Florida Key Deer Screwworm

Final Report (Phase II)

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September 2017

FLORIDA KEY DEER SCREWWORM
FINAL REPORT

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Under Grant Agreement Award F17AP00039
Monitored by U.S. Fish and Wildlife Service
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Citation:
I. D. Parker, B. L. Pierce, J. T. Beaver, Lopez, R. R., N. J. Silvy, D.S. Davis. 2017. Florida Key deer screwworm final report. Texas A&M Natural Resources Institute. College Station, Texas. 13 pages.

FLORIDA KEY DEER SCREWWORM *MONITORING REPORT*

OVERVIEW

This report provides U.S. Fish and Wildlife Service with the final overall report for the contract *Screwworm Assessment and Monitoring for Florida Key Deer – Phase II.* This report synthesizes all data through 31 August. Successful resolution of the screwworm incident reduced the need for Key deer data collection (i.e., less radiotelemetry and fewer driving surveys) after April 2017. The primary focus changed to monitoring baseline fawn ecology and overall Key deer health using reduced radiotelemetry and driving surveys. Data results can be used by USFWS managers to determine specific recovery actions for the Key deer population in response to the current screwworm incident. The report is divided into 3 primary reporting sections: (1) density estimates/population indictors, (2) radiotelemetry, and (3) screwworm mortalities.

DENSITY ESTIMATES

Road surveys were officially conducted from November 2016–August 2017 on Big Pine and No Name keys along a standardized route (Silvy 1975, Lopez 2001, Lopez et al. 2004). These surveys were designed to provide an index (i.e., average number of deer seen/km) to population size, population structure (i.e., sex, age), and deer density (i.e., number of deer/ha) using mark-resight and distance sampling methods (Silvy 1975, Lopez 2001, Roberts 2005). For the latter, distance sampling was calibrated and validated by concurrent mark-resight efforts (Buckland et al. 1993, Roberts 2005) in 2005. Surveys from October 2016–April 2017 were initially conducted every day but reduced to every Thursday by November 2016 (official start date for distance analyses). Distance survey intensity was reduced in May 2017 to once/month upon completion of the screwworm incident response. Please note that the reduction in survey intensity did not allow for sufficient data to accurately estimate encounter rates or density for May-August 2017. A pooled monthly density estimate was calculated for November–May but a pooled encounter rate was not attainable for the limited late project data. Survey methods applied in obtaining a population estimate as part of this study are outlined by Roberts (2005). Please note that some numbers have been adjusted from the previous report due to updated analyses.

Following collection of road survey data, we used Program DISTANCE to estimate density and population size for both islands by month, with stratified detection, density, cluster size, and encounter rates. Data were right truncated at 100 m, and best fit model was selected by model fit (Kolmogorov-Smirnov Test) and AIC (Lopez et al. 2016). The analysis selected a half-normal model with 2 cosine adjustment terms for both months. While the data for both months was spiked near distance zero, this analysis clarifies differences between periods due to weather, deer perturbations, surveyors, survey effort, and changes in population estimates. Sampling effort summaries and statistical outputs are provided (see Appendix).

Mean encounter rates also serve as good index to detecting Key deer population changes, particularly as related to recommended PVA thresholds (Lopez et al. 2016). Encounter rates for November surveys (1.046) were slightly higher compared to December (1.015) but lower compared to January (1.099) and February (1.062) (Figure 1). Key deer had much higher encounter rates in March (1.444) and April (1.8101) that may be attributable to spring behavioral differences in deer and humans. This may also be attributable to large mosquito populations that pushed deer towards roads and residential areas. The reduced survey intensity prevented accurate encounter rate or density estimation for May-August 2017. However, the analytical framework is a running analysis by month which provides a pooled estimate (November – April) at the end.

USFWS personnel conducted 56 road surveys over 30 sample days in November 2016–August 2017 (sunrise/sunset each Thursday through April, once/month for May-August). A total of 26 identified marked deer and 7 unknown marked deer (119 marked deer observations overall) were observed during the 56 road surveys. The marked deer originated from the radiotelemetry component of Key deer monitoring (30 marked deer).

