The 27th Annual Meeting of the North Pacific Anadromous Fish Commission (NPAFC) was held from May 13–17, 2019, in Portland, Oregon, USA. At the Annual Meeting, plenary sessions and the Commission’s three standing committees, Enforcement, Scientific Research and Statistics, and Finance and Administration, were convened to discuss issues related to ocean salmon and steelhead in the North Pacific Ocean. The NPAFC is an international organization that promotes the conservation of Pacific salmon and steelhead in the North Pacific and its adjacent seas. It serves as a venue for cooperation in and coordination of enforcement activities and scientific research. The vast majority of salmon catches in the North Pacific originate from NPAFC member countries, which are Canada, Japan, the Republic of Korea, the Russian Federation, and the United States.

This year, the Commission presented Capt. John Vincent O’Shea, United States Coast Guard (USCG) (Ret.) with the prestigious NPAFC Award for his significant contributions to the NPAFC for many years. He is a retired U.S. Coast Guard Captain and Senior Executive with more than 25 years of experience managing marine fisheries policy issues at the regional, national, and international levels. His last assignment in the US Coast Guard was Chief of Operations for the 17th Coast Guard District, in Alaska. Capt. O’Shea was given the NPAFC Award in recognition of his sustained contributions in the areas of compliance and enforcement to the Commission’s mission to conserve and manage anadromous salmon and steelhead stocks in the North Pacific Ocean and its adjacent seas. For more information on his achievements, please see the article on page 3.

The North Pacific Anadromous Fish Commission (NPAFC) and the North Pacific Fisheries Commission (NPFC) have signed a formal cooperation agreement to foster and strengthen the long-term relationship between the two intergovernmental organizations. Representing each Commission, NPAFC President Suam Kim and NPFC Chairperson Kenji Kagawa signed the Memorandum of Cooperation (MOC) on May 13, 2019 at the NPAFC Annual Meeting in Portland, Oregon, USA. For the full text of the Memorandum of Cooperation, please visit our website (https://npafc.org).

At the Commission’s enforcement meetings, multilateral cooperative enforcement operations and regular information exchanges between NPAFC-member enforcement agencies were reviewed. Patrols by Canadian and US fisheries enforcement aircrafts from airports in Japan helped maximize operational effectiveness. In a bilateral arrangement, the United States Coast Guard (USCG) hosted People’s Republic of China (PRC) Coast Guard law enforcement officers aboard a USCG cutter to further increase the effectiveness of ship patrols. Thanks to this arrangement, the illegal Chinese fishing vessel, Run Da, conducting HSDN fishing was intercepted by the USCG with a boarding and inspection by the USCG and PRC in June 2018. For more information on these activities, please see the article on pages 5–6.
Prior to the ENFO meeting, a one-day ENFO workshop on “Combating IUU Fishing and New Technologies” was held. At the workshop, there were presentations from six invited global enforcement and industry experts. Presentations focused on overviews of contemporary approaches to Monitoring, Control and Surveillance (MCS) development, including collaborative organizations and new technologies in combating IUU fishing that could potentially be applied within the NPAFC Convention Area.

At the Commission’s scientific meetings, leading salmon researchers from member countries reviewed commercial catch statistics compiled from information provided by each of the member nations. Preliminary 2018 North Pacific-wide salmon catches exceeded one million metric tonnes (1,067 thousand metric tonnes; 651.3 million fish). Pink salmon constituted the majority of the total commercial catch (55% by weight) followed by chum (26%) and sockeye salmon (16%). Coho comprised 2% of the catch, while Chinook salmon, cherry salmon, and steelhead trout were each less than 1% of the catch by weight. For more information on these activities, please see the article on page 7.

On March 18, 2019, the International Gulf of Alaska Expedition 2019 was successfully completed with 21 scientific personnel from five Pacific Rim countries (Canada, Japan, Korea, Russia, and the United States) aboard the chartered Russian Research Vessel Professor Kaganovskiy. Such international expedition is the first in decades to study salmon in the high seas and has already made many exciting discoveries. For the summary of preliminary findings of the International Gulf of Alaska Expedition, please find out the Doc. 1858, which is open to the public at the NPAFC website.

The Commission discussed activities and plans for the International Year of the Salmon (IYS) which has a focal year in 2019 with research and outreach projects and events continuing through 2022. In October 2018, the NPAFC officially announced the start of the IYS by holding an opening event in Vancouver, BC, Canada. They released a call to action for an intense burst of outreach and research through 2022 that will fill knowledge gaps, develop tools to equip and train a new generation of scientists and managers and raise awareness among decision makers, which, in combination, will achieve the conditions necessary for the future resilience of salmon and people in a rapidly changing world. Following the 27th Annual Meeting, the Second NPAFC-IYS Workshop on Salmon Ocean Ecology in a Changing Climate took place in Portland, Oregon, USA, May 18–20, 2019. For more information on this workshop and the subsequent Third NPAFC-IYS Workshop, please see the article and the poster on pages 16 and 18.

The five-day NPAFC Annual Meeting closed with an invitation from Japan to host the 28th Annual Meeting on May 18–22, 2020 in Hakodate, Japan.
Capt. John V. O’Shea, USCG (Ret.) received the 2019 North Pacific Anadromous Fish Commission Award at the Commission’s 27th Annual Meeting in May. Capt. O’Shea is a retired US Coast Guard Captain and Senior Executive with more than 25 years of experience managing marine fisheries policy issues at the regional, national, and international levels. His last assignment in the Coast Guard was Chief of Operations for the 17th Coast Guard District, in Alaska.

Capt. O’Shea was selected for the award in recognition of his sustained contributions in the areas of compliance and enforcement to the Commission’s mission to conserve and manage anadromous salmon and steelhead stocks in the North Pacific Ocean and its adjacent seas. He contributed substantially to the functioning of the Commission’s Committee on Enforcement (ENFO) for many years. From 1991–1996, he served at the US Coast Guard Headquarters, Office of Law Enforcement as Program Manager for Fisheries Law Enforcement. In this position, he was responsible for Policy and Resources for all of the Coast Guard’s fisheries law enforcement domestic and foreign activities. He coordinated Coast Guard participation in the NPAFC as part of the Coast Guard’s on-going operations in the North Pacific against the use of large-scale high seas driftnets.

In 1991, Capt. O’Shea was the Senior U.S. Coast Guard member of the U.S. Delegation attending the final negotiating meeting in Ottawa, Canada, where an agreement was reached on the details of the structure of the NPAFC. This marked the beginning of what would become his 10-year involvement with the NPAFC ENFO. In 1993, Capt. O’Shea was a member of the US State Department delegation that negotiated a bi-lateral boarding agreement with the People’s Republic of China (PRC). Thanks to his involvement during the negotiation, the resulting agreement brought substantial benefits to both parties, reflected in the fact that it has remained in effect for more than 25 years. The US-PRC Boarding Agreement provisions facilitate fisheries boarding on the high seas and enable the deployment of PRC fisheries enforcement officers onboard US Coast Guard vessels.
conducting High Sea Driftnet (HSDN) patrols. As a result, the Agreement has enhanced the efficacy and efficiency of the US and other NPAFC member patrol efforts. From 1999–2001, Capt. O’Shea chaired the Committee on Enforcement working with ENFO members from all of the Parties to improve the visibility, efficiency and effectiveness of HSDN patrols. Thanks to the results of their efforts, HSDN cases are rare events now and, when apprehensions do occur, they are often the result of a multi-nation effort coordinated through the mechanisms of NPAFC.

Capt. O’Shea stated: “It is a great privilege to have been a part of this important and effective intergovernmental organization and to be honored with the distinguished North Pacific Anadromous Fish Commission Award. I am grateful to the United States for nominating me for this award and for the Commissioners who approved the award. It has been a great honor for me to be a member of the US delegation to the NPAFC over the years. In accepting this award, I recognize the contributions, cooperation and great efforts of all my dedicated ENFO colleagues from Canada, Japan, the Republic of Korea, the Russian Federation, and the U.S., who supported me, and who continue to work tirelessly to support the goals of the Commission. It is indeed the highest honor for me. Thank you so much.”

Established in 2011, the NPAFC Award is given to recognize an individual or group whose sustained and significant contributions in scientific research, enforcement, international cooperation, or management have helped improve the conservation of anadromous salmon and steelhead stocks in the North Pacific Ocean.
International Collaboration Key Element for Success in Combatting IUU Fishing—2019 ENFO Meeting and Workshop

Fisheries enforcement representatives from member countries (Canada, Japan, the Republic of Korea, the Russian Federation, and the United States) reported on successful 2018 efforts to combat IUU (illegal, unreported, and unregulated) fishing on the high seas of the North Pacific at the 2019 ENFO meeting.

Vessels fishing on the high seas historically used large-scale high seas driftnets (HSDN)—a gear that is now internationally banned due to the high rates of bycatch of non-target species, including salmon. The Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean further prohibits fishing for salmon within the high seas of the North Pacific Ocean. The NPAFC member countries have achieved a unique forum for successful and efficient enforcement of these conservation measures within the NPAFC Convention Area. These efforts have brought pressure on fishing vessels and their flag States and drastically reduced high seas driftnet salmon fishing within the North Pacific.

The coordinated enforcement efforts of the NPAFC member countries in 2018 covered significant portions of the NPAFC Convention Area with over 400 hours of aircraft patrols, and more than 100 ship-days, to deter and interrupt IUU activity. These combined multilateral efforts identified multiple possible instances of IUU fishing in 2018. A Chinese flagged fishing vessel, Run Da, conducting HSDN fishing was intercepted by the United States Coast Guard (USCG) Cutter Alex Haley in June. After a joint boarding and inspection on June 16 by the USCG and the People’s Republic of China (PRC) Coast Guard shipriders, custody of the vessel was transferred from the USCG Cutter Alex Haley to the PRC Coast Guard Vessel 2301 on June 21, 2018, for prosecution. The joint boarding team discovered 80 tons of frozen salmon, one ton of squid, five tonnes of tuna, and 10 tonnes of sharks on board. It is reported that members of the crew and the captain of the illegal fishing vessel were imprisoned and fined in the PRC.

At the ENFO/CSRS Working Group on Inter-committee Coordination (WGIC) meeting, which was formed for the first time this year, Dr. Chris Kondzela, Auke Bay Laboratories, Alaska Fisheries Science Center NMFS, NOAA, made a presentation regarding genetic analysis on the seized salmon from Run Da. Among those 80 tonnes of frozen whole salmon, 52 fish were sampled for DNA. These 52 fish underwent species ID with genetic analysis and were determined to be composed of one chum, four Chinook, and 47 pink. Based on the location of vessel and the size of fish, the pink salmon were likely from the even-year broodline of Asian origin. It is said that Auke Bay Laboratories is working on a pink salmon microsatellite baseline and the University of Washington is working on a SNP baseline. Further analysis on the IUU fish samples and other scientific information are expected to be known through the next winter newsletter.

Member countries also discussed the status of acceptance of the Food and Agriculture Organization Port State Measures Agreement. This international agreement is designed to harmonize and strengthen controls and deter illicit activity by preventing illegally caught fish from entering the global marketplace. The Agreement went into force on June 5, 2016. As at June 2019, 61 States and one Member Organization (EU) have formally deposited their instruments of adherence. The Republic of Korea acceded on January 14, 2016; the US ratified on February 26, 2016; Japan deposited its instrument of accession to the Agreement on May 19, 2017; and Canada ratified on June 20, 2019. Effective and consistent application of this Agreement by nations will add a new level of deterrent by decreasing the profitability of illegal transshipping of fish at sea and in port.
Ongoing efforts to curtail the large-scale HSDN threat by continuing a constant vigilance at sea and ports is crucial for sustainable fisheries management and the conservation of salmon in the North Pacific. Multilateral enforcement operations coordinated in the NPAFC arena, regular information exchanges between NPAFC-member enforcement agencies, and a consistent enforcement presence in the North Pacific, all act as effective deterrents against IUU fishing activities.

Prior to the 2019 Committee on Enforcement (ENFO) regular meeting, a one-day ENFO workshop on “Combating IUU Fishing and New Technologies” was held. The 2019 ENFO Workshop brought governments, NGOs, and private industry together to discuss approaches to countering IUU fishing with a focus on emerging technologies. At the workshop, a representative of New Zealand’s Ministry for Primary Industries presented on their regional approach to addressing IUU in the South Pacific and Antarctic regions, and the challenges of pursuing sanctions for IUU fishers. NOAA presented on IUU as transnational crime. Private industry representatives presented on the emerging technologies available to enhance maritime domain awareness. The Global Fishing Watch provided their perspective and approach to addressing IUU by enhancing transparency in fisheries.

The ENFO members felt this was a valuable opportunity to learn about outside perspectives, and they agreed to host another ENFO workshop next year before the commencement of the NPAFC 2020 Annual Meeting in Hakodate, Japan.
The Committee on Scientific Research and Statistics (CSRS) met from May 13–16, 2019, in Portland, Oregon, USA, to review current information related to salmon abundance and biology at the Commission’s 27th Annual Meeting. In addition to presenting salmon catch and hatchery statistics, scientists planned, reviewed, and coordinated exchanges of scientific data and samples, and assessed scientific studies of Pacific salmon and steelhead in international waters and adjacent areas of the North Pacific. Documents submitted for consideration at the meeting are available at [https://npafc.org/published-documents-2019/](https://npafc.org/published-documents-2019/).

The International Year of the Salmon (IYS) Signature Project, The International Gulf of Alaska Expedition 2019 was successfully completed with 21 scientific personnel from Canada, Japan, Korea, Russia, and the United States aboard the chartered Russian Research Vessel Professor Kaganovskiy. Such international expedition is the first in decades to study salmon in the high seas and has already made many exciting discoveries.

This expedition covered an area of approximately 700,000 km² between February 16 and March 18, 2019. A summary of preliminary findings of this expedition was reviewed at the meeting.

The Commission discussed activities and plans for the IYS, which has a focal year in 2019 with research and outreach projects and events continuing through 2022. In October 2018, the NPAFC officially announced the start of the IYS by holding an opening event in Vancouver, BC, Canada. They released a call to action for an intense burst of outreach and research through 2022 that will fill knowledge gaps, develop tools to equip and train a new generation of scientists and managers, and raise awareness among decision-makers, which, in combination, will achieve the conditions necessary for the future resilience of salmon and people in a rapidly changing world.

