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Sign Systems and Shared Worlds: Nonhuman Communication, Collective Knowledge and Epistemic Justice in Contemporary Speculative Fiction

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Abstract

Contemporary speculative fiction unsettles anthropocentric assumptions about language, intelligence and the production of knowledge. This article compares Laline Paull's The Bees (2014) to Ray Nayler's The *Mountain* in the Sea (2022) and The *Tusks* of Extinction (2024), exploring how the novels represent the conditions under which non-human knowledge is produced, recognized and transmitted. Drawing on biosemiotics and critical posthumanism in conversation with Andrew Lopez's account of epistemic injustice towards non-human animals, it develops a comparative framework based on recognition, access and continuity. The key argument is that the novels depict epistemic harm not merely as a failure to interpret non-human signs but as the institutional restriction of the very environments and social relations through which practical knowledge can flow. In Paull's hive caste is the source of authority which controls access to sensory information; in Nayler's oceanic enclave corporate power turns scientific attention into a potential tool of appropriation; and in the de-extinction narrative, biological restoration is simply not enough without the recovery of the skills that are socially transmitted. The novels are not being read as descriptions of actual animal species. Rather they are being used as a lens through which to examine the political and ethical dimensions of human authority over other ways of knowing. The article makes a contribution to contemporary literary studies by linking multispecies representation to the distribution and preservation of epistemic goods.

Keywords: *Biosemiotics; critical posthumanism; epistemic injustice; nonhuman communication; collective knowledge; multispecies justice; contemporary speculative fiction*

1. Introduction

In many of the major Western philosophical traditions articulate human speech has been the paradigm of rationality. Literary animals have thus been used as stand-ins for human behavior or as figures whose meaning is derived from their similarity to humans. Animal studies, the environmental humanities and posthumanist criticism all challenge that hierarchy by asking how literature might represent forms of perception and modes of communication that are not predicated on human language. Contemporary speculative fiction is particularly useful

in this respect as it can present us with alien perceptual worlds alongside the political systems that are set up to deal with them.

Laline Paull's The Bees (2014), Ray Nayler's The *Mountain* in the Sea (2022) and Nayler's novella The *Tusks* of Extinction (2024) all form a very useful comparative corpus. In each case knowledge is dependent on the relationships between organisms, communities and habitats. In The Bees Flora 717's movement through the hive reveals a society in which chemical signals, vibration and choreographed movement co-exist with a very clear hierarchy. In The *Mountain* in the Sea marine biologist Ha Nguyen is studying an octopus population whose visual displays appear to be symbolic in nature, while the corporation that owns the research site has interests which go well beyond the acquisition of scientific knowledge. In The Tusks of Extinction, the problem of mammoth resurrection is that genetic restoration in itself cannot restore the social learning and practical knowledge which would be required for the group to survive.

The article poses two interlocking questions. How do these narratives represent non-human sign systems and the collective practices through which knowledge becomes knowable? And how do institutions, commercial interests and ecological disruption determine the conditions under which such knowledge can be accessed, interpreted and transmitted? The contention is that the novels exemplify epistemic harm at three interrelated levels: the erasure of the significance of non-human meaning making, the restriction of access to information and to experience of the environment and the rupture of the transmission of knowledge across generations. These are not mutually exclusive levels of analysis but rather analytical foci which become apparent in different ways in the three texts.

The article's contribution is comparative rather than a claim to have discovered non-human communication as a new field of literary study. There is already a body of work on animal signification, Paull's ecocritical concerns and biosemiotics readings of Nayler. Pavithra R. and S. Mahadevan read The Bees alongside Paull's Pod through an ecocritical lens (Pavithra R. and Mahadevan 2731–37); Yogi Hale Hendlin's 2026 review and interview of The *Mountain* in the Sea engages with the work in the context of biosemiotics fiction and makes a brief connection between Nayler's later novella and species culture (Hendlin; Pla Ángel 60–62). This study takes a different approach: it positions Paull's hive and Nayler's oceanic and mammoth communities in a single comparative argument about the governance of knowledge. It is not just a question of whether non-human signs can be read, but rather who governs the conditions of knowledge circulation and whether those conditions can be sustained.

