# 2014 Barataria Bay Dolphin Tracking – Final Report

**Order No**: AB133C-11-CQ-0050 **Title**: Deepwater Horizon
**Activity:** A3i **MMST170** - *Estuarine Dolphins*

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## Introduction

The Chicago Zoological Society (CZS), through its Sarasota Dolphin Research Program (SDRP), was contracted to provide expertise and logistical support for wild bottlenose dolphin capture-release health assessments, including tagging and tracking of dolphins in Barataria Bay, Louisiana during 2014. The work was performed in support of field and sampling needs for bottlenose dolphin health assessments conducted by the National Centers for Coastal Ocean Science (NCCOS) of NOAA's National Ocean Service and partners. The SDRP was tasked with preparing and deploying satellite-linked tags on the dorsal fins of up to 12 of the captured dolphins in Barataria Bay, and taking responsibility for all aspects of remote tracking, including monitoring the tags, and processing the data received. With regards to specific deliverables related to tagging and tracking, the SDRP was asked to:

1) Prepare/program satellite-linked tags for deployment in Barataria Bay;
2) Deploy the satellite-linked tags on up to 12 dolphins;
3) Track the tagged dolphins throughout their transmission duration (from the date that the first tag was deployed until the date that the last tag transmission was received);
4) Report the tracking results.

With the submission of this final report, all of the objectives were addressed, successfully. This report compiles the complete tracking location records for each of the tagged dolphins, previously presented to stakeholders as daily and weekly updates. Tags and attachments were prepared, and 11 tags were deployed in Barataria Bay in June 2014. Signals were received through 18 November 2014, with the final tag transmitting over a period spanning 161 days. The following information summarizes the movements and ranges of the tagged dolphins in Barataria Bay over the entire period of remote tracking, based on the final, fully processed Argos data provided to the SDRP on 9 December 2014.

## Materials and Methods

### *Tags and Attachments*

We used SPOT-299B satellite-linked tags (Single-point Finmount, 2-Lay, Custom, Wildlife Computers, Redmond, WA) to obtain location data for the dolphins (Figure 1). The tags were what remained of a batch purchased in 2013 to be deployed in Barataria Bay and Mississippi Sound (Wells *et al.* 2014). The tags were not used in 2013, and were stored in a freezer at the Hollings Marine Lab, in Charleston, SC, from August 2013 until 8 April 2014. They were then shipped to Wildlife Computers for modifications to provide additional protection for the antenna base. The reinforcements were performed in response to observations in 2013-14 that several tags deployed from the same batch had lost their antennae. Following modifications, the tags were shipped to the SDRP for final preparations and programming for deployment in June 2014.

The tags were designed to both send transmissions to satellites for remote tracking, and to produce a signal that could be tracked directly in real time. Each tag included a UHF beacon that sent out low power, very short, unmodulated pings at the same frequency as the Argos transmissions, in the 400 MHz range. These signals were designed to be located in the field by a direction finding receiver and antenna.

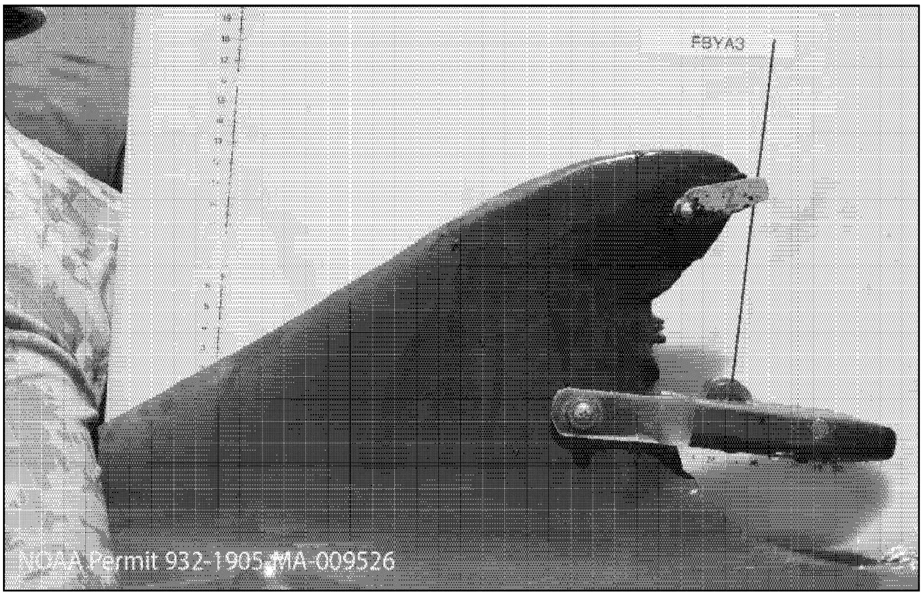
Each tag was 10.5 cm long, 2.0 cm wide, 2.5 cm high, weighed 62 g, and had a flexible 17.3 cm-long antenna (Figure 1). Plastic wings, 6.5 cm-long x 2.0 cm-tall, extending forward from the tag body were positioned on each side of the trailing edge of the dorsal fin, with a matching 5/16" diameter hole in each for attaching the tag 3.5 cm cranial to the fin's trailing edge. The basic shape of the tag was slightly different from that used in 2011 with Barataria Bay dolphins. The new version built on recent design developments where single pin attachments were used and follow-up observations were possible (Balmer *et al.* 2011, 2014; Wells *et al.* 2013a,b). Computational flow dynamics (CFD) tests performed by Laurens Howle (Duke University) prior to production of tags for the project resulted in shape and configuration refinements leading to significant reduction in drag as compared to previous designs (Wells *et al.* 2013b). In 2014, parallel ridges were added on each side of the base of the antenna to provide protection. Additional CFD tests performed by Laurens Howle indicated that these modifications did not add significantly to tag drag. Each tag was coated with Propspeed™ to reduce biofouling (Wells *et al.* 2013b).

Tag attachment to the dorsal fin was identical to the approach used with Barataria Bay dolphins in 2011 and 2013, and Mississippi Sound in 2013 (Wells and Balmer 2012, Wells *et al.* 2014). The attachment pin was a 5/16" Delrin pin, machine-bored to accept a zinc-plated steel flathead screw in each end. The screws were 3/8" thread-forming screws for plastic, with 10-14 threads. A stainless steel washer was inserted between the screw head and the wings.

*Tag Deployment*

Once it was determined that tags would be deployed on dolphins in the capture corral, they were switched from "standby" to "deploy" mode in preparation for attachment, and tested to ensure they were transmitting. The tag attachment process required less than five minutes. The tag was positioned on the fin and the center of the hole in the attachment wing was marked with a permanent marker. The site was cleaned with a Dermachlor scrub followed by methanol. Using a dental injector gun, Lidocaine with epinephrine was injected directly into the center of the hole, with 1-2 injections around the edge of the hole as well. A sterilized stainless steel 5/16" coring tool was centered over the mark, and pushed by hand through the fin into a rubber sanding block held against the fin on the other side. The fin core was saved for genetic analyses, in a vial of DMSO. A calibrated 5/16" diameter Delrin measuring pin was then inserted through the hole to determine the appropriate pin length. From a selection of pins of different lengths soaking in Dermachlor, a pin of appropriate length (typically, 20-24 mm) was selected and secured to one wing of a tag. The wing was folded back, and the beveled edge of the pin was inserted through the hole in the dorsal fin. The free wing of the tag was positioned over the hole in the pin, and the remaining screw and washer were attached. Both screws were secured by hand-tightening with screw drivers, to the point where playing-card-thick spaces remained between each wing and the fin. The tag was tested again for transmission function, the serial number of the tag was recorded and re-checked against the tag ID number, photos were taken of the attachments and fin, and the animal was ready for release. By design, the screws/washers in the ends of the Delrin attachment pins corrode, allowing the tags to fall off the fins after the end of tag's battery life.

Figure 1. Satellite-linked SPOT-299B tag deployed on bottlenose dolphin YA3 in Barataria Bay, LA, in 2014. Ruler indicates cm. Photo by NOAA.




