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01 — A digital model of a large old tree – colours indicate branches preferred by birds. Such modelling can help landscape architects design for and with nonhuman lifeforms. Image: Stanislav Roudavski and Alexander Holland.

# Tree designers and bird clients

**Using more-than-human design as a theoretical framework and artificial habitats for arboreal wildlife as a case study, Deep Design Lab explores approaches for better inclusion of nonhuman contributions.**

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**Text** Stanislav Roudavski and Alexander Holland

Human redesign of landscapes often leads to dramatic losses. These losses are grossly unfair, with some suffering more than others. The harms are often inversely proportionate to societal power, with nonhuman lifeforms at the worst disadvantage. In response, this article reconsiders design as a communal activity that is not unique to humans. All lifeforms including plants, animals, and bacteria can self-design, affect others, act as niche constructors and ecosystem engineers. Human-driven design can produce huge effects but remains a component within this picture.

Seeking ways to co-design with all life, we advocate greater powers for nonhuman designers. Let us tackle this idea in three parts. We first mention the current efforts to cater for nonhuman lifeforms, which are commendable but insufficient. Next, we provide alternative steps of participation that introduce a journey toward designing with interspecies communities. Finally, we describe a concrete example that follows these steps in practice.

**Designing for non-human beings**

The interest in green design is growing but most current practices entrust improvements to human experts. Sustainable development, ecosystem services and nature-based solutions are openly human-centric. Bioinspiration, rewilding, and ecological engineering ascribe greater value to self-organizing capabilities of "natural systems" but still refer to humans for key decisions. Unfortunately, the human track record is poor. Food, pests, parasites, and invasive species exemplify some of the labels that humans use to justify intentional damage. Inadvertent harms of design are even greater. For example, many forms of human construction stifle evolved cultures and behaviours, destroying complex mutualisms. In a reverse move, human suppression of some lifeforms – through poisoning or physical expulsion – results in accelerated emergence of dangerous traits. Resulting wrongs affects all beings, human or nonhuman.

To resist the arrogance and biases of human design, let us acknowledge that nonhuman beings can act as capable participants in the construction of the future. It is not fair to treat them as enemies, resources, or hapless clients.

**Steps of participation**

To indicate an alternative, we introduce steps of more-than-human participation that rethink Sherry Arnstein's framework for collaboration within human collectives. Horizontal elements of each step represent relationships within more-than-human communities. The vertical parts are actions that enable greater inclusion. We begin from the top. This end privileges humans by seeing their sentience, cognition and reasoning as unique abilities that entitle them to sit in unobstructed judgement. From here, the steps descend to the bottom, where consideration is afforded to all beings, without prejudice.

The first step is that of acknowledgement. A common attitude of powerful humans toward weak minorities is that of paternalism. Here, humans decide what is best for trees and birds. A willingness to acknowledge the capabilities of others is a necessary step in more-than human design and can lead to recognition of needs and capabilities. In our work, artificial-intelligence feature recognition exemplifies this step by accounting for habitat properties that humans cannot perceive.

The next riser of empathy leads from recognition to solidarity. Here, humans can foster compassion towards nonhuman lifeforms through appeals to commonalities such as motherhood or sentience. The use of modelling to represent nonhuman subjectivities supports this step in our practice.

Human empathy is important but not sufficient. "Nothing about us without us" is a well-known slogan of many minorities.[1] It emphasizes the need to involve affected stakeholders in all impacting decisions. What is true for ethnicity-based or disability-based marginalization within human communities also applies to more-than-human collectives. We argue that nonhuman agents should be empowered to pursue their own interests in


