SCDNR MARINE RESOURCES RESEARCH INSTITUTE REPORT TO GSARP

September 17th-19th 2014, Houston, Texas

Peter Kingsley-Smith [1] *& David Knott* [2]

[1] Associate Marine Scientist, Marine Resource Research Institute, South Carolina Department of Natural Resources (SCDNR), Charleston, SC USA 29422; Tel. No.: 843-953-9840; E-mail: kingsleysmithp@dnr.sc.gov

[2] Poseidon Taxonomic Services, LLC, Charleston SC (SCDNR, retired); E-mail: david.knott@why-knott.com

Invasive castrating barnacle parasite, *Loxothylacus panopaei*

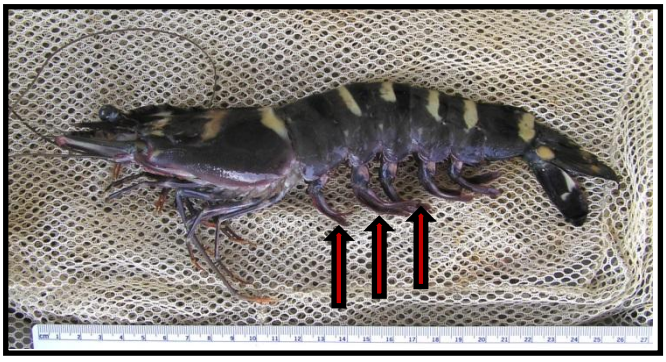
In January 2014, Dr. Amy Fowler was hired by the SCDNR to manage the Crustacean Research Section of the Marine Resources Research Institute. Amy has a PhD from the University of Auckland, where she worked on the invasive Indo-Pacific swimming crab*, Charybdis japonica* (a congener of *Charybdis hellerii*, which is established along the Atlantic coasts of North and South America and the Gulf of Mexico). Since she graduated in 2011, Dr. Fowler has held several postdoctoral research fellowships, including positions at Villanova University and the Marine Invasions Research Laboratory at the Smithsonian Environmental Research Center (SERC), where she studied the infection of small mud crabs by the invasive castrating barnacle *Loxothylacus panopaei*. This parasite was introduced to the US Atlantic coast from the Gulf of Mexico, most likely in the 1960s as part of the oyster aquaculture trade in the Chesapeake Bay. In 2012, Amy and collaborators found the most northern extent of the introduced barnacle in Long Island Sound, NY. She is monitoring population prevalence and impacts on the crab communities with researchers in NY. This fall she will be co-advising a new post doctoral researcher in the marine invasions laboratory at SERC, along with a senior researcher at SERC and a collaborator at Long Island University, to examine the possible adaptations that the mud crabs have undergone in response to parasitism across a co-evolutionary mosaic of historical interactions (native-native), recent interactions (invasive parasite - native crab), and recent escape (crab invasions into freshwater lakes at salinities that the parasite cannot tolerate). Amy also led a group that assessed the diversity and abundance of aquatic invasive species (AIS) hitchhikers in the live bait trade out of Maine and experimented with various ways to reduce the organisms that are transported via this "sleeper" vector. These researchers found more than 37 different live marine macroinvertebrates, 10 species of macroalgae, *Spartina alterniflora*, *Zostera* spp., 11 taxa of semi-terrestrial/aquatic larvae, pupae, and adults, and several egg cases of snails, platyhelminth eggs, and live gravid marine invertebrates (isopods, amphipods) associated with

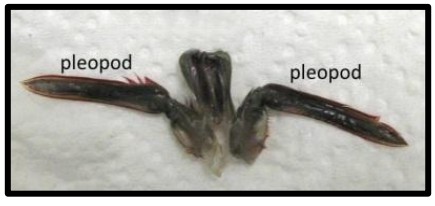
the packing algae that survived transit to the Mid-Atlantic region. A simple wash of the packing algae for 12 hours in tap water reduced the abundance of live organisms surviving transit by up to 80%. Currently, Amy is working on quantifying the community composition of crab populations in South Carolina intertidal oyster reefs with a focus on the invasive anomuran *Petrolisthes armatus*, which may have been negatively impacted by the cold winter temperatures this past winter. Previous research (Canning-Clode *et al*., 2011) suggests that cold winter kills could set back the range extension of *P. armatus*.

