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Introduction: Cultivating Capture Fisheries

Lessons from Salmon Culturing and Cultures

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One of the central themes of anthropology has been the role of agriculture in changing not only relationships within societies but the structure of cultures. The "neolithic revolution" refers to the transition from foraging to farming in which subsistence increasingly came from domesticated plants and animals (Childe 1936), and the urban revolution followed as agricultural surplus supported the expanding state. Building on the theme that technological change in food production, metallurgy, and transportation structure society, a "science of culture" further elaborated the role of agriculture in the "evolution of society" (White 1949, 1959). In the twenty-first century, this materialist perspective (Harris 1979, 1980) receives less attention. More common is a critique of power, symbolism, discourse, and structural elements that is used to analyze the impacts and implications of industrial agricultural practices, address the disadvantaging of Indigenous and minority peoples, identify factors affecting the agency of actors, and review the neoliberal pressure for market-based solutions (Bourdieu 1991; Clifford 1986; Foucault and Gordon 1980; Geertz 1963; Nadasdy 2003).

The demands of urban and industrial growth have been widely identified as the main cause for the decline of salmon and other resources and for the loss of fishing and foraging cultures (Lackey, Lach, and Duncan 2006; White 1995; Wolf and Zuckerman 1999). Agriculture supporting urbanization and industrial growth leads to the extensive modification of

landscapes for growing crops, trees, and animals. Industrial agriculture requires extensive transportation systems; the application of chemicals, fertilizers, and water; and the general reorganization of landscapes. Salmon and natural resource decline results from the physical presence of industrialized agriculture and systems for its support (Botkin et al. 1995; NRC 1996).

An industrial agricultural philosophy reinforces the idea that humans can modify ecological systems to make them more productive. Simplification, selection, and modification increase, for a time, productivity and the abundance of food and fiber. This productivity often comes at the cost of diversity both ecological and cultural. The authors in this book explore the experiences of North Pacific peoples who are at the forefront of the tension between growth and diversity.

"Cultivating capture fisheries" is a play on words that doubly reflects how agricultural metaphors affect salmon production and thinking. *Culturing* can refer to the aquaculture of stocks like salmon, steelhead, trout, and increasing numbers of other commercially important species. The first culturing technique for salmon mainly involved hatcheries. Culturing selects specific stocks for hatchery production based on their cultural value, productivity, and behaviors. Hatchery stocks only spend the early part of their life cycle in production facilities before being released into rivers and estuaries to travel to and mature in the ocean and then return to capture fisheries. *Culturing* also refers to salmon farming, which is artificial propagation that controls the growth of the fish stock throughout its life cycle. Another use of *culture* encompasses ways of thinking with respect to the environment and its management.

The cases in this book follow an arc across the North Pacific from Sakhalin and Kamchatka in Russia to Alaska, British Columbia, and the Columbia Basin. They serve to highlight some common patterns and processes across the North Pacific. Going from south to north by latitude, human populations decrease in concentration and size, and salmon habitats are less degraded, although mining and forest harvest still pose a threat. Moving clockwise from Russia to the Columbia Basin by longitude, salmon are in increasingly worse shape (Augerot 2000, 2005; Augerot and Smith 2011). Yet despite differing patterns, agricultural actions and metaphors affect salmon fisheries and fishing peoples in all areas. Forest practices, energy exploration, and food production activities restructure landscapes that are home to both salmon and the peoples who depend upon them.

In general, industrialized agriculture supported growth in human populations, provided nutrition to extend the average life span, enabled improved material well-being, and supported state societies. Much of the

focus of political ecology is on those left out of these processes (Peña 1998; Sturgeon 2009; Wolf 1997). Nevertheless, the overwhelming majority of people gain their sustenance using culturing techniques, and the reliance on agricultural approaches structures values toward resources and nature. Industrializing nations came to regions of the North Pacific in the nineteenth century to explore and then to exploit salmon production for international trade.

EXPORTING SURPLUSES

Indigenous peoples of the North Pacific used large quantities of naturally spawning salmon. The exact amount is unknown, but estimates based on per capita use times population provide insights about the quantity (Boyd 1999b; Chapman 1986; Hewes 1947; NPPC 1986). Contact with explorers, missionaries, entrepreneurs, and settlers led to major changes in use of the salmon resource. Typically, this change included entrepreneurs who saw the possibilities for profit in salting, canning, and smoking salmon or taking eggs for export to distant places. The cannery is a measure of this early international trade. Salmon canners took the salmon heading to die, what they saw as the waste of natural production, and exported it to industrializing areas of the world. These canners acted as the agents for colonizing nations that were absorbing resources to fuel their industrializing economies.

Canneries spread up the Northwest Coast from the Sacramento River in 1864 to the Columbia River in 1866, the Fraser River in 1870, and Klawock, Alaska, in 1878 (table 1.1). In Asia, the first Hokkaido salmon cannery went into operation in 1913 (Augerot 2000:43). Russian salmon were not exported, but intercepting home-bound fish was more of an issue. The treaties between Russia and Japan allowed or disallowed each entry into the other's waters for the purpose of capture fishing.

Canning food was an early nineteenth-century French invention (Appert 1814), and it enabled the transport of salmon to emerging industrial areas. Courtney Carothers (chapter 7) details how the cannery affected Alaska's Alutiiq peoples and documents a seventy-five-hundred-year history of Alutiiq cultural dependence on marine resources. Built in 1882, the Karluk River cannery was followed by many others. Canners shipped salmon to the United Kingdom and British colonies throughout the world. The cannery was also a source of jobs both in the cannery and in fishing, a place to get loans and purchase goods, and a force that consolidated communities.

