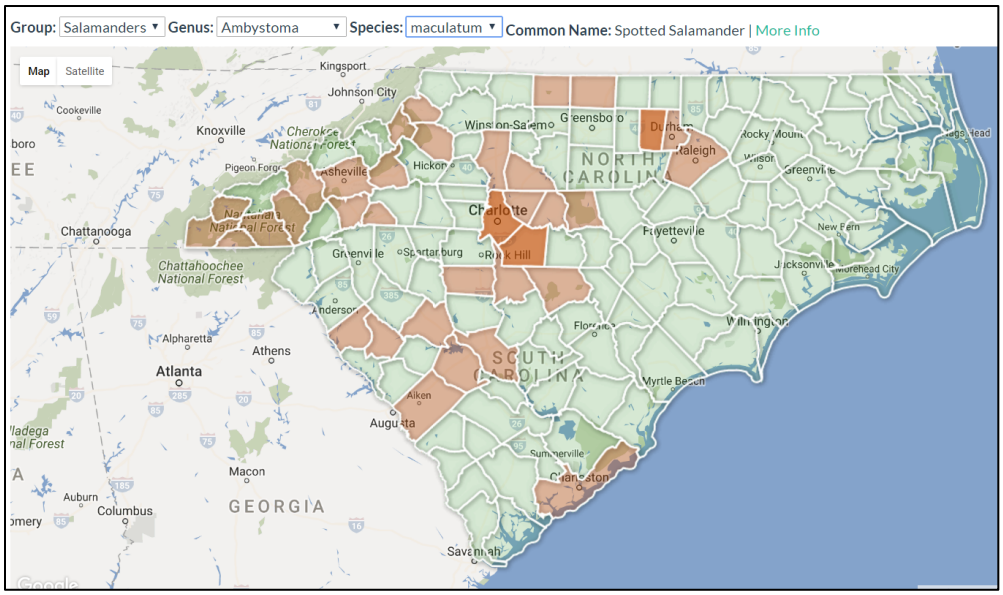
The Carolina Herp Atlas: Final Report to the South Carolina Department of Natural Resources



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Purpose

This final report details the efforts and results of the Carolina Herp Atlas from 30 March 2007 to 1 September 2016. The Carolina Herp Atlas is an online database that uses observations by citizen scientists to track amphibian and reptile distributions in North and South Carolina.

Suggested Citation

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PROJECT SUMMARY

This report details the efforts and results of the Carolina Herp Atlas (CHA; www.carolinaherpatlas.org) from 30 March 2007 to 1 September 2016. The CHA is an online database that uses observations by citizen scientists to track amphibian and reptile distributions in North and South Carolina. Since the launch of the CHA in March 2007, citizen scientists, field naturalists, and biologists have provided 6,636 amphibian and reptile observational records from South Carolina (24,833 total from North and South Carolina). Specifically, the CHA documented distributions for 133 species of amphibians and reptiles in South Carolina, including the occurrence of 31 anurans, 33 salamanders, 38 snakes, 13 lizards, 17 turtles, and the American alligator. Several records of amphibians or reptiles considered special concern, threatened and endangered by the state of South Carolina were contributed to the CHA.

OVERVIEW OF THE CAROLINA HERP ATLAS

The Carolina Herp Atlas (CHA; www.carolinaherpatlas.org), developed by the Davidson College Herpetology Laboratory and Davidson College Information Technology Services, is an online database that uses observations by citizen scientists to track amphibian and reptile distributions in North and South Carolina. The CHA also allows users a simple way to maintain a personal database of their observations, but county-level species distribution maps can be viewed by anyone who visits the website. Ultimately, wildlife biologists can use observation records from CHA to understand activity periods, distribution, and other facets of amphibian and reptile ecology.

Prior to submitting a record, the user must first register and set-up an account. Once registered, the user is able to add records and maintain a database of amphibian and reptile observations. Data collected for each observation include: 1) genus and species, 2) state and county, 3) date and time of observation, 4) number and condition of individuals observed, 5) a digital photo for verification of the species identification, and 6) location (including geographic coordinates obtained from our GeoLocator). The GeoLocator allows the user to pinpoint the exact location of their reptile or amphibian observation.

Data can be viewed in either a tabular form or through county-level distribution maps in the “Data” tab. County-level records can be sorted by group (e.g., salamanders, turtles), genus, and species by clicking on the column headings. The "Photos" tab allows the user to view and search photos of amphibian and reptile records submitted to the CHA. We ensure that the photos do not contain precise information on locations.

FEATURES OF THE CAROLINA HERP ATLAS

The CHA contains a number of features that ensure quality of data, allow users to keep a personal database that is protected via log-in features, and allow non-registered public and registered users to view species distribution maps, charts, tables, photos and other information on North and South Carolina's amphibians and reptiles. Specific features include 1) Registration, 2) My Herps, 3) Data (i.e., distribution maps and tabular data), 4) Photos, and 5) Administrator and Database Management**.**

Registration & My Herps

All users are required to register in order to submit a record. The account created allows for personal database management and can be changed at any time. The "My Herps" section allows users to add records to the CHA and maintain a personal database of their observations. Each previously submitted observation is available for the user to view in "My Herps," including a map location of the record and any photos attached. Users also have the option to delete any of their records with inaccurate information. To **Submit records** the CHA contains:

1) **Drop-down menus** for group, genus, and species.

2) **Common names** appear once users choose the scientific name of the species.

3) **A Species identification web page** (http://herpsofnc.org/) is linked next to the common name to help users correctly identify species.

4) **Date and time of day** is automated, but can be changed so that historic data can be entered. To enter other dates or times, users can select the month and year on a calendar to find the date of interest, and scroll through a list of times.

5) **GeoLocator** is available to help users pinpoint the exact location of their observation. After clicking on the locator, the user is brought to a map/aerial image of the Carolinas. Users can manually enter the UTM coordinates of their observation or can use the "Locator" to navigate to their observation. The "Locator" feature centers the map on the user's personal computer IP address (if allowed by the user's personal geolocation settings). Once the location of the observation is identified, the user can automatically add the UTMs to their observation. Accuracy varies depending on imagery available but generally is accurate to within 5 meters.

6) **Remarks and a Location Description** can be included for each observation. Remarks could include whether the animal was observed alive or dead, and the body condition or sex of the individual.

7) **Digital photographs** can be uploaded for each record for identification verification. Multiple images can be uploaded for a single record.

Data and Photos

The "Data" and "Photos" tabs allow the registered user and the non-registered public to view data submitted to the CHA. Features of these sections include:

1) **County-level distribution maps** (Figure 1) can be searched by group, genus, and species, and display the number of observations CHA users have recorded of a species in each county in North and South Carolina.