Canning-Clode, J., Fowler AE, Byers JE, Carlton JT & Ruiz GM (2011). 'Caribbean Creep' Chills Out: Climate Change and Marine Invasive Species. PLoS ONE 6(12): e29657. doi: 10. 1371/journal.pone.0029657.

Asian tiger shrimp (*Penaeus monodon*) invasion of the South Atlantic Bight

Drs Peter Kingsley-Smith and Amy Fowler (SCDNR Marine Resources Research Institute, Charleston, SC) were successful in securing funding under the State and Interstate ANS Management Plan Program to improve our understanding of the recent invasion of the South Atlantic Bight and Gulf of Mexico by the Asian tiger shrimp, *Penaeus monodon*. This funding will support the hiring of a new temporary grant Wildlife Biologist I position at the Institute. The focus will be on the collection of tiger shrimp across a range of habitats, from shallow coastal juvenile nursery habitats in estuaries and tidal creeks to sandy or muddy-sand offshore habitats of mature adults. Some of the potential effects of the establishment of this large predatory penaeid on native shrimp, crab, and bivalve populations will be examined through an investigation that will look for ontogenetic shifts in feeding preferences using stable isotope analyses. Results should address concerns that the introduced species may compete for food resources with native species and may even consume some of them.





The preservation and archiving of pleopod tissue samples for genetic analyses commenced in 2008, and it continues as specimens become available. Sampling typically involves the collection of the first three pairs of pleopods (shown by the red arrows right, and below right from a male specimen). These samples are being held in a tissue repository in Beaufort, NC which is maintained by the NOAA National Centers for Coastal Ocean Science Laboratory. The need for obtaining additional samples from across the introduced range of the species, as well as from its native range and other regions of introduction and establishment, continue to be a priority. Using this tissue, USGS researchers will try to identify the geographic origins of *P. monodon* living along the Gulf and

Atlantic coasts of the US, in the hope of answering questions regarding the status of their establishment, the number of releases, and the population structure of this shrimp in its introduced range. In relation to this goal, it would also be informative to obtain tissue samples from invaded regions of the current *P. monodon* geographic range. Two such invaded regions of particular interest are Belize and Colombia. In May 2014, Hank Bauman, hatchery and broodstock manager at Paradise Shrimp Farm, Danriga, Belize reported to Shrimp News International that it is not uncommon to find "a handful of *P. monodon* in harvests of white shrimp (*P. vannamei*) in shrimp ponds in Belize. How do they get in the ponds? The current thinking is that the wild monodon postlarvae enter the ponds when they are being filled." Bauman reports that his technical team has successfully produced first generation postlarvae from "Caribbean" tiger shrimp.

For Colombia, *Penaeus monodon* were first reported off the Guajira Peninsula in the Colombian Caribbean by Gómez-Lemos and Campos (2008), although according to interviews with fishermen reported by Sandoval *et al.* (2014) *P. monodon* first appeared in the Gulf of Urabá in about 2007. Sandoval *et al.* (2014) conducted the first effort in Colombia to estimate the distribution and abundance of *P. monodon* in the Gulf of Urabá. From April 1st to November 30th 2011, previously trained fishermen collected catch information (numbers of individuals) of *P. monodon*. Shrimp were collected using fixed, nylon gill nets that were 1200m long x 0.9m high and with a 63.5mm mesh size. CPUE ranged from 0.6 to 37.8, and individuals ranged between 50 and 500g, with an average weight of 232g. During this sampling period, 397 individuals were collected from 20 fishing localities in the Gulf of Urabá. These collections of *P. monodon* were coincident with the "peak" number of reports of *P. monodon* in the North Carolina to Texas region in 2011 (2009: n=45; 2010: n=32; 2011: n=678; 2012: n=208; 2013: n=333) further increasing our interest in obtaining genetic samples from this region.