The article begins by surveying the relevant scholarship and methodology, then goes on to analyze each of the primary texts before comparing the institutional and ecological contexts in which non-human knowledge is circulated.

2. Scholarship and Research Context

Zoosemiotics and biosemiotics provide the vocabulary for looking at communication outside of human language. Thomas A. Sebeok was instrumental in establishing the study of

signification and communication between animal species (Sebeok 77-86). Jakob von Uexküll's concept of Umwelt is also very important here: an organism experiences a meaningful world which is structured by its own sensory modalities and its practical relations to the world, rather than a world which is simply available to it in a neutral way (von Uexküll 61-76). The same environment can therefore present quite different signs and opportunities to different organisms. Umwelt doesn't simply mean habitat; it's a way of focusing on the organism's selective relation to its environment.

Kull and Torop's account of biotranslation is useful in that it presents translation between Umwelten as a complicated process rather than a simple case of code for code (Kull and Torop 411-26). It's an account which helps us to understand why a human observer might be able to identify a pattern in the behavior of an animal without in any way possessing the animal's own experience of that pattern. Leatherland's study of language and communication in animal fantasy is equally useful in that it shows how the use of fictional animal languages and forms of communication can reveal the limits of our own linguistic assumptions (Leatherland 101-30). It is not a reading of Paull's novel; it's a more general account of the way in which animal languages and animal forms of communication in the literary sense can complicate the human/non-human divide.

Critical posthumanism brings a political and ethical dimension to this semiotic account. Rosi Braidotti challenges the very idea of the autonomous humanist subject as the sole measure of agency, while Donna Haraway's work on multispecies relations argues that beings become through their relations rather than as discrete units (Braidotti 61; Haraway 30, 58-61). This is obviously of value when it comes to reading speculative fiction as it means we need to be wary of treating non-human characters simply as human minds in animal bodies. It also means we have to be attentive to the representational limits of the narrative: a novel can certainly prompt the reader to imagine another kind of perceptual world; it can't give us unmediated access to the actual consciousness of an animal.

The scholarship on the texts in question is rather patchy. Pavithra R. and S. Mahadevan (2025) have a paper in the journal which looks at The Bees and Paull's Pod with a view to ecocritical subversion and the persistence of anthropocentric hierarchies (2731-37). Hendlin (2026) has a review and interview which proposes the term "biosemiotics fiction" to describe the kind of speculative fiction in which sign relations and the difficulty of translation are themselves ethically significant; it's The Mountain in the Sea that is the primary focus of the piece, with a brief mention of The *Tusks* of Extinction (Hendlin). There's also a 2026 review of the novella which highlights its preoccupation with cultural and generational restoration (Pla Ángel 60-62). It's simply not possible to say that Paull's or Nayler's treatment of non-human communication has been ignored. What this paper seeks to do is provide a comparative account of the ways in which knowledge is governed within and between non-human communities, using the concept of epistemic injustice to link up the semiotic with the institutional.

Miranda Fricker's account of epistemic injustice provides another useful point of departure (though it has to be used with care). Her two main categories of injustice (testimonial and hermeneutical injustice) were developed to account for harms that occur in human

epistemic relations (Fricker 1, 28, 147-75). Lopez goes further and argues that non-human animals can also be victims of epistemic injustice when human intervention results in their being deprived of epistemic goods (Lopez 154-55). His focus on know-how is particularly pertinent to The *Tusks* of Extinction where the loss of know-how in the form of socially transmitted practices is a direct threat to survival. It also provides a useful bridge between the communication systems in the other novels and the issues of access and practical agency.

