

National Shellfisheries Association Quarterly Newsletter



Est. 1908

2015 (1)

President's Message

As I scribe this last message as NSA President, the third blizzard in as many weeks has engulfed mid-coast Maine in nearly four feet of snow. Needless to say, gathering for our annual meeting in sunny California will be a welcome respite from this winter of shoveling snow and then shoveling yet more snow...

With over two hundred presentations, very strong student participation and a beautiful location, this 107th Annual Meeting of our Association is shaping up to be one of our best. Large meetings "don't just happen", but are the result of considerable planning and hard work and so thanks are due to Conference Manager Sandy Shumway for leading the effort in producing what will be a great meeting.



Thanks are also due to the Student Recruits for all their work helping to make the meeting run smoothly. Keeping costs down at our annual meeting is always a concern, and to that end, the generous support of meeting sponsors is greatly appreciated. This year, we should all thank the California, Oregon and Washington Sea Grant programs, Elsevier, Wiley-Blackwell and Sheridan publishers, Reed Mariculture and the Monterey Bay Aquarium for their support.

Serving as President of the NSA these past two years has been a privilege to work with such a talented and dedicated group of individuals serving as officers, committee chairs and staff of this great association. As I join those who have transitioned through these positions before me, I look forward to continuing to build both the professional and personal relationships that have grown over the years and welcome Karolyn Hansen as our new President. Finally, I'm told that serving as past-President is no cake-walk and so I won't be going anywhere soon!

Chris Davis

Monterey is just weeks away!

Everything is in place for an exciting meeting in Monterey. There are over 200 oral presentations in 3 concurrent sessions, over 70 posters and some key vendors.

Plenary speakers have become a welcome feature of the meetings, and this year we are most fortunate to have outstanding presenters to kickstart each day: Paul Dayton (Scripps Oceanographic Institute), Robert Vrijenhoek (Monterey Bay Aquarium Research Institute), Sam Dupont (University of Gothenburg), and Peter Cook (University of Western Australia).



We will be welcoming two special guests, artists Sylvia Gottwald and Bruce Koike, who will be displaying their artistic visions of shellfish throughout the meeting.

This promises to be a very busy meeting for the students and ~100 are expected to participate! This may be a record setting showing. A special panel discussion for the students is planned for Monday evening: 'The career path is never straight'.

And there will be no reason for folks to play hookie during the meeting to enjoy the splendors of Monterey -

Continued on page 2.

In this issue:

- **Meeting Update**
- **Student Research Updates**
- **Pacific Coast Section News**

Recruits' Corner

Hello recruits!

Hope this newsletter finds you well as we prepare for the upcoming meeting in Monterey, CA. This is promising to be a great meeting, where the recruits are sure to be well represented. Over 80 abstracts from student members were submitted, with 50 oral presentations and 30 poster presentations by student first authors. We all look forward to hearing from everyone and seeing your research.



Congratulations to all the travel award winners. As a general reminder, winners are expected to volunteer during the meeting. Your help is essential in ensuring a smooth operation; we can't do it without you!

There will be a brief student orientation meeting prior to the President's Reception. We encourage all recruits, particularly if this is your first meeting, to attend and meet your co-chairs and fellow students. At the orientation we will go over some of the details that will ensure a good meeting for all. We encourage you to seek us out and ask any questions you may have. If you miss the orientation, don't forget the student breakfast. This will take place Monday morning and is a chance for the students to meet some of the Executive Committee and NSA officers, including the NSA President. The breakfast is included as part of your student registration.

We are very excited to announce some great activities planned for the students at this meeting. The student session is on for Monday the 23rd. This special panel, titled "The Career Path is Rarely Straight" will feature industry professionals, who will share some of their experiences and "pearls of wisdom" as you transition to a "settled recruit". Questions addressed to the panel are encouraged. After the panel, we will be heading out to local haunts in the Monterey area with drink and food specials. More details about the outing will be available with the student packet you'll receive at registration.

On Tuesday the 24th the Student Endowment Fund auction will take place. This auction raises funds to cover some of the meeting costs for students, including travel awards and research awards. Food will be provided during the auction, and we encourage everyone to attend. You might even score some sweet shellfish related gear.

