

**Fishery Data Series No. 09-20**

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**Assessment of Anchorage School District Students  
Participating in the *Salmon in the Classroom* Program,  
2006-2007**

by

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April 2009

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Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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<b>Weights and measures (metric)</b>		<b>General</b>		<b>Measures (fisheries)</b>	
centimeter	cm	Alaska Administrative		fork length	FL
deciliter	dL	Code	AAC	mid eye to fork	MEF
gram	g	all commonly accepted		mid eye to tail fork	METF
hectare	ha	abbreviations	e.g., Mr., Mrs., AM, PM, etc.	standard length	SL
kilogram	kg			total length	TL
kilometer	km	all commonly accepted			
liter	L	professional titles	e.g., Dr., Ph.D., R.N., etc.	<b>Mathematics, statistics</b>	
meter	m	at	@	<i>all standard mathematical</i>	
milliliter	mL	compass directions:		<i>signs, symbols and</i>	
millimeter	mm	east	E	<i>abbreviations</i>	
		north	N	alternate hypothesis	H <sub>A</sub>
<b>Weights and measures (English)</b>		south	S	base of natural logarithm	<i>e</i>
cubic feet per second	ft <sup>3</sup> /s	west	W	catch per unit effort	CPUE
foot	ft	copyright	©	coefficient of variation	CV
gallon	gal	corporate suffixes:		common test statistics	(F, t, $\chi^2$ , etc.)
inch	in	Company	Co.	confidence interval	CI
mile	mi	Corporation	Corp.	correlation coefficient	
nautical mile	nmi	Incorporated	Inc.	(multiple)	R
ounce	oz	Limited	Ltd.	correlation coefficient	
pound	lb	District of Columbia	D.C.	(simple)	r
quart	qt	et alii (and others)	et al.	covariance	cov
yard	yd	et cetera (and so forth)	etc.	degree (angular)	°
		exempli gratia	e.g.	degrees of freedom	df
<b>Time and temperature</b>		(for example)		expected value	<i>E</i>
day	d	Federal Information	FIC	greater than	>
degrees Celsius	°C	Code		greater than or equal to	≥
degrees Fahrenheit	°F	id est (that is)	i.e.	harvest per unit effort	HPUE
degrees kelvin	K	latitude or longitude	lat. or long.	less than	<
hour	h	monetary symbols		less than or equal to	≤
minute	min	(U.S.)	\$, ¢	logarithm (natural)	ln
second	s	months (tables and		logarithm (base 10)	log
		figures): first three		logarithm (specify base)	log <sub>2</sub> , etc.
<b>Physics and chemistry</b>		letters	Jan, ..., Dec	minute (angular)	'
all atomic symbols		registered trademark	®	not significant	NS
alternating current	AC	trademark	™	null hypothesis	H <sub>0</sub>
ampere	A	United States		percent	%
calorie	cal	(adjective)	U.S.	probability	P
direct current	DC	United States of		probability of a type I error	
hertz	Hz	America (noun)	USA	(rejection of the null	
horsepower	hp	U.S.C.	United States	hypothesis when true)	α
hydrogen ion activity	pH		Code	probability of a type II error	
(negative log of)		U.S. state	use two-letter	(acceptance of the null	
parts per million	ppm		abbreviations	hypothesis when false)	β
parts per thousand	ppt, ‰		(e.g., AK, WA)	second (angular)	"
volts	V			standard deviation	SD
watts	W			standard error	SE
				variance	
				population	Var
				sample	var

***FISHERY DATA SERIES NO. 09-20***

**ASSESSMENT OF ANCHORAGE SCHOOL DISTRICT STUDENTS  
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by

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## ABSTRACT

The Alaska Department of Fish and Game, Division of Sport Fish and the Anchorage School District conducted an assessment of the *Salmon in the Classroom* program in Southcentral Alaska (Region II). Anchorage School District students in 4<sup>th</sup>–6<sup>th</sup> grades who participated in the program were given a pre- and post-test that consisted of 21 multiple-choice questions measuring basic knowledge about salmon, and four opinion statements. Although 536 pre-tests from 18 schools, and 384 post-tests from 13 schools, were returned, paired pre-post tests were only available for 124 students. This occurred because very few student identification numbers were provided on the tests by teachers. We were therefore unable to conduct hypothesis tests correlating teacher and classroom characteristics with test results. Results of the post-test were therefore conservative because students who joined the program after it began were included in post-test scores.

Overall, students' knowledge increased from September 2006 to May 2007; students averaged 61% (SE = 0.8) correct on the pre-test and 71% (SE = 1%) on the post-test. The objective for 25% of students in the program to score at least a 70%, from the Region II strategic plan for aquatic education, was exceeded: 60% (SE = 3%) of students scored at least a 70% on the post-test. Although the percent of students answering the multiple choice questions correctly increased for all questions, misperceptions remained at the end of the program for many important concepts. Student enthusiasm, as measured by the percent of students responding "yes" or "maybe," decreased for the four opinion statements concerning learning about salmon, fishery careers, real fish in class, and sport fishing.

To increase effectiveness of the *Salmon in the Classroom* program, Sport Fish aquatic educators should look carefully at topics for which misunderstandings remained at the end of the 2006-2007 school year to identify potential improvements to the program, consider possible reasons for the decrease in student enthusiasm, identify ways to engage students more effectively, and develop a mechanism for encouraging feedback on the program from teachers and students. The assessment project should be conducted again in 2007-2008, but participation in the pre- and post-tests needs to be increased, and particular effort should be made to obtain student identification numbers so that a sufficient sample of paired pre- and post-tests is available for analysis.

Key words: *Salmon in the Classroom*, aquatic education, education assessment, education evaluation, pre-test, post-test, multiple choice test, student, strategic plan, Anchorage School District.

## INTRODUCTION

The Alaska Department of Fish and Game (ADF&G), Division of Sport Fish (Sport Fish) began dedicating staff and funding to information and education activities in Southcentral Alaska (Region II; Figure 1) in 1996. Dubbed the STREAM (Salmon Trout Restoration Education and Aquatic Management) program, the goal was "to increase the public's awareness of Alaska's healthy wild salmon stocks through education and the offering of hands-on opportunities" (Kraus 1999; Kraus et al. 2000; Kraus and Olson 2003a, 2003b). Region II's main aquatic education focus was the "Salmon in the Classroom" program (also called "Salmonids in the Classroom" or "Inclass Salmon Incubation Program"), primarily for elementary students. The number of schools in the program increased from 34 in 1996 to 110 in 2004, and the communities served increased to include the Anchorage, Matanuska-Susitna, Kenai Peninsula, Kodiak, and Prince William Sound areas (Kraus et al. 2000; Kraus and Olson 2003a, 2003b; Kraus 2005a, 2005b; Kraus 2006a, 2006b).

The program, modeled after similar ones in Washington, British Columbia, and Oregon, supports aquariums placed in public school classrooms in which students raise salmon, from eggs to fry. In Region II, the program includes the following five components, all led by Sport Fish employees: (1) support for classroom aquariums for raising salmon, from egg to fry; (2) field trips to watch an egg take at a local stream and receive eggs for the aquarium; (3) salmon dissections in the classroom; (4) ice fishing field trips to a local stocked lake; and (5) "salmon celebration" field trips to release fry raised in the classroom or to watch release of hatchery fish

