A CHARACTERIZATION OF THE DIETS OF WILD AND REINTRODUCED WHOOPING CRANES (*GRUS AMERICANA*)

By

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ABSTRACT

Grus americana, the Whooping Crane, is an endangered species of crane residing solely within North America. As the result of indiscriminate shooting prior to the 1920s and habitat destruction, population numbers for the Whooping Crane dropped to 21-22 individuals in 1941. Captive breeding began at the Patuxent Wildlife Research Center in 1967. In 2001, a second wild migratory population was established using captive-bred Whooping Cranes. These birds breed in Wisconsin and winter in Florida and other southern states. Using proventriculus and ventriculus contents from dead birds collected from the both the new Wisconsin-Florida population – also called the Eastern Migratory Population – and the wild Wood Buffalo-Aransas population, the diets were compared. The wild population consumed beetles, crabs/crayfish, vegetation, seeds, mollusks and unidentified vertebrates. The new population consumed benthic invertebrates, beetles, crabs/crayfish, vegetation, seeds, mollusks and unidentifiable vertebrates. Both populations also consumed a variety of non-food items, including plastic and metal. There were no statistical differences found between the quantities of each food type found by each population. Therefore, the wild and reintroduced Whooping Crane populations are consuming similar types and amounts of food.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The Whooping Crane, *Grus americana*, is the tallest bird in North America (Couzens 2010, Bent 1963), reaching a height of 1.5 m or more (Chavez-Ramirez 1996). They have white feathers over most of their body with the exception of black primary feathers. They have a red skin area on the top of their head and a black feather mustache (Beacham et al. 2001). A detailed review of the life history of the Whooping Crane was completed by Bent (1963) and updated by Urbanek and Lewis (2015). They have been threatened with extinction for a long time. Habitat loss, uncontrolled hunting from the 1870s until the 1920s and other disturbances led to a population crash (Beacham et al. 2001).

In the 1890s, breeding populations were extirpated from the North Central United States. Hunting of Whooping Cranes was stopped during the 1920s (Beacham et al. 2001, Collar et al. 1992). The breeding population in Canada was driven out of Saskatchewan in 1922 by indiscriminate shooting. It was not until May 1955 that their breeding ground was discovered in Wood Buffalo National Park. Alberta, Canada (Williams 2013). During earlier surveys in 1923 and 1933, other species were mistakenly identified as Whooping Cranes, causing the population to be overestimated (Greenway 1967). A non-migratory population in Louisiana was devastated by a storm in 1940. The last crane from that population was brought into captivity in 1950 (Beacham et al. 2001). The wild migratory Wood Buffalo-Aransas population numbered only 15 or 16 individuals in 1941. This decline caused the Audubon Society to initiate public education and television news broadcasts to discourage the shooting of Whooping Cranes and increase their protection (Williams 2013).

The establishment of the Wood Buffalo National Park in 1922 and the Aransas Wildlife Refuge in 1937 helped to protect the migratory population (Beacham et al. 2001), though neither location was established specifically to protect Whooping Cranes. In 1967, captive breeding

began at the Patuxent Wildlife Research Center (Beacham et al. 2001). In an attempt to supplement the wild population, Whooping Cranes are hatched and raised in captivity for future release to the wild. In recent years, the caretakers wear white costumes in an effort to keep the birds from imprinting on humans. The exact methods by which the chicks are raised and released have changed over the years. At the beginning of this project, eggs from the captive population were sent to the Gray's Lake National Wildlife Refuge in Idaho to be hatched and raised by Sandhill Cranes (*Grus canadensis*) (Beacham et al. 2001, Collar et al. 1992).

In 1985, a plan for joint Federal-State Cooperative Protection of Whooping Cranes was approved in the United States. A Whooping Crane Recovery Plan was published by the Canadian Wildlife Service in 1988. The potential of avian illness affecting the sole captive population prompted the initiation in 1992 of a Whooping Crane health management workshop (Beacham et al. 2001) and the establishment of several new breeding centers. In 2001 the project expanded with the formation of the Whooping Crane Eastern Partnership (WCEP) to introduce these birds to a Wisconsin-Florida eastern flyway, henceforth called the Eastern Migratory Population (EMP). These chicks are raised by costumed humans and receive additional training to follow costumed humans flying ultralight aircraft. The objective of WCEP is to establish a migrating population that breeds in Central Wisconsin and winters in Chassahowitzka and St. Marks National Wildlife Refuges on the Florida Gulf Coast or elsewhere in the southern United States (Williams 2013). In 2006, the first chick was hatched in this population, raised by its parents, and migrated south with them to Florida. By 2009, the new population had 80 birds while the original Wood Buffalo-Aransas population (WBAP) had 270 (Couzens 2010).

The objective of the restoration project is to see the Whooping Crane delisted from endangered to vulnerable and ultimately removed from the threatened species list. To achieve

this objective, the population levels must be sufficient to maintain a genetically stable population. These population requirements are estimated to be a minimum of 40 reproductive pairs in the Wood Buffalo - Aransas population and 25 pairs in two other locations (U.S. Fish and Wildlife Service 2006). The three populations must be self-sustaining at these levels for a decade or more (Canadian Wildlife Service and U.S. Fish and Wildlife Service 2005). This is the beginning of a promising project, but there is much to learn about these great birds. One issue of concern is nest abandonment in Wisconsin. In 2007, 2008, and 2009, all of the nests were abandoned (Anonymous 2009). This has continued in recent years, and is hypothesized to be partially due to black fly infestation (Urbanek et al. 2010). Another hypothesis is that diet could contribute to nest abandonment if returning Whooping Cranes in the spring do not have enough nutrients gained on the winter grounds to successfully lay and incubate their eggs. Thus, they may abandon nesting to do more foraging for food.

The diet of wild Whooping Cranes is of great interest. The winter diet is most important because the cranes need to store energy as fat for spring migration (Chavez-Ramirez 1996). Prior to 1946 the knowledge of crane diet came from observations of feeding cranes and speculation based on the presence of known food items in the habitat. Hunt and Slack (1985) summarized earlier work by Stevenson and Griffin from the 1940s and Allen from the 1950s. The researchers looked at a total of 35 scat samples. Out of 45 known food items they consumed, blue crabs, clams, crayfish, fish, and snails were the most important. However, much plant material and soft bodied invertebrates are lost when examining scat samples. In 1948 Allen looked at the stomach contents of a crane that had been shot on the Aransas refuge (as cited in Hunt and Slack 1985). The diet of that crane consisted of 52% snails, 30% crayfish, 16% acorns and 2% sedge tubers. Uhler and Locke (cited in Hunt and Slack 1985) looked at the stomach

contents of a bird that had been shot in 1968. They found that the diet was 43% snails, 43% sedge tubers, and 14% small blue crabs (as cited in Hunt and Slack 1985). Hunt and Slack (1985) looked at the esophagus and gizzard contents of two birds that were found dead in the Aransas National Wildlife Refuge. One of the cranes was found on February 2, 1985. They found 33 whole acorns in the esophagus, 17 of which had nut weevil larvae. The contents of the gizzard were 99% acorns with the remainder being wolfberries and blue crabs. The other crane was found on Blood Worth Island on November 15, 1984. The gizzard contents consisted of 92% fiddler crab and blue crab with the remainder wolfberries and smaller crayfish (Hunt and Slack, 1985). Hunt and Slack (1989) concluded that Whooping Cranes wintering on Aransas National Wildlife Refuge ate crayfish, acorns, blue crabs, clams, fish, snails and wolfberries. They estimated, volumetrically, that 90.3% of the diet was animal-based and 7.7% was plant-based. They also noted that the availability of these food items varied with human activity. Chavez-Ramirez (1996) found that Whooping Cranes would also eat shrimp, and occasionally snakes and insects. He also noted a decrease in the number of crabs consumed by the cranes between the winters during which he did his work. He attributed this decrease to a severe crab mortality event in 1993. This difference is important since he concluded that an average of 88% of the energy needed by wintering Whooping Cranes comes from blue crabs (Chavez-Ramirez 1996). Nelson, Slack and Gee (1996) performed feeding tests in order to determine how much energy was obtained from the know winter foods. They fed their test cranes blue crabs, razor clams, acorns and wolfberries. The researchers found that cranes consumed no more than 200g of food per day. The nutrition and calorie content varied between food types. Acorns and wolfberries are high in calories but low in protein. Blue crabs and razor clams are low calorie but

high in protein. Because of available changes, habitat range and ease of acquisition, obtaining enough energy for spring migration is difficult.

Chavez-Ramirez (1996) and Nelson, Slack and Gee (1996) observed that the change in food availability between the winters of 1992-1993 and 1993-1994 caused a reduction in the potential energy available to wintering Whooping Cranes. Insufficient energy was thought to have caused reproductive decline in the following spring. Of 45 nests built in Wood Buffalo National Park during the spring of 1993, 36 young were hatched and 15 made it to the wintering ground. In the spring of 1994, 29 nests were established, 13 chicks were hatched, and eight survived to winter in Aransas. This represents a 36% reduction in nests, a 64% reduction in chicks hatched, and a 47% reduction in chick survival. Also in the spring of 1994, 15 cranes did not migrate until May and three over-summered in Aransas (Chavez-Ramirez, 1996; Nelson, Slack and Gee, 1996).

Other researchers have observed that weather conditions can affect the abundance of different Whooping Crane food items. Wozniak et al. (2012) documented that changes in water flow and salinity affected the availability of wolfberries, finding an inverse relationship between salinity and wolfberry abundance. With the reality of high natural variation in food availability, knowledge about the diet of Whooping Cranes is vital to informing conservation efforts.

The diet of the new Eastern Migratory Population (EMP) of Whooping Cranes has only recently been studied (Barzen et al. 2018). This work attempted to determine the diet of the EMP by observing foraging behavior in the wild. They observed that the birds can be territorial, and that the forage range for each bird can be limited. Some birds were observed to only consume one food type. They observed that the flock consumed cranberries, dewberries, corn, earthworms, crayfish, mussels and snails (Barzen et al. 2018). Considering that most of these

birds have been raised in captivity and fed a pellet diet, they may not be as familiar with the entire spectrum of foods available.

In wading birds, knowledge of where to eat and what to eat is culturally transmitted from parent to chick (Kushlan 1981). In the Wood Buffalo-Aransas Population, the primary food of chicks was dragonfly nymphs (Bergeson et al. 2001). The female of the pair does most of the feeding while the male watches over the chick. When there is more than one chick in the nest, the older chick tends to get more of the food that the parents collect. The parents do not preferentially feed one chick over the other. They simply feed the chick they encounter first, so the older and faster chick gets to the food first. After three days, the chick will follow the parents while foraging (Bergeson et al. 2001). Within the captive rearing program, chicks can either be raised by costumed humans or by their parents. The latter is less common and has only been used by WCEP since 2013. This parent rearing is as close as we can come in captivity to how the chicks would be raised in the wild. Kreger et al. (2004, 2005) demonstrated a behavioral difference between parent-reared and hand-reared birds, both in captivity and upon reintroduction to the wild. Kreger and coworkers (2004, 2005) also found that hand-reared birds spent more time foraging than parent-reared birds. The consequence of this difference on diet has not been tested. Could this increase in foraging time be a reason behind nest abandonment—are they forced to leave the nests in order to get enough to eat because their foraging efforts are less efficient and therefore they spend more time foraging?

Only the winter diet of the Wood Buffalo-Aransas population has been studied (Chavez-Ramirez 1996; Hunt and Slack 1985 and 1989; Nelson, Slack and Gee 1996), and since the Eastern Migratory Population is new, there is little information on their diet at various seasons. Since it is the goal of the captive rearing program to reestablish a self-sustaining Whooping

Crane population, we need to pursue whatever management options will maximize survival. My hypothesis is that there are dietary differences, between the WBAP and the EMP, in terms of presence or absence of different food items and the total energy of the meal, between the wild and reintroduced birds. If this is the case, rearing procedures can be improved to help the chicks raised in captivity learn what to eat.

METHODS AND MATERIALS

Study Birds

The two main populations considered in this study were a wild population and a reintroduced migratory population (Fig. 1). The wild population (WBAP) breeds at the Wood Buffalo National Park in north central Canada and winters at the Aransas National Wildlife Refuge on the Gulf Coast of Texas. The reintroduced population (EMP) breeds in central Wisconsin and winters in Florida and various southeastern states. There is also a third, non-migratory, population in Louisiana (LNMP) that will be included as extra data but not used in the statistical analysis because of low sample size.

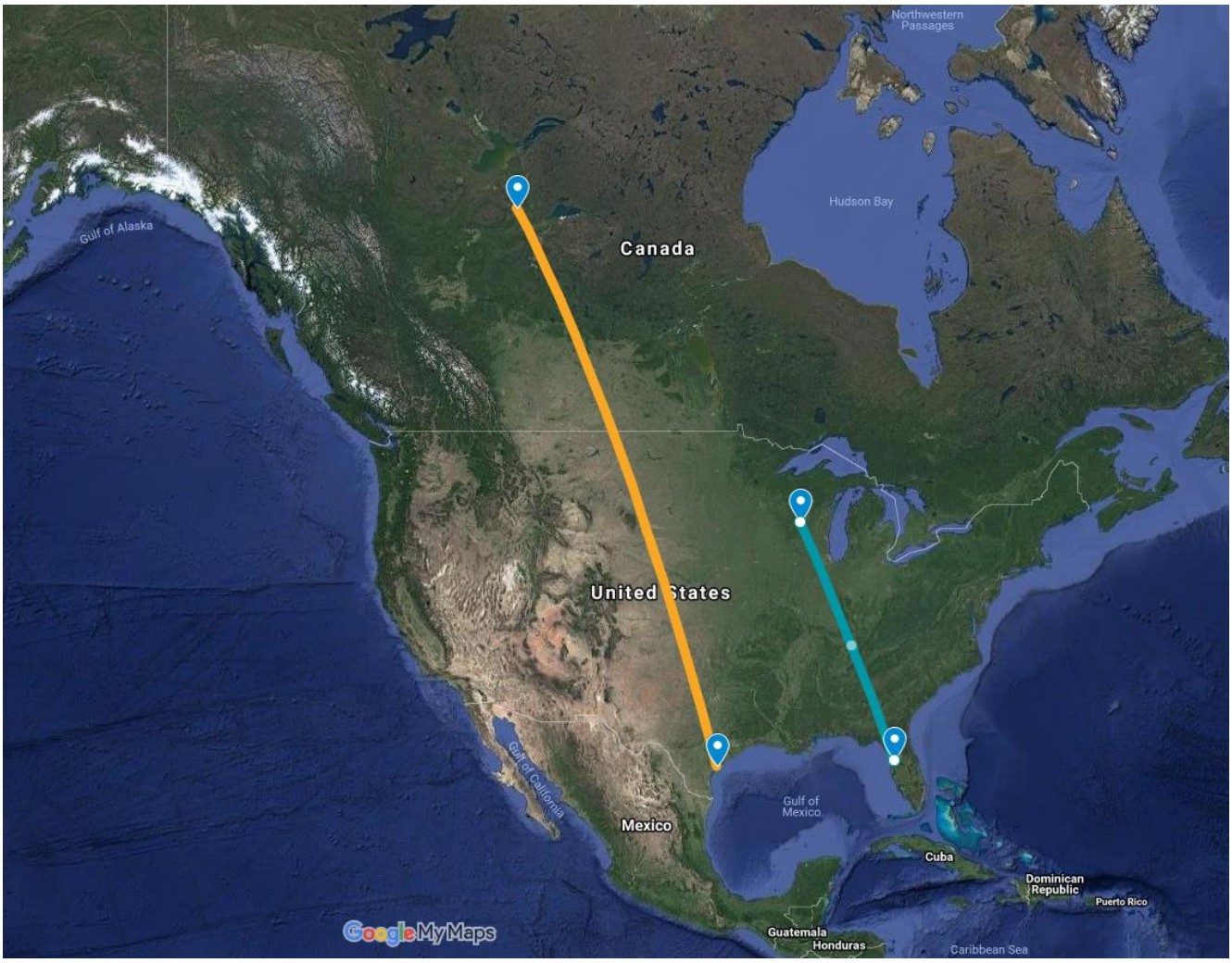

Figure 1: Map of the migration paths used by the Wood Buffalo – Aransas Population (left line) and the Eastern Migratory Population (right line).

