

Third Workshop on the Ecology, Status, and Conservation of Diamondback Terrapins (*Malaclemys terrapin*): Results and Recommendations

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The Third Workshop on the Ecology, Status, and Conservation of Diamondback Terrapins (*Malaclemys terrapin*) was held in Jacksonville, Florida, on 17–19 September 2004. The workshop was sponsored by the University of North Florida and the Florida Turtle Conservation Trust. Sixty-six individuals from academic, scientific, regulatory, and private institutions/organizations met to discuss recent research findings and conservation concerns related to this ecologically significant coastal wetland species. All 16 states within the range of the species were represented. Eighteen papers were presented in sessions on ecology, conservation concerns, environmental education, and status; 13 posters were presented in a separate session. Abstracts can be viewed at <http://www.dtwg.org>.

This conservation meeting built upon the accomplishments of 2 earlier workshops. The first workshop was held in August 1994 in response to reports of potential declines of diamondback terrapin (*Malaclemys terrapin*) populations in several locations within its range. That workshop provided an opportunity to share data on terrapin biology and status, and to produce specific recommendations for action by local, state, and federal management agencies. A result of the workshop was the publication of a paper identifying the threats and steps needed to conserve the species (Seigel and Gibbons 1995). The second workshop in the series was held in October 2000 and provided a welcome opportunity to share new research findings and discuss conservation concerns.

Results of an Updated Status Survey

In preparation for the third workshop, we sought to revisit a questionnaire concerning the status and research needs of terrapins devised and reported by Seigel and Gibbons (1995). Nearly 10 years had passed, so it seemed appropriate to conduct another survey, the results of which

would be presented and discussed at the workshop. We added new questions and categories, and sent the questionnaire to 168 researchers, state agency biologists, and other individuals with an interest in terrapins. The questionnaire asked respondents to assess the status of terrapins in their states as declining, stable, increasing, or unknown. Respondents were also asked to rank the following list of 12 specific threats: channelization of marshes, crab pot mortality, invasive non-native plants, motorboat propellers, oil spills, predation, commercial harvest, habitat loss, mortality by automobiles, nesting habitat alteration, pollution, and other. Finally, they were asked to rank the following list of 16 actions to be taken: abandoned/derelict crab pot removal, initiate field studies, crab pot regulations, eliminate game status, habitat protection, motorboat regulations, rangewide distribution surveys, retain legal status, designate protected status, conservation education programs, education of enforcement officers, habitat identification (aquatic/nesting), invasive non-native plant removal, rangewide population studies, none, and other.

Population Status. — We received 54 completed survey forms, representing all 16 states within the range of the species. Five states returned only 1 survey form, and the other 11 states had up to 14 responses (Table 1). In assessing the status of terrapins, 29.6% of the 54 respondents said that diamondback terrapins were declining in their states, 14.8% said populations were stable, and 55.6% said the status was unknown. No one considered terrapin populations to be increasing. Nine states had unanimous responses regarding status (5 of these returned only 1 survey form). All respondents from Alabama agreed that terrapins were declining in that state, while all from Rhode Island considered them to be stable. States unanimously ranking terrapin status as unknown were Massachusetts, Connecticut, Delaware, Virginia, North Carolina, Georgia, and Louisiana.

The other 7 states had mixed status responses, and, where possible, we attempt to explain the variety. In most cases, some respondents had specific areas within the state in mind when they declared populations to be declining or stable, while others from the same state assessed statewide populations and ranked their status as unknown due to insufficient population surveys. This was true for New York, Maryland, South Carolina, and Florida. For New Jersey, Mississippi, and Texas, some respondents simply thought there was enough data to declare populations to be declining while others selected unknown due to insufficient data.

Threats. — In the survey, some respondents ranked all 12 threats and all 16 actions, while others ranked only the ones they felt pertained to their state. In either case, respondents were directed to rank the most important threat or action as number 1, with numbers increasing as importance decreased. To determine the ranking of both threats and actions, we calculated the means of all

Table 1. Summary of the results of a 2004 survey concerning the status of diamondback terrapins (*Malaclemys terrapin*), threats facing them, and actions needed to remedy the threats. Only the top 3 threats and actions are listed for each state. Asterisk (*) indicates a tie.

