multitude of ways and there is no need to presuppose that only the strictest (and most simplistic) atomistic account of the individual would qualify as the appropriate subject of an individualist ethic.[34]

Moreover, one might also ask whether, as the complexity of an organism increases—that is, in the usual understanding with increasing sentience and cognitive capacities—the organism also becomes more individualised. As mentioned above, Baxter (2005) employs this distinction to separate claims of what he calls 'merely living' beings from more complex living beings. The latter get attributed claims as individuals, while the former only get attributed claims (of justice—in his theory) as populations. The base intuition here, which many people will find plausible, is that being more or less individualised (or having individuality) is morally relevant. Of course, the question that biocentric accounts that take such a position need to answer is how individualisation should be understood in this context. That is, what is the morally relevant capacity or feature (or set of features) of living entities along which we can measure individualisation, and why do microbes lack such individuality. I will not engage with Baxter's account now, which is more elaborate that I can present at this point. Here are just a couple of issues that anyone finding the concept of individualisation as a means of differencing different claims, duties etc. humans might hold towards different living beings appealing needs to consider.

For one, the relevance of individuality depends on one's answer regarding the earlier question about how to conceptualise an individual. Based on one's preferred definition, there appear to be two options. Either being an individual is a 'yes or no' affair, which means that being more or less individualised is conceptually not applicable; or what it means to be an individual indeed allows for graduation and therefore the possibility of being more or less individualised. Secondly, there also seem to be several dimensions of individualisation at play when it comes to the intuition about its moral relevance. So, one needs to ask whether it is that individuation in of itself which does the normative relevant work here or whether we use it as shorthand for highlighting other features which are deemed morally relevant. These could be, for example, differentiating by cognitive complexity and self-awareness (at best, an entity perceiving itself as an individual being with its own interests such as in the case of humans) or behavioural features (for example, the preference for not living very closely with fellow species members and thereby living a more solitary and 'autonomous' life). Especially regarding the case of differentiating by cognitive complexity (that is, sentience), for example, one needs to ask whether individualisation in of itself is the relevant factor, or whether it is only a shorthand for other features of that one deems morally relevant for building a hierarchical account of moral significance (see the earlier section on this topic).

Limiting the scope

I will not provide a satisfactory answer to the problem of individuation at this point. However, there is one way of addressing the challenges associated with this while retaining a partial commitment to individualist biocentrism, when taking it as a given—for the purpose of the argument—that it constitutes a serious challenge. *Even if* the problem of individuation is a serious concern, it can be addressed by reducing the scope of the theoretical applicability of biocentrism. Putting it differently, so far I have inquired into the possibility of individualist biocentrism providing a coherent base for a theory of

[31] Putting it more formally, Goodpaster (1978) also introduced a second helpful distinction for biocentric theorising, which is useful for these deliberations by distinguishing between 'regulative' and 'operative' moral consideration. In Goodpaster's words: "It seems to me that there clearly are limits to the *operational character* of respect for living things. We must eat, and usually this involves killing (though not always). […] We must protect ourselves from predation and disease, and sometimes this involves killing (though not always). The *regulative character* of the moral consideration due to all living things asks, as far as I can see, for sensitivity and awareness, not for suicide (psychic or otherwise). But it is not vacuous, in that it does provide a *ceteris paribus* encouragement in the direction of nutritional, scientific, and medical practices of a genuinely life-respecting sort" (1978, p. 324, some italics added).

[32] For a good introduction to environmental virtue ethics see Sandler (2016).

[33] The severeness of this problem is of course dependent on a range of questions. On the face of it, consequentialist accounts might have less trouble than deontological approaches, because for them the satisfaction of interests (if these can be determined) matters more than the entity that is attributed these interests. Thanks to Anna Deplazes-Zemp for drawing my attention to this difference.

[34] On the face of it, it seems that on the problem of individuation several issues intersect that muddy the waters. One of these appears to be that our moral intuitions become less reliable when moving from the macro to the micro world which relates to the third question posed at the beginning of this section. Microbes are not visible to us; their lifecycles are much shorter than ours; generally, our usual frames of reference become inappropriate. Their 'natural otherness' (e.g., Hailwood, 2000, Wienhues, 2021b)—understood in several senses of the term—moves to the foreground. Because theorising about microbes moves beyond our lived reality, it seems methodologically reasonable to be cautious about our intuitions about microbe-related problem cases.

environmental ethics in light of the specific challenges posed by microbes. I have argued that some of these challenges can be met, despite that one needs to address additional, more wide-ranging questions about the theoretical viability of biocentrism. The group of challenges posed by microbes that I have collated here under the heading of undermining individualist biocentric intuitions are in some ways more fundamental problems. Yet, one way of making biocentrism more plausible is to situate it within its appropriate *theoretical niche*, as part of a broader pluralist theory of environmental ethics.

