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Examining harbor seal predation impacts on Bellingham Technical College's salmon smolt release

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Madison Gard

Marine Mammal Ecology Lab

Dr. Alejandro Acevedo-Gutiérrez

June 6, 2023

My Career in WWU's Marine Mammal Ecology Lab

The Marine Mammal Ecology Lab offered me my first official research opportunity of my hopefully long career in marine ecology. I remember asking my mom, a lab manager and research specialist for the University of Arizona's Cancer Center, to help review my application materials because I so wanted to stand out. I grew up in Tucson, Arizona surrounded by saguaro cacti in the Sonoran Desert. My love for marine science was sparked by the time I spent with my grandparents in Cholla Bay, México growing up. In just my lifetime, I've watched how anthropogenic impacts can transform a coastline, and this has made me incredibly passionate about the conservation and restoration of marine ecosystems. For a long time, I've wanted to use my career to promote positive changes and be an advocate for these natural spaces. That's why when it was time to choose a college to attend, Western Washington University caught my eye. The marine and environmental programs, its location, and the undergraduate access to hands on opportunities made it ideal to continue my education. So, in the fall of 2019 I packed my bags and hopped on a plane to the Pacific Northwest. Six months later the pandemic began, which landed me back in my high school bedroom in Tucson, searching for ways to remain connected to the Western community. That's when the recruitment flyer for MMEL's Whatcom Creek project appeared in my email inbox. Immediately, and without hesitation, I knew I wanted to join the lab and began to assemble my application materials.

My virtual interview was with Grace Freeman and Delaney Adams. When they offered me the position, I was so excited to land my first-ever experience in a lab. The following fall of 2020, I returned to Bellingham, WA and was trained to conduct field observations out at Whatcom Creek. It was wild to observe the foraging behaviors of harbor seals for the first time, and to this day it still feels like a nature documentary to see them catch and eat an adult salmon. Over time, I fell in love with the seals and began to recognize certain individuals that frequented the creek, especially ID 0039, or “Goggles”. For three years now, I’ve conducted field observations, cropped, and identified photos of the harbor seal population in Whatcom Creek. This little corner of the universe will always have a special place in my heart.

MMEL has also provided several opportunities for me to grow as a researcher. The first of these presented itself during a field observation with Grace Freeman. Two new graduate students, Zoë Lewis and Kathleen McKeegan, were planning their thesis studies and Zoë was looking for a research assistant to help process her samples. Grace told me she had recommended me, and I reached out to let Zoë know I was interested. Little did I know that conversation would lead me to one of my closest friends and 2.5 years and counting of diet and genotyping research. Keep in mind this all occurred during my second year at WWU – the year we were fully online. The opportunity to gain more experience processing samples in a lab at Western was rare, Zoë and I were practically the only people in the Biology building each day we worked. As you can imagine, this led to many days of working long hours processing samples and having “deep” conversations while Glass Animals, Maggie Rogers, or Taylor Swift played on a speaker. I have learned so much from Zoë, it’s difficult to even quantify or explain. On a professional level, she both explained and modeled the process of completing a master’s in science program. It was instrumental in my growth as a scientist to assist in her process – from the acquisition of scat

sample materials, to the careful planning of methods, to the execution of processing 352 scat samples, analyzing the results, and finally drafting, presenting, defending, and submitting her thesis. Throughout her project, I wanted to help with any steps I could because I was genuinely interested in the study itself. It blew my mind when she explained the process of DNA metabarcoding for diets and qPCR sex-identification. Not only did she explain these methods but opened doors for me to continue as an assistant for the qPCR sample processing component. The molecular methods were my favorite part of the entire process – and not just because it was less stinky than homogenizing scats by hand. It felt like a puzzle to piece together, I enjoyed picturing what each step accomplished on the molecular level. Building the plates of wells to be run in the thermocycler was such a tedious process, but I appreciated the importance of ensuring each step was completed correctly.