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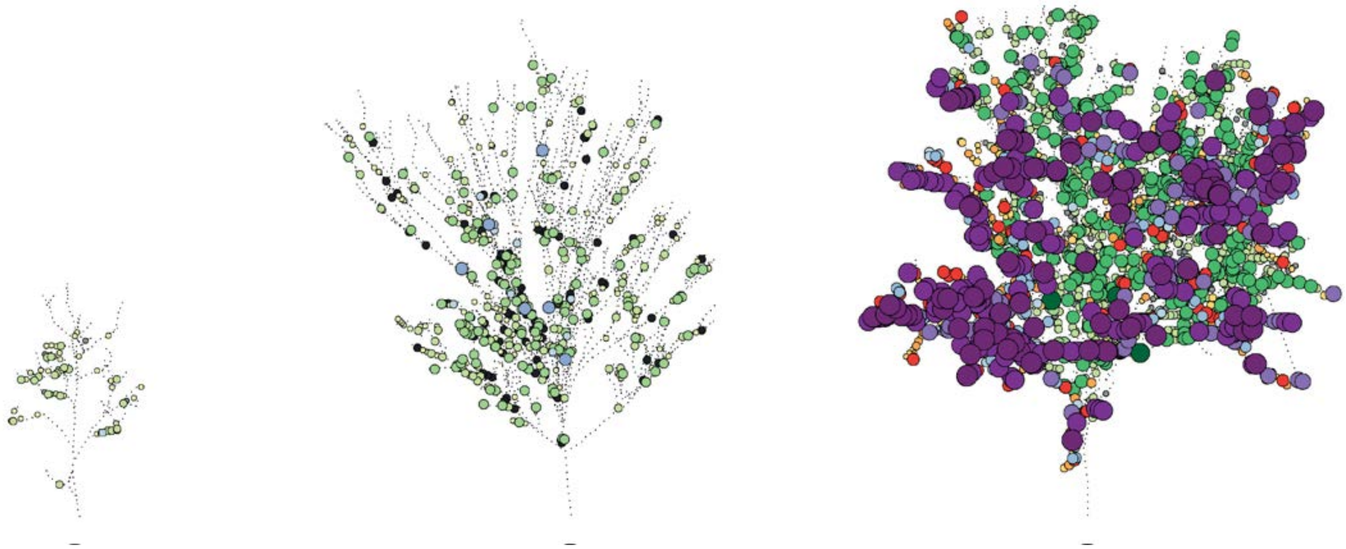
design situations, leading from solidarity to autonomy. Here, our example is the ability of digital data to represent individual histories of complex beings such as trees. Resulting information can support ongoing efforts to understand capabilities of plants and defend their rights for movement, communication, and procreation. History demonstrates that political empowerment of minorities is necessary to support the entitlements to safe labour, intellectual property, health, and wellbeing that many nonhuman beings have yet to receive.[2]

Individual autonomy can imply selfish competition, or "nature red in tooth and claw."[3] This interpretation is contradictory to the current state of knowledge about complex relationships within ecosystems. In response, this step of the stair promotes care as an attitude that can support stakeholder interests in ways that account for the needs and preferences of others, leading from autonomy to conviviality. One example of care in our practice is the use of dynamic computational models to simulate relationships within more-than-human communities, at landscape scales and for durations that encompass several generations of trees.

Finally, caring relationships within empowered communities are of little consequence unless they can persist. Here, human time scales are clearly insufficient. Impacts on biological and geological systems occur both faster (in microbial evolution) and slower (in forest formation) than humans can experience. Persistence of relationships converts conviviality to commoning—an attitude with inclusive, interspecies, and ecocentric aspirations.[4] Our work illustrates this step via artificial-intelligence modelling of habitat interaction, as we briefly discuss below.

**For birds by trees**

Deep Design Lab is an interdisciplinary research and design group that links



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many people and organizations. Founded by Stanislav Roudavski, the collective aims to design for and with all life. Its projects investigate interspecies cultures,[5] replacement homes for arboreal wildlife,[6] heritage of plants,[7] examples of living infrastructure,[8] and artificial intelligence for habitat replication.[9]

Let us describe our project that strives towards the more inclusive steps described above. The project in question emerged when humans sought to "offset" the harm caused by new housing developments by revitalizing a degraded hill. Birds exist on the periphery of this site but struggle because they depend on large trees that are increasingly rare.
In recent years, humans have planted many thousands of new seedlings. However, these trees will be too small to provide avian homes before they enter old age, hundreds of years from now. Artificial replacements might help, but what is a good design for an artificial tree? Our approach is to ask birds and trees. Trees design and make the homes that birds select and use. Birds know what they need and – if so empowered – can guide the design.