A commitment of resources to continue implementation of the International Year of the Salmon has been made to support collaboration with partners across the Northern Hemisphere to implement coordinated outreach and research, including continued commitment to build a five-country research plan for a high seas expedition across the North Pacific in the winter of 2021. On the evening of May 14th, the NPAFC hosted a reception with active and potential partners from around the Pacific Rim to raise awareness of the IYS. The importance of international collaboration was brought to light with stories from scientists including Dr. Laurie Weitkamp from the National Marine Fisheries Service laboratory in Newport, Oregon, who participated in the recent Gulf of Alaska Expedition this past February.

Additional research cruise plans for 2019 were also discussed. These could include salmon surveys in the
Bering Sea, the northwestern North Pacific, and the southern Sea of Okhotsk. Research cruises may employ survey vessels from a variety of sources including government, university, and chartered fishing boats. Research survey objectives vary by season and location, and include data-gathering on topics such as, migration timing, abundance, distribution, survival, marine ecology, run size forecasting, stock identification, and salmon growth and body condition.

The current 2016–2020 NPAFC Science Plan supports the NPAFC’s primary objective of promoting the conservation of Pacific salmon and steelhead trout within the Convention Area, and is integrated with the IYS initiative. The 2016–2020 NPAFC Science Plan is available at https://npafc.org/science-plan/. To review the research progress for the NPAFC Science Plan, and to promote IYS activities and outreach in member countries, it was agreed that the third NPAFC-IYS Workshop on Linkage between Pacific Salmon Production and Environmental Changes will be held in Hakodate, Japan on May 23–25, 2020, following the 28th NPAFC Annual Meeting. The objectives of the workshop will be to: (1) improve current knowledge of the migration, distribution, growth, and survival of salmon and their environments; (2) increase understanding of the causes of variations in salmon production in a changing environments; (3) anticipate future changes in the distribution and abundance of salmon and their marine ecosystems; (4) develop and apply new technologies and analytical methods to research and management of salmon; (5) invent integrated information/management systems to support research, sustainable management, and understanding for the conservation of salmon; and (6) deliberate policies that will ensure the resilience of salmon and people in changing environments.

Improved understanding of the mechanisms that regulate the distribution and abundance of Pacific salmon will promote the conservation of anadromous populations in the North Pacific Ocean, allow for better forecasts of salmon production trends in the future, and enhance sustainable fisheries management, food security, and economic security in member nations. Based on information submitted at the 2019 meeting, NPAFC statistics have been updated to include 2018 statistics plus some additions/corrections to catches and hatchery release statistics in 2017 and in earlier years. Commercial, subsistence, and recreational catches and hatchery release statistics are available at https://npafc.org/statistics/.

The preliminary North Pacific-wide total salmon catches for 2018, was reported by its member countries Canada, Japan, the Republic of Korea, Russia, and the United States. Although Pacific salmon abundance in the North Pacific has declined somewhat since 2009, as indexed by aggregate commercial catches, catches
remain at near all-time high levels. The total catch in 2018 exceeded one million metric tonnes (1,067 thousand metric tonnes; 651.3 million fish), the highest catch for an even-numbered year.

The member nations’ portions of the total catch included 63% by Russia (676.2 thousand metric tonnes), 27% by the United States (286.8 thousand metric tonnes; Alaska—278.1 thousand metric tonnes), 9% by Japan (91.3 thousand metric tonnes), 1% by Canada (12.6 thousand metric tonnes), and less than 1% by Korea (240 metric tonnes).

Pink salmon constituted the majority of the total commercial catch (55% by weight) followed by chum (26%) and sockeye salmon (16%). Coho comprised 2% of the catch, while Chinook salmon, cherry salmon, and steelhead trout were each less than 1% of the catch by weight.

Pink and chum salmon dominate Asian catches. The majority of pink salmon were caught by Russia, which was 86% of the total North Pacific pink salmon catch of 592.1 thousand metric tonnes. The total catch of chum salmon was 272.5 thousand metric tonnes, with the largest portions of the catch by weight from Russia (41%) and Japan (29%). Catches by Asian member countries in 2018 were higher than any year since 2010, and the pink salmon catch was the highest on record.

Interannual variability in the total catch in North America has been more pronounced during the last decade than in previous decades, primarily because of variability in pink salmon catches. The relative abundance of salmon species varies with latitude. In Alaska, pink and sockeye salmon are the primary species, followed by chum salmon. In Canada, sockeye, pink, and chum salmon have historically comprised the largest catch, but in 2018 sockeye, chum and Chinook salmon were the most abundant species caught. In Washington, Oregon, and California, chum, sockeye, and Chinook salmon are typically the most abundant species caught. A particularly low catch of pink salmon (71.3 thousand metric tonnes) in 2018 resulted in the lowest total catches of salmon in North America since 1978.

Hatchery releases of salmon and steelhead from NPAFC member countries have been fairly stable since 1993, with approximately 5 billion fish released annually, but have declined slightly each year since 2014, primarily because of reduced Asian hatchery releases. Hatcheries released 2,147 million fish (44% of the total) in the United States, 1,648 million (34%) in Japan, 842 million (17%) in Russia, 262 million (5%) in Canada, and 11 million (< 1%) in Korea.

Hatchery releases were mostly chum (2,915 million, 59%) and pink salmon (1,437 million, 29%), followed by Chinook (235 million, 5%), sockeye (215 million, 4%), and coho salmon (80 million, 2%), steelhead trout (20 million, <1%), and cherry salmon (7 million, <1%).
Table 1. Preliminary 2018 commercial salmon catches in Canada, Japan, Korea, Russia, and the United States. Commercial catches by foreign fleets in the Russian EEZ are not included. Japanese catch data are based on Fisheries Research Agency data sources, not official statistics. Commercial catch weight for Alaska is based on landed weight (Alaska Department of Fish and Game).

(a) Preliminary 2018 commercial catch in millions of fish.

<table>
<thead>
<tr>
<th></th>
<th>Sockeye</th>
<th>Pink</th>
<th>Chum</th>
<th>Coho</th>
<th>Chinook</th>
<th>Cherry</th>
<th>Steelhead</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>2.618</td>
<td>0.240</td>
<td>0.751</td>
<td>0.198</td>
<td>0.152</td>
<td>-</td>
<td>-</td>
<td>3.959</td>
</tr>
<tr>
<td>Japan</td>
<td>0.000</td>
<td>7.309</td>
<td>26.706</td>
<td>0.001</td>
<td>0.001</td>
<td>-</td>
<td>0.000</td>
<td>34.017</td>
</tr>
<tr>
<td>Korea</td>
<td>-</td>
<td>-</td>
<td>0.096</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.096</td>
</tr>
<tr>
<td>Russia</td>
<td>19.536</td>
<td>420.805</td>
<td>49.772</td>
<td>4.430</td>
<td>0.072</td>
<td>0.010</td>
<td>-</td>
<td>494.625</td>
</tr>
<tr>
<td>USA</td>
<td>51.647</td>
<td>41.118</td>
<td>21.197</td>
<td>4.012</td>
<td>0.619</td>
<td>0.015</td>
<td>118.608</td>
<td></td>
</tr>
<tr>
<td>Alaska</td>
<td>50.649</td>
<td>41.118</td>
<td>20.348</td>
<td>3.737</td>
<td>0.266</td>
<td>-</td>
<td>0.000</td>
<td>116.117</td>
</tr>
<tr>
<td>WOCI</td>
<td>0.998</td>
<td>0.000</td>
<td>0.849</td>
<td>0.275</td>
<td>0.353</td>
<td>-</td>
<td>0.015</td>
<td>2.491</td>
</tr>
<tr>
<td>Total</td>
<td>73.801</td>
<td>469.472</td>
<td>98.522</td>
<td>8.641</td>
<td>0.844</td>
<td>0.010</td>
<td>0.015</td>
<td>651.305</td>
</tr>
</tbody>
</table>

WOC: Washington, Oregon, and California

(b) Preliminary 2018 commercial catch in metric tonnes (round weight).

<table>
<thead>
<tr>
<th></th>
<th>Sockeye</th>
<th>Pink</th>
<th>Chum</th>
<th>Coho</th>
<th>Chinook</th>
<th>Cherry</th>
<th>Steelhead</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>6,899</td>
<td>514</td>
<td>3,790</td>
<td>586</td>
<td>820</td>
<td>-</td>
<td>-</td>
<td>12,609</td>
</tr>
<tr>
<td>Japan</td>
<td>0</td>
<td>9,715</td>
<td>80,338</td>
<td>2</td>
<td>5</td>
<td>1,254</td>
<td>0</td>
<td>91,314</td>
</tr>
<tr>
<td>Korea</td>
<td>-</td>
<td>-</td>
<td>240</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>240</td>
</tr>
<tr>
<td>Russia</td>
<td>43,280</td>
<td>511,093</td>
<td>110,763</td>
<td>10,682</td>
<td>363</td>
<td>20</td>
<td>-</td>
<td>676,201</td>
</tr>
<tr>
<td>USA</td>
<td>121,369</td>
<td>70,822</td>
<td>77,411</td>
<td>13,840</td>
<td>3,331</td>
<td>-</td>
<td>68</td>
<td>286,841</td>
</tr>
<tr>
<td>Alaska</td>
<td>118,791</td>
<td>70,822</td>
<td>73,992</td>
<td>13,062</td>
<td>1,432</td>
<td>-</td>
<td>1</td>
<td>278,100</td>
</tr>
<tr>
<td>WOCI</td>
<td>2,578</td>
<td>0</td>
<td>3,419</td>
<td>778</td>
<td>1,899</td>
<td>-</td>
<td>67</td>
<td>8,741</td>
</tr>
<tr>
<td>Total</td>
<td>171,548</td>
<td>592,144</td>
<td>272,542</td>
<td>25,110</td>
<td>4,519</td>
<td>1,274</td>
<td>68</td>
<td>1,067,205</td>
</tr>
</tbody>
</table>

WOC: Washington, Oregon, and California

Table 2. Preliminary 2018 hatchery releases in NPAFC member countries in millions of fish.

<table>
<thead>
<tr>
<th></th>
<th>Sockeye</th>
<th>Pink</th>
<th>Chum</th>
<th>Coho</th>
<th>Chinook</th>
<th>Cherry</th>
<th>Steelhead</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>138.661</td>
<td>14.721</td>
<td>61.835</td>
<td>8.002</td>
<td>38.224</td>
<td>-</td>
<td>0.285</td>
<td>261.728</td>
</tr>
<tr>
<td>Japan</td>
<td>0.187</td>
<td>112.766</td>
<td>1,527.884</td>
<td>-</td>
<td>-</td>
<td>7.224</td>
<td>-</td>
<td>1,648.061</td>
</tr>
<tr>
<td>Korea</td>
<td>-</td>
<td>-</td>
<td>10.710</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10.710</td>
</tr>
<tr>
<td>Russia</td>
<td>14.306</td>
<td>257.159</td>
<td>567.337</td>
<td>2.546</td>
<td>0.949</td>
<td>0</td>
<td>-</td>
<td>842.297</td>
</tr>
<tr>
<td>USA</td>
<td>61.723</td>
<td>1,052.345</td>
<td>747.397</td>
<td>69.907</td>
<td>195.437</td>
<td>-</td>
<td>20.037</td>
<td>2,146.846</td>
</tr>
<tr>
<td>Alaska</td>
<td>44.734</td>
<td>1,051.799</td>
<td>697.061</td>
<td>30.731</td>
<td>9.528</td>
<td>-</td>
<td>-</td>
<td>1,833.853</td>
</tr>
<tr>
<td>WOCI</td>
<td>16.989</td>
<td>0.546</td>
<td>50.336</td>
<td>39.176</td>
<td>185.909</td>
<td>-</td>
<td>20.037</td>
<td>312.993</td>
</tr>
<tr>
<td>Total</td>
<td>214.877</td>
<td>1,436.991</td>
<td>2,915.163</td>
<td>80.455</td>
<td>234.610</td>
<td>7.224</td>
<td>20.322</td>
<td>4,909.642</td>
</tr>
</tbody>
</table>

WOCI: Washington, Oregon, California, and Idaho
Figure 1. Annual commercial catch of salmon and steelhead trout by country in thousands of metric tonnes.

Figure 2. Annual commercial catch of salmon and steelhead trout by species in thousands of metric tonnes.
Figure 3. Annual hatchery release of salmon and steelhead trout by country in millions of fish.

Figure 4. Annual hatchery release of salmon and steelhead trout by species in millions of fish.
The RAFOS Ocean Acoustic Monitoring (ROAM) Tag: A Highly Accurate Fish Tag for At-sea Movement Studies

By Camrin D. Braun¹, Godi Fischer², H. Thomas Rossby³, Heather Furey⁴, and Simon R. Thorrod⁵

¹School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA
²Department of Electrical, Computer and Biomedical Engineering, University of Rhode Island, Kingston, RI
³Graduate School of Oceanography, University of Rhode Island, Narragansett, RI
⁴Physical Oceanography, Woods Hole Oceanographic Institution, Woods Hole, MA
⁵Biology Department, Woods Hole Oceanographic Institution, Woods Hole, MA

Camrin Braun is an Assistant Professor at the School of Aquatic and Fishery Sciences at the University of Washington where he studies biophysical interactions in the ocean using animal telemetry. He received his PhD from the Massachusetts Institute of Technology-Woods Hole Oceanographic Institution Joint Program in Oceanography on the oceanographic drivers of large pelagic fish movements in the North Atlantic. He recently completed a postdoc at the Applied Physics Laboratory at the University of Washington studying the influence of (sub)mesoscale oceanography on pelagic ecosystems.

