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DEMOGRAPHY OF THE SNAIL KITE IN BLUE CYPRESS MARSH COMPLEX

FINAL REPORT 2005

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By
Julien Martin, Wiley Kitchens,
Christopher Cattau, Andrea Bowling, Melinda Conners, and Daniel Huser

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U. S. Geological Survey
Florida Cooperative Fish and Wildlife Research Unit
University of Florida
PO Box 110485
Gainesville, Florida 32611

ABSTRACT

This report presents data on the snail kites that use the Blue Cypress Marsh Complex (BCMC). This report will concentrate on demographic data collected in 2005, but will also synthesize data collected since 2001 in BCMC.

The number of birds observed on each survey was reported as well as GPS locations when available. Kites used the Eastern section of BCMC considerably more than the Western section. A total of 9 nests (i.e., nest containing eggs or young) were observed in 2005, but only 3 young were fledged.

Because the snail kite population in Florida is best viewed as a single population, it is essential to also report the demographic results (i.e., abundance, survival reproduction) at the scale of the whole population. Consequently besides reporting on kite usage of the BCMC, this report also presents information on the demography of snail kites throughout central and southern Florida using the data from the 2005 breeding season. Statewide data synthesized since 1992 will also be presented.

Recent demographic results show alarming trends concerning the snail kite population in Florida. First we found that kite abundance drastically declined between 1999 and 2003. The population size estimate for 2005 does not indicate any significant recovery. In fact, reproduction in 2005 was exceptionally low. No kites were observed fledging out of the Water Conservations Areas (WCAs). For the period 1992-2005, statewide reproductive success was at its lowest in 2005. For the BCMC however, 2005, was one of the rare years for which nest success was higher than the average nest success for all other areas combined. Comparatively, the average nest success for BCMC between 1992 and 2005 was significantly lower than nest success for all other areas combined. There is evidence that BCMC is critical to kites persistence especially when other areas are undergoing drying events, however its potential as a source of recruitment is less certain. It should be possible to increase the carrying capacity of BCMC for kites. In this report we also make specific recommendations for restoring some habitats within BCMC. Finally, we also discuss the demographic trends in the context of the draw down that was initiated in BCMC in 2005.

INTRODUCTION

The snail kite (*Rostrhamus sociabilis plumbeus*) is an endangered raptor that inhabits flooded freshwater areas and shallow lakes in peninsular Florida and Cuba (Sykes 1984, Sykes et al. 1995). The historical range of the snail kite once covered over 3.6 million ha in Florida (Davis and Ogden, 1994), but is now restricted mainly to the watersheds of the Everglades, Lake Okeechobee, Loxahatchee Slough, the Kissimmee River, and the Upper St. Johns River.

The snail kite is unique in that it is the only avian species whose population in the U.S. is restricted to freshwater wetlands in central and south Florida. The snail kite in addition to being endangered is considered by many to be an excellent barometer of the success of the restoration efforts currently underway.

Snail kite habitats in south and central Florida exhibit considerable variation in their physiographic and vegetative characteristics, which include graminoid marshes (wet prairies, sloughs), cypress swamps, lake littoral shorelines, and even some highly disturbed areas such as agricultural ditches and retention ponds (Bennetts and Kitchens 1997a). Three features that remain constant within the selected habitats are the presence of apple snails, sparsely distributed emergent vegetation (Sykes 1983b, 1987a), and suitable nesting substrates.

Snail kites are dietary specialists, feeding almost exclusively on the freshwater apple snail, *Pomacea paludosa* (Sykes 1987a, Sykes et al. 1995). They use two visual foraging methods, either flying above the water surface or hunting from a perch (Sykes 1987a), and both require open water and sparse vegetation. Kites typically nest in woody vegetation overhanging water, such as willows, bald cypress, pond apple, wax myrtle, etc. (Beissinger 1988, Bennetts et al. 1988). The snail kite's survival depends on maintaining hydrologic conditions that support these specific vegetative communities and subsequent apple snail availability in at least a subset of critical size wetlands across the region each year (Bennetts et al. 2002).

Wetland habitats throughout central and southern Florida are constantly fluctuating in response to climatic or managerial influences, resulting in a mosaic of hydrologic regimes. Snail kites respond to these fluctuations through movements between wetlands. (Bennetts and Kitchens, 1997a, 1997b). Developing a thorough understanding of kites ability to move between wetlands, their resistance and resilience to disturbance events (e.g. droughts) or changes in habitat is essential to optimizing the management of the systems inhabited by the snail kite in Florida.

This report will present data on snail kite usage of Blue Cypress Marsh Complex (BCMC) of the St Johns River Basin, particularly during the 2005 breeding season. Because the St Johns River Water Management District, initiated a draw down of the BCMC, we also discuss some of the implications of that management action for kites. Given the nomadic nature of the snail kite population in Florida, we also deem it essential to report on demography at the scale of the whole population. Consequently this report also presents information on the current demography of snail kites throughout central and southern Florida using data from 1992 to 2005.

METHODS

Study area

The BCMC comprises approximately 6,000 ha of marsh within the Upper St. Johns River Basin in Indian River County, FL. Toland (1991, 1992, 1994) describes the vegetation and hydrologic characteristics of the BCMC. BCMC is a highly compartimentalized wetland.

BCMC is a small part of the entire network of wetlands that are monitored for snail kites each year (Fig. 1). In fact, the population of snail kites is best viewed as one continuous population that is distributed among a network of heterogeneous wetland units in central and southern Florida (Bennetts and Kitchens 1997a, 1997b). They use the entire spatial extent of their range (Bennetts and Kitchens 2000). The study area for the entire population includes a large portion of these different wetland units used by snail kites in peninsular Florida (Fig. 1).