*Remote Tracking of Satellite-linked Tags*

Transmission windows (duty cycles) were selected to: 1) optimize satellite availability, 2) spread windows out for independence, and 3) make remote tracking data available at the beginning of a field day to facilitate searching for specific individuals in real time. They were all set to the same two 4-hour "on" windows, of hour blocks 00, 01, 02, 03 UTC (19:00-22:59 local, CDT) and 08, 09, 10, 11 UTC (03:00-06:59 local, CDT), based on the Argos on-line satellite pass prediction values, looking for satellites with >20$^{o}$ elevation for at least 3 minutes. The tags were programmed to transmit up to 250 times each day, yielding a maximum estimate of up to 240 tracking days based solely on battery life. Preliminary tracking data (locations plotted on charts) for each dolphin were available from the satellite data processing provider, Argos (CLS-America), within minutes/hours of each transmission, and within a day through Satellite Tagging and Tracking (Coyne and Godley 2005), via the internet. Final data were provided by Argos on cd-roms each month following completion of data processing. Summary data were distributed to stakeholders identified by NOAA daily for the first 30 days, and then weekly through the end of transmissions. Original data cd-roms were stored in a secure, locked vault at the Sarasota Dolphin Research Program's base of operations at Mote Marine Laboratory in Sarasota, FL.

*Location Data and Home Range Analyses*

Data selection for mapping and home range analyses involved filtering for location plausibility. Argos classifies location quality relative to an estimated error radius. The best quality data, LC3, has an estimated error of <250m. LC2 has an estimated error of <500m. LC1 locations are estimated to be accurate to within 1,500m. Satellite-linked location data of qualities LC3 and LC2 only were used as input data to calculate overall home (95% utilization distribution [UD]) and core (50% UD) ranging areas. To remove the potential for autocorrelation, one randomly selected location per day was retained for home range analysis. Home and core ranging areas were calculated using a fixed-kernel density (Worton 1989) while accounting for land barriers using methods suggested by MacLeod (2013).

A utilization distribution represents a probability of finding a given individual in a plane and describes an animal's use of space (White and Garrott 1990). UDs measure areas of intense use; therefore, the resulting ranging areas may not be continuous, but rather broken in space (Powell 2000). Kernel densities are used to calculate specified UDs (Worton 1989). The smoothing parameter (*h*) or bandwidth is the most important parameter when calculating home and core ranges as it determines the size and shape of spatial use (Wand and Jones 1995, Kie 2013). Bandwidths were calculated using a rule-based *ad hoc* method as described in Rodgers and Kie (2011). Analysis of estimated *h* parameters was completed using the Home Range Tools for ArcGIS (HRT) extension for ArcGIS 9.0 (ESRI, Inc. 2004). All other ranging pattern analyses were completed using ArcGIS 10.0 (ESRI, Inc. 2011).

The technique for measuring UDs is the same as we used for the 2013 tracking data (Wells *et al.* 2014). Previous studies of dolphin home ranges typically used kernel density methods assuming animals could move anywhere in space. These methods were not ideal for species which encountered a strong barrier, such as land (Benhamou and Cornélis 2010), and often over-estimated individual home range size (MacLeod 2013). However, the kernel density methods used for this report (accounting for a barrier) may under-estimate home range size as this method highlights areas of intense use and may not indicate the connectivity between areas of use (Powell 2000, Kie et al. 2010). Despite this, accounting for barriers in the analysis more adequately accounts for the functional size and shape of home range estimates for species experiencing a hard barrier, such as shorelines.

**Results and Discussion**

In total, 11 dolphins received satellite-linked tags during June 2014, in and around the waters of Barataria Bay. Tracking continued into November 2014.

*Satellite-linked Tag Performance*

Satellite-linked transmitter data were received from all 11 dolphins post-deployment (Table 1). Three types of data were received from the satellite-linked tags: locations, transmissions, and status updates. Location data were described above. Some transmissions merely indicated that the tag was still active, but the transmission was of insufficient quality to provide data on tag condition or location. These transmissions were generally interpreted as meaning that the animal was still alive and the tag was still on the fin, unless other information indicated to the contrary. Status updates provided information on the parameters such as battery voltage remaining, and cumulative number of transmissions, allowing assessment of tag condition and potential longevity.

The time from date tagged to final transmission ranged from a minimum of 50 days (YA5) to 161 days (Y71), with an average of 117 days ($\pm$ 32 sd). Transmission duration measures were less in 2014 than those from tagged dolphins in Barataria Bay in 2013 (2013 mean = 140 days $\pm$

46 sd; range =80-256 days. Sensors on ten of the 11 tags (91%) indicated healthy tags at the time of cessation of transmissions, and the other tag indicated low battery voltage (as expected at the end of normal tag function). No observations of tagged Barataria Bay dolphins in 2014 were conducted to assess tag and antenna condition, nor were any photo-ID surveys conducted during the period the tags were active. Wildlife Computers has suggested the possibility that extended freezer storage of the tags might have reduced the effectiveness of the anti-fouling coating. Transmission characteristics (few high quality locations, premature cessation of transmissions) were similar to what would be expected for tags deployed without biofouling protection.

*Location and Home Range Analysis*

The number of locations with estimated error radius (LC3, LC2, and LC1) for tagged dolphins ranged from 55 (YA5) to 307 (Y91) (Table 2). On average, dolphins in Barataria Bay had 92 filtered locations (± 33 sd). Up to 173 locations of LC3 and LC2 accuracy (Y91) were obtained for a given individual over the course of the project. These best quality (LC3 and LC2) locations provided the basis for the following maps and measures.

Satellite-linked locations (LC3 and LC2), along with 95% and 50% fixed-kernel home range contours for all dolphins tagged in Barataria Bay in 2014 combined are shown in Figure 2. Individual dolphin LC3 and LC2 locations and fixed kernel home range contours (95%, 50%), were plotted to illustrate movements in and around Barataria Bay in 2014 (Figures 3-13). The dolphins exhibited habitat use patterns comparable to those recorded for dolphins tagged in 2011 and 2013. Dolphins tagged just inshore of the barrier islands tended to remain inshore of the barrier islands, or ventured short distances into the Gulf of Mexico coastal waters. Dolphins tagged near the marsh islands further north in Barataria Bay tended to remain in marsh island habitat.

As has been the case in previous years, the tagged dolphins did not exhibit long-range movements over the course of this project. In Barataria Bay in 2014, fixed kernel home range size (95% UD) ranged from 6.1 $km^2$ (Y81) to 111.4 $km^2$ (YA3) (Table 2). Fixed kernel home range size (50% UD) ranged from 1.5 $km^2$ (Y81) to 23.3 $km^2$ (YA3). The maximum straight line measures across the longest dimension for a dolphin range varied across individuals, from 11.7 km (Y81) to 39.1 km (YA1). These home range measures are similar to those reported for Barataria Bay dolphins tagged in 2011 and 2013 (Figure 14).

Consistent findings across all years of tagging and tracking, with regards to the lack of long-distance movements, small home range sizes, and habitat use suggest that these dolphins are residents of Barataria Bay. The ranging patterns exhibited by the tagged dolphins of Barataria Bay are comparable to those reported for bottlenose dolphins resident to many other bays, sounds, and estuaries in the northern Gulf of Mexico and elsewhere (Waring *et al.* 2011; Wells and Scott 1999).

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Table 1. Satellite-linked transmitter performance data collected in and around the waters of Barataria Bay, LA from June 2014 to November 2014.

| Dolphin: FB | Tag: PTT ID | Deploy Date | Deploy Lat | Deploy Lon | No. of Locations | Date Final Location Received | Deploy to Final Location (# of Days) | Most Recent Signal Date | Deploy to Final Signal (# of Days) | First Date Seen without Tag | Final Tag Status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Y71 | 130021 | Jun 10, 2014 | 29.22010 | -90.02553 | 313 | Nov 14, 2014 | 157 | Nov 18, 2014 | 161 | No resight without tag | Sensor values indicate a healthy tag |
| Y75 | 129994 | Jun 12, 2014 | 29.23976 | -90.01583 | 441 | Sep 11, 2014 | 91 | Sep 11, 2014 | 91 | No resight without tag | Sensor values indicate a healthy tag |
| Y81 | 129993 | Jun 16, 2014 | 29.28056 | -89.94211 | 204 | Oct 19, 2014 | 125 | Oct 19, 2014 | 125 | No resight without tag | Low battery voltage |
| Y83 | 130012 | Jun 16, 2014 | 29.28056 | -89.94211 | 134 | Oct 05, 2014 | 111 | Oct 18, 2014 | 124 | No resight without tag | Sensor values indicate a healthy tag |
| Y85 | 130022 | Jun 16, 2014 | 29.28056 | -89.94211 | 189 | Sep 13, 2014 | 89 | Sep 25, 2014 | 101 | No resight without tag | Sensor values indicate a healthy tag |
| Y91 | 130018 | Jun 17, 2014 | 29.24874 | -89.99117 | 655 | Nov 18, 2014 | 154 | Nov 21, 2014 | 157 | No resight without tag | Sensor values indicate a healthy tag |
| Y97 | 130026 | Jun 18, 2014 | 29.34362 | -89.99118 | 379 | Nov 10, 2014 | 145 | Nov 10, 2014 | 145 | No resight without tag | Sensor values indicate a healthy tag |
| Y99 | 130020 | Jun 19, 2014 | 29.22289 | -90.02250 | 290 | Sep 27, 2014 | 100 | Oct 07, 2014 | 110 | No resight without tag | Sensor values indicate a healthy tag |
| YA1 | 129995 | Jun 19, 2014 | 29.22804 | -90.02049 | 551 | Oct 08, 2014 | 111 | Oct 05, 2014 | 108 | No resight without tag | Sensor values indicate a healthy tag |
| YA3 | 130016 | Jun 19, 2014 | 29.22804 | -90.02049 | 545 | Oct 15, 2014 | 118 | Oct 15, 2014 | 118 | No resight without tag | Sensor values indicate a healthy tag |
| YA5 | 130001 | Jun 20, 2014 | 29.22959 | -90.02103 | 131 | Jul 20, 2014 | 30 | Aug 09, 2014 | 50 | No resight without tag | Sensor values indicate a healthy tag |