3. Method and Scope

This is a qualitative comparative close reading. The texts were selected because each one foregrounds a different mode of non-human knowledge: the hive's chemical and choreographic communication in The Bees; the octopuses' visual displays and the way they are interpreted by humans in The *Mountain* in the Sea; and memory, social learning and ecological survival in The *Tusks* of Extinction. It's a comparison at the thematic and conceptual level, not a claim that bees, octopuses and mammoths have the same kind of cognitive or social system.

The analysis is concerned with sensory description, focalization, information exchange, institutional control and intergenerational learning. It makes a clear distinction between fictional systems (the ones constructed by Paull and Nayler) and actual claims about animal behavior. The symbolic communication in The *Mountain* in the Sea is a fiction, not evidence that octopuses in reality use symbolic language in any human-like fashion. Farley's interview provides the context for Nayler's account of cephalopod display. The only relevant scientific context available for octopus embodiment and nervous system organization is that provided by Godfrey-Smith and the relevant ethology (Gutnick et al. 4322–27.e3).

The method has two drawbacks. Literary depictions of non-human experience are always mediated through human language and genre. Recognition, access and continuity are all interpretive concepts rather than an empirical classification of animal knowledge or animal welfare.

4. Theoretical Framework: Signs, Relational Subjectivity and Epistemic Goods

Biosemiotics is the framework for the article's account of signification. For Uexküll, Umwelt is the world of significance which is available to an organism via its sensory and active capacities (von Uexküll 61-76). A gradient of scent, a vibration, a movement or a change of color might be a significant signal in the world of one organism and not at all in the world of another. It's not just a synonym for habitat. It's a way of thinking about the organism's selective relationship to its world. In the context of literary analysis, it's a way of identifying how a text constructs a non-human world of significance and how the human characters in the text attempt to make sense of it.

Sebeok's zoosemiotics of course goes further than that in challenging the idea that sign processes are purely the province of human language. Von Frisch's work on the honeybee waggle dance is a classic example of the transmission of spatial information via patterned movement (von Frisch 141-56). Paull's novel is very much in the spirit of that ethological work,

but it takes it a stage further by making the hive into a fictional political order. The critic has to be very careful to separate the biological reality from the novel's own construction. The dance in *The Bees* is not just a sign of animal communication; it is also a narrative device which enables information to be made into something which is shared and which can be acted upon.

Kull and Torop's concept of biotranslation neatly defines the boundaries of cross-species interpretation. Translation from one Umwelt to another is not simply a neutral transfer from one stable code to another. The interpreter has to select, reconstruct and in some cases misread what is presented. This is particularly pertinent in The *Mountain* in the Sea where scientific observation does not in any way guarantee that we get to the full experience of the octopus. It's equally relevant to the other novels in that the reader of the hive and the mammoth worlds is presented with those worlds through a literary medium which makes them in some way intelligible but also preserves their otherness.

Critical posthumanism stops the analysis simply treating human cognition as the ultimate benchmark against which all other forms of life are to be assessed. Braidotti's relational account of subjectivity and Haraway's notion of multispecies becoming both provide a basis for a reading which sees agency as arising out of the relations between bodies, technologies, institutions and environments (Braidotti 61; Haraway 30, 58-61). It is not necessary for the critic to assert that all forms of life have the same kind of consciousness. Rather it is a call for attention to the specific relations which make different forms of life possible.

The last theoretical element is epistemic injustice. Fricker's account demonstrates how power can impact a subject's status as a knower and the common resources through which experience becomes intelligible. The categories of testimonial and hermeneutical injustice of course cannot be just slotted in to the case of fictional animals as if they were human speakers. Lopez's argument provides a more nuanced bridge: non-human animals can be epistemically harmed when human action prevents them from accessing information in their environment, engaging in social learning and acquiring the practical skills they need. The harm need not be that the animal's testimony is disbelieved; it could simply be that the animal is prevented from learning what it needs to learn to get on with its life (Lopez 154-55).