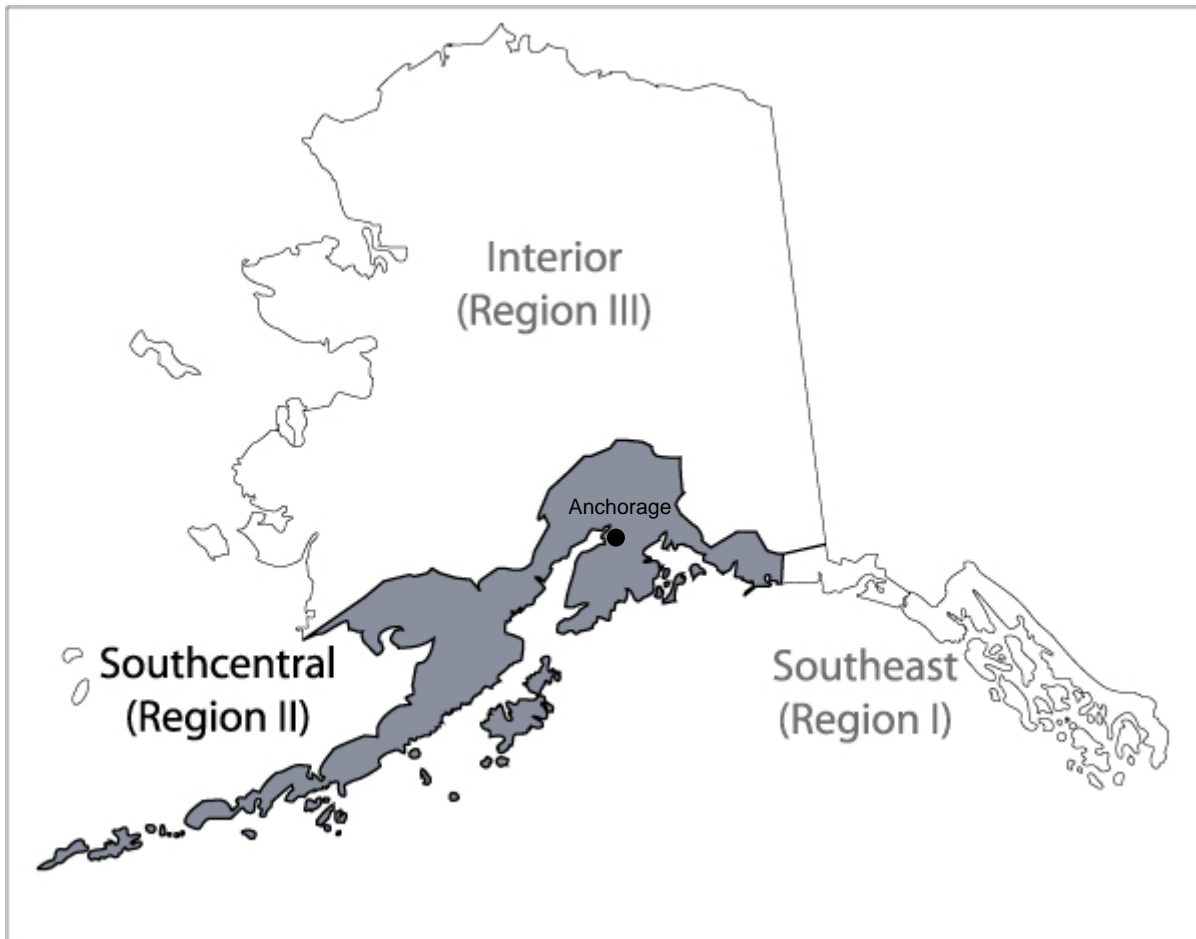


Figure 1.-Location of Sport Fish Division, Region II, and Anchorage, Alaska.

into a local stream. The ice fishing field trip was cancelled for the 2006-2007 school year because fish stocked into the lake used for the event were too small.

Teachers wishing to participate in the program are provided an aquarium in which to raise salmon eggs, equipment such as a chiller to maintain the correct water temperature, food for the salmon fry, and support from aquatic education employees in the form of assistance with troubleshooting and repairs to the aquarium equipment. Some limited educational support materials are also available, including a guide to setup and maintenance of the aquariums, a curriculum for elementary grades (“Salmonids in the Classroom,” aimed specifically at 2<sup>nd</sup> grade), a salmon life cycle poster, and the publication “Alaska’s Wild Salmon.” To accommodate as many classes as possible, aquariums are limited to one per school. However, aquariums are frequently placed in common areas in the schools, such as libraries, so that multiple classes within the school can participate in the program, and multiple classes per school may participate in the dissections and field trips. Any grade is allowed to participate, but historically, most participation is by elementary schools, particularly grades K-3, although in recent years participation has expanded widely and now includes many classes in grades 4-6 as well.



In 2004, Region II began the process of developing a strategic plan (Timmons 2006) to guide the aquatic education programs of Region II in supporting the overall mission and goals of the Region, the Division as provided in its strategic plan (ADF&G 2002), and ADF&G. A vision, mission, and seven goals were outlined for the aquatic education program, and measurable objectives and strategies for accomplishing the objectives were developed (Timmons 2006). The *Salmon in the Classroom* program remained one of the primary tools for meeting the goals and objectives of the plan. The vision of the Region II aquatic education plan is:

Alaskans and visitors to Southcentral Alaska understand and appreciate the unique value of the region's aquatic resources and sport fisheries, the factors affecting them and principles for conserving them, and the role of ADF&G, Division of Sport Fish in sustaining those valuable resources;

Alaskans and visitors demonstrate this understanding and appreciation through responsible sport fishing practices, sustainable uses of aquatic resources, involvement in fishery management, and support for the missions of the Department and Division.

The mission is:

To foster an informed and educated public that appreciates, respects and sustainably uses the State's fisheries and aquatic resources in Southcentral Alaska, and supports the Division's mission to protect, improve, and manage the use and development of those fisheries and aquatic resources.

The three goals pertinent to the *Salmon in the Classroom* program are:

Among children in Southcentral Alaska, cultivate an understanding of the basic fundamentals of fish biology and aquatic resource principles, and fisheries and aquatic resources management; and kindle a life-long appreciation and stewardship of aquatic resources;

Among Alaskans in Southcentral Alaska and visitors to the area, foster knowledge about and support for the core activities of the Division of Sport Fish used to accomplish its mission: stock assessment, management, hatchery production, access development and maintenance, habitat assessment, information and education, enforcement, and planning and surveys.

Encourage and facilitate new anglers in adopting sport fishing as a pastime, and promote responsible sport fishing by children and adult anglers in Southcentral Alaska.

Evaluation is essential to determine if programs should be continued, how they can be improved, and to document whether or not they are producing the desired outcomes (Hinchcliff et al. 2004). But although outputs (such as numbers of students, presentations, and classes) have been well documented, there has been no evaluation of the various components of the region's education program, particularly *Salmon in the Classroom* which is the main focus of the region's educational resources.

Therefore, a study to assess the *Salmon in the Classroom* component of the region's education program was initiated for the 2006-2007 school year. Although the regional aquatic education plan includes goals and objectives for all aquatic education programs across the entire region,

this first evaluation project is focused narrowly on selected knowledge-related objectives from the plan that pertain to students participating in the *Salmon in the Classroom* program in the Anchorage School District (ASD).

## **STUDY LOCATION AND PARTICIPANTS**

Anchorage is Alaska's center of commerce, and with a population of 260,000, its largest city. Its 2,000 square mile area ranges from the dense city center, to semi-rural mountainous regions north and east, to the sea on the western edge. Challenges to this urban community include rapid demographic changes rising from a "boom and bust" economy, rising poverty rates, and accelerating immigration. The cultural and ethnic profile of the city profoundly shifted in the post-oil boom 1990s. Minorities now comprise 30% of the population, and that number is rapidly growing. Large influxes of Hispanic, Filipino, Asian, Pacific Islanders, and eastern Europeans have changed the face of the city and the learning needs of the children. Anchorage now is home to 20% of Alaska's Natives, forming the state's largest single "Native village."

ASD was chosen for this project because of the long history of the *Salmon in the Classroom* program there; strong support for the program among teachers, school officials, and parents; and willingness of ASD to provide critical infrastructure support for implementing an evaluation. In addition, the *Salmon in the Classroom* program is an approved component of the ASD science curriculum for 2<sup>nd</sup> grade. ASD is the 88th largest school district in the nation, enrolling almost 50,000 students, or about 39% of the state's school-age population; and with about 3,500 teachers. It is a U.S. Department of Education-designated "central city" district. Minorities in the schools grew by 53% in the 1990s. Currently, 50% of ASD students are ethnic non-whites; and all racial, ethnic, and language groups have grown in absolute numbers over the past 5 years. The greatest growth is among Alaska Natives, now at 13% of ASD students; Asian/Pacific Islanders, and Hispanics. More than 84 languages are spoken in the 90 public schools. Significantly, over 37% of ASD students now live in poverty, and this proportion is increasing (ASD Title I). Yet, these students are Alaska's future—they will be the workforce, researchers, developers, and leaders. Alaska's borders are non-contiguous with other states. Alaska cannot afford to lose any groups or individuals to the achievement gap.

