August 25, 2017

Mr. David Shindle
South Florida Ecological Services Field Office
U.S. Fish and Wildlife Service
12085 State Road 29
South Immokalee, FL 34142

RE: 5-Year Status Review of the Florida panther (*Puma concolor coryi*) [FWS-R4-ES-2017-N024; FXES11130900000C2-178-FF09E32000]

Dear Mr. Shindle,

As the U.S. Fish and Wildlife Service (FWS) conducts its five-year review of the Florida panther,[1] the undersigned organizations write to provide the best available science relevant to the ongoing threats to Florida panther survival. The Florida panther has been an essential part of Florida indigenous ecosystems for millennia. As our state mammal –selected by students in 1982- the panther needs continued protection at the highest level in order for our natural heritage to persist into perpetuity against intensified threats of habitat loss and its associated impacts, increased human population and interactions, genetic isolation, and other factors. These enduring threats continue to warrant listing of the Florida panther as endangered.

Further, the best available science regarding panther recovery establishes that reclassification to threatened status should only be considered if there are two viable populations of at least 240 adults and subadults for at least twelve years, in addition to other criterion related to habitat and

[1] U.S. Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants 5-Year Status Review of 23 Southeastern Species, 82 Fed. Reg. 29916 (June 30, 2017).

corridor connections.[2] For delisting, three populations of 240 panthers are needed. The latest population estimate of 120 to 230 adult and subadult panthers[3], if accurate, is not enough to even constitute even one viable population.

As demonstrated by this letter, there is scientific support to continue to list the Florida panther as a subspecies, as it is currently recognized. However, even if the FWS were to find that the Florida panther is not a distinct subspecies, the evidence overwhelmingly supports a finding that the Florida panther qualifies as a Distinct Population Segment (DPS) of *Puma concolor*. If the FWS pursues a listing as a DPS, it should do so concurrently to avoid any lapse in protected coverage. We respectfully request that the FWS fully consider the following information in their review of this important endangered species.

I. Summary of Florida Panther Biology

Since the last 5-Year Status Review in 2009,[4] substantial new information about panther biology, population trends, distribution, abundance, demographics, and genetics has been made available, as described herein.

Population abundance, densities, and demographics

In February 2017, the FWS and Florida Fish and Wildlife Conservation Commission (FWC) released the paper "Determining the Size of the Florida Panther Population" estimating the current population at 120-230 adult and sub-adult individuals, excluding kittens.[5] This document acknowledged that counting panthers is difficult and that the estimate "can't be categorized as a scientific population estimate" due to "sampling effort, imperfect detection of animals, or provide a margin of error."[6]

The lower bound of the most recent 2017 population estimation (120 panthers) is based on the most recent minimum count from 2015.[7] Continuing to obtain a minimum count, at least every other year, is important as the agencies vet the reliability of other methods. The top range of the estimate is based on applying a density of panthers from select sampling units within the Primary Zone to the entire Primary Zone.[8] While all Primary Zone panther habitat is equally important to the survival and recovery of the panther, particularly in regards to maintaining spatial extent, not all Primary Zone acres would likely contain the same density of cats. McClintock et al., 2015[9] states that the panther population likely never exceeded 150 individuals

[2] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. x, 79-87.
[3] Florida Fish and Wildlife Conservation Commission, 2017. Determining the Size of the Florida Panther Population.
[4] U.S. Fish and Wildlife Service, 2009. Florida Panther 5-Year Review: Summary and Evaluation.
[5] Florida Fish and Wildlife Conservation Commission, 2017. Determining the Size of the Florida Panther Population.
[6] *Ibid.*
[7] *Ibid.*
[8] *Ibid.*
[9] McClintock et al., 2015. Endangered Florida Panther Population Size Determined from Public Reports of Motor Vehicle Collision Mortalities. Journal of Applied Ecology, Vol. 52, P. 893-901.

in their assessment of data from 2000 through 2012,[10] and that "progress associated with recovery of critically endangered animals should preferably rely on conservative measures of population estimates or lower bounds, especially when data are sparse due to the challenges of monitoring rare species."[11]

Further, Johnson et al., 2010,[12] states that while the panther population appears to be increasing, "ongoing density-dependent factors (related to limited and decreasing habitat availability) and stochastic events will continue to regulate population growth, requiring continued commitments to identify and maintain additional quality habitat to preserve Florida panther evolutionary potential for the long term."[13] Habitat loss and possible saturation south of the Caloosahatchee River -acknowledging that Thatcher et al. believe the lands north of the Caloosahatchee would support about 36 panthers[14]- needs to be contemplated by the FWS, along with this additional information related to species biology.

Regarding survival rates, Hostetler et al., 2009,[15] found that the overall annual survival rate of Florida panther kittens to one year of age was about 33 percent.[16] The survival rate of kittens to adulthood at around age three[17] would presumably be even lower.

Taxonomy and Genetics of the Panther

Researchers have examined the genetics of the Florida panther on several occasions since the 1990s. In 1990, O'Brien et al. used mitochondrial DNA and nuclear markers to find the existence of two distinct genetic stocks with concordant morphological phenotypes.[18] The researchers found a population of panthers in southwestern Florida that descended from historical *Puma concolor coryi*.[19] Another population segment in southeastern Florida, appeared to have evolved in South or Central America, which was accounted for by the release of seven captive animals into Everglades National Park between 1957 and 1967.[20]

A decade later, Culver et al., 2000 performed a molecular genetic analysis of the American puma (*Puma concolor*).[21] Using three mitochondrial sequences and ten microsatellite loci from biological samples collected from 315 pumas throughout the range, the researchers concluded

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[10] *Ibid*. P. 893.
[11] *Ibid*. P. 900. Citing Miller & Waits, 2003 and Mills, 2007.
[12] Johnson et al., 2010. Genetic Restoration of the Florida Panther. Science, Vol. 329, 1641. DOI: 10.1126/science.1192891.
[13] *Ibid*. P. 1644.
[14] Thatcher et al., 2009. A Habitat Assessment for Florida Panther Population Expansion into Central Florida. J Mammal, 90 (4): 918-925, doi: 10.1644/08-MAMM-A-219.1.
[15] Hostetler et al., 2009. Population Ecology of the Florida Panther. Final Report submitted to Florida Fish and Wildlife Conservation Commission and U.S. Fish and Wildlife Service. December 31, 2009.
[16] *Ibid*. P. 2.
[17] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 16.
[18] U.S. Fish and Wildlife Service, 2009. Florida Panther 5 Year Review: Summary and Evaluation. Citing O'Brien et al.
[19] *Ibid*. P. 8-9.
[20] *Ibid*. P. 9.
[21] Culver et al., 2000. Genomic Ancestry of the American Puma (Puma concolor). Journal of Heredity, 91, 186-197.

that they could not confirm the previous classification of 32 subspecies.[22] Based on subspecific criteria suggested by O'Brien and Mayr they recognized six subspecies of puma and suggested that all North American individuals be reclassified as a single subspecies (*P. c. cougar*).[23] Culver et al., however, also determined that the Florida panther was one of several smaller populations that had unique features, the number of polymorphic microsatellite loci and amount of variation were lower, and it was highly inbred (with eight fixed loci).[24]

In 2009, the FWS considered Culver et al. in its 5-year review of the Florida panther and explained:

> The degree to which the scientific community has accepted the use of genetics in puma taxonomy is not resolved at this time. The existing Florida panther population represents the last remaining population of Puma in the eastern United States, and is therefore important to the genetic representation for pumas in North America. Additional research is needed to understand genetic and morphological similarities and differences of puma across North America. The Florida panther is listed under the ESA and any change in its listing status based on best available science would require completing the formal rulemaking process pursuant to the ESA. The panther and its habitat continue to receive ESA protections.[25]

Since Culver's findings in 2000 and the FWS 2009 5-Year Review, scientists have made additional information about the use of genetics in puma taxonomy available. Nearly ten years after the Culver study, Hostetler, et al. utilized a model-based clustering method that demonstrated the contemporary Florida panther population was significantly differentiated from Texas and western cougars.[26] Even with advancements in genetic research, however, experts in taxonomy and systematics have further cautioned against an over-reliance on DNA barcoding and phylogenetics for taxonomic delineations.[27] Instead, a holistic approach that also considers morphology, behavior, ecology, biogeography, and other factors should be employed.[28]

As explained in greater detail below, the best available science supports a finding that the FWS should maintain the current classification for Florida panthers as endangered subspecies under the ESA. However, if the FWS were to conclude that the Florida panther is no longer a subspecies of *Puma concolor*, it should undoubtedly be listed as an endangered DPS.

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[22] *Ibid.* P. 196.
[23] *Ibid*.
[24] *Ibid.*
[25] U.S. Fish and Wildlife Service, 2009. Florida Panther 5 Year Review: Summary and Evaluation. P. 10-11.
[26] Hostetler et al., 2009. Population Ecology of the Florida Panther, Final Report Submitted to The Florida Fish and Wildlife Conservation Commission and U.S. Fish and Wildlife Service. Dec. 31, 2009.
[27] Rubinoff, 2006. Utility of Mitochondrial DNA Barcodes in Species Conservation. Con. Bio., 20(4): 1026-1033; Rubinoff & Holland, 2005. Between Two Extremes: Mitochondrial DNA is Neither the Panacea Nor the Nemesis of Phylogenetic and Taxonomic Inference, Syst. Biol. 54(6):952-961.
[28] Rubinoff & Holland, 2005; Will, et al. The Perils of DNA Barcoding and the Need for Integrative Taxonomy, Syst. Biol. 54(5):844-851.

Culver et al.(2000) Methods and Subsequent Advancements in Genetic Research

Of the 315 pumas from which biological samples were collected, only six (6) living panthers in Florida were included in the study.[29] Culver et al. found reduced levels of microsatellite variation compared to other North American subspecies, noting that the reduction may reflect evidence for historic inbreeding "but may also result from small sample size."[30] The Culver et al. study must be considered in view of these limitations; indeed, more recent research has demonstrated that at least 25-30 individuals are required from a single population to obtain accurate and reliable estimates from allele-frequency based analyses.[31] Furthermore, microsatellites are representative of genetic changes in the most recent generations that were sampled and thus incapable of elucidating historical evolutionary changes that cause speciation. More informative genomic markers, such as single nucleotide polymorphisms (SNPs), substantially outperform both maternally inherited mitochondrial DNC and microsatellite markers, and have been recently used to reevaluate subspecies designs and phylogenetics of another large carnivore, the American black bear.[32]

In addition to the above issues, alternative methods for identifying genetic structuring have been developed since the Culver study was published seventeen years ago. In the same year the Culver et al. study was published, Pritchard et al. published a paper on their development of a Bayesian clustering method to identify genetic clusters.[33] Since then, researchers have relied on this Bayesian clustering method and similar techniques (e.g. BAPS) to reliably delineate populations and admixture among populations across both homogeneous and fragmented landscapes.[34] As discussed below, researchers at the University of Florida (UF) and FWC more recently utilized a Bayesian clustering via STRUCTURE to identify substantial population structure and differentiation among Florida panthers, Texas cougars, and thirdly, western cougars.

Research by Hostetler, et al. (2009)

In 2009, researchers with FWC and UF submitted a final report to the FWS, which estimated demographic parameters for the Florida panther.[35] The study examined in part the influence of the 1995 genetic introgression program involving the release of 8 female Texas cougars to the

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[29] Culver et al., 2000. Genomic Ancestry of the American Puma (Puma concolor). Journal of Heredity, 91. P. 188.
[30] *Ibid.* P. 192.
[31] Hale et al., 2012. Sampling for Microsatellite-Based Population Genetic Studies: 25 to 30 Individuals Per Population Is Enough To. PLoS One 7(9): e45170,doiL10.1371/journal.pone.0045170.
[32] Puckett et al., 2015. Phylogeographic Analysis of American Black Bears (*Ursus americanus*) Suggest Four Glacial Refugia and Complex Patterns of Postglacial Admixture. Mol. Biol. Evol., 32(9): 2238-2530. Doi:10.1093/molbev/msv114.
[33] Pritchard et al., 2000. Inference of Population Structure Using Multilocus Genotype Data. Genetics 155:945-959.
[34] Bohling et al., 2013. Evaluating the Ability of Bayesian Clustering Methods to Detect Hybridization and Introgression Using an Empirical Red Wolf Data Set. *Mol. Ecol.* 22: 74-86; Corander & Marttinen, 2006. Bayesian Identification of Admixture Events using Multilocus Molecular Markers. Mol. Ecol. 15(10):2833-43.; Randi et al., 2001. Genetic Identification of Wild and Domestic Cats (Felis silverstris) and Their Hybrids Using Bayesian Clustering Methods. Mol. Biol. Evol. 18(9):1679-1693.
[35] Hostetler et al., 2009. Population Ecology of the Florida Panther, Final Report Submitted to The Florida Fish and Wildlife Conservation Commission and U.S. Fish and Wildlife Service. Dec. 31, 2009.

population.[36] As part of their study, Hostetler, et al. extracted DNA from blood and tissue samples collected from wild-caught panthers and captive pumas in south Florida and west Texas between 1981 and 2006.[37] They amplified and scored 23 microsatellite loci[38]and using STRUCTURE they identified populations or genetic clusters to estimate the genetic origin of individual cats based on microsatellite allele frequencies.[39] The analysis also permitted estimating the proportion of genetic contribution from each population based on the level of admixture present within and among individuals.[40] Based on the results of the STRUCTURE analysis, along with pedigree results and field evidence, the researchers assigned panthers to three groups that reflected the genetic makeup of the south Florida population.[41] These groups consisted of: (1) pre-introgression type panthers, (2) F1 admixed panthers, and (3) other admixed panthers.[42] The pre-introgression type panthers represent the genotypes present on the landscape prior to the introgression program;[43] this group consisted of non-admixed Florida panthers and panthers that showed no evidence of non-Florida genotypes.[44] In other words, there were no direct non-Florida relatives or less than 10 percent non-Florida genetic contribution based on the STRUCTURE analysis.[45] Further, even with genetic restoration, Florida panthers continue to still cluster into their own subset, away from Texas and western subsets.[46]

Research by Ochoa et al. (2017)

In February 2017, Ochoa et al., released a study regarding mitogenomics and the Florida panther.[47] The study performed analysis of admixed Florida panthers. The study identified 5 haplotypes, including one haplotype (Pco2) that was native to Florida. Haplotype Pco2 was separately identified from other haplotypes that originated in Costa Rica/Panama (Pco1), Texas (Pco3 and Pco4), and another from an undetermined origin (Pco5).[48] This study appears to suggest similar findings in unpublished materials that find this species has DNA markers that are distinct and specific to the Florida panther.

The Role of Genetics in Taxonomy

Even with advancements in genetic research, taxonomists have cautioned against the over-reliance of genetics in making phylogenetic inferences.[49] In particular, the role of mitochondrial

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[36] *Ibid.* P.3.
[37] *Ibid*. P. 131.
[38] *Ibid.*
[39] *Ibid.* P. 132.
[40] *Ibid.*
[41] *Ibid.*
[42] *Ibid.*
[43] *Ibid.*
[44] *Ibid.*
[45] *Ibid.*
[46] D. Onorato, personal communication, August 8, 2017.
[47] Ochoa et al., 2017. Evolutionary and Functional Mitogenetics Association With the Genetic Restoration of the Florida Panther. Journal of Heredity, 1-7. Doi: 10.1093/jhered/esx015.
[48] *Ibid*.
[49] Rubinoff, 2006. Utility of Mitochondrial DNA Barcodes in Species Conservation. Con. Bio., 20(4): 1026-1033; Rubinoff & Holland, 2005. Between Two Extremes: Mitochondrial DNA is Neither the Panacea Nor the Nemesis of Phylogenetic and Taxonomic Inference. Syst. Biol. 54(6):952-961.

DNA sequencing in taxonomy and phylogenetic inference has spurred debate as studies revealed that individual gene and species phylogenetic trees are not always congruent,[50] and there are often discrepancies between nuclear and mitochondrial DNA inheritance patterns.[51] Some have contended that DNA "barcoding" can identify all life, some have cautioned against its use in some taxa, and some have questioned its usefulness for any study of systematics.[52] Many researchers have concluded that DNA sequencing can be a useful tool, but it cannot be the only tool. As Will & Rubinoff explain:

> Research in the field of speciation has indicted that there are a multitude of different biological and historical conditions that may or may not ultimately lead to lineage divergence or reticulation. What defines "species" is an intractable debate that cannot be resolved satisfactorily using part of a single gene. No single process or pattern can define or identify all species, and no single character set can adequately track and therefore reliably recognize most species. This is especially true for closely related species, where taxa are in the process of diverging or recently diverged and are frequently represented by incomplete genomic sorting.[53]

Therefore, DNA sequencing must be used as part of a more holistic, integrated approach where mitochondrial and nuclear DNA analysis is used in conjunction with morphological, behavioral, ecological, biogeographical, and other considerations.[54]

In their study of listing subspecies under the ESA, Haig et al. explained that while "molecular genetic techniques will continue to be useful for evaluating subspecies designations…[i]t is important to recognize that although these tools excel at exploring historic reproductive isolation, they usually do not directly address adaptive divergence."[55] Haig et al. go on to explain that "all else being equal, species with high dispersal rates will have fewer subspecies identified via molecular markers than species with lower rates of dispersal. Consequently, they will generally require additional information beyond molecular markers to justify designation of subspecies, such as evidence of local adaptation in spite of ongoing gene flow."[56] Because adaptive divergence can occur despite gene flow, it is important to use multiple sources of information when evaluating a taxon's status.[57] "Higher levels of confidence can be

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[50] *Ibid*.; Avise, 2004. Molecular Markers, Natural History and Evolution, 2nd Edition. Sinauer Associates, Sunderland, Massachusetts.
[51] Rubinoff & Holland, 2005. Between Two Extremes: Mitochondrial DNA is Neither the Panacea Nor the Nemesis of Phylogenetic and Taxonomic Inference. Syst. Biol. 54(6):952-961.; Funk & Omland, 2003. Species-Level Paraphyly and Polyphyly: Frequency, Causes, and Consequences, With Insights from Mitochondrial DNA. Ann. Rev. Ecol. Syt. 34:397-423.
[52] Rubinoff & Holland, 2005. Between Two Extremes: Mitochondrial DNA is Neither the Panacea Nor the Nemesis of Phylogenetic and Taxonomic Inference. Syst. Biol. 54(6):952-961.
[53] Will & Rubinoff, 2004. Myth of the Molecule: DNA Barcodes For Species Cannot Replace Morphology for Identification and Classification, Cladistics 20:47-55.
[54] Rubinoff & Holland, 2005. Between Two Extremes: Mitochondrial DNA is Neither the Panacea Nor the Nemesis of Phylogenetic and Taxonomic Inference. Syst. Biol. 54(6):952-961; Mishler & Wheeler. The perils of DNA Barcoding and the Need for Integrative Taxonomy, Syst. Biol. 54(5):844-851.
[55] Haig et al., 2006. Taxonomic Considerations in Listing Subspecies Under the U.S. Endangered Species Act, Con. Bio. 20(6): 1584-1594.
[56] *Ibid*. P. 1591.
[57] *Ibid.*

obtained in classifications based on the concurrence of multiple morphological, molecular, ecological, behavioral, and/or physiological characters."[58] Indeed, where researchers have utilized multiple criteria, they have confirmed that many subspecies are evolutionarily definable entities.[59]

