Chapter 2
History and Management of the Fishery

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Chapter 2
History and Management of the Fishery

2.0 Introduction

This chapter includes a brief history of the Bristol Bay salmon fishery, including historical harvests and a background on limited entry and the maximum numbers of permits in the drift and set gillnet fisheries. It summarizes the current management of the fisheries, outlining the principle goals of management and providing detail on how those goals are achieved. The methods that biologists use to gather the information necessary to make their decisions is also summarized.

2.1 Overview of the Bristol Bay Area

The Bristol Bay management area encompasses all coastal and inland waters east of a line from Cape Newenham to Cape Menshikof (Figure 2.1). The area is divided into five fishery management districts that correspond to the major river systems; the districts are: Egegik, Ugashik, Naknek-Kvichak, Nushagak, and Togiak.[1]

The river systems of Bristol Bay support some of the largest runs of sockeye salmon in the world, with commercial harvests averaging approximately 18 million fish annually from 1965 to 2003.[2] Prices for sockeye salmon are typically higher than those paid for other species, making the Bristol Bay fishery the most valuable of Alaska's salmon fisheries. The Bristol Bay drift and set gillnet fisheries also have the highest numbers of permit holders in Alaska's salmon fisheries, with 1,857 potentially active entry permits in the drift gillnet fishery and 992 in the set gillnet fishery.[3]

Although sockeye salmon predominate and comprise approximately 91% of the pounds of salmon harvested in the region, four other species of Pacific salmon are also present and are commercially harvested. Chum and coho salmon are found in significant numbers in the Nushagak and Togiak Districts, with chum salmon caught incidentally during the sockeye fishery. The Nushagak River also produces the region's highest numbers of chinook and pink salmon. Pink salmon are most abundant in even-numbered years.

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[1] In 2004, the Alaska Board of Fisheries passed regulations creating an additional "general district" located outside the five main districts and extending seaward out to the 3-mile territorial sea limit. The regulations allow fishery managers to open the general district to drift gillnet fishing during the period June 7 through June 25. The general district was created in response to a forecasted large return of sockeye salmon in 2004. It is expected that fishing in the general district early in the season will allow a head start on harvesting – it could spread the harvest over a longer period of time, thereby avoiding some of the problems with lack of processing capacity during the peak of the run. The regulation is temporary and expires at the end of 2004.

[2] See Ken Middleton, *Bristol Bay Salmon and Herring Fisheries Status Report Through 1982*; ADFG Informational Leaflet No. 211, (1983) and the CFEC gross earnings data base.

[3] Number of entry permits on July 20, 2004.

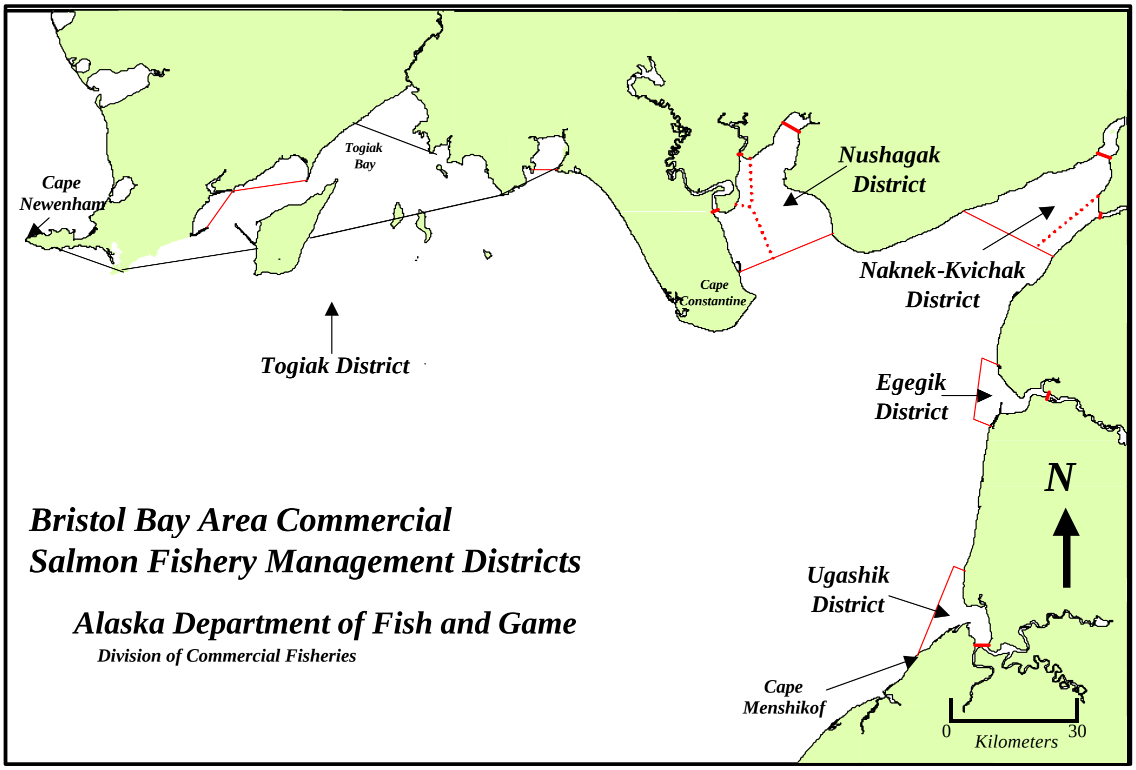

Figure 2.1

2.2 Sockeye Salmon Biology

Sockeye salmon (*Onchorhynchus nerka*), like all Pacific salmon, are anadromous, spending part of their life in freshwater and part in the ocean. Bristol Bay sockeye return from the ocean to their natal streams in late June and July. Female salmon deposit eggs in the gravel of clearwater streams and on lake beaches. After fertilization by male fish, embryonic eggs develop slowly until February or March, when they hatch into alevin fish. Alevins have an egg sac that is gradually absorbed; once absorbed, they are referred to as fly. By May, the majority of the fish leave the gravel substrate and move into the region's lake systems where they begin feeding. These juvenile fish remain in freshwater for 1 to 2 more years. Eventually, in the springtime of subsequent years, the fish - now called smolts - migrate to the ocean to begin the adult phase of their life. Nearly all sockeye spend either two or three years in the ocean before returning to spawn as mature adults.

This pattern of rearing in both freshwater and saltwater – with a varying number of years spent in each environment – means there are multiple age classes of returning fish each year. The offspring of these fish will, in turn, mature and spawn over several subsequent years. Biologists have developed a nomenclature to refer to the age classes. A 1.2 fish is a salmon that has spent 1 year in freshwater and 2 years in the ocean and is returning in its 4th year of life; a 2.3 fish has spent 2 years in freshwater and 3 in the ocean; and so on. Bristol Bay sockeye salmon returns are composed of four principal age classes of fish: 1.2; 2.2; 1.3; and 2.3.

