What can 60 million DNA reads contribute to the conservation of chub in the Alvord Basin?

The Alvord Basin is a desert valley found in southeastern Oregon and northern Nevada. The handful of small ponds and streams that dot the Alvord Basin are home to two endemic fish species: Alvord chub (*Siphateles alvordensis*) and Borax Lake chub (*S. boraxobius*). Alvord chub are found in several pools in the Basin, but currently face a number of threats including water withdrawals, nonnative fishes, grazing, habitat fragmentation, and increased desiccation. A lack of information regarding population structure has been cited as a primary challenge for developing conservation strategies for this species. Borax Lake chub are restricted to a single water body and are listed as endangered under the ESA.

Over the past two years, staff at Abernathy FTC collaborated with the states of Oregon and Nevada, the Bureau of Land Management and Oregon State University to conduct a survey of population structure across the ranges of Alvord chub and Borax Lake chub. The technique we used, commonly known as Restriction site
What can 60 million DNA reads contribute to the conservation of chub in the Alvord Basin? (continued)

Associated DNA (RAD) sequencing, allows not only the characterization of contemporary structure, but also of deeper historical relationships.

The results of our analysis revealed that the ancestors of our two species were isolated together in the Alvord Basin when the mountains surrounding the basin were formed from lava flows 17 million years ago. We also learned that Borax Lake chub and Alvord chub still shared common ancestors during the most recent ice age, when the Alvord Basin was filled with a massive pluvial lake that encompassed the ranges of both species. As the pluvial lake rapidly retreated to become a desert 10 thousand years ago, we found evidence that Alvord chub populations in the Thousand Creek drainage in Nevada were the first to become stranded and isolated from the other populations of this species. The lake continued to retreat northward, until at last a large population of Alvord chub and the Borax Lake chub were trapped together in a pool near the northern edge of their contemporary ranges. Finally, the water continued to retreat to form the water bodies we see today, separating Borax Lake chub from Alvord chub. This process yielded two major groups of populations of Alvord chub (those separated in the Thousand Creek Drainage and those that remained in the Pool with Borax Lake chub), with some structure in each.

These results will be used to inform conservation strategies for Alvord chub, and also underscore the importance of these small fish to the evolutionary legacy of the region.

(Left and top right) Remnants of pluvial Lake Alvord, a 12 mile wide x 70 mile long lake during the last glaciation, which retreated to form a series of small ponds around 10 thousand years ago. This process is thought to have repeated 19 or 20 times during the past several million years, with chub being isolated in ponds during dry periods (such as the present), only to be reunited during glaciations. (Bottom right) Borax Lake chub. Photo credit USFWS.
Program Highlights

Administration & Facilities

Facilities staff completed the project to replace the main laboratory asphalt shingle roof with a more durable steel roof. During the project, asbestos ventilation piping was removed and replaced with stainless steel piping, new gutters and snow blocks were installed as well. This was a deferred maintenance project that had been on the list for replacement for several years and the RO paid for supplies.

The facilities staff successfully replaced a leaking valve in an 8-inch well water pipeline to the degassing tower. The replaced valve will conserve water and increase the efficiency of the degassing unit.

Mona E. Derby completed the required 500 hours for her internship at Abernathy FTC for the degree of Master of Science in Fisheries and Wildlife Administration, Department of Fisheries and Wildlife, Oregon State University. She summarized her experiences in a paper titled: “Converting a Production Fish Hatchery to a Fisheries Research Center: Lessons Learned from a Six Decade Transition”.

Roger successfully coordinated the implementation of a VOIP phone system with assistance from HQ telecommunications staff, Steve M., Alina, Mark, and RO IT staff. The new system still has a few surprises to work out but is a far more reliable means of making audible phone calls. There may be some issues with brief interruptions of service this winter. The new system is very sensitive to the loss of power that occurs when the electricity goes out and the generator kicks on.

Conservation Genetics

Our work evaluating the impact of hatchery releases on native trout in upper Deschutes River tributaries was completed. The key finding was that collections of juvenile fish taken in recent years include far greater proportions of hatchery-origin fish than collections taken even a few years ago. Matt S., who led this research, shared the final report with our partners at Portland General Electric, and has been asked to present the work at a Deschutes Basin meeting this fall.

