ONCORHYNCHUS

Newsletter of the Alaska Chapter, American Fisheries Society

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In this issue:

William F. Thompson, Director of the International Pacific Halibut Commission during 1923–1940 and one of the first persons to develop statistical reporting areas for fisheries off Alaska, shown at Sidney Island, B.C., 1912. Photo from William F. Thompson papers, Archives, School of Aquatic and Fishery Sciences, University of Washington, Seattle.

Managing Alaska's Commercial Fisheries: A History of Statistical Management Areas in Alaska

Bob King

Sustainable management of Alaska's abundant fishery resources depends on knowing a few key statistics: how many of what species were caught, when and how those fish were caught, and, critically, where those fish were caught. Understanding these aspects has been an issue since the beginning. In 1892, salmon canneries in Alaska were spreading from Southeast to Bristol Bay, and Congress required the first statistical reports on Alaska's fisheries. These early reports left a lot to be desired as catch data was based on self-reporting of production records by each cannery. Given priorities at the time, the U.S. Treasury agents in charge of the Alaska Territory kept better statistics on imports of booze into Alaska than on the number of fish being shipped out.

By 1905, the Treasury Agents wanted a better idea where all these fish were being caught so they divided catch information by region: Southeast Alaska, Central Alaska (Cordova, Cook Inlet, Karluk, and Chignik), and Western Alaska, which at the time was just Bristol Bay. The total fisheries catch from Alaska in 1905, a respectable 117 million pounds, was composed mostly of salmon. While they started to narrow down on where fish were being caught, it was still mainly economic data that was being collected. Nobody was really managing fisheries then.

Biology first became an issue with Pacific Halibut *(Hippoglossus stenolepis)*. Halibut catches along the Pacific coast grew in the early 20th century, but catch rates declined. Halibut fishermen had to fish longer and sail farther to catch the same amount. It was such a big enough problem that in the 1920s the United States and Canada signed a Pacific Halibut treaty and hired a promising young Stanford graduate to figure it all out.

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The President's Corner

Aaron Martin,
AFS Alaska Chapter President.

Ahhh. Summer time in Alaska. Also, known as the open water season; something I look forward to ALL, WINTER, LONG. Being on the water with friends and family while rafting or fishing is restorative and healing. It reminds me how appreciative I am, and how fortunate we are, to have the amazing aquatic resources we have in Alaska. As I watch the crowds of resident and out-of-state anglers and rafters take to the water, I'm also reminded how vulnerable the state's aquatic resources are. Much of Alaska's aquatic ecosystems remain intact despite localized development, resource extraction, habitat degradation, and emerging infestations of aquatic invasive species. The geographic isolation from the lower 48 states and our state's remoteness has kept us sheltered from high-risk invasive species for a long time. These do not insulate us from this issue anymore. The alarming part to me is that invasive species are considered the second greatest threat to native ecosystems across the world, and the risks to our way of life and economy in Alaska is underappreciated by many.

We already have invasive species in Alaska (e.g., *Elodea* and, Northern Pike *[Esox lucius]*) which have caused serious ecological and economic problems, and there are

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Statistical Management Areas, continued

William F. Thompson applied science to the problem. In 1927, he carved out the first statistical areas along the Pacific coast. Thompson created 35 areas from Coos Bay, Oregon, to Unimak Pass, defining a new statistical area every 60 miles. The data generated led to one of the first actions of the International Pacific Halibut Commission (originally called the International Fisheries Commission when established in 1923). Thompson's data showed that half the halibut catch came from south of Cape Spencer, near the top of the Southeast panhandle, and the other half came from father west. Cape Spencer became the first district line in the halibut fishery and remains in effect to this day.

Federal biologists copied Thompson's idea and created statistical areas in Southeast, Prince William Sound, and Kodiak. These nascent areas were complicated, initially reused the same numbers, and applied only to Pacific herring *(Clupea pallasii)*. These early statistical efforts ground to a halt when World War II broke out in 1941. As the world returned to normal after the war, the matter of counting fish soon came back to surface.

In 1950, the U.S. Fish and Wildlife Service created a new statistical unit and carved up the Alaska coast into statistical areas identified by three-digit codes, later expanded to five digits to better subdivide areas. Learning from past mistakes, statistical areas were given unique numbers that weren't necessarily consecutive, leaving room for change. This general system remains in place today.

An unrelated event would also shape statistical areas. After World War II, the U.S. wanted to restore food security for Japan. The result was the International North Pacific Fisheries Convention (INPFC) signed in 1952. The treaty allowed Japan to fish for salmon in the open waters of the Bering Sea. Annual harvests grew to tens of millions of salmon, many of which were Alaska origin.

Controversial to Alaskans, the U.S. State Department said good relations with Japan were more important than fish. But the department agreed about the importance of good catch accounting. As a result, the INPFC created yet another new set of statistical areas for the high

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President's Corner, continued

many pathways for others to get here. In fact, pathways and suitable habitats are increasing rapidly through increasing tourism, shipping, development, and water temperatures. While multiple Tribal, local, state, and federal agencies are trying to control and eradicate existing aquatic invasive species, we have a chance to stay ahead of new introductions and further expansion of existing species by increasing prevention and identification abilities, reducing pathways of introductions, and addressing infestations while they're still contained to relatively small areas. This will take us all.

Everyone that appreciates clean rivers, lakes, and oceans that support vibrant populations of native species has a role in bolstering early detection and rapid response efforts by knowing what to look for, reporting it, and understanding and minimizing the pathways. FYI, we are all potential pathways as we go to the field, recreate in our backyards, or travel abroad.

Alaska's Governor, Bill Walker, issued a proclamation in May designating June 18–24, 2017 Alaska Invasive Species Awareness Week. Help keep the conversation going by talking with your friends, family, and coworkers about the risk aquatic invasive species present to what we value in Alaska and how to minimize the threat. Alaska has some of the most pristine and intact ecosystems on the planet that support some of the most vibrant fisheries in the world.

If we don't proactively confront aquatic invasive species, our ecosystems and fisheries are at risk. It's not a matter of "if" aquatic invasive species will show up in Alaska. It is a matter of when, and how prepared we are to find and eradicate them early before they have significant impacts on the things we value.

Collectively, we can make a difference in preserving our native aquatic species. So, as you prep your boat or gear for your next adventure, take an extra few minutes to think about where that gear was used last. Could you be unconsciously moving aquatic invasive species to a new location? What would the ramifications be if that happened? What can you do to minimize the negative impacts that may arise from a new infestation?

