V. THE ALTERNATIVES

Introduction - Alternatives presented herein represent those actions which could reasonably be implemented in an attempt to address specific genetic needs as identified under Section B, above. Alternatives are evaluated on their projected capability to result in improvements in the high incidence of maladaptive traits which include reproductive and medical abnormalities, as well as projected impacts on the environment of implementing each alternative. Specific details for the proposed action reflect the results of the last three workshops detailed earlier which were held specifically to evaluate existing population viability and growing concerns regarding the overall health of the panther population and to develop a course of action to address these concerns. It should be noted that if reliable artificial insemination technology was available, it possibly would be the preferred means for achieving genetic restoration in the wild population. Artificial insemination was initially considered as a possible alternative, but because this technology is presently not available, is not addressed in detail.

Alternative 1 - Continue Current Genetic Management Program (No Action) -- Under this alternative, there will be no "outside" (non-*coryi*) genetic material utilized in the genetic management program. This alternative will continue ongoing actions to protect, preserve, and manage the limited genetic resources presently contained in the Florida panther (existing wild and captive populations). This effort will be carried out by continuing the program initiated in 1991, which will result in the establishment and management of a large captive population.

Under this alternative, select kittens (up to 6 per year) from genetically important adults (individuals considered genetic founders in the population) will continue to be brought into captivity over a 3 to 6-year period to form the core for the captive population. For genetic protection and management, the captive population is to be increased as rapidly as possible. The captive population can serve three major functions. One, provide security against extinction of the taxon. Two, provide a means to better preserve existing genetic diversity. Three, provide a source for animals that can be used in possible future population reestablishment programs.

The initial goal of the captive program is to represent in captivity genetic material from all key individuals in the wild population (individuals considered genetic founders), and that these representatives successfully produce viable offspring. The removal regime developed in 1991 to achieve this goal provides for the removal of up to six kittens per year over a 3-6 year period

(approximate period of time needed to achieve full genetic representation for the captive population). Up to 36 kittens could be removed under this program.

To date, 10 kittens have been removed for the captive population (6 in 1991 and 4 in 1992). Genetically important, non-reproducing adults not represented by offspring in the wild or in captivity are also candidates for the captive program (up to 2 individuals per year).

Because of existing demographic and genetic conditions in the wild population, the captive population will need to be intensively managed for rapid growth. Under the present program a total population goal of 500 breeding age animals by the year 2010 has been established for the Florida panther (combination of existing wild population, plus all wild populations that can be reestablished and the captive population). This figure represents the number determined necessary to achieve and maintain population viability (Seal et al. 1989). A population of this size would be expected to retain 90 percent of its genetic diversity over a 100 year period (Seal et al. 1989).

The long-range recovery goal would be to increase the numbers contained in the wild segment of the total population as much as possible and maintain this segment as high as possible (recovery goal is to have a minimum of three wild populations). This would reduce the population requirements of the captivity segment (i.e. total population goal of 500, less number contained in wild segment equals number needed in captivity). Initially, a high proportion of the total population would have to be maintained in captivity (possibly exceeding 200 animals). However, it is projected that eventually a population of perhaps up to 300 panthers might be achievable in the wild (combination of all wild populations that can be reestablished throughout the historic range.

The four institutions presently permitted for participating in the captive breeding program have facilities and capabilities to only maintain approximately 15-20 individuals. Consequently, full implementation of this alternative will require a significant increase in the number of participating institutions, facilities and support staff to maintain the additional 200+ panthers in captivity. Public funds are not presently available to provide for the needed additional facilities and capabilities.

Panthers produced in captivity in excess of the level needed for genetic management purposes would be available to either augment the existing wild population in south Florida for genetic/demographic purposes or for future population reestablishments when such programs are on line and

ready for implementation. The number of individuals needed for genetic/demographic purposes would likely be minimal, possibly ranging from only 1-2 per year or less.

