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Mediating nature: Expertise and species data in the climate crisis

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ABSTRACT: This article examines skilled practices and modes of value creation within two 'nature communities' in Singapore, foregrounding the social transactions that shape the formation of expertise among their members. The ethnographic study is based on a combination of in-depth interviews, handwritten fieldnotes, photographs, and screengrabs of app interfaces. Drawing on long-term ethnographic fieldwork, the study illuminates how interspecies relations evolve within Anthropocene patches sprinkled over the island city. Against the backdrop of the recent urban greening history in Singapore, the article assesses a community of urban farmers and their ways of assigning meaning to practices of nurturing and selling snake plants. Furthermore, the investigation demonstrates how nature conservationists make use of mobile apps to document butterfly species living in multispecies landscapes nested in Singapore's forests, gardens, and parks. Juxtaposing these two contrastive ethnographic cases, the investigation brings to light how the mediation of nature reshaped interspecies relations within the two researched communities. The first ethnographic case addresses the performative labour of a plant farmer while analysing modes of value creation during a ritual event at a biannual garden festival. The second ethnographic case illustrates how nature conservationists in Singapore acquire a specific set of expertise that structures their relationships with wildlife. The mobile apps they use for documenting butterfly species are entangled in the dynamics of a technoscientific data extractivism, converting information about breeding and nectar plants of butterflies into commodified digital data. Based on an ethnographic immersion in local multispecies landscapes as well as two 'nature communities' in Singapore, the study suggests that the mediation of nature within the two researched communities enfolded their interspecies relations in an ecology of capitalist becoming, forging interdependencies between multispecies landscapes and processes of capitalist accumulation.

Keywords: environmental data; expertise; mediation; Anthropocene; butterflies; Singapore

Introduction

Chloe is about to meet her aunt Laila in the Bedok Reservoir Park, which flanks a lake in the eastern part of Singapore. They often meet at the Bistro Wawawa in the reservoir. Awaiting Laila, Chloe produces her smartphone and follows a butterfly fluttering over the lawn. Hoping to capture an image of the butterfly, she walks towards the shrub on which the insect has landed. As she approaches the butterfly, it flies off, only to rest on another shrub nearby. Chloe carefully follows it once more and finally takes a high-resolution photograph at close range. Walking over to a bench, she opens the mobile app *SGBioAtlas*, which enables registered users to quickly share their sightings of animals or plants with other nature enthusiasts. Chloe searches on Google for relevant images to identify the butterfly she has just photographed. She compares the colours of the wings and concludes that the

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butterfly is a tailed jay. As the photograph uploads, she enters the name of the insect, and the exact location of the sighting. Finally, she adds a comment for the image: 'Beautiful tailed jay searching for food'.

Choe's stroll illustrates how Singapore's flora and fauna are mediated through everyday practices. The term mediation circumscribes the social transactions enabling the movement of persons, images, discourses, and things on the one hand, and the ways these entities become meaningful on the other (e.g. Boyer 2012). A theoretical focus on mediation accentuates the meaning-making surrounding everyday practices and the formation of human experiences in specific local contexts (Costa 2022). Accordingly, the mediation of nature refers to everyday practices shaping the circulation of images, discourses, skills, and data about biodiversity within the specific spatial settings of a community of practice. This ethnographic account is based on four stays in Singapore between 2019 and 2024. I conducted ethnographic fieldwork in the city-state in January 2019, January 2020, and, following the global pandemic, in July and August 2023, and lastly, in August and September 2024. During these stints, I attended various events in local parks, nature reserves and community gardens. In doing so, I encountered numerous members of Singapore's 'nature communities', such as plant farmers and biodiversity conservationists. Urban farms were further field sites, which enabled longer periods of participation in the labour of cultivating tropical plants. The field notes were complemented by transcripts from 20 in-depth interviews, photographs, and screengrabs of app interfaces. Anthropologists conducting research in a physical-digital continuum negotiate their identities and research practices within a terrain of multimodality (Collins et al. 2017b), and during encounters with local communities, I was mainly perceived as a white temporary visitor with an 'arrival card'.

The aim of this ethnographic investigation is to gain a better understanding of the underlying social transactions shaping the formation of expertise within local nature communities. The Anthropocene heralded a new planetary era in which humans became the dominant force shaping the Earth's bio-geophysical composition and processes (Chua and Fair 2019). A landscape can be broadly conceived as the aggregate of the material and symbolic features of an area of land or scenery. While becoming an object of study, landscapes can be assessed along the dynamic tensions between proximity and distance, observation and inhabitation, and finally, eye and land (Wylie 2007: 2). The concept of multispecies landscapes recognises the role non-human agents play in the formation of urban spatiality. Singapore's urban landscapes can thus be seen as more-than-human assemblages consisting of complex interrelations between animals, plants, humans, and microbes.