Following this logic, we first model the suitability of each branch, as experienced by birds. To do this, we gather high-resolution data about geometries of tree canopies and use machine learning to recognize branches. This operation describes trees with much greater fidelity than that which is attainable via unassisted observations by humans.

We correlate these digital models with field observations. From them, we know that birds prefer to land and perch on dead and exposed branches. Our modelling can quantify spatial distributions of bird preferences, making them useful in design. The proactive part of our workflow uses this information to make innovations flow from trees, through machines, to birds.

Generative design can automatically define a broad variety of patterns. Our numerical

02 — New houses border a degraded hill. Sites such as these can benefit from the installation of artificial trees to supply habitat features that newly planted trees will not be able to provide for hundreds of years. Photo: Stanislav Roudavski and Alexander Holland

03 — Features birds find meaningful include exposed dead branches (highlighted in purple) and lateral branches (highlighted in green). The older tree on the right has many more suitable branches than the younger trees on the left. Image: Stanislav Roudavski and Alexander Holland

Step 1 (Structure to Data)

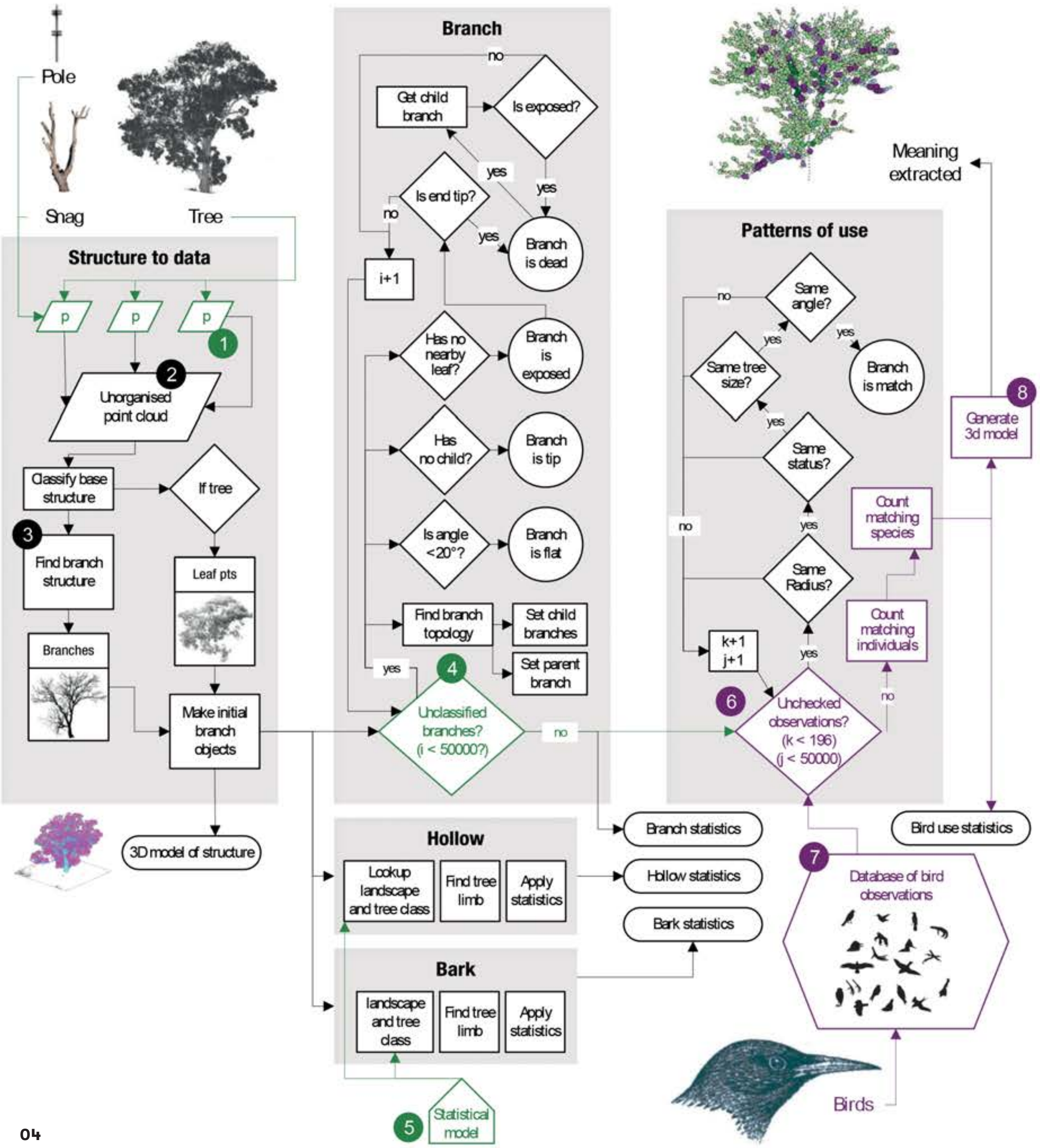
Scan structure and convert to organised branch objects.