Genetics staff worked with colleagues at Washington Department of Fish and Wildlife (WDFW) to maintain standardization of genetic data generated by our two agencies, and improve the efficiency with which both agencies can collect needed genetic data. An example of a recent benefit of this effort has been our ability to use the WDFW baseline data to inform passage work by Mid Columbia FWCO in the Yakima Basin, and thus to do the work at a greatly reduced cost to the FWS.

Abernathy FTC geneticists provided input to FAC leadership regarding risks associated with proposed fish transports this year. Poor salmon returns, thought to result primarily from degraded river and ocean conditions, have been observed throughout the Region in 2018 and fish transports have been proposed to the FWS by multiple partners as a way to compensate for local shortages.

Ashley and Justin collected the final samples for our investigation into less-invasive genetic sampling techniques. Taking a large enough fin clip for DNA extraction from a juvenile fish can result in risk of injuring the fish and thus being counterproductive for conservation efforts. This study thus aims to develop and test new, less-invasive methods that might be used for future monitoring of hatchery and natural-origin populations.

Jennifer and Matt S. worked on a HQ-funded initiative to develop genetic resources to species of strategic interest to the FAC Program. The resources generated by this project will be useful to partners monitoring populations of species ranging from Chinook Salmon and Bull Trout to Lost River Suckers and Delta Smelt. The work is expected to be completed and the data made publicly available this fall.

working with others

Brice and Matthew assisted biologists with AVISTA Corporation in conducting bull trout surveys in tributaries to the Clark Fork River. Both also participated in the interagency Clark Fork River Aquatic Implementation Team Meeting, where Brice gave a presentation on the work Abernathy FTC is doing in that basin.
Program Highlights (continued)

Nutrition & Physiology

Abernathy FTC obtained a Washington State mussel collecting permit. With this in hand we can now proceed with mussel behavioral studies planned with the Idaho FWCO. The initial study will be concerned with testing the effect of different water temperatures on the burrowing rate of the western pearlshell mussel.

The 2018 annual report comparing the physiology of steelhead reared in the Partially Recirculating Aquatic Systems (PRAS) and raceways at Hagerman NFH was completed and emailed to the Lower Snake River Compensation Plan (LSRCP) office which funded the evaluation.

working with others

James and Racheal transported lamprey from the Yakama Nation’s Prosser Hatchery to Abernathy FTC. These fish will be used in studies investigating rearing conditions and methodology including feeding frequency, density and diet. Partners on this project are the Yakama Tribe, NOAA Fisheries and the Confederated Tribes of the Umatilla Indian Reservation. The project is funded by the Chelan PUD.

Ron discussed methods of reducing (altered feeding) and identifying (measuring circulating hormone levels) precocious maturation in male Chinook salmon captive broodstock with Paul Adelizi of the California Department of Fish and Wildlife.

James, Ann Racheal and Ashley had a conference call with Elizabeth Glidewell, Freshwater Mussel Project Lead for the Confederated Tribes of the Umatilla Indian Reservation. She is interested in doing collaborative work with us looking at composition of mussels to determine their nutritional status in relation to health and survival. We discussed the testing she wanted done as well as gave her an update on our progress with mussels. She offered to help with our projects.

A copy of the 2016 Hagerman NFH PRAS steelhead proximate composition report was provided to the Idaho Department of Fish and Game.

Ron and Ann participated in a conference call discussing the salvage and possible hatchery rearing of bull trout from the Gold Creek and Upper Kachess River. During the call, Ann answered questions about the fish-rearing portion of the Biological Assessment to capture and hold bull trout in a Yakama Nation Hatchery facility.

The acting manager at Jones Hole NFH (Utah) contacted about possible steatitis in Bear Lake Bonneville cutthroats they raise. They will be sending feed in for testing.

Ann was contacted by Fish Health at the Leavenworth Complex about testing adults and offspring for selenium. She is still trying to find the underlying cause of the cataract occurrences at Winthrop NFH.

Edenton NFH (North Carolina) inquired about different sturgeon feeds, their quality and acceptance by the fish.

Ann provided information about carbohydrate digestibility in Pacific salmon to the Oregon Department of Fish and Wildlife (ODFW) fish pathologist.

