



Sampling Grass Shrimp in Georgia's Tidal Creeks: Providing a Foundation for Student Research via Long-Term Monitoring

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Introduction

Grass shrimp – a foundational organism in the estuarine food web.

2 main species

- *Palaemonetes vulgaris*
common grass shrimp



- *Palaemonetes pugio*
daggerblade grass shrimp



12-month lifespan

- reach maturity in 1.5 - 2 months
- females spawn twice during their lifespan (spring and late summer)
- eggs hatch within 12 to 60 days



Daggerblade grass shrimp (*P. pugio*) can become infected with multiple parasites

- haplosporidians
- trematodes
- bopyrid isopods



Materials & Methods



**4 tidal
creeks
near
Savannah,
GA**



**Moon River
2007 - present**



**Country Club Creek
2007 - 2012**

J. McCullars



**Tybee Island
2011 - 2013**

K. Doyle

B. Brinton

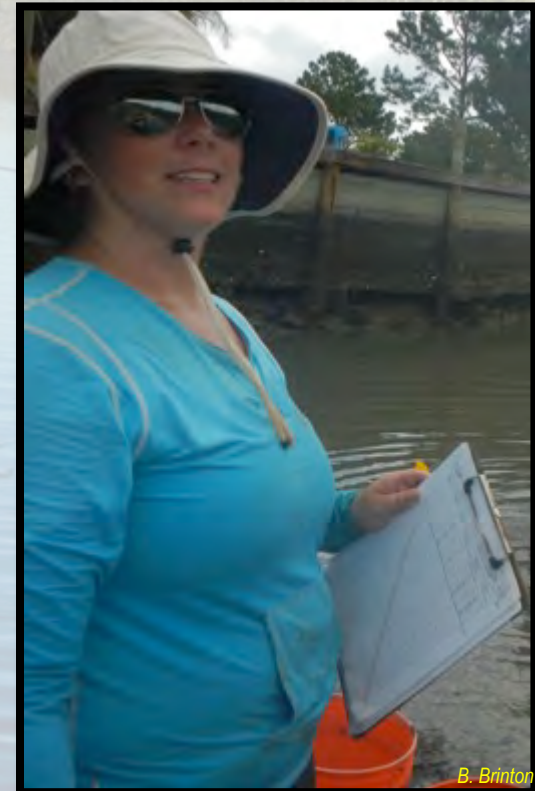


**Burnside Island
2011 - 2012**

M. Partridge

Materials

- 0.25 m² custom-built weighted throw-trap
- 3 mm mesh, long-handled dip net
- buckets – 1 per quadrat
- YSI probe (temperature, salinity, dissolved oxygen)
refractometer (salinity)
thermometer (temperature)



Methods

2007-2010: "throw" method

2010-present: "pounce" method



- within 2 hours of low tide
- multiple quadrats (6-12)
- scoop with dip net until 5 empty scoops
- 1 bucket per quadrat
- identify & release

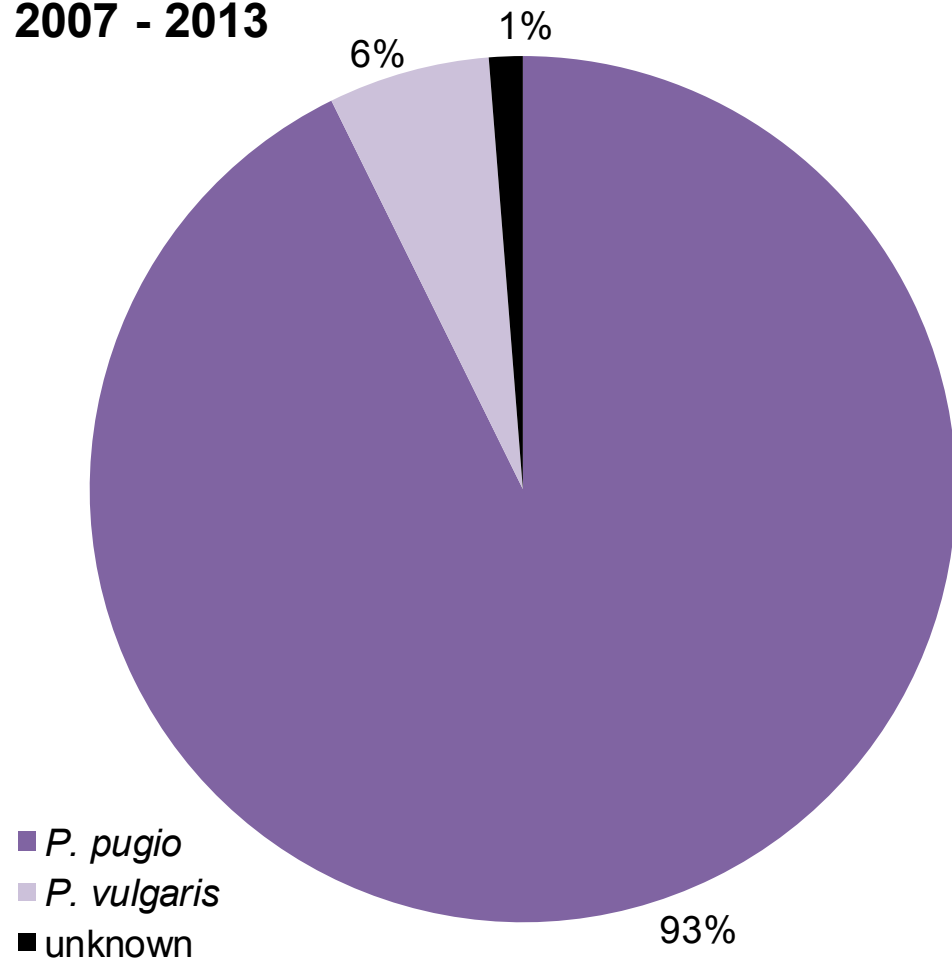


Results



Overall abundance analysis using raw data

Overall shrimp abundance - all sites
2007 - 2013



daggerblade grass
shrimp (*P. pugio*)



common grass
shrimp (*P. vulgaris*)

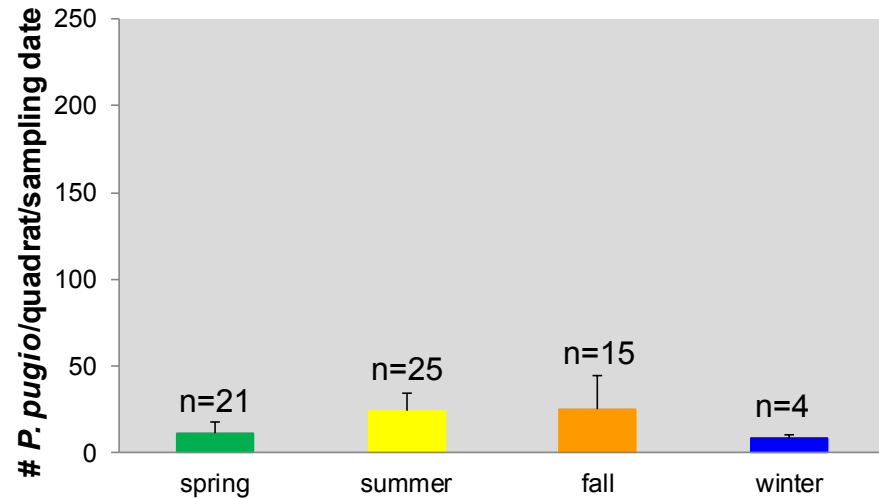


“unknown” grass
shrimp

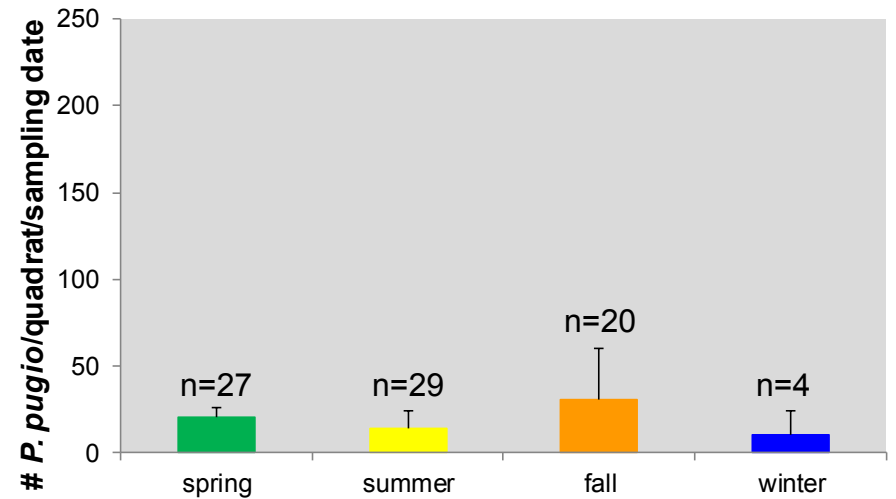


Seasonal abundance analysis of daggerblade grass shrimp (*P. pugio*)

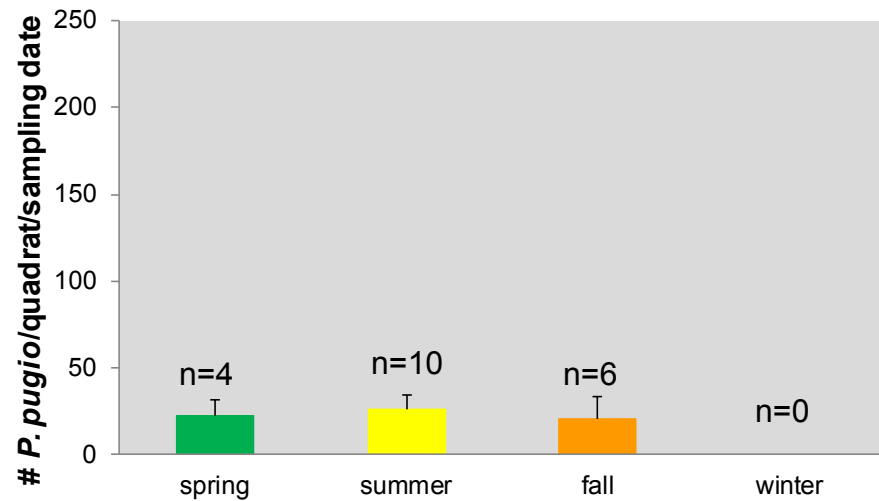
Moon River - *P. pugio* abundance
2007 - 2013



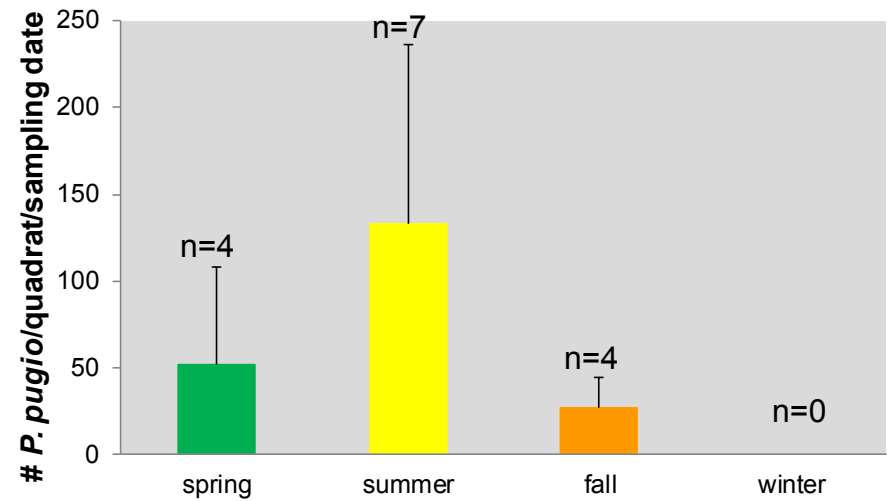
Country Club Creek - *P. pugio* abundance
2007 - 2012



