Preliminary Analysis of Sea Turtle Stranding Event: Northern Gulf of Mexico, May/June 1993

by

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Executive Summary

o All available information on fisheries activities and environmental factors were evaluated to determine the cause of mortality of 107 turtles in May/June 1993 near Grand Isle, Louisiana.

o It was determined that the event which included 102 Kemp's ridley turtles, 3 loggerhead turtles, and 2 leatherback turtles likely occurred from May 26-June 17, 1993. Most of the turtles were reportedly stranded from about May 26-June 5.

o Stomach contents analyses indicated that turtles were feeding at the time of death and were apparently healthy. Tissue analysis has not been completed.

o Analysis of sea surface temperature as collected by NOAA satellites indicate that a warm water filament of the Loop Current may have brought small pelagic turtles into near shore waters.

o The average carapace length of Kemp's ridleys in this event was smaller than the annual average length for turtles stranded since 1984.

o The proportion of turtles reported as headstarted was very small compared to those reported as wild turtles. This is consistent with annual proportions for the period 1984-1992.

o Most of the available information indicate that the bottom trawl shrimp fishery was most likely responsible for these mortalities. While TED compliance was reported to be high, the unusually small size of the turtles may have resulted in their lack of success from escaping TED equipped trawls.

o Placement of scientific observers of vessels can provide information on the relative impacts of each fishery.

o The results of the tissue analyses and comparative sea surface temperature analyses will be included when available.

Introduction

On June 1st, the NMFS/SEFSC Sea Turtle Stranding and Salvage Network (STSSN) was alerted that numerous turtles had stranded on Louisiana beaches primarily on Grand Isle. In response to this alert, SEFSC persons were sent to the area to conduct on site observations including aerial surveys, beach surveys, carcass salvage and necropsies. It was noted that numerous shrimp vessels were fishing in the offshore waters (June 18, 1993 memo Brown to Kemmerer). In addition, in an independent survey, Dr. Ren Lohoefner, FWS, indicated that "hundreds of shrimp fishermen, using the butterfly net type....were fishing the pass that separate Barataria Bay from the Gulf of Mexico." (memo Lohoefner to Flemming, FWS, June 17,1993). This information was corroborated via aerial overflights by NMFS enforcement (memo T. Shuler to S. Montero, June 1, 1993). Shuler speculated that the closure of Texas inshore waters forced shrimp fishermen to fish in Louisiana waters during this time period.

Immediately, NMFS/SEFSC initiated an investigation into the proximate cause of death with the purpose of ending the mass mortality. This effort included sampling the beaches on the ground and via aerial overflights, and the placement of observers on vessels fishing off of the Grand Isle area. The results of the immediate investigation were reviewed in June (June 18 memo Brown to Kemmerer). In that progress report, it was noted a single turtle carcass was reported from Grand Isle on May 20. A total of 35 Kemp's ridleys were retrieved from Grand Isle on June 1 and all purportedly had stranded beginning on May 26. This is consistent with the opening of state waters to shrimp fishing and also corresponds to an accident reported for a menhaden purse seine accident. The final strandings were reported on June 17. In the period up to June 17, information on the turtles, fishery activities, and environmental information was provided to determine cause of death.

Beach sampling with cooperators from the state was initiated on June 2. On June 4, an initial aerial survey with NMFS and USCG personnel sighted 3 stranded turtles on the beaches of Louisiana in the Grand Isle vicinity. During daily ground sampling conducted by NMFS, the additional carcasses were reported from June 4 through June 17, 1993. In addition, in anticipation of the opening of the shrimp fishery in Mississippi and Alabama, both states were contacted to determine if beach coverage were sufficient in these states to sample for strandings. The STSSN state coordinators indicated to us that they had sufficient coverage and would contact us if additional coverage were needed. The state coordinators for all Gulf of Mexico states were contacted to verify that this event was limited to the northern Gulf of Mexico.

In the June 18 report, it was noted that up to 35 carcasses were

buried on the beach about May 26. These carcasses were buried with dead fish which washed up and were attributed to a menhaden accident; that is, a seine reportedly ruptured and the contents were not retrieved. An attempt by the local government was made to uncover these turtle carcasses with a backhoe, but this was unsuccessful. However, it was determined that these turtles were most likely Kemp's ridleys based on the descriptions given. These data are included in the total 107 for this event.

Scientific observers were placed on shrimp bottom trawlers operating in central Louisiana waters from June 16 to July 2, 1993. Observers were those trained and utilized by NMFS to collect biological information on shrimp bycatch. Increased observer coverage was emphasized off the Grand Isle area. Vessels were rigged with two trawls, with one trawl equipped with a bottom exiting TED. The TED-equipped trawl served as the experimental net and the trawl without a TED as the control. Tow times were restricted to 55 minutes. Gear and biological data were collected from each trawl haul. Sampling effort was limited to depths ranging from 1.3 to 2.8 fathoms. Data from 97 tows were collected during the observation period with no turtles captured.

Necropsies were performed on as many animals as possible. Tissues and stomach content analyses were preserved for examination of toxins and pollutants. Three fishery activities which may have been instrumental in the mortalities were identified as ongoing when strandings were reported: the menhaden net fishery, the bottom trawl shrimp fishery, and the butterfly shrimp fishery.

Real time sea surface temperature information via NOAA AVHRR satellite imagery was provided during the event by the Stennis Laboratory. All the information suggested that a warm water filament of the Loop Current on the north central Gulf of Mexico had aggregated small, usually pelagic Kemp's ridleys and moved them into nearshore waters, making them vulnerable to human activities.

The small size of these animals initially suggested that they would pass through all NMFS certified TEDs, with 4 inch bar width (June 18 memo, Brown to Kemmerer). This was particularly significant because it was estimated that TED compliance in this fishery was from 95-97% (Shuler memo to Bohr, June 22, 1993). In addition, it was hypothesized that the orientation of the TED opening could impact the successful escape of small turtles. At the time of the June 18 report any possible interaction with the menhaden fishery was not absolutely ruled out.

The present report summarizes all available data which has been compiled since the June 18 report in an attempt to determine cause of mortality. The information compiled herein includes progress on the 1) results from necropsy reports and tissues analyses 2) evaluation of all fishery activities coincidental to the mortality

and 3) examination of sea surface temperature data.

Stranding Event

The STSSN contains records for a total of 107 turtles which stranded on Louisiana beaches through June 17, 1993. Of these, up to 70 turtles reportedly stranded over the period May 26-June 1 and the remainder were reported through June 17. Of these 107 turtles, 102 (95%) were identified as Kemp's ridley turtles 3 (3%) as loggerhead turtles, and 2 (2%) as leatherback turtles.

