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Factors Influencing Mottled Duck Nest Success on the Atchafalaya River Delta

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FACTORS INFLUENCING MOTTLED DUCK NEST SUCCESS ON THE ATCHAFALAYA RIVER DELTA

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ABSTRACT

The Atchafalaya River Delta system along with the Wax Lake Outlet Delta and the Mississippi River Delta are the only three areas in Louisiana where land is being gained. Beneficial use of dredge spoil from shipping channel maintenance is used on the Atchafalaya River Delta to supplement natural accretion. These dredge spoil islands have the ability to provide valuable nesting habitat for a variety of waterbirds, including Mottled Ducks. Previous studies on these islands reported mammalian predation to be a significant cause of nest failure for Mottled Ducks. I tested the hypothesis that predator reduction through trapping would increase Mottled Duck nesting success. I selected six islands based on vegetative conditions optimal for nesting vegetation and separated them into three trapped and three control islands. I found mammalian depredation of Mottled Duck nests to be rare and was not successful in detecting or trapping any predators. Instead, I found that flooding, which had been a minor issue in a previous study, to be the major cause of nest failure during the 2012 and 2013 nesting seasons. I found that Mottled Ducks strongly preferred nesting on islands that were isolated from the main delta complex. I used LIDAR elevation data as well as NOAA and pressure transducer data logger water level data to evaluate the relationship between nest elevation and nest success. I found no apparent relationship between nest elevation and nest success. Mayfield nest success for Mottled Duck nests was 20.5% in 2012 and 11.5% in 2013 with 34.5% of nests destroyed by flooding. Further research into the effects of flood duration, frequency, and incubation stage at flooding as well as considering partial loss of clutches may show a clearer relationship between nest success and the effects of flooding.

INTRODUCTION

Mottled Ducks (Anas fulvigula) are non-migratory waterfowl endemic to the southeastern United States and northern Mexico, primarily along the Gulf Coast. They are a S4 species of concern in Louisiana and populations are believed to be declining in abundance over much of their range (Stuzenbaker 1988). Most Mottled Ducks spend their entire life in the coastal marshes in the panhandle of Florida and the coastal plain of Louisiana and Texas (Stuzenbaker 1988). Mottled Ducks rely on coastal marshes not only for wintering habitat like the majority of the Mississippi Flyways waterfowl (Davis et al. 2011), but also for breeding habitat (Stuzenbaker 1988, Durham and Afton 2003). Habitat loss is thought to be the most significant threat to Mottled Ducks across the Gulf Coast (Stuzenbaker 1988). Marshland loss to subsidence is especially rapid in coastal Louisiana, however the Atchafalaya River Delta (ARD) is one of only three places in Louisiana where new habitat is being created (Coleman et al. 1998), with the others being the Wax Lake Outlet immediately west of the ARD and to a lesser extent the Mississippi River Delta. Like the ARD, the Deltas at Wax Lake Outlet and the Mississippi River provide fine wintering habitat for Mottled Ducks. In a previous study of the ARD, 40.4% of Mottled Duck nests failed, 34.5% were depredated and 2.4% were flooded (Holbrook 1997). Unlike the ARD, previous studies have found no evidence of nesting by Mottled Ducks on the Wax Lake Delta (Holbrook et al. 2000), presumably because it is at too low of an elevation and is regularly flooded.

In addition to the natural delta building that occurs on the ARD, the Louisiana Department of Wildlife and Fisheries (LDWF) works with the U.S. Army Corps of Engineers (USACE) to use dredge spoil from channel maintenance to add height and area to naturally created islands or create completely artificial islands (Cassidy Lejeune Pers. Comm.). The USACE is charged with maintaining a 7.3-m deep navigation channel in the Atchafalaya River to allow ships access between the Port of Morgan City and the Gulf of Mexico. Dredge sediments from channel maintenance are deposited in the shallow bays of the ARD to create islands approximately 1.2 m above mean low water level (MLWL) (Cassidy Lejeune Pers. Comm.) to provide habitat for a variety of birds, including Mottled Ducks. Dredge spoil islands provide excellent nesting habitat for a variety of waterbirds as they undergo rapid successional changes in vegetation (Holbrook 1997, Wires and Cuthbert 2000).

Dredge spoil islands often acquire grassy and herbaceous vegetation two to three years after their creation and provide excellent nesting habitat for Mottled Ducks, with nest densities often greater than observed on mainland areas (Holbrook 1997, Durham and Afton 2003). Past studies have also shown mammalian predation was one of the major causes of nest failure and flooding was relatively uncommon (Holbrook 1997, Durham and Afton 2003). Based on the previous studies showing predation as the major cause of nest failure, my goal was to evaluate the effectiveness of predator reduction through lethal trapping as a means to increase nest success rates (Pieron and Rohwer 2010).

METHODS

Study Area

My study was conducted on islands within the Atchafalaya Delta Wildlife Management Area (ADWMA) located approximately 25km south of Morgan City, Louisiana. These islands are a combination of (a) naturally formed islands, (b) naturally formed islands augmented by the placement of dredge spoil and (c) completely artificial dredge spoil islands in the Atchafalaya Delta directly adjacent to the Atchafalaya River shipping channel and in the surrounding shallow bays. Islands range from 10 ha to 100 ha in size and generally are dominated by woody and herbaceous vegetation species common to fresh marshes. The formation of these islands in the mid-1970s, their vegetation, use by nesting shorebirds, and use by nekton were previously described (Johnson et al. 1985, Penland et al. 1995, Spengler et al. 1995, Castellanos and Rozas 2001).

