

Consortium on Law and Values in Health, Environment & the Life Sciences

2014-15 Student Proposal Cover Page

Applicant Information

Applicant name: Irene Bueno	Email: bueno004@umn.edu
Project title: Antibiotic Resistance and Aquaculture in Chile: Bridging the Gap between Science and Policy	
Department: Veterinary Population Medicine	College: College of Veterinary Medicine
Degree program: PhD (VMED)	Faculty advisor name & email: <input type="checkbox"/> NA
	Dominic Travis (datravis@umn.edu)
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Dept. Head: Thomas Molitor	Dept. Head's email: molit001@umn.edu
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How did you hear about this funding opportunity?	
<input checked="" type="checkbox"/> Consortium e-mail <input type="checkbox"/> The Brief <input type="checkbox"/> Advisor <input type="checkbox"/> Dept. email/newsletter <input type="checkbox"/> OVPR website <input type="checkbox"/> Other	

Funding

Total amount of funding requested: \$7,000
Executive summary (maximum 200 words)

Salmon farms are rapidly expanding in Chile, accompanied by heavy use of antibiotics which can enter the environment via effluent from the salmon farm. Once in the aquatic ecosystem, antibiotic residues can continue to increase the development, spread and persistence of resistant bacteria. However, the role of the salmon farm in this globally significant but complex problem remains unclear. In southern Chile salmon farming is expanding in the river named rio Bueno. A golden opportunity exists to collect baseline data at key locations in this river at a time when new farms are being developed. No data have been collected from the currently operating farms. We will lead an interdisciplinary team in this project to design a system for quantifying the impact of these salmon farms on the ecosystem health of the region. Aquaculture will continue to expand, but there is an urgent need to fully understand the potential environmental and public health risks that the use of antibiotics in this industry might pose. Assessing this risk will help in developing innovative management solutions that could be very useful for the aquaculture industry as well as for the Ministry of Health in Chile. Funds will be used for laboratory analysis and to cover travel expenses to Chile.

Approvals

Check all appropriate approvals required for your proposal. Approvals must be obtained prior to receipt of funding. If you have applied for approval but have not yet received it, indicate that below.

IRB	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> NA	<input type="checkbox"/> Application pending	
Other	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> NA	<input type="checkbox"/> Application pending	Specify:

Checklist

- X The proposal is 1000 words or less excluding budget, biographies, references and citations.
- X The proposal includes a work plan with a specific timeline using months or quarters to identify work to be done and completion dates.
- X The proposal includes a 1-2 paragraph biography of the applicant and all co-investigators.
- X The budget form is complete including the funds sought for this project, other pending applications for this project, and the amount/source of matching or other funds.
- X The applicant's faculty advisor is copied on the application email. Professional students w/o advisors check NA.
- X All necessary approvals are pending or received.

Antibiotic Resistance and Aquaculture in Chile: Bridging the Gap between Science and Policy

Aquaculture is a fast-growing industry globally (1). This is in part due to the demand for high quality protein to feed a rapidly increasing human population, coupled with the fact that wild stocks of aquatic species are decreasing due to overexploitation. The most common form of aquaculture is fish farming. One of the criticisms of this activity is the environmental impact that it poses (2). For example, the discharge of waste products from the fish farms into aquatic ecosystems can have a significant impact on the health of the ecosystem. Waste products from these farms include organic matter, solids, and veterinary drug residues, including antibiotics. These antibiotics have the potential of selecting for resistant bacteria in the aquatic ecosystems, and these organisms can impact both human and animal health. Antibiotic resistance is a global public health crisis recognized by many international organizations such as the World Health Organization (3).

The environment plays an important role in the dissemination and persistence of antibiotic resistant bacteria. Rivers are a great place for this to happen, because of their capacity for long-distance dissemination of bacteria. Despite the relevancy of this issue, there is a dearth of knowledge about the selection for resistant bacteria and their spread in aquatic ecosystems.

