



A perfect storm may threaten Florida panther recovery

Peer-reviewed letter

The Florida panther (*Puma concolor coryi*), once distributed throughout the southeastern US, remains one of the world's most endangered mammals. With fewer than 200 individuals remaining in the wild (FFWCC 2010a), this federally endangered subspecies is currently restricted to one population located in southwestern Florida, where it is primarily associated with upland and wet forests but also uses a mosaic of other habitat types, such as prairie grassland and marsh–shrub land (Cox *et al.* 2006; Kautz *et al.* 2006; Onorato *et al.* 2011). The panther population has increased nearly threefold during the past 15 years primarily as a result of genetic restoration (Johnson *et al.* 2010), along with intensive management efforts to conserve and improve habitat quality and quantity, reduce vehicle-related mortalities, and maintain or augment the abundance of prey species (FFWCC 2010a).

Optimism regarding news of recent population growth of panthers should be tempered by concerns about current and predicted developments that will likely negatively affect panther abundance. The panther population faces immediate threats from range restrictions and prey population declines. More frequent reports of panthers near urban/developed areas – as well as a marked increase in road-kills during the past 2 years (FFWCC 2010b) in areas beyond the traditionally recognized region of core panther habitat – suggest that the panther population may be nearing carrying capacity in the higher-quality habitats of its current range. Population increases along the colonization front or in marginal habitat areas may be increasingly offset by a concomitant increase in mortality associated with more frequent human–panther encounters and an increase in intra-specific killing resulting from higher panther densities. Furthermore, in the

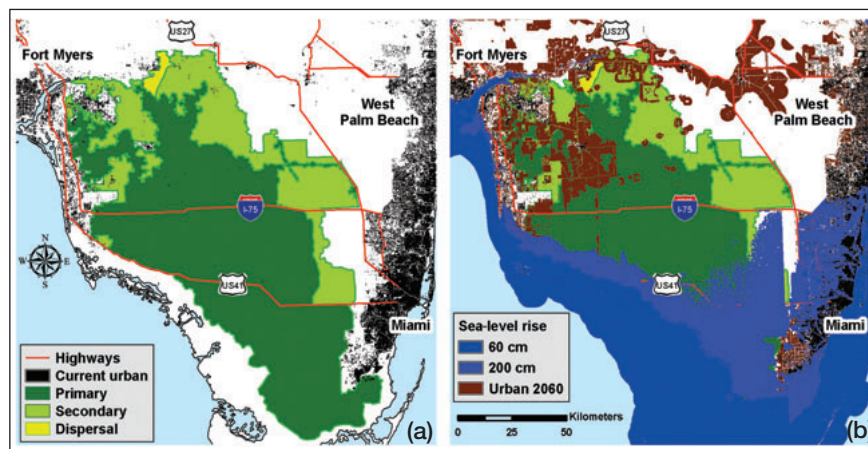


Figure 1. (a) Current Florida panther habitat zones (as described in Kautz *et al.* 2006) and their surrounding urban landscape. (b) Potential impact of projected urbanization by 2060 and predicted sea-level rise (60 cm and 200 cm) on Florida panther habitat.

past decade there has been a rapid decline in the panther's two most important prey – white-tailed deer (*Odocoileus virginianus*) and wild hog (*Sus scrofa*) – in some portions of its range, notably within the Big Cypress National Preserve (FFWCC 2010c). The rapid loss of primary prey portends a future population decline of panthers in areas where extended periods of standing water are detrimental to deer and hog numbers (Smith *et al.* 1996).

