Applied Population Biology

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What is applied population Biology

How can conservation biologists know if a plan for endangered species will succeed?

Populations can be stable, increasing, decreasing, or fluctuating.

Human disturbance often destabilizes populations.

Applied population biology studies factors affecting the abundance and distribution of rare and endangered species.

Applied population biology helps understand factors affecting abundance and distribution of rare and endangered species.

Implementing Effective Population-Level Actions

Environment

Habitat types and area

Environmental variability

Frequency of catastrophes

Human impacts

Distribution

Where the species occurs in its habitat

Are individuals clustered, random, or evenly spaced?

Movement and migration among habitats or regions

Ability to colonize new habitats

Human impacts on species distribution

Biotic Interactions

Food and resource needs

Competition with other species

Predators, parasites, and diseases

Mutualists (pollinators, dispersers)

Dispersal of juveniles

Human impacts on species interactions

Morphology

Physical appearance: shape, size, color, and structure of body parts

Relationship between body form and function for survival

Features that distinguish the species from similar species

Physiology

Requirements for survival: food, water, minerals, and resource use efficiency

Tolerance to environmental conditions (heat, cold, wind, rain)

Reproduction timing and physiological requirements

Methods for Studying Populations

Published Literature

Previous studies, books, and reports provide information on population size and distribution

Sources include databases, journals, and online tools (e.g., Web of Science, Google Scholar)

Literature must be evaluated carefully for accuracy and used to find additional references

Unpublished Literature

Valuable information found in reports from scientists, government agencies, and conservation organizations

Includes “gray literature” not formally published but widely used in conservation

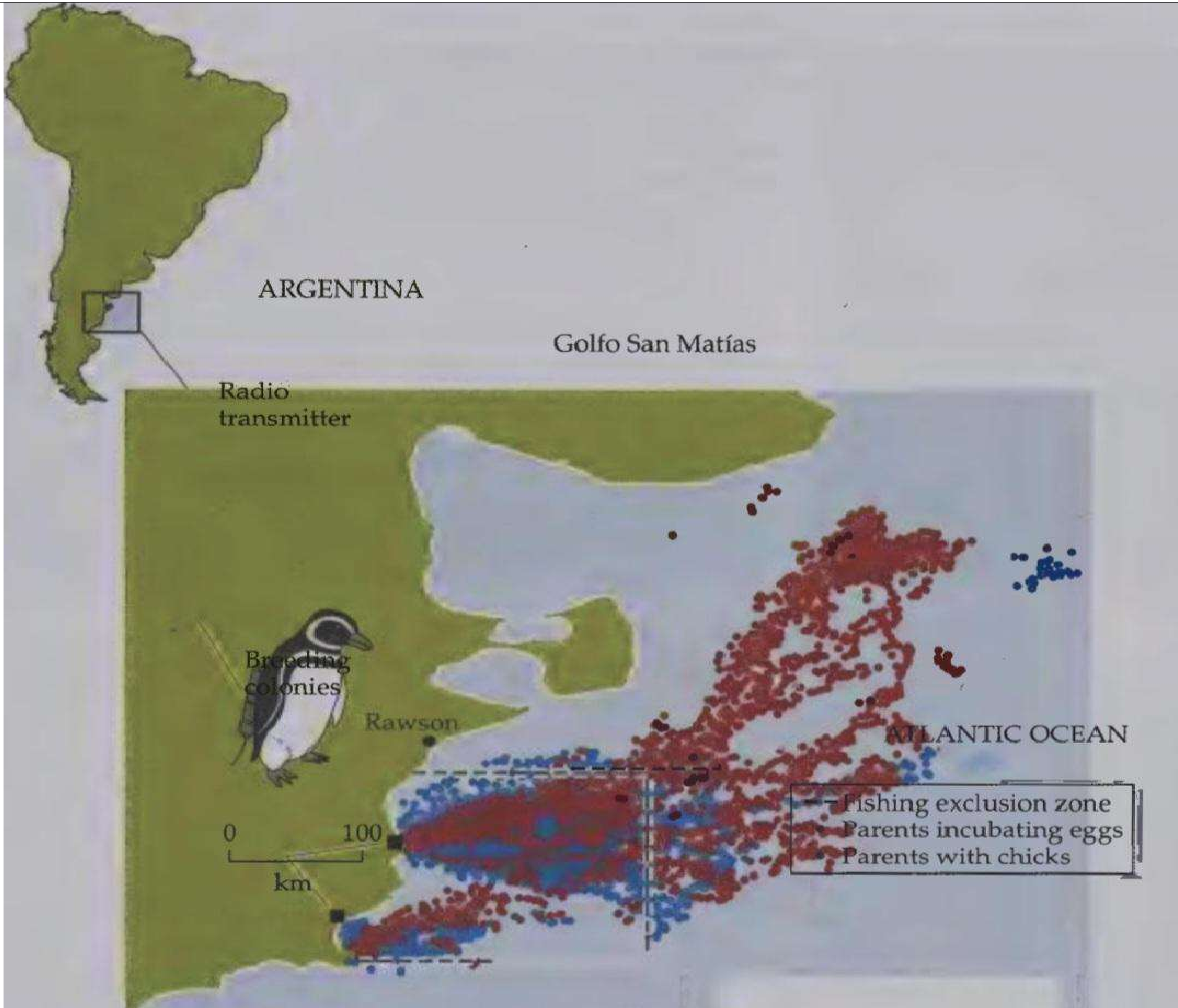
Can be obtained through direct contact, organizations, or online sources