Introduction

Animal migrations are some of the most fascinating and impressive biological phenomena on the planet. Nonetheless, marine ecologists have, until recently, known remarkably little about the movements of large pelagic fishes due to the logistic challenges of tracking fish in a vast, largely opaque ocean. Light-level geolocation techniques using current generation pop-up satellite archival transmitting (PSAT) tags generally exhibit poor accuracy (±100–200 km; ~10,000 km²) even under best-case situations when movements are confined to surface waters (< 100 m) during daytime hours (Braun et al. 2015, 2018). Poor accuracy has, in turn, led to a paucity of mechanistic studies addressing the mechanisms influencing at-sea habitat use by salmonids. Similarly, identifying the location and cause of ocean-phase mortality remains a critical question for improving salmon management and conservation efforts. This knowledge is critical as we continue to lean heavily on marine-capture fisheries to sustain human populations worldwide while experiencing drastic changes in the Earth’s climate and oceans.

We are developing a new satellite archival tag technology—the RAFOS Ocean Acoustic Monitoring (ROAM) tag—to solve both accuracy and depth constraints inherent in conventional PSAT tags that will provide accurate geolocations of fish throughout the water column across ocean basins.

Figure 1. Example RAFOs array used to study deep circulation in the Gulf of Mexico using RAFOs floats (Hamilton et al. 2018) and a sound speed profile for the region indicating the deep sound channel used to propagate sound.
Proven oceanographic instruments and infrastructure: the RAFOs system

The technical approach of RAFOs builds on decades of research and development for tracking ocean currents by means of subsurface drifters capable of receiving sound (Rossby et al. 1986).

RAFOs float-tracking networks have been used to study the physical oceanography of several ocean basins from the Gulf of Mexico (Fig. 1) (Hamilton et al. 2018; Furey et al. 2018) to under-ice environments in the Southern Ocean (Chamberlain et al. 2018). These networks rely on moored acoustic transmitting units that emit a unique acoustic signal. A hydrophone onboard the RAFOs float detects the sounds from the network, and a triangulation algorithm uses the differential sound reception from multiple moorings to calculate position onboard the float (Fig. 2).

The ROAM Tag

The ROAM tag employs the same acoustic technology and infrastructure that is widely used for tracking RAFOs oceanographic floats to geolocate fish. The ROAM tag contains a hydrophone that listens for low frequency “pongs” from the sound source network and differential reception of these sounds are used to triangulate tag position. In other words, the ROAM tag is the reverse of acoustic telemetry systems widely used in aquatic telemetry today. In order for this approach to work, we have miniaturized current RAFOs technology through the development of a new single board receiver and enclosed the tag in a cylindrical housing which functions as the hydrophone (Fig. 3) that is duty-cycled to match the sound source signals. We modeled the rest of the tag after pop-up satellite archival tags by equipping the new micro-printed circuit board (“fish-chip”) with the capability to log pressure and temperature and added an electronic burn wire for predetermined pop-off and an Argos satellite transmitter for data recovery through the Argos satellite system as is conventional with animal telemetry technology. With two 1.5 V batteries the tag can, for example, listen a dozen times a day for two years while also sampling pressure and temperature every 30 minutes in order to capture vertical movements in the water column (Rossby et al. 2017). The fish-tag can operate at almost any depth, depending upon the rating of the pressure sensor. By using pop-up technology and an Argos transmitter, rather than an archival tag only, the tag will transmit a summarized version of the high-resolution data it collects. Thus, we will ensure that the tag does not need to be recovered for data acquisition, making it applicable to a number of species where tag physical recovery rates are typically very low.
**Testing a new fish tag**

We recently performed a preliminary field test of this technology in the Mississippi River Delta (USA), which is a notoriously challenging acoustic environment due to alternating layers of warmer and cooler water as well as saline and fresh lenses. Despite the challenges inherent in this environment, we were able to hear acoustic signals as far away as 60 km (Rossby et al. 2017). The accuracy of this prediction ranged from 70 m to 560 m which depends critically on clock accuracy in the tags. Using standard RAFOS clock error recovery techniques, clock errors can be kept to a few seconds on yearlong missions. Our preliminary testing suggests this technology may be able to accurately locate tagged fish, even at depth, with error bounds (±5 km²) that are unmatched by any current tag geolocation technique. In addition, long-range transmission testing in RAFOS float studies suggests leveraging the deep sound channel in the open ocean can render the acoustic source signals detectable by the fish tag up to 1,000 km range.

Additional testing of the prototype ROAM tag is scheduled for Fall 2019 in which we plan to tag an oceanographic glider and program it to conduct vertical movements through the water column similar to some representative fish taxa. Such a test will confirm the range and accuracy of the ROAM tag when idealized fish behavior is added to the geolocation problem.

**Summary**

Current technologies are restricted to organisms that frequent in the surface layer or photic zone to acquire position estimates, and accuracy using light geolocation is often ±100–200 km (~10,000 km²). Our inability to provide position estimates below the photic zone with existing technologies further inhibits our understanding of meso- and bathypelagic organisms. The resulting data from initial deployments are enabling us to assess the feasibility of this technique for improving position estimation and resolving location at depth that are both beyond the capability of current animal telemetry technologies. Once proven, the ROAM tag should provide a transformative view of fish movements in the global ocean by increasing accuracy of movement studies by ~4 orders of magnitude while retaining functionality at depth. In addition, the ROAM tag will be applicable to all large and medium-sized pelagic fish species, as it does not require the fish to occupy surface waters to determine accurate positions. Using these improvements in location accuracy, ROAM tag deployments will foster in-depth understanding of biophysical drivers of fish movements (e.g., prey aggregation along fronts or vertically migrating mesopelagic biota), habitat association (e.g., seamounts), sociality among tagged individuals, and other currently cryptic behavior (e.g., spawning aggregation and location). This knowledge will greatly improve our understanding of data-deficient, commercially valuable species and will have far-reaching impacts on science and industry by revolutionizing the way we are able to study these species in the open ocean.

**References**


NPAFC holds the Second International Year of the Salmon Workshop in Portland, Oregon, USA: Wrap-up Summary

By Ed Farley
Auke Bay Laboratories, Ted Stevens Marine Research Institute
NMFS, USA
Chairperson of the Workshop

The North Pacific Anadromous Fish Commission (NPAFC) convened the Second NPAFC-IYS Workshop on Salmon Ocean Ecology in a Changing Climate, in partnership with Salmon Ocean Ecology Meeting (SOME) for three days following its 27th Annual Meeting in Portland, Oregon, USA to discuss results on research conducted for the International Year of the Salmon (IYS). Forty-four oral presentations, including ten keynote oral presentations, and twenty-four posters were presented. Over 150 participants from Canada, Japan, Korea, Russia, and the USA, gathered in Portland on May 18–20. Oral and poster presentations given at the workshop are currently available at [https://npafc.org/workshop-presentations-2019/](https://npafc.org/workshop-presentations-2019/). Extended abstracts are being compiled in Technical Report 15, which will be available online in the winter. The IYS is a five-year outreach and research initiative of the North Pacific Anadromous Fish Commission (NPAFC) and the North Atlantic Salmon Conservation Organization (NASCO). Countries across the Northern Hemisphere are banding together in a new partnership of government, academia, NGOs, Indigenous Peoples and industry to drive an intense burst of outreach and research that will establish the conditions necessary for the resilience of salmon and people in an uncertain future. Workshop topics included 1) current status of salmon and their environments; 2) salmon in changing ocean conditions; and 3) new technologies and information systems for salmon research and management. There was also a discussion of results from the successful winter high seas survey in the Gulf of Alaska that occurred during February to March 2019.

Total biomass of Pacific salmon in the North Pacific Ocean (NPO) has remained at an historic high level from 1990 to present, however there are differences in regional production that suggest southern stocks of salmon are not doing as well as northern stocks. For instance, the abundance of chum salmon returning to Japan and sockeye salmon returning to the Fraser River in Canada have declined during the past decade. However, returns of pink, chum, and sockeye salmon stocks in more northern latitudes remain strong. While production dynamics among pink, chum, and sockeye salmon stocks vary within the NPO, Chinook salmon and Steelhead returns are down basin wide suggesting other factors are affecting their survival.

The sustained high biomass of adult and immature Pacific salmon in the NPO over the past 25 years includes mostly chum salmon (60%), pink salmon (22%), and sockeye salmon (18%). Nearly 40% of the biomass of these three species is comprised of hatchery fish; Alaska generates 68% of hatchery pink salmon while Japan generates 75% of the hatchery chum salmon. The recent high production of pink salmon (wild and hatchery) in the NPO may be exerting top-down control on the food web of the NPO ecosystem that may be impacting the growth and survival of other salmon species. The mechanistic understanding of how pink salmon interact with the ecosystems of the NPO and their top-down effect on prey resources is still being debated.
Earth's climate is changing more rapidly than scientists predicted and the ecosystems of the NPO are responding in various ways. Climate models predict continued warming of the surface waters in the NPO and that new extreme states are much more possible in the first half of the 21st century. As an example, during 2014 and 2015 a large portion of the coastal and offshore regions of the eastern Pacific experienced exceptionally high ocean temperatures. The anomalous warming event, known as the “Blob”, because of the extreme magnitude of the region of warm water is believed to be responsible for shifts in zooplankton community structure in coastal ecosystems and northward movement of sub-tropical fish species to the Gulf of Alaska. Consequently, salmon returns to the Gulf of Alaska one to three years after the “Blob” event were much lower than predicted. We have time series data sets on salmon marine ecology from ocean surveys, tagging, spawner and recruitment data, and others that are available for modeling efforts to help link marine ecosystem structure to salmon distribution, fitness, and survival. Coupling this information with freshwater data will improve our understanding of climate impact on the full life-cycle of salmon.

The IYS scientists are also employing new technologies such as eDNA to help address population and ecosystem-level hypotheses as well as analytical methodologies and new equipment (i.e., acoustics) to help address distribution and migration questions over broad geographical space and through time. Some of these methods are being used during ocean surveys by IYS scientists to test their utility in real time applications.

I would like to acknowledge the hard work of the Workshop Organizing Committee, particularly the co-chairpersons Richard Brodeur, Mark Saunders, Shigehiko Urawa, and Brian Wells as well as NPAFC Secretariat staff, including Jeongseok Park, Jennifer Chang, Mariia Artiushkina, Stephanie Taylor, Nathan Bendriem and Caroline Graham who did a great job in ensuring the workshop ran smoothly.

I look forward to seeing all of you at the third NPAFC-IYS Workshop in Hakodate, Japan, in 2020.
The Third NPAFC-IYS Workshop on Linkages between Pacific Salmon Production and Environmental Changes

**MAY 23–25, 2020**
Hakodate Research Center for Fisheries and Oceans, Hakodate, Japan


**CALL FOR PAPERS**
Abstracts due: **January 15, 2020**
Email abstracts to: secretariat@npafc.org
More information: [https://npafc.org](https://npafc.org)

**MAJOR TOPICS**
- Salmon production in changing environments
- New technologies/integrated information systems for salmon research and management
- Resilience for salmon and people: lessons from the Great East Japan Earthquake in 2011

*International Year of the Salmon (IYS) is an international framework for collaborative outreach and research. Through outreach efforts the IYS will raise awareness of what humans can do to better ensure salmon and their habitats are conserved and restored against increasing environmental variability. For more information visit: [https://yearofthesalmon.org/](https://yearofthesalmon.org/)*

**HOSTED BY**
The North Pacific Anadromous Fish Commission
Tel: +1-604-775-5550
E-mail: secretariat@npafc.org
Website: [https://npafc.org](https://npafc.org)

**PARTNERS**
水産庁 - Fisheries Agency of Japan
Hokkaido Research Organization (HRO)
Japan Fisheries Research and Education Agency (JFR)
Japan Salmon & Trout Resources Enhancement Association
North Pacific Marine Science Organization
Tohoku Ecosystem-Associated Marine Sciences
The Third NPAFC-IYS Workshop on

Linkages between Pacific Salmon Production and Environmental Changes

Date: May 23–25, 2020
Venue: Hakodate Research Center for Fisheries and Oceans (20-5 Benten-cho, Hakodate, Hokkaido 040-0051, Japan; https://center.marine-hakodate.jp/en/)
Host: North Pacific Anadromous Fish Commission (NPAFC), https://npafc.org/

Partners:

- Fisheries Agency of Japan (FAJ), http://www.jfa.maff.go.jp/e/index.html
- Japan Fisheries Research and Education Agency (FRA), http://www.fra.affrc.go.jp/english/eindex.html
- Japan Salmon and Trout Resources Enhancement Association (JSTREA), http://www.honkei.jp/index.html
- North Pacific Marine Science Organization (PICES), https://meetings.pices.int/
- Tohoku Ecosystem-Associated Marine Sciences (TEAMS), http://www.i-teams.jp/e/index.html

Science Committee:

- Jun Aoyama (TEAMS, International Coastal Research Center, Atmosphere and Ocean Research Institute, Univ. Tokyo, Japan; IYS TCG-2)
- Ed Farley (Auke Bay Laboratory, NMFS, USA; SSC, IYS WG, TCG-1)
- Jim Irvine (Pacific Biological Station, DFO, Canada; SSC, IYS WG, TCG-1)
- Ju Kyong Kim (Inland Life Resources Center, FIRA, Korea; SSC, IYS WG, TCG-1)
- Svetlana Naydenko (Pacific Branch of VNIRO (TINRO), Russia; SSC)
- Mark Saunders (IYS WG & NPSC chairs, Canada)
- Shigeo Urawa, Chairperson (Hokkaido National Fisheries Research Institute, FRA, Japan; SSC chair, IYS WG, TCG-4)
- Jeongseok Park (NPAFC Secretariat, Canada)

Local Organizing Committee:

- Yasuyuki Miyakoshi (Central Fisheries Research Institute, HRO, Japan; IYS TCG-1)
- Kazushi Miyashita (Field Science Center for Northern Biosphere, Hokkaido Univ., Japan; IYS TCG-3)
- Hayato Saneyoshi (Salmon and Freshwater Fisheries Research Institute, HRO, Japan)
- Shunpei Sato (Hokkaido National Fisheries Research Institute, FRA, Japan; IYS WG, TCG-3)
- Kengo Suzuki (Hokkaido National Fisheries Research Institute, FRA, Japan; IYS WG & NPSC, TCG-4)

Background:

Pacific salmon face many challenges and uncertainties associated with environmental variability such as climate change. It is more important than ever that we promote new international cooperative research that provides better scientific information on the ecological mechanisms regulating production of anadromous populations and climate impacts in North Pacific marine ecosystems.

