

Science

FINDINGS

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“Science affects the way we think together.”

Lewis Thomas

Alaska’s Forest Fish: Calculating the Value of Wild Salmon From the Chugach and Tongass National Forests

U.S. Forest Service



Spawning sockeye salmon in Tern Lake on the Kenai Peninsula, Chugach National Forest, Alaska’s two national forests supported about 25 percent of the commercially caught salmon in Alaska between 2007 and 2016.

“The more sand has escaped from the hourglass of our life, the clearer we should see through it.”

—Niccolo Machiavelli

The annual Pacific salmon runs are a miracle of nature.

In a process that is still not completely understood, mature salmon sense the Earth’s magnetic field and use a “smell map” to swim upstream, hundreds of miles in some cases, to their ancestral stream so that they can spawn and die.

The annual salmon migrations transfer massive amounts of nutrients from the ocean to the headwaters of relatively low-productive rivers, feeding predators, such as the brown bear, and nourishing riparian forests in the process.

The importance of salmon to southeast Alaska—to food webs, for the economy and jobs, and as a cultural symbol—cannot be overstated.

Salmon play a central role in the culture and daily life of Alaska Natives, and the residents of coastal communities rely on salmon for subsistence as a healthy and plentiful source of protein. Many also rely on salmon for their livelihood. Commercial fishing and seafood processing comprise the largest private sector industry in southeast Alaska, accounting for 15 percent of regional employment, according to a 2017 report by the Alaska Seafood Marketing Institute.

It is clear that salmon are one of the most important products provided by Alaska’s forests, rivers, streams, and lakes.

IN SUMMARY

Forests provide a suite of goods and services that are vital to human health and livelihoods. Studies of ecosystem services, which frequently attempt to place a monetary value on forest processes and organisms, can help inform management decisions by providing a baseline for discussing the costs and benefits of different management options.

A recent study by Pacific Northwest Research Station researchers, Adelaide “Di” Johnson and Ryan Bellmore, along with retired Forest Service fisheries biologist Ron Medel and Alaska Department of Fish and Game fisheries biologist Stormy Haught, aimed to quantify the number and monetary value of commercially caught Pacific salmon from Alaska’s Tongass and Chugach National Forests. These two national forests contain some of the world’s largest remaining tracts of intact temperate rain forest.

Between 2007 and 2016, the Tongass and Chugach supported harvests of approximately 48 million salmon per year, valued at more than \$88 million annually. This comprised approximately 25 percent of all commercially caught salmon in Alaska and 16 percent of its total monetary value. Quantitative information about the value of Alaska’s national forests for fish production can contribute to discussions about management decisions that might influence the capacity of these forests to sustain Pacific salmon in the future.



KEY FINDINGS



- From 2007 to 2016, rivers and lakes on the Tongass and the Chugach National Forests supported an average of 48 million commercially caught salmon per year, with an average annual dockside value of \$88 million.
- The Tongass and Chugach National Forests contributed approximately 25 percent of all commercially caught salmon in Alaska and 16 percent of its total harvest value.
- In the Tongass National Forest, pink salmon (*Oncorhynchus gorbuscha*) dominated by number and value of the commercial catch, while in the Chugach National Forest, pink salmon were most numerous, but sockeye salmon (*O. nerka*) had the greatest monetary value.

But knowing this intrinsically is not the same as being able to speak in the quantifiable terms often needed when discussing potential management strategies for more than one natural resource. Adelaide “Di” Johnson and Ryan Bellmore, researchers with the USDA Forest Service Pacific Northwest (PNW) Research Station, along with Ron Medel, a retired fisheries biologist and Alaska Department of Fish and Game fisheries biologist Stormy Haught, set out to quantify the number and monetary value of commercially caught Pacific salmon from Alaska’s Tongass and Chugach National Forests.

The Chugach and Tongass are the two largest national forests in the United States and they contain significant salmon spawning and rearing habitat. The Chugach has 1,800 miles of

streams that are used by salmon and 48,100 acres of documented anadromous fish lakes. The Tongass has 12,930 miles and 3,432 lakes and ponds totaling 182,483 acres that support and produce wild salmon.

