Dietary Habits of Diamondback Terrapins, Jamaica Bay Wildlife Refuge, New York

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ABSTRACT

The diamondback terrapin *Malaclemys terrapin* is a small to medium-size turtle that lives along the Atlantic coast of the United States from Cape Cod to the Gulf Coast of Texas. This species inhabits salt marshes and estuary ecosystems where fresh water from terrestrial sources mixes with salt water from the ocean. Terrapins are abundant in Jamaica Bay Wildlife Refuge, and over 2000 turtle nests per year are laid on the largest island, Ruler's Bar Hassock. This turtle spends most of the day feeding in the marshes and basking in the tidal creeks. Their dietary and nesting habits may play an important role in carrying marine nutrients into the low-nutrient terrestrial beach environment. They may also have a significant effect on prey populations. Previous studies of terrapins were mostly based on fecal analyses and suggested that they mostly eat invertebrates, but these studies were short term and may have been biased against soft tissue prey. I analyzed terrapin fecal samples and stomach contents from 21 turtles from Jamaica Bay Wildlife Refuge to determine their food habits. Fecal samples were obtained by soaking the turtles in fresh water; stomach contents were collected by flushing stomachs. I observed that the diet was highly variable and included different type of food items such as gastropods, jellyfish, marine plants, and marine annelids which are not found commonly in other turtles.

TABLE OF CONTENTS

LIST OF THE FIGURES AND TABLES

INTRODUCTION

The diamondback terrapin *Malaclemys terrapin* is found in salt marshes of the Eastern United States. As with other turtles, terrapin activities include nesting (in May, June, July), feeding and basking; these are affected by temperature, gender, food sizes and food availability (Mahmound and Klicka 1979). Air temperature can affect terrapin activities due to seasonal variability that can have an effect on digestion rates and reproduction (Allen and Littleford 1955). For example, seasonal climate changes influence the nesting season and the amount time of turtles bask after food ingestion (Moll and Legler 1971). Due to sexual size dimorphism, the larger females and smaller males forage on different sizes of food, particularly snails and crabs (Davenport et al. 1992). Food habits also vary depending on season and turtle age (Allen and Littleford 1955). Salinity and pH are two other factors that could affect the food habits of this species. The importance and possible interactions of these factors remain poorly studied.

Terrapin food habit studies have been carried out since the early 1900s (Coker 1906). Studies of captive terrapins by filming of feeding behavior showed that they ingest prey of variable sizes and energetic content, including whole mussels *(Mytilus edulis)*, limbs of crabs, snails of different sizes (*Littorina littorrea*), and shellfish (Allen and Littleford 1955, Bels et al. 1998, Davenport et al. 1992). Food habits studies of wild terrapins are limited to a few descriptions from dissected specimens and fecal sampling. Studies conducted at Beaufort Harbor and Kiawah Island, South Carolina, indicated that their chief foods included crabs (*Uca pignax, Sesarna reticulatum, Callinectes sapidus*), gastropods, small bivalves, clams, carrion, marine annelids, snails (*Littorina irrorata, Melampus bidentatus)*, and plant material (*Spartina,* unidentified grass fragments and

marine plants), which together constituted 76-79% of the overall diet (Coker 1906, Roosenberg et al. 1999, Tucker et al. 1995, Tucker et al. 1997)

Tucker et al. (1995) analyzed the diet of terrapins by identifying fecal samples through visual comparison with reference collection of marine invertebrates. They observed that soft-bodied prey items were poorly represented in their fecal samples. Snails were not detected during their sampling; however, Davenport et al. (1992) reported that snails were an important part of the diet of terrapins. To remedy the possible under-reporting of soft-bodied prey, dietary composition could be studied using a stomach flushing technique (Fields et al. 2000), which might detect the food before it passes through the digestive system. Stomach flushing can provide data on the kinds, the amount, and the nutritional quality of food resources used by terrapins, as have been demonstrated in slider turtle *Trachemys scripta* (Parmenter and Avery 1990) and giant South American river turtle, *Podocnemis expansa* (Fachin et al.1995).

The purpose of this study was to investigate the diet habits of terrapins and improve understanding of their ecology and role in the salt marsh ecosystem. I hypothesized that the terrapin diet would be highly variable, including food items such as gastropods, marine plants, and marine annelids as shown in previous studies completed in the southern part of the range. I expect that the diet of Jamaica Bay Wildlife Refuge (JBWR) terrapins will be similar to that reported in Tucker et al. (1995), but I hoped to improve on their work by investigating seasonal variation ant the possibility of soft-bodied prey items that might be missed in fecal samples.

