Florida Key Deer Post-Hurricane Irma Report

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FLORIDA KEY DEER HURRICANE POST-IRMA REPORT
POST-HURRICANE IRMA
SALINITY AND ABUNDANCE ANALYSES

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OVERVIEW

Hurricane Irma was a Category 4 storm when the eye of the storm passed through the center of the Florida Key deer (hereafter Key deer) range on 9 September 2017 (Fig. 1). The passage of Hurricane Irma caused significant property damage, impacts to vegetation/water resources, and direct mortality to Key deer. In this report we synthesize post-Hurricane Irma salinity and Key deer abundance estimates. This will provide managers with comprehensive data for Key deer management efforts.

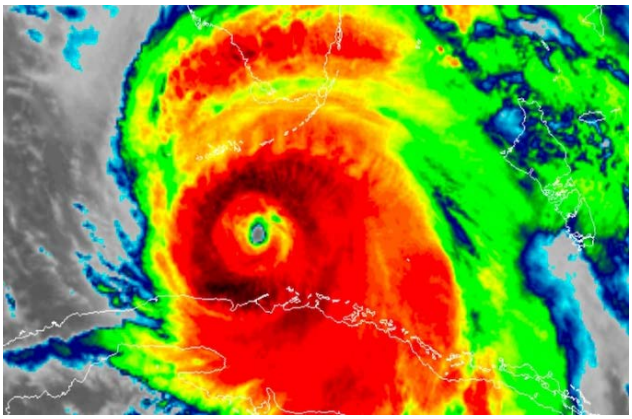

Figure 1. Hurricane Irma prior to the arrival in the Lower Florida Keys, 2017.

METHODS

SALINITY MEASUREMENTS

Stormsurge from Hurricane Irma flooded many freshwater sources with highly saline ocean water. Freshwater is critical for Key deer population persistence and is relatively limited throughout their range (approximately 270 freshwater sources). Key deer require water less than 5 parts per thousand (ppt) for long-term persistence, but can survive on water up to 15 ppt in the short term (Lopez 2001). This makes changes in quality and availability of freshwater sources a monitoring priority. Following Hurricane Irma, we collected salinity measurements using a pen-style water sampling meter (Extech Instruments Model EC170) at select freshwater sources (n = 14–16 sources depending on availability) throughout the Key deer range to estimate recovery of freshwater sources (Fig. 2). Freshwater sources have been sampled repeatedly from 17 September 2017 to 19 April 2018 (n = 14 sampling occasions). We focused predominantly on Big Pine Key (n = 12 sources) as this is the core of the Key deer population. However, we sampled additional freshwater sources on No Name Key (n = 1), Big Torch Key (n = 1), Sugarloaf Key (n = 1) and Cudjoe Key (n = 1).

Figure 2. Location of freshwater holes monitored post-Hurricane Irma.

KEY DEER ABUNDANCE ESTIMATES

Post-Hurricane road surveys were conducted from October 2017 to March 2018 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, Roberts et al. 2006). For the latter, distance sampling was calibrated and validated by concurrent mark-resight efforts (Buckland et al. 1993, Roberts 2005) in 2005. Due to limitations in USFWS personnel availability and additional post-hurricane duties, surveys methods were inconsistent. Survey times and number of personnel conducting the surveys fluctuated. Survey methods applied in obtaining a population estimate as part of this study are outlined by Roberts (2005).

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.

RESULTS

SALINITY MEASUREMENTS

Immediately following Hurricane Irma (17 September 2017) all monitored freshwater sources were above 15 ppt (*n* = 15, 100%) with an average salinity of 23 ppt (SD = 6.4ppt). This is 35% above maximum tolerance (15 ppt) and 78% above requirements for long-term survival (5 ppt). Salinity declined through 13 October 2017 with 47% strongly freshwater (*n* = 7 below 5 ppt) and 87% at least somewhat fresh (*n* = 13 below 15 ppt). Average salinity had declined to 7 ppt (SD = 5.7 ppt) indicating a partial recovery of freshwater sources (Fig. 3). However, salinity began to increase dramatically from October 2017 through March 2018 as the dry season decreased precipitation inputs and water volume declined. By 23 March 2018, salinity had returned to levels comparable to those immediately following Hurricane Irma. Average salinity was 23 ppt (SD = 16.3 ppt). The increased variance of the estimate stemmed from several important differences from measurements made immediately post-Hurricane Irma. By March 2018, more water sources were fresh (*n* = 1 below 5 ppt) or somewhat fresh (*n* = 5 below 15 ppt) for a total of 38% fresh (*n* = 6 fresh out of 16 sampled). In March 2018, the saline water sources (*n* = 9) had relatively high salinity (31 ppt, SD = 14.7 ppt). Finally, freshwater sources began to dry up in early January peaking with 5 dry freshwater sources in by 20 February (Fig. 4).

