Evaluation and Use of Precast Wildlife Crossings by Florida Wildlife

Mark A. Lotz, *Florida Game and Fresh Water Fish Commission, Big Cypress Wildlife Field Office, 566 Commercial Blvd., Naples, FL 34104*

E. Darrell Land, *Florida Game and Fresh Water Fish Commission, Big Cypress Wildlife Field Office, 566 Commercial Blvd., Naples, Fl 34104*

Kenneth G. Johnson, *Florida Game and Fresh Water Fish Commission, Big Cypress Wildlife Field Office, 566 Commercial Blvd., Naples, Fl 34104*

Abstract: We studied use of a new, less expensive design of wildlife crossing to determine the acceptance of the structure by wildlife. We documented wildlife use of 2 precast concrete wildlife crossings from 27 March 1995 to 30 June 1996 on State Road (SR) 29 in southwest Florida. Two additional crossings of a different design were monitored on Interstate (I)-75 for comparison. Over 1,000 photographs were taken of >20 species of wildlife, domestic animals, and humans using those 4 wildlife crossings. The SR 29 structures were utilized by Florida panthers (*Felis concolor coryi*), black bears (*Ursus americanus*), bobcats (*Felis rufus*), white-tailed deer (*Odocoileus virginianus*), raccoons (*Procyon lotor*), and 17 other species. Panther use of the I-75 wildlife crossings increased over time. The new design of wildlife crossing on SR 29 allowed safe passage of many species of wildlife, including panthers.

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Highway mortality is one of the most visible sources of mortality for many wildlife species. Some wildlife populations can absorb this unnatural mortality without suffering declines, but for endangered large mammals like the Florida panther, additional mortality could imperil their existence. A contiguous system of wild lands is necessary to accommodate the spatial needs of the Florida panther population. Adult male and female panthers maintain home ranges of >500 km^2 and >190 km^2 (Maehr et al. 1991), respectively, that often include many miles of improved and unimproved roads. Twenty percent of the 1979–1996 mortality to radio-collared panthers was by vehicle collisions (Fla. Game and Fresh Water Fish Comm., unpubl.

data). Florida panthers and other wildlife were documented crossing underneath I-75, a 4-lane, divided highway, at bridges which were constructed for wildlife crossings (Foster and Humphrey 1995), but bridge construction was expensive, and a more cost-effective design was needed for rural 2-lane highways. Our objectives were to evaluate wildlife acceptance and use of precast concrete box culverts as wildlife crossings installed under SR 29 in a 6.4-km stretch north of I-75, and to compare use between precast culvert and bridge-style wildlife crossings.

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Methods

The study area was located in central Collier County, Florida, along the 2-lane SR 29 corridor north of I-75 and a15-km stretch along I-75 extending west from SR 29 (Fig. 1). The 6.4-km section of roadway on SR 29 where crossings were installed separated the Florida Panther National Wildlife Refuge (FPNWR) from the Bear Island Unit of the Big Cypress National Preserve. The SR 29 wildlife crossings were completed in March 1995 and located 1.4 km and 4.5 km north of I-75. These were designated as 29S and 29N, respectively. Four lanes of I-75 separated FPNWR from Fakahatchee Strand State Preserve (FSSP). There are 12 bridge-style wildlife crossings on I-75 west of SR 29, 2 of which were monitored during this study for comparison with the SR 29 wildlife crossings. Some of the bridge-style structures were placed for water flow concerns and use by aquatic animals (e.g., alligators), and were of limited or no value as panther crossings. These structures were excluded from consideration in our study. Wildlife crossing #2, located 12.3 km west of SR 29, was selected for its favorable conditions to set up equipment. Wildlife crossing #8, located 5.3 km west of SR 29, was selected so that we could also compare current crossing activity with a previous study (Foster and Humphrey 1995). The construction of wildlife crossings on I-75 required several phases concluding in 1993. Placement of wildlife crossings was based on analysis of radio telemetry data, landscape features, and locations of road-kills (Logan and Evink 1988, Evink 1990). The areas around each wildlife crossing encompassed habitats ranging from seasonally flooded mixed swamp lands to dry pine lands and hardwood hammocks (Davis 1943).

