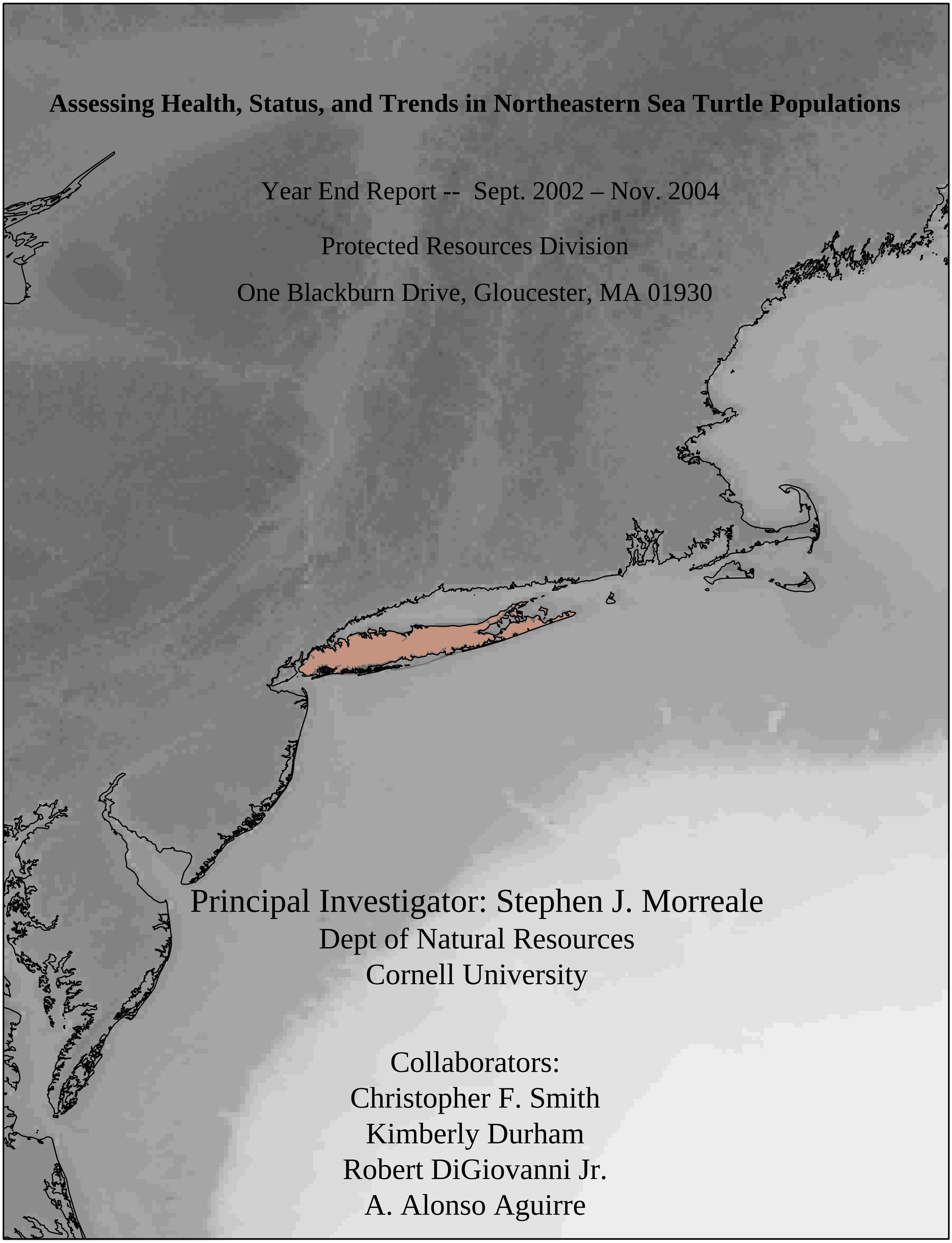

Assessing Health, Status, and Trends in Northeastern Sea Turtle Populations

Year End Report -- Sept. 2002 – Nov. 2004

Protected Resources Division

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Introduction

Along the continental shelf of the eastern U.S. four sea turtle species, the loggerhead turtle *(Caretta caretta)*, the Kemp's ridley turtle *(Lepidochelys kempii)*, the green turtle *(Chelonia mydas)*, and the leatherback turtle *(Dermochelys coriacea)*, migrate seasonally from offshore and warmer southern waters far into northern latitudes each summer. Contrary to earlier beliefs that the northeastern U.S. portions of this range were harsh environments for otherwise southern turtles, the highly productive coastal northern waters provide a rich and diverse assemblage of benthic biota. This richness, in turn, apparently attracts and supports large assemblages of sea turtles each year during the summer, a phenomenon that has prompted the waters as far north as New York and New England to have been repeatedly described as critical habitat for foraging loggerhead, leatherback, and Kemp's ridley turtles (Lazell 1976, 1980; Lutcavage and Musick, 1985; Musick, 1988; Shoop and Kenney, 1992; Morreale and Burke, 1997; Musick and Limpus, 1997, Morreale and Standora, 2005).

In the broader view, these northern assemblages of turtles are not disjunct groups isolated
from the main populations. Rather, it is apparent that many turtles migrate into northern nearshore habitats from southern waters each summer, and return southward each fall (Lutcavage and Musick, 1985; Henwood and Ogren, 1987; Byles, 1988; Morreale and Standora, 1990, Shoop and Kenney, 1992; Keinath, 1993, Epperly et al. 1995*a*, Morreale and Standora, 1998, 2005). Thus, coastal sea turtles of the Northeast

represent the northern portion of the same populations that mate, nest, and overwinter in southern and tropical regions. As such, Northeastern coastal habitats can provide valuable information for monitoring and estimating general patterns of sea turtle abundance, health, and species status.

A notable distinction between northeastern coastal turtles and those farther south, however, is the increasing proportion of small and apparently young individuals observed along a northward gradient (Morreale and Standora, 2005). This pattern is evident in loggerheads and green turtles, and is starkly obvious in Kemp's ridleys. In North Carolina and Virginia, the proportion of breeding adult loggerheads in bays and estuaries is smaller than in Georgia and Florida, with most individuals being classified as medium-sized juveniles (Lutcavage and Musick, 1985; Byles, 1988; Epperly et al., 1995*a*). In comparable habitats farther north, virtually none of the loggerheads or green turtles are adult-sized (Morreale and Standora, 1994; Morreale and Burke, 1997). For Kemp's ridleys in Atlantic waters, most individuals throughout the range are immature, but the latitudinal gradient still exists. In southern and mid-Atlantic states of Florida, Georgia, South Carolina, and Virginia, a few larger individuals (SCL greater than 50 cm) have been reported, but the vast majority are smaller (for review, see Morreale and Standora, 2005). In the northeastern waters of New York and Massachusetts, Kemp's ridleys appear to be further restricted to size classes smaller than 45 cm SCL (Morreale et al., 1992; Morreale and Burke, 1997; Still et al., 2003). The small sizes, and presumable youth of the Northeastern coastal turtles does not really diminish the importance of these assemblages as indices for regional population trends. Instead, these young turtles are more closely linked to, and therefore are indicative of, trends in reproduction, nesting success, and early life-stage survivorship.

As a result of an extensive mark-recapture project we conducted more than a decade ago (Morreale and Standora, 1998), it was previously determined that the vast majority of the annual migrants into coastal New York waters were young loggerhead and Kemp's ridley turtles that came mainly to feed within the shelter of the varied embayments of the Peconic Bay and Long Island Sound Estuaries. Green turtles also were present, but generally in low numbers. Throughout the foraging season, the loggerhead and Kemp's ridley turtles fed heavily, predominantly on crabs and mollusks, while the less numerous green turtles fed mainly on algae. High growth rates were measured in these developing turtles, and individuals encountered were apparently in excellent health during the foraging season. The picture that emerged from these and related studies was that, both historically and currently, New York and other Northeastern coastal waters play a crucial role in the early developmental life stages of many loggerhead and Kemp's ridley turtles.

In the face of intense human pressure and ongoing environmental changes to the region over the subsequent decade, it has become important to re-examine the Northeastern coastal developmental habitats upon which juvenile sea turtles are highly dependent. In this context, it was deemed essential to once again begin to closely monitor and assess the current health status of the sea turtle populations that use these specialized habitats, and to gauge recent and current human impacts on Northeastern turtles. It was assumed that observed similarities or changes in status of turtles in New York waters would reflect similar trends in sea turtle populations region-wide. Therefore, a new study was initiated beginning in September 2002, employing many of the same techniques for observing and estimating sea turtle activity in coastal New York waters. The main impetus of the study was to re-establish a northern index site for monitoring regional populations of sea turtles.

It was presumed from the outset that a new investigation would provide comparative data to determine whether health, relative abundance, and seasonal distribution of juvenile sea turtles has changed in association with human activity and environmental changes. At the least, the many-year span between studies at this site provided an opportunity to gain a synoptic view of longer term population trends. For example, comparisons across years might make it possible to directly measure the regional or global population impacts of recent increases in nest production recorded for Kemp's ridleys in Mexico, or for green turtles in Florida. Similarly, from this study, we may be able to directly assess the effectiveness of management and conservation policies of the past 10 to 20 years, such as trawling restrictions, gill net regulations, and TED enforcement.

The new study began in September 2002, when we re-instituted an intensive capture-recapture and health assessment investigation of the sea turtle populations that use the waters of Long Island Sound and the Peconic Bay Estuary (Fig. 1). The following report is a summary and discussion of the results of the fall of 2002 and the two subsequent summer and fall activity seasons for sea turtles in the study area. To date, the study has emphasized the conservation ecology of sea turtles, primarily evaluating the current health, distribution, and abundance of juvenile sea turtles in the Peconic system and nearby waters. In addition, the current study is designed to collect many of the same data that were collected more than 10 years ago, from the same study area, and using the same capture and retrieval techniques. It was expected that such a design would enable more obvious and immediate comparisons of current sea turtle ecology relative to the previously established baseline.

Indeed, results of the first years' research, summarized in the following report, lead us to believe that sea turtles of the region may be undergoing a shift in relative abundances from what was observed in the previous decade. Although it is relatively early in the study, this shift in species composition appears to be a major finding. Details and discussion of this species shift are presented and discussed with respect to potential regional changes.

Project Objectives

Short-term: The primary emphasis during the initial phase of the study was to institute a long-term mark-recapture study intended to monitor and compare contemporary population levels and health status of sea turtles inhabiting the Long Island Sound and Peconic Bay Estuaries. In the early stages a major emphasis was placed on setting up a study design, and putting in place a collection and monitoring scheme. Essential to these efforts was the re-establishment of a cooperative network of participants and partners in retrieving, reporting, and responding to live-captured turtles. Essential collaborators include local fishing community, Federal and State agencies, and a select group of professionals from the realms of Extension, Education, Conservation, and Academia. Particular efforts were made to include many of the participants in this new study that were members of the original research and retrieval teams.

