AN ASSESSMENT OF POTENTIAL MINING IMPACTS ON SALMON ECOSYSTEMS OF BRISTOL BAY, ALASKA

VOLUME 3—APPENDICES E-J

Appendix E: Bristol Bay Wild Salmon Ecosystem: Baseline Levels of Economic Activity and Values

Bristol Bay Wild Salmon Ecosystem

Baseline Levels of Economic Activity and Values

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December 2013

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BIOECONOMICS

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Executive Summary

The objective of this report is to characterize the baseline levels of economic activity and related ecosystem services values for the Bristol Bay wild salmon ecosystem. The overarching purpose of this report is to provide baseline economic information to the Environmental Protection Agency in order to inform review of mining proposals in the Nushugak and Kvichak drainages. Both regional economic significance and social net economic accounting frameworks are described in this report. This study reviews and summarizes existing economic research on the key sectors in this area and reports findings based on original survey data on expenditures and net benefits. This report combines efforts on the part of Bioeconomics, Inc. and the University of Alaska Institute of Social and Economic Research. John Duffield and Chris Neher compiled the report and authored the executive summary, Sections 1, 2, and 5. Gunnar Knapp wrote Section 3 (commercial fisheries), and Tobias Schwörer, Ginny Fey and Scott Goldsmith wrote Section 4.

The major components of the total value of the Bristol Bay area watersheds include subsistence use, commercial fishing, sport fishing and other recreation, and the preservation values (or indirect values) held by users and the U.S. resident population. The overall objectives of this study is to estimate the share of the total regional economy (expenditures, income, and jobs) that is dependent on these essentially pristine wild salmon ecosystems and to provide a preliminary but relatively comprehensive estimate of the total economic value (from an applied welfare economics perspective) that relies on a healthy ecosystem.

It is important to note that while the geographic scope of this economic characterization report is targeted to the Bristol Bay wild salmon ecosystem, the scope of the proposed mining activity is somewhat narrower, including the Nushugak and Kvichak drainages. Values tied to, and specific to, the proposed mining activity (and discharges) in the Nushugak and Kvichak Drainages would be a subset of those reported here, and have not been identified in this general characterization analysis. This report uses existing information and data to target this economic characterization report to ecosystem services and associated economic activity and values, specific to the Bristol Bay Region. However, data on different economic sectors vary in quality, and available data on some economic activities (such as non-consumptive tourism) make it more difficult to identify activities and associated economic values narrowly targeted to the Bristol Bay area. The overall intent of this report is to provide a general picture of the full range of economic values associated with ecosystem services supplied by the entire Bristol Bay region.

Following this executive summary, the report is organized into five main sections. Section 1 provides a brief introduction to the report. Section 2 addresses economic visitation and expenditures related to sport fishing, subsistence harvests, hunting, and non-consumptive recreation. Section 3 focuses on commercial fishing. Section 4 combines the regional economic activity associated with recreation and commercial fishing into an analysis of regional economic significance of these activities. Finally, Section 5 focuses on the net economic values associated with recreation and commercial fisheries in the Bristol Bay ecosystem.

For purposes of a baseline year, the most recent generally available data year is used (2009). Where available, (primarily in the commercial fisheries discussion) data on 2010 is also shown. Summary values are presented for 2009 data and in 2009 dollars.

The rivers that flow into the Bristol Bay comprise some of the last great wild salmon ecosystems in North America (Figure 1). The Kvichak River system supports the world's largest run of sockeye salmon. While these are primarily sockeye systems, all five species of Pacific salmon are abundant, and the rich salmon-based ecology also supports many other species, including Alaska brown bears and healthy populations of rainbow trout. The Naknek, Nushugak, Kvichak, Igushik, Egegik, Ugashik, and Togiak watersheds are all relatively pristine with very few roads or extractive resource development. Additionally, these watersheds include several very large and pristine lakes, including Lake Iliamna and Lake Becherof. Lake Iliamna is one of only two lakes in the world that supports a resident population of freshwater seals (the other is Lake Baikal in Russia). Additionally, there are nationally-important public lands in the headwaters, including Lake Clark National Park and Preserve, Katmai National Park and Preserve, Togiak National Wildlife Refuge, and Wood-Tikchick State Park (the largest state park in the U.S.).

The existing mainstays of the economy in this region are all wilderness-compatible and sustainable in the long run: subsistence use, commercial fishing, and wilderness sport fishing, hunting, and wildlife viewing and other non-consumptive recreation. Commercial fishing is largely in the salt water outside of the rivers themselves and is closely managed for sustainability. The subsistence, sport fish and other recreation sectors are primarily personal use and catch and release fishing, respectively. The limited harvest from these activities is relatively low impact when compared to the commercial fishery harvest.

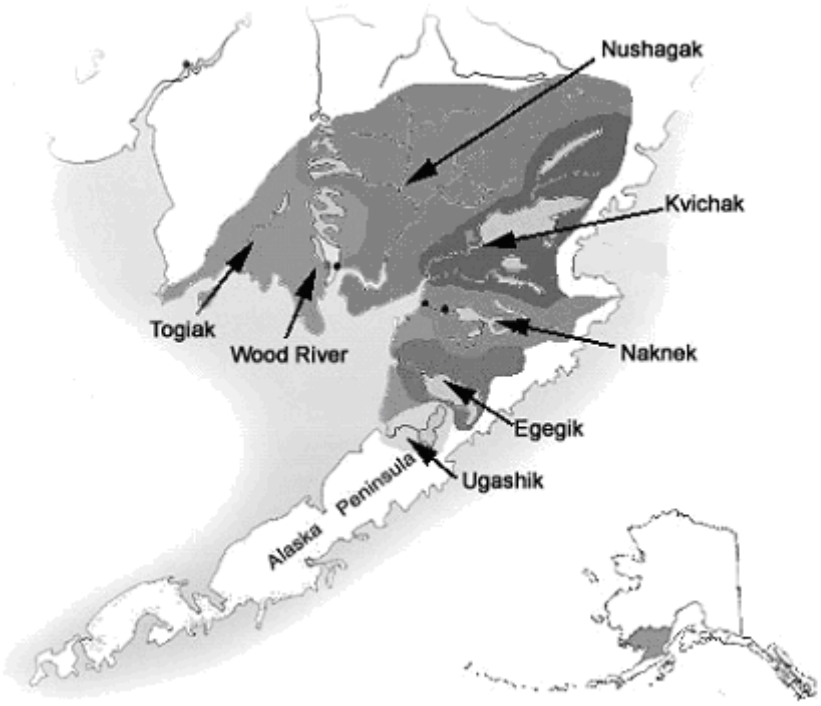

Figure 1. Map of Bristol Bay Study Area

This report focuses on an overview of values based on existing data and previous studies, and estimation of both the regional economic significance (focusing on jobs and income) of these ecosystems using an existing regional economic model. Total value in a social benefit-cost framework is also considered. This report provides a preliminary but relatively comprehensive estimate of the range of fishery-related values in this region (Figure 1).

This summary provides a brief characterization of each of the major sectors, followed by the primary economic findings.

Subsistence and Village Economies

The Bristol Bay economy is a mixed cash-subsistence economy. The primary features of these socio-economic systems include use of a relatively large number of wild resources (on the order of 70 to 80 specific resources in this area), a community-wide seasonal round of activities based on the availability of wild resources, a domestic mode of production (households and close kin), frequent and large scale non-commercial distribution and exchange of wild resources, traditional systems of land use and occupancy based on customary use by kin groups and communities, and a mixed economy relying on cash and subsistence activities (Wolfe and Ellanna, 1983; Wolfe et al. 1984). The heart of the cash-subsistence economy in Bristol Bay is the resident population of 7,475 individuals located in 25 communities (Table 1) spread across this primarily un-roaded area (Figure 2). Archeological evidence indicates that Bristol Bay has been continuously inhabited by humans at least since the end of the last major glacial period about 10,000 years

ago. Three primary indigenous cultures are represented here: Aleuts, Yupik Eskimos, and the Dena'ina Athapaskan Indians. The share of the population that is Alaska Native is relatively high at 70 percent, compared to Alaska as a whole, with 16 percent.

Table 1. Bristol Bay Area Communities, Populations, and Subsistence Harvest

Bristol Bay Area Community /year of AKF&G survey	Population (2010 census)	Per Capita Harvest (AKF&G Surveys)	Total Annual Harvest (lbs)	% Native Population (2000 census)
Aleknagik 2008	219	296	64,824	81.9%
Clark's Point 2008	62	1210	75,020	90.7%
Dillingham 1984	2,329	242	563,618	52.6%
Egegik 1984	109	384	41,856	57.8%
Ekwok 1987	115	797	91,655	91.5%
Igiugig 2005	50	542	27,100	71.7%
Iliamna 2004	109	469	51,121	50.0%
King Salmon 2008	374	313	117,062	29.0%
Kokhanok 2005	170	680	115,600	86.8%
Koliganek 2005	209	899	187,891	87.4%
Levelock 2005	69	527	36,363	89.3%
Manokotak 2008	442	298	131,716	94.7%
Naknek 2008	544	264	143,616	45.3%
New Stuyahok 2005	510	389	198,390	92.8%
Newhalen 2004	190	692	131,480	85.0%
Nondalton 2004	164	358	58,712	89.1%
Pedro Bay 2004	42	306	12,852	40.0%
Pilot Point 1987	68	384	26,112	86.0%
Port Alsworth 2004	159	133	21,147	4.8%
Port Heiden 1987	102	408	41,616	65.6%
South Naknek 2008	79	268	21,172	83.9%
Ugashik 1987	12	814	9,768	72.7%
Togiak City 2000	817	246	200,982	86.3%
Twin Hills 2000	74	499	36,926	84.1%
Un-surveyed communities	457		--	
Total	**7,475**	**343**	**2,563,313**	

Sources: US Census Bureau (2010 census statistics), and ADF&G Division of Subsistence Community Profile Data Base; Personal Comm. David Holen, ADF&G Oct 25, 2011.

Wild renewable resources are important to the people of this region and many residents rely on wild fish, game, and plants for food and other products for subsistence use. Total harvest for these 25 communities is on the order of 2.6 million pounds based largely on surveys undertaken from the late 1980s through 2008, as summarized in the Alaska Division of Subsistence community profile data base. A new round of surveys is now underway to update this data. Estimates for the 2004-2008 study years (Fall et al. 2006; 2008; 2009) are included in the data presented in Table 1. Additionally, as yet unpublished data from 2009 for Alegnagik, Clarks Point and Manokotak are included in the table (Per. Com. David Holen, ADF&G, Oct. 25, 2011). Per capita harvests average about 343 pounds. Primary resources harvested include salmon, other freshwater fish, caribou, and moose. Based on recent surveys, subsistence use continues to be very important for communities of this region and participation in subsistence activity, including

harvesting, processing, giving and receiving is quite high. Compared to other regions of Alaska, the Bristol Bay area has many features characteristic of an unique subsistence economy, including the great time depth of its cultural traditions, its high reliance on fish and game, the domination of the region's market economy by the commercial salmon fishery, and the extensive land areas used by the region's population for fishing, hunting, trapping and gathering. (Wright, Morris, and Schroeder, 1985; Fall, Krieg, and Holen, 2009).

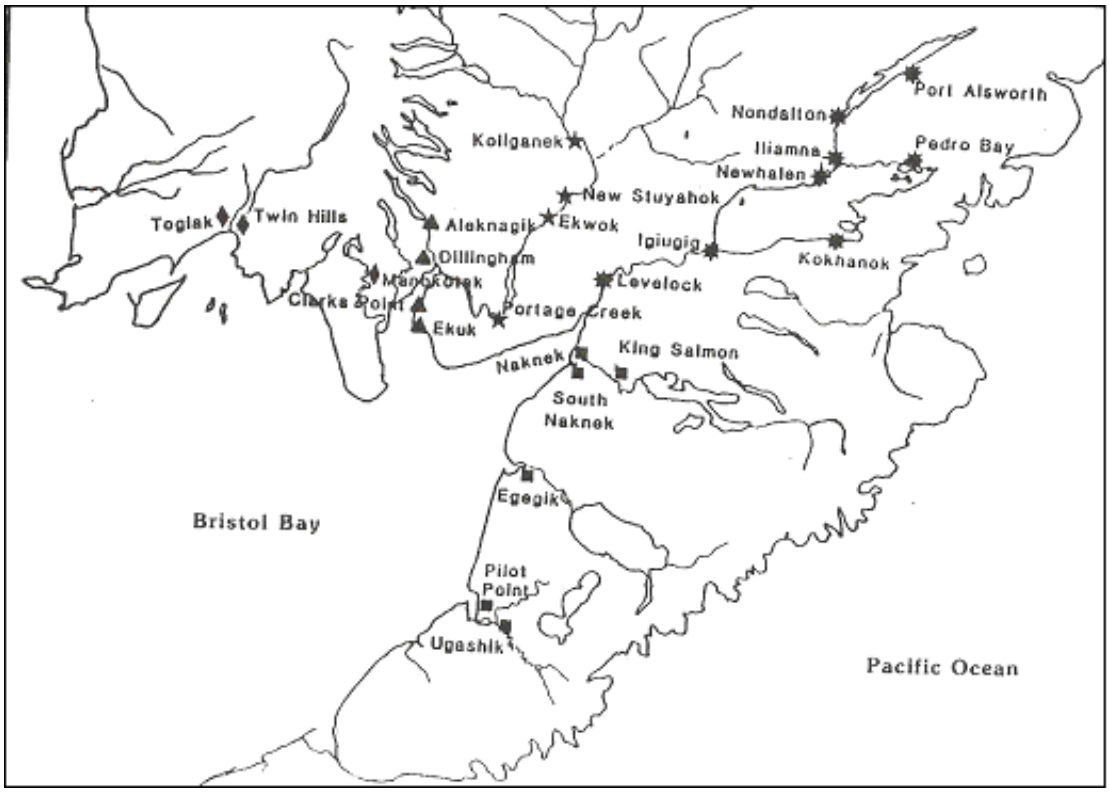

Figure 2. Bristol Bay Area Location and Major Communities

The primary private source of cash employment for participants in Bristol Bay's mixed cash-subsistence economy is the commercial salmon fishery. The compressed timing of this fishery's harvesting activity makes it a good fit with subsistence in the overall Bristol Bay cash-subsistence economy. Participation in the Bristol Bay salmon fishery is limited to holders of limited entry permits and their crew. There are approximately 1,860 drift gillnet permits for fishing from boats and approximately 1,000 set net permits for fishing from the shore. The driftnet fishery accounts for about 80% of the harvest. Most of the harvest is processed by about ten large processing companies in both land-based and floating processing operations which employ mostly non-resident seasonal workers.

Many commercial fishing permit holders and crew members, as well as some employees in the processing sector, are residents of Bristol Bay's dominantly-native Alaskan villages. An ADF&G summary of subsistence activity in Bristol Bay (Wright, Morris, and Schroeder 1985)

noted that as of the mid-1980's traditional patterns of hunting, fishing, and gathering activities had for the most part been retained, along with accommodations to participate in the commercial fishery and other cash-generating activities. In the abstract to this 1985 paper, the authors characterize the commercial salmon fishery as "a preferred source of cash income because of its many similarities to traditional hunting and fishing, and because it is a short, intense venture that causes little disruption in the traditional round of seasonal activities while offering the potential for earning sufficient income for an entire year." Commercial fishing is a form of self-employment requiring many of the same skills, and allowing nearly the same freedom of choice as traditional subsistence hunting and fishing (Wright, Morris, Schroeder 1985; p. 89).

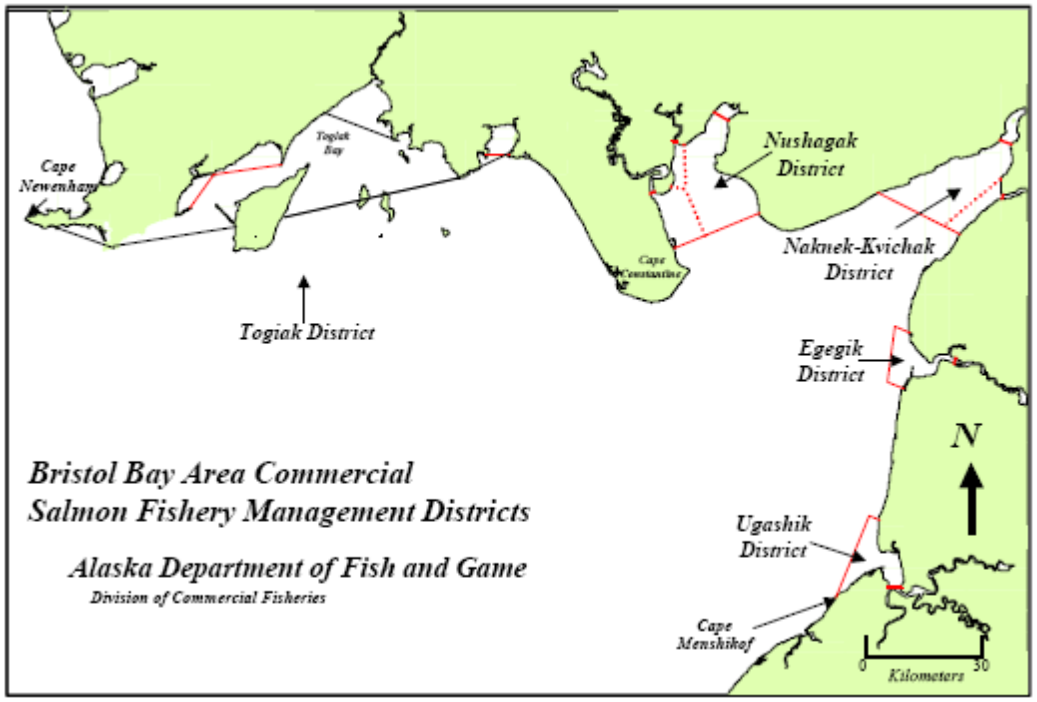

Figure 3. Bristol Bay Area Commercial Salmon Fishery Management Districts

Commercial Fisheries

The Bristol Bay commercial salmon fishery harvests salmon which spawn in and return to numerous rivers over a broad area. The Bristol Bay commercial fishery management area encompasses all coastal and inland waters east of a line from Cape Menshikof to Cape Newhenham (Figure 3). This area includes eight major river systems: Naknek, Kvichak, Egegik, Ugashik, Wood, Nushagak, Igushik and Togiak. Collectively these rivers support the largest commercial sockeye salmon fishery in the world (ADF&G, 2005). This is an interesting and unique fishery, both because of its scale and significance to the local economy, but also because it is one of the very few major commercial fisheries in the world that has been managed on a

sustainable basis. The substantial diversity in this system, both across species and within species (population diversity or the "portfolio effect"), leads to relatively stable populations. Schindler (2010) estimated that variability in annual Bristol Bay salmon runs is 2.2 times lower than if the system consisted of a single population, and that a single homogeneous population of salmon would lead to 10 times more frequent fisheries closures. These findings indicate the importance of maintaining population diversity in order to protect the ecosystem and the economy that depends on it.

The five species of pacific salmon found in Bristol Bay are the focus of the major commercial fisheries. Sockeye salmon account for about 94% of the volume of Bristol Bay salmon harvests and an even greater share of the value. The fishery is organized into five major districts (Figure 3) including Togiak, Nushagak, Naknek-Kvichak, Egegik, and Ugashik. Catches in each district vary widely from year to year and over longer time periods of time, reflecting wide variation in returns to river systems within each district. Currently there is particular interest in the significance of fisheries resources of river systems in the Nushagak and Kvichak districts, because of potential future resource development in these watersheds. Over the period 1986-2010, the Naknek-Kvichak catches ranged from as low as 5% to as high as 52% of total Bristol Bay catches; Nushagak district catches ranged from as low as 9% to as high as 45% of total Bristol Bay catches. For most of the past decade, the combined Nushagak and Naknek-Kvichak districts have accounted for about 60% of the total Bristol Bay commercial sockeye harvest.[1]

Management is focused on discrete stocks with harvests directed at terminal areas at the mouths of the major river systems (ADF&G, 2005). The stocks are managed to achieve an escapement goal based on maximum sustained yield. The returning salmon are closely monitored and counted and the openings are adjusted on a daily basis to achieve desired escapement. Having the fisheries near the mouths of the rivers controls the harvest on each stock, which is a good strategy for protection of the discrete stocks and their genetic resources. The trade-off is that the fishery is more congested and less orderly, and the harvest is necessarily more of a short pulse fishery, with most activity in June and early July. This has implications for the economic value of the fish harvest, both through effects on the timing of supply, but also on the quality of the fish. Most fish are canned or frozen, rather than sold fresh. Total catches vary widely from year to year. Between 1980 and 2010, Bristol Bay sockeye salmon harvests ranged from as low as 10 million fish to as high as 44 million fish. Harvests can vary widely from year to year and annual pre-season forecasts are subject to a wide margin of error.

Strong Japanese demand for frozen sockeye salmon drove a sharp rise in Bristol Bay salmon prices during the 1980s. Competition from rapidly increasing farmed salmon production drove a protracted and dramatic decline in prices between 1988 and 2001, which led to an economic crisis in the industry. However, growing world salmon demand, a slowing of farmed salmon production growth, diversification of Bristol Bay salmon products and markets, and improvements in quality have driven a strong recovery in prices over the past decade. The real ex-vessel value paid to fishermen fell from $359 million in 1988 to $39 million in 2002, and rose

[1] Bristol Bay salmon harvest statistics can be found at http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareabristolbay.salmon

to $181 million in 2010 (values in 2010 dollars).[2] The real first wholesale value of Bristol Bay salmon production fell from $616 million in 1988 to $124 million in 2002, and then rose to $390 million in 2010. In 2009, the ex-vessel value of Bristol Bay salmon harvest was approximately $300 million. Many other factors, such as changes in wild salmon harvests, exchange rates, diseases in Chilean farmed salmon, and global economic conditions have also affected prices. In general, changes in ex-vessel prices paid to fishermen have reflected changes in first wholesale prices paid to processors.

There are many potential economic measures of the Bristol Bay salmon industry (Table 2). Which measure is most useful depends upon the question being asked. For example, if we want to know how the Bristol Bay salmon fishery compares in scale with other fisheries, we should look at total harvests or ex-vessel or wholesale value. If we want to know how it affects the United States balance of payments, we should look at estimated net exports attributable to the fishery. If we want to know how much employment the industry provides for residents of the local Bristol Bay region, Alaska or the United States, we should look at estimated employment in fishing and processing for residents of these regions. If we want to know the net economic value attributable to the fishery, we should look at estimated profits of Bristol Bay fishermen and processors. These different measures (Table 2) vary widely in units, in scale, and in the measure of how economically "important" the fishery is. For example, for the period 2000-2010, Bristol Bay harvests were 62% of all Alaska sockeye salmon harvests and 45% of total world production for the species.

Table 2. Selected Economic Measures of the Bristol Bay Commercial Salmon Industry, 2000-2010.

Measure	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg.	Range
Sockeye Salmon Havests													
Millions of fish	21	14	11	15	26	25	28	30	28	31	29	23	11 - 31
Millions of pounds	125	96	65	93	152	155	165	173	160	183	170	140	65 - 183
Bristol Bay harvest volume as a share of:													
Alaska sockeye salmon	61%	56%	48%	50%	59%	58%	69%	62%	71%	71%	74%	62%	48% - 74%
World sockeye salmon	45%	40%	28%	38%	47%	47%	49%	47%	52%	55%		45%	28% - 55%
Alaska wild salmon (all species)	18%	12%	10%	13%	19%	16%	22%	18%	23%	25%		18%	10% - 25%
World wild salmon (all species)	7%	5%	4%	5%	8%	7%	8%	7%	9%	7%		7%	4% - 9%
World wild & farmed salmon (all species)	3%	2%	1%	2%	3%	3%	3%	3%	3%	3%		2%	1% - 3%
Gross Value ($ mllions)													
Ex-vessel value	80	40	32	48	76	95	109	116	117	144	181	94	32 - 181
First wholesale value	175	115	100	114	176	220	237	249	262	293	390	212	100 - 390
Total value of US exports of Bristol Bay salmon products	150	137	97	111	172	193	173	183	206	230	254	173	97 - 254

[2] The ex-vessel value is the total post-season adjusted price paid to fishermen for the first purchase of commercial harvest.

Recreation

Next to commercial fishing and processing, recreation is the most important private economic sector in the Bristol Bay region. This recreational use includes sport fishing, sport hunting, and other tourism/wildlife viewing recreational trips to the Bristol Bay Region. The 2005 Bristol Bay Angler Survey (Duffield et al. 2007) confirmed that the fresh water rivers, streams, and lakes of the region are a recreational resource equal or superior in quality to other world renowned sport fisheries.

In survey responses Bristol Bay anglers consistently emphasize the importance of Bristol Bay's un-crowded, remote, wild setting in their decisions to fish the area. Additionally, a significant proportion of these anglers specifically traveled to the region to fish the world-class rainbow trout fisheries. These findings indicate that Bristol Bay sport fishing is a relatively unique market segment, paralleling the findings of Romberg (1999) and Duffield, Merritt and Neher (2002) that angler motivation, characteristics, and values vary significantly across Alaska sport fisheries.

Recreational fishing use of the Bristol Bay region is roughly divided between 58% trips to the area by Alaska residents and 42% trips by non-residents. These non-residents (approximately 12,500 trips in 2009 (personal communication, ADF&G, 2011)) account for the large majority of total recreational fishing spending in the region. It is estimated that in 2009 approximately $50 million was spent in Alaska by nonresidents specifically for the purpose of fishing in the Bristol Bay region. In total, it is estimated that $60 million was spent in Alaska in 2009 on Bristol Bay fishing trips.

While sport fishing within the Bristol Bay region comprises a large and well-recognized share of recreational use and associated visitor expenditures, thousands of trips to the region each year are also made for the primary purpose of sport hunting and wildlife viewing. Lake Clark and Katmai National Parks are nationally significant protected lands and are important visitor destinations attracting around 65,000 recreational visitors in 2010 (NPS public visitation statistics). Additionally, rivers within Katmai NP provide the best locations in North America to view wild brown bears.

Summary of Economic Significance

Table 3 through 7 detail the summary results of the analysis of economic values. Table 3 shows estimated direct expenditures in Alaska related to harvest or use of Bristol Bay area renewable resources. Total estimated direct expenditures (that drive the basic sector of the economy) were estimated to be $479 million in 2009. The largest component is commercial fishing harvesting and processing. These estimates were obtained from the Alaska Department of Revenue and the Commercial Fishing Entry Commission. The next most significant component is wildlife viewing/tourism at $104 million in 2009. Sport fishing is estimated to constitute another $60 million in spending. This estimate is derived from the 2005 Bristol Bay Angler survey data as well as AK F&G use estimates. Sport hunting is less important economically.

The direct economic spending and sales shown in part A of the table supports an estimated 14,200 direct full and part-time jobs in the Bristol Bay region during peak season.

Table 3. Summary of Regional Economic Expenditures Based on Wild Salmon Ecosystem Services (Million 2009 $)

Ecosystem Service	Estimated direct expenditures / sales per year
(A) Direct Expenditures and Sales	
Commercial fish wholesale value[3]	300.2
Sport fisheries	60.5
Sport hunting	8.2
Wildlife viewing / tourism	104.4
Subsistence harvest expenditures	6.3
Total direct annual economic impact	**479.6**
(B) Estimated Direct Full & Part-Time Jobs at Peak Season	
Commercial fish Sector	11,572
Sport fisheries	854
Sport hunting	132
Wildlife viewing / tourism	1,669
Subsistence harvest expenditures	Not Captured by the Market
Total direct annual economic impact	**14,227**

Table 4 provides additional detail on recreation expenditures, including number of trips and spending by residence of the participants. A large share of total recreation expenditures is by nonresident anglers ($49.8 million) and nonresident non-consumptive (tourism/wildlife viewing) visitors ($92.9 million). This reflects the high quality of this fishery and other recreational opportunities in the region, in that the area is able to attract participants from a considerable distance in the lower 48 states as well as foreign countries. Subsistence harvest expenditures are based on limited data and are likely to be conservative. (Goldsmith, 1998)

[3] Estimates of some year-specific commercial fishery total harvest and total sales vary slightly within this report. This is due to differences in how these data are aggregated and reported by the Alaska Fish and Game, and the point in time these statistics were accessed during the preparation of this report.

Table 4. Total Estimated Recreational Direct Spending in Alaska Attributable to Bristol Bay Wild Salmon Ecosystems, 2009

	Local residents	Non-local residents	Non-residents	**Total**
Visitors				
Non-consumptive	-	4,506	36,458	**40,964**
Sport fishing	13,076	3,827	12,464	**29,367**
Sport hunting	-	1,319	1,323	**2,642**
Total	**13,076**	**9,652**	**50,245**	**72,973**
Spending per visitor				
Non-consumptive	-	$2,548	$2,548	
Sport fishing	$373	$1,582	$3,995	
Sport hunting	-	$1,068	$5,170	
Spending ($million)				
Non-consumptive	-	$11.5	$92.9	**$104.4**
Sport fishing	$4.9	$6.0	$49.8	**$60.7**
Sport hunting	-	$1.4	$6.8	**$8.2**
Total	**$4.9**	**$18.9**	**$149.5**	**$173.3**

Table 5 summarizes the full time equivalent employment (annual average) for the cash component of the economy associated with the major economic sectors of the Bristol Bay economy, those dependent on wild salmon ecosystems—recreation, commercial fishing, and subsistence, as well as other major employment sectors. The economy of the Bristol Bay Region depends on three main activities or sectors—publicly funded services through government and non-profits, commercial activity associated with the use of natural resources (mainly commercial fishing and recreation), and subsistence. Subsistence is a non-market activity in the sense that there is no exchange of money associated with the subsistence harvest. However, local participants invest a significant portion of their income to participate in subsistence and the harvest has considerable economic value and their expenditures have significant economic effects.

Public services and commercial activities bring money into the economy (basic sectors) and provide the basis for a modest support sector. The support sector (non-basic sector) consists of local businesses that sell goods and services to the basic sectors including the commercial fishing industry, the recreation industry, the government and non-profit sectors. The support sector also sells goods and services to participants in subsistence activities.

The relative importance within the regional economy of government as contrasted with commercial fishing and recreation can be measured by the annual average employment in each sector. In 2009, more than two thousand jobs were directly associated with government spending from federal, state, and local sources. Commercial fishing and recreation accounted for

approximately three thousand or 57 percent of total basic sector jobs. Since much of the recreation is using public lands and resources, a share of the government sector; for example administration of the federal and state parks and wildlife refuges, is directly related to providing jobs and opportunities in the recreation sector. Accordingly, the estimate of recreation-dependent jobs is conservative.

The support sector depends on money coming into the regional economy from outside mainly through government, commercial fishing, and recreation. The relative dependence of the support sector on the three main sectors is difficult to measure. One reason for this is that government employment is stable throughout the year, while employment in commercial fisheries and recreation vary seasonally. Due to the seasonal stability of government jobs, the payroll spending of people employed in government is likely to contribute more to the stability of support sector jobs in the region than their share of basic sector jobs indicates.

Table 5. Cash Economy Full-time Equivalent Employment Count by Place of Work in the Bristol Bay Region, 2009

	Annual Average	Summer	Winter	Swing
Total jobs count	**6,648**	16,386	3,792	12,594
Basic	**5,490**	14,877	2,430	12,447
Fish harvesting	**1,409**	6,909	-	6,909
Fish processing	**1,374**	4,480	354	4,126
Recreation	**432**	1,297	-	1,297
Government & Health	**2,039**	1,712	2,056	(344)
Mineral Exploration	**197**	450	70	380
Non-basic	**1,406**	1,509	1,362	147
Construction	**61**	92	55	37
	634	717	593	124
Trade/Transportation/Leisure				
Finance	**155**	142	162	(20)
Other wage & salary	**239**	241	235	6
Non-basic self employed	**317**	317	317	-
Resident jobs count	**4,675**	10,351	3,225	7,126

Note, estimates based on ISER Input-Output modeling described in section below. Fish harvesting and processing include other fisheries besides salmon, thus employment numbers cannot be compared with other tables shown in this report. Summer and winter employment shown, are point estimates that either show the maximum or minimum job count. Swing refers to the difference between maximum and minimum.

Subsistence users are not the only hunter-gatherers in this economy. Essentially the entire private economy is "following the game" (or in this case fish), with many commercial fishermen, processors, sport anglers, sport hunters, and wildlife viewers coming from elsewhere in Alaska or outside the state to be part of this unique economy at the time that fish and game are available. The estimated earnings associated with the salmon ecosystem-dependent jobs are shown in Table 6. The total of $283 million was divided among $78 million for residents of the Bristol Bay region, $104 million to residents of the rest of Alaska, and $100 million to residents of other states.

Table 6. Cash Economy Estimated Economic Significance of Bristol Bay Ecosystems

	Total	Residents			Non-Residents
		Non-local	Local	Total	
Direct jobs					
Peak	**14,227**	4,365	2,273	6,639	7,587
Commercial fish	***11,572***	*3,251*	*1,089*	*4,341*	*7,231*
Recreation	***2,655***	*1,114*	*1,184*	*2,298*	*356*
Subsistence	***non-mkt.***	*non-mkt.*	*non-mkt.*	*non-mkt.*	*non-mkt.*
Annual average	**2,811**	914	585	1,499	1,313
Commercial fish	***1,897***	*530*	*177*	*707*	*1,190*
Recreation	*914*	*384*	*408*	*792*	*123*
Subsistence	***non-mkt.***	*non-mkt.*	*non-mkt.*	*non-mkt.*	*non-mkt.*
Multiplier Jobs	**3,455**	2,008	1,447	3,455	-
Total jobs (annual average)	**6,266**	2,922	2,032	4,954	1,313
Direct wages ($000)	**$166,632**	$40,149	$31,048	$66,199	$100,435
Commercial fish	***$134,539***	*$22,698*	*$17,608*	*$40,307*	*$94,233*
Recreation	***$32,093***	*$12,451*	*$13,440*	*$25,892*	*$6,202*
Subsistence	***non-mkt.***	*non-mkt.*	*non-mkt.*	*non-mkt.*	*non-mkt.*
Multiplier wages	**$115,976**	$69,250	$46,724	$115,976	-
Total wages	**$282,608**	$104,399	$77,772	$182,175	$100,435

Note, estimates based on ISER Input-Output modeling described in section below.

Table 6 provides an accounting of jobs and wages for the cash economy component of the Bristol Bay mixed cash-subsistence economy. Kreig et al. (2007) describe the participation in the subsistence side of the economy through sharing, bartering, and cash exchange for subsistence harvests. An estimate of the number of jobs or livelihoods supported by the subsistence sector

(besides those associated with expenditures for tools, equipment, and supplies in Table 3) can be approximated through either a top-down or bottom-up estimation approach.

Population levels in Bristol Bay were 7,475 in 2010 (Table 1). Based on 2010 census counts, the number of Bristol Bay residents aged 16 and over was 5,448. The cash economy and equivalent full-time employment of Alaskans in the Bristol Bay region is estimated at 4,675 (Table 5). The estimated cash economy employment for local Bristol Bay residents only is 2,032 (Table 6). By not choosing to move elsewhere, Bristol Bay residents reveal their preference for the livelihood presented by the mixed cash-subsistence economy. This is supported by the findings in Borass (2011). For example, several local interviewees were quoted as saying "But I wouldn't trade this place for anything. This is home; this is where I find clean water to drink." And "We love this place. Moving is not an option to me." (Boraas (2011) p. 3.)

Data in Holen et al. (2011) indicate that for Bristol Bay communities participation in subsistence activities is very high. In the towns of King Salmon, Naknek and South Naknek 90% or more of residents reported participation in subsistence harvest activities (p. 20). One estimate of participation (employment) in the subsistence livelihood (full-time equivalent jobs) would be to attribute the residual of the adult (16 and over) population less the cash economy jobs (Table 5)—or around 3,400 jobs to this sector. Therefore, the non-cash economy jobs associated with the subsistence sector may be roughly 3,400.

Another approach would be to examine the effort levels (days in subsistence activities) based on subsistence fishing permit data. Fall et al. (2009) indicates that the harvest levels per day are actually constrained not by potential daily harvest, but by the processing capacity of the family unit (or extended family).

The total number of full-time equivalent jobs directly dependent on the wild salmon ecosystem is the sum of the cash economy jobs (6,266) plus the subsistence sector livelihoods (roughly estimated at (3,400 jobs), or about 9,600 jobs.

Net Economic Values

The preceding discussion has focused on a regional economic accounting framework and job and wage-related measures of economic significance. This section introduces the net economic value measures for evaluation of the renewable Bristol Bay resources. The framework for this accounting perspective is the standard federal guidelines for estimating net economic benefits in a system of national accounts (Principles and Standards, U.S. Water Resources Council 1985). EPA (2010) is a more recent and complementary set of guidelines.

The Alaskan subsistence harvest is not traditionally valued in the marketplace. Because the subsistence resources are not sold, no price exists to reveal the value placed on these resources within the subsistence economy. The prices in external markets, such as Anchorage, are not really relevant measures of subsistence harvest value. The supply/demand conditions are unique to the villages, many of which are quite isolated. Native preferences for food are strongly held

and often differ from preferences in mainstream society. Additionally, because these are highly vertically integrated economies, substantial value-added may occur before final consumption (such as drying, or smoking fish and meats). In their research on estimating the economic value of subsistence harvests, Brown and Burch (1992) suggest that these subsistence harvests have two components of value, a product value, and what they call an "activity value." The product value is essentially the market value of replacing the raw subsistence harvest. The activity value would primarily include the cultural value of participating in a subsistence livelihood. The activity value component is also associated with the value of engaging in subsistence harvest and food processing activities. This activity value would include maintaining cultural traditions associated with a subsistence livelihood. Duffield (1997) estimated a hedonic model of subsistence harvest of 90 Alaskan communities. This model was updated to incorporate current subsistence harvest data, and education and income data, and estimated a total NEV per pound of usable subsistence harvest of between $60.24 and $86.06.

Based on an estimated 2.6 million pounds of subsistence harvest per year in the Bristol Bay region, and valued at an estimated range of $60.24 to $86.06 per pound, this harvest results in an estimated net economic value annually of subsistence harvest of between $154.4 and $220.6 million.

The net economic value of commercial fisheries is estimated based on data on salmon fishery permit sales prices for Bristol Bay. The Commercial Fish Entry Commission reports average permit transfer prices annually (and monthly) for the Bristol Bay salmon fishery.[4] Over the period from 1991-2011 the average sales price for Bristol Bay drift net permits has been $149,000 (in 2011 dollars). The average price for set net permits over the same period has been $42,200. The 95% confidence interval on the mean drift net price for this period is from $105,500 to $192,700. For the set net permit transfers, the 95% C.I. on the mean sales price was between $28,700 and $55,700.[5] For both types of permits combined, it is estimated that the total market value of the permits ranges from approximately $225 million to $414 million.

In order to be comparable to other annual net economic values in this analysis (such as sport fishing or sport hunting) the net present value of commercial fishing permits, as represented by the market value, must be converted into an annual value reflecting expected annual permit net income The permit total value can be annualized using an appropriate amortization (or discount) rate. The decision to sell a commercial fishing permit at a given price is an individual (or private) decision. In deciding on an acceptable sales price, a permit holder considers past profits from operating the permit, risk associated with future operation of the permit (both physical and financial), and many other factors. All these considerations weigh on how heavily a permit seller discounts (reduces) potential future profits from fishing the permit in order to arrive at a lump-sum value for the permit. Huppert et al. (1996) specifically looked at Alaska commercial salmon permit operations and sales and estimated the individual discount rate on drift net permit sales in the Bristol Bay and surrounding fisheries. This discount rate was estimated from both profitability and permit sales price data. Huppert et al. estimated the implied discount rate

[4] A long time series of monthly and annual permit transfer prices is continuously updated at, http://www.cfec.state.ak.us/pmtvalue/mnusalm.htm

[5] Over the period 1991-2011, a total of 3,246 Bristol Bay drift net salmon permits and 1,867 set net salmon permits were reported sold by the Commercial Fish Entry Commission.

appropriate for annualizing permit sales prices in this setting at 13.52%. This estimate was consistent with previous estimates for the fishery.[6] Use of the 13.52% discount rate from Huppert results in an estimated average annual permit net income associated with Bristol Bay commercial salmon fishing of between $30.4 million and $55.9 million.

Net income for the processing sector is more difficult to estimate. Relative to the fishing sector, with ex-vessel value of $181 million in 2010, the processing sector provides an approximately equal value added of $209 million in 2010 (first wholesale value of $390 million in 2010 less the cost of buying fish at the ex-vessel cost of $181 million. (Figure 4) However, information on profits or net income for this sector are difficult to obtain. As with permit prices, processor profits are highly variable year-to-year. The average value added associated with salmon processing for the Bristol Bay fishery is generally equal to or more than the ex-vessel value. Salmon processors in the Bristol Bay fishery have an "oligopsony" market structure, in that a small number of buyers of raw fish exist in the market. Additionally, these buyers are largely "price makers" in that they set the price paid per pound to fishermen each season. Given the unique relationship between fisherman that the small number of processors in the Bristol Bay, it is estimated that processors derive profits (net economic value) equal to that earned by fishermen. Therefore, for the purposes of this report it is estimated that the NEV for salmon producers is equal to that for the fishing fleet. Estimation of harvest and processing sector net income using a second independent set of net income estimates and assumptions supports the result that a range of annual NEV commercial fisheries estimates from $60.8 to $111.8 million provides a conservative estimate for this sector.

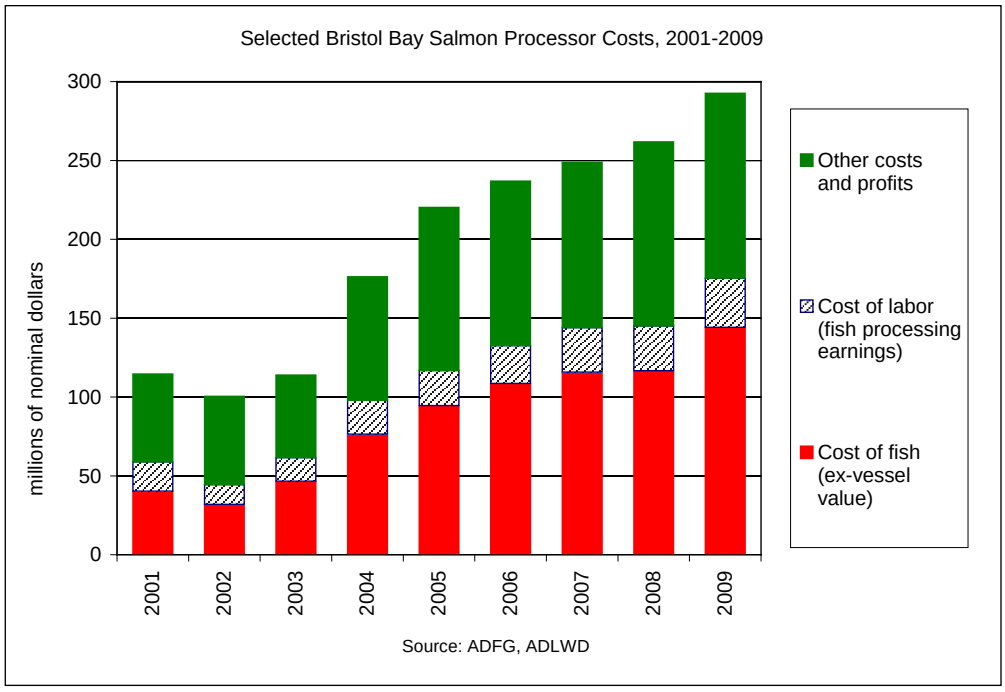

Figure 4. Selected Bristol Bay Salmon Processor Costs: 2001-2009

[6] Huppert, Ellis and Nobel (1996) estimated the real discount rate associated with sales of Alaska drift gill-net commercial permits of 13.52%. Karpoff (1984) estimated the discount rate from sales of Alaska limited entry permits at 13.95%.

The sportfish net economic values are angler recreational benefits (consumer surplus) in Duffield et al. (2007). These estimates are consistent with values from the extensive economic literature on the value of sportfishing trips (for example Duffield, Merritt and Neher 2002). Sport hunting values are based on studies conducted in Alaska McCollum and Miller (1994). Direct use values for all uses total from $237 million to $354 million per year. In addition to recreationist's net benefits, net income (producer's surplus) is recognized by the recreation and tourism industry. This is a component that remains to be estimated.

Based on the National Research Council panel on guidelines for valuation of ecosystem services (NRC 2005), it is important to include intrinsic or passive use values (aka "non-use" values) in any net economic accounting of benefits (Figure 5).

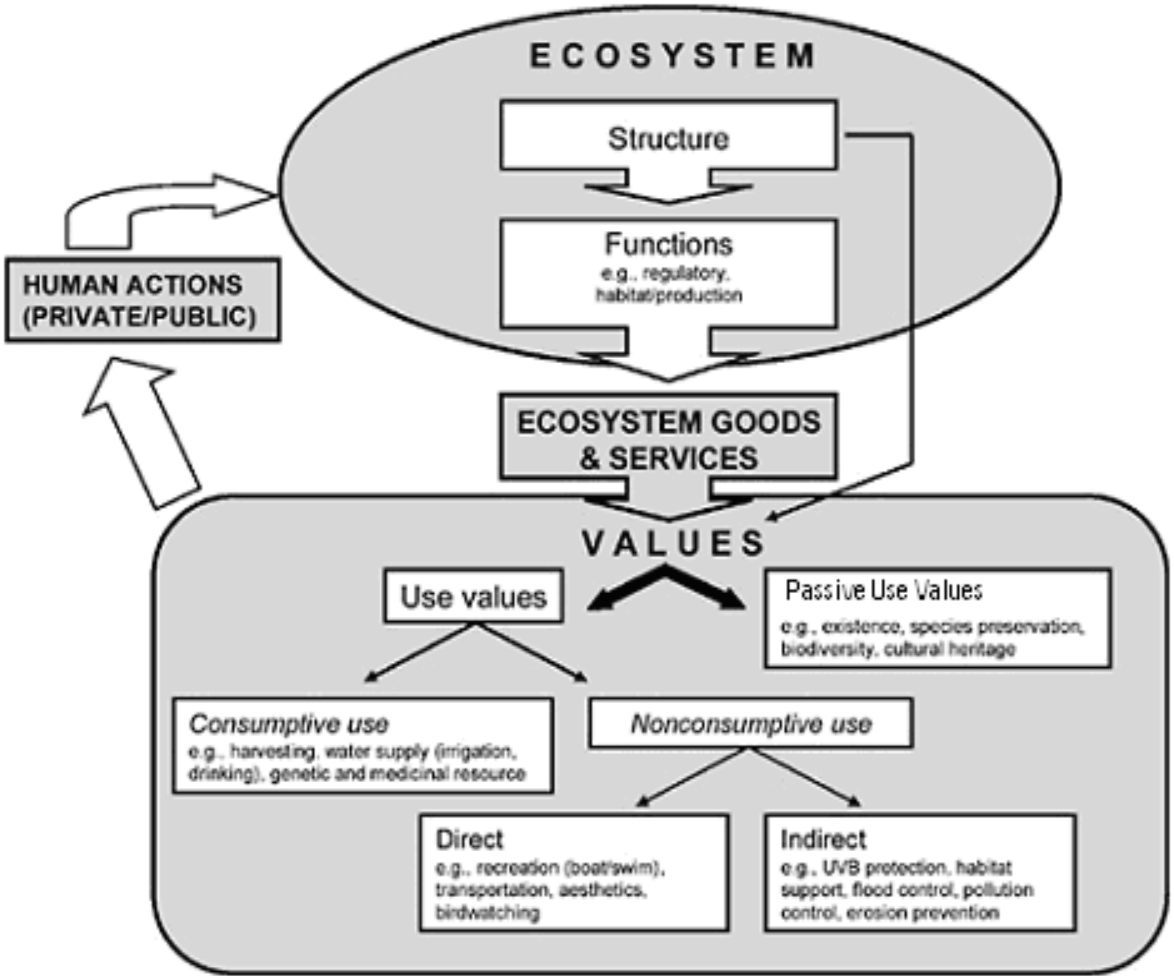

Figure 5. Flows of Ecosystem Services (adapted from (National Research Council 2005))

A major unknown is the total value related to existence and bequest motivations for passive use values. Goldsmith et al. (1998) estimated the existence and bequest value for the federal wildlife

refuges in Bristol Bay at $2.3 to $4.6 billion per year (1997 dollars). There is considerable uncertainty in these estimates, as indicated by the large range of values. Goldsmith's estimates for the federal wildlife refuges are based on the economics literature concerning what resident household populations in various areas (Alberta, Colorado) (Adamowicz et al. 1991; Walsh et al. 1984; Walsh et al. 1985) are willing to pay to protect substantial tracts of wilderness. Similar literature related to rare and endangered fisheries, including salmon, could also be applied here. It is possible that from a national perspective the Bristol Bay wild salmon ecosystems and the associated economic and cultural uses are sufficiently unique and important to be valued as highly as wilderness in other regions of the U.S.. Goldsmith et al.'s (1998) estimates assume that a significant share of U.S. households (91 million such households) would be willing to pay on the order of $25 to $50 per year to protect the natural environment of the Bristol Bay federal wildlife refuges. The number of these households used in Goldsmith's analysis is based on a willingness to pay study (the specific methodology used was contingent valuation) conducted by the State of Alaska Trustees in the Exxon Valdez oil spill case (Carson et al. 1992). These methods are somewhat controversial among economists, but when certain guidelines are followed, such studies are recommended for use in natural resource damage regulations (for example, see Ward and Duffield 1992). The findings of the Exxon Valdez study were the basis for the $1 billion settlement between the State and Exxon in this case. Willingness-to-pay analyses have also been upheld in court (Ohio v. United States Department of Interior, 880 F.2d 432-474 (D.C. Cir.1989)) and specifically endorsed by a NOAA-appointed blue ribbon panel (led by several Nobel laureates in economics) (Arrow et al. 1993).

While the primary source of passive use values for Bristol Bay are likely to be with national households (lower 48), it is important to note that the Alaska natives living in Bristol Bay also likely have significant passive use values for the wild salmon ecosystem. For example, Boraas (2011) quotes Bristol Bay natives in saying "We want to give to our children the fish, and we want to keep the water clean for them…It was a gift to us from our ancestors, which will then be given to our children.) (Boraas p. 33).

Goldsmith's estimates for just the federal refuges may be indicative of the range of passive use values for the unprotected portions of the study area. However, there are several caveats to this interpretation. First, Goldsmith et al. estimates are not based on any actual surveys to calculate the contingent value specific to the resource at issue in Bristol Bay. Rather, they are based on inferences from other studies, a method referred to as benefits transfer. Second, these other studies date from the 1980's and early 1990's and the implications of new literature and methods have not been examined. Additionally, the assumptions used to make the benefits transfer for the wildlife refuges may not be appropriate for the larger Bristol Bay study area which includes not only the wildlife refuge, but also two large national parks. This topic is an area for future research.

Table 7. Summary of Bristol Bay Wild Salmon Ecosystem Services, Net Economic Value per Year (Million 2009 $)

Ecosystem Service	Low estimate	High estimate
Commercial salmon fishery		
Fishing Fleet	$30.4	$55.9
Fish Processing	$30.4	$55.9
Sport fishing	$12.2	$12.2
Sport hunting	$1.4	$1.4
Wildlife viewing / tourism	$8.1	$8.1
Subsistence harvest and activity	$154.4	$220.6
Total Direct Use Value	**$236.90**	**$354.10**

Table 7 provides a summary of annual net economic values. Since these are values for renewable resource services that in principle should be available in perpetuity, it is of interest to also consider their present value (e.g. total discounted value of their use into the foreseeable future). The controlling guidance document for discounting in cost benefit analysis, OMB Circular A-4 (2003), generally requires use of discount rates of 3% and 7%, but allows for lower, positive consumption discount rates, perhaps in the 1 percent to 3 percent range, if there are important intergenerational values. Weitzman (2001), conducted an extensive survey of members of the American Economic Association, and suggests a declining rate schedule, which may be on the order of 4 percent (real) in the near term and declining to near zero in the long term. He suggests a constant rate of 1.75% as an equivalent to his rate schedule. Weitzman's work is cited both in the EPA guidance (EPA 2000) and in OMB guidance (*Circular A-4* (2003)). Table 8 shows the estimated net present value in perpetuity of direct use values within the Bristol Bay Ecosystem. The table shows a range of alternative discount rates from the standard "intragenerational" rates of 7% and 3% to the more appropriate "intergenerational" rates for the Bristol Bay case of 1.75% and 1.0%. The entire range of NPV estimates in the table is from $3.4 to $35.4 billion. The range of estimated direct use NPV of the resource using the more appropriate intergenerational discount rates is from $13.5 to $35.4 billion. These estimates are likely quite conservative as they do not include estimates of passive use values, but are limited to direct economic uses of the wild salmon ecosystem services.

Table 8. Estimated Net Present Value of Bristol Bay Ecosystem Net Economic Use Values and Alternative Assumed Perpetual Discount Rates

Estimate		Net Present Value (million 2009 $)			
	Annual Value	7% Discount	3% Discount	1.75% Discount	1% Discount
Low Estimate	$236.9	$3,384	$7,897	$13,537	$23,690
High Estimate	$354.1	$5,059	$11,803	$20,234	$35,410

1.0 Introduction and Setting

This report provides information on the importance of wild fisheries and the natural environment in the Bristol Bay region to the economies of the Bristol Bay region, the State of Alaska and the U.S. as a whole.

1.1 Study Objectives and Report Organization

The primary purpose of this report is to estimate baseline levels of economic activity and values associated with the current Bristol Bay Region wild salmon resource. This comprehensive report includes and synthesizes individual reports on separate components of economic activity and values linked to the Bristol Bay Ecosystem. Economic activity linked to Bristol Bay includes sportfishing, subsistence harvest, sport hunting, and commercial fishing. Additionally, an analysis of the structure of the Bristol Bay economy and the significance of these ecosystem-related economic activities to the economy is presented.

This report on the baseline levels of economic activities (as of 2009) within the Bristol Bay Ecosystem is organized as follows:

Section 1: Introduction and Setting
Section 2: Baseline Recreation and Subsistence Economics
Section 3: Baseline Commercial Fisheries Activity
Section 4: Economic Significance Analysis (Schworer et al.)
Section 5: Baseline Net Economic Values

The major components of the total value of the Bristol Bay area wild salmon ecosystems include subsistence use, commercial fishing and processing, sportfishing, and the preservation values (or indirect values) held by users and the U.S. resident population. The overall objectives of this work are to estimate the share of the total regional economy (expenditures, income and jobs) that is dependent on these essentially pristine wild salmon ecosystems, and to provide a preliminary but relatively comprehensive estimate of the total economic value associated with the ecosystem.

It is important to note that while the geographic scope of this economic characterization report is targeted to the Bristol Bay wild salmon ecosystem, the scope of the proposed mining activity is somewhat narrower, including the Nushugak and Kvichak drainages. Values tied to, and specific to, the proposed mining activity (and discharges) in the Nushugk and Kvichak Drainages would be a subset of those reported here, and have not been identified in this general characterization analysis.

This report used existing information and data to target this economic characterization report to ecosystem services and associated economic activity and values, specific to the Bristol Bay Region. However, data on different economic sectors vary in quality, and available data on some

economic activities (such as non-consumptive tourism) make it more difficult to identify activities and associated economic values narrowly targeted to the Bristol Bay area. The overall intent of this report is to provide a general picture of the full range of economic values associated with ecosystem services supplied by the entire Bristol Bay region.

1.2 Definition of Study Area

The Bristol Bay region is located in southwestern Alaska. The region, which includes Bristol Bay Borough, the Dillingham Census Area, and a large portion of Lake and Peninsula Borough, contains a relatively small number of communities, the largest of which are shown in Figure 6. The area is very sparsely populated and the large majority of its population is comprised of Alaskan Natives (Table 9). Although median household income varies among census areas within the region, outside of the relatively small Bristol Bay Borough, income is somewhat lower than for the state of Alaska as a whole. As noted, Alaskan Natives make up over two-thirds of the total population within the region as compared to approximately 15% for the entire state (Table 9)

Table 9. Demographic and Socioeconomic Characteristics of the Bristol Bay Region

Area	Population 2010	Percent Alaska Native	Percent 18 or over	Number of households	Median household income 2009
Bristol Bay Borough	997	48.2%	77.4%	423	$ 64,418
Dillingham Census Area	4,847	80.4%	67.1%	1,563	$ 46,580
Lake & Peninsula Borough	1,631	74.6%	69.8%	553	$ 42,234
Total Bristol Bay Region	7,745	73.8%	66.7%	2,539	$ 48,010
State of Alaska	710,231	14.8%	73.6%	234,779	$ 66,712

Source: US Census Quickfacts. Quickfacts.census.gov

Table 10. Bristol Bay Area Communities and Populations

Bristol Bay Area Community	Population (2010 census)
Aleknagik	219
Clark's Point	62
Dillingham	2,329
Egegik	109
Ekwok	115
Igiugig	50
Iliamna	109
King Salmon	374
Kokhanok	170
Koliganek	209
Levelock	69
Manokotak	442
Naknek	544
New Stuyahok	510
Newhalen	190
Nondalton	164
Pedro Bay	42
Pilot Point	68
Port Alsworth	159
Port Heiden	102
South Naknek	79
Ugashik	12
Togiak City	817
Portage Creek	2
Twin Hills	74

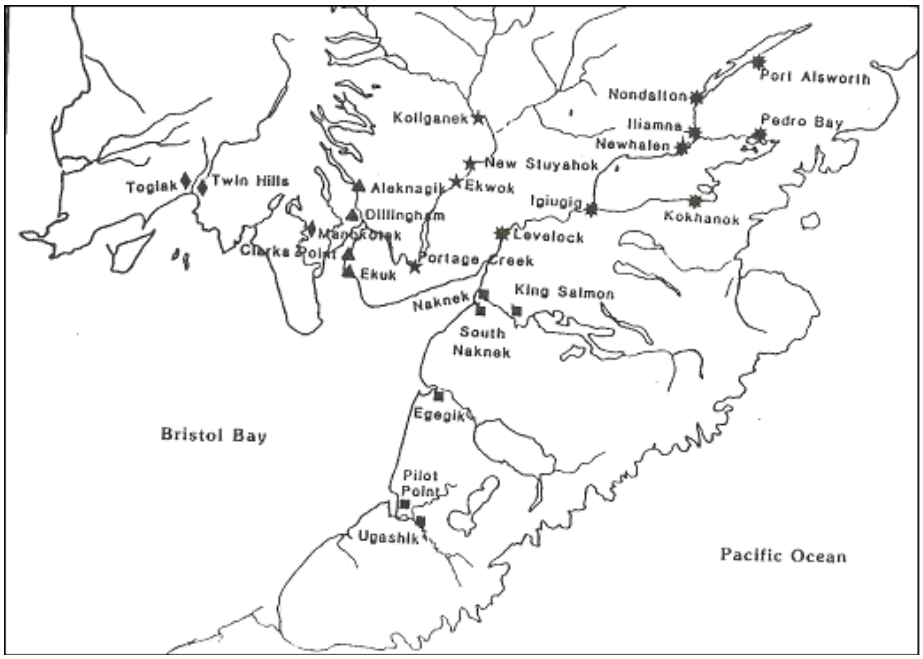

Figure 6. Bristol Bay Area Location and Major Communities

This study focuses on the economic contributions of the Bristol Bay ecosystem. The rivers that flow into the Bristol Bay comprise some of the last great wild salmon ecosystems in North America (Figure 7). All five species of Pacific salmon are abundant, and the rich salmon-based ecology also supports many other fish species, including healthy populations of rainbow trout. The Naknek, Nushagak-Mulchatna, and Kvichak-Lake Iliamna watersheds are relatively pristine with very little roading or extractive resource development. The existing mainstays of the economy in this region are all wilderness-compatible and sustainable in the long run: subsistence use, commercial fishing, and wilderness sportfishing. Commercial fishing largely takes place in the salt water outside of the rivers themselves and is closely managed for sustainability. The subsistence and sportfish sectors are relatively low impact; primarily personal use and catch and release fishing, respectively. Additionally, there are important public lands in the headwaters, including Lake Clark National Park and Preserve, Katmai National Park and Preserve, and Togiak National Wildlife Refuge.

The Bristol Bay area includes the political designations of Bristol Bay Borough, the Dillingham census area, and most of Lake and Peninsula Borough. The largest town in the area is Dillingham. In 2010 the Dillingham census area had an estimated population of 4,847 (US Census, Quick Facts).

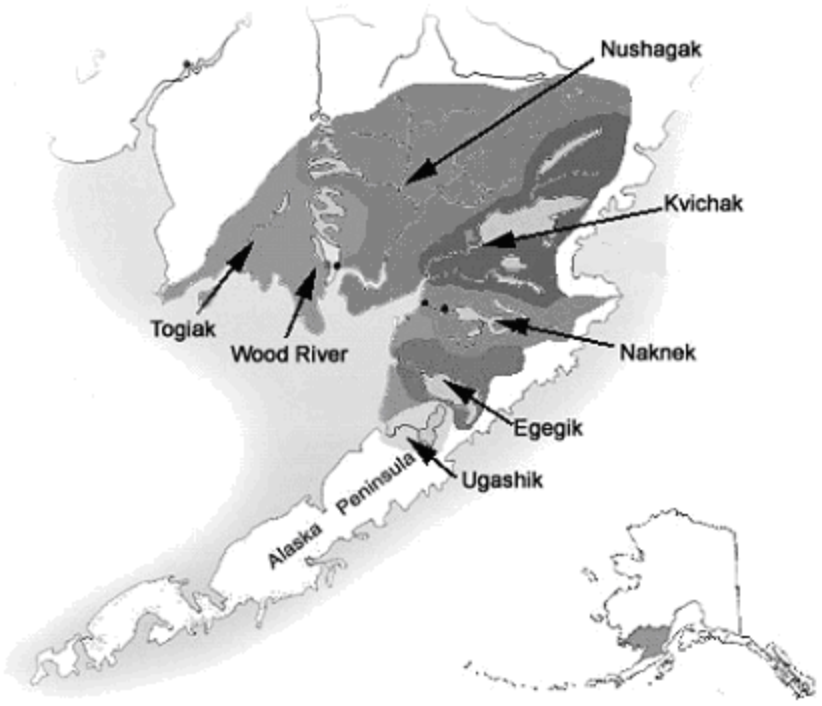

Figure 7. Map of Bristol Bay Study Area

1.3 Focus of Study-Economic Uses

As noted, this report focuses on estimating baseline levels of ecosystem services provided by the Bristol Bay Region. These services are broad and substantial and include, but are not limited to commercial, aesthetic, recreational, cultural, natural history, wildlife and bird life, and ecosystem services.

A primary dichotomy of economic value is the division of values into those that are, or can be traded within existing economic markets, and those for which no developed market exists. Examples of ecosystem services specific to the Bristol Bay region that are traded in markets are commercial fish harvests and guided fishing trips. While a number of services provided by Bristol Bay natural resources can be classified as market services (with associated market-derived values), there are many services provided by this area that are classified as non-market services. These non-market resource services include noncommercial fishing, wildlife watching, subsistence harvests, protection of cultural sites, and aesthetic services.

A second dichotomy of resource services and associated values is that of direct use and passive use services and values. The most obvious type, direct use services, relates to direct onsite uses. The second type of resource services are so-called passive use services. These services have values that derive from a given resource and are not dependent on direct on-site use. Several types of passive use values were first described by Weisbrod (1964) and Krutilla (1967), and

include existence and bequest values. Existence values can derive from merely knowing that a given natural environment or population exists in a viable condition. For example, if there were a proposal to significantly alter the Bristol Bay natural ecosystem, many individuals could experience a real loss, even though they may have no expectation of ever personally visiting the area. Bequest values are associated with the value derived from preserving a given natural environment or population for future generations. While use values may or may not have associated developed markets for them, passive use services are exclusively non-market services.

When passive use and use values are estimated together, the estimate is referred to as total valuation. This concept was first introduced by Randall and Stoll (1983) and has been further developed by Hoehn and Randall (1989).

The National Research Council in their 2005 publication "Valuing Ecosystem Services: Toward Better Environmental Decision Making" provided an outline of ecosystem services. Table 11 provides an application of the NRC outline to Bristol Bay resources, and details examples of the ecosystem services, both use and passive use, that are produced by natural resources such as those found in the Bristol Bay region.

Table 11: Types of Ecosystem Services

Use Values		Nonuse Values
Direct	**Indirect**	**Existence and Bequest Values**
Commercial and recreational fishing	Nutrient retention and cycling	Cultural heritage
Aquaculture	Flood control	Resources for future generations
Transportation	Storm protection	Existence of charismatic species
Wild resources	Habitat function	Existence of wild places
Potable water	Shoreline and river bank stabilization	
Recreation		
Genetic material		
Scientific and educational opportunities		

A comprehensive economic evaluation of these Bristol Bay wild salmon ecosystems needs to include two distinct accounting frameworks. One is regional economics or economic significance, focused on identifying cash expenditures that drive income and job levels in the regional economy. The other is a net economic value framework that includes all potential costs

and benefits from a broader social perspective. The latter necessarily includes non-market and indirect benefits, such as the benefits anglers derive from their recreational activity, over and above their actual expenditure. Both perspectives are important for policy discussions and generally both accounting frameworks are utilized in evaluating public decisions.

2.0 Bristol Bay Recreation and Subsistence Economics

Section 2 of this report addresses the regional economic activity associated with the recreation and subsistence sectors. Primary recreational activities examined include sportfishing, sport hunting, and tourism/wildlife viewing.

2.1 Bristol Bay Sportfishing Economics

Sportfishing is a consistently economically significant economic activity in the Bristol Bay Region. Information sources for this section are the Duffield et al. (2007) report on Bristol Bay Salmon Ecosystem economics (referred to hereafter as the 2005 Bristol Bay Study), and Alaska Department of Fish and Game estimates of the total populations of anglers fishing the Bristol Bay Area waters. (pers. Comm. G. Jennings, August 2011)

The sport angler and trip characteristics, expenditures, and values are presented using several sub-sample breakouts. Comparisons of sub-samples are presented to highlight similarities as well as differences between sample groups. Primary sub-samples examined include non-resident anglers, non-local Alaska resident anglers, and Bristol Bay resident anglers.

The 2005 Bristol Bay study examined angler responses to a wide range of questions on their opinions, preferences, and experiences relating to fishing in the Bristol Bay area. The following sportfishing results focus on key characteristics of Bristol Bay sportfishing. Estimates of angler spending and net economic values have been adjusted from the original 2005 dollars to 2009 dollars using the Consumer Price Index-Urban (CPI-U).

2.1.1 Bristol Bay Area Trip Characteristics and Angler Attitudes

The 2005 Bristol Bay Study reported several differences between how nonresident anglers and Alaska anglers access Bristol Bay fisheries and the types of accommodations they use when there. For non-resident anglers the most common trip included staying at a remote lodge and flying or boating with a guide (35.2%). Resident anglers accessed the Bristol Bay area with their own plane or boat (49.9%), driving to area by motor vehicle (11.3%), and “other” type of trips (24%). Those who reported driving to access Bristol Bay fisheries were primarily residents and nonresidents staying in the King Salmon and Dillingham area, where a few local roads exist and provide some access to nearby fisheries.

Table 12. Bristol Bay Angler Distribution across Trip Types, by Residency

Trip Type	*Non-residents (%)*	*Alaska Residents (%)*
Stayed at a remote lodge and flew or boated with a guide to fishing	35.2	-
Stayed at a tent or cabin camp and fished waters accessible from camp	23.7	7.8
Hired other lodging in an area community and either fished on own or contracted for travel on a daily basis	6.4	4.2
Floated a section of river with a guided party	3.9	2.8
Hired a drop-off service and fished and camped on our own	4.3	2.2
Accessed the area with my own airplane or boat	8.3	49.9
Drove to the area by motor vehicle	4.3	11.3
Other	14.0	24.0
Sample Size	246	55
Note: sample size for resident sample is not large enough to divide into local and non-local sub-samples		

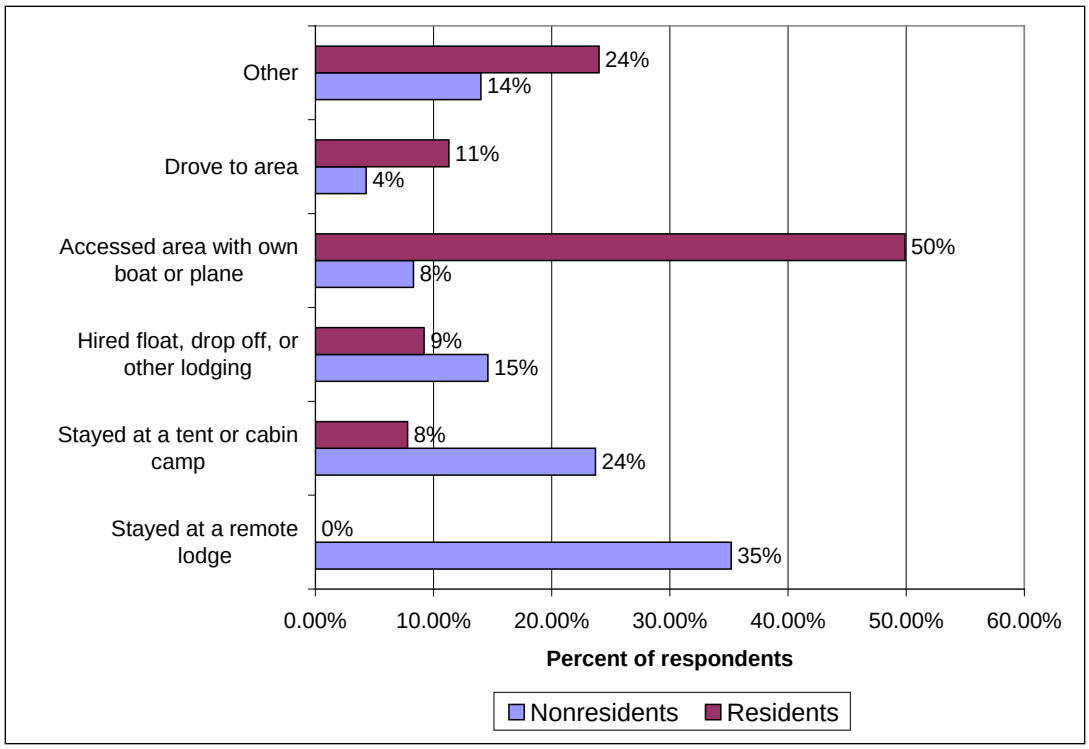

Figure 8. Comparison of Resident and Nonresident Bristol Bay Angler Trip Types

Respondents to the 2005 Bristol Bay survey were asked what was the primary purpose of their trip to the Bristol Bay area. A majority of nonresidents (73%) reported fishing as their major purpose; 30% of resident anglers reported fishing as the main purpose of their most recent Bristol Bay trip. Table 13 also shows that a much larger proportion of non-residents (45%) than residents (11.4%) were on their first trip to their primary fishing destination.

Table 13: Bristol Bay Angler Trip Characteristics.

Statistic	*Nonresidents (sample size)*	*Alaska Residents*
Major purpose of trip was for fishing	72.7% (246)	29.5% (54)
Trip was first trip to primary destination	45.2% (245)	11.4% (48)

Survey respondents in the 2005 study were asked what fish species they targeted on their most recent trip to Bristol Bay. Table 14 reports these results. Overall, king salmon and rainbow trout were the most frequently targeted species for both residents and non-residents.

Table 14: Bristol Bay Angler Survey, Targeted Species.