Monitoring protocol

Survey method

Multiple consecutive surveys were conducted throughout the designated wetland units (Figure 1) from March to June at 2-3 week intervals of each year since 1992. This time period coincides with the occurrence of peak nesting (Bennetts and Kitchens 1997a). The surveys followed a format similar to the quasi-systematic transects conducted by airboat for the annual count (Sykes 1979, 1982; Bennetts et al. 1994). Because surveying the entire BCMC in one day was not always possible, we often surveyed the Eastern and Western part of BCMC on separate days (Table 1 and Appendix 1). We note that one should be cautious in interpreting numbers reported for BCMC as indices of relative abundance. Indeed, detection probability could not be estimated for BCMC (sample sizes were too small). Therefore only an unknown proportion of kites using BCMC were reported. Several sources of variation could affect detection (e.g., observer effect; environmental conditions; habitat type). Furthermore, there is a possibility that some unmarked birds were counted twice.

Nest monitoring

Nests were checked with a telescoping mirror pole to determine their status. Water depths at certain nests were determined by placing a meter stick vertically into the water column until it rested on the sediment. GPS (Global Positioning System) locations of the nest, nesting substrate and height were also recorded. We also reported the number of eggs counted in each nest as well as the number of nestling per nest. In 2005 four surveys were conducted between the 19^{th} of April and the 18^{th} of June. These surveys started later than for other years because our earlier preliminary surveys (in January and February) had indicated that kites were not using BCMC. As a result of the scheduled draw down, we had anticipated that kites would not be using BCMC in 2005. In April we were informed that kites were in fact present in the BCMC and subsequently initiated surveys of the area.

Mark-resighting

Snail kites were banded during fledging time (approximately 25 days old) with alpha-numeric bands. During each of the surveys we reported the number of unmarked and marked kites. Individually marked birds were identified using a spotting scope.

Data reported and statistical analysis

Nest Success

We calculated nest success for the period of record using the following estimator:

$$\hat{S} = x/n$$

Where $\hat{S}$ is the maximum likelihood estimate of the probability of nest survival (or nest success), x is the number of nests which produced at least one fledgling, and n is the number of nests initially observed to contain at least one egg (Williams et al. 2002). Standard error for estimates of $\hat{S}$ was reported (denoted $\widehat{SE}(\hat{S})$). We also used a logistic regression to test whether there were any statistically significant difference in nest success between BCMC and other areas, a p-value less than 0.05 indicated that the difference was significant. Additional details about this method are available in Dreitz et al. (2001).

Survival

The Cormack-Jolly-Seber model (CJS, Cormack 1964, Jolly 1965), implemented in program MARK (White and Burnham 1999), was used to estimate survival probability (denoted $\hat{\phi}$). The Aikaike Information Criterion (AIC) was used to select the best model describing survival (Burnham and Anderson 1998). The protocol and previous survival estimates (up to 1999) have been published elsewhere (Bennetts and Kitchens 1997a, Bennetts et al. 2002). CJS models were also used to estimate detection probability (i.e., the probability of detecting a snail kite given that it is present in the study area during the period of sampling). We also reported this calculated detection probability (denoted $\hat{p}$).

Total population size

We used the superpopulation approach described in detail by Dreitz et al. (2002) to estimate population size of snail kites between 1997 and 2005. Estimates presented in this report are part of the results of a manuscript that has been submitted.

RESULTS

Number of birds counted

The number of snail kites counted during the surveys of BCMC are summarized in Table 1 (See Appendix 2-5, for the spatial distribution)

AREA	DATE	SURVEY	# birds
EAST	19 Apr	I	36
WEST	21-Apr	I	11
EAST	10-May	II	17
WEST	11-May	II	14
EAST	28-May	III	9
WEST	30-May	III	16
EAST	17-June	IV	10
WEST	18-June	IV	1

Table 1. Number of snail kites counted, dates and areas, for the 2005 nesting season

Reproduction

Number of nests observed

A total of 15 nests were observed in the BCMC in 2005. Of these 9 contained eggs or young. Only 2 nests were successful (i.e., young survived more than 24 days).

UTMX	UTMY	Substrate	Max number eggs	Max number young	Young Fledged
541982	306086	SALIX	2	0	0
542350	3060289	SALIX	0	2	0
541688	3060231	TAXODIUM	0	0	0
541507	3060630	TAXODIUM	2	2	1
540147	3060158	TYPHA	3	0	0
534598	3058000	CLADIUM	3	2	2
534455	3057759	CLADIUM	3	3	0
533146	3058926	TAXODIUM	2	0	0
539580	3060719	CLADIUM	0	2	0
540160	3061640	SABAL	?	?	0
542211	3061041	MYRICA	0	0	0
533246	3059380	TAXODIUM	0	0	0
533030	3059389	CLADIUM	2	1	0
532836	3059402	TAXODIUM	0	0	0
533773	3058018	TAXODIUM	0	0	0

Table 2. Nests in BCMC (2005), Latitude and longitude (in UTM NAD 83), substrate (latin name) maximum number of eggs ever reported in each nest, maximum number of young observed, number of young successfully fledged, for the 2005-nesting season, the symbol (?) indicates that the status of the nest is unknown. **We attached an electronic copy of all the nests monitored in BCMC between 2001 and 2005 (BCMC2001_2005.XLS).**

Nest success

In 2005, the nest success rate ($\hat{S}$) was 0.29 ($\widehat{SE}(\hat{S}) = 0.17$) in BCMC. Average nest success in BCMC between 1992 and 2005 was 0.23 ($\widehat{SE}(\hat{S}) = 0.04$), but it was 0.38 ($\widehat{SE}(\hat{S}) = 0.02$) in all other areas combined. The difference was statistically significant (p=0.01). Nest success between 1992 and 2005 is presented in Fig. 2.

Number of juveniles fledged

Three young were successfully fledged in BCMC in 2005. The number of young fledged in BCMC in 2005 represented 10% of the total number of young fledged for the entire state. This is rather exceptional. Typically, only 6% of the total number of young are fledged in BCMC. This is explained by the fact that the total number of young fledged rangewide in 2005 was exceptionally low. The total number of young fledged throughout the entire state dropped substantially after 1998, but 2005 was particularly low (Figure 5).

