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Kaitiakitanga i ngā Taonga Tuku Iho: The Symbiotic Conservation of Indigenous Languages and Biodiversity

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Abstract

It is now a well-known fact within both the popular and academic spheres that the Earth is currently in the midst of a mass extinction, in which biodiversity is disappearing at 1,000 to 10,000 times the historical background rate. Though this mass extinction of species is the sixth of its kind in Earth's history, it is nevertheless unprecedented due to its anthropogenic causes and, furthermore, because it also entails the first ever mass extinction of languages. 50-90 percent of extant languages—almost all of them indigenous—may be gone by the end of the 21st century, along with an untold number of species. This paper will argue that these ostensibly disparate phenomena are in fact two aspects of a single event, and will provide an overview of the connections between biological and linguistic diversity, including their global geographic coincidence; their concurrent devastation by globocapitalism; and the intimate relationship between indigenous cultures, their languages, and the environment. Thus, drawing upon the parallel circumstances in which biological and linguistic diversity arise, thrive, and perish, this paper will argue that a mutually-inclusive understanding of these domains is necessary to address the extinction crisis afflicting them both. Finally, using a global array of examples, including an integrative analysis of the Māori language of Aotearoa New Zealand, this paper will demonstrate that the traditional ecological knowledge (TEK) and general ethic of sustainability encoded in many indigenous languages can do much to concretely bolster conservation efforts within Western science and global culture.

1. Introduction

When one speaks of the unprecedented mass extinction that we are experiencing today, it is typically followed by talk of the anthropogenic ecological crisis which is devastating Earth's biodiversity[1,2]. Though this is true, it is an incomplete answer. What makes the current extinction crisis truly unprecedented is not only its human drivers, but the fact that it consists of *two simultaneous extinctions.* For while the mass extinction of species is the sixth of its kind, we are also experiencing the first ever mass extinction of languages[3].

It is appropriate to refer to these ostensibly disparate phenomena as a single event for several reasons. First is because they are occurring largely collocationally as well as synchronically: there exists a significant geographic coincidence of biodiversity and linguistic diversity, as well as a temporal coincidence of their decline[4,5,6,7]. Furthermore, they share a common root: the globocapitalist exploitation of ecosystems that comprise a wealth of biological species, including many indigenous[8] human groups[9,10,11]. The current devastations of biodiversity and language diversity are thus inextricable because they are mutually compounding, for as external economic, social, and political forces gain greater control over environments, they erode both its ecosystem and the indigenous cultures who often maintain a rich knowledge base thereof. Much of this knowledge, in turn, is encoded in their languages, which—like many biological species—are outcompeted by "invasives" such as English, Spanish,

Portuguese, Russian, or other dominant regional languages[12,13,14,15]. Moreover, because the overwhelming majority of indigenous languages are not written, their disappearance—again like biological species—is irretrievable. Hence, humanity loses in a 'one-two punch' of globalism run amok both the biological systems which sustain us and immeasurable know-how which could be key to the revival and conservation of what remains.

Still more, as we lose indigenous languages we also lose indigenous voices. Though historically language shift has not always been an overtly imperious process, contemporary examples are replete with rapid socioeconomic coercion, forcing speech communities to leave behind their ancestral languages so hurriedly that they lose much of the attached culture[16,17,18]. In the case of indigenous and local peoples, this most often includes traditional philosophical systems—comprising cultural narratives, cosmology, and ancestral wisdom—which emphasize humanity's dependence on mutualistic interactions with the environment[19,20,21]. Thus, every time a language fades away, so does the potential of its speakers to add their unique worldview to the global dialogue, and we find our discourse increasingly impoverished. For the cultures most directly affected, language death can spell nothing less than the end of a way of life. For the rest of us, failing to learn from these systems before they perish could ultimately yield a similar result. If we wish to halt this catastrophic double-extinction of biological and linguistic diversity, it falls to us in the developed world to listen to those who hold the key to both, in their own words.

While there are already many established arguments for the real-world utility of biodiversity conservation, there remains a dearth of pragmatic arguments for conserving linguistic diversity. This paper will seek to address this deficiency by explicating the practical value of indigenous-language conservation to biodiversity conservation. Drawing upon the parallel circumstances in which biological and linguistic diversity arise, thrive, and perish, I will argue that a mutually-inclusive understanding of these domains is necessary to address the extinction crisis afflicting them both. Then, using a global array of examples, including an integrative analysis of the Māori language of Aotearoa New Zealand (ANZ)[22], I will demonstrate that the traditional ecological knowledge (TEK) and general ethic of sustainability encoded in many indigenous languages can do much to concretely bolster conservation efforts within Western science and global culture.

2. Biological and Linguistic Diversity: Where We Stand Now, and What We Stand to Lose

The phenomenon of biodiversity loss is now well within the scope public consciousness. Since the late 1980's biosystematists and conservation biologists have successfully worked to raise awareness of the problem, such that recognition of a current and ongoing mass extinction has now gained traction in both the popular and academic spheres[23,24,25]. Estimates of the magnitude of biodiversity loss vary greatly due to problems recording contemporary extinction events, but experts posit that species are going extinct at 1,000 to 10,000 times the historical background rate, and that as many as half of the species on Earth are in danger of disappearing by the end of the century[26,27]. The uncertainty of these estimates, and of the quantity of species that they might implicate, is due to our incomplete catalogue of Earth's biodiversity. Scholars calculate that Western science has discovered and named only about 10 to 23 percent of non-microscopic species[28,29].

Given that approximately 77-90% of Earth's macroorganisms remain completely undescribed, it is impossible to know what species act as the ecological lynchpins of their ecosystems, nor which of these might be experiencing extinction pressures. We do know that the most stable ecosystems have a plurality of species occupying similar niches, such that the disappearance of one among them can be compensated by multiple others, and thus making biodiversity a critical component of ecological resilience[30,31]. Furthermore, though the precise number or spread of species necessary to sustain ecosystem services is yet unknown, Isbell et al. conclude that 84% of 147 grassland plants studied promoted ecosystem functioning at least once, while many of that number are needed to perform a variety of functions at a variety of times[32]. Whether this might hold true for other types of ecosystems should be a focus of further research, but it is nevertheless clear that biodiversity is critical—probably in more ways than we are currently aware—to maintaining the ecosystems upon which all life depends. As species go extinct at alarming rates, we can liken our situation to playing a perilous game of ecological *Jenga*. Which species' removal will send it all crashing down?

