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2018 NERA Funding Support for Grant Applications

Project Title: (Epi)Genomically-informed Breeding of Bivalve Molluscs

Team Leader Contact Information:

Name:	Marta Gomez-Chiarri
Address:	University of Rhode Island, 169 CBLS, 120 Flagg Road, Kingston, RI, 02881
Phone:	+1-401-874-2917
E-mail:	gomezchi@uri.edu

Team Leader Signature: _____ **Date:** _____

Station Director Signature: _____ **Date:** September 12, 2018

Team Members (see proposal below for more participants)

Name	Institution/Agency/Organization
Dina Proestou	USDA Agricultural Research Services, Shellfish Genetics
Standish K. Allen Jr.	Aquaculture Breeding Ctr, Virginia Ite. Mar. Sci., VA
Robert Rheault	East Coast Shellfish Growers Association, RI
Paul Rawson	University of Maine, ME
Ximing Guo	Rutgers University, NJ
Louis Plough	University of Maryland, Eastern Shore, MD
Steven Roberts	University of Washington, Seattle, WA
Katie Lotterhos	Northeastern University, MA
Jon Puritz, Hollie Putnam, Steve Irvine	University of Rhode Island, RI
Jose Eirin-Lopez	Florida International University

(Epi)Genomically-informed Breeding of Bivalve Molluscs

Grant opportunity: Comparative Genomics Research Program [PAR-17-482](#), National Human Genome Research Institute, NIH ([NHGRI](#)) and USDA NIFA. Deadline for new proposals: Feb 5, 2019 and June 5, 2019. Estimated amount to be requested: \$1.2 million (direct costs). Theme (from RFP): “Comparative approaches that can be used to understand genome structure and function and the relationship between genomic features and phenotypes” ...”in agriculturally important animals”.

Prospective grant proposal abstract: Due to population growth, it is expected that the world will need to produce at least 60% more food by 2050. This increase should be accomplished with consideration to challenges imposed by climate change and environmental pollution while preserving the natural ecosystems that support food production and other ecosystem services. Historically, the eastern oyster *C. virginica* represented the most productive bivalve fishery in the U.S.; however, overfishing, diseases, and environmental pollution have nearly eradicated wild populations, particularly in the Northeast. An emergent aquaculture industry is rapidly expanding to fill the production void, but the growth of the industry is threatened by the impacts diseases and environmental stress. This collaborative project builds upon recent Eastern Oyster Genome (EOG) sequencing and assembly effort to provide the reference genome and transcriptome critical to the discovery and analysis of the genetic basis for traits that are important for improving the culture of this species for food and restoration purposes (private and public aquaculture). These traits include, for example, disease resistance, resistance or tolerance to environmental stress, fast growth, and desired shell characteristics. Key components of this research include *i*) the use of genetic and epigenetic approaches to identify fixed genetic traits and environmentally labile traits and *ii*) the direct involvement of the Eastern oyster research community (as members of the Eastern Oyster Genome Consortium; EOGC) in tool development and implementation. Development of an “extensive, genome-wide catalog of functional elements” for the EOG is critical for the application of Marker Assisted Selection and other genomically-informed approaches in selective breeding and consideration of epigenetic priming approaches to improve the precision and efficacy of breeding in this commercially important species. This functional annotation of the EOG will also facilitate understanding of the mechanisms involved in adaptation to a changing environment in this ecologically important keystone species. Most notably, the proposed EOG annotation efforts will have synergistic pay-offs by performing informative comparisons with the Pacific oyster genome and the genomes of other commercially important bivalve molluscs, such as mussels and scallops.

Team members: This proposal harnesses broad expertise in (epi)genomics, (epi)genetics, bivalve shellfish breeding, diseases, and oyster biology and state of the art facilities to conduct experimental work through the University of Rhode Island (Gomez-Chiarri, Puritz, and Putnam), the USDA Agricultural Research Service (ARS) Shellfish Genetics lab (Proestou), and multiple collaborating institutions. The project will be coordinated by Marta Gomez-Chiarri (URI), an aquatic pathologist with expertise in genomics, who has led the sequencing of the eastern oyster genome (Gomez-Chiarri et al. 2015; see attached CV) and has more than 20 years of experience working with the shellfish industry. Participants include members of the Eastern Oyster Genome Consortium (EOGC) and the East Coast Shellfish Breeding Consortium (ECSBC). Core team members include expertise in genetics and genomics of aquatic species (Proestou, Guo, Plough, Irvine, Puritz), epigenetics and epigenomics (Putnam, Roberts, Eirin-Lopez, Lotterhos), shellfish breeding (Allen, Guo), and the industry (Rheault, Executive Director of the East Coast Shellfish Growers