Prior to 1998, the number of young fledged annually for the entire state varied between 117 and 306. From 1999 to 2003, the annual number varied between 26 and 97. Proportionally, the bulk of birds fledged over time have been generated from the Water Conservation Areas, principally WCA3A. This trend of lowered reproduction raises concerns regarding the population sustainability.

Survival

Adult survival remained fairly constant from 1992 to 2000 but dropped between 2000 and 2002 (especially during the period 2001-2002). This reduction in survival is believed to be a response to the regional drought of 2000-2001, and indeed, adult survival rebounded immediately following the drought (Fig. 3.a, from Martin et al. in review). Juvenile survival has varied widely over time, but it reached a record low between 2000 and 2001 (Fig. 3.a, from Martin et al. in review). Note that detection probability (probability of resighting a snail kite given that it is present in the sampled area) has increased over time (Fig. 3.b).

Total population Size

The population of snail kites in Florida decreased dramatically between 1999 and 2002 (Fig. 4). Population estimates between 2003 and 2005 remained fairly constant, but there was no evidence of recovery (Fig. 4).

DISCUSSION

Discussion of results specific to BCMC

Comparison between the average number of snail kite counted in the Eastern part versus the Western part of BCMC between 2001 and 2005 indicates that more birds used the Eastern part during the breeding season (see Appendix 1). Interestingly, there were a lot more birds counted in BCMC in 2004 than in 2005 (Appendix 1). In fact, more birds were counted in BCMC in 2004 than during any other years between 2001 and 2005. This is consistent with the prediction that kites moved from the Kissimmee Chain of Lakes (KCL) to BCMC because of the draw down of the KCL in 2004. Thus, postponing the draw down of BCMC from 2004 to 2005 may have allowed kites to better cope with the disturbances that occurred in 2004 in the KCL. This also supports the hypothesis that habitats that are located nearby should not be managed independently. However, we note that these observations should be interpreted with caution because they rely primarily on counts which do not consider detection probabilities. The possible higher movement toward BCMC in 2004 may also explain why 2004 was the year with the highest nest count for the period 2001 –2004.

Despite a relatively high number of nesting attempts, nest success was exceptionally low in 2004. We found evidence of predation or post mortality scavenging for at least 15% of the nests in 2004 and 27% in 2005(these percentages correspond to a minimum as a number of predation or post scavenging events may have gone undetected). Three potentially major predators are: raccoons, snakes and Great Horned Owls (Bennetts and Kitchens 1997a). All of which have been observed during our surveys. We observed great horned owls in BCMC in several occasions (including one instance of one owl caring for young owls at the nest). We also observed raccoons during the driest part of the season (raccoons have been found crossing stretches of shallow prairies within BCMC). Racoons favor nests that are located on fairly dry land. Snakes have also been observed occasionally at proximity of nest sites, but snakes typically only predate eggs or very young chicks snakes do not leave any evidence of predation as they swallow the entire chick or egg and typically do not damage nests. Two of the predation events in 2004 can almost certainly be attributed to owls as adults remains were found at the nest (it is unlikely that a raccoon would be able to capture an adult snail kite). At this point we cannot make any definitive statements about the relative importance of predation on nest success of kites at BCMC, as we do not currently have any means to record predation events accurately. We note that we only recorded information about predation in BCMC since 2004.

In 2005, we observed at least 9 nests with eggs or young, which was unexpected given that the draw down of the BCMC was predicted to deter kites from breeding. We were also surprised to observe two successful nests. However, our radiotracking protocol indicates that out of the three young that were fledged from BCMC in 2005 only one was still alive by October 2005. We also should note that the average nest success in BCMC between 1992 and 2005 was lower than the average nest success for all the other areas combined. BCMC also appeared to only contribute 6% of the total number of young marked for the period 1992 to 2005.

Discussion of results pertaining to the entire snail kite population

Our recent demographic studies point toward alarming trends in the snail kite population in Florida. First, we have found that kite numbers have drastically declined since 1999 (Fig. 4). Concurrent with the population decline there is a corresponding decline in both nesting attempts and the number of young fledged (Fig. 5). A number of factors have likely contributed to these observed declines. Lake Okeechobee, which from 1985 to 1995 was a productive breeding site, has become only a minor contributing unit since 1996. In 2000 and 2001 south Florida experienced a major drought that affected nearly the entire habitat network of the kite (although the KCL appeared to be less affected) (Martin et al. in review). Survival of both adults and juveniles were strongly affected by this natural disturbance, especially in the Water Conservation Areas and Lake Okeechobee (Martin et al. in review). The KCL appeared to serve as a refugia to drought because the hydrology of wetlands located in the north were less affected by the drought than the ones located in the south. As a consequence survival of kites that occupied KCL in 2001 did not decrease substantially. The extent of the drought effect on kites that used

BCMC was less clear, but it is possible that BCMC also served as a refugia in 2001 (Martin et al in review). Indeed confidence intervals of survival estimates of birds that used BCMC during the 2001 drought were so wide that we could not measure precisely the magnitude of the drought effect on BCMC (Martin et al. in review). Following this drought there was also an intensive draw down of the Upper Kissimmee Chain of Lakes along with extensive aquatic weed control activities in the littoral zone of the various lakes with potentials to affect nesting activities (pers. observation). While adult survival declined temporarily during the 2000-2001 drought (Fig.3.a), we are particularly concerned about an apparent continuing lack of recruitment which is currently limiting population growth. A preliminary population viability analysis (PVA, not presented in this report), predicts very high extinction probabilities, in the next 50 years if survival and reproduction maintain the same rates as per the last 10 years.