Sample Collection

Upper gastrointestinal content samples were collected from birds that were found dead within the United States. These dead birds were sent to the USGS National Wildlife Health Center in Madison, Wisconsin. During the necropsies the contents of the proventriculus and gizzard were collected in a plastic self-closing pouch and frozen for later analysis. Each sample was labeled with case number, type of sample, location and a direction to freeze and save. The samples were collected from 2000 to 2014, with no samples collected in 2002, 2004 and 2006. Thirty-five samples were sent to the USGS Patuxent Wildlife Research Center in the winter of 2012, and seven more were sent in July 2014. The sample size was limited because only dead birds that were reported or found were collected for analysis.

Sample Analysis

Samples were analyzed at the USGS Patuxent Wildlife Research Center in Laurel, Maryland following the procedure used by the Migratory Food Habits Laboratory for the analysis of samples from waterfowl (personal communication with Peter Ostenton, December 2012).

Sample Preparation: Individual samples were removed from the freezer and allowed to defrost at room temperature. Once the sample was defrosted, a portion was removed from the pouch and placed in a plastic tray. The selected portion of the sample was suspended in a small amount of water to separate the clumps of material.

Sorting: Large items were removed, without the aid of a dissecting microscope, and placed in aluminum weight boats separated by item type. Once large items, such as rocks, were removed, a dissecting microscope (Thomas Scientific Dissecting Microscope) with

magnifications of 10X and 30X was used to remove smaller items. Soft-bodied creatures (such as benthic macro-invertebrates) or items that would be degraded by drying were sorted into glass vials and preserved with 70% ethanol. All hard items were sorted onto aluminum weigh boats. Once the entire sample was sorted, the hard items were dried in a drying oven (GCA/Precision Scientific THELCO model 17) for approximately one hour at a low heat setting.

Identification: Once the items were dried, all of the items (preserved and hard) were identified. A variety of field guides were used to aid in identification (Montgomery 1977; Martin and Barkley 1961). Where the field guides provided multiple possibilities, Google Images was used to obtain color pictures of the possibilities so identification could be made. Items were identified to the lowest taxonomic level possible. Most were identified to family, some to genus and species and others only to phylum or order because they were too degraded for more specific classification.

Quantification: Once all items were identified, the amount of each was quantified. Amounts of each item were measured by volume using variously sized graduated cylinders. Any items that measured less than 0.1 milliliters were considered trace. Once the items had been measured, all dried items were stored in glass vials. The items that were stored in ethanol were also measured volumetrically. For these items, the volume was taken by measuring the height of the vial in cm before the item was placed in the vial, then measuring the height of the sample in the vial and finally estimating the volume of the sample based on the known volume of the vial.

Data Organization: All of the food items that were collected and identified from the samples were sorted into categories in order to standardize food species variability across the Whooping Cranes' vast range. Cranes seek out the same broad categories of food regardless of the area in which they are foraging. Food categories were used to enable comparisons of broad

diet composition without particular food species differences being a factor. Food species variability was also analyzed to determine whether one population ate a more varied diet than another.

Statistical Analysis

The collected qualitative and quantitative data were entered into Microsoft Excel. This file was used as the source to create a summary data file so that the datum for each sample was summarized by food type. The food type summary data were entered into IBM SPSS Statistics (Version 22) for statistical analysis. The qualitative data were analyzed using logistic regression. The quantitative data were tested to see if they fit the LINE assumptions of normality before running ANOVA tests. If the data failed these assumptions, non-parametric alternatives were used. The presence and absence data were entered into Logistic Regression models. Population, season, sex and age were used as the independent variables while each of the different food categories were the dependent variables. Since the independent variables were categorical, SPSS created dummy variables. Each dummy variable looked at the effect the category it represented had on the dependent variable in comparison to the reference category. For population, the reference category was the Eastern Migratory population; for season, the reference category was spring migration; for sex, the reference category was females and for age the reference category was age unknown.

Energetics:

Energetics: It was decided not to send the samples to an energetics laboratory because the samples would be destroyed in the process, and some of the food items were preserved in ethanol which would affect the results. Instead, the estimated energy of each food item was obtained from the literature. Before the energy of the meal could be calculated, the mass of each food item was calculated using density data obtained from the literature and reliable websites. Also the ratio of indigestible and digestible material was obtained for each food type from the literature in order to know how much organic material corresponded to the remaining parts. Table 1 contains all of the references used to calculate the energetics.

Table 1 - Table of references for energetics calculations.

Food type		Density of indigestible portion	Indigestibility (ratio of bone, shell or carapace to tissue)	Energy
Benthic Macroinvertebrates		Neville 2012	Ravzanaadii et al. 2012	Ravzanaadii et al. 2012
Beetles		Neville 2012	Sánchez-Muros et al. 2014	van Huis et al. 2013
Crayfish/Crabs		Neville 2012	Kindahl (2015)	Krzynowek and Murphy 1987
Fruits		Various 1998	Sorensen 1984	Sorensen 1984
Seeds		Various 1998; Fos'hat et al. 2011	N/A	Kendeigh and West 1965
Mollusks		Pubchem Open Chemistry Database	Jurkiewicz-Karnkowska 2005	Krzynowek and Murphy 1987
Vegetation		Niklas 1993	N/A	Gorhm and Sanger 1967
Vertebrates		An and Draughn 1999	Morales et al. 1945	Dierenfeld 2002

RESULTS

Sample Statistics:

Forty-two upper gastrointestinal tract content samples, from birds in three different populations, were analyzed for their diet. The samples came from a span of 15 years, from 2000 – 2014. There were no samples from 2002, 2004 and 2006. Four of the samples will not be considered further because two were from birds that died while in captivity, the third was compromised due to human error during analysis, and the fourth was from a bird that was seen to have difficulty moving around before it died, thus restricting its opportunity to forage properly. Of the 38 remaining samples, 29 samples came from the Eastern Migratory Population (EMP), seven from the Wood Buffalo-Aransas Population (WBAP) and two from the Louisiana Non-Migratory Population (LNMP, Tables 2 - 5). Each sample was sorted into an age category based on the age in years of the bird at death. Juveniles represent birds from 0 to 1 years old, Immatures represent birds 1 to 4 years old and Adults represent birds 5 years and older.

Eastern Migratory Population: The 29 samples from this population spanned 14 years (Table 2). For this population there was at least one sample represented for each season, for each sex and for each age group (Tables 3, 4 and 5).

Wood Buffalo-Aransas Population: The samples from this population spanned all 15 years that samples were collected but the samples only came from six years within that time span (Table 2). This population only had samples from the breeding, winter, and spring migration seasons (Table 3). Each of the sexes was represented in the samples from this population (Table 4). Although the Juvenile age group was not represented in the samples from this population, there was at least one sample from each of the other age groups (Table 5).

Table 2 – Number of samples collected by USGS from each North American Whooping Crane population, by year collected.

Populations	Number of samples	Year											
		2000	2001	2003	2005	2007	2008	2009	2010	2011	2012	2013	2014
EMP	29	0	1	1	3	8	1	3	2	4	3	2	1
WBAP	7	1	0	0	0	1	1	1	0	0	0	2	1
LNMP	2	0	0	0	0	0	0	0	0	0	2	0	0
Total	38	1	1	1	3	9	2	4	2	4	5	4	2

Table 3 – Number of samples collected by USGS from each North American Whooping Crane population, by season found.

Populations	Number of Samples	Seasons			
		Winter	Spring Migration	Fall Migration	Breeding
EMP	29	1	4	6	18
WBAP	7	3	3	0	1
LNMP	2	0	0	0	2
Total	38	4	7	6	21

Table 4 – Sex distribution of samples by breeding population.

Populations	Number of Samples	Sex		
		Male	Female	Unknown
EMP	29	8	17	4
WBAP	7	4	2	1
LNMP	2	0	1	1
Total	38	12	20	6

Table 5 – Age distribution of samples by breeding population.

Populations	Number of Samples	Age			
		Adult	Immature	Juvenile	Unknown
EMP	29	9	14	4	2
WBAP	7	4	2	0	1
LNMP	2	0	2	0	0
Total	38	13	18	4	3

Louisiana Non-Migratory Population: The two samples from this population came from the breeding season of 2012 (Table 3). One was from a female and one was from a bird of unknown sex (Table 4). Both of the samples from the Louisiana population were from immature birds (Table 5).

Summary of foods consumed: food categories consumed:

Apart from unidentifiable organic matter, the crane's gastrolith and non-consumable items, six different food item categories were consumed and identified in one or more of the 38 samples. These categories were benthic macro-invertebrates, arthropods, vegetation, seeds, mollusks and vertebrates. Not all of the food categories were consumed during all of the years of the samples. All food categories and non-consumables were consumed during 2005, 2007, 2009, 2011, 2012 and 2013 while in other years some categories were not consumed (Table 6). Not all food categories were consumed during all seasons. During the breeding season, spring migration and fall migration, all six food categories and non-consumables were consumed. During the winter season, benthic macro-invertebrates, arthropods, vegetation, mollusks and non-consumable items were eaten (Table 7). Across all the samples, all food categories were consumed by each sex (Table 8). Food categories consumed varied by age. All of the food categories were consumed by adult and immature birds. All of the other age groups consumed two or more food types but not all food types (Table 9).

Table 6 – Number (%) of Whooping Cranes with ventriculus and proventriculus items from each category sorted by year.

Year (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
2000 (1)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	1 (100)
2001 (1)	1 (100)	0 (0)	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
2003 (1)	1 (100)	0 (0)	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)
2005 (3)	3 (100)	3 (100)	2 (67)	3 (100)	2 (67)	1 (33)	1 (33)	2 (67)	1 (33)
2007 (9)	9 (100)	2 (22)	8 (89)	8 (89)	9 (100)	7 (78)	4 (44)	5 (56)	3 (33)
2008 (2)	2 (100)	0 (0)	1 (50)	2 (100)	0 (0)	2 (100)	0 (0)	1 (50)	1 (50)
2009 (4)	4 (100)	1 (25)	4 (100)	1 (25)	2 (50)	3 (75)	1 (25)	3 (75)	2 (50)
2010 (2)	1 (50)	0 (0)	2 (100)	1 (50)	1 (50)	2 (100)	1 (50)	2 (100)	1 (50)
2011 (4)	4 (100)	2 (50)	4 (100)	4 (100)	4 (100)	1 (25)	4 (100)	3 (75)	2 (50)
2012 (5)	5 (100)	2 (40)	5 (100)	3 (60)	3 (60)	2 (40)	3 (60)	4 (80)	3 (60)
2013 (4)	4 (100)	1 (25)	1 (25)	1 (25)	2 (50)	3 (75)	1 (25)	4 (100)	2 (50)
2014 (2)	2 (100)	0 (0)	1 (50)	1 (50)	0 (0)	2 (100)	0 (0)	2 (100)	2 (100)

Table 7 – Number (%) of Whooping Cranes with ventriculus and proventriculus items from each category sorted by season.

Season (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Winter (4)	4 (100)	1 (25)	1 (25)	2 (50)	0 (0)	3 (75)	0 (0)	2 (50)	2 (50)
Spring Migration (7)	7 (100)	1 (14)	6 (86)	4 (57)	4 (57)	5 (71)	3 (43)	6 (86)	4 (57)
Breeding (21)	20 (95)	7 (33)	18 (86)	15 (71)	13 (62)	9 (43)	9 (43)	14 (67)	10 (48)
Fall Migration (6)	6 (100)	2 (33)	5 (83)	5 (83)	6 (100)	6 (100)	3 (50)	5 (83)	3 (50)

Table 8 – Number (%) of Whooping Cranes with ventriculus and proventriculus items from each category sorted by sex.

Sex (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Male (12)	12 (100)	3 (25)	9 (75)	10 (83)	7 (58)	8 (67)	4 (33)	8 (67)	3 (25)
Female (20)	19 (95)	5(25)	16(80)	11(55)	11(55)	11(55)	6(30)	17(85)	13(65)
Unknown (6)	6 (100)	3 (50)	5 (83)	5 (83)	5 (83)	4 (67)	6(100)	2 (33)	3 (50)

Table 9 – Number (%) of Whooping Cranes with ventriculus and proventriculus items from each category sorted by age category.

Age (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Adult (13)	13 (100)	5 (38)	8 (62)	9 (69)	8 (62)	6 (46)	6 (46)	11 (85)	8 (62)
Immature (18)	18 (100)	4 (22)	6 (33)	12 (67)	9 (50)	11 (61)	3 (17)	11 (61)	9 (50)
Juvenile (4)	3 (75)	0 (0)	3 (75)	3 (75)	3 (75)	4 (100)	3 (75)	3 (75)	2 (50)
Unknown (3)	3 (100)	2 (67)	3 (100)	2 (67)	3 (100)	2 (67)	3 (100)	2 (67)	0 (0)

Eastern Migratory Population: All of the food categories were found in the samples collected from the Eastern Migratory population. All six food categories, organic matter and non-consumables were found in 2005, 2007, 2009, 2011 and 2012, but only some of the categories were consumed in other years (Table 10). All six food items were found during the breeding season, spring migration and fall migration. During the winter season only benthic macro-invertebrates were found (Table 11). All of the food categories were found in samples from each of the sexes (Table 12). All of the food categories were found in samples from the adult, unknown age and immature birds (Table 13).