State	No. of responses	Status	Threats (in rank order)	Actions (in rank order)
MA	1	Unknown	Habitat loss, nesting habitat alteration, predation	Habitat protection, designate protected status, habitat restoration
RI	2	Stable	Predation, mortality by automobiles, habitat loss	Habitat protection, population studies, conservation education programs
CT	1	Unknown	Unknown	Eliminate game status
NY	3	Unknown/Stable	Predation, habitat loss, invasive non-native plants	Habitat protection, habitat identification, conservation education programs
NJ	3	Unknown/Declining	Predation, crab pots, habitat loss	Population studies, distribution surveys, conservation education programs
DE	1	Unknown	Habitat loss, crab pots, mortality by automobiles	Habitat protection, field studies, crab pot regulations
MD	5	Unknown/Declining	Crab pots*, nesting habitat alteration*, commercial harvest	Eliminate game status, crab pot regulations, habitat protection
VA	4	Unknown	Crab pots, nesting habitat alteration, predation	Distribution surveys, crab pot regulations, population studies
NC	1	Unknown	Crab pots, habitat loss, nesting habitat alteration	Crab pot regulations, distribution surveys, population studies
SC	8	Unknown/Declining	Crab pots, predation, nesting habitat alteration	Abandoned crab pot removal, population studies, distribution surveys
GA	3	Unknown	Crab pots, mortality by automobiles, nesting habitat alteration	Crab pot regulations, population studies, abandoned crab pot removal*, distribution surveys*
FL	14	Unknown/Declining/ Stable	Predation, habitat loss, crab pots	Initiate field studies, crab pot regulations, distribution surveys
AL	3	Declining	Crab pots, habitat loss, nesting habitat alteration	Initiate field studies, crab pot regulations, designate protected status*, habitat protection*
MS	2	Unknown/Declining	Habitat loss, crab pots, nesting habitat alteration	Crab pot regulations, habitat identification*, abandoned crab pot removal*
LA	1	Unknown	Commercial harvest	Initiate field studies, distribution surveys, habitat identification
TX	2	Unknown/Declining	Habitat loss, crab pots*, nesting habitat alteration*	Distribution surveys, initiate field studies, abandoned crab pot removal

numbered responses and the percent of respondents who ranked a particular threat or action at any level (Table 2).

Mortality in crab pots was the highest-ranking threat to terrapins in the survey, and 76% of respondents ranked this as a threat at some level. Six states ranked crab pot mortality as the most important threat to terrapins, and it was among the top 3 threats in 5 other states (Table 1). The only states not listing crab pot mortality as a threat were Louisiana and those in the northeastern range (Massachusetts, Rhode Island, Connecticut, New York). The highest percentage (78%) of respondents ranked habitat loss as a threat, and it had the second highest mean rank (Table 2). Four states ranked this as their most important threat, and 6 others had it in their top 3. Nesting habitat alteration was third in mean rank, and 9 states chose it in their top 3. Predation ranked fourth, and 7 states included it in their top 3 threats. The survey did not make a distinction between nest/egg mortality, hatchling mortality, or adult mortality, so this ranking represents a mix of these factors. Mortality due to automobiles ranked number 5 overall and was listed in the top 3 threats in Rhode Island, Delaware, and Georgia. Long-term studies of road mortality are ongoing in 2 areas in New Jersey (Wood and Herlands 1997; Hoden and Able 2003), but statewide, other threats were ranked higher. Of the other threats, invasion by non-

native plants was third in New York, and commercial harvest was included in the top 3 threats in Maryland and Louisiana.

Management Actions. — The highest-ranked action to be taken was crab pot regulations to prevent terrapin mortality (Table 2), reflecting the opinion that crab pots are the greatest threat to terrapins. The fourth-ranked action, removal of abandoned crab pots, is also related to this threat. Eight states had crab pot regulation as one of their top 3 priorities, and crab pot removal was highly ranked by 4 states. Habitat protection was selected at some level by 69% of respondents, and it was the second choice of actions to be taken. This also mirrored the threat of habitat loss. Six states ranked this in their top 3. Initiating field studies, rangewide distribution surveys, and rangewide population studies ranked third, fifth, and sixth respectively, likely reflecting that in most states, too little is known about the ecology of terrapins to accurately assess their status. The next 4 ranked actions (designating protected status, identifying habitat, eliminating game status, and initiating conservation education programs) were listed in the top 3 actions to be taken in 1 or more states.

During the workshop, a session was dedicated to an open discussion of questionnaire results. It was agreed that

Table 2. Ranking of threats to diamondback terrapins (*Malaclemys terrapin*) and actions to be taken to deter those threats as determined by a 2004 survey. Ranks were determined by calculating the means of all responses and are presented with the lowest mean being the highest rank. The percentage of respondents who ranked a particular threat or action at any level is based on total responses.

