allowing for the detection of loci under selection in response to ecological pressures (Pérez-Cobas et al., 2020; Ozerov et al., 2025). This integrative approach enhances the understanding of how natural selection operates in heterogeneous environments and informs the identification of adaptive genetic variation.

6.2 Identifying eco-genomic units for management

Defining eco-genomic units—populations or lineages characterized by distinct ecological and genomic profiles—enables more precise conservation management (Katsikis et al., 2014; Guevara-Escudero et al., 2021). Integrative studies that combine ecological, phylogeographic, and genomic data can map the geographic distribution of genealogical lineages and adaptive traits across landscapes (Guevara-Escudero et al., 2021). This process helps identify locally adapted populations and informs the delineation of management units that reflect both genetic diversity and ecological function, which is critical for maintaining evolutionary potential and ecosystem resilience (Katsikis et al., 2014; Guevara-Escudero et al., 2021).

6.3 Predictive models for population viability

The integration of ecological and genomic data supports the development of predictive models for population viability under changing environmental conditions (Richardson et al., 2016; Matthews et al., 2018). By incorporating genomic estimates of adaptive capacity and ecological variables, these models can forecast population responses to threats such as habitat loss, climate change, and disease (Richardson et al., 2016; Matthews et al., 2018). Such models are essential for adaptive management, as they allow conservationists to anticipate future challenges and prioritize actions that enhance the persistence of genetically and ecologically important populations (Richardson et al., 2016; Matthews et al., 2018).

7 Conservation and Management Implications

7.1 Conservation priorities based on integrated data

Effective conservation of the Saker Falcon requires integrating ecological, genomic, and social data to set priorities that address both species persistence and ecosystem health. Area-based conservation remains foundational, but its effectiveness depends on adaptive management, robust monitoring, and the use of open data infrastructures to track population trends and threats (Maxwell et al., 2020; Hoffmann, 2021). Conservation actions—such as habitat protection, invasive species control, and restoration—have been shown to improve or slow declines in biodiversity in most cases, but require scaling up and continuous evaluation to meet global targets (Maxwell et al., 2020; Langhammer et al., 2024). Prioritizing conservation actions should also consider the evolutionary impacts of management, ensuring that strategies maintain genetic diversity and adaptive potential (Shefferson et al., 2018).

7.2 Transboundary cooperation in falcon protection

Given the Saker Falcon's wide range across multiple countries, transboundary cooperation is essential for effective conservation. International agreements, shared monitoring protocols, and coordinated management of protected areas can help address threats such as habitat loss, illegal trade, and environmental change that cross national borders (Van Kerkhoff et al., 2018; Maxwell et al., 2020). Collaborative frameworks should secure adequate financing, harmonize biodiversity policies, and mainstream conservation into broader land, water, and sea management to ensure long-term success (Van Kerkhoff et al., 2018; Maxwell et al., 2020). The "One Conservation" approach, which integrates in situ and ex situ efforts and involves multiple sectors, further highlights the need for joint action across regions and disciplines (Pizzutto et al., 2021).

7.3 Role of citizen science and local communities

Engaging local communities and citizen scientists is critical for the long-term success of conservation initiatives. Community-based conservation, co-management, and biocultural approaches that integrate local knowledge and address social, economic, and cultural needs can reduce conflicts and increase support for protected areas (Bennett, 2016; He et al., 2020; Hoffmann, 2021). Positive perceptions and active participation by local people enhance compliance, monitoring, and adaptive management, while also ensuring that conservation benefits are equitably shared (Bennett, 2016; He et al., 2020; Mubalama et al., 2020). Citizen science initiatives can fill data gaps, improve monitoring efficiency, and foster stewardship, making them valuable tools for both research and management (Bennett, 2016; Hoffmann, 2021).