

## Research Activities



Ralph M. Garruto

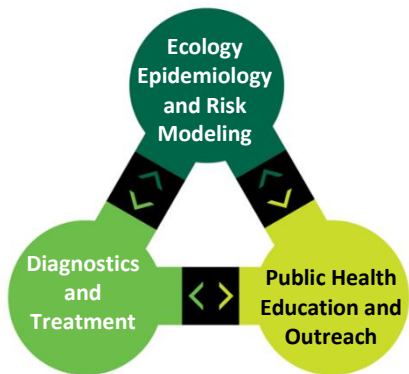
**Professor of Biomedical Anthropology**  
**Professor of Biological Sciences**  
**Director, Biospecimen Archive Facility**  
**Director, Tick-borne Disease Research Center**

<http://www.binghamton.edu/freshman-research-immersion/>

<http://biomedical.binghamton.edu/>

## Current Field and Laboratory Research

**Tick-Borne Disease Research Center: A Trans-disciplinary Research Center for Lyme and Other Tick-borne Diseases:**



Research Pillars of the Center

We are consolidating and coordinating Lyme and other tick-borne disease research at Binghamton University, leading to an integrative, interdisciplinary, transformative National Research Center. There are **three main Pillars** of the Center that collaborating faculty, physicians, and researchers are implementing:

**Pillar I: Ecology, Epidemiology and Risk Modelling:** Host-vector and pathogen interactions and integrative models of disease transmission and spread.

**Pillar II: Diagnostics and Treatment:** New diagnostic tools for both acute and chronic Lyme disease and development of new treatment regimes.

**Pillar III: Public Health:** Mitigation strategies and policy changes working with County Health Departments to enhance the public's health; **Education:** Primary and secondary school teacher and K-12 student education and University training of the

next generation of researchers; **Outreach:** Community education through our annual Lyme Disease Conference and community workshops and lectures.

Key to the success of the Center will be the expansion of our existing outreach activities to regional and national patient communities, foundations, and medical health professionals. In keeping with the increasing interdisciplinary nature of the University, the Center's core faculty cuts across four diverse colleges and schools: Harpur College of Arts and Sciences, the School of Pharmacy and Pharmaceutical Sciences, and the Thomas J. Watson School of Engineering and Applied Science, and the School of Nursing. The Center also includes collaborations with faculty from SUNY Upstate Medical University, SUNY Broome, SUNY Delhi, and SUNY College of Environmental Science and Forestry and with physicians at United Health Services (UHS) hospitals and clinics (28 sites) throughout New York.

Outreach and community engagement are core principles of the Center. Currently, faculty and students involved in Lyme disease research regularly accept community invitations to participate in educational programs on Lyme and other tick-borne illnesses in New York, New Jersey, and Pennsylvania. Such programs include educational events provided for local and regional K-12 schools and adult public educational programs through the New York State Master Teachers Program, regional Lyme support groups, and adult education programs (Lyceum). This educational outreach will be significantly expanded with the eventual creation of a national center and participating faculty will expand the educational and community service components of the Center.

The Center trains graduate students in our new MPH program and in various other graduate programs within the University, including our Graduate Program in Biomedical Anthropology. It provides research training of undergraduate students in our Freshman Research Immersion (FRI) program in Molecular and Biomedical Anthropology as well as the training of undergraduates throughout the University across all departments. Currently there are 28 undergraduate students in research training on Lyme and other tick-borne illnesses, not counting the dozen or so students work on tick-borne diseases in our Freshman Research Immersion (FRI) program.