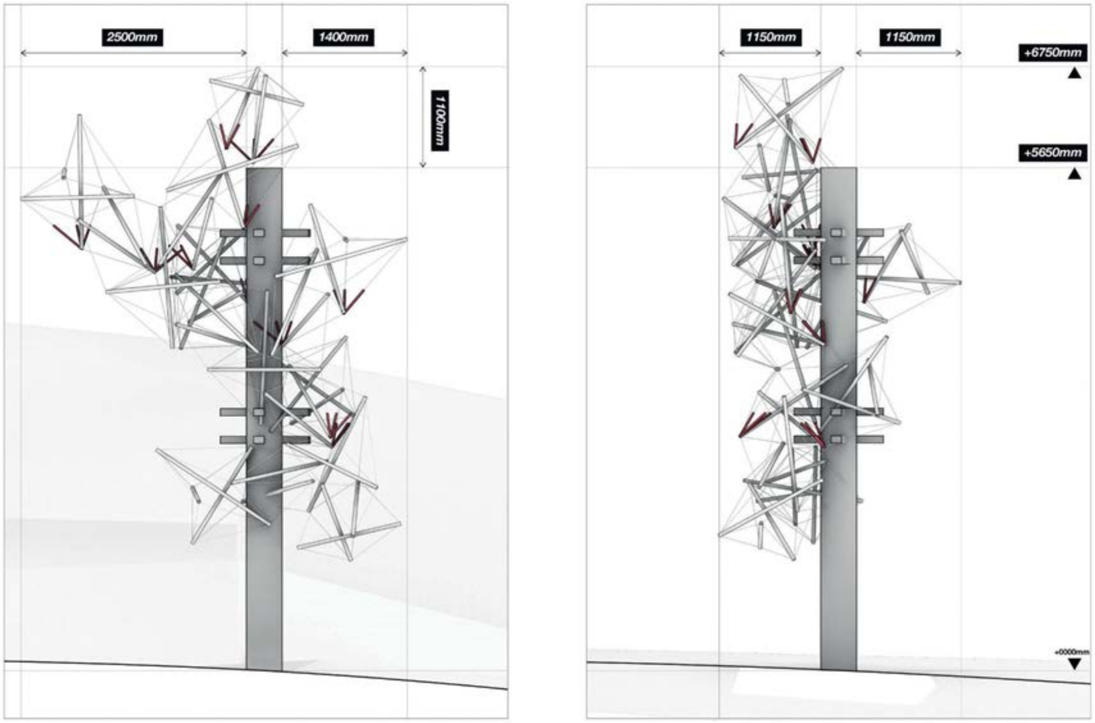
Step 2 (Search Data)

Assign structural properties associated with birds to branch objects.

Step 3 (Compare Data)

Estimate patterns of bird use by comparing branch structures to bird behaviour.



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04 —A diagram depicting the design process. Image: Roudavski and Alexander Holland.