Biodiversity is not only an ecological necessity, but also an enormous economic asset. For all human history our species has availed itself of other organisms' alimentary, medical, material, technological, and aesthetic applications, and we continue to do so. The modern enterprise of *bioprospecting*, led chiefly by the pharmaceutical and biotech industries, seeks new medicinal and technological solutions to contemporary problems within the myriad phylogenetic lineages that high biodiversity affords. In a globocapitalist context this economic incentive is a double-edged sword—on the one hand affirming the untapped value of biodiversity and on the other targeting it for exploitation and likely depletion. This and other ethical dilemmas associated with capitalizing on biodiversity will

be covered throughout the rest of this paper, along with some possible correctives offered by indigenous discourse. For now, however, suffice it to say that many recent discoveries of economic import have emerged from understanding biodiversity. For example, roughly a quarter of today's pharmaceutical products are based on or derived from plants[33,34]. One such plant is the Pacific Yew, *Taxus brevifola*, which was found to contain a compound effective in controlling ovarian and breast cancer[35,36]. An analysis of *T. brevifola*'s phylogenetic relationships led researchers to the European Yew, *Taxus baccata*, whose leaves provided a better source of the compound, now marketed as the drug Taxol[37]. Coupling the global rate of extinction with the paltry 10-23% of species so far identified by Western science—where only a fraction of that number has been studied in any detail—it is impossible to speculate what other miracle drugs, superfoods, or technological inspirations might disappear before we even know them[38]. In short, we have no idea what we're losing.

From a global standpoint, the same is true for languages. For starters, it is difficult to know how many languages we are losing because, like biological species, we are unsure of how many there are. Due to a lack of consensus on what, exactly, constitutes a distinct language, as well a general lack of investigation into many remote communities, it is next to impossible to give an accurate tally of the world's languages. In fact, that number is so notoriously difficult to pinpoint that there is not only a wide range estimate, but a range of range estimates: Bernard throws out 3,000 to 7,000 total languages; Crystal gives both extremes with 3,000 to 10,000; while Nettle and Romaine attempt to give a more precise figure of 5,000 to 6,700[39,40,41]. In order to establish a working estimate, however, most scholars ballpark the final count at around either 6,000 or 7,000, the latter of which this paper will use as a reference.

The fragility of the vast majority of these languages becomes readily apparent with the distribution of their speakers. Depending on one's criteria for what constitutes a distinct language, the top 10 to 25 tongues claim half of the global population among their speakers[42,43,44,45,46,47]. Enlarging that number to the top 100 languages encompasses 90 percent of humanity, while the top 300 capture fully 95 percent of people on Earth[48,49]. Conversely, this means that 95 percent of the world's languages are spoken by only about 5 percent of the population, who are mostly indigenous and local people. To complete this wildly skewed survey, half of all linguistic diversity—about 3,500 languages—are in the hands (or rather, the mouths) of just 0.2 percent of humanity[50,51].

The absolute preponderance of the 25 largest speech communities says much about the cultural power dynamics at play, which are crowding out more vulnerable languages with alarming speed: one every ten to fourteen days[52,53]. At this rate we may hear no more of 50 to 90 percent of extant languages by the end of this century[54,55]. While these are estimates that could change with concerted effort, it is a fact that 6 to 11 percent of currently spoken languages are moribund, meaning that they will almost certainly be lost within a generation[56]. Linguists and anthropologists have decried this progressively rapid erosion of the majority of the world's languages since the 1980's, when it became fully apparent how globalization was advancing "monocultural" languages such as English, Spanish, Russian, Portuguese, and Mandarin Chinese[57]. In today's world this designation refers to such languages' particular association with globocapitalism, a "hegemonic neoliberal political ideology" which seeks to homogenize economic models along with their underlying cultural discourse[58]. Individuals' and communities' advancement in this, as in any, socioeconomic order is contingent upon their ability to participate equally in said discourse, often leading them to abandon their ancestral language and customs in favor of the dominant culture's (a phenomenon which adversely impacts biodiversity as well, as I will discuss in the next paragraph). The full impact of globalization on linguistic diversity could only be inferred from anecdotal evidence and general trends up through the end of the 1990's, when experts began to collect and analyze data on global language loss. The organization Terralingua has since compiled their comprehensive Index of Linguistic Diversity, which statistically demonstrates a 20 percent decline in global linguistic diversity since 1970[59]. The Index definitively shows that the proportion of the global population who are native speakers of dominant languages is increasing at the expense of local and indigenous languages, ultimately vindicating linguists' and anthropologists' claim that we are indeed in the midst of an extinction crisis[60].

All this raises the question: Why should we care? Because as our linguistic landscape shrinks, so too does our intellectual horizon. As the collective possession of an entire community, innovated over generations, a language acts as a repository of its speakers' accumulated experience, insights, and cultural assumptions—ultimately constituting a unitary system for the codification and transmission of knowledge[61,62,63]. Accordingly, the languages of local and indigenous peoples often encode much information about their natural environment, whose currency among speakers is vital to the maintenance of their way of life, including the biodiversity which sustains it[64,65,66,67,68,69,70]. This *traditional ecological knowledge* (TEK) can comprise a wide variety of information about individual species, interspecific interactions, and overarching ecosystem processes, as well as specific land or population management practices—all of which can contribute to the efforts of Western conservation biologists[71]. The Canadian Environmental Assessment Agency affirms the potential of TEK to bolster conservation science and ecological initiatives:

> Traditional and local knowledge may, for example, contribute to the description of the existing physical, biological and human environments, natural cycles, resource distribution and abundance, long and short-term trends, and the use of lands and land and water resources. It may also contribute to project siting and design, identification of issues, the evaluation of potential effects and their significance, the effectiveness of proposed mitigation, cumulative effects and the consideration of follow-up and monitoring programs… Although the basis for traditional and local knowledge and science-based knowledge can differ, they may on their own or together, contribute to the understanding of these issues[72].

However, as a primarily oral, un-codified, and therefore dynamic form of knowledge, most of the world's TEK remains accessible only in the languages of traditional peoples, variously encoded in their proverbs, endogenous taxonomic systems, and lexicons[73,74,75,76,77,78]. This is not simply because Western science has yet to apprehend the world's wealth of TEK, but because local knowledge stemming from and encapsulated within a radically different culturo-philosophical system does not easily "translate" into dominant languages. To illustrate this point I quote at length two structural linguists: the Māori activist Dr. Margaret Mutu, who explains why cross-cultural translation can be problematic, and Dr. Jeffrey Wollock, who details the intellectual and ecological consequences of language loss.

> [There are] inherent difficulties that exist when one attempts to describe the concepts and values of one culture using the language of another culture. These difficulties arise from the fact that… each of the world's natural languages has been specifically crafted over time by its community of speakers to express the culture of that community. Where languages are closely related, as for example, Māori and Rarotongan, or English and French are, then the difficulties are not great since the cultural differences are not great. But in the case of say, Rarotongan and French, or, as in our present case, English and Māori, where the two cultures derive from quite different value systems and world views, difficulties arise when one attempts to express the culture of either of the pair in the language of the other[79].

> A new language embodies another discourse, in terms of which the actions that had formerly upheld the land-management regime that maintained the traditional biodiversity may no longer make sense… The wisdom that kept up the sustainability of the environment was encoded in that old language; in its entire, concrete usage, its proverbs, its thought patterns, its metaphors. If the language no longer exists, most of that wisdom is lost as well[80].

