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METHODS FOR THE COMPARISON OF TIMING BEHAVIOR APPLIED TO THE PINK SALMON FISHERIES OF PRINCE WILLIAM SOUND, ALASKA

by

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May, 1984

Approved by:

Phillip R. Mundy (Director)

ABSTRACT

METHODS FOR THE COMPARISON OF TIMING BEHAVIOR APPLIED TO THE PINK SALMON FISHERIES OF PRINCE WILLIAM SOUND, ALASKA

by

Louis John Rugolo
Department of Oceanography
Old Dominion University, 1984
Director: Dr. Phillip R. Mundy

Harvest control in salmonid fisheries was examined as a problem in the objective formulation of regulations which restrict the time and area of fishing. An ability to rigorously define and compare the form of the progression of the migration across time and between harvest areas was judged fundamental to objective harvest management decisions. The identification and evaluation of statistical methods appropriate to a quantitative comparison of empirical migratory time densities between years and harvest areas was performed.

Previously applied methods for the comparison of migratory behavior were shown to be lacking. The development of the measure of central tendency (mean date) of the time density as the consistent, unbiased estimator of migratory behavior was given. Practical evidence demonstrated that the mean date was highly resistant to factors which contribute variability to the basic expression of migratory behavior. The mean date was the statistic of choice to serve as the basis for the comparative analysis of empirical time densities.

Brood year cycle and locality were treated as fixed effects in statistical analyses which were applied to the timing statistics of catch and spawning escapement. Fixed effects, two-way and one-way analysis of variance models were examined to analyze differences in the mean dates of migration. Multiple comparison analysis, Scheffe's a priori method, correlation, and multiple regression analyses were employed to objectively define the performance of the fishery and the escapement in time and space.

Highly significant differences were shown to exist between the timings of odd and even populations. For each cycle year for both catch and escapement the management districts were shown to be highly distinct with respect to timing behavior.

Considering even-cycle catch data, the combined migratory behavior in the Coghill and Northwestern districts was shown to be significantly different from the the combination of the remaining districts. Multiple regression analysis revealed that these two districts explained 99.98% of the total variation in the sound-wide timing behavior. Using odd-cycle catch data, Northern, Coghill, and Northwestern combined had a highly distinct timing behavior from other districts, and they collectively explained 95.95% of the total sound-wide variation in timing behavior.

Linear combinations of escapement data for historically early districts were identified which collectively explained a large percentage of the total sound-wide variation in the mean dates of migration for both cycle years. For even-cycle escapement, the subset of districts consisted of Eastern, Northern, and Coghill while for odd-cycle escapement several combinations of Eastern, Northern, Coghill and Southeastern Districts were suitable for predictive purposes.

It was concluded that migratory timing as a quantitative description of migratory behavior could be rigorously compared across years and harvest areas. Several statistical models were shown to be extremely robust for determining differences in migratory behavior when the measures of central tendency of the time densities were employed as modeled variables. Results of the analysis of even and odd cycles were consistent with the genetic distinctness between these two populations, and with the hypothesis of the genetic heritability of migratory timing.

The statistical system of analysis identified was shown to be highly appropriate for quantitatively describing the functional relationships between timing behaviors across spatial and temporal dimensions. It was concluded that this system will serve as a design standard for the comparison of migratory behavior, and that it will be applicable to the needs of harvest control for any migratory organism.

To

Evelyn and Johnny

with my eternal devotion and love.

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I extend my sincere appreciation to Sam Sharr, Kris Monk, and Dave Dickson for their friendship, and for providing the fondest memories I have of my stay in Cordova. The education I gained while working with Sam's stock biology group could not have been purchased at any price.

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CHAPTER 1

INTRODUCTION

Harvest control can be viewed as an algorithm for the interpretation of information which is used to direct the operation of a fishery toward some objective (Mundy 1983a). In commercial marine fisheries, the ultimate objective is the proper division of a biologic population into two categories, catch (dead) and escapement (alive). The minimum information necessary to achieve the objectives of harvest control is divided into the categories of spatial distribution (where), temporal distribution (when), and abundance (how many) with respect to each identifiable stock of fish and fishing gear under the jurisdiction of the harvest control authortity. Indeed, a rational system of harvest control is the fundamental requirement of a properly managed fishery (Mundy 1983a).

Harvest control in salmonid fisheries, or in other migrating organisms, is a problem of objectively formulating regulations which restrict the time and area of fishing. Within the course of a season, the harvest manager directs the operation of the fishery toward the achievement of the harvest objective that is established by the proprietor of the resourse. In fisheries of this type, it is often the complement of the harvest objective, the escapement goal, that forms the basis for harvest control decisions. In either case, the extent to which the management agency can define the abundance of stocks and gear types by area and time, determines the ability of the agency to direct the fishing operation toward the achievement of the specified harvest objective (Mundy 1983a).

In general terms, the harvest control process consists of a series of decisions to harvest or not to harvest. The consequences of such decisions are immediate and irrevocable. Fish that have been harvested can no longer contribute to the annual escapement, while those that have escaped the fishery are no longer susceptible to commercial harvest. It is the dynamic process of balancing these mutually exclusive events on the fulcrum of specified harvest goals that necessitates precise and timely harvest information.

In the case of maturing salmonids, an ability to rigorously define the form of the progression of the migration through time in each harvest area is fundamental to objective management decisions. In fisheries that operate over very large geographic reference frames, the ability to quantitatively define the spatial progression of the migration is also necessary. Any method which could provide such information, and rules for its implementation, would be of significant benefit to the management agency in terms of the formulation of harvest control regulations during the course of fishing operations.

The central objective of this study is to identify and evaluate those statistical methods which are appropriate to a rigorous, and quantitative comparison of empirical migratory time densities, the quantitative representation of migratory behavior. The methods will then be incorporated into a dynamic system of analysis whose utility will be demonstrated on the Prince William Sound commercial pink salmon fisheries. To be successful, the system must quantitatively describe, for any year, the functional relationships between the timings of catches, and spawning escapements by geographic area for any arbitrary level of production. Such a description would provide a rational basis for harvest control decisions which direct the operations of the fishery toward the achievement of catches within conservation limits, and which achieves a distribution of spawning escapement that provides full utilization of spawning grounds in each area.

Prince William Sound, Alaska is the location of major commercial fisheries for salmon and other species. All five of the Pacific salmon species indigenous to North America (Oncorhynchus spp.) occur in these waters, among which the pink salmon (O. gorbuscha) is of greatest economic importance. Lesser fisheries exist for chum (O.keta) and sockeye (O.nerka). Pink salmon usually constitute ninety percent, by number, of the annual salmon migration into Prince William Sound. Chum and sockeye account for approximately six and three percent, respectively. Less than one percent is attributed to chinook (O. tshawytscha) and coho (O. kisutch) combined. Total annual numbers (catch plus escapement) for pink salmon from 1960 to 1982 averaged 7.8 million (S = 6.1). The ex-vessel economic value of commercial catch for natural returns of pink salmon during this period is estimated to be 8.9 million dollars per season (based on an historic average commercial catch of 6.2 million (S = 5.6), a weight of 3.9 pounds per fish and a price of 0.37 dollars per pound) (Anonymous 1982).

Fisheries management in Prince William Sound is characterized by extraordinary complexity. Harvest control operations must function under a variety of competing biological, economic, and geographic constraints. The Alaska Department of Fish and Game (ADF&G) office in Cordova is responsible for approximately 38,000 square miles of coastal waters and inland drainages, in which more than 800 tributaries have been identified as sources of pink salmon production (Noerenberg, 1961). Fisheries occur in eleven major management districts corresponding to the local geography and distribution of the five species of Pacific salmon harvested by the commercial fishery (Anonymous 1982). The geographic component of these constraints is expressed in the difficulties encountered in directing the operations of the fishery within these eleven districts. Additional dimensions of complexity have been imposed by the development of five major hatchery facilities and by changes in productivity created by the catastrophic earthquake of March 27, 1964.

Hatchery races of salmon with similar migratory timing and migration routes occur coincidentally with natural stocks in the fishery. Optimal utilization of these stocks is achieved with higher exploitation rates than those applied to natural stocks. Regulatory complexity is imposed, consequently, by the necessity of the distribution and allocation of various levels of fishing effort among stocks of widely differing optimum exploitation rates (Wright 1981).

Effective apportionment of effort, of course, must consider spatial as well as temporal dimensions. A number of authors (see Killick 1955, Alexandersdottir and Mathisen 1982) have suggested, in the case of maturing salmonids, that each stock (geographic isolate) may have a characteristic migratory timing. Harvest regulations, therefore, must also be directed at achieving a proportionate distribution of catch through time in an attempt to avoid differential exploitation of the stocks.

The management objective in Prince William Sound for both sympatric and supplementally produced fish is to maintain and enhance salmon runs by the achievement of desired escapement goals for each stock component, while allowing orderly harvest of all fish surplus to spawning requirements. Ideally, this objective would be best achieved by managing the salmon escapement on a stream-by-stream basis with a 'terminal area fishery' for each stream (Wright 1981, Schnute and Sibert 1983). Logistic and economic limitations imposed by the requirement to formulate complex regulations across an area of such geographic complexity, however, preclude this type of control. Regulatory action, consequently, can presently control fishing operations only on the district level, with minor exceptions.

Harvest management in Prince William Sound requires a flexible, rigorous, and quantitative definition of the relation between the progression of catch and spawning escapement in time and space. Knowledge of the migratory timing of the target species in each district is paramount to such model development, since the aim of harvest control is to define the relation between the timings of catch and escapement for as many areas as the data permit. The formulation of fishing regulations which minimize errors in the attainment of spawning escapement objectives across temporal and spatial dimensions, and which allow the fleet to take the maximum possible harvest, must rely on the definition of the relations between the timings of catches and escapements.

The following specific objectives and questions to be addressed by this study will each be evaluated for differences between the average performance across the even-year, and the odd-year brood cycles for pink salmon;

(1) To what extent do catch and spawning escapement data allow the description of the fishing operation?

(2) Are there significant differences in the mean dates of catches and spawning escapements between districts. If so, which districts are similar, and which are different?

(3) Determine the timing of catches, and spawning escapements among the management districts.

(4) Determine the individual contribution of the management districts to the overall, sound-wide timing behavior.

(5) Are there linear combinations of the eight districts which can be used to predict the timings of catches and escapements on a sound-wide basis?

(6) Determine the nature of the relation, if any, between the timings of catches, and spawning escapements among districts.

Migratory Timing

The basic operational hypothesis governing this analysis holds that migratory behavior in salmonids is a genetically transmitted, environmentally mediated, adaptive response of the population (see Leggett 1977; Mundy 1979, 1982). The time of arrival in the fishery of the members of a migratory stock is an inherited trait that may be influenced by abiotic or physical factors. Migratory time densities across time and space, therefore, may be sufficiently distinct and conservative to serve as reliable classificatory characteristics of migratory species.

The evaluation of this migratory behavior from commercial catch data introduces the variability of regulatory, economic, and social factors which may obscure its fundamental form. While it is realized that this variability may be present, it is assumed that it is the sourse of only a small constant bias.

In Pacific salmon fisheries, management operations are necessarily driven by the dominant aspect of behavior of the target species, the migratory timing or abundance per unit time (Mundy 1982). The representation of an annual migration in terms of abundace per unit time and its application as an objective harvest control tool has been demonstrated in a number of commercial marine applications (Vaughan 1954; Roberson and Fridgen 1974; Walters and Buckingham 1975; Mundy 1979; Mundy 1982; Mundy and Mathisen 1981; Hornberger and Mathisen 1982;

Brannian 1982; Schnute and Siebert 1983).

The empirical methodology based on catch and effort data, which is used to characterize the migratory behavior of the target species in Alaskan salmon fisheries is given by Mundy (1984). Migratory timing is defined as the abundance as a function of time in a fixed geographic reference frame for a single life history stage of a population whose abundance may be measured from that locale (Mundy 1979). The daily proportion of catch (or catch-per-unit-effort) per unit time is termed the 'time density'.

The time density is an empirical probability density function in the time domain with variable t_i (date of capture) which can be discrete or continuous depending on the magnitude of the time interval employed. This function assigns a probability to each of the elements of the random variable T (time) in its space R; $t_i \in T$ in space R. If the arrival of a single individual in the fishery on the i-th time interval ($i = 1$ to m) is defined as an event with outcome t_i, and n_i is the number of such events, then the empirical probability density function (time density) of T is:

$$f(t) = P(T=t_i) = n_i / n \qquad (1)$$

where, $n = \sum_{i=1}^{m} n_i$

Equivalently, $P(T=t_i) = p_i$ where, p_i is the probability associated with the outcome t_i. Thus, the time density of the random variable T assigns an empirical probability measure to each element in the space R of T. The random variable T, therefore, has a distribution of probability associated with the space R.

We note that f(t) is a real-valued function which satisfies the properties of a probability density function (Hogg and Tanis 1977) since, $f(t) = P(T=t_i)$, $t_i \in R$:

(1) $f(t) > 0 \quad t_i \in R$

(2) $\sum_{t \in R} f(t) = 1$

(3) $P(T \in A) = \sum_{t \in A} f(t)$ where, $A \in R$.

When each observation is the sum of the probability (or proportion) of the current time interval, and all preceeding probabilities, the time series is termed the cumulative time density or performance curve (Mundy 1983). By analogy, therefore, the empirical cumulative probability density function (cdf) is:

$$F(t) = P(T \leq t) = N(n_i: t_i \leq t) / n \qquad (2)$$

where, n and n_i are as previously defined, and N represents the number events defined within the parentheses. The cumulative density function, therefore, represents the number of events (n_i) with outcomes t_i that are less than or equal to t divided by the total number of outcomes (n).

The measure of central tendency, or mean date of capture, of the time density is represented by:

$$E(T) = \bar{t} = \sum_{i=1}^{m} t_i \, f(t_i), \tag{3}$$

while the measure of dispersion, or variance, of the distribution function is:

$$V(T) = S^2 = \sum_{i=1}^{m} (t_i - \bar{t})^2 \, f(t_i). \tag{4}$$

To model the migratory behavior in terms of proportion of total abundance as a function of time is a significant achievement in that the migration is no longer measured with the dimension, number of fish, but is solely measured in the dimension of time. Annual migrations of salmon, therefore, may be conveniently and explicitly described in terms of the mean ($\bar{t}$) and variance (S^2) of the time density.

The basic premise underlying this analysis is that migratory timing, as a quantitative description of migratory behavior, can provide the basis for a comparative analysis of migrations across time and space. Migratory timing by definition, however, is specified with respect to a single, fixed geographic reference frame. Demonstrating the utility of the time density function as a comparative tool in fisheries which operate over different geographic reference frames, or between different fisheries, is the principal objective of this study. Note that 'different geographic reference frames' is used in the generic sense. It could, for instance, also denote different classes of migratory time densities within a single point in space, i.e. that based on catch, CPUE, or spawning escapement, for example.

The question of the reliability of the statistics of migratory timing is very crucial to the analysis of Prince William Sound. In a simulation study of the Yukon River chinook salmon fishery, Butt (1984) found that estimates of the mean date of migration were within 35% of the true mean of the population if the time domain was randomly sampled at a rate greater than 12%. Sampling randomly 50%, and 75% of the time domain, the estimates of the true population mean date were within 2%, and less than 1%, respectively. Butt's analysis assumed a 100% exploitation rate of all available fish on each date sampled, and a non-varying catchability coefficient q, during the course of the season.

Schaller (1984), in a simulation study of the Copper River sockeye fishery, found that the mean date of migration was a highly conservative property of migratory behavior. Estimates of the mean of the time density, he found, were independent of the rate of migration of the target species, patterns of fishing effort, and a variable catchability coefficient, q, as long as a threshold exploitation rate of 70% was achieved.

Highly conservative estimates of rates of exploitation for the commercial pink salmon fisheries in Prince William Sound (1969 - 1982) averaged 81% (S = 8.3), and 77% (S = 7.7) for the even-year and odd-year cycle, respectively. Sample estimates for the mean of the time densities, therefore, are likely to be extremely reliable. A contributing factor in this regard is that the regulatory agency in Prince William Sound intentionally manages for a proportionate distribution of effort through time, which further improves the reliability of the estimate of the mean date of migration.

The mean of the time density is a most promising statistic for the comparative analysis of migratory behavior. As an estimator, it possesses all of those characteristics identified as being most desirable. In addition to its unbiased and consistent properties, it is, unexpectedly, highly resistant to factors which contribute variability to the basic genetic expression of migratory behavior. Practically, it benefits from being easily estimable and readily understood.

The Pink Salmon

Pink salmon display a unique life history trait relative to other salmonids, they spawn and die in their second year of life. Two genetically distinct lines (odd-year and even-year spawners) exist (Altukhov and Salmenkova 1981; Alexandersdottir and Mathisen 1982). In contrast to other Pacific salmon, pink salmon migrations of commercial importance occur in both even and odd numbered (or cycle) years. Considering the genetic inheritability of migratory timing, it is inconsistent with the basic operational hypothesis to combine even-year and odd-year harvest data when generating migratory time densities. The models constructed and analyzed by this study, therefore, will be applied to even-year and odd-year cycles independently.

Pink salmon utilize intertidal areas to for spawning. Virtually all streams in Prince William Sound with year round flow, gravel substrate, and moderate intertidal gradient have pink spawning populations (Anonymous 1975). Alexandersdottir and Mathisen (1982) suggest that separate population components of pink stocks occur in streams located within a defined geographic area and having spawning times similar to each other. Early, middle and late runs (the term, run, is a synonym for migration) of pink salmon are distributed by geographic zones associated with different stream temperature regimes (Sheridan 1962; Anonymous 1975). Early runs (peaking 7/20-8/5) occur in a few fiords of the northern mainland. Middle runs (peaking 8/6-8/20) utilize most large, cold mountain streams while late runs (peaking

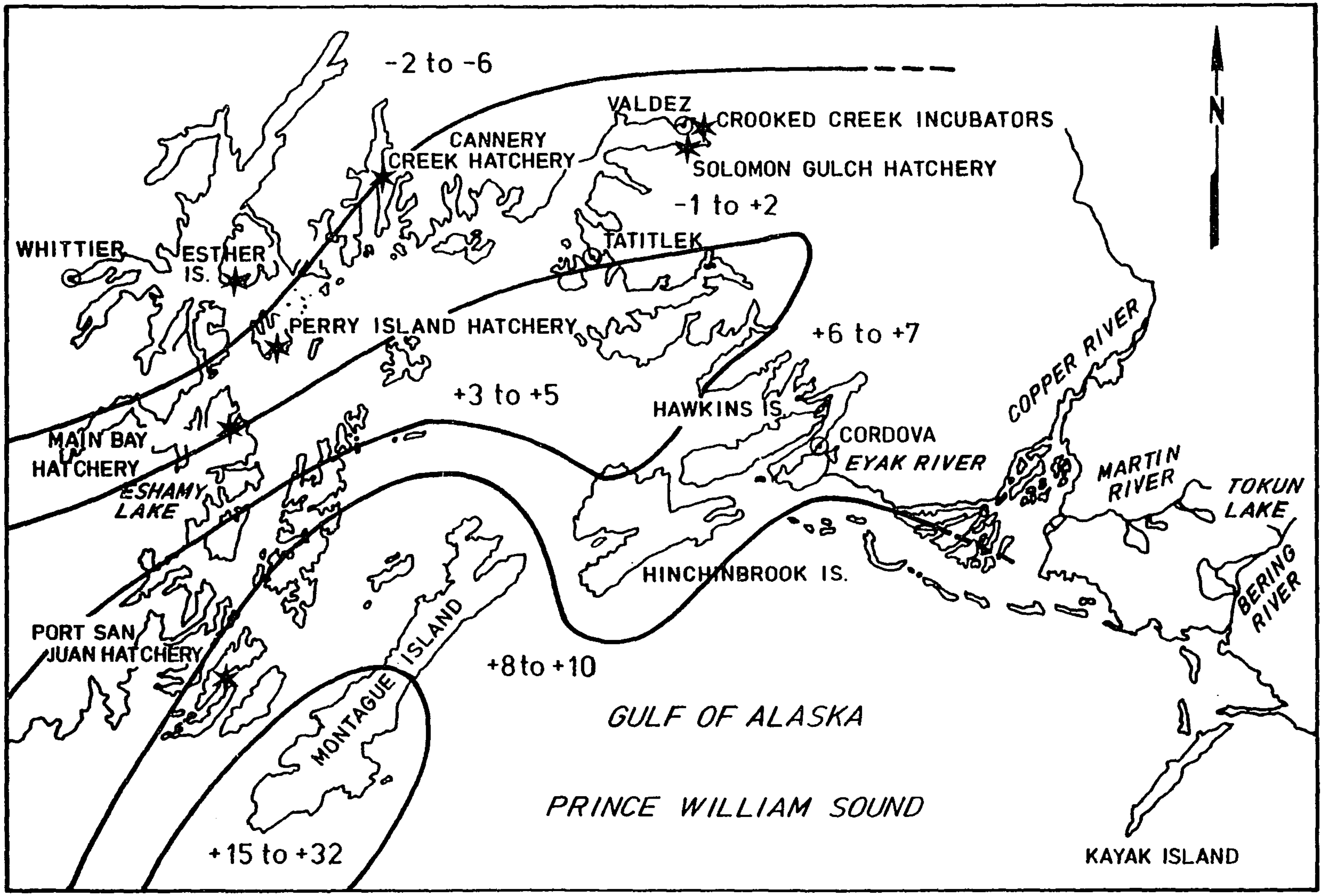
8/20-9/10) occupy the majority of island, mainland and lake fed streams. Long term trends in cycle or single year dominance favor even-year stocks (Anonymous 1975; McCurdy 1981; Anonymous 1983a).

On March 27, 1964 an earthquake of severe intensity, measuring 8.5 on the Richter scale, struck Prince William Sound. Topographic adjustments occurred in both horizontal and vertical directions. The seaward shift was as much as 64 feet while elevations changed from -6 feet in Whittier to +32 feet near Montague island (Fig. 1). Of those tributaries identified as major sources of pink salmon production, approximately 62% experienced uplift from 3 to 32 feet, 19% subsided from 2 to 6 feet, and 19% remained essentially unchanged (-1 to +2 feet) (Anonymous 1975; Anonymous 1983a).

Intertidal spawning and rearing environments utilized by pink salmon were heavily impacted. Alterations ranged from the complete removal of tidal influence through uplift to the elimination of intertidal and freshwater environments through subsidence and subsequent saltwater inundation (Noerenberg and Ossiander 1964; McCurdy 1983). The net effect, however, was to increase the amount of potential spawning area by several million square meters as a result of the overall lengthening of stream courses (Anonymous 1975; Anonymous 1983a). It may take many years to realize this potential, since uplifted intertidal zones must stabilize and rehabitation must occur before production of pink salmon can begin.

The altered intertidal area resulted in reversed productivity rates in favor of odd-year stocks which utilize, to a greater extent, upstream or freshwater spawning grounds (Noerenberg 1963). These environments experienced less alteration than the intertidal zones in the aftermath of the earthquake. Not surprisingly, the migratory timing of the annual migration for both stocks was affected. Comparisons of migratory behavior prior to the earthquake to subsequent behavior for pink stocks, consequently, are not valid (Noerenberg and Ossiander 1964; Roys 1968; McCurdy 1983).

Figure 1. Topographic adjustments due to the earthquake of March 27, 1964.


N
-2 to -6
VALDEZ
CROOKED CREEK INCUBATORS
CANNERY CREEK HATCHERY
SOLOMON GULCH HATCHERY
-1 to +2
WHITTIER
ESTHER IS.
TATITLEK
PERRY ISLAND HATCHERY
+6 to +7
+3 to +5
HAWKINS IS.
COPPER RIVER
CORDOVA
EYAK RIVER
MAIN BAY HATCHERY
ESHAMY LAKE
MARTIN RIVER
TOKUN LAKE
HINCHINBROOK IS.
BERING RIVER
PORT SAN JUAN HATCHERY
MONTAGUE ISLAND
+8 to +10
GULF OF ALASKA
PRINCE WILLIAM SOUND
+15 to +32
KAYAK ISLAND

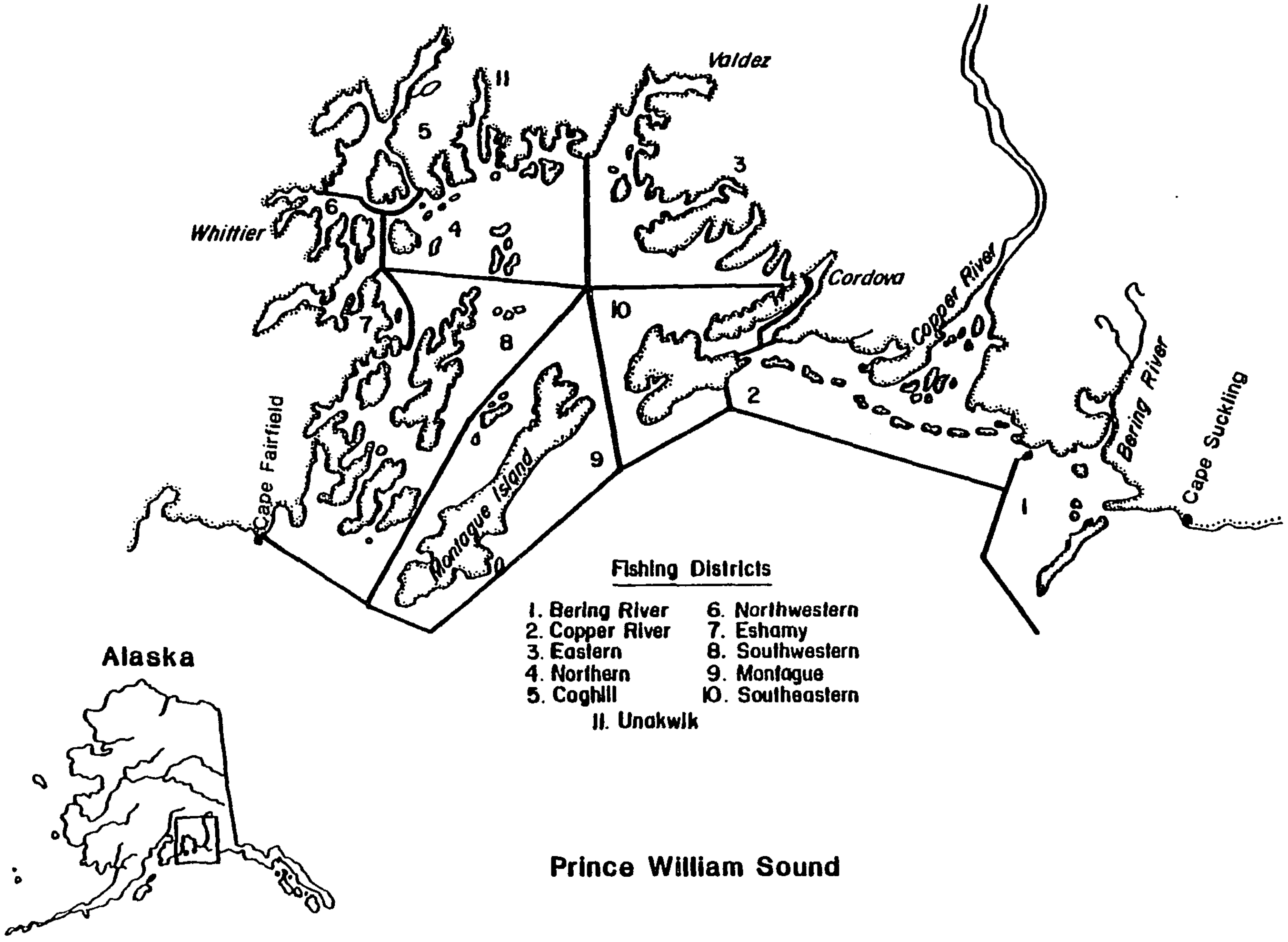
CHAPTER 2

STUDY AREA AND FISHERY DESCRIPTION

Located in the south-central area of Alaska, Prince William Sound is a region of great economic importance in natural resources, of which the salmon fishery is the mainstay of the economy. Of the five species of Pacific salmon (*Oncorhynchus* spp.) indigenous to this area, pink salmon constitute an average ninety percent (1960-1982), by number, of the annual salmon migration (Anonymous 1982).

The sound is a relatively deep, island studded embayment of substantial complexity, shaped over time by glacial activity, earthquakes, and meltwater runoff. Commercial fisheries management, seated in Cordova, has jurisdiction over all coastal waters and inland drainages on the north-central Gulf of Alaska between Cape Suckling and Cape Fairfield consisting of the Bering River, the Copper River, and Prince William Sound (Fig. 2). These watersheds, together with their adjacent land area, represent an approximate area of 38,000 square miles. The region consists of eleven management districts corresponding to the local geography and distribution of the five species harvested by the commercial fishery. The management objective for all districts is the achievement of desired escapement goals for each stock component of the annual migration and the full utilization of fish which are surplus to these needs (Anonymous 1982).

Figure 2. Prince William Sound Management Region.



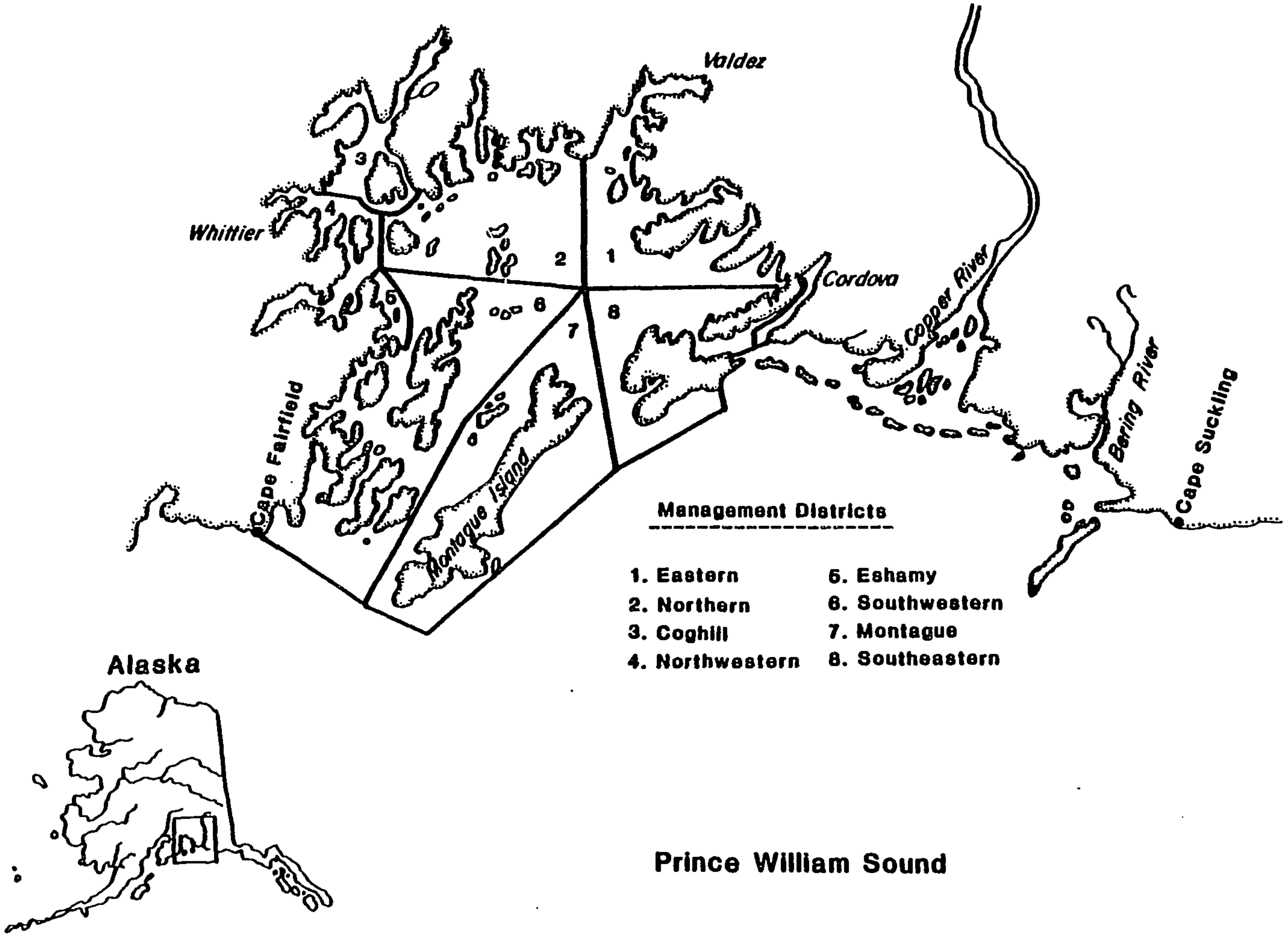
Prince William Sound

Of the eleven management districts which constitute the Prince William Sound region, the annual pink salmon commercial harvest is restricted, almost entirely, to eight districts known as Prince William Sound proper, (1) Eastern, (2) Northern, (3) Coghill, (4) Northwestern, (5) Eshamy, (6) Southwestern, (7) Montague, and (8) Southeastern (Fig. 3). Only incidental catches of pink salmon occur outside this area (Anonymous 1982). In spite of the relative proximity of the Bering River, Copper River, and Unakwik districts to these eight districts, sufficient physical and regulatory differences exist to account for the concentration of pink salmon catches in Prince William Sound proper.

Prince William Sound proper represents approximately 8000 square miles of coastal waters and inland drainages. More than 800 tributaries have been identified within this area as sources of pink salmon production. For the purposes of this study, the analysis of the pink salmon commercial fishery in Prince William Sound will be restricted to these eight districts.

The commercial fishery of Prince William Sound has existed since 1889 with the establishment of the first salmon cannery at Eyak. It has since experienced three distinct phases of development (Anonymous 1975; Anonymous 1983a). During the initial phase, 1889-1915, sockeye and, to a lesser extent, chinook and coho salmon were the preferred species due to marketing conditions. The major fishery occurred on the Copper River delta where these species were most abundant. Pink salmon were harvested incidentally to other catches, while chums were avoided entirely.

Figure 3. Pink Salmon Management Districts in Prince William Sound.



Prince William Sound

Cannery construction and operation proliferated in the second phase of development, 1915-1959, and management of the fishery resource was assumed by the federal government. A major trap fishery (floating and pile driven) accounted for the majority of the annual harvest relatively small purse seine and gill net fisheries also were in operation. Traps and sites were continually varied in a search for the design and location which produced the greatest catches. Ultimately, federal regulations fixed these localities to the sound entrances and the major migratory zones.

With the development of such intense fishing effort, catches of both pink and chum salmon escalated to high levels which peaked in the late 1940's and harvests of these stocks declined, thereafter. Average annual catches of even-year pink, odd-year pink, and chum salmon were approximately 8.0, 6.0, and 0.7 million fish, respectively. At the close of this era of federal management, stocks of both pink (even-year) and chum salmon were driven to approximately one-half of the historic maximum levels while the odd-year pink cycle was, seemingly, near total extinction (Anonymous 1975; Anonymous 1983a).

Following Alaskan statehood in 1959, the third phase of development began with the prohibition of the trap fishery and the subsequent proliferation of the purse seine fleet, and the assumption of the management, research and law enforcement responsibilities for the resource by the state government. The commissioner of the Alaska Department of Fish and Game (ADF&G) was granted authority to adjust intraseason fishing operations in terms of time and area. Pink and chum salmon remained the primary target species, whose harvest was regulated according to the achievement of desired escapement goals for each district. As a result of a greater flexibility in regulatory powers granted to the resident biologist, and a few initial years of favorable survival, significant increases in pink and chum salmon stocks occurred.

A fourth and ongoing phase in the history of this fishery was initiated in 1971 by legislative action which emphasized the establishment of large scale salmon aquaculture programs. Further legislation on limited entry to the commercial salmon net fisheries and the formation of regional salmon planning associations sets the stage for a bold new era whose consequences are still not fully understood. Presently, there are two public, and four private non-profit hatchery locations either operational or proposed in Prince William Sound (Fig. 4) (McCurdy 1981). The public sites are Cannery Creek and Main Bay, both operated by the ADF&G Fisheries Rehabilitation, Enhancement and Development Division (FREDD). The private non-profit sites are; (1) Solomon Gulch - proposed by Valdez Fisheries Devopment Association (V.F.D.A.), (2) Perry Island - operated by NERKA, Incorporated, (3) Esther Island facility, and (4) Port San Juan, Evans Island site - proposed and operated, respectively, by Prince William Sound Aquaculture Corporation (P.W.S.A.C.).

The successful management of both wild and hatchery stocks with similar timing and migration routes, but requiring different exploitation rates, poses additional levels of regulatory complexity (see Wright 1981). Although state policy mandates management action favoring the protection of wild stocks, the resource manager must permit hatchery owners and common property fishery participants to harvest hatchery returns in a timely fashion. This is necessary to ensure product quality and to allow the proper level and distribution of escapement to the hatchery for purposes of brood stock and operational budget requirements (McCurdy 1981).

Legal gear for the salmon fishery is restricted to purse seines and both drift and set gill nets. Purse seine fishing is permitted in all districts with the exception of the Eshamy, Copper and Bering River districts. Pink and chum salmon are the primary target species of this gear type. Drift gill netting is permitted in the Bering River, Copper River, Coghill, Unakwik and Eshamy districts. Set gill netting is legal in Eshamy only. The gear is restricted to one gill net of 150 fathoms in length, or to one purse seine of 125-150 fathoms in length, per boat (Anonymous 1983b).

In 1982, 525 drift gill net and 260 purse seine permit holders participated at some time during the season. There was no set gill net fishery this year due to the closure of Eshamy. The duration of the pink salmon fishery in Prince William Sound is usually from mid-May to late August, and it is regulated by emergency orders in terms of the time and area allocation of fishing effort permitted during the season (Anonymous 1982).

Catch data are generated by gill net and purse seine participants. Escapement data are collected by aerial and ground observations from two-hundred eleven (211) index spawning streams which, collectively, represent an average of eighty-five percent of the total spawning activity in Prince William Sound (Pirtle 1977). The weekly escapement estimates for each index stream are separated into the categories of stream, mouth (of stream), and bay (adjacent to stream), according to the actual location of the fish on the date of the survey.

Intraseason control of the commercial pink salmon fishing operation depends on the timely analysis of catch and escapement data. Commercial fisheries regulations are developed by comparing the time series of current performance of escapement by district to the time series of historical performance of both the cycle year and the brood year. Similarly, current catch by district is compared to historical performance of average cycle and brood year catch.

Simply stated, whenever the current time series of escapements are greater than or equal to the historic time series, scaled to current escapement goals, regularly scheduled fishing periods are permitted. Otherwise, management action to prevent harvest is indicated. Management also considers the comparison of the current time series of catch to the historic time series of catch which is expected on the basis of the current forecast of total abundance (Pirtle and McCurdy 1980; Mundy et al. 1982; Anonymous 1982; Anonymous 1983a).

Figure 4. Hatchery Facility locations.

I. Solomon Gulch

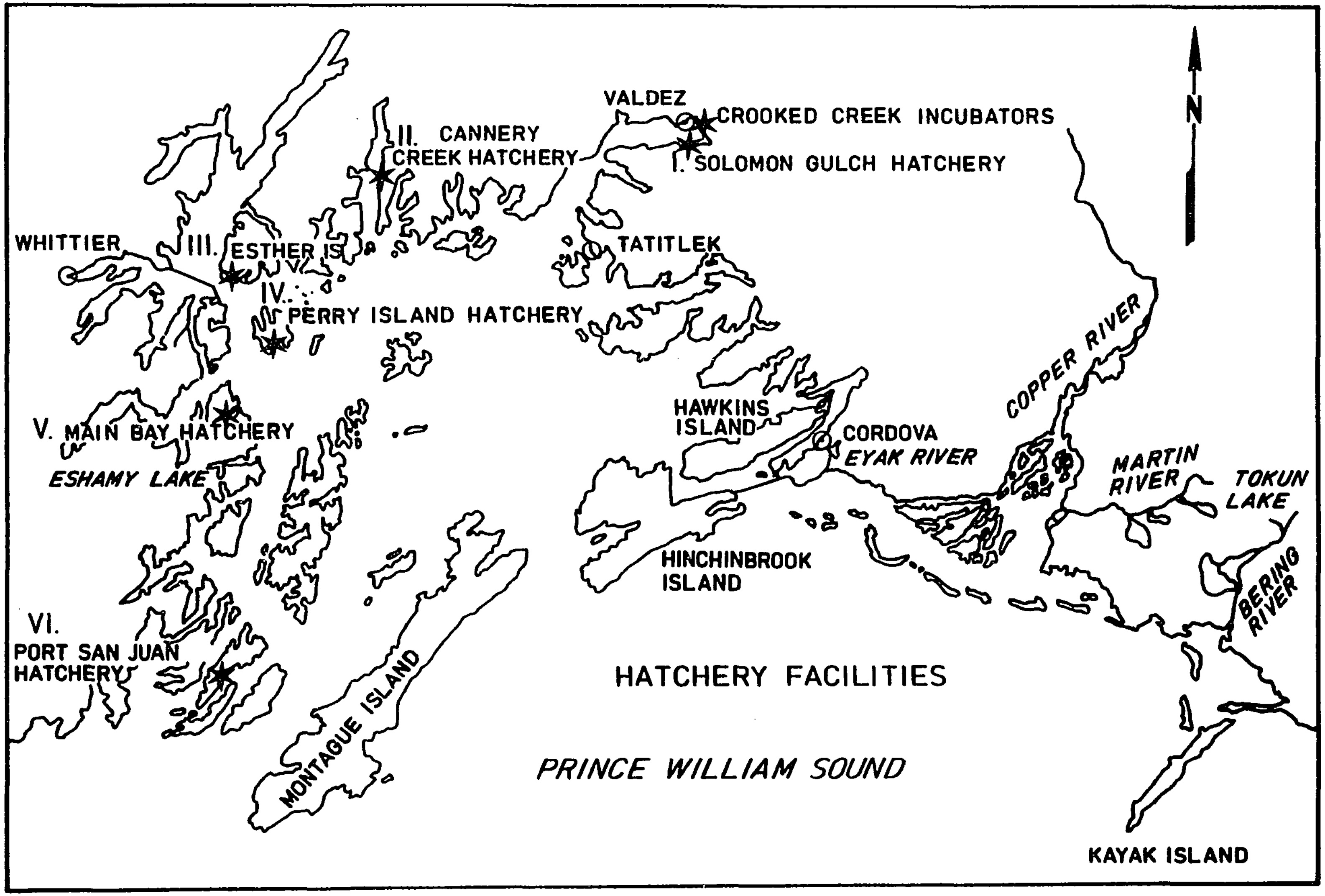
II. Cannery Creek

III. Esther Island

IV. Perry Island

V. Main Bay

VI. Port San Juan


N
VALDEZ
CROOKED CREEK INCUBATORS
I. SOLOMON GULCH HATCHERY
II. CANNERY CREEK HATCHERY
WHITTIER
III. ESTHER IS.
IV. PERRY ISLAND HATCHERY
TATITLEK
V. MAIN BAY HATCHERY
ESHAMY LAKE
HAWKINS ISLAND
CORDOVA
EYAK RIVER
COPPER RIVER
MARTIN RIVER
TOKUN LAKE
BERING RIVER
HINCHINBROOK ISLAND
VI. PORT SAN JUAN HATCHERY
MONTAGUE ISLAND
HATCHERY FACILITIES
PRINCE WILLIAM SOUND
KAYAK ISLAND

CHAPTER 3

METHODS

The daily catch and effort data of thirteen years, obtained from the Computer Services Division of the Alaska Department of Fish and Game, (1969-1982, inclusive) were the subject of the analysis. A maximum of seven years of observations for the odd-cycle, and six years of observations for the even-cycle, were available for any single district. Catches from the purse seine fishery were treated independently from the catches of the set and drift gill net fisheries.

The measure of nominal effort used in the construction of the catch-per-unit-effort (CPUE) time densities was the boat day, the number of boats that made at least one commercial delivery of fish to a processor within a given twenty-four hour period. Vessels that made multiple deliveries during the same fishing period were counted only once in the calculation of total effort. Catch-per-unit-effort is the ratio of the total numbers caught (C) to total nominal effort (f) during the fishing period, C/f (CPUE).

At the time of delivery of fish to a processor, catches are reported according to the area of capture. The district boundaries which constitute the management area of Prince William Sound (Fig. 3) have long been fixed and the fishery operates effectively within them.

The vast majority of catches are obtained in near shore waters and embayments adjacent to 'home-stream' entrances. Indeed, it can be argued that virtually no overlap of districts by the fishing operation occurs. Inaccurate reporting of locality of catch, on the other hand, may be a source of error, however such error is regarded as a small constant bias. Adjustment in the catch data for area effects, therefore, was not undertaken.

The following time series data categories were designated for the analysis: daily catch, daily proportion of total catch, cumulative daily catch, and cumulative daily proportion of total catch. The same four data categories were used for the analysis of catch-per-unit-effort.

Twenty years of weekly escapement data (1964-1983, inclusive) of the 'stream count' variety, collected from the index spawning streams (Computer Services Division, ADF&G), were subject to the analysis. A maximum of ten years of observation for the odd-cycle, and ten years of observation for the even-cycle, were available for any single district. Escapement enumeration of the 'bay count' and 'mouth count' varieties were not considered. The following time series data categories were designated for the analysis: weekly escapement, weekly proportion of total escapement, cumulative weekly escapement, and cumulative weekly proportion of total escapement.

3.1 Migratory Time Densities and Associated Statistics

Using the empirical methodology of Mundy (1979), migratory time densities for each annual data category of catch, CPUE, and spawning escapement, were computed on a sound-wide basis (all districts combined) and for each district independently, for every available year of data (Tables 1 and 2). The descriptive statistics of mean (central date of the migration), and variance (dispersion of the migration through time), along with the measures of the shape of the distribution function (skewness and kurtosis), were calculated for all annual time densities. Unless otherwise noted, the eight management districts plus the sound-wide category will, collectively, be referred to simply as 'districts'.

The mean and variance of the migratory time density, being conserved across generations, provide a convenient and quantifiable summary of migratory behavior. To calculate these statistics, the empirical migratory time density was defined as the time series of daily proportions, P'_t, where

$$P'_t = n_t \; / \; N \qquad (5)$$

n_t = abundance or CPUE on time interval t, and

N = total annual abundance or CPUE.

Table 1. Historic catch and catch-per-unit-effort data base. Availability of data by year and by district suitable to the calculation of annual migratory time densities. + = data were available, – = no data were avaialble for that year. District codes: 1 = Eastern, 2 = Northern, 3 = Coghill, 4 = Northwestern, 5 = Eshamy, 6 = Southwestern, 7 = Montague, 8 = Southeastern, 1-8 = Sound-Wide.

Year Cycle		Management District								
		1	2	3	4	5	6	7	8	1 - 8
	1970	+	+	+	+	–	+	–	+	+
E	1972	–	–	–	–	–	–	–	–	–
V	1974	–	–	+	+	–	–	–	–	+
E	1976	+	+	+	+	–	+	–	+	+
N	1978	+	+	+	–	–	–	–	+	+
	1980	+	+	+	+	–	+	–	+	+
	1982	+	+	+	+	–	+	–	+	+
	Total	5	5	6	5	0	4	0	5	6
	1969	+	+	+	+	–	+	–	+	+
	1971	+	+	+	+	–	+	–	+	+
O	1973	+	+	+	+	–	+	+	+	+
D	1975	+	+	+	+	–	+	+	+	+
D	1977	+	+	+	+	–	+	+	+	+
	1979	+	+	+	+	–	+	+	+	+
	1981	+	+	+	+	_	+	+	+	+
	Total	7	7	7	7	0	7	5	7	7

Table 2. Historic escapement data base. Availability of data by year and by district suitable to the calculation of annual migratory time densities. + = data were available, − = no data were available for that year.
District codes: 1 = Eastern, 2 = Northern, 3 = Coghill, 4 = Northwestern, 5 = Eshamy, 6 = Southwestern, 7 = Montague, 8 = Southeastern, 1-8 = Sound-Wide.

Year Cycle		Management District								
		1	2	3	4	5	6	7	8	1 - 8
	1964	+	+	+	+	+	+	+	+	+
	1966	+	+	+	+	−	+	+	+	+
	1968	+	+	+	+	+	+	+	+	+
E	1970	+	+	+	+	+	+	+	+	+
V	1972	+	+	+	+	−	+	+	+	+
E	1974	+	+	+	+	−	+	+	+	+
N	1976	+	+	+	+	−	+	+	+	+
	1978	+	+	+	+	−	+	+	+	+
	1980	+	+	+	+	+	+	+	+	+
	1982	+	+	+	+	+	+	+	+	+
	Total	10	10	10	10	5	10	10	10	10
	1965	+	+	+	+	−	+	+	+	+
	1967	+	+	+	+	+	+	+	+	+
	1969	+	+	+	+	−	+	+	+	+
O	1971	+	+	+	+	+	+	+	+	+
D	1973	+	+	+	+	−	+	+	+	+
D	1975	+	+	+	+	−	+	+	+	+
	1977	+	+	+	+	+	+	+	+	+
	1979	+	+	+	+	−	+	+	+	+
	1981	+	+	+	+	+	+	+	+	+
	1983	+	+	+	+	−	−	+	+	+
	Total	10	10	10	10	4	9	10	10	10

For each annual time density with a duration of migration of 'm' days, the mean of 't' was estimated by:

$$\hat{\bar{t}} = \sum_{t=1}^{m} t \, P'_t, \tag{6}$$

and its variance by:

$$\hat{S}_t^2 = \sum_{i=1}^{m} (t-\bar{t})^2 \, P'_t. \tag{7}$$

Only those days fished, in the case of catch, or those weeks with actual escapement enumerations, were used to compute these statistics. On all other days, P'_t is undefined.

Proportions were used for the purpose of constructing the empirical probability density function as an approximation of the true migratory time density. In practice, the use of proportion as a function of time minimizes the effect of relatively large fluctuations in interannual numerical abundance of salmon populations. Such time densities, therefore, become suitable for comparisons across years.

The catch, effort, and spawning escapement data obtained from the Computer Services Division were ordered on a calendar date basis. For convenience, these dates were coded as integers referenced to some starting date in the season. It is these coded dates that were used in the calculation of the migratory time densities. For the catch season with a duration of 95 days, day 1 = June 13, day 2 = June 14, ... , day 95 = September 15. The escapement data, provided on a weekly basis, had a season duration of 15 weeks and was coded in the following manner: week 1 = week ending date June 19, week 2 = week ending date June 26, ... , week 15 = week ending date September 25. Coded dates and their corresponding calendar dates are provided in the tables for reference.

Since estimates of migratory behavior based on catch data may be influenced by abiotic factors, the time density of a single year, for a geographic area, may be of limited use in harvest control for describing the migratory timing. The time density of a single year when used in a harvest control system may pose more risk of error than the use of the average time density based on several past years. Similarly, the fishery may be of varying duration year-to-year, or may not cover every day of the migration. To minimize these effects, while obtaining the best image of migratory behavior, migratory time densities and cumulative time densities were averaged across years.

All district annual migratory time densities for each data category (catch, CPUE, and spawning escapement) were grouped according to even and odd years (see Tables 1 and 2). Average daily proportions, and average cumulative daily proportions were calculated for both cycle years on a district basis. In the case of daily proportions, each date averaged can have a variable number of records depending on the number of observations available for that date for the years averaged. In the calculation of average cumulative proportions, daily records were considered to exist, in any year, for every date in the season starting with the first date on which a catch observation or escapement enumeration was made.

The average daily, P'_t, or average cumulative daily proportion, P_t for day 't' (t = 1 to m) and 'j' years (j = 1 to y), was calculated by:

$$\bar{P}_t = 1/y \sum_{j=1}^{y} P_{tj} \qquad (8)$$

for all years where $P_{tj} \neq 0$, and where P_{tj} is defined as the proportion on the t-th time interval in the j-th year.

A fundamental premise of this study is that migratory timing is conserved across generations. If the mean of the time density function in year 'i', i = 1 to y, is represented by $\bar{t}_i$, this premise is analogous to the statement: $E(\bar{t}_1) = E(\bar{t}_2) =, \ldots , = E(\bar{t}_i)$ for a fixed geographic reference frame, absent abiotic influences. It can be argued, consequently, that $E(P_{t1}) = E(P_{t2}) =, \ldots , = E(P_{tj})$, j = 1 to y, t = 1 to m. With the exception of a random error of measurement term, whose expectation is zero, and external modulating influences of abiotic factors, the 'y' proportions on a fixed time interval 't' are assumed to be equal.

Considering these proportions as an independent and identically distributed random sample from a normal population with unknown population mean and variance, the $(1-\alpha)\%$ confidence interval for the average daily ($\bar{P}'_t$) or average cumulative proportion ($\bar{P}_t$) on 'y' years was calculated by:

$$\bar{P}_t \pm b_{\alpha,y-1} \left[S^2_{\bar{P}_t} / y \right]^{\frac{1}{2}} \qquad (9)$$

where Student's - t is denoted by 'b' to avoid confusion, and where the estimate of the variance of the average cumulative proportion, $\bar{P}_t$, and average daily proportion $\bar{P}'_t$ was determined by:

$$S^2_{\bar{P}_t} = 1/(y-1) \sum_{j=1}^{y} (P_{tj} - \bar{P}_t)^2 \qquad (10)$$

Preliminary analysis of the time densities required the ability to compare the variability among the data categories (catch, CPUE, and escapement) over the years. In populations which differ appreciably in their means, numerical and proportional data for example, direct comparison of their variances is not informative since the variance of a data category is proportional to the magnitudes of the observations. The coefficient of variation (CV) (Sokal and Rohlf 1981), which expresses the standard deviation as a percentage of the mean, provides a method for making such comparisons. Simply stated, the data category that is less variable will have a lower numerical CV.

The coefficient of variation was computed for each data category by date over all years of record. As an example, the CV of a proportional data category is:

$$CV = (S_{\bar{P}_t} / \bar{P}_t)\ 100 \qquad (11)$$

Empirical time densities based on CPUE are thought to better approximate the distribution of total abundance than those based on catch alone, provided that the units of fishing gear are not highly competitive, and that catchability does not vary over the course of the season (Brannian 1982; Mundy 1982; Schaller 1984). This is expected when effort is not the same on each and every time interval. When effort is constant throughout the season, the time densities of catch and CPUE are identical. The comparison of catch and CPUE data categories will be based on an examination of the behavior of the coefficients of variation over time. The statistics of the least variable category will serve as the basis for the comparison of migratory behavior among districts.

3.2 Analysis of Variance and Multiple Comparison Methods

A fixed effects two-way analysis of variance model with interaction (Neter and Wasserman 1974; Hogg and Tanis 1977) was constructed to analyze the differences in the mean dates of migration between cycle years and among districts. The model was applied to catch, CPUE, and spawning escapement data categories independently. The two factors, or independent variables, represented in this model were cycle year (A) and management district (B), consisting of two and eight levels, respectively.

The coded mean dates of the empirical density functions for each district across all years of record constituted the observations of the response variable for each level of both factors. The fixed effects model for the two factor design was represented by:

$$Y_{ijk} = \mu_{..} + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk} \qquad (12)$$

where,

Y_{ijk} is the k-th observation of the response variable for the i-th level of factor A (cycle year) and the j-th level of factor B (management district), $i = 1, \ldots, a$; $j = 1, \ldots, b$; $k = 1, \ldots, c$.

$\mu_{..}$ is a constant, unknown component common to all observations i.e. the overall or grand mean response for all levels of both factors.

α_i is the additional or main effect due to the i-th level of factor A (cycle year), $i = 1$ to 2.

β_j is the additional or main effect due to the j-th level of factor B (management district), $j = 1$ to 8.

$(\alpha\beta)_{ij}$ is the interaction effect between the i-th level of factor A and the j-th level of factor B.

ε_{ijk} is the random experimental error associated with the k-th observation of the response variable for the i-th level of factor A and the j-th level of factor B.

The model assumes ε_{ijk} are independent $N(0,\sigma^2)$, and Y_{ijk} represent $n = abc$ mutually independent random variables that are normally distributed with mean μ_{ij} and common but unknown variance σ^2. Corresponding to each factor level, therefore, is a probability distribution for the response variables which differs only with respect to their means. In terms of expectation, the mean date of migration for year-cycle (i) and management district (j) is represented by:

$$E(Y_{ijk}) = \mu_{ij} = \mu_{..} + \alpha_i + \beta_j + (\alpha\beta)_{ij} \tag{13}$$

This formulation implies that the mean for any factor can be viewed as the sum of four components:

1. an overall unknown effect $\mu_{..} = \sum_i \sum_j \mu_{ij} / ab$,
2. the main effect α_i for factor A at the i-th level,
3. the main effect β_j for factor B at the j-th level, and
4. the interaction effect $(\alpha\beta)_{ij}$ when factor A is at the i-th level and factor B is at the j-th level.

Restrictions of this model are: $\sum_i \alpha_i = \sum_j \beta_j = \sum_i (\alpha\beta)_{ij} = \sum_j (\alpha\beta)_{ij} = 0$.

Guided by the previously stated harvest control objectives, three hypotheses of interest were examined by this model. They were:

1. H_0: $\alpha_i = 0$ against H_a: not all $\alpha_i = 0$, i=1, ..., a. Are there significant differences in the mean dates of the empirical distributions of catch, catch per unit effort, or spawning escapement between the odd-year and the even-year cycle? This hypothesis is equivalent to testing the genetic distinctness between odd-year and even-year pink salmon populations.

2. H_0: $\beta_j = 0$ against H_a: not all $\beta_j = 0$, j=1, ..., b. Within any one data category, are there significant differences in the mean dates

of time densities among districts for odd-year and even-year cycles combined?

3. H_0: $(\alpha\beta)_{ij} = 0$ against H_a: not all $(\alpha\beta)_{ij} = 0$. for all i and j. Do different combinations of the levels of the two factors produce different effects? If so, factor A and B are said to interact. Testing the hypothesis of interaction is equivalent to examining whether or not all factor means μ_{ij} can be expressed according to: $\mu_{ij} = \mu_{..} + \alpha_i + \beta_j$. If they can, no interaction is present. This hypothesis is sometimes represented by: H_0: $\mu_{ij} = \mu_{..} + \alpha_i + \beta_j$ for all i,j against H_a: $\mu_{ij} \neq \mu_{..} + \alpha_i + \beta_j$ for some i,j.