One detrimental effect of international trade in salmon stocks is the

Table 1.1
Timing of international events in development of salmon fisheries of the North Pacific

Date	Event
1604	Japanese grant Ainu exclusive fishing rights
1639	Russian explorers find huge quantities of salmon in the Armur River
1784	Russian settlement of Three Saints Bay southeast of Kodiak Island
1805	Lewis and Clark reach the Clearwater in Idaho
1864	First salmon cannery on the Sacramento River
1866	First salmon cannery on the Columbia River
1870	First British Columbia salmon cannery on the Fraser River
1875	Russo-Japanese Treaty of Saint Petersburg gives Japan fishing rights in Russian waters
1878	Klawock, first Alaskan salmon cannery built
1882	Karluk River salmon cannery built
1884	Russian Primore Law limits Japanese salmon fishing
1907	Russo-Japanese Fisheries Convention delineates Russian only fishing areas, Japanese get Sakhalin Island
1917	P. E. Harris salmon cannery begins the settlement of False Pass, Alaska
1920	Japanese take over Armur and Sakhalin fisheries
1937	Japanese intercepting increasing amounts of Soviet salmon
1937	Fraser River Salmon Convention mandates 50/50 US/Canada split
1977	Law of the Sea extends territorial limits to 200 mi, Soviets limit Japanese interceptions
1985	Pacific Salmon Treaty signed by United States and Canada
2008	UNDP Conference "Problems of Traditional Fishing by Indigenous People of the North and Prospects of Local Communities Based on Their Inclusion into Management of Fish Resources" brings international biodiversity concerns to Kamchatka

fishing for caviar described by David Koester (chapter 3). Caviar is produced from the eggs of female salmon, as well as other fish, returning to spawn. Fishing techniques that do not provide for live capture and the difficulty in distinguishing a female from a male fish means that as much as half the catch is not used for harvesting caviar. Some of the carcasses, critical to many ecological processes, are not returned to streams, and the eggs do not produce the next generation.

A second measure of international trade is treaties between nations that affect entry into fisheries. Japanese distant-water fishers have historically taken salmon returning to Russian waters, and in 1875 the Russo-Japanese Treaty of Saint Petersburg gave Japan the right to fish Russian waters. Russia regained the rights to its native salmon with the 1977 Law of the Sea Treaty.

The effects of international trade continue with the introduction of exotic species, principally Atlantic salmon, to the farms along the west

coasts of Washington and British Columbia, mining and mineral exploration (Reedy-Maschner, chapter 6; Wilson, chapter 2), the influence of global nongovernmental organizations (NGOs; Colombi, chapter 9; Diver, chapter 10; Sharakhmatova, chapter 5; Wilson, chapter 2), competition from nonlocal fishers (Kasten, chapter 4; Koester, chapter 3; Menzies, chapter 8; Reedy-Maschner, chapter 6; Sharakhmatova, chapter 5; Wilson, chapter 2), and world market exchanges and labor requirements (Carothers, chapter 7; Koester, chapter 3; Reedy-Maschner, chapter 6).

The cumulative effect of international trade in salmon has been the reduction of wild stocks (Augerot 2005; FAO 2011; Netboy 1974). Initially, this loss came from fishing pressure and habitat loss. The combination of high catch expectations and the production of hatcheries led to declines in wild stocks mixed with heavily fished hatchery stocks. In addition, river modifications—including dams for energy to mill grains and produce electricity, water diversions for irrigation, and channelizing to protect land for farming, make rivers more easily navigable, and prevent floods—led to more losses (Lichatowich 1999; NRC 1996; Williams 2006).

AGRICULTURAL METAPHORS FOR CULTIVATING FISH

The agricultural metaphor has been applied with both important benefits and negative effects. Increasingly, industrial agriculture has been a powerful cultural process for feeding and clothing people. The technology for culturing plants and animals creates the primary subsistence base for industrializing nations, but it also brings significant changes to ecosystems well beyond the boundaries of the nation and threatens ecosystem services. This is not to say that small-scale horticulture does not continue to exist in many parts of the world, but the nineteenth-century efforts to harvest salmon and include this harvest in international trade provided high-quality protein and the "fast food" of nineteenth-century industrial workers (Smith 1979).

Harvesting, however, is also a metaphor that when applied to fish and wildlife management reflects a way of thinking that differs from the views of many Indigenous peoples (Nadasdy 2011). Metaphors structure thinking (Lakoff and Johnson 1980; Ortony 1993). Introducing industrial-agricultural thinking results in system simplification, resource specialization, system stabilization, density-dependent management, surplus production for exchange, sedentary living, hatcheries for production, environmental manipulation, damming and channelizing of rivers, rearing of farmed salmon, property rights, closed-system perspectives, genetic analysis and modification, and linear perspectives on evolution. Prior to the arrival

of international trading entrepreneurs, North Pacific Indigenous communities co-evolved with their ecosystems, developing patterns that enabled many communities to survive the growth and decline of salmon populations, major floods, significant earthquakes, tsunamis, extensive drought, and major fires. The "maintenance of social relations" in relation to the components of the natural system that characterizes Indigenous perspectives is very different from the "wildlife management is agriculture" view of industrial agriculture (Nadasdy 2011:136). The concept of co-evolution recognizes that people who depend on a resource can develop a symbiotic relationship wherein the actions of each affect characteristics of the other (Durham 1991; Ehrlich 1968; Ehrlich and Raven 1964). Harvesting does not reflect a symbiotic relationship; it is a process of control over natural systems in which sowing and gathering a crop is the goal.

The application of culturing technology to maximize abundance and productivity changes this symbiotic link into more of a command and control approach to fisheries. The US Commission of Fish and Fisheries, established in 1871, designed artificial propagation facilities to increase fish production with the objective of sustaining commercial fisheries. In 1872 Congress gave the commission the task of fish culturing because studies showed resource decline along the New England shore and in lakes. With the help of the American Fish Culturalists' Association, the commission established a marine hatchery at its Woods Hole headquarters (NOAA 2006).

The culturing of fish improves productivity by reducing mortality in early fish life history and increasing growth, selecting for desirable traits and characteristics, increasing efficiency, and meeting societal goals for predictable and stable production. Greater productivity from the culturing of plants and animals is one reason that societies could expand in population and material goods. The cost has been lost abundance, decline in reproductive capacity, environmental modification, and reduced natural diversity for many fish and wildlife populations important to North Pacific peoples.