The most recent Florida Panther Recovery Plan also recognizes that "a considerable amount of work is still required before a consensus can be reached regarding felid systematics and the consensus must involve both morphological and molecular work."[60] "A consensus molecular, morphological, and ethological classification scheme would provide a framework for conservation programs and will become increasingly important as wild populations become smaller and increasingly isolated."[61] The FWS reiterated these sentiments in its 2015 proposed rule to delist the eastern cougar from the ESA. In continuing to recognize the eastern cougar as a subspecies, the FWS explained:

> There is ongoing debate about the taxonomic assignment of puma subspecies, including the question as to whether North American pumas comprise a single subspecies or multiple subspecies. In particular, there has been disagreement about whether the scientific community should accept the use of genetics as the driving factor in puma taxonomy, as was done by Culver et al. (2000, entire). The Service's position is that until a comprehensive evaluation of the subspecies status of North American pumas, including genetic, morphometric, and behavioral analyses, is completed, the best available information continues to support the assignment of the eastern taxon to *Puma concolor couguar* as distinct from other North American subspecies.[62]

We therefore submit–consistent with the prior position of FWS- that genetics is just one factor the FWS should consider in its evaluation of the taxonomic status of the Florida panther and there is not enough evidence at this time for the FWS to conclude that the panther is not a subspecies of *Puma concolor*. Additional research is needed before "a comprehensive evaluation…including genetic, morphometric, and behavioral analyses" will have been completed.[63] More research is also identified as a need in the IUCN Special Issue.[64]

Subspecies are defined as "groups of individuals that mostly share morphological and molecular characteristics that distinguish them from other individuals within a species and that occupy a distinct part of the geographical range of the species."[65] The IUCN Special Issue noted that morphological indicators supporting the *Puma concolor couguar* subspecies as identified in

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[58] *Ibid.*
[59] *Ibid.*
[60] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 7.
[61] *Ibid.*
[62] Department of Interior, Fish & Wildlife Service, 2015. Endangered and Threatened Wildlife and Plants; Removing Eastern Puma (=Cougar) from the Federal List of Endangered and Threatened Wildlife, Proposed Rule, 80 Fed. Reg. 34595, 3459. June 17, 2015.
[63] *Ibid.*
[64] IUCN, 2017. A Revised Taxonomy of the Felidae. Cat Specialist Group. Special Issue 11, Winter 2017. This document stated that while there were correlated evidence on data from closely related species, "further research required."
[65] *Ibid.*

Culver et al. were not as prevalent as the molecular evidence. Morphological traits and other factors, as discussed below, provide additional support for continuing to classify the Florida panther as a subspecies of *Puma concolor* warranting protection as endangered under the ESA.

However, even if the FWS were to find that the Florida panther is not a subspecies, the evidence, as applied to the FWS DPS Policy,[66] overwhelmingly supports a finding that the Florida panther qualifies as a DPS.

Morphological, Physiological, and Geographical/Natural History Characteristics

In its 2009 5-Year Review, the FWS listed several criteria identified by O'Brien and Mayr for subspecies classification. "Following their criteria, a subspecies includes members that share a unique geographic range or habitat, a group of phylogenetically concordant phenotypic characters, and a unique natural history relative to other subdivisions of the species."[67]

Studies of the morphological traits of Florida panthers have long supported classification as a subspecies. These studies include Nelson & Goldman, Young & Goldman, and Wilkins et al.[68] Wilkins et al. quantified and re-evaluated characters previously used to describe *Puma concolor coryi*. All historical specimens and specimens from the southeastern United States collected were examined for pelage color, cranial profile and proportions and other morphological traits and compared to a sample of other North America and South America specimens. Wilkins et al. found that *Puma concolor coryi* appeared to be well defined based on pelage markings, color, and the cranial profile. Among other features, the cats had inflated nasals, which distinguished them from others. This was consistent with the findings of Goldman, 1946. Wilkins et al. 1997, concluded "[t]he Florida panther exhibits a combination of unique and shared characters that are measurable and quantifiable" and the "morphotype remains relatively unchanged from the early historic specimens of the late 1800s in spite of a possible introgression with another form."[69] The Wilkins et al. study did not examine the genetic restoration program the FWS began in 1995.

In 2013, Finn et al. studied the impact genetic restoration efforts had on cranial morphology of Florida Panthers.[70] They examined the arched nasal profile identified as a morphologically unique trait of Florida panthers and discussed how "morphology played a pivotal role in the

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[66] U.S. Fish and Wildlife Service and National Marine Fisheries Service, 1996. Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act, Notice of Policy, 61 Fed. Reg. 4722. Feb. 7, 1996 ("DPS Policy").

[67] U.S. Fish and Wildlife Service, 2009. Florida Panther 5 Year Review: Summary and Evaluation. P. 8.

[68] Nelson & Goldman, 1929. List of Pumas With Three Described as New. *Journal of Mammalogy* 10:345-350; Young & Goldman, 1946. The Puma, Mysterious American Cat. American Wildlife Institute, Washington, D.C.; Wilkins et al., 1997. The Florida Panther Puma Concolor Coryi: A morphological investigation of the subspecies with a comparison to other North and South American cougars. Bulletin of the Florida Museum of Natural History 40:221-269.

[69] Wilkins et al., 1997. The Florida Panther Puma Concolor Coryi: A morphological investigation of the subspecies with a comparison to other North and South American cougars. Bulletin of the Florida Museum of Natural History 40:221-269.

[70] Finn et al., 2013. The Impact of Genetic Restoration on Cranial Morphology of Florida Panthers. *Journal of Mammology*, 94(5): 1037-1047.

historic delineation of the subspecies *P. c. coryi*."[71] Studying panther crania from both pre- and post-genetic restoration panthers, Finn et al. found that neither through historical gene flow with the Texas subspecies[72] or as a result of genetic restoration[73] has this feature unique to the Florida panther been diminished. The researchers explained, "whether we view differences from a genetic (ancestry) or temporal (era) perspective, these skull morphology measures have not changed significantly as a result of genetic restoration."[74] Admixed panthers retain similar morphology to nonadmixed panthers.[75] Finn et al. concluded "the genetic restoration did not significantly alter the skull morphology or change the uniqueness of the Florida panther."[76] These morphological findings of continue to support listing the Florida panther as a subspecies under the ESA.

Other studies since the last 5-Year Review provide additional evidence that there may be, population and demographic differences between non-admixed Florida panthers, admixed panthers, and western cougars. Florida panther kitten survival rate was found to be "lower than those reported for western North American populations of pumas."[77] Sollmann, et al., 2013, found that density for Florida panther (even as it has increased over time), is far less than found for Central and South American pumas where density ranges from 1 to 7 individuals per 100 km^2.[78]

Additionally, Florida panthers have a unique geographic range and habitat. The Florida panther once ranged across the southeastern United States.[79] As people exterminated puma in eastern North America, the only population that remained was in peninsular Florida. These panthers became isolated from other puma populations, eliminating gene flow. The lack of gene flow coupled with a small panther population size resulted in a high rate of inbreeding and a loss of genetic diversity in the 20th century.[80] With the increased frequency of individual cats exhibiting physiological abnormalities in the late 1980s and early 1990s, the FWS released eight Texas puma in south Florida in 1995, five of which produced a total of 20 offspring.[81] The genetic rescue of the Florida panther was found to be successful.[82]

While genetic restoration efforts helped increase population size, improve genetic integrity, and increase dispersal,[83] the Florida panther occurs in a tiny fraction (5%) of its once large

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[71] *Ibid*. P. 1042.
[72] *Ibid.* P. 1039.
[73] *Ibid.* P. 1043.
[74] *Ibid*. P. 1043.
[75] *Ibid* P. 1044.
[76] *Ibid*. P. 1045.
[77] Hostetler et al., 2010. Genetic introgression and the survival of Florida panther kittens. Biological Conservation, 143, 2789-2796, p. 2794.
[78] Sollmann et al., 2013. Using Multiple Data Sources Provides Density Estimates for Endangered Florida Panther. *J. Applied Ecology*, 50, 961-968, doi: 10.111/1365-2664.12098.
[79] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 12.
[80] *Ibid.* P. 9.
[81] *Ibid.* P. 10.
[82] U.S. Fish and Wildlife Service, 2009. Florida Panther 5 Year Review: Summary and Evaluation. P. 9.
[83] *Ibid*. P. 19.

historical range.[84] Despite intensive searches, no reproducing populations of panthers have been found outside of south/south-central Florida. Until recently, there was no evidence of breeding females north of the Caloosahatchee River since the 1970s.[85]

In 2011, the FWS declared the eastern cougar extinct and in 2015 proposed to remove the subspecies from the ESA.[86] Reproduction of the Florida panther is also largely confined to a portion of peninsular Florida in Collier, Lee, Hendry, Miami-Dade, and Monroe counties south of the Caloosahatchee River.[87] Only this year have researchers documented panther kittens north of the Caloosahatchee River - the first time since 1973.[88] While some animals have crossed the Caloosahatchee in recent years, "given the many other substantial barriers to dispersal, it is considered highly unlikely that Florida panthers are dispersing out of Florida with enough frequency to establish populations elsewhere in the Southeast, although adequate prey and habitat are available in Georgia."[89] The existing Florida panther population represents the last remaining population of *Puma* in the eastern United States, and is therefore critical to the genetic representation for pumas in North America.[90]

Distinct Population Segment

Under the ESA, the FWS may list as threatened or endangered a vertebrate wildlife species, subspecies, or DPS.[91] Even if the FWS were to determine that the Florida panther is not a subspecies of *Puma concolor*, it would undoubtedly qualify as an Endangered DPS under the ESA. In 1996, the FWS issued a joint policy with the National Marine Fisheries Service interpreting the term "Distinct Population Segment" for the purpose of listing, delisting, and reclassifying species under the Act.[92] The DPS Policy identifies three elements necessary to designate a vertebrate population as a DPS: 1) the "*discreteness* of the population in relation to the remainder of the species to which it belongs;" 2) the "*significance* of the population segment to the species to which it belongs;" and 3) the "population segment's conservation status in relation to the Act's standards for listing (i.e. is the population segment, when treated as if it were a species, endangered or threatened?)."[93] As explained below, the Florida panther clearly qualifies as a discrete and significant population segment that is endangered. Therefore, should

[84] Frakes et al., 2015. Landscape Analysis of Adult Florida Panther Habitat. PLoS ONE 10.7: 1-18.
[85] *Ibid.*
[86] Department of Interior, Fish & Wildlife Service, Endangered and Threatened Wildlife and Plants; Removing Eastern Puma (=Cougar) from the Federal List of Endangered and Threatened Wildlife, Proposed Rule, 80 Fed. Reg. 34595-34605. June 17, 2015.
[87] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 13.
[88] Pittman, 2017. Florida Panther Kittens Found North of Caloosahatchee River for First Time in Decades. March 27, 2017. Accessed at http://www.tampabay.com/news/environment/wildlife/florida-panther-kittens-found-north-of-caloosahatchee-river-for-first-time/2318043.
[89] 80 Fed. Reg. 34603.
[90] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 12; Culver et al., 2000. Genomic Ancestry of the American Puma (Puma concolor). Journal of Heredity, 91. P. 10.
[91] 16 U.S.C. §1532(16)(defining "species" to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature").
[92] Policy Regarding the Recognition of Distinct Population Segments Under the Endangered Species Act, 61 Fed. Reg. 4721. Feb. 7, 1996.
[93] 61 Fed. Reg. 4725 (emphasis added).

the FWS find that it no longer qualifies as a subspecies of *Puma concolor*, it nevertheless warrants continued and uninterrupted listing under the ESA as a DPS.

Discreteness

According to the FWS DPS Policy, a species is considered "discrete" if, in relevant part, it is "markedly separated from other populations" because of "physical, physiological, ecological, or behavioral factors."[94] Under this test, a population need not have "absolute reproductive isolation" to be recognized as discrete.[95] In fact, on several recent occasions the FWS has identified a discrete DPS even where limited contact with other populations was documented.[96]

The Florida panther is "markedly separated from other populations" because of "physical" factors under this standard.[97] With the exception of the occasional dispersing male into southern Georgia, the population is limited to peninsular Florida.[98] The Florida panther population is approximately 1,000 miles from the nearest *Puma concolor stanleyana* in Texas, which is well beyond the maximum dispersal distance of any Florida panther.[99]

Even within Florida, the population is almost entirely limited to areas south of the Caloosahatchee River. As noted earlier, reproduction of the Florida panther is largely confined to Collier, Lee, Hendry, Miami-Dade, and Monroe counties south of the Caloosahatchee River.[100] The river, along with heavily trafficked roads, intense land uses, and lack of suitable habitat, can pose physical and ecological barriers to panthers dispersing northward.[101] As Thatcher et al. documented, human-made structures can serve as significant barriers to panther movement.[102] Most panthers, particularly females, do not explore areas north of Okaloacoochee Slough far

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[94] *Ibid.* P. 4725.
[95] *Ibid.* P. 4724.
[96] U.S. Fish and Wildlife Service, 2008. Final Rule Designating the Northern Rocky Mountain Population of Gray Wolf as a Distinct Population Segment and Removing This Distinct Population Segment From the Federal List of Endangered and Threatened Wildlife, 73 Fed. Reg. 10,514-01. Feb. 27, 2008; US Fish and Wildlife Service, 2007. 90-day Finding on a Petition To List the Yellowstone National Park Bison Herd as Endangered, 72 Fed.Reg. 45,717, 45,718. Aug. 15, 2007; U.S. Fish and Wildlife Service, 2003. 12-Month Finding for a Petition To List the Lower Kootenai River Burbot as Threatened or Endangered, 68 Fed.Reg. 11,574, 11,577. Mar. 11, 2003.
[97] DPS Policy, 61 Fed. Reg. at 4725.
[98] Incidents of Florida panthers dispersing outside of peninsular Florida are exceedingly rare. In 2011, a Georgia hunter was find $2,000 and sentenced to two years probation for killing a Florida panther in south Georgia. See http://www.sun-sentinel.com/news/sfl-george-man-sentenced-for-shooting-florida-panther-20110824-story.html. This appears to be the only incident in recent years of a Florida panther documented outside the state (based on DNA analysis). See https://www.fws.gov/southeast/news/2009/08/troup-county-panther-was-a-florida-panther-wildlife-csi-high-tech-genetic-testing-used-to-determine-cat-s-parentage/.
[99] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 18. Research by Maehr et al. 2002 found the maximum dispersal distance recorded for a young male Florida panther to be 139.2 miles or 224.1 kilometers with a secondary dispersal distance of 145 miles or 233 kilometers. A Florida panther was shot in Troup County, Georgia, about 500 miles from the current established breeding range.
[100] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P.13.; Julian, 2011. Home Range Dynamics of Female Florida Panthers in Response to Kitten Production. Florida Scientist. 74(4): 215-223 (stating that the current breeding population is restricted to an area of approximately 10,000km2 in southern Florida).
[101] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 19, 183.
[102] Thatcher et al., 2009. A Habitat Assessment for Florida Panther Population Expansion into Central Florida. J. Mammal. 90(4): 918-925.

enough to reach the Caloosahatchee River as agricultural and urban land use immediately south of the river likely impedes panther movements.[103] These land uses call into question the likelihood that a sufficient number of females will expand into central Florida. Fei et al. further noted that most development in South Florida is likely to occur along an east-west axis between Ft. Myers and West Palm Beach, thus reducing or halting further panther colonization northward and severing important escape routes to higher elevations (in the midst of sea level rise), such as the Lake Wales Ridge in the middle of the peninsula.[104]

This evidence shows that the Florida panther population is "discrete" from other *Puma concolor* populations in the United States because it is "markedly separated" from such populations due to well-documented "physical" factors.[105] The Florida panther's isolation on the southern Florida peninsula and rarity of dispersals north of the Caloosahatchee River -let alone north of the state boundary- would satisfy even a much stricter standard for discreteness than the FWS has adopted in the DPS policy.

Significance

A population is considered "significant" based on, but not limited to, the following factors: (1) "persistence of the discrete population segment in an ecological setting unusual or unique for the taxon;" (2) "evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon;" (3) "evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historical range;" or (4) "evidence that the discrete population segment differs markedly in its genetic characteristics."[106]

Were the FWS to determine that the best available science no longer supports a subspecies level listing, the Florida panther would quality as a "significant" population segment of *Puma concolor* under these factors. First, the Florida panther occurs almost exclusively in "an ecological setting unusual or unique for the taxon"[107] - the Everglades and southern coastal plain ecoregions, which comprise one of the only subtropical regions in the lower 48 states. The Everglades and southern coastal plain have unique vegetation communities, soil and climate.[108] These ecoregions contain cypress swamp, pinelands, hardwood swamp, and upland hardwood forests, which are the habitat types "most selected by panthers."[109] Dense, understory vegetation, comprised of saw palmetto (*Serenoa repens*) "provides some of the most important resting and denning cover for panthers,"[110] with Shindle et al. finding 73% of panther dens were in palmetto

[103] *Ibid.* P. 923.
[104] Fei, et al. 2011. A Perfect Storm May Threaten Florida Panther Recovery: Peer-Reviewed Letter. Frontiers in Ecology and the Environment. 9(6): 317-318.
[105] DPS Policy, 61 Fed. Reg. at 4725.
[106] *Ibid.* P. 4725.
[107] *Ibid.*
[108] Omernick, & Griffith, 2014. Ecoregions of the Conterminous United States: Evolution of a Hierarchical Spatial Framework. Environmental Management. 54(6): 1249-1266.
[109] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 28.
[110] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 15, 29.

thickets.[111] *Serenoa repens* occurs naturally throughout Florida, with limited occurrence elsewhere in the southern coastal plain.

Second, the Florida panther is the last population of panthers in the entirety of the eastern United States, such that "the loss of the [Florida population] would result in a significant gap in the range" of the broader taxon.[112] The Eastern cougar was declared extinct by the FWS in 2015, leaving the Florida panther as the sole surviving *Puma concolor* population east of the Mississippi River. The nearest population of *Puma concolor* is found in Texas, and as discussed earlier, is not within range of any dispersing male panthers, eliminating any possibility at this time of natural admixture. Accordingly, the loss of the Florida panther would result in a significant gap in the range of *Puma concolor*.