Strandings were reported exclusively from Louisiana and primarily from shrimp statistical zones 13 & 14. However, the SEFSC initial investigation was not limited to Louisiana alone and included both Alabama and Mississippi. These two states were added because of concern over potential mortalities resulting from the impending opening of the shrimp fishing seasons in these states waters. All other states were ruled out following verbal verification that strandings were not occurring elsewhere. The north central Gulf of Mexico remained the focus of all subsequent data analyses (Figure 1).

The annual total strandings were summed by year from 1984-1993 for all species and for Kemp's ridley turtles alone (Figure 2). Note that data for 1993 are only for the period January through June. In 1986 when over 100 turtles were reported as stranded in this area, the number of Kemp's ridley turtles reported was comparable to the total reported so far for 1993.

The monthly occurrence of strandings was evaluated for Kemp's ridley turtles only, and with and without 1993 data (Figure 3). The peak in strandings has been June with a secondary peak in August. When the 1993 data are added, there is a notable increase in the strandings in May. In 1984-1992, about 15% of the total strandings were reported in May and when 1993 data are included, about 25% of the total strandings were reported in May.

Mean straight line carapace length was estimated for Kemp's ridley turtles for each year from 1984-1993 (Figure 4). For turtles with curved measurements only, the straight to curved length relationship from Teas (Teas, W. G. 1992. Species composition and size class distribution of marine turtle strandings on the Gulf of Mexico and southeast United States coasts, 1985-1991. NOAA Technical Memorandum NMFS-SEFSC-315) was used to convert curved to straight length. In 1993, the turtles that stranded were both included and excluded from the estimation of mean length. The mean length for turtles that stranded in the May/June north-central Gulf event were significantly smaller than turtles that stranded every year except in 1984. The increasing length of turtles from 1984-1988 is followed by a decreasing trend in turtle length from 1989-1993. The length of turtles that were reported in 1986, were

larger than the turtles reported in the May/June 1993 event. Notably, the 95% confidence intervals, as estimated from ±2 standard errors of the estimated mean, were small relative to the estimated mean in 1986 and 1993. This suggests that a typical mass mortality may be of animals of similar size. In 1993, mean length was estimated as 25 cm for January through June. For May/June 1993, the mean length was estimated as 23.7 cm. In all other years, mean length was about 30 cm or larger. In 1988, the mean length was about 43 cm, which was the largest annual estimate.

It was noted that the turtles from the May/June 1993 event were less than 4 inches in body depth (see June 18 memo Brown to Kemmerer).

The annual number of headstart to non-headstart turtles was evaluated (Figure 5). Each year, the relative number of headstart to non-headstart turtles has been consistently small. This remained consistent in the May/June event where 3 Kemp's ridleys were verified headstart turtles.

Necropsy Results

No toxicological analyses could be completed because turtles were too decomposed. Sex was not determined because turtles were too small. Results from stomach contents analyses indicated typical stomach contents including crabs, sea urchins, clams, and fish parts. No shrimp were noted in the stomach contents. Tissue sent for PCB and on metal analyses revealed have not yet been analyzed.

Based on this preliminary information it appears that the turtles examined were healthy and feeding at the time of death.

Environmental Factors

Sea surface temperature as indexed via NOAA satellite imagery indicated a warm filament from the Loop Current was intruding into nearshore waters (Figures 6-8). Figure 6 shows the developing filament of warm water towards the coast on 5/21/93; figure 7 shows the continued intrusion of this water to the coast on 5/22/93; and figure 8 shows the expansion of warm water near the coast on 5/23/93.This filament may have brought small, usually pelagic animals into the nearshore and inshore benthic environment. A comparison of sea surface temperature in 1986 with 1993 data will be completed to determine if conditions were similar.

Fishery Activities

Three activities are relevant: blue crabbing, menhaden fishing, and shrimp fishing. The blue crab fishery is of interest as a

potential predictor of turtle abundance. Both menhaden and shrimp fishing could cause mortality.

Annual landings of blue crab in pounds were evaluated by year and month (Figure 9). Peaks in total landings were estimated for 1987 and 1988 and again in 1991 and 1992. The 1993 data are not yet available. The peak in landings by month occurred from June and July for 1984-1992. The relationship between strandings by year and month was evaluated with a least squares linear regression, with strandings as the dependent variable and landings by year and month as the independent variables (Figure 9). Blue crab landings by weight do not appear to be a predictor of turtle strandings on an annual basis. However, on a seasonal basis blue crab landings by weight may predict the occurrence of turtles as indexed by strandings. This suggests that a "good" year for blue crabs is not predictive of a large mortality. However, on a seasonal basis, blue crab landings can predict turtle presence within any year.

Menhaden fishing peaks from June to August annually (L. Usey memo to N. Thompson, October 7, 1993). Gear sizes range from 400 to 600 square yards per purse seine with most between 400-500 square yards. Each vessel uses one purse seine. Soak time is from 1/2 - 1 hour with an average of 36 minutes. A total of 57 large vessels fished in this area in 1992, and Usey noted this should be the same in 1993. Effort is primarily from shore to 10 fathoms and some effort is inshore east of the Mississippi River. This fishery has not changed significantly over the years. Based on the soak time it is unlikely, that a mass mortality of turtles resulted from this fishery, unless turtles were extremely concentrated. It <u>is</u> possible that an occasional turtle is caught and killed. Note that on May 20 <u>one</u> turtle was reported to the network (memo Brown to Kemmerer, June 18, 1993).

The shrimp fishery targets brown shrimp in this area in May and June (L. Usie, personal communication). Two major types of gear are used in this fishery. The typical bottom trawls are used in both the inshore and offshore fisheries. The other type of gear are called butterfly nets because two nets on either side of a vessel actually look like a butterfly. These nets are considered fixed; that is they are not pulled through the water column. The rectangular opening is about 6 feet deep by 9 feet in width and about the first 5 feet or so of depth are placed in the water. These nets are fished passively and require moving water to pass through the nets. The shrimp are removed from the cod end about every half hour to forty minutes and cod end removal does not require removal of the remainder of the net from the water. In this way, shrimp are removed from the net, but the net remains in the water. The mesh size is typically 1 1/4 to 1 1/2 inch mesh and is pulled taught over the frame with no slack. Placement of both gear was concentrated during this period at the mouth of Barataria Bay which is bounded on the west by Grand Isle. The butterfly net

fishers were targeting brown shrimp coming out of Barataria Bay with the outgoing tide. Those shrimp that are not captured by these fishers, are targeted then by the bottom trawlers which fish just beyond the butterfly fishers. Most of the effort as reported is for the bottom trawl fishing which is representative of the fishery (L. Usie, personal communication). Fishing effort as reported is not separated by gear type. Based on the information provided on these gear types and when and where they fish, it is possible that both types of gear contributed to this mass stranding event. This would be particularly true for the butterfly net fishery if turtles were very concentrated near the surface of the water and drowning could occur within 30-40 minutes of submergence. The only way to determine what the respective catch and mortality rates are for each type of gear would be from the collection of data by observers placed on vessels.