The evidence that fish culturing through artificial propagation in hatcheries improves production is contested (Bottom 1997; Hilborn 1999; Lichatowich 1999; Naish et al. 2007; Sharma, Cooper, and Hilborn 2005). Intuitions based on experience with artificial propagation have resulted in continued pursuit of fish culturing to increase the abundance of salmon and other species for capture fishing. In parallel with *agriculture*, fish culturing is called aquaculture or mariculture. An even more productive industrial-agricultural technique to increase abundance is salmon farming, pioneered in Norway in the 1960s (Lien, chapter 11). Salmon farming has come to create greater market abundance than capture fisheries do.

Agricultural metaphors are also found in fishery management, as in discussion of "harvest." Like "livestock," hatchery workers manage "fish stocks." They "plant" fish in streams. A major fishery management concept is "maximum sustainable yield," and Daniel Bottom (1997:586) writes that "maximum sustainable yield…was based on a logistic growth curve developed from animal populations held under constant food supply and environmental conditions (Barber 1988; Botkin 1990)." Maximum sustainable yield allowed for calculating the optimum point of fishing intensity that would continue to yield the maximum crop of fish indefinitely. Much as in forest management, the perspective developed that when a fish died from natural causes and was not used by humans, it was wasted.

Fishery management "increased total production of food…and increased net economic return to the fishermen" (Schaefer 1957:679). In the 1940s, fishery biologists and economists noted the limits of land-based production (Gordon 1953; Le Gall 1951; Schaefer 1957) and pointed to the potential for fisheries to produce additional protein needed by a growing human population. H. Scott Gordon (1953:442) emphasized, "The purpose of a fishery is the human use of a source of food. Fishing is carried on by human beings for human purposes."

Culturing metaphors are deeply rooted in how agricultural peoples address problems. John Perkins (1997:267) in a review of the green revolution observed, "Our relentless obliteration of nonhuman ecosystems in favor of agricultural ecosystems is a major force determining the balance between humankind and other species with whom we share the earth." C. G. Johannes Petersen (1903) emphasized the need to thin young fish, like one thins crop or tree plantings, so the remaining stock would grow bigger and more rapidly. This practice is an early formulation of the density-dependent perspective in fisheries, an agricultural concept in which the spacing of seeds and thinning of crops leads to greater productivity.

Density-dependent recruitment and growth were two concepts that structured fishery managers' arguments for increasing abundance and productivity after World War II (Beverton and Holt 1957; Ricker 1975). Before maximum sustainable yield in the 1940s (Finley 2009), a similar concept was discussed by E. S. Russell (1931, 1942:94), who wrote, "The rate of fishing which gives the maximum steady yield is of course not necessarily the most economical rate of fishing." Carmel Finley (2009) adds that this concept "also reflects an agricultural model of conservation, and a belief that fish populations are malleable and can be controlled for human benefit (McEvoy 1988) and that the oceans can be reordered to produce high-value species." In the North Pacific, salmon have been transplanted

between streams and hatcheries that have promised to augment depleted stocks. Development of the Oregon Moist Pellet in the 1960s to feed hatchery salmon provided disease control and improved hatchery survival (Hublou et al. 1959), while also promoting belief in vastly increased production possibilities. The belief was that rearing of salmon could produce a "surplus" to support a vastly enlarged fishing effort. Salmon became a crop to be harvested (Bottom 1997; Bottom et al. 2009).

Charles Menzies (chapter 8) describes how Gitxaała people managed the environment related to their fisheries. Menzies argues that it is logical to conclude that these actions affected the rest of the Gitxaała ecosystem. Gitxaała people saw themselves as working with the other parts of the ecosystem to maintain their joint survival—an example of co-evolution.

Indigenous leaders have noted that non-Indigenous people who settled in the Northwest in the nineteenth century lacked an ecological perspective appropriate to the resources of the region, and tribal leaders have described the loss of cultural and ecological diversity. Late twentieth-century Native American leader Ted Strong (NPR, *Science Friday*, February 14, 1997) stated, "We are going to be vilified as those people who destroyed the innocents of this Earth, and that is something that Native Americans absolutely will not stand for."

Indigenous peoples have articulated and demonstrated that they are interested in fish for the purpose of meeting their cultural needs, and Indigenous North Pacific salmon cultures had beliefs that emphasized fish as partners of human beings. They had stories and beliefs that described their responsibilities to the ecosystem as a whole, for example, the Itelmen view of a river as a living being. Koester (chapter 3) relates how they worried that an axe could cut through a river and kill the resources.

Some biologists suggest "looking at things from the viewpoint of the salmon" (Larkin 1979:105). Peter Larkin (1979:105) goes on to say, "Protection, regulation, and enhancement should thus be bent to serve the interests of salmon as a resource rather than to those who use the resource."

Thinking "from the viewpoint of the salmon" is central to the perspectives of the four tribes who created the Columbia River Inter-Tribal Fish Commission (CRITFC) and a plan for Columbia Basin salmon restoration (Diver, chapter 10). Their philosophy is that "stewardship extends respect for life beyond the dignity of the human person to the whole of creation.… As long as nature is taken care of, nature will take care of the people" (CRITFC 1996). Diver details how CRITFC gained influence by participating in decisions about managing Columbia River fisheries and the allocation of resources for correcting the system of dams that severely damaged

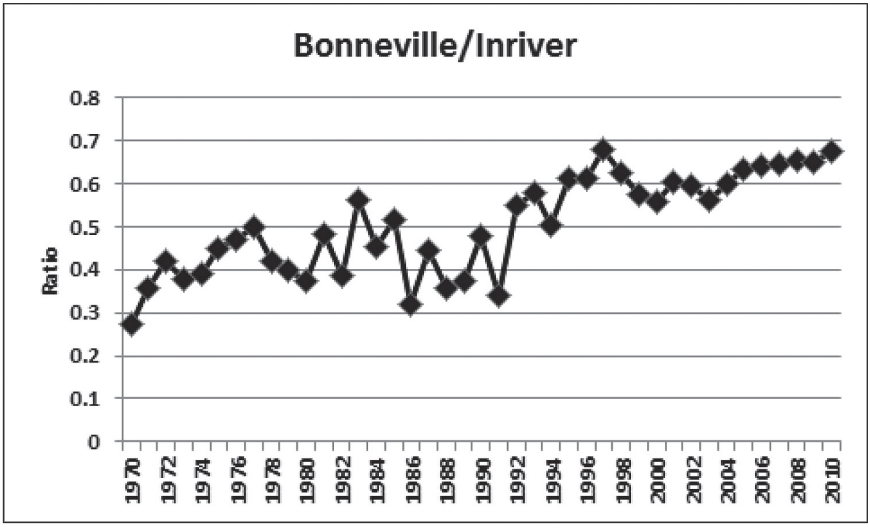

Figure 1.1

Ratio of number of fish reaching Bonneville Dam versus the total in-river run. Tribal fisheries on the Columbia River take place above Bonneville Dam. Source: Dave Ward, Columbia Basin Fish and Wildlife Authority.

