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SUBMITTED PAPER

Is a vegetarian diet morally safe?

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Abstract If non-human animals have high moral status, then we commit a grave moral error by eating them. Eating animals is thus morally risky, while many agree that it is morally permissible to not eat animals. According to some philosophers, then, non-animal ethicists should err on the side of caution and refrain from eating animals. I argue that this precautionary argument assumes a false dichotomy of dietary options: a diet that includes farm-raised animals or a diet that does not include animals of any kind. There is a third dietary option, namely, a diet of plants and non-traditional animal protein, and there is evidence that such a diet results in the least amount of harm to animals. It follows therefore that moral uncertainty does not support the adoption of a vegetarian diet.

Keywords Animals · moral uncertainty · New omnivorism · Vegetarianism · Precaution

There is disagreement about the moral status of non-human animals. Some philosophers argue that many non-human animals enjoy similar rights as human beings, and so it is wrong to eat them (Regan 1983; Francione 2008; Bruers 2015). Other philosophers argue that many animals enjoy some moral status, even if it is not the same moral status as human beings.[1] Still, on this view, it is wrong to eat animals with some moral status because these animals suffer immensely in animal agriculture and we do not need to eat them in order to live flourishing lives (McPherson

[1] In this paper, I use the term "animals" to refer to non-human animals.

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2014 and 2016, DeGrazia 2009, Rachels 2011, Rachels 2004). Still other philosophers argue that non-human animals lack moral status altogether and fall outside the scope of the moral community (Hsiao 2015, 2017; Carruthers 2011, 1992; Lee and George 2008; Oderberg 2000). There is nothing wrong with eating animals on this view. Given the persistent scholarly disagreement surrounding animals, it would seem reasonable for observers of animal ethics—i.e., non-animal ethicists—to conclude that philosophers are uncertain about the moral status of animals, and hence, the ethics of eating them. After all, despite these philosophers' familiarity with the arguments for and against eating animals, they arrive at very different positions, which should suggest to non-animal ethicists that no argument for or against the practice is conclusive.

For a non-animal ethicist looking for dietary guidance, the rampant disagreement among philosophers and ensuing uncertainty can be unsettling. A number of philosophers are in broad agreement that this uncertainty about the ethics of eating animals has clear implications for how non-animal ethicists ought to eat (see Bykvist 2017; Matheson 2016; Moller 2011; Guerrero 2007). A reconstruction of the argument is as follows: If animals have high moral status, then we commit a grave moral error by eating them. Eating animals is thus morally risky, while everyone agrees that it is morally permissible to not eat them, as Dan Moller observes: "avoiding meat doesn't seem to be forbidden by any view" (2011: 441). In light of the uncertainty regarding the moral status of animals, the risk of committing grave moral error should animals have high moral status, and the moral permissibility of not eating animals, these philosophers argue that non-animal ethicists have a reason to err on the side of caution and adopt a vegetarian diet. I refer to this argument as the *precautionary argument for vegetarianism*.

In this paper, I argue that the precautionary argument for vegetarianism assumes a false dichotomy of dietary options: a diet that includes farm-raised animals or a diet that does not include animals of any kind. There is a third dietary option, namely, adopting a mixed diet of plants with some non-traditional animal protein, and there is evidence that such a diet causes the least amount of harm to animals, assuming animals have high moral status. Importantly, given our current empirical and moral uncertainty about which diet actually causes the least amount of animal harm, it follows that moral uncertainty does *not* support the adoption of a vegetarian diet after all. Indeed, if we factor in research on plant sentience and recent arguments that plants may have higher than previously thought moral status, then it would seem that our uncertainty about the moral status of plants *and* the moral status of animals collectively supports the adoption of a diet that includes some non-traditional animal protein.

1 The Precautionary Argument for Vegetarianism

I begin by explaining the precautionary argument for vegetarianism (hereafter PV), which is a subset of a more general type of argument that has the following form. When there is a non-zero epistemic possibility that a creature has high moral status, we risk committing a serious moral offence by killing that creature or otherwise using

it merely for our ends. This second-order reflection on the possibility of committing grave moral wrong provides us with a reason for not acting as though that creature has little or no moral status. When in doubt about whether a creature might have high moral status, and there is no moral problem with performing alternative action(s), we have reason to err on the side of caution and perform the alternative, morally safe action(s).