Non interaction implies that the expected difference between the mean responses for any two levels of one factor is the same for all levels of the other factor. There would be no interaction between factor A and B if, for example, the differences in the means of the time densities between any two management districts was the same for both cycle years, or if the difference in means between the two cycle years was the same for any two management districts.

A fixed effects one-way analysis of variance model (Neter and Wasserman 1974; Hogg and Tanis 1977) was constructed to analyze differences in the mean dates of migration among districts for a given cycle year. The model was applied to catch, CPUE, and spawning escapement categories for odd-year and even-year cycles independently. The independent variable, or treatment effect, examined by this model was the management district, consisting of eight levels.

The coded mean dates of the empirical density functions for each district across all years of record (within a cycle year) constituted the observations on the response variable for each level of the treatment. The design of the one-way fixed effect model was represented by:

$$Y_{ij} = \mu. + \tau_j + \varepsilon_{ij} \tag{14}$$

where,

Y_{ij} is the i-th observation of the response variable for the j-th treatment level, $i = 1, \ldots, n_j$; $j = 1, \ldots, k$.

$\mu.$ is a constant, unknown component common to all observations, the overall mean for all k levels of the treatment.

τ_j is the treatment deviation, or the additional effect that the j-th treatment level (management district) has on the response variable, $j = 1, \ldots, 8$.

ε_{ij} is the random experimental error associated with the i-th observation of the response variable for the j-th treatment level.

Assumptions for this model are:

1. ε_{ij} are independent $N(0,\sigma^2)$.

2. The k sets of observed data constitute k independent random samples of size n_j from their respective populations.

3. Each of the populations from which the samples come is normally distributed with mean μ_j and common but unknown variance σ^2.

4. The τ_j's are unknown constants and $\sum \tau_j = 0$ since the sum of the deviation of the μ_j from the mean $\mu.$ is zero.

Associated with each treatment level, therefore, is a probability distribution for the response variables which differ only with respect to their means. This can be expressed in terms of expectation by: $E(Y_{ij}) = \mu_j = \mu. + \tau._j$. The mean of the migratory time density for each management district j, can be viewed as the sum of an overall effect $\mu. = \sum \mu_j / k$, and the main effect τ_j due to treatment j.

The hypothesis of interest tested by this model was that all treatment means are equal against the alternative that the members of, at least, one pair are not equal. This analysis provides a method, therefore, for examining differences in the means of the migratory time densities among the management districts for any category of data within a given cycle year. The null hypothesis was formally stated as:

H_o: $\mu_1 = \mu_2 = \ldots = \mu_k$

H_a: not all μ_j are equal.

If the population means are equal, each treatment effect is equal to zero, so that, alternatively, the null hypothesis may be stated as:

H_o: $\tau_j = 0, \quad j = 1, \ldots, k$

H_a: not all $\tau_j = 0$.

The one-way analysis of variance F test was the initial step in the analysis used to determine if significant differences existed among the treatment means. Once this was concluded, the next objective was then to test for likenesses and differences among the k treatments. Two a posteriori procedures for multiple comparison analysis between treatment means were selected for this purpose, namely, Tukey's Honestly Significant Difference (HSD) technique, and a modified Least Significant Difference (LSD) method.

With the proviso, therefore, of a significant F test, the multiple comparison procedure was used to test the hypotheses that all possible pairwise combinations of the k treatment means were equal. The advantage of these procedures is that the 'k choose 2' possible confidence intervals for treatment means are constructed in such a manner that the joint probability for all comparisons is guaranteed not to fall below an overall significance level σ. The probability is σ, then, that one or more of the null hypotheses is false.

For the modified LSD procedure, a set of $100(1-\sigma)\%$ simultaneous confidence intervals for m = 'k choose 2' pairwise differences $(\mu_i - \mu_j)$ is given by:

$$(\bar{Y}_{.i} - \bar{Y}_{.j}) \pm t_{\alpha/2k}\, S[1/n_i + 1/n_j]^{\frac{1}{2}} \qquad (15)$$

where,

$S = [MSE/2]^{\frac{1}{2}} = [SSE\ /\ 2(N-k)]^{\frac{1}{2}}$,

k = number of treatment levels in the experiment,

N = total number of observations in the experiment,

$t_{\alpha/2k}$ = the upper $\alpha/2k$ point of the t distribution with (N-k) df,

$\bar{Y}_{.i}$, $\bar{Y}_{.j}$ = sample estimates for treatment means i and j,

n_i, n_j = the number of observations in treatments i and j, respectively,

$$LSD = t_{\alpha/2k}\, S[1/n_i + 1/n_j]^{\frac{1}{2}}$$

Using this procedure, the probability of all m comparisons being simultaneously correct is at least $(1 - \alpha)$. If the confidence interval for two treatment means constructed in this manner contains zero, or if the absolute difference between the sample estimates for the treatment means is greater than LSD, we reject H_0: $\mu_i = \mu_j$ in favor of H_a: $\mu_i \neq \mu_j$, at the α significance level.

Tukey's HSD test makes use of a single value against which treatment means are compared. This value, called HSD, is given by:

$$HSD = q_{\alpha,k,N-k}\, [MSE\ /\ (1/n_i + 1/n_j)]^{\frac{1}{2}} \qquad (16)$$

where, $q_{\alpha,k,N-k}$ is obtained from a table of percentage points of the Studentized Range, and all other parameters are as defined for the LSD procedure.

If the absolute difference between the sample estimate for the treatment means (i,j) is greater than HSD, we reject H_0: $\mu_i = \mu_j$ in favor of H_a: $\mu_i \neq \mu_j$ at the α significance level. We accept H_0 otherwise.

Scheffe's a priori method for multiple comparisons was used to examine linear combinations of treatment means defined by the contrast,

$L = \sum C_j\mu_j$ where, C_j's are constants subject to the restriction $\sum C_j = 0$. This procedure has the advantage that an infinite number of such contrasts can be examined for the k treatments, not just 'k choose 2' pairwise comparisons. The analysis tests the null hypothesis H_0: $L = 0$ against H_a: $L \neq 0$ on the basis that the simultaneous probability is $(1-\alpha)$ that all such contrasts lie between:

$$\hat{L} \pm S\,[\mathrm{Var}(\hat{L})]^{\frac{1}{2}} \tag{17}$$

where,

$$\mathrm{Var}(\hat{L}) = MSE \sum C_j^2 \,/\, n_j, \text{ and}$$
$$S^2 = (k-1)F_\alpha(k-1,N-k).$$

When zero falls within this $(1-\alpha)$% confidence interval, accept H_0: $L = 0$, otherwise reject in favor of H_a: $L \neq 0$ at the α significance level.

An example of the application of Scheffe's procedure would be a test of whether the mean date of migration in management districts one, two, and three combined was significantly different from the overall mean date of migration in management districts four, five, and six. The contrast tested in this case would be $L = (\mu_1 + \mu_2 + \mu_3)/3 - (\mu_4 + \mu_5 + \mu_6)/3$. Scheffe's method proves useful in the context of this study since an infinite number of a priori contrasts can be tailored to the data in a fashion that lends most insight to the nature of the relationships of migratory behavior among districts.

3.3 Correlation and Regression Analysis.

The models so far developed were intended to permit the evaluation of the nature of the relationships and differences, if any, in timing behavior among the management districts for any cycle year and category of data. In support of any conclusions drawn from these models, and to further evaluate methods which could contribute, in a predictive sense, to our understanding of the timing behavior by district, various correlation and regression models were considered.

The targeted objectives of these methods, for any cycle year and data category, were: (1) to determine the degree of association between the timing behavior among districts, (2) to determine the nature of the association between the eight districts and the overall sound-wide timing behavior, and (3) to determine if there were linear combinations of the management districts which could be used to predict the timings of catches and spawning escapements on a sound-wide basis.

For each data category of catch, CPUE, and spawning escapement, the Pearson product moment correlation coefficient, r (Neter and Wasserman 1974) was computed for all possible pairwise combinations of the management districts for odd-cycle and the even-cycle independently. The principal intent of this analysis was to examine the strength of the linear relationships or dependency in migratory behavior among the management districts, and to make conditional inferences on timing behavior for one district given another district. The coded mean dates of the empirical density functions for each district across all years of record constituted the observations on the ordered pairs of the response variables. Within any cycle year and data category, therefore, 'nine choose two' or seventy-two unique correlation coefficients were computed.

If $\bar{t}_{ik}$ ($i = 1, \ldots, j$, $k = 1, \ldots, n$) represents the mean of the time density for district 'i' in year 'k', the Pearson correlation model assumes that:

1. $\bar{t}_{ik}$, $\bar{t}_{jk}$ ($i \neq j$) are random samples of size 'n' from normal populations $N(\mu_{\bar{t}_i}, \sigma^2_{\bar{t}_i})$, $N(\mu_{\bar{t}_j}, \sigma^2_{\bar{t}_j})$, respectively.

2. each ordered pair $(\bar{t}_i, \bar{t}_j)$ of the random sample vary together according to a joint bivariate normal distribution with parameters $\mu_{\bar{t}_i}$, $\mu_{\bar{t}_j}$, $\sigma^2_{\bar{t}_i}$, $\sigma^2_{\bar{t}_j}$, and ρ where, ρ is the population correlation coefficient which measures the strength of the linear relationship between $\bar{t}_i$ and $\bar{t}_j$.

Given the sample analog, r, to the population correlation coefficient ρ, and any pairwise combination $(\bar{t}_i, \bar{t}_j)$, a hypothesis test was conducted to determine if the value of r was of significant magnitude to indicate that $(\bar{t}_i, \bar{t}_j)$ were correlated. When the population is modeled as a bivariate normal, the test of independence between $(\bar{t}_i, \bar{t}_j)$ is based on the test statistic:

$$t^* = r((n-r)/(1-r^2))^{\frac{1}{2}} \qquad (18)$$

which is distributed as Student's - t distribution with (n-2) degrees of freedom. If the computed valut of $t^* \geq t_{\sigma/2}, n-2$, the null hypothesis

H_0: $\rho = 0$ was rejected at the α significance level in favor of H_a: $\rho \neq 0$, and the two variables were concluded to be correlated. Otherwise, the null hypothesis was accepted. The critical or 'p-value' was also computed for all such hypothesis tests.

Multiple linear regression models (Neter and Wasserman 1974) were constructed to determine if there were linear combinations of the management districts which could be used to predict the timings of catches and spawning escapements on a sound-wide basis. For a given cycle year, the models were applied to catch, CPUE, and spawning escapement data categories, independently. The coded mean dates of the empirical density functions for each district across all years of record constituted the observations on the dependent and independent variables. In all models constructed, the dependent variable Y_i ($i = 1, \ldots, n$ years) was the overall sound-wide mean date of migration, while the dependent variables X_{ij} ($i = 1, \ldots, n$, $j = 1, \ldots, k$) represented the corresponding mean dates of migration for each management district.

The first order, multiple linear regression model was represented by:

$$Y_i = \beta_o + \beta_1 X_{i1} + \beta_2 X_{i1} + \ldots + \beta_k X_{ik} + \varepsilon_i \qquad (19)$$

where:

$\beta_o, \beta_1, \ldots, \beta_k$ are the regression coefficients or parameters which are considered to be unknown quantities.

Y_i is the response of the dependent variable for the i-th observation which represents the overall sound-wide mean date of migration for year $i = 1, \ldots, n$.

X_{ij}'s are the fixed values of the independent or predictor variables for the i-th observation which represent the mean dates of migration for districts $j = 1, \ldots, k$, and

ε_i are the error components which are independent $N(0,\sigma^2)$.

The analysis of variance procedure for the decomposition of the total variation in the response variable Y_i into its component parts was performed for the purposes of making inferences on the significance of the fitted regression relation. To test whether there was a relation between the dependent variable Y_i and the set of independent variables $X_{i1}, \ldots, X_{ik}$, the statistic $F^* = MSR/MSE$ was computed. Under the assumptions of the model, F^*, is distributed as an F distribution with $(k, n-k-1)$ degrees of freedom. If the computed value of $F^* \geq F(1-\alpha, k, n-k-1)$, the null hypothesis H_0: $\beta_1 = \beta_2 = \ldots = \beta_k = 0$ was rejected at the α significance level in favor of H_a: not all $\beta_k = 0$. If the null hypothesis is rejected, we conclude that one or more of the regression coefficients has an absolute value greater than or equal to zero, and that the regression equation explains a significant portion of the total variation in Y. The coefficient of multiple determination, denoted R^2, which measures the proportionate reduction of the total variation in Y_i associated with the use of the set of X_{ij} variables, was also computed for each regression equation.

Several methods for selecting the subsets of independent variables, and for specifying their order of inclusion into the regression model were examined. For any one cycle year and category of data, however, only that method or methods which produced the most appropriate models, in terms of harvest control information, were used. In such instances, comparisons of the models were made. In the case where the independent variables were added to the model in a stepwise manner, the incremental R^2 attributable to the variable added at each step was computed. Significance tests on these part correlation coefficients were performed, when necessary, by standard methodology (see Neter and Wasserman 1974).

The forward, stepwise inclusion method was used to isolate the 'best' subset of independent variables that yielded the optimal prediction equation with as few terms as possible. The term 'best' implies that the subset of independent variables selected accounted for the greatest reduction in the total variation of the response variable Y_i. Hierarchial methods of selection and inclusion of the independent variables were also performed according to certain prespecified criteria. The criteria established for this purpose were:

1. Inclusion of all independent variables in a stepwise manner beginning with that district most highly correlated with the dependent variable (sound-wide mean date of migration) in terms of having the highest r, followed by the next most highly correlated district, ..., the least most highly correlated district.

2. The selection of a subset of independent variables on the basis of those districts with an earlier average mean date of migration than the sound-wide average mean date of migration, then ordering their inclusion beginning with the 'earliest' district, the next 'earliest'

district, ..., the 'latest' district from this subset. No districts in that year cycle and data category with an average mean date later than the sound-wide average mean date were considered for inclusion in this model.

3. The selection of a subset of independent variables on the basis of those districts that were both highly correlated with the dependent variable, and had an earlier average mean date of migration than the sound-wide average mean date.

4. The selection of those independent variables on the basis of subsets, of districts, if any, identified from the analysis of variance model, and from Scheffe's a priori method of multiple combinations.

CHAPTER 4

RESULTS

4.1 Timing Behavior of the Pink Salmon Fishery

Migratory time densities for each data category of catch, CPUE, and spawning escapement were calculated on a sound-wide basis (all districts combined), and for each district independently, for every available year of data (Tables 1 and 2). The descriptive statistics of mean and variance for all annual time densities of the categories of catch, CPUE, and escapement were also calculated (Tables 3, 4, and 5). A total of three-hundred and fifty-seven such empirical density functions were generated by the analysis (Rugolo 1984), ninety-three each for catch and CPUE, and one-hundred and seventy-one for spawning escapement.

All district and sound-wide annual migratory time densities for each data category were grouped according to even and odd years. Average daily proportions and average cumulative daily proportions were calculated for both cycle years on a district basis for all years of record. A total of 42 management district average historical time densities for both cycle years (Appendix B), together with the corresponding graphs of the time series of average daily (weekly) cumulative proportions (Appendix A), were generated by the analysis. Six sound-wide average historical time densities for the categories of

Table 3. Mean and variance of the annual migratory time densities for pink salmon catch in Prince William Sound Alaska 1969 - 1982. Mean: digit one = calendar month, digits two and three = calendar day. Variance in square days.

MEAN DATE

Year	Management District								
	1	2	3	4	5	6	7	8	1 - 8
1969	731	724	718	723	—	729	—	730	729
1970	726	726	713	724	—	727	—	728	726
1971	806	801	724	729	—	802	—	804	803
1972	—	—	—	—	—	—	—	—	—
1973	731	727	718	720	—	729	729	728	727
1974	—	—	715	714	—	—	—	—	715
1975	725	723	721	723	—	728	801	727	726
1976	730	722	721	723	—	723	—	723	726
1977	709	716	710	713	—	722	726	717	715
1978	805	730	714	—	—	—	—	805	803
1979	715	716	709	720	—	726	726	724	722
1980	802	725	723	724	—	731	*	727	731
1981	717	712	720	729	—	723	729	723	721
1982	808	804	731	730	**	807	***	806	806

VARIANCE

Year	1	2	3	4	5	6	7	8	1 - 8
1969	41.5	34.7	156.7	40.4	—	47.6	—	39.3	50.6
1970	66.4	49.2	139.8	37.8	—	45.0	—	1.2	56.4
1971	55.6	61.3	48.4	41.6	—	48.3	—	42.4	58.6
1972	—	—	—	—	—	—	—	—	—
1973	21.8	11.9	19.6	24.7	—	14.0	9.4	13.7	26.1
1974	—	—	11.5	22.2	—	—	—	—	14.5
1975	50.4	47.2	43.2	67.8	—	32.5	21.5	40.8	47.5
1976	182.0	38.5	64.3	31.7	—	27.7	—	34.6	122.1
1977	171.4	55.8	48.2	75.5	—	35.0	1.3	45.0	124.0
1978	144.8	122.1	45.5	—	—	—	—	7.8	133.3
1979	226.3	69.5	117.2	30.1	—	96.2	51.0	65.9	144.8
1980	110.9	50.4	73.3	75.7	—	75.0	*	47.8	85.8
1981	183.8	114.3	177.5	9.2	—	105.8	15.0	57.8	128.2
1982	85.8	44.3	58.9	102.0	**	60.0	***	15.3	66.8

* - Mean = 818, Variance = 0.0 - based on one day of catch.
** - Mean = 715, Variance = 0.0 - based on one day of catch.
*** - Mean = 812, Variance = 0.2 - based on two days of catch.

Table 4. Mean and variance of the annual migratory time densities for pink salmon CPUE in Prince William Sound Alaska 1969 - 1982. Mean: digit one = calendar month, digits two and three = calendar day. Variance in square days.

MEAN DATE

Year	Management District 1	2	3	4	5	6	7	8	1 - 8
1969	728	726	728	726	—	724	—	728	727
1970	724	727	722	726	—	727	—	729	725
1971	804	803	727	802	—	802	—	804	803
1972	—	—	—	—	—	—	—	—	—
1973	729	728	720	719	—	728	727	728	723
1974	—	—	713	713	—	—	—	—	713
1975	725	724	723	725	—	727	730	726	725
1976	723	719	721	723	—	724	—	723	723
1977	713	718	712	714	—	719	727	716	715
1978	809	803	717	—	—	—	—	806	808
1979	722	724	715	720	—	731	727	723	728
1980	801	728	724	727	—	809	*	728	802
1981	724	718	727	729	—	811	731	722	810
1982	805	804	801	729	**	803	***	809	803

VARIANCE

Year	1	2	3	4	5	6	7	8	1 - 8
1969	70.3	46.4	77.5	46.5	—	158.9	—	88.8	108.8
1970	60.1	52.8	75.6	44.8	—	82.7	—	2.0	108.5
1971	68.1	72.2	48.0	38.6	—	58.7	—	51.2	72.1
1972	—	—	—	—	—	—	—	—	—
1973	20.4	16.3	46.4	84.9	—	14.3	9.6	13.4	69.4
1974	—	—	22.3	28.1	—	—	—	—	26.0
1975	47.5	46.2	62.2	59.7	—	42.3	17.5	60.1	70.6
1976	137.9	56.2	57.1	32.3	—	41.8	—	35.0	155.2
1977	145.9	54.2	72.7	96.3	—	62.5	2.6	58.1	133.7
1978	204.5	104.6	22.0	—	—	—	—	9.9	192.6
1979	272.6	71.4	157.4	39.5	—	225.5	67.7	70.4	328.4
1980	114.6	54.5	65.1	81.3	—	154.3	*	66.1	122.2
1981	211.8	88.4	88.3	13.7	—	168.3	23.7	117.8	239.4
1982	254.0	96.6	74.2	81.7	**	180.4	***	37.2	204.6

* - Mean = 818, Variance = 0.0 - based on one day of catch.
** - Mean = 715, Variance = 0.0 - based on one day of catch.
*** - Mean = 812, Variance = 0.2 - based on two days of catch.

Table 5. Mean and variance of the annual migratory time densities for pink salmon escapement in Prince William Sound Alaska 1969 - 1982. Mean: digit one = calendar month, digits two and three = calendar day. Variance in square weeks.

MEAN DATE

Year	Management District								
	1	2	3	4	5	6	7	8	1 - 8
1964	818	822	812	820	811	825	820	819	819
1965	818	821	813	826	828*	823	826	823	823
1966	808	817	818	819	724*	820	824	823	815
1967	822	809	820	809	828	821	821	821	818
1968	730	808	806	819	825	825	823	823	813
1969	816	805	801	815	—	817	802	802	810
1970	816	814	815	813	823	813	819	819	816
1971	829	815	908	910	905	904	902	829	830
1972	818	820	813	818	—	820	825	825	819
1973	803	804	813	821	—	821	815	813	810
1974	811	814	811	817	—	817	817	816	814
1975	805	805	808	824	—	825	824	822	812
1976	825	823	824	818	—	820	826	826	824
1977	803	805	824	823	820	821	819	817	814
1978	824	818	818	817	—	818	825	825	821
1979	807	808	820	829	—	826	814	813	813
1980	814	818	818	817	824	818	820	820	817
1981	807	807	801	815	812	824	814	811	810
1982	815	824	820	819	817	819	824	823	820
1983	723	724	730	729	—	728**	729	729	727

VARIANCE

Year	1	2	3	4	5	6	7	8	1 - 8
1964	3.7	3.1	4.3	2.7	5.2	4.1	2.0	1.8	3.5
1965	5.4	1.9	3.4	0.6	0.0*	1.0	0.6	0.6	2.3
1966	2.7	8.1	3.3	3.1	0.0*	2.6	1.2	1.4	4.6
1967	3.6	1.8	2.5	2.3	0.2	2.4	1.9	2.0	3.2
1968	1.9	1.8	1.0	0.2	0.1	0.2	1.1	1.2	3.8
1969	4.2	2.9	2.8	2.1	—	1.7	0.8	0.8	3.8
1970	5.2	2.1	2.2	2.3	1.0	1.9	2.8	3.1	3.8
1971	5.6	3.7	6.4	4.7	0.7	1.9	2.3	3.2	4.7
1972	2.4	2.0	1.6	1.8	—	2.0	1.5	1.7	2.3
1973	4.7	3.5	2.2	1.9	—	1.3	2.4	2.3	3.7
1974	4.0	2.1	1.4	2.3	—	2.9	3.9	4.0	3.1
1975	3.3	2.8	1.9	0.6	—	1.5	2.6	3.0	3.9
1976	5.0	3.9	2.2	3.2	—	2.8	1.2	1.2	4.0
1977	5.4	5.5	5.4	2.1	5.6	2.1	2.7	3.2	5.5
1978	4.8	2.0	1.3	1.5	—	1.0	1.9	2.0	3.0
1979	7.3	5.9	3.0	1.5	—	3.4	5.0	5.1	6.3
1980	4.5	2.2	2.6	3.0	1.3	2.3	2.9	3.3	3.5
1981	8.3	7.0	3.7	5.1	0.9	1.0	5.0	4.9	6.8
1982	4.5	2.6	2.4	4.0	3.1	4.6	3.1	3.1	3.7
1983	1.0	1.5	0.4	0.2	—	0.2**	0.4	0.4	0.8

* / ** - based on one / two week(s) of escapement enumeration, respectively.

Table 6. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970 - 1982, excluding 1972. All districts combined, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
6	618	1	.0000	0	0	1	.0000	0	0
7	619	1	.0000	0	0	2	.0000	0	0
8	620	1	.0000	0	0	2	.0000	0	0
9	621	2	.0000	100	0	2	.0000	100	0
10	622	3	.0001	70	0	3	.0001	74	0.01
11	623	2	.0002	60	0.01	3	.0003	70	0.02
12	624	2	.0002	19	0	3	.0005	74	0.03
13	625	2	.0002	60	0.01	3	.0006	79	0.05
14	626	3	.0007	84	0.05	4	.0010	64	0.06
15	627	3	.0002	112	0.02	4	.0012	65	0.07
16	628	2	.0003	66	0.02	4	.0013	51	0.07
17	629	3	.0005	75	0.04	4	.0017	50	0.08
18	630	2	.0008	75	0.06	4	.0021	63	0.13
19	701	3	.0010	64	0.06	4	.0029	65	0.19
20	702	3	.0009	36	0.03	4	.0035	65	0.23
21	703	2	.0034	8	0.02	4	.0053	75	0.40
22	704	1	.0024	0	0	4	.0059	78	0.46
23	705	3	.0036	99	0.36	5	.0068	106	0.73
24	706	3	.0016	62	0.10	5	.0078	94	0.74
25	707	3	.0020	40	0.08	5	.0091	80	0.73
26	708	4	.0098	129	1.27	5	.0169	107	1.82
27	709	4	.0252	102	2.57	5	.0371	112	4.17
28	710	5	.0200	116	2.33	5	.0572	105	6.02
29	711	3	.0132	70	0.93	5	.0651	102	6.69
30	712	5	.0347	111	3.89	5	.0999	105	10.52
31	713	4	.0234	51	1.21	5	.1186	83	9.85
32	714	6	.0166	69	1.15	6	.1155	83	9.62
33	715	5	.0407	81	3.31	6	.1495	84	12.63
34	716	5	.0452	102	4.64	6	.1872	90	16.87
35	717	6	.0397	119	4.76	6	.2270	93	21.22
36	718	5	.0398	114	4.56	6	.2602	97	25.26
37	719	4	.0627	119	7.52	6	.3019	105	31.95
38	720	4	.0329	50	1.66	6	.3239	96	31.30
39	721	5	.0321	50	1.63	6	.3508	86	30.47
40	722	5	.0292	71	2.10	6	.3751	79	29.85
41	723	4	.0357	50	1.80	6	.3990	73	29.43
42	724	4	.0256	100	2.57	6	.4160	69	29.08
43	725	3	.0188	78	1.47	6	.4255	67	28.86
44	726	4	.0209	136	2.86	6	.4394	65	28.81
45	727	3	.0618	52	3.22	6	.4704	61	29.13
46	728	4	.0578	46	2.68	6	.5090	58	29.54
47	729	4	.0463	49	2.30	6	.5398	55	30.21
48	730	4	.0447	18	0.83	6	.5697	53	30.26
49	731	4	.0413	54	2.25	6	.5972	49	29.67
50	801	3	.0456	67	3.09	6	.6200	45	28.39
51	802	1	.0541	0	0	6	.6290	43	27.29
52	803	3	.0831	60	5.02	6	.6706	35	23.99
53	804	4	.0784	53	4.21	6	.7229	29	21.03
54	805	4	.0356	54	1.93	6	.7467	26	19.97
55	806	3	.0507	14	0.74	6	.7721	25	19.36

Table 6 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
56	807	3	.0317	58	1.85	6	.7879	23	18.39
57	808	2	.0466	29	1.38	6	.8035	21	17.19
58	809	2	.1053	50	5.31	6	.8386	15	12.91
59	810	1	.0383	0	0	6	.8449	14	12.05
60	811	3	.0693	55	3.83	6	.8796	11	9.83
61	812	2	.0401	9	0.38	6	.8930	9	8.86
62	813	3	.0465	40	1.88	6	.9162	8	7.65
63	814	3	.0642	65	4.23	6	.9484	5	5.21
64	815	3	.0237	59	1.41	6	.9602	4	4.13
65	816	2	.0130	99	1.29	6	.9646	3	3.33
66	817	1	.0234	0	0	6	.9685	2	2.69
67	818	3	.0232	58	1.35	6	.9801	2	2.00
68	819	3	.0092	66	0.61	6	.9847	1	1.85
69	820	1	.0127	0	0	6	.9869	1	1.72
70	821	2	.0055	5	0.02	6	.9887	1	1.72
71	822	3	.0126	84	1.06	6	.9950	0	0.77
72	823	2	.0050	56	0.28	6	.9967	0	0.49
73	824	3	.0022	70	0.15	6	.9977	0	0.33
74	825	2	.0038	45	0.17	6	.9990	0	0.12
75	826	2	.0015	3	0	6	.9995	0	0
76	827	2	.0001	33	0	6	.9996	0	0
77	828	2	.0002	0	0	6	.9997	0	0
78	829	0	.0000	0	0	6	.9997	0	0
79	830	2	.0007	73	0.05	6	.9999	0	0
80	831	0	.0000	0	0	6	.9999	0	0
81	901	0	.0000	0	0	6	.9999	0	0
82	902	0	.0000	0	0	6	.9999	0	0
83	903	0	.0000	0	0	6	.9999	0	0
84	904	0	.0000	0	0	6	.9999	0	0
85	905	0	.0000	0	0	6	.9999	0	0
86	906	0	.0000	0	0	6	.9999	0	0
87	907	0	.0000	0	0	6	.9999	0	0
88	908	0	.0000	0	0	6	.9999	0	0
89	909	0	.0000	0	0	6	.9999	0	0
90	910	0	.0000	0	0	6	.9999	0	0
91	911	0	.0000	0	0	6	.9999	0	0
92	912	0	.0000	0	0	6	.9999	0	0
93	913	0	.0000	0	0	6	.9999	0	0
94	914	1	.0002	0	0	6	1.0000	0	0

Table 7. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981, inclusive. All districts combined, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
2	614	1	.0000	0	0	1	.0000	0	0
3	615	0	.0000	0	0	1	.0000	0	0
4	616	1	.0001	0	0	2	.0000	100	0
5	617	2	.0000	0	0	3	.0000	141	0
6	618	1	.0000	0	0	3	.0000	141	0
7	619	1	.0000	0	0	3	.0000	141	0
8	620	3	.0000	141	0	4	.0000	100	0
9	621	4	.0000	173	0	5	.0000	89	0
10	622	3	.0000	141	0	6	.0001	125	0.01
11	623	3	.0002	70	0.01	6	.0002	128	0.02
12	624	3	.0058	139	0.81	6	.0031	202	0.63
13	625	5	.0026	190	0.50	6	.0053	207	1.11
14	626	5	.0020	174	0.35	6	.0070	204	1.44
15	627	6	.0172	149	2.57	7	.0208	121	2.52
16	628	5	.0140	128	1.80	7	.0308	130	4.02
17	629	5	.0125	119	1.50	7	.0398	135	5.38
18	630	6	.0052	166	0.86	7	.0443	138	6.12
19	701	5	.0065	150	0.98	7	.0490	141	6.92
20	702	7	.0029	150	0.44	7	.0519	135	7.05
21	703	5	.0033	121	0.40	7	.0543	131	7.16
22	704	6	.0057	169	0.98	7	.0593	135	8.02
23	705	7	.0060	159	0.97	7	.0653	136	8.95
24	706	6	.0101	108	1.09	7	.0740	134	9.98
25	707	6	.0080	126	1.01	7	.0809	132	10.73
26	708	5	.0099	110	1.09	7	.0880	130	11.45
27	709	7	.0091	136	1.24	7	.0971	122	11.87
28	710	6	.0089	115	1.03	7	.1048	116	12.22
29	711	6	.0111	133	1.49	7	.1144	117	13.45
30	712	6	.0133	117	1.56	7	.1259	117	14.74
31	713	5	.0222	64	1.44	7	.1417	113	16.12
32	714	6	.0217	68	1.48	7	.1604	103	16.59
33	715	6	.0208	71	1.50	7	.1783	97	17.46
34	716	7	.0193	62	1.21	7	.1977	88	17.53
35	717	7	.0222	73	1.63	7	.2199	80	17.62
36	718	6	.0295	61	1.81	7	.2452	76	18.84
37	719	5	.0242	55	1.33	7	.2626	75	19.78
38	720	6	.0277	71	1.98	7	.2864	74	21.35
39	721	6	.0375	51	1.94	7	.3185	68	21.69
40	722	6	.0363	62	2.25	7	.3497	63	22.16
41	723	7	.0460	62	2.86	7	.3958	52	20.79
42	724	7	.0374	79	2.99	7	.4333	45	19.91
43	725	6	.0503	54	2.73	7	.4764	43	20.62
44	726	7	.0352	98	3.47	7	.5117	40	20.66
45	727	6	.0416	51	2.13	7	.5473	39	21.49
46	728	6	.0508	52	2.69	7	.5909	35	21.10
47	729	6	.0422	50	2.11	7	.6271	32	20.67
48	730	7	.0552	48	2.65	7	.6823	27	18.86
49	731	6	.0525	49	2.61	7	.7274	25	18.66
50	801	5	.0480	60	2.91	7	.7617	24	18.80
51	802	5	.0399	70	2.79	7	.7902	21	17.09

Table 7 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
52	803	5	.0442	62	2.78	7	.8218	19	16.06
53	804	5	.0496	59	2.97	7	.8572	15	13.33
54	805	5	.0439	69	3.03	7	.8886	12	11.33
55	806	6	.0409	59	2.43	7	.9237	10	9.34
56	807	5	.0191	85	1.64	7	.9374	9	9.29
57	808	6	.0107	124	1.34	7	.9466	10	9.60
58	809	3	.0269	125	3.38	7	.9582	7	7.04
59	810	3	.0253	108	2.74	7	.9690	5	4.87
60	811	3	.0195	118	2.31	7	.9774	3	3.12
61	812	3	.0134	128	1.72	7	.9832	1	1.90
62	813	3	.0168	46	0.77	7	.9904	1	1.10
63	814	4	.0028	63	0.18	7	.9920	1	1.04
64	815	3	.0023	71	0.17	7	.9930	0	0.98
65	816	3	.0095	131	1.26	7	.9971	0	0.52
66	817	1	.0013	0	0	7	.9973	0	0.52
67	818	1	.0049	0	0	7	.9980	0	0.35
68	819	0	.0000	0	0	7	.9980	0	0.35
69	820	2	.0023	36	0.08	7	.9987	0	0.24
70	821	1	.0005	0	0	7	.9988	0	0.24
71	822	2	.0019	79	0.15	7	.9993	0	0.11
72	823	1	.0003	0	0	7	.9994	0	0.11
73	824	2	.0014	92	0.13	7	.9998	0	0
74	825	1	.0002	0	0	7	.9998	0	0
75	826	0	.0000	0	0	7	.9998	0	0
76	827	0	.0000	0	0	7	.9998	0	0
77	828	1	.0001	0	0	7	.9998	0	0
78	829	0	.0000	0	0	7	.9998	0	0
79	830	0	.0000	0	0	7	.9998	0	0
80	831	1	.0003	0	0	7	.9999	0	0
81	901	0	.0000	0	0	7	.9999	0	0
82	902	0	.0000	0	0	7	.9999	0	0
83	903	0	.0000	0	0	7	.9999	0	0
84	904	0	.0000	0	0	7	.9999	0	0
85	905	0	.0000	0	0	7	.9999	0	0
86	906	0	.0000	0	0	7	.9999	0	0
87	907	0	.0000	0	0	7	.9999	0	0
88	908	0	.0000	0	0	7	.9999	0	0
89	909	0	.0000	0	0	7	.9999	0	0
90	910	0	.0000	0	0	7	.9999	0	0
91	911	0	.0000	0	0	7	.9999	0	0
92	912	1	.0006	0	0	7	1.0000	0	0

Table 8. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970 - 1982, excluding 1972. All districts combined, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
6	618	1	.0008	0	0	1	.0008	0	0
7	619	1	.0000	0	0	2	.0004	100	0.04
8	620	1	.0001	0	0	2	.0004	77	0.03
9	621	2	.0005	83	0.05	2	.0010	80	0.08
10	622	3	.0011	63	0.06	3	.0013	93	0.12
11	623	2	.0013	18	0.02	3	.0020	81	0.16
12	624	2	.0015	16	0.02	3	.0033	74	0.24
13	625	2	.0015	26	0.04	3	.0043	71	0.30
14	626	3	.0057	106	0.62	4	.0072	68	0.49
15	627	3	.0015	105	0.16	4	.0084	71	0.61
16	628	2	.0019	63	0.11	4	.0095	60	0.57
17	629	3	.0022	35	0.07	4	.0112	47	0.53
18	630	2	.0035	42	0.14	4	.0130	45	0.59
19	701	3	.0050	77	0.38	4	.0167	54	0.91
20	702	3	.0040	37	0.14	4	.0197	56	1.12
21	703	2	.0116	20	0.23	4	.0255	65	1.67
22	704	1	.0111	0	0	4	.0282	73	2.06
23	705	3	.0122	85	1.05	5	.0298	103	3.07
24	706	3	.0055	14	0.08	5	.0332	90	2.99
25	707	3	.0073	51	0.37	5	.0374	75	2.83
26	708	4	.0290	113	3.29	5	.0608	95	5.82
27	709	4	.0363	102	3.72	5	.0902	103	9.36
28	710	5	.0476	80	3.84	5	.1376	89	12.28
29	711	3	.0172	62	1.08	5	.1478	89	13.17
30	712	5	.0356	91	3.25	5	.1835	89	16.36
31	713	4	.0225	45	1.01	5	.2016	77	15.62
32	714	6	.0189	26	0.50	6	.1868	86	16.23
33	715	5	.0335	76	2.56	6	.2148	86	18.58
34	716	5	.0341	80	2.76	6	.2435	86	21.11
35	717	6	.0447	76	3.41	6	.2879	83	24.06
36	718	5	.0326	80	2.63	6	.3148	83	26.35
37	719	4	.0479	114	5.50	6	.3473	89	31.07
38	720	4	.0247	24	0.61	6	.3638	83	30.52
39	721	5	.0255	29	0.74	6	.3851	77	29.73
40	722	5	.0240	42	1.01	6	.4051	71	29.11
41	723	4	.0306	17	0.54	6	.4255	67	28.55
42	724	4	.0295	28	0.84	6	.4451	62	28.02
43	725	3	.0375	21	0.81	6	.4638	58	27.31
44	726	4	.0375	13	0.52	6	.4890	55	26.94
45	727	3	.0429	28	1.21	6	.5103	53	27.18
46	728	4	.0407	15	0.64	6	.5376	50	27.05
47	729	4	.0357	17	0.61	6	.5613	48	27.10
48	730	4	.0304	18	0.56	6	.5816	46	27.12
49	731	4	.0513	57	2.95	6	.6158	45	28.12
50	801	3	.0330	42	1.41	6	.6325	43	27.77
51	802	1	.0197	0	0	6	.6358	43	27.60
52	803	3	.0513	53	2.75	6	.6615	38	25.31
53	804	4	.0522	55	2.90	6	.6963	32	22.45
54	805	4	.0612	76	4.67	6	.7370	25	18.86
55	806	3	.0348	34	1.21	6	.7544	24	18.63

Table 8 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
56	807	3	.0291	23	0.68	6	.7691	24	18.58
57	808	2	.0252	11	0.29	6	.7774	23	18.09
58	809	2	.0483	61	2.95	6	.7936	20	15.91
59	810	1	.0171	0	0	6	.7965	19	15.66
60	811	3	.0402	47	1.90	6	.8165	16	13.71
61	812	2	.0266	16	0.44	6	.8253	15	13.18
62	813	3	.0314	27	0.86	6	.8413	13	11.63
63	814	3	.0450	53	2.41	6	.8636	13	11.53
64	815	3	.0280	34	0.96	6	.8776	11	10.08
65	816	2	.0166	20	0.33	6	.8831	11	9.90
66	817	1	.0198	0	0	6	.8865	10	9.63
67	818	3	.0286	22	0.63	6	.9008	10	9.77
68	819	3	.0232	37	0.87	6	.9125	10	9.86
69	820	1	.0190	0	0	6	.9156	10	9.70
70	821	2	.0198	39	0.77	6	.9223	10	9.73
71	822	3	.0339	32	1.09	6	.9393	9	8.58
72	823	2	.0213	35	0.76	6	.9465	7	7.50
73	824	3	.0328	43	1.44	6	.9628	6	5.87
74	825	2	.0375	64	2.40	6	.9755	3	3.68
75	826	2	.0221	29	0.65	6	.9828	2	2.56
76	827	2	.0052	2	0.01	6	.9845	2	2.34
77	828	2	.0152	44	0.67	6	.9896	1	1.53
78	829	0	.0000	0	0	6	.9896	1	1.53
79	830	2	.0233	65	1.52	6	.9975	0	0.55
80	831	0	.0000	0	0	6	.9975	0	0.55
81	901	0	.0000	0	0	6	.9975	0	0.55
82	902	0	.0000	0	0	6	.9975	0	0.55
83	903	0	.0000	0	0	6	.9975	0	0.55
84	904	0	.0000	0	0	6	.9975	0	0.55
85	905	0	.0000	0	0	6	.9975	0	0.55
86	906	0	.0000	0	0	6	.9975	0	0.55
87	907	0	.0000	0	0	6	.9975	0	0.55
88	908	0	.0000	0	0	6	.9975	0	0.55
89	909	0	.0000	0	0	6	.9975	0	0.55
90	910	0	.0000	0	0	6	.9975	0	0.55
91	911	0	.0000	0	0	6	.9975	0	0.55
92	912	0	.0000	0	0	6	.9975	0	0.55
93	913	0	.0000	0	0	6	.9975	0	0.55
94	914	1	.0149	0	0	6	1.0000	0	0

Table 9. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981, inclusive. All districts combined, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
2	614	1	.0000	0	0	1	.0000	0	0
3	615	0	.0000	0	0	1	.0000	0	0
4	616	1	.0168	0	0	2	.0084	99	0.84
5	617	2	.0009	89	0.08	3	.0063	119	0.75
6	618	1	.0002	0	0	3	.0063	118	0.74
7	619	1	.0001	0	0	3	.0063	117	0.74
8	620	3	.0005	128	0.06	4	.0052	131	0.68
9	621	4	.0004	139	0.06	5	.0045	139	0.63
10	622	3	.0005	129	0.07	5	.0044	147	0.64
11	623	3	.0020	105	0.21	6	.0046	145	0.67
12	624	3	.0016	112	0.18	6	.0055	119	0.65
13	625	5	.0012	91	0.11	6	.0065	103	0.67
14	626	5	.0017	128	0.22	6	.0078	83	0.65
15	627	6	.0157	142	2.24	7	.0201	118	2.37
16	628	5	.0130	134	1.75	7	.0295	133	3.94
17	629	5	.0101	139	1.42	7	.0367	141	5.19
18	630	6	.0068	139	0.95	7	.0427	143	6.11
19	701	5	.0051	169	0.86	7	.0465	146	6.81
20	702	7	.0044	106	0.47	7	.0508	142	7.26
21	703	5	.0020	109	0.22	7	.0522	139	7.28
22	704	6	.0059	120	0.71	7	.0572	138	7.93
23	705	7	.0114	83	0.95	7	.0690	121	8.41
24	706	6	.0085	89	0.76	7	.0764	118	9.04
25	707	6	.0085	81	0.69	7	.0838	113	9.55
26	708	5	.0077	76	0.59	7	.0891	111	9.97
27	709	7	.0133	74	0.99	7	.1024	104	10.66
28	710	6	.0095	83	0.80	7	.1107	94	10.44
29	711	6	.0119	70	0.83	7	.1207	92	11.21
30	712	6	.0181	85	1.54	7	.1365	87	11.95
31	713	5	.0191	69	1.32	7	.1500	84	12.69
32	714	6	.0174	61	1.07	7	.1650	78	12.88
33	715	6	.0183	60	1.10	7	.1807	74	13.38
34	716	7	.0183	46	0.85	7	.1990	69	13.80
35	717	7	.0216	54	1.18	7	.2207	64	14.26
36	718	6	.0280	33	0.93	7	.2448	62	15.26
37	719	5	.0240	39	0.95	7	.2620	61	16.07
38	720	6	.0206	33	0.69	7	.2795	59	16.53
39	721	6	.0252	52	1.32	7	.3014	54	16.57
40	722	6	.0273	52	1.43	7	.3247	51	16.84
41	723	7	.0437	71	3.13	7	.3685	53	19.67
42	724	7	.0289	71	2.07	7	.3974	49	19.84
43	725	6	.0396	48	1.92	7	.4314	49	21.31
44	726	7	.0315	57	1.80	7	.4630	48	22.35
45	727	6	.0332	49	1.65	7	.4914	46	22.94
46	728	6	.0355	52	1.88	7	.5218	43	22.90
47	729	6	.0326	42	1.37	7	.5498	41	22.88
48	730	7	.0397	41	1.66	7	.5895	40	23.72
49	731	6	.0394	44	1.76	7	.6234	38	23.72
50	801	5	.0366	47	1.75	7	.6495	37	24.60
51	802	5	.0344	37	1.29	7	.6742	36	24.51

Table 9 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
52	803	5	.0283	60	1.70	7	.6945	34	24.15
53	804	5	.0399	45	1.80	7	.7232	32	23.71
54	805	5	.0461	50	2.31	7	.7560	31	23.68
55	806	6	.0280	57	1.60	7	.7800	30	23.83
56	807	5	.0226	71	1.61	7	.7961	29	23.65
57	808	6	.0294	74	2.19	7	.8215	28	23.81
58	809	3	.0221	104	2.32	7	.8310	28	23.39
59	810	3	.0186	120	2.23	7	.8391	27	23.06
60	811	3	.0215	62	1.33	7	.8481	26	22.76
61	812	3	.0158	78	1.24	7	.8550	26	22.35
62	813	3	.0172	41	0.70	7	.8624	26	22.51
63	814	4	.0126	75	0.94	7	.8697	25	22.43
64	815	3	.0935	103	9.69	7	.9097	16	14.77
65	816	3	.0280	51	1.43	7	.9218	16	15.22
66	817	1	.0100	0	0	7	.9232	16	15.20
67	818	0	.0000	0	0	7	.9232	16	15.20
68	819	0	.0000	0	0	7	.9232	16	15.20
69	820	2	.0874	85	7.46	7	.9482	10	9.68
70	821	1	.0076	0	0	7	.9492	10	9.65
71	822	2	.0955	93	8.92	7	.9767	3	3.73
72	823	1	.0044	0	0	7	.9772	3	3.66
73	824	2	.0364	90	3.27	7	.9877	2	2.19
74	825	1	.0089	0	0	7	.9890	2	2.14
75	826	0	.0000	0	0	7	.9890	2	2.14
76	827	0	.0000	0	0	7	.9890	2	2.14
77	828	1	.0063	0	0	7	.9898	2	2.13
78	829	0	.0000	0	0	7	.9898	2	2.13
79	830	0	.0000	0	0	7	.9898	2	2.13
80	831	1	.0081	0	0	7	.9911	2	2.16
81	901	0	.0000	0	0	7	.9911	2	2.16
82	902	0	.0000	0	0	7	.9911	2	2.16
83	903	0	.0000	0	0	7	.9911	2	2.16
84	904	0	.0000	0	0	7	.9911	2	2.16
85	905	0	.0000	0	0	7	.9911	2	2.16
86	906	0	.0000	0	0	7	.9911	2	2.16
87	907	0	.0000	0	0	7	.9911	2	2.16
88	908	0	.0000	0	0	7	.9911	2	2.16
89	909	0	.0000	0	0	7	.9911	2	2.16
90	910	0	.0000	0	0	7	.9911	2	2.16
91	911	0	.0000	0	0	7	.9911	2	2.16
92	912	1	.0618	0	0	7	1.0000	0	0

Table 10. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1964 - 1982, inclusive. All districts combined, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
1	619	1	.0214	0	0	1	.0214	0	0
2	626	2	.0000	100	0	3	.0071	140	1.00
3	703	4	.0011	74	0.08	5	.0051	157	0.81
4	710	8	.0030	81	0.24	8	.0062	107	0.67
5	717	9	.0146	63	0.93	10	.0182	81	1.48
6	724	10	.0615	97	6.03	10	.0797	77	6.16
7	731	10	.0765	34	2.65	10	.1563	46	7.33
8	807	9	.1216	39	4.77	10	.2657	25	6.71
9	814	10	.2125	27	5.83	10	.4783	24	11.76
10	821	9	.1817	39	7.14	10	.6419	17	10.94
11	828	10	.2060	49	10.14	10	.8479	13	11.14
12	904	8	.1415	53	7.55	10	.9612	5	4.99
13	911	5	.0696	69	4.81	10	.9960	0	0.90
14	918	3	.0106	83	0.89	10	.9992	0	0.22
15	925	1	.0074	0	0	10	1.0000	0	0

Table 11. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1965 - 1983, inclusive. All districts combined, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
2	626	3	.0004	84	0.03	3	.0004	84	0.03
3	703	4	.0135	92	1.24	4	.0138	92	1.28
4	710	10	.0171	101	1.73	10	.0226	120	2.72
5	717	9	.0522	54	2.82	10	.0696	68	4.75
6	724	10	.0942	75	7.14	10	.1639	68	11.24
7	731	10	.1668	91	15.25	10	.3307	75	24.99
8	807	9	.1181	48	5.68	10	.4371	53	23.40
9	814	9	.1494	67	10.13	10	.5716	38	21.78
10	821	9	.0948	64	6.07	10	.6570	31	20.48
11	828	9	.2477	70	17.49	10	.8800	18	16.43
12	904	6	.1145	51	5.87	10	.9487	11	11.07
13	911	4	.0898	117	10.57	10	.9847	3	3.39
14	918	3	.0464	84	3.92	10	.9986	0	0.40
15	925	1	.0136	0	0	10	1.0000	0	0

catch, CPUE, and spawning escapement (Tables 6 through 11), together with the corresponding graphs of the time series of average daily cumulative proportions (Figs. 5 through 10), were also constructed.

Sound-wide timing of the even-cycle of catch

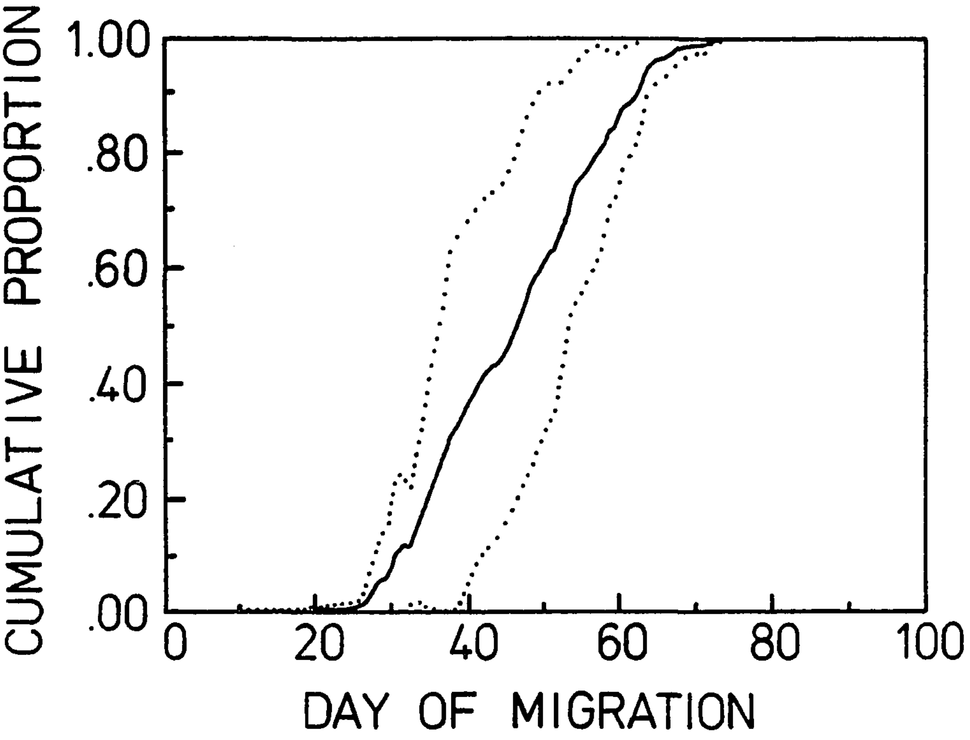
Maturing even-year pink salmon migrated into Prince William Sound from June 18 through September 14, based on commercial catches from the purse seine fishery from 1970 through 1982. On the average, 90% of all the commercial catch was taken during a period of 57 days (June 18 - August 13) in these years, with one-half of the catch occurring prior to July 28 (Table 6). Maturing salmon continued to migrate into Prince William Sound waters during September, but the migration was nearly over by mid-August. Less than 1% of the commercial catches during even years 1970 - 1982 usually were taken after August 21.

On the average, the central half of the population (25 - 75%), was available for harvest over a span of 19 days (July 18 - August 5). The major portion of the migration (2.5 - 97.5%) required an average 46 days (July 8 - August 18) to completely traverse the harvest area. The curve for the average daily cumulative proportions of catch showed a linear increase in catch of approximately 2.6% per day for the central half of the migration (Fig. 5) during even-years, 1970 - 1982. The 95% confidence interval about the average daily cumulative proportions was fairly large over the major portion of the migration (Fig. 5).

Considering even-year catch data, the mean dates of migration have

Figure 5. Sound-wide. Average cumulative proportion of even-cycle pink salmon catch, and the upper and lower bound for its 95% confidence interval.

Figure 6. Sound-wide. Average cumulative proportion of even-cycle pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.


CUMULATIVE PROPORTION
1.00
.80
.60
.40
.20
.00
0
20
40
60
80
100
DAY OF MIGRATION

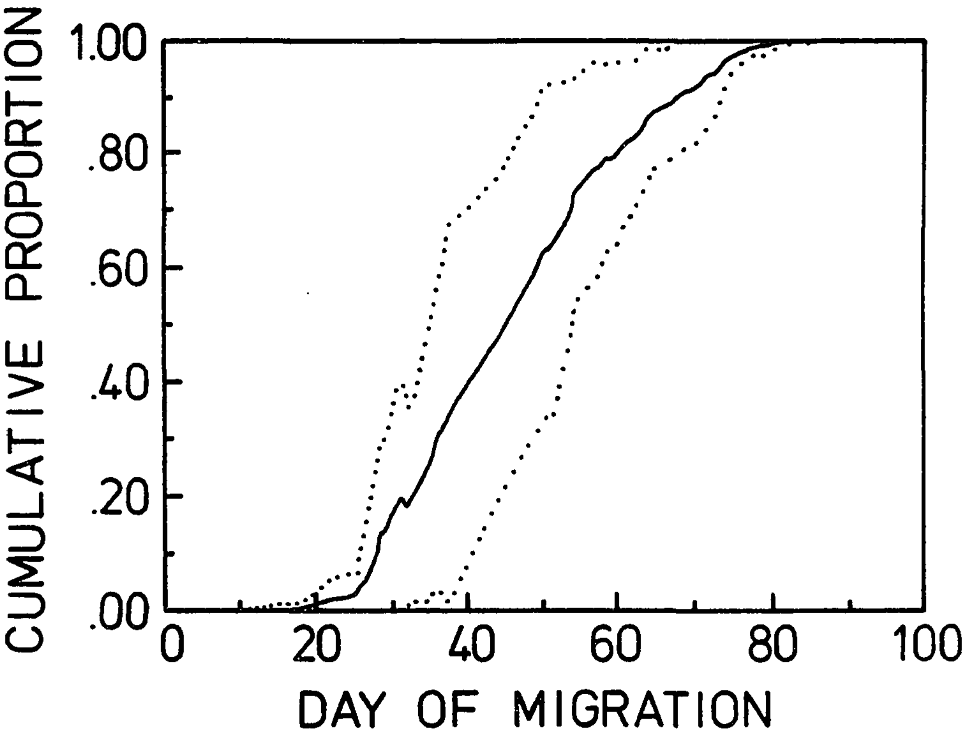
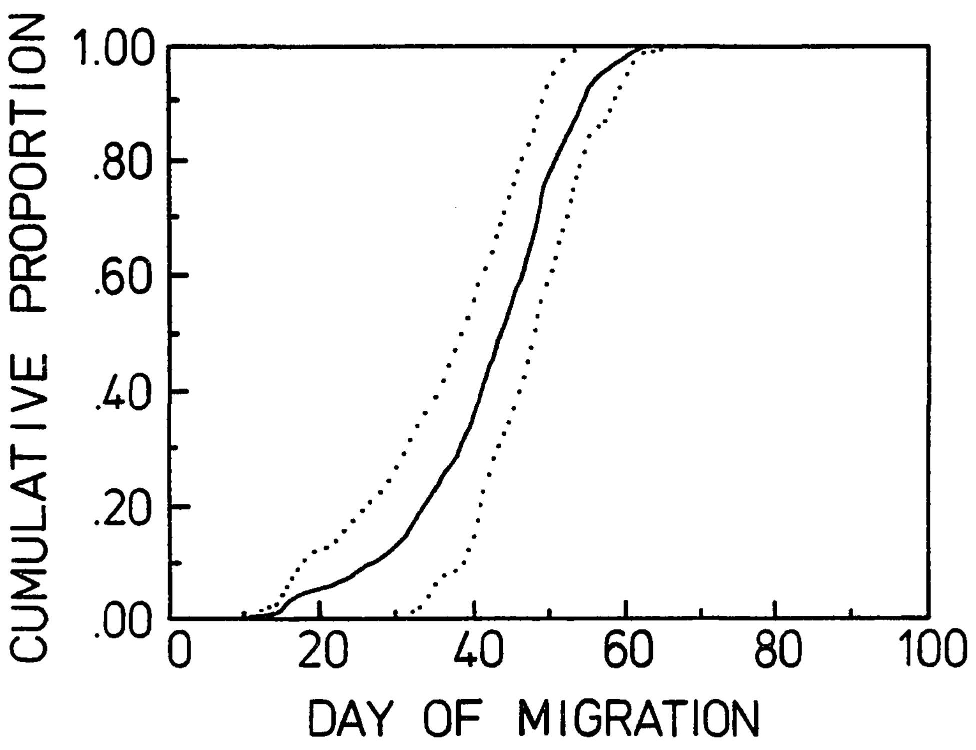

CUMULATIVE PROPORTION
1.00
.80
.60
.40
.20
.00
0
20
40
60
80
100
DAY OF MIGRATION

Figure 7. Sound-wide. Average cumulative proportion of odd-cycle pink salmon catch, and the upper and lower bound for its 95% confidence interval.

Figure 8. Sound-wide. Average cumulative proportion of odd-cycle pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.


