

**WILDLIFE USE AND INTERACTIONS WITH STRUCTURES CONSTRUCTED  
TO MINIMIZE VEHICLE COLLISIONS AND ANIMAL MORTALITY ALONG  
STATE ROAD 46, LAKE COUNTY FLORIDA**

Contract No. BD-162

FINAL REPORT

October 2003



Submitted by Principle Investigators:

Gregg Walker, M.S.

Jo Anna Baber, B.S.

Florida Department of Environmental Protection  
Division of Recreation and Parks  
Wekiva River Basin State Parks  
1800 Wekiwa Circle  
Apopka, FL 32712  
(407) 884-2006  
[gregg.walker@dep.state.fl.us](mailto:gregg.walker@dep.state.fl.us)  
[jbaber@sjrwmd.com](mailto:jbaber@sjrwmd.com)

1. Report No.		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle <b>Wildlife Use and Interactions with Structures Constructed to Minimize Vehicle Collisions and Animal Mortality Along State Road 46, Lake County, Florida</b>				5. Report Date <b>October 30, 2003</b>	
				6. Performing Organization Code	
7. Author(s) <b>Gregg Walker and Jo Anna Watson Baber</b>				8. Performing Organization Report No.	
9. Performing Organization Name and Address <b>Florida Department of Environmental Protection Division of Recreation and Parks, Wekiva River Basin State Parks 1800 Wekiwa Circle, Apopka, FL 32712</b>				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. <b>Contract BD-162</b>	
12. Sponsoring Agency Name and Address <b>Florida Department of Transportation 605 Suwannee St. MS 30 Tallahassee, Florida 32399 (850)414-4615</b>				13. Type of Report and Period Covered <b>Final Report</b>	
				14. Sponsoring Agency Code	
15. Supplementary Notes  <b>Prepared in cooperation with the USDOT and FHWA</b>					
16. Abstract  The Florida black bear ( <u><i>Ursus americanus floridanus</i></u> ) is listed as a Threatened species by the Florida Fish and Wildlife Conservation Commission and is considered an umbrella species. State Road 46 in Lake County Florida has one of the highest concentrations of black bear roadkills in the state. A box culvert underpass and associated wildlife fencing was constructed in 1994 to facilitate the north-south movement of Florida black bears and other wildlife under S.R. 46. This study was designed to evaluate the effectiveness of the underpass and determine how different species of wildlife are affected by the fencing.  The study included the collection of roadkill data, monitoring wildlife tracks adjacent to the wildlife fence and monitoring wildlife utilization of the underpass structure with a motion-sensing camera. The fieldwork was conducted for two years.  The roadkill data clearly indicates that the fencing is reducing the number of roadkills within the fence limits, especially for mammals. The fence endpoints did not appear to be significant hotspots for wildlife roadkill. The tracking surveys revealed that the distance traveled along the fenceline differed for each wildlife species. The distance traveled by black bear were the shortest of all species monitored. This implies that they remember the location of the underpass or that they are influenced by the landscape manipulation – forested areas funneling them to the underpass entrance.  The underpass camera captured ten species of animals utilizing the underpass. The data reveal that more bears used the underpass in the summer of 2003 compared with the summer of 2002. A total of ten species of wildlife have been photodocumented in 672 photos over the study period.					
17. Key Word wildlife, underpass, roadkill, highway, Florida black bear, transportation, wildlife fence, State Road 46			18. Distribution Statement <b>No Restriction This report is available to the public through the NTIS, Springfield, VA 22161</b>		
19. Security Classif. (of this report) <b>Unclassified</b>		20. Security Classif. (of this page) <b>Unclassified</b>		21. No. of Pages <b>28</b>	22. Price

## INTRODUCTION AND BACKGROUND

The staff of the Wekiva River Basin State Parks (a division of the Florida Department of Environmental Protection (FDEP) formerly called the Wekiva Basin GEOPark) submitted a study proposal to the Florida Department of Transportation (FDOT). The proposed study was to determine the effectiveness of the existing wildlife underpass and associated barriers on State Road 46 in Lake County, Florida. On October 1, 2001 a Notice to Proceed was received from FDOT. The justification for funding the study is based upon the established fact that S.R. 46, in and adjacent to the study area, has the highest incidence of roadkill of the Florida black bear (*Ursus americanus floridanus*) (Gilbert 1994). Florida black bears are protected by state statute as a threatened species throughout Florida except those in Baker and Columbia counties and Apalachicola National Forest and those held in captivity under permit (Eason 2003).

Given their legal status and the high incidence of roadkill, FDOT designed and constructed an experimental type underpass that connects state owned lands on either side of S.R. 46. To the north of S.R. 46, Seminole State Forest is managed by the Florida Division of Forestry (FDOF). To the south of S.R. 46, Rock Springs Run State Reserve is co-managed by three state agencies including the Florida Fish and Wildlife Conservation Commission, FDOF, and the Wekiva River Basin State Parks serving as the lead agency. The construction of the underpass was completed in the first week of December 1994.

The underpass was considered experimental due to the fact that it was not a bridge or span as typically used for large mammal crossings. Instead, a box culvert was installed, roughly at grade, and S.R. 46 was routed over it (Exhibit 1). The inside dimensions of the underpass are 14.3 m long, 7.3 m wide, and 2.4 m tall and the floor is dirt.

The actual culvert must be considered as only one element of the wildlife underpass system. In addition, a barrier fence was constructed on both sides of S.R. 46 in order to prevent road crossings in proximity to the underpass. The fence is 3 m high and extends 0.6 km to the west of the underpass and 1.1 km to the east of the underpass. Thirdly, the habitat near the underpass was manipulated in order to “direct” wildlife towards the underpass. Because many species of animals prefer to travel under the cover of vegetation, pine trees were planted just north of the underpass to funnel wildlife towards the northern entrance to the underpass. The south side of the underpass was already forested and walking paths were bulldozed through the forest to the southern entrance of the underpass.

Roof and Wooding (1996) conducted a study to evaluate the effectiveness of this system. They concluded that the size and design of the structure was adequate as wildlife crossing for a two-lane highway such as S.R. 46.

The current study contains three separate but related elements: 1) roadkill surveys 2) tracking strip monitoring and 3) wildlife camera monitoring. The roadkill surveys on S.R. 46 were conducted from Camp Challenge Road to the west of the underpass and



Exhibit 1. State Road 46 Wildlife Underpass, Lake County Florida.

extended 12.7 km east to Lake Markham Road. Additionally, 17.2 km of S.R. 46A (from S.R. 44 to S.R. 46) were monitored (Exhibit 2). The entire 29.9 km was canvassed at a minimum interval of three times per week and all roadkilled animals recorded.

An 8-foot tracking strip was cleared to mineral soil adjacent to the wildlife barrier fence on the south side of S.R. 46 to monitor wildlife tracks adjacent to the fenceline. The entire fenceline was traversed at least once per week on an all terrain vehicle (ATV) or by foot and all footprints were recorded. The information collected included species, location, direction, distance traveled, and whether the animal appeared to encounter the fence, utilize the underpass, went around the fence, or went back to the south. Because track reading is, at best, an inexact science, not all data could be collected for each event.