Given the contribution of the WCA's to the annual production of kites there is little doubt at this point in time that the persistence of kites in Florida depends principally on the habitat quality within these wetlands. Current water regulation schedules have the potential to drastically shorten the window during which kites can breed (Mooij et al. in review) (see "Recommendations"). In addition, rapid water level recession rates from the elevated stage schedule between February and July can present enormous foraging difficulties to both juvenile and even adult kites (Mooij et al. in review). During low precipitation regimes the current regulation schedule increases the likelihood of localized drought, which may reduce kite survival if other habitats are not available in close proximity (Martin et al in review). In 2004 for instance, we estimated that 430 juveniles were produced (the water levels in the WCAs were fairly high during the initial part of the breeding season). Out of 68 birds that we radioed, only 10% were re-observed in December (indicating that the recruitment was minimal). We attribute this mass mortality to the premature and prolonged drying of the WCAs (Fig. 6). In addition this drying event occurred at the same time as the managed draw down of the entire Kissimmee Chain of Lakes, which reduced the potential for this area to serve both as a refuge and as an alternate source of recruitment. In 2005, only 30 fledglings were observed and marked which is a record low since 2001. No fledglings were observed in the WCAs which typically is the most productive area. This absence of reproduction is particularly disturbing given that the WCAs did not dry down extensively. It is possible that part of the problem is due to the prolonged drying of the WCAs that occurred in 2004 (which may have substantially affected the apple snail population). However we note that over 80 kites were fledged and marked in 2002 which followed the 2001 drought. Therefore other factors may be involved (see recommendations).

Concerning the effect of hurricanes on snail Hurricanes certainly have the potential to affect nesting and foraging habitat of kites, by altering the vegetation through wind effects but also through the effect of flooding. Hurricanes could also directly affect kite survival but we currently do not have any quantitative measures of the direct or indirect effect of hurricanes on kites. We hope to be able to provide management agencies with some quantification of the effect of hurricanes on survival of snail kites using radiotelemetry information in future reports.

RECOMMENDATIONS

Recommendations relevant to the management of the entire population

A recent radio telemetry study showed that although kites move extensively among contiguous wetlands (i.e. KCL or WCAs) most kites do not move as freely as previously thought among wetlands which are isolated by extensive areas of unsuitable habitats (Martin et al. in review). This may actually impede a significant proportion of birds from moving successfully to refuge habitats during drying events.
"This observation is of particular importance to management of the Everglades Ecosystem, given the paradigm that the persistence of good natural habitats requires occasional drying events (Bennetts *et al.*, 1998; Kitchens *et al.*, 2002). Restoration projects that involve wholesale dry downs of an entire region (e.g., restoration of Lake Tohopekaliga) (Welch, 2004) may want to consider the option of conserving water in at least some local patches within the region to be affected, to serve as refuge for snail kites" (Martin et al. in review). The sequencing of draw downs of local patches should occur sequentially, allowing a sufficient recovery period for previously dried areas to return to a productive level. Moreover, the pattern of drying and inundation should optimally attempt to mimic as closely as possible the hydrology of the Everglades under a more natural landscape (Fennema *et al.*, 1994)" (Martin et al. in review).
We also would like to reiterate the importance of the water regulation of WCA3A and maintaining a monitoring program to document habitat shifts and quality relative to kite usage.

Recommendations specific to BCMC

BCMC is clearly a critical part of the network of habitat used by kites. A portion of the kite population occupies and utilizes these wetland complexes consistently (Martin et al in review). It may also serve as a refugia habitat, particularly when other wetlands are drawn down (natural drying events or managed draw down). The higher number of kites observed during the draw down of the Kissimmee chain of lakes, as well as modeling of snail kite movements, suggests that wetlands that are in close proximity to BCMC (e.g., KCL) should be managed given this perspective (Martin et al in review). On the other hand, the exceptionally high rate of nest predation in 2004 should concern managers of the potential for BCMC to serve as an ecological trap (Schlaepfer et al. 2002). Indeed, the small size and compartimentalized nature of this wetland complex may make it particular vulnerable to predation Birds breeding in BCMC may suffer unsustainable predation rates on both adults at the nest, eggs and young. Also nest success was lower in BCMC than for the average nest success for all areas combined between 1992 and 2005. This lower nest success in BCMC may be due to higher predation, however no data specific to predation are available for this study (indeed at this point one cannot distinguish predation from post scavenging events; lack of data on nest predation is common problem to most avian studies). We emphasize that the hypothesis that BCMC may serve as an ecological trap (because of predation on nests or breeding kites) is for now just an hypothesis that remains to be supported by rigorous analyses, but we feel that managers of BCMC should be aware of this possibility.

Managed draw downs of the BCMC may be necessary to maintain suitable foraging habitat for kites, however the intensity and frequency of these events should be carefully examined. We suggest that draw downs should be avoided when wetlands nearby are experiencing exceptionally dry conditions. Maintaining sustained water levels in BCMC during drought may be greatly beneficial for kites. The BCMC could serve as refugia to drought, mitigating at least partially, the effect of drought on survival (particularly adult survival). Thus, if logistically feasible, draw downs of BCMC should be attempted during wetter years (for instance during El Nino years), or when no other managed draw downs are planned. By contrast draw downs should be avoided during La Nina years which are typically characterized by drier conditions (Martin et al. in prep).

Kites still use the West part of BCMC, however foraging kite habitat in this section of BCMC has been seriously degraded because of prolonged hydroperiods. Restoring this section should be a priority since it could be done with little risk to kites (presently, only a few kites are using these wetlands, there is therefore a great potential to restore this section of BCMC). The Western part of BCMC could also serve as an experimental unit to test the hypothesis that reducing hydroperiod and increasing draw down frequency may (if carefully implemented) restore suitable foraging kite habitats. Because the Western part of BCMC can be draw down without drying down the Eastern part, birds could take full advantage of the main foraging habitats in BCMC (located in the East) while restoration of the Western part could be undertaken.

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Figure 1. Study area, with the number indicating the area sampled during the surveys. The red rectangle indicates Blue Cypress Marsh Complex (BCMC).