The purpose of this project is to evaluate selected outcomes from the Region II aquatic education strategic plan (see Appendix A1 in Timmons 2006), as they relate to 4<sup>th</sup>–6<sup>th</sup> grade ASD students participating in the *Salmon in the Classroom* program, to help determine if goals 1, 3 and 4 of the plan are being met. Because teaching methods and student ability differ greatly by student age, and because valid assessment techniques are different for younger students, only students in grades 4-6 were included in the study.

## **OBJECTIVES**

The objectives for this study were to estimate, for ASD students in 4<sup>th</sup>–6<sup>th</sup> grades who participated in the *Salmon in the Classroom* program during the 2006-2007 school year:

1. the percent who scored at least 70% on the post-test at the end of the school year;
2. the average score on the pre-test and the post-test;
3. the average change in score between the pre-test and post-test; and
4. test the null hypothesis that there was no correlation between:

- a. teacher experience (years participating in the *Salmon in the Classroom* program) and the average post-test score for the class;
- b. the number of *Salmon in the Classroom* activities and the average post-test score for the class;
- c. teacher experience (years participating in the *Salmon in the Classroom* program) and the average change in score between pre- and post-tests for the class;
- d. the number of *Salmon in the Classroom* activities and the average change in score between pre- and post-tests for the class.

In all cases the alternative hypothesis was that there was a positive correlation. In all cases the null hypothesis was rejected if the sample correlation coefficient was  $\geq 0.25$  with probabilities of Type I and Type II error being 0.20 and 0.05, respectively.

In addition, the following task was included:

1. test the hypothesis that there was no significant difference in the average post-test score of the class among teachers who used (1) no materials, (2) only materials supplied by ADF&G, and (3) materials supplied by the teacher (regardless of ADF&G material).

## **METHODS**

### **STUDY DESIGN AND DATA COLLECTION**

Students in ASD 4<sup>th</sup>–6<sup>th</sup> grades in classes participating in the *Salmon in the Classroom* program during the 2006-2007 school year were given a pre-test and post-test concerning their knowledge of topics covered by the program (Appendix A1). All teachers in the program were provided the tests, although not all students took the tests. The test was reviewed by the ASD science and assessment departments to ensure validity, such as non-biased wording and age appropriateness. The test was multiple-choice, “bubble” format in which students selected a response by filling in a circle adjacent to their answer of choice. Pre- and post-tests included a student field in which teachers were to fill in the students’ identification numbers (ID) so that pre- and post-test results could be paired at the student level. Personal identities of students were not included. School codes were also included on the test. A teacher survey was distributed with the post-test (Appendix A2).

ASD distributed tests to participating teachers, who administered the tests and returned them to ASD. ASD scanned completed tests, and provided the final resulting data to ADF&G for analysis.

The pre-test was administered in early September 2006 prior to the first field trip. The post-test and teacher survey were administered in late May 2007 after the final field trip of the school year. The exact dates of test administration were chosen by individual teachers.

### **DATA ANALYSIS**

The percent of students scoring at least 70% on the post-test was calculated as a binomial proportion (Cochran 1977) by:

$$\hat{p}_{>70\%} = \left( \frac{n_{>70\%}}{n} \right) * 100, \tag{1}$$

with variance estimated as:

$$\hat{V}ar(\hat{p}_{>70}) = \frac{\hat{p}_{>70}(1 - \hat{p}_{>70})}{n - 1} * 100^2, \quad (2)$$

where:

- $n_{>70\%}$  = the number of students who scored >70% on the post-test,
- $n$  = the total number of students who took the post-test.

The average score on the pre-test and the post-test was calculated as:

$$\bar{x}_t = \frac{\sum_{s=1}^{n_s} x_{ts}}{n_s}, \quad (3)$$

with variance:

$$s_t^2 = \frac{\sum_{s=1}^{n_s} (x_{ts} - \bar{x}_t)^2}{n_s - 1}, \quad (4)$$

where:

- $x_{ts}$  = the score of student  $s$  on test  $t$  (pre or post),
- $n_s$  = the number of students who took test  $t$ .

For each student for which there were paired pre- and post-test data, the change in score between the pre-test and post-test was calculated as:

$$d_s = x_{post,s} - x_{pre,s}, \quad (5)$$

where:

- $x_{post,s}$  = the score of student  $s$  on the post-test,
- $x_{pre,s}$  = the score of student  $s$  on the pre-test.

The average change in score was calculated as:

$$\bar{d} = \frac{\sum_{s=1}^{n_s} d_s}{n_s}, \quad (6)$$

with variance:

$$s_{\bar{d}}^2 = \frac{\sum_{s=1}^{n_s} (d_s - \bar{d})^2}{n_s - 1}, \quad (7)$$

where:

$n_s$  = the number of students with paired pre- and post-test data.

A t-test was used to test all four correlation hypotheses:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}, \quad (8)$$

where  $r$  (sample correlation coefficient) was calculated as:

$$10. r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2} \sqrt{n(\sum y^2) - (\sum y)^2}}, \quad (9)$$

where  $n$  = the number of teachers participating in the program and  $x$  and  $y$  depended on which hypothesis was being tested and are defined as follows:

hypothesis	x	y
a	teacher experience	average post-test score for the class
b	the number of activities	average post-test score for the class
c	teacher experience	average change in score between pre- and post-tests for the class
d	the number of activities	average change in score between pre- and post-tests for the class

An analysis of variance was used to determine if there was a significant difference in the average post-test score of the class among teachers who used (1) no materials, (2) only materials supplied by ADF&G, and (3) materials supplied by the teacher (regardless of ADF&G material).

## RESULTS

### SUMMARY STATISTICS

For the 2006-2007 school year, 536 pre-tests from 18 schools were returned and 384 post-tests from 13 schools. There was a clear break between the percent of students answering 22 versus 23 questions, so students answering 22 questions or less were eliminated from the analysis for both the pre- and post-tests (Figure 2). This resulted in eliminating 6% (31) of the pre-tests and 5% (19) of the post-tests, for a sample size of 505 pre-tests and 365 post-tests. Paired data for pre- and post-tests were available for only 124 students because the student ID was either missing or incorrectly coded for a large number of tests. Paired student data that could also be associated with the individual teacher were available for only five classes. Data from the teacher surveys were available for 17 teachers.

Students averaged a score of 61% (SE = 1%) on the pre-test and 71% (SE = 1%) on the post-test. Scores on the pre-test ranged from 14% to 100% and from 23% to 100% on the post-test. Mean scores by school ranged from 40% to 79% on the pre-test and from 51% to 83% on the post-test (Figure 3). On the post-test, 60% (SE = 3%) of the students scored at least a 70%.

### PAIRED TESTS

For students with paired test scores, the mean change in score was +14.1 (SE = 1.4) percentage points, and the change was significant ( $t = 9.8$ ,  $P < 0.01$ ). Because our sample size was only