the fisheries. In thirty-five years of working with Columbia River fishery managers, the co-management described by Diver increased the tribal catch from 5 to 40 percent of the total salmon caught (ODFW 2011). Between 1978 and 2008 CRITFC received the largest share (19 percent) of two billion dollars paid to contractors by the Northwest Power and Conservation Council (NPCC 2009:table 5). Evidence for CRITFC influence is the ratio of in-river salmon reaching tribal fishing areas above the Bonneville Dam. Figure 1.1 shows a pattern of increase in this ratio from 1970 to 2010. In many years prior to 1991, fewer than 40 percent of the total number of fish reached the dam. After 1992, the ratio reaching tribal fisheries was greater than 50 percent and many years exceeded 60 percent. The tribes fish the river above Bonneville, so when more salmon reach their fishing grounds, they have the opportunity to catch a larger share of the total run entering the river.

Ben Colombi and Sibyl Diver (chapters 9 and 10, respectively) note that in the mid-1990s CRITFC and individual tribes launched habitat restoration and conservation programs, both to help steward the salmon and broader ecosystem, as well as to raise salmon population levels to allow for increased catch. The tribal philosophy is, "Gravel-to-gravel management

acknowledges the relationship between the biology of the fish, the degree of human pressures on them, and the condition of their physical environment throughout all life history stages" (CRITFC 1996).

Colombi and Diver document how tribal philosophy led to both the keeping and refocusing of hatchery programs in the Columbia Basin. Many biologists have been critical of the impact of hatchery fish on wild runs of salmon and have recommended ending or significantly modifying hatchery programs, but the tribes favored the perpetuation of hatcheries as mechanisms for supplementing lost salmon stocks. The tribes are concerned about the detachment of nontribal society, saying, "Contemporary society is removed from what traditional native thinkers of the Columbia Basin called the 'connectedness' or 'connection of all life'" (CRITFC 2011).

Menzies (chapter 8) discusses how Gitxaała values influence decisions regarding Canadian fisheries. The Columbia Basin and British Columbia experiences suggest the hypothesis that US and British Columbia tribes are exercising sovereignty to affect decisions on the future of salmon and other species important to tribal people. The Indigenous peoples in Russia are trying a similar path. Erich Kasten and Victoria Sharakhmatova (chapters 4 and 5, respectively) write about the constitutional rights of Indigenous peoples; however, rights relate very differently to agency when enforcement is lacking.

CONTROLLING THE COMMONS

To protect resources from the effects of industrial harvest practices, gear, area, and time limits were imposed, and limits to entry that created restrictions on those who fished followed gear, area, and time limits (table 1.2). The application of gear, area, and time rules was not significantly different in concept from rules that Indigenous people used to restrict catch. Menzies (chapter 8) shows how Gitxaała rules determined "who could fish, when they could fish, and how much fish would be taken." Further, fishing techniques allowed the release of nontargeted species and juvenile fish. Kasten (chapter 4) discusses how Indigenous communities operated fish weirs to allow salmon to escape to their spawning grounds, which is a practice common to Indigenous fishery management.

About the same time that gear, area, and time restrictions were imposed, limitations to entry were also prescribed. Similar rules restricting who can fish local stocks can be found among Indigenous peoples where a village leader or village territory may restrict who can catch salmon and other species (Harkin and Lewis 2007; Hunn and Williams 1982; Lake 2007; Thornton 2008; Williams 1980).

TABLE 1.2

Dates of activities related to managing fisheries in Japan, Russia, Alaska, British Colombia, and northwestern United States. Representative dates selected from a larger and more complete list.

Date	Activity	A[1]	H[1]	E[1]	F[1]	Q[1]
1855	Treaties with Columbia River tribes			E		
1859	Washington prevents nonresidents from taking fish	A				
1863	Miomote River artificial propagation, Japan		H			
1870	British Columbia promulgates fishing rules	A				
1870	US Fish Commission goal to augment salmon using hatcheries		H			
1872	McCloud fish hatchery established					
1872	First Oregon game laws, fish ways required over dams					
1875	Russo-Japanese Treaty of Saint Petersburg gives Japan fishing rights in Russian waters			E		
1877	Washington establishes closed periods	A				
1878	Oregon established minimum mesh sizes and closed periods	A				
1884	First British Columbia salmon hatchery on the Fraser River		H			
1888	Hokkaido salmon hatcheries constructed		H			
1907	Russo-Japanese Fisheries Convention—Sakhalin Island given to Japan			E		
1920	Japanese take over Armur and Sakhalin fisheries			E		
1924	Soviet quotas, closures, spawning protrection	A				
1924	White Act—Alaska fisheries oppose exclusive access rights			E		
1928	Soviet Union builds two hatcheries on Armur River		H			
1930	First Alaskan salmon hatchery built		H			
1937	Fraser River Salmon Convention establishes 50/50 US/Canada split			E		
1944	Japan operating twenty-two hatcheries on souther Sakhalin Island		H			
1952	Japanese Fisheries Conservation Law establishes marine ranching		H			
1960	Salmon farming experiments at University of Washington				F	
1968	British Columbia limited access initiated			E		
1971	First salmon farm with British Columbia license				F	
1972	Atlantic salmon farming begins in Puget Sound				F	
1973	Alaska Limited Entry Act			E		
1977	Law of the Sea extends territorial limits to 200 mmi			E		
1990	Russia builds Sakhalin Island hatcheries		H			
1995	Sablefish and halibut longline IFQs introduced in Alaska					Q
1997	Farmed salmon and trout surpass wild production				F	
2002	CQE authorized by North Pacific Fishery Management Council					Q
2006	Alaska king crab quota system introduced					Q
2008	British Columbia largest fish farmer in the North Pacific				F	

1. For the right five columns, A=area, gear, and time rules; H=hatcheries; E=entry limits; F=salmon farming; and Q=quota management that gives a property right.