Fieldwork

Essential for understanding species' natural history and conservation status

Involves direct observation of populations and their environment

Important for developing conservation plans and may include local knowledge and specialized methods


ARGENTINA
Golfo San Matías
Radio
transmitter
Breeding
colonies
Rawson
ATLANTIC OCEAN
0
100
km
Fishing exclusion zone
Parents incubating eggs
Parents with chicks

hree Primatologist (Trimates)

hree scientists — Jane Goodall, Dian Fossey, and Birutė Galdikas — studied great apes (chimpanzees, gorillas, orangutans).

hey did long-term field studies and discovered important behaviors (like tool use and social interactions).

Their work helped improve scientific methods and understanding of animal behavior.

They later became conservation activists, working to protect endangered apes.

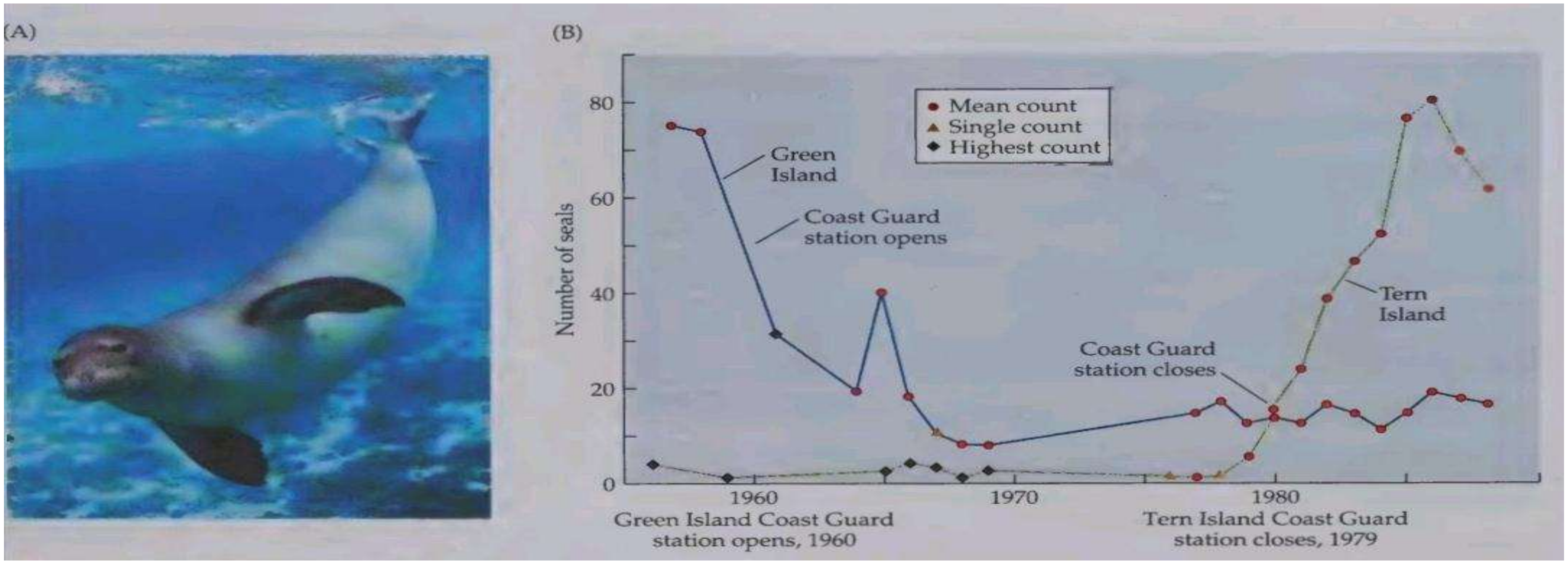
Jane Goodall studied chimpanzees in Tanzania starting in 1960. She discovered tool use, meat eating, and complex social behaviors. Her study has continued for over 50 years.