Mid-range: After the establishment of a collection, retrieval, and research network it has become important to expand data collection on turtles and their essential habitats in coastal New York waters. This includes beginning to assess impacts of human activities and recent management efforts. The expanded focus during the mid-term will be on collecting data directly comparable to those of our past studies, compiling and analyzing complementary data on population structure and ecosystem health, and identifying new influences and recent effects of human activities, both detrimental and beneficial to sea turtles. It was anticipated that early results during this phase would stimulate other avenues of research. In addition, from the beginning of data collection, there has been an ongoing effort to analyze and predict patterns and compare contemporary and past turtle population structure. Early on, it has been necessary to take a cautious and adaptive approach because of the smaller sample sizes inherent to the early phases. Nevertheless, the accumulated data already have indicated similarities in distribution and demographic structure, and potential shifts in patterns of species composition.

Long-term: The extended plan is to continue to monitor population levels and health status of sea turtles within the same nearshore waters using the same techniques in all future years. One of the ultimate objectives will be to establish, through continued presence in the coastal waters of the New York, a long-term ecological research and monitoring site from which to closely monitor sea turtles, their food, their basic habitat characteristics, and any potential disturbances. In effect, renewed scrutiny and continued scientific study in the region will extend the value of the study area as a practical index site from which to gauge population trends of juvenile Western North Atlantic sea turtles. The potential for long-term monitoring, coupled with longer term comparisons already has attracted the attention of conservation organizations, such as Wildlife Trust and The Nature Conservancy, in addition to local, State, and Federal agencies. Incorporating the expertise of these agencies will contribute to another long-term goal of this project: the improvement and enrichment of local and regional marine habitats and the development of sound integrated management plans for sea turtles within coastal U.S. waters.

Early Activities and Accomplishments

As a necessary first step, we successfully obtained a Permit for Scientific Purposes under the Endangered Species Act of 1973 (Permit No. 1389) that authorizes us to coordinate the capture, measurement and biological sampling of juvenile sea turtles retrieved from commercial fishers who operate pound nets in New York waters. The acquisition of this permit represented a significant accomplishment because it was the first permit of its kind for New York sea turtle research. Additionally, it enabled us to establish a network of cooperating fisherman and scientific agents to monitor endangered sea turtles, and to collect data for years to come. The legal authorization was a result of many months of document modifications, discussion, and development of new legal processes. The length of the deliberation over the permit process with NMFS Permits, Conservation and Education Division was only matched by the importance of the completed permit to successful long-term research and conservation efforts.

Research efforts started with the official authorization of the Federal Permit on 19 September 2002. Much preparation had already been done by then, and many elements of the study were in place. This enabled us to begin, even before the end of the year's turtle activity season, with hopes of gathering data on some end-of-the-year captured turtles. Early November marked the end of the 2002 field season. Field activities were resumed again in summer 2003, and continued through November, and again from July through October in 2004.

In overview, during our first year, we instituted effective and efficient retrieval, handling, marking, and scientific collection procedures following the protocols designed in our Permit No. 1389. In order to develop the necessary collaboration between commercial fisherman and project staff we instituted a communication network to facilitate the retrieval of sea turtles from fishermen. By establishing a hotline response number, dedicating to the project a vehicle equipped with a transportation tank, and outfitting our research team with cell phones to respond immediately to calls from the fisherman, the response and research program went according to plan. Therefore, no methodological modifications were required during the 2003 or 2004 field season. Rather, as a complement to the mark-recapture and comparative aspects of our originally planned research, in 2003 we were able to develop methods for additional sea turtle health and environmental assessment to integrate into our long-term research plans. In 2004, we were able to further improve and strengthen our response and research capabilities by fully incorporating the researchers at Riverhead Foundation for Marine Research and Preservation.

Establishment of Partnerships, Collaborators, and Cooperative Network Participants

Once empowered with the authority granted by our permit, we began including and training a key group of commercial fishers and local conservation and education professionals to provide proper instruction of notification, sea turtle handling guidelines, and sampling protocols. The original team consisted of a small and important group of commercial fishermen who operate pound nets in some of the most turtle-productive areas within the Peconic Bay Estuary. The working nets of this group (see Appendix) were in the same vicinity, and in some cases, the same exact locations as those in our previous studies more than a decade earlier. This is not peculiar because pound nets apparently have been placed in many of these locations for centuries.

Through subsequent interviews and discussions, the original group of five fishermen was expanded in 2003 and 2004 to include several other interested participants. These and some other key individuals are being added to the growing network of cooperators to provide data and possibly turtles in future seasons.

Crucial among the group of professional collaborators is the Cornell Cooperative Extension (CCE) Marine Program of Suffolk County, which has contributed greatly, especially in terms of resources and professional scientific and educational staff participation. Moreover, the CCE Marine Program, headed by Christopher Smith, has agreed to partner with this research project for the long term, providing a 24 hr reporting hotline, a rapid-response team, on-site lab and office facilities, and logistical support (see Appendix).

A second partner, critical to the long-term success of the research project is the Riverhead Foundation for Marine Research and Preservation, located at the geographic center of the project in Riverhead, NY. The Riverhead Foundation scientific staff, directed by Robert DiGiovanni and Kimberly Durham, also has committed to long-term involvement in the project. During the first year this conservation and research organization generously provided expertise and training, additional support to the rapid-response team, office space for data processing and storage, and a full-functioning laboratory (see Appendix). Since then, the laboratory has become the principal site in which blood, tissue, and genetic samples are initially processed and stored. In conjunction with the Riverhead Foundation scientists, during the first seasons we stocked this lab with supplies and equipment, including blood centrifuge and staining equipment, along with an ultra-cold freezer for long-term storage for genetics and toxicology samples. In the third season, the Riverhead Foundation took more of a lead role, heading up the response, retrieval, and data collection operations along with CCE staff.

All of the sea turtle health assessment portions of the project, including blood and tissue sampling and processing protocols, have been conducted in close collaboration with Wildlife Trust's Conservation Medicine Program, headed by research veterinarian Dr. Alonso Aguirre. Through this collaboration, we instituted a Veterinary Intern Program, which is now incorporated into our long-term research design. In the first years of the project, our veterinary intern collaborators were Dr. Katie McGonigle (2002) and Dr. Michele Sims (2003), both graduates of Tufts University School of Veterinary Medicine. After initial intensive training in established sea turtle handling protocols, the field veterinarians were charged with medical oversight, sample processing and analysis, and exploring new avenues of health-related research in the context of sea turtle conservation.

After three seasons, the field research and retrieval efforts have remained relatively constant, with no profound changes except for steady improvement in the system. The consistency of effort and response, along with the high level of professional accomplishment, has provided us with a solid scientific basis from which we can analyze our field results.

Field Results

After obtaining authorization on 19 September 2002, we retrieved, measured, individually tagged, and biologically sampled 54 individual sea turtles, 3 of which were recaptured within the same vicinity at a later date (Tables 1-3). All 57 of the captures were in pound nets. In all, there were 35 green turtles, 17 Kemp's ridley turtles, and 2 loggerhead turtles. Two recaptures occurred in 2003 and another was recaptured twice in 2004. An individual green turtle was recaptured after an interval of 13 days, another individual green turtle after 31 days, and another green after 14 and 16 days. All were recaptured within 15 km of their original captures sites. All turtles were apparently healthy upon retrieval and subsequent release. In addition, the recaptured turtles exhibited measurable growth between captures.

Capture locations during all three seasons were distributed throughout the eastern Peconic Bay Estuary system, at a site in eastern Long Island Sound, and in Shinnecock Bay on Long Island's southern shore. Overall, the sampling design for the current study is a subset of the sampling scheme of the previous decade. The capture techniques are limited to pound nets, the study area is limited to eastern Long Island, and the number of participating fishermen (and therefore presumably active pound nets) is smaller. Although the sampling scheme may expand through time, it will likely remain a subset of the former study. Thus, results should be interpreted accordingly, especially when comparing absolute abundance of turtles captured. To date, there has been a relatively even distribution of captures in all areas within the Peconic Bay system where there were pound nets. There was no evident clustering in any particular area, nor were there any other obvious abnormal trends in the spatial distribution of the turtles. As seen in the previous study, there may be a seasonal tendency for turtles to move out toward the open ocean in the fall. In 2003, the three turtles captured farthest east all were encountered in October. In previous years, such a temporal pattern was interpreted as an indicator the timing of emigration from the bays (Morreale and Standora, 1998).

Upon retrieval, all turtles were weighed, measured, and inspected for external signs of health, damage, scars, or previous tags (see Appendix). Before release, all turtles were tagged with individually coded tags of two types (Tables 3-4) and photographs were taken. An internal PIT tag was inserted beneath the skin of the right front flipper, and an external inconel tag was attached to the trailing edge of the left front flipper. None of the turtles in 2002-2004 had been previously tagged from other studies. In addition, small biopsy samples were taken from distal regions of left and right hind flippers, and blood samples were taken from each animal, in accordance with guidelines and instructions of the Federal Permit. Tissue samples were banked in an ultra-cold freezer for future genetic, virological, histopathological, and toxicological analysis. Blood morphology also was analyzed and catalogued for comparison to future and past samples (see Appendix).

<u>2002</u>

During the 2002 field season, turtle captures occurred from 25 September through 3 November, yielding nearly an even distribution of five Kemp's ridley turtles and four green turtles (Fig. 2). All individuals were juveniles, with mean standard carapace lengths of 29.1 cm for the green turtles and 29.9 cm for the Kemp's ridley turtles, and mean weights of 3.26 and 4.27 kg respectively. These sizes are consistent with benthic immature life stage, and ages of approximately 2 to 3 years-old for these species. Contrary to expectations, no loggerhead turtles were captured in 2002.

During the 2002 field season, the first eight sea turtles observed were healthy and active upon retrieval. Immediately after field measurements and processing, all of these turtles were transported back to the point of capture and released nearby. The last turtle, which was encountered on 3 November 2002 was a Kemp's ridley retrieved by a fisherman after being observed floating lethargically in a pound net. Our field crew, along with personnel from the stranding network of the RFMRP, retrieved the turtle from the fisherman and immediately suspected that the turtle may have stayed in northern waters too long, lingering into the cold season.

The turtle's general condition was different than the captures from earlier weeks. Externally, the turtle appeared thin and possibly dehydrated, and hosted a growth of algae on its head and carapace. In addition, the water temperatures at the time were low in response to an extended cold snap, which occurred more than a week after the last capture of the main activity season. Furthermore, this turtle was encountered within a few days of the first reported cold-stunned turtle in Massachusetts waters. Based on previous experience, the time of year, and a tendency toward caution, this turtle was classified as a cold-stunned turtle, and treated accordingly. The animal was transported to the RFMRP for rehabilitation and examination by Dr. Rob Pisciotta, DVM. After a short and successful rehabilitation, it was deemed healthy and ready for release during the following spring as is the normal procedure for cold-stunned turtles.

The immediate success with this turtle underscores the benefits of institutional partnerships that have been formed for this project. We have developed a good working relationship with the personnel from the RFMRP, and have included them in subsequent and future study plans in order to respond effectively and immediately to these rare events where turtles may need special care.