The North Pacific Anadromous Fish Commission (NPAFC) and North Atlantic Salmon Conservation Organization (NASCO) are leading a major initiative entitled “International Year of the Salmon (IYS)”. IYS provides an international framework for collaborative outreach and research. These efforts will raise awareness of the challenges salmon face for improved stewardship during this period of increased environmental variability.

The IYS overarching theme is “Salmon and People in a Changing World” with six subthemes: (1) Status of Salmon; (2) Salmon in a Changing Salmosphere; (3) New Frontiers; (4) Human Dimension; (5) Information Systems; and (6) Outreach and Communication. IYS is stimulating investment in research expected to provide a legacy of knowledge, data/information systems and tools, and help train a new generation of scientists better equipped to provide timely advice to improve stewardship of salmon. In addition, the IYS program is connected to the 2016–2020
NPAFC Science Plan, whose research themes are (1) Status of Pacific salmon and steelhead trout; (2) Pacific salmon and steelhead trout in a changing North Pacific Ocean; (3) New technologies; (4) Management systems; and (5) Integrated information systems. Annual progress for each research theme is reviewed at a series of NPAFC-IYS workshops including the present one.

**Workshop Objectives:**

- Improve knowledge of the migration, growth and survival of salmon and their environments;
- Increase understanding of the causes of variations in salmon production in changing environments;
- Anticipate future changes in salmon ecosystems and resulting changes in the distribution, survival, and abundance of salmon;
- Discuss application of new and developing technologies and analytical methods to research and manage of salmon;
- Demonstrate integrated information/data management systems to support research, sustainable management, and understanding for the conservation of salmon; and
- Describe policies designed to ensure the resilience of salmon and people in changing environments.

**Topic Sessions:**

**Topic 1. Salmon production in changing environments**

Moderators: Ed Farley* (SC & TCG-1), Jim Irvine* (SC & TCG-1), Ju Kyoung Kim (SC & TCG-1), Svetlana Naydenko (SC), and Hiromichi Ueno (TCG-1) *session co-leader

The response of Pacific salmon to climate-driven environmental changes is variable and differs by species, populations, life stages, geographical locations, and/or seasonal timing. Variation in the early marine survival of salmon has been hypothesized to have a major role in determining brood year strength. However, there has been limited evidence to support this hypothesis. We need to understand the causes and mechanisms of mortalities at each stage of salmon life cycle. Climate change may result in significant variability and overall declines in the carrying capacity and usable habitat of Pacific salmon in the North Pacific Ocean, potentially leading to expanded use of the Arctic Ocean. An improved understanding of linkages between environmental changes and salmon production will help to project reliable forecasting of salmon distribution and abundance for the sustainable resource management.

**1-1. Status and trends of key salmon populations and their environments**

Time series of regional salmon production and biological and physical characteristics of key salmon populations and their ocean habitat provide broad scale perspectives necessary to examine the underpinnings of ocean salmon production and marine ecosystem conditions. The purpose of this sub-session is to understand the current status and trends of Pacific salmon production and their habitat environments.

(Keywords: key salmon populations, trend, spawning escapement, catch, survival rate, body size, fecundity, smolt production, distribution, abundance, habitat conditions, and others)

**1-2. Effects of freshwater habitat changes on salmon production**

Physical changes to freshwater ecosystems resulting from human impacts and climate change will degrade and diminish available habitat, reduce reproductive success, and impact migration of salmon. Increasing water temperatures may cause direct and indirect impacts on salmon including physiological stress, increased depletion of energy reserves, increased susceptibility and exposure to diseases and disruptions to breeding efforts. The sub-session will: (1) review the impact of freshwater habitat changes on salmon production; and (2) evaluate effectiveness of habitat restoration programs to enhance resilience of salmon.

(Keywords: freshwater salmon habitat, human impact, climate change, reproductive success, growth, migration, physiological stress, diseases, mortality, restoration, resilience, and others)

**1-3. Survival mechanism of juvenile salmon in changing ocean environments**

There is growing recognition that size-dependent mortality of juveniles within the first ocean year regulates Pacific salmon production, which also suggests that environmental influences are greater in the first ocean year than later. The sub-session aims to increase our understanding of survival mechanism of juvenile salmon and their responses to changing environments including SST, salinity, currents, prey abundance, inter- and intra-specific competition, and predators.

(Keywords: juvenile salmon, marine survival mechanism, ocean entry, feeding, growth, migration, SST, salinity, currents, prey, competition, predators, and others)
1-4. Winter ocean ecology and survivals of Pacific salmon

One hypothesis is that winter is a critical period for Pacific salmon in the ocean, but winter surveys have been limited to test this hypothesis. Key gaps in our understanding of winter ocean ecology and survivals of salmon include: (1) winter ocean distribution and abundance by species and population, (2) ocean habitat environments including prey abundance, (3) key factors influencing winter distribution and abundance, (4) effects of changing winter environments on feeding, growth and metabolism, and (5) mechanisms determining winter survival. The international Gulf of Alaska expedition conducted in the winter/spring of 2019 was the first comprehensive survey of Pacific salmon this time of year in the North Pacific Ocean in several decades. Results from this expedition will be presented to fill gaps in our knowledge of winter salmon in the ocean. Other presentations on winter salmon ecology and survivals are welcome.

(Keywords: winter salmon, spatial and temporal dynamics of habitat conditions, stock-specific distribution and abundance, preys, food web, feeding, metabolism, growth, trophic and health conditions, survival mechanisms, and others)

1-5. Linkages between salmon production and climate/ocean changes

The future of salmon is uncertain. Climate change may increase variability in the carrying capacity and usable habitat (distribution) of salmon in the ocean. Improved understanding of linkages between environmental changes and salmon production will help anticipate the economic consequences of these changes. The objectives of the sub-session are to: (1) understand and quantify the effects of environmental variability and anthropogenic factors affecting salmon distribution and abundance; (2) develop methods to predict future changes in salmon distribution and abundance with climate change, and (3) predict implications of climate/ocean environmental changes on salmon management.

(Keywords: climate impact, distribution, abundance, carrying capacity, linkage between salmon, climate and ocean changes, forecast models, energy budget models, biophysical models, and others)

1-6. Summary and discussion

Topic 2. New technologies/integrated information systems for salmon research and management

Moderators: Kazushi Miyashita (TCG-3), Dion Oxman (TCG-3), Shunpei Sato (TCG-3), and Mark Saunders* (SC) *session leader

With recent advancements in technology, data processing, and analytical methods, new tools are available to better study and manage salmon. The IYS aims to further advance the development of new and emerging technologies and analytical methods that are immediately available for salmon research and management. In addition, the IYS seeks to create open-access information systems for salmon research and management, and to develop management systems to aid the sustainable conservation of salmon in a changing climate.

2-1. New technologies

Novel stock and fish identification methods including molecular analyses, genomics, environmental DNA (eDNA), hatchery mass marking, intelligent tags, and remote sensing, continue to be developed, and these tools are integral to the formulation of effective models predicting the distribution and abundance of salmon populations. This sub-session will emphasize: (1) eDNA as an indicator of salmon distribution and abundance in aquatic ecosystems; (2) use of existing scale and otolith collections to determine ocean distribution of salmon (otolith microchemistry) and analyses of growth patterns to examine size-dependent mortality hypotheses; (3) potential for the application of real-time GSI and detection of pathogens at sea; and (4) intelligent data logger and tacking methods to determine migration behavior and survivals.

(Keywords: genomics, environmental DNA, molecular identification, mass marking, intelligent tags, salmon observation systems, remote sensing, microchemistry, and others)

2-2. Integrated information and management systems

The IYS seeks to develop integrated information/data management systems using new and existing data sets to increase the resiliency of salmon and people in a changing world, and support research and management as well as public understanding the role of salmon in ocean ecosystems. For the sustainable conservation of uncertain salmon populations, we need to develop integrated management systems including the ecosystem-based management, improved management strategies for harvest and escapements, long-term sustainable conservation of genetic units and diversity, restoration and protection of marine and freshwater habitat, control of diseases and pollution, resilient salmon enhancement/hatchery technologies, and application of indigenous and local/traditional knowledge.

(Keywords: integrated information system, management strategy of harvest and escapements, genetic conservation, habitat restoration and protection, control of diseases)
and pollution, renovation of enhancement/hatchery technologies, indigenous and local/traditional knowledges and others

2-3. Summary and discussion

Topic 3 (Special Session). Resilience for salmon and people: lessons from the Great East Japan Earthquake in 2011

Moderators: Jun Aoyama* (SC & TCG-2), Masahide Kaeriyama (TCG-1), and Shigehiko Urawa (SC & TCG-4) *session leader

The IYS is seeking to ensure that salmon and people are resilient to changing environments. The Great East Japan Earthquake (GEJE) on March 11, 2011 was devastating for salmon and people. It created a massive tsunami that killed more than 18,000 people and gravely damaged the coastal zone systems, including salmon habitats, hatcheries and fishery facilities along the Pacific coast of northern Honshu. Tohoku Ecosystem-Associated Marine Sciences (TEAMS) was launched in January 2012 as a decade-long project to clarify the impacts of the GEJE and the restoration process of marine ecosystems for the reconstruction of local subsistence and fishery industries. In conjunction with TEAMS, this special session is planned to review the impact of the GEJE on salmon, people and coastal ecosystems, and their recovery processes for human security and risk management. Lessons learned from this project should contribute to enhancing the resilience of salmon and people in the face of future challenges elsewhere.

3-1. Restoration of ecosystems and human society in the coastal zone systems

Salmon have a long historical association with local people in northern Honshu, being a vital resource for various aspects such as food, economy, recreation, culture and education. The GEJE damaged coastal ecosystems as well as human society connecting with salmon and other marine resources. Long-term monitoring surveys have been initiated by TEAMS to access changes in the marine ecosystems and human society affected by the GEJE. This sub-session introduces the outcomes of TEAMS to understand the process and mechanism of restoration in the coastal ecosystems and the recovery of human society.

(Keywords: coastal ecosystem, human society, impact of earthquake/tsunami, restoration, and others)

3-2. Research for retrieval and sustainable management of salmon populations

Chum salmon are an important fish resource in northern Japan, and most populations have been maintained by hatchery releases. This sub-session introduces research results of TEAMS in order to: (1) assess the impact of the GEJE and other factors on the behavior, survival and returns of chum salmon; and (2) review the procedure of recovery and sustainable management for chum salmon populations.

(Keywords: chum salmon, survival, impact of earthquake/tsunami, recovery procedure, sustainable management, and others)

3-3. Risk management and sustainability for the coastal zone systems and salmon production

As a result of the huge tsunami, millions of tones of marine debris including live organisms were widely dispersed into the Pacific Ocean. Radioactive materials were also released into freshwater and marine environments from the damaged Fukushima Daiichi nuclear power plant. In addition, non-native coho salmon escaped from broken net-pens in the coastal water. The sub-session intends to recommend: (1) the risk management approaches including the adaptive management, precautionary principle and feedback control between monitoring and modeling, and (2) sustainable processes for the coastal zone systems and salmon production from catastrophic disaster such as the GEJE and global warming effects.

(Keywords: risk management, adaptive management, monitoring, modeling, sustainable process, coastal zone system, salmon production, and others)

3-4. Summary and discussion: overview of lessons learned for future challenges

Oral and Poster Presentations:

The workshop will be conducted by oral and poster presentations in English. Sessions will be comprised of contributed presentations, which will be selected for oral or poster presentation.

Abstracts:

✔ Abstracts for oral and poster presentations must be received by the NPAFC Secretariat by e-mail (secretariat@npafc.org) no later than January 15, 2020.

✔ Abstracts must be prepared according to guidelines and sample format.

✔ The Science Committee will select abstracts by mid-February 2020, and authors will be notified of the results by the NPAFC Secretariat.
Presenters who had their abstracts selected will receive guidelines for their oral or poster presentations and a formatting guide for extended abstracts from the NPAFC Secretariat.

**Workshop Proceedings:**

Oral and poster presenters are asked to submit an extended abstract. The extended abstracts will be compiled into the workshop proceedings and issued as a NPAFC Technical Report after the workshop. The Technical Report will be available online at the NPAFC website.

**Key Dates for Workshop:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 23, 2019</td>
<td>First announcement of workshop and call for papers</td>
</tr>
<tr>
<td>January 15, 2020</td>
<td>Abstract submission due</td>
</tr>
<tr>
<td>Mid-February 2020</td>
<td>Announcement of abstract selection to authors</td>
</tr>
<tr>
<td>Late-February 2020</td>
<td>Second announcement of workshop and registrations</td>
</tr>
<tr>
<td>Early-March 2020</td>
<td>Workshop and hotel registrations open</td>
</tr>
<tr>
<td>April 24, 2020</td>
<td>Workshop and hotel registrations due</td>
</tr>
<tr>
<td>May 23–25, 2020</td>
<td>Workshop</td>
</tr>
<tr>
<td>June 30, 2020</td>
<td>Extended abstract due (Late submission of extended abstracts may not be included in a Technical Report)</td>
</tr>
</tbody>
</table>

**Registration:**

Regular Registration: **US$150**  
Student Registration: Free except for reception  
Registration includes:

- Transportation (shuttlebus) between official hotel and venue  
- Attendance all oral and poster sessions  
- A program and abstract booklet  
- Coffee/tea breaks  
- Reception on May 23, 2020 (with fee 6,000 yen or US$60 for students and companions)

Space may be limited. Registration is accepted on a first come, first served basis. Late registrants may not receive a hardcopy of the workshop booklet due to limited supply.

**For More Information Contact:**

Jeongseok Park, NPAFC Deputy Director  
Suite 502, 889 West Pender Street, Vancouver, BC, V6C 3B2, Canada  
Tel: +1-604-775-5550, Fax: +1-604-775-5577  
E-mail: secretariat@npafc.org; Website: [https://npafc.org](https://npafc.org)
The International Year of the Salmon (IYS)—Connecting the Pacific and Atlantic

By Mark Saunders, IYS Director
North Pacific Region

The midnight sun was just touching down on the horizon on June 13 at 70 degrees North in Tromsø, Norway and a small group of visitors from eastern Canada, Greenland and the United States were there to witness this from a mountain high above the city. The group was part of the 150 people attending the annual meeting of the North Atlantic Salmon Conservation Organization and its special IYS Symposium on Managing Atlantic Salmon in a Changing World.