Third, the Florida panther "differs markedly in its genetic characteristics" as compared to other *Puma concolor* populations and/or subspecies.[113] There is evidence of both genetic and morphological discontinuity. As explained earlier, a more recent genetics analysis by researchers at FWC and UF yielded distinct clusters for Texas, western, and Florida panthers. Further, Finn et al. and Wilkes et al. point to Florida panthers possessing unique cranial features. These features include a skull that has a broad, flat, frontal region, and broad, high-arched or upward-expanded nasal bones.[114] Wilkes et al. found the cranial morphology and pelage color to remain distinct even after the introduction of eight female pumas from Texas in 1995. Culver et al. also found that Florida panthers are one of several smaller populations that have "unique features."

Conservation Status

As described throughout this letter, the Florida panther remains an endangered species based on population status and ongoing threats. Current population estimates are between 120-230 individuals, excluding kittens.[115] While this is certainly an improvement since the species was listed in 1967, there is a long way to go before downlisting is warranted under the Florida Panther Recovery Plan. As mentioned below, the best available science indicates that for the subspecies to even *be considered* for down-listing from its current status of endangered, there must be two (2) viable populations of at least 240 individuals (adults and subadults).[116] These populations must be established and subsequently maintained for a minimum of twelve years (two panther generations).[117] Moreover, sufficient habitat quality, quantity, and spatial configuration to support these populations must be retained and protected or secured for the long-term.[118] In addition, for de-listing to be considered, there must be three viable, self-sustaining populations of at least 240 individuals (adults and subadults) that have been established and subsequently maintained for a minimum of twelve years.[119] Similar to down-

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[111] *Ibid.*
[112] DPS Policy, 61 Fed. Reg. at 4725.
[113] DPS Policy, 61 Fed. Reg. at 4725.
[114] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 5 (citing Young and Goldman 1946).
[115] http://myfwc.com/media/4156723/DeterminingPantherPopulation2017.pdf
[116] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. x.
[117] *Ibid.*
[118] *Ibid.* P. xi.
[119] *Ibid.*

listing, sufficient habitat quality, quantity, and spatial configuration to support these populations must be retained and protected or secured for the long-term.[120] Exchange of individuals and gene flow among subpopulations must also be natural.[121]

The Recovery Plan goals have not been met for the purposes of even considering down-listing, let alone de-listing. At best, current population estimates still fall short of qualifying as one of two viable populations that must be established and maintained for the FWS to even consider down-listing the species from endangered to threatened. In addition, the expansion of a population outside of South/South-Central Florida has not been achieved (recovery objective #2).[122]

As further explained below, the species also face continued threats from vehicle collisions and habitat loss and fragmentation fueled by a rapidly expanding human population[123] which now exceeds 20 million residents, increasing by approximately 1,000 new residents moving to the state every day.[124]

South Florida lost over 1.8 million acres of forest between 1935 and 1995 and gained 11,000 miles of public roads in just twelve years (1991-2003).[125] Gross et al. found panther habitat shrinking at a rate of 1% per year and noted that if that trend continues, over 15% of all remaining panther habitat will vanish in 25 years.[126] Frakes et al. recently developed a model based on collected data to predict the distribution of suitable panther breeding habitat remaining in Florida south of the Caloosahatchee River.[127] The model identified 5,579 km^2 of suitable breeding habitat remaining in southern Florida; 1399 km^2 (25%) of this habitat is in non-protected private ownership. Frakes et al. found:

> This population may already be at or close to carrying capacity, yet the panther population is probably below what is required for long-term genetic viability. Therefore, protection of the remaining breeding habitat in south Florida is essential to the survival and recovery of the subspecies and should receive the highest priority by regulatory agencies. Further loss of adult panther habitat is likely to reduce the prospects for

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[120] *Ibid.* P. xii.
[121] *Ibid.*
[122] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision.
[123] Gross, 2005. Why Not the Best? How Science Failed the Florida Panther. PLoS Biol 3(9): e333. https://doi.org/10.1371/journal.pbio.0030333; Onorato et al., 2010. Long-term research on the Florida panther (Puma concolor coryi): historical findings and future obstacles to population persistence. Biology and Conservation of Wild Felids (eds D. Macdonald & A. Loveridge). P. 453–469. Oxford University Press, Oxford, UK; Fei et al., 2011. A Perfect Storm May Threaten Florida Panther Recovery: Peer-Reviewed Letter. Frontiers in Ecology and the Environment, vol. 9, no. 6, 317–318; Frakes et al., 2015. Landscape Analysis of Adult Florida Panther Habitat. PLoS ONE 10.7: 1-18. Academic Search Premier.
[124] Turner, 2015. Florida Population Over 20 Million, Adding Nearly 1,000 People a Day. Accessed at http://spacecoastdaily.com/2015/12/florida-population-over-20-million-adding-nearly-1000-people-a-day/.
[125] Gross, 2005. Why Not the Best? How Science Failed the Florida Panther. PLoS Biol 3(9): e333. https://doi.org/10.1371/journal.pbio.0030333.
[126] *Ibid.*
[127] Frakes et al., 2015. Landscape Analysis of Adult Florida Panther Habitat. *PLoS ONE* 10.7 (2015): 1-18. Academic Search Premier.

survival of the existing population, and decrease the probability of natural expansion of the population into south-central Florida.[128]

Because there is less panther habitat remaining than previously thought, this study recommends that all remaining breeding habitat in south Florida should be maintained, and the current panther range should be expanded into south-central Florida.

Road-related mortalities are a leading cause of known panther mortality,[129] and continue to rise.[130] According to FWC, 59% of all known panther mortalities are from collisions with automobiles.[131] The number of collisions has increased significantly since 2000, with an all-time high of 34 panthers killed on Florida roads in 2016.[132] Citing a 2006 population distribution study by Zwick and Carr, Hostetler, et al. noted that road mortalities were unlikely to subside given projected human population growth and an imminent increase in traffic volumes.[133]

At the same time, funding for Florida Forever (the state's premier land conservation program) was slashed by 94% between 2008 and 2015.[134] Florida Forever received zero funding in the 2017 legislative session.[135] Despite overwhelming popular support for Amendment 1 (which passed by about 75% of the Florida voters in 2014), land acquisition has only received a mere $10 million dollars for the Rural and Family Lands program in 2017.

In addition, there have been significant changes to the state's growth management laws since the FWS last reviewed the status of the Florida panther. Many provisions of Florida's Growth Management Act of 1985 were repealed and/or amended in 2011. Most notable perhaps is that any state challenge to local government comprehensive plans or plan amendments (including amendments that propose or amend a sector plan), must specifically state how the plan or plan amendment will adversely impact an "important state resource or facility" (a term not defined in the Florida statutes).[136] It appears this determination is at the discretion of the Florida Department of Economic Opportunity (DEO). It is possible that many important panther habitats, particularly those that do not occur within or near state parks or other public lands (to the extent that state parks or other public lands would be considered important state resources or facilities), could arbitrarily be excluded from the meaning of "important state resource or facility."

Since the last 5-year Status Review, Florida's state legislature amended Florida's laws regarding developments of regional impact (DRIs). The law now exempts several types of uses from the DRI process including many industrial, multiuse projects, new solid mineral mines, and

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[128] *Ibid.* P. 15-16.
[129] Benson et al., 2011. Intentional Genetic Introgression Influences Survival of Adults and Subadults in a Small, Inbred Felid Population. Journal of Animal Ecology 80:988-967.
[130] Hostetler et al., 2013. A Cat's Tale: The Impact of Genetic Restoration on Florida Panther Population Dynamics and Persistence. Journal of Animal Ecology 82:608-620.
[131] http://myfwc.com/wildlifehabitats/managed/panther/biology/life-expectancy/.
[132] *Ibid.*
[133] *Ibid.*
[134] Dixon, 2015. Florida Forever funding cut 94% since 2008. Tc Palm. June 15, 2015. Accessed at http://www.tcpalm.com/news/florida-forever-funding-cut-94-since-2008-ep-1137241031- 332549492.html.
[135] http://www.miamiherald.com/news/local/environment/article148862139.html.
[136] Fla. Stat. §163.3184. 2015.

any proposed addition to, expansion of, or change to an existing mineral mine.[137] The Florida Panther Recovery Plan identifies urbanization, residential development, and mining and mineral exploration as specific threats to the species.[138]

The best available science does not support the reclassification of the Florida panther as merely one of many populations of *Puma concolor* rather than a separate subspecies. Nevertheless, should the FWS reach the conclusion that it cannot maintain the current subspecies listing, ESA protections must remain in place because the Florida panther meets the longstanding definition of a DPS and that DPS is on the brink of extinction.

II. Summary of Habitat Conditions

Since the last 5-Year Status Review in 2009,[139] there have been substantial changes in panther habitat conditions, including regarding amount, distribution, and suitability.

The FWS habitat assessment methodology and Section 7 ESA analyses are currently based on the habitat zones identified by Kautz et al., 2006.[140] The Primary, Secondary, and Dispersal habitat zones are essential to long-term viability, survival, and recovery of the species. The area defined as the Primary Zone is the minimum "space to support a population that is barely viable demographically as long as the habitat base remains stable."[141] The Secondary Zone area is important to accommodate an expanding panther population, and the Dispersal Zone area is important to facilitate dispersal north of the Caloosahatchee River.[142] The study also states that to prevent loss of viability, conservation efforts should allow no net loss of landscape function or carrying capacity of the Primary Zone or throughout the range of the panther.[143] Loss may occur if areal extent of habitat within the Primary Zone is reduced, if habitat base is reduced or degraded, with land use intensification, or if landscape fragmentation occurs.[144]

Additional panther habitat science by Frakes et al became available in 2015.[145] This study was not intended to replace the Kautz et al., 2006 study, and focuses on identifying "adult breeding habitat." Frakes et al. modeled 5579 km^2 of suitable breeding habitat that remain in southern Florida, concluding: "less panther habitat remaining than previously thought."[146] The study found that when human density increased to only 10 people per km^2, that there was a marked decrease in probability of panther use, even if the habitat surrounding the human presence was good panther habitat otherwise.[147] At 50 people per km^2, the use of the area by

[137] Fla. Stat. §§ 380.06(2)(d), (1)(c), 380.06(24)(t). 2015.
[138] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. ix, 36, 183, 192.
[139] U.S. Fish and Wildlife Service, 2009. Florida Panther 5 Year Review: Summary and Evaluation.
[140] Kautz et al., 2006. How Much is Enough? Landscape Scale Conservation for the Florida Panther. Biological Conservation, 130, 118-133.
[141] *Ibid*. P. 129.
[142] *Ibid*. P. 119.
[143] *Ibid*. P. 118-119.
[144] *Ibid*. P. 118-119.
[145] Frakes et al., 2015. Landscape Analysis of Adult Florida Panther Habitat. PLoS ONE, 10(7): e0133044. DOI: 10.1371/journal.pone.0133044.
[146] *Ibid*. P. 1.
[147] *Ibid*. P. 11. 0.3 decrease out of 1.0.

panthers decreased by half.[148] The study found similar results regarding density of roads. For example, an area with no roads was about twice as likely to support adult panthers than an area with a density of 5 km of roads.[149]

Frakes et al., 2015 states that "since human population and roads generally occur together, the combined impact of increased roads and increased population density in residential developments, even low density developments, is predicted to be large."[150] The hopeful news of breeding females north of the Caloosahatchee, acknowledged by the agencies in March 2017, does not diminish the findings of Frakes et al., that "there is not enough adult panther (breeding) habitat remaining in south Florida to maintain one genetically viable population" and therefore, "protection of the remaining breeding habitat in south Florida is essential to the survival and… must be maintained."[151]

To date, neither Kautz et al., 2006, nor Frakes et al., 2015, has been fully implemented in the FWS regulatory methodology to adequately protect Florida panther habitat. Kautz et al. stated that:

> When adverse land uses within the Primary Zone are unavailable, affected lands should be compensated by the restoration or enhancement of habitat that maintains or increases the potential carrying capacity for panthers elsewhere within the Primary Zone. In addition, maintaining the total areal extent of the Primary Zone may require expanding the boundaries of the zone in appropriate locations (e.g. into the Secondary Zone adjacent to protected habitat within the Primary Zone) to compensate for loss of area. In such cases, lower quality areas should be restored to land cover types and landscape configurations that promote healthy prey densities, connectivity, and habitat context to compliment conservation efforts within the Primary Zone.[152]

The FWS has not limited development in Primary Zone habitat, and, further the regulatory methodology does not consider areal extent or restoration of Secondary Zone in its compensation considerations to meet the expectations of the Section 7 ESA process. Further, Frakes et al., 2015, found that the current methodology is flawed and overestimates the value of non-Primary Zone lands.[153] For over 10 years, Secondary Zone lands utilized as mitigation have been valued at 69% of the value of Primary Zone lands; however, the Frakes study found that there is "little value" in these areas, and that the mitigation lands provided in compensation for impacts has been inadequate.[154]

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[148] *Ibid*.
[149] *Ibid*.
[150] *Ibid*. P. 11.
[151] *Ibid*. P. 1 and 15.
[152] Kautz et al., 2006. How Much is Enough? Landscape Scale Conservation for the Florida Panther. Biological Conservation, 130, P. 131.
[153] Frakes et al., 2015. Landscape Analysis of Adult Florida Panther Habitat. PLoS ONE, 10(7): e0133044. DOI: 10.1371/journal.pone.0133044. P. 15.
[154] *Ibid*.

Over a five-year period from 2008 to 2013, FWS has not objected to the loss of 27,659 acres in Florida panther habitat.[155] Since 1977, the FWS has not objective to 155,284 acres of intensification and development in panther habitat.[156] About half of these losses were over the last 15 years.[157] Equally concerning is that the agency appears to have incomplete records about habitat loss since 2012 (based on a Freedom of Information Act Request in fall 2016), and only appears to include projects that received formal consultation.[158] However, since that time, southwest Florida, including Lee and Collier counties, has become one of the fastest-growing areas in the nation.[159] Data by Robert Kawula has shown that, between 2003-2015, the Florida panther lost 36,377 acres of upland forest (23,372 acres in the Primary Zone), and 139,517 acres of wetland forest (136,677 acres of that being Primary Zone), as well as 23,288 acres of open pasturelands, based on analysis of land cover type changes.[160] In 2005, it was estimated that about 1% of panther habitat is being lost every year.[161] This has likely increased due to the intensive development further described below.

III. <u>Conservation Measures</u>

Since the last 5-Year Status Review in 2009,[162] there is additional information to consider regarding panther conservation measures.

Compensation Lands

As mentioned above, recent best available science has identified that the current regulatory methodology used to assess habitat impacts and compensation by the FWS as flawed due to the overestimation of the value of non-Primary Zone lands.[163] The methodology is also flawed due to not having a component to protect the areal extent of habitat, as well as the base ratio that is an integral part of the Panther Habitat Assessment Methodology being outdated. Any gains in panther conservation lands as compensation/mitigation for development should be considered only in light of these deficiencies.

Value of Panthers to Humans

Since it was first measured in 1978 by Stephen Kellert, the public's values towards mammalian carnivores have grown substantially more positive over the past three decades.[164]

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[155] U.S. FWS, 2012. Panther Impacts and Compensation 2003-2001_06-07-2012. Received through CSWFL FOIA request.
[156] U.S. FWS, 2012. Main Consultation Table. From 20120607. Received through CSWFL FOIA request.
[157] *Ibid*.
[158] *Ibid*.
[159] Deluca, Dan, 2015. Lee, Collier Population Growth in Top 10 Nationally. NewsPress. March 26, 2015.
[160] Kawula, Robert, 2016. Habitat Loss 2003-2015. Powerpoint presentation.
[161] Gross, 2005. Why Not the Best? How Science Failed the Florida Panther. PLoS Biol 3(9): e333. https://doi.org/10.1371/journal.pbio.0030333.
[162] U.S. Fish and Wildlife Service, 2009. Florida Panther 5 Year Review: Summary and Evaluation.
[163] Frakes et al., 2015. Landscape Analysis of Adult Florida Panther Habitat. PLoS ONE, 10(7): e0133044. DOI: 10.1371/journal.pone.0133044. P. 15.
[164] George et al., 1996. Changes in Attitudes toward Animals in the United States from 1978 to 2014. Biological Conservation, 201 (9// 2016). http://dx.doi.org/http://dx.doi.org/10.1016/j.biocon.2016.07.013; Stephen R. Kellert, 1996. *The Value of Life* (Washington, D.C.: Island Press).

According to George et al., 2016, few Americans view large carnivores negatively and those that do are "'drowned out'" by the vast majority, who hold a growing concern for animal welfare, including for *Puma concolor*.[165] In 1982, by a vote of Florida's school children, the Florida panther was nominated as the state's animal,[166] a symbol of wildness and iconic beauty.

Golden Gate Estates, an ex-urban development located in southwestern Florida, is the site where most human-panther interactions occur.[167] Despite these conflicts, most residents of Florida and Golden Gate Estates in particular, view panthers positively and worry that their habitats are too quickly disappearing.[168] Moreover, studies show that ranchers are willing to consider various economic incentives to co-adapt to panthers.[169] If carnivores are to persist, co-adaption is necessary.[170]

Carnivores not only hold intrinsic value,[171] they are important to human economies—whether people view them or just have the satisfaction of knowing that they are present.[172] For example, the Big Cypress National Preserve, which is part of the National Park System, serves as habitat for the Florida panther. According to the National Park Service:

> In 2016, 1.1 million park visitors spent an estimated $88 million in local gateway regions while visiting Big Cypress National Preserve. These expenditures supported a total of 1,300 jobs, $48.8 million in labor income, $77.5 million in value added, and $126 million in economic output in local gateway economies surrounding Big Cypress National Preserve.

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[165] *Ibid*. P. 240.

[166] Florida Department of State. State Animal. Accessed at http://dos.myflorida.com/florida-facts/florida-state-symbols/state-animal/.

[167] Rodgers & Pienaar, 2017. Amenity or Nuisance? Understanding and Managing Human–Panther Conflicts in Exurban Southwest Florida. Human Dimensions of Wildlife. Accessed at http://dx.doi.org/10.1080/10871209.2017.1318322.

[168] *Ibid*.; Langin & Jacobson, 2012. Risk and Residency Influences on Public Support for Florida Panther Recovery. Wildlife Society Bulletin 36, no. 4. Accessed at http://dx.doi.org/10.1002/wsb.187.

[169] Jacobs & Main, 2015. A Conservation-Based Approach to Compensation for Livestock Depredation: The Florida Panther Case Study. Plos One 10, no. 9. http://dx.doi.org/10.1371/journal.pone.0139203; Pienaar et al., 2015. Conflicts between Cattlemen and the Florida Panther: Insights and Policy Recommendations from Interviews with Florida Cattlemen. Human Ecology 43, no. 4. Accessed at http://dx.doi.org/10.1007/s10745-015-9765-x; Kreye et al., 2017. The Role of Community Identity in Cattlemen Response to Florida Panther Recovery Efforts. Society & Natural Resources 30, no. 1. Accessed at http://dx.doi.org/10.1080/08941920.2016.1180730.

