Special Publication No. 07-13

The Arctic-Yukon-Kuskokwim Salmon Database Management System

Final Report for Project 07-11, *Norton Sound Salmon Information Database,*
Norton Sound Salmon Research and Restoration Program and
Project FIS 04-701, *Develop Shared Fishery Database,*
USFWS Office of Subsistence Management, Fisheries Information Services Division

by

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Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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The Division of Sport Fish Special Publications series was established in 1991 for the publication of techniques and procedures manuals, informational pamphlets, special subject reports to decision-making bodies, symposia and workshop proceedings, application software documentation, in-house lectures, and other documents that do not fit in another publication series of the Division of Sport Fish. Since 2004, the Division of Commercial Fisheries has also used the same Special Publication series. Special Publications are intended for fishery and other technical professionals. Special Publications are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm. This publication has undergone editorial and peer review.

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ABSTRACT

The Alaska Department of Fish and Game (ADF&G), Division of Commercial Fisheries, Arctic-Yukon-Kuskokwim (AYK) Region, has created a salmon database management system (DBMS). The goal is to provide managers, researchers, and the public involved in salmon fisheries in the AYK Region with a system to enter and process new data, as well as to retrieve historical data. The AYK salmon DBMS allows users to store, modify, and extract AYK project descriptions (metadata), biological measurements of salmon age, sex, and length, escapement data, and Norton Sound test fisheries data, through an Internet site. The DBMS functions via the internet and desktop applications. It is available at http://sf.adfg.state.ak.us/CFPROJECTS/AYKDBMS/Default.aspx. This report represents a final report for two projects providing funding support. It is the fifth year of funding from the Fishery Disaster Relief Program for Norton Sound (NOAA NA16FW1272) which supported Norton Sound components of the AYK salmon DBMS and the third year of funding from the United States Fish and Wildlife Service, Office of Subsistence Management for project FIS 04-701.

Key words: Arctic, Yukon, Kuskokwim, Norton Sound, database management system, metadata, salmon, salmon age-sex-size data, ASL, escapement.

INTRODUCTION

Effectiveness of fishery management is enhanced when full use is made of existing information. Timely access to critical information from many sources is needed to make informed decisions. Furthermore, increasing participation by public entities and federal agencies in both data collection and fishery management decision-making makes it imperative all parties have access to the same information. Funds were provided by the U.S. Fish and Wildlife Service (USFWS) Office of Subsistence Management (OSM), the Alaska Department of Fish and Game (ADF&G) general funds and other federal grants, specifically the Norton Sound Salmon Research and Restoration fund (NSSRR), for the Arctic-Yukon-Kuskokwim (AYK) Region of ADF&G to create a database management system in which all data will be centralized, have a standard format, and be shared among management agencies and the general public.

AYK Region salmon fisheries are managed by both State (all users) and Federal (federally qualified subsistence users only) staff. This region encompasses over 70% of the landmass in Alaska and includes Norton Sound, Kotzebue Sound, Port Clarence, and the Yukon and Kuskokwim rivers (Figure 1). It is characterized by a diversity of commercial, subsistence, sport, and personal use fisheries harvesting freshwater, anadromous, and marine fish species. ADF&G, Division of Commercial Fisheries (CF) has divided the region into four areas for salmon management purposes: (1) Kuskokwim, (2) Yukon, (3) Norton Sound/Port Clarence, and (4) Kotzebue Sound areas. The Yukon River also extends into the Yukon Territory of Canada where fisheries are managed by Canada Department of Fisheries and Oceans (CDFO).

GOAL AND OBJECTIVES FOR THE AYK SALMON DATABASE MANAGEMENT SYSTEM

The AYK salmon database management system (DBMS) was supported by two projects. The Norton Sound Salmon Research and Restoration fund supports project 07-11, *Norton Sound Information Database,* and the USFWS OSM approved funding for project FIS 04-701, *Develop Shared Fishery Database*. Each project specified annual objectives and deliverables for the components they fund (Brannian et al. 2004, 2005a; 2005b, 2006). The overall goal and objectives for the AYK salmon DBMS are:

Goal: Provide managers, researchers, and public entities involved in salmon fisheries in AYK a system to submit and process new data as well as retrieve historic data for salmon age, sex, and length (ASL), escapement, and harvest.

Objectives:

1. Provide a system to store, modify, and extract location, agency contact, and general metadata on salmon projects operated (past and present).
2. Provide a system to store, modify, and extract salmon ASL data, escapement count data, escapement survey data, test fishery data, and tagging data.
3. Provide a system to extract data for reporting salmon subsistence and commercial harvest data.
4. Provide a system to direct users to the appropriate website or contact address to obtain AYK salmon data maintained outside ADF&G or outside the AYK Region of the Division of Commercial Fisheries.

AYK SALMON DATABASE MANAGEMENT SYSTEM

The AYK Salmon Database Management System is a data repository system capable of housing different types of data for the AYK Region. The AYK salmon DBMS was planned to offer users three levels of access through the Internet or desktop applications to AYK salmon data (Figure 2). Priority data sets collected or maintained by AYK region Commercial Fisheries Division (CF) staff now resides in databases in which users can store new data, modify existing data, and extract data for reporting and further analysis. Other priority datasets maintained in client-server SQL-compatible databases by ADF&G staff have not been made accessible. This represents a change from our scope of work (Brannian et al. 2004, 2005a; 2005b) and affects only one objective for the Norton Sound project. Users interested in datasets not accessible through the AYK salmon DBMS, but maintained by ADF&G and/or listed as an AYK project in the AYK salmon DBMS, will receive either a contact email address or website link.

The heart of the AYK salmon DBMS is actually its metadata. The metadata stores information about individual projects such as the project's name, description, location, years of operation, agencies involved, and the types of data collected. Additional information allows projects to be categorized by type of project, location, and method associated with each data type collected.

Six datasets maintained by AYK Region CF staff were of sufficiently high priority to be included in the AYK salmon DBMS. The datasets included (1) AYK project descriptions (metadata), (2) ASL data, (3) escapement count data from towers, weirs, and sonar, (4) escapement survey data from aerial, ground, and boat surveys, (5) Yukon River subsistence harvest data, and (6) test fish data for the Norton Sound Area. Only qualified users will be able to store current year data or modify historic data. All users will be able to extract and report non-confidential data[1].

Two datasets maintained by ADF&G staff outside the AYK Region are of priority interest (Hamner et al. 2002; 2003a, 2003b) to potential AYK salmon DBMS users and are not currently internet-accessible. Both commercial and subsistence harvest data outside the Yukon River reside in SQL databases compatible with, and accessible by, the AYK salmon DBMS. We had

[1] Examples of confidential data are Yukon subsistence harvests by individual.

planned for users of the AYK salmon DBMS to be able to extract non-confidential data and run summary reports (for example, commercial catch by day, area, and year) for the Norton Sound area only. This feature was given a lower priority and when staff resources were not available we deferred its development. Applications may be developed to extract data from these databases in the future. Instead users will be provided a link and email contact information for those seeking access to these data.

The AYK salmon DBMS will provide users with a link to the appropriate website or a contact name and email address if data collected by that project are not currently accessible through our system. Examples are ADF&G laboratories which maintain their own data such as the Gene Conservation Laboratory, Pathology Laboratory, and the Mark, Tag, and Age Laboratory, each with a website and contact information. All projects in the AYK project database provide agency contact name, email address, and comments on whether data currently resides in our database.

USING THE AYK SALMON DATABASE MANAGEMENT SYSTEM

The AYK Salmon DBMS is now available through the internet at website: http://sf.adfg.state.ak.us/CFPROJECTS/AYKDBMS/Default.aspx. The key to navigating this website is the text we have prepared describing data types, search filters, project background, metadata, and auxiliary reference material. The purpose of the opening page (Figure 3) is to provide guidance and access to background information on our AYK salmon database management system. In this relational database, we have described the projects in AYK that collect information on salmon. Users are encouraged to learn about our projects and download datasets.

We have attempted to design an easy-to-use system. Users should take the time to understand how we define management areas, data types, project types, and method types. A glossary can be accessed from the main page (Figure 3) and from there access to maps delineating the management areas and fishing districts. This will greatly increase their ease of entry and enhance their understanding of salmon fisheries, stock assessment, and research data available in the AYK Region. To view or extract data, users must develop filters to search for data of interest.

AYK SALMON MANAGEMENT AREAS

An enormous quantity of historical salmon data exists for the AYK region. More than 840 projects to monitor salmon harvests, escapements, and measure stock abundance and biological attributes have been conducted in the region in the last 47 years. Salmon observations have been made at more than 630 locations in the AYK Region. Biological information has been collected for over 46 years from harvests and escapements to estimate the ASL composition of these salmon populations.

Though the AYK salmon database does not operate in a Geographic Information System (GIS), all data are geo-referenced. Users will need to know the geographic area of interest when looking for data. Therefore it is important to know how we have defined AYK, its management areas, and the order of our rivers and lakes.

The Arctic-Yukon-Kuskokwim (AYK) Region includes all waters of Alaska that drain into the Bering Sea, Chukchi Sea, and Arctic Ocean north from Cape Newenham. For the purposes of salmon fishery management the region has been divided into four Management Areas which have been subsequently divided into districts and subdistricts. Area definitions and the designations of districts or subdistricts within each area of AYK in Alaska follow those defined in regulation (AS 5AAC.). The Yukon River in Canada has been defined as a fifth Management Area in AYK for purposes of archiving data in the AYK salmon DBMS. For the Canadian portion of the Yukon River, area names and definitions follow those used by the managing agency; Canada Department of Fisheries and Oceans.

The Kotzebue Area includes all waters of Alaska between Point Hope and Cape Prince of Wales including those waters draining into the Chukchi Sea. It has only one salmon fishing district (Kotzebue District).