Dian Fossey studied mountain gorillas in Rwanda (1967–1985). She discovered female movement between groups and male infanticide, helping explain gorilla social structure.

Birutė Galdikas studied orangutans in Borneo starting in 1971. She discovered their diet, long maternal care, and social behavior.

All three used long-term fieldwork and later became conservation activists to protect endangered apes.

Census



Census Importance

Determines if population is stable, increasing, or decreasing

Helps identify species decline and distribution

Used in conservation decisions (e.g., endangered species listing)

Population viability Analysis

PVA predicts the probability of extinction using mathematical and statistical models

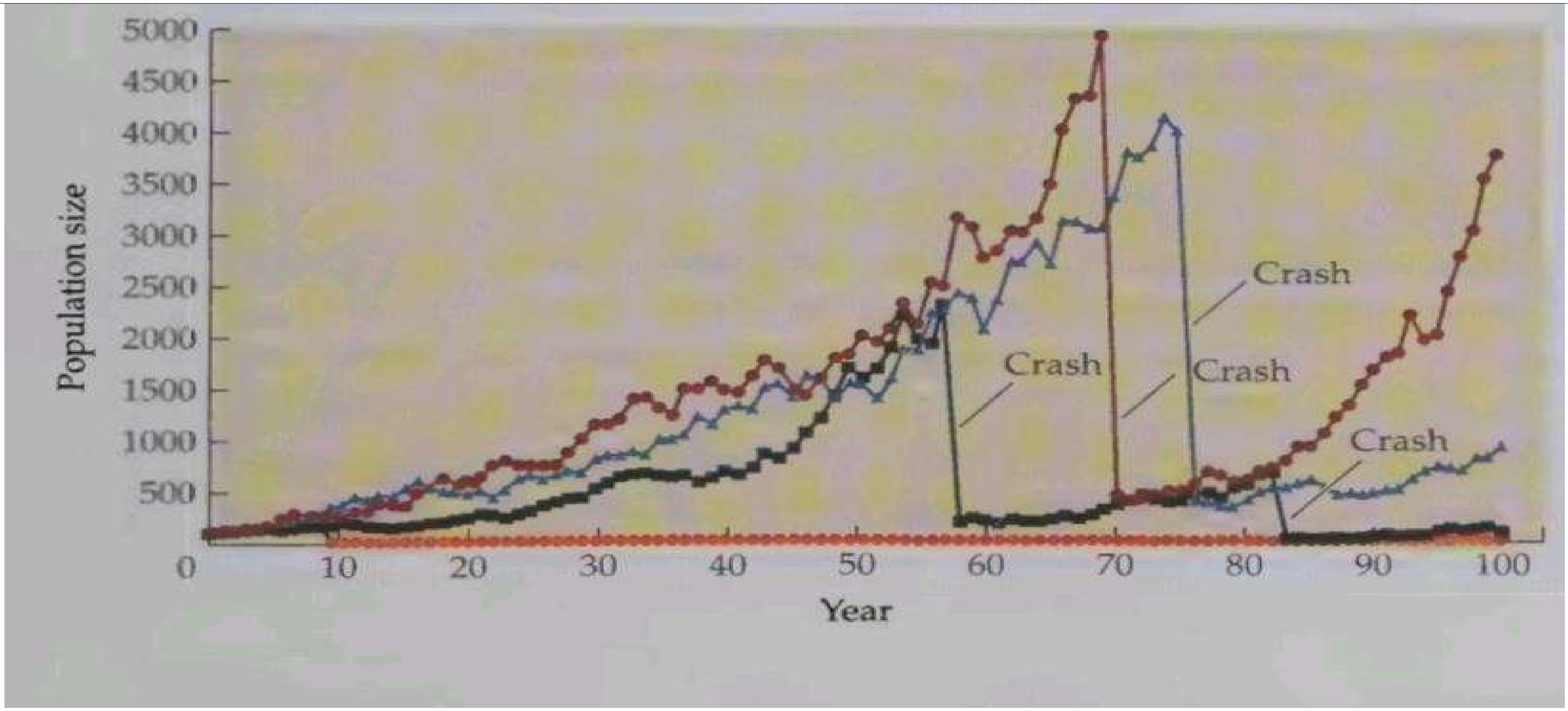
Identifies vulnerable stages and effects of habitat loss, fragmentation, and management actions

Uses population data (mortality, reproduction, age structure) to simulate future outcomes

Uses mathematical and statistical methods to predict extinction probability

Estimates survival of a population over a specific time period

Models effects of habitat degradation and management actions



The graph shows population size over time (years)

There are 4 different populations being simulated

All populations grow about 5% per year, but:

There are random changes (environment + chance)

Sometimes a catastrophe happens (2% chance)Some populations recover after a crash