Thus, when we lose a language, the invaluable experience and insights of its speakers perish from our view—sometimes irrevocably. Invaluable TEK, couched within the language and culture of its keepers, may simply not be viable in the discursive mainstream of monocultures. Furthermore, in the case of the majority of the world's local and indigenous languages, which remain both unwritten and largely undescribed, language death may occur before we even have a chance to try and calque their wisdom[81]. As with the value of biodiversity, so too with the value of languages: we, humanity, simply cannot imagine what it is that we're losing.

3. The Parallel Narratives of Biological and Linguistic Diversity: Living and Dying Together

The ties between biological and linguistic diversity go much deeper than superficial comparisons of "extinction[82]." The connection is rooted in the land itself. Over hundreds and sometimes thousands of years, indigenous cultures have often adapted to their local ecosystems as much as any other species therein. This adaptation includes their languages, which encode the TEK necessary to a sustainable relationship with the environment and its component biodiversity. The field of *biocultural diversity* (sometimes termed *biolinguistic diversity*) recognizes the inextricable relation between language, knowledge, and environment, and seeks to apply this understanding for the benefit of both language and species richness[83,84]. Maffi and Woodley define biocultural diversity as "the diversity of life in all of its manifestations—biological, cultural, and linguistic—which are interrelated (and likely co-evolved) within a complex socio-ecological adaptive system[85]."

A biocultural evaluation of the current extinction crisis would therefore assert language and biodiversity loss to be two aspects of the same process, producing a singular result: the decimation of life on Earth. At present this threat looms only over local and indigenous languages—many (if not most or all) of which encode a wealth of TEK. With this in mind, the biocultural logic is as follows: insofar as language defines culture, and indigenous cultures constitute a functional part of their local ecosystems, the extinction of an indigenous language is of as much ecological import as the extinction of a species—perhaps even more, given humans' unparalleled capacity to influence the environment[86]. In other words, we can see a TEK-rich language as the expression of its speakers' ecological niche, such that when the language disappears, so too does that culture's traditional role within the ecosystem[87,88].

By this logic, regions which can sustain many ecological niches should be home to a high volume of biological and linguistic diversity alike. On a global scale, this is precisely what we find. Surveys carried out by Gorenflo et al. and Terralingua have mapped the geographic distribution of the world's biological and linguistic diversity and demonstrated a strong overlap between the two (see **figure 1**)[89,90]. Additionally, both Harmon and Gorenflo et al. note the high incidence of endemism among languages and species in these regions[91,92]. Despite these compelling correlations, however, a functional relationship between biological and linguistic diversity has yet to be conclusively demonstrated, though the possibility continues to be the focus of much discussion[93]. The following biogeographical conditions, adapted from Harmon, comprise one such hypothesis to account for the local coincidence of biological and linguistic diversity, as well as their endemism:

(1) heterogeneous terrain producing a plurality of microclimates and microecosystems
(2) insular territories, especially with internal geophysical barriers
(3) tropical climates, with high ecological productivity and an abundance of natural resources
(4) small-scale coevolution of particular human groups with their local ecosystems[94]

The first three factors all posit the importance of geography in fostering biocultural diversity. Condition (1) reasons that a bioregion's physical variation encourages niche diversification and biolinguistic endemism, while (2) suggests that topographical isolators, even in relatively small and homogenous landscapes, can produce the same effect[95]. Condition (3) postulates that the warmth and wetness of tropical climates promotes high numbers and densities of species, altogether constituting ideal conditions for small, independent bands of hunter-gatherers[96]. In each case, the ultimate result is the respective genetic and linguistic divergence of species and human groups, whose plurality and mutual isolation produces high rates of endemism. Condition (4) echoes a central (though yet-unproven) claim of biocultural diversity: that biological and linguistic diversity are mutually-reinforcing[97,98,99,100,101]. In this scenario, small cultural groups' close interaction with their local ecosystems lead them over long periods of time to modify their environment and develop a special knowledge thereof, which enables them to act as effective ecological stewards[102].

Smith also proposes a series of hypotheses to explain the geographic overlap of biological and linguistic diversity, and similarly speculates on a "coevolutionary process of mutual reinforcement between cultural and biological diversity[103]." It is important to note, however, that the timescales of biological evolution and language change are extremely disparate[104], calling into question the appropriateness of the term "coevolution" in describing whatever symbiosis may have arisen between cultures and biodiversity. Smith gives several examples, including plant breeding and a variety of land management strategies, as support for the idea that indigenous cultures actually propagate biodiversity, but goes on to remark that the source of most biodiversity "has natural rather than anthropogenic causes[105]." Though the debate continues, there has yet to be any conclusive evidence that the historical presence of indigenous cultures has influenced the ensemble of biodiversity to such an extent that we might say, without qualification, that they "coevolved."

Regardless of causality, the fact remains that the world's most biodiverse ecoregions are typically under indigenous stewardship[106,107,108]. While the genesis of biocultural diversity in these regions remains an unsettled question, independent inquiries corroborate "a reality that ethnographers, ethnohistorians, political ecologists have long documented: The peoples who depend on biodiversity most immediately preserve it most effectively[109]". According to Gorenflo et al., traditional indigenous economies and land management strategies "essentially enable high biological diversity to persist[110]." Using the Brazilian Amazon as an example, they point out that areas with a relatively high indigenous presence always contain at least as much, if not more, biodiversity than areas with a lower such presence—a fact which suggests that significant biodiversity loss occurs only in predominantly non-indigenous areas[111]. Satellite data of the region corroborates this view, showing that indigenous lands currently act as the most important bulwark against deforestation, a major cause of biodiversity loss in the Brazilian Amazon[112]. Finally,