The Kuskokwim Area includes the Kuskokwim River drainage, all waters of Alaska that flow into the Bering Sea between Cape Newenham and the Naskonat Peninsula, and Nunivak and St. Matthew Islands. It has four salmon fishing districts representing the Kuskokwim River (W1 and W2), Kuskokwim Bay (W4), and Goodnews Bay (W5).

The Norton Sound- Port Clarence Area includes all waters that drain into Norton Sound from Cape Prince of Wales to Point Romanof, including the waters of Alaska surrounding St. Lawrence Island and those waters draining into the Bering Sea. The area has been divided into two salmon fishing districts; Point Clarence and Norton Sound. The Norton Sound District has been subdivided into six subdistricts: Nome Subdistrict (1), Golovin Subdistrict (2), Moses Point Subdistrict (3), Norton Bay Subdistrict (4), Shaktoolik Subdistrict (5), and Unalakleet Subdistrict (6).

The Yukon-Northern Area includes all waters of Alaska between the latitude of Point Romanof and the latitude of the westernmost point of the Naskonat Peninsula, including those waters draining into the Bering Sea and all waters of Alaska north of the latitude of the westernmost tip of Point Hope and those waters of Alaska draining into the Arctic Ocean and the Chukchi Sea to the north and east. Only the Yukon River drainage has been divided into salmon fishing districts (Y1 through Y6) and represents the area from which salmon data have been collected in the area. The Yukon River also extends into Canada and those waters have been defined as another area for the AYK salmon DBMS.

The Yukon-Canada Area includes all waters of the Yukon River and its tributaries that drain the Yukon Territory and the province of British Columbia in Canada. Salmon do spawn in the Canadian portion of the Porcupine River and the Yukon River. Salmon are not known to pass into the Canadian portion of the Tanana River.

AYK SALMON DATA TYPES

We have attempted to categorize related data into “types” allowing them to reside in separate databases which can accommodate their different data structure (Table 1). Not all data “types” have been added to our DBMS. Currently we include ASL, CPUE (catch per unit effort), Escapement Counts, and Survey Counts as data types. This is in contrast to data relating to radio telemetry locations of salmon (Tag/Mark data), environmental measurements (temperature, water depth, velocity, etc.) or juvenile salmon data which could be added at a later time. We

have also not been able to link to other databases in which reside commercial and subsistence harvest data (Harvest data type).

Age, Sex, and Length

Salmon age, sex, and length data are collected annually from sampled commercial and subsistence harvests, escapement, run timing and abundance monitoring projects in the AYK Region. Scales are collected primarily to determine the age of fish, but may also be examined for growth patterns.

ASL data have been collected in the Yukon Area since 1960, in the Kuskokwim Area since 1961, in the Norton Sound-Port Clarence Area and Kotzebue Areas since 1962. All salmon species have been sampled but the emphasis has been on chum and Chinook salmon. Scales collected from salmon are stored on gum cards along with an acetate impression used to determine age. Both are organized into files by year, species, and project and stored in cabinets located in the Anchorage ADF&G office.

This data type consists of biological measurements of individual salmon sampled from fishery harvests, stock assessment, or research projects. Biological measurements consist of length in mm generally mideye to tail fork, age in European notation as judged from a scale or bony structure, and sex of the fish determined from external characteristics or internal inspection of sex organs. The location of capture for the sampled salmon consists of the general location of the harvest area or more specific location code for the project (weir, tower, test fishery, etc.). Capture gear type may also be included in the data record and should correspond to the method type filter on the website.

Data are generally collected as a sample from a larger population with the intent that the sample's age, length, or sex composition will be representative of the larger population. Examples are the age composition of a harvest from an area, time, and gear combination or the estimation of the age composition of a run of salmon to a specific river.

ASL sampling methods follow standard procedures throughout AYK which were documented by Kohler (2003) for the Kotzebue and Norton Sound-Port Clarence areas, by DuBois and Molyneaux (2000) for the Kuskokwim Area and Bales and Dubois (2007) for the Yukon Area. Three scales were removed from the preferred area of each Chinook, sockeye, and coho salmon, and one to three scales from chum salmon. Scales were then mounted on gum cards (INPFC 1963). Length was generally measured to the nearest millimeter from mideye to the tail fork using a meter stick or tape. The type of length measurement is noted in the database and very old data may represent total length. Sex is determined by visually examining external morphological characteristics such as development of the kype, roundness of the belly, the presence or absence of an ovipositor, and overall size or by internal inspection of sex organs. Data are recorded on computer mark-sense forms, field notebooks, or logged electronically on a computerized fish measuring board or hand held data logger. Data from the 1960s and early 1970s were recorded on tally sheets. The original scale cards, acetates, and data forms are archived at the ADF&G office in Anchorage.

Age is determined from the annuli of scales taken from the preferred area of the fish (INPFC 1963). The scales, which are mounted on gum cards, are impressed in cellulose acetate using methods described by Clutter and Whitesel (1956). The scale impressions are magnified with a

microfiche reader and age is determined through visual identification of annuli. Ages are directly entered into the computer ASCII files using European notation.

Catch per Unit Effort Data

The catch per unit effort (CPUE) data type consists of catches of salmon collected with standardized gear and fishing procedures by ADF&G employees or other cooperating groups. Explicit location, time of day (if less than continuous), and gear dimensions used to capture salmon are also collected. CPUE are calculated from these data.

Test fisheries generally collect CPUE data to monitor salmon migrations and relative abundance. CPUE data are also collected as a secondary objective by other project types. For example, CPUE data are collected as the result of fishing to collect salmon to tag (Capture/Recapture projects) or to estimate the species composition of sonar counts. Fish wheels, set gillnets, and drift gillnets have been used in AYK. CPUE has been expressed for drift gillnets as number of salmon per 100 fathom hours fished. CPUE for set gillnets has been expressed as catch per day.

Only CPUE data from Norton Sound and Kotzebue test fisheries currently reside in the AYK salmon DBMS. These data represent test fish projects operated in the mouth of the Unalakleet River of Norton Sound since 1981 and the lower Kobuk River in the Kotzebue area since 1993. Other AYK CPUE data will be included, as time allows. Fishing location descriptions, methods, and estimation of daily CPUE have been documented for the Unalakleet River by Kohler (2002) and for the Kobuk River by Menard and Kent (2007).

Escapement Count Data

The escapement count data type consists of daily counts or daily estimates of salmon in the AYK Region. Salmon are counted by observers stationed along freshwater migration corridors. Salmon were 1) counted as they were allowed to pass upriver through weirs, 2) counted as they migrated upriver past observers in elevated locations (towers) and, 3) counted by sonar equipment placed in river.

Tower and sonar counts generally represent a sample and are expanded to represent a 24 h period. A number of projects have collected counts since 1965 and represent total spawning populations in major spawning rivers or their tributaries draining into Kotzebue Sound, Norton Sound, Port Clarence, Bering Sea or the Yukon and Kuskokwim rivers. Location, daily count (or estimate), date collected, and count type (observed or estimated) are included in a data record.

Data are collected to estimate or document total spawning abundance; and estimate and document daily and seasonal timing of salmon migrating into the rivers of the AYK Region. We have attempted to include all project data collected in AYK by federal agencies, non-governmental organizations, and data sent to us by CDFO. New project data will be added as we become aware of them.

Escapement count data collected by ADF&G are well documented in department publications. Counting location descriptions, methods, and estimation of daily totals have been documented for each counting location and counting method (tower, weir, or sonar) following routine procedures used by ADF&G. For examples in the Kotzebue area see Dinnocenzo (1982) or LaFlamme (1995). Reports are published annually for Kuskokwim area projects (Costello et al.

2006; Linderman 2005a, 2005b; Shelden et al. 2005). Specific ADF&G reports can also be found at:

http://www.sf.adfg.state.ak.us/statewide/divreports/html/dsp_Simple_Search.cfm.

Generally, escapement count data collected by other agencies are also reported annually and copies of those reports are often posted on the AYK website. For examples see:

http://www.cf.adfg.state.ak.us/region3/pubs/pubshom3.php?a=a.

Harvest Data

The harvest data type consists of catch and effort data collected from commercial, subsistence, or personal use fisheries in AYK. Currently this type of data is not in or can be viewed by the AYK salmon DBMS.

Generally, a sales receipt ("fish ticket") is issued each time salmon are sold by fishers participating in Alaska's commercial fisheries. Data recorded on the fish ticket include fishers permit number, boat identifier if required, catch by species recorded in numbers and pounds, area caught, date caught, etc. Electronic records of these fish tickets from 1969 to the present are archived by the Division of Commercial Fisheries, Computer Services Section, in the ADF&G office in Juneau. Catch by individual fishers of catch purchased by individual processors are confidential.

Detailed information on subsistence harvests by salmon species, number of households, dogs in each household, and other information is collected and maintained by the Division of Subsistence of ADF&G for the Kuskokwim, Norton Sound-Port Clarence, and Kotzebue area, by ADF&G Division of Commercial Fisheries for the Alaska portion of the Yukon drainage, and by CDFO for the Canadian portion of the Yukon drainage. Annual harvests by Alaskan communities are included in a statewide database maintained by the Division of Subsistence. Personal use fisheries only occur in the Yukon River and are monitored by ADF&G. Personal use fishers must obtain and return permits upon which they record harvest data.

Commercial, subsistence, personal use, and sport harvest data are well documented in department publications. The divisions of Commercial Fisheries and Sport Fish publish Annual Management Reports by fishery and area. Copies for AYK can be found at:

http://www.sf.adfg.state.ak.us/statewide/divreports/html/dsp_Adv_Search.cfm

A specific example for the Kuskokwim Area is found at:

http://www.sf.adfg.state.ak.us/FedAidPDFs/fmr05-72.pdf

Survey Count Data

The survey count data type consists of counts of migrating, pre- or post- spawning salmon in the AYK Region. Counts of salmon were made by observers conducting surveys using aircraft, boats, or while walking in or along waterways. Surveys were conducted by ADF&G, U.S. federal agencies, non-governmental organizations, and by CDFO in Canada.