	Bristol Bay Anglers	
Primary species targeted on trip / statistic	**Nonresidents**	**Alaska Residents**
Rainbow Trout	30.6%	31.3%
King Salmon	35.2%	29.8%
Silver Salmon	16.3%	16.5%
Sockeye Salmon	9.1%	0%
Other Species	8.8%	22.4%
Sample size	235	48

Respondents to the 2005 Bristol Bay angler survey were presented with a series of statements regarding fishing conditions on their Bristol Bay area trip. They were asked to indicate their level of agreement or disagreement with each statement. Table 15 shows the percent of residents and non-residents who either "agreed" or "strongly agreed" with each statement. Across all of the statements presented in the survey, majorities of both resident and non-resident respondents agreed with the positive statements about their fishing experience. The highest levels of agreement for both nonresidents and Alaska resident anglers were with the statements "there was a reasonable opportunity to catch fish", "there was minimal conflict with other anglers", and "fishing was in a wilderness setting."

Table 15: Bristol Bay Angler Rating of Selected Attributes of Fishing Trip

Statement	*% of respondents who either "agree" or "strongly agree"*	
	Nonresidents	**Alaska Residents**
Fishing conditions were un-crowded	87.2%	75.4%
There was a reasonable opportunity to catch fish	96.5%	93.0%
There was minimal conflict with other anglers	93.3%	90.7%
Fishing was in a wilderness setting	92.4%	95.0%
There was opportunity to catch trophy-sized fish	81.4%	70.0%
There was opportunity to catch and release large # of fish	87.3%	76.6%
Sample Size	235	47

2.1.2 Bristol Bay Angler Expenditures

Respondents to the 2005 Bristol Bay angler survey were asked a series of questions relating to the amount of money they spent on their fishing trips. Average spending per trip was estimated for three types of anglers: local Bristol Bay Area residents, Alaska residents from outside the Bristol Bay region, and nonresidents. Adjusted to 2009 price levels, nonresidents reported spending the most for their sportfishing trips to Bristol Bay ($3,995). Alaska resident anglers, those from outside Bristol Bay spent an average of $1,582 per trip and those living within the Bristol Bay region reported spending an average of $373 per sportfishing trip.

Table 16 breaks out average expenditures by impact region and type of fishing trip for the nonresident angler sample. Where money is spent on a trip determines local economic impacts. For instance, a given amount of money spent within the very small Bristol Bay economy has a much greater relative impact than the same amount of money spent in a larger economy, such as Anchorage. Table 16 shows that the largest per-trip spending is made by nonresident anglers who stay at a remote lodge with daily guiding services ($6,950/trip). This compares to the lowest spending levels per trip of about $1,400 for driving to the fishing site, accessing the area with own plane or boat, and hiring a drop-off service and fishing or camping on own.

The first two rows of Table 16 show that a large portion of Alaska trip costs for remote lodge or tent or cabin camp trips is associated with the cost of a sport-fishing package or tour. This sport-fishing package spending is assumed to be spent in the Bristol Bay region.

Table 16. Nonresident Trips to Bristol Bay Waters, Mean Expenditure Per Trip Estimates By Trip Type

Trip type	*Total Reported Trip Spending*	*Bristol Bay spending*[a]	*Package sport-fishing trip spending*
Stayed at a remote lodge and flew or boated with a guide to fishing sites most days	$6,950	$1,900	$6,089
Stayed at a tent or cabin camp and fished waters accessible from this base camp	$4,158	$1,357	$3,517
Hired other lodging in an area community and either fished on own or contracted for travel on a daily basis	$2,643	$1,818	$2,576
Floated a section of river with a guided party	$2,187		
Hired a drop-off service and fished and camped on our own	$1,515	$1,145	
Accessed the area with my own airplane or boat	$1,437	$1,291	
Drove to the area by motor vehicle	$1,453	$1,062	
Other	$2,233	$1,047	$2,422

[a] all spending in Bristol Bay except package sportfishing trip expenditures (package trip expenditures are also assumed spent in the Bristol Bay Region)

Note: cells with less than 5 observations are left blank. Category values are the average values for those respondents reporting an expense in that category. Bristol Bay spending and Package sport-fishing tour spending will not necessarily sum to Total spending due to varying sample sizes.

Table 17 details the distribution of Bristol Bay trip spending across expenditure categories. For non-residents visitors, the largest three spending categories within the Bristol Bay area were for commercial and air taxi service and for lodging or camping fees (totaling about 66% of all spending in Bristol Bay). For non-local Alaska residents the three largest categories of spending were "gas and other Alaska travel costs," camping fees, and commercial air travel (totaling about 58% of all Bristol Bay spending by non-local Alaska residents).

Table 17: Distribution of Trip Expenditures across Spending Categories, by Residency and Area

	Nonresidents		***non-local AK residents***
Expenditure category	**In Bristol Bay**	**In rest of AK**	**In Bristol Bay**
Commercial air travel	31.1%	51.9%	18.1%
Air taxi service	20.5%	1.3%	11.1%
Transportation by boat	0.0%	0.0%	0.0%
Boat or vehicle rental	5.3%	4.8%	7.5%
Gas or other travel costs in AK	4.1%	1.4%	16.3%
Lodging or camping fees	13.9%	11.9%	23.6%
food or beverages	9.2%	19.3%	16.7%
Guide fees	6.2%	0.6%	0.0%
Fishing supplies	4.1%	5.2%	6.7%
Other non-fish package tours	0.1%	0.7%	0.0%
Other	5.4%	2.9%	0.0%

2.1.3 Aggregate Direct Sport fishing Expenditures in Bristol Bay

In order to derive estimated aggregate angler expenditures related to sportfishing in the Bristol Bay region, two primary pieces of information were needed: 1) the number of angler trips per year to the region by Alaska residents and nonresidents, and 2) the average spending per trip by resident and nonresident anglers. A trip is defined here as a roundtrip visit from home, and return. Estimates of the number of anglers who fished in the Bristol Bay region in 2009 were derived by ADF&G staff (Table 18). The average number of trips per angler, estimated from responses to the 2005 Bristol Bay angler survey, is also shown in Table 18. In total approximately 29,000 sport fishing trips were taken in 2009 to Bristol Bay freshwater fisheries. These trips are roughly split between 12,000 nonresident trips, 13,000 Bristol Bay resident trips, and 4,000 trips by Alaskans living outside of the Bristol Bay area.

Table 18. Estimated 2009 Bristol Bay area angler trips, by Angler Residency

Statistic	*Nonresidents*	*Out-of-area AK residents*	*BB Residents*
Annual Anglers fishing Bristol Bay waters	9,572	2,561	1,133
Average trips per angler for 2005	1.30	1.49	11.54
Estimated total trips	12,464	3,827	13,076

Table 19 presents the aggregation of total angler expenditures within the Bristol Bay region. This table shows average and aggregate estimated expenditures for three angler groups: 1) nonresident anglers, 2) local-area resident anglers (those who live in the Bristol Bay area), and 3) non-local resident anglers (those Alaska residents living outside of the Bristol Bay region). This table also shows average and total annual spending by nonresident anglers for package sportfishing trips in the Bristol Bay region.

Overall, the large majority of angler spending in the region is attributable to nonresident anglers. Additionally, the majority of nonresident spending is due to the purchase of sportfishing packages such as accommodation and angling at one of the areas remote fishing lodges. Estimates of variability were derived for average expenditure levels, and total visitation estimates. It is estimated that annually Bristol Bay anglers spend approximately $58 million within the Bristol Bay economy. Given the variability in the components of this estimate, the 95% confidence interval for Bristol Bay area spending by anglers from outside the area ranges from $0 to $130 million annually. The vast majority of this spending (approximately $47 million annually) is spent by nonresident anglers.

Table 19. Estimated Aggregate Spending Associated with Sportfishing in the Bristol Bay Region (2009 dollars)

	Nonresidents		*out-of-area AK residents*	*BB Residents*	**Total**
	All Non Residents	Remote Lodge Increment			
Mean expenditures in Bristol Bay region	$ 1,471	$4,698	$ 1,582	$ 373	
Estimated trips	12,464	6,187	3,827	13,076	29,367
Total Bristol Bay direct expenditures	$ 18,333,187	$ 29,068,303	$ 6,053,700	$ 4,874,848	$ 58,330,039

Table 20 presents total estimated direct angler expenditures by residency, and location of spending. Again, among all direct spending related to Bristol Bay angling, the large majority is associated with nonresidents traveling to Alaska. Additionally, the large majority of this spending is reported to have occurred within the Bristol Bay economy. This table categorizes spending by origin and destination. This classification is then used in the regional economic significance analysis presented in Section 4.

Table 20. Bristol Bay Sportfishing: Aggregate in and out of Region and State Spending (2009)

Population	In Bristol Bay Spending		In Alaska Spending	
	Total spending in Bristol Bay	Total spending from outside Bristol Bay	Total in-state spending	Spending from outside Alaska
NONRESIDENT Base trip spending	$ 18,333,187	$ 18,333,187	$ 20,727,318	$ 20,727,318
NONRESIDENT Sportfish package spending	$ 29,068,303	$ 29,068,303	$ 29,068,303	$ 29,068,303
NONRESIDENT TOTAL	$ 47,401,490	$ 47,401,490	$ 49,795,621	$ 49,795,621
RESIDENTS				
OUT-OF-BB RESIDENT base trip spending	$ 6,053,700	$ 6,053,700	$ 6,053,700	$ -
BB RESIDENT base trip spending	$ 4,874,848	$ -	$ 4,874,848	$ -
ALASKA RESIDENT TOTAL	$ 10,928,549	$ 6,053,700	$ 10,928,549	$ -
TOTAL	**$ 58,330,039**	**$ 53,455,190**	**$ 60,724,170**	**$ 49,795,621**

2.2 Bristol Bay Subsistence Harvest Economics

The subsistence harvest within the Bristol Bay region generates regional economic impacts when Alaskan households spend money on subsistence-related supplies. Goldsmith (1998) estimated that Alaskan Native households that use Bristol Bay wildlife refuges for subsistence harvesting spend an average of $2,300 per year on subsistence-related equipment to aid in their harvesting activities. Additionally, Goldsmith estimated that Non-Native households spend $600 annually for this purpose. Correcting for inflation from 1998 to 2009 implies annual spending for subsistence harvest of about $3,054 for Native households and $796 for Non-Native households.[7]

Figure 9 shows the general distribution of subsistence harvest by Bristol Bay residents. Overall, salmon make up the largest share of all harvest (on a basis of usable pounds), and accounts for over one-half of all harvest. Another nearly one third of harvest come from land mammals (31%), and non-salmon fish comprise another 10% of harvest.

[7] A 1998-99 survey of the village of Atyqasuk (North Slope Borough) found that 33% of households spent between $4,000 and $10,000 on subsistence activities and 9% spent more than $10,000 per year (US DOI, BLM and MMS 2005). The simple parametric mean for this inland community that harvested no whales was $3,740 per year per household (1999 dollars). The use of the adjusted Goldsmith estimates therefore likely provides a conservative estimate of subsistence expenditures.

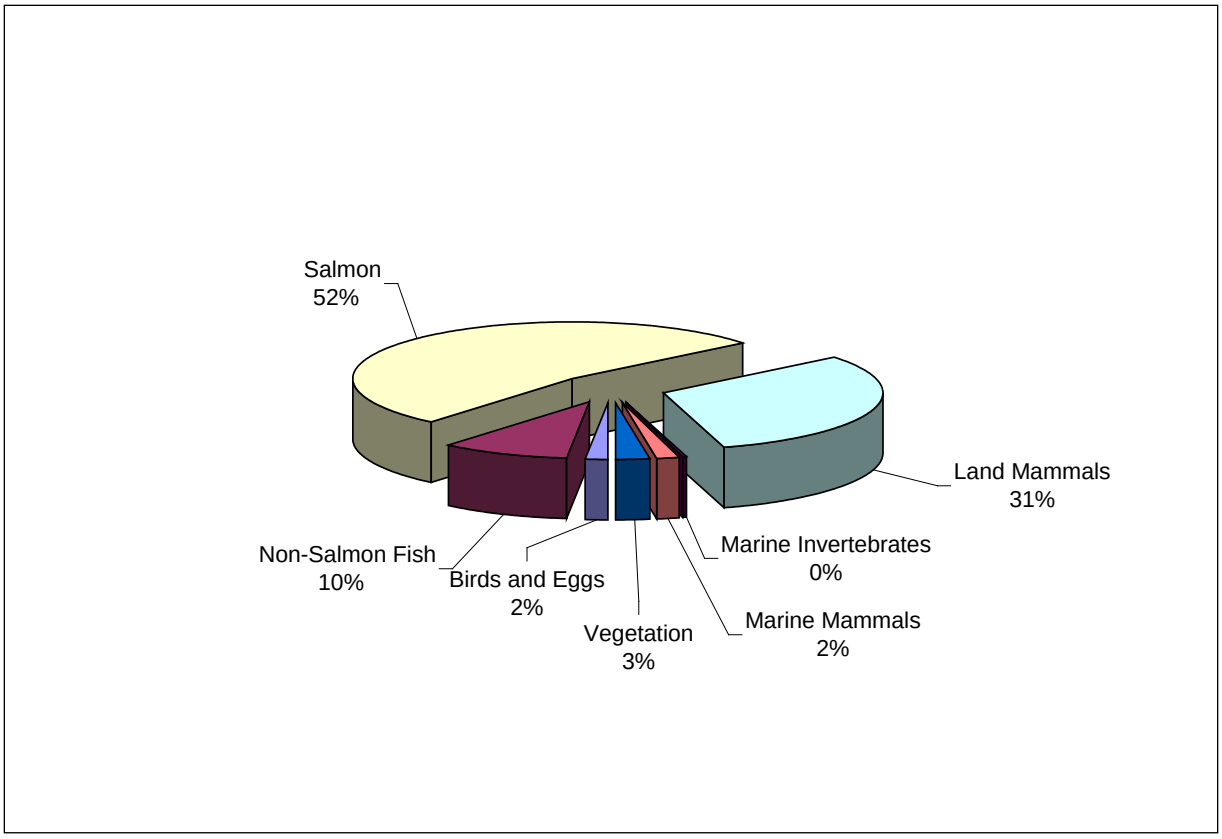

Figure 9. Distribution of Bristol Bay Subsistence Harvest

Table 21 shows average per capita and total estimated community subsistence harvest for the Bristol Bay communities. In total, individuals in these Bristol Bay communities harvest about 2.6 million pounds of subsistence harvest per year for an average of 343 pounds per person annually. Table 22 and Table 23 detail Bristol Bay area subsistence harvest by salmon species and location.

Table 21. ADF&G Division of Subsistence Average Per Capita Subsistence Harvest for Bristol Bay Communities

Bristol Bay Area Community /year of AKF&G harvest data survey	Population (2010 census)	Per Capita Harvest (raw pounds of harvest)(AKF&G Subsistence Surveys)	Total Annual Harvest
Aleknagik 2008	219	296	64,824
Clark's Point 2008	62	1210	75,020
Dillingham 1984	2,329	242	563,618
Egegik 1984	109	384	41,856

Ekwok 1987	115	797	91,655
Igiugig 2005	50	542	27,100
Iliamna 2004	109	469	51,121
King Salmon 2008	374	313	117,062
Kokhanok 2005	170	680	115,600
Koliganek 2005	209	899	187,891
Levelock 2005	69	527	36,363
Manokotak 2008	442	298	131,716
Naknek 2008	544	264	143,616
New Stuyahok 2005	510	389	198,390
Newhalen 2004	190	692	131,480
Nondalton 2004	164	358	58,712
Pedro Bay 2004	42	306	12,852
Pilot Point 1987	68	384	26,112
Port Alsworth 2004	159	133	21,147
Port Heiden 1987	102	408	41,616
South Naknek 2008	79	268	21,172
Ugashik 1987	12	814	9,768
Togiak City 2000	817	246	200,982
Twin Hills 2000	74	499	36,926
Total surveyed communities	7,018		
Un-surveyed communities	457		--
Total including un-surveyed areas	**7,475**	**343**	**2,563,313**

Table 22. Historical Subsistence Salmon Harvest for Bristol Bay, Alaska: 1975-2007 (ADF&G Division of Subsistence ASFDB)

Year	Permits	Number of Fish Harvested						
		Chinook	Sockeye	Coho	Chum	Pink	Total	Harvest per permit
1975	686	8,600	175,400	8,500	7,500	1,300	192,700	280.9
1976	716	8,400	120,900	3,500	9,100	4,400	137,900	192.6
1977	738	7,000	127,900	6,600	9,100	300	143,900	195
1978	773	8,100	127,600	4,400	16,200	12,700	160,900	208.2
1979	829	10,300	116,500	7,300	7,700	500	132,000	159.2
1980	1,243	14,100	168,600	7,300	13,100	10,000	199,000	160.1
1981	1,112	13,000	132,100	12,200	11,500	2,600	158,400	142.4
1982	806	13,700	110,800	11,500	12,400	8,600	143,300	177.8
1983	829	13,268	143,639	7,477	11,646	1,073	177,104	213.6
1984	882	11,537	168,803	16,035	13,009	8,228	217,612	246.7
1985	1,015	9,737	142,755	8,122	5,776	825	167,215	164.7
1986	930	14,893	129,487	11,005	11,268	7,458	174,112	187.2
1987	996	14,424	135,782	8,854	8,161	673	167,894	168.6
1988	938	11,848	125,556	7,333	9,575	7,341	161,652	172.3
1989	955	9,678	125,243	12,069	7,283	801	155,074	162.4
1990	1,042	13,462	128,343	8,389	9,224	4,455	163,874	157.3
1991	1,194	15,245	137,837	14,024	6,574	572	174,251	145.9
1992	1,203	16,425	133,605	10,722	10,661	5,325	176,739	146.9
1993	1,206	20,527	134,050	8,915	6,539	1,051	171,082	141.9
1994	1,193	18,873	120,782	9,279	6,144	2,708	157,787	132.3
1995	1,119	15,921	107,717	7,423	4,566	691	136,319	121.8
1996	1,110	18,072	107,737	7,519	5,813	2,434	141,575	127.5
1997	1,166	19,074	118,250	6,196	2,962	674	147,156	126.2
1998	1,234	15,621	113,289	8,126	3,869	2,424	143,330	116.2
1999	1,219	13,009	122,281	6,143	3,653	420	145,506	119.4
2000	1,219	11,547	92,050	7,991	4,637	2,599	118,824	97.5
2001	1,226	14,412	92,041	8,406	4,158	839	119,856	97.8
2002	1,093	12,936	81,088	6,565	6,658	2,341	109,587	100.3
2003	1,182	21,231	95,690	7,816	5,868	1,062	131,667	111.4
2004	1,100	18,012	93,819	6,667	5,141	3,225	126,865	115.3
2005	1,076	15,212	98,511	7,889	6,102	1,098	128,812	119.7
2006	1,050	12,617	95,201	5,697	5,321	2,726	121,564	115.8
2007	1,063	15,444	99,549	4,880	3,991	815	124,679	117.3
Average	**1,035**	**13,825**	**121,906**	**8,329**	**7,733**	**3,099**	**152,371**	**153**

Table 23. Bristol Bay Subsistence Salmon Harvests by District and Location Fished, 2007. (Fall et al. 2009)

Area and river system	Number of permits issued[a]	Estimated salmon harvest					
		Chinook	Sockeye	Coho	Chum	Pink	Total
Naknek–Kvichak District	480	672	69,837	1,104	405	262	72,280
Naknek River subdistrict	287	664	22,364	1,078	375	260	24,742
Kvichak River/Iliamna Lake subdistrict:	196	8	47,473	26	30	1	47,538
Chekok	1	0	310	0	0	0	310
Igiugig	4	1	1,419	0	2	0	1,422
Iliamna Lake-general	31	0	5,017	0	0	0	5,017
Kijik	4	0	769	0	0	0	769
Kokhanok	30	6	15,540	26	22	1	15,595
Kvichak River	12	0	1,203	0	0	0	1,203
Lake Clark	34	0	3,604	0	0	0	3,604
Levelock	1	1	102	0	6	0	109
Newhalen River	39	0	8,732	0	0	0	8,732
Pedro Bay	20	0	5,569	0	0	0	5,569
Sixmile Lake	26	0	5,208	0	0	0	5,208
Egegik District	28	165	980	334	72	26	1,577
Ugashik District	17	43	1,056	281	88	79	1,546
Nushagak District	496	13,330	25,127	3,050	3,006	430	44,944
Wood River	135	1,793	6,813	293	249	36	9,184
Nushagak River	117	5,479	5,879	1,127	1,572	213	14,270
Nushagak Bay noncommercial	228	5,138	9,545	1,467	1,009	163	17,322
Nushagak Bay commercial	33	418	887	113	119	12	1,550
Igushik/Snake River	25	500	2,000	36	57	6	2,599
Nushagak, site unspecified	1	1	3	15	0	0	19
Togiak District	48	1,234	2,548	110	420	19	4,332
Total	**1,063**	**15,444**	**99,549**	**4,880**	**3,991**	**815**	**124,679**

Notes Harvests are extrapolated for all permits issued, based on those returned and on the area fished as reported on the permit. Due to rounding, the sum of columns and rows may not equal the estimated total. Of 1,063 permits issued for the management area, 917 were returned (86.3%).

a. Sum of sites may exceed district totals, and sum of districts may exceed area total, because permittees may use more than one site.

Source ADF&G Division of Subsistence ASFDB.

In 2010 the US Census reported an estimated 1,873 Native and 666 non-native households in the Bristol Bay Region (Bristol Bay Borough, Lake and Peninsula Borough, and Dillingham). Based on the Goldsmith (1998) estimate of direct expenditures related to subsistence harvest, this implies an annual direct subsistence-related expenditure of approximately $6.3 million in the Bristol Bay region.

Table 24. Estimated Total Annual Bristol Bay Area Subsistence-Related Expenditures (2009 $)

Area	*Population 2010*	*Percent Alaska native*	*Number of households*	*Number of Native Households*	*Number of non-native Households*
Bristol Bay Borough	997	48.2%	423	204	219
Dillingham Census Area	4847	74.6%	553	413	140
Lake & Peninsula Borough	1631	80.4%	1563	1257	306
Total Bristol Bay Region	7,475	73.8%	2539	1873	666
Annual Spending/ household				$ 3,054	$ 796
Total Estimated Subsistence Spending				$ 5,720,054	$ 530,350
Total					$ 6,250,404

2.3 Bristol Bay Sport Hunting and Non-consumptive Economics

2.3.1 Sport Hunting

In addition to sport fishing, sport hunting also plays a significant (but smaller) role in the local economy of the Bristol Bay region. While not a large share of the economy, sport hunting in the Bristol Bay area offers high quality hunting opportunities for highly valued species. Bristol Bay sport hunting provides hunting opportunities for caribou, moose, and brown bear, among other species. Table 25 shows reported hunter numbers for the most recently reported representative years for several species hunted in the region. The big game hunting numbers are reported for the two Game Management Units (GMUs) that comprise the Bristol Bay Region. GMUs are spatial areas delineated by AKF&G to more closely correspond to wildlife habitat and population ranges than do other geographical or political boundaries.

Table 25. ADF&G Reported Big Game Hunting in Bristol Bay and Alaska Peninsula Game Management Units

Most recent Big Game Hunting Estimates from ADF&G Wildlife Management Reports
(Number of hunters)

	Alaska Peninsula (GMU 9)		Bristol Bay (GMU 17)	
	Non-local Residents	Nonresidents	Non-local Residents	Nonresidents
Moose	91	157	200	195
Caribou	0	0	311	230
Brown bear	600	624	117	117
	691	781	628	542

The caribou estimate for GMU 17 is for the Mulchatna herd and extends beyond GMU 17 borders
Shaded cells include both non-local residents and local residents
Sources: AKDF&G Species-specific Wildlife Management Reports

Table 26 outlines the estimation of total annual expenditures for big game hunting within the Bristol Bay region. These estimates are based on an assumption of one trip per hunter per year for a species, and utilize estimates of hunter expenditures per trip developed by Miller and McCollum (1994) adjusted to 2009 price levels.

Table 26. Estimated annual big game hunting expenditures for Bristol Bay region

Statistic	***Non-local Residents***	***Nonresidents***
Estimated trips	1,319	1,323
Expenditure per trip	$ 1,068	$ 5,170
Total estimated direct expenditure	$ 1,408,351	$ 6,839,301
Total	**$ 8,247,652.52**	

In total, it is estimated that Bristol Bay area big game hunters living outside of the area spend about $8.2 million per year in direct hunting-related expenditures. The expenditure estimate above may include some caribou hunting of the Mulchatna herd outside of the closely defined Bristol Bay region game management units, resulting in an overestimate of spending for hunting this species.

2.3.2 Non-consumptive Wildlife Viewing / Tourism Economics

Many of the sport fishing and sport hunting visitors to the Bristol Bay region also engage in other activities such as kayaking, canoeing, wildlife viewing or bird watching. These activities

are typically referred to as non-consumptive because unlike hunting or fishing, no resource is "consumed," rather the goal is to leave the resource (flora and fauna) unchanged.

The Bristol Bay region has a number of nationally-recognized special management areas for wildlife. These include Katmai and Lake Clark National Parks, the Togiak and Becherof National Wildlife Refuges, and Wood-Tikchick State Park. The most accessible and popular destination for visitors interested in non-consumptive recreation activities is Katmai National Park, and in particular Brooks Camp on Naknek Lake which is world famous as a site for bear viewing. The camp accommodates both day and overnight visitors who are there to view the bears, as well as sport fishermen.

Information on the number of non-consumptive use visitors, their itineraries and activities while in the region, and their expenditures is somewhat limited. Unlike sport fishing and sport hunting, no license is required for these other activities so there is no consistent and comprehensive record documenting these trips.

The visitation estimates that form the basis for the analysis of non-consumptive use in Southwest Alaska are primarily based on McDowell Group's (2006) Alaska Visitor Statistics Program (AVSP) estimate . The AVSP is a comprehensive State of Alaska research program initiated in 1982 and follows a strict and proven methodology. The methodology utilizes an exit survey to intercept visitors. As a result of the concentration of visitors in urban parts of the state, the survey method tends to oversample urban visitors and undersample rural visitors. Based on a separate stratified rural sample conducted during the 2001 AVSP, it is known that the survey methodology tends to underestimate visitation to remote rural parts of the state such as Southwest Alaska. Thus, the overall visitation used for this analysis can be considered conservative. In addition to McDowell Group (2006), Fay and Christensen (2011)'s 2007 estimate of visitation to Katmai was utilized.

For this analysis non-consumptive users are defined as those who reported wildlife viewing, camping, kayaking, hiking, or photography as their primary purpose of their visit. We adjust the most recent 2006 summer and winter visitor estimate for Southwest Alaska excluding Kodiak by applying the 2006-2009 percent difference in air travelers for Alaska overall (McDowell Group, 2007a & 2007b). The trend in air travelers to Alaska serves as the best indicator for changes to visitation in Southwest Alaska for two reasons. First, visitors to rural Alaska are mainly independent travelers, and second they primarily arrive by air in comparison to the statewide largest share of visitors who arrive by cruise ship. The Southwest Alaska region closely matches the Bristol Bay study region with the exception of Kodiak and the Aleutian Islands. Our analysis excludes Kodiak but includes an insignificant portion of visitors to the Aleutian Islands.

Since the Alaska Visitor Statistics Program counts out-of-state visitors only, we calculate visitor volume originating within the state based on Littlejohn and Hollenhorst (2007) and Colt and Dugan (2005) resident share of between ten and eleven percent. We treat visitation to Katmai NPP separate from other areas of the Bristol Bay region. Visitor volume and expenditure for Katmai NPP are from Fay and Christensen (2010) and for the remaining Bristol Bay area are from McDowell Group (2007a). We net out sport fishing and hunting visitation in Katmai NPP using Littlejohn and Hollenhorst (2007) and for the rest of the region by applying the McDowell

Group (2007a and 2007b) estimate. We assume equal expenditures for residents and non-residents because the non-resident per person expenditure estimate in both cases does not include the cost of travel to and from Alaska. For most non-residents all in-state travel expenditures are included, based on the assumption that the primary reason for the travel to Alaska is the visit the Bristol Bay region. For all of these estimates, we paid special attention to the potential for double counting and addressed those issues.

Based on the most recent studies of non-resident visitors to the state and two studies that estimated visitation and economic impacts related to Katmai National Park and Preserve, we estimate that on an annual basis including summer and winter visitation, approximately 2,300 residents and 18,900 non-residents visited Katmai NPP. Other areas in the Bristol Bay region received approximately 2,300 resident visitors and 19,000 non-resident visitors. Note, these estimates exclude visitation where sport fishing or sport hunting was in part or the primary activity of choice. After adjusting the per capita expenditures to 2009 dollars we estimate per person expenditures to amount to $2,245 annually for Katmai NPP and $2,873 per person annually for visiting other destinations in the Bristol Bay region.

To be consistent with the expenditure data for sport fishing and hunting, we assume that the visit to the Bristol Bay region was the primary reason for their visit to Alaska. Based on these assumptions, 2009 total expenditure for this group is estimated to be $104.2 million.

It should be noted that an earlier estimate of Bristol Bay non-consumptive (wildlife watching) visitor expenditures (Duffield et al. 2007) reported a much lower spending level by this group ($17.1 million). As noted in that report, the estimate was based on extremely limited and dated information from one location within the region (Brooks Camp). The estimate was derived and presented as an approximation, as was also noted in the report, “This is an approximate estimate based on limited and outdated information, and is an area for further research.”(Duffield et al. 2007, p. 91).

The estimates derived in this later, current report utilizes both visitation and expenditure estimates that were not available when the earlier report was drafted.

3.0 Bristol Bay Commercial Fisheries

3.1 Introduction

This section provides an economic overview of Alaska's Bristol Bay commercial salmon industry. The report begins with a brief overview of the industry. Subsequent sections discuss harvests, products and markets, prices, harvest and wholesale value, fishermen, processors, employment, taxes, the regional distribution of permit holders, fishery earnings and processing employment, and the role of the industry in the Bristol Bay regional economy. The final section discusses selected economic measures of the Bristol Bay salmon industry.

A challenge in characterizing the Bristol Bay fishery is that there is wide variation from year to year in catches, prices, earnings, employment and other measures of the fishery. No single recent year or period is necessarily "representative" of the fishery or what it will look like in the future. To illustrate the range of historical variation in the fishery, wherever possible this report provides data or graphs for at least the years since 2000, and in many cases for longer periods.

This report focuses on the economic significance of the entire Bristol Bay commercial salmon fishery. The fishery harvests salmon returning to several major river systems, including the Nushagak and Kvichak. Currently, because of potential future resource development in these watersheds, there is particular interest in the fisheries resources and economic significance of these two river system. As discussed in greater below, historically the relative contribution of these river systems to total Bristol Bay commercial salmon harvests has varied widely from year to year and over longer-term periods. There is no simple way to characterize what share of the Bristol Bay commercial fishery is attributable to the Nushagak and Kvichak river systems, or what this share will be in the future.

Some of the prices and values presented in this report are presented as *nominal* prices and values (not adjusted for inflation), and others are presented as *real* prices and values (adjusted for inflation). In general, we used nominal prices where our primary purpose was to show actual prices and values over time (and as they appeared to people over time), and we used real prices where our primary purpose was to compare prices and values over time. Prices and values are expressed in nominal dollars except where the report specifically notes that they are real dollars. All real prices are expressed in 2010 dollars, as calculated using the Anchorage Consumer Price Index. This is far from an ideal measure, but it is the only long-term measure of inflation available for any Alaska location.[8]

[8] In theory, it may appear more technically accurate to express all prices in real dollars. In practice, there are several reasons why nominal prices are preferable for much of the data presented in this report. First, it is far from obvious what the measure of inflation should be: while the Anchorage CPI is the best available measure, it is not necessarily a good characterization of the inflation actually experienced by Bristol Bay fishermen or processors. Secondly, when price or value data are converted to "real" values it is harder to compare them to other data unless those data have been converted to real values for the same year. Data converted to real dollars quickly use their utility as a reference source. Third, people familiar

The report presents a wide variety of data for the Bristol Bay salmon industry in graphs and tables as well as in the text of the report. Detailed information on the data sources for all graphs , tables and text are provided in the data appendix at the end of the report. The report is based on data available as of October 2011.

We've included pictures in the report to help readers who haven't had the opportunity to visit Bristol Bay to have a sense of what the industry looks like. Except where otherwise noted, pictures in the report were taken by Gunnar Knapp.

3.2 Overview of the Bristol Bay Salmon Industry

The Bristol Bay salmon fishery is one of the world's largest and most valuable wild salmon fisheries. Between 2006 and 2010, the Bristol Bay salmon industry averaged:

- Annual harvests of 31 million salmon (including 29 million sockeye salmon)
- 51% of world sockeye salmon harvests
- Annual "ex-vessel" value (the value earned by fishermen) of $129 million
- Annual first wholesale value after processing of $268 million.
- 26% of the "ex-vessel" value to fishermen of the entire Alaska salmon harvest.
- Seasonal employment of more than 6800 fishermen and 3700 processing workers.

Bristol Bay is located in southwestern Alaska. Each year tens of millions of sockeye salmon return to the major river systems which flow into Bristol Bay, of which the most significant (in numbers of returning salmon) are the Nushagak, Kvichak, Naknek and Egegik Rivers. Sockeye salmon spend a year or more in freshwater lakes before migrating to saltwater. The large lakes of the Bristol Bay region provide habitat for sockeye salmon during this life stage.

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with the Bristol Bay fishing industry remember what fish and permit prices actually were in any given year: it is harder for them to recognize and believe prices or values converted to real dollars.

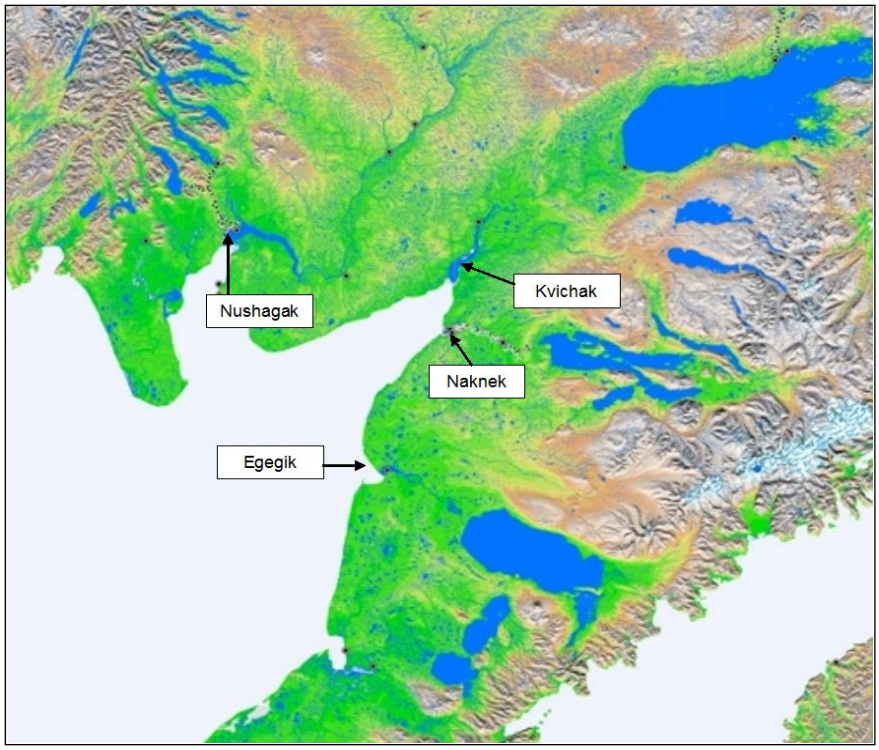


Figure 10. Major Bristol Bay River Systems

Map source: www.purebristolbay.com/images/layout/BBNC_Base_Map-800.jpg

Almost all Bristol Bay commercial fish harvests occur during a brief four-week season from mid-June to mid-July. At the peak of the season, millions of salmon may be harvested in a single day.

The Naknek River near King Salmon

Two kinds of fishing gear are used in the Bristol Bay fishery: drift gillnets (operated from fishing boats) and set gillnets (operated from shore). Drift gillnets account for most of the total catch. Technically, the drift gillnet fishery and the set gillnet fishery are managed as separate fisheries.

Both the drift gillnet fishery and the set gillnet fishery are managed under a "limited entry" management system which was implemented for all of Alaska's twenty-seven salmon fisheries in the mid-1970s. The basic purpose of the limited entry system is to limit the number of boats fishing in each fishery, which makes it easier for managers to control the total fishing effort and makes the fishery more profitable for participants than it would be if entry (participation) were unrestricted and more boats could fish. Every drift gillnet fishing boat or set net operation must have a permit holder on board or present—so the number of boats or set net operations cannot exceed the number of permit holders. There are approximately 1860 drift gillnet permits and approximately 1000 set net permits. Section 3.7 below (Bristol Bay Salmon Fishermen) provides more details about the limited entry system and Bristol Bay management regulations.

Drift Gillnet Boats Fishing in the Naknek River

The Bristol Bay salmon harvest is processed by about 10 large processing companies and 20 smaller companies employing about 3700 processing workers at the peak of the season in both land-based and floating processing operations. Most of the land-based processors operate only during the short summer salmon season. Most of the workers are flown in from outside the region and live in bunkhouse facilities at the processing plants.

The Ekuk Processing Plant in the Nushagak District near Dillingham, photographed at low tide. Extreme tides complicate logistics for land processing facilities in Bristol Bay. At many plants, fish can be delivered only when the tide is in.

Most Bristol Bay salmon is processed into either frozen headed and gutted salmon or canned salmon. Formerly almost all Bristol Bay frozen salmon was exported to Japan. In recent years exports to Japan have declined sharply while shipments to the U.S. domestic market have increased and exports have increased to Europe and to China (for reprocessing into fillets sold in Europe, Japan and the United States). Most canned salmon is exported, primarily to the United Kingdom, Canada, and other markets.

Fish on a Bristol Bay fishing boat

Photograph by Gabe Dunham

Bristol Bay salmon catches vary widely from year to year and over longer periods of time. Catches set all-time records in the early 1990s, fell sharply after 1995, and then rose again after 2002. The 2011 catch was about 25% lower than the average for the previous five years.

Wholesale prices for Bristol Bay salmon products and "ex-vessel" prices paid to fishermen increased during the 1980s, peaked in 1988, and then declined dramatically during the 1990s. The main cause of the decline in prices was competition in world markets from dramatically increasing world production of farmed salmon, although many other factors also contributed. Since 2001, wholesale and ex-vessel prices have been increasing, as the growth of farmed salmon production has slowed and new markets for Bristol Bay sockeye salmon have been developed.

The decline in catches and prices during the 1990s led to a drastic decline in value in the Bristol Bay

salmon fishery. The ex-vessel value paid to fishermen fell from a peak of $214 million in 1990 to just $32 million in 2002. The loss in value led to a severe economic crisis in the Bristol Bay salmon industry. Many land-based salmon processing operations closed and many floating processors left Bristol Bay. Many fishing permit holders stopped fishing, and permit prices fell drastically.

As catches and prices have improved since 2002, the Bristol Bay salmon industry has experienced a significant economic recovery. The ex-vessel value paid to fishermen increased to $149 million in 2010. Participation in the fishery has increased and permit prices have strengthened. Among both fishermen and processors there is a renewed sense of optimism about the economic future of the Bristol Bay salmon industry, taking advantage of growing world demand for wild salmon. This optimism is tempered by recognition of the variability of harvests and value associated with fluctuations in salmon returns and markets.

A tender, floating processor, and freighter anchored in the Nushagak district

Photograph by Gabe Dunham

A Bristol Bay processing worker holding a sockeye salmon

Photograph by Gabe Dunham

3.3 Bristol Bay Salmon Harvests

Although all five species of Pacific salmon are caught in Bristol Bay, commercial salmon harvests are overwhelmingly sockeye salmon. Between 2001 and 2010, sockeye accounted for 94% of total Bristol Bay salmon catches. Except where otherwise noted, references in this report to harvests, production, prices, etc. are specifically for Bristol Bay *sockeye* salmon.

Between 1975 and 2010, annual Bristol Bay commercial sockeye salmon harvests ranged from 5 million to 44 million fish, with an annual average of 22.5 million fish. Harvests increased from depressed levels of less than 6 million fish in the mid-1970s to more than 15 million fish for most of the 1980s and more than 25 million fish annually for the years 1989-1996. Sockeye salmon harvests peaked at 44 million fish in 1995. Harvests then fell off sharply to lows of 10 million fish in 1998 and 2002 before rebounding to 29 million fish in 2007 and 31 million fish in 2009—the highest sockeye harvest since 1995. The 2011 harvest of 22 million fish was significantly lower than the previous five years and the lowest since 2003.

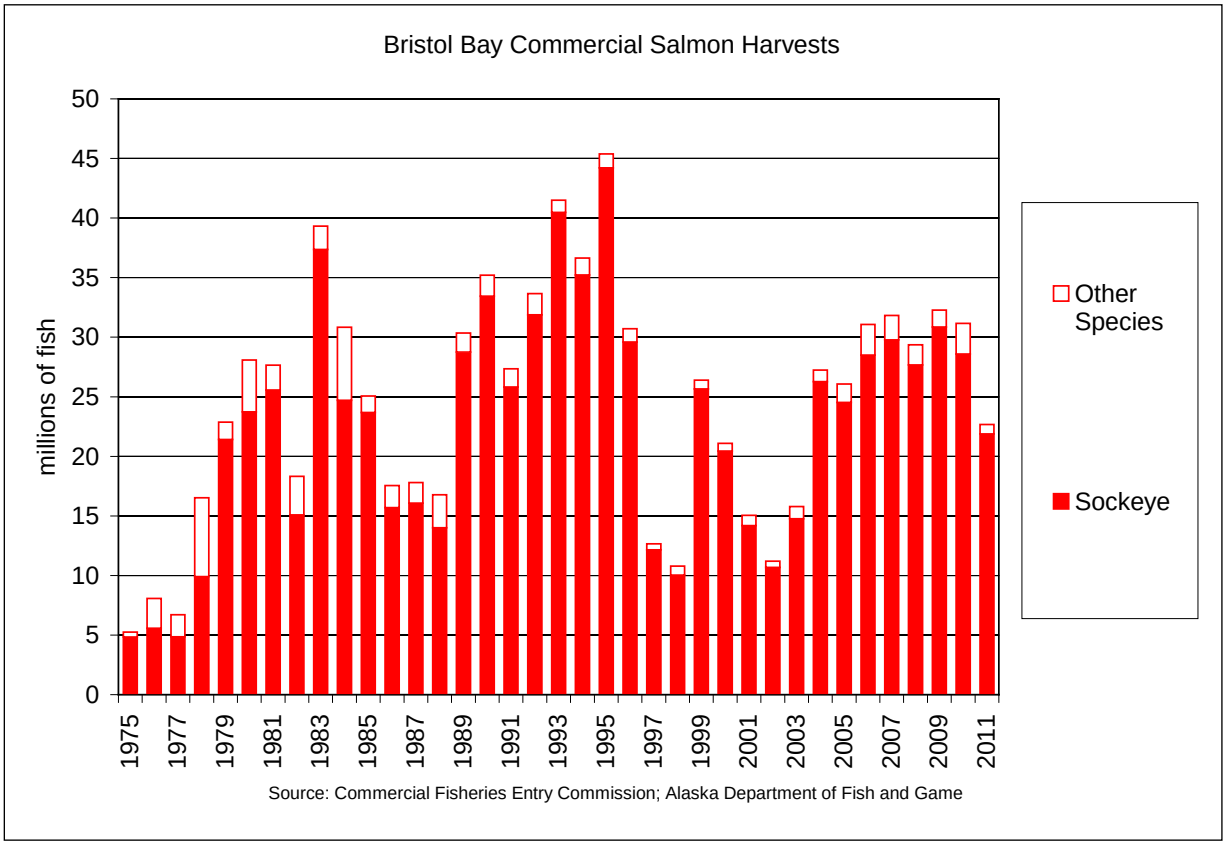


Figure 11. Bristol Bay Commercial Salmon Harvests.

The average weight of a Bristol Bay sockeye salmon is typically about 6 pounds. Between 1975 and 2010 average weights varied from as low as 5.3 pounds to as high as 6.7 pounds. . There was no significant trend in average fish weight over this period. Fish weight tended to be slightly lower in years when more fish were harvested.[9]

Bristol Bay sockeye salmon harvests may be expressed either in fish, pounds, or metric tons. Over the period 1975-2010, sockeye salmon harvests averaged:

	22.7 million sockeye	
=	133 million pounds	(@ average weight of 5.9 pounds per fish)
=	60,200 metric tons	(@ 2204.6 pounds per metric ton)

For commercial fishery management purposes, Bristol Bay is divided into five different fishing districts: Naknek-Kvichak, Egegik, Nushagak, Ugashik, and Togiak, which correspond to different major Bristol Bay river systems.

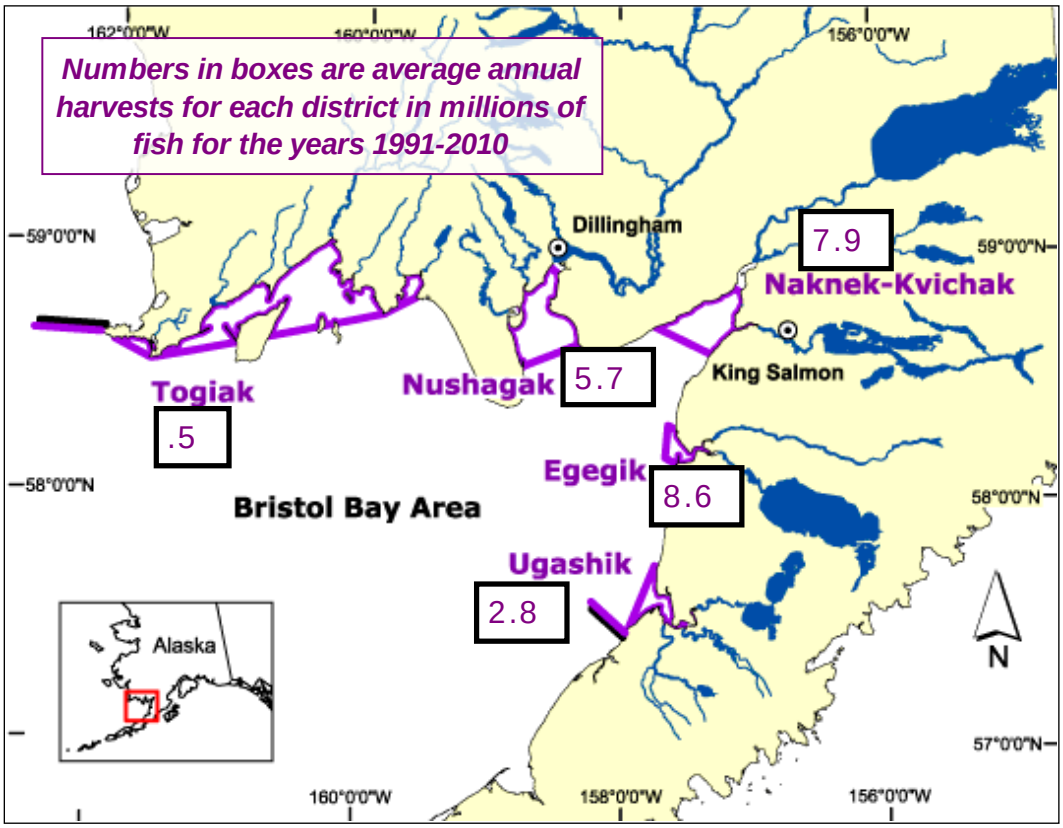


Figure 12. Bristol Bay Fishing Districts. ***Source: ADFG map posted at:***

www.adfg.alaska.gov/index.cfm?adfg=CommercialByFisherySalmon.salmonmaps_districts_bristolbay

[9] The correlation between fish weight and the number of fish harvested was -.433, which is statistically significant at the 1% level in a one-tailed t-test (N = 36).

Annual harvests within each district vary widely from year to year, as does the relative share of each district in the total catch. Most of the record Bristol Bay catches of the mid-1990s were caught in the Naknek-Kvichak and Egegik districts. Similarly, most of the decline in catches after the mid-1990s resulted from a decline in catches in these two districts—particularly the Naknek-Kvichak. Most of the recovery in catches since 2002 has also occurred in these two districts, as well as in the Nushagak district, where catches have been very strong.

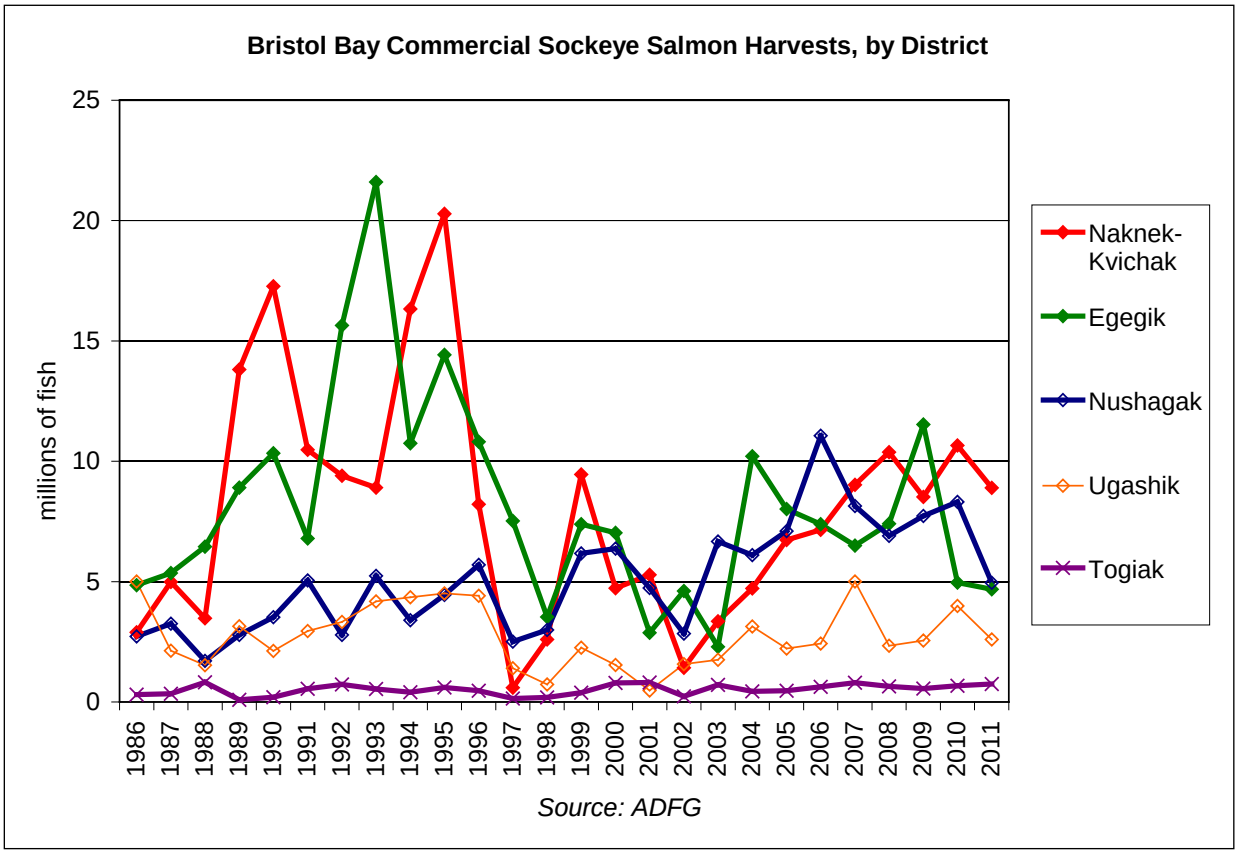


Figure 13. Bristol Bay Commercial Sockeye Salmon Harvests, by District.

Currently, there is particular interest in the fisheries resources and economic significance of the Nushagak and Kvichak watersheds because of potential future resource development in these watersheds, Given the wide variation in catches by district from year to year and over longer time periods of time, there no obvious way to characterize the relative share of the Bristol Bay commercial salmon fishery attributable to these river systems or to the rivers, streams and lakes that make up each river system.

In general, over most of the past decade, the Nushagak and Naknek-Kvichak districts have accounted for about 60% of the total Bristol Bay commercial sockeye harvest (Figure 14).

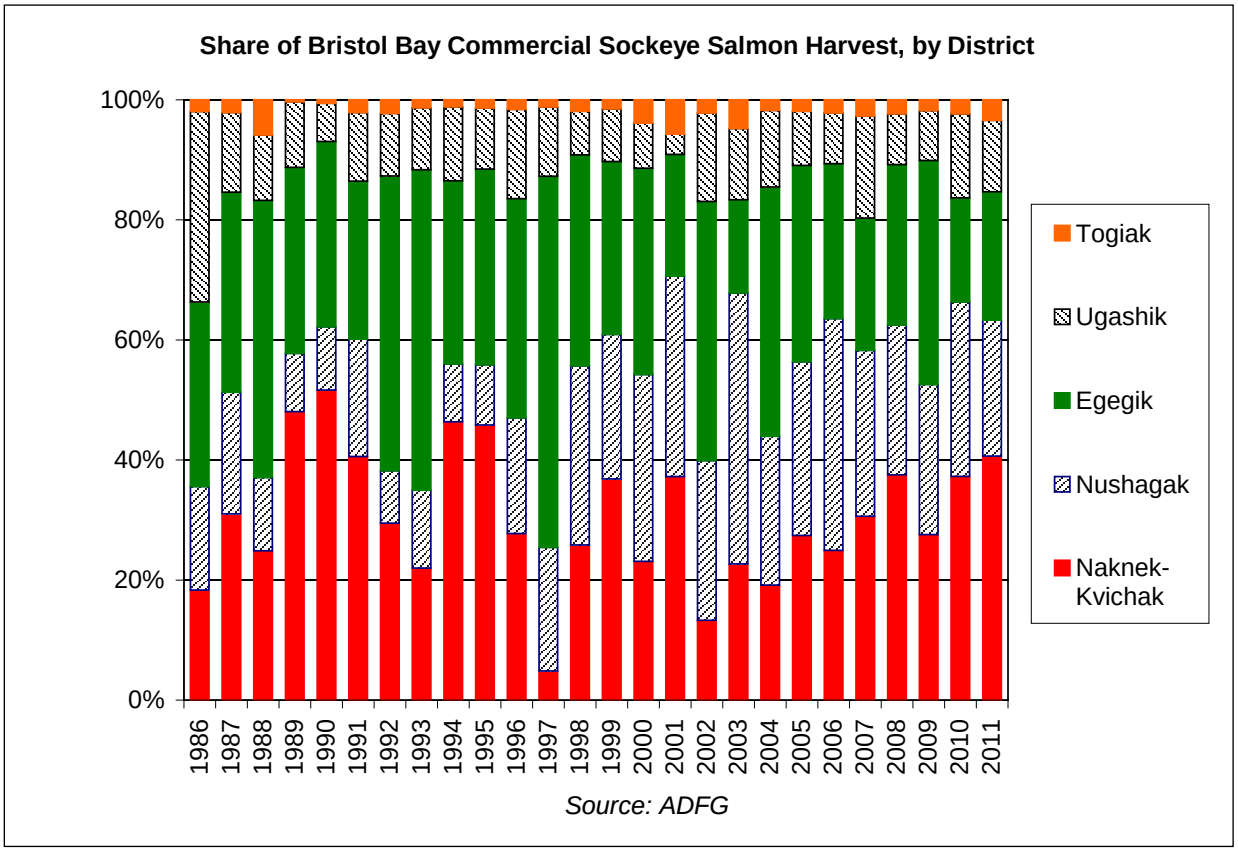


Figure 14. Share of Bristol Bay Commercial Sockeye Salmon Harvest, by District.

Note however that both districts include other major rivers beside the Nushagak and Kvijak rivers. For example, the Kvichak River generally accounts for less than half of Naknek-Kvichak district harvests (Figure 15).

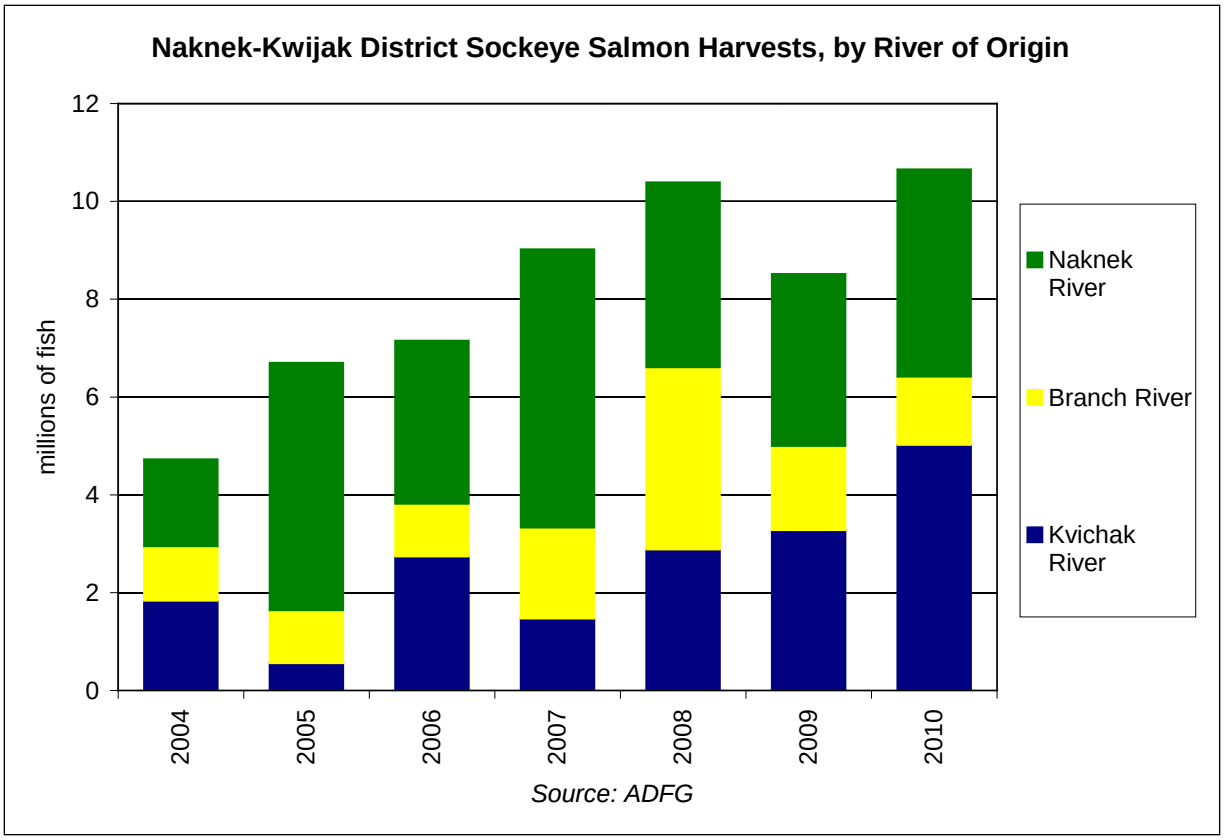


Figure 15. Naknek-Kvichak District Sockeye Salmon Harvests, by River of Origin.

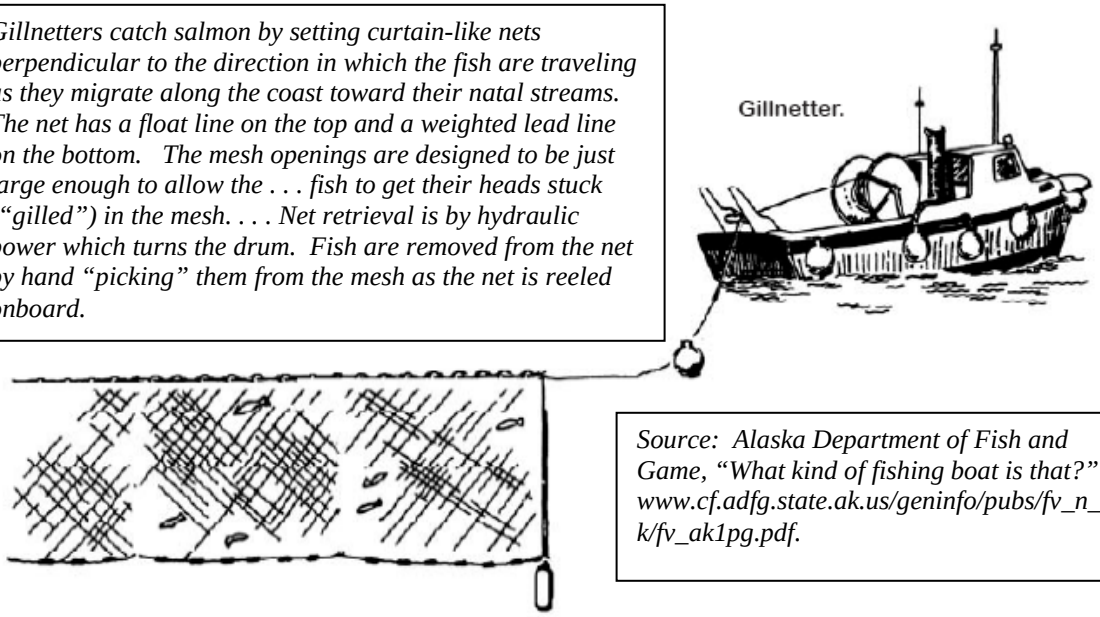
As discussed more below, economic measures of the Bristol Bay commercial fishery are not necessarily proportional to fish harvests. If total fish harvests were to change by a given percentage, the value of the fishery, employment, and other measures would not change by the same percentage amount.

Bristol Bay Gear Types

All Bristol Bay salmon are harvested using gillnets. Gillnets hang in the water perpendicular to the direction in which returning salmon are swimming. The fish get their heads stuck in the nets and are "picked" from the net as it is pulled from the water.

There are two types of gillnet fishing operations in Bristol Bay: drift gillnets and set gillnets. Drift gillnets hang in the water behind the fishing boat. After a period of time, the nets are pulled back into the boat for picking.

Gillnetters catch salmon by setting curtain-like nets perpendicular to the direction in which the fish are traveling as they migrate along the coast toward their natal streams. The net has a float line on the top and a weighted lead line on the bottom. The mesh openings are designed to be just large enough to allow the . . . fish to get their heads stuck ("gilled") in the mesh. . . . Net retrieval is by hydraulic power which turns the drum. Fish are removed from the net by hand "picking" them from the mesh as the net is reeled onboard.



Source: Alaska Department of Fish and Game, "What kind of fishing boat is that?" www.cf.adfg.state.ak.us/geninfo/pubs/fv_n_ak/fv_ak1pg.pdf.

Picking salmon from the net on a Bristol Bay drift gillnet boat

Bristol Bay fishing boats stored in a Naknek boat yard for the winter

Most Bristol Bay drift gillnet fishing boats are used only during the short, intense summer salmon season (although some are used to fish for herring in the spring) and are stored in boat yards for the rest of the year. The fact that fishing boats and processing plants are idle for much of the year adds to costs in the fishery.

Crowded fishing near the boundary of a Bristol Bay fishing district

Photograph by Bart Eaton

Drift gillnet fishermen have the advantage of being able to move to where the fishing is best—and the disadvantage that other fishermen are likely to want to fish in the same places. Bristol Bay drift gillnet fishing boats are often crowded along the "lines" which are the boundaries of legal fishing districts, established by GPS coordinates. Often fishing is best when fishermen are able to place their nets along the line, catching fish as they swim into the district.

Bristol Bay drift gillnet fishing boats are limited to 32 feet in length. Over time, wider and taller boats have been built as fishermen try to get more working space and hold capacity.

Drift gillnet boats waiting for an opening in the Nushagak district

Photograph by Gabe Dunham

In set gillnet fishing, one end of the net is attached to the shore, while the other is attached to an anchor in the water. Fishermen pick the fish from a skiff or from the beach at low tide.

A set-net fishing operation on the Nushagak River

There are more drift gillnet permits fished than set gillnet permits, and average catches are higher for drift gillnet permits than for set gillnet permits. As a result, drift gillnet permits account for about four-fifths of the Bristol Bay sockeye salmon catch.

Table 27. Comparison of Bristol Bay Drift Gillnet and Set Gillnet Fisheries (2006-10 Average)

Comparison of Bristol Bay Drift Gillnet and Set Gillnet Fisheries (2006-10 Averages)

	Drift Gillnet	Set Gillnet	Total	Ratio, Drift Gillnet to Set Gillnet	Drift Gillnet %	Set Gillnet %
Total Permits Fished	1,470	847	2,317	1.7	63%	37%
Average Pounds	102,109	37,575	139,684	2.7		
Total Pounds	150,053	31,813	181,866	4.7	83%	17%

Source: Commercial Fisheries Entry Commission, Basic Information Tables.

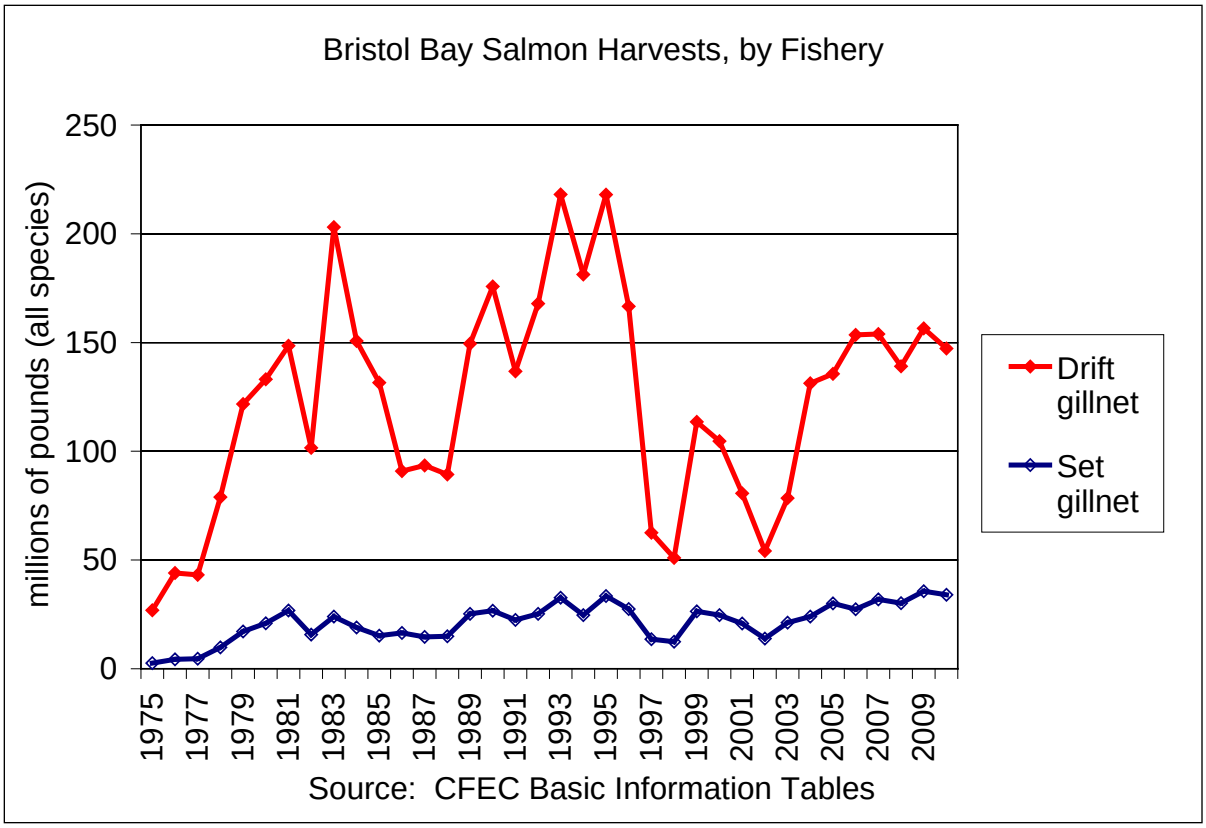


Figure 16. Bristol Bay Salmon Harvests, by Fishery

Relative Scale of Bristol Bay Sockeye Salmon Harvests

There are several ways to measure the relative scale of Bristol Bay sockeye salmon harvests in comparison with other sources of supply, which are illustrated by the three graphs below:

Sockeye salmon fisheries. Bristol Bay is by far the largest sockeye salmon fishery in the world. Between 1980 and 2009 Bristol Bay averaged 59% of total Alaska sockeye salmon supply and 44% of total world sockeye salmon supply.

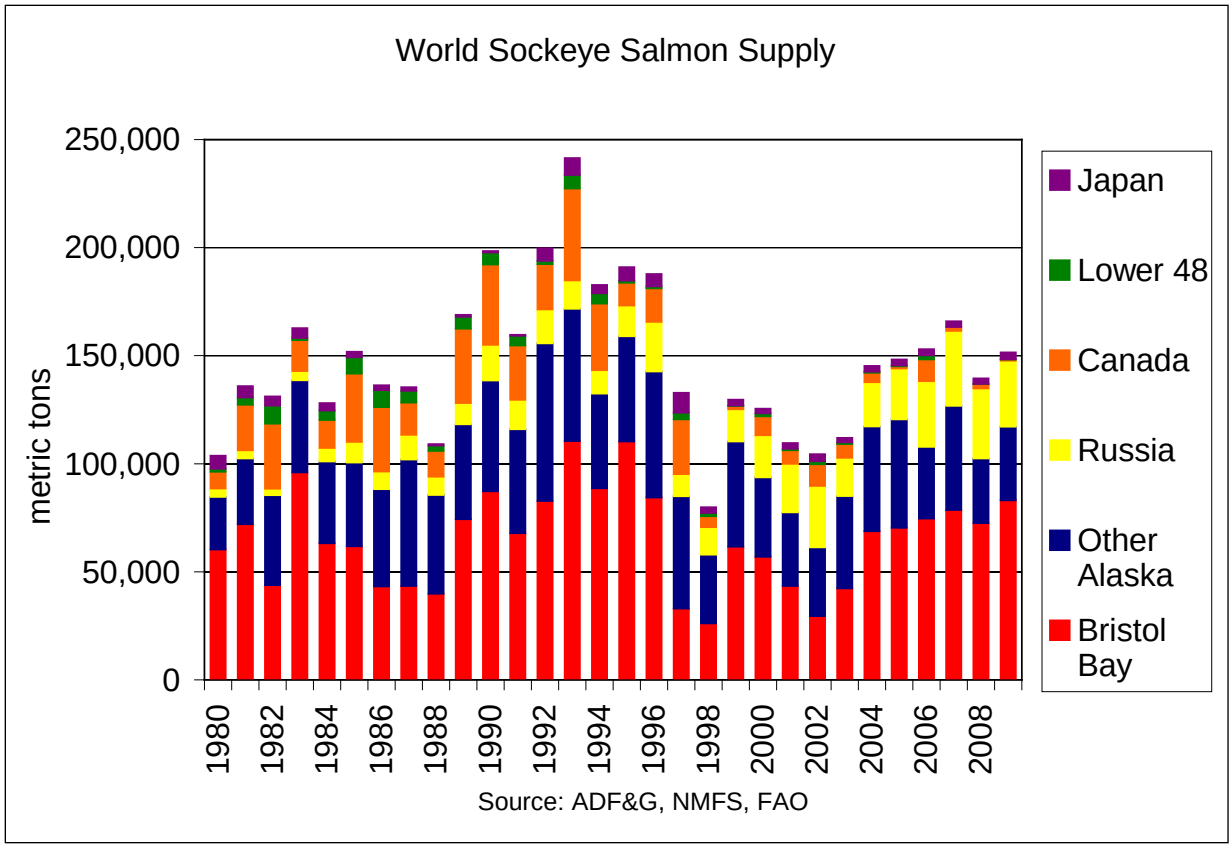


Figure 17. World Sockeye Supply

Alaska salmon fisheries. In most years, Bristol Bay sockeye is the single largest fishery in Alaska. Between 1980 and 2009, Bristol Bay sockeye salmon averaged 20% of Alaska salmon supply for all species combined.