Wood Buffalo-Aransas Population: The food categories found in samples from the WBAP were less consistent due to the smaller number of samples. None of the years contained all of the categories (Table 14). In none of the seasons were all of the food categories consumed (Table 15). Benthic macroinvertebrates and vertebrates were the only food categories not found in samples from males. Samples from females contained mollusks and non-consumables. The one unknown sex bird had arthropods, seeds, mollusks and vertebrates in the sample (Table 16). None of the age groups contained all of the food categories. Each of the three age groups contained between two and five food categories (Table 17).

Louisiana Non-Migratory Population: Both samples from this population came from the breeding season. Between the two samples, all six food categories were represented. One sample contained arthropods, vegetation, vertebrates, mollusks and non-consumable items. The other sample contained benthic macro-invertebrates, arthropods, vegetation, seeds and vertebrates. Only one species or type was consumed in the category of benthic macro-invertebrates, mollusks and non-consumables. Two arthropod species and four seed species were found.

Table 10 – Number (%) of Whooping Cranes in the Eastern Migratory Population with ventriculus and proventriculus items from each food category sorted by year.

Year (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
2001 (1)	1 (100)	0 (0)	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
2003 (1)	1 (100)	0 (0)	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)
2005 (3)	3 (100)	3 (100)	2 (67)	3 (100)	2 (67)	1 (33)	1 (33)	2 (67)	1 (33)
2007 (8)	8 (100)	2 (25)	7 (88)	7 (88)	8 (100)	7 (88)	4 (50)	4 (50)	3 (38)
2008 (1)	1 (100)	0 (0)	1 (100)	1 (100)	0 (0)	1 (100)	0 (0)	1 (100)	1 (100)
2009 (3)	3 (100)	1 (33)	3 (100)	1 (33)	2 (67)	2 (67)	1 (33)	3 (100)	2 (67)
2010 (2)	1 (50)	0 (0)	2 (100)	1 (50)	1 (50)	2 (100)	1 (50)	2 (100)	1 (50)
2011 (4)	4 (100)	2 (50)	4 (100)	4 (100)	4 (100)	1 (25)	4 (100)	3 (75)	2 (50)
2012 (3)	3 (100)	1 (33)	3 (100)	1 (33)	2 (67)	1 (33)	2 (67)	3 (100)	2 (67)
2013 (2)	2 (100)	1 (50)	0 (0)	1 (50)	1 (50)	1 (50)	0 (0)	2 (100)	1 (50)
2014 (1)	1 (100)	0 (0)	1 (100)	0 (0)	0 (0)	1 (100)	0 (0)	1 (100)	1 (100)

Table 11 – Number (%) of Whooping Cranes in the Eastern Migratory Population with ventriculus and proventriculus items from each food category sorted by season.

Season (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumable
Winter (1)	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	1 (100)
Spring Migration (4)	4 (100)	1 (25)	4 (100)	3 (75)	2 (50)	4 (100)	2 (50)	3 (75)	3 (75)
Breeding (18)	17 (94)	6 (33)	16 (89)	13 (72)	12 (67)	7 (39)	8 (44)	12 (67)	8 (44)
Fall Migration (6)	6 (100)	2 (33)	5 (83)	5 (83)	6 (100)	6 (100)	3 (50)	5 (83)	3 (50)

Table 12 – Number (%) of Whooping Cranes in the Eastern Migratory Population with ventriculus and proventriculus items from each food category sorted by sex.

Sex (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Male (8)	8 (100)	3 (38)	7 (88)	7 (88)	6 (75)	5 (63)	4 (50)	6 (75)	2 (25)
Female (17)	16 (94)	4 (24)	15 (88)	10 (59)	10 (59)	10 (59)	5 (29)	14 (82)	11 (65)
Unknown (4)	4 (100)	3 (75)	3 (75)	4 (100)	4 (100)	2 (50)	4 (100)	1 (25)	2 (50)

Table 13 – Number (%) of Whooping Cranes in the Eastern Migratory Population with ventriculus and proventriculus items from each food category sorted by age category.

Age (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non - consumables
Adult (9)	9 (100)	5 (55.56)	7 (77.78)	7 (77.78)	7 (77.78)	4 (44.44)	6 (66.67)	7 (77.78)	5 (55.56)
Immature (16)	16 (100)	4 (25)	15 (93.75)	11 (68.75)	9 (56.25)	9 (56.25)	3 (18.75)	11 (68.75)	9 (56.25)
Juvenile (4)	3 (75)	0 (0)	3 (75)	3 (75)	3 (75)	4 (100)	3 (75)	3 (75)	2 (50)
Unknown (2)	2 (100)	2 (100)	2 (100)	2 (100)	2 (100)	1 (50)	2 (100)	1 (50)	0 (0)

Table 14 – Number (%) of Whooping Cranes in the Wood Buffalo - Aransas Population with ventriculus and proventriculus items from each food category sorted by year.

Year (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
2000 (1)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	1 (100)
2007 (1)	1 (100)	0 (0)	1 (100)	1 (100)	1 (100)	0 (0)	0 (0)	1 (100)	0 (0)
2008 (1)	1 (100)	0 (0)	0 (0)	1 (100)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)
2009 (1)	1 (100)	0 (0)	1 (100)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)
2013 (2)	2 (100)	0 (0)	1 (50)	0 (0)	1 (50)	2 (100)	1 (50)	2 (100)	1 (50)
2014 (1)	1 (100)	0 (0)	0 (0)	1 (100)	0 (0)	1 (100)	0 (0)	1 (100)	1 (100)

Table 15 – Number (%) of Whooping Cranes in the Wood Buffalo - Aransas Population with ventriculus and proventriculus items from each food category sorted by season.

Season (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Winter (3)	3 (100)	0 (0)	1 (33)	2 (67)	0 (0)	3 (100)	0 (0)	1 (33)	1 (33)
Spring Migration (3)	3 (100)	0 (0)	2 (67)	1 (33)	2 (67)	1 (33)	1 (33)	3 (100)	1 (33)
Breeding (1)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	1 (100)	1 (100)

Table 16 – Number (%) of Whooping Cranes in the Wood Buffalo - Aransas Population with ventriculus and proventriculus items from each food category sorted by sex.

Sex (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Male (4)	4 (100)	0 (0)	2 (50)	3 (75)	1 (25)	3 (75)	0 (0)	2 (50)	1 (25)
Female (2)	2 (100)	0 (0)	0 (0)	0 (0)	0 (0)	1 (50)	0 (0)	2 (100)	2 (100)
Unknown (1)	1 (100)	0 (0)	1 (100)	0 (0)	1 (100)	1 (100)	1 (100)	1 (100)	0 (0)

Table 17 – Number (%) of Whooping Cranes in the Wood Buffalo - Aransas Population with ventriculus and proventriculus items from each food category sorted by year.

Age (N)	Grit	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Adult (4)	4 (100)	0 (0)	1 (25)	2 (50)	1 (25)	2 (50)	0 (0)	4 (100)	3 (75)
Immature (2)	2 (100)	0 (0)	1 (50)	1 (50)	0 (0)	2 (100)	0 (0)	0 (0)	0 (0)
Unknown (1)	1 (100)	0 (0)	1 (100)	0 (0)	1 (100)	1 (100)	1 (100)	1 (100)	0 (0)

Summary of foods found in samples: Number of food species found in samples:

Five of the six food categories and the non-consumables were represented by multiple species or types. Over all 38 samples, there were 25 species of seeds, five species of benthic macro-invertebrates, six species of arthropods, three types of vegetation, six species of mollusks, and five types of non-consumables (including different kinds of plastic and metals) (Table 18; See Appendix A for list of species found). Whooping Cranes consumed different numbers of species within each food category. The birds from the EMP consumed more species or types of benthic macro-invertebrates, arthropods, vegetation, seeds, and five types of non-consumables. The birds from the WBAP consumed more species of mollusks. The two birds from the Louisiana population consumed one species of benthic macro-invertebrates, two species of arthropods, two types of vegetation, four species of seeds, one species of mollusks, and one type of non-consumables.

The number of species per food category found in the samples varied between the years the samples were collected, the seasons, the sexes and the age groups. The variation of species between the years did not have a discernable pattern (Table 19). The breeding season had the most number of species across all of the food categories except mollusks; the greatest number of species of mollusks was consumed during winter (Table 20). Adult birds had the most species for all food types except arthropods and non-consumables. Samples from immature birds contained the most species of arthropods and non-consumables (Table 21). The variation in the number of consumed species between the sexes displayed no discernable pattern (Table 22).

Table 18 – Number of species or types of food items identified within each food category for each population.

Population	Benthic Macro - Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
EMP	10	6	3	17	2	1	1	5
WBAP	0	2	1	3	5	1	1	2
LNMP	1	2	2	4	1	1	1	1

Table 19 – Number of species or types of food items identified within each food category for each year.

Year	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
2000	0	1	0	0	0	0	1	2
2001	0	1	1	0	0	0	0	0
2003	0	1	1	0	0	0	0	1
2005	4	1	2	4	2	1	1	2
2007	4	4	3	9	2	1	1	4
2008	0	1	1	0	2	0	1	1
2009	1	3	1	2	3	1	1	2
2010	0	2	1	2	2	1	1	1
2011	3	2	1	7	2	1	1	2
2012	0	2	3	6	2	1	1	2
2013	1	1	2	4	2	1	1	4
2014	0	1	1	0	4	0	1	2

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Table 20 – Number of species or types of food items identified within each food category for each season.

Season	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Winter	1	1	1	0	5	0	1	4
Spring Migration	1	2	2	5	1	1	1	4
Breeding	6	5	3	19	2	1	1	4
Fall Migration	5	4	3	5	2	1	1	1

Table 21 – Number of species or types of food items identified within each food category for each age group.

Age	Benthic Macro - Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-Consumables
Adult	5	2	3	14	4	1	1	3
Immature	5	3	2	13	4	1	1	4
Juvenile	1	1	2	4	2	1	1	1
Unknown	3	3	2	4	1	1	1	0

Table 22 – Number of species or types of food items identified within each food category for each sex.

Sex	Benthic Macro - Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Male	2	3	3	9	6	1	1	3
Female	5	3	3	18	2	1	1	5
Unknown	4	5	3	9	1	1	1	2

Eastern Migratory Population: The number of species of food items in the sample varied across years, seasons, sexes and age groups. The number of species in the samples varied between the years and the sexes (Table 23 and 24). The breeding season had the most variety of species among all of the food categories (Table 25). Variety of species consumed varied across age groups; this variation was consistent with that observed in the wild population (Table 26).

Wood Buffalo-Aransas Population: The number of species found in the samples from this population varied with the year (Table 27). There was no clear season that had more species of all of the food types. Winter had the most species of mollusks, spring migration had the most for seeds and breeding had the most for arthropods (Table 28). Adults consumed the greatest variety of species across all of the food types (Table 29). The number of species consumed also varied with no observable significance between the sexes (Table 30)

Louisiana Non-Migratory Population: The samples from two birds from the Louisiana population consist of several species or types for each of the food items found (Table 18). Due to small sample sizes from this population, the results are not presented by year, season, sex and age group as for the EMP and WBAP.

Table 23 – Number of species or types found in each food category by year for the Eastern Migratory Population.

Year	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
2001	0	1	1	0	0	0	0	0
2003	0	1	1	0	0	0	0	1
2005	4	1	2	4	2	1	1	2
2007	4	4	3	7	2	1	1	4
2008	0	1	1	0	1	0	1	1
2009	1	3	1	2	1	1	1	2
2010	0	2	1	2	2	1	1	1
2011	3	2	1	7	2	1	1	2
2012	0	2	2	2	2	1	1	2
2013	1	0	2	3	1	0	1	3
2014	0	1	0	0	2	0	1	1

Table 24 – Number of species or types found in each food category by sex for the Eastern Migratory Population.

Sex	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Male	2	2	3	7	2	1	1	2
Female	4	3	3	14	2	1	1	5
Unknown	4	4	3	8	1	1	1	2

Table 25 – Number of species or types found in each food category by season for the Eastern Migratory Population.

Season	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Winter	1	0	0	0	0	0	1	3
Spring Migration	1	2	2	3	1	1	1	4
Breeding	6	5	3	15	2	1	1	4
Fall Migration	5	4	3	5	2	1	1	1

Table 26 – Number of species or types found in each food category by age group for the Eastern Migratory Population.

Age	Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-Consumables
Adult	5	2	3	12	2	1	1	3
Immature	4	3	2	6	2	1	1	4
Juvenile	1	1	2	4	2	1	1	1
Unknown	3	3	2	3	1	1	1	0

Table 27 – Number of species or types found in each food category by year for the Wood Buffalo - Aransas Population.

Year	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
2000	0	1	0	0	0	0	1	2
2007	0	1	1	2	0	0	1	0
2008	0	0	1	0	2	0	0	0
2009	0	1	0	0	2	0	0	0
2013	0	1	0	1	2	1	1	2
2014	0	0	1	0	2	0	1	1

Table 28 – Number of species or types found in each food category by season for the Wood Buffalo - Aransas Population.

Season	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Winter	0	1	1	0	5	0	1	1
Spring Migration	0	1	1	2	1	1	1	2
Breeding	0	2	0	0	2	0	1	2

Table 29 – Number of species or types found in each food category by age group for the Wood Buffalo - Aransas Population.

Age	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-Consumables
Adult	0	1	1	2	4	0	1	2
Immature	1	1	0	4	3	0	0	0
Unknown	1	1	0	1	1	1	1	0

Table 30 – Number of species or types found in each food category by sex for the Wood Buffalo - Aransas Population.

Sex	Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Organic Matter	Non-consumables
Male	0	2	1	2	5	0	1	1
Female	1	1	0	4	2	0	1	2
Unknown	0	1	0	1	1	1	1	1

Summary of foods consumed: average energy

The average estimated energy obtained from each food type varied considerably between the populations. The Eastern Migratory Population obtained the most energy from each food type except vegetation. The Louisiana Population obtained the most energy from vegetation (Table 31). During the breeding season birds consumed the most energy for all food types except from mollusks. The most energy obtained from mollusks occurred during the winter (Table 32). The energy consumed varied between the sexes, age groups and years without a discernible pattern (Tables 33, 34 and 35).

Eastern Migratory Population: For this population, the average estimated energy obtained in the samples was the greatest during the breeding season for all food types except mollusks. During spring migration, the most energy came from mollusks (Table 36). The birds of unknown sex consumed the most energy from invertebrates, seeds and vertebrates. Females consumed the most energy from arthropods and males from mollusks (Table 37). There was no observable relationship between the energy obtained from each food type by the different age groups and within the years (Tables 38 and 39).

Wood Buffalo – Aransas Population: Only six of the seven samples obtained from this population add enough different identifiable items to be used for the energetics analysis. For the samples from this population, the greatest average estimated energy obtained was found during the winter season for all food types except seeds. During spring migration, the birds obtained the most energy from seeds (Table 40). Males obtained the more energy from arthropods, vegetation and mollusks than females. (Table 41). There was no observable difference between the energy obtained from each food type by each age group and within each year (Tables 42 and 43).