The argument applied to eating animals can be set forth as follows. [2]It would seem reasonable that, given the options, we are morally permitted to eat animals *if and only if* we are certain that animals lack high moral status. However, as noted already, there is rampant disagreement among philosophers regarding the moral status of animals, not to mention the disagreement around the notion of moral status itself, which suggests that non-animal-ethicists should be less confident in their belief that animals lack high moral status or not, as Jonathan Matheson explains: "once we are aware of the widespread disagreement among the experts on moral matters, we should be skeptical about the relevant moral propositions as well" (2016: 125-126). Proponents of the PV claim that, given the moral uncertainty, and the fact that the alternative course of action—namely, adopting a vegetarian diet—is agreed upon by all to be morally permissible, non-experts should err on the side of caution and adopt a vegetarian diet. Therefore, since "it is uncontroversially morally permissible to be a vegetarian or a vegan," Matheson argues, "[e]xercising moral caution in these epistemic circumstances has it that we should not eat animals for pleasure" (2016: 128). Krister Bykvist explains that the "rational thing for you to do is thus to eat vegetables, given your beliefs and preferences" (2017: 3).[3]

2 A Third Dietary Option: New Omnivorism

Despite its simplicity and appeal, the PV is not as airtight as proponents assume, for it overlooks a third dietary option, namely, a diet of plants with some non-traditional animal protein.[4] According to a relatively new position in animal and food ethics, such a diet results in the least amount of harm to animals overall. Andy Lamey refers to this position as "*new omnivorism*" because it "endorses animal protection as philosophy but goes on to defend eating animals" (2019: 1). New omnivorists agree that animal suffering is morally significant and that factory-farm animals suffer greatly: we should not support factory farming, even humane farming.

[2] This presentation of the argument is drawn from Bykvist (2017: 3), Bass (2016), Matheson (2016), Sepielli (2013), Guerrero (2007: 76-78), and Moller (2011: 441).

[3] Proponents of the PV do not delineate among non-animal consumption diets (e.g., vegetarianism, veganism, fruitarianism) and neither will I in this paper. The argument in section 2 applies all non-animal consumption diets that rely on industrialized farming practices.

[4] For criticism of this general type of argument, see MacAskill (2019), Weatherson (2014), and Harman (2015). MacAskill, Bykvist, and Ord (2020) argue that the PV is too simplistic, for it does not factor in all the implications of uncertainty. For instance, the PV is silent about the value of bringing animals into existence, the possibility that factory farm animals lack lives worth living, and the weight of other obligations that may be in tension with the adoption of a vegetarian diet. The argument of this paper is distinct from and complementary to their argument.

Table 1 New omnivore assessment of dietary options assumed in the PV

Options	Animals have high moral status	Animals do not have high moral status
Traditional diet	Serious moral wrong	Morally permissible
Vegetarian diet	Serious moral wrong	Morally permissible

They go on to note, however, that animals also suffer in a variety of ways in plant agriculture: vegetarian diets are not harmless to animals (Milburn and Bobier, 2022). Insecticides, pesticides, land-clearing, damming and irrigation, transportation, salinity, soil erosion, tilling and harvesting, food safety testing on animals, fencing, non-poison pest control, and food storing all harm animals. For example, over a three month period in Myanmar, around 2.6 million rats were caught and killed to protect rice crops (Singleton et al., 2010), water bird numbers declined 90% over a 19 year period due to damming (Hampton et al., 2021), and pesticide and insecticide runoff harm fish populations in large numbers (Fischer and Lamey, 2019). Although it is difficult to gather reliable data on how many animals are harmed in plant agriculture, and the research on the number of field animal deaths has been subject to scrutiny (Fischer and Lamey 2018; Lamey 2019: 66-73), it remains true that agricultural farming is not innocent of causing animal deaths or harms. Donald Bruckner writes that everyone "seems to agree that extensive harm is done to animals in the production of plants" (2015: 36).[5]

New omnivorists thus deny the simple set of options assumed in the PV. Specifically, they deny that a vegetarian diet is the morally right diet to adopt *if animals have high moral status*, for a vegetarian diet also involves a significant amount of animal harm. They may be taken to redescribe the decision-matrix as follows (Table 1).

Just as a traditional diet that includes eating farm animals is morally wrong if animals have high moral status, so also a vegetarian diet is morally wrong, for it too involves plenty of animal harm. *Prima facie,* then, neither diet seems preferable.

Moral vegetarians could—indeed, should—resist the new omnivorist's redescription of the decision-matrix on two grounds. First, they can argue that a vegetarian diet results in less animal suffering compared to a traditional diet. The reason is relatively straightforward. There is a multiplication of animal suffering in the production of a traditional diet, for field animals suffer in the production of food for farm animals, who in turn suffer on the farms (Deckers, 2016). Thus, animals die in the field and on the farm in order to sustain a traditional diet, while animals only die in the field in order to sustain a plant-based diet. Second, moral vegetarians regularly note that factory farming of animals intends animal suffering and death, whereas plant agriculture largely does not. This difference is morally significant (Lamey, 2019; Abbate, 2019). These two points suggest a revision of the new omnivorist's proposed decision-matrix (Table 2).

On this revised matrix, moral vegetarians can grant that it is morally significant that animals die in plant agriculture, but go on to insist that this is necessary in order

[5] The claims of this section can be strengthened by discussion of the various ways that human beings are harmed through plant agriculture, e.g., exploitation of farm workers (Martin, 2019) and consumption of residual pesticides (World Health Organization, 2018).