In order to monitor the wildlife utilization of the underpass, a still camera with a motion detector was installed to photo-document utilization. The camera system was installed on June 20, 2002 by Park staff and has been monitored to date on a weekly basis. The images captured by the system were developed to film and then scanned by Park staff for easy distribution to interested parties via digital files.

The original proposal included analysis of the existing wildlife underpass associated with the S.R. 46 bridge over the Wekiva River. The span over the river was lengthened in order for wildlife to pass under S.R. 46 on the west shoreline of the Wekiva River. However, trespassing is prevalent in the area by hikers, campers, fishers, and other forms of recreation. Therefore, tracking data was not reliable and extremely biased based upon other human factors. In addition, we feel the site was not secure enough to place a wildlife camera. The site was removed from the study and the labor hours and budget scaled back appropriately.

In related events, Governor Jeb Bush signed an Executive Order on September 26, 2002 (E.O. No. 2002-259) that launched a Task Force to investigate the best way to construct an expressway through the Wekiva Basin to complete the partially constructed beltway around Orlando. Wildlife movements and habitat fragmentation were important issues to this investigation and emphasized the need for more roadway bridging to maintain and improve wildlife movement. The recommendations of this Task Force are detailed in the final report entitled Recommendations for Planning and Locating the Wekiva Parkway while Preserving the Wekiva Basin Ecosystem (January 15, 2003).

Graduate students at the University of Central Florida conducted another related study. The Park staff provided the class with historic roadkill data on S.R. 46 and a detailed analysis was conducted on the spatial distribution of roadkills. This report is titled Effectiveness of a Wildlife Underpass in Reducing Vertebrate Road Mortality (Hollingworth, et al.). This report, submitted to Dr. John Weishample on December 5, 2001 was not peer reviewed in a refereed journal, but contains interesting information. Some of this information will be summarized in this report.

This final report to FDOT is expected to be a stepping stone in several ways. The data collected can be analyzed further for more detailed results including GIS spatial analysis. Also, the study illuminated knowledge gaps and shortcomings that can be capitalized on in future studies on this very important topic.

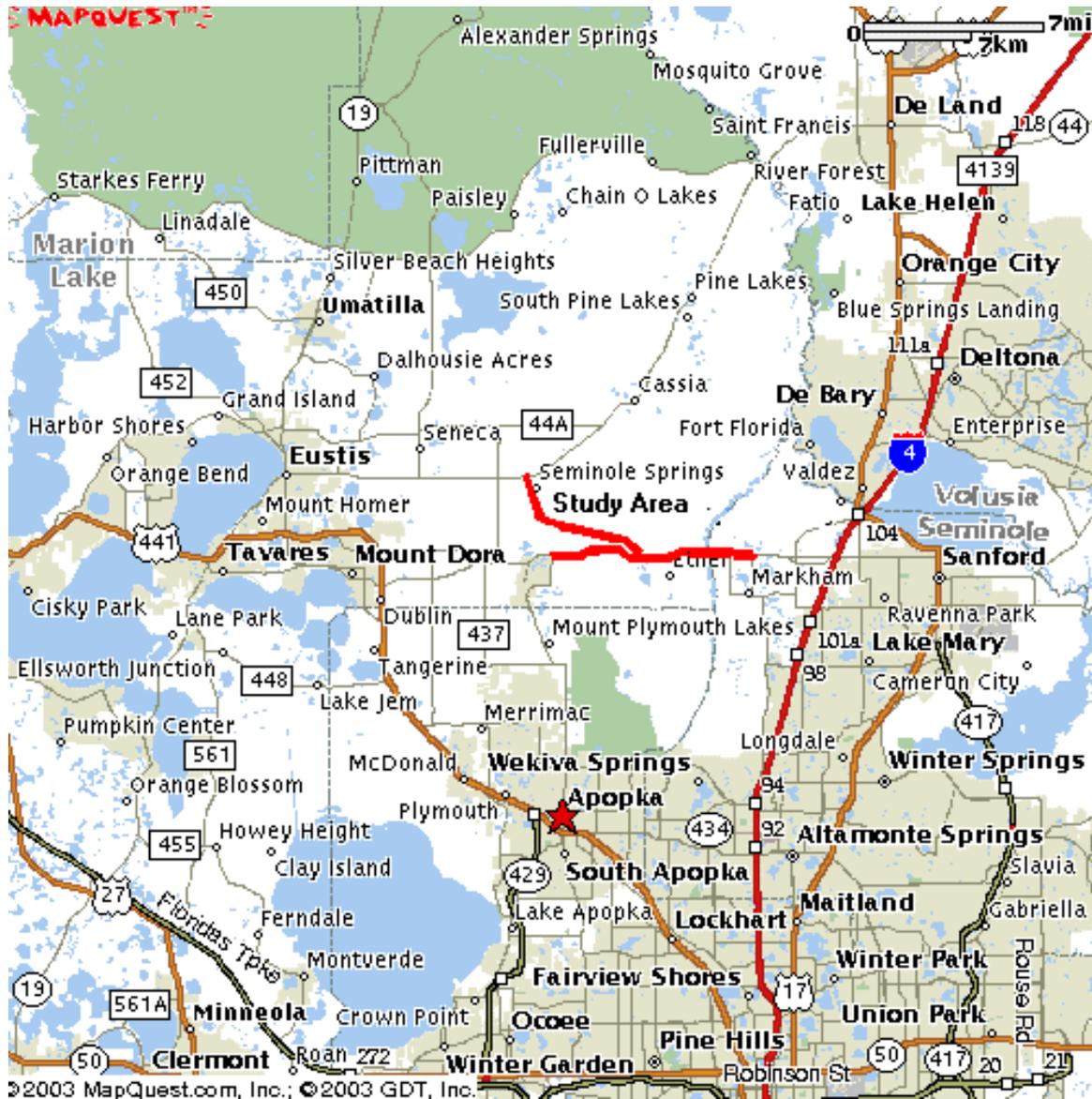
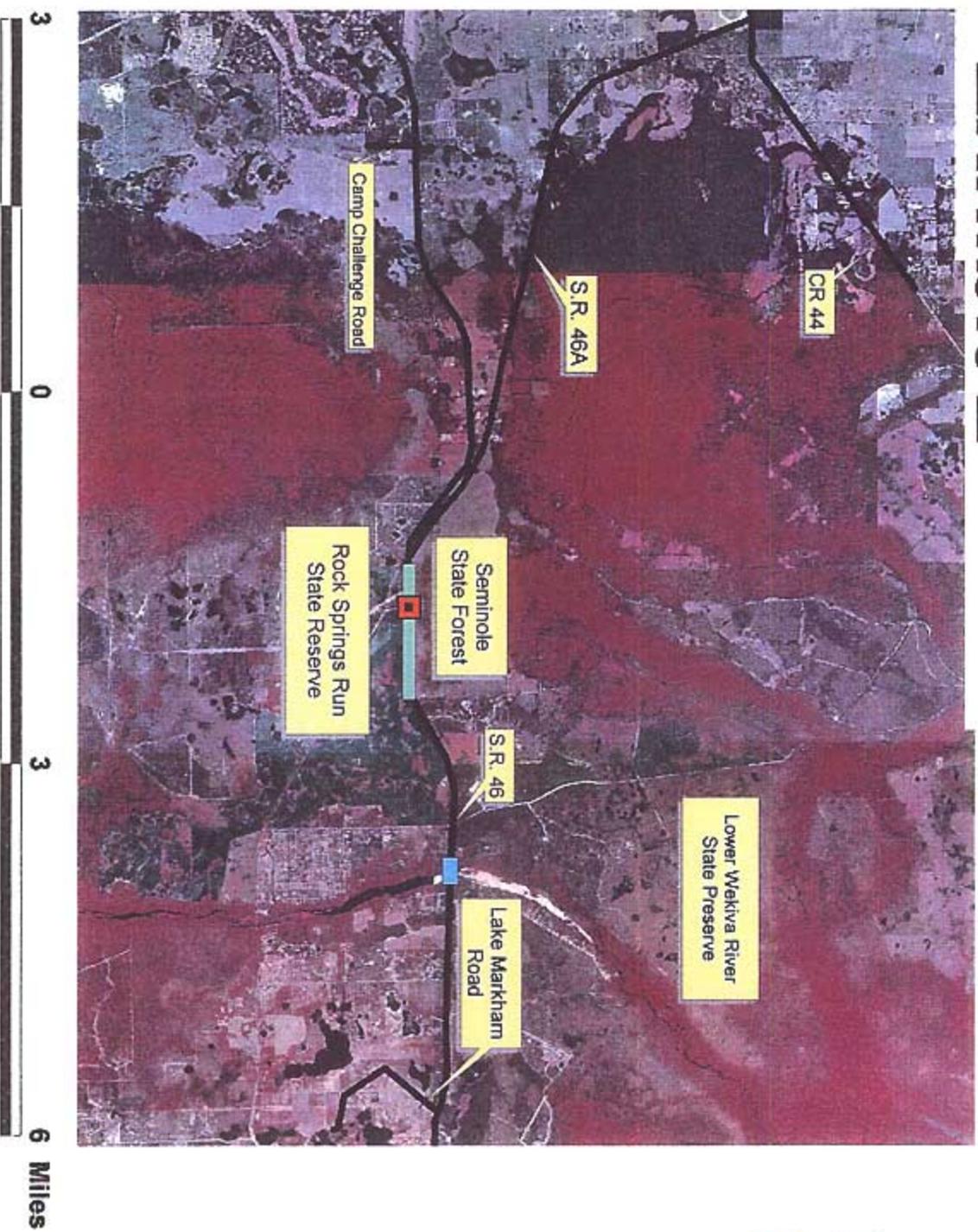