Study Site Selection

Study sites were selected based on time since the last dredge material was added to the islands, favorable Mottled Duck nesting habitat, and my ability to access the islands with the required equipment to enable nest searching. I selected islands I considered suitable for nesting Mottled Ducks based on vegetation associations described by (Johnson et al. 1985, Penland et al. 1995). I selected Ibis, Long, T-Pat, Donna, Miestro, and Mathies islands (Holbrook 1997) (Figure 1). Succession of vegetation on many of the islands used by Holbrook (1997) into dense stands of woody vegetation; subsidence on others led to stands of emergent vegetation. Thus, most islands on the ADMWA appeared unsuitable for nesting Mottled Ducks. I selected islands that contained large patches of suitable nesting cover; i.e., grassy and herbaceous vegetation. These islands were then paired by age and proximity and assigned randomly to a treatment of trapped or control.

Figure 1. Map showing the location of the six study islands selected for Mottled Duck nest monitoring in 2012 and 2013

Nest Searching

I conducted weekly nest searches from March 28, 2012 through June 28, 2012 and March 14, 2013 through June 26, 2013. I based dates on peak Mottled Duck nesting dates described by Stuzenbaker (1988), Johnson et al. (2002), and on my observations of nesting activity.

I used a combination of two methods to locate nests. The first consisted of two people on ATVs dragging a 30-meter length of 0.47-cm steel chain over nesting cover to flush attending hens from nests. This chain had additional 30-cm sections of chain attached perpendicularly to the main drag chain every 1.5 m to create extra noise (Klett et al. 1986, Pieron and Rohwer 2010). The second method relied on groups of volunteers to search likely nesting habitat on foot beating the grass with PVC poles in an attempt to flush attending hens from their nests. I conducted nest searches between 0800 and 1400 hrs. to maximize the likelihood of the attending hen being present (Loos and Rohwer 2004, Pieron and Rohwer 2010). Once I located a nest, I placed a 91-cm steel TIG welding rod painted orange at the periphery of the nest bowl and a numbered 152-cm section of 12.7-mm PVC pipe 5 meters north of the nest bowl to aid in future location and identification of the nest for subsequent checks of nest fate.

Upon discovery, the Universal Transverse Mercator (UTM) coordinates of the nest were recorded and the incubation stage was estimated by field candling the eggs. I recorded the location, number of eggs present, incubation stage, date, hen status (present or absent), and nest status (warm uncovered, cold uncovered, warm covered, and cold covered). I estimated the Julian date of nest initiation by using the formula: Initiation Julian Date = Julian date at nest discovery – (incubation stage -1) – number of eggs present at nest. We then used the Mayfield (1961) method to estimate nest success.

Nests were rechecked approximately every 7 days until either the nest hatched or was destroyed. Incubation progress was monitored by field candling eggs. I classified a nest as successful if it hatched at least one egg. Causes of nest failure included flooding, egg depredation, hen depredation, abandonment, investigator damage and unknown causes. I classified the cause of failure as flooding if I observed a wet nest bowl with cold eggs, intact eggs displaced from the nest bowl or a nest that was not attended by a hen with a wet bowl. I classified the cause of failure as egg depredation if I observed damaged eggs with membranes intact or eggs with punctures. I classified the cause of failure as hen depredation. I classified the cause as abandonment if I observed eggs that were cold but covered or showed no other obvious cause for a lack of viable eggs. I classified the cause of failure as investigator damage if the nest was destroyed by the investigators in which more than half of the eggs were destroyed or the hen was not present and the surviving eggs had not progressed since the last visit. I classified the cause of failure as unknown for all other nest failures.

Predator control

Previous studies on the ADWMA as well as other locations in Louisiana and Texas indicated that nest predation was a major cause of nest failure (Holbrook 1997, Stuzenbaker 1988). To evaluate the effectiveness of predator control on these islands, I paired my six study islands into trapped and non-trapped groups. I was able to select three pairs of islands with similar locations, ages, and vegetative conditions. I selected T-pat, Long, and Miestro islands as my trap islands and Donna, Ibis, and Mathies as my control. I used Conibear type traps to specifically target raccoon, (Procyon lotor). Previous studies by Delta Waterfowl showed that these types of traps were particularly effective against raccoons (Frank Rohwer Pers. Comm.). I used a combination of baited bucket and trail sets to target raccoons, which had been found by Holbrook (1997) to be the major nest predator on the ARD.

I conducted predator track surveys on all of my islands using one square meter plots of bare sand saturated with mineral oil so that tracks would be clearly identifiable. These track plots were baited using scent tags impregnated with fish oil, eggs, or canned cat food and checked every 24 to 48 hours for 60 days. I also used baited trail camera sites for 53 days in an attempt to catalog predator presence and species composition. I placed trail cameras (Bushnell Trail Cam) 5 meters from a site baited with similar baits to my track surveys. Coyote call surveys were conducted at various times throughout the night for two nights per island using an electronic predator call and the absence or presence of coyotes was determined by either sightings or call responses.

Flooding and Water Level Monitoring

I began monitoring flooding of nests in 2013 after observing a high level of nest failures caused by flooding in 2012. I placed a 12mm by 152mm polystyrene test tube into the ground at the edge of the nest bowl of every nest discovered in 2013. These test tubes were capped to prevent filling from rain water and had a 12 mm hole drilled in the side one inch from the top of the tube to allow the tube to fill with flood water. The tubes were placed into the ground so that the hole was at the same level as the bottom of the nest bowl to show if the nest had experienced flooding. These tubes were checked and emptied weekly during nest checks (Figure 2). Nests in which the flood detector was full, bowl was damp, or eggs were found intact but displaced from the bowl were considered flooded.

