Florida Panther Population Viability Models

HOW WE ARRIVED AT A NUMBER OF 240 PANTHERS AS A VIABLE POPULATION

A PRESENTATION TO THE
FLORIDA PANTHER RECOVERY CRITERIA REVIEW TEAM

RANDY KAUTZ
JANUARY 27, 2016

Belden
1245

Florida Panther

Population Viability Analysis

February 23, 1989
Captive Breeding Specialist Group

CBSG

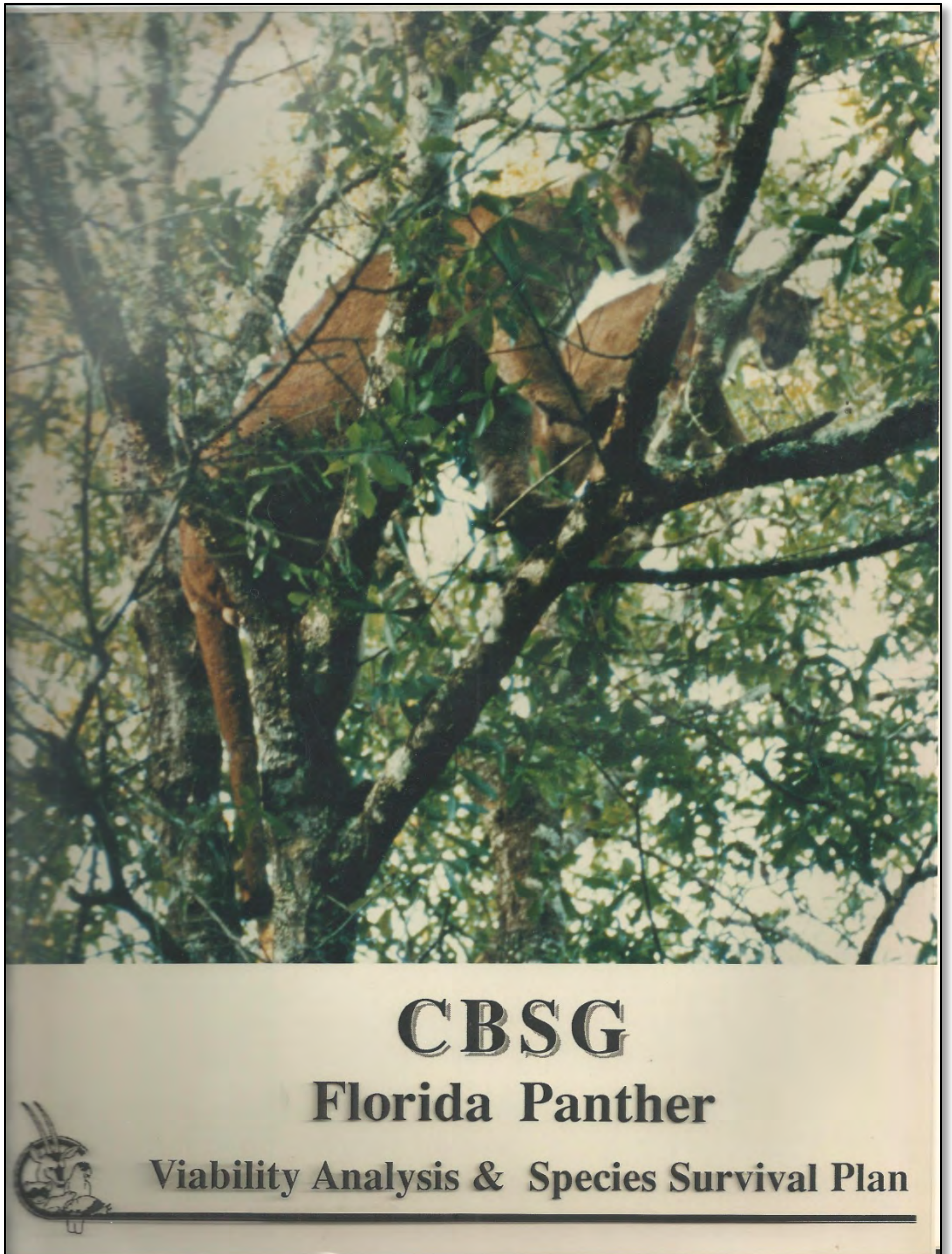
J. D. Ballou, T. J. Foose, R. C. Lacy, And U. S. Seal. 1989.

Based on a PVA workshop held in Naples FL January 4-6, 1989.

Fulfillment of USFWS Cooperative Agreement

Ballou et al. 1989 Findings

- Goal: recommend actions and a schedule to assure 95% probability of survival for 100 years and retention of 90% of heterozygosity
- 1989 Population Size: approximately 30 adults, 15 juveniles (initial population of 45)
- Demographic Projections: 85% probability of extinction in 25 years; mean time to extinction of 20 years
- Genetic Projections: 30 adults have effective size of 8-15, and lose 50-75% of heterozygosity in 100 years
  - Cryptorchidism and sperm abnormalities already present
- Conclusion: establish a captive breeding population