Spawning systems are sometimes dominated by one or two age classes of fish. For example, adult sockeye returning to the Naknek River can be predominately age 1.3, whereas age 2.2 and 2.3 sockeye are more prevalent in the Egegik River. The reason for these dominate age classes is likely a mix of heritable traits and a function of the rearing habitat of the juvenile salmon.[4]

2.3 Historical Harvests

In Bristol Bay, commercial harvests of salmon began in 1883 when the transient schooner *Neptune* prospected for salmon on the Nushagak River, harvesting and salting fish.[5] By the end of that year, the Arctic Packing Company had constructed cannery buildings and was ready for operations in the summer of 1884. Within a short period of time, the river systems of Bristol Bay were recognized as having the highest runs of sockeye salmon anywhere in the world; harvests there represented more than one-half of the entire Alaska salmon production.

In the early 1900's, the number of harvested fish was directly related to the capacity of the fish processors. Abnormally inclement weather, fishery conservation restrictions, and fishermen striking for higher prices also sporadically impacted harvests. However, in more recent years, especially since Alaska statehood, processing capacity has not been as large an issue, and total harvests have been determined mainly by the number of returning salmon.

The total salmon return to Bristol Bay is strongly influenced by sockeye returns to the Kvichak River, which is historically the largest salmon producer in the region, and perhaps the largest in the world. The Kvichak sockeye return is highly variable, and has exhibited a pattern of oscillating cycles. In recent years, the Kvichak sockeye return has been weaker and has been classified as a "stock of management concern" by ADFG and the Alaska Board of Fisheries.

From 1900 through 2003, commercial harvests of all salmon in Bristol Bay averaged 15.6 million fish, nearly all of which were sockeye salmon. Figure 2.2 shows the variability of the harvests over the time period, which have ranged from 1.5 million fish in 1973 to 45.4 million in 1995.

Returns and harvests from 1970 to 1973 were exceptionally low and may have been the result of harsh winter weather during that time. By 1978, however, returns and harvests improved dramatically. The average harvest from 1978 through 2003 was 25.2 million fish, considerably higher than the long-term average. A series of especially high harvests occurred from 1989 through 1996, averaging 35.1 million fish.

[4] Dr. Ray Hilborn, University of Washington, Fisheries Research Institute; personal communication.
[5] Much of the discussion in this section is derived from *Salmon Management in Bristol Bay*, in *Alaska Fisheries: 200 years and 200 Miles of Change*, by Ole Matheisen, in Proc. 29th Alaska Science Conference, Fairbanks, AK. 1978.

Bristol Bay Salmon Harvests

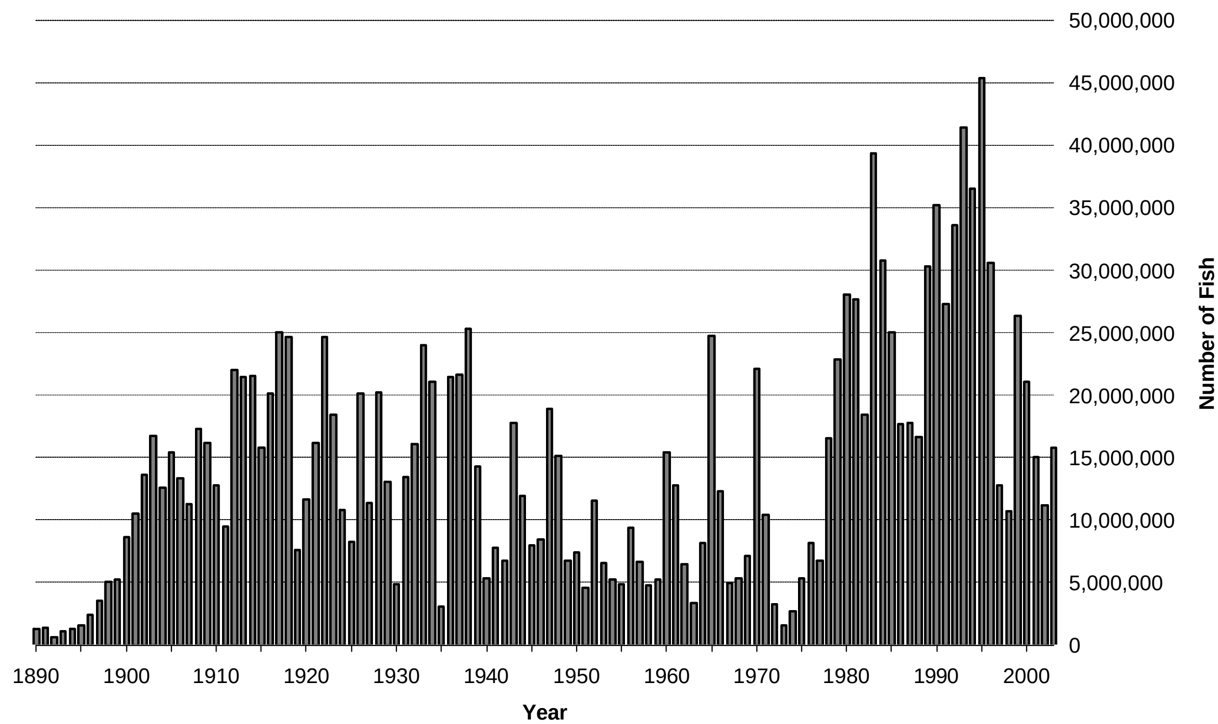

Figure 2.2

2.4 Historical Development of Management Regulations

As the fishery in Bristol Bay developed, the federal government attempted to ensure adequate escapements to spawning streams by imposing restrictions on commercial fishing. From 1900 to the 1920's, the government developed regulations that prohibited fishing near stream mouths and banned the construction of dams or obstructions in salmon streams. Other rules provided a 36-hour fishery closure each week. Gillnet mesh size was also regulated, and in 1923, power boats were banned.[6] However, by most accounts, enforcement of many of these regulations was negligible and the restrictions proved to be inadequate to achieve sufficient spawning escapements.

The White Act of 1924 was the first set of rules designed to guarantee specific quantities of spawning salmon to Alaska's streams. The Act called for a division of salmon returns: in streams where counting weirs were constructed, at least half the run would be reserved as escapement; the remainder would be available for harvest. In practice, however, these regulations were ineffective and cumbersome. Weirs on most major salmon streams were expensive and difficult to construct and maintain. In Bristol Bay, the sheer numbers of

[6] The ban on power boats was repealed in 1951.

migrating fish made weirs impractical. Furthermore, when weir counts indicated that escapements might not be achieved, rules to restrict the commercial fishery had to be promulgated in Washington, D.C. These delays often meant the restrictions had no practical effect during the short, intense salmon seasons. By the late 1920's there were strong indications that Bristol Bay salmon were being overfished; production in major river systems declined dramatically, and the Kvichak River stocks exhibited increased oscillations between years of peak and off-cycle production.

The salmon industry eventually saw a need for more information on salmon biology, which they hoped would lead to a better system of managing the Bristol Bay fishery. The industry contracted with Dr. William F. Thompson of the University of Washington to do these studies. His work – supported by funding from the industry – eventually led to the establishment of the Fisheries Research Institute, which continues today to provide important studies on the biology and management of salmon in Bristol Bay.