Based on ethnographic fieldwork among plant farmers and biodiversity conservationists in Singapore, I raise the following questions about the social transactions underlying their interspecies relations: How did the staging of expertise in nurturing snake plants at the 2024 Singapore Garden Festival become a source of value creation for plant farmers? In what ways did biodiversity conservationists' use of the mobile app *iNaturalist* during butterfly sightings entangle their expertise with hidden forms of social transaction? And, more broadly, to what extent did the mediation of nature enacted within the two communities under investigation reshape their interspecies relations? The anthropology of expertise assesses socialisation processes through which people establish intimacy with classes of objects, learn to communicate their familiarity with such objects, and enact authority over certain ways of seeing and knowing (e.g. Summerson Carr 2010). In the context of this study, nature

expertise can thus be conceived as ways of seeing and knowing components of multispecies landscapes. People embody these skilled practices and are qualified to speak as experts on particular classes of objects, such as a freshwater pond or the canopy of a secondary forest. Based on an ethnographic immersion in Singapore's multispecies landscapes, this investigation suggests that the mediation of nature within the two researched nature communities enfolded their interspecies relations in an ecology of capitalist becoming, forging interdependencies between multispecies landscapes and processes of capitalist accumulation. The first section of this essay appraises the anthropological scholarship on the Anthropocene and provides a historical context for urban greening in Singapore. The second part assesses a gathering of local gardening enthusiasts, while the third foregrounds the role of mobile apps in biodiversity conservation.

Anthropological perspectives on the Anthropocene

Environmental disasters such as oil spills, wildfires, droughts, floods, smogs, typhoons, and other forms of extreme weather have recently intensified, both in strength and frequency, around the globe, necessitating coordinated climate action and new theoretical perspectives on the manifold relationships among humans, animals, plants, and digital technologies. The concept of the Anthropocene emerged from the collaboration between the meteorologist and atmospheric chemist Paul J. Crutzen and the freshwater biologist Eugene F. Stoermer, and refers to the impact of human activities on global ecosystems (Crutzen and Stoermer 2000). Anthropologists are increasingly contributing to in-depth understandings of localised meaning-making about global warming and other dramatic changes in the Earth system. Humans and nonhumans co-habit in diverse multispecies settings, while human lives and politics produce natural worlds and vice versa (Haraway et al. 2015). Although the scientific concept of the Anthropocene as a geological epoch was rejected in February 2024, present-day Anthropocene researchers have been tasked with politicising how human-nonhuman entanglements can be arranged in mutually nurturing ways (Marslin and Swyngedouw 2024).

Many strategies for mitigating the effects of climate change are conceived primarily as responses to environmental volatility, which relates to the destabilisation of natural annual cycles of drought and flooding, along with a general lack of predictability (Eriksen 2023: 39). Anthropological ethnography is well-equipped to illuminate uneven processes of acceleration and deceleration, and overheating and cooling (Hann 2017). Focusing on intertwined natural and human histories, anthropologists of the Anthropocene draw on systems thinking to explore capitalist world systems, patchy landscapes, infrastructures, ecological models, emerging socio-technical assemblages, and the re-emergence of spirits in the re-enchanted world (Mathews 2020). Global environmental change can be empirically studied in Anthropocene spaces where transformations to the physicality of the earth surface become tangible (Moore 2015). Based on an ethnography of Sweden's West Coast, Larsson and Sjölander-Lindqvist (2022) demonstrate how different actors engage in environmental communication to inform decisions on sustainable development in coastal and marine areas. Indigenous communities, such as the Turpos in Peru, conserved their cosmopolitan visions and interactions with earth beings, which was explored in Marisol de la Cadena's (2015) lauded ethnography.

Grounded in an anthropology of life that considers other forms of life as research participants, multispecies ethnography confers voice and agency to nonhumans and

destabilises categories of order privileging human knowledge over other beings (Gibson and Venkateswar 2015: 13). "Patchy" Anthropocene is a conceptual tool for structurally thinking about more-than-human social relations (Tsing et al. 2019). Situating landscapes within multispecies histories, ethnographers can retell stories of Anthropocene patches and foreground the uneven conditions of liveability in landscapes dominated primarily by industrial form (Tsing et al. 2019: S186). As Anthropocene patches are the interlocking components of multispecies landscapes, they can be thoroughly assessed to reveal the structures of such landscapes. The patches of landscapes are interrelated to other structures and processes (Tsing 2015: 227). Ethnography can foreground patches as sites for knowing intersectional inequalities among humans (Tsing et al. 2019: S186). Committed to foregrounding difference and inequalities, Anthropocene researchers trace interspecies relations within multispecies landscapes while maintaining a focus on social justice. Phenomenologically speaking, landscape structures are accessible to the senses and can manifest themselves as specific trajectories revealing the history of social relations (Tsing et al. 2019: S188). To explore multidimensional environmental crises, anthropologists can take landscapes as a starting point that is attuned to the structural synchronicities between ecology, capital, human and more-than-human histories (Tsing et al. 2019: S186). Ethnographies of the Anthropocene unveil landscape structures which are phenomenological markers of field sensibilities (Tsing et al. 2019: S187). Multispecies histories become evident while anthropologists focus on landscape forms and beings-in-landscape.