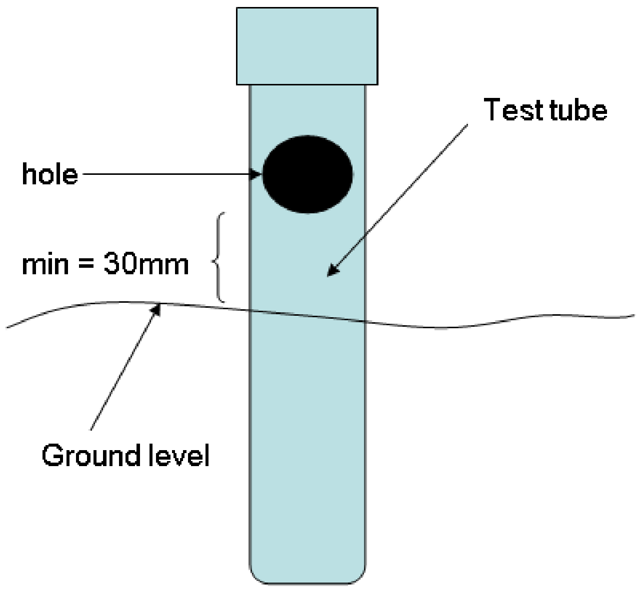

Figure 2. Nest-side food detector comprised of a capped polystyrene test tube with a 12mm hole drilled in the side and placed at the edge of the nest bowl with the opening at the level of the bottom of the nest bowl.

I placed three water level monitoring wells in the bays between Long and Ibis islands, Maestro and Mathis Islands, and west of the shipping lane between T-pat and Donna Islands. These wells consisted of a piece of 4 inch perforated PVC pipe was anchored into the substrate with pressure transducers (HOBO logger pro) suspended in each well from a 4mm stainless steel aircraft cable. The pressure transducers recorded water level, barometric pressure, water temperature, and air temperature at 5 minute intervals throughout the 2013 nesting season. I established the elevation of these stations by attaching a high accuracy real time kinematic (RTK) GPS receiver to the top of the standpipe and subtracting the length of the aircraft cable drop to find the elevation of the pressure transducer. I then used data from a fourth barometric pressure monitoring HOBOlogger suspended below the cap of the T-Pat standpipe. This barometric pressure data was used to correct the depth above sensor data from the other three HOBOloggers using HOBOware software giving me true depth above sensor. I then used high resolution LIDAR data in ArcGIS to estimate elevation at each nest site. A multinomial regression showed a weak relationship between flood detector status and nest failure

RESULTS

My Mayfield nest success determined by the standard Mayfield (1961) method was 20.5% in 2012 and 11.5% in 2013. Flooding was the most common cause of nest failure (Table 1).

Table 1. Nest fates Mottled Duck nests on the Atchafalaya River Delta using historical (Holbrook 1997) and current data.

Nest Fate	1995-1996 Holbrook	2012-2013 Caillouet
Hatched	40.4%	50.4%
Depredated	34.5%	5.9%
Abandoned	22.7%	12.8%
Flooded	2.4%	30.6%

I failed to track, trap, or photograph any predator on any of the islands where birds were actively nesting. I also did not get any responses from the coyote call-back surveys. I did observe coyotes on an island in the camping area near the LDWF headquarters and saw several coyotes swimming across both the small bayous and the main river pass in the ARD. I reject the hypothesis that trapping can reduce nest predation on the ARD due to the fact that predation rates were low compared to previous studies and because I failed to observe or trap any raccoons, which I predicted would be the major cause of nest failure.

I found that in both years flooding was the major cause of nest failure. According to the water level logger data both years mean nest elevation was within one standard deviation of the mean water level throughout the nesting season (Figure 9). Nests at higher elevation did not appear to be more successful than lower nests (Figures 7, 8), which suggested that the LIDAR data lacked sufficient spatial precision to accurately reflect elevation differences among nests. However, LIDAR data also showed that T-Pat and Donna, the outer islands where most of the nests were concentrated, had higher elevation than the other islands in the main delta complex, which suggested that the LIDAR data sufficiently reflected the elevation differences among islands. This relatively high elevation in conjunction with the expected safety from predators of nesting on isolated islands may account for the preferential use of T-pat and Donna islands by nesting Mottled Ducks.