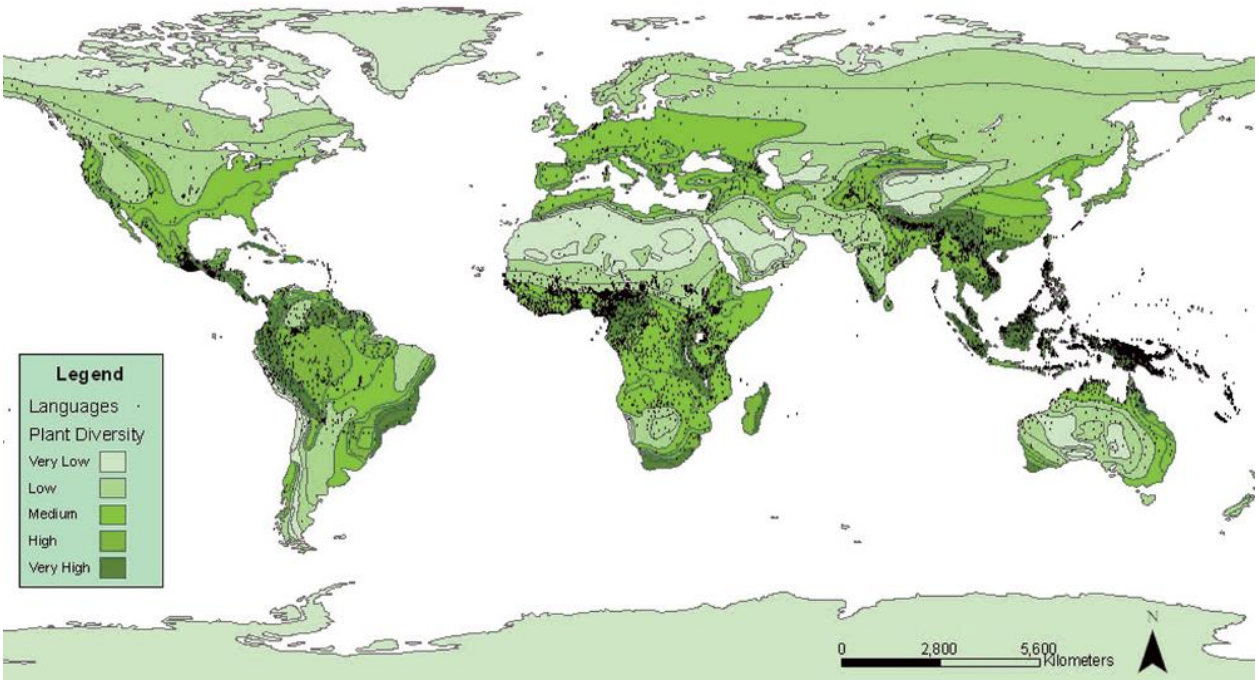

Figure 1: A Global Map of Linguistic and Plant Diversity. SOURCE: Terralingua 2010

Gorenflo et al. note that the effectiveness of indigenous lands in impeding deforestation does not correlate with indigenous population density[113]. These trends altogether support the biocultural hypothesis that traditional indigenous lifeways conserve biodiversity.

The clear correlation between indigenous cultures and biodiversity notwithstanding, the last of Smith's hypotheses turns the question around to address why other parts of the world are comparatively poor in biocultural diversity[114]. He offers up the explanation that "large-scale, centralized cultural systems require or generate low cultural, linguistic, and biological diversity"—a more general formation of Wollock's observation that "colonizing cultures" tend to do the same[115,116]. The circumstances of the current mass extinction seem to support this hypothesis, as biocultural diversity began to decline at the same time, and in many of the same places, as the most recent and ongoing upswing in economic globalization[117,118,119,120,121]. Terralingua and the World Wildlife Federation trace the declines of biological and linguistic diversity, respectively, to the 1970's: a decade which ushered in record levels of international trade, owing primarily to the increased openness of noncore countries[122,123,124,125,126]. All of the planet's most bioculturally diverse regions exist within these noncore countries, and those which have since undergone the most globalization (i.e. "semi-peripheral countries") now all notably contain *biodiversity hotspots* (see **figure 2**). Gorenflo et al. define hotspots as "regions characterized by exceptionally high occurrences of endemic species and by loss of at least 70 percent of natural habitat[127]." They also remark that biodiversity hotspots altogether house nearly half (3,202) of the world's languages[128]. Taken together, the overlapping geographies and timeframe of both economic globalization and the current mass extinction support the view that globocapitalism, at least in its present state, is deadly to biocultural diversity.

Globocapitalsim is characterized by a "hegemonic neoliberal political ideology" that places it firmly within the canon of western imperialism[129]. Like its predecessors, globocapitalism constitutes the ideological antithesis of typical indigenous lifeways, which, as we have seen, are the preservers of biological and linguistic diversity. Where indigenous lifeways naturally support multiplicity, colonizing cultures seek to streamline: ideologically, economically, and linguistically[130,131]. For example, the imported values of western legal philosophy trivialize the traditionally collective maintenance (i.e. through memory and custom) of local law, ethics, and worldviews, treating them as baseless and arbitrary next to "official" institutions[132]. Furthermore, in the utilization of local plant and animal resources, colonizing cultures do not seek, like many indigenous groups, to maximize niche-diversification, but rather to alter the environment so as to extract a maximum yield of but a few uniform, profitable,

biotechnological products[133]. Underlining both of these trends, the new colonial language "embodies a system of values that conceives of land and