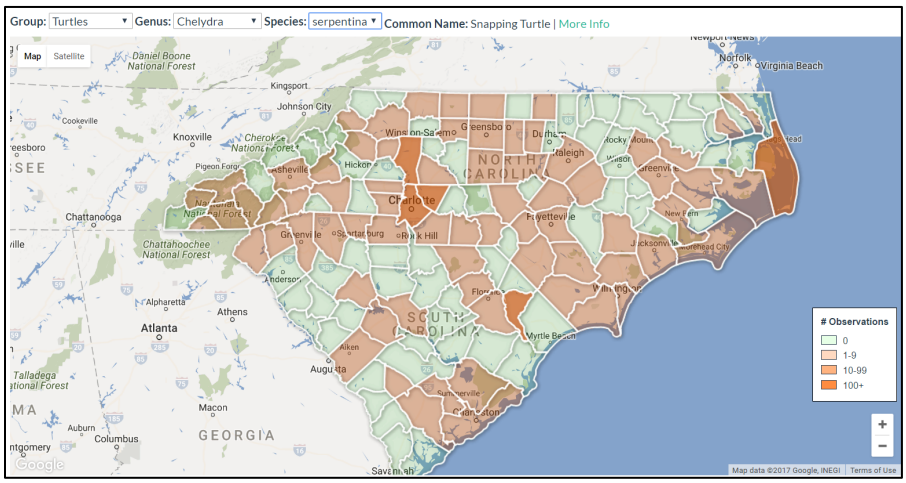

Figure 1. County-level distribution map for the Snapping Turtle, *Chelydra Serpentina.*

2) **Tabular data** allows users to view the total number of records submitted to the CHA for each species by state and county. Users can filter data by typing a common name, scientific name, county, or state into a search box.

3) The **Photos** tab allows the user to view all photos submitted to the CHA. Photos can be filtered by group, genus and species, and each photo will enlarge in size when selected. However, users are not able to view geographic coordinates for these photos (only the state in which the photo was taken).

Administrator and Database Management

The administrator and database management section can only be accessed by those with permission as database administrators. Administrators have the ability to review each record to ensure the accuracy of data entered into the CHA. Upon review, the administrator assigns each record a status code. For example, observations that do not contain a photo will receive a lower status code than those records that do contain a voucher photo. The current record classifications include:

- **Unverified with image (6):** A record has an attached photo, but it still needs to be verified by an administrator. This is the default status for records with attached photos. Records with photos that match the assigned species will be given a status of 10 by an admin.
- **Confirmed (10):** A record has an image attached and an administrator has ensured the image matches the species listed on the record.
- **Probable with image (3):** A record is most likely accurate because the species is common in the listed area. However, the record cannot be identified to species due to the quality of the image. This is a category that was added in the last year to meet our needs for classifying records with low quality photos.
- **Unverified without image (5):** A record does not have an attached photo, and an admin has yet to determine whether the listed species could be found in the geographic area. This is the default status for records without attached photos. If the species is common in a particular area, the record could be assigned a status of 2 by the admin. Alternatively, it could be given a status of 1, if the record is deemed to be invalid by an administrator.
- **Probable without image (2):** A record is most likely accurate because the species is common and found in the listed area. However, we place less confidence in records without photos. This is a category that was added in the last year to meet our needs for classifying records without images.
- **User deleted (4):** A record deleted by a user for any reason. We expect users to submit the most accurate data possible and thus, we allow users to delete their own records to add an additional layer to the verification process. This is

the only code that a user can modify; a record's status is automatically changed to a "4" when it is deleted by the user.

- **Invalid needs correction (1):** A record that was found to be incorrect when verified and needs to be edited to reflect the correct information (e.g., a user incorrectly identified the species, but a photo is attached). This is a category that was added in the last year to differentiate deleted records (4) from those that could be modified.

In addition to verifying records, admins can export record data and provide voucher photos upon request by wildlife biologists. Records can be exported to an Excel spreadsheet, which the admin will filter to select the data of interest to the biologist. Photos are stored in Google Drive and are classified according to a naming convention: [Record ID_PhotoID_Collector_Genus_Species_County_State]. The Record ID refers to the associated record in the database and the Record and Photo ID numbers may be different because more records are submitted than photos. For example, the photo [36114_18252_kagreene@davidson.edu_Thamnophis_sirtalis_Aiken_SC.jpg] indicates that this photo is attached to the record 36114 in the database.

RESULTS AND DISCUSSION

Thus far, the CHA has collected species-level, distribution data on 133 South Carolina species of amphibians and reptiles, including the occurrence of 31 anurans, 33 salamanders, 38 snakes, 13 lizards, 17 turtles, and the American alligator (Figures A1-A5 in Appendix A). The most commonly reported species include the Yellow-bellied Slider (*Trachemys scripta*; 382 records), Banded Watersnake (*Nerodia fasciata;* 289 records), Cope's Grey Treefrog (*Hyla chrysoscelis*; 203 records), Southern Cricket Frog (*Acris gryllus*; 202 records), and Green/Bronze Frog (*Lithobates clamitans*; 191 records).

Amphibians of greatest conservation need (i.e., priority species) from the State Wildlife Action Plan (SWAP) in the state of South Carolina that have been submitted include the Dwarf Siren (*Pseudobranchus striatus;* 1 record), Tiger Salamander (*Ambystoma tigrinum*; 2 records), Carolina Gopher frog (*Lithobates capito*; 2 records), Wood Frog (*Lithobates sylvaticus*; 2 records), Bird-voiced Treefrog (*Hyla avivoca*; 3 records), Pine Barrens Treefrog (*Hyla andersonii*; 3 records), Shovel-nosed Salamander (*Desmognathus marmoratus*; 3 records), Green Salamander (*Aneides aeneus*; 4 records), Chamberlain's Dwarf Salamander (*Eurycea chamberlaini*; 8 records), Dwarf Salamander (*Eurycea quadridigitata*; 8 records), Webster's Salamander (*Plethodon websteri*; 23 records), Pickerel Frog (*Lithobates palustris*; 25 records), Upland Chorus Frog (*Pseudacris feriarum*; 67 records), and Northern Cricket Frog (*Acris crepitans*; 132 records).

Reptiles of greatest conservation need (i.e., priority species) from the SWAP in the state of South Carolina that have been submitted to the CHA include the Florida Softshell Turtle (*Apalone ferox*; 1 record), Gopher Tortoise (*Gopherus polyphemus*; 1 record), Island Glass Lizard (*Ophisaurus compressus*; 1 record), Leatherback Sea Turtle

(*Dermochelys coriacea*; 1 record), Pine Woods Snake (*Rhadinaea flavilata*; 3 records), Striped Mud Turtle (*Kinosternon baurii*; 3 records), Slender Glass Lizard (*Ophisaurus attenuatus*; 4 records), Loggerhead Sea Turtle (*Caretta caretta*; 7 records), Florida Cooter (Pseudemys floridana; 8 records), Coral Snake (*Micrurus fulvius*; 9 records), Southern Hognose Snake (*Heterodon simus*; 10 records), Chicken Turtle (*Deirochelys reticularia*; 12 records), Diamondback Terrapin (*Malaclemys terrapin*; 13 records), Spiny Softshell Turtle (*Apalone spinifera*; 13 records), Eastern Diamondback Rattlesnake (*Crotalus adamanteus*; 14 records), Pine Snake (*Pituophis melanoleucus*; 15 records), Spotted Turtle (*Clemmys guttata*;18 records), Florida Green Watersnake (*Nerodia floridana*; 25 records), Milk Snake (*Lampropeltis triangulum*; 29 records), Eastern Painted Turtle (*Chrysemys picta*; 30 records), Timber Rattlesnake (*Crotalus horridus*; 41 records), Common Snapping Turtle (*Chelydra serpentina*; 50 records), Black Swamp Snake (*Seminatrix pygaea*; 69 records), American Alligator (*Alligator mississippiensis*; 72 records), River Cooter (*Pseudemys concinna*; 72 records) Eastern Box Turtle (*Terrapene carolina*; 135 records), and Yellow-bellied Slider (*Trachemys scripta*; 382 records). See Appendix B for county-level distribution maps for each of the priority species from the SWAP.