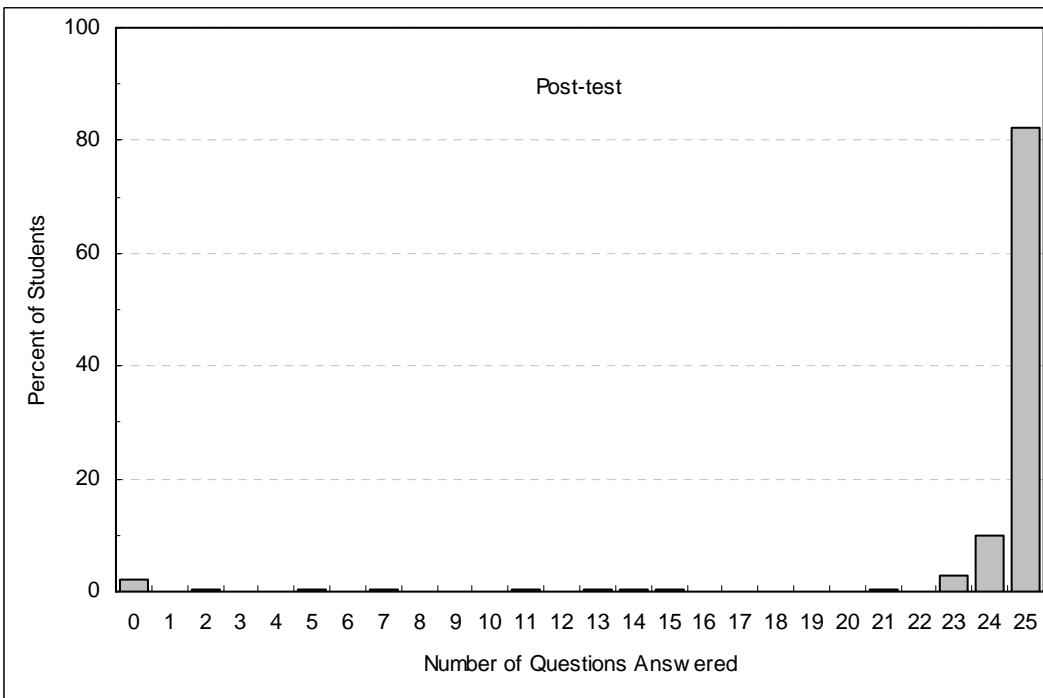
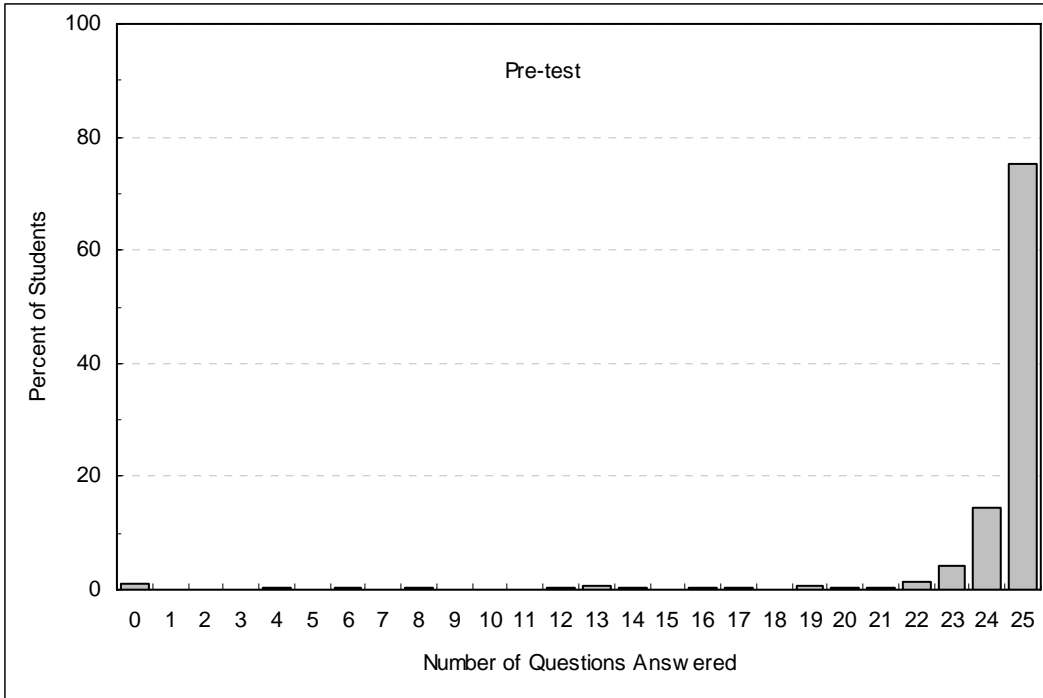
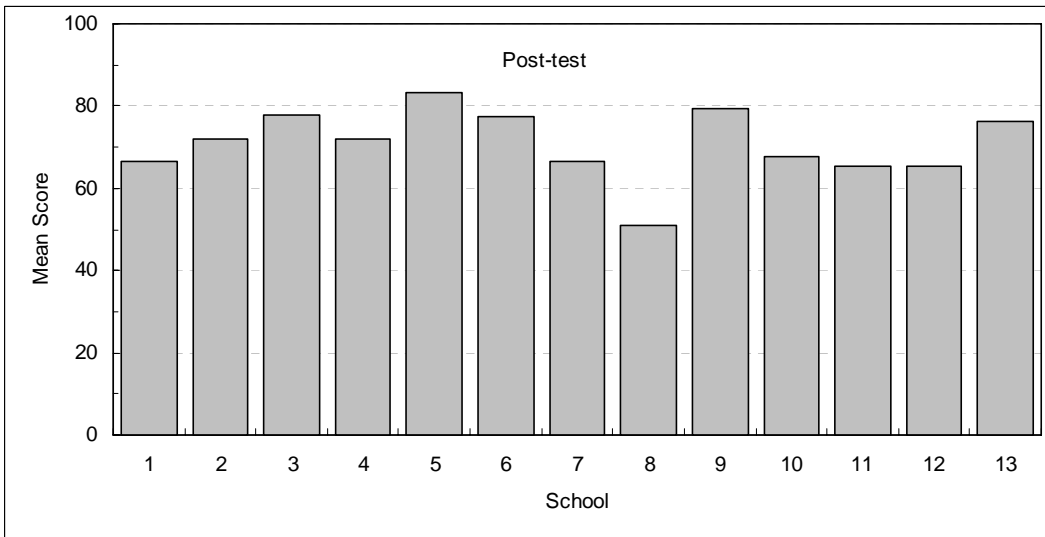
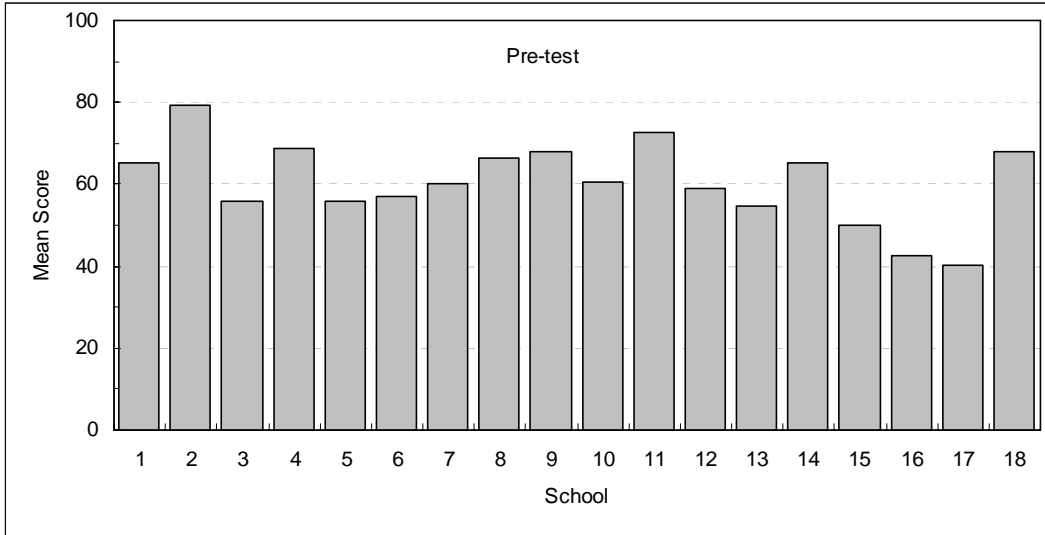


Figure 2.-Percent of students by number of questions answered on the pre- and post-tests, 2006-2007.



*Note:* School numbers are aliases and schools with the same pre- and post-test alias are not necessarily the same school.

Figure 3.-Mean score on the pre- and post-tests, by school, 2006-2007.

124 paired tests, we tested the hypothesis that there was no difference between the mean score of paired tests versus non-paired tests. On the pre-test, there was no significant difference between paired and non-paired tests (mean for paired = 61.3%, mean for non-paired = 61.1%,  $t = -0.05$ ,  $P = 0.96$ ). On the post-test, paired and non-paired scores were significantly different (mean for paired = 75.4%, mean for non-paired = 69.2%,  $t = -3.3$ ,  $P < 0.01$ ).

## **RESULTS BY ITEM**

On the pre-test, the highest percent (86%) of students selected the correct answer for question 1 (fins), and the lowest (27%) for question 5 (swim bladder) (Table 1; Figure 4). On the post-test, the highest percent correct was question 4 (90%, heart), and the lowest percent was question 16 (38%, spawners). For all opinion questions, the percent of students selecting “yes” decreased from the pre-test to the post-test, as did the percent selecting “yes” or “maybe a little” (Table 2; Figure 5).

## **TEACHER AND CLASS CHARACTERISTICS**

Because of the small sample size of only five classes for which paired data were available that could be matched with an individual teacher, we did not conduct the hypothesis tests of correlation between teacher characteristics and changes in test scores.