Exhibit 2. Location of the State Road 46 and 46A Wildlife Underpass Study. Lake and Seminole Counties, Florida.

# Exhibit 2



Underpass

Wildlife Barrier Fenc

Wekiva River Bridge



## METHODS AND MATERIALS

### Roadkill Surveys

Approximately 29.9 km of road were continuously surveyed for road-killed animals. On S.R. 46, 12.7 km were surveyed from Camp Challenge Road to Lake Markham Road. On S.R. 46A, 17.2 km were surveyed from S.R. 46 to S.R. 44.

Surveys were conducted by car, driving at slow speeds, often on the shoulder of the road. All road-killed animals observed were recorded and the following information collected:

Species (if possible), sex (if possible), and location (mile marker)

When safety allowed, the roadkill was then removed from the roadway. The location resolution was recorded to the tenth of a mile. This information was summarized in Microsoft Excel format and later converted to ArcView/GIS for mapping. The exception to this is that all black bear roadkills were handled by the Florida Fish and Wildlife Conservation Commission. The roadkill data for bear was subsequently gathered from FFWCC staff.

It is fortunate that the Research Assistant resided off of S.R. 46 and therefore roadkill surveys were conducted on almost a daily basis.

### Tracking Strip Surveys

Prior to initiating surveys, an eight-foot wide track adjacent to the wildlife barrier fence on the south side of S.R. 46 was herbicided and then disked down to mineral soil. Every attempt was made to place the tracking strip abutting the fence but three existing wetlands adjacent to the fenceline made this impractical. Within the wetlands, the fenceline was often standing in several inches of water. Placing the tracking strip through the wetlands would have required fill material and therefore wetland impacts. Environmental permitting for this work was outside the scope of this project.

Once the tracking strip was disked, the study area (the length of the fence) was marked in 50' increments using aluminum tags attached directly to the fence. Each tag was labeled with the distance, in feet, from the centerline of the underpass and the direction from the underpass. In the first months of the study, additional aluminum tags were placed at 10' increments in areas where high volumes of tracks were observed.

On a weekly basis, the entire tracking strip was traversed by the research assistant and all wildlife tracks recorded. Typically an ATV, dragging a harrow, was used in order to clear the tracks after being recorded. When high water levels or mechanical problems prohibited the use of the ATV, the strip was traversed on foot. Maintenance of the track strip was accomplished using a tractor with disc and rototiller implements.

The following data was collected for each track observation:

species, location entered track, did it encounter the fence, distance and direction traveled within tracking strip, location exiting strip, and did it utilize the underpass or go around the fence ends.

The track data was recorded using a class system. The definitions of Class A, B, C, and D are as follows:

Class A	A single set of prints with a clear entrance and exit point.
Class B	5 or more sets of prints each having a clear entrance and exit point.
Class C	A single set of prints with no clear entrance or exit point.
Class D	Several sets of prints moving in many directions with no clear entrance or exit point.

In the office, the data was transferred in the office to Microsoft Excel format for analysis and reporting.

#### Wildlife Underpass Camera Surveys

Pursuant to Task II of the Scope of Services (dated March 2001) the most appropriate type of wildlife camera was investigated. Previously, a video camera was envisioned at a cost of \$8,000, which was approved by FDOT. However, after considering the installation and maintenance requirements as well as concerns over theft or vandalism, a simpler 35mm still camera was chosen. On June 20<sup>th</sup>, 2002 a Buckshot RTV (Real Tough Version) was installed and subsequently assigned FDOT property decal No. NH 396003. This model was chosen because it is constructed within a lockable steel military ammunition box reducing the risk of vandalism. It was purchased at a cost of \$389.95.

Once installed, the camera system was checked on a 7 to 10 day interval by park staff. It is important to note that the photos taken are only a sample of the total number of crossings. Factors including battery life, technical glitches, animal size and speed, time of day and temperature can alter the effectiveness of the camera. It is assumed that the camera is biased towards larger, warm-blooded animals. Based on tracks in the underpass and the event counter on the motion detector, it is estimated that 70% of all warm-blooded animals larger than an armadillo were recorded on film.