The results of the forest salmon study were published in 2019 in the *North American Journal of Fisheries Management*. The researchers found that between 2007 and 2016, these national forests contributed an average of 48 million Pacific salmon annually to commercial fisheries, with a dock-

side value averaging \$88 million (inflation adjusted to the base year 2017). These “forest fish” represented, on average, approximately 25 percent of Alaska’s total commercial Pacific salmon harvest and 16 percent of its total monetary value. Pink salmon dominated the number and value of the fish coming from the Tongass National Forest, while in the Chugach National Forest, pink salmon were also most numerous, but sockeye salmon had the greatest value.

“We have this precious resource that provides food for people and supports people’s lifestyles,” said Johnson, a hydrologist with PNW Research Station. “And it’s essentially free, if we take care of it.”

The Salmon Road Show

The study was based on work that Medel initiated in 2010 when he was the fisheries program manager for the Tongass National Forest. Medel used salmon harvest data to calculate the commercial value of wild fish originating on the forest.

Medel started gathering the numbers and doing the calculations out of curiosity, but soon learned there were many other people curious about the numbers as well. He created a presentation based on his work and took his

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To provide scientific information to people who make and influence decisions about managing land.

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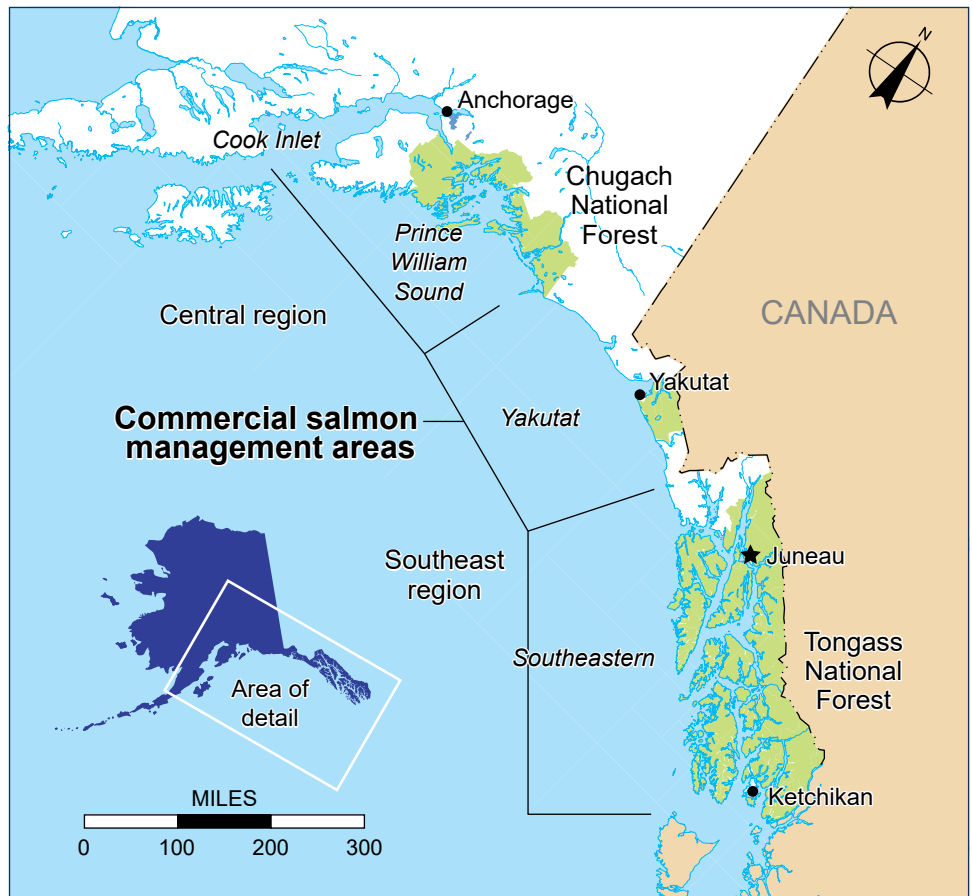
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A map of the Tongass National Forest and Chugach National Forest (land area indicated in green) and adjacent Alaska Department of Fish and Game Commercial Salmon Management Areas.



A seiner pulls in a haul of salmon from the waters off the Tongass National Forest in southeast Alaska. The average dockside value of commercially caught salmon with ties to the Tongass and Chugach National Forests was \$88 million per year from 2007 to 2016.

statistics-packed, PowerPoint show on the road throughout southeast Alaska and the Pacific Northwest, which became popular with land and fisheries managers as well as members of the public.