Statistical Management Areas, continued

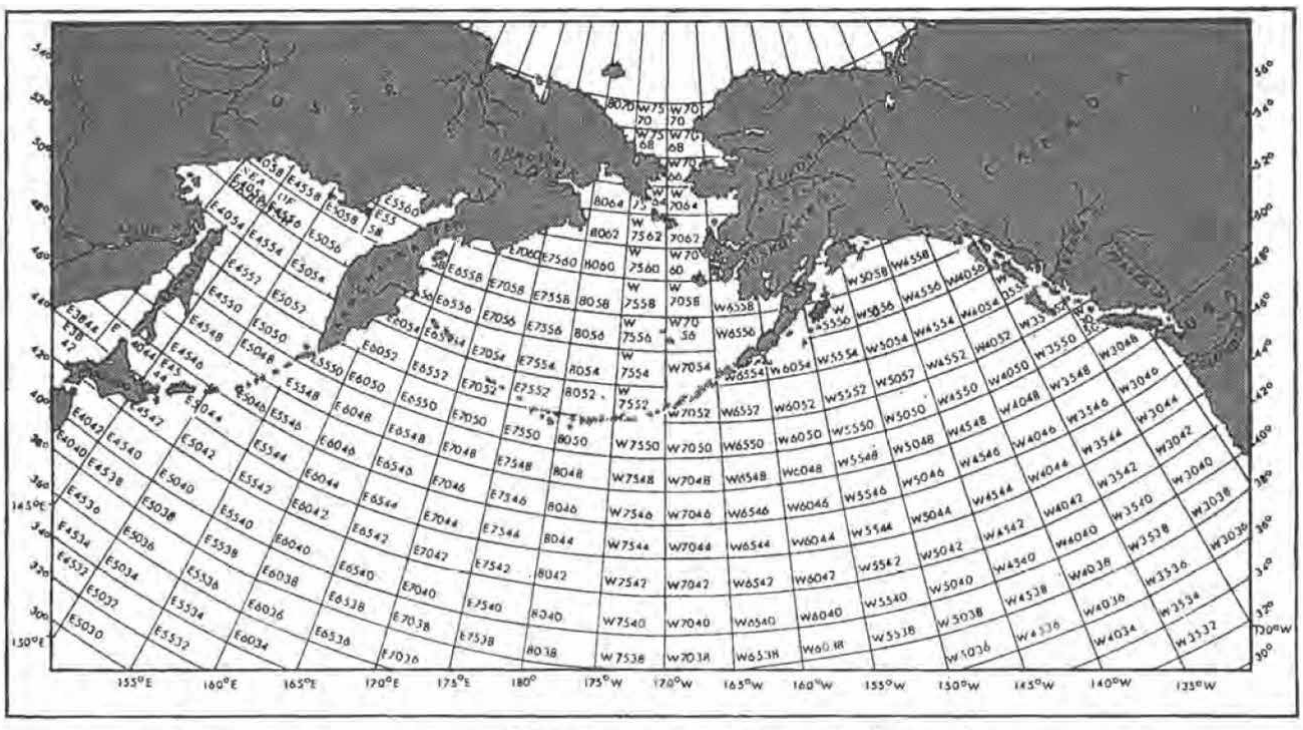

FIGURE 1. INPFC North Pacific area coding as modified for tagging.

Georeferenced statistical areas created after adoption of the International North Pacific Fisheries Convention in 1952. *Figure from Bob King.*

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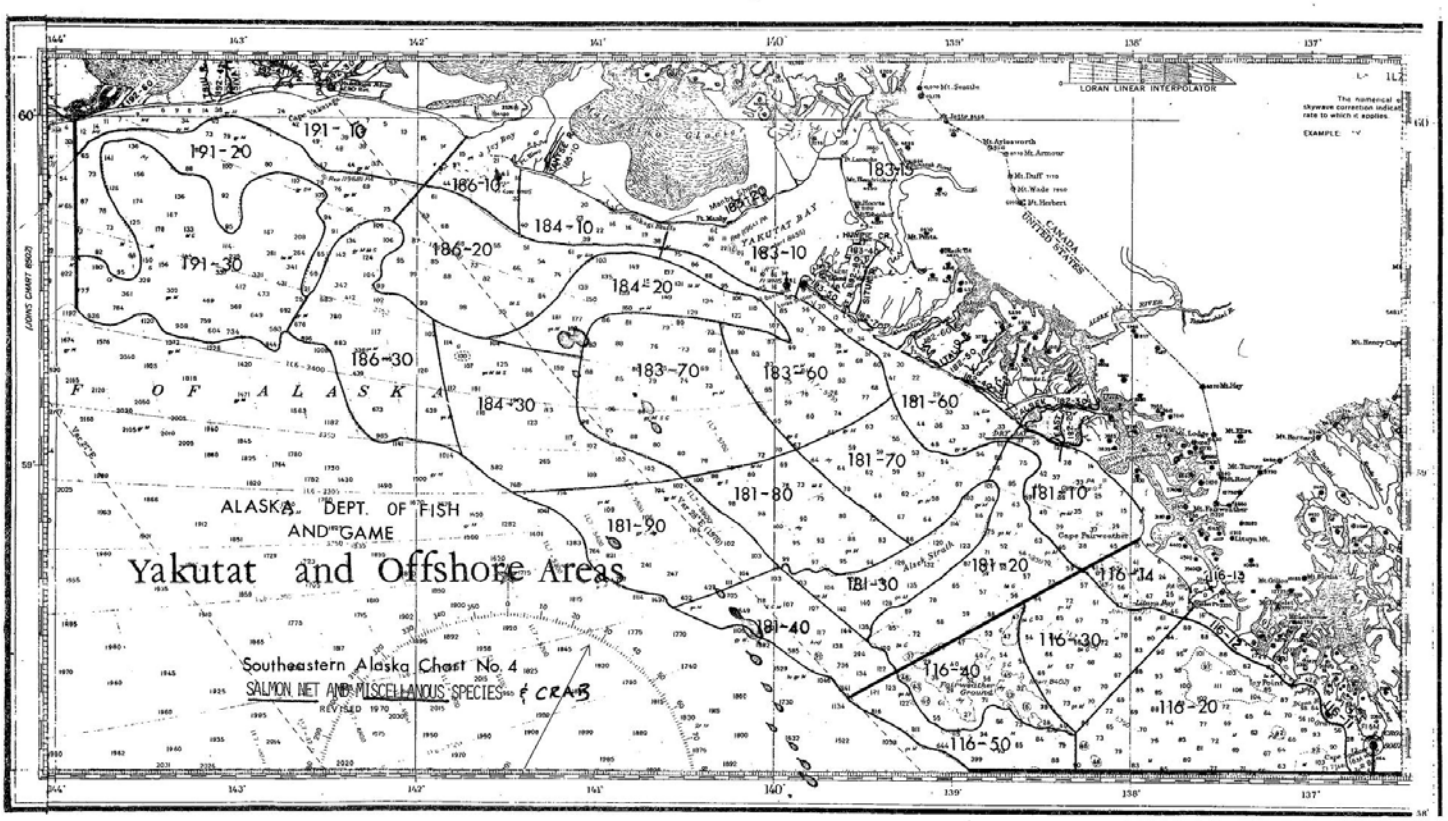
Statistical Management Areas, continued



Example of 5-digit statistical areas modified to reflect bathymetry near Yakutat in 1970. Figure from Bob King.

seas: a grid system that was georeferenced with areas identified by latitude and longitude. These blocks started in the western Aleutians and were later applied throughout the Bering Sea and Gulf of Alaska. Combined with tagging data, fishing impacts on Alaska salmon could begin to be evaluated from a spatial perspective. It was a new way to look at fish statistics.