[170] Carter & Linnell, 2016. Co-Adaptation Is Key to Coexisting with Large Carnivores. *T*rends in Ecology & Evolution 31, no. 8 (2016), accessed 2016/07/21, http://dx.doi.org/10.1016/j.tree.2016.05.006; Guillaume Chapron and José Vicente López-Bao, "Coexistence with Large Carnivores Informed by Community Ecology," Trends in Ecology & Evolution 31, no. 8 (2016), accessed 2016/07/21, http://dx.doi.org/10.1016/j.tree.2016.06.003.

[171] Bruskotter et al., 2015. Hunted Predators: Intrinsic Value. Science 349, no. 6254. Accessed at ISI>://WOS:000361357700031; Bruskotter et al., 2015. Does Nature Possess Intrinsic Value? An Empirical Assessment of Americans' Beliefs. The Ohio State University, Columbus OH, USA. *DOI: 10.13140/RG.2.1.1867.3129* ; Vucetich et al. 2015. Evaluating Whether Nature's Intrinsic Value Is an Axiom of or Anathema to Conservation. Conservation Biology 29, no. 2. http://dx.doi.org/10.1111/cobi.12464.

[172] Duffield & Patterson, 2008. Wolf Recovery in Yellowstone: Park Visitor Attitudes, Expenditures, and Economic Impacts. Yellowstone Science 16, no. 1.; Elbroch et al., 2017. Contrasting Bobcat Values. Biodiversity and Conservation. Accessed at http://dx.doi.org/https://www.springerprofessional.de/en/contrasting-bobcat-values/13278284.

> In 2016, 930,900 park visitors spent an estimated $91.3 million in local gateway regions while visiting Everglades National Park. These expenditures supported a total of 1,300 jobs, $53 million in labor income, $84.1 million in value added, and $136.4 million in economic output in local gateway economies surrounding Everglades National Park.[173] Some visitors who travel to Big Cypress Preserve and Everglades National Park hope to see panthers or any signs of their presence.[174] Recently, a photographer had a chance encounter with a mother panther moving her infant kittens along a road, which prompted viral sharing of his photos.[175]

Panthers also play an important role in the management of white-tailed deer herds. Panthers reduce the risks of vehicle collisions with deer and also the spread of Lyme disease. Maehr et al., 2003, assert the importance of panthers on the landscape:

> One aspect of cougar ecology that is becoming less debatable is its role in biotic communities . . . . *P. concolor* has the potential to structure the distribution and demography of prey (Logan and Sweanor 2001, Maehr et al. 2001). Browse lines, highway collisions, Lyme disease (Wilson and Childs 1997), loss of biodiversity (Alverson et al. 1988, Waller and Alverson 1997), and other problems associated with overabundant white-tailed deer (*Odocoileus virginianus*) hint at the benefits of returning such a predator to the East.[176]

According to the Florida Department of Health, there were 673 reported cases of Lyme disease in the state from 2002 to 2011, with 23 percent of those cases being contracted in Florida.[177] Kilpatrick et al., 2014, found that reducing deer density resulted in a reduction in tick abundance, which subsequently resulted in a reduction of reported cases of Lyme disease.[178]

Predation on deer by predators can also provide significant socioeconomic benefits to humans. Recent research has shown that, in South Dakota, mountain lions reduced vehicle collisions with deer by nine percent between 2008 and 2012, preventing an estimated 158 collisions and saving residents approximately $1.1 million annually in counties with established

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[173] National Park Service, 2017. 2016 National Park Service Vistor Spending Effects Report. Accessed at *https://www.nps.gov/subjects/socialscience/vse.htm*.

[174] McBride & McBride, 2011. Photographic Evidence of Florida Panthers Claw-Marking Logs. Southeastern Naturalist, 10, no. 2. Accessed at http://dx.doi.org/10.1656/058.010.0220; McBride & McBride, 2010. Predation of a Large Alligator by a Florida Panther. Southeastern Naturalist, 9, no. 4. Accessed at http://dx.doi.org/10.1656/058.009.0420; McBride & Sensor, 2012. Photographic Evidence of Wild Florida Panthers Scent-Marking with Facial Glands. Southeastern Naturalist,11, no. 2. Accessed at http://dx.doi.org/10.1656/058.011.0216.

[175] Torres, 2017. Purrfect Encounter: Man Spots Panther, Kittens at Big Cypress. Naples Daily News. Accessed at http://www.naplesnews.com/story/news/environment/2017/08/12/purrfect-encounter-man-spots-panther-kittens-big-cypress/562271001/.

[176] Maehr et al., 2003. Eastern Cougar Recovery is Linked to the Florida Panther: Cardoza and Langlois Revisited. Wildlife Society Bulletin, 31:849-853.

[177] Florida Department of Health. Lyme Disease Occurrence in Florida. Accessed at http://www.floridahealth.gov/diseases-and-conditions/lyme-disease/index.html.

[178] Kilpatrick et al., 2014. The Relationship Between Deer Density, Tick Abundance, and Human Cases of Lyme Disease in a Residential Community. Journal of Medical Entomology.

cougar populations.[179] Moreover, if lion populations were restored in eastern states – including increased Florida panther populations, it could result in more than 700,000 fewer vehicle collisions with deer over a 30-year period, leading to 21,400 fewer injuries and 155 fewer deaths and a savings of more than $2 billion.[180]

The removal of panthers initiates changes in ecosystem structure and lost biodiversity. Maintaining federal protections for panthers and the large areas of habitat they require benefits a variety of plants and animals and maintains the overall health of Florida's remaining wild spaces. Panthers' presence on our landscape can help maintain sustainable, healthy deer populations and significantly reduce human injuries and deaths caused by vehicle collisions with deer.

Floridians appreciate their state animal, the Florida panther. These values should spur the FWS to embrace innovative wildlife management and to better safeguard Florida panthers for future generations. Maintaining panthers' endangered status will ensure the FWS's ability to uphold these values and the economic benefits they provide to Florida.

IV. Threats Status and Trends

Over the last eight years since the last 5-Year Status Review,[181] threats for the Florida panther have mounted considerably. Under the ESA, a review of each listed species' status at least once every five years is required.[182] The possible outcomes of the five year review are no change, changing in status between endangered and threatened, or delisting. The FWS may also wish to consider listing as a DPS.

In determining the appropriate listing status, the following factors must be considered: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization of commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; and (5) other natural or manmade factors affecting its survival.[183] In every applicable category, the Florida panther faces intense threats to its continued survival and recovery. Therefore, the panther warrants continued listing as endangered.

(1) The present or threatened destruction, modification, or curtailment of its habitat or range, 16 U.S.C. § 1533(a)(1)(A)

As presented in the last 5-Year Status Update, the Florida Panther Recovery Plan, and in past available science, habitat loss, fragmentation, and degradation, along with the associated human disturbance are the greatest threats to panther survival and to its recovery and continue to be threats. In 2016, Florida's population was estimated at 20,612,439 people[184] and rising,[185] with

[179] Gilbert et al., 2016. Socioeconomic benefits of large carnivore recolonization through reduced wildlife-vehicle collisions. Conservation Letters.
[180] *Ibid*.
[181] U.S. Fish and Wildlife Service, 2009. Florida Panther 5 Year Review: Summary and Evaluation.
[182] 16 U.S.C. § 1533(c)(2).
[183] 16 U.S.C. § 1533(a)(1).
[184] U.S. Census Bureau. *Quick Facts Florida*. Accessed at http://www.census.gov/quickfacts/table/PST045215/12.

South Florida seeing the most rapid population growth. The region had more than six million estimated residents, keeping its spot as the eighth largest metropolitan area in the nation[186], with half a million new residents in the last six years.[187] Similarly, from 2010 to 2016, Lee and Collier counties added more than 90,000 people.[188] Models predict that by 2040, Florida's population will reach over 26 million[189] and, by 2070, approximately 33.7 million.[190] Half a million people are predicted to be added to Lee and Collier counties over just the next 20 years.[191] By 2070, there will be an additional 1,356,000 people in the 5-county area of southwest Florida (see Table 1).

Table 1. Human population increases in 5 county region of southwest Florida[192]

County	Population est. 2010	Population est. 2015	Population est. 2070	Population increase from 2010
Charlotte	159,978	166,100	237,515	77,537+
Collier	321,520	343,200	659,687	338,167+
Glades	12,884	13,000	18,352	5,468+
Lee	618,751	670,400	1,550,924	932,170+
Hendry	39,140	38,000	42,110	2,970+
TOTAL				**1,356,312**

Collier County has seen the average number of housing permits increase from about 2,200 per month in 2013 to 3,475 per month in 2017.[193] These additional residents will have grave implications on land use and habitat. 2010 land use estimates indicate that 6.4 million acres of land are developed, and this number is projected to increase to 11.7 million acres by 2070, which is an increase of 82 percent (see Exhibit A).[194] The UF and FWC recognized that at the horizon year of 2060, 300,000 acres of this conversion was expected to be in panther habitat.[195]

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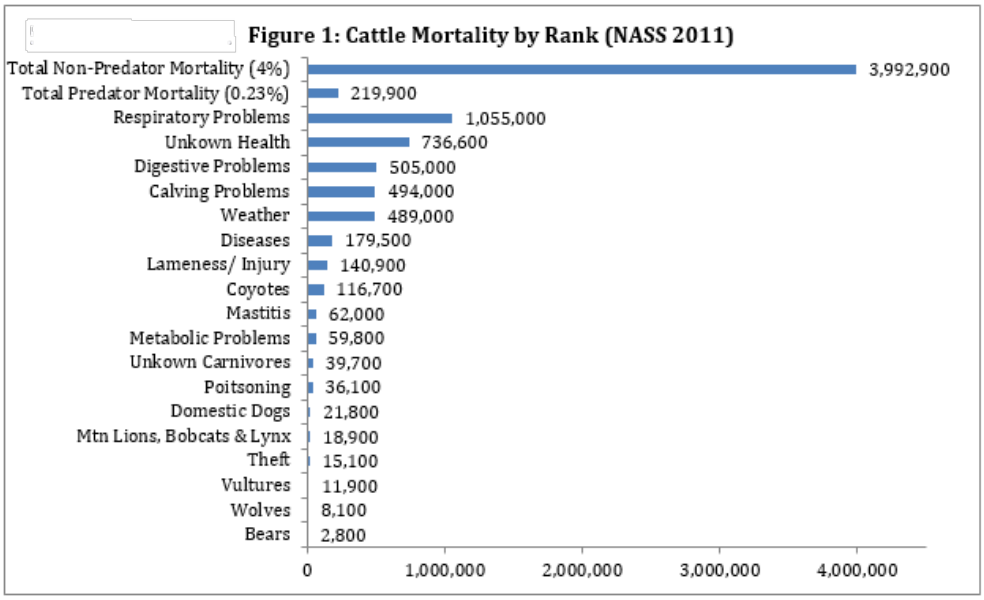
[185] U.S. Census Bureau, *2005 Interim State Population Projections*. Accessed at http://www.census.gov/population/projections/data/state/projectionsagesex.html.
[186] U.S. Census Bureau, *American FactFinder*. Accessed at http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF.
[187] U.S. Census Bureau. *American FactFinder. Accessed at* http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF.
[188] University of Florida, Bureau of Economic and Business Research (BEBR), 2016. Florida estimates of Population, 2016.
[189] Florida Department of Transportation. Florida Transportation Trends and Conditions. 2014. Available at: http://www.dot.state.fl.us/planning/trends/tc-report/Population.pdf.
[190] Florida Department of Agriculture and Consumer Services, University of Florida Geoplan Center, and 1000 Friends of Florida, *Florida 2070 Summary Report*, 1000friendsofflorida.org (Sept. 2016) at 3, http://1000friendsofflorida.org/florida2070/wp-content/uploads/2016/09/florida2070summaryfinal.pdf.
[191] University of Florida, Bureau of Economic and Business Research (BEBR), 2016. Florida estimates of Population, 2016.
[192] *Ibid*.
[193] Collier County Government. *Building Permits Reports*. Accessed at http://www.colliergov.net/your-government/divisions-a-e/building-review/building-permits-reports.
[194] Florida Department of Agriculture and Consumer Services, University of Florida Geoplan Center, and 1000 Friends of Florida, *Florida 2070 Summary Report*, 1000friendsofflorida.org (Sept. 2016) at 5, http://1000friendsofflorida.org/florida2070/wp-content/uploads/2016/09/florida2070summaryfinal.pdf.
[195] FWC, 2008. Wildlife 2060 What's At Stake for Florida.

Increased human population densities will degrade habitat, even as an indirect impact.[196] Habitat loss and development into habitat areas has increased human-panther interactions. A large portion of panther habitat is on private land, including areas utilized for cattle ranching.[197] Concerns over livestock predation by panthers exist. However, data from the U.S. Department of Agriculture's (USDA's) National Agricultural Statistics Service (NASS) show that of the 99.6 million cattle and sheep inventoried in the U.S., less than one percent died from predation (Table 1). According to the National Agricultural Statistics Service, all native carnivores and domestic dogs put together killed less than one percent of the U.S. cattle inventory and about four percent of the sheep inventory nationwide (Table 2, Figure 1).[198] All felids, including panthers, bobcats and lynx, killed fewer cattle than domestic dogs, taking only 0.02 percent of the U.S. cattle inventory in 2010.[199]

Table 2: Comparison of Non-Predator vs. Predator Mortality for Cattle and Sheep			
	Cattle (NASS 2011)	**Sheep (NASS 2010a,b)**	**Grand Total**
Cattle & Sheep Inventory	93,881,200	5,747,000	**99,628,200**
Non-Predator Mortality	3,773,000	387,300	**4,160,300**
% Non-Predator Mortality	4.01 %	6.73 %	**4.18 %**
Predator Mortality	219,900	247,200	**467,100**
% Predator Mortality	0.23 %	4.30 %	**0.47 %**



[196] Frakes et al., 2015. Landscape Analysis of Adult Florida Panther Habitat. PLoS ONE, 10(7): e0133044. DOI: 10.1371/journal.pone.0133044. P. 15.
[197] Jacobs & Main, 2015. A Conservation-Based Approach to Compensation for Livestock Depredation: The Florida Panther Case Study. PLoS ONE 10(9): e0139203. doi:10.1371/journal.pone.0139203
[198] U.S. Department of Agriculture, 2010. National Agricultural Statistics Service, Sheep and Goats. Accessed at http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1145; U.S. Department of Agriculture, 2010. National Agricultural Statistics Service, Sheep and Goats Death Loss. Accessed at http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do;jsessionid=2C78F286010BADDD4D273A4922AD38F4?documentID=1627; U.S. Department of Agriculture, 2011. National Agricultural Statistics Service.
[199] U.S. Department of Agriculture, 2011. National Agricultural Statistics Service.

The primary diet of Florida panthers consists of white-tailed deer, wild hogs, raccoons, and armadillos. Predations on livestock or pets may occur, especially as new housing developments increasingly encroach on panther habitat. Providing ranchers and pet owners with information on how to protect their animals is of the utmost importance in reducing this conflict. In 2016, panther depredation totaled 31 animals, including ten calves.[200]

In 2015, ten calves were recorded as injured or killed by panthers each year.[201] In 2014, eight calves were reported as injured or killed by panthers.[202] Jacobs & Main, 2015, analyzed the predation of calves by Florida panthers on two ranches, and found that panthers were only responsible for 5.3% of mortalities on one ranch and 0.5% on another. [203] Their study also found that predation occurred at a higher rate if the environment was optimal hunting habitat for panthers.[204] They found that "landscapes with low cattle densities, large forest patches, a high percentage of forest cover, small patches of improved pasture, and areas of upland forest" were more likely to be used by panthers.[205] Ranchers seeking to protect their livestock from panthers should use this information to identify risky locations for their cattle -especially for calving areas. Reducing the calving seasons may also help to lessen calf losses.[206]

Residents who live in panther habitat also acknowledge that prevention of predation by panthers is the responsibility of the livestock owner.[207] Rodgers & Pineear, 2017, conducted a survey among residents living in Golden Gate Estates, which is a 68,000 acre area in Collier County that has well documented panther use and is adjacent to public lands that are utilized by panthers, including the Florida Panther National Wildlife Refuge, Corkscrew Swamp Sanctuary, Picayune Strand State Forest, and Corkscrew Regional Ecosystem Watershed. The Golden Gate Estates area has had the highest frequency of human-panther conflicts in the state.[208] In the study all those interviewed stated that "it was residents' responsibility to protect their animals from panthers, and recognized that there are livestock protection practices that will reduce or prevent depredations and conflicts."[209]

When discussing the issue of depredation with Florida cattle ranchers, Pienaar et al., 2015 found that multiple ranchers within the Florida Panther Focus Area stated that that they were unaware of any predation events on their calves by panthers.[210] Pienaar et al., 2015 also report that ranchers expressed skepticism about reported high depredation rates.[211] These individuals

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[200] Florida Fish and Wildlife Conservation Commission, 2016. 2014-2016 Depredations. Accessed at http://myfwc.com/media/4159448/2014-2016Depredations.pdf.
[201] *Ibid*.
[202] *Ibid*.
[203] Jacobs & Main, 2015. A Conservation-Based Approach to Compensation for Livestock Depredation: The Florida Panther Case Study. PLoS ONE 10(9): e0139203. doi:10.1371/journal.pone.0139203.
[204] *Ibid*.
[205] *Ibid*.
[206] *Ibid*.
[207] Rodgers & Pienaar, 2017. Amenity or Nuisance? Understanding and Managing Human–Panther Conflicts in Exurban Southwest Florida, Human Dimensions of Wildlife, DOI: 10.1080/10871209.2017.1318322.
[208] *Ibid.*
[209] *Ibid*.
[210] Pienaar et al., 2015. Conflicts between Cattlemen and the Florida Panther: Insights and Policy Recommendations from Interviews with Florida Cattlemen. Human Ecology, 43:577–588.
[211] *Ibid*.

reported that *all* predators -not just panthers- contributed to only six to seven percent of all calf loss.[212] This finding confirms an earlier international, synthesis study by Baker et al, 2008.[213]

Removing or lowering protections for Florida panthers could actually cause livestock conflicts to increase. Killing the stable, adult members of a population disrupts panthers' social structure, creating a population that's younger and includes more male animals. Subadult males are more likely to attack livestock than are older animals.[214] According to a recent study in Washington, 100 percent removal of resident adults in one year increased the odds of complaints and depredations in the following year by 150 percent to 340 percent.[215]

Instead, with simple livestock management tools, education and outreach, panthers can more peacefully coexist with people, and livestock losses can be decreased or avoided. Additional programs are now in place to assist landowners on these initiatives. Defenders of Wildlife and Conservancy of Southwest Florida have programs in operation to provide assistance in building predator-resistant pen enclosures to citizens to protect pets and small livestock. The Conservancy of Southwest Florida also has a program to provide direct compensation to small ranch operations with less than 300 head of cattle, when a panther predation is verified to have occurred. Further, the federal government has additional programs in place in recent years that also provide direct compensation through the Farm Service Agency's Livestock Indemnity Program, as well as ecosystem service payment through Natural Resource Conservation Program's Regional Conservation Partnership Program.