Table 2 Moral vegetarian assessment of dietary options assumed in the PV

Options	Animals have high moral status	Animals do not have high moral status
Traditional diet	Serious moral wrong	Morally permissible
Vegetarian diet	Less serious moral wrong	Morally permissible

for us to survive and is permitted in virtue of the fact that the alternative—traditional diet—results in greater animal suffering and is morally worse.

New omnivorists are not done arguing, however. They use the observation that animals are harmed in producing and sustaining a vegetarian diet to argue that it is morally permissible or even obligatory to eat certain animals (Milburn & Bobier, 2022; Bobier, 2021). In other words, there is a third dietary option—a diet of plants and some non-traditional animal protein—that causes the least amount of harm to animals. It is at this point that the new omnivorist "position" breaks down, for different proponents argue for the adoption of different kinds of animal protein in one's diet. Stephen Davis (2003) argues that a diet of plants and ruminant animals would cause the least amount of harm to animals. He reasons that herbivores would help cut down on the need to till the land, which would ensure fewer field animal deaths, and since the herbivores are eating off the land, the corn and soybean that is currently grown to feed farm animals can instead be fed to humans. Lawrence Cahoone (2009) and, more recently, Dan Demetriou and Bob Fischer (2018) argue that a diet of plants and hunted meat might result in less overall animal suffering than a vegetarian diet. Wild animals live freer, more fulfilling lives than factory farm animals, and may experience a quicker, less painful death; hunting also serves an important ecological role in maintaining animal ecosystems, and thereby, helps reduce animal suffering resulting from over population. Demetriou and Fischer write that this diet is "at least as morally good, if not preferable" to vegetarianism (2018: 49). Adam Shriver (2009) and Jeff McMahan (2008) propose consuming genetically altered animals, animals that have been edited in such a way that they are insentient or die naturally at the point at which their meat tastes best. Although these proposed new omnivorist diets involve some intentional animal harm, proponents argue that the intentional harm is justified by the lower amount of overall animal suffering.

The preceding options do not exhaust the new omnivorist position, for other versions seek to avoid intentional animal harm altogether. Here are three of the most promising. Proponents of the first version argue that there is flesh that is available to consume (a) that does not contribute to the further exploitation of animals, (b) that will be otherwise wasted, and (c) that is available outside the food production system. Two examples of this kind of meat would be animals killed by vehicles and meat recently discarded by restaurants (Bruckner 2015; Milburn 2017; Fischer 2018). Proponents of the second version of new omnivorism argue that, since the ability to experience felt pain matters morally, we should eat animals who do not experience felt pain. Bivalves and insects lack brains and sophisticated nervous systems required to have a conscious experience of suffering, and so, both appear to be clear candidates for lacking morally significant status (Cox 2010, Meyer 2013, Huemer 2019, Fischer 2016 and 2019). The final new omnivorist version argues for the adoption of cultured or in vitro meat, meat that is grown in a lab (Lamey

Table 3 New omnivore assessment of dietary options

Options	Animals have high moral status	Animals do not have high moral status
Traditional diet	Serious moral wrong	Morally permissible
Vegetarian diet	Less serious moral wrong	Morally permissible
New omnivorist diet	Least serious moral wrong	Morally permissible

2019: 214-234; Fischer and Ozturk 2017). Although this meat currently requires fetal bovine serum, there are techniques that promise to eliminate this dependence, thereby rendering this meat painless to animals.

New omnivorists are thus not a unified bunch but instead come in a variety of flavors. Which of these new omnivorist diets, or combination thereof, results in the least amount animal harm and moral wrongness remains an open question, one that I set aside for now. (I return to it below.) What matters for present purposes is that new omnivorists add a third diet to the list of options, a diet that, they argue, results in the least amount of animal harm and moral wrongness (Table 3).

If animals have high moral status, then factory farming is a serious moral wrong. Since plant agriculture involves intentional and unintentional animal harm, it is also morally problematic if animals have high moral status. New omnivorist diets promise to minimize animal harm by incorporating roadkill, insentient insects, humanely farmed herbivores, farmed oysters, or other non-traditional sources of animal protein. Therefore, given uncertainty about the moral status of animals, new omnivorists argue that we should err on the side of moral caution and adopt a new omnivorist diet, not a vegetarian diet.

3 Empirical & Moral Uncertainty

The moral vegetarian, no doubt, has objections. The new omnivorist position relies on empirical claims about which diet causes the least amount of overall animal harm. The empirical claim is important for the new omnivorist because it complicates the assumed set of dietary options. Unfortunately, as noted above, it remains an open empirical question of how many animals die to produce a vegetarian diet. The evidence in favor of a high number of field animal, bird, and fish deaths has been subjected to scrutiny (see Lamey 2019: chapter 3). Stephen Davis admits that "accurate estimates of the total number of animals killed by different agronomic practices from plowing to harvesting are not available" (2003: 389) and that "[m]ore research is needed to obtain accurate estimations of the number of field animals killed in different crop production systems" (2003: 393). Fischer and Lamey argue that "it's all but impossible to offer a meaningful estimate of all harms associated with plant agriculture, at least if a "harm" is understood as any way in which a being's welfare is negatively affected" (2018: 412). The details of the criticisms of field animal death estimates need not concern us here. Let us grant that recent estimates of the number of field animal, bird, and fish deaths are lower than previously thought.