Back at home, motivated in part by fisheries issues, Alaska gained statehood in 1959. This meant that Alaskans had control over their fisheries. The state created its own statistical unit. The young Alaska Department of Fish and Game (ADF&G) boasted of skilled keypunch operators who processed 1.5 million IBM cards every year and could "provide answers in minutes, instead of months."

This new data and capability brought changes. Many district boundaries were redrawn by ADF&G to facilitate more precise harvest accounting and better management of salmon runs. In Prince William Sound, ADF&G expanded the number of fishing districts from two to eight, which required a complete reorganization of Prince William Sound statistical areas. The same thing happened across the state.

While salmon dominated Alaska's fisheries harvests, the boom of Red King Crab *(Paralithodes camtschaticus)* near Kodiak in the early 1960s brought a new problem. The state's first crab biologist, Guy Powell, argued that the statistical areas for salmon didn't work for shellfish. Guy proposed new areas that followed the seafloor, and he drew bathymetric statistical area lines that followed depth contours of 50, 100, and 500 fathoms, and deeper.

Not everybody liked these contoured area, and bathymetry data then was far from perfect. This approach resulted in some crazy area lines that were hard to follow, and even included localized statistical areas that were shallower or deeper than a surrounding statistical area. Some preferred the georeferenced grid used by the INPFC. For a while, the two systems lived side by side, with bathymetric lines following the coast and a grid system for offshore waters deeper than 1,000 fathoms. But the state grid wasn't fully georeferenced and wasn't used by many Alaskans.

Those offshore international waters attracted more

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Statistical Management Areas, continued

attention from foreign distant-water fleets targeting mostly groundfish. Alaskans didn't care much for groundfish at the time. While there was some interest in Sablefish *(Anoplopoma fimbria)* and Pacific Cod *(Gadus macrocephalus),* most groundfish species were considered "trash fish." Alaskans landed just 3.7 million pounds of groundfish in 1976. That same year, Japanese trawlers operating under the INPFC landed 1.2 million tons of groundfish, almost two and a half billion pounds, mostly pollock.

Also in 1976, the U.C. Congress passed the trailblazing Magnuson-Stevens Act (originally titled the Fishery Conservation and Management Act of 1976). The new law pushed our fishery management jurisdiction out to 200 nautical miles and claimed rights to the fish in those waters. It took more than a decade for our domestic industry to gear up for this massive new fishery. While industry prepared, so did the state. In 1985, ADF&G introduced a new grid system for groundfish and shellfish that was fully georeferenced and created areas that were one-half by one degree and designated by six digits.

Alaska's lucrative groundfish fishery was fully "Americanized" in 1991. In just a few years, Alaska production jumped from 500 million pounds to 5 billion pounds annually. We've never looked back. In 2015, Alaska's catch set a new record of over six billion pounds.

Mike Byerly hauling Sablefish over the rail. Photo by James Brady.

Keeping track of all these fish remains a challenge. Over the years, the state has revised and fine-tuned these statistical areas to better manage fisheries. We've added special harvest areas, terminal harvest areas, areas for set gillnet catches, etc. Unfortunately, not all these changes have been well documented.

A federal grant under the Saltonstall-Kennedy program is allowing the state to trace this historical record so we have a more accurate understanding of where Alaska's fish are caught. Under the direction of IT manager Kathy Jones and IT analyst Jennifer Shriver, and Geographic Information System (GIS) specialist Sabrina Larsen, the team is reconstructing these changes, and rebuilding the record of how we counted Alaska's fish.

Better documentation of this history and future changes will help us understand where we catch our six billion pounds of seafood each year so Alaska can continue to manage our abundant fishery resources sustainably.

Bob King works as a research analyst with the Alaska Department of Fish and Game's statistical area team and is author of Sustaining Alaska's Fisheries: Fifty Years of Statehood.

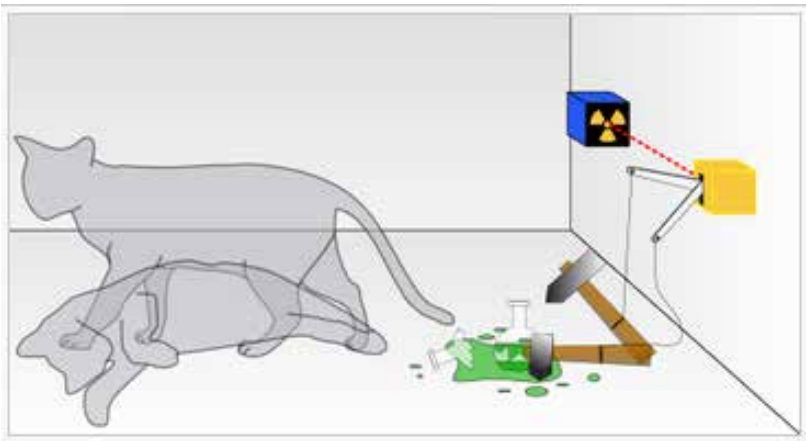
Alaska Sea Grant Fellows Placed

Five Alaska Sea Grant State Fellows start one-year positions with state and federal agencies in Alaska this summer. Starting in 2015, the Alaska Sea Grant State Fellowship program adds capacity to marine policy agencies and encourages fellows to begin their careers in Alaska. Chelsea Clawson, who is earning her M.S. in fisheries at the University of Alaska Fairbanks (UAF), will take a fellowship at the U.S. Geological Survey, while Genevieve Johnson, also in the fisheries M.S. program at UAF, will work at the NOAA Alaska Fisheries Science Center. The North Pacific Research Board and US Fish and Wildlife Service LCC have teamed up to create a position for Liza Mack, who is nearly finished with her Ph.D. in indigenous studies at UAF. Danielle Meeker, completing her M.S. of advanced studies in climate science and policy at Scripps Institution of Oceanography, will take a fellowship at the Alaska Office of the Lieutenant Governor. Kim Ovitz, earning her M.S. in fisheries at the University of Maine, will work at NOAA National Marine Fisheries Service. The new Alaska Sea Grant State Fellows will start their positions between July 1 and late September 2017.