I have been privileged to represent NPAFC and play a meaningful role in connecting our two Regional Fishery Management Organizations through the IYS initiative. These organizations were strangers and the challenges of building connections across these great distances is to foster trust among the individuals and the organizations as a whole. In 2015, at an IYS workshop in Vancouver, the NASCO Secretary Mr. Peter Hutchinson and US Head of Delegation, Mr. Dan Morris together drafted during a late-night session the document that became the Terms of Reference that our two organizations adopted in the summer of 2016. It has been imperative to maintain this relationship despite large distances.

My recent experiences attending NASCO in early-June and a Likely Suspects workshop supported by ICES and NASCO held the week of June 23, convinced me that there is a strong rationale to continue to build this relationship to efficiently share what we know, work on common problems that we are aware of now and effectively face surprises.

A Shared Sense of Urgency

Overall both basins share the sense of urgency to understand and take action in order to preserve salmon. Despite experiencing record numbers of salmon in aggregate over the past decade with the generally strong performance of Pink and Chum salmon there has been a persistent decline in productivity for many populations of Sockeye, Coho, Chinook salmon and some Chum.
Pacific coast participants in NASCO’s June 2019 Symposium on Managing Atlantic Salmon in a Changing World—Tawney Lem (far left), Jennifer Nener (centre right) and Mark Saunders (far right) join Doug Bliss (centre left) the Canadian member of the Symposium Steering Committee. Photo credit: Mark Saunders

Atlantic Salmon Pre-fishery Abundance


salmon, particularly in the southern end of their range. Atlantic salmon at the same time are in a dire situation with unflaggingly poor survival and many populations threatened or extirpated in the southern end of the range as well.

Interestingly, the decline in productivity began in both basins in the early 1990’s with many populations remaining low. The decline in the early 1990’s has been hypothesized to be a result of a regime shift but the common timing and persistence across the two Basins is an important clue that has not received much attention to date. Recent cross basin IYS scientific workshops have begun to consider this connection.

Common Issues

In addition to the coincident timing in the decline in productivity across the two basins the symposium demonstrated a large scope for potential collaboration on research and policy issues. The Symposium included talks on the majority of the threats to Atlantic Salmon and perhaps not surprisingly there is very strong overlap with the Pacific including these highlighted topics:

- Climate change
- Need for adaptive management
- Salmon Farming – impact of genetic introgression, disease
- Role and impact of stocking
- Invasive species
- Pink salmon (invasive)
- Freshwater habitat
- Marine mortality—estuary, coastal processes
- Biological reference points
- Need additional classification to describe populations status
- Managing salmon is managing people - increase human dimension

Two Pacific representatives gave invited talks that were well received and again highlighted the effectiveness of sharing our knowledge and experience. Ms. Tawney Lem from the West Coast Aquatic roundtable on Vancouver Island spoke on Collaborative governance and Ms. Jennifer Nener from DFO in Vancouver spoke on a Pacific perspective on managing salmon in a changing world. A detailed report on the Symposium including recommendations to NASCO and to regulators was completed by the organizing Committee and was presented to the Commission. Interestingly, they held the Symposium before the annual meeting so they could provide recommendations to the Commission. The recommendations are too numerous to list here but this form of advice was unlike anything NPAFC has produced and is worthy of consideration. I will make sure this report is circulated when available.

The well-attended symposium was unanimous on the need for more symposia to address the severity of the issues and the state of Atlantic Salmon. They highlighted the need for more coordination and concerted effort in relation to science overall. One of the topics that was suggested was a symposium on approaches to defining conservation limits which is a topic of interest in both basins and possibly a subject for a joint symposium. The remaining years of the IYS are an obvious vehicle to address these issues and our Coordinating Committee and its Technical should meet this year to consider coordinated action.
Continuing to Strengthen the Connections

NASCO does not have the equivalent of CSRS (Committee on Scientific Research and Statistics) so it is challenging to build connections with broader government and academic scientific community in the Atlantic basin. That being said NASCO has formed an International Atlantic Salmon Research Board with representatives from each party and has recommended we work together with this board to coordinate projects such as the Likely Suspects and ROAM. Other projects of mutual interest could also be developed and brought forward to NASCO.

I was able to build timely connections to the broader community of scientists in the Atlantic because of the draw of the scientific Symposium. I met with Norwegian scientists who have a lot to contribute to our understanding of salmon ecology and high seas surveys. Dr. Ava Thorstad chaired the Symposium Steering Committee and Dr. Peder Fisk is the head of the Institute for Nature Research. I learned that Norway began a new project in 2018 called “SeaSalar”. The project is focusing on salmon at sea and was initiated in Norway in 2018 (https://www.seasalar.no). The main aim of the project is to examine factors impacting variation in marine survival. These topics are directly related to our interests in the Pacific.

We have worked quite closely over the past two years with the NASCO Secretariat and this connection is very important. The NASCO Secretary Dr. Emma Hatfield, who started with NASCO in August 2017, was out to our opening event in Vancouver along with Deputy Sarah Robinson and the Head of Delegation to NASCO for the United States, Ms. Kim Damon-Randall. Together with me, NPAFC Executive Director Dr. Radchenko and IYS Coordinator Ms. Stephanie Taylor we are the Technical Team that supports the IYS Coordinating Committee that in turn links the IYS across the two basins. This was the last meeting for NASCO Deputy Sarah Robinson. She will be missed!! Her replacement will be announced shortly.
One of the good examples of collaboration is the Likely Suspects Framework Project (LSF). This is the first joint NPAFC/NASCO project that was proposed by the Atlantic Salmon Trust and supported by both NASCO’s Atlantic Salmon Research Board and the NPAFC. A successful workshop was held December 2017 with researchers from both basins meeting in Edinburgh, Scotland. The Workshop produced an excellent publication that describes an accounting approach to understanding the bottlenecks affecting populations of salmon across life history stages. Funding has been found by a new alliance of NGO’s in the UK convened to support collaborations such as the IYS and the LSF. We hope to have funding soon in the Pacific to jointly build and apply the framework to test cases in the Pacific basin that will mirror those in the Atlantic.

In the Atlantic they have hired a scientific staff to begin working on the freshwater side of the Likely Suspects in Scotland and ICES has stepped up to fund a series of workshops to link ocean data to salmon data. This is of course a priority for the Pacific as well and we held similar workshops in January 2019 in Vancouver. We are attempting to build the LSF with collaboration on methods between the two basins and having representatives from both basins in both sets of meetings was critical and the joint discussions have moved us forward much faster than if we were working in silos. It is important to note that ICES supported the first data workshop in the Atlantic the week of June 24 in Copenhagen and I was able to attend with travel support from ICES and Richard Brenner from the Alaska Department of Fish and Game (ADF&G) attended with support from London Fishmongers/Atlantic Salmon Trust. While I was at ICES headquarters, I met with Anne Christine Brusendorff, the Executive Secretary for ICES. We agreed that having strong and efficient mechanisms to formally and informally connect NASCO/ICES/NPAFC and PICES to work together to address the significant science and management issues facing both basins was warranted and we then agreed to discuss this further with Mr. Robin Brown the Executive Secretary for PICES and Dr. Vladimir Radchenko the Executive Director for the NPAFC.

The conservation of salmon demands a holistic approach to research and management that covers the breadth of their life history from the headwaters of freshwater systems they spawn and rear to the coastal and high seas environments where they feed and mature. Regional Fisheries Management Organizations such as NPAFC, NASCO and the Pacific Salmon Commission are the only bodies formally linking countries with the capacity to build efficient and effective connections across such large distances. With concerted effort, I believe we can continue to evolve through 2022 to be the organizations that will play a lead role in ensuring the resiliency of salmon and people in an uncertain future.
NPFC Marks its Fifth Year of Operation and Opens a New Era of Cooperation with NPAFC

By Dae-Yeon Moon
Executive Secretary of NPFC

2019 marks the fifth year of operation for the North Pacific Fisheries Commission (NPFC) with the successful conclusion of its 5th Commission (COM) Meeting in July 2019 held in Tokyo, Japan. The Annual Session of the NPFC, preceded by the 4th Technical and Compliance Committee (TCC) and 3rd Finance and Administration Committee (FAC) meetings, was attended by more than 130 participants from eight NPFC Members and seven observer organizations including FAO, IGOs and NGOs. There have been no new Members since the USA and Vanuatu joined the NPFC in 2017, but the Commission approved Panama as a new Cooperating Non-Contracting Party for one year. After the NPFC Secretariat summarized the activities of the Commission, the Commission reviewed all the reports from subsidiary bodies, mainly from the Scientific Committee (SC), TCC and FAC, and adopted them with their recommendations.

The meeting culminated in the approval of ten new and revised Conservation and Management Measures (CMMs): CMMs on Vessel Registration, IUU fishing vessels, Bottom Fisheries and Protection of Vulnerable Marine Ecosystems in the Northeastern and Northwestern Pacific, Chub Mackerel, Pacific Saury, Sablefish, Japanese Sardine and Japanese Flying Squid, Vessel Monitoring System (VMS), and Compliance Monitoring Scheme. For the management of NPFC priority species, these CMMs, either new or revised, were precautionary approaches to ensure that the Members do not increase fishing effort in terms of numbers of vessels and catch until the stock assessment has been completed for chub mackerel, Japanese sardine and Japanese flying squid, and that the Members shall not exceed the total allowable catch for Pacific saury in the Convention Area (CA) and cease fishing for Pacific saury east in certain parts of the Convention Area. In the area of compliance, NPFC has again reaffirmed its commitment in eradicating IUU fishing activities in the CA by launching its High Seas Boarding and Inspection (HSBI) on 1 April, a major milestone for NPFC in 2019. Currently nine inspection vessels from four Members—Chinese Taipei, Japan, Russia, and the USA—are active in CA and are providing relevant authorities boarding reports within three days of the completion of the inspection. The Commission also adopted the 2019 NPFC IUU Vessel List of 33 fishing vessels, an increase by six vessels from the previous year.

On the financial side, the Commission adopted a four-year budget for 2019–2022, allocating approximately 157 million Japanese Yen per annum. Although there was a surplus in the budget for 2019, Commission Members deemed it prudent to keep the overall budgetary contribution at a similar level for the years 2020–2022 in order to maintain the robustness of the NPFC and its Secretariat. The budgets will be reviewed annually and adjusted to accommodate the needs of the Commission in line with the objectives set and agreed upon by the Members.

With respect to cooperation with other organizations, the NPFC has made considerable progress in cooperating with several international organizations including those sharing a boundary with the Convention Area. The Commission welcomed the continuing such cooperation and recognized the need to prioritize cooperation with regional fisheries management organizations (RFMOs) that have their convention areas which are similar to or
overlap with that of the NPFC. Of the organizations with overlapping jurisdiction, the North Pacific Anadromous Fish Commission (NPAFC) was the first intergovernmental organization which has made a formal Memorandum of Cooperation (MOC) with NPFC. NPFC Chair, Mr. Kenji Kagawa and NPAFC President, Dr. Suam Kim jointly signed the MOC on May 13, 2019 at the 27th Annual Meeting of NPAFC in Portland, Oregon, USA. This opens a new era of cooperation and promises to strengthen the long-term relationship between the two organizations. The area of cooperation will be on matters of common interest including the exchange of data and information, collaboration on research efforts on species of mutual interest and implementation of CMMs. While the high priority area of formal cooperation remains unchanged, NPAFC requested NPFC’s TCC to amend its boarding inspection forms to indicate the presence of salmon bycatch or to retain salmon as an urgent area of cooperation in the compliance area. This request was considered by the Members at the TCC meeting as it raised issues of legal, training and financial aspects. In response to the recommendation from the TCC, the Commission decided to share information about the presence of salmon bycatch or retention of salmon with the NPAFC, on a voluntary basis. Another follow-up from the MOC could be NPFC’s participation in a multinational research survey in the North Pacific planned in 2021 under the International Year of Salmon (IYS) project of NPAFC to collect new data on species of NPFC’s interests. To advance this cooperation, the SC nominated Dr. Chris Rooper (Canada) to represent the NPFC at the NPAFC-PICES workshop to be held in October to develop an integrated research program for the survey and Dr. Aleksandr Zavolokin (NPFC Science Manager) will also attend the workshop as a co-convener. In order to facilitate cooperation based on the MOC, it is suggested that as addressed in the MOC, both commissions get together to discuss the development of a five-year work plan to identify topics for cooperation.

The Commission also discussed other administrative issues and endorsed the following: proposal to develop a Strategic Plan for the Commission; the FAC recommendation to hire the top three internship candidates in the ranking prepared by the Secretariat; and circulation of press releases via the NPFC website to share information about the Commission and Committee meetings with the media and public. The Commission also took a positive step in addressing the implementation of Performance Review of the Commission in accordance with the Convention and requested the Secretariat to conduct a review of the methodology applied by other RFMOs in conducting their performance reviews.

During the meeting, the Commission selected new Chairpersons of the Commission and its subsidiary bodies—Dr. Vladimir Belyaev (Russia, COM), Dr. Robert Day (Canada, TCC, extension for additional two years), Dr. Janelle Curtis (Canada, SC) and expressed its sincere appreciation to the out-going Chairpersons for their dedicated services and excellent leadership during their tenure over the past four years—Mr. Kenji Kagawa (Japan, COM and FAC), Dr. Joji Morishita (Japan, SC) and Chairpersons for small working group meetings.

Although NPFC has made excellent progress during the initial four-year period, a number of issues for both compliance and science remain unresolved. Therefore, the year 2020 will be another busy year with these challenging issues to be discussed at the meetings of the Commission scheduled as follows: 1st Small Scientific Committee (SSC) on Bottom Fish and Marine Ecosystems, 6th SSC on Pacific Saury, and 5th SC meetings in April 2020 in Vanuatu, 5th TCC, 4th FAC, and 6th COM meetings in July 30–August 6, 2020 in Japan, and small group meetings with date and venue to be decided.