The assessment of patchy Anthropocene landscapes unravels and reveals the dependencies between biodiversity conservation and capital accumulation. The underlying capitalist structures of Singapore's multispecies landscapes become tangible in Anthropocene patches. In capitalist production chains, things are torn from their lifeworlds and become objects of exchange (Tsing 2015: 121). While goods reach consumers through complex commodity chains and enter the realm of market relations, the ethnographic study of intermediaries foregrounds the relational qualities of goods to create and maintain social ties based on a reciprocity of exchange. The process of becoming a commodity requires that the defining features of things are forged in a way that facilitates a conversion of money into capital (Tsing 2015: 121). In addition to labour as a source of value creation, capitalist projects draw on the social and ecological relations of animals and plants. Capitalist and colonial projects also involve exploitative interspecies relations. Animals, such as cattle, can play active roles in human projects, ranging from supporting extractive activities in mining, to fuelling capitalist expansion across landscapes (Ficek 2019: S263). Capitalist expansion occurs in projects that manage to replicate systems of production through standardised, self-contained units of plants, animals, and humans (Tsing 2012).

Critics of traditional Anthropocene thinking prefer the concept of the Capitalocene, arguing that while the Anthropocene epoch only dates back to the accelerated use of fossil fuels of the 19th-century industrial age, the Capitalocene incorporates the entire history of capitalist-colonialist economic relations shaping every sector of nature for the accumulation of capital since the age of European colonial expansion (Arons 2023: 36). The Capitalocene unfold as a of more-than-human assemblage that can be conceived as a world-ecology of capital, power, and nature (Moore 2016). Furthermore, capitalisation of multispecies landscapes can be based on technoscientific documentations of species (Ficek 2019: S260). Although many early anthropological studies on human-animal interactions were conducted

in rural areas, the global trend of urbanisation and urban ecological disasters shifted the focus to urban political ecologies, foregrounding interspecies relations in cities (Rademacher 2015). Incorporating thinking about spatial scales and social difference into environmental anthropology, urban political ecology pays attention "to the multiscaled conceptual and material systems that organize flows of capital, labor, information, and power" (Rademacher 2015: 141). Urban areas are but one component of these systems. Digital platforms have become a new component of the Capitalocene, as modalities of platform-nested capital accumulation increasingly shape both urban planning and interspecies relations (e.g. Yuan and Zhang 2025). Various professional groups, such as rangers, farmers, fishers, florists, urban engineers, conservationists, and gardeners can be intertwined within such systems. During the ethnographic fieldwork in Singapore, I primarily encountered biodiversity conservationists and urban farmers, and studied their expertise practices in situ. In the following section, I will provide the historical and political contexts for the two contrasting ethnographic cases discussed.

The politics of urban greening in Singapore

The longstanding urban greening strategy launched by the Singaporean government several decades ago provides the context for the ethnographic assessment of multispecies landscapes. The idea of urban greening and its implementation in urban spaces dates back to at least the 1960s. Singapore's founding Prime Minister Lee Kuan Yew officially initiated the greening movement by planting a Mempat Tree at Farrar Circus on 16 June 1963. Four years after the first tree-planting campaign, Lee Kuan Yew created the concept of Singapore as a 'Garden City', and a Tree Planting Day has been held annually since 1971. In the 1970s and 1980s, green infrastructures were built in public spaces to accommodate climber and creeper plants. Subsequently, the Bukit Timah Nature Reserve and the Central Catchment Nature Reserve were established in the 1990s to preserve Singapore's unique flora and fauna. Two further nature parks, the Sungei Buloh Wetland Reserve and Labrador Nature Reserve, were opened in 2002. In the 2000s, the concept of the Garden City was revised and replaced by imaginaries of a biophilic 'City in a Garden'. The Community-in-Bloom programme was launched in 2005, actively encouraging the development of community gardens and regular gatherings of gardening enthusiasts.

Singaporeans are encouraged to become 'stewards for nature' by participating in the OneMillionTrees campaign. Whereas the NationalParks Board has implemented the City in Nature vision through biodiversity conservation initiatives, the colonial history of the city-state continues to shape its urban spaces. Such spaces can be seen as techno-social assemblages containing multiple historical layers that still frame the everyday practices of inhabitants and visiting ethnographers. Syed Hussein Alatas' *Thomas Stamford Raffles: Schemer or Reformer?* (1972) initiated a discourse that blossomed into a decolonisation debate in Singapore. At a time when Euro-American institutions and Cold War ideologies undermined the violence of colonialism through modernisation theory, Alatas delivered one of the first comprehensive sociologies of colonialism (Menon 2022). Chang and Ho (2021) posit that techniques of visual and spatial representation, such as cartography, photography, and painting, have inscribed colonial spatial orders and continue to affect power relations in Southeast Asia. Urban grassroots organisations can play a crucial role in shaping a decolonial spatiality (Goh 2015).

The city-state of Singapore is home to diverse communities. Its multi-ethnic society comprises approximately 76% Chinese Singaporeans, 15% Malay Singaporeans and 8% Indian Singaporeans (Department of Statistics 2021: 25). While these major communities are not homogeneous, the Singaporean economy also attracts a large and diverse population of migrant workers. The highly globalised city is often framed as a site of superdiversity, shaped by complex intersections of difference, escaping binary classifications (Kathiravelu 2022). While local identities are primarily negotiated along ethnic, religious, and linguistic boundaries, the postcolonial state has launched various initiatives for urban greening and biodiversity conservation since the 1960s. Numerous local organisations are committed to protecting natural habitats and preserving biodiversity in Singapore. Set up in September 2011, the Community-in-Nature initiative encouraged state-funded citizen science projects and integrated nature-oriented education in the school curriculum. As urban development in Singapore follows a 'top-down approach', both the Singaporean state and the government agency NationalParks play a crucial role in constructing environmentalist identities. Against the backdrop of a state-imposed nature enthusiasm, various 'nature communities' have emerged in recent decades, and members often feel validated at events such as the monthly Gardeners' Day Out, the biennial Singapore Garden Festival, the annual Biodiversity Festival and other events co-organised by NationalParks.

