

ACUTE MORTALITY OF DIAMONDBACK TERRAPINS FROM THE CHALK POINT OIL SPILL

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This report was prepared for the Natural Resource Trustee Council responsible for assessing injuries to natural resources and restoring losses resulting from the April 7, 2000 oil spill at Chalk Point, Maryland. It presents an estimate of the number of diamondback terrapins (*Malaclemys terrapin*) killed directly by the oil in the weeks immediately following the spill. This injury is described as direct or "acute," in contrast to, for example, the intergenerational loss of terrapins as estimated in Hinkeldey, et al. (2000). A subgroup of the Wildlife Injury Workgroup, established by the Natural Resource Trustee Council, developed the estimates and prepared this report.

EXISTING INFORMATION

Site-specific Information

Site-specific information available on terrapins includes observations reported as part of the oil spill, i.e. extent of shoreline oiling, reported mortality, and rehabilitation of live terrapins. In addition, terrapin population estimates for the late 1980s for the Patuxent River (Roosenburg 1990a, 1990b) were available.

In the weeks following the spill, the extent and degree of shoreline oiling was documented through surveys by Shoreline Cleanup Assessment Teams (ENTRIX, 2000). Based on the Shoreline Assessment Teams' (SCAT) data, three oiled (exposure) zones were defined: 1) heavily oiled - between Chalk Point and Teague Point (oiled shoreline of 11.3 km); 2) moderately oiled - from Teague Point downstream to Long Point (oiled shoreline of 8.2 km); and 3) lightly oiled - from Long Point downstream to Spring Cove (oiled shoreline of 24.7 km).

During wildlife mortality and SCAT surveys, which began shortly after the spill, 7 dead diamondback terrapins were collected and sent to the wildlife morgue. The wildlife morgue was established for the purpose of processing dead animals found in the spill zone. Only two of the dead terrapins showed visible signs of oiling, while four had damaged carapaces. An additional 8 oiled, live terrapins were also captured in the spill zone. Seven of them were rehabilitated and returned to the wild, while the eighth died in captivity. Table 1 lists the information known about each of these 15 terrapins. In addition, Roger Wood (Wood et al., 2000) reported that waterfront landowners in the spill zone told him that they had also collected an additional 4 dead terrapins and buried them.

¹ Michel: Research Planning, Inc.; Greer, ENTRIX, Inc.; Hoffman: Maryland Department of Natural Resources; McGowan: U.S. Fish and Wildlife Service; Wood: Richard Stockton State College.

Table 1. Summary information on the dead and live diamondback terrapins collected during SCAT and wildlife mortality surveys following the PEPCO oil spill

Individuals Collected Dead	Individuals Collected Alive
4/17 off Chalk Point, has carapace markings, assumed to be oiled	4/16 Golden Beach, heavily oiled, 328 g, rehabilitated
4/26 pipeline break marsh, carapace cracked open, dead for a while, assumed to be oiled	4/20 Indian Creek, lightly oiled, 55g, rehabilitated
4/26 Buena Vista, bloated, no visible oil., damaged carapace	4/21 Chalk Point (pipeline break marsh), heavily oiled, 51 g, rehabilitated
4/30 Washington Creek, head missing, damage to carapace, notched, no visible oil	4/22 Indian Creek, moderately oiled, 9g, rehabilitated
5/4 Swanson Creek, no visible oil	5/2 Chalk Point (pipeline break marsh), 115 g, rehabilitated
5/7 Buena Vista, no visible oil	5/6 Buena Vista, lightly oiled, 5g, rehabilitated
5/11 Buena Vista, no visible oil, cracked carapace	5/11 Swanson Creek, moderately oiled, 7 g, rehabilitated
	5/18 Washington Creek, lightly oiled, deep abrasions, died during rehabilitation

Based on the above information, the number of known dead diamondback terrapins associated with the spill is 12 (7 collected dead, 1 died in rehabilitation and 4 were reported dead by Wood). It is important to note that during oil spills, some terrapins can also die from the increased boat traffic associated with the cleanup, so mortality estimates should include both mortality from contact with the oil and from interactions with oil spill response craft. This assumption is supported in part by the fact that there were no terrapins collected until over a week after the spill, as boat operations increased. Furthermore, while it is admittedly a small sample, twice as many dead terrapins were found to have damaged carapaces as were believed to be oiled.