Source: Augerot (2000) and personal communications; Langdon 2008; papers by Colombi, Carothers, Diver, Kasten, Koester, Lien, Menzies, Reedy-Maschner, Sharakhmatova, and Wilson; and administrative records of Alaska, British Columbia, Oregon, and Washington.

Gear, area, and time controls; limits to entry; and hatcheries tend to appear in close succession. Entry limits are seen as conservation measures. Koester (chapter 3) says that in Russia, "the most troublesome aspect is that licenses ('limits') for fishing are given by government authorities based on political influence." Further, catch allocations for Indigenous peoples are too limited to meet their basic needs, even though Indigenous peoples have a constitutional right to a catch share (Kasten, chapter 4; Koester, chapter 3; Sharakhmatova, chapter 5).

Katherine Reedy-Maschner (chapter 6) explains the problems faced by Aleut communities when traditional cultural patterns come up against pressing economic needs caused by continued production for international markets. The Aleut people are "becoming increasingly aware of their vulnerability and mortality," she writes. Sixteen Aleut communities have been abandoned, and population is declining in the consolidated communities. Reedy-Maschner writes, "But, salmon in the north are for the most part renewable, predictable, and harvested in mass quantities for subsistence and commercial ends with a global market in all five species." The state of Alaska's efforts to protect the biological resource have paid less attention to Indigenous needs. Salmon that Aleuts would normally take are instead intercepted by a large nonresident fleet coming from Seattle that takes the allowable catch in a very short time.

Since capture fisheries attract too much effort and the resource gets overfished, economists suggest establishing a property right to enable fishers to fish more safely, match catches to resource availability more effectively, and develop a stewardship interest among harvesters. These rights take the form of quotas. Quotas include IFQs (individual fishing quotas), ITQs (individual transferable quotas), CDQs (community development quotas), CFQs (community fishing quotas), and CQEs (community quota entities) (Langdon 2007; Carothers, chapter 7; Reedy-Maschner, chapter 6; Sharakhmatova, chapter 5). Quotas derive from microeconomic approaches to agriculture. A quota is equivalent to a land-based limit for a crop or like barbed wire that corals livestock for an owner. A fishing quota is a mechanism for establishing individual property rights. This mechanism is different from the allocation of a portion of the available catch to tribal fisheries. Community quotas allow a group to access a particular fishing area or stock, and part of the point of granting a property right is to reduce the number fishing. Quotas divide the whole among many different individuals or communities, but one impact of quotas documented by Carothers and Reedy-Maschner is the inequality they produce, especially the marginalization of Indigenous fishers in gaining their fair share of the resource.

Quota fisheries reduce the number of fishers and total catch to match the estimated "biologically acceptable catch." But fewer boats and less catch deplete community revenues and economic life. While the Aleuts have a CDQ program, investments have not brought economic well-being, village population continues to drop, and a debate goes on about whether petroleum exploration and drilling might offer better returns in their overall portfolio of economic activities (Reedy-Maschner, chapter 6). Reviewing CQE programs, Langdon (2008:38) finds these, too, have not been as effective as hoped and without modification "will exist only as an illusion."

CAPTURE TO CULTURE

The building of hatcheries increases survival of young salmon on the theory that if more survive the alevin, fry, parr, and smolt stages of the life cycle, salmon will be more abundant. Hatchery technology spread quickly around the Pacific in the late nineteenth century as fishery managers increasingly cultured salmon for greater production to meet the demands of capture fishers (see table 1.2, also Dodds 1959; Lichatowich 1999; Taylor 1999). Salmon are held in hatcheries to reduce early life cycle mortality. They are then released to complete the rest of their life cycle in estuaries, the ocean, and rivers, where they spawn.

Agricultural metaphors around the management and production processes in fisheries continued to increase, and about a century later, full-fledged farming brought about significant impacts. Farming salmon controls the whole life cycle in a pen or closed facility. Salmon farming increases productivity by reducing mortality throughout the life cycle and using feeds, antibiotics, and genetic modifications that increase rates of growth. The farming of salmon was an innovation that began on a commercial scale in the 1960s along the coasts of Norway and Scotland using Atlantic salmon (Lien, chapter 11). Experiments were going on at the same time at the University of Washington, and British Columbia opened its first salmon farm in 1971 (see table 1.2).

Farmed fish are most like industrialized agricultural products in that production is controlled throughout the salmon life cycle. As the volume of farmed fish increases, prices received by fishers drop, and worries increase about farmed fish escaping because they could interbreed with or outcompete native salmon. Concern grows about waste products and the use of antibiotics and other chemicals to increase productivity. The biggest concern, however, is loss of diversity as any kind of agricultural process involves selection for certain varieties, traits, behaviors, and life history

characteristics. Perhaps it is ironic that Atlantic salmon are among the main species cultured on the Pacific Coast.

The growth of industrialized agriculture in providing food and fiber, producing animals, and supplying timber to meet human needs has also reduced spawning and rearing habitats for salmon, created obstacles in salmon migration corridors, introduced exotic species (many of which are harmful to salmon), and limited the area that salmon can inhabit. Salmon adapt to a diversity of landscapes in networks of rivers, streams, and tributaries. As a result of occupying different habitats, salmon develop different life history characteristics that tie them to a variety of highly variable natural conditions. Studies show that over a quarter of the fourteen hundred populations of US Pacific Northwest salmon have been lost since settlement (Gustafson et al. 2007; Nehlsen, Williams, and Lichatowich 1991). A focus on culturing removes much of this diversity, just as the sale to international markets creates competitive forces that reduce the diversity of salmon cultures (Augerot 2005) and small communities (Martin 2008).