Although Singapore follows a top-down model for urban development, cascading policies are interpreted and adjusted in communities of practice at the local level. Expertise in flora and fauna is deeply integrated into Singapore's strategies for urban development and is entangled with regimes of knowing, with local stakeholders negotiating expertise sovereignty and counter-expertise (Duarte and Hochsprung Miguel 2023). The formation of expertise occurs in local contexts but is also intertwined with external forces (Ritter 2019). It is increasingly recognised that environmental expertise has become a global issue demanding international coordination and collaboration. Climate change has been conceptualised as a global system, and specific forms of expertise emerged to explain events in terms of their relation to the planetary scale (Callison 2014: 167). In the following section, I present the first ethnographic case exploring urban farming in Singapore.

Knowing sustainable indoor gardening

Focusing on the expertise practices of an urban farmer at the 2024 Singapore Garden Festival, the first ethnographic case illustrates how expertise in sustainable indoor gardening is formed among members of local plant communities. The 9th edition of the popular festival was held at the Suntech Convention & Exhibition Centre from 3 to 11 August 2024. Since its inception in 2006, the biennial event has brought together renowned horticulturalists, florists, landscape designers, and gardeners. Knowledge about multispecies landscapes emerges in communities of practice and manifests itself in guidelines, articles, leaflets, brochures, white papers, and handbooks. Such events facilitate the dissemination of knowledge within local communities, and expertise in sustainable indoor gardening was passionately demonstrated and shared at the Suntech Convention & Exhibition Centre. Urban gardening in Singapore is deeply entangled with regimes of expertise that promote the cultivation of particular tropical plants. Scientific expertise can be given a technocratic authority that drives and shapes transnational geopolitics and the governance of the environment (O'Reilly 2017: 4).

The first case will be assessed with regard to the structural synchronicities between ecology and capital, while illuminating the role of ritual events in value creation. By examining the performance of expertise during a workshop held at the Singapore Garden Festival, I demonstrate how the ecological traits of a snake plant (*Sansevieria trifasciata*) were transformed into consumable products. As the cultivation of, and care for, snake plants have been studied elsewhere (e.g. Mishfa et al. 2024), I primarily focus on the meaning-making surrounding the plant object and the creation of value during its life cycle. Jeryl, an urban farmer specialising in ornamental plants, ran a snake plant workshop on the third day of the festival. He is a member of a plant community leasing plots largely in the urban area of Punggol. Mainly ornamental plants were cultivated in these farms. In the following interview extract, he emphasises the benefits of snake plants:

> The reason why I use snake plants: They are one of the best air purifiers. If you have a lot of snake plants in your house […] This is based on a NASA study, snake plants are one of the top few plants that clean about four indoor air toxins. When we do our workshop, we actually promote the snake plant. Yes, one is not enough to clean your entire house, but having about 20 in your house does have beneficiary effects on your breathing and the space around you [...] When we started our semi-hydroponic journey, we realised that we save a lot of soil. Because this kind of material lasts for up to seven years. A lot of materials don't pass the 1-year mark. They start breaking down or you have to replace them [...] People who come to the workshop learn how to do their own indoor material mix and recognise plants that can be kept inside in the Singaporean setting. They learn how to mix it and pot it themselves. With this method, they can use their glass jars. If you buy pasta, the pasta jar can be a plant home […] We end up buying less soil. We don't dig out soil from the earth.

Standing on a stage in front of twelve spectators, Jeryl facilitated a 'semi-hydroponic workshop', which advocated for an 'eco-friendly way of indoor gardening'. While demonstrating his expertise in sustainable indoor gardening, he held an actual snake plant in hand. Loam materials were placed on an adjacent table. Symbolic meanings of sustainable indoor gardening were attributed to the material objects unknown to most spectators. On stage, Jeryl performed basic gardening routines for mixing loam materials and cutting leaves. These expertise practices required the corporality of the farmer and the plant to be rendered meaningful. Spectators marvelled at the lush foliage of the snake plant, dramatically positioned at the centre of the illuminated stage.

Given the semi-formal character of the festival, ritualised practices were commonplace throughout the venues. The enactment of rituals entails performances, sequences of formal action and utterances, spontaneous improvisation of partially encoded sequences, and activities of living creatures (Rappaport 1999). Rituals are immersed in, and adapted to, wider socio-economic and political processes (Remme and Martin 2022: 637). The rituals staged at the festival, which was primarily organised by the government agency NationalParks, were embedded in local political decision-making. Plant expertise showcased at the event came to the fore in secular rituals during which ways of knowing were performed. Rituals are often designed to reinforce or alter the relational orders of self, society, and cosmos (e.g. Swenson 2015: 334). Central elements of the anatomy of ritual entail acting, stylisation, and staging, which serve to dramatise the performance (Grimes 2014). In the context of this in-depth