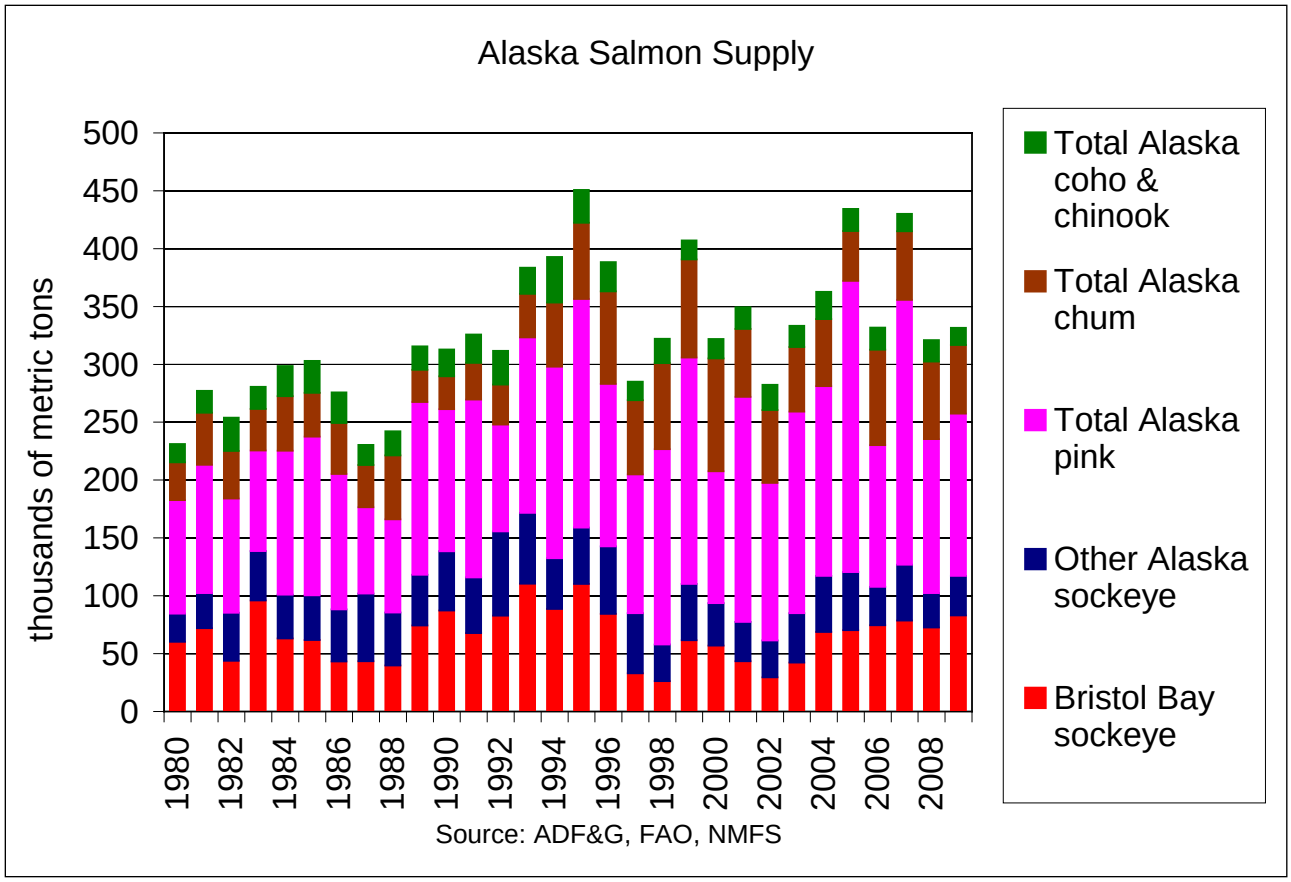


Figure 18. Alaska Salmon Supply

World salmon supply. World farmed salmon and trout production has grown extremely rapidly since the early 1980s. As farmed salmon and trout production increased, Bristol Bay's share of total world salmon supply fell from 11% in 1980 to just 3% in 2009.

Mending gillnets at the historic Peter Pan processing plant in Dillingham

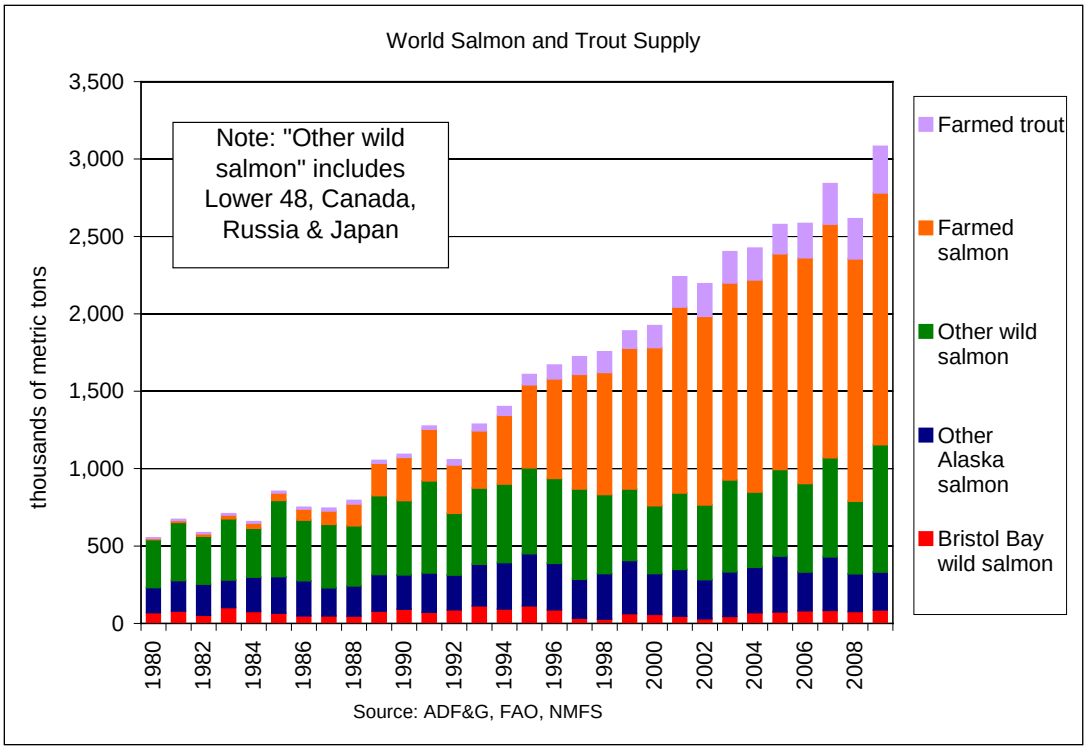


Figure 19. World Salmon and Trout Supply

Future Bristol Bay Salmon Harvests

It is very difficult to predict how Bristol Bay salmon harvests may change in the future. Every year the Alaska Department of Fish and Game, as well as the University of Washington Fisheries Research Institute (FRI) make pre-season projections of how many salmon will return to Bristol Bay and what the harvest will be. The projections are based on estimates for previous years of escapements, the number of juvenile salmon entering saltwater, and the numbers of adult salmon of different age classes which returned.

The pre-season projections provide at best a rough guide to what actual harvests will be. Between 1990 and 2011, actual catches ranged from 51% below the Alaska Department of Fish and Game's projections to 128% over the projections, with an average annual projection error of 31%.

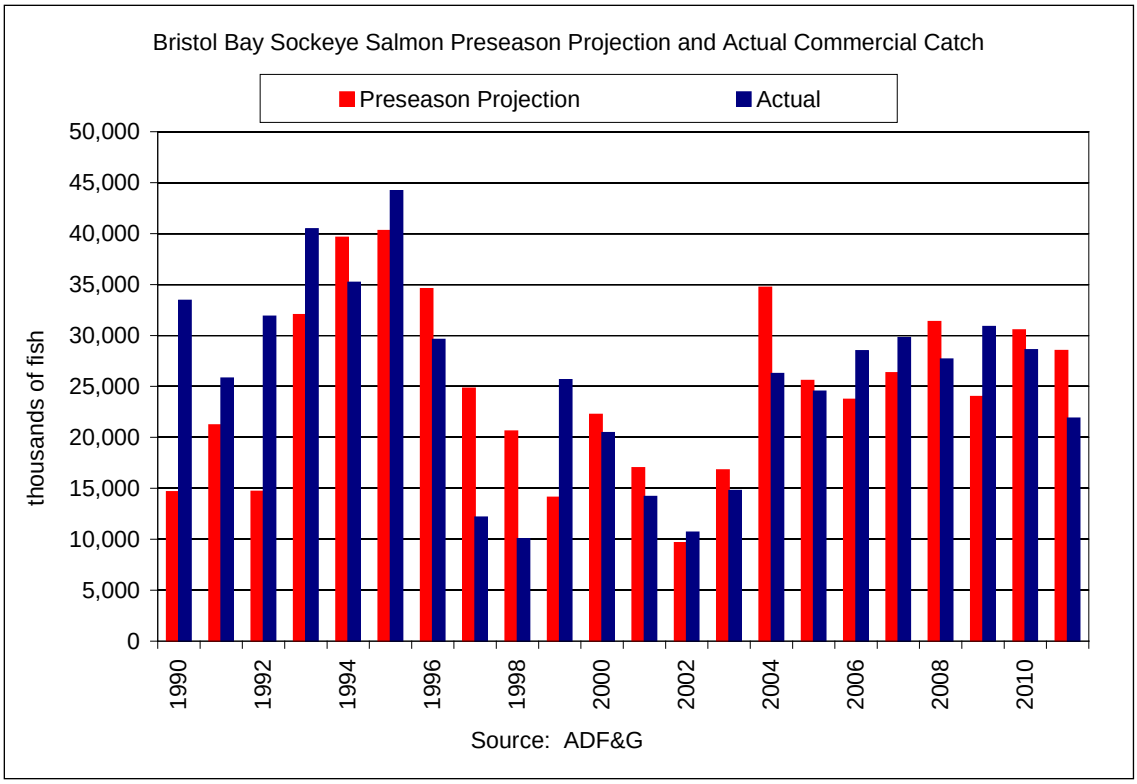


Figure 20. Bristol Bay Sockeye Preseason Projection and Actual Commercial Catch

There are no formal projections of how Bristol Bay salmon harvests may change over the longer term future. As shown by the graph on the following page, historically harvests have varied widely from decade to decade. Analysis of lake-bed sediments has also shown significant historical variation in salmon returns in previous centuries prior to commercial harvesting.

Long-term changes in salmon returns have been shown to be associated with periodic changes in ocean conditions such as water temperature and currents, known as "regime shifts." The much lower average harvests from the 1950s through the 1970s are thought to have resulted in part from a different ocean regime (although other factors, such as interceptions of Bristol Bay salmon by foreign fishing fleets, likely also played a role).

The potential for significant future changes in ocean conditions associated with not only regime shifts but also global climate change could significantly affect future Bristol Bay salmon returns and harvests—but it is very difficult to predict what changes might occur or when they might occur.

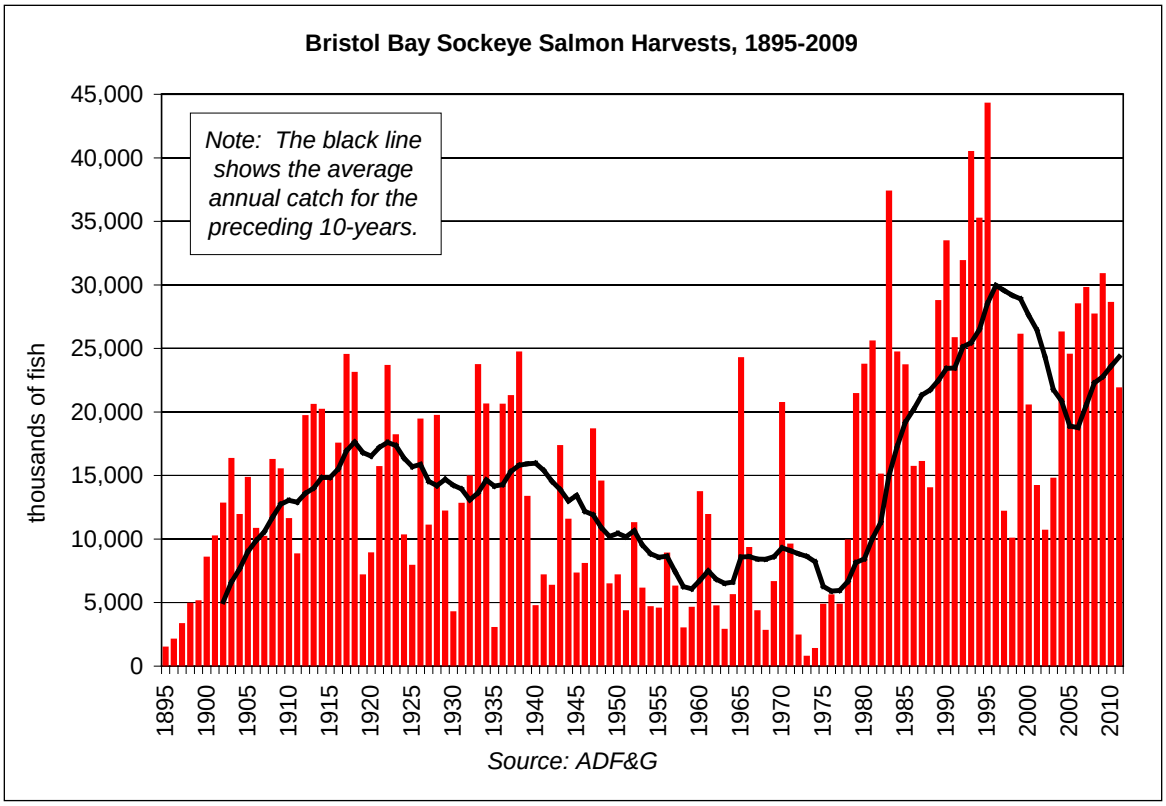


Figure 21. Bristol Bay Salmon Harvests, 1985-2009

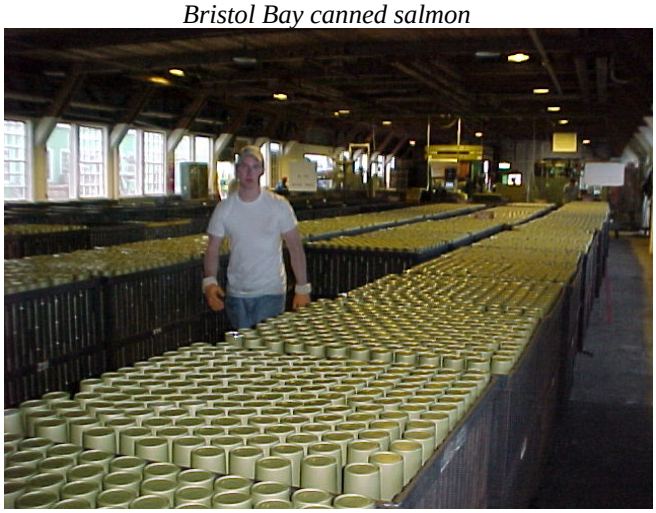
Until the 1950s, only sailboats were allowed to harvest salmon in Bristol Bay

Source: "Sailing for Salmon" exhibition of historic Bristol Bay photographs at Anchorage Museum, summer 2011 (http://www.anchoragemuseum.org)

3.4 Bristol Bay Salmon Products and Markets

The major products produced from Bristol Bay sockeye salmon are canned salmon, frozen headed and gutted (H&G) salmon, frozen salmon fillets, fresh H&G salmon, and salmon roe. Frozen H&G salmon and canned salmon account for most of the product volume.

Bristol Bay canned salmon



Headed and gutted salmon on trays for freezing

Bristol Bay sockeye salmon fillet

Processing Bristol Bay sockeye salmon roe

For most of the more than one-hundred year history of the Bristol Bay salmon fishery, production was overwhelmingly canned salmon. Processing plants were called “canneries” and processing companies were called “canners.”

However, in the 1970s frozen salmon production increased rapidly, as technologies for freezing salmon and shipping frozen salmon developed, and as Japanese demand for frozen Bristol Bay salmon expanded with the end of Japanese salmon fishing in international waters and within the U.S. 200-mile limit. By the mid-1980s, more than 80% of Bristol Bay salmon production was

frozen, almost entirely for export to Japan. The shares of different product forms in Bristol Bay production over time reflect changes in changes in relative prices and total harvests. From the mid-1990s to the mid-2000s, as frozen sockeye salmon prices fell due to increased competition in the Japanese market from farmed salmon, and as harvest volumes fell, the frozen share of production declined and the canned share increased. Since the mid-2000s, as frozen sockeye and harvest volumes have increased, the frozen share of production has risen (Figure 22 and Figure 23).

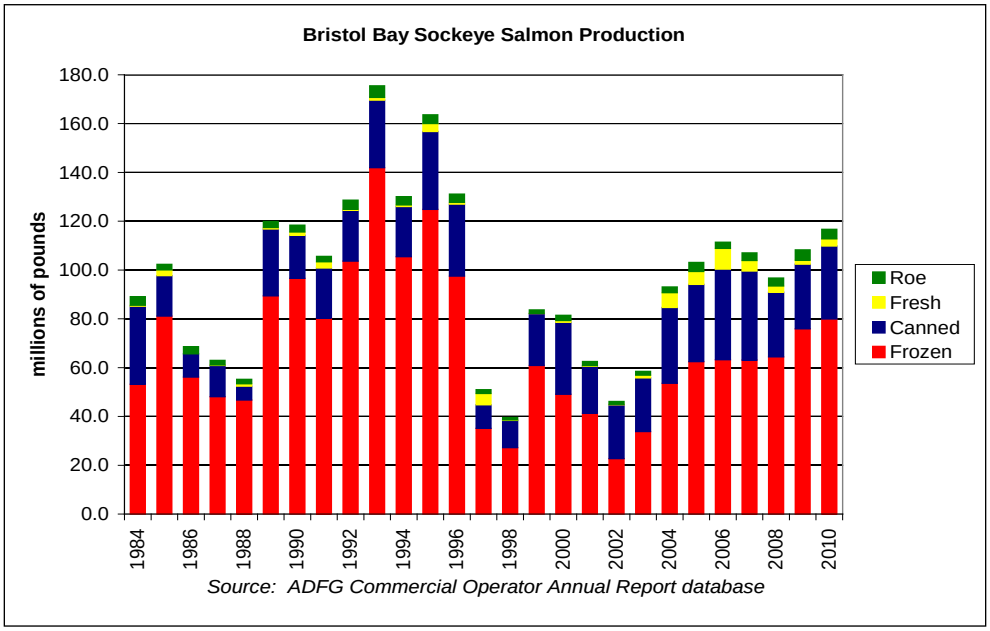


Figure 22. Bristol Bay Sockeye Salmon Production

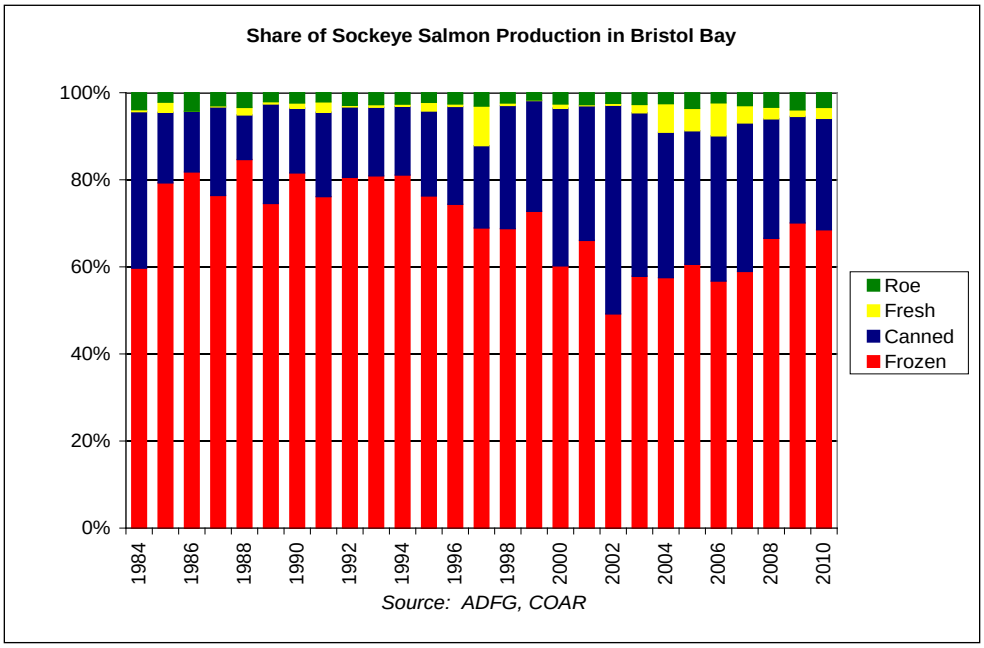


Figure 23. Share of Sockeye Salmon Production in Bristol Bay

Table 28 provides more detail about product forms for canned and frozen Bristol Bay salmon in recent years. In 2010, about one-third of canned salmon production was "talls" (14.75 ounce cans) and about two-thirds "halves" (7.5 ounce cans). Between 2006 and 2010, the share of frozen fillets in total frozen production increased from about 6% to about 18%.

Table 28. Sales of Selected Sockeye Salmon Products.

Sales of Selected Sockeye Salmon Products
by Major Bristol Bay Salmon Processors (pounds)

Type	Form	2006	2008	2010
Canned	Canned Halves	23,349,893	23,672,655	23,486,265
	Canned Talls	*	*	10,592,344
Frozen	Frozen Fillet	3,939,220	7,930,710	13,788,359
	Frozen H&G	61,270,959	53,590,871	63,720,557
Fresh	Fresh H&G	2,958,201	1,904,051	*
Roe	Roe	2,902,082	3,186,876	3,657,859

* Not reported due to confidentiality restrictions

Note: Includes only sales reported by processors with more than 1 million pounds of sales of salmon products in the previous year.

Source: Alaska Department of Revenue, Annual Salmon Price Reports

In any given year, the total volume of Bristol Bay salmon products is less than the annual harvest volume, because part of the weight (25%-35%) is lost in processing as the fish heads and guts are removed, and also because some fish are shipped to plants outside the Bristol Bay region for processing. Between 1984 and 2010, the reported volume of processed salmon products sold by Bristol Bay salmon processors, or production, averaged 67% of the volume of harvests, and ranged from as low as 59% to as high as 75%. The annual variation in the ratio of production weight to harvest weight results from several factors including changes in average fish size, changes in the mix of products produced, and changes in the share of the catch shipped outside the region for processing.

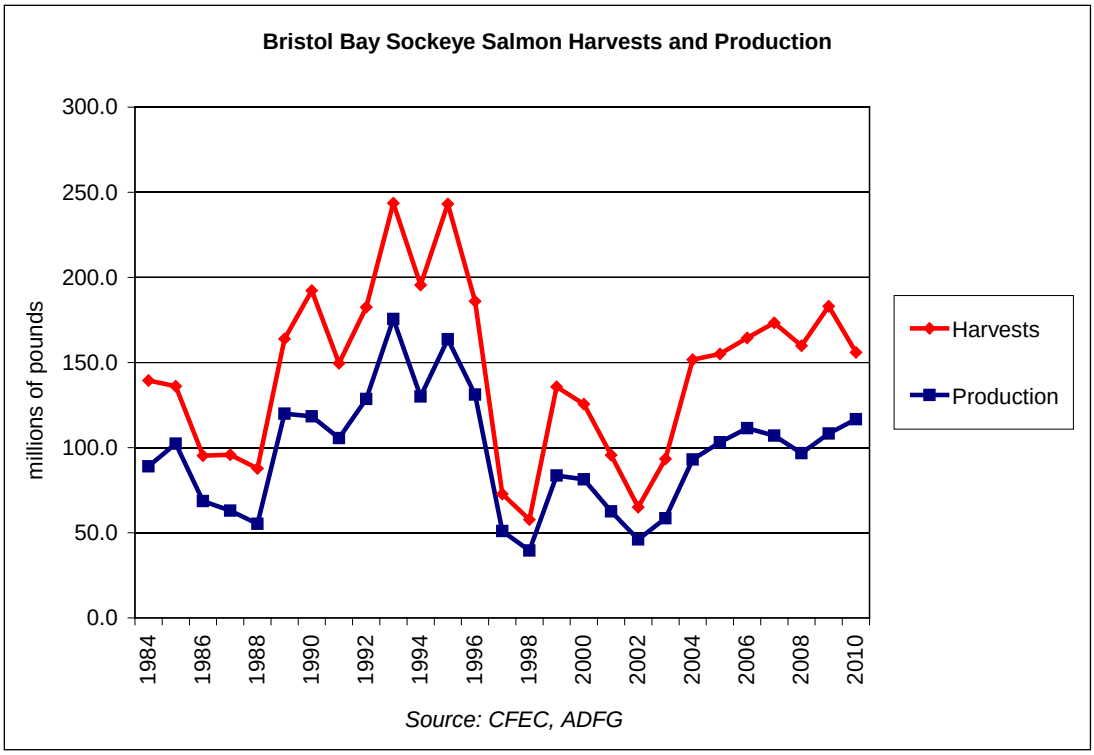
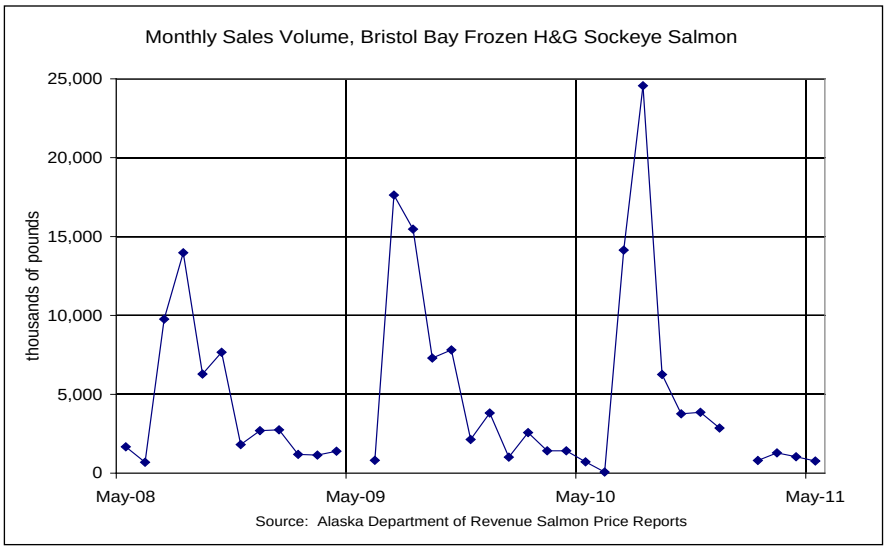
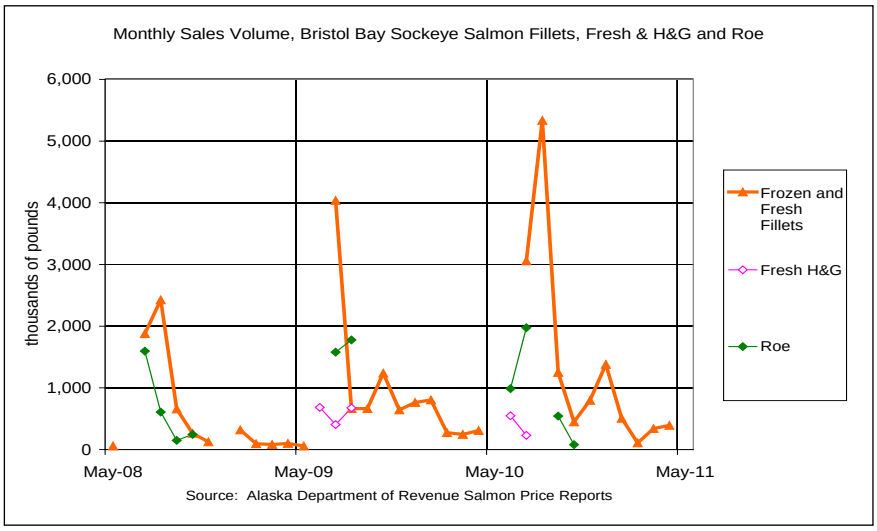


Figure 24. Bristol Bay Sockeye Salmon Harvests and Production





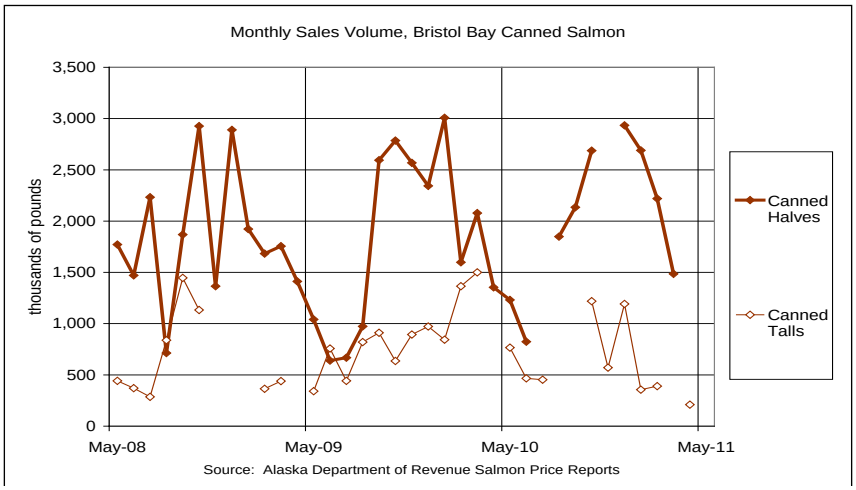


Figure 25. Monthly Sales Volume of Bristol Bay Salmon Products

The timing of processors' sales of Bristol Bay salmon reflects the highly seasonal character of the industry. Sales of products for which storage costs are relatively high—including frozen H&G salmon, frozen and fresh fillets, fresh H&G and roe—are concentrated in the summer in the months during and immediately after the season. Sales of canned salmon are distributed more evenly over the year. For some products, no data are available for sales for some months (to preserve confidentiality, sales are only reported if at least three processors report sales).

Bristol Bay Salmon Markets

Data are not available on the end-markets to which *Bristol Bay* sockeye salmon products are shipped. However, because Bristol Bay represents such a large share of Alaska and United States sockeye salmon production, we can make reasonable inferences about end markets for Bristol Bay sockeye salmon by comparing U.S. export data with Alaska statewide production data.

Prior to about 1998, almost all U.S. frozen sockeye salmon production (including Bristol Bay production) was exported, and almost all exports were to Japan. Beginning in about 1999, this pattern changed in two important ways. First, exports declined relative to production—indicating that significant volumes of Alaska frozen sockeye were beginning to be sold in the U.S. market rather than exported. Secondly, significant volumes of frozen sockeye began to be exported to countries other than Japan—particularly EU countries and China—substantially reducing the Japanese share of U.S. sockeye salmon exports (Figure 26).

These two trends together resulted in a dramatic decline in the volume of Alaska sockeye salmon shipped to Japan—from more than 100,000 metric tons in 1993 to 20,000 lbs or less since 2006—and a corresponding dramatic decline in the dependence of Alaska (and Bristol Bay) sockeye on the Japanese frozen salmon market.

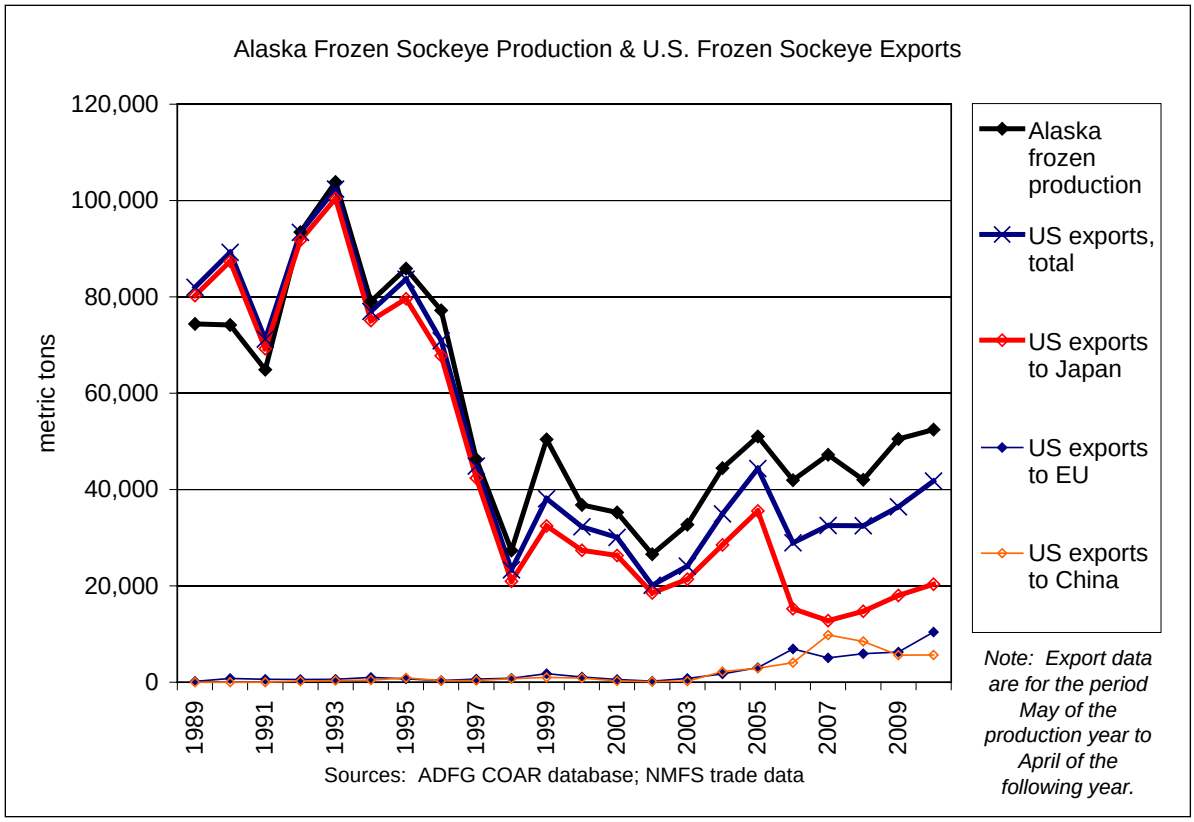


Figure 26. Alaska Frozen Sockeye Production and U.S. Frozen Sockeye Exports.

The volume of Alaska frozen sockeye salmon sold to U.S. domestic markets may be estimated as total production minus exports. This in turn allows estimation of the end-market shares of the United States and export markets. End-market shares have changed dramatically from the early 1990s, when almost all production was estimated to Japan. Between 2006 and 2010, 27-39% of production was exported to Japan, 20-31% was sold in the United States, 10-21% was exported to China, 11-16% was exported to the European Union, and 7-13% was exported to other countries.

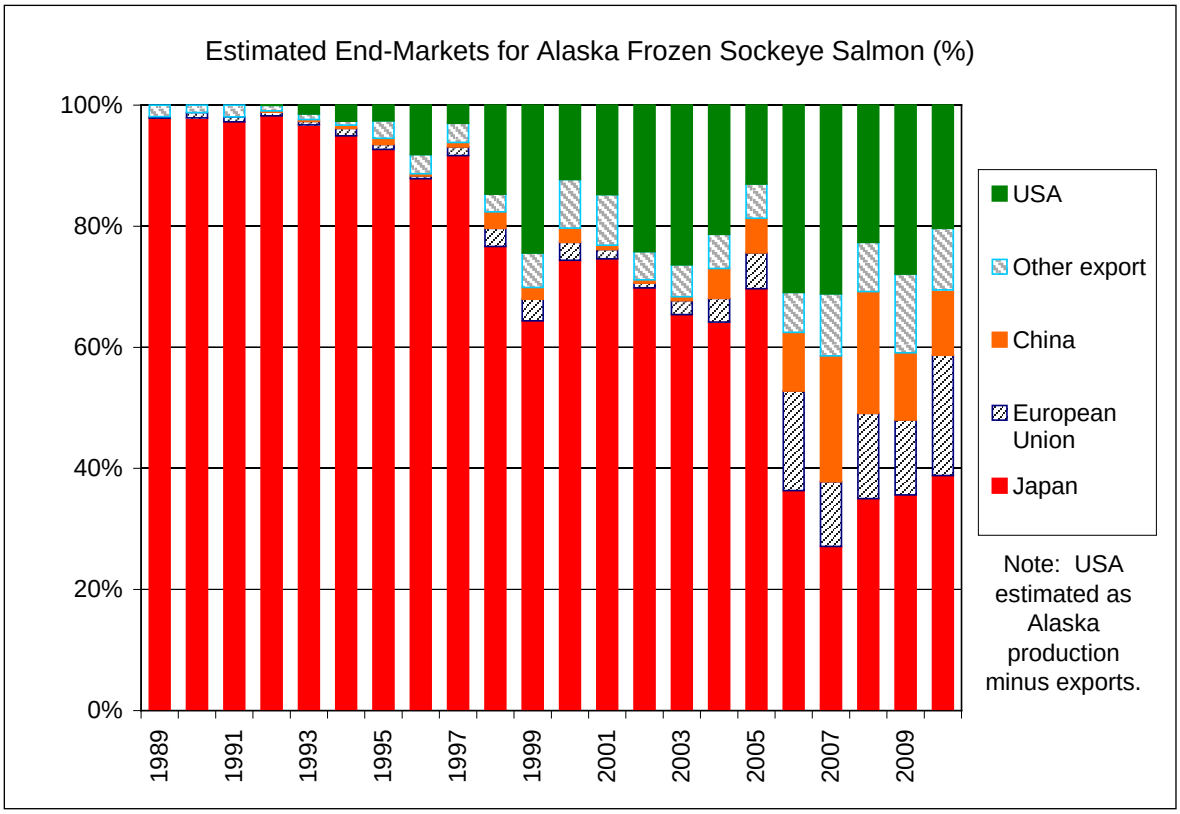


Figure 27. Estimated End-Markets for Alaska Frozen Sockeye Salmon

Note that most of the frozen sockeye exported to China are not consumed in China. Rather, they are thawed and reprocessed—using much cheaper Chinese labor—into fillet and other value-added products which are then re-exported to end-markets in Europe, the United States and Japan. Thus the final end-market shares for Europe, the United States and Japan are larger than are shown in the graph (but data are not available to indicate how *much* larger.)

Boxes of frozen Bristol Bay sockeye in the cold storage of a Chinese reprocessing plant, 2007

Most Alaska canned sockeye—including Bristol Bay canned sockeye—is exported. Total reported U.S. exports are approximately equal to total Alaska production (Figure 28).[10] Historically the United Kingdom was by far the most important market for canned sockeye. In recent years, exports of canned sockeye to Canada have grown dramatically—from which significant volumes are likely re-exported to the UK and other markets.

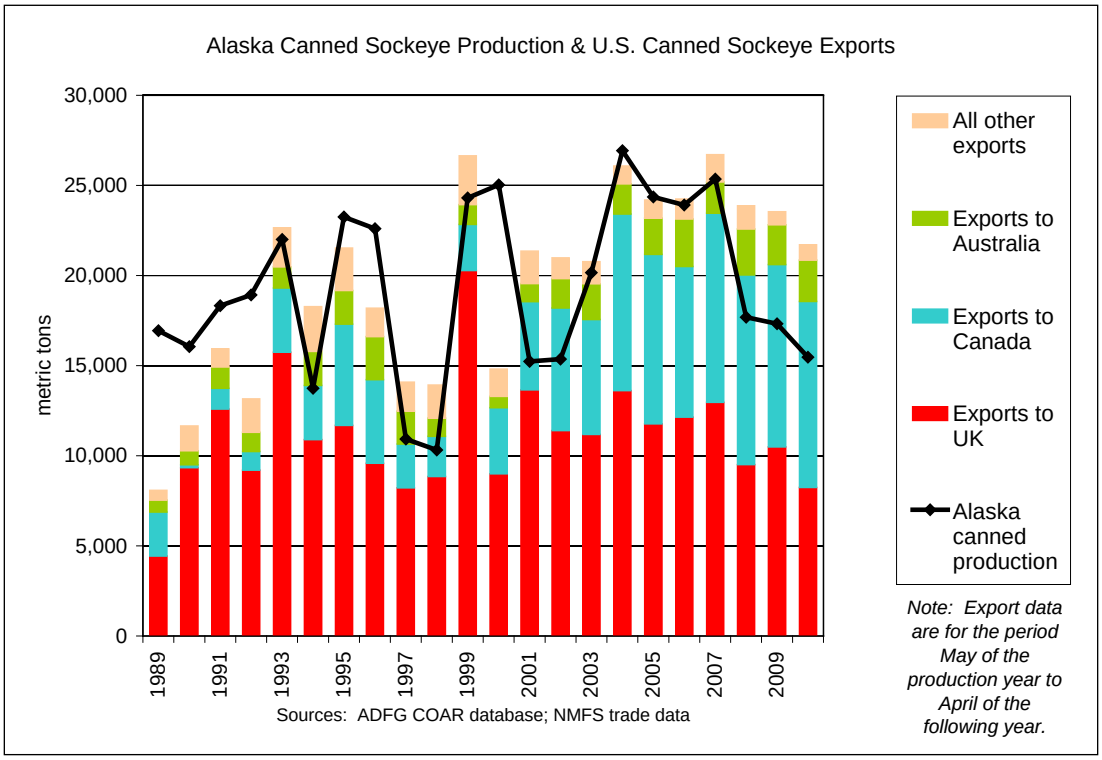


Figure 28. Alaska Canned Sockeye Production and U.S. Canned Sockeye Exports

[10] In some years reported US exports of canned sockeye salmon exceed reported Alaska production. The reasons for this are not entirely clear. One likely contributing factor is that in years of large sockeye production, significant volumes may be kept in inventory and sold during a later year.

Relatively small volumes of fresh salmon are produced in Bristol Bay. It is difficult for Bristol Bay to compete with other areas of Alaska in supplying fresh markets because of the greater distance and cost required to transport fish to the United States market.

Salmon roe accounts for a relatively small share of total Bristol Bay product volume—typically less than 3%--but accounts for a higher share of product value because it commands a higher price per pound than other product forms. Most Bristol Bay sockeye salmon roe is exported as *sujiko* (roe in whole skeins) to Japan.

3.5 Bristol Bay Salmon Prices

Between the late 1980s and 2001, Bristol Bay fishermen and processors experienced a dramatic decline in prices paid for Bristol Bay salmon. The "ex-vessel price" paid to fishermen fell from a peak of $2.10/lb in 1988 to $.42/lb in 2001. After 2001 the ex-vessel price recovered gradually to $.66/lb in 2006 and $.80/lb in 2009 and then rose sharply to $1.07/lb in 2010. Final data for Bristol Bay ex-vessel prices in 2011 were not available when this report was prepared but were expected to be similar to 2010.

In nominal terms 2010 ex-vessel prices were similar to prices for much of the 1990s. In "real" prices adjusted for inflation they remained lower than any year except 1993.

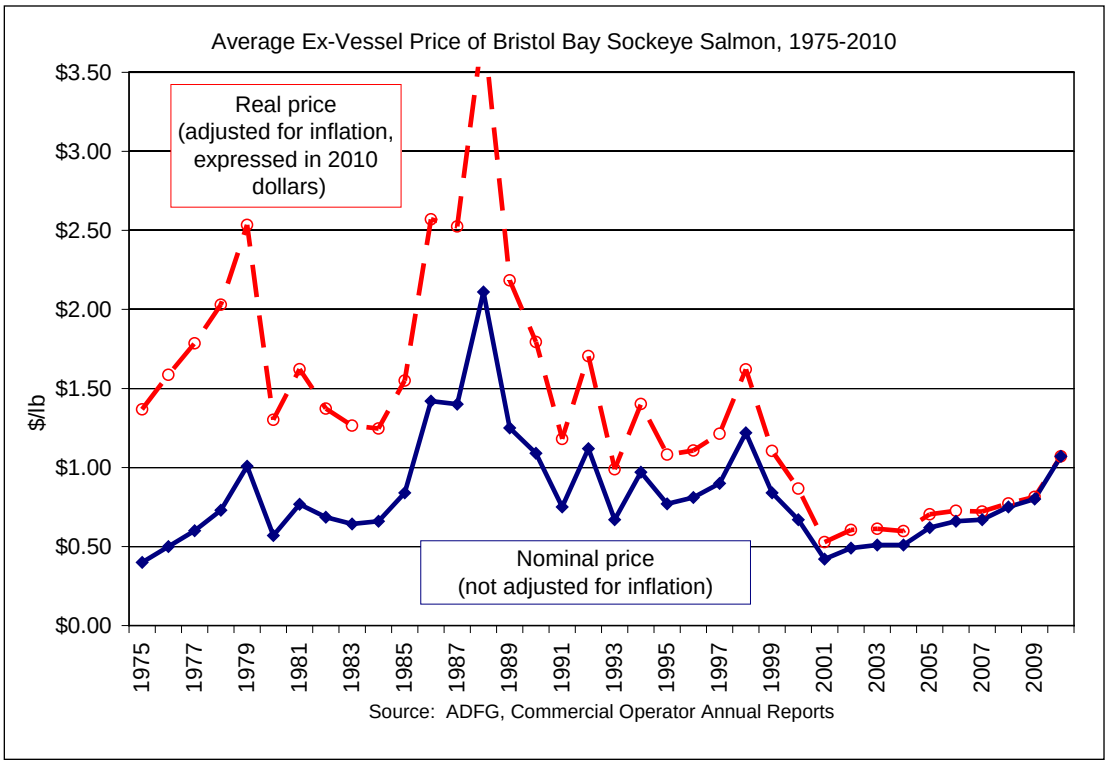


Figure 29. Average Ex-Vessel Price of Bristol Bay Sockeye Salmon, 1975-2010

Cannery at Clark's Point, Nushagak District

Photograph by Gabe Dunham

The decline in ex-vessel prices during the 1990s reflects a decline in first wholesale prices paid to processors for both canned and frozen salmon. Similarly, the increase in ex-vessel prices after 2001 reflects in first wholesale prices for both canned and frozen salmon—particularly for frozen salmon (Figure 30).

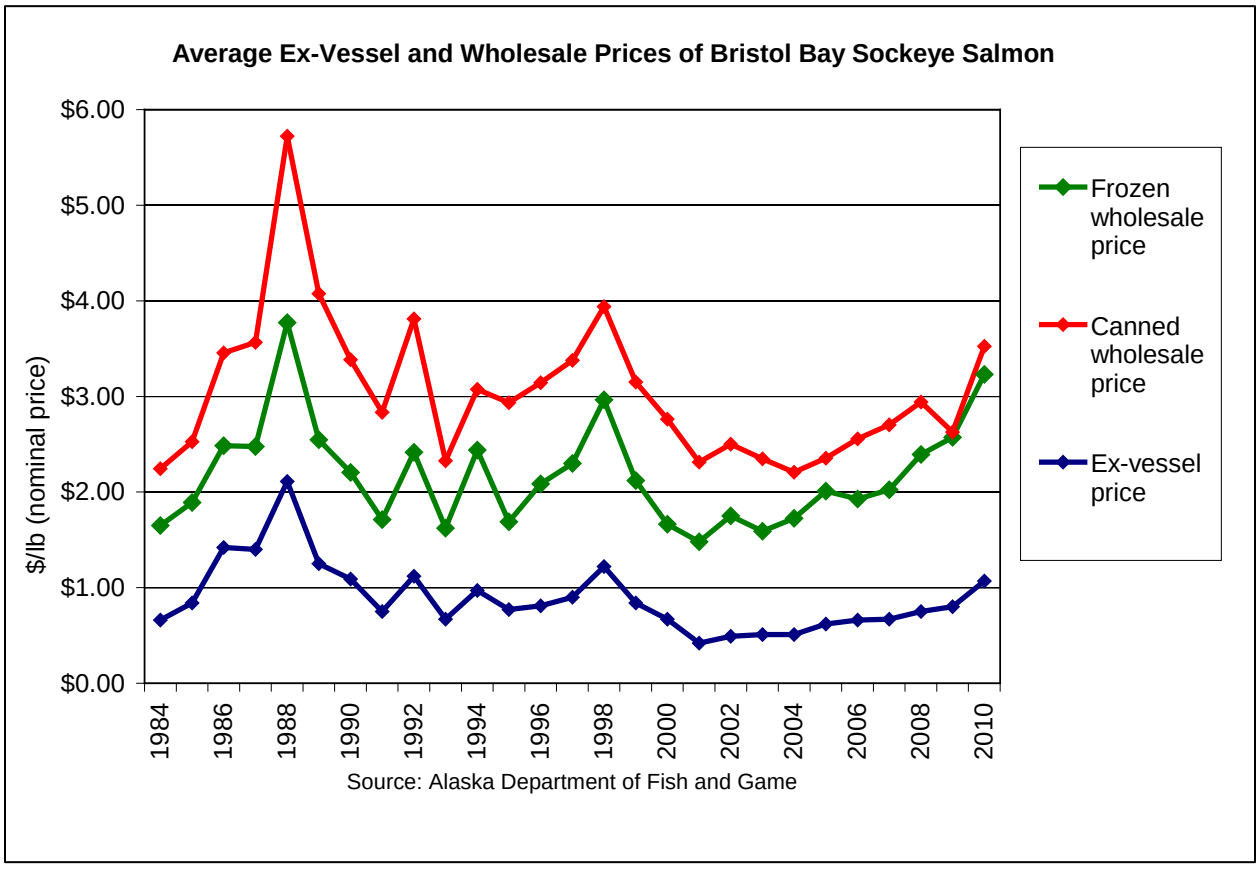


Figure 30. Average Wholesale and Ex-Vessel Prices of Bristol Bay Sockeye Salmon

A loaded Bristol Bay gillnetter

Photograph by Gabe Dunham

Monthly wholesale price data, available for years since 2001, provide more detail about wholesale price trends. Wholesale prices may fluctuate widely over the course of a year due to changes in supply and other market factors.

Wholesale prices for frozen headed and gutted (H&G) salmon increased from about $1.75/lb in 2001 to about $3.00/lb in early 2011. Wholesale prices for canned salmon halves increased from an average of about $2.50/lb in 2001 to about $3.50/lb in early 2011. Wholesale prices for canned salmon talls fell from an average of about $2.30/lb in 2001 to about $2.10/lb in 2005 before increasing to $3.30/lb in early 2011.

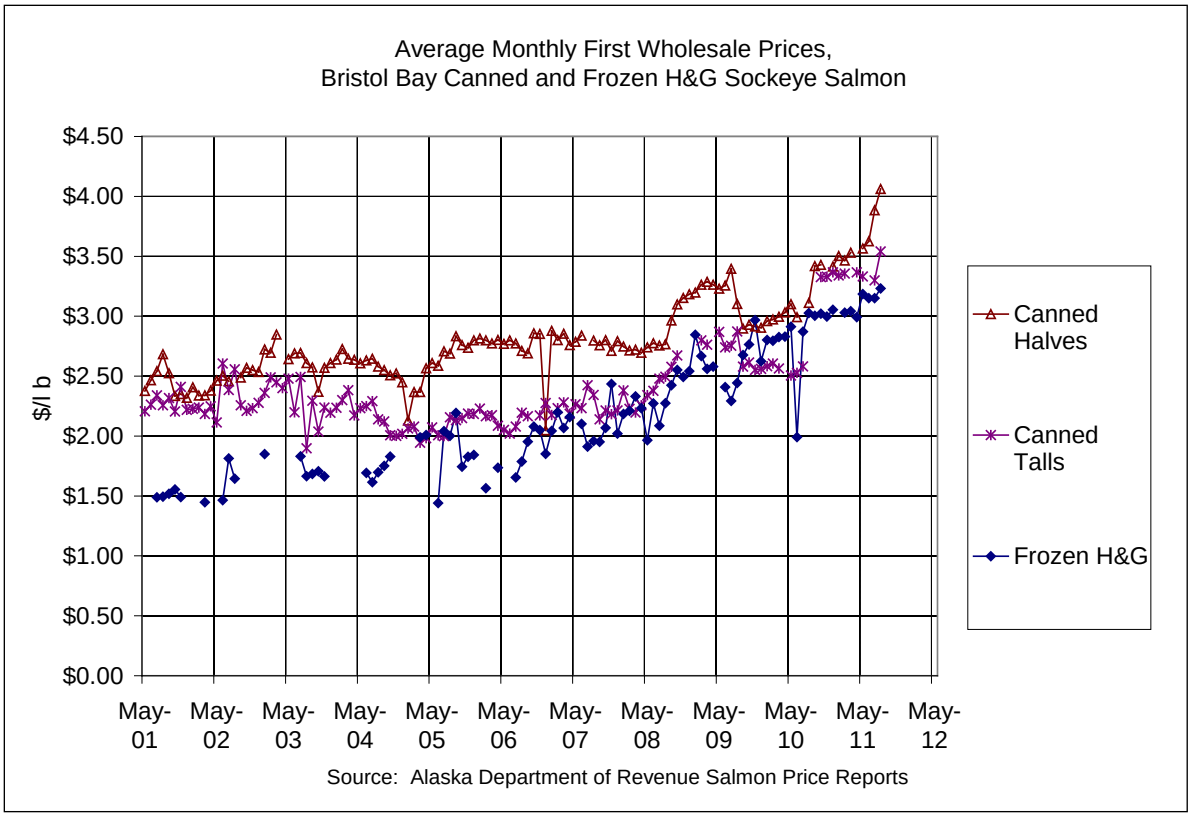


Figure 31. Average Monthly First Wholesale Prices.

In general, wholesale prices paid to processors for canned Bristol Bay sockeye salmon are similar to wholesale prices for canned sockeye salmon from other regions of Alaska. In contrast, wholesale prices paid to processors for frozen Bristol Bay sockeye salmon are typically lower than wholesale prices for frozen sockeye salmon from other regions of Alaska (Figure 32). This may reflect differences in product mix and/or differences in the perceived quality of Bristol Bay frozen sockeye compared with frozen sockeye from other parts of Alaska.

In turn, Bristol Bay ex-vessel price for sockeye salmon are typically lower than ex-vessel prices for sockeye salmon in southcentral and southeast Alaska (Figure 33). This may reflect the fact that processors receive lower wholesale prices for frozen sockeye, as well as the fact that processors face higher operating costs in Bristol Bay than in less remote regions of southcentral and southeast Alaska, as well as generally higher costs for transporting products to market.

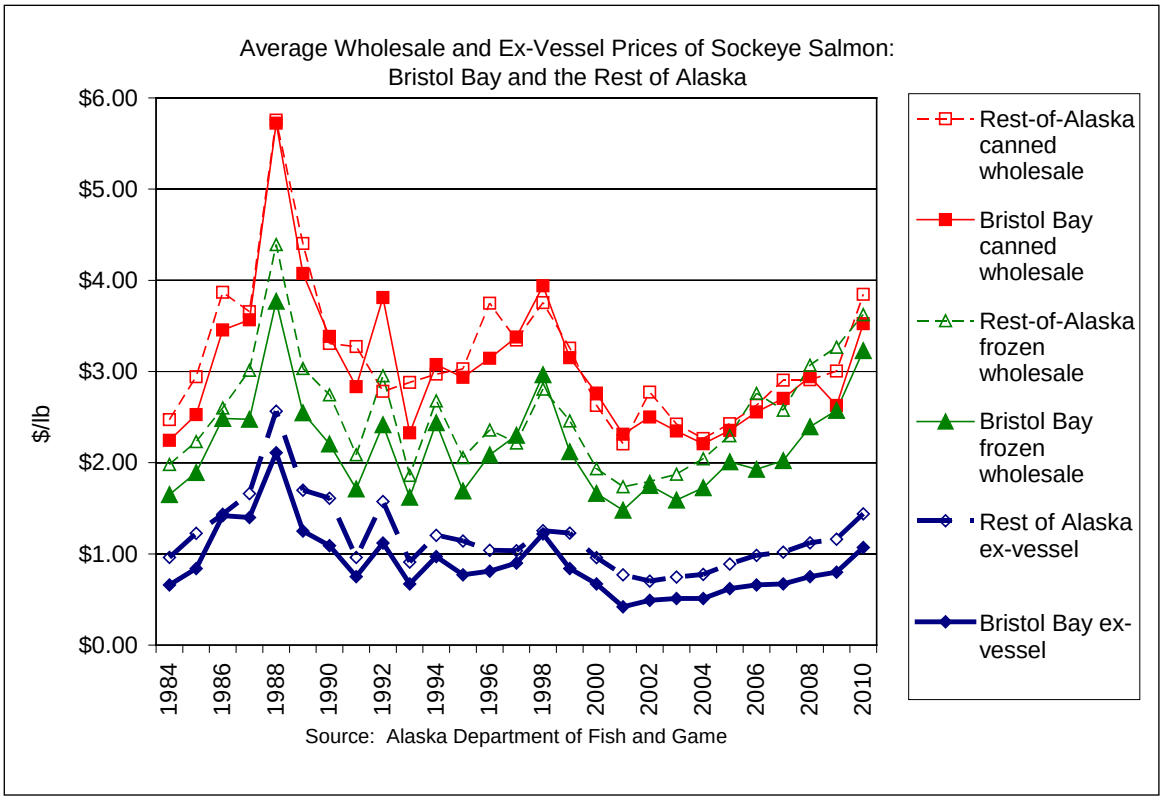


Figure 32. Average Wholesale and Ex-Vessel Prices, Bristol Bay and Rest of Alaska

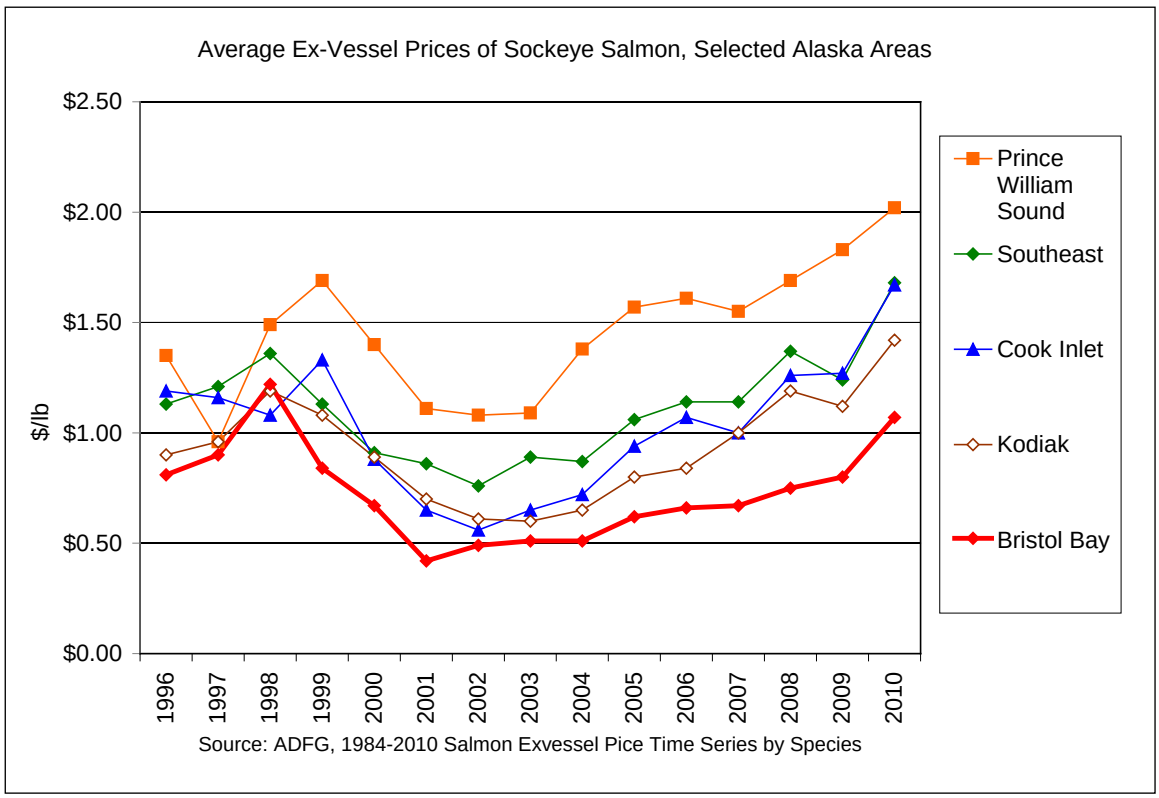


Figure 33. Average Ex-Vessel Prices of Sockeye Salmon, Selected Alaska Areas.

Factors Affecting Bristol Bay Salmon Prices

Changes in Bristol Bay salmon prices over the past three decades reflect dramatic changes in world salmon markets over this period. The most important change was a dramatic increase in world salmon supply resulting from rapid growth in farmed salmon production, mostly in Norway, Chile, the United Kingdom and Canada.

In particular, during the 1990s, Japan—where the market for "red-fleshed salmon has previously been dominated by Alaska sockeye—began to import large volumes of farmed coho salmon from Chile and farmed trout from Chile and Norway. This, together with lower Bristol Bay salmon harvests, led to a dramatic decline in the share of Bristol Bay sockeye salmon in its most important market.

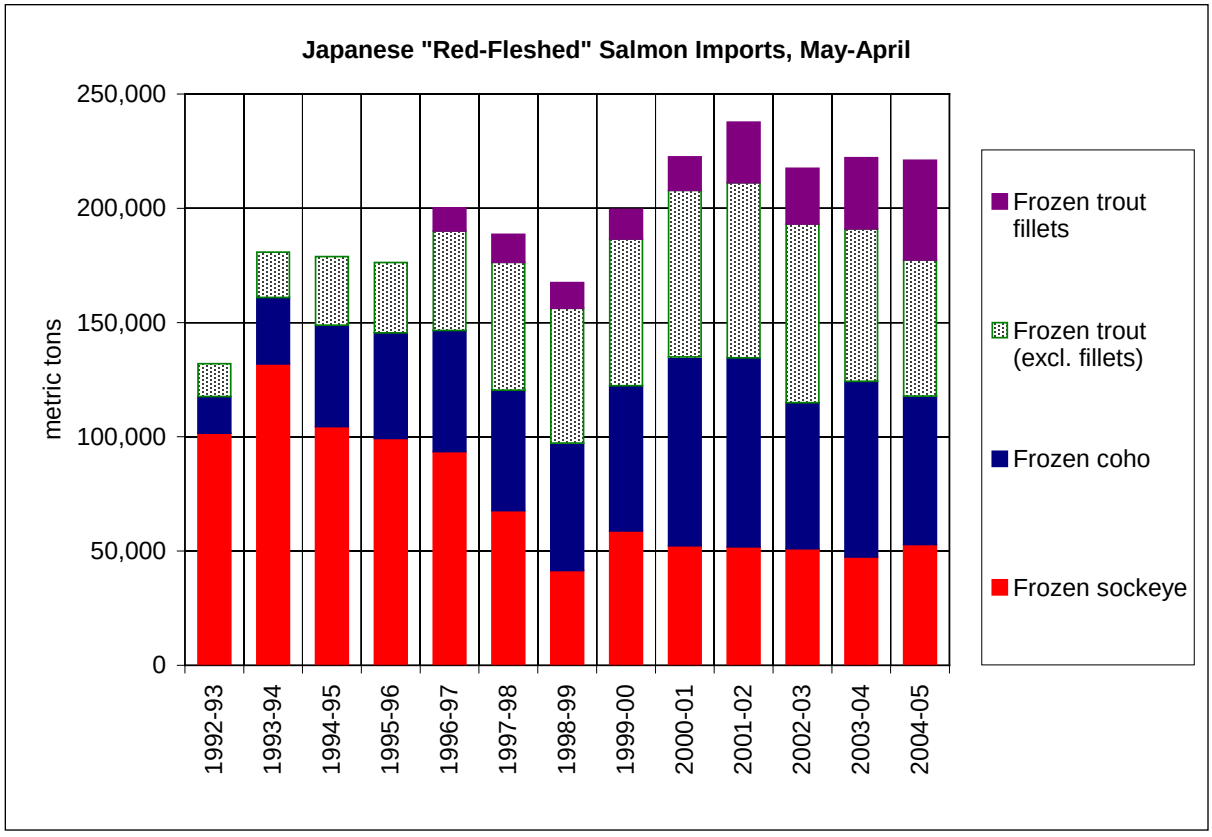


Figure 34. Japanese Red-Fleshed Salmon Imports, May-April

The effects of growing supply were compounded by an economic recession in Japan, changes in the Japanese fish distribution system which increased the market power of retailers, and long-term changes in Japanese food consumption patterns. The combined result was a sharp decline in Japanese wholesale prices paid for Bristol Bay sockeye salmon as well as farmed salmon (Figure 35). This in turn was reflected in a sharp decline in prices paid to Alaska processors and fishermen (Figure 36).

Bristol Bay headed and gutted sockeye salmon

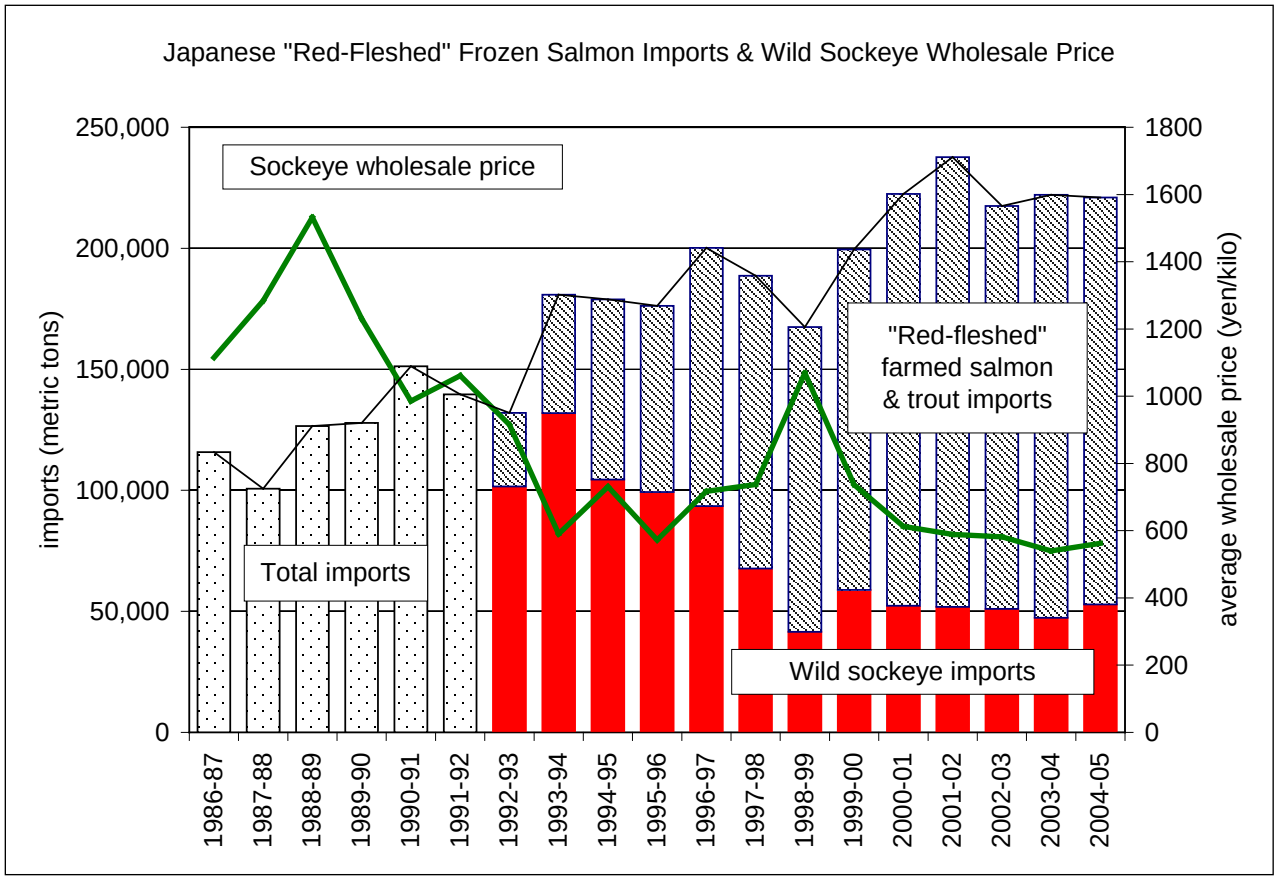


Figure 35. Japanese Red-Fleshed Frozen Salmon Imports & Wild Sockeye Wholesale Price

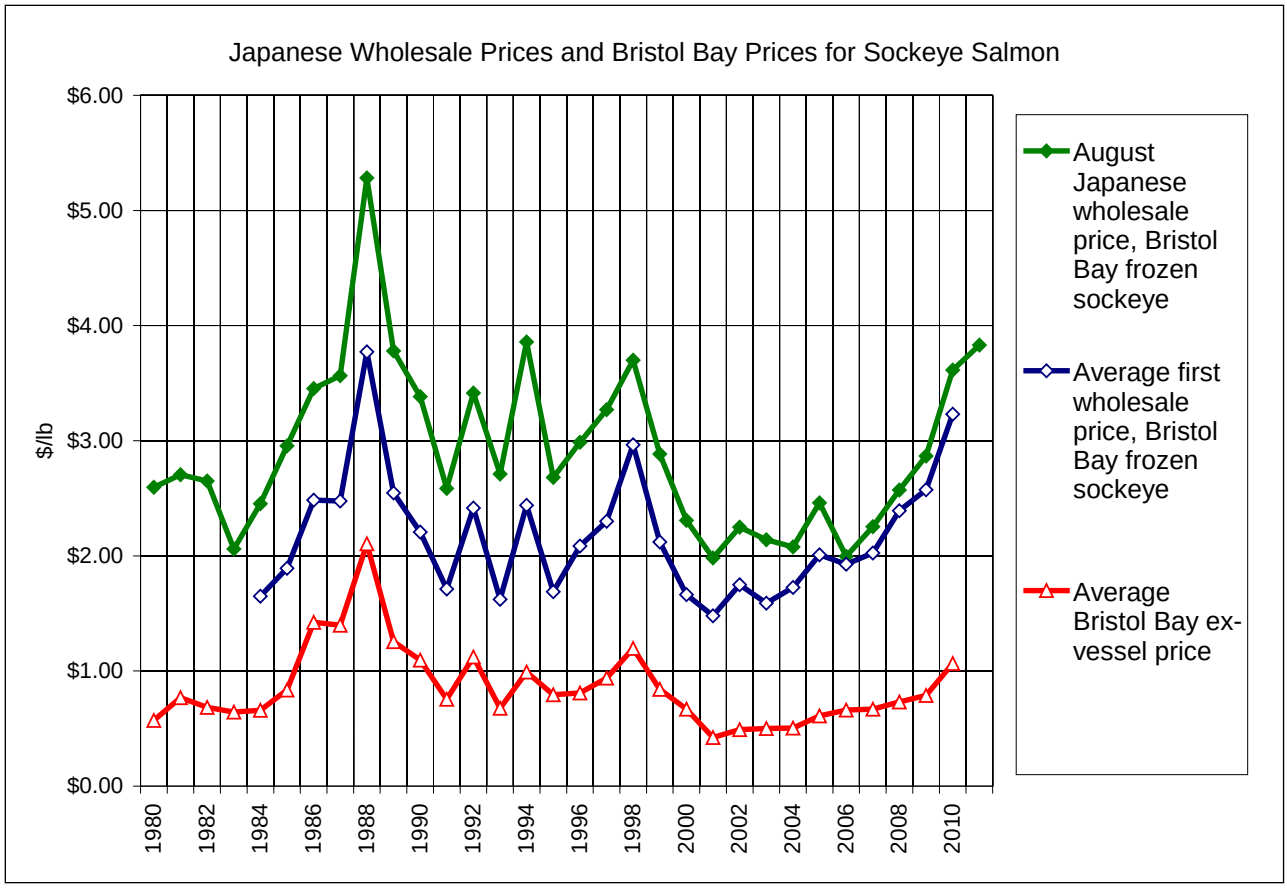


Figure 36. Japanese Wholesale Prices and Bristol Bay Prices for Sockeye Salmon

Just as multiple factors contributed to the fall in Bristol Bay salmon prices during the 1990s, multiple factors contributed to the recovery in prices after 2001. Probably the most important factors was a strong recovery in world market prices for farmed salmon, driven by rapidly rising world demand and a slowing of the growth in world salmon production (Figure III-9), exacerbated by major disease problems in the Chilean salmon industry which greatly reduced Chilean production. Prices of farmed Atlantic salmon in particular rose dramatically from 2002 through 2010 (Figure 37 and Figure 38).