Is What We See Real?: A Cautionary "Tail"

Jim Reynolds

Quantum theory deals with the properties of subatomic particles. Electrons are the most familiar to us, but there are many others, like quarks and photons. Results of early work in quantum physics suggested that particles could exist in two states at once (called quantum superposition), a difficult concept for most of us to grasp. In 1935, after discussions with like-minded Albert Einstein, Austrian physicist Erwin Schrödinger proposed a thought experiment to criticize the concept. His experiment became known as Schrödinger's Cat. It went like this: a cat is placed in a sealed box with a radioactive source, a Geiger counter, and a flask of poison. If the counter detects a random decay event (release of a radioactive atom), it releases a hammer that breaks the flask, releases the poison, and kills the cat. Until that happens, the cat can be considered simultaneously dead and alive. Not until we look in the box can we see the actual state of the cat. In other words, our observation determines reality — the observer effect. (Note: since then, physicists have learned that, in fact, quantum superposition is a real possibility.)



Cartoon of Schrödinger's Cat. *Figure provided by Jim Reynolds as obtained from Wikimedia Commons.*

Now, an animal is not a quantum particle and exists in only one state. But we can only know that state by our observation. The observer effect is a dilemma faced by anyone who studies animal behavior: Would the animal behave differently if we had not observed it? To use a common example, what effect, if any, does the capture, marking, and release of a fish have on its normal behavior? We are acutely aware of this problem and do our best to take it into account. Observation by direct and remote means, if feasible, may provide assurance that our studies yield viable results. Technology has given us smaller tags that should minimize the effect of our study. When my students and I were using earlier versions of radio tags on Arctic Grayling (Thymallus arcticus) in northern Alaska, the "2-percent rule" (the implanted transmitter should weigh less than 2% of the fish weight) was difficult to achieve because the fish were often not large enough; 3-4% was often the reality. So, we crossed our fingers and hoped that the fish would behave as expected. That is, we expected them to move to areas with groundwater upwelling for the winter. And that is what most of them — the ones that lived — did. Later ground-truth studies verified our telemetry results. We did the best we could to assure ourselves that the fish behaved "normally."

The observer effect can play a subtle, but significant, role in many of our studies of fish and other animals — and plants, for that matter. We must not assume that the observer effect plays no role in our studies. Independent corroboration of our results is the only method we have for quality assurance. We don't need Schrödinger's Cat walking in and messing with us!

Jim Reynolds was President of the AFS Alaska Chapter during 1981-1982.

Help Needed
Western Division Meeting of the American Fisheries Society

The Alaska Chapter of the American Fisheries Society (AFS) will host the Western Division AFS meeting in Anchorage, May 21-25, 2018. Planning for the program, including socials, symposia, and continuing education, is currently underway. We've had enormous interest in the meeting both within Alaska and across the Western Division. Committees are forming to help plan and carry out the meeting - and we still need help from volunteers! We are also soliciting input regarding continuing education courses and symposia. Please contact Alaska Chapter President-Elect Jeff Falke at *afs.alaska.presidentelect@gmail.com* or 474-6044 to volunteer or submit program ideas.

Molly Ahlgren Scholarship Award 2017 Recipient

Kelly Ireland

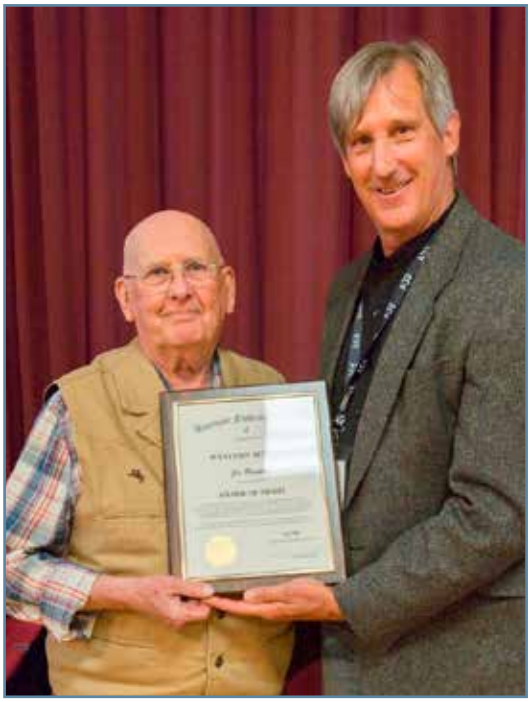
When I applied for the Molly Ahlgren Scholarship, I read about what a great woman Molly was. I didn't imagine I could be picked for an award named after such an upstanding woman. From what I've read, Molly Ahlgren seems like most of the women I look up to. She was a fisheries professor, a volunteer EMT, loved dogs, and was known for her kindness. I have immense gratitude that I was selected for the award in Molly Ahlgren's honor. I hope that this opportunity will allow me to make a difference like Molly Ahlgren did in the lives around her as I pursue a career in fisheries. Thank you to the Molly Ahlgren Scholarship Committee for their belief and support in my undergraduate studies.

With this scholarship I will be able to complete my undergraduate studies at UAA in Journalism and Public Communications and Biological Sciences. The scholarship will also help me continue to pursue my research in Kat Milligan-Myhre's lab into the host microbe interactions of sticklebacks and their gut microbiota. Attending the 2017 AFS Alaska Chapter Annual Meeting in Fairbanks was an inspiration to continue to pursue fisheries and my research. It was interesting to see how different agencies and fisheries biologists have been working together to learn more about the Chinook Salmon *(Oncorhynchus tshawytscha)* decline. I also thoroughly enjoyed seeing all the work being done in Alaska by Master's students. Their work is a testament to me that students can do big things. Their enthusiasm for their projects showed me just how rewarding completing a research project can be. I felt inspired to get back into the lab and the field after attending the annual meeting.

Again thank you so much to the Molly Ahlgren Scholarship Committee for selecting me for the award. It is such an honor to be selected and I hope to live up to the big things that Molly Ahlgren did in her life.

AOOS Film Contest

The deadline for the Alaska Ocean Observing System's 2017 ocean short film contest is September 15. Films must be under 10 minutes and focus on Alaska's ocean and coast. Topics vary and include educational, informational, and just for fun. Additional contest rules and the submission form are on the AOOS website. You can view the 2016 grand prize winner on YouTube at *http://www.aoos.org/aoos-2016-film-contest/*. For more information on the 2017 contest, go to *http://www.aoos.org/*.



Jim Reynolds accepts the AFS Western Division Award of Merit from Jim Bowker, Division Past President. *Photo from WDAFS Tributary.*

Dr. Jim Reynolds Receives WDAFS Award of Merit

Jim Reynolds, former AFS Alaska Chapter President and now retired from the University of Alaska Fairbanks, received the AFS Western Division Award of Merit at the May 2017 Division meeting in Missoula, Montana. Dr. Reynolds was recognized for his passion and tireless energy in conducing electrofishing courses throughout the country and, specifically, in the western U. S. Jim notably helped develop the foundation of fish electroshocking by advocating for the concept of the Power Transfer Theory, having taught more electroshocking courses around the country that any other person, and having authored the electroshocking chapters for all three editions of the *Fisheries Technique* Manual published by AFS.

