Ralph Werner, 6 Caroline Ln, Ocean City, NJ 08226. 609-652-4462.

HEALTH ASSESSMENT OF CAPTIVE RAISED AND WILD DIAMONDBACK TERRAPINS (*Malaclemys terrapin terrapin)*: A PRELIMINARY STUDY

Ralph E. Werner, V.M.D.

Division of Natural Science and Mathematics

Richard Stockton College of New Jersey

Jim Leeds Road

Pomona, NJ 08240

Dana J. Ehret

Department of Geological Sciences

University of Florida

273 Williamson Hall

Gainesville, FL 32607

Lisa M. Jensen

University of Virginia

1519 Trailridge

Charlottesville, VA 22903

ABSTRACT: *In recent years there has been growing concern over the possibility of disease transmission when captive raised or rehabilitated animals are released into a wild population. For over a decade, Richard Stockton College has been raising and releasing diamondback terrapins into New Jersey marshes to help replace losses that occur due to motor vehicle trauma. This preliminary study looked at various health parameters in both captive raised and wild terrapins to screen for any obvious diseases that might be present in either cohort. Both populations seemed to be relatively free of parasites or overt disease. The conclusion was that the release of captive raised turtles did not appear to be a health threat to the native terrapins, nor are the wild turtles an obvious source of disease for the released hatchlings.*

KEY WORDS: Diamondback terrapin, health assessment, repopulation

INTRODUCTION

In recent years the problem of rising infectious disease in wildlife has been noted by several authors (Real, 1991; Haebler, 1992; Viggers et al.,1993; Woodford, 1993; Cunningham, 1996; Baskin, 2000; Daszak et al., 2000). Of particular concern is the possible introduction of disease into a wild population through the release of captive raised or rehabilitated specimens. In response to the decline of many species, programs have been initiated to help restore native populations. Unfortunately the health status of both the released and native animals is usually unknown and has largely been neglected in reintroduction programs (Viggers et al., 1993; Jacobson, 1999). Not only does this create the potential to introduce new disease into a susceptible wild cohort, it opens up the possibility of newly released specimens succumbing to disease from the existing population.

Over a decade ago Richard Stockton College of New Jersey (RSC) developed an ongoing program to help maintain the diamondback terrapin population in Cape May County, New Jersey. This unique salt marsh terrapin is found along the Atlantic Coast from Massachusetts to Florida and along the Gulf Coast to Texas. Motor vehicles traveling through the salt marshes of Cape May County annually kill hundreds of terrapins as they cross causeways trying to reach a nesting site. Harvesting the eggs from fatally injured diamondbacks and raising them

at RSC has provided a source of new turtles each year and has presumably helped to maintain the existing population. The 9-12 month old hatchlings are released back into the marshes from which their mothers emerged the previous summer (Wood and Herlands, 1993).

This study was undertaken to survey the health status of both the captive raised terrapins and their wild counterparts. Any problems found in one population but not the other would be cause for concern and further investigation.

MATERIALS AND METHODS

The diamondback terrapins assessed were from four groups:

GROUP A: those raised (at RSC) from salvaged eggs

GROUP B: display specimens at RSC and the Wetlands Institute, Stone Harbor, NJ

GROUP C: wild terrapins rescued, trapped, or mortally injured by motor vehicles in Cape May County, NJ

GROUP D: wild diamondbacks trapped in the marshes of Hackensack, NJ

The parameters to evaluate the health status of terrapins were selected primarily as screening procedures. Time and budget constraints prohibited detailed techniques such as histology, blood chemistries, blood counts, and parasite concentrating methods. The goal was to look

for obvious pathology with the intent of conducting in depth diagnostics on any suspicious findings. The parameters selected were (Table I):

1. Physical examination. Observations were made on 381 terrapins for nasal discharge, eye abnormalities, overall activity and responsiveness, skin and shell abnormalities, and cloacal abnormalities.

2. Blood. Samples were obtained from the dorsal post- occipital venous sinus, the dorsal tail vein, or free, unclotted blood at the time of necropsy from 189 terrapins. Two smears were made from each blood sample and were stained with a commercial thiazine and eosin kit (a). At least ten high power (400X) fields were examined per smear, with a minimum of ten cells per field.

3. Feces. Fecal material was macerated in a saturated sucrose or sodium nitrate solution (specific gravity 1.020) to cause flotation of parasitic ova. If feces could not be obtained, the cloaca was flushed with Ringer's solution using a disposable plastic pipette and a direct smear was made. Examination of the cover slip slides was performed at 100X magnification. Suspicious material was further examined at 400X magnification.