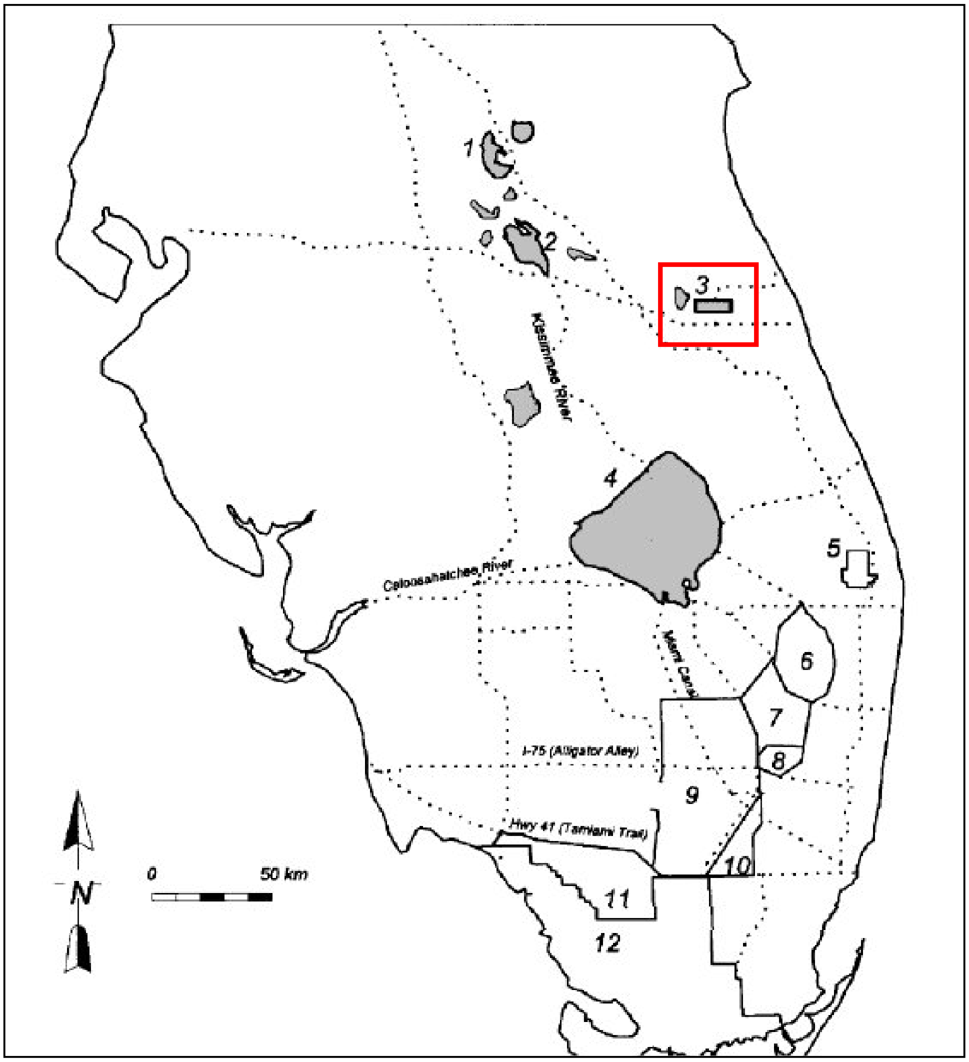

1
2
3
Kissimmee River
4
5
Caloosahatchee River
Miami Canal
6
7
8
I-75 (Alligator Alley)
9
Hwy 41 (Tamiami Trail)
10
11
12
N
0
50 km

Figure 2. Comparison of nest success in BCMC and all other wetlands combined between 1992 and 2005 (estimates from 1992 and 1997 were taken from Dreitz et al 2001). Error bars correspond to 95% confidence intervals.

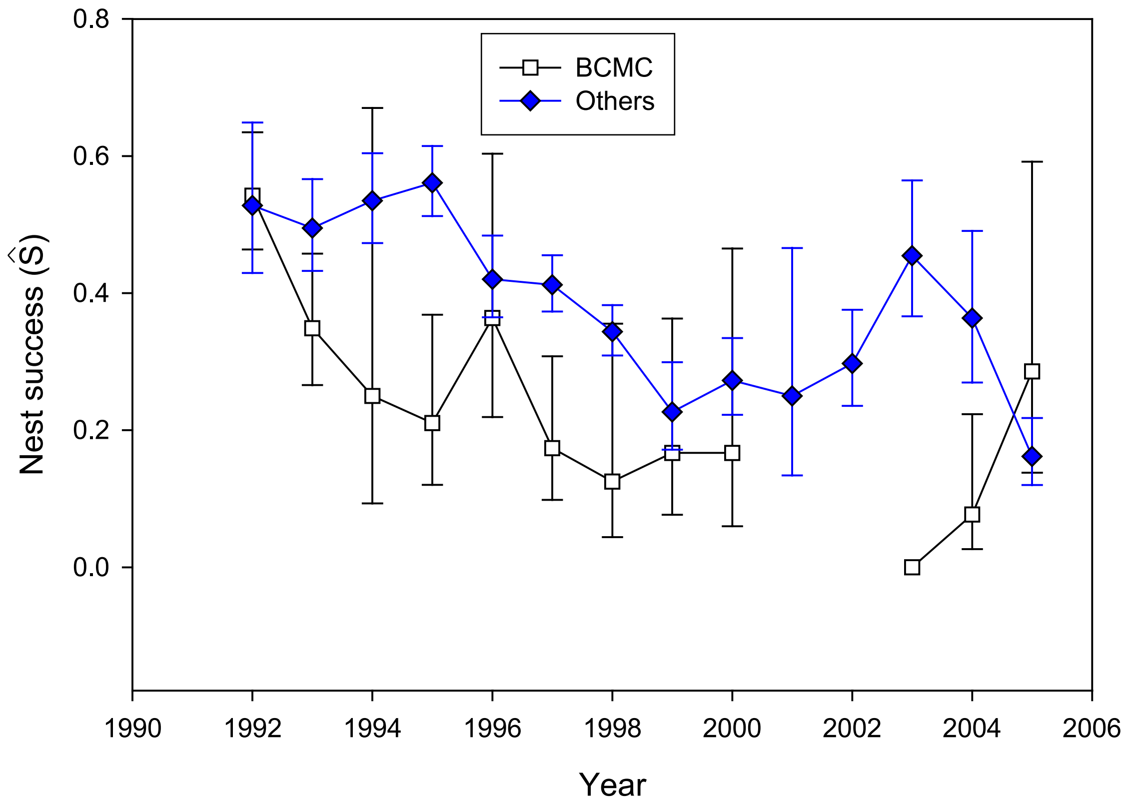


Figure 3. (a) Model averaged Estimates of adult and juvenile survival ($\hat{\phi}$) between 1992 and 2005; (b) estimates of detection probability ($\hat{p}$) (from Martin et al. in review). Error bars correspond to 95% confidence intervals