Moreover, the moral vegetarian has objections to each variety of the new omnivorist position. Here are four examples. Cheryl Abbate argues, among other things,

that field animals may not, all things considered, be harmed when they die in plant agriculture and that consuming roadkill disrespects animals (2019). Andy Lamey argues that incorporating scavenged meat might not actually lower overall animal deaths (2019). Simon Knutsson and Christian Munthe argue that, because science is unsettled on the matter, and because the ability to feel pain is morally significant, we should err on the side of caution and refrain from eating insects (2017). Rebekah Sinclair argues that animals are not to be eaten, and so we should reject anything that mimics animal flesh (2016). The details of the criticisms need not concern us; what matters for present purposes is that there is debate over each of the proposed new omnivorist diet and there is no clear consensus on the matter.

Proponents of the PV might be tempted to argue that the empirical uncertainty surrounding the number of field animal deaths *and* the fact that each new omnivorist position has been criticized favors the adoption of a vegetarian diet. They might reason as follows. We can gain reliable numbers of how many animals are killed annually to produce a meat-based diet, and we can estimate, more or less, the number of animals killed annually to sustain a certain type of new omnivorist diet. Davis, for instance, estimates that his proposed mixed diet of plants and large herbivores would result in 1.35 billion or so animal deaths per year, while the total number of animals killed in animal farming in 2000 was 8 billion (2003: 390-391). Fischer estimates that a diet that incorporates insects would require around 130,090 insect deaths per acre (2016: 261). These numbers are high, and while we are not exactly sure how many animals die to sustain a strict plant-based diet, that number seems unlikely to be as high as the alternatives. Consequently, assuming a lower number of field animal, bird, and fish harm from plant agriculture, as well as uncertainty surrounding the new omnivorist diet, the safest bet is to adopt a vegetarian diet.

This response will not do, however, for two reasons. First, as noted above, not all new omnivorist diets involve intentional, direct harm to animals; indeed, Davis's proposal to eat herbivores is unique among new omnivorists. To consume roadkill or in vitro meat does not evidently promote more animal suffering. Incorporating such animal protein into one's diet will lower overall animal harm by reducing the amount of food needed to sustain a person. Second, and more importantly, although there is empirical uncertainty about how many field animals, birds, and fish are harmed in plant agriculture, there is no uncertainty that animals are harmed. It is true, as Bob Fischer writes, that "no one disputes that some wild animals are currently harmed" in traditional plant agriculture (2018: 247). This empirical uncertainty is as important to the PV as our epistemic uncertainty regarding the moral status of animals, for no one is in an epistemic position to claim with confidence that a particular new omnivorist diet will result in more animal harm and suffering than a vegetarian diet would. If we adopt a vegetarian diet on the assumption that such a diet causes less harm to animals, we may be committing a moral error if it turns out that we are factually wrong about the number of animal deaths. Likewise, if we adopt a new omnivorist diet of insentient insects and plants on the assumption that such a mixed diet causes the least amount of harm to animals, we may be committing a moral error if it turns out we are wrong about insects being insentient. The same holds

Table 4 Revised new omnivore assessment of dietary options

Options	Animals have high moral status	Animals do not have high moral status
Traditional diet	Serious moral wrong	Morally permissible
Vegetarian diet	Less serious moral wrong	Morally permissible
New omnivorist diet	Less serious moral wrong	Morally permissible

true for the objections to each version of the new omnivorist position.[6] The debate is by no means settled.

What is the upshot, then? Well, it appears that, *assuming* a lower number of field animal, bird, and fish deaths in plant agriculture, and *assuming* moral uncertainty regarding the new omnivorist position, we get the following decision-matrix (Table 4).

Given that we have to act—we need to eat in order to survive—it seems that, in light of uncertainty regarding animal moral status and uncertainty regarding the number of field animals harmed in plant agriculture, we are morally permitted to adopt *either* a vegetarian diet or a new omnivorist diet.

4 Industrialized Agriculture and Humane Agriculture

Another worry with the new omnivorist response to the PV is that it overlooks the possibility of farming crops in a manner that is not harmful to animals (Lamey 2019; Abbate 2019). There are a plethora of options available today, from backyard farming and community gardens to growing vegetables without pesticides and in greenhouses, all of which result in markedly fewer animal deaths. This suggests, therefore, the following modified decision-matrix (Table 5).

The argument offered by new omnivorists above focuses on field animal deaths on large-scale, industrialized farms. These are not small farms, but intensive farming operations over four or more acres of land. New practices and new technologies may eliminate or otherwise minimize the number of animal deaths (Fischer and Lamey, 2018).

The problem with this response is that most people—especially people living in population dense places—do not have access to plants that have been grown humanely, i.e., in a way that eliminates or greatly reduces field animal deaths.