The most recent population estimate available for diamondback terrapins in the Patuxent River was based on a 1987-1989 mark-recapture study by Roosenburg (1990b). The study area extended from Long Point to Spring Cove, which includes approximately 26.6 km of shoreline based on a shoreline length estimate reported by ENTRIX (2000). Roosenburg (1990b) estimated the mean of the population in the study area to be 2,293 adult and juvenile animals (with a 95% confidence interval of 1,717 - 2,895). This estimate indicates there was a mean of 86.2 terrapins per kilometer of shoreline (with a 95% confidence interval of 64.5 - 108.8).

General Information on Oil Impacts to Terrapins

A comprehensive literature search for information on the effects of oil on terrapins was conducted. In addition, turtle experts were contacted to identify any previous studies on the impacts of oils spills on turtles (Kiviat, 2000; Lutcavage, 2000; Wood ET al., 2000). Only one publication was found that describes the impacts of oil on terrapins following a spill. Burger (1994) described the behavior of eleven female diamondback terrapins that were oiled during the January 1990 spill of No. 2 fuel oil in Arthur Kill, New York. The terrapins were hibernating at the time of the spill, and when they

emerged from hibernation, were found to be oiled. The terrapins voided oil from their digestive tracks for two weeks in rehabilitation. They developed edema, scored low on strength tests, and were slow to right themselves when placed on their backs. Eight of the eleven died; these animals "had oil traces in their tissues and exhibited digestive-tract lesions consistent with oil exposure" (Burger, 1994).

There have been several turtle and oil studies involving sea turtles. The most applicable study for extrapolation to terrapins was a laboratory study of the impact of oil on loggerhead turtles (Vargo, ET al., 1986). In that study, juvenile turtles were exposed to floating oil for 48-96 hours. There was no mortality, but the individuals exhibited some skin sloughing, changes in blood chemistry, and oil was observed in the feces. One of the researchers indicated that impacts of oiling could be more severe for diamondback terrapins due to their smaller size (<1 kg) compared to juvenile loggerheads (8-12 kg; Lutcavage, 2000). A representative from Tri-State Bird Rescue stated they had good success in rehabilitating turtles oiled during spills (Gilbert, 2000).

Additional background information on the life history and habitat utilization of diamondback terrapins in the mid-Atlantic region was obtained from Drs. Roger Wood and Stan Hales (Wood, et al., 2000).

MORTALITY ESTIMATES

After reviewing the extent of available information to support an estimate of acute mortality to adult and juvenile terrapins, the trustees elected to take a risk assessment (i.e., population at risk) approach. The population at risk from exposure to the oil was based on the mean population estimate of 2,293 adults and juveniles, or 86.2 terrapins per km of shoreline, from Roosenburg (1990b). The total length of shoreline between Chalk Point and Spring Cove is estimated to be 54.5 km, including both oiled and unoiled shoreline (note that only the oiled portions are used to estimate the mortality figures, below, however). Based on the 86.2 terrapins/km of shoreline mean estimate from above, the total population of terrapins between Chalk Point and Spring Cove is estimated (54.5 km x 86.2) to be 4,698 (range of 3,515 to 5,930).

The shoreline was partitioned into the same three oiled (exposure) zones defined above. Total acute mortality was then estimated based on best professional judgement concerning the mortality risks posed by the differential degrees of oiling and on the length of oiled shoreline and population estimates, as follows:

1. Chalk Point to Teague Point - heavy oiling. This zone had the highest degree of oil exposure. Oil slicks/sheening persisted in this area for months following the spill. The mortality rate, based on best professional judgment, for diamondback terrapins is estimated to be 10 percent in this zone because of the degree and persistence of oiling. The total shoreline length of this zone is 14.0 km and the oiled portion was 11.3 km long. Mortality is estimated (11.3 km x 86.2 animals/km x 10% mortality) to be 97 animals (range of 73 to 123).
2. Teague Point to Long Point – moderate oiling. This zone had relatively moderate amounts of oil exposure, with most of the oil confined to a narrow band along the outer fringes of marsh. The degree and persistence of oiling was much reduced, compared to the Chalk Point to Teague Point zone. The mortality rate, based on best professional judgment, for diamondback terrapins is estimated to be 2 percent in this zone. The total shoreline length for this zone is 13.9 km and the oiled portion was 8.2 km long. Mortality is estimated (8.2 km x 86.2 animals/km x 2% mortality) to be 14 animals (range of 11 to 18).
3. Long Point to Spring Cove – light oiling. This zone had relatively light amounts of oil stranded on the shoreline and little sheening. The mortality rate, based on best professional judgment, for diamondback