USF&WS Alaska Conservation Awards

Alaska Native Leader/Elder Conservation Hero Award — This award honors those Alaska Native leaders and elders who work closely with us to incorporate tribal and traditional knowledge into our understanding of the natural world and the resources we manage.

James Charles. Photo from the U.S. Fish and Wildlife Service.

James Charles is a Native leader and elder who has a long history of working closely with both the Alaska Department of Fish and Game (ADF&G) and the U.S. Fish and Wildlife Service (USFWS). Born in 1945 at a fish camp at Kinarmiut near Tuntutliak, Alaska, Mr. Charles grew up practicing the Yup'ik traditional lifestyle. He readily shares his extensive tribal and traditional knowledge and understanding of the natural world and resources in an effort to merge cultural practices with western science. James has served as: ADF&G Advisory Council member since 1956; USFWS Refuge Information Technician in 1984; Kuskokwim River Salmon Management Working Group member since 1986; Regional Advisory Council member for over 10 years; and Executive Council member and Inseason Manager for the Kuskokwim River Intertribal Fish Commission the past three years. Over his lifetime, James Charles has worked tirelessly with the USFWS and others to conserve and sustain the wildlife, fish, and a way of life in the Kuskokwim River region.

Back issues of *Oncorhynchus* can be found online *http://www.afs-alaska.org/newsletter*

Orville Huntington. Photo from the Alaska Board of Fisheries.

Orville Huntington, of the Tanana Chiefs Conference, was recognized as an Alaska Native Conservation Hero. Born in Huslia, Alaska, Mr. Huntington is dedicated to working closely with young people to promote the values of traditional Native elders combined with contemporary western knowledge. His primary responsibilities continue to be the preservation of Native subsistence hunting, fishing, gathering, and trapping opportunities and the cultural events that surround those beliefs. Orville serves as a public servant for the village of Huslia and the 43 villages of the Tanana Chiefs Conference region, and also on the Alaska Board of Fisheries. Able to analyze complicated fish and wildlife issues and understand how these issues will affect subsistence users, Orville is also known for his ability to respectfully communicate and explain complex fish and wildlife resource issues to a variety of audiences. Over the years his stature among his peers across the state has grown. Orville continues to serve as a bridge between natural resource agencies and subsistence users.

Science Excellence Award — Penny Crane is a geneticist with the Conservation Genetics Laboratory of the U.S. Fish and Wildlife Service. In all her work, Penny has facilitated strong state, federal, university, and international collaborations to use genetic data to describe population

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USF&WS Alaska Conservation Awards, continued

characteristics, evolutionary history, marine and freshwater migration patterns, life history, and morphological variation. She is recognized as a leading expert on the genetic diversity of *Salvelinus* species, notably Arctic Char (*Salvelinus alpinus*), Dolly Varden (*Salvelinus malma*), and Lake Trout (*Salvelinus namaycush*) throughout the Pacific Rim and Alaska's North Slope, Penny's studies have addressed key management needs such as identifying the spatial scale of population structure and providing a genetic baseline for management and evaluation of subsistence fisheries. But Penny has also worked extensively on multiple Pacific salmon species to develop genetic baselines for stock identification, evaluation of migration patterns, and habitat usage for juveniles and adults.

Science Excellence Award — Randy Brown, Fairbanks U.S. Fish and Wildlife Conservation Office, and AFS Alaska Chapter Historian, is known for his emphasis on scientific integrity and often recognized for efforts to understand the Bering Cisco *(Coregonus laurettae)* in the Yukon River, while also gaining insights into two other Alaskan cisco stocks. The Bering Cisco has three known spawning populations in Alaska. Actively harvested in subsistence and commercial fisheries, this species is prized for its high fat content. With the decline of the Lake Ciscoes *(Coregonus hubbsi)* in the Great Lakes, demand from the New York kosher market triggered commercial fishing for the Yukon River population in the mid 2000s. At that time, biologists and stakeholders acknowledged the need for stock information to avoid overfishing, and Randy recognized the importance of the species to subsistence users along Alaska's western and northern coasts and the Yukon River, and an expanding commercial fishery could affect the population's status and subsistence users. Randy worked with federal, state, and other partners to improve species information on spawning locations, migration timing, etc. to inform management and conservation.

Outstanding Partner Team Award

The Interior Alaska Land Trust (IALT) has for years facilitated partnerships to conserve important landscapes in Interior Alaska. Recently, IALT, led by President Owen Guthrie, Martha Raynolds, Merritt Helfferich, Alex Prichard, Seth Adams, and Sama Winder, partnered with USFWS to undertake habitat restoration of Cripple Creek, a Chena River tributary. Cripple Creek was rechanneled in 1935 to convey excessive wastewater from hydraulic mining activity. Although the mining activity ceased years ago, the existing channel provides poor salmon habitat. When completed, the Cripple Creek project will restore miles of juvenile Chinook Salmon rearing habitat decimated while improving long-term maintenance of a major roadway.

The Kenai Mountains-to-Sea Partnership envisions private and public lands connected for the benefit to fish and wildlife while sustaining local economies by minimizing landscape impacts from climate change and development. The partnership includes Coordinator of Kenai Watershed Forum Mandy Bernard, Kachemak Heritage Land Trust, Audubon Alaska, Cook Inlet Keeper, Natural Resource Conservation Service, and The Conservation Fund. The Kenai Peninsula, a six million-acre landscape of ice, mountains, forests, fens, alpine tundra, coastal bluffs, rocky shorelines, and salmon, is quickly changing due to climate shifts and parcelization. The partnership is focusing current conservation efforts on 20 interjurisdictional streams, comprising 958 anadromous stream miles (out of 1,800 total miles of salmon habitat), flowing from federal lands through a gauntlet of multiple ownerships to the sea.

Fostering Partnerships Award - Mitch Osborne of the USFWS Fish and Wildlife Conservation Office in Fairbanks has been referred to as the "Prince of Partnerships" after leveraging over two million dollars in contributions to complete nearly 200 projects for the benefit of people and nature. For the past decade Mitch has administered the Partners for Fish and Wildlife program for the northern half of the Alaska Region. Known as a problem solver, Mitch has mastered the art of bringing together multiple partners to work on habitat restoration projects such as Yukon River Chinook salmon and other species. Since 2008, he's coordinated over 50 fish passage replacements, over 100 streambank restorations, and 13 schoolyard habitat projects from Barrow to Fairbanks. Mitch's coordination has leveraged over two million dollars in direct and indirect contributions. The ripple effect of his effort has spun off into other works like the Chena River Watershed Resource Action Plan and the film, *Voices of the Chena*.