The crossings on SR 29 consisted of a precast, concrete box culvert 2.4 m high, 7.3 m wide, and 14.6 m long (Fig. 2). Culverts rested at ground level and the roadway gradually rose over the structures. Each crossing also included a concrete span that formed a bridge across an adjacent canal. The surface of the span contained a layer of soil to support growth of natural vegetation. Chain link fencing enclosed the highway

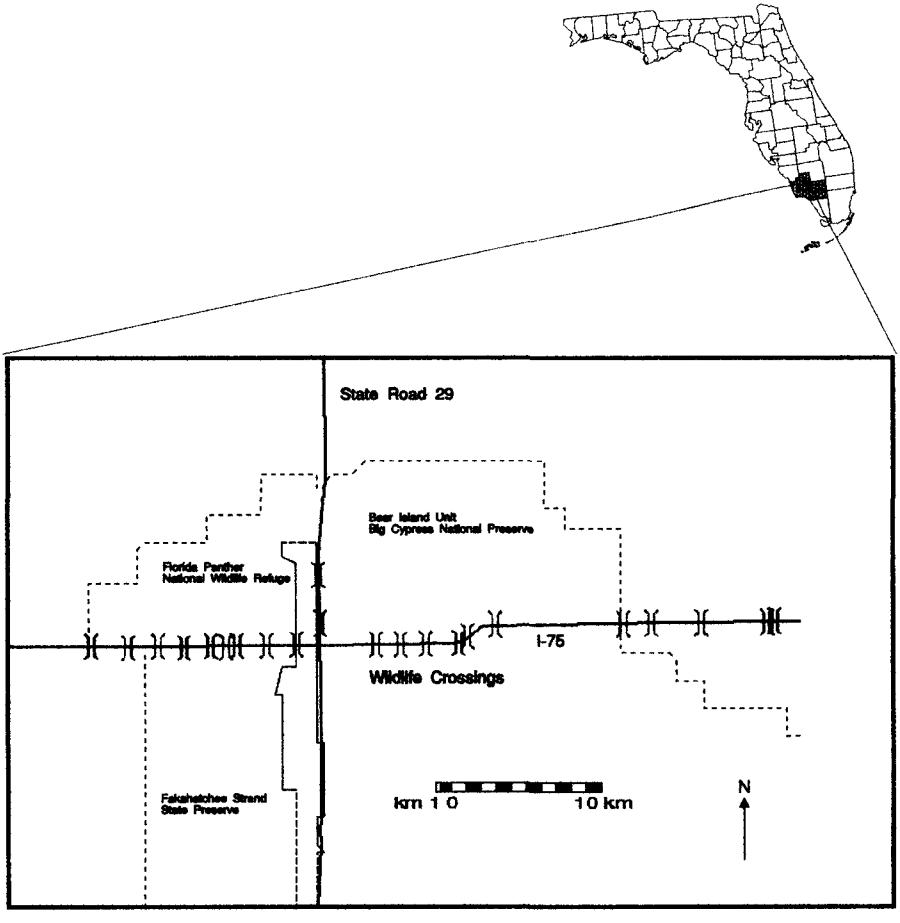

Figure 1. Locations of select wildlife crossings and public land along SR 29 and I-75 in central Collier County, Florida.

6.4 km north from the intersection of I-75 and SR 29 and extended 1.9 km beyond the northernmost wildlife crossing. The fence was 3.4 m in height with a 1-m overhang of barbed wire. The crossings on I-75 were a double bridge configuration 2.4 m high, 24.4 m wide, and 48.5 m long (Fig. 2). Each crossing included 2 spans plus the open median. The same fencing regime existed along these crossings, except that the fence extended 64 km along I-75, breaking only at the crossings (Foster and Humphrey 1995).

Monitoring of crossings began on 27 March 1995 and 12 April 1995 along SR 29 and I-75, respectively, using TrailMaster game monitors (Goodson and Assoc., Lenexa, Kan.). Each monitoring unit consisted of an infrared beam transmitter and a digital counter-receiver coupled with an automatic flash camera. When the infrared beam was broken, a picture was taken and the date, time of day, event, and frame

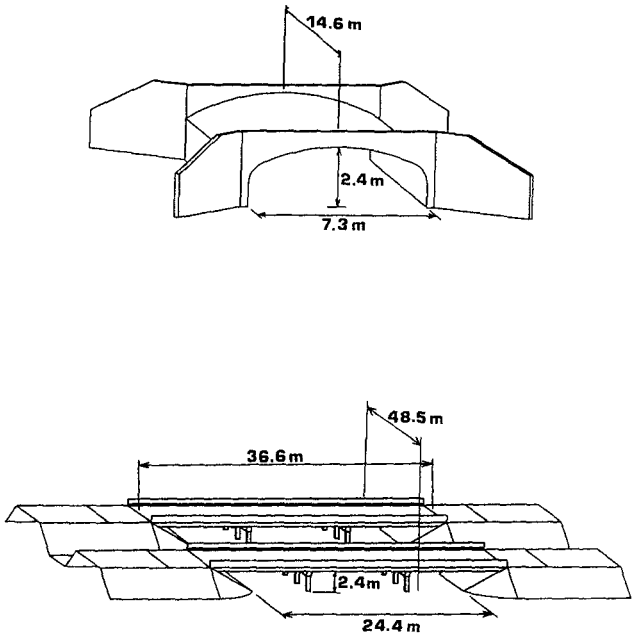

Figure 2. Precast concrete wildlife crossing on SR 29 (top) and bridge-style wildlife crossing (bottom) on I-75 in Collier County, Florida.