<https://www.binghamton.edu/centers/lyme-disease-center/index.html>

<http://www.binghamton.edu/freshman-research-immersion/>

<https://www.binghamton.edu/anthropology/academics/graduate/ms-biomed/index.html>

## Risk of Lyme and Other Tick-Borne Diseases in Fragmented Ecospaces within Built Environments:



Collecting ticks

Ecological factors such as climate change, increasing tick and animal reservoir populations, fragmentation of ecological spaces, and expansion of suburban and peri-urban human populations is resulting in significant numbers of people coming in contact with tick populations carrying human pathogens. Currently, the Centers for Disease Control and Prevention estimates more than 330,000 new cases of Lyme disease annually with 95% of cases in the Northeast and Upper Midwest, among the most densely populated regions within the United States. Spatially, urbanization has drastically altered physical landscapes. The rise of suburban, and peri-

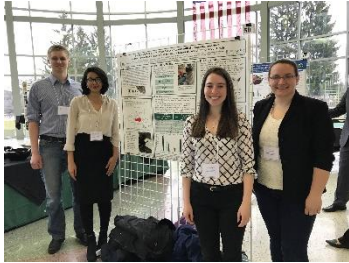
urban spaces and associated infrastructure represents the built environment with numerous fragmented ecologies. Built environments contain high use parks, primary and secondary schools and college campuses, playgrounds and residential neighborhoods where the risk of transmission of vector-borne diseases is often high. Our knowledge of the dynamic interaction between infected ticks, primary reservoir host populations and human secondary hosts in fragmented ecospaces within built environments is minimal. The lack of such knowledge leaves public health professionals at a disadvantage when addressing the emerging problem of tick-borne disease transmission. We are determining the density and infectivity of the primary competent reservoir host (*Peromyscus leucopus*) and the density and prevalence of infection in the tick vector (*Ixodes scapularis*), the transmitter of the Lyme infectious agent (*Borrelia burgdorferi*) and other tick-borne infections to humans and domestic animals in a six county area of the Southern Tier and Upper Susquehanna River Basin of New York. We are also identifying and quantifying key demographic and behavioral factors that place humans at risk of contract with these infectious agents. Our research is contributing to an understanding of the ecological complexities governing the epidemiology and transmission of Lyme and other tick-borne illnesses within built environments and is producing new knowledge that is causing a re-examination of the risk of acquiring tick-borne diseases within settings often perceived as low risk.

## Recent Publications

Roome A, Spathis R, Hill L, Darcy J and **Garruto RM**. 2018. Lyme Disease Transmission Risk: Seasonal Variation in the Built Environment. *Healthcare*. 6(3), 84.

Roome A, Hill L, Al-Feghali V, Murnock C, Goodsell J, Spathis R and **Garruto RM**. 2017. Impact of white-tailed deer on the spread of *B. burgdorferi*. *Journal of Medical and Veterinary Entomology*. DOI: 10.1111/mve.12191.

### **Modeling Lyme Disease in Built Environments in the Northeastern US Using Ecological, Demographic and Behavioral Risk Factors:**



This project adopts a system dynamics approach to study the impact of behavioral and environmental factors on Lyme disease transmission and prevention by developing a simulation model of Lyme incidence using ecological, social and behavioral risk factors. We are also attempting to determine the most cost-effective prevention strategies using the models we develop. Our models are built by assessing tick density, tick infectivity, frequency of tick bites, vegetation factors, human behavioral risks, and current Lyme disease incidence in the six county region within the Upper Susquehanna River Basin, adjacent to the Hudson River Basin, which has the highest incidence of Lyme disease in the US.

## Recent Publications

Sharareh N, Behler RP, Roome AB, Shepherd J, Garruto RM and Sabouchi NS. 2019. Risk Factors of Lyme Disease: An Intersection of Environmental Ecology and Systems Science. *Healthcare* 7(2), 66.

Sharareh, N, Sabouchi NS, Roome A, Spathis R, and **Garruto, RM**. 2017. Model-based risk assessment and public health analysis to prevent Lyme disease. *Royal Society Open Science*, 4(11), 170841.

