HB

110

<TARGET><BILL>HB 110</BILL><SUBJECT>HB 110</SUBJECT><COMM>HFSH28</COMM></TARGET>

Alaska State Legislature

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REPRESENTATIVE PAUL SEATON
HOUSE DISTRICT 30

Sponsor Statement

HB 110

Recently, many runs of Chinook salmon have experienced poor returns. Fishery Disaster Declarations have been made for the Yukon, Kuskokwim, and Cook Inlet regions. People who depend on these king salmon for their economic, recreational, and cultural livelihood are experiencing great hardship due to this low abundance.

Sustainability is critically important and measures should be adopted that help protect Chinook salmon and similar vulnerable species while still maintaining fishing opportunities. One of the best ways to do this is to utilize fishing gear that reduces the mortality to species of concern while still allowing the utilization of healthy stocks.

The use of barbless hooks is proven to reduce the mortality of released fish. Studies by the Pacific Salmon Commission Technical Committee concluded that barbless hook usage reduced mortality by 3.5% in mature fish. A barbless hook is faster to remove and results in less trauma to the fish. This reduces handling and increases the chance a fish will survive to reproduce.

Some fly fishermen currently file the barbs off their hooks to allow a less damaging release of fish. Additionally, Washington and Oregon prohibit the use of barbed hooks while Chinook fishing because wild stock fish must be released while hatchery fish can be retained.

HB 110 would prohibit the use of barbed hooks for freshwater stocks of fish where retention is prohibited, that is in a catch and release fishery.

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LEGAL SERVICES

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MEMORANDUM March 11, 2013

SUBJECT: Location in statute of proposed bill
(CSHB 110( ) (Work Order No. 28-LS0360\N))

TO: Representative Paul Seaton
Attn: Louie Flora

FROM: Alpheus Bullard
Legislative Counsel

This memorandum accompanies the committee substitute Louie requested.

This committee substitute moves the statutory prohibition on the use of barbed hooks from AS 16.10 (Fisheries and Fishing Regulations) to AS 16.05 (Fish and Game Code and Definitions).

Louie asked that the penalties for a violation of the section's prohibition on the use of barbed hooks track those provided for the use of more than one hook in waters designated as single-hook waters (see 5 AAC 75.023). The prohibition against the use of more than one hook in single-hook waters is a regulation adopted by the Board of Fisheries under AS 16.05.251. To ensure that the same statutory sanctions that apply to violations of the single-hook regulation adopted by the board apply to this bill's barbed hook prohibition, I moved the bill's contents to AS 16.05.[1]

The related amendments you requested will be forthcoming, and will be drafted to the version of the bill that is enclosed.

If you have questions, please do not hesitate to contact me.

TLAB:ljw
13-155.ljw

Enclosure

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[1] *See* AS 16.05.410 (Revocation of license) and AS 16.05.925 (Penalty for violations).

Herron Moves

28-LS0360\N
Bullard
3/11/13

CS FOR HOUSE BILL NO. 110( )

IN THE LEGISLATURE OF THE STATE OF ALASKA

TWENTY-EIGHTH LEGISLATURE - FIRST SESSION

BY

Offered:
Referred:

Sponsor(s): REPRESENTATIVES SEATON, Gara

A BILL

FOR AN ACT ENTITLED

"An Act prohibiting the use of barbed hooks in certain freshwater areas."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* **Section 1.** AS 16.05 is amended by adding a new section to read:

Sec. 16.05.422. Prohibition on the use of barbed hooks. (a) A person may not use a barbed hook when participating in a freshwater fishery for a species that may not be retained under a regulation adopted by the Board of Fisheries.

(b) A person may not use a barbed hook when participating in a freshwater fishery in which more than one species is present if there is a significant probability of catching a species that may not be retained under a regulation adopted by the Board of Fisheries.

(c) Whether there is a significant probability of catching a species that may not be retained may be determined by the Board of Fisheries or by emergency order issued by the commissioner under AS 16.05.060.

28-LS0360\N.1
Bullard
3/11/13

AMENDMENT #1 Adopted

OFFERED IN THE HOUSE BY REPRESENTATIVE SEATON

TO: CSHB 110( ), Draft Version "N"

Page 1, following line 13:

Insert a new subsection to read:

"(d) In this section, "barbed hook" means a hook with at least one subsidiary point facing in the opposite direction of the main point of the hook; "barbed hook" does not include a hook from which all barbs have been pinched down, filed off, or otherwise removed."

AMENDMENT #2 Adopted

OFFERED IN THE HOUSE BY REPRESENTATIVE SEATON

TO: CSHB 110( ), Draft Version "N"

Page 1, following line 13:

Insert a new subsection to read:

"(d) In this section,

(1) "freshwater" means all inland water;

(2) "inland water" means water separated from salt water at the mouths of creeks and streams and rivers at a line between the extremities of a river's banks at a mean low tide or at a point to be determined and adequately marked by the department."

HB 110 would also prohibit the use of barbed hooks when there is a significant probability that there will be bycatch of stocks whose retention is prohibited.

This would allow mixed runs to continue to be fished recreationally while helping maintain the continued sustainability of stocks. The use of barbless hooks will help protect our fisheries resources in times of low abundance while avoiding complete fishery closures.

Barbless Hooks: Decreases Incidental catch (wear and tear) on species of low abundance

Fishery disaster declarations

- Yukon River
- Kuskokwim River
- Cook Inlet

Significant concern

- Kenai, saved only by the late run
- Copper River, increased restrictions

Facing further threats in stream

- Invasive pike, Alexander Creek
- Impaired waters

Resulted in user group hardship

- Subsistence, hurts culture and economy
- Commercial, hurts livelihood and economy
- Sport/Personal, hurts wellbeing and economy
- Failed Pacific Salmon treaty obligations

Tool to bridge gap while research is done

- 2.6% to 3.5 % reduction in post release mortality according to Pacific Salmon Joint Chinook Technical Committee
- Reduces handling of fish

Helps maintain fishing opportunities and reduce mortality

- Even with only a 2% reduction in mortality, this means hundreds of fish will survive to spawn
- Help avoid complete closures

Existing Precedent

- Washington and Oregon have already done this
- ADF&G already recommends for catch and release

Barbless Hook Overview

On the pacific coast of the United States many salmon runs are threatened relative to the runs we have here in Alaska. As a result, Washington, Oregon, and California have implemented measures to protect them. In addition to reducing fishing opportunities and bag limits, they have also undertaken efforts to reduce catch and release mortality in their remaining fisheries. A major part of this is gear restrictions. One aspect of this is mandating the use of barbless hooks for many marine and freshwater salmon fisheries. According to three scientific studies given to me by the Washington Department of Fish and Wildlife, the mortality reduction from barbless hook usage appears to average 3-4%.

- All of Washington's marine salmon fisheries use barbless hooks.
- Many of Washington's river salmon fisheries use barbless hooks, especially during the summer.
- The large Columbia River salmon fishery requires barbless hooks in both Washington and Oregon.
- Many salmon fisheries in northwest Oregon, both freshwater and marine, require barbless hooks.
- Even where it is not required, Oregon advises barbless hooks in any fishery where catch and release is expected.
- The vast majority of California's marine salmon fisheries require barbless hooks.
- Most of California's freshwater salmonid fisheries require barbless hooks.
- In Washington, Oregon, and California, a major contributor to the usage of barbless hooks is the requirement for hatchery fish to be released.

When I talked to WDFW, they considered barbless hooks to be a relatively insignificant part of their mortality reduction measures. They considered the use of artificial lures instead of bait to be significantly more important. This is supported by the information in the studies they gave us. Hooking location has much more to do with mortality regardless of the hook type used. To help further reduce the possibility of deep and more lethal hooking locations, California has mandated circle hooks in some marine salmon fisheries as they are more likely to pull up and catch in the jaw area of the fish.

Rapid landing, knotless nets, and gentle handling also play very significant roles in post release mortality levels.

Fiscal Note

State of Alaska
2013 Legislative Session

Bill Version: HB 110
Fiscal Note Number:
() Publish Date:

Identifier: HB110-DFG-BAC-02-15-13
Title: BARBED HOOKS
Sponsor: SEATON
Requester: House Special Committee on Fisheries

Department: Department of Fish and Game
Appropriation: Administration and Support
Allocation: Fish and Game Boards and Advisory Committees
OMB Component Number: 2825

Expenditures/Revenues

Note: Amounts do not include inflation unless otherwise noted below. (Thousands of Dollars)

	FY2014 Appropriation Requested	Included in Governor's FY2014 Request	Out-Year Cost Estimates				
OPERATING EXPENDITURES	**FY 2014**	**FY 2014**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**
Personal Services							
Travel							
Services							
Commodities							
Capital Outlay							
Grants & Benefits							
Miscellaneous							
Total Operating	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Fund Source (Operating Only)

None							
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Positions

Full-time							
Part-time							
Temporary							

Change in Revenues							

Estimated SUPPLEMENTAL (FY2013) cost: 0.0

Estimated CAPITAL (FY2014) cost: 0.0

ASSOCIATED REGULATIONS

Does the bill direct, or will the bill result in, regulation changes adopted by your agency? No
If yes, by what date are the regulations to be adopted, amended or repealed?

Why this fiscal note differs from previous version:

This is the initial version.

Prepared By:	Monical Wellard, Executive Director	Phone:	(907)465-6095
Division	Boards Support Secion	Date:	02/15/2013 02:30 PM
Approved By:	Kevin Brooks, Deputy Commissioner	Date:	02/15/13
	Alaska Department of Fish and Game		

FISCAL NOTE ANALYSIS

STATE OF ALASKA
2013 LEGISLATIVE SESSION

BILL NO. HB 110 \U

Analysis

HB 110 prohibits the use of barbed hooks in freshwater fisheries when participating in a fishery for a species that may not be retained or when participating in a fishery in which more than one species is present if there is a significant probability of catching a species that may not be retained. It is anticipated that the Board of Fisheries would address any regulations needed by the passage of this bill during the established meeting cycle in place.

Rule 43.2. Fish and Game Bail Forfeiture Schedule.

Pursuant to AS 16.05.165(b), the following fish and game offenses are appropriate for disposition without court appearance upon payment and forfeiture of the bail amounts listed and forfeiture of all seized items listed on the citation. If a person charged with one of these offenses appears in court and is found guilty, the fine imposed for the offense may not exceed the bail amount for that offense listed below. In addition, fish, game, or equipment may be forfeited under AS 16.05.190 or AS 16.05.195. An offense for which a bail forfeiture amount has been established shall be charged on a citation which meets the requirements of District Court Criminal Rule 8(c) and shall not be filed, numbered, or processed as a criminal case.

Statute or Regulation	Description of Offense	Bail
AS 16.05.330(a)(1)	Sport fishing without license in possession	$200
AS 16.05.330(a)(2)	Hunting without license in possession	250
AS16.05.340(a)(17)(A)	Taking waterfowl without state duck stamp	75
AS 16.05.340(a)(23)	King salmon stamp required for residents	100
AS 16.05.340(a)(24)	King salmon stamp required for non-residents	200
AS 16.05.420	False statement on license application	300
AS 16.05.480(a)	Crewmember fishing license required	250
AS 16.05.490(a)	Vessel license required	200
AS 16.05.520(a)	Vessel number plate	100
AS 16.05.680(1)	Employ unlicensed crew member	250
5 AAC 01.010(h)	Identification of subsistence finfish fishing gear	100
5 AAC 01.010(i)	Escape mechanism requirements for subsistence fishing gear	100
5 AAC 01.011(i)	Failure to record subsistence catch on proxy form	100
5 AAC 01.015(b)(5)	Failure to record daily catch on subsistence permit (finfish Statewide)	100
5 AAC 01.240(c)	Marking of subsistence taken king salmon (lower Yukon River)	100
5 AAC 01.630(e)(8)	Failure to record salmon on subsistence permit (Glennallen Subdistrict)	100
5 AAC 01.640	Failure to mark subsistence taken salmon (Copper River Districts)	100
5 AAC 01.750	Subsistence fishing from a vessel with greater than 35 HP motor (Klawock Inlet, Southeast Alaska)	150
5 AAC 02.010(e)(1-2)	Identification of subsistence shellfish gear	100
5 AAC 02.010(f)	Escape mechanism requirements for subsistence shellfish pots	100
5 AAC 02.015(a)(5)	Failure to record daily catch on subsistence permit (shellfish Statewide)	100
5 AAC 02.307	Unlawful tanner crab subsistence fishing gear (Cook Inlet)	100
5 AAC 02.310(b)(2)	Subsistence – bag, possession and size limits for littleneck and butter clams (Cook Inlet)	100 plus 1 per illegally taken clam
5 AAC 02.325	Subsistence – tanner crab season, bag, possession and size limits—permit required—recording required (Cook Inlet)	100 plus 20 per illegally taken crab
5 AAC 02.415(a)	Take overlimit/undersized or female Dungeness crab (Kodiak)	100 plus 20 per illegally taken crab
5 AAC 02.506	Take king or tanner crab without subsistence permit, failure to record catch immediately (AK Peninsula and Aleutian Islands)	100
5 AAC 02.515	Take overlimit/undersized or female Dungeness crab (AK Peninsula and Aleutian Islands)	100 plus 20 per illegally taken crab
5 AAC 02.520	Take overlimit/undersized or female king crab, unattended pots to be secured open (AK Peninsula and Aleutian Islands)	100 plus 50 per illegally taken crab
5 AAC 02.525	Take overlimit/undersized or female Tanner crab (AK Peninsula and Aleutian Islands)	100 plus 20 per illegally taken crab
5 AAC 05.334(a)	ID requirements for commercial salmon drift gillnets (Yukon River)	200
5 AAC 05.334(b)	ID requirements for commercial salmon stationary gear (Yukon River)	200
5 AAC 05.340	Failure to display vessel identification (Yukon River)	200
5 AAC 06.331(q)	Unlit set/drift net (Bristol Bay)	250
5 AAC 06.334(c)	Set gillnet buoy and marking requirements (Bristol Bay)	250
5 AAC 07.334(a)	ID requirements for commercial salmon drift gillnets (Kuskokwim River)	200
5 AAC 07.334(b)	ID requirements for commercial salmon stationary gear (Kuskokwim River)	200
5 AAC 07.340	Vessel Identification (Kuskokwim River)	200
5 AAC 28.135(a)(1-4)	Vessel Identification – D and M	200

Statute or Regulation	Description of Offense	Bail
5 AAC 29.125	Vessel Identification – HT	200
5 AAC 30.334	Identification of set gillnet (Yakutat)	200
5 AAC 39.119(a)(1-4)	Vessel Identification – 12 inch numbers	200
5 AAC 47.020	Sport fishing – general seasons, bag, possession, annual and size limits (salt water, Southeast Alaska)	100 plus 150 per king salmon illegally taken, 50 per halibut or lingcod, 20 per other fish, 20 per crab, and 2 per razor clam
5 AAC 47.021	Sport fishing – special provisions, seasons, bag, possession, and size limits (salt water, Southeast Alaska)	100 plus 150 per king salmon illegally taken, 50 per halibut or lingcod, 20 per other fish, 20 per crab, and 2 per razor clam
5 AAC 47.022	Sport fishing – general seasons, bag, possession, annual and size limits (freshwater, Southeast Alaska)	100 plus 150 per king salmon illegally taken, 20 per other fish
5 AAC 47.023	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwater, Southeast Alaska)	100 plus 150 per king salmon illegally taken, 20 per other fish
5 AAC 47.024(a)(3)	Failure to record king salmon landing (Southeast Alaska)	100
5 AAC 47.024(c)(3)	Failure to record steelhead landing (Southeast Alaska)	100
5 AAC 47.030(g)	Maximum number of fishing lines from a charter vessel (Southeast Alaska)	300
5 AAC 47.030(i)	Use of bait in freshwater (Southeast Alaska)	100
5 AAC 52.022	Sport fishing – general seasons, bag, possession, annual and size limits (Upper Copper River and Upper Susitna River)	100 plus 150 per king salmon illegally taken, 20 per other fish
5 AAC 52.023	Sport fishing – special provisions, seasons, bag, possession, and size limits (Upper Copper River and Upper Susitna River)	100 plus 150 per king salmon illegally taken, 20 per other fish
5 AAC 52.024(b)	Failure to record king salmon landing (Upper Copper River and Upper Susitna River)	100
5 AAC 55.022	Sport fishing – general seasons, bag, possession, and size limits (Prince William Sound)	100 plus 150 per king salmon illegally taken, 50 per halibut or lingcod, and 20 per other fish
5 AAC 55.023	Sport fishing – special provisions, seasons, bag, possession, and size limits (Prince William Sound)	100 plus 150 per king salmon illegally taken, 50 per halibut or lingcod, and 20 per other fish
5 AAC 56.120	Sport fishing – general seasons, bag, possession, and size limits (freshwaters, Kenai Peninsula Area, excluding Kenai River Drainage Area)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 56.122	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwaters, Kenai Peninsula Area, excluding Kenai River Drainage Area)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 56.124(a)(2)	Failure to record king salmon landing (freshwaters, Kenai Peninsula Area, excluding Kenai River Drainage Area)	100
5 AAC 56.124(b)(2)	Failure to record rainbow/steelhead trout landing (freshwaters, Kenai Peninsula Area, excluding Kenai River Drainage Area)	100
5 AAC 57.120	Sport fishing – general seasons, bag, possession, and size limits (freshwaters, Kenai River Drainage Area)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 57.121	Sport fishing – special provisions, seasons, bag,	100 plus 150 per