number was recorded. The cameras printed the date and time directly on the film. TrailMaster units and cameras were mounted on 5- by 10-cm posts 61 cm in length screwed into a 40-cm^2 plywood base. The transmitter was attached to one stand and the other held the receiver and camera. Six cameras and 5 TrailMaster units were stolen during the study and equipment was later housed in metal boxes bolted directly to the crossing structures to deter theft. One camera was sufficient to cover the entire span of the crossings on SR 29, but the wider crossings on I-75 required 2 cameras. The TrailMasters were positioned so that the infrared beam was 40 cm above the ground, and the camera was mounted about 61 cm above the ground. Cameras were deployed continually except when theft, high water, depleted film or batteries, and occasional equipment failure caused interruptions.

Photographs were analyzed to discriminate between a crossing event and foraging behavior. A crossing was defined as an animal traveling through the structure in one direction and not returning with 3 minutes. Foraging behavior was assumed when several photos were taken within a short time of each other of the same animal and by noting the activity of the animal.

The wildlife crossings containing cameras on SR 29 and I-75 were inspected weekly for tracks and to change film and batteries as needed. Additionally, the wildlife crossings were searched for tracks when radio-instrumented animals were known, through telemetry, to have crossed either highway near the wildlife crossing.

Animal tracks were recorded whenever possible, but poor substrates prevented use of tracks for most of the study.

Concurrent with this study, radio-instrumented panthers and bears were located 3 times a week from a Cessna 172 airplane (Land 1994, Johnson et al. 1997). Universal Transverse Mercator coordinates, habitat type, and activity were recorded for each animal located. Most flights were conducted between 0630 and 1030.

Results and Discussion

Panther Use

Panther use of the SR 29 wildlife crossings was documented on 6 occasions by 3 individuals; 4 by photos (Table 1) and 2 by tracks. One of the photos was of a Texas cougar (*Felis concolor stanleyana*), #101, released to restore genetic diversity in the Florida panther population (Seal 1994). Another male panther, previously radio-instrumented (#51), was photographed using the 29N wildlife crossing on 3 occasions. Following the death of male panther #12, #51 expanded his range eastward, adding the vacated territory in Bear Island to his range, which previously was known to encompass FSSP and the FPNWR. Male panther #12 used the 29S wildlife crossing even before it was completed (FGFWFC, unpubl. data). Tracks verified 2 crossings by female panther #32 during the study period. Like male panther #12, female panther #32 utilized the 29S wildlife crossing while it was under construction. At least 4 individual panthers were photographed 42 times in the 2 wildlife crossings monitored on I-75. Male panthers #51 and #54 and female panthers #32 and #57 are believed to account for nearly all or all the activity. Panther crossings exhibited a nocturnal pattern, with most crossings ($N = 41$) occurring between 1700 and 0600 hours.

Panther use of the older crossings on I-75 has apparently increased as the animals discovered their locations and learned to use them (FGFWFC, unpubl. data). Panther crossings were greater during this study ($N = 42$, 4 individuals) than reported by Foster and Humphrey (1995) ($N = 10$, 2 individuals). Wildlife crossing #8 was

Table 1. Use of wildlife crossings based on photos taken by TrailMaster game monitors from 27 March 1995 to 30 June 1996 in Collier County, Florida.

	N Photographs				
	State Road 29		Interstate 75		
Species	North	South	#8	#2	Total
Florida panther	3	1	11	31	46
Bear	5	0	0	0	5
Bobcat	44	108	6	23	181
White-tailed deer	20	12	69	61	162
Raccoon	176	111	25	4	316
Otter	6	82	1	0	89
Turkey	23	0	0	16	39
Gray fox	4	11	0	0	15
Total	281	325	112	135	853

monitored during both studies. Foster and Humphrey (1995) reported 2 crossings by panthers during 16 months of monitoring at this location; our study documented 11 crossings by panthers during 9 months. Reed et al. (1975) suggested mule deer may adapt to a wildlife crossing, with up to a 34% increase in use each successive year. Panthers may display similar adaptations over time. Because the wildlife crossings were placed where panthers tended to cross the highway, one would expect the structures to be utilized. However, adaptation to the structures may account for increased use over time.