The collection of 6,636 amphibian and reptile observational records from South Carolina (24,833 total from North and South Carolina) over the course of nine years suggests that the CHA has been a highly successful, citizen-science based project to document the distribution of reptiles and amphibians in the Carolinas. The CHA also continues to receive a high number of submissions each year (Figure A6 in Appendix C).

Thus, we have been able to create a valuable database relying on data collected by the general public, and those citizen scientists can feel empowered to know that they have a significant impact on our understanding of herpetofauna natural history in the Carolinas.

An overarching goal of the CHA is to promote conservation and understanding of reptiles and amphibians in North and South Carolina. The interactive nature of the CHA appears to appeal to a wide variety of people, including school teachers, professional herpetologists, and those generally interested in wildlife. We also regularly respond to emails sent to the Carolina Herp Atlas account requesting help with species identification questions or advice on how to approach certain problems involving herpetofauna (e.g., what to do if you encounter a turtle crossing the road). Thus, we try to stay highly engaged with our users by responding as soon as possible, sometimes even immediately, to any email requests, and resolving any problems that may arise with the website. Additionally, we have made significant changes to improve the quality of the website for CHA users in the past two years, including updating the user interface (e.g., increasing aesthetic appeal) and improving the GeoLocator associated with the submission process. The recent changes have not only made the site more user-friendly, but also improved the quality of the data we are able to provide to other biologists. Specifically, we added new status codes to further discriminate between different types of records (described in Administrator and Database Management section).

To promote the website more widely, we publicize the CHA at all outreach events we attend or coordinate, including the annual Davidson Reptile Day (a popular annual event in Davidson, which over 700 community members attend). Between 2005 and 2015, the Davidson College Herpetology Lab gave 390 talks to various groups, including

school groups and the general public. During that time, we presented to 53,961 people, and reached over 12,300 people in 2015 alone. We expect that some of the individuals that attended our talks in the past became active users of CHA or encouraged others to submit their findings.

ACKNOWLEDGEMENTS

Todor Penev was the primary programmer for the Carolina Herp Atlas. We thank Mary Muchane, Garry Washburn and Paul Brantley for technical assistance and consultation. Funding for this project was provided by the North Carolina Wildlife Resources Commission and the South Carolina Department of Natural Resources. The CHA was developed in partnership with Partners in Amphibian and Reptile Conservation (PARC), North Carolina PARC and the University of Georgia's Savannah River Ecology Laboratory.

APPENDIX A: NUMBER OF RECORDS PER SPECIES

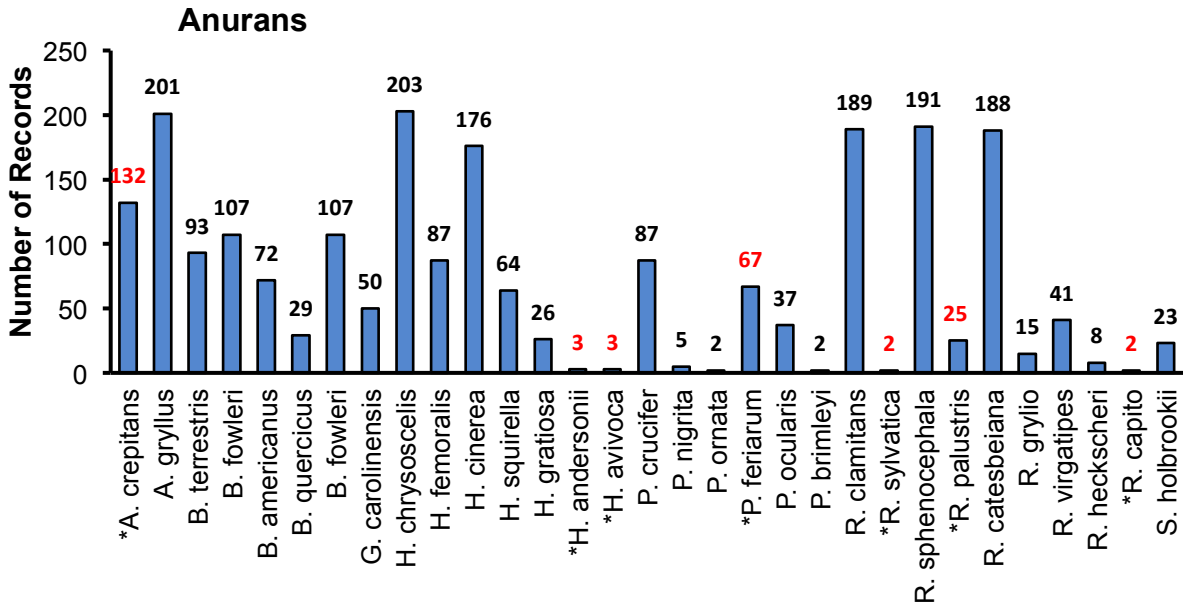

Figure A1. Number of records (of all status codes, with the exception of records known to be incorrect) in CHA database for 31 anurans. The Cope's Gray Treefrog (*H. chrysoscelis*) was the most commonly observed species (203 records) in this group. Species with an asterisk are priority species in the SWAP.