The accuracy of survey count data can be highly variable and is dependent upon a number of factors such as weather and water conditions, timing of survey, altitude, experience of pilot and observer, streambed coloration, and species of salmon enumerated. Surveyors evaluate and record environmental conditions affecting survey quality, rate a survey as poor, fair, or good, and

include notes helpful in data interpretation. Counts, survey location, date collected, observer, agency, environmental conditions, and comments are included as fields in a database record of this data type.

Aerial or ground survey counts of salmon do not necessarily represent total abundance at that location for at least two important reasons. First an observer is rarely able to see all salmon present and the percent observed can vary by observer and weather conditions. Secondly, not all salmon that will migrate into the survey location are present on the day a survey is flown. Some may have arrived much earlier, spawned and their carcasses washed out and some have yet to arrive. Thus the counts are only an index of abundance.

Surveys are generally timed to coincide with peak salmon spawning activity but may be conducted earlier to assess the build up of salmon in a river for fishery management purposes. You should also note that all salmon may be counted but the timing of the survey was chosen to coincide with peak spawning of only one species.

Aerial survey methods in AYK followed routine procedures outlined by ADF&G protocols (Barton 1984). Barton (1987) details aerial survey methods and locations for the Yukon River and documents the codes developed to describe survey conditions. Similar methods and codes for the Kuskokwim Area were published by Burkey and Salomone (1999). Methods and codes used by Burkey and Salomone (1999) and Barton (1987) are applicable to the Kotzebue and Norton Sound – Port Clarence areas. Surveys flown in Canada were conducted by ADF&G staff through 1987 and follow Barton (1987). CDFO surveyors were asked to complete ADF&G data forms with the goal of maintaining consistent data for the Yukon River. General references for aerial salmon surveys include Cousens et al. (1982) and Bevan (1961).

Tag/Mark Data

The tag/mark data type consists of data relating to the release and recapture of tagged or marked salmon. Data consists of tag number, location and date of release, location and date of recovery, fish condition, and other project specific datum. These data are not currently in the AYK salmon DBMS. If interested in these data contact project administrators. Tag/Mark data are well documented in department publications. Copies for AYK can be found at:

http://www.sf.adfg.state.ak.us/statewide/divreports/html/dsp_Adv_Search.cfm

The Mark, Tag, and Age Laboratory of the Division of Commercial Fisheries provides detailed information about thermal marks induced in fish otoliths and maintains a centralized State salmon DBMS for tracking salmon using microscopic tags (coded wire tags among others). Coded wire tags have been placed in chum salmon and Chinook salmon released into the Yukon River. A following website provides access to data in these databases through online reports: http://tagotoweb.adfg.state.ak.us/.

AYK Salmon Project Types

Understanding our definition of a "project" and our attempt to assign each one to a Project Type is key to navigating the AYK salmon DBMS website. Wiktionary defines "project" as a planned endeavor, usually with a specific goal and accomplished in several steps or stages. In AYK all salmon data were collected through "projects" following planned data collection protocols to meet specific objectives for a defined location or area. Furthermore projects can be categorized into types that share common objectives and collect similar "data types" (Table 1).

For example, beginning in 1993 a project was operated on the Nome River which drains into Norton Sound (Management Area). Its objective was to estimate the number of salmon that enter the river to spawn and characterize their age, sex, and size composition (project type: Escapement Monitoring). Salmon were counted as they passed by a tower (data type: Escapement Counts and method type: Tower) from 1993 to 1995 and a weir thereafter (method type: Weir). Salmon were captured at the site and biological measurements and scales were collected to estimate age, sex, and size (data type: ASL). The objective to monitor escapement (total abundance estimation or an index) is common to all projects of the type "Escapement Monitoring." A user could find this project by filtering on at least one of its attributes: Norton Sound Management Area, Escapement Monitoring project type, Tower or Weir method type and ASL or Escapement Count data types. Once the project page is reached the user has the option of highlighting one or more years of interest by data type collected at the project for viewing or retrieval. They can also read background information prepared for the project overall and year specific notes.

We have developed descriptions for all projects, which can be modified and maintained by project administrators. Because of the large number of projects some generic descriptions were developed. Escapement monitoring projects with data type of survey counts number in the 100s and a generic description was developed. Similarly for ASL sampling in general, we developed four generic descriptions, one each for (1) escapement- ancillary or spawning ground sampling projects (2) harvest-commercial, (3) harvest-sport, and (4) harvest-subsistence. Project administrators have the option of customizing project descriptions and year notes in the future.

Capture/Recapture

Projects have been operated in AYK in which tags or marks are placed on or in salmon to monitor migration pathways, spawning destinations, travel time, or are used in mark–recapture experiments to estimate abundance (Hamner et al. 2002). Project data either resides in spreadsheets or published reports. Data from a radio telemetry project for Chinook salmon in the Yukon River and spaghetti tagging projects for chum, sockeye, and coho salmon in the Kuskokwim River and chum salmon on the Tanana River reside in project-specific Access databases and Excel spreadsheets maintained by ADF&G CF staff. Brannian et al. (2004) indicated that funds have not been secured to add tag and mark or CPUE data from these projects to the AYK salmon DBMS. They also recognized these data as a future DBMS component. If ASL data were collected from these projects it is in the DBMS. Metadata for tagging projects (spaghetti or radio telemetry) conducted by ADF&G, federal agencies, and NGOs are also included in the AYK salmon DBMS.

The Mark, Tag, and Age Laboratory of the Division of Commercial Fisheries provides detailed information about thermal marks induced in fish otoliths and maintains a centralized state salmon DBMS for tracking salmon using microscopic tags (coded wire tags, among others). Coded wire tags have been placed in chum salmon and Chinook salmon released into the Yukon River. A website provides access to fisheries data in these databases through online reports. The AYK salmon DBMS direct users interested in these data to http://tagotoweb.adfg.state.ak.us/

Enhancement/Restoration

ADF&G oversees and regulates all salmon rehabilitation and enhancement projects conducted by ADF&G or others. The permitting process for such projects requires the collection of data and approval by geneticists, pathologists, and biologists. Permit and production data are maintained by

staff in the Division of Commercial Fisheries located at the headquarters office in Juneau. Few enhancement projects have occurred in AYK. Data from these projects are not stored in the AYK salmon DBMS. Project description information as name, location, years of operation, and other pertinent data can be viewed. Users of the AYK salmon DBMS interested in these data are directed to http://www.cf.adfg.state.ak.us/geninfo/enhance/enhance.php
or
http://www.sf.adfg.state.ak.us/SARR/Publications/techpub.cfm

Environmental Monitoring

AYK projects which collect environmental data that supports our understanding of salmon biology will be associated with this project type. Examples would be projects with the sole objective of collecting climatological or water chemistry data as it effects salmon production. Weather and water condition data are collected at many of our escapement monitoring projects but as a secondary objective. At this time, environmental data (temperature, flow, water chemistry, etc.) are not stored in the AYK salmon DBMS.

Escapement - Ancillary or spawning ground sampling

ADF&G staff and others with collection permits have routinely traveled to rivers throughout AYK with the sole objective of collecting ASL data from spawning salmon. For other collectors, ASL data may have been a secondary objective. For many older datasets all we know now is that these ASL data exist, collected from these locations, using these method types. Samplers have captured salmon with beach seines, electrofishing gear, gillnets, gigs, hook and line, or merely hand picked spawned salmon and carcasses from sandbars and stream bottoms (all method types). For purposes of data storage and retrieval each location sampled has become a project of type "Escapement-Ancillary or spawning ground sampling". These samples have been collected in freshwater and are not clearly linked to another project for us to associate these data with that project in the DBMS. For example, while Goodnews River (Middle Fork) escapement monitoring project was operated as a tower (1981–1990) it was difficult to capture Chinook salmon to sample for ASL at the tower site. Instead staff would move upriver from the tower site to beach seine or sometimes move high up in the headwaters to sample spawned salmon and carcasses while floating downriver. As a result, samplers coded these data to different ASL project types (see labeled field in ASL data) which resulted in different projects in the ASL salmon DBMS. It will be up to the project administrator to associate these data in the future.

A generic project description was used for all Escapement-Ancillary or spawning ground sampling projects (Table 2). Over 105 of these projects exist. It will be up to project administrators to individualize them in the future if desired.

Escapement Monitoring

Escapement monitoring is a category of projects whose primary object is to estimate or index salmon escapement. Furthermore, these escapement assessments are often meant to represent the spawning population. Escapement monitoring projects operate throughout AYK using a variety of method types and collecting a variety of data types. Escapement monitoring projects either collect Escapement Count data or Survey Count data. Escapement monitoring projects that collect count data often also collect ASL data. Some escapement monitoring projects really only monitor passage as fisheries are known to occur upriver. Examples of these are main stem sonar projects on the Yukon River at Pilot Station and near the Canadian border.

Escapement monitoring projects that collect Survey Count data represent surveys that are conducted of a river or lake to gather counts of migrating, pre-, or post- spawning salmon. Generally a set of "index" streams are surveyed each year, allowing for historic comparisons. Surveys are conducted using aircraft, boats, or while walking in or along the waterways. Counts do not necessarily represent total abundance but are only an index of abundance. Surveys are generally timed to coincide with peak salmon spawning activity but may be flown earlier to assess the build up of salmon in a river for fishery management purposes. Surveys were conducted by ADF&G, U.S. and Canada federal agencies, and non-governmental organizations. Most surveys are aerial surveys and are flown in either fixed wing aircraft or helicopters. A typical aircraft is a two or four-place, single engine aircraft on wheels with a bubble window (Super Cub). Generally an observer flies above the river of interest following its course up or downstream counting salmon by species, live and dead. Counts of salmon redds may also be included.