CUMULATIVE PROPORTION
1.00
.80
.60
.40
.20
.00
0
20
40
60
80
100
DAY OF MIGRATION

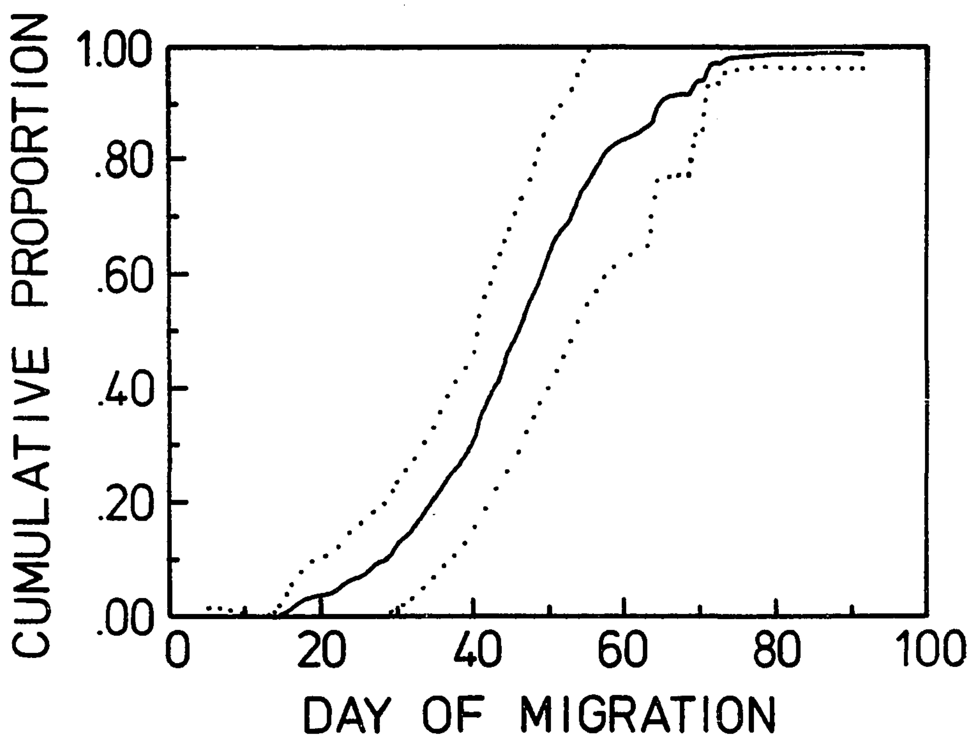
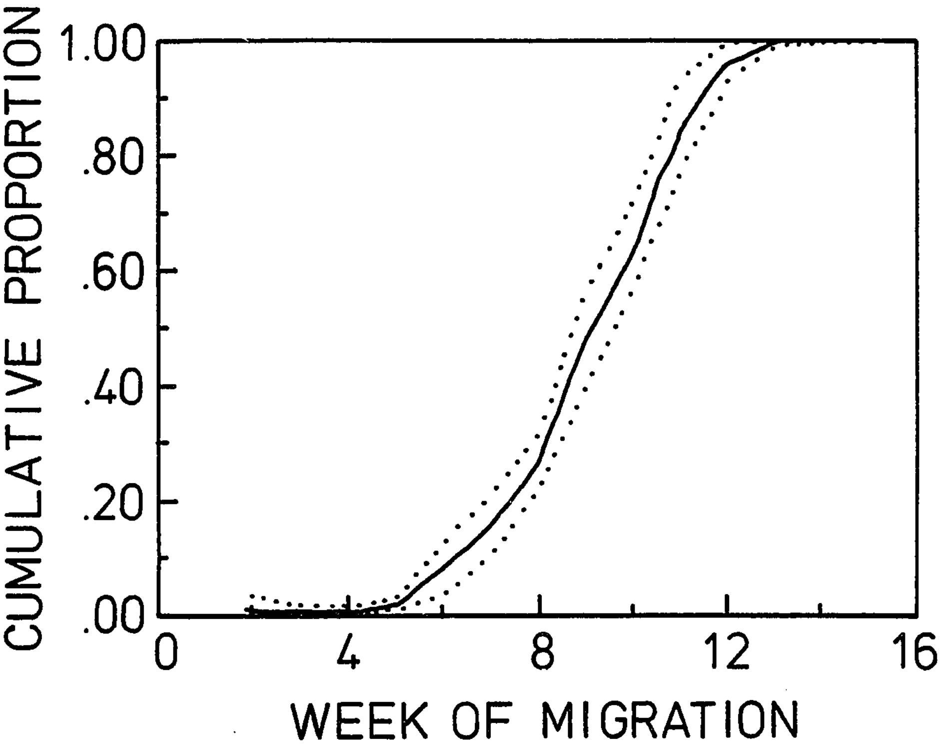
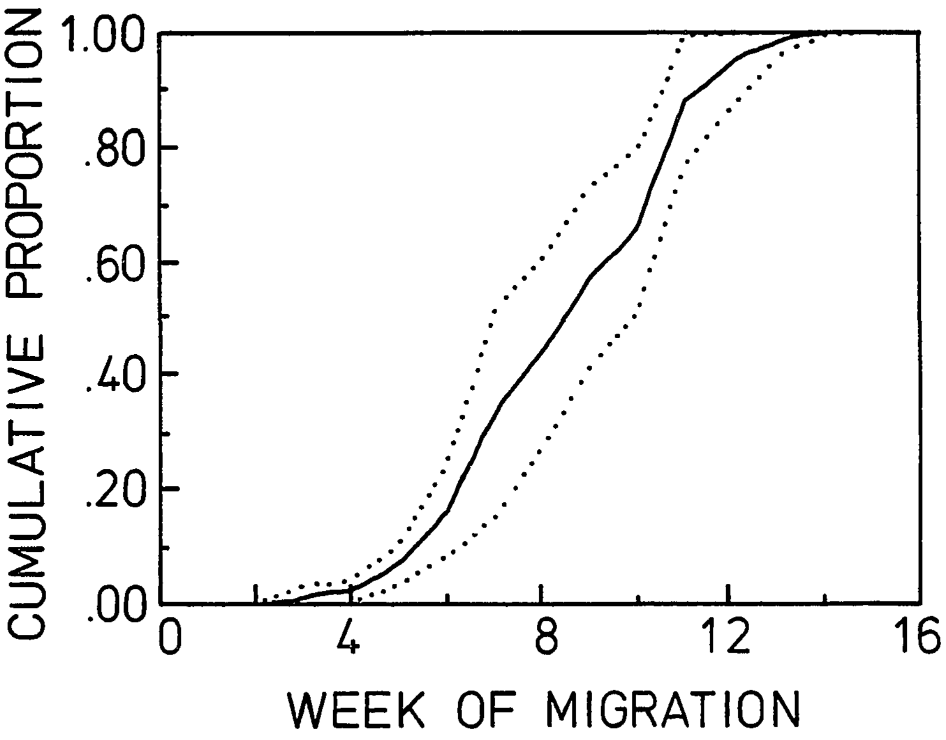

CUMULATIVE PROPORTION
1.00
.80
.60
.40
.20
.00
0
20
40
60
80
100
DAY OF MIGRATION

Figure 9. Sound-wide. Average cumulative proportion of even-cycle pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

Figure 10. Sound-wide. Average cumulative proportion of odd-cycle pink salmon escapement, and the upper and lower bound for its 95% confidence interval.


CUMULATIVE PROPORTION
1.00
.80
.60
.40
.20
.00
0
4
8
12
16
WEEK OF MIGRATION


CUMULATIVE PROPORTION
1.00
.80
.60
.40
.20
.00
0
4
8
12
16
WEEK OF MIGRATION

varied between July 15 (1974) and August 6 (1982), with an overall average mean date of July 28 (S = 7.7 days). In 1974, fishing took place in only management districts, 3 and 4, (Coghill and Northwestern). The 1974 mean date of July 15, therefore, represents a highly censored average performance of the sound-wide fishery. The next earliest average mean date for the even-year cycle was July 26 (1970), which was based on catch data from six of the eight management districts.

Sound-wide timing of the even-cycle of CPUE

Maturing even-year pink salmon migrated into Prince William Sound from June 18 through September 14, based on commercial CPUE data from the purse seine fishery from 1970 through 1982. On the average, 90% of all commercial CPUE occurred during a period of 62 days (June 18 - August 18) in these years, with one-half of the CPUE occurring prior to July 27 (Table 8). Maturing salmon continued to migrate into Prince William Sound waters during September, but the migration was nearly over by the end of August. Less than 1% of the commercial CPUE during even years 1970 - 1982 occurred, on the average, after August 30.

On the average, the central half of the population (25% - 75%) was available for harvest over a span of 22 days (July 16 - August 6). The major portion of the migration (2.5 - 97.5%) required an average 54 days (July 3 - August 25) to completely traverse the harvest area. The curve for the average daily cumulative proportions of CPUE showed an approximately linear increase in CPUE of 2.3% per day for the central half of the migration (Fig. 6) during even-years 1970 - 1982. The 95%

confidence interval about the average daily cumulative proportions was fairly large over the major portion of the migration (Fig. 6).

Using even-year CPUE data, the mean dates of migration have varied between July 13 (1974) and August 8 (1978), with an overall average mean date of July 28 (S = 9.5 days). In 1974, only two of the management districts, 3 and 4, (Coghill and Northwestern) were fished commercially. The 1974 mean date of July 13, therefore, represents a highly censored average performance of the sound-wide fishery. The next earliest average mean date for the even-year cycle was July 23 (1976), which was based on CPUE data from six of the eight management districts.

The time series of average daily proportions of even-year catch and CPUE (Tables 6 and 8) were actually quite different. Comparison of the time series of average daily cumulative proportions for these two data categories (Figs. 5 and 6; Tables 6 and 8), demonstrated a similar behavior. The daily averages for proportions of catch and for proportions of CPUE in this cycle year, indicated that the actual daily proportion was highly variable. The extent of this variability was demonstrated by the behavior of the standard deviations of these observations as a function of time (Tables 6 and 8). Daily variances of average cumulative proportions of both catch and CPUE fluctuated sharply, peaking in the area of the grand mean of migration for both categories, July 28.

From an inspection of the coded standard deviations (Tables 6 and 8), it appeared that the average cumulative proportion of even-year catch was less variable than the average cumulative proportion of even-year CPUE for about 80% of the season. On dates between July 19 (0.30 cumulative proportion) and August 1 (0.62 cumulative proportion), however, the standard deviations for the average cumulative proportions of catch were slightly more variable than the corresponding standard deviations for CPUE, 93% of the time. The 95% confidence interval on the curve of average cumulative proportion of catch was narrower than the corresponding interval about the curve of cumulative average proportion of CPUE (Figs. 5 and 6).

The behavior of the coefficients of variation (CV) of these two data categories (Tables 6 and 8) through time, can be divided into daily and cumulative for comparison. The CV's for the daily proportions for the even-year cycle of catch and CPUE were initially large, and declined to a minimum in the area of the grand mean date, July 28. Beyond the mean date, the daily CV's tended to increase toward the magnitudes initially observed. The time series of the CV's for the cumulative proportions for both data categories were initially large and declined rapidly toward the grand mean. Decline in the CV's for the cumulative proportion time series of both catch and CPUE were relatively small after the grand mean date, July 28.

The CV's of the average daily proportions of even-year CPUE were routinely less than the CV's of the average daily proportions of even-year catch, although the magnitude of the differences were consistently small (Tables 6 and 8). Inspection of the time series of CV's for the average cumulative proportions of catch and CPUE, however, revealed conflicting behavior. On dates prior to August 1 (0.63 cumulative proportion), the CV's for the average cumulative proportion of even-year catch were greater than the CV's for the average cumulative proportion of CPUE 80% of the time, while this pattern was reversed on the remaining 20% of dates prior to August 1 (Tables 6 and 8). On all dates after August 1, the CV's for the cumulative proportion of catch were always less than the corresponding CV's for the cumulative proportion of CPUE.

These results tend to agree with the conclusions drawn from the comparison of the time series of coded standard deviations (Tables 6 and 8), and from the inspection of the width of the 95% confidence interval about the curves for the average cumulative proportions of catch and CPUE (Figs. 5 and 6). The average cumulative proportions of even-year catch were slightly less variable than the average cumulative proportions of even-year CPUE, over the course of the season.

Sound-wide timing of the odd-cycle of catch

Maturing odd-year pink salmon migrated into Prince William Sound from June 14 through September 12, based on commercial catches from the purse seine fishery from 1969 through 1981. On the average, 90% of all the commercial catch was taken during a period of 55 days (June 14 - August 7) in these years, with one-half of the catch occurring prior to July 26 (Table 7). Maturing salmon continued to migrate into Prince William Sound waters during September, but the migration was nearly over by mid August. In any given odd year, less than 1% of the commercial catch is expected to be taken after August 13.

On the average, the central half of the population (25% - 75%), was available for harvest over a span of 15 days (July 18 - August 1). The major portion of the migration (2.5 - 97.5%) required an average 46 days (June 27 - August 11) to completely traverse the harvest area. The curve for the average daily cumulative proportions of catch showed a linear increase in catch of, approximately, 3.3% per day for the central half of the migration (Fig. 7) during odd-years 1969 - 1981. The 95% confidence interval about the average daily cumulative proportions was fairly narrow over the major portion of the migration (Fig. 7).

Using odd-year catch data, the mean dates of migration have varied between July 15 (1977) and August 3 (1971), with an overall average mean date of July 25 (S = 6.2 days).

Sound-wide timing of the odd-cycle of CPUE

Maturing odd-year pink salmon migrated into Prince William Sound from June 14 through September 12, based on commercial CPUE data from the purse seine fishery from 1969 - 1981. On the average, 90% of all commercial CPUE occurred during a period of 63 days (June 14 - August 15) in these years, with one-half of the CPUE occurring prior to July 28 (Table 9). Maturing salmon continued to migrate into Prince William Sound waters during September, but the migration was nearly over by the end of August. Less than 1% of the commercial CPUE during the odd-years 1969 - 1981 occurred, on the average, after August 30.

On the average, the central half of the population (25 - 75%) was available for harvest over a span of 19 days (July 18 - August 5). The major portion of the migration (2.5 - 97.5%) usually required 57 days (June 27 - August 22) to completely traverse the harvest area. The average daily cumulative proportions of CPUE showed a linear increase in CPUE of about 2.6% per day for the central half of the migration (Fig. 8) during odd-years 1969 - 1981. The 95% confidence interval about the average daily cumulative proportions was moderately narrow, but less so than those of the cumulative proportions of odd-year catch, over the major portion of the migration (Fig. 7).

Considering odd-year CPUE data, the mean dates of migration have varied between July 15 (1977) and August 10 (1981), with an overall average mean date of July 28 (S = 8.3 days).

The two time series of average daily proportions of odd-year catch and CPUE (Tables 7 and 9) were quite different. Comparison of these two data categories (Figs. 7 and 8; Tables 7 and 9) demonstrated a similar behavior, although on dates prior to July 23 the two time series of proportions were nearly the same. The daily averages for proportions of catch and for proportions of CPUE in this cycle year, indicated that the actual daily proportion was highly variable. The extent of this variability was demonstrated by the behavior of the standard deviations of these observations as a function of time (Tables 7 and 9). Daily variances of average cumulative proportions of both catch and CPUE increased gradually, peaking in the area of the respective grand means of migration for these categories, July 25 and July 28.

Inspection of the coded standard deviations (Tables 7 and 9), demonstrated that the average cumulative proportion of odd-year catch was less variable than the average cumulative proportion of odd-year CPUE for about 65% of the season. Betweeen July 4 (0.06 cumulative proportion) and July 24 (0.40 cumulative proportion), however, the standard deviations for the average cumulative proportions of CPUE were less than the corresponding standard deviations for catch.

This behavior of alternating roles of the highest and lowest variability between these two time series data categories was also shown by comparison of the width of the 95% confidence interval on the average cumulative proportion curves for odd-year catch and CPUE (Figs. 7 and 8). Prior to cumulative proportion 0.40, the width of the confidence limits about the catch curve is greater than that for the CPUE curve, followed by a reversal of this situation for the remainder of the season.

The CV's for the average daily proportions of odd-year catch and CPUE were initially large and declined to a minimum in the area of the respective grand means of migration, July 25 and July 28 (Tables 7 and 9). Beyond these mean dates, the daily CV's for both data categories tended to increase toward the magnitudes initially observed. The time series of the CV's for the cumulative proportions for catch and CPUE were initially large and declined rapidly toward the grand mean dates. Thereafter, declines in the CV's for the cumulative proportion time series of both data categories were gradual, and relatively small.

The CV's of the average daily proportions of odd-year CPUE were routinely less than the CV's of the average daily proportions of odd-year catch over about 85% of the season (Tables 7 and 9). Inspection of the time series of CV's for the average cumulative proportions for these two data categories, however, revealed that, for approximately 81% of the season, the CV's for the cumulative proportions of CPUE were greater than the corresponding CV's for catch (Tables 7 and 9). On dates between June 14 and July 21 (0.30 cumulative proportion), the CV's for the cumulative proportions of CPUE were greater than those of catch approximately 50% of the time. On all dates after July 21, the time series of CV's for average cumulative proportions of CPUE were always greater than the corresponding time series of CV's for catch.

These results agree with the conclusions drawn from the comparison of the time series of coded standard deviations (Tables 7 and 9), and from the inspection of the width of the confidence limits on the curves for the average cumulative proportions of catch and CPUE (Figs. 7 and 8). The average cumulative proportions of odd-year catch were less variable than the average cumulative proportions of odd-year CPUE, over the major portion of the season.

Within both even and odd cycles, the data category of catch was shown to be less variable than the corresponding data category of CPUE over the course of the season, even though the magnitude of the difference between the two categories was marginal. The more consistent behavior of the time series of cumulative proporiton of catch suggested a higher degree of reliability in its descriptive statistics (mean and variance). Catch data, therefore, was selected to serve as the basis for the comparison of migratory behavior among management districts.

Sound-wide timing of the even-cycle of spawning escapement

Even-year pink salmon escaped to the spawning grounds in Prince William Sound from June 19 through September 25, based on escapement enumeration data collected from the 211 index spawning streams for 1964 - 1982. On the average, 90% of all the escapement occurred during a period of 43 days (June 19 - August 30) in these years, with one-half of the escapement occurring prior to August 17 (Table 10). Spawning escapement continued into October, but it was nearly over by the beginning of September. Less than 1% of the escapement during even-years 1964 - 1982 occurred, on the average, after September 10.

The central half of the distribution of spawning escapement (25 - 75%) occurred over a span of 18 days (August 7 - August 24). The major portion of the escapement distribution (2.5 - 97.5%) required about 53 days (July 17 - September 7) to completely escape the harvest area. The curve of the average weekly cumulative proportions of even-year spawning escapement showed a linear increase in escapement of approximately 2.8% per day for the central half of the distribution (Fig. 9). The 95% confidence interval about the average weekly cumulative proportions was extremely narrow over the major portion of the escapement distribution (Fig. 9).

Employing even-year escapement data, the mean dates of spawning escapement have varied between August 13 (1968) and August 24 (1976), with an overall average mean date of August 18 (S = 3.6 days).

Sound-wide timing of the odd-cycle of spawning escapement

Odd-year pink salmon escaped to the spawning grounds in Prince William Sound from June 26 through September 25, based on escapement enumeration data collected from the 211 index spawning streams for 1965 - 1983. On the average, 90% of all the escapement occurred during a period of 66 days (June 26 - August 30) in these years, with one-half of the escapement occurring prior to August 10 (Table 11). Spawning escapement continued into October, but it was nearly over by mid September. Less than 1% of the spawning escapement during odd-years 1965 - 1983 occurred, on the average, after September 14.

The central half of the distribution of spawning escapement (25 - 75%) occurred over a span of 29 days (July 27 - August 24). The major portion of the escapement distribution (2.5 - 97.5%) required an average 61 days (July 10 - September 8) to completely escape the harvest area. The curve of the average weekly cumulative proportions of odd-year spawning escapement showed a linear increase in escapement of approximately 1.7% per day for the central half of the distribution (Fig. 10). The 95% confidence interval about the average weekly cumulative proportions was fairly narrow over the major portion of the escapement distribution (Fig. 10).

Using odd-year escapement data, the mean dates of spawning escapements have varied between July 27 (1983) and August 30 (1971), with an overall average mean date of August 14 (S = 8.9 days).

Comparison of the time series of average weekly proportion, and average cumulative proportion for even-year escapement with those for odd-year escapement (Figs. 9 and 10; Tables 10 and 11), revealed that these two data categories were quite different. From an inspection of the coded standard deviations (Tables 10 and 11), it appeared that the average cumulative proportions of even-year spawning escapement were much less variable than the average cumulative proportions of odd-year spawning escapement over the course of the season. This behavior was also demonstrated by the tighter 95% confidence interval on the curve for the average cumulative proportion of even-year escapement (Fig. 9), as compared to that of the curve for the average cumulative proportion of odd-year escapement (Fig. 10). Comparison of the time series of CV's for the average weekly proportions, and for the average cumulative proportions for these two data categories, also supports this conclusion.

Descriptive characteristics of the average historical time densities for all management districts by cycle year, analogous to those summarized in the previous descriptions of the sound-wide average historical time densities, were also evaluated for the data categories of catch, CPUE, and spawning escapement (Tables 12 and 13) for every available year of data (Tables 1 and 2).

Table 12. Characteristic percentage points of the migration, the month and day, and the duration in days of the percentage points, the median, the grand mean and standard deviation of the average time densities for the even-cycle of catch, CPUE, and spawning escapement, and the earliest and latest mean dates for the management districts of Prince William Sound.

	Management District			
	1	2	3	4
Percentage	EVEN CATCH			
1% - 99%	705 - 823	708 - 815	618 - 809	626 - 811
	50	39	53	47
2.5%-97.5%	708 - 821	709 - 813	626 - 807	704 - 809
	45	36	43	37
25% - 75%	723 - 811	720 - 804	712 - 727	716 - 729
	20	16	16	14
Median (50%) Date	803	728	718	721
Grand Mean / S.D.	802 / 5.0	728 / 5.2	720 / 6.9	723 / 5.7
Earliest / Latest	726 / 808	722 / 804	713 / 731	714 / 730
Percentage	EVEN CPUE			
1% - 99%	705 - 828	708 - 818	618 - 809	626 - 812
	55	42	56	48
2.5%-97.5%	706 - 826	709 - 815	630 - 809	702 - 809
	52	38	41	39
25% - 75%	719 - 810	721 - 805	715 - 728	716 - 730
	23	16	14	15
Median (50%) Date	730	728	720	723
Grand Mean / S.D.	731 / 7.3	728 / 6.3	721 / 6.3	724 / 6.6
Earliest / Latest	723 / 809	719 / 804	713 / 801	713 / 729
Percentage	EVEN ESCT			
1% - 99%	626 - 909	619 - 906	626 - 904	703 - 904
	76	80	71	64
2.5%-97.5%	703 - 907	621 - 904	715 - 902	718 - 902
	67	76	50	47
25% - 75%	730 - 825	808 - 825	804 - 822	808 - 823
	27	18	19	16
Median (50%) Date	812	814	812	814
Grand Mean / S.D.	816 / 7.7	818 / 5.0	816 / 5.2	818 / 2.0
Earliest / Latest	730 / 825	808 / 824	806 / 824	813 / 820

Table 12 continued.

	Management District			
	5	6	7	8
Percentage	EVEN CATCH			
1% - 99%		706 - 819		712 - 814
		45		34
2.5%-97.5%		713 - 816		713 - 811
		35		30
25% - 75%		722 - 805		720 - 801
		15		13
Median (50%) Date		729		727
Grand Mean / S.D.		730 / 6.5		730 / 6.0
Earliest / Latest		723 / 807		723 / 806
Percentage	EVEN CPUE			
1% - 99%		706 - 824		712 - 818
		50		38
2.5%-97.5%		710 - 822		713 - 816
		44		35
25% - 75%		721 - 807		720 - 805
		18		17
Median (50%) Date		730		726
Grand Mean / S.D.		731 / 7.3		731 / 6.9
Earliest / Latest		724 / 809		723 / 809
Percentage	EVEN ESCT			
1% - 99%	717 - 904	710 - 904	710 - 908	710 - 905
	50	57	61	58
2.5%-97.5%	719 - 828	722 - 902	725 - 903	724 - 903
	41	43	41	42
25% - 75%	728 - 824	808 - 825	811 - 827	810 - 826
	28	18	17	17
Median (50%) Date	822	815	820	820
Grand Mean / S.D.	821 / 5.9	820 / 3.5	822 / 3.2	822 / 3.1
Earliest / Latest	811 / 825	813 / 825	817 / 826	816 / 826

Table 13. Characteristic percentage points of the migration, the month and day, and the duration in days of the percentage points, the median, the grand mean and standard deviation of the average time densities for the odd-cycle of catch, CPUE, and spawning escapement, and the earliest and latest mean dates for the management districts of Prince William Sound.

	Management District			
	1	2	3	4
Percentage	**ODD CATCH**			
1% - 99%	617 - 816	624 - 810	614 - 805	627 - 806
	61	48	53	41
2.5%-97.5%	624 - 812	625 - 809	628 - 804	701 - 805
	50	46	38	36
25% - 75%	702 - 803	706 - 728	708 - 726	716 - 728
	33	23	19	13
Median (50%) Date	727	721	717	720
Grand Mean / S.D.	724 / 10.0	721 / 7.2	717 / 5.7	722 / 5.6
Earliest / Latest	709 / 806	712 / 801	709 / 724	713 / 729
Percentage	**ODD CPUE**			
1% - 99%	617 - 822	624 - 812	614 - 805	627 - 808
	67	50	53	43
2.5%-97.5%	624 - 815	625 - 810	628 - 804	628 - 807
	53	47	38	31
25% - 75%	716 - 802	717 - 730	714 - 731	716 - 730
	18	14	18	15
Median (50%) Date	726	724	723	725
Grand Mean / S.D.	725 / 6.9	725 / 5.6	722 / 6.3	724 / 6.5
Earliest / Latest	713 / 804	718 / 803	712 / 728	714 / 802
Percentage	**ODD ESCT**			
1% - 99%	626 - 913	626 - 903	626 - 910	710 - 923
	80	70	77	76
2.5%-97.5%	703 - 910	703 - 901	706 - 915	718 - 919
	70	61	72	64
25% - 75%	723 - 823	724 - 815	727 - 825	803 - 826
	32	23	30	24
Median (50%) Date	806	801	807	822
Grand Mean / S.D.	810 / 10.9	807 / 7.2	814 / 12.5	820 / 11.8
Earliest / Latest	723 / 829	724 / 821	730 / 908	729 / 910

Table 13 continued.

	Management District			
	5	6	7	8
Percentage		ODD CATCH		
1% - 99%		616 - 813	712 - 809	624 - 812
		59	29	50
2.5%-97.5%		707 - 810	714 - 806	705 - 810
		36	24	37
25% - 75%		721 - 801	719 - 731	719 - 801
		12	13	14
Median (50%) Date		727	727	726
Grand Mean / S.D.		727 / 3.8	728 / 2.4	726 / 5.6
Earliest / Latest		722 / 802	726 / 801	717 / 804
Percentage		ODD CPUE		
1% - 99%		616 - 824	712 - 810	624 - 815
		70	30	53
2.5%-97.5%		629 - 822	713 - 809	704 - 812
		55	28	40
25% - 75%		721 - 804	719 - 731	717 - 801
		15	13	16
Median (50%) Date		729	728	725
Grand Mean / S.D.		729 / 7.4	728 / 1.9	726 / 5.8
Earliest / Latest		719 / 811	727 / 731	716 / 804
Percentage		ODD ESCT		
1% - 99%	710 - 916	724 - 915	703 - 911	703 - 911
	69	54	71	71
2.5%-97.5%	717 - 912	725 - 911	725 - 908	717 - 908
	58	49	46	54
25% - 75%	803 - 829	814 - 827	731 - 825	730 - 824
	27	14	26	26
Median (50%) Date	823	822	814	811
Grand Mean / S.D.	824 / 10.3	824 / 5.0	817 / 10.5	815 / 9.7
Earliest / Latest	812 / 905	817 / 904	729 / 902	729 / 829

The average duration, in days, of the central 95% of the migration (2.5 - 97.5%) for all management districts within a cycle year, was calculated for the data categories of catch, CPUE, and spawning escapement (Tables 12 and 13). Using even-year catch data, the average length of time required for this portion of the migration to traverse the harvest area varied between 45 days (Eastern District) and 30 days (Southeastern District) (Fig. 11). Within this range of days, a central group of management districts was discernible consisting of, Northern (36 days), Northwestern (37 days), and Southwestern (35 days). The central 95% of the migration through Coghill District also required a relatively long period of time (43 days) to fully clear the harvest area.

Using odd-year catch data, the average time required for the central 95% of the migration to traverse the harvest area varied between 50 days (Eastern District) and 24 days (Montague District) (Fig. 12). Within this range of days, a central group of management districts was discernible consisting of, Coghill (38 days), Northwestern (36 days), Southwestern (36 days), and Southeastern (37 days). The central 95% of the migration through Northern District also required a relatively long period of time (46 days) to fully clear the harvest area.

Inspection of the average number of days required for the central 95% of the distribution of spawning escapement to completely escape to the spawning grounds, revealed a similar behavior between management districts for both cycle years (Figs. 13 and 14). Using even-year spawning escapement data, the average time required for the central 95%

of the migration to fully escape the harvest area varied between 75 days District 2 (Northern District) and 41 days Districts 5 and 7 (Eshamy and Montague). Using odd-year spawning escapement data, this same behavior varied between 72 days District 3 (Coghill District) and 46 days District 7 (Montague).

Within the even-year cycle of spawning escapement (Fig. 13), however, the distribution among management districts of these average durations was more segregated than the corresponding distribution within the odd-year cycle of spawning escapement (Fig 14). Two distinct groups of districts were discernible within the even cycle escapement category consisting of, Eastern (75 days) and Northern (67 days) Districts in the group requiring the greater length of time, and all remaining management districts in the group with relatively small durations. Within the odd-year cycle of spawning escapement, the distinction between management districts on the basis of large and small durations was much less defined. Management districts in the odd cycle escapement category with the smaller durations consisted of Southwestern District (49 days) and Montague District (46 days), while Eastern (70 days) and Coghill (72 days) were the management districts which required the longer period of time for the central 95% of the migration to escape to the spawning grounds. All remaining management districts in this cycle year fell within a broad zone of transistion between these extremes.

Regardless of the cycle year or category of data (catch or escapement), a similarity in the behavior among districts of the duration of the 95% of the migration, was demonstrated. The lower numerically-coded districts (Eastern and Northern) required the longest period of time for this portion of the migration to traverse the harvest area, while the migration through the higher numerically-coded districts was generally faster.

The average historical mean date of migration (± 1 standard deviation) for all management districts within both cycle years, was calculated for the data categories of catch, and spawning escapement (Figs. 15 through 18). Under normal theory, ± one standard deviation about the mean of the population spans, approximately, 68% of its distribution.

Considering even-year catch data (Fig. 15), average historical mean dates for the management districts varied between July 20 (Coghill District) and August 2 (Eastern District). Examination of the error bars (± 1 S.D.) about the average mean dates, failed to reveal any distinct differences among management districts with respect to timing behavior. The average mean date of migration in Northwestern District (July 23), was among the earliest of all management districts.

Using odd-year catch data (Fig. 16), average historical mean dates for the management districts varied between July 17 (Coghill District) and July 28 (Montague District). Examination of the error bars about the average mean dates revealed that only one pair of management districts (Coghill and Montague) could be identified as probably having different timing behavior. Comparison of even-year and odd-year catch data (Figs. 15 and 16), showed that the overall pattern of variation in mean dates among management districts was quite similar for both cycle years.

Comparison of even-year and odd-year spawning escapement data (Figs. 17 and 18), revealed that the overall pattern of variation in average mean dates among management districts was quite different for both cycle years. Using even-year escapement data (Fig. 17), average historical mean dates for the management districts varied between August 16 (Eastern and Coghill Districts) and August 22 (Montague and Southeastern Districts). No differences in timing behavior between management districts were detected from the inspection of the error bars about the even-year average mean dates of spawning escapement.

The low degree of variability in the average mean dates among management districts in the even cycle of spawning escapement, indicated a very stable average performance in the time distribution of escapement on a sound-wide basis. This conclusion agreed with that previously obtained from the examination of the width of the 95% confidence intervals about the curve for the average weekly cumulative proportion of even-year escapement (Fig. 9).

Employing odd-year spawning escapement data (Fig. 18), average historical mean dates for the management districts varies between August 7 District 2 (Northern) and August 24 Districts 5 and 6 (Eshamy and Southwestern). Examination of the error bars about the average mean dates, revealed that one pair of management districts (Northern and Southwestern) could be identified as having different timing behavior.

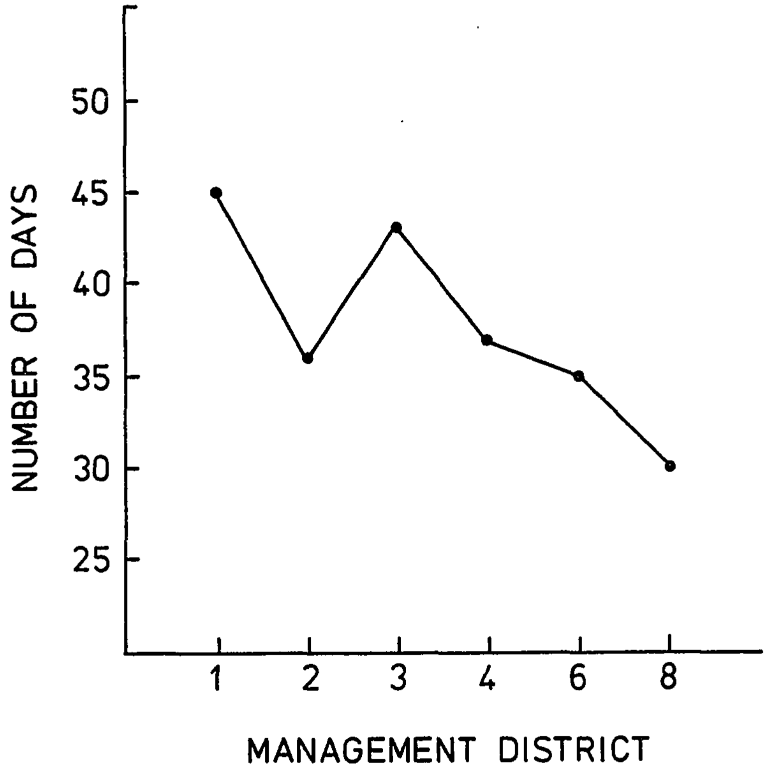
The overall pattern of variation in the average mean dates among management districts for odd-year escapement was quite similar to that for odd-year catch (Fig. 20), indicating a strong relation between the sound-wide time distributions of odd-cycle catch and spawning escapement. Examination of the overall pattern of variation in mean dates among management districts for the even-year cycles of catch and escapement (Fig. 19), however, showed that the sound-wide relation between the even-cycle timing behaviors of catch and spawning escapement were not as strong as that for the odd-year cycle.

Both the variation of average mean dates among districts, and the width of the error bars about the means, were much greater for the odd-year cycle of escapement (Fig. 18) than were the corresponding observations for the even-year cycle of escapement (Fig. 18). The greater variability within the odd cycle escapement category, therefore, may weaken the relation found between the sound-wide time distributions of catch and spawning escapement.

The similarity between the timing behaviors of catch and spawning escapement was shown by the extent of the relation between the time series of annual mean dates of catch and escapement independently (Figs. 21-34). The degree of similarity between the time series of annual mean dates of catch and spawning escapement varied from district to district and from cycle year to cycle year. On the average, however, this relation was stronger for the even-year cycle than for the odd-year cycle as, perhaps, best illustrated by the greater similarity between the sound-wide time series of catch and escapement in the even-year cycle (Fig. 21) than between the corresponding data categories in the odd-year cycle (Fig. 22).

Figure 11. The average number of days required for the central 95% of the migration (2.5 - 97.5%) to completely traverse the harvest area as measured by even-year catch data.

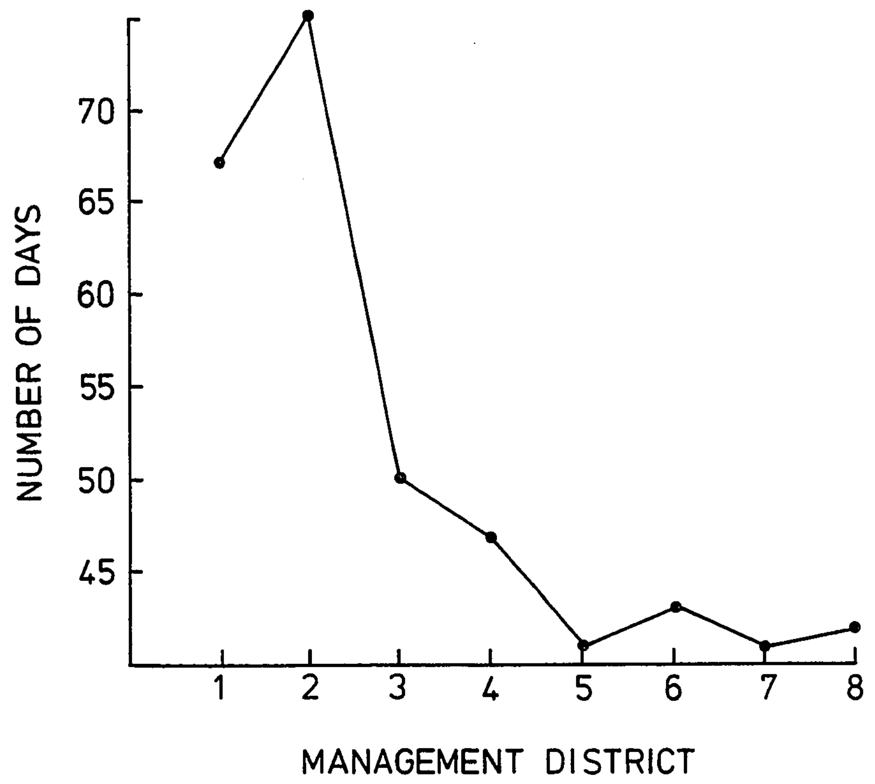
Figure 12. The average number of days required for the central 95% of the migration (2.5 - 97.5%) to completely traverse the harvest area as measured by odd-year catch data.


NUMBER OF DAYS
50
45
40
35
30
25
1
2
3
4
6
8
MANAGEMENT DISTRICT


NUMBER OF DAYS
50
45
40
35
30
25
1
2
3
4
6
7
8
MANAGEMENT DISTRICT

Figure 13. The average number of days required for the central 95% of the migration (2.5 - 97.5%) to completely escape to the spawning grounds in an even year.

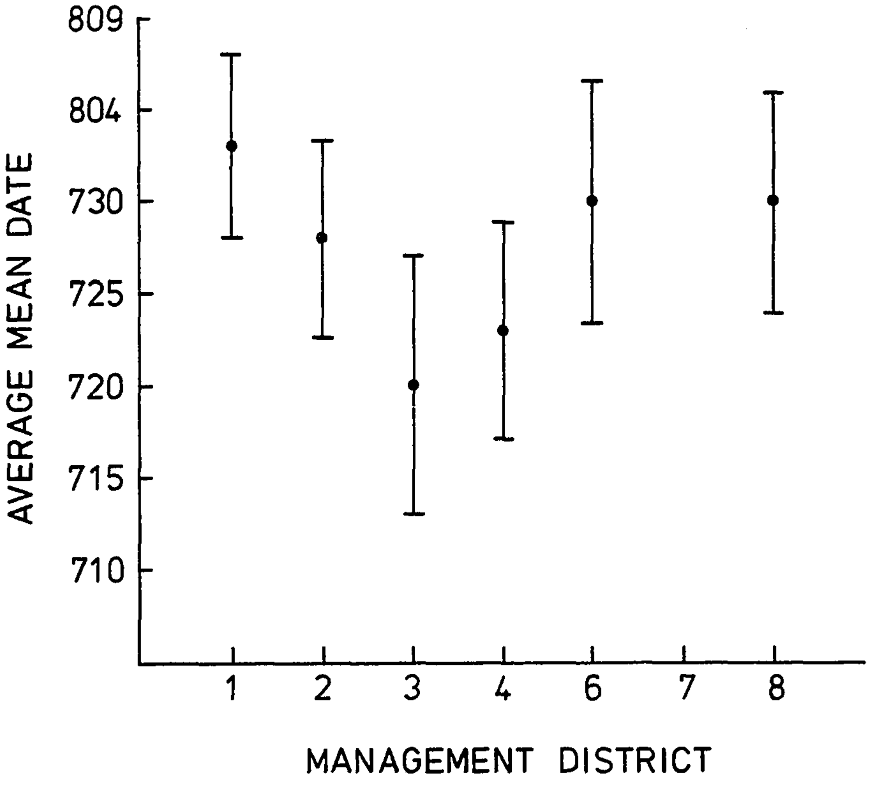
Figure 14. The average number of days required for the central 95% of the migration (2.5 - 97.5%) to completely escape to the spawning grounds in an odd year.

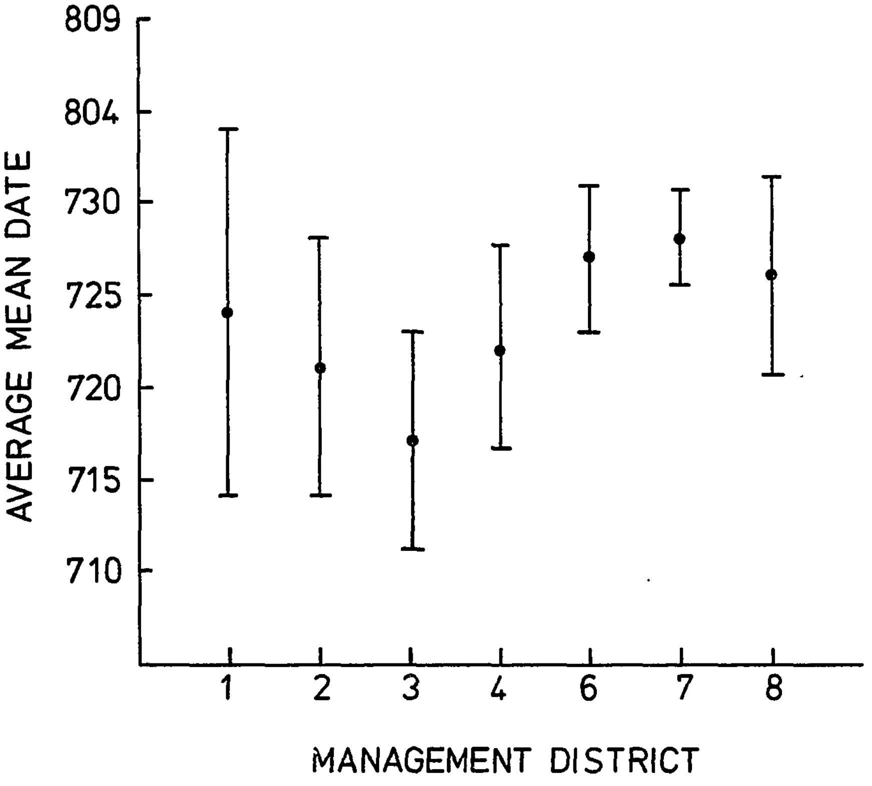

NUMBER OF DAYS
70
65
60
55
50
45
1
2
3
4
5
6
7
8
MANAGEMENT DISTRICT


NUMBER OF DAYS
70
65
60
55
50
45
1
2
3
4
5
6
7
8
MANAGEMENT DISTRICT

Figure 15. The historic average mean date of migration plus and minus one standard deviation by management district as measured by even-year catch.

Figure 16. The historic average mean date of migration plus and minus one standard deviation by management district as measured by odd-year catch.


AVERAGE MEAN DATE
809
804
730
725
720
715
710
1
2
3
4
6
7
8
MANAGEMENT DISTRICT


AVERAGE MEAN DATE
809
804
730
725
720
715
710
1
2
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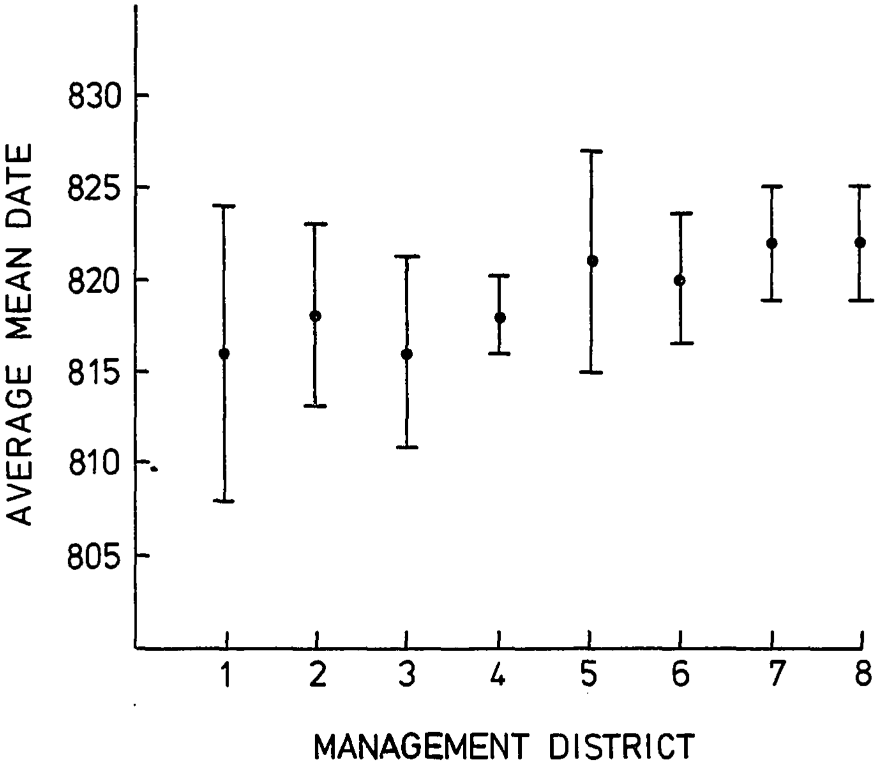
4
6
7
8
MANAGEMENT DISTRICT

Figure 17. The historic average mean date of even-year spawning escapement plus and minus one standard deviation for each management district.

Figure 18. The historic average mean date of odd-year spawning escapement plus and minus one standard deviation for each management district.


AVERAGE MEAN DATE
830
825
820
815
810
805
1
2
3
4
5
6
7
8
MANAGEMENT DISTRICT

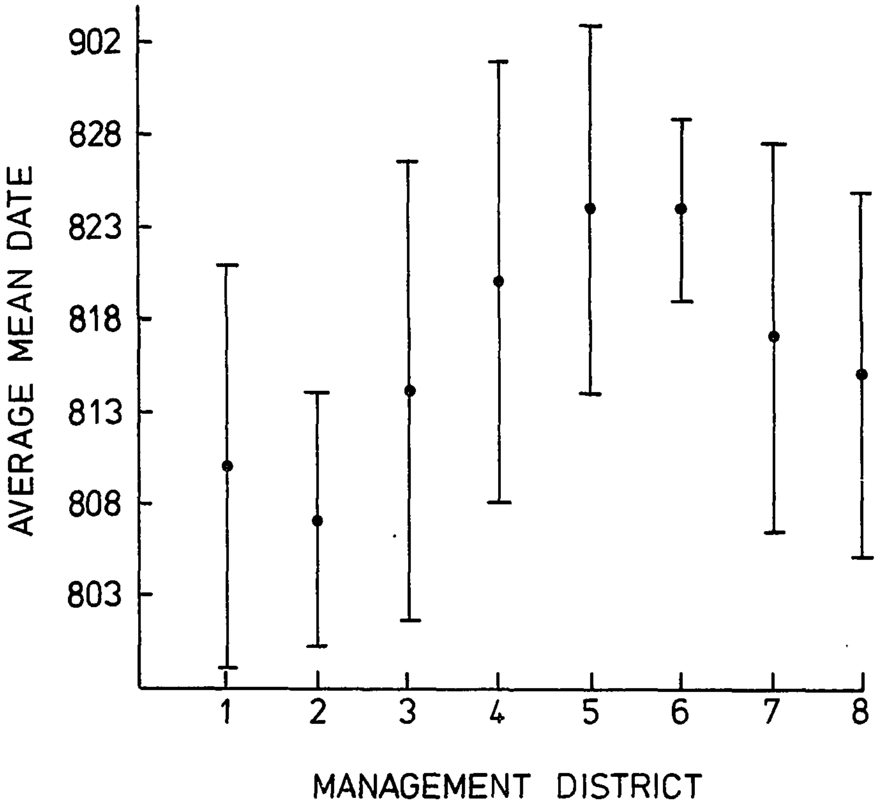
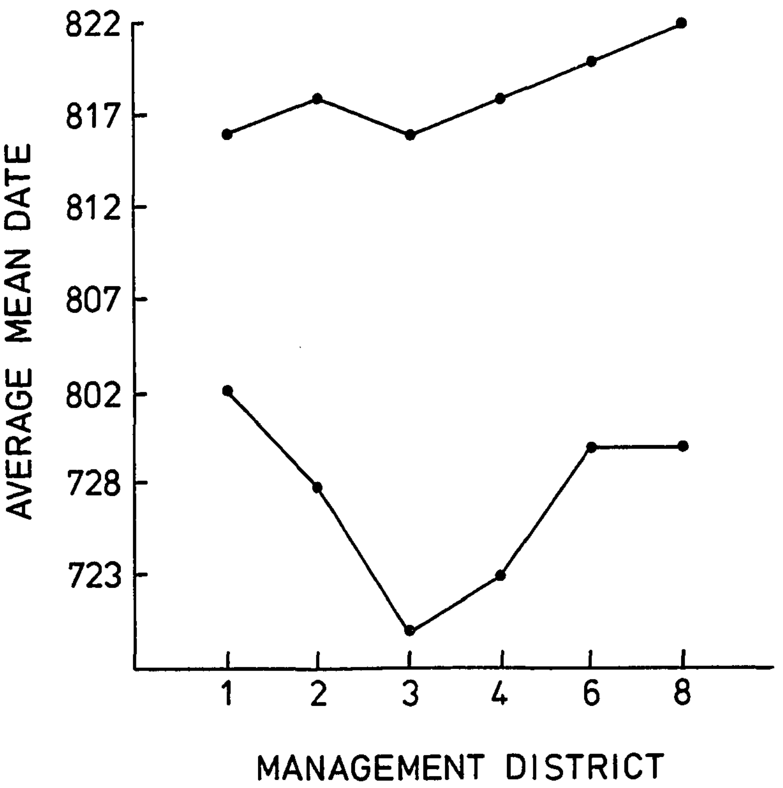
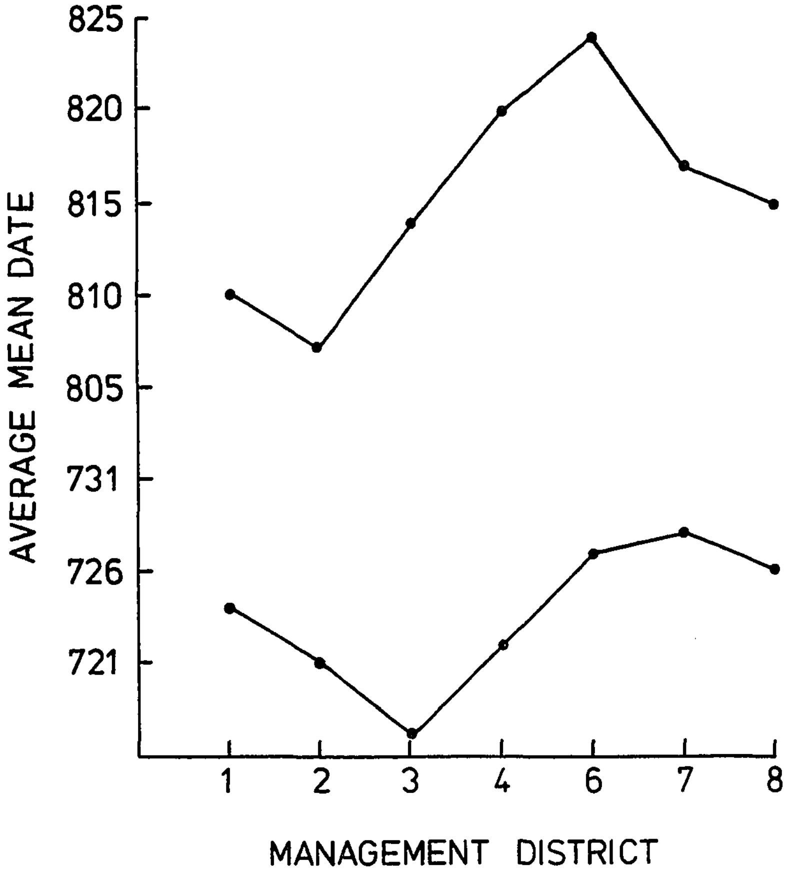

AVERAGE MEAN DATE
902
828
823
818
813
808
803
1
2
3
4
5
6
7
8
MANAGEMENT DISTRICT

Figure 19. The average mean date of spawning escapement (top curve) and the average mean date of catch (bottom curve) of even-year catch and spawning escapement by management district.

Figure 20. The average mean date of spawning escapement (top curve) and the average mean date of catch (bottom curve) of odd-year catch and spawning escapement by management district.


822
817
812
807
802
728
723
AVERAGE MEAN DATE
1
2
3
4
6
8
MANAGEMENT DISTRICT


825
820
815
810
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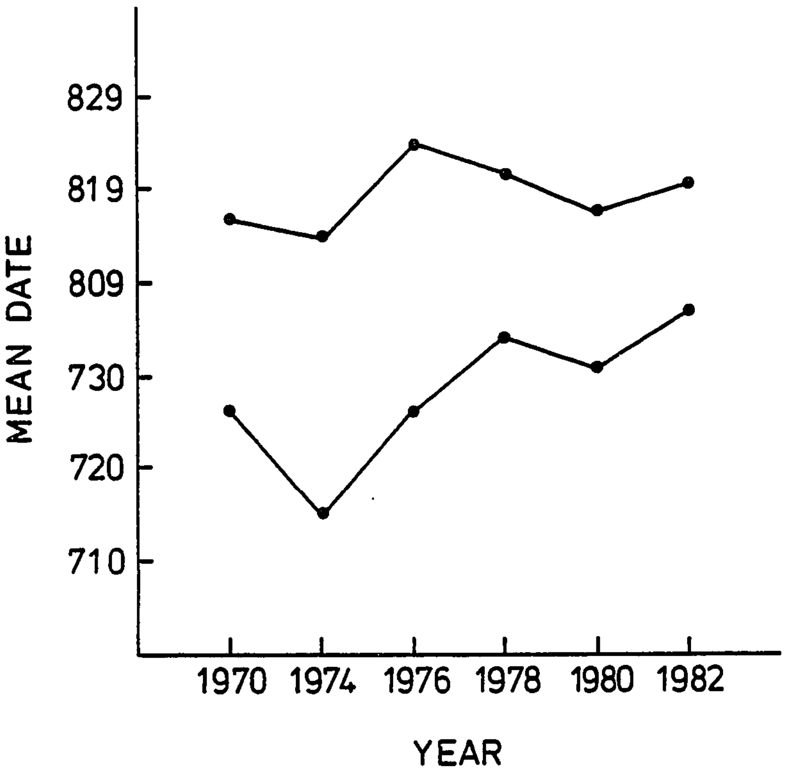
731
726
721
AVERAGE MEAN DATE
1
2
3
4
6
7
8
MANAGEMENT DISTRICT

Figure 21. Sound-wide. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for even years excluding 1972.

Figure 22. Sound-wide. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for odd-years.


829
819
809
730
720
710
MEAN DATE
1970
1974
1976
1978
1980
1982
YEAR

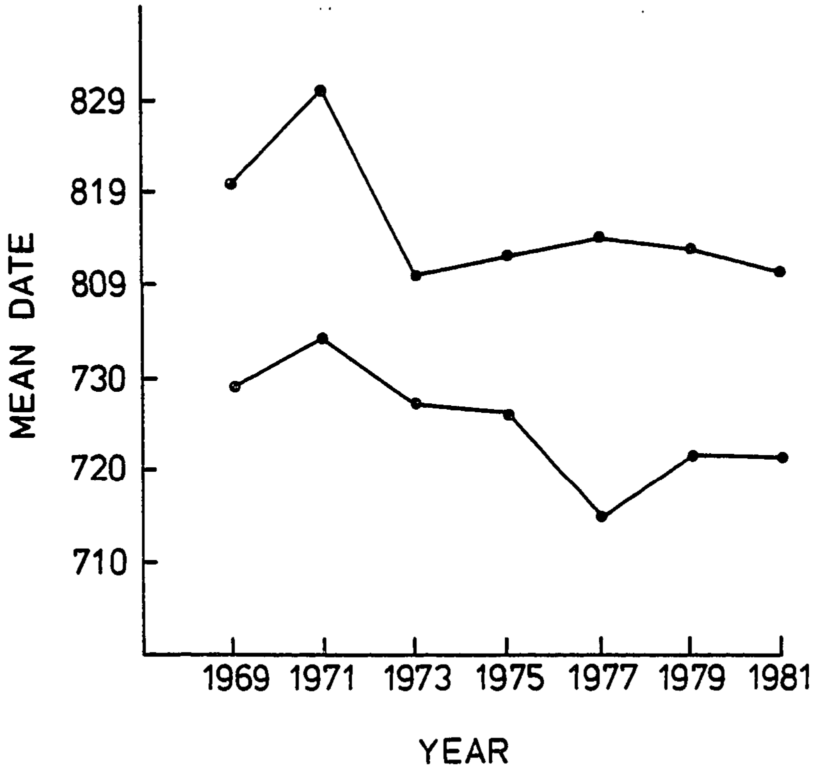
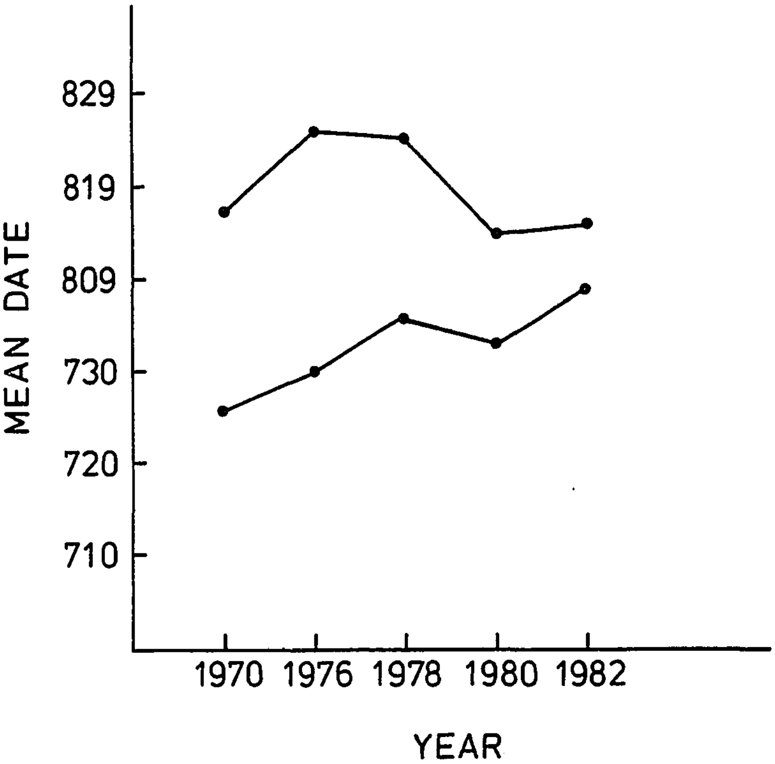

829
819
809
730
720
710
MEAN DATE
1969
1971
1973
1975
1977
1979
1981
YEAR

Figure 23. Eastern District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for even years excluding 1972 and 1974.