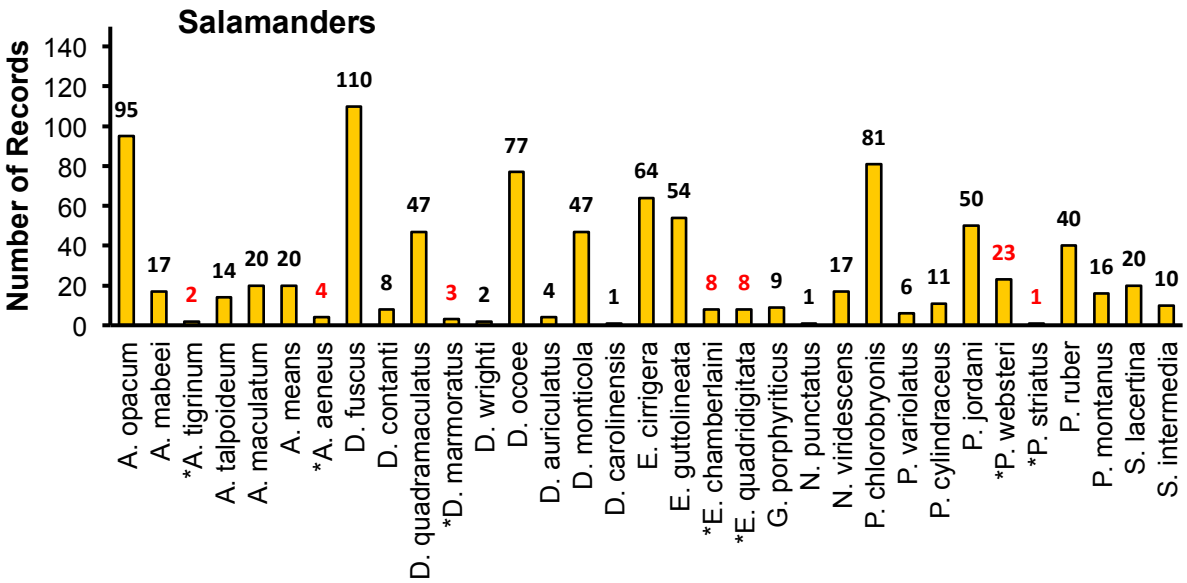

Figure A2. Number of records (of all status codes, with the exception of records known to be incorrect) in CHA database for 33 salamanders. The Northern Dusky Salamander (*D. fuscus*) was the most commonly observed species (110 records) in this group. Species with an asterisk are priority species in the SWAP.

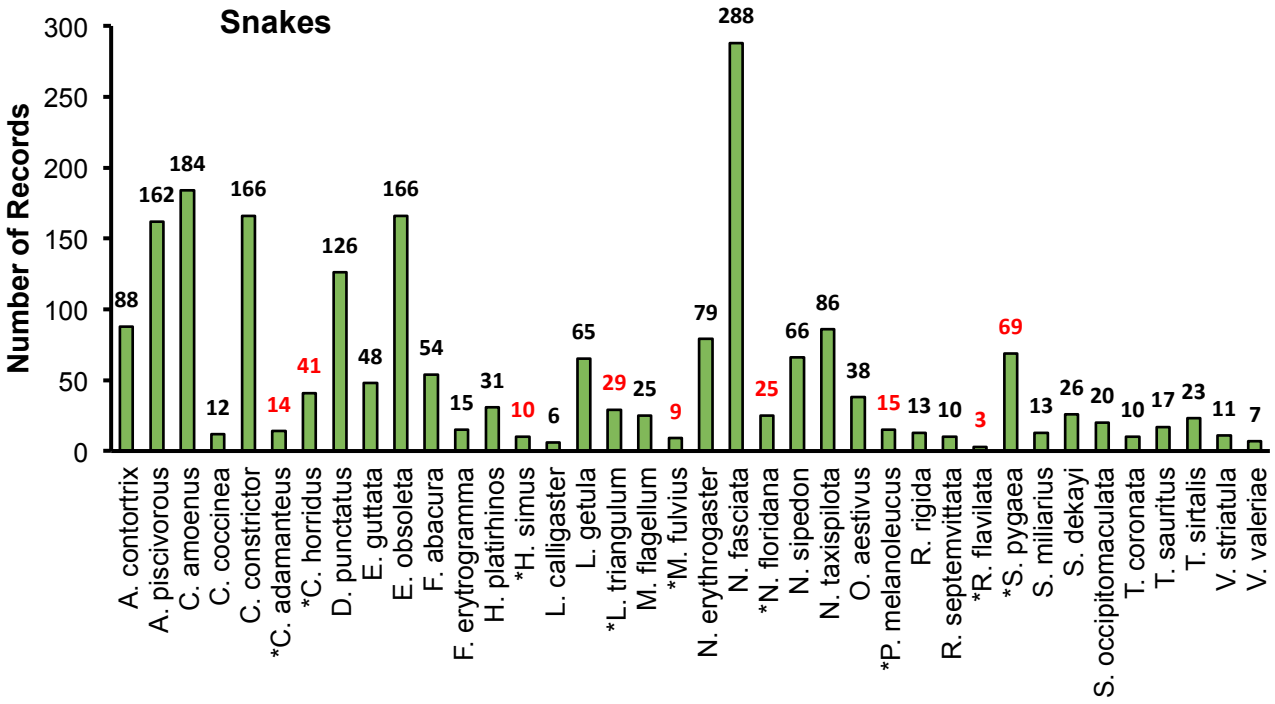

Figure A3. Number of records (of all status codes, with the exception of records known to be incorrect) in CHA database for 38 snakes. The Banded Watersnake (*N. fasciata*) was the most commonly observed species (288 records) in this group. Species with an asterisk are priority species in the SWAP.

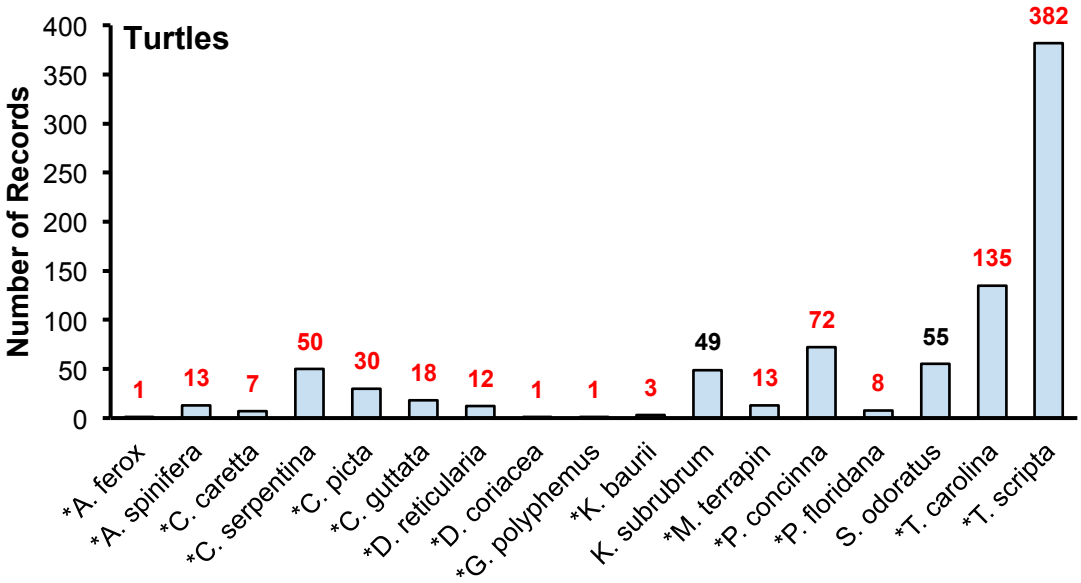

Figure A4. Number of records (of all status codes, with the exception of records known to be incorrect) in CHA database for 17 turtles. The Yellow-bellied Slider (*T. scripta*) was the most commonly observed species (382 records) across all taxonomic groups. Species with an asterisk are priority species in the SWAP.