Table 31 – Estimated energy (KJ) available from each food category across all populations. (Potential energy available in each sample collected)

Population (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
EMP (29)	62 (2)	161(6)	616 (21)	2131(73)	1.3 (0.05)	38,463 (1,326)	41,434 (1,429)
WBAP (6)	0 (0)	2 (0.35)	48 (8)	366 (61)	1.3 (0.21)	565 (94)	982 (164)
LNMP (2)	0.33 (0.17)	1 (0.74)	77 (38)	46 (23)	0 (0)	7 (3)	131 (66)
Total (37)	62 (21)	164 (55)	741 (247)	2542 (848)	3 (0.86)	39,035 (13,012)	42,548 (14,183)

Table 32 – Estimated energy (KJ) available from each food category by season collected. (Potential energy available in each sample collected)

Season (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
Breeding (21)	60 (3)	137 (7)	531 (25)	2146 (102)	1 (0.05)	33,789 (1,609)	36,663 (1,746)
Fall Migration (6)	2 (0.28)	22 (4)	74 (12)	60 (10)	0.02 (0.00)	414 (69)	571 (95)
Spring Migration (6)	0.33 (0.06)	4 (0.7)	92 (15)	366 (61)	0.2 (0.04)	4,832 (805)	5,295(883)
Winter (4)	0.33 (0.08)	2 (0.5)	44 (11)	0 (0)	1 (0.3)	0 (0)	47 (12)
Total (37)	62 (15)	164 (41)	741 (185)	2,572 (643)	3 (0.7)	39,035 (9759)	42,577 (10,644)

Table 33 – Estimated energy (KJ) available from each food category by sex of sample source. (Potential energy available in each sample collected)

Sex (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
Female (19)	2 (0.10)	124 (7)	191 (10)	395 (21)	1 (0.05)	9,475 (499)	10,189(536)
Male (12)	7 (0.66)	27 (2)	420 (38)	1,232(103)	2 (0.14)	8,469 (706)	10,156 (846)
Unknown (6)	53 (8.78)	13 (2)	129 (22)	915 (153)	0 (0)	21,092 (3,515)	22,202 (3,700)
Total (37)	62 (21)	164 (55)	741 (247)	2543 (848)	3 (0.86)	39,035 (13,012)	42,548 (14,183)

Table 34 – Estimated energy (KJ) available from each food category by age group of sample source. (Potential energy available in each sample collected)

Age (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
Adult (12)	9 (0.75)	49 (4)	412 (34)	0.56 (0.05)	0.56 (0.05)	11,735 (978)	13,336 (1,111)
Immature (18)	2 (0.09)	105 (6)	225 (12)	407 (23)	1 (0.08)	4,274 (237)	5,013 (279)
Juvenile (4)	0 (0)	0.23 (0.06)	72 (18)	372 (93)	0.60 (0.15)	2,074 (518)	2,518 (629)
unknown (3)	52 (17)	10 (3)	32 (11)	634 (211)	0 (0)	20,952 (6,984)	21,609 (7,227)
Total (37)	62 (15)	164 (41)	741 (185)	1413 (353)	3 (0.64)	3,903 (9,759)	42,476 (10,619)

Table 35 – Estimated energy (KJ) available from each food category by year collected. (Potential energy available in each sample collected)

Year (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
2001 (1)	0 (0)	0.08 (0.08)	0.09 (0.09)	0 (0)	0 (0)	0 (0)	0.16 (0.16)
2003 (1)	0 (0)	0.08 (0.08)	8 (8)	0 (0)	0 (0)	0 (0)	8 (8)
2005 (3)	1 (0.44)	0.23 (0.08)	320 (107)	31.11 (10)	0 (0)	200 (67)	553 (184)
2007 (9)	52 (5.74)	11 (1)	180 (20)	1,123 (125)	0.23 (0.03)	24,062 (2,673)	25,427 (2,825)
2008 (2)	0 (0)	0.08 (0.04)	0.2 (0.1)	0 (0)	0.29 (0.14)	0 (0)	1 (0.27)
2009 (4)	0.33 (0.08)	85 (21)	39 (10)	0.30 (0.08)	0.90 (0.23)	600 (150)	729 (182)
2010 (2)	0 (0)	17 (8)	8 (4)	12 (6)	0.42 (0.21)	67 (33)	104 (52)
2011 (4)	8 (2)	49 (12)	21 (5)	1,202 (300)	0.18 (0.05)	6,668 (1,667)	7,947 (1,987)
2012 (5)	0.66 (0.13)	2 (0.34)	110 (22)	61 (12)	0.28 (0.06)	5,541 (1,108)	5,714 (1,143)
2013 (4)	0.33 (0.08)	0.08 (0.02)	10 (3)	114 (28)	0.13 (0.03)	564.67 (141)	689 (172)
2014 (2)	0.00 (0)	0.08 (0.04)	44 (22)	0 (0)	0.15 (0.07)	1,334 (667)	1,337(689)
Total (37)	62 (6)	164 (15)	741 (67)	2,543 (231)	3 (0.23)	39,035(3,549)	42,511 (3,865)

Table 36 – Estimated energy (KJ) available from each food category for samples within the Eastern Migratory Population by season collected. (Potential energy available in each sample collected)

Season (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
Breeding (18)	59 (3)	135 (8)	454 (25)	2,072 (115)	1 (0.06)	33,782 (1877)	36,503 (2,028)
Fall Migration (6)	2 (0.28)	22 (4)	74 (12)	57 (10)	0.02 (0.00)	414 (69)	571 (95)
Spring Migration (4)	0.33 (0.08)	4 (1)	87 (22)	0.15 (0.04)	0.26 (0.06)	4,267 (1067)	4,260 (1,090)
Winter (1)	0.33 (0.33)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.33)
Total (29)	62 (15)	161 (40)	616 (154)	2,129 (532)	1 (0.33)	38,463 (9,616)	41,334 (10,334)

Table 37 – Estimated energy (KJ) available from each food category for samples within the Eastern Migratory Population by sex of sample source. (Potential energy available in each sample collected)

Sex (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
Female (17)	2 (0.10)	124 (7)	159 (9)	350 (21)	0.84 (0.05)	9,468 (557)	10,104 (594.34)
Male (8)	7 (1)	25 (3)	372 (47)	979 (122)	0.47 (0.06)	8,468 (1,058)	9,852 (1,231)
Unknown (4)	53 (13)	12 (3)	85 (21)	802 (201)	0.00 (0.00)	20,527 (5,132)	21,479 (5,370)
Total (29)	62 (21)	161 (54)	616 (205)	2,131 (710)	1 (0.44)	38,463 (12,821)	41,435 (13,812)

Table 38 – Estimated energy (KJ) available from each food category for samples within the Eastern Migratory Population by age group of sample source. (Potential energy available in each sample collected)

Age (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
Adult (9)	9 (1)	49 (5)	364 (40)	877 (97)	0.41 (0.05)	11,735 (1,304)	13,035 (1,448)
Immature (14)	1.33 (0.09)	101 (7)	148 (11)	361 (26)	0.30 (0.02)	4,267 (304.81)	4,879 (349)
Juvenile (4)	0 (0)	0.23 (0.06)	72 (18)	372 (93)	0.60 (0.15)	2,074 (518.42)	2,518 (629)
Unknown (2)	52 (26)	10 (5)	32 (15)	521 (261)	0 (0)	20,387 (10,194)	21,003 (10,501)
Total (29)	62 (15)	162 (40)	616 (154)	2,131 (533)	1 (0.33)	38,463 (9,616)	41,434 (10,359)

Table 39 – Estimated energy (KJ) available from each food category for samples within the Eastern Migratory Population by year collected. (Potential energy available in each sample collected)

Year (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
2001 (1)	0 (0)	0.08 (0.08)	0.09 (0.09)	0 (0)	0 (0)	0 (0)	0.16 (0.16)
2003 (1)	0 (0)	0.08 (0.08)	8 (8)	0 (0)	0 (0)	0 (0)	8 (8)
2005 (3)	1 (0.44)	0.23 (0.08)	320 (107)	31 (10)	0 (0)	200 (67)	553 (184)
2007 (8)	52 (6)	11 (1)	176 (22)	870 (109)	0.23 (0.03)	24,061(3,008)	25,170 (3,146)
2008 (1)	0 (0)	0.08 (0.08)	0.09 (0.09)	0 (0)	0.07 (0.07)	0 (0)	0.23 (0.23)
2009 (3)	0.33 (0.11)	83 (28)	39 (13)	0.30 (0.10)	0 (0)	600 (200)	723 (241)
2010 (2)	0 (0)	17 (8)	8 (4)	12 (6)	0.42 (0.21)	67 (33)	104 (52)
2011 (4)	8 (2)	49 (12)	21 (5)	1,202 (300)	0.18 (0.05)	6,668 (1,667)	7,947 (1,987)
2012 (3)	0.33 (0.11)	0.23 (0.08)	33 (11)	15 (5)	0.28 (0.09)	5,534(1,845)	5,583 (1,861)
2013 (2)	0.33 (0.17)	0 (0)	10 (5)	0.45 (0.23)	0.04 (0.02)	0 (0)	11 (6)
2014 (1)	0 (0)	0.08 (0.08)	0 (0)	0 (0)	0.09 (0.09)	1,334 (1,334)	1,334 (1,334)
Total (29)	61 (6)	112 (10)	616 (56)	2,131 (194)	1 (0.12)	38,464 (3,497)	41,434 (3,767)

Table 40 – Estimated energy (KJ) available from each food category for a sample within the Wood Buffalo-Aransas Population by season collected. (Potential energy available in each sample collected)

Season (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
Breeding (1)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (0.09)	0 (0)	0.09 (0.09)
Spring Migration (2)	0 (0)	0.15 (0.08)	4 (2)	366 (183)	0 (0)	565 (282)	935 (468)
Winter (3)	0 (0)	2 (1)	44 (15)	0 (0)	1 (0.39)	0 (0)	47 (16)
Total (6)	0 (0)	2 (1)	48 (16)	366 (122)	1 (0.42)	565 (188)	982 (327)

Table 41 – Estimated energy (KJ) available from each food category for a sample within the Wood Buffalo-Aransas Population by sex of sample source. (Potential energy available in each sample collected)

Sex (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
Female (1)	0 (0)	0 (0)	0 (0)	0 (0)	0.09 (0.09)	0 (0)	0.09 (0.09)
Male (4)	0 (0)	2 (1)	48 (12)	253 (63)	1 (0.29)	0 (0)	47 (16)
Unknown (1)	0 (0)	0.08 (0.08)	0 (0)	113 (113)	0 (0)	565 (565)	678 (678)
Total (6)	0 (0)	2 (1)	48 (16)	366 (122)	1 (0.42)	565 (188)	725 (242)

Table 42 – Estimated energy (KJ) available from each food category for a sample within the Wood Buffalo-Aransas Population by age group of sample source. (Potential energy available in each sample collected)

Age (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
Adult (3)	0 (0)	0.08 (0.03)	48 (16)	253 (84)	0.15 (0.05)	0 (0)	301 (100)
Immature (2)	0 (0)	2 (1)	0.09 (0.04)	0 (0)	1 (0.56)	0 (0)	3 (2)
Unknown (1)	0 (0)	0.08 (0.08)	0 (0)	113 (113)	0 (0)	565 (565)	678 (678)
Total (6)	0 (0)	2 (1)	48 (16)	366 (122)	1 (0.42)	565 (188)	982 (327)

Table 43 – Estimated energy (KJ) available each food category for a sample within the Wood Buffalo-Aransas Population by year collected. (Potential energy available in each sample collected)

Year (N)	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Mollusks	Vertebrates	Total
2007 (1)	0 (0)	0.08 (0.08)	4 (4)	253 (253)	0 (0)	0 (0)	257 (257)
2008 (1)	0 (0)	0 (0)	0.09 (0.09)	0 (0)	0.22 (0.22)	0 (0)	0.30 (0.30)
2009 (1)	0 (0)	2 (2)	0 (0)	0 (0)	0.90 (0.90)	0 (0)	3 (3)
2013 (2)	0 (0)	0.08 (0.04)	0 (0)	113 (57)	0.09 (0.05)	565 (282)	678 (339)
2014 (1)	0 (0)	0 (0)	44 (44)	0 (0)	0.06 (0.06)	0 (0)	44 (44)
Total (6)	0 (0)	2 (0.42)	48 (10)	366 (73)	1 (0.25)	565 (113)	982 (196)

Louisiana Non-Migratory Population: Both of the samples came from immature birds and from the breeding season, so variation between seasons cannot be observed. The one female bird obtained more energy from invertebrates and vertebrates. The other bird of unknown sex obtained the most energy from arthropods, vegetation, seeds and mollusks.

Statistics

All of the quantity data were tested for the LINE assumptions of normality. None of the data were linear in scatter plots with any of the category variables (population, season, sex or age). Only the grit amount data were normal when graphed on a Q-Q plot. Therefore, the Kruskal-Wallis test was used for statistical analysis instead of a one-way ANOVA.

Presence and Absence: Each food type was run in its own model with each of the independent variables. The data were then filtered to just the Eastern Migratory Population samples and run again. The significance values for the models ranged from 0.997 to 0.002 (Table 44). Only eight of the models yielded significance values less than 0.05. For the combined data across all the populations, the significant models were:

- Presence of arthropods between the populations
- Presence of seeds between the seasons
- Presence of mollusks between the seasons
- Presence of vertebrates between the ages

For the Eastern Migratory Population the significant models were:

- Presence of mollusks between the seasons
- Presence of vertebrates between the sexes
- Presence of vertebrates between the ages

Table 44 – Assumed significance values for all logistic regression models run on presence and absence data for each food type.