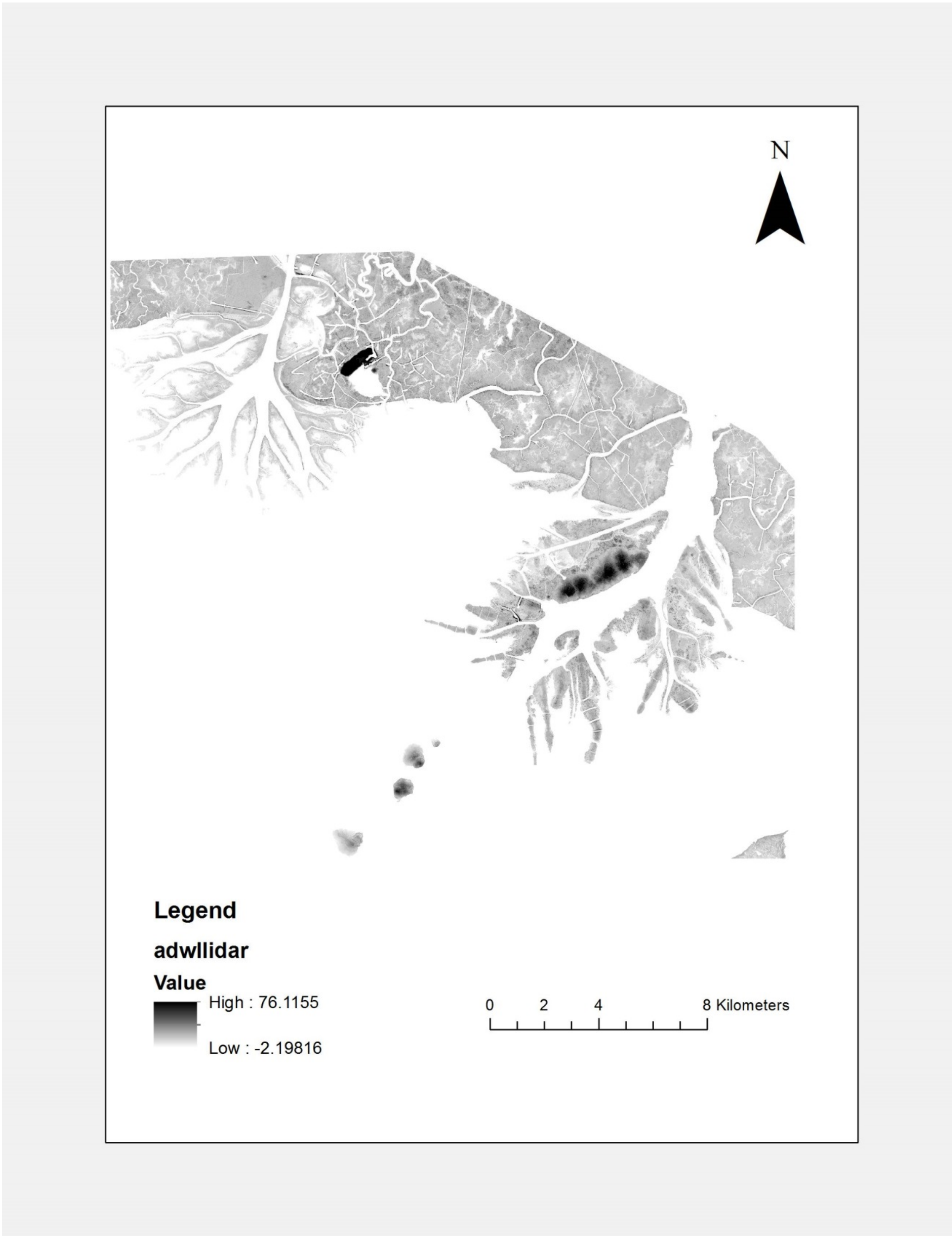

Figure 3. LIDAR overlay of the Atchafalaya River and Wax Lake Outlet Delta complexes

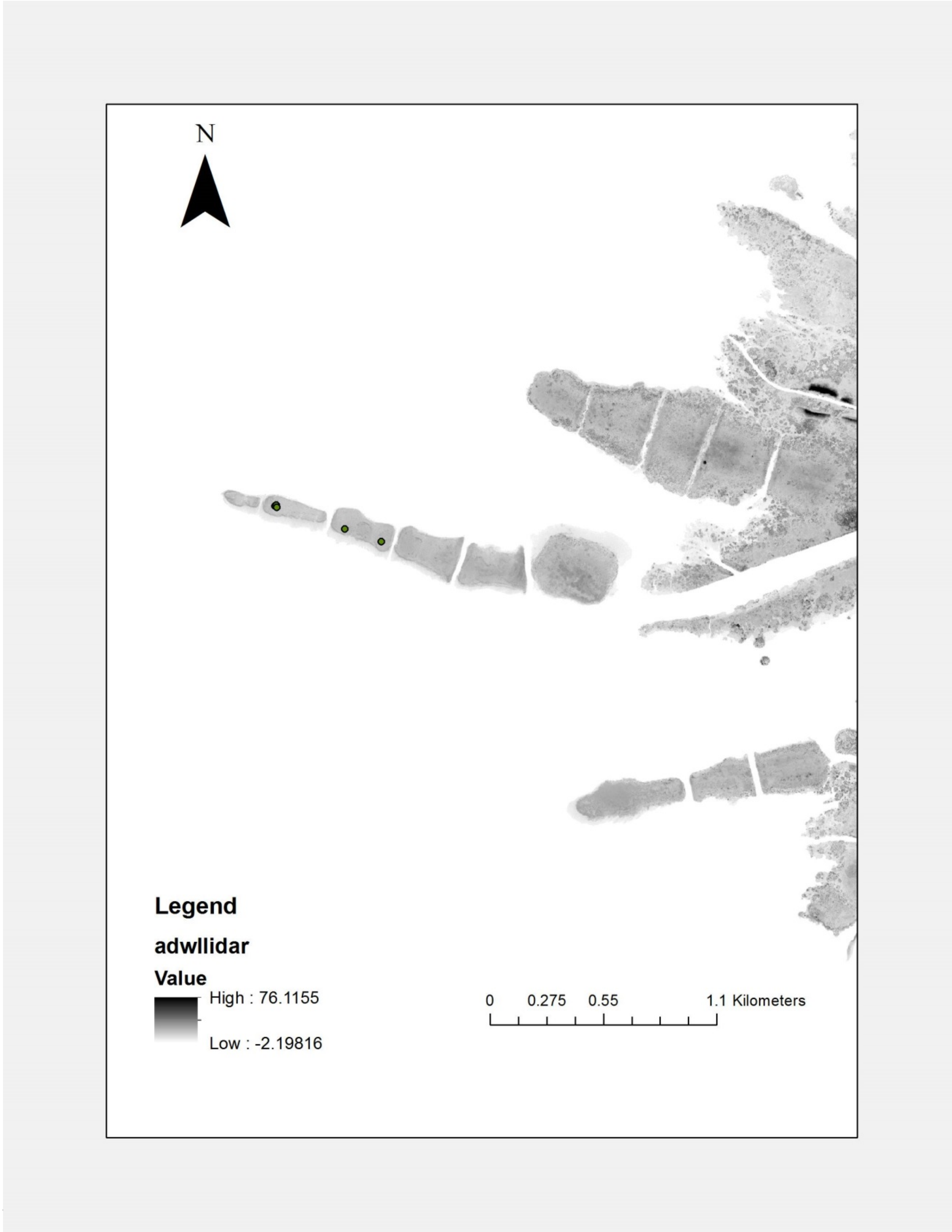

Figure 4. LIDAR overlay showing the position of 2012 Mottled Duck nests on Miestro Island.