Black Bear Use

Black bears used the 29N wildlife crossing 5 times at night (Table 1). One bear appeared intimidated by the flashing camera but passed through the wildlife crossing. Roof and Wooding (1996) reported the same number of bear crossings for a similar monitoring duration on SR 46 in Lake County, Florida. The wildlife crossing on SR 46 is identical to the ones on SR 29 in Collier County. To date, these are the only 3 precast concrete box culvert wildlife crossings in Florida.

Bobcat Use

One-hundred eighty-one bobcat crossings were photographed (Table 1), 152 of which occurred at the SR 29 structures. A minimum of 70 crossings were by the same 2 bobcats, as determined by their unique markings. During a period when water levels were >3-cm in the culvert, no bobcats were photographed using the SR 29 wildlife crossings. Bobcats were photographed crossing I-75 29 times. Bobcat activity was relatively consistent throughout the 24-hour period, but showed peaks at 0500 ($N = 15$) and 1700 ($N = 13$) hours.

Deer Use

One-hundred sixty-two deer crossings were recorded, with only 32 occurring at the SR 29 wildlife underpasses (Table 1). Deer crossings were mainly diurnal; peak crossing use ($N = 123$) occurred between 0700 and 1500 hours. Previous research has focused on how migrating ungulates respond to wildlife crossings (Reed et al. 1975, Singer and Doherty 1985). Although the deer in south Florida are nonmigratory, wildlife crossings provided unrestricted movement throughout their home range. Several factors may have accounted for the greater use by deer of the I-75 wildlife crossings. The habitat around the monitored wildlife crossings on I-75 was generally drier than those on SR 29. Foster and Humphrey (1995) found that deer utilized drier crossings and although travel was noted as the main activity, grazing also was photographed. Another plausible explanation is that the deer have had time to adapt to the structures on I-75 (Reed et al. 1975).

Racoon Use

Raccoons were photographed in the crossings 316 times (Table 1). Most raccoon activity occurred at the SR 29 wildlife crossings ($N = 287$) and at night ($N = 265$). The habitat surrounding the SR 29 wildlife crossings was generally swampy,

resulting in water collecting in the culvert portion of the crossing for long intervals. The standing water harbored potential prey items for raccoons and may have resulted in raccoons foraging in this newly created habitat.

Other Species

Several other species were documented using the SR 29 wildlife crossings (Table 1). Otters (*Lutra canadensis*) were present only during times of high water. They appeared to be traveling between 2 areas separated by SR 29. Additionally, the bridge across the canal was being used as a resting site, as determined by the numerous scat and bedding areas. Turkeys (*Meleagris gallapavo*) were documented using 29N and not 29S. The camera was positioned to record larger mammals such as panthers; therefore, small animals that passed close to the receiver were not captured on film. However, 2 photographs were taken of armadillos (*Dasypus novemcinctus*) when the camera stand was knocked over (presumably by a raccoon). Domestic cats, belonging to residents living in close proximity to the wildlife crossings on SR 29, used the crossings 8 times. Five species of wading birds ($N = 58$) were photographed foraging in the crossings. These species were great blue heron (*Ardea heridias*), little blue heron (*Florida caerulea*), green heron (*Butorides striatus*), great egret (*Casmerodius albus*), and snowy egret (*Egretta thula*). Gray fox (*Urocyon cinereoargenteus*) and opossum (*Didelphis virginianus*) also utilized the SR 29 wildlife crossings for travel.

Due to precipitation extremes in south Florida, we found infrared game monitors more effective than track observations in detecting crossing activity because monitors function independently of tracking conditions. However, local conditions may affect either method and should be taken into consideration when determining the best technique. Although game monitors provided continuous monitoring effort, drawbacks included depleted batteries and film, theft of equipment, and extreme environmental conditions that sometimes rendered them unusable. Despite these difficulties, overall game monitors proved practical in detecting crossing activity by panthers and other wildlife. Steps should be taken to ensure the safety of equipment and data from theft in areas easily accessed by people.

Management Recommendations

The wildlife crossings on SR 29 were effective in permitting the safe passage of many species of wildlife, including panthers, across the roadway. As more animals learn the locations of these crossings, they likely will use them more frequently. Placing wildlife crossings at traditional places where panthers tend to cross may lead to quicker acceptance and use of the structures.

The precast concrete structures used on SR 29 ($110,000 each) were less expensive than the I-75 bridges ($350,000/pair; R. Hall, FDOT, pers. commun.). Additional costs associated with integrating wildlife crossings into SR 29 included fill material needed to elevate the roadway over the crossing and the concrete span across the adjacent canal ($18,000). Another cost associated with both styles of wildlife

crossings was the fence enclosing the highway (approximately $30/linear meter). The less expensive, precast concrete structures were used by Florida panthers and other wildlife and are worth consideration when designing wildlife crossings on 2-lane highways.

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