The camera was returned to the manufacture on one occasion for warranty repairs. Because of this, no images were recorded between November 4, 2002 and November 19, 2002.

All of the images recorded by the camera were developed to photograph format. All film processing was paid for by the Park. After the pictures were developed, each photo was digitally scanned and placed into Microsoft PowerPoint format. Park staff, not funded by the grant, conducted this work. A CD is attached with a complete record of photos taken.

Because the camera was purchased with grant funds it is therefore the property of FDOT. However, if FDOT does not have an immediate need for this camera system, it could be used to collect valuable data at its current location. The park would be responsible for its maintenance and would, of course, return it to FDOT immediately upon request.

## RESULTS

### Roadkill Surveys

During the survey period (November 1, 2001 to August 31, 2003) the established transect areas of S.R. 46 and 46A were monitored at a minimum three-day interval. A total of 381 individual animal carcasses were documented. Raccoons were documented most often with 74 individuals (19.4% of the total number occurrences) and the Virginia opossum was documented 48 times for (12.6%). Black bear accounted for 2.4% with nine individuals. Additionally, gopher tortoises accounted for 5.2% with 20 individuals. Table 1 documents the number of individuals documented by species.

White-tailed deer roadkills appear to have a high concentration of mortality on S.R. 46 between miles 7.1 and 7.4. Six of the ten deer documented were found in this area. Further ground-truthing and exploration in the area revealed a deer feeder on private property approximately 135 meters north of the highway.

There were no noticeable trends of roadkill “hot spots” with any other species or group. However, there were noticeable reductions in animal deaths between the wildlife barrier fences and on the Wekiva River bridge. This is illustrated in Exhibit 3, where all documented road kills are plotted. Also illustrated in Exhibit 3 is a low roadkill area on the north end of S.R. 46A. Possible reasons for this reduction would be extensive fencing and cross fencing in addition to the presence of several homes and agricultural businesses. Exhibits 4 through 11 depict roadkill distribution by species or group.

A total of 26 roadkills were recorded within the area bounded by the wildlife barrier (Figure 1). However, of these 26 roadkills, 17 were located within 0.3 km of either the fence limits or within 0.3 km of a wetland where movement under the fenceline is more likely. Of the nine remaining roadkills within the fenceline, seven were frogs which can easily move through the mesh of the fence. The remaining two roadkills within the fenceline were small mammals (one opossum and one raccoon).

It is important to note that this data represents a sample of the wildlife roadkill occurrences in this area. In some cases, the research assistant witnessed road-killed animals being scavenged by other animals and being collected from the road by people. Additionally, it is expected that some small animals, particularly small reptiles and amphibians, were occasionally overlooked.

### Tracking Strip Surveys

Distances traveled along the tracking strip must be analyzed separately by species. This acknowledges the fact that different species travel at much different rates. For example, it would be meaningless to average the distances traveled by deer and tortoises. The average distance derived would not be relevant to the deer or the tortoise.

**Table 1. Total Road-Killed Animals by Group.**

**MAMMALS**

Species	Common Name	Total
<i>Canis familiaris</i>	Domestic Dog	7
<i>Canis latrans</i>	Coyote	7
<i>Dasyopus novemcinctus</i>	Nine-banded Armadillo	16
<i>Didelphis marsupialis</i>	Opossum	48
<i>Felis silvestris</i>	Domestic Cat	5
<i>Lynx rufus floridanus</i>	Bobcat	2
<i>Odocoileus virginianus</i>	White-tailed Deer	10
<i>Procyon lotor</i>	Raccoon	74
<i>Sciurus carolinensis</i>	Gray Squirrel	49
<i>Sylvilagus palustris</i>	Marsh Rabbit	2
<i>Sylvilagus floridanus</i>	Eastern Cottontail	2
<i>Urocyon cinereoargenteus floridanus</i>	Gray Fox	10
<i>Ursus americanus floridanus</i>	Florida Black Bear	9
	Unknown Mammal	1
<b>Total</b>		<b>242</b>

**AVIANS**

Species	Common Name	Total
<i>Anas platyrhynchos</i>	Mallard	1
<i>Bubulcus ibis</i>	Cattle Egret	1
<i>Buteo lineatus</i>	Red-shouldered Hawk	1
<i>Cardinalis cardinalis</i>	Cardinal	1
<i>Coragyps atratus</i>	Black Vulture	1
<i>Corvus brachyrhynchos</i>	Common Crow	2
<i>Gallus domesticus</i>	Chicken	7
<i>Grus canadensis</i>	Sandhill Crane	1
<i>Numida meteagriss</i>	Guinea Fowl	1
<i>Pandion haliaetus</i>	Osprey	2
<i>Pipilo erythrophthalmus</i>	Eastern Towhee	1
<i>Strix varia</i>	Barred Owl	4
<i>Turdus migratorius</i>	American Robin	2
	Unknown bird species	3
<b>Total</b>		<b>28</b>

**Reptiles and Amphibians**

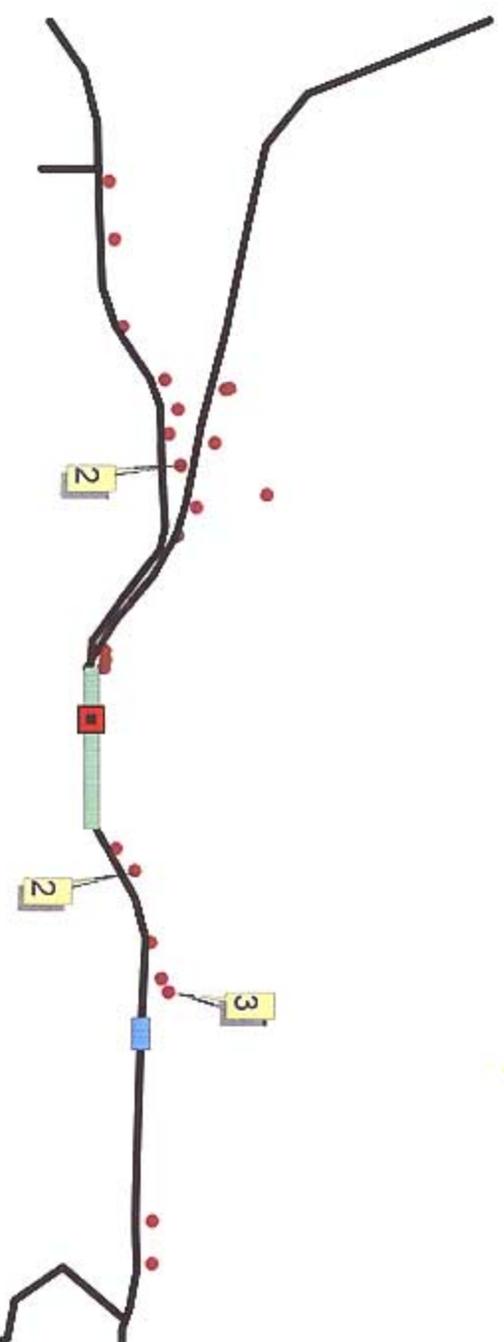
Species	Common Name	Total
<i>Agkistrodon piscivorus conanti</i>	Florida Cotton Mouth Snake	2
<i>Apalone ferox</i>	Softshell Turtle	4
<i>Bufo terrestris</i>	Southern Toad	17
<i>Chrysemys floridana peninsularis</i>	Peninsula Cooter	3
<i>Couluber constrictor priapus</i>	Black Racer	1
<i>Crotalus adamanteus</i>	Eastern Diamonback Rattlesnake	4
<i>Elaphe guttata guttata</i>	Florida Corn Snake	6
<i>Elaphe obsoleta</i>	Yellow Rat Snake	4
<i>Farancia abacura abacura</i>	Florida Mud Snake	5
<i>Gopherus polyphemus</i>	Florida Gopher Tortoise	20
<i>Terrapene carolina</i>	Florida Box Turtle	1
<i>Pituophis melanoleucus mugitus</i>	Florida Pine Snake	1
<i>Rana catesbeiana</i>	Bullfrog	6
<i>Rana grylio</i>	Pig Frog	3
<i>Rana pipiens</i>	Leopard Frog	18
<i>Thamnophis sirtalis</i>	Common Garter Snake	3
	Unknown Snake Species	2
<b>Total</b>		<b>100</b>