Building on Lopez's distinction the paper employs three analytical dimensions. Recognition asks whether non-human sign systems and forms of know-how are recognized as meaningful rather than simply dismissed as noise or instinct. Access is about whether organisms have the social, spatial and environmental opportunities to acquire and use knowledge. Continuity is about whether there is the capacity for the transmission of learned practices and collective memory across generations. The three dimensions are interrelated: a community's knowledge may be recognized in principle while access to the relevant habitat is in fact denied; a population may be re-established in a biological sense while its intergenerational knowledge is entirely broken. The framework makes these relationships visible without of course reducing non-human experience to a human epistemic category.

5. Chemical Communication, Caste and Access in *The Bees*

The Bees build their hive as a highly structured social world in which communication is achieved through scent, vibration, movement and bodily capacity. Flora 717 starts at the very

bottom of the hierarchy, doing the sanitation work and regarded as odd because she has capacities that don't fit with the profile of someone in her position. Her ability to speak and to do things that are outside of her role enables her to get into areas of the hive that would otherwise be off-limits. Thus, the central conflict is not simply one of individual versus collective, but of the collective knowledge of the hive against the authorities who determine who can have access to it.

Paull's depiction of the hive's chemical environment gives communication a material and political dimension. When Flora is exposed to the Queen's Love the comb becomes legible to her as an organized field of information. The scene implies that the hive's architecture is not simply a container but is in fact a medium through which the colony can store, circulate and regulate signals. The knowledge that Flora begins to perceive is not freely available however. Sister Sage's reaction to Flora's understanding makes it clear that the hierarchy is predicated on the restriction of knowledge for the lower ranks. The injunction that knowledge will cause pain to Flora's kin makes ignorance a policy rather than a natural constraint (Paull 10).

The colony's repeated obedience formula is the way the hive's political order is encoded as bodily discipline. The power of it lies in the internalization of authority rather than in the rule itself. Obedience is not just a rule that is imposed from outside. It's an affective and somatic orientation. The priestesses have the advantage in that they control the scent and have access to the comb as a source of information. They can read the signals and they can control the movement of the hive. The others in the colony are simply reliant on the fact that the hierarchy will decide to pass on the information. That's the sense in which Paull's hive is a fictional model of epistemic exclusion within a society that is otherwise extremely communicative. (Paull 10).

The novel's treatment of the waggle dance throws this hierarchy into question. The foragers' movements are the means by which information about the location of the resources is transmitted. The knowledge is thus made available via a practice of the body. Paull's scene in the Dance Hall is important in that the knowledge is not in the possession of a single authoritative speaker. It is produced and interpreted in the relation between the returning forager, the bees who are watching, the spatial organization of the hive and the external landscape. Von Frisch's work on the waggle dance provides the ethological underpinning for this, though we must be careful not to mistake the novel's political allegory for an accurate depiction of honeybee social institutions (Paull 88-89; von Frisch 141-56).

The contrast between the priestesses and the foragers is all about access. The priestesses have a monopoly on interpretation and restrict movement. The foragers on the other hand show how practical knowledge is contingent on participation in a shared world. Flora's interactions with the foragers broaden her understanding of the colony well beyond the official hierarchy. Her exposure to the world outside the hive also throws into question the notion that the colony's rules are all there is to bee life. "Variation is not the same as deformity" is a crucial phrase here in that it directly challenges the ideological equation of difference with disorder (Paull 16). Flora's bodily difference is what allows the narrative to challenge the social order which claims to be preserving the hive by insisting on uniformity.

A posthumanist reading has to accept the novel's anthropomorphic structure. The caste system, the priesthood, the control over reproduction is all very much in the realm of human political institutions. That analogy is very useful in terms of making the violence of hierarchy palpable, but it can also make the bee world seem rather too easily readable through the categories of the human. The point isn't to reject the novel for using that analogy, it's to recognize that our access to the non-human world is necessarily mediated by the form of the human narrative. The Bees is most productive as a piece of speculative fiction about the way communication can lead to the creation of collective knowledge and the way institutional power can in fact work to suppress that.