The relationship between monthly shrimping effort including both butterfly net and bottom trawl effort, as measured in 24 hour days fished, and number of strandings was evaluated. Monthly estimates were pooled for both variables over the period 1984-1992. For turtles, the monthly frequency for all species and for Kemp's ridley turtles were included. For shrimping effort, offshore and inshore effort were evaluated (Figure 10). A least squares linear regression was completed using the monthly, total strandings for all species and Kemp's ridley turtles as the dependent variable and offshore and inshore effort as the independent variables. For all species and Kemp's ridley turtles alone, regression results are statistically significant and are positive relative to monthly total shrimp trawling effort (r^2=.746, p=.0092 for all species; r^2=.757, p=.0078 for Kemp's). The 1993 shrimp effort data for this area is only currently available in trips. The use of 24 hour days fished to index effort is to represent the actual time nets are submerged and therefore represents the time nets impact air breathing turtles.

On June 1, 1993, Dr. Warren Stuntz of the SEFSC Pascagoula Laboratory conducted an aerial survey in the area and counted 39 shrimp boats off of Grand Terre, 47 shrimp boats off of Grand Isle and 46 shrimp boats off of Timbalier Island. In addition, Mr. Larry Ogren, SEFSC, Panama City, retiree and Dr. Ren Lohoefner, FWS observed about 100 butterfly net shrimp vessels fishing in the pass near Grand Isle. This is consistent with the information provided by Mr. Lee Usie, SEFSC, Pascagoula Laboratory.

TED Investigation

Fishing gear specialists and SCUBA divers from the Pascagoula Laboratory conducted behavioral studies of juvenile loggerhead sea turtles with body depths of less than 4 inches as they encountered a Georgia jumper style hard TED. The project was conducted from November 1-4 aboard a charted commercial shrimp bottom trawler in

waters off Panama City, Florida. Project objectives were to determine if 1) juvenile turtles with body depths of less than 4 inches are physically incapable of exiting from a hard TED, 2) if juvenile sea turtles can maneuver through the deflector bars of a qualified hard TED and become trapped in the codend of a trawl and ; 3) to design and evaluate bar spacing reduction modifications to hard TEDs to prevent future small turtle captures. The study observed the behavior of small loggerheads as they encountered top and bottom opening hard TEDs with and without floatation attached to the TED. Turtles were observed to maneuver through the deflector bars and into the codend of the trawl in both top and bottom opening configuration. It was also evident that small sea turtles may be unable to escape from bottom opening hard TEDs with inadequate floatation as the exit hole can be sealed off by contact with the sea floor. Small turtles were exposed to TED modifications which reduced deflector bar spacing from 4 inches to 2 1/2 inches. Design criteria for these modifications included the need for durability, low cost, and easy adaptation to a variety of existing hard TED designs. Modifications included PVS pipe sleeve inserts and an offset frame insert. Of 14 turtles which were released into trawls equipped with modified TEDS, all escaped within a 5 minute exposure period. The final report is anticipated by Feb. 1 to include a video presentation.

Conclusions

Small Kemp's ridley turtles were apparently concentrated at least in the vicinity of the mouth of Barataria Bay in May and June 1993. All indications are that turtles were healthy and feeding at the time of death. There is strong circumstantial evidence to suggest that the seasonal occurrence of turtles in the northern Gulf of Mexico is related to the presence of blue crabs. In order of liklihood, it appears that this event was least likely a result of menhaden fishing and most likely the result of the bottom shrimp trawl fishery. However, there is no way to separate the impacts of butterfly net fishing from the impacts of bottom trawl fishing on this species. The only way to determine impacts is via the placement of scientific observers on vessels. However, based on our TED research, small turtles pass through hard TEDs with 4 inch bar spacing and have difficulty escaping from bottom opening TEDs, as currently utilized by the bottom trawl shrimp fishery.

List of Figures

Figure 1. Statistical reporting zones devised by the Bureau of Commercial Fisheries. Note that Barataria Bay is in zone 13.

Figure 2. Annual reported turtle strandings for all species and Kemp's ridley turtles alone for the period 1984 thorough 1993. Note that data for 1993 are through June only.

Figure 3. Kemp's ridley strandings as reported by month pooled over the period 1984-1992 and 1984-1993, through June 1993 only.

Figure 4. Annual mean straight line carapace length for Kemp's ridley turtles stranded in the Northern Gulf of Mexico. The "93" value includes all turtles reported as of June 1993. The "93*" value includes turtles reported in May and June 1993 only.

Figure 5. Total number of Kemp's ridley turtles that stranded in the Northern Gulf of Mexico from 1984-1993 and reported as headstarted. Note that data for "93" include all 1993 data through June. Data from "93*" include only turtles reported in May and June 1993.

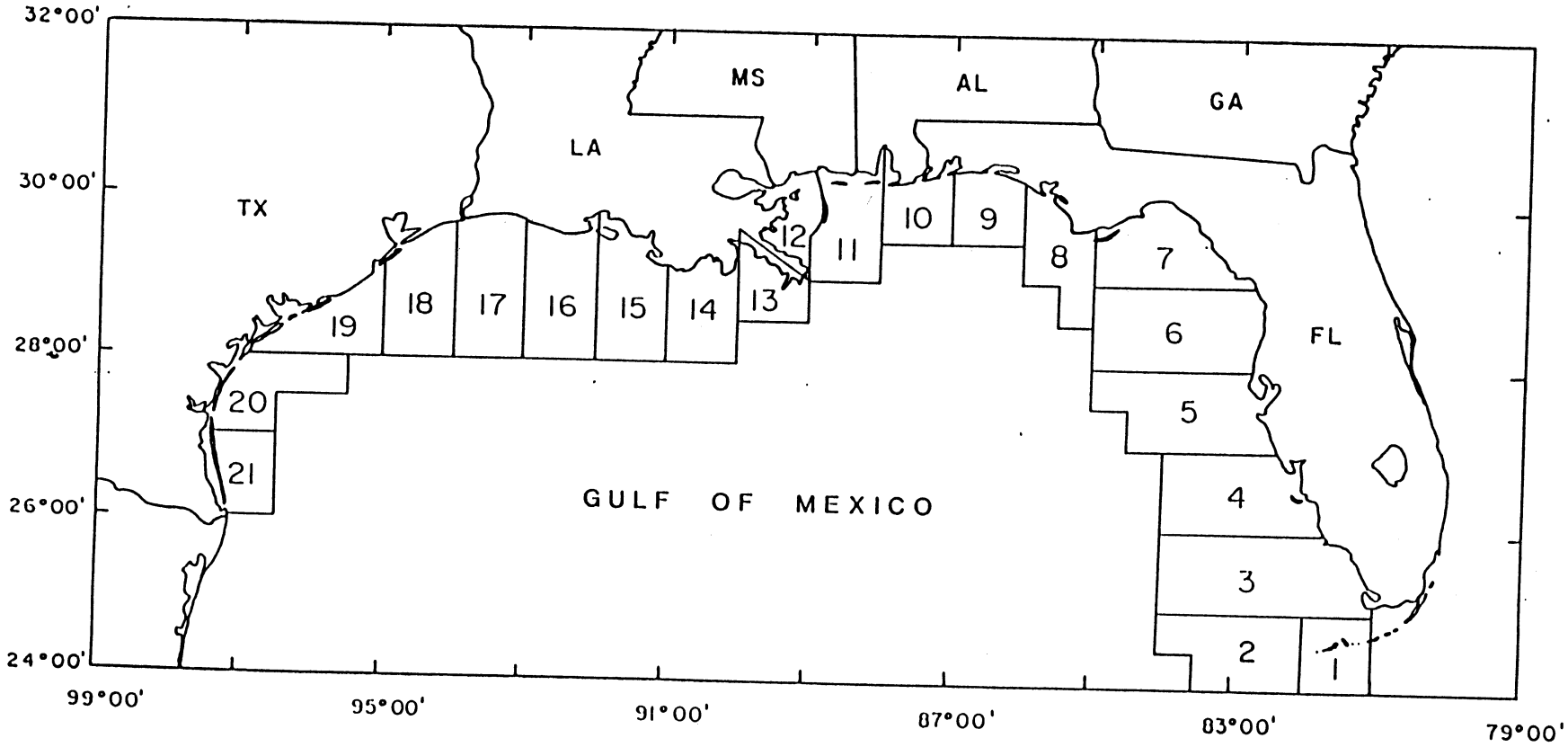
Figure 6. AVHRR image of sea surface temperature on 5/21/93 for the Northern Gulf of Mexico near the Mississippi River delta and adjacent areas. A filament of the Loop Current is identified.