METHODS

Field site

My field studies were completed during the summer of 2005 in the vicinity of West Pond, in JBWR, located within the limits of New York City (Figure 1), and part of the Gateway National Recreation Area. The study site stretches along the western portion of the island called Rulers Bar Hassock and several smaller islands. JBWR is a large estuarine park east of the mouth of the Hudson River. By far the most common reptile species found in JBWR salt marshes is the Diamondback Terrapin.

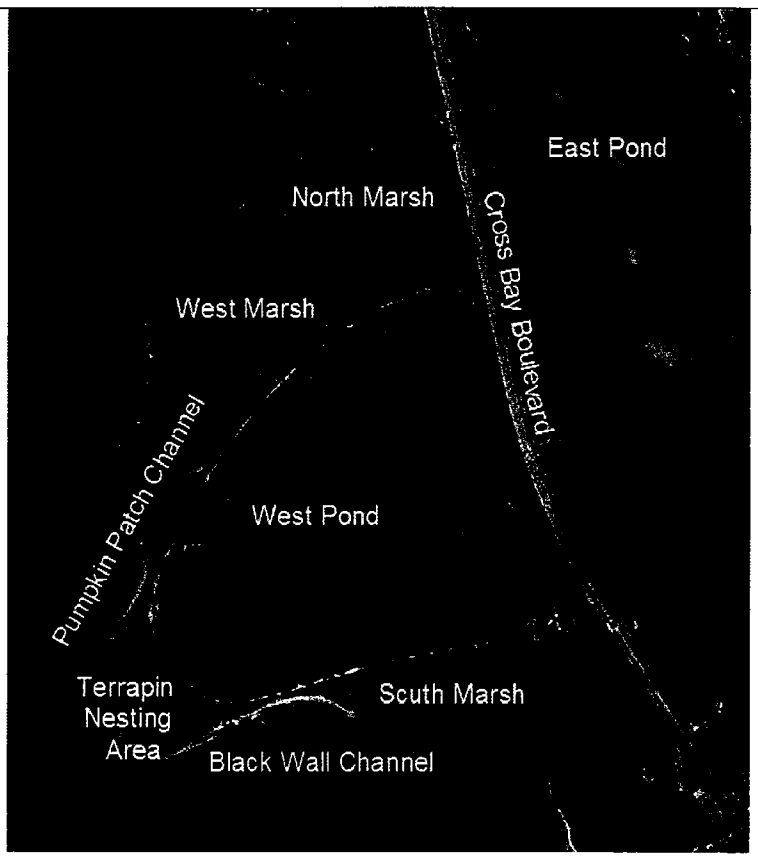

Figure 1. West Pond, Jamaica Bay Wildlife Refuge, Brooklyn, New York forhttp://maps.google.com/

Diamondback Terrapin (*Malaclemys terrapin)* description

Diamondback terrapin is a small to medium sized turtle which lives in estuaries and brackish water (Ernst et al. 1994) along the Atlantic and Gulf coast from Cape Cod to Texas, including the Florida Keys (Figure 2) (U.S. Fish and Wildlife Service 1988). This species can live 25 to 40 years and is characterized by a gray, light brown or black carapace that is broad and sometimes patterned with concentric rings or ridges (Ernst et al. 1994). Its plastron can range from yellowish to greenish gray, with or without bold, dark markings. The large feet are webbed, and the head and limbs may be spotted (Ernst et al. 1994).

Figure 2. Range of Diamondback Terrapin population along the Atlantic and Gulf coast from Cape Cod to Texas, including the Florida Keys. Map source is www.umbi.umd.edu/~panchara/turtle.html

Stomach and feces samples

Terrapin females (n = 21) were caught on land by hand after they had nested. Stomach contents were collected using standard techniques (Fields et al. 2000): turtles

were sedated using the veterinary anesthesia Telazol, injected into a forelimb at 30mg/kg. A feeding tube was coated with jelly lubricant and inserted in the turtle mouth to reach the stomach, with water impelled constantly through the tube. Water was delivered through the tube into the stomach until the stomach was emptied.

Fecal samples were collected by soaking terrapins in fresh water, which often elicits defecation. Females were marked, measured, and released in the field 24-48 hours after stomach contents and fecal samples were collected. Samples were analyzed under microscope and classified by species.

RESULTS

During June and July 2005, nineteen stomach samples and two fecal samples were collected from terrapin females. Turtles caught for sampling had average weights of 1195g and 1164g, and average carapace lengths of 19.6cm and 19.2cm, respectively (Table 1).