terrapins is estimated to be 0.5 percent in this zone. The total shoreline length for this zone is 26.6 km and the oiled portion was 24.7 km. Mortality is estimated (24.7 km x 86.2 animals/km x 0.5% mortality) to be 11 animals (range of 8 to 14).

Thus, total acute mortality of terrapins from the Chalk Point spill is estimated to be 122 (with a 95% confidence interval of 92 to 155) adults and juveniles using the risk assessment approach.

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November 11, 2001

Norman Meade
NOAA Damage Assessment Center (N/ORR3)
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Room 10357
Silver Spring, MD 20910

Dear Norman:

The following are my combined comments on two reports, "Acute Mortality of Diamondback Terrapins from the Chalk Point Oil Spill" and "Estimate of Total Injury to Diamondback Terrapins from the Chalk Point Oil Spill." Both reports address the quantification of natural resource injury to terrapins under the 1990 Oil Pollution Act (OPA) following the April 2000 Chalk Point oil spill in the Patuxent River.

The purpose of the Acute Mortality study was to estimate the direct mortality to diamondback terrapins (*Malaclemys terrapin*) from the oil spill. The goal of the Total Injury report was to estimate the number of lost diamondback terrapin years, based on both acute mortality and the loss of production of the next generation, following the oil spill. My review of these reports addresses the following queries:

1. Were the assumptions used and the data and methods employed by the investigators appropriate for undertaking the stated goals of the study?
2. Were the methods employed properly implemented?
3. Do you have suggestions on how to improve the substance and exposition of the report?

General Statement:

My overall assessment of the two reports is that a fair treatment of the situation was given considering the absence of thorough knowledge of the disposition of terrapins throughout the system and the limited data that were available. In essence, as good a job as possible was done with the material available, and the approach used of building scenarios based on known biological facts was reasonable and appropriate. To the best of my knowledge the model quantifying total lost terrapin years has been properly implemented. A few specific points bear mentioning.

Specific Comments

Acute Mortality Study

Table 1 – The authors need to be consistent in use of "pipeline break marsh" – if this is a specific locality it should be capitalized; need to clarify "notched" on April 30 – does this mean a marked animal from a study or an animal injured by a boat?

page 2 – The point about increased boat traffic is a good one that should be included in the final report, as such activities are a consequence of the spill.

page 3 – The last sentence in first paragraph under Mortality Estimates needs to provide confidence limits (range) for the total population estimate.

page 3 – The most difficult assumption in the acute injury report is the 10%, 2%, and 0.5% estimates of mortality. My suggestion is that these be referred to as professional opinions based on limited availability of data. The rationale for such an estimate is that higher proportions would not be expected because of the minimal number of oiled or dead terrapins found after the spill. However, the finding of several individuals affected by the oil spill suggests that at least a small proportion of the population was affected, which would presumably be reduced in habitats receiving lesser amounts of oil.

Total Injury Study

Table 1 – This table needs to be partitioned into two parts (1. Population parameters and 2. Parameter values) in order to keep the columns clear and consistent.

Table 2 -- The citations need to be provided for Wilbur 1975, Tinkle et al. 1981, and Mitchell 1988. Defining values as both the "mean" and the "average" is confusing as the numbers should be the same for either.

page 5 - The series of assumptions are tedious to follow but seem to be best estimates that are accurate within the context of available data on the species for the Patuxent River area.

page 11 - In the Summary, the maximum of "39 eggs per year" is used in the final calculation. In other parts of the reports, both the mean and range have been given. Explanation should be given for why the maximum is being used for the potential number of eggs.

I hope these comments are useful. Please let me know if you need additional information.

Sincerely,

J. Whitfield Gibbons
Professor of Ecology

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