Figure 7. AVHRR image of sea surface temperature on 5/22/93 for the Northern Gulf of Mexico near the Mississippi River delta and adjacent areas. A filament of the Loop Current continues to move to the coast.

Figure 8. AVHRR image of sea surface temperature on 5/23/93 for the Northern Gulf of Mexico near the Mississippi River delta and adjacent areas. The Loop Current filament expanded and continued to intrude near the coast.

Figure 9. Annual and monthly blue crab landings by weight as reported for the Northern Gulf of Mexico. Annual and monthly Kemp's ridley turtle strandings are included. While there is no relationship between annual landings and strandings there is a significant relationship between monthly landings and strandings.

Figure 10. Monthly shrimp effort as daysfished and turtle strandings. Shrimp effort was separated in offshore and inshore effort; strandings were separated into all species and Kemp's ridley turtles. Monthly cumulative daysfished is statistically related to strandings.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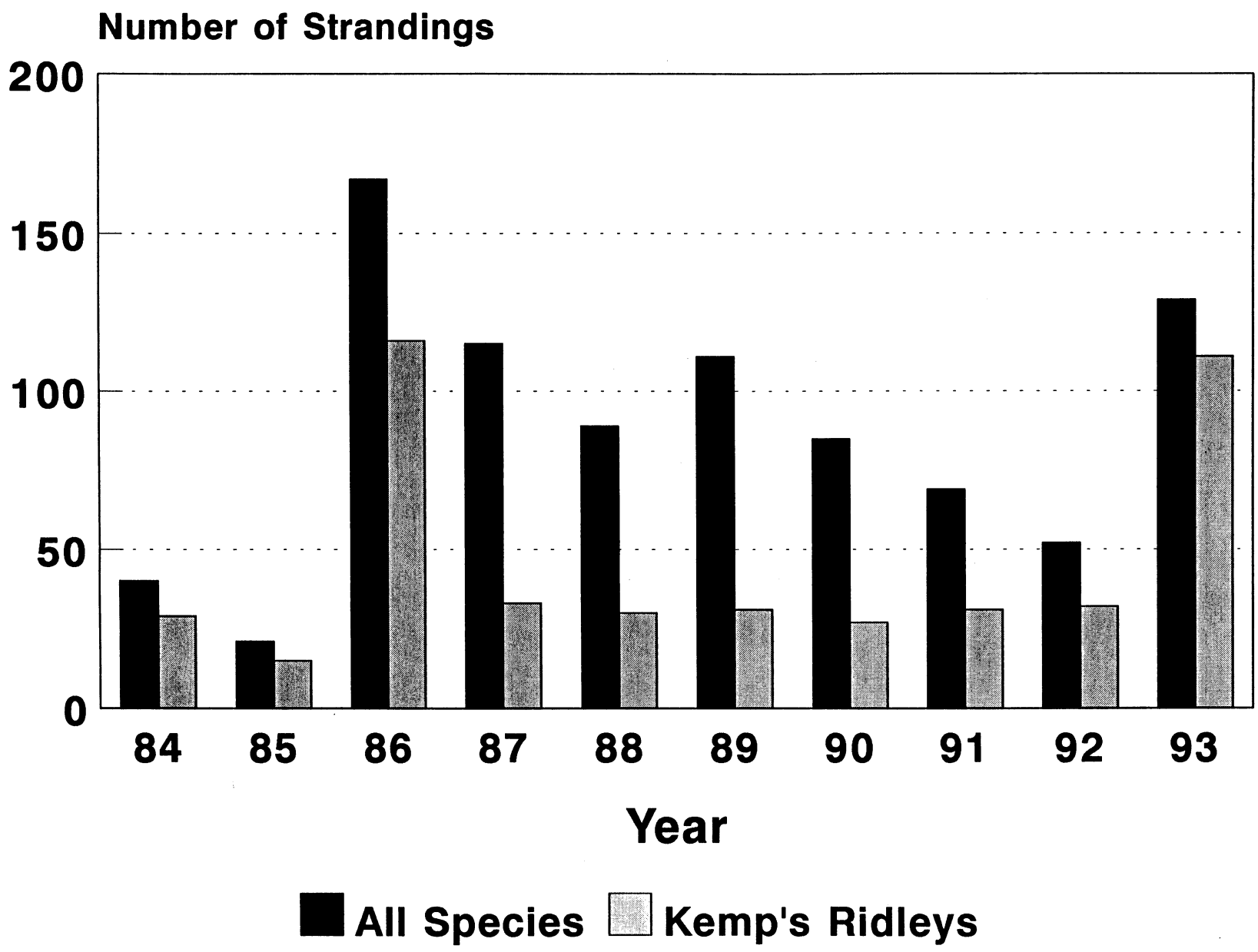
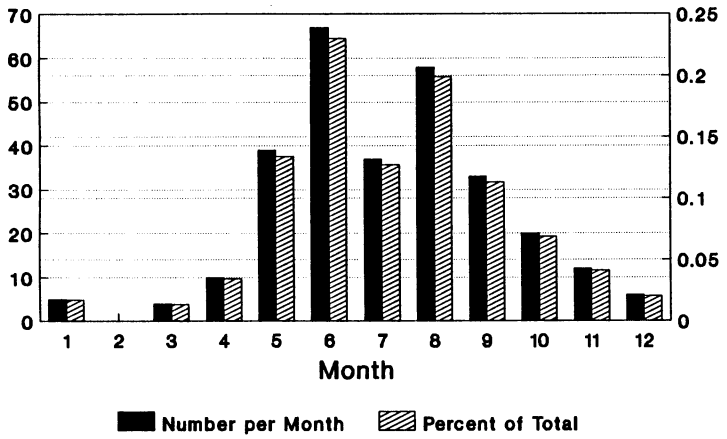
Annual Strandings