Sea-level rise may pose the greatest long-term threat to survival of the panther in South Florida. Attention has seldom been focused on either the potential impacts of sea-level rise on carnivores (Carroll 2007) or synergistic effects that may occur with other extinction risk factors. Global sea level is projected to rise by up to ~60 cm by 2100 under the “business-as-usual” scenario (IPCC 2007; Nicholls and Cazenave 2010) or up to ~2 m under the accelerated polar ice decline scenario (Pfeffer *et al.* 2008). Because the highest elevation in the current panther habitat (Kautz *et al.* 2006; Figure 1a) is around 12 m, 9.6% of the panther habitat (13.1% of the primary zone) is predicted to be inundated by rising seas under the former scenario (Figure 1b). Conversely, under the latter scenario, 32.9% of the panther habitat (41.3%, 10.3%, and 4.0% of the current primary, secondary, and

dispersal zones, respectively) would be inundated (Figure 1b). Although 75.4% of the inundated areas under the latter scenario are marsh lands and mangrove swamps, which are associated with relatively low panther density, additional loss of higher-quality habitat will likely occur from saltwater intrusion.

Urbanization has been a leading cause of habitat loss and fragmentation in Florida and will continue to complicate panther management efforts. Although only 1.3% of the panther primary zone will potentially be urbanized by 2060 based on projected urban growth (Zwick and Carr 2006), most development in South Florida is likely to occur along an east–west axis between Fort Myers and West Palm Beach (Figure 1b), thus reducing or halting further panther colonization northward and severing important escape routes to higher elevations, such as the Lake Wales Ridge in the middle of the peninsula.

Although recent panther population increases are encouraging and supportive of the many active measures taken to ensure the species' survival, current and predicted threats suggest the recovery effort in South Florida may be at or near “high tide” in terms of its success. Continued urbanization, rising seas, and persistently low numbers of primary prey species in protected federal and state lands may act synergistically to cre-

ate a positive feedback loop whereby the availability and quality of panther habitat decline over time as a function of the magnitude and extent of these events. Such a “perfect storm” of events would create a range-constricting noose that could rapidly erase recent panther population gains or catalyze the formation of an extinction vortex within an increasingly inhospitable South Florida. Given these developments in South Florida, we suggest that proactive measures – such as the creation of functional corridors that connect current panther range to central Florida, or successful establishment of a panther population elsewhere in the southeastern US – be implemented to increase the potential for long-term species viability.

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There’s no place like home

We were aghast to see two well-respected ecologists recommending colonizing space as a strategy to preserve the human race in the face of global catastrophe. In an otherwise thoughtful editorial about the need for ecologists to radically change their approach to the engineered environment, Jackson and Haff (*Front Ecol Environ* 2011; 9[2]: 87) suggested that we should be working to colonize other planets quickly so that we could recolonize Earth after a large-scale disaster, reminiscent of the scenario portrayed in the movie *Wall-E*.

We do not dispute the possibility of some such disaster, from environmental degradation, war, or some other cause we cannot anticipate. Moreover, we do not claim to be experts on interplanetary travel. We do, however, question whether spending the enormous resources necessary to attempt a centuries-long venture would be best spent on perhaps sav-

ing a few humans and other species. To date, the International Space Station has cost at least US\$100 billion to just barely colonize Earth’s atmospheric fringe. If a similar amount of money were spent on increasing access to birth control and education for women to reduce population growth or for developing clean-energy technologies, there would be less need to go looking for new worlds to mess up in the first place.

Colonizing space will require lofting enormous payloads from Earth to transport and sustain a founder population of humans while some habitable infrastructure is deployed and maintained on a platform (perhaps a rocky planet or moon) most likely with conditions entirely different from those of Earth. The energy and resource costs of such an undertaking are mind-boggling in an era of tax-cut rhetoric and legislative divisiveness. How can we justify planning for interplanetary colonization when we cannot even pay properly for K–12 education, high-speed rail, or an intergovernmental plan to mitigate and adapt to elevated greenhouse gases here at home?

Most importantly, we are concerned that if ecologists begin promoting space colonization, even as a last-ditch effort to save our species, it will be misinterpreted by the general public as a solution to our current environmental problems and will divert attention from improvement efforts. We ecologists have a hard enough time getting our message through clearly to the media to risk such an idea being taken out of context.

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A reply to Holl and Loik

We, too, were aghast at the necessity of pondering space colonization, as discussed at the end of our editorial on the neoenvironment – our name for the rapidly emerging technologies that are redefining the natural