However, development will continue to encroach on panthers' habitat across the state, and interactions with humans are likely to increase -not due to increased panther populations, but as a result of expanding urban sprawl- stressing the need to keep protections in place for this fragile species.

Panther mortalities, particularly from vehicle collisions, interspecific aggression, disease, and illegal take continue to threaten the Florida panther. In the 2000s, the average annual mortality was about 18 panthers a year.[216] The average annual mortality for 2010 through 2016 has been 30 panthers a year.[217] Although the panther population has appeared to have increased over time, the amount of roadways, vehicles, and trips on those roadways are also increasing. By 2015, there were 3 million more trips on roadways than in 2010 in just Lee and Collier counties.[218]

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[212] *Ibid*.
[213] Baker et al., 2008. Terrestrial Carnivores and Human Food Production: Impact and Management. Mammal Review, 38.
[214] Peebles et al., 2013. Effects of Remedial Sport Hunting on Cougar Complaints and Livestock Depredations. PLOS One 8.
[215] *Ibid*.
[216] Mortality by year: 2000= 12, 2001= 11, 2002= 14, 2003= 24, 2004= 19, 2005= 12, 2006= 18, 2007= 23 (15 roadkill), 2008= 23 (10 roadkill), 2009= 24 (17 roadkill).
[217] Mortality by year: 2010= 23 (16 roadkill), 2011= 24 (9 roadkill), 2012= 27 (18 roadkill), 2013= 20 (15 roadkill), 2014= 33 (25 roadkill), 2015= 41 (30 roadkill), 2016= 42 (34 roadkill).
[218] Florida Department of Transportation, 2010. Public Road Mileage and Miles Traveled 2010; Florida Department of Transportation, 2015. Public Road Mileage and Miles Traveled 2015; Florida Department of Transportation, 2011. 2011 City County Mileage (Data as of September 30, 2010); Florida Department of Transportation, 2016. 2016 City County Mileage (Data as of September 30, 2015).

Although total mortality is unknown, when comparing reported mortalities to the panther population estimate of that time, the proportion of deaths to population has been increasing: in the 2000s, when the population was estimated to be between 90-120 cats[219] and mortality averaged about 15% a year.[220] When the population was estimated to be between 100-160 (2011-2014)[221], the mortality was about 16.25% a year.[222] Since 2014, when the population was estimated to be about 100-180[223], the mortality averaged 23%.[224] These estimates all utilize the top range of the population.

When looking at known panther mortalities from 2010 through 2016, there were about 214 deaths (not including removal of panthers from the wild, or where demographics of the panther were not available due to being undeterminable or where intentional take investigations limited details released to the public).[225] Of these 214 known mortalities, about 120 were of kittens, juveniles, and sub-adult panthers under the age of three (56%),[226] which highlights the need to consider the effect of limited habitat availability and associated risks on young panthers.

Residential/Commercial Development and Mining

The effect to Florida panther survival and recovery from continued residential/commercial development and mining will be devastating. Tens of thousands of acres of panther habitat are at risk or are already lost from recent construction activities. In areas north of the Caloosahatchee River, the new town of Babcock Ranch of nearly 18,000 acres, spanning both Lee and Charlotte County. Current considerations to develop the Lee County portion of approximately 4,100 acres and with 1,630 new dwelling units is under review. The town is adjacent to the Babcock Ranch Preserve and Babcock Webb Wildlife Management Area, Bob Janes Preserve, and Telegraph Creek.[227]

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[219] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. viii; Kautz et al., 2006. How Much is Enough? Landscape Scale Conservation for the Florida Panther. Biological Conservation, 130, 118-133.

[220] Annual mortalities from 2000 to 2010 were 12, 11, 14, 24, 19, 12, 18, 23, 24, and 23, averaging 18 mortalities a year. Average of known mortalities (18) is about 15% of maximum population estimate of 120. Raw mortality data from Florida Fish and Wildlife Conservation Commission.

[221] Florida Fish and Wildlife Conservation Commission, 2010. Statement on Estimating Panther Population Size. December 2010.

[222] Annual mortalities from 2011 to 2014 were 24, 27, 20, and 33, averaging 26 mortalities a year. Average of known mortalities (26) is about 16.25% of maximum population estimate of 160. Raw mortality data from Florida Fish and Wildlife Conservation Commission.

[223] Florida Fish and Wildlife Conservation Commission, 2014. Determining the Size of the Florida Panther Population. August 2014.

[224] Annual mortalities from 2015 to 2016 were 41 and 42, averaging 41.5 mortalities a year. Average of known mortalities (41.5) is about 23% of maximum population estimate of 180. Raw mortality data from Florida Fish and Wildlife Conservation Commission.

[225] Raw mortality data from Florida Fish and Wildlife Conservation Commission.

[226] *Ibid*. 49 of the mortalities were of panthers less than twelve months of age (less than 1 year old), 35 were of panthers between 13 and 23 months of age (between ages 1 and 2), and 36 were of panthers between 24 and 35 months of age (between ages 2 and 3). The remainder, 94 mortalities were of panthers 36 months and greater (at least three years old, e.g. "adults").

[227] Florida Fish and Wildlife Conservation Commission, Babcock Ranch Preserve, available at http://myfwc.com/viewing/recreation/wmas/cooperative/babcock-ranch-preserve

One of the panther's core habitat areas that has seen the most change over the last decade is Lee County, notably in the 81,500-acre southeast Density Reduction/Groundwater Resource (DR/GR) area.[228] This County planning area was designated to limit development and reduce density to protect vital groundwater resources, as well as preserve wildlife habitat and wetland ecosystems. However, there has been a significant amount of development and mining in this area. Over 22,500 acres have already been lost in this area due to mining and development.[229] In addition, Lee County has recently approved over 6,300 acres of new development, adding 5,290 dwelling units to this area intended for low density, restoration, and environmental protection. As demonstrated below tens of thousands of acres are under construction or consideration for intensification (see also Exhibit B):

- WildBlue, a permitted development of 3,560-acres located along Lee County's Corkscrew Road, develops portions of Stewart Cypress Slough and Southern Slough. A former limerock mining site totaling over 2,000 acres[230], this project is largely Primary Zone habitat for the Florida panther.
- The Place (FKA Corkscrew Farms), a permitted development along Lee county's Corkscrew Road that impacts 56 acres of Primary Zone and 766 acres of Secondary Zone panther habitat.
- Pepperland, a proposed 637.5 acre development along Lee County's Corkcrew Road. The project is located primarily within Secondary Zone habitat with telemetry points from radio-collared panthers documented nearby.
- Verdana, a proposed 1,460 acre development along Lee County's Corkcrew Road that is composed of Primary Zone and Secondary Zone panther habitat, some of which is Frakes Adult Breeding Habitat.
- Timbercreek, a proposed development of 695 acres of primary and secondary panther habitat on the southwest corner of SR 82 and Daniels Rd.
- Corkscrew Crossing, proposed in a last remaining corridor between the Florida Forever project of Edison Farms (AKA Agripartners) and the Stewart Cypress Slough would develop 200 acres of Primary Zone panther habitat and good quality of wetlands.[231] The site is the location of a proposed panther underpass that is required mitigation by Lee County for the existing Daniels Parkway Extension.[232] If constructed as proposed, the application would restrict one of the last remaining panther corridor connectors that connect large tracts of utilized by the cats.
- Troyer Brothers, a proposed limerock mine along Corkscrew Road. Of the 907 acres proposed for mining, 841 acres (93%) is Primary panther habitat and 66 acres (7%) is Secondary panther habitat. When looking at the Frakes et al., 828 acres (91%) of the site is considered Adult Breeding Habitat.

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[228] Dover, Kohl & Partners, 2008. Prospects for Southeast Lee County: Planning for the Density Reduction/Groundwater Resource Area (DR/GR). July 2008.
[229] *Ibid*.
[230] WildBlue, Fact Sheet, available at http://wildblueftmyers.com/resources/WildBlue-Fact-Sheet.pdf. The number 2,072 was arrived at by subtracting the total existing lake volume of 888 acres from the total projected development footprint of 2,960 acres.
[231] Army Corps of Engineers, July 2, 2015. Public Notice for SAJ-2006-06379, Argo Corkscrew Crossing, LLP.
[232] U.S. Fish and Wildlife Service, December 8, 1997. Biological Opinion Letter to Army Corps of Engineers. Lee County Department of Transportation, Daniels Parkway Extension.

- Old Corkscrew Plantation, a proposed limerock mine that would result in 1,837 acres destroyed. The land at issue is composed of Primary Zone and Secondary Zone panther habitat and is heavily utilized by panthers as documented through telemetry data.
- FFD/6Ls mine, a proposed limerock mine would destroy 2,585 acres of panther habitat for mining pits adjacent to a major flowway.

The Army Corps of Engineers (Corps) had determined that mining projects in the DR/GR and adjacent lands may have a significant impact on the human environment and explored the need for an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) given its proximity to ecologically critical areas and Florida panther habitat.[233] The Corps also determined that a separate EIS was appropriate for similar reasons in the North Belle Meade area of Collier County when the East Naples Mine (810 acres of panther habitat impacted) and Section 20 Mines (567 acres of Primary Zone lost) were proposed.[234] Additional mines have also been sought in other areas of Collier County, including:

- Hogan Island Quarry, a permitted but unconstructed mine that is located directly adjacent to the Camp Keais Strand. About half of the nearly 1,000 acre site is Primary Zone and the other half is Secondary Zone.
- Immokalee Sand Mine, a proposed sand mine would impact about 900 acres of Secondary Zone habitat and would sever a proposed wildlife linkage.
- Lost Grove Mine, a proposed limerock mine adjacent to the Corkscrew Regional Ecosystem Watershed, would impact over 1,300 acres of panther habitat, that includes some modeled Adult Breeding Habitat.

Further, there is a current proposal through the Eastern Collier Multiple Species Habitat Conservation Plan (ECMSHCP) for incidental take coverage related to 45,000 acres of mining and residential/commercial development. The ECMSHCP is a controversial proposal that would result in the urbanization of a currently rural area that is heavily utilized by the Florida panther comparable to the size of Washington, D.C.[235] State Road 29, once acknowledged as the most deadly roadway for panthers with about a third of mortalities occurring here[236], would become the new urban boundary. Traffic on Corkscrew Road would be upwards of twenty-three times its current level. [237] Vehicle trips would balloon from the rural rate of 300-15,000 daily trips to 40,000 trips a day.[238] Nearly 90 miles of new or expanded roadways are proposed[239] to serve the

[233] Army Corps of Engineers, 2010. Determination to Conduct an Environmental Impact Statement on Limestone Mining Adjacent to Regional Preserved Lands Within the Lee-Collier Limestone Resource Area.
[234] Army Corps of Engineers, 2010. Determination to Conduct an Environmental Impact Statement on Limestone Mining Within the North Belle Meade of Collier County.
[235] Conservancy of Southwest Florida, 2016. Eastern Collier HCP Scoping and Input on Draft Plan. Letter dated April 25, 2016 to U.S. Fish and Wildlife Service.
[236] Smith et al., 2006. East Collier County Wildlife Movement Study: SR29, CR846, and CR858 Wildlife Crossing Project. Unpublished Report. University of Central Florida, Orlando, FL.
[237] Florida Panther Protection Program Technical Review Team, 2009. Technical Review of the Florida Panther Protection Program Proposed for the Rural Lands Stewardship Area of Collier County, Florida. Final Report. P. 52. Report utilized 2006 as baseline figures.
[238] *Ibid*. P. 54.
[239] WilsonMiller (Stantec), 2008. Conceptual Build-Out Roadway Network. Map.

addition of 300,000 new people to this area of the County.[240] The proposal does not meet issuance criteria under the ESA.

As part of the ECHMSP, the new town of Rural Lands West (RLW) is currently being considered by local, state, and federal wetland permitting agencies. RLW is a large-scale master planned- mixed-use development consisting of recreational amenities; a commercial town center; schools, residential neighborhoods with roads, lakes, drainage management systems and other associated infrastructure. It will directly impact about 4,100 acres[241] of land adjacent and within the Shaggy Cypress and Camp Keais Strand. Approximately 76% (or 3,100 acres) of this land is Primary Zone panther habitat, and 24% (about 980 acres) is Secondary Zone panther habitat.

In addition to the mining and development within the ECMSHCP area, there are other large proposals for intensification within other areas of Collier County, including:

- Argo Manatee, a permitted but not yet constructed residential development will impact about 75 acres of land adjacent to the Primary Zone and where numerous roadkills have occurred.
- Hacienda Lakes, a permitted but not yet fully constructed residential development adjacent to the Picayune Strand State Forest contains about 800 acres of Primary Zone habitat.
- Immokalee Road South, a permitted residential development will impact 550 acres is nearby Corkscrew and a regional wildlife corridor.

The most remote rural lands in Hendry County are also threatened with additional large scale residential development and mining, including:

- The Southwest Hendry (King's Ranch) Sector Plan was approved in 2014 by Hendry County. It would allow 23,600 acres of urban development on the other side of the Collier-Hendry line.
- The Rodina Sector Plan was approved in 2012 by Hendry County. It provided local authorization of 10,089 acres of development north of the Southwest Hendry Sector Plan.
- The Keri Road Sand Mine, a proposed mine at over 850 acres of panther habitat directly adjacent to the Okaloacoochee Slough State Forest and Wildlife Management Area, a major panther corridor as documented by Least Cost Pathways[242] and numerous road mortalities.
- FPL Clean Energy Center and solar arrays, proposed off of CR833 in central Hendry County.

Even properties acquired for panther connectivity are at risk. Hydrologic restoration of the Lone Ranger property (a.k.a. American Prime) in Glades County aims to put more water on this

[240] WilsonMiller (Stantec), 2008. Memo to Collier County Tom Greenwood. Estimates of Stewardship Credits Under the Current and Revised RLSA Program and Recommendation for Credit Calibration. September 18, 2008.
[241] Rural Lands West. Conceptual SRA Master Plan. Accessed at http://rurallandswest.com/wp-content/uploads/2017/03/RLW-Conceptual-SRA-Master-Plan-web.pdf
[242] Swanson et al, 2008. Use of least-cost pathways to identify key road segments for Florida panther conservation. Fish and Wildlife Research Institute Technical Report TR-13.

main corridor through the Dispersal Zone to lands north of the Caloosahatchee River, which may restrict upland portions of the property to a mere 150 foot wide swath.

Road Projects

Each year, the record number of Florida panther mortalities is exceeded. The largest proportion of these documents deaths are due to roadkills. New roads or expansion of existing roadways will contribute to loss of habitat, fragmentation of movements, and mortalities due to vehicle collisions.

Several state projects within Florida panther habitat are currently under construction or under review, including:

- US41 has been widened east of CR951 through an area where there have been several panther kills, and where corridors connect lands in the Picayune to Rookery Bay National Estuarine Reserve.
- SR80 is undergoing widening in an area that bisects the Dispersal Zone for the Florida panther.
- SR82 is being considered for widening, which includes construction near the Corkscrew Regional Ecosystem Watershed and through a proposed corridor connector.
- Segments of SR29 from Labelle to US41 in southern Collier County are in various stages of review. This project from its northern extent to its southern terminus would widen a road that has claimed about a third of historic panther roadkill mortalities. It also bisects the Okaloacoochee Slough State Forest, Spirit of the Wild Management Area, the Summerlin Swamp, Florida Panther National Wildlife Refuge, Fakahatchee Strand State Preserve, and the Big Cypress National Preserve.

A number of local road widening projects also threaten to impact Florida panthers:

- Corkscrew Road, running through the middle of Lee County's most environmentally sensitive lands, is proposed to be widened from two lanes to four lanes.
- Extension of Randall Blvd. in Collier County, which will connect Randall to Oil Well Road near the proposed town of Rural Lands West. Portions of this study area were considered to significantly fragment important Florida panther habitat and corridors.[243]
- Continued widening of Oil Well Road from Everglades Blvd to the town of Ave Maria.
- Brand new road in North Belle Meade and adjacent to the Picayune Strand, called Wilson Benfield Extension. FWC has begun to review this project as part of the Efficient Transportation Decision Making (ETDM) process, and determined that "the collective adverse impacts that could result from this project would be inconsistent with the long-term agency goals, management, and protection strategies for these species in this region of southwest Florida."[244]

[243] Florida Panther Protection Program Technical Review Team, 2009. Technical Review of the Florida Panther Protection Program Proposed for the Rural Lands Stewardship Area of Collier County, Florida. Final Report. P. 61.
[244] FWC, 2009. Letter to Collier County from Scott Sanders, Habitat conservation Scientific Services Section. April 29, 2009.

Additionally, there are plans for another I-75 Interchange in eastern Collier County in the County's 2040 Long Range Transportation Plan, even though the wildlife agencies have expressed great concerns for the proposal. In the ETDM process, the FWS found that "the construction of the proposed interchange will result in significant adverse impacts to the Florida panther."[245] These concerns were reaffirmed by the PRT, who recommended that the project receive no further consideration due to loss of panther habitat and overall cumulative impacts.[246]

Oil and Gas Activities

Since the last 5-year panther status review, interest in oil and gas development has increased.[247] This is evident from a marked increase in applications for drilling and exploration,[248] including those both proposed and already occurring in Florida panther habitat.