05 —Attaching bird-friendly structures to utility poles is one way to support birds while newly planted trees mature. Image: Stanislav Roudavski and Alexander Holland.

approach helps to select promising designs by comparing them with descriptions of living trees. Resulting structures can be more suitable than those possible through direct modelling by humans.

Such approaches can have wide implications. To illustrate, our modelling demonstrates that an average old tree provides 18 metres of branches that birds find suitable. The loss of such trees can lead to striking regional deficiencies. Today, our test site has no suitable branches. By contrast, the total length of such branches in 1770 was more than 24,000 metres. We estimate that the total length of such branches for the whole of Australia's grassy woodland ecozone is now 11 times smaller (15,033,600 metres) than it was when European colonists first arrived (167,040,000 metres) and disrupted Indigenous management practices.

### Just design

To conclude, this article argues for cooperation with nonhuman life and proposes a framing for such cooperation. Just cooperation within more-than-human worlds is an open and difficult challenge, but our results suggest that humans and nonhumans can design together. Current anthropocentric approaches are often so detrimental that opportunities for improvements – however partial – are within grasp and should not be shunned.[10]

1. Versions of this slogan motivated Poland's 1505 laws and the narrative of the American Revolution. For an overview in application to disability, see James I. Charlton, *Nothing About Us Without Us: Disability Oppression and Empowerment* (Berkeley: University of California Press, 1998)
2. Intersectionality provides a relevant example here, for examples, see Val Plumwood, "Ecosocial Feminism as a General Theory of Oppression," in *Ecology*, ed. Carolyn Merchant, 2nd ed. (Amherst: Humanity Books, 2008); Nekeisha Alayna Alexis, "Beyond Compare: Intersectionality and Interspeciesism for Co-Liberation with Other Animals," in *The Routledge Handbook of Animal Ethics*, ed. Bob Fischer (New York: Routledge, 2020), 502. Proposals for nonhuman labour and property rights offer further context, see Charlotte E. Blattner, Kendra Coulter, and Will Kymlicka, *Animal Labour: A New Frontier of Interspecies Justice?* (New York: Oxford University Press, 2019); Karen Bradshaw, "Animal Property Rights," *University of Colorado Law Review* vol. 89, no. 3 (2018): 809–62, https://doi.org/10/gfsp3n.
3. This is a Tennyson phrase that was especially popular with nineteenth century naturalists and still has currency due to popular accounts such as that by Richard Dawkins, see Richard Dawkins, *The Selfish Gene* (Oxford: Oxford University Press, 1989), 2.
4. For the background on the idea of commoning, see David Bollier, *Think Like a Commoner: A Short Introduction to the Life of the Commons* (Gabriola Island: New Society Publishers, 2014).
5. Dan Parker, Kylie Soanes, and Stanislav Roudavski, "Interspecies Cultures and Future Design," *Transpositiones* vol. 1, no. 1 (2022): 183–236, https://doi.org/10/gpvsfs.
6. Dan Parker et al., "A Framework for Computer-Aided Design and Manufacturing of Habitat Structures for Cavity-Dependent Animals," *Methods in Ecology and Evolution* vol. 13, no. 4 (2022): 826–41, https://doi.org/10/gpggfj.
7. Stanislav Roudavski and Julian Rutten, "Towards More-than-Human Heritage: Arboreal Habitats as a Challenge for Heritage Preservation," *Built Heritage* vol. 4, no. 4 (2020): 1–17, https://doi.org/10/ggpv66.
8. Bonnie J. Gordon and Stanislav Roudavski, "More-than-Human Infrastructure for Just Resilience: Learning from, Working with, and Designing for Bald Cypress Trees (Taxodium distichum) in the Mississippi River Delta," *Global Environment* vol. 14, no. 3 (2021): 442–74, https://doi.org/10/gmxbh2.
9. Gabriele Mirra et al., "An Artificial Intelligence Agent That Synthesises Visual Abstractions of Natural Forms to Support the Design of Human-Made Habitat Structures," *Frontiers in Ecology and Evolution* vol. 10, no. 17 March (2022): 806453, https://doi.org/10/gpp6mb.
10. The work in this article is an outcome of a collective effort and we thank contributions of all members of Deep Design Lab.