Teachers who responded to the teacher survey had varied experience in the program (Table 3). More than 70% made use of teaching aids available from ADF&G, and 59% used other materials (Table 4). Only 41% used the aquarium setup manual. All of the classes attended the egg take, most made use of an aquarium in the class or school, and most participated in salmon dissections and the end-of-year field trip to the Salmon Celebration.

## **DISCUSSION**

This project provided the first quantitative assessment of Region II’s *Salmon in the Classroom* program. Teachers in the program were willing to administer the pre- and post-tests, and we received no complaints about the assessment being onerous, a concern expressed by some Region II staff at the outset of the assessment project. This may be because assessment is expected in most formal education programs, teachers are well-acquainted with assessment techniques, the pre- and post-tests were short and easy to administer and required minimal effort on the part of teachers, and ASD support staff and ADF&G provided the tests, scored them, and analyzed the data.

However, effort should be made to increase the number of 4<sup>th</sup>–6<sup>th</sup> graders participating in the program and increase the participation rate in the pre- and post-test. Only 18 of about 60 total ASD schools that had 4<sup>th</sup>–6<sup>th</sup> graders took part in the pre-test, and only 13 in the post-test. Our sample of paired students was even lower, only 124 students, and this was primarily a result of student IDs being provided on a very low percentage of tests. Overall participation might be increased by personal contact with teachers in the program and reminders to administer and submit the tests. Teachers might be encouraged to participate, and to be more conscientious about providing student IDs, if overall results of the study and of their individual classes are made available to them, and if ADF&G makes changes to the program that address shortcomings identified by the assessment that are also helpful to teachers.

## **STUDENT KNOWLEDGE**

Overall, students’ knowledge of salmon increased over the school year (Figure 4). The objective for 25% of students in the program to score at least a 70%, from the Region II strategic plan for aquatic education, was exceeded by a large margin: 60% (SE = 3%) of students scored at least a 70% on the post-test. The post-test results are a conservative estimate of mean score because



Table 1.-Percent of students selecting possible answers on the pre- and post-tests.

Note: The correct answer is shaded and bold.

Question/Answer	Percent	
	Pre-test	Post-test
<b>Question 1: How does a fish steer its body through the water?</b>		
A) swim bladder	6	8
B) gills	4	2
<b>C) fins</b>	<b>87</b>	<b>87</b>
D) pyloric caeca	3	3
<b>Question 2: What does the fish's stomach do?</b>		
A) makes eggs	36	22
<b>B) digests food</b>	<b>61</b>	<b>74</b>
C) watches out for predators	1	2
D) helps it hear	2	2
<b>Question 3: What does the fish's liver do?</b>		
<b>A) helps with digestion, stores fat, and removes poisons from the blood</b>	<b>50</b>	<b>65</b>
B) helps the fish breath oxygen out of the water	18	14
C) pumps blood through the fish's body	14	12
D) grows the fishes eggs	18	9
<b>Question 4: What does the fish's heart do?</b>		
A) filters blood	6	4
<b>B) pumps blood</b>	<b>83</b>	<b>90</b>
C) makes blood	6	3
D) stores blood	4	2
<b>Question 5: What does the fish's swim bladder do?</b>		
A) digests food	8	4
B) helps the fish swim faster	30	23
C) holds urine	35	22
<b>D) helps the fish float in one place</b>	<b>27</b>	<b>51</b>
<b>Question 6: What do the fish's kidneys do?</b>		
<b>A) takes waste out of blood</b>	<b>54</b>	<b>64</b>
B) helps the fish hear	7	2
C) pumps blood	6	4
D) helps the fish stay warm	33	30
<b>Question 7: Why are eggs and milt important?</b>		
A) they help pump blood	4	2
B) they help digest food	4	2
<b>C) they make baby salmon</b>	<b>79</b>	<b>85</b>
D) they protect the fish	13	11

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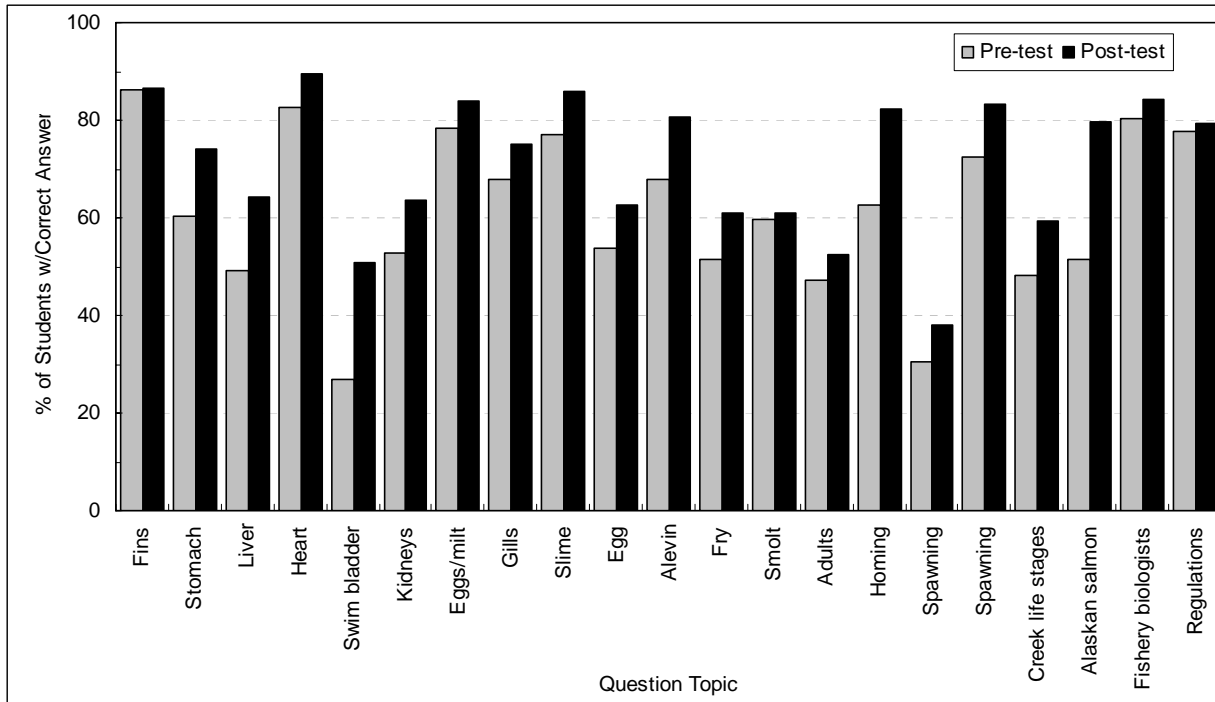
Table 1.-Page 2 of 3.

Question/Answer	Percent	
	Pre-test	Post-test
<b>Question 8: What part of the human body is similar to a fish's gills?</b>		
A) liver	5	5
<b>B) lungs</b>	<b>69</b>	<b>76</b>
C) heart	20	12
D) kidneys	6	8
<b>Question 9: What does the slime on a fish do?</b>		
A) digests food	1	2
B) gets oxygen from the water	18	10
C) filters blood	4	1
<b>D) protects it from germs</b>	<b>77</b>	<b>87</b>
<b>Question 10: When the salmon starts out its life as an egg in a stream, where would it be found?</b>		
A) buried carefully in the mud	29	25
B) in a nest made of sticks	4	3
<b>C) under the gravel</b>	<b>54</b>	<b>63</b>
D) floating on a pond	14	9
<b>Question 11: After hatching, how does an alevin get its food?</b>		
A) it eats small bits of plants	14	8
B) its mother brings it food	10	7
C) it strains insects	8	4
<b>D) from its yolk-sac</b>	<b>68</b>	<b>81</b>
<b>Question 12: Which sentence is NOT true about salmon fry?</b>		
A) Some salmon fry may travel to the ocean right after they come out of the gravel	28	26
B) Birds and other animals eat salmon fry.	11	6
<b>C) All salmon fry are found far out in the middle of the sea.</b>	<b>52</b>	<b>62</b>
D) Some salmon fry live in streams or lakes for a while.	8	7
<b>Question 13: What happens to salmon when they change into smolt?</b>		
<b>A) Their bodies change to a shiny, silvery color.</b>	<b>60</b>	<b>61</b>
B) Their stomachs must be able to digest plants in addition to insects	14	17
C) Their eyesight gets better by 200%.	8	6
D) They make eggs or milt	18	16
<b>Question 14: Which sentence is TRUE about adult salmon living in the ocean?</b>		
A) They always stay close to their home stream.	15	17
<b>B) They may swim thousands of miles.</b>	<b>47</b>	<b>53</b>
C) They only live in the ocean a few weeks.	17	18
D) Their travels in the ocean are very random.	20	13

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Table 1.-Page 3 of 3.