The NSA Business Luncheon on Wednesday the 25th is also

included as part of your student registration. After the luncheon, we have a behind the scenes tour of the Monterey Bay Aquarium. Space is limited, and will be on a first-come first-served basis. If you are interested in attending, e-mail us ASAP to reserve your spot.

To take even more advantage of our host city, we have mapped out a few running routes along the Monterey Bay Coastal Trail, which is just a couple blocks from the conference hotel. We encourage you to explore on your own, or join the group. Details on times when the runs will take place will be given at the student breakfast. One point of interest is the Point Lobos State Reserve, which is a 15-minute drive from the Monterey Marriott. The reserve is a scenic coastal area that features a variety of marine animals and wildlife, hiking trails, and a whaling museum. Walk-out diving is also available at Point Lobos – check out the reserve website for details on fees and reservations. No dive gear is available for rent at the reserve, but there are many local dive shops that will rent gear for the day. We have been in touch with Breakwater SCUBA (831-717-4546) and Aquarius Dive Shop (831-375-1933). Both shops are ready to provide rental dive gear and answer any questions about diving at Point Lobos or in the more immediate Monterey area.

When you pick up your registration information, be sure to grab a student packet with all the information on these events and everything to make your meeting a successful one.

If you are interested in volunteering, or learning more about being involved with the organization, we encourage you to send us an e-mail (maria.rosa@uconn.edu and hlane12@umd.edu). Questions, comments, and suggestions are always welcome!

Looking forward to seeing everyone in Monterey!

Maria and Hillary

Monterey Meeting *Continued from page 1.*

Wednesday afternoon (after the Business Luncheon) has been kept open, i.e. no presentations. A Poster Session/ Happy Hour with hor d'oeuvres is scheduled from 5 - 7, so plane to come back after you've had your fun.

Instructions for poster displays are posted on the web page - please consult them to be sure your poster is displayed properly (48" wide x 40" high).

Further details on all of these activities are provided on the web page (www.shellfish.org) along with the full program.

Don't forget your auction items, see you in Monterey!

2014 George R. Abbe Student Research Grant Update

Awardee: Catherine Drake

“Decorating Behavior in Loxorhynchus crispatus and Consequences of Possible Mutualisms from Living on a Mobile Environment”

The good news is, after presenting a poster on my research at last year’s annual meeting, I left Jacksonville enthusiastic about my thesis. I got the chance to talk to other people interested in crustaceans and was excited to return to California to begin my data collection. The bad news is, one day while diving, I hurt my neck and was unable to dive for six months. But, my neck is better now and I am cleared to dive, so I have gotten back in the cold waters of Monterey Bay in search for decorator crabs!



Through my research, I hope to better understand spider crab decoration by studying a local crab, *Loxorhynchus crispatus*. As we know, crabs in the superfamily Majoidae are known to decorate themselves for camouflage, either through active or passive decoration, and the method of camouflage can change throughout the organism’s lifetime. *L. crispatus* (Stimpson 1857) actively covers its carapace and appendages with elements of its environment after manipulating these elements. Despite large site-to-site and regional variation in benthic community composition along the West Coast, generally the same taxonomic groups are found decorating *L. crispatus*, such as bryozoans, tunicates, sponges, and various algae, throughout its range. This general trend might suggest that the crabs are preferentially choosing specific taxa for decoration, yet the propensity for selective decoration remains unexplored for this species. Decorator crabs are known to decorate their carapaces for one or more of the following reasons: (1) using noxious species to chemically deter predators, (2) using their carapace as a location to store preferred food resources or (3) mimicking their environment with camouflage to avoid predator detection. It is not yet known which method of the behavior *L. crispatus* exhibits, and thus a primary thesis question is proposed: Is there evidence that *L. crispatus* individuals are targeting their decorative organisms in a non-

Continued on page 6.

NSA Pacific Coast Section News

Changing of the guard here in the Pacific Coast Section (PCS) as I step into my new position as PCS Chair. I’d like to extend a heartfelt thank you to Brett Dumbauld who has served in this position for the past 4 years. Over that time, Brett helped with efforts to overhaul the PCS constitution and bylaws, introduce a new logo for PCS, and transfer/update the PCS website. He also contributed to some very successful fundraising efforts that have allowed PCS to fund student travel and participation in our annual meeting. Thankfully, Brett continues to be willing to provide guidance to me. I also have an experienced group of officers I can lean on to make sure I don’t mess up!