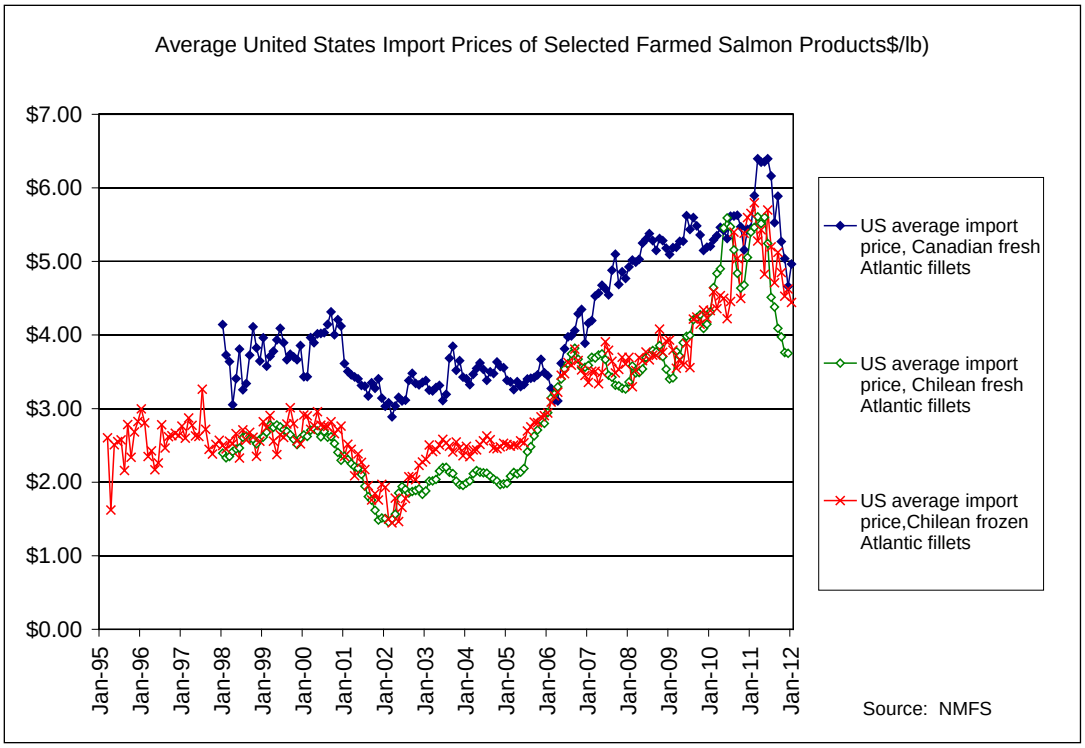


Figure 37. Average United States Import Prices of Selected Farmed Salmon Products

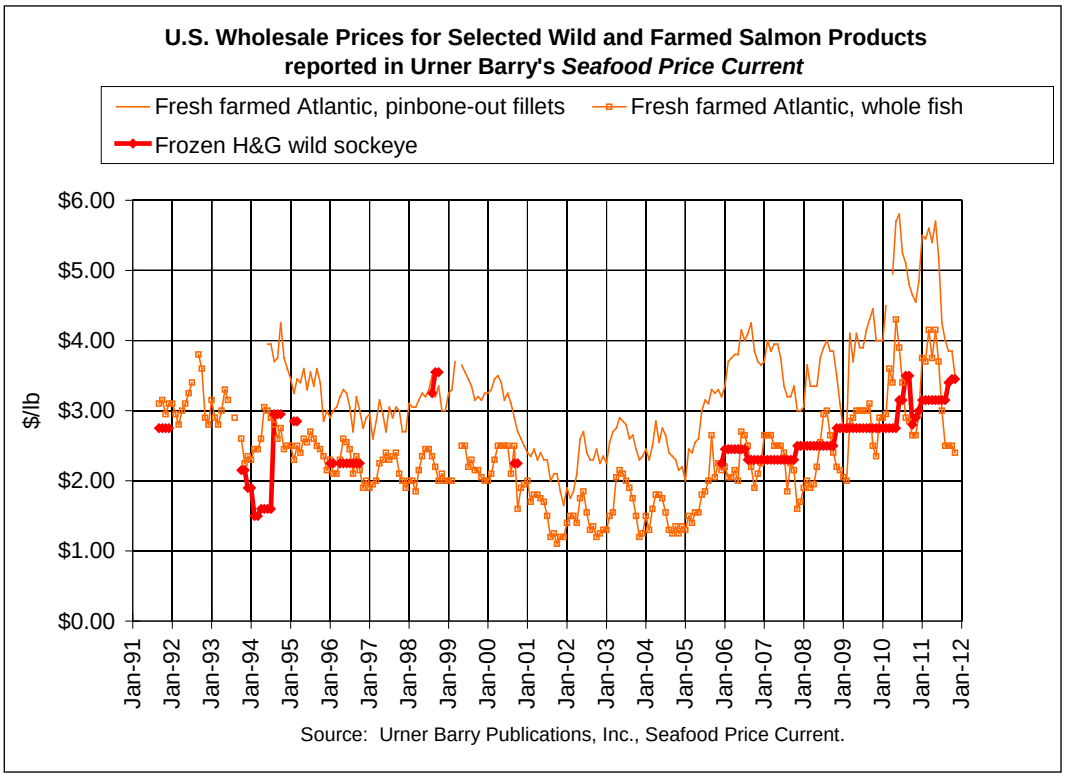


Figure 38. U.S. Wholesale Prices for Selected Wild and Farmed Salmon Products

Other factors which contributed to the increase in prices for Bristol Bay sockeye salmon after 2001 include the strengthening of exchange rates between the yen and the dollar and between the euro and the dollar, diversification of markets for frozen sockeye, and the development of new product forms, particularly fillets.

Unlike frozen salmon markets, canned salmon markets have not been directly affected by competition from farmed salmon—because relatively little farmed salmon is canned. However, canned salmon markets are influenced by frozen market conditions—and thus indirectly by farmed salmon. When frozen prices are high, processors tend to freeze relatively more salmon and can relatively less, which reduces the supply of canned salmon, causing canned salmon prices to rise. When frozen prices are low, processors tend to freeze relatively less salmon and can relatively more, which increases the supply of canned salmon, causing canned salmon prices to fall. Put differently, the ability of processors to shift between freezing and canning salmon causes frozen and canned salmon prices to tend to move together.

This can be seen in the decline in the downward trend in canned salmon prices in the early 1990s, and the upward trend since the early 2000s (Figure 37). However, many other factors affect canned salmon prices, including in particular wild salmon harvests, exchange rates between the dollar and the UK pound, and changing demand patterns for canned salmon.

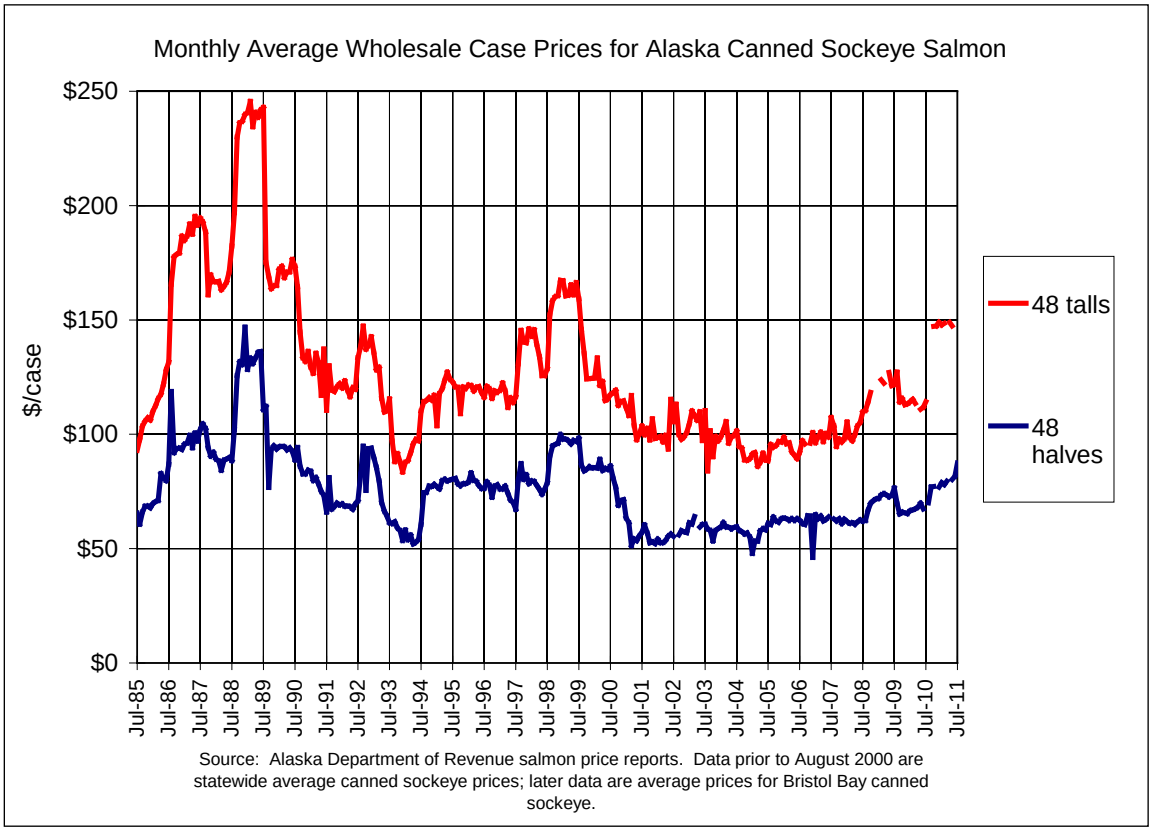


Figure 39. Monthly Average Wholesale Case Prices for Alaska Canned Sockeye Salmon.

Future Bristol Bay Salmon Prices

Since the beginning of 2011 prices of farmed Atlantic salmon have fallen sharply, in response to oversupply of world markets as Chilean production has recovered (Figure 37 and Figure 38, above). Of great importance for the Bristol Bay salmon industry will be the extent to which prices of Bristol sockeye salmon remain high, or alternatively follow the recent downward trend in farmed salmon prices. At the time this report was written, it was too soon to tell how deep or long the decline in farmed salmon prices may be, or how much it may affect sockeye salmon markets.

More generally, the future outlook for Bristol Bay salmon prices is promising but uncertain. There are several reasons for optimism, including growing demand for wild sockeye salmon in the United States and Europe, the development of new higher-valued product forms (particularly fillets), and improvements in the quality of Bristol Bay salmon (discussed below). However, the Bristol Bay salmon industry will face challenges in taking advantage of these new market opportunities. These include continued competition from farmed salmon and other new farmed species, the logistical difficulties of market development given the wide variation in annual Bristol Bay catches, high costs of transportation and labor, and highly concentrated seasonal production which adds to costs and makes it difficult to slow down production and improve quality. These factors make it relatively easier for other regions of Alaska than for Bristol Bay to take advantage of growing market opportunities for wild sockeye salmon.

Bristol Bay Salmon Quality

In an increasingly competitive world seafood industry, quality is of increasing importance. An important challenge for the Bristol Bay salmon industry has been a reputation for quality problems. Many people in the industry believe these problems have historically kept wholesale and ex-vessel prices lower than they would have been with better quality—although it is difficult to quantify how important the effect of quality on prices has been.

Quality problems in the Bristol Bay fishery derive in part from handling practices such as those depicted in these pictures posted on the internet. During the short, hectic and fast-paced Bristol Bay season, fishermen have historically been focused on catching large volumes of fish fast than on handling fish carefully. (In the highly quality-conscious salmon farming industry, it would be unthinkable to step on fish.)

Source: http://bbda.org/Stern_Load06.jpg

Source: www.adn.com/static/includes/highliner/cowboys.jpg

Quality problems in the Bristol Bay fishery have been compounded by the absence of ice or chilling capacity on many fishing boats; the logistics of tendering salmon long distances from fishing grounds to processors, which makes it more difficult to separate fish which have been handled carefully from those which have not (and to pay quality-conscious fisherman a corresponding price premium); and the difficulty of processing salmon soon after they are caught, especially during peak fishing periods.

Improving quality has been a primary focus of the Bristol Bay Regional Seafood Development Association (BBRSDA), [11] a fishermen's marketing association for the drift gillnet fishery financed by permit holders by means of a 1% assessment on the ex-vessel value of landings (harvests). BBRDSA has undertaken a number of projects focused on encouraging chilling (through icing and/or refrigerated sea water) as well as improved handling practices. Annual processor surveys funded by BBRDSA suggest that the share of fish which are delivered chilling is increasing (Figure V-12).[12]

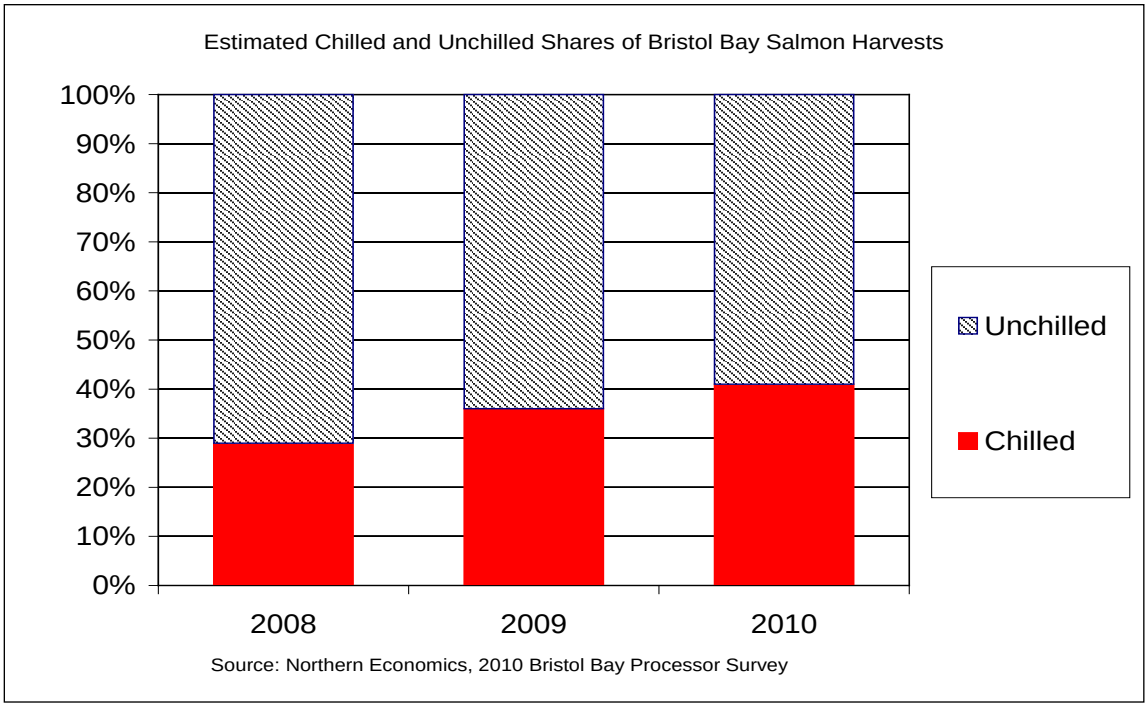


Figure 40. Estimated Chilled and Un-chilled Shares of Bristol Bay Salmon Harvests

[11] BBRSDA was established in 2005. Fishermen voted for the 1% assessment in 2006. Information about BBRSDA may be found at www.bbrsda.com.

[12] Northern Economics, 2010 Bristol Bay Processor Survey. Prepared for Bristol Bay Regional Seafood Development Association, February 2011. http://www.bbrsda.com/layouts/bbrsda/files/documents/bbrsda_reports/BB-RSDA%202010%20Survey%20Final%20Report.pdf

Bristol Bay fishing boats waiting to unload to a tender

Photograph by Gabe Dunham

3.6 Bristol Bay Salmon Ex-Vessel and Wholesale Value

The decline in catches and prices during the 1990s led to a drastic decline in value in the Bristol Bay salmon fishery. The nominal ex-vessel value paid to fishermen fell from a peak of $214 million in 1989 to just $32 million in 2002—a decline of 86%. The inflation-adjusted "real" value (expressed in 2010 dollars) fell by an even greater 89% from a 1989 value of $359 million to $39 million in 2002.

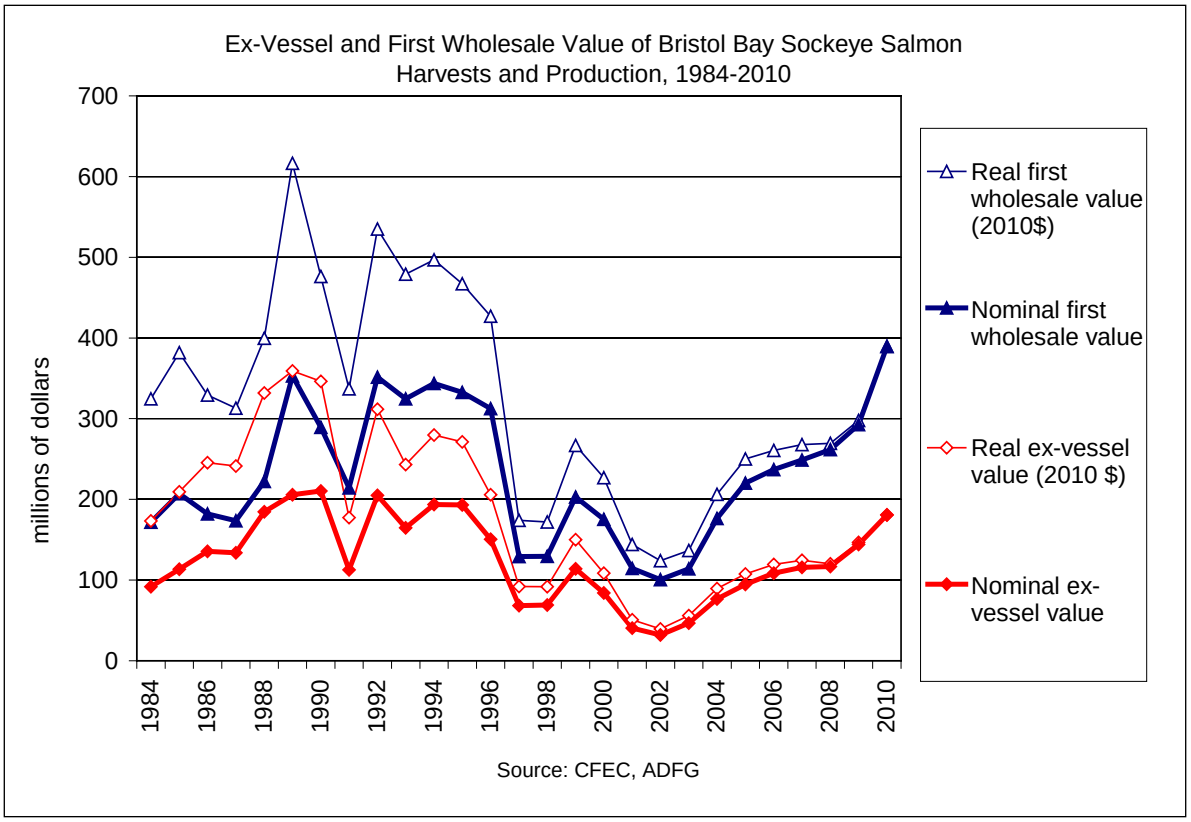


Figure 41. Ex-Vessel and First Wholesale Value: 1984-2010

As catches and prices have improved after 2002, the Bristol Bay salmon industry experienced a significant economic recovery. Ex-vessel value increased to $181 million in 2010. However, this was well below the inflation-adjusted "real" value of the highest-value years of the late 1980s and early 1990s.

The first wholesale value of Bristol Bay salmon production exhibited similar trends over time as ex-vessel value. The nominal first wholesale value fell from a peak of $351 million in 1992 to $100 million in 2002. As catches and prices improved, nominal wholesale value rose to a record $390 million in 2010. Adjusted for inflation, however, the 2010 first wholesale value remained well below the 1989 peak real wholesale value of $616 million.

The decline in value of the Bristol Bay fishery during the 1990s and the rise in value after 2002 was experienced by both processors and fishermen. Like the ex-vessel value to fishermen, the value retained by processors after deducting payments to fishermen (sometimes called the processors' margin) fell dramatically during the 1990s and rose dramatically after 2002 (Figure 42).

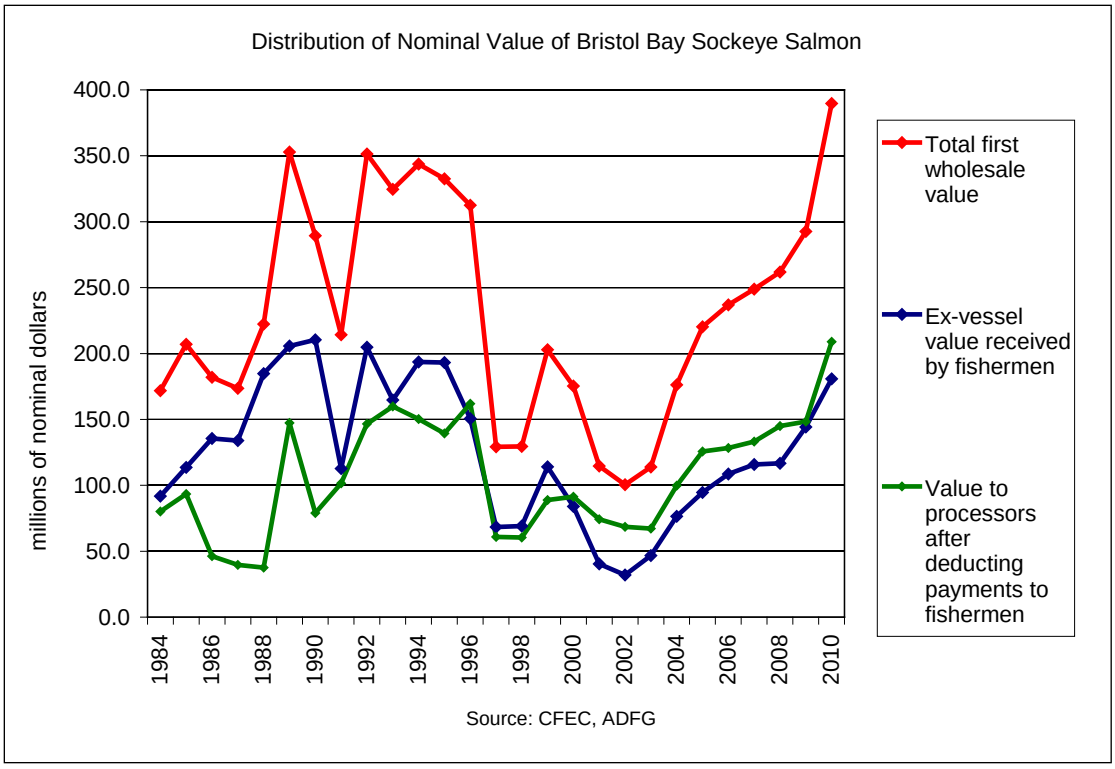


Figure 42. Distribution of Nominal Value of Bristol Bay Sockeye Salmon

The share of first wholesale value received by fishermen fell from 83% in 1988 to 32% in 2002 and then rose to 46% in 2010 (Figure 43).

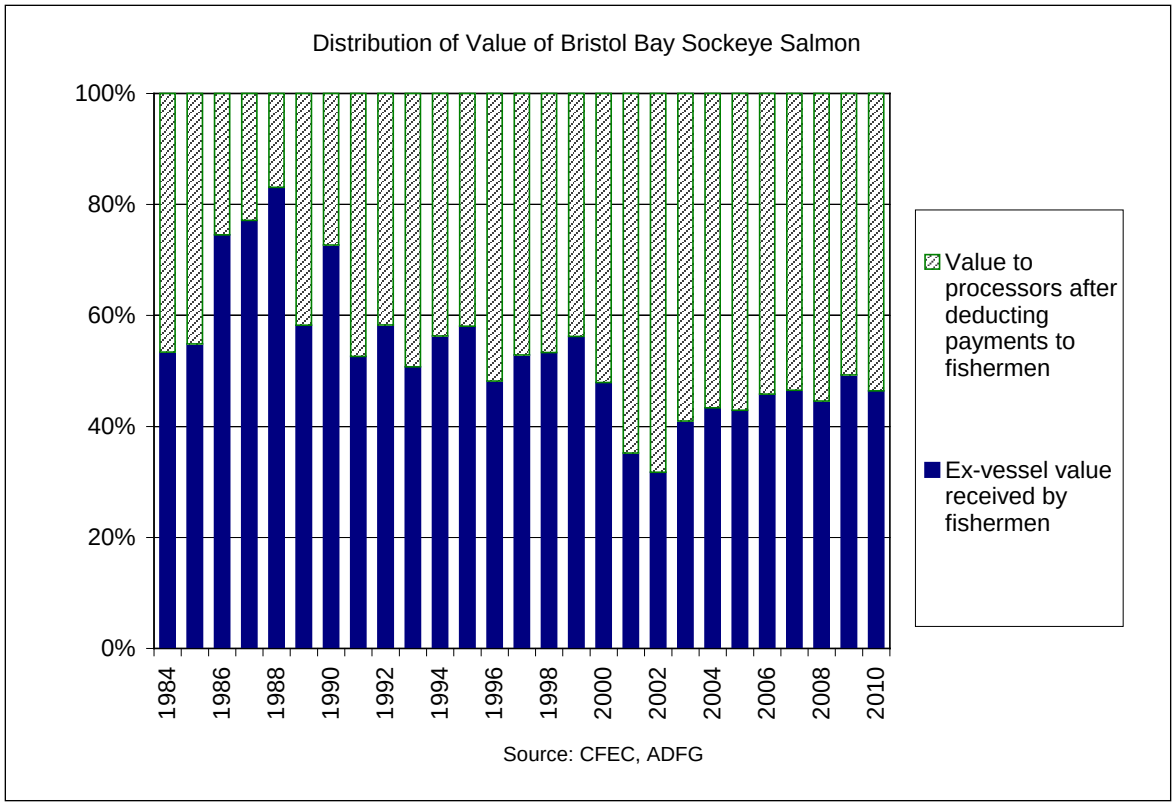


Figure 43. Distribution of Value of Bristol Bay Sockeye Salmon

The relative share of wholesale value received by fishermen and processors has been a subject of contention between fishermen and processors.[13] During the 1990s, fishermen argued that they had experienced a disproportionate and unfair share of the decline in wholesale value. Note, however, that there is no economic reason to expect fishermen or processors' shares of gross wholesale value to remain constant over time. Regardless of wholesale value, processors must cover the costs of processing—which account for a relatively larger share of wholesale value as wholesale value declines.

The loss in value during the 1990s led to a severe economic crisis in the Bristol Bay salmon industry. As discussed above, as the value of the fishery declined, the prices of limited entry permits plummeted and many fishermen stopped fishing their permits. Similarly, many land-based salmon processing operations closed and many floating processors left Bristol Bay.

[13] The decline in the fishermen's share of ex-vessel value was a key issue in an unsuccessful class-action lawsuit filed in 1995, in which Bristol Bay permit holders alleged that major processors and Japanese importers of Bristol Bay salmon had conspired to fix prices paid to fishermen (Alakayak v. All Alaskan Seafoods, Inc). The author served as an expert witness on behalf of the defendant processors and importers.

3.7 Bristol Bay Salmon Fishermen

As discussed earlier, both the Bristol Bay drift gillnet fishery and the Bristol Bay set gillnet fishery are managed under a "limited entry" management system which was implemented for all of Alaska's twenty-seven salmon fisheries in the mid-1970s. The basic purpose and effect of the limited entry system is to limit the number of boats fishing in each fishery, which makes it easier for managers to control the total fishing effort and makes the fishery more profitable for participants than it would be if entry (participation) were unrestricted and more boats could fish.

There are approximately 1860 drift gillnet permits and approximately 1000 set net permits. Every drift gillnet fishing boat or set net operation must have a permit holder on board or present while fishing—so the number of boats or set net operations cannot exceed the number of permit holders.

A permit represents a right (legally a revocable privilege) to *participate* in a fishery. Unlike individual fishing quota (IFQ) or catch-share systems which have been implemented in some United States fisheries, a permit does not restrict a permit-holder to catching a specific number of fish. Fishermen may catch as many fish as they can—as long as they follow the numerous regulations which restrict when, where and how they may fish.

When limited entry management was implemented in 1975, permits were allocated for free to individuals who had historically participated in the fishery. Permit holders may hold permits in perpetuity, although they must renew their permits each year for a nominal administrative fee. Persons without permits can acquire them only by gift, inheritance, or by buying them from existing permit holders.

Permit holders must register to fish in one of the five Bristol Bay fishing districts. They may transfer to fish in another district, but must wait 48 hours before fishing in the new district.

A "permit stacking" regulation implemented in 2004 for the drift gillnet fishery allows two permit holders who opt to fish together on a single vessel to use 200 fathoms of drift gillnet gear (an additional 50 fathoms more than the usual limit of 150 fathoms). The objective of the regulation was to allow two permit holders to team up to reduce their combined harvesting costs to create a more profitable operation.

In addition to permit holders, there are an average of about two crew members for each drift gillnet fishing boat and about two crew members for each set gillnet site. Crew members are usually paid a percentage share of gross earnings after deducting costs of food and fuel. A typical drift gillnet crew share is about 10%.

The Commercial Fisheries Entry Commission (CFEC) maintains detailed public data about salmon permit holders, including their names, addresses, and vessel information. It also publishes annual data on the total number of permits fished, total pounds landed, total gross earnings, and average prices paid for permits sold.[14]

[14] The data may be found at the Commercial Fisheries Entry Commission website: http://www.cfec.state.ak.us/.

In contrast, almost no data are available about Bristol Bay crew members. Although crew are required to purchase an annual Alaska fishing crew license for a nominal fee, no data are available about whether they participate in fishing, which fisheries they fish in, or how much they earn. For this reason, most of the data presented in this section are about Bristol Bay permit holders. But keep in mind that about two-thirds of the people working in Bristol Bay fish harvesting are crew members.

Fishery Participation

Until the late 1990s, most Bristol Bay permits were fished (Figure 44). However, beginning in the late 1990s, a growing number of permit holders stopped participating in the Bristol Bay fishery, because they couldn't make enough money to cover their costs. In 2002—the lowest year for Bristol Bay ex-vessel value since the start of the limited entry program in 1975—only 63% of drift gillnet permits and 66% of set gillnet permits were fished.

Since 2002, as the value of the fishery increased, fishery participation also increased, although many permits remained unfished. In 2010, 80% of drift gillnet permits and 86% of set gillnet permits were fished.

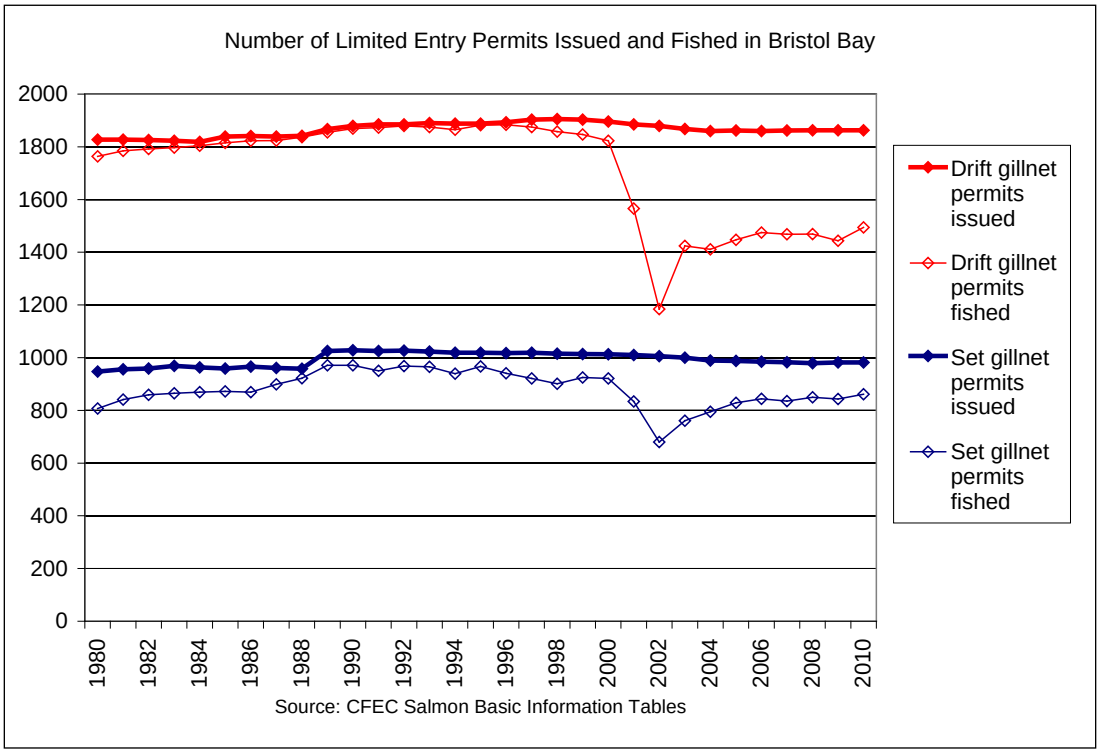


Figure 44. Number of Limited Entry Permits Issued and Fished in Bristol Bay

Understanding the extent of participation in the Bristol Bay drift gillnet fishery since 2004 is complicated by the permit-stacking option for the drift gillnet fishery, under which two permit holders may opt to fish together (with an additional 50 fathoms of gear) from a single boat.

A CFEC analysis of the 2009 fishery, based on district registration data (both permit-holders in a two-permit operation are required to register for fishing in that district) concluded that "for the fishery as a whole, two-permit operations occurred on an estimated 20.9% (278) of the 1,331 vessels registered during the season and one-permit only operations occurred on 79.1% (1,053) of the vessels. Of the 1,610 distinct permit holders who registered during the season, 34.7% (558) were involved in a two-permit operation during the season, while 65.3% (1,052) were involved in a one-permit operation only."[15]

Table 29 and Table 30 (on the following page) provides selected indicators of participation in the Bristol Bay drift gillnet fishery in 2009, based on various measures reported by CFEC. A total of 1863 permits were issued to 1838 permit holders. Of these, 1610 registered to fish during the season in one or more of the Bristol Bay fishing districts. Of these an estimated 1052 fished alone and 558 fished with another permit holder. Of those who fished with another permit holder, an estimated 401 reported landings on their permits while 157 reported no landings on their permits (all of the operation's landings were reported on the other permit holder's permit).

Thus the CFEC data for the "number of permits fished," shown in Figure 44 above (1453 in 2009), overstates the number of boats which fished (1331 in 2009), but understates the number of permit holders who participated in the fishery (1610 in 2009).

Table 29. Selected Indicators of Participation in 2009 Drift Gillnet Fishery

Selected Indicators of Participation in the 2009 Bristol Bay Drift Gillnet Salmon Fishery

Row	Indicator	Source	Number
1	Total permits issued	a, b	1,863
2	Number of permit holders	b	1,838
3	Number of distinct permit holders who registered during the season	c	1,610
4	Estimated number involved in a one-permit operation only during the season	c	1,052
5	Estimated number involved in a two-permit operation during the season	c	558
6	Number of fishermen who fished (reported landings on their permits)	b	1,453
7	Total permits fished (with reported landings)	a, b	1,444
8	Number of vessels registered during the season	c	1,331
9	Estimated number on which only one-permit operations occurred	c	1,053
10	Estimated number on which two-permit operations occurred	c	278

(a) CFEC, Salmon Basic Informaton Tables, Bristol Bay Drift Gillnet Salmon Fishery, http://www.cfec.state.ak.us/bit/X_S03T.HTM.
(b) CFEC, "Permit & Fishing Activity by Year, State, Census Area or City," data for "Grand Total: All Fishermen Combined", http://www.cfec.state.ak.us/gpbycen/2009/00_ALL.htm.
(c) Schelle, K., N. Free-Sloan, and C. Farrington, "Bristol Bay Salmon Drift Gillnet Two-Permit Operations: Preliminary Estimates from 2009 District Registration Data (CFEC Report No. 09-6N, 2009). http://www.cfec.state.ak.us/RESEARCH/09-6N/bbr_final_v4_121409.pdf.

[15] Schelle, K., N. Free-Sloan, and C. Farrington, "Bristol Bay Salmon Drift Gillnet Two-Permit Operations: Preliminary Estimates from 2009 District Registration Data (CFEC Report No. 09-6N, 2009). http://www.cfec.state.ak.us/RESEARCH/09-6N/bbr_final_v4_121409.pdf.

Table 30. Estimated Number of 2009 Drift Gillnet Permit Holders who Fished Alone, With another Permit Holder, or Did Not Fish

Estimated Numbers of 2009 Drift Gillnet Permit Holders Who Fished Alone, Fished with Another Permit Holder, or Did Not Fish

Number of permit holders who:	Estimates	How calculated*
Fished alone	**1,052**	4
Fished with another permit holder	**558**	5
Fished with another permit holder and reported landings	401	5 - (3 - 6)
As the only permit holder who reported landings	*122*	6 - 8
With both reporting landings	*279*	5 - (3 -6) - (6-8)
Fished with another permit holder but did not report landings	157	3 - 6
Held permit but did not fish it	**228**	2 - 3
TOTAL NUMBER OF PERMIT HOLDERS	**1,838**	2

*Numbers refer to rows in the previous table.

Distribution of Earnings

In both the drift gillnet and set gillnet fisheries, each year there is wide variation among permit holders in average earnings, reflecting differences in vessel size, fishing style, fishing experience and skill, how aggressively and for how long they fish, what fishing districts they choose to fish in, and good or bad luck. These differences are reflected in average earnings among four "quartile" groups of permit holders, each of which accounts for one quarter of total Bristol Bay earnings.

In the drift gillnet fishery, typically, the first quartile has about one-third to one-fourth as many fishermen as the fourth quartile, earning on average of about three to four times as much (Figure 45).

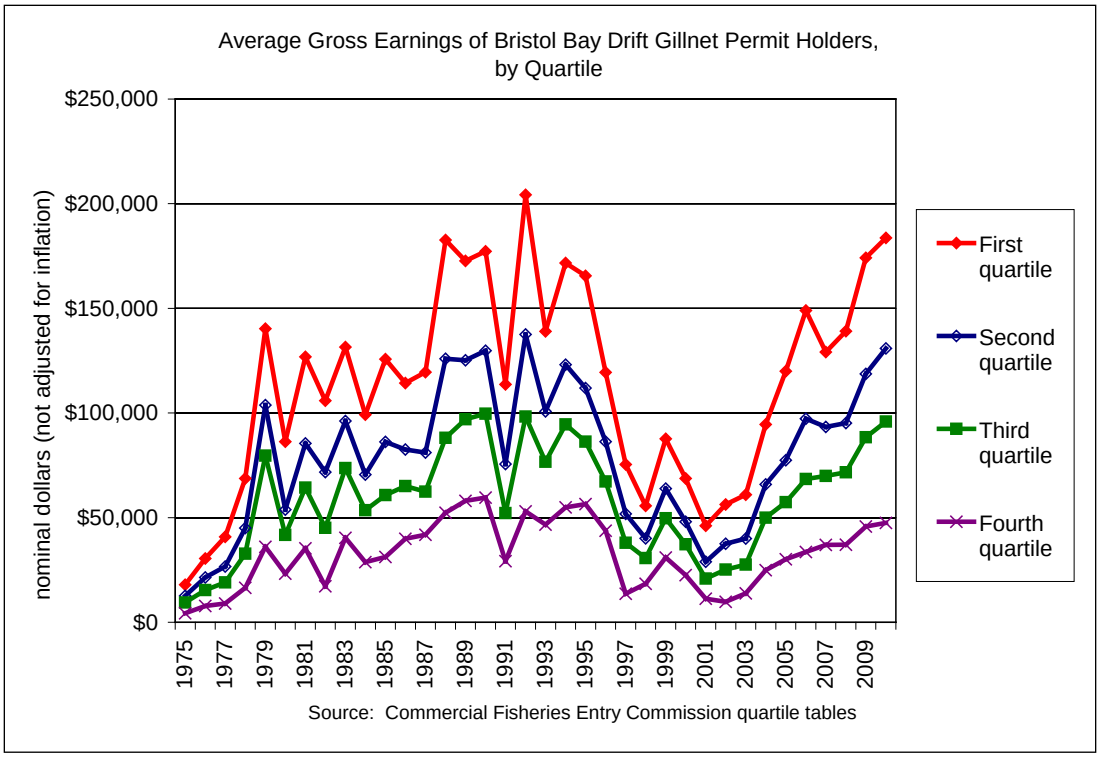


Figure 45. Average Gross Earnings of Bristol Bay Drift Gillnet Permit Holders

Average earnings in the set gillnet fishery are much lower than in the drift gillnet fishery. The highest earning "first quartile" set gillnet permit holders earn about half as much as the "first quartile" drift gillnet permit holders (Figure 46). There is a wider range of variation in earnings of set net permit holders, reflecting in part wide differences in the number of fish swimming past set net sites in different Bristol Bay locations.

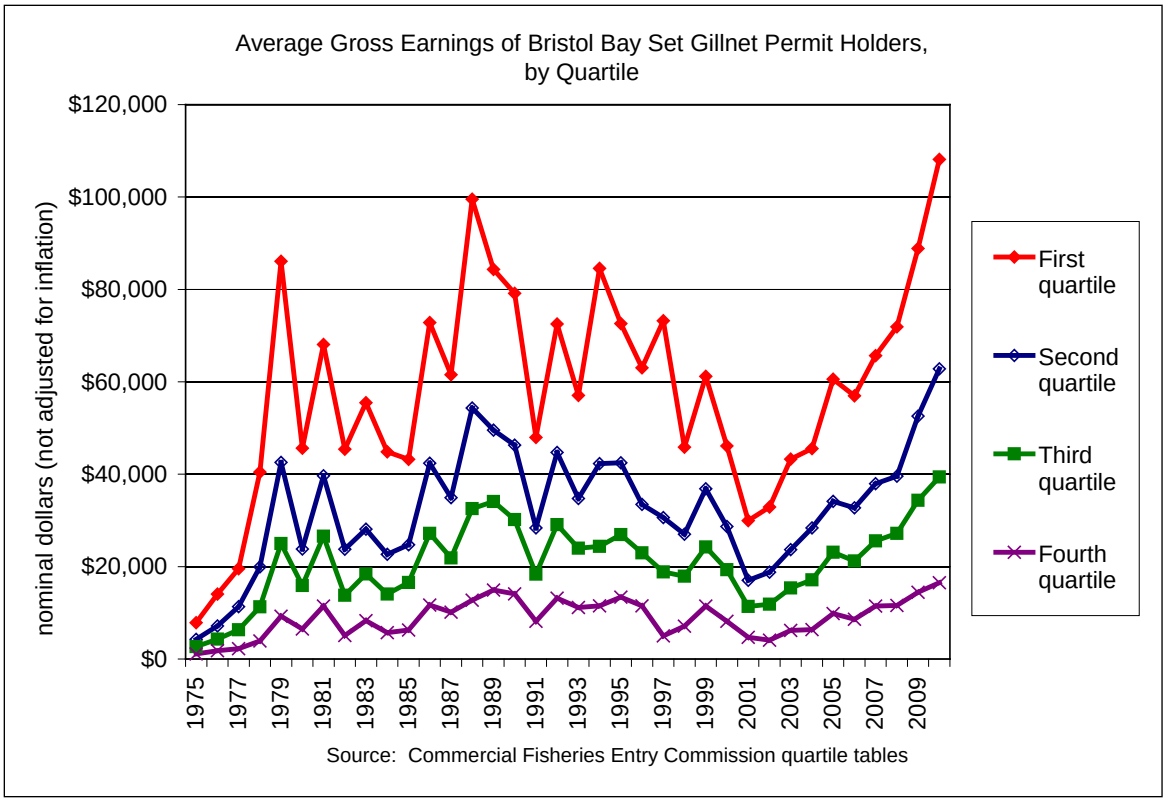


Figure 46. Average Gross Earnings of Bristol Bay Set Gillnet Permit Holders

Permit Prices

The prices paid for Bristol Bay permits have fluctuated dramatically over time. Expressed in nominal dollars, average prices paid for drift gillnet permits rose from $66,000 in 1980 to $249,000 in 1989, fell to $20,000 in 2002, and rose again to $102,000 in 2010. Average prices paid for set gillnet permits rose from $29,000 in 1980 to $65,000 in 1989, fell to $12,000 in 2002, and rose again to $29,000 in 2010.

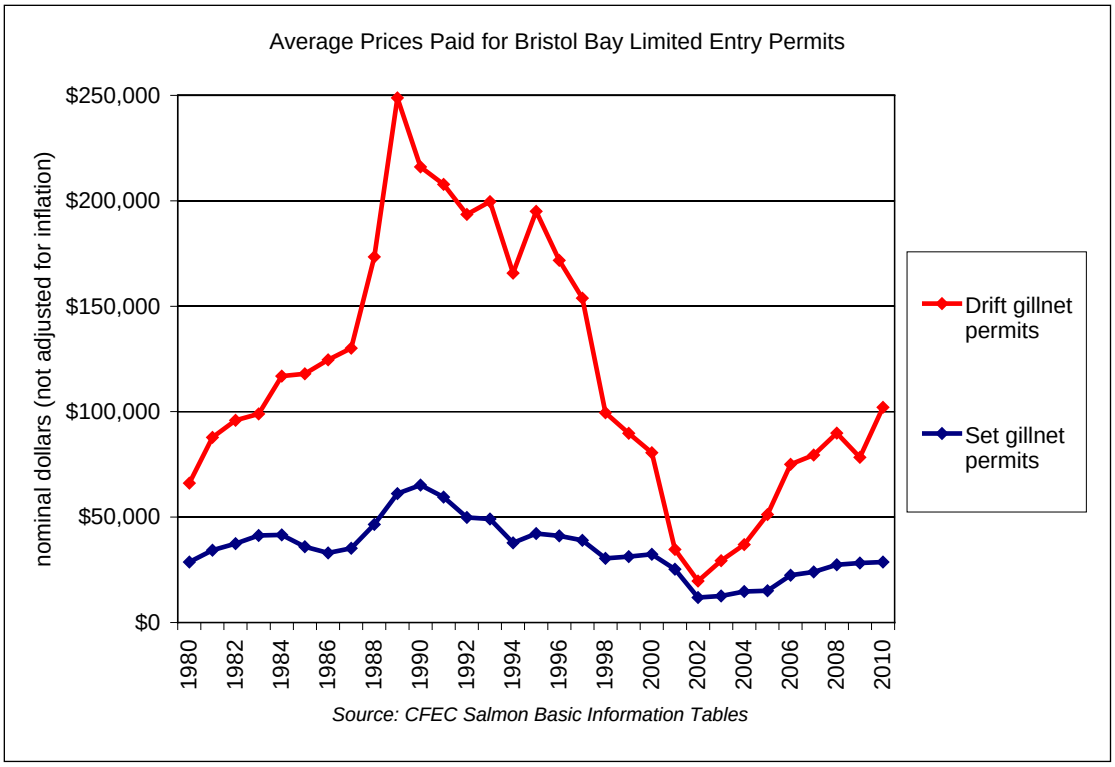


Figure 47. Average Prices Paid for Bristol Bay Limited Entry Permits

Bristol Bay limited entry permit prices are clearly strongly related to total earnings in the fishery. In both fisheries, trends over time in permit prices closely track trends over time in total earnings (Figure 48 & Figure 49). Economic theory suggests that permit prices would be driven by fishermen's expectations of future profits from the fishery. The close relationship between total earnings and permit prices suggests that expectations of future profits are driven by trends in average profits in recent years.

Costs of Fishing

Not all Bristol Bay permit holder earnings are profits, of course. Permit holders face significant costs of fishing, some of which are relatively fixed regardless of the volume or value of their catch—which makes fishing profits relatively more volatile than earnings.

No data are collected on a regular basis on the costs faced by Bristol Bay permit holders. From time to time, studies have estimated costs of fishing based on surveys of Bristol Bay permit holders. However, it is difficult to characterize fishing costs, for several reasons. First, costs may vary widely between fishing operations, because of differences in factors such as vessel size, number of crew, how and where permit holders fish, and where permit holders and crew live. Second, costs may vary significantly from year to year due to changes in prices of fuel, insurance and other inputs to fishing. Third, fixed costs such as vessel storage and insurance may vary widely from year to year when expressed on a per-pound basis due to changes in harvest volumes.

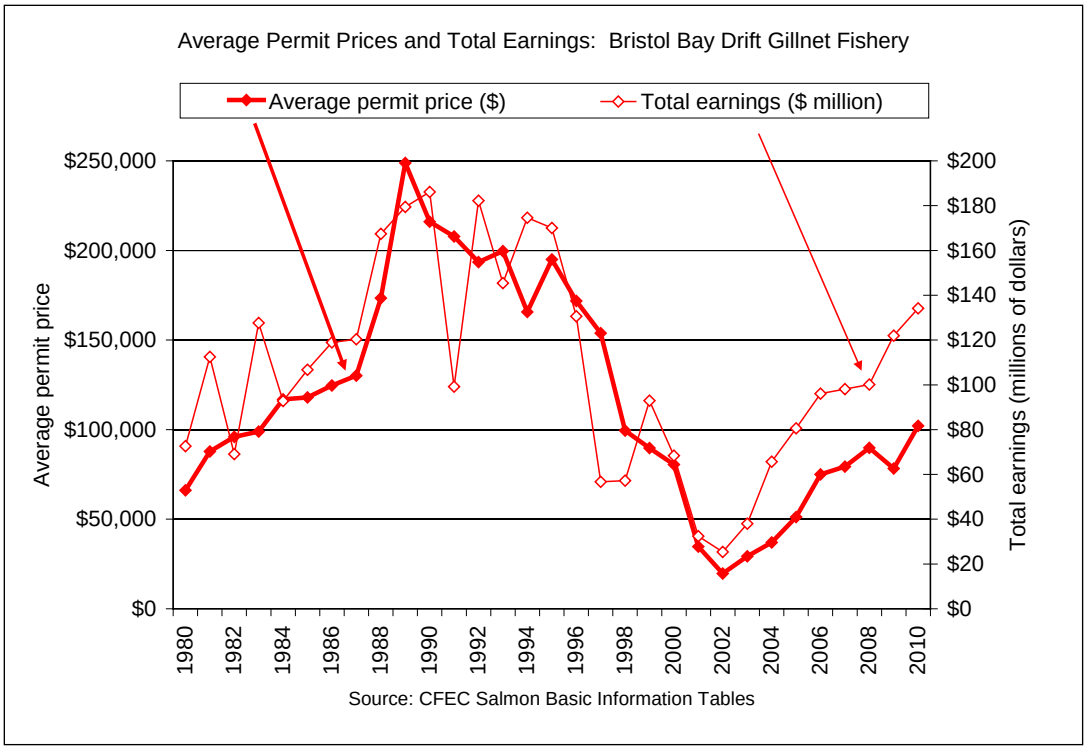


Figure 48. Average Permit Prices and Total Earnings: Bristol Bay Drift Gillnet Fishery

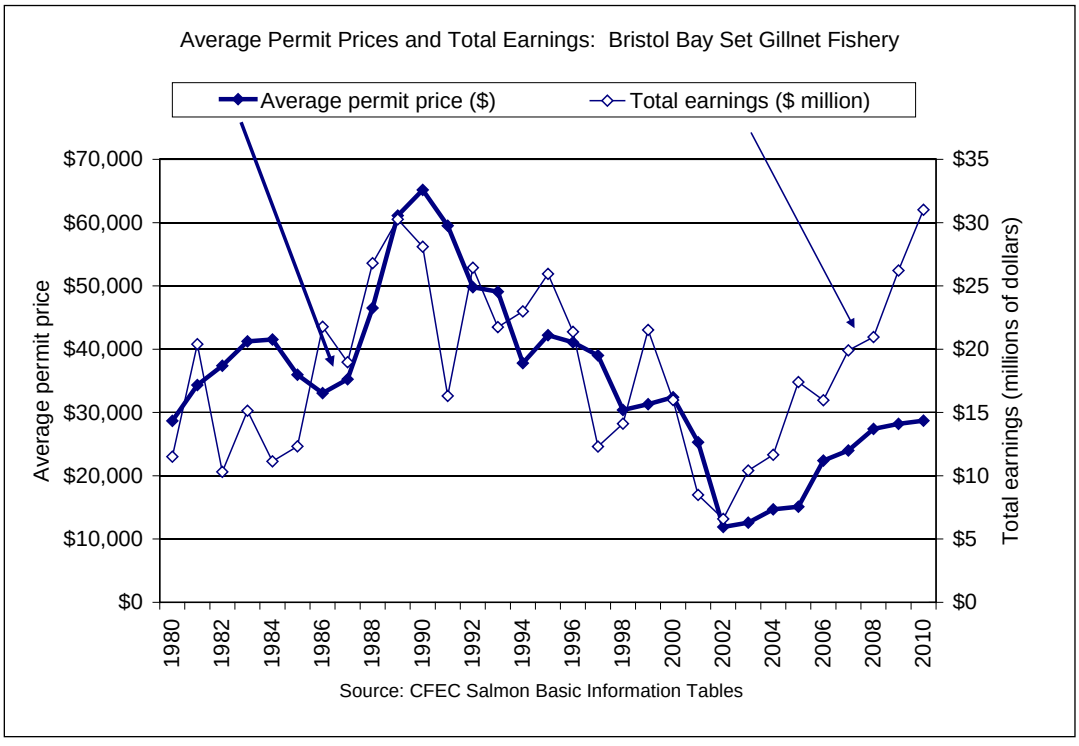


Figure 49. Average Prices and Earnings: Bristol Bay Set Gillnet Fishery

Figure 50 summarizes the estimated 2008 fishery-wide distributions of operating costs and incomes to Bristol Bay permit holders and crew reported by the Anchorage-based economic consulting firm Northern Economics in a recent detailed study of the importance of Bristol Bay salmon fisheries to the Bristol Bay region and its residents, conducted for the Bristol Bay Economic Development Corporation. The estimates were based on updates of estimates of previous analyses by CFEC and Northern Economics to account for changes in fuel prices and other costs. A review of the details of how the estimates were prepared and their limitations is beyond the scope of this report. We include them here as a general indicator of the kinds of costs which are important in the fishery and their approximate magnitudes relative to 2008 earnings. Note that operating costs in both fisheries include fuel and oil, net maintenance, gear, boat and net storage, transportation, food, insurance, taxes, fees and services. Permit holders also face costs of crew share payments (about 10% of gross earnings per crew member, after deducting costs of fuel and food), as well as loan payments for permits and boats.

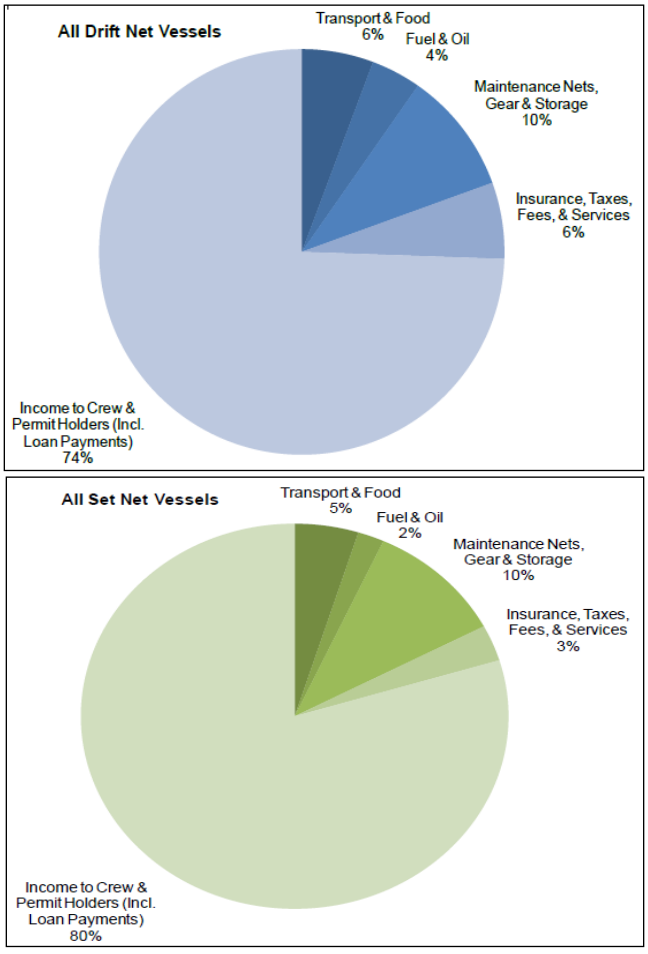


Figure 50. Northern Economics' Estimates of the Breakdown of Operating Costs and Incomes to Crew and Permit Holders, Bristol Bay Salmon Fisheries, 2008

Source: Northern Economics, *The Importance of the Bristol Bay Salmon Fisheries to the Region and its Residents* (report prepared for the Bristol Bay Economic Development Corporation, October 2009). Estimates based in part on earlier analyses by Northern Economics and CFEC.

3.8 Bristol Bay Salmon Processors

Fish processing is an integral part of the Bristol Bay commercial salmon industry, employing approximately half as many people as fish harvesting and more than doubling the value of the fish.

Bristol Bay salmon are processed in both land-based processing facilities and on floating processors. Salmon are canned only in large land-based facilities, which also have salmon freezing capacity. Floating processors produce only frozen salmon. As discussed, the Bristol Bay salmon processing industry typically employs about 3000 to 4000 workers annually at the height of the salmon processing season—depending upon the size of the harvest. Of these, fewer than 5% are residents of the Bristol Bay region. Another 10% to 15% are residents of other parts of Alaska, and about 75% to 80% are residents of other states or countries. Most are relatively unskilled short-term workers: only about 20% work in Bristol Bay for more than five years. Almost all live in bunkhouses provided by the processing companies.

Yardarm Knot Cannery, Naknek

Source: http://www.yardarm.net/red%20salmon%20cannery/cannery%20home4_files/image301.jpg

Icicle Seafoods' Floating Processor Bering Star in the Nushagak River
(the ship on the left is a cargo vessel loading frozen salmon for shipment to Japan)

In 2010, six companies operated salmon canning facilities in Bristol Bay. These included some of the largest seafood processing companies operating in Alaska, such as Trident Seafoods, Ocean Beauty Seafoods, Icicle Seafoods and Peter Pan Seafoods. Most of these companies have both land-based and floating processing operations in many parts of Alaska, which process not only salmon but other major Alaska species as well, such as pollock, crab and halibut. All large processors have home offices in or near Seattle.

In 2010, all of the processors with canning facilities, and five other larger processors purchased salmon in multiple Bristol Bay districts. There were twenty-five other buyers and smaller processors who bought salmon in just one district.

Most of the land-based processing facilities in the Bristol Bay region are located in or near a small number of communities with regularly-scheduled air transportation. The largest number of processors are located in Naknek along the Naknek River. Most of the other land-based facilities are in Dillingham, Egegik and Togiak.

Bristol Bay salmon processing is not an easy business. The list of companies buying and processing salmon in Bristol Bay changes from year to year. The number of large processors operating in Bristol Bay declined in the 1990s, reflecting consolidation in the industry forced by harvest volumes and lower profits. Many land-based processing plants closed and the number of floating processors brought into Bristol Bay each year to process salmon also declined sharply. This consolidation helped to make the industry more efficient and more profitable.

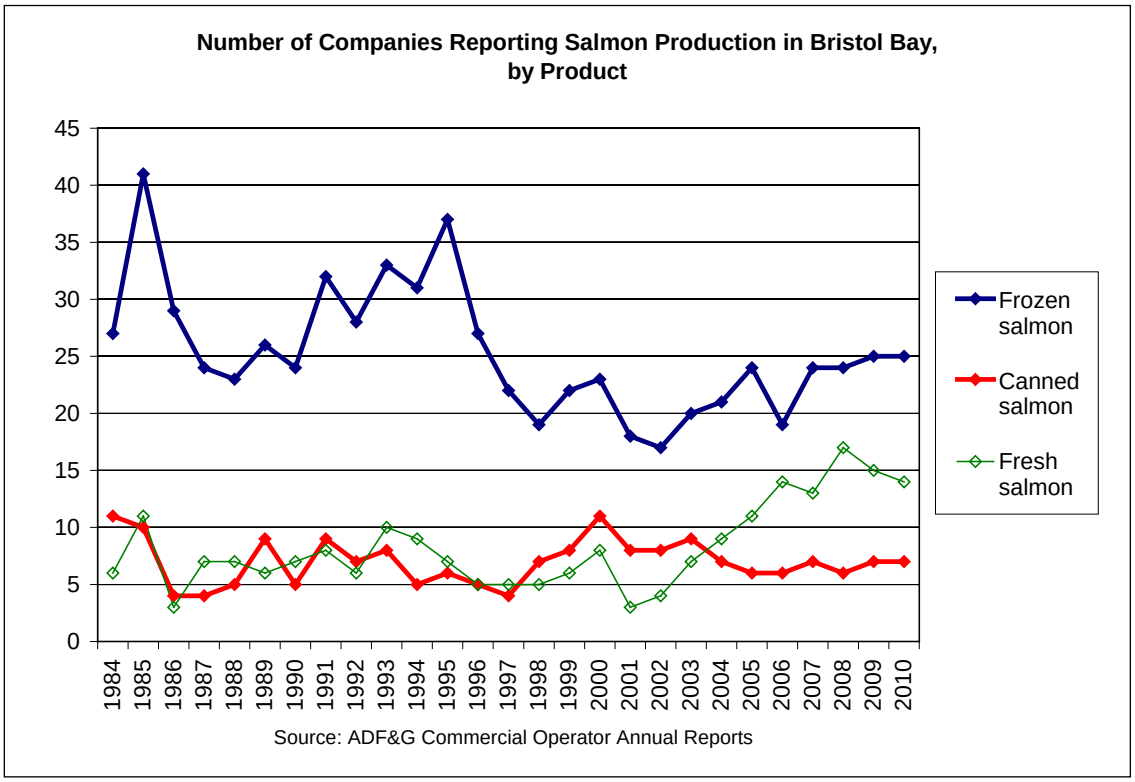


Figure 51. Number of Companies Reporting Salmon Production in Bristol Bay, by Product

Fish account for the largest share of costs of Bristol Bay processors. Other important costs include labor, fish tendering, packaging (boxes and cans), transportation of products and workers, utilities and taxes, maintenance, and costs of equipment and buildings.

Another important "cost" is the adjustment for the yield from the "round pound" weight of fish purchased from fishermen to the "processed pound" weight of fish products. In effect, for any given ex-vessel prices, the lower the yield, the higher the cost of fish per pound of final product weight.

Costs per pound vary between product forms and may also vary widely from year to year as fixed costs are spread over different volumes of salmon. Table 31 provides rough estimates of Bristol Bay salmon processing costs from an analysis for 1994 and 1995. Note that costs have likely risen considerably since these estimates were prepared, due to changes in costs of labor, energy and other factors. However, salmon ex vessel prices are highly variable and not directly tied to general changes in price levels. Therefore the Table 31 data is provided as a picture of two specific years, and not indexed to current price levels.

Table 31. Estimates of Bristol Bay Processor Costs, Prices and Profits

Estimates of Bristol Bay Processor Costs, Prices, and Profits: Mid-Range Estimates for 1994 and 1995

	Frozen Dressed		Frozen Round		Canned	
	1994	1995	1994	1995	1994	1995
Price paid to fishermen	$0.97	$0.75	$0.97	$0.75	$0.97	$0.75
+ Taxes and assessments	$0.03	$0.02	$0.03	$0.02	$0.03	$0.02
+ Tender cost	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17
+ Costs of services to fishermen	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
= Fish cost per round lb.	$1.20	$0.97	$1.20	$0.97	$1.20	$0.97
- Roe value per round lb. (= roe yeild x roe price)	$0.09	$0.09	$0.00	$0.00	$0.07	$0.07
= Fish cost per round lb., net of roe value	$1.11	$0.88	$1.20	$0.97	$1.13	$0.90
÷ Processing yield	74%	74%	97%	97%	59%	59%
= Fish cost per processed lb., net of roe value	$1.51	$1.20	$1.24	$1.00	$1.92	$1.53
+ Processing costs per processed lb.	$0.60	$0.60	$0.40	$0.40	$0.73	$0.73
+ Transportation and storage costs before sale	$0.00	$0.00	$0.00	$0.00	$0.10	$0.10
+ Other costs	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10
= Processor's total cost	$2.21	$1.90	$1.74	$1.50	$2.85	$2.46
Average price received by processor	$2.45	$1.80	$2.20	$1.00	$2.71	$2.80
Profit or loss (= average price - total cost)						
per processed lb.	$0.24	-$0.10	$0.46	-$0.50	-$0.14	$0.34
per round lb.	$0.18	-$0.07	$0.45	-$0.49	-$0.08	$0.20

Note: Costs and prices can vary widely between processors. Any given processor's profits or lesses could be higher or lower than showin in this table.
Source: *Currents: A Journal of Salmon Market Trends* , University of Alaska Anchorage, Salmon Market Information Service, December 1995.

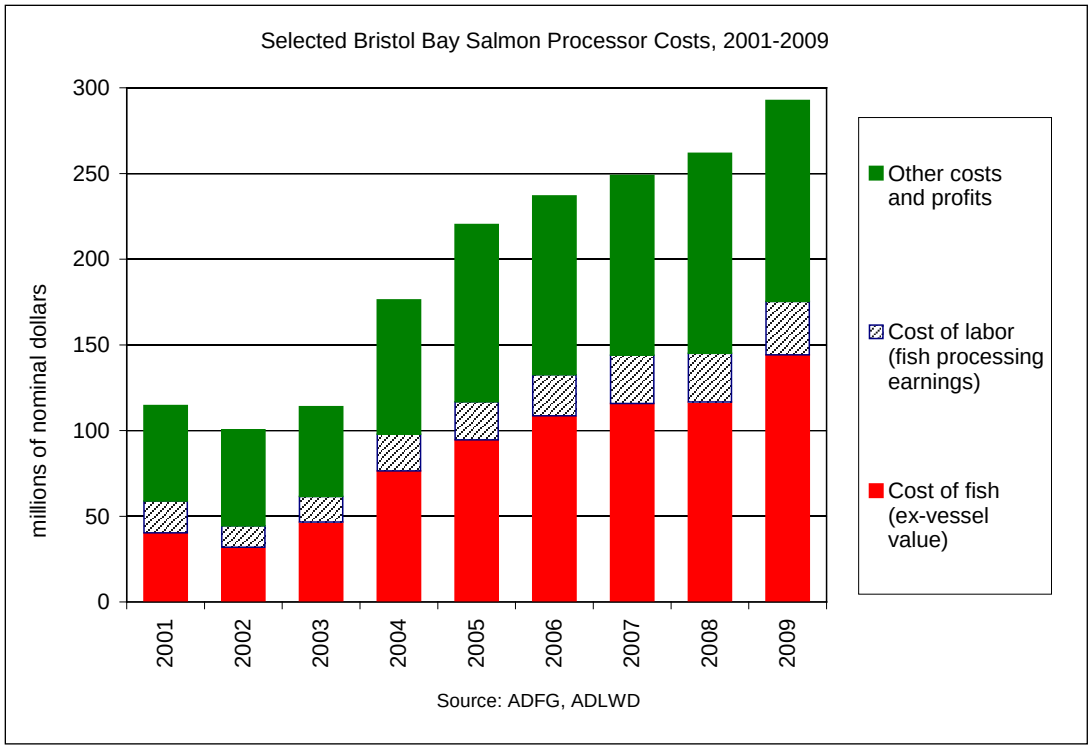


Figure 52. Selected Bristol Bay Salmon Processor Costs, 2001-2009

Most larger Bristol Bay salmon processors contract with tender vessels to transport salmon from fishing vessels at or near the best fishing areas to land-based or floating processing facilities. Tendering represents a significant cost for the industry. Many tender vessels are larger vessels used seasonally in other Alaska fisheries such as the Bering Sea crab fisheries. No data are available on the number of tender vessels used in the Bristol Bay fishery. A rough guess is that there are about fifty.

Fishermen delivering salmon to a tender. As fish are caught, they are placed in brailer bags in the hold of the fishing boat. Here, a brailer bag is being hoisted aboard a tender, where the fish are kept in refrigerated water during transport to the processor.

Photograph by Gabe Dunham

Fish are pumped from tenders into processing plants

Photograph by Gabe Dunham

Sockeye salmon entering a processing plant

Workers cleaning salmon

A processing line

Packaging is an important cost of fish processing

3.9 Bristol Bay Salmon Industry Employment

Challenges in Measuring Bristol Bay Salmon Industry Employment

Measuring employment in the Bristol Bay salmon industry is complicated by several factors. First, no employment data are collected for commercial fishing comparable to the employment data collected for most other industries. This is because commercial fishermen (both permit holders and crew) are considered self-employed, and they do not pay unemployment insurance. Employment data for most industries (including fish processing) are based on unemployment insurance reporting forms filed by employers. To make up for this significant gap in Alaska employment data, as discussed below, the Alaska Department of Labor and Workforce Development (ADLWD) Research and Analysis Division estimates monthly commercial fishing employment by multiplying the number of permits for which fish landings are reported each month by assumed average employment per permit fished (crew factors).

Second, the Bristol Bay salmon industry is highly seasonal. Most of the fishing and processing occurs between the middle of June and the middle of July, with smaller numbers of fishermen and processing workers engaged in smaller-scale fishing and processing as well as start-up and close-down activities earlier and later in the year. Thus a Bristol Bay fishing or processing job which typically lasts less than two months is not directly comparable to a year-round job in another industry. As discussed below, to provide a basis for comparing employment in the Bristol Bay salmon industry with year-round employment in other industries, we estimate "annual average employment," calculated as the total number of months worked divided by 12.

Third, the "Bristol Bay Region" for which ADLWD reports fish processing employment and estimated salmon fishing employment includes the Chignik salmon fishery—an important Alaska salmon fishery although much smaller than the Bristol Bay fishery. By way of comparison, between 2006 and 2010, expressed as a percentage of the Bristol Bay salmon fisheries, total pounds landed in the Chignik salmon fishery were 7.7% of Bristol Bay, earnings were 6.3% of Bristol Bay, and total permits fished were 2.4% of Bristol Bay. Thus ADLWD fish harvesting and processing employment estimates and data for the "Bristol Bay region" slightly overestimate employment for the Bristol Bay salmon fishery.