study, a ritual can be defined as a patterned, repetitive and symbolic enactment of ecological convictions and values shared within a given community (Davis-Floyd and Laughlin 2022: 6). Furthermore, the concept of the ritual event can illuminate how expertise is staged at the Singapore Garden Festival, and the snake plant workshop can be interpreted as one such event. Ritual events have been widely assessed in the context of festivals (Frost 2005), and are filled with meanings of indeterminacy and refer to situations of unknowable futures (Remme and Martin 2022: 636). During the workshop, Jeryl alluded to environmental disasters and the uncertain future habitability of islands, yet his demonstration of the sustainable pastime resonated with the eco-conscious audience. His ritual practices conveyed symbolic meanings. In the secular contexts of Singapore's plant communities, gardening routines were symbolically augmented through connotations of environmental sustainability. Rituals play a substantial role in social and individual lives, while orchestrating the transmission of knowledge (Davis-Floyd and Laughlin 2022: 11). The snake plant workshop primarily passed on knowledge about sustainable indoor gardening to the attendees.

The performative aspects of rituals underline how ritual events are framed and differentiated from other sequences (Strathern and Stewart 2016). For example, during the workshop, Jeryl presented a lush snake plant, which astonished the audience. In this framed sequence, the textures of the plant were accentuated through local meaning-making. Attributing significance to a material object depends on three relationships between the sign and the signified: iconicity, indexicality, and symbolism (Tomlinson 2022: 735). A plant with luxuriant leaves was passed among the audience, allowing spectators to experience its textures first-hand, while Jeryl's explanations provided the indexicality of the shown objects. While presenting the materials on the stage, Jeryl indexed the elements of the loam mixture, which included lava rock, perlite, pumice, leca, clay and seramis. These semi-hydroponic materials play a crucial role in conserving fresh water in gardening. After the demonstration, all participants were given a small set of materials and invited to mix their own loam. The attendees' repetition of the gardening practices solidified the iconicity of both plant and loam. Replicating the mixing of materials established a relationship of resemblance for the workshop attendees. Finally, Jeryl attached symbolic markers, such as 'glass garden' and 'plant home', to the demonstrated objects. In doing so, he created a conventional relationship that defined the objects of sustainable indoor gardening.

Jeryl's performances, as experienced by the attendees, made possible a singularisation of the 'semi-hydroponic system'. The singularisation removed the material objects from the realm of commodity transactions, but paradoxically, it played a crucial role in the value creation process for snake plants in Singapore. The initial value sources of 'hydroponic systems' were the labours of the Bangkok-based farmers, nurturing baby snake plants, and the loam material producers, which were the starting points of the value chain (Foster 2008). The on-stage performance of the workshop facilitator constituted another source of value creation, shifting the material objects to another realm (Foster 2008). Explaining the sustainable features of the plant system and performatively assembling a 'glass garden' formed part of the value creation. Singularisation and commodification are opposing tendencies and driving forces within the Singaporean plant market (e.g. Kopytoff 1986). The making of 'semi-hydroponic systems' is part of Jeryl's flora and fauna expertise. The expertise practices enacted during the workshop carried the seed of commodification as they prepared the capitalist consumption of such systems. The workshop ran five times in 2024, facilitated by

employees from the plant farm. The commodification of objects was interwoven with such non-capitalist relationships (Tsing 2013: 38).

The case of the snake plant workshop illustrates how ritual events facilitated staged meaning-making and a standardised classification of plants. By assigning new meanings to the ecological features of snake plants, the farmers rendered these objects commodities. The commodification of snake plants and their association with 'hydroponic systems' involved modular simplifications (Tsing et al. 2019: S189). Enabling the commodification of snake plants, the ritual events occurred in an ephemeral landscape of spectacle. Although snake plants were not primarily propagated as aesthetic flora, they became prestigious décor items imbued with the promise of a sustainable future. While showcasing the textures of the flora and their ways of knowing air-purifying plants at the Singapore Garden Festival and other events, the researched plant practitioners commercialised their expertise in sustainable indoor gardening. By demonstrating an eco-friendly approach to gardening, they disregarded the ornamental aspects of the plants, instead converting their air-cleaning capacities, and the materials of semi-hydroponic cultivation, into consumable entities. Snake plants can purify air and grow with little water in low-light settings. They require wide-ranging production chains comprising complex relationships among sellers of baby plants, loam material intermediaries, and urban farmers. The snake plant workshop was deeply embedded in the dynamics of capitalist accumulation. The researched plant farmers generated a source of value creation at the ritual events by accentuating the social and ecological relations of snake plants during their performative labour in front of the spectators.