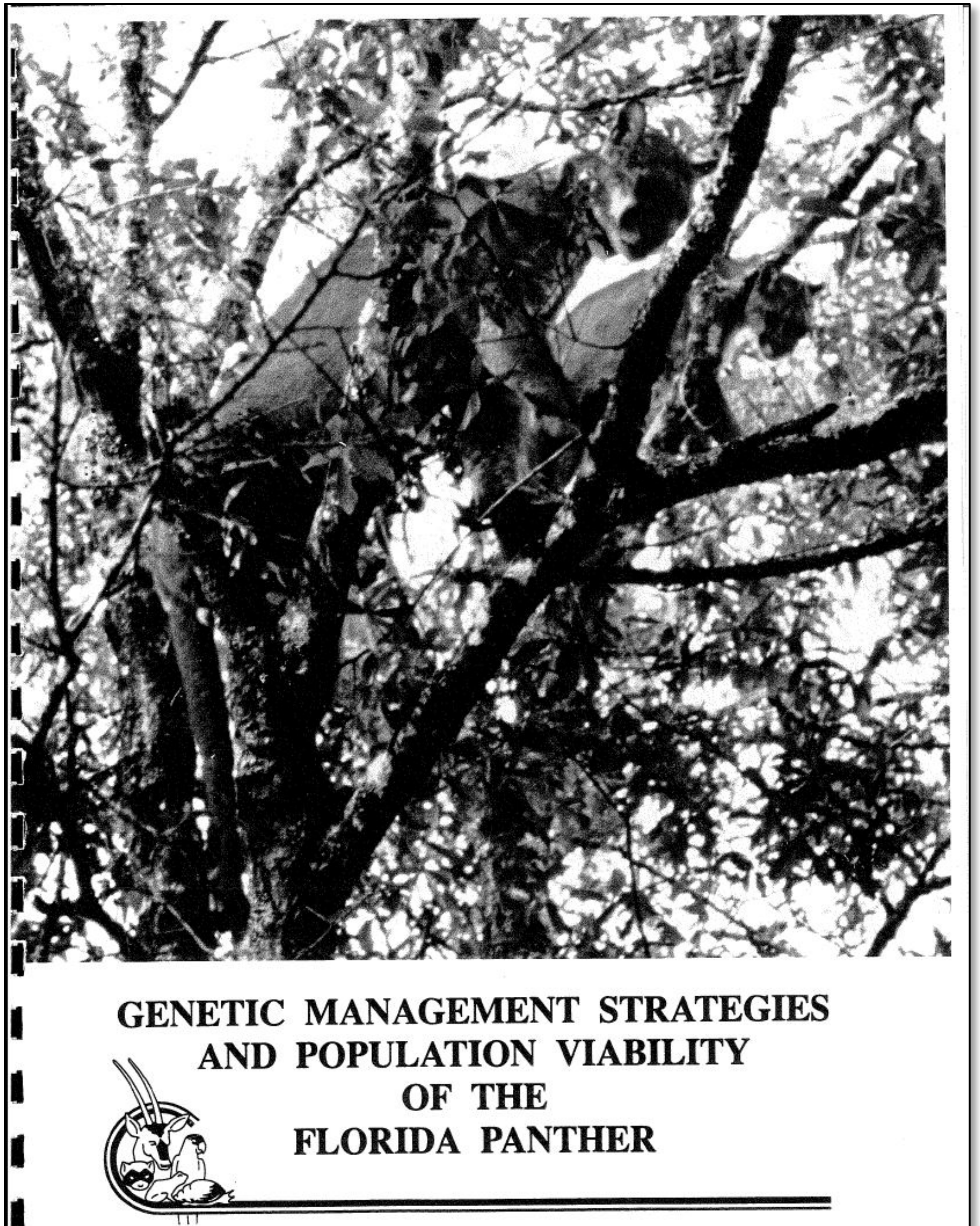
U. S. Seal, R. C. Lacy, and Workshop Participants. 1989.

Based on a PVA and species survival Plan workshop held in Gainesville FL October 31-November 2, 1989.

Fulfillment of USFWS Cooperative Agreement

Goals: Revisit PVA from January workshop and develop a plan for a captive breeding population

No significant change to PVA results



U. S. Seal, R. C. Lacy and Workshop Participants. 1992.

Based on a workshop held at White Oak Conservation Center, Yulee, FL. October 21-22, 1992.

Fulfillment of USFWS Cooperative Agreement

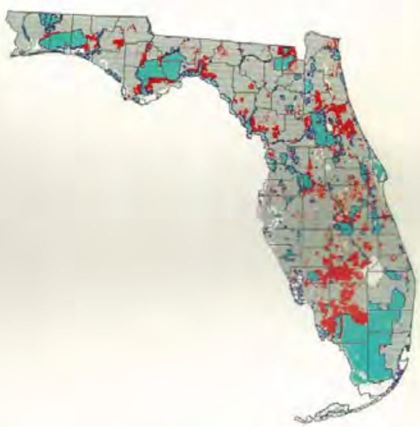
Purpose: increasing evidence of inbreeding resulted in the need to revaluate population viability and to pursue genetic augmentation to reverse effects of inbreeding

1992 Workshop Findings

- New set of PVAs performed using VORTEX
  - Simulations of 250 populations over 25-200 years; three levels of inbreeding depression; initial populations of 30 and 50; varying rates of habitat loss; and varying age at first breeding
- Results: 30-50 adults demographically and genetically unstable and likely to become extinct in 24-63 years assuming 50% juvenile mortality
- Conclusion: results did not differ substantially from those reported in 1989
- Optimistic model: 50 adults, no change in K, first breeding at 2 years, and 20% juvenile mortality had 0% chance of extinction in 100 years
  - But even this model nearly always led to extinction due to interacting effects of demographic variability and inbreeding

CLOSING THE GAPS IN FLORIDA'S WILDLIFE HABITAT CONSERVATION SYSTEM

Recommendations to meet minimum conservation goals for declining wildlife species and rare plant and animal communities.



James Cox, Randy Kautz, Maureen MacLaughlin, and Terry Gilbert

Office of Environmental Services
Florida Game and Fresh Water Fish Commission
620 South Meridian Street
Tallahassee, Florida 32399-1600

1994

Conservation in Practice

Strategic Habitats for Biodiversity Conservation in Florida

RANDY S. KAUTZ* AND JAMES A. COX

Florida Fish and Wildlife Conservation Commission, 620 South Meridian Street, Tallahassee, FL 32399-1600, U.S.A.

Abstract: *Privately owned lands support a large portion of the biodiversity in some areas, but procedures for identifying those private lands critical to the maintenance of biodiversity vary tremendously. We used habitat-based distribution maps in combination with population conservation goals to help identify strategic habitats on private lands in Florida. We used a vegetation map, occurrence data, and published life-history information to create habitat-based distribution maps for 179 rare taxa. We estimated the security of 130 of the taxa by overlaying public land boundaries on habitat maps and then estimating whether conservation lands satisfied a population goal of supporting at least 10 populations of approximately 200 breeding adults. The remaining taxa were evaluated in terms of number of occurrence records on conservation lands. Of the 179 taxa evaluated, existing conservation lands did not adequately protect 56. We then identified habitats on private lands that could best satisfy the minimum conservation goal or else significantly enhance the survival potential of inadequately protected taxa. Strategic habitats included a mix of large and small sites, incorporated some corridor or stepping-stone connections among habitat patches, and protected multiple species. Additional strategic habitats were identified for shorebirds, four natural plant communities, and 105 globally rare plants. The strategic habitats identified in Florida cover 1.65 million ha (12% of the land area) and would cost $8.2 billion (about 15% of Florida's annual state budget) to purchase and $122 million per year to manage. Existing conservation lands account for 3.07 million ha (22% of the land area).*