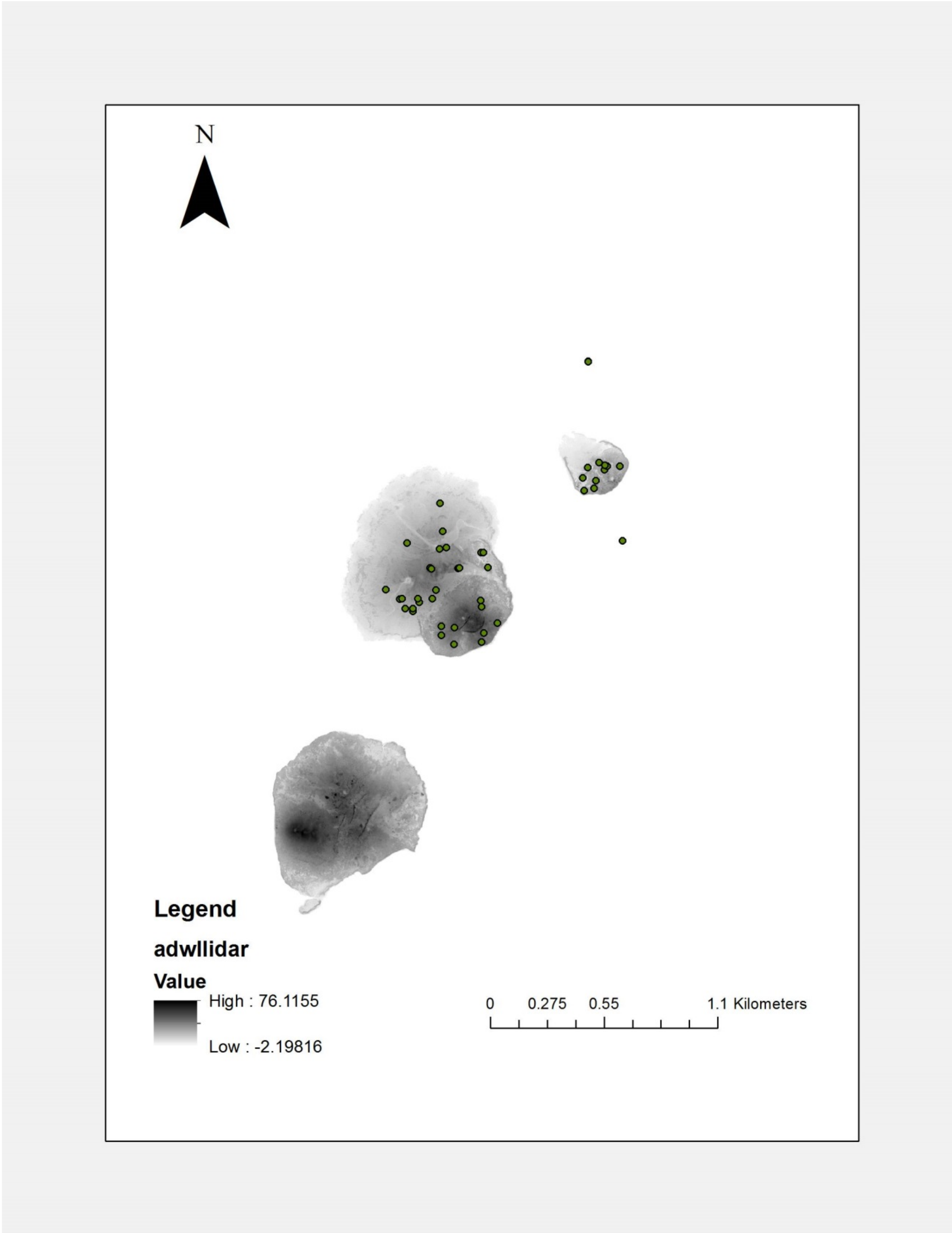

Figure 5. LIDAR Overlay showing the 2012 Mottled Duck nest locations on T-Pat and Donna Islands