Table 5 Revised moral vegetarian assessment of dietary options

Options	Animals have high moral status	Animals do not have high moral status
Traditional diet	Serious moral wrong	Morally permissible
Vegetarian diet	Less serious moral wrong	Morally permissible
New omnivorist diet	Less serious moral wrong	Morally permissible
Humane vegetarian diet	Morally right thing to do	Morally permissible

[6] It is instructive to note that critics of certain iterations of new omnivorism are proponents of others. Abbate (2019: 174-175) seems open to the moral permissibility of eating insects and Lamey (2019: 214-234) defends the consumption of in vitro meat.

Backyard farms and community gardens are not available for many people. Fischer and Lamey are clear that humane agriculture is a future possibility, not a present reality for most people: "current trends would seem to raise the serious possibility that plant agriculture might someday kill very few animals—perhaps even none" (2018: 425). If in the future agriculture reasonably eliminates field animal deaths, then we should adopt a vegetarian diet. In the meantime, however, we have to decide how to eat here and now. The viable set of dietary options for most people, then, is between a vegetarian diet and a new omnivorist diet, and as noted already, this set of options does not show that we are obliged to adopt a vegetarian diet.

It might be objected at this point that this response applies equally to new omnivorists: just as with humane agriculture, so not all new omnivorist diets are available to most people. For example, many people living in cities do not have access to edible roadkill; insects are not found in many grocery stores; and cultured meat is prohibitively expensive. But this only shows that some versions of the new omnivorist diet are implausible, not all of them. It is reasonable to think that insects, farmed oysters, and scavenged meat are available to most people, or at least can become so without serious challenge. After all, bivalves and insects are common food items in certain parts of the world and salvage grocery stores and food banks that accept expired meat are common. Moreover, the kind of available morally permissible meat varies depending on where a person is situated. A person living in the countryside may come across edible roadkill on a somewhat regular occasion, while a New Yorker may never come across edible roadkill but may have access to salvaged meat; a person living in Japan may be in the habit of eating farmed oysters, while a person living in Malaysia may be in the habit of eating insects. The new omnivorist diet will likely change over time, as well. While the cost of cultured meat remains prohibitive for people here and now (not to mention its current dependence on bovine serum), it is not unthinkable that people will have access to readily available, cheap, and harmless-to-animals in vitro animal protein in the future. This goes to show that whether one should choose a vegetarian diet or new omnivorism depends on the situation.

5 The Moral Status of Plants

At best, then, moral uncertainty presents non-animal ethicists with two diets that they may adopt. How should one act? Which diet should one choose? Here I want to introduce a consideration that tips the scales in favor a new omnivorist diet. Just as disagreement about the moral status of animals suggests to proponents of the PV that we are uncertain about their moral status, so disagreement about the moral status of plants suggests that we are uncertain about their moral status. In this section, I present the case for thinking that plants have high moral status in order to show that our uncertainty over the moral status of plants *and* animals supports the adoption of a new omnivorist diet.

There is a growing field of study called "plant neurobiology" that investigates the cognitive-like abilities of plants.[7] Psychologist Arthur Reber writes that the "case for some form of consciousness in plants is becoming stronger by the day" (2018: 1). Before discussing the evidence for the position, it is instructive to clarify how proponents of the field understand their position. Brenner and colleagues, early proponents of the field, define "plant intelligence" as the "intrinsic ability to process information from both abiotic and biotic stimuli that allows optimal decisions about future activities in a given environment" (2006:414).[8] In other words, plants manifest, according to philosopher Michael Marder, "the non-cognitive, non-ideational, and non-imagistic mode of thinking proper to plants" (2013b: 124). On this view, plants are not hardwired to respond to their circumstances as they do; instead, they are able to make purposeful actions in response to their environmental awareness. Plant intelligence or sentience is not akin to our experience of thought, to be sure, because we are radically different types of organisms. Instead, proponents of plant thinking claim that plants manifest "nonhuman" or "nonneural" consciousness or intelligence (Marder 2013a; Calvo and Trewavas, 2020).

While it is difficult for us to understand how a plant can manifest non-cognitive, non-ideational, non-imagistic thinking, proponents of the field point out that it is likewise difficult for us to understand what it is like to be a bat or anaconda.[9] Nevertheless, proponents of plant neurobiology argue that we can infer plant sentience from plant behavior, as Marder explains:

> It is possible to infer plant sentience from the fact that plants explore and pursue unevenly distributed resource gradients, assess environmental dangers from biotic and abiotic stressors and gather and constantly update various types of information about their surrounding. (Marder 2012: 1368)

To appreciate the motivation for the view, it is helpful to imagine space explorers arriving at an alien planet and finding organisms unlike anything on earth. These organisms manifest a very different biology than anything we are familiar with on earth. Their behavior is difficult to observe, much less interpret, because they move more slowly or because parts of them are underground. Imagine further that the explorers want to know whether these organisms are intelligent in their own way, and to this end, they use intelligence tests that are used on earth animals on these organisms. To the explorers' surprise, the organisms pass the tests, albeit more slowly and differently than how an animal on earth would pass the tests. While the explorers cannot comprehend how exactly these organisms manifest intelligence on account of differing biology and ambiguous behavior, they nevertheless are provided with some reason for thinking that said organisms are intelligent in their own way. Proponents

[7] I say "cognitive-like" because plants lack neurons.