This type of cold-stunning event was not without precedent. In our study spanning the previous decades, another cold-stunned turtle similarly wandered into a pound net. On 19 November 1989, a loggerhead turtle was encountered in a pound net, also floating lethargically in the cold water. Upon retrieval, the cold-stunned turtle was successfully rehabilitated, and subsequently released on 29 June 1990.

Despite the modest sample size from the abbreviated 2002 season, there was a notable feature: namely, no loggerhead turtles were encountered. This was contrary to all expectations going into the first season of the new study. In the prior study that spanned the previous decades, loggerhead turtles comprised the majority (59%) of all turtles captured, and it was rare to capture a consecutive series of turtles that did not include a loggerhead turtle. In fact, the calculated probability for capturing two consecutive turtles that were not loggerhead turtles was only 10%; for three in a row, the chance was reduced to 6%; and for the maximum ever recorded of six in a row, the probability plummeted to 0.5%. In this context, the 2002 total of nine consecutive turtles in a row without a single loggerhead was remarkable. The cautious interpretation at the end of the first season was that the sample size needed to be increased before overly scrutinizing this unlikely pattern and the absence of juvenile loggerheads.

<u>2003</u>

During the 2003 field season, turtle captures occurred from 1 August through 22 October 2003, yielding 6 Kemp's ridley sea turtles, 12 green turtles (with two additional recaptures), and 2 loggerhead turtles (Fig. 3). Based on the sizes, all individuals were juveniles, with mean standard carapace lengths of 29.3 cm for Kemp's ridley turtles, 32.1 cm for green turtles, and 59.0 cm for the two loggerhead turtles. Similar to the 2002 field season, the sizes encountered in 2003 were comparable to benthic immature individuals of the first two species, probably around 2 or 3 years old. Throughout the season, the sea turtles observed were healthy and active upon retrieval. All were transported back to the point of capture and released nearby. Although loggerhead turtles were not entirely absent in the 2003 season, the two individuals were not encountered until October.

The recapture records provided us with a first glimpse of growth rates of these juveniles under present-day conditions. Both recaptured green turtles during the 2003 field season showed positive gains in weight and length. Upon original capture on 3 September, turtle 030903-CM-005 measured 28.8 cm standard carapace length, and weighed 3460 g. At first recapture on 16 September, its length was recorded at 29.1 cm, and its weight at 3640 g. Over the 13 days between captures this individual increased its body weight by 180 g, or 5.2%, and increased its carapace length by 0.25 cm, or 0.87 % (see Appendix). Similarly, turtle 030908-CM-008 was originally captured on 8 September with a standard carapace length of 28.3 cm, and weighing 3140 g. Upon recapture on 9 October, its length had increased to 28.5 cm, and its weight to 3340 g. After 31 days at-large this young green turtle increased its body weight by 200 grams, or 6.4%, and its carapace length by 0.2 cm, or 0.7 %. The observed positive growth in these two turtles, supported our assumptions of general good health in the turtles, and provided an indication of general foraging conditions.

Despite, the capture of two loggerhead turtles, the lack of individuals of this species in two consecutive seasons was remarkable. The 10% contribution of loggerheads to the overall species assemblage in 2003 was only mildly more than the total absence in the previous year. This too fell far below the expected value of 59%, the relative rate of encounter of loggerhead turtles in previous decades. Moreover, the string of consecutive captures without a single loggerhead at the beginning of the 2003 season was 12. In addition, after the capture of a single loggerhead turtle, this was followed by another series of seven. Based on calculations of capture records from previous decades, such capture trends would have been highly improbable. The capture of 12 consecutive green turtles and Kemp's ridley turtles was more than twice the previous study's maximum of six consecutive captures of other species; this was after several years of study. But, when combined with the string of captures from the end of the 2002 season, the number of 21 consecutive captures without a single loggerhead turtle was striking. After two consecutive seasons of such unlikely capture patterns in both sequences and species ratios among pound-net captured turtles, it was thought possible that we are in the process of observing a species composition shift in northeastern coastal waters: namely, one in which juvenile loggerheads do not play a major role.

<u>2004</u>

During the 2004 field season, turtle captures occurred from 26 July through 18 October 2004. Again there were 6 Kemp's ridleys, along with 19 green turtles and with two additional recaptures of the same individual (Fig. 4). Based on the sizes, all individuals were juveniles, with mean standard carapace lengths of 27.2 cm for Kemp's ridley turtles and 30.3 cm for green turtles. Similar to the previous 2 field seasons, the sizes encountered in 2004 were comparable to benthic immature individuals, probably around 2 or 3 years old. Throughout the season, the sea turtles observed were healthy and active upon retrieval. All were transported back to the point of capture and released nearby. Loggerhead turtles were entirely absent in the 2004 season.

Once again, the most obvious anomaly of the season was the lack of juvenile loggerhead turtles. The capture locations were widely distributed throughout the Peconic Bays, Shinnecock Bay, and Gardiners Bay, indicating active nets throughout the season. Coupled with the apparently normal seasonal activities of green turtles and Kemp's ridleys, the absence of loggerheads in the pound nets was perplexing. As unlikely as were the previous strings of consecutive captures of turtles without a single loggerhead, the current unbroken capture string is at 26 in a row. After three consecutive seasons, such conspicuous absences of juvenile loggerheads bear much more intense scrutiny. For further analysis, it was first important to examine the current patterns with respect to those of the earlier study from 1987-1992.

Comparisons and Trends Among Decades

The spatial distribution of turtles captured in pound nets in 2002-2004, fell squarely within the boundaries of the distribution of turtles that were captured in pound nets during the previous study from 1987-1992 (Fig.5). Although there is an inherent constraint on the locations of captures, which ultimately are dictated by the locations of pound nets, it was possible to compare trends among the decades. In both studies, turtles were captured in locations distributed throughout the eastern Peconic Bay Estuary system, at a site in eastern Long Island Sound, and in Shinnecock Bay on Long Island's southern shore. In the early study, captures extended farther eastward along Long Island's southern fork, but this likely was the result of greater numbers of pound nets participating at the time. Where the two studies overlap, there was a relatively even distribution of captures in all areas where there were pound nets. In addition there are spatial-temporal similarities; more than one half of all of the captures in the eastern-most pound nets occurred after late September in both studies.

In the 2002-2004 seasons, the size distribution of the turtles captured in pound nets also is a subset of the range of sizes of turtles from the 1987-1992 study (Fig.6). This was true for all three species. Moreover, the relationships between species was very similar among the years. In both studies, the smallest individuals were Kemp's ridley turtles, the mean size was the greatest for loggerhead turtles, and there was an extremely high degree of overlap in size distribution of Kemp's ridley turtles and green turtles. Within species the mean sizes also were highly similar among studies. Not surprisingly, the results of an ANOVA performed to detect inter-decade differences showed no significant difference among the mean standard carapace lengths of green turtles ($p=0.54$), nor of Kemp's ridley turtles ($p=0.30$). The small sample size of contemporary loggerhead turtles precluded a meaningful statistical analysis, but the sizes of the two individuals were well within 2 SD of the earlier mean.

Qualitatively, there appeared little difference in the external appearance or apparent health of turtles among studies. Turtles without obvious injury during all activity seasons appeared healthy, active and alert. Moreover, there were no external signs of papillomas, disease, or abnormal growths on any of the turtles. A small percentage of turtles from pound nets in both studies exhibited minor scars and small missing fragments of both front and rear flippers. A green turtle captured in September and again in October of 2003 had what appeared to be an old fracture of the radius and ulna which had healed, and apparently did not hinder movement. As in the past, there also was direct evidence of recent boat collisions in a small percentage of the live turtles. A Kemp's ridley encountered in late October 2003 was in apparent distress due to a recent boat impact. The propellor had excised chunks from both carapace and a rear flipper, and in another spot, cut through the carapace and plastron, along with the underlying skin and muscle. All told, however, there was not an obvious change in the rate of damaged turtles among the studies. Most turtles in retrieved in pound nets continue to be healthy and active. Further comparisons will be forthcoming with future blood and tissue analysis.

The most obvious and remarkable change observed between the 1987-1992 study, and the 2002-2004 study was the dramatic shift in species composition (Fig. 7). This shift expressed itself in two ways: in percentages of species relative to each other, and in absolute numbers. The latter are a little more complex to interpret given the unbalanced sampling effort. Nevertheless, some patterns ran counter to expectations. The relative numbers are more straightforward. In the study spanning the previous decades, loggerhead turtles comprised the majority of all captures in pound nets, followed by Kemp's ridley turtles, and then green turtles. In the current study, after a span of more than 10 years, the percentage of captures that were loggerhead turtles declined sharply to make up less than 4% of the total, a relative decline of more than 55%. In their place, green turtle captures increased to 66%, and surpassed the numbers of Kemp's ridleys. Thus, in effect, the observed relative species composition in the current study was inverted from the previous study.

A major shift in relative composition by itself is difficult to interpret. There are at least two potential explanations for the observed differences among decades. The first is that, such a species shift could be caused simply by an increase in juvenile Kemp's ridleys and green turtles in the Western North Atlantic. This conclusion is not without basis. During the intervening decade, there have been major changes in management for both of these species, which undoubtedly have contributed to population increases. The most obvious change which likely has been influential in increased numbers of turtles in this region has been the implementation of Turtle Excluder Devices on shrimp trawls since 1990. In conjunction with other efforts at bycatch reduction during the past decade, such as improvements to summer flounder trawl fishery regulations, it is possible that we are measuring the positive effects of improved management strategies for sea turtles in coastal waters.

Because the turtles in northeastern coastal waters mainly are young juveniles, any observed increases in numbers would be directly traceable to the nesting beaches in the preceding few years. Indeed, for the Kemp's ridley turtle, there has been a steady increase of hatchlings produced in the primary beaches in Tamaulipas, Mexico, from 45,000 in 1987, to 476,000 in 2003. Similarly, there have been recorded increases in green turtle nests at index beaches in Florida, from 1,700 in 1989, to 7,000 in 2002. During the same time loggerhead nesting in the along Western North Atlantic beaches has reached a plateau, and may be declining slightly. Thus, the regional increases in production off the nesting beaches could be directly contributing to increases of Kemp's ridley and green turtles in New York's coastal waters, without simultaneous increases in loggerhead turtles. Therefore, on a relative scale, more green turtles and Kemp's ridleys would necessarily reduce the proportion of loggerheads.

However, another important measure of shifts in species composition is the absolute numbers of captures. In 2003 and in 2004, the first complete seasons from which to make comparisons among decades, there were six Kemp's ridleys each year, a value on the low side of the range of 4-14 observed in previous years. This does not add much in the way of supporting a postulate of greater numbers of juvenile Kemp's ridley turtles in the region. However, there indeed were more green turtles captured in 2003 and again in 2004 than in any previous year. In the earlier study years, green turtle captures in pound nets ranged from as low as 0 in 1988, to as high as 9 in two of the seasons. In 2003, even with presumably a relatively reduced fishing effort, there were 12 individual green turtles captured in pound nets. In the 2004 season, there were 19 individuals captured, more than twice the previous study's record total. Such increases in green turtles could go a long way toward explaining the shift in relative species composition.