“My main goal was to emphasize the importance of this wild resource, this sustainable forest resource, from the Tongass,” said Medel. “I talked about how many jobs wild salmon produced every year, and how many millions the fishery contributed to the economy.”

Johnson attended one of Medel’s presentations a decade ago and came away with a new understanding of the need to protect spawning habitat.

“Ron was working to illuminate the value of our forests for fish,” Johnson said. “He was giving people a different perspective of the forest and what we need to do to enhance these resources by restoring and protecting some areas.”

Studies assessing the monetary value of the benefits, or “ecosystem services,” that forests provide to society beyond timber, such as maintenance of wildlife habitat, watershed protection, or carbon storage, have been around

for decades. Johnson believes these types of studies can help inform management actions and facilitate communication by creating a common language for the different stakeholders and interest groups that are often pitted against each other in resource management contexts.

Counting the Forest Fish

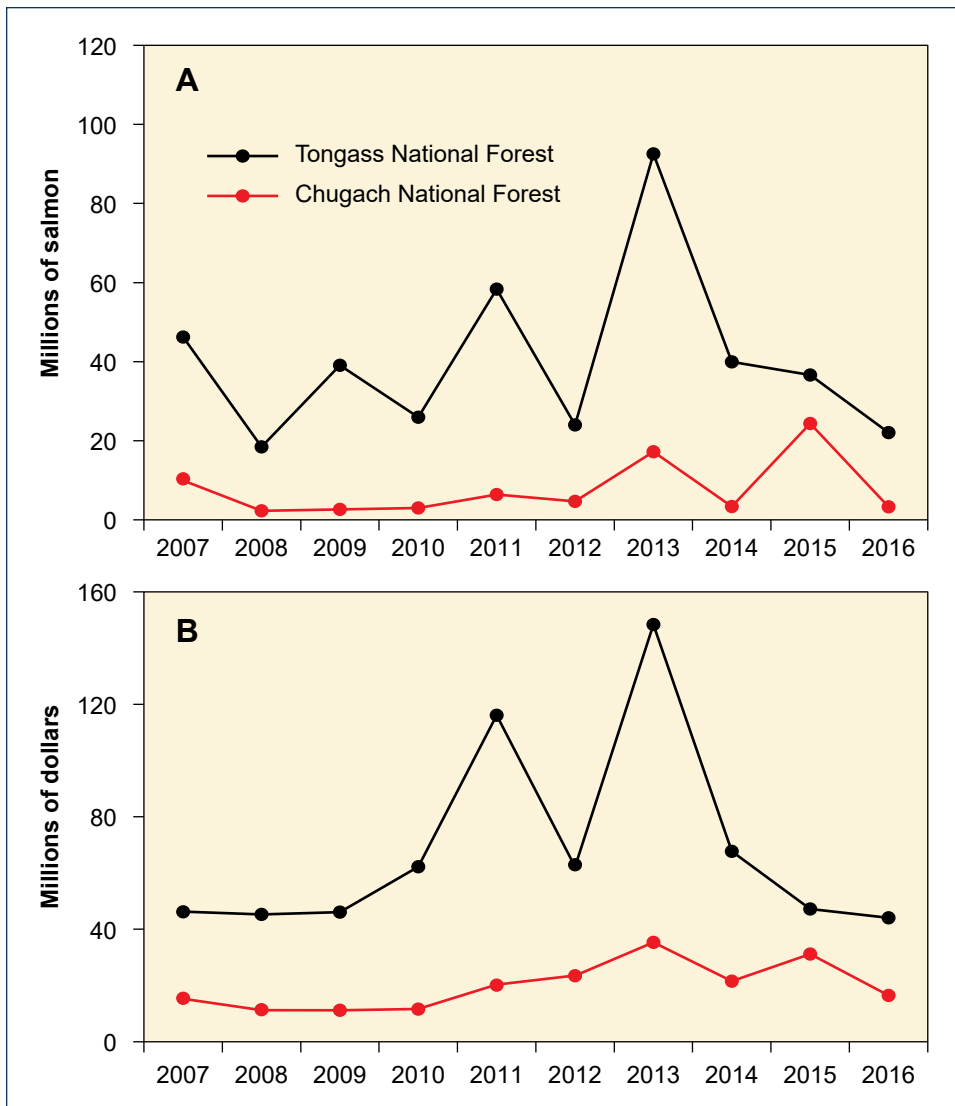
The study focused on five commercially important salmon species—Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), sockeye (*O. nerka*), pink (*O. gorbuscha*), and chum (*O. keta*). From 2007 to 2016, the total commercial Pacific harvest for these five species from the marine management areas adjacent to the Tongass and the Chugach National Forests averaged more than \$225 million per year. However, not all these Pacific salmon originated from national forest land. A significant number were raised in one of the 21 hatcheries along the coast that produce massive numbers of Pacific salmon every year for commercial fisheries. Salmon also originate from lands outside the national forests’ boundaries.