		Grit Presence	Benthic Macro-Invertebrates Presence	Arthropods Presence	Vegetation Presence	Seeds Presence	Mollusks Presence	Vertebrates Presence	Organic Matter Presence	Non-Consumables Presence
Overall	Population	0.760	0.061	**0.043**	0.159	0.142	0.780	0.276	0.812	0.915
	Season	0.751	0.773	0.100	0.624	**0.004**	**0.024**	0.219	0.512	0.979
	Sex	0.520	0.492	0.907	0.161	0.417	0.763	0.053	0.052	0.083
	Age	0.191	0.138	0.192	0.990	0.240	0.160	**0.006**	0.534	0.183
EMP	Season	0.807	0.510	0.151	0.394	0.058	**0.002**	0.730	0.719	0.440
	Sex	0.579	0.155	0.808	0.078	0.143	0.918	**0.017**	0.090	0.169
	Age	0.214	0.015	0.566	0.598	0.429	0.166	**0.006**	0.895	0.371

A total of seven logistic regression models were run for each variable: four when all samples were included and three when only the Eastern Migratory Population was considered. In total, 63 models were run. When all three populations were considered, only five of the models were statistically significant. These models were:

Independent Variable	Dependent Variable	Assumed Significance
Population	Arthropods	0.043
Season	Seeds	0.004
Season	Mollusks	0.024
Age	Vertebrates	0.010
Age	Non-consumable items	0.041

The effect of the independent variable on the dependent was found to be significant in these models, however only the coefficients for the equation for population and arthropods were significant. The coefficient constant was 1.833 and for dummy variable 1 (which looked at the difference between arthropods consumed by the Eastern Migratory Population and the Wood Buffalo – Aransas population) was -2.213. The model therefore shows that birds of the EMP obtained statistically more arthropods than the WBAP. When the samples were limited to the Eastern Migratory Population samples, only three models were considered significant:

Independent Variable	Dependent Variable	Assumed Significance
Season	Mollusks	0.002
Sex	Vertebrates	0.017
Age	Vertebrates	0.005

Here, none of the coefficients for any of the models were significant. Therefore, even though the logistic regression calculation showed that the different levels of the independent variable had an effect on the birds finding the food type, the model could not generate a

statistically significant equation. In other words, although there is a significant effect, it is not one that could be quantified by the model.

Quantity: For each food type, the difference in quantity was compared among the populations, sexes, age and season. The quantity comparisons among season, sex and age group were repeated for each food type for each population's samples individually. Across all of the samples, the assumed significance values ranged from 0.019 to 0.958. For the EMP, the assumed significance values ranged from 0.014 to 0.921 (Table 44). For the WBAP, the assumed significance values ranged from 0.05 to 0.776 (Table 45). A total of 117 hypotheses were tested across the six different food items, crane gastrolith, decomposing organic matter and non-consumable items. A Bonferroni correction run on the standard P-value of 0.05 yielded a new P-value of 4.27×10^{-4}. None of the tests yielded an assumed significance less than 4.27×10^{-4}. The differences observed in the amount of each food item consumed among the populations, years, seasons, age, or sex were not statistically significant.

Table 45 – Assumed significance for Kruskal-Wallis tests performed on the quantity data. The quantity of each food type consumed in the samples was compared among the populations, years, seasons, sexes and age groups. The samples were then filtered by population to compare the quantity of each food type between years, seasons, sexes and age groups separately for each population.

	food type	Grit	Benthic Macro-Invertebrates	Arthropoda	Vegetation	Seeds	Shells	Vertebrates	Organic Matter	Non-consumables
Overall	Population	0.719	0.075	0.071	0.184	0.384	0.282	0.128	0.303	0.534
	Year	0.541	0.492	0.047	0.668	0.078	0.306	0.301	0.814	0.901
	Season	0.305	0.740	0.575	0.592	0.108	0.350	0.452	0.274	0.893
	Sex	0.049	0.230	0.440	0.135	0.210	0.410	0.117	0.179	0.054
	Age	0.184	0.095	0.154	0.850	0.328	0.309	0.015	0.617	0.344
EMP	Year	0.517	0.687	0.181	0.841	0.140	0.454	0.354	0.497	0.851
	Season	0.354	0.713	0.259	0.590	0.326	0.293	0.818	0.466	0.216
	Sex	0.219	0.041	0.773	0.097	0.105	0.567	0.088	0.265	0.153
	Age	0.177	0.010	0.210	0.375	0.501	0.231	0.019	0.960	0.504
WBAP	Year	0.509	1	0.441	0.306	0.480	0.351	0.776	0.351	0.493
	Season	0.565	1	0.670	0.544	0.211	0.098	0.513	0.098	0.499
	Sex	0.158	1	0.377	0.214	0.368	0.669	0.050	0.479	0.098
	Age	0.158	1	0.472	0.644	0.368	0.148	0.050	0.129	0.214

Number of species: For each food category that had more than one identifiable species or type, the difference in the number of species present was compared among the populations, seasons, age groups and sexes. The number was compared among seasons, age group and sexes individually for each population (Table 46). Across all of the samples the assumed significance values ranged from 0.012 to 0.968. For the EMP the assumed significance values ranged from 0.036 to 0.964. For the WBAP the assumed significance values ranged from 0.061 to 0.717. For number of species, a total of 78 hypotheses were tested across five different food types and non-consumable items. A Bonferroni correction run on the standard P-value of 0.05 yielded a new P-value of 6.41×10^{-4}. None of the tests yielded an assumed significance less than 6.41×10^{-4}. Thus, the differences observed in the number of species of each food type consumed by each population, age, sex, and season and year were not statistically significant.

Energetics: For each food type where the energy obtained could be estimated, the difference in the energy obtained from each species was compared among the populations, seasons, age groups and sexes. The estimated energy was compared among seasons, age group and sexes individually for each population (Table 47). Across all of the samples, the assumed significance values ranged from 0.015 to 0.955. For the EMP, the assumed significance values ranged from 0.009 to 0.879. For the WBAP, the assumed significance values ranged from 0.082 to 1. A total of 78 different hypotheses were tested across all six food types; the Bonferroni corrected p-value, therefore, is the same for this set of analyses. None of the tests yielded an assumed significance less than 6.41×10^{-4}. Therefore, even though the energy per food type varied between population, year, season, sex and age group, these differences were not statistically significant.

Table 46 – Assumed significance for Kruskal-Wallis tests performed to compare the number of species consumed for each food category among the populations, seasons, sex and age for all samples and by population.

	food type	Benthic Macro-Invertebrates	Arthropoda	Vegetation	Seeds	Shells	Non-consumables
Overall	Population	0.075	0.012	0.175	0.063	0.210	0.930
	Year	0.500	0.126	0.557	0.056	0.260	0.890
	Season	0.752	0.093	0.968	0.032	0.067	0.869
	Sex	0.193	0.180	0.404	0.256	0.238	0.084
	Age	0.094	0.175	0.858	0.800	0.284	0.012
EMP	Year	0.687	0.306	0.793	0.130	0.418	0.964
	Season	0.679	0.216	0.558	0.134	0.061	0.197
	Sex	0.032	0.354	0.386	0.036	0.470	0.237
	Age	0.012	0.162	0.409	0.157	0.205	0.011
WBAP	Year	1	0.514	0.306	0.480	0.396	0.569
	Season	1	0.513	0.513	0.211	0.061	0.360
	Sex	1	0.287	0.185	0.368	0.717	0.093
	Age	1	0.624	0.459	0.420	0.172	0.082

Table 47 – Assumed significance for Kruskal-Wallis tests performed to compare the estimated energy obtained for each food category among the populations, seasons, sex and age for all samples and by population.

	Food type	Benthic Macro-Invertebrates	Arthropods	Vegetation	Seeds	Shells	Vertebrates
Overall	Population	0.099	0.087	0.361	0.389	0.120	0.152
	Year	0.468	0.073	0.775	0.078	0.282	0.374
	Season	0.818	0.371	0.763	0.096	0.289	0.346
	Sex	0.252	0.491	0.186	0.081	0.346	0.259
	Age	0.420	0.268	0.955	0.147	0.154	0.015
EMP	Year	0.701	0.268	0.879	0.212	0.453	0.341
	Season	0.716	0.437	0.605	0.101	0.249	0.718
	Sex	0.047	0.636	0.108	0.016	0.555	0.193
	Age	0.081	0.405	0.686	0.194	0.128	0.009
WBAP	Year	1	0.412	0.287	0.441	0.351	0.736
	Season	1	0.486	0.616	0.091	0.172	0.368
	Sex	1	0.576	0.337	0.516	0.675	0.082
	Age	1	0.307	0.531	0.630	0.300	0.172

DISCUSSION

Of the 38 viable samples found and analyzed, only seven samples were obtained from the WBAP. Since the population spends half of the year in northern Canada in remote locations, samples could not be obtained for the breeding season and part of each of the migration seasons. This also limited the ages of the sample birds to categorization as adult and immature. The EMP yielded samples from every season and all but one age group. Representation of each sex was not limited by this geographic restriction. The WBAP had twice as many samples from males as from females. From the EMP, there were more samples from females than from males. The limited number of samples from the WBAP makes comparative analysis difficult. Also given the vast geographical range that the two populations span, the particular genera/species consumed would be different. This was why analysis was limited to food type. If each population was consuming the same basic food type but not exactly the same species then the diets would be considered similar with regional variations in species.

Most of the variation in food items consumed among samples correlated to year, season and age. The only variation seen between sex came from the Wood Buffalo-Aransas Population. More samples would likely have reduced this variation. While it is known that females spend more time taking care of the eggs and the chicks, there was no significant difference between the diets of males and females during the breeding season. One can conjecture that females are given time by their mates to forage. The differences noted between foods consumed among years may be explained by variations in availability of food items each year. The differences noted between foods consumed among seasons relate to the availability of the different food types in those seasons and in the different areas as the birds migrate. For example, seeds, vegetation and vertebrates are more abundant in spring and the summer breeding season. Also during the

migration, birds are limited by what they find in their stopovers. The differences in foods consumed among ages are similar to that of the seasonal variation. The younger birds (nestlings and yearlings) would consume foods that are appropriate for their size and foods they had seen their parents eat while they were younger. As they grow and explore, they would find more foods that are available to them. Also as they grow, they find more species and types of each food type they eat. Therefore, the variations that were seen with seasons and age follow reasonable expectations based on seasonal changes and growing knowledge of available foods.

None of the statistical analyses run on the data yielded significant results. From this set of samples, the diets of the two populations do not significantly differ. This result might be due to the smaller number of samples from the Wood Buffalo – Aransas population. A larger number of samples from that population might reveal a difference in the diets. However, I only had access to samples collected by USGS. In any case, the crane breeding grounds in Alberta are inaccessible year-round.

As I observed no significant difference between the diets of the two migratory populations, I do not expect to find any difference between the migratory and non-migratory populations. Seasonal variation would be less intense for a non-migratory population because individuals have greater opportunity to forage during spring and fall. The migratory population is limited to their stopover sites for food during those months, while the non-migratory population has their whole range to forage.

Analysis of *G. americana* upper gastrointestinal tract contents revealed a wider variety of foodstuffs available to 21st-century cranes than were documented by historic studies by Chavez-Ramirez (1996) and Hunt and Slack (1985 and 1989). Blue crabs, clams, crayfish, fish and snails were found to be the most important food items by those early researchers. Hunt, Slack, and

Chavez-Ramirez found that the wild cranes ate crayfish, acorns, blue crabs, clams, fish, snails, wolfberries, shrimp, snakes and insects. The birds of the EMP found all of these items except for wolfberries, which could not be positively identified in stomach samples. The EMP birds also found various seeds and fruits; as acorns are a known part of the diet of *G. americana*, their consumption of other plant products is feasible. Whooping Cranes have also been observed foraging in farm fields. Overall, cranes from the Eastern Migratory Population consumed most of the items recorded by previous researchers (Hunt and Slack 1985 and 1989; Chavez-Ramirez 1996).

As time moves on and their environment keeps changing, the variety of foodstuffs available will differ as climate change accelerates. Climate change is already having an effect on migratory species (Jenni and Kéry 2003, Lehikoinen et al. 2004, Tøttrup et al. 2006). Changes in climate affect atmospheric temperatures, affecting the development of insects and appearance of flowering plants. If migratory species do not shift their migration patterns to match this change, they are less likely to find enough food (Both et al. 2006). Climate change could therefore have a long-lasting impact on the diet of Whooping Cranes. Because cranes primarily migrate based on the length of the day, temperature changes may alter the peak appearance of preferred food items without altering the timing of their migration. Cranes will be forced to adapt to these and other changes. Over the span between 1985 and 2014, cranes have expanded their chosen food items. Because their diet does consist of a wide range of foods, they may be more adaptable to such changes. It is likely that cranes will move their nesting sites to follow their foods. It is also likely that Whooping Cranes will shift their diet to focus on the food items that are more available.

CONCLUSIONS AND FURTHER RESEARCH

Birds from both the Wood Buffalo-Aransas and Eastern Migratory populations consumed the foods that were mentioned in the literature: mollusks of various kinds, fish, snakes, crabs, insects, and acorns. They also consumed items that had not been previously mentioned: beetles, vegetation, plant seeds, and non-consumable items such as plastic and metal. Both populations consumed the same food items and in amounts that were not statistically different from each other. Overall, it seems that the human-introduced population is finding the foods that their wild cousins have previously been known to eat. Cranes raised in captivity do not have an adult crane role model to teach them what to eat; they must therefore have some genetic or innate knowledge that directs them to appropriate food items. They are, however, curious creatures. They consume plastic and metal from the environment. It is possible that they pick up plastic and metal as they are looking for rocks for their gizzards. Further study is needed to understand how much of their food knowledge is innate and how much comes from trial and error. Further study is also needed to know if their consumption of plastic and metal is accidental. Their migration habits also need to be observed more closely. Changes in temperature and plant distribution are going to alter the availability of various food items. The timing of Whooping Crane migration needs to be mapped over many years and correlated to temperature change to see what impact global warming could have on their diet.