**Miscellaneous**

Species	Common Name	Total
<i>Micropterus salmoides floridanus</i>	Largemouth Bass	6
	Unknown Species	1
<b>Total</b>		<b>7</b>







● All Avians

■ Underpass



Wildlife barrier fence



Wekiva River bridge

# Exhibit 5

Unless otherwise indicated, one dot represents one roadkill event.



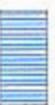


● Florida Gopher Tortoise

■ Underpass



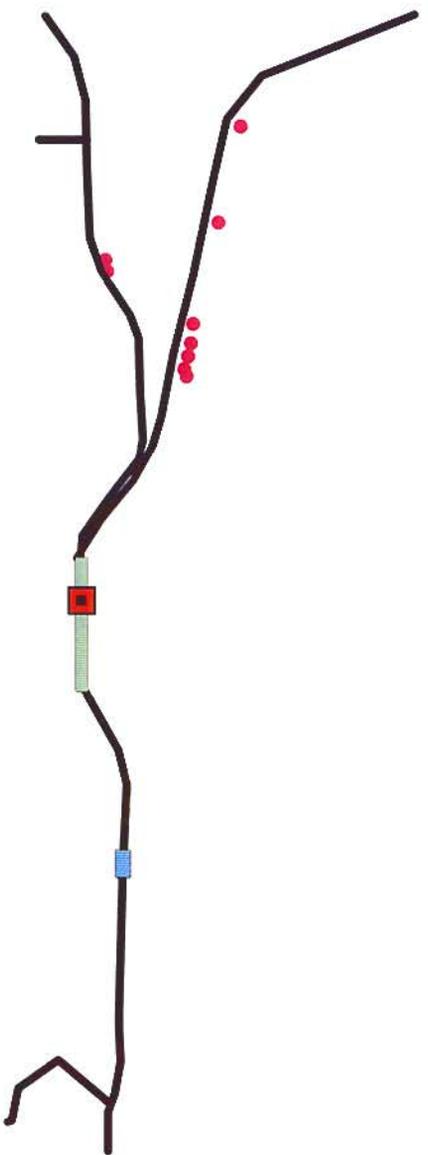
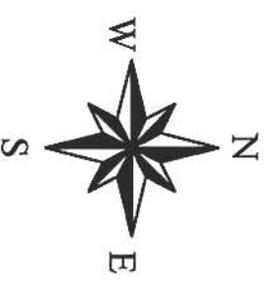
Wildlife barrier fence



Wekiva River bridge

# Exhibit 7

Unless otherwise indicated, one dot represents one roadkill event.



● Florida Black Bears

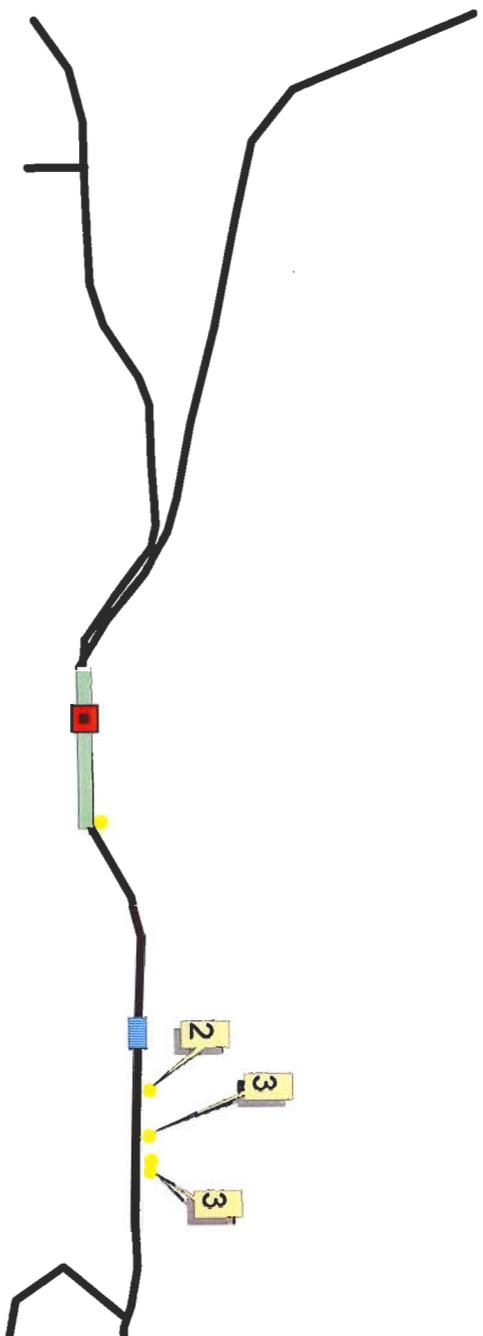
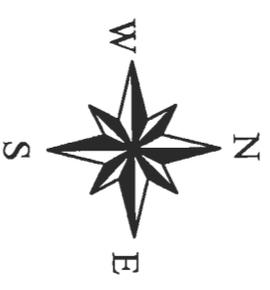
■ Underpass