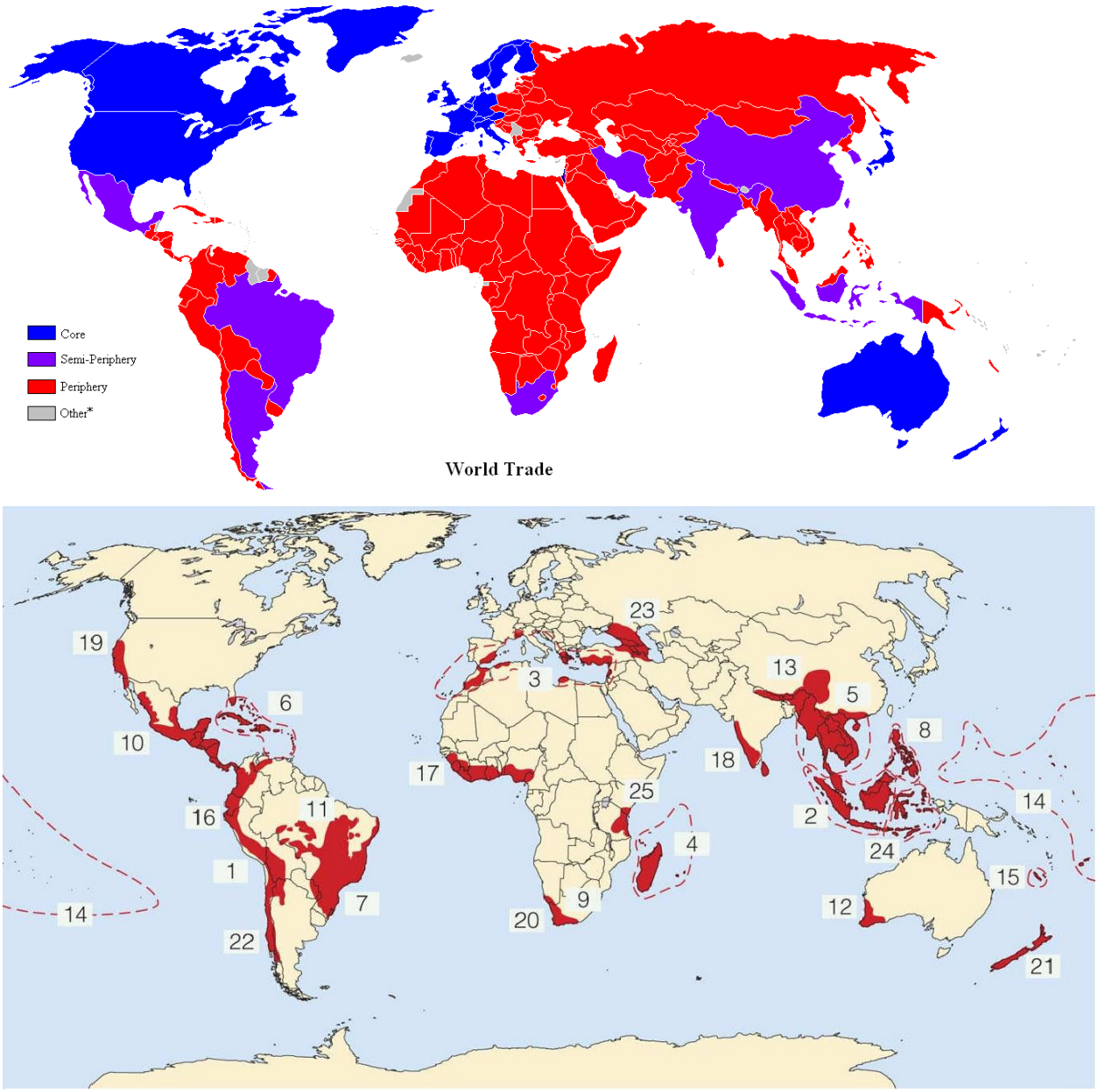

Figure 2: A Geographic Comparison of Non-Core Countries and the Top 25 Biodiversity Hotspots
SOURCE: Chase-Dunn, Kawano, and Brewer 2000; Morris 2009

nature as arbitrary signs, objects of domination and profit, a discourse in which maintenance of biodiversity (which it equates with forgoing monetary profit) is equated with 'waste'[134]." This manifold, radical shift in the socioeconomic system ultimately yields a familiar story: indigenous peoples are deprived of their traditional rights over land and resources, leading to poverty, population growth, and the economic coercion of their communities into environmental overexploitation[135,136]. As ecosystems collapse, and traditional lifeways with them, ancestral languages eventually lose all of their survival value for the present generation, who then adopt the dominant language and its discourse[137,138]. Finally, the loss of a distinct linguistic identity significantly undermines any

political or socioeconomic claims based upon ethnicity, leaving indigenous communities even more powerless to redress injuries to their cultural environment[139]. The monoculturization of the land and people is thus complete.

4. Words Shape the World: The Hard Evidence

The historical majority of arguments for language conservation have been largely philosophical in nature, focusing on the "intrinsic value" of language diversity. With regards to this body of literature, Pawley astutely observes that "The problem with much discourse about language in the humanities is that it is vague and impressionistic," while Hunn evenly notes that "Utilitarian arguments are hard to come by in defense of linguistic diversity[140,141]…" However, since the turn of the 21st century especially, the explicitly practical value of language conservation has been the focus of increasing research and discussion. This line of inquiry has shown us that language diversity, and in particular the TEK contained therein, has much to contribute to the present struggle against ecological decay.

The replacement of TEK systems with what Terralingua calls "monocultures of the mind" ultimately destabilizes human civilization in the same way that biodiversity loss destabilizes ecosystems: in the case that one ideological model, or one species, fails, there will be fewer 'backups' to take its place[142]. This is the reasoning which leads Bernard to claim that "any reduction of language diversity diminishes the adaptational strength of our species because it lowers the pool of knowledge from which we can draw[143]." This is an alarming assertion, to say the least, since we are in the midst of a mass extinction event which will strongly test the "adaptational strength of our species" while simultaneously reducing it. At any rate, it is clear that the discourse that is currently steering our collective fate—that of monocultural globocapitalism—is not by itself adaptive. Wollock explains this point succinctly:

> The cause of the environmental crisis is not industrial and military pollution, excessive resource extraction and harvesting, or an economic system that maximizes energy use, distorts local economic priorities, and spurs the growth of huge urban slums. These are only symptoms. The real cause of the environmental crisis is a particular way of thinking. The state of the world's environment is, as it were, experimental proof that something is fundamentally wrong with this way of thinking, today strongly reflected in most of the world's dominant languages… [T]he problem lies in the concrete historical evolution of rhetoric in these languages and the present expression, in them, of destructive ways of thinking (or not thinking) that guide the decisive actions of the day[144,145].

Where, then, should we look for a solution? Whorf contends: "Western culture has made, through language, a provisional analysis of reality and, without correctives, holds resolutely to that analysis as final. The only correctives lie in all those other tongues by which aeons of independent evolution have arrived at different, but equally logical provisional analyses[146]." Thus, faced with dominant discourses' manifestly faulty analysis of our environmental reality, we should seriously probe more ecologically-invested languages for such "correctives."

According to Mühlhaüsler, the idea that languages occupy an integral role within ecosystems and discursively construe speakers' natural environment goes back to Whorf's writings concerning the effects of language on cognition[147,148]. While Whorf's hallmark claim of linguistic relativity fell completely out of favor for decades, the 1990's saw a revival of interest (and debate) concerning the language-cognition question among linguistic anthropologists and cultural psychologists. Taking a cue from cognitive linguistics, however, this new wave largely inverted the functional relationship hypothesized by linguistic relativity, positing language as the collective expression of a speech community's (i.e. a culture's) perceptions, instead of their determinant[149,150,151,152,153]. According to this view, as espoused above by Bernard, language diversity offers a multitude of perspectives that directly augment humanity's bank of problem-solving approaches[154,155,156].

Research has shown that the associative strength of language with cultural attitudes can indeed alter individuals' approaches to a situation, in a phenomenon known as *cultural frame switching*. Several studies involving Chinese-English bilinguals have supported this notion, demonstrating that language can act as a significant prime in eliciting culture-specific responses to questions of cultural values, including the construal of an individual versus a collective self[157,158,159,160]. Ramírez-Esparza et al. conclude that cultural frame switching can produce not only incidental shifts in values and behavior, but also more fundamental personality traits[161]. Furthermore, the work of Akermans, Harzing and van Witteloostuijn with Dutch-English bilinguals demonstrated that use of the English language caused study participants to act much less cooperatively in playing a prisoner's dilemma game, attributing the results to Anglophone culture's higher valuation of masculinity, performance, and assertiveness[162]. All in all, these studies strongly suggest—with a distinctly Whorfian flavor—that the cultural paradigm associated with a particular language can have significant real-world impacts on speakers' perspectives and behavior. As such, we can

justifiably speculate that the ecological preponderance of many indigenous languages might be rife with potential for inciting environmental consciousness. This hypothesis would be a worthy object of further research.