Kemp's Ridley Strandings by Month
1984-1992, Northern Gulf



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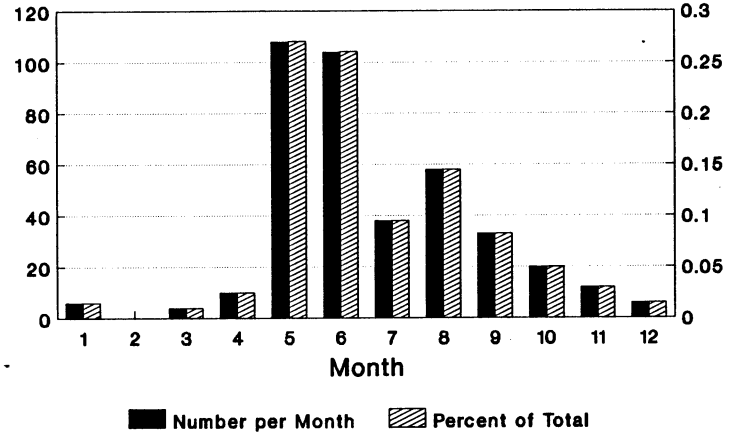
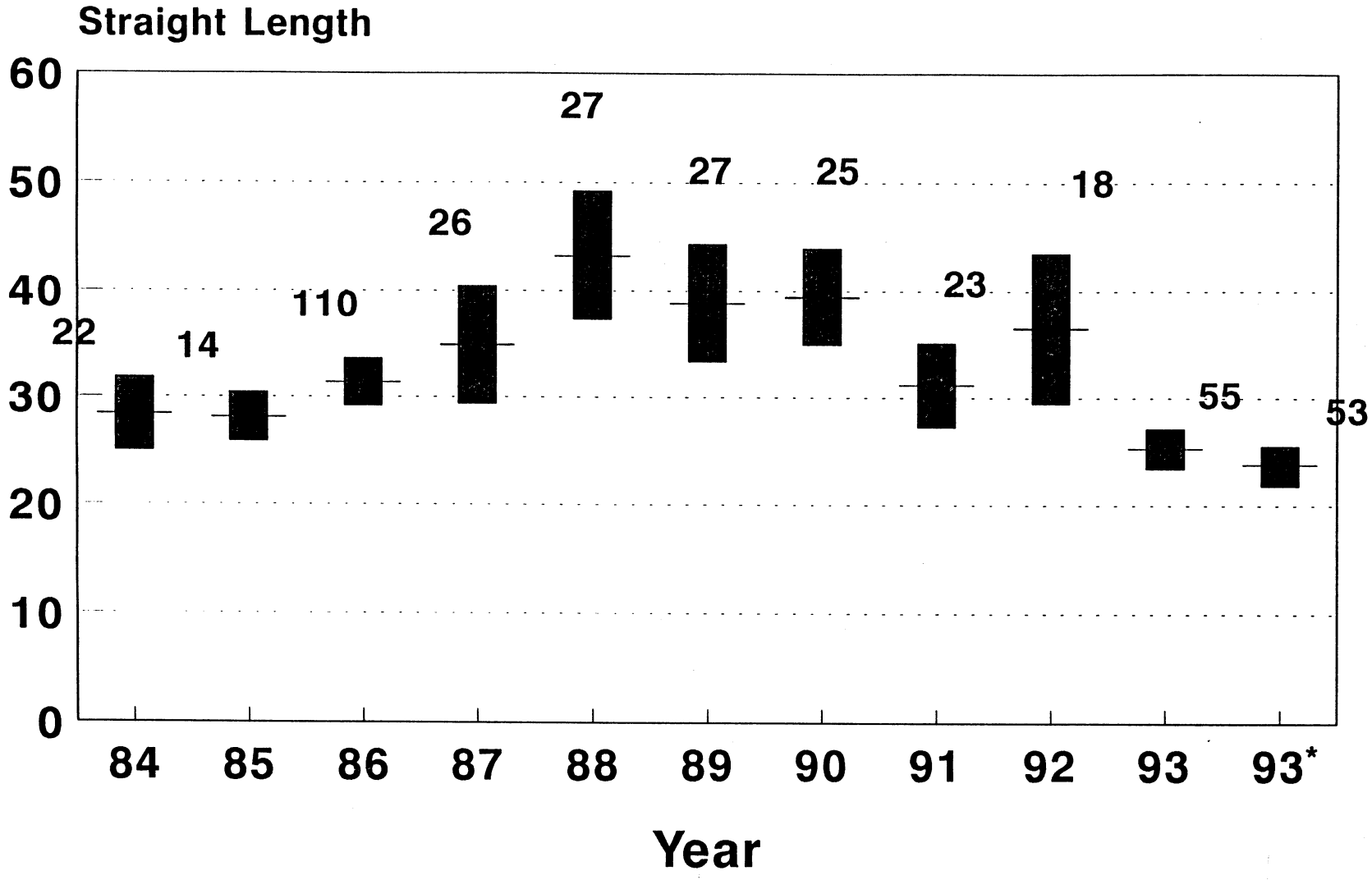
1984-1993, Northern Gulf