Proper conditioning of captive-born individuals for survival in the wild is time consuming and expensive. Conditioning captive-born western cougars serving as surrogate panthers for reintroduction experiments cost approximately $30,000 per individual (J. Lukas, personal communication, 1994). Current conditioning facilities/capabilities are extremely limited and can only handle 2-4 individuals every two years. Existing reintroduction data indicate that 10-20 individuals would be initially needed for each population reestablishment effort. This number would likely need to be supplemented during the first couple of years in order to maintain a functioning population level. Reproduction and recruitment after a couple of years would be expected to exceed losses and provide opportunity for population growth. To move toward the population goal of 500 breeding age animals needed for genetic management purposes under this alternative, conditioning capabilities will have to be increased to handle 10 or more individuals per year as a minimum.

<u>Alternative 2</u> - Translocate Wild Non-Florida Individuals Into The Wild Population (Proposed Action) -- The proposed action would implement a genetic restoration and management strategy designed to restore lost natural gene flow into the panther from other *Felis concolor* subspecies. This method would translocate a limited number of wild non-Florida individuals into the south Florida population.

The genetic restoration action addressed under this alternative would be intended to replicate the natural process of genetic exchange and would seek to mimic historic emigration into the population. Expected results would include reduced occurrence of inbreeding, restored genetic variability and vitality of offspring produced and recruited as breeders into a healthier, more resilient population of Florida panthers, and resumed evolutionary adaptive potential of the south Florida population by restoring levels of genetic diversity to levels typical of other subspecies of *Felis concolor* in western North America.

It is difficult to precisely describe *F.c. coryi* as it previously existed and thus design a genetic profile upon which to base a restoration objective. The major differences observed in morphological and genetic traits between the Florida population and other populations of *Felis concolor* are likely due to the severe inbreeding and genetic bottleneck that has occurred in the Florida population. However, western populations of *Felis concolor* have not

undergone inbreeding and genetic bottlenecks similar to that of the *F.c. coryi*. For these reasons, we assume that they appear today as they did at the time the Florida population became geographically isolated and thus are the best model for what *F.c. coryi* did look like previous to geographic isolation. Molecular genetic analysis indicate that western populations have levels of genetic diversity significantly higher than currently exist in the Florida population. Because there are low levels of genetic divergence among subspecies of *Felis concolor* and because of the absence of barriers to intercrossing between the Florida panther and several of these subspecies, it likely does not make much difference which wild population would be used for genetic restoration for the panther. However, the Texas population (*F.c. stanleyana*) formerly constituted part of a continuous range across which genetic material was likely exchanged with the Florida panther and for this reason should serve as the source of genetic stock for translocation under this alternative. The objective is to restore levels of genetic diversity in the Florida population to the levels typical of western populations of *Felis concolor.*

It has been determined that the level of genetic introgression required to reverse the effects of inbreeding and genetic loss in the Florida panther is approximately 20 percent (Seal et al. 1994). This translates to 6 to 10 breeding individuals for a population the size of the Florida panther's.

Restoration of gene flow would be accomplished through the strategic placement of 8 young-adult females from Texas, representing a subspecies (*F.c. stanleyana)* historically contiguous with the Florida panther, into vacancies occurring in the present panther population in south Florida (social structure vacancies). Young females would be used because they would be more prone to remain near release sites, less likely to have adverse impacts on the existing population, and more easily assimilated into the existing panther population. The Texas population (*F.c. stanleyana*), is believed to represent the best source to replace lost genetic variation because it represents the geographically closest extant subspecies that historically interacted with the Florida population. Population modelling results and conclusions of specialists in the fields of genetics and small populations indicate that the proposed genetic admixture (8 breeders) would be expected to be sufficient for the Florida panther to recover from deleterious effects of inbreeding, but would not change the basic genetic makeup of the panther or swamp the existing gene pool which may be adapted to local environmental conditions (Seal et al. 1994).

The release of Texas animals into south Florida is not intended to add more individuals to the population but to restore overall health and vitality of the population to a more natural level. Intrinsic limiting factors related to habitat

quality and availability may already maintain panther numbers at or near maximum density or may be the cause for fluctuating or ephemeral populations in some areas such as Everglades National Park or the southern Big Cypress National Preserve. Releases of too many additional animals into an area of already limited resources may have destabilizing or other negative effects on the tenuous and apparently recent sub-population.