4. Necropsy. Terrapins that had to be euthanized due to severe injuries were given an intraperitoneal injection of a pentobarbital sodium solution (b) and were immediately necropsied for any gross abnormalities. This group consisted of 66 adult females that were severely injured while crossing roads and one display female. Tissues

observed were: trachea, bronchi, lungs, heart, coelomic cavity, esophagus, stomach, intestine, colon, liver, pancreas, gall bladder, kidneys, and urinary bladder. No healthy terrapins were sacrificed for necropsy.

5. Culture. Cloacal specimens, obtained from 46 turtles by a cloacal flush using sterile lactated Ringer's solution and a disposable plastic pipette, were cultured for bacteria using an SS agar plate which is selective for gram negative enteric bacteria and is especially sensitive for *Salmonella* isolation (Kodjio et al., 1997). Suspicious colonies were sent to the New Jersey Department of Agriculture, Division of Animal Health for confirmation of genus. This part of the study was a screen for the active shedding of *Salmonella* bacteria by terrapins. Cultures were incubated at room temperature (21-23C) since they came from poikilothermic reptiles.

RESULTS

With the exception of motor vehicle trauma and one display female, physical examinations on all terrapins revealed no obvious abnormalities for any of the four groups (table 1). All terrapins appeared healthy, alert and in good condition. Barnacle infestation was not seen in any individuals (Seigel, 1983). One older display female stopped eating and became dehydrated and listless during the study. This turtle had been in captivity for several years and had no known health problems. She was

euthanized and necropsy revealed small, pale kidneys. A cloacal culture was positive for *Proteus*, *Escherichia coli*, and *Salmonella*. All other terrapins in the same tank were treated with enrofloxacin (c) at a dose of 5 mg/kg/day for six days and they remained healthy for at least the next three months.

Blood smears from 189 (49.5%) terrapins were negative for *Hemogregarines*, a common intracellular parasite of turtle red blood cells (RBC) (Siddall & Dessler, 1993). In addition, no intracellular *Hemoproteus* or *Plasmodium* species were seen (Frye, 1991). *Cardianema* microfilariae were not observed and no changes in RBC or white blood cell morphology were noted (Frye, 1991).

Fecal flotations and/or direct smears were done on 128 samples (33.5% of the total sample population). Parasitic ova or protozoans were not found on any slide. The only structures observed that resembled parasite eggs were determined to be centric diatoms, a common marsh water inhabitant. Many samples contained pollen and/or pieces of crab shells.

Necropsies were performed on 67 turtles (17.5%) of the total sample population. No grossly visible parasites were seen in any digestive tracts, coelomic cavities, respiratory tracts, or livers. Two live (!) dermestid beetle larvae were discovered in the mid-intestine of one terrapin that had been necropsied immediately following euthanasia. Yellow-white fibrinous material covering part of the surface of the liver

and lungs was noted in three animals but the parenchyma of the organs appeared normal. The one older display turtle that was euthanized due to anorexia and dehydration had small, pale kidneys. All other diamondbacks appeared grossly normal.

All 46 cultures (12% of the terrapins) were positive for *Escherichia coli*. In addition, *Proteus sp.*, *Pseudomonas sp.*, *Actinobacter sp.*, and *Citrobacter sp.* were identified in some turtles by the NJ Department of Agriculture. Three of the samples were positive for *Salmonella* when re-cultured at 37 C.

There were 26 (7%) terrapins that had stool samples that were negative for parasitic ova and also had no visible gastrointestinal parasites at necropsy. Only 48 terrapins (12.5%) had both a fecal exam and blood smear examined. A combination of fecal exam, cloacal culture, and blood smear was performed on 15 diamondbacks (4%).

DISCUSSION

When trying to assess the health status of a reptile, the selection of parameters becomes somewhat arbitrary. Terrapins that look normal and have no obvious parasite problems could theoretically harbor potentially dangerous viruses, bacteria, fungi, or protozoans. In the absence of overt signs of disease, testing for all possible infectious agents is not feasible. By choosing physical examination, blood parasites, intestinal parasites, necropsies, and enteric cultures the authors felt that the more common

terrapin diseases might be identified. In addition, any unusual findings would be cause for more extensive investigation such as blood chemistry evaluation and histology.

The most obvious parameter when assessing health status is physical appearance. None of the four groups of terrapins examined (other than trauma victims and the display female) showed any outward signs of disease. All were very active, responsive to external stimuli, and did not show signs of emaciation or dehydration. The large number of turtles examined led us to conclude that both captive raised and wild diamondbacks appear to be free of obvious disease.

Red blood cell parasites seem to be non existent in the diamondback terrapin as evidenced by the 189 negative blood samples and a search of the literature. This may be due to the lack of blood-sucking parasites (such as the leech) in the saline environment that are necessary for transmission. Other possibilities are natural resistance, seasonal fluctuations, and basking habits (McAuliffe, 1977).