Escapement monitoring projects that collect escapement count data are stationary projects that count salmon as they migrate upstream. Salmon are counted by observers stationed along freshwater migration corridors (primary, secondary, or higher order streams). Salmon are 1) counted as they were allowed to pass upriver through weirs, 2) counted as they migrated upriver past observers in elevated (towers) locations and, 3) counted by sonar equipment placed in river. Tower and sonar counts generally represent a sample and are expanded to represent a 24 h period. Data are collected to estimate or document total spawning abundance and daily and seasonal timing of salmon migrating into the rivers of the AYK Region. These data have been collected by ADF&G and U.S., and Canada federal agencies and non-governmental organizations.

Harvest – Commercial

The Harvest–Commercial project type includes data collection activities associated with monitoring commercial catch and effort levels and describing the age, sex, and size composition of the salmon harvested. Harvest monitoring activities include collecting sales receipts ("fish tickets") issued each time salmon are sold by fishers participating in Alaska's commercial fisheries. Fish ticket data have been entered inseason since 1981 in Emmonak and 1984 in Fairbanks, Nome, Bethel, and Kotzebue. Both hardcopy fish tickets and electronic data are archived post season in Juneau. Commercial harvest data from fish tickets is not currently accessible through the AYK salmon DBMS.

ASL data have also been collected during harvest monitoring activities. Commercial harvest monitoring projects have been defined by district for Kotzebue, Kuskokwim, and Yukon Management Areas and by subdistrict for the Norton Sound District of the Norton Sound-Port Clarence Management Area. Maps of AYK Management areas and districts can be found at: http://www.cf.adfg.state.ak.us/region3/finfish/salmon/maps/ayk_all.php located from the home page of ADF&G Division of Commercial Fisheries.

A generic project description (Table 2) was used for all harvest monitoring projects. Project administrators may prepare unique descriptions for their projects in the future.

Harvest – Sport

The Harvest–Sport project type includes data collection activities associated with monitoring sport fish harvests. Currently the AYK salmon DBMS has ASL data from a few sport harvest

monitoring projects generally of 1 year duration. Other catch, harvest, and effort data collected from these fisheries are archived and collected by ADF&G Division of Sport Fish. Users should contact the Division of Sport Fish if interested in more complete ASL data or other data collected with these projects. Again only a generic project description (Table 2) was included for these projects. Project administrators may prepare unique descriptions for their projects in the future.

Harvest – Subsistence or Personal Use

ADF&G routinely monitors subsistence and personal use fisheries, and both activities are included under this project type (Harvest–Subsistence). "Subsistence fishing" is defined in Alaska state law as the taking of fish, shellfish, or other fisheries resources by Alaska residents for subsistence uses (AS 16.05.940[30]). "Subsistence uses" of wild resources are defined as "noncommercial, customary and traditional uses" for a variety of purposes. These include: direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation, for the making and selling of handicraft articles out of non-edible by-products of fish and wildlife resources taken for personal or family consumption, and for the customary trade, barter, or sharing for personal or family consumption (AS 16.05.940[32]). Personal use fishing is defined as the taking, fishing for, or possession of finfish, shellfish, or other fishery resources, by Alaska residents for personal use and not for sale or barter (AS 16.05.940[25]).

Subsistence and personal use harvest monitoring projects have been defined by district or area in AYK. Only ASL data collected through these projects currently reside in the AYK salmon DBMS. Again only a generic project description (Table 2) was included for these projects. Project administrators may prepare unique descriptions for their projects in the future.

Research - Adult

For the purpose of categorizing all projects that have collected data on salmon in AYK, projects which operated for a short duration and were generally not designed to estimate abundance were considered research. Examples of research projects involving adult salmon are those studying fecundity of AYK salmon or the presence of disease (*Ichthyophonus*). Others have studied the freshwater ecological or spawning behavior of adult salmon and these projects have also been categorized as research.

Research – Smolt

For the purpose of categorizing all projects that have collected data on salmon in AYK, projects which operated for a short duration with the emphasis on juvenile salmon were considered research. Examples of research projects involving juvenile salmon are those studying freshwater rearing habitat use, run timing and abundance at outmigration, or juvenile energetics and biometrics.

Stock Identification

Projects to identify and delineate stock structure have been conducted on salmon of the AYK Region. Various techniques used to differentiate stocks include scale pattern analysis and genetic techniques. A scale pattern analysis project for Yukon River Chinook salmon archives data in individual files and these data will not be included in the AYK salmon DBMS. The Gene Conservation Laboratory of the Division of Commercial Fisheries has conducted studies on salmon in the AYK Region, using molecular techniques to detect genetic variants. These markers describe genetic relationships among populations and species and have been used to

identify population units (discrete stocks) and individuals of particular stocks in mixed stock samples. The Gene Conservation Laboratory maintains a website describing ongoing projects, publications, and staffing. AYK salmon DBMS directs users interested in genetic data to this website at http://www.cf.adfg.state.ak.us/geninfo/research/genetics/genetics.php. Projects have also been conducted by the USFWS Conservation Genetics Laboratory and are directed to their website at http://www.r7.fws.gov/fisheries/genetics/index.htm.

Test Fishing

Test fish projects employ standardized methods and fishing procedures to provide an index of salmon abundance and run timing. Methods used for test fish projects include set and drift gillnets as well as fish wheels. Data are expressed as catch per unit of effort (CPUE) and commonly used for inseason management of commercial and subsistence fisheries. Test fish projects may also collect ASL data in an effort to characterize the age, sex, and length of the run going by. A test fishery may operate in conjunction with an escapement project which utilizes sonar as a method type in an effort to determine species apportionment and ASL composition. Whenever possible, salmon caught in the test fishery are provided to the local population of subsistence users to avoid waste.

Other

This project type is currently unused but is a placeholder for unique projects not falling into any other category.

AYK Salmon Method Types

The final filter developed for the AYK salmon DBMS was "method type." This category represents the dominant gear, technology, or sampling method associated with a data type, project, and year. Method types were defined as the vehicle that carries observers making survey counts of escapement (aircraft, boat, foot) or the type of gear used to capture salmon for ASL or CPUE data (fish wheel, gill net, trap, etc.). Method can vary by year and by data type. For example at an Escapement Monitoring project (project type); Escapement Count data (data type) might be collected using method type "Tower" for the first few years and method type "Weir" there after. Furthermore salmon might be captured for ASL sampling using method type "Seine" for some years and captured in the weir trap (method type "Weir") in other years. When searching for data by project the method type is listed by year for each data type collected.

We have also included method type for data not yet in the database. For examples for the capture/recapture projects we have indicated whether the method type is Tags/Marks External, Internal, or Radiotelemetry.

Aircraft

Salmon escapement is assessed from aircraft throughout the AYK region and for many streams form the most extensive escapement time series available. Aerial surveys are intended to index relative abundance of salmon escapement as opposed to providing an estimate of total escapement. Generally an observer flies above the river of interest following its course up or downstream counting salmon by species, live and dead. Aerial surveys are restricted to clear water streams and lakes, which exclude many salmon bearing waters in the AYK region where water clarity is typically obscured by dissolved organics, glacier runoff, or sediment load. Surveyors fill out a form indicating the standard latitude and longitude of the water body

surveyed, weather and water conditions at time of survey, and an overall survey rating. For consistency, aerial survey counts are reported by formally defined segments of the water body called index areas.

- **Yukon and Kuskokwim:**
  In the Yukon and Kuskokwim areas, aerial surveys are conducted using fixed-wing aircraft. Water bodies are typically surveyed one time each season during the targeted species' peak run timing. Chinook and sockeye salmon are the species most often targeted in Kuskokwim area aerial surveys as these species are highly visible to the surveyor and have a similar peak run timing, between late July and early August. Chinook salmon are the species most commonly surveyed in the Yukon Area. Chum salmon have been surveyed in the past, but because they are difficult to see from the air, survey counts are no longer used to index chum salmon abundance in the Yukon and Kuskokwim areas. Coho are not often targeted by aerial surveys because their late run timing often coincides with poor weather conditions and limited aircraft availability during the fall hunting season. Limited funding is also a factor in the decline of aerial surveys.

- **Norton Sound/Port Clarence and Kotzebue:**
  In the Norton Sound/ Port Clarence and Kotzebue areas, aerial surveys are conducted to obtain abundance index estimates for Chinook, chum, sockeye, and coho salmon. Fixed-wing aircraft are generally used to monitor Chinook, chum, and coho salmon; helicopters are used to survey sockeye lake habitat. Escapement goals for sockeye salmon are based on aerial survey counts.

Boat

This method refers to stream surveys of adult salmon conducted from boats. Typically beginning at the upstream end of a surveyed stretch, a crew including one boat operator and at least one fish counter drift downstream to the designated survey termination point, usually the stream outlet. The counter keeps track of the number of one or more targeted species within each survey section. Similar to aerial and foot surveys, boat surveys use counts as an index of salmon abundance and may be conducted once in a season during peak abundance or at set intervals throughout the run. With a few exceptions boat surveys have been conducted irregularly and have a historical data series insufficient to gauge relative salmon abundance.

Electrofishing

Electrofishing is a method type which uses electricity to capture fish. Electrodes from a power source (battery or generator) are placed into the water column and an electric current is passed into the water. The current shocks the fish and stimulates them to swim into a net. Battery-powered backpack electrofishers are typically used in wadable streams, and generator-powered electrofishers are typically mounted on a boat or the shore in larger, unwadable streams.

Electrofishing has been found to be the most effective method to capture the greatest variety of fish life stages and species, so electrofishing is often used in stream fish community studies. Although a useful method type, electrofishing is rarely used on adult salmon or trout because it is more likely to injure larger fish. Small fish are less likely to be harmed by electrofishing because they have less surface area exposed to the current.

In addition to stream fish community studies, electrofishing has also been used to capture salmon for (1) tagging in capture and recapture projects and (2) sampling for age, sex, and length (ASL) data often associated with escapement monitoring projects.