Table 2. Location and home range summaries for satellite-linked transmitter data collected in and around the waters of Barataria Bay, LA from June 2014 to November 2014.

| Dolphin ID: FB | Tag: PTT ID | Deploy Date | No. of Locations with Error Radius Estimates | Location Class 3 (~250 m) | Location Class 2 (~500 m) | Location Class 1 (~1500 m) | 95% Fixed Kernel Home Range Area (km$^2$) | 50% Fixed Kernel Home Range Area (km$^2$) | Maximum Distance Between Locations (km) | Distance Between Capture and Farthest Location (km) |
|---|---|---|---|---|---|---|---|---|---|---|
| Y71 | 130021 | Jun 10, 2014 | 105 | 25 | 43 | 37 | 14.9 | 3.6 | 16.3 | 12.9 |
| Y75 | 129994 | Jun 12, 2014 | 202 | 21 | 101 | 80 | 43.8 | 9.9 | 17.2 | 11.1 |
| Y81 | 129993 | Jun 16, 2014 | 107 | 23 | 44 | 40 | 6.1 | 1.5 | 11.7 | 6.9 |
| Y83 | 130012 | Jun 16, 2014 | 62 | 13 | 27 | 22 | 8.4 | 3.0 | 12.6 | 9.9 |
| Y85 | 130022 | Jun 16, 2014 | 56 | 13 | 20 | 23 | 48.3 | 11.0 | 32.4 | 34.6 |
| Y91 | 130018 | Jun 17, 2014 | 307 | 53 | 120 | 134 | 37.6 | 8.4 | 22.8 | 20.6 |
| Y97 | 130026 | Jun 18, 2014 | 107 | 20 | 47 | 40 | 22.4 | 7.2 | 18.1 | 11.5 |
| Y99 | 130020 | Jun 19, 2014 | 129 | 30 | 56 | 43 | 29.2 | 4.4 | 26.2 | 17.1 |
| YA1 | 129995 | Jun 19, 2014 | 294 | 44 | 126 | 124 | 103.1 | 18.7 | 39.1 | 25.1 |
| YA3 | 130016 | Jun 19, 2014 | 228 | 51 | 95 | 82 | 111.4 | 23.3 | 37.3 | 24.9 |
| YA5 | 130001 | Jun 20, 2014 | 55 | 13 | 29 | 13 | 16.2 | 2.9 | 20.9 | 12.6 |

Figure 2. (a) Satellite-linked locations (LC3 and LC2), and (b) 95% and (c) 50% fixed-kernel home range contours for all dolphins tagged in Barataria Bay, LA from June 2014-November 2014.

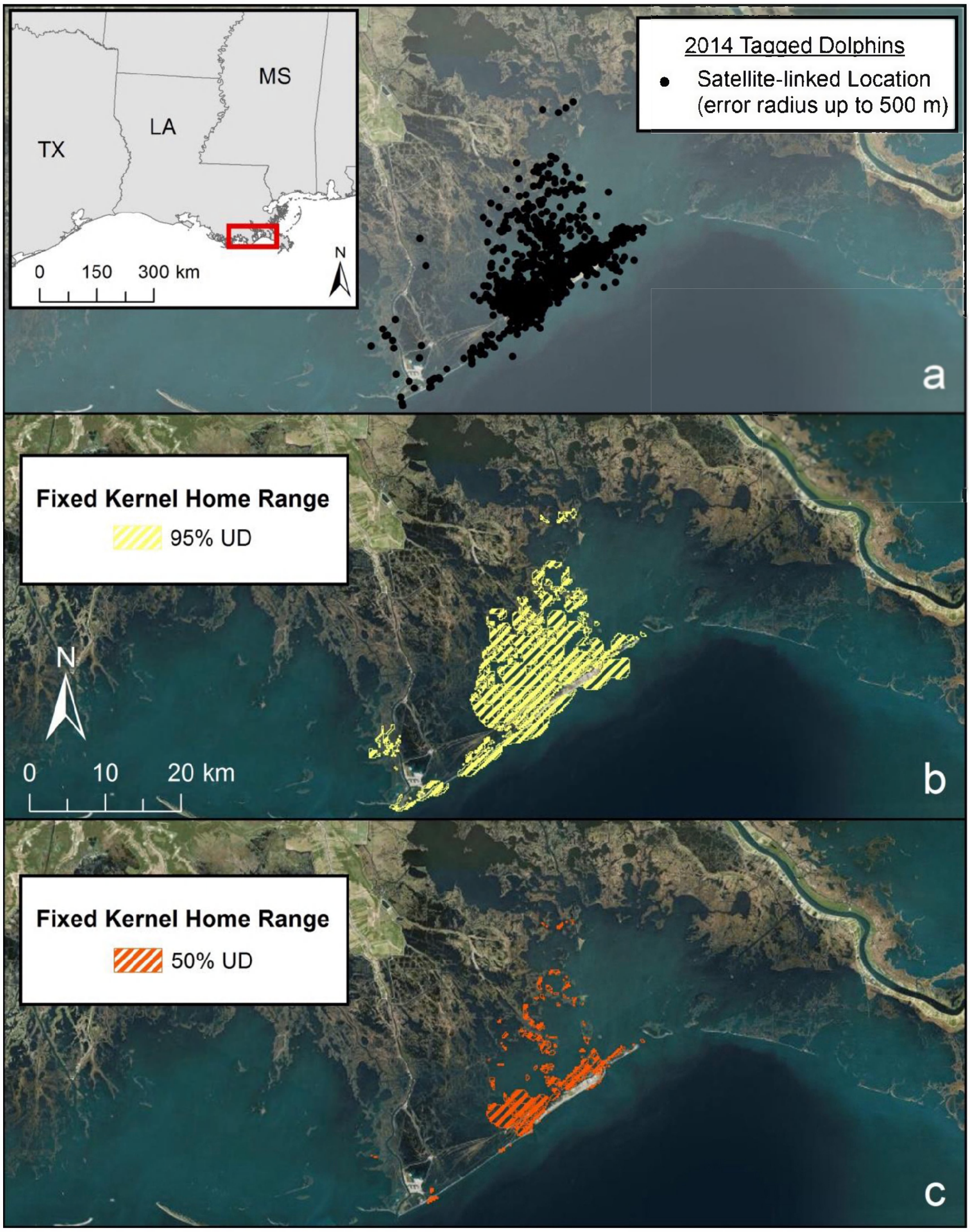

Figure 3. Y71's capture location and satellite-linked locations (LC3 and LC2), and 95% and 50% fixed-kernel home range contours.