Of mediated butterflies

Following an assessment of the performance of plant expertise at the 2024 Singapore Garden Festival, the interrelations between capital and ecology during local butterfly sightings will now be examined. While the first ethnographic case dealt with a plant community in Singapore, the second one addresses a different type of nature community. It focuses on the Nature Society Singapore (NSS), a volunteer-based organisation that aspires to mitigate biodiversity loss on the island. The non-profit organisation for nature enthusiasts seeks to conserve the island's biodiversity through education, advocacy, and research. Founded in 1954 as a branch of the Malayan Nature Society, the organisation became an Institution of Public Character in 2008, and has roughly 1,000 members today. NSS can be considered a conservationist community, which brings together volunteers and professionals seeking to protect the local flora and fauna (e.g. Kiik 2019). During the fieldwork in Singapore, I came across two mobile apps that members of NSS used to document, among other things, the various butterfly species living in the city. The mobile apps *SGBioAtlas* and *iNaturalist* enable users to collect species data for digital platforms. The spatiality of Singapore's urban landscapes is co-produced by app developers, their users, digital technologies, plants, animals, and material infrastructures (Lefebvre 1991; Ritter 2023). Ethnographic research can trace socio-political dimensions and experiences of infrastructures, foregrounding how organisations and states relate to regulatory environments and governance through users' perspectives on navigating infrastructural systems (Horst 2013). Anthropologists have recently paid significant attention to digital platforms, their governance and underlying profit-making processes (e.g. Casas-Cortés et al. 2023; Lindquist and Weltevrede 2024). Jane Guyer (2016) defines platforms as entities built of components and applications from

which everyday practices are performed outward into a world that is not depicted elsewhere. This capacious concept is attentive to all entanglements or layers of components and flows (Guyer 2016: 114). Although present-day platform economies are global phenomena, response strategies for platformisation processes cannot be disconnected from historical relations between labour and state, as well as local repertoires of sociality and organisation (Frey 2020: 46). Instead of conceptualising economic processes as transfers of monetary assets, anthropological perspectives foreground everyday acts of exchange and economic practices in a world of platform-based coordination (Guyer 2016). The intermediary character and scalability of platforms necessitate ethnographic investigations into the actual uses of mobile apps and interconnected data practices. Mobile apps provide conduits for sharing information and collective experiences (Collins et al. 2017a: 102). The mobile apps *SGBioAtlas* and *iNaturalist* can be studied as components of the material infrastructures within which Singapore's multispecies landscapes are increasingly entangled.

SGBioAtlas has been developed as a citizen science platform for sharing sightings of plants and animals in Singapore. Its mobile app was officially launched on 16 April 2015, available to download from Google Play and the Apple App Store. The app collects crowd-sourced information to document the distribution of flora and fauna across Singapore. The Singaporean government and the NationalParks Board commissioned the app project as part of the wider City in Nature initiative. The main objectives of the app are to collect information on Singapore's biodiversity and to educate users about local plants and animals. Its imagined users have been 'nature lovers' willing to share their experiences of Singapore's flora and fauna by uploading photographs to the platform (see Fig. 1), and in doing so, they contribute to the mapping of local multispecies landscapes.

SGBioAtlas was integrated with the digital repository BIOME, the Biodiversity and Environment Database System of NationalParks. Employees of NationalParks developed an urban biodiversity conservation model, committed to preserving Singapore's ecosystems. The biodiversity repository stores data about plants and animals living in Singapore. Species data can be understood as a continuation of familiar practices of social ordering, enabling an examination of how discourses, practices, and imaginaries of

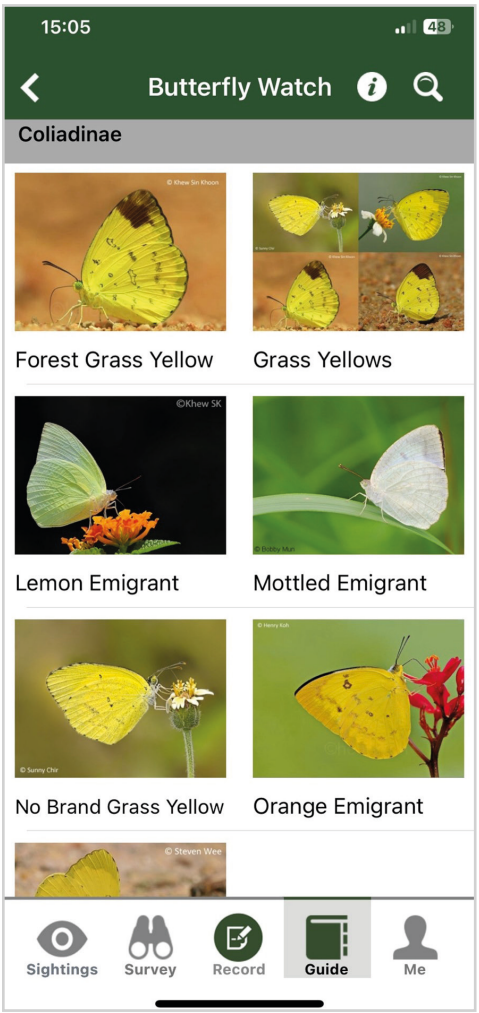

Figure 1: SGBioAtlas app interface showing butterfly sightings.

species data configure everyday life (Douglas-Jones et al. 2021: 10). Non-governmental organisations (NGOs), government agencies, and educational institutions have all participated in the collection of crowd-sourced information.