6. Symbolic Possibility, Scientific Access and Corporate Power in The *Mountain* in the Sea

The *Mountain* in the Sea shifts the question of epistemic authority from the internal hierarchy of the hive to the boundary between human institutions and a non-human community. Dr Ha Nguyen is brought in to look at an octopus population off the Con Dao archipelago in Vietnam. The site is controlled by DIANIMA, a tech company which has effectively sealed it off and is restricting access. The company's interest in the scientific investigation is inextricably linked to its interest in the potential technological and commercial value of non-human intelligence. The novel is therefore asking whether the recognition of another species' capacity for communication can occur within an institutional framework in which knowledge is treated as a commodity.

The octopuses' changing skin displays are the key speculative image of communication in the novel. Nayler takes real cephalopod display behavior and turns it into a fictional system whose very pattern of repetition is designed to make the human observer think about the possibility of symbolic use. Farley's interview with Nayler is very useful in separating the biological basis from the literary construction: the novel is taking a real repertoire of bodily display and making it into a speculative form of communication (Farley). It by no means establishes that octopuses in reality have the symbolic language that is imagined in the novel. What it does is use that possibility to interrogate the assumptions we make about what counts as communication and what counts as culture.

The issue of recognition is therefore far more complicated than the simple question of whether octopuses are intelligent. Ha's work requires her to interpret patterns generated by organisms whose bodies and sensory apparatuses are very different from her own. The work on octopus nervous system organization does suggest that there is a degree of control and sensory processing that occurs in both the central and the peripheral nervous system; that scientific background is crucial in preventing the literary analysis from simply imagining the octopus as a human mind operating through an alien body (Gutnick et al. 4322–27.e3). All the same, the fictional communication system of the novel is still a construction. The divide between empirical biology and speculative symbolism has to be kept open.

Ha's ethical stance emerges from the simple fact that the octopuses aren't there for the sake of human research. Her work only has any merit if it recognizes the octopuses as having their own interests and that their signs may not be fully accessible to us. The novel is very much concerned with communication as an encounter between two very different worlds and so translation is an ethical as much as a technical issue. To interpret another species is to run the risk of appropriating their signs, particularly when you are the interpreter in a research context where you are working for an institution which has control over the site and the research. The novel's insistence on the octopuses' autonomy is not a rejection of science per se; it is a direct challenge to the notion that science gives you ownership (Nayler, Mountain 301).

DIANIMA's control of the archipelago makes this issue even more acute. By enclosing the research environment, they dictate who can observe the octopuses, what questions can be asked and who benefits from the results. The very same apparatus that enables intensive observation also enables surveillance and extraction. Scientific access is thus clearly a politically organized process. The octopuses can be made legible to the researchers whilst remaining vulnerable to a system which treats their intelligence as a source of proprietary value. Recognition without protection can thus be another form of appropriation (Nayler, Mountain 176).

The broader narrative of the novel (its treatment of AI and of the exploitation of human labor) situates the octopus research within a political economy which reduces all forms of life to a set of manageable resources. The experiences are of course not the same and the novel by no means erases the difference between the exploitation of humans and the vulnerability of non-humans. What it does do is reveal an institutional logic in which the capacity to know or to control another being becomes a source of economic advantage. The issue is not simply whether the octopuses' signs can be read, but whether the conditions of their lives and their communications remain under their own control.

Hendlin's 2026 review and interview is a very useful recent account of the novel's biosemiotics concerns in particular its resistance to the fantasy of total translation. The present reading builds on that context but moves the emphasis from genre and the limits of translation to the question of access. DIANIMA's enclosure is a clear example of the fact that the recognition of nonhuman signification can co-exist with the denial of nonhuman agency. The novel thus shows that recognition is inextricably bound up with the institutional arrangements through which research is conducted (Hendlin).

7. De-Extinction, Social Learning and Continuity in The *Tusks* of Extinction

The *Tusks* of Extinction moves from the consideration of a living non-human community to the attempt to reconstitute a species whose social and ecological relations have been utterly shattered. It's a story of the resurrection of the woolly mammoth via genetic engineering, but the resulting animals have no accumulated practices through which a herd would learn to forage, to move, to protect its young, to respond to the environment. The point

of the story is that the mere existence of bodies doesn't necessarily mean that the relations which make a population viable are restored.