### **Prion Diseases: Chronic Wasting Disease in Upstate New York:**



White-tailed deer

The emergence and continuing spread of Chronic Wasting Disease (CWD) in cervids is now in 24 US states, 4 Canadian provinces, and South Korea, producing a potential for transmission of CWD prions to humans and other animals globally. In 2005, CWD spread for the first time from the Midwest to more densely populated regions on the East Coast. As a result, a large cohort of individuals attending a wild game feast in upstate New York were exposed to and ingested meat from a deer that was subsequently confirmed positive for CWD. We have been assessing this exposure yearly since 2005 to 1) determine if individuals exposed in a variety of ways to a CWD infected animal have health issues or symptoms which

may be related to the development of a human prion-like disease; and 2) to determine if exposed individuals have altered their general risk behaviors since the point-source exposure occurred. (Photo Credit: <http://www.portsullivanranch.com/images/upload/whitetail-deer-hunting-in-dallas.jpg>)

## Recent Publications

Olszowy KM, Lavelle J, Rachfal K, Hempstead S, Drouin K, Darcy II JM, Reiber C and **Garruto RM**. 2014. Six-year follow-up of a point-source exposure to CWD contaminated venison in an Upstate New York community: Risk behaviors and health outcomes 2005-2011. *Public Health* 128: 860-868.

**Garruto RM**, Reiber C, Alfonso MP, Gastrich H, Needham K, Sunderman S, Walker S, Weeks, J, DeRosa N, Faisst E, Dunn J, Fanelli K and Shilkret K. (2008). Risk behaviors in a rural community with a known point-source exposure to chronic wasting disease. *Environmental Health*, 7(1), 31.

**Health Transitions in Vanuatu:** The overall goal of this project is to identify key



behaviors and other risk factors associated with increased chronic disease risk. The South Pacific archipelago of Vanuatu, like many developing countries, is currently experiencing a shift in disease burden from infectious to chronic disease, a component of a health transition. We surveyed more than 3,000 children and adults on five islands in Vanuatu with varying degrees of economic development. We measured height, weight, waist, hip and upper arm circumferences as well as triceps, subscapular and suprailiac skin folds and percent body

fat (%BF). We also assessed diet (through 24 hour dietary recall and a simplified food frequency questionnaire) and physical activity patterns using a survey instrument. We are comparing the anthropometric patterns among islands and are analyzing their associations with diet and physical activity patterns in order to understand the risk of chronic disease as a result of modernization and inter-island migration.

## Recent Publications

Van Horn A, Weitz C, Olszowy KM, Dancause KN, Sun C, Pomer A, Silverman H, Chan C.W, Lee G, Tarivonda L, Chan CW, Kaneko A, Lum JK, **Garruto RM**. 2019.

Using multiple correspondence analysis to identify behavior patterns associated with overweight and obesity in Vanuatu adults. *Public Health Nutrition* 22(9): 1533-1544. DOI:10.1017/S1368980019000302.

Olszowy KM, Little MA, Pomer A, Dancause KN, Sun C, Silverman H, Chan, CW, Tarivonda L, Kaneko A, Weitz C, Lum JK, **Garruto RM**. 2018. Coming to grips with economic development: Variation in adult hand grip strength during health transition in Vanuatu. *American Journal of Physical Anthropology*. DOI:10.1002/ajpa.23704.

Olszowy KM, Sun C, Silverman H, Pomer A, Dancause KN, Chan CW, Lee G, Tarivonda L, Reganvanu R, Kaneko A, Weitz C, Lum JK, **Garruto RM**. 2016. Short report: Secular change in adult stature associated with modernization in Vanuatu. *American Journal of Human Biology*. 29: e23008.

Weitz CA, Olszowy KM, Dancause KN, Sun C, Pomer A, Silverman H, Lee G, Tarivonda L, Chan CW, Kaneko A, Lum JK, **Garruto RM**. 2016. Rolling tobacco in banana leaves, newspaper or copybook paper associated with significant reduction in lung function in Vanuatu. *Asia Pacific Journal of Public Health*. 29(3): 180-188.