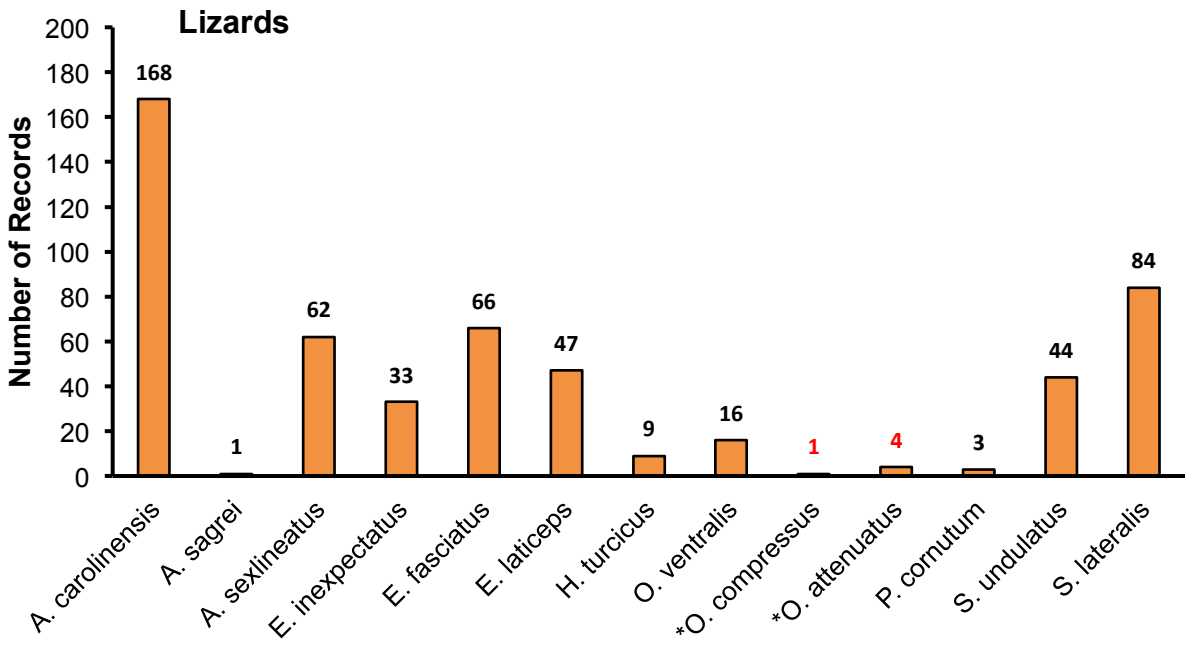

Figure A5. Number of records (of all status codes, with the exception of records known to be incorrect) in CHA database for 13 lizards. The Green Anole (*A. carolinensis*) was the most commonly observed species (168 records) in this group. Species with an asterisk are priority species in the SWAP.

APPENDIX B: SPECIES DISTRIBUTION MAPS

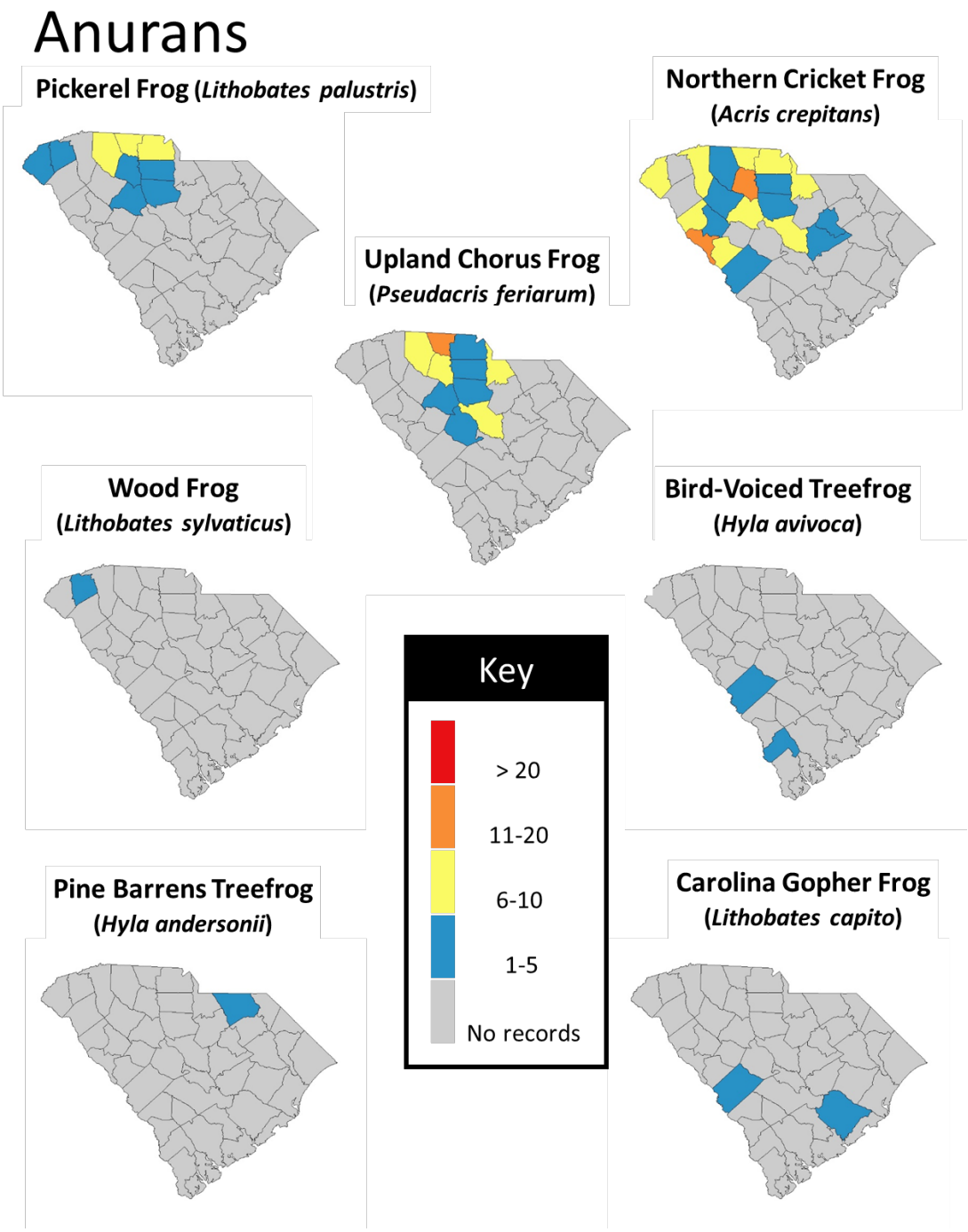

Figure B1. Species distribution maps for high priority anuran species in the SWAP.