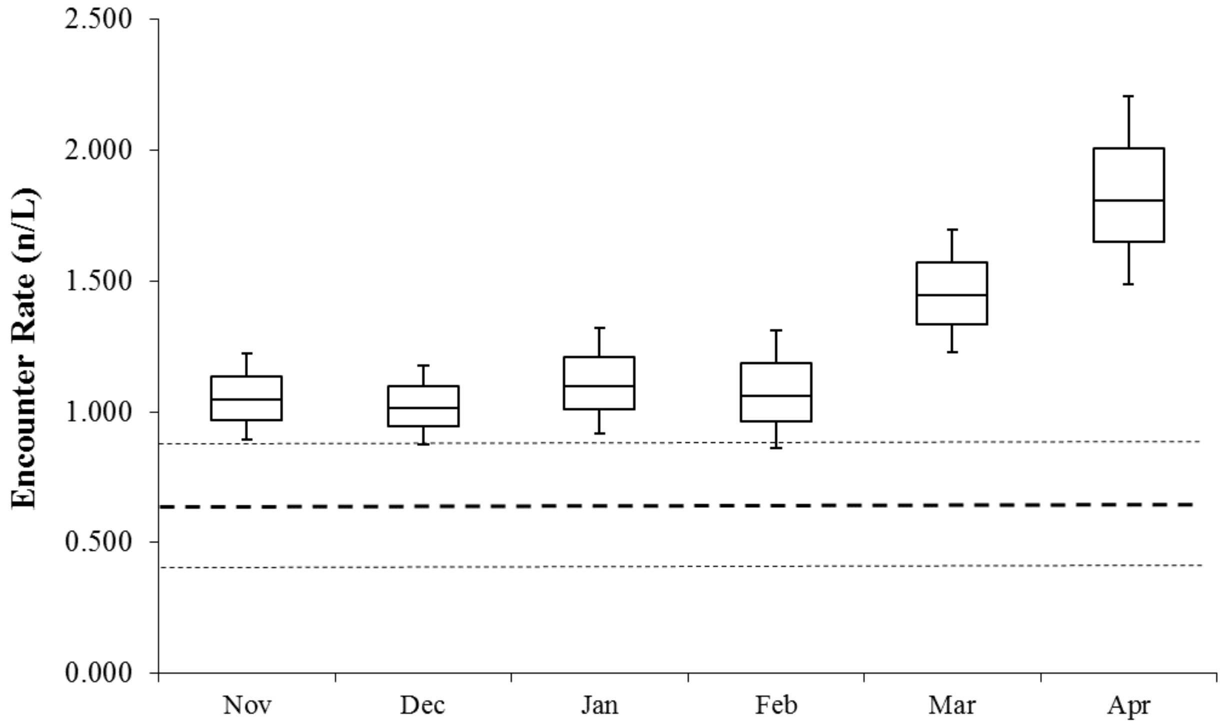

Figure 1. Key deer mean encounter rate (n/L) for Big Pine and No Name keys from distance sampling via road surveys, November 2016-present.

<u>Note</u>: Dash lines represent recommended PVA thresholds (Lopez et al. 2016). Estimated thresholds have been adjusted to account for positive-bias in density model to allow direct comparison to PVA results. Pooled encounter rates were of little value and not calculated.

Pooled monthly distance sampling data from November–April resulted in estimates of total density (D=1163, CI=799-1693) and female density (D=802, CI=551-1168) in line with initial estimates of density and carrying capacity (Figure 2, pooled estimates in Appendix). We do not believe the higher abundance estimates for March and April reflect a population increase during that time period. Rather these likely were due to increased road encounter rates and larger observed group sizes reflective of seasonal or other changes that can appear in monthly analyses. Distance survey abundance estimates for April (and part of March) likely were inflated due to increased deer activity near roads. Large mosquito populations may have also pushed deer towards roads and residential areas that support fewer mosquitos. This effectively decreased perpendicular sighting distances which impacted abundance estimates. Abundance estimates derived from mark-resight efforts during the April road surveys provided an estimate (D=925, CI=698-1353) closer to pre-March and pooled distance survey estimates (Figure 3). Mark-resight estimation was not possible with the reduced May data collection.