For example, the first of four planned phases of a seismic oil exploration project is already underway in the Big Cypress National Preserve, encompassing over 70,000 acres.[249] All four phases of oil exploration will encompass 230,000 acres, or about one-third of the Preserve. [250] The size, magnitude, and survey technology of the proposed action is unprecedented in the Preserve[251] that adversely impacts Florida panther habitat. Notably, the seismic oil exploration in Big Cypress is located within Primary Zone panther habitat and was and will continue to be conducted during the panther's denning period.[252] The National Park Service (hereinafter, NPS) found that, "[w]ildlife could display avoidance behaviors as a result of the seismic survey activities. Some species could be subjected to short-term stress during their breeding season…Although not anticipated, mortality/injury to wildlife could also occur." [253] The

[245] Florida Department of Transportation, 2009. ETDM Summary Report, Project #6311, I-75 Interchange at Everglades Blvd. Preliminary Programming Screen. June 13, 2009.
[246] Florida Panther Protection Program Technical Review Team, 2009. Technical Review of the Florida Panther Protection Program Proposed for the Rural Lands Stewardship Area of Collier County, Florida. Final Report. P. 74.
[247] Garrett, 2017. The Barrel Blog. New Frontiers: A Once-Booming Florida Oil Industry Tries to Get Back to the Past. Accessed at http://blogs.platts.com/2013/01/07/florida_oil/.
[248] Florida Department of Environmental Protection, 2017. Oil and Gas Current Drilling Applications. Accessed at http://dep.state.fl.us/water/mines/oil_gas/drill-apps.htm.
[249] *See* Burnett Oil Co., Inc. 2014. Nobles Grade 3-D Seismic Survey, Big Cypress National Preserve and Big Cypress National Preserve Addition Plan of Operations. P. 1. Accessed at: http://parkplanning.nps.gov/document.cfm?parkID=352&projectID=53498&documentID=66527.
[250] *See* Burnett Oil Co., Inc. 2014. Nobles Grade 3-D Seismic Survey, Big Cypress National Preserve and Big Cypress National Preserve Addition Plan of Operations. P. 1. Accessed at: http://parkplanning.nps.gov/document.cfm?parkID=352&projectID=53498&documentID=66527.
[251] National Park Service, Revised Environmental Assessment for A Proposed Oil and Gas Plan of Operation: Nobles Grade 3-D Seismic Survey within Big Cypress National Preserve proposed by Burnett Oil Company, Inc. at 8 (March 2016), *available at:* https://parkplanning.nps.gov/document.cfm?parkID=352&projectID=53498&documentID=71803.
[252] National Park Service, Revised Environmental Assessment for A Proposed Oil and Gas Plan of Operation: Nobles Grade 3-D Seismic Survey within Big Cypress National Preserve proposed by Burnett Oil Company, Inc. at 75 (March, 2016).
[253] National Park Service, Revised Environmental Assessment for A Proposed Oil and Gas Plan of Operation: Nobles Grade 3-D Seismic Survey within Big Cypress National Preserve proposed by Burnett Oil Company, Inc. at 85 (March 2016).

operator recently applied to the Florida Department of Environmental Protection seeking authorization to continue its seismic oil exploration in Big Cypress.[254]

Directly north of Big Cypress, there is another proposed project to explore for oil and gas that will impact the Florida panther and its habitat, by Tocala, LLC, using explosives to generate seismic signals.[255] This project encompasses 104,229 acres in Eastern Collier and Western Hendry counties, all of which has been identified as panther habitat. The majority of the project area, 99,810.8 acres, is comprised of Primary panther habitat, which makes up about 99% of the entire project. The remaining 4,418.2 acres are located within Secondary panther habitat. There have been a documented 78 cats that have repeatedly utilized this specific area over the last three decades.

As noted above, studies have indicated that panthers and their prey species alter their normal behavior and use of habitat areas due to concentrated human activity.[256] Therefore, it is possible that panthers could practice avoidance behaviors, including den abandonment, during large scale disturbances to their habitats from seismic oil exploration in the Big Cypress National Preserve and on adjacent lands by Tocala, LLC. It is also possible that these highly invasive activities will directly impact individual panthers that utilize these areas.

Recreation Activities – Use of Off-Road Vehicles (ORVs)

Panthers select for habitat edge zones to utilize stalking and ambush cover in order to successfully grapple prey. Examining the harvest reports from 2011-2015 for white-tailed deer - a primary prey species for Florida panthers- shows that the white-tailed deer harvest has remained fairly steady.[257] In addition, Florida's population of wild pigs, another primary source of prey for panthers and a popular target for hunters, is second in the country only to Texas, with an estimated at a population of about 500,000 animals.[258]

Recreational activities utilizing ORVs can disturb panthers. Janis et al. found that female panthers killed prey more often in the non-hunting season than during the hunting season.[259] The study also found the disturbance from ORVs affected prey items, and therefore the panther indirectly.[260] McCarthy and Fletcher found that recreationists/hunters on ORVs had a statistically significant effect on panther resource selection.[261] McCarthy and Fletcher also found that hydrology during the hunting season contributes to the level of disturbance from these

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[254] Florida Department of Environmental Protection, 2017. Reapplication of Geophysical permit application G166-3. Accessed at: http://dep.state.fl.us/water/mines/oil_gas/drill-apps.htm.
[255] Florida Department of Environmental Protection, 2015. Geophysical permit application G166-13. Accessed at http://dep.state.fl.us/water/mines/oil_gas/drill-apps.htm.
[256] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 53.
[257] Florida Fish and Wildlife Conservation Commission. Statewide Annual Harvest Reports. http://myfwc.com/Deer
[258] Giuliano, 2010. Wild Hogs in Florida: Ecology and Management. Accessed at http://edis.ifas.ufl.edu/uw322.
[259] Janis & Clark, 2002. Responses of Florida Panthers to Recreational Deer and Hog Hunting. Journal of Wildlife Management, 66(3): 83-848.; Janis & Clark, 1999. The Effects of Recreational Deer and Hog Hunting on the Behavior of Florida Panthers. Final Report to Big Cypress National Preserve National Park Service.
[260] *Ibid*.
[261] McCarthy & Fletcher, 2014. Does Hunting Activity for Game Species Have Indirect Effects on Resource Selection by the Endangered Florida Panther? Animal Conservation, 18, 138-145.

activities.[262] During the hunting season and because of high water levels, panthers are constricted to less space, resulting in an increased use of less suitable wetland habitat.[263]

(2) Overutilization for commercial, recreational, scientific or educational purposes

There are no authorized commercial or recreational uses of the Florida panther.[264]

(3) Disease, pollutants, or predation

Disease

Cunningham et al., 2008 warn that any disease outbreak in Florida panthers must be managed aggressively since the species is comprised of only a small, isolated population, making it susceptible to extinction.[265] Likewise, Miller et al., 2006 wrote: "infectious diseases are a concern because individuals from genetically inbred populations have the potential to be immunosuppressed."[266] The loss of habitat in Florida has concentrated panthers, bobcats, and house cats altogether, making disease transmission to wild cat populations more acute. Disease could potentially threaten inbred Florida panther populations with extirpation.

Reichard et al., 2015 tested dead Florida panthers for *Trichinella*, a nematode parasite commonly found in wild carnivores. They found that Florida panthers had the highest rate of *Trichinella pseudospiralis* ever detected in a mammal population in North America (N = 16 of 112 panthers, or 14.3 percent infection rate).[267] Significantly more males (28.1 percent) than females (12.5 percent) were infected by *T. pseudospiralis* and of four kittens tested, none had the parasite.[268] *Trichinella spiralis* also infected Florida panthers, but to a far lesser degree (N = 1 of 112, or 0.9 percent).[269] The vector for these parasites likely comes largely from wild pigs, who make up approximately 42 percent of Florida panthers' diet.[270] While Reichard et al., 2015 did not speculate how *Tricheinella* threatened panthers or their fitness, in domestic cats they can be asymptomatic to displaying a variety of behaviors, including weakness, lethargy, inflamed or painful muscles, fever diarrhea (which may contain blood), hypersalivation and disorientated behavioral changes.[271]

Foster et al., 2006, found that *Alaria marcianae*, *Ancylostoma pluridentatum*, *Spirometra mansonoides*, and *Taenia omissa* were the most common parasites found in Florida panthers.

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[262] *Ibid.*
[263] *Ibid.*
[264] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 41.
[265] Cunningham et al., 2008. Epizootiology and Management of Feline Leukemia Virus in the Florida Puma. Journal of Wildlife Diseases 44, no. 3. <Go to ISI>://WOS:000258668600001.
[266] Miller et al., 2006. Feline Immunodeficiency Virus and Puma Lentivirus in Florida Panthers (Puma Concolor Coryi): Epidemiology and Diagnostic Issue. Veterinary Research Communications 30, no. 3: 308, http://dx.doi.org/10.1007/s11259-006-3167-x.
[267] Reichard et al., 2015. High Prevalence of Trichinella Pseudospiralis in Florida Panthers (Puma Concolor Coryi). Parasites & Vectors 8. http://dx.doi.org/10.1186/s13071-015-0674-z.
[268] *Ibid.*
[269] *Ibid.*
[270] *Ibid.*
[271] "Trichinellosis in Cats," https://www.vetary.com/cat/condition/trichinellosis.

Using a control (an untreated group) and treatment group, researchers gave the treatment group subcutaneous injections of ivermectin and praziquantel for intestinal parasites.[272] Adults from the treatment group realized a six-month benefit before parasite infection reoccurred through consumption of Florida panthers' common prey: wild pigs, white-tailed deer, raccoons and armadillos.[273] While adult panthers can apparently survive with parasites, kittens are not so hardy. Anthelmintic (parasite-destroying medication) injections changed the life expectancy for a two-week-old kitten, who was lethargic and in poor body condition prior to treatment (citing Dunbar et al., 1994).[274] Foster et al., 2006 found, from two different mothers, three young, dead kittens, who had trematodes called *Alaria marcianae* in their lungs that likely created an environment making them susceptible to bacterial pneumonia.[275] Because of their young age, the researchers deduced that the kittens had only consumed milk, making the mothers the paratentic hosts, who unwittingly infected their offspring. Foster et al., 2006 noted that dam FP107 lost several litters, and while her kittens had not been examined for parasites, they were the likely cause.[276]

Losing kittens to parasites is a concern, because even in adults who had been treated with an anthelmintic, the parasites reappeared within six months because their common prey are infected.[277] This study demonstrated that parasites can limit recruitment of Florida panthers, because of kitten mortalities. Anthelmintic treatments on panther kittens could prevent mortalities.

Cytauxzoon felis is a protozoan (one-celled) parasite commonly found in bobcats and is often fatal to domestic cats.[278] Shock et al., 2011 reported that four Florida panthers were found infected with *C. felis* resulting in hemolytic anemia, a condition that prematurely destroys red blood cells, and they also suffered from liver damage.[279] While *C. felis* did not result in mortality for these four panthers, their fitness was compromised.

Researchers had been monitoring Florida panthers for feline leukemia virus (FeLV) found none present in the population for 20 years until 2002. From 2001 to 2007, 19 Florida panthers tested positive for FeLV and 5 in the Okaloacoochee Slough area died.[280] The epidemic

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[272] Foster et al., 2006. Gastrointestinal Helminths of Free-Ranging Florida Panthers (Puma Concolor Coryi) and the Efficacy of the Current Anthelmintic Treatment Protocol. Journal of Wildlife Diseases 42, no. 2. <Go to ISI>://WOS:000239580000022.
[273] Foster et al., 2009. Transmammary Infection of Free-Ranging Florida Panther Neonates by Alaria Marcianae (Trematoda: Diplostomatidae). Journal of Parasitology 95, no. 1. http://dx.doi.org/10.1645/ge-1749.1.
[274] *Ibid*.
[275] *Ibid*.
[276] *Ibid*.
[277] Foster et al., 2006. Gastrointestinal Helminths of Free-Ranging Florida Panthers (Puma Concolor Coryi) and the Efficacy of the Current Anthelmintic Treatment Protocol. Journal of Wildlife Diseases 42, no. 2. <Go to ISI>://WOS:000239580000022.; Foster et al., 2009. Transmammary Infection of Free-Ranging Florida Panther Neonates by Alaria Marcianae (Trematoda: Diplostomatidae). Journal of Parasitology 95, no. 1. http://dx.doi.org/10.1645/ge-1749.1.
[278] Shock et al., 2011. Distribution and Prevalence of Cytauxzoon Felis in Bobcats (Lynx Rufus), the Natural Reservoir, and Other Wild Felids in Thirteen States. Veterinary Parasitology 175, no. 3-4. http://dx.doi.org/10.1016/j.vetpar.2010.10.009.
[279] *Ibid*.
[280] Johnson et al., 2010. Genetic Restoration of the Florida Panther. Science, Vol. 329, No. 5999, 1641-1645.

increased rapidly. However, by July 2004, no new cases appeared; in part, because panther managers inoculated panthers in the Okaloacoochee Slough region. The FeLV virus could plague panthers again if contracted through domestic house cats or other infected felines through direct transmission, including from male panthers to females through semen.[281] Once a panther obtains the virus from a house cat, and the "species barrier [is] crossed," panthers can readily transmit it to other panthers.[282]

FeLV infection rate could increase as panthers grow in density while their habitat shrinks. Habitat loss increases the odds of panthers consuming infected domestic cats, sickening panthers and leading to the spread of disease.[283] FeLV infections of panthers showed no demographic prevalence -all animals no matter their age or sex could be sickened. Some panthers, who showed antibodies for FeLV, were free from FeLV when retested nine months to three years later.[284] In the outbreak area, nearly half (46 percent) of all panthers captured, tested positively for FeLV. Feline leukemia-positive panthers died from septicemia, intraspecific aggression and anemia or dehydration.[285] Death after exposure to FeLV ranged from 9 to 18 weeks.[286] The outcome of contagion is different among individuals: from regressive infections,[287] to persistent infection, to death. For domestic housecats, the younger the animal, the more severe the reaction. In Florida, of all the infected panthers researchers found, they were adults, which could indicate that kittens died from FeLV.

VandeWoulde et al., 2010 have likened FIV (feline immunodeficiency virus) to HIV because both diseases are fairly new, the viruses target similar cells and the timeframe for illness, clinical signs and outcomes are similar.[288] At first researchers thought that clade A of FIV_{Pco} appeared as a divergent strain from the more common strain, clade B, FIV_{Pco}, and it only infected bobcats and panthers in Florida.[289] From 1995 to 2005, the prevalence of FIV_{PCO} has increased from 16% to 80%.[290] Johnson et al., 2010 found that FIV_{PCO} infection "may predispose individuals to other diseases due to low lymphocyte numbers."[291]

Miller et al., 2006 tested 51 Florida panthers and 10 Texas cougars, who came to Florida, and showed that some members of the two species were likely positive for FIV and PLV (puma

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[281] Shock et al., 2011. Distribution and Prevalence of Cytauxzoon Felis in Bobcats (Lynx Rufus), the Natural Reservoir, and Other Wild Felids in Thirteen States. Veterinary Parasitology 175, no. 3-4. http://dx.doi.org/10.1016/j.vetpar.2010.10.009.
[282] *Ibid*., P. 549.
[283] *Ibid*.
[284] *Ibid*.
[285] *Ibid*.
[286] *Ibid*.
[287] In regressive infection, virus replication and viremia are contained prior to or shortly after bone marrow infection.
[288] S. VandeWoude et al., 2010. Restrictions to Cross-Species Transmission of Lentiviral Infection Gleaned from Studies of Fiv. Veterinary Immunology and Immunopathology 134, no. 1-2. http://dx.doi.org/10.1016/j.vetimm.2009.10.005.
[289] *Ibid*.
[290] Johnson et al., 2010. Genetic Restoration of the Florida Panther. Science, Vol. 329, No. 5999, 1641-1645.
[291] *Ibid.*

lentivirus).[292] FIV- and PLV-infected domestic housecats experienced three phases of the illness: an acute phase, an asymptomatic latent phase and then a chronic terminal phase. Transmission of these diseases come from domestic cats to pumas or even from privately-owned and then released pumas, who then shared the disease with other pumas either through mating or territorial sympatry. Further, mother panthers can pass FIV or PLV to their kittens either in utero or during the postnatal period either during birth or from infected milk.[293]

On an Avon Park Air Force Range in Florida, of the 60 feral pigs tested, 42 were positive for pseudorabies (PRV), a virus in the herpes family.[294] Engeman et al., 2014 suggest that wild pigs, the most fecund of all North America's wild animals, could harm both panthers and Florida black bears (*Ursus americanus floridanus*) by sickening them with PRV as it is a density-dependent disease and wild pigs are a widespread Florida invasive species despite hunting and lethal-wildlife-control efforts.[295]

In sum, parasites and disease threaten Florida panthers. Infection is derived from their prey and from bobcats and domestic cats. Transmission between panthers occurs when individuals sharing sympatric territories, during mating rituals and from mothers to kittens. The FWS must consider that the loss of habitat in Florida has heightened disease and parasite transmission risk further threatening the persistence of Florida panthers. For these reasons, Florida panthers require full endangered protections under the ESA.

Pollutants

Mercury in the environment can result in mercury toxicosis and has been linked to panther mortalities in the past.[296]The chemicals in various agricultural fertilizers can lead to accumulations of toxic mercury in fish and wildlife, including the Florida panther.[297] Although the Florida Department of Environmental Protection (FDEP) and US Environmental Protection Agency (EPA) set mercury pollutant standards through a statewide mercury Total Maximum Daily Load (TMDL), the TMDL will not likely address sulfates which increases panthers' exposure to methyl mercury poisoning.

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[292] Miller et al., 2006. Feline Immunodeficiency Virus and Puma Lentivirus in Florida Panthers (Puma Concolor Coryi): Epidemiology and Diagnostic Issue. Veterinary Research Communications 30, no. 3: 308, http://dx.doi.org/10.1007/s11259-006-3167-x.
[293] *Ibid*.
[294] Engeman et al., 2014. Impacts from Control Operations on a Recreationally Hunted Feral Swine Population at a Large Military Installation in Florida. Environmental Science and Pollution Research 21, no. 12. http://dx.doi.org/10.1007/s11356-014-2727-9.
[295] *Ibid*.
[296] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 25.
[297] Doren et al., 2009. Ecological Indicators for System-Wide Assessment of the Greater Everglades Ecosystem Restoration Program. Ecological Indicators, 9:S2-S16.; Doren et al., 2009. Invasive Exotic Plant Indicators for Ecosystem Restoration: an Example from the Everglades Restoration Program. Ecological Indicators, 9:S29-S36.; Evans & Crumley, 2005. Mercury in Florida Bay Fish: Spatial Distribution of Elevated Concentrations and Possible Linkages to Everglades Restoration. Bulletin of Marine Science, 77:321-345.

Intraspecific aggression

Aggressive interactions and territorial disputes between panthers, known as "intraspecific aggression", is one of the top causes of mortality for panthers. Most intraspecific aggression mortalities are undocumented since they often occur in remote locations. Deaths from intraspecific aggression are likely to increase as available habitat becomes squeezed by development and individuals come into more contact with each other. [298] Hostetler et al., 2009 stated that intraspecific aggression is "the most important cause of sub-adult and adult panther mortality."[299] Since 2010, at least 31 panthers were killed by intraspecific aggression.[300]

(4) The inadequacy of existing regulatory mechanisms

State management of Florida panthers would not be an appropriate or adequate substitute for the current federal protections provided under the ESA. FWC, while performing outstanding scientific research and monitoring of the species when funds are available, currently defers to the federal agency on Florida panther regulatory decision making.[301] While this deference depends on the subspecies being listed under the ESA, a delisting would drop the Florida panther into a regulatory void. Specifically, while Florida panthers are currently included on the State's Endangered and Threatened Species List, panthers are only included on that state list by virtue of their existing federal status – in the event that FWS delists Florida panthers, the state would need to undertake a biological status review and develop a management plan.[302]

FWC has a unique history, as it was formed by consolidating one state agency originally created by the State Constitution (the Game and Fresh Water Fish Commission), and another originally created by statute (the Marine Fisheries Commission).[303] The legislature can enact legislation in aid of FWC's constitutional authority, but much of FWC's authority—including much of its authority over terrestrial wildlife—comes directly from the Constitution, and therefore creates far less transparency and accountability for the agency.[304]

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[298] U.S. Fish and Wildlife Service, 2008. Florida Panther Recovery Plan, Third Revision. P. 21.

[299] Hostetler et al., 2009. Population Ecology of the Florida Panther. Final Report submitted to Florida Fish and Wildlife Conservation Commission and U.S. Fish and Wildlife Service. December 31, 2009.

[300] Florida Fish and Wildlife Conservation Commission. 2017. Panther Pulse. Retrieved from http://myfwc.com/wildlifehabitats/managed/panther/pulse/.