▨ Wildlife barrier fence

▨ Wekiva River bridge

# Exhibit 8

Unless otherwise indicated, one dot represents less than three roadkill events



● White-tailed deer

■ Underpass



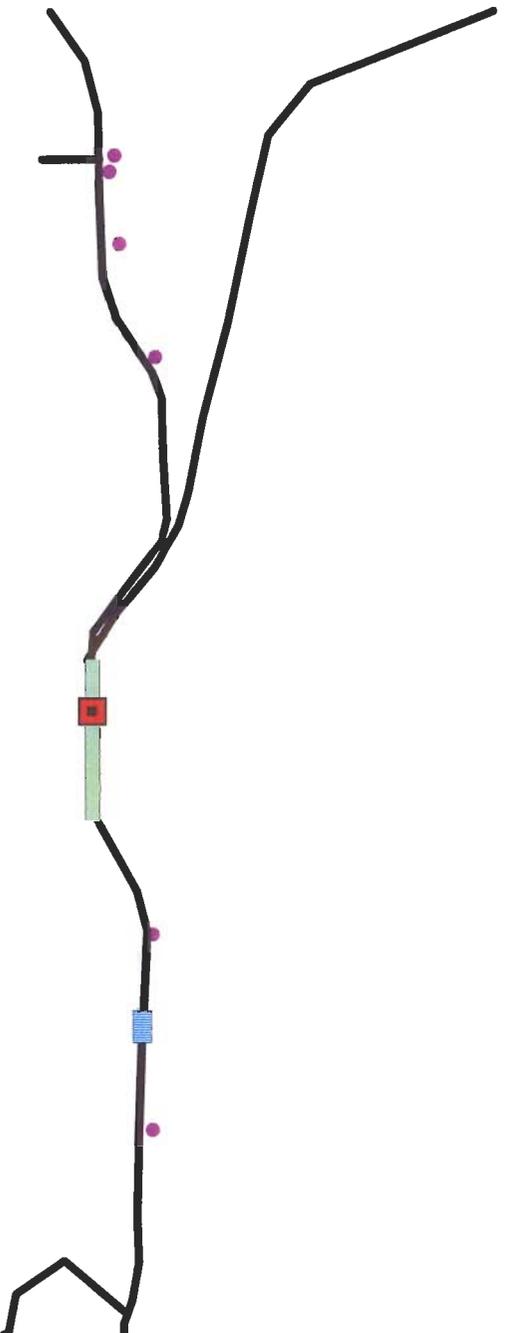
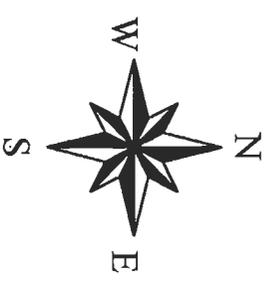
Wildlife barrier fence



Wekiva River bridge

# Exhibit 9

Unless otherwise indicated, one dot represents one roadkill event.



● Coyote

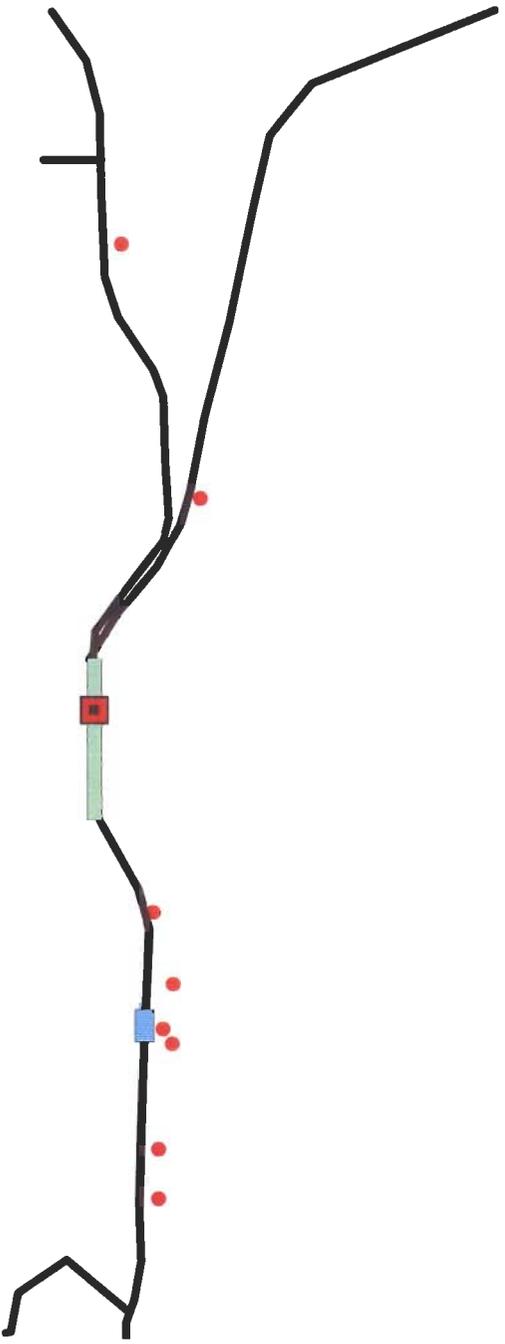
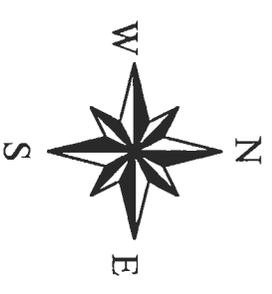
■ Underpass

▭ Wildlife barrier fence

▭ Wekiva River bridge

# Exhibit 10

Unless otherwise indicated, one dot represents one roadkill event.



● Gray Fox

■ Underpass



Wildlife barrier fence

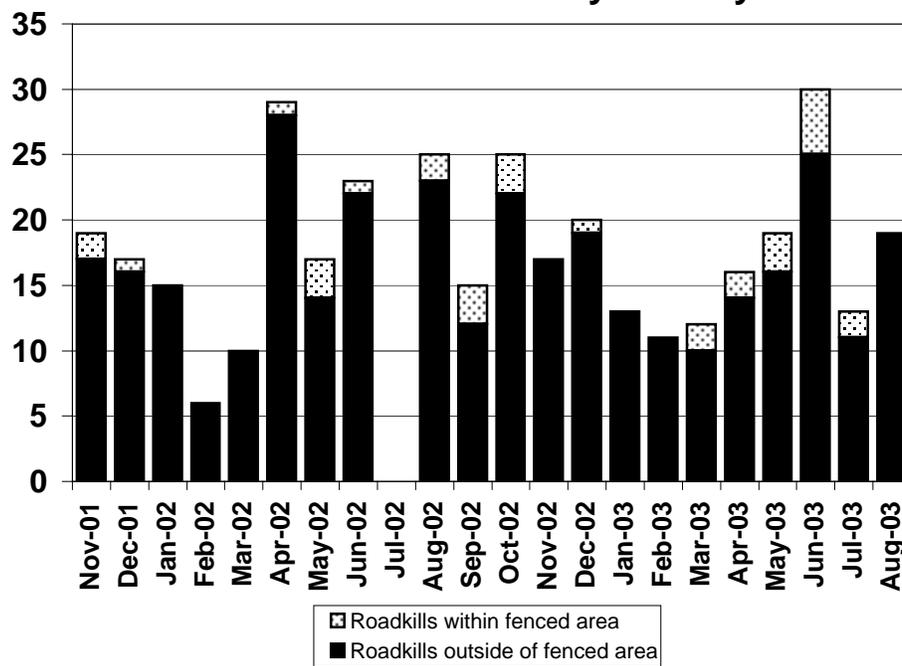


Wekiva River bridge

# Exhibit 11

Unless otherwise indicated, one dot represents one roadkill event.