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The purpose of the Fish Feed Quality Control (FFQC) program is to ensure that fresh feed that meets the dietary requirements of the fish is used at our NFHs. As part of the routine analyses, feeds from hatcheries are checked for rancidity. The regional nutritionist (Ann) writes the feed memos, which are sent to the hatchery and the feed mill. A quarterly FFQC report is written and sent out to Tribal, State, and Pacific and Pacific Southwest Region hatchery partners. The report gives analytical data concerning the proximate analysis (protein, lipid, moisture and ash) and rancidity of the sampled feeds.
In mid-July, SCA Intern Katey Strailey left Abernathy FTC to begin a PhD program in Aquatic Ecology at the University of Illinois-Champagne. Katey began her internship with us in August 2018 and made significant contributions not only to QET projects, including as common carp research at Malheur NWR and a Passive Integrated Transponder (PIT) tag loss study at Hagerman NFH, but she also helped in other programs and helped conduct a saltwater challenge study with hatchery steelhead in collaboration with the Nutrition & Physiology Program. We will miss her work ethic and sense of humor and with her the best of success in her next career step!

Kurt, with assistance from Kelli, began testing the performance of PIT tag antennas housed in PVC of different diameters. Antenna performance can be influenced by the proximity of the wire to the water, so Kurt is trying to determine the smallest diameter PVC that will give good performance, because that would result in lower-cost, lighter-weight antenna systems that are easier for biologists to implement in the field.

Doug, with help from the Columbia River FWCO and Regional FAC staff, submitted a proposal to FWS Headquarters for AIS funding that would support a proof-of-concept evaluation of using YY males to eradicate brook trout from Tyee Springs, the water source for Carson NFH. This would be a joint Columbia River FWCO-Abernathy FTC project, and would help demonstrate the efficacy of the YY male method and, if successful, would eliminate the probability that brook trout would be in inadvertently released during distribution of juvenile Chinook salmon from Carson NFH.
ANN AND ASHLEY SET UP THE ABERNATHY FTC BOOTH FOR THE COWLITZ COUNTY FAIR. THE BOOTH PROVIDED INFORMATION CONCERNING RESEARCH DONE AT ABERNATHY FTC AND PROVIDED VARIOUS HANDOUTS INCLUDING ONES ABOUT LAMPREY AND THEIR LIFE CYCLE.

JUL 25-29
Ann and Ashley set up the Abernathy FTC booth for the Cowlitz County Fair. The booth provided information concerning research done at Abernathy FTC and provided various handouts including ones about lamprey and their life cycle.

AUG 17
The Tualatin NWR YCC crew helped to convert lawn into a garden for pollinators then got a tour of Abernathy FTC.

AUG 12
The Julia Butler Hansen Refuge YCC crew spent a very hot day preparing for a pollinator garden for plants then got a tour of Abernathy FTC.

AUG 7
Ashley attended an outreach event at the Evergreen Girl Scout campground (Mill Creek). She explained what the Abernathy FTC does for conservation, the salmon life cycle and ways the girl scouts could help in conservation efforts. There were about 30 girls present at the event that took place in the evening.

AUG 21
Keepers and managers from the Oregon Zoo visited Abernathy FTC to discuss rearing techniques, sharing technical expertise, and collaborating with regards to holding aquatic organisms. Abernathy FTC staff may get a behind the scenes tour of the aquatics and marine mammal sections of the zoo sometime this fall.