Reporting of *P. monodon* specimens collected in US waters appears to be down considerably for 2014 compared to previous years, which we suggest is primarily due to reporting apathy rather than a reflection of a change in abundance. Furthermore, in 2014 there have been ***no reports*** from commercial shrimpers trawling offshore, whom in past years provided the majority of reports. The majority of 2014 reports were derived from recreational cast nets, minnow traps and crab pots in inshore waters. While the number reported to USGS for 2014 is low so far (FL=3; MS=3; SC=8, as of September 3rd 2014, compared to 333 in total in 2013), those reports include a noteworthy collection, specifically the smallest *P. monodon* ever collected in US waters since the reappearance of this invasive species in 2006. This specimen (shown *right*, image courtesy of Dany Burgess, Southeastern Regional Taxonomic Center, SERTC) was collected in a recreational minnow trap in Horlbeck Creek, SC on June 22nd 2014 and measured 61mm (total length) and weighed 1.46g (total wet weight). Prior to 2014, the smallest reported from US waters since the reappearance in 2006 was 102mm. The 14 reports for 2014 thus far represent captures spanning June 22nd through August 18th, approximately 2 months, with

individuals ranging in size from 61 to 209 mm total length. Collections of smaller individuals earlier in the year support the premise that this species is now established and reproducing in US waters. Investigations of the reproductive condition of *P. monodon*, such as the presence of ripe females, would help to resolve these questions. Drs Amy Fowler and Peter Kingsley-Smith are in the process of hiring a Wildlife Biologist I position to help with their tiger shrimp research efforts (supported from USFWS funds directed towards State Management Plan activities for aquatic nuisance species).

Gómez-Lemos LA & Campos NH (2008). Presencia de *Penaeus monodon* Fabricius (Crustacea: Decapoda: Penaeidae) en Aguas de la Guajira Colombiana. *Bol. Invest. Mar. Cost*. 37(2):221-225.

Sandoval LA, Leal-Florez J, Taborda A & Vásquez JG (2014). Spatial distribution and abundance of the giant tiger prawn, *Penaeus monodon* (Fabricius, 1798), in the Gulf of Urabá (Caribbean), Colombia, South America. *BioInvasions Records* 3(3): In press.

Invasive nematode swimbladder parasite, *Anguillicoloides crassus*, in South Carolina populations of the American eel, *Anguilla rostrata*

Anguillicoloides crassus is an invasive parasitic nematode that infects the swimbladder of the American eel *Anguilla rostrata*. The parasite is believed to originate from Asia, where it infects the Japanese eel, *Anguilla japonica*; however, *A. crassus* has been unintentionally spread around the world and now infects numerous other anguillid eel host species. *A. crassus* was first detected in wild American eels in 1995 in animals collected from Winyah Bay, South Carolina. Since then, the parasite has spread to other areas along the North American coastline. Infections can have negative health impacts on non-native hosts, either by directly inducing mortality or by damaging the swimbladder and impairing the ability of eels to migrate to their oceanic spawning grounds. With respect to the American eel, *A. rostrata*, this is of concern because the species has declined in recent decades. The US stock of American eels is considered to be 'depleted', and a proposal to have the species listed under the Endangered Species Act is currently under review.

Recent studies in South Carolina found that at leat 58% of eels were infected and that juvevile eel stages became heavily infected soon after their coastal ingress from the Atlantic. In 2014, SCDNR received funds from the Gulf States Marine Fisheries Commission (Subcontract Award

No. FWS-800-037-2014-SC) entitled “Detection of an invasive parasite of American eels using qPCR)”. The main goals of this project are to undertake a pilot study testing the use of quantitave PCR to detect *A. crassus* in intermediate hosts (small planktonic and benthic crustaceans). If successful, the method will provide a useful tool for rapidly screening different habitats for the presence of the parasite. It will also facilitate further research aimed at understanding the parasite’s life cycle and its use of different intermediate and paratenic host species. Efforts on this project to date has focused on the development of the field collection techniques for potential intermediate hosts of *A. crassus*, targeting primarily copepods from the water column and epibenthic crustaceans, such as amphipods. Investigators are also in discussion with researchers in Canada who have previously developed a protocol for qPCR detection for *A. crassus* in order to test this protocol for larval stages of *A. crassus* removed from American adult eels (*A. rostrata*) collected in South Carolina. [Note: There will be an overview presentation of the *A. crassus* research conducted at the SCDNR by Peter Kingsley-Smith on Thursday September 18th @ 9:35am as part of GSARP meeting.]

