

An update on the invasive Asian tiger shrimp, (*Penaeus monodon*).

Peter R. Kingsley-Smith, Ph.D... *and many others!*

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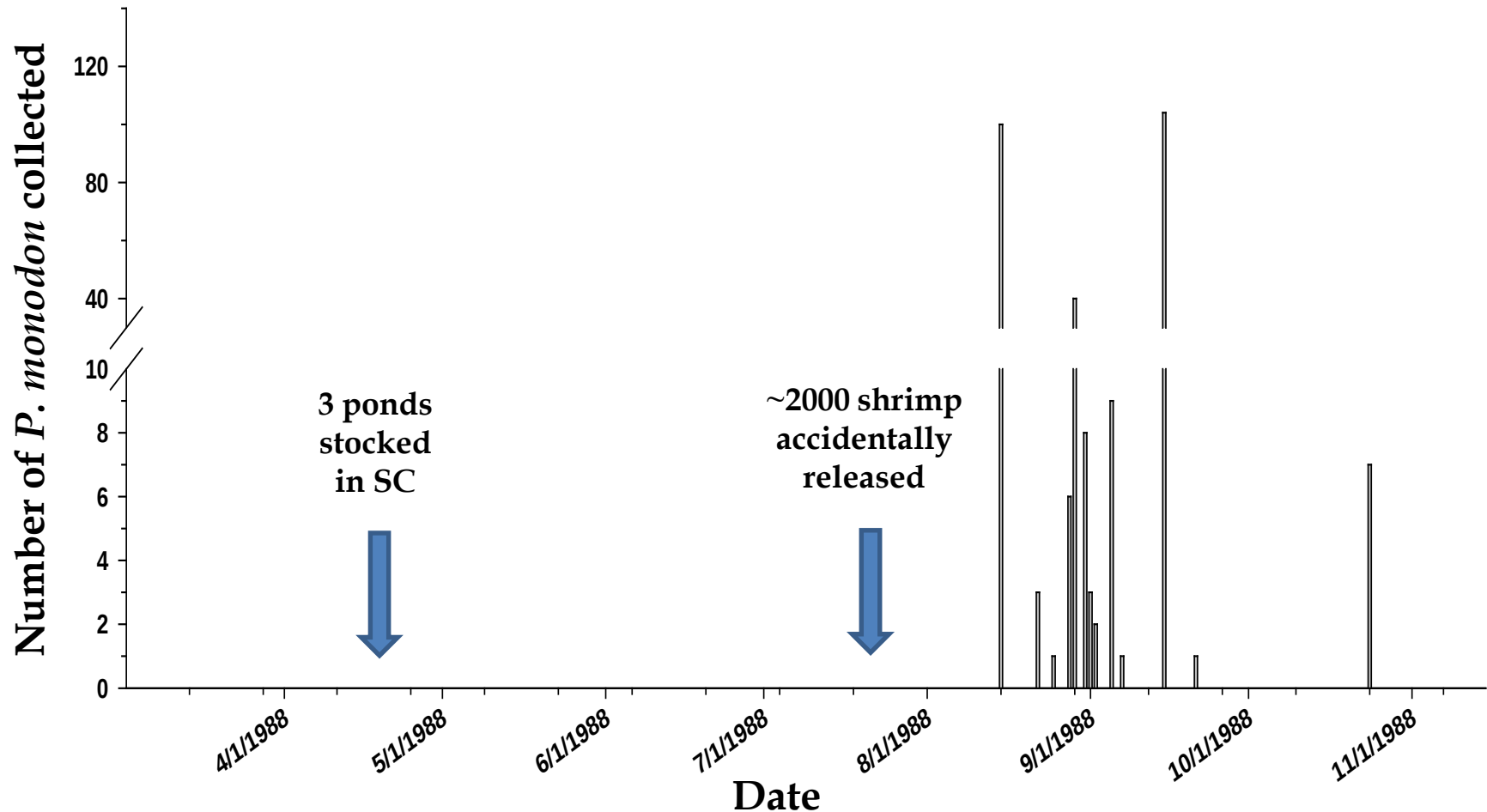
DNR



Photograph courtesy of the Southeast Regional Taxonomic Center, SCDNR

A brief history of the tiger shrimp invasion....

- Tiger shrimp (*Penaeus monodon*) are native to East Africa, Southeast Asia, Japan, China, Korea, Philippines, Australia, Fiji.
- Leading aquaculture shrimp species globally during the 1980s and 1990s.
- ~2,000 *P. monodon* were accidentally released in SC in July 1988.
- ~300 animals collected in trawls in SC, GA & FL over the next 3-4 months.
- Collections ceased by end of November 1988, until reappearance in 2006...





Sept 2006: Mississippi Sound, Dauphin Island, AL (1)
Oct 2006: Pamlico Sound, NC (5)
Aug 2007: Vermilion Bay, LA (1)
Aug 2007: Pamlico Sound, NC (1)
Sept 2007: Fripp Island, SC (1)
Oct 2007: St. Augustine, FL (1)



Reasons for concern surrounding recent reports:

- Re-appearance of *P. monodon* in South Atlantic Bight was sudden and remains poorly understood... people generally fear those things which they do not understand.
- Based on the biology of *P. monodon* in its native habitat, the potential for its interactions with native penaeid shrimp in the southeast U.S. seems high.
- Potential host of viral diseases; transmission to native species?
- Interactions may be indirect (competition for space, food etc.) or direct (diet of *P. monodon* in native habitat includes shrimp and other crustaceans).

Jazz Fest

Three days of music on a health care mission. E20-21

Restaurant Week guide inside



The Post and Courier

THURSDAY, August 30, 2012

North Charleston, S.C. ★ \$1.00

Oysters

Waste Pleasant

BY PR
WHAT
P... connector to Franke
... except to residents who
... ed in subdivisions along
... at section of the road, which
... ing home



PRENTISS FINDLAY/STAFF

... removed a corroded pipe that caused
... on wastewater spill on Rifle Range Road.

SPILL, Page A6

'I abhor racism'

McManus

dev. private
And yes, the con-
vention began on
Tuesday with bio-
graphical tributes.
... appealing speech from the anti-
... date's appealing...

Shrimp caught by Will Leland, off McClellanville, SC on August 31st 2012.

Above - tiger shrimp, *Penaeus monodon*; below - white shrimp, *Litopenaeus setiferus*.

Possible sources of introduction?

- Continuous ballast transport and delivery?
- Re-distribution of animals by tropical storms, bringing in animals from the Caribbean?
- Continuing immigration following escapement from Caribbean aquaculture operations?
- Persistence following 1988 SC escapement?
- Immigration from established Caribbean populations?
- Invasion of the SE United States is almost certainly ultimately related to its global use in aquaculture for food production.
- Many questions remain unanswered...



“If I could just figure out where these tiger shrimp are coming from... then maybe I could put an end to some of this finger-pointing and arm-waving!”