Indigenous languages provide a living memory of sustainable relationships with nature which has passed out of the discourse of dominant, monocultural languages. The TEK that they encode permeates speakers' lived experience with ecological information and awareness, from the characteristics of species, to ecosystem processes, to a people's place within their environment. Lewis explains:

> The study of traditional ecological knowledge begins with nomenclatures [for plant and animal taxa] and ultimately proceeds to considerations of processes (functional relationships): the understandings that people have of environmental systems and the networks of cause and effect therein. A part of these perceptions involves a people's perceptions of their own roles within environmental systems: how they affect, and how they are affected by, natural processes[163].

As Lewis states, the most elemental component of a TEK system is its taxonomic classification of organisms, which typically provides useful information about species' particular traits or their roles within the ecosystem. In addition to a taxonomic lexicon describing flora and fauna, some indigenous languages also possess precise words which contextualize humans within the overarching scheme of their environment. Finally, a language's oral tradition, comprising its repertoire of stories, proverbs, myths, and so forth, can likewise make all the above types of TEK a part of everyday discourse. Together these domains solidify language's capacity as both a comprehensive, unitary system for the maintenance of TEK, and as a versatile guide for environmental conservation and documentation efforts alike. To illustrate these points, as well as their global applicability, I will here present diverse examples from Oceania, the North American Desert, and the Canadian Subarctic.

5. Examples of Linguistically-Encoded TEK: A Global Survey

The environmental aptitude of indigenous languages is clearly evinced by the fact that their single largest lexical domain typically pertains to plants[164]. The Papuan language Kalam, for instance, has upwards of 1500 terms for plant taxa referring to more than 1000 species—in total representing about 15 percent of the recorded lexicon of Kalam[165]. Because of plants' manifold applications toward sustenance, medicine, aesthetics, materials, and technology, there usually exists a correspondingly large and refined terminological field for classifying them by their properties and social function[166,167]. However, the appraisal and appellation of flora sometimes has nothing to do with their use by humans, and instead reflects their relationship to other organisms. For example, the Diné language of the Colorado Plateau refers to the flowers *Castilleja lanata* and *Penstemon barbatus* as *dah yiitihidaa tsoh* and *dah yiitihidaa'ts'ooz*, respectively, meaning "big hummingbird's food" and "slender hummingbird's food[168]." Nabhan, Pynes, and Joe suggest that ecological restoration projects in the region could incorporate such taxonomic TEK for the purpose of supporting biodiversity in the forest understory[169]. Nabhan's work with the Sonoran Seri people likewise endorses the potential of indigenous nomenclature to contribute to our knowledge of interspecific interactions, especially those of rare or endangered species whose status as such makes contemporary observation difficult[170]. In these cases, indigenous names can offer invaluable leads to conservation biologists trying to better ascertain the web of ecological interactions. Such was the case of the endangered desert tortoise (*Gopherus agassizii*) and five plants which the Seri refer to as *xtamoosni oohit* "desert tortoise's forages" (*Chorizanthe* brevicornu; *Chaenactis carphoclinia*; *Fagonia californica* and *F. pachyacantha*; *Phacelia ambigua*)[171]. Pursuant to this indication, all of these plants have now been shown to figure into the desert tortoise's diet, allowing conservation biologists to establish the animal's foraging ranges and, from there, possible locations for future wildlife refuges[172,173].

On the other hand, Mühlhaüsler relates the case of Norfolk Island, a small island of rainforests and many endemic species that had no permanent inhabitants when the British colonized it in 1788[174]. The distinct Norfolk language which came to be spoken on the island never developed a lexicon for describing the unique species and complex ecology of the local environment, leading Mühlhaüsler to conclude that a lack of appropriate terms with which to talk about the environment predicated its mismanagement by the immigrant islanders[175]. As a result, present-day Norfolk Island has lost 95 percent of its rainforests while large areas are overrun with exotic invasives[176]. These examples from North America and Norfolk Island respectively demonstrate the conservational worth of indigenous naming schemata as well as the conversely destructive effect of a maladapted discourse imposed upon a complexly biodiverse ecosystem.

In addition to the species-specific TEK found in taxonomies, some indigenous languages also possess terms encapsulating a comprehensive understanding of ecosystem dynamics. Throughout the world there exist indigenous words for ecosystem-like concepts, whose apparent cognizance of natural processes in many ways reflects only the most recent, sophisticated analyses of Western ecoscience[177]. These insights contrast with longstanding paradigms that still largely underlie contemporary Western discourse about the environment, again vindicating the corrective value of TEK. The TEK systems in which these ecosystem-like concepts reside eschew nature-culture and mind-matter dichotomies in favor of a holistic view of the natural environment, equally comprised of flora, fauna, humans, and abiotic components alike[178]. The typical indigenous worldview thus implicates ecosystem processes that are nonlinear, multi-equilibrious, and therefore unpredictable, in notable accordance with Western science's most up-to-date models[179]. This contrasts with the outmoded yet still prevalent conception of ecosystems as mechanistic, Newtonian constructs, with governable inputs and predictable outputs that give human beings a distinct mastery over nature[180]. Such a "clockwork" paradigm can be traced back to enlightenment-era philosophy, when industrialization and the consequent rise of modern capitalism began to alienate societies from nature, thereby instilling in them a view of the environment as a commodity distinct from and belonging to human beings.

Indigenous societies, however, do not see themselves as separate from the environment, and often express this view by making themselves verbally synonymous with it. In Oceania, the Yap word *tabinau*, the Solomon Islands *puava*, and the Fijian *vanua* all refer to a distinct bioregional unit comprising a human group along with the totality of local lands, reefs, lagoons, and organisms[181]. These terms lexically integrate specific groups of people into an area roughly corresponding to an entire ecosystem, insofar as they denote the interrelation of diverse terrains (i.e. multiple divisions of land and sea) as inextricable components of a single ecological unit[182]. The words *tabinau*, *puava*, and *vanua* therefore construct a community's essential identity alongside a refined notion of ecosystem dynamics. Similarly, the Cree and related groups of the Eastern and Central Subarctic share cognates such as *ashkii* (Eastern James Bay Cree) and *aski* (Anishnabe/Ojibwa), which conceptually fuse the ensemble of plants, animals, humans, and the physical environment into a single lexeme[183]. In the Dene languages of the Western Subarctic, the term *ndé* denotes both a geographic area and the web of interactions between all the entities—living and nonliving alike—upon it[184]. Given the ecological understanding expressed in *ndé*, the most appropriate English translation is *ecosystem*; however there exists no English equivalent that equally captures *ndé*'s philosophical underpinnings, which accord life and spirit to everything in the environment[185]. Indeed, while all the above terms integrate sophisticated ecological understandings into their speakers' everyday experience and most basic conceptions of the self and the world, they also carry a distinctly metaphorical and spiritual significance which, beyond the purely intellectual value of such concepts, serves to inspire a livable ethic of environmental stewardship.