Chile is the 2nd largest producer of farmed salmon globally, and in 2013 its salmon industry used the most antibiotics of any aquaculture industry in the world (4). Most salmon farms in Chile are located in rivers near the ocean. In Valdivia (southern part of the country), salmon farms are rapidly expanding. A specific river (the 'rio Bueno') already has seven farms, and two more are being built. Given the rising concern about the amounts of antibiotics used and the effect that the disseminated antibiotic residues can have on antibiotic resistance, there is considerable pressure on the salmon industry to reduce the use of antibiotics and to improve waste management. However, there are no rigorous scientific studies evaluating the attribution of antibiotic resistance to salmon farms, in part because of the challenges of collecting the appropriate data for evaluating this relationship.

The current situation in Valdivia, Chile, represents a golden opportunity to develop a well-designed epidemiological study that fills critical data gaps on the environmental antibiotic resistance issue. One of the key components of the proposed work will be its interdisciplinary nature. The team will include researchers from the University of Minnesota (epidemiologists, fish and wildlife health experts), from Universidad de Concepcion in Chile (a microbiologist), from the University of Zaragoza in Spain (a hydrologist), public health officials from the Ministry of Health in Chile, and representatives from the aquaculture industry in Chile. Each one of the collaborators on the team will bring a specific expertise that will greatly raise the quality and subsequent impact of this project.

Data from our team's previous studies in this area of Chile will help this project dramatically. Drs. Singer and Gonzalez have previously investigated antibiotic resistance associated with salmon farms in Chile (5). These studies identified the potential risk but were lacking data specific to the use of antibiotics in the salmon industry and the effects these antibiotics have on

the observed resistance. In other studies, they have evaluated the spread of resistance *Escherichia coli* in the rivers of this region in Chile. In one study they observed that the resistant isolates from the rivers matched very closely with the isolates collected from the human wastewater treatment plants and not from nearby animal agriculture. They explained the challenges of linking specific environmental insults to observed antibiotic resistance levels in a key paper in this field (6).

The goal of this project is to assess the attributable risk of antibiotic resistant bacteria in the 'rio Bueno' to salmon farms. Despite the presence of seven farms, there are no baseline data in this river with regard to antibiotic resistance in the rivers near these farms. The Ministry of Health of this region of Chile is looking to our team to help them develop a system for collecting these data. What makes this project unique is the interdisciplinary nature of the team and the innovative approach for collecting data prospectively. Additionally, this river is located near a protected estuary, listed as a global biodiversity hotspot by groups such as The Nature Conservancy. The data generated from this project will help assess ecosystem health in the estuary.

This grant will allow for the collection of baseline samples in the 'rio Bueno'. Specifically, sediment samples from 20 key points along the river (both upstream and downstream from the salmon farms) will be collected every other month over a period of 12 months. In total, 120 samples will be obtained. Microbiology analysis will be done at the Universidad de Concepcion (Chile). The samples will be cultured for specific bacteria such as *E. coli* and molecular analyses will investigate specific antibiotic resistance genes from the samples. The results will be analyzed using the geography software ArcGIS, with which we have considerable experience (Dr. Bueno is currently TAing VMED 5181 class, in the use of this software). This work will ultimately be incorporated into a mathematical model with the goal of predicting the risk of antibiotic resistance from salmon farms in the 'rio Bueno'.

This project is the first step in creating a larger ecosystem health evaluation system with the ultimate goal of developing a tool that the Ministry of Health in Chile can use to predict risks to human, animal and environmental health. This model will likely be utilized in other regions of Chile as well as in countries, as everyone is currently struggling with the task of evaluating environmental risks associated with antibiotic resistance.

Fish consumption will continue to increase, and it is critical that fish farming be done sustainably. The judicious use of antibiotics is a critical aspect of this sustainability, and this project will help advance this critical goal. The effect of salmon production on the environment is a critical data gap that must be addressed immediately.