Specific protocols vary by project and interested parties should refer to published reports or contact project administrators for more information.

Fish Ladder

This method type utilizes a fish ladder or fishway to count migrating salmon. Fish ladders are commonly used on dammed rivers to facilitate fish passage upstream to spawning grounds and to collect stock abundance and run timing data. Fish may be counted visually through a viewing window or by electronic counters. Viewing windows also allow sex, general size and fish origin (hatchery vs. wild) to be recorded. Fish ladders may be temporarily closed off to allow scale, length, and genetic data collection from migrating salmon.

Fish Wheel

Fish wheels consist of trap-like baskets assembled to rotate in a circle around a central pivot point or axle. The river current pushes the fish wheel baskets around and as migrating salmon swim upstream, some are caught in the fish wheel baskets and guided into a holding box. ADF&G uses fish wheels as a method type in a wide variety of projects to monitor salmon abundance and run-timing, collect age, sex, and length data, collect genetic samples for baseline data, and capture salmon for tagging.

Foot

This method refers to stream surveys of adult salmon conducted on foot. Survey crew members walk along stream banks and visually count salmon, keeping track of the number of one or more targeted species within each survey section. Similar to aerial and boat surveys, foot surveys use counts as an index of salmon abundance and may be conducted once in a season during peak abundance or at set intervals throughout the run. With a few exceptions foot surveys have been conducted irregularly and have a historical data series insufficient to gauge relative salmon abundance.

Gillnet

Gillnetting is a method type used in many AYK projects to capture salmon during their spawning migration. Gillnets are either drifted or set. Drift gillnets are deployed from a boat with one end of the net attached to the boat and the other end attached to a buoy. The boat drifts down current keeping the net perpendicular to and in pace with the stream current. As fish swim into the nets, their heads pass through the mesh of the net, catching their gills and trapping them in the net. In contrast, set gillnets are either deployed from shore and anchored offshore perpendicular to the current or deployed from a boat and anchored at both ends. The gear is stationary and salmon must swim into the net.

Handpick, Carcass, or Gig

This method is used to gather spawned-out salmon near spawning grounds. Carcasses or spawned-out live salmon are speared (gigged) or are handpicked from stream banks and gravel bars. Intact fish are typically sampled for age, sex, and length following standard ASL protocols.

Additional samples may be taken for genetic analysis, otoliths for aging or microchemical analysis, or tissue collections to test for parasites such as *Ichthyophonus*.

Hook and Line

This method type utilizes a rod and reel to capture salmon for ASL data. In some cases salmon caught by subsistence or sport fishers using a hook and line may be sampled by ADF&G personnel and included under this method type.

Seine (Purse, Beach)

Seining is a method type used to sample salmon populations with specific types of nets. Seines trap fish by enclosing or encircling them or act as a barrier to keep fish in a restricted area. Beach and purse seines are used in the AYK region.

A beach seine is typically deployed perpendicular to the stream current and allowed to drift downstream close to the shoreline. For example, one person may walk along the shore holding on to one end of the net while the other end of the net is held out in the stream by a slowly drifting boat.

A purse or bag seine contains a centrally located bag or purse and as the seine is pulled through the water, fish are herded towards the center and captured in the purse. Individual methods of deployment vary by project and interested parties should refer to published reports or contact project administrators for more detailed information.

Sonar

Projects which employ sonar as a method type use hydroacoustic technology to estimate salmon escapements. A transceiver projects sound waves into the water, and when a sound wave encounters an object with a different density than /-water, an echo is returned. The returned echo is received by the transceiver, processed, and depending upon the technology used, displayed on an oscilloscope, chart recorder, or computer screen. Sonar is an effective method of enumerating salmon, and is often used when poor visibility or river size limits the usefulness of towers or weirs.

Echo-counters manufactured by the Bendix Corporation[2] were the first sonar technology used in the AYK region. Simply, echo-counters count all echoes above a threshold and divide by the number of echoes per fish to generate estimates. Echo-counters are effective at detecting fish close to shore and are easy to operate; however, they are no longer manufactured and have been replaced with newer technologies. Dual-beam and split-beam sonar typically operate at lower frequencies allowing for detection of fish further offshore (roughly 250 m) and allow storage of the data either electronically or as paper charts for postseason review. Counts from dual or split-beam systems are obtained by counting fish traces on electronic or paper echograms. In addition, split-beam sonar can measure the target's position in the beam, making it possible to determine direction of travel (i.e. upstream or downstream). The latest technology, dual-frequency identification sonar (DIDSON^{TM}), produces video-like images of fish making it possible to determine direction of travel; however, the high-frequency limits the detection range

[2] Product names are included for completeness, but do not represent endorsement by Alaska Department of Fish and Game.

making DIDSON™ suitable for short distances or use on small rivers. DIDSON™ may also be used on large rivers such as the Yukon in conjunction with split-beam to maximize detection throughout the desired counting range.

To maximize fish detection near shore where the beam is narrow, a lead is often used to guide fish away from the bank and further out into the river where the beam is wider. Although this lead is often called a weir, it should not be confused with a weir method type as described elsewhere in the glossary.

A test gillnet fishery is sometimes coupled with a sonar project in order to apportion sonar counts to species. In cases where a high percentage of the salmon population is known to be a certain species, a test fishery may be considered unnecessary.

Tag/Mark

Tags or marks are used to identify individual fish in studies involving capture/recapture, movement, abundance, distribution, or stock identification. Data are collected and later analyzed based on tagged/marked fish that are recaptured through a variety of means. Tags may be external or internal. Commonly used external tags include spaghetti and t-bar anchor tags which are inserted into flesh just under the dorsal fin of the fish. Common internal tags include coded wire tags, and radio tags. Coded wire tags are commonly used to mark fish from hatcheries. Radio tags are small transmitters that may be surgically implanted into the abdomen of fish or inserted into the stomach through the esophagus. Signals from radio tags may be intercepted from radio towers placed along rivers or tracked from aircraft or boats to identify the individual and to determine location. An example of a mark is the banding of otoliths by artificially altering water temperatures during incubation.

Tower

Projects that use a tower as a method type monitor escapement by visually counting migrating salmon. The tower provides a raised vantage point, often employing a scaffold, and the crew keeps tally of how many of each targeted species pass upstream for a portion of every hour. In order to improve visibility, a flash panel is placed on the river bottom. A flash panel is a sheet of heavy, light-colored material, often canvas, which allows a favorable background for counting and identifying different fish species. An underwater fence or weir is placed from the river's edge to the flash panel in order to restrict the number of fish swimming past at once and guide fish to the area of improved visibility.

The actual count is expanded to estimate passage for the full hour. If, for example, the crew counts for 10 minutes (one-sixth) of every hour the tally is multiplied by 6 to estimate hourly passage. At the end of every 24-hour period the hourly counts are added to estimate daily passage. In case of missed counts or days off, previous and subsequent totals are used to obtain a passage estimate. Specific estimation methods vary by project and are detailed in published reports. Tower projects often collect additional information such as climatological, hydrological, and age, sex, and length data, but again these vary by project and can be found in published reports.

Trap

A variety of experimental traps have been used in the AYK region for sampling purposes. If trap is noted as a method type used in conjunction with a weir, this may refer to the fish chute or live

trap where salmon are held briefly for sampling before passing them upstream. For details on trap design and usage please refer to published reports or contact the project administrator.

Video

Video monitoring is a method type still in the early stages of development within AYK. Feasibility studies have been conducted to assess the usefulness of video technology used in conjunction with a fish wheel or weir to provide abundance estimates or enumeration and run timing of salmon and identify tagged fish for capture/recapture projects. Using video greatly reduces stress as it allows salmon to migrate without impediment or delay and minimizes the need for handling by humans. Video cameras have been deployed both underwater (i.e. to record fish passage through an opening in a weir) or above water (i.e. positioned to record fish as then pass from a fish wheel back into the water).

Weir

Escapement monitoring projects that employ an adult salmon weir as a method type generally collect a census of each targeted species. These weirs span the entire channel width of a river and guide targeted species towards a passage chute or gate for visual identification of each fish. The weir is composed of a structure that supports pickets of metal or plastic pipe. Pickets are spaced close enough together that targeted species cannot swim between them, but water flows easily past. Live traps are generally employed to collect fish for age, sex, and length sampling and to recapture tagged fish.

Two styles of adult salmon weirs are used in the AYK region. Fixed-picket or fixed-panel weirs are supported by a series of bipods or tripods across the channel. These are said to be “fixed” because they are not designed to adjust to changing water levels, and are vulnerable to serious damage during flood events. Resistance board weirs are a flood resistant alternative to fixed-picket construction. The pickets of a resistance board weir are positively buoyant and are anchored to the riverbed at one end. The other end of each picket is attached downstream to a resistance board that utilizes stream flow to suspend it above the water’s surface. This portion of the weir is designed to float during normal water conditions and sink during flood events, allowing debris to pass freely over.

METADATA

Metadata are literally "data about data," a description of a dataset’s content, quality, lineage, contacts, condition, and other characteristics. The description of the data is organized in a standardized format using a common set of terms. Metadata has been created for inventoried data in AYK according to standards for biological datasets by the NBII, a division of the USGS (USGS 2005), and provides a national clearinghouse of biological metadata. The AYK salmon DBMS metadata will be posted to the NBII website soon after the website is available to the public. A link to the NBII website is included on the main page of the AYK salmon DBMS.

DATA SEARCHES AND RETRIEVAL

Users can approach data retrieval in one of two ways. They can “Search for Projects” (Figure 4) or “Search by Data Type (Figure 5). These options are displayed when you highlight “Search” which is displayed along the side of the main page for the AYK DBMS (Figure 3).

When searching for data by project, the user can narrow their search by Management Area, Data Type, Project Type and/or Method Ttype (Table 1). The search begins with the creation of a

filter by selecting attributes of interest involving management area, data type, project type and or method type. When a filter is submitted, only projects meeting those attributes are returned. The user can then choose the project of interest and the data types and years of collection. Last, the users may download data in several different formats including easy importation into Microsoft Excel.