Figure 24. Eastern District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for odd years.


MEAN DATE
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720
710
1970
1976
1978
1980
1982
YEAR

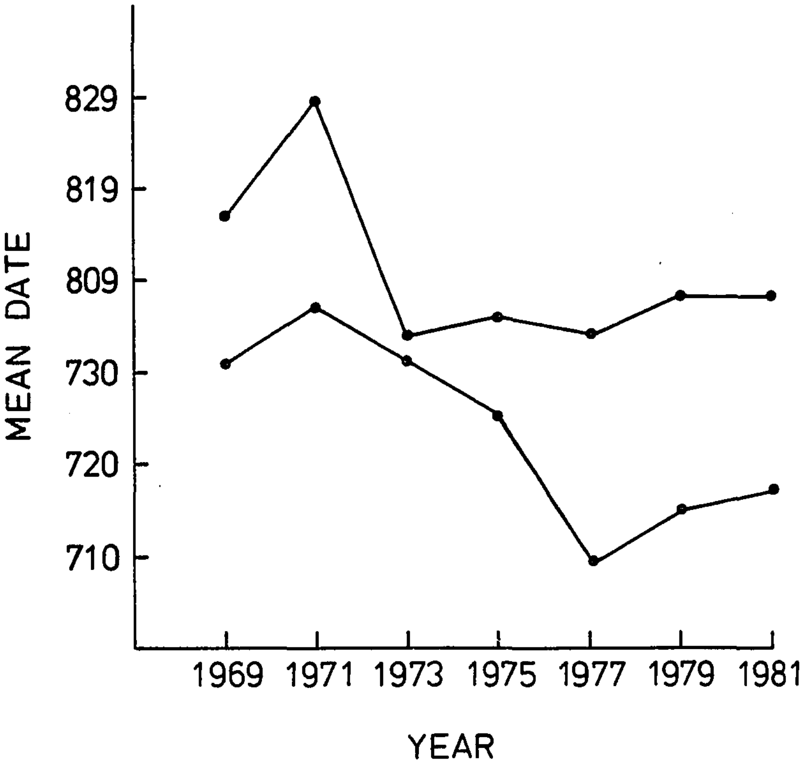
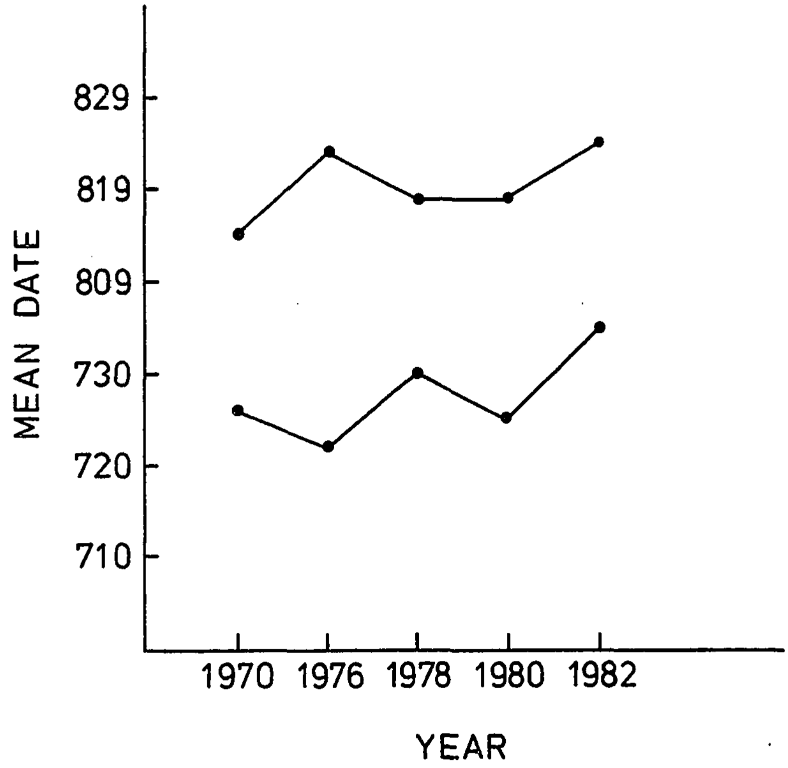

MEAN DATE
829
819
809
730
720
710
1969
1971
1973
1975
1977
1979
1981
YEAR

Figure 25. Northern District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for even years excluding 1972 and 1974.

Figure 26. Northern District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for odd years.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710
1970
1976
1978
1980
1982
YEAR

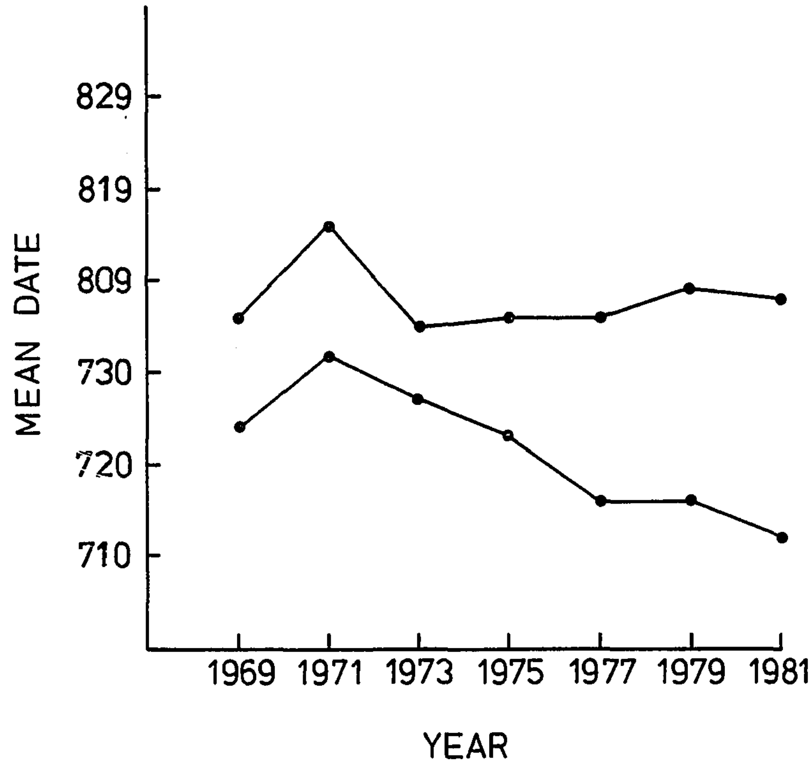
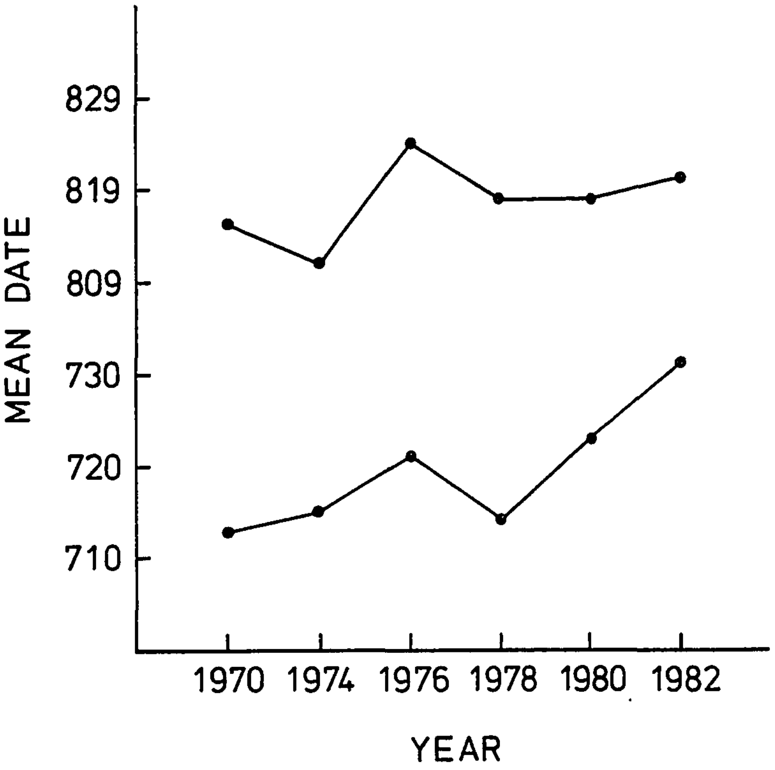

MEAN DATE
829
819
809
730
720
710
1969
1971
1973
1975
1977
1979
1981
YEAR

Figure 27. Coghill District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for even years excluding 1972.

Figure 28. Coghill District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for odd years.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1970
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1982
YEAR

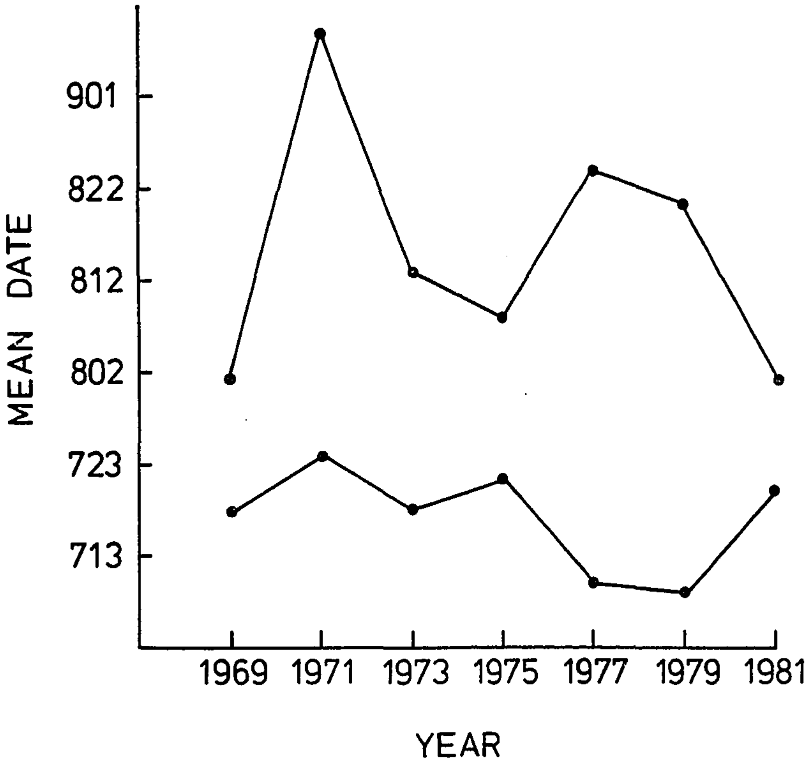
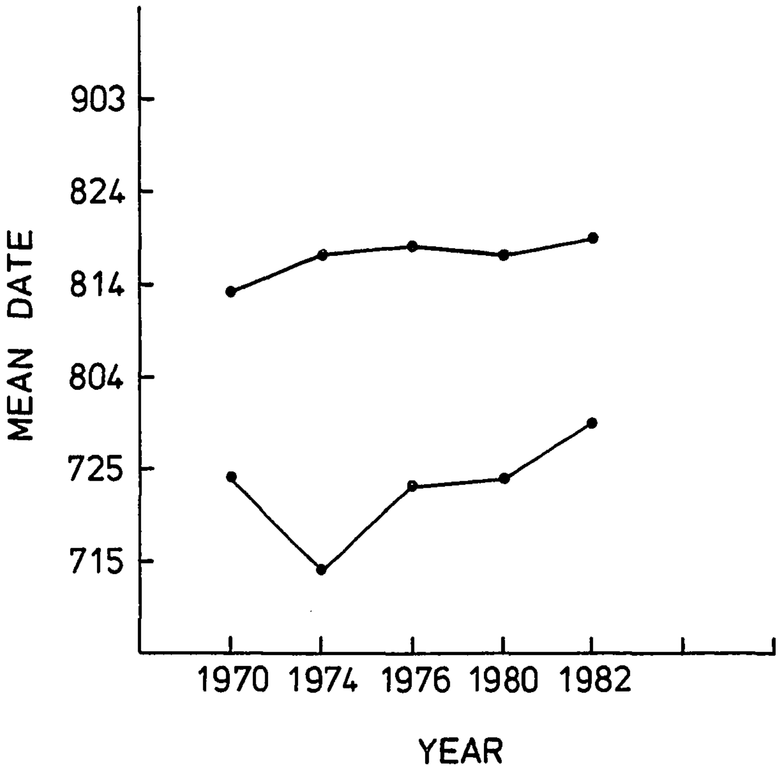

MEAN DATE
901
822
812
802
723
713
1969
1971
1973
1975
1977
1979
1981
YEAR

Figure 29. Northwestern District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for even years excluding 1972 and 1978.

Figure 30. Northwestern District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for odd years.


MEAN DATE
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725
715
1970
1974
1976
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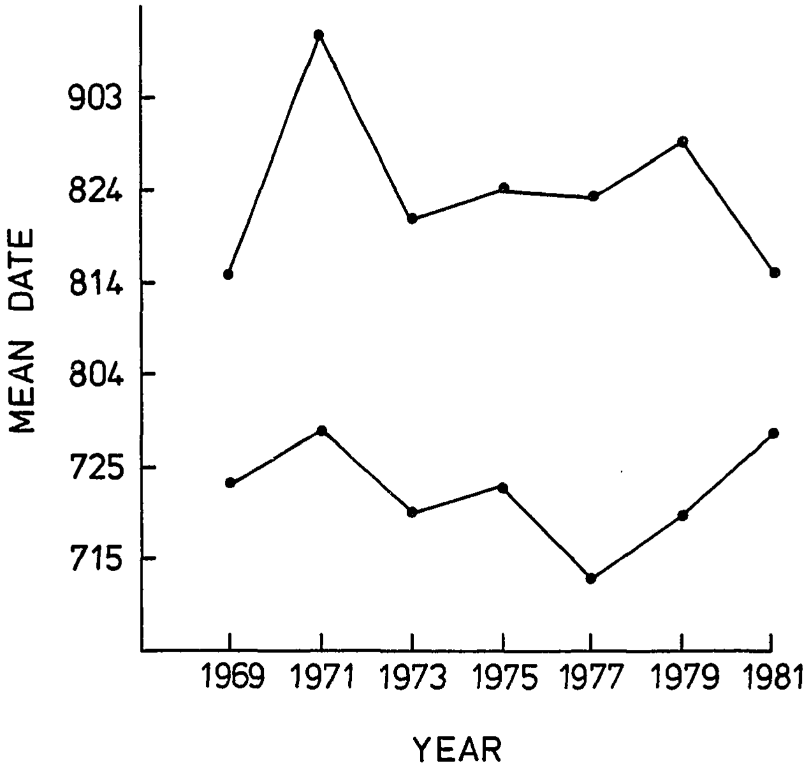
1982
YEAR


MEAN DATE
903
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725
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1969
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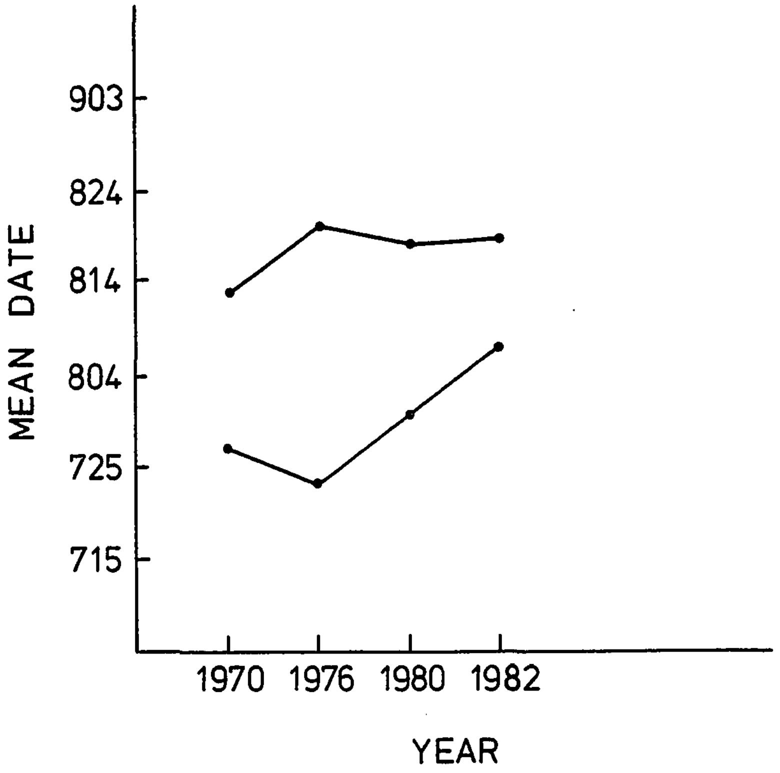
1981
YEAR

Figure 31. Southwestern District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for even years excluding 1972, 1974 and 1978.

Figure 32. Southwestern District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for odd years.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824
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715
MEAN DATE
1970
1976
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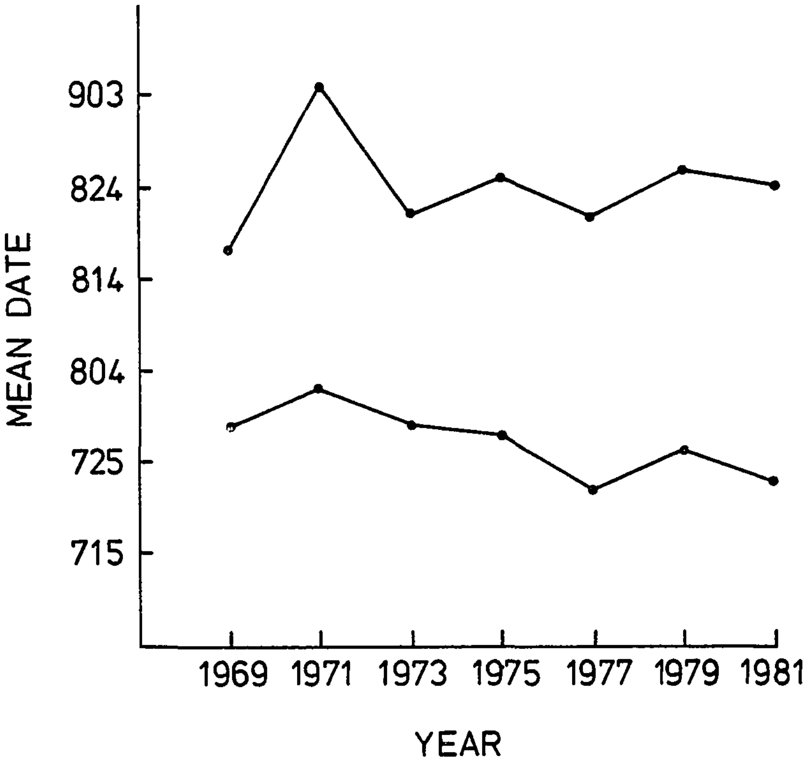
1982
YEAR


903
824
814
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725
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MEAN DATE
1969
1971
1973
1975
1977
1979
1981
YEAR

Figure 33. Montague District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for odd years excluding 1969 and 1971.

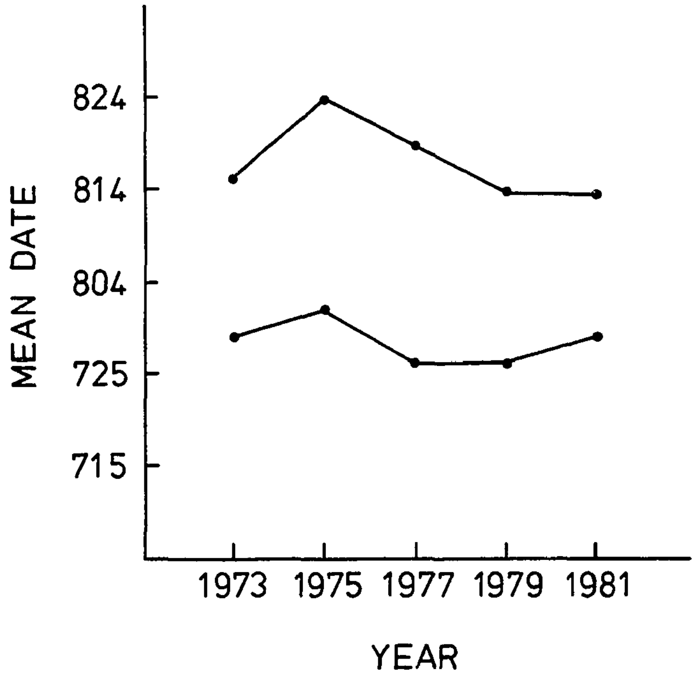
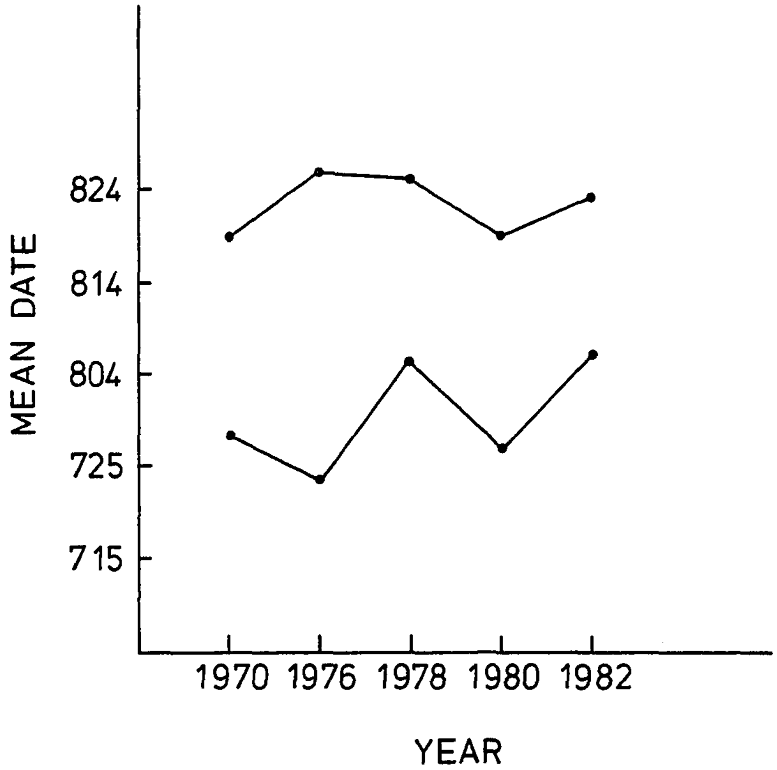
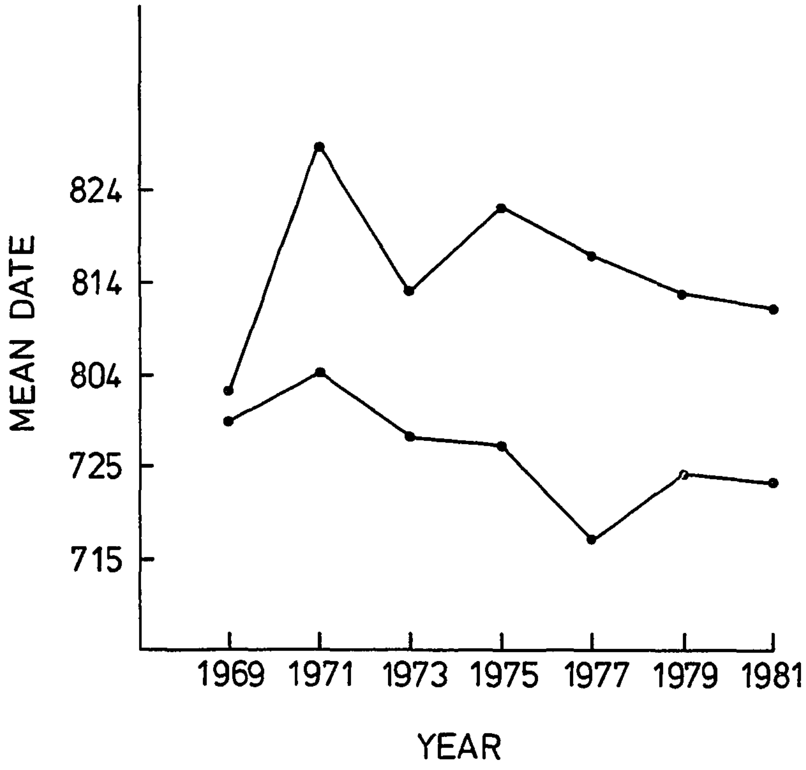

MEAN DATE
824
814
804
725
715
1973
1975
1977
1979
1981
YEAR

Figure 34. Southeastern District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for even years excluding 1972 and 1974.

Figure 35. Southeastern District. The mean date of spawning escapement (top curve) and the mean date of catch (bottom curve) for odd years.


MEAN DATE
824
814
804
725
715
1970
1976
1978
1980
1982
YEAR


MEAN DATE
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725
715
1969
1971
1973
1975
1977
1979
1981
YEAR

4.2 Analysis of Variance and Multiple Comparison Methods

A fixed effects two-way analysis of variance model with interaction was constructed to analyze differences in the mean dates of migration between cycle years and among districts, for the data categories of catch and spawning escapement. In each data category, the two factors, or independent variables, examined by this model were, cycle year (A), and management district (B), consisting of two and eight levels, respectively.

Two-way Analysis of Catch Data

Using catch data, results of the three hypotheses of interest examined by this model were:

1. H_o: $\alpha_i = 0$ against H_a: not all $\alpha_i = 0$, $i = 1, \ldots, a$. Are there significant differences in the mean dates of the empirical distributions of catch between the odd-year and the even-year cycles? The test concluded a significant $F^* = 8.36$ ($p = 0.005$), based on the F distribution with 1 and 64 degrees of freedom (df). Based on empirical distributions of catch, therefore, the analysis supported, at the 99.5% confidence level, that the odd-year population and the even-year population of pink salmon were genetically distinct.

2. H_o: $\beta_j = 0$ against H_a: not all $\beta_j = 0$, $j = 1, \ldots, b$. Are there significant differences among districts in the mean dates of the empirical distributions of catch when the odd-year and the even-year data are combined? The test concluded a significant $F^* = 4.76$ ($p \leq 0.0001$), based on the F distribution with 6 and 64 df. When odd-year

and even-year catch data were combined, therefore, a highly significant difference was shown to exist in the migratory behavior among management disticts, at the 99.99% confidence level. Since it is inconsistent with the genetic inheritability of migratory timing to combine even-year and odd-year catch data, this result may be of limited value.

The significant sample F value with respect to distinct effects on combined even and odd populations demonstrates that the differences between districts are stronger than the differences between even and odd populations within districts. The timing behaviors of the districts really do differ, and they differ substantially enough to overcome the combination of even and odd populations, which combination we know to be biologically inappropriate.

3. H_0: $(\alpha\beta)_{ij} = 0$ against H_a: not all $(\alpha\beta)_{ij} = 0$, for all i and j. Do different combinations of the levels of the two factors produce different effects? The test failed to conclude a significant $F^* = 0.72$ ($p = 0.61$), based on the F distribution with 5 and 64 df. Based on empirical distributions of catch, therefore, differences in the means of the time densities between any two management districts were the same for both even-year and odd-year populations, and differences in the means between the two populations were the same for all management districts.

Two-way Analysis of Spawning Escapement Data

Using escapement data, results of the three hypotheses of interest examined by this model were:

1. H_0 $\alpha_i = 0$ against H_a: not all $\alpha_i = 0$, $i = 1, \ldots, a$. Are there

significant differences in the mean dates of the empirical distributions of spawning escapement between the odd-year and the even-year cycles? The test concluded a significant $F^* = 5.65$ ($p = 0.019$), based on the F distribution with 1 and 132 df. Based on the empirical distributions of escapement, therefore, the analysis supported, at the 98.1% confidence level, that the odd-year population and the even-year population of pink salmon were genetically distinct.

2. H_0: $\beta_j = 0$ against H_a: not all $\beta_j = 0$, $j = 1, \ldots, b$. Are there significant differences among districts in the empirical distributions of escapement when the odd-year and the even-year data are combined? The test concluded a significant $F^* = 3.80$ ($p = 0.001$), based on the F distribution with 7 and 132 df. When odd-year and even-year data are combined, therefore, a highly significant difference was shown to exist in the migratory behavior among management districts, at the 99.9% confidence level.

3. H_0: $(\alpha\beta)_{ij} = 0$ against H_a: not all $(\alpha\beta)_{ij} = 0$, for all i and j. Do different combinations of the levels of the two factors produce different effects? The test concluded a significant $F^* = 2.19$ ($p = 0.039$), based on the F distribution with 7 and 132 df. Based on the empirical distributions of escapement, therefore, differences in the means of the time densities between any two management districts were not the same for both populations, and differences in the means between the two populations were not the same for all management districts.

A fixed effects one-way analysis of variance model was constructed to analyze differences in the mean dates of migration among districts for each cycle year independently, for the data categories of catch and spawning escapement. The independent variable, or treatment effect, examined by this model was the management district, consisting of eight levels.

One-way Analysis of Even-year Catch Data

Using even-year catch data, the hypothesis of interest examined by this model was: H_0: $\tau_j = 0$ against H_a: not all $\tau_j = 0$, $j = 1, \ldots, k$. Are there significant differences among management districts in the mean dates of the empirical distributions of even-year catch? The test concluded a significant $F^* = 3.68$ ($p = 0.013$), based on the F distribution with 5 and 24 df. When only even-year catch data were examined, therefore, a highly significant difference was shown to exist between the timing behavior among management districts, at the 98.7% confidence level.

One-way Analysis of Odd-year Catch Data

Using odd-year catch data, the hypothesis of interest examined by this model was: H_0: $\tau_j = 0$ against H_a: not all $\tau_j = 0$, $j = 1, \ldots, k$. Are there significant differences among management districts in the mean dates of the empirical distributions of odd-year catch? The test concluded a significant $F^* = 2.41$ ($p = 0.044$), based on the F distribution with 6 and 40 df. When only odd-year catch data were examined, therefore, a significant difference was shown to exist between the timing behavior among management districts, at the 95.6% confidence level.

One-way Analysis of Even-year Spawning Escapement Data

Using even-year spawning escapement data, the hypothesis of interest examined by this model was: H_0: $\tau_j = 0$ against H_a: not all $\tau_j = 0$, $j = 1, \ldots, k$. Are there significant differences among management districts in the mean dates of the empirical distributions of even-year escapement? The test concluded a significant $F^* = 2.79$ ($p = 0.013$), based on the F distribution with 7 and 67 df. When only even-year escapement enumeration data were examined, therefore, a highly significant difference was shown to exist between the timing behavior among management districts, at the 98.7% confidence level.

One-way Analysis of Odd-year Spawning Escapement Data

Using odd-year spawning escapement data, the hypothesis of interest examined by this model was: H_0: $\tau_j = 0$ against H_a: not all $\tau_j = 0$, $j = 1, \ldots, k$. Are there significant differences among management districts in the mean dates of the empirical distributions of odd-year escapement? The test concluded a significant $F^* = 3.00$ ($p = 0.009$), based on the F distribution with 7 and 65 df. When only odd-year data were examined, therefore, a highly significant difference was shown to exist between the timing behavior among management districts, at the 99.1% confidence level.

With the proviso of a significant F test for differences in the mean dates of migration among districts, multiple comparison analysis was performed to test for likenesses and differences among the management districts in each cycle year and data category. Contrasting results between the two a posteriori procedures selected for this analysis were anticipated since Tukey's method of multiple comparisons is more conservative than that of the LSD procedure. For the purposes of obtaining a higher level of sensitivity in the analysis, the method of LSD was preferred. With the exception of those instances where highly contradictory conclusions were suggested by these two methods, only the results of the LSD procedure were reported. Differences between the 'k choose 2' pairwise combinations of management districts were tested at the $\alpha = 0.05$ significance level unless otherwise noted.

Multiple Comparison Analysis of Catch Data

Considering even-year catch data, the mean date of migration in District 3 (Coghill) was found to be significantly different from the mean dates of migration in Districts 1 (Eastern), 2 (Northern), 6 (Southwestern), and 8 (Southeastern), but not from District 4 (Northwestern). District 4 (Northwestern) was found to differ significantly from District 1 (Eastern), but it is not likely to be different from Districts 6 (Southwestern) ($\alpha = 0.14$), and 8 (Southeastern) ($\alpha = 0.10$). Northwestern was not significantly different in timing from Districts 2 (Northern), and 3 (Coghill).

Using odd-year catch data, the mean date of migration in District

3 (Coghill) was found to be significantly earlier than the mean dates in Districts 6 (Southwestern), 7 (Montague), and 8 (Southeastern), but it may not be significantly earlier than District 1 (Eastern) ($\alpha = 0.10$). Coghill District was not found to differ significantly in timing from Districts 2 (Northern), and 4 (Northwestern). District 7 (Montague) was shown to be significantly later than District 3 (Coghill), but it may not be later than Districts 2 (Northern) ($\alpha = 0.10$), and 4 (Northwestern) ($\alpha = 0.19$).

Multiple Comparison Analysis of Spawning Escapement Data

Employing even-year escapement data, the mean date of the distribution of escapement in District 3 (Coghill) was found to be significantly earlier than Districts 6 (Southwestern), 7 (Montague), and 8 (Southeastern), but not different from Districts 1 (Eastern), 2 (Northern), and 4 (Northwestern). Coghill may not be significantly different from District 5 (Eshamy) ($\alpha = 0.14$). District 1 (Eastern) was shown to be significantly earlier than Districts 7 (Montague), and 8 (Southeastern), but it may not be earlier than Districts 5 (Eshamy) ($\alpha = 0.19$), and 6 (Southwestern) ($\alpha = 0.11$). Eastern was not found to differ in timing from Districts 2 (Northern), 3 (Coghill), and 4 (Northwestern). The mean date of migration in District 4 (Northwestern) may be significantly different from District 8 (Southeastern) ($\alpha = 0.075$), while District 2 (Northern) may not be different from Southeastern ($\alpha = 0.10$). The mean dates of migration in Northern and Northwestern were not shown to differ significantly from any other district.

Considering odd-year escapement data, the mean date of the distribution of spawning escapement in District 2 (Northern) was shown to be significantly earlier than Districts 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), and 7 (Montague), but probably not earlier than District 8 (Southeastern) ($\alpha = 0.15$). Northern did not differ significantly from Districts 1 (Eastern) and 3 (Coghill). District 1 (Eastern) differed significantly from Districts 4 (Northwestern), 5 (Eshamy), and 6 (Southwestern), but not from Districts 2 (Northern), 3 (Coghill), 7 (Montague), and 8 (Southeastern). District 3 (Coghill) was shown to differ significantly from District 6 (Southwestern), but it is not likely to be different from District 5 (Eshamy) ($\alpha = 0.16$). The mean date of migration in District 8 (Southeastern) may be significantly different from that of District 6(Southwestern) ($\alpha = 0.075$), but not from any other district.

Scheffe's method for multiple comparisons was used to examine whether significant differences existed among the mean dates of migration defined by linear combinations of management districts for each cycle year and category of data. The design of the contrasts was guided by the relationships among the management districts as shown by the pairwise comparison analysis, and by the relative timings of the districts to the overall sound-wide timing within the cycle year.

Scheffe's Multiple Comparison Analysis of Catch Data

Inspection of the average means of the time densities by district for even-cycle catch data, revealed that both District 3 (Coghill) and District 4 (Northwestern) had earlier historic average mean dates of migration (July 20 and July 23, respectively) than the overall sound-wide average mean date of July 27. District 2 (Northern) was also among the earliest of all management districts, although its grand mean date of migration (July 28) was greater than the sound-wide historic average. On the basis of the pairwise comparison analysis (LSD) of even-cycle catch data, District 3 (Coghill) was not shown to differ significantly with District 4 (Northwestern), nor was District 4 (Northwestern) shown to be significantly different from either District 2 (Northern) or District 3 (Coghill).

Using even-year catch data, four linear combinations of management districts were examined for significant differences in the mean dates of migration:

1. Is the overall mean date of even-year catch in Districts 2 (Northern) and 3 (Coghill) combined significantly different from Districts 1 (Eastern), 4 (Northwestern), 6 (Southwestern), and 8 (Southeastern) combined? The test concluded that this contrast was significant (p = 0.029).

2. Is the overall mean date of even-year catch in Districts 3 (Coghill) and 4 (Northwestern) combined significantly different from Districts 1 (Eastern), 2 (Northern), 6 (Southwestern), and 8 (Southeastern), combined? A highly significant difference was concluded (p = 0.001).

3. Is the overall mean date of even-year catch in Districts 2 (Northern) and 4 (Northwestern) combined significantly different from

Districts 1 (Eastern), 3 (Coghill), 6 (Southwestern), and 8 (Southeastern) combined? The test failed to conclude that this contrast was significant (p = 0.237).

4. Is the overall mean date of even-year catch in Districts 2 (Northern), 3 (Coghill), and 4 (Northwestern) combined significantly different from Districts 1 (Eastern), 6 (Southwestern), and 8 (Southeastern) combined? A highly significant difference was concluded (p = 0.002).

Examination of the average means of the time densities by district for odd-year catch data, revealed that only Districts 2 (Northern), 3 (Coghill), and 4 (Northwestern) had earlier historic average mean dates of migration (July 21, July 17, and July 22, respectively) than the overall sound-wide average mean date of July 24. Pairwise comparison analysis of odd-cycle catch data, revealed that District 3 (Coghill) was significantly different from Districts 2 (Northern) and 4 (Northwestern).

Employing odd-year catch data, four linear combinations of management districts were examined for significant differences in the mean dates of migration:

1. Is the overall mean date of odd-year catch in Districts 2 (Northern) and 3 (Coghill) combined significantly different from Districts 1 (Eastern), 4 (Northwestern), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test concluded that this contrast was significant (p = 0.004).

2. Is the overall mean date of odd-year catch in Districts

3 (Coghill), and 4 (Northwestern) combined significantly different from Districts 1 (Eastern), 2 (Northern), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test concluded a significant difference did exist (p = 0.009).

3. Is the overall mean date of odd-year catch in Districts 2 (Northern), and 4 (Northwestern) combined significantly different from Districts 1 (Eastern), 3 (Coghill), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test failed to conclude that this contrast was significant (p = 0.206).

4. Is the overall mean date of odd-year catch in Districts 2 (Northern), 3 (Coghill), and 4 (Northwestern) combined significantly different from Districts 1 (Eastern), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test concluded a significant difference (p = 0.003).

Scheffe's Multiple Comparison Analysis of Spawning Escapement Data

Inspection of the average means of the time densities by district for the even-cycle of spawing escapement, showed that only Districts 1 (Eastern), 2 (Northern), 3 (Coghill), and 4 (Northwestern) had earlier historic average mean dates of migration (August 16, August 18, August 16, and August 18, respectively) than the overall sound-wide grand mean date of escapement (August 19). Pairwise comparison analysis revealed that District 3 (Coghill) was not significantly different from Districts 1 (Eastern), 2 (Northern), and 4 (Northwestern), and that District 1 (Eastern) did not differ significantly from Districts 2 (Northern), 3 (Coghill), and 4 (Northwestern). All possible two-way, three-way, and four-way combinations of these four districts were examined for combined differences in migratory behavior with the combined remaining districts.

Using even-year escapement data, eleven linear combinations of management districts were examined for differences in the mean dates of escapement:

1. Is the overall mean date of even-year escapement in Districts 1 (Eastern), 3 (Coghill), and 4 (Northwestern) combined significantly different from Districts 2 (Northern), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? A highly significant difference was concluded (p = 0.001).

2. Is the overall mean date of even-year escapement in Districts 2 (Northern), 3 (Coghill), and 4 (Northwestern) combined significantly different from Districts 1 (Eastern), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test concluded that this contrast was significant (p = 0.017).

3. Is the overall mean date of even-year escapement in Districts 1 (Eastern), 2 (Northern), and 4 (Northwestern) combined significantly different from Districts 3 (Coghill), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test concluded a significant difference (p = 0.022).

4. Is the overall mean date of even-year escapement in Districts 1 (Eastern), 2 (Northern), and 3 (Coghill) combined significantly different from Districts 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? This contrast was shown to be highly significant (p = 0.001).

5. Is the overall mean date of even-year escapement in Districts

1 (Eastern), and 3 (Coghill) combined significantly different from Districts 2 (Northern), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? A highly significant difference was concluded (p = 0.001).

6. Is the overall mean date of even-year escapement in Districts 3 (Coghill), and 4 (Northwestern) combined significantly different from Districts 1 (Eastern), 2 (Northern), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test concluded that this contrast was significant (p = 0.024).

7. Is the overall mean date of even-year escapement in Districts 1 (Eastern), and 4 (Northwestern) combined significantly different Districts 2 (Northern), 3 (Coghill), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? A significant difference was concluded (p = 0.033).

8. Is the overall mean date of even-year escapement in Districts 2 (Northern), and 3 (Coghill) combined significantly different from Districts 1 (Eastern), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test concluded a significant difference (p = 0.028).

9. Is the overall mean date of even-year escapement in Districts 2 (Northern), and 4 (Northwestern) combined significantly different from Districts 1 (Eastern), 3 (Coghill), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test failed to conclude that this contrast was significant (p = 0.313).

10. Is the overall mean date of even-year escapement in Districts 1 (Eastern), and 2 (Northern) combined significantly different from Districts 3 (Coghill), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern),

7 (Montague), and 8 (Southeastern) combined? A significant difference was concluded ($p = 0.037$).

11. Is the overall mean date of even-year escapement in Districts 1 (Eastern), 2 (Northern), 3 (Coghill), and 4 (Northwestern) combined significantly different from Districts 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test concluded that this contrast was highly significant ($p < 0.001$).

Examination of the average means of the time densities by district for the odd-cycle of spawning escapement, showed that only Districts 1 (Eastern), 2 (Northern), 3 (Coghill), and 8 (Southeastern) had earlier historic average mean dates of migration (August 10, August 7, August 14, August 15, respectively) than the overall sound-wide grand mean date of escapement. Pairwise comparison analysis revealed that District 2 (Northern) was not significantly different from Districts 1 (Eastern), and 3 (Coghill), and that District 1 (Eastern) did not differ significantly from Districts 2 (Northern), 3 (Coghill), 7 (Montague), and 8 (Southeastern). All possible two-way, three-way, and four-way combinations of these four management districts were examined for combined differences in migratory behavior with that of the combined remaining districts.

Considering odd-year escapement data, eleven linear combinations of management districts were examined for differences in the mean dates of escapement:

1. Is the overall mean date of odd-year escapement in Districts 1 (Eastern), 2 (Northern), and 3 (Coghill) combined significantly

different from Districts 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test concluded that this contrast was highly significant ($p < 0.001$).

2. Is the overall mean date of odd-year escapement in Districts 2 (Northern), 3 (Coghill), and 8 (Southeastern) combined significantly different from Districts 1 (Eastern), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), and 7 (Montague) combined? A significant difference was concluded ($p = 0.007$).

3. Is the overall mean date of odd-year escapement in Districts 1 (Eastern), 3 (Coghill), and 8 (Southeastern) combined significantly different from Districts 2 (Northern), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), and 7 (Montague) combined? The test concluded a significant difference ($p = 0.032$).

4. Is the overall mean date of odd-year in Districts 1 (Eastern), 2 (Northern), and 8 (Southeastern) combined significantly different from Districts 3 (Coghill), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), and 7 (Montague) combined? A highly significant difference was concluded ($p = 0.001$).

5. Is the overall mean date of odd-year in Districts 2 (Northern), and 8 (Southeastern) combined significantly different from Districts 1 (Eastern), 3 (Coghill), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), and 7 (Montague) combined? The test concluded that this contrast was significant ($p = 0.012$).

6. Is the overall mean date of odd-year escapement in Districts 3 (Coghill), and 8 (Southeastern) combined significantly different from Districts 1 (Eastern), 2 (Northern), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), and 7 (Montague) combined? The test failed to

conclude that this contrast was significant ($p = 0.341$).

7. Is the overall mean date of odd-year escapement in Districts 1 (Eastern), and 8 (Southeastern) combined significantly different from Districts 2 (Northern), 3 (Coghill), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), and 7 (Montague) combined? A significant difference was concluded ($p = 0.062$).

8. Is the overall mean date of odd-year escapement in Districts 1 (Eastern), and 2 (Northern) combined significantly different from Districts 3 (Coghill), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? This contrast was shown to be highly significant ($p < 0.001$).

9. Is the overall mean date of odd-year escapement in Districts 2 (Northern), and 3 (Coghill) combined significantly different from Districts 1 (Eastern), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? A significant difference was concluded ($p = 0.006$).

10. Is the overall mean date of odd-year escapement in Districts 1 (Eastern), and 3 (Coghill) combined significantly different from Districts 2 (Northern), 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) combined? The test showed that this contrast was significant ($p = 0.033$).

11. Is the overall mean date of odd-year escapement in Districts 1 (Eastern), 2 (Northern), 3 (Coghill), and 8 (Southeastern) combined significantly different from Districts 4 (Northwestern), 5 (Eshamy), 6 (Southwestern), and 7 (Montague) combined? This contrast was shown to be highly significant ($p < 0.001$).

4.3 Correlation and Regression Analysis

For the data categories of catch, and spawning escapement, the Pearson product moment correlation coefficient r, was computed for all possible pairwise combinations of the management districts for the odd-cycle and the even-cycle independently. For the purposes of determining the nature of association between the management districts and the overall sound-wide timing behavior, the sound-wide category was included as a 'district' member. A test of significance was performed on each correlation coefficient computed which was based on the Student's – t distribution with (n-2) degrees of freedom. The critical or 'p' value was reported for all hypotheses tested.

Correlation Analysis of Catch Data

Employing the mean dates of migration for even-cycle catch data, r was calculated for all possible combinations of Districts 1 (Eastern), 2 (Northern), 3 (Coghill), 4 (Northwestern), 6 (Southwestern), and 8 (Southeastern) (Table 14). Those management districts whose mean dates of migration were found to be most highly correlated with the overall sound-wide migratory behavior were: 4 (Northwestern) ($r = 0.98$, $p = 0.002$), 1 (Eastern) ($r = 0.96$, $p = 0.004$), and 6 (Southwestern) ($r = 0.96$, $p = 0.018$). Districts 2 (Northern) ($r = 0.87$, $p = 0.023$), and 8 (Southeastern) ($r = 0.87$, $p = 0.027$) were also significantly correlated with the overall sound-wide timing behavior. Only District 3 (Coghill) failed to show a significant correlation with the sound-wide mean dates of migration ($r = 0.57$, $p = 0.12$).

Table 14. Pearson product moment correlation coefficients (r), sample sizes (n), and critical values (p) for pairwise combinations of management districts (r/n/p), for the even-cycle of catch. District codes: 1 = Eastern, 2 = Northern, 3 = Coghill, 4 = Northwestern, 5 = Eshamy, 6 = Southwestern, 7 = Montague, 8 = Southeastern, 1-8 = Sound-wide. *** = data were not available. —— = correlation was not performed.

	Management District								
	1	2	3	4	5	6	7	8	1-8
1	——	0.751 5 0.072	0.672 5 0.107	0.864 4 0.068	***	0.858 4 0.071	***	0.737 5 0.078	0.964 5 0.004
2	0.751 5 0.072	——	0.383 5 0.262	0.964 4 0.018	***	0.908 4 0.046	***	0.956 5 0.006	0.886 5 0.023
3	0.672 5 0.107	0.383 5 0.262	——	0.723 5 0.084	***	0.782 4 0.109	***	0.175 5 0.389	0.568 6 0.120
4	0.864 4 0.068	0.964 4 0.018	0.723 5 0.084	——	***	0.910 4 0.045	***	0.951 4 0.024	0.979 5 0.002
5	***	***	***	***	——	***	***	***	***
6	0.858 4 0.071	0.908 4 0.046	0.782 4 0.109	0.910 4 0.045	***	——	***	0.925 4 0.038	0.963 4 0.018
7	***	***	***	***	***	***	——	***	***
8	0.737 5 0.078	0.956 5 0.006	0.175 5 0.389	0.951 4 0.024	***	0.925 4 0.038	***	——	0.873 5 0.027
1-8	0.964 5 0.004	0.886 5 0.023	0.568 6 0.120	0.979 5 0.002	***	0.963 4 0.018	***	0.873 5 0.027	——

Using the mean dates of migration for odd-cycle catch data, r was calculated for all possible pairwise combinations of Districts 1 (Eastern), 2 (Northern), 3 (Coghill), 4 (Northwestern), 6 (Southwestern), 7 (Montague), and 8 (Southeastern) (Table 15). Districts 8 (Southeastern) ($r = 0.995$, $p < 0.001$), 1 (Eastern) ($r = 0.97$, $p < 0.001$), and 6 (Southwestern) ($r = 0.97$, $p < 0.001$) were the most highly correlated with the sound-wide mean dates of migration. District 2 (Northern) ($r = 0.86$), and District 3 (Coghill) ($r = 0.76$) were also significantly correlated with the sound-wide timing behavior, $p = 0.006$ and $p = 0.02$, respectively. Only Districts 4 (Northwestern) ($r = 0.61$, $p = 0.74$), and 7 (Montague) ($r = 0.69$, $p = 0.10$) failed to demonstrate significantly correlated behavior with the sound-wide mean dates of migration at the $\alpha = 0.05$ significance level.

Correlation Analysis of Spawning Escapement Data

Considering the means of the annual migratory time densities of even-cycle escapement data, r was computed for seventy-two different combinations of Districts 1 through 8 plus District 1-8 (Sound-wide) (Table 16). Those districts shown to be most highly correlated with sound-wide mean dates of migration were: 2 (Northern) ($r = 0.87$, $p = 0.001$), 3 (Coghill) ($r = 0.76$, $p = 0.005$), and 1 (Eastern) ($r = 0.73$, $p = 0.008$). District 8 (Southeastern) ($r = 0.59$), and District 7 (Montague) ($r = 0.57$) were also significantly correlated with the overall timing in the sound with $p = 0.037$ and $p = 0.042$, respectively. Districts 5 (Eshamy) ($r = -0.74$, $p = 0.07$),

Table 15. Pearson product moment correlation coefficients (r), sample sizes (n), and critical values (p) for pairwise combinations of management districts (r/n/p), for the odd-cycle of catch. District codes: 1 = Eastern, 2 = Northern, 3 = Coghill, 4 = Northwestern, 5 = Eshamy, 6 = Southwestern, 7 = Montague, 8 = Southeastern, 1-8 = Sound-wide. *** = data were not available. —— = correlation was not performed.

	Management District								
	1	2	3	4	5	6	7	8	1-8
1	——	0.904 7 0.003	0.785 7 0.018	0.522 7 0.115	***	0.945 7 0.001	0.697 5 0.095	0.961 7 0.001-	0.973 7 0.001-
2	0.904 7 0.003	——	0.605 7 0.075	0.208 7 0.327	***	0.933 7 0.001	0.500 5 0.195	0.857 7 0.007	0.863 7 0.006
3	0.785 7 0.018	0.605 7 0.075	——	0.799 7 0.016	***	0.647 7 0.058	0.889 5 0.022	0.757 7 0.024	0.761 7 0.023
4	0.522 7 0.115	0.208 7 .0327	0.799 7 0.016	——	***	0.444 7 0.159	0.533 5 0.177	0.626 7 0.066	0.608 7 0.074
5	***	***	***	***	——	***	***	***	***
6	0.945 7 0.001	0.933 7 0.001	0.647 7 0.058	0.444 7 0.159	***	——	0.545 5 0.171	0.972 7 0.001-	0.971 7 0.001-
7	0.697 5 0.095	0.500 5 0.195	0.889 5 0.022	0.533 5 0.177	***	0.545 5 0.171	——	0.689 5 0.099	0.688 5 0.100
8	0.961 7 0.001-	0.857 7 0.007	0.757 7 0.024	0.626 7 0.066	***	0.972 7 0.001-	0.689 5 0.099	——	0.995 7 0.001-
1-8	0.973 7 0.001-	0.863 7 0.006	0.761 7 0.023	0.608 7 0.074	***	0.971 7 0.001-	0.688 5 0.100	0.995 7 0.001-	——

Table 16. Pearson product moment correlation coefficients (r), sample sizes (n), and critical values (p) for pairwise combinations of management districts (r/n/p), for the even-cycle of spawning escapement. District codes: 1 = Eastern, 2 = Northern, 3 = Coghill, 4 = Northwestern, 5 = Eshamy, 6 = Southwestern, 7 = Montague, 8 = Southeastern, 1-8 = Sound-wide. —— = correlation not performed.

	Management District								
	1	2	3	4	5	6	7	8	1-8
1	——	0.630 10 0.025	0.571 10 0.042	-0.312 10 0.190	-0.583 5 0.151	-0.432 10 0.106	0.022 10 0.476	0.023 10 0.474	0.733 10 0.008
2	0.630 10 0.025	——	0.748 10 0.006	0.224 10 0.267	-0.724 5 0.083	0.004 10 0.495	0.372 10 0.145	0.365 10 0.150	0.872 10 0.001
3	0.571 10 0.042	0.748 10 0.006	——	-0.096 10 0.396	-0.122 5 0.423	-0.379 10 0.140	0.408 10 0.121	0.416 10 0.116	0.761 10 0.005
4	-0.312 10 0.190	0.224 10 0.267	-0.096 10 0.396	——	-0.384 5 0.262	0.835 10 0.001	0.424 10 0.111	0.382 10 0.138	0.084 10 0.409
5	-0.583 5 0.151	-0.724 5 0.083	-0.122 5 0.423	-0.384 5 0.262	——	-0.375 5 0.267	0.082 5 0.448	0.172 5 0.391	-0.745 5 0.074
6	-0.432 10 0.106	0.004 10 0.495	-0.379 10 0.140	0.835 10 0.001	-0.375 5 0.267	——	0.284 10 0.213	0.270 10 0.225	-0.036 10 0.461
7	0.022 10 0.476	0.372 10 0.145	0.408 10 0.121	0.424 10 0.111	0.082 5 0.448	0.284 10 0.213	——	0.995 10 0.001-	0.571 10 0.042
8	0.023 10 0.474	0.365 10 0.150	0.416 10 0.116	0.382 10 0.138	0.172 5 0.391	0.270 10 0.225	0.995 10 0.001-	——	0.587 10 0.037
1-8	0.733 10 0.008	0.872 10 0.001	0.761 10 0.005	0.084 10 0.409	-0.745 5 0.074	-0.036 10 0.461	0.571 10 0.042	0.587 10 0.037	——

4 (Northwestern) ($r = 0.08$, $p = 0.41$), and 6 (Southwestern) ($r = -0.04$, $p = 0.46$) failed to show show significant correlation with the overall sound-wide even-year timing behavior.

Using the means of the annual migratory time densities of odd-cycle escapement data, r was computed for seventy-two unique combinations of all nine district categories (Table 17). All management districts demonstrated significant correlation with the sound-wide timing behavior. In order of decreasing level of significance they were: 1 (Northern) ($r = 0.91$, $p < 0.001$), 8 (Southeastern) ($r = 0.88$, $p < 0.001$), 7 (Montague) ($r = 0.88$, $p < 0.001$), 1 (Eastern) ($r = 0.88$, $p < 0.001$), 3 (Coghill) ($r = 0.80$, $p = 0.002$), 4 (Northwestern) ($r = 0.80$, $p = 0.003$), 6 (Southwestern) ($r = 0.70$, $p = 0.019$), and 5 (Eshamy) ($r = 0.95$, $p = 0.023$).

For each cycle year of data, first order multiple linear regression models were constructed for the purpose of determining if there were linear combinations of the management districts which could be used to predict the timings of catches and spawning escapements on a sound-wide basis. In all such models, the dependent variable was the sound-wide mean date of migration while the dependent variables were the corresponding mean dates of the migratory time densities for each management district.

Selection of the subset of dependent variables was guided by the results obtained from the pairwise comparison analysis, by linear combinations of districts suggested by Scheffe's method of multiple

Table 17. Pearson product moment correlation coefficients (r), sample sizes (n), and critical values (p) for pairwise combinations of management districts (r/n/p), for the odd-cycle of spawning escapement. District codes: 1 = Eastern, 2 = Northern, 3 = Coghill, 4 = Northwestern, 5 = Eshamy, 6 = Southwestern, 7 = Montague, 8 = Southeastern, 1-8 = Sound-wide. —— = correlation not performed.

	Management District								
	1	2	3	4	5	6	7	8	1-8
1	——	0.781 10 0.004	0.596 10 0.035	0.522 10 0.061	0.894 4 0.053	0.386 9 0.153	0.629 10 0.026	0.649 10 0.021	0.879 10 0.001-
2	0.781 10 0.004	——	0.559 10 0.046	0.700 10 0.012	0.835 4 0.083	0.446 9 0.114	0.791 10 0.003	0.785 10 0.004	0.910 10 0.001-
3	0.596 10 0.035	0.559 10 0.046	——	0.751 10 0.006	0.906 4 0.047	0.706 9 0.017	0.755 10 0.006	0.773 10 0.004	0.805 10 0.002
4	0.522 10 0.061	0.700 10 0.012	0.751 10 0.006	——	0.609 4 0.196	0.835 9 0.003	0.770 10 0.005	0.748 10 0.006	0.804 10 0.003
5	0.894 4 0.053	0.835 4 0.083	0.906 4 0.047	0.609 4 0.196	——	0.657 4 0.172	0.946 4 0.027	0.988 4 0.006	0.953 4 0.023
6	0.386 9 0.153	0.446 9 0.114	0.706 9 0.017	0.835 9 0.003	0.657 4 0.172	——	0.760 9 0.009	0.730 9 0.013	0.695 9 0.019
7	0.629 10 0.026	0.791 10 0.003	0.755 10 0.006	0.770 10 0.005	0.946 4 0.027	0.760 9 0.009	——	0.996 10 0.001-	0.879 10 0.001-
8	0.649 10 0.021	0.785 10 0.004	0.773 10 0.004	0.748 10 0.006	0.988 4 0.006	0.730 9 0.013	0.996 10 0.001-	——	0.883 10 0.001-
1-8	0.879 10 0.001-	0.910 10 0.001-	0.805 10 0.002	0.804 10 0.003	0.953 4 0.023	0.695 9 0.019	0.879 10 0.001-	0.883 10 0.001-	——

comparisons, and by the nature of the relative timings of the districts to the overall sound-wide timing within each cycle year and category of data. The coefficient of multiple determination, R^2, was computed for each regression equation. Simply stated, R^2 can be interpreted as the proportion of total variation in the sound-wide timing behavior, Y that is explained by the use of the set of management districts, X_i's according to the rules of the model.