One of the factors contributing to difficulty of interpretation of the capture patterns is the potential inequity in fishing effort among years and among studies. However we believe that the 2002-2004 seasons almost certainly represent a subset of the fishing effort of the earlier study. This reduced effort would be expected to result in a commensurate reduction in captures of turtles. Furthermore, because of the widespread distribution of the pound nets in the current study, we would expect a relatively uniform reduction among all three turtle species. However, this was not the case with regard to numbers of green turtles and loggerhead turtles (Fig. 8). So, at the very least, it seems that juvenile green turtles are increasing in numbers in the New York Index site.

A second, and potentially alarming, possibility is that the low numbers of loggerhead turtles captured in pound nets during the 2002-2004 seasons in New York are indicative of a regional decline in juveniles of this species. Not only were the proportions of this species far lower than in the previous study, but the absolute numbers of 2 loggerhead turtles in the 2003 season and 0 loggerheads in 2004, were the lowest totals ever recorded for any of the complete years of study. This was in stark contrast to the previous decade in which total numbers of individual loggerheads ranged from 11 to 28 per year. Although a potential reduction in fishing effort could account for the lack of loggerhead turtles, it remains possible that the complete absence of turtles from the size classes between 30 and 55 cm could be indicative of a more far-reaching influence. After the first to seasons, we were interpreting the reduced numbers with caution. But after the third season, the trend is becoming even a bit alarming.

Unlike the trends of increasing Kemp's ridley and green turtles, the observed lack of juvenile loggerhead turtles in New York waters cannot be explained by obvious recent declines of nests on U.S. beaches. That leaves open other possibilities, such as a major shift in foraging grounds, which would be hard to reconcile with the continued presence of other species of turtles in New York. Alternatively, the low numbers and the complete absence of young loggerhead turtles in this northern index site may be representative of a larger and more insidious pattern of recent increases in mortalities of early-stage juveniles, before they reach the coastal benthic foraging stage. Admittedly, it is hard to imagine something of such great potential impact going otherwise unnoticed. At the least, this potential reduction in numbers of loggerhead turtles warrants immediate attention. Most certainly, this will be the focus of more scrutiny in our upcoming season, with particular emphasis on comparisons of fishing efforts, analysis of potential shifts in environmental patterns, scrutiny of recent stranding patterns, and comparisons with observations and similar in-water studies elsewhere along the Eastern Seaboard.

Ongoing Lab Studies

An important component of the study to assess and compare the overall status of sea turtles in Northeastern coastal waters lies within the realm of conservation medicine. In effect, our goal for this is to combine an understanding of the health status of the turtles, including known diseases, environmental threats, and pathogens, with our accumulating knowledge of the detailed ecology of the juvenile turtles that occur in the region.

Early in this portion of the study, much of the emphasis has been placed on collection, preliminary processing, and proper archival of blood, tissues, and samples to build up a bank for future analysis. Also, there has been a great deal of effort in quantifying and cataloguing basic characteristics of the turtle's blood, namely the cell counts and blood morphology (see Apendix). Over the upcoming months these analyses will continue, including comparisons of blood morphology of northern and southern sub-populations of Kemp's ridley turtles, and comparisons of cell counts with similar data from 1987-1992.

Other major emphasis is being placed on the eventual evaluation of both sea turtle and environmental health through the analysis of histopathology and virology. While there have been no measurable signs of widespread disease, or chronic illness in the juvenile turtles of this study, viral infection in individuals often can be latent. It is possible too that young turtles moving into inshore waters for the first time in their lives, are just beginning to accumulate toxins or biological pathogens, and are as yet subclinical.

Currently, three separate avenues for the above studies are being pursued. All of these will first require additional funding. For the toxicology analysis, we will likely concentrate on organochlorine compounds and some select heavy metals. Along these lines, we also are working toward creating new partnerships, potentially with Grice Marine Laboratory and the National Institute of Standards and Technology to analyze blood, tissue, and scute material for toxic residue, especially methyl mercury, and perhaps MTBE, the gasoline oxygenate. For the virology analysis, we are working toward collaborating with researchers at Cornell University College of Veterinary Medicine. Essential to all of these health studies is the establishment of baseline values from which to compare samples. Ultimately, the results of the analyses of these studies will be compared to samples from our own previous study, and to those of other regions.

Summary

Total sea turtle captures by fisherman during the initial three seasons of this current study appear comparable to the numbers observed during the early part of the study more than a decade ago, indicating the overall success of our current initial efforts. In the first season, records of the participating fisherman indicated that they encountered 10 sea turtles prior to the start of our sampling, which combines with our captured individuals for a total of 19. This slightly exceeded the first year of the previous study (1987) in which there were 17 recorded pound net captures. Similarly, the following complete season's total of 22 captures, exceeded the 18 that were captured in pound nets in 1988.

Similar total numbers notwithstanding, the first three seasons' observations reveal some interesting new patterns with respect to species composition. There was a conspicuous absence of loggerhead turtles observed in the initial year. Furthermore, reports from fisherman who caught turtles prior to the start of our sampling suggested that only one loggerhead turtle was encountered during the early part of the activity season. Again in the 2003, loggerhead turtles were noticeably absent until October, when only two were encountered; both were large juveniles. None were encountered in the entire 2004 season. This absence is in stark contrast to the results of our previous study in which loggerheads were the most often encountered species, representing 59% of all turtles captured in pound nets. In the current study juvenile loggerheads comprise less than 4% of the total. We do not have a definitive explanation why the numbers of loggerhead turtles in New York waters would be substantially reduced just a decade after the last study, but our curiosity definitely is piqued, and our concern is increasingly heightened. Some possible explanations are recent shifts in behavioral or environmental factors, or a recent regional increase in mortality of young juvenile loggerhead turtles. However, for obvious reasons, our preliminary conclusions are speculative and should be interpreted with caution. At the least, the anomalous absence should be investigated more thoroughly.

Simultaneous to a decline in numbers of loggerhead turtles, was a measured increase in numbers of green turtles. The total of 18 captures represents 66% of the overall total among all three species. Furthermore, the number of 12 individual green turtles captured in 2003 and 19 in 2004 were the highest single season totals to date recorded in New York pound nets. This may be due to a regional increase in juvenile green turtles, which may be related to recent increases in nesting on U.S. beaches. It is possible that similar increases on Kemp's ridley nesting beaches could have a similar effect, but, as yet, no such obvious trend was detected in captures of that species in New York waters.

Aside from the shift in species composition, there were few quantitative or qualitative differences observed among study populations. There were no significant differences in the mean sizes of Kemp's ridley turtles or green turtles between the decades of study. In addition, the ranges of sizes of all three species captured in 2002-2004 all fell within the sizes recorded during the 1987-1992 study. Qualitatively, there were no obvious outward changes in appearance, health or overall condition of the juvenile turtles from pound nets, as was observed in the original study. More recaptures and subsequent growth measurements, along with ongoing and future blood and tissue analyses will help to quantify these factors more.

The overall successful outcome from our first two field seasons was directly attributable to the support and extraordinary collaboration of many individuals from many organizations. We were fortunate to have had Dr. Michele Sims, Dr. Katie McGonigle participate as field veterinarians for the first two seasons, as a result of our collaboration with Wildlife Trust and the establishment of a Veterinary Intern Program. In addition, the collaboration and support from the Riverhead Foundation for Marine Research and Preservation, the Marine Program of Cornell Cooperative Extension, and NMFS Protected Resources were integral to the project's early success. Perhaps the most important success during the first year was the establishment and incorporation of a team of collaborators from the commercial fishing community. This project would not have been possible without the support of the pound net fisherman who graciously joined this project and who have agreed to participate in future sea turtle conservation research. Overall, the commitment and collaborative relationship with these institutions and individuals provided an effective foundation for the successful beginning of this project, and the impetus for excellent future success.

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Table 1. Summary of numbers of individuals and species of sea turtles retrieved from the Peconic Bay Estuary System and eastern Long Island waters during the 2002 field season of the research project: Assessing health, status, and trends in northeastern sea turtle populations.

Individuals #	**Species**	**Life Stage**	**Sex**	**Origin**	**Take Activity Category**	**Location**	**Dates**	**Details**
4	Sea turtle, Green *Chelonia mydas*	Juvenile live	n/a	Wild	Incidental capture, measure, Blood biopsy, tag and release	Peconic Bay Estuary, LI Sound	9/25/02 through 10/25/02	Turtles intercepted during normal activities
5	Sea turtle, Kemp's ridley *Lepidochelys kempii*	Juvenile live	n/a	Wild	Incidental capture, measure, Blood biopsy, tag and release	Peconic Bay Estuary, Shinnecock Bay	10/17/02 through 11/3/02 [a]	Turtles intercepted during normal activities

[a] Upon retrieval, a turtle retrieved on 3 November 2002 was identified to be cold-stunned. New York State Stranding Coordinators from the RFMRP were on site to determine that the individual was a class 1 – 2 cold-stun. The individual was thin, dehydrated, and covered with algae; it was immediately transported to the RFMRP for rehabilitation and release in the subsequent season.

Table 2. Summary of numbers of captures and species of sea turtles retrieved from the Peconic Bay Estuary System and eastern Long Island waters during the 2003 field season of the research project (through October).

Captures #	Species	Life Stage	Sex	Origin	Take Activity Category	Location	Dates	Details
14 (2 recap)	Sea turtle, Green *Chelonia mydas*	Juvenile live	n/a	Wild	Incidental capture, measure, Blood biopsy, tag and release	Peconic Bay Estuary, LI Sound, Shinnecock Bay	8/1/03 through 10/22/03	Turtles intercepted during normal activities
6	Sea turtle, Kemp's ridley *Lepidochelys kempii*	Juvenile live	n/a	Wild	Incidental capture, measure, Blood biopsy, tag and release	Peconic Bay Estuary, Shinnecock Bay	8/8/03 through 10/17/03	Turtles intercepted during normal activities
2	Sea turtle, Loggerhead *Caretta caretta*	Juvenile live	n/a	Wild	Incidental capture, measure, Blood biopsy, tag and release	Peconic Bay Estuary	10/3/03 and 10/19/03	Turtles intercepted during normal activities

Table 3. Summary of numbers of captures and species of sea turtles retrieved from the Peconic Bay Estuary System and eastern Long Island waters during the 2004 field season of the research project (through October).