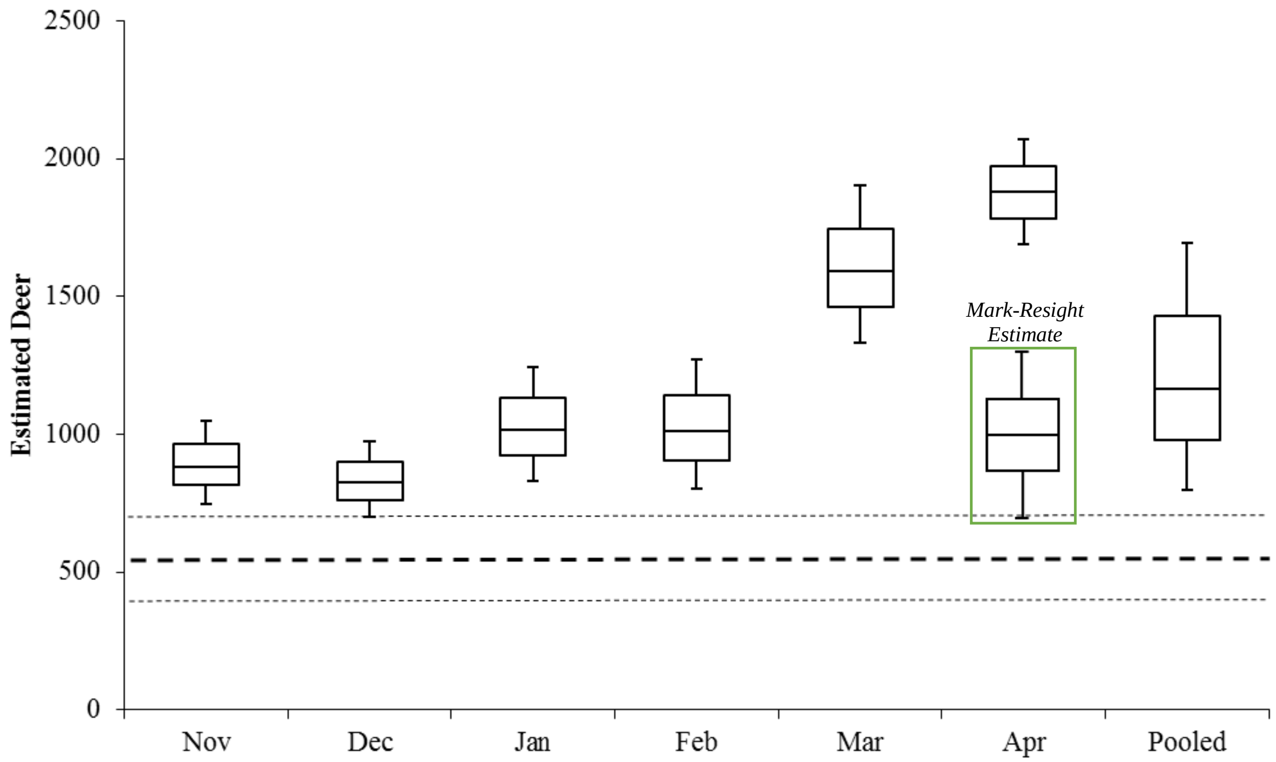

Figure 2. Key deer abundance estimates for Big Pine and No Name keys from distance sampling via road surveys, November 2016-present.

Note: Dash lines represent recommended PVA thresholds (Lopez et al. 2016). Estimated thresholds have been adjusted to account for positive-bias in density model to allow direct comparison to PVA results.