Sun C, Pomer A, Dancause KN, Chan CW, Olszowy KM, Silverman H, Lee G, Tarivonda L, Taleo G, Reganvanu R, Kaneko A, Weitz C, **Garruto RM** and Lum JK. 2017. Ownership of consumer electronics is associated with measures of adiposity during health transition in Vanuatu. *American Journal of Human Biology*. 29(2), e22928. DOI: 10.1002/ajhb.22928.

Olszowy KM, Pomer A, Dancause KN, Sun C, Silverman H, Lee G, Chan CW, Tarivonda L, Reganvanu R, Kaneko A, Weitz CA, Lum JK, **Garruto RM**. 2015. Impact of Modernization on Adult Body Composition on Five Islands of Varying Economic Development in Vanuatu. *American Journal of Human Biology*. 27(6): 832-844.

Dancause KN, Vilar M, Wilson M, Soloway L, DeHuff C, Chan CW, Tarivonda L, Reganvanu R, Kaneko A, Lum JK and **Garruto RM**. 2013. Behavioral risk factors for obesity during health transition in Vanuatu, South Pacific. *Obesity* 21:E98-E104. (January).



## Using Anthropology to Build Research Capacity and Inform Public Health Policy in the Republic of Vanuatu:

The Republic of Vanuatu, an island nation in



Research Team Aneityum Island

the South Pacific, is undergoing a rapid health transition as a result of modernization and accompanying changes in diet, activity, and lifestyle as mentioned above. Our previous research has demonstrated that obesity is rapidly increasing in prevalence in urban areas, and that rural areas with tourism are at risk due to rapid culture change, including increased access to processed and packaged foods. The goals of our engagement project are four-fold: 1) to inform the Vanuatu Ministry of

Health of our findings in order to stimulate the development of targeted intervention strategies; 2) to provide training in anthropometrics, statistics and survey techniques to Ministry of Health workers in order to facilitate wider surveillance of health transitions in Vanuatu; 3) to inform community members in the urban capital, Port Vila, and in island villages of our findings through public forums held in community centers; 4) to disseminate our results to rural communities and islands through community presentations and the creation of informative posters on the health transition, on obesity, hypertension and associated risk behaviors including smoking, alcohol and other drug use, to be posted at community centers and first-aid posts; and 5) with a request from the Vanuatu government, to develop a plan to build research capacity for the nation. This project is ongoing and continues to develop.

## Recent Publications

This project is new and there are no recent publications.

## Genetic Diversity Within and Among Trans-New Guinea Language Speakers of Highland Papua New Guinea:

The main objectives of this project are to: 1)



Papua New Guinea

characterize the genetic diversity within and among Trans-New Guinea Language speaking populations of Highland Papua New Guinea through DNA isolation of 1000 individuals for whole mitochondrial and nuclear genome sequencing, and 2) to correlate and contrast the genetic, linguistic, and geographic distances between these population groups. Although all of the Eastern Highland languages are spoken by neighboring villages within a contiguous 75 km diameter region, the

linguistic diversity is extreme compared to other regions or continents. For example, Fore and Gimi villages are within walking distance yet the languages share only 46% of their cognates, exceeding that of the Indic languages (50%) and similar to Greek and Italian (45%) while the sharing between Goroka and Kainantu (19-20%) or between them and Southern Highland language families (19%) are nearly twice as divergent as the Indo-European language family (35%) that extends Northwestward from India to Scotland and Scandinavia.