Samples	n	Sex	Average weight	Average carapace
Stomach	19	Females	1195 g	19.6
Fecal	2	Females	1164 g	19.2

Table 1. Morphometrics of terrapins used in this study.

Stomach samples were composed of the outer layer (periostracum) of ribbed mussel (*Geukeusia demissa*), lateral layer of amphipods, barnacle (*Balanus sp.*), and legs and body structure of green crab (*Carcinus maenas*). Also, exoskeletons of crustaceans, clams (top of the shell), flies (Diptera), plant material such as leaves, pieces of wood and

sand were found in the samples. Other items such as green gel (algae) and gel material (possibly jellyfish) were difficult to identify under microscope. Fecal samples showed that the turtles ingested ants, leaves, barnacle exoskeleton, jellyfish material, fibrous material and shells. These items were not identified to species because they were poorly represented in those samples.

DISCUSSION

The contents of the stomach and fecal samples of the female diamondback terrapins from JBWR were similar to those of previous studies made elsewhere (Table 2). This study indicates that the diet of JBWR terrapins is largely crabs, snails and plant material. Green crab parts, legs and whole body, were found in stomachs showing that this ram feeder eats crab limbs separately from the body as observed Bels et al. (1998). Stomach samples showed that amphipods and barnacles (*Balanus spp.*) were ingested by terrapins in JBWR as seen in terrapins in South Carolina by Roosenberg et al. (1999) and Tucker et al. (1995) (Table 2). Jelly-like material that could be parts of jellyfish (phylum Cnidaria) was observed in most of the stomach and fecal samples, but was difficult to identify. Also, mucus-coated masses were found that might be indicator that the stomach was completely flushed (Legler 1977).

It is unclear why fecal samples were so hard to collect; in previous years most terrapins defecated when left in fresh water overnight (R. Burke, pers. obs.). Terrapins could have been affected by the anesthesia, making their digestive system less responsive to the fresh water. Also, nothing is known about the time it takes food to move through terrapin intestines (Alderton 1988); if passage time is sometimes rapid then they might be

less likely to defecate. Some terrapin feces included fibrous material that looked like a filter cigarette that a turtle might have ingested from garbage.

This study demonstrated that JBWR terrapins can eat hard-shelled prey because samples showed bivalves, barnacles and crabs as part of their diet, which could fluctuate in shape and size on tidal amplitude affecting their resource availability (Tucker et al. 1995). The diversity of the terrapin diet may depends on terrapin size (Tucker et al. 1995); but however, this statement can not be tested here because the females in this study were very similar in size and weight and showed little variety in size of food items.

This paper documents the first study of dietary habit in JBWR terrapins that utilized a stomach flushing technique (Fields et al. 2000). It demonstrated that these terrapins have a completely aquatic diet. To improve this study, many more fecal and stomach samples will be collected from females, in addition to males and juveniles, with data compared between genders and maturity states.

Studies	Source of Data	Terrapins	Field Site	Prey Species	Class or Order
Alen 1955	Captive	752		*Littorrina irrorata*	Gastropoda
				Shellfish	
Bels 1998	Captive	11		*Mytilus edulis*	Bivalvia
				Carcinus maenas	Malacostraca
Coker 1906	Stomachs of dissected animals	14	Beauford Harbor, NC	*Spartina alterniflora*	Liliopsida
				Melampus bidentatus	Gastropoda
				Uca spp	Malacostraca
				Litorrina irrorata	Gastropoda
				Gelasimus	Malacostraca
Davenport 1992	Captive	11		*Mytilus edulis*	Bivalvia
				Littorina littorea	Gastropoda
Roosenburg 1999	Field	34	Patuxent River, MD	*Mya arenaria*	Bivalvia
				Tagelus spp	Bivalvia
				Amphipods	Amphipoda
				Isopods	Isophoda
Tucker1995	Fecal	294		*Uca pugnax*	Malacostraca
				Callinectes sapidus	Malacostraca
				Sesarma reticulatum	Malacostraca
				Barlanus spp	Cirripedia
Sierra 2005	Stomach	21	Jamaica Bay, NY	Clams	Bivalvia
				Amphipods	Amphipoda
				Flies	Diptera
				Carcinus maena	Malacostraca
				Barlanus spp.	Cirripedia
				Geukeusia demissa	Bivalvia
	Fecal			Ants	Hymenoptera
				Barnacles exoskeleton	Cirripedia
				Fibrous material	

Table 2. Comparison among the items found in the diet of diamondback terrapin in previous studies.

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