Statute or Regulation	Description of Offense	Bail
	possession, and size limits (freshwaters, Kenai River Drainage Area Lower Section)	king salmon illegally taken and 20 per other fish
5 AAC 57.122	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwaters, Kenai River Drainage Area Middle Section)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 57.123	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwaters, Kenai River Drainage Area Upper Section)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 57.124(a)(2)	Failure to record king salmon landing (freshwaters, Kenai River Drainage Area)	100
5 AAC 57.124(b)(2)	Failure to record rainbow/steelhead trout landing (freshwaters, Kenai River Drainage Area)	100
5 AAC 57.180(c-d)	Sport fishing – Riparian habitat bank closures (freshwaters, Kenai River Drainage Area)	75
5 AAC 58.022	Sport fishing – waters, seasons, bag, possession, size limits, and special provisions (Cook Inlet – Resurrection Bay saltwater)	100 plus 150 per king salmon illegally taken, 50 per halibut or lingcod, 20 per other fish, 20 per crab, 2 per razor clam, and 1 per littleneck or butter clam
5 AAC 58.024(a)(2)	Failure to record king salmon landing (Cook Inlet – Resurrection Bay saltwater)	100
5 AAC 58.026(a)	Failure to record crab on harvest record (Cook Inlet – Resurrection Bay saltwater)	100
5 AAC 58.030(c)	Snagging or attempting to snag where prohibited (Cook Inlet north of a line extending west from Anchor Point)	125
5 AAC 58.030(d)	Snagging or attempting to snag where prohibited (saltwater of the Homer Spit, fishery enhancement lagoon)	125
5 AAC 58.035(b-g)	Shellfish methods and means (Cook Inlet – Resurrection Bay saltwater)	100
5 AAC 59.120	Sport fishing – general seasons, bag, possession, and size limits (freshwaters, Anchorage Bowl Drainages Area)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 59.122	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwaters, Anchorage Bowl Drainages Area)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 59.124(a)(2)	Failure to record king salmon landing (freshwaters, Anchorage Bowl Drainages area)	100
5 AAC 59.124(b)(2)	Failure to record rainbow/steelhead trout landing (freshwaters, Anchorage Bowl Drainages Area)	100
5 AAC 60.120	Sport fishing – general seasons, bag, possession, and size limits (freshwaters, Knik Arm Drainages Area)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 60.122	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwaters, Knik Arm Drainages Area)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 60.124(a)(2)	Failure to record king salmon landing (freshwaters, Knik Arm Drainages Area)	100
5 AAC 60.124(b)(2)	Failure to record rainbow/steelhead trout landing (freshwaters, Knik Arm Drainages Area)	100
5 AAC 61.110	Sport fishing – general seasons, bag, possession, and size limits (freshwaters, Susitna River Drainage Area)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 61.112	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwaters, Susitna River Drainage Area Unit 1)	100 plus 150 per king salmon illegally taken and 20 per other fish

Statute or Regulation	Description of Offense	Bail
5 AAC 61.114	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwaters, Susitna River Drainage Area Unit 2)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 61.116	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwaters, Susitna River Drainage Area Unit 3)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 61.118	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwaters, Susitna River Drainage Area Unit 4)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 61.120	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwaters, Susitna River Drainage Area Unit 5)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 61.122	Sport fishing – special provisions, seasons, bag, possession, and size limits (freshwaters, Susitna River Drainage Area Unit 6)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 61.123	Sport fishing – restrictions on fishing after taking king salmon (freshwaters, Susitna River Drainage Area)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 61.124(a)(2)	Failure to record king salmon landing (freshwaters, Susitna River Drainage Area)	100
5 AAC 61.124(b)(2)	Failure to record rainbow/steelhead trout landing (freshwaters, Susitna River Drainage Area)	100
5 AAC 62.120	Sport fishing – general seasons, bag, possession, and size limits (freshwaters, West Cook Inlet Area)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 62.122	Sport fishing – special provisions, bag, possession, and size limits (freshwaters, West Cook Inlet Area)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 62.124(a)(2)	Failure to record king salmon landing (freshwaters, West Cook Inlet Area)	100
5 AAC 62.124(b)(2)	Failure to record rainbow/steelhead trout landing (freshwaters, West Cook Inlet Area)	100
5 AAC 64.022	Sport fishing – waters, seasons, bag, possession, size limits, and special provisions (Kodiak)	100 plus 150 per king salmon illegally taken, 50 per halibut or lingcod, 20 per other fish, and 20 per crab
5 AAC 64.025(a)(2)	Failure to record king salmon landing (Kodiak fresh water)	100
5 AAC 64.025(c)(2)	Failure to record rainbow/steelhead trout landing (Kodiak)	100
5 AAC 65.010	Sport fishing – seasons (AK Peninsula and Aleutian Islands)	100 plus 150 per illegally taken king salmon, 50 per halibut or lingcod, and 20 per crab
5 AAC 65.020	Sport fishing – bag, possession, and size limits (AK Peninsula and Aleutian Islands)	100 plus 150 per illegally taken king salmon, 50 per halibut or lingcod, 20 per other fish, and 20 per crab
5 AAC 65.022	Sport fishing – special provisions for methods and means (AK Peninsula and Aleutian Islands)	100 plus 150 per illegally taken king salmon, and 20 per other fish
5 AAC 65.024(b)(2)	Failure to log king salmon or Rainbow/steelhead landing (AK Peninsula and Aleutian Islands)	100

Statute or Regulation	Description of Offense	Bail
5 AAC 67.020	Sport fishing – bag, possession, and size limits (Bristol Bay)	100 plus 150 per king salmon illegally taken, 50 per halibut or lingcod, 20 per other fish, and 20 per crab
5 AAC 67.022	Sport fishing – special provisions for seasons, bag, possession, size limits, and methods and means (Bristol Bay)	100 plus 150 per king salmon illegally taken
5 AAC 67.024(b)(2)	Failure to record king salmon landing (Bristol Bay)	100
5 AAC 69.110	Sport fishing – seasons, bag, possession, and size limits (North Slope)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 70.011	Sport fishing – seasons, bag, possession, and size limits (Northwestern)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 70.024(b)(2)	Failure to record king salmon landing (Unalakleet River)	100
5 AAC 71.010	Sport fishing – seasons, bag, possession, and size limits (Kuskokwin-Goodnews)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 71.024(a)(2)	Failure to record king salmon landing (Aniak River)	100
5 AAC 71.024(b)(2)	Failure to record rainbow trout landing (Kisaralik, Kwethluk, Kasigluk, and Arolik Rivers)	100
5 AAC 73.010	Sport fishing – seasons, bag, possession, and size limits (Yukon River)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 74.010	Sport fishing – seasons, bag, possession, and size limits (Tanana River)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 75.006(a)(2)	Failure to record finfish landing established by regulation or emergency order (statewide)	100
5 AAC 75.011(i)	Failure to record sport fishing catch on proxy form	100
5 AAC 75.012(b)(4)	Fail to record shark landing	100
5 AAC 75.020	Sport fishing with more than one line	100
5 AAC 75.021	More than 2 lines, hooks, or lures while ice fishing	50
5 AAC 75.022(a)(1)	Using fixed or weighted hook – freshwater	100
5 AAC 75.022(a)(2)	Multiple hook with gap larger than ½" – freshwater	100
5 AAC 75.022(a)(3-4)	Unauthorized use of spear or arrow – sport fishing in fresh water	100
5 AAC 75.022(c)	Attempt to snag or fail to release snagged fish – freshwater	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 75.023(a-b)	Illegal gear in single-hook waters	50
5 AAC 75.035(1)	ID requirements for shellfish sport fishing gear	100
5 AAC 75.035(2)	Escape mechanism requirements for shellfish sport fishing gear	100
5 AAC 75.050(a-b)	Sport fishing in closed waters	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 75.070(b)	Filleting or disfiguring halibut to prevent determination of number of fish caught or possessed	200
5 AAC 75.075(c)	Failure to have required licenses and documents in possession (sport fish guiding Statewide)	200
5 AAC 75.076(c)	Failure to complete log book as required (sport fish guiding Statewide)	200
5 AAC 75.076(e)	Failure to submit logbook (sport fish guiding Statewide)	200
5 AAC 75.077(b)	Failure to display guide boat decals or annual stickers (sport fish guiding State-wide)	100
5 AAC 77.010(a)	Sport fish license required for personal use fishing	200

Statute or Regulation	Description of Offense	Bail
5 AAC 77.010(d)	ID requirements for personal use fishing gear	100
5 AAC 77.010(f)	Marking of personal use fish	75
5 AAC 77.010(m)	Escape mechanism requirements for personal use fishing	100
5 AAC 77.015(c)	Personal use permits and report requirements	200
5 AAC 77.016(i)	Failure to record personal use catch on proxy form	100
5 AAC 77.507	Shellfish pot permit required – recording required (Cook Inlet)	100
5 AAC 77.509(a-d)	Illegal gear for shellfish (Cook Inlet)	100
5 AAC 77.516	Tanner crab – seasons, bag, possession, and size limits (Cook Inlet)	100 plus 20 per illegally taken crab
5 AAC 77.518(2)(A)	Over limit of razor clams (From the terminus of the Kenai River to southernmost tip of Homer Spit)	100 plus 2 per clam illegally taken
5 AAC 77.518(2)(B-C)	Bag, possession, and size limits for littleneck and butter clams (Cook Inlet)	100 plus 1 per clam illegally taken
5 AAC 77.525(c)	Take overlimit salmon (Cook Inlet)	100 plus 150 per king salmon illegally taken and 20 per other fish
5 AAC 77.527(2)(A-B)	Take smelt during a closed period (Cook Inlet)	100
5 AAC 77.540(a)	Personal use permit required (Upper Cook Inlet)	200
5 AAC 77.540(a)(2)	Failure to record salmon on personal use permit (Upper Cook Inlet)	100
5 AAC77.540(c)(1)(A)	Take salmon during closed period (Kenai River)	100 plus $5 per minute early or late up to $300 total
5 AAC 77.540(c)(1)(C)	Take salmon from a boat powered by a two stroke motor (Kenai River)	100
5 AAC 77.591(d)	Failure to record salmon on personal use permit (Chitina Subdistrict dipnet)	100
5 AAC 77.612(2-3)	Personal use – taking overlimit, female, or undersize Dungeness crab (Yakutat)	100 plus 20 per crab illegally taken
5 AAC 77.614(2)	Personal use – taking overlimit or female king crab (Yakutat)	100 plus 50 per crab illegally taken
5 AAC 77.616(2)	Personal use – taking overlimit or female Tanner crab (Yakutat)	100 plus 20 per crab illegally taken

Statute or Regulation	Description of Offense	Bail
5 AAC 77.662(2-3)	Personal use – taking overlimit, female or undersize Dungeness crab (Southeast)	100 plus 20 per crab illegally taken
5 AAC 77.662(5)	Failure to use escape rings in Dungeness pots (Southeast)	100
5 AAC 77.664(a-c)	Personal use – king crab provisions (Southeast)	100 plus 50 per crab illegally taken and 50 per pot over limit
5 AAC 77.664(f)	Failure to use escape rings in king crab pots (Southeast)	100
5 AAC 77.666(2)	Personal use – taking overlimit or female Tanner crab (Southeast)	100 plus 20 per crab illegally taken
5 AAC 77.670(2-3)	Personal use – taking overlimit or undersize abalone (Southeast)	100 plus 10 per abalone illegally taken
5 AAC 85.020(a)(1&3)	Failure to obtain registration permit – brown bear (Units 1 and 4)	150
5 AAC 92.010	Harvest ticket not in possession; failure to validate	150
5 AAC 92.012(a)	Taking waterfowl without federal duck stamp	75
5 AAC 92.012(a)	Unsigned federal duck stamp	25
5 AAC 92.018	Unsigned state duck stamp	25
5 AAC 92.029(a)	Possess, import, release or export live game animal without permit (statewide)	250
5 AAC 92.050(a)(7)	Failure to cancel permit after killing big game	150
5 AAC 92.050(a)(8)	Failure to submit permit hunt report	100
5 AAC 92.062(d)	False information on application for Tier II permit	200
5 AAC 92.080(1)	Unlawfully taking game by shooting from, on or across highway	300
5 AAC 92.100(a)(1-6)	Taking migratory birds by illegal methods	100
5 AAC 92.100(b)	Transportation of migratory bird without fully feathered wing or head attached	50
5 AAC 92.100(c)	Taking migratory birds before or after legal shooting hours	50 plus $2 per minute early or late up to $200 total
5 AAC 92.150(a)	Possess mountain sheep without both horns	100
5 AAC 92.150(b)	No evidence of sex attached – big game	150

Statute or Regulation	Description of Offense	Bail
5 AAC 92.150(d)	No evidence of sex attached – bear	150
5 AAC 92.165(a-e)	Failure to seal bear or possess unsealed bear skin or skull	100
5 AAC 92.170	Failure to seal wolf, wolverine, lynx, marten, beaver, and otter	100
5 AAC 92.200(d)	Failure to submit required report	75
5 AAC 92.230(a)(1)	Feeding game	300
5 AAC 92.410(b)(2-3)	Failure to submit required report	75
5 AAC 93.060 (except (f))	Failure to pay fee (Little Susitna Public Use Facility) (This does not include commercial violations under subparagraph (f))	50
5 AAC 95.505(1)	Vehicle use off road (Palmer Hay Flats State Game Refuge)	300
5 AAC 95.515(1)	Vehicle use off authorized roads without permit (Susitna Flats State Game Refuge)	300
5 AAC 95.515(4)(A)	Refuse and waste (Little Susitna Public Use Facility)	100
5 AAC 95.515(4)(B)	Damage/deface state property or sign (Little Susitna Public Use Facility)	200
5 AAC 95.515(4)(C)	Damage/deface natural object (trees, etc.) (Little Susitna Public Use Facility)	200
5 AAC 95.515(4)(D)	Failure to use leash/control pets (Little Susitna Public Use Facility)	50
5 AAC 95.515(4)(E)	Assembly of more than 20 people without permit (Little Susitna Public Use Facility)	50
5 AAC 95.515(4)(F)	Fires not in campstove or authorized structure (Little Susitna Public Use Facility)	50
5 AAC 95.515(4)(G)	Use or discharge a weapon (Little Susitna Public Use Facility)	100
5 AAC 95.515(4)(H)	Limit on number of persons/vehicles (Little Susitna Public Use Facility)	50
5 AAC 95.515(4)(I)	Camping in designated areas (Little Susitna Public Use Facility)	50
5 AAC 95.515(4)(J)	Unattended campsite/vehicle (Little Susitna Public Use Facility)	50
5 AAC 95.515(4)(K)	Camping over 15 days or authorized limit (Little Susitna Public Use Facility)	50
5 AAC 95.515(4)(L)	Unauthorized concessions (Little Susitna Public Use Facility)	100
5 AAC 95.515(4)(M)	Traffic violations (Little Susitna Public Use Facility)	50
5 AAC 95.515(4)(N)	Violation of campground rules (Little Susitna Public Use Facility)	50

(Adopted by SCO 778 effective January 1, 1987; amended by SCO 892 effective April 1, 1988; by SCO 1000 effective October 1, 1989; by SCO 1033 effective July 6, 1990; by SCO 1076 effective July 1, 1991; by SCO 1077 effective nunc pro tunc July 21, 1991; by SCO 1101 effective July 9, 1992; by SCO 1143 effective August 9, 1993; by SCO 1170 effective May 1, 1994; by SCO 1218 effective May 15, 1995; by SCO 1256 effective September 15, 1996; by SCO 1327 effective July 1, 1998; by SCO 1346 effective August 13, 1998; by SCO 1387 effective January 1, 2000; by SCO 1484 effective December 1, 2002; by SCO 1523 effective August 15, 2003; by SCO 1577 effective June 1, 2005; by SCO 1615 effective June 1, 2006; by SCO 1632 effective nunc pro tunc to October 1, 2006; by SCO 1673 effective May 5, 2008; and by SCO 1734 effective July 20, 2010)

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Hooking Mortality of Chinook Salmon Released by Commercial Trollers

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Abstract.—Immediate and short-term (1-5-d) hooking mortality associated with the incidental catch of chinook salmon *Oncorhynchus tshawytscha* was assessed during periods when troll fishing for that species (only) was prohibited. Two chartered power trollers fished their normal complements of gear directed at coho salmon *O. kisutch* in Hawk Inlet, southeastern Alaska. Wound location, fork length, and lure type were the factors principally associated with mortality of incidentally caught chinook salmon. Severity of the hooking wound was also related to mortality. Maximum-likelihood estimates (with 95% confidence intervals in parentheses) of total mortality were 24.5% (20.1-29.0%) for sublegal-sized (<66 cm fork length) chinook salmon and 20.5% (9.0-31.9%) for legal-sized chinook salmon. The delayed-mortality rates were used to recalculate hooking mortality estimates from previous tagging experiments in which it was assumed that no delayed mortality occurred for certain locations and severities of wounds. The recalculated estimate of total hooking mortality for sublegal fish, based on wound location, was 25.7%. The recalculated estimate of total hooking mortality for legal and sublegal fish, based on wound severity, was 23.5%.

Minimum-size restrictions to protect young age-classes are common for hook-and-line fishing directed at chinook salmon *Oncorhynchus tshawytscha*. In the commercial troll fishery in southeastern Alaska, for example, chinook salmon less than 71 cm long (sublegal fish) must be released. Some mortality is associated with the hooking and release of sublegal fish in these fisheries. Recently, there has been an increase in the number of closures of the chinook salmon (only) troll fishery. During such periods, trolling is directed primarily at coho salmon *O. kisutch*, and incidentally captured chinook salmon must be released. Fisheries managers require mortality estimates for released fish to assess the effectiveness of these closures for protecting chinook salmon.

Estimates of hooking mortality for chinook salmon vary widely. Immediate-mortality estimates range from 2.5% (Van Hyning 1951) to 10.6% (Davis et al. 1986), whereas estimates that include both immediate and delayed mortality range from 11.8% (Butler and Loeffel 1972) to 71% (Parker and Black 1959). Reviewers of published and unpublished data on hooking mortality of chinook salmon have proposed estimates of 30% (Wright 1970), 38% (Horton and Wilson-Jacobs 1985), and 50% (Ricker 1976).

The wide variations in the estimates may be due to biases associated with different experimental approaches, but this cannot be quantified because of the lack of experimental controls. The lowest hooking-mortality estimates (11.8-12.0%) are from tagging studies in which fish with certain superficial injuries were assumed to suffer no delayed mortality; investigators used tag recovery rates of these fish to calculate delayed mortality for all injury categories (Wright 1970; Butler and Loeffel 1972). Estimates like these are negatively biased if fish with superficial injuries suffer delayed mortality.

Mortality estimates based on the investigator's judgement of whether or not a fish has been mortally wounded are higher than those calculated from immediate mortality (12-31%; Wright 1970), but these, too, may be biased. Chinook salmon with severe wounds have been subsequently recovered in tagging experiments (Wright 1970; Butler and Loeffel 1972), and fish with superficially minor injuries may suffer delayed mortality. Mortality rates up to 71% have been reported for fish with apparently minor injuries when the fish were held for several hours in live tanks aboard a fishing vessel (Parker and Black 1959). These deaths were attributed to lactic acid accumulation caused by hyperactivity while the fish fought the troll gear (Parker et al. 1959). Ellis (1964), however, concluded that just holding fish for extended periods may stress the fish, causing lactic acid buildup and high mortality.

Previous estimates of hooking mortality of chinook salmon included sublegal fish only or all fish sizes together. The limited information on mortality rates of chinook salmon relative to size indicates that larger fish are not as severely affected by hooking as smaller fish (Parker and Kirkness 1956; Loeffel 1961; Davis et al. 1986). However, Fry and Hughes (1951) found no size-related differences in recoveries of tagged chinook salmon.

The main objective of this study was to determine immediate and short-term (1–5-d) mortality rates of chinook salmon hooked and released from commercial trolling gear typical of the gear used in coho salmon fishing. Secondary objectives were to examine the association of mortality with wound location and to make a qualitative assessment of wound severity so that observed rates of delayed mortality could be used to refine mortality estimates from previous tagging studies.

Methods

Gear.—Two power trollers were chartered to fish for two 5-d periods, 11–20 August 1986, at Hawk Inlet in southeastern Alaska. This site was chosen because of its accessibility, the availability of mooring sites for a large net-pen, and the high catch rates of chinook salmon during previous trolling research in the area. Vessel 1 was a 13.7-m troller rigged with bow poles to separate the forward and aft trolling lines, and vessel 2 was a 14.3-m troller rigged with float bags to separate the lines. Four wire lines with 8–10 individual lures per line were used. To simulate fishing during chinook salmon closures, the operators fished their normal complement of coho salmon gear, including hootchies (imitation squid) with flashers, spoons, and plugs; the selection of colors and relative proportions of the lures deployed was varied by the operators. Hook size was limited to 6/0 barbed, single hooks. Operators were instructed to operate the gear in their normal manner. Typically, all lines were checked if a strike was detected on one or more lines, or when a complete circuit of the fishing area had been made.

Processing the catch.—Techniques for boating fish differed between vessels because of differences in vessel design. When a chinook salmon was caught, it was placed in an electrically charged basket (Orsi and Short 1987) to stun the fish. On vessel 1, fish were lifted from the water by the leader before being placed in the electric basket. On vessel 2, they were led to the electric basket, which was in the water, and simultaneously lifted and stunned. Operators removed the hook in their normal manner by inserting a gaff into the curve of the lure hook and turning the gaff so that the weight of the fish pulled it free of the lure. An observer noted the lure type, depth fished, and location of the wound, and rated the severity of the wound by the Alaska Department of Fish and Game troll observer criteria (Davis et al. 1986). Condition 1 denotes a minor injury, including hooking injuries near the outer portion of the mouth and little or no bleeding. Condition 2 denotes a serious injury, including hooking injuries in or near the gills or eyes and severe bleeding. Condition 3 denotes a dead fish. Fork lengths of fish were measured to the nearest centimeter. On the basis of conversions given by Van Hyning (1951), a fork length of 66 cm was considered equivalent to a total length of 71 cm, the legal size limit. Fish were marked with numbered Floy anchor tags. Average processing time was less than 45 s.

Each fish was placed in a 175-L covered live tank with flowing seawater until it was transferred with a large dip net (6-mm knotless webbing) to a similar tank in a skiff. Typically, only one or two fish were held at a time in each live tank. Live fish were transferred from the skiff to a net-pen; this was accomplished by pouring the contents of the live tank into the pen. Transfer time from capture until placement in the net-pen varied from 7 to 60 min and averaged 22 min. Transfer times tended to be longer in poor weather, but this was compensated for by keeping the trollers closer to the net-pen.

The net-pen, constructed of 2.5-cm knotless nylon mesh suspended from a float frame, had a total volume of 1,700 m^3, a depth of 12 m, and an area of 142 m^2 defined by eight sides that were alternately 9.1 and 2.2 m long. This design eliminated the blind tunnels that can form in the corners of square or rectangular net-pens. The pen was checked by divers at the end of each fishing day; dead fish were removed and their tag numbers were recorded. At the end of five fishing days, all fish in the pen were released.

Temperature and salinity profiles in the holding net were determined five times over the course of the experiment with a conductivity–temperature probe. A temperature and salinity profile also was determined on the fishing grounds with a single bathymetric cast of a recording conductivity–temperature instrument.

To test the hypothesis that "stunned" fish are frequently killed by predators, some chinook salmon dead at landing were returned to the water after being tied to a 30-m-long, 6-mm diameter line attached to a buoy. The line used was alternately either yellow polypropylene with slight positive bouyancy or brown nylon with slight negative bouyancy. The buoy was retrieved by a skiff operator, when convenient, after a minimum of 20 min.

Statistical analysis.—The BMDPLR stepwise logistic regression program (Dixon et al. 1983) was used to identify the independent variables significantly related to mortality (the binary response variable). For the logistic regression model, the probability of mortality is

$$e^u/(1 + e^u); \quad (1)$$

u is a linear function of the independent variables. The variables considered in the regression model were injury location, fork length, vessel, lure depth, lure type, and transfer time. An independent variable could be included in the regression model if the improvement chi-square test, computed from the $\log_e$ of the ratio of the likelihood function without the variable to the likelihood function with the variable was significant ($P < 0.05$). At each step of the regression, the BMDPLR program computed goodness-of-fit tests. Two stepwise regression analyses were performed, based on when mortality occurred. In the first, all deaths were included; in the second, fish dead at landing were excluded from the model. Lure type was not recorded for 45 chinook salmon. Observations with missing values were excluded from the stepwise regression analysis.

The G-test for independence (Sokal and Rohlf 1981) was used to examine the relationship between severity of the hooking wound and subsequent mortality between vessel and number caught by size category, and among vessel, lure type, and mortality.

Mortality rates were determined for each of six time periods: immediate (fish dead at landing or at the time of transfer to the pen) and at the end of fishing days 1–5. The BMDP3R nonlinear regression program (Dixon et al. 1983) was used to generate maximum-likelihood estimates and asymptotic standard deviations for each time period, as well as the correlation matrix for the estimates. The maximum-likelihood estimates usually are distributed about the true value of the parameter, which is close to the mean for large samples (Mood and Graybill 1963). The total mortality is the sum of mortality estimates for individual time periods. The variance of this estimate is the sum of the variances for individual time periods plus the off-diagonal sum of the variance–covariance matrix (Mood and Graybill 1963):

$$V\left(\sum_{i=1}^{6} \hat{P}_i\right) = \sum_{i=1}^{6} V\hat{p}_i + 2\sum_i \sum_j \text{cov}(\hat{p}_i; \hat{p}_j);$$

$\hat{p}_i$ is the estimated mortality rate for the ith period and j denotes a period after i. The variance calculations derived from BMDP3R were confirmed by calculating the variance–covariance matrix with a separate program.

To recalibrate the estimates of delayed mortality based on the tag recovery data reported by Wright (1970) and Butler and Loeffel (1972), who assumed there was no delayed mortality for the groups with the highest tag recovery rates, I applied mortality rates from the present study. The earlier investigators calculated a recapture coefficient (r) for fish with the lowest wound severity (Wright 1970) or for fish hooked in the maxillary (Butler and Loeffel 1972):

$$r = n/N'; \quad (2)$$

n is the number of recaptures, and N' is the number of tagged fish released. In using this equation, one assumes delayed mortality is 0. To calculate r when delayed mortality is some other value, the equation is

$$r = n/(N' - D); \quad (3)$$

D is N' times the delayed mortality rate. Once r has been recalculated, the number of deaths due to delayed mortality in a particular category can be determined by

$$D_k = N_k' - (n_k/r); \quad (4)$$

k is a particular condition or wound location. Delayed mortality for category k is then D_k divided by N_k'. (Delayed mortality expressed as the proportion of the fish landed would be D divided by N; $N = N' + I$, and I is the number of immediate deaths.)

Wright's (1970) calculations are equivalent to equations (2) and (4), although his terminology is not identical. However, Butler and Loeffel (1972) calculated the number of delayed deaths by

$$D_k = r(N_k - I_k) - n_k. \quad (5)$$

This equation is incorrect; the number computed was actually the number of fish that would have been expected to be recovered from the fish that died, $r \cdot D_k$. Thus, it was necessary to recalculate the original values for delayed mortality given in Butler and Loeffel (1972).

Results

Altogether, 108 legal and 398 sublegal chinook salmon were caught and landed. The catch of legal chinook salmon was similar between boats: 52 for vessel 1 and 56 for vessel 2. Vessel 2 caught 239 sublegal chinook salmon, 36% more than the 159 caught by vessel 1; however, this difference was not statistically significant (chi-square; $P > 0.10$).

Ninety-six percent of the legal and 93% of the sublegal fish were caught at depths greater than 12 m. Only 6% of the legal and 3% of the sublegal fish were caught at depths greater than 35 m. Once in the holding pen, fish in good condition primarily used the lower half of the pen, whereas severely injured fish swam slowly at the surface or along the pen margins, or lay quiescently on the bottom.

Temperature decreased and salinity increased with depth in both the net-pen and fishing area. Temperatures in the net-pen were 10.3°C at 5 m and 9.0°C at 12 m, the depths where most of the fish remained. Temperatures where most fish were caught in the fishing area decreased from 9.3°C at 12 m to 6.5°C at 35 m. Salinity increased from 29.3‰ at 5 m to 30.7‰ at 12 m in the net, and from 29.8‰ at 12 m to 31.1‰ at 35 m in the fishing area.

Effect of Predation

Of the 506 chinook salmon captured, one had a fresh predator wound, probably received while hooked. Twenty-six dead fish were tethered to a buoy and allowed to drift or sink for an average of 31 min. None of these fish were damaged or removed by predators even though Stellar's sea lions *Eumetopias jubatus*, harbor seals *Phoca vitulina*, bald eagles *Haliaetus leucocephalus*, and glaucous-winged gulls *Larus glaucescens* were frequently observed in the fishing area.

Variables Affecting Mortality

Three variables—length, injury location, and lure type—were significantly associated with mortality both when all observed mortality was included in the analysis and when immediate mortality was excluded (Table 1). These variables were also significantly associated with mortality in both analyses when no other variables were in the logistic regression model (Table 1). Vessel did not enter the regression model in either analysis but was significantly related to delayed mortality if other variables were excluded. Transfer time entered the model when it was considered a variable but was not significant when other variables were excluded (Table 1).

The relationship between fork length and mortality was obvious when the fish were grouped by legal and sublegal categories. Ninety-four (23.6%) of the 398 sublegal fish died over the course of the study, and only 14 (13.0%) of the 108 legal fish died.

TABLE 1.—Summary of stepwise logistic regression analyses of chinook salmon mortality after fish were hooked. Analysis 1 included all observations of mortality in the model; analysis 2 excluded observations of immediate mortality from the regression model and included transfer time as an independent variable. Asterisks denote $P \leq 0.05$* or $P \leq 0.01$**.

Variable	Approximate F, no other variables in model	Improvement chi-square
Analysis 1		
Fork length	18.30**	18.91**
Injury location	16.55**	106.43**
Lure type	12.01**	31.87**
Vessel	2.21	
Lure depth	1.53	
Analysis 2		
Fork length	15.53**	18.13**
Injury location	11.92**	82.56**
Lure type	14.26**	26.91**
Time	1.52	4.88*
Vessel	6.47*	
Lure depth	0.95	

In both size categories, fish hooked in the gills had the highest total mortality (Table 2). Further comparisons were not meaningful for legal fish because of the small sample size. Among sublegal fish, the total mortality rates, based on hooking location (exclusive of tongue and "other," for which there were few observations) were lowest for snout, maxillary, corner of the mouth, and cheek; intermediate for lower jaw, isthmus, and eye area; and highest for gills (Table 2). Postmortem examinations of 18 fish (total number dead at landing or removed from the net-pen during 2 d of the study) revealed that these fish incurred some gill injury although not all were so classified by the on-board observer. The original assessments were wounds to gills (8), eye (5), lower jaw (4), and isthmus (1).

The predominant lure types that caught both size-classes of fish were hootchies on vessel 1 and spoons on vessel 2 (Table 3). The numbers of fish captured by lure type were significantly different ($P < 0.05$) between vessels for both legal and sublegal fish. This difference between vessels was probably due to differences in the proportions of lure types fished, which were not measured. Because of the low expected values for fish caught on plugs, differences in mortality between vessels and lure type were tested only for sublegal fish caught on hootchies or spoons. Mortality significantly differed between these lure types ($P < 0.05$) but not between the vessels.

TABLE 2.—Total catch and subsequent mortality by hooking location and size-class of chinook salmon. I = immediate mortality; numbers 1–5 indicate number of days in pen. Delayed mortality shown is total number of deaths minus immediate deaths, divided by total number captured; it is not weighted for smaller sample size associated with longer holding periods. Sublegal fish were smaller than 66 cm fork length.

Hooking location	Total catch	Number of deaths by day in net-pen						Mortality (%)		
		I	1	2	3	4	5	Immediate	Delayed	Total
					Sublegal fish					
Snout	22	1	0	0	0	0	0	4.5	0.0	4.5
Maxillary	34	0	2	0	0	0	0	0.0	5.9	5.9
Corner of mouth	52	2	2	0	0	0	0	3.8	3.8	7.6
Cheek	53	3	3	0	0	0	0	5.7	5.7	11.4
Lower jaw	90	6	12	1	1	1	0	6.7	16.7	23.4
Tongue	4	0	1	0	0	0	0	0.0	25.0	25.0
Isthmus	35	5	4	0	0	0	0	14.3	11.4	25.7
Eye, orbit of eye	73	8	10	1	0	0	0	11.0	15.1	26.1
Gills	33	15	15	0	0	0	0	45.4	45.4	90.8
Other	2	0	1	0	0	0	0	0.0	50.0	50.0
					Legal fish					
Snout	2	0	1	0	0	0	0	0.0	50.0	50.0
Maxillary	10	0	0	0	0	0	0	0.0	0.0	0.0
Corner of mouth	13	0	1	0	0	0	0	0.0	7.7	7.7
Cheek	13	0	0	0	0	0	0	0.0	0.0	0.0
Lower jaw	20	0	1	0	0	0	0	0.0	5.0	5.0
Tongue	0									
Isthmus	3	0	0	0	0	0	0	0.0	0.0	0.0
Eye, orbit of eye	38	1	2	1	0	0	2	2.6	13.2	15.8
Gills	9	3	1	0	0	1	0	33.3	22.2	55.5

Wound Severity and Mortality

For vessels and size-classes, substantially more severely wounded fish died than slightly wounded fish (Table 4). Size-classes had to be combined to statistically compare mortality between wound-severity classifications. For both vessels, severely wounded fish had significantly higher mortality ($P < 0.05$). There also was a significant difference between vessels in the proportion of fish assigned to the wound-severity categories: 66% of the fish were graded slightly wounded on vessel 2 versus 31% on vessel 1 (Table 4). The observer on vessel 1 made a more detailed survey of the fish, noting wound severity as he measured and tagged the fish and taking into consideration the amount of bleeding in the live tank. The observer on vessel 2 made his assessment as each fish was removed from the hook. The observations from vessel 2 were more consistent with the observations of wound severity at release made by troll observers during chinook salmon closures in the Alaska troll fishery (Davis et al. 1986).

TABLE 3.—Chinook salmon catch and mortality by vessel, lure type, and size-class (sublegal fish were smaller than 66 cm fork length).

Vessel	Lure type	Number of fish caught	Landings (%)	Mortality (%)
		Sublegal fish		
1	Hootchie	108	78.3	13.0
	Spoon	25	18.1	36.0
	Plug	5	3.6	20.0
2	Hootchie	97	42.2	13.1
	Spoon	125	54.3	36.8
	Plug	8	3.5	25.0
		Legal fish		
1	Hootchie	30	69.8	13.3
	Spoon	5	11.6	20.0
	Plug	8	18.6	25.0
2	Hootchie	20	40.0	5.0
	Spoon	28	56.0	3.6
	Plug	2	4.0	50.0

TABLE 4.—Total catch and mortality weighted by days held of chinook salmon by size-class, vessel, and condition. Conditions 1 and 2 are minor injuries and serious injuries, respectively. Sublegal fish were smaller than 66 cm fork length.

Condition	Vessel 1		Vessel 2	
	Catch (number)	Mortality (%)	Catch (number)	Mortality (%)
		Sublegal fish		
1	12	0.0	33	3.3
2	38	28.2	23	32.9
		Legal fish		
1	54	0.0	162	15.3
2	94	21.9	69	47.2

If only the observations for vessel 2 were considered, mortality still was significantly different between wound-severity classifications ($P < 0.05$). Again, sample sizes required pooling the size-classes to compare the classifications. These pooled values are 13.3% mortality for slightly wounded and 43.6% mortality for severely wounded fish.

Total Hooking Mortality

When maximum-likelihood estimates of immediate and daily mortality rates were summed, the estimated total mortality was 24.5% for sublegal and 20.5% for legal fish (Table 5). The cumulative mortality over a 5-d period differed distinctly between size-classes. The rate for sublegal fish appeared to be approaching an asymptote, whereas mortality increased on days 4 and 5 for legal fish. This increase in mortality for legal fish was based on the deaths of only three fish that were weighted heavily because of small sample size (Table 5); this weighting also caused the estimate of total mortality to be considerably higher than the 13% of the legal catch that died during the study. The 95% confidence intervals for total mortality were 9.0–31.9% for legal fish and 20.1–29.0% for sublegal fish. The wide confidence interval for legal fish was due to the small sample size and variability of mortality for fish held 4–5 d.

Recalculation of Previous Mortality Estimates

To recalculate the mortality estimates of Butler and Loeffel (1972) for sublegal chinook salmon, a positive estimate of delayed mortality was used instead of the 0% delayed mortality assumed by those authors for maxillary-hooked fish. Few (34) fish were hooked in the maxillary (Table 2); therefore, fish with hooking injuries that resulted in low delayed mortalities (maxillary, snout, corner of the mouth, and cheek wounds) were pooled to derive a delayed-mortality rate applicable to maxillary-hooked fish. Of the 161 fish in these categories, 7 fish died (Table 2); the estimated delayed mortality was 4.3%, and the binomial 95% confidence interval was 1.2–7.5%. Pooling these fish seemed reasonable because (1) in the study by Butler and Loeffel (1972), tagged fish injured in locations other than the maxillary were recovered at lower rates than maxillary-hooked fish; (2) the confidence range of the pooled estimate included the delayed-mortality rate (5.9%) for the 34 fish hooked in the maxillary; and (3) no fish in the low-mortality category died after the day of capture (Table 2), indicating that delayed mortality due to hooking had been completely expressed for this group of fish.

TABLE 5.—Total numbers of chinook salmon caught and held for various time periods, numbers dying, and maximum-likelihood estimates of mortality. Sublegal fish are smaller than 66 cm fork length.

Time period	Number of days in sample	Number of fish: Caught	Number of fish: Died	Maximum-likelihood estimate: Mortality (%)	Maximum-likelihood estimate: SD
		Sublegal fish			
Immediate	10	398	40	10.0	1.51
Day 1	10	398	48	12.0	1.63
Day 2	8	323	4	1.2	0.61
Day 3	6	201	1	0.5	0.49
Day 4	4	131	1	0.8	0.77
Day 5	2	54	0	0.0	0.00
Sum			94	24.5	2.29
		Legal fish			
Immediate	10	108	4	3.7	1.81
Day 1	10	108	5	4.6	2.01
Day 2	8	93	2	2.1	1.50
Day 3	6	65	0	0.0	0.00
Day 4	4	48	1	2.2	2.12
Day 5	2	30	2	7.9	4.82
Sum			14	20.5	5.85

Equation (4) was used to estimate the numbers of delayed deaths for each injury location, based on the tag recovery data reported in Table 5 of Butler and Loeffel (1972). When the correct equation was used, overall delayed mortality, expressed as a percentage of fish landed, increased from Butler and Loeffel's 5.1% to 14.1%, still with an assumed 0% delayed mortality for maxillary-hooked fish (Table 6). With incorporation of 4.3% delayed mortality for these fish, estimated delayed mortality for all groups rose further to 17.7% (Table 6). To complete the recalculation of Butler and Loeffel's (1972) data, their observation of 8.0% immediate mortality for 1,066 sublegal chinook salmon caught on barbed hooks was added to the delayed mortality estimate to arrive at an estimated total mortality of 25.7%.

Recalculation of the data reported by Wright (1970) for tag recovery by condition category for chinook salmon was carried out in a similar manner. In this case, the delayed-mortality rate of 9.9% observed for slightly wounded legal and sublegal fish caught by both vessels (Table 4) was used to replace the zero mortality for "good" fish assumed by Wright (1970). The resulting estimate was a total delayed mortality of 16.8%, based on the number of fish released. When an 8% immediate mortality was assumed, delayed mortality was

TABLE 6.—Total catch and delayed mortality rates of sublegal chinook salmon (<66 cm fork length) by hooking location, based on tag recovery data reported by Butler and Loeffel (1972). Shown are the original rates reported by these researchers with the assumption that delayed mortality for maxillary-hooked fish was 0, the correct calculation of these values, and the recalculated rates incorporating 4.3% delayed mortality of maxillary-hooked fish.

		Delayed mortality					
		Original		Corrected		Recalculated	
Hooking location	Total caught	Number	%	Number	%	Number	%
Snout	234	6	2.6	17	7.3	26	11.1
Corner of mouth	444	27	6.1	75	16.9	90	20.3
Maxillary	280	0		0		12	4.3
Eye	158	33	20.9	91	57.6	94	59.5
Gills	55	7	12.7	21	38.2	22	40.0
Tongue	23	1	4.3	2	8.7	3	13.0
Cheek	442	11	2.5	31	7.0	48	10.6
Lower jaw	324	11	3.4	30	9.3	43	13.3
Isthmus	119	9	7.6	26	21.8	29	24.4
Combined	2,079	105	5.1	293	14.1	367	17.7

15.5%, based on the number of fish landed, and total mortality was 23.5%.

Discussion

Potential Sources of Bias

Are the mortality rates observed in this study representative of the mortality that actually occurs during a commercial troll fishery? Certain factors inherent in the study may have biased the observed rates. As in previous studies on hooking mortality, it was not possible to maintain a control group. Therefore, it is necessary to examine the degree and direction of the potential sources of bias.

During this study, each fish was landed and then stunned in an electronarcosis basket prior to removal of the hook. In an actual troll fishery, the hook is removed while the fish is either partially or completely out of the water. On one study vessel, the fish was lifted out of the water to the boat by the leader; on the other vessel, it was lifted out in the basket. These two techniques represent the extremes in the way a fish is normally handled when it is being released by a commercial fishing operator: some operators remove the hook without lifting the fish from the water, but others must first lift the fish out by the leader. However, there was no difference in mortality between vessels for a given lure type, suggesting that differences in release methodology are not important factors influencing mortality.

If released fish are likely to be attacked by predators before they recover from the shock of hooking, then holding the fish during this study reduced mortality and biased the results. None of our dead fish tethered to simulate stunned fish were damaged or removed by predators, however. A hooked fish is probably more at risk of predator attack than one that is floating or sinking because it is among an array of lures that may attract a predator, and its struggling against the hook and line gives visual and vibrational cues for a potential predator. Only one (0.2%) chinook salmon caught during this study was bitten by a predator. From 1978 to 1981, troll fishermen in southeastern Alaska reported that 0.6–1.9% of their catch of coho salmon and chinook salmon was mutilated by predators (Krygier 1982). Fishermen who encounter high predation, which is typically a localized problem, minimize it by moving to another area (Krygier 1981). These observations do not mean that dying or severely damaged fish are not more susceptible to predation than uninjured fish. They do suggest that fish with minor injuries are not normally exposed to immediate predation mortality that we avoided by holding the fish.

Electronarcosis, tagging, transfer, and holding may stress the fish enough to increase mortality. However, evidence indicates that electronarcosis, tagging, and holding the fish in net-pens do not cause mortality. No deaths occurred among 50 pen-reared chinook salmon that were hooked on sportfishing gear, landed in the electronarcosis basket, tagged, and held for 19 d in a large net-pen (J. A. Orsi, Auke Bay Laboratory, personal communication). Chinook salmon are routinely cultured in net-pens, indicating the pens provide an adequate environment for these animals. Although it is arguable whether comparisons between cultured fish and wild animals are appropriate, no chinook salmon hooked in the snout, maxillary, corner of the mouth, or cheek died after the first day of this study. Milne and Ball (1956) reported 89% survival for coho salmon that were held for 35 d in a pen of an undisclosed size after being caught on troll gear and held in live tanks on a troller for 1–6 h.

There is evidence that holding fish in small live tanks increases mortality for troll-caught chinook salmon. Fry and Hughes (1951) found a tenfold decrease in tag recovery rates when chinook salmon were held in live tanks overnight rather than being tagged and immediately released. Parker and Black (1959) reported 71% mortality for tagged chinook salmon caught on commercial troll gear and held up to 11 h. They included only fish with superficially minor injuries in their study. In contrast, with holding times of up to 5 d, less than 25% mortality was observed in the present study for all fish, including those severely injured and dead at landing. These results support the conclusion of Ellis (1964) that holding fish in live tanks for extended periods caused stress that contributed to the mortality observed by Parker and Black (1959). In the present study, a significant, albeit weak, relationship existed between mortality and time in the live tanks, even though time in the live tanks never exceeded 1 h. Therefore, it must be assumed that holding the fish in the live tanks caused some unquantified, positive bias to the observed mortality.

Another possible bias is that all mortality due to hooking injuries may not have occurred by the end of the holding period. Parker et al. (1959) reviewed experiments in which troll-caught fish were held in live tanks, and concluded that mortality due to hooking occurred within 6 h. Their findings were based primarily on fish with superficially minor injuries. In the present study, 10–12 fish, all of which had an eye torn out or destroyed by hooking, were observed swimming sluggishly at the surface at the end of both 5-d holding periods. It is unlikely that a high proportion of immature fish with this type of injury would survive. From 1984 to 1986, 2,954 adult chinook salmon returning to the National Marine Fisheries Service experimental hatchery at Little Port Walter were examined for hooking scars; 170 scars were attributed to hooking, but no fish were observed with only one functioning eye (F. P. Thrower, Auke Bay Laboratory, personal communication). The eye is not necessarily destroyed on all fish hooked through the orbit. In the present study, an observer on one of the trollers examined a small sample (17) of eye-hooked fish and noted that the eye in 65% of these fish had been destroyed (burst or torn out). The observed mortality rates for eye-hooked fish in this study were 26% for sublegal fish and 16% for legal fish (Table 3); weighted for days held, these rates were 26.5% and 25.4%, respectively. Additional mortality of fish in this wound category would likely occur subsequent to the end of the study.

Comparison with Recalculated Estimates

The general agreement between the estimates generated in this study and the recalculated estimates from previous studies is strong evidence that the estimates are good representations of the actual mortality rate, and that the biases previously identified for the current estimates are either small or compensatory. The mortality rates for sublegal chinook salmon are similar to those recalculated from tagging data from Butler and Loeffel (1972). As would also be expected if the rates were representative, the estimated rates for the two size-classes of fish in the present study were intermediate between these recalculated from tagging data of Wright (1970). This consistency between the two types of studies supports the conclusions of Wright (1970) that estimates of hooking mortality above 30% are probably excessive because they are based on experiments in which seriously injured fish were included among total mortalities or based on experiments in which stress caused by holding fish in tanks may have contributed to observed losses.

The recalculated tagging data of Butler and Loeffel (1972) may represent the best estimate of hooking mortality of sublegal fish. Tag recovery data are not biased by continued delayed mortality after an experiment ends, because they represent fish that survived to be caught or recovered during spawning runs. To estimate hooking-related mortality from such data, it need only be assumed that the effects of handling are similar across all wound categories. Substitution of observed mortality rates for fish with minor injuries in this study for the zero delayed mortality of maxillary-hooked fish assumed by Butler and Loeffel (1972) eliminated a source of bias in the original estimates derived from the tagging data. The recalculations give conservative estimates of mortality, because they incorporate any positive bias due to experimental handling of the fish. The gear used by Butler and Loeffel (1972) included a wider range of hook sizes (5/0 to 7/0) than used in this study (6/0), so the 26% rate calculated from the tagging data may apply to the incidental catch of sublegal chinook salmon during directed commercial trolling for chinook salmon, as well as to fish caught incidentally during chinook salmon closures.

The observed mortality of legal fish was lower than that of sublegal fish. Previous studies (e.g., Parker and Kirkness 1956; Loeffel 1961; Davis et al. 1986) concluded that large fish were less severely affected by hooking than smaller fish, based on the lower incidence of dead and seriously injured legal fish. In contrast, the incidence of dead and seriously injured fish in this study was actually higher for legal than sublegal fish. However, the relationship between size and mortality and the lower estimate of total mortality do indicate a lower mortality for larger fish. The mortality rate for legal fish observed in this study has a wide (9–31%) confidence interval because of the small sample size, and the mean size of the legal fish was only 73 cm fork length (77 cm total length). More research is needed on the relative mortality of legal and sublegal chinook salmon to accurately define the differences. At this time, the 20% mortality estimate from this study is a reasonable figure to use for legal chinook salmon incidentally hooked during closures because (1) mortality of legal chinook salmon appears to be lower than that of sublegal chinook salmon, and (2) the estimate of mortality for sublegal chinook salmon from this study is similar to the estimate calculated from tag recovery data.

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Mortality of coho salmon caught and released using sport tackle in the Little Susitna River, Alaska

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ABSTRACT

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Coho salmon (*Oncorhynchus kisutch*) were caught with sport gear in the estuary of the Little Susitna River, southcentral Alaska. Fish were double marked and released. All coho salmon observed migrating through a weir above the estuary and a portion caught in a sport fishery below the weir were examined for marks. A second group of coho salmon were caught using similar sport gear above the estuary. These fish were handled and marked identically as the fish captured in the estuary, except that they were held in a holding pen at the weir with an equal number of coho salmon dip netted at the weir. Coho salmon which were caught and released in the estuary suffered a significantly higher rate of mortality (69%) than did either the coho salmon caught and held above the estuary (12%) or those which were dip netted and held at the weir (1%). Factors that could influence rates of hook-induced mortality were measured at the time of hooking. Hook location, hook removal, and bleeding significantly affected the measured mortality rate.

INTRODUCTION

In many sport fisheries, anglers are asked to release all or a portion of the fish they catch. This management strategy is commonly called 'catch-and-release' (Pettit, 1977). Catch-and-release is a generally accepted and widely applied management tool in sport fisheries across North America (Reingold, 1975; Pettit, 1977; Johnson and Bjorn, 1978; Hunt, 1981; Anderson, 1982; Jones, 1982; Anderson and Nehring, 1984). It is a tool which enables managers to continue maximizing the opportunity to participate in recreational fisheries while reducing mortality to what can be termed 'catch-and-release

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mortality'. In this way, the economic value of recreational fishing is not jeopardized as the opportunity to participate is not reduced (Clawson, 1965; Gordon et al., 1973). The mortality associated with a catch-and-release fishery is a cost that must be considered when developing a management strategy for specific sport fisheries (Cutter, 1974; Anderson, 1975; Wydoski, 1977).

In contrast to resident fish populations (Klein, 1965; Hunsaker et al., 1970; Wydoski et al., 1976; Dotson, 1982; Schill et al., 1986), little quantitative information is available describing catch-and-release mortality in sport fisheries for Pacific salmon (*Oncorhynchus* sp.) (Warner, 1976, 1978; Warner and Johnson, 1978; Warner, 1979). Many salmon sport fisheries are conducted with bait, a practice which has been shown to result in high mortality rates for resident fish (Hunsaker et al., 1970; Wydoski, 1977; Warner and Johnson, 1978).

The Little Susitna River supports the second largest freshwater sport fishery for coho salmon (*Oncorhynchus kisutch*) in Alaska (Mills, 1988). Fishing effort has tripled and harvests of coho salmon have doubled since 1981. Most of the fishing effort and harvest of coho salmon is concentrated in the estuary of the river (Bartlett and Conrad, 1988). Anglers predominantly fish with bait in the estuary (Bentz, 1987) and release about 13% of the coho salmon caught in the estuary (Bentz, 1987; Bartlett and Conrad, 1988). Managers have raised concern that these released fish suffer high mortality rates (Bentz, 1987).

The objectives of this study were to estimate the short-term (5 day) rate of mortality of coho salmon caught and released in and above the estuary of the Little Susitna River and estimate the effects that several hooking factors have on observed rates of hook-induced mortality.

STUDY AREA

The Little Susitna River is a clearwater tributary to Upper Cook Inlet, Alaska (Fig. 1). The river is approximately 180 km in length and has a drainage area of approximately 1000 km^2. The river has an average stream flow of approximately 6 $m^3\ s^{-1}$, with winter flows typically less than 2 $m^3\ s^{-1}$ and peak summer flows near 30 $m^3\ s^{-1}$. During the study, stream flows ranged from 10 to 20 $m^3\ s^{-1}$. In the study area, the river has a channel gradient of approximately 1.0 m km^{-1} and channel widths of approximately 25–30 m. Depths in the study area range from less than 1 to 2 m, depending upon stream flow.

METHODS

Three hundred and eighty-four coho salmon were caught in the estuary using sport gear from 20 July through 18 August 1988. All coho salmon were hook-induced mortality. However, if true, then our estimate of hook-induced mortality from the estuary fishery is conservative, as recoveries from the sport fishery are assumed to be survivors in this analysis.

Mortality rates

The measured rate of hook-induced mortality for coho salmon caught by anglers using bait in the estuary of the Little Susitna River (69%) is higher than mortality rates reported in the literature for bait-caught fish while the measured mortality rate for coho salmon caught above the estuary of the Little Susitna River (12%) was lower than rates reported in the literature. Warner and Johnson (1978) found that landlocked Atlantic salmon *Salmo salar* caught with bait suffered a mortality rate of 35%. Wertheimer (1988) estimated hooking mortality for troll-caught chinook salmon *Oncorhynchus tshawytscha* to be 20.5–24.5%. Bendock and Alexandersdoitter (1991) found that the mortality of chinook salmon caught in the estuary of the Kenai River using baited sport tackle was less than 10%. Rates of hook-induced mortality for brown *Salmo trutta* and brook *Salvelinus fontinalis* trout (Shetter and Allision, 1958), cutthroat trout *Salmo clarki* (Hunsaker et al., 1970), and rainbow trout *Oncorhynchus mykiss* (Shetter and Allision, 1958; Stringer, 1967; Klein, unpublished data, 1974) caught with bait ranged from 20 to 48%. In combination, these data suggest that release mortality of coho salmon caught with bait in estuarine waters is higher than for other species of salmon and trout.

Factors influencing hook-induced mortality

The factors which influenced observed rates of hook-induced mortality during this study were hook location, hook removal, and bleeding. Hook location has been reported in the literature to influence hook-induced mortality. Rainbow trout (Stringer, 1967), brook trout (Shetter and Allision, 1958), and landlocked Atlantic salmon (Warner, 1979) hooked in the gullet or gills suffered higher rates of mortality than when hooked in other locations. Wertheimer (1988) reported that wound location was associated with mortality in troll-caught chinook salmon. Wertheimer (1988) also reported that wound severity was related to mortality. Warner and Johnson (1978) observed that 86% percent of the landlocked Atlantic salmon that were bleeding later died, and that there was a probable relationship between hooking location and bleeding. Mason and Hunt (1967) and Hulbert and Engstrom-Heg (1980) showed that removal of hooks from deeply hooked rainbow and brown trout resulted in higher mortality than when the hook was left in place. Nearly 95% of the rainbow trout and 60% of the brown trout died when the hook was removed in comparison with just over 30% and 20%, respectively, when the hook was not removed. Although increased play and handling time (Marnell and Hunsaker, 1970; Wedemeyer, 1972; Hattingh and van Pletzen, 1974); and scale loss (Black, 1957, 1958) have all resulted in increased rates of mortality, these factors did not significantly influence rates of hook-induced mortality in our study.

The degree of mortality suffered by coho salmon in the Little Susitna River appeared to be related to the location of catch in the river. Fish that were caught and released in the estuary suffered significantly higher rates of mortality (69%) than did fish caught and released above the estuary (12%). This appears in part to be due to the higher incidence of gill or gullet hookings in the estuary than above the estuary. Identical gear was used to catch fish in both areas, suggesting that coho salmon are more likely to become hooked in a lethal location in the estuary than above the estuary. We could not find any explanations for this in the literature. One possible explanation, however, may be that coho salmon in the estuary are still actively feeding and as a result, strike more aggressively at the bait, than do fish which are above the estuary and are off the feed. Although not specifically measured in this study, participants reported an increased aggressive behavior of salmon in the estuary compared with those above the estuary.

Other hooking factors also appeared to contribute to the high rate of hook-induced mortality for coho salmon caught in the estuary of the Little Susitna River. For instance, our data showed that estuary-caught fish hooked in a non-lethal location were more likely to survive and reach the weir if their hook was removed. Because we did not remove deeply embedded hooks from the coho salmon we caught in the estuary, this practice likely contributed to the high measured mortality for estuary-caught fish. We also observed that a large number of coho salmon handled in the estuary easily lost their scales, while those at the weir did not lose their scales as readily when handled. In the estuarine experiment, scale loss was not significant, but high scale loss has been observed to be a contributing factor to increased mortality in other studies. Black (1957, 1958) found that scale loss and abrasion of the mucus coat were major factors contributing to observed rates of mortality.

Various environmental factors can influence rates of hook and release mortality of sport-caught fish, one of which is temperature. Increased temperature at time of hooking and play has been shown to increase the mortality rate of sport-released fish (Dotson, 1982). In this study, water temperatures were relatively constant (only a 3 °C variation) between areas of the river sampled. Given this, we believe that temperature probably did not influence the differences in mortality rates of coho salmon hooked and released in different areas of the river during this study. Also, the observed temperatures recorded during this study were relatively cool (10–13°C) in comparison with other studies, suggesting that the mortality rates observed in this study may be minimum rather than maximum rates.

MANAGEMENT IMPLICATIONS

The rates of hook-induced mortality observed in this study for coho salmon show that the mortality of released coho salmon in intertidal sport fisheries is high. This is especially important in intertidal fisheries which have a large catch-and-release component. In such fisheries, catch-and-release may not be a viable management option.

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SPECIAL REGULATIONS FOR INDIVIDUAL DRAINAGES

Unless listed below, seasons, bag, and possession limits are shown under GENERAL REGULATIONS on page 22.

CHITINA RIVER DRAINAGE

King salmon: Open season July 1–August 10

Chokosna River

Closed to king salmon fishing

***Lakina River** and all flowing waters within ¼-mile radius of its confluence with the Chitina River:*

Closed to king salmon fishing

***Gilahina River** and all flowing waters within ¼-mile radius of its confluence with the Chitina River:*

Closed to king salmon fishing

COPPER RIVER DRAINAGE—*downstream of the upstream bank of the Klutina River*

King salmon:

- Open season July 1–August 10

▮ See specific regulations for Klutina and Tonsina rivers on pages 25 and 26.

COPPER RIVER—*mainstem only*

▮ Bait and artificial lures permitted, including treble hooks.

COPPER RIVER—*mainstem and flowing waters* of east bank Copper River tributaries, and in flowing waters of west bank Copper River tributaries downstream of the Richardson Highway and Glenn Highway (Tok Cutoff), ***excluding*** the Gulkana River:

▮ Burbot may be taken in the mainstem Copper River with more than one line and hook, as specified on page 22 under "Setlines—for burbot."

FISH CREEK (tributary to Mentasta Lake)

Closed to salmon fishing

If you fish in catch-and-release waters or intend to release your fish, **please use barbless hooks or crimp the barbs on your barbed hooks.**

GAKONA RIVER—clearwater tributaries, including all flowing waters within ¼-mile radius of their confluence with the Gakona River

Closed to king salmon fishing

GULKANA RIVER DRAINAGE—*The following regulations apply to all waters of the Gulkana River drainage, unless specified otherwise in the Gulkana River Drainage Specific Waters Regulations.*

▮ Entire year: Only unbaited, single-hook, artificial lures may be used.

Rainbow/steelhead trout:

- Catch-and-release only for the entire year. All rainbow/steelhead trout caught must be released immediately.

Arctic grayling:

- 5 per day, 5 in possession. **Only one 14" or longer** may be possessed or retained as part of the daily bag and possession limit. See special regulations for waters upstream of Paxson Lake (waters of Paxson Lake within a 100 yd radius of the mouth of the East Fork, waters of the East Fork Gulkana River, Summit Lake, and Gunn Creek drainage).

GULKANA RIVER DRAINAGE SPECIFIC WATERS REGULATIONS:

See maps on pages 28-29.

***Gulkana River mainstem**—downstream of the downstream edge of the Richardson Highway Bridge to an ADF&G marker about 500 yd downstream of its confluence with the Copper River:*

▮ June 1–July 31: Only unbaited, single-hook, artificial flies allowed, with gap between point and shank that does not exceed ¾ inch. Additional weight may only be used 18 inches or more ahead of fly. A bead fished on the line above a bare hook or a single bare hook is not an artificial fly.

▮ August 1–May 31: Only unbaited, single-hook, artificial lures may be used.

***Gulkana River mainstem**—upstream of the upstream edge of the Richardson Highway Bridge to an ADF&G marker 7½ miles upstream of the West Fork confluence:*

▮ June 1–July 19: Bait and artificial lures are permitted, including treble hooks.

▮ July 20–May 31: Only unbaited, single-hook, artificial lures may be used.

***West Fork Gulkana River**—flowing waters upstream from an ADF&G marker ½ mile upstream of the confluence of the West Fork and mainsteam Gulkana:*

▮ August 1-December 31: The bag and possession limit for sockeye salmon is 6 per day, 6 in possession. The bag and possession limit for the remainder of the year is 3 (three) sockeye salmon.

Crosswind Lake:

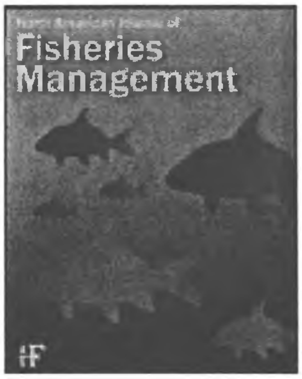
New as of 2012

▮ April 16–October 31: Only unbaited, single-hook, artificial lures may be used.

▮ November 1–April 15: Single hooks only, bait may be used.

Lake trout:

- Entire year, 1 per day, 1 in possession, no size limit.



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Hooking Mortality of Chinook Salmon Released in the Kenai River, Alaska

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Hooking Mortality of Chinook Salmon Released in the Kenai River, Alaska

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Abstract.—Short-term (5-d) mortality of chinook salmon *Oncorhynchus tshawytscha* caught and released in the Kenai River was assessed with radiotelemetry. From 1989 to 1991, 446 adult chinook salmon were tagged with radio transmitters in four experiments. Overall hooking mortality averaged 7.6% and ranged from 10.6% in 1989 to 4.1% in 1991. Mortality was highest for small males (<750 mm mid-eye length) compared with large males and all females. Wound location and bleeding were the factors principally associated with mortality. Survival of chinook salmon that were hooked in the gills or were bleeding was significantly reduced; however, the frequency of these injuries was small in all experiments. Most mortalities occurred within 72 h of release. These results support the use of hook-and-release regulations in similar freshwater chinook salmon fisheries to reduce sportfishing mortality effectively and achieve spawning escapement goals.

A widespread and successful strategy for managing commercial fisheries for Pacific salmon *Oncorhynchus* spp. is to achieve a desired spawning escapement by manipulating fishing mortality (Minard and Meacham 1987). Implicit in this management strategy is an ability to estimate the in-river abundance of fish. This strategy was recently adopted for the Kenai River, which sustains the largest recreational fishery for chinook salmon *Oncorhynchus tshawytscha* in Alaska. The Kenai River supports two runs of chinook salmon (Burger et al. 1985). Separate escapement goals have been developed for the early run (May–June) and the late run (July–August). Hydroacoustic assessment (sonar) is used to estimate the in-river abundance of chinook salmon, and fishing mortality is estimated from a creel survey. The difference between these two estimates equals the spawning escapement. Management options for the recreational fishery, such as mandatory catch-and-release fishing, restrictions on the use of bait, and total fishery closures, are used to regulate the harvest of chinook salmon to achieve escapement goals for each run.

The Kenai River enjoys a wide reputation for abundant catches of large chinook salmon. As the fishery expanded during the 1980s and bag limits were reduced, voluntary catch-and-release fishing emerged as a popular method to selectively harvest trophy-sized fish. By 1988, the Alaska Department of Fish and Game estimated that the released component of the early-run catch was equivalent to 73% of the spawning escapement. The rapid growth of catch-and-release fishing and the likelihood of using it to achieve spawning escapement goals raised concerns among anglers and fishery managers over the mortality of released fish. Few studies are available on hooking mortality of salmon in freshwater (Wydoski 1980; Mongillo 1984). Estimates of hooking mortality for chinook salmon in marine fisheries vary widely, ranging from 20.5% (Wertheimer 1988) to 71% (Parker and Black 1959). If hooking mortality were high in the Kenai River, the spawning escapement could be seriously underestimated.

The objective of our study was to estimate the short-term (5-d) mortality rate for chinook salmon that were hooked and released in the Kenai River recreational fishery. In this study, we used radiotelemetry to monitor the daily locations of chinook salmon and a matrix of criteria based on telemetry signals and movement behavior to estimate the fates of tagged fish. Associations between mortality and biological and fishery variables were also examined. Based on our results, we discuss the appropriateness of catch-and-release angling as a management option for Kenai River chinook salmon.

Study Site

The Kenai River (Figure 1) is a glacial stream that flows west 136 km across the Kenai Peninsula lowlands before reaching Cook Inlet in south-central Alaska. The river drains an area of approxi-

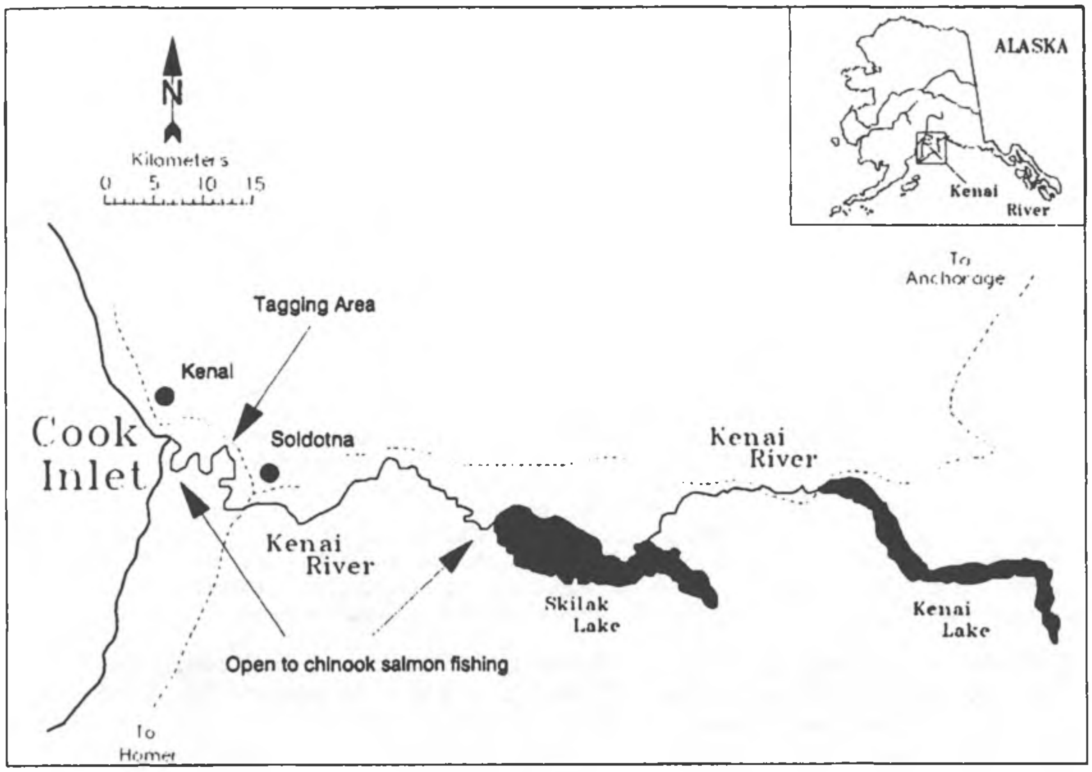

FIGURE 1.—Map of the Kenai River drainage in south-central Alaska.

mately 5,700 km^2 and has a mean annual flow of 160 m^3/s (Scott 1982). Flows are highest in summer due to glacial meltwater; however, peak discharges from glacier-dammed lakes may occur throughout the year. Changes in stream temperature and discharge are moderated by the presence of two large lakes that are intersected by the mainstem Kenai River.

In recent years, up to 26% of the total statewide fishing effort has occurred in the Kenai River drainage. Much of that effort (annual mean, 473,320 angler-hours) is directed at chinook salmon, resulting in a mean annual harvest of 17,223 fish since 1985. Most chinook salmon are caught by anglers fishing from small outboard-powered boats. Fishing takes place throughout the lower 80 km of the main stem; however, 82% of the chinook salmon fishing effort and 88% of the harvest occurs in a 19-km reach of the lower river where our study was conducted.

Methods

Experimental design and assumptions.—The turbidity of the Kenai River prevents direct observation of study animals. The absence of weirs or similar structures and the remoteness of many spawning areas makes the recovery of marked-and-released fish problematic. We used radiotelemetry to identify and locate individual fish, and determine their fates following release. Thus, the mortality we estimate includes effects of handling and tagging. Although radiotelemetry has been used to study chinook salmon spawning and migratory behavior (Liscom et al. 1978; Gray and Haynes 1979; Burger et al. 1985; Eiler 1990), we are not aware of other studies that have used radiotelemetry to estimate hook-and-release mortality.

Radiotelemetry provided a means of estimating the mortality of fish that were released back into the river after hooking, unlike most hooking mortality studies, in which the study population is confined. Daily records of fish locations and status allowed determination of survival of tagged fish, and methods of survival and analysis (Cox and Oates 1984) accounted for removal of animals from the study (tagged fish could be retaken in the fishery or removed from the population of tagged fish if tag failure or emigration occurred). We estimated mortality during the 5 d following hook and release because up to 95% of salmonid hooking mortality has occurred within 48 h of capture in previous studies (Warner 1979; Mongillo 1984).

Attenuation of radio signals is high in salt water (Stasko and Pincock 1977) and there is some evidence that hooking mortality of salmon is higher in salt water than in freshwater (Parker et al. 1959). Consequently, we limited our tagging to a 4.8-km reach of the lower Kenai River that corresponded to the upper limit of tidal influence but was 5–6 km above salt water. We assumed that all fish had a similar opportunity to acclimate to freshwater before entering the study.

Tagging was carried out in four experiments; two replicates for each run of Kenai River chinook salmon provided four separate estimates of survival and an estimate of annual variability. Separate mortality experiments were conducted during the early runs in 1990 and 1991, and the late runs in 1989 and 1990. We attempted to tag 100 fish in each experiment and to deploy the tags in equal weekly proportions throughout each run.

Major assumptions of this study were (1) there was no tagging or natural mortality, (2) fish did not loose their tags, and (3) tags that were detached for reasons other than hook-and-release mortality or that we failed to locate were a random subset of the total sample.

Radiotelemetry.—We used low-frequency transmitters (48–50 MHz; Advanced Telemetry Systems, Inc., Isanti, Minnesota) that had unique radio frequencies separated by 10 kHz. Transmitters measured approximately 20 × 70 mm and had a 350-mm external wire antenna and a battery life of 85 d. Transmitters operated in one of three modes based on pulse rates: (1) normal, indicated by 1 pulse/s and maintained by intermittent movement of the tag; (2) mortality, indicated by 2 pulses/s and triggered when the tag was motionless for 6 h; or (3) active, indicated by the addition of pulses in the normal mode that resulted from exaggerated or rapid movement of the tag (Eiler 1990).

Transmitters were mounted on the right side of each fish beneath the anterior half of the dorsal fin. Nickle pins (7.6 mm), epoxied to each end of the tags, were inserted through the fish's musculature and securely tied against 2.5-cm plastic Petersen discs.

We located tagged fish daily from a Piper Super Cub (PA-18) aircraft that had a directional loop antenna mounted to the left wing jury strut. Aerial tracking was conducted at approximately 105 km/h and 300 m above the water surface. A programmable receiver scanned for frequencies at 2-s intervals, and the location of each fish was estimated to be under the point of maximum acoustic signal strength. Fish activity was recorded as either normal, active, or nil, depending upon transmitter pulse rates. We continued to locate tagged fish for up to 60 d or until a final fate for each fish could be estimated.

Fish acquisition and processing.—Fish used in our study were caught by recreational anglers. We did not attempt to influence the methods or terminal gears used to capture fish; however, a single-hook artificial lure requirement was in place during the 1990 and 1991 early-run fisheries. Our tagging crew, working from a small boat, started a stopwatch when a fish strike was observed. We subsequently inquired if the angler intended to release the fish and, if so, whether we could equip the fish with a radio transmitter. Fish that were obtained in this manner were played to the angler's boat and placed in a landing net. The leader was cut, and the fish and net were passed to the tagging boat without being removed from the water. Our crew started a second stopwatch to record the handling time, removed the fishing tackle, noted the location(s) of hook wound(s), and transferred the fish to a tagging cradle. Fish were not anesthetized, nor were they removed from the water during capture, transfer, or handling. All fish obtained in this manner were tagged and released regardless of the apparent severity of hooking injuries. Biological and fishery variables were recorded for each angling event (Table 1). When tagging and processing were concluded, the cradle was opened and fish were allowed to swim away.

Determining fates of tagged fish.—Each fish was assigned a 5-d and a final fate (Table 2). Tag recoveries from sport, commercial, and subsistence fisheries, interpretations of daily movements, and radio transmission modes were used to estimate fates. Five-day fates could not be established in some cases until later in the experiment due to the tendency of some fish to mill for extended periods in the lower river. The following three classifications defined fates at the end of 5 d.

(1) Survived—fish that sustained upstream movement, transmitted radio signals in either active or normal modes, or were harvested after the 5-d period.

(2) Died—fish that failed to move upstream from the intertidal area at river kilometer (rkm) 19.3, transmitted radio signals in the mortality mode, or were recovered dead (still tagged) within 5 d of release.

(3) Censored—fish removed from the study due

TABLE 1.—Summary of values for biological and fishery variables recorded during each hook-and-release event in the Kenai River, Alaska, 1989–1991.

Variable	1989 Late run (N = 100)	1990 Early run (N = 125)	1990 Late run (N = 120)	1991 Early run (N = 101)	All runs (N = 446)
Sex					
Male	56	69	89	53	267
Female	44	56	31	48	179
Mean mid-eye length (mm)					
Males	854	904	704	836	819
Females	1,003	936	957	911	948
Guided angler					
Yes		96	66	72	234
No		29	54	29	112
Angling method					
Back-troll	8	125	26	101	260
Drift	92	0	91	0	183
Back-bounce	0	0	3	0	3
Terminal gear					
Bait	0	0	0	0	0
Artificial lure	15	125	23	101	264
Bait and lure	85	0	97	0	182
Hook type					
Single	94	122	106	87	409
Treble	6	3	14	14	37
Number of hooks					
One	1	119	9	81	210
Two	99	6	111	20	236
Hooking location					
Gill, eye, tongue	9	8	1	6	24
Jaw, snag	91	117	119	95	422
Hooks removed					
Yes	97	112	112	93	414
No	3	13	8	8	32
Bleeding					
Yes	11	26	15	18	70
No	89	99	105	83	376
Sea lice					
Yes	79	93	101	84	357
No	21	32	19	17	89
Condition					
Vigorous	91	120	116	100	427
Lethargic	9	5	4	1	19
Mean handling time (min)	17.0	14.8	14.8	14.7	15.3

to factors other than hook-and-release mortality, such as harvest in the recreational fishery, commercial fishery, or two in-river gill-net fisheries; fish that returned to salt water and were not subsequently located; and fish that were never located following release.

The most difficult determination of fate was estimating mortality. Because radio transmitters occasionally provided ambiguous evidence of fish death, we developed the following series of decision rules to help determine fate 2.

(2a) If a carcass was recovered within 5 d, the fish was allocated to hook-and-release mortality.

(2b) If a fish consistently moved upstream at any time during and after the first 5 d, it was considered a survivor (regardless of signal mode).

(2c) If a fish remained immobile, transmitted a mortality signal within 5 d, and continued to transmit in the mortality mode thereafter, the fish was considered a hook-and-release casualty regardless of river kilometer of location.

(2d) If a fish remained immobile in the intertidal area below rkm 19.3 within 5 d of release and remained immobile or moved slowly downstream, the fish was considered a hook-and-release casualty regardless of signal mode.

The first two rules (2a and 2b) are unambiguous; tracking a fish farther and farther upstream was

TABLE 2.—Fates of radio-tracked chinook salmon caught and released in the Kenai River, Alaska, 1989–1991. Small males were less than 750 mm (mid-eye length), and large males were 750 mm or longer.

Fate	Late run 1989			Early run 1990			Late run 1990			Early run 1991			
	Small males	Large males	Females	Small males	Large males	Females	Small males	Large males	Females	Small males	Large males	Females	Total
						First 5 d							
Died[a]	4	3	2	3	2	6	6		1	2		2	31
Survived	17	24	22	14	49	49	55	23	28	12	37	45	375
Gill-net harvest	4	2	8		1		2			1	1	1	20
Sport harvest		2	11			1	1	1	1				17
Dropout[b]							1	1					2
Unknown[c]			1										1
Total	25	31	44	17	52	56	65	25	30	15	38	48	446
						End of season							
Died[d]	4	3	2	4	2	9	6		1	3		3	37
Spawner	11	14	15	12	43	39	34	15	22	8	33	36	282
Gill-net harvest	4	4	10		2		7	4	1	2	1	1	36
Sport harvest	2	8	12		3	6	6	3	3	1	3	1	48
Tag failure							1				1	1	3
Dropout[b]	4	1	2	1	1	1	6	3	1			3	23
Upstream, lost[e]		1	2		1	1	5		2	1		3	16
Unknown			1										1
Total	25	31	44	17	52	56	65	25	30	15	38	48	446

[a] Fish that died within 5 d are classified as hook-and-release mortalities.
[b] Fish that returned to salt water and were not subsequently located.
[c] Tagged fish that we never relocated.
[d] Some fish were classified as dead that died after 5 d but prior to spawning.
[e] Fish that moved upstream and subsequently stopped transmitting a signal.

considered proof of survival. Rules 2c and 2d are necessary because transmitter mortality signals did not provide a clear indication of death. We observed mortality signals even in instances when fish were consistently located farther and farther upstream. Transmitters could also transmit several days of mortality signals while the fish remained immobile, then suddenly resume a normal signal while the fish moved upstream. Transmitters on stationary fish could transmit a mixture of mortality and normal signals. Assumptions that we made in rules 2c and 2d were (1) fish that disappeared from the Kenai River were alive, because a dead fish could not float out to sea; (2) because no spawning occurs in the intertidal area below rkm 19.3, fish observed to be stationary or slowly moving downstream in this area were dead regardless of signal; and (3) fish above rkm 19.3 that were immobile but transmitted normal signals were survivors.

Thus, location became crucial in our decision process. The most important assumption was that there was no spawning below rkm 19.3 (Burger et al. 1985), and a fish that did not migrate upstream of this point was dead.

Survival estimation.—Chinook salmon survival was estimated with the nonparametric Kaplan–Meier procedure (Cox and Oates 1984; Pollock et al. 1989). This procedure computed the percentage of fish dying on each day of the experiment from all fish at risk at the beginning of that day, and it allowed for fish that were lost (censored) due to transmitter failure, harvest, or emigration (Pollock et al. 1989). The variance for the survivor function was estimated with Greenwood's formula (Cox and Oates 1984). The Kaplan–Meier estimator was stratified and a chi-square statistic was computed by the log-rank method (Kalbfleisch and Prentice 1980) to test the hypothesis that the survivor functions did not differ among strata. The influence of biological and fishing variables on hook-and-release mortality was estimated with Cox's proportional hazards regression model (Cox and Oates 1984); the Kaplan–Meier estimator was used as a base hazard.

An assumption of survival analysis is that censorship is a random process. We compared the size distributions of tagged fish that were censored with the distribution of the total released sample by using the Kolmogorov–Smirnov statistic (Conover 1980). The hypothesis of no association between the distribution of explanatory variables and censorship was tested with chi-square statistics (Snedecor and Cochran 1967). A chi-square test of independence was also used to compare the distributions of fates by 2-week periods. All statistical tests were conducted at the 95% significance level.

Results

Retention of chinook salmon in the recreational fishery was prohibited during most of the 1990 and 1991 early runs. In order to achieve optimum early-run escapement goals during these runs, the use of bait was prohibited and terminal gear was limited to single-hook artificial lures only. Consequently, a catch-and-release fishery was in place during these periods of the study. Fishery variables recorded during the study (Table 1) reflect these regulatory changes and account for the disparity in fishing methods and gears between the early- and late-run fisheries.

In total, 446 chinook salmon were caught, tagged, and released during 1989–1991 (Table 2). Tagging each fish required from 2 to 10 min and averaged 4.3 min (SD, 1.5 min). Angling times ranged from 20 s to 1 h and averaged 6.5 min (SD, 6.5 min). We tagged 100 fish during the late run in 1989, 125 fish during the early run in 1990, 120 fish during the late run in 1990, and 101 fish during the early run in 1991. Most (375) of these fish survived for 5 d after release, 31 fish died, and 40 were censored (Table 2).

Only 3 chinook salmon defined as hook-and-release casualties were recovered dead within 5 d of release. The remaining 28 casualties were fish that did not move above the intertidal area (rkm 19.3). About half of the tags on these fish transmitted consistently in the mortality mode; the remainder transmitted intermittent mortality signals.

The majority (282 fish; 63%) of our tagged fish were assigned final fates as spawners, and 84 fish (19%) were ultimately harvested. Thirty-nine fish (9%) either returned to salt water or were lost at some point upstream. One fish's (0.2%) final fate was unknown, three fish (0.7%) had tag failures, and an additional six fish (1.3%) died following the 5-d period but before spawning (Table 2).

Mortality of hooked-and-released fish during our four sampling events ranged from 10.6% during the 1989 late run to 4.1% during the 1991 early run. The average mortality for all experiments was 7.6%. The stratified Kaplan–Meier estimates of survival for these four experiments were not significantly different (χ^2 = 4.8, df = 3, P = 0.19). However, the size and sex distributions of fish and censoring patterns differed significantly among the four experiments.

The size distribution of tagged chinook salmon varied among experiments. Females ranged from 590 mm to 1,155 mm (mid-eye length) and averaged 948 mm. Males ranged from 405 mm to 1,210 mm and averaged 819 mm. Few (2%) tagged females were under 750 mm in length because most females mature after spending at least 3 years in the ocean, by which time they are larger than 750 mm. However, the age composition of mature males encompasses younger fish, and 125 (47%) of our tagged males were under 750 mm. The relative proportion of small males varied, constituting up to 54% of the late-run experimental population in 1990.

The rate of censoring was different for the late run in 1989 compared with the other experiments. In 1989, 28 fish (28%) were censored within 5 d of release. Thirteen fish were harvested in the sport fishery and 14 fish were harvested in gill-net fisheries. Most (20) of the censored fish were females, and 11 of these were taken in the sport fishery. This high rate of censoring was not repeated in the 1990 or 1991 experiments, in which only 12 fish were censored (Table 2). To meet the assumption that censoring was random, we stratified our results for the survival analysis by experiment (1989 versus 1990–1991) and by size–sex groups: small males (<750 mm), large males (≥750 mm), and females.

Survival Following Hook-and-Release

Small males had the lowest survival in all experiments. In 1989, females had the highest survival, followed by large males, whereas in 1990–1991, large males consistently had higher survival rates than females. Survival curves (Figure 2) were much steeper for small males, reflecting the higher mortality rates for this group.

The overall survival estimate for 1989 was 0.894 (SE = 0.033). Estimated survival was 0.825 (SE = 0.081) for small males, 0.901 (SE = 0.054) for large males, and 0.935 (SE = 0.044) for females. Survival estimates for the three size–sex groups during 1989 were not significantly different (P = 0.48), but the proportion censored was significantly different among the three groups.

The overall survival estimate for the combined 1990–1991 experiments was 0.936 (SE = 0.013). Estimated survival was 0.885 (SE = 0.033) for small males, 0.982 (SE = 0.013) for large males, and 0.932 (SE = 0.022) for females. These esti-

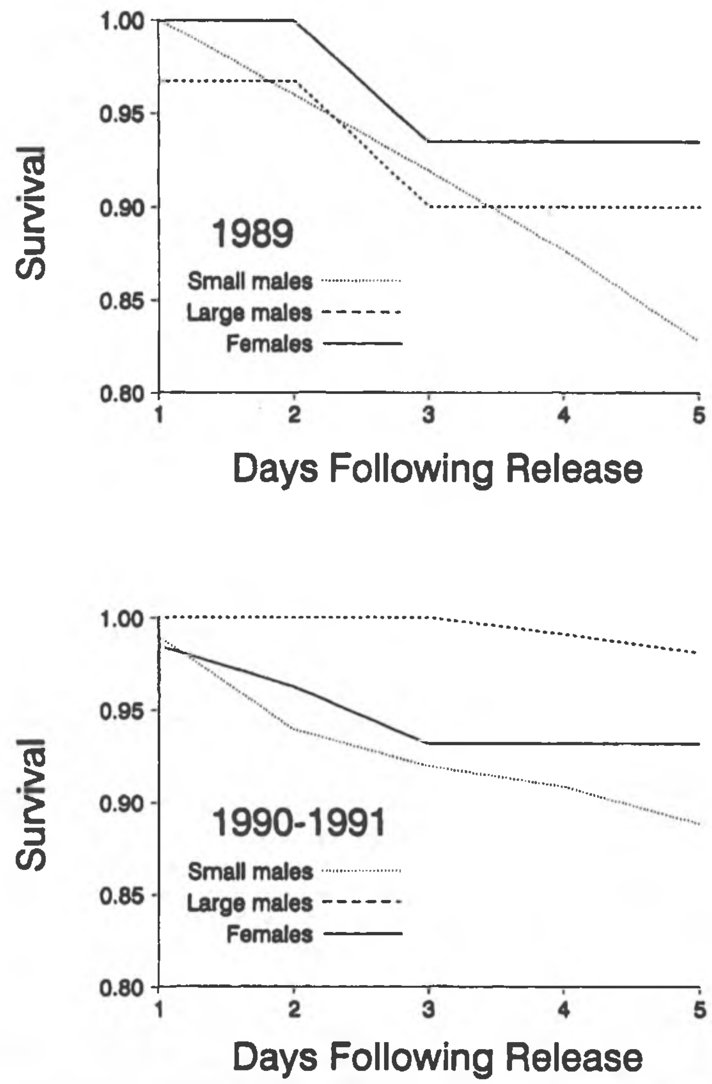

FIGURE 2.—The Kaplan-Meier survival function for chinook salmon by experiment and size-sex group, 1989-1991.

mates of survival by size-sex groups were significantly different. There was little censoring during 1990-1991 and no difference in censoring among size-sex groups.

Thirty-one hook-and-release casualties were detected during the four experiments. Of these, 24 (80%) died on or before the third day following release (Table 3). Hook-and-release mortality was independent of date of release for all of the experiments, and there was no significant association between the rate of censoring and fishery variables. Although two chinook salmon runs enter the Kenai River, and these are managed separately, there was no difference between these runs in their overall rate of hook-and-release mortality.

Variables Affecting Mortality

Hooking location was the most significant factor affecting the survival of released fish. Two proportional hazard models were fit to the data stratified by size-sex groups, one to the 1989 data and the second to the 1990-1991 data. Hooking location was the only explanatory variable that was identified as a significant covariate. Data were stratified by size-sex groups of released fish, and hooking locations were combinated into two

TABLE 3.—Daily numbers of hook-and-release fish at risk[a] and survival estimates for radio-tracked chinook salmon in the Kenai River, Alaska, 1989–1991. Small males were less than 750 mm (mid-eye length), and large males were 750 mm or longer.

Day[b]	Small males		Large males		Females	
	At risk	Survival	At risk	Survival	At risk	Survival
			1989			
1	25	1.000	31	0.968	44	1.000
2	24	0.958	30	0.968	37	1.000
3	23	0.917	29	0.901	31	0.935
4	21	0.873	24	0.901	27	0.935
5	18	0.825	24	0.901	23	0.935
			1990-1991			
1	97	0.990	115	1.000	134	0.985
2	96	0.938	115	1.000	131	0.963
3	90	0.917	112	1.000	128	0.932
4	86	0.907	112	0.991	122	0.932
5	84	0.885	109	0.982	122	0.932

[a] Numbers of fish at risk declined because of both death and data censorship (see Table 2). Fish censored during the first 5 d did not count against survival.

[b] Represents day after release. After day 5, all surviving salmon were censored from the experiment.

groups: vital areas including gills, tongue, or eye; and jaw or snag locations (Table 4). Over the entire 3 years, 24 fish were hooked in vital areas and 11 (46%) of these died (Table 4). The remaining 422 fish were hooked in the jaw or snagged, and of these only 20 (4.7%) died (Table 4). During 1990–1991, bleeding was also found to be significant. In total, 70 fish were bleeding when released and 15 (21.4%) of these died, whereas 16 of 376 fish not bleeding (4.3%) died (Table 4).

The effects of hooking location and bleeding were most pronounced on small males and females (Table 4). The predicted survival for each value of the covariate was estimated, all other covariates being held at their mean values. In the model fit to the 1990–1991 data, a small male hooked in a vital area was predicted to have only a 56.3% chance of survival and a female a 64.2% chance; a large male would still have a 91.6% chance of surviving upon release (Table 5). The predicted values for the model fit to 1989 data were more extreme, but

TABLE 4.—Distribution of explanatory variables by size–sex class and 5-d fates of radio-tracked chinook salmon during 1989–1991. Small males were less than 750 mm (mid-eye length), and large males were 750 mm or longer.

Size–sex group and variable	Numbers of fish (%) by 5-d fate		
	Censored	Died	Survived
	Hooking location		
Small males			
Vital area[a]	1 (11)	4 (44)	4 (44)
Jaw or snag	8 (7)	11 (10)	94 (83)
Large males			
Vital area[a]		1 (20)	4 (80)
Jaw or snag	8 (6)	4 (3)	129 (91)
Females			
Vital area[a]		6 (60)	4 (40)
Jaw or snag	23 (14)	5 (3)	140 (83)
	Bleeding		
Small males			
Not bleeding	9 (9)	8 (8)	83 (83)
Bleeding		7 (32)	15 (68)
Large males			
Not bleeding	7 (5)	3 (2)	119 (92)
Bleeding	1 (6)	2 (12)	14 (82)
Females			
Not bleeding	23 (16)	5 (3)	119 (81)
Bleeding		6 (19)	25 (81)

[a] Vital area includes gills, tongue, and eye.

TABLE 5.—Comparison of observed 5-d survival probabilities to those predicted with Cox's proportional hazard model (Cox and Oates 1984). Small males were less than 750 mm (mid-eye length), and large males were 750 mm or longer.

Year and fish status	Probability of survival		
	Small males	Large males	Females
Observed			
1989	0.825	0.901	0.935
1990–1991	0.885	0.982	0.932
Predicted			
1989			
Hooked in jaw or snagged	0.876	0.920	0.970
Hooked in gills, eye, or tongue	0.005	0.034	0.316
1990–1991			
Hooked in jaw or snagged	0.931	0.989	0.946
Hooked in gills, eye, or tongue	0.563	0.916	0.642
Not bleeding	0.942	0.991	0.955
Bleeding	0.794	0.966	0.837

sample sizes were much smaller ($N = 101$) compared with the 1990–1991 combined data set ($N = 346$).

Discussion

Assumptions of the Study

We assumed that fish did not loose their tags in our study. Only three transmitters were not relocated daily during the first 5 d after release. No fish were found in any fishery with tagging scars, and there were no loose tags reported or turned in. We also assumed that there was no mortality resulting from the tagging procedure. We felt that tagging mortality was unlikely due to the brief handling time and low overall mortality estimates. Our data were stratified in order to satisfy the assumption that censorship was a random process. There were no indications that removal in any fishery or movement out of the river within the first 5 d was associated with any of the variables we measured or the time of tagging.

Estimates of Mortality

Our estimates of mortality for chinook salmon that were caught and released in the Kenai River are low, ranging from 4.1 to 10.6% and averaging 7.6% over four experiments. It is likely that these estimates are conservative, because they include effects from handling and radio-tagging. Also, 66 radio-tagged fish were caught again in the recreational fishery, and some of these fish were released again. Thus it is possible that tagged fish were subject to additional hook-and-release events not reported to us. Our estimates are lower than mortality rates in sport fisheries for many other species caught with bait (Wydoski 1980; Mongillo 1984), and they are considerably lower than estimates for troll-caught chinook salmon in marine fisheries. Parker and Black (1959) estimated a mortality rate of 71% (all sizes of chinook salmon) and Wertheimer (1988) estimated rates of 24.5% for small chinook salmon and 20.5% for large chinook salmon that were caught in marine troll fisheries.

Although our four experiments differed in several aspects, including the size and sex distributions of tagged fish, the rate and pattern of censoring, and the distribution of fishery variables, the final conclusion on the survival of fish that were hooked and released is the same for all experiments. Fish length, hooking locations, and bleeding were the only variables that affected mortality in our study. There were consistent differences in mortality among size–sex groups for all four experiments. Hooking mortality was highest for small males and ranged from 9.2 to 17.6%. For large males, estimates ranged from 0 to 9.7%; for females the range was 3.3–10.7%. The observed relationship between size and mortality was consistent with findings in previous studies of chinook salmon (Wertheimer 1988) and lake trout *Salvelinus namaycush* (Loftus et al. 1988).

Effects of Fishery Variables

Numerous studies have focused on the relationship between anatomical hook locations and subsequent mortality (Wydoski 1980; Mongillo 1984). Bleeding has also been associated with decreased survival of hooked fish (Warner and Johnson 1978; Nuhfer and Alexander 1992). A Kenai River chinook salmon that was hooked in a vital location (gills, eye, or tongue) had a significantly reduced chance of surviving compared with one that was snagged or hooked in the jaw. Fish that were bleeding also suffered increased mortality. However, the frequency of chinook salmon that were hooked in vital areas (5.4%) or bleeding (18.6%) was small in our study. Hence, the overall effect of these factors was minimal. We found no significant difference in mortality rate between fish caught with bait or with artificial lures, even though all of our early-run fish were caught on lures and most (83%) late-run fish were caught on baited hooks. Thus, chinook salmon caught in the Kenai River by backtrolling or drifting in small boats are apparently hooked superficially regardless of the terminal tackle that is used.

Most (80%) of the hooking-related deaths in our study occurred on or before the third day following release, suggesting that mortally wounded chinook salmon succumb quickly. We found no evidence for delayed mortality of our tagged fish. Most of our tagged fish could be accounted for in a fishery or on the spawning grounds up to 45 d following release.

Management Implications

Our findings suggest that fishing mortality for Kenai River chinook salmon can be reduced by over 90% by implementing catch-and-release regulations. However, the findings also suggest that these low mortality rates depend upon the characteristics of the fishery and to some extent on the large size of Kenai River chinook salmon. Nearly all chinook salmon fishing in the Kenai River is conducted from boats, and regulations prohibit an angler from removing a fish from the water if it is intended to be released. These factors must be considered before our results are applied to other stocks of salmon in freshwater fisheries.

Increased pressures on declining stocks have resulted in catch-and-release regulations for selected fisheries in most states and provinces across North America (Barnhart 1989). Catch-and-release regulations for the Kenai River have been successfully used to achieve escapement goals by reducing fishing mortality without restricting angling opportunity. Nevertheless, angler participation on the Kenai River declined precipitously in 1990 and 1991 following the implementation of catch-and-release regulations for the early-run fishery. Strong chinook salmon returns in adjacent Cook Inlet drainages contributed to the decline in Kenai River effort, but it is more likely that anglers who fish for food have been slow to embrace catch-and-release regulations for salmon fisheries.

Acknowledgments

We thank Jeffery A. Breakfield, who tagged the fish used in this study. Additional field assistance was provided by Dominique Collett, Richard Simpson, Trennis Stanley, and Nicky Szarzi. We are grateful to the numerous Kenai River sport anglers and charter boat operators who cooperated in this study. Funding for this project was provided through Federal Aid in Sport Fish Restoration.

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UNITED FISHERMEN OF ALASKA

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Physical Address: 410 Calhoun Ave Ste 101, Juneau AK 99801
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Email: ufa@ufa-fish.org **Website:** www.ufa-fish.org

March 11, 2013

Representative Paul Seaton, Chairman
House Special Committee on Fisheries
Alaska State Legislature
State Capitol, 120 Fourth Street
Juneau, AK 99801-1182
Email: Rep.Paul.Seaton@akleg.gov

RE: OPPOSITION TO HB 110 – BARBLESS HOOKS

Dear Chairman Seaton and Committee Members,

United Fishermen of Alaska (UFA) represents 36 Alaska Commercial fishing organizations from fisheries throughout Alaska and its offshore federal waters.

We appreciate the intention behind HB 110 - to protect the sustainability of Alaska's fisheries resources by reducing catch and release mortality of fish that are required by regulation to be released in non-retention freshwater fisheries. Studies have shown that barbless hooks, when combined with minimal handling and attention to having the fish remain in the water, have resulted in the lowest catch and release mortality.

However, we have long supported the Alaska Board of Fisheries and its deliberative process as the appropriate forum for promulgating fisheries regulations, particularly regarding methods and means. Adaptive management is the hallmark of the State's fisheries management and this requires careful and selective implementation of methods that are applicable to a specific set of conditions.

For this reason we oppose HB 110 as a matter to be addressed in the Legislature.

Thank you for your attention on this matter.

Sincerely,

Julianne Curry
Executive Director

Louie Flora

From: Rep. Paul Seaton
Subject: FW: House Bill 110

From: Duane Mathes [mailto:duanemathes@gmail.com]
Sent: Wednesday, February 20, 2013 4:01 PM
To: Rep. Paul Seaton
Cc: Rep. Eric Feige; Rep. Lynn Gattis; Rep. Bob Herron; Rep. Craig Johnson; Rep. Kurt Olson; Rep. Jonathan Kreiss-Tomkins
Subject: House Bill 110

Please be advised I oppose HB 110, let's do something that's meaningful and quit acting like our DC representatives.

Representative Seaton,

The Alaska Outdoor Council strongly opposes House Bill 110, prohibiting the use of barbed hooks in certain freshwater fisheries.

The Alaska Outdoor Council, incorporated in the Territory of Alaska in 1955, is the voice of over 10,000 Alaskans who belong to 51 member clubs throughout the state. Many of our members (as well as many other Alaskans who are not AOC members) harvest wild food as part of their traditional lifestyle, including fishing for salmon for their personal use. Unfortunately, they are currently placed at a distinct disadvantage in doing so, because they are limited to using hook and line instead of nets. HB 110 puts these users at even more of a disadvantage.

On the Kenai Peninsula, the Kenai River dipnet fishery provides a reasonable opportunity for Alaskans to catch - with a dipnet - personal use salmon. In the Copper River drainage, the Chitina River dipnet fishery provides a reasonable opportunity for Alaskans to catch - with a dipnet - personal use salmon. In other parts of the state Alaskans can use gill nets to catch personal use and subsistence salmon. However, in the drainage nearest to the largest population of Alaskans, the Susitna River and its tributaries, residents are limited to using hook and line to catch their personal use fish. The reason is that Susitna drainage fisheries are classified by the Board of Fisheries as "sport" fisheries, even though the end use of these fish is exactly the same as other Alaskans who are able to use nets - it is eaten fresh, or dried, smoked or frozen for use at a later date to feed themselves and their families.

While it is true that some residents (and non-residents) engage in "catch-and-release" fishing for sport, where a fish is caught with a hook, then unhooked and released, this is a small group. According to the Alaska Department of Fish and Game, commercial users take 98.3% of the fish and game in Alaska, subsistence and personal use takes 1.1% and sport takes 0.6%. If there is a problem your legislation is attempting to solve, which I haven't seen evidence of, it's hard to believe that six-tenths of users are the source. HB 110 is scheduled to be heard on February 21. Before it is heard again, and certainly before it moves from the Fisheries Committee, you owe the thousands of Alaskans who live in the Upper Cook Inlet area - both long-term residents who have practiced personal use fishing for multiple generations, and short-term residents, many of whom have recently relocated from rural villages - a hard look at the effect this legislation will have on their ability to harvest Alaska salmon, especially in light of the disadvantages they already face.

As the executive director of the AOC I have attended every Board of Fisheries meeting for the past several years. I am also at many of the local fish and game advisory committee meetings where ADF&G biologists and personnel present information. Further, I attend the various outdoors shows, meetings, conferences all over the state. I will not say that barbed hooks are not causing a problem, but I will say that not one time has anyone from ADF&G or anyone else with a deep knowledge of freshwater fisheries told me they are a problem, nor have I read anything from ADF&G which stated they are a problem. You chair the Fisheries Committee and with that position come certain privileges, such as hearing bills of your choosing, like HB 110. I will grant you that, but urge you to use your time on topics that make a difference to more Alaskans.

--

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Louie Flora

From: Rep. Paul Seaton
Subject: FW: HB110 - barbed hooks

From: Bill Iverson - AOC [mailto:bill@alaskaoutdoorcouncil.com]
Sent: Wednesday, February 20, 2013 11:48 AM
To: Rep. Paul Seaton
Cc: Rep. Eric Feige; Rep. Lynn Gattis; Rep. Bob Herron; Rep. Craig Johnson; Rep. Kurt Olson; Rep. Jonathan Kreiss-Tomkins
Subject: HB110 - barbed hooks

Representative Seaton,

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Sincerely,

Rod Arno, Executive Director

Alaska Outdoor Council

Email:

rep.paul.seaton@akleg.gov

then cc:

rep.eric.feige@akleg.gov

rep.lynn.gattis@akleg.gov

rep.bob.herron@akleg.gov

rep.craig.johnson@akleg.gov

rep.kurt.olson@akleg.gov

Rep.Jonathan.Kreiss-Tomkins@akleg.gov

Thank You,

Bill Iverson

President

Alaska Outdoor Council

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Phone: (907) 264-6645

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*note new email address (.com instead of .org)

Email: president@alaskaoutdoorcouncil.com

Web site: www.alaskaoutdoorcouncil.org

Louie Flora

From: Alaska Outdoor Council <alaskaoutdoorcouncil@gmail.com>
Sent: Tuesday, February 19, 2013 8:50 AM
To: Rep. Paul Seaton
Cc: Rep. Eric Feige; Rep. Lynn Gattis; Rep. Bob Herron; Rep. Craig Johnson; Rep. Kurt Olson; Rep. Jonathan Kreiss-Tomkins
Subject: HB110 - Bared hooks

Categories: Opened

February 19, 2013

RE: House Bill 110

Representative Seaton,

The Alaska Outdoor Council (AOC) strongly opposes House Bill 110, prohibiting the use of barbed hooks in certain freshwater fisheries.

The Alaska Outdoor Council, incorporated in the Territory of Alaska in 1955, is the voice of over 10,000 Alaskans who belong to 49 member clubs throughout the state. Many of our members (as well as many other Alaskans who are not AOC members) harvest wild food as part of their traditional lifestyle, including fishing for salmon for their personal use. Unfortunately, they are currently placed at a distinct disadvantage in doing so, because they are limited to using hook & line instead of nets. HB 110 puts these users at even more of a disadvantage.

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Sincerely,

--
Rod Arno
Alaska Outdoor Council
310 K Street, Suite 200
Anchorage, Alaska 99501
Phone: 907-841-6849

Louie Flora

From: Rep. Paul Seaton
Subject: FW: Barbed hooks.

-----Original Message-----
From: Greg Svendsen [mailto:gsvendsen@gci.net]
Sent: Tuesday, February 26, 2013 5:20 PM
To: Rep. Paul Seaton
Subject: Re: Barbed hooks.

Yes, I would appreciate that. I have been flying, hunting and fishing my whole life and if my experiences would help anyone I would come and testify if it would help.

One other thing that would help is if lodges were held accountable for their fisherman just as the hunting lodges are. There would be far fewer infractions and you would have a built in free enforcement system. I have had a cabin at Lake Creek for 33 years,which is on the Yetna river,part of upper Susitna drainage and because there are so few fish game enforcement officers there are many infractions we see. We do our best to police it ourselves, but because no one holds the lodges responsible, it is very difficult, especially when fisherman, take home over their allowed limits and some of the lodges turn a blind eye afraid they will lose future bookings. This especially prevalent with out of the country fisherman.

Thanks,

Greg Svendsen

On 2/25/13 5:01 PM, "Rep. Paul Seaton" <Rep.Paul.Seaton@akleg.gov> wrote:

> Hi Greg,
>
> Would you like your e-mail included as a part of the committee packet?
>
> Louie Flora
> House Fisheries Committee Aide,
> Representative Paul Seaton, Chair
> House Fisheries Committee
>
> -----Original Message-----
> From: Greg Svendsen [mailto:gsvendsen@gci.net]
> Sent: Monday, February 25, 2013 11:02 AM
> To: Rep. Paul Seaton
> Subject: Barbed hooks.
>
> I was born and raised in Anchorage and am 65 years old. We already,as
> of last years use single hooks in the Susitna drainage, which I have no problem with.
> How about doing something about all of Cook Inlet being managed, as is
> stated in ADFG manage plan for Cook Inlet, during the month of July
> for the Kenai red run. This is done to the detriment of many of the

> northern Cook Inlet streams as this a mixed stock fishery and they
> catch many fish going north into these streams causing them to miss their escapement goal.
>
> This would seem to me to be much more important than a barb-less hook
> when we only use single hooks as it is.
>
> Greg Svendsen
>
> 3590 E. Klatt Rd. Anch. AK.
>
> 907-345-1461.
>
>

Louie Flora

Subject: FW: HB 110 I oppose it.
Attachments: Barbless hook post Yahoo .doc; problems with regulations for brown trout.doc

---

From: Rep. Paul Seaton
Sent: Friday, March 08, 2013 11:46 AM
To: Louie Flora (Louie_Flora@legis.state.ak.us)
Subject: FW: HB 110 I oppose it.

From: Dan Dunaway [mailto:dlgdunaway@gmail.com]
Sent: Friday, March 08, 2013 1:45 AM
To: Rep. Paul Seaton; Rep. Bryce Edgmon; Sen. Gary Stevens
Cc: Rep. Kurt Olson; Rep. Bob Herron; Rep. Eric Feige; Rep. Craig Johnson; Rep. Beth Kerttula; Rep. Jonathan Kreiss-Tomkins; Rep. Lynn Gattis
Subject: HB 110 I oppose it.

Dear Rep. Seaton and House Fisheries Committee.

I am disappointed to become aware of HB110.

My first objection to this bill is based on process.

The authority to set fishing regulations in Alaska lies with the Alaska Board of Fisheries and it should stay there.

To move HB110 forward is a mistake, threatens the authority of the BOF and would set a very poor precedent.

Since you are from Homer I'm sure you are well aware of the BOF process and I urge you to respect it , its citizens' involvement process, and withdraw this bill.

I just returned from the BOF meeting in Anchorage addressing AK Peninsula and Aleutians fisheries.

While its an imperfect process and I'm not totally happy with the results, I support the process and object to any legislative interference.

Second, I object to the bill on the basis of science.

Current best science does not support this bill.

Note that several lower 48 states are in the process of removing such regulations as science has shown them to be of minimal value or even detrimental.

I believe Idaho is in this situation right now.

Today, I talked to biologist Dan Schill of Idaho Fish and Game who has investigated the effects of barbless hooks. He still believes there are minimal benefits vs significant social costs to such measures.

Further I believe he said he recently worked with individuals in Montana to discourage virtually the same law you propose here.

There have been some new scientific studies conducted on this question since Schill and Scarpella (1997) conducted their meta-analysis on the use of barbless hooks.

But I don't believe any of the newer work shows any significant change to the conclusion of minimal to non-existant biological benefit for significant social costs in the form of alienating new or inexperience anglers.

There are new studies that show increased injuries from barbed hooks in some cases, but in my experience, there are a huge amount of studies out there and studies can be found to justify about any conclusion one might want to support.

Much depends on the study design, gear used, species involved and numerous other parameters.

Schill and Scarpella 1997 may still be the most far reaching in that it accumulates the results of many studies to reach its conclusions.

Finally, as I live in Dillingham and have considerable experience in the smaller remote villages, where catch and release is often very unpopular, I think imposing barbless hooks on such residents would cause additional animosity.

In parts of Alaska hook and line fishing is recognized as a legal subsistence method; where it is not, villagers still often employ the gear for subsistence, but under sport regulations.

In all of these cases, the folks go to the lake or river with the plan to catch something to eat. If they are required to use barbless hooks and lose fish that are not of the species protected, there will be much frustration.

If such villagers are cited for improper hooks there will be additional frustration - for no useful biological gain. In many places there is vigorous opposition to single hook regulations or to being required to cut prongs off their treble hooks.

Local biologists and law enforcement staff will bear the brunt of that frustration when they are working hard to cultivate amiable relations.

Further many rural people who are often well aware of the Board of Fish Process will wonder how such regulations came to be without the local input.

That is too high of a price to pay.

In the process of composing this note I did one more Google search on this topic and found the following blog. I have no idea who the person is but he summarizes better than I what I believe to be the best science today.

I have captured it in an attachment with links to the original.

Further, I have attached another abstract that has an important thought I have underlined for your consideration. Also in this same piece is mention of problems with barbless hook regs in Wisconsin where often a high percentage of anglers were found to be using barbless hooks in waters where they were prohibited. If the included link is followed there are a number of articles that discuss various aspects of regulations, problems with them etc.

thank you for your consideration.

Dan Dunaway
Dillingham Alaska.

apparently posted by someone in British Columbia. As I am not a member of Yahoo I could not fully explore this posting. I do not know the author.

Dan Dunaway

copied from the following site on 3-8-2013:

http://groups.yahoo.com/group/okbcwf/message/4986

Barbless hooks: Do They Really Make a Difference?

<http://skinnymoose.com/fishgeek/2007/06/10/barbless-hooks-do-they-really-make-a\
-difference/>

I encountered an interesting scientific article recently regarding the difference in mortality between barbed and barbless hooks used in recreational fisheries. Dan Schill an R. L. Scarpella (1997) conducted a literature review and meta-analysis on all studies comparing the use of these two hook types, and came up with some very interesting results.

In the first study comparing barbed vs. barbless, Westerman (1932) concluded that barbed hooks caused higher mortality than barbless hooks, however, he did not use any statistical analysis to test these results. Since then, a number of different studies have taken place. Taylor and White (1992) summarized datasets from these studies using meta-analysis, and concluded that barbed hooks caused higher mortality than barbless as well.

Upon reviewing the Taylor and White review, Schill and Scarpella noticed that some previous studies were NOT included in the the analysis, and furthermore, the approach of statistical analysis in the review was questionable. They therefore decided to use a more common approach to the meta-analysis, and use all the existing available data up to 1997.

Using a more thorough data set and better methods of statistical analysis, Schill and Scarpella determined in 1997 that barbless hooks showed NO EVIDENCE OF REDUCING FISH MORTALITY IN COMPARISON TO BARBED
HOOKS. Some studies did show higher mortality rates using barbed hooks, and others showed the opposite. However, the differences were so small (usually just a couple of percentage points) that they did not overcome the difference that could have been caused simply by random error.

Since the Schill and Scarpella paper in 1997, a number of other studies have examined the difference between barbed and barbless hooks. The results of all the studies I could track down are as follows:

Dubois & Dubielzig (2004) - showed no biological advantage in using barbless hooks

Dubois & Dubielzig (2004, different study) - no difference between barbed and barbless, except when fish deeply swallowed the hooks, in which case barbless were better.

Schaeffer & Hoffman (2002) - no significant difference in mortality between barbed and barbless. Barbed hooks landed 22% more fish. Quicker hook release time with barbless.

Meka (2004) - higher injury rates with barbed hooks, however she did not compare mortality, so results are not applicable.

Clearly, there has been no demonstrated evidence that barbless hooks cause lower mortality rates than barbed hooks. However, barbless hooks are becoming a more and more popular regulation in recreational fisheries. Why is it that these regulations persist? Even in Idaho, where Schill and Scarpella demonstrated the facts, barbless restrictions exist in many waters. I believe that the barbless regulation is simply a feel-good regulation. People are still convinced that barbless hooks "must" be better than barbed, despite what the science says.

Simply put, a mouth hooked fish, handled properly, has a very miniscule chance of dying whether or not the hook used is barbed or barbless. Mortality issues arise when the hook is swallowed and significant bleeding and tearing occur, as well as when a fish is improperly handled and held out of the water for too long. Therefore, we should quit worrying about the little barb that helps anglers land more fish, and start thinking about ways to improve other facets of angling mortality, particularly how we handle the fish once caught.

One final note: Schill and Scarpella quote the annual estimated NATURAL mortality of trout in streams to be between 30% - 65%. With such an incredibly high mortality rate already occuring, most fishing mortality is probably compensatory (the fish would have died naturally by the end of the year, whether or not you killed it). Therefore, how can we be justified in griping about a 0.3% mortality difference between barbed and barbless hooks?

http://files.dnr.state.mn.us/publications/fisheries/misc_pubs/trout_angler.pdf #page=91
I found thins looking for another article but i think it has some bearing on the issue. I'll attach the whole file but the abstract caught my eye.

Successful Restrictive Regulations for Brown Trout:
Why Are They Rare?

William C. Thorn1, Charles S. Anderson2, and Deserae L. Hendrickson3

Abstract -

Many special or experimental regulations that restrict harvest of stream trout were implemented for social reasons. This is unfortunate because it may fuel the tendency of many anglers to overestimate the potential biological benefits from proposed regulations. Because predicting biological results is uncertain, regulations need to be treated as experiments, and the results need to be effectively explained to anglers. We will explain what we have learned from experimental regulations for brown trout Salmo trutta in southeast Minnesota, what variables we now quantify, and make suggestions to improve the success rate of regulations. Equally important to improving success of regulations is for anglers to better understand the factors limiting trout populations and the potential for conflicts among angler groups.

Petersburg Vessel Owners Association

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February 25, 2013

Alaska State Legislature
House Fisheries Committee
Representative Paul Seaton, Chair
State Capitol
Juneau, AK 99811

RE: Oppose HB 110

Dear Chairman Seaton and Fisheries Committee Members,

Petersburg Vessel Owners Association (PVOA) is a diverse group of over 100 commercial fishermen and businesses operating primarily in Southeast Alaska. Our members provide millions of meals to the public annually by participating in a variety of fisheries statewide including salmon, herring, halibut, cod, crab, black cod, shrimp, and dive fisheries. PVOA appreciates the opportunity to comment on HB 110..

PVOA is in opposition to HB 110. Our opposition is not so much on the merits of the effectiveness of barbless hooks to reduce freshwater catch and release injury and mortality, but we are opposed to HB 110 because this issue should be taken up the Alaska Board of Fisheries (BOF), not the Alaska State Legislature. The BOF was established for the purpose of the conservation and development of the fishery resources of the state and, as such, is the regulatory body best qualified to consider the merits of fishing methods and means. **AS 16.05.251. REGULATIONS OF THE BOARD OF FISHERIES** sets out the regulations that the BOF may adopt and section (a)(4) specifically identifies establishing the means and methods employed in the pursuit, capture, and transport of fish. For the abovementioned reasons, we respectively request that you do not move HB 110 out of the Fisheries Committee and allow this issue to be addressed and acted upon by the BOF.

Thank you for the opportunity to comment on this legislation. If we can provide further information or answer any questions, please feel free to contact us.

Sincerely,

Brian Lynch
Executive Director