After Alaska became a state in 1959, the federal government turned over management of salmon fisheries to the Alaska Department of Fish and Game. The state system differs from the old federal system, involving teams of biologists located at or near the fisheries who have the authority to manage the fisheries in-season. This "emergency order" management authority allows on-scene managers to open and close fishing areas, change fishing area boundaries, and adjust fishing time to conserve the salmon runs and achieve other management objectives.

2.5 Limited Entry in Bristol Bay

In 1972, Alaska voters passed an amendment to the state's constitution authorizing limited entry into the state's commercial fisheries. Following the amendment, in 1973 the state legislature enacted Alaska's Limited Entry Act (AS 16.43), giving the Commercial Fisheries Entry Commission the responsibility for administering the new program. Limited entry was implemented in 19 of the state's salmon fisheries in 1974, including the Bristol Bay salmon drift and set gillnet fisheries.

The Bristol Bay drift and set gillnet fisheries were part of an original group of salmon fisheries identified under AS 16.43.230 as "distressed fisheries." According to the statute, the commission determined distressed fisheries to be those that had reached a level of participation where the optimum number of entry permits was likely less than the highest number of units of gear fished during any one of the four years immediately preceding January 1, 1973. Under this law and under AS 16.43.240, the maximum number of permits to be issued in each fishery was to be the highest number of units of gear fished in any one of the four years prior to January 1, 1973. This date was also adopted by the commission as the qualification date for the 19 salmon fisheries limited in 1974.[7]

Using fish ticket and commercial fishing license files, CFEC derived estimates of the number of units of gear fished from 1969 to 1972. The highest number in the drift gillnet fishery

[7] See 20 AAC 05.330 (a) and (b).

occurred in 1971, when 1,669 units of gear were estimated to have been used. In the set gillnet fishery, CFEC estimated the highest number was 803, which occurred in 1969. The commission adopted these two figures as the maximum numbers.[8]

Under the law, persons who apply for permits are ranked based upon the relative hardship they would suffer if they do not initially receive a permit from the state.[9] These priority ranking systems – also called "point systems" – credit persons using measures for both past participation and economic dependency on a fishery. Applicants are ranked in descending order based upon the number of points they acquire under the ranking system. Permits are issued to the highest ranked persons, down to a level until the maximum number is achieved.

However, in the Bristol Bay salmon drift and set gillnet fisheries, CFEC has issued far more permits than the adopted maximum numbers, mainly as a result of two lawsuits brought against the commission. In *Isakson v. Rickey*,[10] the Alaska Supreme Court reversed a commission decision and allowed persons who held gear licenses and harvested salmon for the first time in 1973 or 1974 to become eligible to apply for a permit in any of the 19 originally limited salmon fisheries.[11] With the ability to apply for permits, some of these persons were then able to qualify for sufficient points under the existing point systems to be awarded an entry permit.

Wassille v. Simon was the other lawsuit that resulted in a substantial increase in the number of Bristol Bay salmon permits.[12] This particular case was a class-action suit brought against CFEC in 1975 on behalf of Alaska Natives. It alleged that because of geographic location, language, cultural background, or race, some persons were unable to complete their permit applications before the regulatory deadline in the original 19 limited salmon fisheries. CFEC prevailed in trial court, and the plaintiffs appealed. Before a decision was reached the parties settled, whereupon persons who were admitted into the class were allowed to apply for a permit under the point system rules. Under this agreement, 1,116 persons applied to be class members and 275 persons were accepted. Eventually, 150 Wassille class members qualified for permanent permits, the majority of which qualified in either in the Bristol Bay salmon drift gillnet (60 permits) or set gillnet (75 permits) fisheries.

As of October 4, 2004, there were 1,857 potentially active entry permits in the drift gillnet fishery, and 992 in the set gillnet fishery. Originally, higher numbers of permits were issued, but some permits have been cancelled and are no longer in use. Cancellation normally occurs on nontransferable permits when the permit holder dies or does not renew the permit.[13] In the drift gillnet fishery 1,874 permits were originally issued, but 17 permits have

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[8] See 20 AAC 05.320
[9] See AS 16.43.250.
[10] See *Isakson v. Rickey* 550 P2.d 359 (Alaska 1976).
[11] State statute (AS 16.43.260) stipulated that to apply for an entry permit in the original 19 limited salmon fisheries, a person must have held a gear license and harvested salmon in at least one year between 1969 and 1972. The qualification date for these fisheries was established in 20 AAC 05.330 as January 1, 1973.
[12] See *Wassille v. Simon* 3AN-75-506.
[13] AS 16.43.250 requires the commission to determine a point level within each hardship ranking system where persons would suffer only minor economic hardship if they are excluded from the fishery. Persons who receive permanent permits and who are ranked at or below the minor economic hardship level receive nontransferable permits. As of July 20 2004, 111 nontransferable permits had been issued in the set gillnet fishery (approximately 11% of the total permits issued). There have been no nontransferable permits issued in the drift gillnet fishery.

been cancelled. In the set gillnet fishery, 48 out of 1,040 originally issued permits have been cancelled.[14]

2.6 Current Management Objectives

ADFG's management of the salmon fisheries in Bristol Bay includes the regulatory objectives of managing for sustained yields (largely accomplished by adhering to escapement goals), maintaining the genetic diversity and overall health of the escapement, providing an orderly fishery, helping to obtain a high-quality fishery product, and harvesting fish consistent with regulatory management plans.[15]

Regulatory management plans, which are established in a public process through the Alaska Board of Fisheries (Board), are designed to promote conservation of fisheries resources and to specify allocations of fish to distinct groups of harvesters. When the Board implements allocation regulations or establishes allocation policy, ADFG has the responsibility to manage under these regulations, while also attempting to achieve the other management objectives. The regulations specify, however, that ADFG's highest priority will be to obtain escapement goals and maintain the genetic diversity of the escapement.[16]

2.6.a Escapement Goals and Maximum Sustained Yield

Article VIII, Section 4 of the Alaska state constitution contains a clause expressly calling for managing the state's fishery resources upon the principles of sustained yield:

> *Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses.*

This principle is also expressed in the state's Sustainable Salmon Fisheries Policy (SSFP), which was adopted by the Board of Fisheries as a regulation in March, 2000,[17] and also in the state's Policy for Statewide Salmon Escapement Goals (PSSEG).[18] In practice, sustained yield in salmon fisheries can be obtained largely by preserving salmon habitat and adhering to conservative escapement goals. Fish returns may vary widely from year to year, but with adequate environmental protections and escapements, populations should remain viable and not diminish over the long term, despite some commercial harvest.

Maximum sustained yield (MSY) is an extension of the sustained yield principles. As the name suggests, it is the greatest average annual yield that one could expect from a stock of fish without harming the population. Achieving maximum sustained yield calls for a high

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[14] As of October 4, 2004, there were 5 Bristol Bay drift gillnet permit applications in the CFEC adjudications process. The final results of these adjudications will determine whether the permit applicant will be issued a permanent permit. In the meantime, the applicants are eligible to fish with an interim-use permit. At the October 4 date, there were no Bristol Bay set gillnet permit applications remaining in the adjudications process.