Surveilliance of invasive benthic invertebrates in the ACE Basin National Estuarine Research Reserve (NERR) in South Carolina (USFWS State Management Plan Funding)

Faunal identification of invertebrates scraped from settlement blocks (n=15) deployed for approximately three months (April through July 2013) at various locations throughout the ACE Basin NERR (named for the confluence of the Ashepoo, Combahee and Edisto Rivers) has now been completed. Results from these identifications present a faunal list of 62 invertebrate taxa (24 identified to species level, 5 to genus, 15 to family, and 18 to various higher level taxa). Four of those species are known to be invasive (*Amphibalanus amphitrite* [barnacle], *Paradella dianae* and *Synidotea laevidorsalis* [isopod crustaceans], and *Petrolisthes armatus* [anomuran crustacean]). An additional species, the South American mussel *Mytella charruana*, was collected from outside of the targeted sampling surface of one block, and it is likely that the ubiquitous nonindigenous barnacle *Balanus trigonus* had settled on blocks that were lost from tethers on pilings that were located in high salinity waters near ocean inlets at three sites.

Invasive red algal, *Gracilaria vermiculophylla*

In previous reports we have described the investigations of Dr. Erik Sotka (College of Charleston) and colleagues on the impacts of a nonindigenous seaweed, *Gracilaria vermiculophylla*, on mudflat communities in South Carolina and Georgia. Much of their initial work has been published in Byers *et al.* (2012). Likely the result of worldwide transport of Japanese oysters, the seaweed can now be found along the Pacific North American coast from

Canada to Mexico, on the Atlantic seaboard from Maine to Georgia, and in the eastern North Atlantic from Morocco to the Baltic Sea, according to Sotka.

Dr. Sotka and colleagues continue to investigate the ecology and evolution of *G. vermiculophylla* on mudflats of South Carolina and Georgia. One recent highlight from this research effort is the thesis of College of Charleston Masters' student Nicole Kollars (now a PhD student at the University of California – Davis) which documented the mutualism between the non-native seaweed and the native decorator annelid *Diopatra cuprea*. The worm actively attaches the seaweed to its tube domicile (as shown *right*). The seaweed gains a point of attachment within the photic zone and away from stressful high marsh environment. The worm gains greater access to native amphipod prey that are attracted to the seaweed. Novel mutualisms are rarely described, but may be more common among aquatic native and non-native species than is currently recognized.

Byers JE, Gribben PE, Yeager C & Sotka EE (2012). Impacts of an abundant introduced ecosystem engineer within mudflats of the southeastern US coast. *Biological Invasions* 14(12):2587-2600.

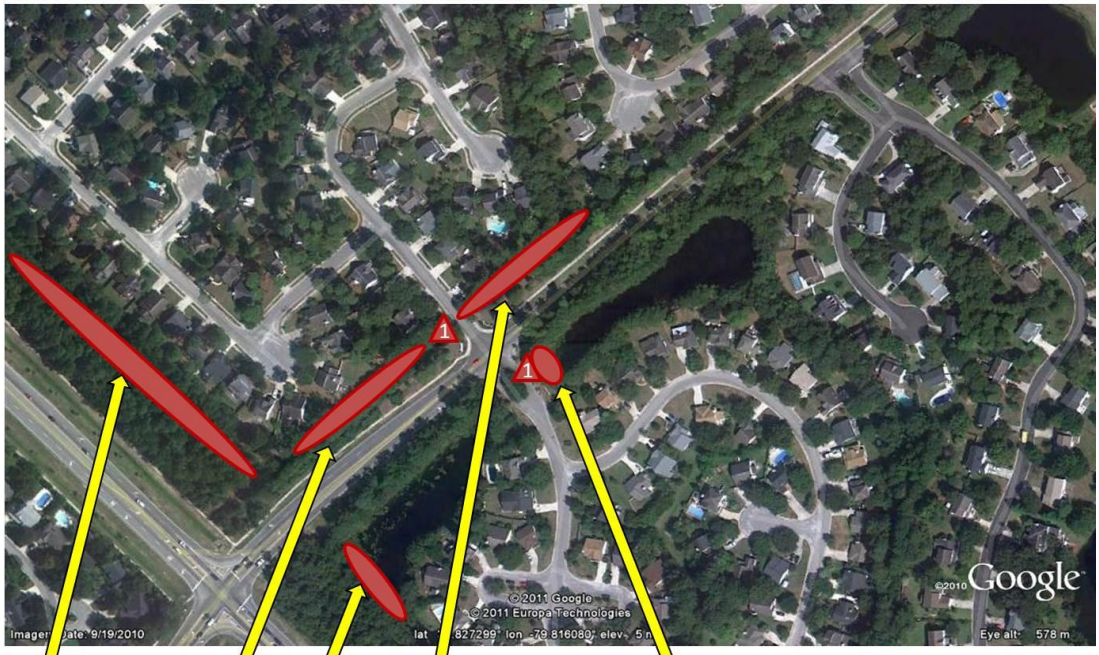
Update on the island apple snail, *Pomacea maculata* (previously *P. insularum*)