Hábitats Estratégicos para la Conservación de la Biodiversidad en Florida

Resumen: *Las tierras de propiedad privada albergan una porción grande de la biodiversidad en algunas áreas, pero los procedimientos para identificar aquellas tierras privadas críticas para el mantenimiento de la biodiversidad varía tremendamente. Nosotros utilizamos mapas de distribución basados en hábitats, en combinación con metas de conservación poblacional que ayudan a identificar hábitats estratégicos en tierras privadas en Florida. Usamos un mapa de vegetación, datos de ocurrencia e información publicada sobre historias de vida para crear mapas de distribución basados en hábitats de 179 taxones raros. La seguridad de 130 de los taxones fue estimada al sobreponer límites de tierras públicas en mapas de hábitat y estimando si las tierras para conservación satisfacían las metas poblacionales de albergar por lo menos a 10 poblaciones de aproximadamente 200 adultos reproductores. Los taxones restantes fueron evaluados con base en el número de registros de ocurrencias en tierras de conservación. De los 179 taxones evaluados, las tierras para conservación existentes no fueron adecuadas para proteger a 56 de ellas. Se identificaron los hábitats en tierras privadas que podrían satisfacer de mejor manera la meta mínima de conservación o por lo menos mejorar significativamente el potencial de supervivencia de taxones protegidos inadecuadamente. Los hábitats estratégicos incluyeron una mezcla de sitios grandes y pequeños, incorporando algo de corredor o conexiones clave entre los parches de hábitat y protegiendo múltiples especies. Hábitats estratégicos adicionales fueron identificados para aves playeras, cuatro comunidades naturales de plantas y 105 plantas mundialmente raras. Los hábitats estratégicos identificados en Florida cubren 1.65 millones de ha (12% del área terrestre) y costarían 8.2 mil millones de dólares (cerca del 15% del presupuesto estatal anual para Florida) para comprar y 122 millones de dólares por año para manejar. Las tierras para conservación existentes involucran 3.07 millones de ha (22% del área terrestre).*

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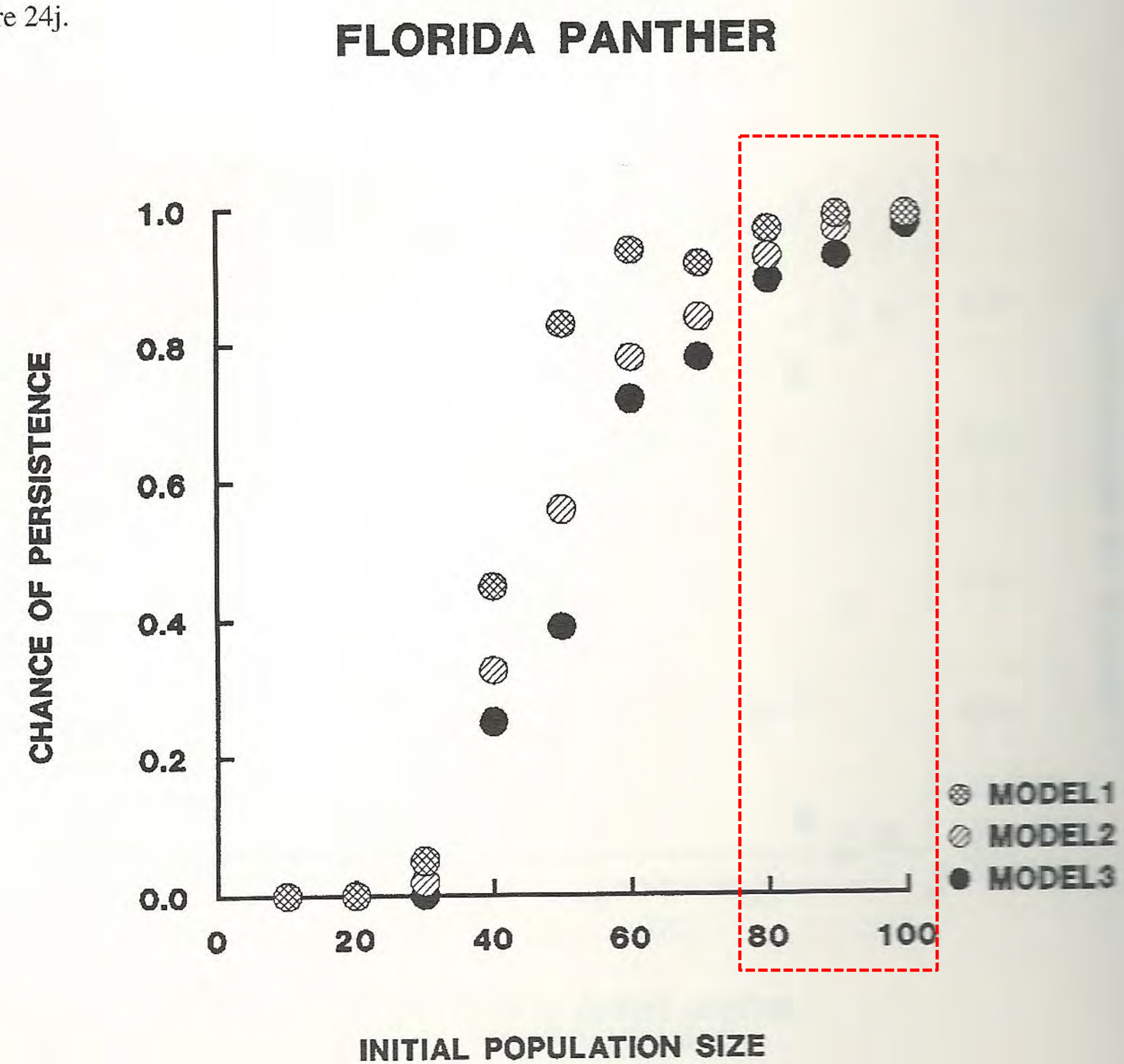
Paper submitted July 13, 1998; revised manuscript accepted May 31, 2000.