Concern for abundance and productivity leads to the enumeration of fish produced and caught (Koester, chapter 3). The amount of hatchery salmon in capture harvest becomes of interest. Figure 1.2 compares the percentage of total capture harvest among five areas for the first decade of the twenty-first century (top line) with the percentage of that harvest in each area produced from hatcheries. The top line shows the percent contribution by region that comes from hatchery production (Augerot 2005; Knapp, Roheim, and Anderson 2007; Ruggerone et al. 2010; The Research Group 2009). Washington, Oregon, California, and Idaho (WOCI) have the least—less than 1 percent of the total for the five regions with 80 percent hatchery produced. British Columbia has approximately 2 percent with 70 percent hatchery produced. Japan produces nearly all salmon in hatcheries. Russia has the lowest percentage of hatchery production, 14 percent, and 39 percent of the total North Pacific catch. The capture harvest of chum is the largest, and twice as many chum are harvested as all other salmon species. Estimates vary from year to year due to environmental conditions, according to species mix, and with international market conditions. Alaska and Russia have better habitats and produce the most nonhatchery salmon (Augerot 2005). Japan uses mostly chum salmon from hatcheries for its capture harvest (The Research Group 2009:7). Alaska is successful with chum and pink salmon hatcheries. In Russia, the overwhelming majority of effort regarding artificial propagation has been devoted to sockeye and chum salmon (Augerot 2005). These data omit the production of farmed salmon.

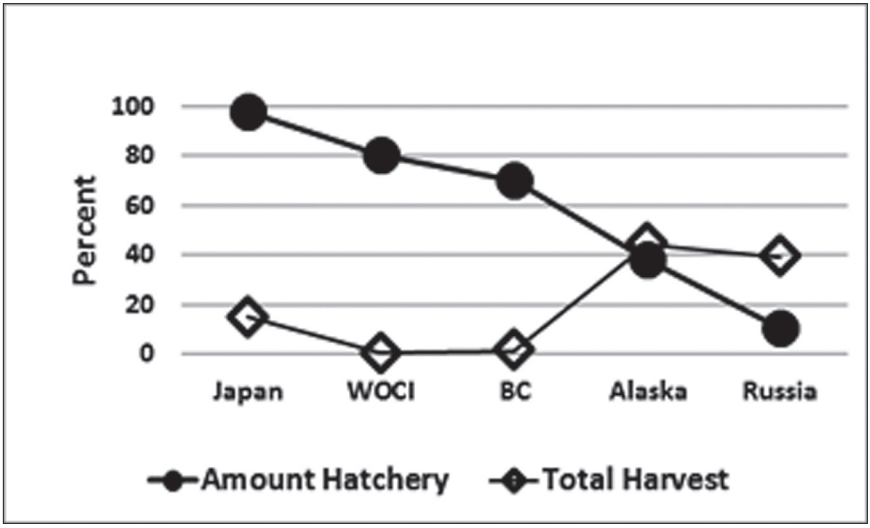

Figure 1.2

Diamonds show the percentage of the total North Pacific catch by fishing area for the first decade of the twenty-first century. Solid circles show the percentage that comes from hatchery production for each area. Thus, Japan has 97 percent hatchery-produced salmon and 15 percent of the capture harvest among the five areas. Russia has 39 percent of the capture harvest among the five areas, of which 10 percent comes from hatcheries. Source: adapted from Augerot 2005:33; Knapp, Roheim, and Anderson. 2007; Ruggerone et al. 2010; The Research Group 2009.

These comparisons show several north–south patterns. First, Russia and Alaska in the north have very low numbers of people and density relative to Japan and WOCI. A higher percentage of the north's population includes Indigenous peoples. In the Columbia Basin and British Columbia, a greater portion of the resource is allocated to Indigenous communities than in Russian and Japan.

When looking at the north, we see that it is richer in numbers of salmon and salmon diversity. In Kamchatka and Alaska, both numbers and biodiversity are greater because the habitat has been in better condition during the first decade of the twenty-first century. The best habitat remaining for salmon is in northeast Russia and Alaska, although Kamchatka and Sakhalin Island habitats are currently under threat from mineral extraction, oil and gas development, and illegal poaching for salmon (Kasten, chapter 4; Koester, chapter 3; Sharakhmatova, chapter 5; Wilson, chapter 2). However, Emma Wilson provides an example of how mineral exploration and extraction can provide help for Indigenous peoples to adapt

to new conditions while maintaining cultural practices. The Nivkhi of Sakhalin's northeast coast retained the centrality of salmon to their culture. They developed leadership and were able to collaborate in the design of the Sakhalin Indigenous Minorities Development Plan, which gained financial and program support from oil and gas companies.

One of the significant habitat changes meant to support agriculture is the building of dams on the Columbia River. For agriculture, the dams provide three benefits. First is irrigation water; second is electricity to pump water; and third is "a river highway" to move agricultural products downstream. Energy and fertilizer supplies return upstream. Colombi (chapter 9) describes how the Nimiipuus are leaders in an effort to remove dams on the Snake River, a major tributary to the Columbia, that inhibit salmon from leaving and returning to their home rivers—Clearwater River in Idaho and Grande Ronde in Oregon.[1] Colombi also notes that the Nimiipuus are leaders in restoring watersheds and in efforts to increase Snake River salmon stocks through supplementation practices designed to mimic natural processes. He writes that the Nimiipuus also use their reserved water rights to help the downstream migration of salmon. While Colombi refers to the Nimiipuu case as "sovereignty through salmon," he also documents how the Nimiipuus are building salmon through use of their sovereignty.

The quantity of farmed salmon has grown dramatically. From 1950 to 2009, farmed salmon have increased from next to nothing to over 60 percent of the total quantity of salmon produced worldwide (FAO 2011:top graph). The total salmon production shown in figure 1.3 is the amount captured from naturally spawning and hatchery stocks, plus the amount farmed, and these aggregated global data come from a diversity of sources and protocols. Further, these data reflect quantities, not value: chinook, coho, and sockeye salmon and steelhead trout command higher prices than the more abundant chums and pinks. Figure 1.3 shows the general pattern of change toward greater reliance on farmed salmon. In 1996 the amount of farmed salmon exceeded wild and hatchery-born salmon for the first time. As table 1.2 shows, farming of salmon is a relatively late addition to the North Pacific salmon story.