Haught, with the Alaska Department of Fish and Game, said determining the proportion of the salmon harvest that was wild versus

Thermally Tagging Hatchery Salmon

Salmon hatcheries “tag” their fish by fluctuating the water temperature between hot and cold cycles in tanks used for rearing juvenile fish. The fluctuations leave a distinctive pattern of light and dark growth rings on the otoliths (ear stones) of the fish, much like the rings on a tree. Alaska Department of Fish and Game recovers sample otoliths from fish harvests to determine the proportions of the harvest from different hatcheries. Fishery managers use the otoliths to track hatchery fish all over the North Pacific.

hatchery raised was possible because hatchery salmon are thermally tagged whereas wild salmon are not. The state agency also maintains a database of commercial fish sales, which was critical. The researchers used total harvest numbers from that database for each of the salmon management areas, then subtracted the number of salmon originating from hatcheries.



Estimates of the (A) total number and (B) value of Pacific salmon harvested in Alaska's commercial fisheries from 2007 to 2016 that originated from the Chugach and Tongass National Forests.

Estimating the proportion of wild Pacific salmon that originated outside of national forest lands was a little trickier. This category includes salmon spawned in Canadian portions of the transboundary rivers, such as the Taku, Stikine, and Unuk; salmon spawned in streams on state land, other federal lands, private land, and Alaska Native corporation land; and even salmon from rivers farther south in the lower 48 states.

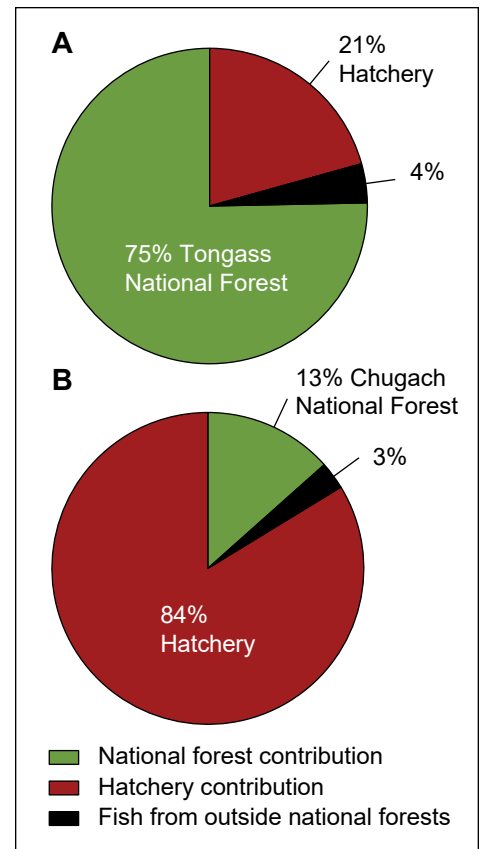
For the northern portion of the study area, the researchers used the Alaska Anadromous Waters Catalog to calculate the proportion of documented spawning habitat outside Chugach National Forest boundaries. They assumed that the proportion of spawning habitat outside of the forest represented the fraction of harvested Pacific salmon that originated outside of national forest lands.

"It was essentially a GIS [geographic information system] exercise of overlaying land status maps and the Alaska Anadromous Waters Catalog and coming up with how much of, say

the sockeye spawning habitat, is on national forest land," said Haught.

For the Tongass piece of the analysis, significant portions of the spawning habitat are on transboundary rivers in Canada. Also, the harvest contains a large proportion of fish from farther south in Oregon, Washington, and southern British Columbia. In this region, Johnson said the research team consulted local fisheries biologists with the Alaska Department of Fish and Game to develop estimates of the salmon originating from outside of national forest lands.

"We relied on information from the Alaska Department of Fish and Game because their job is to determine the fish returns, so they could manage fisheries allowing for both adequate escapement and additional fishing opportunities on fish surplus to escapement," said Johnson. "Stormy was right there with us on that portion, and we leaned on his expertise heavily."