Multiple Regression Analysis of Catch Data

Considering even-cycle catch data, the following multiple linear regression equations were computed:

1. $Y = -0.774 + (0.161)X_4 - (0.328)X_3$, $R^2 = 0.9998$

District 4 (Northwestern) accounted for the majority of the explained variation ($R^2 = 0.958$), while the incremental R^2 attributable to District 3 (Coghill) given that Northwestern was already in the model was 0.041. The test of the regression relationship concluded a significant $F^* = 831.74$ ($0.001 \leq p \leq 0.005$), based on the F distribution with 2 and 2 df.

2. $Y = -0.245 + (0.804)X_1 + (0.621)X_6$, $R^2 = 0.9993$

District 1 (Eastern) accounted for the majority of the explained variation ($R^2 = 0.929$), while the incremental R^2 attributable to District 6 (Southwestern) given that Eastern was already in the model was 0.07. The test of the regression relationship concluded a significant $F^* = 708.34$ ($0.025 \leq p \leq 0.05$), based on the F distribution with 2 and 1 df.

Using odd-cycle catch data, the following multiple linear regression equations were computed:

1. $Y = -0.649 + (0.811)X_2 - (0.416)X_3 + (0.790)X_4$, $R^2 = 0.9595$

District 2 (Northern) accounted for 74.45% of the explained variation, while the incremental R^2's attributable to Districts 3 (Coghill) and 4 (Northwestern) were 0.09 and 0.12, respectively. The test of the regression relationship concluded a significant $F^* = 23.67$ ($0.01 \leq p \leq 0.025$), based on the F distribution with 3 and 3 df.

2. $Y = -0.327 + (0.662)X_2 + (0.495)X_4$, $R^2 = 0.9361$

District 2 (Northern) accounted for the majority of the explained variation ($R^2 = 0.745$), while the incremental R^2 attributable to District 4 (Northwestern) given that Northern was already in the model was 0.19. The test of the regression relationship concluded a significant $F^* = 29.29$ ($0.001 \leq p \leq 0.005$), based on the F distribution with 2 and 4 df.

3. $Y = 0.677 + (0.545)X_2 + (0.412)X_3$, $R^2 = 0.835$

District 2 (Northern) accounted for the majority of the explained variation ($R^2 = 0.745$), while the incremental R^2 attributable to District 3 (Coghill) given that Northern was already in the model was 0.09. The test of the regression relationship concluded a significant $F^* = 10.11$ ($0.025 \leq p \leq 0.005$), based on the F distribution with 2 and 4 df.

4. $Y = 0.567 + (0.422)X_1 + (0.331)X_2 - (0.436)X_3 + (0.542)X_4$, $R^2 = 0.9905$

The decreasing order of inclusion of these districts into the model was: 3 (Coghill), 2 (Northern), 4 (Northwestern), and 1 (Eastern). The incremental R^2's attributable to each district when added to the model in this order were 0.580, 0.255, 0.125, and 0.031, respectively. The test of the regression relationship concluded a significant $F^* = 51.84$ ($0.001 \leq p \leq 0.005$), based on the F distribution with 2 and 4 df.

Multiple Regression Analysis of Spawning Escapement Data

Considering even-cycle escapement data, the following multiple linear regression equations were computed:

1. $Y = 0.239 + (0.126)X_1 + (0.398)X_2 + (0.125)X_3$, $R^2 = 0.8305$

District 2 (Northern) accounted for the majority of the explained variation ($R^2 = 0.759$), while the incremental R^2's attributable to Districts 1 (Eastern) and 3 (Coghill) were 0.044 and 0.027, respectively. The test of the regression relationship concluded a significant $F^* = 9.8$ ($0.005 \leq p \leq 0.01$), based on the F distribution with 3 and 6 df.

2. $Y = 0.254 + (0.483)X_2 + (0.14)X_1$, $R^2 = 0.8161$

District 2 (Northern) accounted for the majority of the explained variation ($R^2 = 0.759$), while the incremental R^2 attributable to District 1 (Eastern) given that Northern was already in the model was 0.056. The test of the regression relationship concluded a significant $F^* = 15.53$ ($0.001 \leq p \leq 0.005$), based on the F distribution with 2 and 7 df.

3. $Y = 0.314 + (0.204)X_1 + (0.345)X_3$, $R^2 = 0.7112$

District 1 (Eastern) accounted for the majority of the explained variation ($R^2 = 0.579$), while the incremental R^2 attributable to District 3 (Coghill) given that Eastern was already in the model was 0.133. The test of the regression relationship concluded a significant $F^* = 8.62$ ($0.025 \leq p \leq 0.01$), based on the F distribution with 2 and 7 df.

4. $Y = 0.233 + (0.488)X_2 + (0.168)X_3$, $R^2 = 0.7866$

District 2 (Northern) accounted for the majority of the explained variation ($R^2 = 0.759$), while the incremental R^2 attributable to District 3 (Coghill) given that Northern was already in the model was 0.027. The test of the regression relationship concluded a significant

$F^* = 12.90$ ($0.001 \leq p \leq 0.005$), based on the F distribution with 2 and 7 df.

Using odd-cycle escapement data, the following multiple linear regression equations were computed:

1. $Y = -0.149 + (0.232)X_1 + (0.602)X_2 + (0.262)X_3$, $R^2 = 0.9828$

District 2 (Northern) accounted for the majority of the explained variation ($R^2 = 0.827$), while the incremental R^2's attributable to Districts 1 (Eastern) and 3 (Coghill) were 0.072 and 0.083, respectively. The test of the regression relationship concluded a significant $F^* = 114.25$ ($p < 0.001$), based on the F distribution with 3 and 6 df.

2. $Y = -0.185 + (0.325)X_1 + 0.353X_2 + (0.37)X_8$, $R^2 = 0.9615$

District 2 (Northern) accounted for the majority of the explained variation ($R^2 = 0.827$), while the incremental R^2's attributable to Districts 1 (Eastern) and 8 (Southeastern) were 0.072 and 0.062, respectively. The test of the regression relationship concluded a significant $F^* = 49.93$ ($p < 0.001$), based on the F distribution with 3 and 6 df.

3. $Y = -0.357 + (0.83)X_2 + (0.308)X_3$, $R^2 = 0.9547$

District 2 (Northern) accounted for the majority of the explained variation ($R^2 = 0.827$), while the incremental R^2 attributable to District 3 (Coghill) given that Northern was already in the model was 0.127. The test of the regression relationship concluded a significant $F^* = 73.73$ ($p < 0.001$), based on the F distribution with 2 and 7 df.

4. $Y = 0.519 + (0.435)X_1 + (0.496)X_8$, $R^2 = 0.9408$

District 1 (Eastern) accounted for the majority of the explained variation ($R^2 = 0.772$), while the incremental R^2 attributable to District 8 (Southeastern) given that Eastern was already in the model was 0.169. The test of the regression relationship concluded a significant $F^* = 55.61$ ($p < 0.001$), based on the F distribution with 2 and 7 df.

5. $Y = -0.270 + (0.701)X_2 + (0.403)X_8$, $R^2 = 0.9013$

District 2 (Northern) accounted for the majority of the explained variation ($R^2 = 0.827$), while the incremental R^2 attributable to District 8 (Southeastern) given that Northern was already in the model was 0.074. The test of the regression relationship concluded a significant $F^* = 31.97$ ($p < 0.001$), based on the F distribution with 2 and 7 df.

6. $Y = 0.155 + (0.355)X_1 + (0.711)X_2$, $R^2 = 0.8997$

District 2 (Northern) accounted for the majority of the explained variation ($R^2 = 0.827$), while the incremental R^2 attributable to

District 1 (Eastern) given that Northern was already in the model was 0.072. The test of the regression relationship concluded a significant $F^* = 31.38$ ($p < 0.001$), based on the F distribution with 2 and 7 df.

7. $Y = 0.129 + (0.509)X_1 + (0.312)X_3$, $R^2 = 0.8945$

District 1 (Eastern) accounted for the majority of the explained variation ($R^2 = 0.772$), while the incremental R^2 attributable to District 3 (Coghill) given that Eastern was already in the model was 0.123. The test of the regression relationship concluded a significant $F^* = 29.66$ ($p < 0.001$), based on the F distribution with 2 and 7 df.

CHAPTER 5

DISCUSSION

This research has been a search for the understanding of the dynamics of the pink salmon fisheries of Prince William Sound. During the course of the analysis several statistical methods have been identified as unexpectedly robust for the purposes of the comparison of timing behavior. It is the system of analysis constructed from these statistical utilities which provide the fisheries management staff in Cordova with extremely useful objective information. The order of the statistical analyses was dictated by biological and physical constraints on the search for the understanding of the dynamics of the fishery.

Initially, because of the unique life history of pink salmon there were obvious questions about differences between the odd-cycle and the even-cycle populations. The first issue to be addressed, therefore, was whether differences between the two populations were discernible. Would the hypothesized genetic distinctness between the populations of odd and even years be quantifiable?

The two-way analysis of variance model was constructed to analyze differences for catch and spawning escapement data. For both data categories, highly significant differences were shown to exist between the timings of odd-year and even-year populations of pink salmon.

Compelling quantitative evidence which is consistent with the genetic heritability of migratory behavior was demonstrated with high levels of confidence.

From a management point of view, the principal issue to be considered was the difference between the management districts with respect to timing behaviors for the cycle years of catch and spawning escapement. Each of the four one-way analysis of variance models constructed for this purpose concluded highly significant differences among districts. What was previously supported by only intuition was now rigorously demonstrated; the management districts were highly distinct with respect to timing behaviors in both even-years and odd-years.

Even when the odd-year and the even-year data were combined, the distinctness between management districts was still shown for each category of data. The timing behaviors of the districts really did differ, and they differed substantially enough to overcome the combination of even and odd populations, which combination we know to be biologically inappropriate.

It was not intuitively obvious from inspection of the one standard deviation error bars about the average mean dates of migration (Figs. 15 through 18) that such highly significant differences existed among districts with respect to migratory behavior for any cycle year and data category. It was concluded that a simple one-dimensional graphic analysis of this type was inadequate for discerning differences in the mean dates of migration among management districts.

The analysis of variance procedure, or more appropriately the analysis of variation about means, on the other hand is a more versatile statistical tool for studying the relation between the means of populations. During the analysis, the total variation present in a set of data is partitioned into several components. Associated with each of these components is a specific source of variation, so that it is possible to ascertain the magnitude of the contributions of each of these sources to the total variation. The nature of this partitioning of the total variation into component parts makes the analysis of variance procedure highly appropriate to the comparative analysis of migratory behavior between years and across harvest areas.

Given that the timing behavior among districts was distinct, the next logical questions to be addressed were those of the likenesses and differences among the management districts in each cycle year and data category. Natural corollaries to these issues were the questions of existence of linear combinations of the management districts which could be used as indices to predict the timings of catches and spawning escapements on a sound-wide basis. A final issue concerned the extent to which any linear combination of districts could be used as an index to predict the timings of catches and escapements on a sound-wide basis.

When even-cycle catch data were examined, a preliminary grouping of management districts on the basis of the LSD procedure indicated that Districts 3 (Coghill), 4 (Northwestern), and to some extent

2 (Northern), displayed similar timing behavior. Further refinement by Scheffe's analysis revealed that Coghill and Northwestern Districts combined displayed a highly distinct timing behavior when compared to the other management districts combined. A less distinct conclusion was obtained when Northern was added to the contrast with Coghill and Northwestern. From a harvest control point of view this outcome was ideal, since Coghill and Northwestern Districts were the earliest two management districts based on historical mean dates of migration. When modeled by a multiple linear regression equation, these two districts were shown to explain 99.98% of the total variation in the sound-wide timing behavior.

Considering odd-cycle catch data, multiple comparison analysis identified an initial group of similar management districts consisting of Districts 2 (Northern), 3 (Coghill), and 4 (Northwestern). Scheffe's analysis demonstrated that the timing behavior in this linear combination of districts was highly distinct from that of the other remaining districts combined. Multiple linear regression analysis revealed that these districts collectively explained 95.95% of the total variation in the sound-wide timing behavior. Since Northern, Coghill, and Northwestern Districts are also the earliest of all management districts based on historical mean dates of migration, these results were highly desirable in terms of this linear combination serving as an index of sound-wide timing behavior.

The analysis of spawning escapement data for both cycle years revealed equally exciting results. The pattern of results was similar to that for catch data where a subset of historically early districts was identified which collectively explained a large percentage of the total variation in the sound-wide timing behavior. For each cycle year of spawning escapement, four management districts were selected on the basis of the results of multiple comparison analysis, and on the basis of the relative timings among districts to the overall sound-wide timing behavior.

Considering even-year spawning escapement data, Districts 1 (Eastern), 2 (Northern), 3 (Coghill), and 4 (Northwestern) were identified for this purpose. Scheffe's analysis tested several linear combinations of these four districts, and the application of multiple regression analysis determined the best contrasts to be used for predictive purposes. The subset of districts consisting of Eastern, Northern, and Coghill appears to be the best linear combination to use as an index of sound-wide timing behavior.

The most exciting results were obtained when odd-cycle escapement data were examined. Nearly all of the management districts in this cycle year are highly correlated with the sound-wide timing behavior. Not suprisingly, a variety of linear combinations of Districts 1 (Eastern), 2 (Northern), 3 (Coghill), and 8 (Southeastern) demonstrated significant predictive potential giving the management authority greater flexibility in choosing any one linear combination to use. It appears that the best linear contrast consisted of Eastern, Northern, and Coghill which collectively accounted for 98.28% of the total variation in the sound-wide timing behavior.

The use of multiple regression analysis proved useful in the context of this study in that the predictive models not only explained a significant portion of the total variation in the response variable Y_i, they did so on the basis of a subset, or linear combination, of the eight independent variables (districts). In order to produce estimates on the overall sound-wide mean date of migration, therefore, a significantly reduced amount of harvest information is required to fit the model. Since these models are primarily intended to be used within a harvest control system delivering intraseason estimates of the timing of the fishery, the latter is a highly desirable outcome.

Application of these predictive models in an intraseason harvest control system requires timely estimates of the mean dates of migration for those management districts fitted by the linear equation. Barth (1984) demonstrated the utility of a two parameter linear model for the purposes of an intraseason yield forecasting system for commercial marine fisheries. It is anticipated by this author that a similar forecasting technique will produce reliable intraseason estimates of the mean dates of migration for any management district.

If such estimates can be realized in a timely fashion, a reliable sound-wide estimate of the mean date of migration can be determined by fitting the predictive multiple linear regression equations defined above. Prediction or confidence intervals on the estimates of the sound-wide mean date of migration can also be determined using standard regression methodology.

The difference between the estimate of the overall sound-wide mean date of migration and the mean date of the average historical sound-wide empirical time density function, would provide the harvest manager an indication of whether the migration was early or late. The magnitude and direction of the difference can be employed as a location or shift parameter for reconciling the historical empirical time density function to the current pattern of incoming migration in the manner of Mundy and Mathisen (1981). The potential benefit of this procedure is a reduction in the error of the yield estimate derived from the application of the average historical time densities. Estimates of the mean dates of migration for the individual districts can similarly be employed for the purposes of producing yield estimates on a management district level.

The Unbiased, Consistent Estimator of Migratory Behavior

The characterization of an annual migration in terms of an empirical probability density function in the time domain is a relatively recent development in fisheries science. Several applications of the migratory timing concept to commercial marine fisheries (Babcock 1983; Paula 1983; Hill 1984) have attempted to compare migratory behavior between years and harvest areas on the basis of migratory time densities.

To determine if brown shrimp (Panaeus aztecus) were recruited to the commercial fishery in a discrete or continuous manner, Paula (1983) compared the means of the time densities by calculating 99% confidence intervals on the mean dates of migration for each size class and by employing a Bonferroni correction to guarantee an overall significance level α for all intervals. All other comparisons of migratory behavior by Babcock, Paula, and Hill were based on a test that considers the 'closeness' of fit between the empirical distribution functions themselves, the Kolmogorov-Smirnov goodness of fit test (Hogg and Tanis 1977).

While the procedures of applying this test to the data were not violated by these authors, the use of the Kolmogorov-Smirnov test is inappropriate for comparing migratory behavior simply because of the way in which the random variable of the density function is defined. Recall, the random variable t_i is defined according to the number of individuals n_i which arrive in, or which are harvested by the fishery, on the i-th time interval. Strictly speaking, the sample size 'n' for an annual migration is the total number of individuals which have been harvested (total catch) or which have migrated through the geographic reference frame of the fishery (total abundance) during the entire year. In most commercial marine fisheries, the 'time density' sample size ranges from hundreds of thousands to tens of millions. By applying an 'n' of this magnitude to the Kolmogorov-Smirnov goodness of fit test, the analysis becomes highly over-sensitive to even the slightest difference between the density functions being compared. Almost invariably, conclusions of significant differences result with such frequency that it is inconsistent with the genetic heritability of migratory timing.

Hill (1984), attempted to correct for the large sample size problem in an analysis of a weakfish (Cynoscion regalis) fishery by expressing 'n' as a function of effort. While this procedure produced more reasonable estimates of 'n', on the order of a few hundred, it did not adequately address the problem of over-sensitivity of the test statistic. In each of his comparisons Hill concluded significant differences between each annual time density and all other annual time densities.

To place this in perspective, one must consider that a fishery is a human activity (Royce 1983), and that abiotic factors as well as methods of data collection can modulate the expression of migratory behavior. The time density function, as a consequence, represents the combined behavior not only of the target species, but also that of the harvest community, as well as climatic events. Indeed, it may be impossible to distinguish between the various biologic, sociologic, and environmental factors that are expressed on each time increment of the time density.

If it is the intent to objectively compare migratory behavior, it is ill-advised to do so by such a close scrutinization of empirical distribution functions which have been constructed from data that have an inherent variance. Erroneous conclusions can be drawn from a homogeneity test of migratory time density functions, especially when that test has been applied under the strict interpretation of the definition of migratory timing. Alternate procedures suitable to a rigorous comparison of migratory behavior across time and space, consequently, had to be identified and evaluated.

The determination of the most representative characteristic or estimator of migratory behavior was a prerequisite to the realization of the objectives of this study. Such an estimator would be unbiased, and consistent. To be of most benefit to a harvest manager, it should also be easily estimable and readily understood. The consistent, unbiased estimator of migratory behavior is, in fact, the measure of central tendency (mean date) of the time density, $\bar{t}$.

An unbiased, consistent estimator of a parameter, in a statistical sense, is one whose mathematical expectation equals the parameter, and whose variance converges to some value (zero) as the sample size approaches infinity (Hogg and Tanis 1977). To show that $\bar{t}$ is such an estimator of migratory behavior, let f(t) be the actual time density within the fishery such that, ${}_{a}\int^{b} f(t)$ is the proportion of total abundance succeptible to harvest between any two dates a,b. From the 'sampling' of f(t) by the fishery, therefore, we can generate an empirical distribution function of catch, and an estimate, $\hat{t}$ (Equation 3), of the parametric mean date of the migration μ_T where,

$$\mu_T = \int_{+\infty}^{-\infty} t\ f(t)\ dt \tag{20}$$

The difficulty with arguing that $\hat{t}$ is an unbiased, consistent estimator of μ_T, is twofold; (1) the form of the density function f(t) is unknown, and (2) we are estimating the mean of a continuous distribution by a discrete process, fishing. If we assume a particular form for the migratory time density of total abundance f(t) (normal, logistic, etc.), it could be shown that $\hat{t}$ is not only the consistent, unbiased estimator of μ_T, but it is also the maximum likelihood estimator of μ_T. Since, in practice, f(t) is never known, a redefinition of the distribution function f(t) is necessary to permit the development of $\hat{t}$ as the consistent, unbiased estimator of μ_T.

Let f(t) be the actual time density within the fishery which describes the distribution of probability associated with the space R of the random variable T, time. We can choose a magnitude for the increment in the time domain such that, the abundance N_t available within any one time increment t_i, i = 1, ..., k can be represented by some constant, average abundance, $\bar{N}_t$. If f(t) is observed at each of k distinct points, t_1, ..., t_k, so that $f(t_1)$, ..., $f(t_k)$ are completely known, then

$$\bar{t}_k = \sum_{i=1}^{k} t_i f(t_i) \tag{21}$$

and, $E(\bar{t}_k) = \mu_T$ if k spans the entire space of the random variable T. Being 'completely known' is analogous to a 100% exploitation rate which requires every available fish on time increment t_i to be harvested by the fishery. Over the course of the season, therefore, catch (n_i) on time increment t_i equals abundance (N_i) on time increment t_i, and total catch (n) equals total abundance (N) when $t_i = t_k$. When the distribution function of total abundance, f(t) defined in this manner is sampled, what is the consistent, unbiased estimator of the parametric mean μ_T?

Suppose that on each of k distinct points, the distribution of catch, defined by $\hat{f}(t_i)$, measures the distribution of total abundance with a corresponding distribution of error, ε_i, whose elements are independent $(0,\sigma^2)$. The distribution of catch on time increment t_i would be:

$$\hat{f}(t_i) = f(t_i) + \varepsilon_i \tag{22}$$

The mean date of migration based on the catch distribution would be represented by:

$$\hat{\bar{t}}_k = \sum_{i=1}^{k} t_i \hat{f}(t_i) = \bar{t}_k + \sum_{i} t_i \varepsilon_i \qquad (23)$$

whose variance is:

$$V(\hat{\bar{t}}_k) = \sum t_i^2 \sigma^2 = \sigma^2 (\sum t_i^2) \qquad (24)$$

For $\hat{\bar{t}}_k$ to be an unbiased estimator of μ_T, the expected value of $\hat{\bar{t}}_k$ must equal μ_T. Since $E(\varepsilon_i) = 0$, it follows that $E(\hat{\bar{t}}_k) = \mu_T$, which implies that the mean of the sample distribution of catch is an unbiased estimator of the parametric mean date of migration. For $\hat{\bar{t}}_k$ to be a consistent estimator of μ_T, $V(\hat{\bar{t}})$ must ---> 0 as n ---> ∞. The variance of $\hat{\bar{t}}_k$ will equal zero if and only if $\sigma^2 = 0$, so that $\hat{f}(t_i) = f(t_i)$. As the sample size, n approaches infinity, $\hat{f}(t_i)$ $i = 1,\ldots k$ are completely known, and $\hat{f}(t_i) = f(t_i)$. The mean of the sample distribution of catch, therefore, is also a consistent estimator of the parametric mean date of migration.

The mean date of migration, consequently, is a reliable estimator of migratory behavior. In addition to its highly desirable unbiased and consistent properties, it is extremely resistent to factors which contribute variability to the basis expression of migratory behavior. It also benefits from being easily estimable and readily understood.

To be suitable as the basis for a comparative analysis between years as well as harvest areas, the mean of the time density function must also be a consistent estimator of interannual migratory behavior. Since in the case of maturing salmonids migratory timing is genetically transmitted (see Leggett 1977; Mundy 1979, 1982), the time of arrival in the fishery of the members of a migratory stock is conserved across generations, absent abiotic influences. If the mean date of migration in year 'i', i = 1 to y, is represented by $\bar{t}_i$, this premise is analogous to the statement: $E(\bar{t}_1) = E(\bar{t}_2) = \ldots = E(\bar{t}_i)$, for a fixed geographic reference frame.

The consistent, unbiased properties of the estimator $\bar{t}$, as well as its conservative behavior across generations makes its use well suited to many statistical methods. The mean date of migration is appropriate, therefore, to serve as the basis for a comparative analysis of timing behavior across spatial as well as temporal dimensions.

CHAPTER 5

CONCLUSION

Fisheries management is appropriately directed toward the achievement of rational utilization of the resource. Since fisheries invariably represent complex, dynamic systems of interacting components, mathematical modeling is used to express these interactions in terms of identifiable, functional relationships. The very nature of the regualtory complexities imposed on the Prince William Sound pink salmon fisheries lent itself to such an approach.

Several principal conclusions can be drawn from the results of this research;

1. Migratory timing as a quantitative description of migratory behavior can, in fact, be rigorously compared across years and areas.

2. The mean date of migration as a consistent, unbiased estimator of migratory behavior, can serve as the basis for a comparative analysis of empirical time densities.

3. Many classical statistical models are extremely robust for determining differences in migratory behavior between years and across harvest areas when the measures of central tendency of the time densities are employed as variables in the models.

4. The results of the analysis of the even and odd cycles of pink salmon are consistent with the genetic distinctness between these two populations, and with the hypothesis of the genetic heritability of migratory timing.

5. The dynamic statistical system of analysis identified by this research is highly appropriate for quantitatively describing the functional relationships between timing behaviors across spatial and temporal dimensions. It is anticipated that this system will serve as a design standard for the comparison of migratory behavior, and that it will be applicable to the needs of harvest control for any migratory organism.

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APPENDIX A

AVERAGE CUMULATIVE PROPORTION CURVES FOR ALL MANAGEMENT DISTRICTS

Figure 1. Eastern District, even-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

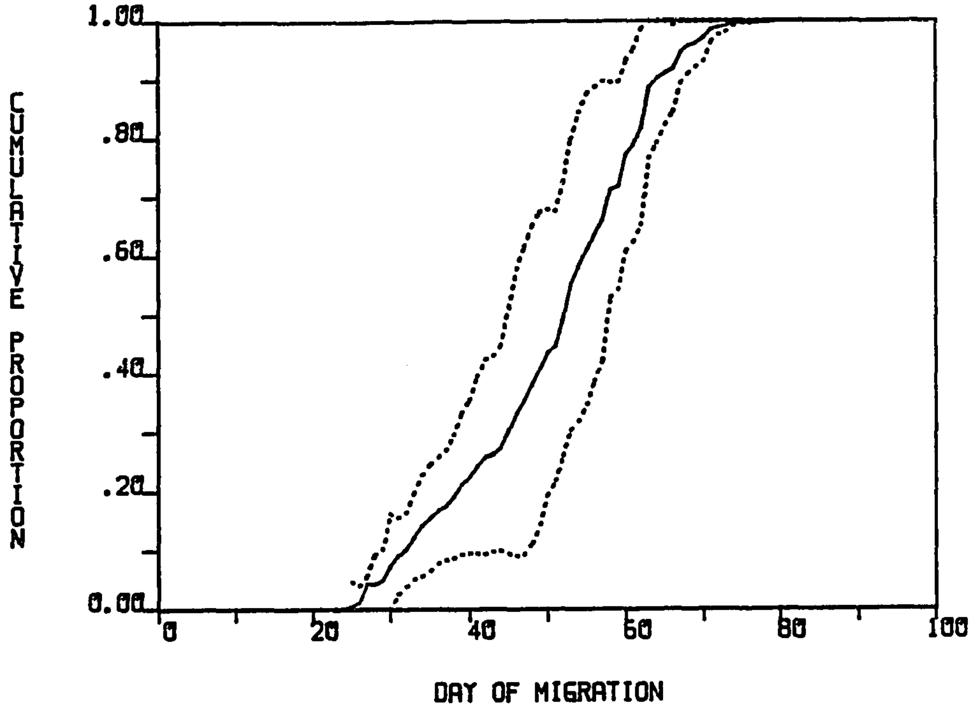


Figure 2. Eastern District, even-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

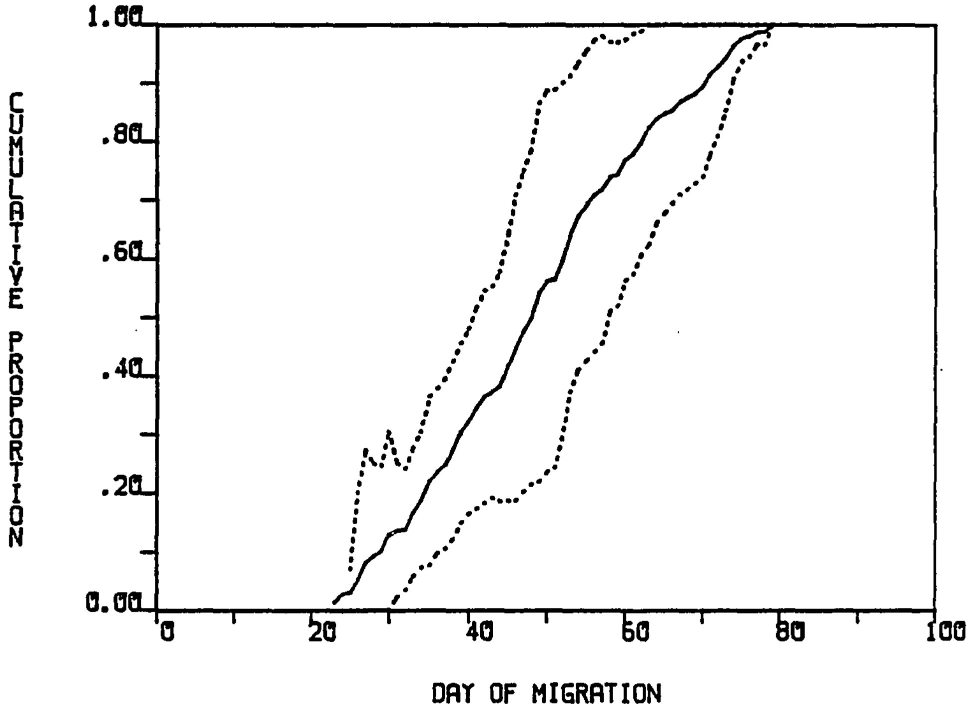


Figure 3. Northern District, even-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

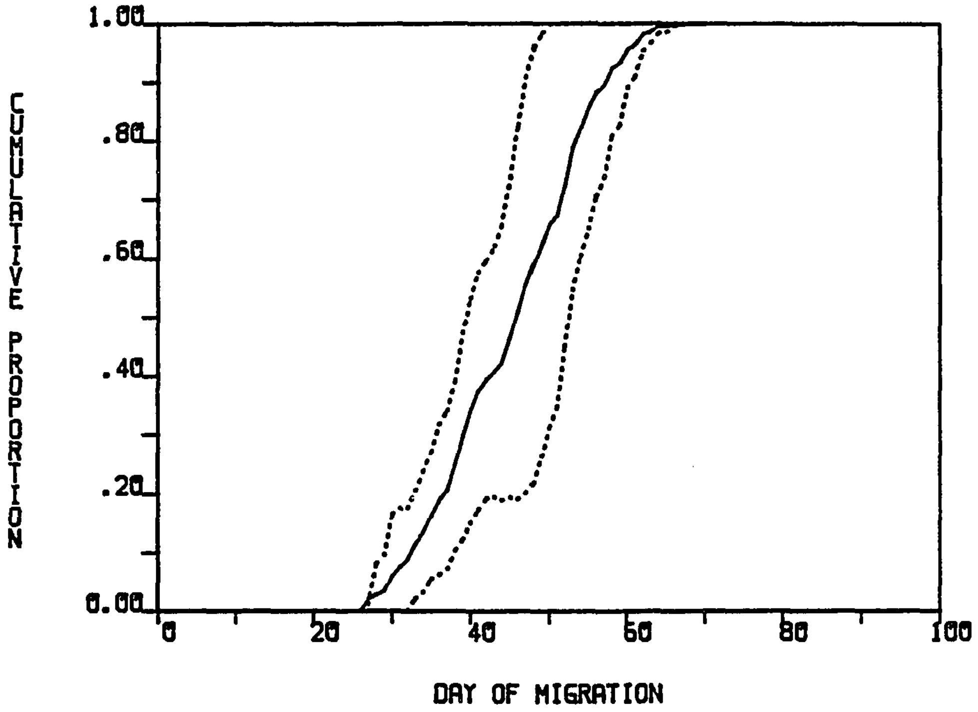


Figure 4. Northern District, even-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

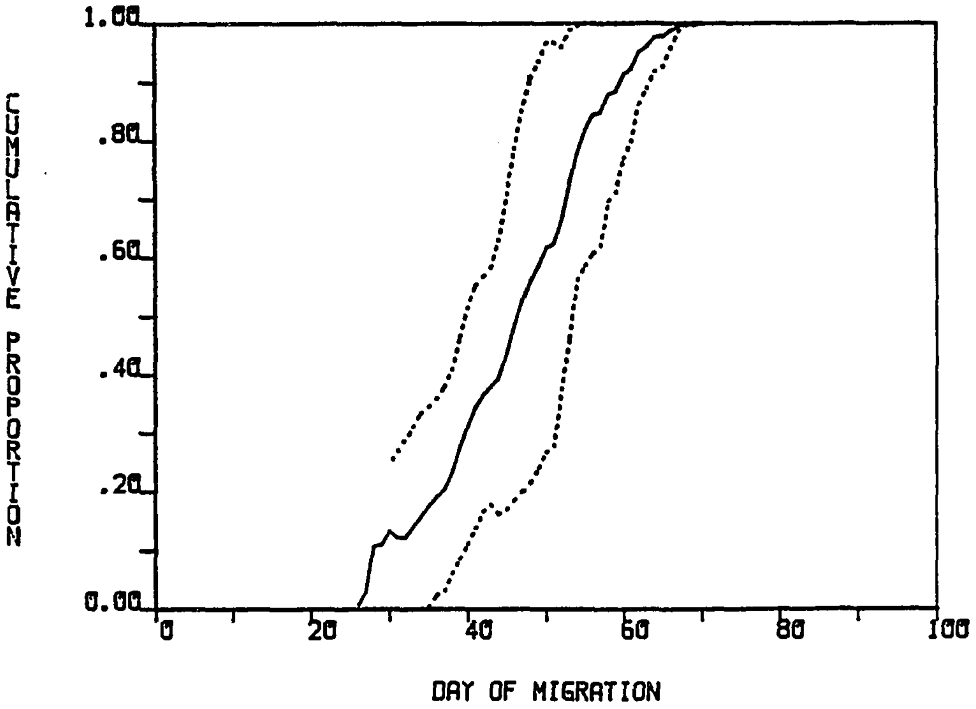


Figure 5. Coghill District, even-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

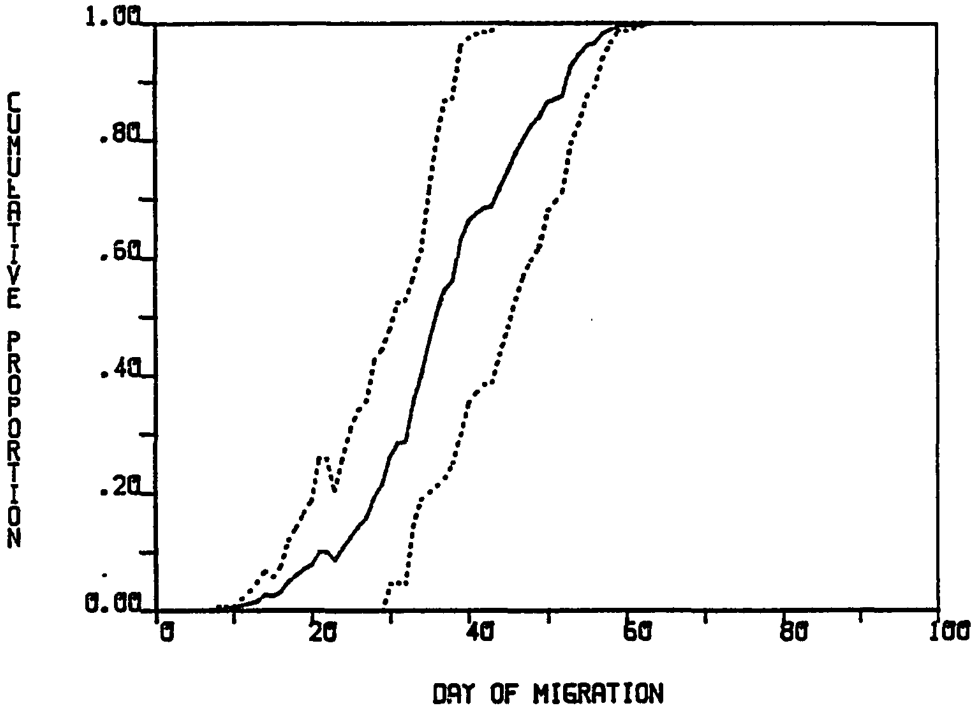


Figure 6. Coghill District, even-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

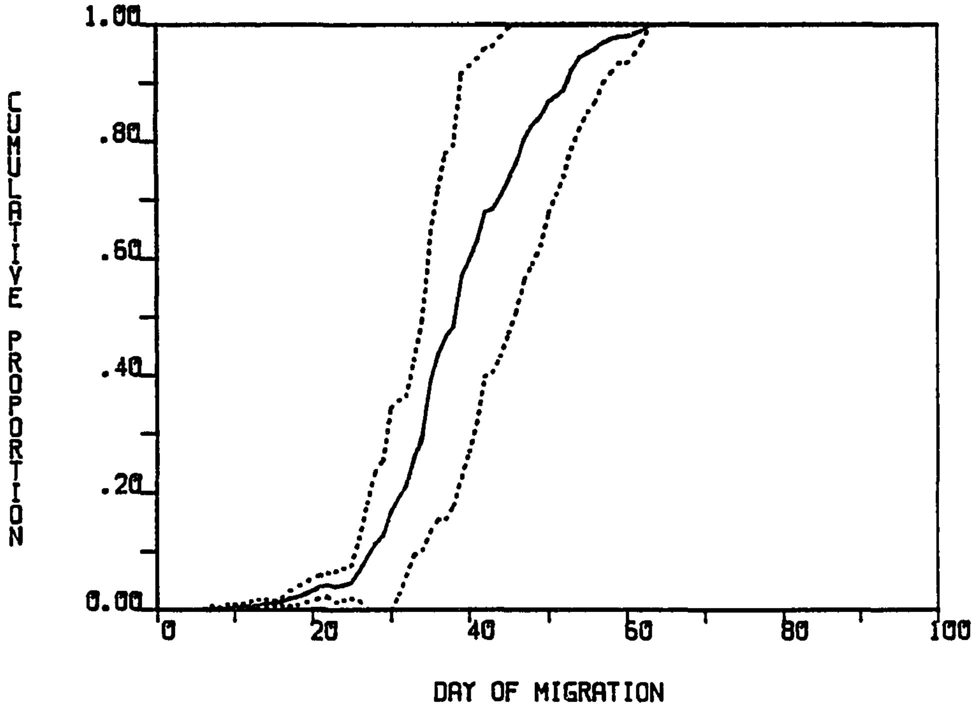


Figure 7. Northwestern District, even-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

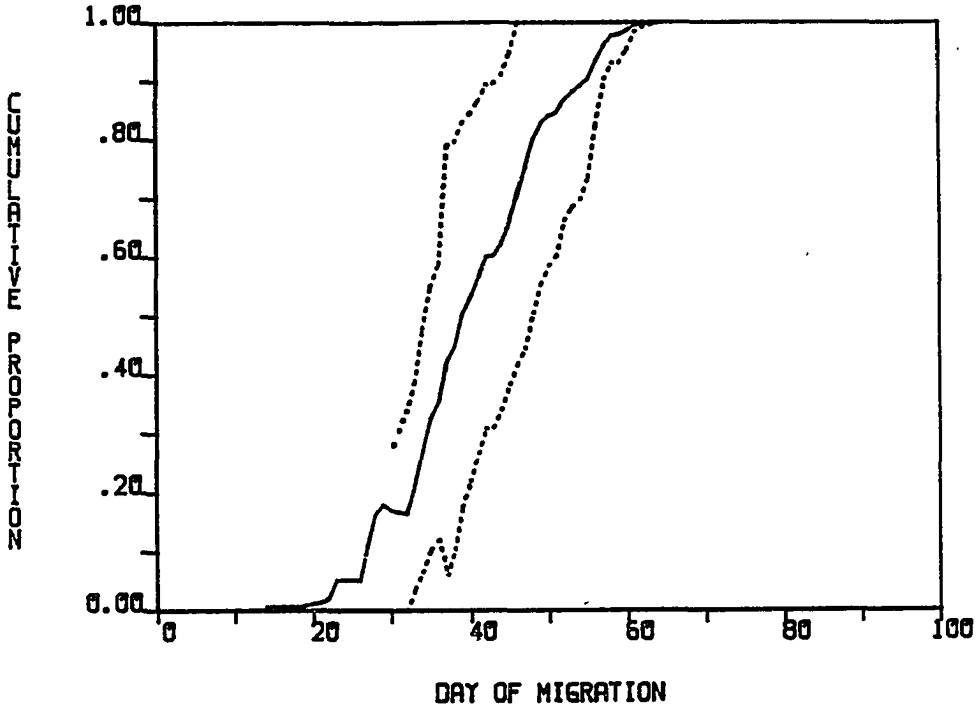


Figure 8. Northwestern District, even-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

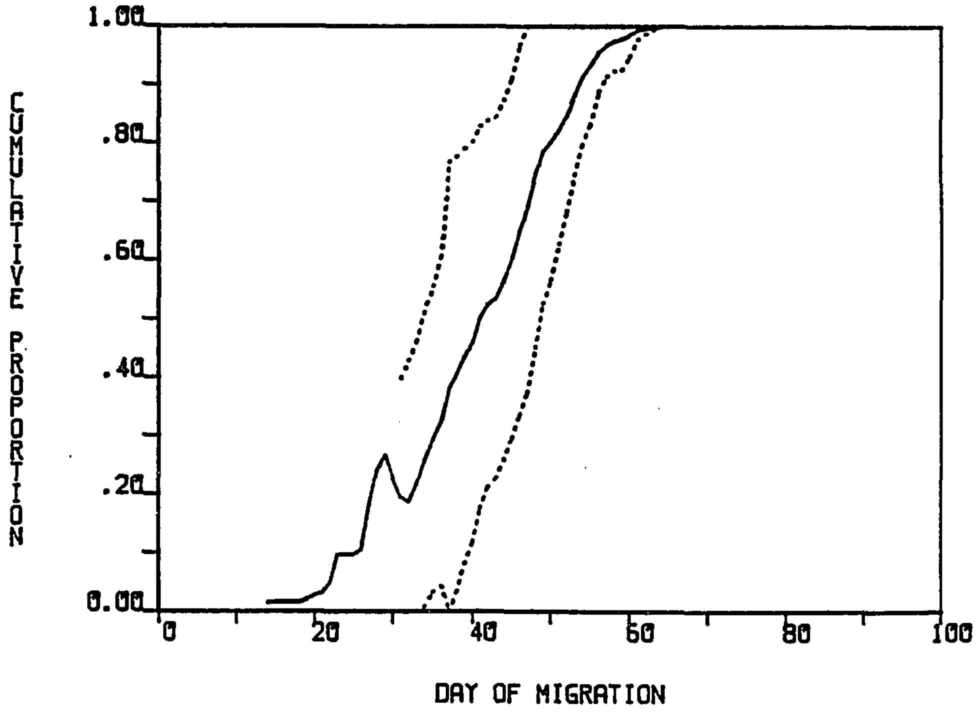


Figure 9. Southwestern District, even-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

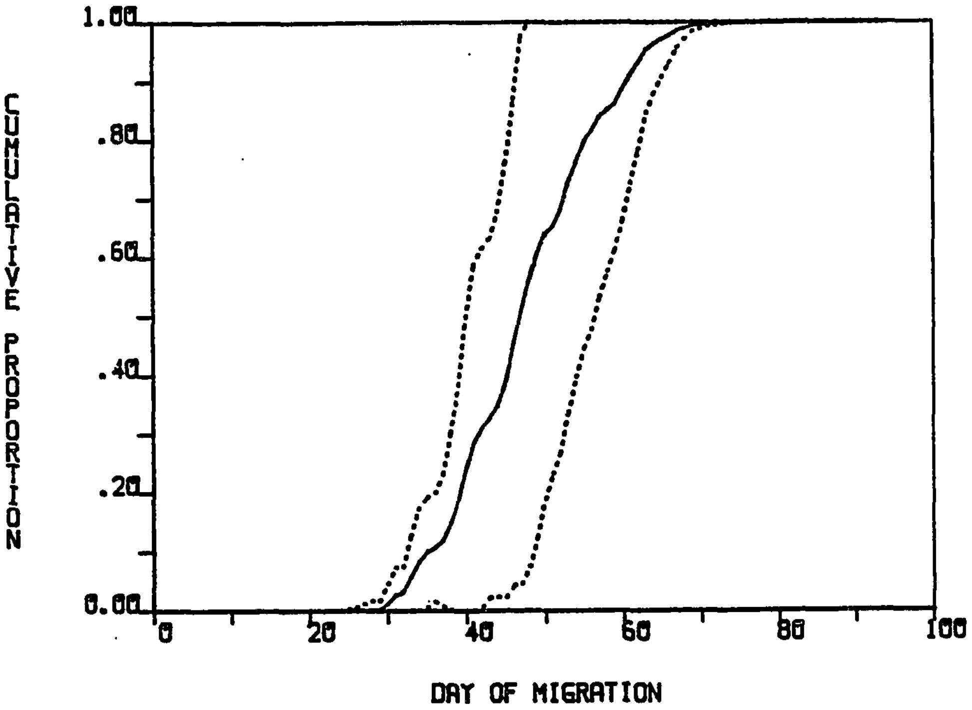


Figure 10. Southwestern District, even-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

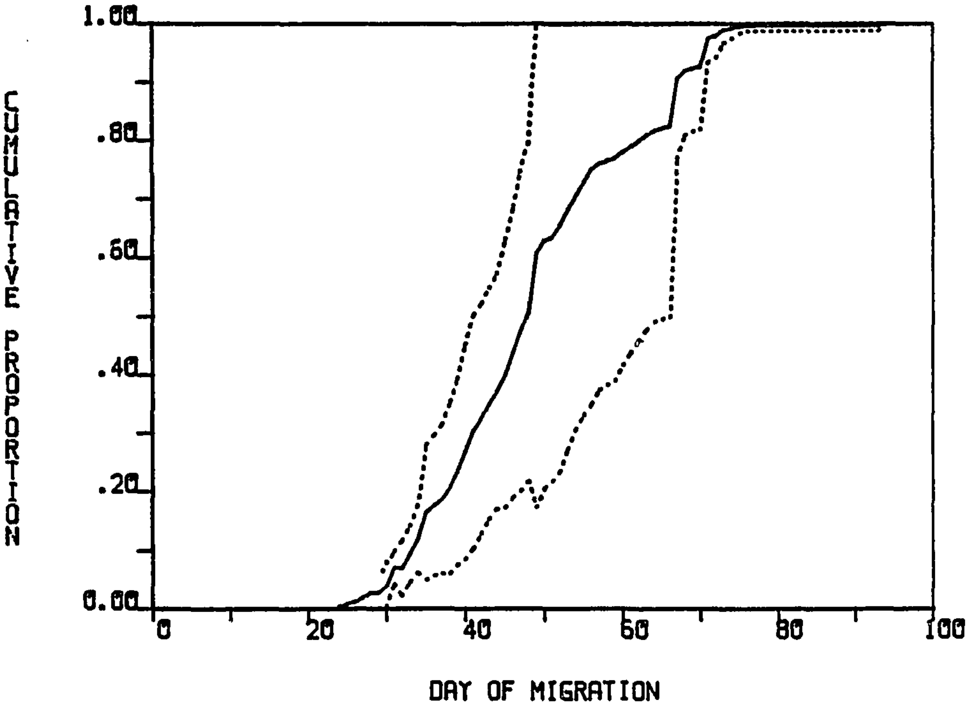


Figure 11. Southeastern District, even-year cycle. Average cumulative proportion of pink salmon catch. Construction of a 95% confidence interval was not possible.

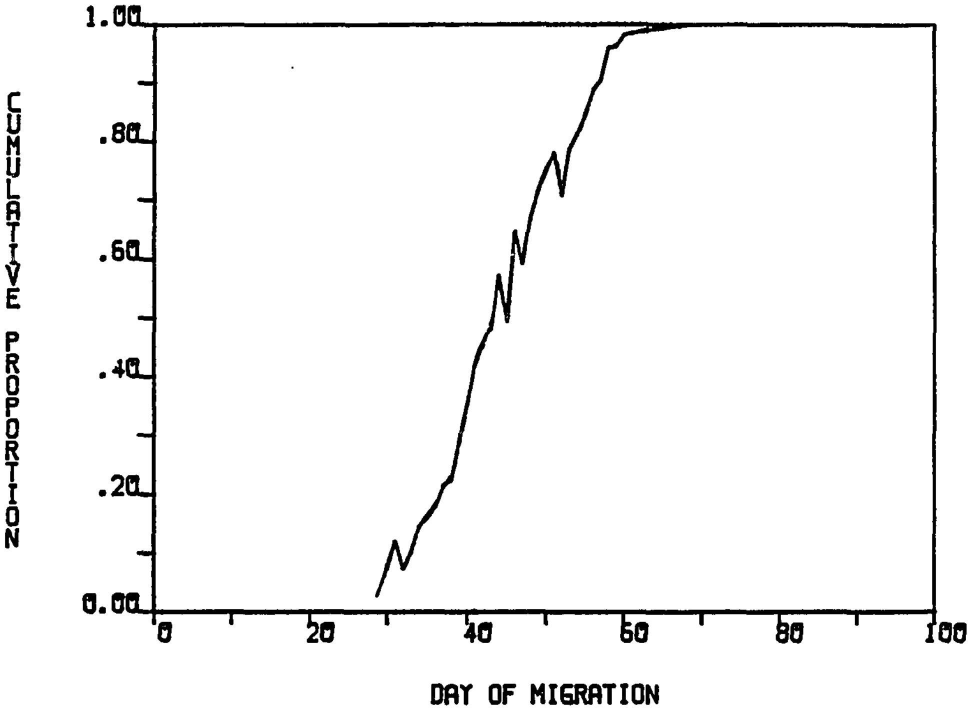


Figure 12. Southeastern District, even-year cycle. Average cumulative proportion of pink salmon CPUE. Construction of a 95% confidence interval was not possible.