Annual Mean Length and 95% C.I.
Kemp's Ridley, Northern Gulf



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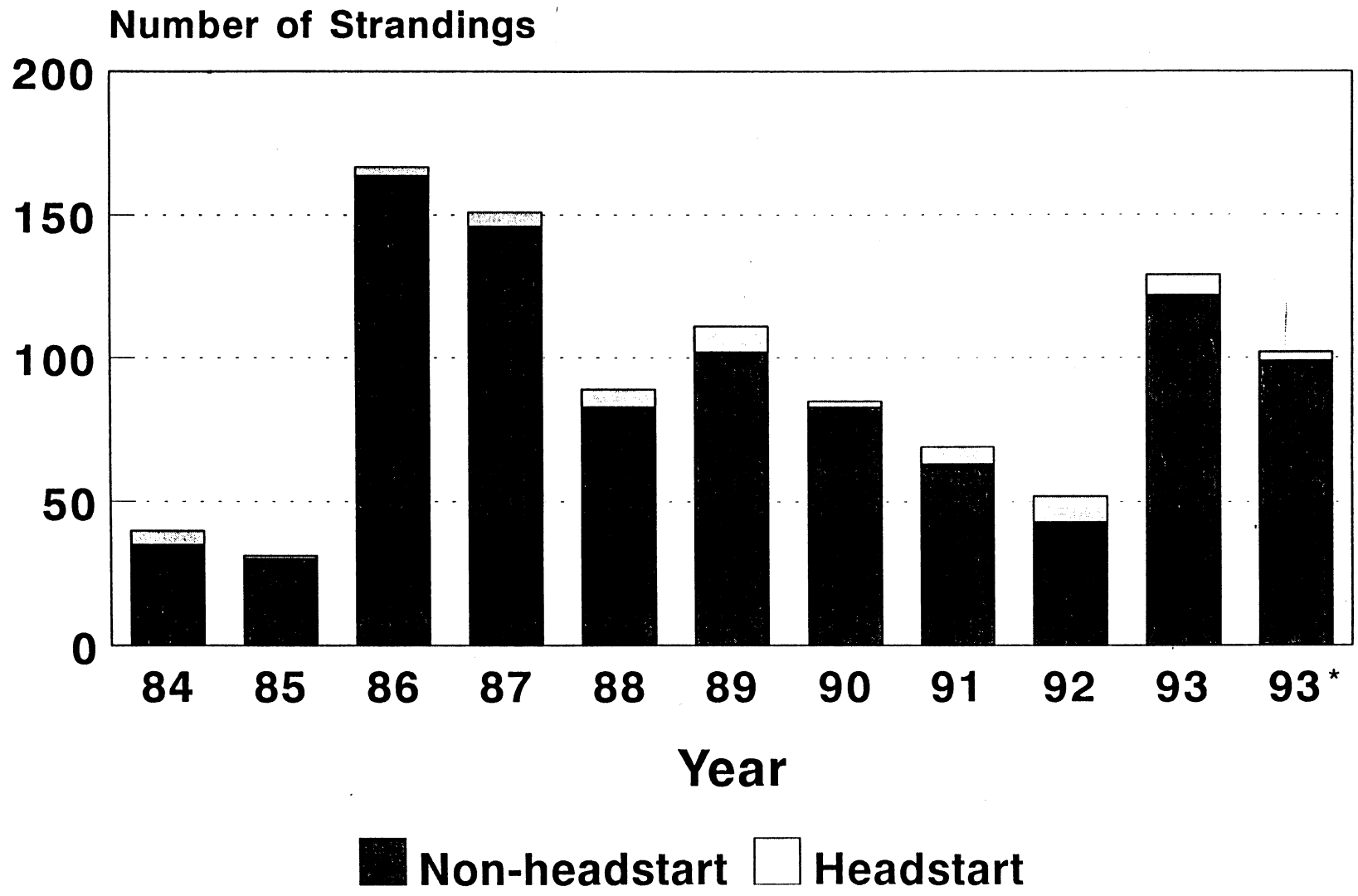
Headstart vs. Non-headstart Turtles
Northern Gulf