In 2010 and 2011, we reported observation and collection of island apple snail shells, *Pomacea maculata*, at a location in Mount Pleasant, South Carolina (close to Charleston). It was believed that following chemical treatment of this population, combined with consecutive cold winters, this population had been eradicated. A recent visit by David Knott on August 29th 2014, however, revealed the presence of empty shells and egg masses laid this season. While no live snails were observed during this visit last month, it does not appear that this population has indeed been eradicated, although it may be contained and under control. Recent modeling studies based upon climatic and water quality variables (Byers et al. 2013) have shown that the coastal plain, from Texas to North Carolina, provides suitable habitat for *P. maculata* [reported as *P. insularum*]. Those models also present a reliable spatial basis for the prediction of its future spread in the southeastern US.

Byers JE, McDowell WG, Dodd SR, Hanie RS, Pintor LM & Wilde SB (2013). Climate and pH predict the potential range of the invasive apple snail (*Pomacea insularum*) in the southeastern United States. PLoS ONE 8(2): e56812. doi:10.1371/journal.pone.0056812).

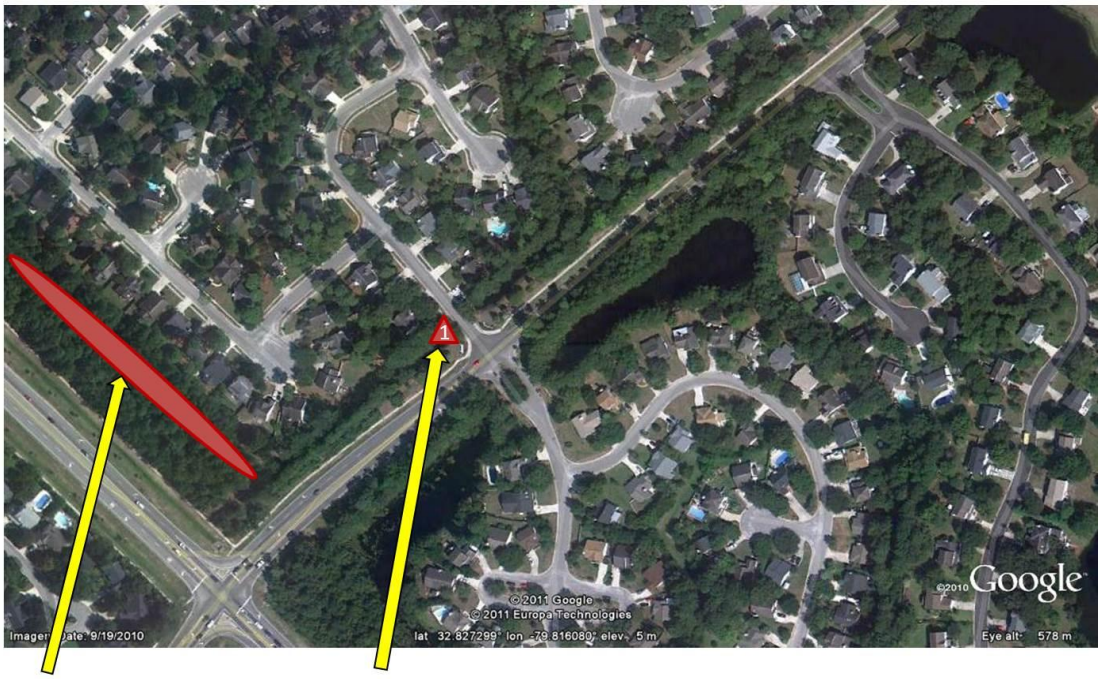
Distribution of *P. maculata* empty shells and remnant eggs masses in 2011 vs. 2014:

intersection of IOP Connector and Rifle Range Rd, Mt Pleasant; sampled 16Aug2011 Empty shells Egg capsule remnants