Captures #	**Species**	**Life Stage**	**Sex**	**Origin**	**Take Activity Category**	**Location**	**Dates**	**Details**
19 (1 recap twice)	Sea turtle, Green *Chelonia mydas*	Juvenile live	n/a	Wild	Incidental capture, measure, Blood biopsy, tag and release	Peconic Bay Estuary, LI Sound, Shinnecock Bay	7/26/04 through 10/13/04	Turtles intercepted during normal activities
6	Sea turtle, Kemp's ridley *Lepidochelys kempii*	Juvenile live	n/a	Wild	Incidental capture, measure, Blood biopsy, tag and release	Peconic Bay Estuary, Shinnecock Bay	8/12/04 through 10/18/04	Turtles intercepted during normal activities

Table 4. PIT tags and inconel tags used to mark sea turtles retrieved from the Peconic Bay Estuary System and eastern Long Island waters during the 2002 field season of the research project: Assessing health, status, and trends in northeastern sea turtle populations.

Species	**ID number**	**PIT Tag #**	**Inconel Tag #**
Chelonia mydas	020925-CM-001	131454185A	PPY100
	021020-CM-004	131652537A	PPY079
	021024-CM-007	131433814A	PPY082
	021025-CM-008	131127615A	PPY077
Lepidochelys kempii	021007-LK-002	131565440A	PPY099
	021008-LK-003	131635543A	PPY078
	021024-LK-005	131579481A	PPY080
	021024-LK-006	131332324A	PPY081
	021103-LK-009	RFMRP	RFMRP

Table 5. PIT tags and inconel tags used to mark sea turtles retrieved from the Peconic Bay Estuary System and eastern Long Island waters during the 2003 field season of the research project (through October).

Species	ID number	PIT Tag #	Inconel Tag #
Caretta caretta	031003-CC-012	131539537A	PPJ891
	031019-CC-019	136848354A	PPJ883
Chelonia mydas	030801-CM-001	131627090A	PPJ872
	030810-CM-003	131649185A	PPJ900
	030825-CM-004	131445737A	PPJ899
	*030903-CM-005	131648091A	PPJ898
	030906-CM-007	131568330A	PPJ895
	*030908-CM-008	047381797 B	PPJ894
	030917-CM-009	131444497A	PPJ861
	030924-CM-010	131131521A	PPJ892
	031005-CM-013	131621193A	PPJ890
	031012-CM-015	131653127A	PPJ888
	0310178-CM-017	047126586	PPJ885
	031022-CM-020	136855185A	PPJ882
Lepidochelys kempii	030808-LK-002	131451253A	PPY098
	030906-LK-006	131567212A	PPJ897
	030929-LK-011	131576527A	PPJ893
	031009-LK-014	131625574A	PPJ889
	031014-LK-016	131569314A	PPJ886
	031017-LK-018	RFMRP	RFMRP

* Recaptured once

Table 6. Summary statistics of body measurements recorded for each sea turtle retrieved from the Peconic Bay System during the 2002-2004 field seasons of the research project.

Species	Statistic	Standard Carapace Length (cm)	Carapace Width (cm)	Plastron Length (cm)	Weight (kg)
C. caretta (n=2)					
	Mean	59.0	50.9	47.2	32.38
	St. Error	3.6	1.7	2.7	3.08
	Max	62.6	52.6	49.9	35.45
	Min	55.4	49.2	44.5	29.30
C.mydas (n=35)					
(orig. caps only)	Mean	30.8	26.9	25.8	4.07
	St. Error	.7	.7	.6	.3
	Max	41.7	34.1	34.5	8.86
	Min	25.5	20.4	20.8	1.50
L. kempii					
	Mean	28.7	26.9	22.8	3.75
	St. Error	.8	.8	.6	.3
	Max	36.2	33.7	27.50	7.14
	Min	23.9	2.9	19.5	2.30

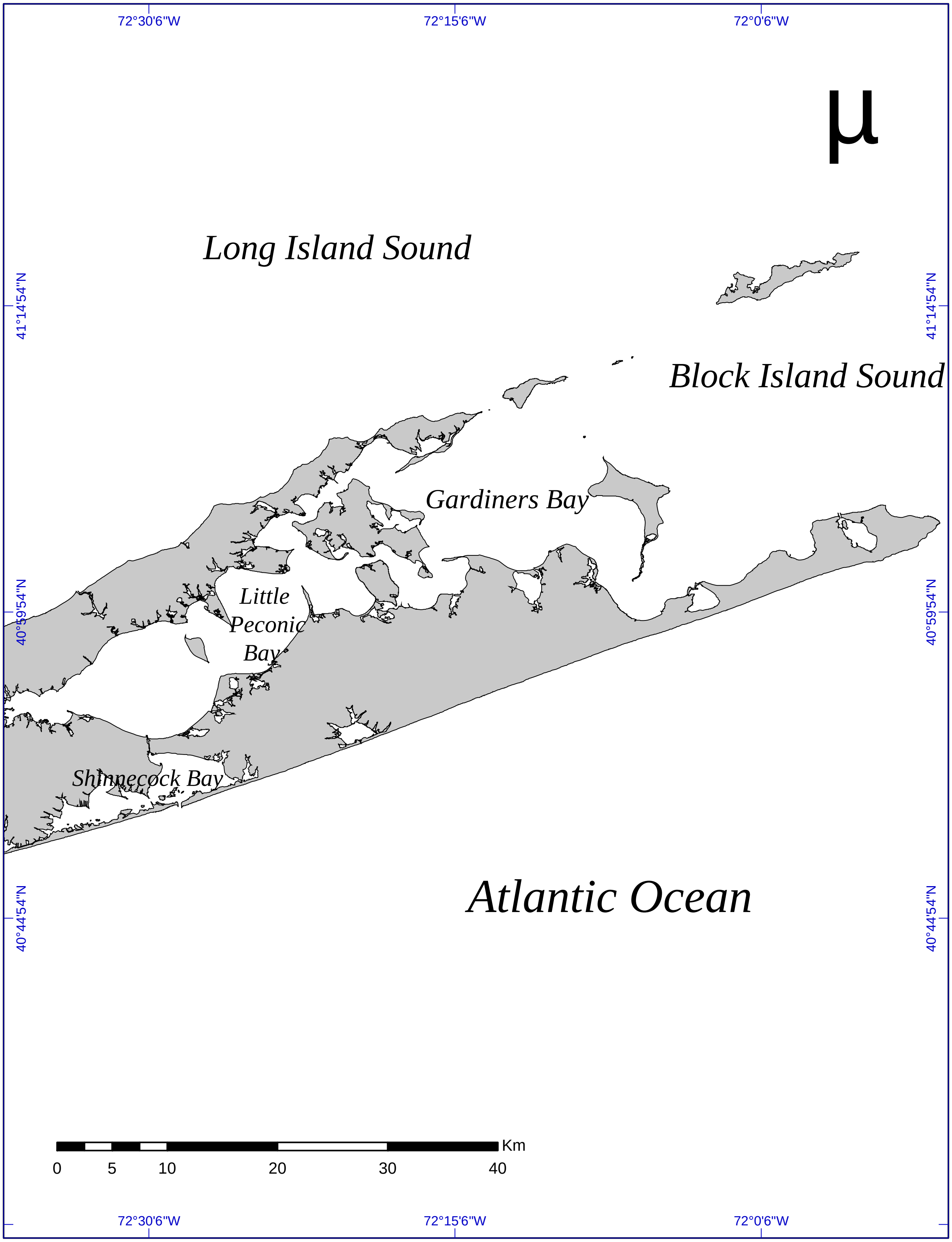


Fig. 1. Study site in eastern Long Island Sound and Peconic Bay Estuary systems. The sea turtle study was re-established in 2002, after more than a decade.

2002

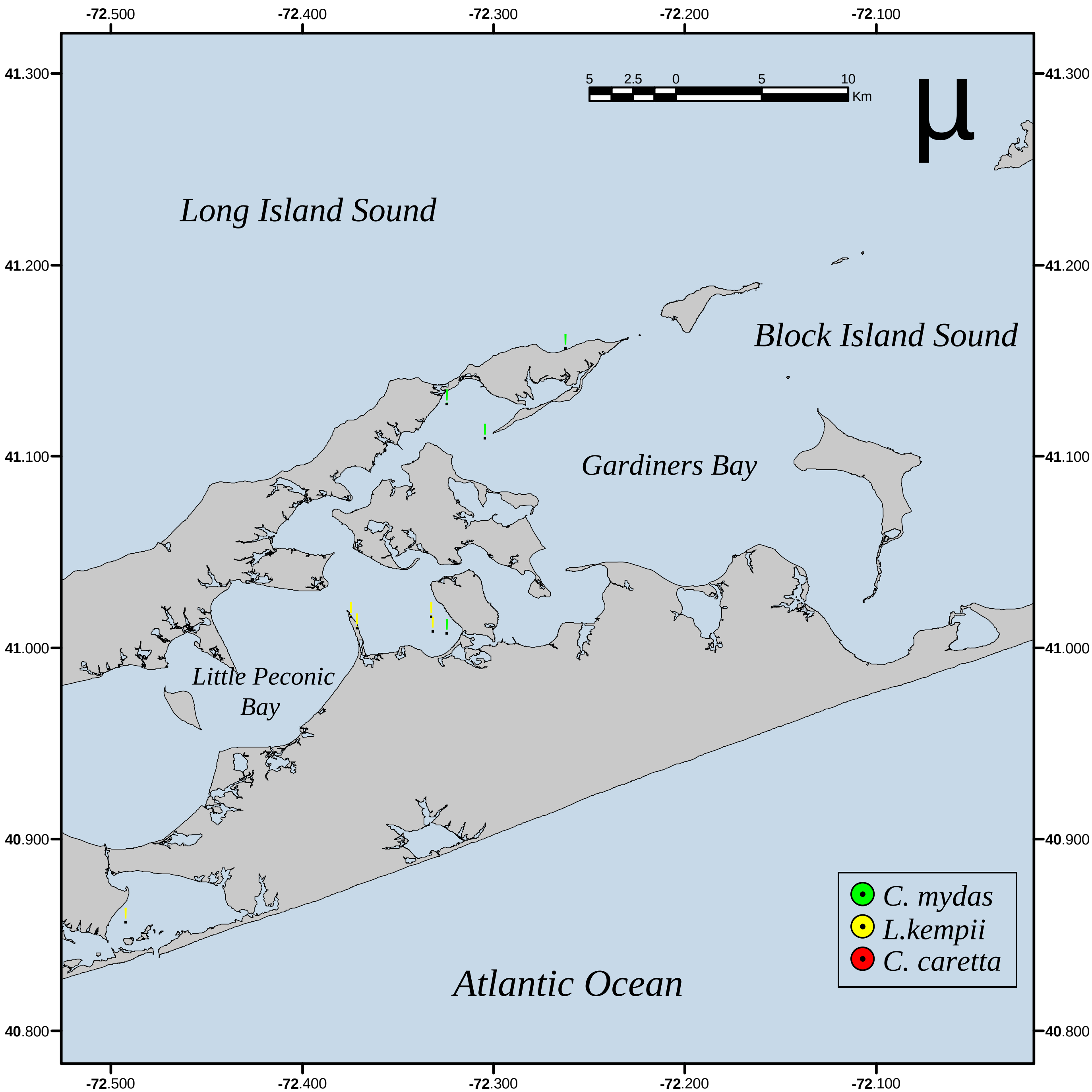


Fig. 2. Captures of sea turtles in eastern New York pound nets from 25 September to 3 November 2002. Captures of four green turtles (green) and five Kemp's ridleys (yellow) were distributed throughout the bays. No loggerhead turtles were encountered during the 2002 study period.