The highland populations of New Guinea, therefore, are among the most isolated and linguistically diverse populations in the world. Comparisons of populations within and among these regions will allow us to determine if genetic similarity changes over short distances, like cognates, or decreases only with greater geographic distances. (Photo Credit: [http://www.indopacificimages.com/wp-content/uploads/2010/09/PNG-Map\\_750.jpg](http://www.indopacificimages.com/wp-content/uploads/2010/09/PNG-Map_750.jpg))

## Recent Publications

There are no recent publications

### **Biology of High Altitude Han and Tibetan Populations in Western China:**



Traditional Qinghai Tibetan

Qinghai Province has a total population of slightly over 4 million and a land area of 721 million km<sup>2</sup>, of which 54% lies between 4000m and 5000m. Among the most important theoretical questions in evolutionary biology are whether human populations with distinct gene pools adapt similarly to a given unmodifiable environmental stress (hypoxia), and whether such adaptations are short-term, developmental or generational. The Qinghai

inhabitants include several linguistically and genetically different populations (Tibetan and Hui) that are indigenous to these high altitude regions, as well as first generation Han migrants of low altitude ancestry and their second generation children born at high altitude. An opportunity to answer these questions and to examine gene-environment interactions occurred as early as 1985 when we developed a collaborative high altitude research program in Western China to look at the physiological and morphological adaptation of human populations in Qinghai to major environmental stressors.

## Recent Publications



Weitz CA, **Garruto RM**. 2016. Stunting and the Prediction of Lung Volumes Among Tibetan Children and Adolescents at High Altitude. *High Altitude Medicine & Biology*. 16(4): 306-317.

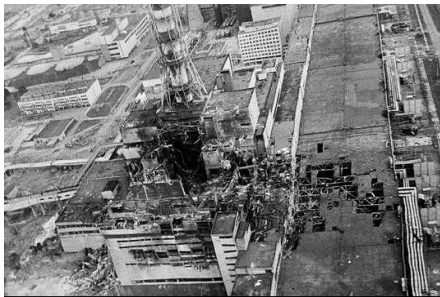
Weitz CA, **Garruto RM**, Chin CT. 2016. Larger FVC and FEV1 among Tibetans compared to Han born and raised at high altitude. *American Journal of Physical Anthropology*. 159(2): 244-255.

Weitz CA, Liu JC, He X, Chin CT and **Garruto RM**. 2013. Responses of Han migrants compared to Tibetans at high altitude. *American Journal of Human Biology* 25:169-178.

Little MA, Thomas RB and **Garruto, RM**. 2013. A half-century of high altitude studies in anthropology: Introduction to the plenary session. *American Journal of Human Biology* 25:141-150.

Little MA, Thomas RB and **Garruto RM**. Guest editors. 2013. A half-century of high altitude studies in anthropology. *American Journal of Human Biology* 25:148-190.

**Effects of Long-term Chronic Low-Dose Radiation Exposure thru the Human Food Chain in the Polissia-Chornobyl Region of Ukraine and its Effects on Birth Outcomes:** Chornobyl represents the greatest nuclear disaster in human



Chornobyl reactor

history and its consequences continue to be debated. The health effects of chronic low-dose radiation exposure remains a controversial question. Monitoring after the Chornobyl nuclear accident in Ukraine suggested that chronic low-dose radiation exposure was not linked to cancer mortality among the general population. However, elevated rates of birth defects in contaminated, compared to uncontaminated regions, suggest that chronic

exposure to low-dose radiation in utero might impact development and represent an underestimated risk to human health. The overall goal of this study is to determine if continuing exposure to chronic low dose radiation in the Polissia region of Ukraine through the food chain and from inhalation of burning debris is having an impact on the health of newborns, on child health and as a contributor to the development of chronic disease risk in both children and adults. (Photo Credit:

<http://graphics8.nytimes.com/newsgraphics/2014/04/02/chernobyl/assets/images/reactor-640.jpg>)

## Recent Publications

Wertelecki W, Chambers CD, Yevtushok L, Zymak-Zakutnya N, Sosyniuk Z, Lapchenko S, Levtyushok B, Akhmedzhanova D and Komov O. 2017. Chornobyl 30 years later: Radiation, pregnancies, and developmental anomalies in Rivne, Ukraine. *European journal of medical genetics*, 60(1), 2-11.

