DECLARATION ON THE SOCIAL-ECOLOGICAL IMPACTS OF AGAVE MONOCULTURES FOR MEZCAL PRODUCTION

At the 61st Annual Meeting of the Association for Tropical Biology and Conservation (ATBC), held in Oaxaca, Mexico—a region emblematic for its biocultural richness and its role in mezcal production—the scientists, professionals, community representatives, and non-governmental organizations signing this declaration express our deep concern about the growing social-ecological impacts resulting from the expansion of agave monocultures.

This transformation of the landscape, driven by high demand for mezcal worldwide (bottled and distributed by transnational corporations), poses a risk to biodiversity, traditional agroecological systems, key pollinators, and the Indigenous and Local Knowledge associated with agave cultivation by local maestros that have sustained agave and mezcal production in harmony with nature for centuries. Faced with this critical situation, we urgently call for responsible action, a long-term vision, and a commitment to social and environmental justice, as outlined in the following remarks.

1. Recent estimates indicate that tropical regions lost a record 6.7 million hectares of primary forest in 2024, marking an 80% increase over the previous year (Global Forest Review, 2025).

2. Forest loss is the primary driver of biodiversity decline in tropical regions (Newbold et al., 2016). This loss is mainly driven by the conversion of natural ecosystems, such as tropical forests, savannas, and wetlands, into industrial agricultural lands, pastures, or monoculture plantations. According to the IPBES

Global Assessment Report (2019), land-use change accounts for over 50% of forest loss in tropical areas. Similar patterns have been documented across Latin America, Southeast Asia, and Africa (Fitzherbert *et al*., 2008; Barlow *et al*., 2016; Curtis *et al*., 2018).

3. In Mexico, the expansion of agave monocultures for mezcal production has become an increasing threat to biodiversity, water availability, and traditional and indigenous food systems. In recent years, growing national and international demand for mezcal (Arellano-Plaza *et al*., 2022) has driven a shift away from diversified, agroforestry-based agave cultivation toward large-scale monocultures of *Agave angustifolia* (Torres-García *et al*., 2019; Klimova *et al*., 2023; Lucio, 2023). These intensive systems rely heavily on agrochemicals, disrupting long-standing ecological processes and cultural practices (Klimova *et al*., 2023; Valiente-Banuet, 2023).

4. At the same time, the extraction of wild agave species (e.g., *Agave cupreata*, *Agave potatorum*, *Agave marmorata*, *Agave karwinskii*, among others) for mezcal production is putting their populations and genetic diversity at risk in their natural ecosystems (Torres *et al*., 2015; Torres-García *et al*., 2020; 2021; García-Mendoza *et al*., 2019a, 2019b; 2019c; Alducin-Martínez *et al*., 2023; Ruiz-Mondragón *et al*., 2023, 2024; Valiente-Banuet, 2023).

5. The social-environmental impacts of these agave management models include one or several of the following impacts:

- The overexploitation of agaves and firewood from natural environments for mezcal production will have significant impacts, including the co-extinction of species and ultimately the collapse of ecosystems (Valiente-Banuet, 2023).

- Loss of native vegetation and habitat: Monocultures reduce landscape heterogeneity and fragment critical habitats, affecting wildlife and native flora (Foley *et al*., 2005).
- Genetic erosion: The widespread use of clonal reproduction in agave cultivation and the wild species overexploitation diminishes genetic diversity, making populations more vulnerable to pests, diseases, and climate change (Mondragón *et al*., 2022; Klimova *et al*., 2023).
- Decline of pollinators: Monoculture practices involve harvesting agave before flowering, which prevents pollination and harms mutualistic species, such as nectar-feeding bats (*Leptonycteris* spp.; Valiente-Banuet and Verdú, 2013; Trejo-Salazar *et al*., 2016).
- Unregulated, indiscriminate movement of germplasm from different agave species to areas where they are not native, bringing with it the movement of pests, such as the agave weevil (*Scyphophorus acupunctatus*), which is already attacking wild agave populations (Red Nacional de Manejadores de Maguey Forestal, 2019).
- Soil degradation and contamination: Excessive use of fertilizers and pesticides leads to reduced soil fertility, erosion, and water pollution (Foley *et al*., 2005).
- Decline in natural populations of wild agave species being harvested (Torres *et al*., 2015; Torres-García *et al*., 2021; Alducin-Martínez *et al*., 2023).
- Displacement and loss of traditional ecological knowledge and cultural practices: Industrial mezcal production displaces sustainable Indigenous and

peasant farming practices that integrate agave into biodiverse systems (Perfecto and Vandermeer, 2010; Valiente-Banuet and Verdú, 2024).