2003

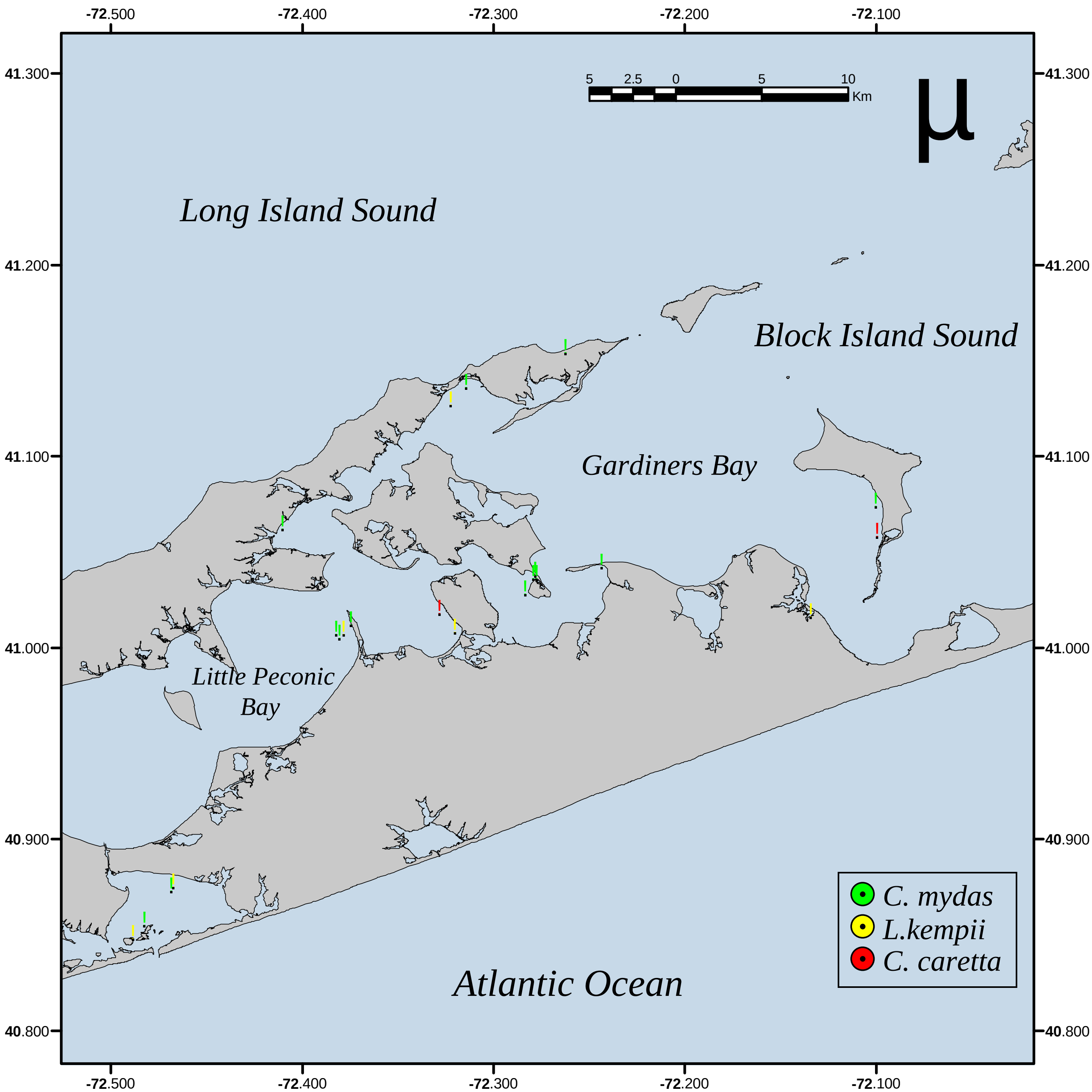


Fig. 3. Captures of sea turtles in eastern New York pound nets from 1 August to 22 October 2003. Captures of 12 green turtles (green), 6 Kemp's ridleys (yellow), and 2 loggerheads (red) were distributed widely throughout the bays. Two green turtles were recaptured once each during the 2003 season. The three easternmost captures in 2003 all occurred in October as turtles presumably were emigrating.

2004

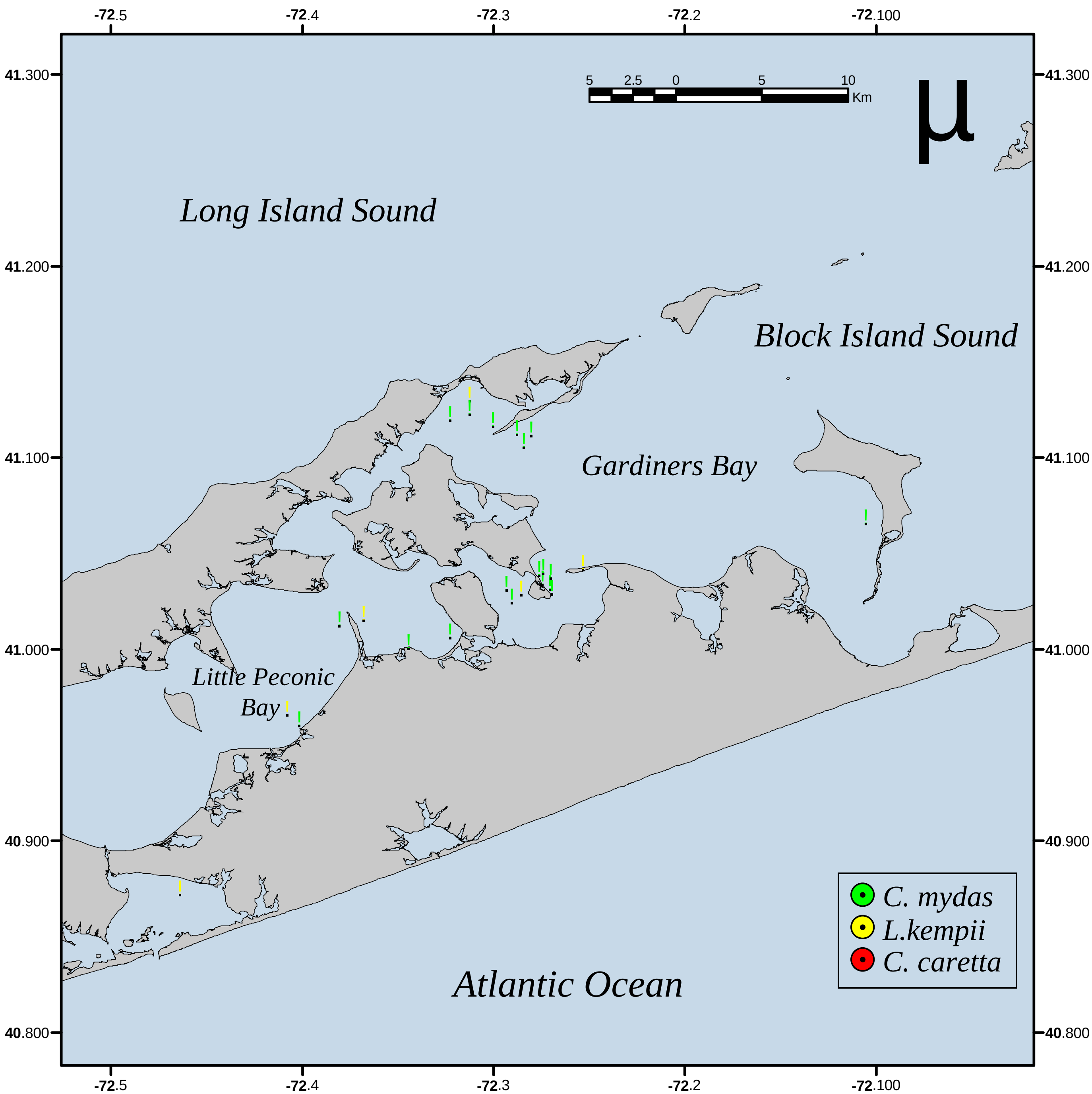


Fig. 4. Captures of sea turtles in eastern New York pound nets from 26 July to 18 October 2004. Captures of 19 green turtles (green) and 6 Kemp's ridleys (yellow) were distributed widely throughout the bays. One green turtle was recaptured twice after intervals of 14 and 17 d. No loggerhead turtles were encountered during the 2004 study period.