[8] Anthony Trewavas describes plant intelligence in more positive terms: "a simple definition of plant intelligence can be coined as *adaptively variable growth and development during the lifetime of the individual*" (2003: 92). Michael Pollan reports that Stefano Mancuso defines plant intelligence as "ability to solve problems" (2013). More recently, Trewavas and colleagues define "nonhuman consciousness and sentience...as the capacities to be aware of the environment and to integrate sensory information for purposeful organismal behavior" (2020: 1).

[9] For discussion of "what it is like to be a plant", see Calvo (2017: 216-222).

of plant thinking argue that the same is true of plants, as Trewavas and colleagues explain: "Indicators for the ascription of plant consciousness are the same ones we use for the study of animal-based interactions. To wit, anatomical and morphological traits, (electro)physiological responses, and behavioral/ethological data, among other evidence pools" (2020: 1).[10] Just as the performance of animals in certain studies indicates intelligence, so also the performance of plants in such studies indicates intelligence.

What evidence is there for taking plant neurobiology seriously? What convinces researchers that, in the words of Michael Pollan, there "may exist some brainlike information-processing system to integrate the data and coordinate a plant's behavioral response" (2013). Here are some studies that have been offered in support of plant intelligence:

1. A 2014 study used the same experimental paradigm used to assess learning in animals on the *Mimosa pudica,* a plant whose leaves fold inward when touched (Gagliano et al., 2014). The researchers repeatedly dropped the plant from a relatively short height to see if the plant would come to ignore being dropped. The researchers found that the *Mimosa pudica* did come to reopen its leaves after a short number of drops, which suggests that the plant also comes to learn that the drop is painless.
2. Another 2014 study shows that plants can distinguish predatory insect sounds (caterpillars) from non-predatory insect or wind sounds (Appel and Cocroft, 2014). The authors report that "*Arabidopsis thaliana* plants exposed to chewing vibrations produced greater amounts of chemical defenses in response to subsequent herbivory, and that the plants distinguished chewing vibrations from other environmental vibrations" (2014: 1258).
3. A study of the *Boquilla trifoliolata*, the climbing wood vine, demonstrates its ability to modify the appearance of its leaves to mimic the color, size, shape, and orientation of the host plant (Gianoli and Carrasco-Urra, 2014). Another study demonstrated that *Arabidopsis thaliana* seedlings are able to distinguish their neighbors by recognizing their body shapes (Crepy and Casal, 2015). Both of these studies suggest that plants gather information about and respond to their surrounding (Baluška and Mancuso 2018).
4. Bohm et al. (2016) have demonstrated that the Venus flytrap counts and memorizes electrical pulses from trigger hairs to estimate the nutrient content of prey. Rainer Hedrich and Erwin Neher, in a follow up article, describe the Venus flytrap as manifesting an "animal-like" process by which they make "decisions...based on 'counting' the number of stimulations of sensory organs" (2018:220).
5. Gagliano et al. (2016) and Gagliano (2017) used a classical conditioning paradigm in which a neutral environmental stimulus predicted the occurrence of light on pea seedlings. Both experiments reveal that seedlings are able to acquire learned associations between stimulus and light to guide their behavior.
6. Gagliano et al. (2017) report that *Pisum sativum* "roots were able to locate a water source by sensing the vibrations generated by water moving inside pipes, even in

[10] For fuller discussion of plant neurobiology, see Trewavas (2014) and Mancuso & Viola (2015).

the absence of substrate moisture" (Abstract). This reveals that roots are able to, in some sense, hear water through acoustic vibrations at a distance.

7. A 2014 study of chilli plants (*Capsicum annuum, Solanaceae*) demonstrated that they are able to discriminate between an adult conspecific and a fennel plant, which is inimical to their growth, when common communication channels are blocked. "This demonstrated," the authors write, "that plants were able to sense their neighbours even when all known communication channels are blocked (i.e. light, chemicals and touch) and most importantly, recognise the potential for the interfering presence of a 'bad neighbour' and modify their growth accordingly" (Gagliano and Renton, 2013: 2).

These are just some of the studies that lead biologists Alessandro Pelizzon and Monica Gagliano to confidently assert that "recent research has been able to show that plants exhibit sophisticated abilities to actively perceive, assess, learn, remember, solve problems, make decisions and communicate with each other by acquiring information from their environment, all indicators of human and non-human sentience" (2015: 11). Philosophical defenses of plant consciousness, intelligence, and sentience have been offered by Paco Calvo (2016 & 2017), Chauncey Maher (2017), and Alex Morgan (2019), among others.