Data can also be retrieved by data type. This requires more familiarity with data type attributes. Generally, these users will be biologists who want to extract data across projects and are familiar with data collection and the data structure. In practice, as users become familiar with the data through the project search interface, searching by data type may be more efficient. To extract data by data type the user must first select a data type and then prepare a filter by management area and data attributes appropriate to that data type. Again data can be viewed and or saved in files of the user's choice.

MAINTANENCE OF THE AYK SALMON DATABASE MANAGEMENT SYSTEM

The AYK Salmon Database Management System supports two specific functions. The first function is to allow users to search for project details, data collected, and in the future locate published reports using system metadata. The second function is to allow ADF&G staff to perform system maintenance. System maintenance involves the editing of project metadata or editing and uploading project data. System maintenance occurs at the web page (the .NET client application) and through an application loaded the desktop (ASP.NET) (Figure 6).

The metadata and stored data are considered to be publicly viewable. However, the right to edit metadata or stored data is controlled to ensure its integrity. Individuals with edit permissions for a project have access to alter both the metadata definitions as well as the actual data stored in the system. Initially, edit rights for any given project is granted to the "Project Administrator." A project's administrator is an ADF&G staff member most familiar with the project and its data. This will often be the principal investigator or perhaps the staff member who has inherited the project from a previous staff member. If the data are collected by another agency the Project Administrator might be the ADF&G biologist in whose area of responsibility that project is located. For example the ADF&G Kuskokwim research project biologist would be the administrator for a USFWS project located on the Kwethluk River, a tributary of the Kuskokwim.

Those individuals in the Project Administrator role are also viewed as the primary custodians of the AYK Salmon Database Management System. The website allows them to perform all the core duties associated with this task. Perhaps the most important duty is that of controlling who has the right to edit the names, definitions, and data associated with their own projects. These duties will often be delegated to others, perhaps junior biologists or technicians. To facilitate this, the Project Administrator may grant temporary edit permissions to others at the project, year, or data type levels. Currently, these temporary permissions cannot exceed 6 months.

To support the ongoing needs of this system the Project Administrators can also add new users as staff are hired, add new project definitions, and removing project definitions from the system. It is believed that these tasks will remove the need for IT staff intervention for daily operations, thus decreasing the overall maintenance costs associated with the system.

In addition to the website, a desktop client application was developed. The purpose of this application is to serve as a platform for the more intensive processes related to data editing and importing. This client application may be freely distributed since the same rules apply regarding edit permissions on the website. Without granted permissions users will only be allowed to download "view only" representations of the data.

The desktop client will allow those with edit permissions to download datasets which can be worked on offline. The application allows them full access to add, edit, and delete data. They may also export the data to an Excel spreadsheet if they prefer to manipulate the data using that format. The client application also allows users to import data from Excel spreadsheets and text/ascii file formats (i.e. bubble sheet data) and Access database imports will be added later. When data editing is complete, only users with appropriate permissions will be allowed to upload datasets back into the repository.

The development of the AYK Salmon Database Management System has always been focused on empowering the users. By placing control of the system in their hands through the website and desktop client, the need for direct IT staff involvement has been nearly eliminated. The staff currently assigned to this system will be freed to develop solutions to address other AYK information management needs. The regional IT staff will remain available to this system to add additional databases into the system (AYK subsistence harvest database, AYK region-wide test fish database, etc), aid users with global data cleaning tasks, and future expansion of the website and desktop client to adapt to changing users' needs.

RECOMMENDATIONS

Work on the AYK salmon DBMS will continue. We plan to add 2006 project data, additional datasets, and add or improve options for viewing and retrieving data. For example, data from test fisheries outside the Norton Sound and Kotzebue Management Areas need to be added. Additional data sets include (1) capture and recapture data, (2) environmental data, and (3) copies of the brood tables maintained for some salmon stocks in AYK. Software maintenance and compatibility is an issue, and converting some applications to Java may need to be done.

We recommend the following:

1. Add 2006 data when staff is available after the 2007 field season. Add 2007 data when they are finalized and ready for publication. Generally, data collected during the field season (May–November) should be loaded into the AYK Salmon DMBS by March of the next year.
2. Add Kuskokwim and Yukon River test fish data.
3. Review project descriptions and train project administrators to update and maintain.
4. Respond to project leader concern for additional detailed editing of some data. For example, Yukon River staff are concerned that edits to aerial and ground survey data conducted in the late 1990s were never completed or implemented. Paper copies of survey results with editorial comments were discovered in the Fairbanks office. Staff recommends hiring a technician under the direction of a biologist to see if those edits were done to the electronic version of the data that was ultimately loaded into the AYK salmon DBMS.

5. Much data collected in the Canadian portion of the Yukon River have not been loaded into the DBMS. We recommend staff prepare a proposal to the Yukon River US/Canada Research and Restoration fund to support this editing and loading of Canadian data not currently in our database.
6. Some fields in the ASL database are still not standardized. Those include mesh size, project type, and gear. Those fields still need editing.
7. Add data views and inseason capabilities to AYK salmon DBMS in order to replace the large Excel workbooks currently used by the ADF&G fisheries management staff for the Yukon River (Poetter Unpublished; Sollee Unpublished).
8. Task a publication specialist to develop additional data displays, retrievals, and reports from the DBMS; customized for AYK staff annual reporting needs.
9. Add to project description metadata in the AYK salmon DBMS links to reports published within the ADF&G report series.

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TABLES AND FIGURES

Table 1.–Filtering attributes for the AYK salmon database management system.

Management Areas	
Kotzebue	Kuskokwim
Norton Sound-Port Clarence	Yukon
Yukon (Canada)	
Data Types	
Age Sex Length (ASL)	Catch per Unit Effort (CPUE)
Escapement Counts	Harvest
Survey Counts	Tag/Mark
Project Types	
Capture/Recapture	Enhancement/Restoration
Environmental Monitoring	Escapement – Ancillary or spawning ground
Escapement Monitoring	Harvest – Commercial
Harvest – Sport Fish	Harvest – Subsistence
Research – Adult	Research – Smolt
Stock Identification	Test Fishing
Method Types	
Aircraft	Boat
Electro Fishing	Fish Wheel
Fish Ladder	Foot
Gillnet	Hand pick, carcass, or gig
Hook & Line	Seine
Sonar	Tags/Marks - External
Tags/Marks – Internal	Tags/Marks – Radio Telemetry
Trap	Unknown
Video	Weir

Table 2.–Generic project descriptions for projects that collect ASL data in AYK.

Ancillary or Spawning Ground Sampling: Salmon age, sex, and length (ASL) data have been collected from this project for the years listed below. ASL data are generally collected as a sample from a larger population with the intent that the sample's age, length and sex composition be representative of the salmon run. The crew attempts to sample a predetermined target number of salmon during the sampling event. Example of sampling events are a float trip by raft over the spawning grounds of a particular river, days a crew camps along a river (drop off and pick by aircraft), or day trips by boat to salmon spawning areas. In some years and locations sampling may not be representative due to small sample sizes, unrepresentative sampling through time or space, unusual run timing or selective nature of the capture gear among other reasons. Please contact the project leader or refer to publications including these data before assuming the samples are representative. Inconsistencies in recorded net mesh sizes have been noted and ADF&G is working to correct these. Please contact the project leader before assuming mesh sizes published in the data tables are correct.
Escapement Monitoring: Salmon age, sex, and length (ASL) data have been collected from this project for the years listed below. ASL data are generally collected as a sample from a larger population with the intent that the sample's age, length and sex composition be representative of the salmon run migrating past the project's location. Often the crew attempts to catch a predetermined target number of salmon in each quartile of the salmon run for sampling. In some years and locations sampling may not be representative due to small sample sizes, unrepresentative sampling through time or space, unusual run timing or selective nature of the capture gear among other reasons. Please contact the project leader or refer to publications including these data before assuming the samples are representative. Inconsistencies in recorded net mesh sizes have been noted and ADF&G is working to correct these. For the time being please contact the project leader before assuming mesh sizes published in the data tables are correct.
Harvest projects (Commercial, Sport, Subsistence): Salmon age, sex, and length (ASL) data have been collected from this project for the years listed below. ASL data are generally collected as a sample from a larger population with the intent that the sample's age, length and sex composition be representative of a harvest. To gather ASL data from subsistence, sport, and commercial harvests, ADF&G employees visit the respective fishers, collect and record the ASL data, then return the fish to the commercial processor or subsistence/sport user. In some cases ADF&G will train subsistence fishers or other community members in standard ASL sampling procedures, provide them with a sampling kit and pay participants to collect ASL data. In some years and locations sampling may not be representative due to small sample sizes, unrepresentative sampling through time or space, unusual run timing or selective nature of the capture gear among other reasons. Please contact the project leader or refer to publications including these data before assuming the samples are representative. Inconsistencies in recorded net mesh sizes have been noted and the Alaska Department of Fish & Game is working to correct these. Please contact the project leader before assuming mesh sizes published in the data tables are correct.
Test Fish Projects: Salmon age, sex, and length (ASL) data have been collected from this project for the years listed below. ASL data are generally collected as a sample from a larger population with the intent that the sample's age, length and sex composition be representative of the salmon run going by or just the project's catch. Test fisheries generally catch salmon with drift or set gillnets and data are expressed in terms of catch per unit effort (CPUE). Whenever possible, salmon caught in the test fishery are provided to the local population of subsistence users to avoid waste. In some years and locations sampling may not be representative due to small sample sizes, unrepresentative sampling through time or space, unusual run timing or selective nature of the capture gear among other reasons. Please contact the project leader or refer to publications including these data before assuming the samples are representative. Inconsistencies in recorded net mesh sizes have been noted and ADF&G is working to correct these. For the time being please contact the project leader before assuming mesh sizes published in the data tables are correct.