The consciousness of Dr Khismatullina (an elephant behavior specialist) is digitized and uploaded into a mammoth. As matriarch of the herd, she gives the herd access to a vast store of human knowledge about elephant behavior. The narrative doesn't at all present this as a straightforward fix. She has to go through the experience of being in a completely different sensory and bodily world and the knowledge she possesses is transformed by that experience. The very first section of the novel is all about smell, bodily orientation and social memory, making it clear that cognition is inextricably bound up in the material body of the organism and its environment (Nayler, *Tusks* 1). The transfer of a human mind into a mammoth cannot be understood as the simple act of inserting a body of information into a blank vessel.

The central problem of the novella is intergenerational continuity. Mammoth behavior is not simply a matter of genetic inheritance. Practical skills are learnt through observation, imitation, correction and participation in the herd. The absence of older animals breaks the social pathways through which such knowledge is normally acquired. The crisis that results is very much the form of epistemic harm that Lopez describes. When human activity disrupts animal lifeways it can deprive animals of the very opportunities to learn the information and skills that would enable them to cope (Lopez 154-55). In Nayler's imagined future extinction has not just wiped out the individual animals but the social conditions through which a way of life could have been transmitted.

The treatment of memory in the novella further complicates the relationship between knowledge and continuity. Damira's human memories are not simply left intact in the mammoth body into which they have been transplanted. They are affected by smell, by movement, by the demands of her life. The narrative therefore actively resists any notion of memory as purely archival. Knowledge is not simply stored information that can be retrieved in its original form; it is also a capacity which is developed through the repeated process of bodily and social engagement. The reflection on memory and the future at the end of the novella makes this quite clear (Nayler, *Tusks* 80).

The economic structure of the de-extinction project is in itself a second problem. The mammoths are being brought back within a corporate framework in which conservation is seen as being perfectly compatible with commercial exploitation. The very possibility of trophy hunting underlines the contradiction between the preservation of a species and the very act of making its bodies available as commodities. Damira's observation that the elephants are an 'extraction zone' links the speculative future of the novella directly to the histories of ivory extraction and the conversion of the living into a resource (Nayler, Tusks 56). The significance of that phrase is that it brings the physical harm of extraction into conjunction with the destruction of the habitat and the loss of the collective knowledge.

The novella doesn't simply present a neat case for human intervention. Damira's expertise is absolutely vital to the herd's recovery and in that sense, she is the key to the whole thing. The danger is that it reinforces the notion that human knowledge is the ultimate authority

over the survival of the non-human. The story subverts that by making Damira's knowledge contingent upon the mammoth's body and upon the herd's responses. It's not simply a case of a human expert teaching the animals. What we have is a process of knowledge being transformed through the process of interspecies embodiment and social practice. That doesn't get rid of the ethical imbalance of the experiment per se, it just means the story doesn't present human technology as a complete substitute for ecological continuity.

The Tusks of Extinction is the most sustained expression of continuity. The restoration of genetic material in itself will not restore the social relations, the environmental familiarity and the learned behaviors that have been lost. The novella therefore offers a potent challenge to a very narrow conception of de-extinction. It's not simply a question of whether we can bring a species back. It's a question of whether we can also rebuild the conditions that allow a community to teach, to remember and to adapt. The question of justice is then a question of what we owe to the forms of life whose worlds we have damaged.

8. Comparative Discussion: Recognition, Access and Continuity

Placed in dialogue the three works map out very different but related forms of epistemic disruption. The Bees is a community whose communication is governed by the authority of caste. The *Mountain* in the Sea is a non-human community whose signs are the object of scientific interest within a corporate enclosure. The *Tusks* of Extinction is a population whose very survival is at risk should the social learning processes be disrupted even after the biological restoration has been achieved. In all three cases the conditions of knowledge are a product of institutional and environmental structures rather than of individual cognition.