DISCUSSION

The exporting of perceived surpluses by entrepreneurs from dominating nation-states, application of agricultural metaphors, efforts to control the commons, and increasing use of culturing techniques highlight four ways that agricultural metaphors and the actions that follow from them are detrimental to salmon and salmon fishers: First is the impact of

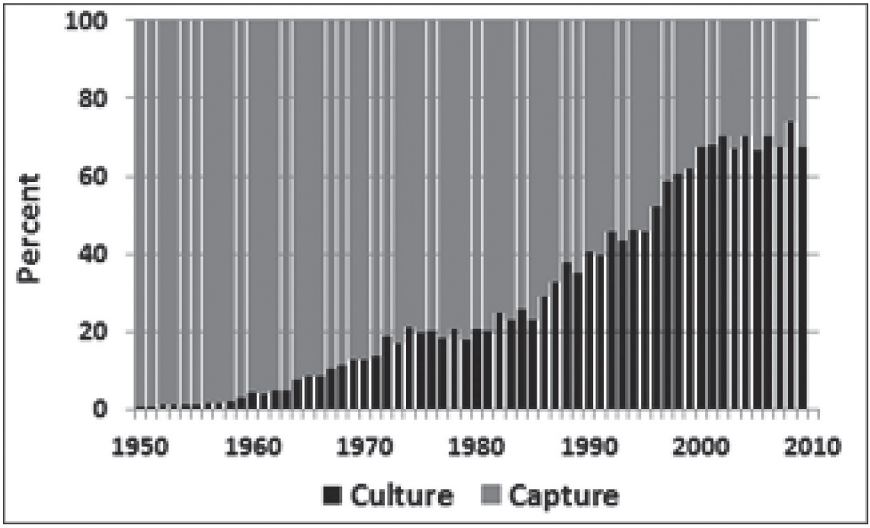

Figure 1.3

Wild and hatchery capture production versus farmed salmon production for 1950–2009. The graph shows the increasing percentage of production by aquaculture that has overtaken the percentage from capture fishing. Source: FAO 2011.

agricultural metaphors that have become part of fishery management. The goal of maximum sustainable yield implies the continuation of a maximum surplus production, but salmon stocks are highly variable due to a variety of natural processes, and command and control management of salmon fisheries has not matched fish abundance to the efforts of fishers. Second is the direct effect of fish culturing to increase abundance, which was the original use of salmon hatcheries and continues to be the case. The simplification and selection practices at hatcheries greatly reduce salmon biodiversity. Third is the growth of fish farming, whose effects are less direct. Fish farming competes with capture fisheries in world markets, putting pressure on fish prices and thus the incomes of capture fishers, and many fear that fish farming will damage natural runs of salmon. Fourth is the impact of industrial-agricultural production on the habitats of salmon, whether they will retain their historic diversity in a network of streams that enables them to adapt to natural and human disturbances. An examination of culturing thus reveals a dire list of threats to salmon populations and fishing peoples.

These case studies of North Pacific salmon fishing peoples show the impacts of culturing, but also the adaptability of culture. The cases suggest that portfolio building, resource quota allocations, sovereignty and

leadership, and values are ways of creating alternatives to the impacts of industrial agriculture, and all show a diversity of subsistence resource portfolios that come from adaptation over thousands of years. Each Indigenous group had a portfolio of activities from which they derived their well-being. Historically, as reflected in Kasten's (chapter 4) description of the paired economies of marine Koryaks and reindeer Koryaks, salmon peoples relied on a diversity of subsistence activities. Kasten notes the diversity of Koryak subsistence resources: fishing; hunting sea mammals, snow sheep, and fur-bearing animals; collecting sprouts, wild onions, berries, and roots; and trading with reindeer herders. In Koester's chapter, Tatiana Petrovna reflects on Itelmen foods including salmon and many other fish, a variety of plants and roots, birds' eggs, and seals, bears, ravens, foxes, gulls, mice, and many other hunted animals, all of which are threatened by industrial agricultural perspectives and practices of productivity maximization, stabilization, and simplification.

The Nimiipuus, too, are portfolio builders. Colombi (chapter 9) points to Nimiipuu "narratives built on harvesting several different runs of chinook, coho, chum, and sockeye salmon; cutthroat, lake, Dolly Varden, and steelhead trout; and different varieties of whitefish, sturgeon, suckers, lampreys, and pikeminnows." Colombi goes on to say that in addition to fish, the Nimiipuus used plant resources for food and "medicinal and industrial purposes." With the coming of Protestant missionaries, the Nimiipuus added farming to their portfolio. They became successful small-scale farmers and outstanding animal breeders.

Catch quotas are a second approach to creating options for capture fishers. Victoria Sharakhmatova (chapter 5) reports on how Russia allocated salmon to outside businesses and prevented Indigenous people from catching salmon from the runs that could have provided for an Indigenous catch. In other words, Indigenous Kamchatkans do not receive the benefit of salmon runs because Russian economic development plans allocated catches to non-Indigenous commercial fishers. Sharakhmatova describes a United Nations Development Programme (UNDP) to help Kamchatka Indigenous peoples obtain fishing rights using the CDQ concept. Here is a potentially complementary impact of caring for salmon ecosystems: the UNDP is concerned about biodiversity, and Kamchatka Indigenous peoples are concerned about getting their Indigenous rights; the UNDP/GEF (Global Environment Facility) Kamchatka Salmon Biodiversity Project has a global interest in biodiversity that is complementary to a local interest in gaining catch shares to pursue in traditional ways.

Catch is increased by the application of Indigenous sovereignty. Diver

(chapter 10) discusses the 1855 treaties that recognized tribal sovereignty signed with the Nimiipuu, Umatilla, Warm Springs, and Yakama nations. As Diver points out, the Columbia River Inter-Tribal Fish Commission (CRITFC) worked to secure the allocation of catch in which legal decisions were interpreted "in common" to mean equal shares (Cohen 1986). The treaties, which are agreements between sovereigns, are a critical factor in Columbia Basin tribes being able to retain their rights and have the ability to affect fishery management decisions (Cone 1995).