[15] See 5 AAC 06.355: *Bristol Bay Commercial Set and Drift Gillnet Sockeye Salmon Fisheries Management and Allocation Plan.*

[16] See 5 AAC 06.355 (c)(1).

[17] See 5 AAC 39.222.

[18] See 5 AAC 39.223.

degree of management precision and scientific information. The most important information needed to obtain MSY for salmon are accurate escapement counts and information on the corresponding returns from escapements (return-per-spawner or brood tables). With this data, managers can optimize escapements to provide high future returns with a maximum surplus production. The SSFP directs ADFG to manage all of Alaska's salmon fisheries – to the extent possible – for maximum sustained yield, unless otherwise directed.[19] Bristol Bay sockeye salmon are managed under these principles.

An important consideration in managing for MSY is the carrying capacity of salmon spawning systems. Although minimum spawning requirements may ensure the viability of future returns, it is possible to reduce yields by putting too many spawning fish in a system. Because freshwater environments have a limited capacity for spawning and rearing fish, the return-per-spawner ratio can diminish when exceptionally large numbers of fish spawn in a system. In this sense, it is possible to have "too much" escapement. Under MSY there is an optimum range of escapement that produces, on average, the highest harvests. This optimum escapement range is what fishery managers try to attain.

Escapement goals are expressed as a range, with managers targeting the mid-point. The ranges take into account that return-per-spawner rates can exhibit wide variation. From year-to-year, spawning success fluctuates and the survivability of immature salmon in the fresh and saltwater environments is highly variable. Escapement goal ranges also account for uncertainties in the data used to estimate spawning productivity.

Under the state's salmon escapement goal regulations, river systems and their escapement goals are classified based upon the amount of knowledge possessed by ADFG. Escapement goals that provide the greatest potential to achieve MSY are called biological escapement goals (BEG). Each major spawning system in Bristol Bay has a BEG for sockeye salmon. There is also a BEG for chinook and coho on the Nushagak River (see Tables 2.1 and 2.2).

Sometimes there are biological, allocative, or economic considerations apart from MSY that require ADFG to manage for an escapement level that is different from the biological escapement goal. These objectives are referred to in the SSFP as optimal escapement goals (OEG), which are established by the Board of Fisheries and set out in state regulatory management plans. When an OEG is set, it becomes the primary management objective, taking precedent over biological escapement goals. In Bristol Bay, the Naknek and Nushagak River sockeye runs are the only stocks that currently have an OEG. In the Naknek River, the upper limit of the escapement goal range is raised from the BEG of 1.4 million fish to an OEG upper limit of 2.0 million fish when the fishery moves into the Naknek River Special Harvest Area.[20] In the Nushagak River, when the sockeye run is projected to be less than 1.0 million fish, and the ratio of Wood River to Nushagak River sockeye is greater than 3 to 1, the escapement goal range drops from the BEG lower limit of 340,000 fish to an OEG lower limit of 235,000 fish. In each of these situations the Board of Fisheries has decided there are potential benefits that outweigh concerns for managing only for BEG's.

[19] See 5 AAC 39.222 (3)(c)(2)(B)
[20] See 5 AAC 06.360 (f)

In systems where BEG's cannot be estimated due to a lack of scientific information on salmon returns, ADFG may establish a sustainable escapement goal (SEG), which is an estimate based upon historical performance and/or indices known to conserve the stock. Maximum sustained yield may not be attained with these goals, but the stock should remain healthy while still allowing some level of commercial harvest. There are several stocks of Bristol Bay salmon with escapement goals that fall into this classification (see Table 2.2).

If substantial harvests by commercial, sport, or subsistence users occur in a system upstream from the point where escapements are enumerated, ADFG may be required to allocate a portion of the resource to those users and adjust escapement goals accordingly. Escapement goals that consider specific upriver allocations are referred to as inriver goals. Similar to OEG's, inriver goals are established by the Board of Fisheries in regulatory management plans. Nushagak chinook and coho are the only Bristol Bay stocks with inriver escapement goals. Whereas the mid-point BEG for Nushagak chinook is 65,000, the inriver goal is 75,000 fish, which accounts for substantial sport and subsistence harvests upstream of the enumeration site. The Nushagak coho BEG is 90,000, with an inriver goal of 100,000; which, similar to chinook salmon, allows for upriver subsistence and sport harvests.

Irrespective of the classification of escapement goals, if salmon stocks begin to fail, the Board of Fisheries must determine if they have reached levels of yield, management, or conservation concern, as defined in the SSFP regulations.[21] Yield concerns are considered the least serious of the three, followed by management concerns, then conservation concerns. Through regular stock status reports by ADFG to the Board of Fisheries, the agencies review escapement goals and identify any stocks that may have reached levels of yield, management, or conservation concern. These concerns are then addressed through management plans which outline actions that will be taken to protect the stocks.

If stocks decline to the most serious levels of concern, the Board may establish a Sustainable Escapement Threshold (SET) for that stock. The SET will always be lower than the lowest bound of either the BEG, OEG, or SEG and will represent a level of escapement below which the stock may not be able to sustain itself.

Following the SSFP procedures for identifying stocks of concern, in January 2001 the Board classified Kvichak River sockeye as a stock of yield concern. After three more successive years of low returns, in December, 2003 the Board changed the status of Kvichak sockeye from that of a yield concern to the more serious level of management concern. The next section examines this process in more detail and illustrates how current management addresses the problems of poor salmon returns to the Kvichak River in Bristol Bay.

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[21] From 5 AAC 39.222:

"conservation concern" means concern arising from a chronic inability, despite the use of specific management measures, to maintain escapements for a stock above a sustained escapement threshold (SET); a conservation concern is more severe than a management concern;

"management concern" means a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG, BEG, OEG, or other specified management objectives for the fishery; a management concern is not as severe as a conservation concern;

"yield concern" means a concern arising from a chronic inability, despite the use of specific management measures, to maintain expected yields, or harvestable surpluses, above a stock's escapement needs; a yield concern is less severe than a management concern, which is less severe than a conservation concern;

Table 2.1. 2004 Sockeye Escapement Goals (in 1,000's of fish)

District	River	Mid-Point Goal	Management Range
Naknek-Kvichak	Kvichak	6,600 [a]	6,000 - 10,000
	Naknek	1,100	800 - 1,400
	Alagnak	185	170 - 200
Egegik	Egegik	1,100	800 - 1,400
Ugashik	Ugashik	850	500 - 1,200
Nushagak	Nushagak	550	340 - 760
	Wood	1,100	700 - 1,500
	Igushik	225	150 - 300
Togiak	Togiak	150	100 - 200

[a] The target escapement goal for the Kvichak River is based upon a 50% exploitation rate of the estimated return. The preseason estimate for the 2004 return is 13.23 million fish. In off-cycle (low run) years, the lower end of the Kvichak River escapement management range drops to 2.0 million fish.