Most surprising was the lack of grossly visible intestinal parasites. Initially this finding was thought to be due to improper fecal examination techniques since a few helminths have been reported to occur in *Malaclemys* (Ernst and Barbour, 1972; Ernst and Ernst, 1977). Subsequent necropsies confirmed that no grossly visible parasites, including nematodes, trematodes, cestodes, pentastomids, and acanthocephalans were present (McFarlen, 1991), at least in the adult

female terrapins that were mortally injured by traffic. Possibilities for this observation include: infestation with microscopic helminths; a highly resistant turtle population; a hostile environment for the development of parasitic ova or larvae; a lack of suitable intermediate hosts; seasonal fluctuations; ingestion of natural parasiticides. An article on the efficacy of a chelonian vermifuge observed that cloacal flushes lack sensitivity which may also be partly responsible for our negative results (Bodri et al., 1993). Finding live dermestid beetle larvae in the mid-intestine was quite a testimony to the sturdiness of this insect, considering that terrapins easily digest crabs.

Necropsy results agreed with the lack of obvious pathology or disease in diamondback terrapins that was noted in the blood and fecal specimens. The older display female may have had chronic renal failure - a common turtle problem (Frye, 1991) - but this is speculation. The superficial fibrinous material noted in three specimens might have been a mild inflammatory reaction. Although all autopsies were performed on mature, gravid females, the authors feel that the results are still a good representation of the health of the entire terrapin population. Since conservation is one of the major goals of terrapin research, it was decided not to euthanize healthy male and immature terrapins for necropsy. While histology on all tissues would more accurately reflect the true state of health of the necropsied terrapins, it was neither practical nor affordable in this survey.

The final portion of the study was an enteric bacteriological screen for the active shedding of *Salmonella* or other pathogenic species. This part of the study was intended to identify the public health aspects of handling turtles more than to assess health status (thus the low number of tests). Even though *Salmonella* was isolated using enhancement and 37C incubation techniques, it would appear from this study that diamondbacks do not shed this pathogen in very large numbers. Another study of *Salmonella* in diamondback terrapins came to a similar conclusion (Harwood et al., 1999). This in no way implies that good sanitation should be ignored when handling terrapins. The prudent rule is that all reptiles should be considered as a source of *Salmonella* and should be handled accordingly.

The relatively small number of terrapins that had all parameters measured was due to several factors. Blood sampling and fecal collection were often difficult to accomplish in a limited time frame, so many turtles only had one procedure performed. Autopsies were only carried out on mature females who were mortally injured - no healthy individuals were sacrificed. This restriction accounts for the low percentage of terrapins that had negative fecal exams confirmed by necropsy. Regardless of how the various assessments or combinations of assessments were evaluated, the results all point toward the lack of obvious disease in every diamondback terrapin population examined.

The results of this study suggest that captive raised and wild diamondback terrapins are not infested with blood or intestinal parasites – an unlikely occurrence. Since virtually all reptiles in the wild harbor parasites (Lane and Mader, 1996), this finding will require additional research. The harboring of *Salmonella* by turtles was confirmed by our small sampling of cultures and underscores the importance of good sanitation by human handlers.

The overall health assessment of both populations in this preliminary study leads to the conclusion that neither population is passing obvious disease to the other and that the RSC release program is therefore presumed to be aiding in the replacement of terrapins killed by motor vehicles.

Hopefully other groups involved in wildlife restoration will use this project as an example of how a preliminary health evaluation can be accomplished on a limited budget. With funding, additional parameters should include complete blood counts and blood chemistry panels, along with histology on necropsy specimens. It is also necessary for all rehabilitation personnel to constantly observe terrapins for obvious signs of illness (emaciation, sluggishness, eye/nose discharge, etc.). The earlier a potential disease problem is recognized, the sooner it can be resolved.

Table 1. Number of terrapins examined for each parameter and the percentage (%) of the total number of terrapins in the study.

	Group A	Group B	Group C	Group D	Totals
Physical	80	19	249	33	381 (100%)
Blood	20	18	125	26	189 (49.5%)
Fecal	18	9	81	20	128 (33.5%)
Necropsy	0	1	66	0	67 (17.5%)
Culture	8	19	4	15	46 (12%)

FOOTNOTES

a. Dip Quick Stain, Jorgensen Laboratories Inc., Loveland, CO 80538.

b. Beuthanasia-D Special, Schering-Plough, Kenilworth, NJ 07033.

c. Baytril Injectable, Bayer Corp., Shawnee Mission, KS 66201.

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