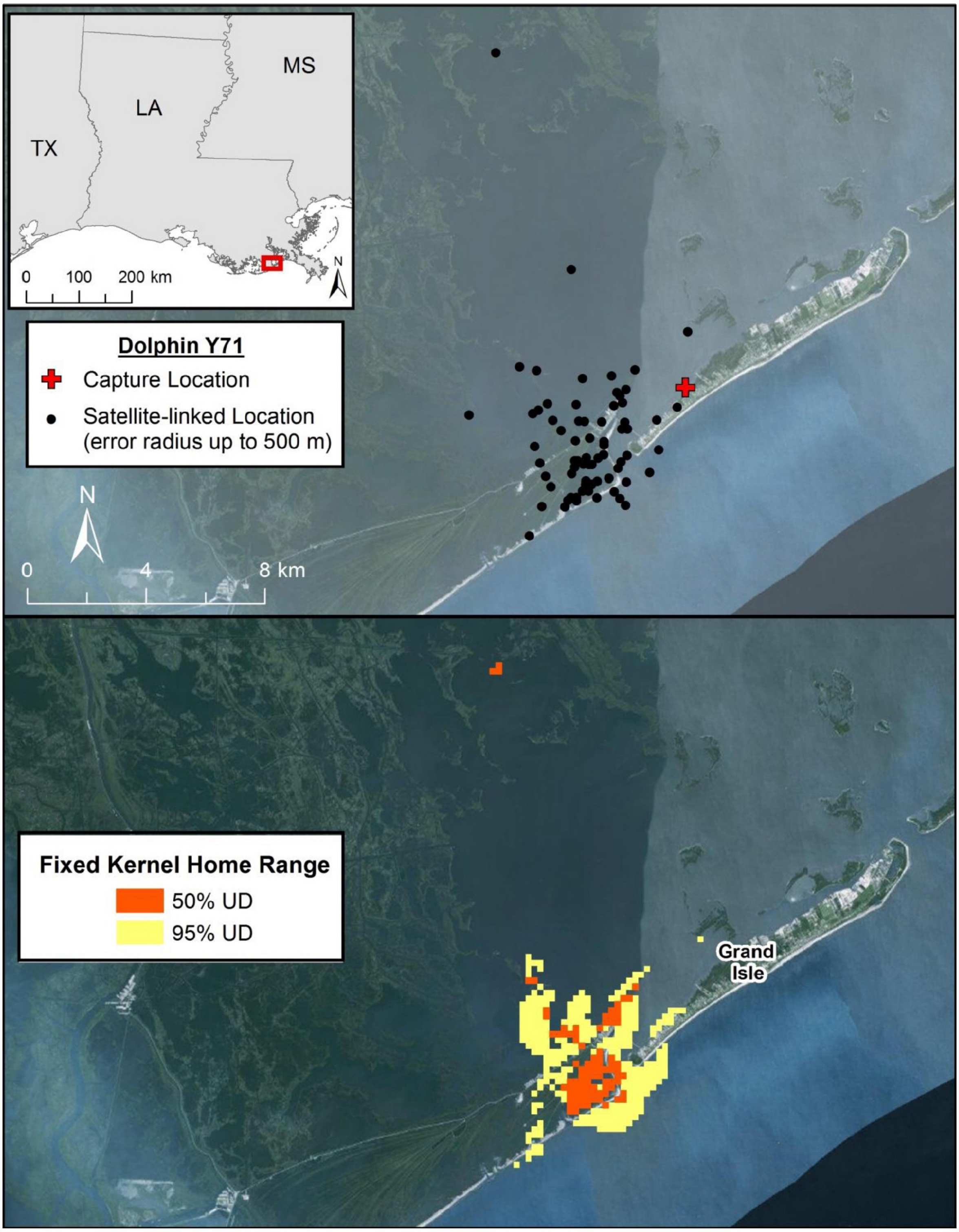

Figure 4. Y75's capture location and satellite-linked locations (LC3 and LC2), and 95% and 50% fixed-kernel home range contours.

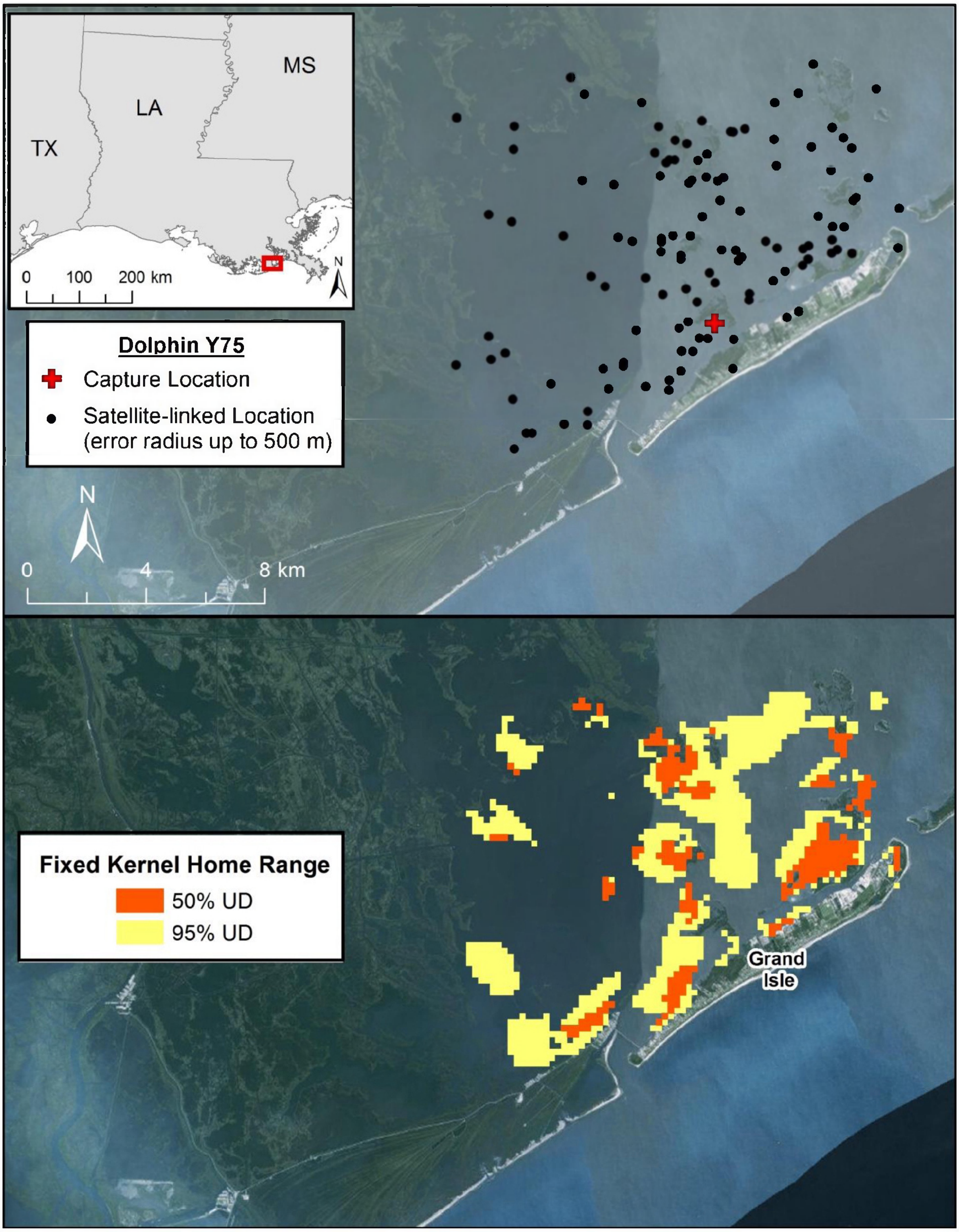

Figure 5. Y81's capture location and satellite-linked locations (LC3 and LC2), and 95% and 50% fixed-kernel home range contours.