[301] Rule 68A-27.007, F.A.C. states that "activities that result in take or incidental take of Federally-designated Endangered or Threatened Species do not require a permit from the Commission when authorized by the U.S. Fish and Wildlife Service or the National Oceanic and Atmospheric Administration's National Marine Fisheries Service…."

[302] Rule 68A-27.003(1)(g)(3), F.A.C.

[303] *Caribbean Conservation Corp. v. Florida Fish & Wildlife Conservation Comm'n*, 838 So. 2d 492, 494-95 (Fla. 2003).

[304] *See*, Fla. Const. Art. IV § 9 ("The legislature may enact laws in aid of the commission, not inconsistent with this section . . . ."); *Caribbean Conservation Corp.*, 838 So. 2d at 492, 501-02 (Fla. 2003) (explaining that the Constitution's language differentiates between FWC's powers over "wild animal and fresh water aquatic life" and its powers over "marine life," with the latter being more limited and more statutorily -derived); *Airboat Ass'n of Florida, Inc.*, 498 So. 2d 630 (Fla. 3d DCA 1986) (holding that a rule governing the hunting of terrestrial animals was not subject to APA scrutiny); *Wakulla Commercial Fishermen's Ass'n v. Florida Fish & Wildlife Conservation Comm'n*, 951 So. 2d 8, 9 (Fla. 1st DCA 2007) (explaining that FWC rules promulgated under constitutional authority "come before the court with a strong presumption of validity and must be upheld if they are rationally or reasonably related to a legitimate state interest."); *Airboat Ass'n of Florida, Inc. v. Florida Game & Fresh Water*

This problematic regulatory scheme—and FWC's stated desire to open up recreational hunting for recently delisted species—played out recently in the case of the Florida black bear. In 2012, FWC delisted the Florida black bear under the Florida Endangered and Threatened Species Act.[305] Just three years later, in 2015, FWC passed regulations opening up a hunting season for the species—the first one in over two decades, which resulted in the death of over 300 bears in less than 48 hours.[306] While the population of Florida black bears had increased since the species was listed, the main threats to the species (namely, habitat loss and fragmentation, and human-related mortalities) remain serious obstacles to the species' recovery, and a hunt was clearly neither warranted, nor in the best interest of bear conservation.[307] A lawsuit was filed to stop this hunt, but because the rules creating the hunt were created under FWC's constitutional powers, the court dismissed the Plaintiffs' challenge.[308]

For that hunt, FWC sold approximately the same number of permits as total bears thought to exist in the state, and as a result the harvest quota was nearly met within two days, after more than 300 bears had already been killed, including 36 lactating mothers.[309] Fortunately, FWC recognized the harmful and unnecessary nature of its 2015 hunt, and chose not to authorize hunts in 2016 and 2017.[310] But it remains to be seen how FWC will continue to manage this large carnivore population, after rushing to a hunt so quickly after delisting.

FWC's past statements on the Florida panther indicate that the agency would support the panther being maintained at a "sustainable level as supported by available habitat and addressing the challenges associated with human-panther coexistence."[311] This statement is concerning, given that the panther population needs to expand and grow in order to meet the established recovery goals for the subspecies and to be viable. Given FWC's lack of regulatory oversight protecting the Florida panther,[312] its constitutional powers that insulate its decisionmaking from

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Fish Comm'n, 498 So. 2d 629, 630 (Fla. 3d DCA 1986) (holding that a rule on hunting wild animals was "tantamount to a legislative act," and thus the court lacked jurisdiction to review the rule under the APA). FWC must abide by the APA for its rulemaking processes, it is not necessarily required to follow these processes for policy changes. *See* FWC, About the Rulemaking Process, http://myfwc.com/about/rules-regulations (last visited Aug. 21, 2017).

[305] Fla. Stat. § 379.2291; FWC, Management Plan Frequently Asked Questions, http://myfwc.com/wildlifehabitats/managed/bear/plan-faqs/ (last visited Aug. 21, 2017).

[306] *See* FWC, Management Plan Frequently Asked Questions.

[307] *See id.*

[308] *See Speak up Wekiva, Inc. v. Wiley*, No. 372015CA001781 (Fla. 2nd Cir. Ct., filed July 31, 2015); *Wakulla Commercial Fishermen's Ass'n*, 951 So. 2d at 9.

[309] Wayne Pacelle, "Trophy hunters should leave Florida's bears alone."

[310] *See* FWC, FWC Votes to Postpone Bear Hunting in 2016, http://myfwc.com/news/news-releases/2016/june/22/bear-management/ (June 22, 2016); Wayne Pacelle, "Breaking news: Florida commissioners reject trophy hunt, spare bears for at least two years," A Humane Nation (Apr. 20, 2017), https://blog.humanesociety.org/wayne/2017/04/breaking-news-florida-commissioners-reject-trophy-hunt-spare-bears-least-two-years.html; Wayne Pacelle, "Breaking news: Florida black bears get a 2016 stay of execution," A Humane Nation (June 24, 2016). https://blog.humanesociety.org/wayne/2016/06/florida-black-bears-get-2016-stay-execution.html.

[311] Florida Fish and Wildlife Conservation Commission, 2015. Position Statement, Florida Panther Recovery and Management: Strategic Priorities. September 3, 2015.

[312] FWC has acknowledged that while they receive well over 1,000 regulatory review requests annually, they have responded to less than half, focusing on select projects and avoiding relying solely on the regulatory process. Florida

judicial review, and its history of opening up hunting seasons soon after delisting, the FWS cannot rely on existing State regulatory mechanisms to protect Florida panthers should the subspecies' federal listing status change. Therefore, this listing factor should be evaluated in favor of continued federal listing.

(5) Other natural or manmade factors affecting its continued existence

Intentional Take

Unless a Florida panther wears a radio collar, finding illegally-killed individuals is virtually impossible, and their deaths go unrecorded.[313] Since 2008, wildlife managers have detected five Florida panthers killed by poachers.[314] Poaching, or illegal killing, is an increasing threat to panthers' persistence. Evidence of birdshot shrapnel is often found in necropsy for other causes of mortality.

Poaching is a major mortality factor in large carnivore populations which prevents recovery, particularly if the species occurs at low densities, such as the Florida panther.[315] Poaching accounted for more mortality events than any other cause in the reintroduced populations of the red wolf (*Canis rufus*) and more than half of the total mortality of Mexican grey wolves (*C. lupus baileyi*). In a unique, large but closed population, poaching accounted for half of the mortality of grey wolves in Scandinavia, yet two-thirds of poaching remained undetected using direct methods of observation.[316] Maintaining current endangered protections for Florida panthers is needed to prevent increased poaching potential.[317] Without federal protections, the panthers could be subject to state game regulations opening them up to trophy hunting and or retaliatory kills for the take of domestic livestock. Research shows that poaching is not diminished when an animal becomes a designated game species.[318] Mountain lions are frequently subject to poaching in the majority of their western and mid-western range.[319] In a nine-year study in the Blackfoot River watershed of west-central Montana, researchers documented multiple cases of poaching. Out of the 121 mountain lions who were tracked over the nine years, 63 had died. Poaching caused 11 of these deaths, second only to legal hunting,

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Fish and Wildlife Conservation Commission, 2015. Letter to Conservancy of Southwest Florida from FWC, October 1, 2015.

[313] Without radio collars, grizzly bear management agencies would be unaware of one-half (46 to 51 percent) of the killings that occur. McLellan et al., 1999. Rates and Causes of Grizzly Bear Mortality in the Interior Mountains of British Columbia, Alberta, Montana, Washington, and Idaho. Journal of Wildlife Management 63, no. 3, http://dx.doi.org/10.2307/3802805. One-half to two-thirds of human-killed grizzly bears are never reported. Schwartz et al., 2003. Grizzly Bear (*Ursus Arctos*) in Wild Mammals of North America: Biology, Management, and Conservation (G.A. Feldhamer, B.C. Thompson, and J.A. Chapman, eds). Chapron & Treves, 2016. Blood Does Not Buy Goodwill: Allowing Culling Increases Poaching of a Large Carnivore. Proceedings of the Royal Society, B 283.

[314] Florida Fish and Wildlife Conservation Commission. 2017. Panther Pulse. Retrieved from http://myfwc.com/wildlifehabitats/managed/panther/pulse/

[315] Andren et al., 2006. Survival rates and causes of mortality in Eurasian lynx (Lynx lynx) in multi-use landscapes. Biological Conservation 131:23-32.

[316] Chapron & Treves, 2016. Blood Does Not Buy Goodwill: Allowing Culling Increases Poaching of a Large Carnivore. Proceedings of the Royal Society, B 283.

[317] *Ibid*.

[318] *Ibid*.; Treves, 2009. Hunting for Large Carnivore Conservation. Journal of Applied Ecology 46:1350-1356.

[319] The Humane Society of the United States, 2017. State of the Mountain Lion: A Call to End Trophy Hunting of America's Lion. Washington, DC.

which caused 36 deaths.[320] Additional causes of death were natural (10 lions), killed for livestock protection purposes (two lions), vehicle collision (one lion) and unknown (three lions).

Florida panthers are also at risk of incidental hounding and trapping, practices permitted by FWC for other species throughout the state. Traps and wire snares do not discriminate between species and often catch non-target animals.[321] Incidental trapping of mountain lions is an unfortunate but all too common occurrence in many states across the western U.S.[322]

The risk of increased panther poaching opportunity and potential warrants more systematic study given that poaching of large carnivores is a major source of mortality that has slowed or reversed several population recoveries.[323] FWS must consider these threats during the current status review process.

Climate change

Anthropogenic climate change stressors including sea level rise, increasing storm surge and tidal flooding, more intense hurricanes, changes in precipitation, and rising temperatures and increases in extreme weather events pose significant and growing threats to the Florida panther. Key climate change harms to the Florida panther include the significant loss and degradation of habitat due to sea level rise, flooding, and storm surge; increasing stress from more frequent heat waves and other extreme weather events; and the disruption of ecosystem structure and function.

Sea level rise is a primary threat to the Florida panther because it is projected to inundate and fragment large regions of the panther's existing habitat in South Florida.[324] For example, two studies projected that three feet of sea level rise, which is highly likely within this century, would inundate about 30 percent of existing panther habitat. [325] The panther's habitat in South Florida is particularly vulnerable to sea level rise because of its low elevation, flat topography, extensive coastline, frequency of large storm events, and porous limestone geology.[326] In Monroe County,

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[320] Robinson & Desimone, 2011. The Garnet Range Mountain Lion Study: Characteristics of a Hunted Population in West-Central Montana: Final Report. Montana Fish, Wildlife & Parks.

[321] Lemieux & Czetwertynski, 2006; Muth et al., 2006; Iossa et al., 2007; Proulx et al., 2015; Andelt et al., 1999. Trapping Furbearers: an Overview of the Biological and Social Issues Surrounding a Public Policy Controversy. Wildlife Society Bulletin 27:53-64.

[322] The Humane Society of the United States. 2017. State of the Mountain Lion: A Call to End Trophy Hunting of America's Lion. Washington, DC.

[323] Goodrich et al., 2008. Survival Rates and Causes of Mortality of Amur Tigers On and Near the Sikhote-Alin Biosphere Zapovednik. Journal of Zoology 276:323-329; Liberg et al., 2012. Shoot, Shovel andShut Up: Cryptic Poaching Slows Restoration of a Large Carnivore in Europe. Proceedings of the Royal Society of London Series B 270:91-98; Treves et al., 2017. Gray Wolf Mortality Patterns in Wisconsin from 1979 to 2012. Journal of Mammalogy 98:17-32.

[324] Fei et al., 2011. A Perfect Storm May Threaten Florida Panther Recovery. Frontiers in Ecology and the Environment 9: 317-318.

[325] Whittle et al., 2008. Global Climate Change and its Effects on Large Carnivore Habitat in Florida. Abstract, Florida's Wildlife: On the Frontline of Climate Change, October 1-3, 2008, http://www.ces.fau.edu/floc/posters.html; Miller, n.d.. Climate Change and Florida's Wildlife. [online] Defender.org. Available at: http://www.defenders.org/sites/default/files/publications/climate_change_and_floridas_wildlife.pdf.

[326] Weiss et al., 2011. Implications of Recent Sea Level Rise Science for Low-Elevation Areas in Coastal Cities of the Coterminous U.S.A. Climatic Change 105:635-645; Strauss et al., 2012. Tidally Adjusted Estimates of

for example, 74 percent of the land area is less than 3 feet above sea level.[327] Low elevation presents the risks of inundation due to hurricanes and storm surges, reduced stormwater release capacity, saltwater intrusion, and seawater flooding of inland ecosystems.[328] Saltwater intrusion from sea level rise and invasive species has already compromised the Everglades by altering habitat and making it inhospitable to native wildlife.[329]

Global average sea level has already risen by roughly eight inches over the past century, and sea level rise is increasing in pace.[330] A rapid acceleration in the rate of sea level rise along the U.S. Atlantic Coast since 2000 has been attributed to the weakening of the entire Gulf Stream system.[331] Consistent with this acceleration, coastal areas of South Florida have experienced rates of sea level rise that are higher than the global average. For example, off Virginia Key, the average rate of regional sea level rise since 2006 was 9 ± 4 mm per year, which is much higher than the global average rate between 1993 and 2012 of 3.2 ± 0.4 mm per year based on satellite data and 2.8 ± 0.4 mm per year based on in-situ data.[332]

According to the Third National Climate Assessment, global sea level rise of three to four feet is likely by 2100, with sea-level rise of 6.6 feet possible.[333] The 2017 inter-agency technical report *Global and Regional Sea Level Rise Projections for the United States*, created to inform the Fourth National Climate Assessment,[334] revises sea level rise projections upward. The report adds an "extreme" upper-bound scenario for global mean sea level (GMSL) rise of 2.5 m by the year 2100, and revises the lower-bound scenario upward to 0.3 m by the year 2100. The report provides six emissions-based, probabilistic GMSL rise scenarios for 2100: Low (0.3 meters or 1 foot), Intermediate-Low (0.5 meters or 1.6 feet), Intermediate (1.0 meters or 3.2 feet),

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Topographic Vulnerability to Sea Level Rise and Flooding for the Contiguous United States. Environmental Research Letters 7: 014033; Melillo & Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program; Parkinson et al., 2015. Managing the Anthropocene marine transgression to the year 2100 and beyond in the State of Florida U.S.A. Climatic Change 128: 85-98.

[327] Strauss et al., 2014. Florida and the Surging Sea: A Vulnerability Assessment With Projections for Sea Level Rise and Coastal Flood Risk. Climate Central Research Report. Accessed at http://sealevel.climatecentral.org/uploads/ssrf/FL-Report.pdf. P. 23.

[328] Obeysekera et al., 2011. Past and Projected Trends in Climate and Sea Level for South Florida. Interdepartmental Climate Change Group. South Florida Water Management District, West Palm Beach, Florida, Hydrologic and Environmental Systems Modeling Technical Report. Accessed at http://www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/ccireport_publicationversion_14jul11.pdf.

[329] Finkl et al., 2017. The Florida Everglades: An Overview of Alteration and Restoration. Pages 3-45 in C. W. Finkl and C. Makowski (Eds.). Coastal Wetlands: Alteration and Remediation. Springer International Publishing, Cham.

[330] Melillo & Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program. P. 44.

[331] Sallenger et al., 2012. Hotspot of Accelerated Sea-Level Rise on the Atlantic Coast of North America. Nature Climate Change 2: 884-888; Ezer et al., 2013. Gulf Stream's Induced Sea Level Rise and Variability along the U.S. Mid-Atlantic coast. Journal of Geophysical Research: Oceans 118: 685-697; Compact 2015; Park, J. and W. Sweet. 2015. Accelerated Sea Level Rise and Florida Current Transport. Ocean Science 11: 607-615.

[332] Wdowinski et al., 2016. Increasing Flooding Hazard in Coastal Communities Due to Rising Sea Level: Case Study of Miami Beach, Florida. Ocean & Coastal Management 126: 1-8.

[333] Melillo & Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program.

[334] Sweet et al., 2017. Global and Regional Sea Level Rise Scenarios for the United States. National Oceanic and Atmospheric Administration, Silver Spring, Maryland, January 2017.

Intermediate-High (1.5 meters or 5 feet), High (2.0 meters or 6.6 feet), and Extreme (2.5 meters or 8.2 feet). The report also projects that, at most locations examined, with only about 0.35 m (<14 inches) of local relative sea level rise, the annual frequencies of disruptive and damaging flooding will increase 25-fold as early as 2030 under the Intermediate-High scenario, and as early as 2040 under the Intermediate scenario.