Figure 1.–AYK Region Salmon Management Areas.

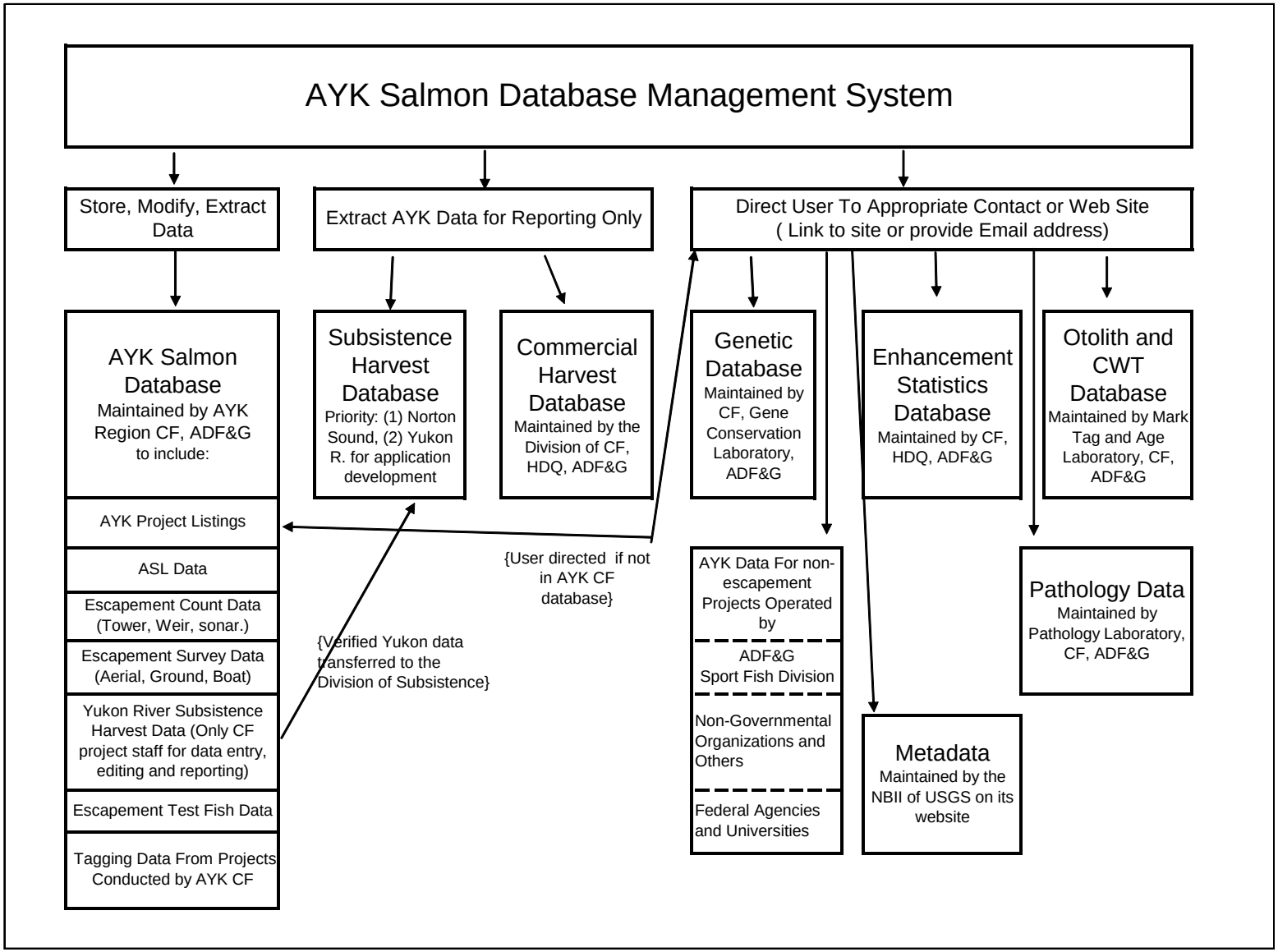

Figure 2.–Components of the AYK salmon database management system.

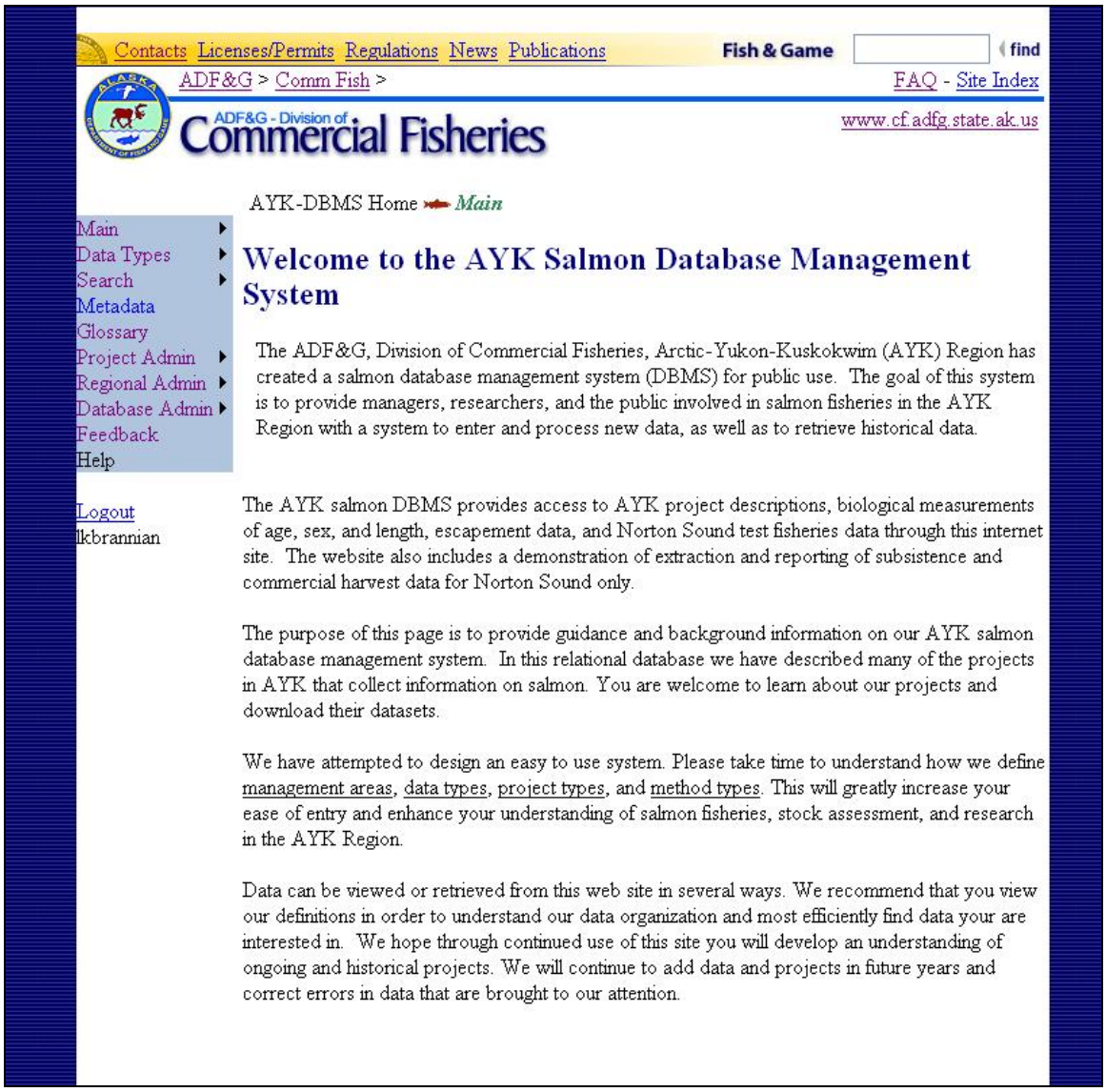

Figure 3.–Home page for the AYK salmon database management system, July 2007.