Here the central question is whether biocentrism should be taken as a starting point of a broader theory of environmental ethics, or whether biocentrism is only a coherent starting point for a sub-area of environmental theorising. I will leave this an open question and only briefly indicate that limiting the theoretical scope of biocentrism in this way can aid to lessen some of the problems introduced above. For instance, I have argued that limiting the scope of biocentrism—when confined to specific questions of global distributive interspecies justice[35] —can protect it from a range of theoretical challenges (Wienhues, 2020, chap. 2).[36] When limiting biocentrism in this way, for instance, it can aid the theorisation of questions of global interspecies justice while also allowing one to set aside—for the moment—the individuation question. For instance, looking at global interspecies justice via the lens of biocentrism as a complementary area of inquiry to global intra-human environmental justice allows us to move beyond individual conflict situations and its related questions of weighting up and (importantly) counting 'individual' living beings such as bacteria which are difficult to count.

Rather the question becomes what our duties of global justice are towards the non-human community of justice as a whole in a more abstract sense, despite that the relevant entitlement holders remain individual living beings (however defined). For instance, how much appropriation of 'ecological space' (which includes, among other things, natural resources and land) by humans can be considered distributively just against the background that also fellow humans (intra-human environmental justice) and fellow living beings (interspecies justice) hold entitlements towards habitats, natural resources and so on? At least in this specific sub-area of environmental ethics—that is, distributive interspecies justice—microbes can be right holders (that is, holding conditional entitlements to ecological space which is neither identical to other moral rights, nor presupposes other moral rights)[37] without relying on the need to count microbes, which would bring again the problem of individuation to the foreground.

Accordingly, there are ways of justifying habitat protection on biocentric grounds via a theory of distributive interspecies justice, for instance, which can acknowledge the moral considerability of microbes, while also relying less heavily on a theoretical account of individuation that is more central for inquiries into individual conflict situations—such as often-engaged thought experiments about moral choice dilemmas (that it, if I can only rescue one or the other, what am I supposed to do?). It seems that the counter-intuitiveness of biocentrism for many people seems to lie in such individual conflict situations where we are prompted to 'count' and 'weigh' the moral worth of individuals against each other.

Firstly, to alleviate the *counting problem*, which comes in tandem with the problem of individuation, I have suggested that one can limit the scope of biocentrism to a theory of distributive interspecies justice. This means, that biocentrism might not be the appropriate grounding for a broader theory of environmental ethics (which I am leaving an open question), but it can answer more specific questions such as how we should conceive just habitat protection. Secondly, in the subsection above, *microbes and the incommensurability of moral significance*, I have already suggested that understanding the moral significance of different nonhuman living beings as being incommensurable can address the *weighting problem*. Both of these together, in turn, can partially address some of the practical implementation problem cases that arise when attributing microorganisms moral standing that I have discussed so far.

Conclusion and outlook: Adding complexity to human-nature relations

As I have illustrated in this paper, human-microbe relations are morally complex and come with a range of challenges. At least three non-exhaustive challenges are posed by the existence of microorganisms for biocentric environmental ethics theorising. These were (1) the moral significance challenge, (2) the self-defence predicament and (3) undermining individualist biocentric intuitions. Together these challenges amount to adding considerable complexity to human-nature relations, but I have presented some initial thoughts about why not all of these challenges might pose a serious threat to biocentric theorising.

For instance, the moral significance challenge can be considerably alleviated if we move beyond the usual choice of hierarchical and egalitarian accounts of moral standing and take the moral significance of different non-human living beings to be incommensurable. On a different note, regarding the justifiability of self-defence against microbes, I have argued that we need to be particularly careful when theorising the human-microbe relationship when employing analogies that compare self-defence against a human aggressor and self-defence against disease-causing bacteria, for instance. The two cases differ substantially in several regards, more so than other self-defence scenarios involving non-human beings such as sentient non-human animals.