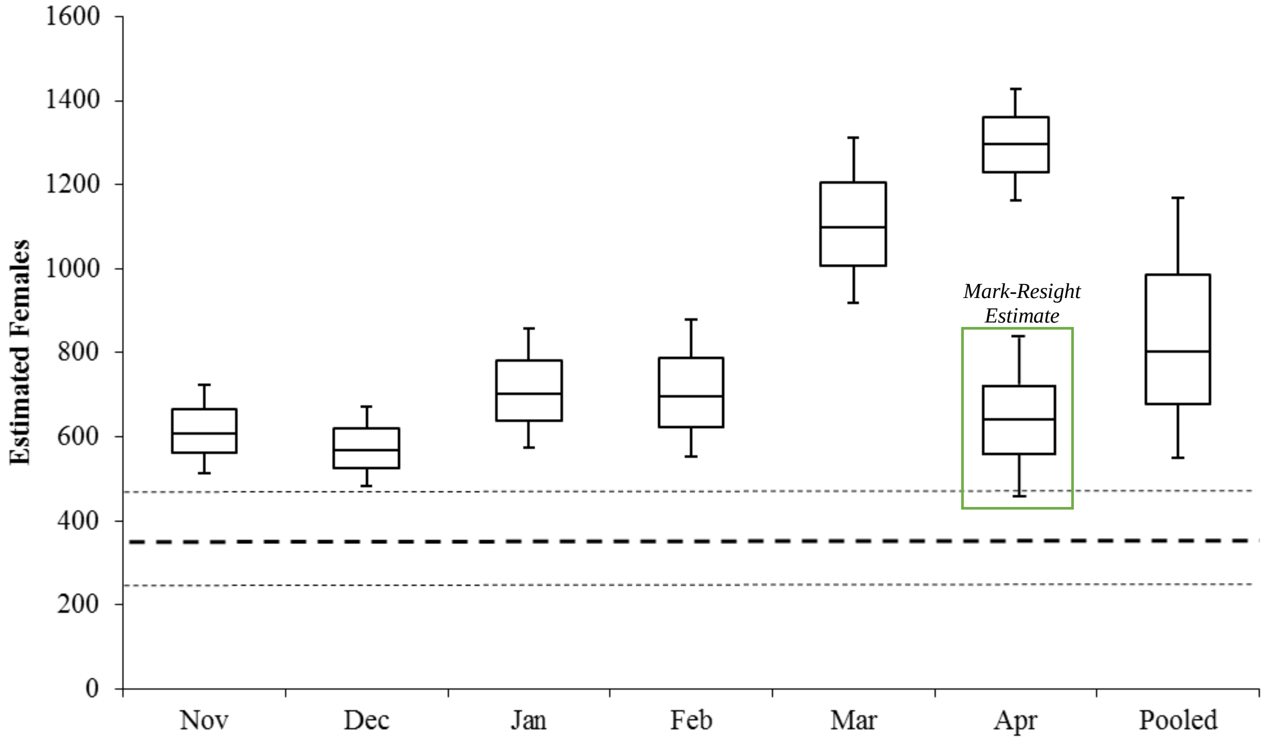

Figure 3. Female Key deer abundance estimates for Big Pine and No Name keys from distance sampling via road surveys, November 2016-present.

Note: Dash lines represent recommended PVA thresholds (Lopez et al. 2016). Estimated thresholds have been adjusted to account for positive-bias in density model to allow direct comparison to PVA results.

RADIOTELEMETRY

A total of 30 adult female Key deer were captured and radio-collared 16–18 January on Big Pine and No Name keys. Capture locations were geographically diverse and capture quotas were observed (e.g., approximately 3 deer captured/location) to ensure radio-collared deer were representative of the entire core area. This provided excellent geographic coverage for screwworm monitoring in females with the added benefit of providing marked individuals for rough abundance estimation (during road surveys) in support of distance surveys.

Key deer radiotelemetry was scheduled for the work week (Monday–Friday) to minimize scheduling impacts on USFWS personnel. Two weekdays were devoted to tracking deer on North Big Pine Key (north of Watson Blvd.), another two days focused on South Big Pine Key and No Name Key, and finally, one day a week all deer were located throughout the range (NBPK, SBPK, NNK). Tracking times were varied such that if one geographic location was surveyed in the morning, the next time that location would be surveyed in the evening. This minimized the impacts of deer temporal behavior patterns. This radiotelemetry pattern was changed beginning 1 May. Radiotelemetry efforts were reduced to once per week resulting in four sampling occasions in May.

By 31 August 2017, USFWS personnel had 87 full tracking days and 1 partial day (radiotelemetry training on January 20). USFWS personnel successfully tracked all remaining radio-collared deer (20 January–30 May) and recorded 1,467 radiotelemetry locations (visual, n=782 observations; homing, n=685 observations). Due to fewer collars and reduced radiotelemetry effort after 30 May, USFWS had recorded only an additional 109 locations (1,576 radiotelemetry locations total; visual, n=841; homing, n=735) by project conclusion (31 August). The collar for deer #29 detached in February and was recovered by USFWS personnel on the eastern shoreline of No Name Key. The reason for detachment is unknown, though the break point was smooth and may indicate that the collar was cut off by unknown persons. By 30 May, collars had been removed from deer #2, #13, #21, #24, and #25 due to minor neck chafing. In early June, observers found deer #30 severely emaciated with concomitant lethargy. Deer #30 was humanely euthanized and tissue samples collected for analysis by the Southeastern Cooperative Disease Study. Results of these analyses will be included in the subsequent final report. In early August, NRI and USFWS personnel collaborated to remove additional deer radiocollars. By the end of the project period (August 31), all but eight radiocollars were removed. Remaining radiocollared deer included #6, #10, #16, #19, #22, #23, #26, and #27.

The Key deer fawning season generally begins in April and can extend into July and August. Marked females began to show evidence of pregnancy (e.g., heavily gravid, lactation evident) in late March and early April 2017. By 2 May, several marked females had new fawns (n=5 females) while others were lactating (n=7 females) or heavily gravid (n=3 females). By 30 May, three additional marked females had fawns (n=8 total females), and others were lactating (n=4 females) or heavily gravid (n=1 female). The remaining marked deer (n=12 females, not yet observed as pregnant or fawned) did not display obvious indicators of pregnancy or recent parturition. However, the status of an additional four marked females could not be confirmed. All observed fawns looked healthy with no signs of temporary or persistent injuries. By 28 July (prior to concerted collar removal efforts), deer #18 and #21 were obviously lactating. Deer #22, #24, and #30 were heavily gravid. Observations of deer #10, #25, and #27 provided inconclusive evaluations of pregnancy or fawning. By the end of the project (31 August), 18 of 30 radiocollared deer (60%) either had confirmed fawns or strong evidence of pregnancy (i.e., lactating, gravid).

Radiotelemetry locations were collected 20 January–30 May and used to calculate 95% ranges and 50% core areas for Key deer. However, radiocollars were deliberately removed beginning in May 2017 (with large-scale removal efforts beginning in early August), thereby reducing the sample size. Additionally, radiotelemetry was reduced to once/week maximum. We did not include radiotelemetry locations after 30 May due to bias concerns arising from the decreased marked population combined with reduced radiotelemetry effort. We estimated the final pooled range estimates through 30 May. Deer had relatively large 95% ranges (mean=69 ha, SD=77 ha, range=19–333 ha) and 50% core areas (mean=12 ha, SD=12 ha, range=4–50ha). The number of observations for each deer (mean=50 observations/deer) is relatively low for kernel estimation and likely contributed to the high variances. The observed deer had high site fidelity and remained clustered around capture sites.

USFWS personnel were highly involved in the capture and radio-collaring process. This provided invaluable and comprehensive training for USFWS personnel in the use of drive and drop nets, safe radio-collar fitting, and proper baiting and monitoring. Additionally, USFWS personnel were trained to use radiotelemetry equipment to accurately track the radio-collared deer. USFWS personnel are now able to independently capture, process, and monitor Key deer.

SCREWWORM MORTALITIES

USFWS refuge staff have recorded Key deer mortalities since 1966. Direct sightings, citizen reports, or observation of turkey vultures have located most dead animals. Key deer collected are typically examined, and sex, age, body weight, location, and cause of death recorded in a database (Nettles et al. 2002, Quist et al. 2002). The management of the Key deer population is unique in having this long-term mortality dataset. During the screwworm incident, these deer mortalities continued to be recorded, and in many cases, cause of death was listed as euthanasia though presence of screwworm infection was noted. A total of 135 screwworm-caused mortalities have been recorded as of 31 August 2017. However, the majority of these mortalities occurred during October 2016 and none occurred after January 2017. The decline in screwworm infestations post-November (*n*=7 since 1 November) suggests the impact of doramectin treatments, application of sterile flies, and decline in rutting behavior is likely resulting in a decline in the screwworm infestation for the Key deer population (Figure 4).

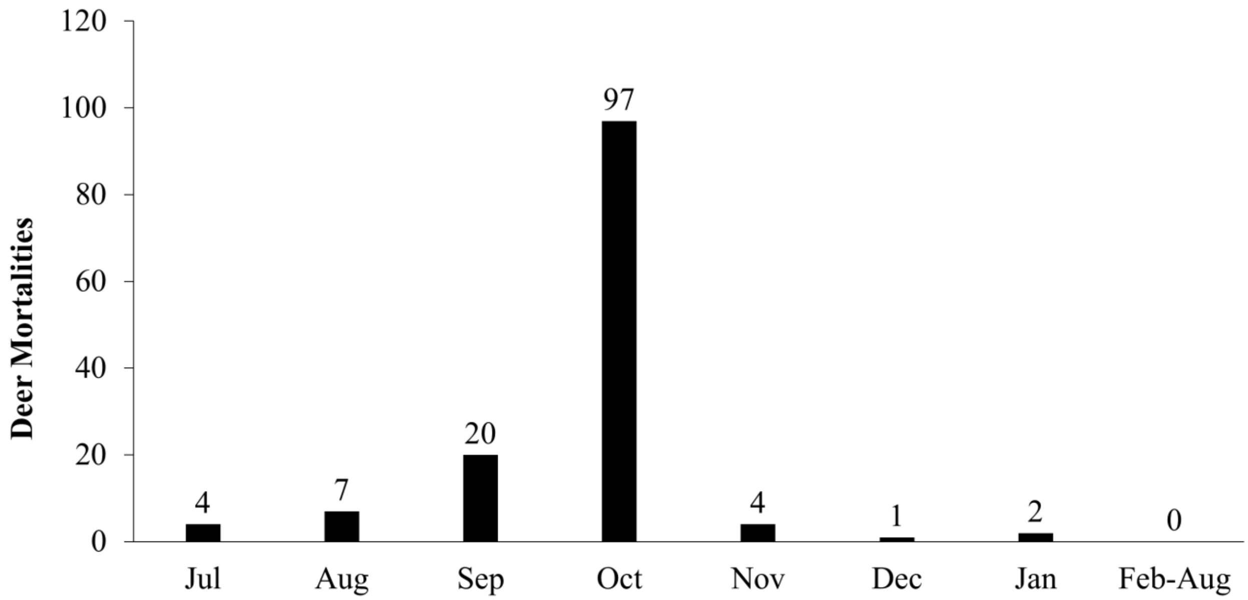

Figure 4. Monthly screwworm mortalities in Key deer, July 1-present.

POPULATION STATUS

Population metrics presented as potential indicators of Key deer population status suggests the Key deer population is stable and above the PVA management "trigger points" requiring more active management by USFWS personnel. These indicators include mean encounter rate (Figure 1), monthly deer density (Figures 2–3), and screwworm mortalities (Figure 4), and allow comparison of population trends to PVA thresholds described in response plan (Lopez et al. 2016). Radiotelemetry and road surveys provided additional important data on deer health and reproduction as moving into the fawning season. At this time, it is recommended that USFWS continue baseline monitoring efforts for the Key deer population.

REFERENCES

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance sampling. Estimating abundance of biological populations. Chapman & Hall, London, reprinted 1999 by RUWPA, University of St. Andrews, Scotland.

Lopez, R. R., N. J. Silvy, J. D. Sebesta, S. D. Higgs, and M. Salazar. 1998. A portable drop net for capturing urban deer. Proceedings of the Southeastern Association of Fish and Wildlife Agencies 52:206-209.

Lopez, R. R. 2001. Population ecology of Florida Key deer. Dissertation, Texas A&M University, College Station, Texas, USA.

Lopez, R.R., N.J. Silvy, B. L. Pierce, P. A. Frank, M. T. Wilson, and K. M. Burke. 2004. Population density of the endangered Florida Key deer. Journal of Wildlife Management 68:570–575.

Lopez, R. R., I. D. Parker, N. J. Silvy, B. L. Pierce, J. T. Beaver, A. A. Lund. 2016. Florida Key deer screwworm final report (Phase I). Texas A&M Institute of Renewable Natural Resources. College Station, Texas. 40 pages.

Nettles, V. F., C. F. Quist, R. R. Lopez, T. J. Wilmers, P. Frank, W. Roberts, S. Chitwood, and W. R. Davidson. 2002. Morbidity and mortality factors in Key deer, (*Odocoileus virginianus clavium*). Journal of Wildlife Diseases. 38:685-692.

Quist, C. F., V. F. Nettles, E. Manning, D. G. Hall, J. K. Gaydos, T. J. Wilmers, and R. R. Lopez. 2002. Paratuberculosis in Key deer (*Odocoileus virginianus clavium*). Journal of Wildlife Diseases. 38:729-737.

Roberts, C. W. 2005. Estimating density of Florida Key deer. M.S. thesis, Texas A&M University. Texas A&M University. Available electronically from http://hdl.handle.net/1969.1/3812.

Silvy, N. J. 1975. Population density, movements, and habitat utilization of Key deer, *Odocoileus virginianus clavium*. Dissertation, Southern Illinois University, Carbondale, Illinois, USA.

APPENDIX

DISTANCE Sampling Output

Glossary of Terms

Data items:

n - number of observed objects (single or clusters of animals)
L - total length of transect line(s)
k - number of samples
K - point transect effort, typically K=k
T - length of time searched in cue counting
ER - encounter rate (n/L or n/K or n/T)
W - width of line transect or radius of point transect
x(i) - distance to i-th observation
s(i) - cluster size of i-th observation
r-p - probability for regression test chi-p- probability for chi-square goodness-of-fit test

Parameters or functions of parameters:

m - number of parameters in the model
A(I) - i-th parameter in the estimated probability density function(pdf)
f(0) - 1/u = value of pdf at zero for line transects
u - W*p = ESW, effective detection area for line transects
h(0) - 2*PI/v
v - PI*W*W*p, is the effective detection area for point transects
p - probability of observing an object in defined area
ESW - for line transects, effective strip width = W*p
EDR - for point transects, effective detection radius = W*sqrt(p)
rho - for cue counts, the cue rate
DS - estimate of density of clusters
E(S) - estimate of expected value of cluster size
D - estimate of density of animals
N - estimate of number of animals in specified area Detection Fct/Global/Model Fitting

NOVEMBER 2016 - APRIL 2017

The November 2016 estimate of cluster density was 0.19738 (DS; clusters per hectare), yielding an estimated density of 0.28770 deer per hectare (D) and an estimated population size of 883 ± 74.409 (N ± SE).

The December 2016 estimate of cluster density was 0.19442 (DS; clusters per hectare), yielding an estimated density of 0.26864 deer per hectare (D) and an estimated population size of 825 ± 67.435 (N ± SE).

The January 2017 estimate of cluster density was 0.20463 (DS; clusters per hectare), yielding an estimated density of 0.33137 deer per hectare (D) and an estimated population size of 1017 ± 100.08 (N ± SE).

The February 2017 estimate of cluster density was 0.18684 (DS; clusters per hectare), yielding an estimated density of 0.32872 deer per hectare (D) and an estimated population size of 1009 ± 113.66 (N ± SE).

The March 2017 estimate of cluster density was 0.27359 (DS; clusters per hectare), yielding an estimated density of 0.51826 deer per hectare (D) and an estimated population size of 1591 ± 139.5 (N ± SE).

The April 2017 estimate of cluster density was 0.33372 (DS; clusters per hectare), yielding an estimated density of 0.61176 deer per hectare (D) and an estimated population size of 1878 ± 190.53 (N ± SE).

Changes in cluster density, deer density, and deer population size are a function of sample size, encounter rates, cluster size, cluster density, perturbations in deer distribution, and actual changes in deer abundance.

	Estimate	%CV	df	95% Confidence Interval	
Stratum: 1. November					
Half-normal/Cosine					
DS	0.19738	8.15	35.58	0.16733	0.23283
D	0.28770	8.43	40.58	0.24274	0.34099
N	883.00	8.43	40.58	745.00	1047.0
Stratum: 2. December					
Half-normal/Cosine					
DS	0.19442	7.75	26.73	0.16586	0.22789
D	0.26864	8.17	33.05	0.22755	0.31715
N	825.00	8.17	33.05	699.00	974.00
Stratum: 3. January					
Half-normal/Cosine					
DS	0.20463	9.28	20.72	0.16877	0.24811
D	0.33137	9.84	26.22	0.27084	0.40543
N	1017.0	9.84	26.22	831.00	1245.0
Stratum: 4. February					
Half-normal/Cosine					
DS	0.18684	10.65	20.18	0.14972	0.23317
D	0.32872	11.26	25.19	0.26087	0.41421

N	1009.0	11.26	25.19	801.00	1272.0

Stratum: 5. March
Half-normal/Cosine

DS	0.27359	8.23	24.24	0.23093	0.32412
D	0.51826	8.77	31.19	0.43356	0.61950
N	1591.0	8.77	31.19	1331.0	1902.0

Stratum: 6. April
Half-normal/Cosine

DS	0.33372	9.73	18.12	0.27218	0.40917
D	0.61176	10.15	21.41	0.49578	0.75486
N	1878.0	10.15	21.41	1522.0	2317.0

Pooled Estimates:

	Estimate	%CV	df	95% Confidence Interval	
DS	0.22782	10.01	5.00	0.17625	0.29448
D	0.37894	14.67	5.00	0.26038	0.55148
N	1163.0	14.67	5.00	799.00	1693.0