Table 2.2. 2004 Chinook, Chum, Coho, and Pink Salmon Escapement Goals

District	River	Species	Point Goal	Management Range	Enumeration Method
Naknek-Kvichak	Naknek	Chinook	5,000		Aerial Survey
	Alagnak	Chinook	2,700 [a]		
Egegik	Egegik	Chinook	450 [a]		Aerial Survey
Nushagak	Nushagak	Chinook	65,000 (BEG), 75,000 (inriver)	40,000 - 80,000	Hydroacoustic
		Chum	190,000		Hydroacoustic
		Coho	90,000 (BEG), 100,000 (inriver)	50,000 - 100,000	Hydroacoustic
		Pink (even yrs)	900,000	600,000 - 1,100,000	Hydroacoustic
Togiak	Togiak	Chinook	10,000		Aerial Survey
		Coho	50,000	25,000 - 75,000	Aerial Survey
	Kulukak	Coho	15,000		Aerial Survey

[a] Alagnak and Egegik chinook escapement goals are at this time only proposed goals; they have not been formally adopted.

Sources for each of the above tables are: 1) Fair, L.E., B. Bue, R. Clark, and J. Hasbrouck, *Spawning Escapement Goal Review of Bristol Bay Salmon Stocks*. ADFG Regional Information Report 2A04-17, Alaska Department of Fish and Game. May, 2004; and, 2) Fried, S. M. *Pacific Salmon Spawning Escapement Goals for the Prince William Sound, Cook Inlet, and Bristol Bay Areas of Alaska.* Special Publication No. 8, Juneau: Alaska Department of Fish and Game, (1994).

2.6.a.1 Kvichak River Escapement

The Kvichak River has historically been the largest producer of salmon in Bristol Bay; however, in recent years Kvichak sockeye returns have been poor, and ADFG and the Board of Fisheries have had to implement measures to conserve the stock. This process is outlined here to provide an example of how the SSFP is applied in Bristol Bay.

The Kvichak River sockeye stocks exhibit a wider variation in returns than other Bristol Bay rivers, with runs that appear to be on 5-year cycles. Immediately following a peak-year return, sockeye returns often drop for three years, then increase in the following year to a pre-peak, or sub-dominant return, followed again by a year of dominant, or peak production. These cycles complicate ADFG's management of the Kvichak River, and make it difficult to determine a sockeye biological escapement goal.[22]

The reasons for the cycles are unknown. Some biologists have hypothesized they are the result of a combination of natural conditions, such as predation, weather, or competition in the freshwater environment between peak-year rearing fish and fish from post-peak years. It has also been suggested that fertilization by salmon carcasses could help maintain the cycles by diminishing the effects of density dependant salmon growth in river and lake systems. An alternative hypothesis suggests the cycles are due to the effects of the commercial fishery itself, which has historically tended to exploit the run at a higher rate in off-cycle years than in peak years. It is also possible the cycles are caused - or at least amplified - by a combination of these factors.[23]

To address these cycles, Kvichak biological escapement goals have varied between off-cycle, pre-peak, and peak years. Current management strategies for maximum sustained yield on the Kvichak call for escapements that range from 2 to 10 million fish, with a 50% exploitation rate on returning fish within that range. The escapement goals vary according to the Kvichak cycles: in off-cycle years, the escapement goal range is 2 to 10 million fish; in pre-peak and peak years, the range is 6 to 10 million fish.

In September, 2000 following several years of unexpected low returns, the Board classified Kvichak River sockeye salmon as a stock of yield concern.[24] In accordance with the SSFP, ADFG developed action plans reviewed by the Board to address these concerns, with the goal of rebuilding the Kvichak stocks to provide yields at historical levels. Primarily, these actions involved changing existing management plans to reduce possible interception of Kvichak fish in other districts. Several management plans already contained provisions to reduce the interception of fish between districts; but in this case, the Board decided to change some of the plans to make them even more conservative, to further reduce the possibility of harvests of Kvichak sockeye in years with poor returns.

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[22] See Lowell Fair, *Critical Elements of Kvichak River Sockeye Salmon Management*. Alaska Fishery Research Bulletin; vol 10, no. 2. (2003).

[23] See Doug Eggers, and D.E. Rogers. *The Cycle of Runs of Sockeye Salmon (Onchorhynchus nerka) to the Kvichak River, Bristol Bay, Alaska: Cyclic Dominance or Depensatory Fishing?* in Canadian Special Publications of Fisheries and Aquatic Sciences 96; Ottawa, Canada. (1987).

[24] To reach this determination, the ADFG and the Board compared Kvichak sockeye returns for the 1996 through 2000 period (5 years, or 1 sockeye salmon generation) with historical returns going back to 1956. See *Kvichak River Sockeye Salmon Stock Status and Action Plan, 2000*. ADFG Regional Information Report 2A00-37, Alaska Department of Fish and Game. Dec., 2000.

One change allowed fishing in the Naknek River Special Harvest Area (NRSHA) as early as June 27, which was significantly earlier than it had been in prior years. Fishing only in the NRSHA of the Naknek/Kvichak District reduces harvests of Kvichak fish (see the discussion of management plans and special harvest areas below). Another change was in the Ugashik District sockeye management plan. The plan now stipulates that when Kvichak sockeye exploitation rates are projected to be less than 40%, total fishing time in the Ugashik district from June 16 through June 23 will not exceed 48 hours. And finally, the Board stipulated that when fishing in the Naknek/Kvichak District is restricted to the NRSHA, the Ugashik District boundaries will be reduced until June 29 and the Egegik District is reduced in size while the NRSHA is in effect. Again, this was done to reduce possible interceptions of sockeye bound for the Kvichak River.

Despite these measures, returns to the Kvichak in 2002 and 2003 were poor. Although the Kvichak District was closed throughout the 2002 season, final sockeye escapements were only 703,884 fish – well short of the 2 million fish minimum. In 2003, sockeye returns increased somewhat, with a final escapement of approximately 1.7 million fish, but once again, no directed harvest was allowed on Kvichak fish and the total yield from the parent-year escapement was low.[25]

Following a scheduled triennial review, in December, 2003 the Board reviewed the status of Bristol Bay salmon stocks. Due to the poor returns and yields observed over the 1998 through 2003 seasons, ADFG recommended the Kvichak River sockeye salmon stock be elevated to a stock of management concern. Again, the SSFP calls for management actions to address this level of concern. Similar to 2002, the Board changed an existing management plan to make it more conservative: they changed the Naknek/Kvichak sockeye salmon management plan to restrict fishing only to the NRSHA if the preseason forecast for the Kvichak River sockeye return is less than 30 percent above the minimum BEG.