The ethnographic case of the mediation of biodiversity in Singapore involves the assessment of a further mobile app. At the time of this investigation, the platform *iNaturalist* could be accessed through web browsers and its mobile app, allowing users to collect biodiversity data. *iNaturalist* is primarily used by biologists, conservationists and other nature enthusiasts. Mobile apps such as *SGBioAtlas* and *iNaturalist* foreground the multiplicities and particularities of species data, evolving in the contexts of diverse local worlds (Douglas-Jones et al. 2021: 10). Grounded in understandings of data practices, everyday discourses of users, and places of usage, anthropological enquiries can assess boundaries of inclusion and exclusion from a wide analytical sphere of vision (Guyer 2016: 114). Akin to the app *SGBioAtlas*, *iNaturalist* is a citizen science platform for crowd-sourced biodiversity data (see Fig. 2). Its collaborative nature has enabled users to share their observations, identifications and photographs. However, users have granted the platform a licence to reproduce such content (iNaturalist 2024b). *iNaturalist* originated as a Master's thesis project at UC Berkley School of Information in 2008, and the platform was acquired by the California Academy of Sciences in 2014. Three years later, the organisation joined forces with the National Geographic Society. The platform adheres to an open data approach, allowing users to retrieve biodiversity data. To date, some 4,000 scientific papers have been published drawing on data sets retrieved from *iNaturalist* (Lohan 2024).

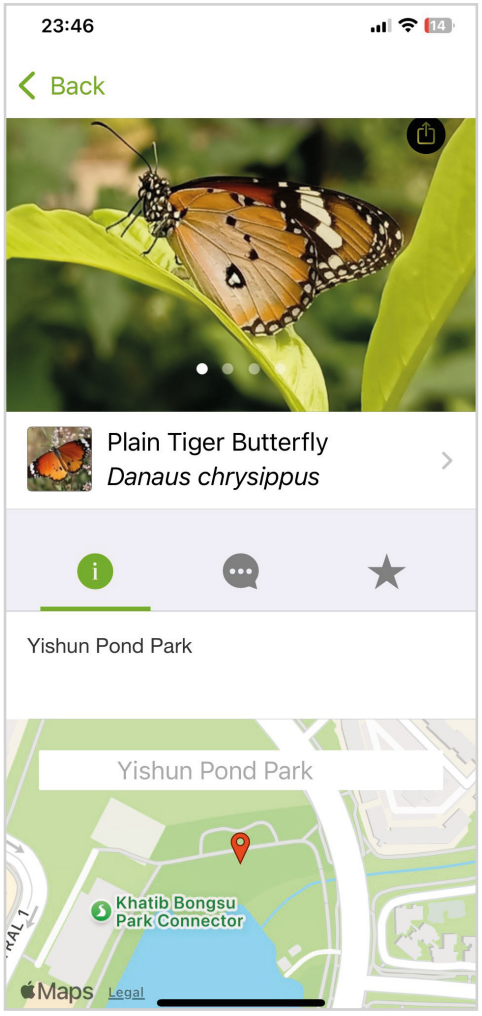

Figure 2: iNaturalist app interface showing a photograph of a plain tiger butterfly.

iNaturalist has proven popular among many nature communities in the city-state. Indeed, the Nature Society Singapore has regularly created projects on the platform, and its members have contributed substantially to the global biodiversity database. The webpage *NSS Singapore Nature Sightings* reports that 461 users have registered approximately 242,300 observations of about 8,800 species for the organisation on the biodiversity platform (iNaturalist 2024a). The generation of species data is grounded in the skilled vision of the photographers and their practices of sharing species data. However, the operationalisation of a photograph as a scientific data point is based on unchallenged

assumptions of objectivity and the belief that the mobile phone camera is a legitimate instrument of scientific inscription (Altrudi 2021: 134).

The biodiversity conservationist and trained biologist Li Fang has chaired various NSS projects on *iNaturalist*, preferring the global platform over the one commissioned by NationalParks. Here she explains her stance on data sharing in biodiversity conservation:

> NParks have developed this app [The app SGBioAtlas, author]. We don't know where the data goes. We call it a black hole. It has always been. We have worked for many years with NParks, and they almost never share data with us. It's like one-way communication. They request data from us, and we always give, but they are not willing to share. It's not very helpful. It's not a very collaborative spirit. We find iNaturalist is a lot more controllable. Whoever uploads the record has full control. It doesn't belong to anyone, not even the government… I've been asking some members if we should apply to be the official partner of iNaturalist for Singapore. Because, obviously, NParks is not keen to be it because they just want to do their own thing. You know, in our view iNaturalist is ready-built, and we just need to adapt it. There is no need to control any data flow or anything. We will be spending some time and resources to manage the platform. So what could it do for us? We also acknowledge that we are heavy users of iNaturalist. Being a country partner has some extra obligations that we need to study a little bit more. Actually, the data has been used for some scientific publications on Singapore based on data from Singapore. It is used in that way for research.

As the interview passage indicates, NSS members were more inclined to upload data to *iNaturalist* as the platform allowed more control over species data than the platform *SGBioAtlas*. Furthermore, the platformisation of species data in the Singaporean context has unveiled a decolonialisation dilemma. The postcolonial government commissioned the citizen science app to establish a local platform for gathering and analysing species data about Singapore's flora and fauna. Because of the history of colonisation in Singapore, and across Southeast Asia, the launch of the app *SGBioAtlas* can be interpreted as a further step towards a decolonisation of urban spaces in the city-state. Such ongoing decolonialisation processes in contemporary Singapore, however, have coincided with the rise of platform capitalism that increasingly entangles local stakeholders, such as government agencies and conservationists, with global data infrastructures. The conservation practices and day-to-day decision-making of NSS members reflect this dilemma. Given that species data is required for producing reliable knowledge about multispecies landscapes, decisions on processing and accessing such data are crucial expertise practices for biodiversity conservation and climate action. Although species data, on the one hand, should be accessible to experts across national borders, on the other hand, it may be required for decisive governance of human-animal relationships in local contexts, and therefore, priority should be placed on sharing with local partner organisations.