When Zoë offered to have me take the lead on the qPCR validation of methods manuscript, I jumped at the opportunity to write as an author. The actual process of designing the Taqman assays and validating them using our known samples from the Vancouver Aquarium and Marine Mammal Center's was, to this day, one of my most challenging experiences in science. I'll be forever grateful for the mentorship and guidance both from Zoë and Dr. Dietmar Schwarz as we fell down rabbit-hole after rabbit-hole in the design of our primers. Eventually, we accomplished success and ordered our novel assays for experimentation! As science processes usually go, we immediately hit another roadblock of low-quality DNA in our known Steller sea lion samples, causing them to fail in signal amplification. However, prior to reaching this conclusion, we attempted a second extraction of DNA using a NucleoSpin instead of QIAGEN kit and reran every sample using both the existing Pv and novel Ej primers we designed. When these still yielded a 69.79% failure rate, we decided it was likely that the DNA quality itself was

too low and outside of our control. So, we pivoted to reframe the narrative focusing on our California sea lion known IDs for validation of methods. This process of troubleshooting and perseverance, critical thinking when samples didn't yield expected results, and deep diving into the molecular methods was invaluable for me. It demonstrated the reality of science is that you won't always have a simple, direct process, especially within ecology studies. It also taught me the perseverance and dedication it requires to see a project to its completion, constantly troubleshooting along the way.

The ongoing process of drafting, reviewing, and revisiting the qPCR validation of methods manuscript has been another, separate, learning process. I genuinely wish that I had fewer extracurriculars and responsibilities in order to have dedicated more time to the authoring process this year. However, I feel incredibly accomplished to be graduating after sending out the second completed draft to my coauthors this week. While I'll continue to revise and progress on this manuscript post-graduation, it has taught me much about the scientific writing process. The stakes of producing a scientific piece of literature are very high, especially as a first-time author. This makes the accuracy of our information and usefulness for the progression of the field that much more important than a lab report I might write for a class at the university to be graded once by a TA. Zoë has been a major role model for me, both professionally and personally. I wouldn't be the scientist I am today without her example. Her continued support and advice have been invaluable.

During my third year at WWU, and second year in the Marine Mammal Ecology Lab, I continued to work as a research assistant on the Whatcom Creek project. Only now it was Kathleen McKeegan and Kate Clayton managing the project and working on their TAST study. They had such a gentle leadership style but are some of the most badass scientists I know. Both

of their work ethics are unmatched, and their ability to ID seal individuals in the field was beyond impressive. Observing them, I realized the extent of the “behind the scenes” work that goes into coordinating a team of student researchers and the data processing that goes into the Whatcom Creek study. Their commitment and passion to their studies certainly inspired me to become more invested in my own within the MMEL.

In my last year at WWU, I wanted to design my Honors Capstone Project around a study observing harbor seal responses to the BTC Hatchery’s Chinook salmon smolt release. Pinniped predation pressures are a concern for the recovery of salmon populations in the Salish Sea, so it seemed both tangible and practical for the advancement of our ecological understanding. I proposed the idea to Dr. Alejandro Acevedo-Gutiérrez in the fall and he was onboard! I leaned even further into the MMEL to start preparing for the huge undertaking of coordinating such a study as an undergraduate. By working closely with the MMEL lab managers during this time, it came to my attention that the Whatcom Creek project would need support for the winter and spring field seasons, since Kate Clayton was graduating in December. She asked if I would be interested in becoming a manager for the project. I was thrilled to gain more experience and take on a larger role in the study so close to my heart. Prior to her graduation, we worked very closely so I could learn everything that goes into the Whatcom Creek study, including the process of photo collection, identification, organization, and storage of field data for future studies to utilize. I’ve very much enjoyed working as a leader for this project over the last six months. My comanager during winter quarter, Brianna Hull, and I developed a close friendship coordinating the project together. She was indispensable during our recruitment process for new undergraduate research assistants and helped to set up both Whatcom Creek and the Smolt Studies for success with a great team this spring. Additionally, we came up with the idea of

promoting certain research assistants to the titles of “field lead” or “photo lead” in order to reward the additional responsibilities they were taking on, as well as to delegate some of the hours that go into coordinating a project so large. This worked even better than expected, as we had an amazing, supportive group of leaders that were passionate about the study and spread their energy to the incoming members during training. I feel as though the autonomy and trust that was granted through the promotions and delegation of responsibilities created a stronger team atmosphere amongst the undergraduates on the WC study this spring. Even though the seal activity was low, moral was very high during field observations.