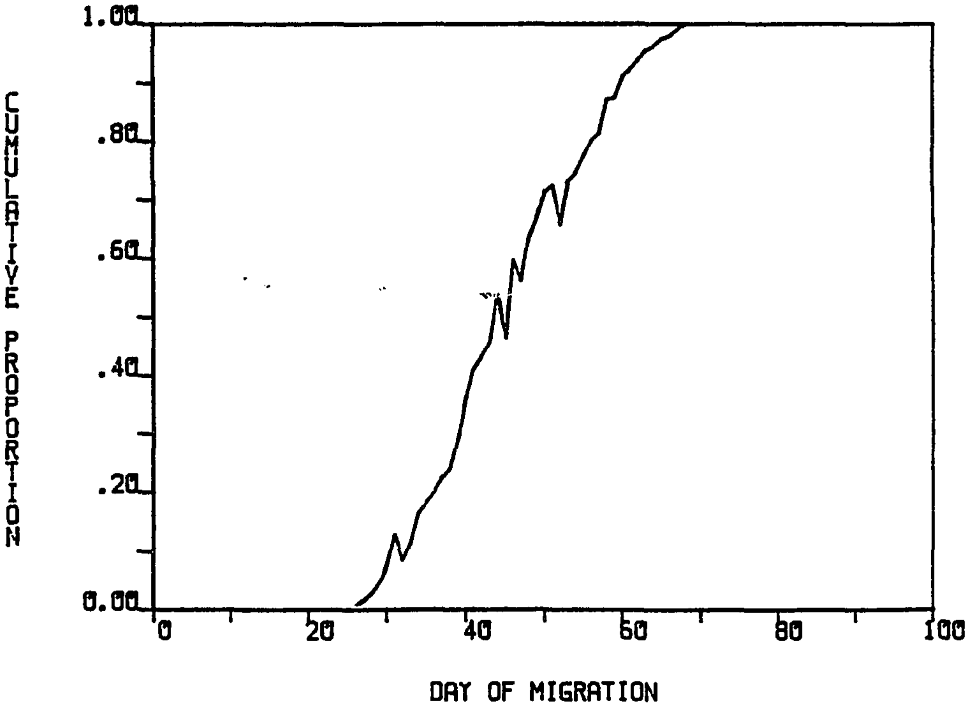


Figure 13. Eastern District, odd-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

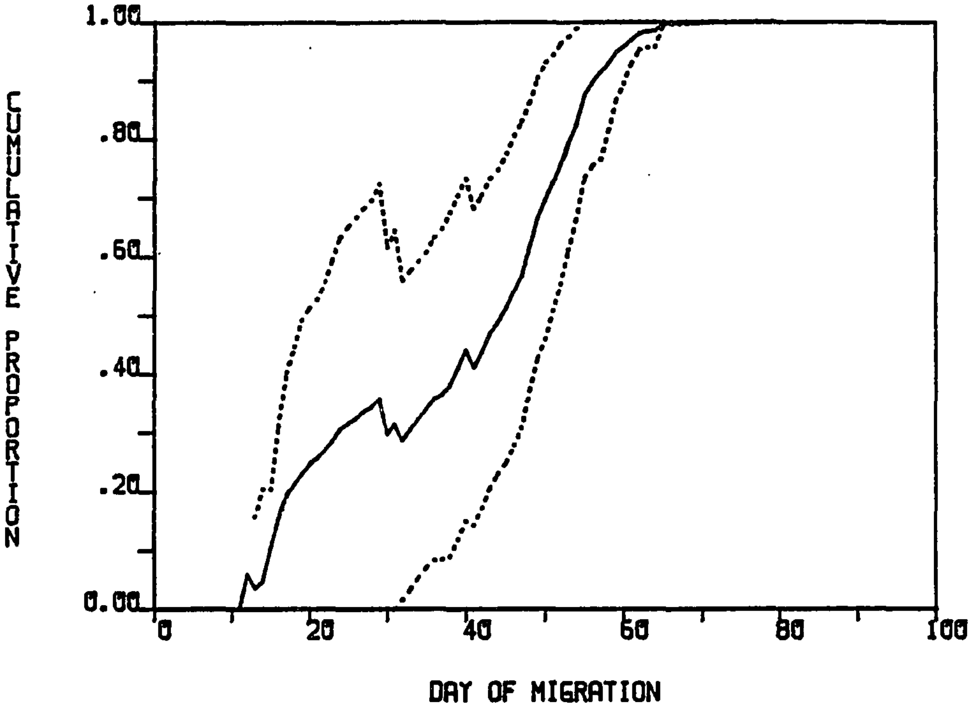


Figure 14. Eastern District, odd-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

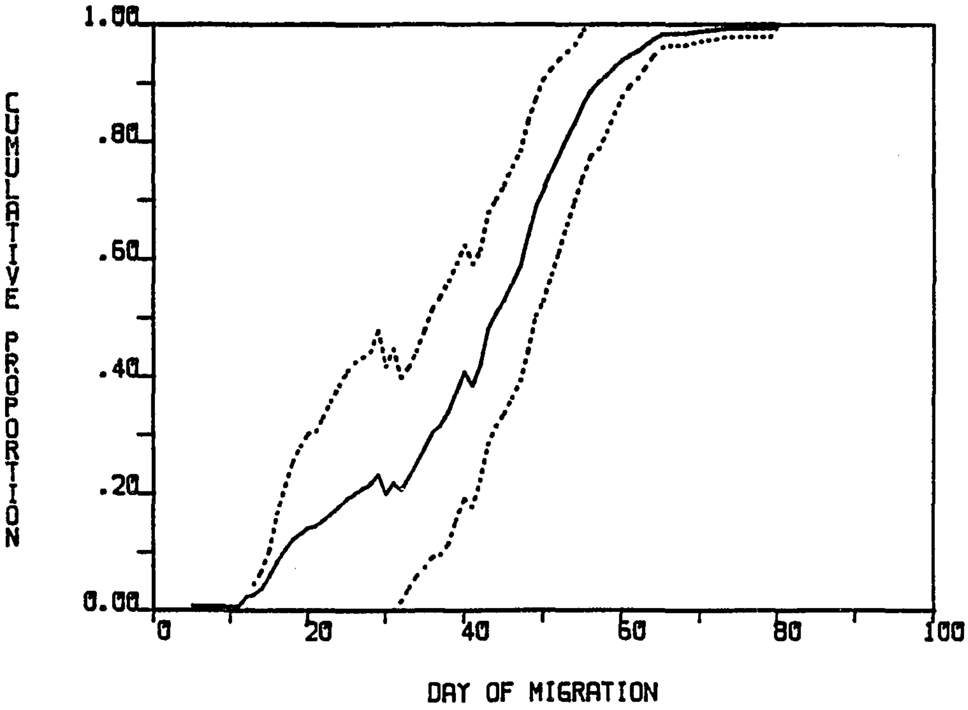


Figure 15. Northern District, odd-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

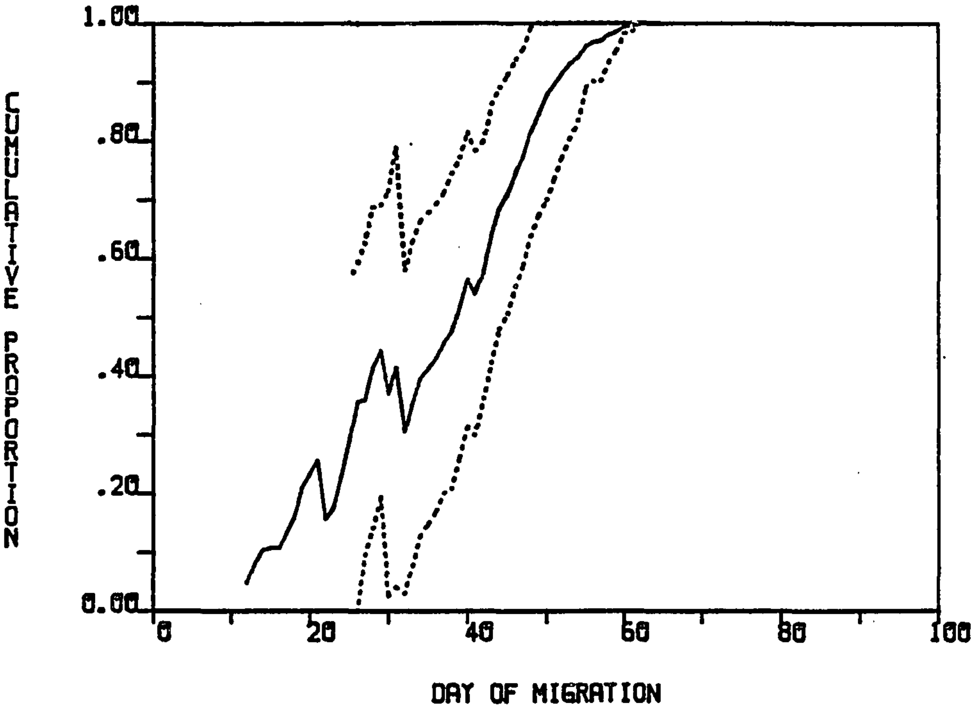


Figure 16. Northern District, odd-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

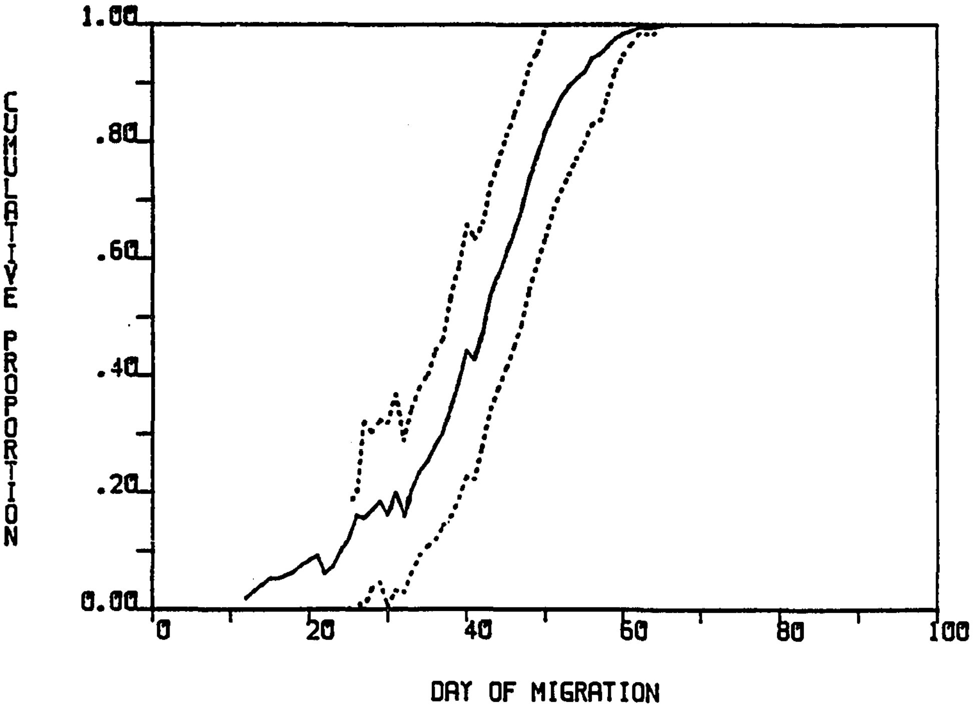


Figure 17. Coghill District, odd-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

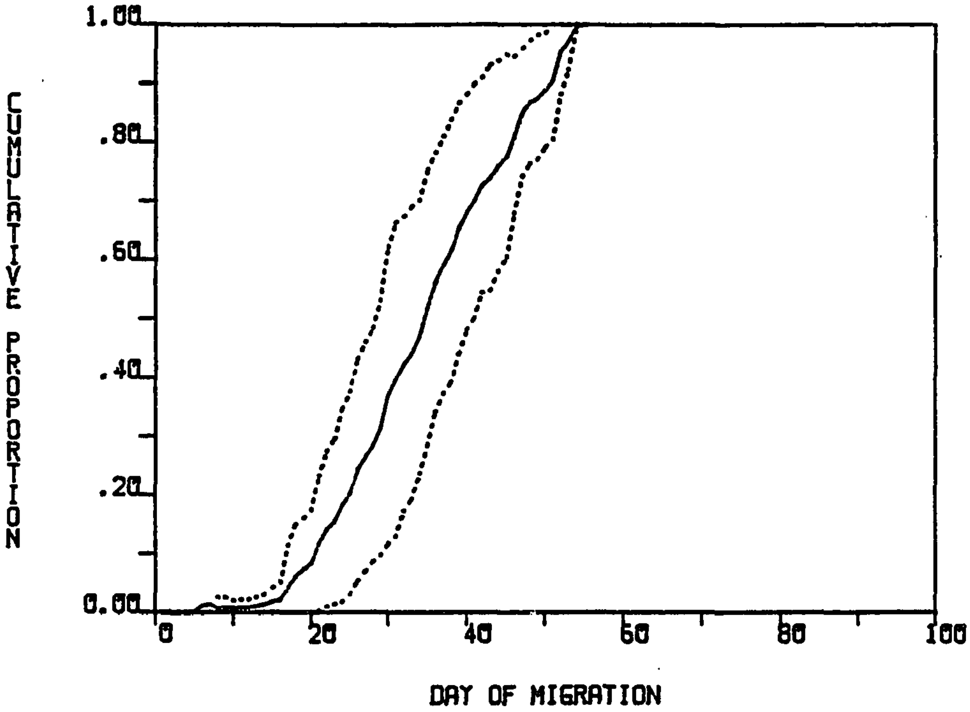


Figure 18. Coghill District, odd-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

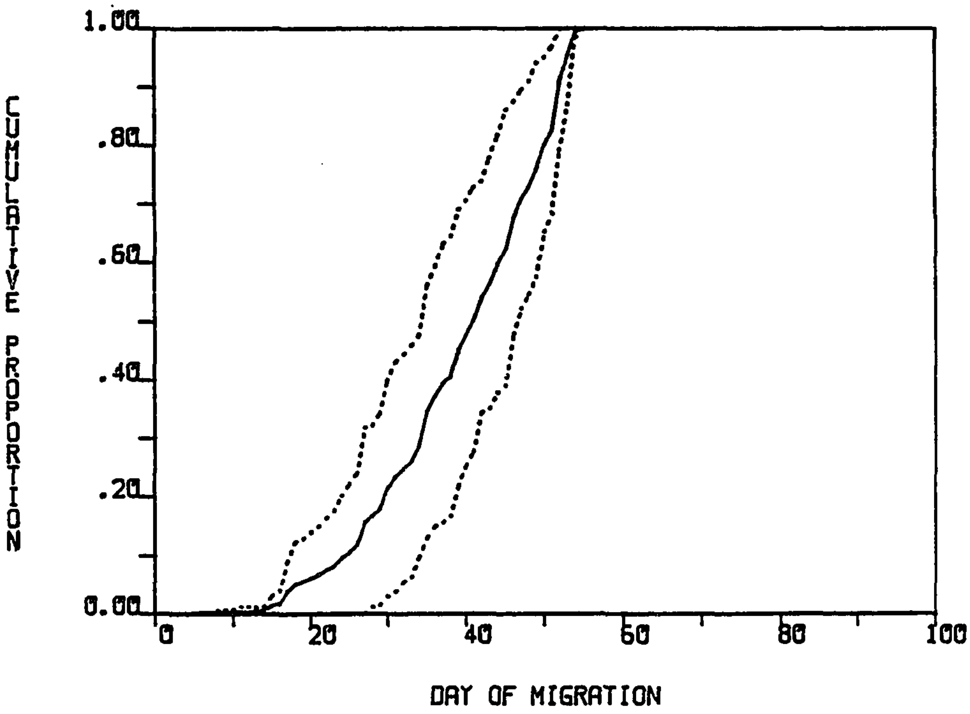


Figure 19. Northwestern District, odd-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

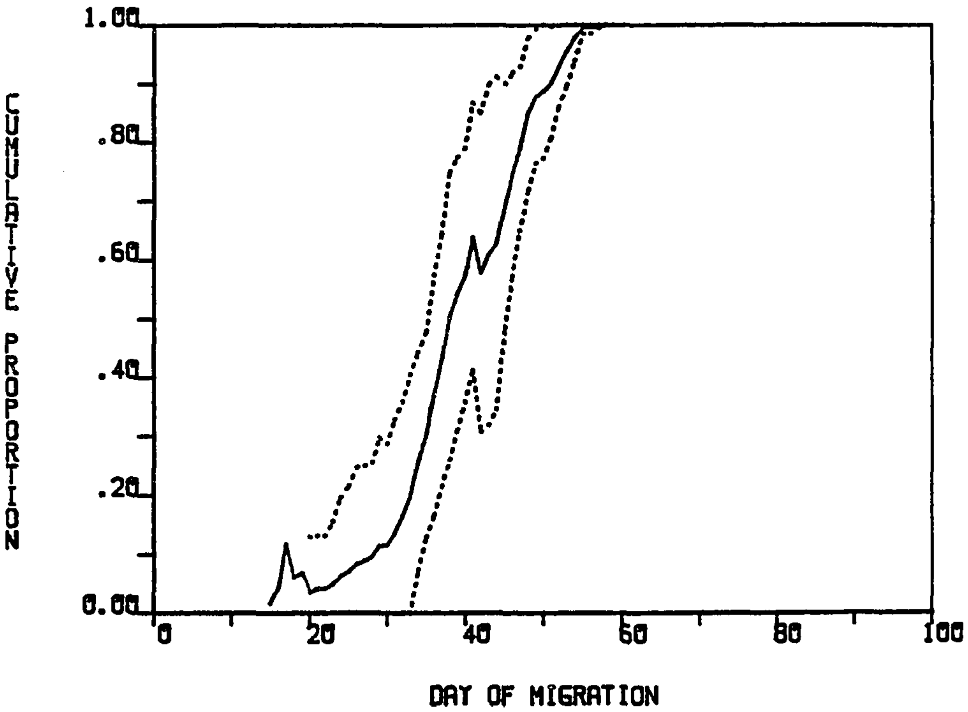


Figure 20. Northwestern District, odd-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

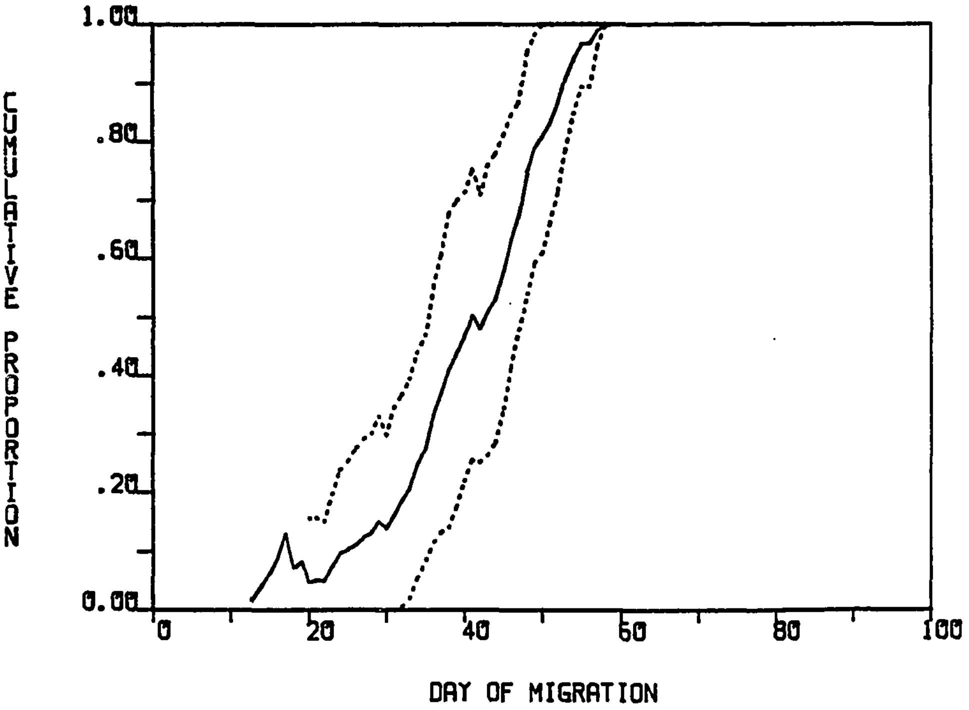


Figure 21. Southwestern District, odd-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

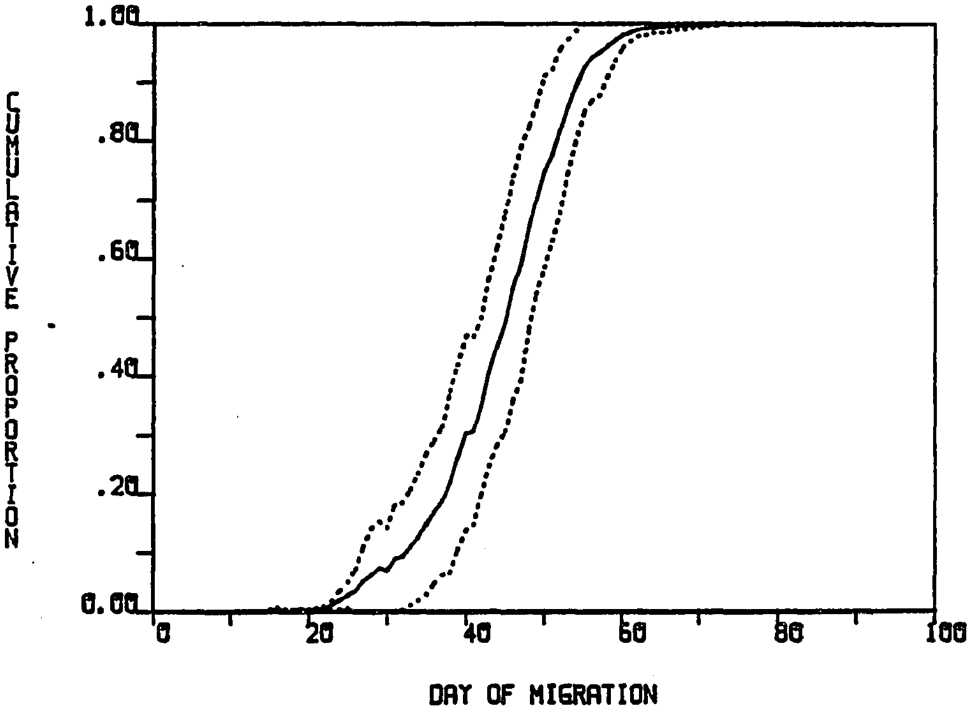


Figure 22. Southwestern District, odd-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

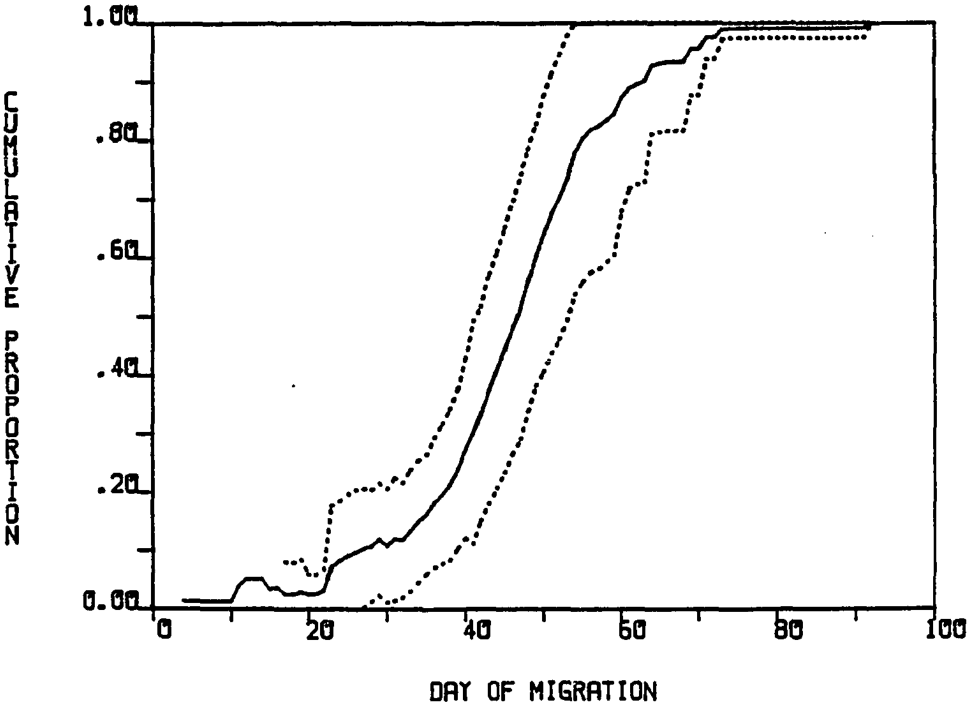


Figure 23. Montague District, odd-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

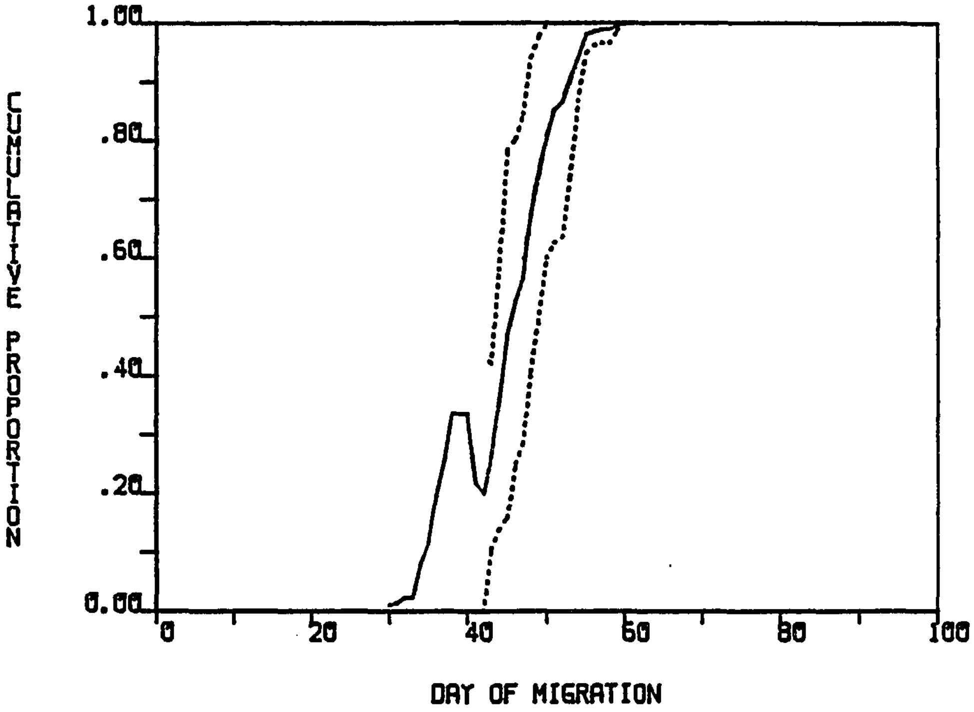


Figure 24. Montague District, odd-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

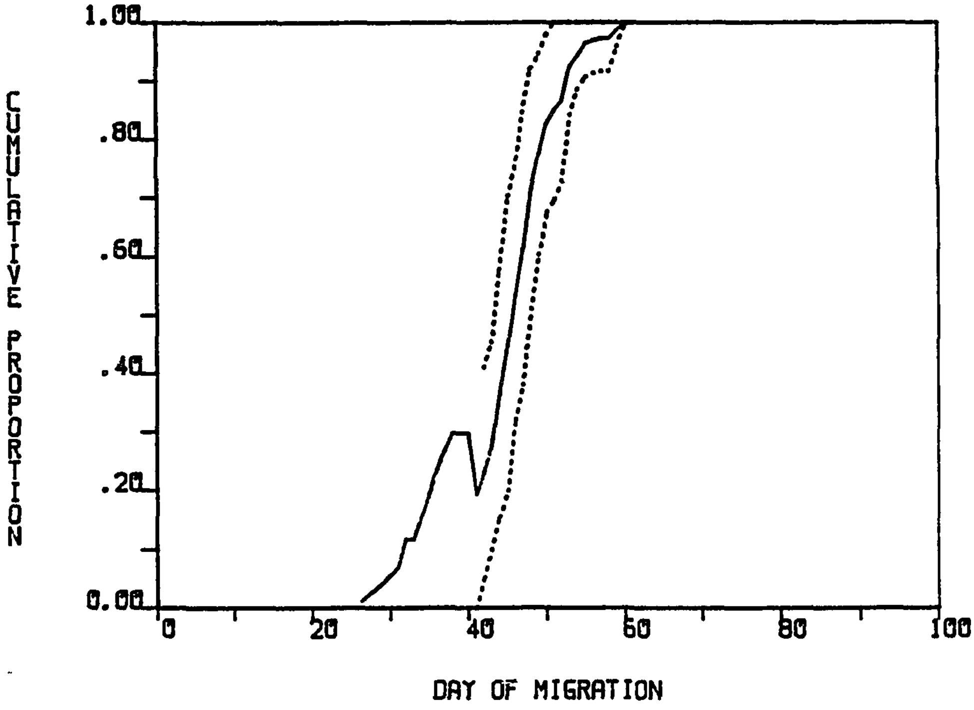


Figure 25. Southeastern District, odd-year cycle. Average cumulative proportion of pink salmon catch, and the upper and lower bound for its 95% confidence interval.

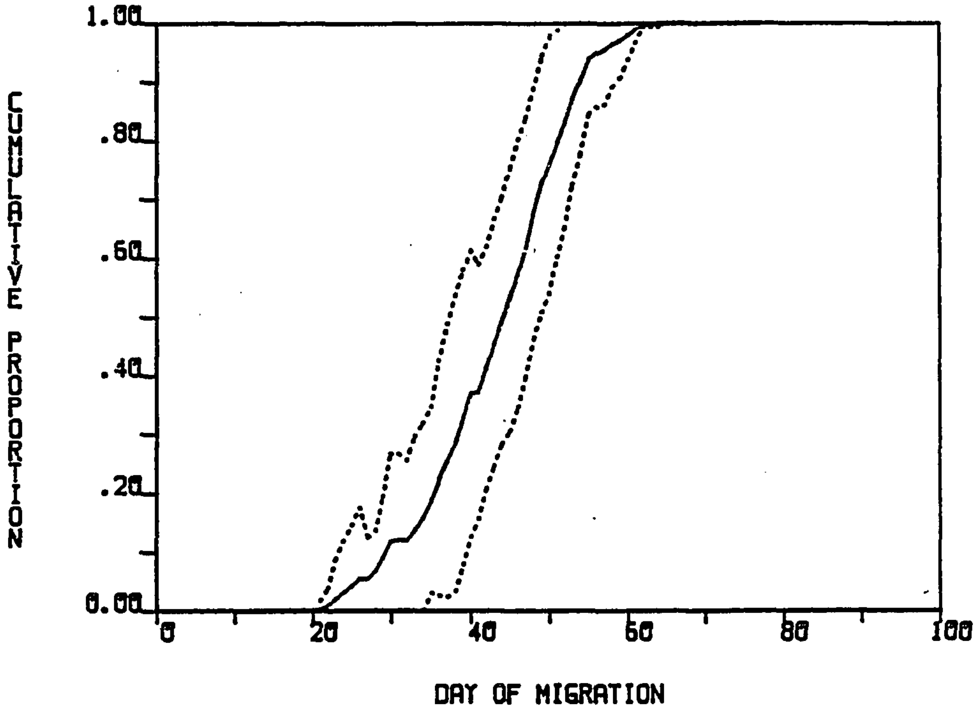


Figure 26. Southeastern District, odd-year cycle. Average cumulative proportion of pink salmon CPUE, and the upper and lower bound for its 95% confidence interval.

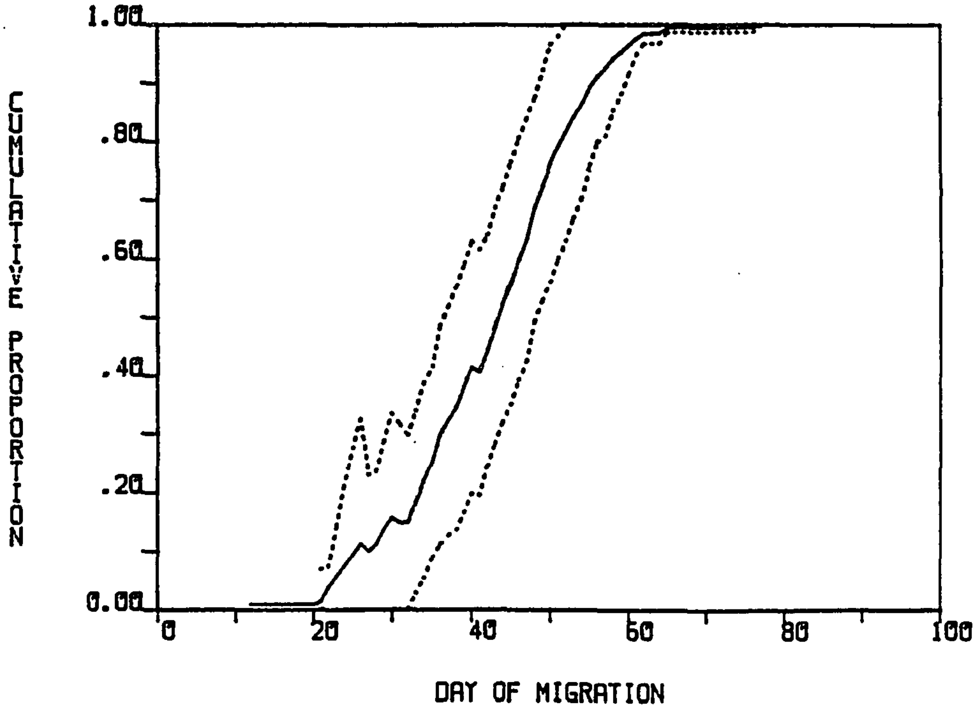


Figure 27. Eastern District, even-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

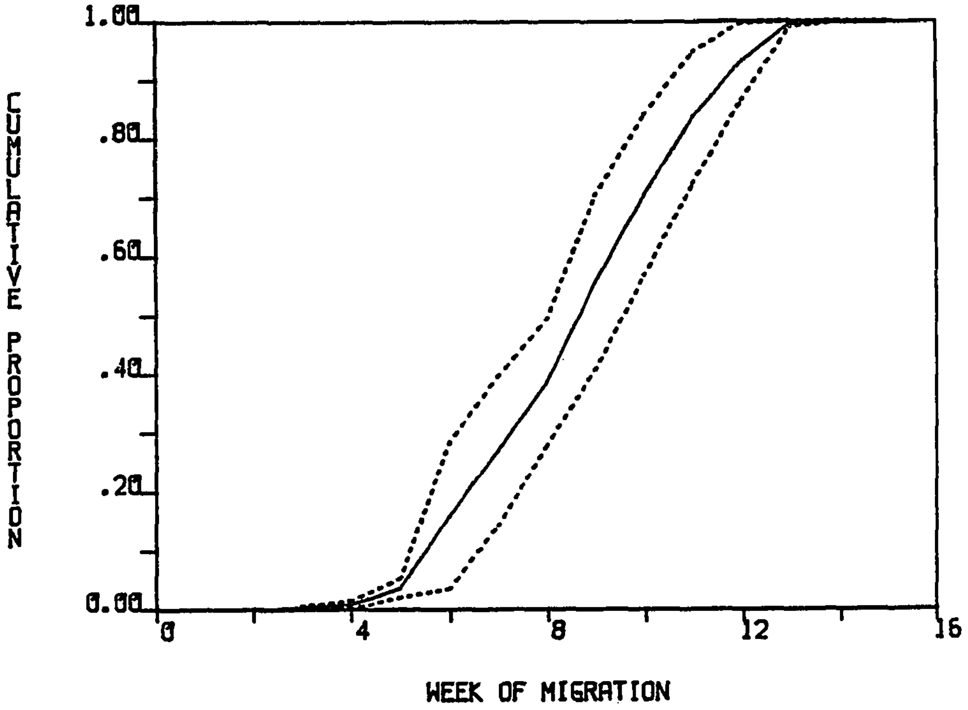


Figure 28. Eastern District, odd-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

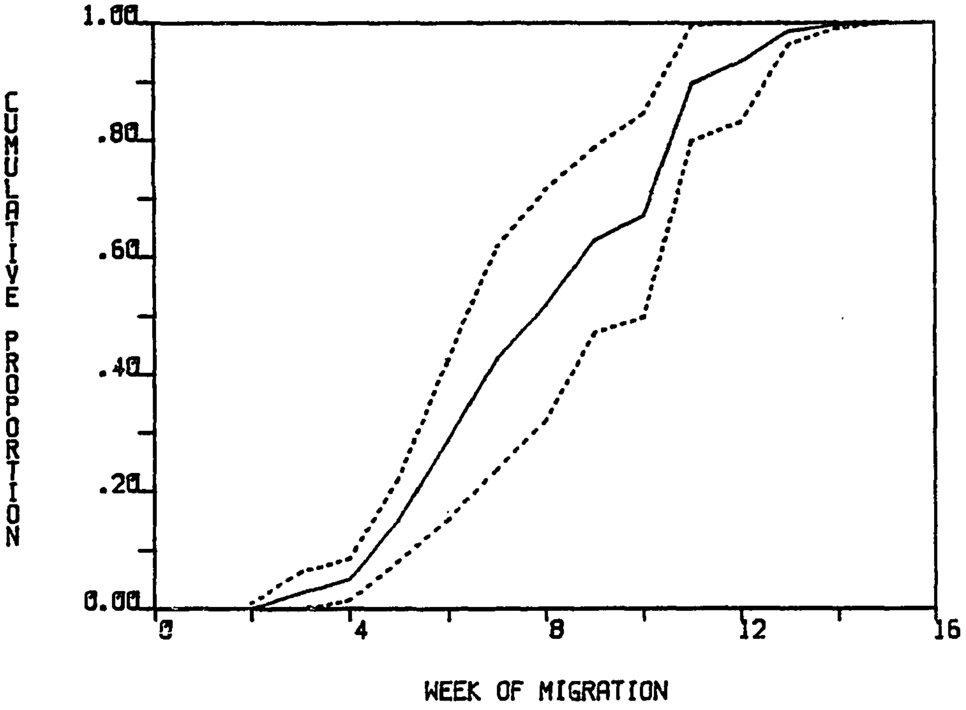


Figure 29. Northern District, even-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

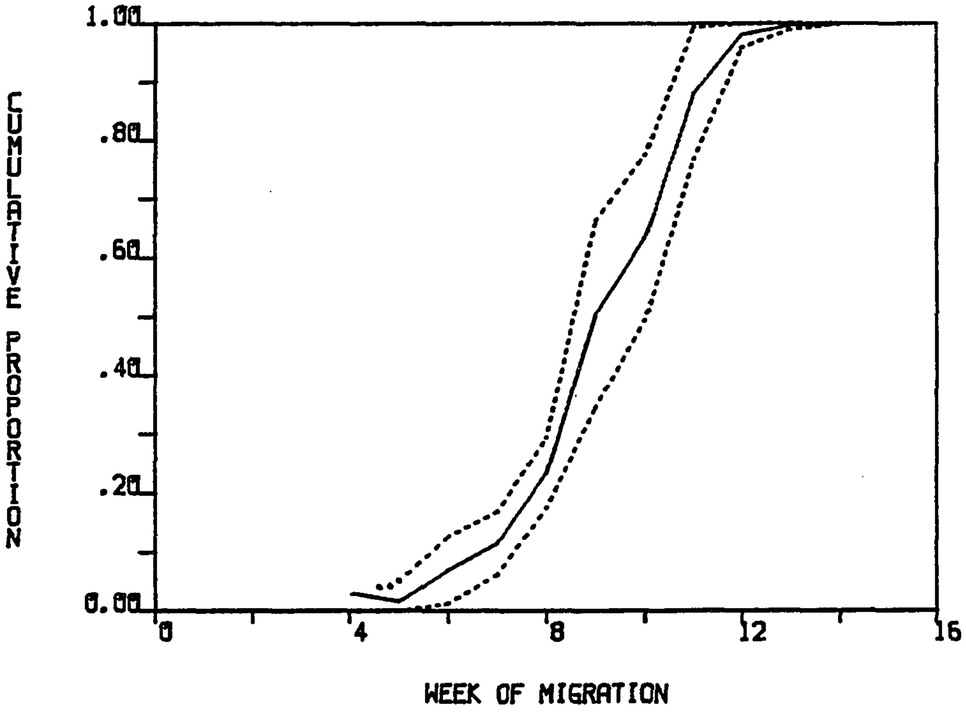


Figure 30. Northern District, odd-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

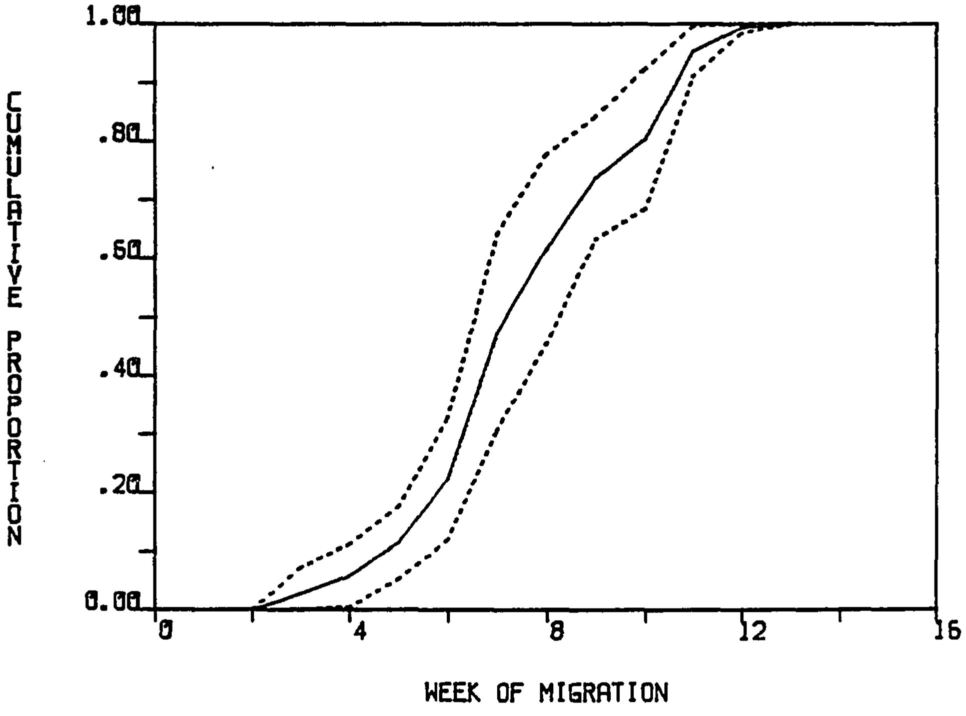


Figure 31. Coghill District, even-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

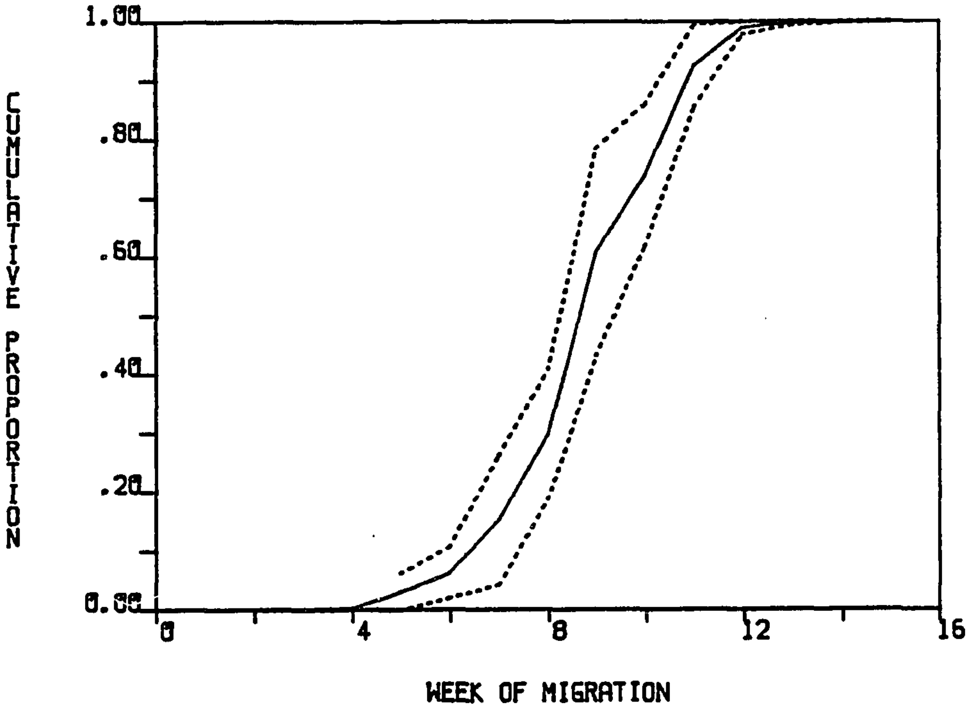


Figure 32. Coghill District, odd-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

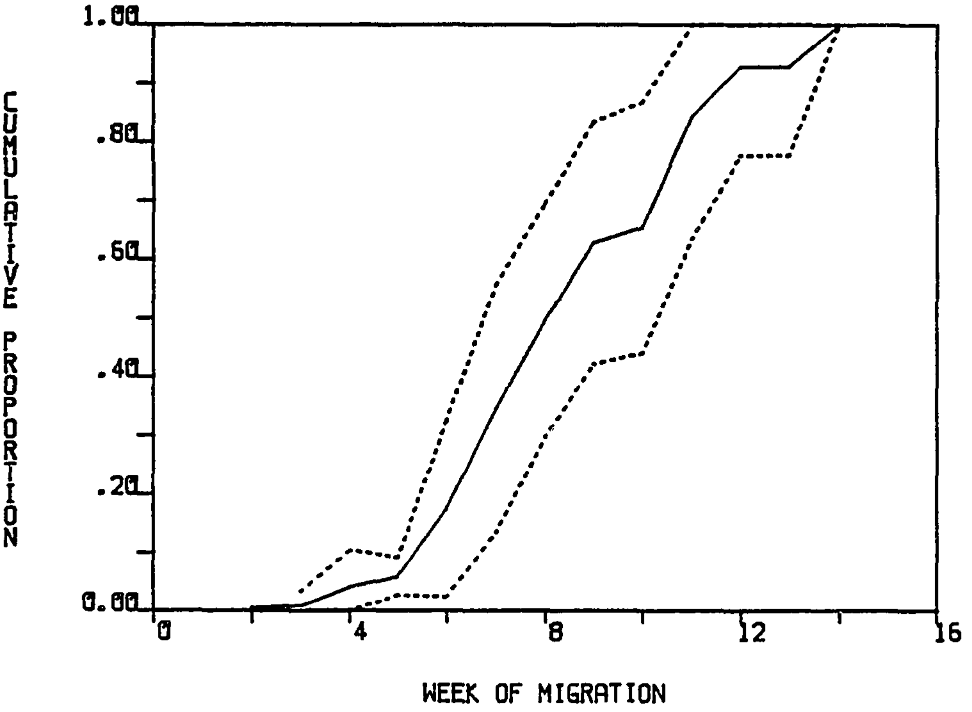


Figure 33. Northwestern District, even-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

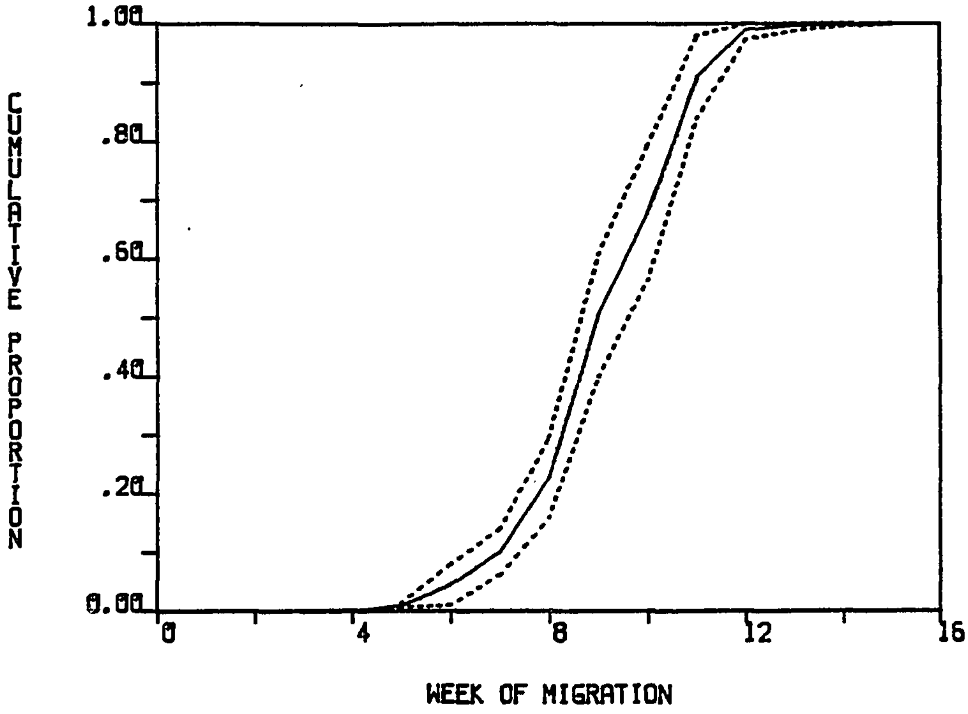


Figure 34. Northwestern District, odd-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

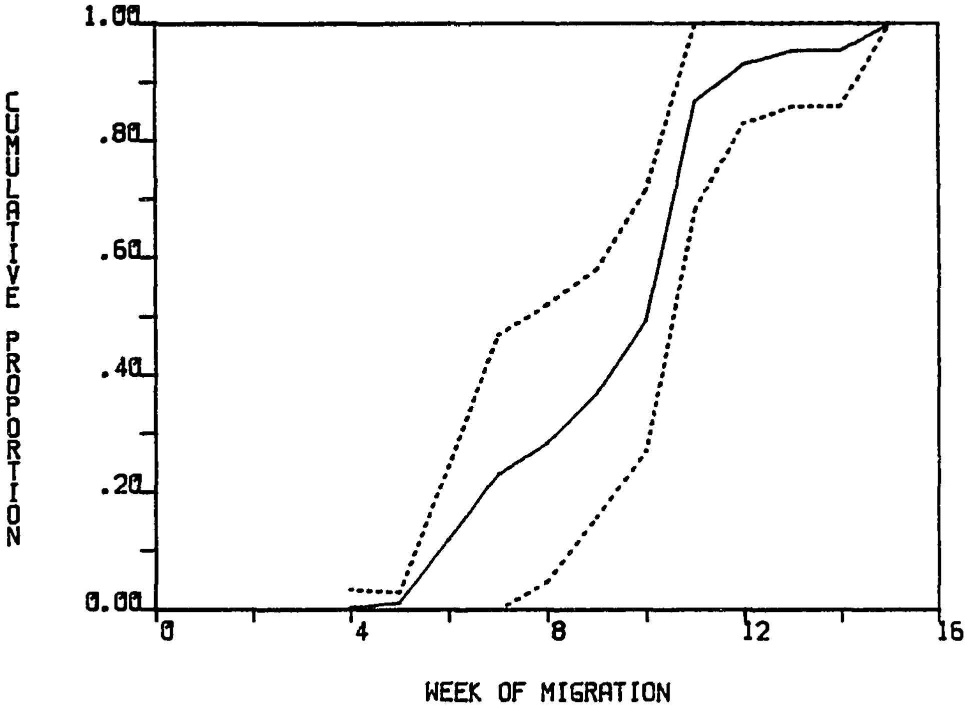


Figure 35. Eshamy District, even-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

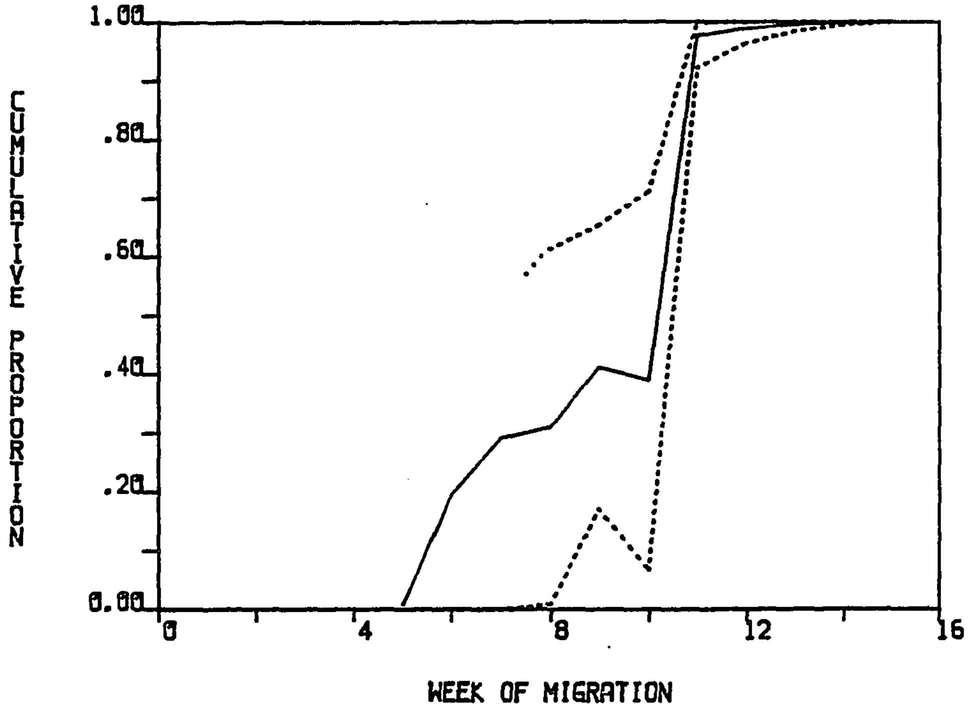


Figure 36. Eshamy District, odd-year cycle. Average cumulative proportion of pink salmon escapement. Construction of a 95% confidence interval was not possible.

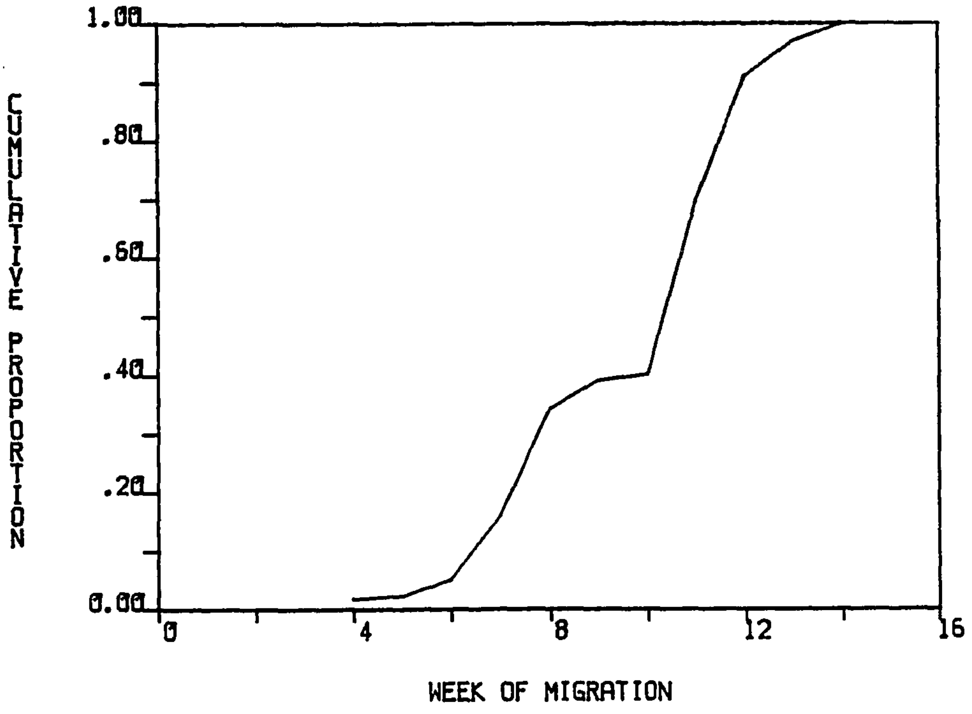


Figure 37. Southwestern District, even-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

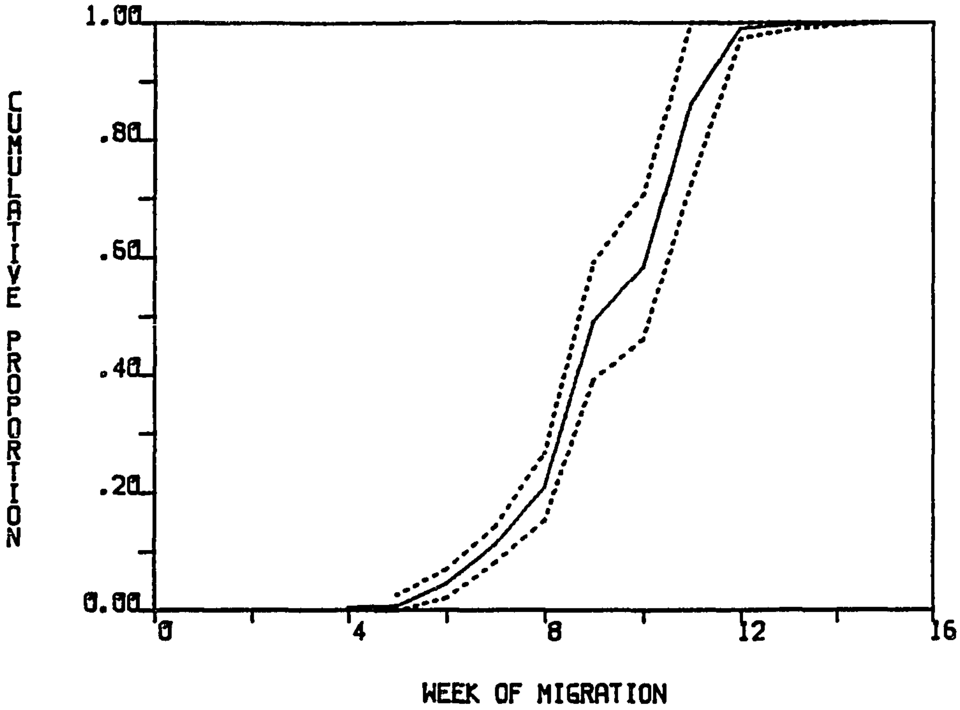


Figure 38. Southwestern District, odd-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

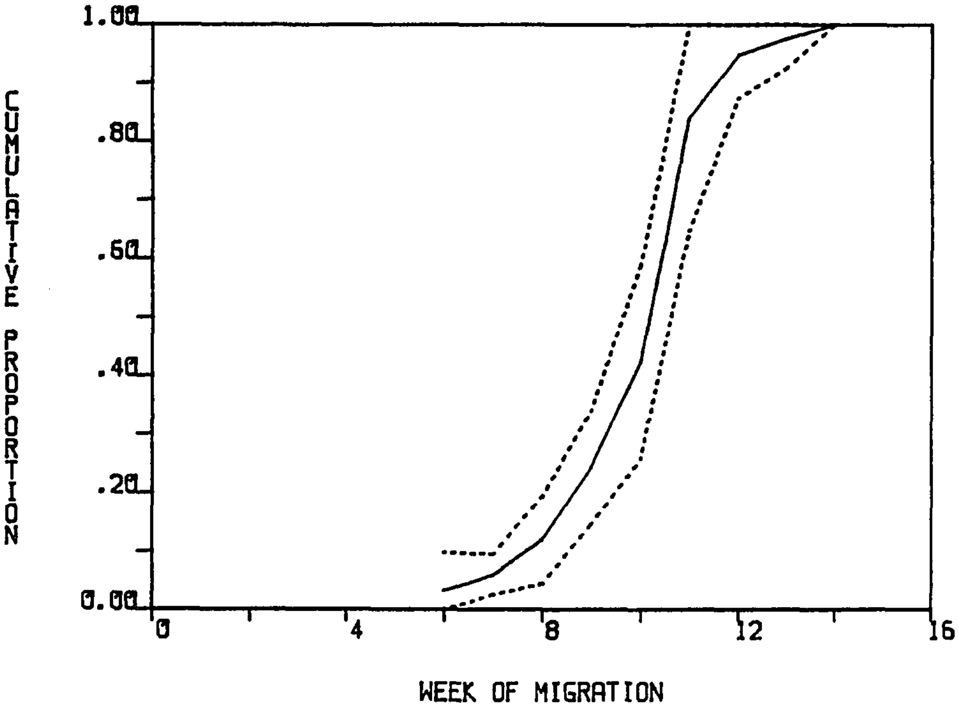


Figure 39. Montague District, even-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

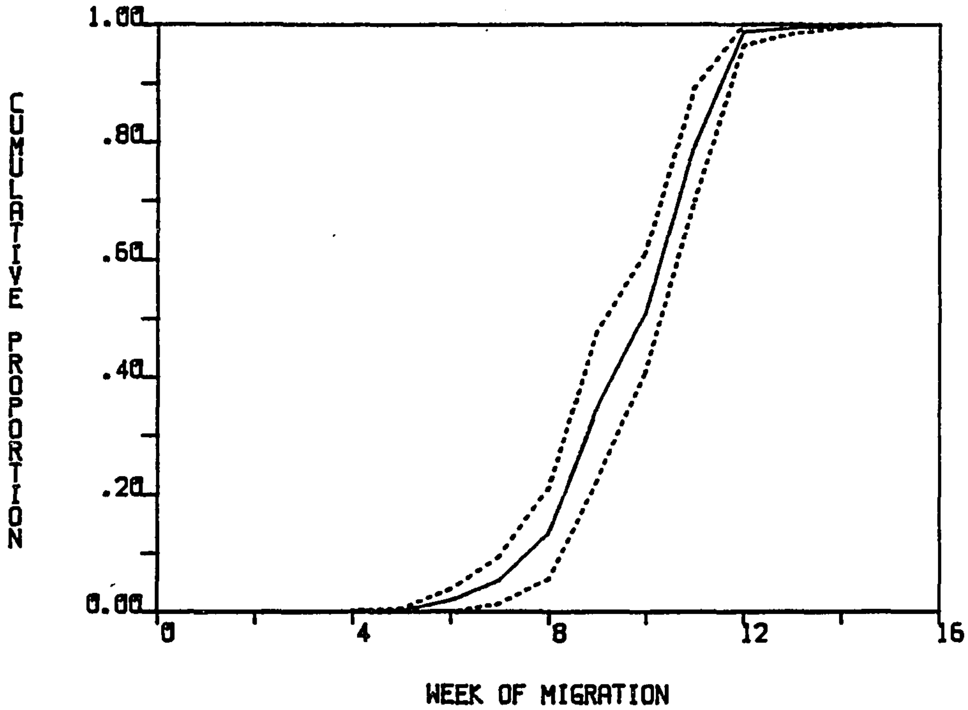


Figure 40. Montague District, odd-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

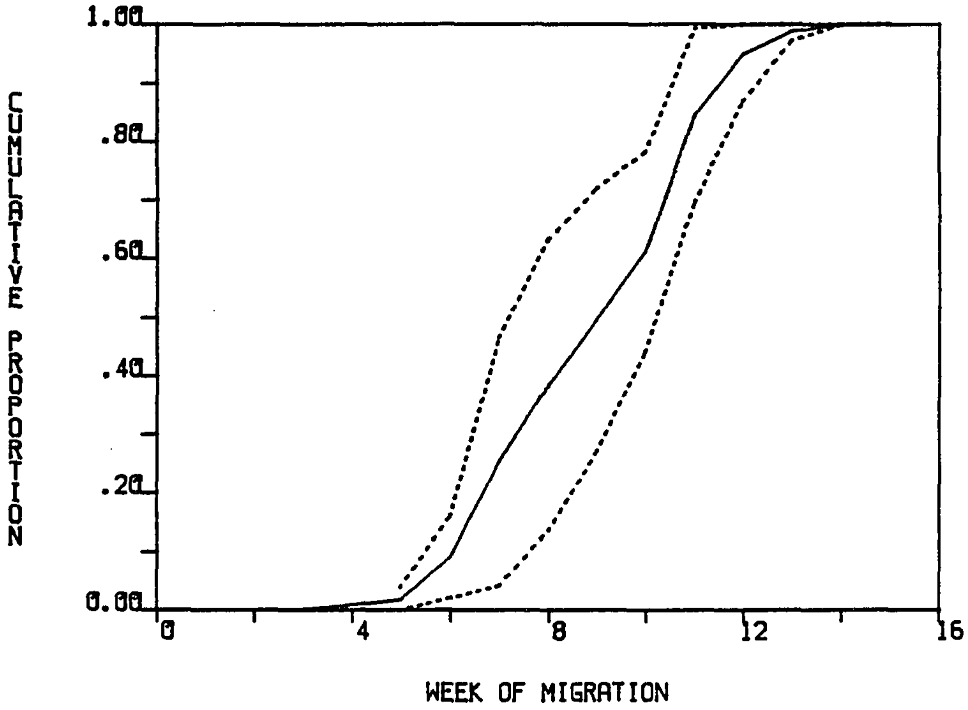


Figure 41. Southeastern District, even-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.