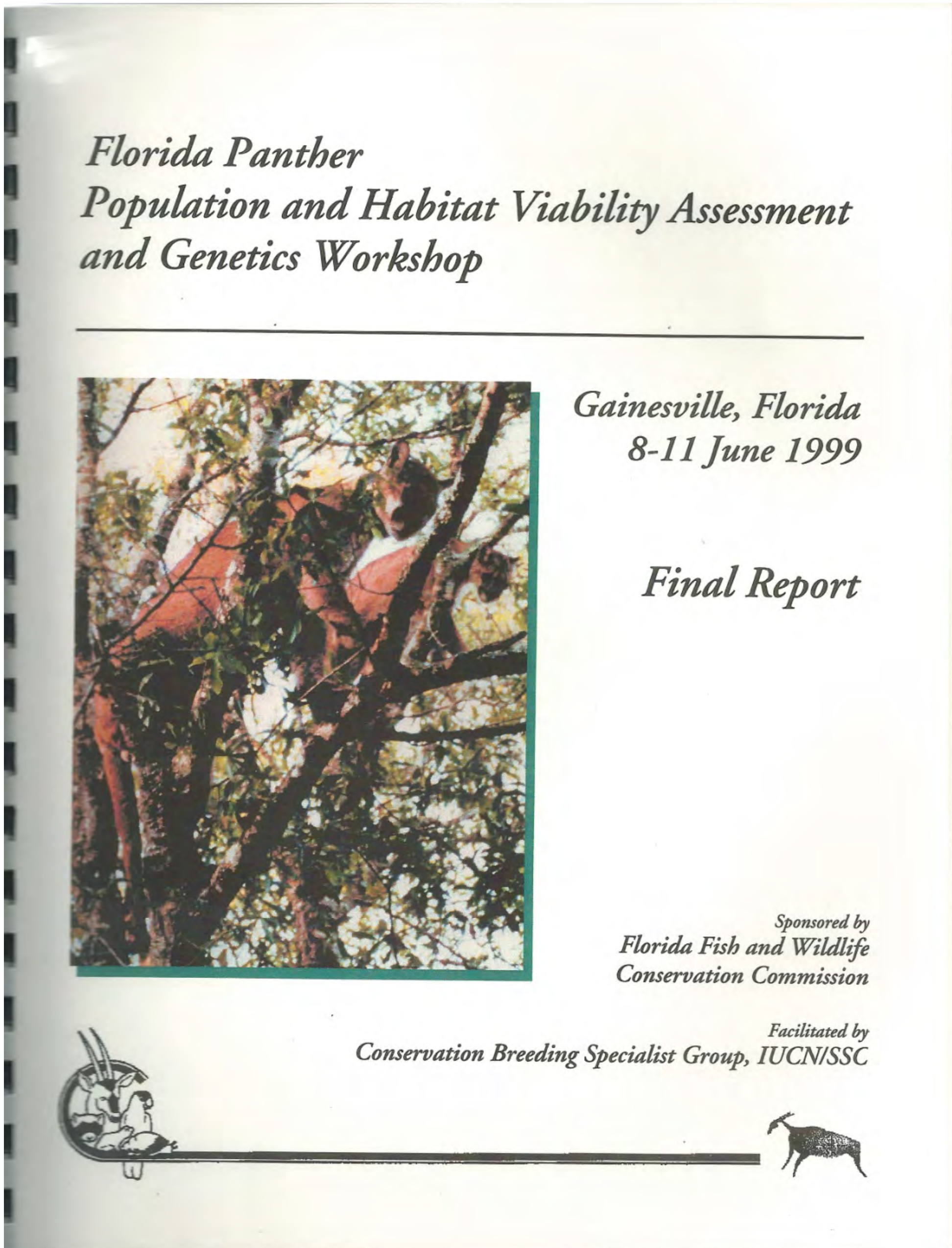
Conservation Biology, Pages 55–77
Volume 15, No. 1, February 2001

Closing the Gaps Findings

- PVAs performed for 11 species including Florida panther
- Model followed females only and simulated annual changes in fecundity and survival for 200 years
- Catastrophic events were included in the model
- Favorable, moderate, and harsh environmental conditions were modeled
- Smallest populations with 90% probability of persistence over 200 years were:
  - 63 panthers under favorable conditions
  - 76 panthers under moderate conditions
  - 84 panthers under harsh conditions
- Population of 100-200 individuals needed to achieve an effective population size of 50

Figure 24j.


FLORIDA PANTHER
CHANCE OF PERSISTENCE
1.0
0.8
0.6
0.4
0.2
0.0
0
20
40
60
80
100
INITIAL POPULATION SIZE
MODEL 1
MODEL 2
MODEL 3


Florida Panther
Population and Habitat Viability Assessment and Genetics Workshop

Gainesville, Florida
8-11 June 1999

Final Report

Sponsored by
Florida Fish and Wildlife Conservation Commission

Facilitated by
Conservation Breeding Specialist Group, IUCN/SSC

S. Ellis, R. C. Lacy, S. Kennedy-Stoskopf, D. E. Wildt, J. Shillcox, O. Byers, and U. S. Seal (editors). 1999.

<u>Goals</u>:

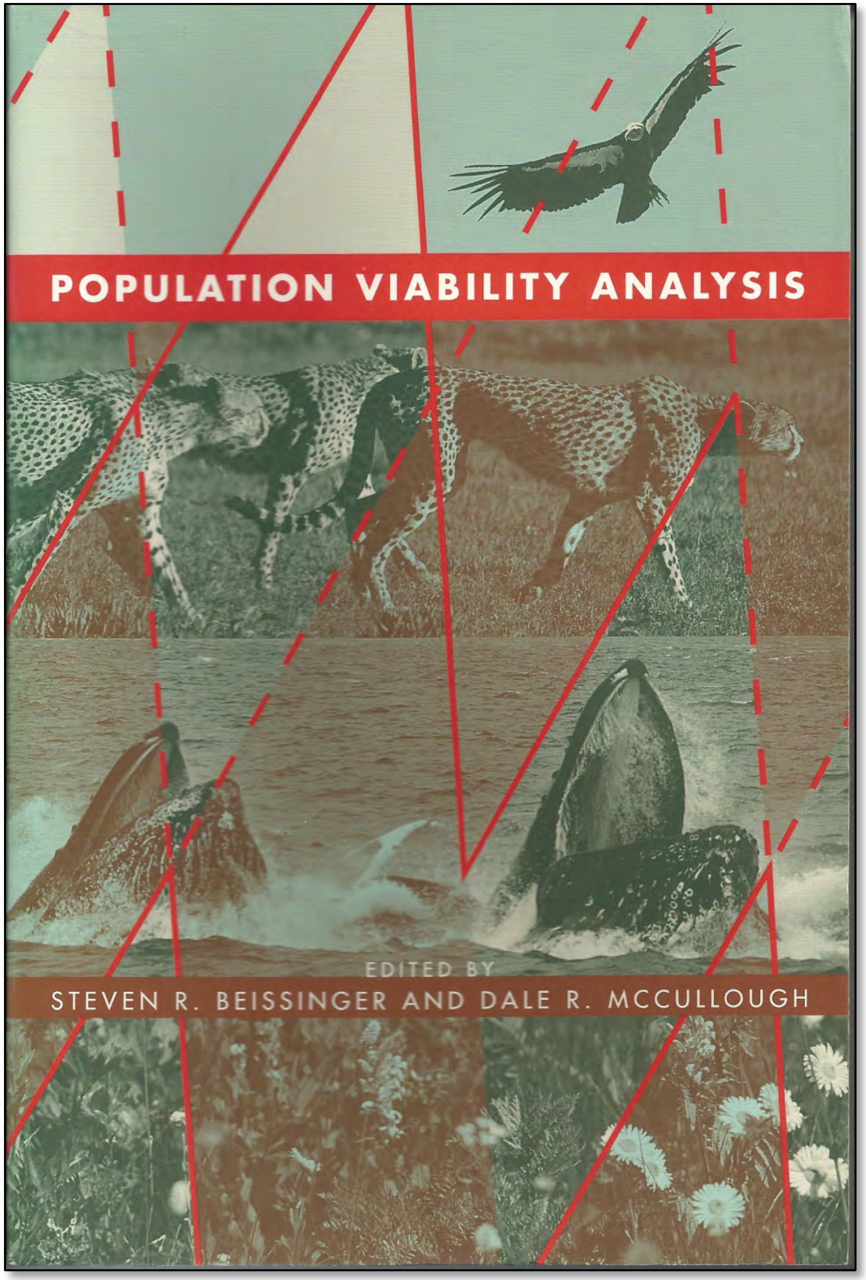
1. Review PVAs from 1989 and 1992 workshops and results of Maehr et al. (in press) PVAs