Tybee Island - *P. pugio* abundance
2011 - 2013



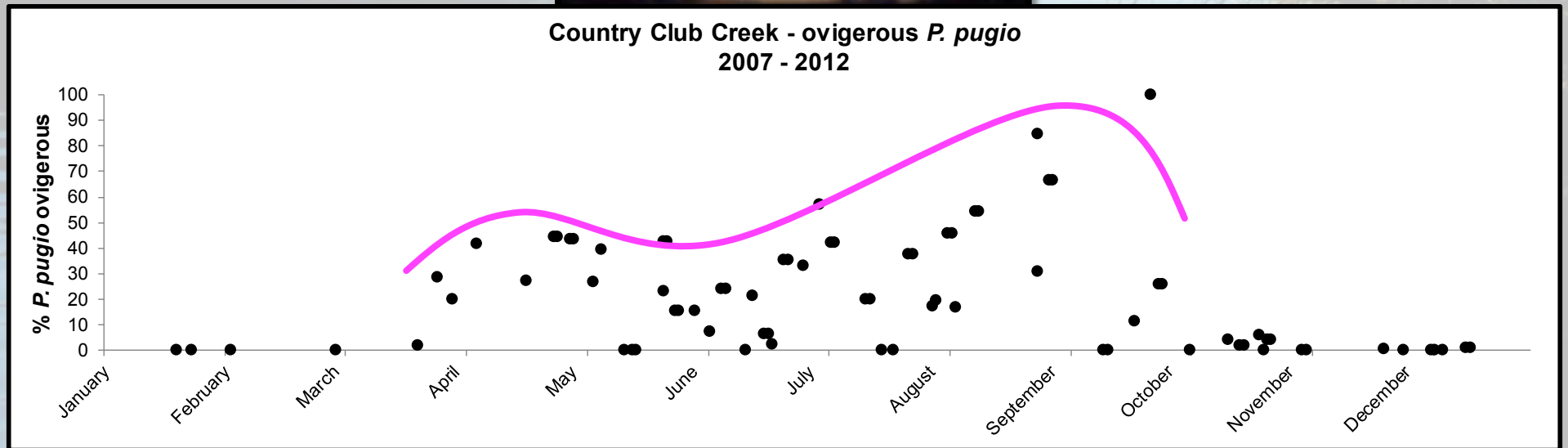
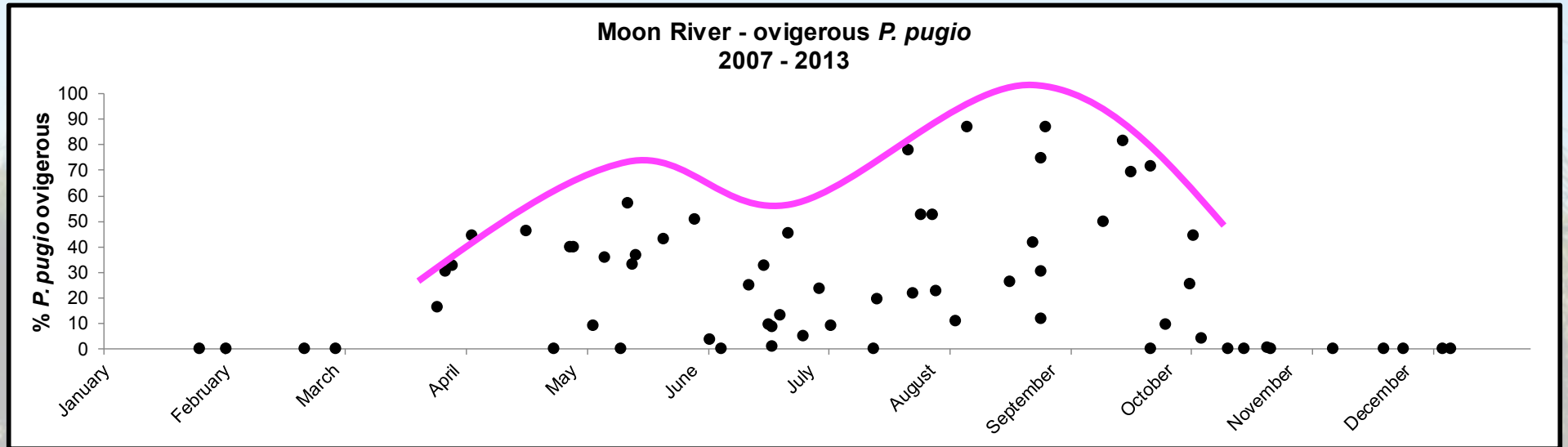
Burnside Island - *P. pugio* abundance
2011 - 2012



**Parasite prevalence (%)
in daggerblade grass shrimp (*P. pugio*)**

YEAR	Moon River	Country Club Creek	Tybee Island	Burnside Island
2007	4.0 ± 3.6	6.3 ± 4.3	ND	ND
2008	2.0 ± 1.7	2.5 ± 2.6	ND	ND
2009	3.3 ± 2.4	1.3 ± 1.8	ND	ND
2010	0.4 ± 0.4	2.7 ± 0.6	ND	ND
2011	1.0 ± 1.4	2.4 ± 2.5	0.8 ± 0.0	0.5 ± 0.5
2012	1.4 ± 0.4	3.4 ± 0.6	1.7 ± 1.0	1.2 ± 0.9
2013	0.5 ± 0.5	ND	2.7 ± 1.7	ND
AVERAGE (range)	1.8 ± 1.4 (0.4 – 4.0)	3.1 ± 1.7 (1.3 – 6.3)	1.7 ± 0.9 (0.8 – 2.7)	0.8 ± 0.5 (0.5 – 1.2)

Percent of egg-bearing female daggerblade grass shrimp (*P. pugio*)



Discussion



Summary of Results

- Daggerblade grass shrimp (*P. pugio*) dominate the catch (>85%) at every site in every year.
- The season(s) of highest yields for daggerblade grass shrimp (*P. pugio*) varied from site to site. At Moon River & Country Club Creek the largest catches were in the fall, and for Tybee & Burnside islands it was in the summer.
- The percent of daggerblade grass shrimp (*P. pugio*) parasitized with the bopyrid isopod averaged between about 1% - 3%, which supports previously published literature.
- The percent of egg-bearing daggerblade grass shrimp (*P. pugio*) peaks in spring (>40%) and late summer (>50%) at all sites, which supports previously published literature.



Undergrad projects

2004: Comparing the activity patterns of gravid & nongravid *P. pugio*
– S.S. Burrows



2004: The incidence of bopyrid parasitism in male & female *P. pugio*
– D. Burke



2006: The mean density, percent parasitism, and percent gravidity of
P. pugio in Chatham County, GA – W.J. Butts

2009: The effect of starvation on survival time of parasitized and non-
parasitized *P. pugio* – S. Corning



2009: Behavioral effects of the parasitic isopod on its host *P. pugio* in
the presence of a predator – J. LaBarre



2011: Density of *P. pugio* and *P. vulgaris* in Savannah, GA – J.
McCullars



2012: The effect of the parasitic trematode on the predation of *P.*
pugio by mummichogs – K. Thompson



Graduate theses



2009: Effect of two potential stressors on *P. pugio* in southeastern Georgia – T.M. Modeste

2009: The effects of coded wire tags and the parasitic isopod on growth and predation of *P. pugio* – K. Ludwig-Yozzo



2010: Behavioral effects of the bopyrid isopod on the swimming endurance and toxicity of fipronil to *P. pugio*, and integrating shrimp density data into a K-12 activity – M. Partridge



2011: The effect of the bopyrid isopod on the predation and gravidity of *P. pugio* – J. John



2013: The effects of the bopyrid isopod on starvation rate and reproductive capabilities of *P. pugio* – M. Sherman



2014: The effects of the bopyrid isopod on the predation preferences of the mummichog and the effect of *P. pugio* intermolt variability on the reproduction of the isopod – B. Brinton



Publications

Chaplin-Ebanks, S. & M.C. Curran. 2005. The effect of the parasitic isopod, *Probopyrus pandalicola* (Packard, 1879), on tidal activity patterns of the grass shrimp *Palaemonetes pugio* Holthuis, 1949. *Crustaceana* 78(9):1053-1061.

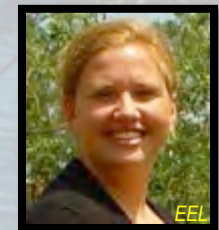


Chaplin-Ebanks, S. & M.C. Curran. 2007. Prevalence of the bopyrid isopod *Probopyrus pandalicola* in the grass shrimp, *Palaemonetes pugio*, in four tidal creeks on the South Carolina-Georgia coast. *J. Parasitol.* 93(1):73-77.

Williamson, C. et al. 2009. Toxicity of synthetic pyrethroid insecticides to the grass shrimp, *Palaemonetes pugio*, parasitized with the bopyrid isopod, *Probopyrus pandalicola*. *Journal of Environmental Science and Health Part B* 44:810-816.



Sherman, M.B. & M.C. Curran. 2013. The effect of the bopyrid isopod *Probopyrus pandalicola* (Packard, 1879) (Isopoda, Bopyridae) on the survival time of the daggerblade grass shrimp *Palaemonetes pugio* Holthuis, 1949 (Decapoda, Palaemonidae) during starvation at two different temperatures. *Crustaceana* 86 (11):1328-1342.



Published GK-12 activities

Aultman, T. & M.C. Curran. 2008. Grass shrimp: small size but big role in food web. *Current* 24(3):29-33.

Aultman, T. et al. 2010. Bringing scientific inquiry alive using real grass shrimp research. *Science Scope* issue:54-60.

Siler, A. & M.C. Curran. 2011. The learning cycle: engaging children in the scientific method. *Current* 27(3):24-32.

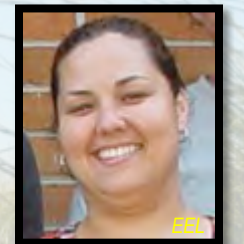
Gunzburger, L. & M.C. Curran. 2013. Counting parasites: using shrimp to teach students about estimation. *Natural Sciences Education* 42:9-13.

Future work

Continue with parasite prevalence – build a baseline

Climate change may result in increased water temperatures

- Higher temperatures speed up the parasitic isopod growth cycle. (B.Brinton)
- A higher prevalence of the parasite could increase the impact of the reduction in fecundity for the grass shrimp. (M. Sherman)
- Reduced grass shrimp fecundity can decrease that population such





Thank you!

Acknowledgments:

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NSF GK-12 award #DGE-0841372

**NOAA Living Marine Resources Cooperative Science Center
award #NA17AE1626**

Estuarine Ecology Lab

Reference Literature

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- Welsh, B.L. 1975. The role of grass shrimp, *Palaemonetes pugio*, in a tidal marsh ecosystem. Ecology 56(3):513-530.
- Wood, C.E. 1967. Physioecology of the grass shrimp, *Palaemonetes pugio*, in the Galveston Bay estuarine system. Contributions in Marine Science of the University of Texas 12: 54-79.