PUBLICATIONS AND REPORTS


### MEETINGS, CONFERENCES & TRAININGS

| JUL 1 | Patty participated in a R1 Science Coordination Team call. |
| JUL 2 | Ann, Ashley, Racheal and Ron participated in a conference call with the multi-region Physiology and Nutrition Group to discuss research proposals to be submitted at the next FTC Meeting. |
| JUL 5 | Christian participated in the monthly FWS Genetics Community of Practice teleconference. Staff from each region provided updates on system-wide work at the Tech Centers funded by headquarters. Sharing of computational resources among the regions to address periodic needs of each, and sharing of resources between FWS and USGS were also discussed. |
| JUL 5 | Christian Participated in the Deschutes Spring Chinook Hatchery Coordination Meeting to address questions from FWS, ODFW and Confederated Tribes of Warm Springs Reservation of Oregon regarding genetic risks associated with potential fish transport actions. The actions are being considered as a response to low returns to the Warm Springs River, and a common understanding of the risks involved by all partners was seen as important. |
| JUL 6, 9 | Ashley and Racheal completed their electrofishing safety training. |
| JUL 11 | Justin represented Abernathy FTC at the Quilcene NFH Co-manager Meeting. There, he presented the results of a recent collaboration between Abernathy FTC and the Northwest Watershed Institute to evaluate genetic structure of Coho Salmon in Hood Canal. One of the primary objectives of the work was to evaluate gene flow from the hatchery into naturally spawning populations, and the results indicated that this was very low, relative to gene flow among the naturally-spawning populations. |
| JUL 12 | Patty, Roger, and Steve M. participated in a call with regional engineering staff and Mark Ahrens to discuss a contract involving rehabilitating the Abernathy FTC intake. |
| JUL 12 | Patty and Roger participated in the monthly FTC call. |
| JUL 18 | Genetics staff participated in a Webex on “Regulating the development and use of advanced biotechnologies for the eradication and control of invasive species”. This meeting was hosted by the National Invasive Species Council and provided helpful information on how various agencies (FDA, EPA, USDA, and State Department) are navigating legal and policy issues raised by new genetic technologies. |
| JUL 19-20 | Ben and Kelli attended FWS airboat operator’s training held at Willipa Bay NWR. |
| JUL 25 | Christian participated in a teleconference with Columbia Gorge Complex, Columbia River FWCO, and Regional office staff to discuss the possibilities of using fish transfers from Round Butte Hatchery or Parkdale Fish Hatchery to help Warm Springs NFH meet production goals. |
| JUL 25 | Patty participated in the Gorge Complex HET at Spring Creek NFH |
### MEETINGS, CONFERENCES & TRAININGS (continued)

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>JUL 30</td>
<td>Christian participated in an inter-agency meeting to plan reintroduction of ESA listed Sacramento River Winter Chinook Salmon into Battle Creek, CA. Establishment of additional populations is a key requirement defined in the recovery plan for this endangered species.</td>
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<tr>
<td>JUL 31</td>
<td>Abernathy FTC staff participated in safety training about hazardous communications and SDS sheets.</td>
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<td>JUL AUG</td>
<td>Ben participated in bi-monthly conference calls with the FWS Pacific Lamprey Conservation Team.</td>
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<tr>
<td>JUL AUG</td>
<td>Ann participated in three conference calls as a member of the Science Support Partnership (SSP) Committee to discuss projects submitted for funding in the SSP program. There were two in July and one in August.</td>
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<tr>
<td>AUG 2</td>
<td>Christian participated in a monthly meeting of the Pacific Region FAC Database Implementation Team. The team is developing a plan to implement the recommendations spelled-out in the database white paper, produced by the FAC Program in 2018.</td>
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<td>AUG 2</td>
<td>Justin represented Abernathy FTC on the FWS Genetics Community of Practice teleconference. Topics included two new courses the group is helping to organize at NCTC: Applied Conservation Genetics, and eDNA Best Practices.</td>
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<td>AUG 18</td>
<td>Ann gave a presentation, Fish Nutrition: Feed Manufacturing, Feed Development, FFQC, at an Oregon Hatchery Research Center workshop concerning fish nutrition titled “Fish Nutrition: Feed manufacturing, Feed Development, Fish Feed Quality Control”.</td>
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<td>AUG 16</td>
<td>Roger participated in the monthly FTC call.</td>
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<td>AUG 22</td>
<td>Patty listened in on the Makah/Quinault NFHs HET meeting.</td>
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<td>AUG 27-28</td>
<td>Ben, Ron, Brice and Christian attended a Research Project Progress Review hosted by the Northwest Power and Conservation Council. The purpose of this meeting was to share information collected on several comparisons of hatchery-origin and natural-origin fish in the Columbia River Basin. Ben shared findings of a BPA-funded study conducted at Abernathy FTC in his talk titled “Natural Reproductive Success and Demographic Effects of Hatchery-Origin Steelhead in Abernathy Creek, Washington”.</td>
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<td>AUG 30</td>
<td>Ben represented Abernathy FTC and Region 1 FAC at the multi-stakeholder Double-breasted Cormorant and Free-Swimming Fish workshop in Portland, OR. The meeting purpose was to discuss options and gather information on how to manage cormorant predation and impacts on fishes.</td>
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