What is the moral status of plants, then, if they do enjoy a level of sentience, intelligence, and thought?[11] There would be a morally significant similarity between plants and animals—both manifest sentience and intelligence, and if sentience is morally significant for animals, then it should be morally significant for plants. Some scholars argue that we should afford plants higher moral status than we have hitherto afforded them. Matthew Hall argues that, although plant killing is "not the same" as killing a person, nevertheless "killing plants is still considered to be violent" (2011: 160). The 2008 Swiss Confederation Federal Ethics Committee on Non-Human Biotechnology, in a document titled, *The dignity of living beings with regard to plants: Moral consideration of plants for their own sake*, report unanimous agreement among committee members that "an arbitrary harm caused to plants to be morally impermissible" and a majority agreement that "we require justification to disturb plants' *lives*" (2008: 17 and 20). Some scholars go further than merely claiming that plants have higher moral status than previously thought. These scholars argue that plants have high moral status. For example, the evidence offered in the preceding section suggests to Prudence Gibson and Monica Gagliano that we should raise "the status of plants from sub-species to co-species. This suggests a model of thought where vegetal life is equal to human life" (2017: 130). Anne Stephens and colleagues write that "recent experimental findings [demonstrate] that plants are able to express higher forms of learning and associate events in meaningful ways as one may expect of animals" and that this should lead us to redefine our "narrow and highly anthropocentric definitions" of consciousness and related terms (2019: 4- 5). They go on to argue that we have a moral obligation, grounded in concerns for justice, to consider plants as having moral status equal to human beings, writing:

[11] Lamey (2019: 206) writes, "It is this property of animals, and the related capacities of being able to experience pleasure and pain, which have traditionally been denoted by the term 'sentience.'".

"Taking the sentience of plants seriously requires an ontological shift" in how we envision and engage with plants in order to "realize a full and complete inclusion of their agency on equal terms with human sentience" (2019: 16). Andrew Smith argues that plants manifest more or less the same moral status as humans and other animals, writing: "People can act intentionally and autonomously. They have minds of their own and they use them. These are all characteristics that both plants and animals exhibit" (2016: 53).

Let us not deceive ourselves. This way of thinking about plant sentience and plant moral standing has been subject to scrutiny and remains a disputed position in botany, biology, ecology, and philosophy. Some criticisms are scientific. Lincoln Taiz and colleagues report that some of the studies offered above could not be replicated (2019: 681). Other criticisms are philosophical. Adam Lamey argues that applying learning tests to plants need not suggest that said plants are actually learning: "A more likely explanation is that the action is the result of so-called mechanosensitivity... [M]imosa experiments do not establish that plants have the ability to learn in any sense of the term that presupposes the existence of a mind" (2019: 205). Taiz and colleagues also argue that plants cannot, in principle, be conscious because they lack both a nervous system and brain; they warn readers of the dangers of anthropomorphizing plants (2019: 682-682; 685-686). Alex Hamilton and Justin McBrayer argue that "there is no good reason to think that plants feel anything at all" on the grounds that our traditional ways of knowing whether another creature is sentient do not apply to plants (2020: 73). Lamey argues that, even if plants are intelligent in some sense, they do not manifest sentience, because sentience requires a first-person, conscious awareness of the self as a self. It is this first-person conscious awareness of pain and pleasure that has "traditionally been denoted" by the term 'sentience' (2019:206-207). Even if we grant that plants have some moral status, Lamey suggests that their moral status falls well below the moral status of animals (2019: 208-211). Evidence of this would be that most people would agree that stepping on a lily flower is nowhere near as morally problematic as kicking a puppy.

However, that there is disagreement surrounding plant sentience and moral status does not undermine the precautionary argument for adopting a mixed diet of plants and animals. To better appreciate this point recall that the PV relies on epistemic uncertainty about the moral status of animals, and it regularly motivates claims of uncertainty by appeal to disagreement among scholars.[12] For example, it is because of the persistent disagreement between vegetarians, vegans, and meat-eaters that Matheson writes that "we should suspend judgment about what our evidence supports on this matter" (2016:127). Likewise, there is persistent disagreement about plant intelligence, as Lamey notes: "The criticisms that plant neurobiology has received is a sign of its disputed status among botanists" (2019: 205). The Swiss Confederation Federal Ethics Committee on Non-Human Biotechnology reports:

[12] To be clear, the PV does not need to motivate uncertainty by disagreement. There can be other grounds that motivate uncertainty. One might think we are ill suited to abstract theorizing about complicated matters or that we have an entrenched anthropocentric bias. Both of these apply to theorizing about the moral status of plants and animals.