**Figure 1**  
**Total Roadkills Within Study Area by Month**



**Note: No Data Available for July 2002**

A total of 394 track occurrences were recorded during the period of study. The following table summarizes the tracking data for the most common species recorded where N is the number of track occurrences for that particular species:

<u>Species</u>	<u>Average Distance Traveled (feet)</u>	<u>One Standard Deviation (feet)</u>	<u>N</u>
Florida black bear	125	208	36
White-tailed deer	276	381	189
Coyote	477	437	74
Gray Fox	152	218	14
Bobcat	295	513	7

With the information above, one fact becomes clear; the distance traveled by any given individual of any of the species reported is extremely variable. The empirical rule of thumb is that one standard deviation contains approximately 68% of the measurements (McClave and Dietrich 1985). Therefore, approximately 30% of the measurements were greater than the average distance plus one standard deviation.

Florida black bears have the smallest standard deviation listed. This implies that they are utilizing the adjacent forest landscaping effectively or that they remember the location of the underpass and avoid walking aimlessly along the fenceline.

The landscape contouring of the scrub directly south of the underpass appears to attract both bear and deer. White-tailed deer were documented traveling in a north/south direction directly through the underpass a total of 31 times. Additionally, 14 black bear traveled in a north/south direction. This demonstrates that 38% of documented black bear occurrences and 16% of deer occurrences were traveling in direct paths between the underpass and the contoured woods. Additionally, two coyote and one gray fox were documented moving in a north/south direction in this area.

Numerous field observations were made that suggest trends not readily apparent through data analysis. They are as follows:

- Track observations suggest that coyote and bobcat are periodically hunting the fence line, explaining the longer distances traveled by individual animals.
- It was noticed that large groups of white-tailed deer would enter the track strip near a food source, browse around in the vicinity, then traveled down the line stopping at another food source before exiting the strip. The food source was determined to be in small stands of oaks on or near the strip and the behavior was noticed to be more frequent during acorn masts.

Additional field observations include:

- All gopher tortoise occurrences were in close proximity to an active burrow. On one occasion a juvenile burrow was observed directly beneath the barrier fence.
- Coyote, bobcat, and bear scat were observed numerous times on the track strip.

- One dead gopher tortoise was documented on the strip. It appeared to have been trampled by horses.

Again, it is important to note that these results represent a sample of the total animals crossing the tracking strip. Environmental conditions, primarily rain, obliterate the tracks. In addition, during the second year of the study, extremely high water made track analysis extremely difficult in several portions of the study area.

### Wildlife Underpass Camera Monitoring

During the period the new camera was installed (June 4, 2002 to September 18, 2003) 672 images were captured. White-tailed deer accounted for 408 (60.7%) of the total number of images while turkey accounted for 96 (14.2%) of the images. Black bear were third most prevalent with 73 (10.9%) of the total images captured. In lesser numbers were bobcats (44, 6.5%), coyotes (33, 4.9%), raccoons (14, 2.1%) and gray fox (4, 0.6%).

Of course, black bear crossings are of primary interest due to the bear's threatened status. The bear crossings in June through September 2002 were all in the southbound direction (Figure 2). This may imply that although bear were passing through the underpass in the southbound direction, they were moving outside the fenced area (a journey of 0.6 or 1.1 km) for the return trip north. A more balanced north-south ratio appears after this period. Other animals use the underpass on occasion. We have photos of domestic dogs, domestic cats, and even an alligator.

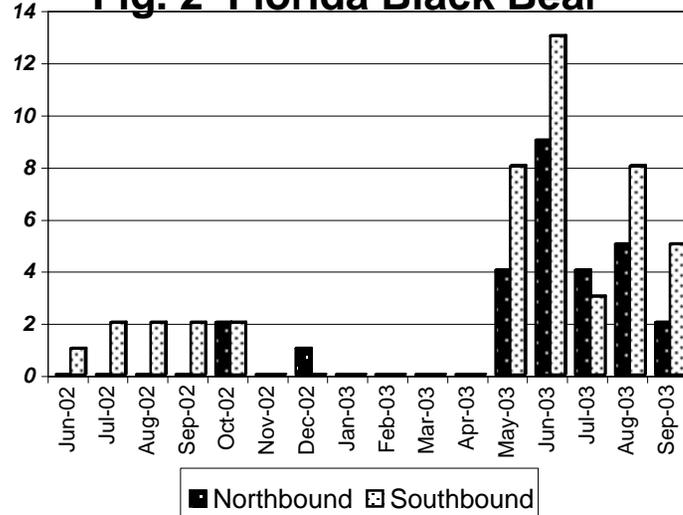
Perhaps more interesting is the quantity of bear photos in the summer of 2002 (22) compared to the summer of 2003 (49). Although we do not have enough years of data to make statistically valid conclusions, it suggests that bears may becoming more accustomed to the underpass structure. Because of this fact, it would be extremely beneficial to leave the camera in the underpass for at least another year.

All of the animals exhibit seasonal use of the underpass. Mammals appear to be more active in the summer and fall (Figure 3) whereas turkeys appear to be more active in the spring (Figure 4).

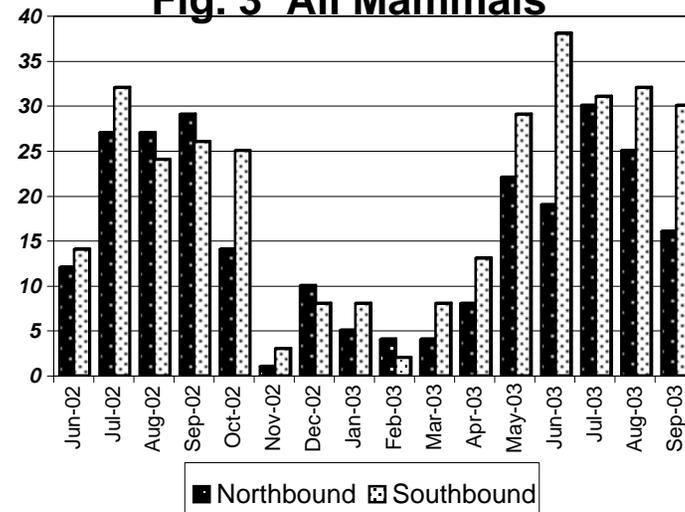
One of shortcoming of this monitoring system is that it is difficult to determine how many unique individuals of a species are utilizing the underpass. By comparing photos we can safely determine that at least five individual bears are utilizing the underpass. However, a great deal more may be utilizing it and we cannot differentiate their physical features from the photographs. A future study should include hair snares and DNA analysis in order to determine how many individual bears are utilizing the underpass. From this information we may be able to determine what percentage of the local population are successfully using the underpass.