My final quarter at WWU and as an undergraduate researcher in the MMEL was a whirlwind, to say the least. I somehow feel as though I spent a lifetime of late nights in the lab, but at the same time blinked for an instant to have it all pass me by. This quarter was a testament to how hard I can dig my heels in to accomplish big goals and finish out my undergraduate career. For context, outside of managing the two studies in MMEL, I continued to progress the qPCR manuscript, trained a class of new tour guides for the Office of Admissions and a new Marketing Assistant for Outreach and Continuing Education to “pass the baton” in my campus positions, as well as trained the next set of undergraduate leaders to carry on the Whatcom Creek project for its thirteenth fall season of data collection. Further, I completed two capstone course projects to round out my degrees in Spanish and Environmental Science with a Marine Emphasis. Outside of WWU, I started, endured, and graduated from training to be a whitewater raft guide for Triad River Tours with my PRO-1 Swiftwater Rescue, First aid and CPR, and 50+ River Hour WA state certifications. This summer, I’m looking forward to new adventures as well as sharing my love for the outdoors and salmon habitat restoration with the customers on my

rafts. To say the least, I haven't gotten much sleep the last three months, but I wouldn't want to end my time at WWU any other way.

The Smolt Study observations were an overwhelming success, all things considered! In March, I focused on gaining site access in Log Pond for everybody by collecting 34 Hold and Release Harmless forms for the City of Bellingham. I designed the datasheets and observation protocols to be used in the study, and asked the research leads, Alejandro, and Dr. Kathryn Sobocinski to be sounding boards for the methods. In April, I held 3 training sessions in the field to introduce research assistants to the observation sites and data collection protocols. In hindsight, I wish I had made these slightly more intensive in order to collect more uniform observation data from the large team of researchers. Preliminary results suggest that there was a lot of variation in the styles that researchers collected their data. I also had everyone submit their availabilities online in order to build a schedule for 24 days of twice-daily dawn (5:30-7:30) and dusk (18:00-20:00) field observations with two teams of three student researchers and sets of equipment. From May 8-31, we collected 5 days of observational data pre-release of smolt from the BTC Hatchery, 6 days in-between releases, and 13 days post-releases of smolt for a total of 48 observations. This was no small task and weighed heavily on me as the manager responsible for the building key, equipment, and the safety of 34 researchers. Ultimately, we have some exciting pre-liminary results that suggest the harbor seals did respond to the smolt release, with increased activity and hunting events following the release. Further, we observed many other predator species feeding on the smolt, which suggests that pinniped predation pressures are not the only ones experienced by out-migrating smolt and should be considered in management decisions.

This experience of conducting a research study from its conceptual idea, the execution of its data collection, and the beginning of results analysis has made me grow so much as a scientist. My confidence as a professional in the field of ecology has increased, and the imposter syndrome doesn't feel so real anymore. The Smolt Study is the first research study I've designed and led the efforts for myself, and I feel very proud of these accomplishments in the MMEL. The guidance of Dr. Alejandro Acevedo-Gutiérrez has been influential in the success of these efforts, and I'm forever grateful to have such a wise and experienced mentor. I look forward to continuing learning from him as we complete the qPCR manuscript and begin the new Smolt Study manuscript. The friendships and connections I've made in the MMEL will long outlast our careers at WWU, and I'm so thankful to have found this community of scientists and support. I very much look forward to presenting the process and preliminary results of the Smolt Study on Friday, May 9, at 10 a.m. for my Honors Capstone.