The app *iNaturalist* converted the wonderment of nature and the beauty of butterflies into digital data. The case of the biodiversity conservationists shows that the use of the app during butterfly sightings entangled their expertise practices with a digital transaction system: users are granted free access to the app's interfaces while simultaneously granting the platform permission to reproduce the uploaded content and repackage data associated with it. The systematic, platform-nested data collection commodified species data about

butterflies. Rather than producing solely scientific evidence, the platform collected multiple forms of metadata, which were meaningful to stakeholders beyond the local communities inhabiting the multispecies landscapes. Such data collection was embedded in a perpetual cycle of capital accumulation. This form of technoscientific data extractivism is a modality of a rampant, invasive capital accumulation (e.g. Sadowski 2019: 9). Information about butterfly nectar and breeding places, and the identification of species, entered a world of digital infrastructures, and was drawn into a landscape of backend interfaces. The ecological features of butterflies became objects of digital standardisation, and information about them was converted into data capital. The technoscientific collection of information on particular butterfly species in Singapore's urban landscapes was embedded in a new mode of value creation. The traditional pipeline model of value creation has been displaced, and platforms have bundled together new relations between nature photographers, data infrastructures, and platform providers. This form of value creation entangled Singapore's multispecies landscapes with the data capitalism of large-scale platform corporations. Such platform-driven capitalism reconfigured social transactions through new modes of accumulation. Value creation has been increasingly made possible by data capture in specific places, providing opportunities for viable cooperative and community organisations to integrate platforms as intermediaries and regulators (Foster 2024: 984). Anthropocene patches that manifested themselves in Singapore's multispecies landscapes were interrelated to manifold data flows. To assess the structure of such landscapes, researchers can trace data trajectories, which are components of transaction systems, facilitating the movements of species information in more-than-human assemblages (Hill 2022: 570).

Conclusions

Urban parks and gardens served as starting points for this ethnographic study, which assessed the expertise practices of two nature communities in Singapore. Its subcases foregrounded how snake plants and butterflies were entangled in commodification processes. While the performative labour of plant farmers during ritual events added value to the presented snake plants, the app *iNaturalist* scraped the expertise practices of biodiversity conservationists into systematic, platform-nested collections of species data about local butterflies. The fieldwork in Singapore brought to light that expertise in the cultivation of snake plants and documenting butterflies was deeply embedded in locally negotiated ways of seeing and knowing. The meanings assigned to snake plants and butterflies were produced in local contexts, but were significantly intertwined with event venues, market structures, and even data capture regimes. The two contrastive cases illustrate how the Capitalocene extends into Singapore's multispecies landscapes and its surrounding communities. The ethnographic study suggests that the mediation of nature within both nature communities enfolded their interspecies relations in an ecology of capitalist becoming, forging interdependencies between multispecies landscapes and processes of capitalist accumulation. The outcomes of the ethnographic investigation inform wider anthropological debates about biodiversity conservation in urban settings, and contribute to growing insights into the relations between multispecies landscapes and infrastructures. Rippa (2023) argues that human-made infrastructures and the non-human are intimately intertwined, and this investigation provides new evidence for unravelling the manifold relationships between infrastructures and the environment. Ways of knowing plant species came into being within the walls of a convention

and exhibition centre, while information on butterfly life cycles trickled into databases. The non-human and the non-built are intrinsically intertwined with technological systems such as urban architecture and data infrastructures. Therefore, ethnographic enquiries into environmental repair should examine historically situated interspecies relations alongside the material infrastructures that facilitate the articulation of ways of knowing. The outcomes of this ethnographic investigation imply that Anthropocene thinking can be advanced through a cross-fertilisation of the anthropology of infrastructure and ethnographic accounts of multispecies landscapes. Future anthropological research could examine the political economy of infrastructures that shape animal-human encounters, and further untangle relations between environmental expertise and capitalist modes of transaction.

Finally, this study revealed that local knowledge about biodiversity can be entrapped by data extraction agendas of digital platforms. The platform dynamics initiated by large-scale data corporations, such as Alibaba, Instagram, TikTok, X, and Yandex, have reached local communities that care for biodiversity conservation. Free access to front-end interfaces is frequently traded for voluntary, unpaid data generation. However, the case of sharing species data also reveals the potential of platform co-operativism. Species data can be harnessed for globally accessible open-access databases. Cloning open-source software for species data could enable the establishment of democratic governance structures and new regulatory frameworks for species data property (Scholz 2017). By combating current inequalities of access and the privatisation of metadata, the cloning of citizen science apps could open avenues for extensive data sharing among conservationist communities worldwide. As butterflies continue to breed in dense urban areas and nature enthusiasts continue to photograph wildlife and upload their sightings to platforms, there remains hope that species data can be more democratically curated, and that the populations inhabiting multispecies landscapes can own both the publicly shared photographs of their sightings and the data that follow.

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