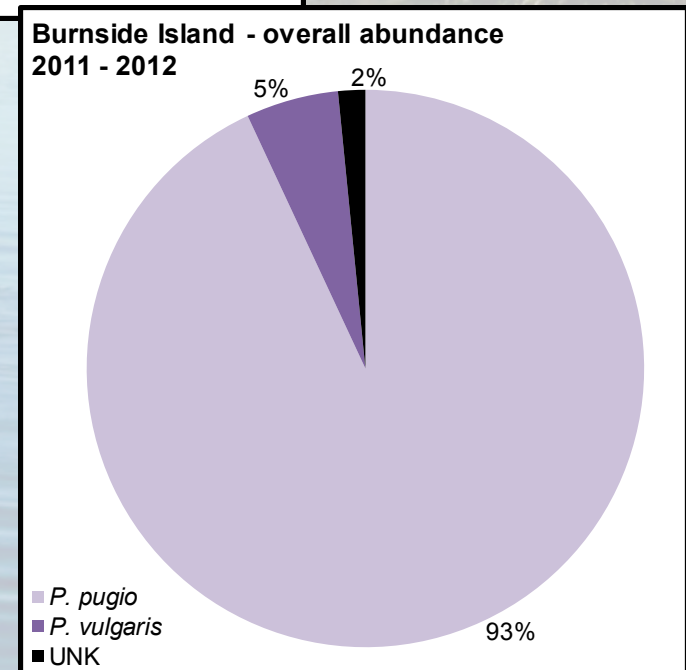
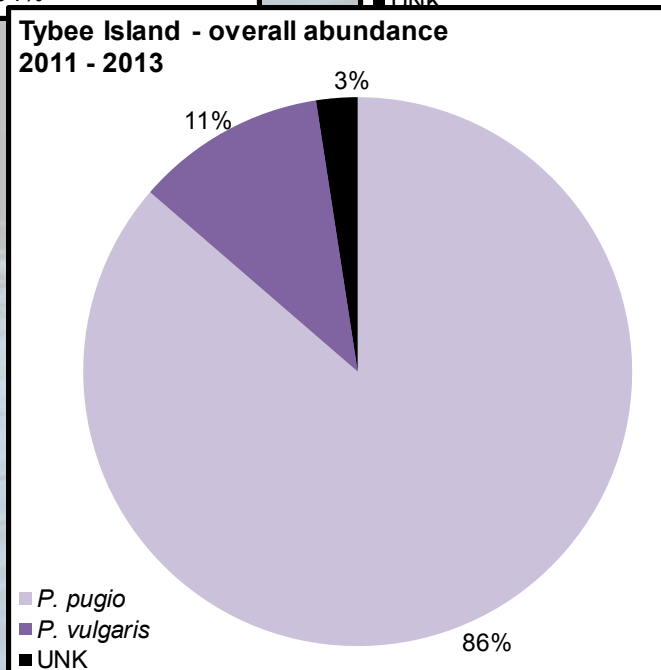
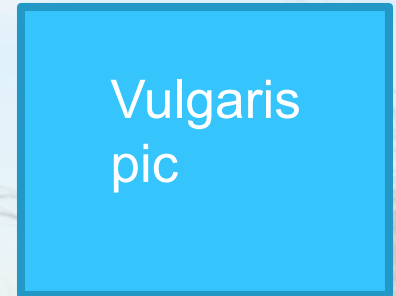
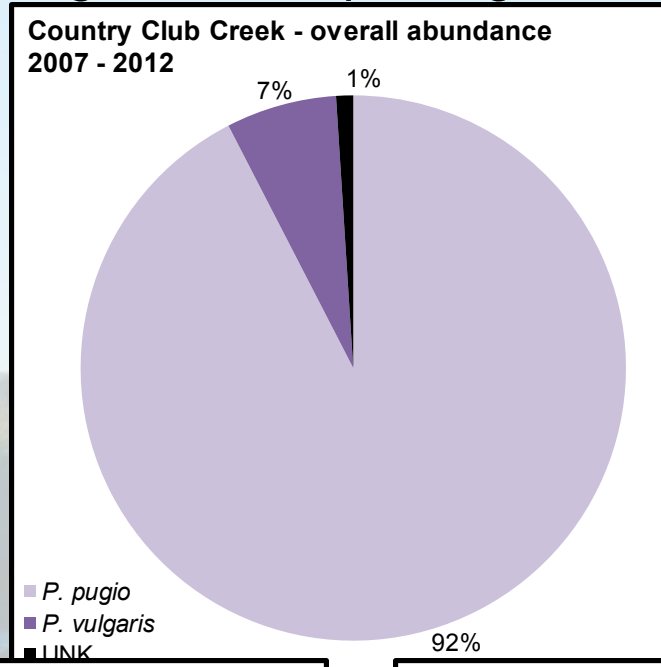
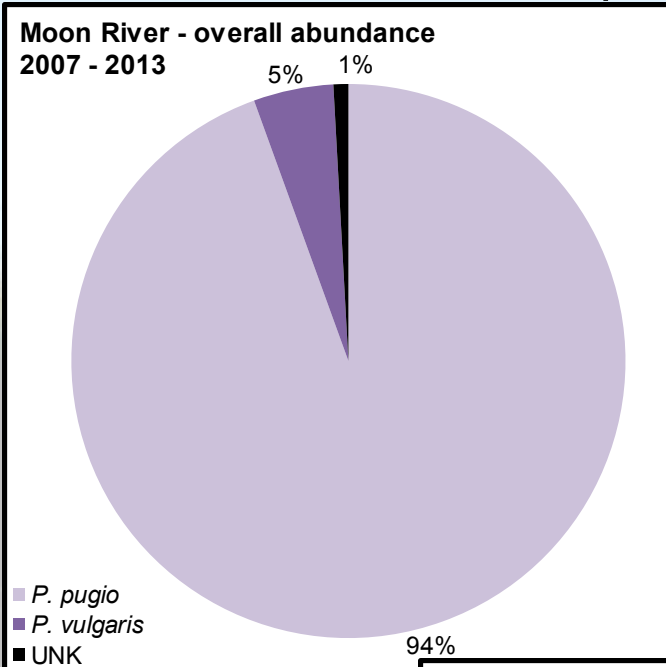
ABSTRACT

Long-term data sets are invaluable resources that enable analysis of trends over time. Often the protocols implemented to collect such data are designed to answer one specific question. For the last seven years we have employed a sampling regime that allows several variables to be examined efficiently while also providing the basis for multiple student projects at the graduate and undergraduate level. Our methodology targets multiple grass shrimp species in shallow creeks. In the results to date, 91% of grass shrimp collected were daggerblade grass shrimp (*Palaemonetes pugio*), while only 9% were the common grass shrimp (*P. vulgaris*). Over the years of the study, an average of 28% of all grass shrimp captured between June and August were ovigerous. Approximately 2% of all *P. pugio* were parasitized by the isopod *Probopyrus pandalicola*, which inhibits reproduction and thereby potentially impacts shrimp populations. Data collection occurred in 2 to 4 different tidal creeks from 5 to 12 months in a given year, enabling our data to be further refined into spatial and seasonal patterns, and analyzed with respect to physical parameters. There were large differences in mean shrimp abundance across sites. A tidal creek on Burnside Island, GA consistently yielded over half ($54 \pm 0.59\%$) of the total shrimp caught, with the highest catches occurring between June and August. Spatial and temporal data such as these help to elucidate the role of grass shrimp in the estuarine food web as well as their life history.



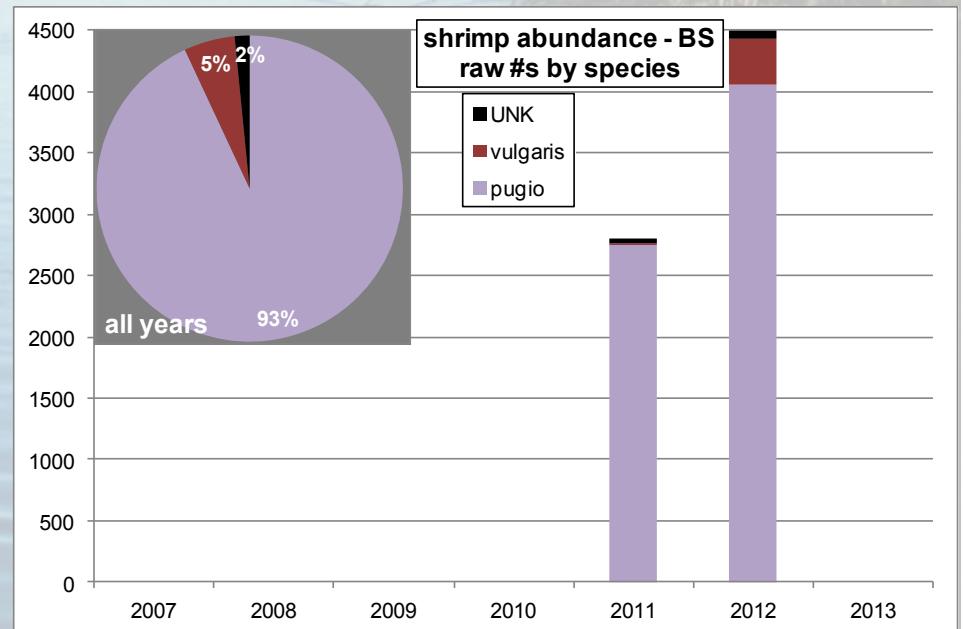
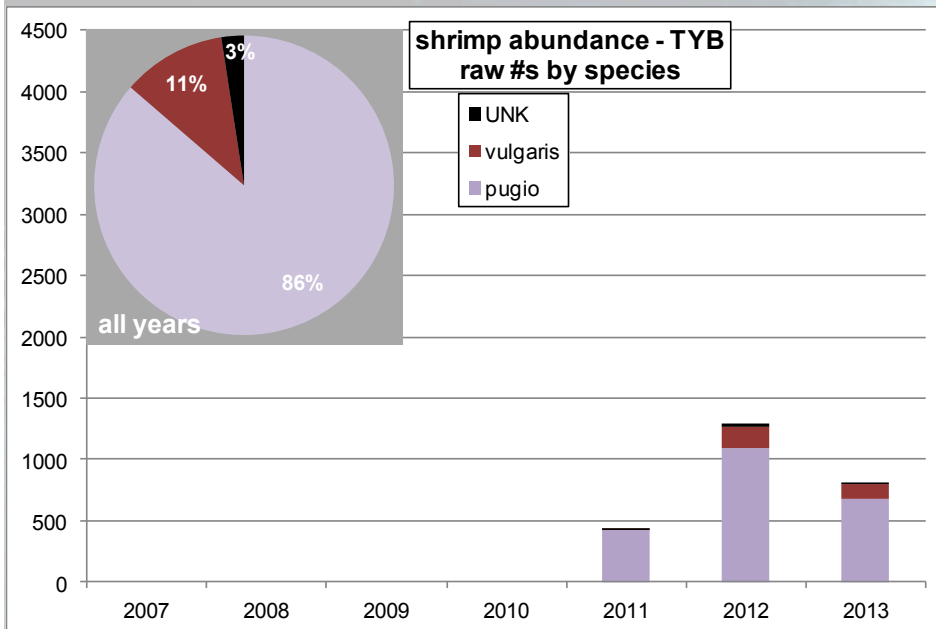
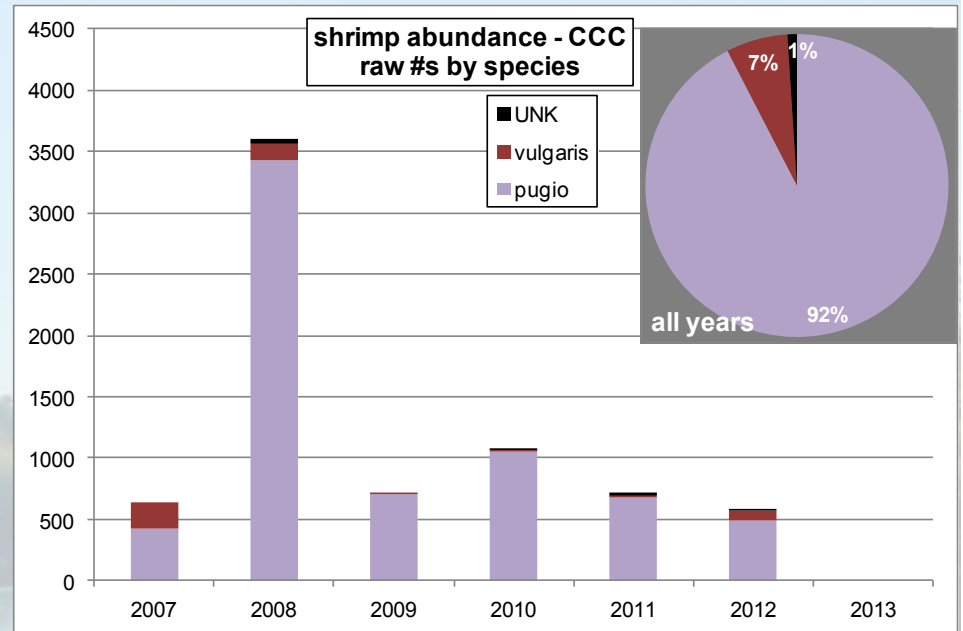
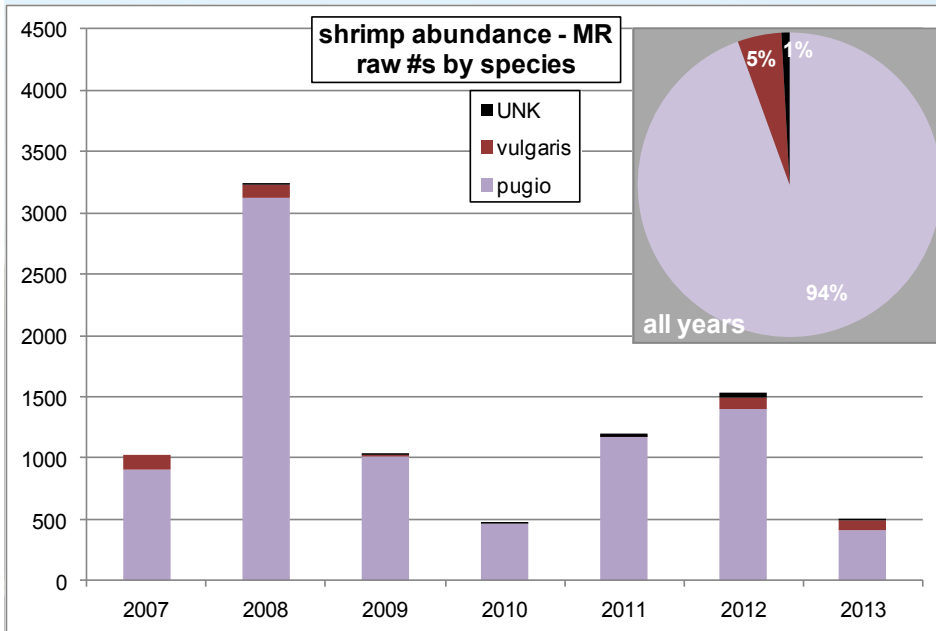
Overall abundance for 2 species of grass shrimp using raw data