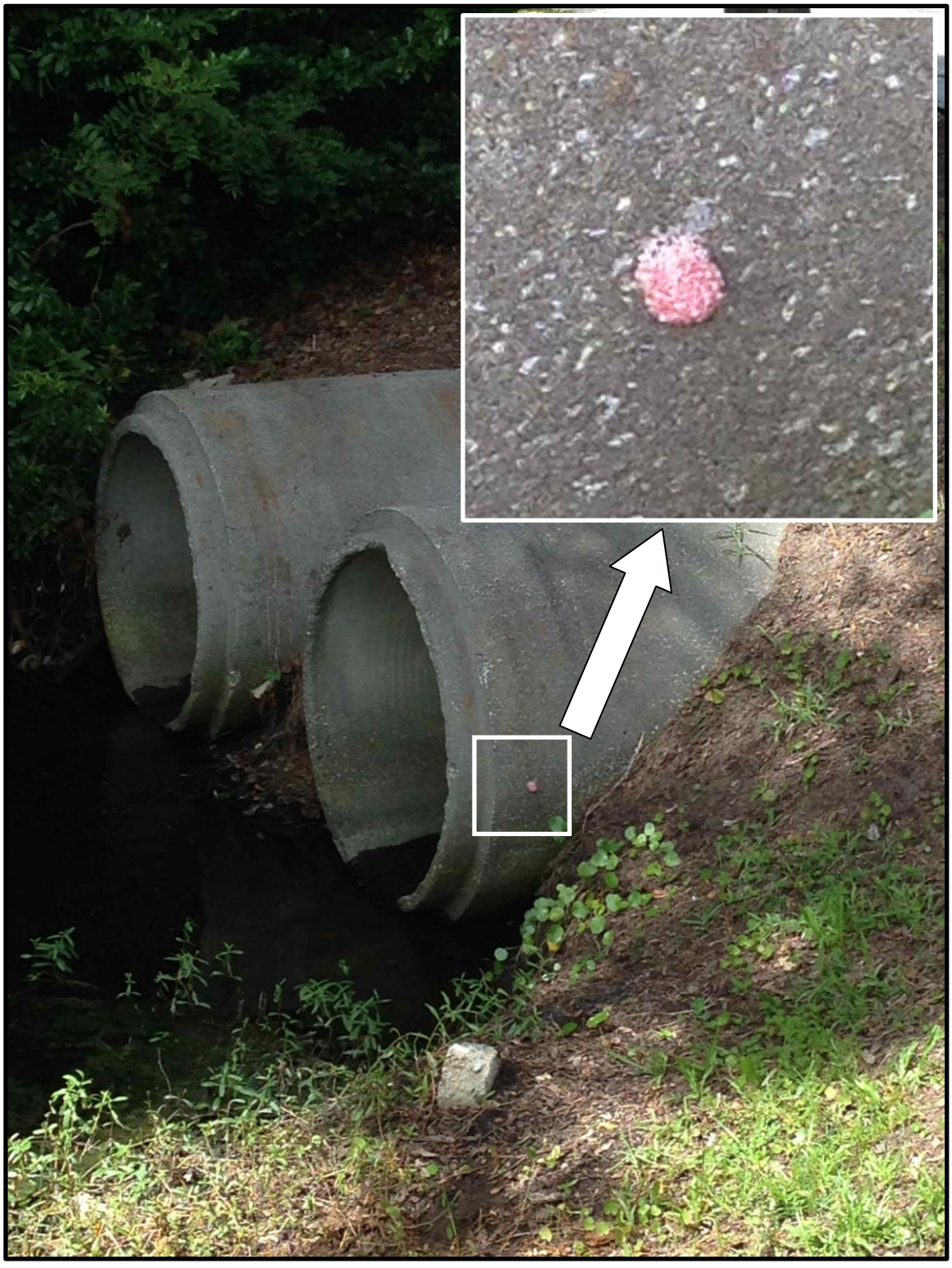
6 shells 2 shells 5 shells 3 shells 1 shell

intersection of IOP Connector and Rifle Range Rd, Mt Pleasant; sampled 29Aug2014 Empty shells Egg capsule remnants



4 empty shells 1 egg cluster

Remnant egg mass from *P. maculata* during site visit on August 29th 2014:



Empty *P. maculata* shell (not heavily weathered) seen during site visit on August 29th 2014: