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material because the latter is so expensive to produce. With glass, paper and plastic, on the other hand, the cost of collecting and processing recyclable material is equal to or greater than the cost of producing raw materials. In such cases, there is no guarantee industry will use recycled material.

Many local governments have embraced recycled content mandates as a way to add stability to the thus-far capricious marketplace. "The newspaper industry went from zero percent to 40 to 50 percent recycled content in a decade," says Bob Schaeffer of Conservatree, a San Francisco-based recycled paper manufacturer. "That happened because courageous state governments and municipalities initiated legislation requiring the use of recycled paper."

Industry, however, has tended to oppose the idea of such mandates. Bailey Condrey with the Council for Solid Waste Solutions, Washington, D.C., says government is "trying to force the hand of the manufacturer."

"They may think that is necessary," he says. "But two of the biggest manufacturers (of plastics), Lever Brothers and Proctor & Gamble, are using recycled-content bottles. They did that without anybody saying, 'you have to have this much recycled material in your plastic.'"

Newspaper producers point to the fact that in numerous states, newspapers have agreed on their own to use certain percentages of recycled material. But is this because the industry is committed to recycling or because it is afraid of having local- or state-imposed mandates thrust upon it?

"Several states passed laws saying all the newspapers had to include a certain percent of recycled paper. Then all of a sudden news groups conceded and voluntarily agreed to do that all over the country," says Gershman.

"Newspaper recycling was happening slowly," he says. "Mandates greatly accelerated that process."

Now that threats of imposed mandates exist, however, cities and counties may have more leverage in negotiating voluntary agreements with industry, ensuring recycled-content goals are met without alienating the companies using the material.

Producers fear imposed requirements could be overambitious. "We are afraid in some cases, areas will think it's such a great idea they will all compete with each other to raise the percentages higher and higher, and before you know it, we are at levels that are technically impossible to meet," says Dave Miller, executive director of the Southeast Glass Recycling Program.

Producers warn if they are forced to meet recycled-content levels prematurely, products could come out flawed, and the use of recycled goods as raw materials could fall into disrepute. Miller recommends that mandated levels be reasonable and allow sufficient time for upgrading of infrastructure.

*Now that threats of imposed mandates exist, cities and counties may have more leverage in negotiating voluntary agreements with industry.*

## Priming The Pump

Until market prices justify the costs of collecting, processing and transporting recyclables to markets, government dollars may have to be used to "prime the pump."

But with education, crumbling roads and bridges and a myriad of other needs competing for city and county dollars, localities are hesitant to launch expensive recycling programs. Some help may be available from the states, several of which offer grants to localities with programs that will stimulate the development of markets or recycling infrastructure.

New York, for example, offers capital assistance grants for cities with comprehensive recycling programs. The state will pay 50 percent (up to $2 million) of the cost of a recycling program's facilities and equipment.

The state's legislature also has considered developing an environmental infrastructure fund. However, these efforts have stalled because of disagreements over financing.

Minnesota has a grant program dedicated specifically to local efforts to develop markets. "In Minnesota, (government) is definitely subsidizing recycling," says Kevin Johnson. "If we were to rely on market prices, communities probably wouldn't be collecting."

Some states also offer grants, low-interest loans and technical assistance for private companies that will provide markets or processing for recyclables, and localities can take advantage of the programs to lure such companies to their areas.

New York awards grants and low-interest loans for businesses with under 100 employees. "We really feel that (small companies) have a need because they might have a great idea, but they are often underfinanced to begin with," says Jan Foley, spokesperson for the state office of economic development. She says the grant and loan program is an attempt to "foster progress in ways that have a lot of potential for use down the line."

New York City and the borough of Brooklyn recently took advantage of the program to lure a company making traffic-safety products from recycled plastics. The company, Utility Plastics, decided to locate in the economically-disadvantaged "enterprise zone" of East New York and received tax incentives in addition to $900,000 in low-interest loans.

Johnson says Minnesota's technical assistance program has been a good way to bring markets to an area without having to offer actual monetary incentives. The program involves putting any company interested in recycling ventures in touch with city and county agencies interested in using its services or buying their products.

"A de-tinning company we didn't give any money to, but provided with lots of assistance, decided to locate in St. Paul," says Johnson. "Now we have an in-state market for tin cans."

But even such seemingly sound programs as economic incentives have their detractors. Frola warns that "grants tend to skew the marketplace. If you give a company a $100,000 gift," she says, "that is $100,000 the company doesn't have to be responsible for in its profits. The whole system becomes based upon an unsound economic

premise."

"You have to take a careful look at what economic centives mean and who is going to pay for them," says SWANA spokesperson Gil Buch. "Unfortunately, it all boils down to money again."

## Cooperative Marketing

After the fiasco that landed Tucson's collected glass in a landfill, the city realized its recycling difficulties were not unique to the region. The wide-open countryside of the Southwest means recyclables often have to travel a long way to market, and transportation costs can be prohibitive.

Local representatives at a two-day regional recycling conference in January 1991 agreed that bringing markets to the area would require massive cooperative effort. Twenty cities from six different states formed the Southwest Public Recycling Association (SPRA).

The cities plan to implement similar collection programs, as well as uniform purchasing policies favoring the procurement of recycled goods. With 20 cities offering a consistent recycled material supply and promising to buy it back when it is remade into consumer goods, the association hopes to attract recycling industries to the region.

The organization has attracted funding from the United States Environmental Protection Agency and other groups, including Public Technologies Inc. (PTI), Washington, D.C., a nonprofit corporation dedicated to furthering local government enterprises. PTI's funds will be directed towards "developing a marketing strategy for the southwest that hopefully is transferrable to other parts of the country," says Gary Olson, executive director of SPRA.

*In Rhode Island, a propane tank from someone's backyard grill made its way to a metal recycling station and blew up during processing.*

Other areas of the country also are choosing to co-op the sale of their recyclable waste. Two of the recipients of the Minnesota county grant program were nine-county and 15-county partnerships.

"A lot of counties will protect their own turf and not get involved with another county," says Mark Bauman, manager of the Olmsted County recycling center. For Olmsted and the other eight counties in the Southeast Minnesota Recyclers Exchange, this attitude would have been a severe impediment.

"If you get all those little loads (of recyclables) together, you can make one big load, and that allows you to leverage more selling power, get better prices and get a better handle on the quality and consistency of the material," says Susan Schmidt, who helped coordinate the alliance.

"A paper company may be looking at 30 different locations in one area that are selling newspapers. Now, instead, you have one person communicating with the buyers and making market arrangements," she says. "The company might say, 'Hey, you guys are serious about this. We're going to give you 50 cents more a ton.'"

## Meeting Specs

Even when the infrastructure and markets are in place, cities and counties are sending significant amounts of col-

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lected recyclables to landfills because they are not in useable condition. In Dade County, Fla., one of every two glass bottles collected between July 1990 and June 1991 wound up in the dump.

After being placed curbside by Dade residents, the bottles were picked up by the collection company, Community Recycling. About 50 percent of the glass collected throughout the year shattered while in transit to the processing center and was landfilled.

Experiences like Dade's are due in part to the fact that, with so much more material than there is a demand for, processors can afford to be picky. But cities and counties do collect a lot of materials that, if used, could greatly damage processing equipment.

Workers at a sorting center in Newark, N.J., have extracted everything from tennis balls and binoculars to a desk-top Nativity scene. So much "drag" — unwanted material — was extracted and piled outside the facility that the center was cited for violating disposal laws.

In Rhode Island, a propane tank from someone's backyard grill made its way to a metal recycling station and blew up during processing. Fortunately, no one was injured.

The possibility of such contamination and the cost of trying to find it reduces the value of a community's recyclables.

One possible solution, says Pat Franklin of the National Container Recycling Association, is to collect certain items through deposit refunds rather than curbside collection.

According to Franklin, while prices for curbside PET drop, manufacturers are increasing what they will pay for deposit-collected recyclables. Wellman, Shrewsbury, N.J., a major plastics manufacturer, gets about 90 percent of its recycled plastic from collection centers, she says.

Many local officials worry about how removing certain goods from curbside programs would affect their potential for profit. Franklin says there is a need to "dispel the myth that glass and plastic are revenue-generating. They simply aren't. They cost much more to collect than they reap in revenues," she says.

But again, there is a tradeoff. Surveys have indicated that people are more inclined to put recyclables out by the curb than they are to drive to a collection center. "If it gets too inconvenient, people lose interest," says Dave Miller.

The best laid plans of local officials will not work if consumers do not purchase recycled goods. And in an environment where recycling is still a fairly costly endeavor, goods made from recyclables may not be the cheapest on the market.

But local governments favor purchase of goods made from recycled material, even if the latter are more cos .. Most will allow paying 5, 10 or 15 percent more for these goods. Newark, for instance, requires the purchase of recycled paper if it is available.

Additionally, localities are encouraging citizens to buy recycled goods. "Recycling is more than just putting a bottle into a bin," says Buch. "What citizens should know is that they have to buy recycled products to make the supply/demand equation equal out."

## Recycled Content Myths

Consumer interest in recycled goods, however, has spurned a rash of dubious "recycled content" claims on paper and packaging. One of the most contested labeling systems is that of recycled paper.

"Responding to pressure from the paper industry, EPA has said you can call paper recycled if you use scrappings from the mill called dry mill broke," says Conservatree's Bob Schaffer. "Historically, this has *always* been used in the paper making process." he says. Hence, a fairly high percentage of recycled paper does not eliminate one shred of paper from the waste stream.

A Conservatree newsletter stated the American Paper Institute's "40 percent recycling plan" would reduce the amount of paper waste generated in the United States by less than two percent. "That is hardly progress," the report says.

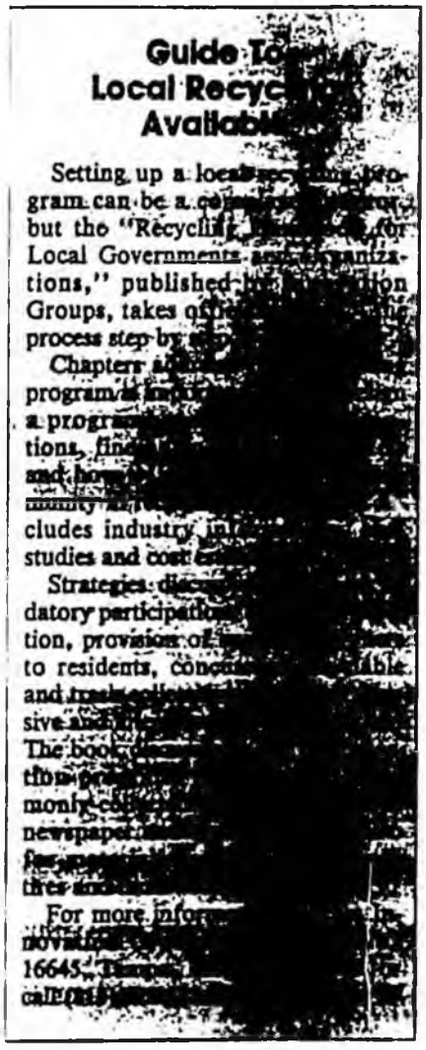
The company feels that "recycled paper" should be graded according to the amount of paper it actually removes from the waste stream and is pushing for language to that effect in the Resource Conservation and Recovery Act (RCRA) legislation.

"Once there was a grading system, there would be greater incentive for mills to install de-inking equipment and build state-of-the-art machines," Schaeffer says.

With an endeavor as complex and large in scope as recycling, it may be a long time before anybody discovers the perfect formula to make the system

work smoothly. For the time being, localities will have to accept the fact that recycling doesn't come cheap. "We don't sell our garbage, we pay somebody to take it away," says Chas Miller, manager of recycling programs for the National Solid Wastes Management Association (NSWMA). "But in the long run, for those materials that are easily recyclable, recycling will be the least expensive way to manage solid waste."

American's interest in recycling has been piqued. People are separating their recyclables and putting them on the curb or taking them to collection centers at an unprecedented rate. Now local officials must find a place for the recyclables to go. □



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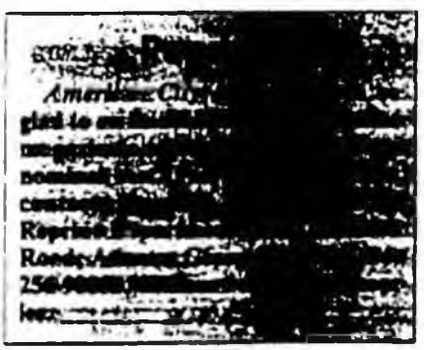

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# Minimum Content Standards:

## State and National Actions to Build Recycling Markets through Mandating the Use of Secondary Materials

by

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and
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Center for the Environment
Council of State Governments

October 28, 1991

# FOREWORD

The purpose of this paper is to provide a brief overview of states activities in legislating specific minimum content standards for recycled materials of various commodities. The paper was prepared as background material for a presentation to the Western States Recycling Coalition during September 1991. This update includes additional information on recent activities in Congress to address minimum content standards during national reauthorization discussions of the Resource Conservation and Recovery Act. The authors wish to thank William Hull, from the Council of State Governments Western Regional Staff, for allowing Karen Armstrong-Cummings to share this information to the Western States Recycling Coalition during their meeting.

## OVERVIEW

During recent years, states have enacted various laws and implemented administrative policies to mandate or encourage manufacturers to use recycled products. These efforts all further a major policy emphasis on increasing states recycling activities, reducing use of virgin materials in manufacturing, and diverting the amount of products disposed at landfills and burned in incinerators.

At present, no national legislation mandates the amount of recycled content which paper, plastics or other commodities must contain. Seven states, as of Spring 1991, had established their own minimum recycled content standards for newsprint and some other commodities, while several regional and national coalitions of states have begun to work together toward voluntary standards. Congress, in the reauthorization of the Resource Conservation and Recovery Act, has entered into the discussion on minimum content standards. Congressional proposals, most recently by Representative Al Swift, for recycled-content standards present national approaches for manufacturing goals on ways to reduce waste and promote recycling markets for various products including glass, aluminum, paper and newsprint.

The present patchwork of state laws, regulations, policies and initiatives presents an unwieldy morass for manufacturers, many of who are beginning to call for federal intervention from Congress as well. Spurred by tough state initiatives, these national debates on recycling, methods to encourage use of recycled products, and the role of material content standards will proceed throughout discussion on the Resource Conservation and Recovery Act as Congressional action progresses during the 102nd Congress.

## INTRODUCTION

Much of the discussion on minimum content standards covers three general areas:

- Which states mandate standards and what do they mandate;
- What efforts are underway to coordinate standards nationally and in multi-state regions, and;
- Where is all this heading – what trends can we observe on the issue of minimum content standards?

An initial overview of state actions on minimum content standards indicates action in several areas such as legislation, executive orders or administrative mandates, and voluntary initiatives.

According to the National Solid Wastes Management Association, seven states require manufacturers to use recycled materials. These include: Arizona, California, Connecticut, Illinois, Maryland, Missouri, and Wisconsin, all of which require newspaper publishers to use varying amounts of recycled newsprint. California also requires recycled content in plastic trash bags and glass food and beverage containers. Wisconsin requires recycled content in some plastic containers and Connecticut requires phone books to be printed on recycled stock. Connecticut and California were first to pass such laws. Since the National Solid Waste Management Association produced their summary report early in 1991, three additional states have enacted standards – North Carolina, Washington and Oregon.

The following summary examines each of the seven states specifically, discussing each state's requirements for recycled-content of newsprint, reporting requirements and enforcement mechanisms to implement the law, and any follow-up requirements, for those failing to meet the specified standards.

*Specific Requirements:* Article eight of Arizona's Laws Relating to Environmental Quality entitled "Arizona Recycling Program", requires newspaper publishers to use at least 25% recycled-content newsprint in their publications by July 1, 1991, if the following conditions applied:

- Recycled content newsprint is available at a comparable prices to that of newsprint from virgin material;
- Recycled-content newsprint meets quality standards established by the Director of the Department of Environmental Quality, including:

  (1) The director is to publish standards based on the average numerical standards of printing opacity, brightness level and cross machine tear strength available from all producers selling recycled-content newsprint in Arizona in quantities of at least 5,000 metri tons/year.

  (2) The director is to review these standards once every two years and determine needed adjustments or changes, and;

- Recycled-content newsprint must be available within a reasonable period of time.

Arizona defines recycled-content newsprint to be newsprint in which not less than forty percent of its fiber consists of post-consumer wastepaper. Arizona requires the percentage of newsprint used to be made from recycled-content newsprint to be calculated in tons/year, increasing to 30% by 1/1/94; 35% by 1/1/96; 40% by 1/1/98 and 50% by 1/1/2000. Newsprint purchased efore 1/1/90 is exempt.

*Reporting Requirements and Enforcement Mechanisms:* Consumers of newsprint must certify to Arizona's Department of Environmental Quality (DEQ) the number of tons of newsprint used and the number of tons of recycled-content newsprint used during the calendar year.

DEQ may conduct audits of the information; companies which supply newsprint to consumers (publishers) must certify the amounts of shipments. Publishers unable to obtain recycled-content newsprint must conduct a certification process, indicating who was contacted and why newsprint was not available.

## CALIFORNIA

*Specific Requirements:* Chapter fifteen of California Senate Bill number 937 passed in March 1990 entitled "newsprint" requires that after 1/1/91, every consumer of newsprint in California must ensure that at least 25% of all newsprint used by that consumer is made from recycled-content newsprint, given several conditions. These conditions are almost exactly the same as in Arizona.

The recycled-content newsprint must:

- Be available at a price comparable to that of newsprint made from virgin material;
- Meet the quality standards established by the Board;
- Be available within a reasonable period of time.

California requires that the percentage of newsprint used, made from recycled-content newsprint, to be calculated in tons per year, increasing to 30% by 1/1/94; 35% by 1/1/96; 40% by 1/1/98 and 50% by 1/1/2000, and exempts papers purchased prior to 1/1/90.

California's Integrated Waste Management Board must set newsprint quality standards for each grade of newsprint and review their standards every two years. The Board began promulgating its regulations for these standards in May of this year, then modified the proposal in August, ending the comment period on September 11,

1991. The public comments and Board responses are not yet cleared for distribution by the Board, but California plans to soon have their standards in place.

In the Board's proposal for standards, California indicated that the Board will survey newsprint manufacturers, in July of each year, who sell more than 5000 metric tons of recycled-content annually for use in California. The Board will conduct testing and establish standards based on the results of the testing, following specifications using specified methods for sampling procedures, brightness, printing opacity and cross-machine tear strength. The Board will make available comparable quality standards by November 30 of each year.

Comparable prices, according to the proposal, will be the price comparable to each specific grade. A reasonable delivery time for recycled-content newsprint for a commercial publisher was proposed to be 45 days and for a commercial printer, 3 days.

*Reporting Requirements and Enforcement Mechanisms:* California, just as Arizona, requires a certification from newsprint consumers to certify to the California Board the number of tons of newsprint used during the preceding calendar year. Anyone who is found to have made false or misleading claims about the certification can be fined, but not more than one thousand dollars.

## CONNECTICUT

Specific Requirements: In their state Substitute House Bill No. 5812, titled "An act concerning the recommendations of the Newsprint Recycling Task Force", Connecticut mandated that their newspaper publishers must work together to use a certain amount of recycled content in their newspapers. Connecticut set out the goals for materials content, that by:

- 12/31/91, 11% or more of the newsprint would contain recycled content;

- 1993, 16% or more;
- 1994, 20% or more;
- 1995, 23% or more;
- 1997, 40% or more;
- 1998, 45% or more and
- 1999, 50% or more and 50% for each year thereafter.

Unlike California and Arizona, Connecticut did not define recycled newsprint based on the 40% standard. Instead, Connecticut defined "recycled fiber" to mean the fiber derived from post-consumer waste paper or waste paper resulting from printing operations.

*Reporting Requirements and Enforcement Mechanisms:* If the newspaper publishers do not achieve these percentages as a group, each publisher individually must meet it for the remaining years. Beginning in the year following this failure to meet the standard, the newspapers face a fine of $5 per ton for amounts not recycled, and can be fined no less that $2500.

Newspaper publishers must report information to the Commissioner of Connecticut's environmental program, indicating the percentage of recycled fiber used in the preceding calendar year, along with any information regarding compliance provisions. Connecticut provides for certain exemptions, relating to availability of recycled fiber, and other issues.

## ILLINOIS

*Specific Requirements:* In article two of state House Bill number 3183 cited as "The Recycled Newsprint Use Act", Illinois requires that newsprint used in the state shall have an annual average recycled fiber usage consistent with the goals established as follows:

- 22% beginning January 1, 1991;

- 25% beginning January 1, 1992;
- 28% beginning January 1, 1993.

Illinois defines recycled fiber to mean fiber of old newspaper or postconsumer waste paper dissolved into pulp and deinked and used to create recycled content newsprint. Illinois also defines old newspaper and postconsumer waste paper, and includes printing plant waste paper and old magazine print. Illinois does not set a percentage content in the law for present consumption, but does require that if goals of aggregate average usage of recycled fiber are not met, then everyone must ensure recycled fiber use of at least 28% in 1994. Certain exemptions do apply, related to availability of recycled fiber.

*Reporting Requirements and Enforcement Mechanisms:* Each newsprint consumer must submit a certification to the Illinois Department of Energy and Natural Resources, specifying the amount in tons of every type of newsprint used, and the percentage of recycled fibers present in each type of newsprint. The Department of Energy and Natural Resources can audit these reports and persons making false or misleading certifications are turned over to the Attorney General for prosecution for fraud.

## MARYLAND

*Specific Requirements:* In state House Bill number 131 titled as "Newsprint Recycling", Maryland lists standards requiring 12% recycled content by 1992; 12% by 1993; 20% by 1994; 25% by 1995; 30% by 1996; 35% by 1997 and 40% by 1998 and all subsequent calendar years. The percentage attained applies, by weight, for all newspapers distributed in the state, whether or not the newsprint is produced in the state of Maryland.

A Newsprint Recycling Board was established, with representatives from various sectors involved in recycling and

newspaper publishing. The Board's duties include: to review reports filed by publishers, review required reports, to analyze availability and utilization of newsprint containing recycled material, to comment on the appropriateness of the recycled content percentage requirements, to comment on the need for the continuation of the program, and to work with local governments and other collectors of old newspapers to develop reliable systems of providing stable and quality supplies of old newspapers for recycling.

*Reporting Requirements and Enforcement Mechanisms:* Newspaper publishers are required to file a quarterly report with the state, indicating the total weight of newsprint used by the publisher and the weight of recycled material contained in that newsprint. These reports are reviewed by the Board described above. Maryland's law also establishes a newsprint recycling incentive fee of $10 per ton of a publisher's recycled content deficiency for the year.

The "recycled content deficiency" is calculated as the total tons of newsprint used by the publisher for the year, multiplied by the required percentage for that year, and finally subtracted from the actual tonnage of recycled material contained in the newsprint used by the publisher for the year. The proceeds of these fees are credited to a state recycling trust fund, to be used for providing grants to counties for recycling plans and to fund the Office of Recycling.

Newspaper publishers may elect to be exempt from the recycling requirements. If they choose this option, however, then Maryland's Sales and Use Tax Exemption for the Printing and Sale of Newspapers [S 11-215(c)] do not apply to that publishers newspapers.

Maryland, in May 1991, enacted a laws which imposes recycled content percentage requirements on the publishers of telephone directories. The law requires publishers of those directories distributed in the state to satisfy a specified recycled content percentage requirement, or pay a fee of $10 per ton.

## MISSOURI

*Specific Requirements:* In section 260.255 of state Senate Bill number 530, Missouri requires recycled content standards of 10% recycled content by 1993, 20% by 1994, 30% by 1995, 40% by 1996 and 50% by the year 2000, with reporting requirements similar to those of other states. Missouri enacted its legislation in 1990.

Missouri also operates an aggressive state procurement program, spending $2.1 million on products made from recycled material in 1990, after spending only $323,000 in 1989. Missouri also mandates that at least 15% of the oil used in state vehicles be a re-refined product.

## WISCONSIN

*Specific Requirements:* In section 159.31 of Wisconsin State Act 335, Wisconsin enacted targets for the use of recycled newsprint in the publication of newspapers and created a newspaper recycling fee to be paid annually by the publisher of a newspaper that fails to meet those targets. Recycled content is defined as the proportion of fiber in a newspaper which is derived from postconsumer waste. Targets for recycled content are: 10% by 1992; 25% by 1994; and 45% by 2001 and subsequent years.

*Reporting Requirements and Enforcement Mechanisms:* The amount of the newspaper recycling fee imposed on a publisher in any calendar year is 1% of the total cost of the newsprint used to print the newspaper during the year times the "recycling status." The "recycling status" is the target recycled content minus the average of the recycled content of all newsprint used by that publisher to print the publisher's newspaper during the year.

In addition to newsprint, Wisconsin requires that plastic containers used for products sold at retail, after 1/1/95, must consist of at least 10% recycled or remanufactured material. This

requirement applies to rigid plastic bottles, jars and cartons, but not for containers for food, beverages or drugs unless the FDA has approved the specific use of recycled material.

## OTHER STATE INITIATIVES

While the seven states mentioned above have laws in place, other states have been active as well. Oregon recently passed laws setting recycled content for newsprint and mandated content for telephone directories. North Carolina also enacted a mandatory program for newsprint users, emphasizing standards for newsprint.

Some states have taken other types of actions to encourage the use of recycled materials in manufacturing. These types of measures include actions by executive order of the Governor, legislative task force discussions, or through regional, multi-state initiatives involving voluntary agreements. Many states, such as Indiana, have legislative task forces or committees examining the issue of paper content standards. At least 15 states have municipal solid waste task forces or councils looking at market development, recycling, packaging taxes, advance disposal fees or other aspects of recycling content such as minimum content standards.

Several states have achieved goals through actions of the Governor's Executive Orders and Policies, and through working in voluntary programs with other states. As of 1990, seven states (New York, Pennsylvania, Massachusetts, Michigan, Vermont, Iowa and Connecticut) had developed and negotiated voluntary practices. In these states, newsprint industries have negotiated voluntary purchase and use standards for recycled newsprint in lieu of mandatory laws.

These actions regarding legislating recycled content, and other initiatives, indicate the general trend to mandate certain actions for manufacturers. Whether or not this is achieving the overall goal of increasing recycling is difficult to measure, due

to the lack of national standards.

## REGIONAL AND NATIONAL COORDINATION INITIATIVES

Several national activities are underway to coordinate minimum content standards, such as the National Association of State Purchasing Officials' (NASPO) project to establish nationwide standards on recycled paper and the Recycling Advisory Council's (RAC) actions on paper and other commodities. In addition, the U.S. Environmental Protection Agency has issued several procurement guidelines. These are regulations that require government agencies to buy products made of recycled materials.

The NASPO project, staffed by the Council of State Governments, includes representatives from NASPO meeting with paper and paper product producers, together with the American Standards and Testing Materials Society (ASTM) standards development subcommittee on recycled paper. The ASTM standards are voluntary standards approved by a consensus process[1]. The actual voting is unbiased in that the producers can have no greater total of votes than the user plus the consumer plus general interest. This precludes the effected industry from developing standards by outnumbering the user, consumer or general interest parties.

Individual Task Groups are responsible for developing the proposed standards or specifications. Five Task Groups were formed to address specific areas: Terminology, Printing/Writing Paper, Tissue Paper, Newsprint and Packaging Paper and Board. After development, the proposed standards are forwarded to the Technical Subcommittee for balloting. The Technical Subcommittee votes by letter ballot on the proposed standards. The results must be sixty six and two-thirds percent affirmative based on a sixty percent return rate from the Subcommittee before the proposed standards are referred to the Main Society for approval.

At the Main Society level, the voting process must result in ninety percent affirmative ballots before a standard is accepted. A negative vote must contain technical reasons. At this point the

Main Society may return it to the Subcommittee and/or the Task Group for review and modification.

During NASPO's process of setting definitions, the issues causing considerable disagreement was the separation of pre and post consumer. The ASTM Recycled Paper Terminology Task Group, chaired by William Warstler of Michigan, agreed in June of this year to move away from defining "pre" and "post-consumer" and establish recycled paper definitions that are in line with the content standards proposed by the Recycling Advisory Council (RAC)[2].

The Recycling Advisory Council is a panel of experts selected by the National Recycling Coalition's Board, committed to establishing sound recycling and resource management policies. The RAC consists of 16 members representing industrial, environmental, business, government and community organizations. The Recycling Advisory Council's Recycled Paper Committee, in April, 1991, proposed recycled paper standards for government purchases of paper products which are based on two criteria, both of which must be met. These standards would be expressed as a percentage and measure "total recycled content" and "processed secondary fiber content"[3]. Content percentages would be calculated by fiber weight.

The ASTM Task Group took action to formally notify the ASTM that they accepted the criteria established by the RAC, but not the suggested standards. The Task Group submitted several additional terms for ballot, including processed secondary fiber, deinking, flotation, and washing processes. In relation to the RAC's propsed criteria, it is important to note that current EPA standards, as required by RCRA, measure only post consumer waste. A change in the statutory language of the law would be necessary to provide for a "total recycled content" component and to expand the definition of "post consumer recovered material" to include the "processed secondary fiber" element of the proposed standards[4].

The most well known and highly successful regional initiative in this area is the Northeast Recycling Council (NERC). NERC

actually initiated discussions on minimum content standards, working with states in the Northeast, including Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont. In all the states except Delaware, there were existing laws or executive orders favoring the purchase of recycled products.

NERC facilitated working sessions between NERC state officials and newspaper publishers (The American Newspaper Publishers Association and New England Newspaper Publishers Association) to explore opportunities for accelerating demand for products containing secondary materials. As a result, a majority of the NERC member states have reached agreements with their newspaper publishers to increase consumption of recycled fibers from current levels of approximately seven percent to 40 - 50 percent by the year 2000[5]. NERC is currently working on a cooperative regional market development project.

## FEDERAL LEGISLATION

Because of the intensity of state activity, and the wide variety of approaches, several groups have argued that Congress should establish national standards in RCRA. In June of this year, a coalition of public interest and environmental groups testified before Congress, calling for establishing rates for the use of post-consumer materials in the manufacturing and packaging of consumer goods. These groups set out specific proposals for standards for paper, plastics, glass, steel and aluminum.

One federal bill which addresses minimum content standards is H.R. 1201, the Recycled Paper Procurement Act of 1991, sponsored by Representative John Porter, and others. This bill sets a goal of 50 percent of paper purchased by federal agencies shall be recycled paper, by 1993, and sets out several grades of recycled paper, based on a definition using the terms "post-mill material" and "deinked material."

Representative Al Swift, a member of the House committee on

Energy and Commerce, recently began circulating a draft recycling proposal to amend RCRA. The proposal sets forth specific minimum content standards for aluminum, glass, newsprint, paper and paperboard packaging, plastic packaging and steel packaging[6]. Swift's proposal sets specific goals for attaining minimum recycled content standards in these commodities by 1995 and by the year 2000.

## TRENDS AND IMPLICATIONS

With all the emphasis on recycling and setting content standards, what trends prevail and what implications are indicated? If the 1990 trends continue, several factors are assured:

- States and local governments will continue to emphasize and encourage recycling as an alternative to landfilling and in some cases, incineration;
- Businesses will be held increasingly responsible for reducing the impact of their products and services on waste management systems;
- States will continue to emphasize the need for manufacturers to use secondary materials, either through voluntary market development programs or actual mandates for manufacturers' products;
- Manufacturers, faced with increasingly different demands from various states, will press for national consistency from legislation or other areas.

Is the emphasis on recycling and mandatory recycled-content standards reducing waste and increasing recycling? The relative successfulness of different states' recycling laws has been difficult to measure due to inconsistency in how recycling has been counted.

Additionally, some experts stress that the amount and type of

material reclaimed will be far more important to market development than the recycling percentages reported, which also underscores some legislative support to ensure consistency in the materials reclaimed and reused. The fast growing numbers and types of standards, together with the timing of national solid waste legislation, tend toward a policy emphasizing more regional and national standards for recycled content in manufactured goods, that if not mandatory, will at least bring about greater agreements on voluntary standards.

FOR IMMEDIATE RELEASE

February 10, 1992
Contact: Caleb Stewart
465-4947

ULMER SPONSORS "RECYCLABLE PRODUCTS PROCUREMENT" BILL

Juneau - Rep. Fran Ulmer today introduced legislation to promote procurement of recycled products by state agencies. HB 465 authorizes the Depts. of Administration, Commerce & Economic Development, and Environmental Conservation to identify products that can be made from recycled material and promote the development of markets which produce and distribute those products.

"By encouraging the state to purchase more products made from recycled materials, Alaska can join with a number of other Northwest states in helping to develop a sustainable industry in recycled products," said Ulmer.

HB 465 would direct DEC to identify the origin and destination of recyclable wastes generated by government in Alaska. The Dept. of Commerce would be directed to examine ways to develop markets for recycled products in the Northwest. The Dept. of Administration would establish a procurement plan increasing purchases of recycled products by state agencies.

Ulmer said recycled products that may be suitable for purchase by the state include plastics, tires, paints, and motor oil. The state already purchases a sizable quantity of recycled paper products, and is experimenting with the purchase of retread tires.

The idea of encouraging development of regional markets for recycled goods grew out of Rep. Ulmer's participation in the Pacific NorthWest Economic Region (PNWER), a regional cooperative

-MORE-

effort aimed at increasing the competitive position of Alaska, Alberta, British Columbia, Idaho, Montana, Oregon, and Washington. "By increasing the demand for recycled products, we support the development of a regionally based industry manufacturing goods made from recycled materials," said Ulmer.

# FISCAL NOTE

## STATE OF ALASKA
## 1992 LEGISLATIVE SESSION

**BILL NO.** HB 465

Revision Date: _____

Title: An Act relating to recycling and the management of solid and hazardous . . .

Sponsor: Representative Ulmer

Requestor: _____

Department Affected: Administration

BRU: General Services

Component: Purchasing

COMPONENT SERIAL NO. | | | 6 | 0 |

Expenditures/Revenues: (Thousands of Dollars)

| OPERATING | FY 93 | FY 94 | FY 95 | FY 96 | FY 97 | FY 98 |
|---|---|---|---|---|---|---|
| PERSONAL SERVICES | 0 | 0 | 0 | 0 | 0 | 0 |
| TRAVEL | 0 | 0 | 0 | 0 | 0 | 0 |
| CONTRACTUAL | 0 | 0 | 0 | 0 | 0 | 0 |
| SUPPLIES | 3.4 | 0 | 0 | 0 | 5.1 | 5.1 |
| EQUIPMENT | 0 | 0 | 0 | 0 | 0 | 0 |
| LAND & STRUCTURES | 0 | 0 | 0 | 0 | 0 | 0 |
| GRANTS, CLAIMS | 0 | 0 | 0 | 0 | 0 | 0 |
| MISCELLANEOUS | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL OPERATING | 3.4 | 0 | 0 | 0 | 5.1 | 5.1 |
| CAPITAL | 0 | 0 | 0 | 0 | 0 | 0 |
| REVENUE FUND SOURCE: | 0 | 0 | 0 | 0 | 0 | 0 |

FUNDING: (Thousands of Dollars)

| | | | | | | |
|---|---|---|---|---|---|---|
| GENERAL FUND | 0 | 0 | 0 | 0 | 0 | 0 |
| FEDERAL FUNDS | 0 | 0 | 0 | 0 | 0 | 0 |
| OTHER FUND SOURCE: | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 0 | 0 | 0 | 0 | 0 | 0 |

POSITIONS:

| | | | | | | |
|---|---|---|---|---|---|---|
| FULL-TIME | 0 | 0 | 0 | 0 | 0 | 0 |
| PART-TIME | 0 | 0 | 0 | 0 | 0 | 0 |
| TEMPORARY | 0 | 0 | 0 | 0 | 0 | 0 |

Estimate of current year impact: None.

ANALYSIS: (Attach a separate page if necessary.)
See attached.

Prepared by: Dugan Petty
Division: General Services

Phone: 465-2250
Date: February 27, 1992

Approved by Commissioner: Nancy Bear Usera
Agency: Administration

Date: 3/2/92

Distribution (by preparer): Leg. Fin., Legislative Sponsor, Requestor, OMB/DBR, Gov. Legis. Ofc., & Impacted Agency(ies).

# FISCAL NOTE

**STATE OF ALASKA**
**1992 LEGISLATIVE SESSION**

**BILL NO. HB 465**

This bill requires the department to prepare a procurement recycling plan which would set goals for purchases of various recycled products.

The plan can be prepared by the division with no fiscal impact. The monitoring and accounting of agency expenditures for recycled products must be tracked by the agencies.

Agency fiscal impacts result mostly from the additional costs of recycled paper. These costs are estimated to be minimal and would amount to a potential additional cost of $3,425 in FY 93 and $5,100 in FY 97 and FY 98. The following analysis for recycled paper procurement fiscal impacts demonstrates the assumptions and basis to support these costs.

The remaining recycled products which could have potential impact are not possible to assess at this time. Recycled latex paint has no known source in-state at this time. Recycled plastics are finding new applications on an almost daily basis. Many of these products are replacing products made of other material at a comparable price or at a savings.

Vehicle lubricants, recycled tires, and compost products are bought almost exclusively by and for the Department of Transportation and Public Facilities and are not addressed in this fiscal note.

Recycled Paper Procurement Fiscal Analysis

1. Estimated annual paper expenditure: $1,900,000.

2. The greatest cost differential for recycled paper is with bond and Xerographic and computer paper. We estimate approximately $685,000 per year is spent on these papers.

3. We have been advised by paper suppliers that recycled bond and Xerographic paper currently costs about 15 percent more than comparable virgin paper. We are assuming bids will result in a 10 percent cost differential for FY 93 over virgin paper. We project the differential will decrease down to 5 percent by FY 97 because of the increased supply and production capabilities.

4.

| | AS 36.30.095 State Minimum Percentage Expended for Recycled Paper | HB 465 Plan Minimum Percentage Expended or Recycled Paper | Difference |
|---|---|---|---|
| FY 93 | 15% | 25% | 10% |
| FY 94-96 | 25% | 25% | 0 |
| FY 97-98 | 25% | 40% | 15% |

**Cost Impacts**

FY [A x B] x C = D

FY 93 [342,500 x 10%] x 10% = $3,425

FY 94-96 [685,000 x 0%] x 15% = $0

FY 97 [685,000 x 15%] x 5% = $5,100

FY 98 [685,000 x 15%] x 5% = $5,100

Where: A is estimated annual paper expenditures for bond and Xerographic type paper.

B is the difference in minimum percentage expended for recycled paper between the current law and HB 465.

C is estimated percentage cost increase for recycled paper.

D is fiscal impact for the year.

# FISCAL NOTE

**STATE OF ALASKA**
**1992 LEGISLATIVE SESSION**

**BILL NO.** HB 465

Revision Date: 2/26/92
Department Affected: Commerce & Econ. Dev.
Title: Solid and Hazardous Waste Management
BRU: Economic Development
Component: General Business
Sponsor: F. Ulmer
Requestor: F. Ulmer
**COMPONENT SERIAL NO.** 0 8 0 1

**EXPENDITURES/REVENUES: (Thousands of Dollars)**

| OPERATING | FY 93 | FY 94 | FY 95 | FY 96 | FY 97 | FY 98 |
|---|---|---|---|---|---|---|
| PERSONAL SERVICES | 108.9 | 114.3 | 120.1 | 126.1 | 132.4 | 138.9 |
| TRAVEL | 15.0 | 17.5 | 20.0 | 20.0 | 20.0 | 20.0 |
| CONTRACTUAL | 80.0 | 5.0 | 5.0 | 5.0 | 100.0 | 5.0 |
| SUPPLIES | 5.0 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| EQUIPMENT | 15.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| LAND & STRUCTURES | | | | | | |
| GRANTS, CLAIMS | | | | | | |
| MISCELLANEOUS | | | | | | |
| **TOTAL OPERATING** | 223.9 | 144.3 | 152.6 | 158.6 | 259.9 | 171.4 |
| **CAPITAL** | | | | | | |
| **REVENUE FUND RESOURCE:** | | | | | | |

**FUNDING: (Thousands of Dollars)**

| | | | | | | |
|---|---|---|---|---|---|---|
| GENERAL FUND | 223.9 | 144.3 | 152.6 | 158.6 | 259.9 | 171.4 |
| FEDERAL FUNDS | | | | | | |
| OTHER FUND SOURCE: | | | | | | |
| TOTAL | | | | | | |

**POSITIONS:**

| | | | | | | |
|---|---|---|---|---|---|---|
| FULL-TIME | 2.0 | 1.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| PART-TIME | 1.0 | | | | | |
| TEMPORARY | | | | | | |

Estimate of current year impact:

**ANALYSIS** (Attach a separate page if necessary.)

Prepared By: W. G. Paulick, Development Specialist
Phone: 465-2017
Division: Economic Development
Date: 2/26/92
Approved by Commissioner: Glenn A. Olds
Agency: Department of Commerce & Economic Development
Date: 2-28-91

Distribution (by preparer): Leg. Fin., Legislative Sponsor, Requestor, OMB/DBR, Gov. Legis. Ofc., and Impacted Agency(ies).



WGP/dg115190-1/022892b
(Rev. 12/91)

February 24, 1992

SECTIONAL ANALYSIS - HB 465 - PROCUREMENT OF RECYCLABLES

* Section 1. Legislative Findings and Purposes.

Subsection (a) That unrelated countries around the world are forging cooperative agreements to increase the economic competitiveness of their economies, and that five Northwest states and two Canadian provinces, the Pacific Northwest Economic Region (PNWER), can adopt purchasing standards for recyclable products which will increase the marketability of these products.

Subsection (b) To substantially increase the purchase of recycled products which will increase the market potential for those products and substantially affect the states waste management problems, and develop standards that are compatible with the other members of PNWER.

* Section 2. Amends AS 36.30 to add a new section (36.30.075)

Subsection (a) requires the Dept. of Admin. to develop a plan to increase the purchase of certain recycled products.

Subsection (b) requires the plan to have minimum purchase goals, expressed as a percentage of the total dollar amount of purchases by state agencies.

Subsection (c) requires goals for the purchase of recycled paper and compost products to increase on a total dollar basis to 60 percent by 1999.

Subsection (d) defines the standards for the purchase of motor oil products.

Subsection (e) defines the standards for the purchase of retread tires, and provides for the exception of certain emergency vehicles.

Subsection (f) requires that the plan include effort to eliminate the purchase of paper products that cannot be recycled.

Subsection (g) defines the terms "plan", "recycled product", and "retread tire."

* Section 3. Amends AS 46.06 to add a w section (AS 46.06.025)

Subsection (a) requires the Dept. of Environmental Conservation to develop a statewide plan to manage solid and hazardous

waste generated by state agencies, and to consult with the affected state agencies.

Subsection (b) requires the plan to identify the characteristics of recyclable materials in the waste stream and their present destination.

Subsection (c) requires the plan to include an evaluation of those recyclable materials that can be used for trade in the state and in the PNWER.

Subsection (d) requires the plan to updated every two years.

Subsection (e) requires the director of the court system to adopt a solid and hazardous waste management plan, consistent with (a) - (d) of this section.

Subsection (f) requires the legislative council to adopt a solid and hazardous waste management plan, consistent with (a) - (d) of this section.

Subsection (g) defines "plan" and "state agency."

* Section 4. Market Development Report.

Subsection (a) directs the Dept. of C&ED to submit a report to the legislature by January 1, 1993 on ways the state can encourage development of markets for recycled products.

Subsection (b) requires the report to have an analysis on the role procurement preferences can play in the development of recycled markets.

Subsection (c) requires the commissioner of C&ED to consult with the Dept. of Admin. and Dept. of Environmental Conservation when preparing this report.

* Section 5. requires the Dept. of Admin. to adopt the minimum purchasing requirements required by AS 36.30.075(b), section 2 of this Act, by January 1, 1993.

# Pacific NorthWest Economic Region

February 25, 1992

Representative Fran Ulmer
Alaska State Legislature
District 4B - Juneau
P.O. Box V
Juneau, Alaska 99811-3100

Dear Representative Ulmer:

On behalf of the Pacific NorthWest Economic Region, I am writing to express our support for House Bill No. 465 to establish procurement policies throughout the State of Alaska. This legislation is the starting block to build a united coalition between the five northwestern states and the two provinces in Canada to develop minimum content standards for recycling.

The Northwest has traditionally held recycling as a key environmental issue. Northwest legislators now have the opportunity to enact legislation to provide a government model to encourage comparable commitment by its citizens and businesses in their purchasing practices. By encouraging the development of markets for recycled products, northwest legislators can strengthen the region's economy and also gain the full waste-reduction benefits from existing recycling efforts.

The Pacific NorthWest Economic Region consists of the states of Alaska, Idaho, Montana, Oregon, Washington, and the two provinces of Alberta and British Columbia. As a region, we are in a strategic position to act together in setting recycled procurement standards and therefore increasing the overall market effect of such standards.

We applaud Alaska's proposed recycling legislation which targets government procurement policies. The Pacific NorthWest Economic Region fully supports solutions to the region's waste management problems and commends you in pursuing a regional strategy to this critical issue.

Sincerely,

Alan Bluechel

Alan Bluechel, President
Pacific NorthWest Economic Region
Vice-President Pro Tem
Washington State Senate

AB:bf:swn

c/o Northwest Policy Center • University of Washington • 327 Parrington Hall, DC-14 • Seattle, Washington 98195
(206) 543-7900 FAX (206) 543-1096

# Alaskans for Litter Prevention and Recycling

*Keeping Alaska Beautiful*

February 21, 1992

Representative Fran Ulmer
Room #421
State Capitol Building
Juneau, Alaska 99801

Dear Representative Ulmer,

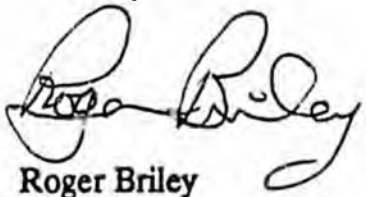
On behalf of Alaskans for Litter Prevention and Recycling, I want to express my congratulations and support for House Bill Number 465.

As you know, a major dilemma confronting the practice of recycling is the lack of markets for recyclables. I believe that by increasing the procurement of recycled products by state governmental agencies your bill will help to develop those markets and to send a clear message to private business and individual citizens by government's example: that using recycled products is a vital part of the recycling process.

Requiring a statewide solid waste plan to manage waste generated by state agencies as indicated in the Bill is an obvious complement to the procurement requirement that will be an important step towards recycling overall waste. This evaluation will also fulfill another of ALPAR's key goals of truly recognizing the cost related to land fills in Alaska.

I applaud your efforts. If I can be of any assistance whatsoever in helping to achieve passage of this Bill, please don't hesitate to contact me,

Sincerely,



Roger Briley
President
Alaskans for Litter Prevention and Recycling



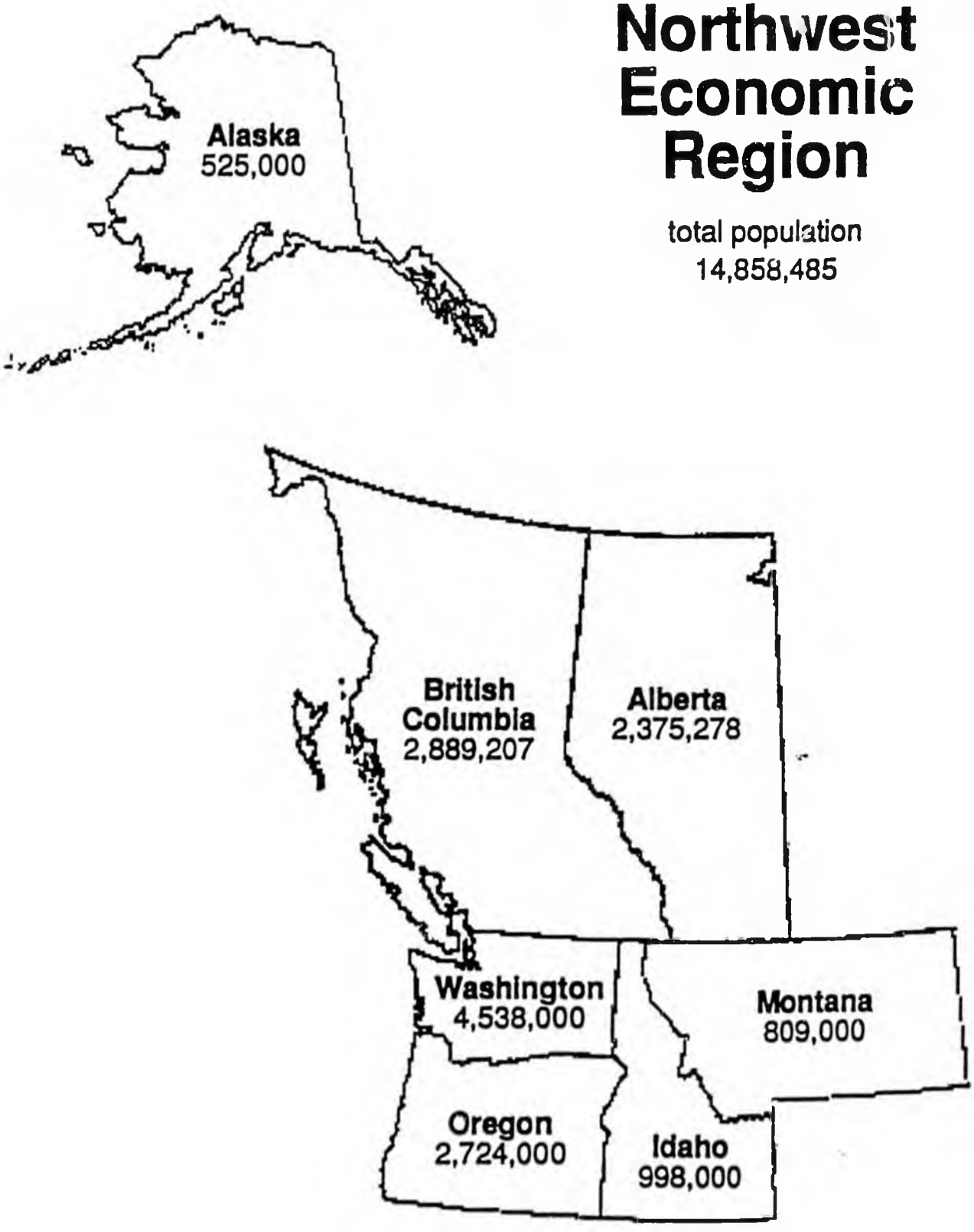

P O Box 231231
Anchorage, Alaska 99523

3514 Vassar Drive
Anchorage, Alaska 99508

(907) 272-9326
FAX (907) 272-2425

# Pacific Northwest Economic Region

total population
14,858,485



HB

467

# FISCAL NOTE

STATE OF ALASKA
1992 LEGISLATIVE SESSION

BILL NO. HB 467

Revision Date: _____
Title: "...the definition of 'economic benefit' in relation to a subsistence economy..."
Sponsor: Representative Kubina
Requestor: Representative Kubina

Department Affected: Department of Law
BRU: Exxon Valdez Litigation
Component: Exxon Valdez Litigation

COMPONENT SERIAL 1175

Expenditures/Revenues: (Thousands of Dollars)

| OPERATING | FY 93 | FY 94 | FY 95 | FY 96 | FY 97 | FY 98 |
|---|---|---|---|---|---|---|
| PERSONAL SERVICES | | | | | | |
| TRAVEL | | | | | | |
| CONTRACTUAL | | | | | | |
| SUPPLIES | | | | | | |
| EQUIPMENT | | | | | | |
| LAND & STRUCTURES | | | | | | |
| GRANTS, CLAIMS | | | | | | |
| MISCELLANEOUS | | | | | | |
| TOTAL OPERATING | -0- | -0- | -0- | -0- | -0- | -0- |
| CAPITAL | | | | | | |
| REVENUE FUND SOURCE: | | | | | | |

FUNDING: (Thousands of Dollars)

| | | | | | | |
|---|---|---|---|---|---|---|
| GENERAL FUND | -0- | -0- | -0- | -0- | -0- | -0- |
| FEDERAL FUNDS | | | | | | |
| OTHER FUND SOURCE: | | | | | | |
| TOTAL | | | | | | |

POSITIONS:

| | | | | | | |
|---|---|---|---|---|---|---|
| FULL-TIME | -0- | -0- | -0- | -0- | -0- | -0- |
| PART-TIME | | | | | | |
| TEMPORARY | | | | | | |

Estimate of current year impact: _____

ANALYSIS: (Attach a separate page if necessary.)

Please see the attached analysis.

Richard I. Pegues

Prepared by: Richard I. Pegues, Director — Phone: 465-3672
Division: Administrative Services — Date: February 28, 1992

Richard I. Pegues FOR

Approved by Commissioner: Charles E. Cole, Attorney General
Agency: Department of Law — Date: February 28, 1992

Distribution (by preparer): Leg. Fin., Legislative Sponsor, Requestor, OMB/DBR, Gov. Legis. Ofc., & Impacted Agency(ies).

# CONTINUATION of FISCAL NOTE ANALYSIS

For Bill/Resolution No. HB 467

This bill amends AS 46.03.826(a), retroactive to March 24,1 989, to include within the meaning of "economic benefit," the value of a subsistence economy to the physical, economic, traditional, and cultural existence of persons participating in the subsistence economy. As it is used under current law in AS 46.03.822 - 46.03.828, "economic benefit" is defined to mean a benefit measurable in economic terms, including but not limited to the gathering, catching, or killing of food or other items utilized in a subsistence economy and their replacement cost.

It is our view that the bill clarifies existing law by defining the term subsistence economy as it is used in the current statute. Consequently, the bill should not impact the Department of Law.

Alaska State Legislature

Chairman
State Affairs
Committee

Legislative Council

Transportation
Committee

Representative Eugene Kubina

During Session:
State Capitol
P.O. Box V
Juneau, Alaska 99811
(907) 465-4859

During Interim:
P.O. Box 2463
Valdez, Alaska 99686
(907) 835-2111

## SPONSOR STATEMENT

**Sponsor:** **Representative Gene Kubina**

**Subject:** **House Bill 467; An Act amending the definition of 'economic benefit' in relation to a subsistence economy; and providing for an effective date."**

**Date:** **26 February 1992**

---

Subject: compensability of Native subsistence claims within the context of the Exxon Valdez claims of the Trans-Alaska Pipeline Liability Fund.

The Alaska Environmental Conservation Act of 1972 represents a broad effort by the Alaska Legislature to require polluters, including oil spillers, to compensate victims of spill for their full measure of "damages," including all damages measurable in terms of an economic loss. The term "damages" is broadly defined in AS 46.03.824, and refers to "the loss of an economic benefit." The term "economic benefit" is in turn defined in AS 46.03.826(2) to mean any "benefit measurable in economic terms." Included within the scope of such damages are damages to "a subsistence economy," and that term is also defined in the statute at AS 46.03.826. The Legislature's purpose in enacting these provisions was to assure that oil spillers would have to pay all of the economic damages caused by their actions.

In the wake of the Exxon Valdez Oil Spill the subsistence-dependent villages of Prince William Sound and elsewhere have been pressing claims under the Alaska Environmental Conservation Act against Exxon to recover the full measure of economic damages brought about as a result of the immediate and continuing severe impact of the spill on their subsistence way of life. Because the value of subsistence involves considerably more than the bare dollar value of a duck not taken or a fish not caught, computing the damages requires extensive

and sophisticated economic analyses which in many ways are similar to the analyses applied in determining the dollar value of natural resource damages.

While the villages have been pursuing their claims under the Alaska Environmental Conservation Act in state court, they have simultaneously been required under a Federal court order to present their claims to a federally created body known as the Trans-Alaska Pipeline Liability Fund. The Fund is a more limited avenue of relief for oil spill victims than the Alaska Environmental Conservation Act, because it only contains $86 million for all of the victims of any one spill, while the Alaska Environmental Conservation Act carries no dollar limit. Recently, the Fund rejected the bulk of the subsistence claims on the ground that governing federal law did not authorize the Fund to pay any economic damages suffered by subsistence-dependent people other than the bare dollar value of subsistence foods not consumed. The decision was made by retired Federal Judge John Gibbons, who was hired by the Fund to dispose of all claims.

The decisions by Judge Gibbons, while unfortunate, would be of little consequence to the Alaska Legislature were it not for the fact that, in the course of a lengthy November 12, 1992 memorandum, Judge Gibbons expresses his view that the subsistence damage claims presented to and rejected by the Fund would similarly not be compensable under the Alaska Environmental Conservation Act.

Retired Federal Judge Gibbons is simply wrong in his assessment of our State's laws and of the Legislature's broad intent in making special provision to assure that polluters will pay the full measure of damage to our subsistence-dependent people. My view of the scope of the current law is shared by the Attorney General's office, which, I am informed, agrees that the Alaska Environmental Conservation Act authorizes the application of contingent valuation methodologies and other economic damage assessment models to compute the full measure of damages required to be paid under the Act. Nonetheless, Judge Gibbons' remarks are disturbing, and if they are accepted by the courts, would represent a severe undermining of the Legislature's intent.

For this reason, I have introduced House Bill 467 to remove any possible doubt regarding the Legislature's intent in 1972, and as reinforced by more recent amendments in 1986 and 1991. If the oil companies can hold their liability for the devastation caused to the village citizens of this State down to the mere food dollar value of their subsistence catches, a grave injustice will have been done to our citizens. I believe the Legislature has a duty to assure that this does not occur, and to remove even the most remote doubts that may have been raised as a result of the unfortunate rulings by the Trans-Alaska Pipeline Liability Fund.

HB

477

# UNITED FISHERMEN OF ALASKA

211 4th Street, Suit 112
Juneau, AK 99801
907-586-2820
Fax# 907-463-2545

April 22, 1992

**MEMBER ASSOCIATIONS**

Alaska Crab Coalition
Alaska Independent Fishermen's Marketing Association
Alaska Longline Fisherman's Association
Alaska Trollers Association
Bering Sea Fishermen's Association
Bristol Bay Drift netters Association
Concerned Area 'M' Fishermen
Cook Inlet Aquaculture Association
Copper River Fishermen's Cooperative
Cordova District Fishermen United
Kenai Peninsula Fishermen's Association
North Pacific Fisheries Association
Northern Southeast Regional Aquaculture Association
Peninsula Marketing Association
Petersburg Vessel Owners Association
Prince William Sound Aquaculture Association
Prince William Sound Seiners Association
Seafood Producers Cooperative
Southeast Alaska Seiners
Southern Southeast Regional Aquaculture Association
United Cook Inlet Drift Association
United Southeast Alaska Gillnetters
Western Alaska Cooperative Marketing Association
Area K Seiners Association

The Honorable Cliff Davidson
House of Representatives
Chairman, House Resources Committee
Post Office Box V (MS 31000)
Juneau, Alaska 99811

Dear Representative Davidson:

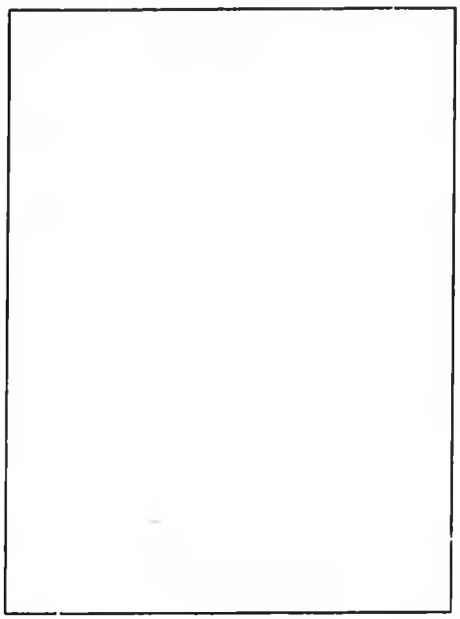
On behalf of the United Fishermen of Alaska, I would like to express to you our support of House Resources Committee Substitute for House Bill 477.

Although there are some reservations among members of the fishing industry about this type of assessment, it is our belief that the proposed legislation is an honest attempt to address those concerns.

We appreciate the effort that you and the members of the House Resources Committee have expended to develop this legislation.

Sincerely,

Greg Seider
Executive Director



# Care and Handling of Salmon: The Key to Quality

John P. Doyle

March 1992
Marine Advisory Bulletin No. 45

University of Alaska Fairbanks

# Care and Handling of Salmon: The Key to Quality

by

John P. Doyle
Professor of Fisheries
Marine Advisory Program
School of Fisheries and Ocean Sciences
University of Alaska Fairbanks

Marine Advisory Bulletin No. 45
March 1992

This bulletin is dedicated in memory of A.K. Larssen, who worked tirelessly to increase the professionalism of North Pacific fishermen and to improve the quality of fish landed in North Pacific ports. A.K. was a fisherman and writer whose educational guidelines for commercial fishermen have been published in the United States and Norway. His works include *Safety Notes for the North Pacific Fisherman*, a Marine Advisory bulletin published in 1975 by the University of Alaska Sea Grant Program, and "Some ABC's of Fo'c'sle Living," which was co-authored by Sig Jaeger, appeared in the July 1974 edition of *Marine Fisheries Review*, and later was published as a handbook.

# Contents

# Preface

The purpose of this bulletin is to summarize available information on the major quality problems encountered by users of wild Pacific salmon and to make recommendations for the improvement of quality. Much information included in this bulletin has been developed since the most recent previous work of its kind, *Recommended Salmon Quality Guidelines for Fishing, Tendering and Processing Operations,* was published by the Alaska Seafood Marketing Institute (ASMI) in 1986. Although this bulletin is directed primarily to fishermen, the general facts and information it contains are applicable to all persons who handle or transport raw salmon.

Fish quality education has been a priority of the Marine Advisory Program since its inception in 1963 as the Fisheries Extension Program at the University of Alaska. Captain Chuck Wells, who has fished commercially in Alaska for many years, is prominent among those who influenced the establishment of fish quality education and resource conservation as long-term objectives of the program. To him I extend my sincerest thanks.

ASMI, Icicle Seafoods, Inc., and the University of Alaska cosponsored this publication. Many other organizations and individuals contributed to its development and production. Dr. Donald Kramer provided continual encouragement, sources of information, and many helpful comments on the manuscript. Others who reviewed the manuscript and made valuable suggestions are Chuck Crapo, Marine Advisory Program, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks; Charles C.R. Campbell, Chief, Technical Services and Product Inspection, Department of Fisheries and Oceans, Government of Canada; and Kenneth Hilderbrand, Marine Advisory Program, Oregon State University.

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manuscript; and Deborah Mercy produced the illustrations. Their efforts are greatly appreciated. ASMI contributed the cover photograph. One of the photos in this publication appears courtesy of the U.S. Food and Drug Administration, and two appear courtesy of G. Baker and G. Gibbard, as noted in captions; others were taken by the author at seafood processing plants.

Although many persons provided information for this publication, the author is entirely responsible for any erroneous facts, interpretations, or recommendations that may appear in it.

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# I. Introduction

Salmon that are bruised in handling are a major economic drain on the fishing industry. They create an unfavorable market image, have higher weight loss, and are of lower grade and quality than salmon that are handled carefully. Bruised products have long plagued many segments of the food industry. For example, bruising of even the hardy potato is a serious economic problem in the industry it supports (Kline-Schmidt 1989). To compete effectively for the consumer's food dollar, all segments of the food industry must continually improve the quality of their products.

Quality is especially important in today's highly competitive salmon market. Unlike rice, potatoes, or pasta, salmon is not daily fare; it is a speciality food in North America, Asia, and Europe. Consumers must be attracted to salmon, and if they are to be repeat customers, the product must meet their expectations. To meet consumer expectations, the quality of net caught salmon must improve. The old ways of handling and taking care of fish are nc longer acceptable.

Over the past 15 years, the following major changes in the salmon market have affected all aspects of the industry: (1) in the mid-1970s, the amount of salmon going to the frozen market increased at the expense of the canned volume, and (2) in the late 1980s, the production of farmed salmon expanded rapidly.

The industry did not react quickly to meet market needs for a better product as consumer demand shifted from canned to frozen salmon. The quantity of frozen salmon increased, but in general its quality still does not meet market expectations. Historically, most Pacific salmon destined for the frozen and mild cure markets were taken by trollers and gillnetters in Southeast Alaska, British Columbia, and the Pacific Northwest. These fishermen traditionally fished for the high value markets and took very good care of their catch, meeting the demand for kings, silvers, and bright Southeast Alaska chum salmon. In the mid-1970s, the demand for fresh and frozen fish, including frozen salmon, increased rapidly in the U.S. market. Later increases in demand were spurred by a devaluation of the dollar against European and Japanese currency. To meet the increased demand, salmon freezing expanded in Southcentral Alaska

and Western Alaska. However, fishermen operating in these areas had little experience in producing fish for the frozen market, so the product quality did not meet market needs.

A second major source of pressure on Alaska's salmon markets is the recent rapid expansion in production of farmed salmon. From 1985 through 1990 the world supply of farmed salmon increased from 102 million pounds to 621 million pounds. In contrast, between 1982 and 1990 Alaska's production of fresh and frozen salmon has averaged 323 million pounds annually. (See figure 1 on page 3). Most farmed salmon are sold fresh, and limited amounts are frozen, so it is obvious that Alaska no longer controls the salmon market; instead, the market controls the Alaska salmon industry.

A very recent trend in salmon farming will put even greater pressure on wild salmon markets. In 1990 and 1991 Norway froze large amounts of salmon to ease the glut of fresh salmon on the world market. Salmon farmers in Chile freeze about half of their total production. In 1990 Chilean exports of frozen farmed salmon to Japan accounted for 7% of Japan's salmon imports, according to a forthcoming paper by J. L. Anderson and Y. Kusakabe.

## A. The problem

Bad attitudes that persist among some members of the fishing sector are a major cause of poor product quality. Such attitudes stem from short seasons, fierce competition for fish, and limited vessel capacity for fish and machinery. These conditions produce a general feeling that the first and foremost job is to maximize the harvest and that care of the product is secondary. This feeling leads to rough handling; poor or no chilling; and in some cases, dirty, unsanitary holding conditions. These practices must change if the Alaska salmon industry is to regain control of the salmon market.

Despite bad attitudes among some in the fishing sector, during the past 25 years all segments of the Alaska salmon industry have made good progress in improving product quality. For example, fish pughs are no longer commonly used, dry scow tendering is almost a thing of the past, and a large percentage of the purse seine fleet uses

(Continued on page 4)

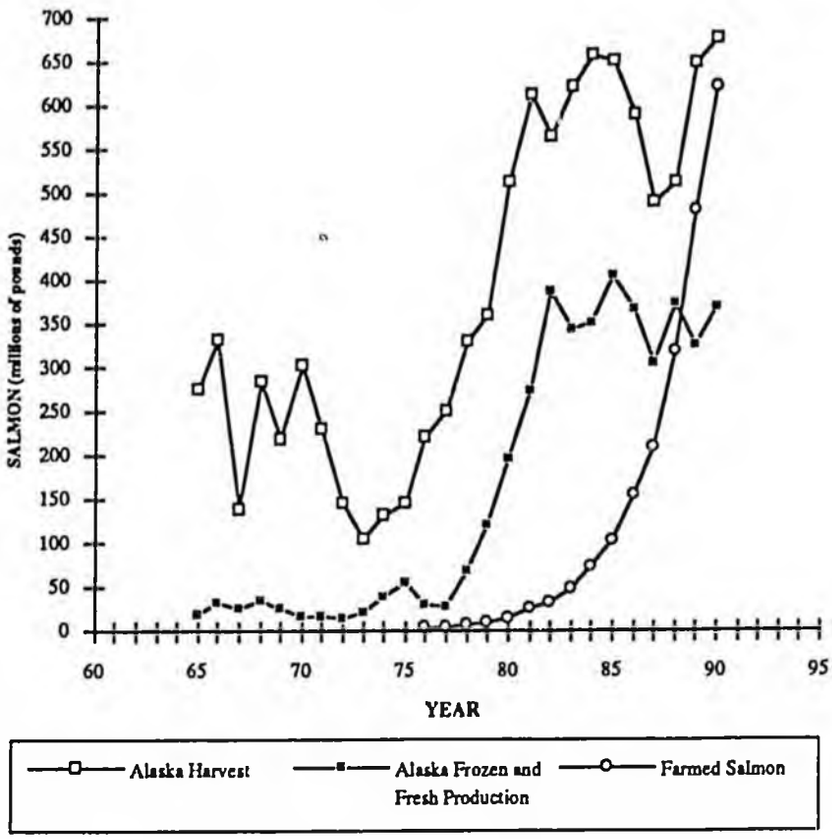


**Figure 1.** Comparison of total Alaska salmon harvest, world production of farmed salmon, and Alaska's fresh and frozen salmon production. Alaska's canned salmon production is the difference between the total Alaska salmon harvest and the total Alaska production of fresh and frozen salmon. All figures are in round weight. Sources: Alaska Department of Fish and Game statistical leaflets, Alaska Seafood Marketing Institute, National Food Processors Association, and Alaska Fisheries Entry Commission.

(Continued from page 2)

some form of chilling. Some in the gillnet fleet (even in remote areas) use ice or chilled sea water to cool their fish.

The problem facing the Alaskan salmon industry is that its competitors have advanced so rapidly in marketing a high-quality product. For example, handling of farm reared salmon is designed to produce the freshest, most defect-free product possible. Farm reared salmon, regardless of their source of origin, are usually in transit to market within four hours after they are slaughtered.

## B. The opportunity

The world supply of salmon increased rapidly during the 1980s, and by 1990 farmed salmon amounted to 28 percent of the world production (Alaska Seafood Marketing Institute [ASMI] 1991). This indicates that the growth in farmed fish has increased the consumption of salmon. Currently, most farmed fish are marketed fresh, which reduces inventory costs. More importantly, freshness appeals to consumers. The 1991 ASMI report shows that quality, freshness, and consistency of supply are the *most important* factors in attracting users to farmed salmon. Until ocean ranching of chinook, sockeye, and coho becomes a major element in overall "wild" salmon production, Alaskan fish producers can control only quality, one attribute of which is freshness. Producers of farmed salmon can control supply as well as biological factors such as weight, flesh color, flesh firmness, and oil content.

## C. The characteristics of quality

Each species of salmon has its own distinctive quality attributes. Quality is what buyers consider desirable in a product, a set of characteristics that makes eating the product an enjoyable experience. For salmon, these characteristics include appearance, flavor, odor, texture, and freshness. (As the word *freshness* is used here, it is a function of time and temperature and does not differentiate between frozen and unfrozen fish.) Freshness is given primary emphasis by marketers of farmed salmon. For the most part, harvesters and processors of wild salmon do not pay enough heed to freshness. Neither the U.S. Food and Drug Administration nor the Alaska

Department of Environmental Conservation inspects for freshness. Both agencies ensure only that minimum standards are met. Their main concerns are that the product is wholesome (free from decomposition, adulteration, and contamination) and was not handled and processed under conditions wherein it may have become contaminated or adulterated.

A voluntary seafood inspection program has been administered for many years by the National Marine Fisheries Service for the U.S. Department of Commerce (USDC). The USDC inspection certifies only that salmon is processed under sanitary conditions and meets a company's own definition of standards as stated on its packages. In the North American scientific community, most seafood technology research has been devoted to understanding bacterial spoilage, chemical measurements of spoilage, and methods of extending the shelf life of fish. No wonder we pay so little attention to the overall quality and freshness of our seafood. In contrast, much research in Japan and Europe is devoted to methods for measuring freshness, and both physical and chemical methods have been developed. In Japan the chemical score for freshness often is displayed on a product at the retail level. This chemical score is a measure of chemical changes in fish flesh which occur before significant bacterial growth takes place. These methods are little used in North America. Our lack of concern for freshness is an attitude which must change if Pacific wild salmon from North America are to compete successfully with farm reared fish.

## II. Objective

The objective of this bulletin is to increase awareness of quality problems in the care and handling of wild salmon harvested by gillnet, purse seine, and troll gear in all areas of the northeast Pacific. This bulletin points out quality problem areas commonly encountered in the production and manufacturing of wild salmon and makes recommendations that, if followed, will reduce complaints encountered in the marketplace.

# III. Biology

Several aspects of salmon life history affect the quality of the end product. Genetic controls determine flesh and skin color as well as oil content; however, degree of maturity also strongly affects these quality attributes. Factors associated with the method of harvest and killing also have an impact.

## A. Intrinsic quality

Intrinsic quality refers to the set of characteristics unique to a species, to populations within species, and to individuals within populations.[1] These characteristics reflect the natural condition of a live fish. Intrinsic quality characteristics that are important market factors include size, color of skin and flesh, oil content, flesh texture, and degree of maturity. Intrinsic quality varies with stage of maturity, age, and season.

## B. Extrinsic quality

Extrinsic quality refers to changes in fish flesh that take place during and after harvesting. These changes include preventable defects caused by bruising, poor workmanship during processing, contamination, or physical abuse. Extrinsic quality is influenced by the method of harvest and by every person who handles the fish (from the fisherman to the consumer). It also is affected by bacterial growth and chemical changes which cannot be stopped, but can be slowed by proper handling and storage. Fishermen can have their greatest impact on quality, and therefore the market, by controlling extrinsic quality.

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[1] Because there are so many genetically separate populations within a species of salmon, the intrinsic quality of fish of the same species varies greatly. All major buyers of Alaska salmon are well aware of that fact. For example, Yukon king salmon are renowned for their high oil content, bright flesh color, and thick belly walls. In 1991 Yukon fishermen received an average of $4.10 per pound for gillnet caught fish. Cook Inlet kings are large but do not enjoy a good reputation because they have low oil content, relatively poor skin color, and thin belly walls. The average price for Cook Inlet king salmon in 1991 was $1.15 per pound. Fish buyers also recognize the differences in handling practices and other extrinsic quality factors in salmon produced in different regions.

## C. Maturity

Salmon go from the juvenile stage to sexual maturity, spawning, senility, and death in a short time. The timespan for the maturing process varies by species and is closely correlated to the distance from salt water to the spawning grounds. The onset of maturity coincides with rapid growth, increase in gonad size, firming of the flesh, and setting of the scales. Growth can be spectacular. For example, coho salmon in Southeast Alaska grow at a rate of 1 pound per week during the August through September period prior to spawning. An immature, 3-pound coho harvested at the end of June easily could have exceeded 12 pounds by the first week of September. An increase in gonad size and flesh oil content coincides with an increase in body weight. High oil content, roe weight, and maturity are important attributes of intrinsic quality.

As salmon mature, they migrate to their home stream or spawning system. Feeding stops with the onset of sexual maturity, and from that point on, intrinsic quality characteristics deteriorate. Stored oil and proteins are the only energy sources. Proteins are used as the primary energy sources during spawning migration. Oils are transferred to the gonads and are used as secondary energy sources during the maturation process and spawning migration. Pigments are metabolized along with the oils and protein. The carotenoid pigments (red color compounds) are transferred to the eggs and skin in females and to the skin in males (Ando 1986). As maturity progresses, skin color changes and the bright silver color is lost. Morphological changes in body conformation associated with maturity also have a negative effect on quality. In addition, odor and flavor compounds undergo chemical changes which result in a less desirable product as maturity progresses (Josephson, Lindsay, and Stuiber 1991). These important intrinsic quality properties which change with age are relevant to the selection of fishing locations and periods during the season. Therefore, salmon management has an important impact on the ultimate quality of Alaskan salmon. No buyer wants a salmon with a dull color and low oil, low protein, and high water contents.

## D. Death and rigor mortis

The way a salmon is killed impacts its overall flesh quality. A quick, nonviolent death by stunning and bleeding causes the least damage. A violent, protracted struggle has a negative impact on quality. It causes a series of rapid chemical changes that directly control rigor mortis and affect freshness and storage life.

When a fish dies, its flesh and skin are bright and elastic and its body is limber. This immediate post-death period is called pre-rigor mortis. During pre-rigor, the chemical breakdown of high energy compounds and enzyme activity continues at a temperature-controlled rate in the same way as when a fish is alive. When a fish is alive, chemical breakdown and buildup are in balance, but upon death, all system repair stops. The resultant chemical changes bring about contractions of the skeletal muscle tissue. The stiffening of the body is called rigor mortis. Rigor is similar to a severe muscle cramp or charley horse. During pre-rigor and rigor, the breakdown of high energy compounds is accompanied by the oxidation of glycogen. Glycogen metabolism produces lactic acid. The buildup of lactic acid in the flesh lowers pH; that is, it raises its acidity. High acid content inhibits bacterial growth, so spoilage bacteria do not start to increase until after the fish comes out of rigor. The period after rigor is post-rigor mortis. During the immediate post-rigor period, the fish becomes flaccid. At that time bacteria build up and spoilage begins. The longer a fish stays in pre-rigor and rigor, the longer freshness is maintained.

The length of rigor varies from species to species and within species. Much depends on the condition of the individual fish. However, maximizing rigor time must be one of the handling objectives. The critical period for maintaining freshness begins at the time the fish first encounters the gear and extends through the rigor period. The longer a fish struggles before it is killed, the faster it will go into rigor and the shorter will be the rigor period. Struggling causes a rapid breakdown of high-energy compounds and the rapid oxidation of glycogen, leaving little to be consumed during the rigor process.

Temperature also controls the length of the pre-rigor and rigor periods, because it controls the chemical reaction rates. The higher the temperature, the faster the reaction rates, and the shorter the

periods of pre-rigor and rigor. For cod the time in rigor at 0°C (32°F) is three times longer than at 11°C (51.8°F). Even gentle handling of fish during rigor shortens the rigor period (Jones 1964). The importance of extending the rigor period as long as possible cannot be overemphasized.

# IV. Causes of Quality Problems

Once a fish loses freshness and general quality, no amount of processing or technology can reverse the process. Fishermen get first crack at the product because they are first in a long chain of handlers extending from the ocean to the consumer. Each time a fish is handled, irreversible damage takes place. The degree of damage depends on how gently or how roughly the fish is handled. There is no magic in the fish business: careful handling and attention to every detail of quality are the only ways to prevent quality problems.

## A. Physical defects

Physical damage is the primary cause of quality loss in net caught salmon. Gaping flesh is the most common serious defect, followed by bruising and soft (mushy) flesh. Many of these defects cannot be detected in fresh or frozen dressed salmon until the fish are split, filleted, or steaked. Damage from net marks results in a loss of scales. Gillnet marks detract from the appearance of fish, but unless the marks are deep, damage is superficial and easily trimmed.

### 1. Gaping

Gaping is the separation of the muscle layers due to weakening of connective tissue that causes holes or slits to appear between the muscle layers (see photograph 1 on page 23). The severe gaping shown in photograph 1 is a serious defect that makes the side unsuitable for mild curing or a cold smoked product. It also detracts from the appearance of fillets and steaks. The chief causes of gaping are:

a. Allowing the fish to go into and through rigor at high temperature (Love and Haq 1970). This is directly correlated with the pH of the flesh (Love 1979). At a high temperature, the muscle tissue contracts so violently that it separates from the connective tissue. (The thin, white layers shown between the large, red muscles in photograph 6 on page 28 and photograph 11 on page 33 are connective tissue.) The connective tissue in fish is very weak compared to that of mammals, and is further weakened at high temperature.

b. The nutritional condition of the fish. A fish in good condition has higher stores of glycogen that provide for greater lactic acid buildup and more violent contraction of muscle tissue.

**c.** Physically bending the fish while it is in rigor. The muscles are very hard and rigid during rigor. Bending or straightening the fish will tear its connective tissues and lead to gaping.

**d.** Lifting or pulling the fish by its tail, particularly when removing salmon from a gillnet or lifting a heavy fish. This form of abuse causes gaping in the area of the caudal peduncle (tail section).

Gaping is insidious in that neither the external appearance nor the belly cavity of the fish may reveal any sign of poor handling. Gaping eliminates many fish of otherwise fine quality from the high price side of the market because they are not acceptable for manufacturing as smoked salmon or for use in the white tablecloth restaurant trade.

## 2. Bruising

As explained in the opening paragraph of this bulletin, internal bruises are the bane of the wild salmon industry. A large bruise not only prevents the fish from being manufactured as lox, it represents waste because the bruised area and the soft, mushy flesh adjacent to it must be cut away. The equivalent of several steaks or the entire caudal peduncle area may be wasted. Bruising just in front of the caudal peduncle, as shown in photograph 2 on page 24, may be caused by lifting a salmon by the tail, dropping it on the tail, or bending the tail when the fish is in rigor. Any action that breaks the backbone of the fish can cause a severe bruise.

Bruising can occur both when the fish is alive and after it is dead. The flesh of the salmon shown in photograph 3 on page 25 was bruised after the frozen fish was defrosted. Japanese research on gillnet caught chum salmon showed that the incidence of bruising increased from 21% in fresh, split fish to 40% after the fish had been frozen. Apparently, freezing of the soft flesh in the area of a bruise further damages the tissue, allowing blood to spread.

Most fish with external gillnet marks will have superficial bruises along the dorsal bones and near the dorsal fin (see photograph 4 on page 26). These bruises easily can be trimmed away when splitting the fish; they are not obvious in steaks. Deep gillnet marks that leave indentations in the skin and flesh can be accompanied by bad bruises (see photograph 5 on page 27). Such bruises generally

result from leaving gear in the water too long in heavy seas. As the net surges in heavy seas, the fish again may be gilled by a section of net. This will cause the net to stretch and can result in serious damage to the fish, including breaking the back and cutting the skin. Towing a gillnet containing salmon also will damage the catch. Fish damaged as severely as the salmon shown in photograph 5 should be discarded but seldom are.

Other causes of bruising include heavy blows to the flesh, as when fish are hit with the back of a gaff, dropped from the brailer to the bottom of the hold, stepped on, gaffed or pughed in the body, or thrown into holds, onto the deck, or into totes. Bruises still occur in troll caught fish due to improper gaffing (see photograph 6 on page 28) and in gillnet caught fish due to puncturing with a picking hook, gaff, or pugh (see photograph 7 on page 29). Bruises appear more often and are larger in fish held at a high temperature (Jones 1964). Bruises appear in both canned and frozen products. They are unsightly and unappetizing, and they result in unhappy consumers. *Remember, when salmon bruises, everyone loses:* Handle with care.

### 3. Mushy flesh

Mushy or soft flesh is caused by physical damage or by chemical damage such as enzymatic breakdown and bacterial digestion. Physical damage will be emphasized in this section. Photograph 8 on page 30 shows physical damage in the caudal area of a gillnet caught sockeye salmon. The yellowing of the flesh just posterior to the belly cavity below the backbone shows that oxidation of the oil in that area has taken place much faster than in the undamaged dorsal muscle. Mushy flesh is caused by the same kinds of abuse that cause bruising, including stepping on fish, piling them too deep, and dropping them, but the damage is more general.

Mushiness is easily detected when a salmon is split, because the knife will stick to the flesh. Mushy flesh renders a side unsuitable for the manufacture of lox. It will give a fillet a poor, dull appearance. The cooked flesh will have a dry, mealy texture and may have an off flavor associated with rancidity. Preventing mushy flesh by handling salmon more carefully is a must.

## B. Enzymatic breakdown of protein

Enzymes are chemical compounds responsible for speeding up reactions such as the breakdown of protein. They also are essential for building proteins. However, all maintenance stops when the fish dies. Enzyme activity is temperature controlled; it increases in proportion to increases in temperature.[2]

The most commonly seen effect of enzymatic degradation is belly burn (shown in photograph 9 on page 31). Belly burn is caused by digestive enzymes that break down the wall of the intestinal tract, leak into the belly cavity, and then begin to digest the body wall. In less severe cases the belly wall will have a deep red color, but no rib bones will be exposed. Other enzymes which control protein breakdown are present in the muscle cells. They are responsible for the general softening of flesh.

Other major factors that hasten enzymatic degradation of fish flesh are crushing and pressure. Experiments have shown that even relatively low pressure will significantly increase enzyme activity. Sockeye salmon that were held under 36 inches of fish for 24 hours had enzyme activity three times higher than that of sockeye held for the same time under only 12 inches of fish (Motohiro and Akazawa).

The degree of maturity affects enzyme activity in some fish. For example, immature silver salmon become very soft immediately post-rigor, even though they are firm and resilient before and during rigor. Salmon which have stopped feeding have lower stomach enzyme activity than do actively feeding fish.

## C. Spoilage

The narrow definition of spoilage is decomposition and putrefaction caused by protein digesting bacteria. Bacterial spoilage is still a problem with salmon produced in Alaska. It can be found in fresh, frozen, and canned products. While incidents of decomposition are much less common than other defects, the loss of quality and freshness due to bacterial changes are problems encountered statewide.

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[2] This is generally true between 32°F (0°C) and 68°F (20°C); however, each enzyme has a specific temperature at which it is most active. Most enzymes which break down protein are denatured at high temperatures.

A live salmon has bacteria on the skin, gills, and in large numbers in the gut. The flesh of a live fish is sterile; however, when the skin is broken or punctured, bacteria enter the flesh. After the fish has been killed, bacteria populations remain relatively stable during pre-rigor and rigor. When the fish emerges from rigor, bacteria populations grow at a fairly predictable rate which is temperature dependent. As with enzyme reactions, the higher the temperature, the faster bacteria populations increase. Bacteria can be added to the product from anything that comes in contact with the fish, such as gloves, the boat deck, the beach, and the chilling system. The more bacteria on the fish, the faster they lose freshness and spoil. Cuts or punctures in the skin or belly wall expose flesh, and the things that make these cuts or punctures can inject bacteria into the flesh. This will greatly accelerate spoilage of the fish.

## D. Other causes of quality problems

### 1. Rancidity

Rancidity in fish is caused by the oxidation of oils (lipids). The first sign of rancidity in salmon is yellowing of the exposed flesh of the belly cut and collar. In more advanced stages, further yellowing of flesh takes place, especially in the belly, and the flesh has a strong, unpleasant odor. In the most severe cases, the oils bleed to the surface of the belly wall and skin and develop a rusty color. Such fish are unfit for human consumption.

Rancidity usually doesn't show up in properly handled, fresh fish, because the reaction rate for lipid oxidation is slower than it is for bacterial spoilage or enzymatic breakdown. The chain reaction of lipid oxidation starts soon after the fish is killed but proceeds more slowly. Sunlight and certain ions (such as iron and copper ions) are catalysts for lipid oxidation reactions. The ultraviolet (UV) in sunlight is a particularly strong catalyst. Exposure of flesh to direct sunlight for as little as one hour can cause oils to oxidize to the point that rancid odors become obvious. Once the oxidation reaction starts, it cannot be stopped at frozen storage temperatures of 0°F (-17.78°C) to -15°F (-26.11°C), even if air is sealed off by glazing or impermeable vacuum packaging.

## 2. Sunburn

Sunburn can be a serious problem in the setnet and skiff fisheries. In mild cases sunburn appears as a slight blushing during freezing. After freezing a deeper blush will appear. In severe cases the skin will be dry and wrinkled, as shown in photograph 10 on page 32. Such fish have mushy flesh from enzymatic breakdown and are unfit for human consumption. Direct sunlight is not necessary either for sunburning or for catalyzing oxidation reactions. The UV in sunlight will penetrate cloud layers and cause the same problems as will direct sunlight.

## 3. Dirt

Dirt is a problem with many fish caught in setnets. In Cook Inlet and Bristol Bay, which have high tidal ranges, fast currents make it difficult to pick fish from the nets except during high and low tide slack periods. Wide tidal flats ensure that the nets will go dry at low tide, allowing fish to lie in mud. This adds large quantities of bacteria to the surface of the fish. Sand and mud are difficult to wash off fish because they lodge in the slime and especially in the gill cavity. There is the potential for dirt to end up in the finished product. Dirty decks, checkers, and holds add to the bacteria load. Pets present special sanitation problems, so they should *not* be permitted on vessels that catch or transport salmon.

# V. Improving Handling Techniques

The quality of Alaskan salmon can be greatly improved by better care and handling of the fish at every step from harvesting through processing. The temperature and manual handling of the product are under the control of the fishermen. Facts and recommendations that must be considered in any attempt to improve product quality and regain lost markets include the following.

## A. Temperature

Shelf life is defined as the maximum length of time a food is desirable for human consumption. Shelf life is a direct function of product temperature. When all else is equal, the rate of loss of freshness will increase with increases in temperature (Doyle 1989).

The shelf life of fresh sockeye salmon handled under ideal conditions generally is considered to be 12 days, assuming that the fish is held at 32°F (0°C) from the time of death. In a 24-hour period, when a fish is held at 32°F (0°C), 1 day of shelf life is used; at 39°F (3.89°C), 2 days of shelf life are used; and at 50°F (10°C), 4 days of shelf life are used. In other words, when a sockeye salmon is held at 50°F (10°C) for 1 day, only 8 days are left to get the product to the consumer (see table 1 on page 18). The shelf life of a fish varies with its intrinsic quality at the time it is harvested. The expected shelf life for various species of high-quality, commercially caught and processed salmon is as follows: kings, 10 days; silvers, 10 to 12 days; chums, 13 days; and pinks, 6 days.[3]

Many fishermen believe that holding salmon from 12 to 24 hours at ambient temperature does little damage. *This is sheer nonsense.* As pointed out above, the first few hours after death are critical in determining the duration of the pre-rigor and rigor periods. Extending rigor as long as possible is a primary objective of chilling fish. Crapo, Kramer, and Doyle (1988) have shown that mature silver

[3] Because laboratory experiments usually are conducted under ideal handling conditions in which the fish receive little abuse, published shelf life times usually are longer than those listed here. Laboratory experiments usually do not reflect the "real world" in which a large quantity of product must be handled in a short time.

salmon caught in a purse seine and bled, gutted, and layer iced were in excellent to good condition after 8 days. In the same experiment, silvers held at 50°F (10°C) for 12 hours and then iced were in fair to good condition after 8 days, while delaying chilling for 24 hours prior to icing resulted in a product that was unacceptable on the fresh or frozen market 8 days after harvesting. Immediate chilling of the catch is the only acceptable holding method if wild salmon are to compete at the top end of the market.

Another marketing disadvantage in unchilled fish is shrinkage. Research by Tomlinson et al. (1969a) showed that sockeye salmon stored in boxes 12 inches deep and held at 60°F (15.56°C) for 12 hours lost 0.7% of their body weight, while those held 24 hours lost 1.2% of body weight. Sockeye salmon held in the hold of a vessel will lose much more weight than the fish held in a box only 12 feet

Table 1. Relative rates of spoilage and loss of equivalent days on ice for different temperatures and times*

| Temperature | | Relative rate of spoilage | Equivalent days on ice with time | |
|---|---|---|---|---|
| °C | °F | | 12 hrs. | 24 hrs. |
| -2.00 | 28.40 | 0.64 | 0.32 | 0.64 |
| 0.00 | 32.00 | 1.00 | 0.50 | 1.00 |
| 2.00 | 35.60 | 1.44 | 0.72 | 1.44 |
| 4.00 | 39.20 | 1.96 | 0.98 | 1.96 |
| 6.00 | 42.80 | 2.56 | 1.28 | 2.56 |
| 8.00 | 46.40 | 3.24 | 1.62 | 3.24 |
| 10.00 | 50.00 | 4.00 | 2.00 | 4.00 |
| 12.00 | 53.60 | 4.84 | 2.42 | 4.84 |
| 15.00 | 59.00 | 6.25 | 3.12 | 6.25 |

* Equivalent days on ice computations were carried out to three places for mathematical accuracy only. Because of biological variablility within a species, numbers are meaningful only to one place past the decimal point. For example, if a fish is held a 50° F (10°C) for 24 hours, r= 4 means 4 days of shelf life are used in 24 hours; 2 days are used in 12 hours.

deep, because the greater physical pressure on them will squeeze out more body fluid and slime.

The old saying, Colder is better, is true to a point: a low temperature inhibits bacterial growth. However, at 28.4°F (-2°C), where fish flesh is partially frozen, ice crystals form in the cells and some enzymes become more active. Salmon roe turns dark and is of low value when partially frozen. An ideal holding temperature for salmon is 31°F (-0.56°C) to 32°F (0°C).

## B. Chilling methods

The three acceptable options available to a fisherman for cooling his fish on a vessel are ice; chilled sea water (CSW), which is sea water chilled with ice and mixed using air; and refrigerated sea water (RSW). CSW is also known as "champagne ice." Of the three choices, properly applied ice is best, followed by CSW, and then RSW (Tomlinson et al. 1974; Crapo et al. 1990). Laboratory experiments show that pink salmon held in ice are acceptable to taste panels up to 10 days, while pinks held in CSW at 31°F (-0.56°C) are unacceptable after 6 days (Crapo et al. 1990).

Each of the chill storage methods has the following advantages and disadvantages.

### 1. Advantages of ice

- **a.** Keeps salmon fresh longer.
- **b.** Results in a better appearing product when properly applied.

### 2. Disadvantages of ice

- **a.** Requires more labor and time than do other methods.
- **b.** Requires horizontal shelving in holds more than 4 feet deep.
- **c.** Is unavailable in some locations.

### 3. Advantages of CSW

- **a.** Low labor input needed for fish stowage.
- **b.** Has a simple mechanical system.
- **c.** Fish are maintained at a constant temperature of 31°F (-0.56°C) in properly designed systems.
- **d.** Is cheaper to install and operate than RSW.

**e.** Can absorb heat from large loads of fish more rapidly than ice or RSW.

### 4. Disadvantages of CSW

**a.** Maximum storage time is shorter than that of ice because fish spoil faster.

**b.** Scale loss can be severe in heavy weather.

**c.** Requires more ice than does the ice storage method alone, because after ice is used to lower the temperature of sea water in the hold to 31°F (-0.56°C), ample quantities of ice must be left to refrigerate the added fish.

### 5. Advantages of RSW

**a.** Low labor input needed for fish stowage.

**b.** Requires no ice and can operate anywhere clean sea water is available.

**c.** Cools fish more rapidly than ice.

**d.** Can obtain lower temperature than ice or CSW.

### 6. Disadvantages of RSW

**a.** Maximum storage time is shorter than that of ice because fish spoil faster.

**b.** Has high initial costs and operating costs.

**c.** Requires skilled operators.

**d.** Has no backup if system breaks down.

**e.** Temperature fluctuation is greater than that of CSW or ice.

Despite the fact that RSW and CSW systems can be colder than ice, salmon keep better in ice for several reasons. Fish held in RSW or CSW gain weight and absorb salt. For example, research by Crapo et al. (1990) has shown that the salt content of pink salmon held in CSW doubled in 24 hours and was 4 times higher than the original content in 4 days. The water uptake of a pink salmon stored in CSW reached 3.5% of the body weight in 4 days. Water absorption makes salmon more susceptible to handling damage. Salt and water uptake affect both the texture and flavor of frozen salmon, and salt uptake promotes rancidity. Salmon keep better in fresh water ice because the salt content of the flesh will not change significantly during storage. Salmon iced in layers less than 12 inches deep absorb about 0.5 percent of their body weight in 4 days (Tomlinson

et al. 1969a). (Additional information about the effects of deep stowage is provided on page 22.)

Another factor that shortens the shelf life of salmon held in CSW or RSW is the difference in the kinds of bacteria which grow on the skin of the fish (Crapo et al. 1990). *Pseudomonas* bacteria are potent spoilers of protein foods and cause objectionable odors and flavor. In CSW systems this group of bacteria, which always is present in sea water and in fish slime, quickly becomes the dominant bacterial group. In contrast, the *Pseudomonas* populations gradually drop to zero in salmon held in ice (Crapo et al. 1990).

Any oxygen in an RSW system is rapidly used by aerobic bacteria, which produces anoxic conditions. Anaerobic bacteria (a type of bacteria which grows only in the absence of air) quickly dominate the system. Many anaerobic bacteria take their oxygen from sulfur compounds present in the slime, skin, and flesh. This produces hydrogen sulfide, which is the source of the strong, objectionable odor found in most RSW systems after several days of operation. This odor is readily absorbed by the fish and affects its flavor.

## 7. Changing from ice to RSW or CSW and vice versa

It is common practice to switch fish held in ice to CSW or RSW or the opposite when the fish are transferred from one part of the harvesting chain to another. Some fish handlers believe that fish transferred from RSW or CSW to ice or vice versa lose their quality faster than fish held in ice. This has been verified in work by Crapo et al. (1990), who found that pink salmon which were changed from one system to the other had quality scores intermediate between pink salmon held in ice and those held in CSW. When iced fish were switched to CSW, the results were closer to those of the fish stored in CSW. When fish held in CSW were switched to ice, the quality scores were closer to those of the iced fish. Crapo et al. (1990) concluded that it is less detrimental to fish quality to change fish from CSW to ice than vice versa.

The bulk of salmon produced in Alaska are frozen or canned. Therefore, the storage period for fresh fish before processing must be short enough to allow for shelf life after processing. The maximum preprocessing storage times for salmon in ice and RSW or CSW are:

| Ice | | RSW or CSW |
|---|---|---|
| pink | 4 days | 3 days |
| sockeye | 8 days | 4 days |
| chum | 8 days | 4 days |
| king | 8 days | 3 days* |
| silver | 8 days | 3 days* |

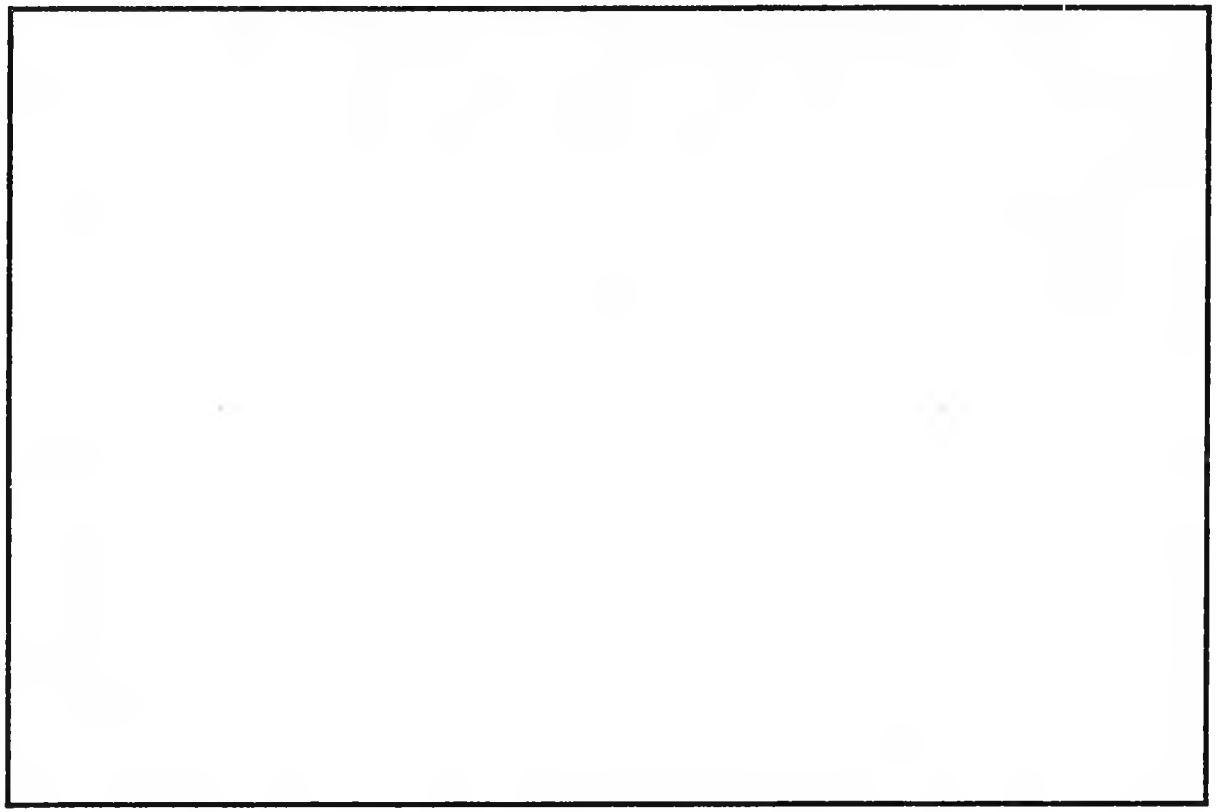
*Recommendations for storage of king and silver salmon are based on anecdotal evidence. Frozen king salmon previously stored in RSW or CSW can be soft and mushy when thawed. Because king salmon taken by seine and gillnet often are pumped or brailed and subsequently are held in RSW or CSW, rough handling may be the cause of or a contributing factor to the poor texture.

## 8. Special problems with chilling systems

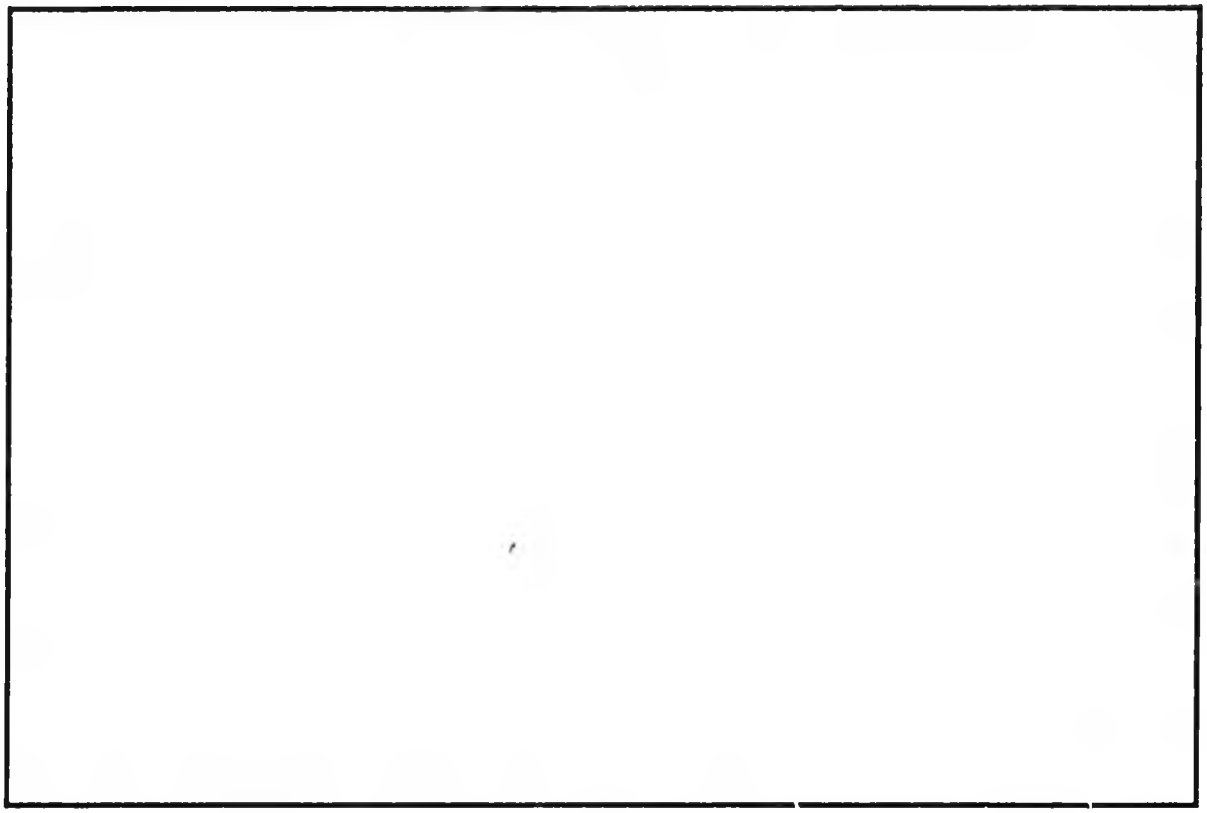
**a. Ice:** The weight of iced fish puts pressure on fish stowed at lower levels in deep holds. Well-iced sockeye stored 40 inches deep lost about 2.5% of their body weight in 4 days at sea (Tomlinson et al. 1969b). Enzyme activity in fish increases as pressure from the weight of fish stored above them increases, as was pointed out on page 14.

The use of horizontal shelving reduces pressure on fish stored beneath other fish. Shelving in pens of iced fish should be about 24 inches apart and never more than 36 inches apart.Enough ice to absorb incoming heat and cool the fish must be applied in the right places. Sources of incoming heat must be considered in estimating adequate amounts of ice. Major heat sources are the engine room bulkhead, sides of the hold, and shaft alley. The deck head will absorb heat on warm days. If the hold is well-insulated (with the equivalent of 6 inches of urethane foam on the engine room bulkhead and 4 inches on other surfaces), 4 inches of ice on the bottom, sides, and engine room bulkhead should be adequate for a 2-day or 3-day fishing period. Each layer of fish should be only 1 fish deep, with enough ice to just cover each layer. When shelving is used, leave enough room for 2 inches of ice between fish and shelving boards. When the pen is full, 3 inches of top ice are plenty if fish are delivered to dock or tender winthin 24 to 72 hours after harvesting. Keep

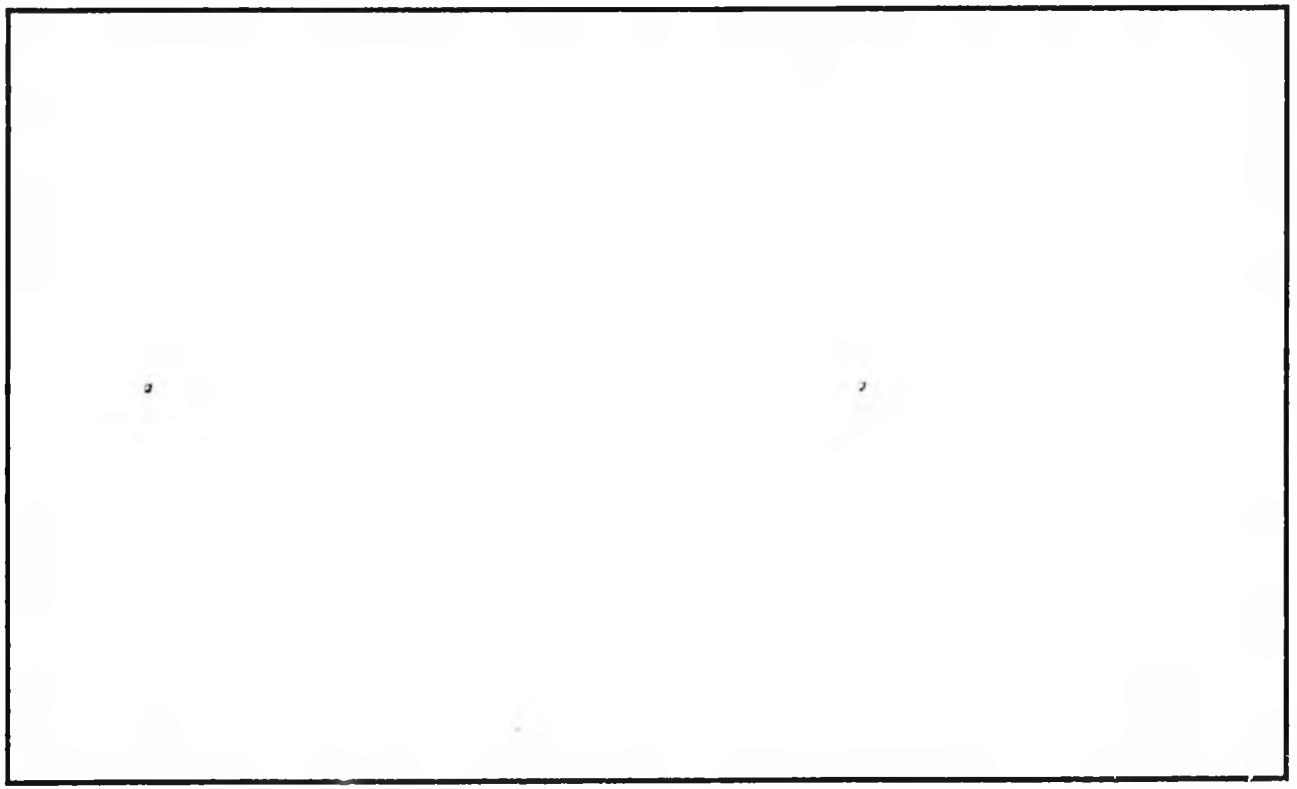
(Continued on page 39)



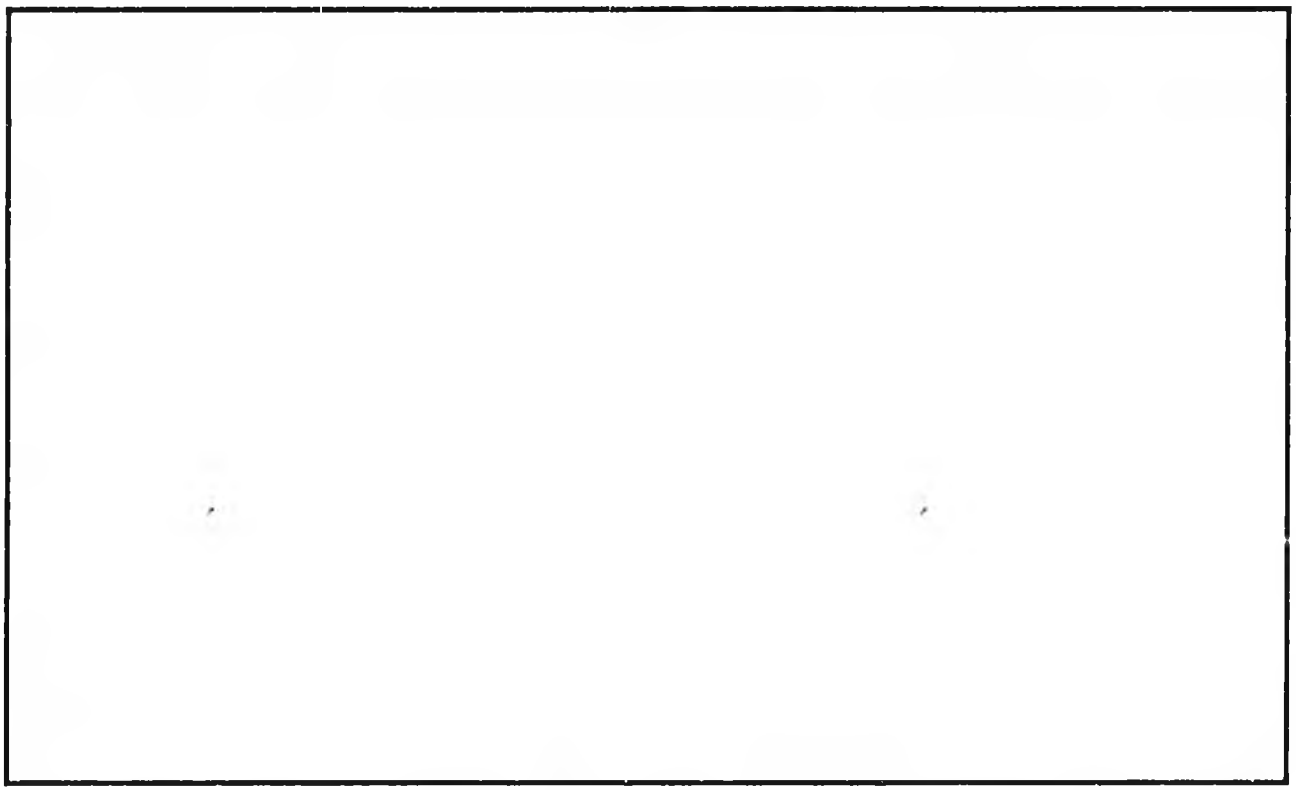
**Photograph 1.** Severe gaping is shown in the caudal peduncle area of a gillnet caught chum salmon. In this case, the gaping extended up the back of the collar region. This was a silver bright fish with no external sign of abuse. The belly cavity was clean with no marks, bruises, or damage.



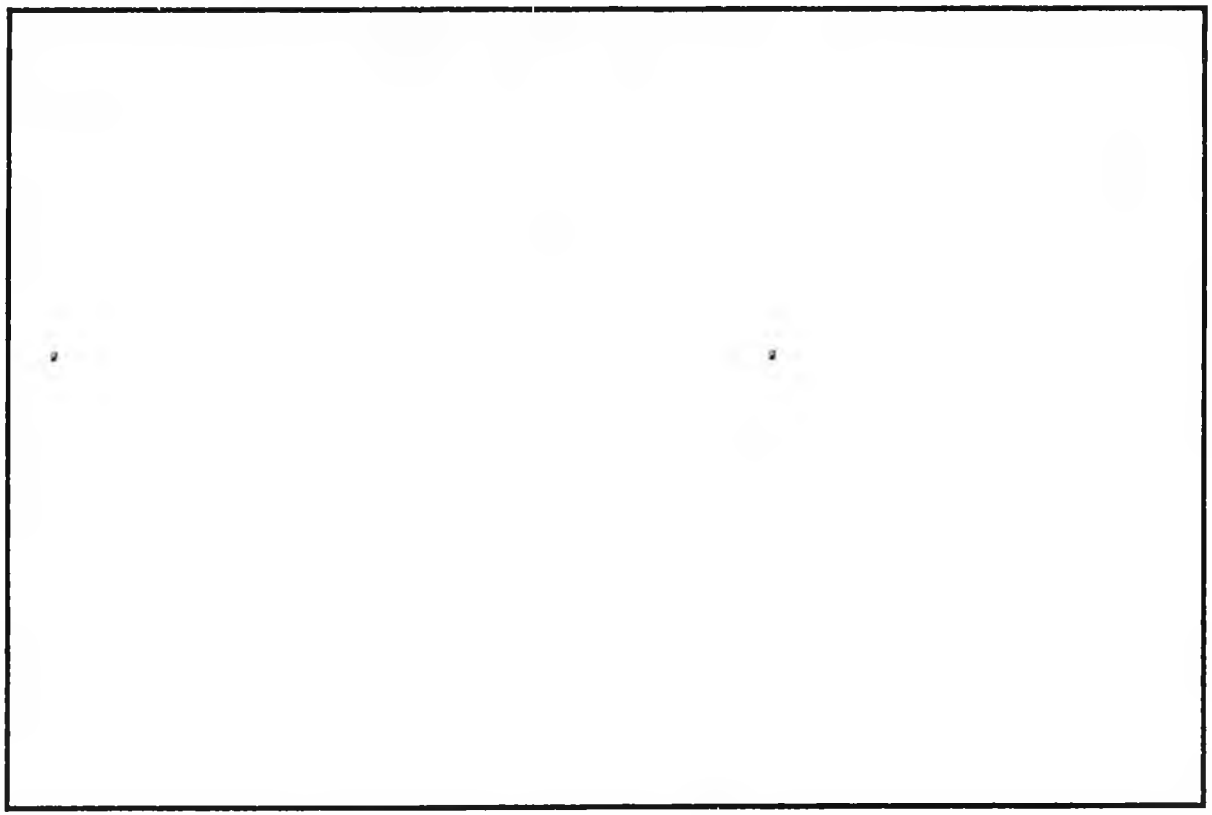
Photograph 2. The bruise in this area is typical for a broken backbone and probably was caused by handling the fish by the tail. Note the dark blood between the vertebrae.



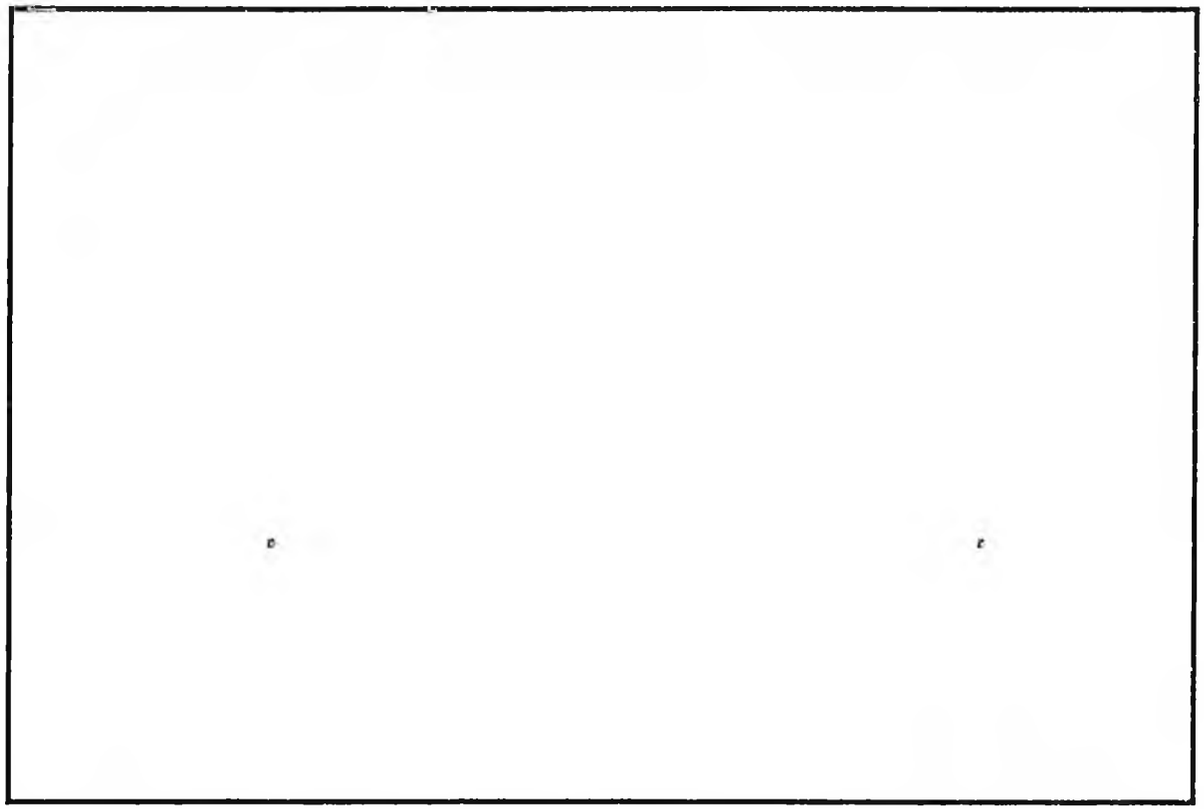
**Photograph 3.** No blood was obvious at the time this previously frozen sockeye salmon was split. The backbone was broken intentionally, and this photo was taken ten minutes later.



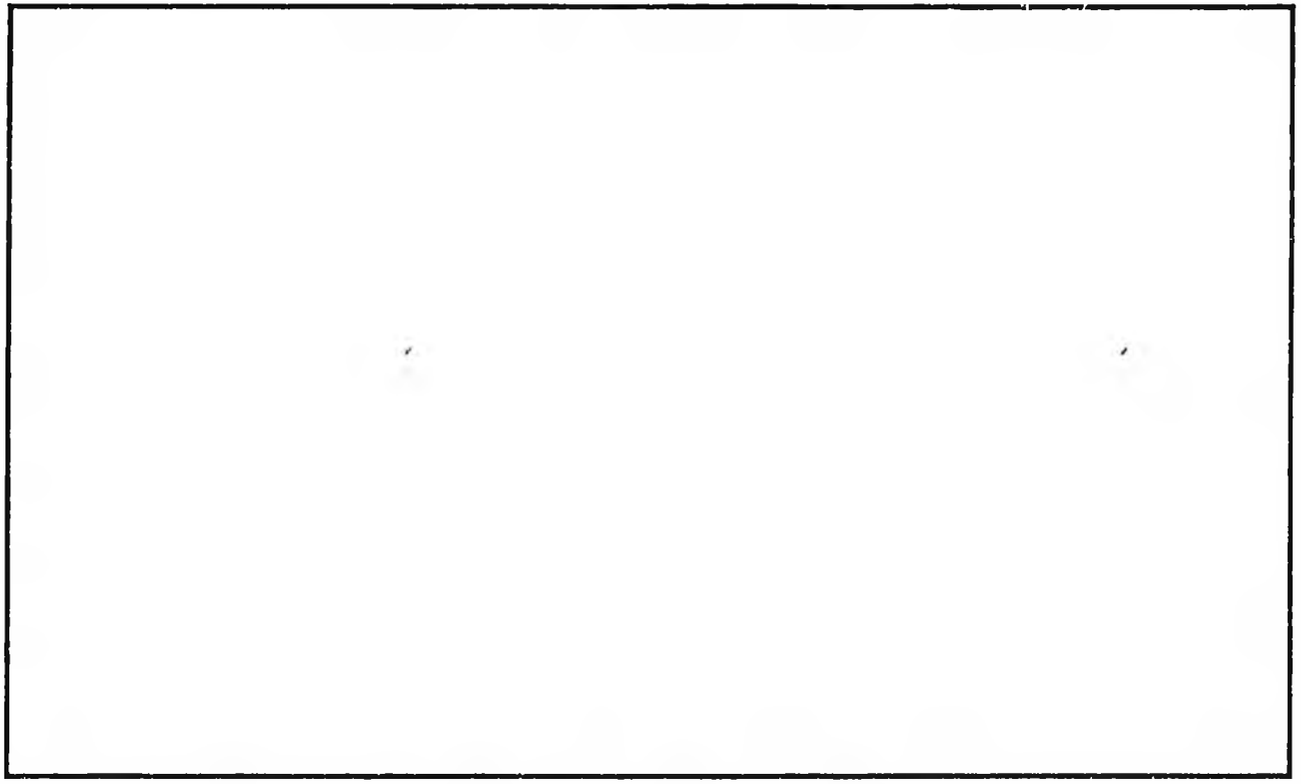
**Photograph 4.** Bruising by a gillnet along the dorsal vertebrae is shown in this photo. Most of these bruises are removed by minor trimming at the time the fish is split. The bruises do increase trim loss.



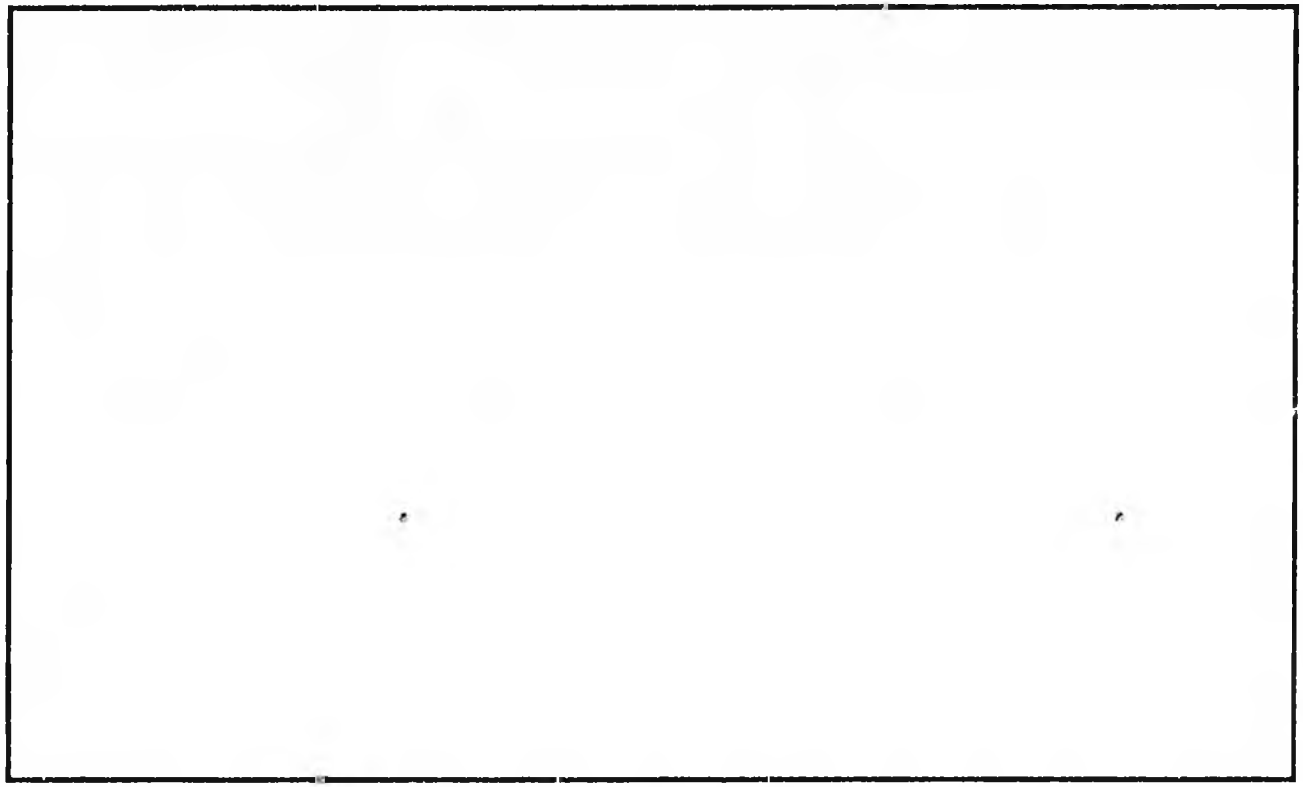
Photograph 5. A gillnet caused the bruise and broken back shown above. This fish has no market value.



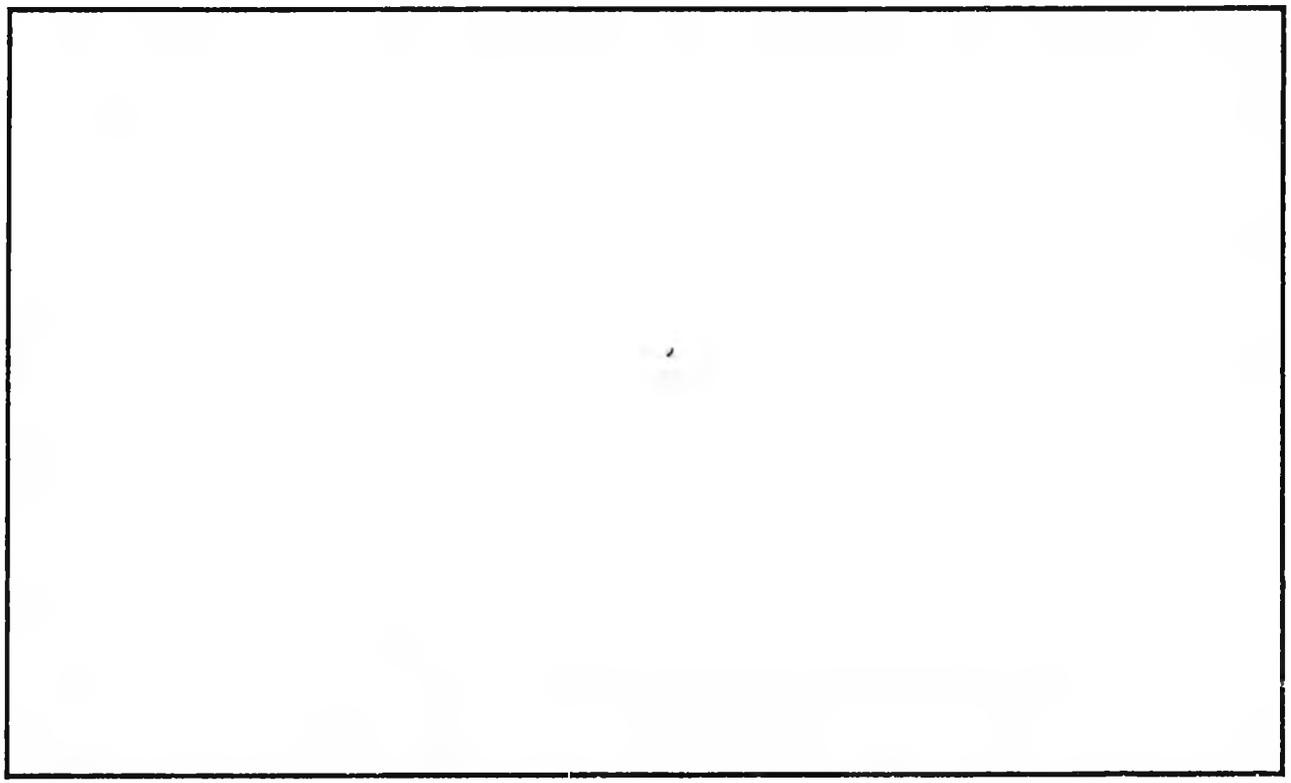
**Photograph 6.** The deep puncture wound in this troll caught king salmon was caused by gaffing the fish in the back. The bruise spread from the gaff wound.



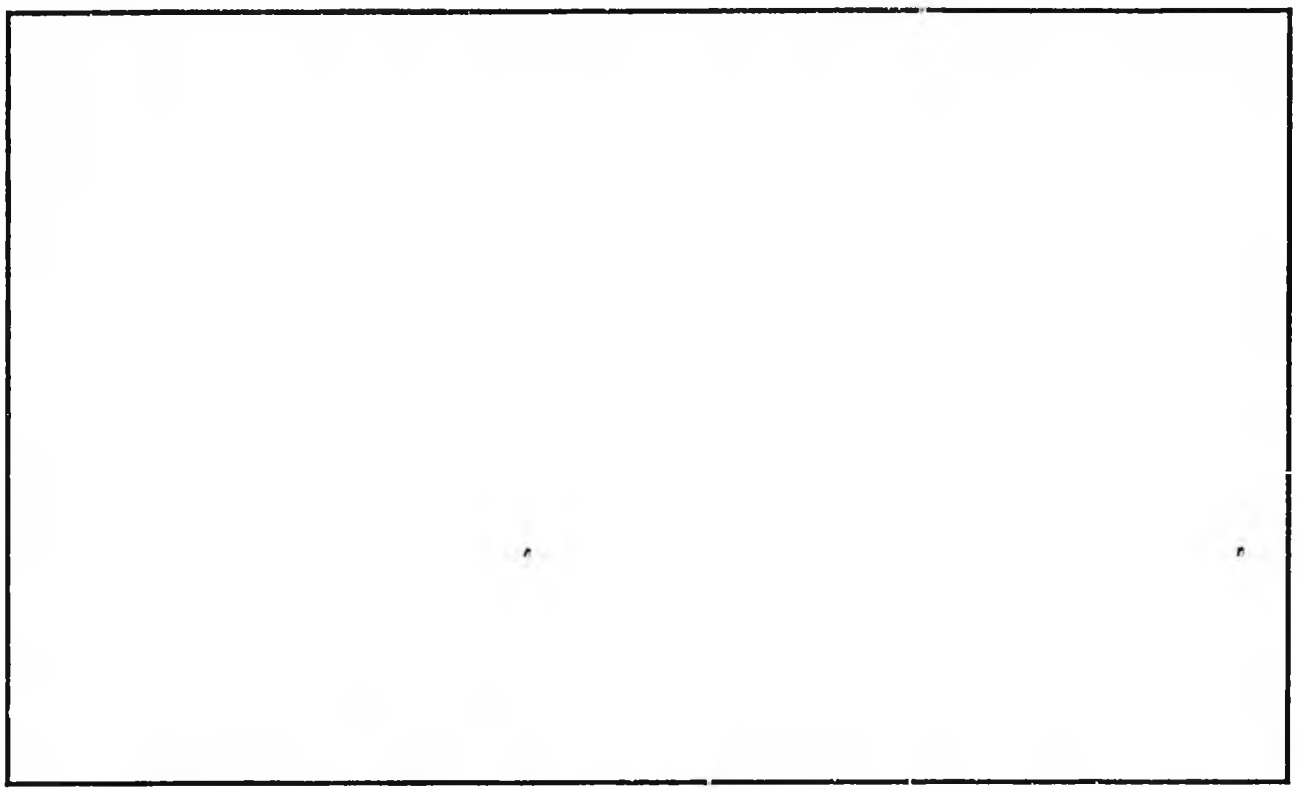
**Photograph 7.** The puncture wound in this sockeye salmon taken by gillnet in Cook Inlet during the 1990 season was made by a picking hook, pugh, or gaff.



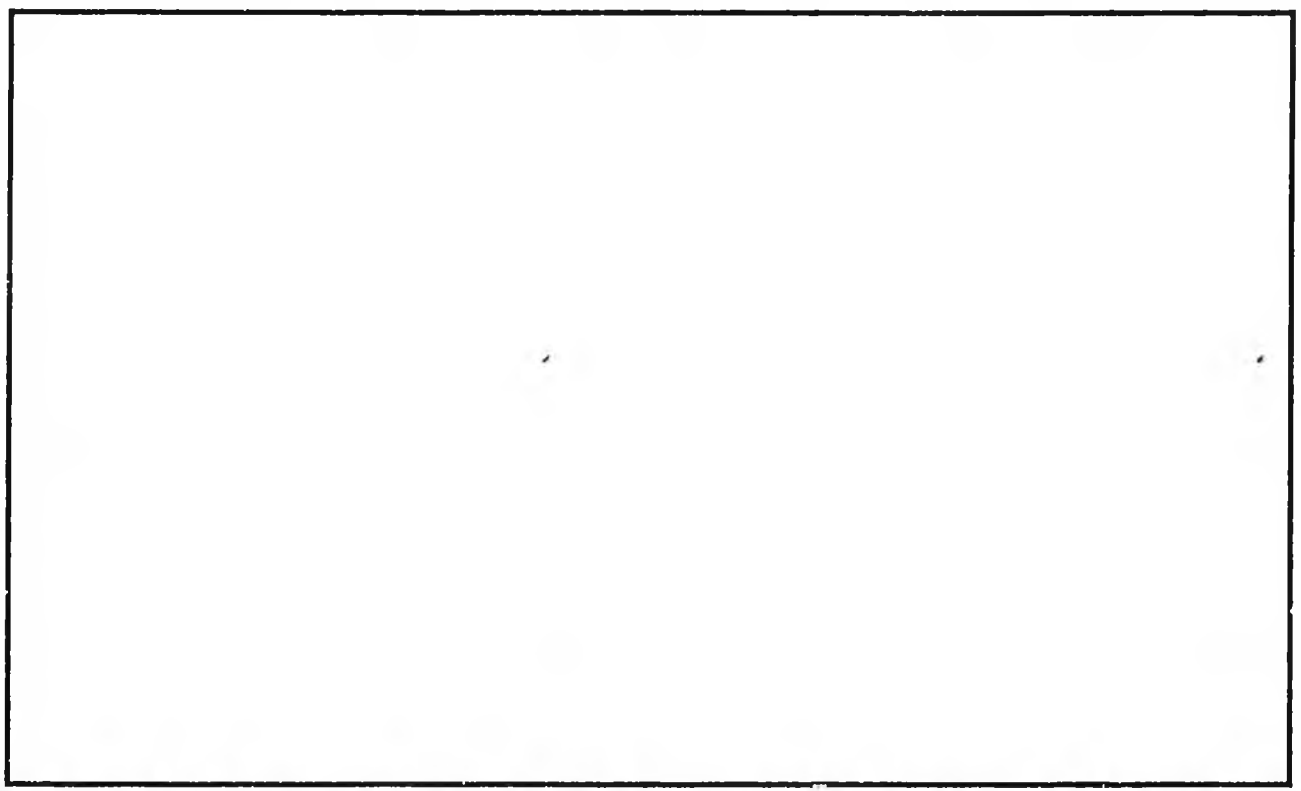
Photograph 8. Gaping, mushy flesh is shown in this sockeye salmon. The soft flesh hastened oxidation of the flesh posterior to the body cavity.



**Photograph 9.** Moderate belly burn is shown in a gillnet caught sockeye salmon. Note the evidence of poor workmanship in dressing the salmon.

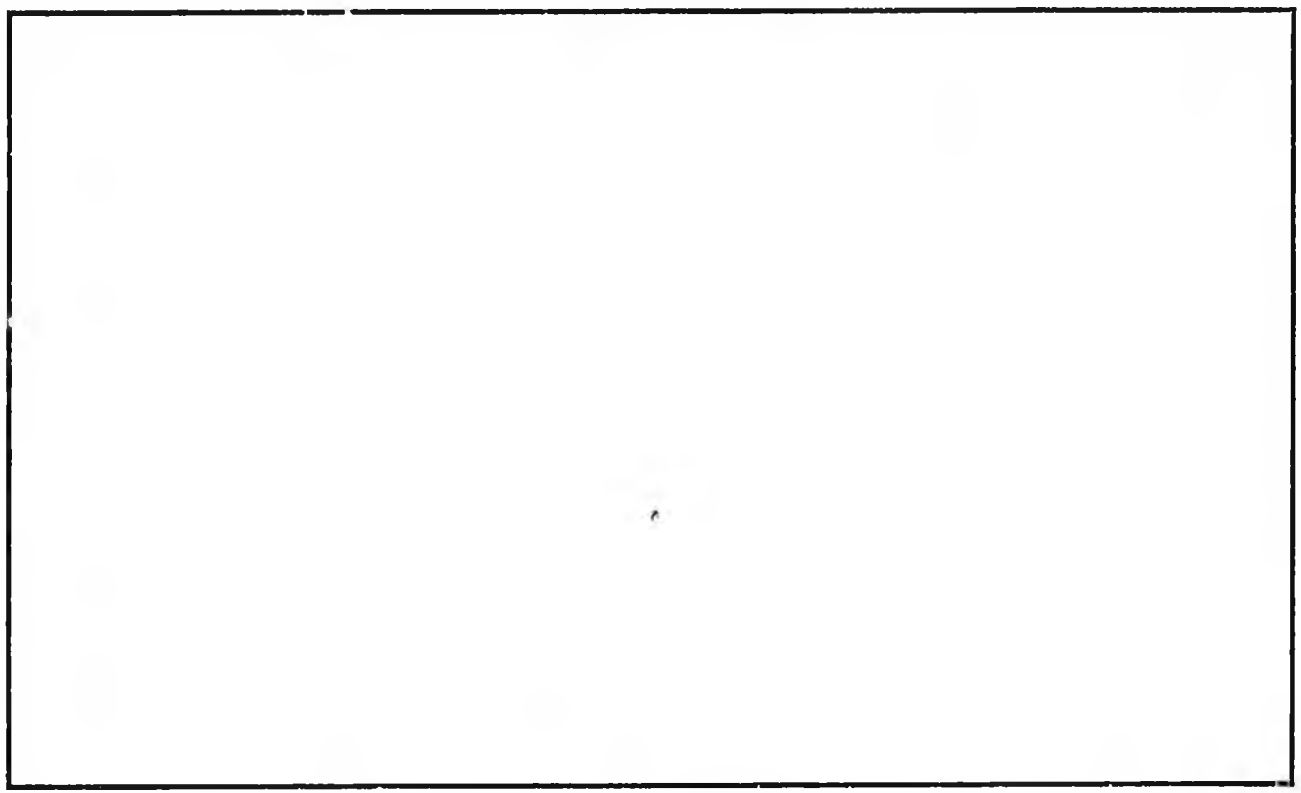


**Photograph 10.** The dry skin of these sunburned sockeye salmon will turn much darker on freezing. The tag on the fish indicates that they were embargoed by the U.S. Food and Drug Aministration (FDA) and condemned by the State of Alaska. Photo courtesy of the FDA.

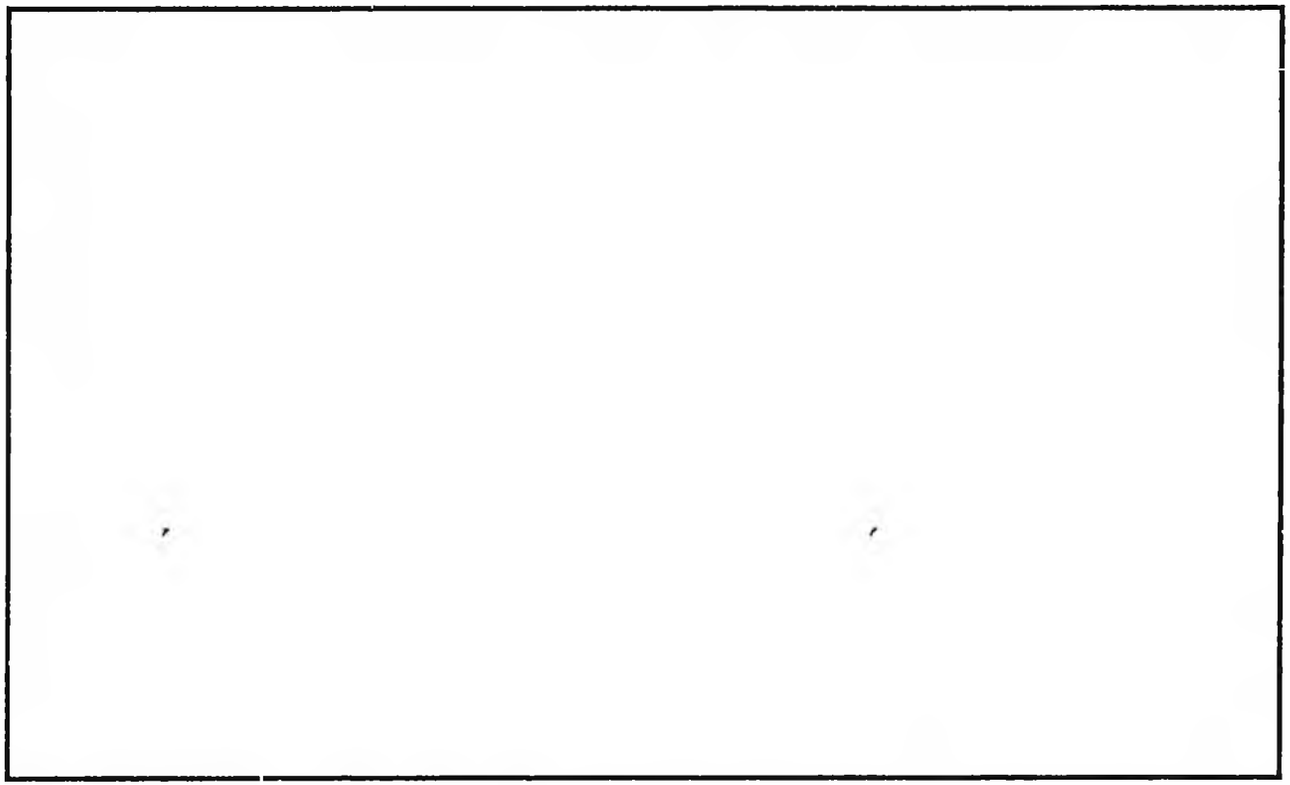


**Photograph 11.** The bruise on this troll caught king salmon was caused by a blow from a gaff when the fish was stunned.

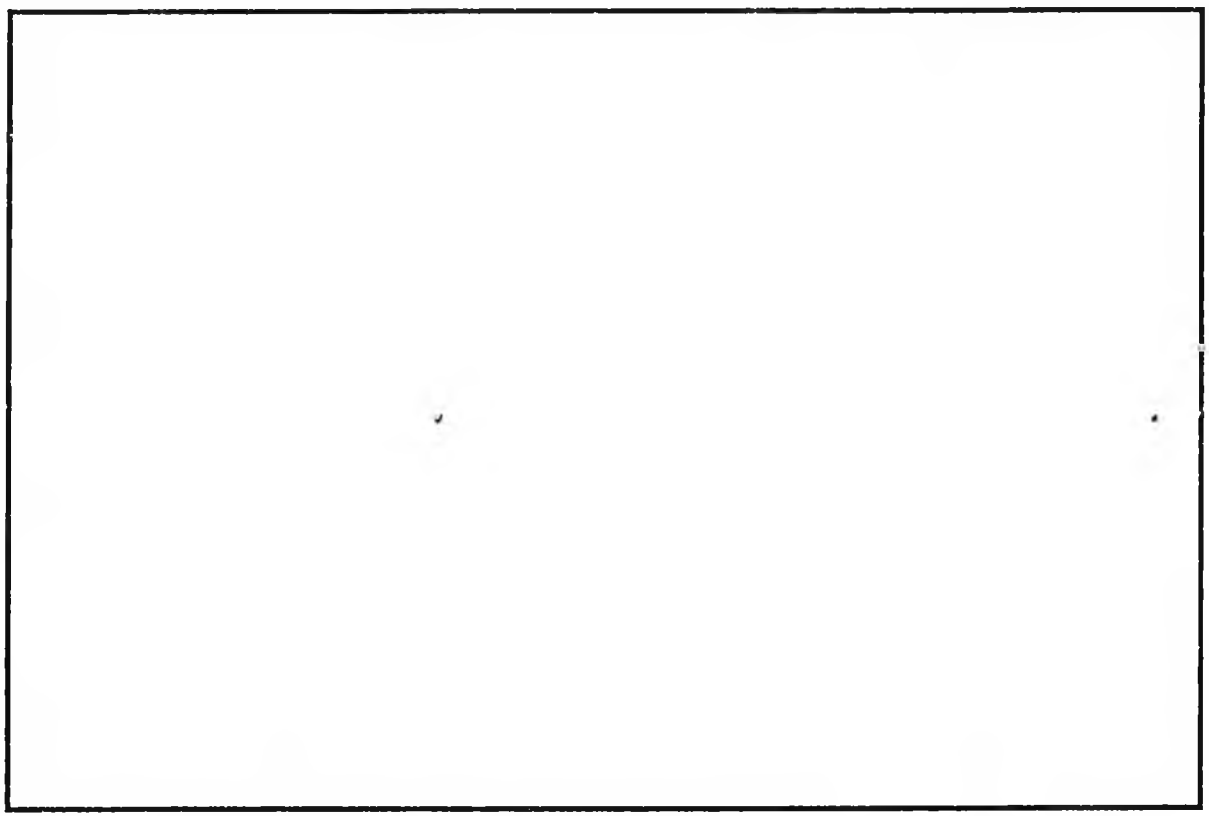
**Photograph 12.** This is a proper head cut of a frozen, troll caught king salmon. Photo courtesy of G. Baker and G. Gibbard.



**Photograph 13.** This is a poor head cut of a troll caught king salmon. The flesh exposed at the nape will increase the possibility of freezer burn. Photo courtesy of G. Baker and G. Gibbard.



Photograph 14. The bad body bruise on this sockeye salmon, harvested in a setnet in 1991, probably was caused by throwing or dropping it against a sharp surface. Note the gaping flesh, which is another indication of poor handling.



**Photograph 15.** Rough, multiple handling and pumping badly damaged these chum salmon harvested by purse seine off the west coast of Prince of Wales Island in 1990. Externally, the fish appeared to be of good quality. The entire lot of fish had to be destroyed.