A hopeful sign for Indigenous participation in fishery management is Diver's review of CRITFC's role in co-management. Diver tells the story of the emergence of co-management between CRITFC and other groups interested in the management of Columbia River salmon fisheries. She points to how CRITFC grew out of the 1935 Celilo Fisheries Committee, which enforced regulations to uphold sharing of traditional fishery resources, limited access to tribal fishing places by outsiders, and determined the timing and location of Indian dip-net fishing.

Leaders who bring vision and the ability to implement new practices make sovereignty more effective. Wilson (chapter 2) explains how the Nivkhi were able to develop the leadership to think strategically about the future. Reedy-Maschner (chapter 6) points to how leadership allows the Aleuts to undertake new development ventures. Gitxaała leaders guided fishing practices and relations with the Canadian government. CRITFC leaders showed how to use tribal perspectives to restore Columbia Basin salmon fisheries. Colombi (chapter 9) documents Nimiipuu leadership in bringing attention to the problems of hydroelectric dams in the Columbia Basin and the potential benefits of their removal.

A diversity of values brings a diversity of options to resource use planning. One of the values that salmon fishing peoples bring is the idea of giving something back for the gifts received from nature (CRITFC 1994). Tribal people are thought to have a more reciprocal relation with salmon and ecosystems, and the First Salmon ceremonies common to the Northwest Coast honor salmon and an abundant, animate earth (Gunther 1926; Swezey and Heizer 1977). Another characteristic of Indigenous cultures is that they tend to limit what they take from ecosystems and do not seek to maximize productivity (Butler and Campbell 2004; Lake 2007; Langdon 2008; Thornton 2008; Thornton and Manasfi 2010). Certainly, there are exceptions (Krech 2005, 2007), but common to many salmon peoples discussed in this volume is an ethic to protect and preserve salmon and the habitats they require.

Kasten (chapter 4) describes the cultural ethic of not taking more

than is needed, practices of knowing the environment and not polluting the river, and ceremonies to honor the fish. While the marine Koryaks had paired economies with the reindeer Koryaks and needed salmon to feed their sled dogs as well as people, they were careful not to take more than they needed. These actions show a concern for the resource. Kasten tells of Koryak people giving back by returning some fish to the river "'so that there would be many fishes in the future'" and of their concerns that too many fish are being taken to provide caviar. He summarizes, "In contrast to Soviet or Western ideology, Indigenous people were aware that they would never be able to 'conquer'…or to control nature." As the fisheries of Kamchatka became commercialized, Indigenous peoples were forced to resort to poaching, "a grassroots social response to the inequitable distribution of natural resource rent." In other words, poaching occurs when fishery management is not seen as fair and reasonable.

Menzies (chapter 8) says that the actions toward and modifications of their environment by the Gitxaała "are framed in terms of relations with nonhuman social beings and humans." He continues, "This implies and requires a structure of obligation and reciprocity." Menzies argues that Gitxaała care for the environment is one of the factors that keeps fish stocks from declining—that declines correlate with the outlawing of Gitxaała conservation practices by government managers. While it might not be *the* answer, the hopeful message is that values diversity creates an array of options to consider.

CONCLUSIONS

Each region is affected differently by agricultural metaphors and their applications. The future may be fish farming, but Russia, Alaska, and the Columbia Basin still do not have fish farms. Salmon farming is very extensive in British Columbia, where fish farmers and capture fishers are actively hostile toward each other. Even without a physical presence, fish farms in Europe and Chile have an impact on all North Pacific salmon peoples. Fish farms affect the international trade in salmon by lowering the price received by capture fishers, while also making salmon more available and cheaper for consumers. A market in wild-caught salmon exists, but it is small relative to the overall salmon market. Further, many of the "wild-caught" salmon are hatchery produced. Thus, the hatchery component of fish production plays very directly into the opportunities for salmon peoples in all areas. In the first decade of the twenty-first century, the Columbia Basin and British Columbia relied most on hatcheries, Russia the least.

Alaska, the biggest producer of salmon, relies on hatcheries for 40 percent of the wild-caught harvest.

Threats to salmon habitat from the urban-industrial footprint affect all the groups discussed. Whether mining and oil extraction in Russia; the timber harvest in Russia, Alaska, and the Pacific Northwest; or extensive agricultural development in the Columbia Basin, the demands of urban and industrial growth threaten capture fisheries. Japan is an example of a place where capture fisheries exist only because of hatchery production. Agricultural metaphors and the practices they engender cause loss of natural and cultural diversity and raise concerns about the future.

With the loss of salmon biological and cultural diversity has come new forms of diversity—in production practices, such as using hatcheries to augment salmon abundance, in the complexity of ecosystems for conserving and restoring salmon, and in fish farming systems. Salmon are important to many diverse groups of people. They are living metaphors of wildness and tenacity, while also important for catch and release, commercial, recreational, and trophy fishing. Some salmon live natural life cycles, others are hatched and ocean ranched, while still others have their life cycle controlled by farming. Fishers include people using Indigenous, tribal, recreational, commercial, trolling, set-net, dip-net, purse seine, gillnet, and hook and line methods. Salmon are distributed as first foods for Indigenous peoples, local ceremonial and subsistence purposes, and commercial sale in local, national, and international markets. Fisheries are managed according to values that range from neoliberal to deep ecology. Despite the abundance of salmon for some purposes, there are not enough for all purposes, and many of the purposes conflict. Resolving this human diversity dilemma is a critical problem that is being addressed in each of the case studies in this volume. While many patterns may be similar, solutions will likely vary from location to location.

The North Pacific salmon history and these nine case studies show a pattern of change that most often has worked to the disadvantage of salmon-dependent peoples, who use capture techniques. The result has been marginalization and the loss of opportunities to practice traditional culture, secure traditional rights, and pursue traditional resources. Industrial-agricultural metaphor and practice point to a difficult future for capture fisheries. Yet principles from each of these case studies suggest options for the future: what new portfolios, use rights, sovereignty, leaders, values, cultural understandings, restoration activities, and partnerships can abate the devastation that culturing exerts on capture fisheries?

Note

1. *Nimiipuu* is the Indigenous name for people who make up the Nez Perce Tribe.