North Carolina
Department of Environment
and Natural Resources

North Carolina Division of Marine Fisheries

3441 Arendell St.
Morehead City, NC 28557

Phone: (800) 682-2632
Email: Trish.Murphey@ncmail.net

Attention Shrimpers



Please be on the lookout for a non-native species of shrimp called the black tiger shrimp, *Penaeus monodon*. This species has been captured by shrimpers fishing in portions of Pamlico Sound and near shore ocean waters of North Carolina. This shrimp is native to the Western Pacific and could pose a threat to our native shrimp species. The black tiger shrimp has distinct dark and white stripes along its back. If you capture a black tiger shrimp, please freeze it, record the date and location where the shrimp was taken, and contact Trish Murphey at the NC Division of Marine Fisheries at (800) 682-2632 or Trish.Murphey@ncmail.net.

Please contact NCDMF at (800) 682-2632

Increased research efforts
to gather more data and
information on the tiger
shrimp invasion

e.g., recognition flyer to
docks / press releases

Sp #	TL		Weight		Sex		
	☐ mm	☐ inches	☐ grams	☐ ounces	Male	Female	Undet
1					☐	☐	☐
2					☐	☐	☐
3					☐	☐	☐
4					☐	☐	☐
5					☐	☐	☐
6					☐	☐	☐
7					☐	☐	☐
8					☐	☐	☐
9					☐	☐	☐
10					☐	☐	☐

Sp #	TL		Weight		Sex		
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5					☐	☐	☐
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9					☐	☐	☐
10					☐	☐	☐

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4					☐	☐	☐
5					☐	☐	☐
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7					☐	☐	☐
8					☐	☐	☐
9					☐	☐	☐
10					☐	☐	☐

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6					☐	☐	☐
7					☐	☐	☐
8					☐	☐	☐
9					☐	☐	☐
10					☐	☐	☐

Centralized storage of collection information by USGS:

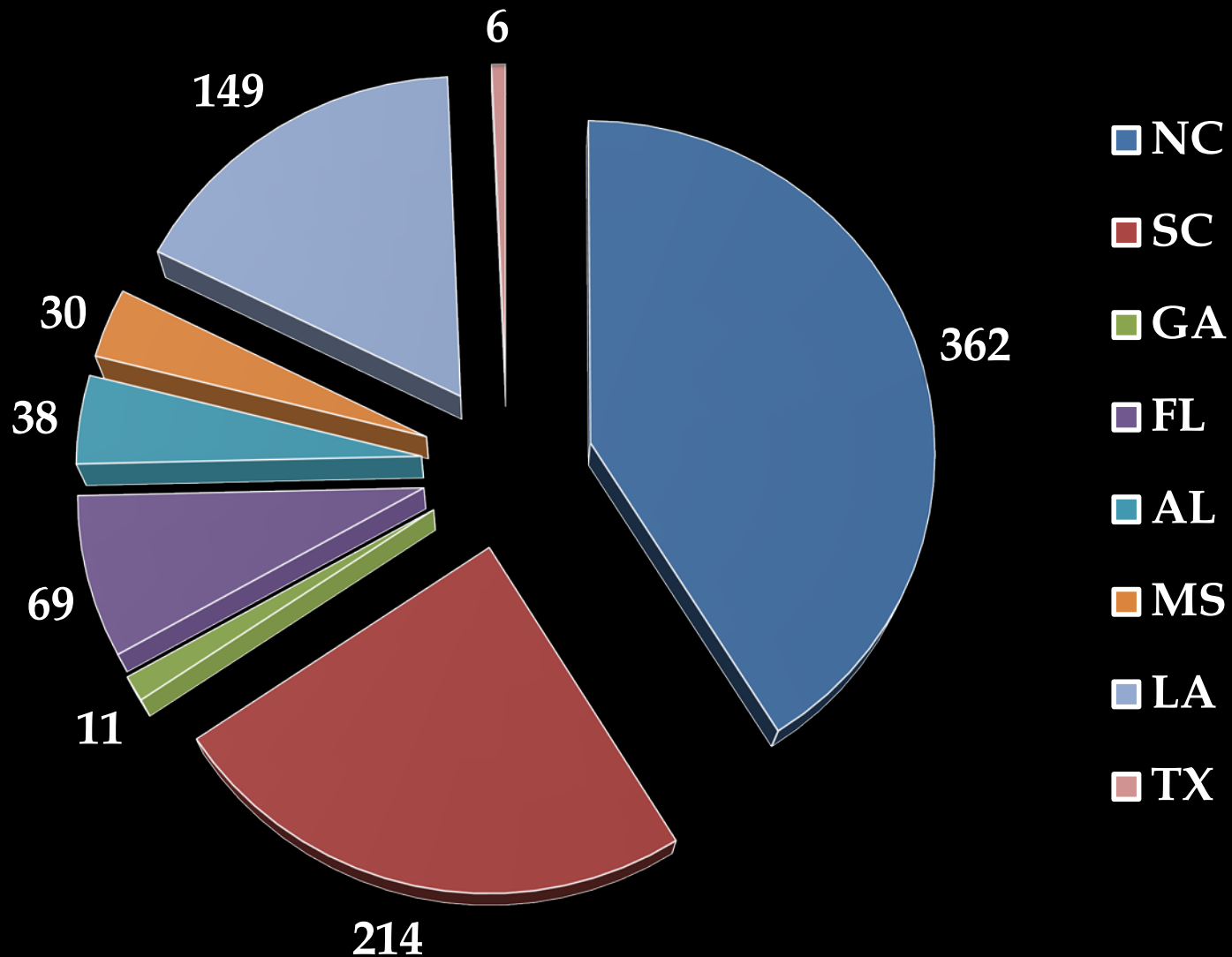
<http://nas.er.usgs.gov>

Thanks to Amy Benson and Matt Cannister from USGS for their ongoing efforts to add new reports of *Penaeus monodon* to the USGS NAS database!

