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BATS FORAGING TECHNIQUES ENHANCE FOREST ECOSYSTEM SERVICES AND AID IN PLANT SURVIVAL

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Bats foraging techniques enhance forest ecosystem services and aid in plant survival

Ecosystem - Tropical and temperate forests, rainforests: Tropical and temperate forests, including rainforests, are biodiverse ecosystems essential for global biodiversity and climate regulation. They act as major carbon sinks that capture atmospheric CO_2 and mitigate climate change (Pan *et al*., 2011). Rainforests regulate local and global climates by influencing temperature, humidity, and rainfall patterns, and by supporting the water cycle, stabilising river flows and replenishing groundwater to reduce the risk of droughts and floods. Their dense vegetation and extensive root systems prevent soil erosion and enhance soil fertility. In addition, rainforests provide valuable resources, including medicinal plants and raw materials, such as timber, oils, and fruits, which support industries, human health, and traditional practices (Boyles *et al*., 2011; Brandt *et al*., 2014; Alamgir *et al*., 2016). As ecotourism locations they offer recreational and economic benefits while also holding cultural and spiritual significance for many indigenous communities.

Species - Migratory Bats: There are 51 species of migratory bats listed on the CMS Appendices (CMS, 2020). In tropical and subtropical regions, migration movements are generally in response to the availability of ephemeral food resources (Fleming & Eby, 2003). Bats are threatened by various human-induced factors, including deforestation, habitat fragmentation, and climate change-induced shifts in food availability and migration routes (Voigt & Kingston, 2016).

Ecosystem services - plant reproduction and forest connectivity: Despite their often-negative associations with pathogen transfer, bats provide important contributions to a range of ecosystem services (Ramírez-Fráncel *et al*., 2021). Bats are one of the few groups of species that provide ecosystem services that are directly relevant to plant growth and survival, as well as aiding forest regeneration, and controlling insect populations (Kunz *et al*., 2011; Ramírez-Fráncel *et al*., 2021; Brasileiro *et al*., 2022). By dispersing seeds and pollinating plants, bats enhance forest restoration and resilience, promoting flora growth that supports diverse wildlife and increases carbon sequestration in trees and soil (Sritongchuay *et al*., 2019; Voigt *et al*., 2021). Each bat species provides at least one of the following ecosystem services: pollination, seed dispersal, pest control and fertiliser via guano (Frafjord, 2007; Krauel, Westbrook & McCracken, 2015; Burke *et al*., 2021; Ramírez-Fráncel *et al*., 2021; Manning & Ando, 2022). Megabats (flying foxes) are predominantly frugivores targeting fruiting trees, consuming both the fruit as well as blossoms, pollen, leaves and insects. Rainforest regeneration is important given the reduction in rainforest habitat due to direct human destruction but may also play a key role in facilitating changes in the distribution of fruiting trees in response to climate change. Nectivorous bats, such as those which migrate through the Chihuahuan and Sonoran Deserts, crossing between the US and Mexico, are important pollinators and seed dispersers of columnar cacti and agave (*Agave spp.*) which are found in tropical dry forests. As this habitat is increasingly becoming patchy, the continued pollination and seed dispersal by the bats will be imperative for these plant species to retain genetic diversity (Burke *et al*., 2021).

Conservation Actions: Legislation protecting rainforest reserves and national parks has been crucial in safeguarding biodiversity hotspots and migratory corridors, supporting bat populations through carbon credit projects, reforestation, and emission reduction efforts (Frick *et al*., 2020). Local community involvement in these areas has raised awareness

about bats' ecological roles, helping mitigate threats like habitat loss and wind turbine collisions (CMS, 2020). International frameworks like the CBD and CMS, along with NGOs such as Bat Conservation International and WWF, have facilitated bat conservation efforts through funding, research, and habitat protection. Since bats use both primary and secondary forests, reforestation and protecting secondary forests are vital for providing essential roosting and foraging habitats.

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