2. Evaluate status of introduction of Texas females

3. Model effects of habitat loss and colonization of new habitats

Ellis et al. 1999 Findings

- Reviewed past results and performed additional PVAs using VORTEX
- Starting population size = 60 panthers
- Results:
  - Panther population is self-sustaining only if juvenile mortality remains below 40% (close to estimate at the time)
  - K>100, final population of >68, extinction probability ~0%
  - K=70 and no habitat loss, population declines from 60 to 37 over 100 years, extinction probability of 9%, and genetic diversity declines
  - K=70 and 25% habitat loss, population declines from 60 to 11, probability of 53%, and low genetic diversity
  - (Note: ~27% of Primary Zone in private ownership)
- Genetics: livestock breeding goal is to maintain >90% of initial gene diversity
  - 400-500 panthers needed to meet 90% target
  - 100-200 panthers needed if target is lowered to 80% of initial gene diversity



D. S. Maehr, R. C. Lacy, E. D. Land,
O. L. Bass, Jr., and T. S. Hoctor. 2002.

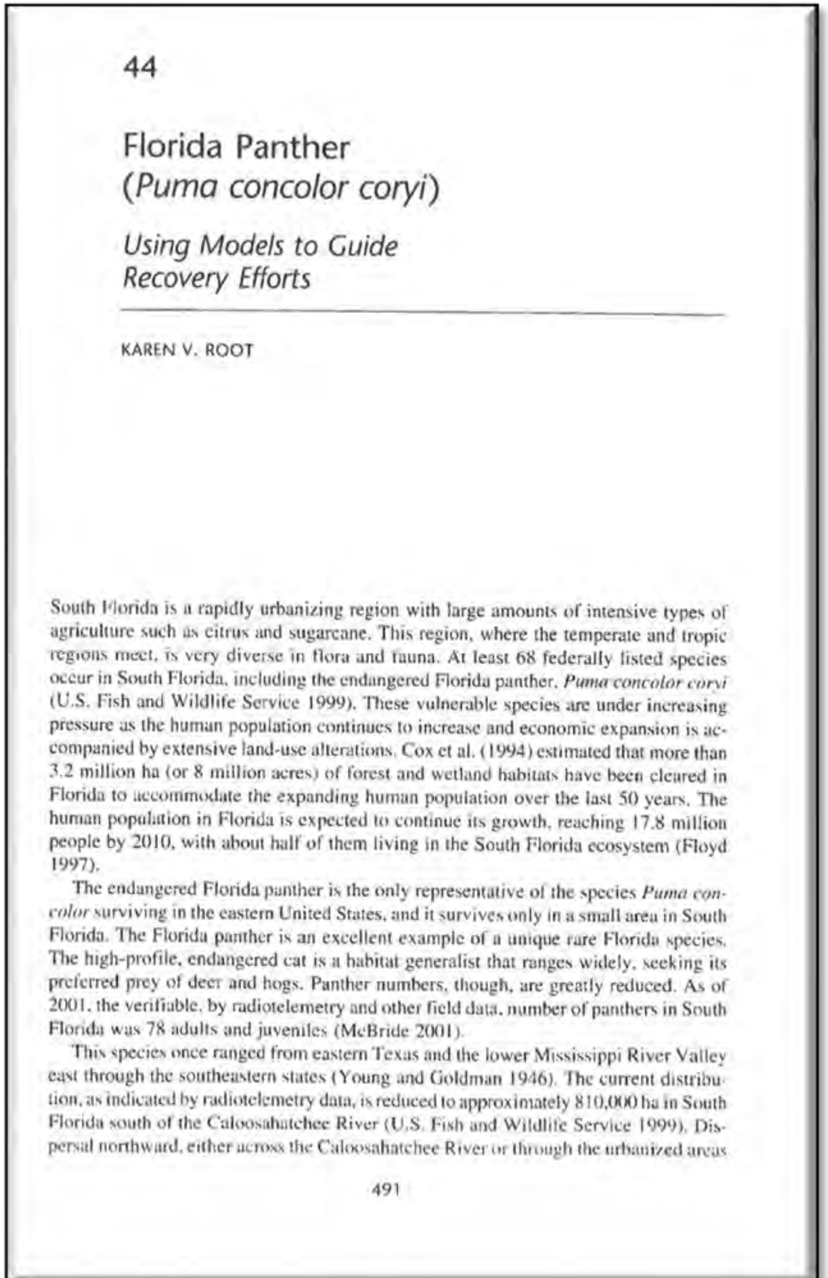
Evolution of Population Viability
Assessments for the Florida Panther:
A Multiperspective Approach.

Pages 284-311.

1. VORTEX PVA model by each author
2. Consensus PVA model
3. Models for various management
scenarios

Maehr et al. 2002 Findings

- Each author developed input values individually
- Consensus model variables:
  - Starting population = 60 panthers; K=70; juvenile mortality =20%; no habitat loss; augmentation with 2 females every 10 years for 100 years
- <u>Results</u>:
  - Panther population has >98% probability of persistence for 100 years with median final population of 65.72 panthers
  - Panthers are capable of rapid population growth
  - Genetic problems can become severe beyond 100 years
  - 300 panthers needed to retain 90% of initial heterozygosity



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Florida Panther
(*Puma concolor coryi*)

Using Models to Guide Recovery Efforts

KAREN V. ROOT

South Florida is a rapidly urbanizing region with large amounts of intensive types of agriculture such as citrus and sugarcane. This region, where the temperate and tropic regions meet, is very diverse in flora and fauna. At least 68 federally listed species occur in South Florida, including the endangered Florida panther, *Puma concolor coryi* (U.S. Fish and Wildlife Service 1999). These vulnerable species are under increasing pressure as the human population continues to increase and economic expansion is accompanied by extensive land-use alterations. Cox et al. (1994) estimated that more than 3.2 million ha (or 8 million acres) of forest and wetland habitats have been cleared in Florida to accommodate the expanding human population over the last 50 years. The human population in Florida is expected to continue its growth, reaching 17.8 million people by 2010, with about half of them living in the South Florida ecosystem (Floyd 1997).

The endangered Florida panther is the only representative of the species *Puma concolor* surviving in the eastern United States, and it survives only in a small area in South Florida. The Florida panther is an excellent example of a unique rare Florida species. The high-profile, endangered cat is a habitat generalist that ranges widely, seeking its preferred prey of deer and hogs. Panther numbers, though, are greatly reduced. As of 2001, the verifiable, by radiotelemetry and other field data, number of panthers in South Florida was 78 adults and juveniles (McBride 2001).

This species once ranged from eastern Texas and the lower Mississippi River Valley east through the southeastern states (Young and Goldman 1946). The current distribution, as indicated by radiotelemetry data, is reduced to approximately 810,000 ha in South Florida south of the Caloosahatchee River (U.S. Fish and Wildlife Service 1999). Dispersal northward, either across the Caloosahatchee River or through the urbanized areas

491

Karen Root PVA Models for the Panther Subteam of MERIT. 2002.