Association). Other experts that have been invited to participate will be Peter Kube (Quantitative Genetics; CSIRO, Australia, who will be visiting the Virginia Institute of Marine Sciences at the time of the workshop), Matt Hare (population genetics and genomics, Cornell University), Bassem Allam and Emanuelle Espinosa-Pales (shellfish genomics and pathology, Stony Brook University, NY), Jose Antonio Fernandez-Robledo (shellfish pathology and genetic transformation, Bigelow Institute, ME), several hatchery managers and directors of shellfish breeding programs (Amy Wilbur, University of North Carolina, Wilmington; John Supan, Louisiana State University; William Walton, Auburn University; Gary Wikfors, NOAA Milford Lab), extension specialists (Julie Davis, South Carolina Sea Grant; Chris Davis, Maine Aquaculture Institute), as well as members of the shellfish industry and commercial hatchery managers (e.g. Mook Sea Farms, Maine; Island Creek Oysters, MA). We have also invited program managers and directors of relevant agencies, such as Mike Rubino (NOAA) and Caird Rexroad III (USDA ARS). Around 23 participants, 15 of them from out of state, have confirmed attendance. Some of the participants will be attending remotely through video-conferencing.

Budget narrative: Funds will be used to help fund participation of experts in a planning workshop to be held at the University of Rhode Island, Narragansett Bay Campus, on October 3 – 4th, 2018. Out of state participants (up to 15) will receive an average of \$300 for travel and \$166 for lodging. Priority will be given to those participants attending in person that require air travel and have no additional funding to cover participation in the workshop. No funding will be provided to federal employees (NOAA, USDA ARS). We also expect to apply for some funds from NOAA and USDA ARS. Participants will be reimbursed after travel, and we expect funds to be spent by December 2018.

PROPOSAL BUDGET	
Project Title: (Epi)Genomically-informed breeding of bivalve molluscs	
PI: Gomez-Chiarri	
Period of Performance: Oct 1, 2018 - Sep 30, 2019	
	Year 1
F. Participant Support Costs (estimate of 20 participants)	
Stipends	
Travel (15 participants from out of state @ \$300 per participant)	4,500
Subsistence (lodging, 15 participants, 1 night, \$166 per night)	2,500
Total Participant Support Costs	7,000
H. Total direct costs	7,000
I. Indirect Cost Rate - not allowed	
J. Total amount requested	7,000

MARTA GOMEZ-CHIARRI - *Curriculum vitae*

Department of Fisheries, Animal and Veterinary Science

University of Rhode Island

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Google Scholar: <http://scholar.google.ca/citations?user=yhNe6CcAAAAJ&hl=en>

EDUCATION

1988 Universidad Complutense Madrid, Spain, B.S. Biochemistry and Molecular Biology

1992 Universidad Complutense Madrid, Spain, Ph.D. Biochemistry and Molecular Biology

EMPLOYMENT HISTORY

2014 – present Chair, Department of Fisheries, Animal and Veterinary Science

2009 - Present Professor, University of Rhode Island

2003 - 2009 Associate Professor, University of Rhode Island.

1997 - 2003 Assistant Professor, University of Rhode Island

1993 -1997 Postdoctoral Fellow, Hopkins Marine Station, Stanford University.

1988 -1992 Graduate Fellow MEC, Fundación Jiménez Díaz, Madrid, Spain

APPOINTEMENTS (selected, most relevant)

2013 – 2014 Vice-President, National Shellfisheries Association

2010 – 2012 Secretary, National Shellfisheries Association

2003 – Present Member of the Aquaculture Biosecurity Board, Rhode Island Coastal Resources Management Council

AWARDS AND HONORS (selected)

2014 URI Outstanding Contributions to Intellectual Property

2012 URI Excellence Award in Intellectual Property (with D. Nelson)

2010 Research Excellence Award College of the Environment and Life Science, URI

PROFESSIONAL ASSOCIATIONS National Shellfisheries Association, East Coast Shellfish Growers Association (affiliated), International Society of Fish and Shellfish Immunologists.

GRANT AWARDS (most relevant; 5 last years)

2017 – 2018 Rhode Island Commerce Corp Innovation Awards. “The Matunuck Oyster Hatchery” (\$50,000, in collaboration with Matunuck Oyster Farms). *Area: Applied Research and Development*

2017 – 2018 USDA NRSP-8 Aquaculture Genomes; 2 projects: “Comparative Genomics in Bivalve Species Workshop” and “Exploring adaptation in eastern oysters through resequencing” (\$10,000 each proposal, Gomez-Chiarri, Proestou, Putnam). *Area: Research, Training, and Extension.*

2016 – 2019 USDA AFRI Animal Health. Mechanisms of interspecies interactions in mitigating aquaculture diseases (\$450,000; 30% co-PI with D. Rowley, PI, and D. Nelson)

2016 – 2018 Northeast Regional Aquaculture Center. Safe Feedstocks for Bivalve Aquaculture (\$200K, 30%, Co-PI with D. Rowley, PI, and D. Nelson). *Area: Research & Outreach*

2015 – 2019 USDA ARS Cooperative Agreement. Defining Disease Resistant and Tolerant Phenotypes among selectively bred oyster families (\$107,750 PI). *Area: Research*