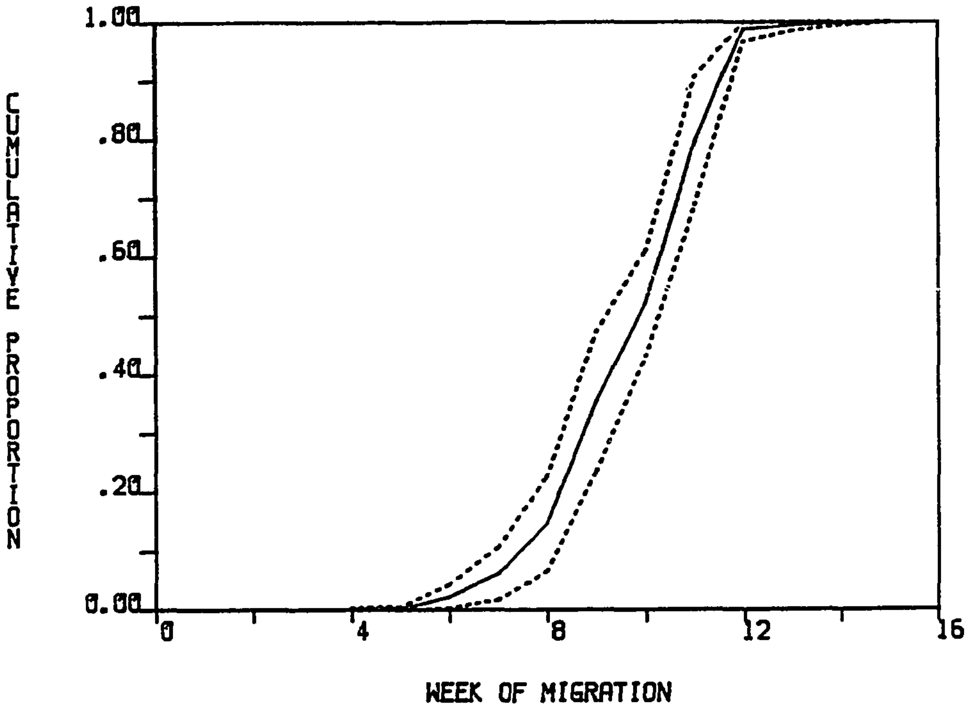
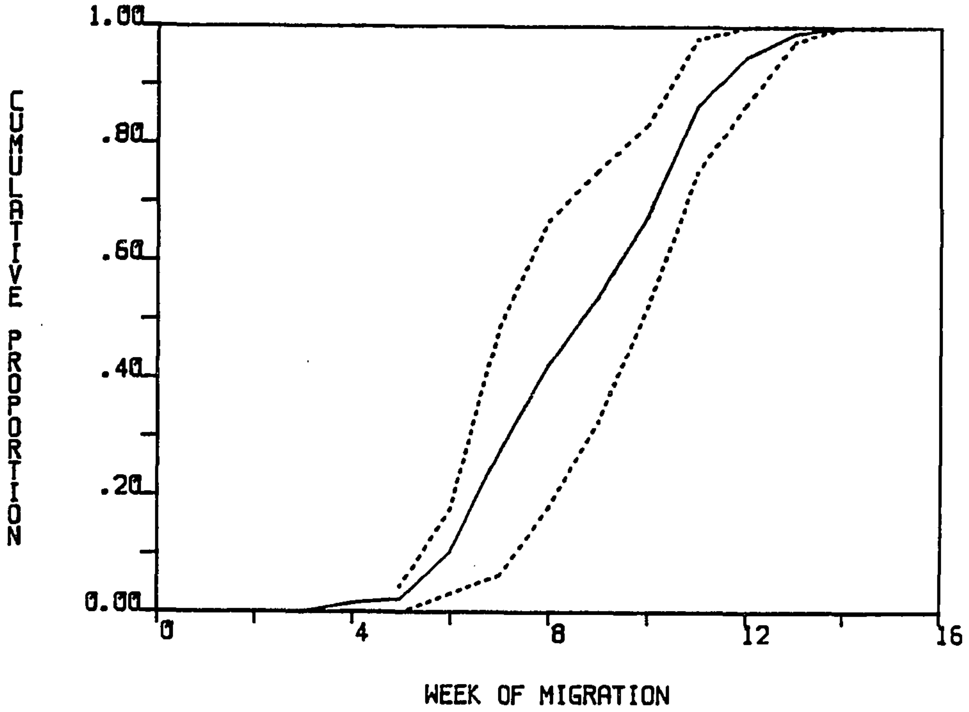


Figure 42. Southeastern District, odd-year cycle. Average cumulative proportion of pink salmon escapement, and the upper and lower bound for its 95% confidence interval.



APPENDIX B

AVERAGE HISTORICAL TIME DENSITIES
FOR ALL MANAGEMENT DISTRICTS

Table 1. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1976 - 1982. Eastern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
23	705	1	.0006	0	0	1	.0006	0	0
24	706	1	.0006	0	0	1	.0012	0	0
25	707	2	.0054	96	0.52	2	.0060	76	0.46
26	708	2	.0059	24	0.14	2	.0120	26	0.31
27	709	2	.0320	84	2.69	2	.0440	54	2.37
28	710	3	.0143	113	1.62	3	.0436	46	2.02
29	711	2	.0111	99	1.10	3	.0510	40	2.07
30	712	3	.0229	66	1.52	3	.0739	48	3.56
31	713	4	.0365	90	3.30	4	.0920	44	4.06
32	714	5	.0283	69	1.97	5	.1019	49	5.06
33	715	4	.0286	52	1.49	5	.1249	47	5.93
34	716	4	.0232	77	1.81	5	.1435	48	6.95
35	717	5	.0136	79	1.09	5	.1572	46	7.35
36	718	4	.0148	85	1.26	5	.1691	43	7.27
37	719	3	.0128	61	0.79	5	.1768	42	7.54
38	720	4	.0194	53	1.04	5	.1924	43	8.42
39	721	5	.0214	68	1.46	5	.2139	45	9.64
40	722	4	.0156	59	0.93	5	.2264	46	10.49
41	723	4	.0239	77	1.86	5	.2455	49	12.17
42	724	3	.0237	80	1.91	5	.2598	51	13.38
43	725	2	.0141	93	1.32	5	.2654	50	13.39
44	726	1	.0458	0	0	5	.2746	51	14.07
45	727	3	.0513	59	3.07	5	.3054	55	16.95
46	728	3	.0494	39	1.93	5	.3351	58	19.67
47	729	4	.0264	78	2.07	5	.3562	59	21.10
48	730	4	.0332	28	0.93	5	.3828	56	21.72
49	731	4	.0346	54	1.89	5	.4106	51	21.34
50	801	3	.0447	71	3.20	5	.4374	44	19.52
51	802	1	.0533	0	0	5	.4481	41	18.37
52	803	3	.0766	57	4.38	5	.4941	37	18.71
53	804	4	.0732	60	4.42	5	.5527	36	19.93
54	805	4	.0366	66	2.44	5	.5820	36	21.09
55	806	3	.0515	20	1.07	5	.6129	34	21.33
56	807	3	.0420	67	2.83	5	.6381	31	20.07
57	808	2	.0590	21	1.26	5	.6617	28	19.05
58	809	2	.1289	51	6.65	5	.7133	20	14.69
59	810	1	.0323	0	0	5	.7197	19	14.22
60	811	3	.0876	55	4.83	5	.7723	16	13.03
61	812	2	.0425	59	2.52	5	.7893	16	13.18
62	813	3	.0525	44	2.31	5	.8208	16	13.45
63	814	3	.1112	91	10.20	5	.8876	10	9.68
64	815	3	.0250	86	2.15	5	.9026	9	8.81
65	816	2	.0245	99	2.43	5	.9124	7	7.08
66	817	1	.0359	0	0	5	.9196	6	5.90
67	818	2	.0685	18	1.28	5	.9470	4	4.21
68	819	2	.0287	11	0.33	5	.9585	3	3.80
69	820	1	.0242	0	0	5	.9633	3	3.35
70	821	2	.0216	16	0.35	5	.9720	3	3.25
71	822	3	.0240	72	1.74	5	.9864	1	1.67
72	823	2	.0115	20	0.24	5	.9910	1	1.09

Table 1 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
73	824	2	.0052	37	0.19	5	.9931	0	0.84
74	825	2	.0092	5	0.05	5	.9968	0	0.40
75	826	2	.0047	39	0.18	5	.9987	0	0.15
76	827	2	.0004	60	0.03	5	.9989	0	0.12
77	828	2	.0008	52	0.04	5	.9993	0	0
78	829	0	.0000	0	0	5	.9993	0	0
79	830	2	.0017	31	0.05	5	1.0000	0	0

Table 2. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1976 – 1982. Northern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
26	708	1	.0006	0	0	1	.0006	0	0
27	709	2	.0215	99	2.15	2	.0218	97	2.12
28	710	2	.0214	58	1.25	3	.0288	73	2.12
29	711	1	.0187	0	0	3	.0350	69	2.43
30	712	3	.0247	81	2.01	3	.0598	71	4.25
31	713	4	.0302	69	2.09	4	.0750	84	6.30
32	714	4	.0358	24	0.86	5	.0887	79	7.01
33	715	3	.0428	29	1.24	5	.1144	65	7.43
34	716	3	.0345	45	1.56	5	.1351	61	8.28
35	717	3	.0466	25	1.20	5	.1631	53	8.73
36	718	2	.0662	25	1.70	5	.1896	54	10.30
37	719	3	.0288	45	1.31	5	.2069	52	10.85
38	720	4	.0524	38	2.00	5	.2488	46	11.61
39	721	5	.0491	74	3.66	5	.2979	47	14.20
40	722	5	.0435	62	2.71	5	.3415	45	15.38
41	723	4	.0411	25	1.06	5	.3744	43	16.22
42	724	3	.0335	49	1.66	5	.3945	41	16.28
43	725	2	.0344	49	1.69	5	.4083	42	17.17
44	726	1	.0692	0	0	5	.4222	44	18.80
45	727	3	.0722	66	4.82	5	.4655	47	21.92
46	728	4	.0543	67	3.64	5	.5090	50	25.59
47	729	4	.0571	67	3.87	5	.5547	51	28.45
48	730	4	.0436	37	1.62	5	.5896	50	29.89
49	731	3	.0581	13	0.80	5	.6245	46	29.00
50	801	2	.0866	2	0.22	5	.6591	42	27.86
51	802	1	.0690	0	0	5	.6729	38	26.22
52	803	3	.0880	69	6.15	5	.7257	30	21.99
53	804	4	.0800	62	4.96	5	.7897	24	19.51
54	805	4	.0408	71	2.92	5	.8224	21	17.46
55	806	3	.0608	12	0.74	5	.8589	19	16.78
56	807	3	.0411	105	4.32	5	.8835	16	14.26
57	808	1	.0681	0	0	5	.8971	14	12.73
58	809	2	.0675	28	1.91	5	.9241	10	9.31
59	810	1	.0453	0	0	5	.9332	9	8.45
60	811	2	.0589	70	4.17	5	.9568	5	5.31
61	812	1	.0403	0	0	5	.9649	4	4.36
62	813	2	.0437	62	2.73	5	.9824	2	2.34
63	814	1	.0228	0	0	5	.9869	1	1.61
64	815	2	.0216	35	0.76	5	.9956	0	0.87
65	816	1	.0034	0	0	5	.9962	0	0.74
66	817	1	.0133	0	0	5	.9989	0	0.22
67	818	1	.0029	0	0	5	.9995	0	0
68	819	1	.0022	0	0	5	.9999	0	0
69	820	0	.0000	0	0	5	.9999	0	0
70	821	1	.0003	0	0	5	1.0000	0	0

Table 3. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1974 - 1982. Coghill district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
6	618	1	.0001	0	0	1	.0001	0	0
7	619	1	.0001	0	0	2	.0001	0	0
8	620	1	.0013	0	0	2	.0008	87	0.06
9	621	2	.0009	15	0.01	2	.0017	29	0.05
10	622	3	.0038	21	0.08	3	.0049	12	0.06
11	623	2	.0059	69	0.41	3	.0088	48	0.43
12	624	2	.0055	63	0.34	3	.0125	65	0.81
13	625	2	.0061	77	0.47	3	.0166	78	1.29
14	626	2	.0164	22	0.36	3	.0276	56	1.57
15	627	3	.0051	133	0.68	4	.0246	81	2.00
16	628	2	.0172	63	1.10	4	.0332	80	2.67
17	629	3	.0238	61	1.47	4	.0510	84	4.30
18	630	2	.0209	84	1.76	4	.0615	82	5.08
19	701	3	.0122	127	1.56	4	.0707	85	6.06
20	702	3	.0109	98	1.07	4	.0789	86	6.82
21	703	2	.0445	90	4.02	4	.1012	98	9.97
22	704	1	.0008	0	0	4	.1013	98	9.95
23	705	3	.0092	120	1.11	5	.0866	109	9.51
24	706	3	.0339	88	3.00	5	.1070	113	12.12
25	707	3	.0309	102	3.17	5	.1255	118	14.86
26	708	4	.0217	68	1.48	5	.1429	111	15.98
27	709	4	.0213	72	1.55	5	.1600	99	15.84
28	710	4	.0416	75	3.14	5	.1934	96	18.71
29	711	2	.0549	70	3.89	5	.2153	85	18.41
30	712	3	.0793	28	2.29	5	.2629	66	17.45
31	713	4	.0287	66	1.91	5	.2858	67	19.18
32	714	6	.0490	136	6.72	6	.2873	79	22.95
33	715	4	.1012	91	9.30	6	.3549	56	19.99
34	716	4	.0698	84	5.86	6	.4014	50	20.16
35	717	4	.0897	87	7.80	6	.4612	53	24.65
36	718	4	.0709	79	5.64	6	.5085	55	28.12
37	719	3	.0760	78	5.97	6	.5465	55	30.50
38	720	4	.0225	51	1.16	6	.5615	52	29.49
39	721	5	.0827	91	7.61	6	.6305	49	31.47
40	722	4	.0488	35	1.72	6	.6631	44	29.52
41	723	3	.0248	56	1.40	6	.6755	42	29.02
42	724	4	.0131	45	0.59	6	.6843	41	28.57
43	725	1	.0211	0	0	6	.6878	41	28.50
44	726	2	.0880	67	5.94	6	.7172	37	26.83
45	727	3	.0602	10	0.61	6	.7473	33	25.28
46	728	4	.0483	100	4.83	6	.7795	30	23.67
47	729	3	.0466	35	1.66	6	.8029	27	22.17
48	730	3	.0448	44	1.98	6	.8253	26	21.75
49	731	4	.0217	89	1.95	6	.8398	24	20.84
50	801	2	.0780	19	1.54	6	.8658	20	17.66
51	802	1	.0337	0	0	6	.8714	19	16.59
52	803	1	.0348	0	0	6	.8772	17	15.51
53	804	3	.1016	46	4.74	6	.9280	13	12.65
54	805	2	.0587	35	2.11	6	.9476	12	11.45
55	806	1	.0884	0	0	6	.9624	8	8.16

Table 3 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
56	807	2	.0141	69	0.98	6	.9671	7	7.30
57	808	2	.0451	97	4.39	6	.9821	4	3.99
58	809	1	.0488	0	0	6	.9902	2	2.17
59	810	1	.0361	0	0	6	.9963	0	0.82
60	811	0	.0000	0	0	6	.9963	0	0.82
61	812	1	.0052	0	0	6	.9971	0	0.63
62	813	1	.0070	0	0	6	.9983	0	0.37
63	814	1	.0100	0	0	6	1.0000	0	0

Table 4. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1974, 1976, 1980, 1982. Northwestern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
14	626	1	.0062	0	0	1	.0062	0	0
15	627	1	.0010	0	0	1	.0072	0	0
16	628	0	.0000	0	0	1	.0072	0	0
17	629	0	.0000	0	0	1	.0072	0	0
18	630	0	.0000	0	0	1	.0072	0	0
19	701	1	.0023	0	0	1	.0094	0	0
20	702	1	.0026	0	0	1	.0120	0	0
21	703	1	.0019	0	0	1	.0140	0	0
22	704	1	.0073	0	0	1	.0212	0	0
23	705	1	.0312	0	0	1	.0524	0	0
24	706	0	.0000	0	0	1	.0524	0	0
25	707	0	.0000	0	0	1	.0524	0	0
26	708	2	.0249	84	2.11	2	.0511	92	4.73
27	709	2	.0610	78	4.76	2	.1121	84	9.50
28	710	1	.1029	0	0	2	.1636	89	14.65
29	711	1	.0326	0	0	2	.1799	90	16.28
30	712	3	.0503	58	2.96	3	.1702	109	18.59
31	713	3	.0527	25	1.33	4	.1672	92	15.49
32	714	4	.0384	19	0.75	5	.1646	84	13.85
33	715	5	.0492	23	1.14	5	.2138	65	14.10
34	716	5	.0586	54	3.17	5	.2724	61	16.65
35	717	4	.0690	61	4.22	5	.3276	54	18.01
36	718	3	.0470	84	3.95	5	.3558	53	18.95
37	719	3	.1166	106	12.46	5	.4258	69	29.38
38	720	3	.0415	79	3.28	5	.4507	61	27.85
39	721	4	.0652	67	4.43	5	.5028	52	26.23
40	722	4	.0364	48	1.75	5	.5320	47	25.16
41	723	4	.0431	60	2.60	5	.5665	42	24.08
42	724	2	.0878	33	2.97	5	.6016	39	23.53
43	725	2	.0053	50	0.26	5	.6037	38	23.52
44	726	2	.0562	94	5.29	5	.6262	36	22.91
45	727	3	.0679	73	5.00	5	.6670	34	22.67
46	728	3	.0792	62	4.94	5	.7145	33	23.74
47	729	4	.0502	58	2.95	5	.7547	32	24.78
48	730	4	.0589	54	3.20	5	.8017	29	23.76
49	731	4	.0333	63	2.11	5	.8285	26	22.00
50	801	2	.0314	27	0.84	5	.8410	24	20.47
51	802	1	.0248	0	0	5	.8460	23	19.52
52	803	2	.0577	48	2.81	5	.8690	18	16.50
53	804	3	.0219	26	0.57	5	.8822	17	15.78
54	805	3	.0182	33	0.61	5	.8931	17	15.64
55	806	2	.0333	72	2.40	5	.9064	14	13.58
56	807	2	.0726	73	5.37	5	.9355	9	8.81
57	808	2	.0663	97	6.49	5	.9620	4	4.64
58	809	1	.0837	0	0	5	.9788	3	3.85
59	810	1	.0080	0	0	5	.9804	3	3.92
60	811	1	.0332	0	0	5	.9870	2	2.58
61	812	1	.0423	0	0	5	.9955	0	0.89
62	813	1	.0109	0	0	5	.9977	0	0.45
63	814	1	.0064	0	0	5	.9989	0	0.20
64	815	1	.0052	0	0	5	1.0000	0	0

Table 5. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1976, 1980, 1982. Southwestern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
24	706	1	.0001	0	0	1	.0001	0	0
25	707	1	.0006	0	0	2	.0004	75	0.03
26	708	1	.0006	0	0	2	.0006	85	0.05
27	709	1	.0010	0	0	2	.0012	91	0.11
28	710	1	.0012	0	0	2	.0018	94	0.17
29	711	0	.0000	0	0	2	.0018	94	0.17
30	712	3	.0113	122	1.39	3	.0125	105	1.32
31	713	3	.0144	56	0.80	3	.0270	68	1.85
32	714	4	.0121	63	0.76	4	.0323	80	2.60
33	715	4	.0256	70	1.80	4	.0579	74	4.33
34	716	4	.0243	63	1.54	4	.0823	68	5.66
35	717	4	.0172	88	1.52	4	.0995	58	5.83
36	718	3	.0106	122	1.31	4	.1076	53	5.79
37	719	2	.0245	87	2.14	4	.1198	59	7.08
38	720	3	.0394	68	2.71	4	.1494	64	9.63
39	721	4	.0406	65	2.67	4	.1900	64	12.25
40	722	4	.0522	76	3.98	4	.2422	66	16.11
41	723	4	.0447	63	2.85	4	.2868	65	18.85
42	724	3	.0328	79	2.60	4	.3115	61	19.09
43	725	3	.0217	66	1.43	4	.3278	58	19.08
44	726	3	.0298	96	2.88	4	.3502	58	20.54
45	727	3	.0568	46	2.62	4	.3929	59	23.20
46	728	4	.0637	44	2.83	4	.4566	56	25.99
47	729	4	.0540	63	3.40	4	.5106	57	29.21
48	730	4	.0493	28	1.42	4	.5600	54	30.50
49	731	4	.0463	53	2.46	4	.6063	49	30.22
50	801	3	.0458	77	3.55	4	.6407	44	28.25
51	802	1	.0508	0	0	4	.6534	40	26.42
52	803	2	.0531	24	1.30	4	.6800	38	25.84
53	804	3	.0606	21	1.32	4	.7254	33	24.38
54	805	3	.0470	28	1.32	4	.7607	29	22.78
55	806	3	.0509	22	1.16	4	.7990	27	22.03
56	807	3	.0240	68	1.63	4	.8170	26	21.26
57	808	2	.0443	9	0.44	4	.8392	22	19.21
58	809	1	.0487	0	0	4	.8513	20	17.27
59	810	1	.0414	0	0	4	.8617	18	15.64
60	811	2	.0503	25	1.30	4	.8869	15	14.00
61	812	2	.0478	24	1.18	4	.9108	12	11.60
62	813	2	.0425	35	1.50	4	.9321	9	9.31
63	814	2	.0424	51	2.17	4	.9533	7	6.72
64	815	2	.0220	55	1.22	4	.9643	5	5.34
65	816	1	.0295	0	0	4	.9717	4	4.07
66	817	1	.0266	0	0	4	.9784	3	2.93
67	818	2	.0168	50	0.84	4	.9868	1	1.91
68	819	2	.0084	86	0.73	4	.9910	1	1.24
69	820	1	.0150	0	0	4	.9948	0	0.61
70	821	1	.0038	0	0	4	.9957	0	0.45
71	822	2	.0049	1	0	4	.9982	0	0.27
72	823	1	.0012	0	0	4	.9985	0	0.22
73	824	2	.0017	64	0.11	4	.9993	0	0.10

Table 5 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
74	825	1	.0013	0	0	4	.9997	0	0
75	826	1	.0006	0	0	4	.9998	0	0
76	827	1	.0002	0	0	4	.9999	0	0
77	828	0	.0000	0	0	4	.9999	0	0
78	829	0	.0000	0	0	4	.9999	0	0
79	830	0	.0000	0	0	4	.9999	0	0
80	831	0	.0000	0	0	4	.9999	0	0
81	901	0	.0000	0	0	4	.9999	0	0
82	902	0	.0000	0	0	4	.9999	0	0
83	903	0	.0000	0	0	4	.9999	0	0
84	904	0	.0000	0	0	4	.9999	0	0
85	905	0	.0000	0	0	4	.9999	0	0
86	906	0	.0000	0	0	4	.9999	0	0
87	907	0	.0000	0	0	4	.9999	0	0
88	908	0	.0000	0	0	4	.9999	0	0
89	909	0	.0000	0	0	4	.9999	0	0
90	910	0	.0000	0	0	4	.9999	0	0
91	911	0	.0000	0	0	4	.9999	0	0
92	912	0	.0000	0	0	4	.9999	0	0
93	913	0	.0000	0	0	4	.9999	0	0
94	914	1	.0003	0	0	4	1.0000	0	0

Table 6. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1976 - 1982. Southeastern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
30	712	1	.0740	0	0	1	.0740	0	0
31	713	1	.0465	0	0	1	.1205	0	0
32	714	2	.0134	61	0.81	2	.0736	92	6.84
33	715	2	.0287	69	2.00	2	.1024	86	8.84
34	716	2	.0434	22	0.96	2	.1459	54	7.87
35	717	1	.0357	0	0	2	.1637	37	6.09
36	718	1	.0346	0	0	2	.1810	24	4.36
37	719	1	.0675	0	0	2	.2147	36	7.73
38	720	1	.0201	0	0	2	.2248	38	8.73
39	721	2	.0630	16	1.04	2	.2877	26	7.69
40	722	2	.0646	18	1.20	2	.3525	18	6.48
41	723	2	.0676	0	0.01	2	.4201	15	6.47
42	724	1	.0673	0	0	2	.4538	6	3.11
43	725	1	.0631	0	0	2	.4853	0	0.04
44	726	1	.1742	0	0	2	.5724	15	8.66
45	727	2	.1701	60	10.26	3	.4950	37	18.53
46	728	3	.1517	64	9.78	3	.6468	17	11.55
47	729	4	.1073	116	12.48	4	.5924	61	36.14
48	730	4	.0767	36	2.76	4	.6692	58	38.86
49	731	3	.0617	59	3.65	4	.7155	50	36.17
50	801	3	.0504	52	2.63	4	.7533	44	33.63
51	802	1	.1066	0	0	4	.7799	37	29.12
52	803	2	.2117	90	19.18	5	.7087	41	29.54
53	804	3	.1278	101	12.95	5	.7854	31	24.83
54	805	2	.0700	90	6.30	5	.8134	24	20.17
55	806	2	.0913	43	3.99	5	.8499	19	16.33
56	807	2	.1004	53	5.35	5	.8901	14	12.83
57	808	2	.0384	96	3.70	5	.9054	12	11.53
58	809	2	.1361	60	8.19	5	.9599	4	4.56
59	810	1	.0183	0	0	5	.9636	4	3.97
60	811	2	.0482	40	1.96	5	.9828	2	2.70
61	812	1	.0114	0	0	5	.9851	2	2.25
62	813	1	.0179	0	0	5	.9887	1	1.57
63	814	1	.0147	0	0	5	.9917	1	1.06
64	815	1	.0060	0	0	5	.9929	0	0.87
65	816	1	.0055	0	0	5	.9940	0	0.73
66	817	1	.0071	0	0	5	.9954	0	0.62
67	818	2	.0094	59	0.56	5	.9992	0	0.11
68	819	2	.0019	57	0.10	5	1.0000	0	0

Table 7. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981. Eastern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
5	617	1	.0001	0	0	1	.0001	0	0
6	618	0	.0000	0	0	1	.0001	0	0
7	619	0	.0000	0	0	1	.0001	0	0
8	620	0	.0000	0	0	1	.0001	0	0
9	621	0	.0000	0	0	1	.0001	0	0
10	622	0	.0000	0	0	1	.0001	0	0
11	623	0	.0000	0	0	1	.0001	0	0
12	624	1	.0601	0	0	1	.0603	0	0
13	625	3	.0155	133	2.07	3	.0356	138	4.91
14	626	2	.0179	81	1.44	3	.0475	133	6.36
15	627	2	.1413	10	1.52	4	.1063	58	6.17
16	628	2	.0958	7	0.69	4	.1542	64	9.89
17	629	3	.0543	49	2.67	4	.1950	66	13.02
18	630	3	.0246	86	2.13	4	.2134	68	14.59
19	701	2	.0355	54	1.94	4	.2312	70	16.34
20	702	3	.0208	76	1.59	4	.2468	67	16.61
21	703	2	.0219	30	0.66	4	.2577	65	16.86
22	704	3	.0165	76	1.26	4	.2701	66	18.02
23	705	2	.0303	8	0.25	4	.2852	67	19.37
24	706	3	.0275	12	0.35	4	.3059	67	20.54
25	707	3	.0143	54	0.78	4	.3167	66	21.06
26	708	2	.0161	5	0.08	4	.3248	66	21.45
27	709	2	.0220	18	0.40	4	.3358	64	21.70
28	710	2	.0181	25	0.45	4	.3448	63	21.96
29	711	2	.0248	8	0.21	4	.3573	64	23.03
30	712	3	.0194	11	0.22	5	.2974	86	25.60
31	713	4	.0213	39	0.84	5	.3145	84	26.55
32	714	6	.0245	127	3.14	6	.2867	90	25.88
33	715	5	.0230	74	1.70	6	.3058	84	25.84
34	716	6	.0169	79	1.34	6	.3228	79	25.62
35	717	6	.0162	87	1.41	6	.3391	75	25.53
36	718	5	.0229	61	1.42	6	.3582	72	26.14
37	719	4	.0102	79	0.80	6	.3651	73	26.76
38	720	5	.0200	75	1.50	6	.3818	73	27.87
39	721	6	.0294	81	2.40	6	.4112	67	27.84
40	722	5	.0362	64	2.33	6	.4414	62	27.68
41	723	6	.0385	50	1.96	7	.4114	70	29.11
42	724	7	.0269	74	2.00	7	.4384	65	28.74
43	725	6	.0363	57	2.10	7	.4695	60	28.38
44	726	6	.0221	88	1.95	7	.4885	57	27.90
45	727	5	.0345	53	1.85	7	.5132	55	28.26
46	728	6	.0335	66	2.24	7	.5419	52	28.55
47	729	6	.0307	66	2.05	7	.5683	49	28.25
48	730	7	.0498	62	3.12	7	.6181	42	26.42
49	731	6	.0562	71	4.02	7	.6663	38	25.72
50	801	5	.0407	69	2.84	7	.6954	36	25.42
51	802	5	.0417	70	2.94	7	.7253	32	23.56
52	803	5	.0469	76	3.58	7	.7588	29	22.20
53	804	5	.0473	72	3.43	7	.7926	24	19.60
54	805	5	.0455	75	3.42	7	.8251	21	17.63

Table 7 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
55	806	6	.0599	60	3.60	7	.8765	17	15.30
56	807	5	.0286	86	2.46	7	.8970	17	15.43
57	808	4	.0305	78	2.39	7	.9144	17	16.14
58	809	3	.0389	121	4.72	7	.9311	13	12.52
59	810	3	.0426	110	4.68	7	.9494	9	8.86
60	811	3	.0221	117	2.59	7	.9588	7	6.91
61	812	2	.0401	96	3.86	7	.9703	4	4.32
62	813	3	.0270	49	1.34	7	.9819	3	3.07
63	814	4	.0053	90	0.48	7	.9850	3	3.08
64	815	2	.0023	52	0.12	7	.9856	3	3.05
65	816	2	.0451	96	4.34	7	.9985	0	0.30
66	817	1	.0019	0	0	7	.9988	0	0.24
67	818	0	.0000	0	0	7	.9988	0	0.24
68	819	0	.0000	0	0	7	.9988	0	0.24
69	820	1	.0027	0	0	7	.9992	0	0.14
70	821	1	.0017	0	0	7	.9994	0	0
71	822	1	.0012	0	0	7	.9996	0	0
72	823	1	.0009	0	0	7	.9997	0	0
73	824	2	.0003	66	0.02	7	.9998	0	0
74	825	0	.0000	0	0	7	.9998	0	0
75	826	0	.0000	0	0	7	.9998	0	0
76	827	0	.0000	0	0	7	.9998	0	0
77	828	0	.0000	0	0	7	.9998	0	0
78	829	0	.0000	0	0	7	.9998	0	0
79	830	0	.0000	0	0	7	.9998	0	0
80	831	1	.0009	0	0	7	1.0000	0	0

Table 8. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981. Northern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
12	624	1	.0484	0	0	1	.0484	0	0
13	625	1	.0326	0	0	1	.0810	0	0
14	626	1	.0236	0	0	1	.1046	0	0
15	627	1	.0036	0	0	1	.1082	0	0
16	628	0	.0000	0	0	1	.1082	0	0
17	629	1	.0249	0	0	1	.1331	0	0
18	630	1	.0286	0	0	1	.1617	0	0
19	701	1	.0486	0	0	1	.2103	0	0
20	702	1	.0232	0	0	1	.2334	0	0
21	703	1	.0234	0	0	1	.2569	0	0
22	704	1	.0541	0	0	2	.1555	65	10.13
23	705	1	.0386	0	0	2	.1748	46	8.20
24	706	2	.0526	7	0.37	2	.2274	37	8.58
25	707	2	.0652	27	1.82	2	.2927	35	10.41
26	708	2	.0639	22	1.43	2	.3566	33	11.85
27	709	3	.1225	107	13.15	3	.3603	29	10.63
28	710	2	.0805	82	6.64	3	.4139	26	10.95
29	711	2	.0434	11	0.49	3	.4428	22	9.96
30	712	3	.0502	44	2.25	4	.3698	58	21.64
31	713	4	.0446	43	1.91	4	.4144	56	23.44
32	714	5	.0343	81	2.78	6	.3049	85	26.15
33	715	5	.0588	84	4.95	6	.3539	74	26.24
34	716	5	.0502	69	3.49	6	.3958	64	25.57
35	717	4	.0260	59	1.56	6	.4132	60	25.14
36	718	4	.0285	73	2.08	6	.4322	57	24.82
37	719	4	.0368	73	2.69	6	.4568	53	24.38
38	720	4	.0284	31	0.88	6	.4758	53	25.46
39	721	6	.0415	70	2.93	6	.5173	46	24.20
40	722	5	.0556	58	3.23	6	.5637	42	23.79
41	723	6	.0668	64	4.28	7	.5404	48	26.07
42	724	6	.0457	98	4.49	7	.5797	40	23.58
43	725	5	.0875	64	5.61	7	.6422	36	23.72
44	726	5	.0605	108	6.58	7	.6854	32	22.11
45	727	5	.0339	70	2.38	7	.7097	30	21.95
46	728	5	.0499	49	2.47	7	.7454	27	20.81
47	729	5	.0391	45	1.78	7	.7734	25	19.85
48	730	6	.0489	31	1.53	7	.8153	23	19.15
49	731	5	.0449	65	2.93	7	.8474	22	18.71
50	801	4	.0559	54	3.07	7	.8794	22	19.47
51	802	3	.0407	57	2.33	7	.8969	19	17.39
52	803	3	.0433	56	2.44	7	.9154	17	15.64
53	804	4	.0267	79	2.13	7	.9307	14	13.76
54	805	3	.0258	106	2.73	7	.9418	12	11.59
55	806	2	.0680	72	4.93	7	.9612	7	7.62
56	807	3	.0149	77	1.16	7	.9676	7	7.24
57	808	1	.0170	0	0	7	.9701	7	7.32
58	809	1	.0685	0	0	7	.9799	5	4.92
59	810	1	.0408	0	0	7	.9857	3	3.49
60	811	1	.0634	0	0	7	.9947	1	1.27
61	812	1	.0080	0	0	7	.9959	1	0.99

Table 8 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
62	813	1	.0264	0	0	7	.9996	0	0
63	814	0	.0000	0	0	7	.9996	0	0
64	815	0	.0000	0	0	7	.9996	0	0
65	816	1	.0022	0	0	7	1.0000	0	0

Table 9. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 – 1981. Coghill district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
2	614	1	.0002	0	0	1	.0002	0	0
3	615	0	.0000	0	0	1	.0002	0	0
4	616	0	.0000	0	0	1	.0002	0	0
5	617	1	.0005	0	0	1	.0006	0	0
6	618	1	.0104	0	0	1	.0111	0	0
7	619	1	.0031	0	0	1	.0142	0	0
8	620	3	.0016	74	0.11	3	.0063	121	0.76
9	621	4	.0033	127	0.42	4	.0080	141	1.13
10	622	3	.0009	141	0.12	5	.0069	151	1.06
11	623	3	.0023	107	0.24	5	.0083	127	1.06
12	624	2	.0004	100	0.04	5	.0085	123	1.05
13	625	5	.0045	111	0.50	6	.0108	129	1.40
14	626	5	.0027	111	0.30	6	.0131	122	1.61
15	627	5	.0101	111	1.13	7	.0185	138	2.57
16	628	5	.0047	136	0.64	7	.0219	143	3.15
17	629	5	.0306	169	5.20	7	.0438	174	7.64
18	630	6	.0216	92	2.00	7	.0623	150	9.38
19	701	5	.0169	81	1.38	7	.0744	125	9.37
20	702	7	.0099	155	1.54	7	.0844	114	9.70
21	703	5	.0457	145	6.63	7	.1171	106	12.42
22	704	5	.0341	94	3.23	7	.1415	101	14.34
23	705	5	.0183	118	2.17	7	.1546	98	15.24
24	706	6	.0327	100	3.29	7	.1827	97	17.82
25	707	4	.0364	89	3.27	7	.2035	91	18.66
26	708	5	.0550	75	4.14	7	.2429	84	20.49
27	709	6	.0252	124	3.13	7	.2645	79	21.01
28	710	5	.0285	122	3.49	7	.2849	75	21.45
29	711	4	.0498	97	4.86	7	.3134	74	23.38
30	712	5	.0780	90	7.02	7	.3691	74	27.35
31	713	4	.0467	55	2.60	7	.3958	73	28.90
32	714	4	.0468	94	4.41	7	.4226	63	27.04
33	715	3	.0446	15	0.70	7	.4417	60	26.90
34	716	6	.0310	76	2.38	7	.4683	53	25.09
35	717	4	.0887	13	1.16	7	.5190	48	25.19
36	718	4	.0738	98	7.25	7	.5612	42	23.82
37	719	4	.0514	113	5.81	7	.5906	40	23.64
38	720	3	.0569	103	5.91	7	.6150	39	24.12
39	721	5	.0536	60	3.23	7	.6533	35	22.97
40	722	4	.0489	96	4.70	7	.6813	31	21.64
41	723	3	.0425	19	0.81	7	.6995	30	21.54
42	724	3	.0617	71	4.42	7	.7260	27	19.76
43	725	4	.0231	59	1.37	7	.7392	27	20.68
44	726	4	.0334	96	3.22	7	.7583	25	19.37
45	727	3	.0413	63	2.62	7	.7760	23	18.62
46	728	4	.0617	107	6.60	7	.8113	17	14.39
47	729	4	.0679	99	6.76	7	.8502	13	11.72
48	730	4	.0310	95	2.95	7	.8679	13	11.31
49	731	5	.0105	95	1.00	7	.8754	13	11.41
50	801	3	.0319	73	2.33	7	.8891	11	10.48
51	802	2	.0524	83	4.39	7	.9041	11	10.77

Table 9 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
52	803	3	.1163	91	10.58	7	.9539	8	7.80
53	804	4	.0313	83	2.61	7	.9718	5	5.35
54	805	3	.0618	109	6.76	7	.9983	0	0.40
55	806	1	.0115	0	0	7	1.0000	0	0

Table 10. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981. Northwestern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
15	627	1	.0162	0	0	1	.0162	0	0
16	628	1	.0297	0	0	1	.0458	0	0
17	629	1	.0729	0	0	1	.1188	0	0
18	630	2	.0011	100	0.11	2	.0605	100	6.05
19	701	2	.0086	97	0.83	2	.0691	99	6.88
20	702	3	.0026	73	0.18	4	.0365	160	5.86
21	703	3	.0070	141	0.99	4	.0418	134	5.64
22	704	3	.0154	141	2.17	5	.0426	167	7.14
23	705	3	.0140	104	1.46	5	.0510	164	8.42
24	706	2	.0328	79	2.60	5	.0642	166	10.70
25	707	2	.0200	31	0.62	5	.0722	160	11.60
26	708	2	.0298	47	1.41	5	.0842	156	13.21
27	709	2	.0131	4	0.06	5	.0894	145	12.98
28	710	2	.0192	64	1.23	5	.0971	131	12.75
29	711	4	.0227	90	2.04	5	.1153	127	14.73
30	712	3	.0413	66	2.74	6	.1167	139	16.28
31	713	3	.0394	67	2.64	6	.1365	134	18.31
32	714	5	.0352	54	1.92	6	.1658	111	18.42
33	715	4	.0529	56	3.00	6	.2011	96	19.48
34	716	6	.0578	53	3.10	6	.2590	67	17.55
35	717	4	.0686	66	4.57	6	.3047	54	16.61
36	718	5	.0798	37	2.96	6	.3713	52	19.39
37	719	5	.0713	76	5.46	6	.4308	47	20.46
38	720	4	.1111	71	7.95	6	.5049	46	23.29
39	721	5	.0455	65	2.97	6	.5428	40	22.06
40	722	4	.0473	20	0.96	6	.5743	35	20.51
41	723	5	.0793	71	5.69	6	.6405	33	21.59
42	724	5	.0412	56	2.31	7	.5784	50	29.34
43	725	5	.0430	43	1.85	7	.6091	51	31.30
44	726	4	.0350	84	2.96	7	.6291	48	30.52
45	727	4	.1115	117	13.10	7	.6929	32	22.25
46	728	5	.0749	45	3.41	7	.7464	25	18.70
47	729	5	.0599	53	3.21	7	.7892	19	15.07
48	730	6	.0697	51	3.60	7	.8490	16	14.00
49	731	5	.0411	81	3.34	7	.8784	14	12.36
50	801	3	.0214	45	0.98	7	.8876	14	12.49
51	802	3	.0344	114	3.92	7	.9023	11	10.17
52	803	3	.0639	78	5.00	7	.9297	8	7.49
53	804	4	.0447	42	1.91	7	.9553	6	6.18
54	805	3	.0527	70	3.71	7	.9779	4	4.15
55	806	3	.0415	88	3.66	7	.9957	1	1.04
56	807	0	.0000	0	0	7	.9957	1	1.04
57	808	1	.0194	0	0	7	.9984	0	0.37
58	809	1	.0098	0	0	7	.9998	0	0
59	810	1	.0008	0	0	7	1.0000	0	0

Table 11. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981. Southwestern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
4	616	1	.0003	0	0	1	.0003	0	0
5	617	0	.0000	0	0	1	.0003	0	0
6	618	0	.0000	0	0	1	.0003	0	0
7	619	0	.0000	0	0	1	.0003	0	0
8	620	0	.0000	0	0	1	.0003	0	0
9	621	0	.0000	0	0	1	.0003	0	0
10	622	0	.0000	0	0	1	.0003	0	0
11	623	1	.0006	0	0	1	.0008	0	0
12	624	1	.0003	0	0	1	.0011	0	0
13	625	0	.0000	0	0	1	.0011	0	0
14	626	0	.0000	0	0	1	.0011	0	0
15	627	1	.0013	0	0	2	.0012	8	0.01
16	628	1	.0008	0	0	2	.0016	31	0.04
17	629	2	.0002	60	0.01	3	.0012	60	0.07
18	630	1	.0006	0	0	3	.0013	40	0.05
19	701	2	.0006	23	0.01	3	.0018	45	0.08
20	702	2	.0011	36	0.03	4	.0019	53	0.10
21	703	2	.0021	2	0	4	.0029	46	0.13
22	704	2	.0034	18	0.06	4	.0047	46	0.21
23	705	4	.0050	67	0.34	4	.0098	52	0.51
24	706	3	.0125	14	0.17	4	.0192	52	1.00
25	707	2	.0168	16	0.26	4	.0276	50	1.39
26	708	2	.0172	61	1.05	4	.0362	62	2.24
27	709	3	.0203	83	1.68	4	.0514	72	3.72
28	710	2	.0240	33	0.81	4	.0634	78	4.97
29	711	3	.0143	73	1.05	4	.0742	67	4.98
30	712	4	.0140	88	1.23	5	.0706	81	5.76
31	713	4	.0241	56	1.36	5	.0899	81	7.29
32	714	6	.0187	93	1.74	6	.0936	92	8.68
33	715	6	.0161	76	1.24	6	.1098	85	9.42
34	716	6	.0168	75	1.27	6	.1266	81	10.29
35	717	5	.0275	62	1.71	6	.1497	76	11.48
36	718	5	.0261	61	1.60	6	.1714	67	11.58
37	719	4	.0270	61	1.65	6	.1894	63	12.07
38	720	4	.0482	46	2.25	6	.2216	66	14.76
39	721	6	.0410	54	2.24	6	.2626	56	14.95
40	722	6	.0416	59	2.48	6	.3043	51	15.78
41	723	7	.0471	44	2.11	7	.3080	56	17.32
42	724	6	.0481	62	3.00	7	.3493	46	16.19
43	725	6	.0683	65	4.49	7	.4079	42	17.24
44	726	6	.0526	76	4.04	7	.4530	40	18.27
45	727	6	.0479	52	2.53	7	.4942	40	20.09
46	728	6	.0659	53	3.52	7	.5507	37	20.51
47	729	6	.0496	47	2.37	7	.5932	36	21.39
48	730	6	.0733	31	2.30	7	.6561	28	18.70
49	731	6	.0564	65	3.67	7	.7044	25	17.63
50	801	4	.0767	47	3.62	7	.7483	23	17.63
51	802	5	.0398	76	3.04	7	.7768	20	15.78
52	803	4	.0730	42	3.12	7	.8186	18	15.19
53	804	5	.0568	57	3.27	7	.8592	14	12.33

Table 11 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
54	805	5	.0465	66	3.09	7	.8924	11	10.28
55	806	5	.0475	39	1.88	7	.9263	8	8.22
56	807	4	.0273	74	2.02	7	.9420	8	7.88
57	808	3	.0223	69	1.55	7	.9515	8	8.01
58	809	2	.0384	81	3.11	7	.9625	5	5.69
59	810	2	.0356	56	2.02	7	.9727	3	3.88
60	811	2	.0301	74	2.22	7	.9813	2	2.29
61	812	3	.0097	112	1.09	7	.9854	1	1.68
62	813	2	.0197	23	0.46	7	.9911	1	1.27
63	814	2	.0042	16	0.07	7	.9923	1	1.26
64	815	2	.0064	35	0.23	7	.9941	0	0.95
65	816	2	.0033	54	0.17	7	.9951	0	0.97
66	817	1	.0022	0	0	7	.9954	0	0.97
67	818	1	.0094	0	0	7	.9967	0	0.64
68	819	0	.0000	0	0	7	.9967	0	0.64
69	820	2	.0041	46	0.19	7	.9979	0	0.43
70	821	0	.0000	0	0	7	.9979	0	0.43
71	822	1	.0070	0	0	7	.9989	0	0.19
72	823	0	.0000	0	0	7	.9989	0	0.19
73	824	1	.0052	0	0	7	.9996	0	0
74	825	1	.0003	0	0	7	.9997	0	0
75	826	0	.0000	0	0	7	.9997	0	0
76	827	0	.0000	0	0	7	.9997	0	0
77	828	0	.0000	0	0	7	.9997	0	0
78	829	0	.0000	0	0	7	.9997	0	0
79	830	0	.0000	0	0	7	.9997	0	0
80	831	1	.0002	0	0	7	.9997	0	0
81	901	0	.0000	0	0	7	.9997	0	0
82	902	0	.0000	0	0	7	.9997	0	0
83	903	0	.0000	0	0	7	.9997	0	0
84	904	0	.0000	0	0	7	.9997	0	0
85	905	0	.0000	0	0	7	.9997	0	0
86	906	0	.0000	0	0	7	.9997	0	0
87	907	0	.0000	0	0	7	.9997	0	0
88	908	0	.0000	0	0	7	.9997	0	0
89	909	0	.0000	0	0	7	.9997	0	0
90	910	0	.0000	0	0	7	.9997	0	0
91	911	0	.0000	0	0	7	.9997	0	0
92	912	1	.0017	0	0	7	1.0000	0	0

Table 12. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1973 - 1981. Montague district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Cum. Prop.	C.V.	S.D. x100
30	712	1	.0098	0	0	1	.0098	0	0
31	713	1	.0050	0	0	1	.0149	0	0
32	714	1	.0085	0	0	1	.0234	0	0
33	715	0	.0000	0	0	1	.0234	0	0
34	716	1	.0567	0	0	1	.0800	0	0
35	717	1	.0354	0	0	1	.1154	0	0
36	718	1	.0820	0	0	1	.1974	0	0
37	719	1	.0587	0	0	1	.2561	0	0
38	720	1	.0798	0	0	1	.3360	0	0
39	721	0	.0000	0	0	1	.3360	0	0
40	722	0	.0000	0	0	1	.3360	0	0
41	723	2	.0488	9	0.48	2	.2168	79	17.28
42	724	4	.0902	63	5.69	4	.1987	76	15.12
43	725	4	.1299	86	11.17	5	.2629	48	12.70
44	726	4	.1208	97	11.78	5	.3596	49	17.80
45	727	4	.1397	66	9.28	5	.4713	53	25.07
46	728	4	.0706	69	4.91	5	.5279	42	22.23
47	729	4	.0465	64	3.00	5	.5651	39	22.54
48	730	5	.1109	96	10.67	5	.6760	31	21.45
49	731	4	.0835	36	3.07	5	.7428	25	18.97
50	801	4	.0856	45	3.89	5	.8114	20	17.02
51	802	2	.1063	24	2.63	5	.8539	21	18.32
52	803	3	.0218	62	1.36	5	.8669	21	18.61
53	804	3	.0583	104	6.12	5	.9020	14	13.13
54	805	1	.1956	0	0	5	.9411	6	5.91
55	806	2	.0972	60	5.91	5	.9800	2	2.45
56	807	1	.0292	0	0	5	.9858	1	1.92
57	808	1	.0203	0	0	5	.9899	1	1.93
58	809	0	.0000	0	0	5	.9899	1	1.93
59	810	2	.0156	96	1.50	5	.9961	0	0.71
60	811	2	.0090	87	0.79	5	.9997	0	0
61	812	1	.0011	0	0	5	1.0000	0	0

Table 13. Average daily proportion of catch, average cumulative proportion of catch, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981. Southeastern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
12	624	1	.0004	0	0	1	.0004	0	0
13	625	0	.0000	0	0	1	.0004	0	0
14	626	0	.0000	0	0	1	.0004	0	0
15	627	0	.0000	0	0	1	.0004	0	0
16	628	0	.0000	0	0	1	.0004	0	0
17	629	0	.0000	0	0	1	.0004	0	0
18	630	0	.0000	0	0	1	.0004	0	0
19	701	0	.0000	0	0	1	.0004	0	0
20	702	0	.0000	0	0	1	.0004	0	0
21	703	1	.0038	0	0	2	.0021	80	0.17
22	704	3	.0092	132	1.22	3	.0106	106	1.13
23	705	1	.0333	0	0	3	.0217	124	2.70
24	706	2	.0156	30	0.47	3	.0322	107	3.45
25	707	2	.0168	13	0.22	3	.0435	95	4.13
26	708	2	.0177	9	0.16	3	.0553	87	4.85
27	709	2	.0283	29	0.84	4	.0556	77	4.31
28	710	2	.0269	42	1.14	4	.0690	61	4.27
29	711	3	.0300	87	2.62	4	.0916	70	6.47
30	712	2	.0543	39	2.11	4	.1187	78	9.35
31	713	4	.0338	66	2.26	5	.1220	96	11.73
32	714	6	.0181	102	1.85	6	.1198	108	13.05
33	715	5	.0231	104	2.40	6	.1391	108	15.07
34	716	6	.0210	79	1.68	6	.1602	94	15.17
35	717	6	.0286	85	2.44	6	.1888	79	15.08
36	718	5	.0443	104	4.65	6	.2257	84	19.02
37	719	4	.0461	82	3.78	6	.2565	86	22.16
38	720	4	.0434	63	2.74	6	.2855	83	23.94
39	721	6	.0446	66	2.94	6	.3301	72	23.85
40	722	6	.0398	70	2.81	6	.3699	62	23.30
41	723	7	.0552	86	4.76	7	.3723	62	23.37
42	724	5	.0577	60	3.48	7	.4136	53	22.22
43	725	5	.0594	24	1.47	7	.4560	49	22.72
44	726	5	.0516	83	4.30	7	.4929	46	22.69
45	727	5	.0529	55	2.95	7	.5306	45	24.21
46	728	6	.0503	64	3.24	7	.5737	42	24.57
47	729	5	.0626	29	1.84	7	.6185	38	23.88
48	730	6	.0668	28	1.88	7	.6758	33	22.89
49	731	5	.0715	16	1.20	7	.7269	32	23.62
50	801	5	.0458	61	2.81	7	.7596	31	23.74
51	802	4	.0630	52	3.33	7	.7957	26	20.90
52	803	4	.0609	45	2.77	7	.8305	23	19.31
53	804	4	.0705	45	3.23	7	.8708	18	15.74
54	805	4	.0562	56	3.16	7	.9029	14	13.52
55	806	5	.0527	69	3.67	7	.9406	10	10.27
56	807	4	.0159	78	1.25	7	.9497	10	10.03
57	808	3	.0139	88	1.23	7	.9557	10	10.22
58	809	2	.0333	96	3.21	7	.9653	8	7.93
59	810	3	.0129	102	1.32	7	.9708	7	6.87
60	811	2	.0337	94	3.17	7	.9804	4	4.59
61	812	1	.0627	0	0	7	.9894	2	2.40

Table 13 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Cum. Prop.	C.V.	S.D. x100
62	813	2	.0290	95	2.76	7	.9977	0	0.44
63	814	0	.0000	0	0	7	.9977	0	0.44
64	815	0	.0000	0	0	7	.9977	0	0.44
65	816	2	.0076	69	0.53	7	.9998	0	0
66	817	0	.0000	0	0	7	.9998	0	0
67	818	0	.0000	0	0	7	.9998	0	0
68	819	0	.0000	0	0	7	.9998	0	0
69	820	0	.0000	0	0	7	.9998	0	0
70	821	0	.0000	0	0	7	.9998	0	0
71	822	0	.0000	0	0	7	.9998	0	0
72	823	0	.0000	0	0	7	.9998	0	0
73	824	0	.0000	0	0	7	.9998	0	0
74	825	0	.0000	0	0	7	.9998	0	0
75	826	0	.0000	0	0	7	.9998	0	0
76	827	0	.0000	0	0	7	.9998	0	0
77	828	1	.0008	0	0	7	1.0000	0	0

Table 14. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1976 - 1982. Eastern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
23	705	1	.0143	0	0	1	.0143	0	0
24	706	1	.0143	0	0	1	.0287	0	0
25	707	2	.0173	57	1.00	2	.0315	14	0.44
26	708	2	.0222	53	1.17	2	.0535	30	1.65
27	709	2	.0285	17	0.50	2	.0823	25	2.13
28	710	3	.0393	64	2.54	3	.0941	67	6.35
29	711	2	.0124	65	0.80	3	.1024	57	5.84
30	712	3	.0283	41	1.18	3	.1308	53	7.03
31	713	4	.0397	72	2.88	4	.1380	52	7.22
32	714	5	.0289	40	1.17	5	.1392	60	8.41
33	715	4	.0356	40	1.45	5	.1678	52	8.79
34	716	4	.0258	73	1.90	5	.1885	49	9.31
35	717	5	.0328	77	2.53	5	.2215	52	11.58
36	718	4	.0206	41	0.86	5	.2380	47	11.29
37	719	3	.0192	29	0.57	5	.2496	46	11.66
38	720	4	.0307	35	1.08	5	.2741	44	12.24
39	721	5	.0297	50	1.50	5	.3039	40	12.33
40	722	4	.0246	44	1.10	5	.3237	39	12.66
41	723	4	.0280	57	1.62	5	.3462	39	13.84
42	724	3	.0309	31	0.96	5	.3647	40	14.61
43	725	2	.0219	61	1.35	5	.3735	38	14.52
44	726	1	.0450	0	0	5	.3825	41	15.74
45	727	3	.0598	31	1.84	5	.4183	44	18.47
46	728	3	.0513	33	1.73	5	.4491	46	20.94
47	729	4	.0347	13	0.46	5	.4769	46	22.01
48	730	4	.0297	42	1.25	5	.5005	45	22.97
49	731	4	.0528	54	2.86	5	.5430	47	25.99
50	801	3	.0333	41	1.37	5	.5629	46	26.11
51	802	1	.0168	0	0	5	.5663	45	25.92
52	803	3	.0507	65	3.30	5	.5969	40	24.37
53	804	4	.0569	84	4.83	5	.6425	33	21.72
54	805	4	.0385	43	1.68	5	.6733	31	21.12
55	806	3	.0313	51	1.60	5	.6920	30	21.29
56	807	3	.0274	33	0.92	5	.7085	30	21.43
57	808	2	.0263	8	0.22	5	.7190	29	21.05
58	809	2	.0537	61	3.30	5	.7406	24	18.46
59	810	1	.0168	0	0	5	.7440	24	18.11
60	811	3	.0423	50	2.12	5	.7694	21	16.53
61	812	2	.0250	55	1.39	5	.7794	21	16.52
62	813	3	.0308	23	0.73	5	.7979	19	15.33
63	814	3	.0440	40	1.77	5	.8243	19	15.99
64	815	3	.0243	71	1.73	5	.8391	17	14.28
65	816	2	.0239	52	1.25	5	.8486	16	13.59
66	817	1	.0319	0	0	5	.8550	15	12.91
67	818	2	.0326	3	0.11	5	.8681	14	12.83
68	819	2	.0208	31	0.66	5	.8763	14	12.68
69	820	1	.0294	0	0	5	.8821	13	12.33
70	821	2	.0321	38	1.21	5	.8950	13	12.50
71	822	3	.0358	28	1.00	5	.9166	12	11.09
72	823	2	.0301	12	0.38	5	.9287	10	9.63

Table 14 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
73	824	2	.0376	59	2.24	5	.9438	7	7.38
74	825	2	.0502	43	2.16	5	.9638	4	4.61
75	826	2	.0323	3	0.11	5	.9769	3	3.08
76	827	2	.0077	18	0.14	5	.9800	2	2.78
77	828	2	.0201	27	0.55	5	.9879	1	1.75
78	829	0	.0000	0	0	5	.9879	1	1.75
79	830	2	.0296	52	1.54	5	1.0000	0	0

Table 15. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1976 - 1982. Northern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
26	708	1	.0081	0	0	1	.0080	0	0
27	709	2	.0264	98	2.61	2	.0303	73	2.23
28	710	2	.1301	72	9.46	3	.1069	113	12.10
29	711	1	.0139	0	0	3	.1115	106	11.84
30	712	3	.0217	71	1.54	3	.1333	100	13.37
31	713	4	.0215	36	0.77	4	.1215	110	13.38
32	714	4	.0308	38	1.19	5	.1219	107	13.05
33	715	3	.0306	3	0.11	5	.1403	98	13.76
34	716	3	.0265	20	0.55	5	.1562	91	14.33
35	717	3	.0309	30	0.93	5	.1749	78	13.75
36	718	2	.0420	50	2.11	5	.1917	70	13.48
37	719	3	.0242	27	0.66	5	.2063	67	13.99
38	720	4	.0364	19	0.72	5	.2355	59	14.01
39	721	5	.0411	40	1.68	5	.2766	55	15.27
40	722	5	.0358	50	1.81	5	.3125	51	16.18
41	723	4	.0407	4	0.17	5	.3451	48	16.67
42	724	3	.0369	23	0.88	5	.3674	44	16.17
43	725	2	.0344	9	0.32	5	.3812	42	16.33
44	726	1	.0708	0	0	5	.3953	47	18.79
45	727	3	.0732	34	2.52	5	.4392	49	21.65
46	728	4	.0576	32	1.85	5	.4854	49	24.19
47	729	4	.0496	32	1.60	5	.5252	49	26.10
48	730	4	.0461	37	1.74	5	.5621	49	27.76
49	731	3	.0432	38	1.65	5	.5881	47	27.87
50	801	2	.0736	62	4.58	5	.6176	45	28.15
51	802	1	.0281	0	0	5	.6232	44	27.72
52	803	3	.0741	47	3.48	5	.6676	35	23.47
53	804	4	.0744	45	3.42	5	.7271	28	21.07
54	805	4	.0636	94	6.03	5	.7782	22	17.44
55	806	3	.0675	50	3.37	5	.8188	22	18.69
56	807	3	.0424	7	0.29	5	.8442	22	19.07
57	808	1	.0278	0	0	5	.8498	21	18.41
58	809	2	.0765	68	5.25	5	.8804	16	14.81
59	810	1	.0262	0	0	5	.8856	15	14.07
60	811	2	.0682	64	4.43	5	.9130	12	11.47
61	812	1	.0468	0	0	5	.9224	10	9.90
62	813	2	.0728	21	1.59	5	.9515	7	7.03
63	814	1	.0396	0	0	5	.9593	5	5.59
64	815	2	.0425	43	1.83	5	.9763	4	4.71
65	816	1	.0119	0	0	5	.9787	4	4.23
66	817	1	.0460	0	0	5	.9879	2	2.39
67	818	1	.0405	0	0	5	.9961	0	0.75
68	819	1	.0151	0	0	5	.9991	0	0.15
69	820	0	.0000	0	0	5	.9991	0	0.15
70	821	1	.0036	0	0	5	1.0000	0	0