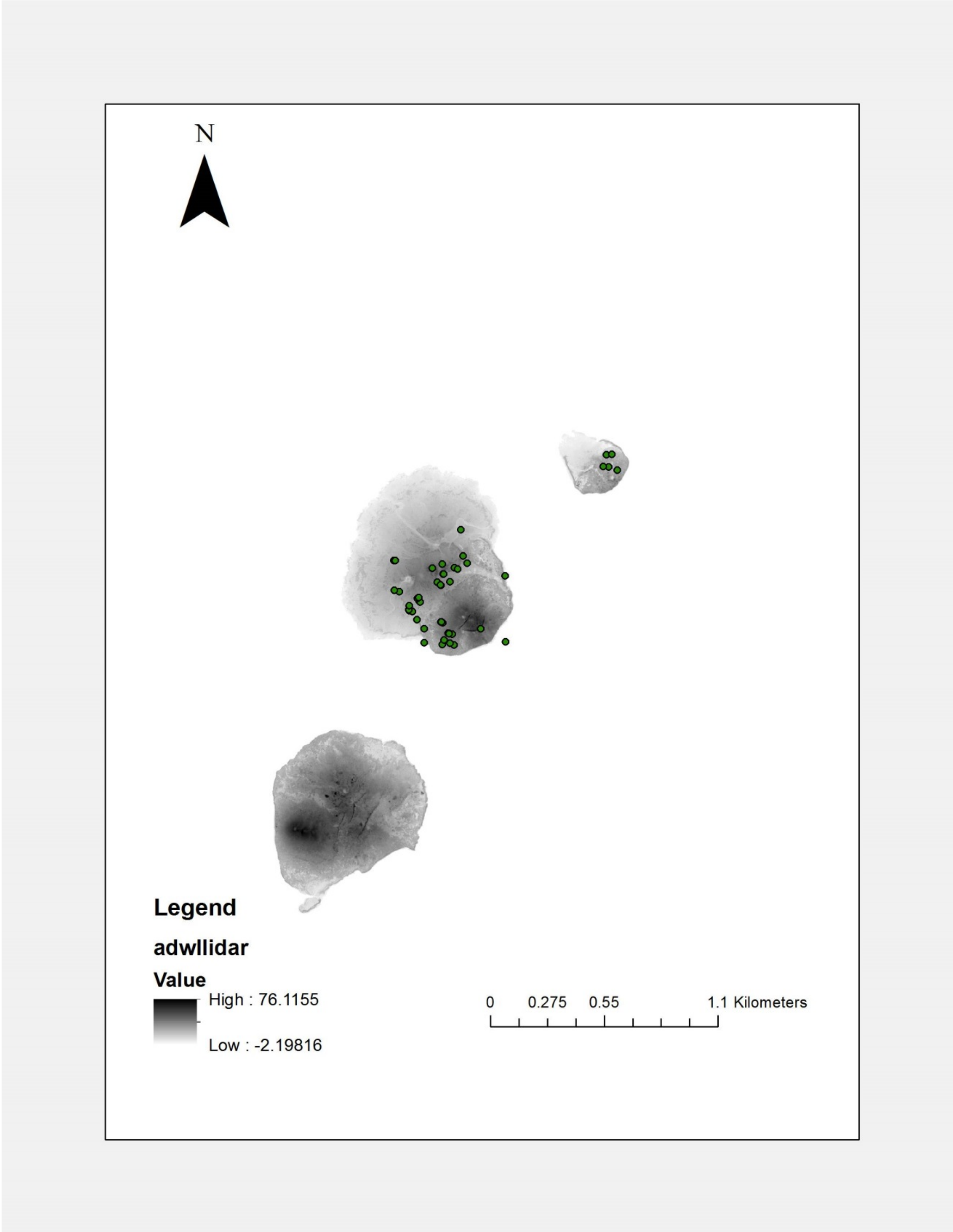

Figure 6. LIDAR overlay showing the 2013 Mottled Duck nest locations on T-Pat and Donna islands

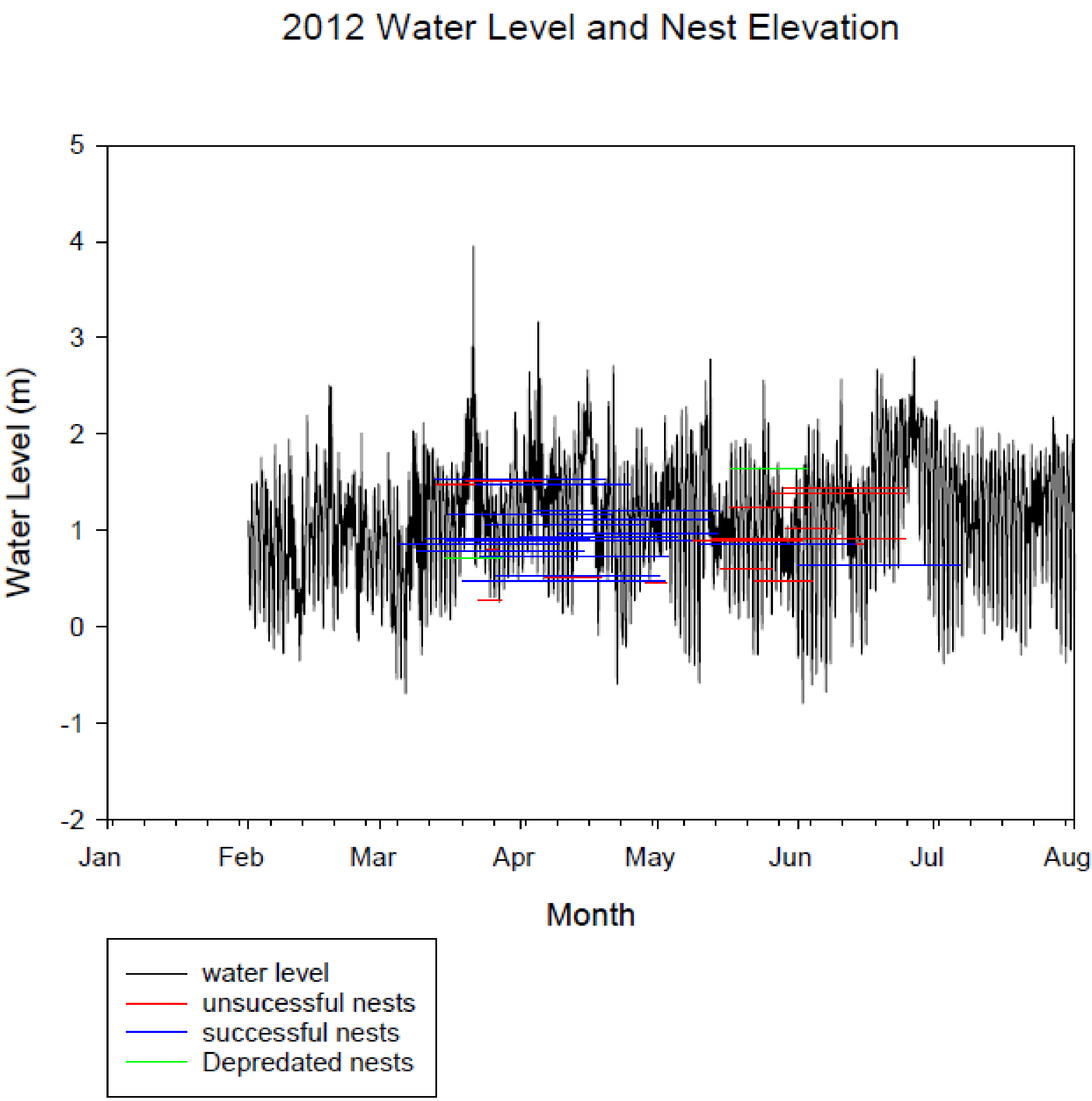

Figure 7 Graph showing the 2012 water level data from the Amerada Pass NOAA station with the nest elevation, date, and fate of 2012 nests for which elevation could be estimated.