2014 – 2017 USDA AFRI Tools and resources for animal breeding, genetics and genomics.
Sequencing the genome of the Eastern Oyster (\$240,000, 70%, PI with W. Warren)
Area: Research

PEER-REVIEWED PUBLICATIONS (most relevant to the project, last 4 years, from a total of >70)

1. Abdelrahman, H., ElHady, M., Alcivar-Warren, A., Allen, S., Al-Tobasei, R., Bao, L., Beck, B., Blackburn, H., Bosworth, B., Buchanan, J., Chappell, J., Daniels, W., Dong, S., Dunham, R., Durland, E., Elasad, A., **Gomez-Chiarri, M.**, Gosh, K., Guo, X., Hackett, P., Hanson, T., Hedgecock, D., Howard, T., Holland, L., Jackson, M., Jin, Y., Kahlil, K., Kocher, T., Leeds, T., Li, N., Lindsey, L., Liu, S., Liu, Z., Martin, K., Novriadi, R., Odin, R., Palti, Y., Peatman, E., Proestou, D., Qin, G., Reading, B., Rexroad, C., Roberts, S., Salem, M., Severin, A., Shi, H., Shoemaker, C., Stiles, S., Tan, S., Tang, K.F.J., Thongda, W., Tiersch, T., Tomasso, J., Prabowo, W.T., Vallejo, R., van der Steen, H., Vo, K., Waldbieser, G., Wang, H., Wang, X., Xiang, J., Yang, Y., Yant, R., Yuan, Z., Zeng, Q., Zhou, T., 2017. Aquaculture genomics, genetics and breeding in the United States: current status, challenges, and priorities for future research. *BMC Genomics* 18, 191. doi:10.1186/s12864-017-3557-1
2. Proestou, D.A., Vinyard, B.T., Corbett, R.J., Piesz, J., Allen Jr., S.K., Small, J.M., Li, C., Liu, M., DeBrosse, G., Guo, X., Rawson, P., **Gómez-Chiarri, M.**, 2016. Performance of selectively-bred lines of eastern oyster, *Crassostrea virginica*, across eastern US estuaries. *Aquaculture* 464, 17–27. doi:10.1016/j.aquaculture.2016.06.012
3. Sohn, S., Lundgren, K.M., Tammi, K., Karim, M., Smolowitz, R., Nelson, D.R., Rowley, D.C., **Gómez-Chiarri, M.**, 2016. Probiotic Strains for Disease Management in Hatchery Larviculture of the Eastern Oyster *Crassostrea virginica*. *Journal of Shellfish Research* 35, 307–317. doi:10.2983/035.035.0205
4. Sohn, S., Lundgren, K.M., Tammi, K., Smolowitz, R., Nelson, D.R., Rowley, D.C., **Gómez-Chiarri, M.**, 2016. Efficacy of Probiotics in Preventing Vibriosis in the Larviculture of Different Species of Bivalve Shellfish. *Journal of Shellfish Research* 35 (2), 319-328. doi:10.2983/035.035.0206
5. Zhao, W., Dao, C., Karim, M., **Gomez-Chiarri, M.**, Rowley, D., Nelson, D.R. Contributions of tropodithietic acid and biofilm formation to the probiotic activity of *Phaeobacter inhibens*. *BMC Microbiology* (2016) 16, 1. doi:10.1186/s12866-015-0617-z
6. **Gómez-Chiarri, M.**, Guo, X., Tanguy, A., He, Y., Proestou, D. The use of -omic tools in the study of disease processes in marine bivalve mollusks. *Journal of Invertebrate Pathology* (2015), *Pathogens and Disease Processes in Marine Molluscs* 131, 137–154. doi:10.1016/j.jip.2015.05.007
7. **Gómez-Chiarri, M.**, Warren, W.C., Guo, X., Proestou, D. Developing tools for the study of molluscan immunity: The sequencing of the genome of the eastern oyster, *Crassostrea virginica*. *Fish & Shellfish Immunology, SI: Molluscan Immunity* (2015) 46, 2–4. doi:10.1016/j.fsi.2015.05.004
8. McDowell IC, Nikapitiya C, Aguiar D, Lane CE, Istrail S, **Gomez-Chiarri M.** Transcriptome of American Oysters, *Crassostrea virginica*, in Response to Bacterial Challenge: Insights into Potential Mechanisms of Disease Resistance. *PLoS ONE* (2014), 9:e105097.

AWARDED PATENTS

Isolation and characterization of an actin gene from abalone., Dennis A. Powers, Lynna Hereford, Marta Gómez-Chiarri. US Patent No: 5,675,061. Date: Oct 7, 1997 (abandoned 2001).

Delivery of DNA into fish by immersion. Marta Gómez-Chiarri and David Nelson. US Patent No: 7,871,629. Date: Jan 18, 2011. (abandoned 2017).