Others become too small and go extinct

Even with good growth, random events can cause extinction

Applied Population Biology in Ethiopia

Used to monitor endangered species such as the Ethiopian wolf and Mountain nyala

Helps assess population size, distribution, and extinction risk

Identifies threats like habitat loss, human disturbance, and disease

Supports conservation actions such as protected areas and species management

The Ethiopian Wolf

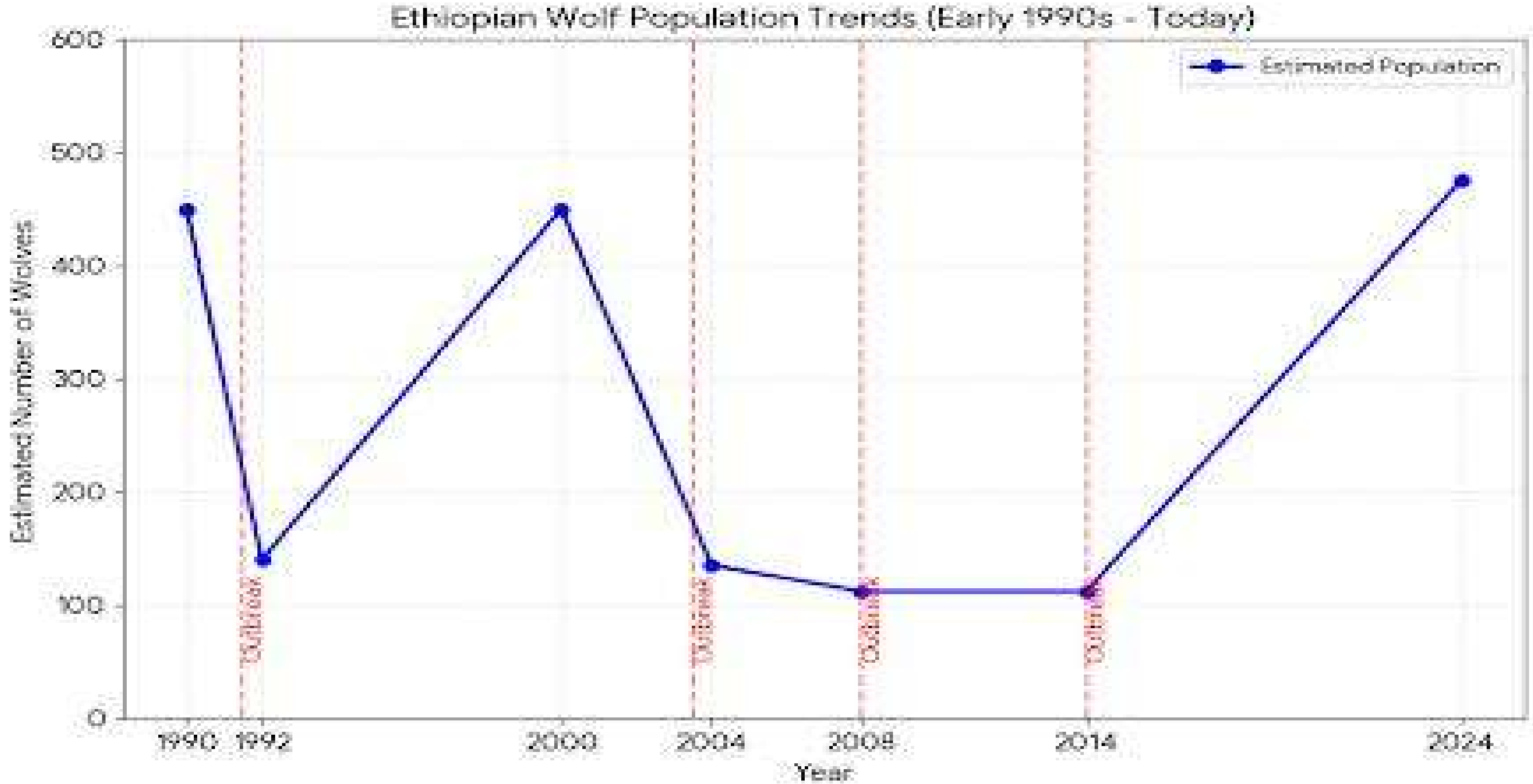
The Ethiopian wolf (Canis simensis) is the world’s rarest canid and Africa’s most endangered carnivore. Found only in the high-altitude mountains of Ethiopia, fewer than 500 adults remain in the wild.