Question/Answer	Percent	
	Pre-test	Post-test
<b>Question 15: How do salmon find their way back to their home stream to spawn?</b>		
A) by sight	24	7
B) by touch	3	4
C) by sound	10	7
<b>D) by smell</b>	<b>63</b>	<b>82</b>
<b>Question 16: Which is NOT true about salmon that are getting ready to spawn?</b>		
A) they eat a lot	31	38
B) they change color	14	10
<b>C) they stop eating</b>	<b>27</b>	<b>32</b>
D) they grow a hump	28	20
<b>Question 17: What happens to salmon after they spawn?</b>		
A) go to lakes for the winter	5	3
B) go back to the ocean	11	7
C) stay with the baby salmon	10	6
<b>D) die</b>	<b>74</b>	<b>84</b>
<b>Question 18: What life stages of salmon are found in creeks in Anchorage?</b>		
A) eggs and smolt	21	12
B) feeding adults and fry	11	8
<b>C) eggs, alevin, fry, smolt, spawner</b>	<b>48</b>	<b>60</b>
D) eggs, alevin, fry	20	20
<b>Question 19: Which one is an Alaskan salmon?</b>		
A) catfish	9	3
B) minnow	27	12
<b>C) coho</b>	<b>55</b>	<b>82</b>
D) perch	8	3
<b>Question 20: What do fishery biologists do for their job?</b>		
A) They take people on fishing trips	8	6
<b>B) They study fish and what fish need to be healthy</b>	<b>80</b>	<b>85</b>
C) They catch fish and sell them to grocery stores.	9	9
D) They make artwork out of fish for fishing stores	3	1
<b>Question 21: What's the best way to know the rules for fishing?</b>		
<b>A) look in the regulation book</b>	<b>78</b>	<b>80</b>
B) look in the dictionary	3	5
C) just catch as many as you want	8	6
D) ask your friends	11	9



Note: See Table 1 for complete question wording.

Figure 4.-Percent of students selecting the correct answer on the pre- and post-test, by question, 2006-2007.

ASD has an over-all district transiency rate of 26.8%, and post-test results include students who may have entered the program mid-way through the school year.

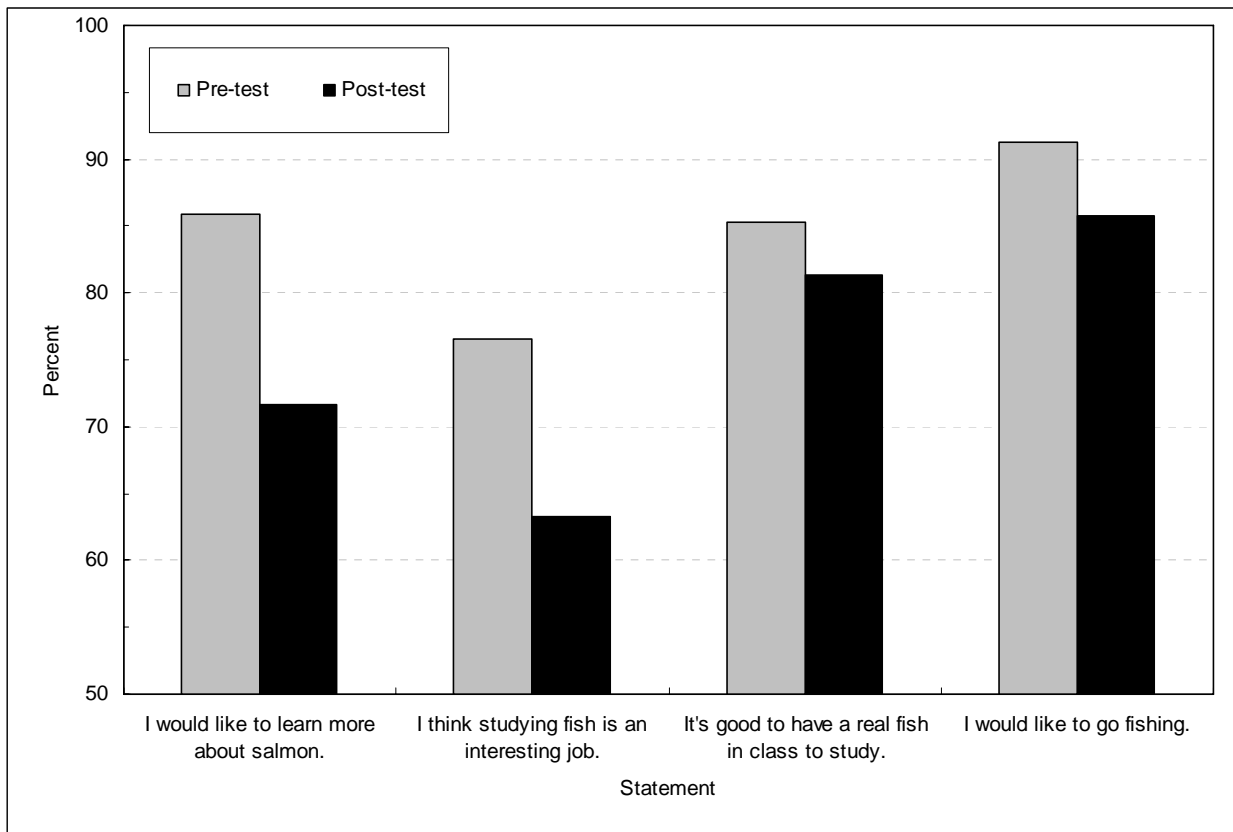
### Prior Knowledge

Prior knowledge is one of the most important considerations in teaching (Gunter et. al 2007). Without any prior knowledge, students will be overwhelmed with new information and will be unable to relate new information to concepts they already understand. On the other hand, if students have an abundance of knowledge about a topic, they could become bored and time may be wasted focusing on concepts they already thoroughly understand. Therefore, assessing prior knowledge is essential to effective teaching and is also crucial to identifying underlying misconceptions that should be explicitly addressed by educators.

The test in this study provided helpful information concerning the prior knowledge students bring about salmon into the program. Based on this study, as they entered the program at the beginning of the school year, many (70%+) students already had a basic understanding of the function of the fish’s fins (Question 1), heart (Question 4), eggs and milt (Question 7), and slime (Question 9); they understood that salmon die after spawning (Question 17); they knew what fishery biologists do (Question 20), and where to find fishing regulations (Question 21). It was surprising that, as they entered the program, nearly 70% of students knew that alevins get their nourishment from the yolk-sac (Table 1, Question 11), because we had expected the terms “alevin” and “yolk-sac” to be unfamiliar terms to most children of this age group.

Table 2.-Student responses to four opinion statements on the pre- and post-test, 2006-2007.

Statement and response	Pre-test		Post-test	
	Number	Percent	Number	Percent
<b>I would like to learn more about salmon.</b>				
Yes!!!	299	59	133	37
Maybe a little.	134	27	128	35
I don't know.	37	7	45	12
Not really.	24	5	44	12
No way.	<u>10</u>	<u>2</u>	<u>14</u>	<u>4</u>
Total	504	100	364	100
<b>I think studying fish is an interesting job.</b>				
Yes!!!	256	51	117	32
Maybe a little.	129	26	114	31
I don't know.	59	12	57	16
Not really.	36	7	55	15
No way.	<u>23</u>	<u>5</u>	<u>22</u>	<u>6</u>
Total	503	100	365	100
<b>It's good to have a real fish in class to study.</b>				
Yes!!!	350	70	225	62
Maybe a little.	79	16	72	20
I don't know.	35	7	36	10
Not really.	21	4	19	5
No way.	<u>18</u>	<u>4</u>	<u>13</u>	<u>4</u>
Total	503	100	365	100
<b>I would like to go fishing.</b>				
Yes!!!	400	80	276	76
Maybe a little.	58	12	37	10
I don't know.	16	3	17	5
Not really.	12	2	24	7
No way.	<u>16</u>	<u>3</u>	<u>11</u>	<u>3</u>
Total	502	100	365	100



Note that the vertical axis begins at 50%.