These charts show the origin of Pacific salmon caught off shore from (A) the Tongass National Forest (southeastern commercial salmon management area) and (B) the Chugach National Forest (Prince William Sound commercial salmon management area).

Working at such a large scale also required other assumptions in the analysis, particularly in relation to spawning habitat. In reality, some spawning grounds are really productive, others are not. But given the scale of the study, covering the two largest national forests in the country, they had to consider all spawning habitat equally.

"Very little information exists on the spawning productivity of individual stream reaches, so we just had to assume a linear mile of documented spawning habitat is equal to another linear mile of documented spawning habitat," said Haught.

Another major assumption made by the study was that only fish whose parents spawned within national forest boundaries were considered "forest fish." But just because juvenile salmon do not emerge from gravel nests (also known as redds) on national forest land doesn't mean that these forest ecosystems don't support them at some point in their life cycle.

"There are a lot of fish that spawn upstream of Forest Service boundaries in rivers like the Taku or Stikine, which flow through the Tongass and Chugach," said Ryan Bellmore, a research fish biologist with the PNW Research

Station. “Those fish are still supported by the national forest—they’re still migrating downstream, and many spend part of their juvenile life stage living and growing within national forest boundaries. But for the purposes of our study, those fish weren’t counted as national forest fish.”

While the methodology likely resulted in a conservative estimate of the contribution of the forests to the commercial fisheries, there are other pieces to the fisheries picture. The researchers’ next step is to conduct more extensive analyses of salmon production from Alaska’s national forest lands, such as those supporting subsistence and recreational fisheries.

Informing the Discussion

Protection of salmon spawning habitat has a long history, from Alaska Native sustainable management for thousands of years to the Magna Carta. The document, which formed the foundation for English civil liberties, and later the U.S Declaration of Independence and U.S. Constitution, also included a lesser known clause that directed King John to remove all royal “fish weirs” from rivers throughout England. The weirs were a threat to salmon stocks, because they prevented adequate numbers of fish from returning to their upriver spawning grounds.

While the terms of the debate have changed over the centuries, the basic question remains: How do we manage forests—and the rivers and streams that flow through them—to provide valuable resources and ecological services for all of society and not just the most powerful interests?

Johnson believes that this study can contribute to discussions about management decisions that might influence the capacity of these forests to sustain Pacific salmon in the future.

“The Tongass and the Chugach National Forests have a great deal of value. They support people’s lifestyles and provide food for people. But at the same time, there are pressures, and these pressures have led to the demise of fish populations in the lower 48,” said Johnson. “So, we wanted to include a more complete understanding of the value of these forests in the dialogue about management options.”

Sheila Jacobson, a fisheries program manager for the Tongass National Forest, said that studies like this can be used to communicate the value of Alaska’s national forests for fish production to a public that may not be aware of the benefits they receive from the forest.

“I don’t think that the public realizes the full value of the wild stocks that the forest



LAND MANAGEMENT IMPLICATIONS



- Alaska’s national forests are crucial for sustaining wild Pacific salmon populations.
- Including ecosystem services in discussions about alternative land management strategies provides insights into how management may affect Pacific salmon populations and associated commercial salmon fisheries.
- Translating the environmental services provided freely by national forests into economic terms can help quantify their importance and facilitate discussions about tradeoffs among proposed management actions.
- The value of forest fisheries resources suggests that investments in restoration efforts to speed recovery of degraded salmon habitat, especially when focusing on high-production systems with the best remaining habitat, could yield economic benefits and jobs.



Sheila Jacobson

Pink salmon schooling in a tributary of the Harris River on Prince of Wales Island, Alaska, after a restoration project designed to create habitat complexity, including deepening pools for staging migrating adults.

contributes,” said Jacobson. “Studies like this really bring that out and say, ‘Hey, this public land is producing a lot of salmon, and these are your fish. These are all of our fish. We need to safeguard that resource.’”

*“When the trees are gone
the sky will fall and we and the
salmon will be no more.”*

—Lummi prophecy

Further Reading

Johnson, A.J.; Bellmore, J.R.; Houghton, S.; Medel, R. 2019. Quantifying the monetary value of Alaska national forests to commercial salmon fisheries. *North American Journal of Fisheries Management*. 39: 1119–1131. <https://www.fs.usda.gov/treesearch/pubs/59395>.

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