EXTRA

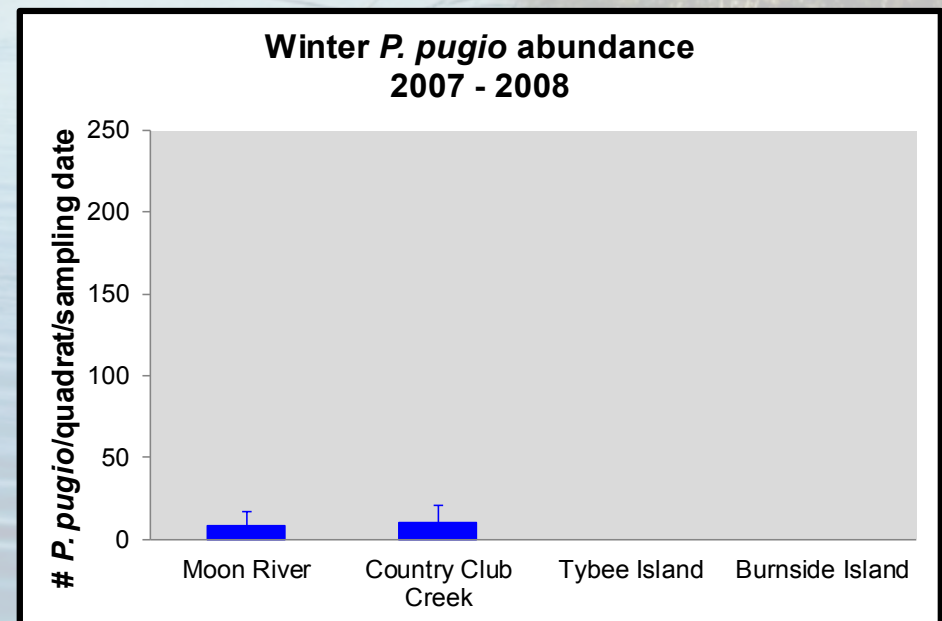
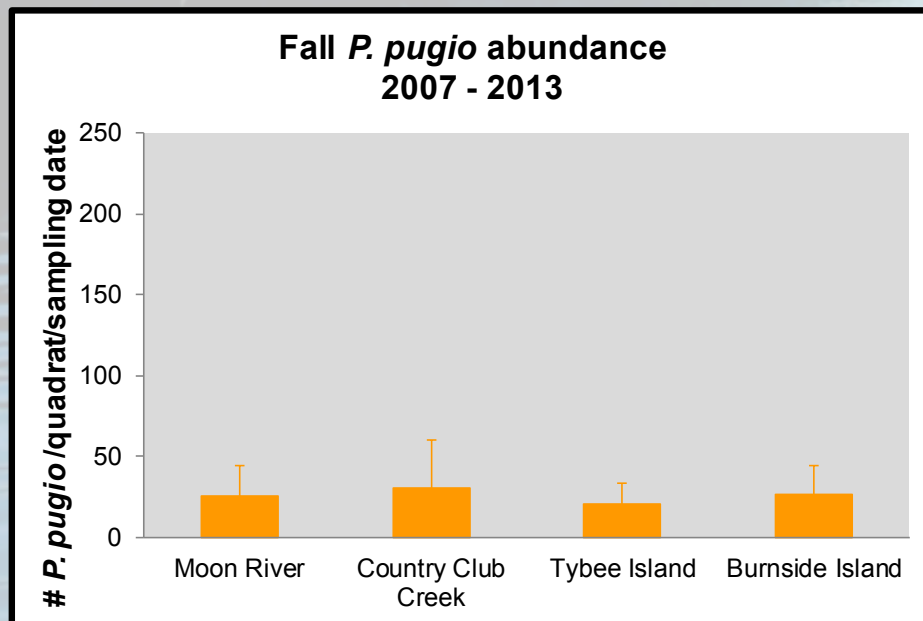
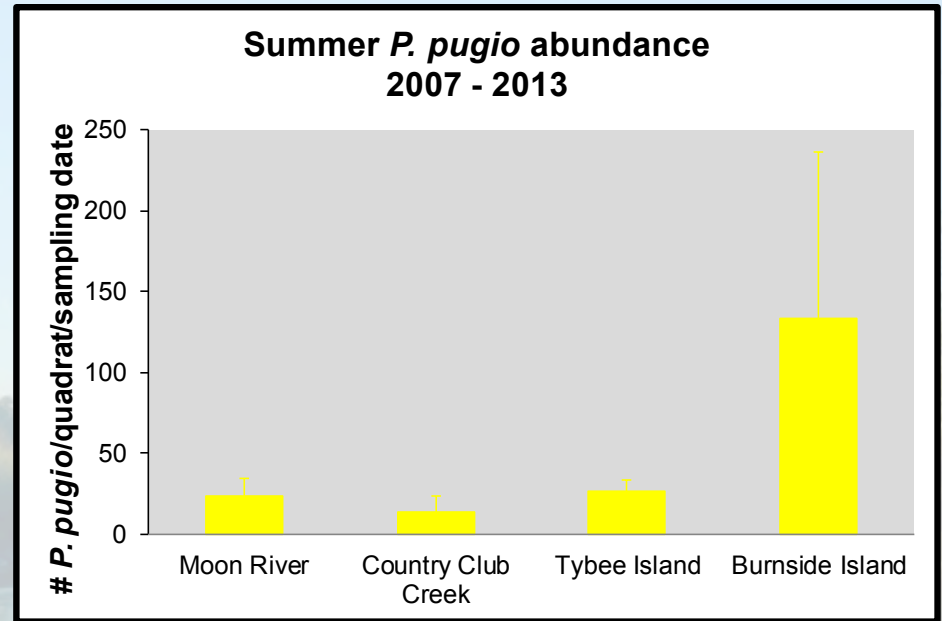
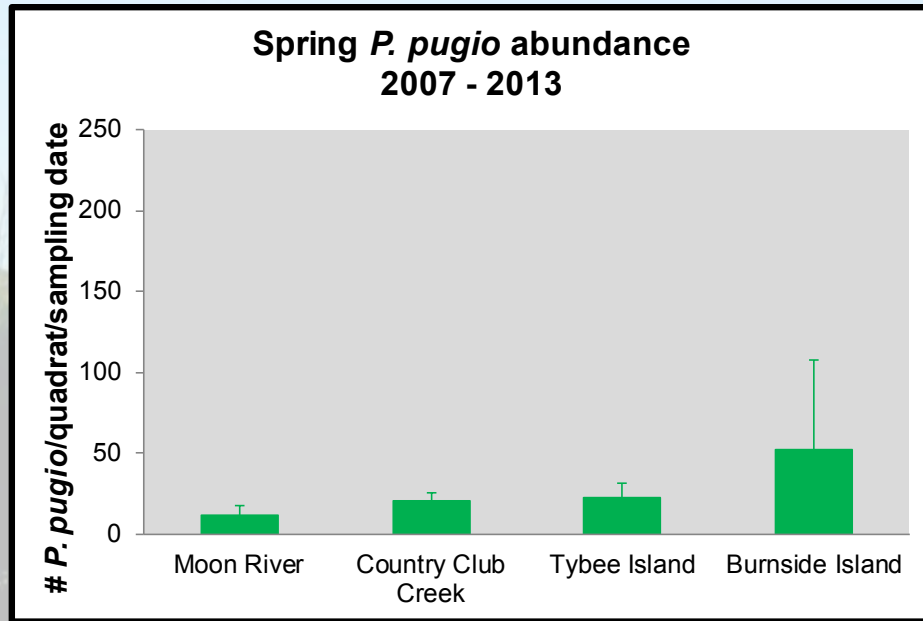