Figure 5.-Percent of students responding “yes” or “maybe a little” to four opinion statements on the pre- and post-test, 2006-2007.

High prior knowledge of these terms and concepts may be from prior involvement in our program or students may have obtained the knowledge from other sources. In many ASD schools, the program is open to the whole school. Even though it may not be the primary emphasis for younger grades, younger children may be exposed to the program through the aquarium being in a common area and they may attend the field trips with their older classmates. In addition, many children in Alaska are involved in sport fishing or other similar activities, and many different areas of modern Alaskan culture emphasize salmon.

Another possibility is that some classes might have begun the unit on salmon prior to administration of the pre-test. Pre-tests were distributed to teachers right before the egg take in mid-September because we had assumed that teachers use the egg take as the introductory activity for the program. However, we discovered in a subsequent study that at least some teachers begin teaching about salmon from the first day of school in mid-August. Therefore, for some of the students, the pre-test may not have really been a pre-test. We do not know how many classes began the unit prior to the pre-test, but for future studies, this potential issue can be avoided by distributing the pre-test near the beginning of the school year.

Table 3.-Teacher responses to the survey distributed with the post-test, 2006-2007.

Question and response	Responses	
	Number	Percent
<b>Question 1. How many years have you participated in the <i>Salmon in the Classroom</i> program, including this year?</b>		
<b><u>Experience</u></b>		
1 year (this is my first year)	4	25
2-3 years	3	19
4-5 years	2	13
More than 5 years	<u>7</u>	<u>44</u>
Total <sup>a</sup>	16	100
<b>Question 2. Which of the following supporting materials do you use for teaching about salmon?</b>		
<b><u>Materials Used</u></b>		
Salmonids in the Classroom curriculum	12	71
Salmon life cycle poster	16	94
Alaska's Wild Salmon	13	76
Aquarium setup manual	7	41
Other <sup>b</sup>	10	59
<b><u>Number of Materials Used</u></b>		
1	1	6
2	1	6
3	8	47
4	4	24
5	<u>3</u>	<u>18</u>
Total	17	100
<b>Question 3. In which of the following activities did your class participate during the 2006-2007 school year?</b>		
<b><u>Activities Participated In</u></b>		
Egg takes	17	100
Aquarium in classroom or school	16	94
Salmon dissection	14	82
Salmon Celebration	15	88
Other <sup>b</sup>	4	24
<b><u>Number of Activities</u></b>		
1	0	0
2	1	6
3	2	12
4	12	71
5	<u>2</u>	<u>12</u>
Total	17	100

<sup>a</sup> No response by one teacher.

<sup>b</sup> See Table 4 for a list of "other" materials/activities written in by teachers.

Table 4.-Write-in responses on the teacher survey, listing of other materials used (Question 2), 2006-2007.

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Other materials used by teachers

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Salmon trade books

3 part cards of Alaska's salmon. Made salmon bulletin board. Researched/dissected fish.

Created a salmon book.

Salmon science notebooks, math/story problems.

Assorted web pages.

Watershed health/bugs helped create materials for helping teach other students at the "Salmon Celebration"

Was given various materials from 6th grade teacher.

Background information: salmon anatomy.

Scales & Tales and news clippings: they were hand down materials.

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The basic understandings of fish and salmon that many students already have as they enter the program are important, in that they give Sport Fish educators a foundation on which to build. However, the amount of time and effort spent targeting these concepts should be evaluated. Rather than focusing on concepts many students already understand, basic concepts can be used as building blocks to teach concepts that showed little improvement or for which misconceptions continued through the end of the school year.

### **Misconceptions**

A pre/post-test assessment can be beneficial for identifying concepts that need clarification through more time, emphasis, or modified teaching techniques. Several such areas were identified through this assessment. Although the percent of students choosing the correct answer for the question concerning the function of the stomach increased from 61% on the pre-test to 74% on the post-test, most students who did not select the correct answer chose "makes eggs" instead. Even after participating in a dissection, 22% of students thought that the function of the stomach was to "make eggs" rather than "digest food." This could reflect confusion among children this age who may equate "stomach" with "body cavity," or who think that babies develop in the "stomach" of the mother in humans. During dissections, Sport Fish aquatic educators should consider focusing time on carefully explaining the function of the stomach, and pointing out the location of eggs and stomach in the body cavity of the fish. However, educators should be aware that overcoming prior misconceptions can be extremely difficult, and in fact, educators may inadvertently reinforce misconceptions.

Continued lack of understanding or misconceptions were indicated for the liver, swim bladder, kidneys, and gills (Table 1, Questions 3, 5, 6 and 8); and concerning egg, fry, smolt and ocean life stages (Questions 10, 12, 13, 14). Sport Fish aquatic educators should carefully evaluate presentations as they are currently structured to ensure that the program covers these topics and in ways that are meaningful to students. The *Salmonids in the Classroom* curriculum will be revised during 2007-2008. During the revision process, special attention should be given to these concepts.



## STUDENT OPINIONS AND PROGRAM FEEDBACK

Students' opinions about the program after participating are a concern. Students were less positive about learning about salmon, studying fish for a job, having a real fish in class, and sport fishing at the end of the program than at the beginning. Of course, we cannot expect that 100% of students will be enthusiastic about these topics, and it is also possible that these results simply reflect students' overall readiness to be done with school in general at the end of the school year. However, we need to seriously consider the possibility that these results are a reflection of the program itself. For example, perhaps the way material is presented does not fully engage students, making them less interested in learning about salmon at the end of the program. Perhaps Sport Fish educators should highlight a broader variety of careers available in fisheries. Perhaps students find dissecting a real fish distasteful or even disturbing; or perhaps they find caring for live fish in a cold-water aquarium onerous or boring. Perhaps they were excited about the prospect of sport fishing, but cancellation of the ice fishing field trip dampened their spirits.

In the past, the only feedback received from students and teachers came from those who were enthusiastic about the program. There has been no effective mechanism to receive constructive criticism, concerns, or suggestions about the program, or to contact teachers who drop out of the program to find out why they did so. Therefore, in the past it was assumed that the program was meaningful and effective for all participants and that the program increased enthusiasm for studying salmon, becoming a fishery biologist, and sport fishing. Although it would be tempting to look at the post-test results alone and conclude that the program is having a positive outcome on students, program staff should rather make efforts to discover why students are less enthusiastic at the end of the program than at the beginning.

There are several ways to collect this kind of information. First, feedback from teachers should be gathered. Although the teacher survey in this study provided write-in space for suggestions and this program has conducted informal surveys of teachers in the past, most input appears to be given hastily, input is received from a self-selecting sample of teachers, and teachers provide few detailed concerns or suggestions for improvements on surveys (*unpublished data*). To receive truly useful feedback that accurately reflects the program, a random sample of teachers should be selected. A Sport Fish aquatic education representative should meet with the selected teachers individually and in-person. During the meeting, teachers should be assured that the purpose of receiving feedback is not because of program cuts or drastic changes, but to ensure that the program is responsive to the needs of teachers and students, and to increase program effectiveness. Teachers also should be shown results of this study, and changes already made to the program to increase its effectiveness based on study results and previous teacher input. This will assure teachers that the time they take to provide feedback will result in program improvements and effectiveness, and that Sport Fish Division is sincere in its desire for input from participants and to improve the program.

Second, teachers who drop out of the program should be contacted and an exit interview should be conducted, preferably in person. This will allow drop-out rates to be determined, information that has not been available previously. Reasons for dropping out of the program should be documented and tracked to discover if there are commonalities and to elucidate possible areas for program improvement.

Third, Sport Fish educators should adopt feedback tools to use with students during presentations. These tools, called classroom assessment techniques in formal education, are

intended to be used frequently to make immediate adjustments to teaching methods. Classroom assessment has several benefits for the instructor, providing “day-to-day feedback that can be applied immediately... useful information about what students have learned without the amount of time required for preparing tests, reading papers, etc. ... allow you to address student misconceptions or lack of understanding in a timely way...help to foster good working relationships with students...” For students, classroom assessment can “reduce feelings of isolation and impotence, especially in large classes; increase understanding and ability to think critically about the course content; foster an attitude that values understanding and long-term retention” (Haugen 1999). There are many classroom assessment tools (Angelo and Cross 1993) that Sport Fish educators could adopt or modify for use in the *Salmon in the Classroom* program that will give them immediate information about student engagement and understanding, and could provide insight into the decrease in enthusiasm indicated by results of this study.