The translocation of non-Florida animals into south Florida will restore genetic variation and, therefore, may increase fecundity and survival. In addition, the restored genetic variation will allow for more rapid adaptive evolution of the population, allowing for continued maintenance or improved demographic performance and stability, in contrast to the continued decline and instability that might be expected if the population becomes increasing homogeneous and inbred. Thus, we would expect that genetic restoration will lead to an increase in reproductive performance and survivability. Though habitat availability would be expected to limit opportunities for significant population growth in southern Florida, increased reproductive performance and survivability could provide "excess" individuals (excess to carrying capacity of habitat) that could be needed for possible future population reestablishment programs.

Planned genetic restoration would consist of an initial introduction of sufficient animals so that approximately 20% of the breeders in the population would consist of translocated individuals from the Texas population (for a population the size of the panther's, this would be 6-10 individuals). To maintain restored genetic health, it may be necessary that one additional translocated animal be recruiting into the breeding population per generation (about 6 years). This rate of genetic mixture would not be so great as to cause genetic swamping of locally adapted traits presently in the south Florida population (Seal et al. 1994). After the initial genetic restoration, any locally adapted gene would still persist at a frequency of about 80%, and a majority of the next generation would consist of animals that are homozygous for any Florida-adapted genes (Seal et al. 1994). Natural selection would further increase the frequency of non-Florida genes that were advantageous, and would keep low the frequency of any non-Florida genes that maybe maladaptive in the south Florida habitats (Seal et al. 1994). Ongoing gene flow at a rate of at least 1 new breeder recruited per generation (perhaps 2-4% of the breeding population) would, over many generations, lead to the replacement of locally adapted traits only if the selective advantage of the locally adapted trait over the non-local variant of the gene was less than the rate of immigration (2-4%). The low probability of loss of genetic traits that have a slight adaptive advantage in the Florida environment would likely be much more than offset by the substantial

advantage gained by the reversal of the deleterious effects of inbreeding already seen in the populations.

Parallel intercrossing activities would be carried out simultaneously in the captive population. This would provide key opportunities to very closely monitor program activities and results.

Significant elements of the proposed action are presented below. Additional details are contained in the enclosed "Plan for Genetic Restoration and Management for the Florida Panther" (Enclosure I).

*Eight young adult (2-4 years old), non-pregnant *F.c. stanleyana* females, captured from widely distributed areas of southwest Texas, would be translocated into suitable unoccupied territories or potential territories in south Florida (projected costs of $1,500 - $2,000 each). Individuals of this sex and age group represent the adult component of a population most likely to successfully recruit into the existing population. Litter mates or individuals with cowlicks, kinked tails, or cardiac abnormalities would not be used. Candidate individuals would be quarantined to collect biomedical information for health screening prior to release. The proposed translocation could occur as soon as early 1995. This is an important consideration, for at each of the five workshops alluded to previously, geneticist and small population specialists have continued to emphasized the critical need to implement an aggressive genetic management strategy immediately. Funds necessary to implement and monitor the proposed program in 1995 are already budgeted and will be provided by the Florida Game and Fresh Water Fish Commission.

*Prior to release, individuals will be quarantined and carefully screened and monitored to reduce the likelihood of introducing undesirable pathogens into the panther population. Screening and monitoring details are presented on pages 13 and 14 of Enclosure 1.

*Translocation sites in southern Florida could be comprised of public and/or privately owned land. Based on population conditions at the present time, potential sites are in Everglades National Park (Long Pine Key area), Big Cypress National Preserve (Loop Road and Turner River Units and the eastern addition lands), northern Fakahatchee Strand State Preserve, and select private lands in Hendry County. Releases on private lands would only be carried out with landowner approval. Final site selections would be base on population conditions at the time of translocation. Important site selection criteria include: opportunities for recruitment into the existing population segment are high, opportunities to mate with Florida panther

males are high, a likelihood of significant adverse impacts on the existing population are low, and adequate prey resources are considered available.

*Based on existing genetic conditions and projections, it has been determined that the restoration goal should be to have 8 introduced individuals become breeders in the south Florida population and that each of these individuals produce at least two offspring that in turn also become breeders in the population. Comprehensive monitoring by field personnel would be employed to assure that program goals are achieved. Monitoring would be an extension of activities presently being carried out by involved agencies. Animal movements, denning activity, prey frequency, habitats utilized, interaction with other individuals in the population, mortality, etc. are monitored via radio-telemetry. Reproductive information in terms of number of offspring produced, sex, health and biomedical data, genetic makeup, etc. on offspring are determined through visitations to den sites within 2-4 weeks of birth and through the analysis of biological data obtained at that time. Survival and recruitment of offspring into the population are monitored via radio-telemetry. Prey utilization is determined through visits to kill sites and scat analysis. Intensive monitoring has been a priority activity ever since radio-telemetry activities were initiated in 1981 and would be expected to continue as long as there is a comprehensive recovery program underway for the panther.

*To maintain restored genetic health of the south Florida population, it is anticipated that approximately one new emigrant would likely be needed per generation (6 years).

*A lack of unoccupied, suitable habitat will likely preclude opportunities for significant population growth within areas currently utilized by the radio-instrumented segment of the population (areas south of the Caloosahatchee River). It is anticipated that this population segment will never significantly exceed the present 30-50 adult level. Keep in mind that the goal of adding additional animals to the population is not to increase numbers but to improve the genetic health of the population, over time.

*Translocated individuals, intercrossed progeny, and other components of the recipient ecosystem would be carefully monitored. The extent of introgression of Texas genes into the Florida population would be assessed by three different approaches: (1) pedigree analysis based on founder contributions from the Florida and Texas populations, (2) molecular genetic analysis of markers that show differentiation between the two populations, and (3) analysis of morphological characters that can differentiate between the populations and which may be associated with adaptation.

*Demographic components of fitness would be monitored in the genetically restored Florida population by the involved agencies and compared to data on the present and recent historical population. Components evaluated would include the proportion of adult females producing litters each year, average litter size, sex ratio of offspring, kitten survival, subadult survival, recruitment into the population as breeders, age of first breeding, adult survival, etc. A comprehensive pedigree database (studbook) would be established for the Florida population. Uncertainties regarding parentage would be resolved when possible using such techniques as molecular genetics and behavioral observations.

*It is not anticipated that significant new management actions involving translocated individuals, intercrossed progeny, or components of the recipient ecosystem would be necessary. The goal of the effort would be that translocated individuals become functioning members of the existing panther population. It is not anticipated that any significant changes in existing actions, measures or programs would be necessary as regards to management of the panther population, prey resources, human activities, habitat management or protection, or other such programs. As previously pointed out, existing habitat limitations will preclude opportunities for significant population growth within the project area. Intensive monitoring, already a vital component of the panther recovery program, would be expected to reveal any significant problem that might arise. Opportunities would then be available to initiate corrective actions that may be appropriate. Radio-telemetry technology provides the capability for a timely response to any significant, undesirable situation that might occur. Should a translocated individual move out of the target area, she would be recaptured and either returned to the target area, returned to Texas or used in another segment of the recovery program. Radio-telemetry monitoring technology presently being utilized will enable the immediate recaptured (and removal if appropriate) of any (or all) translocated individual should the need arise.

*As key data becomes available regarding the progress of the genetic restoration program it may be desirable to implement specific management actions along the way to aid in achieving specific goals of the program. This could involve any number of actions including the removal of translocated individuals at the point they have two offspring successfully recruited as breeders into the population, the removal of all F1 male offspring to alleviate the possibility of backcrossing with translocated females, etc. Flexibility in the program would allow for decisions such as these to be made as may be appropriate.

*The role of the captive population would shift from one designed to preserve specific subspecies variability (as under Alternative 1) to one

consistent with meeting the objective for genetic restoration for the Florida panther. Institutions holding Florida panthers in captivity would manage them in accordance with management, research, and educational objectives and needs identified in the genetic management plan (pages 16 & 17 of Enclosure I) and the Florida Panther Recovery Plan. It is not anticipated that the proposed action would require additional captive breeding or conditioning facilities (above those currently in operation) or that any additional panthers would have to be taken from the southern Florida wild population.

Alternative 3 - Translocate Intercrossed Progeny Into The Wild Population -- This alternative would follow the same basic plan of action as the proposed action (Alternative 2) except that intercross progeny (*Felis concolor coryi* x *F.c. stanleyana* or [*F.c. coryi* x *F.c. stanleyana*] x *coryi*) would make up the genetic stock released into the south Florida population. These individuals would be produced and conditioned in captivity. As in Alternative 2, it is not anticipated that additional panthers would have to be brought into captivity from the wild population. Major differences between this alternative and the proposed action are:

*It would require 16 F1 generation or 32 F2 generation (*coryi* backcrosses) intercross individuals to achieve the desired genetic admixture in the wild population. Based on existing data (western cougars produced in captivity for the reintroduction experiment), each captive-borne animal conditioned for release into the wild would costs approximately $30,000 (J. Lukas, personal communication, 1994). Existing demographic data suggests that sufficient unoccupied, suitable habitat within the target population area (i.e. southern Florida) to support this number of additional animals may not be available (Maehr 1990a).

*Existing captive breeding and conditioning facilities would have to be significantly increased to produce and condition the 16 or 32 female intercrosses needed (breeding facilities would likely have to be doubled and conditioning facilities 5X). Also, approximately 10 additional females cougars would have to be brought into the captive population to help produce the 16 F1 female offspring required. As in Alternative 1, public funds are not presently available for these needs.

*If breeding and conditioning facilities were available, it would require a minimum of 2-3 years to have F1 generation offspring ready for release into south Florida, and a minimum of 4-5 years for F2 offspring.

<u>Alternative 4</u> - Utilize Genetic Material From Other Captive Stock (*F.c. coryi or F.c. coryi* intercrosses) In The Genetic Restoration Program -- This alternative would follow the same basic plan of action as Alternative 3 except that *Felis concolor coryi* or *F.c.c.* intercrossed genetic material would be used for the genetic restoration program, provided an acceptable source of genetic material is determined to be available.

With the exception of the nine panthers presently in the Florida panther captive breeding program, there is only one other known potential source of genetic material in captivity containing *Felis c.c.* genes. This genetic material, commonly referred to as "Piper Stock" (Piper being the family name of the original breeders), is comprised of descendants from two litters of Florida panther kittens remove from the Big Cypress Swamp in the 1940's (6-10 generations ago). Perhaps a dozen or two individuals of this genetic lineage are presently contained in private collections. All of these individuals for which genetic analysis have been run show that they are comprised of a mixed ancestral linage, including genetic markers likely arising from South or Central America. Because this source stock has been in captivity for approximately 50 years it would have the disadvantage of possibly being partially adapted (behaviorally and/or genetically) to captivity, and less adapted to survival in the wild. It would take a minimum of 2 years to have individuals conditioned and ready for release into the wild population.

Table 1. Summary of actions by alternative.

ACTION	ALTERNATIVE 1 (No Action)	ALTERNATIVE 2 (Proposed Action)	ALTERNATIVE 3	ALTERNATIVE 4
Non-*coryi* genetic material used/#	N	Y/8	Y/16	Y/16
Captive population necessary/#	Y/200	N	Y/20	Y/20
Additional *F.c. coryi* removed from wild/#	Y/8-26	N	N	N
Additional captive breeding facilities needed	Y(10X increase)	N	Y(2X)	Y(2X)
$ for additional facilities committed	N	NA	N	N
Captive animals placed in wild population	Y	N	Y	Y
Additional conditioning facilities needed	Y(5X)	NA	Y(5X)	Y(5X)
Projected pop. level needed for viability	500[1]	150[2]	150[2]	150[2]
Level of additional funding needs/$ committed	Great[3]/N	$16,000/Y	Moderate[4]/N	Moderate[4]/N
Time interval to get improved genetic material into wild	> 2Yrs.	< .5Yr.	> 2Yrs.	> 2Yrs.

Key: N = No or None, Y = Yes, NA = Not Applicable
1. Combination of wild and captive populations.
2. Represents 3 wild populations with 50 adults each.
3. $1,000,000 in facilities & $500,000/yr. operations (Seal et al. 1989).
4. $200,000 in facilities & $100,000/yr. operations.