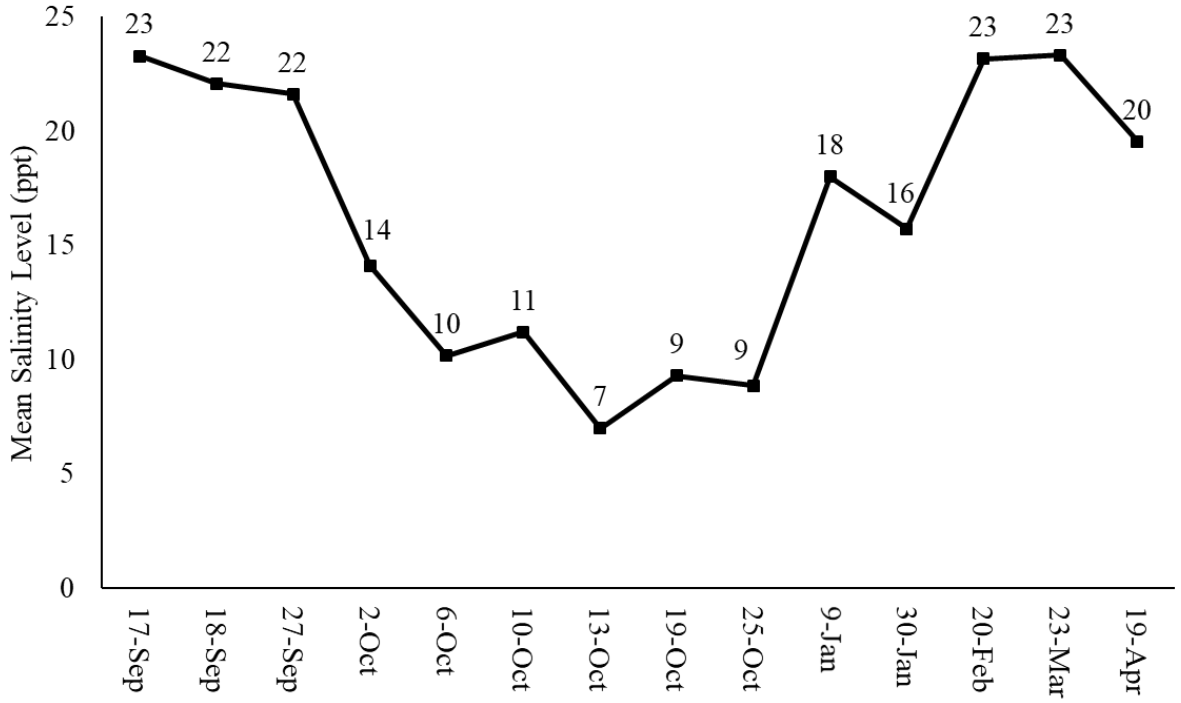

Figure 3. Mean freshwater source salinity (parts per thousand [ppt]) across all monitored sources by date, Lower Florida Keys, 2017–2018. Note that data labels have been rounded for clarity.