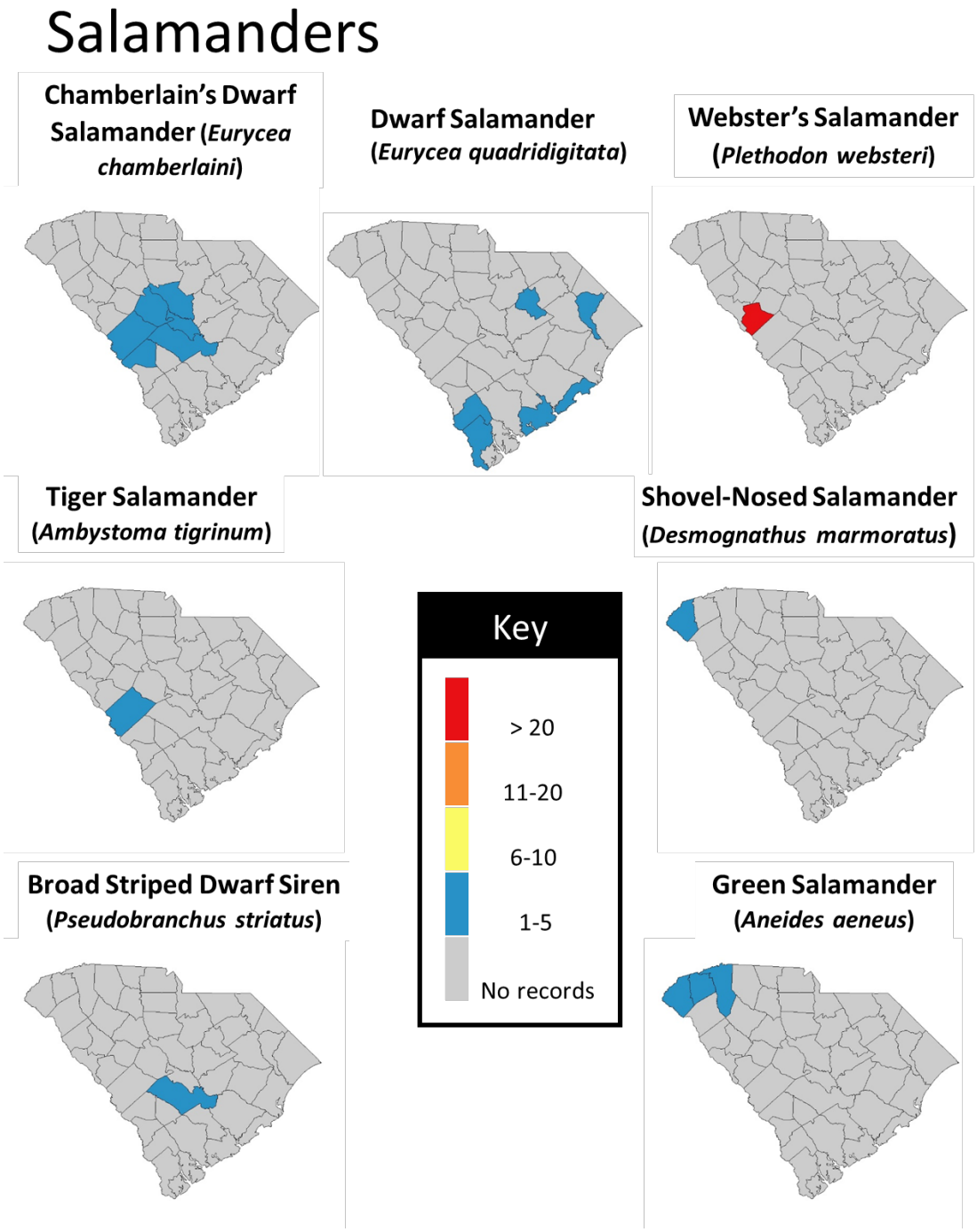

Figure B2. Species distribution maps for high priority salamander species in the SWAP.

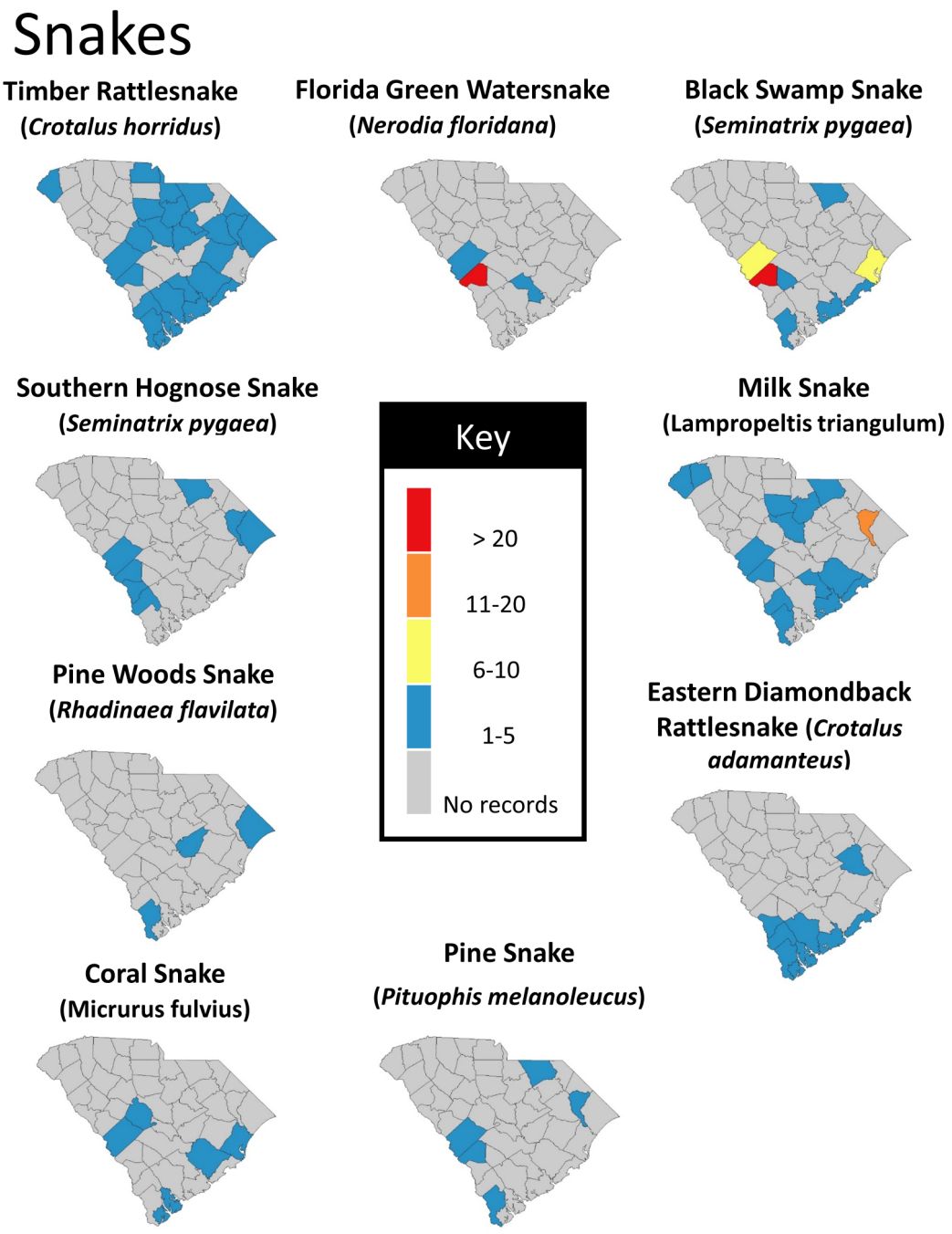

Figure B3. Species distribution maps for high priority snake species in the SWAP.