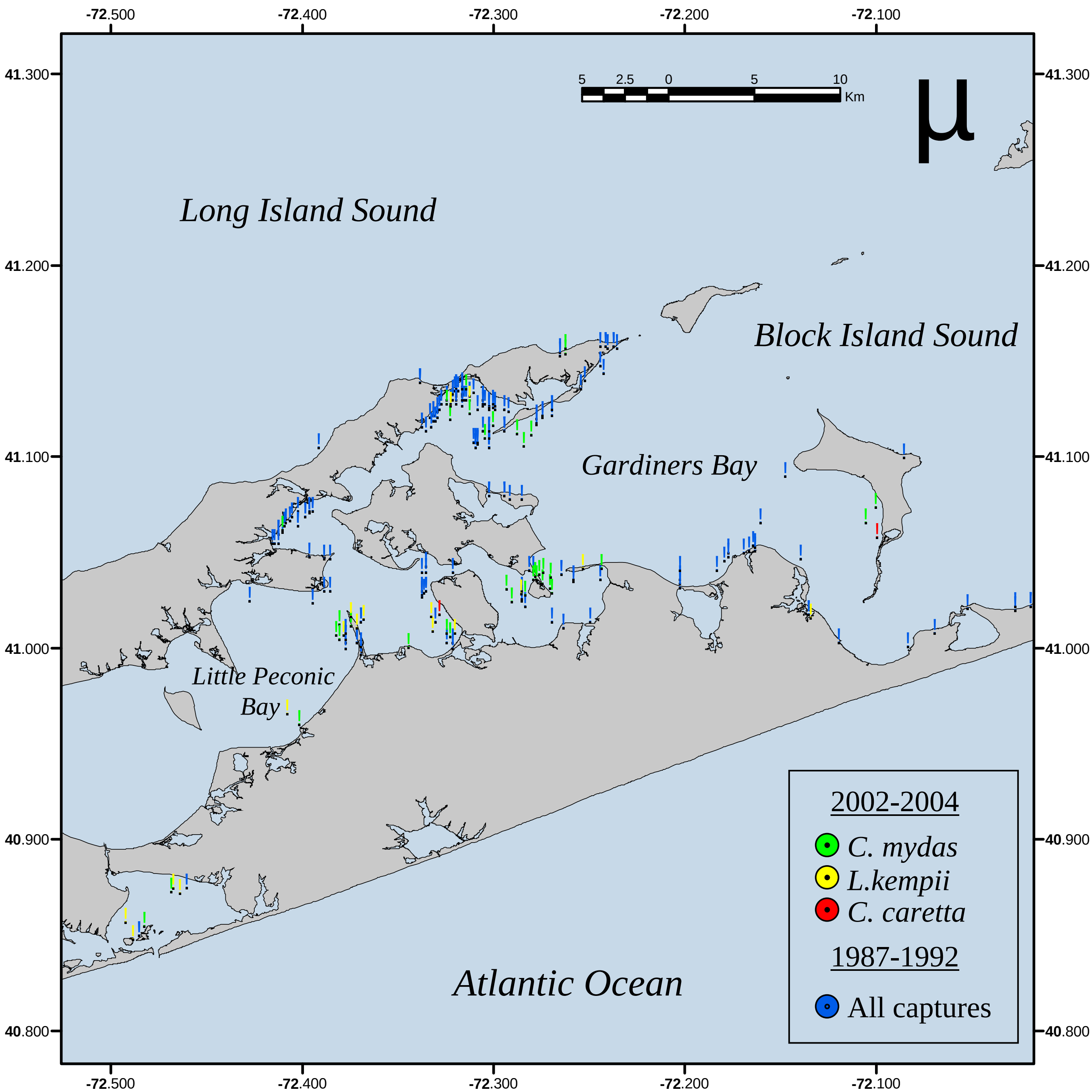


Fig. 5. Comparison, between different decades of study, of the spatial distribution of captures of sea turtles in eastern New York pound nets. Green, yellow, and red dots represent captures of green, Kemp's ridley, and loggerhead turtles, respectively, during the current study, from 2002 to 2004. The overall distribution is very similar to the overall distribution of turtle captures in the previous study, from 1987 to 1992 (blue dots), indicating very little change in spatial distribution. The area shown is the extent of the current study area.

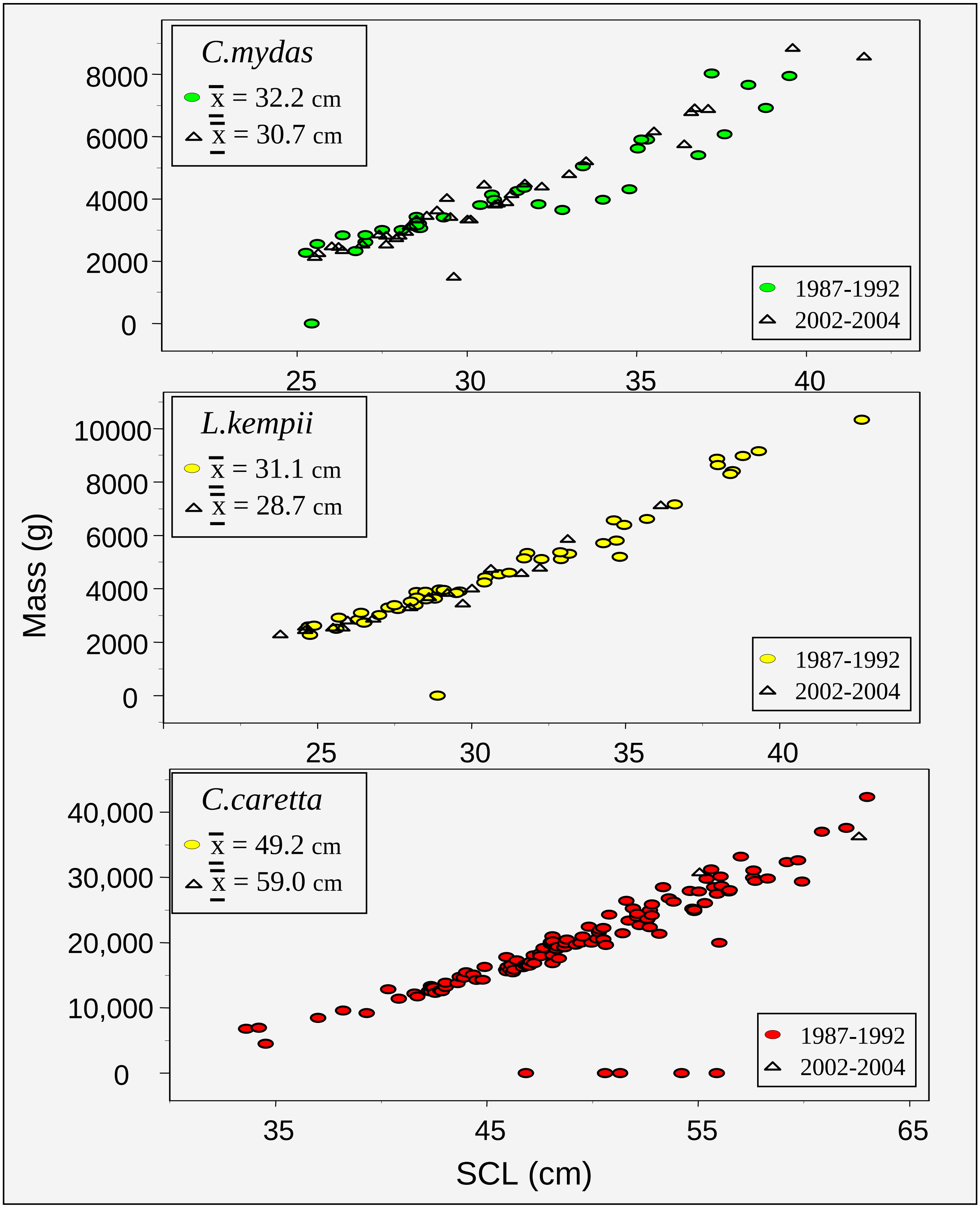


Fig. 6. Comparison, between different decades of study, of the size distributions of turtles captured in pound nets in eastern New York. The ranges of sizes and weights of all three species in 2002-2004 were subsets of those recorded in 1987-1992, indicating very little change in size distribution. The two loggerheads captured in the current study were among the larger turtles.

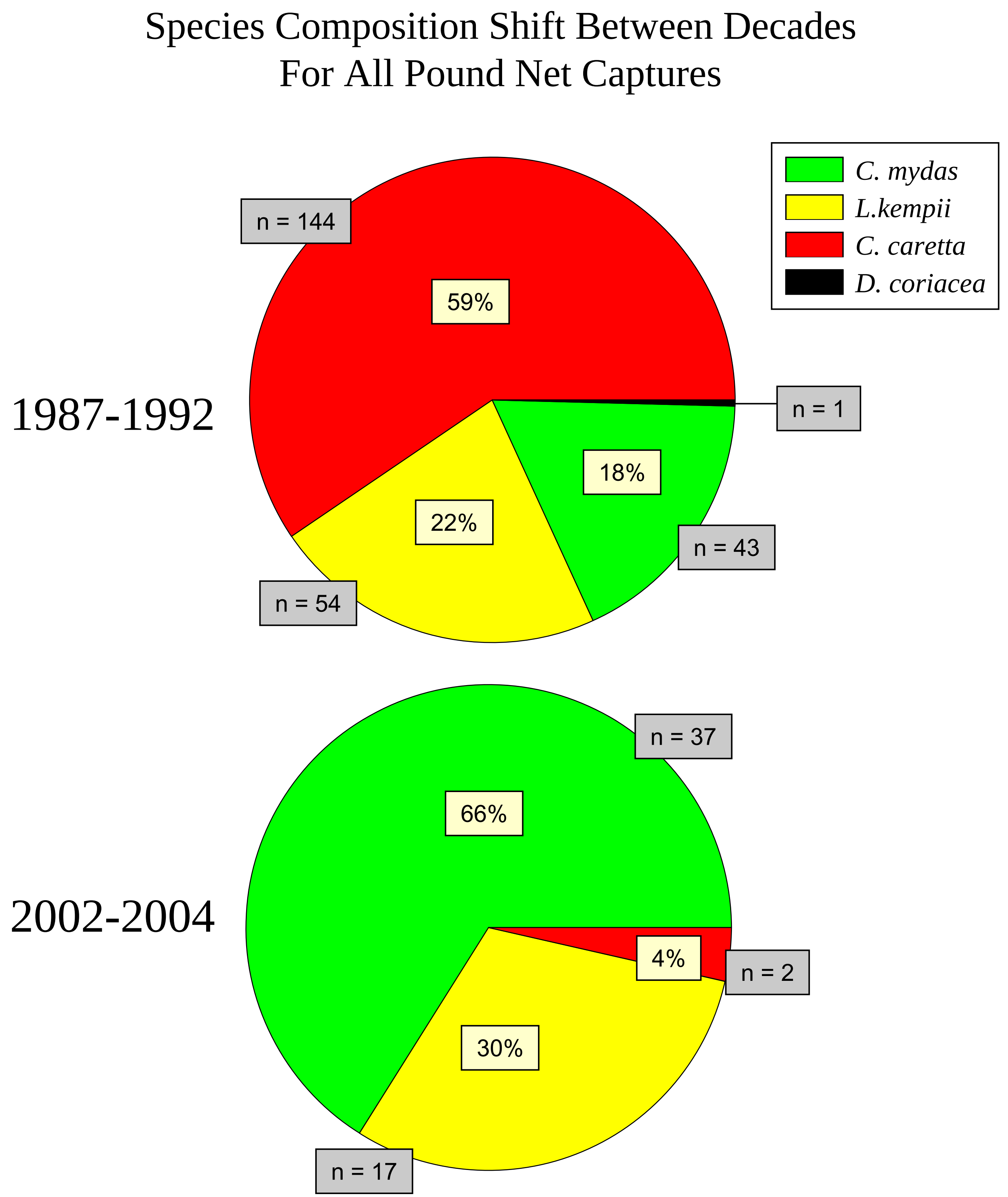


Fig. 7. Species composition changes among pound net captures between the previous study from 1987 to 1992, and the current study in the subsequent decade. There was a substantial change, from a majority of loggerhead turtles, to a majority of green turtles.