Fourth, estimates of fish processing employment are not available by fishery—because in reporting employment fish processing plants do not distinguish between the species of fish that their workers were processing during the reporting period. Thus fish processing employment estimates for the Bristol Bay region include some employment in processing other species such as herring. However, it is likely that fish processing employment data for the Bristol Bay region are overwhelmingly dominated by Bristol Bay salmon. For a comparison of the relative scale of the two fisheries, between 2006 and 2010, expressed as a percentage of the Bristol Bay salmon fisheries, total pounds landed in the Bristol Bay (Togiak) herring seine and gillnet fisheries 22.6% of pounds landed in the Bristol Bay salmon fisheries, earnings were 2.1% of earnings in the salmon fisheries, and the total permits fished were 2.6% of permits fished in the salmon fisheries. Note also that Bristol Bay herring processing is much less labor intensive than salmon processing because Bristol Bay herring are entirely frozen round for export.

Terminology for Measures of Employment

In the subsequent discussion, we use the following terms for different kinds of employment estimates:

Jobs:	The number of distinct work positions
Workers:	The number of different individuals who worked
Annual average employment	The number of months worked divided by 12

For example, suppose a permit holder fishes for two months with two crew members on board his boat. After one month one crew member leaves and is replaced by another crew member. The permit holder's operation would account for 3 jobs, 4 workers, and annual average employment of 0.5 (3 jobs x 2 months = 6 job months which is 6/12 or 0.5 job years).

Estimates of Bristol Bay Salmon Harvesting and Processing Employment

Table 32 (on the following page) summarizes available estimates of Bristol Bay salmon harvesting and processing employment from several different sources calculated in several different ways. Figure 53 (on the subsequent page) graphs several of the estimates shown in Table 32.

Estimated fishing jobs based on salmon permits fished (Rows 1-4)

A simple way to estimate Bristol Bay salmon fishing jobs is from Commercial Fisheries Entry Commission (CFEC) data for the number of permits fished and the Alaska Department of Labor and Workforce Development (ADLWD) assumption of three jobs for each drift gillnet and each setnet fishing operation.[16] Based on this methodology, between 2000 and 2010, the number of Bristol Bay salmon fishing jobs ranged between 5592 and 8232. The estimated number of jobs varied from year to year because the number of permits fished varied from year to year.

A problem with this method of estimating fishing jobs is that since the introduction of "permit stacking" in the drift gillnet fishery, there is no longer necessarily a direct relationship between the number of permits fished and the number of vessels fished. As discussed, the number of permits fished each year likely understates the number of permit holders who fished but likely overstates the number of vessels which fished (since some permit holders fished together on the same vessel).

CFEC reported that 1444 permits were fished in 2009, but only 1331 vessels were registered to fish during the season. This would imply that the number of permits fished overstated that number of vessels fished by 113, which would in turn imply that the estimates in Row 4 overstate the number of fishing jobs by 339. For the same reason, the estimates in rows 6 and 9-12 of Table 32 (discussed below) may also slightly overestimate the number of fishing workers.

[16] According to a table of crew factors provided to Gunnar Knapp by ADLWD in 2004 (crewfactor.xls), ADLWD assumed crew factors of 3.0 for both the Bristol Bay drift gillnet and set gillnet fisheries.

Table 32. Indicators and Estimates of Bristol Bay Salmon Industry Fishing Processing Employment

Indicators and Estimates of Bristol Bay Salmon Industry Fishing and Processing Employment, 2000-2010

Measure	Row	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Estimated fishing jobs based on salmon permits fished (a)												
Permits fished, drift gillnet fishery	1	1,823	1,566	1,184	1,424	1,411	1,447	1,475	1,468	1,469	1,444	1,494
Permits fished, set gillnet fishery	2	921	834	680	761	795	829	844	835	850	843	861
Permits fished, total	3	2,744	2,400	1,864	2,185	2,206	2,276	2,319	2,303	2,319	2,287	2,355
Estimated number of fishing jobs (= permits fished x 3 jobs/permit fished)	4	8,232	7,200	5,592	6,555	6,618	6,828	6,957	6,909	6,957	6,861	7,065
ADLWD estimates of Bristol Bay region salmon fishing workers (b)												
Individuals who fished permits	5		2,412	1,867	2,196	2,210	2,286	2,340	2,239	2,245	2,309	
Total estimated workforce	6		6,969	5,334	6,324	6,294	6,444	7,020	6,717	6,735	9,236	
Ratio of estimated workforce to individuals who fished permits	7		2.89	2.86	2.88	2.85	2.82	3.00	3.00	3.00	4.00	
Estimated crew workers	8		4,557	3,467	4,128	4,084	4,158	4,680	4,478	4,490	6,927	
ADLWD estimates of Bristol Bay region salmon fishing workers by month (c)												
June	9		6,771	4,830	6,045	6,093	6,135	6,201	5,982	6,060	6,393	
July	10		7,098	5,514	6,465	6,513	6,750	6,936	6,891	6,969	6,768	
August	11		276	309	249	375	279	540	444	504	504	
September	12		0	0	0	84	15	3	0	12	54	
Bristol Bay region fish processing workers, all species (d)												
Total worker count	13		2,862	2,273	2,484	3,474	3,272	2,940	3,512	3,952	4,522	
Bristol Bay region food manufacturing employment (e)												
July	14			2,414	3,026	4,189	3,946	4,391	4,480			
Annual average	15			765	992	1,139	1,147	1,339	1,385			
Assumed total salmon industry workers												
Fishing (July employment) (Row 10)	16		7,098	5,514	6,465	6,513	6,750	6,936	6,891	6,969	6,768	
Processing (total worker count) (Row 13)	17		2,862	2,273	2,484	3,474	3,272	2,940	3,512	3,952	4,522	
Total	18		9,960	7,787	8,949	9,987	10,022	9,876	10,403	10,921	11,290	
Estimated annual average salmon industry employment												
Fishing (= total months of employment / 12)	19		1,179	888	1,063	1,089	1,098	1,140	1,110	1,129	1,143	
Fish processing (f)	20		475	366	409	581	532	483	566	640	764	
Total	21		1,654	1,254	1,472	1,669	1,631	1,623	1,675	1,769	1,907	

Sources and notes: (a) CFEC Salmon Basic Information Tables, http://www.cfec.state.ak.us/bit/MNUSALM.htm; (b) ADLWD, "Fish Harvesting Workforce and Gross Earnings by Species, 2001 - 2009," http://www.labor.state.ak.us/research/seafood/BristolBay/BBFHVWrkrErngSpec.pdf. Estimated crew workers= Total estimated workforce - Individuals who fished permits. (c) ADLWD, "Fish Harvesting Employment by Species and Month, 2000-2009, Bristol Bay Region," http://labor.alaska.gov/research/seafood/BristolBay/BBAvgMonthlyRegSpc.pdf; (d) ADLWD, "Bristol Bay Region Seafood Industry, 2003-2009, Processing," http://labor.alaska.gov/research/seafood/BristolBay/BBSFPOver.pdf. 2001 & 2002 data are earlier estimates formerly posted at the same website; (e) ADLWD, Quarterly Census of Employment and Wages Data, http://labor.alaska.gov/research/qcew/qcew.htm; (f) annual average fish processing employment estimated by assuming the same ratio of annual average employment to total worker count as the ratio of estimated annual average fishing employment to July fishing employment.

ADLWD estimates of Bristol Bay region salmon fishing workers (rows 5-8)

These are ADLWD estimates of the salmon harvesting workforce (number of workers) in the Bristol Bay region for the years 2001-2009.[17] Note that these include workers in the Chignik salmon fishery. The total estimated workforce (row 6) was estimated by multiplying the number

[17] The estimates are posted at http://labor.alaska.gov/research/seafood/BristolBay/BBFHVWrkrErngSpec.pdf. A discussion of the methodology used to prepare the estimates is posted on the ADLWD website at:

of individuals who fished permits (row 5) by assumed crew factors for each fishery.[18] We calculated estimated crew workers (row 8) by subtracting individuals who fished permits (Row 5) from the total estimated workforce (row 6).

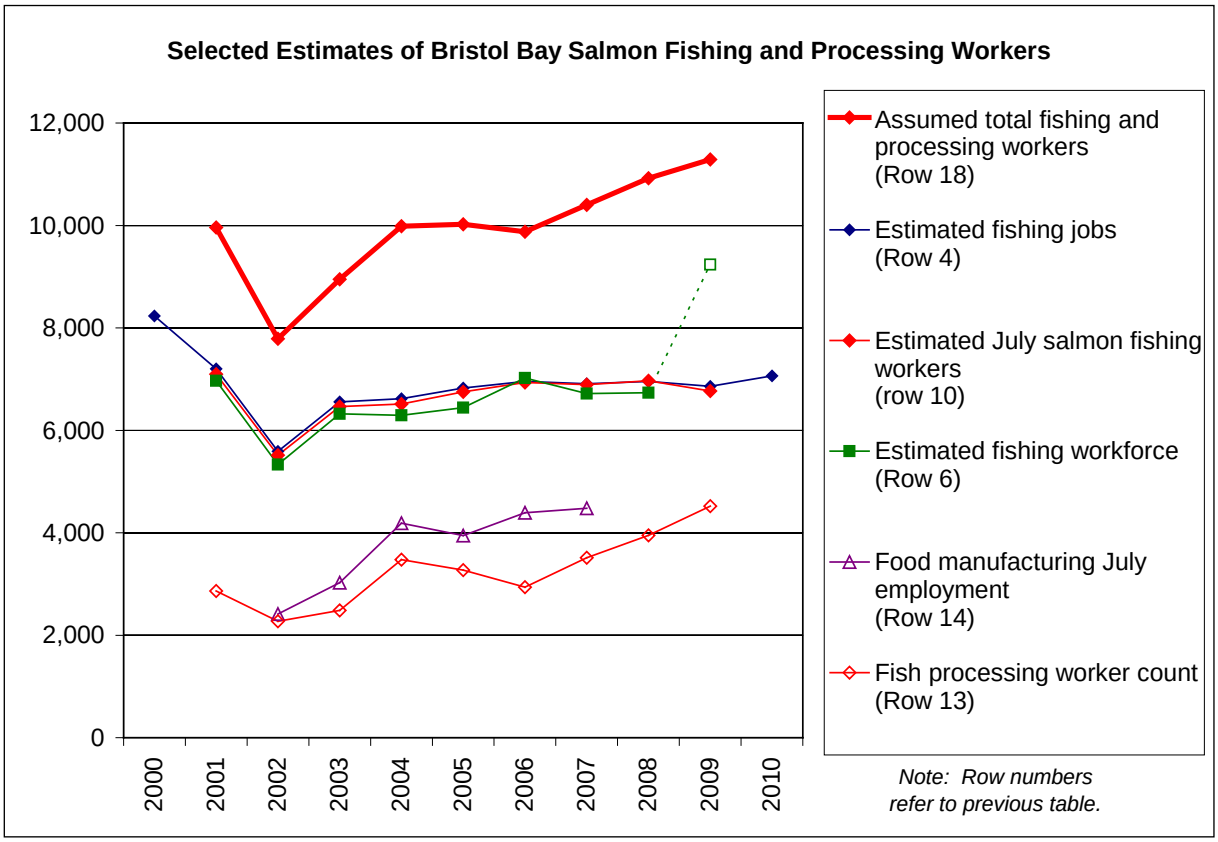


Figure 53. Selected Estimates of Bristol Bay Salmon Fishing and Processing Workers

ADLWD estimates of Bristol Bay region salmon fishing workers by month (Rows 9-12)

These are ADLWD estimates of the salmon harvesting workforce (number of workers) by month in the Bristol Bay region for the years 2001-2009.[19] The methodology used for these estimates

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http://labor.alaska.gov/research/seafood/Methodology.pdf. Additional discussion of the methodology is provided in Josh Warren and Rob Kreiger, "Fish Harvesting in Alaska (Alaska Economic Trends, November 2011); Josh Warren and Jeff Hadland, "Employment in Alaska's Seafood Industry" (Alaska Economic Trends, November 2009); and Paul Olson and Dan Robinson, "Employment in the Alaska Fisheries: A special project estimates fish harvesting jobs" (Alaska Economic Trends, December 2004), These articles are posted on the ADLWD website at http://labor.alaska.gov/trends/.

[18] No documentation was provided as to what crew factors were used for these estimates. The ratio of estimated workforce to individuals who fished permits (Row 7) suggests that crew factors of 3.0 were used for the years 2006-2009. It is not clear why the ratio was lower for the years 2001-2005 (between 2.82-2.89) and much higher for 2009 (4.00), suggesting that different crew factors were used for these years. The estimate for 2009, based on a 25% higher crew factor of 4.0, is indicated with a dashed line in Figure 53.

[19] The estimates are posted at http://labor.alaska.gov/research/seafood/BristolBay/BBAvgMonthlyRegSpc.pdf.

was similar but not identical to that used to for the estimates of salmon fishing workers in rows 5-8), resulting in slightly higher estimates.[20]

Bristol Bay region fish processing workers, all species (Row 13)

These are ADLWD estimates of the total worker count for Bristol Bay region seafood processing.[21, 22]

Bristol Bay region food manufacturing employment (Rows 14 & 15)

These are the sum of ADLWD data for food manufacturing employment in Bristol Bay Borough, Lake and Peninsula Borough, and the Dillingham Census Area (the ADLWD's Bristol Bay region).[23] Table 33 provides the same detail in more detail, by month. Presumably, almost all food manufacturing in the Bristol Bay region is fish processing. It is not clear why the July food manufacturing employment (Row 14) is considerably larger than the total worker count for fish processing for the same region (Row 13).

Assumed total salmon industry workers (Rows 14 & 15)

For the purposes of this report, we assume that the total number of workers in the Bristol Bay salmon industry is July salmon fishing workers (Row 10) and the ADLWD total worker count (Row 13). The inconsistencies between the different estimates discussed above suggest that while these should be considered reasonable indicators of the general magnitude of the number rather than precise data. In general, it appears reasonable to assume that in recent years the total number of workers in Bristol Bay salmon fishing and processing has exceeded 10,000.

Estimated annual average salmon industry employment (Rows 19-21)

These are estimates of salmon industry annual average employment, or job months / 12. Again, these should be considered reasonable indicators of the general magnitude of annual average employment rather than precisely accurate data. In general, it appears reasonable to assume that in recent years average annual employment in Bristol Bay salmon fishing and processing has exceeded 1600.

[20] According to notes provided with the estimates, for these estimates ". . . the permit itself is considered the employer. In other tables where a count of workers was estimated, the employer was considered to be the vessel, or permit holders for fisheries that did not typically use vessels. This means that a permit holder who makes landings under two different permits (in the same vessel) in the same month will generate two sets of jobs whereas for tables where the vessel is the employer there would be only one set of workers."

[21] The data are posted at http://labor.alaska.gov/research/seafood/BristolBay/BBSFPOver.pdf.

[22] The only information about how the data source or methodology is the following: "The Alaska Department of Labor and Workforce Development's Occupational Database (ODB) is the primary source of seafood processing employment data. The ODB contains quarterly information for all Alaska workers covered by unemployment insurance (UI)." (http://labor.alaska.gov/research/seafood/Methodology.pdf).

[23] Quarterly Census of Employment and Wages Data posted at http://labor.alaska.gov/research/qcew/qcew.htm.

Seasonality of Bristol Bay Fish Processing Employment

ADLWD monthly data for Bristol Bay food manufacturing employment provide an indication of the seasonality and geographic distribution of Bristol Bay salmon processing (Figure 54 and Table 33). Presumably salmon processing accounts for most but not all of Bristol Bay region food manufacturing employment. One indicator of this is that for the years 2001-2009, the total fish *harvesting* workforce for other fisheries for which ADLWD reported Bristol Bay region harvesting workforce estimates, expressed as a percentage of the salmon harvesting workforce estimates, averaged 5.5% for herring, 2.1% for halibut and 0.4% for sablefish.[24]

Bristol Bay region food manufacturing employment peaks in July, and is generally much higher during the months from May through September than at other times in the year. Note that a significant part of the work in fish processing occurs before the season starts (getting ready for processing) and after the season ends (closing down processing operations and preparing for the next season). Some people are employed throughout the year in activities such as plant maintenance and repair.

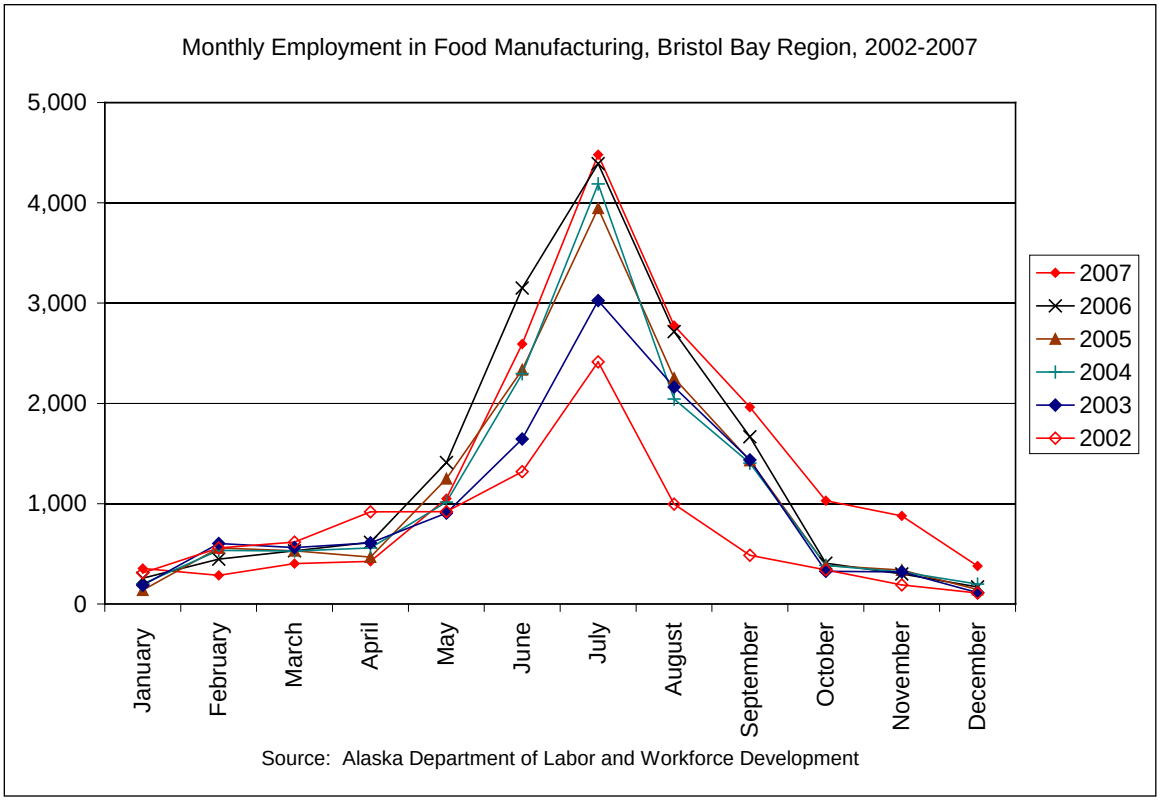


Figure 54. Monthly Employment in Food Manufacturing, Bristol Bay Region

[24] ADLWD, "Fish Harvesting Workforce and Gross Earnings by Species, 2001-2009, Bristol Bay Region," http://labor.alaska.gov/research/seafood/BristolBay/BBFHVWrkrErngSpec.pdf.

Table 33. Monthly Employment in Food Manufacturing, by Borough or Census Area.

Monthly Employment in Food Manaufacturing, by Borough or Census Area, Bristol Bay Region, 2002-2010

Area	Month	2002	2003	2004	2005	2006	2007	2008	2009	2010
Bristol Bay Borough	*Units reporting*	*8*	*9*	*11*	*14*	*11*	*11*	*10*	*12*	*12*
	January	7	52	11	11	14	12			16
	February	8	56	10	12	13	11			19
	March	8	57	21	19	25	19			27
	April	441	197	81	81	113	73			96
	May	495	464	678	818	894	651			977
	June	713	1,115	1,299	1,365	1,957	1,635			1,819
	July	977	1,915	2,644	2,663	2,898	3,018			3,489
	August	325	1,291	1,250	1,424	1,471	1,661			1,738
	September	51	728	834	847	789	826			914
	October	42	41	46	68	61	671			92
	November	29	49	59	72	74	504			66
	December	34	22	46	51	53	188			59
	Average	**261**	**499**	**582**	**619**	**697**	**772**			**776**
Dillingham Census Area	*Units reporting*	*4*	*3*	*3*	*4*	*4*	*3*	*3*	*3*	*3*
	January	283	124	184	123	232	332			
	February	529	512	519	543	418	259			
	March	590	495	496	507	487	366			
	April	455	373	451	377	477	326			
	May	372	390	285	392	455	338			
	June	384	339	739	799	951	760			
	July	1,091	775	1,035	1,057	1,164	1,162			
	August	392	544	544	694	987	901			
	September	347	618	552	567	789	1,040			
	October	283	270	331	306	305	293			
	November	149	260	253	257	199	315			
	December	48	84	147	82	97	167			
	Average	**410**	**399**	**461**	**475**	**547**	**522**			
Lake and Peninsula Borough	*Units reporting*	*7*	*5*	*5*	*4*	*4*	*4*	*4*	*3*	*3*
	January	20	10	5	4	11	10	9		
	February	21	34	5	4	17	15	15		
	March	19	11	11	5	19	17	16		
	April	23	40	27	9	26	25	29		
	May	53	53	52	38	62	61	69		
	June	222	191	258	171	242	197	156		
	July	346	336	510	226	329	300	319		
	August	278	329	250	135	258	215	24		
	September	87	90	18	17	89	97	20		
	October	15	14	8	11	41	66	5		
	November	13	10	7	9	27	59	5		
	December	28	8	6	10	20	24	5		
	Average	**94**	**94**	**96**	**53**	**95**	**91**	**56**		
Total, Bristol Bay Region	Units reporting	*19*	*17*	*19*	*22*	*19*	*18*	*17*	*18*	*18*
	January	310	186	200	138	257	354	9		
	February	558	602	534	559	448	285	15		
	March	617	563	528	531	531	402	16		
	April	919	610	559	467	616	424	29		
	May	920	907	1,015	1,248	1,411	1,050	69		
	June	1,319	1,645	2,296	2,335	3,150	2,592	156		
	July	2,414	3,026	4,189	3,946	4,391	4,480	319		
	August	995	2,164	2,044	2,253	2,716	2,777	24		
	September	485	1,436	1,404	1,431	1,667	1,963	20		
	October	340	325	385	385	407	1,030	5		
	November	191	319	319	338	300	878	5		
	December	110	114	199	143	170	379	5		
	Average	**765**	**992**	**1,139**	**1,147**	**1,339**	**1,385**	**56**		

Source: Alaska Department of Labor and Workforce Development, Quarterly Census of Employment and Wages Data, historical data for 2002-2010, Excel file annual.xls, http://labor.alaska.gov/research/qcew/qcew.htm, downloaded November 27, 2011. Blank cells indicate data were not available.

3.10 Bristol Bay Salmon Industry Taxes

The Bristol Bay salmon industry pays millions of dollars annually in state, local and federal taxes. This section briefly describes these taxes and provides estimates, where available, of taxes paid in recent years.

Alaska Fisheries Business Tax

The Alaska Fisheries Business Tax (AS 43.75.015) accounts for the largest share of local and state taxes paid by the Bristol Bay salmon industry. Under the fisheries business tax, salmon processors pay the state:

5.0% of the ex-vessel value of salmon processed on floating facilities

4.5% of the ex-vessel value of salmon canned at shore-based facilities

3.0% of the ex-vessel value of other salmon processed at shore-based facilities (e.g. salmon processed frozen, fresh, or in other ways except for canning)

The State of Alaska does not publish data on fisheries business tax revenues for specific species and regions. Rows 1-4 of Table 34 provide a lower-bound estimate of tax obligations (before credits) of Bristol Bay salmon processors, assuming that processors pay a tax rate of 5.0% for a share of ex-vessel value equivalent to the share of canned salmon production in total Bristol Bay salmon production, and 3.0% of ex-vessel value on the remaining share of ex-vessel value. This estimate suggests that during the period 2000-2010, fisheries business tax obligations ranged from as low as $1.3 million in 2002 to $6.4 million. Fisheries business tax payments are directly proportional to ex-vessel value and thus highly sensitive to the effects of changes in catches and prices on ex-vessel value.

Actual tax obligations are likely higher than the lower-bound estimates in Row 4, since (a) the estimates do not take account of the higher tax rate (5.0%) on salmon processed on floating processing; and (b) the share of salmon which is canned is likely higher than the share of canned production in total production, because average yields are lower for canning.

Processors are entitled to credits against Fisheries Business Tax obligations up to certain limits for certain kinds of expenditures, including for example investments in salmon product development (AS 43.75.035); investments to improve salmon utilization (AS 43.75.036), and and contributions to the University of Alaska and other Alaska higher education institutions (AS 43.75.018). No data are available on the extent to which these tax credits reduce Bristol Bay fisheries business tax revenues.

Table 34. Selected Data and Estimates for Bristol Bay Salmon Taxes

Selected Data and Estimates for Bristol Bay Salmon Taxes

	Row	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Simple lower-bound estimate of fisheries business tax obligations												
Ex-vessel value of Bristol Bay salmon harvests ($ 000)	1	$84,014	$40,359	$31,898	$46,684	$76,461	$94,556	$108,570	$115,763	$116,717	$144,200	$180,818
Canned share (assumed tax rate = 5.0%)	2	37%	32%	49%	39%	34%	32%	34%	35%	28%	25%	27%
Non-canned share (assumed tax rate = 3%)	3	63%	68%	51%	61%	66%	68%	66%	65%	72%	75%	73%
Lower-bound estimate of fisheries tax obligation ($ 000)	4	$3,145	$1,467	$1,270	$1,760	$2,818	$3,439	$3,998	$4,287	$4,163	$5,061	$6,383
State of Alaska Shared Business Tax Payments to Bristol Bay Boroughs and Cities ($ 000) (a)												
Bristol Bay Borough	5	$1,440	$918	$494	NA	$451	$835	$1,178	$1,296	$1,564	$1,543	$1,797
Lake and Peninsula Borough	6	$357	$246	$162	NA	$113	$71	$99	$134	$138	$152	$215
Dillingham	7	$203	$176	$49	NA	$100	$154	$148	$184	$176	$187	$239
Egegik	8	$30	$176	$78	NA	$36	$29	$29	$74	$63	$63	$85
Total	9	$2,029	$1,517	$784	NA	$700	$1,089	$1,454	$1,687	$1,941	$1,944	$2,335

(a) Source: Alaska Department of Revenue, Annual Shared Taxes and Fees Reports, www.tax.alaska.gov. NA: Not available.

Fisheries Business Tax Refunds

The State of Alaska "refunds" a major share of Fisheries Business Tax revenues to Alaska local governments, as follows (AS 43.75.130):

> Cities receive 50% of the tax revenues collected in unified municipalities and in cities outside organized boroughs, and 25% of tax revenues collected in cities in organized boroughs
>
> Boroughs receive 50% of the tax revenues collected in areas of boroughs outside cities and 25% of the tax revenues collected in cities inside Boroughs.

Rows 5-9 of Table X-1 provide data on State of Alaska shared fisheries tax payments to Bristol Bay boroughs and cities. In total, these payments ranged from $700 thousand in 2004 to $2.3 million in 2010.

Local Government Taxes

Several local governments in the Bristol Bay region impose taxes on the ex-vessel value of salmon processed within their jurisdictions. In 2010, these included the following:[25]

Bristol Bay Borough: raw fish tax	4% fish tax	Egegik:	3%
Lake and Peninsula Borough:	2% raw fish tax		
Pilot Point:	3% raw fish tax		

[25] Alaska Office of the State Assessor, 2010 Alaska Taxable, Table 2, Sales/Special Taxes and Revenues, http://www.dced.state.ak.us/dca/osa/osa_summary.cfm.

Local governments also impose property taxes on processing facilities. No data are published on Bristol Bay local government fish taxes or property taxes. However, it is likely that these taxes are comparable in magnitude to fisheries business taxes, and represent a major share of total local government tax revenues.

Federal Government Taxes

Like all U.S. industries, the Bristol Bay salmon industry pays federal taxes including corporate and individual income taxes paid by processing companies, processing workers, and fishermen. No data are available on federal taxes specifically attributable to the Bristol Bay salmon industry, although it is likely that they significantly exceed total taxes paid to the state and local governments.

3.11 Regional Distribution of Bristol Bay Permit Holders, Fishery Earnings, and Processing Employment

An important characteristic of the Bristol Bay commercial salmon industry is that shares of the participants in the industry—both fishermen and processing workers—do not live in the Bristol Bay region but rather in other parts of Alaska or other states and countries. In this section we review available data on trends in the regional distribution of permit holdings, earnings and processing employment between "local" residents of the Bristol Bay region, other Alaskans, and non-Alaskans.

The Bristol Bay Region

There are twenty-six communities in the Bristol Bay region the Commercial Fisheries Entry Commission (CFEC) considers "local" to the fishery for its analyses (Figure 55). Residents of these villages are considered "Bristol Bay residents" for the CFEC data presented below on permit holdings and earnings of Bristol Bay residents.

Residents of five additional villages on the south side of the Alaska Peninsula (Chignik City, Chignik Lagoon, Chignik Lake, Perryville and Ivanof) are also considered "Bristol Bay residents" for the Alaska Department of Labor and Workforce Development (ADLWD) data on seafood processing employment.

Figure 55. Bristol Bay Region Local Communities ***Source: www.visitbristolbay.org/bbvc/images/bb_map_large.jpg***

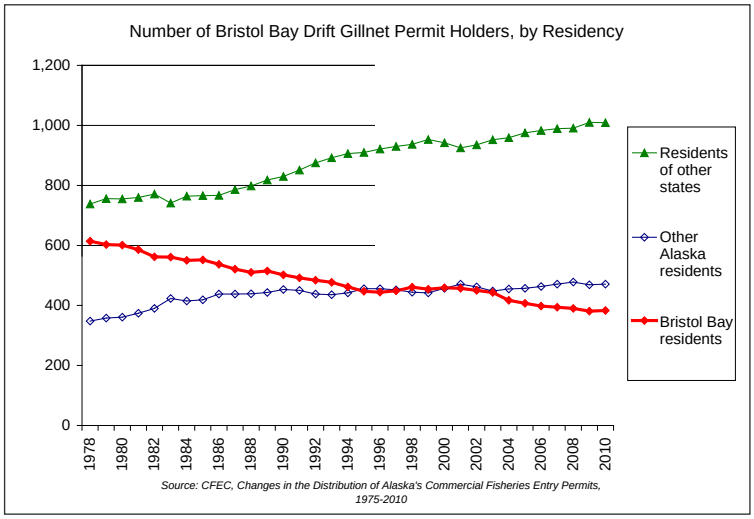
Regional Distribution of Permit Holders

Limited entry was implemented for most Alaska salmon fisheries in 1975, including the Bristol Bay drift gillnet and set gillnet fisheries. The permits were initially issued for free to individuals based on their degree of economic dependence upon the fishery and the extent of their past participation in the fishery. The purpose and effect of this initial allocation system was to ensure that significant numbers of rural local residents received permits in regions of Alaska with limited other economic opportunities, such as Bristol Bay (Knapp, 2011).

Soon after the implementation of limited entry a significant long-term decline began in the share of permits held by local residents in the Bristol Bay fisheries and many other rural Alaska fisheries. There has been a corresponding increase in the number of permits held by other Alaska residents as well as non-Alaska residents. This decline in local permits has been an important concern at both the regional and state level.

Between 1978 and 2010, the number of permits Bristol Bay drift gillnet permits held by local residents fell from 614 to 383 (Figure 56). The share of drift gillnet permits held by local residents fell from 36% to 21%.

Between 1978 and 2010, the number of permits Bristol Bay set gillnet permits held by local residents fell from 530 to 353. The share of permits held by local residents fell from 59% to 36%.



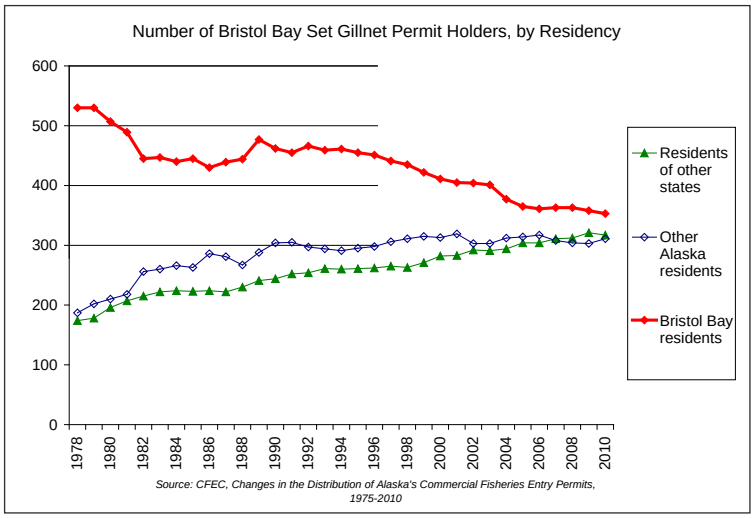


Figure 56. Number of Bristol Bay Permit Holders by Residency

The decline in local permit ownership has come about as a result of both net permit transfers (sales and gifts) from residents of the region to non-local residents, as well as migration of permit holders out of the region. Initially net permit transfers played a far greater role, but migration of permit holders out of the region has also played an important role in recent years.

Regional Distribution of Fishery Earnings

Historically, Bristol Bay residents have had the lowest average earnings (gross revenues) per permit fished, while residents of other stages have had had the highest average earnings per permit fished.

For example, in 2007—the latest year for which CFEC earnings data by residency are available, in the Bristol Bay drift gillnet fishery, average earnings per permit fished were $44,604 for Bristol Bay residents, $66,191 for other Alaska residents, and $73,391 for non-Alaska residents (Figure 57).

In the Bristol Bay set gillnet fishery, average earnings per permit fished were $22,991 for Bristol Bay residents, $23,259 for other Alaska residents, and $25,333 for non-Alaska residents (Figure 57).

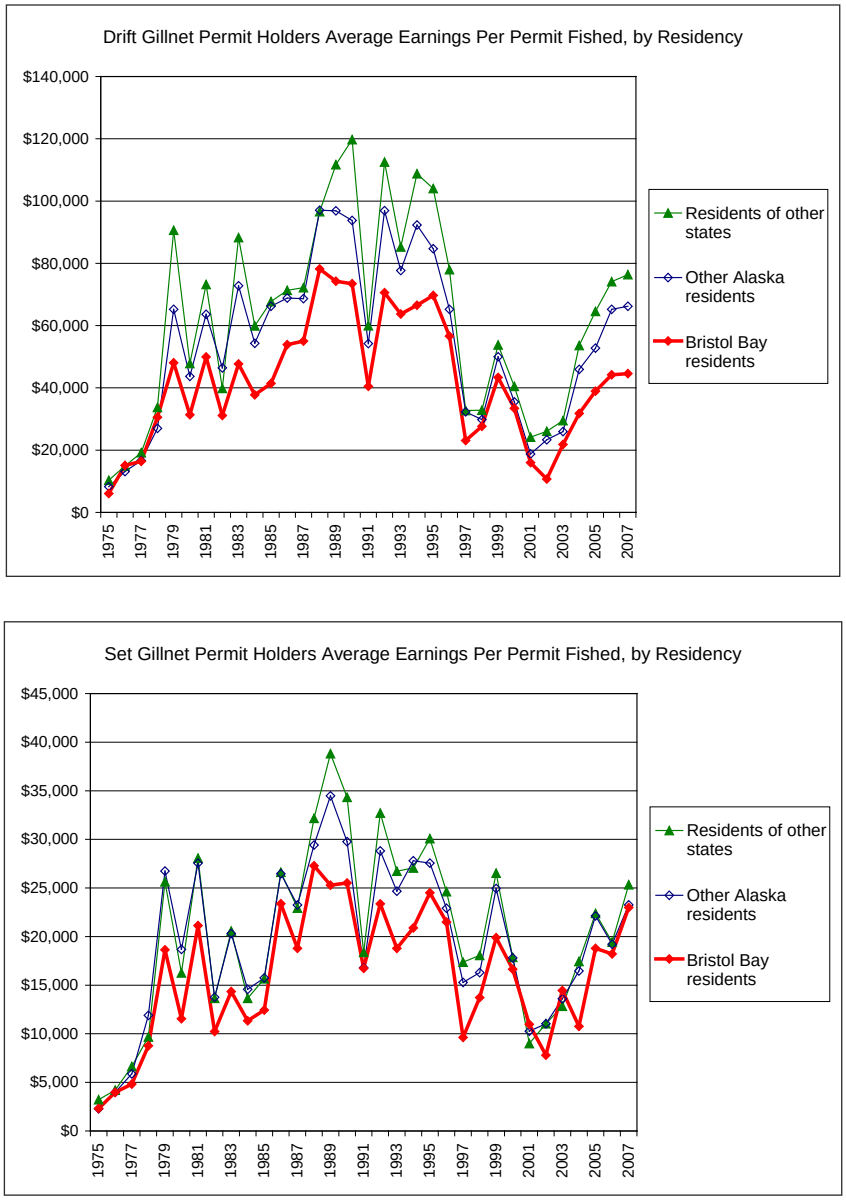


Figure 57. Permit Holders Average Earnings, by Residency

A variety of factors may contribute to these differences in average earnings per permit fished by residency. In the drift gillnet fishery, the vessels operated by Bristol Bay residents tend to be older and smaller, with lower average horsepower and fuel capacity than those of other Alaska residents or residents of other states (Table 35). A much smaller share of the vessels operated by Bristol Bay residents have refrigeration capacity. All of these differences may reflect less access to capital for Bristol Bay residents than for other Alaska residents or residents of other states. However, the reasons for differences in earnings between groups have not been studied in detail or conclusively explained.

Table 35. Comparison of Vessels Used in the Bristol Bay Drift Gillnet Fishery, by Residency of Permit Holder

Comparison of Vessels Used in the Bristol Bay Drift Gillnet Fishery, by Residency of Permit Holder

	Group	1983	1988	1993	1998	2003	2008
Average age of vessels (years)	Bristol Bay Residents	9	11	14	18	22	26
	Other Alaska Residents	9	11	14	17	21	24
	Residents of Other States	11	12	13	16	20	24
	Average	10	11	14	17	21	25
Average horsepower of vessels	Bristol Bay Residents	239	279	282	294	287	337
	Other Alaska Residents	243	271	315	345	350	373
	Residents of Other States	252	286	335	368	372	382
	Average	245	278	311	336	336	364
Average displacement of vessels (gross tons)	Bristol Bay Residents	10	12	12	12	12	12
	Other Alaska Residents	12	13	13	13	14	15
	Residents of Other States	12	12	13	14	14	14
	Average	11	12	13	13	13	14
Average fuel capacity of vessels (gallons)	Bristol Bay Residents	239	288	282	294	287	299
	Other Alaska Residents	306	334	364	357	357	360
	Residents of Other States	283	311	348	352	350	364
	Average	276	311	331	335	331	341
Percent of vessels with refrigeration capacity	Bristol Bay Residents	0.5%	0.5%	2.3%	4.5%	5.5%	7.7%
	Other Alaska Residents	1.3%	2.3%	7.5%	13.7%	15.3%	20.8%
	Residents of Other States	0.5%	2.0%	8.1%	15.5%	17.8%	22.2%
	Average	0.8%	1.6%	6.0%	11.2%	12.9%	16.9%

Northern Economics. 2009. The Importance of the Bristol Bay Salmon Fisheries to the Region and its Residents. Report prepared for the Bristol Bay Economic Development Corporation. 193 pages. Data are from tables on pages 136 and 137 of report. Based on data provided by the Commercial Fisheries Entry Commission.

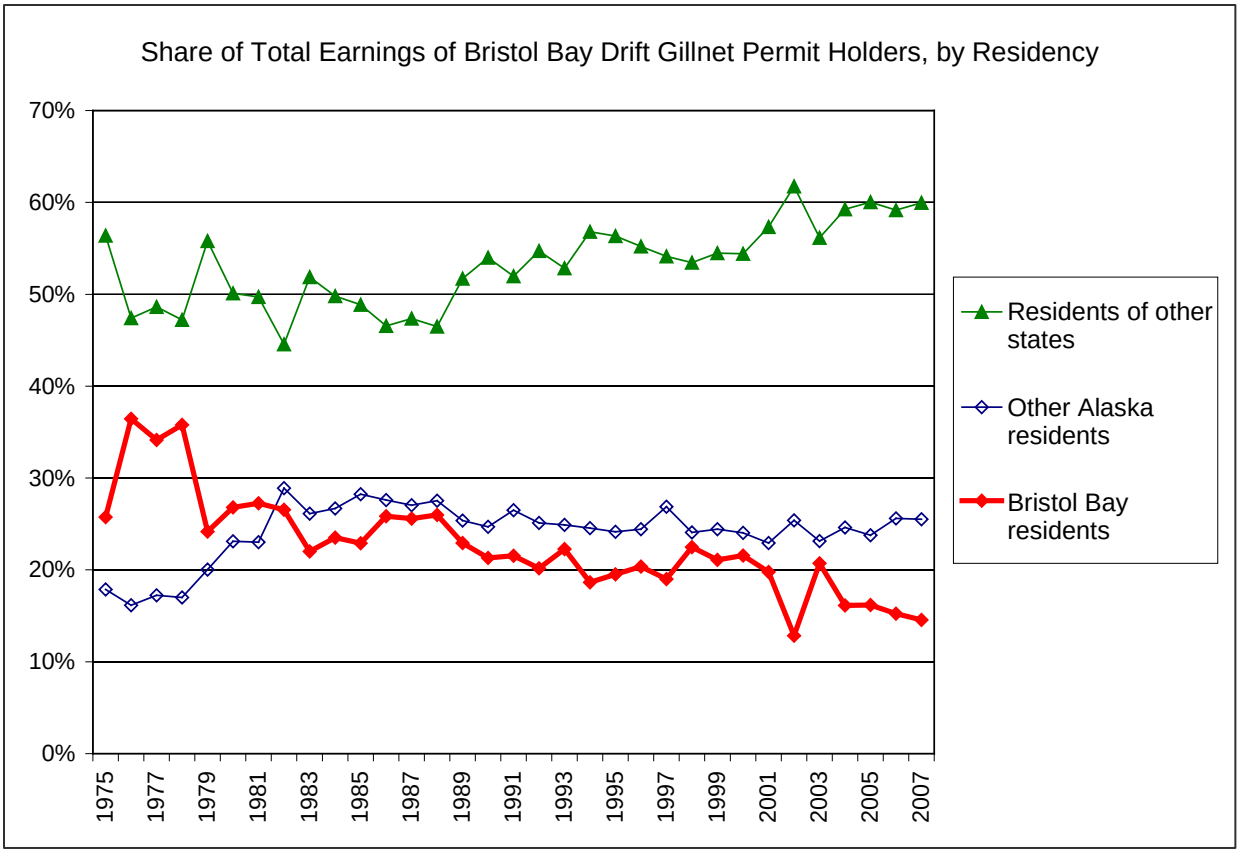


Figure 58. Share of Total Earnings of Bristol Bay Drift Gillnet Permit Holders, by Residency

Trends over time in the share of different groups in total earnings of Bristol Bay permit holders represent the combined effects of trends over time in each group's share of permit holdings as well as differences between groups in average earnings. In the drift gillnet fishery, the share of Bristol residents in total earnings fell from about 35% in the late 1970s to just 15% in 2007. The share of non-Alaska residents increased from less than 50% in the late 1970s to 60% in 2007 (Figure 58).

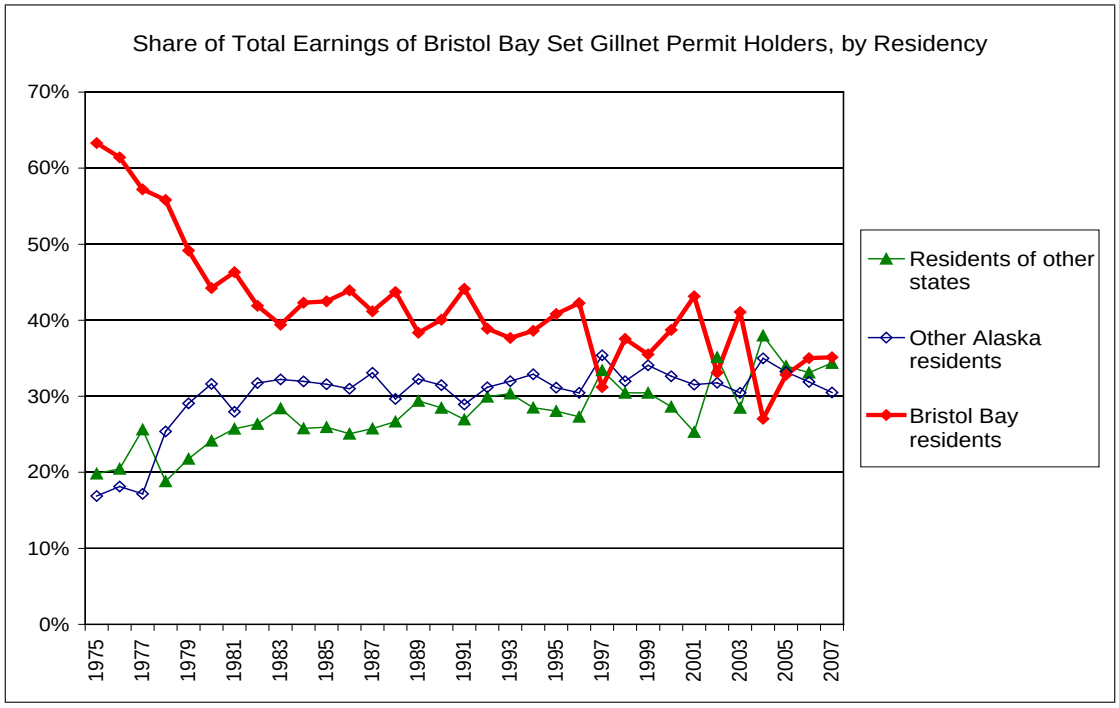


Figure 59. Share of Total Earnings of Bristol Bay Set Gillnet Permit Holders, by Residency

In the set gillnet fishery, the share of Bristol residents in total earnings fell from about 63% in the late 1970s to 35% in 2007. The share of non-Alaska residents increased from about 20% in the late 1970s to 34% in 2007 (Figure 59).

Regional Distribution of Processing Employment

Employment in Bristol Bay seafood processing is overwhelmingly dominated by residents of other states and countries. In 2009, according to Alaska Department of Labor and Workforce Development data, Bristol Bay residents accounted for less than 2% of Bristol Bay processing workers, and other Alaska residents accounted for only 12%. Residents of other states and countries accounted for 87%. (Processing employment data by residency are only available for the years 2004-2009).(Figure 59).

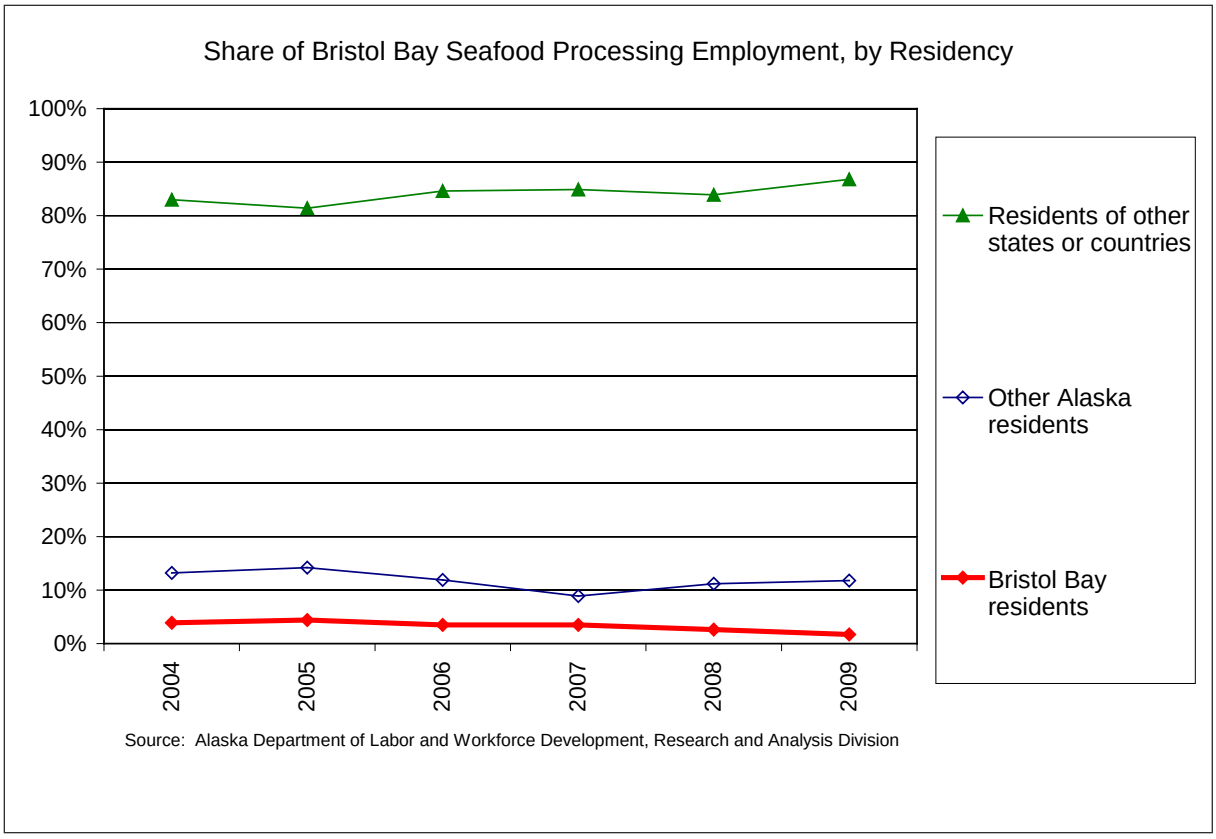


Figure 60. Share of Bristol Bay Seafood Processing Employment, by Residency

A Primarily Non-Local Fishery—With Widely Distributed Benefits

As is clear from the preceding figures, local residents account for a relatively small and declining share of the jobs and earnings in the Bristol Bay salmon industry (Figure 61). In contrast, non-Alaska residents account for relatively large and growing share of the jobs and earnings.

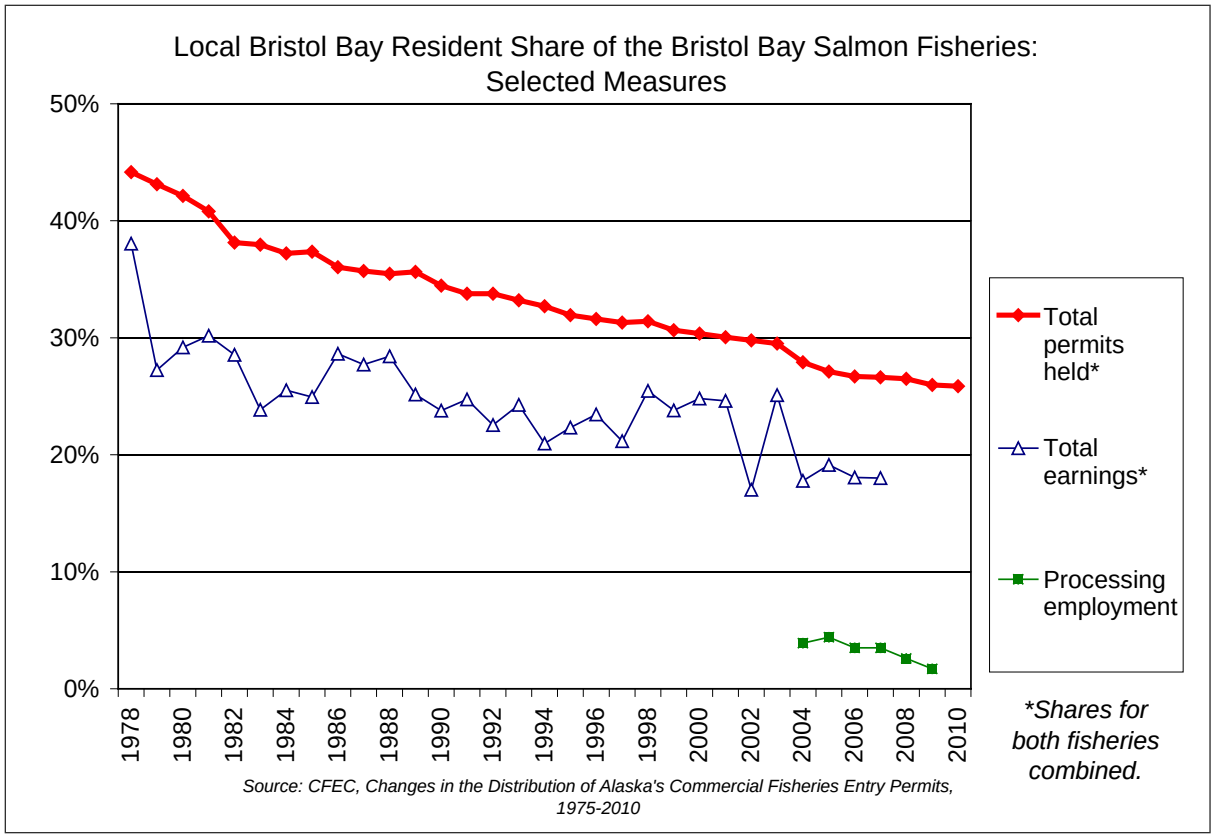


Figure 61. Local Bristol Bay Resident Share of Salmon Fisheries: Selected Measures

This does not mean, of course, that the Bristol Bay salmon fishery is unimportant as a source of jobs or income for local residents. As we discuss in greater detail previously, it remains very important. However, it is not as important for local residents as it might appear if one were to erroneously assume that all the jobs were held by local residents and all the income was earned by local residents.

Bristol Bay processing worker from Turkey

A different perspective is that the Bristol Bay fishery is not just economically important for a remote region of southwestern Alaska. Rather, it is of major economic importance for other parts of Alaska and other states, particularly the Pacific Northwest. Thousands of residents of other parts of Alaska and other states work in and earn significant income from participating in Bristol Bay fishing and processing. For example, as shown in Table 36, in 2010, 597 residents of other parts of Alaska, 656 residents of Washington, 125 residents of Oregon and 119 residents of California fished Bristol Bay salmon permits. They had gross earnings of $40 million (other Alaskans), $59 million (Washington residents), $10 million (Oregon residents, and $9.5 million (California residents).

Table 36. Participation and Gross Earnings in Bristol Bay Salmon Fisheries

Participation and Gross Earnings in Bristol Bay Salmon Fisheries, by Group, 2010

	Number of Fishermen Who Fished*			Estimated Gross Earnings ($1000)		
Group	Drift gillnet fishery	Set gillnet fishery	Total	Drift gillnet fishery	Set gillnet fishery	Total
Bristol Bay Residents, Total	**301**	**297**	**598**	**18,250**	**10,670**	**28,920**
Dillingham Census Area	202	183	385	11,170	6,451	17,620
Bristol Bay Borough	56	83	139	4,227	3,162	7,389
Lake and Peninsula Borough	43	31	74	2,854	1,057	3,911
Other Alaska Residents, Total	**359**	**238**	**597**	**31,215**	**8,858**	**40,074**
Anchorage	86	120	206	6,479	4,288	10,767
Kenai Peninsula Borough	86	44	130	7,968	1,685	9,652
Matanuska-Susitna Borough	38	42	80	3,593	1,504	5,097
Wrangell-Petersburg Census Area	18		18	2,445	0	2,445
Kodiak Island Borough	42	9	51	3,951	321	4,272
Other parts of Alaska	89	23	112	6,780	1,061	7,841
Alaska Residents, Total	**660**	**535**	**1195**	**49,466**	**19,528**	**68,994**
Other States and Countries, Total	**850**	**281**	**1131**	**84,671**	**11,494**	**96,165**
Washington	538	118	656	55,342	4,179	59,521
Oregon	87	39	126	8,383	1,618	10,001
California	87	32	119	8,058	1,449	9,507
Other States & Countries	138	92	230	12,888	4,249	17,136
TOTAL	**1510**	**816**	**2326**	**134,137**	**31,022**	**165,159**

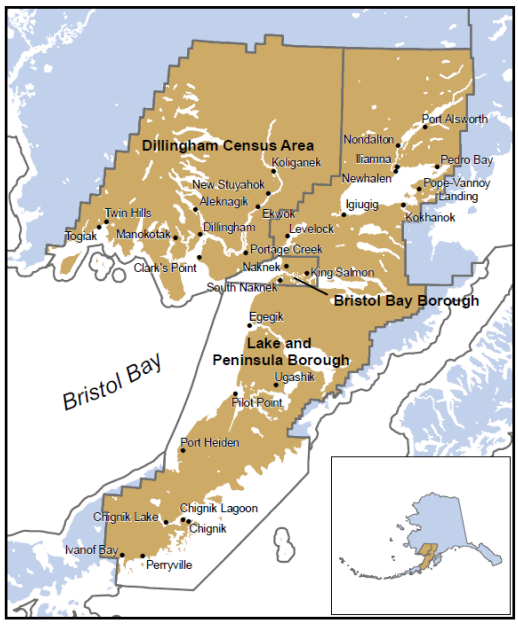
*Number of fishermen who made at least one landing as a permit holder.

Source: Commercial Fisheries Entry Commission, Fishery Participation and Earnings Statistics, 2010: http://www.cfec.state.ak.us/gpbycen/2010/mnu.htm.

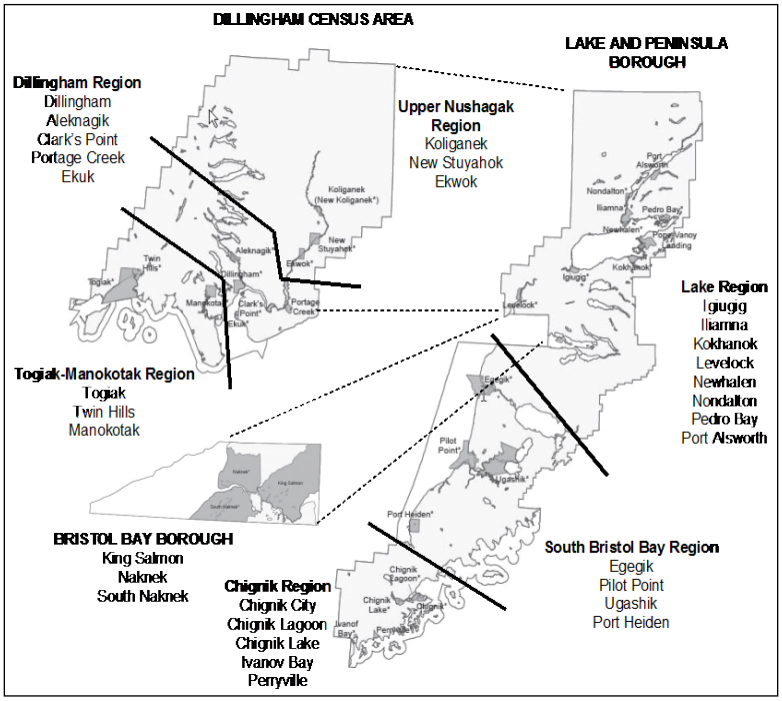
3.12 Distribution of Salmon Permits and Earnings within The Bristol Bay Region

Above, we discussed the distribution of Bristol Bay salmon permits and earnings between local residents of the Bristol Bay region and residents of other parts of Alaska and other states. In this section, we discuss the distribution of permits and earnings within the Bristol Bay region.

For this analysis, we used the Commercial Fisheries Entry Commission (CFEC) definition of the Bristol Bay region as the twenty-six communities within the Bristol Bay watershed. For the analysis in this section, we use the Alaska Department of Labor and Workforce Development (ADLWD) definition of the Bristol Bay region as the Bristol Bay Borough, the Lake and Peninsula Borough, and the Dillingham Census Area. The ADLWD definition is slightly larger because it includes five communities outside the Bristol Bay watershed (Chignik City, Chignik Lagoon, Chignik Lake, Perryville and Ivanof).



Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section



We further divide the Bristol Bay region into seven smaller regions, consisting of the groups of communities:

Bristol Bay Borough
Dillingham Region
Togiak-Manokotak Region
Upper Nushugak Region
Lake Region
South Bristol Bay Region
Chignik Region

We omit the Chignik Region from the figures because residents of the region have very little involvement with the Bristol Bay fishery.

Table 37 summarizes population, numbers of permit holders, and salmon fishery earnings for each community and region in 2000 and 2010. These data were used to calculate per capita

permit holdings and earnings shown in Table 38 and Table 39. We used similar data to calculate Figure 62 through Figure 69 which show trends by region over time.

Table 37. Population, Permit Holders, and Salmon Earnings, by Community: 2000 & 2010

Population, Salmon Permit Holders, and Bristol Bay Salmon Earnings, by Community, 2000 & 2010

	Population		Drift gillnet permit holders		Set gillnet permit holders		Resident drift gillnet earnings ($000)		Resident set gillnet earnings ($000)	
	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010
BRISTOL BAY BOROUGH	**1257**	**997**	**63**	**63**	**117**	**101**	**$1,939**	**$4,227**	**$1,506**	**$3,162**
King Salmon	442	374	14	15	17	17	$589	$1,209	$291	$749
Naknek	678	544	37	38	70	69	$1,120	$2,695	$920	$2,184
South Naknek	137	79	12	10	30	15	$230	$323	$295	$229
DILLINGHAM CENSUS AREA	**4,922**	**4,847**	**326**	**262**	**231**	**199**	**$10,287**	**$10,913**	**$3,901**	**$6,246**
Dillingham Region	**2800**	**2614**	**167**	**142**	**115**	**97**	**$6,284**	**$6,855**	**$2,005**	**$3,032**
Aleknagik	221	219	19	15	9	6	$530	$752	$131	$174
Clarks Point	75	62	8	7	5	4	$329	$0	$68	$117
Dillingham	2,466	2,329	139	120	101	87	$5,425	$6,103	$1,806	$2,742
Ekuk	2	2	0	0	0	0	-	-	-	-
Portage Creek	36	2	1	0	0	0	-	-	-	-
Togiak-Manokotak Region	**1277**	**1333**	**107**	**80**	**106**	**97**	**$2,918**	**$3,222**	**$1,811**	**$3,213**
Manokotak	399	442	28	24	44	35	$847	$696	$646	$1,547
Togiak	809	817	72	53	60	62	$2,071	$2,526	$1,165	$1,666
Twin Hills	69	74	7	3	2	0	$0	$0	$0	$0
Upper Nushagak Region	**783**	**834**	**52**	**40**	**10**	**5**	**$1,084**	**$836**	**$85**	**$0**
Ekwok	130	115	5	3	0	0	$117	-	-	-
Koliganek	182	209	14	16	3	2	$300	$456	-	-
New Stuyahok	471	510	33	21	7	3	$667	$380	$85	-
LAKE AND PEN. BOROUGH	**1,823**	**1,631**	**86**	**57**	**64**	**45**	**$1,454**	**$2,018**	**$436**	**$599**
Lake Region	**986**	**953**	**36**	**28**	**32**	**27**	**$371**	**$865**	**$109**	**$499**
Igiugig	53	50	4	3	0	1	-	-	-	-
Iliamna	102	109	8	9	7	6	$116	$450	$51	$215
Kokhanok	174	170	4	3	4	6	$76	$0	$0	$143
Levelock	122	69	8	4	6	2	$130	$189	$0	$0
Newhalen	160	190	6	6	2	4	$49	$226	$0	$141
Nondalton	221	164	4	2	8	4	-	-	$57	-
Pedro Bay	50	42	1	0	2	3	-	-	-	-
Port Alsworth	104	159	1	1	3	1	-	-	-	-
South Bristol Bay Region	**346**	**291**	**49**	**28**	**31**	**17**	**$1,083**	**$1,152**	**$328**	**$100**
Egegik	116	109	23	10	15	7	$494	$468	$222	$100
Pilot Point	100	68	9	8	11	5	$232	$0	$106	$0
Port Heiden	119	102	15	8	3	3	$357	$684	$0	$0
Ugashik	11	12	2	2	2	2	-	-	-	-
Chignik Region	**456**	**362**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**
Chignik	79	91	0	0	0	0	-	-	-	-
Chignik Lagoon	103	78	0	0	0	0	-	-	-	-
Chignik Lake	145	73	1	1	1	1	-	-	-	-
Ivanof Bay	22	7	0	0	0	0	-	-	-	-
Perryville	107	113	0	0	0	0	-	-	-	-
BRISTOL BAY, TOTAL (a)	**8003**	**7475**	**475**	**382**	**412**	**345**	**$13,679**	**$17,158**	**$5,843**	**$10,007**
BRISTOL BAY, TOTAL (b)	**7547**	**7113**	**474**	**381**	**411**	**344**	**$13,679**	**$17,158**	**$5,843**	**$10,007**

(a) Total includes the Chignik Region; (b) Total excludes the Chignik Region. Note: "-" indicates that earnings data were confidential and not reported. Sources: U.S. Censuses, 2000 and 2010; CFEC.

Bristol Bay Population Trends

Figure 62 and Figure 63 show population trends for the Bristol Bay region. Note that the population data should be considered estimates rather than precise data. They are based on the decennial United States censuses conducted in 1980, 1990, 2000 and 2010, and were estimated for intervening years by the Alaska Department of Labor and Workforce Development. In addition, given the seasonality of the Bristol Bay area employment and the fact that much of the workforce is non-resident, it is difficult to define or measure population precisely. It is most useful to focus on long-term population trends and relative populations of different regions rather than short-term changes which may result from changes in how the data were estimated rather than actual population changes.

In general, the population of the Bristol Bay area increased rapidly during the 1980s, grew more slowly during the 1990s, and declined gradually during the 2000s. The total 2010 population was about 7500.

Of the six regions within the Bristol Bay area (excluding Chignik) the Dillingham Region has by far the largest population and the south Bristol Bay region has by far the smallest.

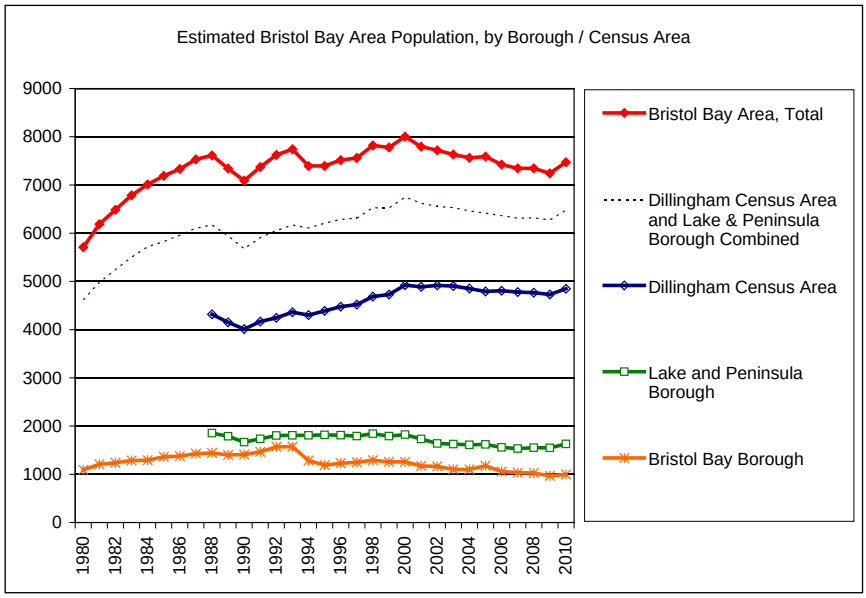


Figure 62. Estimated Bristol Bay Area Population, by Area

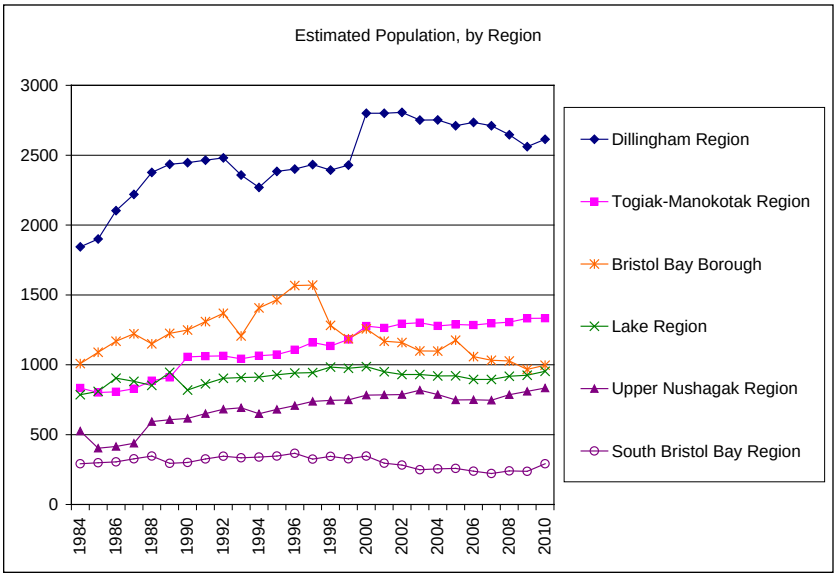


Figure 63. Estimated Population by Region

Permit Holders

Figure 64 shows the number of drift gillnet permit holders by region for the years 1984-2010. The number is highest for the Dillingham Region, followed by the Togiak-Manokotak Region. The number of drift gillnet permit holders has declined in all regions since 1984. The rate of decline has been somewhat less for the Bristol Bay Borough, particularly since 2000.

Figure 65 shows number of drift gillnet permit holders per 100 residents, by region. This measure is equal to per capita permit holdings multiplied by 100.
By adjusting for differences in population over time and between regions, it provides a way of comparing the relative degree of participation by residents in the drift gillnet fishery over time and between regions.

Because the Bristol Bay population is currently higher than it was in the early 1980s, permit holdings per 100 residents have declined relatively more sharply than total permit holdings, and have fallen by about half since 1984 in all regions except the Bristol Bay Borough.