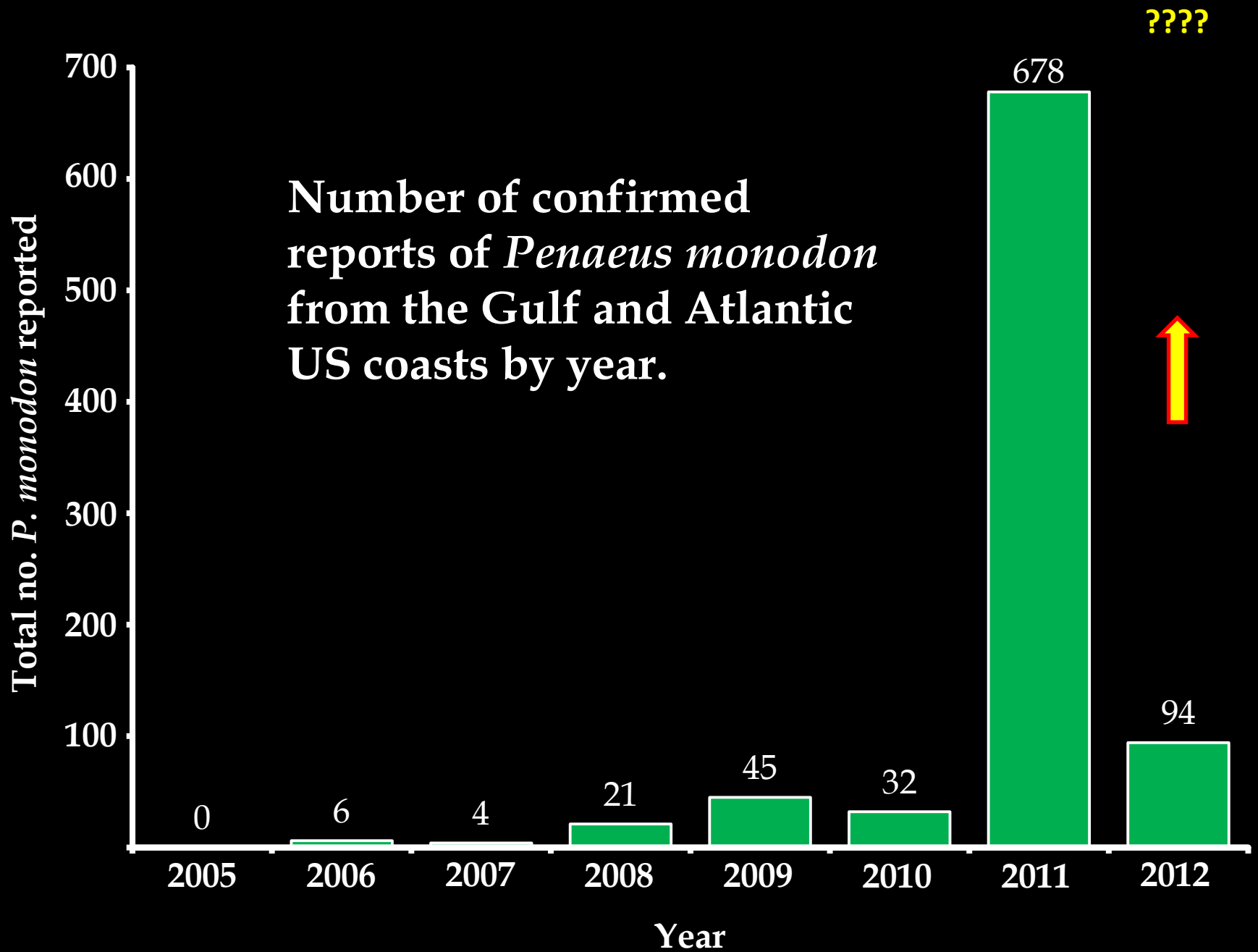
Year	NC	SC	GA	FL	AL	MS	LA	TX	TOTAL
2005	0	0	0	0	0	0	0	0	0
2006	5	0	0	0	1	0	0	0	6
2007	1	1	0	1	0	0	1	0	4
2008	8	6	4	2	1	0	0	0	21
2009	14	15	3	1	5	3	4	0	45
2010	2	20	1	2	0	0	7	0	32
2011	329	144	3	25	28	16	128	5	678
2012	3	28	0	38	3	11	9	1	94
Grand totals to date (9/14/2012)	362	214	11	69	38	30	149	6	880

Reported collections of tiger shrimp showed a 20-fold increase from 2010 to 2011. Even excluding the 2011 NC data there was an order of magnitude increase across the region.

Contribution to *P. monodon* catches by US state.

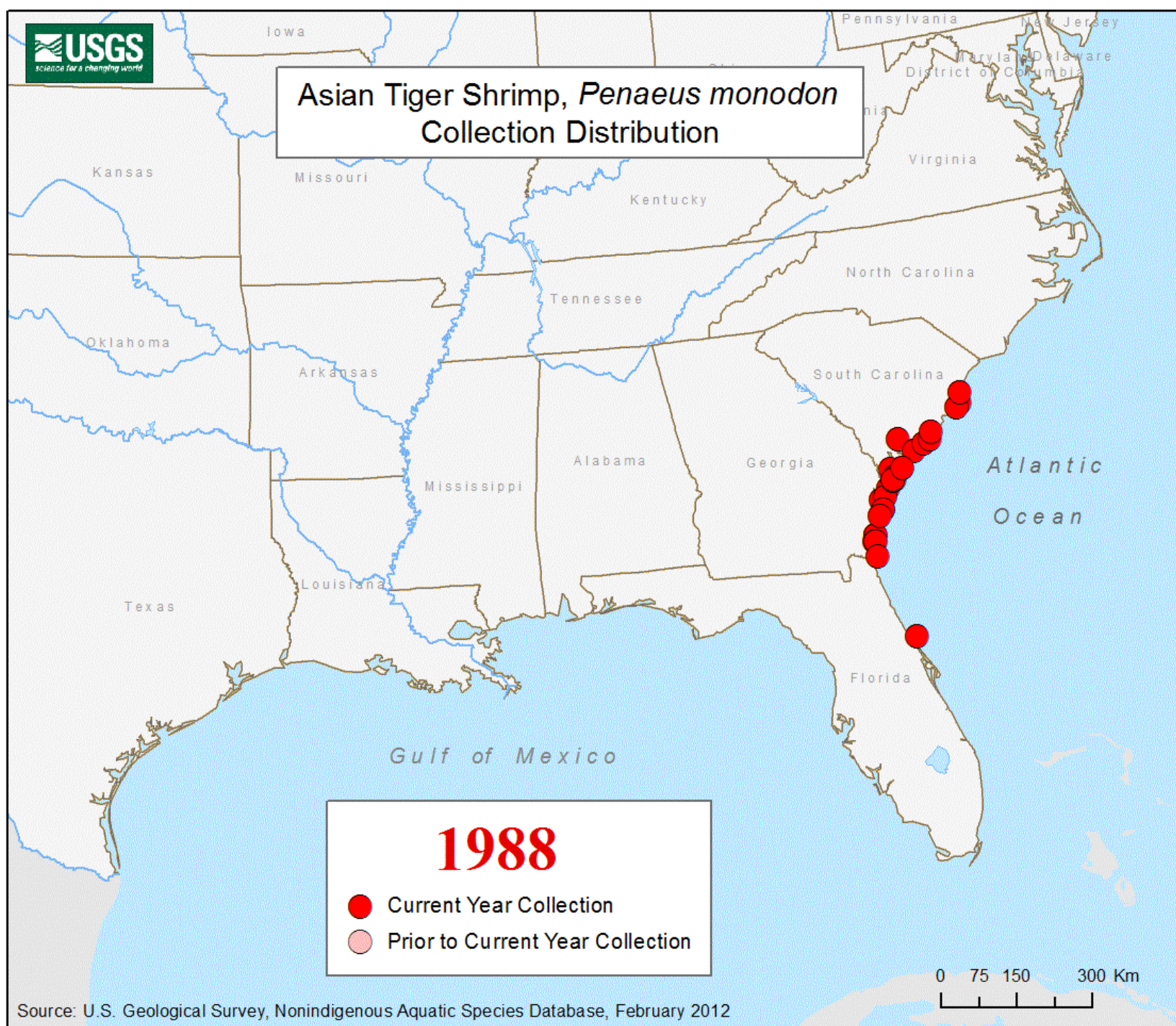


Data through September 10th 2012



Note: Data updated through September 10th 2012

Asian Tiger Shrimp, *Penaeus monodon* Collection Distribution



Collections of *P. monodon* outside the US.