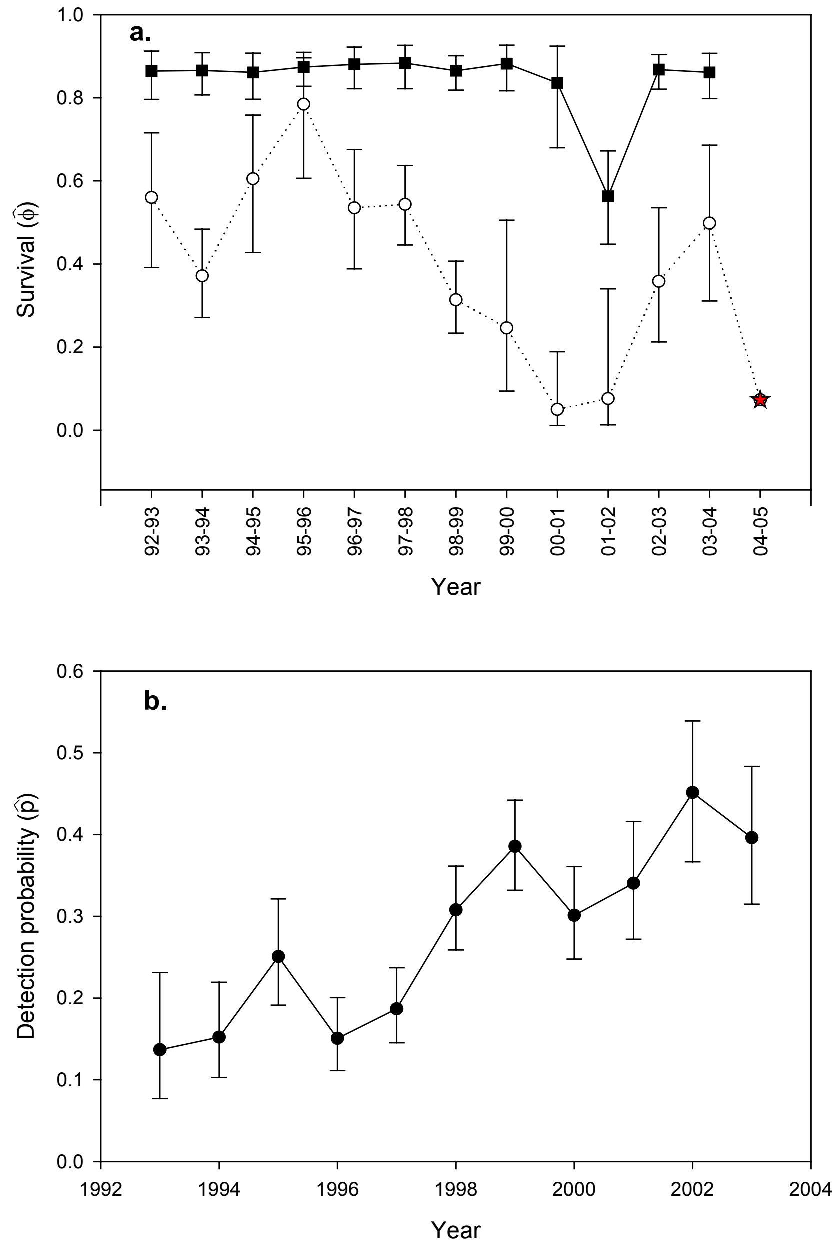


Figure 4. Population size of snail kites estimated using the superpopulation approach (Dreitz et al. 2002; Martin et al. in review).