So, a bit about me. My career has always revolved around food, primarily seafood. I graduated from UC Berkeley in 1993 with a BS in Food Science. My senior research project focused on human plasma lipid profiles when oysters were the primary dietary protein source. I received my MS and PhD from the University of Washington’s School of Aquatic and Fisheries Science (SAFS) in 2001 and 2006 respectively. For my master’s work I developed population parameters for beluga whales via subsistence harvest (I’m not sure everyone appreciated the beluga muktuk I contributed to the annual SAFS ‘Eat What You Study’ potluck). My doctoral work used Steller sea lion blubber fatty acids as indicators of diet.

After graduate school I accepted a job with NOAA Fisheries where I conducted Endangered Species Act and Essential Fish Habitat consultations, and became involved with eelgrass and Olympia oyster restoration. Through my work with Olympia oysters and interest in domestic seafood production, I frequently collaborated with NOAA’s Office of Aquaculture, which ultimately led to my current position as Aquaculture Coordinator for NOAA Fisheries West Coast Regional Office.

On a more personal note, I am a strong believer in producing food domestically so we can maintain the economic benefits and insure proper regulatory oversight. I am a mother to two young boys which keeps me busy. In my free time (when is that?), I enjoy knitting, hiking, snowboarding and boating.

Back to the PCS, I want to emphasize that student involvement continues to be the focus of the PCS mission. Current membership includes students from the University of Washington, the Evergreen State College, Oregon State University, University of Southern California, California State University, UC Davis, and University of Alaska.

Continued on page 6.

2014 Melbourne Carriker Student Research Grant Update

Awardee: Keri Lydon

“Triclosan pollution impacts on intrinsically resistant Vibrios: Understanding risk in shellfish populations”

A major source of antibiotic pollution is wastewater effluent into aquatic systems. Frequently present in this effluent is the antimicrobial triclosan (2,4,4'-trichloro-2'-hydroxydiphenyl ether) due to its presence in many consumer products such as hand soaps and toothpastes. Like many other pharmaceutical products, triclosan is not broken down or removed during the wastewater treatment process and ends up at low concentrations in sediments and near shore waters. Beyond this, triclosan also enters localized marine waters from septic tank drainage fields.

Resistance to triclosan has been observed in *Vibrio cholerae* at levels 20-fold higher than observed in *Escherichia coli*. Considering the high number of cases of *Vibrio* on the rise associated with raw oyster consumption, we began this research to study if the risks of *Vibrio* infections and severity of those infections are exacerbated by increases in triclosan pollution in shellfish harvesting waters by selecting for resistant *Vibrio*.

This project has many questions associated with it that included:

- 1) To what extent are *Vibrio* bacteria resistant to triclosan?
- 2) What genes are responsible for triclosan resistance in *Vibrio*?
- 3) Does triclosan select for *Vibrio* bacteria in natural waters?
- 4) Is triclosan associated with *Vibrio* infection risk in raw oyster consumption?

To answer our first research question, I examined 49 cultures of known *Vibrio* species from environmental and clinical sources through broth microdilution assays to determine triclosan minimum inhibitory concentrations (MIC). MICs are defined as the lowest concentration in which there is no visible growth of bacteria after being incubated overnight. Within this set of isolates were known clinical strains as well as environmental *Vibrio* isolates obtained from distinct habitats: the North Inlet Estuary (Georgetown, SC), residential marine canals in Florida Keys and Looe Key Reef in the Florida Keys National Marine Sanctuary. All but two *Vibrio* strains tested were resistant to triclosan with MICs ranging from 6-300 ug/mL, compared to 3.125 ug/mL found in the *E. coli* control.

We then looked at for the presence of the fabV gene, which had been previously defined as responsible for triclosan resistance in *V. cholerae* through the expression of the FabI isoform FabV. After developing a PCR assay, all isolates were screened for this pathway. Surprisingly, not all strains tested had fabV present. This suggests that there are many pathways beyond fatty acid synthesis that *Vibrio* could be using to be resistant to triclosan.