Fish-friendly roads? Yes, that's a thing.

Katrina Liebich

Have you ever noticed those metal culverts funneling water under roads? They're pretty unremarkable to the untrained eye—invisible from the road, their presence only betrayed by the occasional frost heave, detour, or drowned trees upstream. To get a wholly different perspective, step into any river or creek and take a closer look where it intersects our transportation network. Many culverts cause big problems for fish. When fish can't get where they need to go, it affects our pocket books, decreases our food security, and threatens peoples' recreational pursuits, traditions, and ways of living. Across Alaska and the United States, migratory fish—like salmon, steelhead, and river herring—are particularly hard hit by barriers across streams and rivers.

Rivers and streams are powerful and ever-changing. They carry rocks and logs, flood, and carve out canyons. The main problem is that most culverts underneath our roads are too small! It's not uncommon for a 10 foot wide stream to be forced into a two foot diameter culvert, resulting in the water flow being pinched like an hourglass. These choke points concentrate flows and make fish passage difficult or impossible. When encountering a culvert not designed appropriately, rivers and streams often go over or through the roadbed. For us, this is an inconvenience; for fish, it's potentially life-threatening.

Fish survival and success hinges on being able to move freely to find food and good places to spawn; or to seek shelter from predators, high temperatures, or extreme flows. Some species and life stages are particularly vulnerable. For example, juvenile salmon lack the swimming ability of adults and barriers created by too-small culverts can prevent juveniles from reaching winter nursery habitats. One barrier culvert may not seem like a big deal, but each one chips away at options available to fish.

A small round culvert that failed during a 2012 flood event. Photo from USFW.

Natural variation in flows, especially during high-water events, can overwhelm too-small culverts. Too-small pipes also clog with wood and debris moving downriver, turning roads into dams until they're breached, or the clog is removed. In the meantime, trees upstream drown.

A stream's bed includes boulders, cobble, gravel, sand, or even finer stuff. This roughness breaks up the flow such that water moves slower against the substrate than higher in the water column, providing a path of least resistance for migrating or feeding fish. But a culvert set atop the stream's bottom defeats the break in flow provided by natural substrate. This is further complicated when there's a height difference between the outlet or inlet of a culvert and the stream-bed. These "perched" culverts are extremely common, tending to become more perched over time as high velocities through the pipe carve out a plunge pool below.

Where roads and railways are concerned, what's good for fish is good for us. Stream crossings designed to pass the weakest swimmers at all

A fish-friendly culvert in Tyonek, Alaska. Photo by Ash Adams.

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Fish-friendly roads? Yes, that's a thing., continued

flows minimize culvert problems. What's under our roads should ideally mimic what's upstream and downstream. This helps ensure a seamless transition for fish passing underneath. But stream width and depth varies daily with the amount of water carried, so what culvert width is wide enough? To answer that, we must understand the stream's range of flows. A stream gauge that tracks water level and documents flood events over time can help, but gauges are only present on a fraction of Alaska's waterbodies. We can also measure the stream's width where the water just starts to spill over onto a floodplain. This "bankfull" measurement is what we want. We need to construct a channel inside a culvert that matches the bankfull width of the stream. Ideally, banks can also be constructed inside the culvert to provide resting places for fish swimming upstream and dry ground for wildlife to cross through the culvert too. If we don't want floods to overwhelm our roads, we need to give the rivers and streams they cross room to be their dynamic self—from their different flows down to their moving beds. Crossings sized to accommodate the expected range of flows perform better when encountering those natural flows. For example, the nearly 100 fish-friendly culverts installed in Alaska's Mat-Su Valley remained stable during a 100-year flood event in 2012 whereas the traditional round culvert counterparts required costly maintenance.

To build quality transportation infrastructure that lasts we need to focus not only on water, but also fish—if fish can move freely through road crossings to their preferred habitats, we're on the right track. This means involving transportation planners and engineers and engaging fish passage engineers, hydrologists, and fisheries biologists. Several options are available to facilitate the process. The Fish Passage Program of the U.S. Fish and Wildlife Service (USFWS) invests federal dollars and staff time into voluntary partnerships that improve fish passage where roads cross streams. In addition, the USFWS and the Alaska Department of Fish and Game offer multi-day fish passage workshops for planners, engineers, construction firms, and other practitioners interested in learning about fish-friendly crossings. You or your organization could also support efforts to document flows over time with stream gauges; such data is extremely limited in Alaska. Finally, you could join and support your local fish habitat partnership (*www.akfishhabitat.org*). For more information and additional pictures, go to *https://medium.com/usfws/fish-friendly-roads-yes-thats-a-thing-d3da81e179f8*.

Before the Mine

Kendra Zamzow

Leakage from test wells in the general area of the proposed Pebble Mine. Photo from Kendra Zamzow.

Most mining projects never get off the ground. Drilling may go on for a couple of years, maybe even a decade, and then a decision may be made to abandon the site. While the impacts of mines, as well as mitigations that reduce impacts, are well documented, the impacts from exploration are generally less clear.

Many readers are aware of the Pebble mine, the copper-gold ore deposit at the headwaters of streams that feed Bristol Bay, Alaska. Bristol Bay is also well-known as the largest wild commercial salmon fishery in the world, with the salmon also critical to subsistence users. Sport-fishing also occurs for both salmon and trophy rainbow trout not far from the proposed mine location. The mine has been controversial because of the probability

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Before the Mine, continued

of leaching copper through the alluvial material and wetlands that make up the landscape, into salmon-bearing waters.

In August 2016, the United Tribes of Bristol Bay, a consortium of tribes in Southwest Alaska, asked the Center for Science in Public Participation (CSP2) to investigate whether exploration activities themselves had caused any damage to the landscape or posed a risk to fish habitat. After five days of helicopter-based field sampling at 101 sites, CSP2 determined that there were problems caused by drill waste disposal and by inadequate drill hole reclamation. About half of the sites were reclaimed in good condition; these were frequently sites that were drilled away from wetlands or shallow "geotechnical" holes (200 feet deep or less) that were drilled to determine bedrock competency to plan tailings dams, rather than the deeper holes (up to 6,000 feet deep) drilled to locate the ore zone.

Importantly, free-flowing acid drainage was not observed. However, acidic, high-copper drill cuttings were observed on the landscape. Drilling requires a slurry of drilling muds to cool the drill bit and move the drill cuttings up and out of the drill hole as the drill bores through bedrock to obtain cores that will tell them where the ore zone is located. Frequently the drilling muds that came up out of the hole were disposed of, legally, by pumping them out onto the tundra. Whether the muds themselves cause damage is a debate, but there is now definitive evidence that drill cuttings from the ore zone, when they settle out onto the landscape with the drilling muds, oxidize, become acidic (pH near 3.0), and release high concentrations of copper. This was a key finding and seven general areas were documented with this type of contamination.