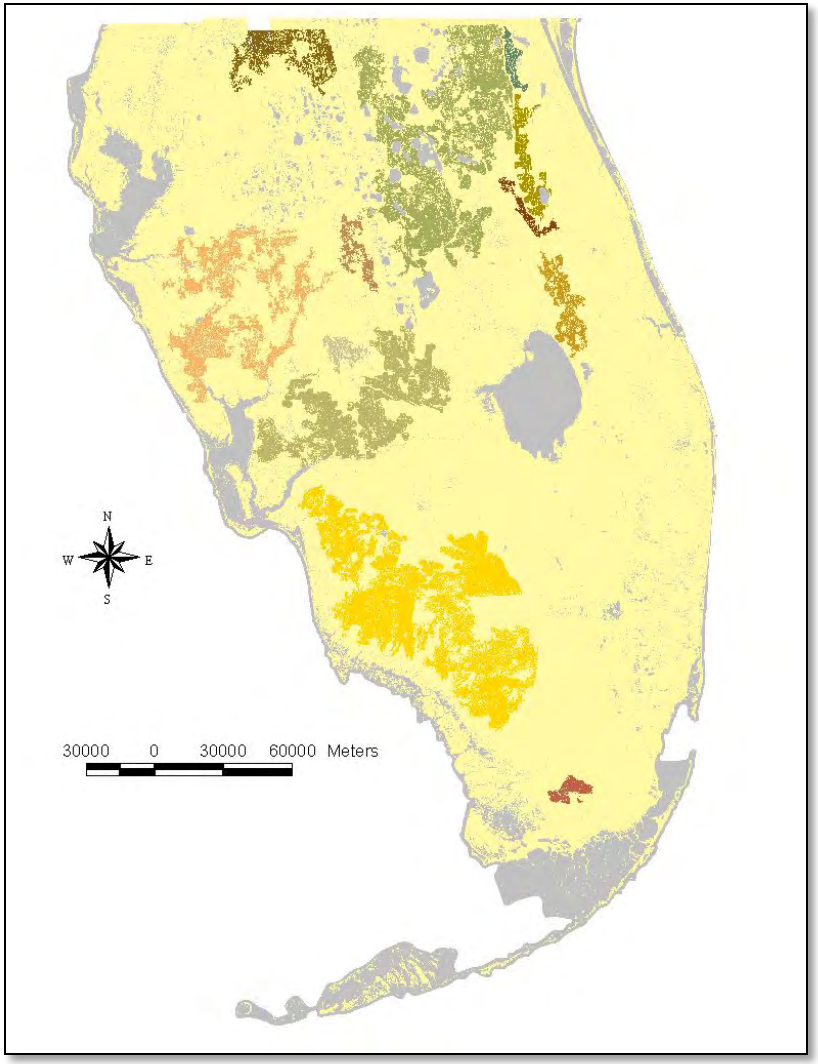
And

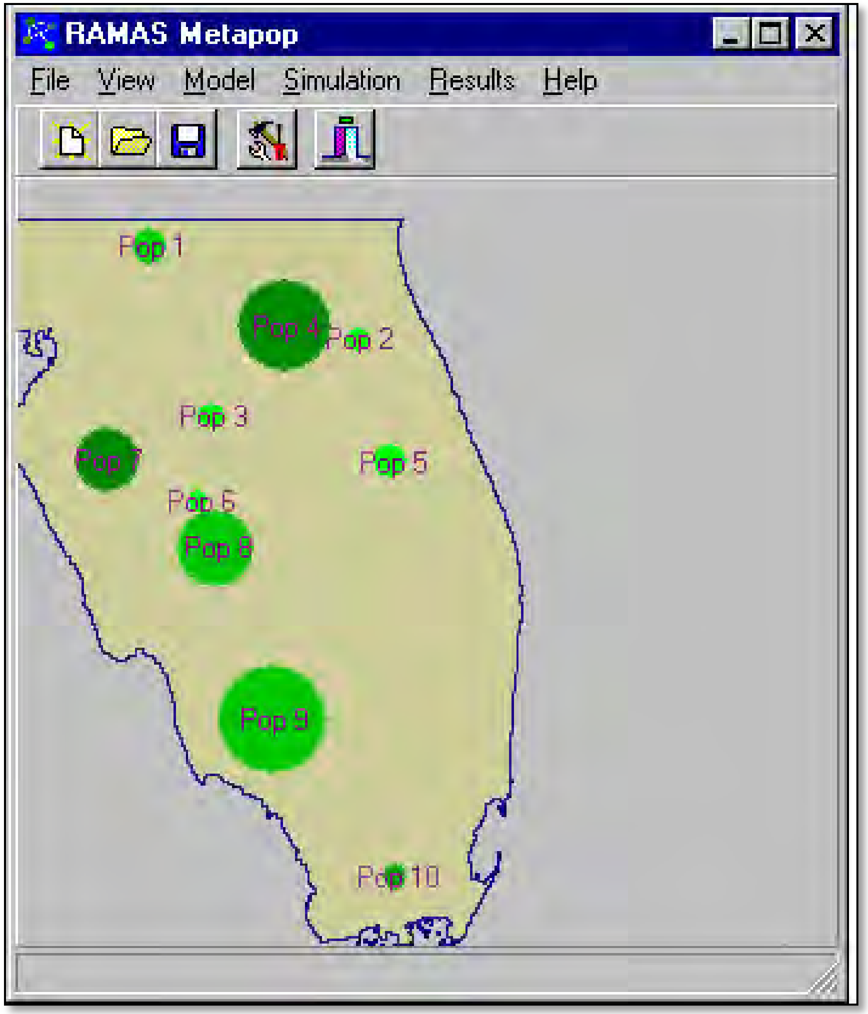
K. V. Root. 2004. Pages 491-504 *in* H. R. Akcakaya, M. Burgman, O. Kindvall, C. C. Wood, P. Sjogren-Gulve, J. Hatfield, And M. McCarthy (editors). Species Conservation and Management: Case Studies. Oxford University Press, New York, NY.