Recognition is most obvious in The Mountain in the Sea where the human research team have to make the decision as to whether the octopus displays should be regarded as meaningful and whether the octopuses themselves should be approached as subjects with interests. It's also very much at play in The Bees where Flora's difference is read as either a threat or as a capacity depending on the authority making the judgement. In The Tusks of Extinction, the need of the resurrected mammoths for social knowledge is a challenge to the notion that a species can be fully represented by its DNA. Recognition in this wider sense is about recognizing forms of knowledge which lie outside the categories through which human institutions normally value life (Nayler, Mountain 176).

Access is absolutely central to both The Bees and The Mountain in the Sea. In Paull's hive access to the comb information and to various parts of the hive is highly unequal. The forager's dance is the paradigm of knowledge as something which is only useful through participation, but the priestesses' control of the hive is the paradigm of knowledge as something which can be withheld through hierarchy. In Nayler's novel DIANIMA has complete control of the site and of the conditions of the research. The enclosure enables the observation of the community while at the same time restricting the community's autonomy. These are both examples of access not being simply the availability of data, but the ability to move about, to participate in, to interpret and to act in the shared world (Paull 88-89; Nayler, Mountain 176).

Continuity is most obviously evident in The Tusks of Extinction where the loss of the elders effectively breaks the transmission of practical knowledge. It's equally important in the other novels though. The hive's collective memory is built on repeated practice and the use of shared signals. The octopus community's symbolic behavior is indicative of meanings which have been developed through interaction over time. Continuity is therefore not just a mammoth thing. It can be disrupted by extinction, by enclosure, by censorship or by the destruction of the environment in which learning takes place (Nayler, Tusks 80).

The comparative framework can be summarized as follows:

Table 1: *Comparative emphases across the three primary texts*

Primary text	**Knowledge/sign system**	**Dominant epistemic pressure**	**Analytical emphasis**
Paull, The Bees	Chemical signals, comb vibration, waggle dance	Caste authority restricts interpretation and movement	Access, with recognition also at stake
Nayler, The Mountain in the Sea	Fictional visual-symbolic displays and embodied communication	Corporate enclosure and appropriation of research knowledge	Recognition and access
Nayler, The Tusks of Extinction	Olfactory perception, memory, herd learning	Extinction and de-extinction disrupt social transmission	Continuity, with access also at stake

Note: these categories identify the dominant analytical pressures rather than being mutually exclusive classifications; recognition, access and continuity all overlap in any given work.

9. Conclusion

The reading of The Bees, The *Mountain* in the Sea and The *Tusks* of Extinction side by side demonstrates how contemporary speculative fiction in fact undermines the notion that knowledge of any kind is predicated on human speech or on human standards of cognition. Paull and Nayler both imagine very different non-human sign systems and social forms and they also show those systems being subjected to the pressures of hierarchy, corporate control, ecological collapse and extinction. The point is that knowledge is made visible as a relational achievement: it is the product of bodies, of environments, of communities and of opportunities for learning.

By bringing biosemiotics into conversation with critical posthumanism and Lopez's account of non-human epistemic injustice, the paper has proposed recognition, access and continuity as three inter-related dimensions of comparative literary analysis. It by no means claims that non-human animals experience injustice in the same way as human speakers, nor does it assume that the societies of fictional animals transparently reflect biological reality. Its

value is in showing how literary texts imagine the conditions under which non-human know-how might be recognized, accessed and transmitted.

The article moves the focus away from the question of whether we can fully translate the signs of the non-human into the institutional and ecological conditions which govern the lives of the sign-users. Scientific interpretation may be required, but that in itself doesn't guarantee autonomy. Biological restoration may be possible, but that in no way guarantees the restoration of cultural and ecological relations. The ethical challenge posed by these novels is not that we should go out and make every non-human world fully legible to the human observer. The challenge is to acknowledge that other forms of life are in a position to have meaningful relations and to possess practical knowledge which is not something we can just afford to lose.

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