This overall complexity, in turn, prompts us to consider in more detail different categories of relationships that I mentioned in the introduction. There are at least four morally relevant relationships between microorganisms and humans. These are:

1. collaboration
2. predation
3. non-interference
4. ecological dependency

The human microbiome is a good example of the case of *collaboration*, i.e., a mutually beneficial relationship. One effect of taking microorganisms into consideration is that it provides a perspective that opens up more inclusive and ecological ways of 'seeing' (as suggested in the previous section). Seeing our bodies as habitat for other species or even seeing ourselves—who we are, how we feel—as a product of interspecies collaboration sets the ground for theorising environmental ethics. The second relationship about danger or *predation* is the case of microbes causing disease that concerns the reflexions regarding self-defence introduced in the section before that.

But we might also find more 'neutral' relationships where there is *not much direct interference* between human and microbe lives. That is, they

[35] Here it should be noted that, usually, justice takes the role of a specific concept within the realm of ethical theorising. That means that justice is a narrower concept and is not identical to ethics more broadly.

[36] So, while I argue that this theoretical scope aids us to avoid some of the questions that biocentric theories need to answer, it also explains why I am particularly interested in the microbe as a challenge to individualist biocentric theories of interspecies justice. Arguably justice is an intrinsically individualistic concept—in terms of giving each *their* due, paraphrasing the *Institutes of Justinian* description of justice that still captures well how we think about justice nowadays (Miller, 2017). That also applies beyond the 'human sphere' when moving into interspecies justice in order to keep some conceptual continuity between intra-human and interspecies justice (Wienhues, 2020).

[37] I understand the entitlements of distributive justice that are attributed to individual living beings as *pro-tanto conditional rights* that arise from a specific relationship that can ground justice claims (Wienhues, 2020, chap. 5). Importantly, these are *distinct* from attributing more fundamental natural rights to microbes, for instance, and their justification *goes beyond* simply attributing intrinsic value in terms of moral considerability (compare Cockell, 2005).

are neither a danger to human health nor do they constitute a direct health benefit to human lives. These 'neutral' relationships can also include instances of 'accidental' interference, for example, by humans pursuing their projects in a way that interferes with microbial life without the microbes in question posing any danger or producing any benefit for humans. The descriptor 'neutral' is not appropriate in a range of other cases, however. Often, microbes that fall into this category are part of important life-sustaining processes on Earth. For example, some cyanobacteria—thermophilic microorganisms—contribute to such processes by converting carbon dioxide and water to oxygen. The Yellowstone National Park in the United States of America is an impressive example where the existence of such microorganisms is actually visible without a microscope in the landscape by creating colourful mats (NPS, 2020). Most microorganisms do not negatively affect human health—on the contrary—many take important ecological functions that are ultimately beneficial to humans and essential to the possibility of life on Earth. Cockell (2004, p. 144; reiterated in 2005) seems right in suggesting, that their importance tends to be "underappreciated". Accordingly, it should be remembered that attributing moral standing to microbes as individuals or non-instrumental value as species is not the only potential reason for their moral relevance. Their instrumental value for the life-sustaining proses on Earth also demands attention and illustrates the human *ecological dependency* on these little beings.

This simplified distinction into four relationships does not cover all the relevant complexities of human-microbe relationships, of course. It is only is meant to illustrate that common distinctions in environmental ethics—such as the wild/domesticated distinction (see Palmer, 2012) or different degrees of naturalness (Siipi, 2008)—that aid our understanding of the differences between morally relevant relationships between humans and nonhuman beings might not always be easily transferable to human-microbes cases. So, this will require more theoretical attention. While my own position is committed to arguing that fairly 'wild' microbes like the cyanobacteria in Yellowstone should be considered entitlement holders of distributive interspecies justice, our moral relationship with the human microbiome is of a different quality. This latter area would benefit from more theoretical attention, as the moral relationship with our microbiome seems to be very specific, different to other relationships that are analysed within environmental ethics. This also constitutes an area for which a broader biocentric theory would need to provide an answer. Accordingly, this constitutes an area of theoretical inquiry that deserves more attention in that not all human-microbe relations are equal and which is connected to some of the challenges that I already introduced in the last section.

Overall, I have aimed to show that microbes pose *additional* challenges for moral theorising that biocentric theories need to address. While I have indicated that these challenges seem surmountable, it remains the case that the environmental ethics literature would benefit from theoretically engaging with the specific theoretical challenges posed by microorganisms in more detail. These living beings might be microscopically small, but their relevance for environmental theorising clearly is not.

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