After characterizing and establishing triclosan resistance in *Vibrio*, we were anxious to see if our main hypothesis of *Vibrio* being selected for by triclosan was true. To do this, I examined the impacts of environmentally relevant concentrations of triclosan on *Vibrio* bacteria densities in natural marine waters at three sampling locations. Locations included North Inlet Estuary (Georgetown, SC), Doctors Arm Canal (Big Pine Key, FL), and Looe Key Reef (FL Keys National Marine Sanctuary). North inlet was considered our pristine location free of septic tank or wastewater effluent inputs. Next, we considered Looe Key Coral Reef to be



free of triclosan. Finally, Doctors Arm Residential Canal was considered our contaminated site due to its proximity to homes on septic systems.

For all three sites, 15 one-liter surface water samples were taken and three were randomly assigned as time zero samples. Remaining bottles were randomly assigned to treatments in triplicate to create micro-

cosms. Treatments included no-triclosan, solvent control, low triclosan (ppb), and high triclosan (ppm). Immediately after treatment, 45 ml of sample were taken to determine background concentrations of triclosan and establish treatments. All microcosms except for time-zero samples were placed in a running seawater raceway outdoors to establish conditions as close to natural as possible. Time-zero bottles were processed by spread plating water onto TCBS microbiological plates for enumeration of *Vibrio* bacteria. These plates were also used to obtain isolates for testing of triclosan resistance. Next, water (900 ml) was filtered onto Sterivex™ filters (Millipore) for analysis of microbial community composition.

Results from these experiments have shown remarkably higher levels of relative mean *Vibrio* densities for high triclosan treatments at all three locations. Beyond this, there are no differences between no addition controls, low triclosan, or the solvent controls. In the next month, samples will be sent out for 16S sequencing on an Illumina MiSeq. After

Continued on page 6.

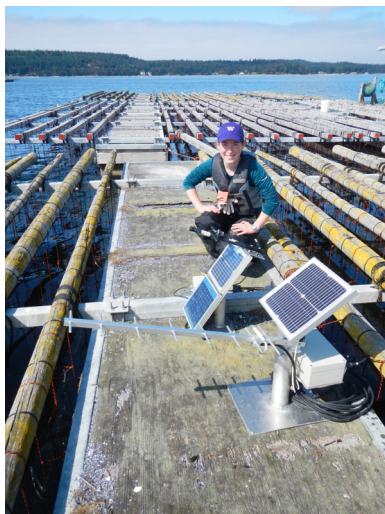
2014 Michael Castagna Student Research Grant Update

Awardee: Laura Newcomb

“Impact of environmental stressors on the mechanics of mussel byssal threads”

Mussels are the Spiderman of the Sea. Sticking out their foot, then using it as a mold, mussel make stretchy fibers called byssal threads that can attach to almost anything. They mold many byssal threads, creating a network of “anchors” strong enough to resist forces of waves, currents, and predators.

Mussel aquaculturists place fibrous collecting lines in the water to which mussels naturally settle and secure themselves. However, sometimes these lines are pulled up entirely void of mussels or with large patches of mussels missing, events known as “fall-off”. Mussel dislodgment has also been observed in wild populations and has been linked to a weakened attachment, that is, when their Spiderman threads don’t anchor as strong as they should. Previous studies have shown that this fall-off follows a seasonal pattern, but it’s still unknown what triggers this change. Farms have reported increasing fall-off in recent years, motivating our interest in solving this problem. We (a team of myself, Dr. Emily Carrington, and Penn Cove Shellfish owner Ian Jefferds) use this study to ask: Does climate change- in the form of elevated temperature and lowered pH from ocean acidification- weaken attachment strength and cause mussel fall-off?



Temperature and pH may alter byssal thread strength through two mechanisms. Living under sub-optimal water conditions may cause mussels to exert more energy to perform general maintenance, leaving less energy available to form threads. Second, mussels mold these threads through a series of chemical reactions and the proper bond formation is likely temperature and pH dependent. Using the laboratory as a controlled environment, we tested how temperature and pH may change the strength of the threads of *Myt-*

ilus trossulus, the bay mussel native to the West Coast of North America. We found temperatures above 18°C and pH below 7.6 weakened byssal threads, which in turn lowers attachment strength. With the identification of two potential causes of field mussel weakening and fall-off, we next needed to ask, do mussels ever experience these threshold conditions in the field? If so, can we see a correlation between dangerous conditions and mussel fall-off?