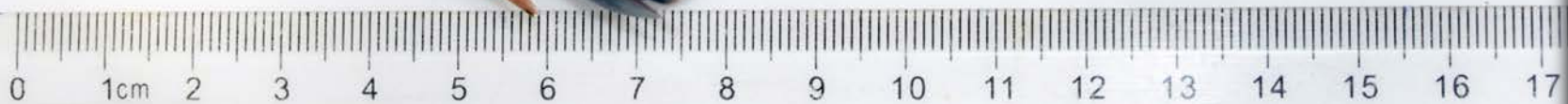


Kingston Harbor, Jamaica
August 10th 2012
Deana Douglas

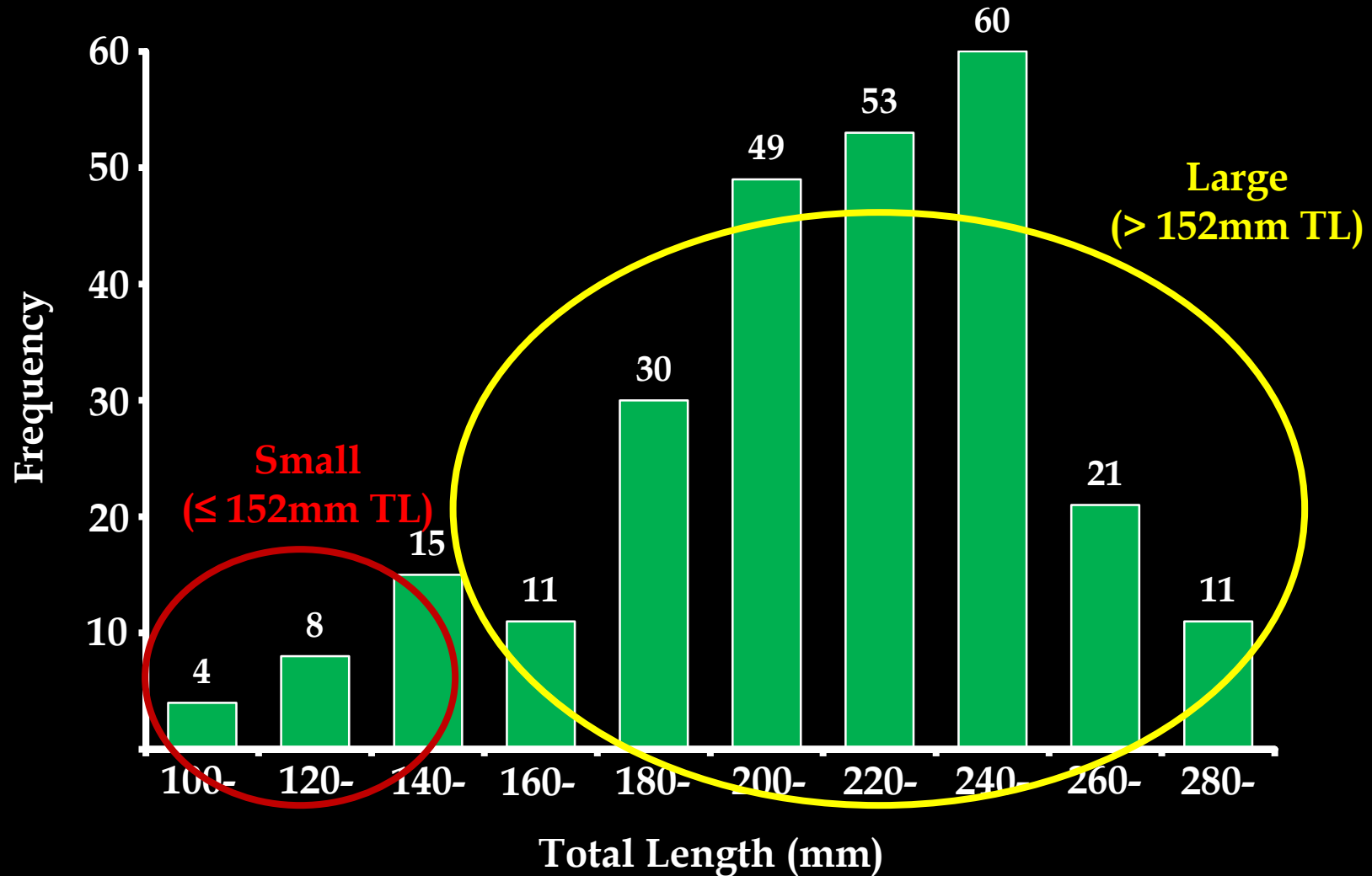
West of Puerto Rico
Mayaguez Sector
La Boquilla
May 3rd 2012
Ramon Acosta



Photo by Dr. Dayne Buddo - University of the West Indies
Discovery Bay Marine Laboratory (March 2012)