Disease outbreaks cause rapid population crashes

Habitat loss reduces available space

Small populations → high extinction risk

Human activities increase pressure on populations

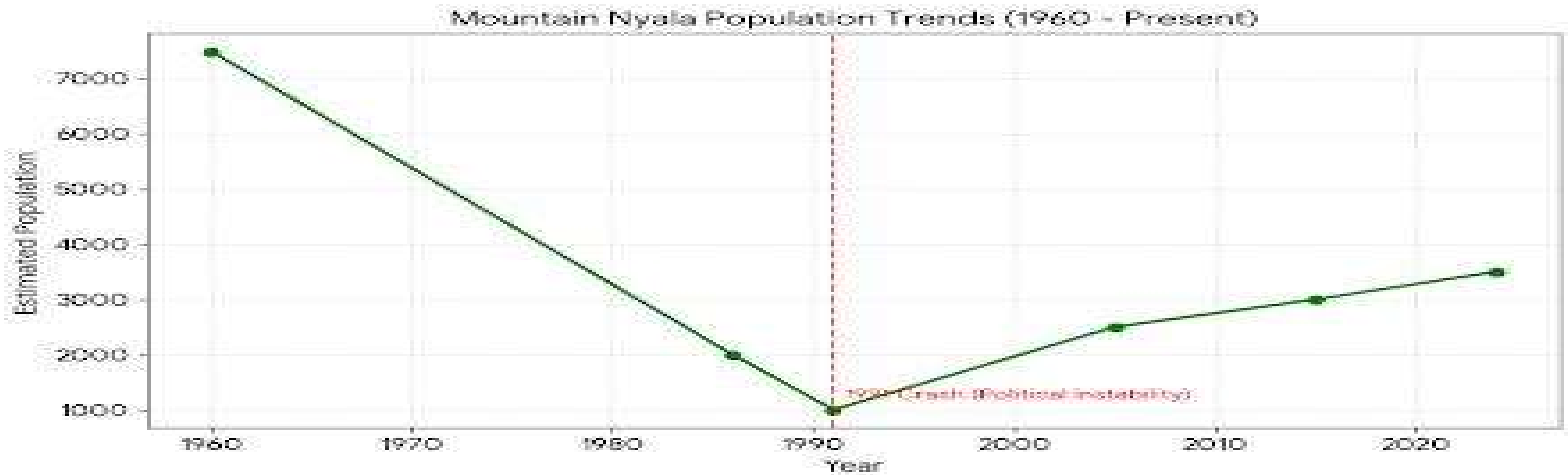


Ethiopian Wolf Population Fluctuations and Disease Impacts (1990–Present)

Cyclical Crashes: The population has historically crashed every 5–10 years due to disease, often losing 70\% to 75\% of its individuals during major outbreaks.

Resilience: Despite these crashes, the species has shown a remarkable ability to recover to a baseline of approximately 450–500 individuals when conservation efforts and vaccinations are in place.

Current Status: The population is currently at a "high" point in its cycle (around 450–500), but remains Endangered due to its fragmented habitat and the persistent threat of future outbreaks.



Gelada: ~200,000 individuals; affected by habitat loss and human expansion

Mountain nyala: ~2,000–4,000 individuals; threatened by hunting and habitat loss

Population studies monitor size, distribution, and threats

Data used to support conservation and management strategies

Strategies in Applied Population Biology: Preserving Ethiopia’s Endemic Biodiversity

High-Tech Genetic Monitoring (Ex-Situ & In-Situ)

Biologists are now using more than just binoculars:

The Ethiopian Biodiversity Institute (EBI): They maintain gene banks and zoological gardens as a "safety net." If a wild population of an endemic bird or reptile crashes, they have the genetic material to potentially reintroduce the species.

Non-Invasive Sampling: Researchers are increasingly using fecal DNA sampling and hair snares to monitor elusive populations (like the Bale Mountain vervet or the Walia Ibex) without stressing the animals by capturing them.

Disease Mitigation Strategies

Oral Vaccination Campaigns: For the Ethiopian wolf, conservationists don't just wait for an outbreak. They deploy Oral Rabies Vaccine (ORV) baits. This is a form of "applied immunology" designed to create herd immunity within the wolf population before the virus even arrives.

Domestic Dog Management: Since rabies usually jumps from domestic dogs to wild wolves, mass vaccination of dogs in the villages surrounding the Bale Mountains is a primary "buffer zone" strategy.

The "Green Legacy" Initiative & Habitat Corridors

Habitat fragmentation is a silent killer for population biology. To fight this, Ethiopia has implemented:

Massive Reforestation: The Green Legacy Initiative has planted billions of trees to reconnect isolated "islands" of forest.

Wildlife Corridors: In southwest Ethiopia, the Tama Community Conservation Area acts as a critical 500,000-acre bridge between Omo and Mago National Parks. This allows genetic exchange for lions, cheetahs, and the rare Somali giraffe, preventing the "inbreeding depression" that often leads to extinction.

Summary