## CONCLUSIONS

Overall, results of this project indicate that the *Salmon in the Classroom* program increased ASD 4<sup>th</sup>-6<sup>th</sup> graders’ overall knowledge of salmon during the 2006-2007 school year, and the program far exceeded the strategic plan objective for 25% of students in the program to score at least a 70% on the post-test. The *Salmon in the Classroom* program thus continues to be one of the primary tools by which Region II pursues its aquatic education goals, and staff should consider a more ambitious objective if the aquatic education plan is revised.

To increase effectiveness of the *Salmon in the Classroom* program, Sport Fish aquatic educators should look carefully at topics for which misunderstandings remained at the end of the 2006-2007 school year to identify potential improvements to the program, consider possible reasons for the decrease in student enthusiasm, identify ways to engage students more effectively, and develop a mechanism for encouraging feedback on the program from teachers and students. The assessment project should be conducted again in 2007-2008 to obtain further information on the program’s effectiveness, and document effects of program changes on students’ knowledge and opinions. Participation in the pre- and post-tests needs to be increased, and particular effort should be made to obtain student IDs so that a sufficient sample of paired pre-post tests is available for analysis.

## ACKNOWLEDGMENTS

Stacie Hall provided helpful expertise and review of this project during the planning phase. Lisa Olson provided reviews of the draft test. Sarah Hotchkiss set up the test form and scanned completed tests. Danise Podvin provided assessment expertise and support in planning the project. Crystal Wrabetz provided assistance in delivering tests to teachers.

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## **APPENDIX A. PRE/POST TEST AND TEACHER SURVEY**

Appendix A1.-Pre- and post-test administered to Anchorage School District 4<sup>th</sup>-6<sup>th</sup> graders participating in the Salmon in the Classroom program, 2006-2007.



## Salmon Assessment 2006-07

Please choose the best answer for each question.

1. **How does a fish steer its body through the water?**  
 swim bladder  gills  fins  pyloric caeca
2. **What does the fish's stomach do?**  
 makes eggs  digests food  watches out for predators  helps it hear
3. **What does the fish's liver do?**  
 helps with digestion, stores fat, and removes poisons from the blood  
 helps the fish breath oxygen out of the water  
 pumps blood through the fish's body  
 grows the fishes eggs
4. **What does the fish's heart do?**  
 filters blood  pumps blood  makes blood  stores blood
5. **What does the fish's swim bladder do?**  
 digests food  helps the fish swim faster  
 holds urine  helps the fish float in one place
6. **What do the fish's kidneys do?**  
 takes waste out of blood  helps the fish hear  
 pumps blood  helps the fish stay warm
7. **Why are eggs and milt important?**  
 they help pump blood  they help digest food  
 they make baby salmon  they protect the fish
8. **What part of the human body is similar to a fish's gills?**  
 liver  lungs  heart  kidneys
9. **What does the slime on a fish do?**  
 digests food  gets oxygen from the water  
 filters blood  protects it from germs
10. **When the salmon starts out its life as an egg in a stream, where would it be found?**  
 buried carefully in the mud  in a nest made of sticks  
 under the gravel  floating on a pond
11. **After hatching, how does an alevin get its food?**  
 it eats small bits of plants  its mother brings it food  
 it strains insects  from its yolk-sac
12. **Which sentence is NOT true about salmon fry?**  
 Some salmon fry may travel to the ocean right after they come out of the gravel.  
 Birds and other animals eat salmon fry.  
 All salmon fry are found far out in the middle of the sea.  
 Some salmon fry live in streams or lakes for a while.
13. **What happens to salmon when they change into smolt?**  
 Their bodies change to a shiny, silvery color.  
 Their stomachs must be able to digest plants in addition to insects.  
 Their eyesight gets better by 200%.  
 They make eggs or milt.

-continued-



# Salmon Assessment 2006-07 page 2

- |                                                                            |             |
|----------------------------------------------------------------------------|-------------|
|                                                                            | School      |
| 14. Which sentence is TRUE about adult salmon living in the ocean?         | 0 ○○○○      |
| ○ They always stay close to their home stream.                             | 1 ○○○○      |
| ○ They may swim thousands of miles.                                        | 2 ○○○○      |
| ○ They only live in the ocean a few weeks.                                 | 3 ○○○○      |
| ○ Their travels in the ocean are very random.                              | 4 ○○○○      |
| 15. How do salmon find their way back to their home stream to spawn?       | 5 ○○○○      |
| ○ by sight ○ by touch ○ by sound ○ by smell                                | 6 ○○○○      |
| 16. Which is NOT true about salmon that are getting ready to spawn?        | 7 ○○○○      |
| ○ they eat a lot ○ they change color ○ they stop eating ○ they grow a hump | 8 ○○○○      |
| 17. What happens to salmon after they spawn?                               | 9 ○○○○      |
| ○ go to lakes for the winter ○ go back to the ocean                        |             |
| ○ stay with the baby salmon ○ die                                          |             |
| 18. What life stages of salmon are found in creeks in Anchorage?           | Student     |
| ○ eggs and smolt                                                           | 0 ○○○○○○○○○ |
| ○ feeding adults and fry                                                   | 1 ○○○○○○○○○ |
| ○ eggs, alevin, fry, smolt, spawner                                        | 2 ○○○○○○○○○ |
| ○ eggs, alevin, fry                                                        | 3 ○○○○○○○○○ |
| 19. Which one is an Alaskan salmon?                                        | 4 ○○○○○○○○○ |
| ○ catfish ○ minnow ○ coho ○ perch                                          | 5 ○○○○○○○○○ |
| 20. What do fishery biologists do for their job?                           | 6 ○○○○○○○○○ |
| ○ They take people on fishing trips.                                       | 7 ○○○○○○○○○ |
| ○ They study fish and what fish need to be healthy.                        | 8 ○○○○○○○○○ |
| ○ They catch fish and sell them to grocery stores.                         | 9 ○○○○○○○○○ |
| ○ They make artwork out of fish for fishing stores.                        |             |
| 21. What's the best way to know the rules for fishing?                     |             |
| ○ look in the regulation book ○ look in the dictionary                     |             |
| ○ just catch as many as you want ○ ask your friends                        |             |

What do you think? Questions 22 - 25 are about your opinions. There is not a right or wrong answer.

22. I would like to learn more about salmon.  
 ○ yes!!! ○ maybe a little ○ I don't know ○ not really ○ no way
23. I think studying fish is an interesting job.  
 ○ yes!!! ○ maybe a little ○ I don't know ○ not really ○ no way
24. It's good to have a real fish in class to study.  
 ○ yes!!! ○ maybe a little ○ I don't know ○ not really ○ no way
25. I would like to go fishing.  
 ○ yes!!! ○ maybe a little ○ I don't know ○ not really ○ no way

This last question doesn't have a right or a wrong answer. Write what you think.

26. What is something you can do to help take care of Alaska's fish and water?

Appendix A2.-Teacher survey conducted with the post-test, 2006-2007.

1. ***How many years have you participated in the Salmon in the Classroom program, including this year?***
  - a) 1 year (this is my first year)
  - b) 2-3 years
  - c) 4-5 years
  - d) more than 5 years
  
2. ***Which of the following supporting materials do you use for teaching about salmon?***
  - a) Salmonids in the Classroom curriculum (yes/no)
  - b) Salmon life cycle poster (yes/no)
  - c) Alaska's Wild Salmon (yes/no)
  - d) Aquarium setup for Dummies (yes/no)
  - e) Other educational materials that I have created and/or collected (yes/no)

If you answered "Yes" to "other", please tell us what they were:
  
3. ***Which of the following activities did your class participate in during the 2006-2007 school year?***
  - a) Egg takes at Campbell Creek (yes/no)
  - b) Aquarium in my classroom or school (yes/no)
  - c) Salmon dissection (yes/no)
  - d) Salmon Celebration (fry or smolt release) (yes/no)
  - e) Other salmon-related presentations by guest experts and/or field trips I arranged myself (yes/no)

If you answered "Yes" to "other", please tell us what they were:
  
4. ***Do you have any suggestions or comments for us about this program or assessment?***