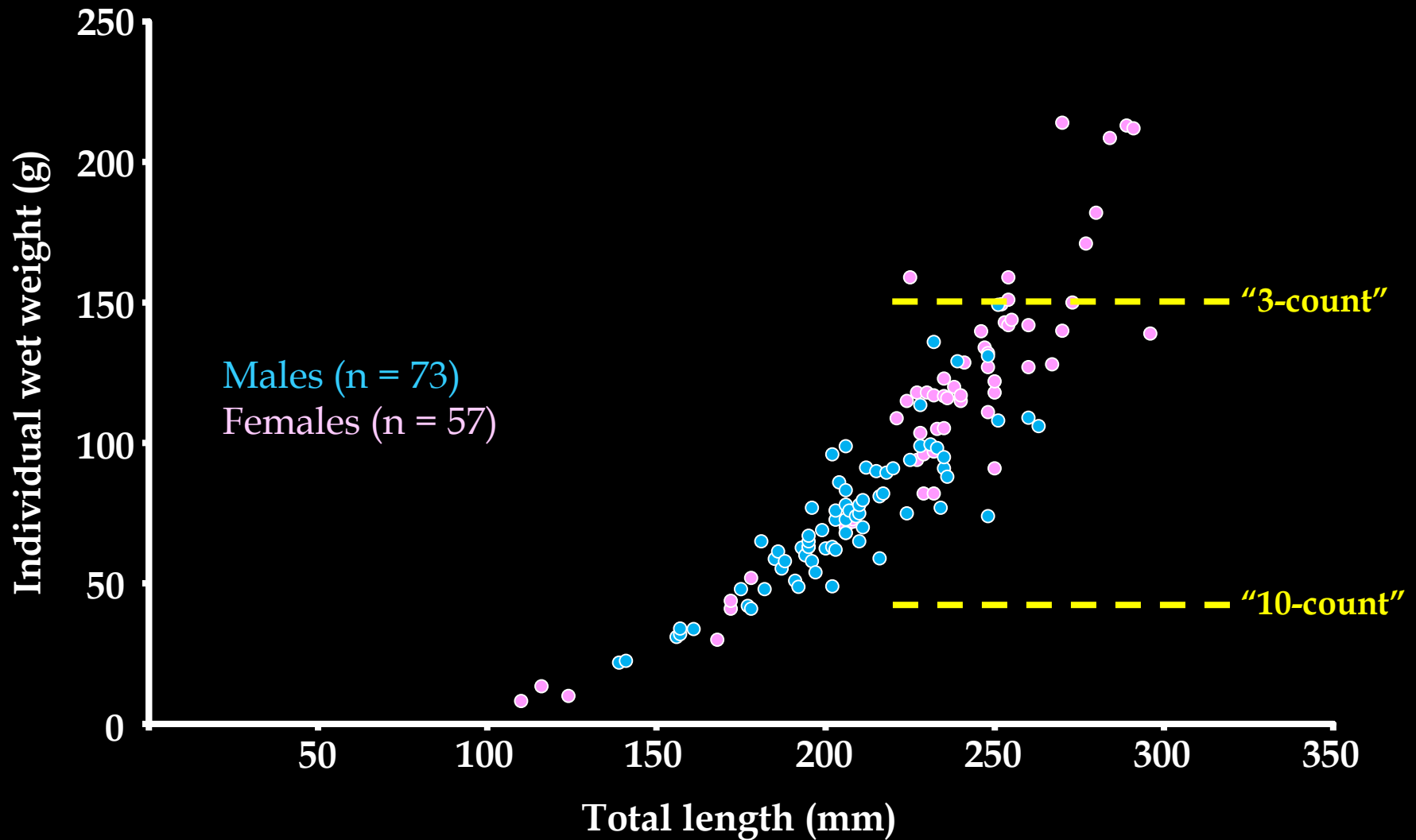


Size-frequency distribution of *P. monodon* collected
in the US between July 19th 2009 and September 10th 2012 (n = 262).



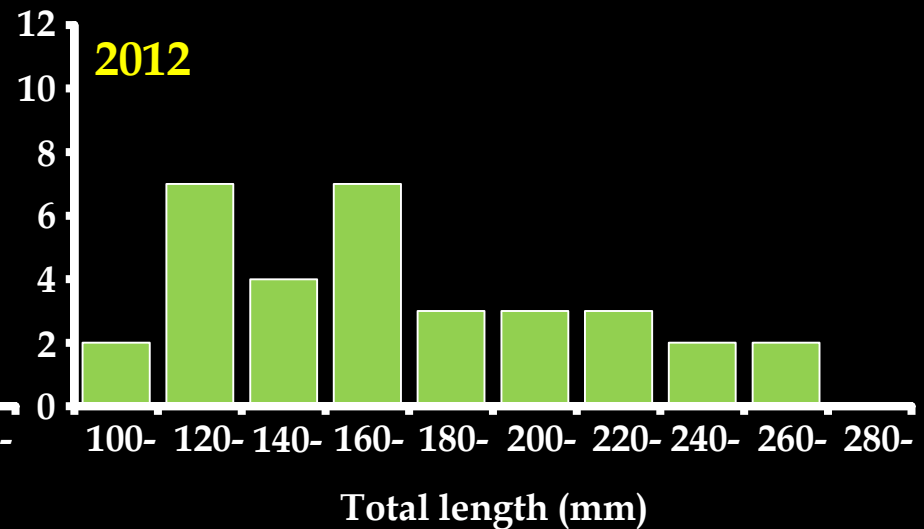
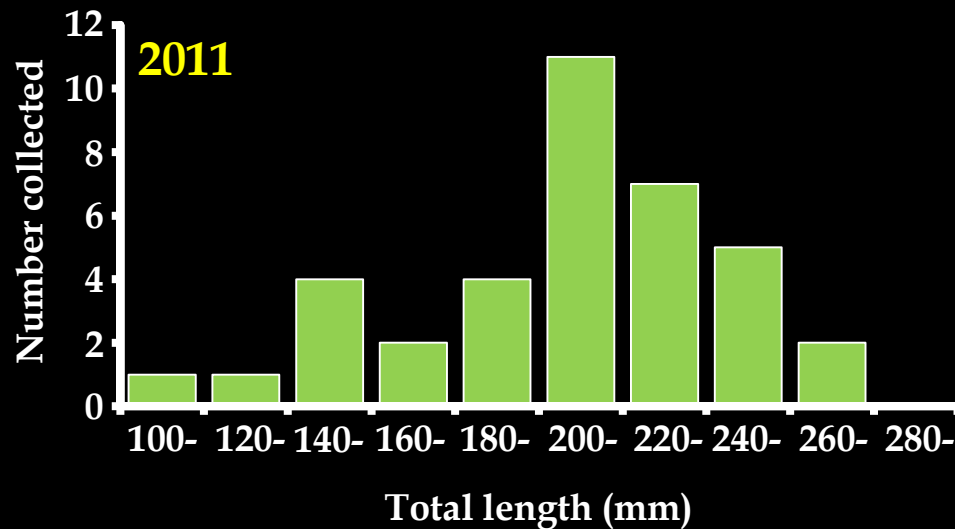
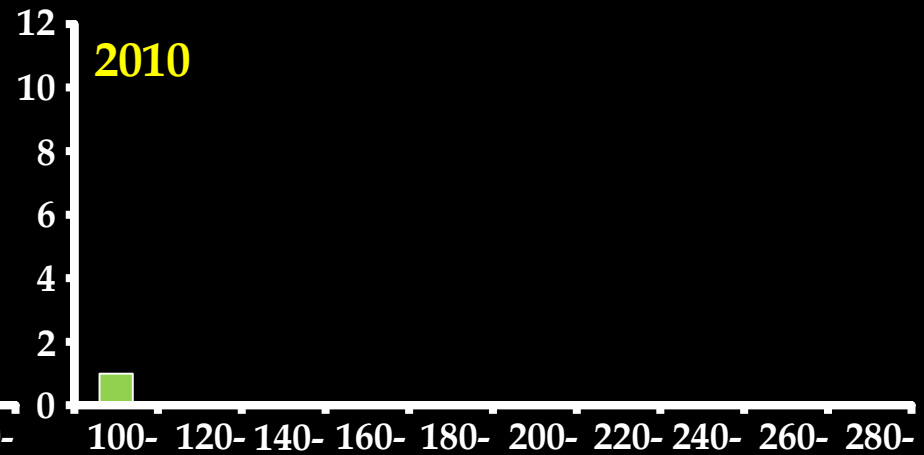
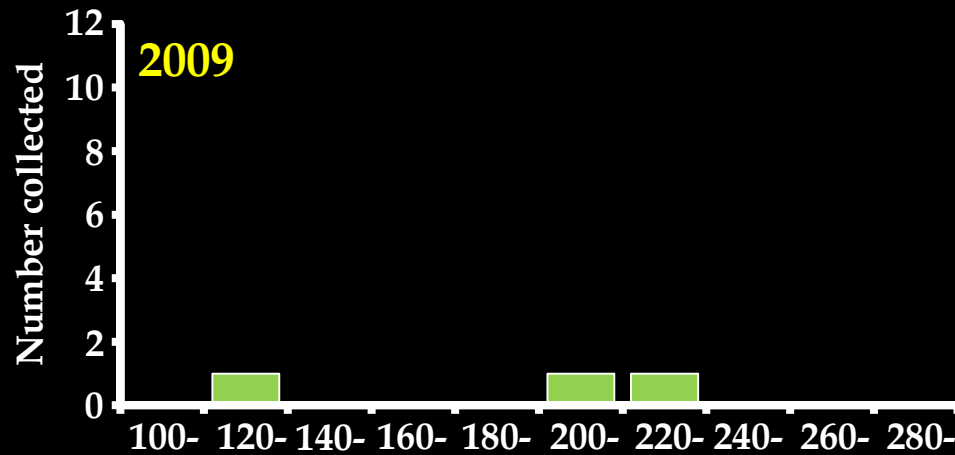
Note: Data updated through September 10th 2012