Other regional projections for Florida also indicate that sea level rise of three to four feet or more is highly likely within this century. The Southeast Florida Regional Climate Change Compact ("Compact") provides guidance on the sea level rise projections that managers should use for different time horizons for South Florida.[335] According to the Compact, in the short term, by 2030, sea level is projected to rise 6 to 10 inches above 1992 mean sea level; in the medium term, by 2060, sea level is projected to rise 14 to 34 inches above 1992 mean sea level; and in the long term, by 2100, sea level is projected to rise 31 to 81 inches above 1992 mean sea level.[336]

The best available science makes clear that the impacts of sea level rise will be long-lived. A recent study estimated that eight feet of sea-level rise are locked in over the long term for every degree Celsius of warming. Under all IPCC emissions scenarios, sea level rise will continue beyond 2100 for many centuries, as summarized by the Third National Climate Assessment:

> Sea level rise will not stop in 2100 because the oceans take a very long time to respond to warmer conditions at the Earth's surface. Ocean waters will therefore continue to warm and sea level will continue to rise for many centuries at rates equal to or higher than that of the current century. In fact, recent research has suggested that even present day carbon dioxide levels are sufficient to cause Greenland to melt completely over the next several thousand years.[337]

The FWS should also consider the effects of climate-change-related flooding resulting from increasing storm surge and storm intensity and increasing tidal flooding, compounded by sea level rise. Nuisance flooding, also called "sunny day flooding," occurs when high tide conditions are exacerbated by sea level rise. Nuisance flooding has increased substantially on the East, Gulf and West coasts by 300 to 925 percent since the 1960s, primarily due to sea level rise.[338] For example, according to a detailed flooding analysis for Miami Beach between 1998 and 2013, flooding frequency significantly increased after 2006, with a 33 percent increase in rain-induced flooding and a more than 400 percent increase in tide-induced flooding.[339] Scientific studies project that nuisance flooding will become much more frequent and severe in the next few

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[335] Southeast Florida Climate Change Compact Sea Level Rise Work Group (Compact), 2015. Unified Sea Level Rise Projection for Southeast Florida. A Document Prepared for the Southeast Florida Regional Climate Change Compact Steering Committee.
[336] *Id.* at 4.
[337] Melillo & Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program. P. 45.
[338] NOAA, 2014. Sea Level Rise and Nuisance Flood Frequency Changes around the United States. NOAA Technical Report NOS CO-OPS 073; Sweet & Park, 2014. From the extreme to the mean: Acceleration and tipping points of coastal inundation from sea level rise. Earth's Future 2: 579-600; NOAA [National Oceanic and Atmospheric Administration], What is nuisance flooding (2016), http://oceanservice.noaa.gov/facts/nuisance-flooding.html.
[339] Wdowinski et al. 2016.

decades.[340] For example, an analysis by Dahl et al. (2017) projected that tidal flooding in Virginia Key off South Florida will increase significantly in the near-term, from 5.1 flood events per year during 2001-2015 to 46 flood events per year by 2030 and 206 events per year by 2045.[341]

Increasingly intense storms and storm surge due to climate change will exacerbate flooding of the Florida panther's habitat. Frakes et al, 2015 acknowledges that water level is one of the most important factors when determining adult breeding habitat, noting that habitat is not useful for breeding panthers if the average water depth is greater than 0.5 meter.[342] As sea levels rise, storm surge rides on a higher sea surface which pushes water further inland and creates more flooding of coastal habitats.[343] The frequency of high-severity Atlantic hurricanes is increasing,[344] which results in more frequent and severe hurricane-generated surge events and wave heights.[345] Large storm surge events of Hurricane Katrina magnitude have already doubled in response to warming during the 20th century.[346] A recent study projected a twofold to sevenfold increase in the frequency of Atlantic hurricane surge events for each 1°C in temperature rise.[347] A separate study projected that, under the RCP 4.5 emissions scenario which the world is exceeding, the intensity of Atlantic hurricanes will increase, accompanied by a median increase in storm surge of 25 percent to 47 percent.[348]

Inland inundation, even under lower scenarios of sea level rise, would create mass human population migration and social crisis, which would have significant direct and indirect effects on Florida panther and its habitat. Hauer et al., 2016 forecast that 13.1 million people in coastal areas of the U.S. will be at risk of flooding from sea level rise by 2100, which would drive mass human migration.[349] With six feet of sea level rise, Florida is projected to account for nearly half of the total U.S. population at risk from displacement by sea level rise. In Monroe County, in core panther habitat, 55 percent of the human population is considered at risk from 0.9 meters (3 feet) of sea level rise, and 85percent of the population is at risk with 1.8 meters (6 feet) of sea

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[340] Moftakhari et al. 2015. Increased nuisance flooding along the coasts of the United States due to sea level rise: Past and future, Geophysical Research Letters 42: 9846–9852.
[341] Dahl et al., 2017. Sea level rise drives increased tidal flooding frequency at tide gauges along the U.S. East and Gulf Coasts: Projections for 2030 and 2045. PLoS ONE 12(2): e0170949.
[342] Frakes et al., 2015. Landscape Analysis of Adult Florida Panther Habitat. PLoS ONE, 10(7): e0133044. DOI: 10.1371/journal.pone.0133044.
[343] Tebaldi et al., 2012. Modelling sea level rise impacts on storm surges along US coasts. Environmental Research Letters 7: 014032. P. 12.
[344] Elsner et al., 2008. The increasing intensity of the strongest tropical cyclones. Nature 455: 92-95; Bende et al. 2010. Modeled impact of anthropogenic warming on the frequency of intense Atlantic hurricanes. Science 327: 454-458; Kishtawal et al. 2012. Tropical cyclone intensification trends during satellite era (1986–2010). Geophysical Research Letters 39:L10810.
[345] Grinsted et al., 2012. Homogeneous record of Atlantic hurricane surge threat since 1923. PNAS 109:19601-19605; Komar & Allan, 2008. Increasing hurricane-generated wave heights along the U.S. east coast and their climate controls. Journal of Coastal Research 24: 479-488.
[346] Grinsted et al., 2013. Projected hurricane surge threat from rising temperatures. PNAS 110: 5369-5373.
[347] *Id.*
[348] Balaguru et al., 2016. Future hurricane storm surge risk for the U.S. gulf and Florida coasts based on projections of thermodynamic potential intensity. Climatic Change 138: 99-110.
[349] Hauer et al., 2016. Millions projected to be at risk from sea-level rise in the continental United States. Nature Climate Change 6: 691-695.

level rise.[350] Therefore, the FWS must evaluate the synergistic effects of development, projected human population growth[351] and displacement from sea level rise on the Florida panther. Due to the Florida panther's already limited range and the high degree of development in and surrounding panther habitat, there is likely little suitable habitat where the Florida panther could disperse, making climate change a dire threat to its survival.

At the ecosystem level, as a result of the combined effects of sea level rise, increased flooding and stronger hurricanes, Southwest Florida's 4,500 square miles of coastal wetlands will be largely inundated.[352] Wetland areas will experience loss of wildlife habitat, land loss, increased vulnerability to storm damage, and increased salinity of rivers, bays, and aquifers.[353] Current vegetated areas will be converted to open water, pushing wetland species landward. Unfortunately, manmade structures such as seawalls and development will inhibit landward migration of estuarine vegetation and wildlife, resulting in complete habitat loss.[354] If landward migration of mangrove and wetland species is possible, it will cause a complete shift in the plant community structure and function. Landward migration of seagrass beds will deplete existing beds due to a lack of sunlight penetration in deeper water. This, combined with increased stormwater runoff, turbidity, and human activity, will cause die-offs at wetland edges.[355]

Concerning the effects climate change on southeastern environments, the Global Change Research Program stated, "[e]cological thresholds are expected to be crossed throughout the region, causing major disruptions to ecosystems and to the benefits they provide to people."[356] Climate models project both continued warming in all seasons across the southeast U.S., and an increase in the rate of warming, and an increased frequency, intensity, and duration of extreme heat events.[357] The warming in air and water temperatures projected for the southeast will create heat-related stress for fish and wildlife. Climate change will alter the distribution of native plants and animals and will lead to the local loss of imperiled species and the displacement of native species by invasives.[358] Both drought and severe storms could result in an altered prey base and food availability.[359] Species' persistence will depend upon, among other factors, the protection

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[350] *Id*. at Supplemental Information Table 2S.

[351] Zwick & Carr, 2006. Florida 2060: A Population Distribution Scenario for the State of Florida; available at www.1000fof.org/PUBS/2060/Florida-2060-Report-Final.pdf.

[352] Florida Oceans and Coastal Council, 2010. Climate change and sea-level rise in Florida: an update of "The effects of climate change on Florida's ocean and coastal resources." [2009 Report] Tallahassee, Florida. Available at http://www.flseagrant.org/wp-content/uploads/2012/02/Climate_Change_and_Sea_Level _Rise_in_FL.pdf

[353] Beever et al., 2009. Adaptation Plan for the City of Punta Gorda. Southwest Florida Regional Planning Council and Charlotte Harbor National Estuary Program, Technical Report 09-4, 406 pages. Adopted by the City of Punta Gorda on November 18, 2009. Available at http://www.swfrpc.org/content/Natural_Resources/Ecosystem_Services/Punta_Gorda_Adaptation_Plan.pdf

[354] *Id*.

[355] *Id*.

[356] Karl et al. (eds.), 2009. Global Climate Change Impacts in the United States. U.S. Global Change Research Program. Cambridge University Press, at 115.

[357] Carter et al., 2014: Ch. 17: Southeast and the Caribbean. Climate Change Impacts in the United States: The Third National Climate Assessment; Melillo et al. (eds.), U.S. Global Change Research Program, 396-417.

[358] Karl et al. (eds.), 2009.

[359] Seager, et al., 2009. Drought in the Southeastern United States: Causes, Variability over the Last Millennium, and the Potential for Future Hydroclimate Change. Journal of Climate, 22: 5021-5045.

of current and future suitable habitat climate refugia, and habitat connectivity to allow species to disperse to suitable habitat.[360]

As further evidence of extensive ecosystem disruption from climate change, a recent analysis found that climate-related local extinctions are already widespread and have occurred in hundreds of species, including almost half of the 976 species surveyed, across climatic zones, clades, and habitats.[361] A separate study estimated that nearly half (47 percent) of terrestrial non-volant threatened mammals (out of 873 species) and nearly one-quarter (23.4 percent) of threatened birds (out of 1,272 species) may have already been negatively impacted by climate change in at least part of their distribution.[362] The study concluded that "populations of large numbers of threatened species are likely to be already affected by climate change, and that conservation managers, planners and policy makers must take this into account in efforts to safeguard the future of biodiversity." A recent meta-analysis concluded that climate change is already impacting 82 percent of key ecological processes that form the foundation of healthy ecosystems and which humans depend on for basic needs.[363] Genes are changing, species' physiology and physical features such as body size are changing, species are rapidly moving to keep track of suitable climate space, and entire ecosystems are under stress.

Conclusion

Thank you for considering our comments, providing scientific and technical information regarding each subject area requested by the FWS.[364] It is evident, based on this best available information,[365] that the Florida panther should continue to be classified as a subspecies of *Puma concolor* warranting the highest level of protection as endangered under the ESA.

Signed,

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(863) 298-8000
jason@evergladeslaw.org

[360] Jones et al., 2016. Incorporating Climate Change into Spatial Conservation Prioritisation: A Review. Biological Conservation 194: 121-130.
[361] Wiens, 2016. Climate-related Local Extinctions are Already Widespread Among Plant and Animal Species. PLoS Biol 14: e2001104.
[362] Pacifici et al., 2017. Species' Traits Influenced their Response to Recent Climate Change. Nature Climate Change doi: 10.1038/NCLIMATE3223.
[363] Scheffers et al. 2016. The Broad Footprint of Climate Change from Genes to Biomes to People. Science 354: 719.
[364] U.S. Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants 5-Year Status Review of 23 Southeastern Species, 82 Fed. Reg. 29916 (June 30, 2017).
[365] U.S.C. 16 § 1533(b)(1)(a).

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Exhibit A

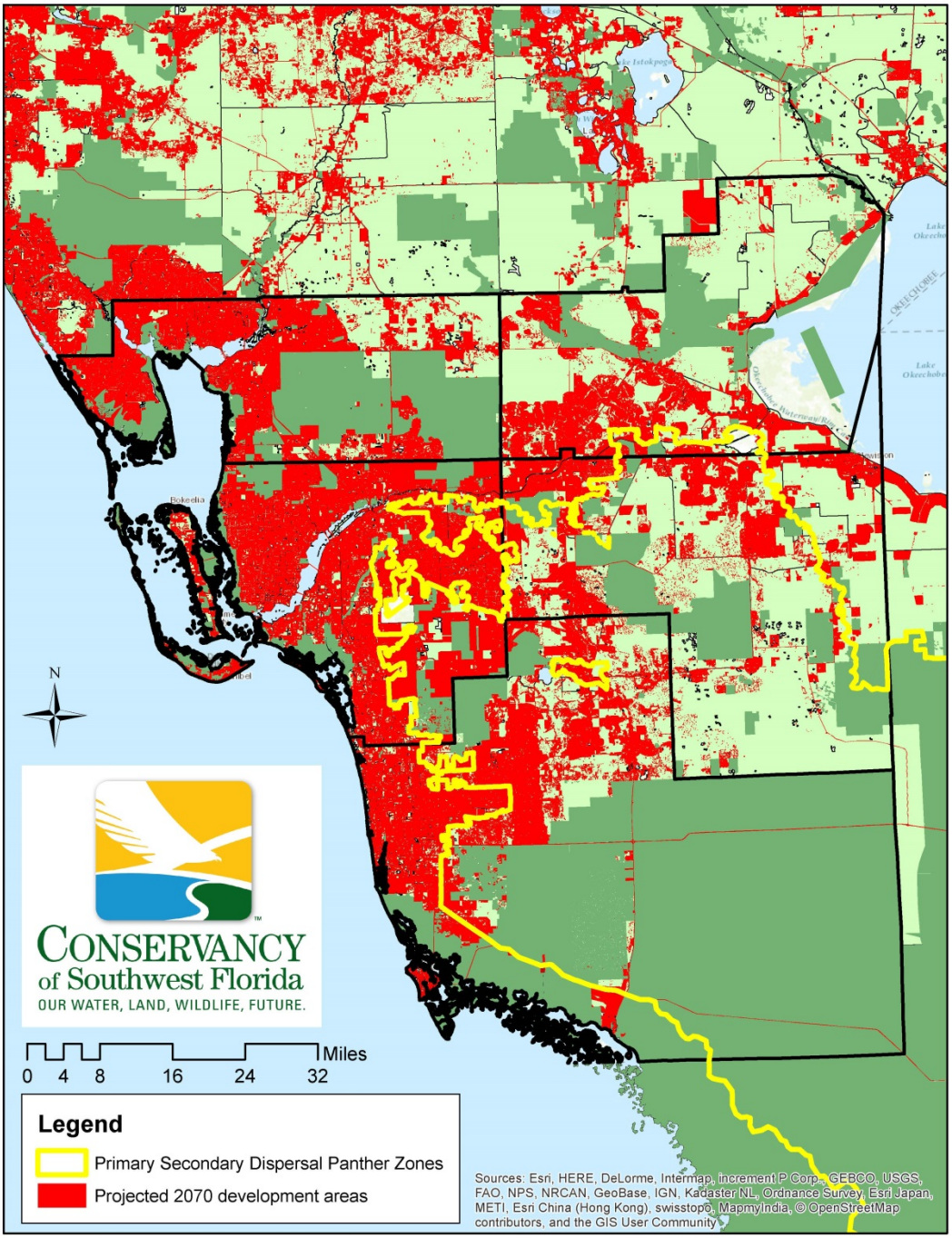
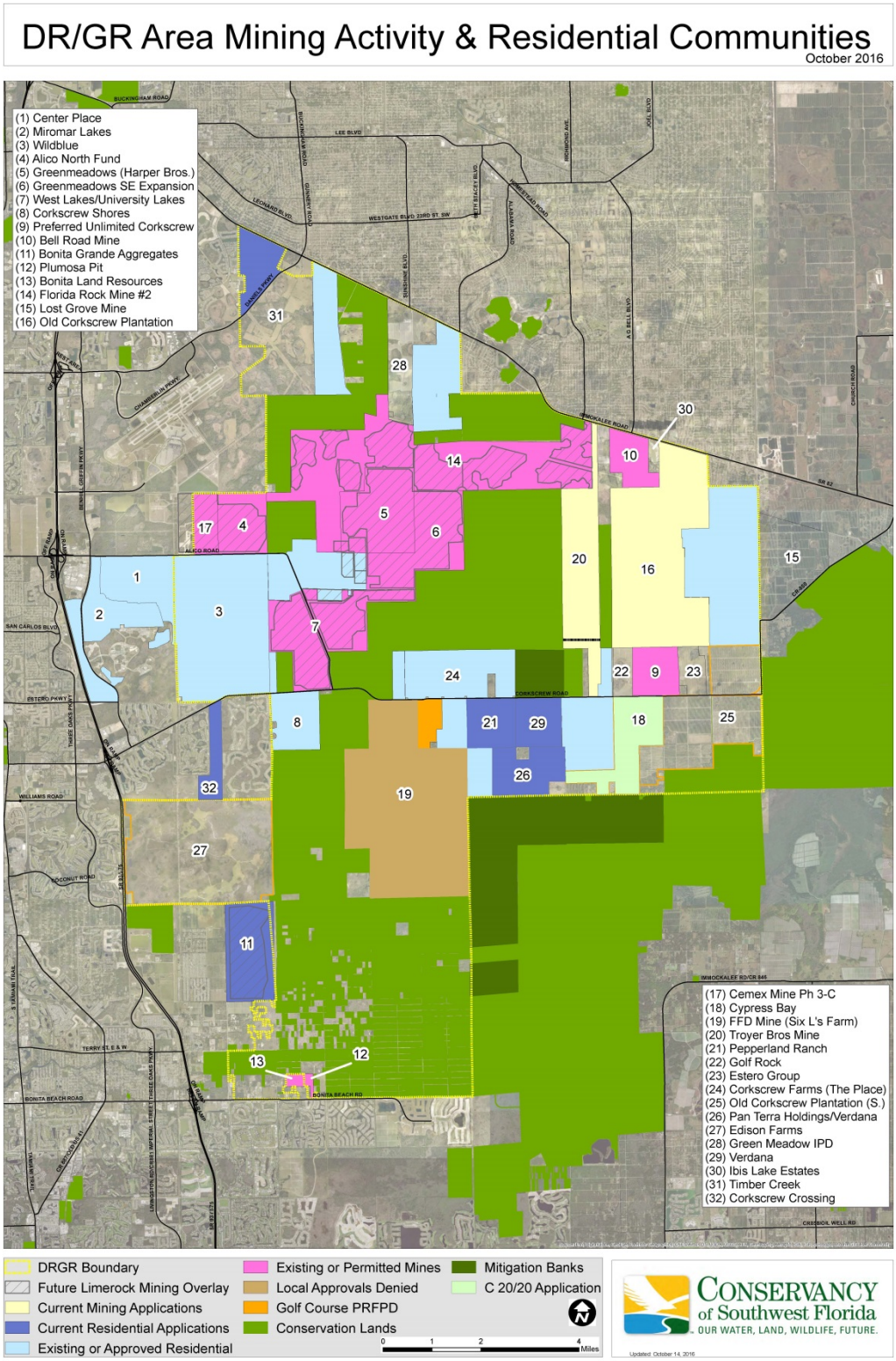

N
CONSERVANCY
of Southwest Florida
OUR WATER, LAND, WILDLIFE, FUTURE.
Miles
0 4 8 16 24 32
Legend
Primary Secondary Dispersal Panther Zones
Projected 2070 development areas
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Exhibit B


DR/GR Area Mining Activity & Residential Communities
October 2016
(1) Center Place
(2) Miromar Lakes
(3) Wildblue
(4) Alico North Fund
(5) Greenmeadows (Harper Bros.)
(6) Greenmeadows SE Expansion
(7) West Lakes/University Lakes
(8) Corkscrew Shores
(9) Preferred Unlimited Corkscrew
(10) Bell Road Mine
(11) Bonita Grande Aggregates
(12) Plumosa Pit
(13) Bonita Land Resources
(14) Florida Rock Mine #2
(15) Lost Grove Mine
(16) Old Corkscrew Plantation
(17) Cemex Mine Ph 3-C
(18) Cypress Bay
(19) FFD Mine (Six L's Farm)
(20) Troyer Bros Mine
(21) Pepperland Ranch
(22) Golf Rock
(23) Estero Group
(24) Corkscrew Farms (The Place)
(25) Old Corkscrew Plantation (S.)
(26) Pan Terra Holdings/Verdana
(27) Edison Farms
(28) Green Meadow IPD
(29) Verdana
(30) Ibis Lake Estates
(31) Timber Creek
(32) Corkscrew Crossing
DRGR Boundary
Future Limerock Mining Overlay
Current Mining Applications
Current Residential Applications
Existing or Approved Residential
Existing or Permitted Mines
Local Approvals Denied
Golf Course PRFPD
Conservation Lands
Mitigation Banks
C 20/20 Application
0 1 2 4 Miles
CONSERVANCY of Southwest Florida
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Updated: October 14, 2016