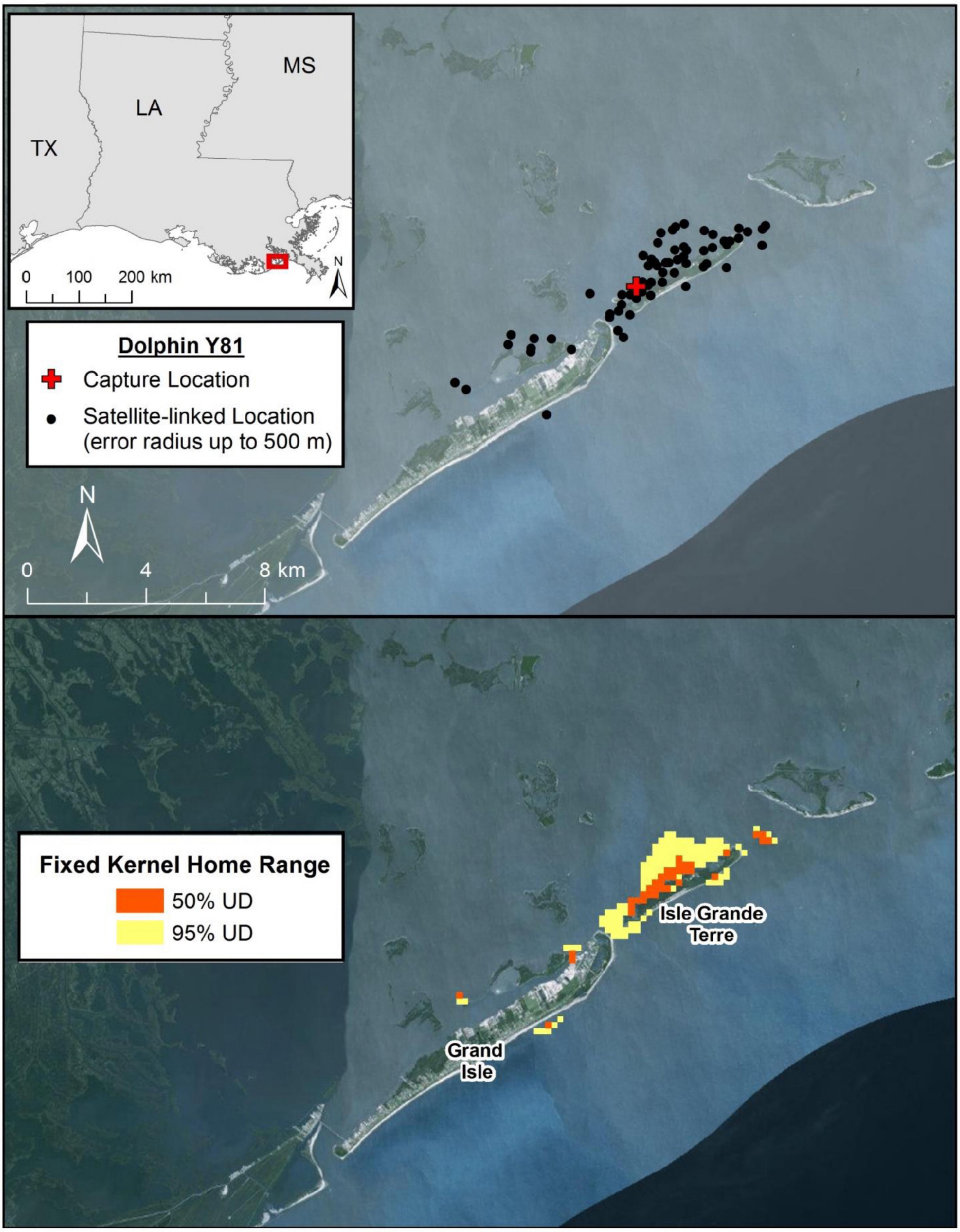

Figure 6. Y83's capture location and satellite-linked locations (LC3 and LC2), and 95% and 50% fixed-kernel home range contours.

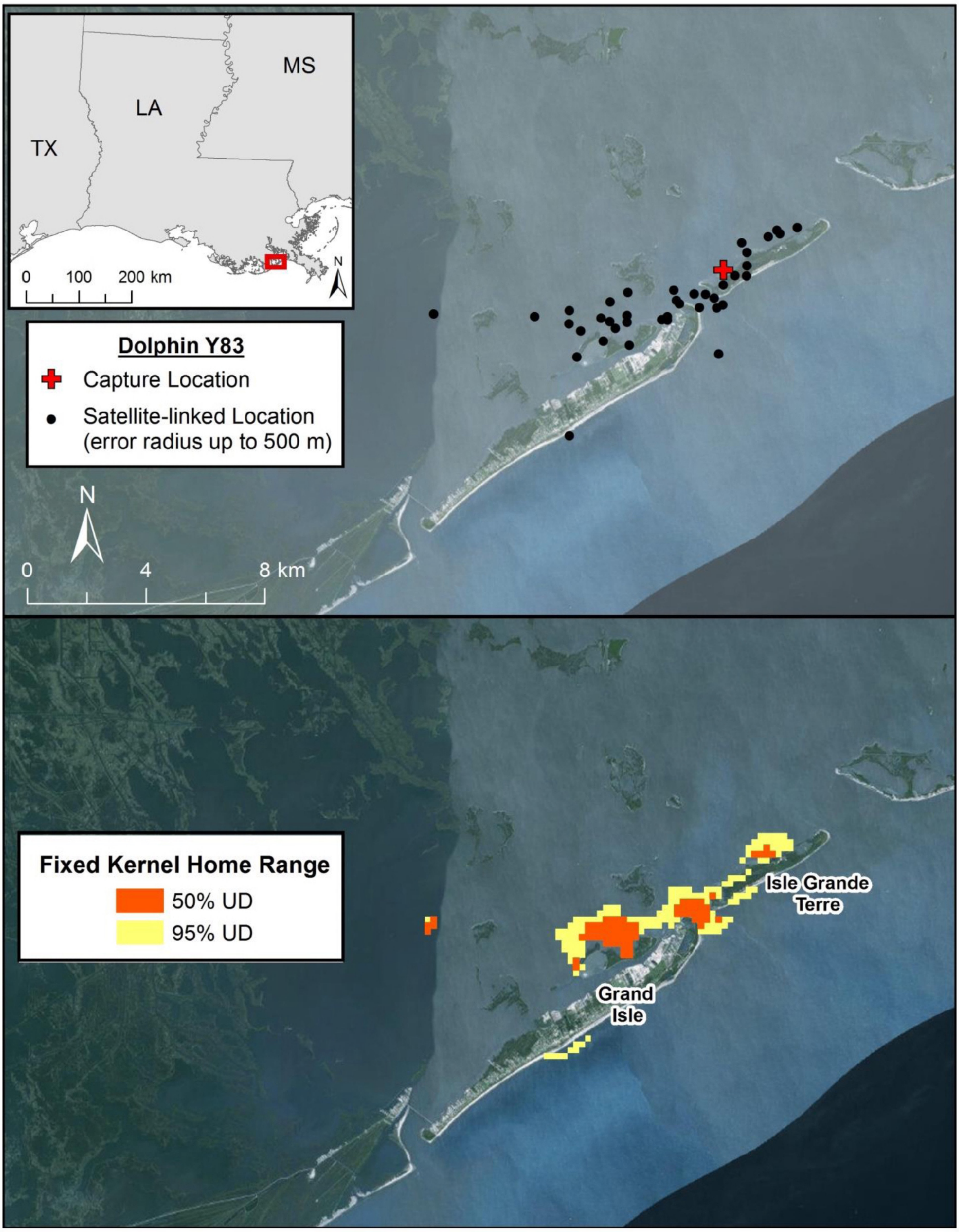

Figure 7. Y85's capture location and satellite-linked locations (LC3 and LC2), and 95% and 50% fixed-kernel home range contours.

