Connecting Salmon Science in an Era of Global Change

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Pacific salmon *Oncorhynchus* spp. are a group of migratory fishes that support diverse economies, cultures, and ecosystems. As such, there is a broad community of salmon scientists and practitioners interested in their biology, management, and conservation. In an era of rapid global change, stakeholders face a growing challenge—and an unprecedented opportunity—to realize connections across this diverse community.

Like many scientific fields, there is an ever-increasing quantity of research focused on Pacific salmon. According to Web of Science, the number of peer-reviewed research articles published annually on "salmon" ballooned from 382 in 1989 to 2,538 in 2019. These numbers reflect an enormous variety of focal topics and sub-disciplines spanning the complex salmon life-cycle, from the freshwater rearing habitats of juveniles to the oceanic feeding grounds of adults. Scientists also employ different tools and perspectives to gain insight into salmon population dynamics, from molecular genetics to isotope biogeochemistry and landscape ecology. Further, Pacific salmon are studied throughout the diverse regions that they call home, encompassing freshwaters from California to Alaska to Japan and the vast ocean that connects them. Salmon have also established well beyond their native range throughout temperate parts of the globe.

Thus, even within the field of salmon science, understanding who is working on what, tracking research developments, and integrating this wealth of information into a big picture can be an overwhelming task. This challenge is especially acute for practitioners, many of whom have limited access to the peer-reviewed literature, never mind the time to digest it. Yet an integrated understanding of salmon dynamics and application of this knowledge is of critical importance—threats faced by Pacific salmon transcend geopolitical boundaries, and global change imperils the productivity of many local populations.

Meetings, gatherings, and networks play a key role in building and maintaining connections within science and its application. One such initiative is the Salmon Science Network (Salmon-Net), launched in 2018 to connect and catalyze scientists and practitioners involved in the conservation and management of Pacific salmon and their ecosystems. Our website (www.salmon-net.org) provides an online portal that distills policy-relevant salmon science and provides public access to key resources, including presentation slides and high-quality photographs. In an effort to bridge the language gap in salmon science, we offer Russian translations of most resources. Through topical working groups, we bring together experts and spark collaboration and dialogue on emerging issues in the field.

In October 2019, Salmon-Net, in partnership with the International Year of the Salmon, hosted a symposium titled "The Science of Pacific Salmon Conservation: Foundations, Myths, and Emerging Insights." Held at the Joint Annual Conference of the American Fisheries Society and The Wildlife Society, the symposium convened thought leaders from across the northern Pacific region, representing a wide variety of sub-disciplines. Experts from California, Oregon, Washington, Canada, Alaska, and Japan had the rare opportunity to come together around a common goal: to distill the big ideas in conservation and management of Pacific salmon.

From genetics to ecology to economics, speakers highlighted key historical and emerging concepts, outlined critical threats, and emphasized conservation actions to maintain resilient Pacific salmon populations. The session began with fundamental concepts underpinning salmon management, including the density dependence and compensatory dynamics that define sustainable harvest levels. Speakers also revealed emergent discoveries: for example, the magnitude of competition between hatchery-propagated and wild salmon continues to intensify. In addition, most salmon populations do not exhibit evidence of "over-compensation," the process responsible for the hump in the Ricker function that is commonly assumed to characterize salmon recruitment.

Several speakers emphasized that climate change is generating unpredictable oceanic regimes, such that historic relationships between the environment and salmon production are

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shifting. Climate change is also warming freshwaters, which accelerates disease transmission. Linkages between watershed complexity and Pacific salmon genetics, life histories, and population dynamics were also showcased, highlighting that multiple stressors are eroding the resilience of many salmon-bearing ecosystems. In our warming world, landscape-scale conservation and restoration of connected, biologically complex, and dynamic habitats can sustain Pacific salmon diversity and bolster resilience.

The event also offered the opportunity for informal connections among participants. A rousing social networking event followed the symposium, where attendees connected with each other and the broader American Fisheries Society community.

Through activities like these, we hope that Salmon-Net will strengthen connections among salmon stakeholders and catalyze more policy-relevant science. While our knowledge grows in leaps and bounds each year, salmon runs continue to dwindle in many regions. Whether via Salmon-Net or other initiatives, there is an urgent need for cross-disciplinary collaboration to inform effective conservation and management of critical resources like Pacific salmon. AFS