Results – abundance, raw

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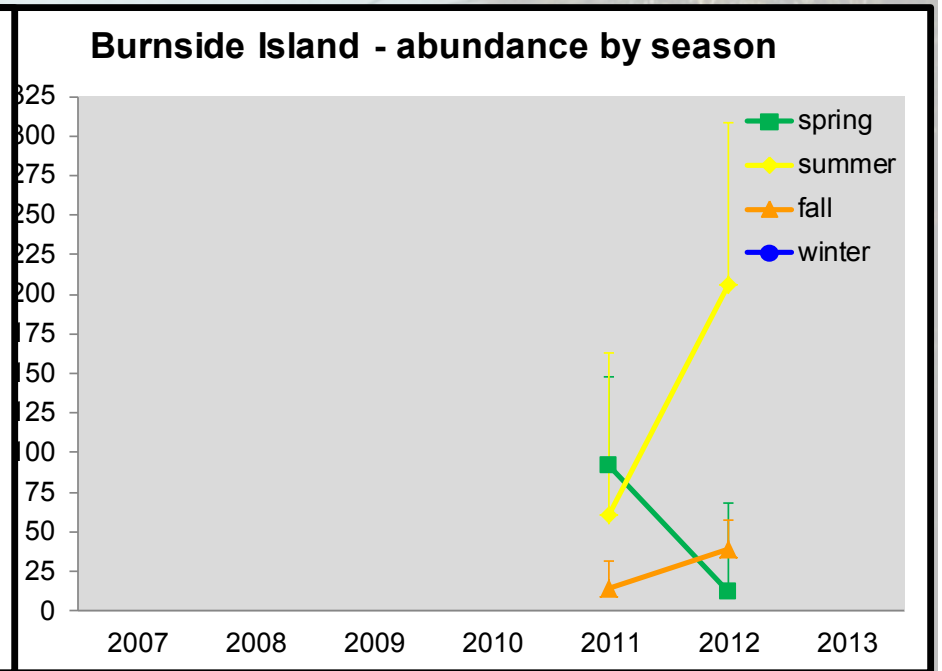
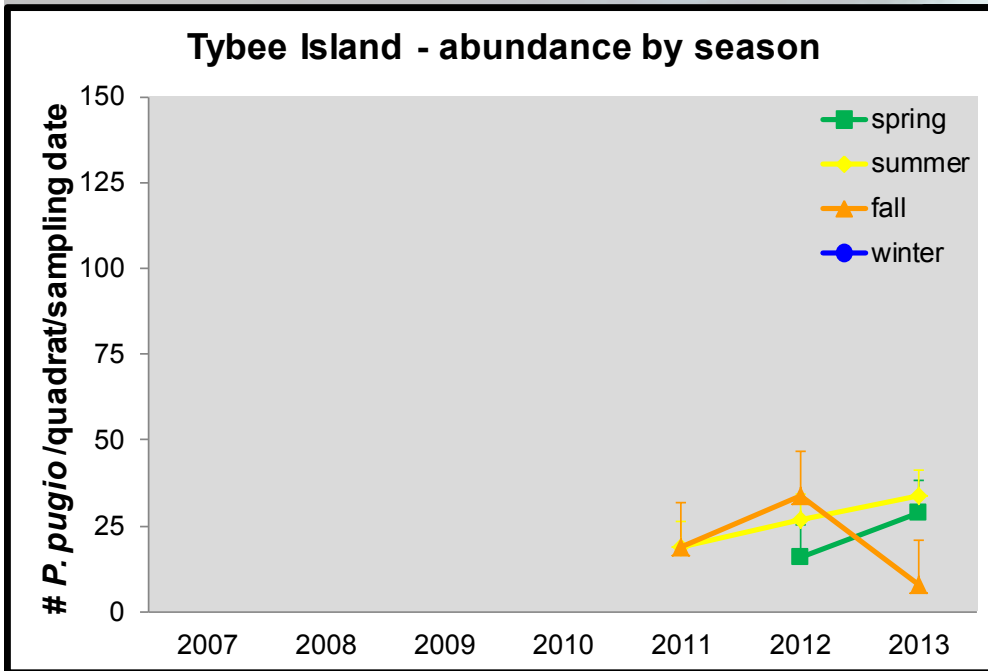
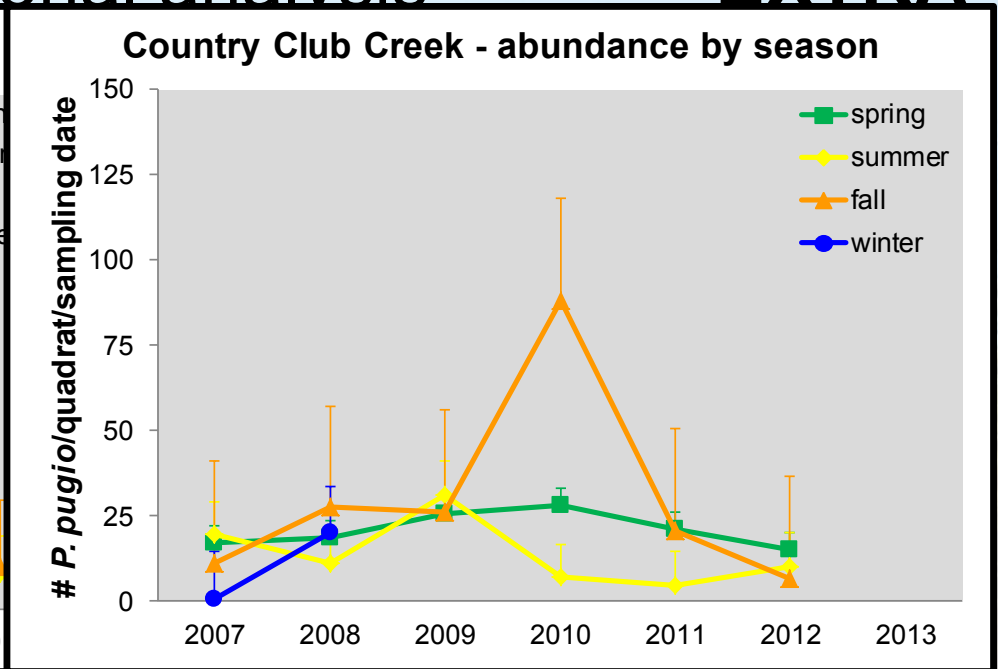
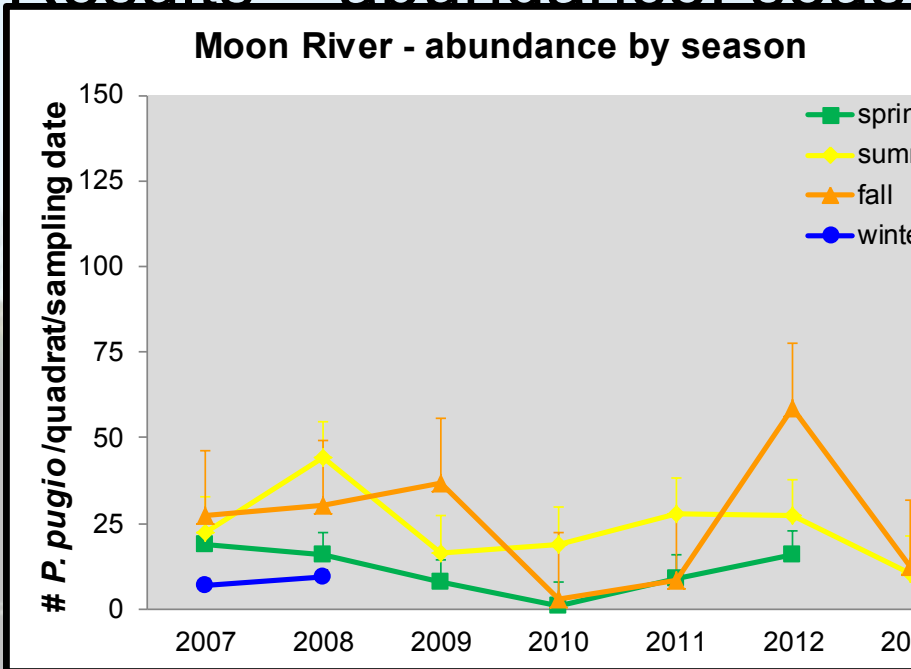


Seasonal abundance analysis of daggerblade grass shrimp (*P. pugio*)



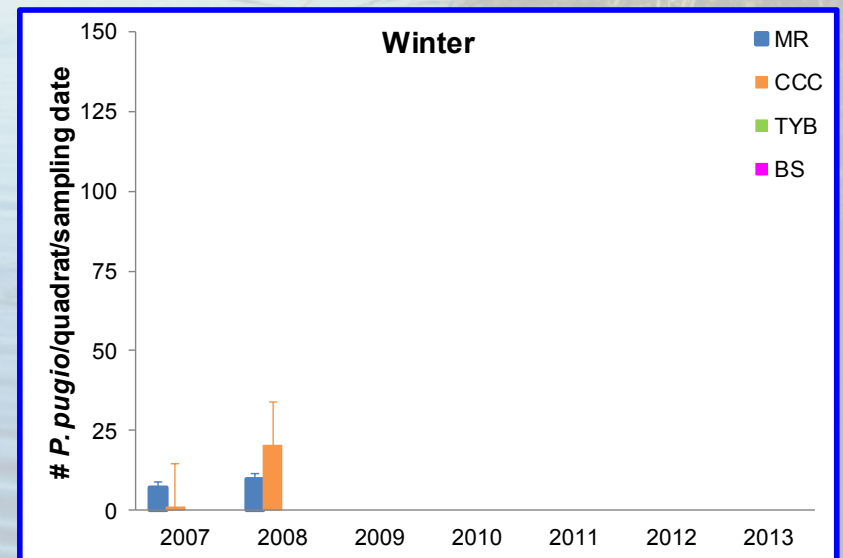
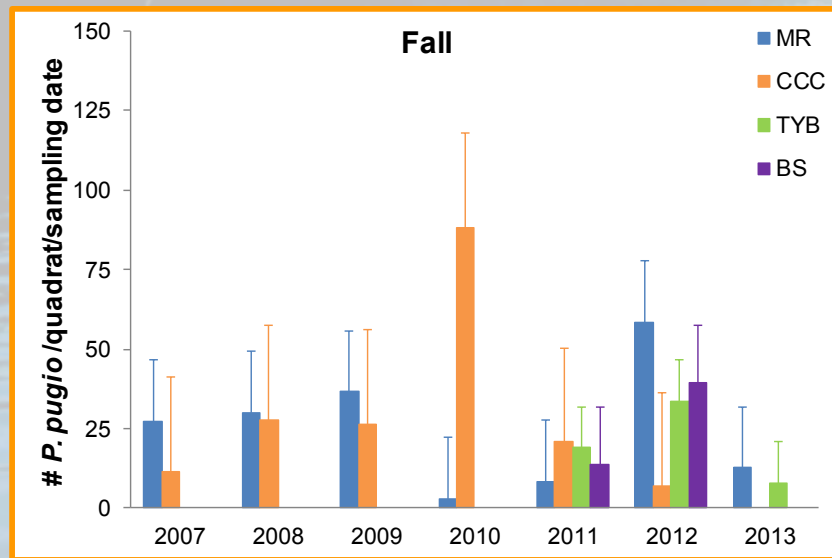
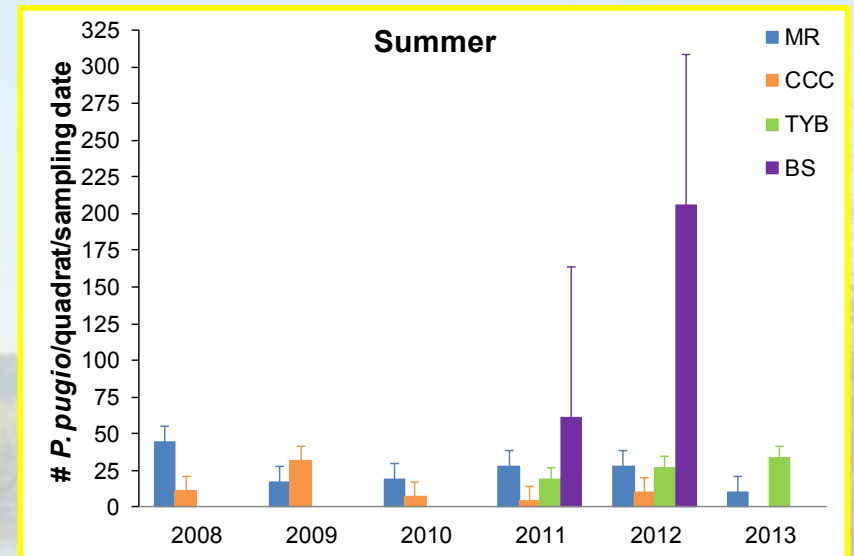
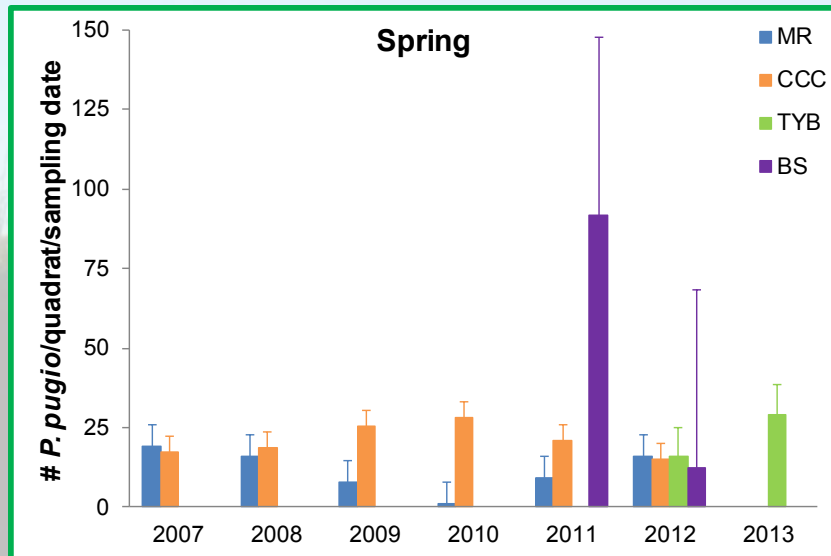
Results – abundance. seasonal analysis