Turtles

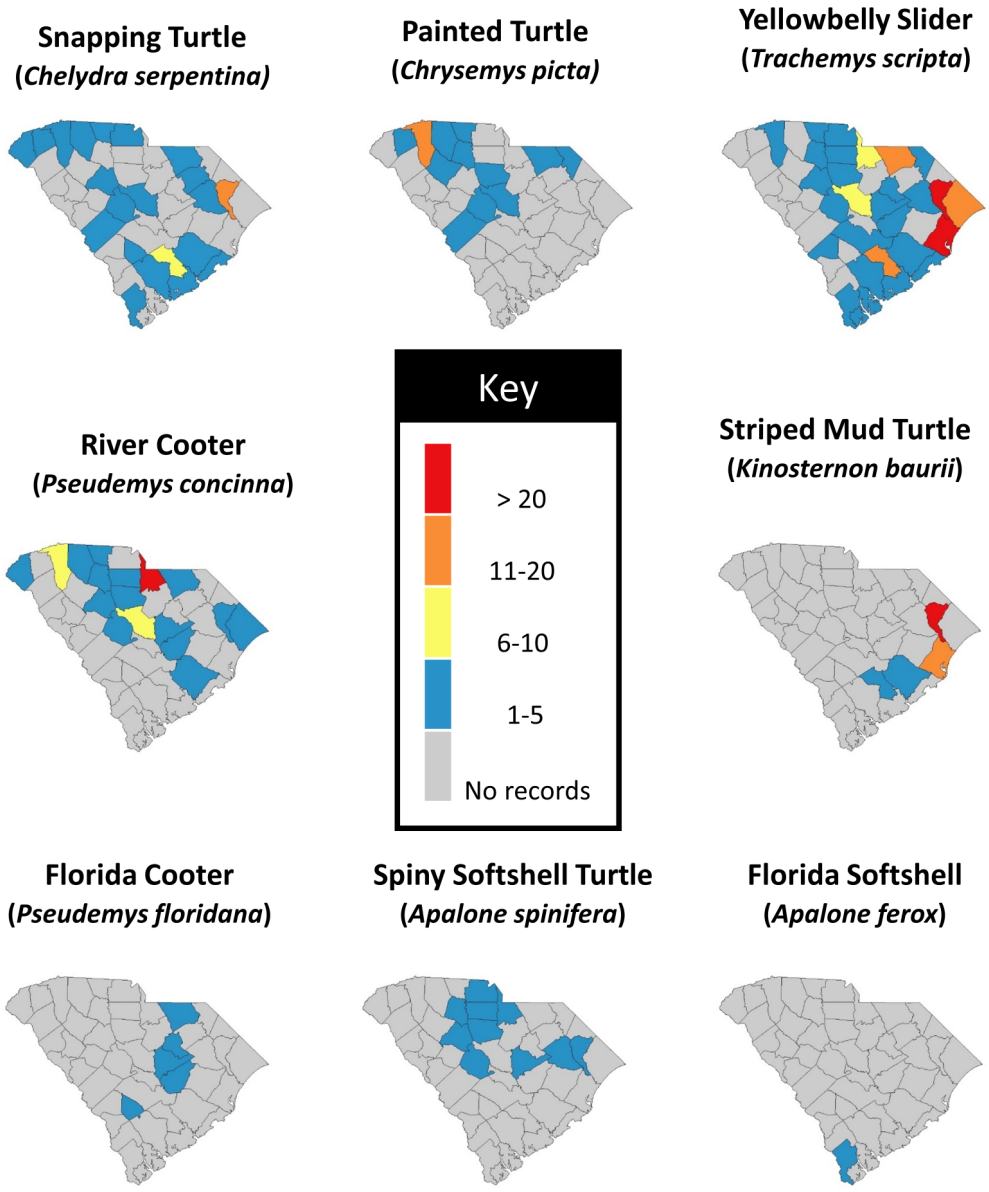

Figure B4. Species distribution maps for high priority turtle species in the SWAP (continued in Figure B5).

Turtles

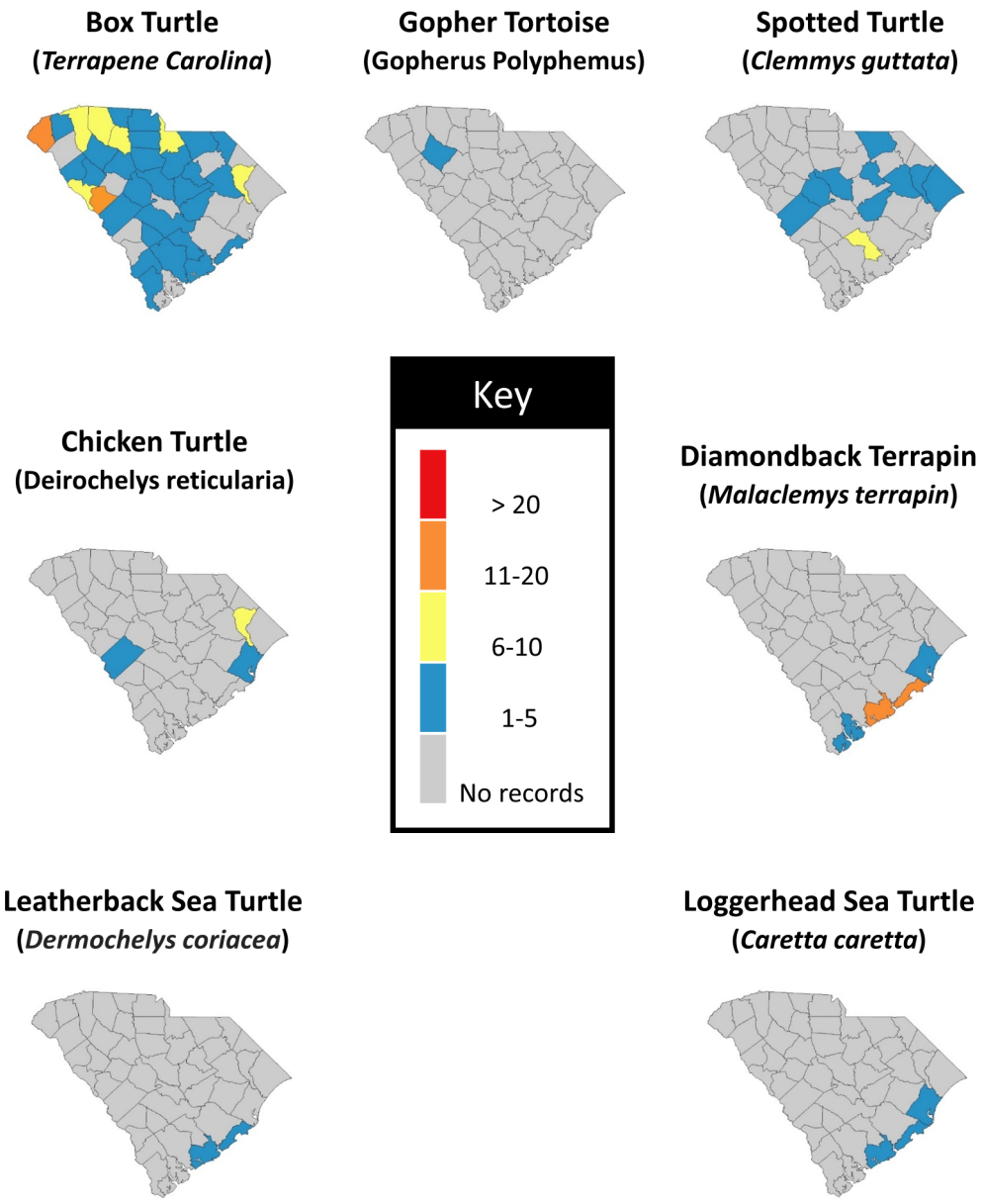

Figure B5. Species distribution maps for high priority turtle species in the SWAP (continued in Figure B4).

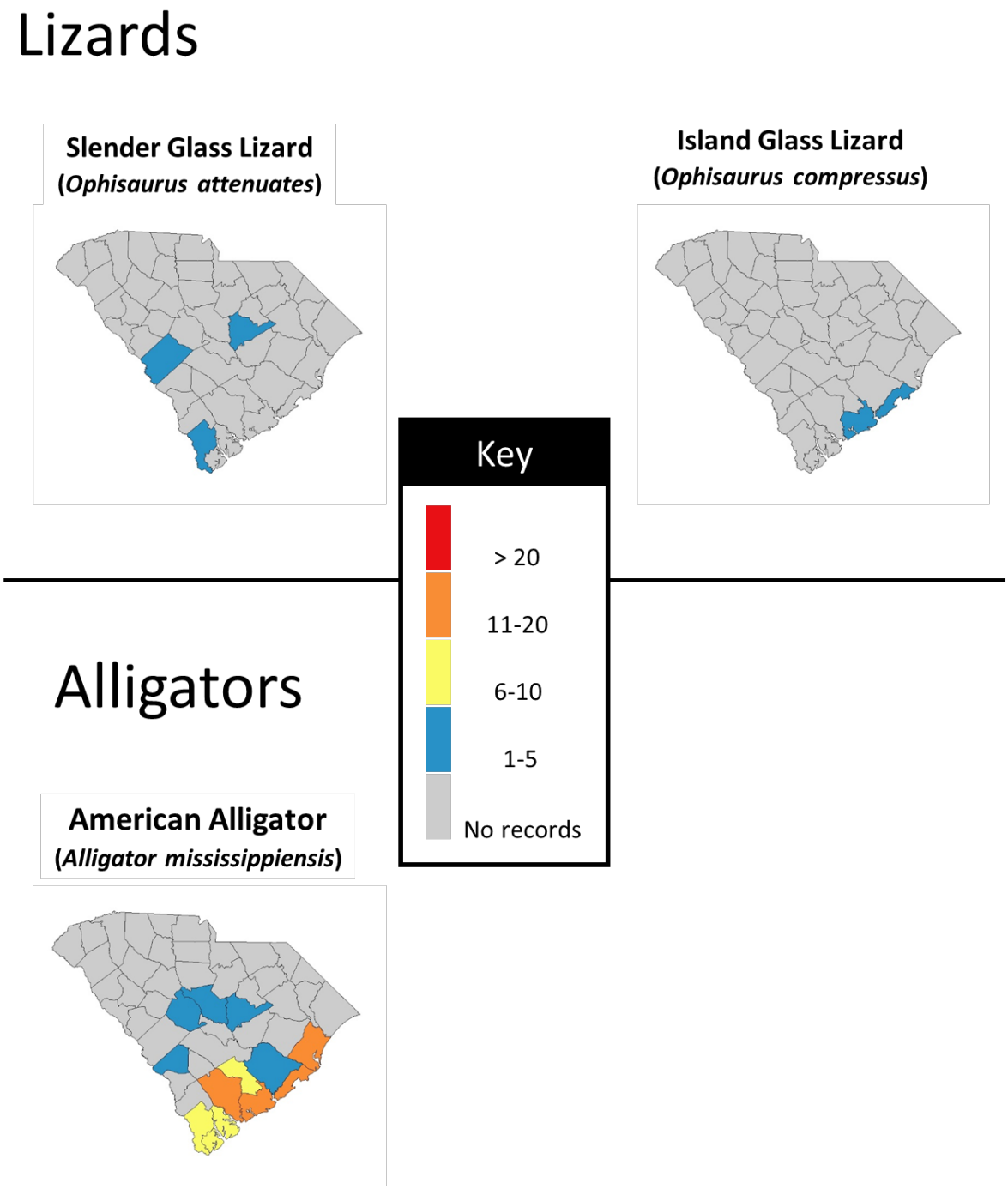

Figure B6. Species distribution maps for high priority lizard and alligator species in the SWAP.

APPENDIX C: CAROLINA HERP ATLAS USERS

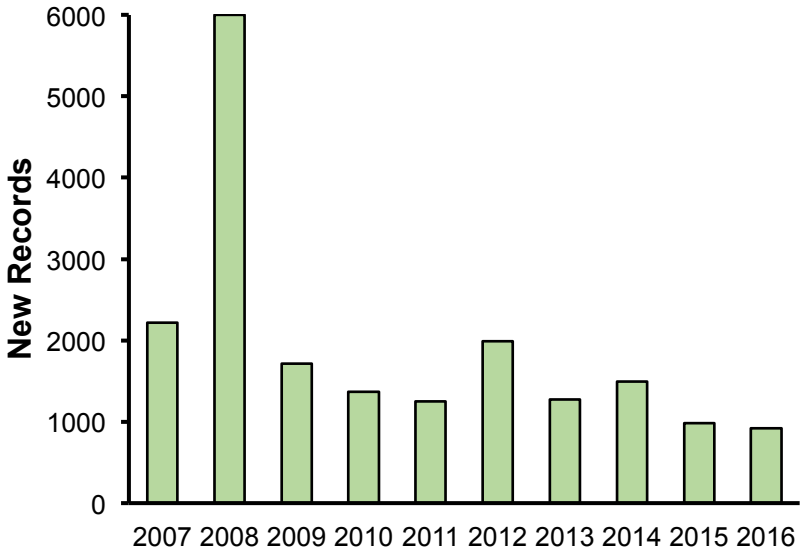

Figure C1. The number of records submitted annually from 2007 through 2016. Although the number of records peaked during 2008, approximately 1,000 records have been submitted each year since.