Table 16. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1974 - 1982. Coghill district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
6	618	1	.0013	0	0	1	.0013	0	0
7	619	1	.0000	0	0	2	.0006	100	0.06
8	620	1	.0008	0	0	2	.0011	18	0.01
9	621	2	.0013	46	0.06	2	.0023	33	0.08
10	622	3	.0023	29	0.06	3	.0040	49	0.19
11	623	2	.0021	14	0.02	3	.0054	39	0.21
12	624	2	.0025	12	0.03	3	.0070	40	0.28
13	625	2	.0023	23	0.05	3	.0087	43	0.37
14	626	2	.0041	9	0.04	3	.0114	21	0.24
15	627	3	.0037	74	0.27	4	.0114	21	0.24
16	628	2	.0055	6	0.03	4	.0142	30	0.43
17	629	3	.0070	61	0.43	4	.0196	42	0.82
18	630	2	.0055	39	0.21	4	.0223	39	0.88
19	701	3	.0093	86	0.81	4	.0294	8	0.23
20	702	3	.0053	13	0.07	4	.0334	8	0.27
21	703	2	.0176	18	0.32	4	.0422	26	1.13
22	704	1	.0054	0	0	4	.0436	29	1.30
23	705	3	.0067	67	0.45	5	.0389	55	2.16
24	706	3	.0080	25	0.20	5	.0436	50	2.20
25	707	3	.0069	34	0.24	5	.0478	47	2.25
26	708	4	.0254	119	3.04	5	.0683	63	4.34
27	709	4	.0289	114	3.30	5	.0916	79	7.28
28	710	4	.0274	100	2.74	5	.1134	86	9.83
29	711	2	.0352	27	0.95	5	.1275	80	10.32
30	712	3	.0682	48	3.31	5	.1685	84	14.20
31	713	4	.0287	54	1.55	5	.1916	69	13.29
32	714	6	.0528	76	4.03	6	.2126	68	14.51
33	715	4	.0727	68	5.00	6	.2611	60	15.83
34	716	4	.0571	77	4.40	6	.2991	62	18.77
35	717	4	.1367	84	11.48	6	.3903	62	24.29
36	718	4	.0706	37	2.67	6	.4374	61	26.95
37	719	3	.0599	73	4.39	6	.4674	63	29.72
38	720	4	.0277	31	0.86	6	.4859	60	29.23
39	721	5	.1029	96	9.89	6	.5717	57	32.76
40	722	4	.0414	31	1.29	6	.5994	52	31.39
41	723	3	.0631	84	5.35	6	.6309	46	29.52
42	724	4	.0717	4	0.29	6	.6789	39	26.65
43	725	1	.0350	0	0	6	.6847	38	26.55
44	726	2	.0627	70	4.40	6	.7057	36	26.01
45	727	3	.0583	35	2.04	6	.7347	33	24.84
46	728	4	.0419	63	2.65	6	.7628	31	23.94
47	729	3	.0813	46	3.74	6	.8034	28	22.64
48	730	3	.0464	25	1.20	6	.8267	27	22.42
49	731	4	.0236	69	1.63	6	.8425	24	20.93
50	801	2	.0791	30	2.44	6	.8688	20	18.06
51	802	1	.0591	0	0	6	.8786	18	16.10
52	803	1	.0607	0	0	6	.8888	15	14.15
53	804	3	.0699	49	3.49	6	.9238	13	12.85
54	805	2	.0606	45	2.78	6	.9440	12	11.69
55	806	1	.0515	0	0	6	.9527	10	9.76

Table 16 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
56	807	2	.0229	37	0.85	6	.9603	9	8.69
57	808	2	.0311	87	2.72	6	.9706	6	6.55
58	809	1	.0320	0	0	6	.9759	5	5.36
59	810	1	.0271	0	0	6	.9804	4	4.35
60	811	0	.0000	0	0	6	.9804	4	4.35
61	812	1	.0271	0	0	6	.9851	3	3.31
62	813	1	.0368	0	0	6	.9911	1	1.97
63	814	1	.0522	0	0	6	1.0000	0	0

Table 17. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1974, 1976, 1980, 1982. Northwestern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
14	626	1	.0143	0	0	1	.0143	0	0
15	627	1	.0022	0	0	1	.0166	0	0
16	628	0	.0000	0	0	1	.0166	0	0
17	629	0	.0000	0	0	1	.0166	0	0
18	630	0	.0000	0	0	1	.0166	0	0
19	701	1	.0053	0	0	1	.0219	0	0
20	702	1	.0059	0	0	1	.0279	0	0
21	703	1	.0044	0	0	1	.0323	0	0
22	704	1	.0168	0	0	1	.0493	0	0
23	705	1	.0480	0	0	1	.0974	0	0
24	706	0	.0000	0	0	1	.0974	0	0
25	707	0	.0000	0	0	1	.0974	0	0
26	708	2	.0560	90	5.08	2	.1047	95	9.95
27	709	2	.0769	63	4.92	2	.1816	81	14.87
28	710	1	.1193	0	0	2	.2413	86	20.83
29	711	1	.0504	0	0	2	.2665	87	23.36
30	712	3	.0489	35	1.73	3	.2267	107	24.29
31	713	3	.0336	15	0.52	4	.1953	111	21.75
32	714	4	.0379	34	1.32	5	.1866	103	19.39
33	715	5	.0317	37	1.19	5	.2184	89	19.62
34	716	5	.0403	35	1.43	5	.2588	78	20.28
35	717	4	.0436	20	0.88	5	.2938	71	21.06
36	718	3	.0510	23	1.17	5	.3244	69	22.68
37	719	3	.0954	97	9.26	5	.3818	81	31.07
38	720	3	.0383	39	1.52	5	.4048	73	29.91
39	721	4	.0386	51	1.99	5	.4357	65	28.54
40	722	4	.0309	47	1.48	5	.4605	59	27.53
41	723	4	.0525	63	3.32	5	.5026	52	26.27
42	724	2	.0554	26	1.48	5	.5248	48	25.25
43	725	2	.0264	51	1.35	5	.5354	46	24.86
44	726	2	.0774	35	2.77	5	.5664	43	24.75
45	727	3	.0624	57	3.60	5	.6039	40	24.72
46	728	3	.0801	38	3.06	5	.6520	38	25.42
47	729	4	.0507	50	2.53	5	.6926	36	25.56
48	730	4	.0698	39	2.77	5	.7485	31	23.89
49	731	4	.0471	70	3.31	5	.7862	26	20.85
50	801	2	.0389	42	1.65	5	.8018	23	18.86
51	802	1	.1033	0	0	5	.8225	19	15.70
52	803	2	.0631	41	2.62	5	.8477	15	13.22
53	804	3	.0611	31	1.95	5	.8844	12	11.10
54	805	3	.0504	15	0.78	5	.9147	10	9.46
55	806	2	.0470	27	1.26	5	.9336	8	8.15
56	807	2	.0560	17	0.97	5	.9560	5	5.38
57	808	2	.0290	88	2.56	5	.9676	4	4.27
58	809	1	.0387	0	0	5	.9754	4	4.13
59	810	1	.0166	0	0	5	.9787	4	4.25
60	811	1	.0325	0	0	5	.9852	2	2.94
61	812	1	.0414	0	0	5	.9935	1	1.28
62	813	1	.0133	0	0	5	.9962	0	0.75
63	814	1	.0104	0	0	5	.9983	0	0.33
64	815	1	.0084	0	0	5	1.0000	0	0

Table 18. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1976, 1980, 1982. Southwestern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
24	706	1	.0041	0	0	1	.0041	0	0
25	707	1	.0153	0	0	2	.0097	57	0.55
26	708	1	.0048	0	0	2	.0121	66	0.80
27	709	1	.0141	0	0	2	.0192	78	1.51
28	710	1	.0165	0	0	2	.0275	85	2.34
29	711	0	.0000	0	0	2	.0275	85	2.34
30	712	3	.0211	48	1.03	3	.0395	36	1.44
31	713	3	.0313	56	1.77	3	.0709	16	1.14
32	714	4	.0170	32	0.54	4	.0702	42	2.96
33	715	4	.0240	42	1.01	4	.0943	31	3.01
34	716	4	.0239	37	0.90	4	.1183	30	3.56
35	717	4	.0467	108	5.08	4	.1650	44	7.27
36	718	3	.0155	12	0.19	4	.1767	42	7.56
37	719	2	.0222	2	0.06	4	.1878	42	7.99
38	720	3	.0270	35	0.94	4	.2082	44	9.22
39	721	4	.0276	29	0.81	4	.2359	42	10.01
40	722	4	.0328	48	1.57	4	.2687	42	11.54
41	723	4	.0349	40	1.42	4	.3037	41	12.53
42	724	3	.0289	51	1.49	4	.3255	37	12.36
43	725	3	.0338	47	1.62	4	.3509	35	12.41
44	726	3	.0278	38	1.08	4	.3718	34	12.68
45	727	3	.0392	33	1.31	4	.4013	35	14.41
46	728	4	.0371	34	1.29	4	.4386	35	15.66
47	729	4	.0351	43	1.52	4	.4737	36	17.12
48	730	4	.0331	32	1.06	4	.5069	35	18.16
49	731	4	.1017	112	11.42	4	.6087	45	27.45
50	801	3	.0268	24	0.65	4	.6289	42	26.54
51	802	1	.0247	0	0	4	.6350	41	26.24
52	803	2	.0417	26	1.10	4	.6559	40	26.48
53	804	3	.0353	19	0.68	4	.6824	37	25.71
54	805	3	.0321	24	0.78	4	.7066	35	25.17
55	806	3	.0330	51	1.70	4	.7314	34	25.16
56	807	3	.0253	39	1.00	4	.7504	33	25.12
57	808	2	.0205	19	0.39	4	.7607	31	24.26
58	809	1	.0211	0	0	4	.7660	31	24.07
59	810	1	.0175	0	0	4	.7704	31	23.94
60	811	2	.0204	23	0.47	4	.7806	29	22.88
61	812	2	.0191	15	0.30	4	.7902	28	22.12
62	813	2	.0195	25	0.50	4	.8000	26	21.44
63	814	2	.0205	45	0.92	4	.8103	25	20.91
64	815	2	.0141	30	0.42	4	.8173	25	20.50
65	816	1	.0174	0	0	4	.8217	24	20.50
66	817	1	.0171	0	0	4	.8260	24	20.54
67	818	2	.1602	88	14.11	4	.9061	9	8.51
68	819	2	.0273	40	1.09	4	.9198	7	6.97
69	820	1	.0172	0	0	4	.9241	7	6.79
70	821	1	.0120	0	0	4	.9271	7	6.72
71	822	2	.0985	78	7.77	4	.9764	2	2.66
72	823	1	.0098	0	0	4	.9789	2	2.28
73	824	2	.0242	21	0.51	4	.9910	1	1.53

Table 18 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
74	825	1	.0086	0	0	4	.9932	1	1.16
75	826	1	.0099	0	0	4	.9957	0	0.73
76	827	1	.0041	0	0	4	.9967	0	0.55
77	828	0	.0000	0	0	4	.9967	0	0.55
78	829	0	.0000	0	0	4	.9967	0	0.55
79	830	0	.0000	0	0	4	.9967	0	0.55
80	831	0	.0000	0	0	4	.9967	0	0.55
81	901	0	.0000	0	0	4	.9967	0	0.55
82	902	0	.0000	0	0	4	.9967	0	0.55
83	903	0	.0000	0	0	4	.9967	0	0.55
84	904	0	.0000	0	0	4	.9967	0	0.55
85	905	0	.0000	0	0	4	.9967	0	0.55
86	906	0	.0000	0	0	4	.9967	0	0.55
87	907	0	.0000	0	0	4	.9967	0	0.55
88	908	0	.0000	0	0	4	.9967	0	0.55
89	909	0	.0000	0	0	4	.9967	0	0.55
90	910	0	.0000	0	0	4	.9967	0	0.55
91	911	0	.0000	0	0	4	.9967	0	0.55
92	912	0	.0000	0	0	4	.9967	0	0.55
93	913	0	.0000	0	0	4	.9967	0	0.55
94	914	1	.0127	0	0	4	1.0000	0	0

Table 19. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1970, 1976-1982. Southeastern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
30	712	1	.0722	0	0	1	.0722	0	0
31	713	1	.0555	0	0	1	.1278	0	0
32	714	2	.0203	3	0.07	2	.0842	76	6.46
33	715	2	.0295	36	1.07	2	.1138	66	7.55
34	716	2	.0511	28	1.47	2	.1649	36	6.07
35	717	1	.0403	0	0	2	.1851	21	4.04
36	718	1	.0334	0	0	2	.2018	11	2.37
37	719	1	.0483	0	0	2	.2260	21	4.79
38	720	1	.0308	0	0	2	.2414	26	6.33
39	721	2	.0501	6	0.31	2	.2916	20	6.02
40	722	2	.0670	6	0.42	2	.3587	15	5.60
41	723	2	.0511	1	0.06	2	.4098	13	5.67
42	724	1	.0486	0	0	2	.4342	7	3.23
43	725	1	.0469	0	0	2	.4577	1	0.88
44	726	1	.1560	0	0	2	.5357	16	8.69
45	727	2	.1612	35	5.77	3	.4646	44	20.73
46	728	3	.1323	80	10.60	3	.5970	22	13.68
47	729	4	.1136	91	10.45	4	.5614	61	34.30
48	730	4	.0745	30	2.27	4	.6360	56	35.89
49	731	3	.0473	36	1.71	4	.6715	51	34.42
50	801	3	.0573	33	1.94	4	.7145	47	33.87
51	802	1	.0420	0	0	4	.7251	44	32.19
52	803	2	.1942	83	16.17	5	.6578	47	31.49
53	804	3	.1206	79	9.63	5	.7301	37	27.26
54	805	2	.0415	8	0.35	5	.7468	35	26.17
55	806	2	.0744	12	0.92	5	.7765	31	24.65
56	807	2	.0630	3	0.20	5	.8018	29	23.29
57	808	2	.0305	41	1.25	5	.8140	27	22.23
58	809	2	.1454	76	11.10	5	.8722	21	18.39
59	810	1	.0233	0	0	5	.8768	19	17.50
60	811	2	.0854	57	4.91	5	.9110	18	16.68
61	812	1	.0653	0	0	5	.9241	15	14.07
62	813	1	.0683	0	0	5	.9378	12	11.34
63	814	1	.0842	0	0	5	.9546	8	7.99
64	815	1	.0345	0	0	5	.9615	6	6.62
65	816	1	.0644	0	0	5	.9744	4	4.07
66	817	1	.0270	0	0	5	.9798	3	3.03
67	818	2	.0278	56	1.56	5	.9910	1	1.34
68	819	2	.0222	55	1.22	5	1.0000	0	0

Table 20. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981. Eastern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
5	617	1	.0070	0	0	1	.0070	0	0
6	618	0	.0000	0	0	1	.0070	0	0
7	619	0	.0000	0	0	1	.0070	0	0
8	620	0	.0000	0	0	1	.0070	0	0
9	621	0	.0000	0	0	1	.0070	0	0
10	622	0	.0000	0	0	1	.0070	0	0
11	623	0	.0000	0	0	1	.0070	0	0
12	624	1	.0166	0	0	1	.0236	0	0
13	625	3	.0204	29	0.60	3	.0283	23	0.67
14	626	2	.0136	25	0.34	3	.0374	32	1.20
15	627	2	.0635	27	1.77	4	.0598	46	2.80
16	628	2	.0481	32	1.56	4	.0839	61	5.17
17	629	3	.0267	69	1.84	4	.1041	66	6.96
18	630	3	.0231	45	1.04	4	.1214	68	8.31
19	701	2	.0191	68	1.31	4	.1310	71	9.33
20	702	3	.0133	36	0.48	4	.1410	71	10.03
21	703	2	.0085	25	0.21	4	.1453	69	10.05
22	704	3	.0116	85	0.99	4	.1541	71	11.00
23	705	2	.0195	30	0.60	4	.1639	73	12.05
24	706	3	.0176	36	0.63	4	.1772	73	12.94
25	707	3	.0190	33	0.63	4	.1914	71	13.63
26	708	2	.0160	4	0.06	4	.1995	70	14.00
27	709	2	.0182	1	0.02	4	.2087	66	13.98
28	710	2	.0162	18	0.30	4	.2168	64	14.07
29	711	2	.0280	23	0.66	4	.2308	67	15.47
30	712	3	.0233	24	0.57	5	.1987	87	17.47
31	713	4	.0239	39	0.95	5	.2178	83	18.28
32	714	6	.0242	78	1.90	6	.2058	88	18.12
33	715	5	.0264	63	1.68	6	.2279	78	17.96
34	716	6	.0224	50	1.13	6	.2503	73	18.28
35	717	6	.0258	57	1.47	6	.2762	69	19.33
36	718	5	.0334	47	1.57	6	.3041	66	20.22
37	719	4	.0175	53	0.93	6	.3158	66	21.02
38	720	5	.0275	36	0.99	6	.3388	62	21.34
39	721	6	.0346	63	2.21	6	.3736	55	20.88
40	722	5	.0401	56	2.27	6	.4070	50	20.54
41	723	6	.0408	54	2.22	7	.3839	58	22.40
42	724	7	.0345	76	2.62	7	.4184	50	21.29
43	725	6	.0729	71	5.22	7	.4811	44	21.34
44	726	6	.0316	81	2.57	7	.5083	41	20.90
45	727	5	.0334	51	1.71	7	.5322	39	21.03
46	728	6	.0320	71	2.29	7	.5596	38	21.32
47	729	6	.0332	37	1.25	7	.5882	35	21.17
48	730	7	.0530	54	2.90	7	.6412	33	21.20
49	731	6	.0560	57	3.23	7	.6893	29	20.01
50	801	5	.0400	51	2.05	7	.7180	28	20.42
51	802	5	.0435	36	1.58	7	.7491	25	19.02
52	803	5	.0385	46	1.79	7	.7767	22	17.80
53	804	5	.0407	46	1.90	7	.8058	19	15.97
54	805	5	.0369	66	2.44	7	.8323	17	14.40

Table 20 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
55	806	6	.0380	49	1.88	7	.8649	15	13.59
56	807	5	.0318	67	2.13	7	.8877	13	12.05
57	808	4	.0268	27	0.73	7	.9031	13	12.48
58	809	3	.0274	84	2.31	7	.9149	11	10.52
59	810	3	.0289	78	2.27	7	.9274	9	8.56
60	811	3	.0309	39	1.23	7	.9407	7	6.95
61	812	2	.0260	67	1.76	7	.9481	5	5.67
62	813	3	.0168	35	0.59	7	.9553	5	5.09
63	814	4	.0184	49	0.90	7	.9659	4	4.17
64	815	2	.0312	62	1.95	7	.9748	3	2.94
65	816	2	.0322	67	2.17	7	.9841	2	2.50
66	817	1	.0119	0	0	7	.9858	2	2.23
67	818	0	.0000	0	0	7	.9858	2	2.23
68	819	0	.0000	0	0	7	.9858	2	2.23
69	820	1	.0127	0	0	7	.9876	2	1.99
70	821	1	.0120	0	0	7	.9893	1	1.84
71	822	1	.0099	0	0	7	.9908	1	1.77
72	823	1	.0071	0	0	7	.9918	1	1.77
73	824	2	.0062	10	0.06	7	.9936	1	1.55
74	825	0	.0000	0	0	7	.9936	1	1.55
75	826	0	.0000	0	0	7	.9936	1	1.55
76	827	0	.0000	0	0	7	.9936	1	1.55
77	828	0	.0000	0	0	7	.9936	1	1.55
78	829	0	.0000	0	0	7	.9936	1	1.55
79	830	0	.0000	0	0	7	.9936	1	1.55
80	831	1	.0444	0	0	7	1.0000	0	0

Table 21. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981. Northern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
12	624	1	.0201	0	0	1	.0201	0	0
13	625	1	.0115	0	0	1	.0317	0	0
14	626	1	.0100	0	0	1	.0418	0	0
15	627	1	.0115	0	0	1	.0533	0	0
16	628	0	.0000	0	0	1	.0533	0	0
17	629	1	.0054	0	0	1	.0587	0	0
18	630	1	.0058	0	0	1	.0646	0	0
19	701	1	.0116	0	0	1	.0763	0	0
20	702	1	.0083	0	0	1	.0847	0	0
21	703	1	.0077	0	0	1	.0924	0	0
22	704	1	.0290	0	0	2	.0607	52	3.17
23	705	1	.0269	0	0	2	.0741	24	1.82
24	706	2	.0262	12	0.33	2	.1004	14	1.49
25	707	2	.0236	6	0.15	2	.1241	10	1.33
26	708	2	.0368	43	1.61	2	.1610	1	0.28
27	709	3	.0480	43	2.07	3	.1554	42	6.65
28	710	2	.0212	45	0.96	3	.1696	31	5.38
29	711	2	.0224	19	0.43	3	.1846	30	5.57
30	712	3	.0311	46	1.43	4	.1618	60	9.87
31	713	4	.0375	42	1.58	4	.1994	52	10.55
32	714	5	.0305	51	1.56	6	.1584	78	12.36
33	715	5	.0535	66	3.58	6	.2030	66	13.43
34	716	5	.0383	64	2.47	6	.2350	58	13.66
35	717	4	.0301	52	1.57	6	.2551	54	13.97
36	718	4	.0390	50	1.95	6	.2812	54	15.43
37	719	4	.0330	58	1.91	6	.3032	50	15.20
38	720	4	.0646	55	3.57	6	.3463	51	17.89
39	721	6	.0453	36	1.67	6	.3917	48	19.10
40	722	5	.0601	29	1.76	6	.4419	46	20.53
41	723	6	.0562	55	3.10	7	.4270	52	22.23
42	724	6	.0498	65	3.26	7	.4697	44	20.68
43	725	5	.0927	51	4.73	7	.5360	38	20.77
44	726	5	.0507	60	3.05	7	.5723	36	20.86
45	727	5	.0571	92	5.29	7	.6131	34	21.33
46	728	5	.0542	60	3.26	7	.6519	33	21.53
47	729	5	.0486	22	1.09	7	.6867	31	21.35
48	730	6	.0613	48	2.98	7	.7394	27	20.69
49	731	5	.0498	45	2.28	7	.7750	24	19.28
50	801	4	.0751	26	1.98	7	.8179	23	19.47
51	802	3	.0740	58	4.31	7	.8497	20	17.81
52	803	3	.0604	75	4.58	7	.8757	19	17.26
53	804	4	.0328	51	1.69	7	.8945	18	16.36
54	805	3	.0317	51	1.63	7	.9081	16	14.96
55	806	2	.0420	28	1.20	7	.9201	14	13.34
56	807	3	.0512	71	3.68	7	.9421	12	12.08
57	808	1	.0544	0	0	7	.9499	12	12.25
58	809	1	.0947	0	0	7	.9634	9	8.93
59	810	1	.0886	0	0	7	.9761	5	5.83
60	811	1	.0566	0	0	7	.9842	3	3.85
61	812	1	.0405	0	0	7	.9900	2	2.43

Table 21 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
62	813	1	.0364	0	0	7	.9952	1	1.15
63	814	0	.0000	0	0	7	.9952	1	1.15
64	815	0	.0000	0	0	7	.9952	1	1.15
65	816	1	.0330	0	0	7	1.0000	0	0

Table 22. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981. Coghill district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
2	614	1	.0001	0	0	1	.0001	0	0
3	615	0	.0000	0	0	1	.0001	0	0
4	616	0	.0000	0	0	1	.0001	0	0
5	617	1	.0012	0	0	1	.0013	0	0
6	618	1	.0015	0	0	1	.0029	0	0
7	619	1	.0005	0	0	1	.0034	0	0
8	620	3	.0010	96	0.09	3	.0021	78	0.16
9	621	4	.0013	96	0.12	4	.0029	101	0.30
10	622	3	.0009	133	0.12	5	.0029	119	0.35
11	623	3	.0026	136	0.36	5	.0045	132	0.60
12	624	2	.0001	0	0	5	.0045	131	0.60
13	625	5	.0025	136	0.35	6	.0059	95	0.56
14	626	5	.0006	88	0.05	6	.0065	87	0.57
15	627	5	.0134	108	1.45	7	.0151	121	1.84
16	628	5	.0045	112	0.51	7	.0184	125	2.31
17	629	5	.0269	149	4.02	7	.0377	148	5.58
18	630	6	.0167	137	2.29	7	.0520	149	7.77
19	701	5	.0061	113	0.69	7	.0564	139	7.88
20	702	7	.0053	103	0.55	7	.0618	136	8.41
21	703	5	.0088	105	0.92	7	.0680	128	8.74
22	704	5	.0122	118	1.45	7	.0768	121	9.36
23	705	5	.0095	107	1.01	7	.0836	118	9.91
24	706	6	.0157	110	1.73	7	.0971	115	11.19
25	707	4	.0168	137	2.31	7	.1067	115	12.28
26	708	5	.0186	75	1.40	7	.1200	107	12.92
27	709	6	.0425	136	5.81	7	.1565	111	17.37
28	710	5	.0147	100	1.48	7	.1670	100	16.74
29	711	4	.0209	69	1.44	7	.1790	98	17.68
30	712	5	.0485	76	3.70	7	.2136	93	19.88
31	713	4	.0361	43	1.55	7	.2343	90	21.23
32	714	4	.0256	57	1.48	7	.2489	84	20.96
33	715	3	.0283	10	0.30	7	.2611	81	21.39
34	716	6	.0308	70	2.17	7	.2876	71	20.45
35	717	4	.1038	67	6.98	7	.3469	66	23.21
36	718	4	.0435	55	2.42	7	.3718	64	24.04
37	719	4	.0385	70	2.73	7	.3938	65	25.72
38	720	3	.0263	61	1.62	7	.4050	63	25.84
39	721	5	.0685	40	2.74	7	.4540	56	25.43
40	722	4	.0434	53	2.30	7	.4788	50	24.38
41	723	3	.0553	41	2.29	7	.5026	48	24.30
42	724	3	.0891	67	5.97	7	.5408	39	21.26
43	725	4	.0402	63	2.54	7	.5638	40	23.09
44	726	4	.0580	58	3.37	7	.5969	39	23.75
45	727	3	.0650	52	3.42	7	.6248	40	25.39
46	728	4	.0906	96	8.70	7	.6766	31	21.39
47	729	4	.0549	51	2.81	7	.7080	28	20.19
48	730	4	.0351	71	2.52	7	.7280	26	19.59
49	731	5	.0416	78	3.27	7	.7578	26	19.73
50	801	3	.1001	71	7.18	7	.8007	20	16.10
51	802	2	.0877	68	6.00	7	.8258	18	15.43

Table 22 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
52	803	3	.1979	70	14.02	7	.9106	14	12.82
53	804	4	.0726	60	4.42	7	.9521	9	8.86
54	805	3	.1007	112	11.29	7	.9953	1	1.14
55	806	1	.0326	0	0	7	1.0000	0	0

Table 23. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981. Northwestern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
15	627	1	.0632	0	0	1	.0632	0	0
16	628	1	.0290	0	0	1	.0921	0	0
17	629	1	.0388	0	0	1	.1310	0	0
18	630	2	.0064	96	0.62	2	.0719	99	7.16
19	701	2	.0103	94	0.96	2	.0820	99	8.14
20	702	3	.0080	77	0.62	4	.0470	143	6.74
21	703	3	.0063	136	0.86	4	.0517	125	6.51
22	704	3	.0151	139	2.11	5	.0505	157	7.96
23	705	3	.0431	75	3.25	5	.0763	127	9.74
24	706	2	.0503	40	2.03	5	.0965	118	11.39
25	707	2	.0184	38	0.71	5	.1038	116	12.09
26	708	2	.0222	54	1.21	5	.1128	116	13.16
27	709	2	.0289	62	1.80	5	.1244	108	13.50
28	710	2	.0181	2	0.03	5	.1316	102	13.52
29	711	4	.0238	46	1.10	5	.1507	95	14.46
30	712	3	.0257	60	1.54	6	.1384	109	15.13
31	713	3	.0439	79	3.50	6	.1604	109	17.63
32	714	5	.0310	55	1.73	6	.1863	92	17.17
33	715	4	.0318	49	1.56	6	.2075	85	17.78
34	716	6	.0391	57	2.23	6	.2467	74	18.30
35	717	4	.0458	28	1.29	6	.2773	66	18.30
36	718	5	.0685	65	4.47	6	.3344	62	20.75
37	719	5	.0429	56	2.40	6	.3702	60	22.55
38	720	4	.0565	83	4.71	6	.4079	62	25.54
39	721	5	.0352	67	2.37	6	.4373	56	24.90
40	722	4	.0430	47	2.06	6	.4660	50	23.49
41	723	5	.0451	43	1.94	6	.5035	46	23.61
42	724	5	.0680	92	6.28	7	.4802	51	24.69
43	725	5	.0429	25	1.10	7	.5108	52	26.66
44	726	4	.0374	30	1.15	7	.5322	49	26.61
45	727	4	.0817	75	6.18	7	.5789	43	25.28
46	728	5	.0730	40	2.97	7	.6311	36	23.18
47	729	5	.0592	41	2.42	7	.6734	31	20.93
48	730	6	.0853	64	5.46	7	.7465	30	22.44
49	731	5	.0569	73	4.16	7	.7872	26	20.97
50	801	3	.0483	38	1.85	7	.8079	26	21.51
51	802	3	.0536	81	4.35	7	.8309	22	18.38
52	803	3	.0781	61	4.77	7	.8644	18	15.82
53	804	4	.0787	36	2.89	7	.9093	14	13.36
54	805	3	.0754	23	1.78	7	.9417	10	10.19
55	806	3	.0602	52	3.17	7	.9675	8	7.95
56	807	0	.0000	0	0	7	.9675	8	7.95
57	808	1	.1472	0	0	7	.9885	2	2.80
58	809	1	.0744	0	0	7	.9991	0	0.19
59	810	1	.0057	0	0	7	1.0000	0	0

Table 24. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981. Southwestern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
4	616	1	.0129	0	0	1	.0129	0	0
5	617	0	.0000	0	0	1	.0129	0	0
6	618	0	.0000	0	0	1	.0129	0	0
7	619	0	.0000	0	0	1	.0129	0	0
8	620	0	.0000	0	0	1	.0129	0	0
9	621	0	.0000	0	0	1	.0129	0	0
10	622	0	.0000	0	0	1	.0129	0	0
11	623	1	.0269	0	0	1	.0398	0	0
12	624	1	.0126	0	0	1	.0525	0	0
13	625	0	.0000	0	0	1	.0525	0	0
14	626	0	.0000	0	0	1	.0525	0	0
15	627	1	.0148	0	0	2	.0336	56	1.88
16	628	1	.0095	0	0	2	.0383	36	1.41
17	629	2	.0007	57	0.04	3	.0260	81	2.13
18	630	1	.0006	0	0	3	.0262	80	2.10
19	701	2	.0074	91	0.68	3	.0312	69	2.16
20	702	2	.0042	74	0.31	4	.0255	82	2.10
21	703	2	.0028	57	0.16	4	.0269	73	1.98
22	704	2	.0110	45	0.49	4	.0325	68	2.21
23	705	4	.0410	117	4.83	4	.0735	88	6.47
24	706	3	.0123	67	0.83	4	.0827	76	6.33
25	707	2	.0175	73	1.28	4	.0915	71	6.57
26	708	2	.0109	32	0.35	4	.0970	68	6.63
27	709	3	.0093	21	0.19	4	.1040	61	6.34
28	710	2	.0080	37	0.30	4	.1080	55	5.97
29	711	3	.0148	43	0.65	4	.1192	50	6.01
30	712	4	.0153	75	1.15	5	.1076	72	7.75
31	713	4	.0144	74	1.08	5	.1191	70	8.40
32	714	6	.0180	57	1.04	6	.1172	79	9.29
33	715	6	.0161	68	1.10	6	.1334	73	9.83
34	716	6	.0152	57	0.86	6	.1487	66	9.90
35	717	5	.0166	60	1.01	6	.1625	59	9.66
36	718	5	.0234	43	1.01	6	.1821	57	10.55
37	719	4	.0218	36	0.79	6	.1966	57	11.38
38	720	4	.0229	58	1.33	6	.2119	57	12.29
39	721	6	.0287	66	1.91	6	.2406	53	12.98
40	722	6	.0337	65	2.22	6	.2744	53	14.60
41	723	7	.0649	93	6.08	7	.3001	68	20.57
42	724	6	.0385	87	3.39	7	.3332	59	19.74
43	725	6	.0492	70	3.44	7	.3754	56	21.15
44	726	6	.0384	77	2.99	7	.4084	53	21.83
45	727	6	.0400	52	2.10	7	.4427	51	22.62
46	728	6	.0449	47	2.11	7	.4812	48	23.30
47	729	6	.0415	40	1.69	7	.5168	47	24.39
48	730	6	.0531	58	3.08	7	.5624	42	24.01
49	731	6	.0492	64	3.18	7	.6046	39	23.98
50	801	4	.0638	40	2.58	7	.6411	39	25.40
51	802	5	.0474	51	2.43	7	.6749	38	25.85
52	803	4	.0500	72	3.63	7	.7035	37	26.26
53	804	5	.0442	57	2.55	7	.7351	35	26.22

Table 24 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
54	805	5	.0617	66	4.11	7	.7793	33	26.15
55	806	5	.0328	51	1.69	7	.8027	32	26.39
56	807	4	.0266	56	1.51	7	.8179	32	26.27
57	808	3	.0167	63	1.06	7	.8251	31	26.39
58	809	2	.0341	71	2.43	7	.8349	31	26.17
59	810	2	.0365	41	1.50	7	.8453	30	26.10
60	811	2	.0981	56	5.55	7	.8733	23	20.93
61	812	3	.0357	84	3.03	7	.8886	20	18.42
62	813	2	.0261	36	0.94	7	.8961	20	18.48
63	814	2	.0178	66	1.18	7	.9012	20	18.61
64	815	2	.0939	82	7.73	7	.9281	13	12.77
65	816	2	.0150	45	0.68	7	.9323	13	12.88
66	817	1	.0120	0	0	7	.9341	13	12.84
67	818	0	.0000	0	0	7	.9341	13	12.84
68	819	0	.0000	0	0	7	.9341	13	12.84
69	820	2	.0779	55	4.31	7	.9563	9	8.64
70	821	0	.0000	0	0	7	.9563	9	8.64
71	822	1	.1379	0	0	7	.9760	4	4.07
72	823	0	.0000	0	0	7	.9760	4	4.07
73	824	1	.1020	0	0	7	.9906	1	1.91
74	825	1	.0067	0	0	7	.9915	1	1.92
75	826	0	.0000	0	0	7	.9915	1	1.92
76	827	0	.0000	0	0	7	.9915	1	1.92
77	828	0	.0000	0	0	7	.9915	1	1.92
78	829	0	.0000	0	0	7	.9915	1	1.92
79	830	0	.0000	0	0	7	.9915	1	1.92
80	831	1	.0036	0	0	7	.9920	1	1.93
81	901	0	.0000	0	0	7	.9920	1	1.93
82	902	0	.0000	0	0	7	.9920	1	1.93
83	903	0	.0000	0	0	7	.9920	1	1.93
84	904	0	.0000	0	0	7	.9920	1	1.93
85	905	0	.0000	0	0	7	.9920	1	1.93
86	906	0	.0000	0	0	7	.9920	1	1.93
87	907	0	.0000	0	0	7	.9920	1	1.93
88	908	0	.0000	0	0	7	.9920	1	1.93
89	909	0	.0000	0	0	7	.9920	1	1.93
90	910	0	.0000	0	0	7	.9920	1	1.93
91	911	0	.0000	0	0	7	.9920	1	1.93
92	912	1	.0554	0	0	7	1.0000	0	0

Table 25. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1973 - 1981. Montague district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
30	712	1	.0555	0	0	1	.0555	0	0
31	713	1	.0142	0	0	1	.0697	0	0
32	714	1	.0479	0	0	1	.1176	0	0
33	715	0	.0000	0	0	1	.1176	0	0
34	716	1	.0376	0	0	1	.1552	0	0
35	717	1	.0399	0	0	1	.1951	0	0
36	718	1	.0421	0	0	1	.2372	0	0
37	719	1	.0316	0	0	1	.2687	0	0
38	720	1	.0290	0	0	1	.2978	0	0
39	721	0	.0000	0	0	1	.2978	0	0
40	722	0	.0000	0	0	1	.2978	0	0
41	723	2	.0443	27	1.24	2	.1931	70	13.64
42	724	4	.1341	84	11.28	4	.2307	48	11.27
43	725	4	.1144	63	7.22	5	.2760	51	14.27
44	726	4	.1127	64	7.24	5	.3662	46	16.99
45	727	4	.1054	52	5.50	5	.4506	45	20.28
46	728	4	.1060	40	4.30	5	.5354	32	17.28
47	729	4	.0967	62	6.08	5	.6128	30	18.70
48	730	5	.1028	51	5.25	5	.7156	23	16.50
49	731	4	.0733	21	1.57	5	.7743	17	13.79
50	801	4	.0660	27	1.79	5	.8271	14	12.19
51	802	2	.0591	19	1.16	5	.8508	14	12.42
52	803	3	.0276	68	1.89	5	.8674	12	11.24
53	804	3	.0966	48	4.65	5	.9253	7	6.73
54	805	1	.0917	0	0	5	.9437	5	4.78
55	806	2	.0537	50	2.69	5	.9652	4	4.70
56	807	1	.0254	0	0	5	.9703	4	4.58
57	808	1	.0163	0	0	5	.9735	4	4.62
58	809	0	.0000	0	0	5	.9735	4	4.62
59	810	2	.0314	94	2.97	5	.9861	2	2.22
60	811	2	.0315	61	1.94	5	.9987	0	0.25
61	812	1	.0064	0	0	5	1.0000	0	0

Table 26. Average daily proportion of CPUE, average cumulative proportion of CPUE, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1969 - 1981. Southeastern district, Prince William Sound.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
12	624	1	.0095	0	0	1	.0095	0	0
13	625	0	.0000	0	0	1	.0095	0	0
14	626	0	.0000	0	0	1	.0095	0	0
15	627	0	.0000	0	0	1	.0095	0	0
16	628	0	.0000	0	0	1	.0095	0	0
17	629	0	.0000	0	0	1	.0095	0	0
18	630	0	.0000	0	0	1	.0095	0	0
19	701	0	.0000	0	0	1	.0095	0	0
20	702	0	.0000	0	0	1	.0095	0	0
21	703	1	.0217	0	0	2	.0156	39	0.61
22	704	3	.0295	58	1.71	3	.0399	35	1.40
23	705	1	.0522	0	0	3	.0573	61	3.51
24	706	2	.0273	67	1.84	3	.0755	72	5.48
25	707	2	.0293	46	1.34	3	.0950	76	7.24
26	708	2	.0271	24	0.65	3	.1131	75	8.56
27	709	2	.0314	15	0.49	4	.1005	81	8.19
28	710	2	.0256	28	0.74	4	.1134	68	7.75
29	711	3	.0331	42	1.39	4	.1382	68	9.40
30	712	2	.0397	29	1.17	4	.1581	70	11.12
31	713	4	.0273	64	1.76	5	.1483	91	13.50
32	714	6	.0255	57	1.47	6	.1491	94	14.05
33	715	5	.0423	21	0.92	6	.1844	80	14.78
34	716	6	.0370	45	1.69	6	.2214	71	15.86
35	717	6	.0318	75	2.40	6	.2533	61	15.57
36	718	5	.0567	35	2.03	6	.3005	59	17.77
37	719	4	.0363	41	1.51	6	.3248	57	18.70
38	720	4	.0310	51	1.58	6	.3455	57	19.87
39	721	6	.0346	43	1.52	6	.3800	53	20.25
40	722	6	.0347	46	1.62	6	.4147	49	20.48
41	723	7	.0502	75	3.80	7	.4057	55	22.68
42	724	5	.0519	68	3.55	7	.4428	48	21.38
43	725	5	.0597	40	2.41	7	.4855	44	21.76
44	726	5	.0515	82	4.25	7	.5224	41	21.83
45	727	5	.0500	48	2.40	7	.5581	40	22.34
46	728	6	.0488	26	1.29	7	.5999	37	22.29
47	729	5	.0462	32	1.49	7	.6330	35	22.25
48	730	6	.0610	30	1.89	7	.6853	30	20.63
49	731	5	.0581	35	2.07	7	.7269	29	21.18
50	801	5	.0507	27	1.37	7	.7631	28	21.91
51	802	4	.0478	27	1.31	7	.7904	25	20.47
52	803	4	.0443	42	1.89	7	.8158	24	20.04
53	804	4	.0438	43	1.91	7	.8408	22	18.56
54	805	4	.0394	45	1.78	7	.8634	20	17.28
55	806	5	.0424	63	2.70	7	.8937	16	14.52
56	807	4	.0331	74	2.47	7	.9126	13	12.22
57	808	3	.0359	60	2.16	7	.9280	13	12.70
58	809	2	.0525	76	3.99	7	.9430	10	9.60
59	810	3	.0251	90	2.28	7	.9538	8	7.75
60	811	2	.0410	87	3.59	7	.9655	5	5.19
61	812	1	.0737	0	0	7	.9760	2	2.92

Table 26 continued.

Day No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
62	813	2	.0325	75	2.45	7	.9853	1	1.91
63	814	0	.0000	0	0	7	.9853	1	1.91
64	815	0	.0000	0	0	7	.9853	1	1.91
65	816	2	.0381	40	1.54	7	.9962	0	0.92
66	817	0	.0000	0	0	7	.9962	0	0.92
67	818	0	.0000	0	0	7	.9962	0	0.92
68	819	0	.0000	0	0	7	.9962	0	0.92
69	820	0	.0000	0	0	7	.9962	0	0.92
70	821	0	.0000	0	0	7	.9962	0	0.92
71	822	0	.0000	0	0	7	.9962	0	0.92
72	823	0	.0000	0	0	7	.9962	0	0.92
73	824	0	.0000	0	0	7	.9962	0	0.92
74	825	0	.0000	0	0	7	.9962	0	0.92
75	826	0	.0000	0	0	7	.9962	0	0.92
76	827	0	.0000	0	0	7	.9962	0	0.92
77	828	1	.0263	0	0	7	1.0000	0	0

Table 27. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1964 - 1982. Eastern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
2	626	1	.0003	0	0	1	.0003	0	0
3	703	4	.0030	74	0.22	4	.0031	71	0.22
4	710	8	.0075	81	0.61	8	.0091	89	0.81
5	717	9	.0337	63	2.14	10	.0376	59	2.24
6	724	9	.1355	125	17.00	10	.1596	107	17.23
7	731	10	.1115	53	6.01	10	.2712	65	17.77
8	807	9	.1278	29	3.77	10	.3862	39	15.14
9	814	10	.1706	37	6.45	10	.5569	36	20.57
10	821	8	.1862	26	4.87	10	.7059	27	19.06
11	828	8	.1649	50	8.38	10	.8378	18	15.61
12	904	7	.1354	59	8.01	10	.9326	9	9.15
13	911	4	.1603	48	7.79	10	.9968	0	0.66
14	918	2	.0147	23	0.34	10	.9997	0	0
15	925	1	.0024	0	0	10	1.0000	0	0

Table 28. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1964 - 1982. Northern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
1	619	1	.0866	0	0	1	.0866	0	0
2	626	0	.0000	0	0	1	.0866	0	0
3	703	0	.0000	0	0	1	.0866	0	0
4	710	3	.0023	80	0.18	3	.0311	128	4.00
5	717	4	.0015	69	0.10	6	.0166	191	3.18
6	724	8	.0665	118	7.87	9	.0702	105	7.39
7	731	10	.0523	69	3.61	10	.1155	64	7.50
8	807	9	.1320	61	8.09	10	.2343	35	8.25
9	814	10	.2709	62	16.85	10	.5052	43	22.18
10	821	5	.2559	22	5.87	10	.6332	31	19.65
11	828	7	.3535	43	15.24	10	.8807	17	15.79
12	904	5	.2021	73	14.87	10	.9318	3	3.27
13	911	4	.0374	76	2.87	10	.9968	0	0.95
14	918	1	.0319	0	0	10	1.0000	0	0

Table 29. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1964 - 1982. Coghill district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
2	626	1	.0000	0	0	1	.0000	0	0
3	703	1	.0011	0	0	1	.0011	0	0
4	710	1	.0022	0	0	1	.0033	0	0
5	717	6	.0302	100	3.05	6	.0308	97	3.01
6	724	8	.0409	75	3.09	8	.0639	80	5.17
7	731	7	.1459	127	18.58	10	.1533	100	15.36
8	807	9	.1616	56	9.19	10	.2988	51	15.43
9	814	10	.3092	41	12.84	10	.6080	40	24.64
10	821	5	.2647	48	12.95	10	.7404	22	16.83
11	828	7	.2648	42	11.27	10	.9257	10	9.78
12	904	5	.1306	66	8.69	10	.9911	1	1.58
13	911	2	.0324	45	1.48	10	.9976	0	0.47
14	918	2	.0098	10	0.10	10	.9995	0	0.12
15	925	1	.0043	0	0	10	1.0000	0	0

Table 30. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1964 - 1982. Northwestern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
3	703	1	.0002	0	0	1	.0002	0	0
4	710	0	.0000	0	0	1	.0002	0	0
5	717	5	.0108	26	0.28	5	.0108	26	0.28
6	724	8	.0444	98	4.36	9	.0455	99	4.53
7	731	9	.0679	80	5.50	10	.1021	53	5.46
8	807	9	.1409	35	4.95	10	.2290	42	9.64
9	814	10	.2759	37	10.21	10	.5050	28	14.47
10	821	6	.2895	84	24.43	10	.6787	23	16.15
11	828	8	.2895	52	15.18	10	.9104	10	9.83
12	904	6	.1335	64	8.63	10	.9905	2	2.47
13	911	2	.0296	60	1.77	10	.9964	1	1.06
14	918	1	.0236	0	0	10	.9988	0	0.35
15	925	1	.0118	0	0	10	1.0000	0	0

Table 31. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1964, 1968, 1970, 1980, 1982. Eshamy district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
5	717	1	.0089	0	0	1	.0089	0	0
6	724	2	.1900	84	15.99	2	.1945	79	15.54
7	731	2	.0980	22	2.19	2	.2925	60	17.74
8	807	2	.1748	0	0.07	3	.3116	39	12.17
9	814	3	.2386	50	11.97	4	.4126	36	15.20
10	821	2	.1484	67	10.08	5	.3895	66	25.91
11	828	5	.5879	49	29.33	5	.9775	4	4.50
12	904	1	.0605	0	0	5	.9895	2	2.08
13	911	1	.0301	0	0	5	.9956	0	0.87
14	918	1	.0148	0	0	5	.9985	0	0.28
15	925	1	.0072	0	0	5	1.0000	0	0

Table 32. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1964 - 1982. Southwestern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
4	710	1	.0051	0	0	1	.0051	0	0
5	717	3	.0062	81	0.50	3	.0079	93	0.74
6	724	8	.0429	61	2.63	8	.0459	63	2.92
7	731	9	.0725	43	3.14	9	.1134	35	3.99
8	807	7	.1252	36	4.57	9	.2108	35	7.45
9	814	9	.2808	31	8.82	9	.4916	26	12.98
10	821	6	.2373	65	15.59	10	.5849	29	17.17
11	828	9	.3097	65	20.32	10	.8636	22	19.09
12	904	5	.2558	78	19.99	10	.9916	2	2.50
13	911	1	.0479	0	0	10	.9964	1	1.07
14	918	1	.0239	0	0	10	.9988	0	0.35
15	925	1	.0119	0	0	10	1.0000	0	0

Table 33. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1964 - 1982. Montague district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
4	710	2	.0005	27	0.01	2	.0005	27	0.01
5	717	5	.0019	115	0.22	5	.0021	97	0.21
6	724	8	.0208	110	2.30	9	.0196	122	2.42
7	731	8	.0460	80	3.72	10	.0545	102	5.57
8	807	9	.0878	64	5.64	10	.1336	80	10.71
9	814	9	.2392	32	7.72	10	.3489	50	17.60
10	821	7	.2311	50	11.65	10	.5108	27	14.13
11	828	7	.4077	42	17.29	10	.7962	16	13.39
12	904	8	.2402	44	10.61	10	.9884	3	3.25
13	911	1	.0623	0	0	10	.9946	1	1.39
14	918	2	.0188	65	1.23	10	.9984	0	0.46
15	925	1	.0156	0	0	10	1.0000	0	0

Table 34. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for even-years: 1964 - 1982. Southeastern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
4	710	2	.0007	33	0.02	2	.0007	33	0.02
5	717	5	.0022	106	0.23	5	.0025	88	0.22
6	724	8	.0243	103	2.51	9	.0230	114	2.64
7	731	8	.0527	81	4.28	10	.0629	99	6.27
8	807	9	.0938	59	5.56	10	.1473	76	11.21
9	814	9	.2309	23	5.35	10	.3552	46	16.44
10	821	7	.2362	45	10.80	10	.5206	24	12.53
11	828	7	.3947	49	19.44	10	.7969	19	15.16
12	904	7	.2741	38	10.44	10	.9888	3	3.08
13	911	1	.0590	0	0	10	.9947	1	1.32
14	918	2	.0190	55	1.05	10	.9985	0	0.44
15	925	1	.0147	0	0	10	1.0000	0	0

Table 35. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1965 - 1983. Eastern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
2	626	2	.0011	90	0.09	2	.0011	90	0.09
3	703	4	.0270	82	2.22	4	.0275	83	2.31
4	710	10	.0400	82	3.29	10	.0511	97	4.99
5	717	9	.1120	49	5.50	10	.1519	63	9.70
6	724	9	.1523	71	10.91	10	.2890	66	19.12
7	731	10	.1399	61	8.59	10	.4289	61	26.57
8	807	8	.1121	44	5.00	10	.5186	52	27.46
9	814	8	.1393	51	7.17	10	.6302	34	22.00
10	821	5	.0853	21	1.85	10	.6728	36	24.27
11	828	9	.2505	83	20.95	10	.8983	15	13.80
12	904	5	.0719	58	4.20	10	.9343	15	14.40
13	911	3	.1734	114	19.92	10	.9863	3	3.13
14	918	3	.0354	134	4.76	10	.9969	0	0.91
15	925	1	.0305	0	0	10	1.0000	0	0

Table 36. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1965 - 1983. Northern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
2	626	2	.0007	6	0	2	.0007	6	0
3	703	4	.0286	95	2.73	4	.0290	95	2.77
4	710	7	.0423	88	3.74	7	.0589	97	5.76
5	717	7	.0891	46	4.16	9	.1152	69	8.02
6	724	8	.1507	33	5.04	10	.2242	65	14.63
7	731	10	.2511	49	12.45	10	.4753	49	23.41
8	807	8	.1766	39	6.97	10	.6167	36	22.48
9	814	6	.2016	41	8.35	10	.7376	19	14.66
10	821	5	.1309	73	9.64	10	.8031	20	16.64
11	828	8	.1878	80	15.14	10	.9534	6	6.03
12	904	5	.0811	81	6.59	10	.9940	1	1.38
13	911	2	.0298	52	1.55	10	1.0000	0	0

Table 37. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1965 - 1983. Coghill district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
2	626	1	.0055	0	0	1	.0055	0	0
3	703	2	.0069	0	0	2	.0097	29	0.28
4	710	4	.0372	111	4.15	4	.0421	93	3.92
5	717	5	.0499	66	3.30	7	.0597	57	3.42
6	724	7	.1401	107	15.11	8	.1748	102	18.00
7	731	10	.2070	122	25.46	10	.3469	85	29.54
8	807	9	.1673	38	6.46	10	.4975	56	27.87
9	814	6	.2182	123	26.89	10	.6284	45	28.74
10	821	3	.0893	85	7.67	10	.6552	45	29.91
11	828	7	.2706	83	22.60	10	.8447	34	29.15
12	904	3	.2802	92	25.91	10	.9288	22	21.22
13	911	1	.0040	0	0	10	.9292	22	21.23
14	918	1	.7079	0	0	10	1.0000	0	0

Table 38. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1965 - 1983. Northwestern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
4	710	2	.0038	92	0.35	2	.0038	92	0.35
5	717	2	.0147	48	0.71	3	.0123	56	0.69
6	724	4	.1399	63	8.89	5	.1193	84	10.10
7	731	9	.1661	151	25.12	9	.2324	132	30.88
8	807	7	.1077	115	12.44	10	.2846	115	32.97
9	814	4	.2117	44	9.48	10	.3693	80	29.63
10	821	5	.2482	99	24.67	10	.4935	63	31.25
11	828	7	.5353	33	17.70	10	.8682	29	25.63
12	904	3	.2135	68	14.55	10	.9323	15	14.27
13	911	2	.1137	91	10.46	10	.9550	14	13.48
14	918	0	.0000	0	0	10	.9550	14	13.48
15	925	1	.4494	0	0	10	1.0000	0	0

Table 39. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1967, 1971, 1977, 1981. Eshamy district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
4	710	1	.0185	0	0	1	.0185	0	0
5	717	1	.0055	0	0	1	.0240	0	0
6	724	1	.0273	0	0	1	.0514	0	0
7	731	1	.1109	0	0	1	.1622	0	0
8	807	3	.2909	90	26.32	3	.3450	74	25.69
9	814	1	.1430	0	0	3	.3927	68	26.98
10	821	3	.1442	102	14.83	4	.4027	99	39.94
11	828	2	.5922	65	38.86	4	.6988	55	38.45
12	904	2	.4220	94	39.95	4	.9098	10	10.00
13	911	1	.2417	0	0	4	.9702	5	5.14
14	918	1	.1189	0	0	4	1.0000	0	0

Table 40. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1965 - 1981. Southwestern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
6	724	4	.0335	120	4.05	4	.0335	120	4.05
7	731	6	.0480	69	3.34	7	.0603	61	3.71
8	807	6	.1083	67	7.30	9	.1191	81	9.69
9	814	5	.2226	53	11.93	9	.2428	51	12.53
10	821	6	.2711	91	24.91	9	.4236	51	21.62
11	828	7	.5348	20	10.71	9	.8396	29	25.01
12	904	4	.2439	86	21.21	9	.9480	10	9.57
13	911	2	.1285	94	12.11	9	.9765	6	6.62
14	918	1	.2107	0	0	9	1.0000	0	0

Table 41. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1965 - 1983. Montague district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
3	703	1	.0009	0	0	1	.0009	0	0
4	710	1	.0087	0	0	1	.0095	0	0
5	717	6	.0205	119	2.45	7	.0189	121	2.30
6	724	9	.0765	102	7.83	9	.0912	98	9.01
7	731	10	.1727	127	22.01	10	.2548	116	29.71
8	807	8	.1633	93	15.33	10	.3855	89	34.66
9	814	8	.1380	88	12.28	10	.4959	63	31.43
10	821	8	.1460	53	7.76	10	.6128	38	23.67
11	828	7	.3329	56	18.74	10	.8458	24	20.64
12	904	5	.2073	49	10.26	10	.9495	11	10.99
13	911	3	.1311	96	12.68	10	.9888	2	2.26
14	918	2	.0555	17	0.95	10	.9999	0	0
15	925	1	.0001	0	0	10	1.0000	0	0

Table 42. Average daily proportion of escapement, average cumulative proportion of escapement, their coefficients of variation, standard deviations (x100), and sample sizes for odd-years: 1965 - 1983. Southeastern district, Prince William Sound.

Week No.	Date	Sample Size	Avg. Prop.	C.V.	S.D. x100	Sample Size	Avg. Cum. Prop.	C.V.	S.D. x100
3	703	1	.0015	0	0	1	.0015	0	0
4	710	1	.0145	0	0	1	.0160	0	0
5	717	6	.0236	108	2.57	7	.0225	106	2.39
6	724	9	.0866	93	8.11	9	.1042	89	9.35
7	731	9	.2033	107	21.78	10	.2767	107	29.70
8	807	8	.1840	81	15.03	10	.4240	80	34.24
9	814	7	.1650	69	11.41	10	.5395	55	29.87
10	821	8	.1737	63	10.98	10	.6785	32	21.74
11	828	6	.3107	66	20.79	10	.8649	18	16.01
12	904	5	.1699	42	7.30	10	.9499	11	11.28
13	911	3	.1330	105	13.98	10	.9898	2	2.02
14	918	2	.0505	6	0.33	10	.9999	0	0
15	925	1	.0002	0	0	10	1.0000	0	0

VITA

Louis John Rugolo was born on May 31, 1950 in New York City, New York. He completed his secondary education at Msgr. McClancy Memorial High School, Jackson Heights, New York. In 1972 he received a Bachelor of Science in Biology from York College of the City University of New York.

From 1976 - 1978 he attended Queens College of the City University of New York under a non-degree program where his studies emphasized geological sciences. He became an associate member of Sigma Xi, The Scientific Research Society in 1978.

In the fall of 1980 he began his graduate education in oceanography at Old Dominion University receiving a university fellowship for his first academic year. In February 1981 he was granted a bypass of the Master's of Science in Oceanography.

He is a member of Phi Kappa Phi Honor Society, and the National Dean's List of Graduate Scholars. His professional affiliations include, The American Fisheries Society, Sigma Xi, and The American Association for the Advancement of Science.

He was married to Evelyn Main in January 1976, and experienced the joyous birth of his son, John Edward Rugolo, in June 1979.