- Traditional mezcal producers experience more disparities and poverty due to unfair trade.
- Social conflicts at the community level often stem from the breakdown of social relationships.
- The illegal plundering and theft of wild populations to supply the demand in states with protected designations of origin (Red Nacional de Manejadores de Maguey Forestal, 2019).
- International spirits bottlers and distributors have purchased and distributed mezcal worldwide, often in association with tequila brands, which has generated high demand for raw materials over the past decade. The expansion due to the introduction of new players in recent years has increased production from around 2 million liters per year (2014) to more than 14 million liters per year in 2022.

6. Regional studies, especially in Oaxaca—the epicenter of mezcal production—highlight the scale of these impacts. For instance, in two hydrographic sub-basins of Oaxaca, a total of 34,953 hectares of forest were lost between 1995 and 2022, with 68% of this loss attributed to the conversion of forest to agave plantations (Sandoval-García *et al*., 2024). In an indigenous community, agave plantations increased from 5.7% to 21.7% of communal land between 1993 and 2019, coinciding with a 6% decline in tropical dry forest cover and associated biodiversity (Lira *et al*., 2022).

Given this reality, and acknowledging the high biocultural value and economic importance of mezcal for communities, we urge authorities, industry, and civil society to collaborate with rural and Indigenous agave and mezcal-producing communities to defend agave and mezcal, along with their associated biocultural heritage (including territories, ecosystems, genetic and biological resources, and traditional knowledge), and livelihoods. To this end, we propose the following actions:

1. Strengthen community governance mechanisms aimed at land use planning and promoting diverse forms of conservation and sustainable management, primarily in tropical dry forests.

2. Regulate the expansion of industrial agave monocultures, especially in ecologically sensitive areas and Indigenous or communal territories.

3. Regulate the overharvesting of wild agave species and firewood through Management Units (Unidades de Manejo para la Conservación, UMAs) to prevent the extinction of their populations, and stop the "agroextractivism" of native and endemic Agave species (https://onlinelibrary.wiley.com/doi/full/10.1111/joac.12402)

4. Agave producers should consider designating part of their communal lands for conservation to safeguard wild agave species and preserve their genetic diversity.

5. Promote added values to agroforestry, among others, sustainable production models that integrate native species, traditional knowledge, and respect ecological and evolutionary and coevolutionary processes across the biocultural landscape (Red Nacional de Manejadores de Maguey Forestal, 2019; Schroth *et al*., 2004).

6. Ensure protection of the different insect and vertebrate pollinator species, particularly but not only nectar-feeding bats, by allowing a sufficient proportion of

agave plants to flower and maintaining ecological corridors (Trejo-Salazar *et al*., 2016; Valiente-Banuet, 2023).

7. Mexican government at all its levels (local, state, federal), consumers, producers and sellers should support certification (or labels) schemes and markets for sustainably and traditionally produced mezcal, emphasizing biodiversity conservation, cultural heritage, and local livelihoods such as "biocultural labels" or "biocultural products" to ensure the "fair" trade and income to conservation measures (Trejo-Salazar et al., 2016; Red Nacional de Manejadores de Maguey Forestal, 2019).

8. Recognize and legally protect Indigenous and Local Knowledge, territorial and biocultural rights of Indigenous and peasant communities, who are key actors in shaping sustainable agroforestry landscapes (Perfecto and Vandermeer, 2010), considering gender and intergenerational perspectives.

9. Stop the standardization of mezcal's organoleptic characteristics, the loss of traditional "identity-cultural sense" promoted by a standard that does not protect culture and mezcal sustainability (Nogales, 2024).

Based on scientific evidence and the principles of social-environmental and cultural responsibility, we call for the respect to the traditional practices of production of mezcal and in all the other agave-based drinks (spirits, including but not just restricted to pulque, tequila, bacanora, raicilla, among others)— one that prioritizes sustainability, maintains biodiversity, respects cultural and biocultural heritage, and ensures ecological and economic viability to strengthen the livelihoods of communities in the long-term.

"Preserving nature and its associated bioculturality means preserving mezcal."

"Saving biodiversity and tradition means saving mezcal."

"Without nature and bioculturality, no mezcal will endure."

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