Karen Root Methods

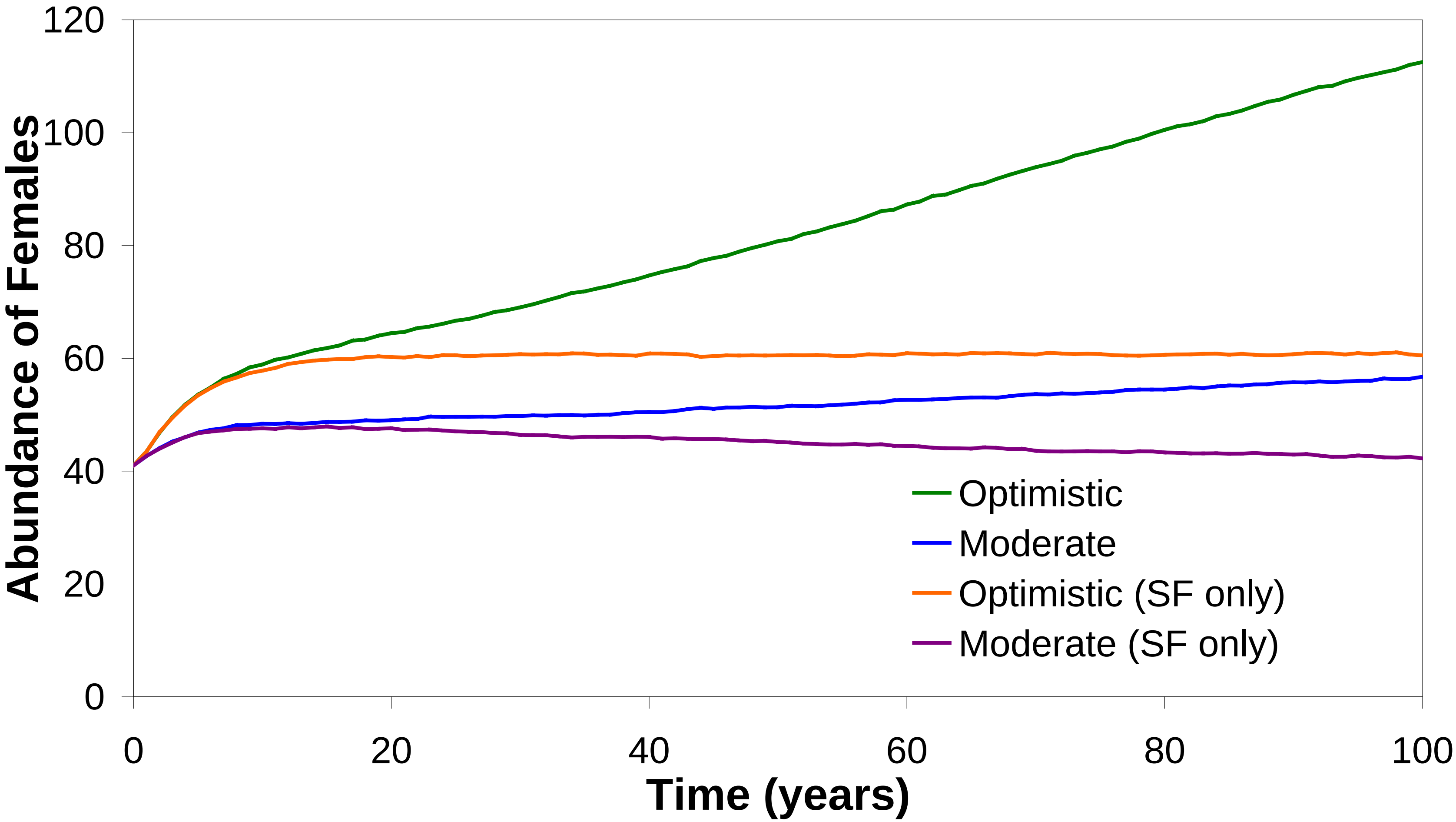
- PVA models using RAMAS GIS, a spatially explicit single-sex viability modeling program
- Three PVA models (10,000 simulations, 100 years):
  - Conservative – parameters from Ballou et al. (1989)
  - Moderate – parameters from optimistic model of Maehr et al. (2002)
  - Optimistic – parameters from consensus model of Maehr et al. (2002)
  - Each model run with juvenile mortality set at 38%
- <u>Basic models</u>: initial population = 82 panthers (41 females), no catastrophes or epidemics, no change in habitat quality, no habitat loss, and ceiling type of density dependence
- <u>Variants</u>: varying density dependence, varying levels of habitat loss, intermittent catastrophes or epidemics, and scheduled translocations or reintroductions
- <u>Minimum Viable Population Size</u>: initial population size of each model was increased until the probability of extinction at 100 years was <5%
  - No catastrophes, no habitat loss, no inbreeding, and no habitat limitations