In 2010, the number of permit holders per 100 residents was highest in the South Bristol Bay Region (10) and lowest in the Lake Region (3). Thus the degree of participation in the drift gillnet fishery varies between these regions by

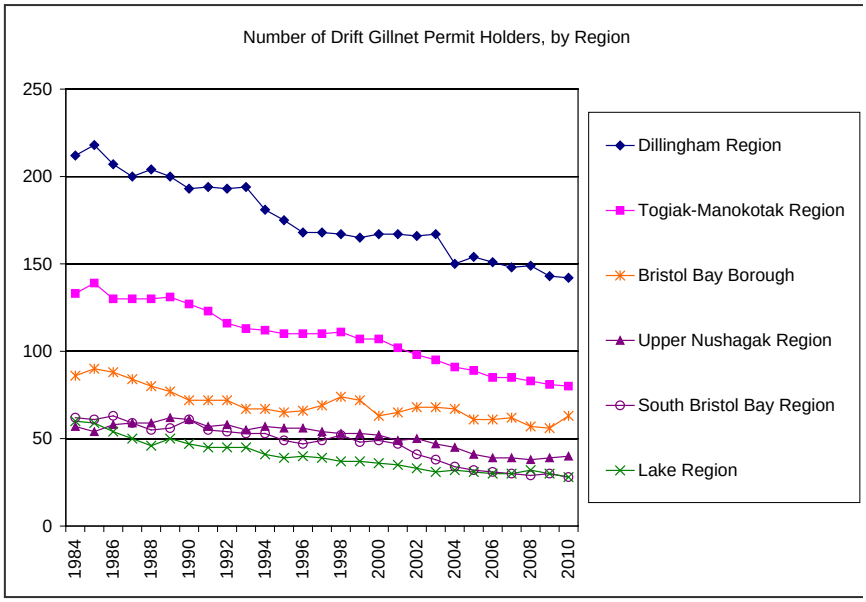


Figure 64. Number of Drift Gillnet Holders, by Region

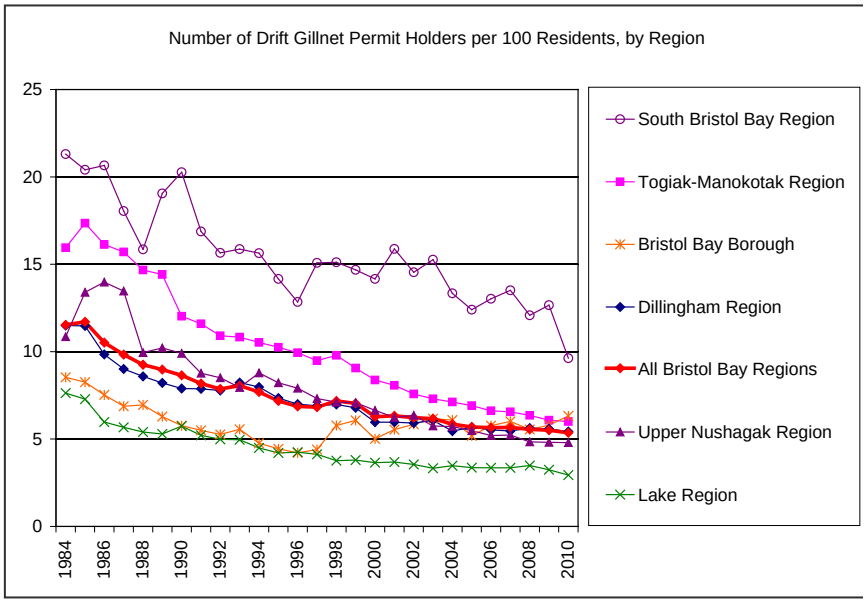


Figure 65. Number of Drift Gillnet Holders per 100 Residents, by Region

a factor of 3.

Figure 66 shows the number of set gillnet permit holders by region for the years 1984-2010. The number is highest for the Bristol Bay Borough, Togiak-Manokotak Region, and Dillingham Region, and is much lower for the other three regions. Since 1984, the number of set gillnet permit holders has declined in four regions (Bristol Bay Borough, Dillingham Region, Lake Region, and South Bristol Bay Region). However, the declines have generally not been as steep as the declines in the number of drift gillnet permit holders. The number of set gillnet permit holders has stayed about the same in the Togiak-Manakotak Region. It is very small in the Upper Nushagak Region.

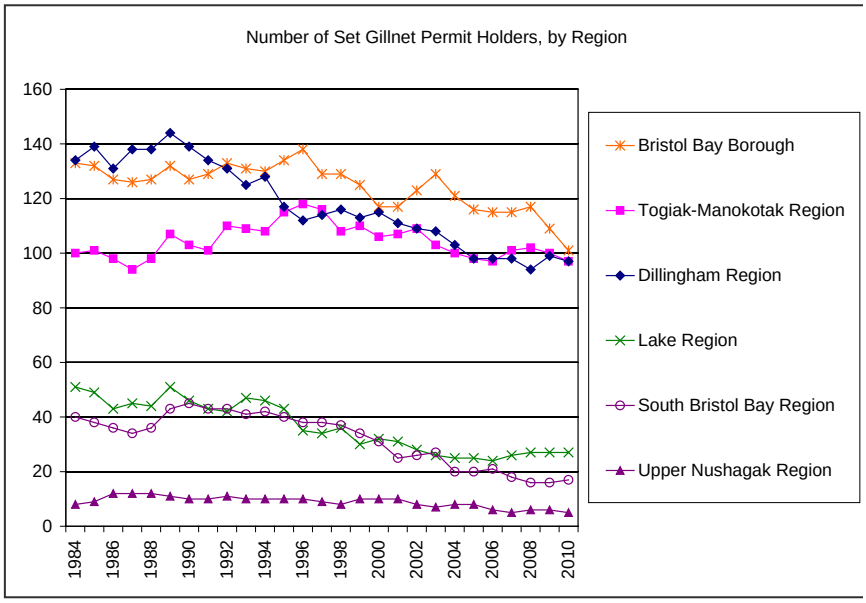


Figure 66. Number of Set Gillnet Holders, by Region

Figure 67 shows number of set gillnet permit holders per 100 residents, by region. In general, the number of set gillnet permit holders per 100 residents has trended downward in all regions except for the Bristol Bay Borough.

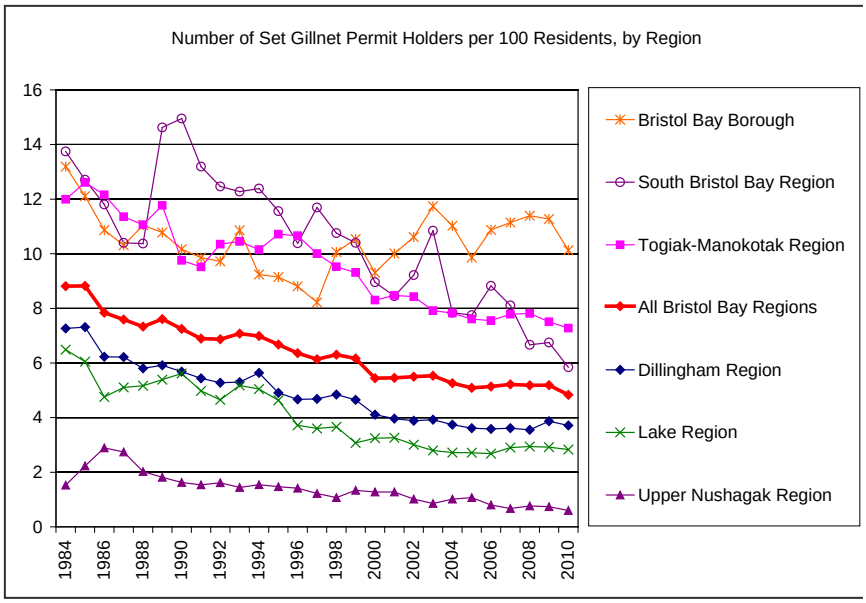


Figure 67. Number of Set Gillnet Permit Holders per 100 Residents, by Region

There is wide variation between regions in the degree of participation in the set gillnet fishery, from as high as 10 permit holders per 100 residents in the Bristol Bay Borough to as low as 1 in the Upper Nushagak Region.

Just as there is wide variation between regions in the numbers of permit holders per 100 residents, there is also wide variation between individual communities within

regions and within the Bristol Bay watershed as a whole (Table 38). In 2010, some communities, such as Ekwok and Nondalton, had fewer than 5 permit holders (drift and set gillnet combined) per 100 residents. Others communities, such as Naknek and South Naknek, had 20 or more.

Table 38. Salmon Permit Holders per 100 Residents, by Community

Salmon Permit Holders Per Hundred Residents, by Community, 2000 & 2010

	Drift gillnet permit holders per hundred residents		Set gillnet permit holders per hundred residents		Total permit holders per hundred residents	
	2000	2010	2000	2010	2000	2010
BRISTOL BAY BOROUGH	**5**	**6**	**9**	**10**	**14**	**16**
King Salmon	3	4	4	5	7	9
Naknek	5	7	10	13	16	20
South Naknek	9	13	22	19	31	32
DILLINGHAM CENSUS AREA	**7**	**5**	**5**	**4**	**11**	**10**
Dillingham Region	**6**	**5**	**4**	**4**	**10**	**9**
Aleknagik	9	7	4	3	13	10
Clarks Point	11	11	7	6	17	18
Dillingham	6	5	4	4	10	9
Ekuk	0	0	0	0	0	0
Portage Creek	3	0	0	0	3	0
Togiak-Manokotak Region	**8**	**6**	**8**	**7**	**17**	**13**
Manokotak	7	5	11	8	18	13
Togiak	9	6	7	8	16	14
Twin Hills	10	4	3	0	13	4
Upper Nushagak Region	**7**	**5**	**1**	**1**	**8**	**5**
Ekwok	4	3	0	0	4	3
Koliganek	8	8	2	1	9	9
New Stuyahok	7	4	1	1	8	5
LAKE AND PEN. BOROUGH	**5**	**3**	**4**	**3**	**8**	**6**
Lake Region	**4**	**3**	**3**	**3**	**7**	**6**
Igiugig	8	6	0	2	8	8
Iliamna	8	8	7	6	15	14
Kokhanok	2	2	2	4	5	5
Levelock	7	6	5	3	11	9
Newhalen	4	3	1	2	5	5
Nondalton	2	1	4	2	5	4
Pedro Bay	2	0	4	7	6	7
Port Alsworth	1	1	3	1	4	1
South Bristol Bay Region	**14**	**10**	**9**	**6**	**23**	**15**
Egegik	20	9	13	6	33	16
Pilot Point	9	12	11	7	20	19
Port Heiden	13	8	3	3	15	11
Ugashik	18	17	18	17	36	33
Chignik Region	**0**	**0**	**0**	**0**	**0**	**1**
Chignik	0	0	0	0	0	0
Chignik Lagoon	0	0	0	0	0	0
Chignik Lake	1	1	1	1	1	3
Ivanof Bay	0	0	0	0	0	0
Perryville	0	0	0	0	0	0
BRISTOL BAY, TOTAL (a)	**6**	**5**	**5**	**5**	**11**	**10**
BRISTOL BAY, TOTAL (b)	**6**	**5**	**5**	**5**	**12**	**10**

(a) Total includes the Chignik Region; (b) Total excludes the Chignik Region. Sources: U.S. Censuses, 2000 and 2010; CFEC.

Salmon Fishery Earnings

Figure 68 and Figure 69 show total and per capita salmon fishery earnings for Bristol Bay regions. Note that trends in fishery earnings for each region, as well as differences between regions, reflect the combined effects of three factors: (1) trends in overall catches, prices and value of the fishery; (2) trends in the number of permit holders in each region; and (3) trends in average catch shares of permit holders within each region.

The combined effect of the decline in total value of the fishery as well as a decline in the number of permit holders was a dramatic decline in salmon fishery earnings and per capita earnings for all regions between the late 1990s and 2002. Note that this effect would appear even more dramatic if adjusted for the inflation which occurred during this period of time.

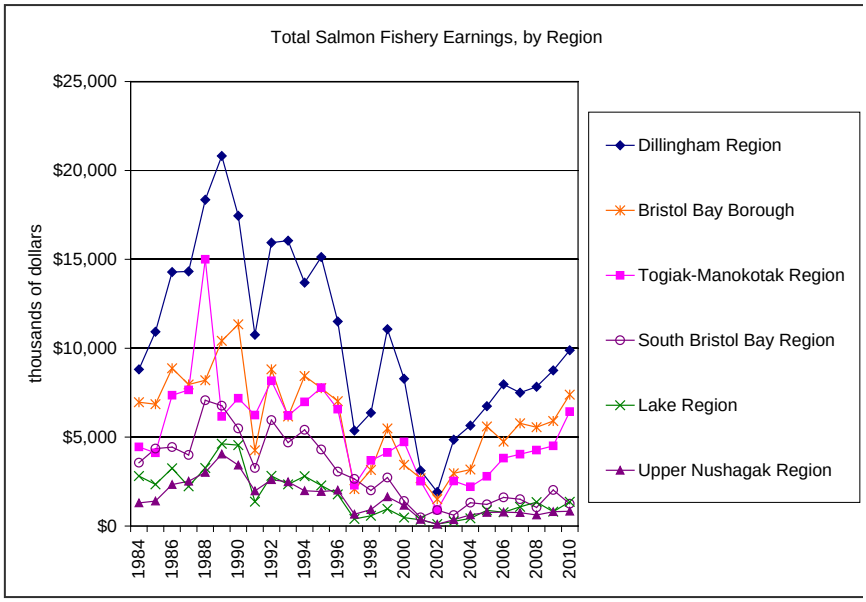


Figure 68. Total Salmon Fishery Earnings, by Region

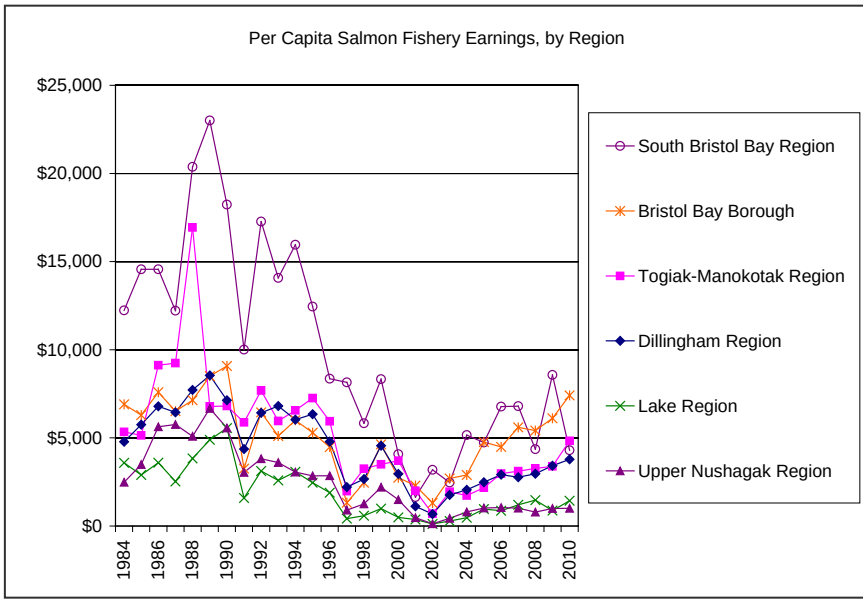


Figure 69. Per Capita Salmon Fisheries Earnings, by Region

Between 2002 and 2010, both earnings and per capita earnings have recovered significantly in all regions. However, except for the Bristol Bay Borough, per capita earnings were well below the levels of the 1980s, particularly for the Lake Region and Upper Nughagak Region.

Just as there is wide variation between regions in per capita salmon fishery earnings, there is also wide variation between individual communities within regions and within the Bristol Bay watershed as a whole

(Table 39). In 2010, per capita salmon fishery earnings in some communities, such as Kokhanok and Newhalen, were less than $2000. Presumably they were much lower in other communities, such as Nondalton and Ekwok, for which earnings data were confidential due to the small number of permit holders. In other communities, such as Naknek, South Naknek, Iliamna and Port Heiden, they per capita earnings exceeded $6000. Thus there is clearly wide variation within the Bristol Bay watershed in the extent to which communities and regions participate in and benefit economically from Bristol Bay salmon fisheries.

Table 39. Bristol Bay Salmon Fishery Earnings, by Community

Bristol Bay Salmon Fishery Per Capita Earnings, by Community, 2000 and 2010

	Drift gillnet fishery per capita earnings		Set gillnet fishery per capita earnings		Total salmon fishing per capita earnings	
	2000	2010	2000	2010	2000	2010
BRISTOL BAY BOROUGH	**$1,542**	**$4,240**	**$1,198**	**$3,172**	**$2,740**	**$7,411**
King Salmon	$1,334	$3,232	$657	$2,004	$1,991	$5,236
Naknek	$1,652	$4,954	$1,357	$4,015	$3,009	$8,969
South Naknek	$1,675	$4,093	$2,154	$2,892	$3,829	$6,986
DILLINGHAM CENSUS AREA	**$2,090**	**$2,252**	**$793**	**$1,289**	**$2,882**	**$3,540**
Dillingham Region	**$2,244**	**$2,623**	**$716**	**$1,160**	**$2,960**	**$3,783**
Aleknagik	$2,399	$3,435	$591	$794	$2,990	$4,229
Clarks Point	$4,385	$0	$901	$1,882	$5,286	$1,882
Dillingham	$2,200	$2,620	$733	$1,177	$2,933	$3,798
Ekuk						
Portage Creek						
Togiak-Manokotak Region	**$2,285**	**$2,417**	**$1,418**	**$2,410**	**$3,703**	**$4,828**
Manokotak	$2,123	$1,576	$1,619	$3,500	$3,742	$5,075
Togiak	$2,560	$3,091	$1,440	$2,039	$4,000	$5,131
Twin Hills	$0	$0	$0	$0	$0	$0
Upper Nushagak Region	**$1,384**	**$1,002**	**$109**	**$0**	**$1,494**	**$1,002**
Ekwok	$900					
Koliganek	$1,649	$2,182				
New Stuyahok	$1,416	$745	$181		$1,597	
LAKE AND PEN. BOROUGH	**$798**	**$1,237**	**$239**	**$367**	**$1,037**	**$1,604**
Lake Region	**$377**	**$908**	**$110**	**$524**	**$487**	**$1,432**
Igiugig						
Iliamna	$1,137	$4,127	$504	$1,975	$1,640	$6,102
Kokhanok	$435	$0	$0	$842	$435	$842
Levelock	$1,067	$2,743	$0	$0	$1,067	$2,743
Newhalen	$309	$1,191	$0	$740	$309	$1,931
Nondalton						
Pedro Bay						
Port Alsworth						
South Bristol Bay Region	**$3,129**	**$3,960**	**$947**	**$343**	**$4,076**	**$4,302**
Egegik	$4,261	$4,296	$1,911	$915	$6,173	$5,211
Pilot Point	$2,316	$0	$1,058	$0	$3,375	$0
Port Heiden	$2,998	$6,705	$0	$0	$2,998	$6,705
Ugashik						
Chignik Region						
Chignik						
Chignik Lagoon						
Chignik Lake						
Ivanof Bay						
Perryville						
BRISTOL BAY, TOTAL (a)	**$1,709**	**$2,295**	**$730**	**$1,339**	**$2,439**	**$3,634**
BRISTOL BAY, TOTAL (b)	**$1,813**	**$2,412**	**$774**	**$1,407**	**$2,587**	**$3,819**

(a) Total includes the Chignik Region; (b) Total excludes the Chignik Region. Blank cells indicate that earnings data were confidential and not reported. Sources: U.S. Censuses, 2000 and 2010; CFEC.

3.13 Economic Measures of the Bristol Bay Salmon Industry

There is no single or best economic measure for the Bristol Bay fishery. Which measure is appropriate depends upon the question being asked.

For example, if we want to know how the Bristol Bay salmon fishery compares in scale with other fisheries, we should look at total harvests or ex-vessel or wholesale value. If we want to know how it affects the United States balance of payments, we should look at estimated net exports attributable to the fishery. If we want to know how much employment the industry provides for residents of the local Bristol Bay region, Alaska or the United States, we should look at estimated employment in fishing and processing for residents of these regions. If we want to know the net economic value attributable to the fishery, we should look at estimated profits of Bristol Bay fishermen and processors. These different measures vary widely in units, in scale, and how economically "important" they make the fishery appear.

In this section, we summarize selected economic measures of the Bristol Bay commercial fishery for recent years. These include harvests, gross ex-vessel and wholesale value, estimated export value, direct employment and earnings in fishing and processing by region of residency, and limited entry prices and total estimated limited entry permit value. We present tables of each of these measures for the years 2000-2010. Where data are available, we present graphs for longer periods, showing dollar values in both nominal and real (inflation-adjusted) prices expressed in 2010 dollars. Blank cells in the tables indicate that data were not available as of November 2011. Refer to earlier sections in this report for more detailed discussions of each measure.

Harvests

The Bristol Bay salmon fishery is a world-scale commercial salmon fishery. Between 2000 and 2010, Bristol Bay averaged 60% of total Alaska sockeye salmon harvests (by volume), 45% of world sockeye salmon harvests, 18% of all Alaska wild salmon harvests, 7% of all world wild salmon harvests, and 2% of all world salmon production (wild and farmed combined).

Table 40. Economic Measures of Bristol Bay Salmon Industry: Sockeye Salmon Harvests

Economic Measures of the Bristol Bay Salmon Industry: Sockeye Salmon Harvests

Measure	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg.	Range
Harvests													
Millions of fish	21	14	11	15	26	25	28	30	28	31	29	23	11 - 31
Millions of pounds	125	96	65	93	152	155	165	173	160	183	170	140	65 - 183
Bristol Bay harvest volume as a share of:													
Alaska sockeye salmon	61%	56%	48%	50%	59%	58%	69%	62%	71%	71%	74%	62%	48% - 74%
World sockeye salmon	45%	40%	28%	38%	47%	47%	49%	47%	52%	55%		45%	28% - 55%
Alaska wild salmon (all species)	18%	12%	10%	13%	19%	16%	22%	18%	23%	25%		18%	10% - 25%
World wild salmon (all species)	7%	5%	4%	5%	8%	7%	8%	7%	9%	7%		7%	4% - 9%
World wild & farmed salmon (all species)	3%	2%	1%	2%	3%	3%	3%	3%	3%	3%		2%	1% - 3%

Sources: Alaska Department of Fish and Game, National Marine Fisheries Service, FAO.

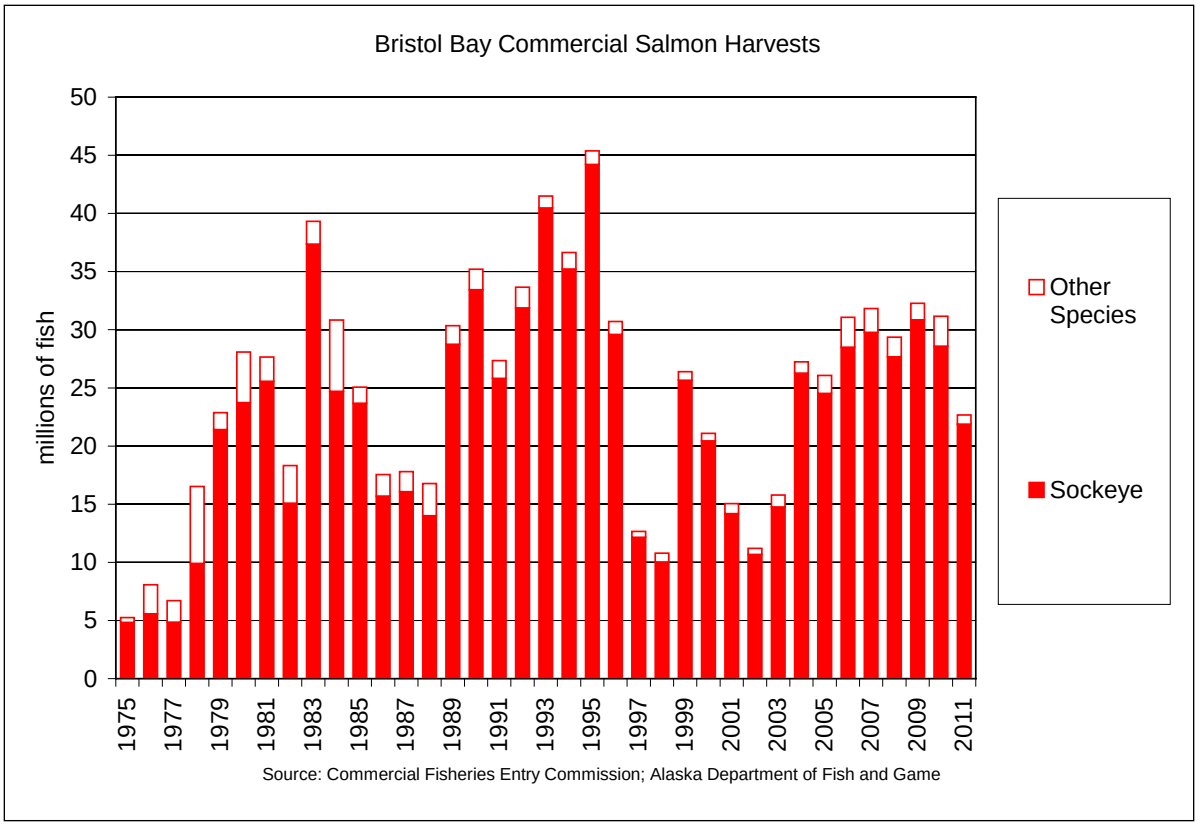


Figure 70. Bristol Bay Commercial Salmon Harvests

Gross Ex-Vessel Value and First Wholesale Value

During the period 2000-2010, Bristol Bay sockeye salmon harvests had an average annual real ex-vessel value to fishermen of $101 million (expressed in 2010 $). During this period of time, the value was generally increasing, from a low or $39 million in 2002 to $181 million in 2010. The real first wholesale value of salmon products processed from Bristol Bay sockeye salmon in Bristol Bay was more than twice as high as harvest value, averaging $234 million for the period 2000-2010, and increasing from $124 million in 2002 to $390 million in 2010.

Table 41. Economic Measures of Bristol Bay Salmon Industry: Sockeye Value

Economic Measures of the Bristol Bay Salmon Industry: Sockeye Salmon Ex-Vessel Value and First Wholesale Value

Measure	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg.	Range
Ex-Vessel Value ($ mllions)													
Nominal value (not inflation-adjusted)	80	40	32	48	76	95	109	116	117	144	181	94	32 - 181
Real value (inflation adjusted, 2010 $)	104	51	39	57	90	107	119	125	120	147	181	104	39 - 181
First wholesale value													
Nominal value (not inflation-adjusted)	175	115	100	114	176	220	237	249	262	293	390	212	100 - 390
Real value (inflation adjusted, 2010 $)	227	144	124	137	206	250	261	268	270	298	390	234	124 - 390
Bristol Bay sockeye salmon share of:													
Alaska wild salmon ex-vessel value (all species)	23%	14%	16%	19%	24%	24%	28%	24%	22%	29%	25%	23%	14% - 29%
World wild salmon ex-vessel value (all species) *	12%	6%	6%	8%	13%	12%	13%	11%	10%	9%		10%	6% - 13%
United States fish & shellfish landed value (all species)	2%	1%	1%	1%	2%	2%	2%	2%	2%	3%	3%	2%	1% - 3%
Rank of Naknek-King Salmon among U.S. ports in annual landed value	21	49	87	58	12	8	8	7	7	4	4	24	87 - 4

* Valued at average prices of Alaska wild salmon, by species.

Sources: Alaska Department of Fish and Game, National Marine Fisheries Service, FAO.

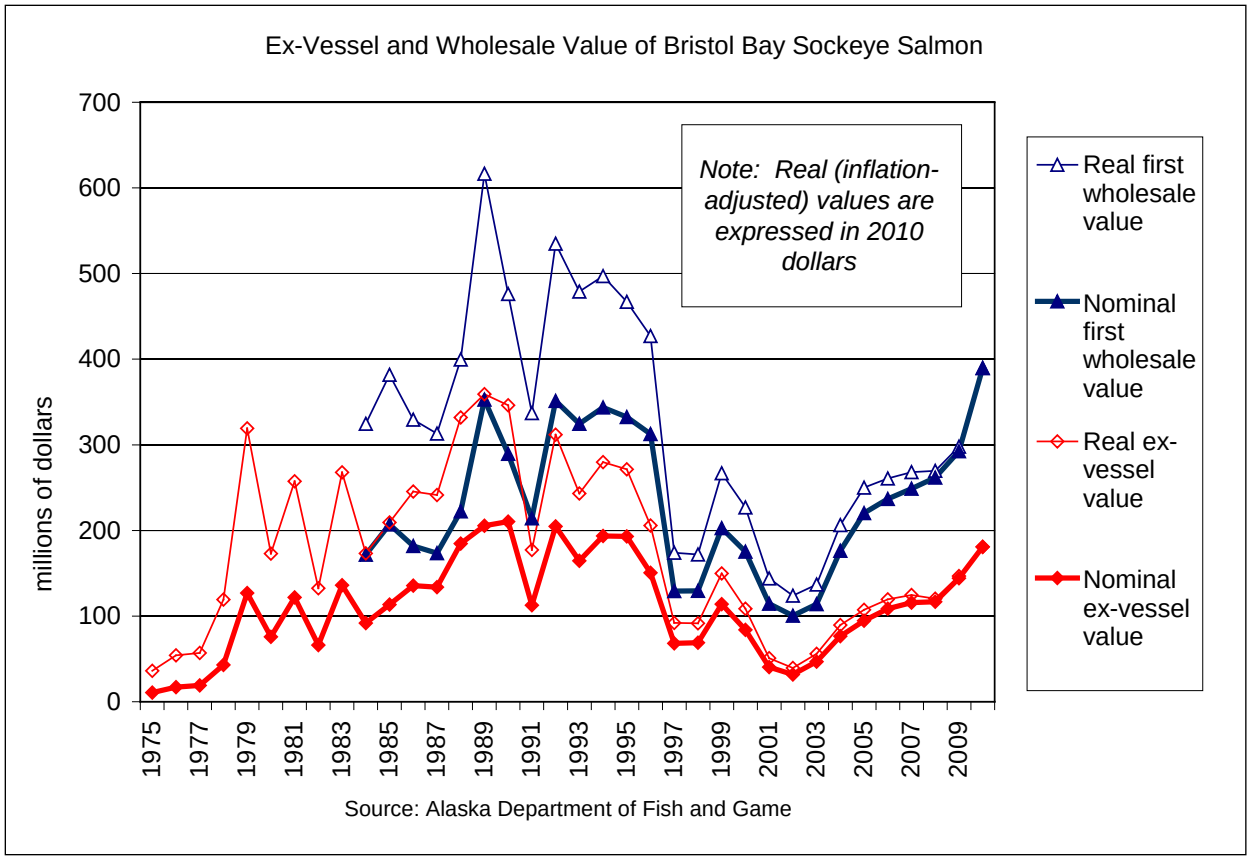


Figure 71. Ex-Vessel and Wholesale Value of Bristol Bay Sockeye Salmon

Between 2000 and 2010, Bristol Bay averaged 23% of the ex-vessel for all Alaska wild salmon, an estimated 10% of the harvest value of world wild salmon harvests, and 2% of the value of U.S. fish and shellfish landings of all species combined.

As ex-vessel value increased dramatically between 2003 and 2010, the Bristol Bay port of Naknek-King Salmon rose from a rank of 87th to 4th among all U.S. ports in annual landed value (ex-vessel value, or value paid to fishermen, of fish landed in the port).

Export Value of Bristol Bay Salmon Products

During the period 2000-2010, the value of Bristol Bay salmon products exported from the United States averaged $173 million for the years 2000-2010, and was $254 million in 2010.

Table 42. Economic Measures of the Bristol Bay Salmon Industry: Export Value.

Economic Measures of the Bristol Bay Salmon Industry: Estimated Export Value of Bristol Bay Sockeye Salmon Products

Measure	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg.	Range
Nominal value of exports (millions of dollars)													
Canned	44	49	41	45	68	65	79	79	84	86	80	65	41 - 86
Frozen	8	3	11	10	13	10	5	8	8	8	8	8	3 - 13
Fresh	87	76	40	48	82	105	80	82	92	113	146	87	40 - 146
Roe	11	8	5	7	8	13	9	14	22	24	20	13	5 - 24
Total	150	137	97	111	172	193	173	183	206	230	254	173	97 - 254
Real value of exports (millions of 2010 $)													
Canned	57	62	50	54	80	74	86	85	86	87	80	73	50 - 87
Frozen	11	4	14	12	15	11	6	9	8	8	8	10	4 - 15
Fresh	112	96	49	58	96	119	88	89	94	115	146	97	49 - 146
Roe	14	11	6	8	9	14	10	15	23	24	20	14	6 - 24
Total	193	173	120	133	201	219	191	197	212	234	254	193	120 - 254

Note: The value of US exports of Bristol Bay sockeye salmon products was estimated as the total value of US sockeye salmon exports multiplied by the share of Bristol Bay sockeye in total Alaska sockeye salmon havests. The value of Bristol Bay sockeye salmon roe exports was assumed to be equal to the first wholesale value of sockeye salmon roe production. The data source for US exports was the National Marine Fisheries Serivce Foreign Trade in Fisheries Products website.

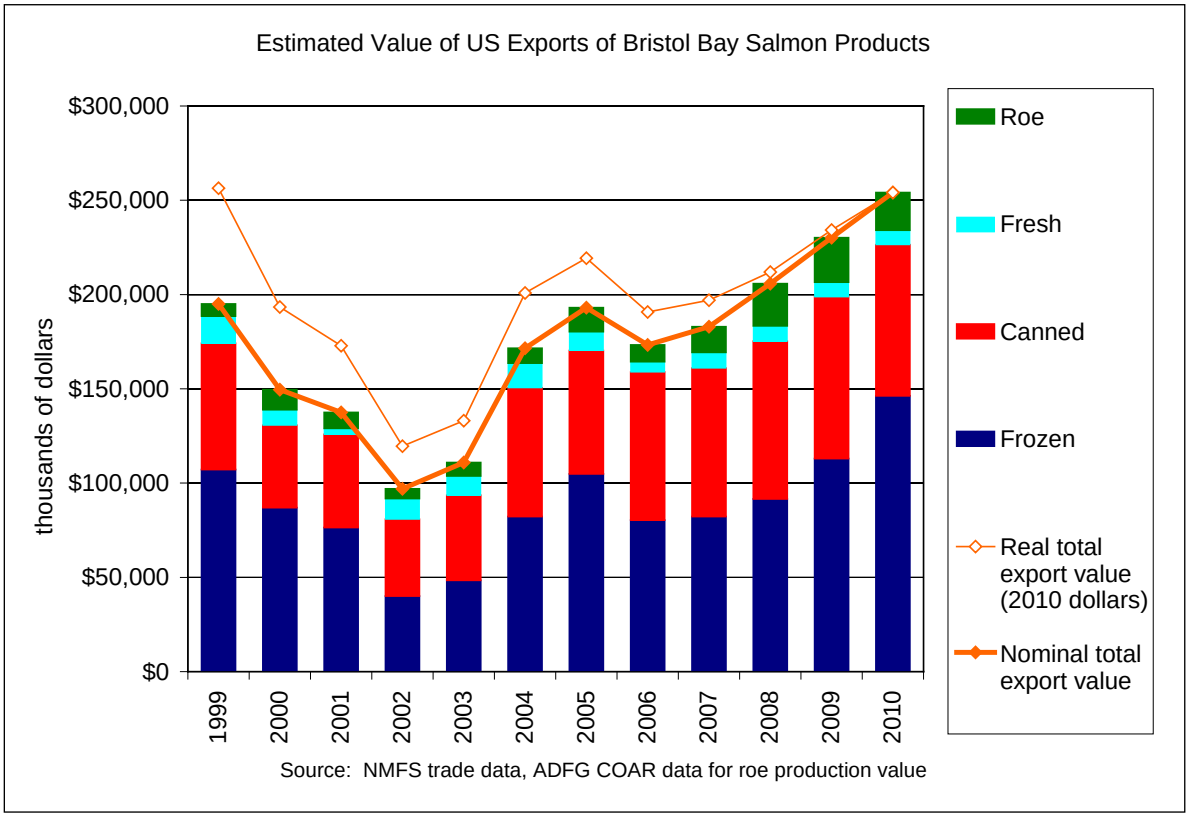


Figure 72. Estimated Value of US Exports of Bristol Bay Salmon Products

Employment

During the period 2001-2009, estimated peak employment in the Bristol Bay salmon industry averaged 6,656 fishermen and 3,255 processing workers, for average total peak employment of 9,911.

Because the fishery occurs almost entirely in June and July, estimated annual average employment is only about one-sixth as high as peak employment. During the period 2001-2009, estimated annual average employment averaged 1,093 in fishing and 535 in processing, for a total of 1,628 annual average jobs.

During this period Bristol Bay salmon annual average fishing employment averaged 15% of Alaska statewide annual average fishing employment. Peak Bristol Bay commercial fishing employment averaged 33% of peak statewide Alaska commercial fishing employment. Put differently, in July—the busiest month for Alaska commercial fishing—about one third of all the people fishing commercially in Alaska were fishing in Bristol Bay. Bristol Bay fish processing accounted for an average of 14% of the individuals who worked in Alaska fish processing.

Table 43. Economic Measures of the Bristol Bay Salmon Industry: Employment

Economic Measures of the Bristol Bay Salmon Industry: Employment

Measure	2001	2002	2003	2004	2005	2006	2007	2008	2009	Avg.	Range
Estimated peak employment or number of workers											
Peak (July) fishing employment	7,098	5,514	6,465	6,513	6,750	6,936	6,891	6,969	6,768	6,656	5,514 - 7,098
Number of fish processing workers	2,862	2,273	2,484	3,474	3,272	2,940	3,512	3,952	4,522	3,255	2,273 - 4,522
Total	9,960	7,787	8,949	9,987	10,022	9,876	10,403	10,921	11,290	9,911	7,787 - 11,290
Estimated annual average employment											
Fishing	1,179	888	1,063	1,089	1,098	1,140	1,110	1,129	1,143	1,093	888 - 1,179
Fish processing	475	366	409	581	532	483	566	640	764	535	366 - 764
Total	1,654	1,254	1,472	1,669	1,631	1,623	1,675	1,769	1,907	1,628	1,254 - 1,907
Bristol Bay share of estimated Alaska total											
Annual average fishing employment	15%	12%	14%	15%	15%	16%	15%	16%	16%	15%	12% - 16%
Peak (July) employment in fishing	33%	30%	33%	33%	33%	35%	34%	34%	34%	33%	30% - 35%
Number of fish processing workers	13%	11%	11%	16%	15%	13%	15%	17%	19%	14%	11% - 19%

Source: Alaska Department of Labor and Workforce Development, Research and Analysis Division.

Limited Entry Permit Prices and Values

Limited entry permit prices provide a measure of the value to the marginal permit holder of the present and future right to participate in the fishery. Economic theory suggests that this will be the marginal permit holder's present discounted present value of expected future profits from the fishery. During the period 2002-2010 Bristol Bay permit prices increased from $19,700 to $102,100 for drift gillnet permits and from $11,900 to $28,700 for set gillnet permits. The dramatic recovery in permit prices reflects a dramatic increase in profitability of the fishery and expectations of continued profitability.

The total value of Bristol Bay permits—calculated as the number of permits multiplied by the permit price—provides an estimate of the total present discounted value of expected future profits from the fishery. During the period 2000-2010 the estimated total value of Bristol Bay permits (both fisheries combined) ranged from $48 million to $218 million.

Multiplying the total value of a permit by the rate of return a permit holder demands on a permit investment provides a measure of the annual profit permit holders expect to earn. We do not know the rate of return demanded by permit holders. However, it is likely that it is between 5% and 20% (Hupert et al 1996). This suggests that in 2010 annual expected profits from Bristol Bay commercial fishing between $10.9 million and $43.7 million. Note that this does not include expected profits from fish processing.

Table 44. Economic Measures of the Bristol Bay Salmon Industry: Permit Prices and Values. (Source: www.cfec.state.ak.us/bit/MNUSALM.htm)

Economic Measures of the Bristol Bay Salmon Industry: Permits Prices and Values

Measure	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg.	Range
Number of permanent permits issued													
Drift gillnet fishery	1858	1,861	1,863	1,861	1,857	1,859	1,859	1,861	1,863	1,863	1,863	1,861	1,857 - 1,863
Set gillnet fishery	1,007	1,008	1,004	999	988	988	985	983	979	982	982	991	979 - 1,008
Total	1,007	2,869	2,867	2,860	2,845	2,847	2,844	2,844	2,842	2,845	2,845	2,683	1,007 - 2,869
Average nominal permit price ($)													
Drift gillnet fishery	80,500	34,700	19,700	29,300	37,000	51,200	75,000	79,400	89,800	78,300	102,100	61,545	19,700 - 102,100
Set gillnet fishery	32,400	25,300	11,900	12,600	14,700	15,100	22,400	24,000	27,400	28,200	28,700	22,064	11,900 - 32,400
Estimated total nominal value ($ millions) (a)													
Drift gillnet fishery	149.6	64.6	36.7	54.5	68.7	95.2	139.4	147.8	167.3	145.9	190.2	114.5	36.7 - 190.2
Set gillnet fishery	32.6	25.5	11.9	12.6	14.5	14.9	22.1	23.6	26.8	27.7	28.2	21.9	11.9 - 32.6
Total	182.2	90.1	48.6	67.1	83.2	110.1	161.5	171.4	194.1	173.6	218.4	136.4	48.6 - 218.4
Implied annual nominal profits ($ millions) (b) assuming permit holders demand a rate of return of:													
5%	9.1	4.5	2.4	3.4	4.2	5.5	8.1	8.6	9.7	8.7	10.9	6.8	2.4 - 10.9
10%	18.2	9.0	4.9	6.7	8.3	11.0	16.1	17.1	19.4	17.4	21.8	13.6	4.9 - 21.8
15%	27.3	13.5	7.3	10.1	12.5	16.5	24.2	25.7	29.1	26.0	32.8	20.5	7.3 - 32.8
20%	36.4	18.0	9.7	13.4	16.6	22.0	32.3	34.3	38.8	34.7	43.7	27.3	9.7 - 43.7

(a) Calculated as average permit price x number of permanent permits issued. (b) Estimated total value x assumed rate of return demanded. Source: Commercial Fisheries Entry Commission, Salmon Basic Information Tables.

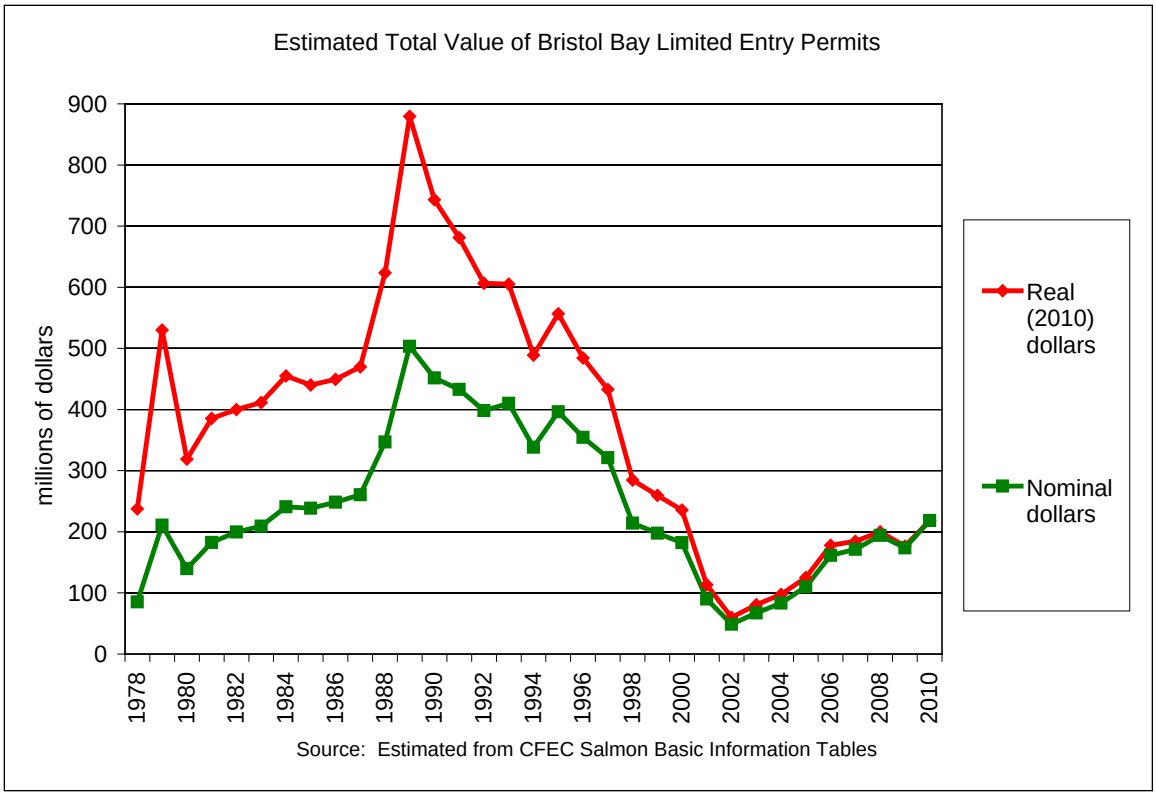


Figure 73. Estimated Total Value of Bristol Bay Limited Entry Permits

3.14 Bristol Bay Commercial Fisheries: Summary

The Bristol Bay sockeye salmon fishery is one of the world's largest and most valuable wild salmon fisheries. Between 2006 and 2010, the Bristol Bay salmon industry averaged:

- Annual harvests of 31 million salmon (including 29 million sockeye salmon)
- 51% of world sockeye salmon harvests
- Annual "ex-vessel" value to fishermen of $129 million
- Annual first wholesale value after processing of $268 million.
- 26% of the "ex-vessel" value to fishermen of the entire Alaska salmon harvest.
- Seasonal employment of more than 6800 fishermen and 3700 processing workers.

Participation in the Bristol Bay salmon fishery is limited to holders of limited entry permits and their crew. There are approximately 1860 drift gillnet permits for fishing from boats and approximately 1000 set net permits for fishing from the shore. The driftnet fishery accounts for about 80% of the harvest. Most of the harvest is processed by about ten large processing

companies in both land-based and floating processing operations which employ mostly non-resident seasonal workers.

Bristol Bay Salmon Harvests

Sockeye salmon account for about 94% of the volume of Bristol Bay salmon harvests and an even greater share of the value. Total catches vary widely from year to year. Between 1980 and 2010, Bristol Bay sockeye salmon harvests ranged from as low as 10 million fish to as high as 44 million fish. Harvests can vary widely from year to year. Annual pre-season forecasts are subject to a wide margin of error.

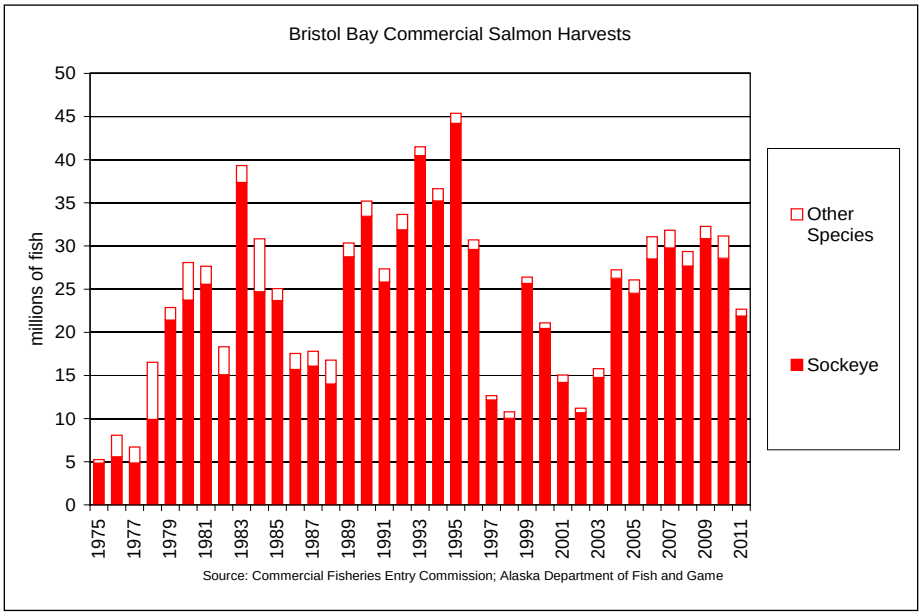


Figure 74. Bristol Bay Commercial Salmon Harvests

There are no formal long-term forecasts of future Bristol Bay harvests. The variability and uncertainty of annual salmon returns are important factors influencing how the fishery is managed and how fish are harvested, processed and marketed.

The Bristol Bay commercial salmon fishery harvests salmon which spawn in and return to numerous rivers over a broad area. For management purposes, the fishery is divided into five fishing districts. Catches in each district vary widely from year to year and over longer time periods of time, reflecting wide variation in returns to river systems within each district (Table). There is no obvious way to characterize the relative share of the Bristol Bay commercial salmon fishery attributable to particular river systems or to the individual streams and lakes that make up each river system.

Table 45. Distribution of Harvests for Bristol Bay Fishing Districts, 1986-2010

Distribution of Harvests for Bristol Bay Fishing Districts, 1986-2010

Measure	District	Minimum	10th percentile	Mean	90th percentile	Maximum	Standard deviation
Harvests (millions of fish)	Naknek-Kvichak	0.6	2.7	8.0	15.3	20.3	5.0
	Nushagak	1.7	2.7	5.1	8.0	11.1	2.3
	Egegik	2.3	4.0	8.3	13.3	21.6	4.3
	Ugashik	0.5	1.5	2.8	4.5	5.0	1.3
	Togiak	0.1	0.2	0.5	0.8	0.8	0.2
Share of total harvests (%)	Naknek-Kvichak	5%	18%	30%	46%	52%	11%
	Nushagak	9%	10%	22%	32%	45%	10%
	Egegik	16%	21%	34%	48%	62%	11%
	Ugashik	3%	7%	11%	15%	32%	5%
	Togiak	0%	1%	2%	4%	6%	1%

Source: Alaska Department of Fish and Game, Bristol Bay Annual Management Reports

Currently there is particular interest in the significance of fisheries resources of river systems in the Nushagak and Kvichak districts, because of potential future resource development in these watersheds. Over the period 1986-2010, the Naknek-Kvichak catches ranged from as low as 5% to as high as 52% of total Bristol Bay catches; Nushagak district catches ranged form as low as 9% to as high as 45% of total Bristol Bay catches. For most of the past decade, the combined Nushagak and Naknek-Kvichak districts have accounted for about 60% of the total Bristol Bay commercial sockeye harvest.

In general, a decline in salmon returns associated with any particular river system might have a relatively small effect on *average* catches over a long period of time in the Bristol Bay fishery. But it might have a much larger effect on catches in those years when the river system would have contributed a relatively larger share of total harvests. For example, if a particular river system accounts for an average of 1% of the return on average but 10% of the return in some years, the loss of that system would reduce catches by only 1% on average but would reduce catches in some years by 10%. Put differently, a decline in catches from any particular river system would increase the variability in catches in the fishery and the overall economic risk associated with the fishery.

An inherent question here is whether 51% of the world's sockeye are caught in Bristol Bay because that is where the fish are or because that is where the boats go. One could envision circumstances where the boats prefer to go to areas that are more safe/convenient (more sheltered, closer to port, etc.) and there are enough fish available there that they don't need to go elsewhere. It is not clear if severe degradation of the Bristol Bay commercial fishery may necessarily result in the total loss of 51% of the world's harvest, but rather displace it to other areas (possibly even in another area of AK). However, such changes in the Alaska and Bristol Bay fishery could result in more dangerous working conditions, negatively affect Alaska native participation in the fishery; and will change the Alaska commercial fishery market structure. Evaluating such impacts is beyond the scope of this baseline assessment.

Bristol Bay Salmon Production and Markets

Most Bristol Bay salmon is processed into either frozen or canned salmon. Traditionally most frozen salmon has been frozen headed and gutted (H&G) for further processing elsewhere, particularly in Japan. However, in recent years production of frozen salmon fillets in the Bristol Bay region has increased.

Formerly almost all Bristol Bay frozen salmon was exported to Japan as frozen headed and gutted salmon. Over the past decade exports of frozen head and gutted salmon to Japan have declined while exports have increased to Europe and to China (for reprocessing into fillets). Most Bristol Bay canned salmon is exported, primarily to the United Kingdom and Canada.

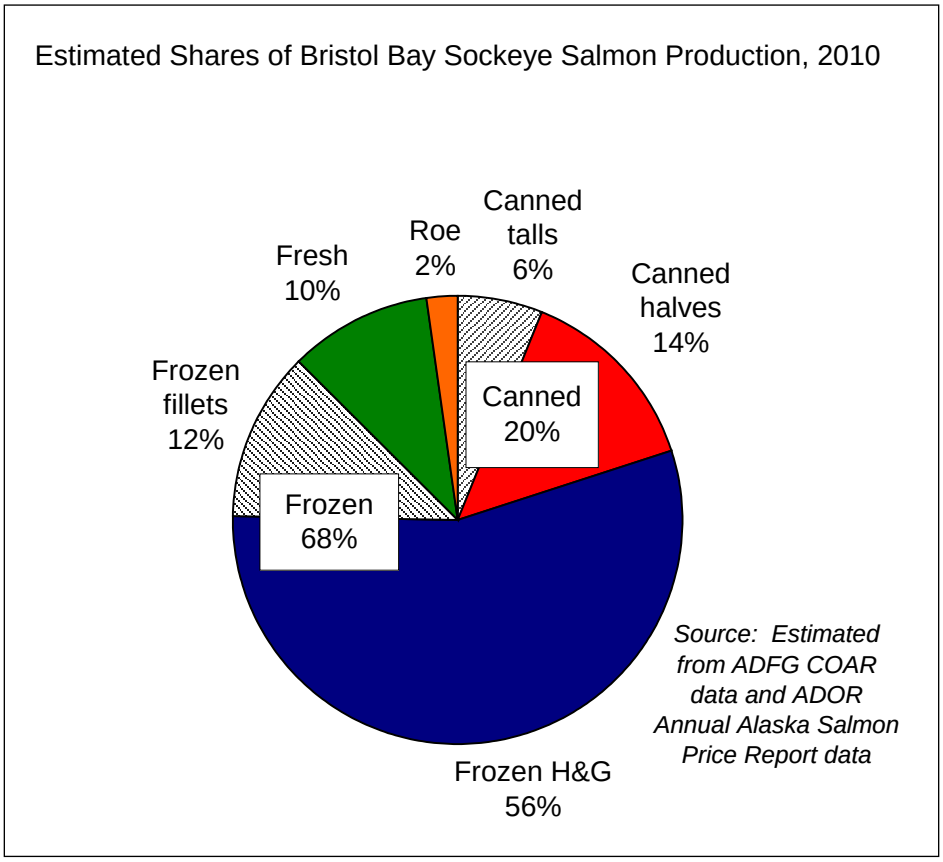


Figure 75. Estimated Shares of Bristol Bay Sockeye Salmon Production, 2010

Bristol Bay Salmon Prices and Value

Ex-vessel prices paid to fishermen and first wholesale prices received by processors in the Bristol Bay salmon fishery have varied widely over the past three decades, reflecting dramatic changes in world salmon markets during this period.

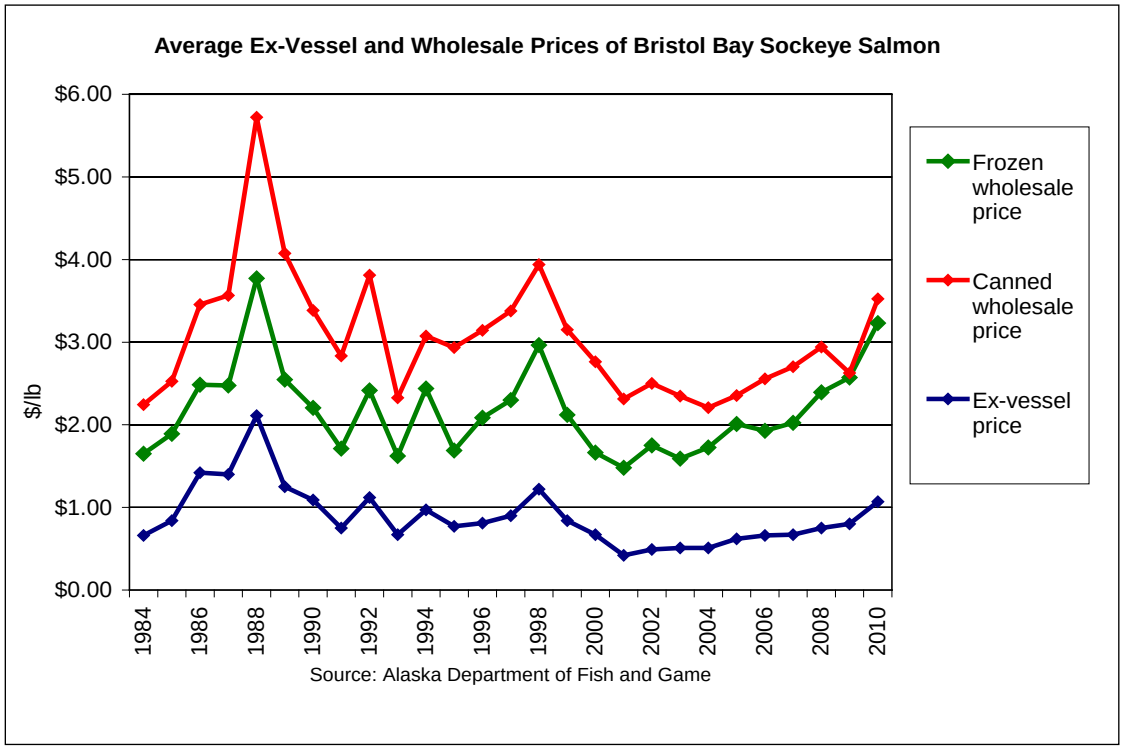


Figure 76. Average Ex-Vessel and Wholesale Prices of Bristol Bay Sockeye Salmon

Strong Japanese demand from frozen sockeye salmon drove a sharp rise in Bristol Bay salmon prices during the 1980s. Competition from rapidly increasing farmed salmon production drove a protracted and dramatic decline in prices between 1988 and 2001, which led to an economic crisis in the industry. Growing world salmon demand, a slowing of farmed salmon production growth, diversification of Bristol Bay salmon products and markets, and improvements in quality have driven a strong recovery in prices over the past decade. Many other factors, such as changes in wild salmon harvests, exchange rates, and global economic conditions have also affected prices. In general, changes in ex-vessel prices paid to fishermen have reflected changes in first wholesale prices paid to processors.

Changes in prices, harvests and production have combined to drive dramatic changes in the ex-vessel and first wholesale value of Bristol Bay salmon over the past three decades . Adjusted for inflation (expressed in 2010 $), the real ex-vessel value paid to fishermen fell from $359 million in 1988 to $39 million in 2002, and rose to $181 million in 2010. The real first wholesale value of Bristol Bay salmon production fell from $616 million in 1988 to $124 million in 2002, and then rose to $390 million in 2010.

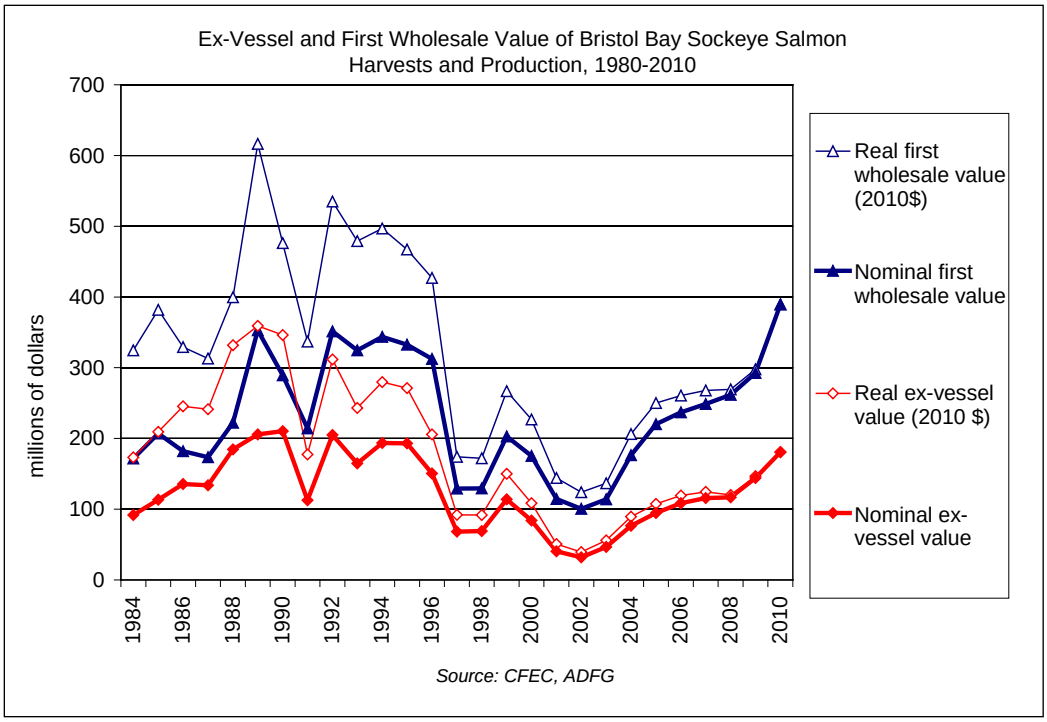


Figure 77. Ex-Vessel and First Wholesale Value 1980-2010

Bristol Bay Salmon Industry Employment

The number of Bristol Bay permits fished each year has varied over time depending on economic conditions in the fishery. Over the past decades, between about 1200 and 1500 drift gillnet permits and between about 700 and 900 set gillnet permits were fished each year.

On average, for each permit fished, about three people were engaged in fishing (the permit holder and two crew members). The estimated total number of people working in fishing during the Bristol Bay season ranged from about 5500 to 7100. Because most of the commercial harvest occurs within a period of a few weeks in late June and early July, annual average employment in the fishery is much smaller than peak employment, ranging from about 900 to 1200 over the past decade.

Over the past decade Bristol Bay fish processors employed between about 2300 and 4500 workers, with annual average employment ranging from about 360 to 760. Together, about 7,800-11,300 people worked seasonally in fishing and processing, for combined annual average employment of 1200 to 1900.

Geographic Distribution of Bristol Bay Salmon Fishery Participation and Earnings

Local residents of the Bristol Bay region account for a relatively small and declining share of employment and earnings in the Bristol Bay salmon industry. Non-Alaska residents account for a relatively large and growing share of employment and earnings.

Table 46. Geographic Distribution of Bristol Bay Salmon Industry Employment and Earnings.

Geographic Distribution of Bristol Bay Salmon Industry Employment and Earnings: Selected Measures

Measure	Measure by Residency				Share of Total		
	Bristol Bay region residents	Other Alaska residents	Residents of other states or countries	Total	Bristol Bay region residents	Other Alaska residents	Residents of other states or countries
Permit holders, drift gillnet fishery	383	471	1,009	1,863	21%	25%	54%
Permit holders, set gillnet fishery	353	311	317	982	36%	32%	32%
Permit holders, total	736	782	1,326	2,845	26%	27%	47%
Earnings, drift gillnet fishery (2007) ($000)	$14,273	$25,020	$58,821	$98,115	15%	26%	60%
Earnings, set gillnet fishery (2007) ($000)	$6,989	$6,071	$6,840	$19,900	35%	31%	34%
Earnings, total (2007) ($000)	$21,262	$31,091	$65,661	$118,014	18%	26%	56%
Processing workers (2009)	76	529	3,916	4,521	2%	12%	87%
Processing workers' earnings (2009) ($000)	$1,000	$3,025	$27,162	$31,187	3%	10%	87%

Sources: Gho, Marcus, K. Iverson, C. Farrington, and N. Free-Sloan, "Changes in the Distribution of Alaska's Commercial Fisheries Entry Permits, 1975 – 2010," CFEC Report 11-3N (2011); Permit holder earnings: Iverson, Kurt, "Permit Holdings, Harvests, and Estimated Gross Earnings by Resident Type in the Bristol Bay Salmon Gillnet Fisheries," CFEC Rpt 09-1N (2009); Processing workers and earnings: Alaska Department of Labor and Workforce Development estimates, http://labor.alaska.gov/research/seafood/seafoodbristol.htm.

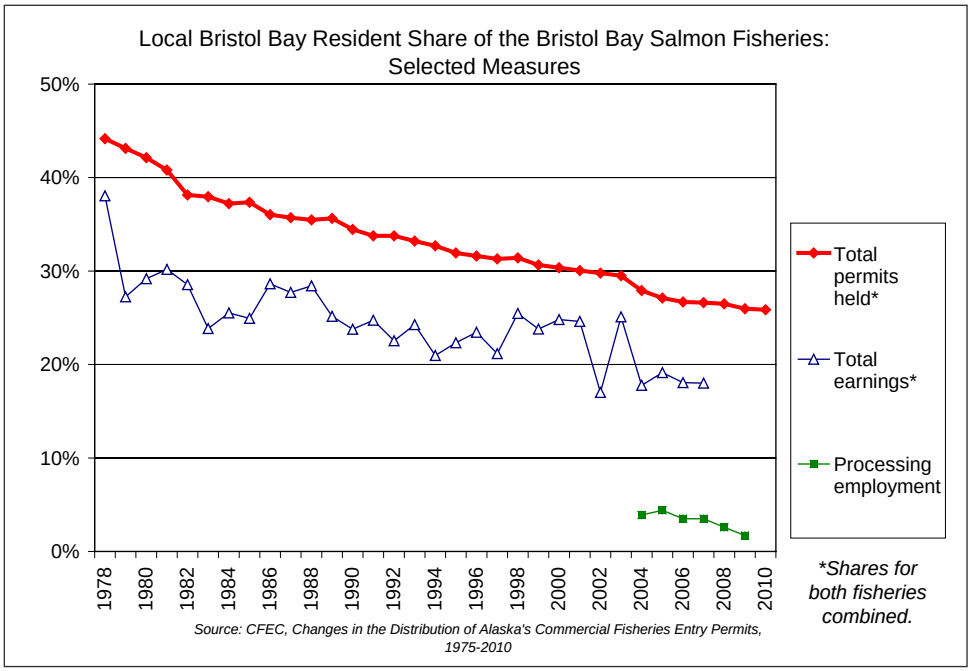


Figure 78. Local Bristol Bay Resident Share of Bristol Bay Salmon Fisheries.

This does not mean, of course, that the Bristol Bay salmon fishery is unimportant as a source of jobs or income for local residents. It remains very important—but not as important as it would be if all the jobs were held by local residents and all the income were earned by local residents.

A different perspective is that the Bristol Bay fishery is not just economically important for a remote region of southwestern Alaska. Rather, it is of major economic importance for other parts of Alaska and other states, particularly the Pacific Northwest. Thousands of residents of other parts of Alaska and other states work in and earn significant income from participating in Bristol Bay fishing and processing.

Distribution of Salmon Permits and Earnings within the Bristol Bay Region

Within the Bristol Bay region, there is wide variation in the extent to which residents of different communities participate in and derive income from the Bristol Bay salmon fisheries. In 2010, the number of permits held per 100 residents ranged from as high as 16 in the Bristol Bay Borough to as low as 5 in the Upper Nushagak Region. Per capita salmon fishery earnings ranged from more than $7000 in the Bristol Bay Borough to only $1000 in the Upper Nushagak Region.

Table 47. Relative Indicators of 2010 Salmon Fishery Participation and Earnings.

Relative Indicators of 2010 Salmon Fishery Participation and Earnings, Bristol Bay Watershed Regions

	Number of permit holders per 100 residents			Per capita salmon fishery earnings		
	Drift gillnet fishery	Set gillnet fishery	Combined fisheries	Drift gillnet fishery	Set gillnet fishery	Combined fisheries
Bristol Bay Borough	6	10	16	$4,240	$3,172	$7,411
Togiak-Manokotak Region	6	7	13	$2,417	$2,410	$4,828
South Bristol Bay Region	10	6	15	$3,960	$343	$4,302
Dillingham Region	5	4	9	$2,623	$1,160	$3,783
Lake Region	3	3	6	$908	$524	$1,432
Upper Nushagak Region	5	1	5	$1,002	*	$1,002
Bristol Bay Watershed	**5**	**5**	**10**	**$2,412**	**$1,407**	**$3,819**

* Confidential. Sources: U.S. Censuses, 2000 and 2010; CFEC.

Economic Measures of the Bristol Bay Salmon Industry

There are many potential economic measures of the Bristol Bay salmon industry. Which measure is most useful depends upon the question being asked. For example, if we want to know how the Bristol Bay salmon fishery compares in scale with other fisheries, we should look at total harvests or ex-vessel or wholesale value. If we want to know how it affects the United States balance of payments, we should look at estimated net exports attributable to the fishery. If we want to know how much employment the industry provides for residents of the local Bristol Bay region, Alaska or the United States, we should look at estimated employment in fishing and

processing for residents of these regions. If we want to know the net economic value attributable to the fishery, we should look at estimated profits of Bristol Bay fishermen and processors. These different measures vary widely in units, in scale, and how economically "important" they make the fishery appear.

Table 48. Selected Economic Measures of the Bristol Bay Salmon Industry, 2000-2010.

Selected Economic Measures of the Bristol Bay Salmon Industry, 2000-2010

Measure	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg.	Range
Sockeye Salmon Havests													
Millions of fish	21	14	11	15	26	25	28	30	28	31	29	23	11 - 31
Millions of pounds	125	96	65	93	152	155	165	173	160	183	170	140	65 - 183
Bristol Bay harvest volume as a share of:													
Alaska sockeye salmon	61%	56%	48%	50%	59%	58%	69%	62%	71%	71%	74%	62%	48% - 74%
World sockeye salmon	45%	40%	28%	38%	47%	47%	49%	47%	52%	55%		45%	28% - 55%
Alaska wild salmon (all species)	18%	12%	10%	13%	19%	16%	22%	18%	23%	25%		18%	10% - 25%
World wild salmon (all species)	7%	5%	4%	5%	8%	7%	8%	7%	9%	7%		7%	4% - 9%
World wild & farmed salmon (all species)	3%	2%	1%	2%	3%	3%	3%	3%	3%	3%		2%	1% - 3%
Gross Value ($ mllions)													
Ex-vessel value	80	40	32	48	76	95	109	116	117	144	181	94	32 - 181
First wholesale value	175	115	100	114	176	220	237	249	262	293	390	212	100 - 390
Total value of US exports of Bristol Bay salmon products	150	137	97	111	172	193	173	183	206	230	254	173	97 - 254
Workers													
Peak (July) fishing employment		7,098	5,514	6,465	6,513	6,750	6,936	6,891	6,969	6,768		6,656	5,514 - 7,098
Number of fish processing workers		2,862	2,273	2,484	3,474	3,272	2,940	3,512	3,952	4,522		3,255	2,273 - 4,522
Total		9,960	7,787	8,949	9,987	10,022	9,876	10,403	10,921	11,290		9,911	7,787 - 11,290
Estimated annual average employment													
Fishing		1,179	888	1,063	1,089	1,098	1,140	1,110	1,129	1,143		1,093	888 - 1,179
Fish processing		475	366	409	581	532	483	566	640	764		535	366 - 764
Total		1,654	1,254	1,472	1,669	1,631	1,623	1,675	1,769	1,907		1,628	1,254 - 1,907
Average permit price ($ 000)													
Drift gillnet fishery	81	35	20	29	37	51	75	79	90	78	102	62	20 - 102
Set gillnet fishery	32	25	12	13	15	15	22	24	27	28	29	22	12 - 32
Estimated total permit value ($ millions)													
Drift gillnet fishery	149.6	64.6	36.7	54.5	68.7	95.2	139.4	147.8	167.3	145.9	190.2	114.5	36.7 - 190.2
Set gillnet fishery	32.6	25.5	11.9	12.6	14.5	14.9	22.1	23.6	26.8	27.7	28.2	21.9	11.9 - 32.6
Total	182.2	90.1	48.6	67.1	83.2	110.1	161.5	171.4	194.1	173.6	218.4	136.4	48.6 - 218.4

Economic impacts and net economic value of the Bristol Bay salmon industry are not necessarily proportional to harvests or gross value, particularly in the short run. Put differently, economic impacts and net economic value are disproportionately affected by changes in value. A 1% change in harvests results in less than a 1% change in fishing and processing employment—particularly if it is unexpected. In contrast, because many of the costs of the fishery are fixed, a 1% change in value results in more than a 1% change in profits and net economic value. For these reasons, short term changes in future fish harvests would likely have less-than-proportional or greater-than-proportional economic effects. Longer-term changes in fish harvests would tend to have proportional economic effects as the scale of the fishing and processing industry changed over time.

Future Economic Importance of the Bristol Bay Salmon Industry

It is impossible to predict the future economic importance of the Bristol Bay salmon industry with certainty. Historically, catches, prices and value have varied dramatically both from year to year and over longer-term periods of time. They are likely to continue to vary.

No particular recent year or period is necessarily a good indicator of future Bristol Bay catches and value. However, it seems likely that future catches, prices and values will fall within the wide range experienced between 1980 and 2010.