Another type of contamination was observed where drill holes had become artesian. Of five artesian sites that CSP2 tested, two were releasing water very high in copper (76-215 µg/L; most surface water in the area is less than 1 µg/L). While some drill stems had bolts, valves, or plates welded to them in an apparent attempt to contain artesian water, and these holes are not intended as a water source, they need to be plugged and reclaimed. The evidence of uncontained artesian sites suggests that there may be significant difficulty in permanently reclaiming some drill holes.

There is also an indication that the drill waste disposal method of running drill muds through trenches in order to settle cuttings may be contaminating wetlands. The trenches were unlined. At one site a groundwater spring 200 feet downgradient from a trench was sampled during drilling in 2011 and again in 2016. Several elements increased by at least an order of magnitude, including increases in copper from 0.25 to 1.8 µg/L, arsenic from < 0.15 to 0.7 µg/L, iron from 0.09 to 7 µg/L, and manganese from 6 µg/L to 336 µg/L; iron and manganese went from meeting to exceeding water quality criteria. While the groundwater table may be rising during snowmelt and rains, rinsing through the unlined trench and carrying contaminants downgradient, drilling practices should be changed to the use of lined, rather than unlined trenches.

Leakage from test wells in the general area of the proposed Pebble Mine. Photo from Kendra Zamzow.

In April 2017, the Alaska Department of Natural Resources determined that the Pebble Limited Partnership, LLC (PLP) should receive their land use permit, but only under the conditions that they put up a $2 million reclamation bond and pay particular attention to closing 138 specific drill holes. Basic science and sampling likely played a role in this decision, and CSP2 continues to encourage state regulatory agencies to develop sampling plans when making reclamation inspections, and also to include fisheries managers when making inspections given the perspectives on the impact of sites on fish habitat.

Student Subunit Happenings

New Student Subunit Representative

My name is Tessa Minicucci and I am excited to be the new representative for the student subunit of the AFS Alaska Chapter! I am originally from Ketchikan, Alaska, where my passion for salmon and the outdoors began at an early age. After earning a B.S. in Zoology from Michigan State University in 2012, I returned to Southeast Alaska and began pursuing a career in fisheries with various state and nonprofit agencies, including the Alaska Department of Fish and Game, the Sitka Sound Science Center, and Southern Southeast Regional Aquaculture Association. After a few years of seasonal work, I decided to return to school and was fortunate to connect with Dr. Megan McPhee at the University of Alaska Fairbanks (UAF) College of Fisheries and Ocean Sciences in Juneau, where I began working on my M.S. in August 2015. My research focuses on potential interactions in the Bering Sea between western Alaska Chum Salmon *(Oncorhynchus keta)* and Asian Pink *(Oncorhynchus gorbuscha)* and Chum Salmon, with funding provided by the Pollock Conservation Cooperative Research Center and the UAF Global Change Student Research Grant. As a student at UAF, I was provided with the opportunity to travel to Bristol Bay, Alaska, and Kamchatka, Russia, as a part of the Alaska-Kamchatka Exchange in Salmon Ecology Program. I also helped organize the 2017 AK-AFS Student Symposium, which piqued my interest in becoming more involved with AFS. I look forward to meeting and working with many of you in the upcoming year.

Student Subunit Happenings

Tessa Minicucci, Student Subunit Representative

Elections for the Juneau and Fairbanks AFS Alaska Chapter student subunits were held at the end of the spring 2017 semester. Juneau student subunit representative Casey McConnell passed on his duties as President to Wendel Raymond, a third year Ph.D. Student (University of Alaska Fairbanks [UAF] - Advisor Dr. Ginny Eckert). Wendel's dissertation focuses on spatial and temporal patterns of Sea Otter *(Enhydra lutris)* harvests and the impacts of Sea Otters on eelgrass ecosystems in Southeast Alaska. Based at UAF's Lena Point facility in Juneau, Wendel conducts his fieldwork off Prince of Wales Island, AK. Wendel previously served as the health insurance liaison for Juneau and other remote College of Fisheries and Ocean Sciences students.

Tessa Minicucci, AFS Alaska Chapter Student Subunit Representative. Photo from Tessa Minicucci.

In Fairbanks, Marta Ree replaced her predecessor Stephanie Berkman as the Fairbanks AK-AFS student subunit President. Marta will be working with Vice President Caitlin Forster, Secretary-Treasurer Marguerite Tibbles, and Social Media Coordinator Chase Jalbert. Ms. Ree is originally from Barrhead, Alberta, near Edmonton, Canada. Marta completed her B.S. at Concordia University of Edmonton, majoring in Integrative Biology. During her undergraduate degree, Marta had the opportunity to do a thesis project on benthic macroinvertebrate communities in Westslope Cutthroat Trout *(Oncorhynchus clarki lewisi)* streams of the Southern Rockies in Alberta. Marta started her M.S. in Fisheries at the UAF Fairbanks campus in fall 2016, aiming to explore the effect of freshwater growth on seaward migration and marine survival of Sockeye Salmon *(Oncorhynchus nerka)* in the context of a changing climate. In Fairbanks, Marta is also a volunteer coach for the 5–6 year olds in the Junior Nordics program and

Continued on next page

Student Subunit Happenings, continued

played her first season in the Fairbanks Women's Hockey Association this year. Marta is excited to take on the role of President for the Fairbanks student group and looks forward to working with her fellow AFS members.

We would like to extent a big thank you to Casey, Stephanie, and Cheryl Barnes for their commitment and hard work over the past year. We look forward to another great year ahead!

The AK-AFS Student Subunit would like to recognize the following University of Alaska students for recently defending their theses or dissertations: Stephanie Berkman (M.S., UAF) – "Evaluation of growth and migration trends on the survival and recruitment of Chinook Salmon in southeastern Alaska rivers;" Matthew Catterson (M.S., UAF) – "Growth and abundance patterns of Situk River Steelhead (*Oncorhynchus mykiss*);" Thomas Farrugia (Ph.D., UAF) – "Interdisciplinary assessment of the skate fishery in the Gulf of Alaska;" Phil Ganz (M.S., UAF) – "Estimability of time-varying natural mortality in groundfishes: covariates and hierarchical models;" John Hagan (M.S., APU) – "Assessing the accuracy of Landsat-derived stream temperature for use in juvenile salmonid habitat assessments on the Anchor River, Alaska;" Sarah M. Laske (Ph.D., UAF) – "Surface water connectivity of arctic lakes drives patterns of fish species richness and composition, and food web structure;" Casey McConnell (M.S., UAF) – "Straying, stress, and potential for reproductive interactions between hatchery-produced and wild Chum Salmon (*Oncorhynchus keta*) in Southeast Alaska;" Ann Riddle-Berntsen (M.S., UAF) – "Sensitivity to hydrocarbons and current cytochrome p450 enzyme activity in Arctic marine birds and waterfowl;" and Sarah Traiger (Ph.D., UAF) – "Otters, sea stars, and glacial melt: top-down and bottom-up factors that influence kelp communities."