The most comprehensive expression of a language's underlying philosophy, metaphors, and knowledge base can be found in its oral tradition, which includes the gamut of "proverbs, riddles, tales, nursery rhymes, legends, myths, epic songs and poems, charms, prayers, chants, songs, dramatic performances and more[186]." As only about 78 languages possess a literature, the vast majority of the world's speech communities maintains and transmits their collective knowledge and worldviews exclusively through oral media[187]. Thus, the preponderance of the world's TEK is stored uniquely in the memories of indigenous speech communities, which, as we have seen, are a highly perishable and increasingly dwindling resource. Furthermore, in oral cultures the content of the oral tradition sets the precedent for community ethics and constitutes the foundation of customary law, including prescriptions for ecological stewardship. I will support these assertions with a concentrated analysis of several aspects of the Māori oral tradition, including the TEK that it encodes and the environmentalist ethics that it underlies.

6. Words of Wisdom: The Māori Language and Ecological Stewardship

The Māori language of Aotearoa New Zealand (ANZ) has an extensive oral tradition including many *whakataukī* ('proverbs', 'ancestral sayings') which contain TEK useful to biodiversity conservation[188]. Wehi's work with *whakataukī* pertaining to the flax plant (*Phormium tenax*)—known to the Māori as *harakeke*—demonstrates the diverse applications of indigenous oral traditions to modern conservation and land management[189]. An ecological staple of wetland and coastal environments, harakeke's prevalence and textile fibers made it an economic cornerstone of the Māori prior to European contact[190]. However the widespread destruction of ANZ's environment in the two centuries since European colonization has significantly altered ecosystem structures, including the distribution of harakeke[191]. Modern efforts to conserve what is left and to restore what has been lost both rely on accurate reference ecosystems, but these are difficult to reconstruct in ANZ due to continuing environmental degradation as well as the lack of a reliable pollen or archaeological record[192]. Ancestral *whakataukī* therefore offer precious insights into the historical ecology of harakeke and its habitat, which are uniquely valuable to modern

conservation and restoration projects[193]. Analysis of *whakataukī* referencing harakeke yields practical TEK describing the plant's adaptability to different environmental conditions, traditional management strategies employed by the Māori, and harakeke's ecological relationships with other species[194]. In addition to being informative, some of the *whakataukī* analyzed also metaphorically denote the responsibility of human beings to care for the environment that sustains them[195]. For example, the saying "*He pā harakeke he rito whakakīkī ngā whāruarua*" ("The harakeke cultivation is a mass of new center shoots that will fill the many gaps.") draws on the image of replacement within the natural world to provide humans with a model for "giving back" [196]. This is because in Māori cosmology plants were created before humans, establishing an older-younger sibling relationship whereby people are obliged to learn such lessons from the senior flora[197]. Similarly "*Kua tupu tōu pā harakeke/ kua aroha ki te pīpī nei, kī te kākā*" ("Your flax bush has grown vigorously, it has nurtured the fledgling, and the full-grown kaka.") uses harakeke's growth patterns as a metaphor for familial nurture, with new shoots at the center representing children and the larger outer leaves symbolizing older relatives[198,199]. The good family, in turn, also supports their surrounding environment, here signified by the "fledgling" and "kaka." Today the endemic kaka (*Nestor meridionalis*), a nectar-feeding parrot, is endangered, making observation of its behaviors difficult[200]. Hence the especial import of this *whakataukī*, which corroborates the kaka's dietary relationship to harakeke—a seldom-recorded association last documented in 1927[201]. This example illustrates the singular value of TEK to biodiversity conservation, and how contemporary scholarship stands much to gain from recognizing indigenous oral traditions as historical sources equal in value to text corpora.

Unlike a text, however, oral traditions are not meant for preserving. They are by definition dynamic, living constructs, uniquely internalized by every individual of each successive generation. This fact notwithstanding, the synonymity of indigenous knowledge systems and oral traditions also engenders a strong sense of fidelity thereto among indigenous cultures, who are typically wary of questioning the hard-won wisdom of their ancestors[202]. As such, oral traditions act as personal reserves of collective mores, serving to inspire in each community member the worldview and ethics which have sustained preceding generations. These lessons are generally cloaked in symbol and metaphor which universalize their content and thereby construct an overarching ethos. In an indigenous context this ethos is invariably rooted in the Earth itself, leading the Māori academic Dr. Charles Te Ahukaramū Royal to assert that "the sense of the divine in the [natural] world is perhaps the distinctive feature of indigenous knowledge traditions[203]." The values and behaviors fostered by this "terracentric" perspective offer yet another corrective to the patent destructiveness of dominant anthropocentric ideologies.

The Māori oral tradition fits into the terracentric paradigm with the organizing principle of *whakapapa*: a universal system of genealogy that traces all existence back to divine creation[204,205,206]. Literally 'creating a foundation', *whakapapa* is a taxonomic framework that cements together the divergent lineages and successive generations of everything comprising both the physical and spiritual realms[207,208]. The Māori traditionally recall *whakapapa* through chants detailing the interlocking genealogies of their ancestors, often including natural features, plants, and animals that are also significant to their hereditary identity[209]. These recitations of familial origins usually culminate in Ranginui and Papatūānuku, Father Sky and Mother Earth, the parents of all life on Earth[210]. The kinship bonds that *whakapapa* establishes between the land and every living thing are deeply ingrained in Māori culture, expressed elsewhere in the oral tradition as proverbs as well as in the lexicon of the Māori language itself.

The Māori word for "land", *whenua* (cognate with the Fijian *vanua*, discussed in section 5), also means "placenta," demonstrating how the terracentric concept of a maternal Earth permeates Māori thought and discourse down to the lexical level[211]. The Māori identify themselves as the *tangata whenua*, "people of the land", whose deep-rooted *whakapapa* in ANZ underlies their assimilation and correlate authority within the islands[212]. The inextricable association of a people with the land that bore them finds expression in *whakataukī* such as "*Ko mea te maunga, ko mea te awa, ko mea te tupuna*" ("Such and such is the mountain, such and such is the river, such and such is the ancestor.") and "*Haha te whenua, haha te tangata*" ("Desolate land, desolate people."), which identify the human condition with that of the natural environment[213,214]. This belief is at the foundation of the Māori ethic of *kaitiakitanga*: the "guardianship" of the environment through respect and responsible management, modelled after the example of the *kaitiaki*, a class of Māori tutelar deities[215]. The imperative of *kaitiakitanga* is further reinforced by the Māori's reverence for the "spiritual energy," or *mana*, of everything in the natural world[216]. The Māori enact this reverence through the application of *tapu*: a certain personal discipline or community restriction which guards against transgressions of *mana*[217]. A *tapu* can be applied to sacred sites, objects, and living things alike, thus ensuring their preservation[218]. Where *tapu* denotes a spiritual proscription, *kaitiakitanga* also provides environmental protections for more pragmatic, purely ecological reasons in the form of a *rāhui*[219]. In order to avoid the overexploitation of plant and animal populations, the Māori will institute a *rāhui* as a kind of local moratorium on the harvest of biotic resources, thus allowing their numbers to recover[220].