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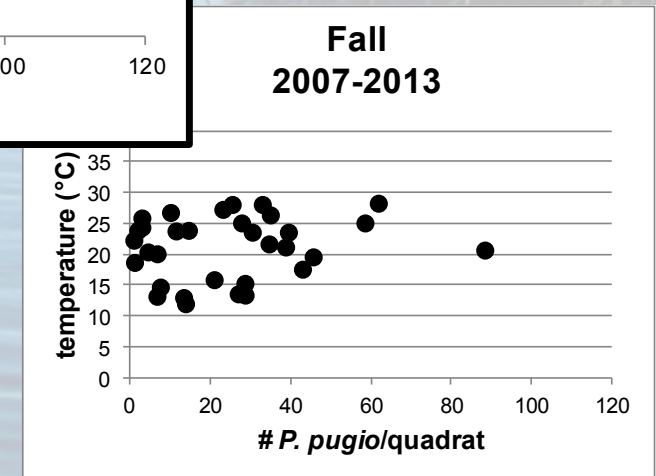
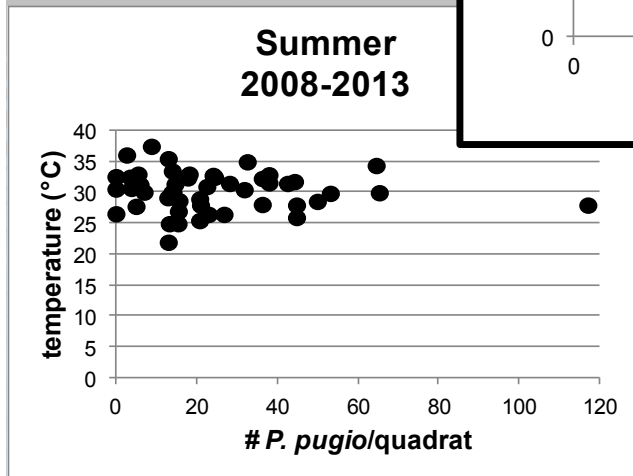
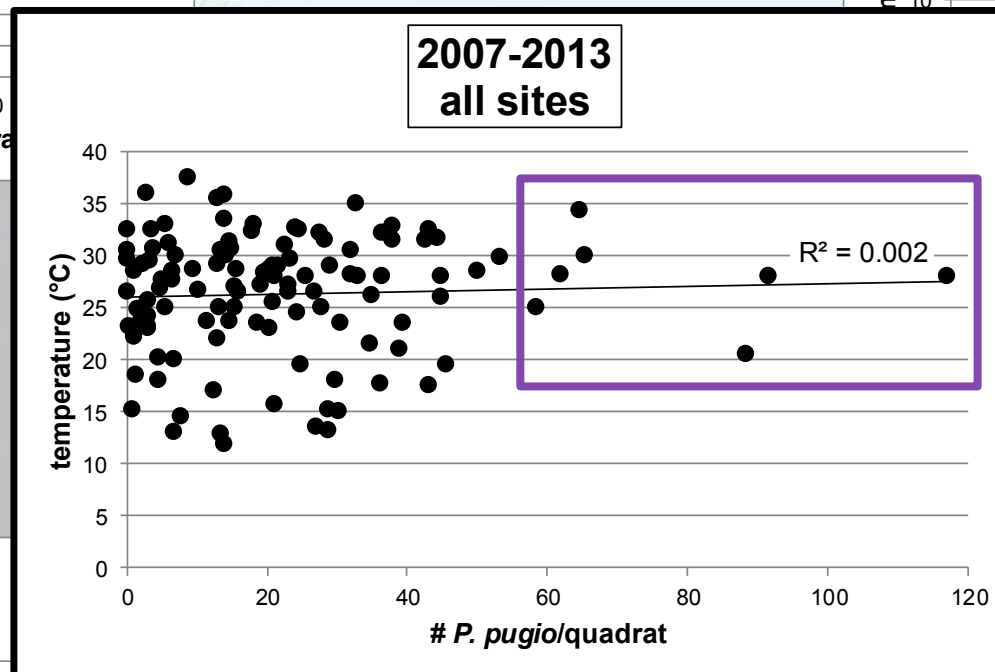
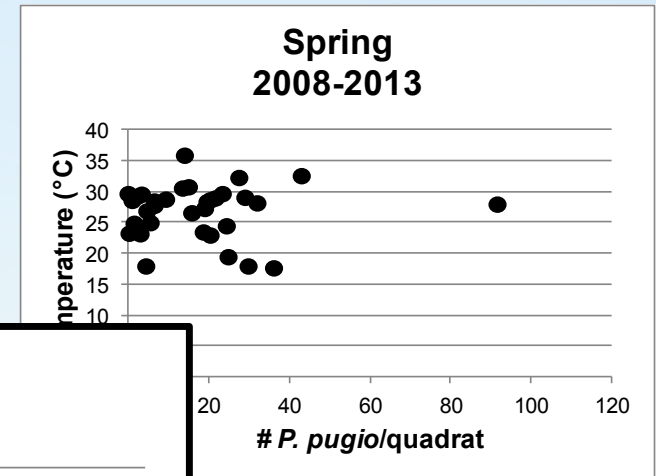
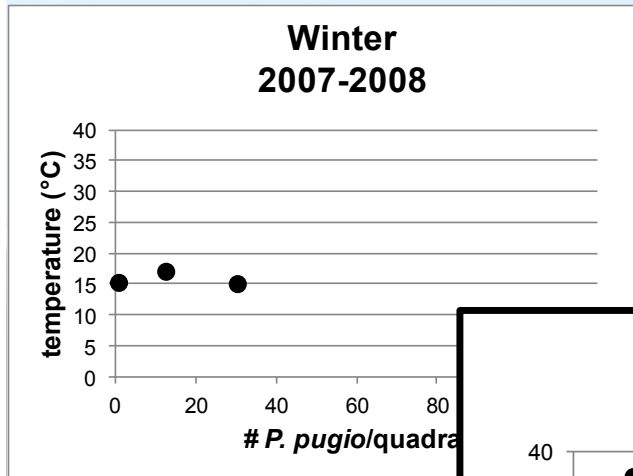


Results – abundance, seasonal analysis

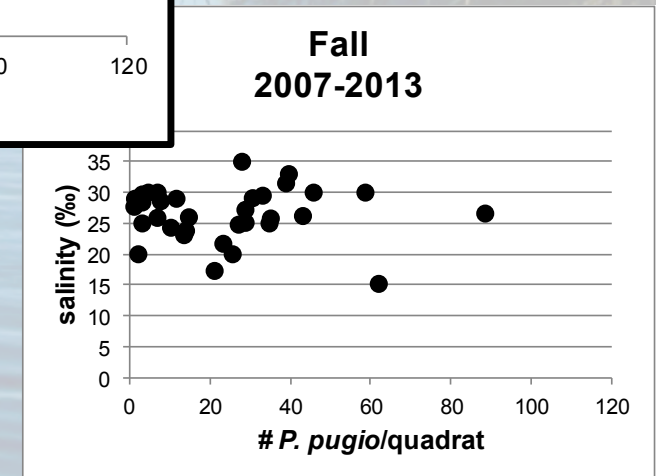
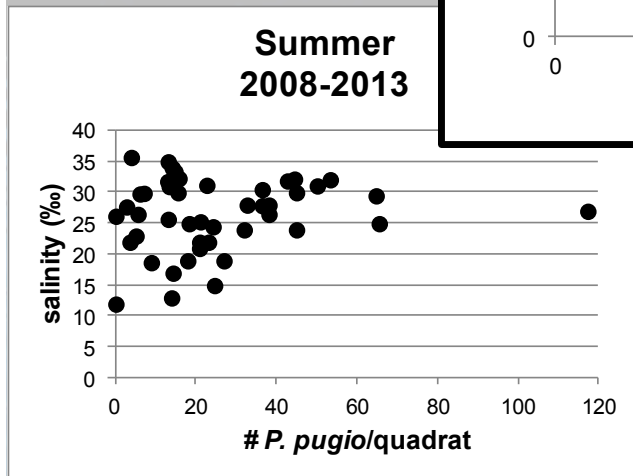
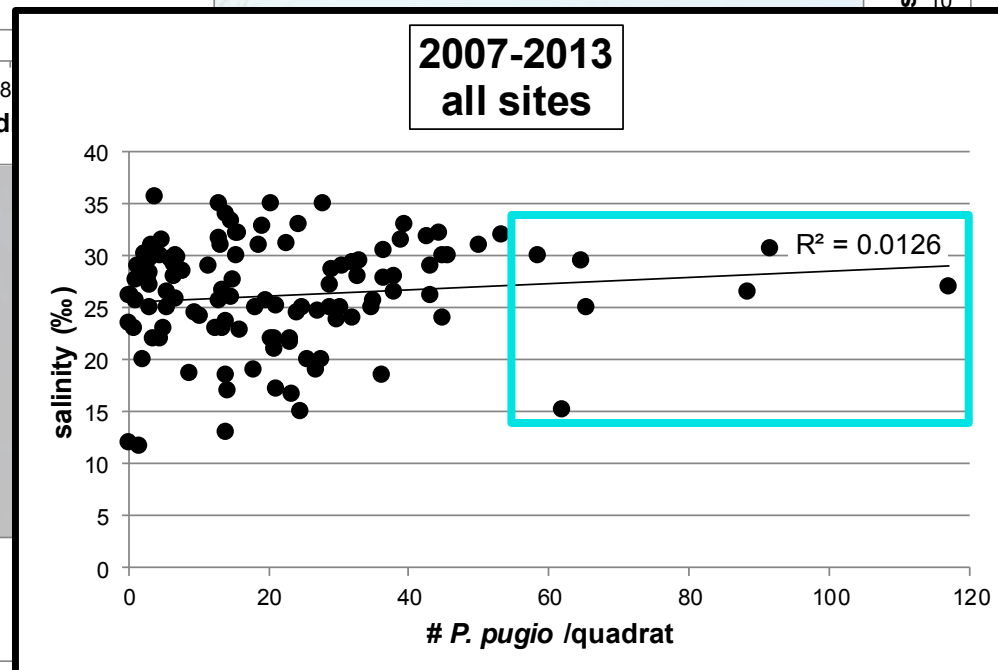
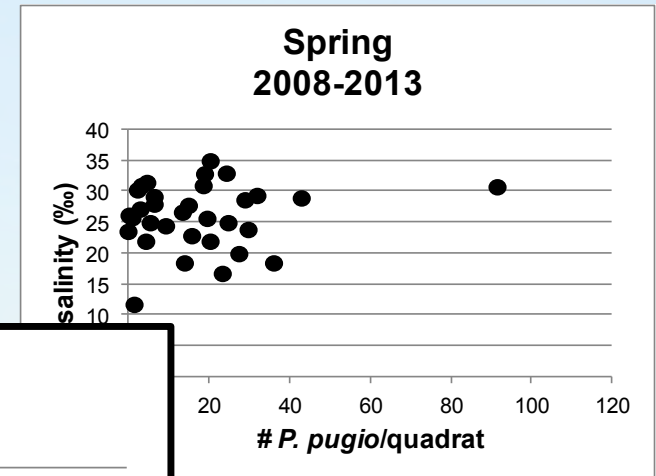
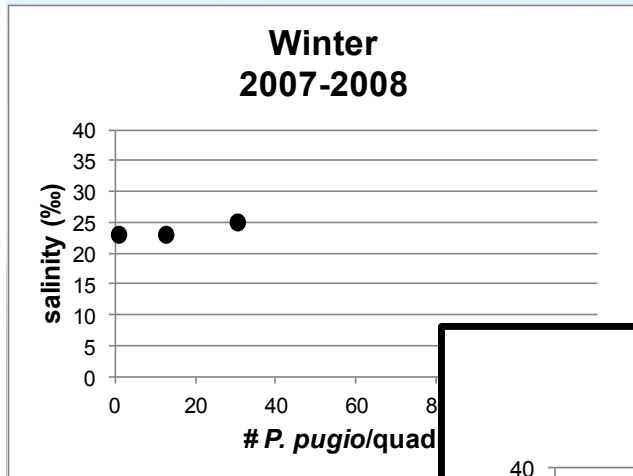
EXTRA