Length-weight relationship for *Penaeus monodon*



Note: Subset of records for which length, weight and sex were reported.
Reports from across the region between September 21st 2009 and September 10th 2012 .

Early season (April – August) captures of *Penaeus monodon* – higher numbers of (smaller) animals collected in 2011 and 2012 than in previous years (2009 & 2010).



More small (≤ 152 mm TL) tiger shrimp were caught in the spring of 2012 in NC, SC, FL and MS than in previous years; ~46% were the “red-stripe morph”.



Red-stripe shrimp bred at High Health Aquaculture, Inc. in Hawaii.

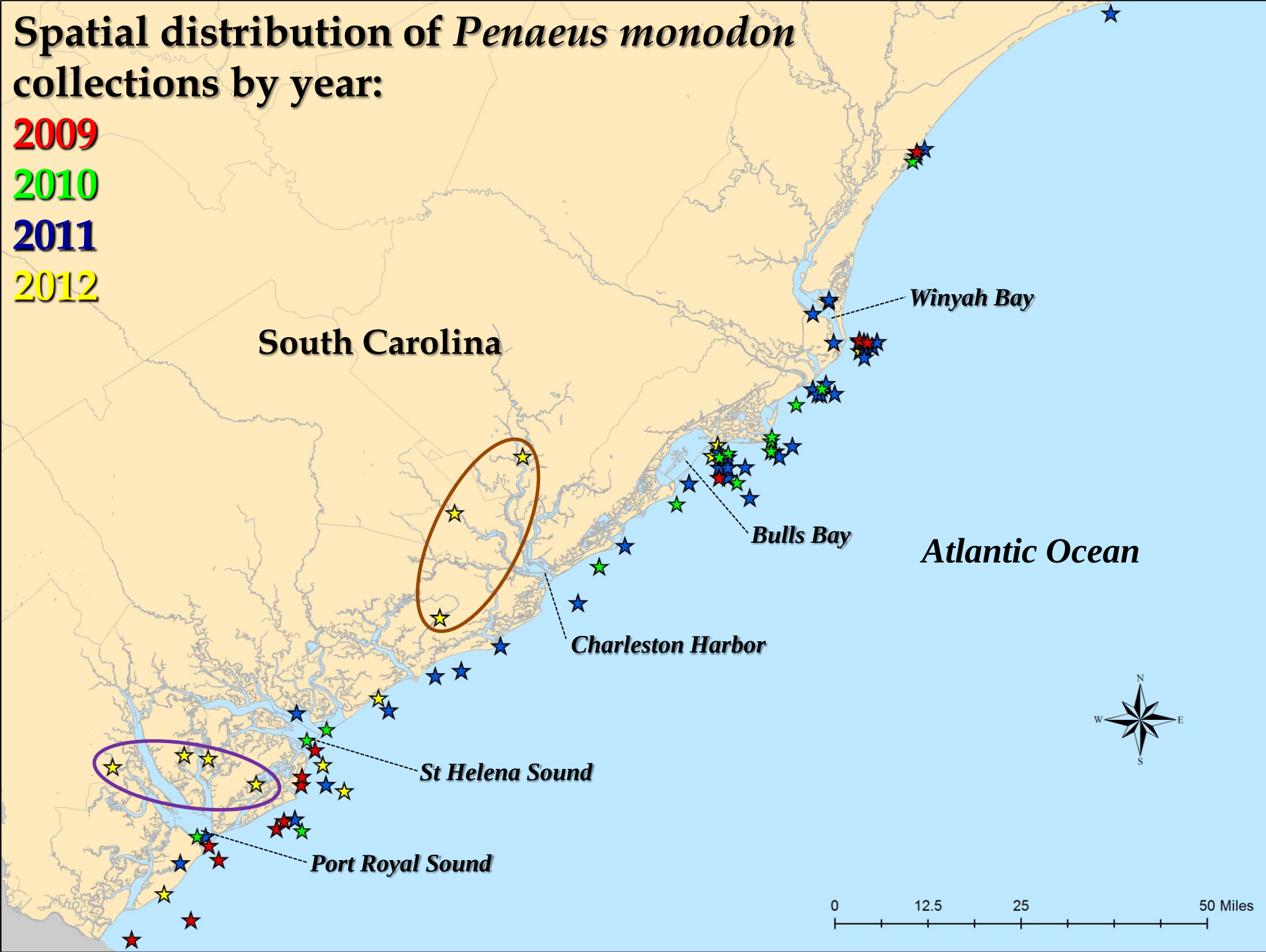


Vero Beach, 4/17/12, photo by T. Stokes.



Beaufort, SC 7/13/12 photo by P. Kingsley-Smith.

A closer inspection of the spatial
distribution of South Carolina tiger
shrimp collection data...