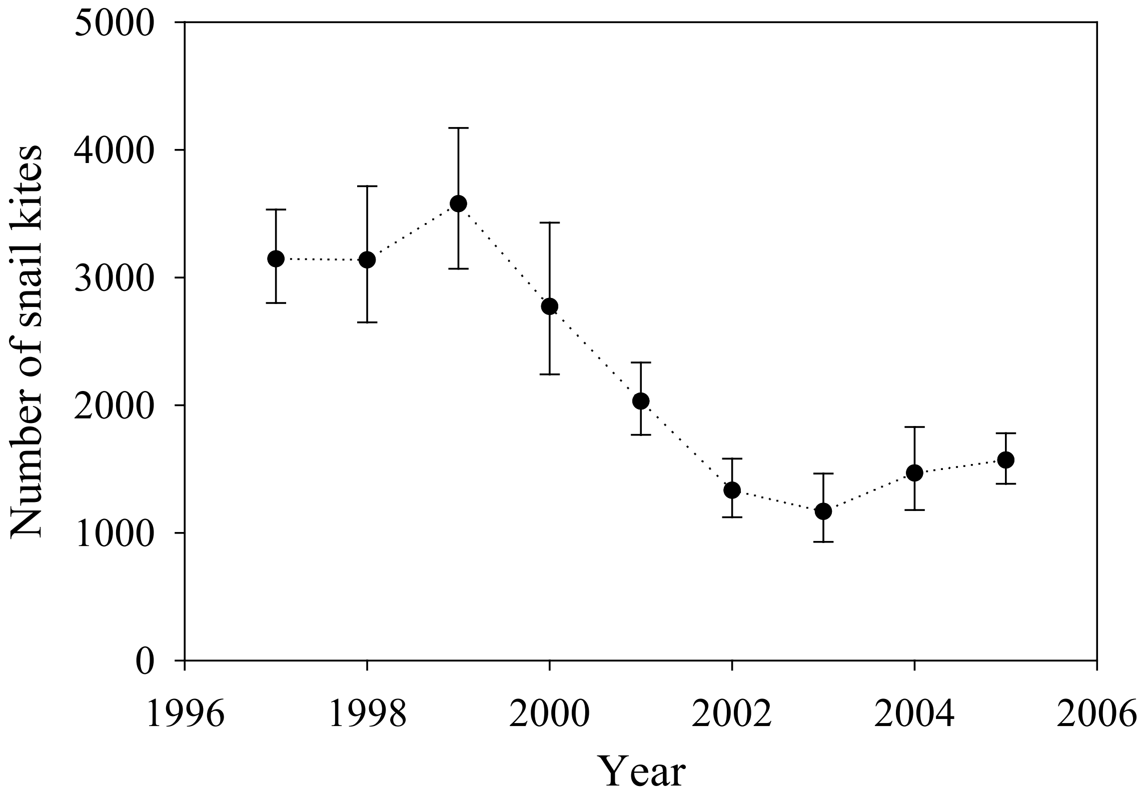


Figure 5. Number of young detected and banded: in the BCMC, Water Conservation Areas (WCA), Kissimmee Chain of Lakes (KCL), Lake Okeechobee, and all areas combined (total), between 1992 and 2005 (Martin et al. in review).

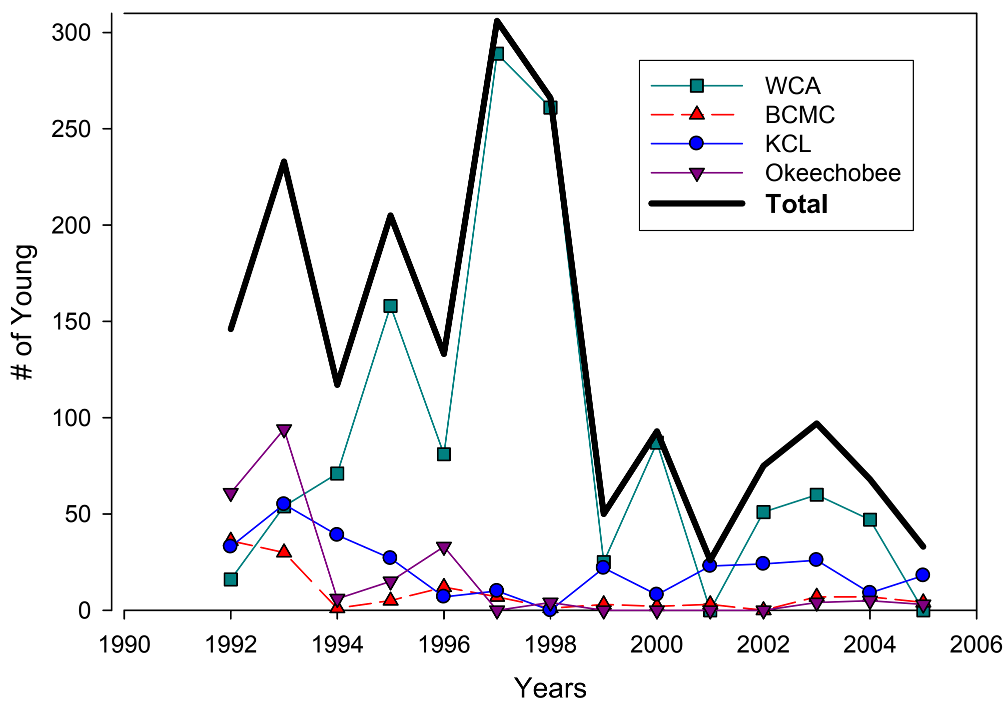
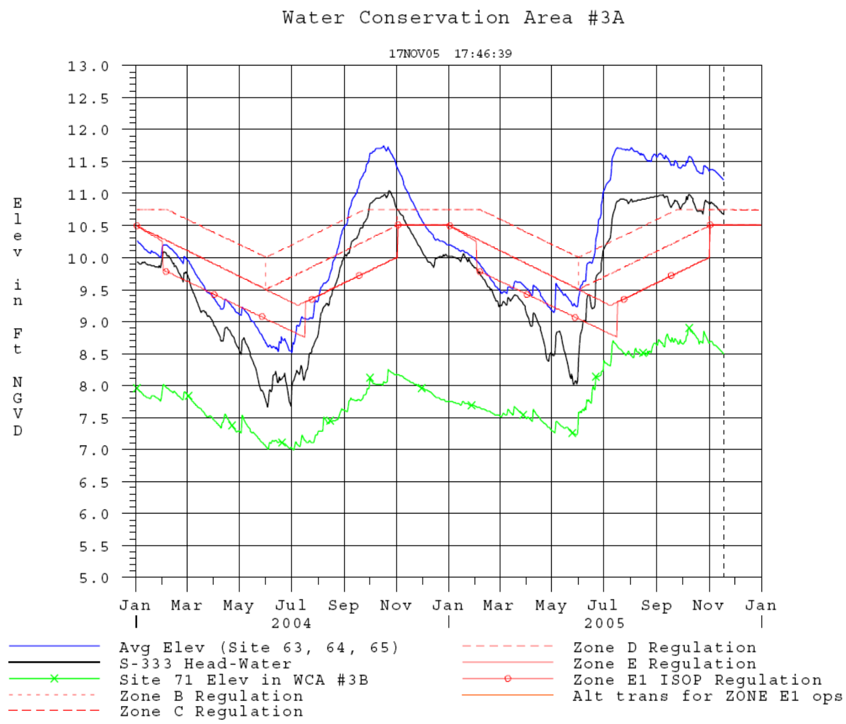