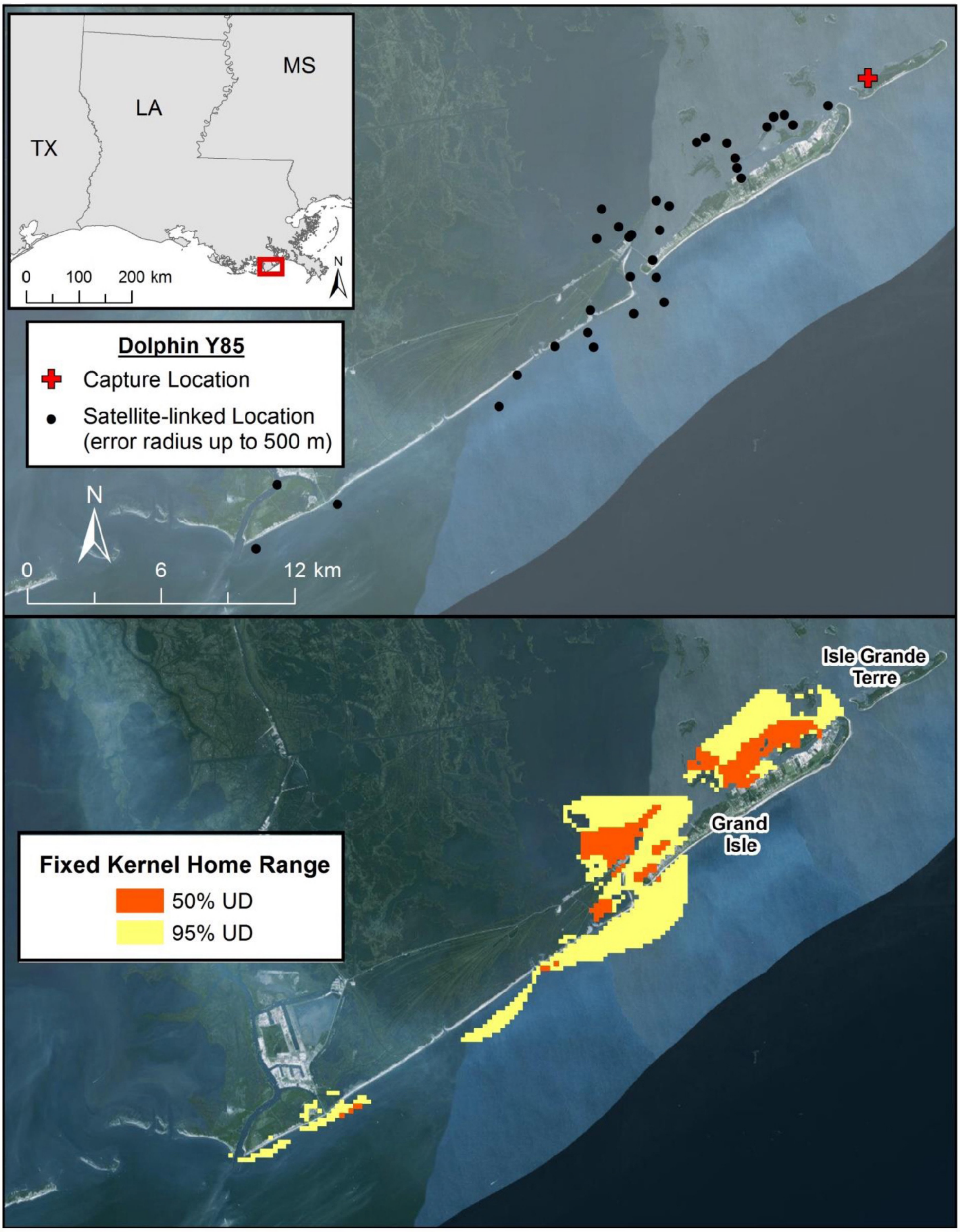

Figure 8. Y91's capture location and satellite-linked locations (LC3 and LC2), and 95% and 50% fixed-kernel home range contours.

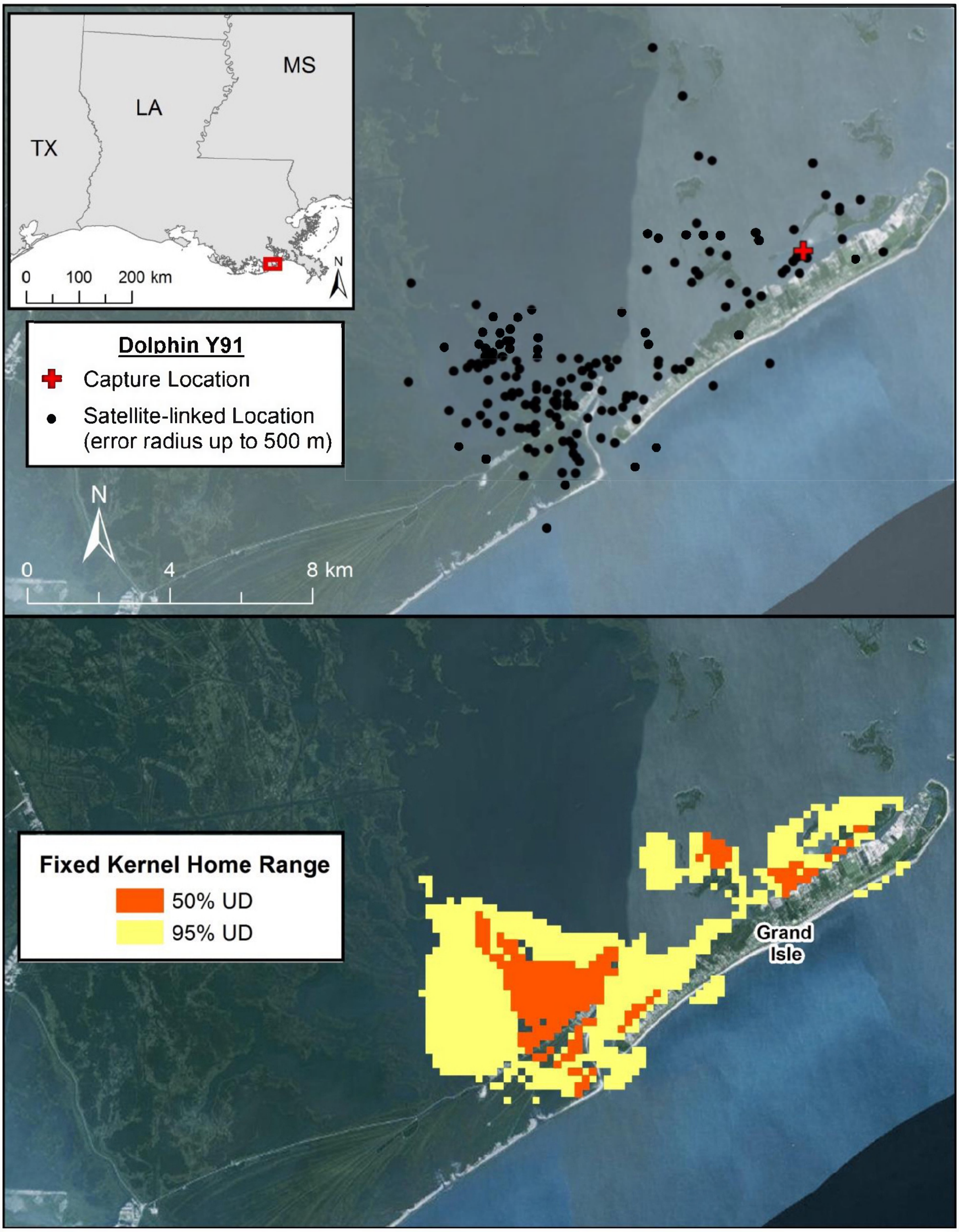

Figure 9. Y97's capture location and satellite-linked locations (LC3 and LC2), and 95% and 50% fixed-kernel home range contours.

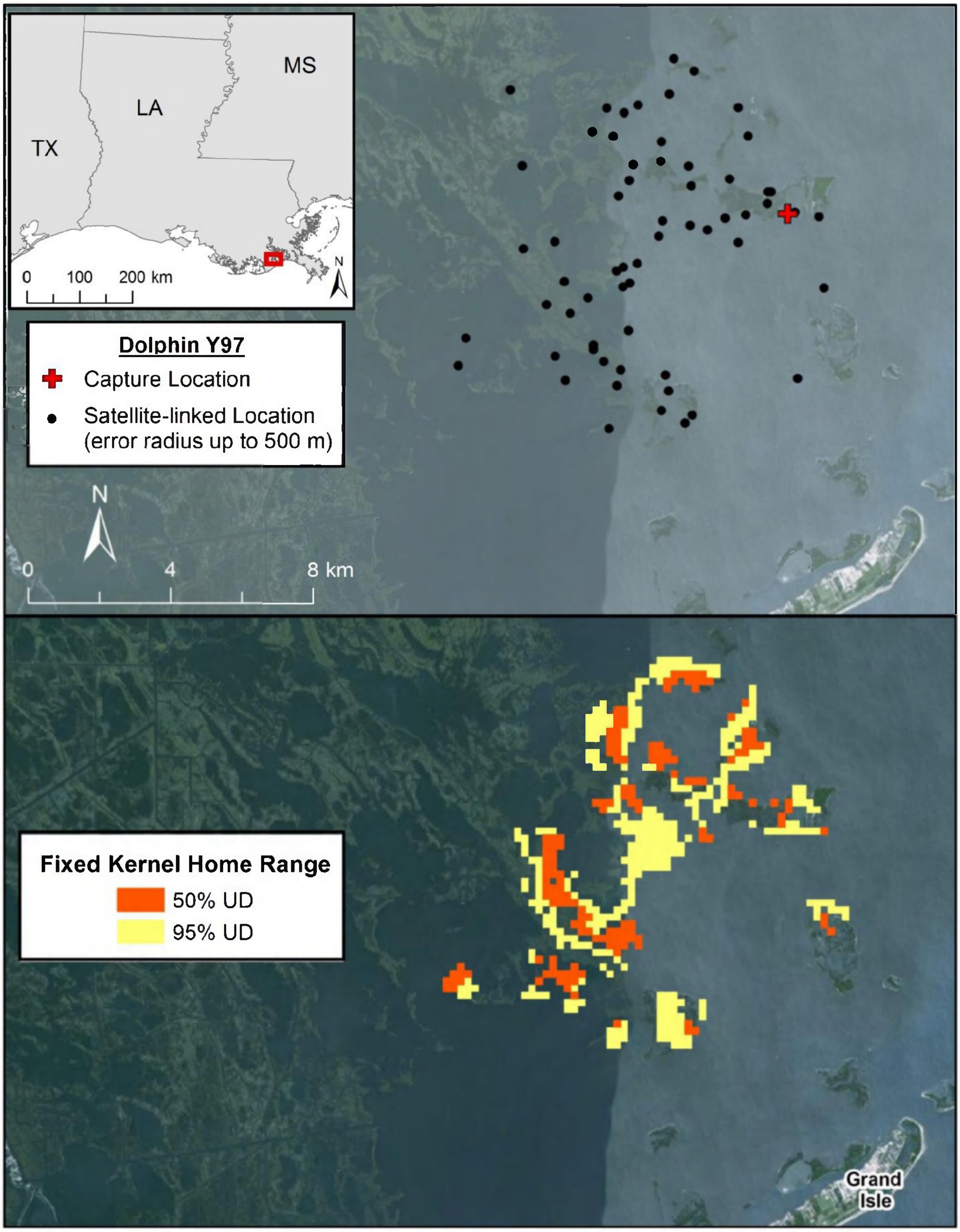

Figure 10. Y99's capture location and satellite-linked locations (LC3 and LC2), and 95% and 50% fixed-kernel home range contours.