5th Annual Session of the Commission Meeting of NPFC, Tokyo, Japan, July 16–18, 2019. Photo credit: NPFC Secretariat
The ENFO Integrated Information System (IIS): Rise and Fall

By Vladimir Radchenko
Executive Director, NPAFC

That happened in March 2018. The Committee’s on Enforcement (ENFO) Joint Patrol Schedule Meeting (JPSM) was successfully completed on March 20th, and the Secretariat uploaded the JPSM Report onto the Integrated Information System (IIS) website, where it became available for all authorized personnel in the fishery enforcement agencies and coast guards of the NPAFC member countries. Unfortunately, things did not go quite their way that time. By Monday of the next week, it was discovered that the IIS website had crashed, and even well experienced IIS Administrator, Ms. Anna Lyaschenko could not restore its working capacities that time.

In total, the IIS has legally existed for almost 14 years after its adoption by the Commission in 2004. The idea was first discussed during the Enforcement Procedures Working Group (EPWG) in October 2002. In those times, ENFO developed the Concept of Operations for the Joint Operations Information Coordination Groups (JOICG). In the final version of that document, adopted at the 2002 NPAFC Annual Meeting in Vladivostok, it was stated that “Building upon the successes of the 2001 Joint Patrol Coordination Group, which was suggested by the Federal Border Service [of the Russian Federation] at the 8th Annual Meeting of the NPAFC, it is now possible to use computer and communications technology to facilitate the exchange of enforcement information and coordinate patrol activities among the Parties enforcement agencies on a year round basis”. Talking about success, the Parties likely noted that 2001 was the first year after the NPAFC establishment, when no HSDN fishing vessels were apprehended or even detected in the Convention Area during the patrol season.
At the 10th Annual Meeting in Vladivostok, the Parties continued to discuss the content of desired enforcement-related information that may be exchanged. As it was agreed in 2002, such information included workplans/schedules for patrol assets, patrol plans, vessels, aircraft types, equipment, and capabilities. In-season and post-seasonally, the Parties agreed to exchange information on patrol activities and results with a summary/evaluation of the current year’s activities. Other desired data, which has not been exchanged thus far, included licensing/permitting information for scientific or commercial vessels authorized to fish outside of the participating countries’ exclusive economic zone (EEZ), and to enter NPAFC member countries EEZ to participate in fishing, offloading/transshipment information, allocated quotas, market observations and trends, and metadata, if any. This list, plus satellite surveillance information that has been collected and shared by the Canadian Party since 2008, shows how these significant informational resources might be exchanged to increase the enforcement capabilities and efficiency of the Parties.

The EPWG met at the 11th NPAFC Annual Meeting in Honolulu, where Capt. Oleg Lukyanov from Russia, who was the Head of the Coordination Center of the Russian Border Service in Vladivostok, gave a presentation about the IIS goals, organizational structure and capabilities. The three main objectives listed in the presentation were: 1) Creating an electronic database of suspected fishing vessels, 2) Ensuring direct and efficient information exchange, and 3) Strengthening between Parties cooperation through the confidence building. The IIS would carry out the following tasks:

- Information support of coordination of patrolling and other enforcement activities;
- Maintaining the constant availability of the informational resources, supporting the information flow of the member countries’ enforcement agencies;
- ENFO members networking by creating individual IIS accounts;
- Processing, cataloguing and storing of incoming information;
- Providing an overview on HSDN threat level;
- Systematization and analysis of essential information for the planning purposes.

The IIS should function overall as a communication tool, allowing authorized access to the database, bulletin board, and an analytical information archive. However, the most important function of the IIS would be to foster a sense of community and develop common goals.

Initially, it was proposed that the NPAFC would create a website-based IIS, but unfortunately this could not be completed in the working version, as features were too advanced. Ideally, the IIS would be capable of identifying spotted fishing vessels by comparing measured parameters (length, width, design, element of construction dimensions, etc.) with the standard parameters of known types of fishing vessels. GIS-based tools should be able to depict the transmitted information on suspicious vessels’ location on an electronic chart. Originally, the IIS was planned to be used by investigation and prosecution agencies, which would result in the ENFO receiving the most contemporary and comprehensive information system among all the World regional fisheries management organizations.

In general, the IIS development was performed in accordance with conventional standards. User needs were identified and agreed upon based on the NPAFC enforcement goals within the working group. System requirements were drawn upon user requirements; its organization and design were presented and discussed at least twice a year.

The following year after the Annual Meeting in Honolulu, at the 2004 Enforcement Evaluation and
Coordination Meeting (EECM) in May, Capt. Lukyanov presented an updated version of IIS with an estimate of financial implications for the Commission. The new proposal was to upload the IIS to a separate secure website for the use of authorized personnel. The IIS prototype included the list of vessels of interest with detailed information, including photos and references to ship owners, and some general information with lists of Pacific salmon species, drift net fishing description, chat forum, etc. Russia requested US$1,200 to purchase the necessary software to develop the IIS website. Other related costs (development and service labor, technical support and administration, website hosting, etc.) were committed by the Russian Party.

All Parties supported the creation of the IIS and proposed to recommend it to the Commission at the ensuing annual meeting along with the funds request. Canada and the United States offered technical assistance for further improvement of the system. A discussion subsequently took place on the IIS content management and administration. Russia proposed that the IIS website should be administered by one representative from each Party having equal access to the site. A reversion to the NPAFC website-based model was also considered, but Executive Director explained that there is no server in the Secretariat’s possession, and the Secretariat staff capacity is not enough to administer it. Therefore, from a practical point of view, the Secretariat will not be capable of managing the IIS.

Thus, an approach was endorsed to have the one-Party based system on its servers and on a separate website. Another possible way would be to increase the Secretariat’s capabilities by purchasing a server, software, and establishing new staff position. All that was done in 2013–14. However, in the early 2000s, the committee chose a more cost-effective approach. Taking into account the Commission’s financial position in 2004, it was understandable: the previous fiscal year ended with the record budget deficit (− C$91,990), and the difficult decision was recently made to increase the Parties’ annual contribution by C$10,000 (from C$135,000 to C$145,000) starting 2004/05. Presumably, the right decision is not always the most cost-effective one.

At the 12th NPAFC Annual Meeting in Sapporo, Japan, a detailed brief on the IIS and its capabilities was presented to ENFO members and distributed on CD. The system database proposal was expanded with inclusion of suspected fishing vessels’ masters. Additional tools were also proposed to display and analyze the integrated information. The cost of the proposed project has respectively grown with inclusion of $2,000 recurring funding for hosting of the website and continued development of the software. Meanwhile, the technical support for the system and members as well as labor...
cost for continued development of the system remained the Russian Party’s responsibility. At F&A, the C$6,000 budget was approved for the project to be financed on a trial basis. Ongoing annual maintenance cost was acknowledged but not adopted in accordance to the Commission’s financial regulations.

Parties started to discuss some practical issues related to the IIS, such as how wide the list of authorized specialists for IIS should be. It was decided that the system would be customized just for the NPAFC usage, and not across all parties of the North Pacific Coast Guards. There was also much discussion about what types of information would be entered into the system, who would be responsible for maintaining the database, and how legitimate fishing vessels would be protected from being mistakenly targeted by Parties as a result of misleading information. The Russian Party suggested that the definition of a suspected vessel should be left to the determination of the Party detecting the vessel, and definitions from other fisheries-related international conventions might be used. Despite all Parties agreeing that the lack of a current suspected vessel definition should not preclude the continued IIS development and testing, a definition issue should be discussed, and a solution be found at the next ENFO meetings.

In fact, the definition problem is still persisting and making it difficult to move ahead with the development of stricter treatment measures to non-contracting party vessels conducting IUU activities in the Convention Area. In 2005, a solution was found by renaming a “suspected vessel” into a “vessel of interest”, first in the IIS manual, English version. Nevertheless, in 2011 and recently in 2018, discussion on the IUU Vessel List bogged down again with disagreements on the IUU fishing definition in the context of the NPAFC Convention. It is remarkable that the same member States (plus People’s Republic of China) in the North Pacific Fisheries Commission (NPFC) adopted the CMM 2017-02 To Establish and List of Vessels Presumed to Have Carried Out IUU Activities in the NPFC Convention Area two years ago. They just followed the IUU fishing definition from the International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU). Two paragraphs in sections 3.2 and 3.3 comprehensively describe all cases pertinent to the area of competence of a relevant regional fisheries management organization.

Consideration on the IIS development continued in 2005–2006. At the 2005 EECM, the IIS Technical Group was established (then, adopted at the 2005 Annual Meeting in Jeju Island, Republic of Korea) that carried out further system elaboration. One year later, Capt. Lukyanov presented a background of IIS and a history of its function both at the 2006 EECM and 14th Annual Meeting in Vancouver. Walking through the functions of the mock-up web page, he demonstrated how to use IIS, what information could be found on the IIS site using available navigation tools, along with how the catalogue looked and functioned. At the end of the discussion, ENFO reached a consensus to adopt a Terms of Reference for IIS Vessels of Interest and revised the definition of a “Vessel of Interest”, which was defined as a vessel that has been sighted in the Convention area and that:

a. Is engaged in fishing, or supporting fishing activity, that could adversely affect the conservation of anadromous stocks within the Convention Area, or
b. Appears to be equipped with driftnet gear, or
c. Is reasonably suspected of having engaged in fishing that could adversely affect the conservation of anadromous stocks within the Convention Area, or
d. Has a previous history of fishing activity or supporting fishing activity that is contrary to the Convention.

The same items were suggested in proposals to transform the Terms of Reference for IIS Vessels of Interest to the Terms of Reference for IUU Vessel List by U.S. and Canada with addition of the criterion “Is on an IUU vessel list of another RFMO” in 2011, and by the Secretariat with addition of the criterion “Are without nationality within the Convention Area” in 2018.

In 2007, the IIS was filled with information on species, vessels, and fishing gear codes based on the standard codes developed by FAO and employed internationally. Patrolling results also started to be uploaded. The Secretariat announced that all ENFO documents, past and
future, will be stored at the IIS. In 2008, the IIS website was moved from the .com web domain to the .ru web domain to improve memory space, multimedia and video potential, and chat service, etc.

As with any successful project, the launched IIS started to grow rapidly by encompassing new areas and obtaining new features. Likely, such growth was too rapid. Users from the NPAFC member counties did not have enough time to completely utilize the opportunities provided by the IIS, as new capabilities were continually developed and presented. At the 2009 Annual Meeting in Niigata, Japan, the Executive Director raised the question whether the IIS was being used effectively. The conclusion was that the use of the system by Parties could be improved. Given the investment and functionality available within IIS, members should be committed to expanding their use of such a valuable communication and information resource. Despite that, new proposals to supplement IIS with relevant information were expressed including information on domestic legal salmon fisheries, lists of all fishing vessels sighted in patrols, Radarsat-2 images and data, analytical reviews and summary articles, etc. A proposal to give access to a restricted amount of data within IIS to a non-contracting party, Taiwan, was endorsed by EECM in 2008.

At the same time, three years after the full-format launching, it became clear that the IIS could not complete one of the major functions it was created for – to support real-time Parties’ communication on urgent issues. Despite national IIS administrators being able to upload information to the system, uploading required the technical administrator’s involvement to make the contribution visible for all authorized users. Such mediated communication was not efficient for an operational coordination of Parties’ patrol vessel efforts. Therefore, at the 2010 EECM, the United States proposed to have bi-weekly conference calls through the patrol season among the Parties to discuss enforcement activity and Canada’s Radarsat-2 information. Despite the IIS being recognized as a viable tool, the U.S. Party felt that it may not get used in a timely fashion to assist with tactical patrol decisions. Bi-weekly conference phone calls were established as a complimentary system to the IIS at the 2010 Annual Meeting in Busan, Korea.

In 2011, the IIS was significantly updated with a section for uploading Radarsat-2 data, where the satellite surveillance results could be viewed against the Convention Area map. There was a plan to expand this section’s capabilities to absorb and present observed vessel’s AIS data that required further system amendments. However, no IIS-related discussion occurred at the last intersessional EECM in 2012. At the 2012 Annual Meeting, the IIS father and creator Capt. Oleg Lukyanov presented results of comparison of the system use by the Parties for two last fiscal years and urged ENFO members to work more actively with the IIS modules. That was the last NPAFC annual meeting attendance for him.

My personal experience working with IIS started in July 2013. At first appearance, the IIS website looked complicated and difficult to navigate. Some users posted new information in the News section, while others submitted similar posts to the Forum section of the system. It was not easy to find a necessary resource. Thus, one Party requested the ENFO universal enforcement grid to be posted on IIS while it was already uploaded there. Some IIS sections showed evident signs of abandonment — no updates for a long time, outdated design and information, uploads from people who already changed their positions and left the NPAFC community.

However, after several days of testing, it was decided that using the IIS did not require any special training. As it was noted by one the NPAFC Party in the 2011 EECM report, when its personnel uploaded information to the IIS module for the first time, they found the website
much easier to use than expected. Truly, the systems kept all its capabilities and worked properly, and System Administrator Anna Lyaschenko was always accessible by phone and ready to help. In 2013–2015, all major IIS sections were updated, including the Vessels of Interest, Radar Satellite, and the Forum. The latter one has become a tool for information exchange from biweekly e-mail conferences replaced the ENFO conference calls since the 2015 patrol season.

There were no major issues with the IIS usage until March 2018. In 2015–2017, fifty-nine Parties' patrol reports were uploaded at secure web pages created by the Secretariat at the IIS website. The majority (80%) of patrol summaries and sighting information were reported utilizing the standard template. This information was archived and organized by half-month time periods. Another important IIS function was supporting the Joint Patrol Schedule Meeting and keeping the summary patrol schedule under the authorized access until it was disclosed in the next NPAFC annual report. In the "HSDN AOI" (Alerts of Interest) section, the US Party published a HSDN Threat Assessment. The whole ENFO reports archive was also accessible from the IIS.