Table 49. Distribution of Selected Economic Measures for the Bristol Bay Commercial Salmon Fishing Industry, 1980-2010

Distribution of Selected Economic Measures for the Bristol Bay Commercial Salmon Fishing Industry, 1980-2010

Measure	Minimum	10th percentile	Mean	90th percentile	Maximum	Standard deviation
Total sockeye salmon harvest (million fish)	10.0	14.0	24.8	35.2	44.2	8.8
Total sockeye salmon harvest (million pounds)	57.7	87.8	145.6	195.5	243.6	48.8
Ex-vessel price paid to fishermn ($/lb)	$0.53	$0.61	$1.31	$2.18	$3.79	$0.70
Average first wholesale price, frozen H&G salmon ($/lb)	$1.48	$1.64	$2.18	$2.73	$3.77	$0.54
Average first wholesale price,canned salmon ($/lb)	$2.21	$2.32	$3.05	$3.86	$5.72	$0.76
Total ex-vessel value ($ millions)	39.3	89.5	184.0	311.8	359.2	90.5
Total first wholesale value ($ millions)	123.9	160.8	324.8	486.2	616.5	131.2
Drift gillnet permit price ($ thousands)	24.3	43.6	180.5	311.6	434.7	106.1
Set gillnet permit price ($ thousands)	14.7	17.2	54.2	83.6	107.2	27.0
Estimated total permit value ($ millions)	60.0	113.3	375.6	623.6	879.5	212.0

Note: All prices and values are adjusted for inflation to real 2010 dollars. 10th and 90th percentiles are interpolated. Estimated total permit value calculated by mulltiplying average permit prices by the number of permanent permits renewed. First wholesale prices and values are for the years 1984-2010. Data are from Alaska Department of Fish and Game and Commercial Fisheries Entry Commission.

3.15 Appendix: Data Sources

A rich variety of data exists for the Bristol Bay commercial salmon fishery. However, the data can be difficult and confusing to work with, for a number of reasons. Some data are not published, and are available only upon request from Alaska state government agencies. Many data series are available only for limited periods of time: some have been discontinued and are not available for recent years; others have been collected or published only beginning relatively recently and are not available for earlier years. Many data series are inconsistent: reports published by the same agency in different years may provide different data for the same series. Preliminary data (particularly for prices and values) are often revised later, sometimes substantially. Some kinds of data are confidential except when aggregated for minimum threshold numbers of permit holders, processors or other firms. Some kinds of data are proprietary (particularly price data gathered by private market information services). Most importantly, what data mean, how they were collected or estimated, and how reliable they are is often unclear. For all these reasons, pulling together the variety of data presented in this report

was a significant task, building on a variety of research conducted over many years, much of it devoted to finding data sources and learning what they meant (and didn't mean).

The purpose of this appendix is to document, as best practical, the sources for the analysis, both for the benefit of readers and for other researchers. The appendix provides details on the data sources for all of the text references, graphs and tables in this report, except where the source is obvious or reported in detail in the text.

This section begins with a description of the major data sources for this report (those used multiple times), listed in alphabetical order of the names used to refer to them.

This section then describes the sources for all data provided in the report, text, figures and tables, except where the source information is provided in the report or is otherwise clear. These are listed in the chronological order in which they appear in the report.

The final section of the appendix provides the price index data used to convert selected prices and values in the report from "nominal" dollars (not adjusted for inflation) to "real" dollars (adjusted for inflation).

Researchers wishing more detailed information about data sources may contact Gunnar Knapp at Gunnar.Knapp@uaa.alaska.edu or 907-786-7717.

Major Data Sources for This Report

Below are descriptions of the major data sources used in this report (those used multiple times), listed in alphabetical order of the names used to refer to them (shown in **bold font**). Website addresses were current as of October 2011 for all data found online.

ADFG Annual Run Forecasts and Harvest Projections. Each year the Alaska Department of Fish and Game publishes a report on "Run Forecasts and Harvests Projections for Alaska Salmon Fisheries" for the current year, which also includes a review of the salmon fisheries for the previous season. This report includes forecasts for the coming season of commercial sockeye salmon harvests in Bristol Bay. The reports for the most recent years are available at the "Commercial Salmon Fisheries Forecasts" website:

http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmonforecast

Reports for earlier years available on the Alaska Department of Fish and Game "Fishing and Subsistence" Publications Searchable Database at:

http://www.adfg.alaska.gov/sf/publications/

To find them, search for the following: Report = All Reports; Field = Title; Operator = Contains; Search String = Forecast. Then scroll through several pages out output until you come to "Commercial Fisheries Reports."

ADFG Bristol Bay Annual Management Reports. These are detailed reports for each salmon season compiled by Alaska Department of Fish and Game Division of Commercial Fisheries Bristol Bay area management staff. Each report also contains an extensive data appendix with dozens of tables of catches and escapements by district, day, gear type, etc. The reports are available on the Alaska Department of Fish and Game "Fishing and Subsistence" Publications Searchable Database at:

http://www.adfg.alaska.gov/sf/publications/

To find them, search for the following: Report = Commercial Fisheries Annual Management Reports; Field = Title; Operator = Contains; Search String = Bristol Bay.

ADFG Bristol Bay Salmon Season Summaries. These are news releases prepared by compiled by Alaska Department of Fish and Game Division of Commercial Fisheries Bristol Bay area management staff after each Bristol Bay salmon season after each salmon season which summarize catches and preliminary ex-vessel price information. The news releases are available on the ADFG Bristol Bay website at:

http://www.cf.adfg.state.ak.us/region2/finfish/salmon/salmhom2.php

ADFG Commercial Operator Annual Report (COAR) Data. In April of every year, all Alaska fish processors are required to submit "Commercial Operator Annual Reports" to the Alaska Department of Fish and Game. In these reports they are required to report the total volume of fish purchased, by species and area; the total amount paid for fish purchased, by species and area; the total volume (weight) of production, by product, species and area; and the total first wholesale value of production. Information about the COAR reporting forms is at:

http://www.adfg.alaska.gov/index.cfm?adfg=fishlicense.coar

The COAR data are not posted on the internet or published regularly by ADF&G (which is unfortunate), but are available by special request from ADF&G. The data used for this report were provided on August 2, 2011 to Gunnar Knapp and were saved as Excel file "Statewide and regional COAR production 1984-2011 provided by ADFG 8-2-11.xls." Average "first wholesale prices" were calculated by dividing first wholesale value by production volume.

ADFG Alaska Commercial Salmon Harvests and Ex-vessel Values Reports. These reports provide summary annual data for each of 11 Alaska salmon harvest areas. The data include average fish weight, average price per pound, numbers of fish, harvest volume in pounds, and estimated value in dollars. Prices for the most recent year are generally preliminary estimates based on fish tickets and reports from area managers. Prices for earlier years are generally based on "Commercial Operators Annual Report and area staff reports." The reports are available at:

http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmoncatch

ADFG Salmon Ex-Vessel Price Time Series by Species 1984-2008. This is a two-page table of ex-vessel prices by species, 1984-2008, for the following areas: Cook Inlet, Kodiak, Alaska

Peninsula, Bristol Bay, Prince William Sound, Southeast, and Statewide. Original source is cited as the Commercial Operator Annual Reports database.
http://www.cf.adfg.state.ak.us/geninfo/finfish/salmon/catchval/blusheet/84-08exvl.pdf

ADLWD Bristol Bay Region Fishing and Seafood Industry Data. The Alaska Department of Labor and Workforce Development (ADLWD) Research and Analysis Division posts a variety of economic information for the Bristol Bay Seafood Industry on its "Bristol Bay Region Fishing and Seafood Industry Data" website at:

http://labor.alaska.gov/research/seafood/seafoodbristol.htm.

ADOR Annual Salmon Price Reports. Every year, "large" Alaska salmon processors (those with sales exceeding 1 million pounds in the previous calendar year) are required to report sales volumes and first wholesale values for major salmon product categories to the Alaska Department of Revenue. Annual statewide summary reports of these data are available on the Alaska Department of Revenue's Tax Division Reports website at:

http://www.tax.alaska.gov//programs/reports.aspx

Once on this page, click on "Alaska Salmon Price/Production." Note that the "Annual Salmon Price Reports" differ from (and sometimes are inconsistent with the "Annual Salmon Production Reports" and "Monthly Salmon Price Reports" which are also available at the same website.

ADOR Canned Salmon Wholesale Price Reports. For many years prior to 2001, the Alaska Department of Revenue prepared "Canned Salmon Average Wholesale Reports." These reported monthly statewide average prices for canned salmon, by species, compiled from information reported by Alaska salmon processors. The University of Alaska Anchorage Institute of Social and Economic Research (ISER) maintains a collection of these reports beginning with the period April 1-September 30, 1983.

ADOR Monthly Salmon Price Reports. Every four months, large Alaska salmon processors (those with sales exceeding 1 million pounds in the previous calendar year) are required to submit salmon price reports to the Alaska Department of Revenue for the following four-month periods: January-April, May-August , and September-December.
The reports include sales volumes and first wholesale values for major salmon product, by area and month. Summaries of the data from these reports, for each four-month period, are available on the Alaska Department of Revenue's Tax Division Reports website at:

http://www.tax.alaska.gov//programs/reports.aspx.

Once at this page, click on "Alaska Salmon Price/Production." Note that these "Monthly Salmon Price Report" differ from (and sometimes are inconsistent with the "Annual Salmon Price Reports" and the "Annual Salmon Production Reports" which are also available at the same website. Data are not reported for product-area-month combinations for which fewer than three processors reported sales.

CFEC Basic Information Tables. The Commercial Fisheries Entry Commission (CFEC) posts "Basic Information Tables" for each Alaska salmon fishery on its website at:

http://www.cfec.state.ak.us/bit/MNUSALM.htm

These tables provide a useful summary of trends since 1975 in each salmon fishery for numbers of permits issued/renewed, numbers of permits fished, total pounds harvested, average pound harvested, gross earnings, average earnings, and average annual permit prices. The most recent data currently available are for 2010.

CFEC Data for Alaska Salmon Harvests 1980-2005. 1980-2005: CFEC Alaska Salmon Summary Data 1980-2005 061113. These are Commercial Fisheries Entry Commission data for Alaska commercial salmon harvest (number of fish, pounds, earnings, and price), by species, for the years 1980-2005. This file was prepared by the Commercial Fisheries Entry Commission on March 31, 2005, in response to a request by Professor Gunnar Knapp of the University of Alaska Anchorage Institute of Social and Economic Research (ISER). The data was provided as an Excel file named SWPrices.xls, containing the worksheet of this file named "Original data." Professor Knapp maintains a copy of the file named "CFEC_Alaska_Salmon_Summary_Data _1980-2005.xls." The data were calculated from CFEC fish ticket database. The harvest and earnings figures include set and drift gill net, test fishing, confiscated and educational permit harvests, and any other harvest where the product was sold.

CFEC Data for Bristol Bay Salmon Harvests 1975-2003. These are Commercial Fisheries Entry Commission data for Bristol Bay commercial salmon harvests for the years 1975-2003, provided by Kurt Iverson, June 9, 2004, as file BBayEarnHarv1.xls. The data were calculated from CFEC fish ticket database. The harvest and earnings figures include set and drift gill net, test fishing, confiscated and educational permit harvests, and any other harvest where the product was sold.

CFEC Quartile Tables. The Commercial Fisheries Entry Commission (CFEC) posts annual "Quartile Tables" for each Alaska salmon fishery on its website at:

http://www.cfec.state.ak.us/quartile/mnusalm.htm

These tables show the number of permit holders and average earnings per permit holder in each "quartile group"—calculated by ranking permit holdings in each year by earnings, and then dividing them into four "quartile" groups with equal total earnings. The first quartile has the smallest number of permit holders with the highest average earnings; the fourth quartile has the highest number of permit holders with the lowest average earnings.

CFEC Permit and Fishing Activity Data. The Commercial Fisheries Entry Commission (CFEC) posts annual data on permit and fishing activity by year, state, census area and Alaska city on its website at:

http://www.cfec.state.ak.us/fishery_statistics/earnings.htm

For each state, census area and city in which permit holders reside, and for each fishery for which residents held permits, data include the number of permits issued, number of permit holders, number of permits with recorded landings, total pounds landed and estimated gross earnings. Earnings data are confidential for fisheries in which fewer than four permit holders in a census area or community had landings.

FAO FishstatJ Database. FAO FishstatJ is software for fishery statistical time series developed by the Food and Agricultural Organization of the United Nations (FAO) Fisheries and Aquaculture Department, based in Rome. The software is designed to be used with global datasets for capture (wild) fisheries catches and aquaculture production, by species, country and year. The software and the global datasets can be downloaded from the FAO Fisheries and Aquaculture Department website at:

http://www.fao.org/fishery/statistics/software/fishstatj/en

NMFS Commercial Fishery Landings Database. The National Marine Fisheries Service (NMFS) Office of Science and Technology maintains an online database of US Commercial Fishery Landings (volume and value) by state, species and year. Customized datasets for Alaska and other states may be downloaded from NMFS Commercial Fishery Landings webite at:

http://www.st.nmfs.noaa.gov/st1/commercial/index.html

NMFS Foreign Trade in Fisheries Products Data. The National Marine Fisheries Service posts very detailed data online about U.S. exports and imports of fisheries products at:

http://www.st.nmfs.noaa.gov/st1/trade/

The export data in this report were calculated from the "Monthly Trade Data by Product, Country/Association" option at this website.

NMFS Major Ports Data. The National Marine Fisheries Service publishes an annual report entitled *Fisheries of the United States* which provides a wide variety of useful data on United States fisheries. A regular table in this report (on page 7 in recent years), entitled "Commercial Fishery Landings and Value at Major U.S. Ports," lists the value and volume of landings for the top 50 United States ports (ranked by value). The *Fisheries of the United States* reports are available at:

http://www.st.nmfs.noaa.gov/st1/publications.html

Data Sources for Report Text, Figures and Tables

Below are descriptions of the sources for data provided in the report text, figures and tables. Except where text sources are given below, the data in the text is from the same sources as the adjacent figures and tables in the same sections of the report. Except where text sources are given below, all of the material discussed in the "Overview" and "Summary" sections of the report is discussed in greater detail in corresponding sections of the report. Refer to the body of

the report for more details as well as sources for information presented in the "Overview" and "Summary" sections.

Page 52. *"Annual harvests of 31 million salmon . . ."* Source: ADFG Alaska Commercial Salmon Harvests and Exvessel Values Reports.

Page 52. *"51% of world sockeye salmon harvests."* Source: See discussion below of sources for Figure 22 (World Sockeye Supply).

Page 52. *"Annual ex-vessel" value to fishermen of $129 million."* Source: ADFG Alaska Commercial Salmon Harvests and Exvessel Values Reports.

Page 52. "Annual first wholesale value . . . of $268 million." ADFG Commercial Operator Annual Report (COAR) Data.

Page 52. *"26% of the ex-vessel value . . ."* Source: ADFG Alaska Commercial Salmon Harvests and Exvessel Values Reports.

Page 52. *"Seasonal employment of more than 6800 fishermen and 3700 processing workers."* Source: See sources for Table 36, page 112.

Figure 11. Bristol Bay Commercial Salmon Harvests. Sources: 1975-2003: CFEC Data for Bristol Bay Salmon Harvests; 2004-2010: ADFG Alaska Commercial Salmon Harvests and Exvessel Values Reports; 2011: ADFG 2011 Bristol Bay Salmon Season Summary (9/26/2011).

Page 57. *"The average weight of a Bristol Bay sockeye salmon is typically about 6 pounds. . . . average weights varied from as low as 5.3 pounds to as high as 6.7 pounds."* Data sources are the same as for Figure 11.

Figure 12. Bristol Bay Fishing Districts. Average annual harvests for the years 1991-2010 were calculated from the same data used for Figure 13.

Figure 13. Bristol Bay Commercial Sockeye Salmon Harvests, by District. Sources: 1986-1989: *ADFG Bristol Bay Annual Salmon Management Report*, 2006, Appendix A3.–Sockeye salmon commercial catch by district, in numbers of fish, Bristol Bay, 1990–2010; 1990-2010: *ADFG Bristol Bay Annual Salmon Management Report*, 2010, Appendix A3.–Sockeye salmon commercial catch by district, in numbers of fish, Bristol Bay, 1990–2010. 2011: *ADFG Bristol Bay Salmon Season Summary*, 2011.

Figure 14. Share of Bristol Bay Commercial Sockeye Salmon Harvest, by District. *Same sources as for* Figure 13.

Figure 15. Naknek-Kvichak District Sockeye Salmon Harvests, by River of Origin. Compiled from ADFG Bristol Bay Annual Management Reports for each year (usually tables 18, 19 or 20).

Table 27. Comparison of Bristol Bay Drift Gillnet and Set Gillnet Fisheries (2006-10 Averages). Source: CFEC Basic Information Tables.

Figure 16. Bristol Bay Salmon Harvests, by Fishery. Source: CFEC Basic Information Tables.

Figure 17. World Sockeye Salmon Supply. Bristol Bay: Sources are the same as for Figure 16. Other Alaska: Calculated by subtracting Bristol Bay data from Alaska data. Alaska data: 1980-2005: CFEC Data for Alaska Salmon Harvests 1980-2005; 2006-2009: ADFG Alaska Commercial Salmon Harvests and Exvessel Values Reports. Lower 48: NMFS Commercial Fishery Landings Database, data for Washington, Oregon and California; Canada, Russia and Japan: FAO FishstatJ Database.

Figure 18. Alaska Salmon Supply. Bristol Bay sockeye: Sources are the same as for Figure 11. Other Alaska sockeye: Calculated by subtracting Bristol Bay data from Total Alaska data. Total Alaska data: 1980-2005: CFEC Data for Alaska Salmon Harvests 1980-2005; 2006-2009: ADFG Alaska Commercial Salmon Harvests and Exvessel Values Reports.

Figure 19 World Salmon and Trout Supply. Wild salmon: Sources are the same as for Figure 17. Farmed salmon and farmed trout: FAO FishstatJ Database. Includes only farmed production of Atlantic, Coho and Chinook salmon. Includes only farmed rainbow trout farmed in a "mariculture" (saltwater) environment.

Figure 20. Bristol Bay Sockeye Preseason Projection and Annual Commercial Catch. Preseaon Projections: 1990-2005: ADFG Bristol Bay Annual Management Reports; Beginning 2006: ADFG Annual Run Forecasts and Harvest Projections. Actual harvests: same sources for Figure 11.

Figure 21 Bristol Bay Sockeye Salmon Harvests, 1895-2009. 1893:-1997: Byerly, Mike; Beatrice Brooks, Bruce Simonson, Herman Savikko and Harold Geiger. 1999. *Alaska Commercial Salmon Catches*, 1878-1997. Alaska Department of Fish and Game Regional Information Report No. 5J99-05. March 1999. 1998-2003: CFEC Data for Bristol Bay Salmon Harvests 1975-2003. 2004-2011: ADFG Alaska Commercial Salmon Harvests and Exvessel Values Reports.

Figure 22. Bristol Bay Sockeye Salmon Production. ADFG Commercial Operator Annual Report (COAR) Data.

Figure 23. Share of Sockeye Salmon Production in Bristol Bay. ADFG Commercial Operator Annual Report (COAR) Data.

Table 28. Sales of Selected Sockeye Salmon Products by Major Bristol Bay Salmon Processors. ADOR Annual Salmon Price Reports.

Figure 24. Bristol Bay Sockeye Salmon Harvests and Production. Harvests: See sources for Figure 11. Production: ADFG Commercial Operator Annual Report (COAR) Data.

Figure 25. Monthly Sale Volume of Bristol Bay Salmon Products. ADOR Monthly Salmon Reports

Figure 26. Alaska Frozen Sockeye Production and U.S. Frozen Sockeye Exports. ADFG Commercial Operator Annual Report (COAR) Data; NMFS Foreign Trade in Fisheries Products Data.

Figure 27. Estimated End-Markets for Alaska Frozen Sockeye Salmon. Sources: ADFG Commercial Operator Annual Report (COAR) Data; NMFS Foreign Trade in Fisheries Products Data. The estimates for the "USA" were calculated by subtracting exports from Alaska production as reported in the COAR data. For the years 1989-1992 reported exports exceeded reported Alaska production. The estimate for the USA was assumed to be zero for these years. This is almost certainly an underestimate. In reality, some frozen sockeye production undoubtedly went to the US market, but the production and export data suggest that the amount going to the US market was relatively low, with most of the production being exported.

Figure 28. Alaska Canned Sockeye Production and U.S. Canned Sockeye Exports. Sources: ADFG Commercial Operator Annual Report (COAR) Data; NMFS Foreign Trade in Fisheries Products Data.

Figure 29. Average Ex-Vessel Price of Bristol Bay Sockeye Salmon. See data sources for Figure 11. Real prices calculated using Anchorage CPI, as discussed below.

Figure 30. Average Wholesale and Ex-Vessel Prices of Bristol Bay Sockeye Salmon. Ex-vessel prices: See data sources for Figure 11. Wholesale Prices: ADFG Commercial Operator Annual Report (COAR) Data.

Figure 31. Average Monthly First Wholesale Prices. Sources: ADOR Monthly Salmon Price Reports

Figure 32. Average Wholesale and Ex-Vessel Prices, Bristol Bay and Rest of Alaska. Rest-of-Alaska wholesale and ex-vessel prices were calculated by dividing Rest -of -Alaska value by Rest-of-Alaska volume. Rest-of-Alaska wholesale value and volume were calculated by subtracting Bristol Bay wholesale value and volume from total Alaska wholesale value and volume, as reported in ADFG Commercial Operator Annual Report (COAR) Data. Rest-of-Alaska ex-vessel value and volume were calculated by subtracting Bristol Bay ex-vessel value and volume (from sources for Figure 16, page 61) from total Alaska ex-vessel value and volume. Sources for total Alaska ex-vessel value and volume were: 1980-2005: CFEC Data for Alaska Salmon Harvests 1980-2005; 2006-2009: ADFG Alaska Commercial Salmon Harvests and Ex vessel Values Reports.

Figure 33. Average Ex-Vessel Prices of Sockeye Salmon, Selected Alaska Areas. Sources: ADFG Alaska Commercial Salmon Harvests and Exvessel Values Reports.

Figure 34. Japanese Red-Fleshed Salmon Imports, May-April. Sources: Japanese monthly import data reported in *Bill Atkinson's News* Report (a weekly compilation of articles and

information from the Japanese seafood industry press, translated into English, published until 2006 by industry analyst Bill Atkinson) and Japanese import data reported on the National Marine Fisheries Service "Fishery Market News" website at: http://www.st.nmfs.noaa.gov/st1/market_news/index.html.

Figure 35. Japanese Red-Fleshed Frozen Salmon Imports & Wild Sockeye Wholesale Prices. Japanese red-fleshed salmon imports are data for May-April, from the same sources as for Figure 34. Sockeye wholesale price data are average prices for the period May-April, from the same sources as for Figure 36.

Figure 36. Japanese Wholesale Prices and Bristol Bay Prices for Sockeye Salmon. Source for ex-vessel price: see sources for Figure 11. Source for average first wholesale price: ADFG Commercial Operator Annual Report (COAR) Data. Sources for Japanese monthly wholesale prices: January 1980-December 1989: Tokyo Central Wholesale Market reports, average price for all frozen sockeye. January 1990-April 2002. Suisan Tsushin (Seafood News), Marine Products Power Data Book, 2002. Beginning May 2002: Japanese frozen market salmon prices posted on www.fis.com and the predecessor "Seaworld" website (data are prices reported for the first day of the month). Monthly wholesale prices in yen/kilo converted to prices in $/lb using monthly Japanese exchange rate data reported on the website of the Federal Reserve Bank of St. Louis (series EXJPUS, available at: http://research.stlouisfed.org/fred2/series/EXJPUS).

Figure 37. Average United States Import Prices of Selected Farmed Salmon Products. Source: NMFS Foreign Trade in Fisheries Products data.

Figure 38. U.S. Wholesale Prices for Selected Wild and Farmed Salmon Products. Prices are from Urner Barry's *Seafood Price-Current*, a twice-weekly market report for U.S. seafood wholesale prices. Data shown in the figure are "low" reported prices for the first reporting date of the month. Products are as follows: "Fresh farmed Atlantic, whole fish": Northeast, Domestic and Canadian Atlantic, 6-8 lbs; "Fresh farmed Atlantic, pinbone-out fillets": Fob Miami, Chilean Atlantic Fillets, Scale-on/Standard, C Trim/Premium,Pinbone out, 2-3 lbs; "Frozen H&G wild sockeye": Red/Sockeye, Gillnet, 4-6 lbs. Information on *Seafood Price-Current* is at www.urnerbarry.com.

Figure 39. Monthly Average Wholesale Case Prices for Alaska Canned Sockeye Salmon. Data through August 2000: ADOR Canned Salmon Wholesale Price Reports (statewide data for canned sockeye salmon). Data beginning September 2000: ADOR Monthly Salmon Price Reports (data for Bristol Bay canned sockeye salmon).

Figure 40. Estimated Chilled and Unchilled Shares of Bristol Bay Salmon Harvests. Northern Economics, *2010 Bristol Bay Processor Survey*. Prepared for Bristol Bay Regional Seafood Development Association, February 2011. Available at: http://www.bbrsda.com/layouts/bbrsda/files/documents/bbrsda_reports/BB-RSDA%202010%20Survey%20Final%20Report.pdf

Figure 41. Ex-Vessel and First Wholesale Value of Bristol Bay Sockeye Salmon Harvests and Production, 1984-2010. Ex-vessel value: Same data sources as for Figure 11. Wholesale value: ADFG Commercial Operator Annual Report (COAR) Data.

Figure 42. Distribution of Nominal Value of Bristol Bay Sockeye Salmon. Sources for ex-vessel value and wholesale value are the same as for Figure 46, page 94. Value to processors after deducting payments to fishermen was calculated by subtracting ex-vessel value from wholesale value.

Figure 43. Distribution of Value of Bristol Bay Sockeye Salmon. Calculated from data used for Figure 42.

Figure 44. Number of Limited Entry Permits Issued and Fished in Bristol Bay. Source: CFEC Basic Information Tables.

Figure 45. Average Gross Earnings of Bristol Bay Drift Gillnet Permit Holders, by Quartile. Source: CFEC Quartile Tables.

Figure 46. Average Gross Earnings of Bristol Bay Set Gillnet Permit Holders, by Quartile. Source: CFEC Quartile Tables.

Figure 47. Average Prices Paid for Bristol Bay Limited Entry Permits. Source: CFEC Basic Information Tables.

Figure 48. Average Permit Prices and Total Earnings: Bristol Bay Drift Gillnet Fishery. Source: CFEC Basic Information Tables.

Figure 49. Average Permit Prices and Total Earnings: Bristol Bay Drift Gillnet Fishery. Source: CFEC Basic Information Tables.

Figure 51. Number of Companies Reporting Salmon Production in Bristol Bay, by Product. Source: ADFG Commercial Operator Annual Report (COAR) Data.

Figure 52. Selected Bristol Bay Salmon Processor Costs, 2001-2009. “Cost of labor” data are ADLWD Bristol Bay Region Fishing and Seafood Industry Data. They are from the column titled “Seafood Processing Wages” in a table named “Bristol Bay Region Seafood Industry 2003-2009” (as well as earlier versions of the same table no longer posted online) posted at:

http://labor.alaska.gov/research/seafood/BristolBay/BBoverall.pdf

The data are also accessible by clicking on “Harvesting and Processing Workers and Wages” at the ADLWD Bristol Bay Region Fishing and Seafood Industry Data website. “Cost of fish” are ex-vessel values from the same data sources as Figure 11. “Other costs and profits” were calculated by subtracting “cost of labor” and “cost of fish” from wholesale value, as reported in ADFG Commercial Operator Annual Report (COAR) Data.

Figure 54. Monthly Employment in Food Manufacturing, Bristol Bay Region, 2002-2007. Alaska Department of Labor and Workforce Development, Quarterly Census of Employment and Wages Data, historical data for 2002-2010, Excel file annual.xls, downloaded November 27, 2011 from:

http://labor.alaska.gov/research/qcew/qcew.htm

Table 34. Selected Data and Estimates for Bristol Bay Taxes. Ex-vessel value of Bristol Bay salmon harvests: see data sources for Figure 11. Canned and non-canned share of production: ADFG Commercial Operator Annual Report (COAR) Data.

Figure 56. Number of Bristol Bay Permit Holders by Residency. Source: Gho, Marcus, K. Iverson, C. Farrington, and N. Free-Sloan, *Changes in the Distribution of Alaska's Commercial Fisheries Entry Permits, 1975 – 2010*, CFEC Report 11-3N (2011), Appendix C. Available at:

http://www.cfec.state.ak.us/RESEARCH/12-1N/12-1N.htm

Figure 57. Permit Holders Average Earnings, by Residency. Source: Kurt Iverson, *CFEC Permit Holdings, Harvests, and Estimated Gross Earnings by Resident Type in the Bristol Bay Salmon Gillnet Fisheries*, CFEC Report 09-1N (February, 2009). Available at:

http://www.cfec.state.ak.us/RESEARCH/09_1N/09_1N.pdf.

Figure 58. Share of Total Earnings of Bristol Bay Drift Gillnet Permit Holders, by Residency. *Same source as for Figure 57.*

Figure 58. Share of Total Earnings of Bristol Bay Set Gillnet Permit Holders, by Residency. *Same source as for Figure 57.*

Figure 60. Share of Bristol Bay Seafood Processing Employment, by Residency. Source: ADLWD Bristol Bay Region Fishing and Seafood Industry Data, posted at:

http://labor.alaska.gov/research/seafood/seafoodbristol.htm

In particular, see the following tables:

(A) “Bristol Bay Region Seafood Industry, 2003-2009, Processing" at:
http://labor.alaska.gov/research/seafood/BristolBay/BBSFPOver.pdf

(B) “Local Seafood Processing Workforce, 2003-2009, Bristol Bay Region" at:
http://labor.alaska.gov/research/seafood/BristolBay/BBSFPLocal.pdf

The number and percentage of residents of other states or countries was calculated from data in (A). The number and percentage of Bristol Bay residents was calculated from data in (B). The share of “Other Alaska residents” was calculated as the residual.

Figure 61. Local Bristol Bay Resident Share of Salmon Fisheries: Selected Measures. Source for local resident share of total permits held: Gho, Marcus, K. Iverson, C. Farrington, and N. Free-Sloan, *Changes in the Distribution of Alaska's Commercial Fisheries Entry Permits, 1975 – 2010*, CFEC Report 11-3N (2011), Appendix C. Available at:

http://www.cfec.state.ak.us/RESEARCH/12-1N/12-1N.htm

Source for local resident share of total earnings: Iverson, Kurt, CFEC Permit Holdings, Harvests, and Estimated Gross Earnings by Resident Type in the Bristol Bay Salmon Gillnet Fisheries, CFEC Report 09-1N (2009). Available at:

http://www.cfec.state.ak.us/RESEARCH/09_1N/09_1N.pdf

Source for local resident share of processing employment: Alaska Department of Labor and Workforce Development, "Local Seafood Processing Workforce, 2003-2009, Bristol Bay Region," available at:

http://labor.alaska.gov/research/seafood/BristolBay/BBSFPLocal.pdf

Table 37. Population, Permit Holders, and Salmon Earnings, by Community: 2000 & 2010. Source for population: U.S. Census, 2000 and 2010, in "Alaska Population Estimates by Borough, Census Area, City and Census Designated Place (CDP), 2000-2011," Excel spreadsheet available on website of Alaska Department of Labor and Workforce Development, Research and Analysis Division at:

http://labor.alaska.gov/research/pop/popest.htm

Source for numbers of permit holders and earnings: CFEC Permit and Fishing Activity Data.

Figure 63. Estimated Bristol Bay Population, by Area and Region. Data for 2000-2010 are from "Alaska Population Estimates by Borough, Census Area, City and Census Designated Place (CDP), 2000-2011," Excel spreadsheet available on website of Alaska Department of Labor and Workforce Development, Research and Analysis Division, at:

http://labor.alaska.gov/research/pop/popest.htm

Data for 1984-1999 are from Northern Economics, *The Importance of the Bristol Bay Salmon Fisheries to the Region and its Residents*, Report prepared for the Bristol Bay Economic Development Corporation (October 2009), Tables A1-A12.

Figure 63 [TOP FIGURE]. Estimated Bristol Bay Population, by Area. Data for 2000-2010 are from "Alaska Population Estimates by Borough, Census Area, City and Census Designated Place (CDP), 2000-2011," Excel spreadsheet available on website of Alaska Department of Labor and Workforce Development, Research and Analysis Division. Data for 1984-1999 are from Northern Economics, *The Importance of the Bristol Bay Salmon Fisheries to the Region and its Residents*, Report prepared for the Bristol Bay Economic Development Corporation (2009), Tables A1-A12.

Figure 63 [BOTTOM FIGURE]. Estimated Population by Region. Data for 2000-2010 are from "Alaska Population Estimates by Borough, Census Area, City and Census Designated Place (CDP), 2000-2011," Excel spreadsheet available on website of Alaska Department of Labor and Workforce Development, Research and Analysis Division. Data for 1984-1999 are from Northern Economics, *The Importance of the Bristol Bay Salmon Fisheries to the Region and its Residents*, Report prepared for the Bristol Bay Economic Development Corporation (2009), Tables A1-A12.

Figure 65 [TOP FIGURE]. Number of Drift Gillnet Holders, by Region. Source: CFEC Permit and Fishing Activity Data.

Figure 65 [BOTTOM FIGURE]. Number of Drift Gillnet Holders per 100 Residents, by Region. Calculated by dividing data for number of drift gillnet holders, shown in Figure 65 [TOP FIGURE], by data for estimated population by region, from the same sources as for Figure 63 [BOTTOM FIGURE].

Figure 67 [TOP FIGURE]. Number of Set Gillnet Holders, by Region. Source: CFEC Permit and Fishing Activity Data.

Figure 67 [BOTTOM FIGURE]. Number of Set Gillnet Holders per 100 Residents, by Region. Calculated by dividing data for number of set gillnet holders, shown in Figure 67 [TOP FIGURE], by data for estimated population by region, from the same sources as for Figure 63 [BOTTOM FIGURE].

Table 38. Salmon Permit Holders per 100 Residents, by Community. Calculated by dividing data for number of permit holders by community, from CFEC Permit and Fishing Activity Data, by data for population by community, from the same sources as for Figure 63 [BOTTOM FIGURE].

Figure 69 [TOP FIGURE]. Total Salmon Fishery Earnings, by Region. Source: CFEC Permit and Fishing Activity Data.

Figure 69 [BOTTOM FIGURE]. Per Capita Salmon Fisheries Earnings, by Region. Calculated by dividing data for total salmon fisheries earnings, shown in Figure 69 [TOP FIGURE], by data for estimated population by region, from the same sources as for Figure 63 [BOTTOM FIGURE].

Table 39. Bristol Bay Salmon Fishery Earnings, by Community, 2000 and 2010. Calculated by dividing data for salmon fishery earnings by community, from CFEC Permit and Fishing Activity Data, by data for population by community, from the same sources as for Figure 63 [BOTTOM FIGURE].

Table 40. Economic Measures of Bristol Bay Salmon Industry: Sockeye Salmon Harvests. *Same sources as for* Figure 11, Figure 17, Figure 18 *and* Figure 19.

Figure 70. Bristol Bay Commercial Salmon Harvests. *Same sources as for Figure 16.*

Table 41. Economic Measures of Bristol Bay Salmon Industry: Sockeye Value. Source for ex-vessel value is the same as for Figure 11. Source for first wholesale value is ADFG Commercial Operator Annual Report (COAR) Data. Source for Bristol Bay ex-value used in calculation of Bristol Bay sockeye salmon shares of value is the same as for Figure 11. Source of Alaska wild salmon ex-vessel value used to calculate Bristol Bay share of Alaska wild salmon ex-vessel value is the same as for Alaska data for Figure 17. World wild salmon harvest value estimated by multiplying world wild salmon harvests (from the same sources as for Figure 17) by Alaska average ex-vessel prices (from the same sources as for Figure 17). Source for United States Fish and Shellfish Landed Value is NMFS, *Fisheries of the United States,* various years, available at:

http://www.st.nmfs.noaa.gov/st1/publications.html

Source for "Rank of Naknek-King Salmon among U.S. ports in annual landed value" is NMFS Major Ports Data.

Figure 71. Ex-Vessel and Wholesale Value of Bristol Bay Sockeye Salmon. *Same sources as for Figure 46.*

Table 41. Economic Measures of the Bristol Bay Salmon Industry: Export Value. Source for U.S. export value is NMFS Foreign Trade in Fisheries Products Data. Source for estimated share of Bristol Bay sockeye in total Alaska sockeye salmon harvests is the same as for Figure 18. Source for first wholesale value of sockeye salmon roe production is ADFG Commercial Operator Annual Report (COAR) Data.

Figure 72. Estimated Value of US Exports of Bristol Bay Salmon Products. *Same sources as for Table 41.*

Table 43. Economic Measures of the Bristol Bay Salmon Industry: Employment. Source for estimated peak employment and estimated annual average employment is Table 43. Source for Alaska totals used to calculate Bristol Bay share is the Alaska Department of Labor and Workforce Development (ADLWD) Research and Analysis Division website for "Statewide Data, Fishing and Seafood Industry" at:

http://labor.alaska.gov/research/seafood/seafoodstatewide.htm

Table 44. Economic Measures of the Bristol Bay Salmon Industry: Permit Prices and Values. Source for permits issued and permit prices is CFEC Basic Information Tables.

Figure 74. Bristol Bay Commercial Salmon Harvests. *Same sources as for* Figure 11.

Table 45. Distribution of Harvests for Bristol Bay Fishing Districts. See the data sources for Figure 13 for the sources for harvests by district used to calculate the distribution data shown in the table.

Figure 75. Estimated Shares of Bristol Bay Sockeye Salmon Production, 2010. Frozen, Canned, Fresh and Roe share estimated from ADFG Commercial Operator Annual Report (COAR) Data. Frozen fillet and frozen H&G shares and canned talls and canned halves shares estimated from the shares of these products in frozen production and canned production reported in ADOR Annual Salmon Price Reports.

Figure 76. Average Ex-Vessel and Wholesale Prices of Bristol Bay Sockeye Salmon. *Same sources as for* Figure 30.

Figure 77. Ex-Vessel and First Wholesale Value of Bristol Bay Sockeye Salmon Production, 1980-2010. *Same sources as for* Figure 41.

Figure 78. Local Bristol Bay Resident Share of Bristol Bay Salmon Fisheries: Selected Measures. *Same sources as for* Figure 61.

Table 47. Relative Indicators of 2010 Salmon Fishery Participation and Earnings, Bristol Bay Watershed Region. *Calculated from data in* Table 37.

Table 48. Selected Economic Measures of the Bristol Bay Salmon Industry. *Selected data from* Table 40-Table 44.

Table 49. Distribution of Selected Economic Measures for the Bristol Bay Commercial Salmon Fishing Industry. Sources for distribution calculations are as follows: Harvest, ex-vessel price, and ex-vessel value: Same data sources as for Figure 11. First wholesale prices and first wholesale value: ADFG Commercial Operator Annual Report (COAR) Data. Permit prices and estimated permit value: CFEC Basic Information Tables.

Price Index Data for Converting from Nominal Dollars to Real Dollars

The Anchorage Consumer Price Index (CPI) was used to convert selected "nominal" price and value data (not adjusted for inflation) presented in this report to "real" price and value data (adjusted for inflation).

Anchorage and US Consumer Price Indexes

Year	Anchorage CPI	US CPI	Adjustment factor to convert to 2010 dollars using: Anchorage CPI	Adjustment factor to convert to 2010 dollars using: US CPI
1980	85.500	82.400	2.282	2.646
1981	92.400	90.900	2.112	2.399
1982	97.400	96.500	2.004	2.260
1983	99.200	99.600	1.967	2.189
1984	103.300	103.900	1.889	2.099
1985	105.800	107.600	1.844	2.027
1986	107.800	109.600	1.810	1.990
1987	108.200	113.600	1.804	1.920
1988	108.600	118.300	1.797	1.843
1989	111.700	124.000	1.747	1.759
1990	118.600	130.700	1.645	1.668
1991	124.000	136.200	1.574	1.601
1992	128.200	140.300	1.522	1.554
1993	132.200	144.500	1.476	1.509
1994	135.000	148.200	1.446	1.471
1995	138.900	152.400	1.405	1.431
1996	142.700	156.900	1.368	1.390
1997	144.800	160.500	1.348	1.359
1998	146.900	163.000	1.328	1.338
1999	148.400	166.600	1.315	1.309
2000	150.900	172.200	1.293	1.266
2001	155.200	177.100	1.257	1.231
2002	158.200	179.900	1.234	1.212
2003	162.500	184.000	1.201	1.185
2004	166.700	188.900	1.171	1.154
2005	171.800	195.300	1.136	1.117
2006	177.300	201.600	1.101	1.082
2007	181.237	207.342	1.077	1.052
2008	189.497	215.303	1.030	1.013
2009	191.744	214.537	1.018	1.016
2010	195.144	218.056	1.000	1.000
2011	201.427	224.939	0.969	0.969

(a) Anchorage CPI: Consumer Price Index for Anchorage Municipality; (b) US CPI: United States Consumer Price Index, All Urban Consumers. Source: U.S. Dept. of Labor, Bureau of Labor Statistics (BLS), downloaded March 15, 2012 from Alaska Department of Labor & Workforce Development website: http://labor.alaska.gov/research/cpi/cpi.htm.

For any given year, the adjustment factor to convert from nominal dollars to real dollars is the Anchorage CPI for 2010 (195.144) divided by the Anchorage CPI for the year. For example, a nominal price of $1.00 in 1990 would have a "real" 2010 value of (195.144 / 118.600) x $1.00 = 1.645 x $1.00 = $1.64.

This report uses the Anchorage CPI rather than the US CPI because it is the only available measure of inflation for Alaska, and it is the most appropriate measure for accounting for the effects of inflation *for Alaskans*. The table above also shows the corresponding alternative adjustment factors using the US CPI. In practice, using the US CPI would have resulted in very similar "real" prices and values, and would not have resulted in any meaningful changes in any of the analysis or conclusions of this report. The source for both the Anchorage CPI and the US CPI was the U.S. Dept. of Labor, Bureau of Labor Statistics (BLS). These data are available on the Alaska Department of Labor & Workforce Development website at http://labor.alaska.gov/research/cpi/cpi.htm.

4.0 Economic Significance of Healthy Salmon Ecosystems in the Bristol Bay Region: Summary Findings

The purpose of this section is to assess the economic significance of commercial activities that are dependent on ecosystems in the Bristol Bay watershed and important to the regional economy and to the state economy of Alaska. The study region consists of the Bristol Bay Borough, the Dillingham Census Area, and the Lake and Peninsula Borough. This economic significance analysis measures how many annual average jobs and how much personal income was generated in Alaska by expenditures associated with the Bristol Bay commercial salmon industry, subsistence activities, as well as various types of recreational activities dependent on Bristol Bay salmon ecosystems. We divide recreation into sport fishing, sport hunting, and non-consumptive use, based on the primary activity reported by visitors to the Bristol Bay region.

For 2009, we estimate that about 6,300 annual average jobs are attributable to the wild salmon ecosystem in the Bristol Bay region. Residents of Alaska hold more than 80 percent of all jobs. About 60 percent of all Alaskans working in the Bristol Bay region live in other parts of Alaska. About 20 percent of all jobs are held by non-residents from outside Alaska. At the peak of the summer season, there are almost 15,000 jobs in the Bristol Bay region associated with the commercial salmon fishery and recreation industries. In 2009, the total payroll traceable to this economic activity amounts to more than $282 million of which $182 million went to Alaska residents, and more than $100 million was received by non-residents from outside Alaska working seasonally in the commercial salmon fishery, recreation industries, or service providing industries. About $77 million went to local residents of the Bristol Bay region.

The commercial fishing industry provides the biggest contribution to the economic significance of the Bristol Bay ecosystem. In terms of the overall direct employment in the region, half of all jobs are in the fishing industry, followed by government (32 percent), recreation (15 percent), and mineral exploration (3 percent). The largest recreation related contributor of direct jobs in the region is the non-consumptive recreational use sector providing 9 percent of the overall employment followed by sport fishing (5 percent) and sport hunting (1 percent).

Table 50. Estimated Economic Significance of Bristol Bay Ecosystems

	Total	Residents			Non-Residents
		Non-local	Local	Total	
Direct jobs					
Peak	**14,227**	4,365	2,273	6,639	7,587
Commercial fish	***11,572***	*3,251*	*1,089*	*4,341*	*7,231*
Recreation	***2,655***	*1,114*	*1,184*	*2,298*	*356*
Subsistence	***non-mkt.***	*non-mkt.*	*non-mkt.*	*non-mkt.*	*non-mkt.*
Annual average	**2,811**	914	585	1,499	1,313
Commercial fish	***1,897***	*530*	*177*	*707*	*1,190*
Recreation	*914*	*384*	*408*	*792*	*123*
Subsistence	***non-mkt.***	*non-mkt.*	*non-mkt.*	*non-mkt.*	*non-mkt.*
Multiplier Jobs	**3,455**	2,008	1,447	3,455	-
Total jobs (annual average)	**6,266**	2,922	2,032	4,954	1,313
Direct wages ($000)	**$166,632**	$40,149	$31,048	$66,199	$100,435
Commercial fish	***$134,539***	*$22,698*	*$17,608*	*$40,307*	*$94,233*
Recreation	***$32,093***	*$12,451*	*$13,440*	*$25,892*	*$6,202*
Subsistence	***non-mkt.***	*non-mkt.*	*non-mkt.*	*non-mkt.*	*non-mkt.*
Multiplier wages	**$115,976**	$69,250	$46,724	$115,976	-
Total wages	**$282,608**	$104,399	$77,772	$182,175	$100,435

Note, table does not include jobs related to mineral exploration, commercial trapping, commercial fisheries other than salmon, or government.

4.1 Introduction

The purpose of this section is to assess the economic significance of commercial activities that are dependent on ecosystems in the Bristol Bay watershed and important to the regional economy and to the state economy of Alaska.
"Economic significance" refers to how many annual average jobs and how much personal income was generated in Alaska by expenditures associated with the Bristol Bay commercial salmon industry as well as various types of recreational activities and subsistence activities dependent on Bristol Bay ecosystems. Thus it represents the jobs and income supported by a healthy Bristol Bay ecosystem. The study region consists of the Bristol Bay Borough, the Dillingham Census Area, and the Lake and Peninsula Borough. An economic significance analysis is different from an economic impact analysis that quantifies the change in management policy or some factor influencing the use of natural resources in the region. This analysis does not attempt to quantify any changes in the ecosystem, rather seeks to estimate economic activity dependent on a healthy Bristol Bay ecosystem.

Note the following important limitations of this analysis: the analysis does not measure the net economic value of the natural resources occurring in the Bristol Bay region to Alaska and/or the U.S. as a whole. For example, we do not measure the economic value visitors and non-visitors to the region place on preservation of fish, wildlife, and wilderness within the Bristol Bay region. Second, the analysis shows the contributions to the regional economy of Bristol Bay and the rest of Alaska but excludes the contributions occurring in other states of the U.S. or other parts of the world. Fourth, the model shows only a one-year-snapshot of the economy. The analysis is based on data sources of earlier years that have been adjusted to reflect 2009 conditions or they are based on 2009 data. Given the large annual variations that occur in catches for the commercial salmon fishery and for visitation and expenditures related to tourism, the estimated economic significance for 2009 is not necessarily representative of historical or future economic significance.

The following sections of the report first describe the methods used to quantify the economic significance of economic activity in the Bristol Bay region. We then provide a brief regional economic overview followed by the multiplier results for each economic activity. The rationale and uncertainties related to assumptions relevant for the analysis are also discussed. Information about all data sources used is also provided.

Except where noted, all values are expressed in 2009 dollars and where necessary were adjusted using the Anchorage Consumer Price Index, the only available measure of inflation for Alaska. We report employment estimates for residents of three different regions: the local Bristol Bay region (local), other parts of Alaska (non-local residents), and residents of other states or countries (non-residents).

Note, for the purpose of this study, we report peak employment as a point estimate of the maximum count of workers observed, and state all other employment estimates (including

multiplier jobs) in terms of *annual average jobs*. For example, six jobs held for 2 month of the year in commercial salmon fishing would result in one annual average job.

4.2 Methods

An economic significance analysis measures the importance of economic activity occurring in a region to the regional and statewide economies. We use jobs and income as two measures to show this significance. To conduct this analysis, we first identify the expenditures and jobs directly associated with the primary economic activity of the region including commercial fishing, recreation, and subsistence. We then calculate the additional expenditures, annual average jobs, and payroll generated by dollars re-circulating through the economy to support industries located in the region and elsewhere in Alaska. These effects are commonly referred to as multiplier effects. Note that these effects are only measuring trade flows in dollars and do not account for non-market trade flows such as bartering and the exchange of goods and services related to subsistence activity.

The process by which purchases by an industry or by households stimulate purchases by other businesses and households is known as the multiplier effect. For this study, we measure multiplier effects for indirect and induced employment and wages. Indirect effects occur when primary industry purchases inputs to their operation from support sectors. For example, fishing boat captains purchase diesel fuel from local gas stations. Induced effects consist of the additional jobs and payroll created when employees of the primary and support industries spend their personal income on consumer goods and services. For example, the manager of the local gas station, where the fishermen purchased fuel, buys bread from the local bakery.

In order to appropriately calculate the effects of re-circulating dollars through the economy, we use a regional Input-Output model developed by University of Alaska Anchorage Economics Professor Scott Goldsmith for the state of Alaska. Models are an imperfect representation of the real world and while they are essential for understanding reality, they should not be confused with that reality itself (Hilborn and Mangel, 1997). Thus the model results we represent are suggestive rather than definitive. If we wished to definitively measure the economic significance of the Bristol Bay ecosystem, we would need to conduct a very large and comprehensive survey of all the economic activity originating from the region and the payment flows that they generate. Such a study would be far outside the scope of this analysis both in terms of its cost as well as the time that it would take to complete.

We refer to the model used in this analysis as the ‘ISER Input-Output model” (Goldsmith, 2000). The model reflects the simplified economic structure of the Alaska economy, consisting of four regions, with the Southwest region encompassing the Bristol Bay study area. Since the model represents the structure of the entire region of Southwest Alaska, it is dominated by the larger urban area (Kodiak and Dutch Harbor), where most of the jobs are located. Other more rural communities, such as those of the Bristol Bay region, have a more rudimentary market economy. As a consequence, the Input-Output model may overstate the local economic activity in a rural area compared to what that spending may actually generate locally In other words, in rural areas, the local jobs multiplier tends to be overstated. However, this slight distortion averages out

across the region of Southwest Alaska and statewide. Thus, the aggregate regional effects across Southwest Alaska and the state-wide Alaska economy can be considered more accurate than the estimated local effects within the Bristol Bay region.

Similarly to variation of economic activity within a region, there is also variation among regions. For example, Anchorage serves as the trade and service center for the state. Thus, any spending occurring in rural parts of the state has economic effects in the rural region and in the Southcentral region, where Anchorage is located. An important feature of the ISER Input-Output model is that wages paid in Anchorage can be attributed back to expenditures made in rural areas.

Another important characteristic of the ISER Input-Output model is that it establishes supply constraints. In Alaska, inter-industry purchases mainly occur with services and raw materials that are supply-constrained due to resource scarcity and the limited availability of capital and labor to extract the raw materials. “Off-the-shelf” Input-Output models developed primarily for other less resource-dependent states, such as IMPLAN, do not take this characteristic into account, and potentially overestimate multiplier effects within Alaska (MIG, 2011). Another important attribute of the Alaska economy is that inter-industry purchases are less important in Alaska compared to more mature economies. The absence of a developed manufacturing sector in Alaska means that most goods must be purchased outside the state, creating large leakages and small indirect multiplier effects.

Despite the outlined advantages of the ISER Input-Output model, there remain many challenges to the analysis. One of these challenges is that the economic structure depends in large part on determining where the workers reside when they are not working. Many workers, particularly in the commercial fishing industry, don’t live in the Bristol Bay region. These workers only come to the region for a two to four months long period in the summer but live elsewhere the rest of the year.

Another challenge is that there is no Input-Output model currently available that incorporates subsistence activity as an industry. Current Input-Output models solely reflect market economies and their sectors and ignore non-market sectors such as household work or subsistence activity. Due to the importance of subsistence to the regional economy of the Bristol Bay region, we believe that ideally the subsistence sector would be incorporated into input-output analysis of the economies of rural Alaska regions such as Bristol Bay where it is an important part of the economy. However, this kind of research would require additional effort and time far beyond the scope of this analysis.

Sections 4.8 and 4.9 further discuss data sources used and the implications of assumptions made on overall results. Due to a lack of certain kinds of data and other sources of uncertainty further discussed in the appendix, the reader should interpret the estimated impacts as suggestive rather than definitive.

The following two tables show how many jobs and income are associated with $1 million in 2009 spending in Southwest Alaska. For example, $1 million dollars of in-state spending on air transportation in Southwest Alaska creates approximately six jobs in Southwest Alaska and one

job in Southcentral Alaska (Table 51). In addition, this spending generates $344,000 in payroll in Southwest Alaska and $54,000 in payroll in Southcentral Alaska (Table 52).

Table 51. Annual average jobs associated with $1 million in spending in each sector in Southwest Alaska, 2009

	SOUTH EAST I	SOUTH CENTRAL II	SOUTH WEST III	NORTH IV	STATE TOTAL
Agriculture and AFF Services	0.0	0.9	5.5	0.0	**6.3**
Forestry	0.0	0.3	4.2	0.0	**4.4**
Fishing	0.0	0.2	4.2	0.0	**4.3**
Crude Petroleum and Natural Gas	0.0	0.9	0.6	0.0	**1.5**
Other Mining	0.0	0.9	4.2	0.0	**5.1**
New Construction	0.0	0.0	4.1	0.0	**4.1**
Maintenance and Repair	0.0	4.0	10.2	0.0	**14.1**
Food and Kindred Products	0.0	0.2	5.3	0.0	**5.5**
Paper and Allied Products	0.0	0.0	5.0	0.0	**5.0**
Chemicals and Petroleum Processing	0.0	0.1	1.1	0.0	**1.2**
Lumber and Wood Products	0.0	0.0	5.6	0.0	**5.7**
Other Manufacturing	0.0	0.4	8.4	0.0	**8.8**
Railroads	0.0	0.2	4.1	0.0	**4.3**
Local and Interurban Transit	0.0	0.2	11.7	0.0	**12.0**
Motor Freight and Warehousing	0.0	1.1	10.2	0.0	**11.2**
Water Transportation	0.0	0.3	4.4	0.0	**4.7**
Air Transportation	0.0	1.0	6.4	0.0	**7.4**
Pipelines	0.0	0.1	3.7	0.0	**3.8**
Transportation Services	0.0	0.3	6.8	0.0	**7.2**
Communication	0.0	1.3	6.1	0.0	**7.4**
Electric, Gas, Water, and Sanitary	0.0	0.8	2.7	0.0	**3.5**
Wholesale Trade	0.0	4.6	10.0	0.0	**14.6**
Retail Trade	0.0	12.3	30.4	0.0	**42.7**
Finance	0.0	4.0	9.2	0.0	**13.2**
Insurance	0.0	2.1	8.9	0.0	**11.0**
Real Estate	0.0	0.9	0.7	0.0	**1.6**
Hotels, Lodging, Amusements	0.0	1.9	15.0	0.0	**16.9**
Personal Services	0.0	2.0	24.2	0.0	**26.3**
Business Services	0.0	6.4	20.2	0.0	**26.6**
Eating and Drinking	0.0	8.5	26.8	0.0	**35.3**
Health Services	0.0	4.8	18.8	0.0	**23.6**
Miscellaneous Services	0.0	4.6	15.1	0.0	**19.7**
Federal Government Ent	0.0	0.4	6.3	0.0	**6.7**
State & Local Government Ent	0.0	0.1	8.3	0.0	**8.4**

Table 52. Annual payroll associated with $1 million in spending in each sector in Southwest Alaska, 2009

	SOUTH EAST I	SOUTH CENTRAL II	SOUTH WEST III	NORTH IV
Agriculture and AFF Services	$ -	$ 43,276	$ 274,635	$ -
Forestry	$ -	$ 13,755	$ 209,563	$ -
Fishing	$ -	$ 8,821	$ 209,563	$ -
Crude Petroleum and Natural Gas	$ -	$ 150,128	$ 92,746	$ -
Other Mining	$ -	$ 72,014	$ 326,900	$ -
New Construction	$ -	$ 254	$ 254,526	$ -
Maintenance and Repair	$ -	$ 243,764	$ 626,678	$ -
Food and Kindred Products	$ -	$ 7,446	$ 181,843	$ -
Paper and Allied Products	$ -	$ 524	$ 165,218	$ -
Chemicals and Petroleum Processing	$ -	$ 12,003	$ 97,505	$ -
Lumber and Wood Products	$ -	$ 1,092	$ 211,898	$ -
Other Manufacturing	$ -	$ 15,244	$ 299,200	$ -
Railroads	$ -	$ 16,082	$ 296,407	$ -
Local and Interurban Transit	$ -	$ 5,409	$ 269,956	$ -
Motor Freight and Warehousing	$ -	$ 35,723	$ 336,974	$ -
Water Transportation	$ -	$ 21,311	$ 316,516	$ -
Air Transportation	$ -	$ 54,410	$ 344,270	$ -
Pipelines	$ -	$ 4,718	$ 268,972	$ -
Transportation Services	$ -	$ 14,772	$ 296,132	$ -
Communication	$ -	$ 87,937	$ 423,144	$ -
Electric, Gas, Water, and Sanitary	$ -	$ 55,677	$ 186,376	$ -
Wholesale Trade	$ -	$ 227,652	$ 494,997	$ -
Retail Trade	$ -	$ 365,739	$ 904,797	$ -
Finance	$ -	$ 206,101	$ 476,973	$ -
Insurance	$ -	$ 108,765	$ 463,912	$ -
Real Estate	$ -	$ 29,189	$ 23,538	$ -
Hotels, Lodging, Amusements	$ -	$ 46,021	$ 360,382	$ -
Personal Services	$ -	$ 44,267	$ 526,104	$ -
Business Services	$ -	$ 298,171	$ 940,459	$ -
Eating and Drinking	$ -	$ 151,775	$ 479,206	$ -
Health Services	$ -	$ 197,932	$ 785,286	$ -
Miscellaneous Services	$ -	$ 172,055	$ 565,071	$ -
Federal Government Ent	$ -	$ 25,818	$ 403,554	$ -
State & Local Government Ent	$ -	$ 5,415	$ 360,384	$ -
Households	$ -	$ 9,129	$ 22,931	$ -

Source: ISER Input-Output Model (Goldsmith, 2000).

4.3 Regional Economic Overview

The economy of the Bristol Bay Region depends on three main activities (basic sectors)—publicly funded services through government and non-profits, commercial activity associated with the use of natural resources (mainly commercial fishing and recreation), and subsistence. Subsistence is a non-market activity in the sense that there is no exchange of money associated with the subsistence harvest. However, local participants invest a significant portion of their time and income to participate in subsistence and the harvest has considerable economic value and their expenditures have significant economic effects.

Public services and commercial activities bring money into the economy (basic sectors) and provide the basis for a modest support sector. The support sector (non-basic sector) consists of local businesses that sell goods and services to the basic sectors including the commercial fishing industry, the recreation industry, the government and non-profit sectors. The support sector also sells goods and services to participants in subsistence activities.

The relative importance within the regional economy of government as contrasted with commercial fishing and recreation can be measured by the annual average employment in each sector. In 2009, more than two thousand jobs were directly associated with government spending from federal, state, and local sources. Commercial fishing and recreation accounted for approximately three thousand or 57 percent of total basic sector jobs (Table 53). Since much of the recreation is using public lands and resources, a share of the government sector; for example administration of the federal and state parks and wildlife refuges, is directly related to providing jobs and opportunities in the recreation sector. Accordingly, the estimate of recreation-dependent jobs is conservative.

The annual spending of federal dollars in the region is another indicator of the importance of the government sector in the region. Table 54 shows that in 2009, $119 million in federal spending flowed into the three labor market areas of the Bristol Bay region.

The support sector depends on money coming into the regional economy from outside mainly through government, commercial fishing, and recreation. The relative dependence of the support sector on the three main sectors is difficult to measure. One reason for this is that government employment is stable throughout the year, while employment in commercial fisheries and recreation vary seasonally. Due to the seasonal stability of government jobs, the payroll spending of people employed in government is likely to contribute more to the stability of support sector jobs in the region than their share of basic sector jobs indicates.

Table 53. Employment Count by Place of Work in the Bristol Bay Region, 2009

	Annual Average	Summer	Winter	Swing
Total jobs count	**6,648**	16,386	3,792	12,594
Basic	**5,490**	14,877	2,430	12,447
Fish harvesting	**1,409**	6,909	-	6,909
Fish processing	**1,374**	4,480	354	4,126
Recreation	**432**	1,297	-	1,297
Government & Health	**2,039**	1,712	2,056	(344)
Mineral Exploration	**197**	450	70	380
Non-basic	**1,406**	1,509	1,362	147
Construction	**61**	92	55	37
	634	717	593	124
Trade/Transportation/Leisure				
Finance	**155**	142	162	(20)
Other wage & salary	**239**	241	235	6
Non-basic self employed	**317**	317	317	-
Resident jobs count	**4,675**	10,351	3,225	7,126

Note, estimates based on ISER Input-Output Model (Goldsmith, 2000).

Note, fish harvesting and processing include other fisheries but salmon, thus employment numbers cannot be compared with other tables shown in this report. Summer and winter employment shown, are point estimates that either show the maximum or minimum job count. Swing refers to the difference between maximum and minimum. See Appendix B for sources used.

Table 54. Federal Spending in the Bristol Bay Region, 2009 ($000)

	Bristol Bay	Dillingham	Lake & Pen	Total
Total	$49,600	$54,345	$16,013	**$119,958**
Retirement	$6,934	$6,764	$545	**$14,243**
Other direct to individuals	$1,930	$10,235	$4,799	**$16,964**
Grants	$32,867	$32,467	$7,878	**$73,212**
Procurement	$4,440	$1,005	$857	**$6,302**
Wages	$3,430	$3,874	$1,934	**$9,238**

Source: U.S. Department of Commerce (2009).

Table 55. Estimated Residence of Workers in the Bristol Bay Region 2009

	Local	Other Alaska	Outside Alaska	Total
Bristol Bay				
State government	24	14	9	**47**
Local government	126	12	18	**156**
Private sector	273	332	1,916	**2,521**
Sum	**423**	**358**	**1,943**	**2,724**
Dillingham				
State government	90	24	8	**122**
Local government	877	66	94	**1,037**
Private sector	1,033	270	728	**2,031**
Sum	**2,000**	**360**	**830**	**3,190**
Lake & Pen				
State government	7	7	3	**17**
Local government	417	105	66	**588**
Private sector	179	322	685	**1,186**
Sum	**603**	**434**	**754**	**1,791**
Total Private	**1,485**	**924**	**3,329**	**5,738**
Share	26%	16%	58%	**100%**

Source: ADOL (2009). Note, this is a count of workers (unique individuals) and not a measure of Full Time Equivalent or annual average jobs. Also, the table includes processing workers but excludes harvesters in the commercial fishery (private sector).

The estimated personal income in the region varies by borough/census area. The Bureau of Economic Analysis (BEA) reports more than $58,000 as the 2009 per capita personal income for the Bristol Bay Borough. Per capital personal income in the Lake and Peninsula Borough or in the Dillingham Census Area is approximately equal to $35,000 (Table 56). For comparison, the 2009 per capita personal income in Anchorage amounts to $48,598.

The commercial salmon fishery provides above average income to seasonal workers and residents of the region. Because of the large amounts of income received by seasonal workers that do not reside in the Bristol Bay region, BEA applies the *Alaskan seasonal worker adjustment*. This residence adjustment lowers the income generated in the region by the amount that is believed to be received by people working in Bristol Bay but not residing in the region. In part, it is a subjective measure for the amount of income flowing out of the Bristol Bay Borough to other areas of Alaska and to Washington State, Oregon, and California (BEA, 2007). Thus, the per capita income measures stated here are uncertain and should be viewed as suggestive rather than definitive.

Table 56. Estimated Personal Income in the Bristol Bay Region, 2009 (000$)

	Bristol Bay	Dillingham	Lake & Pen	Total
Wages	$57,018	$96,654	$27,551	**$181,223**
+ Supplements to wages	$16,694	$28,021	$9,164	**$53,879**
+ Proprietor income	$9,421	$16,194	$2,605	**$28,220**
= Earnings by place of work	$83,133	$140,869	$39,320	**$263,322**
- Contributions for government social insurance	$8,799	$14,820	$3,736	**$27355**
+ Residence adjustment	-$39,175	-$4,530	-$1,055	**-$44,760**
= Net earnings by place of residence	$35,159	$121,519	$34,529	**$191,207**
+ Dividends	$7,382	$20,314	$7,980	**$35,676**
+ Transfers	$9,189	$35,764	$11,981	**$56,934**
= Personal Income	$51,730	$177,597	$54,490	**$283,817**
Population	881	4,957	1,485	**7,323**
Per Capita Income	$58,717	$35,828	$36,694	**$38,757**

Source: BEA (2009).

4.4 Commercial Salmon Fisheries

The largest share of jobs and income generated in the Bristol Bay region comes from commercial salmon fishing, including drift gillnet and set gillnet fisheries. The commercial salmon fishery is described in detail in Section 3 of this report. Here we provide a brief summary description prior to presenting estimates of the economic significance of the industry.

The number of commercial fishing jobs and income varies from year to year due to the varying size and value of the salmon harvest. For example, the ex-vessel value paid to fishermen fell from a peak of $214 million in 1989 to $32 million in 2002, and recovered to $148 million in 2009. The 2009 harvest was 192 million pounds. The whole sale value of these fish amounted to $300.2 million.[26]

At the peak of the 2009 commercial salmon fishery, about 1,000 local residents and 6,000 seasonal workers from outside the region participated in the commercial salmon fishery's harvest. In addition, approximately 4,500 non-local processing workers came to the Bristol Bay region. At the peak of the season approximately 11,500 workers had jobs in harvesting and processing combined. About 4,300 of these workers were Alaska residents and approximately 7,200 came from outside the state.

We estimate that total income to harvesters in 2009 was approximately $103 million of which permit holders received $72 million (70 percent) and $31 million went to crew members. Alaskans participating directly in harvesting and processing earned approximately $40 million amounting to 42 percent of total direct wages. Local residents of the Bristol Bay region earned $17.6 million (12 percent) of total direct income in processing and harvesting combined.
The commercial salmon season is highly seasonal. Almost all fishing and processing activity occurs between June and August. For the purpose of our analysis, we assume that each seasonal fishing job lasts two months. Therefore, six seasonal jobs equate to one annual average job.

The in-state spending by harvesters, processors, and workers in the region and in other places of Alaska created additional jobs in other sectors of the economy through the multiplier effect. We estimate that on an annual average basis, 1,586 additional jobs (754 locally and 832 in the rest of Alaska) and $54.7 million in indirect wages were traceable to commercial fisheries. These jobs were in the trade, service, finance, and other support industries. Jobs created outside of the state are not included in these estimates.

In 2009, the total income traceable to commercial salmon fishing in Bristol Bay equaled $189 million. Accounting for the short two months summer season in commercial salmon fishing, the 11,500 direct commercial salmon fishing jobs translate to approximately 1,900 jobs on an annual average basis. With the addition of multiplier jobs, about 3,500 annual average jobs would be attributable to the commercial salmon fishing industry (Table 57).

[26] Estimates of some year-specific commercial fishery total harvest and total sales vary slightly within this report. This is due to differences in how these data are aggregated and reported by the Alaska Fish and Game, and the point in time these statistics were accessed during the preparation of this report.

Table 57. Estimated Economic Significance of Commercial Fishing

	Total	Residents			Non-Residents
		Non-local	Local	Total	
Direct jobs					
Peak	**11,572**	3,251	1,089	4,341	7,231
Harvesting	***7,050***	*2,694*	*1,013*	*3,708*	*3,342*
Processing	***4,522***	*557*	*76*	*633*	*3,889*
Annual average	**1,897**	530	177	707	1,190
Harvesting	***1,143***	*437*	*164*	*601*	*542*
Processing	***754***	*93*	*13*	*106*	*648*
Multiplier Jobs	**1,586**	832	754	1,586	-
Total jobs (annual average)	**3,483**	1,362	931	2,293	1,190
Direct wages ($000)	**$134,539**	$22,698	$17,608	$40,307	$94,233
Harvesting	***$103,354***	*$19,645*	*$16,609*	*$36,255*	*$67,100*
Processing	***$31,185***	*$3,053*	*$999*	*$4,052*	*$27,133*
Multiplier wages	**$54,705**	$28,101	$26,604	$54,705	-
Total wages	**$189,244**	$50,799	$44,212	$95,012	$94,233

Note, estimates based on ISER Input-Output Model (Goldsmith, 2000).

4.5 Recreation

The second largest portion of jobs and income generated by spending dependent on Bristol Bay salmon resources comes from the recreation sector which directly employs approximately 2,600 workers during peak season translating to about 900 annual average jobs with an annual payroll of more than $32 million. Most recreational visits occur during the summer months, creating a peak in economic activity that largely coincides with the peak of the commercial salmon fishery. Recreational activity concentrates in Katmai National Park and Preserve, Lake Clark National Park and Preserve as well as the National Wildlife Refuges: Alaska Peninsula/Becharof, Ixembek, and Togiak. Sport fishing activity occurs mainly in the Nushagak and Naknek River watersheds, whereas sport hunting occurs predominately in the Mulchatna River watershed. Visitors travel to Alaska by air, ferry, highway, and cruise ship. Each of these travel markets has distinct visitor attributes, demographics and regional impacts. Visitation to Southwest Alaska is primarily driven by independent travelers who predominately arrive by air. Statewide visitation declined 5.8 percent between 2008 and 2009 as a result of the recession following the collapse of financial markets in late 2008. Cruise passenger volume remained essentially the same in 2009 because ship deployment decisions require a longer lead time than air. In contrast, air visitor traffic decreased by 15 percent in 2009.

The rebound in Alaska visitation in 2010 was led by independent travelers arriving by air, and to a lesser extent road, ferry, and international visitors. This rebound is expected to continue in 2011 and again be comprised primarily of independent travelers. These independent visitors tend to visit Alaska's more remote regions, while cruise visitors primarily visit the marine accessible Southeast region and the Southcentral and Interior regions including Denali National Park and Preserve. Katmai National Park and Preserve in Southwest Alaska showed a rebound in visitor numbers in 2010 after declines in 2008 and 2009, based on National Park Service Commercial Use Authorization permit report data. Among those that reported boosts in independent-visitor traffic are lodges, tour operators, and campgrounds, according to the Alaska Travel Industry Association.

We estimate that there were approximately 40,964 non-consumptive recreation visitors to Southwest Alaska in 2009 of which approximately 10 percent were Alaska residents. Visitor related spending amounted to approximately $173.3 million in 2009. The average spending per visitor and the average length of stay are higher in Southwest Alaska compared to respective statewide averages. Based on the Alaska Visitor Statistics Program (2011), non-residents visiting Southwest Alaska spent $2,873 per visitor and stayed 12.9 nights whereas the statewide average visitor spent $992 and stayed 9.1 nights. Fay and Christensen (2010) estimate per visitor spending in Katmai to amount to $2,332. Also, recreational expenditures occurring inside Katmai NPP are relatively high for a remote Alaska park because of the location of Brooks Camp and concession businesses located inside the park. Based on the visitor spending reported by the Alaska Visitor Statistics Program (2011) and Fay and Christensen (2010), we estimate non-consumptive visitor spending in the Bristol Bay region to equal $2,548 per visitor and year.