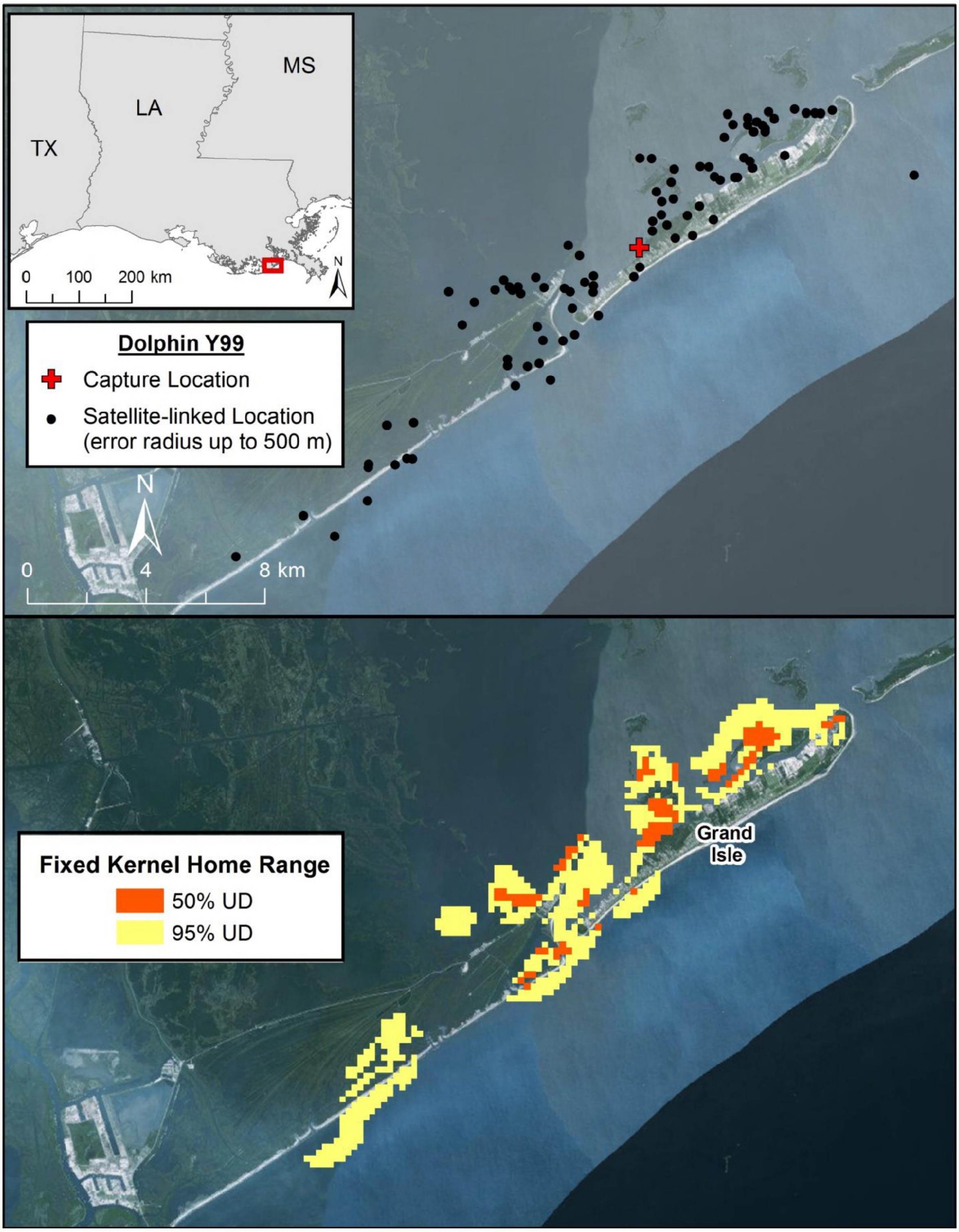

Figure 11. YA1's capture location and satellite-linked locations (LC3 and LC2), and 95% and 50% fixed-kernel home range contours.

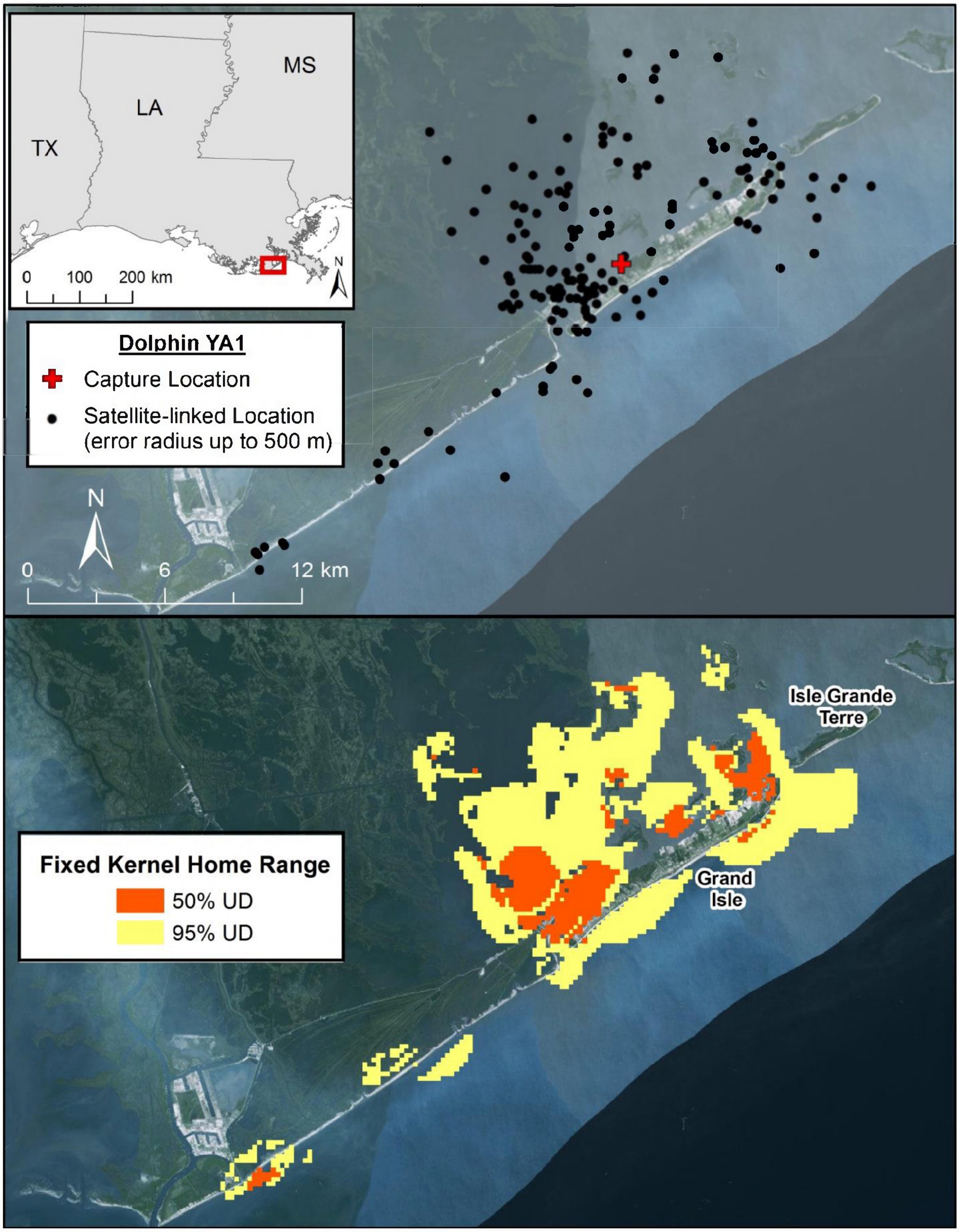

Figure 12. YA3's capture location and satellite-linked locations (LC3 and LC2), and 95% and 50% fixed-kernel home range contours.