It remains to be seen what effect these measures will have. The rate of interception of Kvichak fish in other districts during the recent period of low returns has not been estimated, but ADFG estimates the exploitation of Kvichak fish within the Naknek/Kvichak District has been very low, particularly in 2002 and 2003.[26]

2.6.b Genetic Diversity and Healthy-Fish Escapement

Along with the goal of attaining escapements for maximum sustained yield, the SSFP directs ADFG to conserve distinct genetic races of fish within a spawning system. Large spawning systems, such as those found in Bristol Bay, contain multiple stocks of fish that return to particular areas to spawn. For example, the Kvichak system contains two large lakes: Lake Illiamna and Lake Clark. Numerous spawning streams and rivers feed each lake, and spawning fish also utilize the gravel shorelines of the lakes. These spawning areas may be used by genetically distinct groups of fish with subtle traits that separate them from other fish in the system. Preserving the genetic diversity of spawning stocks ensures the overall health of the system. ADFG attempts to maintain this diversity by allowing proportionate catches

[25] ibid.
[26] See Fair, *Critical Elements of Kvichak River Sockeye Salmon Management*. The exploitation rate for a stock is the ratio of harvest to total return (escapement plus harvest). The estimated exploitation rate of Kvichak sockeye in the Naknek / Kvichak District in 2002 was zero. In 2003, it was 2%.

and escapements to occur throughout the run, avoiding excessive harvests or escapements at any particular time. Additionally, biological escapement goals themselves are designed to protect the genetic integrity of a spawning system. If escapement levels are set correctly, small stocks of fish will receive adequate escapements, even at the lower limits of escapement goals.

ADFG also takes efforts to maintain the quality, or health, of escaped fish. Fish that escape through an active fishery are often harmed by gillnets; many fish come in contact with nets and then escape, exhausting themselves and sustaining wounds and losing scales and the protective layer of slime on their skin. Biologists feel these fish are less likely to spawn successfully. By scheduling frequent fishery closures throughout the run, ADFG allows healthy, untouched fish to escape upriver. As mentioned, these “pulse” closures also help to maintain the genetic diversity of the escapement. Although frequent closures may facilitate healthy and genetically diverse escapement, they can also lessen management precision; it is easier to exceed escapement goals with frequent closures, particularly when the run is strong and large numbers of fish enter the district quickly. ADFG also advances healthy escapement by attempting to schedule fishery openings to occur near the high tide; fishing during periods of deeper water allows more fish to escape unharmed by gillnets.

ADFG specifically addresses escapements of healthy fish in the Naknek River Special Harvest Area management plan. Because significant numbers of escaped fish are likely harmed by the intensely crowded fishing conditions in the NRSHA, ADFG manages for an optimum escapement with an upper limit that is higher than the biological escapement goal, assuming that a BEG of lower-quality escapement might not provide adequate conservation protections. Raising the upper limit of the escapement range also allows managers more flexibility when scheduling fishery closures.

2.6.c Product Quality

High product quality is another regulatory goal of Bristol Bay salmon management. ADFG can manage for the quality of the delivered catch by scheduling shorter openings. Closed periods - even if they are short - allow fish to be delivered and processed sooner. However, as mentioned above, short openings with frequent closures can also present problems with achieving escapement goals.

Bristol Bay regulations provide special inriver harvest areas that reduce the interception of fish between rivers, thereby allowing harvests on stocks bound for one river while helping to achieve escapement goals on adjacent rivers; however, product quality is reduced when fisheries move from the larger districts into the inriver harvest areas. In the small inriver areas where fishing conditions are crowded, currents are especially strong and boats frequently have to drag their nets to keep them from snagging or tangling with other nets, or to keep the nets from drifting out of the allowable fishing area. Fishing in this fashion damages captured fish and lowers product quality.

2.6.d Orderly Fisheries

Orderly fisheries are supported by regulations that discourage congestion on the fishing grounds. There are regulations for keeping a minimum distance between set and drift gillnet gear and for reducing the amount of allowable gear when fisheries are restricted to small, inriver special harvest areas.[27] ADFG and the Board of Fisheries also promote orderliness through regulations for more effective fisheries enforcement, such as the requirements for marking and identifying gear, and for restrictions on how many fathoms of gillnet each vessel may have onboard.[28]

Orderliness is also a consideration when ADFG sets the length of fishery openings. Shorter, more frequent openings tend to promote orderliness, especially in certain districts. Before a fishery opening, fish will usually be distributed throughout the district, but if there are enough boats in the district, most of the fish will be caught shortly after the fishery opens. After this initial phase of harvest, oftentimes the only productive fishing that remains will be on the district boundary line, where fresh incoming fish can be caught. The infamous Bristol Bay "line fisheries" result, with boats extremely congested at the district boundary. Collisions and other accidents are frequent, and fishery violations are common.

If fishing is closed shortly after the initial harvest phase, then line fisheries are less likely to occur. Fresh fish can enter the district, again distributing themselves throughout the area, where they can be harvested in the next fishing period. As mentioned above, these short "pulse" periods also serve to enhance product quality and allow escapement to occur throughout the run. Recall, however, that short openings can sometimes make it difficult for biologists to manage for escapements. It is easier to exceed escapement goals if there are frequent closures, especially when returns are large.

Orderly fisheries also have meaning in the avoidance of wasting harvested fish and in promoting higher product quality. For example, when processors reached their capacity during the 1999 season, ADFG reduced fishing time to avoid wasting fish that could have spoiled before they were processed.

Although inriver harvest areas specified in some management plans are designed to promote conservation and to help allocate fish among gear and user groups, they also interfere with managing for orderly fisheries. The inriver areas are much smaller than the full districts and orderliness declines when vessels crowd into small areas. Collisions between vessels are more frequent, gillnets tangle, product quality declines, and regulation violations increase - particularly violations for fishing "over the line," or fishing outside of the allowable fishing district.

2.7 Inseason Management

ADFG's most important management objective is to achieve escapement goals, which are accomplished mainly by restricting fishing time and allowing fishing only in the terminal

[27] See 5 AAC 06.335 and 06.358(d)(2)
[28] See 5 AAC 06.334 and 5 AAC 06.331 (e)

areas of each management district. However, actually attaining the escapement goals can be very difficult, involving a complicated set of considerations. The sockeye salmon run occurs over a very short time period - the vast majority of the fish enter the streams in only a two-week period - but the fishing power of the drift and set gillnet fisheries is extraordinary; the fishing fleet can harvest enormous numbers of fish in a short time. The behavior of the fish can also complicate management; how quickly and in what direction fish move through a fishing area can dramatically affect their vulnerability to fishing gear. In addition to achieving escapement goals, ADFG must also balance the other management objectives of fishery allocations, high product quality, providing for an orderly fishery, and maintaining the genetic diversity of fish populations by spreading escapements proportionately over the entire run.

To judge the size, movements, and age composition of salmon returns, ADFG receives inseason information from a variety of sources, each one giving managers more information that helps them determine what actions are needed to achieve their objectives.

Regulatory management plans also determine many management actions. These plans, adopted by the Board of Fisheries, call for specific adjustments to fishing time, fishing areas, and allowable gear. The plans are primarily designed to allocate portions of the harvest to specific groups of fishermen (set gillnet or drift gillnet), or to help achieve escapements under certain conditions.

2.7.a Escapement Enumeration

In Bristol Bay, ADFG enumerates salmon escapement with hydroacoustics (sonar), counting towers, and aerial surveys. Hydroacoustics are used on the lower Nushagak River. Counting towers are used on the Togiak, Igushik, Wood, Nuyakuk, Naknek, Kvichak, Alagnak (Branch), Ugashik, and Egegik Rivers. The Alagnak River counting tower operated from 1956 to 1976, then renewed operation in 2001 with federal funding. Currently, there is funding to operate this tower through the 2004 season.

