

6.2 Ecological challenges facing the galápagos marine iguana

The Galápagos marine iguana faces several ecological challenges, primarily due to anthropogenic threats and environmental changes. The species is currently listed as Vulnerable on the IUCN Red List, with small effective population sizes on certain islands such as Floreana and San Cristobal, making them particularly susceptible to extirpation (MacLeod and Steinfartz, 2016).

Additionally, the iguanas exhibit size-related differences in foraging behavior, with larger individuals feeding subtidally and smaller ones intertidally, which may affect their thermoregulatory strategies and vulnerability to environmental changes. The iguanas' diet, primarily consisting of marine macroalgae, also shows geographical variation, with different subspecies consuming distinct algal species, potentially reflecting differences in algal abundance or dietary preferences (Anslan et al., 2021).

6.3 Conservation strategies implemented

Conservation strategies for the Galápagos marine iguana have increasingly incorporated molecular data to better understand and manage population structures. Recent studies have identified distinct population clusters across the archipelago, which are proposed as management units to prioritize conservation efforts. These strategies emphasize the need for accurate census size estimates and focus on islands with critically small populations. Additionally, the development of new microsatellite loci has provided powerful tools for monitoring genetic diversity and population dynamics, aiding in the formulation of effective conservation plans (MacLeod et al., 2012). Field-based radiographic imaging has also been explored as a non-invasive method to assess the health and physiological status of marine iguanas in their natural habitat (Figure 1), offering a novel approach to conservation research (Lewbart et al., 2018).

6.4 Lessons Learned and Broader Implications

The conservation of the Galápagos marine iguana highlights the importance of integrating ecological and evolutionary perspectives in conservation programs. The species' unique evolutionary history, characterized by hybridization and speciation, underscores the need for conservation strategies that consider genetic diversity and population structure. The use of molecular tools has proven invaluable in identifying management units and informing conservation priorities, demonstrating the potential for similar approaches in other species with complex evolutionary backgrounds (Quezada and Steinfartz, 2015).

Furthermore, the ecological challenges faced by the marine iguana, such as dietary specialization and thermoregulatory behavior, illustrate the intricate interplay between environmental factors and species adaptation, offering insights into the broader implications of climate change and habitat alteration on marine and terrestrial ecosystems (Anslan et al., 2021).

7 Innovative Approaches in Reptile Conservation

7.1 Application of genomic tools in conservation

The application of genomic tools in reptile conservation has emerged as a pivotal strategy to address biodiversity loss and extinction risks. Genomic approaches provide insights into genetic diversity, population dynamics, and evolutionary histories, which are crucial for effective conservation planning. For instance, the use of genome-wide SNP datasets has been instrumental in understanding the diversification and adaptation of reptile species in specific environments, such as the Hajar Mountains in Arabia, where genomic data revealed high levels of within-mountain diversification and the impact of past climatic events on species assemblage (Burriel-Carranza et al., 2024). Similarly, the development of high-quality reference genomes for species like the Christmas Island blue-tailed skink and Lister's gecko has provided valuable information on genetic diversity and inbreeding patterns, which are essential for managing captive populations and planning reintroductions (Dodge et al., 2023).

Moreover, genomics has facilitated the identification of cryptic lineages and the assessment of genetic variation critical for the survival of endangered species. This is particularly important for reptiles, which often inhabit remote and understudied regions (Shaffer et al., 2015). Despite the potential of genomic tools, challenges remain in translating genomic data into practical conservation actions. There is a need for improved infrastructure, mature