Among all recreational users of the region, non-residents spent the largest amount, equaling $149.5 million or 86 percent of total spending. Alaskans from outside the region spent an estimated $18.9 million, whereas locals had the smallest amount equaling $4.9 million in

recreation related expenditures. The per-visitor expenditures to destinations in Southwest Alaska are higher compared to other locations in Southcentral Alaska because most travelers go by air to the more remote locations such as Bristol Bay, whereas the largest portion of visitors to Southcentral Alaska come to Alaska by cruise ship.

Table 58. Estimated Recreational Visitors and Expenditures in the Bristol Bay Region, 2009

	Local residents	Non-local residents	Non-residents	**Total**
Visitors				
Non-consumptive	-	4,506	36,458	**40,964**
Sport fishing	13,076	3,827	12,464	**29,367**
Sport hunting	-	1,319	1,323	**2,642**
Total	**13,076**	**9,652**	**50,245**	**72,973**
Spending per visitor				
Non-consumptive	-	$2,548	$2,548	
Sport fishing	$373	$1,582	$3,995	
Sport hunting	-	$1,068	$5,170	
Spending ($million)				
Non-consumptive	-	$11.5	$92.9	**$104.4**
Sport fishing	$4.9	$6.0	$49.8	**$60.7**
Sport hunting	-	$1.4	$6.8	**$8.2**
Total	**$4.9**	**$18.9**	**$149.5**	**$173.3**

Note that some visitors combine fishing with non-consumptive use activities. These visitors are included here in sport fishing. Cost of travel to Alaska for non-residents not shown. Annual spending per non-consumptive visitor is the weighted average of visitor spending related to Katmai and other locations in the Bristol Bay Region.

The local economic impact of visitor spending occurs primarily through local purchases of goods and services. This effect is captured in the multiplier jobs and wages in . The multiplier jobs are held in the transportation, accommodation, and trade sectors of the economy. A large share of these jobs is located outside the Bristol Bay region in Southcentral Alaska where most of the goods and services originate from. The jobs in these sectors are more likely to be filled by Alaska residents who live where they work, and they are more likely year-round rather than seasonal jobs.

For 2009, we estimate the total annual average number of jobs that are traceable to recreational visits to the Bristol Bay region to equal 2,715 with total payroll of $90.8 million. On an annual average basis, the majority (44 percent) of the 914 direct jobs were held by local residents of the region followed by other Alaska residents (384 jobs). Other Alaskans either moved into the

region to fill a job during the summer season, or their job was located in Anchorage and attributable to recreation occurring in the Bristol Bay region. A smaller share of total jobs (13 percent) was taken by non-residents. Also, some of the indirect jobs in transportation, trade, and accommodations were probably filled by non-residents rather than residents. Important to note is that due to a lack of data, the distribution of jobs and income by residency is uncertain. However, total employment and total income estimates are more robust measures.

Note, since many of the goods and services consumed in Alaska, are produced outside of Alaska and consequently have economic effects elsewhere, these spillover effects are not part of this economic analysis.

Table 59. Estimated Economic Significance of All Recreation

	Total	Residents			Non-Residents
		Non-local	Local	Total	
Direct jobs					
Peak	**2,655**	1,114	1,184	2,298	356
Non-cons.	***1,669***	*735*	*741*	*1,475*	*193*
Sport Fish	***854***	*328*	*383*	*712*	*142*
Sport Hunt	***132***	*51*	*60*	*111*	*21*
Annual average	**914**	384	408	792	123
Non-cons.	***575***	*253*	*255*	*509*	*67*
Sport Fish	***294***	*113*	*132*	*245*	*49*
Sport Hunt	***45***	*18*	*21*	*38*	*7*
Multiplier Jobs	**1,801**	1,129	672	1,801	-
Total jobs (annual average)	**2,715**	1,513	1,080	2,593	123
Direct wages ($000)	**$32,093**	$12,451	$13,440	$25,892	$6,202
Non-cons.	***$19,107***	*$7,823*	*$7,925*	*$15,748*	*$3,359*
Sport Fish	***$11,279***	*$4,020*	*$4,777*	*$8,797*	*$2,482*
Sport Hunt	***$1,707***	*$608*	*$738*	*$1,347*	*$361*
Multiplier wages	**$58,672**	$39,380	$19,290	$58,672	-
Total wages	**$90,765**	$51,831	$32,730	$84,564	$6,202

Note, estimates based on ISER Input-Output Model (Goldsmith, 2000). All direct jobs are in the Bristol Bay region. Multiplier jobs are divided between Bristol Bay and Southcentral Alaska. Multiplier jobs are assumed to be all taken by residents of the region where they occur. Peak and annual average direct wages are assumed to be equal.

4.5.1 Non-Consumptive Use

Most of recreational spending in the Bristol Bay region is related to non-consumptive use, for example wildlife viewing of coastal brown bears and bird species, or kayaking and camping activities. For this part of the analysis we estimate visitation based on the most recent studies of non-resident visitors to the state and two studies that estimated visitation and economic impacts related to Katmai National Park and Preserve. On an annual basis including summer and winter visitation, approximately 2,300 residents and 18,900 non-residents visited Katmai NPP. Other areas in the Bristol Bay region received approximately 2,300 resident visitors and 19,000 non-resident visitors. Note, these estimates exclude visitation where sport fishing or sport hunting was in part or the primary activity of choice. After adjusting the per capita expenditures to 2009 dollars we estimate per person expenditures to amount to $2,245 annually for Katmai NPP and $2,873 per person annually for visiting other destinations in the Bristol Bay region.

To be consistent with the expenditure data for sport fishing and hunting, we assume that the visit to the Bristol Bay region was the primary reason for their visit to Alaska. For these visitors we include all their instate spending in the calculation of multiplier jobs and income.

We estimate a total of 1,681 annual average jobs to be attributable to non-consumptive use of natural resources in the Bristol Bay region with a payroll of $54.8 million. The main proportion (57 percent) of jobs are held by residents of Alaska that do not live in the Bristol Bay region either because they move to Bristol Bay for the summer months to fill a seasonal job or because they work in Anchorage for a supplier of goods and services to the Bristol Bay region. The total income generated in 2009 for residents of Alaska amounted to $51.4 million.

Table 60. Estimated Economic Significance of Non-Consumptive Use

	Total	Residents			Non-Residents
		Non-local	Local	Total	
Direct jobs					
Peak	**1,669**	735	741	1,475	193
Annual average	**575**	253	255	509	67
Multiplier Jobs	**1,106**	703	403	1,106	-
Total jobs (annual average)	**1,681**	956	658	1,615	67
Direct wages ($000)	**$19,107**	$7,823	$7,925	$15,748	$3,359
Multiplier wages	**$35,668**	$24,059	$11,608	$35,668	-
Total wages	**$54,775**	$31,882	$19,533	$51,416	$3,359

Note, estimates based on ISER Input-Output Model (Goldsmith, 2000). All direct jobs are in the Bristol Bay region.

4.5.2 Sport Fishing

The second largest share of total recreational expenditures in the Bristol Bay region is associated with sport fishing, either as the only or as the primary activity of the visitor. Non-residents account for 53 percent of visitors that fish in the region and spend 82 percent of total sport fish related expenditures attributable to the region, excluding travel to Alaska. Non-residents are most likely to hire guides and stay at local lodges. Alaska residents account for 47 percent of visitation and spend 10 percent of total sport-fish-related expenditures. We also include spending on sport fishing by local residents, even though that spending does not bring in money from outside the region to the Bristol Bay region. If there would not be any sport fishing opportunities in the region, that local spending could likely shift to other areas outside the region and thus provides the rationale for including it in our calculations.

At the peak of the fishing season in July, employment in sport fishing reaches 854 direct seasonal jobs. The annual average employment traceable to sport fishing in the region amounts to approximately 300 annual average jobs, of which almost half are taken by local residents. The total estimated payroll attributable to sport fishing activities in the Bristol Bay region amounts to $31.4 million in 2009. We estimate that about a third of total payroll went to local residents of the Bristol Bay region. After counting for multiplier jobs, more than 900 annual average jobs are traceable to sport fishing occurring in the Bristol Bay region.

Table 61. Estimated Economic Significance of Sport Fishing

	Total	Residents			Non-Residents
		Non-local	Local	Total	
Direct jobs					
Peak	**854**	328	383	712	142
Annual average	**294**	113	132	245	49
Multiplier Jobs	**608**	371	237	608	-
Total jobs (annual average)	**902**	484	368	853	49
Direct wages ($000)	**$11,279**	$4,020	$4,777	$8,797	$2,482
Multiplier wages	**$20,118**	$13,339	$6,779	$20,118	-
Total wages	**$31,397**	$17,359	$11,556	$28,915	$2,482

Note, estimates based on ISER Input-Output Model (Goldsmith, 2000). All direct jobs are in the Bristol Bay region.

4.5.3 Sport Hunting

Compared to other recreation activities, sport hunting accounts for the smallest share of total recreational expenditures (3 percent) and the fewest visitors overall (5 percent) (Table 58). The larger per person expenditure of $3,122 per visitor is related to higher travel costs. In addition, non-residents are by law required to hire local guide services which adds to the cost for hunting, including air service to remote hunting locations. Sport hunters are also more likely to hire commercial operators for sport hunting. Of the 125 total annual average jobs in Alaska attributable to sport hunting, most are taken by residents of the state with the majority of workers residing outside the Bristol Bay region. The total payroll attributable to spending traceable to sport hunting in the Bristol Bay region is more than $4 million, with the majority going to non-local residents of Alaska residing in the Southcentral region of Alaska.

Table 62. Estimated Economic Significance of Sport Hunting

	Total	Residents			Non-Residents
		Non-local	Local	Total	
Direct jobs					
Peak	**132**	51	60	111	21
Annual average	**45**	18	21	38	7
Multiplier Jobs	**87**	55	32	87	-
Total jobs (annual average)	**132**	73	53	125	7
Direct wages ($000)	**$1,707**	$608	$738	$1,347	$361
Multiplier wages	**$2,886**	$1,982	$903	$2,886	-
Total wages	**$4,593**	$2,590	$1,641	$4,233	$361

Note, estimates based on ISER Input-Output Model (Goldsmith, 2000). All direct jobs are in the Bristol Bay region.

4.6 Subsistence

Subsistence is an important component of the regional economy even though it is not part of the market economy. Consequently there is no official measure for employment or the amount of payroll associated with the pursuit of subsistence resources. However, there remains a link between subsistence and the market economy in form of equipment, goods, and services purchased by households participating in subsistence. Typically these purchases include boats, rifles, nets, snow mobiles, and fuel used exclusively to take part in subsistence activities. Data on expenditures related to subsistence activities in the Bristol Bay region is not publically available. Our estimate of $3,054 per household relies on data from a survey conducted in 1993 in the North Slope Borough (North Slope Borough, 1993; Goldsmith, 1998). Although, income, employment opportunities, and subsistence methods used in the North Slope Borough are different, there is evidence that suggests the estimate is justified. The results of a 1980s subsistence survey in Western Alaska communities are consistent with the 1993 North Slope estimate (Peterson et al., 1992).

A large share of the 68 multiplier jobs occurs in the Southcentral region (47 jobs) with more than $1.8 million in payroll. Local multiplier jobs amount to approximately 16 and an annual payroll of $830,000. The small number of multiplier jobs that are generated by household spending on equipment is also affected by the limited capacity of local businesses to supply goods and services.

Table 63. Estimated Economic Significance of Subsistence

	Total	Residents			Non-Residents
		Non-local	Local	Total	
Direct jobs					
Peak	**Non-mkt.**	Non-mkt.	Non-mkt.	Non-mkt.	Non-mkt.
Annual average					
Multiplier Jobs	**68**	47	21	68	-
Total jobs (annual average)	**68**	47	21	68	-
Direct wages ($000)	**Non-mkt.**	Non-mkt.	Non-mkt.	Non-mkt.	Non-mkt.
Multiplier wages	**$2,599**	$1,769	$830	$2,599	-
Total wages	**$2,599**	$1,769	$830	$2,599	-

Note, estimates based on ISER Input-Output Model (Goldsmith, 2000). All direct jobs are in the Bristol Bay region.

4.7 Conclusions

In 2009, the Bristol Bay salmon ecosystem supported more than 6,000 annual average jobs with a payroll of $282 million. Non-residents of Alaska held one fifth of all jobs and received one third of all income generated, about $100 million. Alaskans held approximately 5,000 jobs (80 percent of all jobs) and earned $182 million, one third of total income. Local residents of the Bristol Bay region held about a third of all jobs and earned almost $78 million (28 percent) of total income traceable to the Bristol Bay salmon ecosystem (Table 64).

The majority of jobs held by Alaskans are taken by residents from other regions of Alaska, particularly by harvesters in the commercial salmon fishery. More than half of all jobs are held by workers in the support industries for commercial fishing and recreation, which are mainly located in Southcentral Alaska. Multiplier wages amount to about a third of total income generated.

The regional economy is primarily driven by the commercial salmon industry, followed by tourism and participation in subsistence, considered to be a non-market economic activity. The economy of the Bristol Bay is a mixed cash-subsistence economy, where subsistence activity requires labor inputs without exchange of money for the labor performed. Subsistence creates non-cash jobs to local residents of the region who are pursuing subsistence activities to support their families' need for food. The subsistence economy provides a direct link between the health of the Bristol Bay salmon ecosystem and human well-being. Subsistence is integral to the local way of life in the Bristol Bay region. However, even though it is an important part of the regional economy, work related to subsistence similar to household work, is not officially measured and neither is it subject to an exchange of money for the work performed. Thus, in the context of this study which is solely focused on market values, we are unable to quantify the economic significance of subsistence in the sense of direct jobs and income. Thus we present these jobs as non-market jobs. However, we present multiplier jobs resulting from subsistence-related spending on capital equipment and gasoline for example. These expenditures are necessary inputs to participating in subsistence activities and are included under multiplier jobs and wages (Table 64).

Table 64. Estimated Economic Significance of Bristol Bay Ecosystems

	Total	Residents			Non-Residents
		Non-local	Local	Total	
Direct jobs					
Peak	**14,227**	4,365	2,273	6,639	7,587
Commercial fish	***11,572***	*3,251*	*1,089*	*4,341*	*7,231*
Recreation	***2,655***	*1,114*	*1,184*	*2,298*	*356*
Subsistence	***non-mkt.***	*non-mkt.*	*non-mkt.*	*non-mkt.*	*non-mkt.*
Annual average	**2,811**	914	585	1,499	1,313
Commercial fish	***1,897***	*530*	*177*	*707*	*1,190*
Recreation	*914*	*384*	*408*	*792*	*123*
Subsistence	***non-mkt.***	*non-mkt.*	*non-mkt.*	*non-mkt.*	*non-mkt.*
Multiplier Jobs	**3,455**	2,008	1,447	3,455	-
Total jobs (annual average)	**6,266**	2,922	2,032	4,954	1,313
Direct wages ($000)	**$166,632**	$40,149	$31,048	$66,199	$100,435
Commercial fish	***$134,539***	*$22,698*	*$17,608*	*$40,307*	*$94,233*
Recreation	***$32,093***	*$12,451*	*$13,440*	*$25,892*	*$6,202*
Subsistence	***non-mkt.***	*non-mkt.*	*non-mkt.*	*non-mkt.*	*non-mkt.*
Multiplier wages	**$115,976**	$69,250	$46,724	$115,976	-
Total wages	**$282,608**	$104,399	$77,772	$182,175	$100,435

Note, estimates based on ISER Input-Output Model (Goldsmith, 2000). All direct jobs are in the Bristol Bay region.

4.8 Key Assumptions and Uncertainties

Description	Potential Bias	Sensitivity relative to overall results
GENERAL		
The ISER Alaska Input-Output model consists of four regions. The Bristol Bay region is only part of one of these regions, the Southwest region. Larger communities outside Bristol Bay such as Kodiak and Dutch Harbor are part of the Southwest region.	The expenditures related to economic activity in the Bristol Bay region overestimate the employment generated in the region and underestimate the employment generated in other regions. The bias in overall Alaska economic impact is unknown.	Moderate
The commodity by industry matrix is part of the Input-Output model and allocates commodity expenditures among costs of goods, transportation margins, trade margins, and to industries, based on statewide averages.	Transportation and trade margins may be higher for purchases made in small, rural parts of Alaska than for the state as a whole. This would result in an underestimate of the transportation and trade share of the total economic impact. Bias in overall Alaska economic impact is unknown.	Moderate
Composition of household expenditures is based on statewide averages.	The composition of rural household expenditures may be different from the state average, which is heavily weighted by urban households. Bias in overall Alaska economic impact is unknown.	Moderate
COMMERCIAL FISHING		
Unrepresentative base year for harvest and ex-vessel value estimates	Given the large annual variations that occur in catches for the commercial salmon fishery the estimated economic significance for 2009 is not necessarily representative of historical or future economic significance.	High
Assumptions about the level of expenditures per harvester and processor	Unknown	Moderate
Assumptions about the composition of harvester and processor purchases	Unknown	Moderate
Assumption about the regional allocation of expenditures by	Unknown	Moderate

Description	Potential Bias	Sensitivity relative to overall results
harvesters and processors		
Assumption about the residence of harvesters and processor employees	Unknown	Moderate
Travel cost related to non-resident and Alaska resident travel between place of residence and place of work in Bristol Bay.	While we consider the in-state economic impact of all earnings for harvesters' and processors' earnings, we ignore the in-state cost of travel between place of residency and place of work for participants in the commercial fishing industry.	Negligible
RECREATION: NON-CONSUMPTIVE USE		
Assumptions about the number of local resident visitors, non-local residents, and non-residents	Underestimate due to the potentially higher number of resident visitors (Fix, 2010).	Moderate
Assumptions about the level of expenditures per trip	Underestimate. Other sources state higher per trip expenditures for Southwest Alaska destinations ranging from $3,068 to $3,760 per person and trip (Colt and Dugan, 2005; Littlejohn and Hollenhorst, 2007).	Moderate
Regional allocation of non-consumptive expenditures	Unknown	Negligible
Assumption about the regional allocation of guide, charter, and lodge purchases.	Unknown	Negligible
Assumption about the residence of guide, charter, and lodge employees	Unknown	Negligible
RECREATION: SPORT FISHING & HUNTING		
Assumptions about the number of trips by local residents, non-local residents, and non-residents	Given the annual variations that occur in the number of visitors to Southwest Alaska the estimated economic significance for 2009 is not necessarily representative of historical or future economic significance.	Moderate
Assumptions about the level of expenditures per trip	Given the national recession and worldwide economic slump the annual variations in visitor expenditures, the estimated economic significance for 2009 is not necessarily representative of historical or future economic	Moderate

Description	Potential Bias	Sensitivity relative to overall results
	significance.	
Regional allocation of sport fishing and sport hunting expenditures	Unknown	Negligible
Assumption about the regional allocation of guide, charter, and lodge purchases.	Unknown	Negligible
Assumption about the residence of guide, charter, and lodge employees	Unknown	Negligible
Capital expenditures related to residents' boats, cabins, and other equipment	We ignore capital expenditures related to equipment due to the difficulty of apportioning a usage-share to specifically sport fishing or hunting in the Bristol Bay region.	Moderate
SUBSISTENCE		
Assumption of number of households engaged in subsistence activities	Unknown	Moderate
Assumption about the level of expenditures on subsistence per household	Unknown. Estimate is from the North Slope of Alaska where there is a different subsistence culture compared to Bristol Bay. Similar subsistence surveys in Western Alaska indicate that the estimate used is justified. The direction of bias is unknown.	Moderate
Assumptions about the composition of subsistence related expenditures	Unknown	Negligible
Assumption about the regional allocation of subsistence-related expenditures	Unknown	Negligible

Source: adapted from Goldsmith et al. (1998).

4.9 Data Sources

(Methods).
Expenditures that are excluded from the Input-Output modeling exercise are tax revenues generated through locally occurring economic activity, expenditures associated with natural resource management, and the commercial trapping industry. In addition, the study excludes the economic importance of herring fisheries in the Bristol Bay region. Compared to salmon, herring fisheries in Bristol Bay are much smaller amounting to $2.5 million in ex-vessel value in 2009 compared to salmon with $148 million (CFEC, 2009). We do not evaluate mineral exploration because it is not dependent on healthy ecosystems in the Bristol Bay region.

(Regional Economic Overview). There are three data sources related to jobs reported in the Bristol Bay region. The Alaska Department of Labor and Workforce Development offers annual average employment for wage earners (ADOL, 2009e) and information on participation in the commercial fisheries such as crew shares and processor employment (ADOL, 2009a-c). The third data source is an annual count of proprietors provided by the U.S. Bureau of Economic Analysis (BEA, 2009). Data from ADOL does not include fishing employment, but BEA provides an estimate of proprietors (including fish harvesters and other proprietors) in the region. Since ADOL data is measured in annual average jobs and the BEA data is a count of workers, we adjust the proprietor data to reflect seasonality assuming a six week harvesting season. Proprietors include local resident crew and local resident captains which are based on crew factors from ADOL (2004) and resident share of crew from ADOL (2009c). In addition, we use information on the number of local permits fished from CFEC (2009) to get an estimate of the number of local captains participating in the fishery. It is important to note that the ADOL data only provides employment estimates by place of work. The BEA proprietor data is based on income tax returns, thus the BEA proprietors counted in our analysis are only the ones that show a business address in the Bristol Bay region. Our analysis does not include businesses registered elsewhere in Alaska or out of state. Consequently, the proprietor data used in this study and shown in Table 2 is an underestimate of the jobs that likely exist. For this reason, employment estimates in Table 2 are not comparable to employment estimates elsewhere in the report.

(Commercial fisheries). For this study we divide the commercial fisheries sector into harvesting and processing. For the **harvest sector**, harvest data by residency of permit holder came from the Commercial Fisheries Entry Commission's Basic Information Tables (CFEC, 2009). Residency of captains is based on Iverson (2009). Residency of crew is unknown but was inferred from crew license data available at ADOL (2009a) for all commercial fisheries in the Bristol Bay region. ADOL (2009a) shows that local captains hire 1.46 local crew in all of Bristol Bay's commercial fisheries. Since the salmon fisheries are by far the largest fisheries in the region we assume that each local captain hires 1.46 local crew with the remainder of crew members coming from other places in Alaska. Non-local captains are assumed to hire exclusively non-local crew and non-resident captains exclusively non-resident crew. The crew size for Bristol Bay commercial salmon fisheries amounts to three including the skipper and is the same in the set net and drift gill net fisheries (ADOL 2004). Crew shares for the set net and drift gill net fisheries are based on a ten year average proportion of crew shares to gross earnings as stated in Schelle et al. (2004). In addition, Schelle et al. (2004) provides expenditure categories for harvesters for

the drift gillnet fishery. Due to a lack of data on expenditures in the set gill net fishery, we assume costs to be about half of what they are in the drift gill net fishery with lower insurance, moorage and storage and other boat related expenses due to the much smaller boats being used for set net operations. We further allocate these expenditures within a commodity by industry matrix to form a final demand vector that is passed to the ISER I-O Model following Goldsmith (2000). For the **processing sector,** we assume that 95 percent of the harvest is processed in the Bristol Bay region, including on-shore and off-shore processing. For simplicity, the Input-Output model assumes processor expenditures for off-shore processing to be similar to on-shore processing. Residency of processing workers is from ADOL (2009). Wholesale value for salmon roe and non-roe combined are from ADF&G (2009). Average processor yield is calculated based on the combined net product weight stated in ADF&G (2009) and pounds harvested (CFEC, 2009). Note, all direct jobs are in the Bristol Bay region. Multiplier jobs are divided between Bristol Bay and Southcentral Alaska. Multiplier jobs are assumed to be all taken by residents of the region where they occur. Peak and annual average direct wages are assumed to be equal.

(Recreation).
No comprehensive analysis has been completed on the economic significance of recreation and tourism in Southwest Alaska. One of the greatest challenges is estimating visitor volume for residents and non-residents. A number of separate studies provide some indication of pertinent levels and patterns of visitation activities. Non-resident visitation, length of stay, and expenditure per visitor to Southwest Alaska are from McDowell Group (2007a). Bluemink (2010) and the Alaska Travel Industry Association provided information on current trends in visitation and so did the National Park Service Commercial Use Authorization permit report data (National Park Service, 2010).

For this study we separated visitor impacts by residency and by type of activity. For **sport fishing and sport hunting**, Duffield and Neher (2002), estimated visitor volume and expenditures for sport fishing and sport hunting based on license data and visitor specific expenditure data from ADF&G (2009b). In addition, Duffield et al. (2007) conducted a lodge survey in the Bristol Bay region that offered detailed angler expenditure categories by residency, as well as expenditure detail for lodges and guiding outfits. After adjusting for inflation, we develop separate final demand vectors for sport hunting and fishing by residency. The analysis follows Goldsmith (2000) and Duffield et al. (2007). According to ADF&G's hunting regulations, the sport hunting season for moose, caribou and bear is mainly in the fall months and varies by area. For the calculation of annual average jobs, we assume the main season for sport hunting to be three months long (ADF&G, 2011).

We define **non-consumptive** users as those who reported wildlife viewing, camping, kayaking, hiking, or photography as their primary purpose of their visit. We adjust the most recent 2006 summer and winter visitor estimate for Southwest Alaska excluding Kodiak by applying the 2006-2009 percent difference in air travelers for Alaska overall (McDowell Group, 2007a & 2007b). The trend in air travelers to Alaska serves as the best indicator for changes to visitation in Southwest Alaska for two reasons. First, visitors to rural Alaska are mainly independent travelers, and second they primarily arrive by air in comparison to the statewide largest share of visitors who arrive by cruise ship. The Southwest Alaska region closely matches the Bristol Bay

study region with the exception of Kodiak and the Aleutian Islands. Our analysis excludes Kodiak but includes an insignificant portion of visitors to the Aleutian Islands.
Since Alaska Visitor Statistics Program counts out-of-state visitors only, we calculate visitor volume originating within the state based on Littlejohn and Hollenhorst (2007) and Colt and Dugan (2005) resident share of between ten and eleven percent. We treat visitation to Katmai NPP separate from other areas of the Bristol Bay region. Visitor volume and expenditure for Katmai NPP are from Fay and Christensen (2010) and for the remaining Bristol Bay area are from McDowell Group (2007a). We net out sport fishing and hunting visitation in Katmai NPP using Littlejohn and Hollenhorst (2007) and for the rest of the region by applying the McDowell Group (2007a and 2007b) estimate. We assume equal expenditures for residents and non-residents because the non-resident per person expenditure estimate in both cases does not include the cost of travel to and from Alaska. For the expenditure categories associated with non-consumptive use, we modeled the final demand vector based on Fay and Christensen (2010). These expenditures categories include transportation within Alaska, food, lodging, guiding services, supplies, licenses, etc. For most non-residents all in-state travel expenditures are included, based on the assumption that the primary reason for the travel to Alaska is the visit the Bristol Bay region. We allocated these expenditures within a commodity by industry matrix to form the final demand vector that's then passed to the ISER I-O Model developed by Goldsmith (2000). For all of these estimates, we paid special attention to the potential for double counting and addressed those issues.

Note, all direct jobs are in the Bristol Bay region but the residency of workers and the location where these workers spend their income is difficult to trace. Multiplier jobs are divided between Bristol Bay and Southcentral Alaska. Multiplier jobs are assumed to be all taken by residents of the region where they occur. Peak and annual average direct wages are assumed to be equal.

(Subsistence).
We estimate **annual expenditures related to subsistence** activities for households based on the only publically available source (North Slope Borough, 1993) and adjust for inflation to 2009$. This estimate is justified as results from similar subsistence surveys are similar (Peterson et al., 1992). We assume that every household in the region participates in subsistence activities with varying degrees of involvement and expense. We assume Native households to be participating in subsistence extensively resulting in the entire per household expenditure, whereas Non-Native households are assumed to be less involved with about a quarter of expenditures related to subsistence activities compared to Native households as indicated by North Slope Borough (1993). Due to the lack of data, the economic significance is quite small if compared to commercial fishing or non-consumptive use, both in terms of the market jobs and the payroll generated. For the **expenditure categories** related to subsistence, we assume maintenance and repair of boats and trucks to amount to 10% of total annual expense each, purchase of boats and trucks (10% each), hunting equipment (7%), fuel, repair, and parts (13% each).

Note, all direct jobs are in the Bristol Bay region. Multiplier jobs are divided between Bristol Bay and Southcentral Alaska. Multiplier jobs are assumed to be all taken by residents of the region where they occur. Peak and annual average direct wages are assumed to be equal.

5.0 Bristol Bay Net Economic Values

The second general accounting framework under which ecosystem services can be measured is the Net Economic Value (NEV) framework. Net economic value is the value of a resource or activity that is over and above regular expenditures associated with engaging in an activity or visiting a resource area. The framework for this accounting perspective is the standard federal guidelines for estimating net economic benefits in a system of national accounts (Principles and Standards, U.S. Water Resources Council 1985). EPA (2010) is a more recent and complementary set of guidelines.

5.1 Commercial Fisheries

In addition to the regional economic impact of commercial fish harvest in the Bristol Bay, the commercial fishery has a net economic value related to the expected differences over time between the *ex vessel* revenues and the costs of participating in this fishery. One method for estimating this value is to look at the market prices for commercial fishing permits in the Bristol Bay. Bristol Bay commercial fishing permits are of two types, drift net permits and set net permits. Regulations closely control many aspects of this permitted commercial harvest, including types of nets, size of boats, areas fished, and start and end dates of season. The value of holding one of these perpetual commercial permits is reflected in the prices that these permits command when they are transferred between owners. These market prices reflect the value that commercial operators place on their right to fish the region. That value in turn is a judgment of the value of the net income stream that would reasonably be expected from operating the permit given current and expected future salmon harvest levels and salmon prices.

In 2011, there were 1,862 salmon drift net permits in the Bristol Bay fishery and 981 salmon set net permits in the fishery. Every year a portion of these permits are sold and change hands. Since 1991, an annual average of 155 drift net permits and 89 set net permits have been sold and changed hands in the Bristol Bay fishery.[27] Permit transfers each year generally account for approximately 8% to 10% of all issued salmon permits in the fishery.

The Commercial Fish Entry Commission also reports average permit transfer prices annually (and monthly) for the Bristol Bay salmon fishery.[28] Over the period from 1991-2011 the average sales price for Bristol Bay drift net permits has been $149,000 (in constant 2011 dollars). The average price for set net permits over the same period has been $42,200. The 95% confidence interval on the mean drift net price for this period ranges from $105,500 to $192,700. For the set net permit transfers, the 95% C.I. on the mean sales price was between $28,700 and $55,700.[29] Table 65 presents the estimated 95% C.I. range of total Bristol Bay drift and set net salmon permit value based on the 1991-2011 permit transfer data. For both types of permits it is

[27] The Alaska Fish and Game Commercial Fish Entry Commission publishes annual data on permit transfers at, http://www.cfec.state.ak.us/RESEARCH/12-1N/12-1N.htm

[28] A long time series of monthly and annual permit transfer prices is continuously updated at, http://www.cfec.state.ak.us/pmtvalue/mnusalm.htm

[29] Over the period 1991-2011, a total of 3,246 Bristol Bay drift net salmon permits and 1,867 set net salmon permits were reported sold by the Commercial Fish Entry Commission.

estimated that the total value of the permits ranges from approximately $225 million to $414 million.

In order to be comparable to other annual net economic values in this analysis (such as sport fishing or sport hunting) the market value of commercial fishing permits must be converted into an annual value reflecting expected annual permit-related net income. The market value of the permits can be annualized using an appropriate amortization (or discount) rate. The decision to sell a commercial fishing permit at a given price is an individual (or private) decision. In deciding on an acceptable sales price, a permit holder considers past profits from operating the permit, risk associated with future operation of the permit (both physical and financial), and many other factors. All these considerations weigh on how heavily a permit seller discounts (reduces) potential future profits from fishing the permit in order to arrive at a lump-sum value for the permit. Huppert et al. (1996) specifically looked at Alaska commercial salmon permit operations and sales and estimated the individual discount rate on drift net permit sales in the Bristol Bay and surrounding fisheries. This discount rate was estimated from both profitability and permit sales price data. Huppert et al. estimated the implied discount rate appropriate for annualizing permit sales prices in this setting at 13.52%. This estimate was consistent with previous estimates for the fishery.[30] Use of the 13.52% discount rate from Huppert results in an estimated annual permit net profit or net income associated with Bristol Bay commercial salmon fishing of between $30.4 million and $55.9 million.

Table 65. Current Bristol Bay Salmon Fishing Permit Numbers and sale prices, 2011

Permit type	***Number of permits***	***Current market value***		***Total***	
		Lower Value - 95% Confidence Interval	***Upper Value - 95% Confidence Interval***	***Lower Value - 95% Confidence Interval***	***Upper Value - 95% Confidence Interval***
Salmon (Drift net)	1862	105,500	192,700	196,500,000	358,800,000
Salmon (Set net)	981	28,700	55,700	28,100,000	54,700,000
Total				224,600,000	413,500,000
Estimated annual net income (at 13.52% real discount rate)				**$30,400,000**	**$55,900,000**

Just as there is an implied net economic value associated with the fishing aspect of the Bristol Bay commercial salmon fishery, as outlined above, there is also a net economic value associated with expected future profits from investments in fish processing facilities in the region. Data on Bristol Bay salmon processor average aggregate profit levels is not published. Table 31, above, shows estimated profit (loss) margins for two years. Clearly, as with permit prices, processor

[30] Huppert, Ellis and Nobel (1996) estimated the real discount rate associated with sales of Alaska drift gill-net commercial permits of 13.52%. Karpoff (1984) estimated the discount rate from sales of Alaska limited entry permits at 13.95%.

profits are highly variable year-to-year. The average value-added associated with salmon processing for the Bristol Bay fishery is generally equal to or more than the ex-vessel value. Salmon processors in the Bristol Bay fishery have an "oligopsony" market structure, in that a small number of buyers of raw fish exist in the market. Additionally, these buyers are largely "price makers" in that they set the price paid per pound to fishermen each season. Given the unique relationship between fisherman that the small number of processors in the Bristol Bay, it is estimated that processors derive profits (net economic value) equal to that earned by fishermen. Therefore, for the purposes of this report it is estimated that the NEV for salmon producers is equal to that for the fishing fleet.

A second estimate of estimated annual net income for the Bristol Bay commercial salmon harvest and processing sectors is derived from data presented in a 2003 study of the industry (Link et al. 2003). The 2003 report, titled "An analysis of options to restructure the Bristol Bay salmon fishery", includes estimates of both Bristol Bay harvester and processor annual profits (net income) for the period 1990-2001. These estimates can be scaled to 2011 values using both changes in general price levels (CPI-U) and changes in harvester permit values. The table below (Table 66) shows the estimation of 2011 harvester and processor net income estimated from the Link et al. (2003) report.

Use of this second set of net income estimates and assumptions leads to a calculation of estimated harvest and processing sector net income that is near the upper 95% bound of the estimates calculated in this report. While the analysis based on 1990-2001 data presented above does suggest that the Table 65 analysis significantly undervalues the harvest sector, while the assumption of an equal processing sector net income somewhat overvalues the processing sector. The net effect is that the range of values for the combined harvest and processing sectors include values significantly below the estimate developed by the second (Table 66) analysis above. For purposes of presenting a conservative range of value estimates for the commercial salmon sector, an estimate of total harvester and processor net incomes from $60.8 to $111.8 million is used.

Table 66. Estimation of Total 2011 Net Income for the Bristol Bay Salmon Harvest and Processing Sectors based on Reported 1990-2001 Net Income (Link et al. 2003).

Parameter	Assumption/operation	Value
(A) BB Commercial Salmon Harvester Sector Average Annual Net Income Estimation		
Average 1990-2001 harvest sector net income	Data from Link et al (2003). Table 12 (p.43).	$93.7 million
Average annual BB commercial salmon fishing sector net income (1990-2001) in 2011 dollars	Annual values updated to 2011 dollars using CPI-U	$113.15 million
Adjusted 2011 profitability based on differences between 1990-2001 average permit values and 2011 permit values	The correlation between profitability in year X and permit sales price in year x+1 for this period is 0.857. Based on this observed close relationship, net income is scaled by the ratio of 2011 permit prices to the average 1990-2001 price, or by 79.27%	$89.69 million
(B) BB Salmon Processing Sector Average Annual Net Income Estimation		
Average BB net income of the salmon processing sector for the years 1990-2001 in 2011 $. (Link et al. 2003)	There is no observed correlation between processor profits and permit prices (r=0.053). Average processor profits are assumed to be a constant 23.3% of harvester profits (the average ratio observed in the 1990-2001 data by Link (2003))	$20.90 million
(C)Estimated Sum of Harvest and Processing Sectors Average Annual Net Income		
Total estimated annual harvester and processor net income (2011$) derived from 1990-2001 data		$110.59 million
(D) Estimated Range of Harvest and Processing Sector Average Annual Net Income		
Range of estimates developed in this analysis		$60.8 to $111.8 million

5.2 Subsistence Harvest

The Alaska Department of Fish and Wildlife, Division of Subsistence reports that most rural families in Alaska depend on subsistence fishing and hunting. ADF&G surveys of rural

communities find that from 92% to 100% of sampled households used fish, 79% to 92% used wildlife, 75% to 98% harvested fish, and 48% to 70% harvested wildlife. Because subsistence foods are widely shared, most residents of rural communities make use of subsistence foods during the course of the year. The subsistence food harvest in rural areas constitutes about 2% of the fish and game harvested annually in Alaska. Commercial fisheries harvest about 97% of the statewide harvest, while sport fishing and hunting take about 1%. Though relatively small in the statewide picture, subsistence fishing and hunting provide a major part of the food supply of rural Alaska (Subsistence in Alaska, a 2000 Update http://www.subsistence.adfg.state.ak.us/download/subupd00.pdf).

The Alaskan subsistence harvest is not traditionally valued in the marketplace. Because the subsistence resources are not sold, no price exists to reveal the value placed on these resources within the subsistence economy. The prices in external markets, such as Anchorage, are not really relevant measures of subsistence harvest value. The supply/demand conditions are unique to the villages, many of which are quite isolated. Native preferences for food are strongly held and often differ from preferences in mainstream society. Additionally, because these are highly vertically-integrated economies, substantial value-added may occur before final consumption (such as drying, or smoking fish and meats). In their research on estimating the economic value of subsistence harvests, Brown and Burch (1992) suggest that these subsistence harvests have two components of value, a product value, and what they call an "activity value." The product value is essentially the market value of replacing the raw subsistence harvest. The activity value would primarily include the cultural value of participating in a subsistence livelihood. The activity value component is also associated with the value of engaging in subsistence harvest and food processing activities. This activity value would include maintaining cultural traditions associated with a subsistence livelihood.

Duffield (1997) estimated the value per pound of Alaskan subsistence harvest though use of a cross-sectional hedonic model of community-specific harvest per capita and community per capita income levels. This "wage-compensating differential model" essentially estimates the average tradeoff across communities between per-capita subsistence harvest (in pounds of usable harvest) and per capita income levels. In essence, residents of rural Alaskan communities tradeoff the opportunity to have higher income in a less rural environment with the opportunity to harvest larger amounts of subsistence resources in more rural communities.

There is a substantial economics literature that utilizes the hedonic wage, or wage compensating differential model. For example, estimates of the trade-off of wages and workplace risk of mortality are the basis of the statistical value of life estimates widely used in regulatory analysis of ambient air and other standards (EPA 2008). There is also a literature that relates wages and amenity values as revealed through choice of location (e.g. Henderson 1982, Clark and Khan 1988). These later models are generally applied to intercity data sets, such as across U.S. Standard Metropolitan Statistical Areas (SMSA) These models are also used to estimate the benefits and costs of climate change (e.g. Maddison and Bigano 2003).

The application of a compensating wage model to a cross-section of Alaska Villages and towns is consistent with the view that these Alaska cash-subsistence economies are not just a transitory

phase in economic development. Rather the village economies represent an equilibrium that is a function of individual choice of where to live and work (Wolfe and Walker 1987; Kruse 1991).

Wolfe and Walker (1987) were the first to estimate a statistical relationship between wage income and subsistence livelihoods using harvested usable pounds as a measure of subsistence productivity. Wolfe and Walker were interested in factors that influenced subsistence productivity, including construction of roads, settlement activity and income. The data was based on extensive surveys of Alaska villages undertaken by the applied anthropology group at Alaska Fish and Game, Division of Subsistence. Duffield (1997) used the Wolfe and Walker dataset for 98 villages in a compensating wage specification to inform subsistence harvest valuation in the context of the Exxon Valdez oil spill litigation. Hausman (1993), who represented the defendant in the case (Exxon) also estimated a compensating wage model using the Wolfe and Walker dataset. Hausman introduced the use of applying an instrumental variable approach to estimating the model, since wages and subsistence harvests are jointly determined.

Hausman's (1993) estimate of the value of subsistence harvests (1982 dollars) was $33.60 per pound and Duffield's (1997) was quite similar at $32.46. The estimated Hausman and Duffield harvest income models are now based on 30 year-old data. Indexing these results using average Alaska personal income per capita suggests that were this same relationship to hold today, total subsistence harvest NEV would be on the order of $75.58 per pound. In order to avoid making the assumption that the income—harvest relationship observed in the early 1980s was still valid, the Duffield (1997) model was updated using the most recently available per capita income,[31] subsistence harvest,[32] education,[33] and cost of living data[34] for the 90 communities included in both the Hausman and the Duffield models.

The updated estimated wage compensating differential model shown in Table 66 uses a two-stage least squares methodology and a linear specification. The two-stage least squares method is used to statistically address the fact that income and harvest levels in the communities are at least partly co-determined. The first stage of the model uses an instrumental variable (the percent of adults in each community with 4 or more years of college education) along with the remaining regional indicator variables to predict adjusted gross income per capita for each community. This predicted income level then was used in the second stage regression. The model explains 54% of the observed variation in harvest levels across communities, and a large majority of the 14 explanatory variables are significant at the 90% level of confidence or greater. The implied value per pound of subsistence harvest is calculated from the parameter estimate for Adjusted Gross Income Per Capita. The implied value per pound is the negative inverse of the income parameter (-0.01162). [(1/-0.01162)*-1 = $86.06]

[31] American Community Survey 5-year averages 2006-2010 (Table B19301) www.census.gov/acs/
[32] Alaska Fish and Game Department of Subsistence , http://www.adfg.alaska.gov/sf/publications/
[33] American Community Survey 5-year averages 2006-2010 (Table GCT1502) www.census.gov/acs/
[34] McDowell Group, Alaska Geographic Differential Survey: 2008.

Table 67. Estimated Two-Stage Least Squares Wage Compensating Differential Model of Subsistence Harvest in 90 Alaska Communities (Duffield 1997).

Variable	Parameter Estimate
Intercept	936.45 (137.89)***
Adjusted Gross Income Per Capita	-0.01162 (0.0051)**
Alaska Peninsula	-174.227 (119.08)
Copper Basin	-522.132 (86.37)***
Kenai Peninsula	-448.975 (120.61)***
Kodiak	-465.551 (111.31)***
North Slope	227.2387 (172.49)
NW Arctic	-112.557 (227.61)
N Cook Inlet	-548.580 (230.87)**
Prince William Sound	-248.607 (173.95)
South East	-314.787 (103.27)**
South West	-265.364 (101.56)**
Upper Tanana	-514.022 (130.35)***
Urban	-590.972 (169.66)***
West	-22.1552 (105.28)
Observations	90
R-Squared	0.536
Endogenous Variable	Adjusted Per Capita personal income (BEA 2010) (adjusted to Anchorage dollars using cost-of-living index)
Instrumental Variable	% of adults with 4 or more years of college (plus region indicator variables)

*=significant at 90% confidence level; **=significant at 95% confidence level; ***=significant at 99% confidence level.

One difference between the Hausman and Duffield models and the updated subsistence model is in the per capita income measure used. Hausman and Duffield both used Alaska Department of Revenue data on community level adjusted gross income (AGI). However, Duffield's updated model utilized average community per capita personal income. This second measure is the more appropriate income measure in that it includes certain amounts that are deducted from total income in the calculation of AGI. The updated income measure is consistently larger than the Alaska AGI originally used, with the latter being on average an estimated 70% of the former.[35] The magnitude of the income measure used is directly proportional to the estimated value of subsistence harvest NEV per pound calculated from the estimated model income parameter. For purposes of this report, a range of values in the following analysis uses both the estimated $86.06 value, based on the updated dataset and adjusted per capita personal income, and a lower bound estimate of $60.24 per pound ($86.06*0.70) based on the assumption of consistently using Alaska AGI.

Based on both the Hausman (1993) and Duffield (1997) analyses, in principle the correct way to value subsistence harvests is to use the compensating wage differential approach. With reference to the Brown and Burch (1992) perspective, the compensating wage estimate includes both product and activity value. Duffield (1997) also reports a replacement cost estimate of just product values for subsistence harvests at $13.28 per pound.[36] In 2009 dollars, this product value is estimated at $18.86 per pound.[37]

Table 67 shows the accounting of ADF&G Division of Subsistence estimates of total annual subsistence harvest in most communities in Bristol Bay. This total has been adjusted to include population in the region not included in the ADF&G subsistence harvest estimates. In total, we estimate that about 2.6 million usable pounds of subsistence harvest per year occur in the Bristol Bay region. Valued at an estimated range of $60.24 to $86.06 per pound, this harvest results in an estimated net economic value annually for subsistence harvest of between $154.4 and $220.6 million (Table 69).

[35] http://www.irs.gov/uac/SOI-Tax-Stats---Historical-Data-Tables "Table 4. Comparison of Personal Income in the National Income and Product Accounts (NIPA) with Adjusted Gross Income (AGI). For Specified Tax Years, 1990-2005).

[36] This value is the simple average of the replacement cost of lost harvest between two definitions of households in the Duffield (1997) paper. p. 109, Table 4.

[37] It should be noted that a significant component of subsistence harvest in some communities is marine mammals, a resource with a very high market replacement cost.

Table 68. Estimated Total Annual Bristol Bay Subsistence Harvest (usable pounds of harvest)

Bristol Bay Area Community /year of harvest data	Total Usable Pounds Raw Subsistence Harvest
Aleknagik 1989	64,824
Clark's Point 1989	75,020
Dillingham 1984	563,618
Egegik 1984	41,856
Ekwok 1987	91,655
Igiugig 2005	27,100
Iliamna 2004	51,121
King Salmon 2008	117,062
Kokhanok 2005	115,600
Koliganek 2005	187,891
Levelock 2005	36,363
Manokotak 2000	131,716
Naknek 2008	143,616
New Stuyahok 2005	198,390
Newhalen 2004	131,480
Nondalton 2004	58,712
Pedro Bay 2004	12,852
Pilot Point 1987	26,112
Port Alsworth 2004	21,147
Port Heiden 1987	41,616
South Naknek 2008	21,172
Ugashik 1987	9,768
Togiak City 2000	200,982
Twin Hills 2000	36,926
Total surveyed communities	2,406,599
Un-surveyed communities (estimated)	156,714
Total including un-surveyed areas	**2,563,313**

Source: Estimates of community-specific subsistence harvest levels are contained within the Subsistence Technical Report Series, available at, http://www.adfg.alaska.gov/sf/publications/

It should be noted that although the total annual value of subsistence harvests implied by the wage compensating differential model is large, simply the market replacement cost of these resources is fully 32% of the lower-bound estimate and 22% of the upper-bound estimate. In addition to simply procuring the usable pounds of raw subsistence harvest, many of these resources have substantial value-added in the form of processing by drying, smoking, or other preserving, cleaning, or other processing methods. This value-added is also captured within the context of the wage compensating differential model.

Another perspective on the revealed economic significance of subsistence harvests in Bristol Bay is seen by comparing the implied NEV associated with subsistence activities and reported per capita income in the region. For the 7,475 Bristol Bay residents (74% of who are Native Alaskan) subsistence harvests valued at $60.24 per pound imply that the value of these harvests are about 34% of their total combined per capita 2009 personal income (as reported by BEA) plus estimated total subsistence value. Valued at $86.06 per pound, subsistence harvest value is

about 42% of total income and subsistence value. Another component of subsistence value is the relative effort or allocation of time put into the subsistence sector instead of spending time in the cash income sector. The effort put into the subsistence sector is estimated to be the same or more than the full-time equivalent jobs included in the cash sector.

Table 69. Estimated Net Economic Annual Value of Bristol Bay Area Subsistence Harvest

Estimates of Subsistence Value	Per Pound Value	Total Subsistence Harvest	Total Annual Value (Million 2009 $)
Value based on Harvested Product Value	$18.86	2,563,313	$48.3
Value based on Wage Compensating Differential Approach (Adjusted to AK DOR AGI income measure))	$60.24	2,563,313	$154.4
Value based on Wage Compensating Differential Approach (Based on BEA per capita personal income measure)	$86.06	2,563,313	$220.6

5.3 Sport Fishing Net Economic Value

In addition to the direct expenditures that Bristol Bay area sport anglers make each year, there is substantial net economic value attached to the trips these anglers take to the region. A measure of the net economic value of sport fishing trips is the amount anglers are willing to pay over and above the costs of their trips. The 2005 Bristol Bay angler survey asked respondents a series of questions relating to what they spent on their fishing trip, and how much, if any, more they would have been willing to spend to have the same experience. This willingness to pay is also referred to as net economic benefit. There is a large economics literature on estimating sport fishing net economic benefits (Rosenberger and Loomis 2001). The method for estimating these benefits here is contingent valuation using the so called "payment card" question format.

Respondents were presented with a set of amounts ranging from $0 to $2,000, and asked to mark the greatest additional increase in spending they would have made to take the same trip. Table 72 shows the mean willingness to pay estimate for the two groups. The net economic value from the survey data was estimated using an interval estimation model.

Following questions on their trip expenditures, survey respondents were asked whether they felt their trip was worth more than the amount they actually spent. Those who answered "yes" were then asked, "What is the largest increase over and above your actual costs that you would have

paid to be able to fish your primary destination?" Respondents were presented with a series of dollar amounts ranging from $10 to $2,000. Table 70 shows the percentage of both resident and nonresident Bristol Bay anglers who responded that they would have paid the various additional amounts to take their Bristol Bay fishing trip.

Table 70. Responses to Current Trip Net Economic Value Question

	NONRESIDENTS	***RESIDENTS***
	Percent	**Percent**
Willing to Pay More	**63.0%**	**73.3%**
$ 10	1.1%	0%
$ 25	0.3%	2.1%
$ 50	0.2%	3.6%
$ 100	6.2%	16.5%
$ 250	16.2%	20.5%
$ 500	15.9%	7.5%
$ 750	2.5%	3.6%
$ 1,000	9.1%	0%
$ 1,500	3.7%	0%
$ 2,000	2.3%	3.6%
Other amount	4.3%	15.7%

The estimates of willingness to pay models based on the Table 70 data were developed using a maximum likelihood interval approach (Welsh and Poe 1998). As noted, respondents were asked to choose the highest amount he or she was willing to pay from a list of possible amounts. It was inferred that the respondent's true willingness to pay was some amount located in the interval between the amount the respondent chose and the next highest amount presented. The SAS statistical procedure LIFEREG was used to estimate the parametric model of willingness to pay based on the underlying payment card responses.

Table 71 shows the estimated parametric willingness to pay for trips to Bristol Bay fisheries. Nonresident anglers state their trip was worth approximately $500 more, on average, than they actually paid. Resident Bristol Bay anglers stated they were willing on average to pay an additional $352 for their most recent trip. These estimates are similar to other estimates for Alaska sport fishing (Duffield et al. 2002; Jones and Stokes 1987).

Table 71: Estimated Mean Willingness to Pay for Anglers' Recent Trip to Bristol Bay

Statistic	*Non-residents*	*Residents*
Estimated mean willingness to pay in addition to trip costs for those willing to pay more	$793	$480
Percent of respondents willing to pay more for their trip	63.0%	73.3%
Net willingness to pay for Bristol Bay fishing trips for all anglers	$500	$352

The net economic value per trip estimates shown in Table 71 were calculated from the results of a bivariate statistical model of the payment card response data using a variant of survival analysis to examine censored interval data. The chi-square test of significance for the key parameters from these models show the estimated coefficients to be statistically significant.

Based on an estimated annual use level of 12,464 trips for nonresidents, and 16,903 trips for Alaska residents, we estimate that the annual net economic value of fishing trips in the Bristol Bay region is approximately $12.2 million.

Table 72. Estimated Willingness to Pay for Sportfishing Fishing in the Bristol Bay Region

	Residents	***Nonresidents***
Estimated mean net willingness to pay	$ 352	$ 500
Estimated number of trips/year	16,903	12,464
Total estimated Net Economic Value	$5,950,093	$6,228,350
Total annual value		$12,178,443

5.4 Sport Hunting Net Economic Value

As in the case of sport fishing, there is additional value associated with sport hunting, above what is actually spent on the activity. Table 73 details the estimation of annual net economic value of big game hunting in the Bristol Bay region. Table 73 utilizes ADF&G estimates of hunter numbers in the game management units associated with the Bristol Bay area, and on estimates of net willingness to pay per trip for hunting (from Miller and McCollum 1994, adjusted to current, 2009 dollars). It is estimated that nonresident net economic value of Bristol Bay hunting is approximately $1 million annually. The annual net economic value of big game hunting in the Bristol Bay region for Alaska residents is estimated at about $380,000. Therefore the total annual estimated net economic value of big game hunting in this region is $1.4 million.

Table 73. Estimated annual big game hunting net economic value for Bristol Bay region

Species / Statistic	*Nonresidents*			*Non-local residents*		
	trips	Value/ trip	NEV	Trips	Value/ trip	NEV
Moose	352	$581	$ 204,549	291	$ 268	$ 77,998
Caribou	230	$ 640	$ 147,298	311	$ 250	$ 77,892
Brown bear	741	$ 897	$ 665,028	717	$ 307	$ 220,535
Total			$ 1,017,000			$ 376,000

5.5 Wildlife Viewing and Tourism Net Economic Value

The 1991 study by McCollum and Miller estimated the net economic value of wildlife watching trips in Alaska. These values adjusted to current dollars results in an estimated value per trip of $199. Using the 40,164 visitor trips to the region we estimate a 2009 net economic value of wildlife watching of about $8.1 million.

5.6 Total Net Economic Value and Present Value and Inter-temporal Issues

Commercial salmon fishery net economic values for fishermen are derived by annualizing the total value of the perpetual permits to fish the Bristol Bay waters held by fishermen. The value of these permits is reflected in the prices paid for them when they are exchanged in an open market and reported by the Commercial Fish Entry Commission. These are on the order of $156,000 for a drift gillnet permit in 2011, and have been as high as $200,000 as recently as 1993.

The total value of Bristol Bay permits—calculated as the number of permits multiplied by the permit price—provides an estimate of the total present discounted value of expected future profits from the fishery. Based on 1991-2011 average permit sales prices (in constant 2011 dollars) the estimated 95% confidence interval on the total value of Bristol Bay permits (both drift net and set net fisheries combined) was between $224.6 million and $413.5 million.

Multiplying the total value of a permit by the rate of return a permit holder demands on a permit investment provides a measure of the annual profit permit holders expect to earn. Using a 13.52% amortization (or discount) rate estimated by Huppert et al. (1996) suggests that annual expected profits (net economic value) from Bristol Bay commercial fishing is currently between $30.4 million and $55.9 million. Note that this does not include expected profits from fish processing.

Net income for the processing sector is more difficult to estimate. Relative to the fishing sector, with ex-vessel value of $181 million in 2010, the processing sector provides an approximately equal value added of $209 million in 2010 (first wholesale value of $390 million in 2010 less the cost of buying fish at the ex-vessel cost of $181 million (Figure 79). However, information on profits or net income for this sector is difficult to obtain. For purposes of this report, net income in the processing sector is assumed to be equal to the value for the fishing fleet.

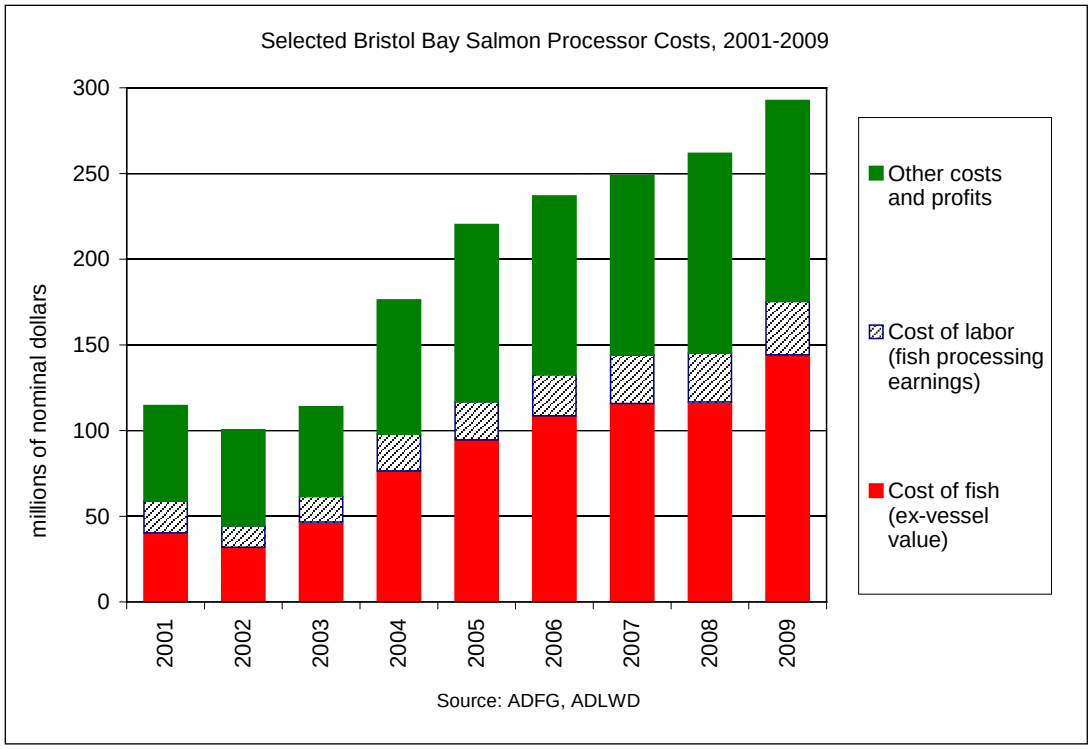


Figure 79. Selected Bristol Bay Salmon Processor Costs: 2001-2009

The sportfish net economic values are angler recreational benefits (consumer surplus) in Duffield et al. (2007). These estimates are consistent with values from the extensive economic literature on the value of sportfishing trips (for example Duffield, Merritt, and Neher 2002). Sport hunting values are based on studies conducted in Alaska by McCollum and Miller (1994). Annual direct use net economic values for recreation use of the Bristol Bay area is estimated to be $22.1 million, including $12.2 million for sport fishing, $1.8 million for sport hunting, and $8.1 million for wildlife viewing and other tourism. In addition to recreationist's net benefits, net income (producer's surplus) is recognized by the recreation and tourism industry. This is a component that remains to be estimated.
Subsistence harvests are valued based on the willingness-to-pay revealed through tradeoffs of income and harvest in choice of residence location (Duffield 1997).

Based on the National Research Council panel on guidelines for valuation of ecosystem services (NRC 2005), it is important to include intrinsic or passive use values (aka "non-use" values) in any net economic accounting of benefits (Figure 80).

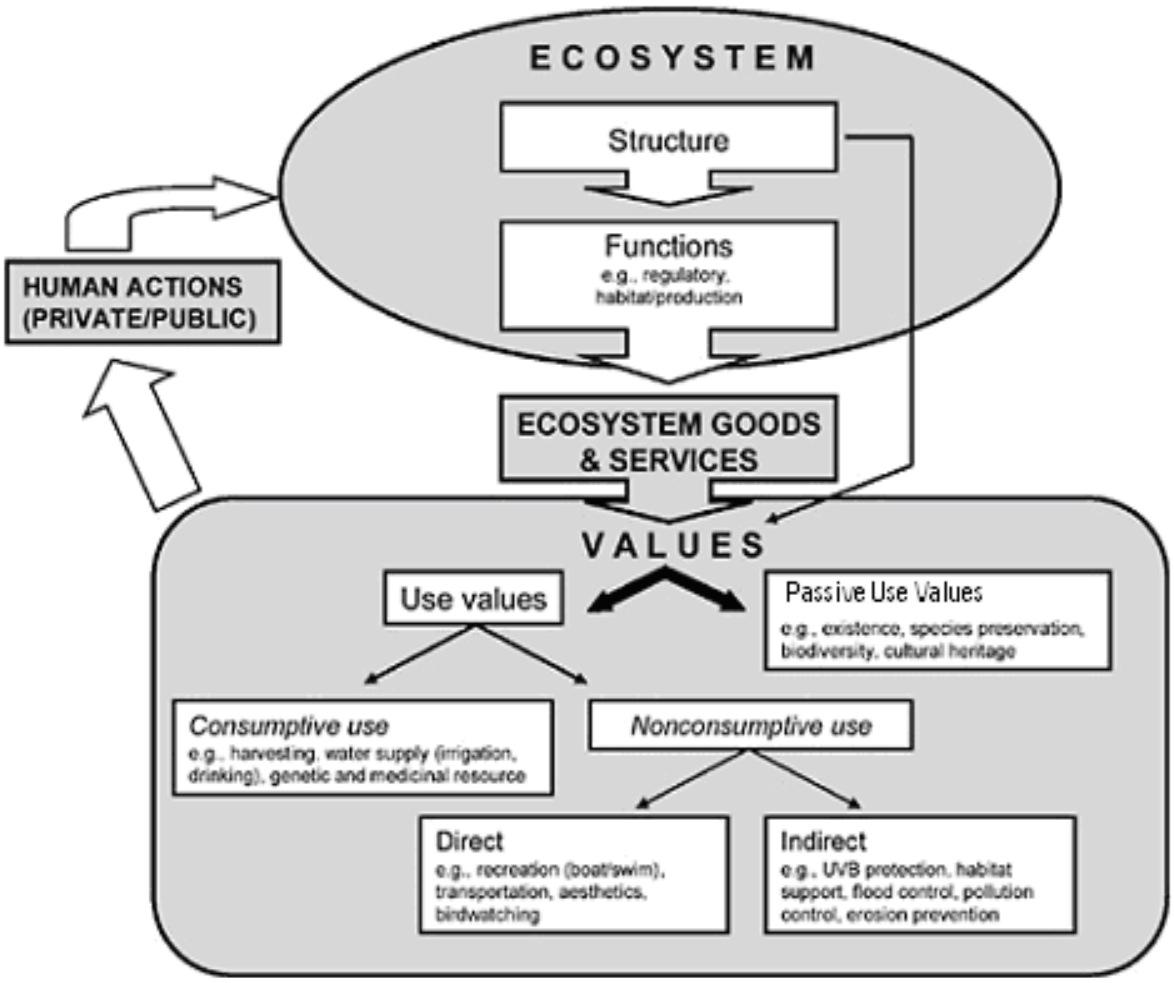


Figure 80. Flows of Ecosystem Services (adapted from (National Research Council 2005))

A major unknown is the total value related to existence and bequest motivations for passive use values. Goldsmith et al. (1998) estimated the existence and bequest value for the federal wildlife refuges in Bristol Bay at $2.3 to $4.6 billion per year (1997 dollars). There is considerable uncertainty in these estimates, as indicated by the large range of values. Goldsmith's estimates for the federal wildlife refuges are based on the economics literature concerning what resident household populations in various areas (Alberta, Colorado) (Adamowicz et al. 1991; Walsh et al. 1984; Walsh et al. 1985) are willing to pay to protect substantial tracts of wilderness. Similar literature related to rare and endangered fisheries, including salmon, could also be applied here. It is possible that from a national perspective the Bristol Bay wild salmon ecosystems and the associated economic and cultural uses are sufficiently unique and important to be valued as highly as wilderness in other regions of the U.S. Goldsmith et al.'s (1998) estimates assume that a significant share of U.S. households (91 million such households) would be willing to pay on the order of $25 to $50 per year to protect the natural environment of the Bristol Bay federal wildlife refuges. The number of these households used in Goldsmith's analysis is based on a willingness to pay study (the specific methodology used was contingent valuation) conducted by the State of Alaska Trustees in the Exxon Valdez oil spill case (Carson et al. 1992). These

methods are somewhat controversial among economists, but when certain guidelines are followed, such studies are recommended for use in natural resource damage regulations (for example, see Ward and Duffield 1992). The findings of the Exxon Valdez study were the basis for the $1 billion settlement between the State and Exxon in this case. Willingness-to-pay analyses have also been upheld in court (Ohio v. United States Department of Interior, 880 F.2d 432-474 (D.C. Cir.1989)) and specifically endorsed by a NOAA-appointed blue ribbon panel (led by several Nobel laureates in economics) (Arrow et al. 1993).

While the primary source of passive use values for Bristol Bay are likely to be with national households (lower 48), it is important to note that the Alaska natives living in Bristol Bay also likely have significant passive use values for the wild salmon ecosystem. For example, Boraas (2011) quotes Bristol Bay natives in saying "We want to give to our children the fish, and we want to keep the water clean for them…It was a gift to us from our ancestors, which will then be given to our children.) (Boraas p. 33).

Goldsmith's estimates for just the federal refuges may be indicative of the range of passive use values for the unprotected portions of the study area. However, there are several caveats to this interpretation. First, Goldsmith et al. estimates are not based on any actual surveys to calculate the contingent value specific to the resource at issue in Bristol Bay. Rather, they are based on inferences from other studies a method referred to as benefits transfer. Second, these other studies date from the 1980's and early 1990's and the implications of new literature and methods have not been examined. Additionally, the assumptions used to make the benefits transfer for the wildlife refuges may not be appropriate for the larger Bristol Bay study area which includes not only the wildlife refuge, but also two large national parks. This topic is an area for future research.

Table 74. Summary of Bristol Bay Wild Salmon Ecosystem Services, Net Economic Value per Year (Million 2009 $)

Ecosystem Service	Low estimate	High estimate
Commercial salmon fishery		
Fishing Fleet	$30.4	$55.9
Fish Processing	$30.4	$55.9
Sport fishing	$12.2	$12.2
Sport hunting	$1.4	$1.4
Wildlife viewing / tourism	$8.1	$8.1
Subsistence harvest	$154.4	$220.6
Total Direct Use Value	**$236.90**	**$354.10**

Table 74 details the estimates of annual net economic values for the major sectors tied to the Bristol Bay Ecosystem. The scope of this characterization report is to use existing data, information, and estimates to provide a comprehensive picture of the economic structure and associated values related to the Bristol Bay Ecosystem. The estimates shown in the table are based on a variety of sources and methods, and based on data and estimates from a range of years. These estimates have been presented in constant 2009 dollars.

Differences in net economic values across sectors are driven by several factors, including the number of individuals impacted, the type of market structure, and the scope of resources and resource services included in the estimates. For instance, the estimates for subsistence NEV are between 38% and 73% higher than for the commercial salmon fishery (and processing) sectors. These two sectors have several key differences, however. The market for commercial salmon is highly competitive, with other fisheries (as well as farmed salmon) providing strong price competition and thus keeping profits and implied NEV low in the sector. Additionally, the estimates of commercial fishery NEV are based on commercial fishing permit sales prices. These sales of generally less than 10% of active permits in a given year represent "marginal" prices, rather than the "average permit value" to all permit holders. Those permit holders who do not sell value their permits more highly than those who do. The commercial fishery NEV estimates, therefore, are based on conservative marginal values while the subsistence values are less conservative "average" values. A third difference between these estimates is that the commercial fishery NEV is narrowly tailored to salmon fishing and processing, while the subsistence harvest NEV includes all resources used (including land and marine mammals, fish, shellfish, and plants). Salmon harvest only accounts for about one-half of all Bristol Bay subsistence harvest (in usable raw harvest weight).

The estimates in Table 74 are for annual net economic values. Since these are values for renewable resource services that in principle should be available in perpetuity, it is of interest to also consider their present value (e.g. total discounted value of their use into the foreseeable future). Recent literature (OMB 2003; EPA 2010; Weitzman 2001) provides some guidance on the use of social discount rates for long term (intergenerational) economic comparisons.

The controlling guidance document for discounting in Federal cost benefit analysis, OMB Circular A-4 (2003), generally requires use of discount rates of 3% and 7%, but allows for lower, positive consumption discount rates, perhaps in the 1 percent to 3 percent range, if there are important intergenerational values. The circular states,

> "Special ethical considerations arise when comparing benefits and costs across generations. Although most people demonstrate time preference in their own consumption behavior, it may not be appropriate for society to demonstrate a similar preference when deciding between the well-being of current and future generations. Future citizens who are affected by such choices cannot take part in making them, and today's society must act with some consideration of their interest.
>
> One way to do this would be to follow the same discounting techniques described above and supplement the analysis with an explicit discussion of the intergenerational concerns (how future generations will be affected by the regulatory decision). Policymakers would be provided with this additional information without changing the general approach to discounting.
>
> Using the same discount rate across generations has the advantage of preventing time-inconsistency problems. For example, if one uses a lower discount rate for future generations, then the evaluation of a rule that has short-term costs and long-term benefits would become more favorable merely by waiting a year to do the analysis. Further, using the same discount rate across generations is attractive from an ethical standpoint. If one expects future

generations to be better off, then giving them the advantage of a lower discount rate would in effect transfer resources from poorer people today to richer people tomorrow.

Some believe, however, that it is ethically impermissible to discount the utility of future generations. That is, government should treat all generations equally. Even under this approach, it would still be correct to discount future costs and consumption benefits generally (perhaps at a lower rate than for intragenerational analysis), due to the expectation that future generations will be wealthier and thus will value a marginal dollar of benefits or costs by less than those alive today. Therefore, it is appropriate to discount future benefits and costs relative to current benefits and costs, even if the welfare of future generations is not being discounted. Estimates of the appropriate discount rate appropriate in this case, from the 1990s, ranged from 1 to 3 percent per annum." (p. 35)

The key question in deciding on an appropriate discount rate or range of rates for analysis is whether the Bristol Bay ecosystem is a resource of intergenerational significance. Clearly, this resource base and ecosystem that has been relied on for thousands of years by Alaska natives, and now has a long-term significance to a growing number of nonnatives, is the very definition of an intergenerational resource.

Weitzman (2001), conducted an extensive survey of members of the American Economic Association, and suggests a declining rate schedule, which may be on the order of 4 percent (real) in the near term and declining to near zero in the long term. He suggests a constant rate of 1.75% as an equivalent to his rate schedule. Weitzman's work is cited both in the EPA guidance (EPA 2000) and in OMB guidance (*Circular A-4* (2003)). Table 75 shows the estimated net present value in perpetuity of direct use values within the Bristol Bay Ecosystem. The table shows a range of alternative discount rates from the standard "intragenerational" rates of 7% and 3% to the more appropriate "intergenerational" rates for the Bristol Bay case of 1.75% and 1.0%. The entire range of NPV estimates in the table is from $3.4 to $35.4 billion. The range of estimated direct use NPV of the resource using the more appropriate intergenerational discount rates is from $13.5 to $35.4 billion. These estimates may be quite conservative as they do not include estimates of passive use values held by those living outside the Bristol Bay Region, but are limited to direct economic uses of the wild salmon ecosystem services.

Table 75. Estimated Net Present Value of Bristol Bay Ecosystem Net Economic Use Values and Alternative Assumed Perpetual Discount Rates

Estimate		Net Present Value (million 2009 $)			
	Annual Value	7% Discount	3% Discount	1.75% Discount	1% Discount
Low Estimate	$236.9	$3,384	$7,897	$13,537	$23,690
High Estimate	$354.1	$5,059	$11,803	$20,234	$35,410

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