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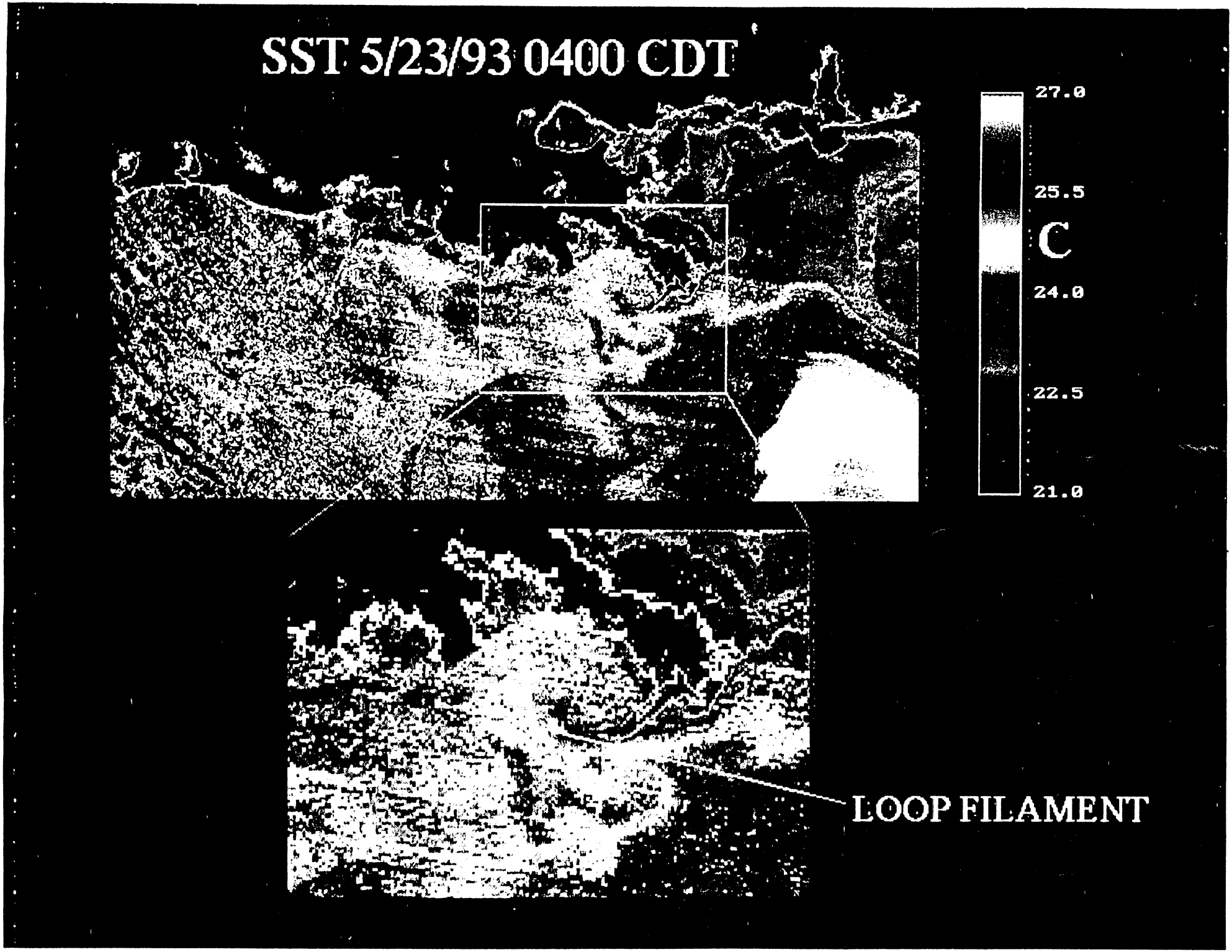
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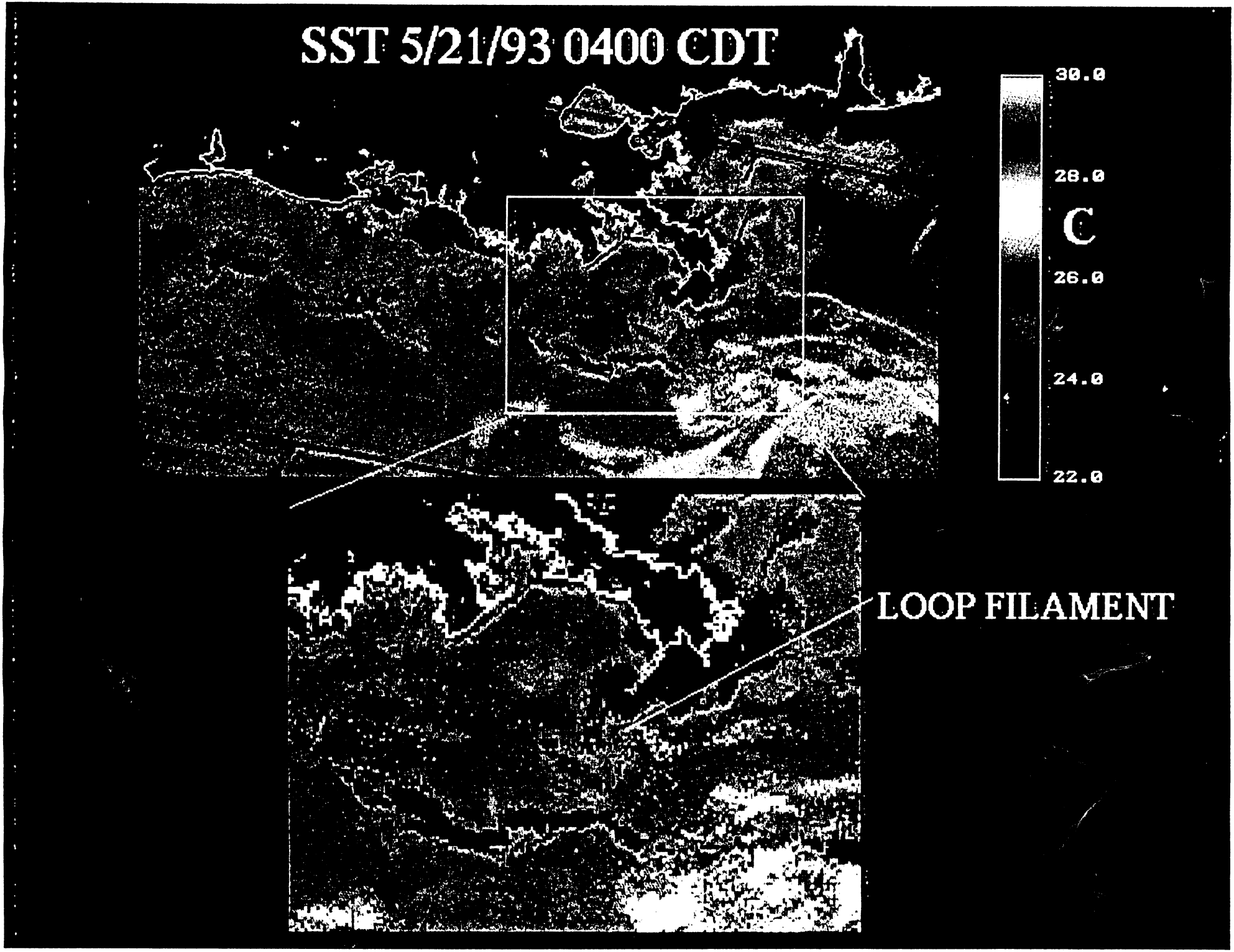
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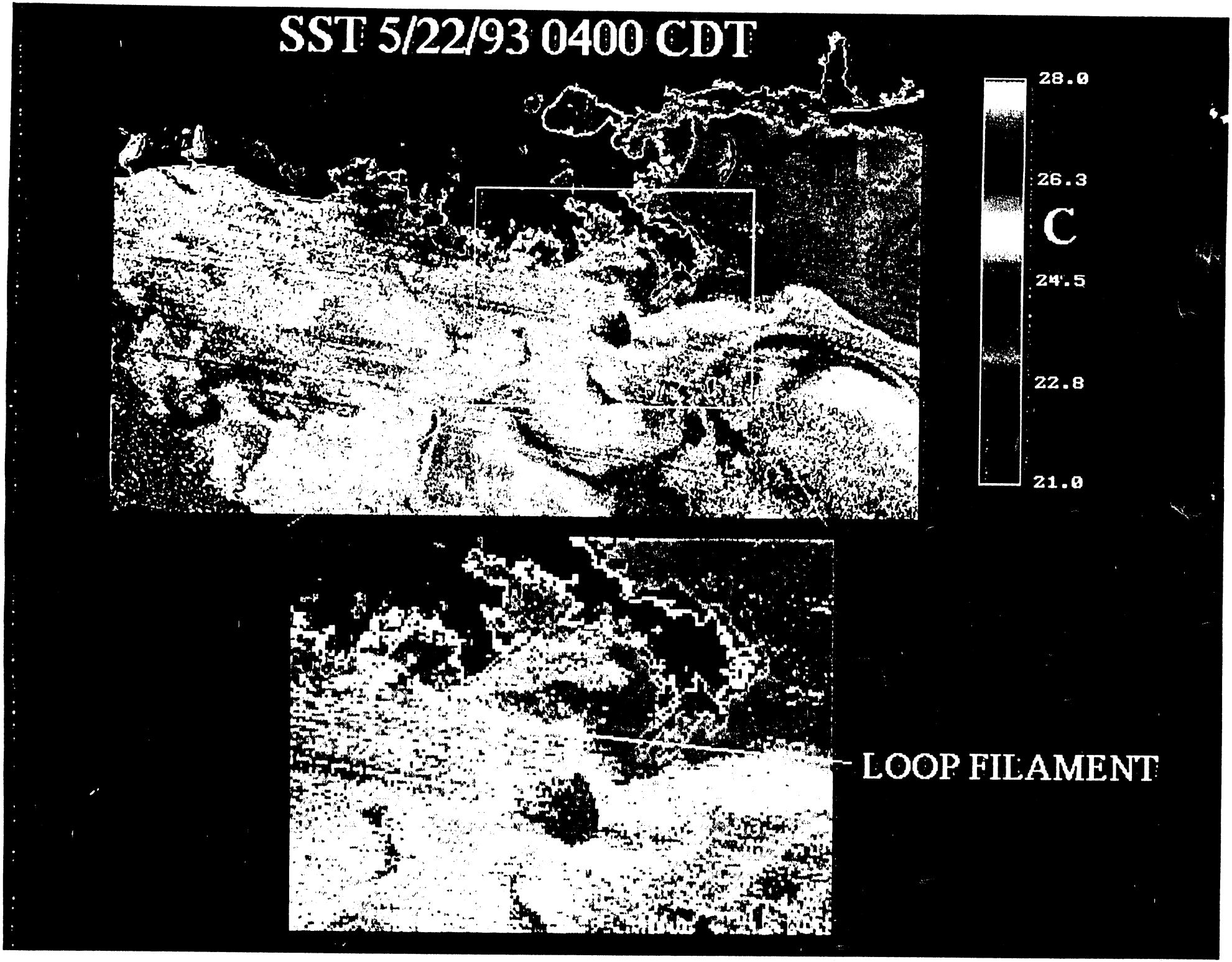
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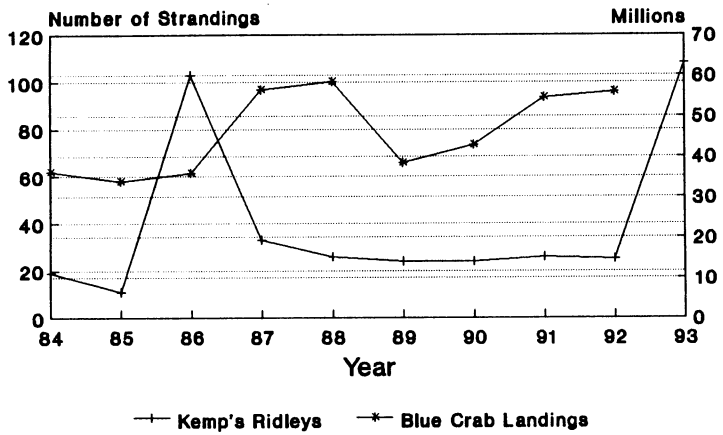