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Appendix A: Species List

Phylum	Class	Order	Family	Genus/Species	Confirmed Instances in Samples
Arthropoda	*Malacostraca*	*Decapoda*	Unknown	unknown	5
			Coleoptera	unknown	29
	Insecta	*Diptera*	*Dixidae*	unknown	3
			Muscidae	unknown	4
			Phoridae	*Megaselia sp.*	3
			Ephydridae	*Allotrichoma simplex*	1
Molluscae	Unknown pieces too small to identify further				21
	Gastropoda	*Basommatophora*	*Planorbidae*	unknown	8
			Physidae	unknown	1
		Neotaenioglossa	*Pleuroceridae*	*Juga sp.*	2
			Littorinidae	*Littorina obtusata*	1
				Philippia krebsi	1
Magnoliophyta	6 Seeds that could not be identified				16
	Magnoliopsida	*Fagales*	*Fagacaea*	*Quercus sp.*	4
		Najadales	*Potmogetonaceae*	*Potamogeton sp.*	2
		Rosales	*Rosacae*	*Rubus sp.*	3
				Prunus sp.	2
		Rhamnales	*Rhamnaceae*	*Ceanothus sp.*	2
		Asterales	*Asteraceae*	*Cyclachena xanthifolia (Iva xanrhifolia)*	1
				Helianthus divaricatus	1
		Fabales	*Fabaceae*	*Centrosema sp.*	1
		Polygonales	*Polygonaceae*	*Polygonum sagittatum*	1
				Polygonum lapathifollum	1
		Dipscales	*Caprifoliaceae*	*Viburnum sp.*	1
		Ericales	*Ericaceae*	*Vaccinium sp.*	5
		Lamiales	*Boraginaceae*	*Lithospermum sp.*	1
		Sapindales	*Anacardiaceae*	*Rhus trilobata*	1
	Liliopsoda	*Cyperlas*	*Poaceae/Gramineae*	*Hordeum vulgare*	1
				Sporobolus cryptondus	1
				Zea mays	1
			Cyperecae	*Carex rastrata*	2
				Dulichium arundinaceaum	2

Appendix B: Necropsy Date Tables

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
12824	2	Whooping Crane	28-Aug-93	ID	Bonneville	Grays Lake	Immature (juvenile)	M	Elevated zinc levels Handling stress suspected Superficial abrasions
16762	1	Whooping Crane	15-Mar-00	CO	Rio Grande	Monte Vista NWR	Adult	F	Trauma
17379	1	Whooping Crane	11-Sep-01	WI	Juneau	Necedah NWR	Immature (juvenile)	M	Peracute capture myopathy Localized thymic necrosis and hemorrhage Chronic active hepatitis
17410	1	Whooping Crane	25-Oct-01	WI	Green	1 mi S of New Glarus St Park	Immature (juvenile)	M	Severe intra-thoracic hemorrhage Compatible with powerline trauma
18747	1	Whooping Crane	07-Aug-03	WI	Juneau	Necedah NWR	Immature (juvenile)	F	Acute trauma (fractured ribs, femur, synsacrum) Resulting in severe internal hemorrhage Multifocal granulomatous pneumonia due to visceral coccidiosis Multifocal pyogranulomatous serositis, esophagus, proventriculus, ventriculus (suspected disseminated visceral coccidiosis)

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
19405	1	Whooping Crane	03-May-05	WI	Jackson	Lat/Long: 44.3477N, 90.5351W	Adult	M	Predation, Severed right common carotid and tracheal arteries Subacute comminuted fracture, left metatarsus Abnormal parathyroid structure - possible hyperplasia Flavivirus antibody positive
19510	1	Whooping Crane	03-Aug-05	WI	Juneau	Necedah NWR	Immature (juvenile)	F	Trauma, History suggests handling trauma
19611	1	Whooping Crane	26-Oct-05	WI	Juneau	Necedah NWR	Adult	M	Acute multifocal hepatic necrosis (suspect trauma-induced) Moderate, multifocal granulocytic enterotyphlitis Intestinal trematodiasis Cecal nematodiasis Pneumonia, mild, lymphoplasmacytic and granulocytic

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
19622	1	Whooping Crane	09-Nov-05	IN	Morgan	near Morgantown	Young of the first year (yearling)	U	Laceration of left lower lid & perforation of sinus, acute, moderate Hemorrhage (bruising), contra-coup, cerebral, acute, moderate Congestive splenomegaly, mild to moderate Fracture of left mandible, greenstick-type, acute, moderate
20251	1	Whooping Crane	13-Apr-07	IN	Daviess	Lat 38.585 Long 86.998, next to a reclaimed mine pit	Second year (SY)	F	Bite wounds on neck with fracture of cervical vertebra, probably bobcat predation Fracture of left radius with callus, chronic-healed, focal Possible salmonella infection (cloacal culture) Abrasion & ulcer, focal, chronic, very mild (assoc with radio transmitter) Metal (aluminum) foreign body in the gizzard, possibly tip of a table or chair leg
20257	1	Whooping Crane	18-Apr-07	ND	Morton	South of the town of Almont	Adult	M	Massive blunt trauma

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
20351	1	Whooping Crane	12-Jul-07	WI	Juneau	44 13.528N by 90 15.387W, Meadow Valley Flowage	Unknown	U	Undetermined cause of death (decomposed, scavenged)
20408	1	Whooping Crane	20-Aug-07	WI	Juneau	Lat/Long: 44* 13.925' by 90* 13.449', Meadow Valley Flowage	After second year (ASY)	F	Septicemia, suspect - possibly bacterial Mild multifocal suppurative and lymphocytic myocarditis Esophageal and proventricular trematodiasis Intestinal trematodiasis Gizzard nematodiasis
20440	1	Whooping Crane	13-Sep-07	WI	Juneau	Meadow Valley Flowage. 44* 14.113' N, 90* 13.242' W.	Unknown	U	Undetermined cause of death (decomposition and scavenging)
20475	1	Whooping Crane	28-Sep-07	WI	Juneau	Necedah NWR	Adult	F	Trauma (with severe internal hemorrhage) probable predation

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
20522	1	Whooping Crane	30-Oct-07	WI	Juneau	Sprague Pool 44 9.469 by 90 8.606	Young of the first year (yearling)	F	Bite wounds on head, upper neck and body, hemorrhagic Rupture of right lobe, segmental, acute, hemorrhagic, moderate Internal hemorrhage, acute, disseminated, mild to moderate Serositis, esophageal, heterophilic, diffuse, mild to moderate Hepatitis, granulomatous, miliary, mild to moderate Pneumonitis, granulomatous, miliary, mild Meningo-encephalitis, non-suppurative, focal, very minimal
20527	1	Whooping Crane	31-Oct-07	WI	Dane	Dane County Airport	Young of the first year (yearling)	U	Blunt impact trauma (probably hit by airplane), numerous fractured bones, crushed kidneys Hemorrhage (aspiration of blood), acute, disseminated, mild to moderate Colopathy, verminous, focal, very minimal

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
20531	1	Whooping Crane	04-Nov-07	KY	Grayson	South of Caneyville, KY	Immature (juvenile)	M	Blunt Force Trauma
20684	1	Whooping Crane	22-Mar-08	IN	Fayette	Glenwood	Immature (juvenile)	F	Trauma
20695	1	Whooping Crane	30-Mar-08	TN	Bledsoe	Pikeville	Immature (juvenile)	F	Predation
									Chondroma-like mass on left leg adjacent to hock
22363	1	Whooping Crane	01-Dec-08	TX	Aransas	40 yards from watering hole near Aransas NWR boat dock	Subadult (adolescent)	M	Subacute laceration, left hock joint, resulting in Septic arthritis, left hock joint Acute and peracute necrosis, skeletal muscle of the legs Possible terminal disseminated intravascular coagulation and hemolysis Emaciation
22410	1	Whooping Crane	15-Jan-09	TX	Aransas	Peanut field	Immature (juvenile)	M	Predation with severe cranial trauma and cervical dislocation Severe emaciation Virus isolated from bursa; IBDV- like

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
22512	1	Whooping Crane	03-Apr-09	WI	Columbia	County Road A	Immature (juvenile)	F	Trauma, flight into wire
22538	1	Whooping Crane	29-Apr-09	WI	Wood	Rudolf, 44° 28.196' N, -89° 48.705' W (approx. 44.466667N, -89.8 W, 1085 ft. elev.)	Immature (juvenile)	F	Trauma, Predation Hepatitis Enteritis
22698	1	Whooping Crane	08-Aug-09	WI	Juneau	Necedah NWR	Immature (juvenile)	F	Predation Mild, multifocal, chronic, lymphohistiocytic pneumonia
23134	1	Whooping Crane	14-Jul-10	WI	Juneau	Necedah NWR	Nestling or suckling	F	Acute unilateral airsacculitis and peritonitis due to E. coli Bacteremia, possible septicemia
23333	1	Whooping Crane	30-Oct-10	WI	Juneau	Necedah NWR	Immature (juvenile)	M	Predation

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
23562	2	Whooping Crane	13-Jun-11	WI	Adams		Adult	F	Septicemia Emaciation Intestinal trematodiasis Plasmodium sp. protozoa Ventricular capillariasis Tracheal trematodiasis
23586	1	Whooping Crane	01-Jul-11	WI	Juneau	Necedah NWR	Nestling or suckling	M	Bite wounds on thorax, hemorrhagic, acute, severe Transverse fracture of vertral column, hemorrhagic, acute, severe Fractures and luxations of ribs, hemorrhagic, disseminated, acute, moderate to severe Atrophy of fat, diffuse, moderate to severe (Emaciation) Salmonella sp.
23595	1	Whooping Crane	07-Jul-11	WI	Juneau	Juneau County Forest; WCEP 31-08 found at 44.01678, -90.19505	Adult	M	Predation

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
23595	2	Whooping Crane	07-Jul-11	WI	Juneau	Juneau County Forest; WCEP 27-05 found at 43.99713, -90.19567	Adult	U	Undetermined due to decomposition
23911	1	Whooping Crane	03-Apr-12	LA	Vermilion	White Lake Wetland Conserv. Area	Immature (juvenile)	F	Cause of death not determined
23966	1	Whooping Crane	31-May-12	WI	Juneau	Necedah NWR	Adult	M	Granulocytic enteritis, diffuse, moderate (Undetermined Cause) Decomposed carcass with autolyzed tissues Intestinal trematodiasis Capillariasis Hepatic nematodiasis, larval, mild

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
23980	1	Whooping Crane	14-Jun-12	WI	Juneau	Necedah NWR	Adult	F	Bite wounds, hemorrhagic, multifocal, moderate (Predation) Atrophy of fat and muscles, diffuse, moderate to severe (Emaciation) Intestinal salmonellosis Abrasion, ulcer and scab, mechanical, focal, chronic Chromomycosis, granulomatous, focal, chronic, minimal

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
24002	1	Whooping Crane	06-Jul-12	WI	Polk	5 mi E of Hwy 35, 45.259269, -92.697357	Immature (juvenile)	F	Hemorrhages & bruises, acute, thoracic, moderate to marked (Blunt or impact trauma) Plumbism (10.97 ppm) Abscesses or granulomata, transmural, chronic, moderate (hardware disease) Atrophy or necrosis, diffuse, severe
24005	1	Whooping Crane	03-Jul-12	LA	Vermilion	Private rice fields	Immature (juvenile)		Predation
24183	1	Whooping Crane	26-Oct-12	IL	Piatt	Cisco, 39.973808, -88.70181	Immature (juvenile)	F	Pulmonary hemorrhage, multifocal, mild Tibio-tarsal fracture, comminuted, reduced, left
24183	001	Whooping Crane	31-Oct-12	IL	Piatt		Immature (juvenile)	F	Trauma
24638	001	Whooping Crane	14-Jan-14	TX	Aransas		Adult	M	Trauma
24337	001	Whooping Crane	05-Apr-13	SD	Hand		Unknown	U	Shot
24353	001	Whooping Crane	18-Apr-13	LA	Red River		Adult	F	Shot

Case	ACC	Species	Date Collected	State Collected	County	Collection Location	Age	Sex	Diagnosis
24371	001	Whooping Crane	23-Apr-13	SD	Hand		Adult	F	Trauma
24378	001	Whooping Crane	26-Apr-13	WI	Adams		Adult	F	Decomposed/previously posted
24612	001	Whooping Crane	03-Dec-13	WI	Dodge		Immature (juvenile)	F	Trauma
24619	001	Whooping Crane	09-Dce-13	WI	Dodge		Immature (juvenile)	M	Infectious Disease
24799	001	Whooping Crane	21-Apr-14	WI	Juneau		Adult	F	Metabolic and/or Nutritional Cause

Appendix C: Individual Sample Tables

Appendix Table 1 – 38: All of the tables contain each food item found in each sample. The quantity of each item was measured volumetrically. The energy obtained from each food type was calculated by first using density to convert the volume into mass. Energy per gram data were collected from government websites and scholarly papers (see Energetics Bibliography). Total energy was calculated from the mass and the energy per gram data. There are no energy data for Sample 16762 because there were no species known for the organic matter. Sex, age, flock, date collected, season and location found data are included for each sample.

Appendix Table 1:

Sample 16762					
Demographic Information					
Population	WBAP				
Location Found	Rio Grande, CO				
Date Collected	3/15/2000				
Season Collected	Winter				
Sex	Female				
Age (Group)	Adult				
	Item Identification			Quantity	
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume
Crayfish? Or Other organic matter hair or feather piece	Organic Matter	N/A	organic matter	Unknown	16.25
Rocks	Grit	N/A	Grit	Unknown	25 ml
plastic	Non-Consumables	N/A	non-consumable	unknown	1 ml
Misc. non-consumable	Non-Consumables	N/A	non-consumable	unknown	Trace

Appendix Table 2:

Sample 17379						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	9/11/2001					
Season Collected	Breeding					
Sex	Male					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
other (plant)	Vegetation	N/A	Vegetation	Unknown	0.1	0.087
Coleoptera	Arthropoda	family	Coleoptera	Unknown	0.1	0.075
Grit (rocks)	Grit	N/A	Grit	Unknown	22	N/A

Appendix Table 3:

Sample 18747						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	8/7/2003					
Season Collected	Breeding					
Sex	Female					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Types	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Plant	Vegetation	N/A	vegetation	N/A	0.9	7.857
Beetle parts	Arthropoda	family	Coleoptera	unknown	0.1	0.075
Other - Glass	Non-Consumables	N/A	non-consumables	5	0.1	N/A
Grit (Rocks)	Grit	N/A	grit	unknown	25	N/A

Appendix Table 4:

Sample 19405						
Demographic Information						
Population	EMP					
Location Found	Jackson, WI					
Date Collected	5/3/2005					
Season Collected	Breeding					
Sex	Male					
Age (Group)	Adult					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Plant (Reed?)	Vegetation	N/A	Vegetation	unknown	36.1	315.153
Seed ?	Seeds	Unidentified	Unidentified	35	0.1	0.151
Unknown Invertebrate parts	Invertebrates	N/A	invertebrate parts	1	0.1	0.314
Glass? (strange rocks)	Non-Consumables	N/A	non-consumables	unknown	1	N/A
other, plastic	Non-Consumables	N/A	non-consumables	2	0.1	N/A
Rocks	Grit	N/A	Grit	unknown	25	N/A

Appendix Table 5:

Sample 19510						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	8/3/2005					
Season Collected	Breeding					
Sex	Female					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	count	Volume (ml)	Energy (KJ)
Plant (2 types)	Vegetation	N/A	Vegetation	Unknown	0.6	5.238
Unknown Invert parts	Invertebrates	N/A	invert Parts	Unknown	0.1	0.332
Unknown Invert parts	Invertebrates	N/A	invert parts	Unknown	0.1	0.332
Coleoptera pieces	Arthropoda	Family	Coleoptera	Unknown	0.1	0.075
other ?	Arthropoda	Family	Coleoptera	1	0.1	0.075
Extra grit		N/A	Remainder	Unknown	0.9	N/A
Rocks	Grit	N/A	Grit	N/A	22	N/A

Appendix Table 6:

Sample 19611						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	10/26/2005					
Season Collected	Fall Migration					
Sex	Male					
Age (Group)	Adult					
	Item identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Roots	Vegetation	N/A	Roots	11	0.1	0.087
Acorn	Seeds	Genus	Quercus sp.	1	1	7.997
Seed	Seeds	Unidentified	Unidentified	7	1.5	22.659
seed	Seeds	Unidentified	Unidentified	1	0.1	0.151
seed	Seeds	genus sp.	*Iva xanthifolia*	3	0.1	0.151
Unknown Invertebrate Parts	Invertebrates	N/A	invert parts	4	0.1	0.332
Coleoptera pieces	Arthropoda	Family	Coleoptera		0.1	0.075
Shell Fragments (snails, zebra)	Molluscae	Phylum	Mollusca		0.1	0.002
small snail shell	Molluscae	Family	Planorbidae	5	0.1	0.002
Bones	Vertebrates	N/A	Bones		0.3	200.032
Decomposing Organic Matter	Organic Matter	N/A	organic matter	unknown	17.7	
Rocks	Grit	N/A	Grit	15	3	

Appendix Table 7:

Sample 20251						
Demographic Information						
Population	EMP					
Location Found	Daviess, IN					
Date Collected	4/13/2007					
Season Collected	Spring Migration					
Sex	Female					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Plant	Vegetation	N/A	Plant	3	0.1	0.087
Other (plant and seeds ?)	Seeds	genus	Centrosema	1	0.1	0.151
Coleoptera pieces	Arthropoda	Family	Coleoptera	11	0.1	0.075
Creature (crab, lobster, etc…)	Arthropoda	Order	Decapoda	Unknown	1.2	0.584
Shell fragments	Molluscae	Phylum	Mollusca	Unknown	1	0.179
Bones	Vertebrates	N/A	Bones	Unknown	5.5	3667.253
Excess grit & organic matter	Organic Matter	N/A	Organic Matter	Unknown	3.2	N/A
sea glass	Non-consumables	N/A	glass	11	0.1	N/A
Other (scales ?)	Non-consumables	N/A	Misc. Non-consumable	Unknown	0.1	N/A
Shot gun shell	Non-consumables	N/A	Shot gun shell	1	4	N/A
Rocks	Grit	N/A	Grit	Unknown	7	N/A

Appendix Table 8:

Sample 20257						
Demographic Information						
Population	WBAP					
Location Found	Morton, ND					
Date Collected	4/18/2007					
Season Collected	Spring Migration					
Sex	Male					
Age (Group)	Adult					
	Item Identification			Quantity		
Item description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
unknown vegetation	Vegetation	N/A	Vegetation	43	0.5	4.365
decomposing seeds	Seeds	genus sp.	*Hordeum vulgare*	67	7.3	90.864
whole seeds	Seeds	genus sp.	*Hordeum vulgare*	155	13	161.812
seed	Seeds	genus sp.	*Ploygonum sagittatum*	1	0.1	0.151
beetle pieces	Arthropoda	family	Coleoptera	605	0.1	0.075
organic matter	Organic Matter	N/A	organic matter	Unknown	39. 6	N/A
Remainder		N/A	Remainder	Unknown	12.5	N/A
Other	Grit	N/A	misc. Grit	25	2	N/A
Rocks	Grit	N/A	rocks	Unknown	21.5	N/A

Appendix Table 9:

Sample 20351						
Demographic information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	7/12/2007					
Season Collection	Breeding					
Sex	Unknown					
Age (Group)	Unknown					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Unknown vegetation	Vegetation	Unknown	Vegetation	Unknown	2.5	21.852
Seeds	Seeds	Genus	*Potamegeton sp.*	unknown	6.55	519.944
Seeds	Seeds	Genus	*Vaccinium sp.*	1	0.1	0.793
benthic invertebrate	Invertebrates	Family	*Dixidae*	unknown	1.5	49.733
benthic invertebrate	Invertebrates	Family	*Muscidae*	25	0.1	0.332
benthic invertebrate	Invertebrates	genus sp	*Megaselia sp.*	10	0.1	0.332
Fly	Arthropoda	Unknown	Unknown	3	0.1	0.075
Beetles	Arthropoda	Family	Coleoptera	unknown	0.75	5.659
Lots of bones	Vertebrates	Unknown	Snake	1	29.6	20179.68
Grit (rocks)	Grit	N/A	Rocks	Unknown	6.5	N/A

Appendix Table 10:

Sample 20408						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	8/20/2007					
Season Collected	Breeding					
Sex	Female					
Age (group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Unidentifiable vegetation	Vegetation	N/A	Vegetation	Unknown	0.1	0.087
Seed	Seeds	Genus	*Potemageton*	Unknown	0.2	15.861
Seed	Seeds	Genus	*Rubus sp.*	Unknown	4	317.221
Beetle/Crayfish parts	Arthropoda	Family	Coleoptera	unknown	0.1	0.075
Shell Pieces	Mollusca	Phylum	Mollusca	unknown	0.2	0.036
Misc. Grit	Grit	N/A	Misc. Grit	Unknown	0.1	N/A
Grit (rocks)	Grit	N/A	Grit	Unknown	15	N/A

Appendix Table 11:

Sample 20440						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	9/13/2007					
Season Collected	Fall Migration					
Sex	Unknown					
Age (Group)	Unknown					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Root tuber	Vegetation	N/A	Vegetation	1	1.2	10.476
Seed	Seeds	genus	*Ceanothus sp.*	1	0.1	0.151
Seed	Seeds	Genus	*Rubus sp.*	4	0.1	0.793
Invertebrate 1	Invertebrates	Family	*Muscidae*	7	0.1	0.332
Invertebrate 2	Invertebrates	genus	*Megaselia sp.*	6	0.1	0.332
Invertebrate 3	Invertebrates	family	*Dixidae*	Unknown	0.1	0.332
Invertebrate 5	Invertebrates	genus sp.	*Ephydridae-Allotrichoma simplex*	1	0.1	0.332
Mite	Arthropoda	genus	*Elysia*	30	0.1	
Beetle Parts	Arthropoda	family	Coleoptera	Unknown	0.6	4.527
Fly	Arthropoda	Phylum	Arthropoda	5	0.1	0.075
Shell Fragments	Molluscae	Phylum	Mollusca	8	0.1	0.002
Unknown Fish	Vertebrates	N/A	Fish	Unknown	2.3	207.552
organic matter					8	N/A
Misc. Grit	Grit	N/A	Misc. Grit	Unknown	0.1	N/A
Grit (rocks)	Grit	N/A	Grit		7	N/A

Appendix Table 12:

Sample 20522						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	10/30/2007					
Season Collected	Fall Migration					
Sex	Female					
Age (Group)	Juvenile					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Seed	Seeds	Unidentifiable	Unidentifiable	3	0.1	0.151
Plant	Vegetation	N/A	vegetation	unknown	0.5	4.365
Coleoptera	Arthropoda	family	Coleoptera	unknown	0.1	0.075
Shell Fragment	Molluscae	Phylum	Molluscae	24	0.1	0.002
Small Shell	Molluscae	Family	Planorbidae	1	0.1	0.002
Organic matter	Organic Matter	N/A	organic matter	unknown	3	N/A
Organic matter	Organic Matter	N/A	organic matter	unknown	3	N/A
Organic matter	Organic Matter	N/A	organic matter	unknown	23.7	N/A
Other	Organic Matter	N/A	organic matter	unknown	0.1	N/A
Plastic	Non-consumables	N/A	Plastic	unknown	0.1	N/A
Clear Spheres	Grit	N/A	clear spheres	unknown	0.1	N/A
Grey stones	Grit	N/A	grey stones	unknown	0.1	N/A
Rocks	Grit	N/A	Rocks		40	N/A

Appendix Table 13:

Sample 20527						
Demographic Information						
Population	EMP					
Location Found	Dane, WI					
Date Collected	10/31/2007					
Season Collected	Fall Migration					
Sex	Unknown					
Age (Group)	Juvenile					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
plant	Vegetation	N/A	unknown plant	unknown	5.9	51.507
seed	Seeds	Unidentified	Unidentified	130	1	15.102
seed	Seeds	Unidentified	Unidentified	91	trace	0.151
shell pieces	Molluscae	Phylum	Mollusca	55	trace	0.002
other ???	Vertebrates	N/A	bones	unknown	trace	6.668
Plastic	Non-consumables	N/A	Plastic	2	trace	N/A
clear spheres - rock	Grit	N/A	clear spheres	13	trace	N/A
Rocks	Girt	N/A	Rocks	unknown	12	N/A

Appendix Table 14:

Sample 20531						
Demographic Information						
Population	EMP					
Location Found	Grayson, KY					
Date Collected	11/4/2007					
Season Collected	Fall Migration					
Sex	Male					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
seed	Seeds	Unidentified	Unidentified	1	0.1	0.151
Unknown ???	Arthropoda	N/A	misc. carapace	62	0.1	0.075
Coleoptera Carapace	Arthropoda	Family	Coleoptera	21	0.1	0.075
shells	Molluscae	Phylum	Mollusca	unknown	0.1	0.002
Organic goo	Organic Matter	unknown	Organic Matter	unknown	2	N/A
rocks	Grit	unknown	Rocks	unknown	35	N/A

Appendix Table 15:

Sample 20684						
Demographic Information						
Population	EMP					
Location Found	Fayette, IN					
Date Collected	3/22/2007					
Season Collected	Spring Migration					
Sex	Female					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Unknown Veg	Vegetation	N/A	Vegetation	a lot	22 with air, ~10 ml squished	87.3
Seed	Seeds	genus	Prunus	3	0.5	
Beetle Carapace	Arthropoda	Family	Coleoptera	52	0.1	0.075
shell fragments	Molluscae	Phylum	Molluscae	21	0.1	0.002
Remainder		N/A	Remainder	N/A	5.6	N/A
Rocks	Grit	N/A	Rocks		15	N/A

Appendix Table 16:

Sample 20695						
Demographic Information						
Population	EMP					
Location Found	Bledsoe, TN					
Date Collected	3/30/2008					
Season Collected	Spring Migration					
Sex	Female					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Unknown Veg	Vegetation	N/A	Vegetation	17	0.1	0.087
Beetle Carapace	Arthropoda	Family	Coleoptera	15	0.1	0.075
Shell Fragments	Molluscae	Phylum	Molluscae	81	0.4	0.072
Organic and remainder	Organic Matter	N/A	Organic Matter	unknown	4.1	N/A
Unknown	Non-consumables	N/A	Misc. non-consumable	unknown	0.1	N/A
Rocks	Grit	N/A	Rocks	unknown	9.8	N/A

Appendix Table 17

Sample 22363						
Demographic Information						
Population	WBAP					
Location Found	Aransas, TX					
Date Collected	12/1/2008					
Season Collected	Winter					
Sex	Male					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
unknown Veg	Vegetation	N/A	Vegetation		0.1	0.087
Shell fragments	Molluscae	Phylum	Molluscae	247	0.3	0.053
Unknown Snail	Molluscae	genus sp.	Juga sp.	22	0.9	0.161
Remainder		N/A	Remainder	N/A	1.6	N/A
Rocks	Grit	N/A	Rocks	N/A	12.5	N/A

Appendix Table 18:

Sample 22410						
Demographic Information						
Population	WBAP					
Location Found	Aransas, TX					
Date Collected	1/15/2009					
Season Collected	Winter					
Sex	Male					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Order Decapoda	Arthropoda	Order	*Decapoda*	94	4	1.947
Unknown Snail (see WC20C)	Molluscae	genus sp.	*Juga sp.*	1	0.1	0.002
Unknown Snail	Molluscae	genus sp.	*Littorina obtusata*	4	5	0.896
Extra Grit/Remainder/organic	N/A	N/A	N/A	N/A	0.5	N/A
other	Grit	N/A	misc. grit	2	0.2	N/A
Rocks	Grit	N/A	Rocks	6	1	N/A

Appendix Table 19:

Sample 22512						
Demographic Information						
Population	EMP					
Location Found	Columbia, WI					
Date Collected	4/3/2009					
Season Collected	Spring Migration					
Sex	Female					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
invertebrate piece	Invertebrates	N/A	unknown parts	3	0.1	0.332
Coleoptera?	Arthropoda	Family	Coleoptera	unknown	0.1	0.075
Crab/Crayfish	Arthropoda	order	Decapoda	unknown	3, 3.9	3.359
Shell fragments	Molluscae	Phylum	Molluscae	unknown	0.1	0.002
Bones	Vertebrates	unknown	Vertebrates	16	0.9	600.096
Organic Matter	Organic Matter	N/A	organic matter	unknown	16.9	N/A
Plastic	Non-consumables	N/A	Plastic	6	4	N/A
other ???	Grit	N/A	misc. grit	4	0.1	N/A
Rocks	Grit	N/A	Rocks	unknown	14	N/A

Appendix Table 20:

Sample 22538						
Demographic Information						
Population	EMP					
Location Found	Wood, WI					
Date Collected	4/29/2009					
Season Collected	Spring Migration					
Sex	Female					
Age (Group)	Immature					
	Item Identification			Quantity		
Item description	Food type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
seed ?	Seeds	genus	Viburnum	3	0.1	0.151
Coleoptera	Arthropoda	Family	Coleoptera	71	0.1	0.075
Organic Goo	Organic Matter	N/A	Organic Matter	unknown	11.9	N/A
Plastic	Non-consumables	N/A	Plastic	6	22.5	N/A
Aluminum ??	Non-consumables	N/A	Metal	102	0.1	N/A
Rocks	Girt	N/A	rocks	unknown	16	N/A

Appendix Table 21:

Sample 22698						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	8/8/2009					
Season Collected	Breeding					
Sex	Female					
Age (Group)	Immature					
	Item identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Plant?	Vegetation	N/A	Vegetation	unknown	4.5	39.285
Seed (WC11K)	Seeds	Unidentified	Unidentified	33	0.1	0.151
Insect wings/parts	Arthropoda	N/A	insect parts	42	2.4	79.572
Coleoptera	Arthropoda	Family	Coleoptera	725	0.1	0.075
Shell fragments	Molluscae	Phylum	Molluscea	59	0.1	0.002
Organic goo	Organic Matter	N/A	Organic Matter	unknown	4.3	N/A
Rocks	Grit	N/A	Rocks	unknown	17	N/A

Appendix Table 22:

Sample 23134						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	7/14/2010					
Season Collected	Breeding					
Sex	Female					
Age (Group)	Juvenile					
	Item Identification			Quantity		
Item description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Coleoptera	Arthropoda	family	Coleoptera	1752	0.1	0.075
Shells	Molluscae	Phylum	Molluscae	2082	2.3	0.0412
Small Shell	Molluscae	Family	*Planorbidae*	100	0.1	0.002
Bones	Vertebrates	Unknown	Vertebrates	200	0.1	66.677
Organic other	Organic Matter	unknown	organic matter	unknown	1.2	N/A
Small parts/remainder		unknown	Remainder	unknown	3.9	N/A

Appendix Table 23:

Sample 23333						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	10/30/2010					
Season Collected	Fall Migration					
Sex	Male					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Unknown vegetation	Vegetation	N/A	unknown veg	unknown	0.1	0.873
Unknown vegetation	Vegetation	N/A	vegetation	unknown	0.8	6.984
Seed	Seeds	Unidentified		70	0.8	12.085
Seed	Seeds			9	0.1	0.151
Beetles	Arthropoda	family	Coleoptera	14	0.1	0.075
insect body parts	Arthropoda	N/A	insect parts	unknown	0.5	16.578
Shell pieces	Molluscae	family	Molluscae	214	0.1	0.002
Small shells	Molluscae	family	Planorbidae	3	0.1	0.002
organic matter/remainder	Organic Matter	N/A	organic matter	unknown	14.9	N/A
Plastic	non-consumables	N/A	plastic	unknown	0.1	N/A
Rocks	Grit	N/A	Rocks	unknown	15	N/A

Appendix Table 24:

Sample 23562						
Demographic Information						
Population	EMP					
Location Found	Adams, WI					
Date Collected	6/13/2011					
Season Collected	Breeding					
Sex	Female					
Age (Group)	Adult					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Seed	Seeds	genus sp.	*Carex rostrata*	2	0.1	0.151
Seed	Seeds	genus sp.	*Dulichium arundinaceum*	18	0.1	0.151
seed	Seeds	Unidentified	Unidentified	6	0.1	0.151
Unknown vegetation	Vegetation	N/A	Vegetation	unknown	0.5	4.365
insect parts (wings, etc..)	Arthropoda	N/A	insect parts	unknown	0.9	29.84
beetle carapace	Arthropoda	family	Coleoptera	2330	1.3	9.808
Bones	Vertebrates	N/A	vertebrate	275	3	2000.32
Organic remainder	Organic Matter	N/A	Organic Matter	unknown	3.6	N/A
Extra grit and organic matter				unknown	4.3	N/A
other - unknown	Non-consumables	N/A	misc. non-consumables	unknown	1.2	N/A
other - unknown	Grit	N/A	misc. Grit	unknown	0.2	N/A
Rocks	Grit	N/A	Rocks	N/A	11	N/A

Appendix Table 25:

Sample 23586						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	7/1/2011					
Season Collected	Breeding					
Sex	Male					
Age (Group)	Juvenile					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Seed	Seeds	genus	*Vaccinium sp.*	a lot	3.3	261707
Seed	Seeds	Unidentified	Unidentified	1	1	15.106
Seed	Seeds	genus	*Prunus*	1	1	79.305
Unknown vegetation	Vegetation	N/A	unknown veg	unknown	1.8	15.714
Beetle carapace	Arthropoda	family	Coleoptera	138	0.1	0.075
shell fragments	Molluscae	phylum	Molluscea	381	1	0.179
small shell	Molluscae	family	*Planorbidae*	15	0.1	0.002
Bones	Vertebrates	Phylum	Cordata	181	3	2000.32
Orgainc Matter	Organic Matter	N/A	Organic matter	N/A	13.6	N/A
Unknown other	Organic Matter	N/A	Organic matter	N/A	0.5	N/A
Remainder		N/A	remainder	N/A	8.2	N/A
Rocks	Grit	N/A	Grit	59	5.5	N/A

Appendix Table 26:

Sample 23595-001						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	7/7/2011					
Season Collected	Breeding					
Sex	Male					
Age (Group)	Adult					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Unknown Seed	Seeds	Genus	*Vaccinium sp.*	too many	7.3	578.928
Unknown seed	Seeds	genus	*Potamogeton*	46	0.1	0.793
Unknown Vegetation	Vegetation	N/A	Vegetation	7	0.1	0.087
Unknown Creature	Invertebrates	N/A	unknown parts	1	0.2	6.631
Beetle Part	Arthropoda	family	Coleoptera	340	1	7.545
Bones	Vertebrates	N/A	Vertebrate	458	3.8	2533.739
Unknown Organic Matter	Organic Matter	N/A	Organic Matter	N/A	7.8	N/A
Remainder		N/A	Remainder	N/A	8.9	N/A
Rocks	Grit	N/A	Rocks	N/A	13	N/A

Appendix Table 27:

Sample 23595-002						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	7/7/2011					
Season Collected	Breeding					
Sex	Indeterminate					
Age (Group)	Adult					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
unknown seed	Seeds	genus	*Vaccinium*	a lot	3	237.961
unknown seed	Seeds	genus	*Carex rostrata*	9	0.1	0.151
unknown seed	Seeds	Unidentified	Unidentified	8	1.8	27.19
unknown seed	Seeds	genus sp.	*Dulichium arundinaceum*	2	0.1	0.151
unknown seed	Seeds	genus sp.	*Sporobolus cryptandrus*	3	0.1	0.151
unknown vegetation	Vegetation	N/A	Vegetation	9	0.1	0.873
unknown invert 1	Invertebrates	family	*Muscidae*	85	0.1	0.332
unknown invert 2	Invertebrates	family	*Dixidae*		0.1	0.332
unknown invert 3	Invertebrates	genus	*Megaselia sp.*	5	0.1	0.314
Coleoptera	Arthropoda	family	Coleoptera	1551	0.2	1.509
whole insect/beetle	Arthropoda	N/A	unknown coleoptera	1	0.1	0.075
Bones	Vertebrates	N/A	Vertebrate	unknown	0.2	133.355
Remainder		N/A	Remainder	unknown	38.6	N/A
feathers				unknown	2	N/A
Sea glass	Non-consumables	N/A	Glass	unknown	0.1	N/A
rocks	Grit	N/A	Rocks	unknown	10	N/A

Appendix Table 28:

Sample 23966						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	5/31/2012					
Season Collected	Breeding					
Sex	Male					
Age (Group)	Adult					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Unknown Vegetation	Vegetation	N/A	Vegetation	10	0.1	0.087
Roots ??	Vegetation	N/A	Roots	53	3.8	33.174
Beetle Pieces	Arthropoda	family	Coleoptera	59	0.1	0.075
Shell pieces	Molluscae	phylum	Molluscea	1604	1.5	0.278
Planorbidae	Molluscae	family	*Planorbidae*	20	0.1	0.002
Bones	Vertebrates	N/A	Vertebrate	361	5.6	3733.931
Remainder/organic matter	Organic Matter	N/A	Organic Matter	unknown	2.6	N/A
Rocks	Grit	N/A	Rocks	unknown	12	N/A

Appendix Table 29:

Sample 23911						
Demographic Information						
Population	EMP					
Location Found	Vermillion, LA					
Date Collected	4/3/2012					
Season Collected	Breeding					
Sex	Female					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
unknown seed	Seeds	genus	Lithospermum	26	3	45.317
unknown seed	Seeds	genus	Quercus	6	0.1	0.08
unknown seed	Seeds	Unidentified	Unidentified	3	0.1	0.151
unknown seed	Seeds	genus sp.	*Helianthus divaricatus*	10	0.1	0.151
unknown Veg	Vegetation	N/A	Vegetation	unknown	3.7	32.301
unknown invert	Invertebrates	family	*Muscidae*	1	0.1	0.332
Beetle Pieces	Arthropoda	family	Coleoptera	5	0.1	0.075
Carapace	Arthropoda	order	Decapoda	2	0.1	0.005
Bones	Vertebrates	N/A	Vertebrate	9	0.1	6.668
Organic Material	Organic Matter	N/A	Organic Matter	unknown	1.1	N/A
Organic Material	Organic Matter	N/A	Organic Matter	unknown	17.1	N/A
Rocks	Grit	N/A	Rocks	unknown	4	N/A

Appendix Table 30:

Sample 23980						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	6/19/2012					
Season Collected	Breeding					
Sex	Female					
Age (Group)	Adult					
	Item Identification			Quantity		
Item Description	Food type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Seed	Seeds	genus	*Vacinium*	277	0.1	0.007
unknown creature	Invertebrates	N/A	unknown parts	unknown	0.1	0.332
beetle pieces	Arthropoda	phylum	coleoptera	392	0.1	0.075
Bones	Vertebrates	N/A	Vertebrate	602	2.7	1800.288
Organic Matter	Organic Matter	N/A	Organic Matter	unknown	16.6	N/A
Plastic	Non-Consumables	N/A	Plastic	4	1.4	N/A
Rocks	Girt	N/A	Rocks	unknown	21	N/A

Appendix Table 31:

Sample 24002						
Demographic Information						
Population	EMP					
Location Found	Polk, WI					
Date Collected	7/6/2012					
Season Collected	Breeding					
Sex	Female					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Unknown Seed	Seeds	Unidentified	Unidentified	4	1	15.105
Unknown Creature	Invertebrate	Unidentified	Unidentified	1	0.1	
Beetle Pieces	Arthropoda	family	coleoptera	28	0.1	0.075
Unknown Organic	Organic Matter	N/A	Organic Matter	unknown	8	N/A
Unknown Organic	Organic Matter	N/A	Organic Matter	unknown	4.5	N/A
Unknown Organic	Organic Matter	N/A	Organic Matter	unknown	26.6	N/A
Metal	Non-Consumables	N/A	Metal	2	0.1	N/A
Rocks	Grit	N/A	rocks	unknown	16	N/A

Appendix Table 32:

Sample 24005						
Demographic Information						
Population	LA					
Location Found	Vermillion, LA					
Date Collected	7/3/2012					
Season Collected	Breeding					
Sex	Unknown					
Age (Group)	Immature					
	Item Identification			Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
plant/reed/unknown	Vegetation	N/A	Vegetation	unknown	5.1	44.523
Beetle pieces	Arthropoda	family	Coleoptera	60	0.1	0.075
carapace	Arthropoda	order	Decapoda	a lot	2.7	1.314
shells	Molluscae	phylum	Molluscae	13	0.1	0.002
Remainder		N/A	Remainder		4	N/A
Plastic	Non-consumables	N/A	Plastic	2	1	N/A
rocks	Grit	N/A	Rocks		2.1	N/A

Appendix Table 33:

Sample 24337						
Demographic Information						
Population	WBAP					
Location Found	Hand, SD					
Date Collected	4/5/2013					
Season Collected	Spring Migration					
Sex	Unknown					
Age (Group)	Unknown					
	Item Identification			Quantity		
Item description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Corn	Seeds	Unidentified	Unidentified	8 & 24	7.5	113.293
Coleoptera ???	Arthropoda	family	Coleoptera	5	0.1	0.075
shells	Molluscae	phylum	Molluscea	215	0.1	0.001
Bones	Vertebrates	N/A	Vertebrate	12	0.5	564.674
Unknown other	Organic Matter	N/A	Organic Matter	15	1.1	N/A
organic matter/remainder	Organic Matter	N/A	Organic Matter	N/A	6	N/A
Rocks	Grit	N/A	rocks	18	0.9	N/A

Appendix Table 34:

Sample 24371						
Demographic Information						
Population	WBAP					
Location Found	Hand, SD					
Date Collected	4/23/2013					
Season Collected	Breeding					
Sex	Female					
Age (Group)	Adult					
		Item Identification		Amount		
Item description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Shells	Molluscae	Phylum	Molluscae	1039	0.5	0.09
Planorbidae	Molluscae	family	*Planorbidae*	4	0.1	0.002
Organic remainder	Organic Matter	N/A	Organic Matter	unknown	30.5	N/A
Plastic disk	Non-consumables	N/A	Plastic	1	0.5	N/A
unknown other	Non-consumables	N/A	misc. non-consumables	unknown	0.1	N/A

Appendix Table 35:

Sample 24378						
Demographic Information						
Population	EMP					
Location Found	Adams, WI					
Date Collected	4/26/2013					
Season Collected	Breeding					
Sex	Female					
Age (Group)	Adult					
		Item Identification		Amount		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
unknown seed 1	Seeds	Unidentified	Unidentified	1	0.1	0.151
unknown seed 2	Seeds	genus sp.	*Rhus trilobata*	1	0.1	0.151
unknown seed 3	Seeds	genus sp.	*Polygonum lapathifollum*	1	0.1	0.151
Roots	Vegetation	N/A	Vegetation	3	0.5	4.365
Unknown Veg	Vegetation	N/A	Vegetation	unknown	0.7	6.111
Shell fragments	Molluscae	Phylum	Molluscae	330	0.2	0.036
Organic Matter	Organic Matter	N/A	Organic Matter	unknown	0.5	N/A
unknown other	non-consumables	N/A	plastic	unknown	0.1	N/A
unknown other	Grit	N/A	misc. grit	unknown	0.1	N/A
Rocks	Grit	N/A	Rocks	unknown	14.5	N/A

Appendix Table 36:

Sample 24612						
Demographic Information						
Population	EMP					
Location Found	Dodge, WI					
Date Collected	12/3/2013					
Season Collected	Winter					
Sex	Female					
Age (Group)	Immature					
		Item Identification		Amount		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Invert ??	invertebrates	N/A	unknown parts	2	0.1	0.332
Yellow Organic Matter	Organic Matter	N/A	Organic Matter	unknown	3.9	N/A
Plastic	Non-Consumables	N/A	Plastic	12	6	N/A
Aluminum	Non-Consumables	N/A	Metal	20	0.1	N/A
Brown Glass	Non-Consumables	N/A	Glass	3	0.2	N/A
Rocks	Grit	N/A	Rocks	unknown	2.9	N/A

Appendix Table 37:

Sample 24638						
Demographic Information						
Population	WBAP					
Location Found	Aransas, TX					
Date Collected	1/14/2014					
Season Collected	Winter					
Sex	Male					
Age (Group)	Adult					
		Item Identification		Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Unknown Vegetation	Vegetation	N/A	Vegetation	unknown	5	43.65
Unknown Snail 1	Molluscae	Genus sp.	*Philippia krebsi*	16	0.3	0.054
Unknown Snail 2	Molluscae	family	*Physidae*	1	0.1	0.002
Organic Remainder	Organic Matter	N/A	Organic Matter	unknown	6.7	N/A
Unknown other	Non-consumables	N/A	Misc. Non-consumable	unknown	0.1	N/A
Rocks	Grit	N/A	Rocks	unknown	9	N/A

Appendix Table 38:

Sample 24799						
Demographic Information						
Population	EMP					
Location Found	Juneau, WI					
Date Collected	4/21/2014					
Season Collected	Breeding					
Sex	Female					
Age (Group)	Adult					
		Item Identification		Quantity		
Item Description	Food Type	Taxonomic Level	Item Name	Count	Volume (ml)	Energy (KJ)
Beetle Carapace	Arthropoda	family	Coleoptera	136	0.1	0.075
Shell fragments	Molluscae	Phylum	Molluscea	953	0.5	0.09
Planorbidae	Molluscae	family	Planorbidae	20	0.1	0.002
Unknown ?	Vertebrates	N/A	Vertebrate	6	2	1333.547
Extra Grit and organic matter	Organic Matter	N/A	Organic Matter	unknown	2.8	N/A
Plastic	Non-consumables	N/A	Plastic	14	3	N/A
Rocks	Grit	N/A	Rocks	unknown	12	N/A