Work plan

Activity/Month	2015-2016											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Sample collection	x		x		x		x		x		x	
Laboratory analysis	x	x	x	x	x	x	x	x	x	x	x	x
Molecular work	x	x	x	x	x	x	x	x	x	x	x	x
Mathematical model												x

Biography

Irene Bueno

Dr. Irene Bueno is a PhD student in the College of Veterinary Medicine, University of Minnesota, minoring in Epidemiology through the School of Public Health. She graduated in 2007 with a Doctor of Veterinary Medicine at the University of Cordoba in her native country of Spain. After earning her degree, she was granted a scholarship from the Andalusian Government from Spain to conduct a two-year clinical internship at The Raptor Center at the University of Minnesota. From 2010-2013, she did a combined residency program at The Raptor Center. This program involved a clinical component in avian medicine and surgery, and a Master in Public Health (MPH) with an Ecosystem Health focus. She completed her MPH in the fall of 2013, when she started in the PhD program.

Dr. Bueno's research interests include the study of problems at the interface between humans, animals, and the environment. She has a growing interest in environmental antimicrobial resistance, specifically concerning wildlife and aquatic ecosystems. Her career goal is to work in the ecosystem health field in emerging problems within the human-wildlife interface.

Selected References

1. 2005-2015, FAO (2005). "Aquaculture topics and activities. State of world aquaculture." Retrieved 02/08/2015, 2015, from <http://www.fao.org/fishery/topic/13540/en>.
2. Organization, FAO (2009). Environmental impact assessment and monitoring in aquaculture. FAO Fisheries and Aquaculture Technical Paper., FAO. 527.
3. Organization, WHO. (2014). "Antimicrobial resistance." Retrieved 01/16/2015, 2015, from <http://www.who.int/mediacentre/factsheets/fs194/en/>.
4. Oceana (2014). "Chilean Salmon Industry Found to Use Highest Amount of Antibiotics Worldwide." Retrieved 01/20/2015, 2015, from <http://oceana.org/blog/chilean-salmon-industry-found-use-highest-amount-antibiotics-worldwide>.
5. Fernández-Alarcón, C., et al. (2010). "Detection of the floR Gene in a Diversity of Florfenicol Resistant Gram-Negative Bacilli from Freshwater Salmon Farms in Chile." Zoonoses and public health 57(3): 181-188.
6. Singer, R. S., et al. (2006). "Can landscape ecology untangle the complexity of antibiotic resistance?" Nature Reviews Microbiology 4(12): 943-952.

Budget for Student Proposals

Project Title:

Antibiotic Resistance and Aquaculture in Chile: Bridging the Gap between Science and Policy

Instructions: Provide justification along with costs.			Requested funding	Matching/other funding	
	Category	Description & justification	Amount	Amount	Source
1	Your stipend	<i>What is hourly wage & fringe based on-- departmental, community or other rate?</i>			
2	Speaker honoraria	___ speakers x \$ _____ honorarium			
3	Supplies & Services	Microbiology Laboratory Analysis at Universidad de Concepcion (Chile): 120 sediment samples x \$40/sample. The samples will be cultured for specific bacteria such as E. coli and molecular analyses will investigate specific antibiotic resistance	\$4,800		
4	Equipment	Identify and explain use.			
5	Travel	Travel to research field site in Valdivia, Chile, for collection of samples and oversee of the project(Airfare from and to MN to Valdivia; Dates for the trip to be determined during March 2015).	\$2,200		
Subtotal research expenses (2-6)				\$0	
TOTAL BUDGET			\$7,000	\$0	

Budget Guidelines

1. Stipend justification. You must justify the amount of stipend you are requesting by identifying the number of hours you plan to work on the project and the hourly wage used for research assistants in your department. Include fringe benefits.
2. For colloquia, identify the number of speakers and the amount of honoraria you will provide.
3. Supplies and services. List out all supplies and their estimated costs. Explain in line 7 or in the body of your proposal what the supplies will be used for.
4. Equipment costs are allowable only if the justification clearly shows that the equipment is necessary for the project. Include explanation of what will happen to equipment at completion of project.
5. Travel costs must include a description of the purpose of the travel, start and stop dates of travel, transportation costs, housing costs, and allowable per diem (use University rates found at [http:// travel/umn.edu](http://travel/umn.edu)).