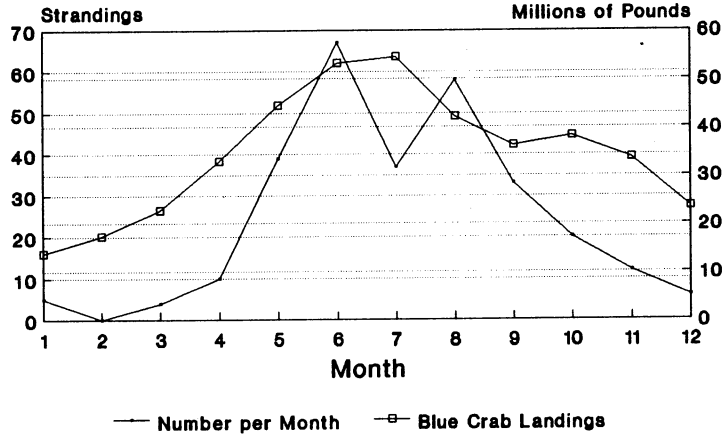
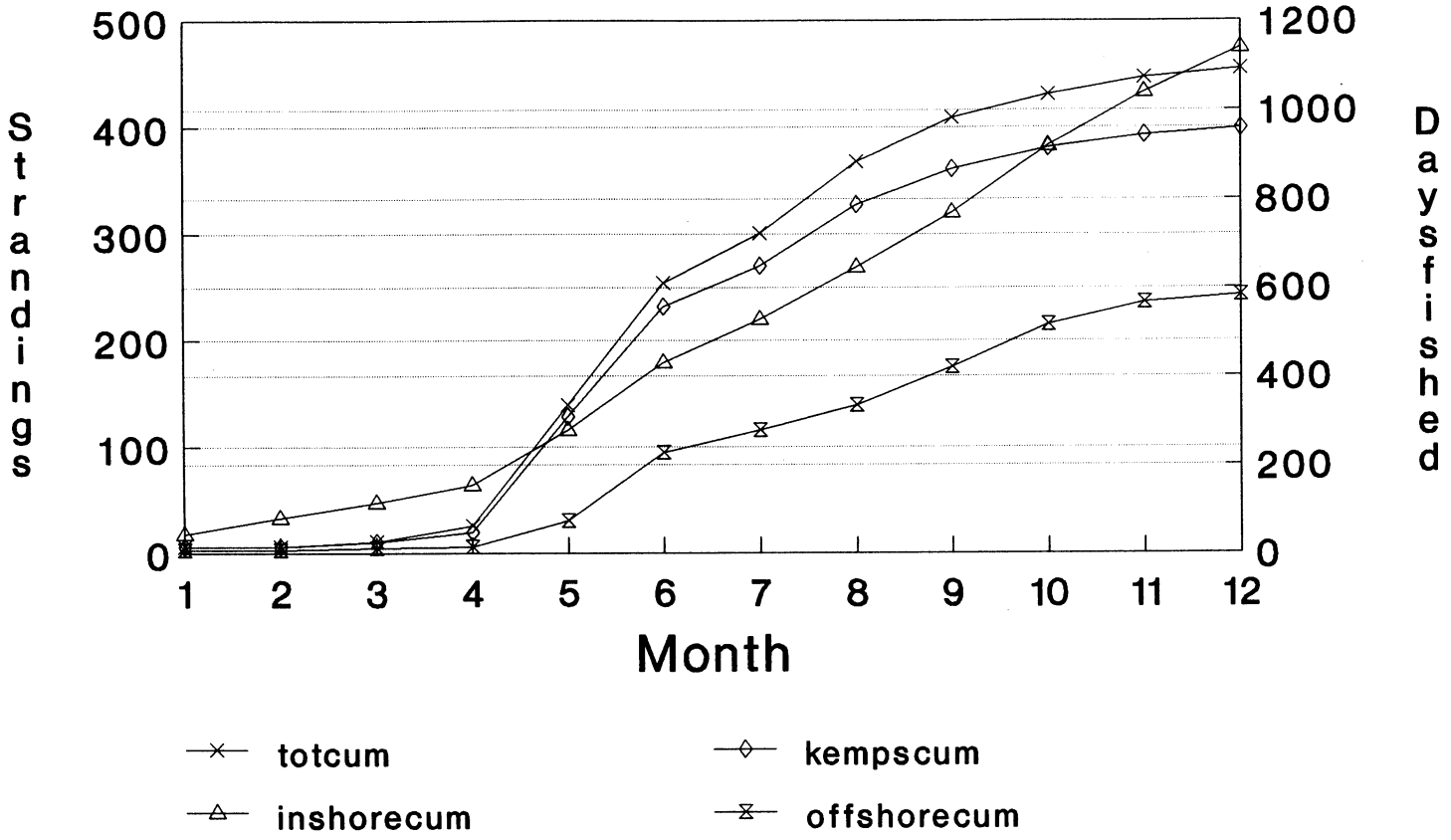
Annual Kemp's Strandings and Blue Crab Landings 1984-1992



Monthly Blue Crab Landings and Turtle Strandings Pooled Over 1984-1992



Monthly Total & Kemp's Only Strandings and Inshore & Offshore Shrimp Effort



pooled over 1984-1992