> Not quite half of the members are doubtful, based on current knowledge, that plants are sentient. Conversely, a small group considers it probable that plants are sentient. A group of equal size considers this question unanswerable on the basis of current knowledge. (2008: 14)

None of us are in a position to confidently assert that plants are not intelligent or sentient. Trewavas and colleagues explain that "there is no reason to exclude the possibility that plants have also evolved their own subjective sense of environmental awareness" (2020:1). Consequently, although there are criticisms of the position that plants think and are sentient in a morally considerable way, it does not seem as though any one is in a position to confidently claim that plants do not possess their own kind of intelligence or sentience and thereby lack moral status.[13]

It is true that the precautionary argument for plants is importantly distinct from the PV.[14] In the case of the PV, the uncertainty for a non-animal-ethicist surrounds the scope of the moral community and whether animals have high enough moral status to render eating them morally wrong. In the case of plants, however, the uncertainty surrounds the supposed sentience of plants; the uncertainty here concerns not the criterion for moral status but rather whether plants meet a (supposed) minimum condition for moral status, i.e., sentience. Most agree that farm animals are sentient but there is immense disagreement whether plants are sentient. There is thus a multiplication of uncertainty in the case of plants that is not present in the case of farm animals: if plants are sentient, it remains to be seen whether they are in the moral community. This difference, while notable, does not undermine the argument but rather highlights it. There are a lot of unknowns when it comes to the (possible) moral status of plants, and there is the possibility that plants have *some* moral status, more so than has been previously recognized. There are plenty of unknowns and that is precisely the point.

Importantly, for present purposes, this new position on plant moral status complicates the PV because it raises the question of the moral status for plants and the possibility of committing moral error by consuming plants. Specifically, it would seem that, in light of the research above, it is epistemically possible that plants enjoy a level of non-human-like sentience and hence *some* moral standing, however slight. I personally would not go so far as to say that plants possibly enjoy human-like moral status, so the claim I am making is modest: plants *may* enjoy higher moral status than previously thought, perhaps moral status akin to insects. Given this moral uncertainty about the moral status of plants, we are confronted with the possibility of committing moral wrong by eating plants, and so, if we limit ourselves to just plants, there is a *precautionary argument for adopting a non-vegetarian diet* (Table 6).

[13] It can also be pointed out that there is persistent disagreement about, not only the moral status of plants, but even the notion of "moral status" itself as philosophers disagree over what qualities or abilities confer moral status. The *Stanford Encyclopedia of Philosophy* entry on "The Grounds of Moral Status" discusses more than seven different accounts of the qualities or abilities that confer moral status (Jaworska and Tannenbaum, 2018).

[14] I would like to thank a reviewer for this observation.

Table 6 Assessment of dietary options given possible plant moral status

Options	Plants have higher than previously thought moral status	Plants do not have higher than previously thought moral status
Traditional diet	Ambiguous moral wrong	Morally permissible
Vegetarian diet	Ambiguous moral wrong	Morally permissible
New omnivorist diet	Least serious moral wrong	Morally permissible

I describe traditional and vegetarian diets as "ambiguous" because the moral status of plants is unclear. If plants have higher moral status than previously thought in virtue of being sentient *in some sense*, then it is wrong to adopt a traditional diet and a vegetarian diet because both involve intensive agricultural production. Plants feed either humans and animals, or just humans, and either way, lots of plants are harmed. A new omnivorist diet would seem to involve overall less plant harm because it incorporates some animal protein and some plants.

Of course human beings have to eat and they can either eat plants or eat animals. When we combine the two precautionary arguments, the end result tips the scale in favor of a new omnivorist diet however slightly for a non-animal-ethicist. In other words, when we factor in our current moral uncertainty regarding animals *and* plants, we get the following decision-matrix (Table 7).

When non-animal-ethicists are uncertain about the moral status of animals, the decision-matrix leaves us undecided between a vegetarian diet and a new omnivorist diet. But when uncertainty about the moral status of plants is factored in, however, the scales tip however slightly in favor of adopting a new omnivorist diet, for the simple reason that a vegetarian diet would result in more plant harm than a new omnivorist would. Adopting roadkill or harmless-to-animals *in vitro* or cultured animal protein, for example, would lower the amount of animals and plants harmed in the production of a vegetarian diet. Thus, given our epistemic uncertainty regarding the moral status of animals and plants, non-animal-ethicists should err on the side of caution and adopt a new omnivorist diet of some non-traditional animals and plants.

Table 7 New omnivore assessment of dietary options given possible plant moral status and animal harm

Options	Plants have higher than previously thought moral status	Plants do not have higher than previously thought moral status	Animals have high moral status	Animals do not have high moral status
Traditional diet	Ambiguous moral wrong	Morally permissible	Serious moral wrong	Morally permissible
Vegetarian diet	Ambiguous moral wrong	Morally permissible	Less serious moral wrong	Morally permissible
New omnivorist diet	Least serious moral wrong	Morally permissible	Less serious moral wrong	Morally permissible

6 Conclusion

I conclude that the PV does not establish its intended conclusion, namely, that in light of a non-animal ethicists' uncertainty regarding the moral status of animals they should adopt a vegetarian diet. The PV shows, at best, that one *may* adopt a vegetarian diet or a new omnivorist diet. However, when we factor in research suggesting plant sentience into the equation, then, in light of moral uncertainty about plants and moral uncertainty about animals, non-animal-ethicists should adopt a new omnivorist diet when feasible.[15]

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