This foresight is characteristic of *kaitikaitanga*, a dialectic in which respect for nature is tantamount to respect for both one's ancestors, who handed down an intact environment, as well as for one's descendants, who will inhabit it in the future[221]. In order to ensure that the current generation has the means to carry on the tradition of environmental stewardship, *kaitiakitanga* also aims to perpetuate "the values, language, culture, and wisdom that has been reliably passed down to [present-day Māori] over hundreds of generations[222]." Along with the environment and all the species that comprise it, the Māori see these cultural heirlooms as indispensable *taonga tuku iho*, "treasures handed down," which will ensure the health of *tangata whenua* for generations to come[223,224]. Thus, there is in *kaitiakitanga* a distinct recognition that in order to protect the environment, one should also protect the language in which people have learned to relate to it.

7. Discussion and Conclusion

The current environmental crisis is arguably the single greatest existential threat that humanity has ever faced. While other catastrophes may loom—like the threat of nuclear annihilation or a global pandemic—they remain nevertheless hypothetical. There is no doubt, however, that the earth-shattering realities of climate change, pollution, habitat destruction, and the resultant mass extinction of biodiversity are all upon us, and set to categorically determine the existence of this and all future epochs of humanity. Furthermore, where many so-called "global issues" are the prerogative of governments and specialists, the maintenance of the environment is a collective enterprise which equally implicates the gamut of everything and everyone on Earth. Indigenous peoples speak with an immanent awareness of this fact. Conversely, the rise and expansion of monocultures has over many generations eroded the memory of unity in diversity, which is conspicuously absent from our prevailing global dialogue. The Western obsession with compartmentalization has to a great extent left our communal wisdom in the hands of a myopic media, our sense of agency in exclusive institutions, and our identities in the manufactured and dangerously isolating narratives that they create. As a result we have locked ourselves into a discourse that construes the world is rigidly linear terms: in the boundaries of "independent" nations, in the bottom line of business, in the trajectory of "progress," and even in such mundanities as the fantastical "away" into which we "throw away" our trash. In an age of unprecedented global connectivity, it is ironic how integral this notion of "away" is to its socioeconomic architecture.

Indigenous cultures, on the other hand, remind us that "global connectivity" is not the triumphant innovation of globocapitalism, but an axiom of life on Earth. Where the discourse of monocultures trumpets linear connections *over* and *around* the Earth, indigenous discourses are rooted in a holistic connection *to* and *with* the Earth. The sense of mutualism that underpins indigenous knowledge systems makes them adaptive and responsive to environmental cues; moreover, their collective tenure reinforces each individual's stake in the wellbeing of their community, which is understood to include the ensemble of their physical and biological surroundings.

To the extent that indigenous knowledge systems are synonymous with indigenous languages, we find their every level replete with such ecological insights. From species nomenclature, to conceptual lexicons, to the spectrum of ancestral sayings and narratives which comprise an oral tradition, indigenous languages comprehensively express the interconnectedness of Earth's biota, and offer many details of just how this web of life fits together. As conservation biologists try to both mitigate and redress the effects of ecological degradation, the specific TEK encoded in indigenous languages constitutes an invaluable resource for enhancing our knowledge of ecosystem dynamics and local biodiversity. More generally, as our dominant global discourse currently promotes a worldview that is wreaking havoc upon the ecological systems and biodiversity which sustain us, we are in desperate need of a remedial, terracentric frame of mind that emphasizes humanity's interdependence with the environment. Indigenous languages present just that for our consideration.

This pseudo-Whorfian claim is probably the most controversial of any made in this paper. However, psycholinguistic inquiries into cultural frame switching support the view that languages act as a repository of cultural values, and, moreover, that the use of a particular language encourages speakers to enact the associated values—even to the exclusion of those internalized in another language[225]. Cultural frame switching therefore indicates that the viability of cultural concepts can be contingent upon a sympathetic linguistic or discursive context, thereby challenging the assertion that calquing linguistically-encoded knowledge can preclude any intellectual loss that language death may incur[226]. To illustrate this point, let us consider the possibility of calquing the Māori concept of *kaitiakitanga* into English, relative to the question of land development. The Māori word for "land development" is *ahuwhenua*, literally "piling up land/placenta (*whenua*)," which intrinsically evokes the entire Māori cosmology of Papatūānuku's *whenua* birthing and nurturing the great, interdependent family of all living things. As such, the spiritual and ecological connotations of *ahuwhenua* naturally implicate *kaitiakitanga* in any

discussion thereof. On the other hand, English neither discursively nor semantically accords *land development* any such spiritual or ecological significance. Thus, in order to viably calque *kaitiakitanga* into the Anglosphere's dialogue about land development, it would also be necessary to calque an appreciation of Māori cosmology into Anglophone culture.

That said, this is in fact occurring to some extent among the Anglophone population of Aotearoa New Zealand, who are progressively adopting many Māori terms, such as *kaitiakitanga*, into both colloquial Kiwi English and into the discourse of conservation science[227,228,229,230,231]. This of course raises the question: Why *can't* we just calque indigenous knowledge and concepts into the world's dominant languages, and then simply let the rest of them live or die as they will? Theory aside, the sheer numbers give us a clear answer: while *kaitiakitanga* may have seeped into one dialect of English, it is patently impossible to condense the unique perspectives and specific TEK of 3,500-6,300 at-risk languages into a mere 300 "safe" ones. Furthermore, the proposition of calquing entire knowledge systems is stupendous overkill, for our dominant global discourse would only have to internalize indigenous languages' sense of mutualism in order to preclude the socioeconomic regime which is in the first place responsible for the mass extinction of languages—thus leaving the bulk of said knowledge systems safe at home, in their native tongues. As such we need only encourage the sort of broad cultural exchanges and indigenous scholarship that we now see in ANZ, brought about through the joint efforts of both the Māori community and a government trying to repent in good faith for its colonial wrongdoings, with the end goal of creating a healthily bilingual nation[232,233]. In this way indigenous speech communities can thrive locally, giving them a platform from which to ultimately add their voices and insights to our global dialogue.

With this in mind, it is horribly egocentric for us in the developed world to consider indigenous languages only in terms of the informational and didactic utility that they present to our societies. It should go without saying that, more than anyone else, indigenous peoples need indigenous languages. A language is an identity, and for the world's indigenous both of these are rooted firmly in the Earth, thus enabling their societies to be the most effective conservationists on it. Indigenous languages link their speakers into the web of life around them, giving them both a sense of place therein and the knowledge of how to care for the many intertwining threads that weave together a people's niche in the world. This is the symbiosis of indigenous languages and biodiversity, two *taogna tuku iho* which are each other's *kaitiaki*.

8. References

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81. Crystal 2001
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104. Speciation in macroorganisms generally occurs over millions of years, while one language can diverge into two new, mutually unintelligible languages over several human generations.

105. Smith 2001, 106

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