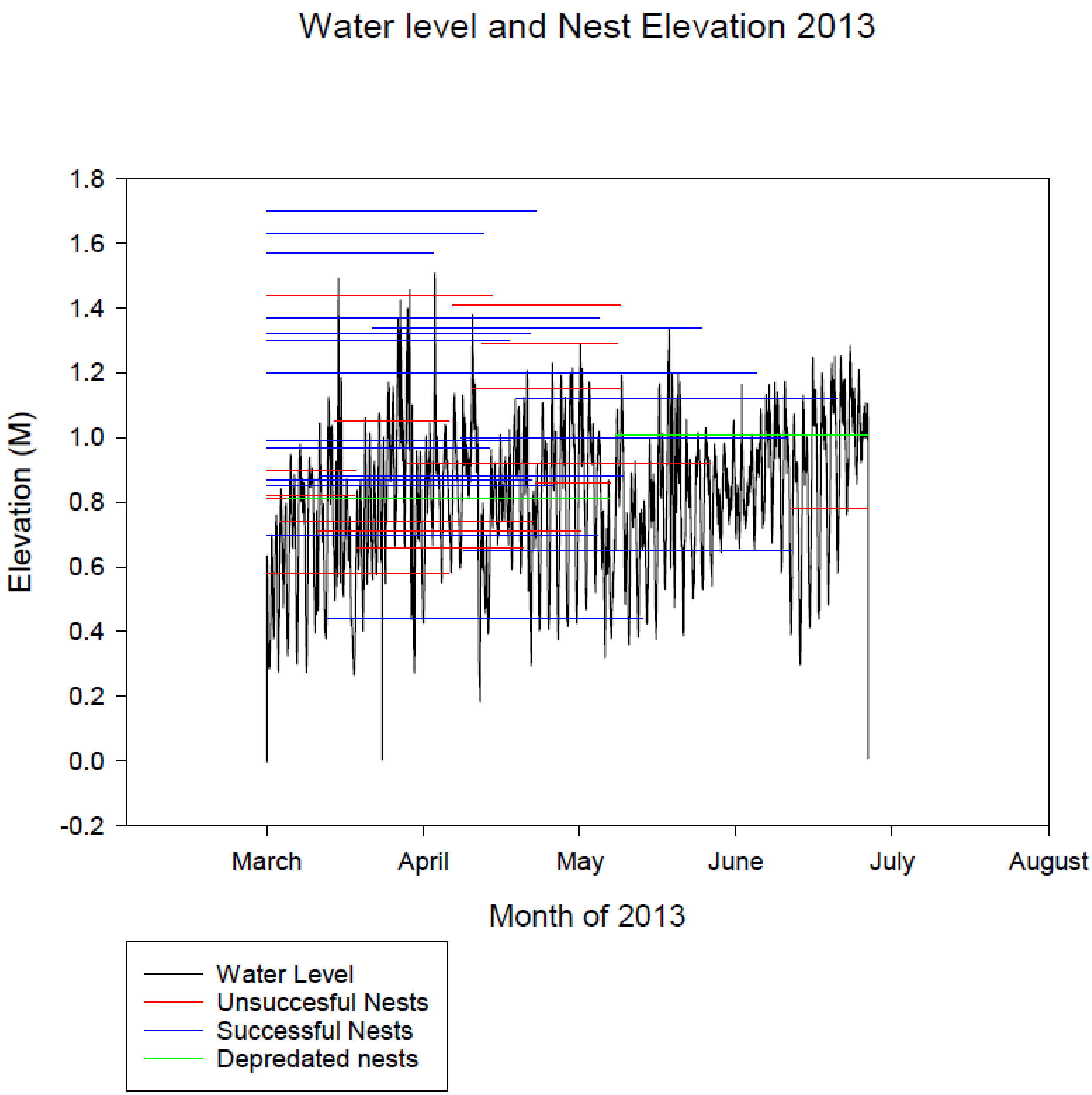

Figure 8. Graph showing the water level data from the T-Pat HOBOlogger water level monitoring station and the nest elevation, date, and fate of 2013 Mottled Duck nests for which elevation could be estimated.