Counting towers allow a visual count by fishery technicians. The towers are located on clearwater portions of the main stem of the spawning systems, as near to the mouth as practical. Located on each bank of the river, the towers have elevated platforms where technicians count individual fish for 10 minutes of each hour of the day. These counts are then expanded to provide an estimate of the total escapement. Counting towers are used primarily to enumerate sockeye escapement. Although attempts have been made to count coho salmon with towers, it has not been effective due to the migration behavior of coho and the poor visibility in the rivers later in the year when coho enter the streams.

ADFG uses a hydroacoustic counter on the Nushagak River because the river's large size and dark-colored water make visual counts ineffective. The Nushagak sonar is used to enumerate all five species of salmon that spawn in the Nushagak system. The Wood River is a clearwater river flowing into the Nushagak estuary; it is the outlet to five large productive lakes and spawning streams of the Wood-Tikchik system. The Nuyakuk River is a major Nushagak tributary and also an outlet to large sockeye spawning systems. With counting towers on the Wood and Nuyakuk Rivers, biologists can differentiate major spawning components of the Nushagak system.

ADFG uses aerial surveys to augment the tower and sonar escapement counts. For sockeye salmon, aerial surveys provide indices of escapement to various spawning locations upriver from the counting towers, providing information on specific stocks of fish. Because counting towers are not normally used to count coho, chinook, and pink salmon, aerial surveys are the primary means of gathering escapement data for these species on all systems except the Nushagak.

2.7.b Age Class Determination

The age of salmon can be determined by examining the pattern of growth on their scales. It is possible to differentiate saltwater from freshwater growth patterns; the difference between winter and summer growth is also visible. Each year, biologists take thousands of scale samples from both commercial catches and escapements. With this information, they are able to estimate the component that each age class contributes to the total return for the year. This, in turn, allows biologists to estimate the return-per-spawners in a system.

Certain age classes often dominate a particular river system. Using inseason age class information in conjunction with test fishing at Port Moller (see below), managers can sometimes obtain an idea of relative run strengths to individual rivers.

2.7.c Pre-season Forecasts

Each year, ADFG provides a forecast of Bristol Bay sockeye returns for all major river systems. The forecasts include estimates for each returning age class of fish. Actual forecasts are a blend of several statistical models based upon the relationships of spawning fish with out-migrating smolt and returning adults. The actual model(s) chosen for forecasts of individual river systems depend upon their past reliability for predicting actual returns.

Pre-season forecasts are important to the processing industry, where they are used to make plans for marketing and processing fish. Fishermen also pay close attention to the forecasts. They use them to determine which district to fish, and they may use age composition data to adjust the size of the mesh of their nets to match the expected average size of returning fish.

2.7.d Port Moller Test Fishing

Port Moller is located on the Alaska Peninsula, 140 miles southeast of the Ugashik district. In most years since 1967, the Fisheries Research Institute of the University of Washington and ADFG has operated a test fishery there, providing early indications of Bristol Bay sockeye run strength, age composition, average fish size, and run timing.

The Port Moller test fishery is funded by both the processing industry and ADFG. Both entities use the test fishery as an important source of inseason information. On average, fish passing Port Moller arrive in the Bristol Bay fishery 6 to 7 days later.

2.7.e Inseason Run Predictions

Each day during the Bristol Bay sockeye season, ADFG research biologists provide managers with predictions of sockeye run size and escapements for the major river systems. The inseason predictions come mainly from two separate models. The first is a regression analysis using inseason catch and escapement data to predict escapements and total run sizes. The second model also predicts escapements and total run sizes, but does so by comparing historical cumulative catch and escapement data with the current year. This model also measures run timing, comparing how many days ahead or behind the current run is compared to historical average run timing.

Perhaps the most difficult aspect of working with inseason run predictions in Bristol Bay is the short duration of the runs and the great numbers of fish that can arrive quickly - or not arrive at all. With “early” or “late” run timing measured by the difference of only a few days, maintaining the precision of inseason run predictions and achieving escapement goals are especially difficult. Large numbers of fish that appear early in the season could be an indication of a large annual return, or it could mean the run is simply returning earlier than usual and is not exceptionally strong. Similarly, a weak showing of fish early in the year could mean the run is poor, or it could mean the run is merely late.

Despite these uncertainties, inseason run predictions that compare cumulative and daily escapement levels with historical run sizes and timing are perhaps the most important tool biologists have in managing for escapement goals. The size and timing of the run is the main determining factor in how much fishing time is allowed in a district. Other factors that may be considered to determine the amount of fishing time include the number of fishing boats (effort) in the district, fishery allocations, orderly fisheries, healthy and genetically diverse escapement, weather and tides, and processing capacity.

2.7.f District Test Fishing

ADFG does test fishing between fishery openings to gauge the influx of fish into individual districts and to provide abundance indices. Test fishing is done on an as-needed basis: when salmon returns are large and escapements can be met quickly, ADFG is more likely to need immediate information on salmon abundance and distribution, hence district test fishing is more likely to occur. District test fishing is an expensive project, usually involving charters with commercial fishing operations.

2.7.g Inside Test Fishing

Because counting towers operate in the narrower, clearwater portions of the main spawning rivers, they are often located far upstream from the fishery. Depending upon the river, it may take 2 to 10 days for fish to move from the closed waters of the districts upstream to the counting sites. ADFG does inside test fishing in the lower reaches of the rivers, downstream from the counting sites, to provide inriver indices of abundance for fish that will eventually be counted upriver. Inside test fishing is done on all the major spawning rivers, including the Nushagak River below the hydroacoustic counting site.

2.7.h Aerial Surveys

Aerial surveys are another means where ADFG collects information on escapements. Aerial surveys provide indices of relative abundance of salmon and are limited to clearwater portions of streams, lakes, and estuaries where fish can be observed from the air.

Similar to inside test fishing, aerial surveys can provide advance estimates of salmon escapement before the fish swim past the counting towers. Aerial surveys are also used to determine the distribution of the overall escapement and spawning above the counting towers. For other species besides sockeye, they are often the only index of escapement in many Bristol Bay streams (Table 2.2)

2.7.i Fishery Performance

Oftentimes, the performance of the fishing fleet gives managers the best information on the relative size of the salmon run. Fishing performance, expressed as catch per unit of effort (CPUE), is derived from timely fish ticket and processor reports. In Bristol Bay, the calculation of CPUE is not a formal research effort; rather, it is done informally and independently by biologists to put catch rates into perspective. Salmon age composition analysis is also done on the commercial catch, providing biologists with still more information from the harvests.