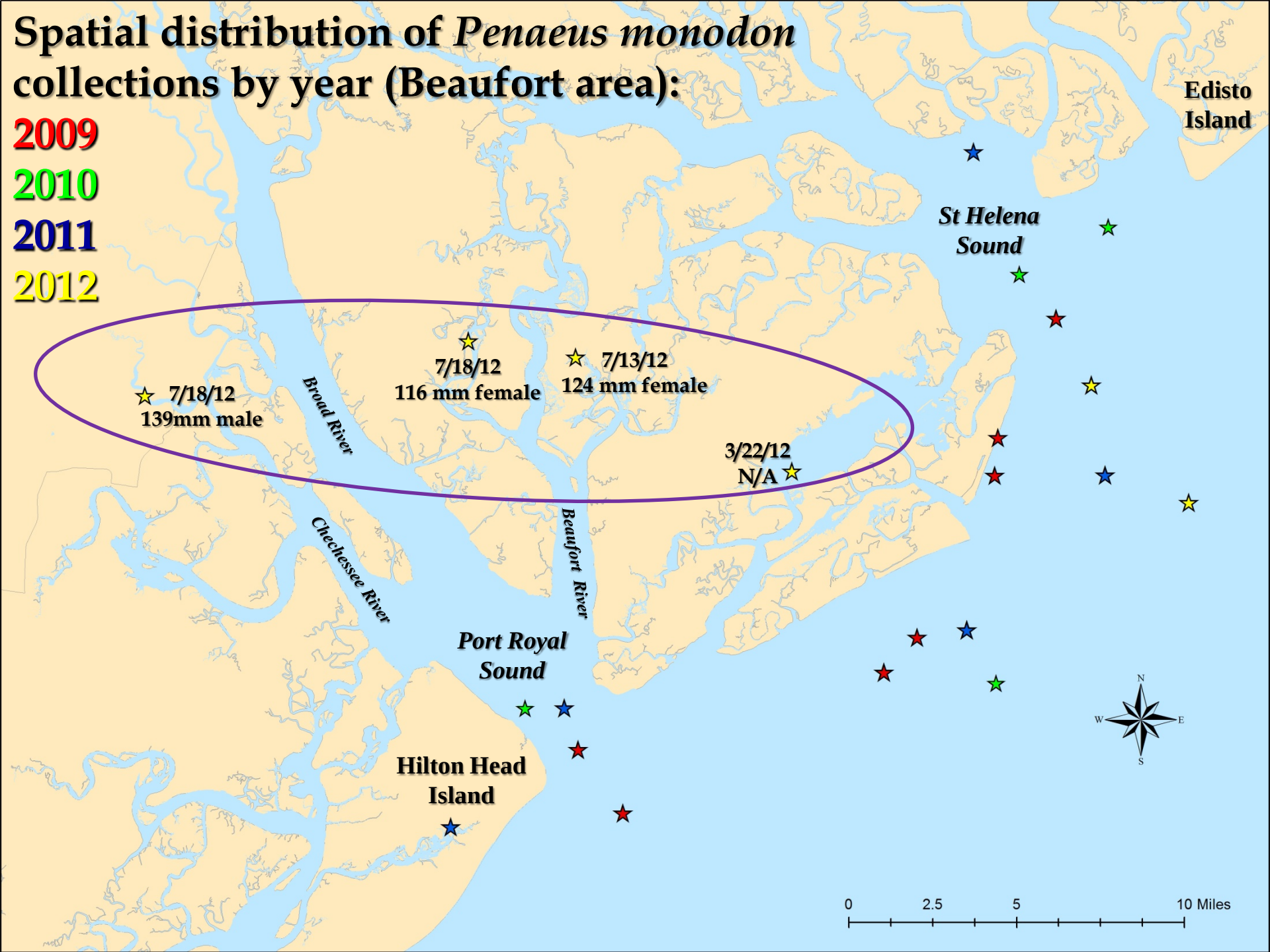
Spatial distribution of *Penaeus monodon* collections by year (Beaufort area):

2009

2010

2011

2012



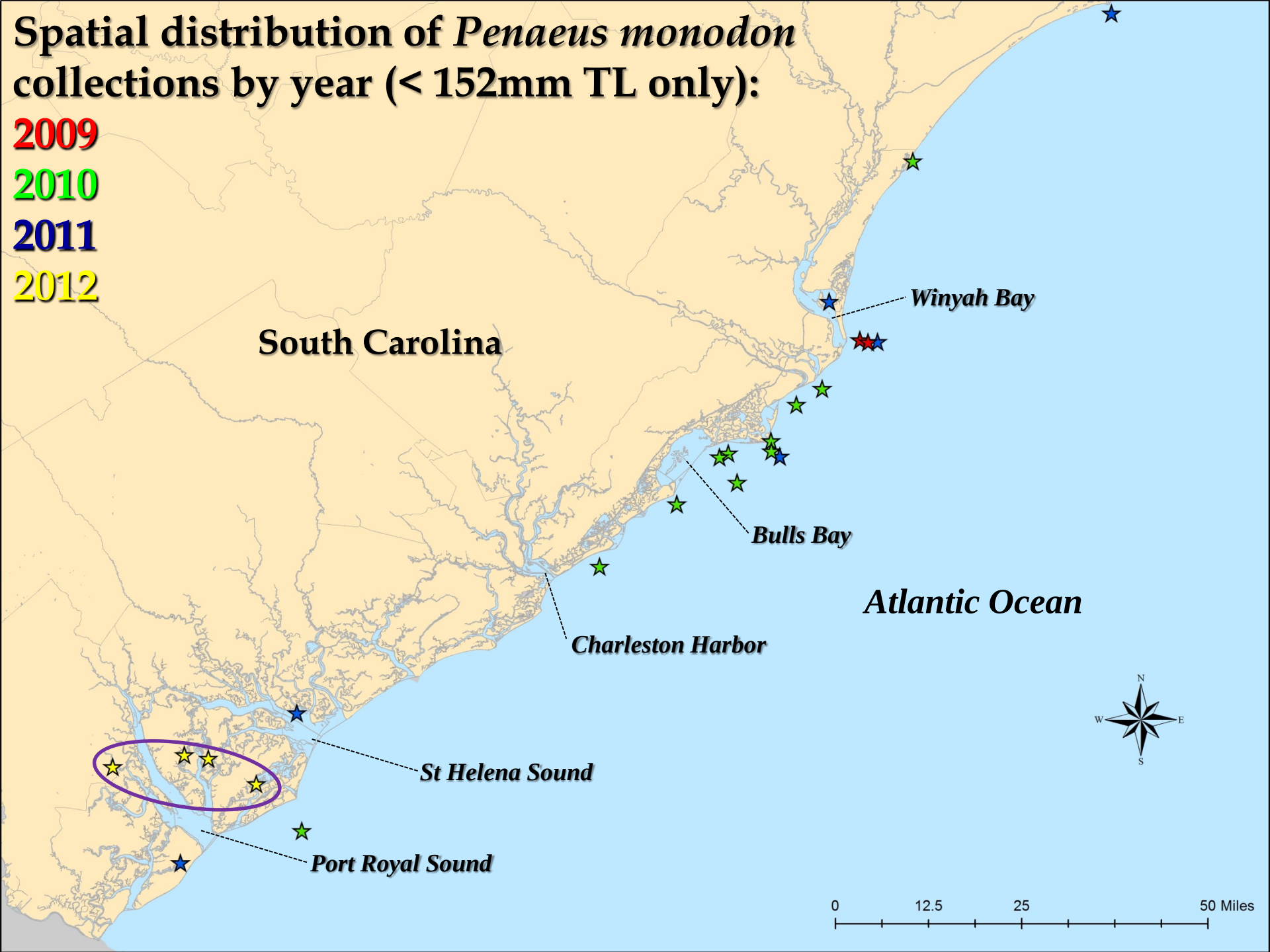
Spatial distribution of *Penaeus monodon* collections by year (< 152mm TL only):