At the same time, additional technical issues had come to light which needed to be addressed. In 2014, the Russian Party presented updated information on the IIS usage (NPAFC Doc. 1540) that showed users consistently underutilizing system services. In the following discussion, the Parties expressed a wish to meet with the IIS technical administrator/expert, who could answer a backlog of technical questions. The Russian Party promised to consider the possibility of bringing an expert to the group. However, the opportunity was not available until the 2018 Annual Meeting in Khabarovsk, only after the IIS failed. The Russian Party proposed, that the other Parties consider the possibility of using an alternative information system or creating a new one, since the IIS is technically obsolete and no longer operational. The North Pacific Coast Guard Automatic System (NPCGAS) was considered as one of the possible solutions but it is not convenient for most of Parties since no agency representatives beyond the coast guard system can obtain access to the NPCGAS. Again, this approach will limit ENFO intentions to improve communications and information exchange amongst all requisite representatives of enforcement, investigation, and prosecution agencies for IUU fishing. As a temporary measure, the Secretariat brought major IIS functions back to the NPAFC website. Point of fact, in a field of information exchange, ENFO occurred in a situation at the beginning of 2000s, when no communication and information toolkit was available.

So, then, what lessons might we learn from this brief IIS history that might be useful to make the right choice in organizing a new ENFO communication tool?

First, the committee should consider whether an approach to have a one-country based information system could be accepted under the current circumstances or a centralized Secretariat-based secure communication tool should be developed. The latter approach may be more expensive but is definitely more reliable. For the IIS, all major developments were made under the enthusiastic leadership of Capt. Lukyanov, and when he left the committee, the system started to stagnate and completely collapsed after Ms. Lyaschenko’s retirement. Enthusiasm is a great quality for startups, but long-term projects need stability and ensuring continuity, i.e.,
should be administered on a permanent and professional basis. Administration-wise, a positive feature of the IIS was that different levels of access existed, and national administrators worked with broader rights of access to solve problems that their Party members occasionally encountered. These approaches should be embodied into a new system if it is created.

Second, the communication/information exchange system functions and database content should be clearly defined with accountability of the system’s operation. The communication system should not duplicate other information sources like keys to fish, fishing gear and/or vessel identification, libraries or archives. It is not reasonable to spend resources for a feature that will not be efficiently used, even if it has a great visual appeal. Operability and practicability should be given top priority, and development should progress "from the simple to the complex". If we checked the theory of management information system, there was likely some confusion between communication and collaboration technologies when the IIS was established. While communication technologies allowed users to access needed knowledge, and to communicate with each other, especially with experts, collaboration technologies provide the means to perform group work (Turban et al. 2005. Introduction to Information Technology. John Wiley and Sons Inc. 2nd edition. 544 p.). No group work was performed in the IIS without the NPAFC Secretariat involvement despite the Secretariat not being mentioned in the IIS Manual. According to the theory, an integrated information system should connect existing systems to maximize the use of their resources while the IIS was created from scratch and occurred as another type of system known as an interorganizational information system which has different goals and functions (see Chapter 8 of book cited above).

Discussions and development of recommendations to establish a new ENFO communication/information exchange system should not be discontinued from one annual meeting to another. This requires continued efforts intersessionally, preferably in a working group format.

Currently, the US Party proposal to use the All Partners Access Network (APAN) is on the ENFO agenda. It appears to be a repetition of a previous approach with a one-country based system, which is a worse option since the IIS was created specifically for ENFO while APAN already exists. Other issues regarding access, administration, account management and other features of the proposal remain unclear. It would be reasonable to start testing this system intersessionally to prepare for a substantive discussion on the advantages vs disadvantages of this practice. Otherwise, the search for appropriate solution might be prolonged for years.
Resilience of Salmon Fishers in an Uncertain Future

By Nathan Bendriem
2018 NPAFC Intern

1.1 Introduction

The International Year of the Salmon is a five-year research and outreach initiative that aspires to establish the conditions necessary to ensure the resilience of salmon and people throughout the Northern Hemisphere. Its objective is to bring people together, develop a better understanding of the factors driving salmon abundance, and work toward solutions to overcome the many challenges that salmon face. My colleague Stephanie Taylor provided a brief overview of some of the current challenges that salmon face in NPAFC Newsletter No. 45. I would like to take the opportunity as the current North Pacific Anadromous Fish Commission intern and dive into the issues that salmon fishers are facing today and the ways in which commercial, recreational, and subsistence fishers may be resilient in an uncertain future.

While the IYS is a ‘salmospheric’ wide collaboration, with contributors from North Pacific and North Atlantic nations, this article will primarily focus on the Eastern Pacific, home to some of the world’s largest salmon rivers, including the Yukon, the Fraser, and the Columbia, in which Indigenous and other local peoples have developed livelihoods in harmony with the environment (Wolf and Zuckerman 2003). This is an area that has been referred to as ‘The Salmon Nation’ and ranges from Alaska’s Arctic to Central California (Wolf and Zuckerman 2003).

Figure 1. The Salmon Nation map (Source: Mertens and Tutak 2018)
1.1 Issues of access and the privatization of a public resource

1.2.1 British Columbia

During the late 1900s, British Columbia’s salmon fisheries, among others, were faced with a number of policy changes that were put in place to improve the economic viability of the fishery, as well as improve the sustainability of the resource itself, via strict conservation measures and reduced bycatch of weak fish stocks (DFO 2001). The results, however; resulted in larger barriers to fishery access, skyrocketed value of licenses, and the capitalization of the fishery to the benefit of a wealthy few (Ecotrust Canada 2004). Similar results have been experienced in Alaska, as well as the states within the Pacific Coast throughout the Salmon Nation.

In 1969, as a response to ‘too many fishermen chasing too few fish’, or an overcapitalization of the fishing industry in BC, the Canadian Federal Government imposed a limited entry scheme for the commercial salmon fishery (Ecotrust Canada 2004). This created a licensing system in which vessels that historically caught substantial amounts of salmon (10,000 lbs or more) were given an ‘A’ license and therefore, the right to fish for salmon.

Salmon fishers were then introduced to an Individual Fishing Quota (IFQ) system, which gave license holders a pre-determined harvest allowance that in total, would not exceed the Total Allowable Catch (TAC) for that year’s returns. In addition, a fisher with a quota was allowed to buy, sell, or lease their quota without restriction, creating an Individual Transferable Quota (ITQ) system (Ecotrust Canada and Ecotrust 2004). The idea was that fishers would buy or sell quotas and over time, those who were successful in their harvest would increase in their quota share, and the smaller, less efficient fishers would leave the fishery or chase another resource (Sumaila 2018). At that time, the salmon fisheries in British Columbia were divided by gear and location, a system that is still in place today (DFO 2001). Fisheries and Oceans Canada has 7 different commercial salmon licenses based on gear and zone in British Columbia. They include two seine licenses (North/Central Coast and South Coast), three gillnet licenses (North/Central Coast, Johnstone Straight/West Coast Vancouver Island, Strait of Georgia/Strait of Juan de Fuca) and three troll licenses (North/Central Coast, West Coast of Vancouver Island, Strait of Georgia/Johnstone Strait/Strait of Juan de Fuca). An example is provided below.

In 1996, Fisheries and Oceans Canada introduced the Pacific Salmon Revitalization Strategy, in which fishers gained the ability to stack licenses, giving them the access to fish multiple gears or multiple areas if they could purchase additional licenses (Ecotrust Canada 2004).

Fishing fleets focused their revenues on their vessels, increasing the engine capacity, Geographic Positioning System (GPS), and deep freeze storage which gave them an advantage within the fishery, thus allowing them to purchase additional licenses and stack them on top of their current license. This led to a concentration of licence ownership, exceedingly so between 1993 and 2012, by corporations or by a single processor (Haas et al. 2016; Silver 2019). As this practice became more prevalent, the market value of the fishing fleet rose. With each additional license, revenue increased and the number of vessels in the fishery decreased. Captains spent less of their profits on repairs and crew wages, contributing to the value of the licence itself (Ecotrust Canada 2004). Salmon licences saw an increase in value in the early 2000s but have since stabilized, with the entire salmon fleet (troll, gillnet, seine) valued at C$175,980,000 in 2015 (Nelson 2016), compared to C$236,775,000 in 2002 (Ecotrust Canada and Ecotrust 2004). Nonetheless, even with a stabilized value over time, the average annual price per salmon licence in BC is C$418,500 for the seine fishery, C$54,300 for the gillnet fishery, and C$124,700 for the troll fishery (Nelson 2016). The value of each licence far outweighs the landed value of the catch (Ecotrust Canada 2004), and will likely continue to do so as fishery closures become more prominent in an era of uncertainty due to climate change. The overall value of landings in British Columbia have dropped 30% between 2000 and 2015, adding more economic shortages within the commercial fisheries (Huffman 2019).

The ability to lease quotas generated additional profits within the fishery, albeit generally at the cost of the fishers. British Columbia has yet to implement an owner-operated fishery policy stipulating that the holder of the quota must be the one fishing. Fully transferable quotas encourage leasing agreements in which a holder will rent the quota to a working fisher and charge an additional fee (Ecotrust Canada and Ecotrust 2004).
Canada and T. Buck Suzuki 2018). This generates a larger disparity between the value of the catch and the profit for the fisher. In addition, leasing further increased the market value of the quotas as quota holders could charge higher prices in cases where a fisher had exceeded their current quota and has no option but to buy more to cover their harvest. The value of each licence far outweighs the landed value of the catch (Ecotrust Canada 2004), and will likely continue to do so as fishery closures become more prominent in an era of uncertainty due to climate change, and landings decrease or remain stable.

![Figure 2A: Salmon Troll Licences](source)

**Figure 3.** Licence value vs. sales value over time. (Source: Ecotrust 2004)

In recent years, there have been steps taken to modify licensing regulations, in all commercial fisheries in BC including in salmon fisheries. If BC is to rebuild the many direct and indirect benefits that salmon have provided for centuries, and ensure that harvesters are the benefactors of these benefits, strategic interventions are required (BC Wild Salmon Advisory Council 2018). In a recent report by the Standing Committee on Fisheries and Oceans in Canada, a set of recommendations based on the current fishery regulations were issued to address the problems described above (Macdonald 2019). A study by G.S. Gislason & Associates LTD (2008) found that while ITQs can produce higher returns to both fishermen and processors, it could also shift the balance of power between the licence/vessel owner, the vessel crew, and the processor-buyer. The licence owner appropriates a greater share of the increase in value, than the processor-buyer or crew (G.S.Gislason & Associates LTD 2008). It has become clear that the free market system underlying the ITQs have “been failing the West Coast’s commercial fisheries” (Macdonald 2019). According to Dr. Evelyn Pinkerton, a Professor at Simon Fraser University, the free market system works well when there is equal access to capital, equal access to information, and a transparent auction like system (Macdonald 2019). Instead, new entrants to the fishery do not possess the capital or funds to enter the fishery, and quotas are traded privately through processors and corporations.

Various business models that are meant to improve the economic viability and the sustainability of the resources have been proposed within British Columbia. One such proposal is a Fisheries Loan Board, which exists in the Eastern provinces of Canada but not yet in the West (Macdonald 2019). These loan boards could provide generous grants, affordable credit, and business management training for young people to acquire capital and licenses as an additional tool to entering the industry (Silver 2019).

Perhaps one of the most sought out changes in the Canadian West Coast fisheries is to implement an owner-operated principle within British Columbia. This principle, often referred to as ‘boots-on-deck’ or ‘owner-on-board’, is a legal requirement in the Eastern seaboard of Canada, as well as Alaska. In Washington, the licence owner must be the designated primary operator of the vessel (WDFW 2019). In Oregon, limited entry permits, such as those used in salmon fisheries, are transferable with a $200 fee, which would provide some limit as to how often a permit is traded with a higher value (ODFW 2019). However, policy on the west coast of Canada has allowed ownership of licences and ITQs “by all sorts of people and companies who never set foot on a boat. Their only qualification: a lot of money” (Pinkerton 2019). According to Dr. Rachel Donkersloot from the Alaska Marine Conservation Council, the owner-operated provision “requires that limited entry permits...only be held by persons, as opposed to corporations or other entities (Macdonald 2019). Leasing of permits is prohibited except in cases of medical or another emergency.” In addition, the state of Alaska has established limits on the amount of quota a vessel can land, and that a single person can hold. These have had tremendous impacts on social sustainability and inclusion within the fishery (Macdonald 2019). Coupled with the apprenticeship programs and the possible approval of the federal Young Fishermen’s Development Act (explained further below), Alaska provides a prime example of social progress within their commercial fisheries (Behnken 2018).

Following the Standing Committee on Fisheries and Oceans’ meeting in February of 2019, the committee issued a list of recommendations that include the following (Macdonald 2019):

*The Minister of Fisheries and oceans establish an independent commission to:

- Develop a concept for a ‘fair-share’ system to equitably allocate the proceeds from the fishery of...*
1.2.2. Pacific Northwest of the United States

In Washington State, the salmon fisheries are managed under a limited licensing system as well (WDFW 2019). Licences can be traded from one vessel to the other but no new licences are issued. Similarly to BC’s management system, the licences are dependent on an area and gear. The same holds true for commercial fishing licences in Oregon, which is divided into Columbia River fisheries and coastal fisheries. However, unlike in British Columbia, the cost of buying a commercial salmon licence has remained affordable. New entrants to the fishery would not be faced with as large of a financial burden as would be expected in BC.

In Alaska, the trend within commercial fisheries has generally been towards a decrease in participation (Beaudreau et al. 2019). Within the commercial salmon fisheries, as well as the sablefish, halibut, herring, and rockfish fisheries, Alaska has experienced high levels of consolidations resulting in fewer permit holders. Policies, like the limited entry and individual quota systems introduced in 1975 have forced consolidation of permits at local and regional scales (Beaudreau et al. 2019). Much like licences in BC, this has created a higher entry cost with licence valued above $200,000 USD (ADF&G 2019).