2.8 Regulations

Fishing districts and allowable fishing areas are defined in the regulations. The districts are relatively small, effectively making each fishing area a terminal fishery. Although some interception of fish occurs between districts, studies indicate the rate is relatively small. In many districts, the regulations also define special harvest areas, which are smaller fishing areas inside the districts. Special harvest areas are designed to adjust harvest rates on specific stocks of fish, to lower rates of interception of fish between river systems, and to allocate fish between the set and drift gillnet fisheries. Special harvest areas are defined in regulatory management plans. The management plans also dictate when the special harvest areas shall be used (see discussion of management plans below).

By regulation, the salmon fishing season is from June 1 to September 30. Fishing periods during the season will vary depending upon the district, the time of year, and local conditions. Unless adjusted by emergency order, fishing in the Togiak District follows a regular schedule. In the Naknek-Kvichak, Egegik, and Ugashik districts, fishing periods are set by emergency order until July 17. Following that date, which is after most of the sockeye salmon run has occurred, the regulations provide scheduled periods from 9:00 am Monday through 9:00 am Friday. However, as occurs in the Togiak District, all regulatory scheduled periods can be changed by emergency order, depending upon existing conditions. In the Nushagak District, regulations stipulate that fishing periods will be set by emergency order throughout the entire June 1 – September 30 season.

As previously stated, several regulatory management plans determine many of ADFG’s in-season fishery management actions. The management plans are developed in a public process through the Board of Fisheries. The purpose or goal of each management plan is spelled out in the regulations, as are the management actions ADFG should take to achieve the goals.

Table 2.3 provides a summary of the Bristol Bay salmon regulatory management plans, showing their purpose and the river and salmon species for which they apply.

Table 2.3
Summary of Bristol Bay Salmon Management Plans

Type	River	Purpose
Special Harvest Areas	Ugashik	Prevent sockeye over escapement
	Wood	Achieve coho and Nushagak sockeye escapement while providing for Wood River sockeye harvests
	Egegik	Minimize interception of Naknek-Kvichak and Ugashik sockeye
	Naknek	Achieve Kvichak sockeye escapement while providing for Naknek sockeye harvests
Sockeye Set and Drift Gillnet Allocations	Naknek-Kvichak	Allocation of sockeye harvest: 84% drift, 16% set (8% Naknek, 8% Kvichak)
	Egegik	Allocation of sockeye harvest: 86% drift, 14% set
	Ugashik	Allocation of sockeye harvest: 90% drift, 10% set
	Nushagak	Allocation of sockeye harvest: 74% drift, 26% set (6% Igushik, 20% Nushagak
Chinook Management	Nushagak - Mulchatna	Ensure chinook escapements and provide guidelines for allocations between user groups
Coho Management	Nushagak	Ensure coho escapements and provide guidelines for allocations between user groups; includes pink salmon escapement objectives
Sockeye, Coho, and Chinook Management	Togiak	Ensure adequate escapements and harvest objectives

Five management plans address escapement and/or fish interception issues. Four of these establish special harvest areas with reduced amounts of allowable drift and set gillnet gear when projected escapements are below specified levels. Six other management plans provide allocation guidelines and actions designed to distribute harvests among set gillnet, drift gillnet, subsistence, and sport users.

Although using the special inriver harvest areas may lower the rates of interception of fish between river systems, thereby helping to achieve escapements on some rivers during years of small returns, there are detriments to using them. As mentioned, when vessels crowd into small areas, orderliness declines and product quality is reduced, as does the health and quality of escaped fish – both sockeye and other species. Managers also have more difficulty managing for the biological escapement goals of systems where inriver fisheries occur. When fishing effort is spread out in the normal district, managers have more advanced notice when large numbers of fish quickly enter the district, but when fishing is restricted only to the special harvest areas, managers lose this response time, making it more likely to exceed escapement goals. Managers also have more problems balancing allocations between drift and set gillnet fisheries in the inriver fisheries.

Apart from management plan regulations, many other Bristol Bay fishery rules are designed to limit competition between fishing operations, or to help enforce the fishery rules. Other regulations may also provide measures to help obtain the management goals of an orderly fishery and higher product quality.

Permit holders must register themselves and their vessels to fish in one of the five management districts. If a permit holder wants to change districts after registering, there is a 48-hour "stand-down" period when they are prohibited from fishing in any district, therefore discouraging the movement of fishing operations between districts.[29] The basis for this regulation is largely allocative; ADFG biologists claim this regulation provides little – if any – advantage to management. ADFG has the regulatory authority to reduce or suspend the stand-down period if conditions dictate.

Since 1949, Bristol Bay drift gillnet vessels have been limited to 32 feet in overall length. Although vessel length has been restricted, vessels have grown larger in other dimensions. CFEC vessel license data indicates the average horsepower and hold capacity of the fleet has substantially increased.

Each drift gillnet operation may operate no more than 150 fathoms of net if a single permit holder is onboard; extra gillnets are prohibited from being carried onboard vessels. Some management plans call for reducing the amount of allowable gear when fishing is limited to special harvest areas. This reduces crowding on the fishing grounds, promoting orderliness and facilitating better product quality. In 2003, the Board implemented new regulations allowing vessels to operate up to 200 fathoms of gillnet if two permit holders are onboard. This regulation was passed on an experimental basis with a sunset clause; it expires at the end of the 2004 season. The department was directed to submit an agenda change request for the series of Board meetings scheduled for 2004/2005, so the Board can review the effectiveness and utility of the regulation for potential permanent implementation.

Regulations provide various gillnet mesh size restrictions designed to protect certain species of salmon under special circumstances. Throughout the year, gillnets may be no more than 29 meshes deep.

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[29] Permit holders registered for the Togiak District before July 17 may not fish in any other district until July 24, nor can permit holders registered for districts outside of Togiak transfer into Togiak until July 24.

2.9 Summary

The Bristol Bay drift gillnet salmon fishery is the largest salmon fishery in Alaska, with 1,857 potentially active entry permit holders. The fishery area is comprised of 5 management districts and 9 major river systems. Nearly all the harvest is comprised of sockeye salmon, making it one of the state's most valuable fisheries in terms of gross earnings. Commercial fishing has occurred in Bristol Bay since 1883 and harvests have varied widely, ranging from 1.5 million to 45 million fish over the 1900 to 2003 period. Average harvests have been approximately 15.6 million fish.

Presently, salmon fishery management is guided by regulatory management plans and Alaska's Sustainable Salmon Fisheries Policy (SSFP). Management largely focuses on achieving escapement goals to the major rivers by adjusting fishing time, but other important management goals include gear and user-group allocations, orderly fisheries, genetic diversity, healthy fish escapement, and high product quality. Escapement goals are designed not only to conserve the resource, but to maximize future harvests under the principles of maximum sustained yield. Achieving escapements and maintaining the genetic diversity of escapements are the highest management priorities, and sometimes conflict with the other stated management goals.

Attaining the management goals is a very complicated and challenging task during the short, intense period when millions of fish return to Bristol Bay. Biologists collect information from a variety of sources to help make their decisions on how much fishing time to allow, and on how to best follow the fishery policies and regulations. Many of their decisions are made within the framework of regulatory management plans, which specify fishery allocations and certain actions designed to conserve stocks. Outside of management plans, some regulations also help to attain management goals, whereas other regulations serve mainly social, economic, or law enforcement purposes.