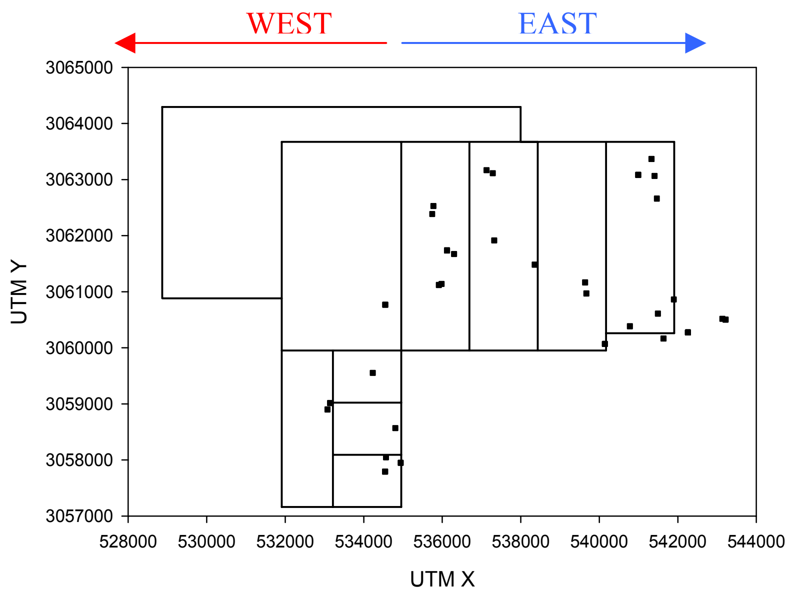
Figure 6. Water regulation schedule for WCA3A.



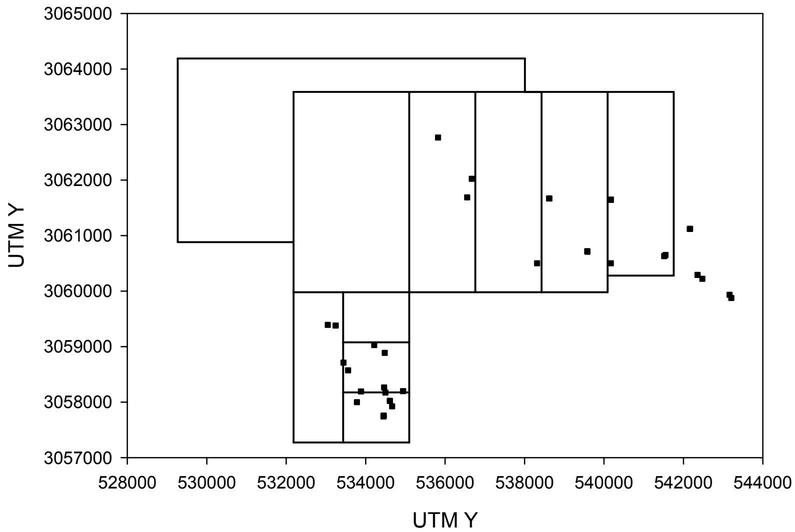
Appendix 1. Count of snail kites during surveys of the East and West part of BCMC between 2001 and 2005. Whenever question marks "?" are reported in column labeled as "East" and "West", this indicates that only the total number of kites was recorded for the entire survey of the BCMC on that date (i.e., no section-specific count is available for that particular date). On a few instances, surveys were only conducted for one of the two sections (i.e., "East" or "West"). In these isolated cases we assigned a question mark the section that was not surveyed.

Year	Date	West	East	Total
2001	15-Mar	?	?	56
2001	5-Apr	?	?	57
2001	26-Apr	?	?	23
2001	10-May	?	?	16
2001	29-May	?	?	8
2001	15-Jun	?	?	6
2002	10-Mar	2	23	25
2002	15-16 Apr	?	?	48
2002	10-May	?	?	48
2002	1-2 Jun	4	38	42
2002	24-Jun	7	31	38
2003	10-11-Mar	7	33	40
2003	1-2-Apr	5	29	34
2003	18-Apr	?	27	?
2003	27-Apr	5	?	?
2003	11-May	?	14	?
2003	25-May	10	?	?
2004	1-2-Mar	13	33	46
2004	25-26Mar	5	46	51
2004	18-19-Apr	23	39	62
2004	6-7May	19	28	47
2004	3-5Jun	7	35	42
2004	20-22-Jun	13	33	46
2005	19-21 Apr	11	36	47
2005	10-11 May	14	17	31
2005	28-30 May	9	16	25
2005	17-18 Jun	1	10	11

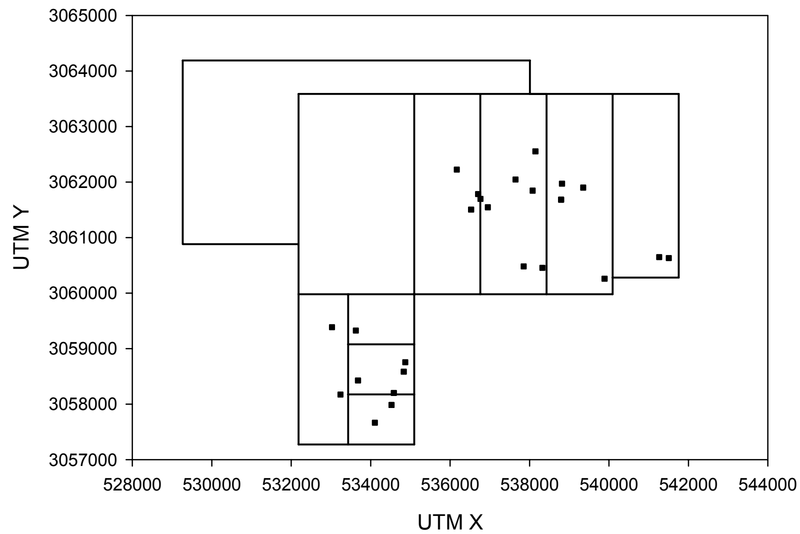
Appendix 2. Locations of snail kites in BCMC (East and West) during the first survey (19-21 Apr 2005).



Appendix 3. Locations of snail kites during the second survey (10-11 May 2005).



Appendix 4. Locations of snail kites during the third survey (28-30 May 2005).



Appendix 5. Locations of snail kites during the fourth survey (17-18 June 2005).