UAF Student Maggie Chan Awarded Marine Policy Fellowship in D.C.

Maggie Chan, UAF Ph.D. student awarded Sea Grant Knauss Marine Policy Fellowship in D.C. Photo from Alaska Sea Grant.

Maggie Chan, graduate student at the University of Alaska Fairbanks, will head to Washington, D.C., next year as a Sea Grant Knauss Marine Policy Fellow. She is among 61 fellows nominated by Sea Grant programs nationwide who will start their fellowships in February 2018.

Chan is a Ph.D. candidate in the College of Fisheries and Ocean Sciences, studying the effects of regulations on subsistence and sport halibut fishing in Alaska. Her study provides information on the adaptations harvesters make in response to environmental and regulatory changes. Chan plans to graduate in December 2017.

If given the option, Chan would choose to work in the legislative branch of government. "A legislative fellowship would help me synthesize our national perspective toward marine resources, and I hope to take that perspective to the international fisheries management stage," she said. Experience in coastal communities from Madagascar to Alaska has inspired her career aspiration to work in international marine policy.

Alaska Sea Grant currently has two Knauss Fellows in DC. Charlotte Regula-Whitefield is a legislative fellow in US Senator Lisa Murkowski's office, and Kelly Cates works as an executive fellow in the NOAA Office of Legislative and Intergovernmental Affairs.

The one-year Knauss Marine Policy Fellowship was established in 1979 to provide an educational opportunity for students interested in marine resources and national policy decisions. The experience has served as a springboard to related careers for over a thousand fellows.

Fish Waste to Pet Treats

Chris Sannito, Alaska Sea Grant's seafood technology specialist, is developing a pet treat made out of Walleye Pollock (*Gadus chalcogrammus*) skins and early feedback indicates that canines particularly like it. Before his hire in March 2015, Sannito worked with faculty at the University of Alaska Fairbanks (UAF) on a research grant from the Pollock Conservation Cooperative Research Center. The task was to determine whether Pollock skins could be turned into a product that was tasty to dogs, easy for humans to handle, and shelf-stable for at least six months. Sannito's initial attempts to dry the Pollock skins were labor and energy-intensive and didn't seem like a good bet for a commercial product. But recalling his graduate school days, Sannito remembered a researcher interested in food extrusion technology. A particular focus was on a Clextral extruder, a machine designed to push material through a barrel with a screw, to create a snack made of rice flour and fish powder, with added flavorings. Sannito explored how pet-treat manufacturers, such as Purina, use extruders to make all kinds of products, and wondered about the potential application to fish skins.

Sannito took 500 pounds of fish skins to Tampa, Florida, for a one-day trial in the Clextral pilot plant. With some experimenting, the extruder produced a semisoft product with little odor but was high in collagen protein. The product had a consistency similar to licorice and could be formed into myriad shapes. Since dogs don't purchase their own treats, Sannito said, it was important to produce something that was easy to handle and not too smelly to humans.

On May 5, Sannito and Quentin Fong, Alaska Sea Grant's seafood marketing specialist, received the 2017 Invent Alaska award for "innovation in research leading to commercialization" from the UAF Office of Intellectual Property and Commercialization. The next step is to find industry partners to develop a commercialized product.

Although the payoff to fish processors could be significant, there are costs involved in extracting skins for further processing. Some processors simply grind and discharge their waste at sea. But where communities have processing plants, truckloads of skins are turned into fishmeal. Pet treats are a higher value commodity, and more and more processors are seeing the opportunities in that type of product.

AmazonSmile

Please spread this message far and wide! Tell your family and friends, your colleagues, and anyone who shops online at Amazon. Anyone interested in AFS and Alaska's fisheries can now support the AFS Alaska Chapter financially, at no additional cost! When customers shop on AmazonSmile (*https://smile.amazon.com/*), the AmazonSmile Foundation will donate 0.5% of the price of eligible purchases to the charitable organizations selected by customers.

There is no additional expense to the customer, not a price add-on, and at no cost to the AFS Alaska Chapter. The shopping experience is identical to Amazon.com with the added benefit that the AmazonSmile Foundation donates to the charitable organizations selected by customer.

Scuba Training at UAS

Interested in learning or building scuba diving skills suitable for Alaska while earning university credits? A field-based program at the University of Alaska Southeast (UAS), Sitka Campus, will work with UAS faculty to become accomplished research divers. Over the semester, students will learn everything from basic dive skills, to underwater rescue procedures, to underwater data collection techniques. Students will become familiar with local fish and invertebrate species, and participate in new and ongoing research projects. Additionally, students will learn basic skiff handling and engine maintenance techniques, critical to underwater field work. Through this 12-credit program, students will receive the following certifications: Professional Association of Diving Instructors (PADI) Open Water Diver; PADI Dry Suit Diver; PADI Advanced Open Water Diver; PADI Research Diver; American Academy of Underwater Sciences (AAUS) Scientific Diver; American Heart First Aid, CPR, & AED; Divers Alert Network (DAN) O2 Provider; and Alaska Boaters Certificate. For more information, contact Dr. Reid Brewer (*rsbrewer@alaska.edu*).

Meetings and Events

Northwest Aquatic Marine Educators 2017 Conference

August 4–11, 2017: This meeting will be held in Homer. For more information, see *http://www.pacname.org/conferences/2017-homer-alaska/*.

147th Annual Meeting of the American Fisheries Society

August 20–24, 2017: This meeting will be held in Tampa, FL. For more information, see *http://afsannualmeeting.fisheries.org/*.

Oceans 17

September 18–21, 2017: This meeting will be held in Anchorage. For more information, see *http://www.oceans17mtsieeeanchorage.org/*.

Planning and Facilitating Collaborative Meetings

September 20–21, 2017: This workshop to design meetings that enhance problem solving and minimize conflict will be held in Anchorage. For more information, see *https://seagrant.uaf.edu/events/2017/planning-collaborative-meetings/*.

Smoked Seafood School

October 12–13, 2017: This workshop for home or commercial applications will be held in Kodiak. For more information, see *https://seagrant.uaf.edu/map/workshops/2017/smoked-seafood-school/*.

2017 Alaska Young Fishermen's Summit

December 6–8, 2017: This summit provides training, information and networking opportunities for commercial fishermen early in their careers will be held in Anchorage. For more information, see *https://seagrant.uaf.edu/map/workshops/2017/ayfs/*.

ONCORHYNCHUS

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