Dancause KN, Yevtushok L, Lapchenko S, Shumlyansky I, Shevchenko G, Wertelecki W and **Garruto RM**. 2010. Chronic radiation exposure in the Rivne-Polissia region of Ukraine: Implications for birth defects. *American Journal of Human Biology*, 22(5), 667-674.

### Neurodegenerative disease among isolated Pacific populations: Biomedical



Pathological brain proteins

scientists realize the importance of studying disease etiology and mechanisms of pathogenesis in non-Western anthropological populations with focal, endemic diseases. Such natural experiments as they are called, are important paradigms for solving etiological and epidemiological problems of widespread medical significance. The systematic search for etiological factor and mechanisms of pathogenesis of neurodegenerative

disorders is perhaps nowhere better exemplified than in the western Pacific. During the past four decades, we have systematically studied hyperendemic foci of amyotrophic lateral sclerosis and parkinsonism-dementia which occur in different cultures, in different ecological zones and among genetically divergent populations. They have served as natural experimental models that have had a major impact on our thinking and enhanced our understanding of these and other neurodegenerative disorders such as Alzheimer's disease. These intriguing neurological diseases and the accumulated cultural, epidemiological, genetic, cellular and molecular evidence strongly implicated environmental factors in their causation. The ultimate significance of these Pacific island paradigms may well depend on our ability to comprehensively evaluate and synthesize the growing body of relevant scientific data from our long-term studies and that of related neurological disorders as well as information from widely divergent academic fields.

## Recent Publications

Mitra J, Guerrero E, Hegde P, Liachko N, Vasquez V, Wang H, Gao J, Pandey A, Taylor JP, Kraemer BC, Wu P, Boldogh I, **Garruto RM**, Mitra S, Rao KS, Hegde ML. (2019). Motor neuron disease—associated loss of nuclear TDP-43 is linked to DNA

double-strand break repair defects. *Proceedings of the National Academy of Sciences*, 116(10), 4696-4705.

Majerova P, **Garruto RM**, Kovac A. 2018. Cerebrovascular inflammation is associated with tau pathology in Guam Parkinsonism Dementia. *Journal of Neural Transmission*. 125(7): 1013-1025.

Forgascova A, Galba J, **Garruto RM**, Majerova P, Katina S, Kovac A. 2018. A novel liquid chromatography/mass spectrometry method for determination of neurotransmitters in brain tissue: Application to human tauopathies. *Journal of Chromatography B*. 1073: 154-162.

Guerrero EN, Wang H, Mitra J, Hegde PM, Stowell SE, Liachko NF, Kraemer BC, **Garruto RM**, Rao KS, Hegde ML. 2016. TDP-43/FUS in motor neuron disease: Complexity and challenges. *Progress in Neurobiology*. 145-146: 78-97.

Arif M, Kazim SF, Grundke-Iqbal I, **Garruto RM** and Iqbal K. 2014. Tau pathology involves protein phosphatase 2A in Parkinsonism-dementia of Guam. *PNAS* 111(3): 1144-1149.

Yoshida, Sohei & Ueda, Takashi & Uebayashi, Yushiro & Kihira, Tameko & Yase, Yushiro & Chen, Kwang-Ming & M **Garruto, RM**. (2014). Reappraisal of the nosological significance of ALS-PDC mixed cases on Guam. *Amyotrophic Lateral Sclerosis and Frontotemporal Degeneration* 14(Supplement 2): 137-147.

Dombroski BA, Galasko DR, Mata I, Zabetian, CP, Craig UK, **Garruto RM**, Oyanagi K and Schellenberg GD. 2013. *C9orf72* hexanucleotide repeat expansion and Guam amyotrophic lateral sclerosis/parkinsonism dementia complex. *The Journal of the American Medical Association: Neurology* 70: 742-745.

Vilar MG, Chan CW, Santos DR, Lynch D, Spathis R, **Garruto RM** and Lum JK. 2013. The origins and genetic distinctiveness of the chamorros of the Marianas Islands: An mtDNA perspective. *American Journal of Human Biology* 25:116-122.