Penn Cove Shellfish, LLC located on Whidbey Island in Washington State, grow mussels on lines hung to a depth of 7 meters from floating rafts. Our team installed multi-parameter datasondes to measure the pH and temperature of the water, as well as oxygen, chlorophyll and salinity at 1 m and 7m.

These measurements allowed us to address our first study question: Do mussels experience conditions in the field that lead to inferior thread formation and attachment? We recorded higher summertime temperatures at the surface of the lines (1 m); these temperatures can sometimes reach a high of 20°C – into the “danger” zone for mussels (above 18°C). Mussels growing at the bottom of the line (7 m) only saw a high of 16°C. However, deeper water may not be the safe haven for mussels either, since the lower depths have pH values during the summer as low as 7.3, moving below the threshold of 7.6 identified in the lab. Seasonally, Penn Cove saw warmer temperatures in the summer and lower pH in the autumn.

We made monthly trips to measure mussel attachment strength both at the top and the bottom of the lines, using a force gauge to pull mussels off of the lines and record peak force for dislodgement.

These measurements allowed us to begin to address our second question: Does mussel attachment change seasonally and correlate with seasonal changes in pH and temperature?

Mussels were attached more strongly to the lines in the winter than the summer. This weaker summertime attachment corresponds to warmer temperatures, known in the lab to produce weaker threads, contributing to this loss in strength. Further, in August and September of both 2013 and 2014, mussels growing at the top were weaker than mussels at the bottom, a trend that may be due to mussels at the top spending the summer months in even warmer water, less conducive to forming a strong attachment.

Ultimately, our goal is to use our real-time environmental data from the farm to forecast fall-off events, enabling alternative harvesting practices to achieve maximum yield. I am grateful for funding from NSA that supported this study and look forward to presenting my results in greater detail in Monterey.

Pacific Coast Section *Continued from page 3.*

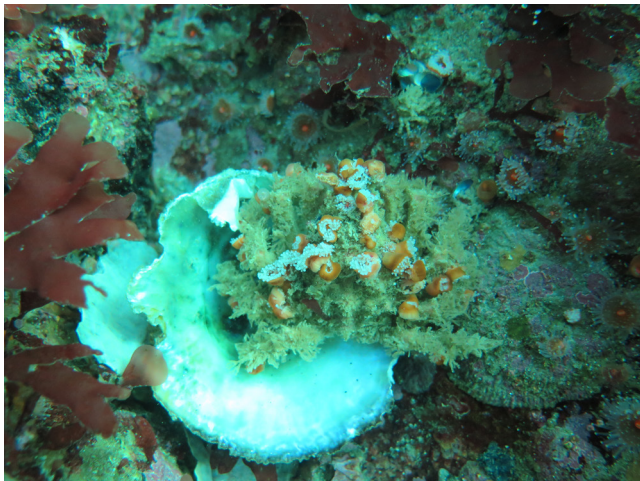
The PCS is happy to announce that we are offering financial support to NSA-PCS student members who are presenting at the upcoming NSA conference in Monterey, CA. These awards will be in the ballpark of \$300 depending on the number of requests we receive and can be used by the student to help fund their conference or travel needs.

The 2015 PCSGA/NSA-PCS conference will be held in Hood River, Oregon from September 20-24, 2015. The call for papers will be posted soon on the PCSGA website with presentation titles due May 1 and full abstracts due July 31. This meeting brings together the academic community with the shellfish aquaculture industry—taking science from the ivory tower and making it applicable. I hope you will join us!

Laura Hoberecht
Pacific Coast Section Chair

Abbe Award Update *Continued from page 3.*

random way, and if so, is their behavior of decoration similar to that of other spider crabs?



Loxorhynchus crispatus

As these crabs cohabitate with their decorations, specialized relationships may develop. Over time, mutualisms have arisen between many species of crabs and other organisms. Since both facultative and obligate mutualisms have been observed between multiple species of spider crabs and other invertebrates, it is possible that mutualisms may arise between *L. crispatus* and its decorative organisms. Conversely, it is also possible that decorative organisms are inhibited by removal from their original substrate, and thus they could evolve methods to deter *L. crispatus* from using the organisms from the environment.