Rank	Threats	% Responding	Rank	Actions	% Responding
1	Crab pot mortality	76	1	Crab pot regulations	67
2	Habitat loss	78	2	Habitat protection	69
3	Nesting habitat alteration	63	3	Field studies	57
4	Predation	70	4	Abandoned pot removal	61
5	Automobile mortality	43	5	Distribution surveys	63
6	Boat propellers	46	6	Population studies	59
7	Invasive nonnative plants	31	7	Protected status	46
8	Pollution	31	8	Habitat identification	59
9	Commercial harvest	31	9	Eliminate game status	32
10	Oil spills	28	10	Conservation education programs	63
11	Channelization	30	11	Educate enforcement officers	41
			12	Invasive nonnative plant removal	22
			13	Change legal status	17
			14	Boating regulations	24

a range map is needed showing locations of various historical and ongoing population studies and where gaps in knowledge persist. Much of the interchange concerned the need for more extensive population and habitat usage studies throughout the range. This would allow us to evaluate more effectively which populations are stable or declining. We considered the value of standardizing research methods, which would allow us to present a more unified front when approaching agencies responsible for management decisions. There was also discussion concerning the meaning of a "stable population," and it was agreed that, although more demographic data including long-term survivorship are necessary from most regions for this evaluation, there are probably few existing stable terrapin populations. It was agreed that we have learned much about nesting habits and land-based threats to terrapins. With limited resources and time, it is now more important that we adequately address the issue of population stability in our research endeavors.

Conservation Recommendations

Although the new survey asked somewhat different questions than that of Seigel and Gibbons (1995), most of the results were similar. A slightly lower percentage of respondents to the current survey (29.6% compared to 34.8%) declared that terrapin populations were declining, but more (55.6% compared to 43.5%) admitted that population status was unknown. One finding of the earlier survey was that insufficient data made assessing population status difficult, and that shortfall in knowledge presented problems in listing terrapins under the Endangered Species Act. It is clear that these problems persist a decade later, and that studies in demography, movement and home range, long-term life history, and behavioral ecology called for by Seigel and Gibbons (1995) are still needed.

Mortality in crab pots was considered one of the major threats to terrapins in the earlier survey, and it ranked first

in the current one. Roosenburg (2004) provided an overview of the history of this problem and the development of a variety of methods to limit or prevent it. The most promising technique is the use of bycatch reduction devices (BRD) on crab pot entrances to prevent larger turtles from entering. Some form of BRD is required on all recreational crab pots in Maryland and Delaware, and on both recreational and commercial pots within 150 feet from the shoreline in New Jersey. While these requirements are reassuring, terrapins throughout most of the range still enjoy no protection from drowning in crab pots. It is of continuing importance that every state with terrapins move toward required use of BRDs unless other solutions can be identified. Perhaps more encouraging is the development and growth of abandoned/derelict crab pot removal programs in North Carolina, South Carolina, Florida, Alabama, Mississippi, Louisiana, and Texas. Involvement of terrapin biologists in these programs will not only help this species, but many others that suffer the same fate in abandoned pots.

Habitat loss and nesting habitat alteration are threats that likely have similar causes, that being manipulation by humans. Most biologists would agree that habitat protection is perhaps the most important conservation activity in which we can engage, but it is also the most challenging. It is imperative that terrapin habitats and their uses be defined and identified through field studies, so that we know which areas must be preserved for this species. With this information, federal, state, and/or local agencies can be advised concerning protection, management, and uses of such areas, and nongovernmental organizations can be approached for assistance.

Predation of terrapin nests and adults is most often associated with raccoons or other small mammals (Burger 1977; Seigel 1980, 1993). Nests can be protected from predators by covering them with screen or hardware cloth (e.g., Goodwin 1994). For cases in which predators are abnormally abundant, it may be advisable to reduce their numbers prior to and during nesting seasons, as such

efforts have benefited other turtle species (Christiansen and Gallaway 1984). The latter method affords the added benefit of protecting nesting females from predators.

Several threats are specific to certain states. We previously mentioned that automobile mortality has been identified as a major problem in several states. It may be possible in some areas to construct underpasses and/or barriers to prevent terrapins from crossing roads (Dodd et al. 2004). Invasive nonnative plants are considered a problem in New York and parts of Florida, and their effects on terrapin nesting areas need to be evaluated. Most states allow harvest of terrapins within strict seasons and with a collecting permit. Terrapins are harvested commercially in Maryland and, to some extent, Louisiana, and this constitutes a population threat when large numbers are taken. Ideally, such harvests should be eliminated, but if they cannot be stopped entirely, state wildlife agencies should establish and strictly enforce regulations concerning the numbers and sizes of animals taken (Reed and Gibbons 2005). This data would be valuable to biologists attempting to monitor the impact of this threat on populations.

Finally, it is noteworthy that 63% of survey respondents voted to initiate conservation education programs concerning terrapins. If the public is more familiar with the natural history of terrapins and has a better understanding of the threats facing this species, they will be more likely to assist with conservation efforts.

The workshop resulted in development of a Diamondback Terrapin Working Group. This initiative will work to unite all individuals and organizations concerned with the decline of the species and lay the foundation for a rangewide conservation plan. The working group is committed to and supports research, management, conservation, and education efforts that benefit diamondback terrapin populations and their associated ecosystems within the 16 state range. Please visit the website listed above to view more information on this conservation initiative.

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