# UNDERPASS UTILIZATION (Camera Documentation)

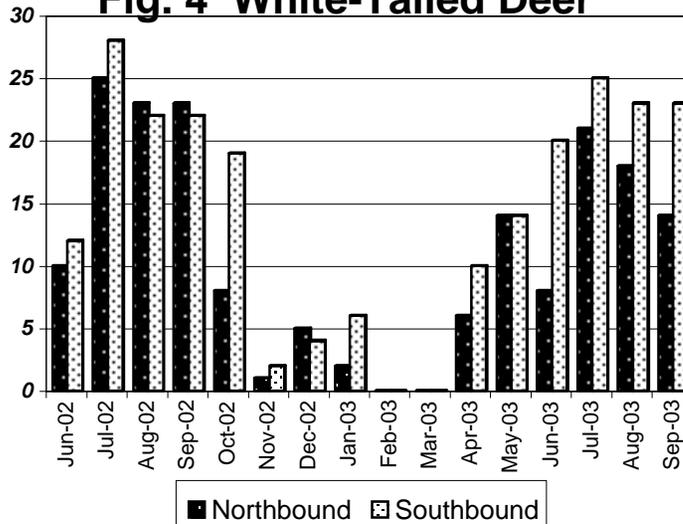
### Fig. 2 Florida Black Bear



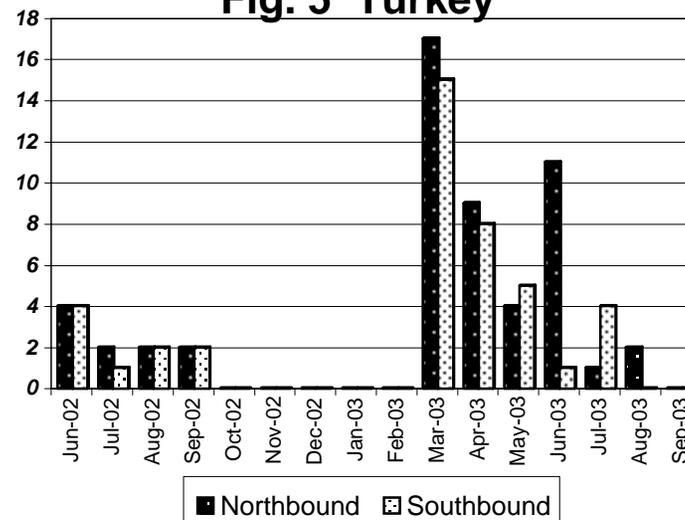
### Fig. 3 All Mammals



### Fig. 4 White-Tailed Deer



### Fig. 5 Turkey



## DISCUSSION

The intent of this study was to evaluate the effectiveness of the underpass system which includes the actual box culvert, the wildlife fence, and the landscape contouring adjacent to the underpass. Two measurements were used to evaluate this – a wildlife camera within the underpass structure and a study of road-killed animals. Additionally, a wildlife tracking study adjacent to the barrier fence was conducted in order to determine how tolerant animals are to the barrier.

Other human activities have also impacted the behavior and movement of animals. In this study, deer feeders on private property and fencing and structures on both private and public lands have effected both the spatial distribution and frequency of wildlife mortality on S.R. 46 and 46A.

The roadkill data clearly indicates that the wildlife barrier is reducing the number of roadkills. However, small mammals, reptiles, and amphibians are able to move either under or through the fence. Additional fencing options should be explored to compliment the existing wildlife fence and exclude small mammals, reptiles, and amphibians.

Although effective, wildlife fencing is often not practical. It is appropriate when conservation lands occur on both sides of the road and all gates are conscientiously closed at night. It has not been shown that private landholders can be relied upon to follow this regiment. Potentially worse than no wildlife barrier are gates being left open at night. In this scenario, bears and other wildlife may become trapped between the fences and unable to find their way back through the open gate.

A future public survey and feasibility study could include the potential use of wildlife fencing and automatic gates on private property.

However, the solution is not to fence miles of roadways in order to minimize road-killed animals. This would severely limit the natural movements of animals and isolate populations potentially reducing genetic variability. Therefore, the distance between wildlife underpasses becomes critical. It was in this light that the tracking study was proposed. If it can be determined for umbrella species (primarily the Florida black bear) what the critical maximum distance traveled along the fenceline is, an appropriate distance between underpasses can be established.

Unfortunately, the data is blurred by environmental factors, particularly habitat type adjacent to the fenceline. The landscape contouring may have a greater impact on underpass utilization by bear than the actual distance. This track strip monitoring study revealed a relationship between the bear underpass and the contoured landscape immediately south of it. Black bear and deer are frequently using both the cover of the contoured landscape and the underpass to safely cross S.R. 46. In this regard, habitat manipulation may play a very significant role in directing bear towards the underpass.

A new wildlife underpass is currently under construction on S.R. 46 to the west of the existing underpass. Unlike the existing underpass, the new one will be a 75' span/bridge. Currently, representatives from FDOT, the University of Central Florida and the Wekiva River Basin State Parks are in the very preliminary stages of developing a more robust study to compare the effectiveness of the two very different underpass systems.

Once the second underpass is constructed, comparative studies can be conducted to compare the effectiveness of each. The new underpass will have a wider span, but a shorter fence system (due to limited publicly held land). Comparative studies can also be conducted by modifying the landscape features and looking for changes in wildlife movements.

The authors would like to sincerely thank the Florida Department of Transportation for funding this study. Through cooperative efforts such as this, an effective and ecologically sound transportation system can be developed for the Wekiva River basin and the region.

## REFERENCES

Eason, T. H. 2003. Conservation Strategy for the Black Bear in Florida. Final Report. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida. 46 pp.

Gilbert, T., 1994. Chronic Roadkill Problem Areas for Black Bear in Florida. A preliminary Report of Transportation Impacts on Wildlife. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida. 24 pp.

Hollingworth, S., Montgomery J., Rodenbeck, B., Seiler, J., and Suazo, A. 2001. Effectiveness of a Wildlife Underpass in Reducing Vertebrate Road Mortality. Unpublished Report. University of Central Florida. 28 pp.

McClave, J. And Dietrich, F. 1985. Statistics. Third Edition. Dellen Publishing Company, Riverside, New Jersey. 823 pp.

Roof, J. And J. Wooding. 1996. Evaluation of S.R. 46 wildlife crossing. Florida Cooperative Fish and Wildlife Service Research Unit, U.S. Biological Service Technical Report #54. 36pp.

Wekiva Basin Area Task Force. 2003. Recommendations for Planning and Locating the Wekiva Parkway while Preserving the Wekiva River Basin Ecosystem. Final Report to Governor Jeb Bush. 34pp.