Hence, it is possible that as *L. crispatus* individuals decorate themselves, they could either enhance or diminish fitness of the selected organisms. Fitness benefits include protection from predators, enhanced feeding opportunities, less competition for resources or substrate space to grow, and reduced sedimentation. In contrast, some costs include decreased growth from a restriction from food, decreased reproductive output due to having to recover from being removed from the bedrock, or increased predation if *L. crispatus* eats its decorations. Thus, an additional thesis question is proposed: Are there measurable benefits or costs for organisms inhabiting a crab carapace?

Similar to previous studies, this study may contribute evidence to determine if *L. crispatus* individuals utilize their community assemblages in some way, whether by eating the assemblage, using the organisms' natural predatory defenses to the crab's advantage, or simply by improving the crab's attempts to avoid predation through camouflage. Additionally, this study may provide evidence of mutualism between the crabs and their camouflage that could suggest coevolution of these groups. Contrarily, organisms may be negatively affected by their use as decoration and may adapt ways of deterring crabs. This study aims to determine whether the association between *L. crispatus* individuals and their community assemblages is simply a facultative relationship facilitated by the behavior of decoration, with no consequence to the organisms used, or if there are benefits or costs to the decorative organisms to inhabiting a mobile environment.

Even though I'm in the beginning stages of data collection, I'm still noticing some changes of decoration behavior, both ontogenetically and by gender. I'll be presenting during the sessions for crustaceans, and hopefully I'll see you all there!

Carriker Award Update *Continued from page 4.*

this, bioinformatics programs will be used to determine if there are differences in communities amongst treatments. We expect there to be changes in the microbial communities, even at the low triclosan treatment where we did not see a *Vibrio* response.

Having shown that *Vibrios* are selected for at ppm levels of triclosan, the next steps for this research are bringing the study full circle and back to the environment. My plans are to go out this summer to coastal Georgia to areas impacted by triclosan pollution and compare levels of *Vibrio* within oysters to levels of triclosan in the oysters, as well as, the surrounding environment (sediment and surface water). It is my objective to compare these with oysters in pristine areas to determine if triclosan is associated with higher levels of *Vibrio* in oysters.

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HAVE YOU RENEWED YOUR NSA DUES FOR 2015?

If not, this is your last issue of the Newsletter, so you better head on over to

www.shellfish.org

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Upcoming Events

10th International Conference on Molluscan Shellfish Safety. March 15-20, 2015, Puerto Varas, Chile. For more information, visit: <http://icmss2015.com/>

107th Annual Meeting of the National Shellfisheries Association. March 22 - 26, 2015, Monterey, CA USA. For more information visit: www.shellfish.org.

20th International Pectinid Workshop. April 22-28, 2015, Galway City, Ireland. For more information visit: <http://ipw2015.com/>

World Aquaculture 2015 – Aquaculture For Healthy People, Planet and Profit. May 26 - 30, 2015 in Jeju, Korea. For more information, visit: www.was.org.

The Third International Symposium on Manila (Asari) Clam – Satellite Symposium of World Aquaculture 2015. June 1 – 2, 2015 in Tsu City, Mie prefecture, Japan. For further information, contact: Satoshi Watanabe, Ph.D., National Research Institute for Aquaculture, Japan: swat@affrc.go.jp.

International Symposium on Genetics in Aquaculture - June 21-27, 2015, Santiago de Compostela, Spain. For more information, visit: <http://www.isga2015.com/>

International Conference on Aquaculture & Fisheries. July 20-22, 2015, Brisbane, Australia. For more information,

visit: <http://aquaculture-fisheries.conferenceseries.com/index.php>.

Aquatic Biodiversity and Ecosystems – “Evolution, Interaction & Global Change”. 30 August - 4 September, 2015, University of Liverpool, United Kingdom. For more information, visit: www.aquaticbiodiversityandecosystems.org.

NSA-PCS/PCSGA Annual Conference. September 20-24, 2015, Hood River, OR. For more information, visit: www.pcsga.org.

6th International Oyster Symposium. October 21-23, 2015, Falmouth, MA. For more information, visit: <http://oystersymposium.org/>

Aquaculture 2016. February 22-26, 2016. Las Vegas, NV. The triennial conference of the NSA in association with the World Aquaculture Society and other participating associations.

If you would like to announce a meeting, conference, workshop, or publication that might be of interest to NSA members, please contact the *QNL* Editors, Joth Davis (jothpdavis@mail.com) or LeRoy Creswell (creswell@ufl.edu).