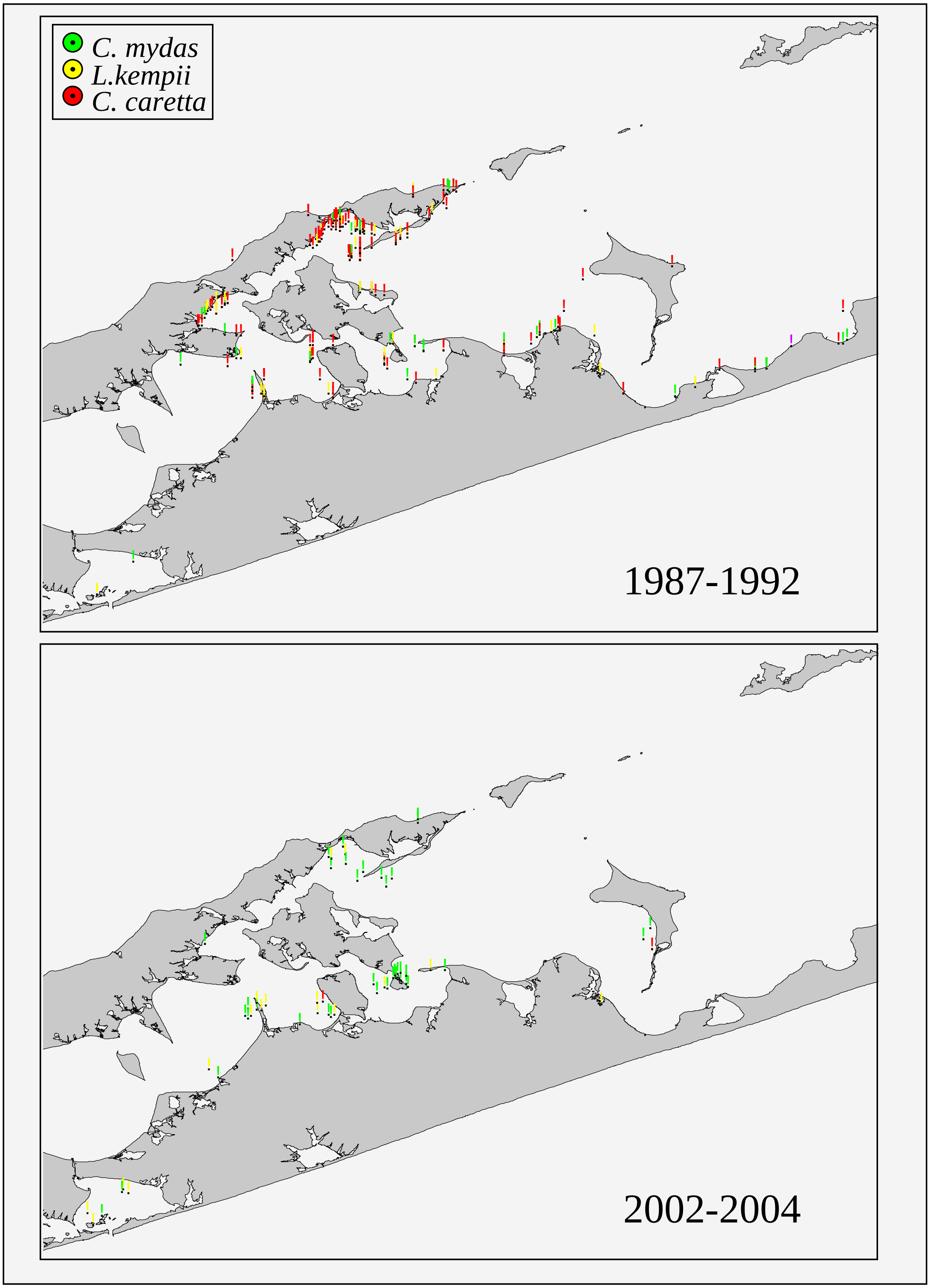
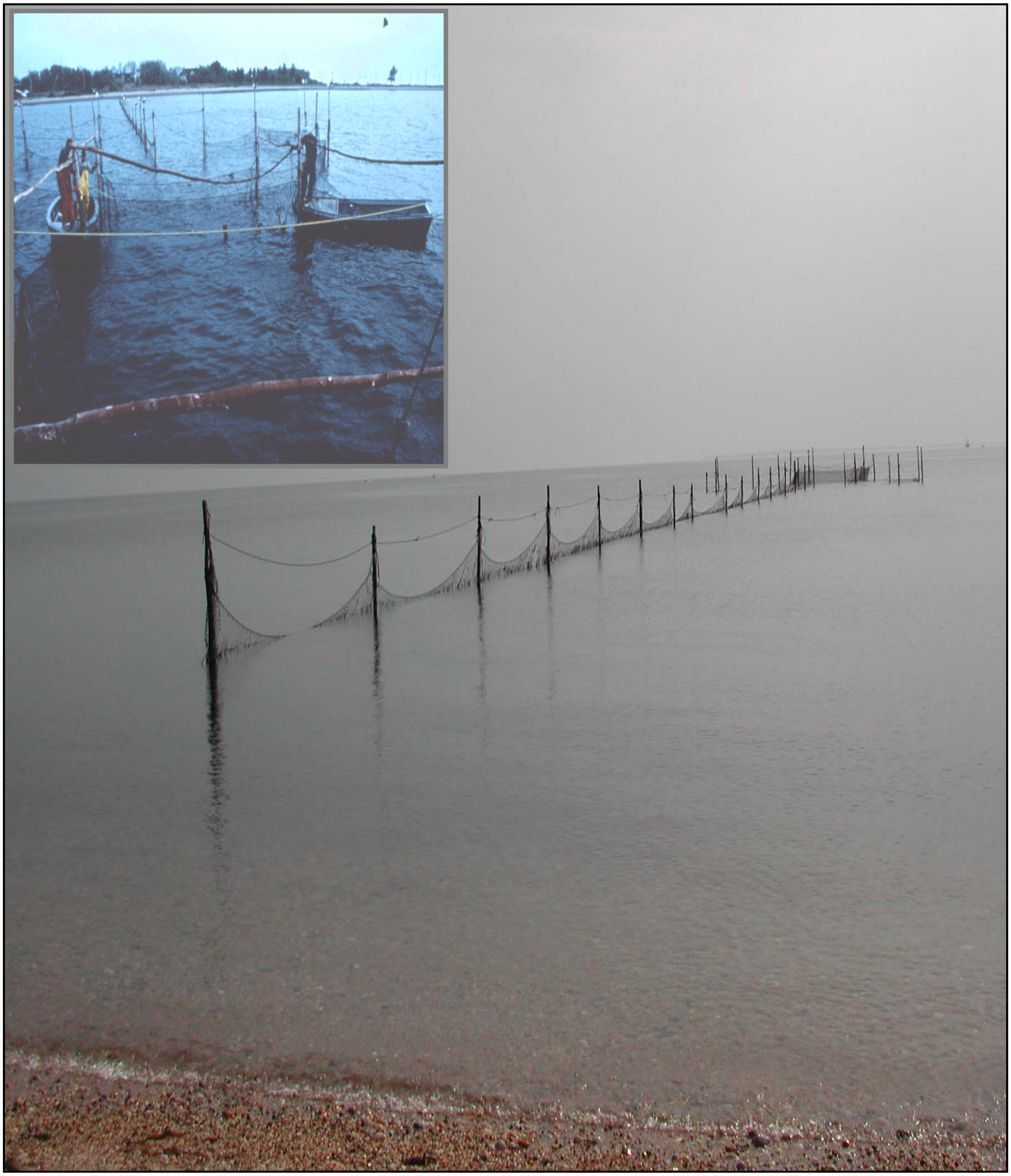


Fig. 8. The major shift in species composition did not appear to alter the spatial distribution pattern of turtles captured in pound nets. Rather, the major difference among the decades of study was the near complete absence of juvenile loggerhead turtles in eastern New York nearshore waters in the past three seasons.

Appendix - Methods, Facilities, and Images



Long Island Pound Net –The sole means of capture of sea turtles

Cornell Cooperative Extension Marine Program
Research and Education Facility - Southold, NY

Riverhead Foundation Facility – Rehab tanks and diagnostic lab

External examination and scanning for previous tags

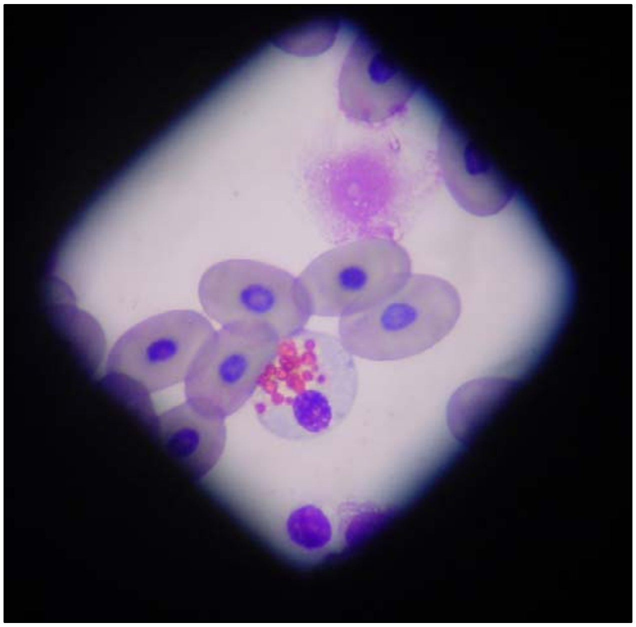
Field measurements before release

PIT tag location site for small turtles (<40cm)

PIT tag location in anterior medial region of the front flipper as depicted in the Southeast Fishery Science Center Protocol.

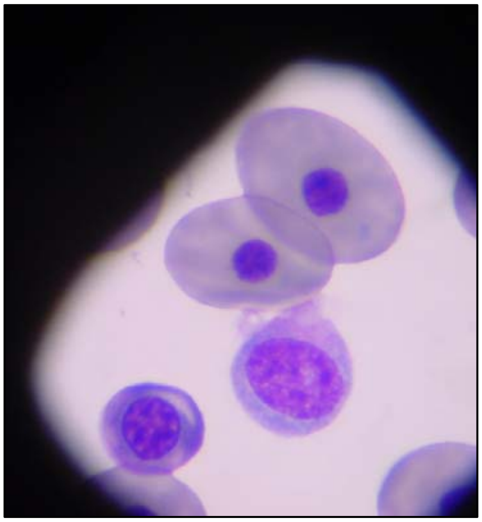
- In the Long Island study, usually the right flipper is tagged, and a different applicator is used.

Release in the bays near the point of capture

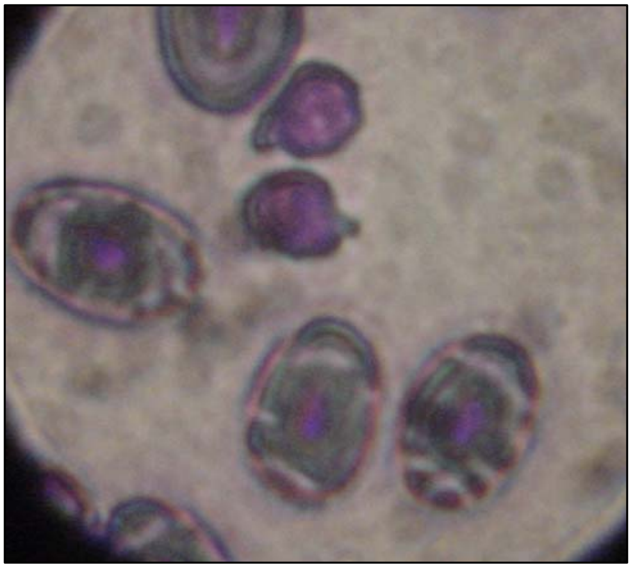


Eosinophil

Heterophil



Monocyte



Lymphocytes

Unidentified cell

Blood morphology 2002-2004

Capture and recapture of green turtle – after 13 d moderate growth