Habitat Patches for Spatial Explicit Models

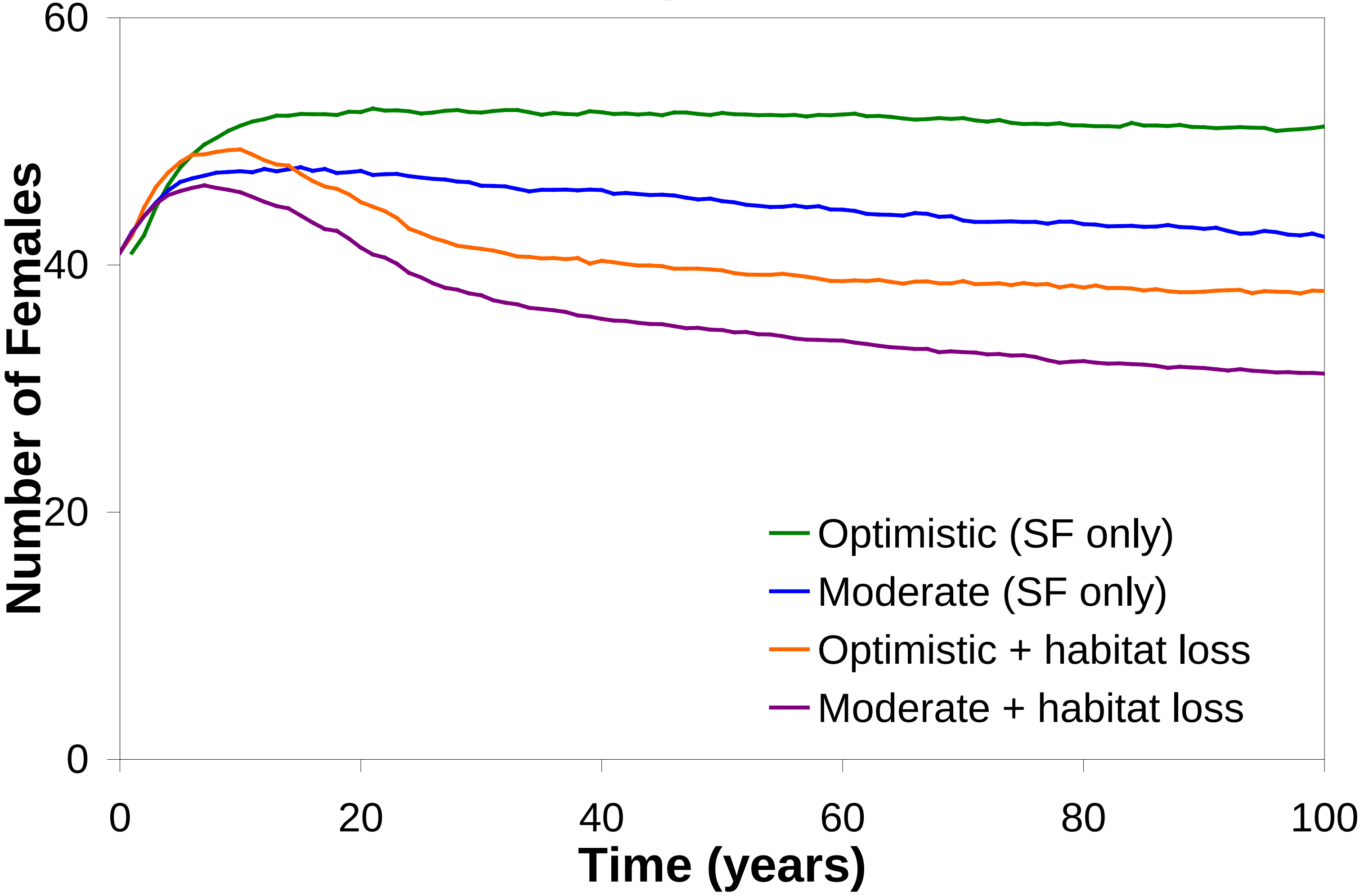




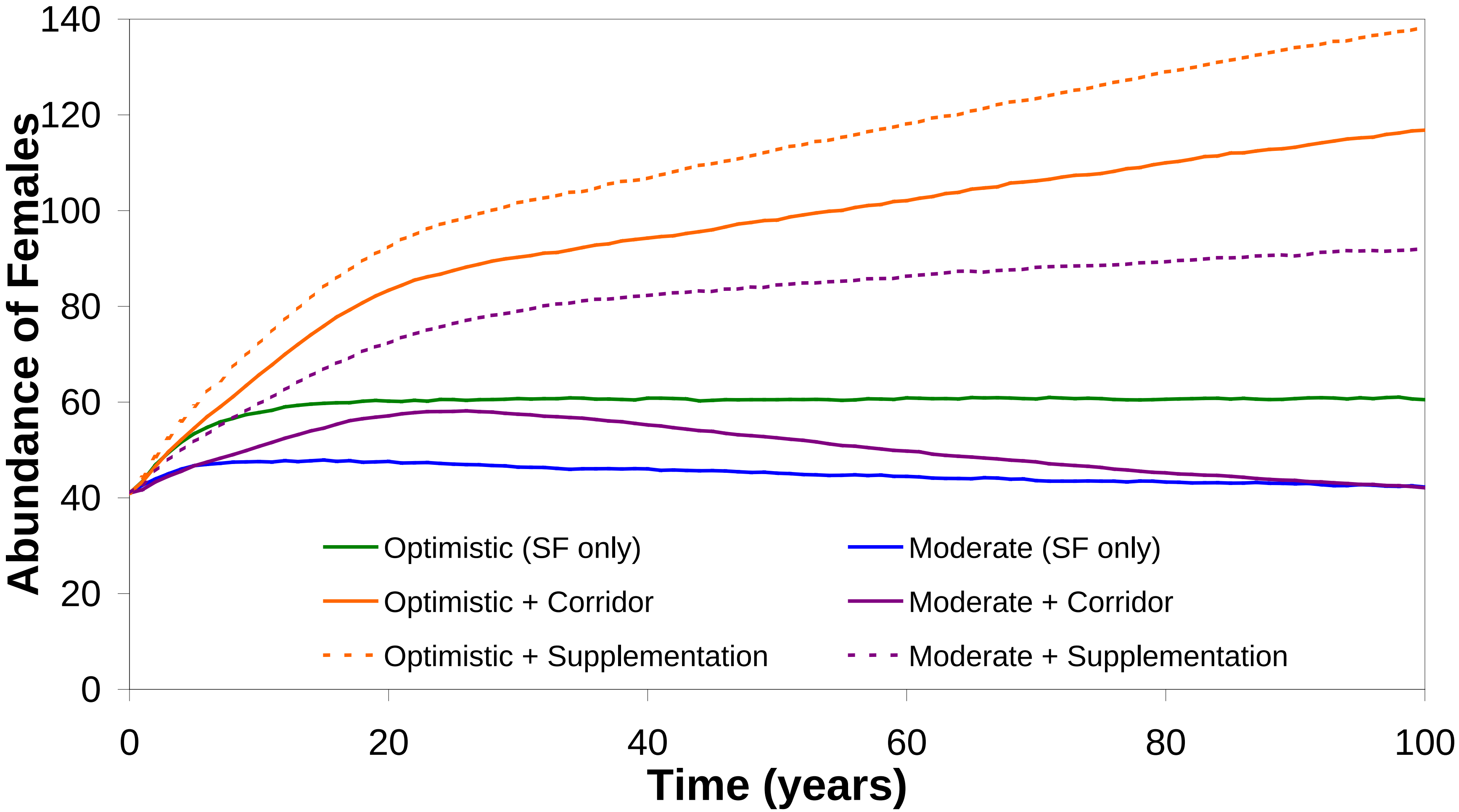
Results of Basic Model Runs



Results with 25% Loss of Habitat



Results with Corridor & Supplementation



General Summary of Results

- With an initial population of 82 adults and juveniles (41 females), Florida panthers are likely to persist at about that level with low risk of extinction for 100 years
- The Conservative model predicted extinction within 100 years, and it was dismissed from further consideration as not reflecting reality
- The Optimistic model appears to present a more rosy picture of panther persistence than reality would seem to bear
- The panther population appears stable even with a 25% loss of habitat in 25 years, but the population may decline somewhat at this level of habitat loss
- A corridor that allows panthers to access suitable patches of habitat in central Florida or supplementation of the population with additional females would result in increased size of the population and increased likelihood of persistence
- RAMAS GIS PVA models do not address genetic problems

Minimum Viable Population Size

- Population parameters from Seal et al. (1989) workshop:
  - No feasible number of panthers produces persistence probabilities of >75%, even if initial population size is 2,000
- Optimistic model (finite growth rate (λ) = 1.077):
  - 50 panthers have 95% chance of persistence for 100 years
  - Mammals rarely exhibit λ >5% in nature
- Moderate model (finite growth rate (λ) ≈ 1.05):
  - 102 panthers have 95% chance of persistence for 100 years
- Alternative model (finite growth rate (λ) ≈ 1.03):
  - 240 panthers have 95% chance of persistence for 100 years

Population Viability Results

- Population < 50: Extinction highly probable in less than 100 years
  - Demographic instability; $N_e << 50$; high level of inbreeding
- Population of 60-70: Barely viable
  - Low probability of extinction in 100 years; 25% decline in population likely; $N_e < 50$; declining heterozygosity; no habitat loss or catastrophes can be tolerated
- Population of 80-100: Stable population likely to persist for 100 years
  - $N_e \approx 50$; slowly declining heterozygosity; no habitat loss or catastrophes can be tolerated
- Population > 240: High probability of persistence
  - $N_e > 50$; able to retain 80-90% of heterozygosity; some habitat loss or mild catastrophes can be tolerated