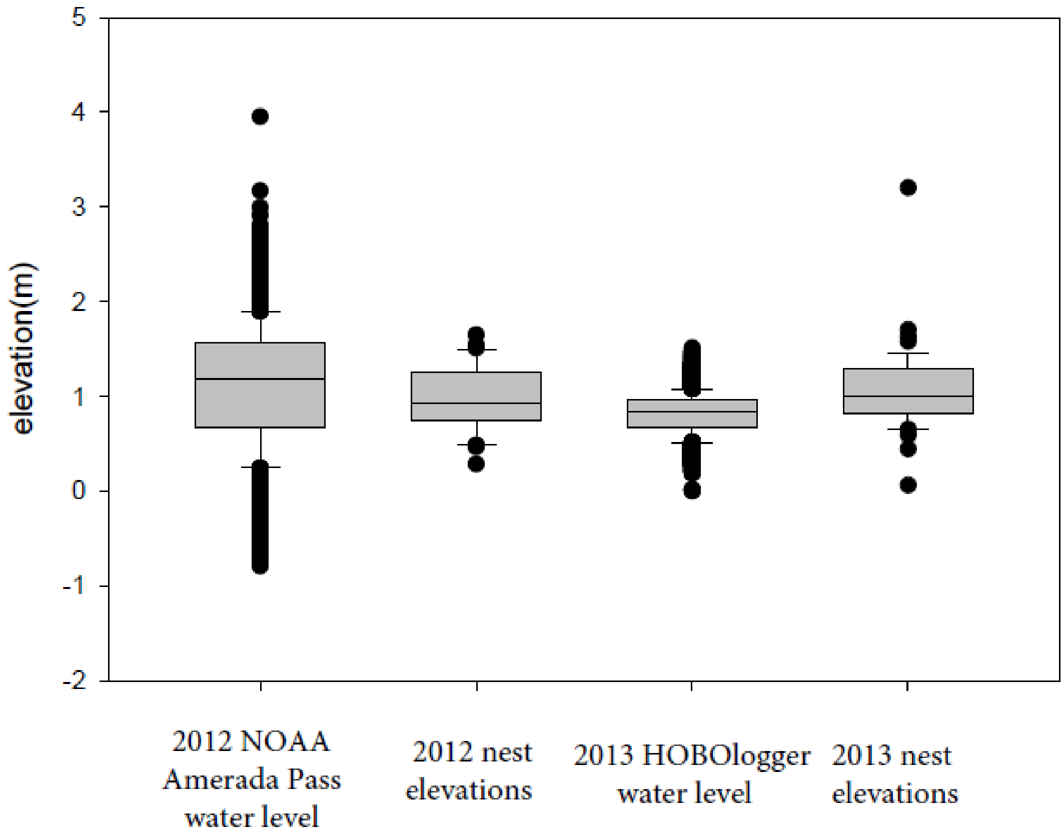

Figure 9. Boxplot comparing Amerada Pass (2012) and HOBOlogger (2013) water level and Mottled Duck nest elevations for the 2012 and 2013 nesting season

DISCUSSION

Predator survey techniques were based on previous work by Holbrook (1997). In Holbrook's (1997) study, 34.5% of Mottled Duck nests on the Atchafalaya River Delta were depredated and only 2.4% were flooded. In my study 30.6% of nests were flooded and only 5.9% were depredated. I attribute this shift from predation to flooding becoming the primary source of nest destruction partly to an increase in the population in coyotes. I believe the increase in coyote populations led to a decrease in raccoon populations, which accounts for the low predation rate I observed. I also suspect subsidence of the islands that were used in Holbrook's study had caused them to no longer be suitable for Mottled Duck nesting. Most islands on the ARD are so low that flooding is a major cause of nest failure for Mottled Ducks. The shift from depredation to flooding as a major cause of nest failure could also reflect that in my study over 90% of my nests were located on islands approximately 5 km toward the open Gulf of Mexico from the main delta and adjacent to the shipping channel. Although these islands had nutria (Myocastor coypus) and rabbits (Sylvilagus aquaticus), I believe they lack sufficient food sources like mast to support raccoon populations. It also is possible that a lack of trees or other elevated features combined with water levels that sporadically flood the entire island reduced use of these islands by raccoons. The rabbit, nutria, and rodent populations of these islands would seem to provide an adequate protein source to support a coyote population, but the small size of the islands outer (100 ha for T-pat and 10 ha for Donna) combined with their remote location, strong river currents, and sporadic may make use by coyotes improbable.

I suspect that the LIDAR data available to us may not have accurately reflected the elevation of individual nests because subsidence and sedimentation may have altered the elevation of the nest sites between the date of LIDAR data collection and the dates of nesting. Furthermore, the LIDAR data may be poorly suited for this analysis because the spatial resolution of LIDAR data was insufficient to account for microtopography. A lack of spatial resolution may account for the fact that there was no apparent relationship among nest elevation, water levels, and dates of nest failure. Another factor that may have contributed to the lack of a relationship among nest elevation, water levels, and nest success is related to how I classified nest success. Data from my flood detectors indicated that many successful nests were flooded at some point during incubation. Many nests that were flooded experienced partial death of the clutch but the standard definition of a successful nest as hatching one egg does not reflect those partial losses in the graph. I believe a future study should measure eggs hatched rather than simple nest success with data loggers placed at every nest site recording the frequency, duration, and temperature change during flooding events as well as factoring in partial clutch losses due to flooding. This would provide a clearer understanding of the effects of flooding on duckling production, which was not the focus of my study

In 2012 there seemed to be a clear temporal trend to nest success, with nests that were initiated earlier being successful than nests that were initiated later. Further research into the duration of flood events, temperature of flood water, and incubation stage during a flood event may provide some insight into this trend.

MANAGEMENT IMPLICATIONS

My study shows that trapping is not required to increase the Mottled Duck hatch on artificial islands in the Atchafalaya River Delta, I did not observe any depredation that was consistent with a mammalian predator. Only one depredation event was attributed to an avian predator.

My results clearly show flooding rather than predation, as seen in previous studies, was the main cause of nest failure. Simply raising the elevation of the islands should increase nest success and use rates. However, higher elevation islands tend to be dominated by woody species like black willow (Salix nigra) and baccharis bush (Baccharis halimifolia) after a few years. Such woody vegetation provides excellent nesting habitat for wading birds. On the other hand, freshly pumped bare sand islands provide habitat for colonial nesting shorebirds. The intermediate successional stages of grass and herbaceous vegetation are the stages preferred by nesting Mottled Ducks. Maintaining nesting habitat for Mottled Ducks in this delta therefore requires a series of new islands every few years. I suggest that three or four large islands (>150 ha) be created every five to ten at least three miles from the main delta and pumped to an elevation of 6-8 feet above mean water levels. As these islands progress through the stages of succession and subside, they would initially provide a combination of mudflat and bare sand for colonial shorebirds, later they would provide desired nesting cover for ground nesting species like Mottled Ducks, and finally they would provide habitat for wading bird rookeries.

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VITA

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