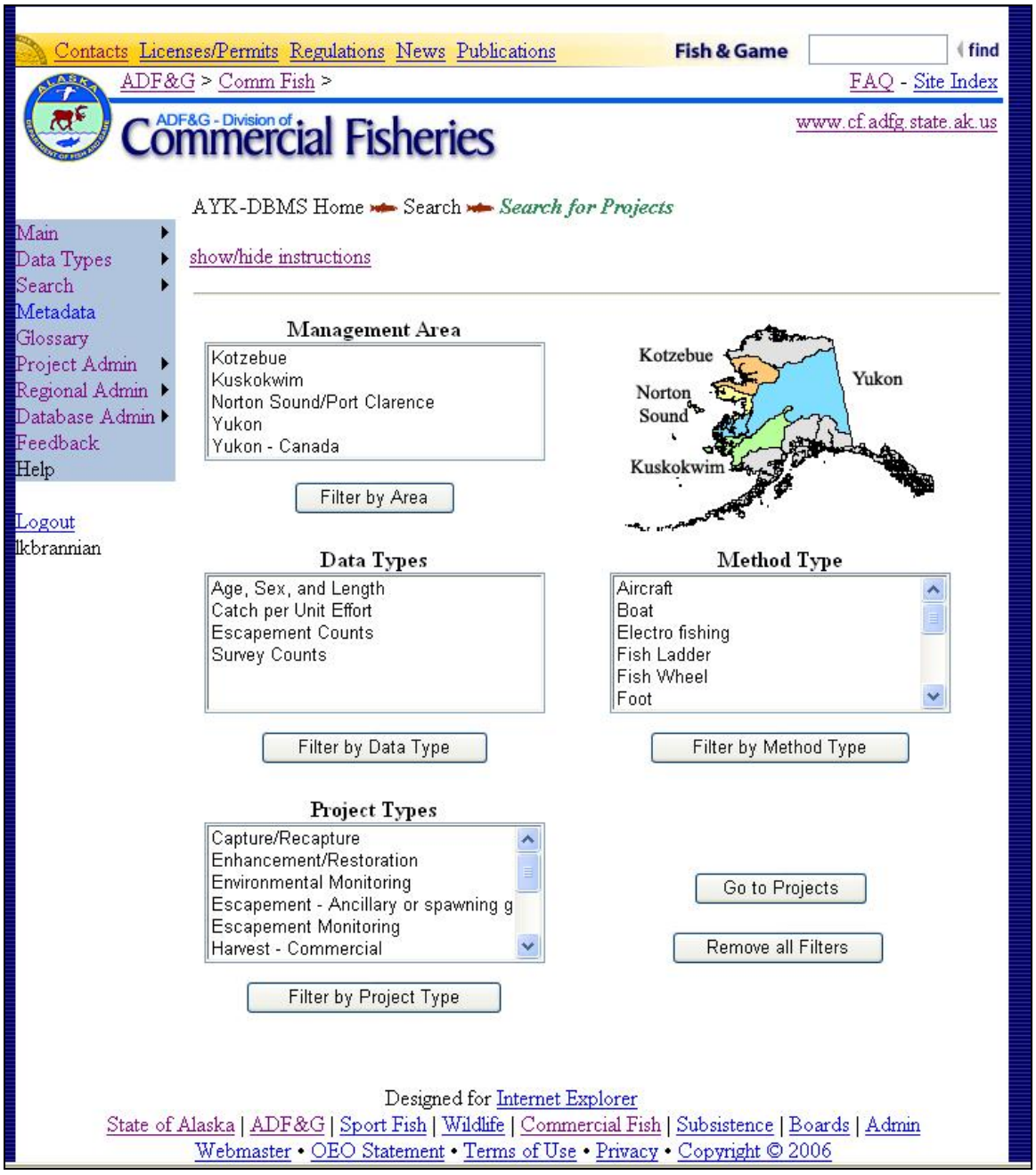

Figure 4.–Search for project web page for the AYK Salmon Database Management System, July 2007.

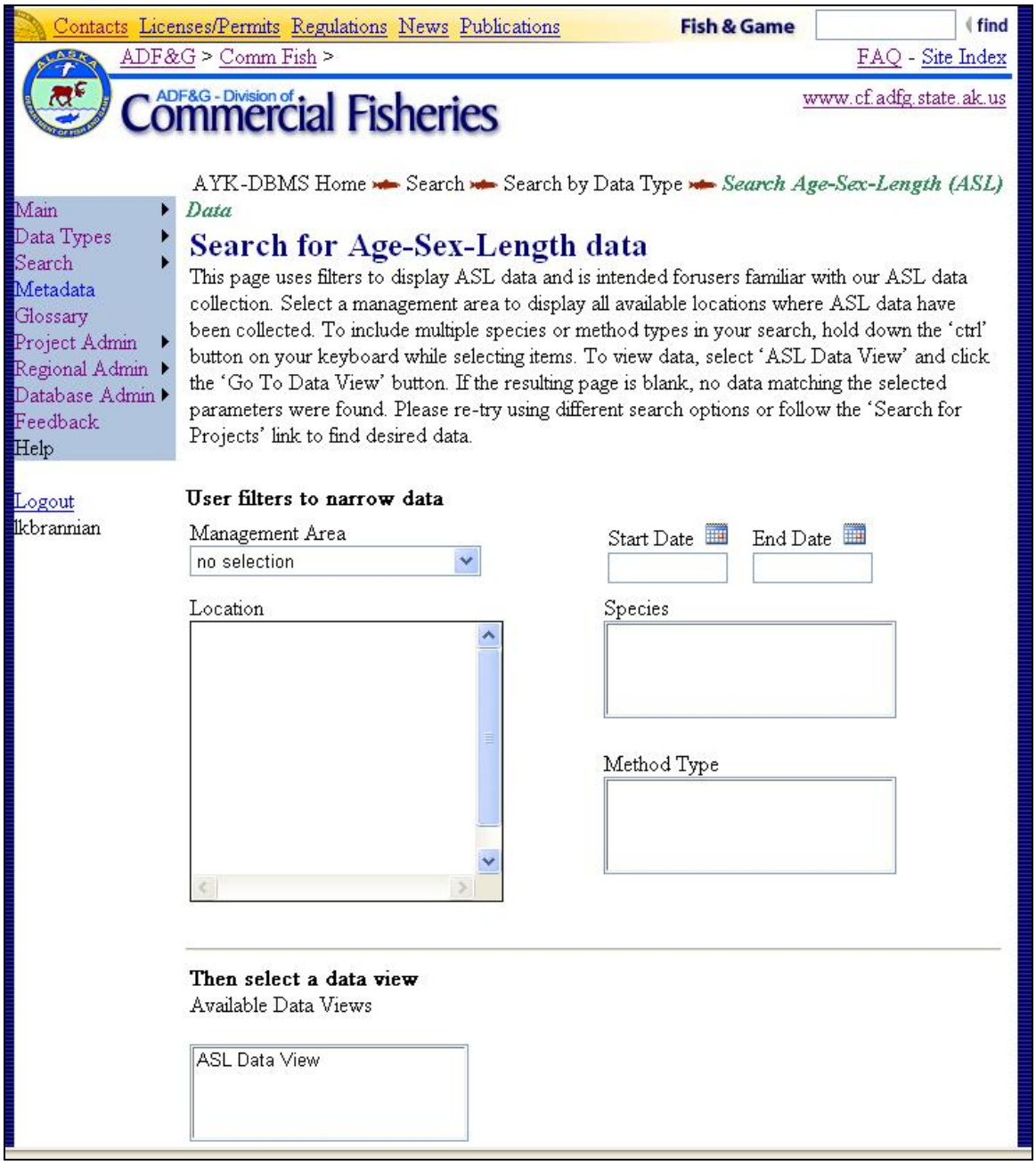

Figure 5.–Search by data type for ASL data from the AYK Salmon Database Management System, July 2007.

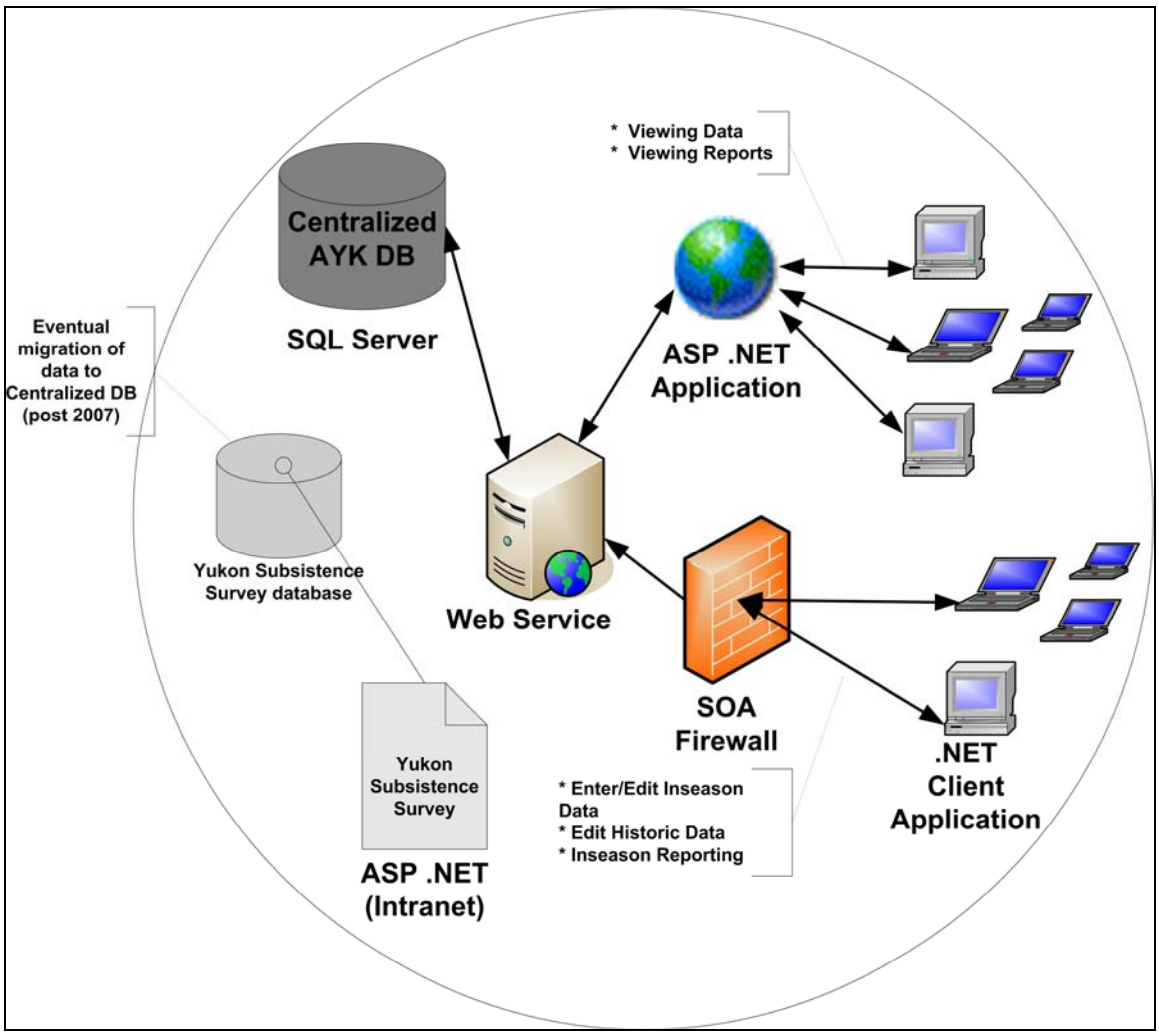

Figure 6.–Final relationship among components of the AYK salmon database management system.