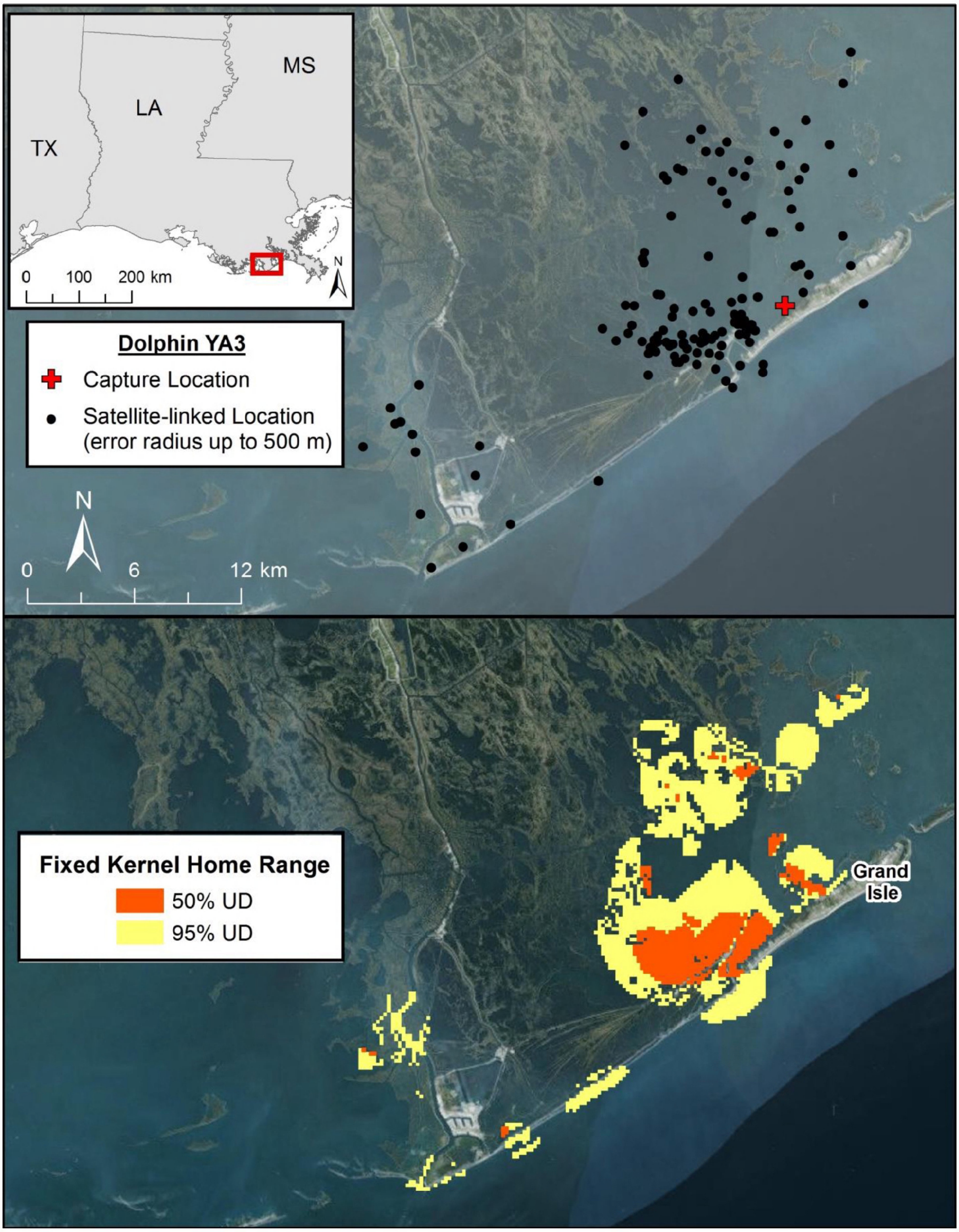

Figure 13. YA5's capture location and satellite-linked locations (LC3 and LC2), and 95% and 50% fixed-kernel home range contours.

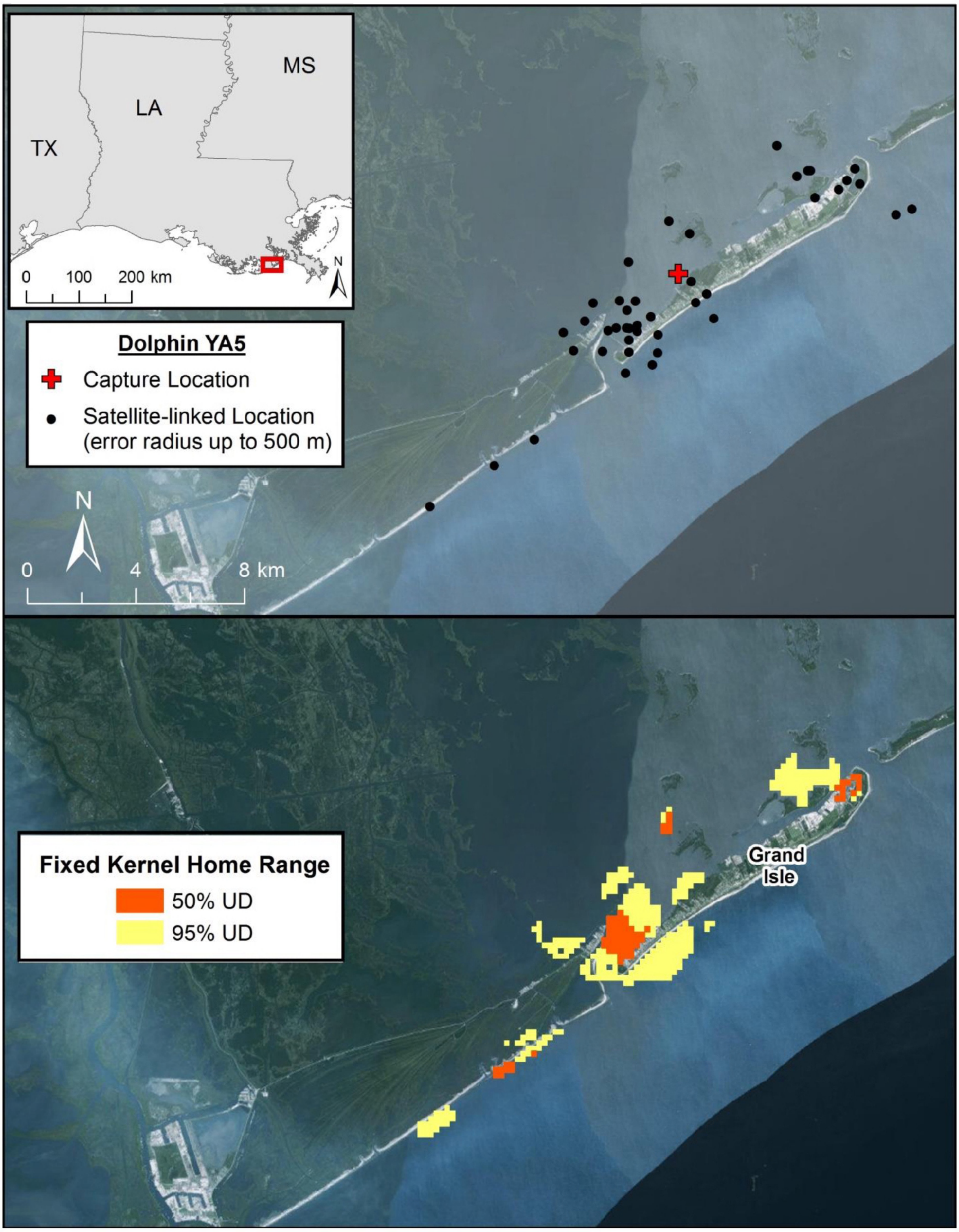

Figure 14. Comparisons of home range parameters, across years. Boxes are the 25th to 75th percentile, median is solid black line, mean is dashed blue line, whiskers go to $10^{th}$ and 90th percentiles, with outliers indicated above and below. a) 95% UD, b) 50% UD, c) maximum range dimension.