1.2.3. Impacts to coastal communities

When identifying the economic benefits of the quota system in salmon fisheries, and the ability for salmon

<table>
<thead>
<tr>
<th>License type</th>
<th>Resident</th>
<th>Non-resident</th>
<th>Resident transfer</th>
<th>Non-resident transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charter</td>
<td>$700</td>
<td>$1,085</td>
<td>$155</td>
<td>$155</td>
</tr>
<tr>
<td>Salmon charter waiver (*)</td>
<td>$240</td>
<td>$240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery (d)</td>
<td>$635</td>
<td>$1,020</td>
<td>$155</td>
<td>$155</td>
</tr>
<tr>
<td>Gill net</td>
<td>$585</td>
<td>$970</td>
<td>$155</td>
<td>$155</td>
</tr>
<tr>
<td>Purse seine</td>
<td>$750</td>
<td>$1,135</td>
<td>$155</td>
<td>$155</td>
</tr>
<tr>
<td>Reef net</td>
<td>$585</td>
<td>$970</td>
<td>$155</td>
<td>$155</td>
</tr>
<tr>
<td>Troll (d)</td>
<td>$585</td>
<td>$970</td>
<td>$155</td>
<td>$155</td>
</tr>
<tr>
<td>Waiver (*) · other than salmon charter</td>
<td>$205</td>
<td>$205</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of License</th>
<th>Resident</th>
<th>Non-Resident</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean Troll Salmon</td>
<td>$127</td>
<td>$177</td>
<td>Commercial Fish License Application (pdf)</td>
</tr>
<tr>
<td>Ocean Pink Shrimp</td>
<td>$502</td>
<td>$552</td>
<td>Commercial Fish License Application (pdf)</td>
</tr>
<tr>
<td>Columbia River Gillnet</td>
<td>$127</td>
<td>$177</td>
<td>Commercial Fish License Application (pdf)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fishery Grouping</th>
<th>Fishery</th>
<th>Licence Des.</th>
<th># Licences</th>
<th>Average Licence Value ($)</th>
<th>Aggregate Licence Value ($)</th>
<th>Aggregate Quota Value ($)</th>
<th>Total Licence &amp; Quota Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmon</td>
<td>Selene</td>
<td>AS</td>
<td>210</td>
<td>418,571</td>
<td>87,900,000</td>
<td>-</td>
<td>87,900,000</td>
</tr>
<tr>
<td></td>
<td>Gillnet</td>
<td>AG</td>
<td>818</td>
<td>54,315</td>
<td>44,430,000</td>
<td>-</td>
<td>44,430,000</td>
</tr>
<tr>
<td></td>
<td>Troll</td>
<td>AT</td>
<td>350</td>
<td>124,714</td>
<td>43,650,000</td>
<td>-</td>
<td>43,650,000</td>
</tr>
</tbody>
</table>

Figure 4. Comparison of commercial salmon licence value in Washington (a, Source: WDFW 2019), Oregon (b, Source: ODFW 2019), and British Columbia (c, Source: Nelson 2016)
fishery to adapt, it is crucial to identify the impacts the transferable quota systems has had on coastal communities (Ecotrust Canada 2004). Rising costs have shut out marginalized fishers, particularly those in rural, small-scale fisheries and indigenous fishers (Kelloway 2019). These communities generally face a disadvantage in economic opportunity and investments have significantly declined in resource-dependent communities, while fishers based out of urban centers have been able (for the most part) to remain active within the fishery. This issue has been prevalent in Alaska and British Columbia (Ecotrust Canada and T. Buck Suzuki 2018, Hill 2017).

Even though the bill is still working its way through congress, fishing organizations, such as the Alaska Longline Fishermen’s Association (ALFA) and the Fishing Communities Coalition (FCC), have been taking the initiative to provide training for the next generation of commercial fishers. The skills focus on necessary knowledge around fishing and fisheries, such as sustainable harvesting practices, marketing and financing, and at-sea safety, amongst others (Behnken 2018).

ALFA provides young people the opportunity to learn about and participate in the decision-making process behind fishing regulations. The association brings younger fishers to local, state, and national forums so that they may testify and advocate for issues that are relevant to their livelihood and the communities that they come from (Behnken 2018). In 2015, ALFA began a Deckhand Apprenticeship program that aims to provide those with an interest in commercial fishing an opportunity to gain experience (Behnken 2018). Fishing is an industry in which the knowledge and skills are passed down from one generation to the next, with few training programs available previous to the 21st century. When generational gaps in employment take place due to the barriers to entry, young fishers are often unable to learn the necessary skills to begin fishing themselves. The Apprenticeship program matches captains with interested skippers and allows the younger fisher the opportunity to better understand commercial fishing, the lifestyle it provides, and its important role in supporting coastal communities, while providing a safe, well-guided, entry level experience (Behnken 2018). ALFA has conducted a crew apprenticeship program in 2017, 2018, and will be doing so in 2019 as well. The passing of the Young Fishermen’s Development Act would provide more funding for ALFA and other state, tribal, local, or regional networks that wish to develop a training program for young fishers.

In Oregon, Governor Kate Brown signed Senate Bill 867 into law that created a task force to focus on maritime sector workforce development. The purpose is for fishing-related jobs have a classification, allowing other resources, such as a workforce program to retain employment, increase wages and progress along career pathway, to be accessible to commercial fishers (The Oregonian 2019).

In British Columbia, the British Columbia Young Fishermen’s Network (BCYFN) has similar ties and aims
to help the next generation of fishers (BCYFN 2019). The BCYFN is a supportive space for the next generation of BC’s fishing fleet. They aim to foster learning, networking, and growth among young fishers, creating connections to the people and resources they need to succeed (BCYFN 2019). Much like the apprentice program from ALFA, the BCYFN provides skill building opportunities and access to industry experts, resources, events, and opportunities across the coast. In addition, the network communicates the value of fish to the coastal communities and seafood consumers in BC, bridging a widening gap that has disconnected consumers from their local fishers and the source of their food. By doing so, there is more support for commercial fishers and more support for the regulations that provide access and affordable licences for those who wish to enter or remain in the industry (BCYFN). Community supported fisheries, as explained in the next section, also provide a stronger connection between the consumer and the harvester.

1.3.2 Community Supported Fisheries

In order to combat the high costs of entry into commercial fisheries and the consolidation of permits into the hands of larger corporations, many fishers and consumers are advocating for community-supported fisheries. These fisheries provide more transparency within the seafood supply chain from the coastal seas to the dinner plate and create connections between the consumer and the fisher, a connection that has been absolved through the modernization of fisheries to global proportions (Witter 2012). CSF’s follow a model that was introduced to community supported agriculture, which was developed in the United States during the 1980s: consumers purchase a share of the catch of locally landed fish and invertebrates (McClenachan et al. 2014) which the fishers then use to purchase the quota, hire and properly support a crew, and help with the necessary repairs before the starting season (Skipper Otto 2019). CSFs may result in more active involvement of fishers in management by encouraging interest in advancing sustainability in their local fisheries by developing rules or protocols that improve on those imposed by state or federal managers (Brinson et al. 2011).

By shortening the supply chain as shown in Figure 6, community supported fisheries can increase profits to the local fisheries, provide high quality seafood to interested consumers, and directly engage consumers using seafood and fishery products. In contrast to community supported agriculture (CSA), consumers cannot view the production technique involved in commercial fishing as they would within community farms. However, connections are still forged between the consumer and the producers, which in turn provides more success to the CSF itself (Brinson et al. 2011). Consumers interact with the fishing communities at seafood expos, websites, newsletters, and local outreach events. As a result, consumers are more prone to be helpful and supportive of fisher-beneficial policies and regulations as they come into play or are subject to amendments (such as Macdonald 2019). Fishers receive the financial support they require by obtaining a premium and fair price for their work, generally receiving a premium by implementing a conservation-focused harvest method, which in turn limits the amount that a fisher must catch to make a profit (Witter 2012). Other profits stem from a CSF’s creation of a purchasing channel for species with lower values in traditional markets as well as protection from volatile market prices through guaranteed up-front pricing scheme (Witter 2012). CSFs offer enhanced economic security to small-scale fishermen in various ways, such as through up-front payments/investment, guaranteed markets, free marketing of a differentiated product, and premium prices (Witter 2012). In addition, CSFs, through seasonal subscriptions, can allow fishermen to know that they will receive a fair payment for their catch before leaving the dock. Without the need to lease a quota, fishers make enough profit required to keep their profession alive and the community support can provide the necessary voices to implement policy changes that favor young fishers and small-scale fishers, both of which have faced barriers to enter or remain in the fishery.

1.4. Conclusion:

Much like the need to establish the conditions for resilience of salmon populations in the Northern Hemisphere, there is a necessity for resilience within the salmon fisheries as well, as people have depended, and will depend on salmon as a source of livelihood and food security for millennia. In the Eastern Pacific Ocean, changes to the regulations that govern the commercial salmon fisheries have made it increasingly hard to become a commercial fisher. Licensing fees have grown tremendously in BC with the introduction of individual transferable quotas that may be traded and sold. In Alaska’s coastal communities, as well as BC’s, Oregon’s, and Washington’s, there is a growing disinterest in joining the fishing industry as the young generations are faced with high costs of entry, and a disassociation with the importance of commercial fisheries to their communities and the necessary skills required to fish.
Proposed changes in British Columbia, including a ‘Made-in-BC owner-operator provision’ to the licensing system may help curb the costs of buying salmon licences. Fishing apprenticeships and programs that focus on financial education can provide advice and experience for the next generation of fishers. Community supported fisheries may also ensure financial security, by advocating for sustainable harvesting, higher prices, and forging connections between the consumer and the fisher. This can help influence further changes to the management and regulations of commercial fisheries, to the benefit of the resource, the harvester, and the community.

References

Alaska Department of Fish and Game (ADF&G). 2019. Alaska commercial fisheries entry commission: permit value reports. https://www.cfec.state.ak.us/mnu_Permit_Values.htm
Fisheries and Oceans Canada (DFO). 2001. Fish stocks of the Pacific Coast. 162 pp.
Taylor, S. 2019. In a rapidly changing world, are mixed stock fisheries the best option? (NPAFC Newsletter No. 45). 35-42.
Salmon Fried Rice

By Shunpei Sato
Stock Conservation Group Head
Hokkaido National Fisheries Research Institute
Japan Fisheries Research and Education Agency

Shunpei Sato graduated from the Faculty of Fisheries, Hokkaido University, Japan, in 1999. Although he studied sexual development patterns of Giant river prawn (*Microbrachium rogenbergii*) as an undergraduate student, he moved his field of study to population genetic structure of chum salmon around the Pacific Rim at the Graduate School of Science, Hokkaido University. After receiving his Ph.D from Hokkaido University, Shunpei joined the staff of the National Salmon Resources Center in 2005. His scientific interests focus on genetic structure of chum and pink salmon populations in Japan, and ocean distribution and abundance of Japanese chum salmon. During 2007–2017, he attended the summer salmon research cruise of R/V *Hokko maru* in the central Bering Sea. Since 2018, he has been the head of Salmon Conservation Group, Salmon Resources Research Department, Hokkaido National Fisheries Research Institute, Japan Fisheries Research and Education Agency. Shunpei loves beer, and he enjoys drinking local beer when he attends the NPAFC annual meeting every year.

**Ingredients:**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Ingredient</th>
</tr>
</thead>
<tbody>
<tr>
<td>200–300g</td>
<td>sliced salmon filet</td>
</tr>
<tr>
<td>80g</td>
<td>carrot</td>
</tr>
<tr>
<td>110g</td>
<td>onion</td>
</tr>
<tr>
<td>30g</td>
<td>piment</td>
</tr>
<tr>
<td>10g</td>
<td>leek</td>
</tr>
<tr>
<td>300g</td>
<td>steamed rice</td>
</tr>
<tr>
<td>3</td>
<td>eggs</td>
</tr>
<tr>
<td>Proper Amount</td>
<td>salt</td>
</tr>
<tr>
<td>Proper Amount</td>
<td>pepper</td>
</tr>
<tr>
<td>Proper Amount</td>
<td>oil</td>
</tr>
<tr>
<td>Proper Amount</td>
<td>sesame oil</td>
</tr>
<tr>
<td>Proper Amount</td>
<td>soy sauce</td>
</tr>
</tbody>
</table>

Serving suggestion. All Photo credits: Shunpei Sato
**Method:**

1. Sprinkle salt over both sides of each sliced salmon fillet and grill the sliced fillets on medium heat.

2. After grilling, remove the skin and flake the fish meal on a dish. Chop a carrot, onion, piment, and leek.

3. In a pan with a little oil, pan-fry carrots, piments, and onions with salt and pepper.


5. Beat the final egg. Heat a pan with a little oil and add the beaten egg, mixing with a wide stirring motion.

6. Add steamed rice to the beaten eggs and stir-fry. Season with salt and pepper when the rice becomes loose.


8. Stir in a splash of soy sauce, sesame oil, and chopped leeks.

9. Enjoy!
Committee on Enforcement Joint Patrol Schedule Meeting

Dates: February/March 2020
Venue: Email Meeting

ENFO Workshop

Dates: May 17, 2020
Venue: Hakodate, Japan

NPAFC 28th Annual Meeting

Dates: May 18–22, 2020
Venue: Hakodate, Japan

The Third NPAFC-IYS Workshop on Linkages between Pacific Salmon Production and Environmental Changes

Dates: May 23–25, 2020
Venue: Hakodate Research Center for Fisheries and Oceans, Hakodate, Japan

NPAFC Technical Report 12
Report of the proceedings for the IYS Workshop—toward effective coupling of the science of a changing climate with salmon and people took place in June 27–29, 2018, Santa Barbara, CA, USA. It is now available online.

NPAFC Technical Report 13
Report of the proceedings for the IYS Workshop—International Year of the Salmon Workshop on salmon status and trend took place in January 23–24, 2019, Vancouver, BC, Canada. It is now available online.

NPAFC Technical Report 14
Report of the proceedings for the IYS Workshop—First International Year of the Salmon Data Laboratory (ISDL) Workshop took place on January 25, 2019, Vancouver, BC, Canada. It is now available online.

NPAFC Annual Report 2018
Includes results of the Commission’s major activities such as the Annual Meeting and other events. Available at https://npafc.org.

NPAFC Technical Report 15
Including extended abstracts of oral and poster presentations at the second NPAFC-IYS Workshop in May 2019 and will be announced when available online.