Results – abundance, seasonal analysis: temp **EXTRA**

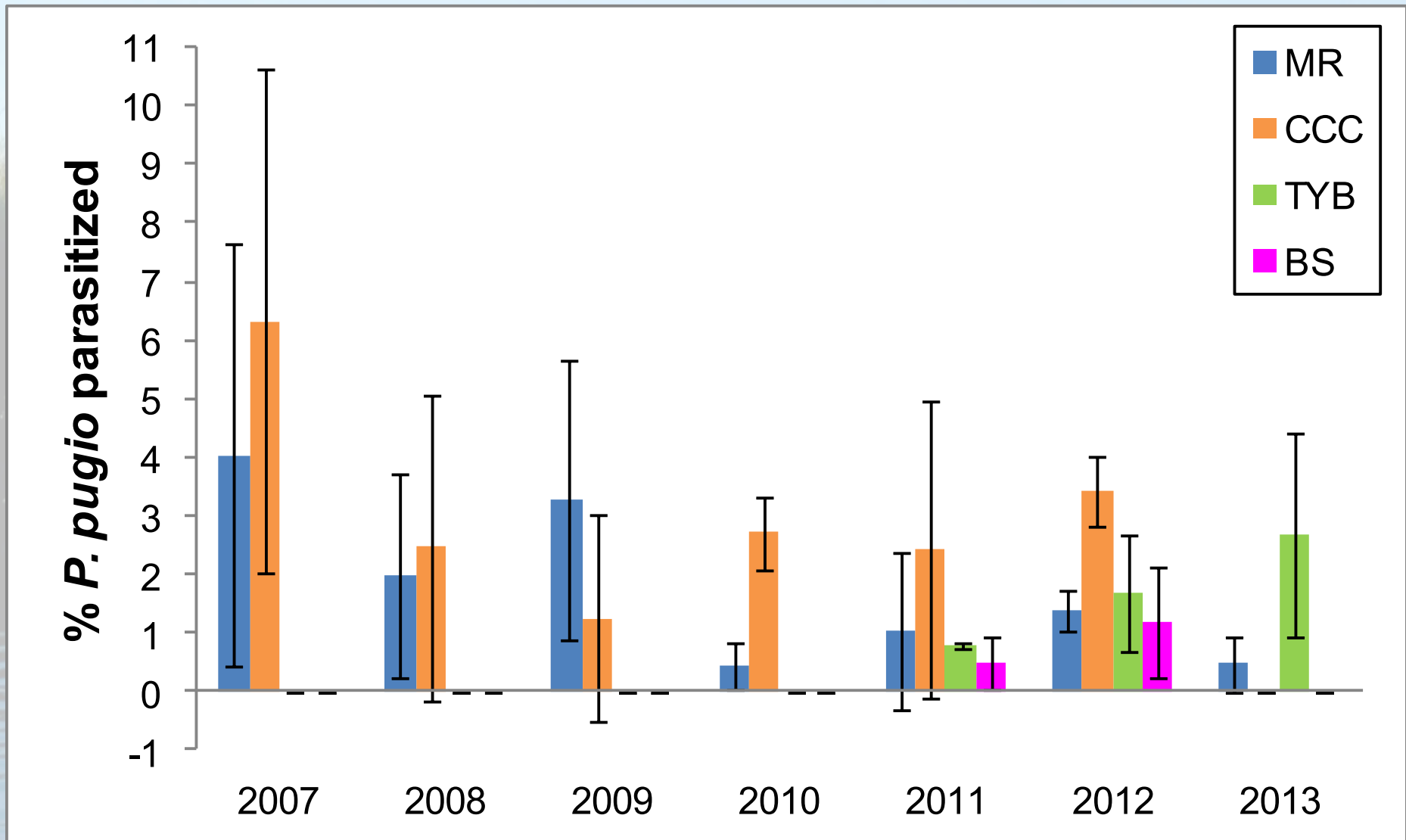


Results – abundance, seasonal analysis: salinity EXTRA



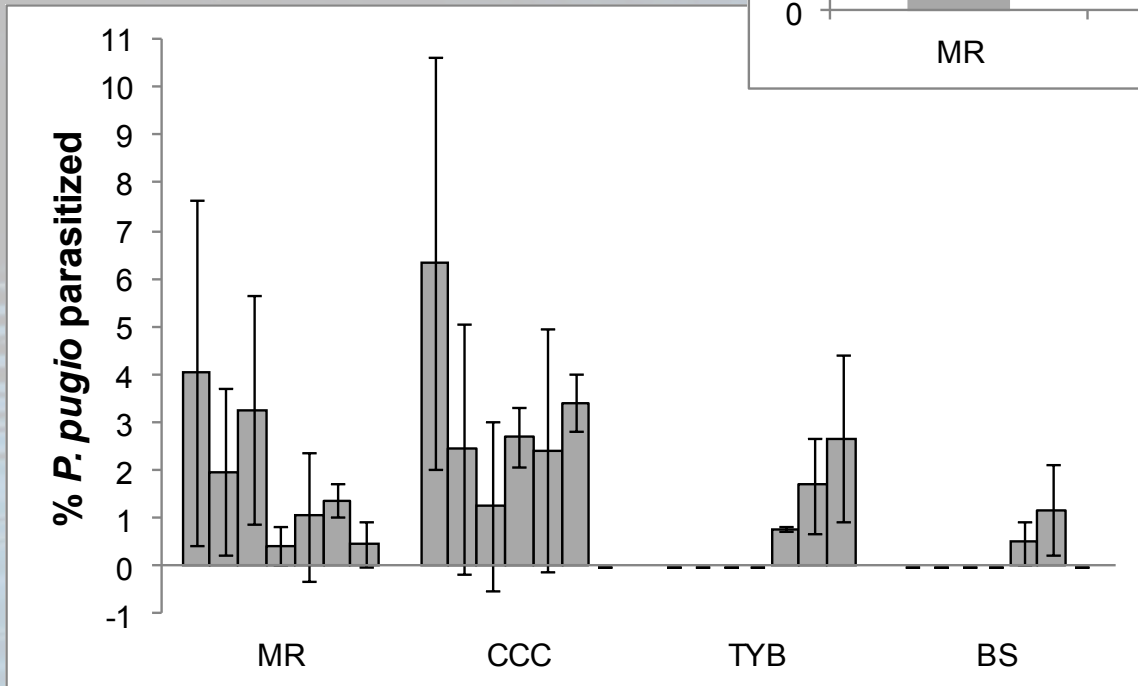
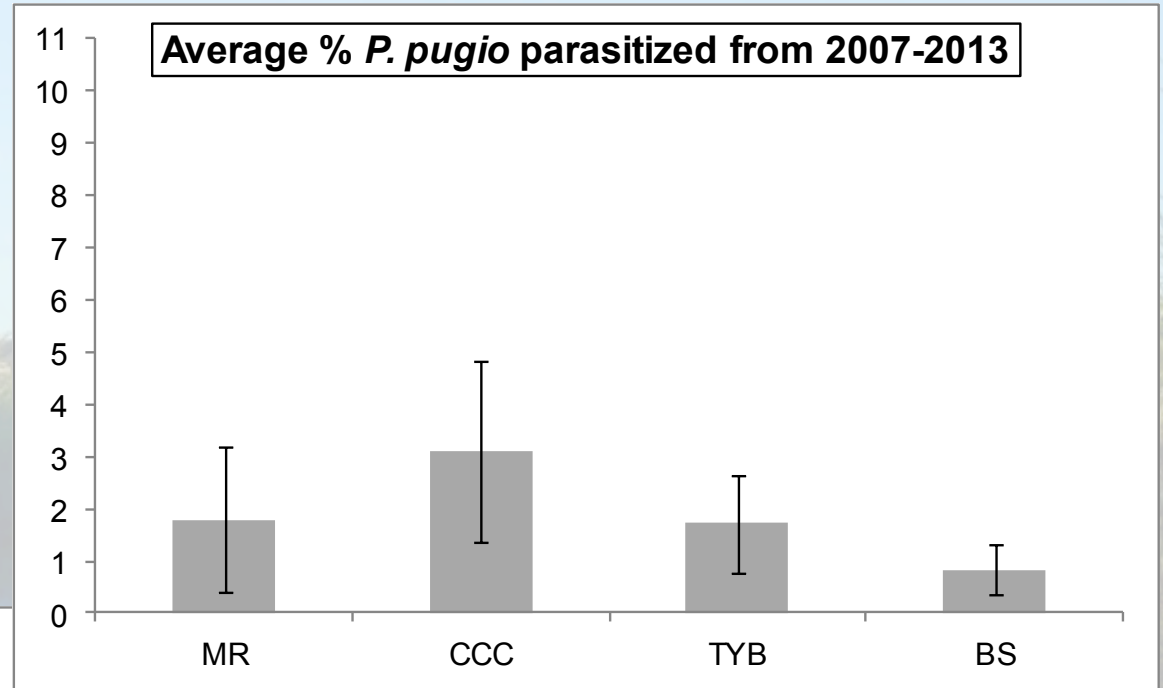
Results – parasite prevalence