2009

2010

2011

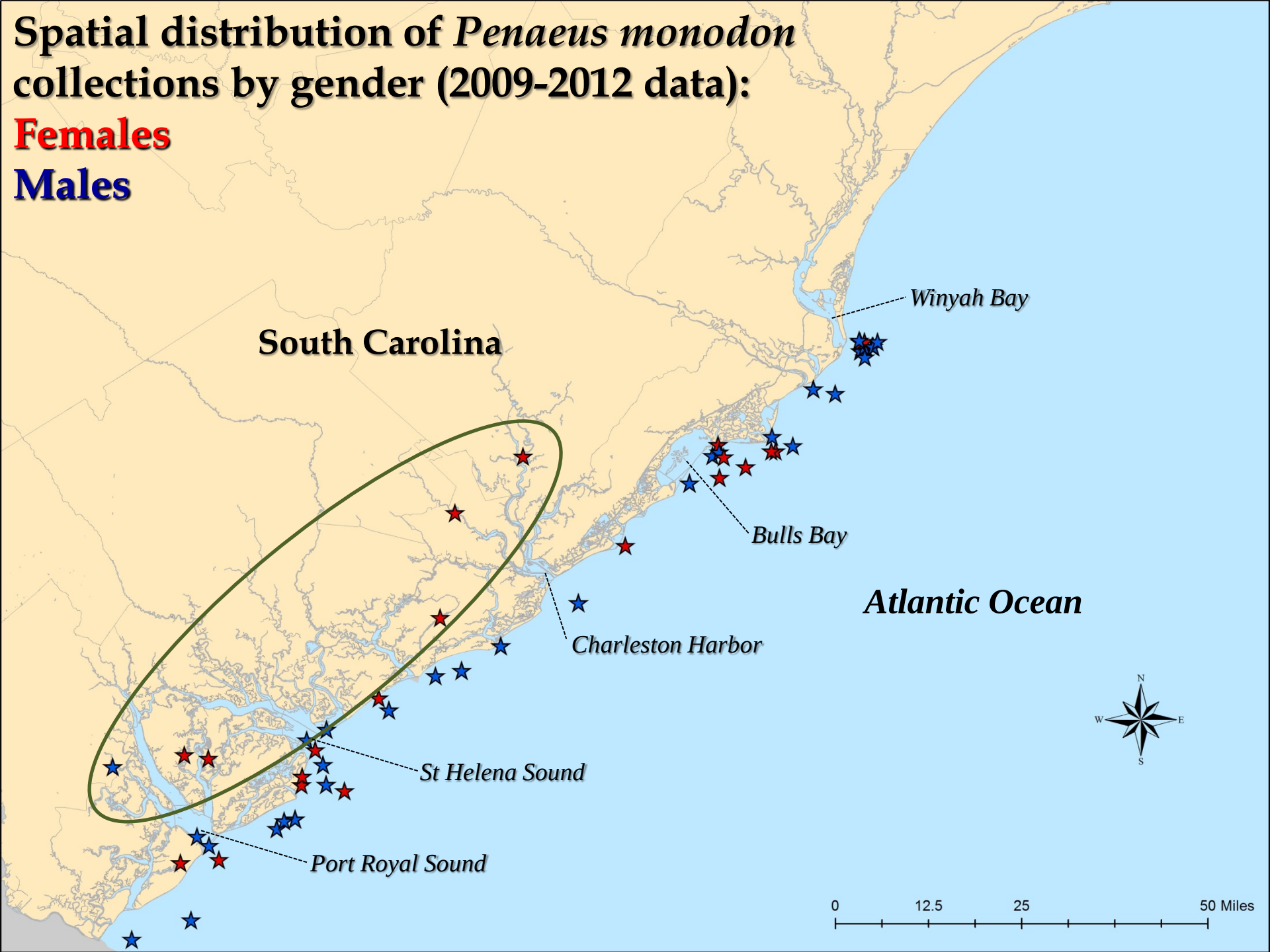
2012



Spatial distribution of *Penaeus monodon* collections by gender (2009-2012 data):

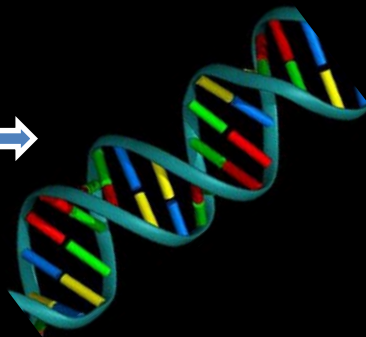
Females

Males



Continuing the theme of improved and increased data acquisition for tiger shrimp:

- NOAA integrated assessment / manuscript preparation.
- Tiger shrimp tissue repository, NOAA-NMFS in Beaufort, NC.
- Collaboration with USGS geneticists to conduct DNA sequencing for tiger shrimp (Drs. Hunter & King).
- Microsatellites and single nucleotide polymorphisms to assess phylogeographic and population genetic structuring among *P. monodon* from the SE U.S.





***P. monodon* collected by SCDNR electrofishing researchers,
August 15th 2012, Cooper River, SC (female, TL = 172mm)**

**Collection and preservation of
pleopods (first two pairs) in 95%
non-denatured ethanol for
genetic analyses.**



Update from genetic analyses so far

Margaret Hunter, Southeast Ecological Science Center US

Department of Interior
US Geological Survey



Goals of this approach:

- Determine number of related populations
- Identify dispersal pathways
- Identify founding populations

Methodology:

- Genetic marker: mitochondrial control region
- 20 samples analyzed from North Carolina to the Florida Gulf Coast
- Phylogenetic studies

Phylogenetic studies

Margaret Hunter, Southeast Ecological Science Center US

Department of Interior
US Geological Survey



Results so far...

- No genetic variation; samples are genetically the same.
- Individuals are likely highly related or inbred.
- Founding individuals may have originated from a single culture facility or related populations .
- Additional samples (~50) will be analyzed this fall.
- Currently testing additional genetic markers to identify phylogenetically informative loci.

NC

SC

MS

AL

GA

LA

Numbers of tiger
shrimp from which
tissue samples have
been collected to date.

FL

State	2008	2010	2011	2012
NC	1	0	10	0*
SC	1	2	4	27
GA	0	0	2	0
FL	0	0	14	4
AL	0	0	2	0
MS	0	0	2	8
LA	0	0	3	0
Total	2	2	37	39

210

Miles

Asian tiger shrimp collaborative working group

Dr. Peter Kingsley-Smith	SC Dept of Natural Resources
David Knott	Poseidon Taxonomic Services
Pam Fuller	USGS (Gainesville, FL)
Amy Benson	USGS (Gainesville, FL)
Matt Cannister	USGS (Gainesville, FL)
Dr. Margaret Hunter	USGS (Gainesville, FL)
Dr. Timothy King	USGS (Kearneysville, WV)
Dr. James Morris	NOAA-NMFS, Beaufort, NC
Christine Buckel	NOAA-NMFS, Beaufort, NC
Leslie Hartman	Texas Parks & Wildlife Division

... and many other individuals across the region who have assisted with specimen collections, outreach and education.



P. monodon collected by Ryan Werner, off Waites Island, SC
October 6th 2011

QUESTIONS?



10.06.2011