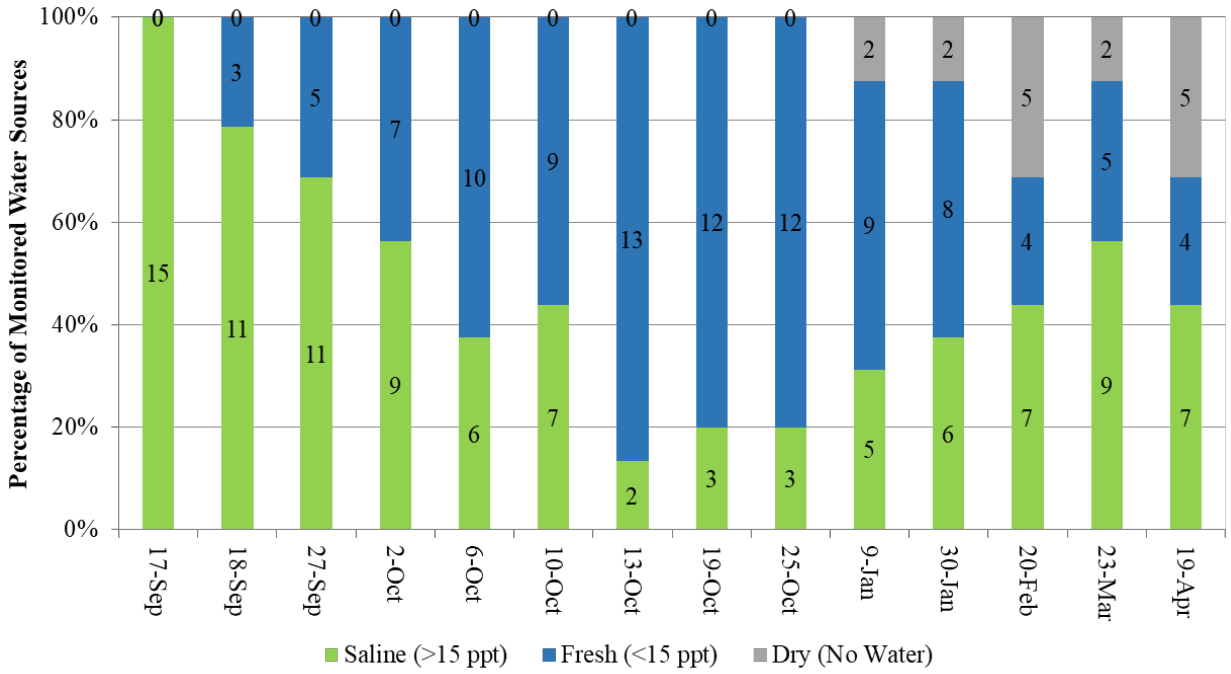

Figure 4. Percentage of monitored water sources falling into each category: saline (>15 parts per thousand [ppt]), fresh (<15 ppt) and dry (no water), Lower Florida Keys, 2017–2018.

KEY DEER ABUNDANCE ESTIMATES

Key deer data were collected via road surveys and abundance estimates were calculated using distance sampling methodology. A total of 48 road surveys was conducted between 1 October 2017 and 30 March 2018. These surveys varied in intensity (number of surveys during a period time), location (routes driven) and observers due to multiple factors including (1) widespread destruction caused by Hurricane Irma along survey routes, (2) lack of available survey personnel due to limited access to Lower Florida Keys, and (3) multiple priorities for limited USFWS personnel during the triage and rebuilding stages. Although data is not presented here, windthrow and subsequent vegetation regrowth caused dramatic changes in sightability of Key deer during road surveys. As such, abundance estimates varied (October 2017: n = 871, CI = 698–1086; November 2017: n = 478, CI = 347–658; January 2018: n = 812, CI = 548– 01; February 2018: n = 714, CI = 420–1213; March 2018: n = 573, CI = 441–743; Fig. 5). The March 2018 surveys (n = 16 surveys) were the most intense and consistent of the post-Hurricane Irma surveys and we feel that population estimate is most accurate and precise.

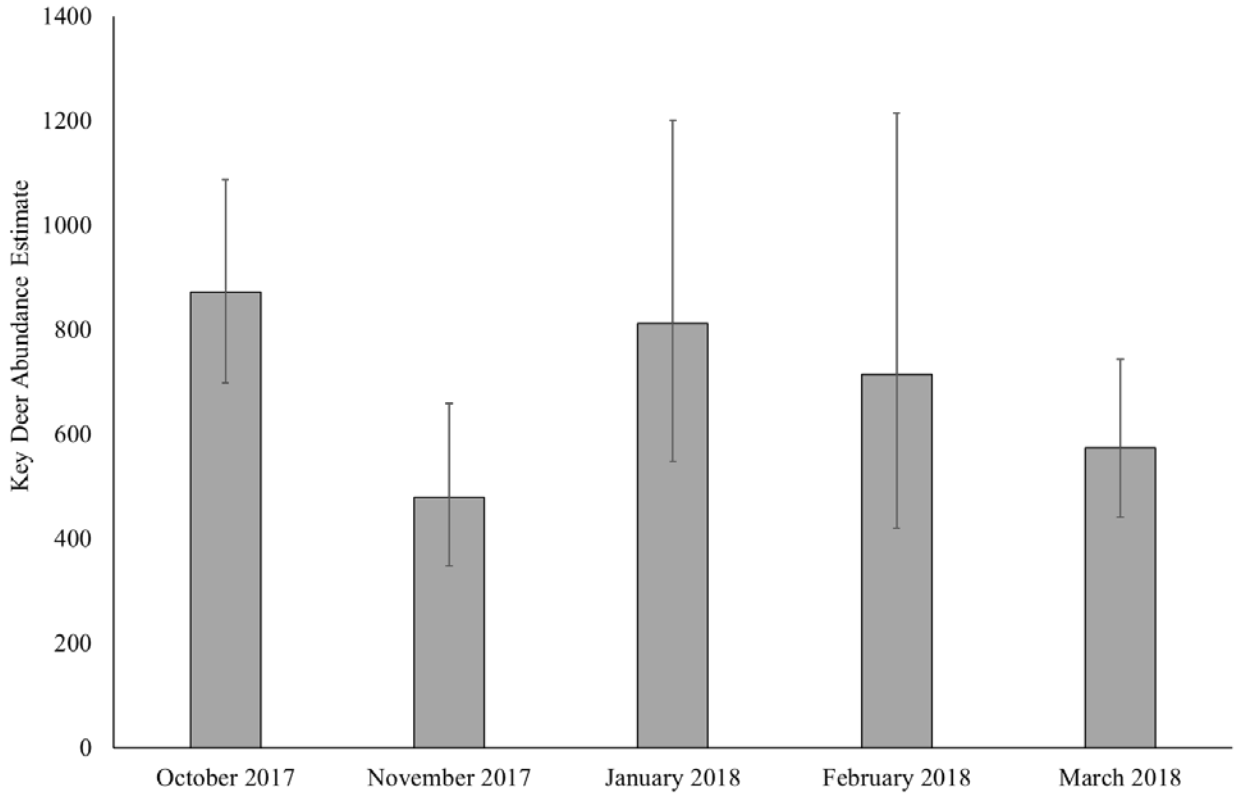

Figure 5. Post-Hurricane Irma Key deer population abundance estimates with 95% confidence intervals, Lower Florida Keys, 2017–2018.

DISCUSSION

Sampled freshwater sources were extremely saline following storm-surge inundation from Hurricane Irma. Both average salinity and number of saline water sources declined across the range over the next month. However, average salinity and number of saline water sources increased as the dry season emerged in mid- to late-October 2017. Declines in precipitation inputs and lower water volume concentrated existing salinity. Although, freshwater declines are common in the Lower Florida Keys during the dry season, this data illustrates a dramatic decline in freshwater availability likely exacerbated by Hurricane Irma inundation. Hurricane Irma was an event relatively unprecedented in power and scope for the Lower Florida Keys. As such, recovery speed and potential of freshwater sources is somewhat unknown. It is critical that monitoring continue for salinity of freshwater sources throughout the 2018 wet seasons and dry seasons. We recommend that freshwater source monitoring continue through 2018 and 2019 to monitor recovery.

Key deer abundance has remained relatively low following Hurricane Irma. Surveys immediately following the hurricane indicated a population decline between 20–40% (Parker et al. 2017). Subsequent surveys further supported a lower Key deer population abundance. We believe that variance in estimates is likely due to changes in survey methodology and sightability. The first few years after a range-wide natural disaster are critical to long-term Key deer recovery. As suggested with the salinity monitoring, we recommended continued population monitoring to determine trajectory of Key deer recovery.

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