EXTRA

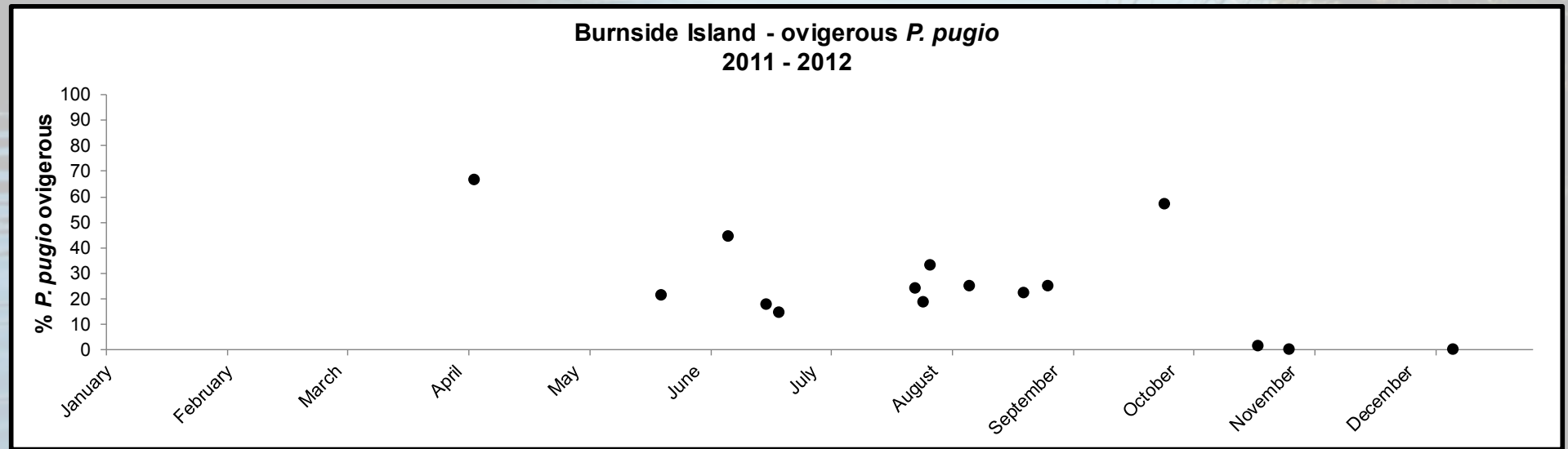
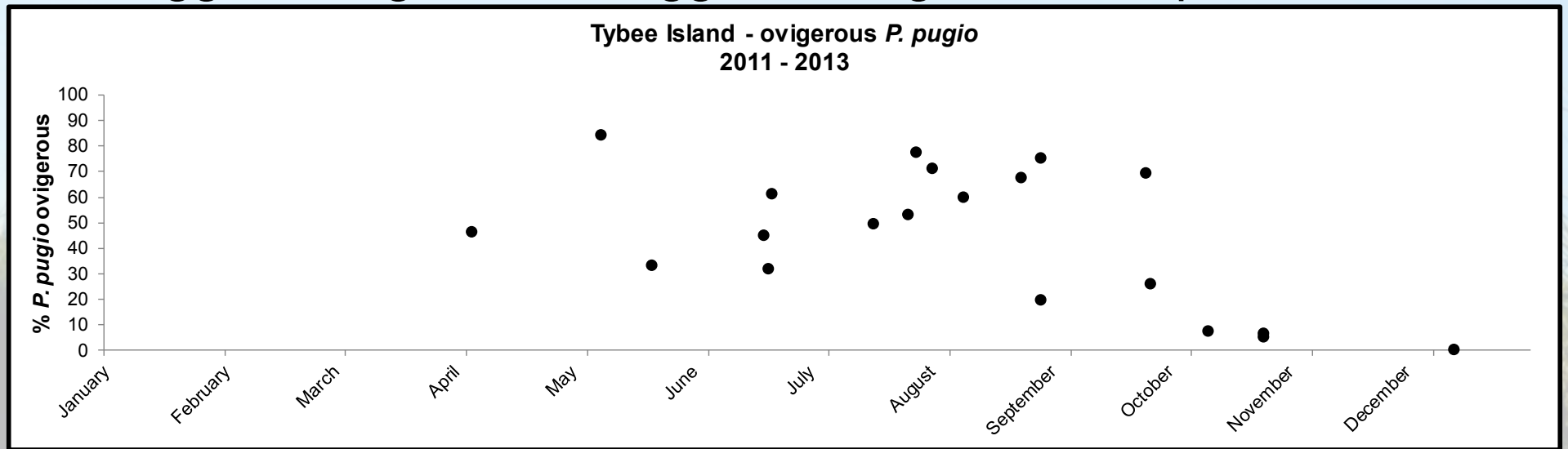


Results – parasite prevalence

EXTRA



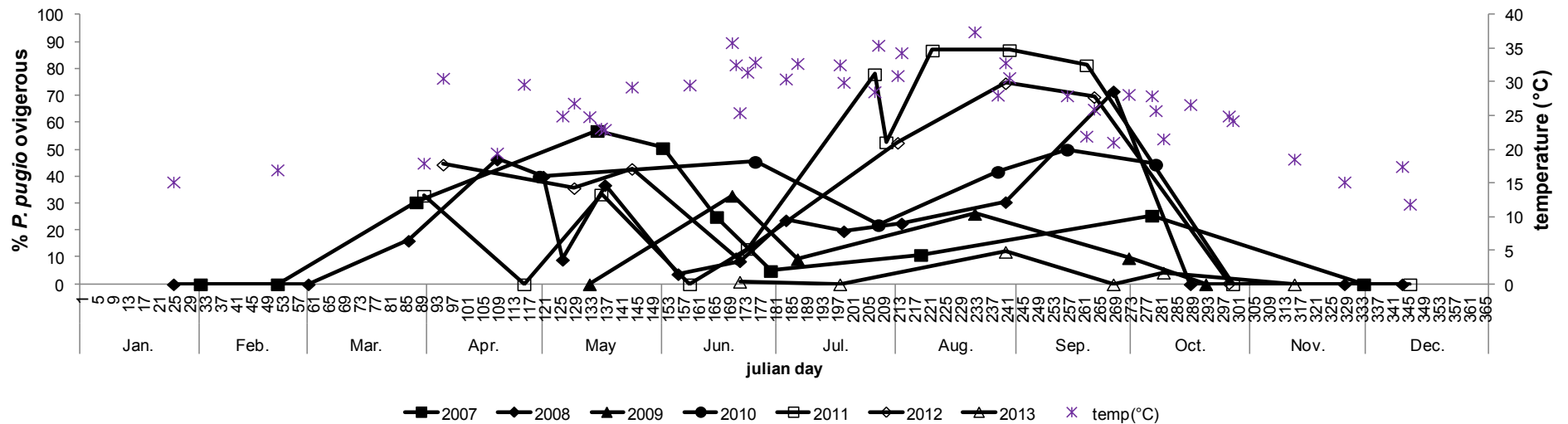
% of egg-bearing female daggerblade grass shrimp (*P. Pugio*) **EXTRA**



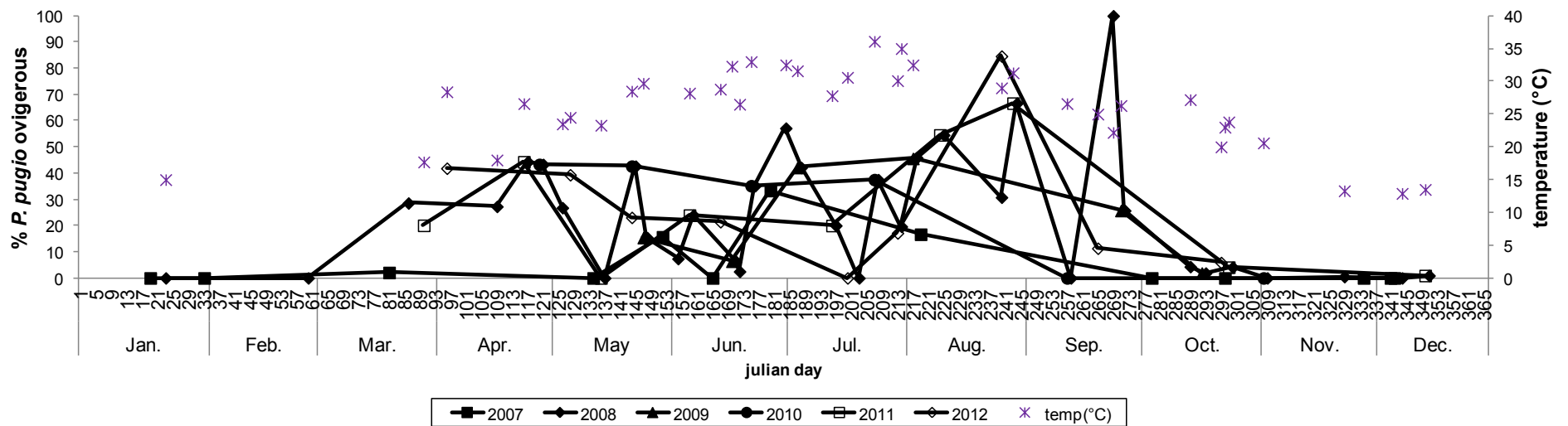
Results – ovigerity+temp

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MR



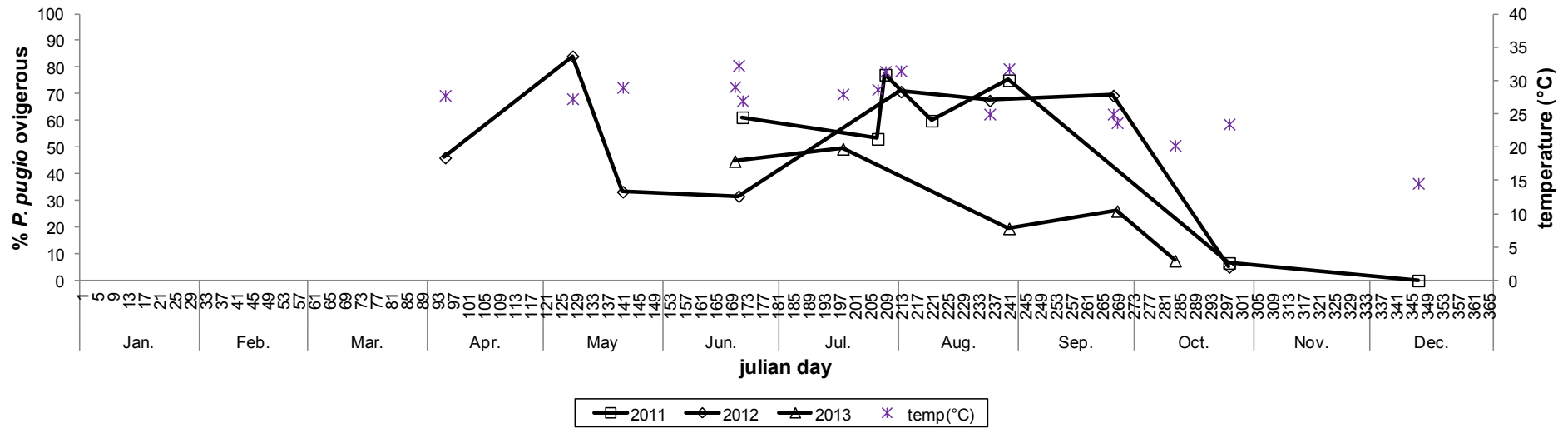
CCC



Results – ovigerity+temp

EXTRA

TYB



BS

